

Solar Power

PRELIMINARY

Electricity in Japan: Two Sports with One Name

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PHOTON Consulting, LLC

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Football

(Overview)

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Football - Traditional version



Source: PHOTON Consulting, LLC. Note: All data are rough estimates.

Football - New version



In English, "football" is two sports with one name

Electricity

(Overview)

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Electricity - Traditional version



Source: PHOTON Consulting, LLC. Note: All data are rough estimates.

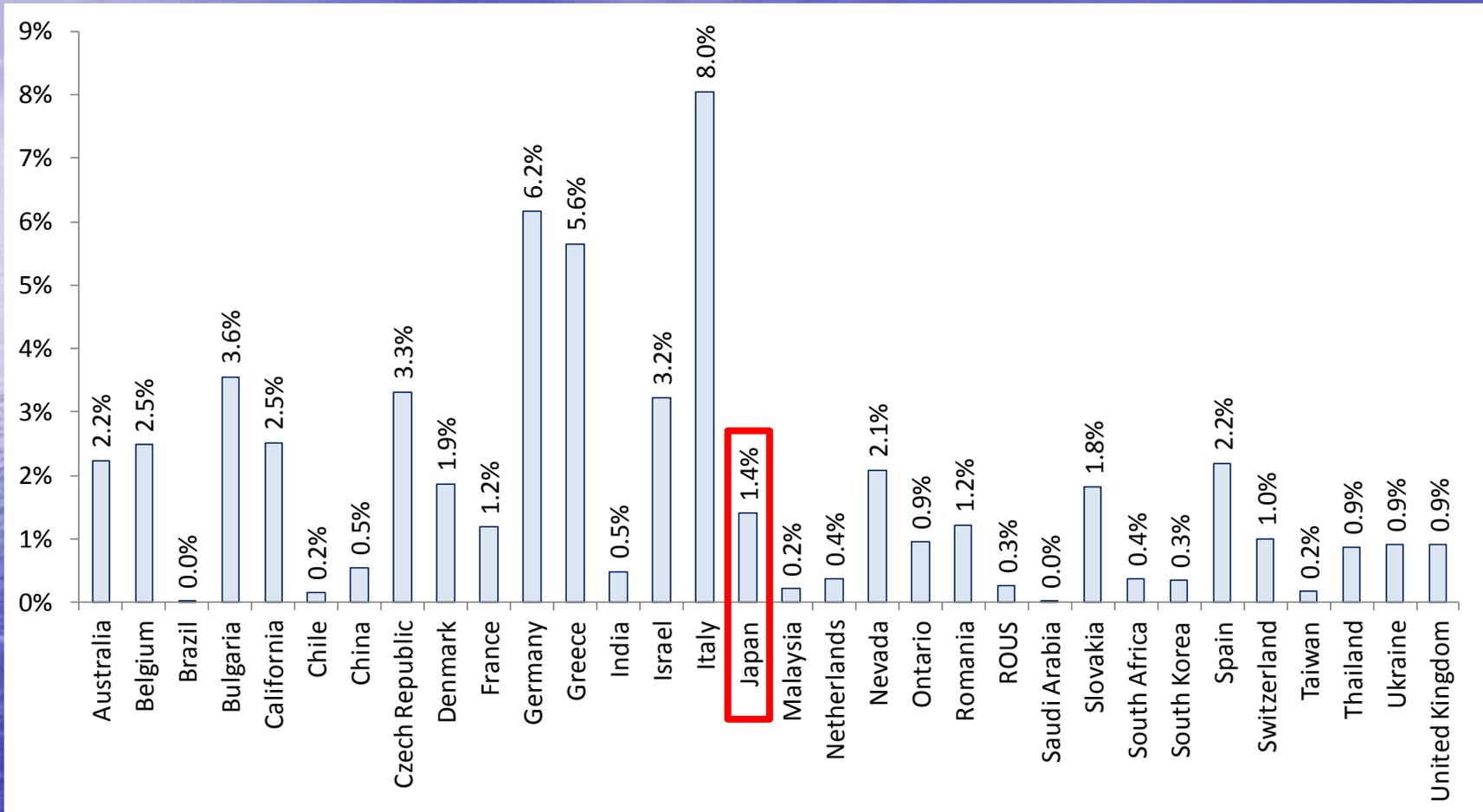
Electricity - New version



In Japan, "electricity" is two sports with one name

Solar power share of consumption

(% - 2013 consumption of electricity from PV) *PRELIMINARY*

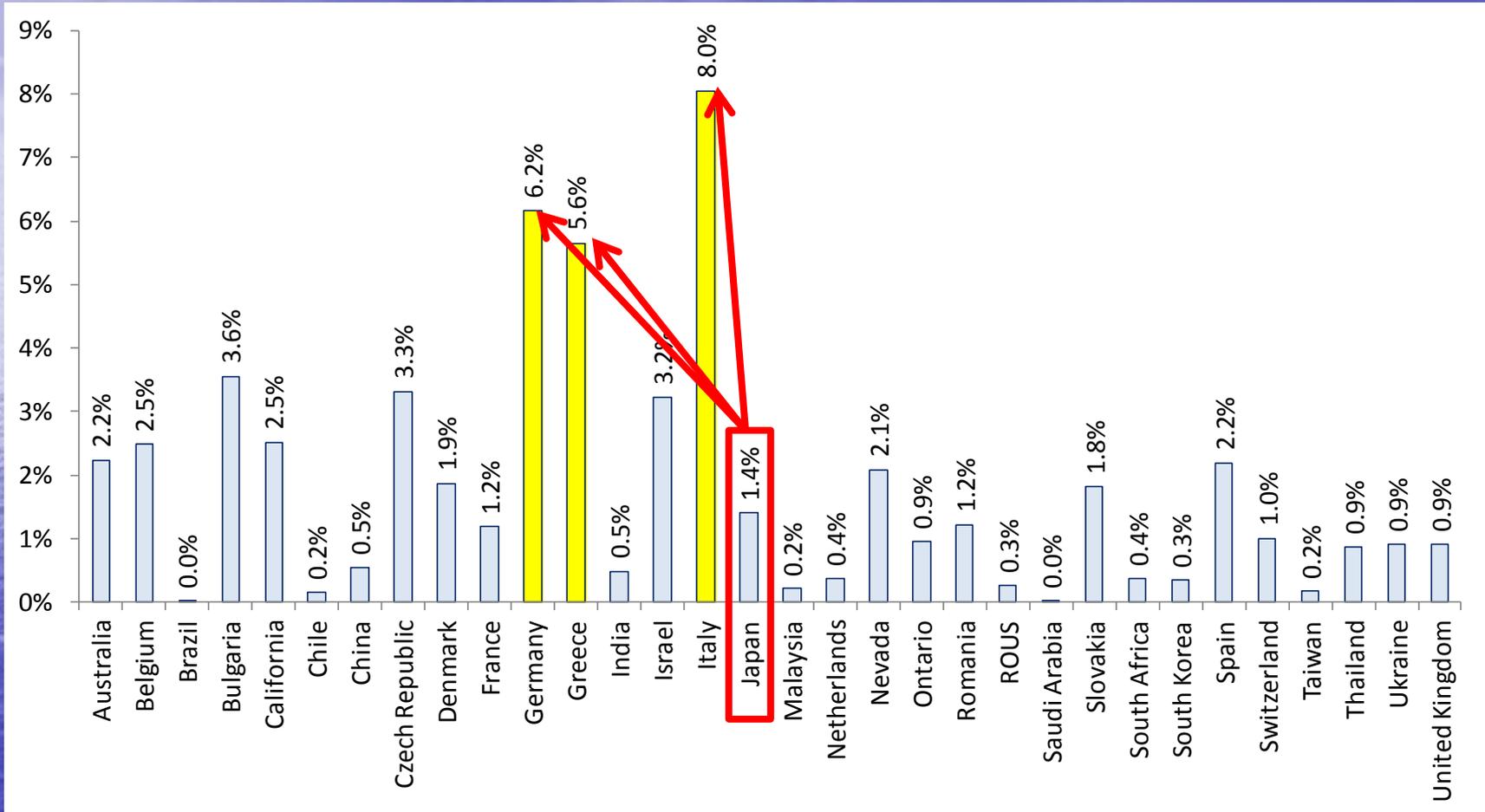


Source: PHOTON Consulting, LLC. Note: All data are rough estimates.

