




**Zpryme Smart Grid Insights**

March 2012

Japan: Tsunami Wakens the Smart Grid

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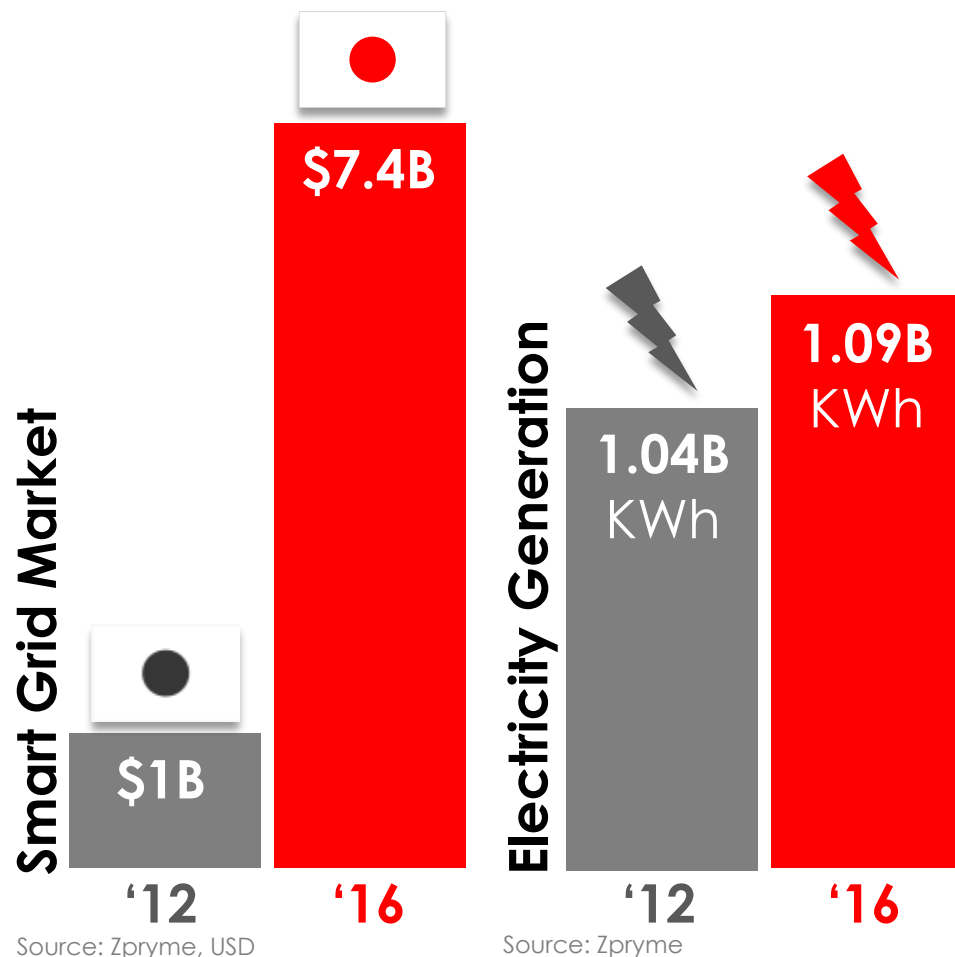


**“Tokyo Electric Power Co plans to install **17 million smart meters in households by 2019** and to invite tenders from both Japanese and foreign firms.”**

