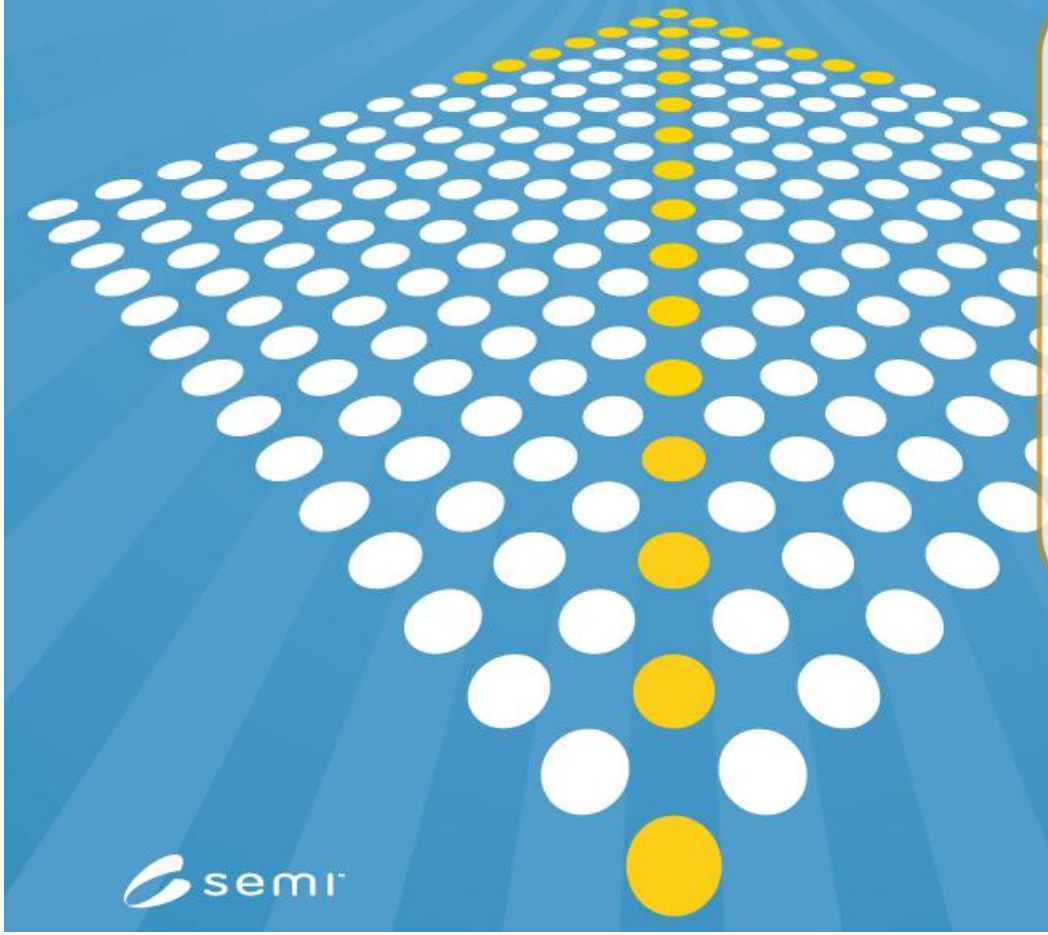
Accelerating Growth and Cost Reduction in the PV Industry



PV Technology Roadmaps and Industry Standards – An Association's Approach

Bettina Weiss / SEMI PV Group

July 29, 2009

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SEMI® : The Global Association

SEMI delivers access to:

- Information
- Global Markets
- People—from governments to customers

SEMI activities include:

- International Standards
- **Market research & statistics**
- Public policy
- Environmental, Health and Safety
- Industry Collaboration and Promotion
- Expositions & Conferences

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PV Group: A New SEMI Initiative

- **Unique Challenges**
  - Policy driven
  - Industry structure
    - Vertically integrated, turn-key systems, etc.
  - Deployment bottlenecks
  - Many more

PV Group: A New SEMI Initiative

- PV is a semiconductor technology that will benefit from chip industry experience
- PV segment has grown to more than 30% of SEMI membership of 2,000 companies
- Semiconductor and FPD expertise, combined with new influences from PV pure players contribute to accelerated commercialization