Solar power was 1.4% of electricity consumption in Japan in 2013

Solar power share of consumption

(% - 2013 consumption of electricity from PV) *PRELIMINARY*

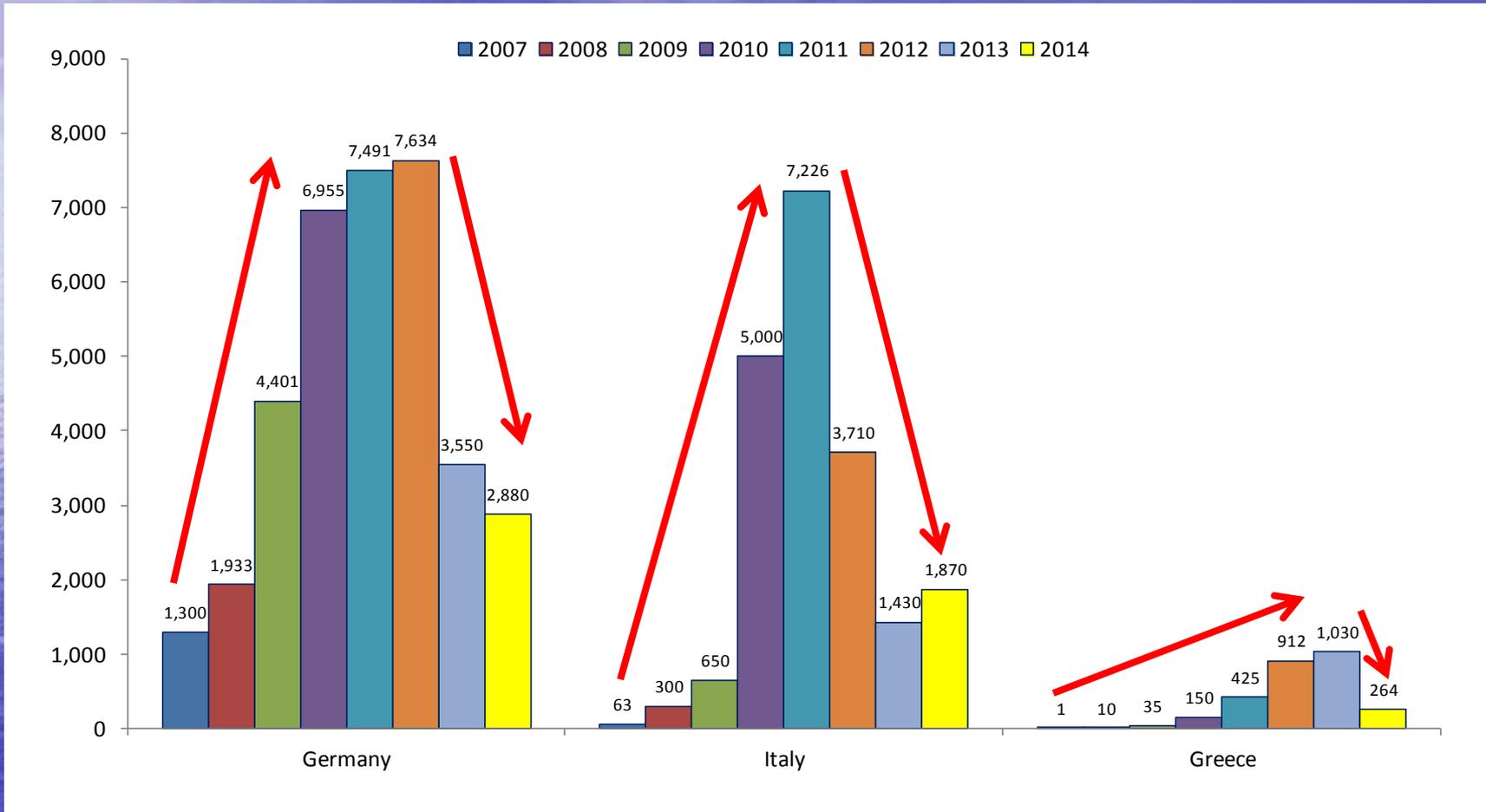


Source: PHOTON Consulting, LLC. Note: All data are rough estimates.

**Japan is following footsteps of other countries
→ Greece, Germany and Italy already above 5%**

Solar power installations (MW/year)

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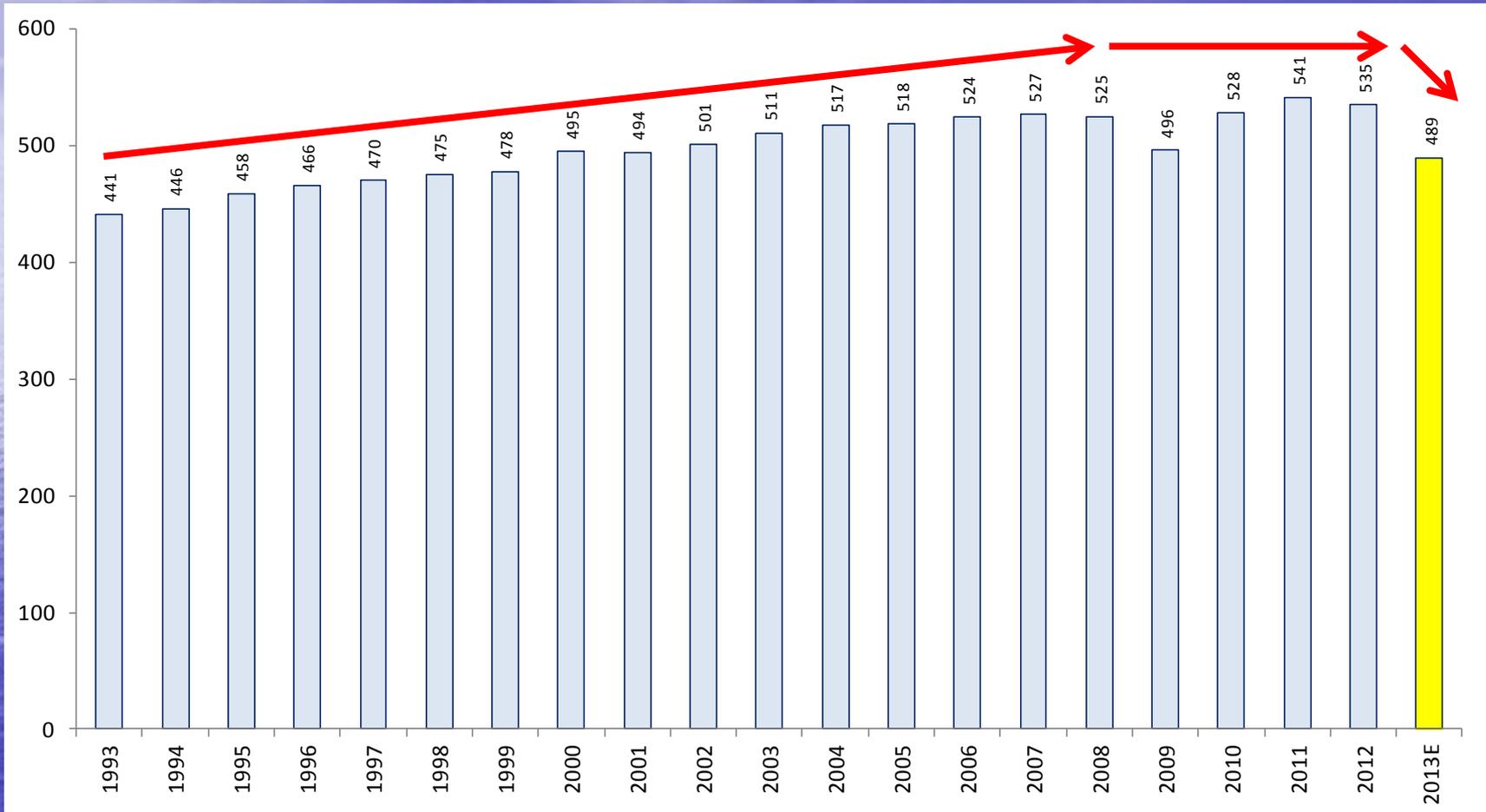
Source: PHOTON Consulting, LLC. Note: All data are rough estimates.

**Japan is following footsteps of other countries
→ ~5% of electricity consumption → Boom-bust cycle**

Germany electricity consumption

(GWh/year)

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Source: PHOTON Consulting, LLC based on AGEB and ENTSO-E. Note: All data are rough estimates.

Electricity consumption in Germany has shifted from historical growth pattern → Pattern is now flat-to-declining

PHELIX peakload year futures

(Euro/MWh for 2015 and 2016)

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Source: PHOTON Consulting, LLC based on EEX.com. Note: All data are rough estimates.

Wholesale prices in Germany declined significantly → Both spot and futures (above) dropped → Futures prices down ~50% as solar penetration rose

RWE and EON stock price

(Euro/share)

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Source: PHOTON Consulting, LLC based on Yahoo Finance. Note: All data are rough estimates.

