



Japan: Solar Photovoltaic Power Generation Industry

Takahiko Suzuki
October 11

Summary

The onset of nuclear accidents at the Fukushima Daiichi Nuclear Power Plant, caused by the Great East Japan Earthquake and tsunami, has led to a thorough re-examination of Japan's energy plan. Japan is now in the process of reconsidering its dependence on nuclear energy and increasing the ratio of renewable energy source considerably, which currently accounts for only 1 percent of the total power generated in Japan. Within Japan's renewable energy industry the solar photovoltaic power generation sector is Japan's largest in terms of dollar value and the number of jobs created, and the trend is expected to continue. Japan's total PV market is estimated at \$10,879 million in 2011 and is expected to grow to \$ 22,537 million in 2020. Under the current circumstances where high growth is expected, U.S. firms that offer not only PV cells but also provide unique products or technologies in areas of raw materials, parts, related appliance, and manufacturing equipment for PV cells and systems stand good opportunities with partnering with key suppliers in the market, who in turn could become prospective buyers of U.S. products and technologies. U.S. firms would do best to enter into the market by establishing distributors or agents; a direct approach to major Japanese PV cell manufacturers may not necessarily work well due to the unique business culture of the country. Widely practiced 10 year-warranty of PV systems and the industry association's move to set up the inspection system in order to monitor the long-term quality of PV cells could become the market issue and obstacles for U.S. firms.

Market Demand

The Government of Japan (GOJ) is currently implementing two programs aimed at boosting solar panel installation in the country.

1. One is a subsidy program under which a homeowner can obtain subsidies from both national and municipal governments. It costs approximately 2.2–2.4 million yen (or \$28,600-\$31,200 at ¥76.92/\$1) to install a typical 4 kW system on a residential rooftop, from which the homeowner can expect - depending on the location of the home – a government subsidy of approximately 700,000 yen (or \$9,100 at ¥76.92/\$1).
2. The other is the Feed-in Tariff (FiT) program. Under the current FiT, a homeowner can sell excessive power at the rate of 42 yen (or \$0.55 at ¥76.92/\$1) per kilowatt-hour for 10 years to the local power company, whereas consumers typically buy electricity at the rate of approximately 22 yen (or \$0.29 at ¥76.92/\$1) per kilowatt-hour from the power company.

Under these programs, there has been strong market demand mainly from the residential sector. According to the Japan Photovoltaic Energy Association (JPEA), an industry association comprised of Japan's major PV cell/module manufacturers, suppliers of raw materials, parts, related equipments, and system integrators, domestic solar cell shipments in fiscal year 2010 grew 170.6 % compared to the previous year, to 1,063 MW. The share of the residential sector was 81.1%, or 862 MW. The latest statistics in the first quarter (April – June) of fiscal year 2011 shows a further increase of 130.7%, compared to the same period in 2010, despite the March 11 earthquake and tsunami, which disrupted the country's manufacturing industry.

Given the aforementioned recent results as well as factors which we will be mentioned in the following sections of this report, it is fair to conclude that market demand in Japan's PV industry is strong and poised to continue growing. This market should provide good opportunity for U.S. firms that wish to enter in the Japanese market.

Market Data

According to "Global Market Outlook for Photovoltaics Until 2015" issued by the European Photovoltaic Industry Association (EPIA), as of 2010 Japan is the world's third largest country in terms of cumulative installed photovoltaic capacity (3.6 GW), next to Germany (17.2 GW) and Spain (3.8 GW). EPIA also reported that, as for the market in 2010 alone, Japan was the world's fourth largest PV country (990 MW), after Germany (7,408 MW), Italy (2,321 MW), and the Czech Republic (1,490 MW). Compared to 2009 (488MW), Japan more than doubled its installed capacity.

