PV Manufacturing Supply Chain Status and Prospects

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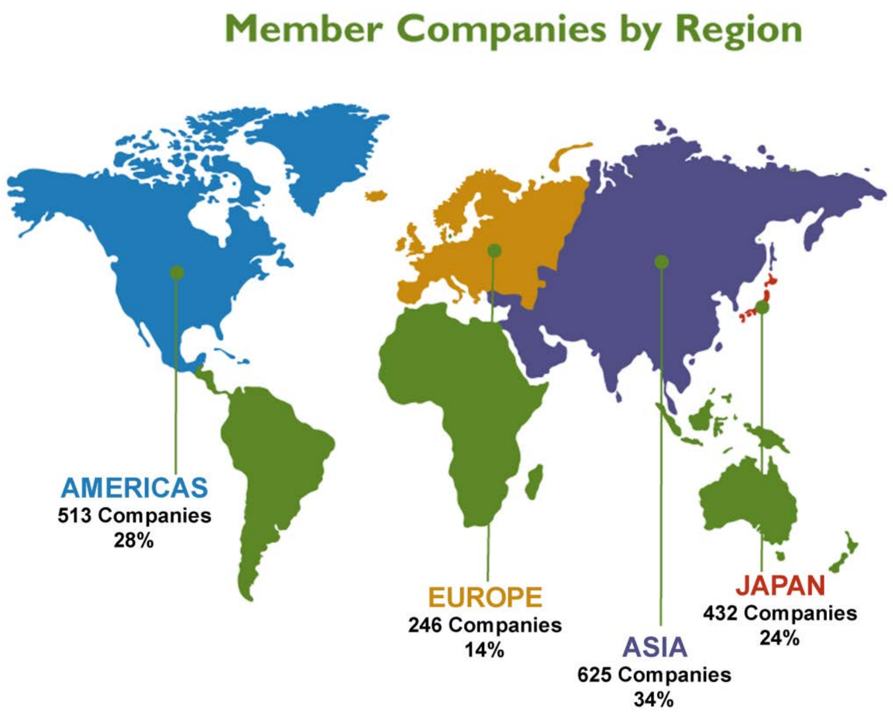
Presentation Outline

- **SEMI and the PV Group**
- Global PV Market
- PV Manufacturing
- Worldwide PV Equipment Bookings and Billings Market Statistics Program
- Impact of Recent Market Weakness on PV Manufacturers
- Outlook

About SEMI and PV Group

- SEMI
  - 40-year old global industry association supporting ~ 1,800 member companies worldwide
  - SEMI Member Companies participate in the global manufacturing supply chains of Semiconductor, Photovoltaic, Flat Panel Display, Nanotechnology, MEMS, and LED / SSL
- PV Group
  - Established in 2008, PV Group represents currently about 500 SEMI members worldwide actively engaged in PV manufacturing, from feedstock/starting materials to module assembly



Source: SEMI

Key Global Initiatives

- Expositions and Conferences
- Technical Programs
- Industry Standards
- Industry Research & Statistics
- Industry Collaboration and Technology Roadmap Development
- EH&S/Sustainability
- Public Policy and Industry Advocacy
- Special Interest Group

Source: SEMI

SEMI Board of Directors

- SEMI is governed by an international Board of Directors
- Five board members sit on the PV Standing Committee
  - Mike Splinter, President & CEO, Applied Materials – Committee Chair
  - Susumu Kohyama, President & CEO, Covalent Materials Corporation
  - Eike Weber, Director, Fraunhofer Institute for Solar Energy Systems
  - Zhengrong Shi, Founder, Chairman & CEO, Suntech Power Holdings
  - Terry Higashi, Chairman & CEO, Tokyo Electron Ltd.

Source: SEMI

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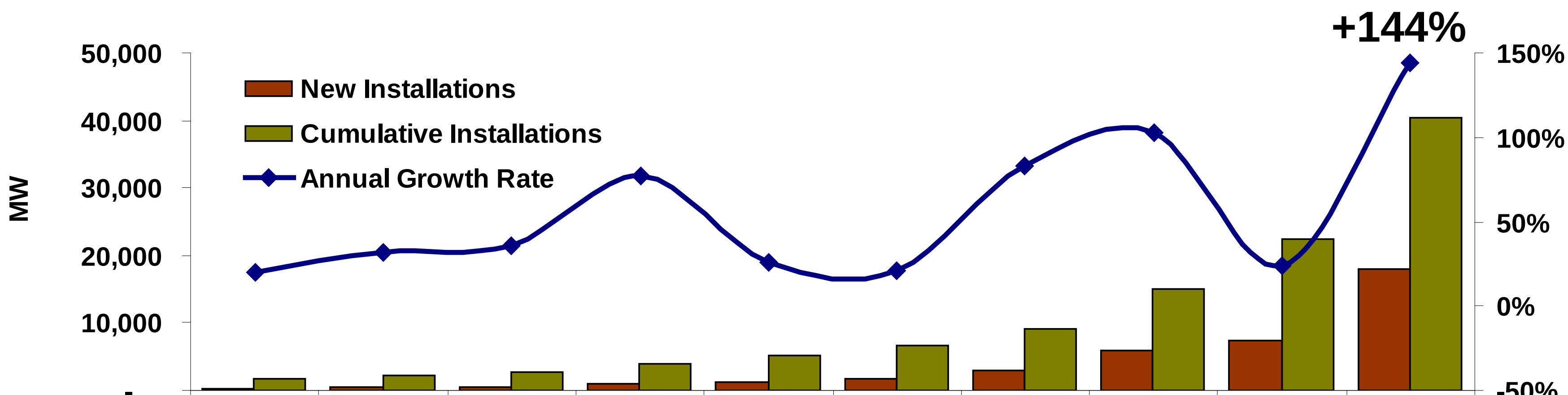
Global PV Market



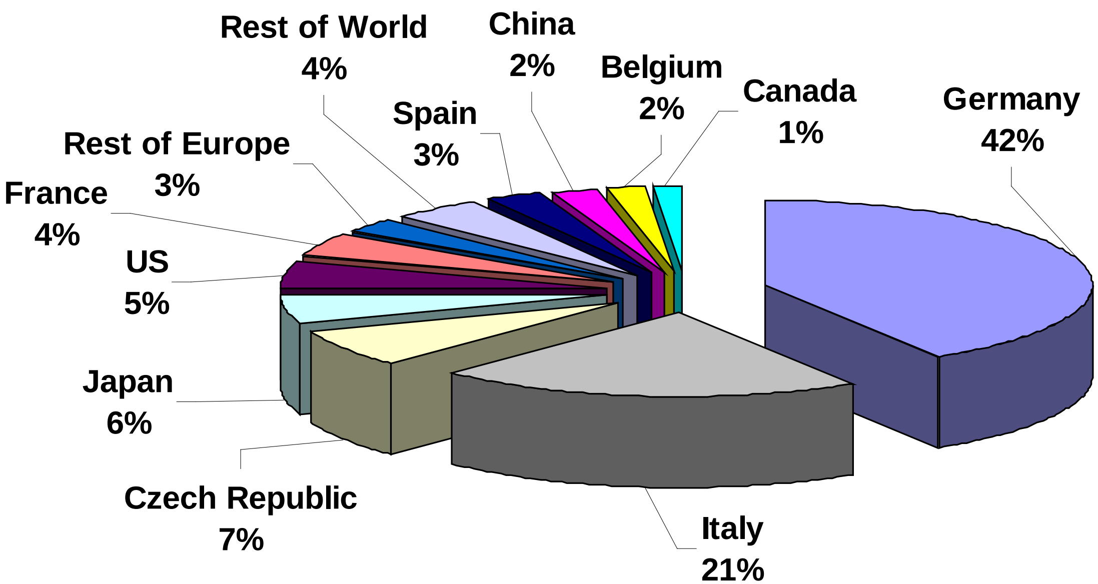
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
New Installations	334	439	594	1,052	1,321	1,603	2,932	5,950	7,380	18,000
Cumulative Installations	1,762	2,201	2,795	3,847	5,167	6,770	9,160	15,110	22,490	40,490
Annual Growth Rate	20%	31%	35%	77%	26%	21%	83%	103%	24%	144%

Source: BSW, GSE, JPEA, EPIA, GTM Research, SEMI

- Global PV market experienced rapid growth in the past decade
- 2010 saw a record level of growth with 144% increase in worldwide new installations
- With 18GW in new installations, global total cumulative installations reached 40GW

