

# **Collaborative Tool Development**

*Reducing Cost per Watt through Tool Development  
& Manufacturing Innovation*

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# PV Energy Market Dynamics

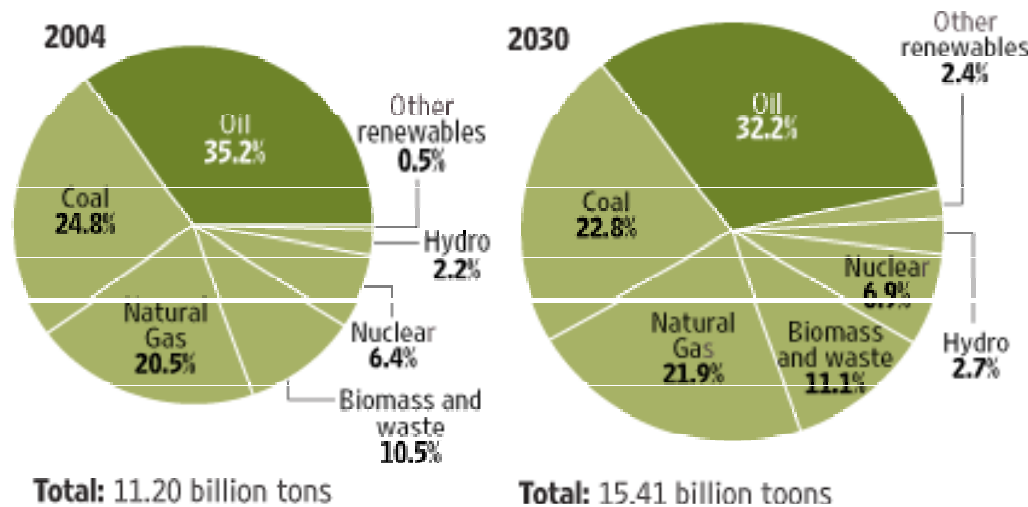
- After 30+ years, solar energy deployment is now rapidly accelerating
- Large ramp in demand in PV products creating extreme need for solar manufacturing equipment and technology
- Fragmented and complex market with many competing technologies & business models; international alliances & worldwide deployments
- Emerging focus on Gen2 and Gen3 PV technologies
- New equipment companies beginning to emerge; potential billion dollar opportunity
- Lack of standards makes factory line connectivity of the tool sets very costly and time consuming
- Current economics pushing PV industry to find a solution to the \$1 per watt requirement



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# Energy Macro View

- Population and economic growth are principle drivers
- Global energy demand will increase by 33% through 2030 even assuming governments adopt energy efficiency and renewable targets.



Shown in metric tons of oil equivalent

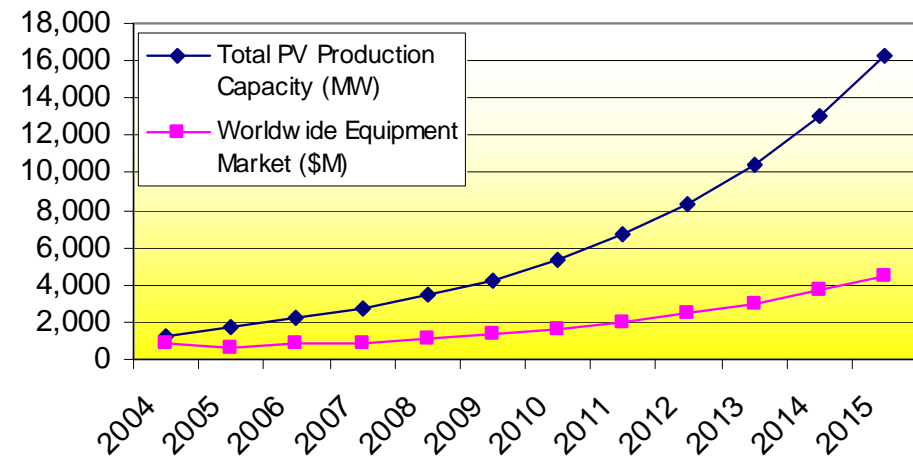


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# Solar PV Demand is Skyrocketing

- Manufacturing capacity will grow at a 25 – 35% CAGR predicted through 2015
- The equipment market needed to support that growth will grow 4x
- What is the real impact of Gen 2 and Gen 3 tool development?