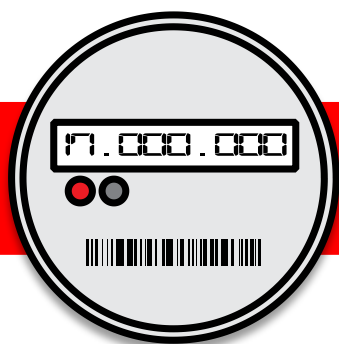
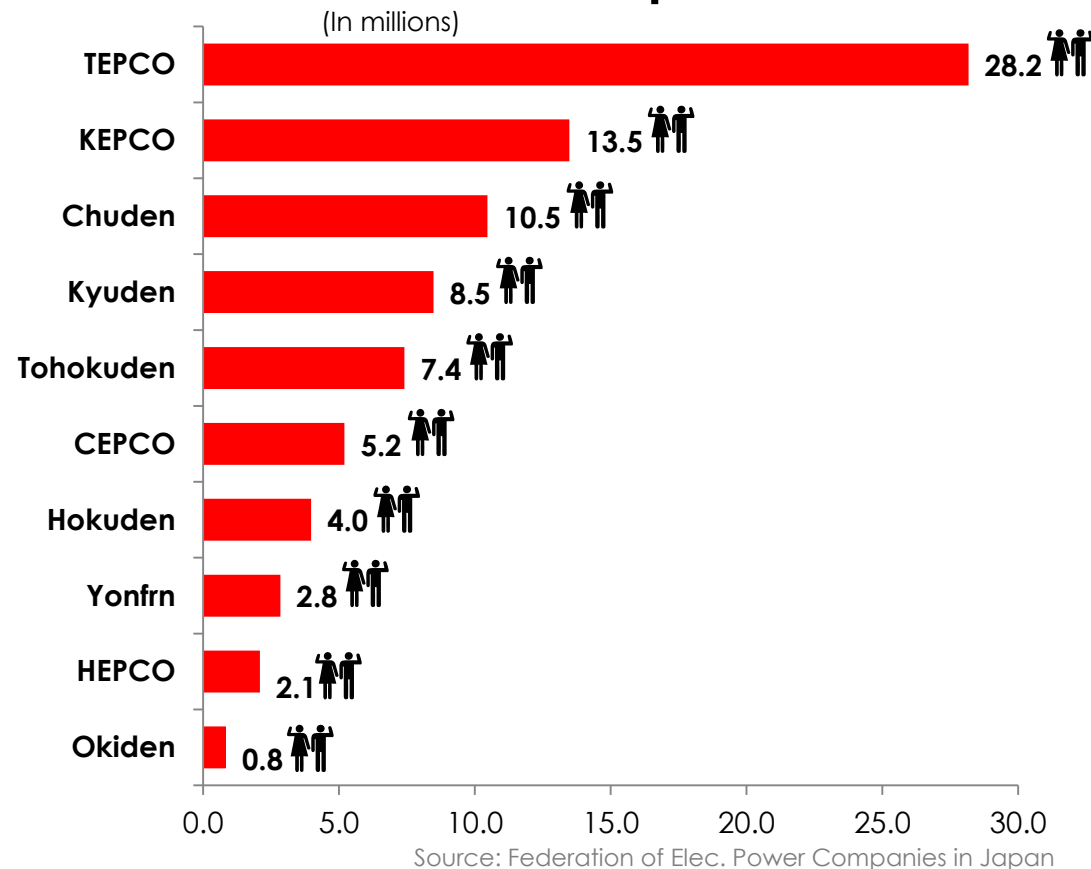
Source: Reuters, Tepco to hold bids for 17 mln smart metres, January 21, 2012 (as originally reported by the Nikkei business daily)

# JAPAN SMART GRID SNAPSHOT

Japan: Tsunami Wakens the Smart Grid



## Customers Served by Japan Electric Companies, '10



**17M Smart Meters by '19**

Source: TEPCO

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## Japan: Tsunami Wakens the Smart Grid

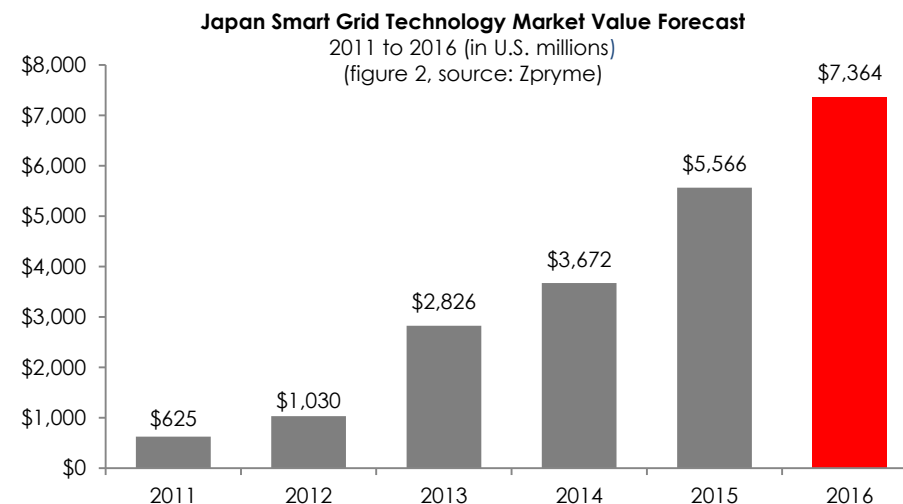
Japan paused this past Sunday at 2:46pm to recall the earthquake-induced tsunami that struck its northeastern coast on March 11, 2011. Much has been learned from last year's tsunami and now government agencies and residents are becoming better equipped to handle another natural disaster. Since the wake of the crisis Tokyo Electric Power Company (TEPCO) was ordered by the government to invite bids from both domestic and foreign firms for approximately 17 million smart meters by 2019, according the Nikkei newspaper. The smart meter initiative is part of a blueprint to slim \$1.3 billion in electric operating costs over the next 10 years. Companies such as Toshiba, GE, Fuji Electric, Hitachi, Panasonic, and Osaki Electric are already engaged with TEPCO on the Yokohama Smart City Project (YSCOP). YSCOP is one of four Smart Cities in Japan designed to establish the country as a global leader in designing Smart Grids.

While millions are gathered in cities around the world to mark the first anniversary of the tsunami this week, Japan will be busy redefining its electricity infrastructure, thus establishing Japan as the 'global role model' for the next generation grid.