[PV Systems]

Yano Economic Institute, a well-known economic research institution in Japan, gauges the market size of PV systems on the basis of the end-user retail price, which is as follows:

	2007	2008	2009	2010	2011 Estimate	2020 Forecast
Installed Capacity in Megawatt (MW)	208.8	235.7	618.5	1,125.0	1466.8	3187.5
Market Size (Million US \$)	1,277	1,589	4,116	7,465	10,879	22,537

*Years are Japanese fiscal years (April – March)

* Exchange rate: 1\$ = 117.76 yen (2007), 103.39 yen (2008), 93.68 yen (2009), 87.78 yen (2010), and 76.54 yen (2011 and 2020)

Given their different year-calculation methodologies the figures for installed capacity (MW) given by Yano Economic Institute are slightly different from those given by EPIA. That said, their market trend figures in 2009-2010 match, providing a clear picture that Japan's PV market is on the rise.

In FY 2010, Yano reports that the residential sector represented a 77% of the market on a dollar basis, and the public/industrial sector represented a 23% share. The residential sector grew 51.3% compared to 2009, driven by the subsidy programs for residential PV systems, the surplus FiT program, and the reduction of PV system prices.

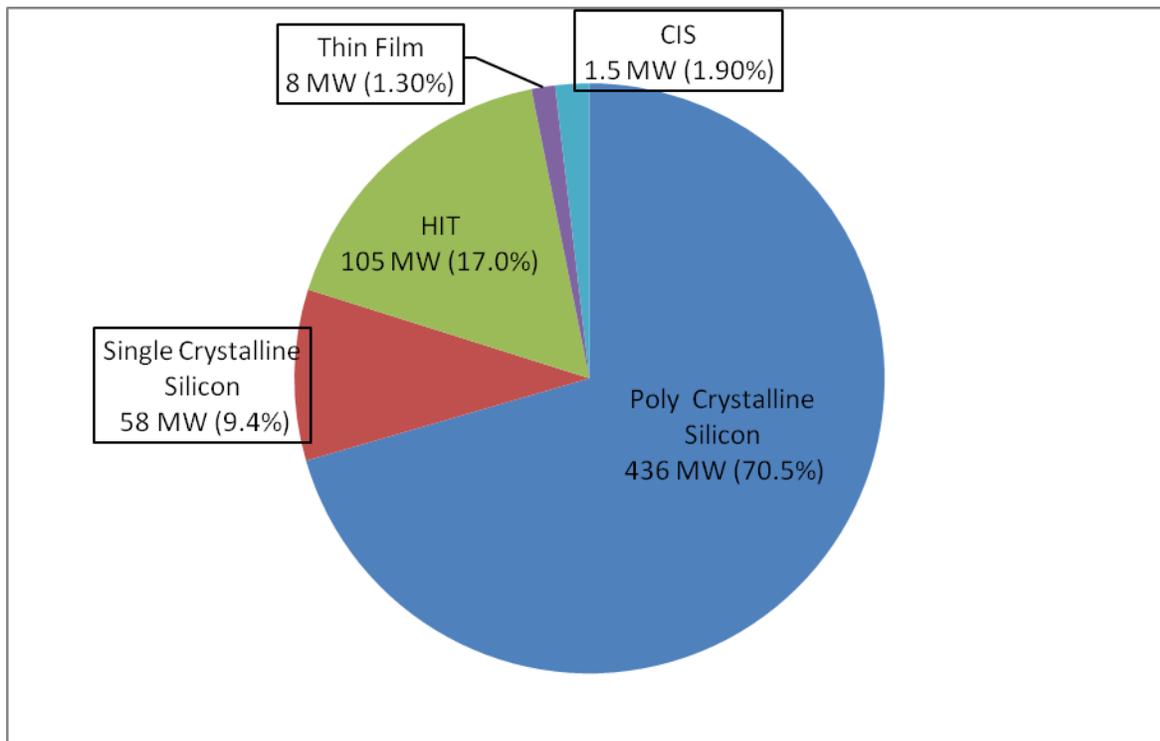
The public/industrial sector attained a high growth rate of 189.2% in 2010, compared to 2009, due to growth in construction of mega solar power generation plants by Japanese utilities and Independent Power Producers, and in the introduction of PV systems in large private sector projects and commercial facilities. Recent major projects include Daiwa House's mega solar project (1MW) in Niigata Prefecture; Miyazaki Solar Way (1 MW) by Kokusai Kogyo Holdings; Ukishima Solar Power Plant (7 MW) in the city of Kawasaki by Tokyo Electric Power Company; 10 MW solar power plant in the city of Sakai by Kansai Electric Power Company.

