2008 Solar Annual Review Meeting

Session: Wafer Silicon
Company or Organization: SunPower Corporation
Funding Opportunity: Technology Pathway Partnership
Title: Grid-Competitive Systems Technology
A Systems Driven Approach to Cost Reduction

Theresa L. Jester
SunPower Corporation
408-457-2705 ph
408-240-5400 fax
terry.jester@sunpowercorp.com

SUNPOWER

Budget and Solar America Initiative Alignment

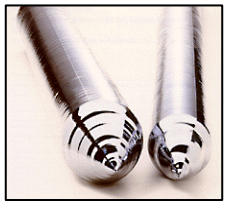
SunPower Corporation				
Project Beginning Date	**Phase I**	**Phase II**	**Phase III**	**Total Budget**
9/1/2007	$ 8.47 M	$ 9.35 M	$ 6.88 M	$ 24.7 M*

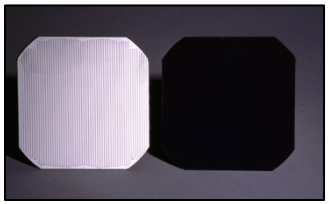
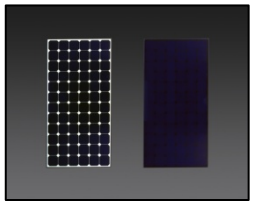
- This project supports the Solar America Initiative:
  - Contributes to goal of grid parity by 2015
  - Reduced materials cost, particularly the silicon substrate
  - Increased conversion efficiency
  - Improved manufacturing processes and higher throughput

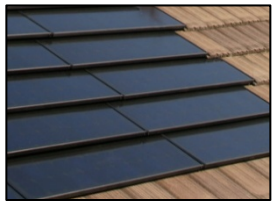
*Total Project= $52.6 M
DOE share=47%
SunPower share=53%