Regional PV Markets – New Installations

Regional Distribution of 2010 New Installations

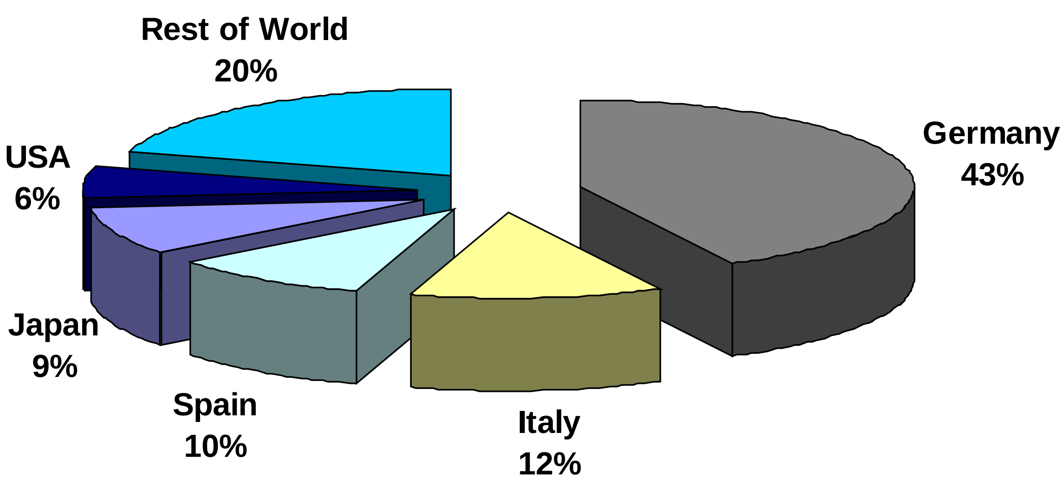


2010 New Installations (MW)	
Germany	7,400
Italy	3,800
Czech Republic	1,300
Japan	1,030
US	887
France	800
Rest of Europe	500
Spain	500
China	400
Belgium	350
Canada	250
Rest of World	800
Global Total	~18,000

Source: BSW, GSE, JPEA, EPIA, GTM Research, SEMI

Regional PV Markets – Cumulative Installations

Regional Distribution of Cumulative Installations (2010)



	Cumulative Installations (MW)
Germany	17,185
Italy	4,978
Spain	3,924
Japan	3,658
USA	2,458
Rest of World	8,300
Global Total	**~40,500**

Source: BSW, GSE, JPEA, EPIA, GTM Research, SEMI

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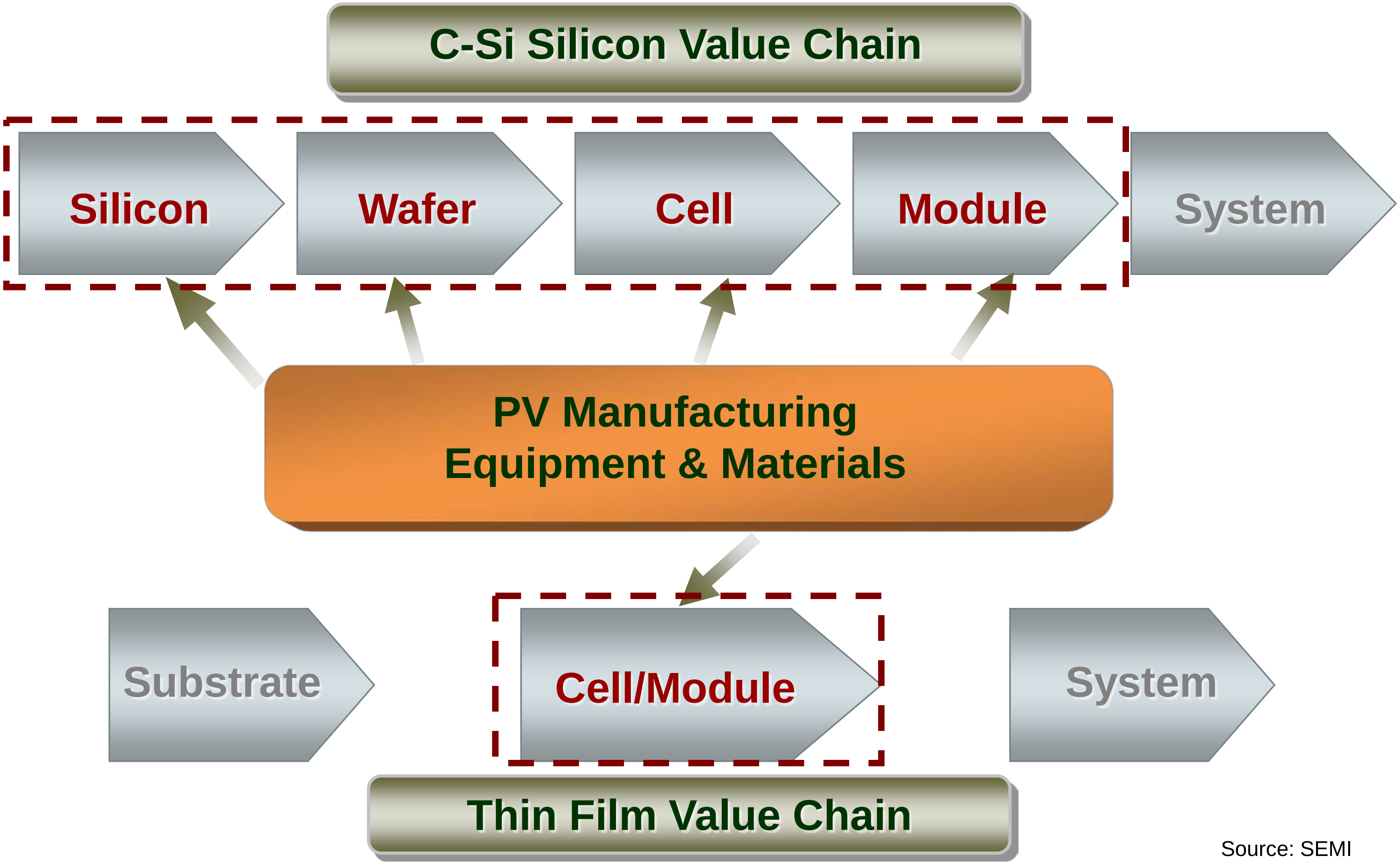
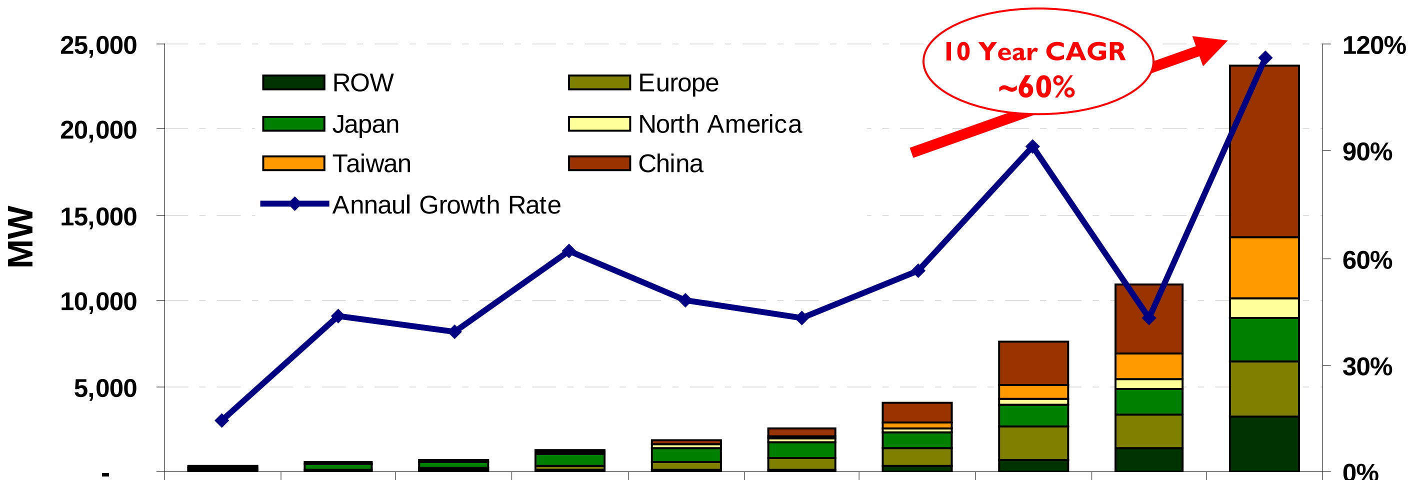
Key Manufacturing Supply Chain Segments



Source: SEMI

Global PV Cell Production



	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
China	5	6	12	50	146	438	1,088	2,600	4,000	10,000
Taiwan	-	-	-	41	88	178	368	785	1,500	3,500
North America	100	121	103	139	153	180	266	399	595	1,200
Japan	172	253	365	604	833	927	920	1,268	1,508	2,500
Europe	74	122	200	312	473	680	1,063	1,949	1,930	3,200
ROW	23	36	66	66	101	159	295	655	1,436	3,280
Annaul Growth Rate	14%	43%	39%	62%	48%	43%	56%	91%	43%	116%

Source: GTM Research, JPEA, China PV Industry Alliance (CPIA), SEMI

- 2010 saw a record ~120% growth, reaching nearly 24GW global production
- In conjunction with the rise of China and Taiwan has been the market share decline of Europe and Japan