Declining volume, declining wholesale price, limited increases in retail price, rising cost → Rising risk → Lower market capitalization

RWE credit scores

(Overview)

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Standard & Poor's			Moody's		
Rating Date	Rating	CreditWatch/ Outlook	Date	Rating	CreditWatch/ Outlook
Jul 2012	BBB+	Stable	Jun 2013	Baa1	Stable
Jun 2011	A-	Negative	Jul 2011	A3	Negative
Apr 2011	A	Watch negative	Apr 2011	A2	Watch negative
Jan 2009	A	Negative	Nov 2009	A2	Negative
Jun 2008	A	Stable	Jan 2009	A1	Watch negative
Feb 2008	A+	Watch negative	Feb 2008	A1	Negative
Mar 2003	A+	Negative	Apr 2005	A1	Stable
Jun 2002	A+	Stable	Mar 2002	A1	Negative
Mar 2002	AA-	Watch negative	Dec 2001	Aa3	Negative
Dec 2001	AA-	Negative	Sep 2001	Aa3	Watch negative
Dec 2001	AA-	Stable	Feb 2000	Aa3	Stable
Sep 2001	AA-	Watch negative			
Feb 2000	AA-	Stable			

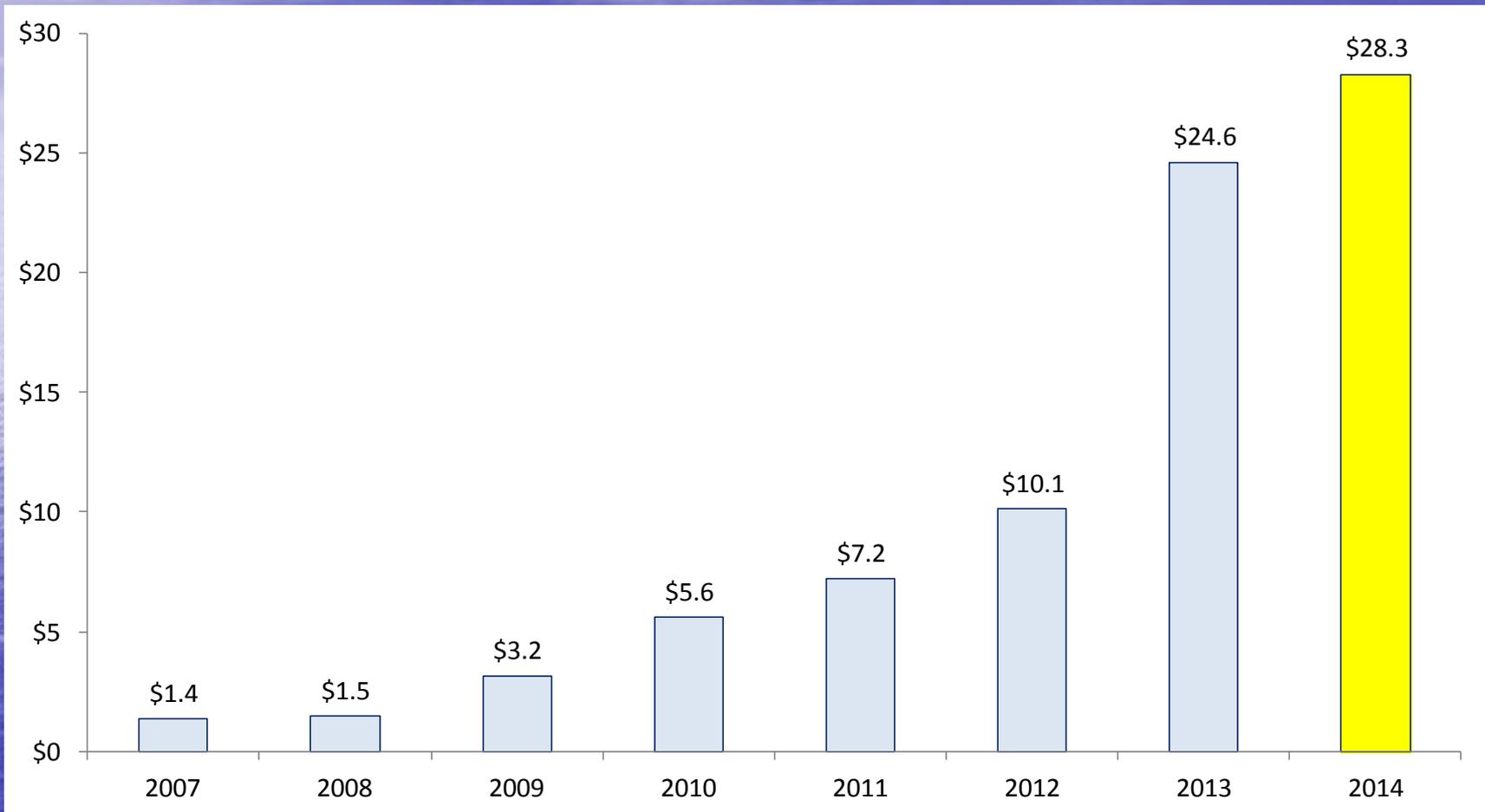
Source: PHOTON Consulting, LLC based on RWE. Note: All data are rough estimates.

Declining volume, declining wholesale price, limited increases in retail price, rising cost → Rising risk → Lower credit scores, lower dividends, asset sales, etc.

Japan solar revenue pool

(\$bn/year - New solar system sales)

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Source: PHOTON Consulting, LLC. Note: All data are rough estimates.

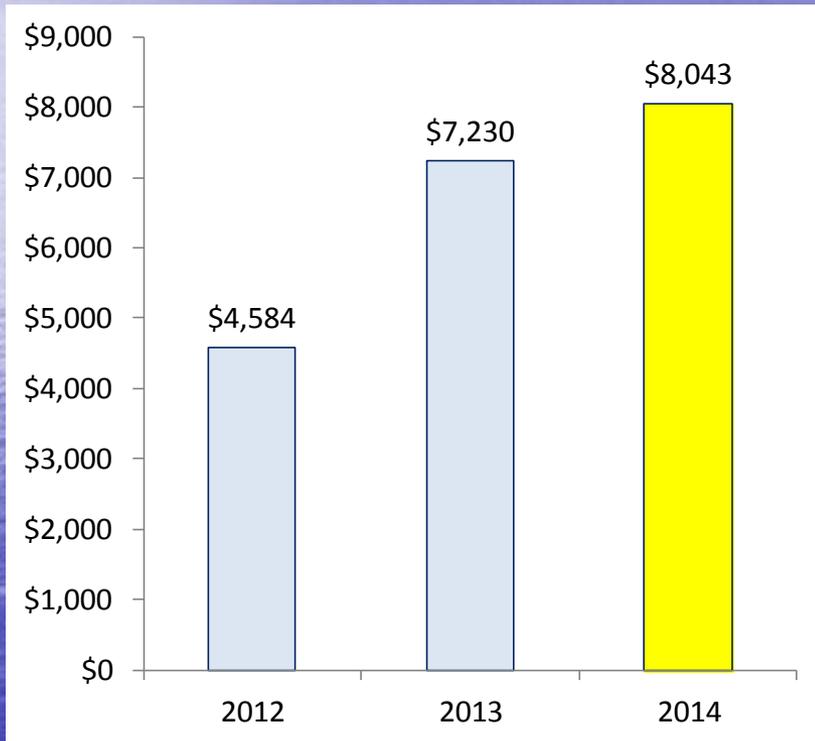
Japan solar revenue pool has expanded rapidly from \$1bn in 2007 (~\$12/person) to \$25bn in 2013 (~\$190/person) → Realistic potential for \$28bn in 2014 (~\$220/person)

Solar revenue and operating profit

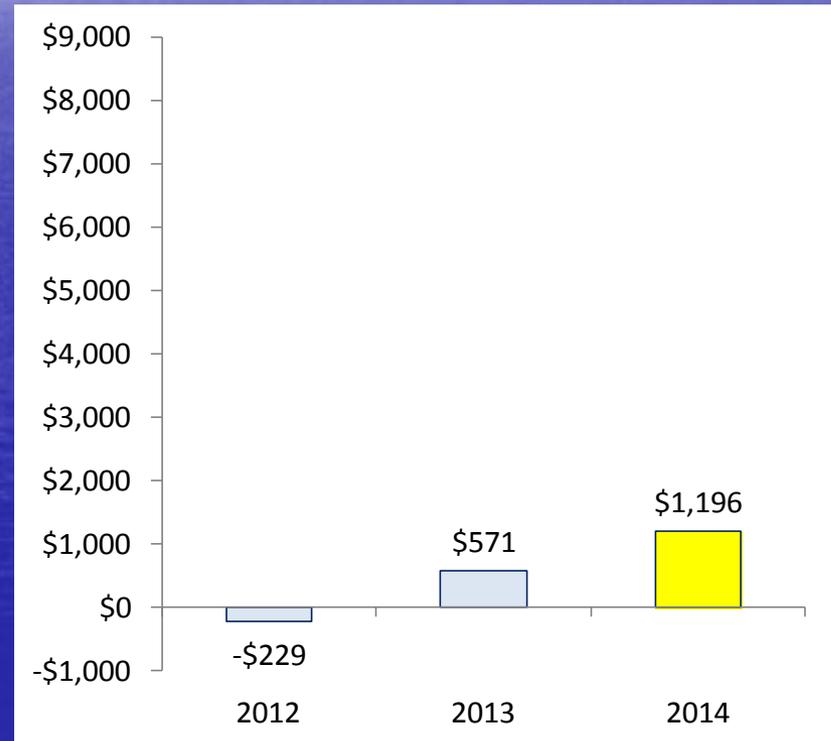
(\$mn/year – Total for 4 large Japanese solar companies)

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Revenue (\$mn/year)



Operating profit (\$mn/year)