Grid Parity by 2015

SunPower is optimizing the full value chain



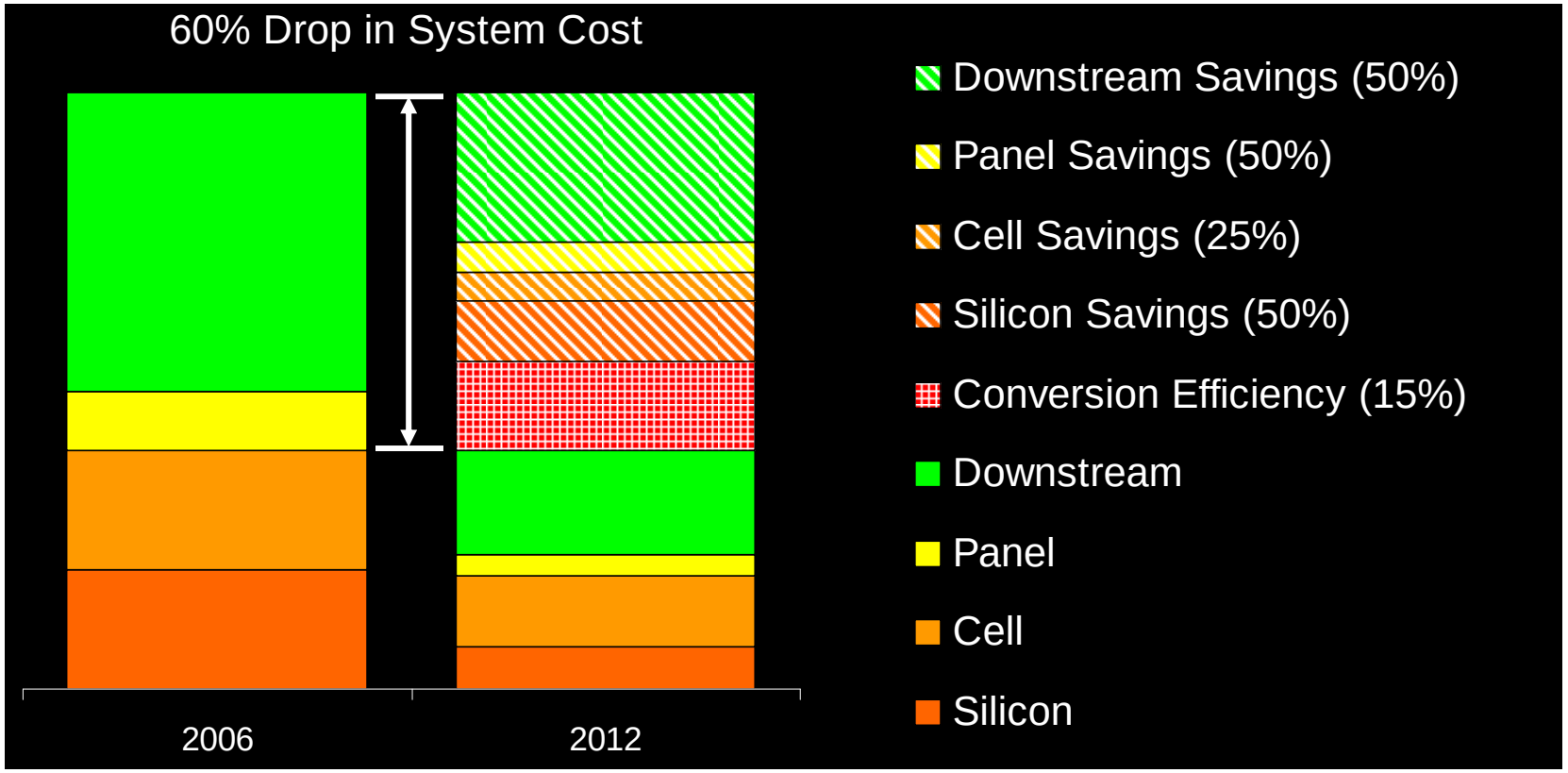





Ingot → Wafer → Solar Cell → Solar Panel → Unitary Product → Integrated System

Developing high-efficiency, turn-key PV systems for the residential and commercial markets to deliver electricity at grid parity by 2010 - 2015

Cost Reduction Areas



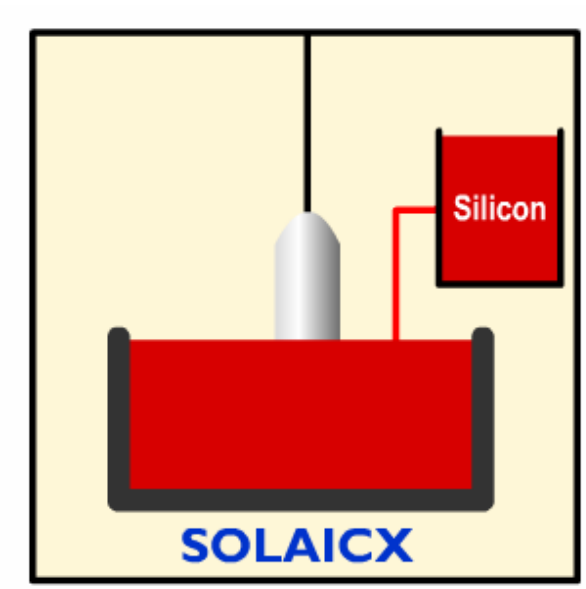
Project Structure

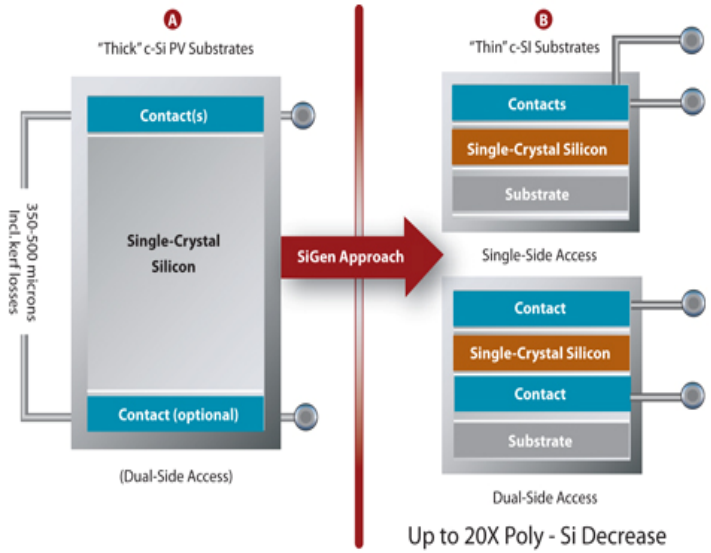
- **Task 1: Ingot Growing Technology Development**
- **Task 2: Wafering Technology Development**
- **Task 3: Inline Manufacturing of Back-Contact Cells**
- **Task 4: Low-cost, High-Performance Modules**
- **Task 5: Unitary Product Development**
- **Task 6: Cells-to-Systems Factory**
- **Task 7: Engineer-to-Order for Design & Deployment**
- **Task 8: Portable Workshop for Distributors**
- **Task 9: Performance Modeling and Monitoring**
- **Task 10: 15-Year Warranty Inverter**

