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Challenges for crystalline silicon cell production, a manufacturer's view

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SunPower Corporation

- Headquarters: San Jose, CA
- Cell Manufacturing: Manila, Philippines
- Cell Products: Cells, Modules
- Cell Technology: High efficiency, back contact cell
- Publically traded: IPO Nov. 2005

Residential Retrofit

Power Plants

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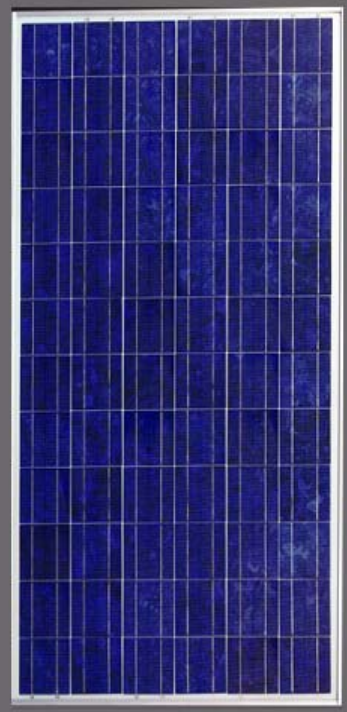
SunPower Technology Leadership

Superior Performance
Superior Aesthetics

SunPower
215 Watt Panel



Conventional
165 Watt Panel

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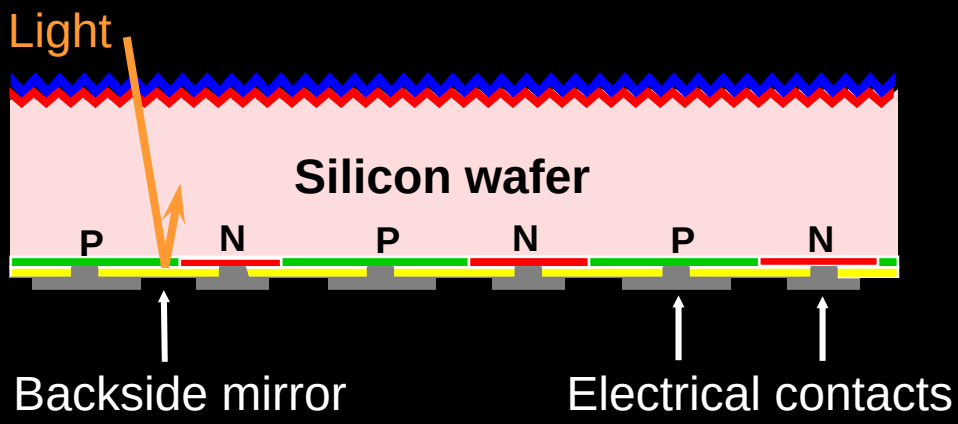
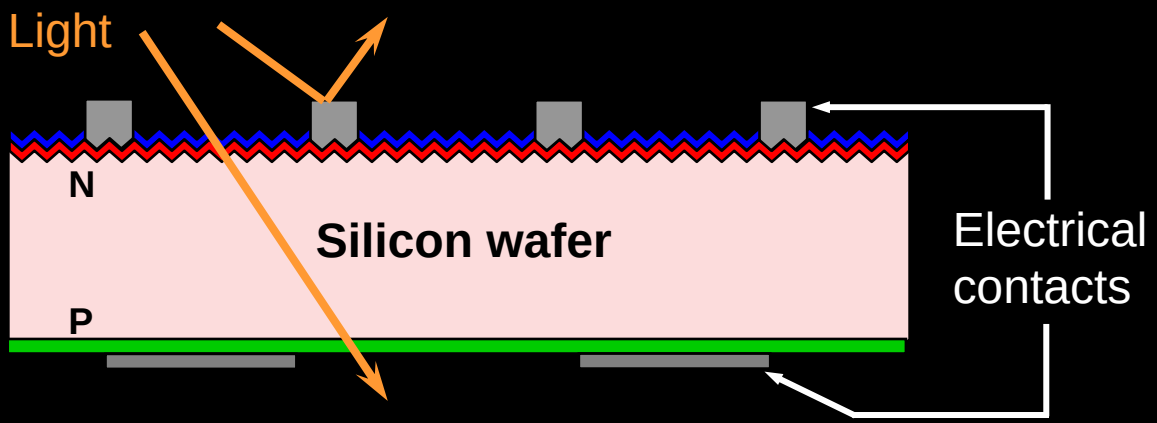
Solar Cell Technology Comparison

