

Energy-saving and alternatives

Connections Series

Earthquake disaster could lead to structural change



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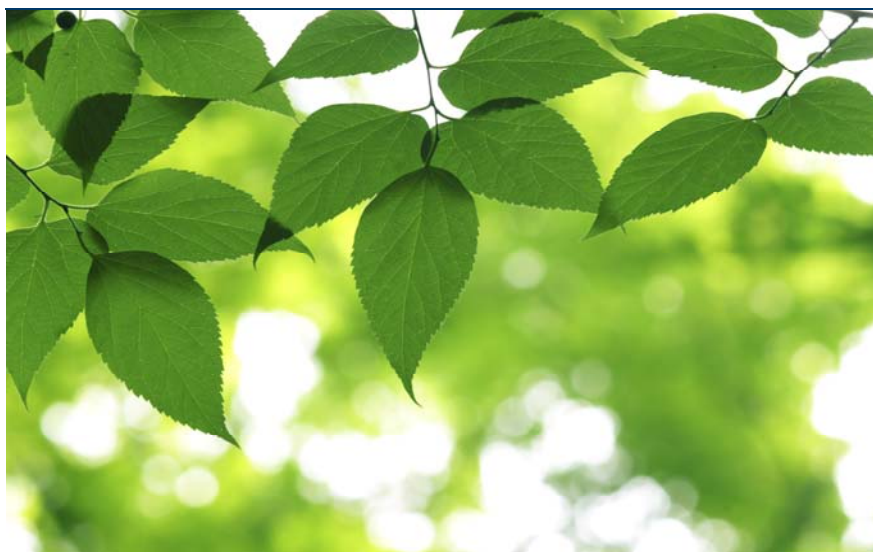
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Source: photos.com

- **Action/summary:** People in Japan and around the world may now have a very different perception of energy following the tsunami triggered by the Tohoku Earthquake on 11 March and the ensuing nuclear accident. We think rolling blackouts and the prospect of power shortages this summer have steadily heightened energy-conservation consciousness in Japan. Now that construction of new nuclear power plants looks to be running into difficulties not just in Japan but worldwide, we think alternative energies will be reassessed as indispensable, and not simply seen as a means of tackling global warming. In this report we analyze the contributions LEDs and insulating glass could make to energy conservation and look at solar cells and the auxiliary storage battery market as alternative energy sources.
- **Key thesis:** We now see potential for structural market growth that is increasingly linked to buying behavior and established trends, as opposed to an amorphous market supported by the need to tackle global warming.
- **Stock calls:** We highlight Toyo Tanso (5310) and Mitsubishi Chemical (4188) in LEDs, Asahi Glass (5201), NSG (5202) and Central Glass (4044) in insulating glass, Toyo Tanso (5310), NSG (5202), Mitsubishi Chemical (4188) and Showa Shell (5002) in solar cells, and NGK Insulators (5333) and GS Yuasa (6674) in storage batteries, and also Mitsubishi Gas Chemical (4182).

DISCLOSURE APPENDIX CONTAINS ANALYST CERTIFICATIONS AND THE STATUS OF NON-US ANALYSTS. FOR OTHER IMPORTANT DISCLOSURES, visit www.credit-suisse.com/researchdisclosures or call +1 (877) 291-2683. U.S. Disclosure: Credit Suisse does and seeks to do business with companies covered in its research reports. As a result, investors should be aware that the Firm may have a conflict of interest that could affect the objectivity of this report. Investors should consider this report as only a single factor in making their investment decision.

Investment ratings and valuations

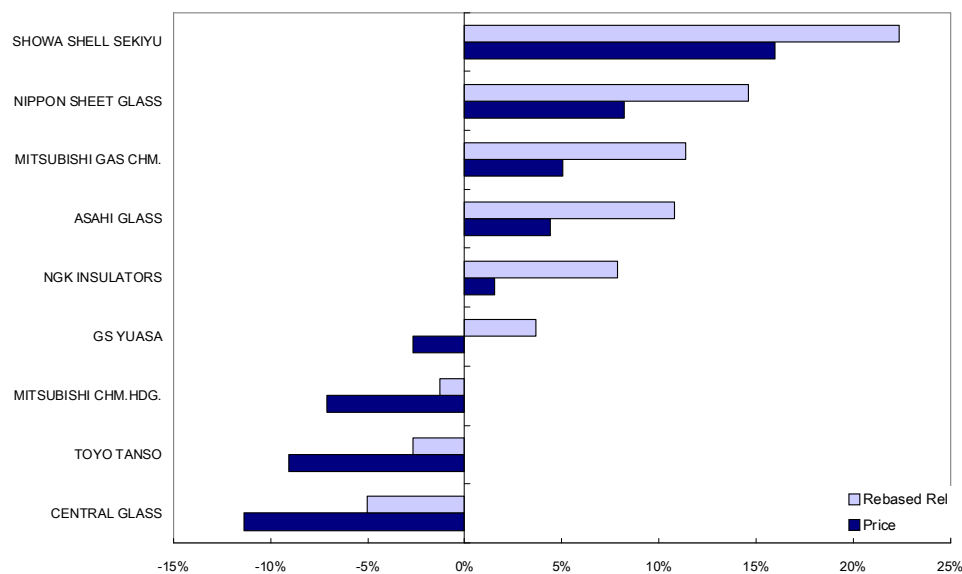
Our stock highlights include Toyo Tanso, Mitsubishi Chemical in LEDs; Toyo Sanso, NSG, Mitsubishi Chemical and Showa Shell in solar cells; Asahi Glass, NSG and Central Glass in insulating glass, and NGK Insulators and GS Yuasa in storage batteries. We show valuations by company in Figure 1 and share price performance since start-2011 in Figure 2. This reveals that Showa Shell, NSG, Toyo Tanso and NGK have all performed solidly since the earthquake, whereas Mitsubishi Gas Chemical (MGC) and Mitsubishi Chemical have both lagged. Global LED and solar cell stocks' performance has lacked momentum (Figures 4–5), while in Japan, battery and insulating glass-related stocks have outperformed the market (Figures 6–7).

Figure 1: Energy-saving and alternative energy-related valuations

	P/E		EV/EBITDA		P/B		Rating	Analyst
	11E	12E	11E	12E	11E	12E		
LED								
4188 MITSUBISHI CHM.HDG.	8.2	7.8	4.9	4.7	0.9	0.9	OUTPERFORM	Masami Sawato
5310 TOYO TANSO	13.9	12.6	4.6	3.9	1.6	1.5	OUTPERFORM	Shinya Yamada
AIXGn.DE Aixtron	13.3	12.9	7.6	7.1	3.8	3.2	NEUTRAL	Karsten Itgen
2448.TW Epistar	14.0	11.8	11.5	9.8	1.8	1.7	OUTPERFORM	Darryl Cheng
2393.TW Everlight	12.3	11.8	9.8	9.0	2.1	2.0	OUTPERFORM	Darryl Cheng
2486.TW I-Chiun	6.9	6.2	3.5	3.4	1.2	1.1	OUTPERFORM	Darryl Cheng
011070.KS LG Innotek	16.6	14.7	6.4	6.0	1.5	1.4	UNDERPERFORM	John Sung
Average	12.2	11.1	6.9	6.3	1.9	1.7		
Photovoltaic cell								
5202 NIPPON SHEET GLASS	11.6	7.9	5.1	4.1	0.9	0.8	NEUTRAL	Shinya Yamada
5310 TOYO TANSO	13.9	12.6	4.6	3.9	1.6	1.5	OUTPERFORM	Shinya Yamada
4188 MITSUBISHI CHM.HDG.	8.2	7.8	4.9	4.7	0.9	0.9	OUTPERFORM	Masami Sawato
5002 SHOWA SHELL	11.8	8.8	7.2	6.1	1.1	1.0	OUTPERFORM	Yuji Nishiyama
FSLR First Solar	14.4	12.9	9.1	6.4	2.8	2.3	NEUTRAL	Satya Kumar
STP.N SUNTECH	17.3		6.7	9.0	0.8	0.8	UNDERPERFORM	Satya Kumar
SPWRA SUNPOWER	8.0	7.2	3.5	3.2	0.9	0.8	NEUTRAL	Satya Kumar
YGE.N YINGLI GREEN	8.3	15.5	4.0	4.8	1.2	1.1	NEUTRAL	Satya Kumar
TSL.N TRINA SOLAR	8.0	11.3	4.3	4.1	1.5	1.3	NEUTRAL	Satya Kumar
JASO.OQ JA SOLAR	7.8	14.3	3.7	3.6	0.9	0.9	UNDERPERFORM	Satya Kumar
6244.TWO MOTECH	11.2	9.5	5.9	5.5	1.8	1.6	NEUTRAL	Darryl Cheng
SWVG.DE SOLAR WORLD	16.2		7.3		1.2		NEUTRAL	Karsten Itgen
QCEG.DE Q-CELLS	10.2		4.0		0.6		NEUTRAL	Karsten Itgen
Average	10.9	10.9	5.3	5.0	1.3	1.1		
Storage battery								
5333 NGK INSULATORS	12.9	10.7	5.1	4.2	1.3	1.2	OUTPERFORM	Shinya Yamada
6674 GS YUASA	20.7	19.0	7.9	5.7	1.9	1.6	NEUTRAL	Jun Yamaguchi
Average	16.8	14.8	6.5	4.9	1.6	1.4		
Double-glazing glass								
5201 ASAHI GLASS	8.0	7.8	4.0	3.7	1.3	1.1	OUTPERFORM	Shinya Yamada
5202 NIPPON SHEET GLASS	11.6	7.9	5.1	4.1	0.9	0.8	NEUTRAL	Shinya Yamada
4044 CENTRAL GLASS	14.8	11.0	4.5	3.8	0.6	0.6	NEUTRAL	Jun Yamaguchi
Average	11.5	8.9	4.5	3.8	0.9	0.9		
Other								
4182 MITSUBISHI GAS CHM.	7.3	6.9	6.9	6.7	0.9	0.8	OUTPERFORM	Masami Sawato
Average	11.5	10.3	5.6	5.0	1.4	1.2		