PV Manufacturing & Equipment Demand



Source: Prometheus Institute, February 19, 2008



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# Solar Technologies

## Photovoltaic (PV)



Wafer based SI

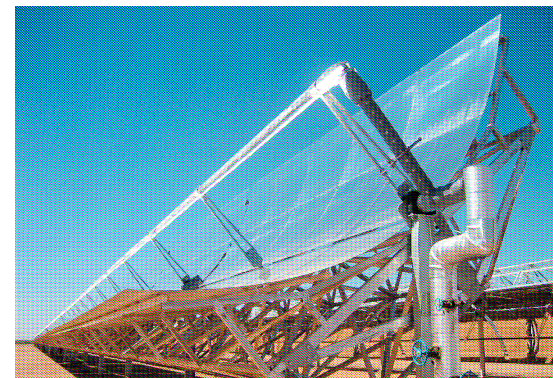


Thin film  
Amorphous  
CdTe, CIGS



Concentrators

## Solar Thermal

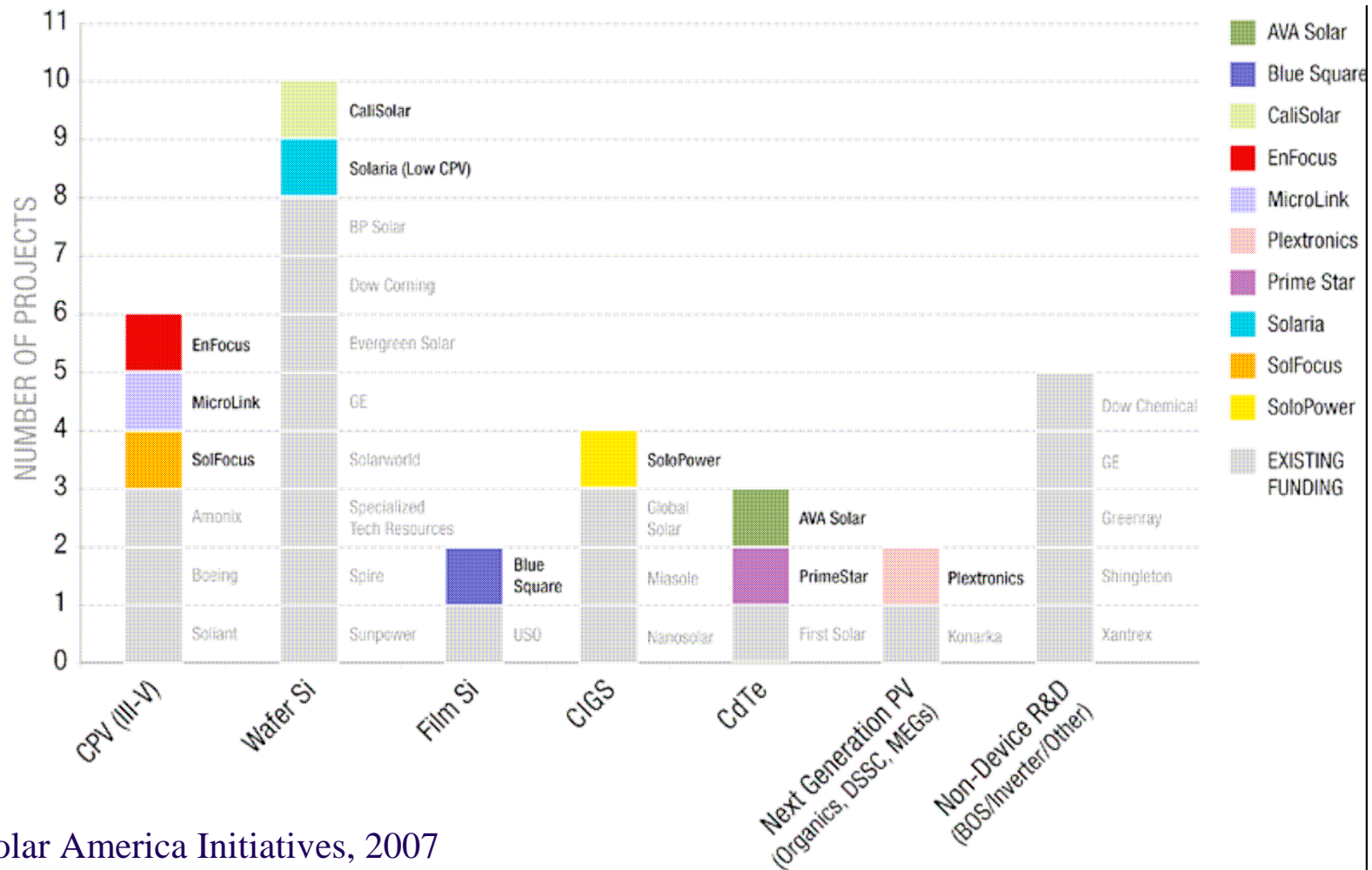


CSP



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# Many Players in the mix for Process Tools



Solar America Initiatives, 2007

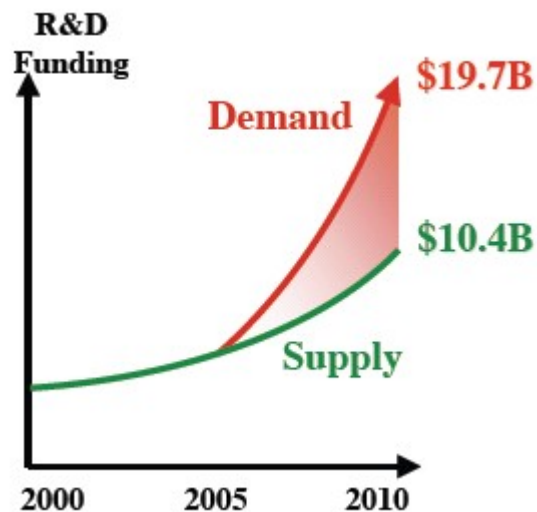
# No Standards for Machine/Factory Interaction

- Solar is where Semi was 15 to 20 years ago!
- Anyone wanting to install new capacity must address the problem of non-standard equipment interfaces
  - Time & resource consuming
  - Costly
  - Throughput matching issues – (buffers)
- There is no “off the shelf” MES solution
- Turnkey lines are an answer – but do not allow the use of “best of breed” tool selection model



# Is there an R&D Funding Gap for Solar?

## Semi OEM R&D Funding Gap



Driven by the IC Development Trajectory dictated by the ITRS & Moore's Law and Current Semi OEM Business Model

## Solar R&D Capability Gap



- R&D \$
- Technical Resources

Driven by the Goal to Achieve Grid Parody of less than \$1 per Watt and the Current Solar OEM Business Model

Source: Ron Leckie, ISS Europe, Feb 2006



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# Outsourcing Innovation - P&G Example

- Innovation Study 2001
  - Old Model – centered on internal “bricks and mortar” approach to R&D not scalable in the real world
  - Found the for every P&G development resource – there were 200 resources on the outside just as capable
  - Innovation done in small to mid size companies
- Reaction
  - Increased R&D capabilities through alliances, licensing, and outsourcing
- Results (2004)
  - 35% of the companies innovations come from collaborative development outside the company
  - R&D productivity has increased 60% (development leading to a product)
  - R&D cost as a % of Revenue down from 4.8% to 3.4%