SunPower's
Solar Cell
20 - 22%
Efficiency



Conventional
Solar Cell
14 - 17%
Efficiency



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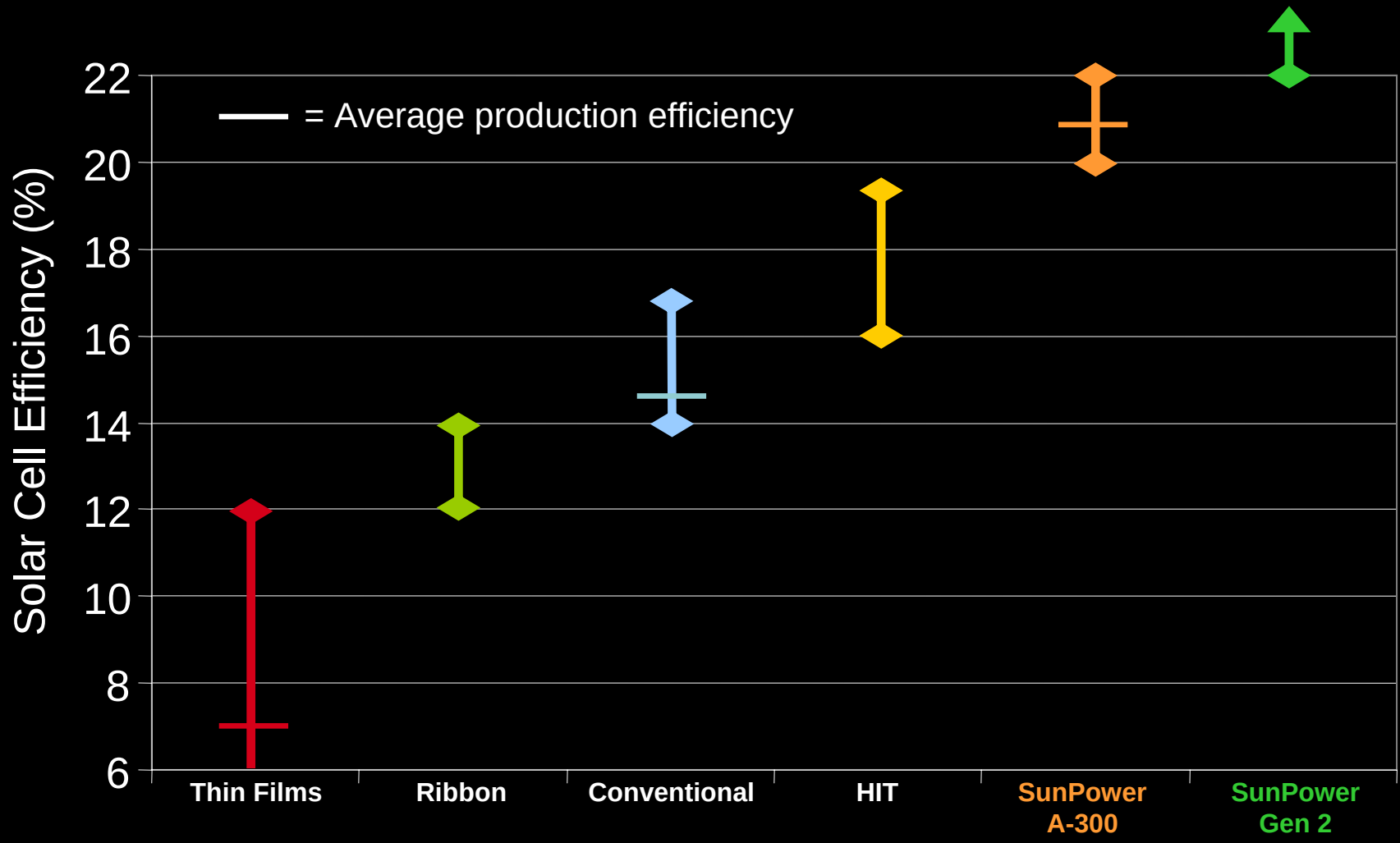
SunPower is Highest Efficiency