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PV Group: A New SEMI Initiative

- Similarities in
  - Materials
  - Processes
  - Process Integration
  - Equipment
  - Yield
  - Innovation
  - Learning Curve Acceleration
- Leverages expanding existing core competencies
  - Supply Chain Collaboration
  - International Standards development
  - Industry research and statistics
  - Global public policy and advocacy
  - Global PV events and conferences

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How to Accelerate the PV Learning Curve

- Industry Standards that reduce cost and spur innovation
- Industry information that guides investment and planning decisions
- Industry advocacy and promotion
- Effective Buyer-Seller collaboration on critical issues
  - Green Supply Chain (EHS)
- High performance, global supply chain

PV Group Mission

The PV Group will be the global industry association of choice for the photovoltaic solar supply chain represented by companies that provide cells, modules, equipment, and materials. The PV Group will provide increasing member value by delivering timely products and services that support continuous manufacturing cost reduction and global market expansion.

The Perfect Industry white paper

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PV Advisory Committees – Guiding PV Group Strategy

- PV Advisory Committees representing equipment and materials suppliers, cell and module manufacturers and other interest are providing strategic guidance to PV Group in many regions and markets around the world
- Collaboration on critical priorities creates a strong voice of the industry on matters of policy, manufa… other issues

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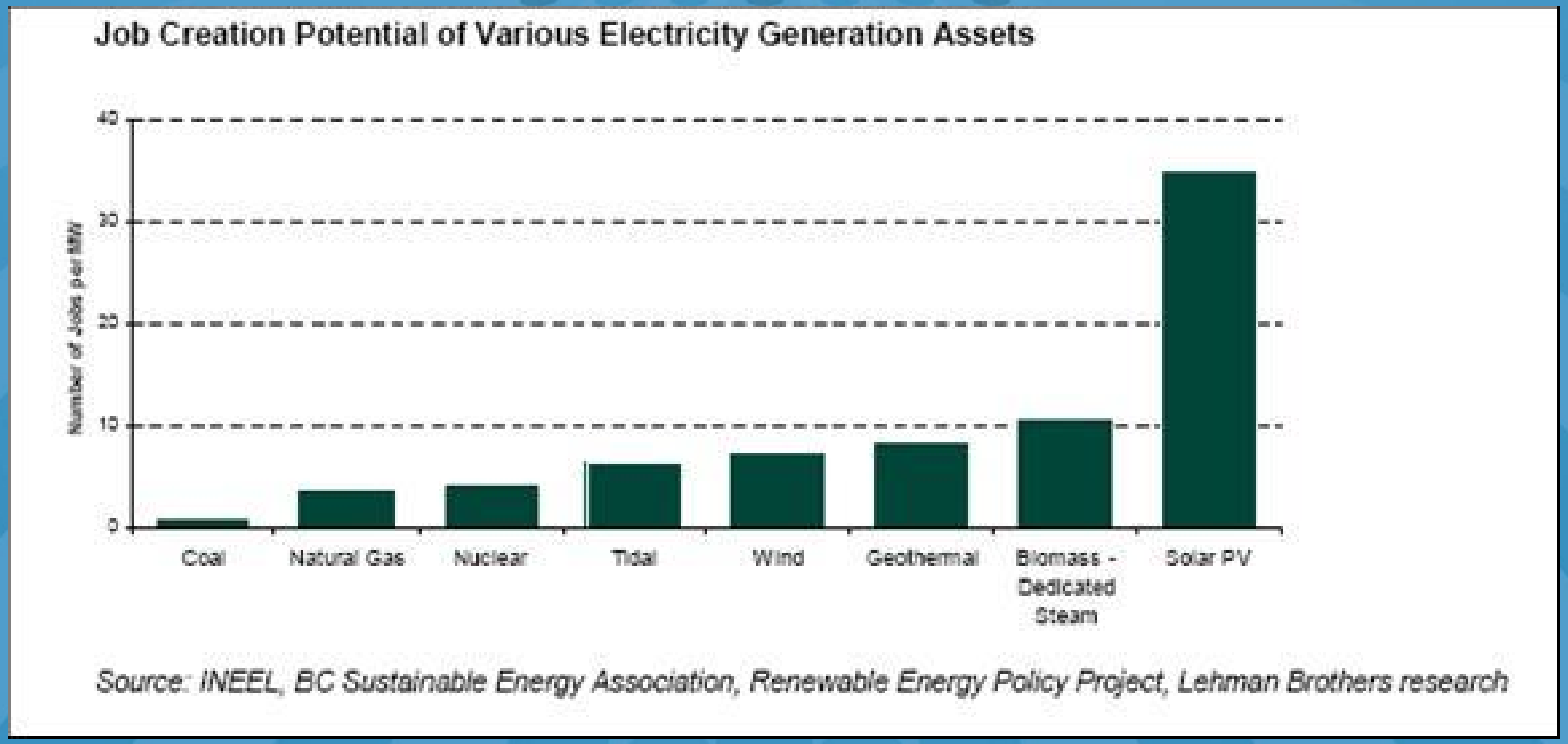
The U.S., PV and the World