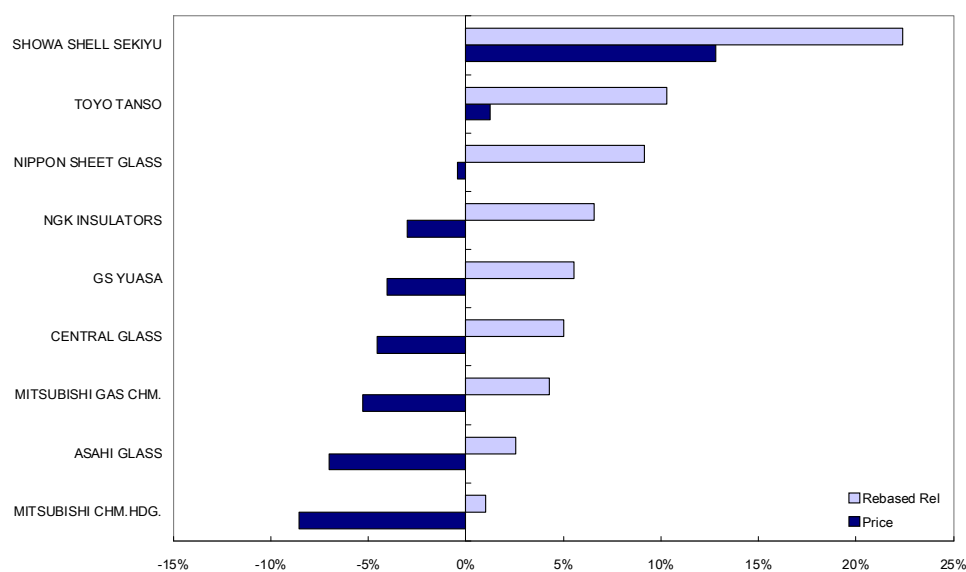
Source: Credit Suisse estimate

Figure 2: Share price performance since start-2011

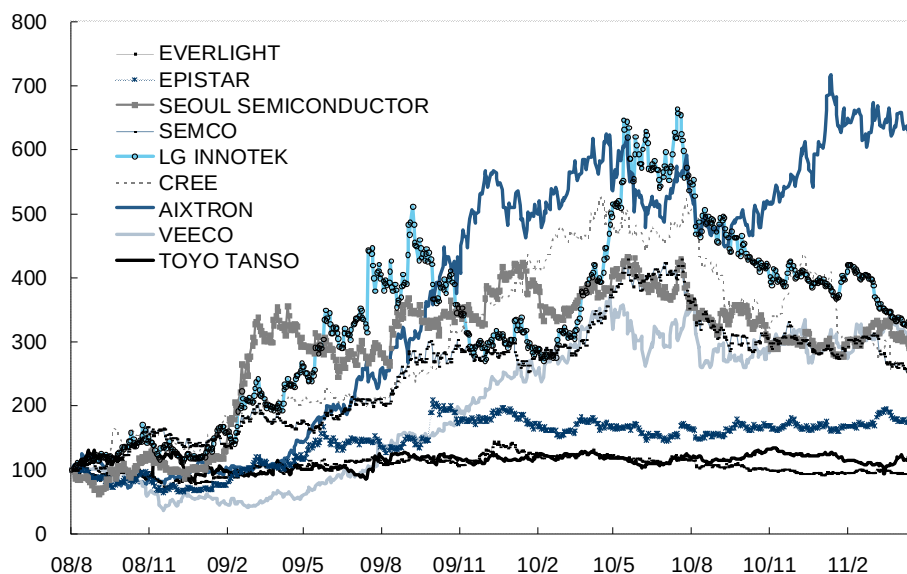


Source: Company data, Credit Suisse estimates

Figure 3: Share price performance since earthquake

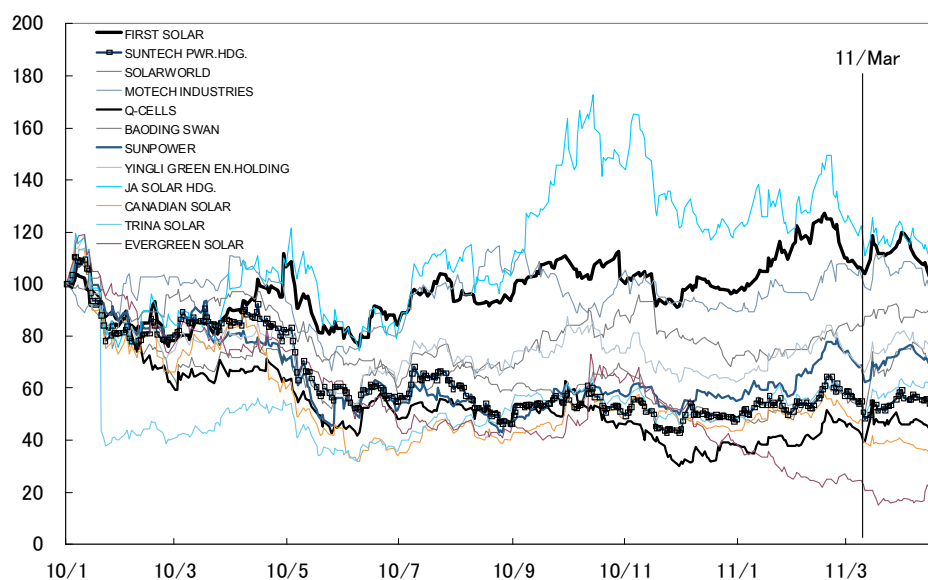


Source: Company data, Credit Suisse estimates

Figure 4: Relative performance of LED-related stocks

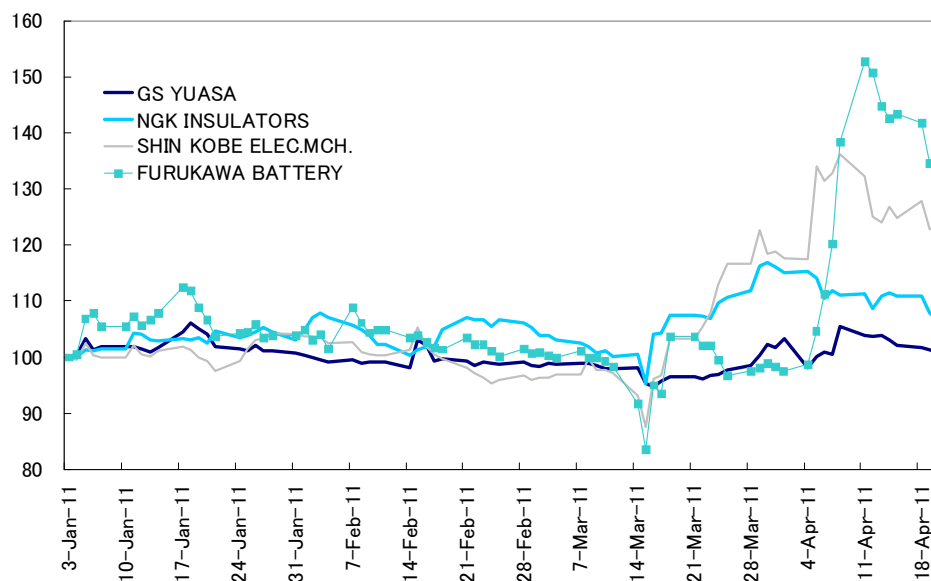
Note: Relative share performance against relevant international markets

Source: Thomson Reuters

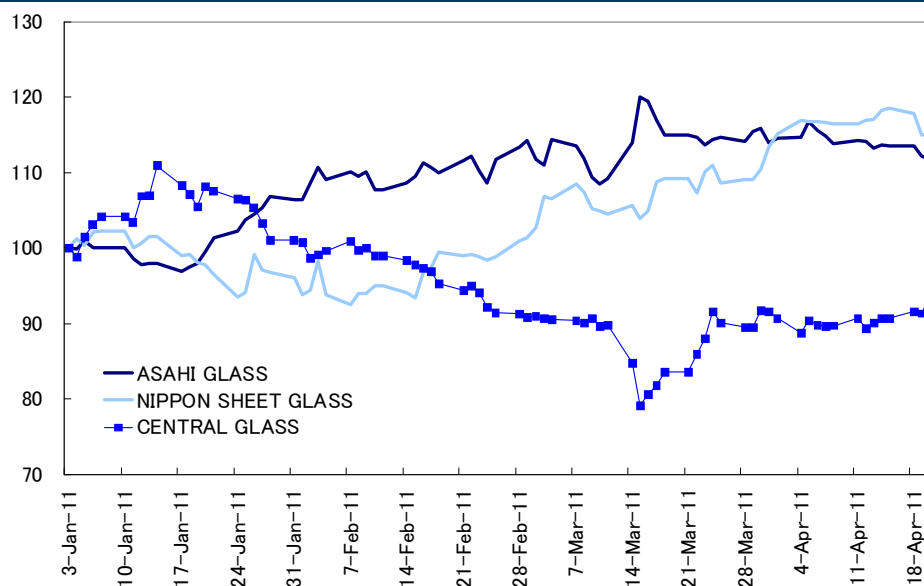
Figure 5: Relative performance of solar panel-related stocks

Note: Relative share performance against relevant international markets

Source: Thomson Reuters

Figure 6: Relative performance of battery-related stocks against TOPIX

Source: Thomson Reuters

Figure 7: Relative performance of double glass-related stocks against TOPIX

Source: Thomson Reuters

Stock comments

Mitsubishi Chemical (4188)

Analyst: Masami Sawato

LEDs

A chemical company boasting energy-saving and alternative energy technologies.

Noteworthy technologies include GaN (gallium nitride) substrate manufacturing technology, which is able to cut the cost of producing high-luminosity LEDs and organic solar cells.

In LEDs, the company's target is to achieve sales of ¥100bn in 2015 through high-quality GaN substrates that are capable of significant production cost savings owing to a self-developed epitaxial growth (bulk formation) method, and through integration of production right through to fluorescent lighting and lighting devices.

Organic thin-film solar cells

These offer less efficient energy conversion than present mainstream crystalline silicon-based solar cells. However, they can be produced at one-third to one-half the cost of existing solar cells by manufacturing semiconductor devices using a coating process. Further, being film-based, these cells can also be used on top of trucks subject to weight restrictions and factory roofs. Future targets are to raise conversion efficiency to 10% and achieve sales of ¥50bn by 2015.

Toyo Tanso (5310)

Analyst: Shinya Yamada

LEDs

Toyo Tanso is the world's top maker of susceptors for MOCVD devices, with an estimated 50% share of the global market. Susceptors are disposable items for which demand grows in line with LED chip output.

Solar cells

Toyo Tanso is also the world's top maker of crucibles for monosilicon and polysilicon used in solar cells with an estimated 30% of the global market. Crucibles, too, are disposable items, demand for which grows in line with solar cell output. Crucibles are in tight supply/demand at the moment so price increases are taking hold.

NSG (5202)

Analyst: Shinya Yamada

NSG is the world's top maker of glass substrates for thin-film solar cells with an estimated 70% of the global market. Thin-film cells are mainly installed in mega solar system arrays, but if there is a backlash against construction of new nuclear power plants worldwide, this could bode well for growth in demand.

NGK Insulators (5333)

Analyst: Shinya Yamada

NGK is the only NaS battery maker in the world. The company exported a large portion of NaS batteries until yen appreciation became an issue and weakened the export business, but we now see potential for a resurgence of demand in Japan prompted by power shortages.

Showa Shell Sekiyu (5002)

Analyst: Yuji Nishiyama

Showa Shell Sekiyu is involved in the manufacture of thin-film solar cell panels. The commissioning of a third factory (due to commence full operations in mid-2011) will increase production capacity from 80MW to 980MW, in an instant transforming the company into a major player. We expect thin-film panels to drive future growth in the solar cell market, as in comparison with the polycrystalline type they offer greater scope for cost cutting and improvement in conversion efficiency.

GS Yuasa (6674)

Analyst: Jun Yamaguchi

GS Yuasa is involved in industrial-use backup batteries and power supply equipment, and solar cell-related equipment. Industrial-use storage batteries and backup power supply

equipment are one of the company's core businesses, accounting for 15–20% of consolidated sales and better-than-average margins, from what we understand. GS Yuasa also has a proven track record in lithium-ion batteries as reserve and backup power supplies. In solar cells it is involved in power conditioners essential to solar power generation systems. There could be a backlash in 2011 following exceptional demand generated by the New Deal for Schools in 2010, but we see future benefits if solar installations become more of an established trend in factories and communal facilities.

Glass companies

Asahi Glass (5201), NSG (5202) and Central Glass (4044)

All three domestic glassmakers are involved in insulating glass and Low-E glass. We think there could be substantial growth in demand for insulating glass to help reduce air conditioner power consumption, which bodes well for improvements in product mix.

Analysts: Shinya Yamada
and Jun Yamaguchi

Mitsubishi Gas Chemical (4182)

Analyst: Masami Sawato

Methanol

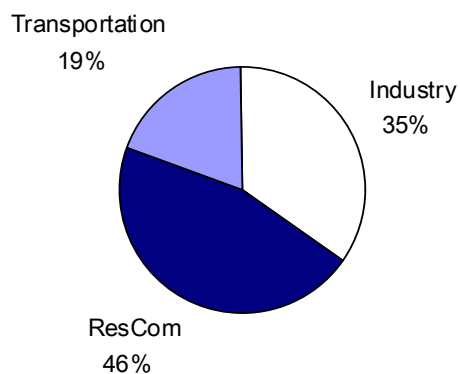
MGC produces low-cost methanol in locations including Saudi Arabia. Methanol is likely to meet with growing demand as an alternative source of energy to oil. In China demand is rising rapidly as a gasoline additive, while dimethyl ether (DME), a methanol derivative, is attracting attention as a next-generation source of clean energy for use in boilers, industrial furnaces, power generators (fuel cells, etc.) and autos (as an alternative to diesel fuel).

Urgent need to cut home electricity consumption

Energy end-user data show that individual consumers accounted for 46% of energy consumption in 2009, followed by the industrial sector at 35% and transportation sector at 19% (Figure 8). With power likely to be in short supply this summer, individual consumers will therefore have to cut back on use. In the home, air conditioners consume 25% of electric power, followed by refrigerators (16%), lighting (16%) and TVs (10%) (Figure 9). Cutting down on length of air conditioner usage naturally conserves energy, but conserving aircon power consumption itself includes replacing older models with energy-efficient models and switching to insulating glass to enhance efficiency. For lighting, key is likely to be replacement through purchases of power-saving devices. One way is to switch from incandescent light bulbs to energy-saving fluorescent bulbs, but we prefer to focus our analysis on LED light bulbs, which use even less power.