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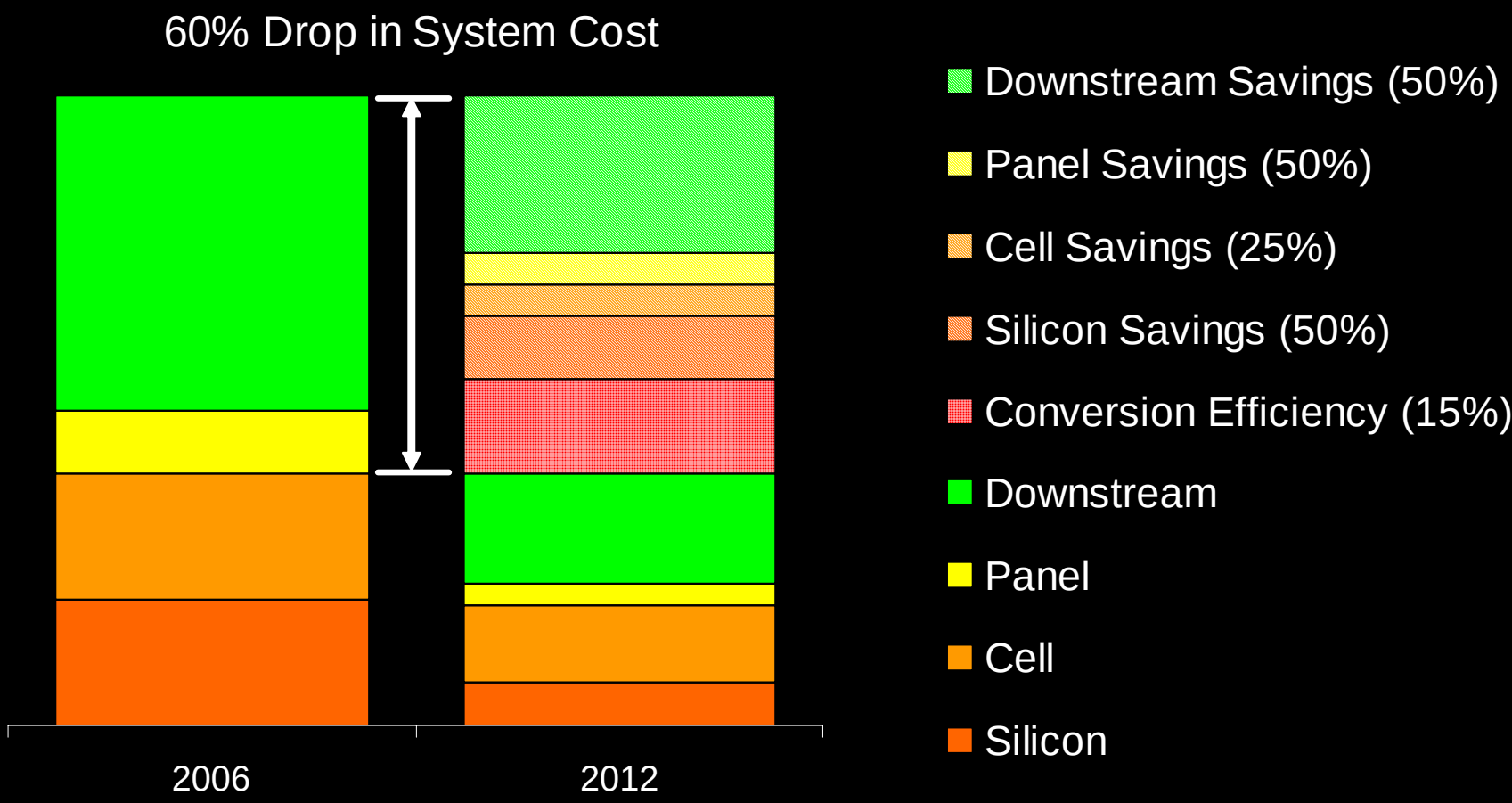
Aim: Reduce Installed System Cost 50% by 2012