- The PV industry is global. Domestic interests have to be aligned with global trade conditions and developments.
- Stronger domestic demand will strengthen the U.S. manufacturing supply chain and help create green collar jobs.

The U.S., PV and the World

- Collaboration between industry and government will positively impact global partnerships.
- Available funding must be directed to projects furthering the U.S. manufacturing platform, enabling industry segments to become stronger and increase competitiveness.

U.S. Solar Job Potential



PV Technology Roadmap Workshop

- Joint DOE-PV Group workshop on July 12 in San Francisco
  - Explored the industry's desire and readiness for a U.S. *or* international PV Technology Roadmap
  - 150 participants from the manufacturing supply chain unanimously voted for a collaborative approach to solve manufacturing challenges
  - Leaders from the semiconductor industry provided perspectives on lessons learned and barriers overcome to pave the way for the future
  - Next steps are being prepared

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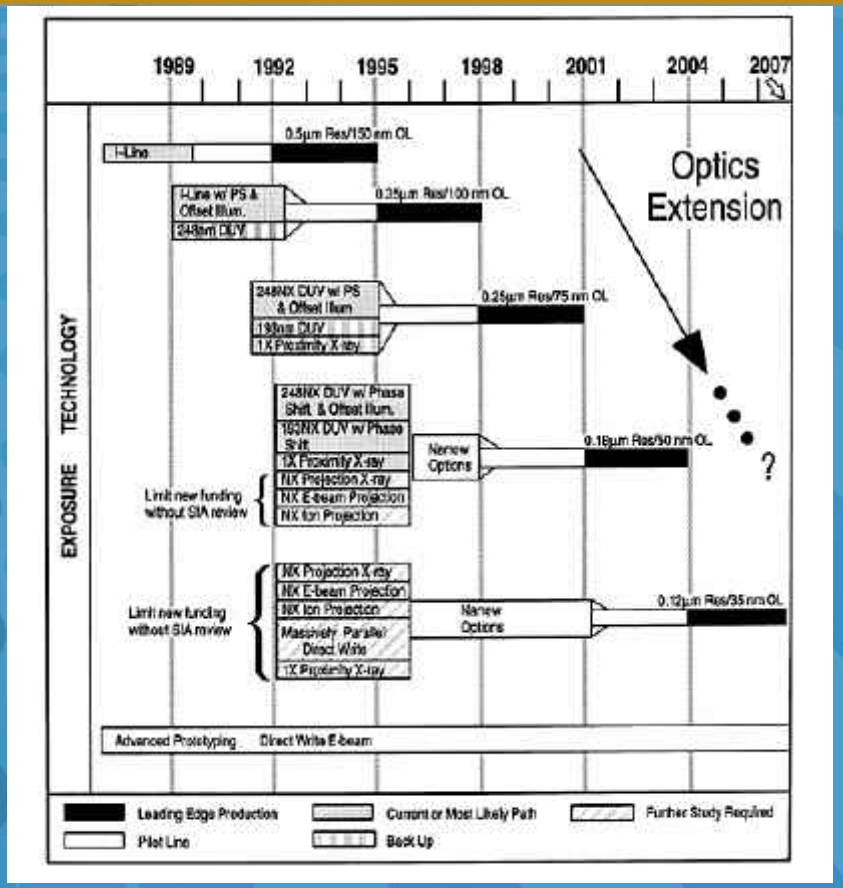
PV Technology Roadmap Workshop

- Key questions:
  - What are the barriers to success in the U.S. PV industry?
  - Which ones should be addressed collectively?
  - How do we decrease the proliferation of custom processes without stifling innovation?
  - How can R&D and industry accelerate commercialization?