Figure 8: Individuals consume the most energy

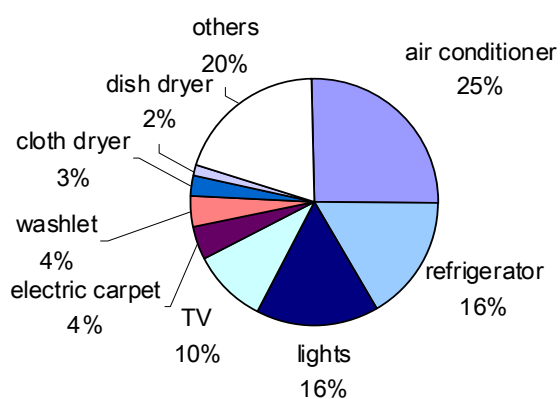
Final energy consumption by user (2009)



Source: MIAC

Figure 9: Air-conditioning and lighting account for large proportion of household electricity usage

energy consumption share in house

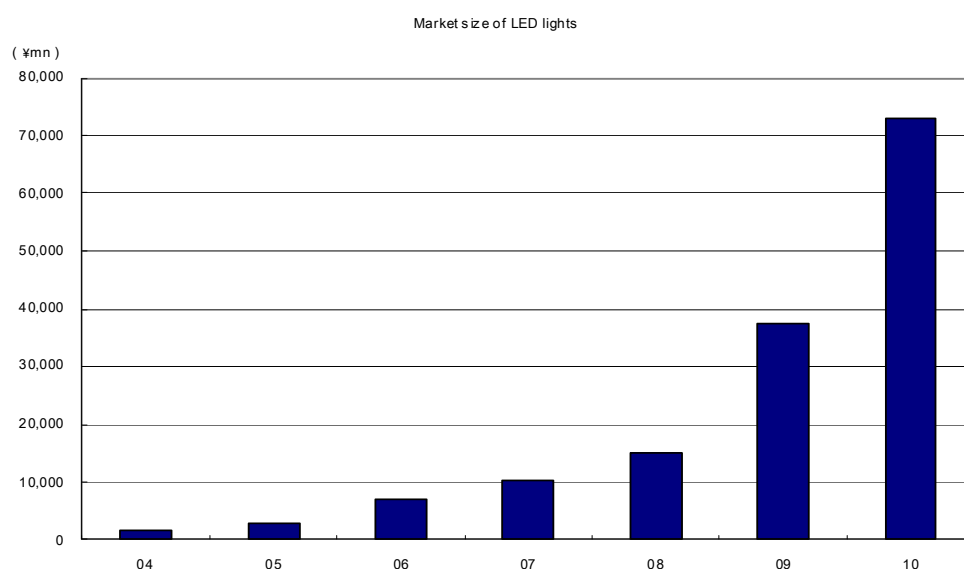


Source: Ministry of Internal Affairs and Communications

LED market

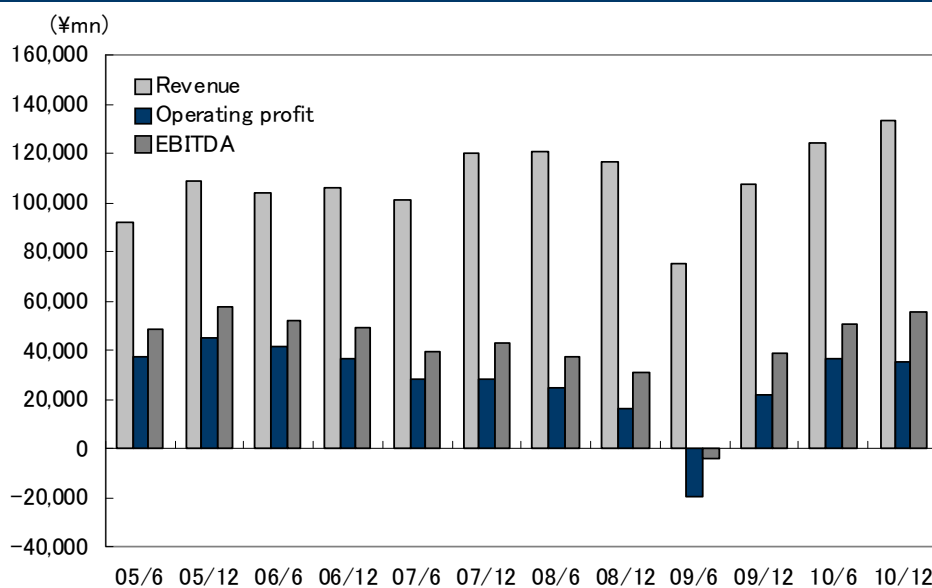
LED lighting is a rapidly growing market, estimated at over ¥70bn in 2010 (Figure 10). Testament to this strong growth is the turnaround in earnings at unlisted company Nichia, developer of the world's first white LEDs. Following a period of earnings deterioration through 1H 2009—a consequence of falling prices—Nichia has since seen earnings rally in tandem with expansion in LED lighting demand (Figures 11–12). The value of LEDs manufactured in Japan dropped after Lehman Brothers' collapse and the financial crisis it precipitated, but by 1H 2010 had rebounded to reach a record high. LCD inventory adjustments weighed on demand for LCD TV backlighting in 2H 2010, but with adjustments now winding down demand has shown signs of recovering. Taiwanese companies Everlight Electronics (an LED packaging major) and Epistar (a chip major) accordingly reported sharply higher sales in March 2011 (Figures 13–14). We see a strong likelihood of renewed growth in the LED market if expanding sales of LED lighting complement a rebound in backlighting demand.

Figure 10: Rapid growth in LED lighting market



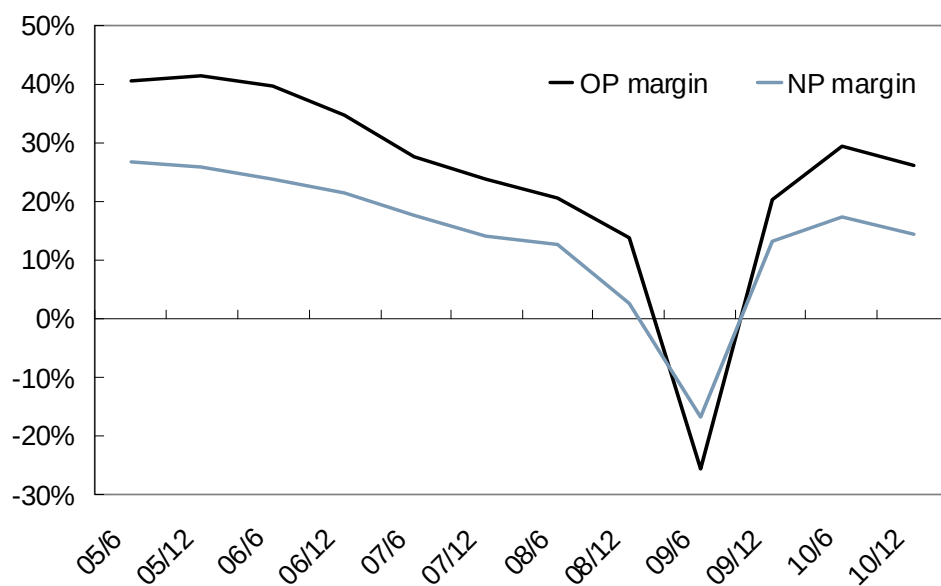
Source: Yano Research Institute

Figure 11: Rebound in earnings at LED lighting major Nichia

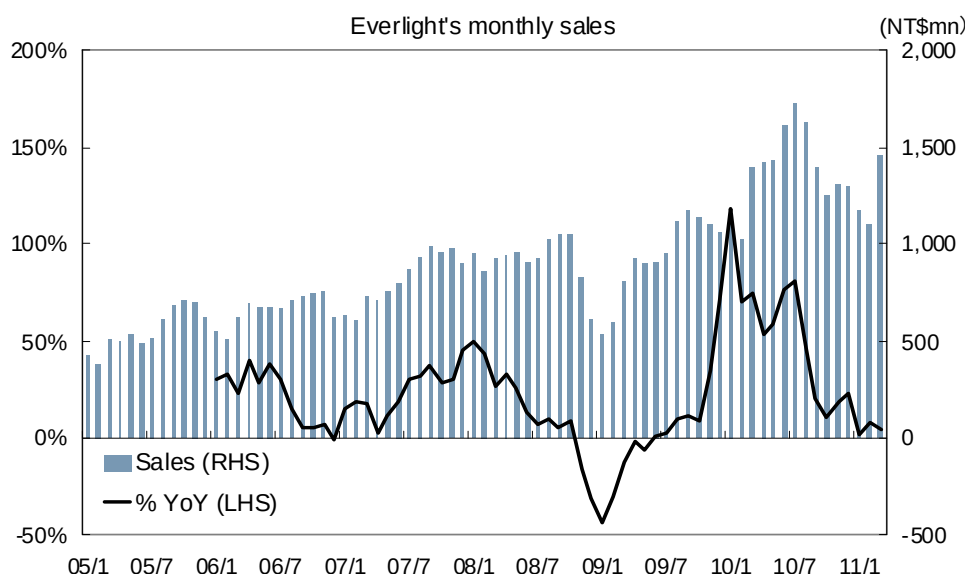


Source: Company data

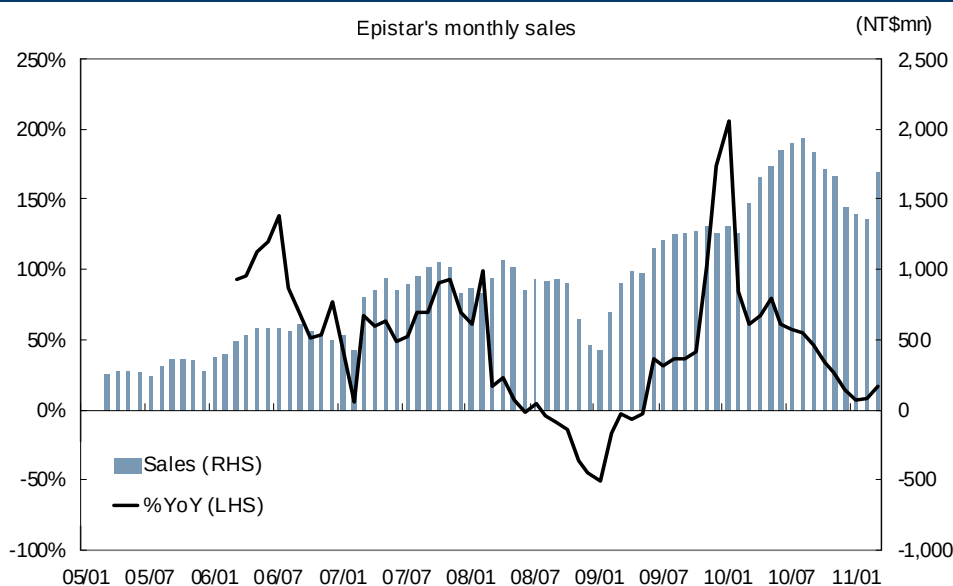
Figure 12: Recovery in Nichia margins



Source: Company data

Figure 13: Sales bouncing back at Taiwanese LED packaging major Everlight Electronics

Source: Company data

Figure 14: Sales bouncing back at Taiwanese LED chip major Epistar

Source: Company data

LED lighting is recognized as being energy efficient, but the perception is that such lighting is also expensive. When running costs are taken into account, however, LED lighting is already looking reasonably priced. We examined bulb-type LED lighting and conventional incandescent lighting and compared the sum of initial costs and running costs over a 10-year period. Assuming average daily usage of 10 hours, we found that LED lightbulbs are ¥47,500 cheaper in a household setting, and ¥24,210 cheaper in a commercial setting (Figure 15). Over the course of a year, moreover, LED lighting consumes just 7kWh of electricity, a 97% reduction versus 219kWh for incandescent lighting. Even in comparison with bulb-type fluorescent lights, which likewise have an edge over incandescent lighting when it comes to energy consumption, LED lightbulbs are ¥15,000 cheaper in a household

setting, and ¥10,580 cheaper in a commercial setting, again assuming average daily usage of 10 hours (Figure 16). Over the course of a year, moreover, LED lighting's 7kWh of electric power consumption represents an 85% reduction versus 47kWh for bulb-type fluorescent lights. If we again assume average daily usage of 10 hours, straight-tube LED lamps are ¥7,580 cheaper than straight-tube fluorescent lamps in a household setting, but ¥2,450 more expensive in a commercial setting (Figure 17). From an economic perspective, we find it hard to envision straight-tube LED lamps taking the place of straight-tube fluorescent lamps in offices. That said, we think more companies are likely to start using straight-tube LED lamps in their offices with a view to conserving energy, as over the course of a year, straight-tube LED lighting's 54kWh of electric power consumption represents a 63% reduction versus 146kWh for straight-tube fluorescent lights. We note that since the 11 March earthquake, some convenience stores have moved to install straight-tube LED lighting.