Non-Japanese PV cell manufacturers have increasingly gained a presence in the Japanese market. In FY 2010, non-Japanese manufacturers had a 13.0% share, or 146 MW, up from 8.5% in FY 2009. Major non-Japanese manufacturers are Suntech Power (China), LS Industrial Systems (Korea), Canadian Solar (Canada), as of FY 2009.

[PV Cells]

PV cells are the minimum units and core products of solar PV power generating systems. As of 2009, crystalline silicon type cells (single crystalline silicon, poly crystalline silicon, and HIT cells) have a 96.9% share of the Japanese market. Thin film PV cells, including CIS solar cell, have an approximately 3.2% share of the market.

PV Cell Share (in types) 1



To gauge the market in dollar value, the Fuji Keizai Group, another well-known industrial and market research corporation, made the following assessment of PV cells in the Japanese market:

	2008	2009	2010 Estimate	2011 Estimate	2020 Forecast
Crystalline Silicon (Single Crystalline, Poly Crystalline, and HIT)	773	1,228	1,709	2,352	4,050
Thin Film Silicon	31	15	59	86	188
CIS PV Cell	6	17	46	71	172
Other Solar Cells	8	0	10	33	449
Total (million US\$)	818	1,260	1,824	2,542	4,859

* Exchange rate: 1\$ = 103.39 yen (2008), 93.68 yen (2009), 87.78 yen (2010), and 76.54 yen (2011 and 2020)

[Raw Material and Parts for PV Cells]

Polycrystalline silicon, or polysilicon, is the primary raw material for the manufacturing of crystalline silicon photovoltaics. Polysilicon is also used as a raw material for the production of silicon ingot wafers, which are converted into PV cells through various processes. Other raw material and parts used for PV cells include surface protection materials (glass or film); anti-fouling coatings; transparent conducting oxide film coated substrates; transparent electrode materials; substrate materials; back sheets; resin and glue for back sheets; solar cell encapsulant; dispersant; electrode pastes; interconnectors (copper); target materials; copper indium gallium selenide (CIGS) nano-particles; tellurium; gas for solar cells; sealants; aluminum frames; transparent conducting oxide films for organic photovoltaic cells (OPVC); backside films for OPVC; electrodes, dye sensitizer, electrolyte, sealing material, and counter electrode catalyst material for dye-sensitized solar cells (DSC); organic semiconductor materials for OPV.

For an indication of trends in demand in the Japanese market, The Fuji Keizai Group provides the following table showing demand for two key materials:

	2008	2009	2010 Estimate	2011 Estimate	2020 Forecast
Polysilicon	629	502	649	862	1,111
Silicon Ingot Wafer	2,447	1,420	1,310	1,502	3,658
Total (million US\$)	3,076	1,922	1,959	2,364	4,769

Source: The Fuji Keizai Group

[Related Components for PV Systems]

Related components for PV systems include inverters (power conditioners); power optimizers; module wiring units (connectors, junction boxes, and cables); tracking devices (rotating solar tracking devices); solar condensers (lens/mirrors). Inverters and module wiring units occupy most of the market volume in this field in Japan:

	2008	2009	2010 Estimate	2011 Estimate	2020 Forecast
Inverter (Power Conditioner)	193	448	672	967	1,829
Module Wiring Unit	37	43	68	102	327
Total (million US\$)	230	491	740	1,069	2,156