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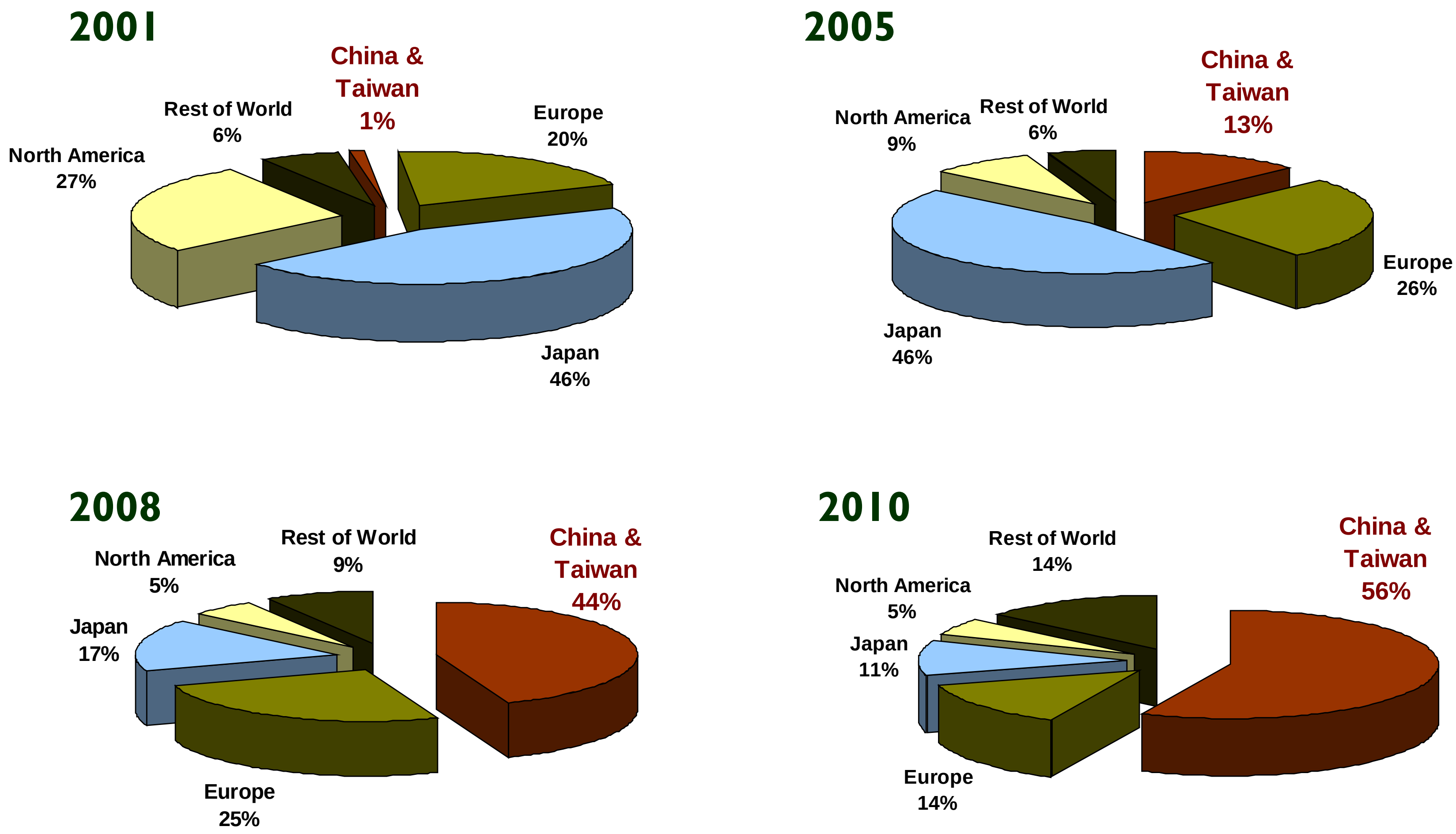
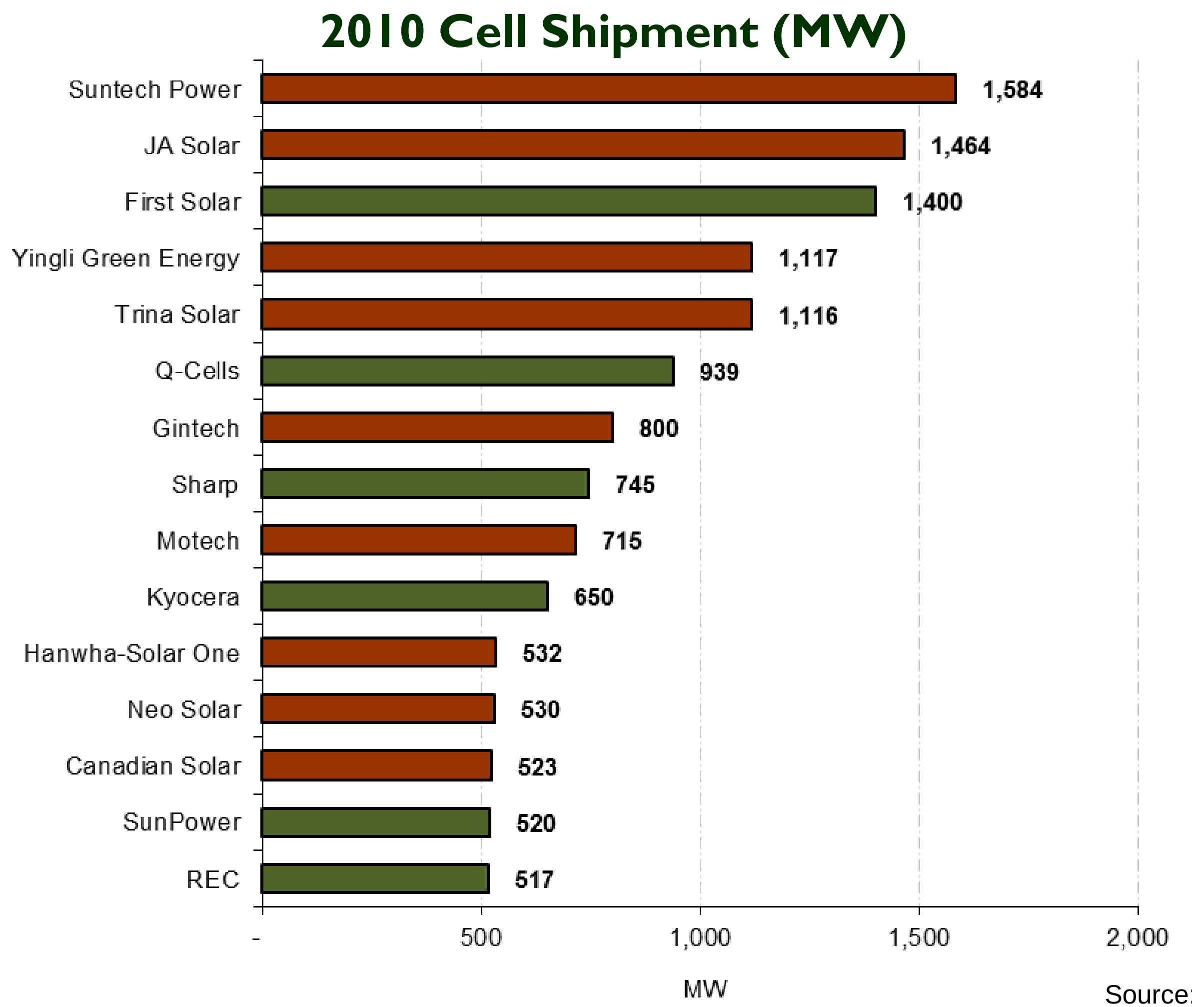
Regional Distribution of PV Cell Production



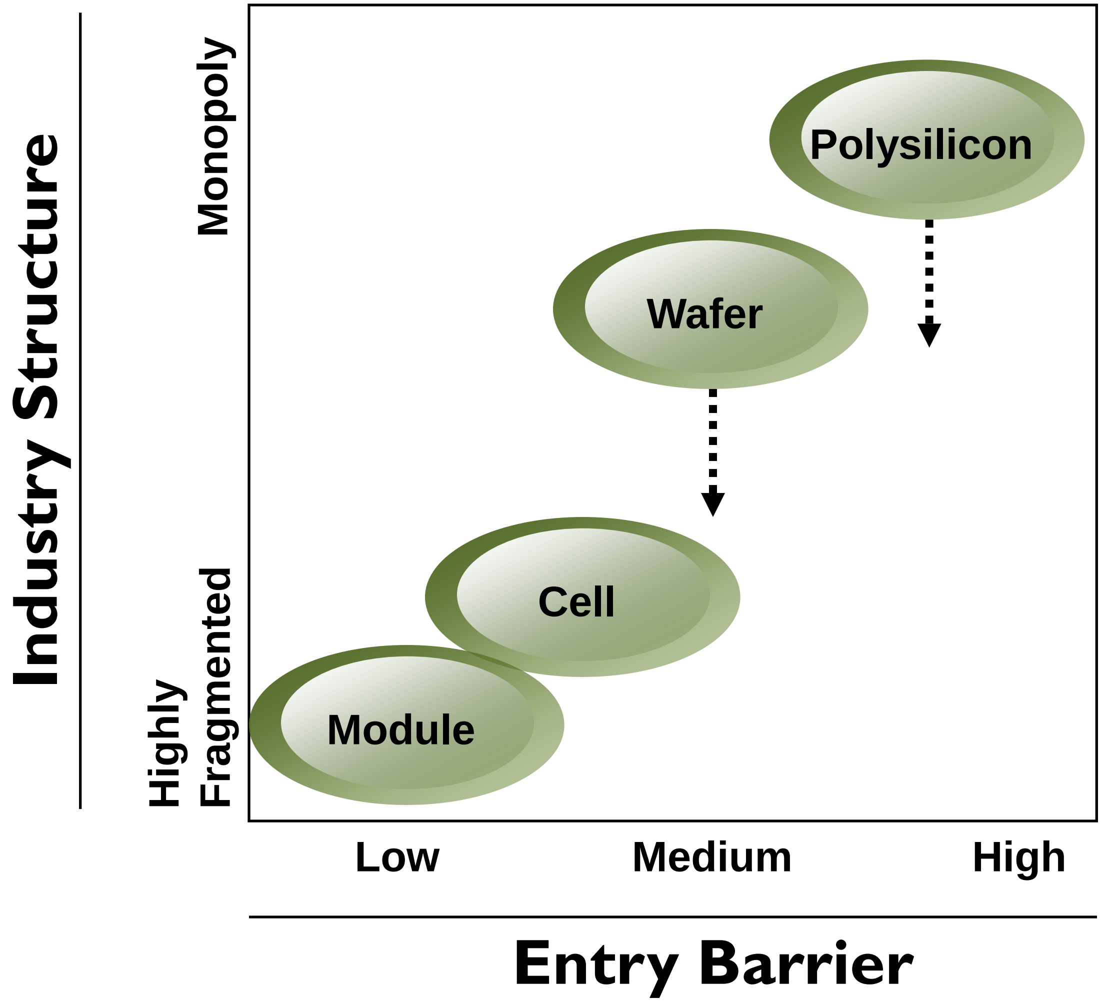
Source: GTM Research, JPEA, China PV Industry Alliance (CPIA), SEMI