Figure 15: LED lighting has cost advantage over incandescent lighting

duration: 10 years

	average operating time per day: 1 hour		average operating time per day: 5 hours		average operating time per day: 10 hours	
	incandescent lamp 60W	LED bulb equ. to 60-80W	incandescent lamp 60W	LED bulb equ. to 60-80W	incandescent lamp 60W	LED bulb equ. to 60-80W
electricity consumption, expense						
total electricity consumption	60W	2W	60W	2W	60W	2W
electricity consumption per year	21kWh	0kWh	109kWh	3kWh	219kWh	7kWh
electricity expense per year (residential, ¥)	504	17	2519	84	5,037	168
electricity expense per year (commercial, ¥)	263	9	1314	44	2,628	88
electricity consumption per decade	219kWh	7kWh	1,095	36	2,190kWh	73kWh
electricity expense per decade (residential, ¥)	5040	170	25190	840	50,370	1,680
electricity expense per decade (commercial, ¥)	2630	90	13140	440	26,280	880
upside of electricity consumption per decade		211 kWh		1,058		2,117 kWh
upside of electricity expense per decade (residential, ¥)		4870		24350		48,690
upside of electricity expense per decade (commercial, ¥)		2540		12700		25,400
device cost (¥)						
initial cost (¥)	130	6000	130	6000	130	6,000
replacement cost per decade	390	0	2,340	0	4,680	0
total device cost (¥)	520	6000	2,470	6,000	4,810	6,000
upside of replacement cost		-5480		-3,530		-1,190
total expense & upside (¥)						
total expense per decade (residential)	5560	6170	27,660	6,840	55,180	7,680
total upside per decade (residential)		-610		20,820		47,500
total expense per decade (commercial)	3150	6090	15,610	6,440	31,090	6,880
total upside per decade (commercial)		-2940		9,170		24,210
CO2 emission [kWh * 0.555]						
CO2 emission per year	12kg	0kg	60kg	2kg	121kg	4kg
CO2 emission per decade	121kg	4kg	607kg	20kg	1,215kg	40kg
upside of CO2 emission per decade		117kg		587kg		1,174kg

electric rate: 23¥/kWh (residential), 12¥/kWh

Source: Credit Suisse estimates

Figure 16: Bulb-type LED lighting has cost advantage over bulb-type fluorescent lighting

duration: 10 years

	average operating time per day: 1 hour		average operating time per day: 5 hour		average operating time per day: 10 hour	
	fluorescent bulb 60W	LED bulb equ. to 60-80W	fluorescent bulb 60W	LED bulb equ. to 60-80W	fluorescent bulb 60W	LED bulb equ. to 60-80W
electricity consumption, expense						
total electricity consumption	13W	2W	13W	2W	13W	2W
electricity consumption per year	4kWh	0kWh	23kWh	3kWh	47kWh	7kWh
electricity expense per year (residential, ¥)	110	17	546	84	1,092	168
electricity expense per year (commercial, ¥)	57	9	285	44	570	88
electricity consumption per decade	47kWh	7kWh	237kWh	36kWh	474kWh	73kWh
electricity expense per decade (residential, ¥)	1,100	170	5,460	840	10,920	1,680
electricity expense per decade (commercial, ¥)	570	90	2,850	440	5,700	880
upside of electricity consumption per decade		40kWh		200kWh		401kWh
upside of electricity expense per decade		930		4,620		9,240
upside of electricity expense per decade		480		2,410		4,820
device cost (¥)						
initial cost (¥)	1,680	6,000	1,680	6,000	1,680	6,000
replacement cost per decade	0	0	5,040	0	10,080	0
total device cost (¥)	1,680	6,000	6,720	6,000	11,760	6,000
upside of replacement cost		-4,320		720		5,760
total expense & upside (¥)						
total expense per decade (residential)	2,780	6,170	12,180	6,840	22,680	7,680
total upside per decade (residential)		-3,390		5,340		15,000
total expense per decade (commercial)	2,250	6,090	9,570	6,440	17,460	6,880
total upside per decade (commercial)		-3,840		3,130		10,580
CO2 emission [kWh * 0.555]						
CO2 emission per year	2kg	0kg	13kg	2kg	26kg	4kg
CO2 emission per decade	26kg	4kg	131kg	20kg	263kg	40kg
upside of CO2 emission per decade		22kg		111kg		222kg

electric rate: 23V/kWh (residential), 12V/kWh

Source: Credit Suisse estimates

Figure 17: LED lighting's cost advantage diminishes in a comparison with straight-tube fluorescent lighting

duration: 10 years

	average operating time per day: 1 hour		average operating time per day: 5 hour		average operating time per day: 10 hour	
	fluorescent tube 40W	LED tube equ. to 40W	fluorescent tube 40W	LED tube equ. to 40W	fluorescent tube 40W	LED tube equ. to 40W
electricity consumption, expense						
total electricity consumption	40W	15W	40W	15W	40W	15W
electricity consumption per year	14kWh	5kWh	73kWh	27kWh	146kWh	54kWh
electricity expense per year (residential, ¥)	336	126	1,679	630	3,358	1,260
electricity expense per year (commercial, ¥)	176	66	876	329	1,752	657
electricity consumption per decade	146kWh	54kWh	730kWh	273kWh	1,460kWh	547kWh
electricity expense per decade (residential, ¥)	3,360	1,260	16,790	6,300	33,580	12,600
electricity expense per decade (commercial, ¥)	1,760	660	8,760	3,290	17,520	6,570
upside of electricity consumption per decade		91kWh		456kWh		912kWh
upside of electricity expense per decade		2,100		10,490		20,980
upside of electricity expense per decade		1,100		5,470		10,950
device cost (¥)						
initial cost (¥)	400	15,000	400	15,000	400	15,000
replacement cost per decade	0	0	400	0	1,200	0
total device cost (¥)	400	15,000	800	15,000	1,600	15,000
upside of replacement cost		-14,600		-14,200		-13,400
total expense & upside (¥)						
total expense per decade (residential)	3,760	16,260	17,590	21,300	35,180	27,600
total upside per decade (residential)		-12,500		-3,710		7,580
total expense per decade (commercial)	2,160	15,660	9,560	18,290	19,120	21,570
total upside per decade (commercial)		-13,500		-6,730		-2,450
CO2 emission [kWh * 0.555]						
CO2 emission per year	8kg	3kg	40kg	15kg	81kg	30kg
CO2 emission per decade	81kg	30kg	405kg	151kg	810kg	303kg
upside of CO2 emission per decade		50kg		253kg		506kg

electric rate: 23V/kWh (residential), 12V/kWh

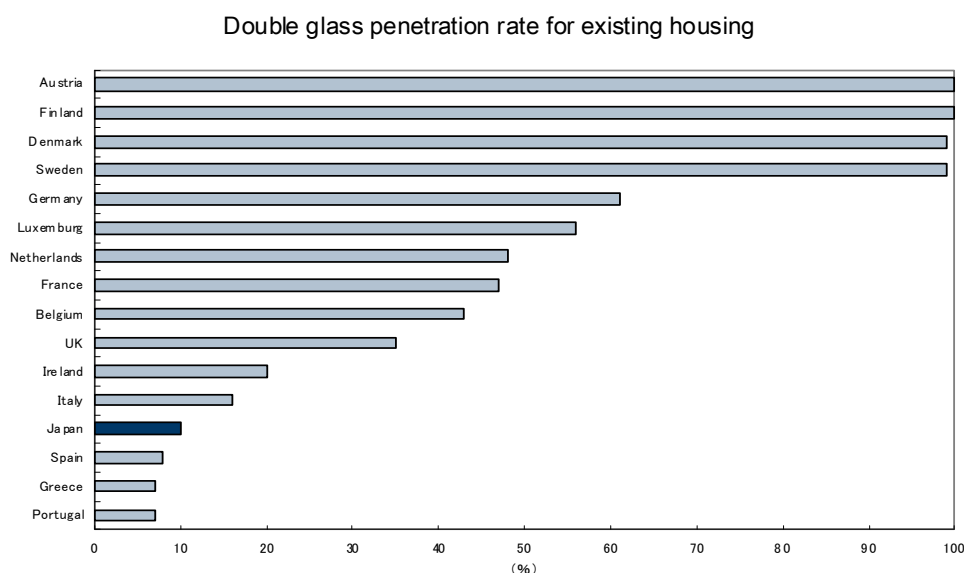
Source: Credit Suisse estimates

Insulating glass market

In an insulating glass unit (IGU), a “spacer” is used to separate two panes of glass, which then trap a layer of sealed dry air. Use of Low-E (low-emissivity) glass further increases the energy efficiency of windows by reducing the transfer of heat or cold through the glass. Low-E insulating glass has a special metal coating that allows the sun's heat and light to pass through, while at the same time reducing heat loss from inside. This glass has been shown to cut energy bills from air-conditioning, which at 25% of the total is the biggest consumer of electricity by households. We expect interest in such products to increase.

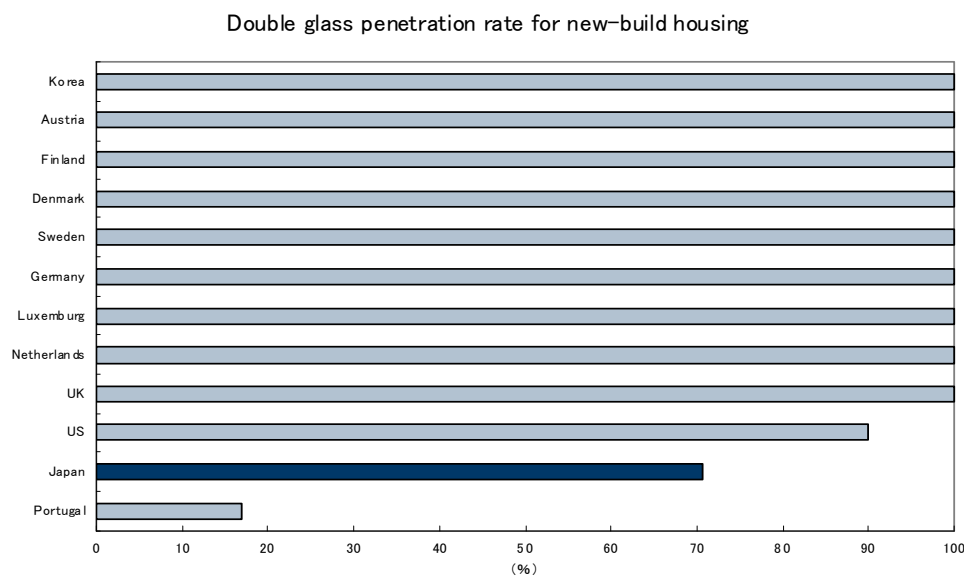
Among the world's leading nations, Japan has been the slowest to adopt insulating glass (Figures 18–19). While uptake is increasing year by year in new-build single-family housing, even now fewer than 50% of new apartment complexes feature insulating glass (Figure 20). For this reason, average uptake for single-family housing and apartment complexes was just 70% in 2009, as compared with 100% in many countries. In existing housing the situation is exacerbated, with Japan's 10% installation rate for insulating glass the lowest among developed nations (Figure 21). Uptake of Low-E glass is lower still, at a mere 0.3% for existing housing, around 40% for new-build single-family housing, and less than 10% for apartment complexes (Figure 22–23).