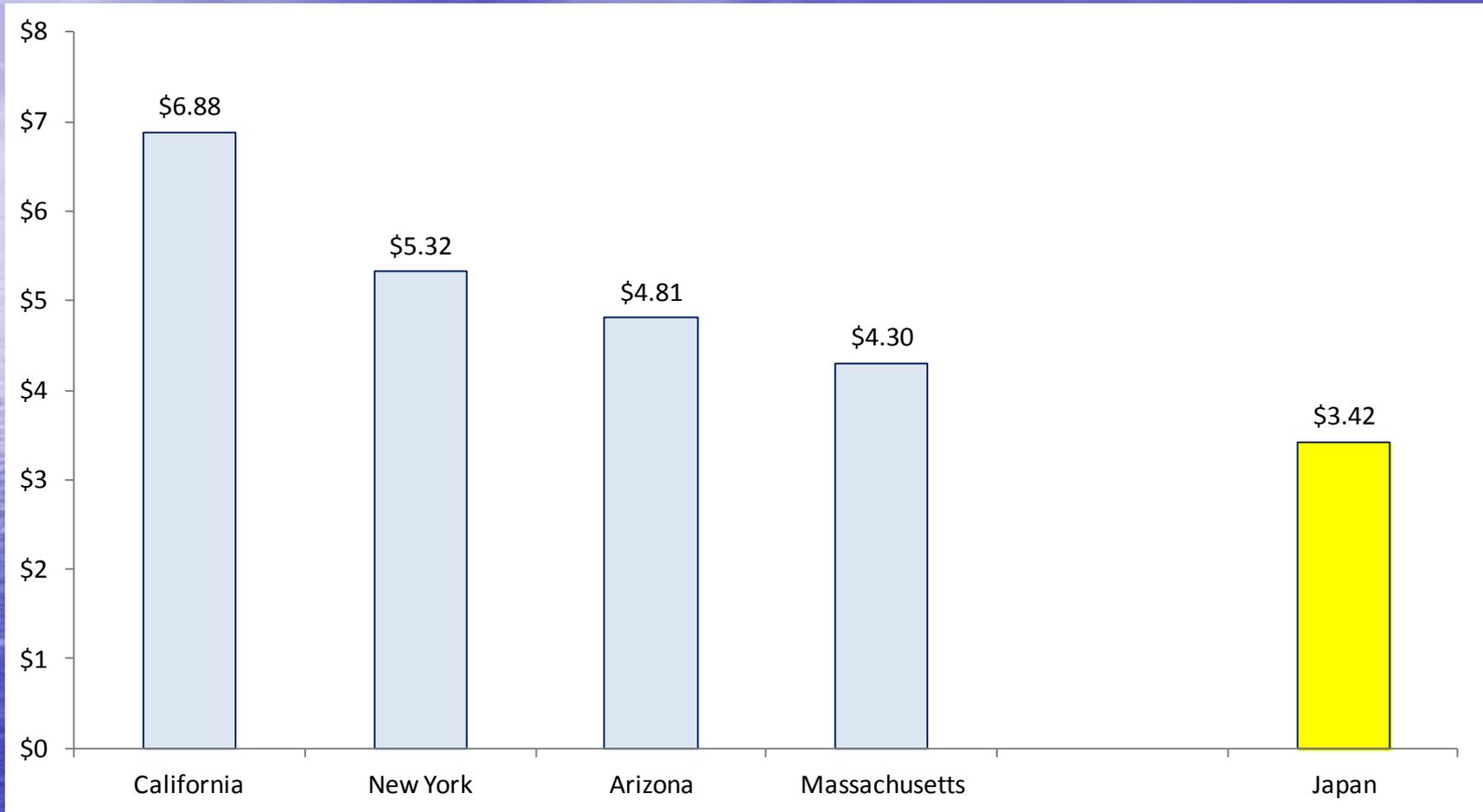


Source: PHOTON Consulting, LLC. Note: All data are rough estimates. Revenue and operating profit for solar power operations, including both Japan and rest of world. The majority of sales for these 4 large Japanese solar companies are within Japan. Companies are Sharp, Kyocera, Panasonic, Solar Frontier.

**Aggregate revenue for 4 Japanese solar players \$7.2bn with \$0.6bn operating profit
→ Revenue increasing to \$8bn in 2014 with \$1.2bn operating profit**

Commercial system price (\$/W - 2013 through Sep-2013)

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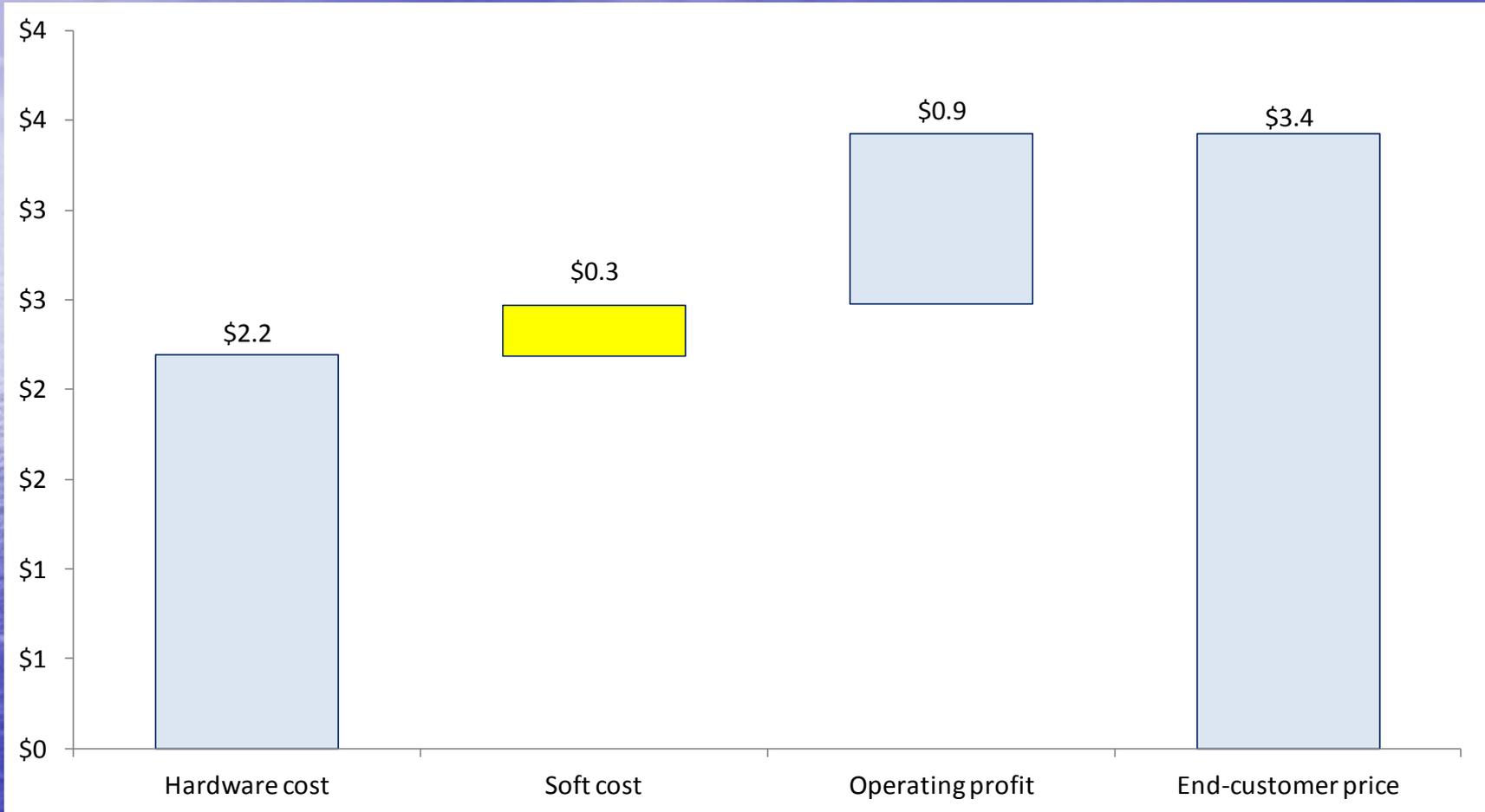
Source: PHOTON Consulting, LLC. Based on NYSERDA, APS, MA DOER, CSI and PHOTON Japan survey of more than 600 electricians and installers. Note: All data are rough estimates.

**Japan's solar system prices already lower than many comparable markets
→ Example: Price in Japan lower than U.S. markets**

Commercial system price

(\$/W - Japan - 2013 through Sep 2013)