## Japan Smart Grid Market Value

Smart grid technology is the focus in Japan after last year's tsunami caused massive blackouts and meltdowns at a key nuclear power plant. Supply has since stabilized, however parts of the country including Tokyo are still closely monitoring daily power consumption and utilities are asking customers to limit power use. Already a focus

for the future of Japan, a forward-looking leader in technology and green information technology, the disaster has brought Smart Grid to the forefront of the agenda for Japan's government, technology and utility companies, and the public psyche alike. All the data point toward a Japanese Smart Grid technology market projected to reach \$7.4 billion in 2016.



- From 2011 to 2016, the market is projected to grow at an annual rate of 63.8%.
- The building information communication technologies segment is projected to grow the fastest, growing at an annual rate of 84.7%.
- The advanced metering infrastructure (AMI) segment is projected to be the largest, reaching \$2.5 billion by 2016.
- Distribution automation and communications are both projected to be over \$1.0 billion by 2016.

## Japan Smart Grid Market Value Forecasts by Technology

(figure 3, source: Zpryme – U.S. millions)

Smart Grid Segment	2011	2012	2013	2014	2015	2016	CAGR
AMI	\$250	\$500	\$1,106	\$1,256	\$2,156	\$2,531	58.9%
Sensing, Detection and Monitoring	\$75	\$104	\$350	\$487	\$676	\$940	65.8%
Comm. & Wireless Infrastructure	\$105	\$134	\$500	\$640	\$819	\$1,049	58.4%
Distribution Automation	\$95	\$143	\$350	\$529	\$798	\$1,205	66.2%
Renewable Energy Integration ICTs	\$45	\$67	\$250	\$373	\$555	\$827	79.0%
EV ICTs	\$20	\$30	\$100	\$139	\$193	\$269	68.1%
Building/Facility ICTs	\$13	\$20	\$75	\$116	\$180	\$279	84.7%
Energy Storage Building/Facility ICTs	\$10	\$15	\$50	\$74	\$108	\$159	73.9%
Other IT Systems and Applications	\$12	\$16	\$45	\$60	\$80	\$106	54.6%
<b>Total Smart Grid Market Value</b>	<b>\$625</b>	<b>\$1,030</b>	<b>\$2,826</b>	<b>\$3,672</b>	<b>\$5,566</b>	<b>\$7,364</b>	<b>63.8%</b>
Percent of Total Market	2011	2012	2013	2014	2015	2016	
AMI	40.0%	48.5%	39.1%	34.2%	38.7%	34.4%	
Sensing, Detection and Monitoring	12.0%	10.1%	12.4%	13.2%	12.1%	12.8%	
Comm. & Wireless Infrastructure	16.8%	13.0%	17.7%	17.4%	14.7%	14.2%	
Distribution Automation	15.2%	13.9%	12.4%	14.4%	14.3%	16.4%	
Renewable Energy Integration ICTs	7.2%	6.5%	8.8%	10.1%	10.0%	11.2%	
EV ICTs	3.2%	2.9%	3.5%	3.8%	3.5%	3.6%	
Building/Facility ICTs	2.1%	2.0%	2.7%	3.2%	3.2%	3.8%	
Energy Storage Building/Facility ICTs	1.6%	1.4%	1.8%	2.0%	1.9%	2.2%	
Other IT Systems and Applications	1.9%	1.5%	1.6%	1.6%	1.4%	1.4%	
<b>Total</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>	

### Japan Smart Grid Market Value Definitions:

- Communications and Wireless Infrastructure excludes AMI related activities
- AMI: Advanced Metering Infrastructure
- ICTs: Information and Communication Technologies

## The Smart Grid Landscape

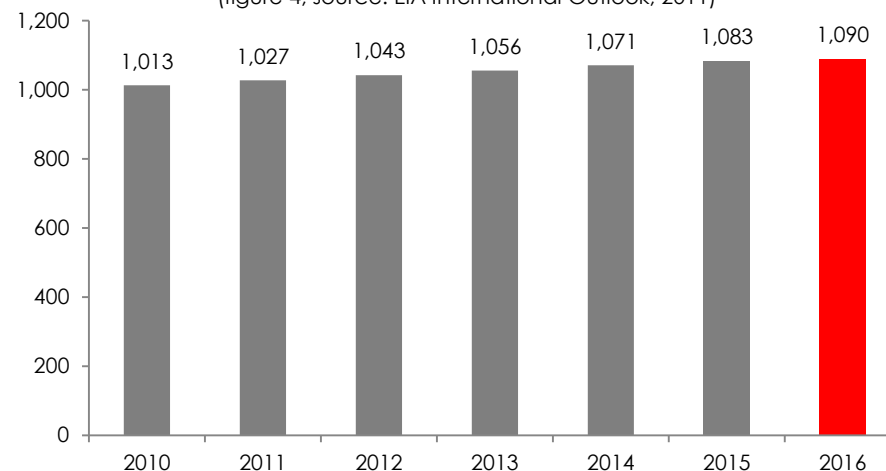
Japan is the world's third largest economy, after the U.S. and China.<sup>1</sup> Japan's economic growth over the next 5 years is expected to be about 2%.<sup>2</sup> Japan is also the third largest energy producer in the world. Japan generated just under 1 TWh in 2009, slightly down from its 2004 level of 1.03 TWh.<sup>3</sup> However, electricity generation in Japan is projected to only grow at 1.2% a year over the next five years, reaching 1,090 billion KWhs in 2016.