Figure 18: Uptake of insulating glass in existing housing is among the lowest in the world



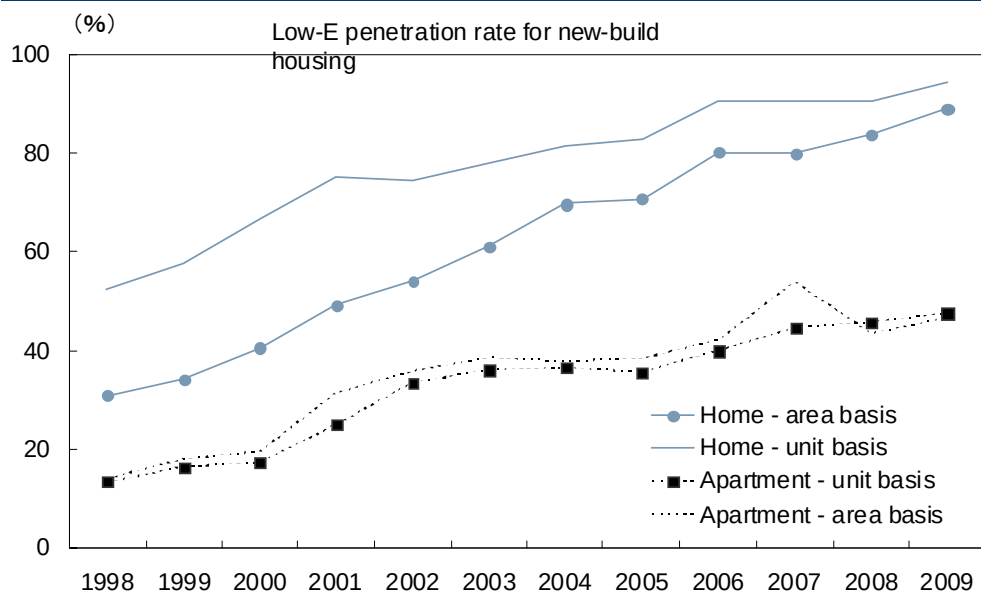
Note: For Japan, Flat Glass Association of Japan 2009 data. For other countries, Flat Glass Association of Japan 1998 data

Source: Flat Glass Association of Japan

Figure 19: Japan lags other nations in uptake of insulating glass in new-build housing

Note: Shows 2009 data for Japan (average for single-family housing and apartment complexes)

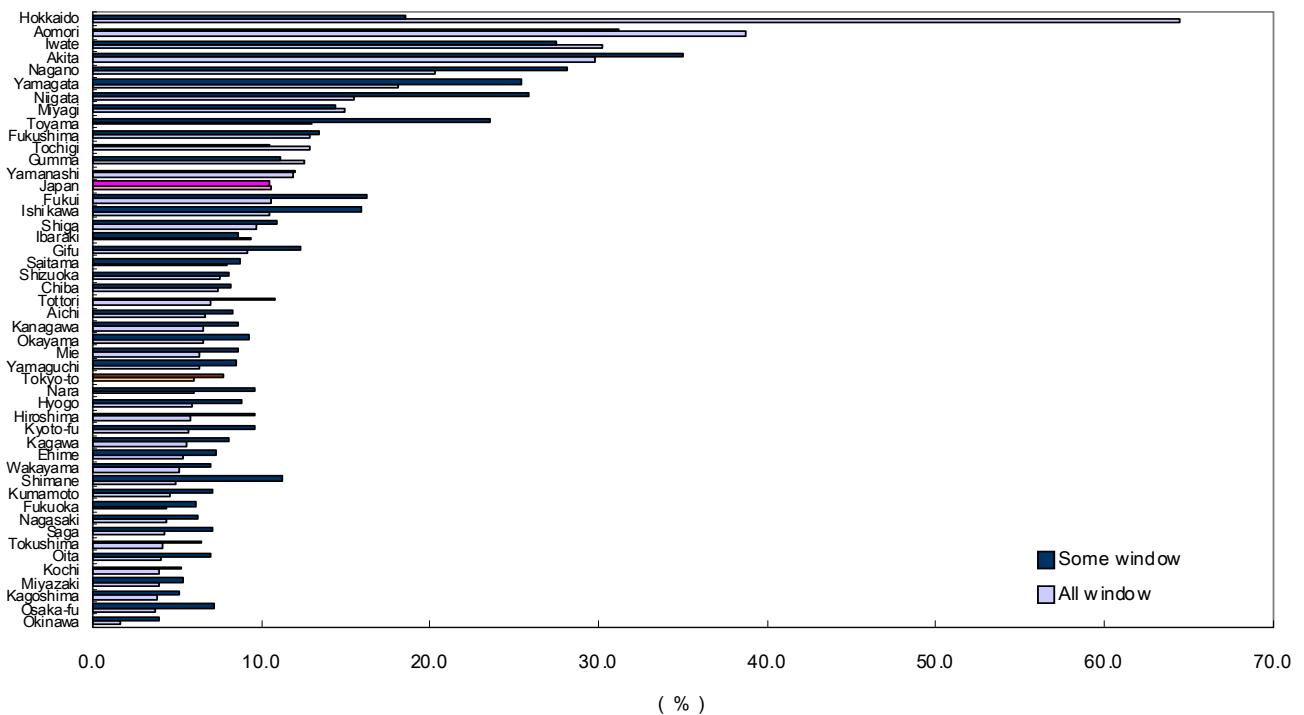
Source: Flat Glass Association of Japan

Figure 20: Increasing use of insulating glass in new-build housing

Source: Flat Glass Association of Japan

Figure 21: Only 10% of Japan's existing housing fitted with insulating glass

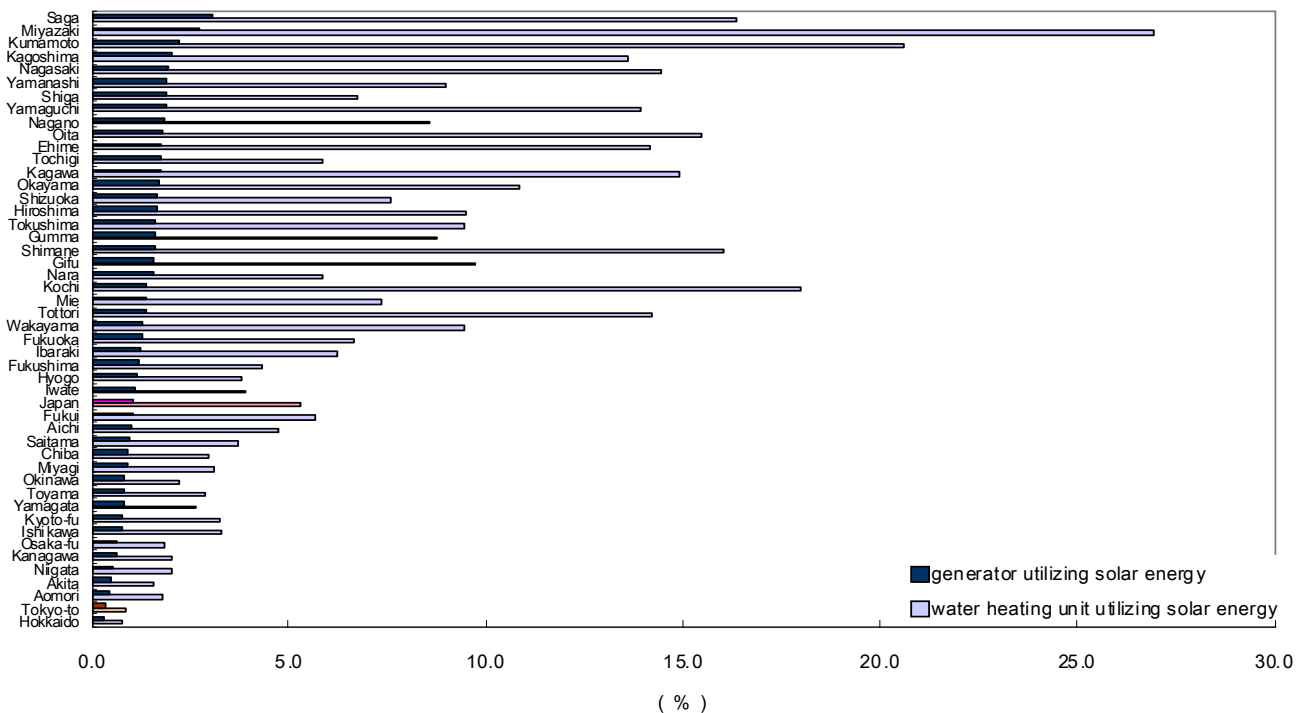
Share of housing with double glass window



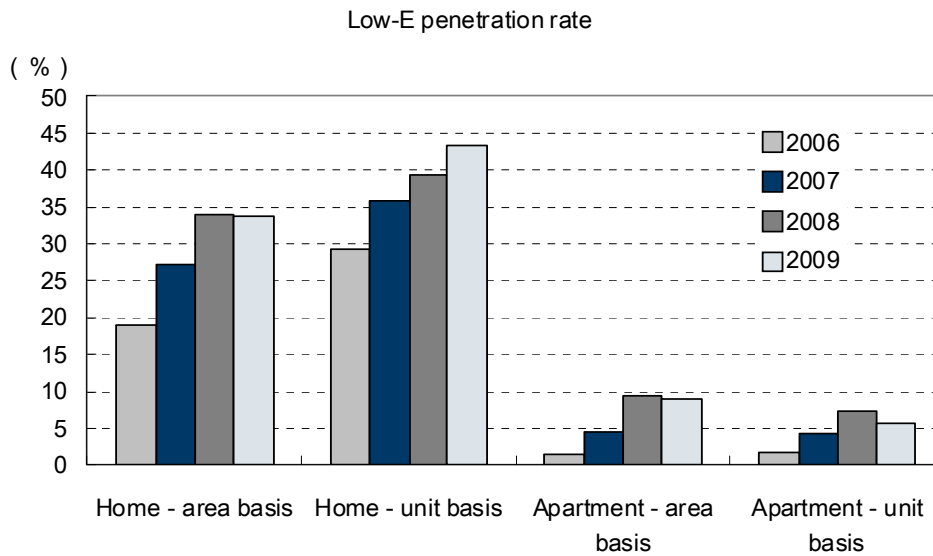
Source: Ministry of Internal Affairs and Communications

Figure 22: Japan's uptake of Low-E glass a mere 0.3%

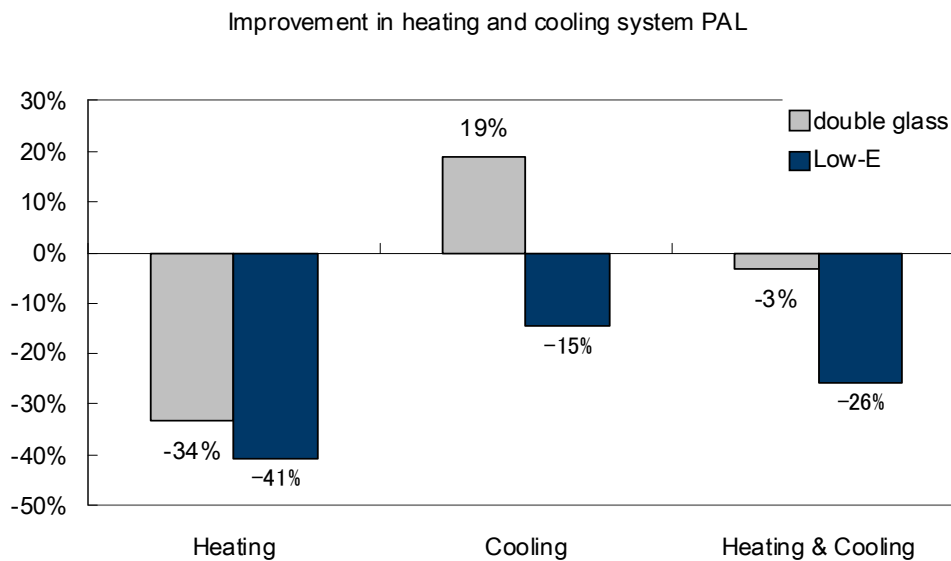
Housing with generator or water heating utilizing solar energy



Source: Flat Glass Association of Japan

Figure 23: Even in new-build housing, installation rate for Low-E glass is low

Source: Company data, Credit Suisse estimates

Figure 24: Improvement in heating and cooling efficiency through use of insulating, Low-E glass

Source: Flat Glass Association of Japan

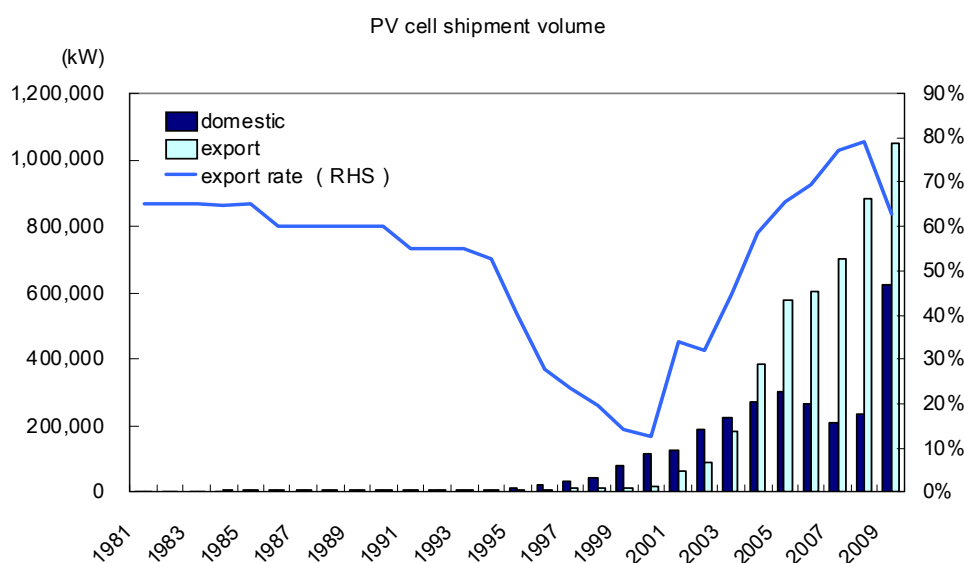
Insulating glass enhances heating and cooling efficiency. According to the Flat Glass Association of Japan, insulating glass produces a 34% improvement in heating efficiency, with Low-E glass boosting efficiency by 41% (Figure 24). There are also data pointing to 15% improvement in cooling efficiency when Low-E glass is used. As the Ministry of Land, Infrastructure, Transport and Tourism, moreover, has figures indicating a 43% reduction in energy consumption for heating and cooling, it seems clear that insulating glass is highly effective in cutting electricity expenses.