Technology gaps identified

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PV Technology Roadmap – Next Steps

- Continue to assess need and feasibility with broader input from cell/module manufacturer community (ongoing)
- Provide an update on the July 12 workshop during PVSEC in Hamburg, Germany , September 21-25, 2009
- Form Steering Council to help structure the Roadmap project and secure funding for 2010 and beyond
- Communicate regularly on progress and barriers alike; Roadmap website in development

Technology Roadmaps and Industry Standards Are Integrated Processes

- The International Technology Roadmap for Semiconductors (ITRS) and the Standards that were produced because of it have provided immeasurable benefit to the industry.
  - Tool-to-tool communication
  - Improved process efficiency
  - Reduced materials volume
  - Reduced risk to operator, tool, the environment

"Technology roadmaps identify where you compete; Standards identify where you collaborate."

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The Need for Manufacturing Standards

- Standards contribute more to economic growth than patents and licenses
- Companies that participate in standards outperform competitors and have reduce risks and development costs
  - DIN (German Institute for Standardization) on th "Economic Benefits of Standardization"
- Software standards and interoperability measurement resulted in approximately $2 billion in benefits (1996-2001)
- Calibration and standard test methods helped generate $7.6 billion in benefits
  - Planning Report 07-2, Economic Impact of Measurement in the Semiconductor Industry, Prepared by: RTI International for NIST, December 2007

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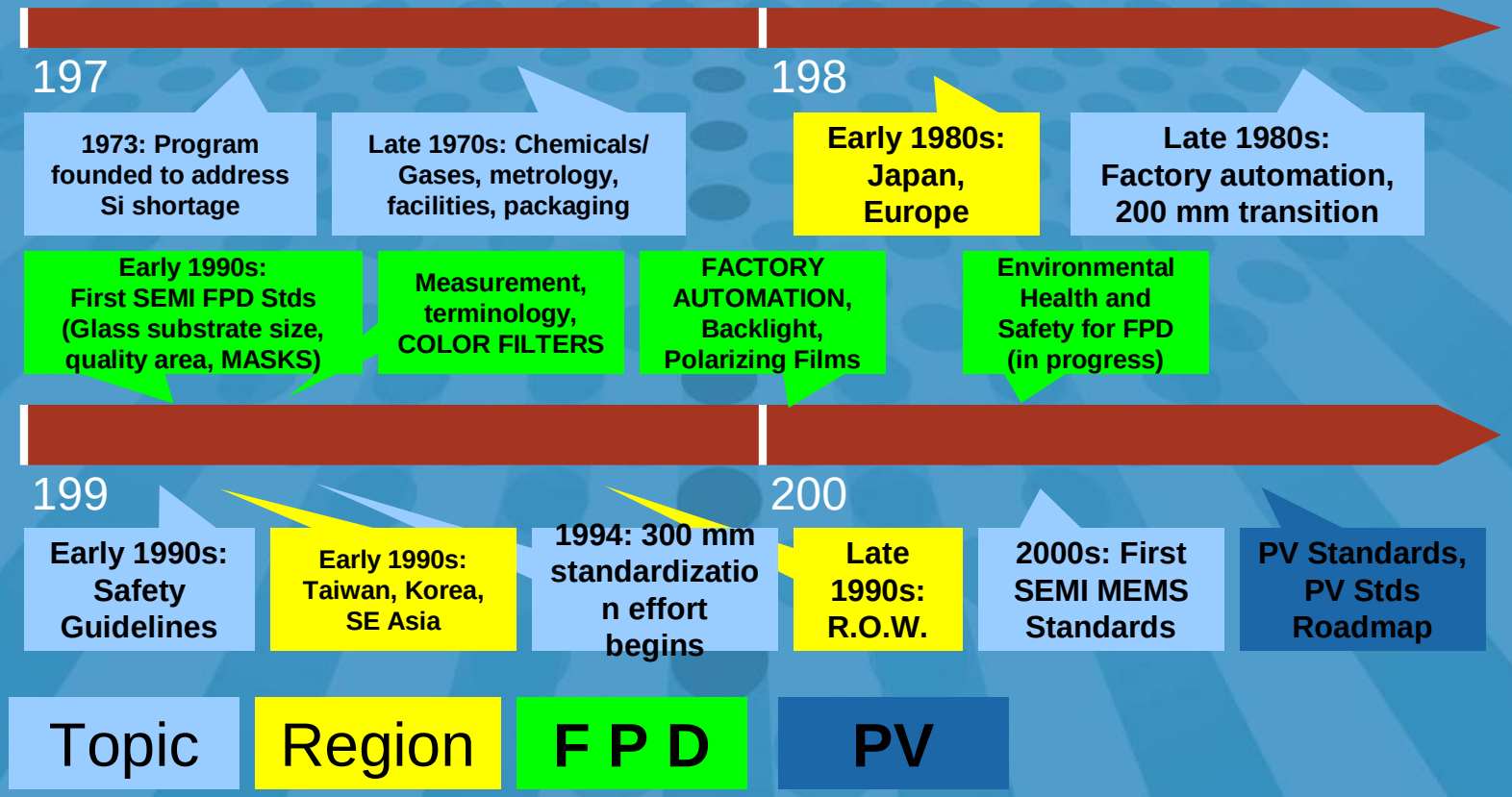
SEMI® International Standards Program