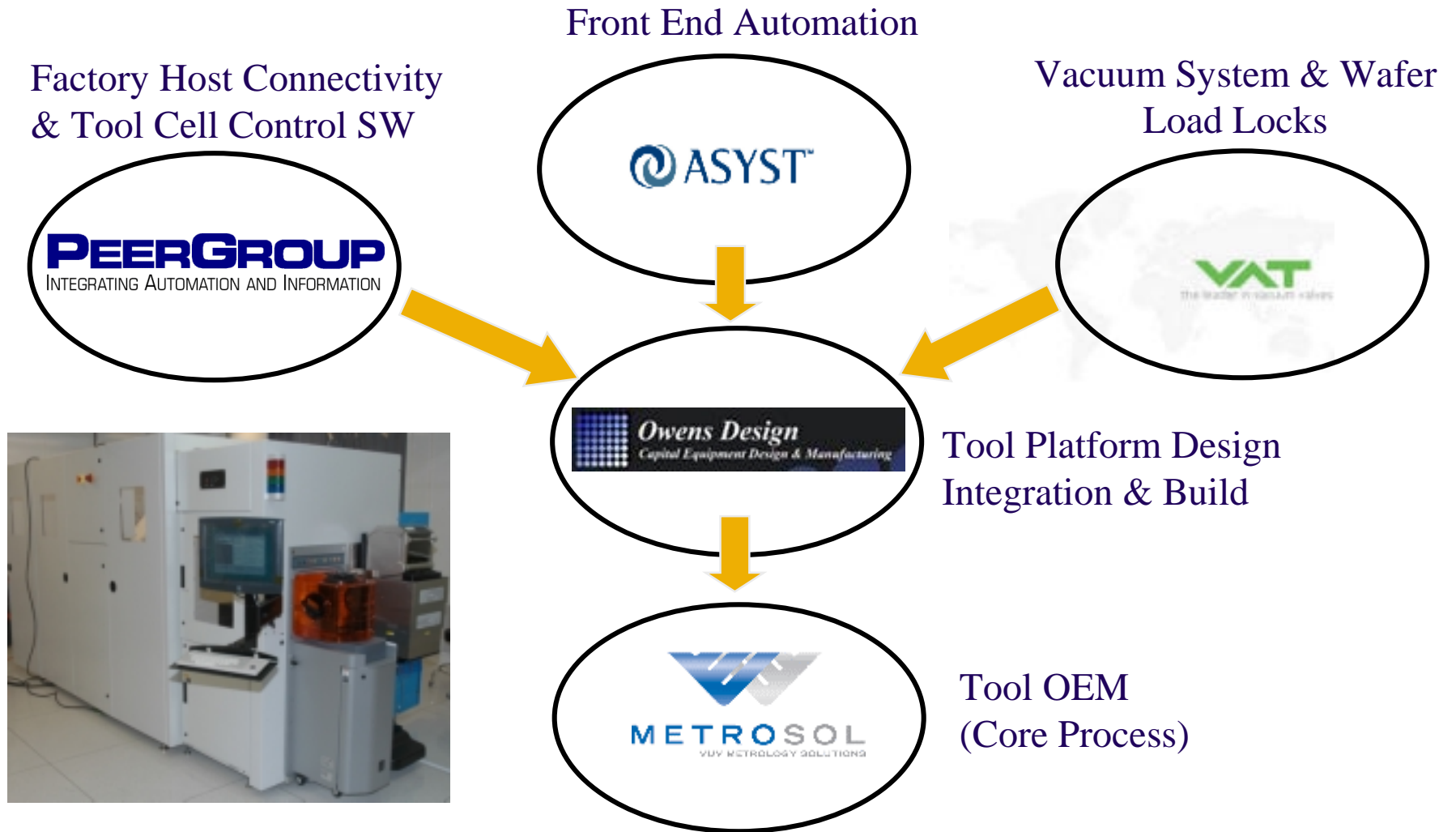
# New Paradigm for Semiconductor OEM Tool Design and Manufacturing

- New business model for tool development and build currently being embraced by startup semi OEM's
- Don't have and don't want the added infrastructure/overhead
- These companies are creating a competitive advantage by strategically outsourcing all non-value added infrastructure, technology, and engineering tasks
- Outsourcing non-core development tasks allows in-house focus on critical core technology development
- Able to meet critical time to market constraints
- Able to keep in house resources to a minimum



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# Expert Innovation Team



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# Results

- “300mm Factory Ready” process tool designed and built in six months
- Fully factory host connectivity
- Tool OEM maintained lean development staff
- Tool OEM resources able to focus on their core technology and not platform development
- Tool OEM was able to leverage the collaboration team as a unique business model to potential customers



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# Summary – Collaborative Innovation

- It is not an outsourcing strategy where work is merely transferred to low cost regions
- It requires a long-term strategic approach aligned with the product and technology roadmap
- It is critical to identify key outside capabilities that will enhance and leverage internal resources and technology
- It can include not only the outsourcing of non-core development but also increase the span of potential technological solutions
- It requires changes in the way a company operates and an attitude how R&D can be accomplished
- Use “Right/Wrong Way Knowledge” from the Semi and Data Storage Industries
- Traditional in-house brick and mortar tool development will not scale to meet the resource demands and timeline needed