Solar cell market

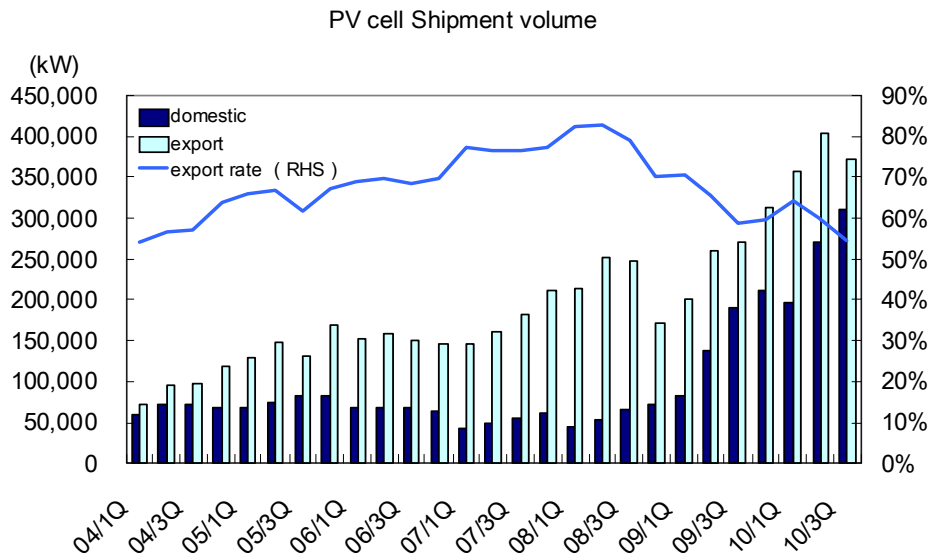
Japan's solar cell market has grown sharply since 2009, when the government resumed subsidies (Figures 25–27). As the Fukushima nuclear power accident has likely made it difficult for now to build new nuclear power facilities, we expect solar cell subsidies to increase. There is certainly ample room for growth in Japan's solar cell uptake, with the percentage of existing homes fitted with solar cells a miniscule 1% (Figure 28). Our global research team expects the world's solar cell market to decrease in size from 2011, owing to feed-in-tariff (FiT) cuts in Europe (Figure 29). The crisis at Fukushima, however, has triggered a worldwide backlash against nuclear power generation, which could well prompt countries worldwide to review their approach to solar cell subsidies and FiT schemes. Further growth in solar cell uptake will require a reduction in costs so that reliance on government subsidies is less of an issue. Under its Solar Photovoltaic Roadmap, the International Energy Agency (IEA) has set European nations a number of targets for reducing prices, as depicted in Figure 30. This roadmap sees solar cell costs dropping to match the retail price of electricity by 2015–20. In the figures below we outline subsidy systems in a number of countries, along with key themes and targets for development. On 31 March, Japan's Ministry of Economy, Trade and Industry announced buyback prices for the FY11 Photovoltaic Electricity Buyback Program. While the buyback price for residential PV facilities of less than 10 kW has been cut to ¥42/kWh from ¥48/kWh, that for non-residential PV facilities has been increased sharply to ¥40/kWh from ¥24/kWh previously. These new prices are to remain effective for 10 years.

We note that there appears to have been a correction recently in the solar cell market, as evidenced by monthly sales figures for solar-cell related companies in Taiwan (Figure 31).

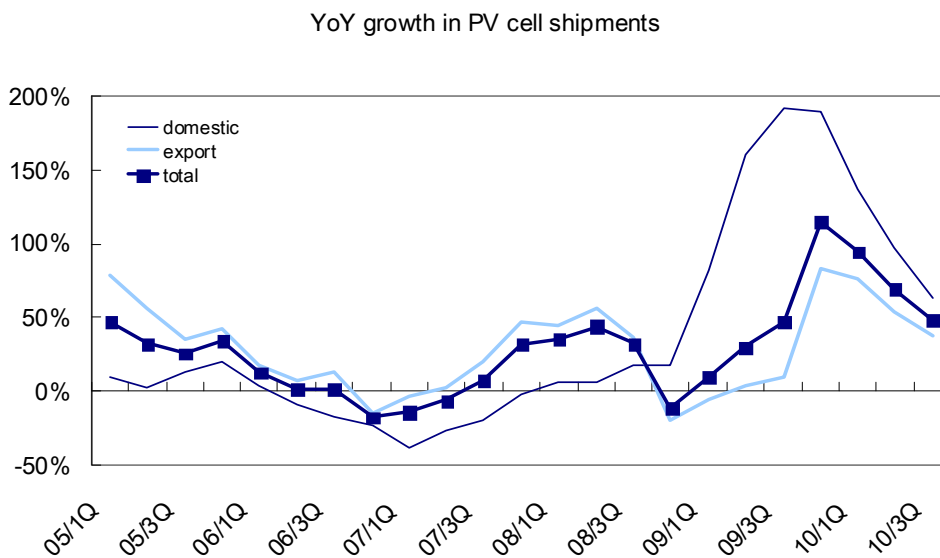
Figure 25: Sharp increase in domestic solar cell shipment volume in 2009



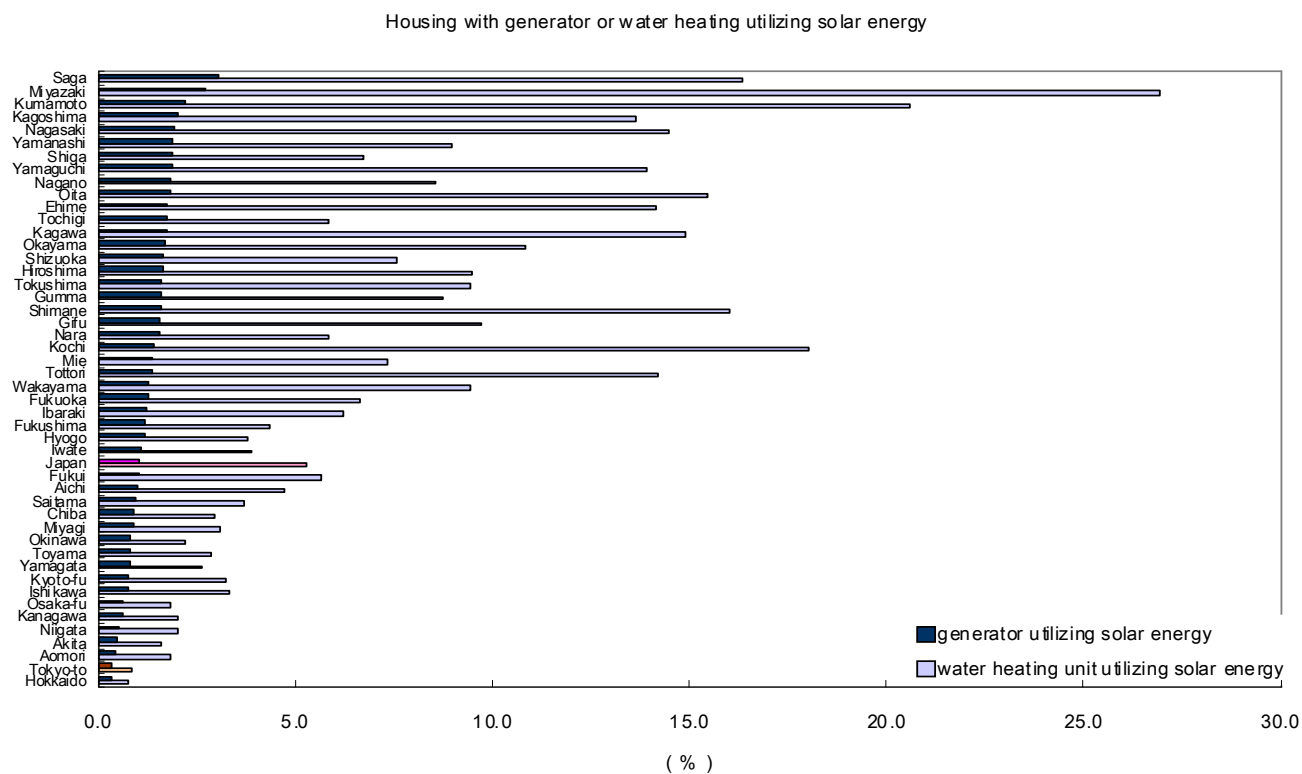
Source: Japan Photovoltaic Energy Association

Figure 26: Domestic solar cell shipment volume remains upbeat

Source: Japan Photovoltaic Energy Association

Figure 27: Brisk growth in solar cell shipment volume

Source: Japan Photovoltaic Energy Association

Figure 28: Percentage of existing homes fitted with solar cells a miniscule 1%

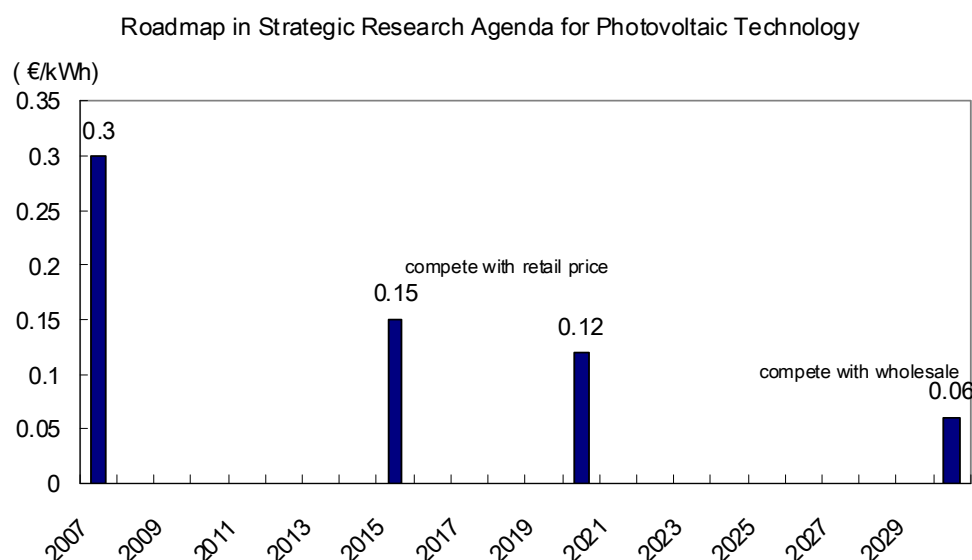
Source: Ministry of Internal Affairs and Communications