Global Top Cell Companies



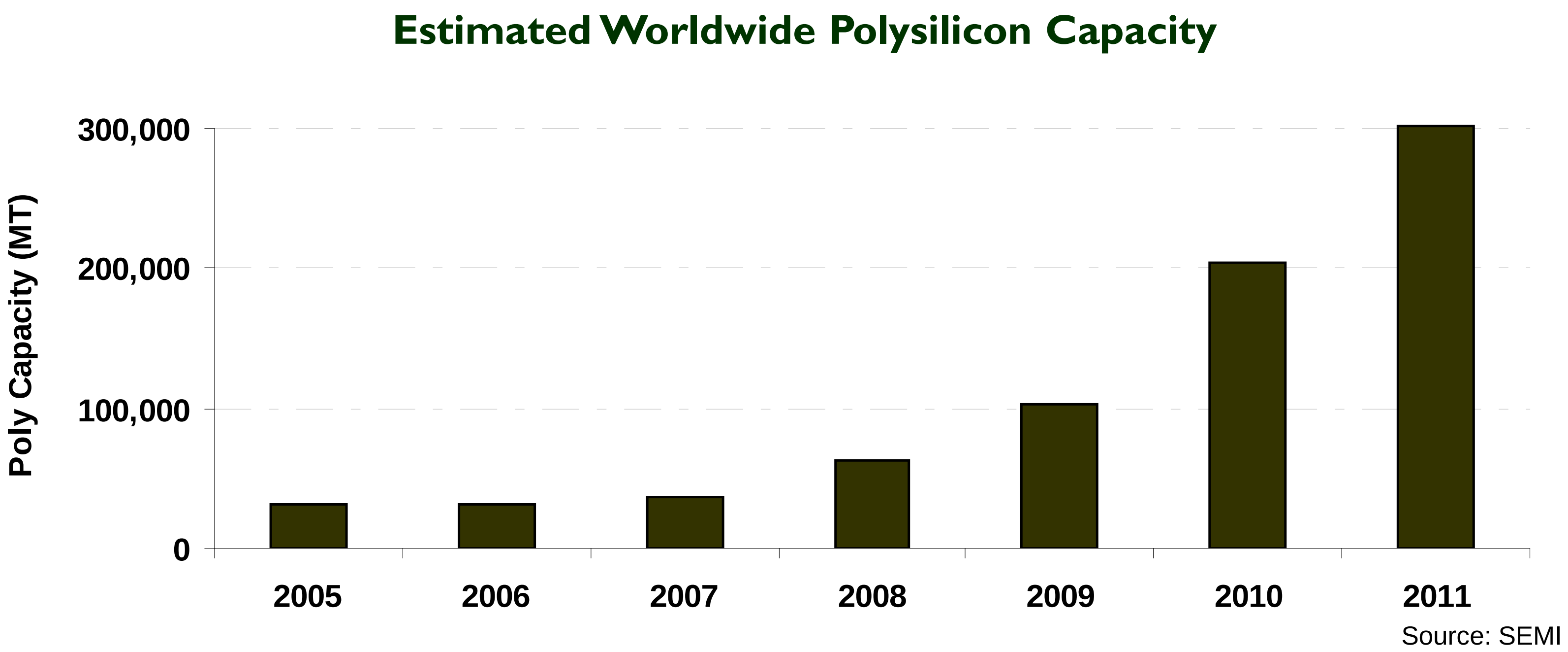
Source: GTM Research, SEMI

Manufacturing Capacity



Source: SEMI

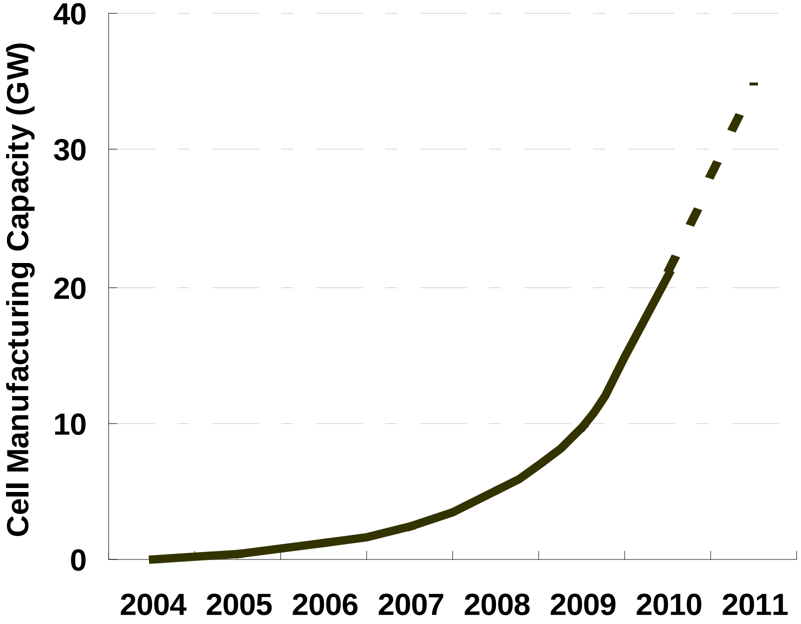
Polysilicon Capacity



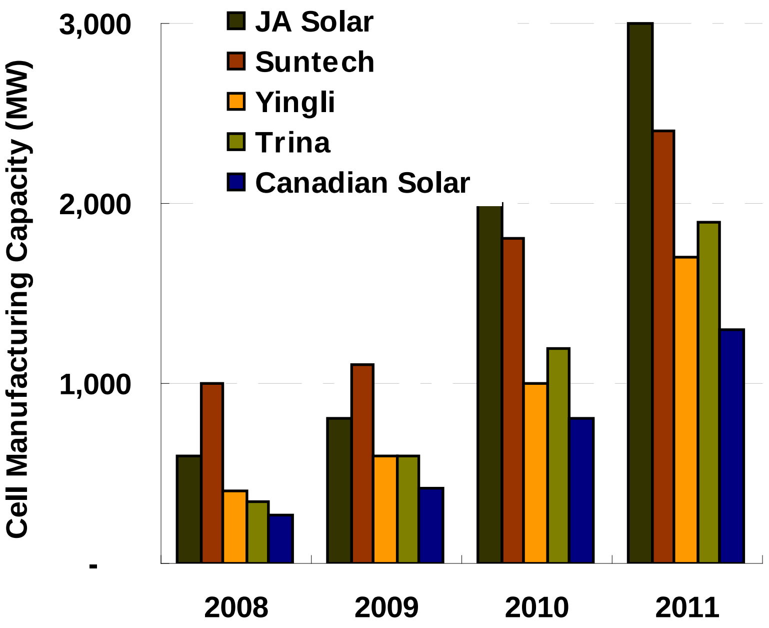
- Poly supply has been increasing rapidly, led by new entrants from Asia
- New supply has eased the constraint at the upstream of the value chain that persisted for years

China's PV Cell Manufacturing Capacity

China's PV Cell Capacity Growth



PV Cell Capacity Growth of Selected Chinese Companies



Source: Company Financial Reporting, SEMI

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Worldwide PV Equipment Data Program

- Quarterly worldwide bookings and billings data collection program for PV manufacturing equipment
- Data is based on direct inputs from PV equipment manufacturers worldwide – truly global coverage
- SEMI and the German Engineering Federation (VDMA) collaborate on data collection
- Quarterly reports provide equipment bookings and billings data by region, by supply chain segment, and by equipment type