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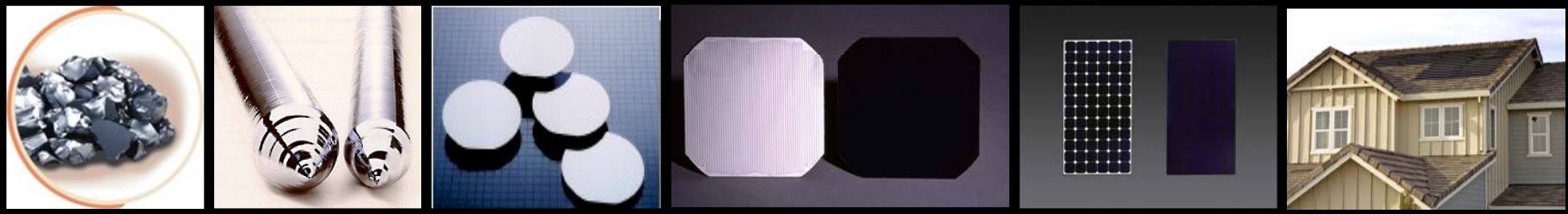
Cost Savings



- Poly/Ingot: Contract prices drop 2008
- Wafers: Thinner wafers, thinner saw wire
- Cells: Higher efficiency, fewer process steps, lower CapEx
- Panels: Smarter design, auto-line
- Systems: Smarter design, channel efficiencies

The Investment into Solar Equipment

Investment:

$$= \frac{\textbf{Capital Equipment \$}}{\textbf{Watt}}$$

(Watts per cell) x (Number of cells produced)