In contrast to the U.S., Japan's investment in electricity infrastructure declined between 1990-2001, due to a decrease in electricity demand, from roughly \$40 billion to \$20 billion per annum. Japan's "gold-plated" electromechanical grid and transmission infrastructure has far fewer reliability issues than its U.S. counterpart, so Japan's focus has been on enhancing its electricity distribution networks. In 2002 through 2010, Japan began investing large amounts of capital, resulting in advanced capabilities of its transmission infrastructure and power delivery service. In fact, Japan's electric grid is among the most efficient in the world, averaging distribution losses of 4.9% from 2000 to 2010, compared to 6.5% for the U.S.

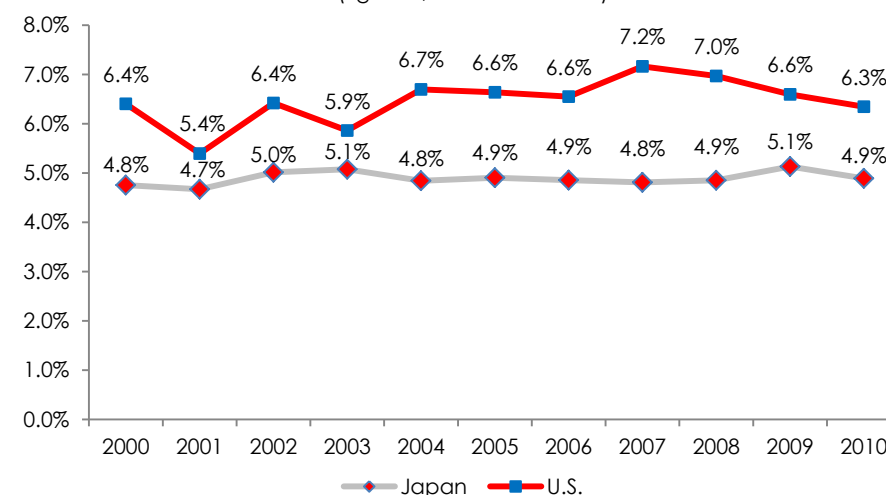
Now, creating power networks that are more intelligent is a pressing need in Japan. Recently Japan has suffered sporadic blackouts after the powerful earthquake, tsunami and the attendant Fukushima nuclear accident, which caused meltdowns at a key nuclear power plant. Central Japan, which includes Tokyo, is still facing tight supply

without the plant. This 2011 sequence of tragic events has begun to redefine not only Japan's Smart Grid planning, but also the direction of its entire utility industry.

**Japan Electricity Generation Forecast**  
2010 to 2016 (in billion kilowatthours)  
(figure 4, source: EIA International Outlook, 2011)



**Electricity Distribution Losses as a % of Total Generation**  
Japan vs. U.S., 2000 to 2010  
(figure 5, source: U.S. EIA)



<sup>1</sup> Gross Domestic Product (GDP) of \$5.47 trillion in 2010, Japan Cabinet, February 2011.

<sup>2</sup> Bank of Japan.

<sup>3</sup> U.S. EIA International Statistics. Note: 0.997 Terra Watt Hours = 997 GWh.

## Japan's Smart Grid Plan and Pilot Projects

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Until recently, the Japanese have been cautious in Smart Grid deployment, remaining on the sidelines and studying what transpires around the world. Japan has, however, already developed outstanding ecosystem technologies including renewable energy such as solar power generation and wind power generation, electric vehicles, home appliances with low-power consumption, energy storage solutions and power-distribution automation systems. Its technological leadership in these areas will lead to exemplary technology and development in other Smart Grid spaces as well. After last year's tragedy, however, Japan is increasingly serious about next generation energy, green and Smart Grid technology.

Just a couple of years ago, declaring that "smart grid is the core of our national strategies" the Japanese government set a target to use 10% of its energy from renewable energy sources by 2020. It is estimated that this will cost \$86 billion by 2030. "The adoption of smart grids is expected to result in a market worth 3.6 trillion yen (\$44 billion) by 2020 and create at least 400,000 new jobs" according to Japan's Ministry of Energy, Trade and Industry (METI).