Source: SEMI

PV Equipment Book to Bill Ratio

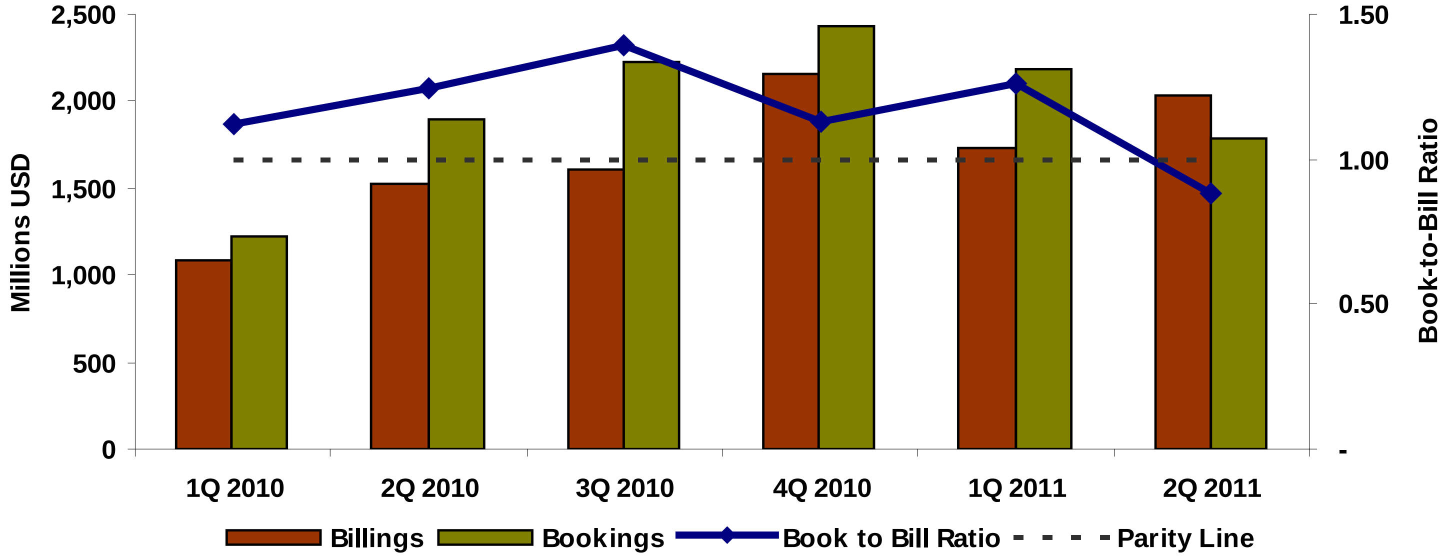
- The book-to-bill ratio is most commonly used in the semiconductor equipment industry, and it is applicable to any industry that takes orders significantly in advance of billings
- Photovoltaic manufacturing equipment industry embodies such characteristics
- A book-to-bill ratio can serve as an important indicator for strategic planning and forecasting in the photovoltaic and related industries:
  - A ratio = 1 indicates stability
  - A ratio > 1 indicates growth
  - A ratio < 1 indicates decline

Source: SEMI

PV Equipment Billings & Bookings

PV Equipment Bookings & Billings
(US Dollars in Thousands)

	2Q 2011	1Q 2011	2Q 2010	QoQ Growth	YoY Growth
Worldwide Billings	2,031,651	1,737,339	1,519,402	17%	34%
Worldwide Bookings	1,789,788	2,185,534	1,895,744	-18%	-6%
Book to Bill Ratio	0.88	1.26	1.25		



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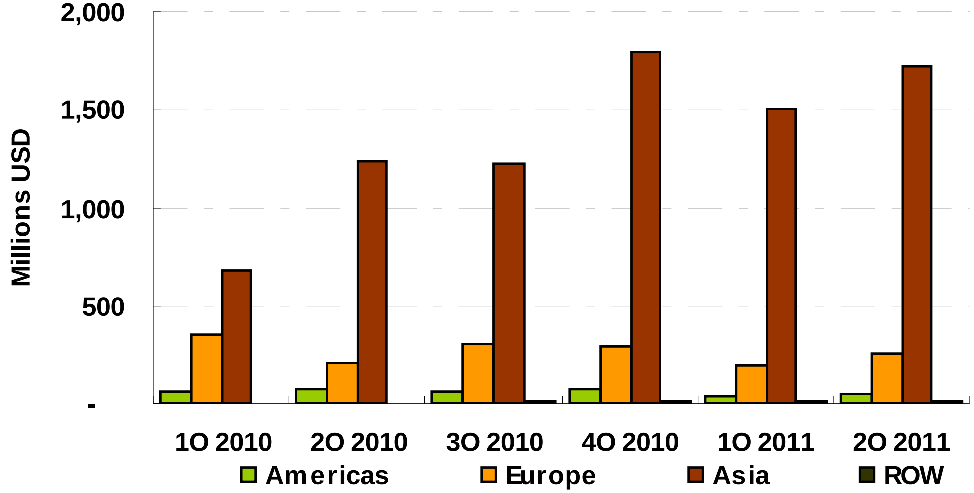
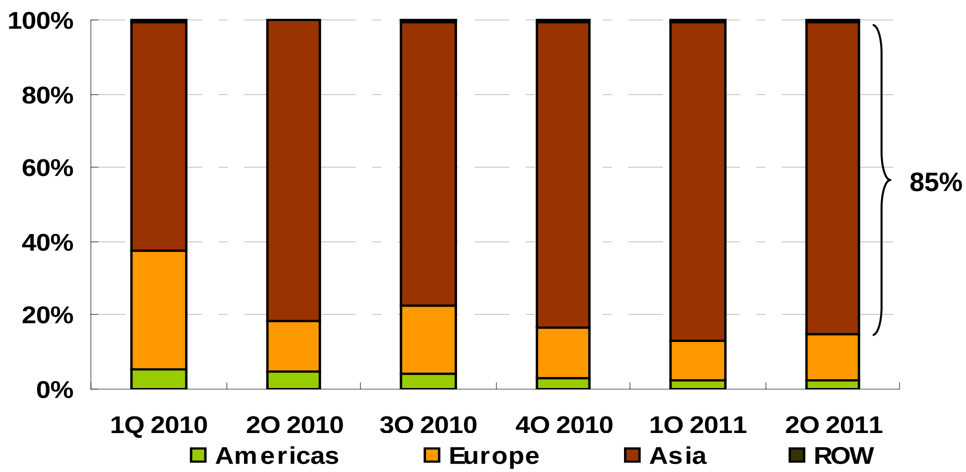
Source: SEMI & VDMA

Worldwide PV Equipment Billings by Region

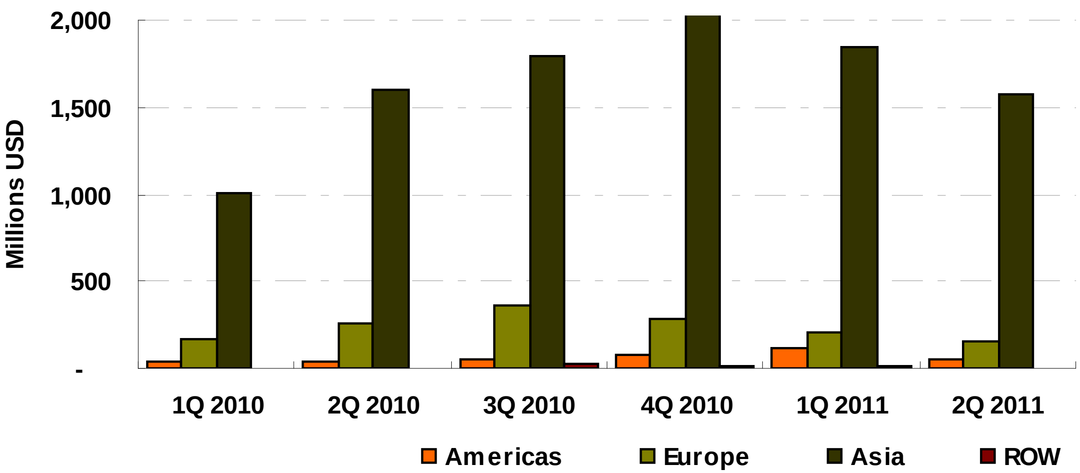


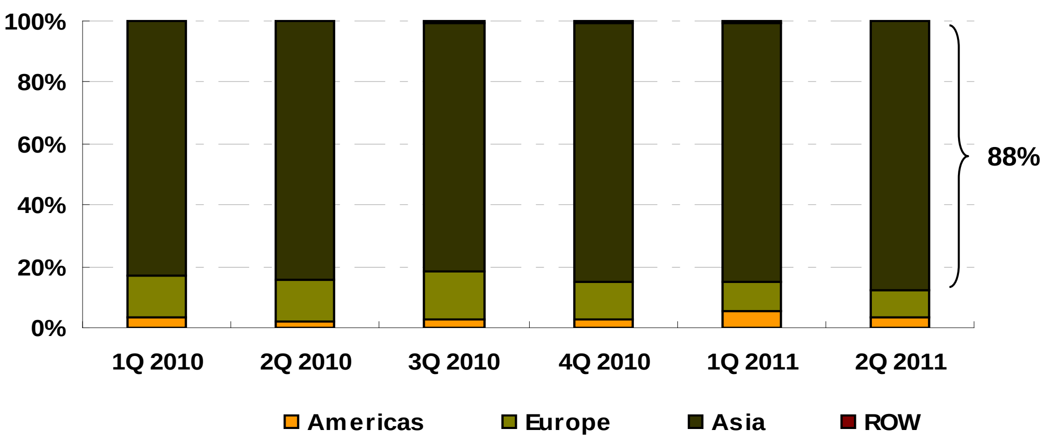


- Asia has increasingly become the center of PV manufacturing capacity expansion
  - 85% of worldwide billings came from Asia in 2Q’11 v.s. 60% in 1Q’10