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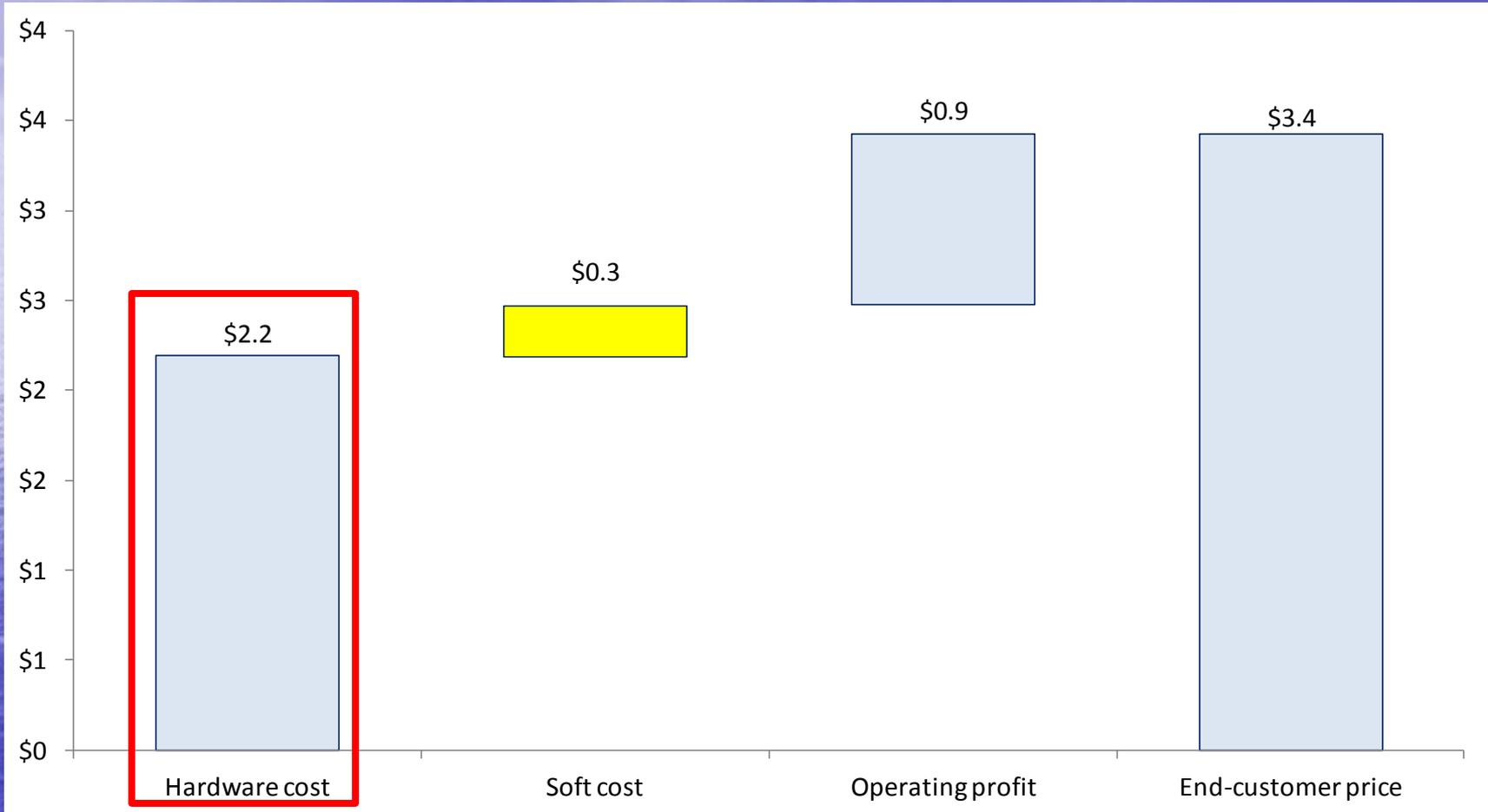
Source: PHOTON Consulting, LLC. Based on PHOTON Japan survey of more than 600 electricians/installers. Note: All data are rough estimates.

Soft costs (including customer acquisition, design, procurement, permitting, financing, contracting, installation, inspection, warranty) are already remarkably low in Japan

Commercial system price

(\$/W - Japan - 2013 through Sep 2013)

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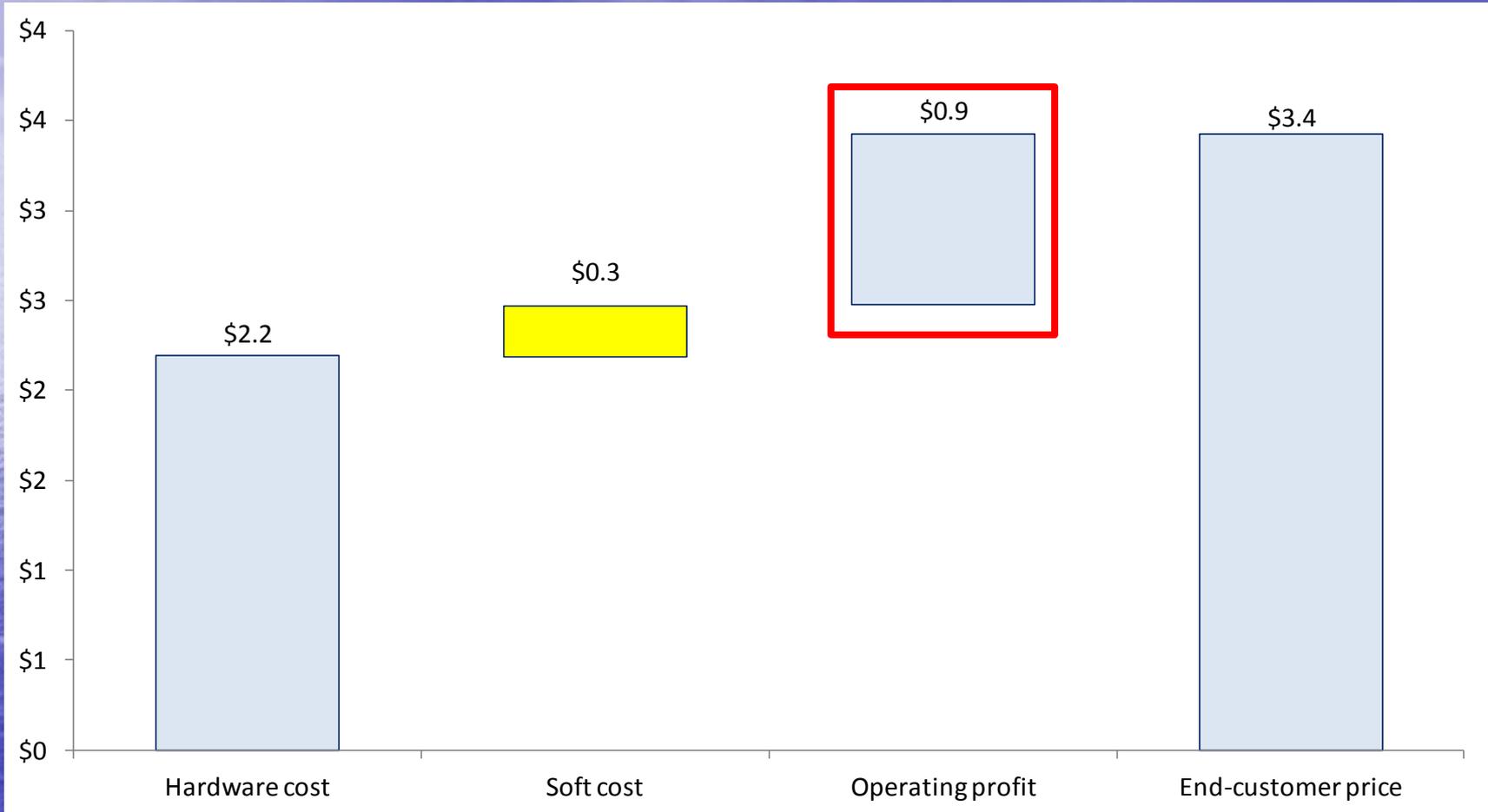
Source: PHOTON Consulting, LLC. Based on PHOTON Japan survey of more than 600 electricians/installers. Note: All data are rough estimates.

In contrast to soft costs, hardware costs are the highest among the world's larger solar power markets → Large suppliers getting paid high prices

Commercial system price

(\$/W - Japan - 2013 through Sep 2013)

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Source: PHOTON Consulting, LLC. Based on PHOTON Japan survey of more than 600 electricians/installers. Note: All data are rough estimates.

Although profitable today, nearly all Japanese installers are pessimistic about the future evolution of Japan's solar power market

View of Japanese electricians

(Based on in-person interactions with >600 Japanese electricians)

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- Traditional Japanese electricity companies will be bankrupted and nationalized due to the rapid rise of distributed energy
- Japanese solar manufacturers do not make efforts to satisfy core needs of end-customers and electricians/installers
- Storage is essential to sustain the electricians' businesses, but Japanese suppliers not providing products addressing the needs of electricians and end-customers
- Overall: Expectations of major challenges ahead, including a downturn in the Japanese solar power market within 3 years