Technology Pathway Partners

- **SunPower Corporation**
  - ***Supplier of the world's highest performance solar modules commercially available***
- **SunPower Corporation, Systems**
  - ***Leading systems integrator in U.S. with most extensive systems performance database***
- **Solaicx Corporation**
  - ***Developer of breakthrough ingot growth manufacturing technologies***
- **Silicon Genesis Corporation**
  - ***Developer of BeamSaw wafering technology***
- **Dow Corporation**
  - ***Premier chemical and processing company***
- **Specialized Technology Resources, Inc.**
  - ***Leading manufacturer of encapsulant materials for photovoltaic cells***
- **Xantrex Technology, Inc.**
  - ***Leader in advanced power electronics***
- **New Power Technologies**
  - ***Leader in optimal siting of solar Distributed Grid models***
- **NREL**
  - ***World Class measurements***

Reduced Materials Costs- Low Cost Substrates





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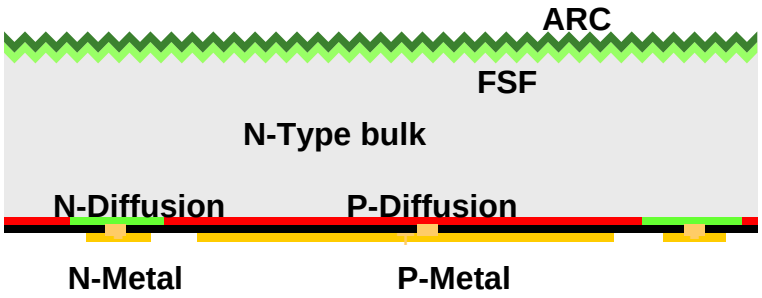
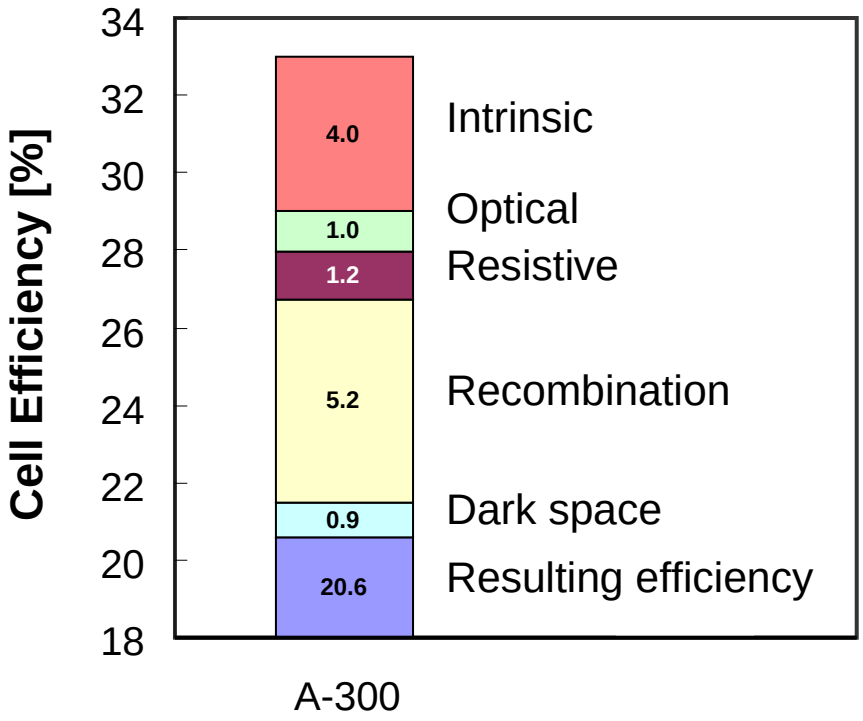
- Solaicx continuous growth methodology being deployed- ingots in house for evaluation
- SiGen in prototype phase for “cleaved- BeamSaw” wafers
- SunPower producing cells at 145 µ thickness in production