Source: SEMI & VDMA

Worldwide PV Equipment Bookings by Region





- Asia will continue to be the center of PV manufacturing capacity expansion
  - 88% of Q2'11 worldwide bookings came from Asia

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Source: SEMI & VDMA

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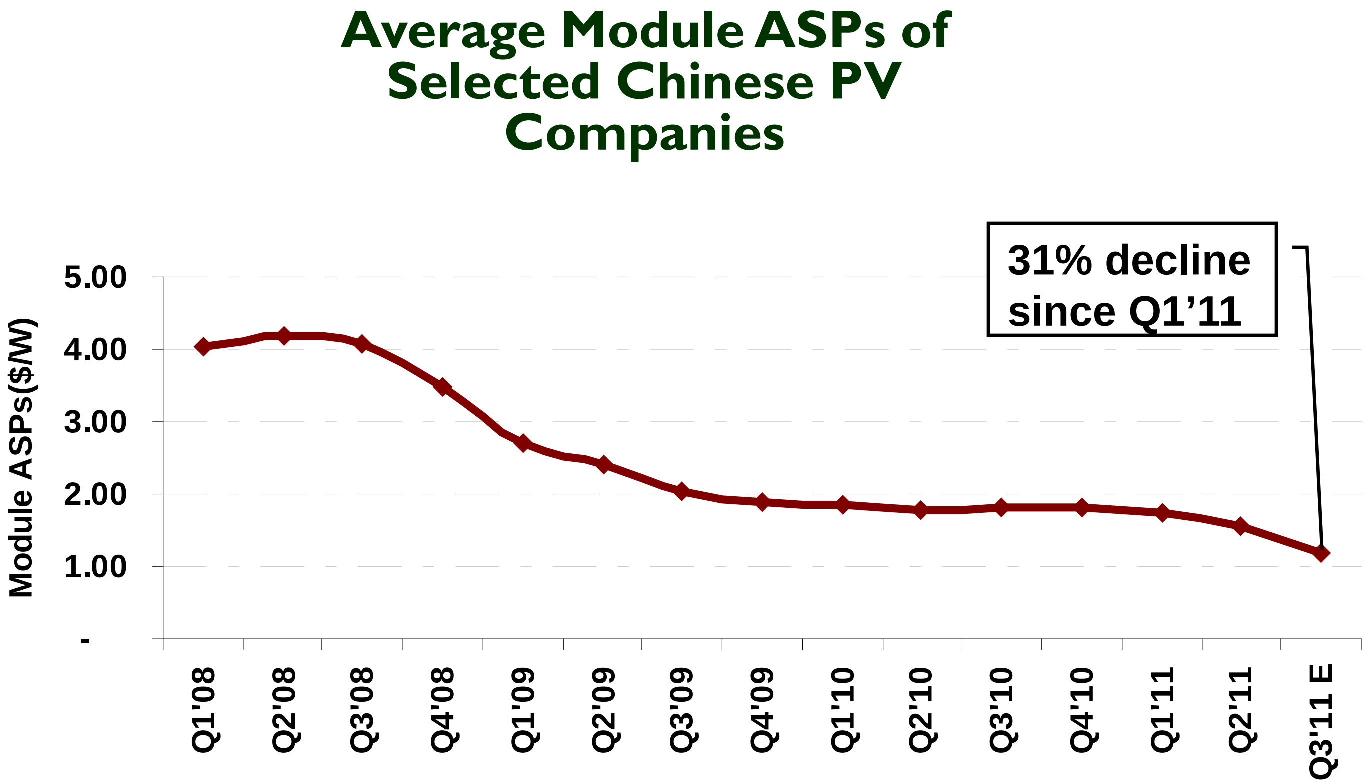
Supply Chain Impact

- PV manufacturers
  - Significant inventory built-up
  - Fierce cost and pricing competition
  - Sharply falling ASPs
  - Overcapacity and low utilization
  - Eroding margins
  - Increasing financial pressures
- PV manufacturing equipment suppliers
  - Customer pushing out or cancelling capacity expansion plans
  - Sharp decline in order intake
  - Significant decline in revenues expected

Declining ASPs



Companies included: Suntech, Yingli, Trina, Canadian Solar, LDK, China Sunergy, and Renesola

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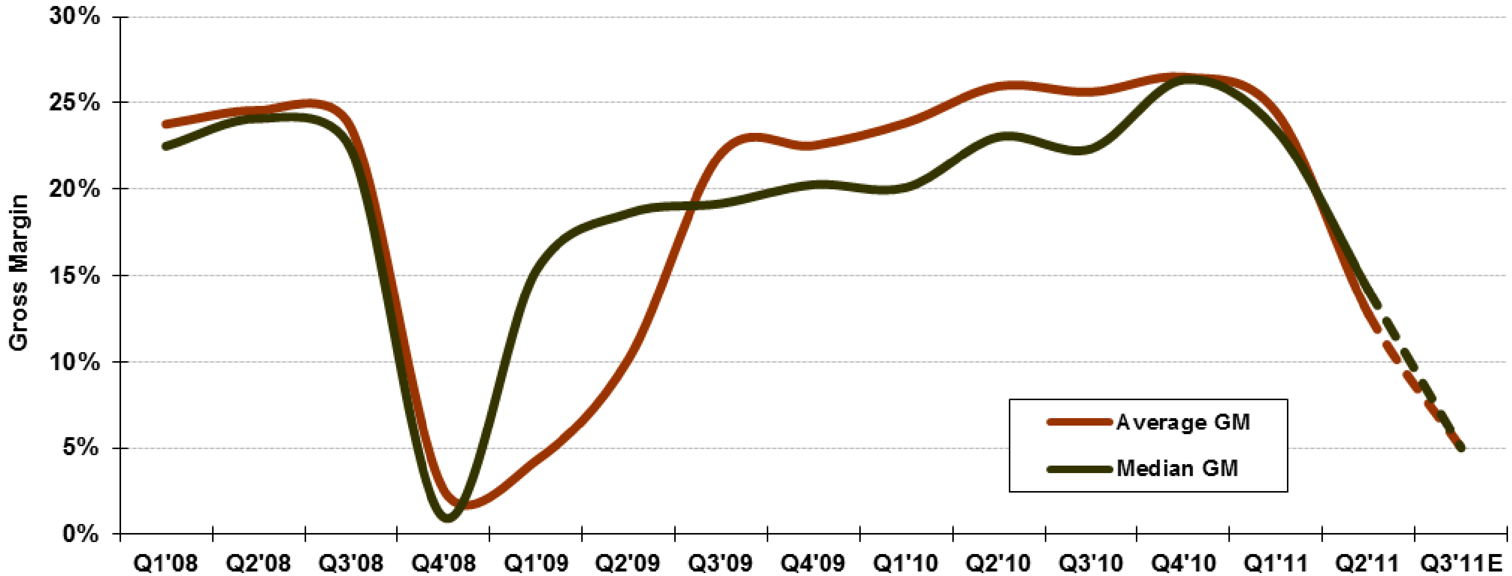
Source: Company financial reporting and SEMI

Declining Gross Margins

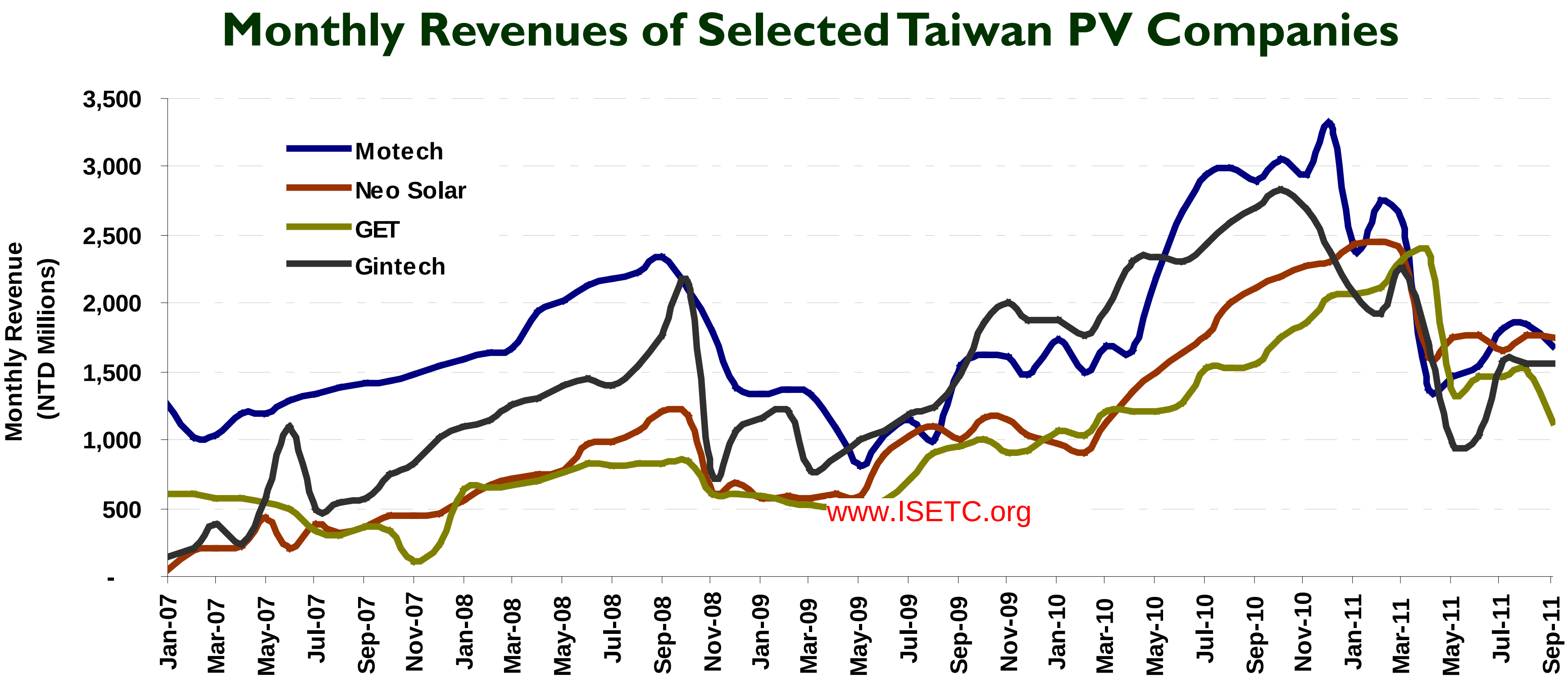
Average and Median Gross Margins of Selected PV Companies



