empower with light™

EMCORE Solar Power

Ardour Capital Energy Tech Conference

November 21, 2011

Christopher Larocca

Chief Operating Officer

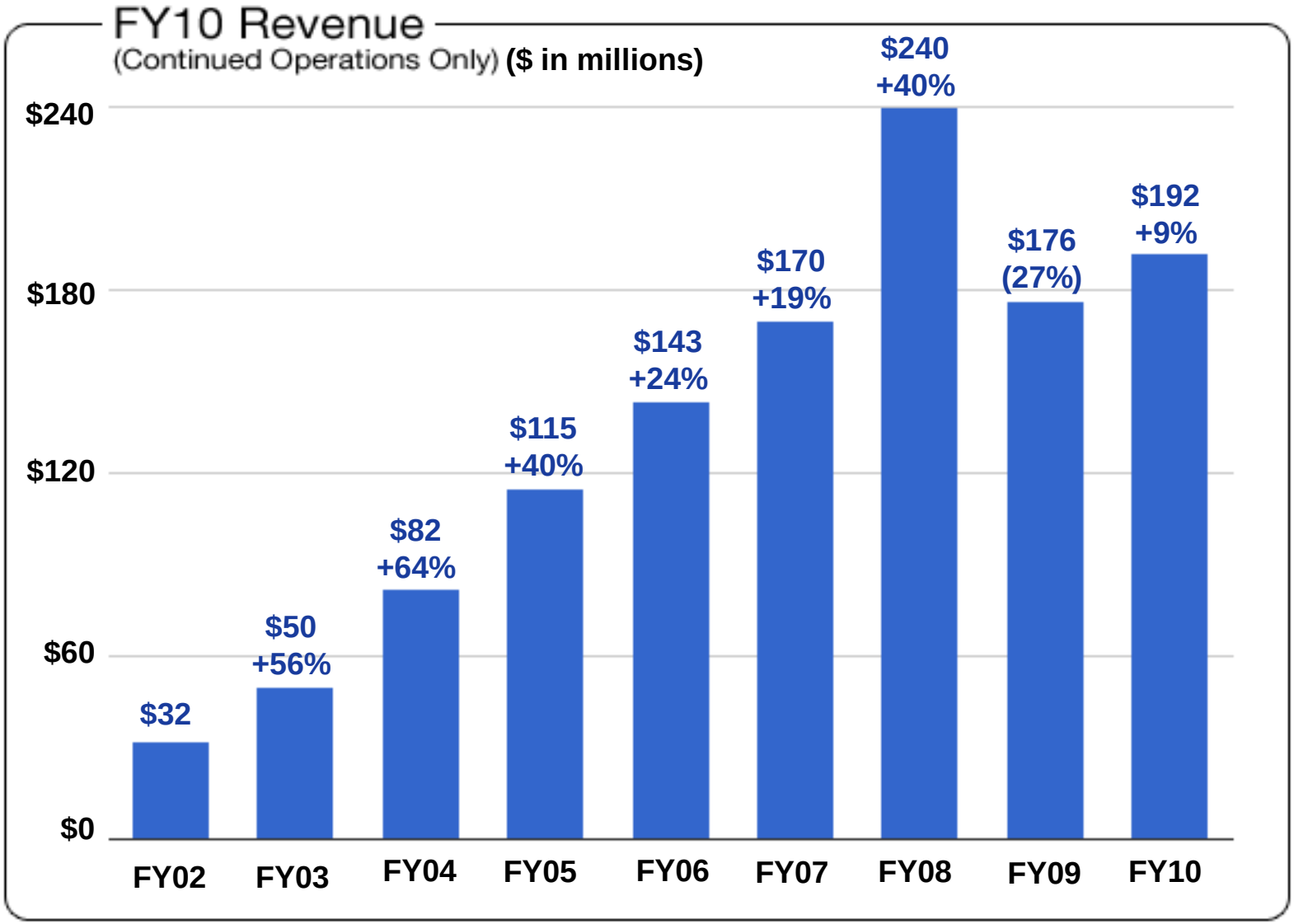
Mark Weinswig

Chief Financial Officer

EMCORE Overview

- **Founded in 1984 by scientists from AT&T Bell Labs**
  - Initial business was the design and manufacturing of semiconductor equipment (MOCVD)
- **EMCORE is a public company listed on NASDAQ, EMKR**
  - IPO in 1997
  - Revenue in FY10: $192M
- **EMCORE Solar at a glance**
  - Headquarters in Albuquerque (relocated from Somerset, NJ in 2006)
  - Total number of employees: ~1000, and ~700 in the US
  - Facilities for Solar Operations:
    - **Albuquerque, NM**: Headquarters, Solar cell design and mfg, Ground mount CPV design center
    - **Somerset, NJ**: Ground mount CPV tracking design center
    - **Alhambra, CA**: Rooftop CPV design center
    - **Huainan, China**: CPV manufacturing base, joint venture with San'an Optoelectronics