SunPower advantage

Solar industry challenge

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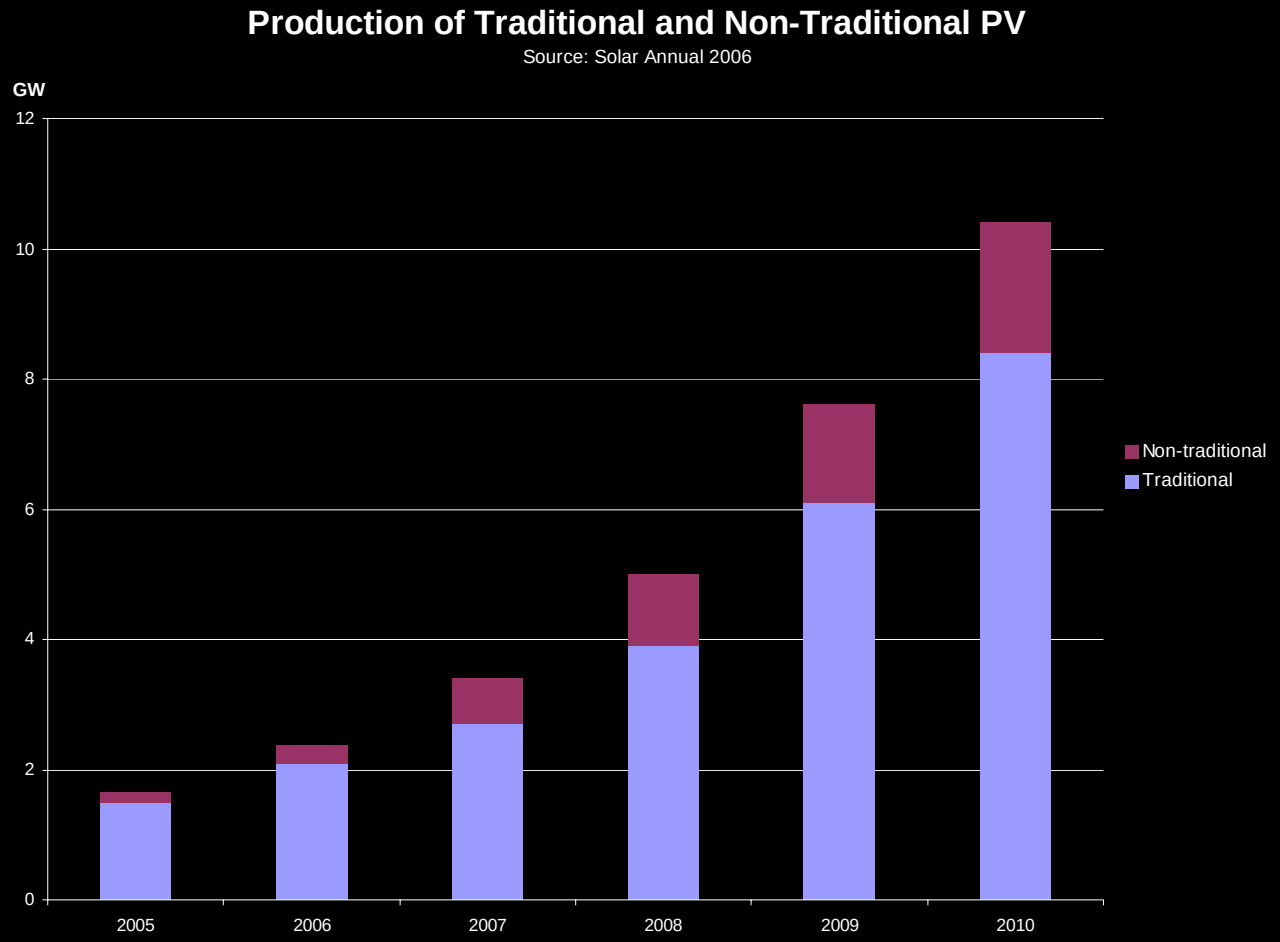
The Challenge

The real challenge for PV manufacturing equipment is keeping up with the growth rate of the solar industry.



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Equipment Supplier Metamorphosis

Standardized equipment manufacturer
Standard platform, multiple tools
Mature infrastructure
Second sourcing
Short lead times

Custom equipment maker
One-off tools
Limited infrastructure
No second sourcing
Long lead times

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PV vs Mature Industry (Semiconductor)

	PV	Semiconductor
Tool Lead Time	6-12 months	Less than 3 months
Manufacturability	Mix, Custom Tools	Standardized Platforms
Service	Mix	On site
Sourcing	Single, sole	Multiple sources
Quality	Medium Uptime	High Uptime
Suppliers	Vendors	Partners
Payment	Upon order, upon delivery, upon FAT	Upon delivery, upon FAT

Improving Equipment Business Practices

- Low cost manufacturing sites
- Build infrastructure for parts, supplies
- Second source
- Manufacturing partners
- Managing the relationship between equipment supplier and cell manufacturer.

Differentiation will be relationship building.