Companies included: Suntech, JA Solar, First Solar, Yingli, Trina, Canadian Solar, LDK, SunPower, China Sunergy, and Renesola

Source: Company financial reporting and SEMI

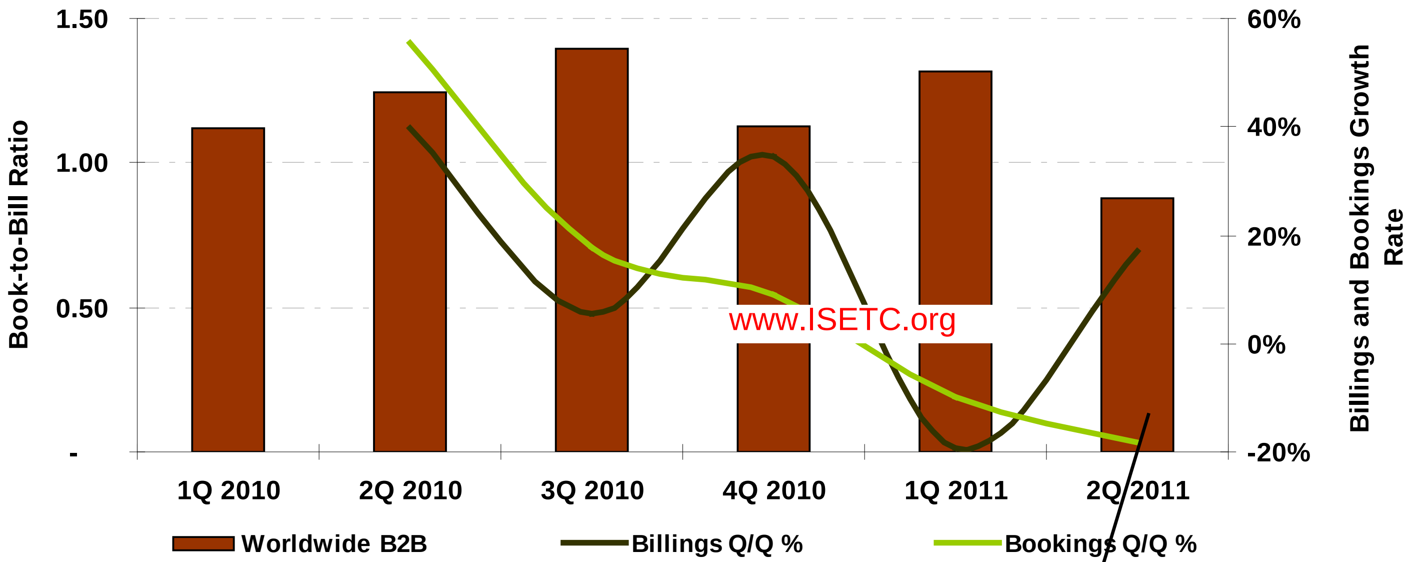
Declining Revenues



Source: Taiwan Stock Exchange and SEMI

Declining Equipment Order Intake

	1Q 2010	2Q 2010	3Q 2010	4Q 2010	1Q 2011	2Q 2011
Worldwide B2B	1.12	1.25	1.39	1.13	1.31	0.88
Billings Q/Q %		40%	5%	35%	-19%	17%
Bookings Q/Q %		55%	18%	9%	-10%	-18%



Book-to-Bill ratio dipped below parity for the first time in the past six quarters

Source: SEMI & VDMA

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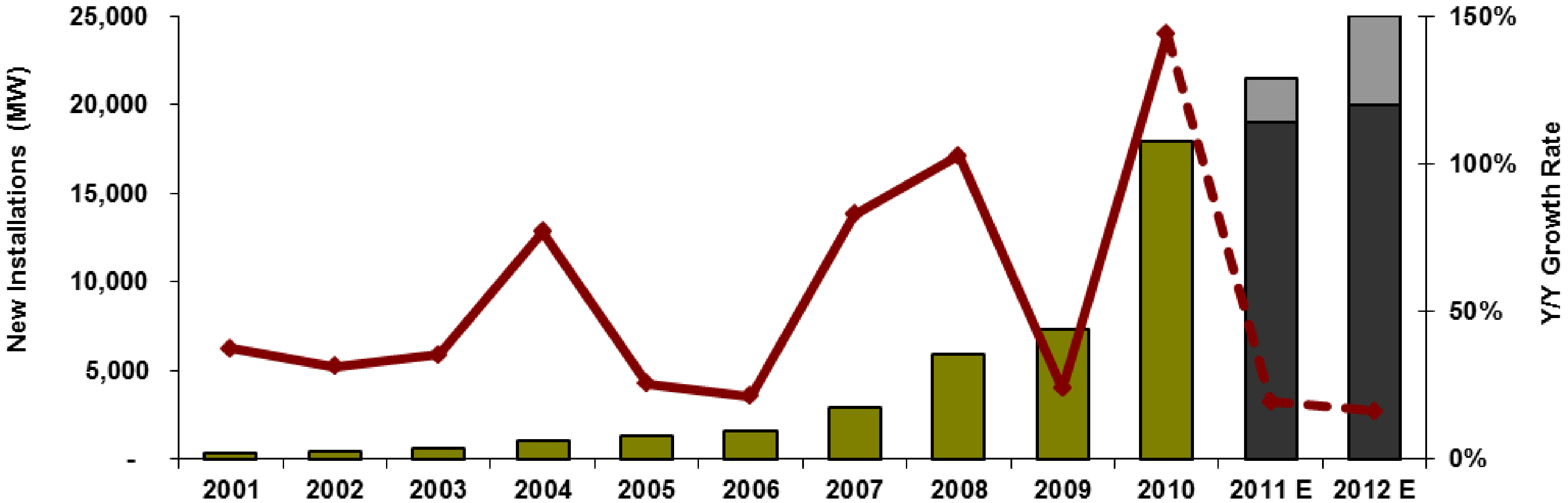
Challenging 2011 & 2012



Source: 2011 and 2012 data includes forecasts by Citibank, Solarbuzz, iSuppli, Deutsche Bank, Digitmies, and SEMI

- The PV industry entered into a down cycle at the end of the first quarter of this year due to weakness in European market
- End market demand growth is expected to be much smaller in magnitude even by the most optimistic forecast
- Europe will continue to be the dominant market in 2011 and 2012, though its market share will decline with flat or even negative growth
- US, emerging markets such as China and India, are expected to be the growth drivers

Ongoing Industry Structure Transformation

- Significant slowdown in capacity expansion
- Continued geographic shift of manufacturing to Asia
- Vertical integration
- Technology differentiation
  - Market demand has been shifting towards solar cells with high conversion efficiencies
- Industry consolidation
  - Weed out inefficient capacities
  - Fewer, stronger, more efficient players
  - Industry supply chain matures
- Large corporations endorsing solar
  - Newcomers with strong financial capital, technology and low production costs will likely accelerate industry transformation
    - TSMC
    - GE
    - Samsung

