With Modest Support Solar Photovoltaics Can Be Competitive with Conventional Electrical Generation Costs This Decade

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The US Has Lost Its Leadership

- Solar Photovoltaics were invented by Bell Labs 50 years ago
- Since then the US has gone from 100% market share to less than 10%
- Japan and Germany dramatically lead the US in solar installations, despite their lack of abundant sunshine
- Thin-film solar technologies will enable the US to regain worldwide solar energy leadership

Thin-Film Photovoltaics
The Potential for Disruptive Change

- 94% of the solar cell market is based on crystalline silicon wafers; a 50 year old technology
- Silicon is in short supply and is expensive. Silicon based PV cells and modules are going up in costs, not down!
- Thin-film solar cells based on copper-indium-gallium-selenium (CIGS) have the potential for dramatic cost reductions
- CIGS films have been heavily researched with the DOE achieving 19.5% conversion efficiencies, comparable to polycrystalline silicon
- Several established companies and new startups are pursuing high volume deposition technologies for producing CIGS solar cells
- The key breakthrough is manufacturing technologies that realize the demonstrated potential of CIGS

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80% Cost Reduction is Possible
CIGS vs. Crystalline Silicon

Solar Cell Cost per Peak Watt Output

	2006	2007	2008	2009
Silicon*	$1.57	$1.49	$1.42	$1.32
CIGS**	$0.57	$0.35	$0.30	$0.27

* CLSA global price forecast assuming 35% gross margin

** Miasolé internal cost projections

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Process Advantages
CIGS Thin-film Solar Cells

- **Continuous roll-to-roll processing: leading to fewer process steps, less capital intensity and lower labor costs**
- **CIGS solar cells require a low energy input compared to crystalline silicon**
- **CIGS cells have 1% the semiconductor material of silicon cells**

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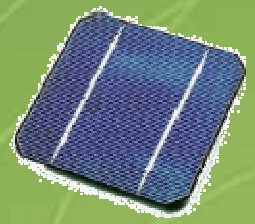
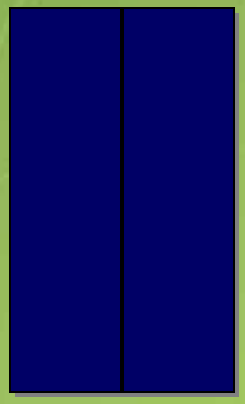
CIGS Paradigm Shift





	Silicon Cells to CIGS Cells	Glass to Flexible Modules	Building Integrated Installation
Market Price	$2.00/Wp to $0.50/Wp	$3.50/Wp to $1.00/Wp	$7.00/Wp to $2.30/Wp
Benefits	Cost & Simplified Assembly	Cost, Lightweight & New Applications	Reduced Installation Costs Electricity Competitive with Conventional Power Sources

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Solar System Costs

- System costs are measured in cost per peak Watt
- 1 Wp generates approximately 1.7kwh/year
- System components costs

	Today	CIGS-2010
PV Modules	$3.50/Wp	$1.00/Wp
Balance of system hardware	1.00/Wp	0.50/Wp
Installation	1.00/Wp	0.30/Wp
OH & Profit	1.50/Wp	0.50/Wp
Total	$7.00/Wp	$2.30/Wp

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Electrical Generation Costs
Projected Cost per kwh

- Combined Cycle Gas Turbine at $550,000 / MW
  - Capital cost 0.5¢
    (25-year amortization; 6% Cost of Capital)
  - Fuel @$10/MMBTU 7.2¢
  - O&M 0.2¢
  - Trans. & Dist. 2.9¢
  - Total 10.8¢

- Distributed CIGS PV System at $2,300,000 / MWp
  - Capital cost 10.6¢
    (25-year amortization; 6% Cost of Capital)
  - Fuel 0.0¢
  - O&M 0.2¢
  - Trans. & Dist. 0.0¢
  - Total 10.8¢

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Intangible Benefits of Solar Electricity

- Energy independence
- The sun is a sustainable free energy source
- Energy costs locked in for 25+ years
- Environmentally friendly
- Distributed power generation
- Job creation

Miasolé's 5MW Production System

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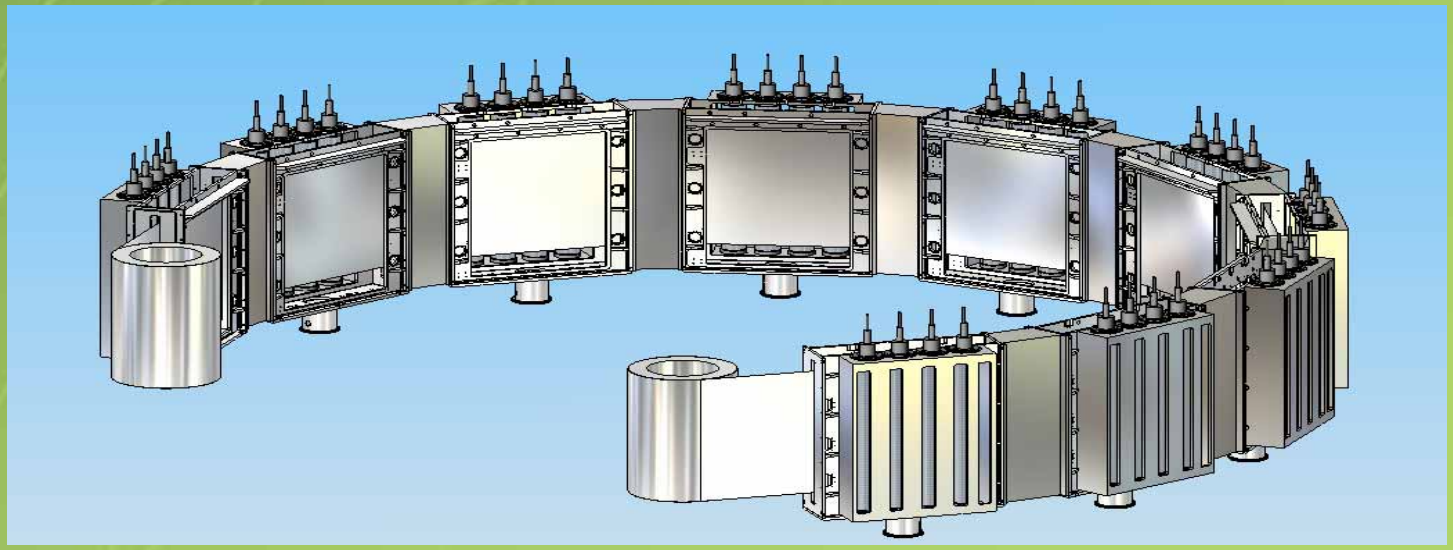
Miasolé's 2nd Generation Roll-to-Roll System

25MW Annual Capacity per System
5-6 Systems Operational in 2006



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How Can the Government Help?

- Increase DOE funding of thin-film manufacturing technologies (Most research emphasizes materials research)
- Provide more direct support of manufacturing technologies
  - Increased grants focused on the most promising technologies
  - Low cost long-term loans to fund capacity expansion
  - Increased solar purchases for Government buildings
  - Extend recent 2-year 30% ITC benefit to 6 years; eliminate $2K residential cap
  - Support at least one major solar farm showcasing multiple technologies
- Encourage state, local and private sector utility support

Summary

- CIGS thin-film solar technology will be competitive with conventional electrical generation sources this decade
- New manufacturing technology is the key to exploiting the demonstrated potential of CIGS
- The Government can help with increased grants, low cost financing, expanded incentives and more PV installations on Government facilities
- With modest support the US will reclaim its founding leadership in solar technology

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