Figure 29: Global solar cell market seen contracting from 2011

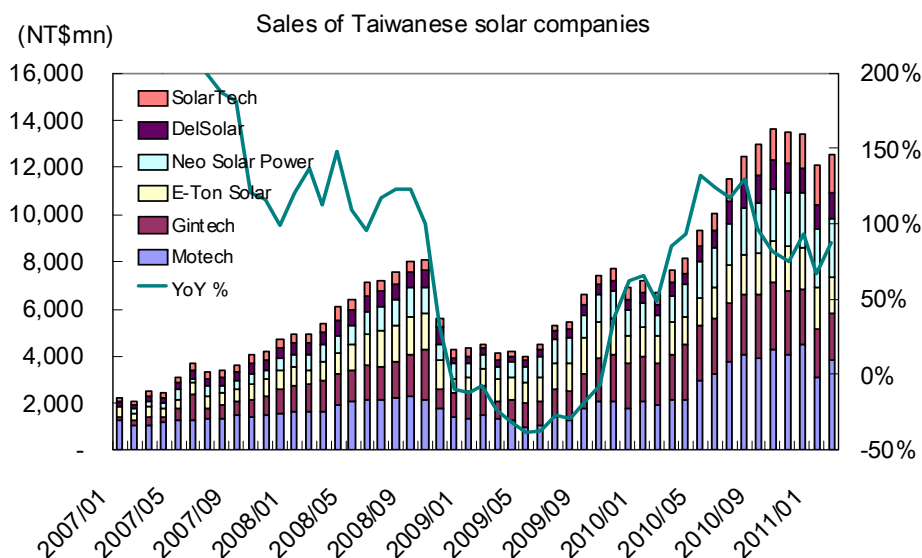
Solar Demand	2005	2006	2007	2008	2009	2010E	2011E	2012E
Germany	837	968	1,328	1,855	3,771	7,412	5,000	5,000
% growth		16%	37%	40%	103%	97%	-33%	0%
% of total demand	57%	57%	47%	31%	51%	38%	27%	28%
% of electricity from Solar	0.31%	0.46%	0.69%	1.01%	1.77%	3.10%	3.99%	4.87%
Spain	35	110	640	2,460	98	400	750	269
% growth		214%	482%	284%	-96%	308%	88%	-64%
% of total demand	2%	6%	23%	41%	1%	2%	4%	2%
% of electricity from Solar	0.02%	0.03%	0.07%	0.33%	1.27%	1.28%	1.40%	1.64%
Italy	7	13	90	240	620	5,000	3,500	1,750
% growth		84%	620%	167%	158%	706%	-30%	-50%
% of total demand	0%	1%	3%	4%	8%	25%	19%	10%
% of electricity from Solar	0.01%	0.02%	0.05%	0.15%	0.38%	2.29%	3.61%	4.25%
France	7	11	50	130	174	719	1,500	750
% growth		55%	359%	160%	34%	313%	109%	-50%
% of total demand	0%	1%	2%	2%	2%	4%	8%	4%
% of electricity from Solar	0.01%	0.01%	0.02%	0.04%	0.07%	0.17%	0.26%	0.35%
US	105	140	220	360	485	900	2,500	3,133
% growth		33%	57%	64%	35%	86%	178%	25%
% of total demand	7%	8%	8%	6%	7%	5%	14%	18%
% of electricity from Solar	0.01%	0.02%	0.03%	0.04%	0.05%	0.08%	0.16%	0.25%
Japan	292	300	230	230	477	950	1,102	1,197
% growth		3%	-23%	0%	107%	99%	16%	9%
% of total demand	20%	18%	8%	4%	6%	5%	6%	7%
% of electricity from Solar	0.13%	0.16%	0.18%	0.20%	0.25%	0.34%	0.44%	0.56%
China	10	15	23	50	208	569	1,206	1,917
% growth		50%	53%	116%	319%	174%	112%	59%
% of total demand	1%	1%	1%	1%	3%	3%	7%	11%
% of electricity from Solar	0.00%	0.00%	0.00%	0.01%	0.01%	0.03%	0.06%	0.11%
Global demand	1,475	1,705	2,804	5,944	7,441	19,628	18,507	17,577
% growth in demand		16%	64%	112%	25%	164%	-6%	-5%

Source: Credit Suisse estimates

Figure 30: Solar cell costs declining



Source: International Energy Agency

Figure 31: Some evidence of correction in solar cell sales

Source: Company data

Figure 32: Germany's FiT scheme

Germany	
	FiT €/kWh
Rooftop	
<30 kW	0.2874
>30 kW<100 kW	0.2734
>100 kW <1,000 kW	0.2587
>1,000 kW	0.2157
Groundmounted	
Groundmounted Conversion and Sealed Areas	0.211
Groundmounted Commercial Zones	0.2207
Captive consumption of plant building	
<30 kW Net Metered <30%	0.1236
<30 kW Net Metered >30%	0.1674
<100 kW Net Metered <30%	0.1095
<100 kW Net Metered >30%	0.1533
>100 kW <500 kW Net Metered <30%	0.0948
>100 kW <500 kW Net Metered >30%	0.1386

Source: Wind-Works.org, Credit Suisse

Figure 33: France's FiT scheme

France	
	FiT €/kWh
Residential	
Integrated < 9 kW	0.464
Integrated > 9 < 36 kW	0.406
Simplified Integrated < 36 kW	0.3035
Simplified Integrated > 36 < 100 kW	0.2885
Education or health facilities more than 2 years old	
Integrated < 9 kW	0.406
Integrated > 9 < 36 kW	0.406
Simplified Integrated < 36 kW	0.3035
Simplified Integrated > 36 < 100 kW	0.2885
Other closed buildings more than 2 years old	
Integrated < 9 kW	0.352
Simplified Integrated < 36 kW	0.3035
Simplified Integrated > 36 < 100 kW	0.2885
Ground-mounted Systems < 12 MW	0.12

Source: Wind-Works.org, Credit Suisse

Figure 34: Italy's FiT scheme

Italy	
	FiT €/kWh
BIPV	
> 1 < 3 kW	0.44
> 3 < 20 kW	0.4
> 20 kW	0.37
Rooftop	
> 1 < 3 kW	0.402
> 3 < 20 kW	0.377
> 20 < 200 kW	0.358
> 200 < 1000 kW	0.355
> 1 < 5 MW	0.351
> 5 MW	0.333
Ground Mounted	
> 1 < 3 kW	0.362
> 3 < 20 kW	0.339
> 20 < 200 kW	0.321
> 200 < 1000 kW	0.314
> 1 < 5 MW	0.313
> 5 MW	0.297

Source: Credit Suisse

Figure 35: Top 10 US states for PV installation

	State	MW	Market Share
1	California	768	61%
2	New Jersey	128	10%
3	Colorado	59	5%
4	Arizona	46	4%
5	Florida	39	3%
6	Nevada	36	3%
7	New York	34	3%
8	Hawaii	26	2%
9	Connecticut	20	2%
10	Massachusetts	18	1%
	All Other States	83	7%
	Total	1256	100%

Source: Wind-Works.org, Credit Suisse

Figure 36: Incentives in state of California

Single-Family Affordable Solar Homes (SASH) Program

Federal Income Tax Liability	CARE-Eligible Homeowners (\$/Watt DC)	Not CARE Eligible (\$/Watt)
\$0	7.00	5.75
\$1 to \$1000	6.50	5.25
\$1001 to \$2000	6.00	4.75

Source: Wind-Works.org, Credit Suisse

Figure 37: Incentives in state of New Jersey

New Jersey's Renewable Energy Manufacturing Incentive (NJREMI)

	incentive (\$/Watt DC)
Residential 0 – 10kW	0.25
Non-Residential 0 – 50kW	0.14
Non-Residential 51 – 100kW	0.12
Non-Residential 101 – 500kW	0.08

Source: Wind-Works.org, Credit Suisse

Figure 38: Incentives in state of Colorado

Residential Renewable Energy Rebate Program

	incentive (\$/W)
located outside a local partner's territory	1.5
located inside a local partner's territory	2.5

Source: Wind-Works.org, Credit Suisse

Figure 39: Japan's FiT scheme

Japan	
	FiT ¥ / kW
Residential	
Only PV generation <10kW	42
Only PV generation >10kW<500kW	40
Double generation <10kW	34
Double generation >10kW <500kW	32
Non residential	
Only PV generation <10kW	40
Only PV generation >10kW<500kW	40
Double generation <10kW	32
Double generation >10kW <500kW	32

Source: Wind-Works.org, Credit Suisse

Figure 40: Comparison of module efficiency for different types of solar cell

silicon	mass-produced	hybrid	SANYO	17.9%
			KANEKA	9.2%
		thin-film	SHARP	9.0%
		polycrystalline	SUNPOWER	19.0%
			MOTECH	15.7%
			JA SOLAR	15.3%
			SOLARWORLD	14.9%
			TRINA SOLAR	14.7%
			SHARP	14.4%
			Q-CELLS	14.4%
			YINGLI	14.4%
			KYOCERA	14.0%
			CANADIAN SOLAR	13.9%
			mitsubishi electric	13.4%
			EVERGREEN	13.4%
		monocrystalline	SHARP	17.0%
			JA SOLAR	16.9%
			SUNTECH	14.9%
			SOLARWORLD	14.9%
			TRINA SOLAR	14.2%
			mitsubishi electric	14.1%
			CANADIAN SOLAR	14.1%
inorganic		CIS	SOLAR FLONTIER	10.3%
		CIGS	HONDA SOLTEC	13.0%
		CdTe	Q-CELLS	12.7%
organic	not mass-produced	InGaAs	FIRST SOLAR	11.8%
			SHARP	35.8%
		DSC	NIPPON STEEL CHM.	10.4%
		power plastic	mitsubishi CHM.	9.2%
			KONARKA	8.3%

Source: Wind-Works.org, Credit Suisse

Large-scale storage battery market

Storage batteries—especially of the lithium ion variety—initially attracted attention owing to their use in mobile applications such as PCs, mobile phones and automobiles. However, we expect to see heightened interest in large-scale batteries for stationary energy storage, in tandem with increased demand for solar cells and other forms of renewable energy, and as a backup power source for use during prolonged electricity interruptions. The proliferation of power cuts (planned and otherwise) since the 11 March earthquake has forced many companies and individuals to curtail their activities, and even at the residential level there are reports of growth in storage battery demand.

Large-scale storage batteries currently in use include lead storage batteries, NaS batteries, nickel hydrogen batteries and lithium-ion batteries. Of these, NaS batteries are the cheapest for use as large-scale storage batteries, at around ¥40,000/kWh, followed by lead storage batteries at ¥50,000, lithium-ion batteries at ¥100,000–300,000, and nickel hydrogen batteries at ¥400,000 (Figure 41). Pumped storage hydroelectricity (pumped hydro) was once widely used for day/night load leveling. According to IEA research, NaS storage batteries cost less than pumped hydro, at about \$2,000/kW versus \$3,000/kW, while the duration of discharge is only slightly less, at eight hours compared with 12. As shown in Figures 42 and 43, NaS batteries look to have a clear advantage over other battery types. (Note that NaS batteries are sodium-sulfur batteries comprising a sodium (Na) anode and sulfur (S) cathode.)

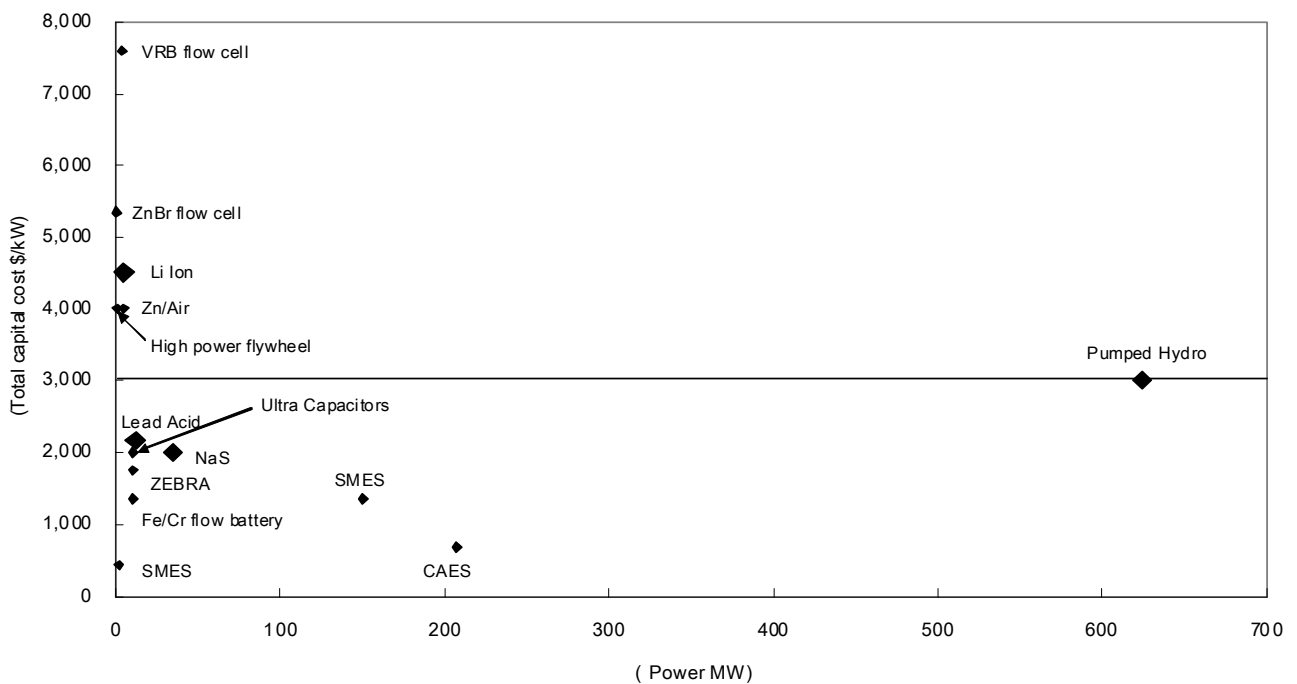
Figure 41: NaS batteries the cheapest option as large-scale storage batteries

	lead storage battery	NaS battery	nickel hydride battery	lithium-ion battery
energy density	approx. 35Wh/kg	approx. 110Wh/kg	approx. 60Wh/kg	approx. 120Wh/kg
charge-discharge efficiency	87%	90%	90%	95%
battery cycle life	4,500 approx. 15 years	4,500 approx. 15 years	6,000 approx. 20 years	3,500 approx. 10 years
unit price as large capacity battery				
present (\10000/kWh)	5	4	40	10 - 30
2020 (\10000/kWh)	3 - 4		4	4