Two of Japan's five strategic energy plan goals are to maintain and enhance energy efficiency in the industrial sector at the highest level in the world and to keep and obtain top-class shares of global markets for energy-related products and systems. Cutting carbon emissions and increasing renewable energy's percentage in Japan's energy portfolio are two sub-goals. The tsunami-related reactor failures have emphasized this second goal,

making the island nation realize it will absolutely have to rely more heavily on variable renewables. As the enabling engine for utilizing renewable energy, this makes Smart Grids essential. The Japanese government is thus paving the way with regulatory and standardization frameworks and setting up a friendly business environment for utilities and key industry players across Japan to focus on Smart Grids as means to accomplish these goals to remain the best in the world.

To remain a world leader, Japan plans to invest \$1.7 trillion in its energy sector over the next 18 years. For example, Japan's 2010 strategic energy plan contains the following initiatives on the supply side:

1. Build the world's most advanced next-generation interactive grid network as early as possible in the 2020s.
2. Consider specific measures to double the electricity wholesale market in three years. These are reflective of the importance the country places on remaining on the cutting-edge.

The following measures are specified on the demand side:

1. Realizing the Smart Grid and smart communities by promoting an intensive cross-sectional mobilization of relevant policies, consideration of special zones, demonstration projects both home and abroad, and strategic international standardization.
2. Promoting the development, installation of smart meters and relevant energy management systems (that can record detailed energy supply-demand



data and control a variety of equipment), seeking to introduce them for all users, in principle, as early as possible in the 2020s.

3. Diffusing fixed fuel cells and developing a hydrogen supply infrastructure, including hydrogen stations for fuel cell vehicles.

With these goals in mind, the Japanese government developed an initial standards roadmap for Smart Grids, several years back. Then, in 2009, the Ministry (METI) announced a massive \$1.1 billion Smart Grid technology trial in four cities and towns (Yokohama, Toyota in Aichi Prefecture, Kitakyushu in Fukuoka Prefecture, and Kansai Science City – including parts of Kyoto, Osaka and Nara Prefectures). The trials will include about 5,000 households and 4,000-5,000 plug-in-hybrid electric vehicles.

The government has also created the Smart Community Alliance (SCA), which extends the concept of Smart Grids beyond the electric system to encompass energy efficiency and efficient management of other resources such as water, gas and transportation. This key public-private organization, launched in 2010, is first charged with developing and refining a set of common standards and is intended to enhance international competitiveness by way of government involvement. Steered mainly by METI and the New Energy and Industrial Technology Development Organization (NEDO), SCA is an alliance of approximately 741 corporations and entities. It represents utilities, energy-related manufacturers, and automobiles, but also a diverse array of other industries. Toyota Motor Corp. and Tokyo Electric Power Company are slated to be part of the secretariat, and Toshiba's CEO is at the helm.

The Japanese government has announced a national smart metering initiative and large utilities have announced Smart Grid programs. In addition, the government is deliberating on measures to thoroughly reform Japan's electric power industry by 2020, such as separating electricity generation and transmission, and reviewing the regional monopolies of power companies. This also supports its aim to promote growth of renewable energies and adoption of Smart Grids.

Both NEDO and METI have launched smart homes, smart city and smart community consortiums and experiments in several target cities in 2010. Some of the best known examples are the Kashiwa Smart City, which includes a new campus at the University of Tokyo, and the Yokohama Smart City Project, in which the city is working in cooperation with five major private companies, including Accenture from the U.S.

In July 2010, ten of the major home technology and power industry companies established the HEMS Alliance consortium to establish common technical standards, to accelerate the development of energy efficient home electronics. While the Japanese smart home does not yet incorporate smart meters, its overall scope is much wider, including renewable energy generation such as solar panels, batteries, electric vehicles, home energy management (HEMS), home electronics, and lighting. Aside from government-led consortiums, private companies (especially housing and electronics makers) are actively researching and testing various strategies related to the smart home. Thus HEMS has received much of the attention and resources; this makes sense, given that Japan has many strong home appliance and home electronics providers.



## Utility Landscape

According to the U.S. Energy Information Administration (EIA), about 85% of the available power is controlled by the ten major regional power utilities. The Japanese electricity market is divided up into 10 regulated companies:

1. **Chugoku Electric Power Company (CEPCO)**
2. **Chubu Electric Power (Chuden)**
3. **Hokuriku Electric Power Company (HEPCO)**
4. **Hokkaido Electric Power Company (Hokuden)**
5. **Kyushu Electric Power (Kyuden)**
6. **Kansai Electric Power Company (KEPCO)**
7. **Okinawa Electric Power Company (Okiden)**
8. **The Tokyo Electric Power Company (TEPCO)**
9. **Tohoku Electric Power (Tohokuden)**
10. **Shikoku Electric Power Company (Yonden)**

In 2010, the largest utility in Japan, TEPCO, had 28.2 million customers, revenues of \$58.0 billion, 38,671 employees, and generated 293,389 GWh of electricity. KEPCO and Chuden are the second and third largest utilities with 13.5 million and 10.5 million customers in 2010, respectively.