Cell Efficiency Improvement
Analysis of loss mechanisms

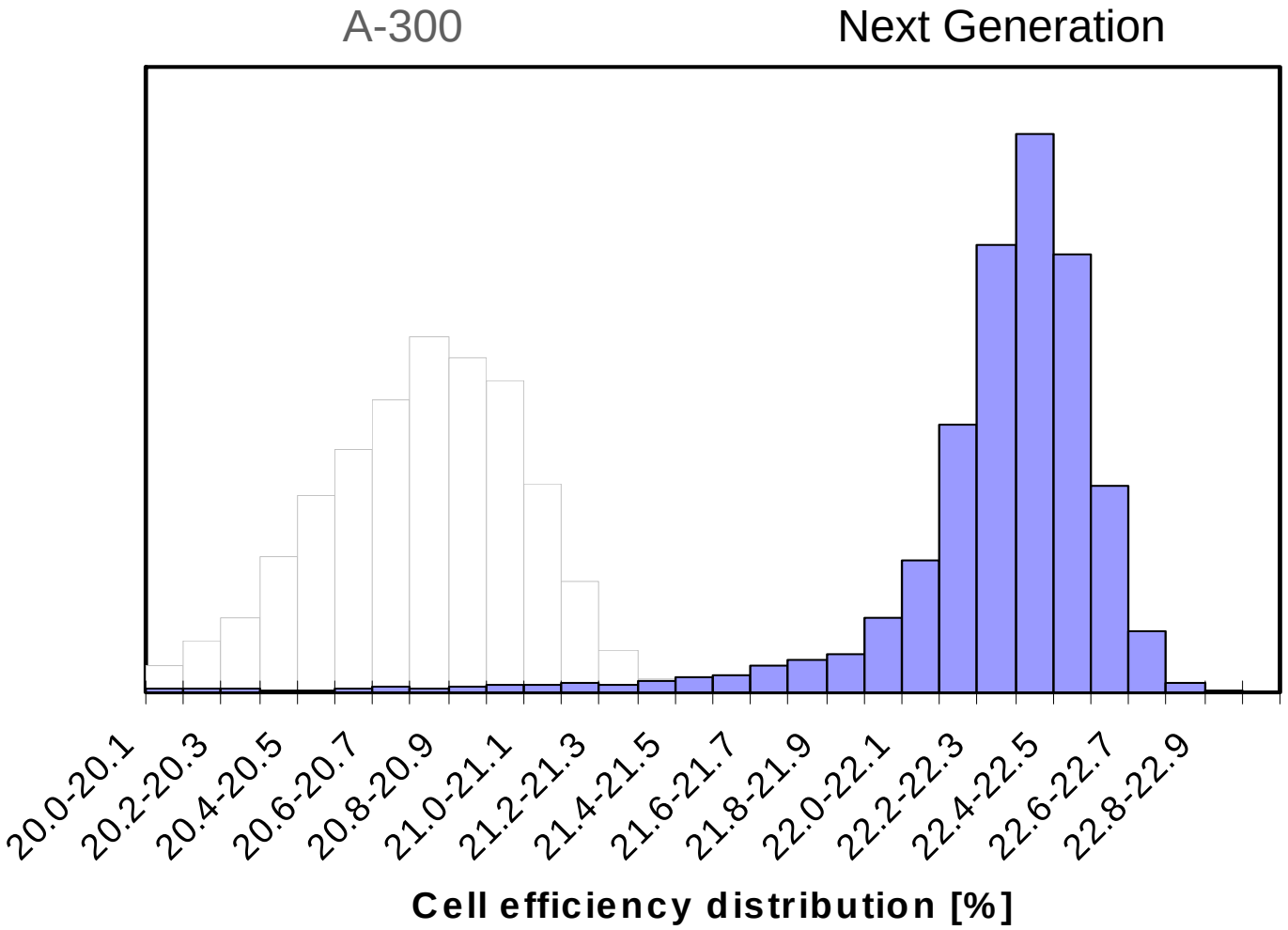


Cross section of an A-300 solar cell

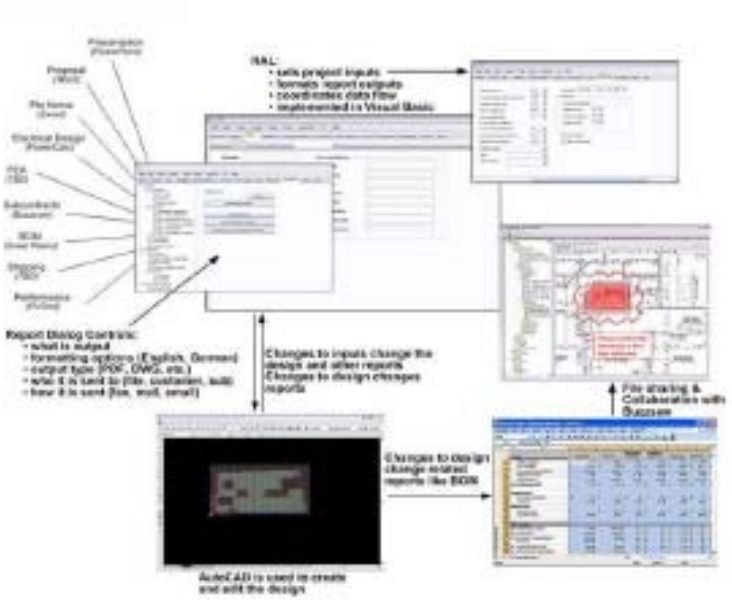


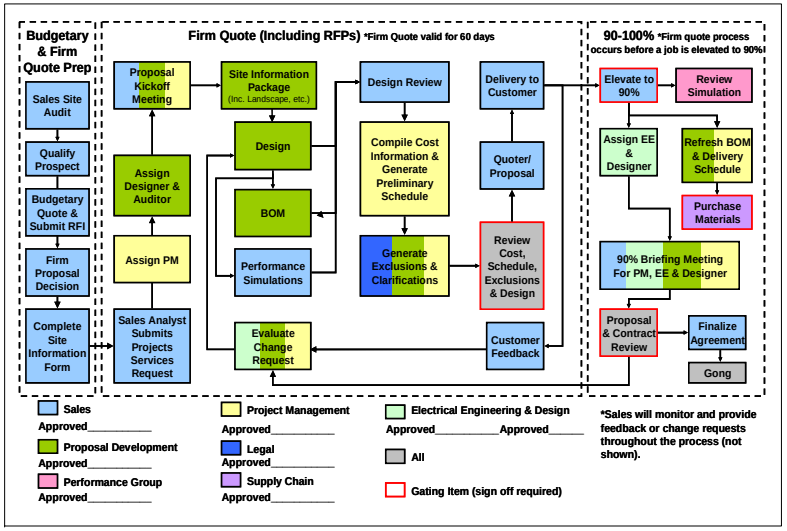
Simulation of loss breakdown in a A-300 solar cell