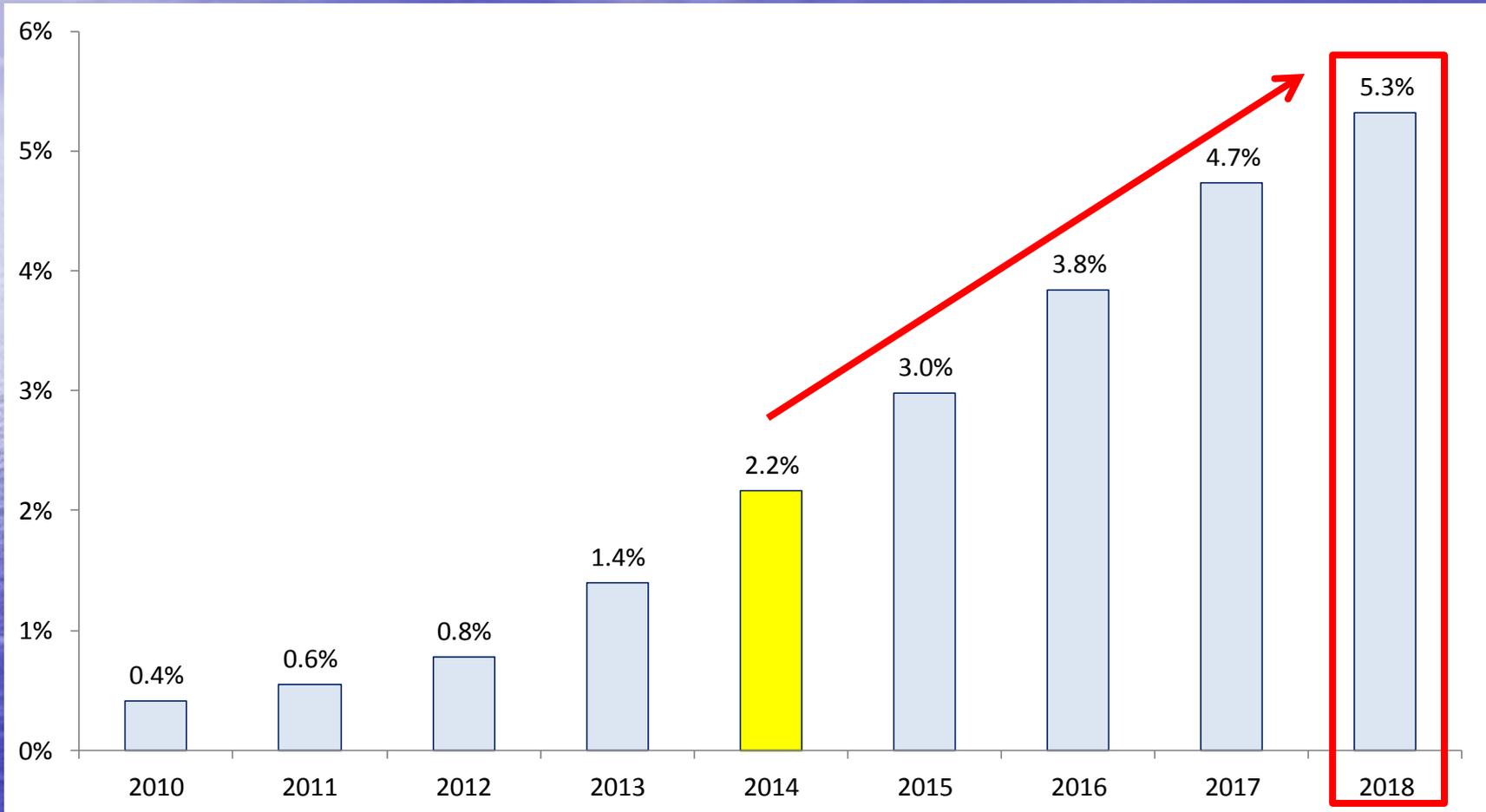
Source: PHOTON Consulting, LLC. Based on PHOTON Japan survey of more than 600 electricians/installers. Note: All data are rough estimates.

Distributed energy will crush traditional companies → No real commitment to solve problems from large Japanese suppliers → Major risks and challenges ahead for PV

Solar power share of consumption

(% - Japan)

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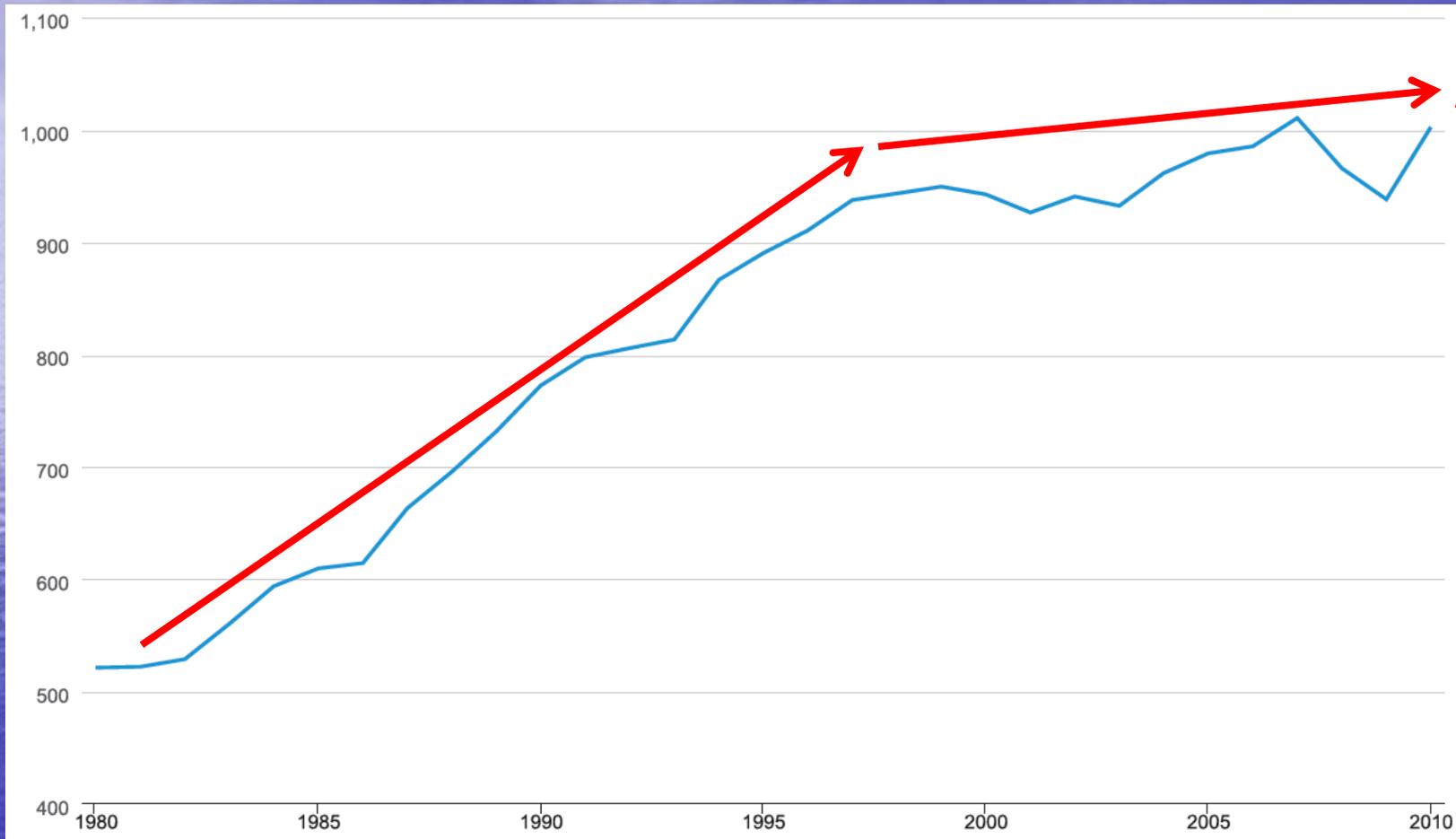
Source: PHOTON Consulting, LLC. Note: All data are rough estimates.

Solar power share of electricity consumption increased from 0.4% in 2010 to 1.4% in 2013 and is on track to reach 5% by 2018 or earlier

Electricity consumption in Japan

(Billion kWh – From centralized sources)

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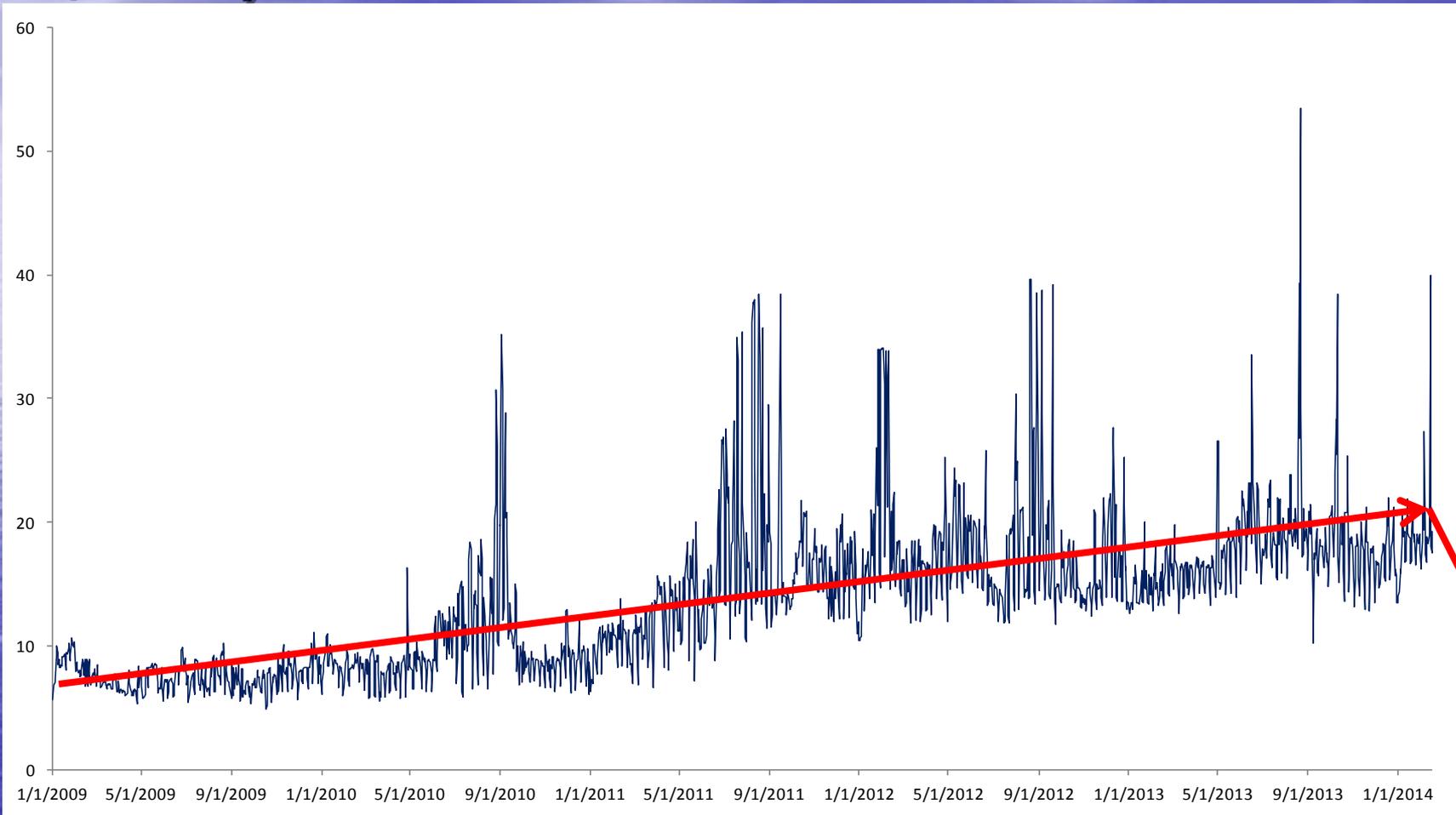


Source: PHOTON Consulting, LLC based on EIA and IEA statistics. Note: All data are rough estimates.