Source: The Fuji Keizai Group

[PV Capital Equipment]

PV capital equipment is the manufacturing equipment for PV products, which includes silicon ingot production devices (mono crystalline grower, polycrystalline silicon ingot casting furnace); silicon wafer manufacturing equipment (wire saw); etching equipment (texturing equipment); diffusion furnaces; plasma CVD equipment; screen printing machinery; drying/firing furnaces; sputtering devices; laser scribes; automatic wiring equipment; laminators; solar simulators.

Japan's domestic production ratio of the capital equipment is 55% (automatic wiring equipment), 50% (etching equipment), 20% (silicon ingot production devices; sputtering devices; laminators), 10% (diffusion furnaces; plasma CVD equipment; screen printing machinery; drying/firing furnaces; solar simulators) and 0% (silicon wafer manufacturing equipment; laser scribes).

Best Prospects

In the report "Towards the Low Carbon Electricity Supply" prepared by a study group of the Ministry of Economy, Trade and Industry (METI), Japan draws up an action plan of implementing 28 GW (accumulated capacity) of solar PV power generation by the year 2020 (a 20-fold increase compared to 2005), and 53 GW by 2030 (a 40-fold increase). METI's Energy White Paper 2010 estimates that the market volume of the industry related to PV power generation was approximately \$4.8 billion in fiscal year 2008 and the market will be worth \$17.1 billion in 2020. In July 2010 JPEA stated that Japanese PV brands aim to be a \$100 billion industry by 2030. Although various organizations give different figures in projecting future market value, and such forecasts may need to be revised as they were made before the March 11 disasters, in general prospects for Japan's PV industry look quite good.

With the onset of nuclear accidents at the Fukushima Daiichi Nuclear Plant, caused by the Great East Japan Earthquake and tsunami, Japan is now in the process of reconsidering its energy policy and has pledged to present by summer of 2012 a new basic energy policy that will reduce the nation's dependence on nuclear energy (nuclear energy accounted for 29% of the nation's energy supply in fiscal year 2009). Expectations are running high among individual citizens and industry alike over increased use of renewable energy sources as alternatives to nuclear energy.

Also in August 2011, the Japanese Diet approved the Renewable Energy Act to take effect from July 1, 2012. The Act substantially expands the scope of energy sources that Japanese power utilities are required to purchase at FiT prices beyond solar to include all renewable sources such as wind, hydro, geothermal and biomass. News media report that the existing rate of 42 yen/kWh will continue to be applied for sellers of surplus power from residential PV systems. Reports also note that all power generated from residential PV systems of 10 kW and over, and from industrial/commercial PV systems, will be purchased. Though the rates are yet to be decided, it is anticipated that rates for PV will be considerably higher than those for other types of renewable energy (15-20 yen/kWh). The discussion of rates will begin in January 2012, led by an advisory body under METI's Agency for Natural Resources and Energy.

Under the aforementioned circumstances, prospects for PV power generation appear quite promising.

Japan's PV industry is export driven (2010 JPEA figure shows the export ratio of 58% at 1,476 MWW against the total shipment at 2,539 MW), and actual domestic market size is less than half total shipments. However, in fiscal year 2010 the share of imports in the domestic market grew an incredible 238.2% compared to the previous year to reach 168 MW. Imports in the first quarter of fiscal year 2011 show a further increase of 123.3% compared to the same period of 2010 to 439 MW.