History of SEMI Standards



PV Standards Progress

- PV Standards Committees active in Europe and N. America since 2007, in Taiwan and Japan since spring 2009
- Standards Core Team established to supervise PV Industry Standards Roadmap
- Outreach to other Standards Developing Organizations (SDOs) to avoid duplication of effort and harmonize work in progress
  - IEEE, IEC, JEDEC

SEMI Standards Applicability to PV

- SEMI Standards apply to PV manufacturing
- 64 out of 80 Standards categories (hundreds of specifications and test methods) work for PV
  - Silicon wafer
  - EH&S
  - Factory integration
  - Facilities
  - Others
- The PV industry can derive immediate benefits from using existing Standards now

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Flat Panel Display PCS Forum – A Case Study

- FPD Production Cost Saving (PCS) Forum established by SEMI in1993 to:
  - Reduce display manufacturing costs
  - Define next generation of equipment and materials
  - 50-60 companies involved
- 1st PCS Forum surveyed flat panel display industry to define needs for the next generation production lines:
  - Equipment, material handling, key components, and materials
  - An additional 3 PCS Forums followed
- Results
  - Today 42” LCD displays for < $900 (1995 – 10” > $500)
    - PCS 1 - Substrate size = Gen 2 – 320 x 340 mm
    - PCS 4 - Substrate size = Gen 8 – 2,200 x 2,500mm

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Flat Panel Display PCS Forum – A Case Study

- A cross-functional industry organization with focus & commitment can deliver major industry-wide benefits and economic growth

Meeting the EHS Challenge

- **The PV Group facilitates industry-wide collective initiatives based on the efforts of member companies**
- Focusing on global EHS topics, compliance and regulatory issues, and the advancement of EHS within the PV industry..
- Established PV EHS Taskforce with Forums on:
  - PV Silane Safety
  - PV Emergency Response
  - PV Waste Minimization & Handling
  - PV Chemical Safety

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Meeting the EHS Challenge

- Standards EHS Committee looking to leverage existing safety guidelines while exploring unique PV issues
- Coordinating activities with other industry groups: International Regulatory & Compliance Committee (ICRC), Chemical Societies, SAHTECH
- Industry education (workshops, seminars, resources, networking)

Conclusion

- The PV Learning Curve needs to accelerate.
- An effective Technology Roadmap can accelerate cost reduction and industry growth
- Technology Roadmaps and Industry Standards go hand-in-hand
- Roadmaps and Standards efforts must be global to be most effective
- www.pvgroup.org

TOGETHER

WE CAN CHANGE THE WORLD