Electricity rates in Japan are among the world's highest. As the utilities have monopoly on power, Japan's high power rates stem from lack of competition and legally insured profitability. Also, Japan doesn't have a single national grid like most other industrial countries have, but has separate eastern and western grids. The grids are connected together by 3 frequency converter stations (Higashi-Shimizu, Shin Shinano and Sakuma), but these can

only handle 1 GW.

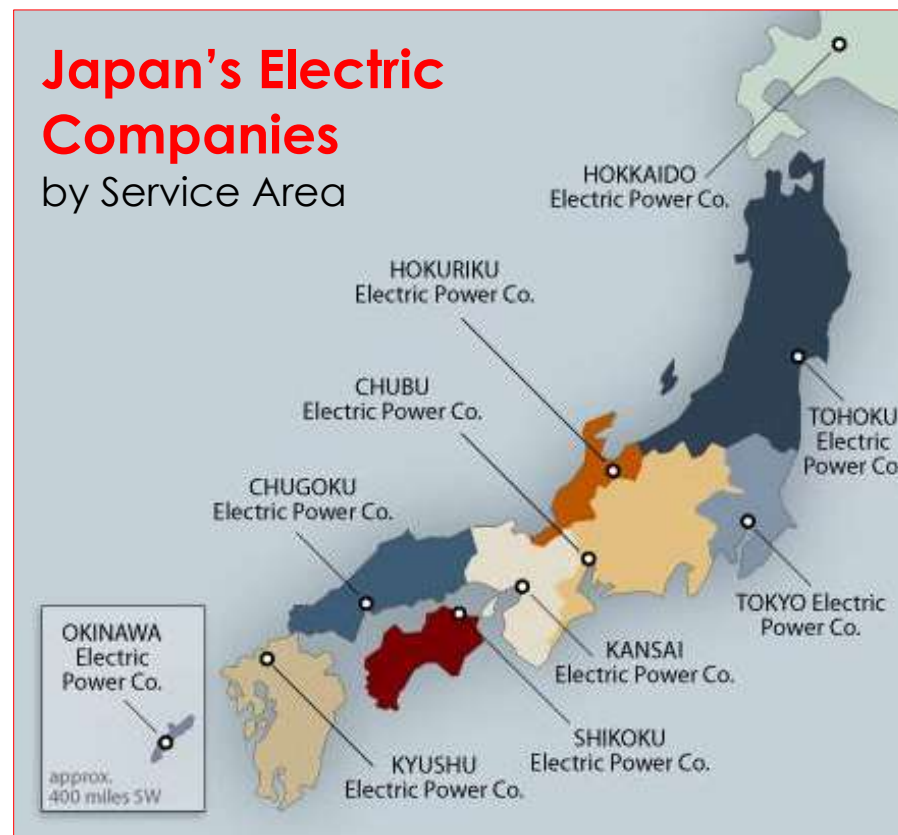
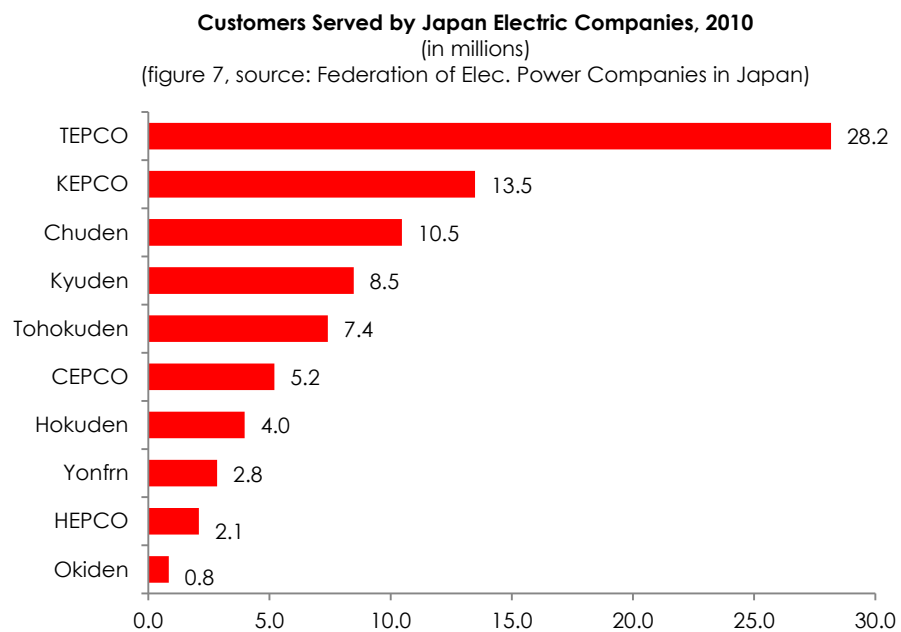


Figure 6, Source: Global Energy Network Institute, msnbc.com

Many of the large utilities have announced Smart Grid programs. For example, to realize a low-carbon society, TEPCO, one of the world's largest utility companies, is focusing on developing a smarter power system network "to integrate a huge amount of renewable energy, promoting more electrification in all sectors, and examining a low-carbon city." TEPCO participates in the Global IUN Coalition, to collaborate with other member utilities to share best practices and to solve common issues. Additionally, the Japanese Federation of Electric

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Power Companies of Japan is developing a Smart Grid that incorporates solar power generation by 2020 with government investment of over \$100 million.