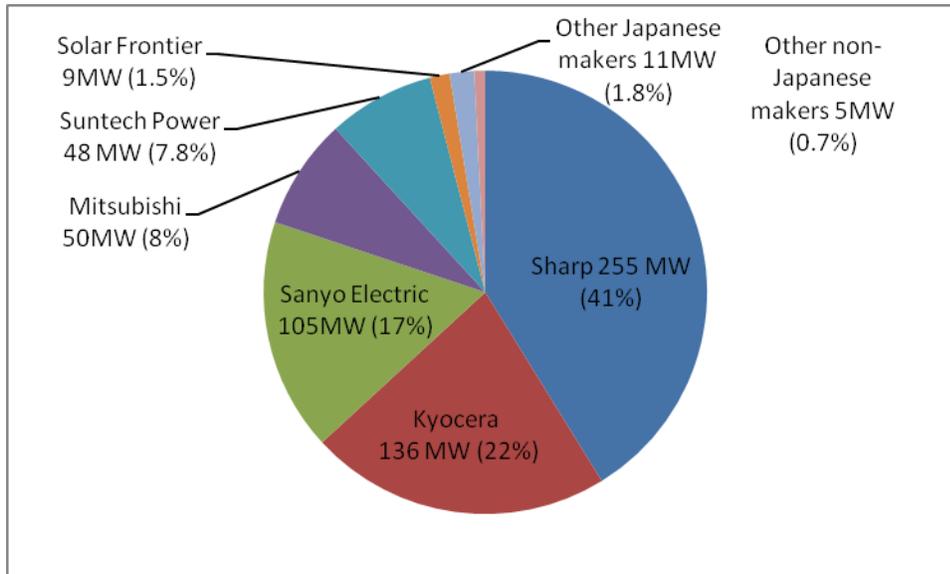
Regarding PV cell manufacturers, current non-Japanese manufacturers include firms from the United States, Canada, Korea, China and Taiwan. While U.S.-made PV cells do not occupy a large share of the market, as explained in the Market Data section of this report the Japanese PV industry encompasses a vast array of sectors under which a number of businesses are interwoven, and U.S. firms that offer unique products or technologies in any of these aforementioned sectors may have a good opportunity for introducing their products to the Japanese market.

Key Suppliers

[PV Cells]

The following chart shows major manufacturers of PV cells in the Japanese market as of 2009. Major Japanese manufacturers occupy 91.5% of the market. Other non-Japanese manufacturers include Chinese (Suntech Power), Korean (LS Industrial Systems), and Canadian (Canadian Solar) manufacturers.

PV Cell Share (manufacturers) 2



Source: Yano Economic Institute

[Raw Material and Parts for PV Cells]

Key suppliers include the following companies:

- Tokuyama Corporation (polysilicon) <http://www.tokuyama.co.jp/eng/index.html>
- Mitsubishi Materials Corporation (polysilicon) <http://www.mmc.co.jp/corporate/en/index.html>
- Kyocera (silicon ingot wafer) http://global.kyocera.com/prdct/solar/spirit/about_solar/index.html
- SUMCO Corporation (silicon ingot wafer) <http://www.sumcosi.com/english/index.html>
- Asahi Glass Co., Ltd. (glass) <http://www.agc.com/english/index.html>
- Nippon Sheet Glass Co., Ltd. (glass) <http://www.nsg.com/>

According to the report “U.S. Solar Energy Trade Assessment 2011” issued by the Solar Energy Industries Association in August 2011, the United States exported \$609 million worth of PV products to Japan in 2010, making Japan the United States’ third largest market for PV product exports followed by China and Germany. However, the report also notes that these exports consist entirely of polysilicon, the raw material for crystalline silicon photovoltaics.