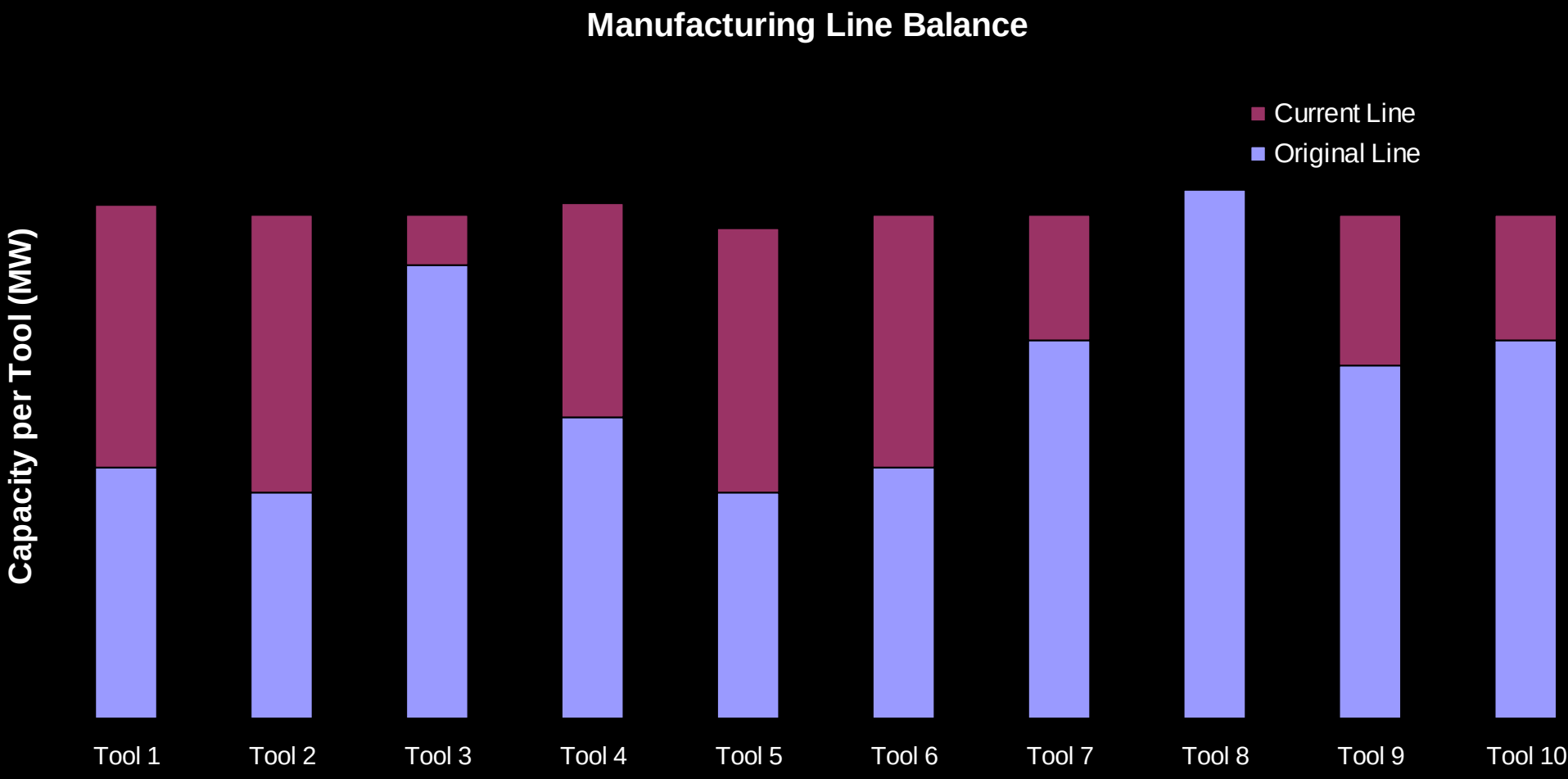
Equipment Design Features

- Standardization across tools: software and hardware
- Small Footprint
- Short PMs
- Reliability
- Uptime
- High mechanical yield
- Cost of Ownership vs Tool Price

Comp Figures PV vs Semiconductor

	PV	Semiconductor
Wafer size	5”, 6”	8”, 12”
Wafer thickness	100-200 microns	500-700 microns
Batch size	1-40	1-4
Wafer Handling	Pallets, cassettes, trolleys, etc.	Pods
Processing UPH	1000’s	10’s
Process Steps	10’s	100’s
Key Challenge	Mechanical Yield	Device Yield
Tool Layout	In-line, batch	Cluster, batch

Manufacturing Line Balance



Balanced line is a better use of capital.