**Attention:** See next page for Japan electric companies by sales, revenues, customers, and employees.

## Japan's Major Electric Companies

(figure 8, electric sales, revenues, customers, and employees, 2010)

Electric Company	Electricity Sales (GWh)	Revenue (U.S. billion)	Customers (in thousands)	Employees	% Electric Sales	% Revenues	% Customers	% Employees
Tokyo Electric Power Company	293,386	\$58.0	28,173	38,671	32%	33%	34%	31%
Kansai Electric Power Company	151,078	\$28.4	13,479	20,277	17%	16%	16%	17%
Chubu Electric Power	130,911	\$25.3	10,463	15,769	14%	15%	13%	13%
Kyushu Electric Power	87,474	\$16.0	8,477	11,727	10%	9%	10%	10%
Tohoku Electric Power	82,706	\$16.1	7,405	11,980	9%	9%	9%	10%
Chugoku Electric Power Company	62,395	\$11.6	5,199	8,928	7%	7%	6%	7%
Hokkaido Electric Power Company	32,302	\$6.4	3,972	4,999	4%	4%	5%	4%
Shikoku Electric Power Company	29,100	\$5.6	2,841	4,556	3%	3%	3%	4%
Hokuriku Electric Power Company	29,543	\$5.1	2,088	4,466	3%	3%	3%	4%
Okinawa Electric Power Company	7,521	\$1.8	842	1,516	1%	1%	1%	1%
<b>Total</b>	<b>906,417</b>	<b>\$174.4</b>	<b>83,479</b>	<b>122,889</b>				

### Japanese Electric Company Definitions:

- Source: Japan Federation of Electric Companies and TEPCO Company Sheet (<http://www.tepco.co.jp/en/corpinfo/overview/pdf-4/02-e.pdf>)
- Table figures may not add up to total due to rounding
- Japan Electric Companies Abbreviations:
  - Tokyo Electric Power Company (TEPCO)
  - Kansai Electric Power Company (KEPCO)
  - Chubu Electric Power (Chuden)
  - Kyushu Electric Power (Kyuden)
  - Tohoku Electric Power (Tohokuden)
  - Chugoku Electric Power Company (CEPCO)
  - Hokkaido Electric Power Company (Hokuden)
  - Shikoku Electric Power Company (Yonden)
  - Hokuriku Electric Power Company (HEPCO)
  - Okinawa Electric Power Company (Okiden)

## Key Industry Players

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Japanese giants Mitsubishi Electric, which will start by fast-tracking overseas infrastructure projects, and NEC, have designated Smart Grid as a core business segment. Additionally, Japanese conglomerates are investing in U.S. and other international projects to gain implementation experience, and to create a competitive advantage for them in their enormous home market. The sheer scale of investment is creating a huge appetite for supply.

Technology suppliers are tailoring their strategies to geographic regions and adopting different approaches depending upon their size, legacy industry expertise and which part of the Smart Grid value chain they serve. Metering manufacturers, distribution/substation automation equipment vendors, software vendors, communications technology suppliers and Smart Grid integrators are all starting to invest to position themselves to glean a portion of this promising market. Some examples follow. Highly confident that the Smart Grid will be widely adopted in Japan; multinational Smart Grid giants are aiming at the Japanese market.

Sweden's huge ABB, strong in high-voltage DC (HVDC) technology which cuts transmission losses, has launched a Japanese Smart Grid division. IBM, which concentrates on smart building infrastructure, is working with Takenaka, a major construction company. And GE will develop, produce and sell commercial, network-capable smart meters and develop residential models in a joint venture with Fuji Electric Co. – a move they see as just the tip of the iceberg in the growing and huge potential market for next generation distribution systems. Toshiba Corp, one of the

top 3 Japanese vendors to the electrical industry, bought leading Swiss-based meter maker Landis+Gyr in a deal valued at \$2.3 billion.

These corporate leaders vying for pole position in the Japanese Smart Grid space foreshadow the development and rapid growth of a marketplace with profits aplenty for a wide range of competitors.

To poise themselves for future profits in this multi-billion dollar market, the \$1.1 billion METI Smart Grid trial secured backing from Toyota Motor, Panasonic and Toshiba. They will take part in the high profile trial, which will initially install smart meters, electric charging stations and 27MW of solar panels in homes in the Japanese city of Yokohama, to be followed by Kyoto, Aichi and Kitakyushu. Mitsubishi has launched full-scale tests of Smart Grid and smart community technologies at its production sites in Japan, spending \$92 million on developing Smart Grid infrastructure since 2010. These are just several examples where the strategic positioning and investment is awe-inspiring.