**Japan on path to follow pattern observed in other markets
→ Declining centralized electricity consumption**

JEPX spot electricity price (JPY/kWh)

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Source: PHOTON Consulting, LLC. Note: All data are rough estimates. The data is based on JEPX spot market 24-hour simple mean value of system price

Japan wholesale electricity price rising since 2009
→ Significant downside potential as solar power penetration rises

RWE and EON stock price

(Euro/share)

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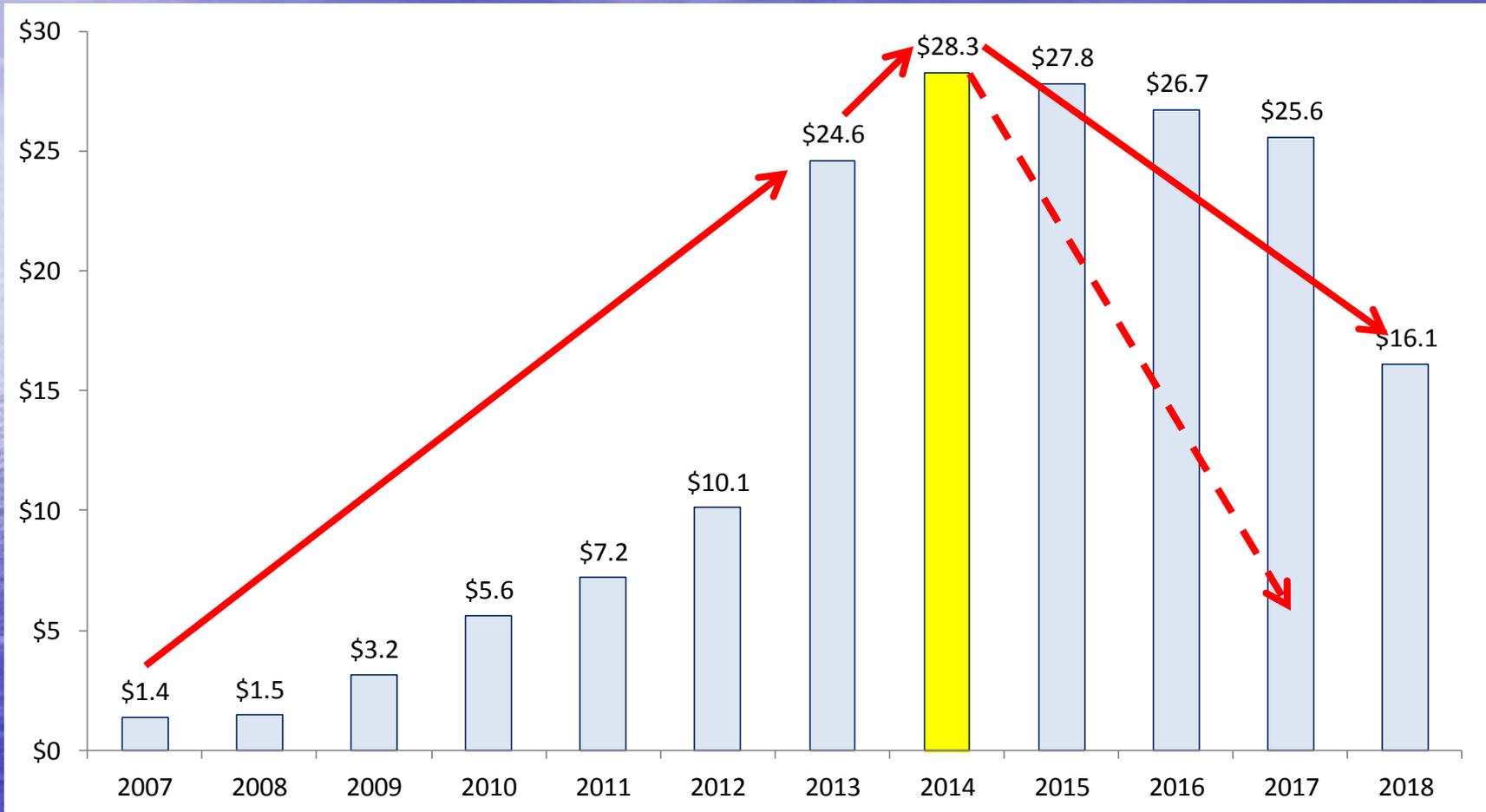
Source: PHOTON Consulting, LLC based on Yahoo Finance. Note: All data are rough estimates.

Will Japan follow European pattern for lower market capitalization and lower credit scores?

Japan solar revenue pool

(\$bn/year - New solar system sales)

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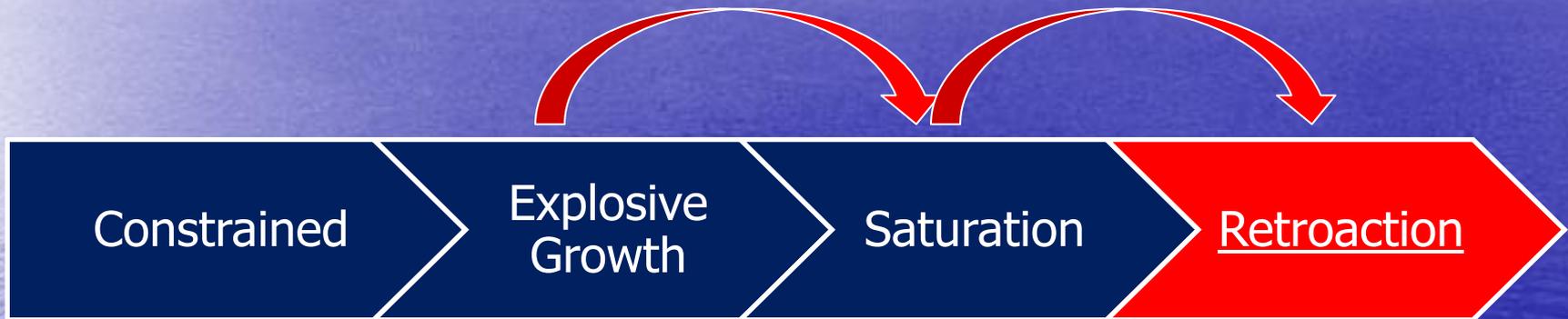


Source: PHOTON Consulting, LLC. Note: All data are rough estimates.

Overall, Japan likely to follow the boom-bust cycle observed in all other major solar power markets

Local PV market stages (Overview)

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Source: PHOTON Consulting, LLC. Note: All data are rough estimates.

Japan will likely follow pattern of other markets from “explosive growth” to “saturation” to “retroaction” → Major downside for players not taking responsibility

Football - Winning

(Overview)

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Traditional football - Winning



Source: PHOTON Consulting, LLC. Note: All data are rough estimates.

New football - Winning



Winning requires overcoming many obstacles
→ Winner must prove worthy of addressing problems

Electricity - Winning

(Overview)

ILLUSTRATIVE

Electricity - Traditional version



Source: PHOTON Consulting, LLC. Note: All data are rough estimates.