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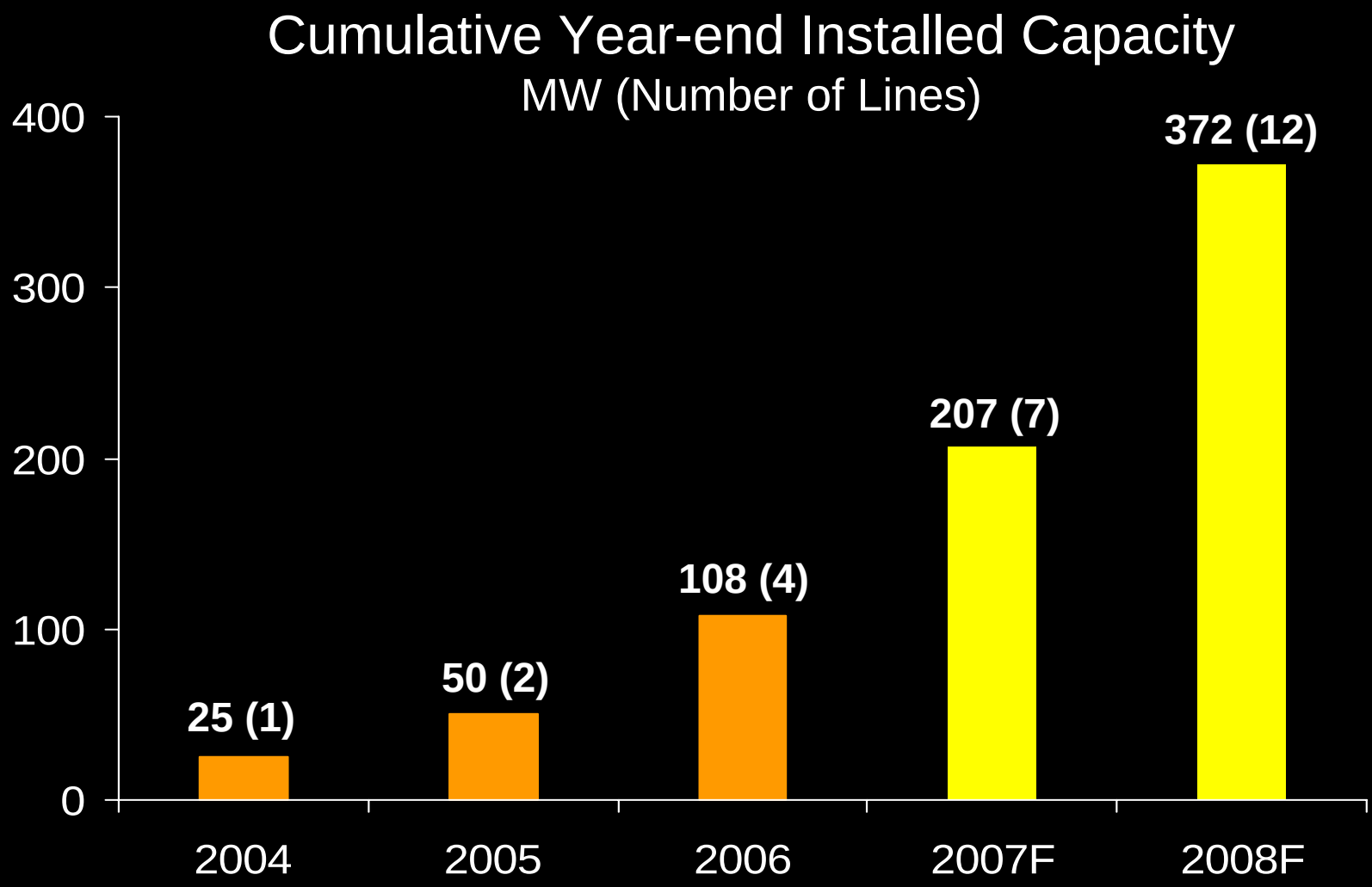
Cell Manufacturing Ramp Plan



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