[Related Components for PV Systems]

Key suppliers include the following companies:

- Tabuchi Electric Co., Ltd. (power conditioner) <http://www.zbr.co.jp/english/index.html>
- OMRON Corporation (power conditioner) <http://www.omron.com/>
- SMK Corporation (module wiring unit) <http://www.smk.co.jp/>

[PV Capital Equipment]

Key suppliers include the following companies:

- Komatsu NTC Ltd. http://www.komatsu-machinery.co.jp/HP/english/top_e.html
- Ishiihyoki Co., Ltd. <http://www.ishiihyoki.co.jp/EN/index.html>
- Ulvac, Inc. <http://www.ulvac.co.jp/eng/>

[PV System Integrators]

For the industrial market, there are approximately 20 system integrators, including such major players as:

- Sumitomo Densetsu Co., Ltd. (in Japanese) <http://www.sem.co.jp/>
- JFE Electrical & Control Systems, Inc. <http://www.jfe-densei.co.jp/english/index.html>
- NTT Facilities, Inc. <http://www.ntt-f.co.jp/english/>

For the residential market, there are approximately 700 integrators in Japan, many of which are authorized by Japanese PV cell manufacturers. System integrators that install PV systems on already-built homes include the following major players:

- Takashima & Co., Ltd. <http://www.tak.co.jp/english/index.html>
- West Holdings Corporation <http://www.west-gr.co.jp/>
- Ecosystem Japan Co., Ltd. <http://www.j-ecosystem.co.jp/>

As for newly-built homes, following major homebuilders provide PV systems:

- Sekisui House, Ltd. <http://www.sekisuihouse.co.jp/english/index.html>
- PanaHome Corporation <http://www.panahome.jp/english/>
- Daiwa House Industry Co., Ltd. <http://www.daiwahouse.co.jp/English/index.html>

Prospective Buyers

Several of the firms mentioned in the previous sections of this report could in turn also be potential buyers or end users of certain U.S. products (depending on market segment). Other prospective buyers could include, but not be limited to:

- AGC Coat-Tech Co., Ltd. (anti-fouling coating) <http://www.agccoat-tech.co.jp/english/index.html>
- DOWA Electronics Materials Co., Ltd. (transparent conducting oxide film coated substrate, transparent electrode material) http://www.dowa.co.jp/en/jigyo/electronics_summary.html
- Toyo Aluminum K.K. (back sheet, resin and glue for back sheet) <http://www.toyal.co.jp/eng/index.html>
- Mitsui Chemical Fablo Inc. (solar cell encapsulant) <http://www.fabro.co.jp/> (in Japanese)
- Yamanaka Hutech (dispersant) <http://hutech-web.com/index.html> (in Japanese)
- Namics Corporation (electrode paste) <http://www.namics.co.jp/e/index.html>
- Hitachi Cable, Ltd. (interconnector) <http://www.hitachi-cable.com/>

Market Entry

An approach to the Japanese market should be tailored depending on the products or technologies being offered. But generally speaking, U.S. firms wishing to enter into the Japanese market should strongly consider establishing a local agent or representative, such as a medium- or large-scale trading company with a nationwide sales network.

The Japanese market is highly mature and competitive, and is dominated by major Japanese manufacturers. Up until 2008 the Japanese PV cell market was almost exclusively controlled by domestic manufacturers. However, non-Japanese manufacturers from nations such as China and Korea are gaining a presence. Most of these non-Japanese manufacturers supply low-cost products, and their presence has accelerated the reduction of market prices. In view of this price competitiveness, a U.S. manufacturer's success in the Japanese market will more likely depend on offering a superior product and a sound business strategy.

In areas of raw material and parts for PV cells, related components for PV systems, as well as PV capital equipment, U.S. manufacturers that wish to enter into the Japanese market may find it most effective to work with a local agent or trading company that is specialized in, and has good knowledge of, the products used in the PV industry, one that ideally has long-standing business relationships with the companies listed in the Key Suppliers and Prospective Buyers sections. While some U.S. manufacturers express interest in reaching out to and working with prospective buyers directly, most U.S. manufacturers (and indeed most overseas firms) find such a direct approach to be impractical and ineffective. Among other things, many prospective Japanese buyers require extensive information, in Japanese, regarding details the U.S. firm's business and their product, track record, test data, etc., before ever reaching the stage of commercial discussions, making a direct approach from overseas impractical.