Electricity - Winning

- Financing distributed power and energy
- Financing distributed storage and controls
- Cross-selling and up-selling other distributed infrastructure (e.g., communications, water)
- Delivering strong value proposition to existing local electricians (often over existing employees)
- Securing financial support for major write-down in traditional centralized assets
- Prioritizing specific local geographies (very small initial footprint)
- Addressing externalities caused in other local geographies (must address equity and access)
- Creating strong, positive brand

Winning for traditional electricity companies requires overcoming many obstacles
→ Local electricians appear correct that these companies appear likely to lose

Electricity - Winning

(Overview)

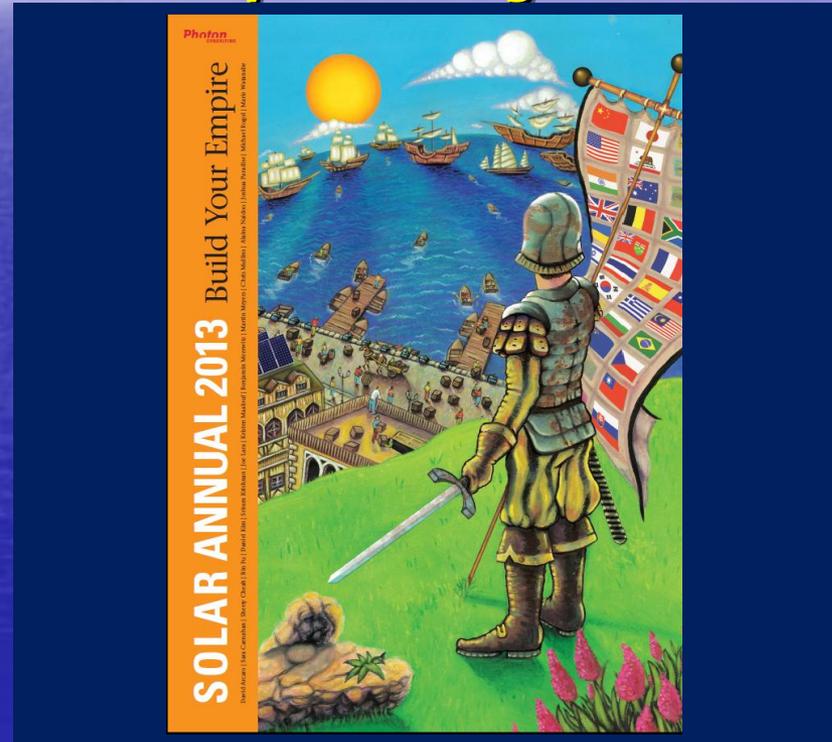
ILLUSTRATIVE

Electricity - New version



Source: PHOTON Consulting, LLC. Note: All data are rough estimates.

Electricity - Winning

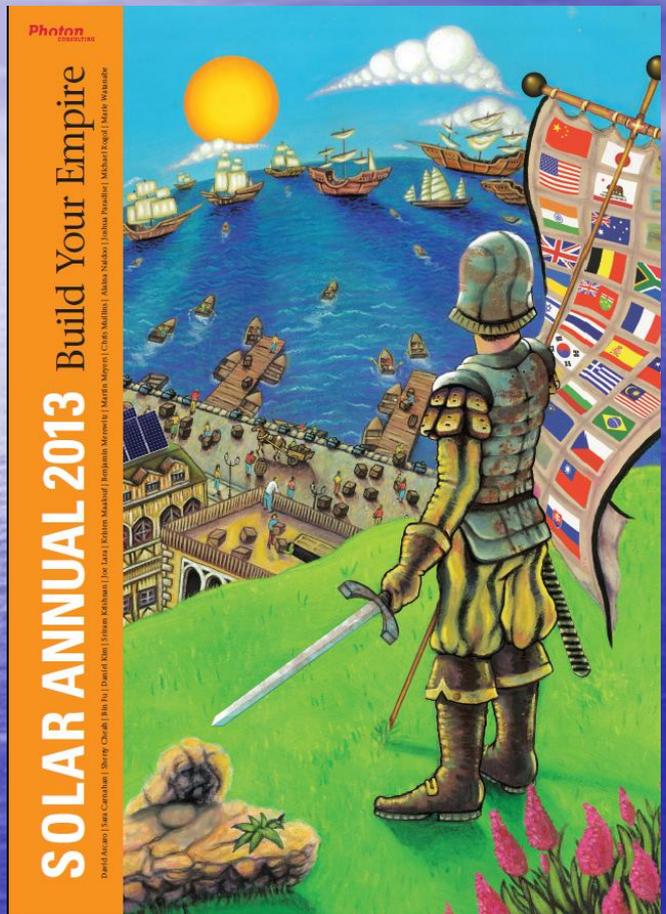


“Build Your Empire” for new energy players likely to follow pattern observed historically by successful energy companies

Electricity - Winning

(Overview)

ILLUSTRATIVE



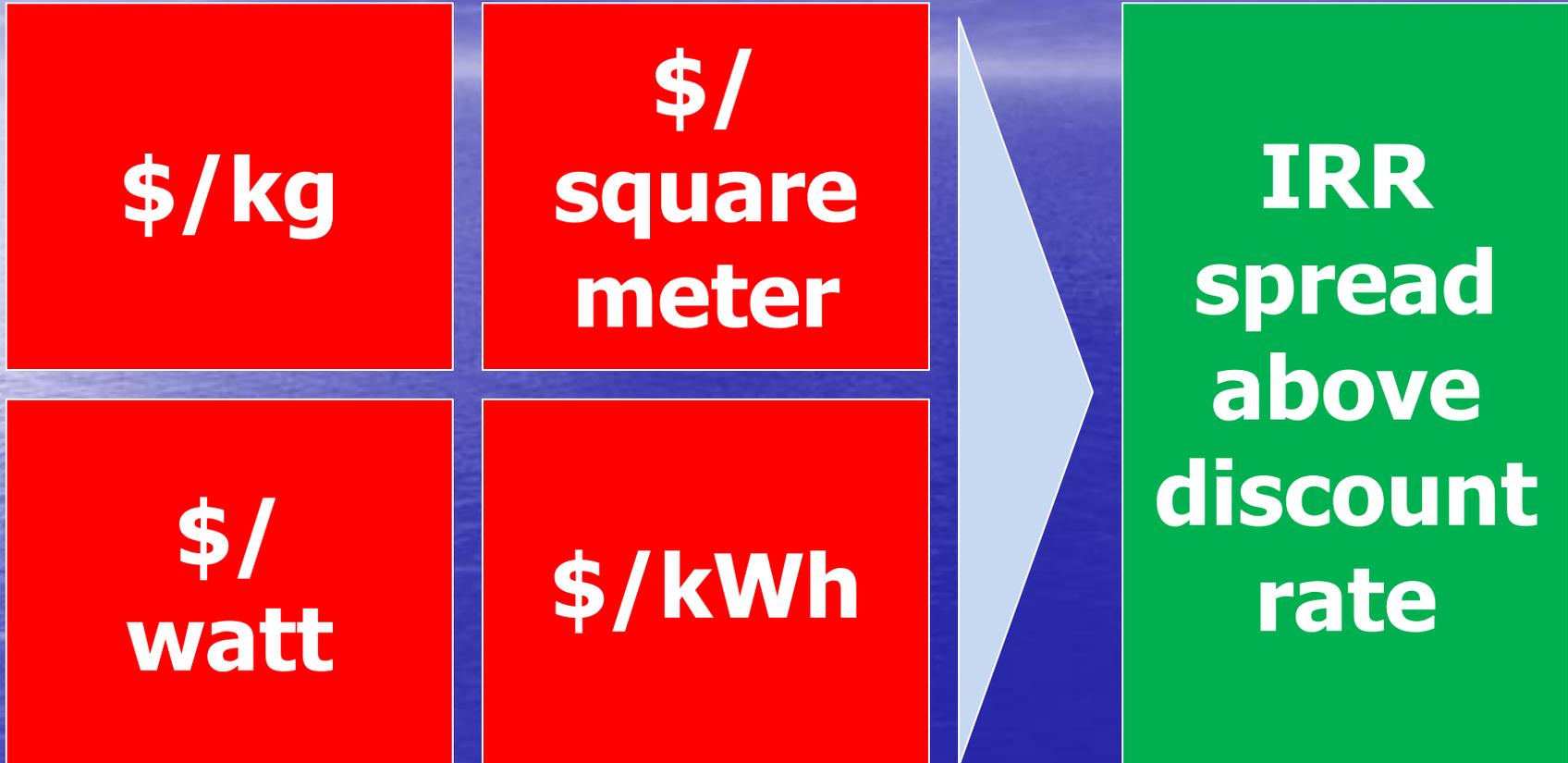
Source: PHOTON Consulting, LLC. Note: All data are rough estimates.

“Build Your Empire” for new energy players follows 7-step action plan based on history of successful energy companies

Units of measure - Winning

(Overview)

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Source: PHOTON Consulting, LLC. Note: All data are rough estimates.

**Winning requires focusing on the most important drivers of success
→ IRR spreads are predictive leading indicators of value creation and value capture**

Key actions for JREF community

(Overview)

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- **Quantify the impacts more thoroughly**, especially in finance terms (IRRs, IRR spreads)
 - Solar power adoption has major consequences for electricity revenue, profit pools and risk
 - JREF community (including Softbank with deep expertise in this area) should make this transparent
- **Organize leaders in new energy financing**
 - New electricity sector is largely driven by energy finance
 - JREF should host a new energy finance forum focusing on the core needs of traditional energy players (including toxic assets) and new energy players beyond current financing vehicles
 - JREF should be champion to drive change in new energy financing
- **Share patterns with other markets**
 - Japan is ~25% of global solar electricity revenue pool
 - Lessons learned in Japan should be shared with other markets
 - JREF should consider hosting fact-sharing mission with business, finance and (possibly) policy leaders in Spain, Italy, Germany, California, etc.

Source: PHOTON Consulting, LLC. Note: All data are rough estimates.

Potential actions for JREF community to consider

Electricity in Japan

(Overview)

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Source: PHOTON Consulting, LLC; ESPN . Note: All data are rough estimates.

**Get ready for major hits because electricity in Japan is a “full-contact” sport
→ Winners must take responsibility for solving the many problems we face**

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