Cell Efficiency Improvement
Average 22.5%



System Measurement and Design Automation



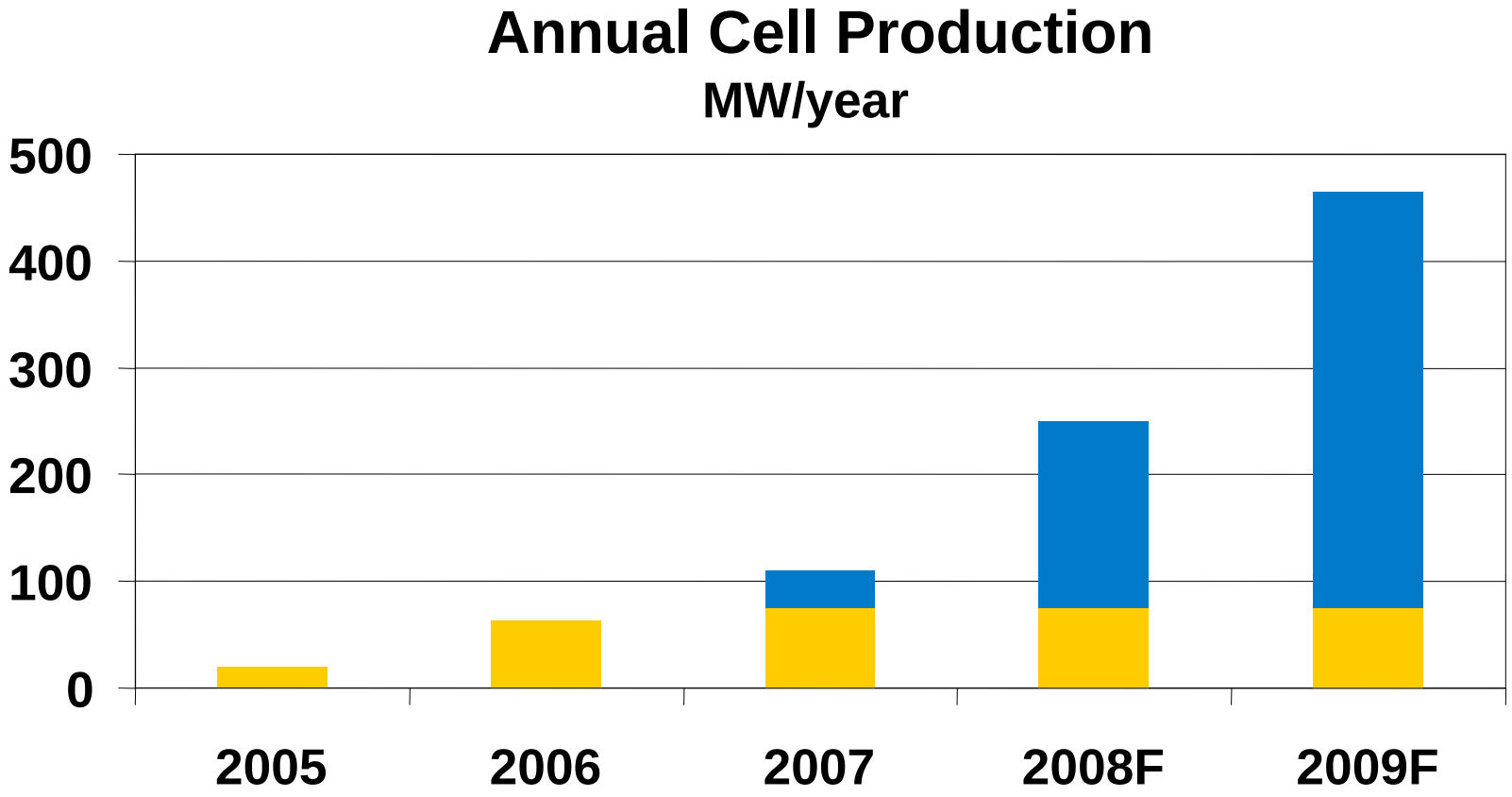


- Improving model for predicting system performance
- Developing Automated software for system design, quotation and deployment

Improved System Modeling Software Correlation near 100%

			Old	New
Site	**System Type**	**Location**	**Actual kWh/ PVGrid kWh v 10 (old) (B3)**	**Actual kWh/ PVGrid kWh v 11 (new)**
BS1 Guenching	T0	Bavaria, Germany	108%	98.4%
BS1 Minihof	T0	Bavaria, Germany	108%	99.6%
BS1 Muehlhausen	T0	Bavaria, Germany	111%	99%
J&J Skillman	T0	Skillman, NJ	108%	98.8%
LVVWD	T0	Las Vegas, NV	113%	99%
Nellis 2H	T20	Las Vegas, NV	N/A	99.6%
Your Vitamins	PowerGuard	Las Vegas, NV	109%	101.6%
Target La Cienega	PowerGuard	Los Angeles, CA	104%	97%
Tiffany RSC	PowerGuard	Parsippany, NJ	103%	95.2%
Wine Services Co-op	T10	Napa, CA	110%	102%
Average Error	All Systems		109%	99%

Manufacturing Volume Increase



Project Alignment with Technology Roadmap

Technology Roadmap Need	**Approach at SunPower**
Reduced materials cost, Improved manufacturing processes and higher throughput	Solaicx and SiGen partners SunPower - 145 µ wafers
Increased conversion efficiency	Production process for 22.5% efficiency
Improved manufacturing processes and higher throughput	Volume increasing year over year

Project Update- Major Milestones September 2008
All on track for delivery

Stage Gates- SunPower/Powerlight Solar America Initiative

Stage-Gate I (Phase I)	Deliverable
Demonstrate cell, laminate, unitary product, and inverter concepts consistent with total system LCOE targets	5 cells with target efficiency of 22%; success at > 21%
Provide clear pathway for baseline “cells-to-system” manufacturing processes to meet 2010 LCOE goals	Prototype laminate for class A fire rating
	Prototype module optimized for roof-top commercial
	Prototype module optimized for ground commercial
	Energy production data from prototype modules
	Demonstrate baseline pilot line equipment required for unitary product manufacturing for commercial applications.
	Demonstrate of ETO design software capabilities
	Decision Point Criteria: Provide analysis of cell, laminate, and product concepts to meet LCOE and capacity targets
	Provide analysis demonstrating clear path of cell, laminate, and inverter design to meeting 2010 LCOE

Obstacle Discussion

- No major obstacles seen at this point in the program

Thanks to Scott Stephens, John Benner, Leon Fabick and Brad Ring for project oversight