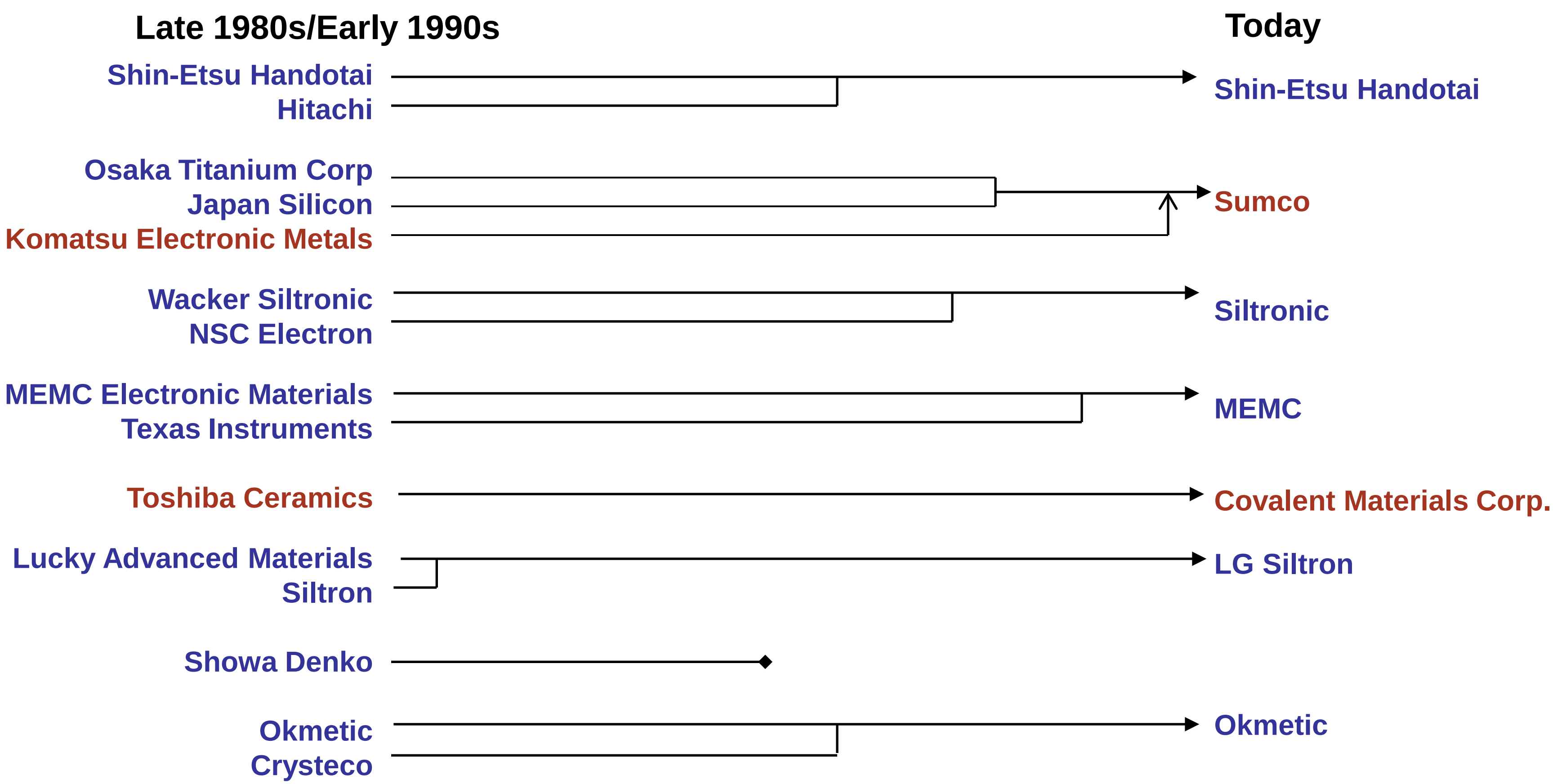
Industry Consolidation – DRAM Industry

Early 1990s		Today
Daewoo	Fujitsu	Elpida
Hitachi	Hyundai	Hynix
IBM	LG Semiconductor	Inotera (Micron/Nanya)
Matsushita	Micron	Micron
Mitsubishi	NEC	Nanya
Nippon Steel	OKI	Powerchip
Samsung	SGS-Thompson	ProMOS
Sharp	SONY	Rexchip (Elpida/Powerchip)
Tohoku	Texas Instrument	Samsung
Toshiba	…	

Source: SEMI

Industry Consolidation – Silicon Wafer Industry

15 Suppliers → 7 Suppliers



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Source: Nikko Citigroup Limited, SEMI

Industry Consolidation – Semiconductor Device Manufacturers

150mm Fabs	200 mm Fabs	300 mm Fabs	450 mm Fabs
Intel	Intel	Intel	
AMD	AMD	AMD	
Dallas Semi.	1st Silicon	Chartered Semi	
Harris	Altis	Flash Alliance	
Hitachi	AMI Semi.	IBM	
Kawasaki Steel	Anam Semi.	IM Flash	
Lucent	Cypress	Qimonda	*3? 4? companies*
Motorola	Grace Semi.	Powerchip	
Nippon Steel	LSI Logic	ProMOS	
Siemens	Motorola	RexChip	
SONY	National	Samsung	
VLSI Technology	SMIC	SMIC	
Yamaha…	SONY	SONY…	
>100 companies	***~70 companies***	***~30 companies***	

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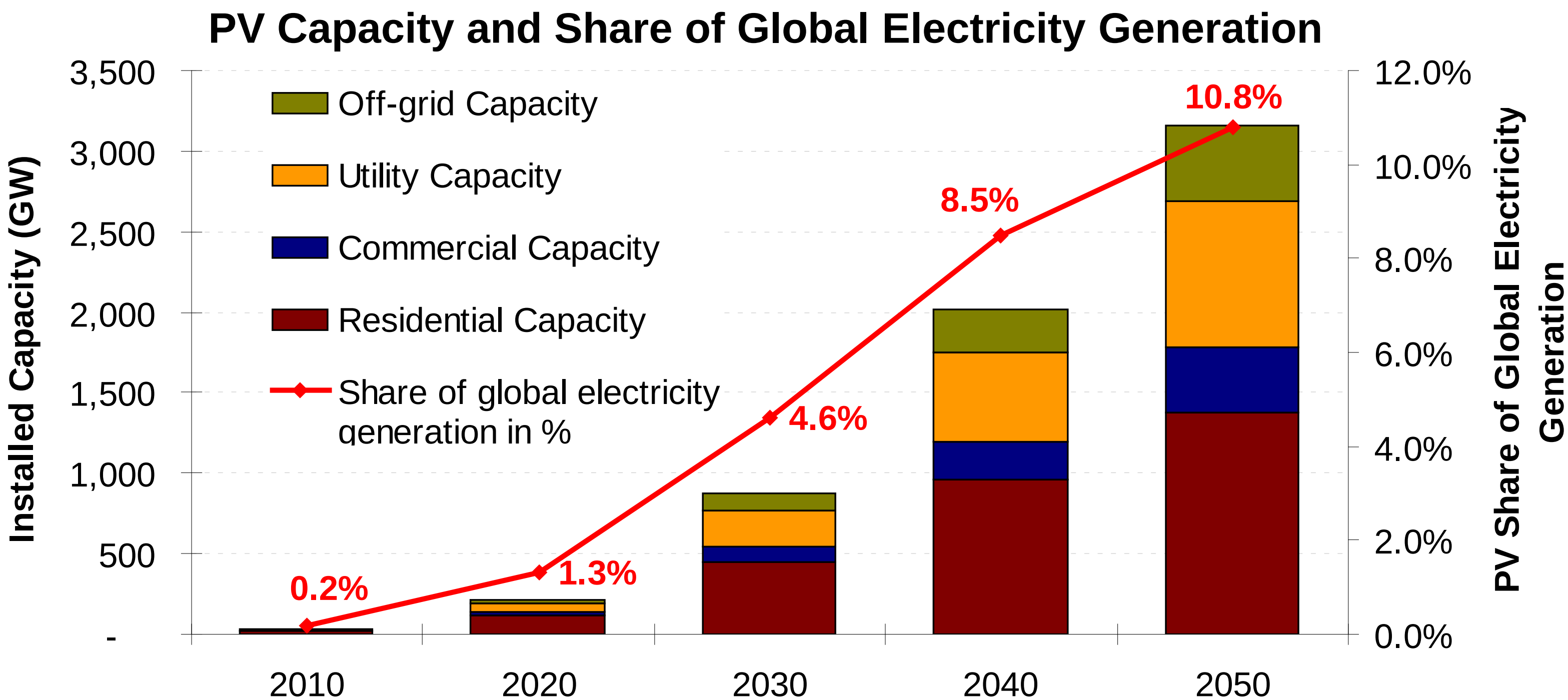
Source: SEMI

PV's Long Term Growth Potential

- "PV power is a commercially available and reliable technology with a significant potential for long-term growth in nearly all world regions." – *IEA Solar PV Roadmap, May 2010*



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Source: IEA and SEMI

2011 SEMI International Roadmapping & Collaboration Activities

- ITRPV International Technology Roadmap for Photovoltaics (Europe)
  - International effort to identify critical technology needs and cost reduction goals for PV materials, manufacturing methods, and process
  - 2nd edition of the International Technology Roadmap for PV released by SEMI and CTM (Crystalline Cell Technology & Manufacturing) Group
- Stakeholder engagement:
  - DOE-SEMI roadmap workshop 2009, related events in 2010 and 2011
  - July 2011: 2nd Annual North American PV Fab Managers Forum at Intersolar NA
  - Focus on critical issues in thin film PV manufacturing shared across the supply chain

US PV Manufacturing Consortium

- CIGS (Copper Indium Gallium Selenide) National Technology Roadmap
- Mission: Engage the U.S. CIGS PV community to identify key industry challenges/gaps in which a roadmap (and standards) would provide useful direction towards creating a strong U.S. manufacturing industry base and support achievement of the DOE SunShot goal.

Thank You!

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