Market Issues & Obstacles

For residential PV systems in Japan, a 10-year warranty is the norm. These warranties are not just for the PV panels, but for the whole system including panels, inverters, installation tools, indicators, flat panel displays, etc. As such, many PV system integrators are hesitant to use components for developed by non-Japanese manufacturers for new home installations, for fear that such adaptation may nullify the warranty approved by the cell manufacturers. Generally speaking, Japanese PV cell manufacturers are said to be reluctant to use related components unless they develop by themselves. Therefore, U.S. manufacturers may find it challenging to promote related products to the new home market. The process of promoting related components to Japanese

cell manufacturers themselves can also be lengthy. However, PV system integrators working on already-built homes tend to have more discretion, and thus offer the most immediate opportunity for U.S.-made components.

Japan has yet to establish standards for the long-term durability of PV cells. Although a 10-year warranty is the norm in Japan, non-Japanese PV cell manufacturers are increasingly extending their warranty periods much longer than 10 years. In order to safeguard the long-term quality of PV cells, in September 2011 JPEA began discussions on setting up a framework regarding the long-term quality of PV cells. JPEA aims to set up such a system before the enforcement of the Renewable Energy Act comes into effect in July 2012. In a September 7 article the Nippon Keizai Shimbun, a major Japanese newspaper, cautioned that such a system should not be set up in such a way that it becomes an obstacle for bringing foreign products into the Japanese market.

Trade Events

INCHEM Tokyo 2011 (November 16-18, 2011), Tokyo <http://www.jma.or.jp/inchem/en/index.html>

PV Japan 2011 (December 5-7, 2011), Chiba <http://www.pvjapan.org/en/>

Renewable Energy 2011 Exhibition (December 5-7, 2011), Chiba
<http://www.renewableenergy.jp/english/index.html>

ENEX 2012 & Smart Energy Japan 2012 (February 1-3, 2012), Tokyo <http://www.low-cf.jp/eng/index.html>

PV Expo 2012 (February 29-March 2, 2012), Tokyo <http://www.pvexpo.jp/en/Home/>

Resources & Contacts

Ministry of Economy, Trade and Industry, Government of Japan <http://www.meti.go.jp/english/index.html>

Agency for Natural Resources and Energy, Ministry of Economy, Trade and Industry, Government of Japan
<http://www.enecho.meti.go.jp/english/index.htm>

Japan Photovoltaic Energy Association (JPEA) <http://www.jpea.gr.jp/08eng.html>

For More Information

The U.S. Commercial Service in Tokyo, Japan can be contacted via e-mail at:
takahiko.suzuki@trade.gov; Phone: 81-3-3224-5076; Fax: 81-3-3589-4235;
or visit our website: <http://export.gov/japan/>

The U.S. Commercial Service — Your Global Business Partner

With its network of offices across the United States and in more than 80 countries, the U.S. Commercial Service of the U.S. Department of Commerce utilizes its global presence and international marketing expertise to help U.S. companies sell their products and services worldwide. Locate the U.S. Commercial Service trade specialist in the U.S. nearest you by visiting <http://www.export.gov/eac>.

Comments and Suggestions: We welcome your comments and suggestions regarding this market research. You can e-mail us your comments/suggestions to: Market_Research_Feedback@trade.gov. Please include the name of the applicable market research in your e-mail. We greatly appreciate your feedback.

Disclaimer: The information provided in this report is intended to be of assistance to U.S. exporters. While we make every effort to ensure its accuracy, neither the United States government nor any of its employees make any representation as to the accuracy or completeness of information in this or any other United States government document. Readers are advised to independently verify any information prior to reliance thereon. The information provided in this report does not constitute legal

advice. The Commercial Service reference to or inclusion of material by a non-U.S. Government entity in this document is for informational purposes only and does not constitute an endorsement by the Commercial Service of the entity, its materials, or its products or services

International copyright, U.S. Department of Commerce, 2007. All rights reserved outside of the United States.