Source: Ministry of Economy, Trade and Industry

Figure 42: NaS batteries cheaper still than pumped storage hydroelectricity

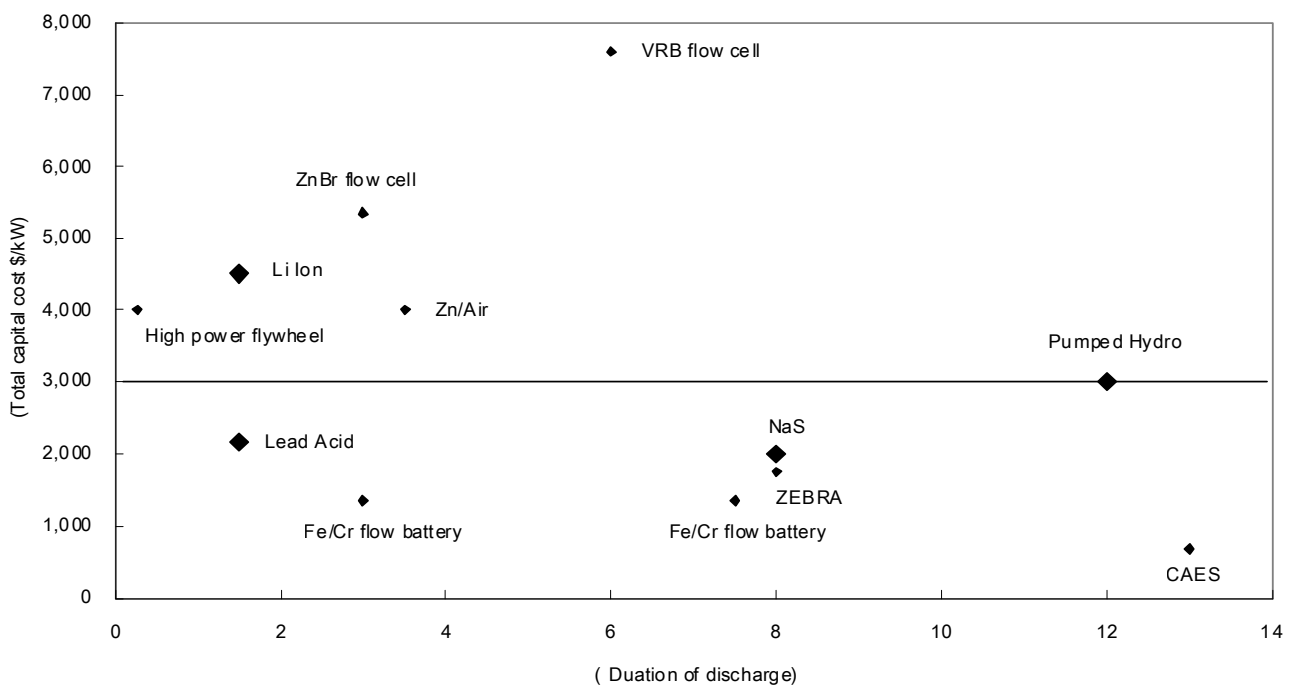
Comparison of major storage batteries



Source: International Energy Agency

Figure 43: Duration of discharge (hours) for NaS batteries not far short of pumped storage hydroelectricity

Comparison of major storage batteries

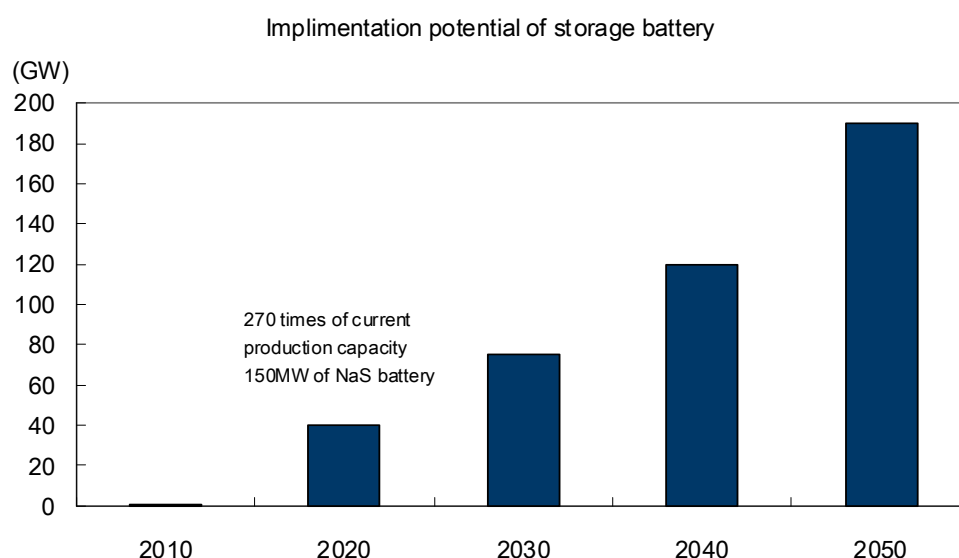


Source: International Energy Agency

NaS batteries have a rating capacity of 300kWh (a standard 2MW, 12MWh system consists of 40 x 50kW modules) and are thus ill-suited for use in small-scale stationary energy storage for households, where energy usage is typically 5kWh or less. They are highly effective, however, in large-scale stationary energy storage for offices, apartment complexes, factories and so forth. Beneath the Tokyo Midtown mixed-use development in Tokyo's Roppongi area, there is an NaS battery producing 750kW of electricity (alongside two 900kW cogeneration systems). We estimate this battery cost around ¥200mn, as the average unit cost of an NaS battery is said to be just over ¥200mn/MW.

The IEA estimates that demand for large-scale storage batteries will amount to 40GW by 2020. This is 270x NGK Insulators' annual NaS battery production capacity of 150MW, and worth a huge amount of more than ¥9tn at current NaS battery prices (Figure 44). If the market does start growing as anticipated, we expect interest in large-scale storage batteries to increase sharply.

Figure 44: Market for large-scale storage batteries potentially huge



Source: International Energy Agency

Use of lithium-ion battery systems set to accelerate

The watt-hour cost of lithium-ion storage batteries is higher than equivalent lead storage battery or NaS battery systems, so their use in large-scale storage battery systems (from tens of kWh to 100s of kWh) has been limited until now. However, inquiries from potential customers apparently have increased since the earthquake, and some companies in the field have rushed new products to market in response. Household power storage systems need roughly 1–5kWh of capacity, so the cost would be no more than ¥2.5mn based on a price of ¥500,000/kWh. We see demand for lithium-ion storage batteries as an emergency backup power source that could be sold in conjunction with solar power systems. Installation costs could also fall further if these systems attract government incentives.

Figure 45: Lithium-ion battery storage systems on the market

Manufacturer	Overview of storage battery systems
Toshiba	Moved up launch of household storage battery systems to June 2011 (original plan was to launch in 2012). Pricing at ¥400–500,000/kWh (1,3 & 5 kWh modules)
Yamada Denki & West Holdings	Announced on April 14 the start of sales of a household LiB system, to be packaged with residential solar power generation systems. The batteries will be supplied by energy start-up Edison Power (headquartered in Kisarazu City, Chiba). A 1kWh unit will be priced at ¥873,000 and a 2.5kWh unit at ¥1.89mn.
Panasonic & Sanyo	Announced last year the development of a home storage battery system comprising multiple cylindrical PC batteries and are now considering moving up the sales launch into FY11. Sanyo also announced sales of units to Tokushima Prefecture for use with solar power generation systems for disasters.
Sony	Announced it would begin sales of a 1.2 kWh commercial-use ferrous iron-phosphate-based storage battery. Several modules can be connected to increase capacity. Pricing at ¥300,000/kWh.
Eliiy Power	Venture formed by Sharp, Daiwa House and others. Targeting residential market and planning to launch sales of a system using Sharp solar batteries from autumn 2011. Pricing expected to be less than 2mn for a 2kWh system. Storage battery will use iron phosphate cathode material provided by Sumitomo Osaka Cement.
GS Yuasa	Has already commercialized industrial-use LiB systems (but not for residential-use). Has successfully sold to customers using as a backup power source for various equipment and facilities, unmanned transport vehicles, and trains.

Source: Company data, Credit Suisse

In most cases, power generated by residential solar power systems is sold to power companies over the grid, and without a storage battery system, households are unable to effectively use power generated by their systems during the day. In effect, merely installing household solar panels is not sufficient to provide backup power; in most cases, the purpose is to generate and sell electricity to power companies. However, if installed even with a relatively small battery storage system, electricity generated by the solar panels and stored within the battery could provide sufficient power for emergencies.

Companies Mentioned (Price as of 22 Apr 11)

Asahi Glass (5201, ¥988, OUTPERFORM, TP ¥1,360, OVERWEIGHT)
 Central Glass (4044, ¥335, NEUTRAL, TP ¥380, OVERWEIGHT)
 GS Yuasa (6674, ¥549, NEUTRAL, TP ¥630, MARKET WEIGHT)
 Mitsubishi Chemical Holdings (4188, ¥524, OUTPERFORM, TP ¥850, MARKET WEIGHT)
 Mitsubishi Gas Chemical (4182, ¥606, OUTPERFORM, TP ¥770, MARKET WEIGHT)
 NGK Insulators (5333, ¥1,342, OUTPERFORM, TP ¥1,800, OVERWEIGHT)
 NSG Group (5202, ¥238, NEUTRAL [V], TP ¥230, OVERWEIGHT)
 Showa Shell Sekiyu (5002, ¥860, OUTPERFORM, TP ¥980, MARKET WEIGHT)
 Toyo Tanso (5310, ¥4,425, OUTPERFORM, TP ¥5,900, OVERWEIGHT)

Disclosure Appendix

Important Global Disclosures

Shinya Yamada, Masami Sawato, Yuji Nishiyama & Jun Yamaguchi each certify, with respect to the companies or securities that he or she analyzes, that (1) the views expressed in this report accurately reflect his or her personal views about all of the subject companies and securities and (2) no part of his or her compensation was, is or will be directly or indirectly related to the specific recommendations or views expressed in this report.

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Outperform (O): The stock's total return is expected to outperform the relevant benchmark* by at least 10-15% (or more, depending on perceived risk) over the next 12 months.

Neutral (N): The stock's total return is expected to be in line with the relevant benchmark* (range of ± 10 -15%) over the next 12 months.

Underperform (U): The stock's total return is expected to underperform the relevant benchmark* by 10-15% or more over the next 12 months.

Relevant benchmark by region: As of 29th May 2009, Australia, New Zealand, U.S. and Canadian ratings are based on (1) a stock's absolute total return potential to its current share price and (2) the relative attractiveness of a stock's total return potential within an analyst's coverage universe, with Outperforms representing the most attractive, Neutrals the less attractive, and Underperforms the least attractive investment opportunities. Some U.S. and Canadian ratings may fall outside the absolute total return ranges defined above, depending on market conditions and industry factors. For Latin American, Japanese, and non-Japan Asia stocks, ratings are based on a stock's total return relative to the average total return of the relevant country or regional benchmark; for European stocks, ratings are based on a stock's total return relative to the analyst's coverage universe**. For Australian and New Zealand stocks a 22% and a 12% threshold replace the 10-15% level in the Outperform and Underperform stock rating definitions, respectively, subject to analysts' perceived risk. The 22% and 12% thresholds replace the +10-15% and -10-15% levels in the Neutral stock rating definition, respectively, subject to analysts' perceived risk.*

***An analyst's coverage universe consists of all companies covered by the analyst within the relevant sector.*

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Analysts' coverage universe weightings are distinct from analysts' stock ratings and are based on the expected performance of an analyst's coverage universe* versus the relevant broad market benchmark**:

Overweight: Industry expected to outperform the relevant broad market benchmark over the next 12 months.

Market Weight: Industry expected to perform in-line with the relevant broad market benchmark over the next 12 months.

Underweight: Industry expected to underperform the relevant broad market benchmark over the next 12 months.

**An analyst's coverage universe consists of all companies covered by the analyst within the relevant sector.*

***The broad market benchmark is based on the expected return of the local market index (e.g., the S&P 500 in the U.S.) over the next 12 months.*

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Restricted	2%	

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