## Market Drivers

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Beyond the obvious driver, government leadership and enablement through investment, policy, and standardization, several key drivers will catalyze and pace the growth of the Japanese SG market:

### 1. Power Outages and Energy Efficiency Goals

Continuing power shortages promise to raise awareness and demand for Smart Grid

implementation. This trend will be enhanced by the shift in consciousness of what a Smart Grid in Japan will encompass. Avoiding power blackouts is a driver, but, in light of Japan's broader energy efficiency and environmental improvement goals:

1. Raising energy efficiency by shifting peak demand.
2. Increased use of renewable energy.
3. Broader infrastructure for electric vehicles will also be key drivers.

## 2. Prosperity Through Technological Leadership

Another strong driver of the Smart Grid market is Japan's general collective mentality of profit-orientation and technological leadership. Japan recognizes that Smart Grid can be its next great export industry. Good for Japanese prosperity, the Japanese view the Smart Grid as much more than just efficient and stable power usage for the country. It can help Japan drive and optimize other value chains globally. If competitive industries and technologies such as automobiles, telecommunications, heavy industries and consumer electronics can become mobilized about increasing the strength of utility grids, this mobilization will create a prime opportunity for Japanese industries to grow in importance in the international market and world society. Like Japan's technological leadership in so many areas, Smart Grid technologies developed in Japan have very high potential to be deployed to overseas markets.

Led by the government and other entities promoting Japanese economic growth and competitiveness, the Japanese will definitely be on the forefront of development at home, so that they can promote their capabilities and products internationally and gain a share of the exploding global market.

## 3. An altruistic perspective: a vision of social change

Another driver of the market in Japan is a Smart Grid's big picture potential to improve society in a socially responsible way. As evidenced by the Japanese government's clever inclusion of the term 'smart community' in the SCA alliance concept, the change leaders' vision goes beyond Smart Grid and zooms out to what else Japan might achieve with Smart Grid technology. Clearly, a Smart Grid also has the potential to deliver a plethora of social, environmental and economic benefits to people everywhere, and the Japanese have always been among the world's leading countries in such concepts. In this vein, the JSCA organization aims to enable a new and sustainable way of living, to serve a new kind of consumer, and also to stimulate a more intelligent, ecologically-sensitive way of living with a safe and comfortable transport system. The whole notion of smart community is futuristic, altruistic and globally friendly; in the realm of social responsibility, it makes possible a broad-based, highly desirable social outcome.

## Outlook and Opportunities

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1. To remain a world leader, Japan will be investing on the order of \$1.7 trillion in electricity modernization over the next 18 years (to 2030). As its generation and transmission infrastructure is already modern and advanced compared to most, the lion's share of this will be in new technology and Smart Grid. This averages out to just under \$100 billion a year. Accordingly, Japanese companies are already, and will continue to be, looking to acquire, merge with, invest in and form strategic alliances with vendors and service providers exhibiting core competency and leadership in next generation green energy technology.
2. In late August 2011, Japan's Diet passed a clean energy bill, effective July 2012, which includes a European-style, feed-in-tariff plan requiring utilities to purchase renewable energy at fixed prices -- including energy generated by solar-powered individual households. With the passage of this plan, a new type of power transmission network will be necessary. This is a huge opportunity for power transmission suppliers, manufacturers, IT Consultants and Smart Grid Integrators alike.
3. The Smart Grid trend will be the catalyst for massive electric vehicle (EV) deployment, thus opportunities to enter EV markets such as charging infrastructure and next-generation automotive manufacturing will offer attractive returns in the Japanese market. For example, utilities will want to leverage their investment in smart meters and make them the nucleus for most consumption of electricity, including EVs. Japan will garner a larger share of the global sales for electric vehicle infrastructure manufacturing in the next 3 to 4 years as it capitalizes on its large installed base of automobile manufacturers and its national commitment to cleaner energy resources. China has enjoyed a 65% share of the industry for years, but we expect its share to fall to below 50% by 2014 as India and Japan emerge as competitive nations by embracing electricity to power their public transportation systems and turn to EVs as cleaner alternatives to internal combustion engines.
4. With its strong foundation in electricity generation and distribution, Japan will invest heavily in smart meters and Smart Grid over the next 20 years. Then, the smart meter market will drive investment in other smart solutions, e.g. smart homes and communities, distributed generation, EV infrastructure, renewables, communications infrastructure, IT applications and HEMs.
5. With its vision of smart homes, cities and communities, smart appliances for pilot Smart Grid initiatives will come out of Japan as well. With a technologically-advanced and change-receptive middle class, Japan will be one of the most rapidly growing smart appliance markets. Companies should craft strategies to capitalize on the household smart appliance market in Japan. Toshiba, Panasonic and Hitachi, for example, are already actively involved in interactive, attractive, and smart consumer electronics and appliances.

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