Revenue History



Business Units

Global Communications and Power at the Speed of Light

Space and Terrestrial Solar Power Based on Multi-Junction Solar Cells

Photovoltaics Space Power

Space Solar Cells
Space Solar Panels

Concentrator Solar Power

CPV Solar Cells
Solar Power Systems

Fiber Optic Components & Systems for Broadband, 10G Ethernet, Datacom & Telecom

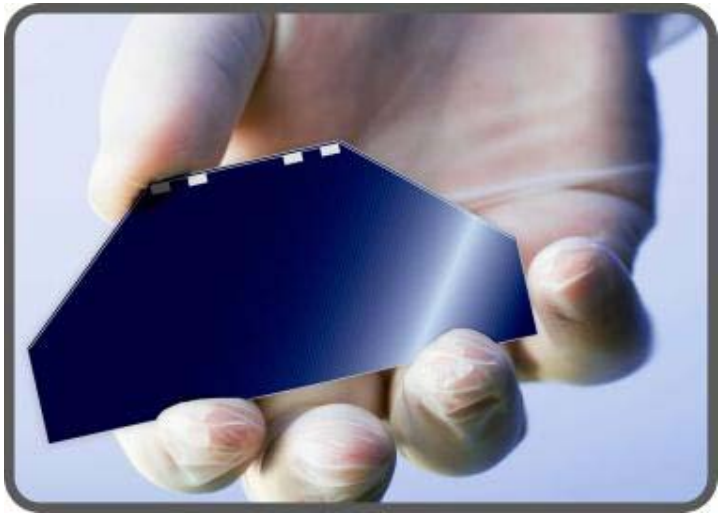
Fiber Optics Broadband

CATV / FTTx
Satellite Com Tx/Rx
Fiber Optic Gyro
Video Transport

Fiber Optics Data & Telecom

10 Gb/s Optical TxRxs
Tunable TxRx, Transpdr
Active Optical Cables
VCSEL, PIN, DFB, APD

EMCORE Photovoltaics Business



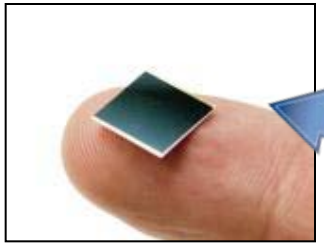
- **Established in 1998 for space power**
- **Based in Albuquerque, NM**
- **Current products**
  - Space solar cells / panels
  - Terrestrial CPV cells, receivers, systems
- **Technology**
  - Multi-junction solar cells
  - Inverted metamorphic (IMM) structures
- **Best performance with outstanding reliability record in the industry, zero failures on over 75 missions**
- **Strong position (>50% market share) to serve the commercial satellite markets**
- **Over $111M in orders booked in over past 12 months, with options for additional $17M**

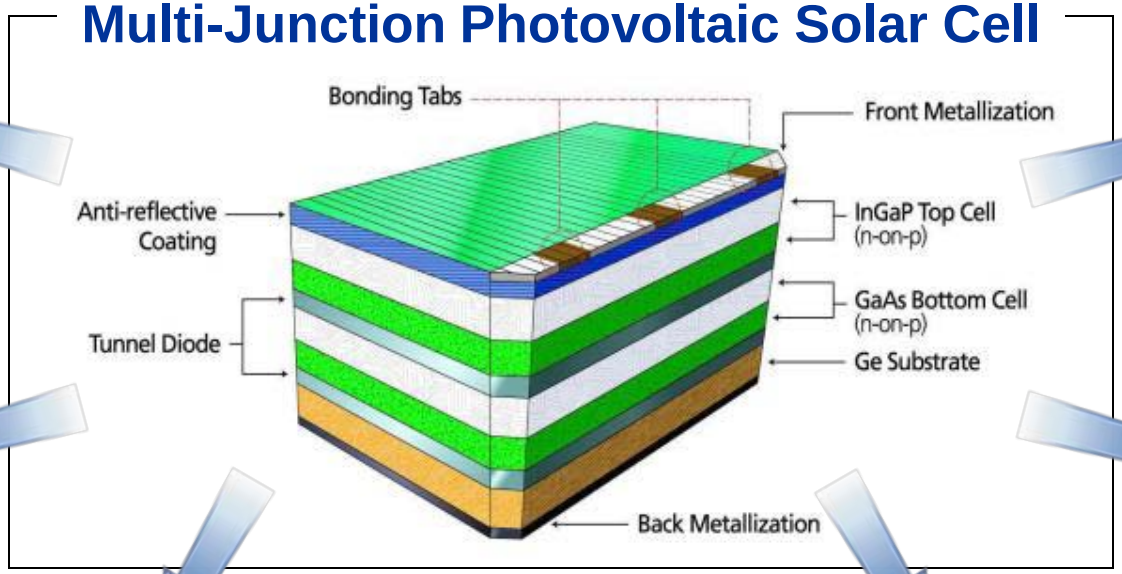
Customers Include:

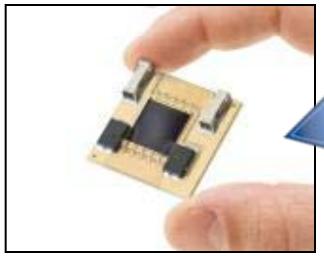
Solar Cell Technology & Applications

CORE TECHNOLOGY:

Multi-Junction Photovoltaic Solar Cell







39.0%

CPV EFFICIENCY

SPACE EFFICIENCY

29.5%

Overview of Space Solar Products

- **Space Solar Cells**
  - Highest efficiency commercially available space solar cells in the industry
  - Currently offer six generations of space solar cell with minimum average efficiency of 27.0% to 29.5%
  - Lowest solar cell mass of 84 mg/cm2 and are fully space-qualified with proven flight heritage

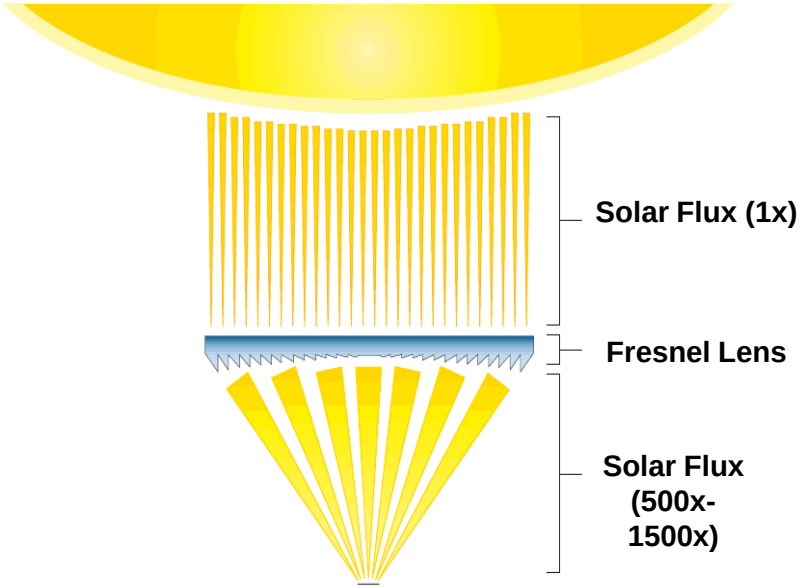
- **Satellite Solar CiC Assemblies**
  - Highest efficiency commercially available CiCs in the industry
  - Extensive flight heritage for LEO, MEO, GEO and interplanetary missions

- **Satellite Solar Panels**
  - Fully tested and wired for integration into solar array assemblies
  - Manufactured and tested per mission profile requirements in a modern Class-10,000 clean room manufacturing highbay under continuous temperature and humidity environmental control

Concentrator Photovoltaic (CPV) Approach to High Efficiency Systems

- CPV technology leverages high-efficiency multi-junction solar cells to produce high-energy density solar power components
- CPV cost reduction benefits directly from advancements in solar cell technology.
- Concentration allows for high-efficiency while reducing the solar cell cost to <$0.15/Watt
- “Sweet spots” for CPV products are geographic areas with high DNI conditions (Italy, China, India, Australia, UAE and southwestern U.S.)

Direct Normal Irradiance



Multi-junction Cell Value Proposition

- One 1 cm^2 TJ CPV

Equivalent Power

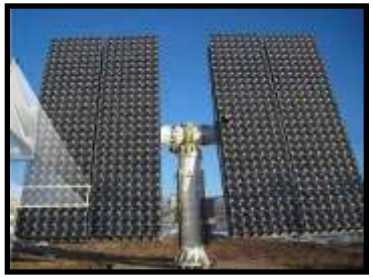
Fourteen 5” Silicon Cells

Evolution of Concentrating Photovoltaics

- **EMCORE's Ground Mount CPV business commenced in 2004**
  - By 2006, a prototype system capable of producing significant power was installed
  - This system was enabled using the following technology:
    - Small triple junction cells (1cm2)
    - Concentrating optics based upon large Fresnel lenses
    - Two axis tracking system
    - Currently have 2.2MW of CPV systems installed throughout 12 locations
  - First commercial installation of third generation system (Gen III) completed in 2010
- **EMCORE's Rooftop CPV business**
  - Acquisition of Soliant in 2011

Four cell prototype

2004



Gen I: 10kW

December 2006

Gen II: 25kW

November 2007

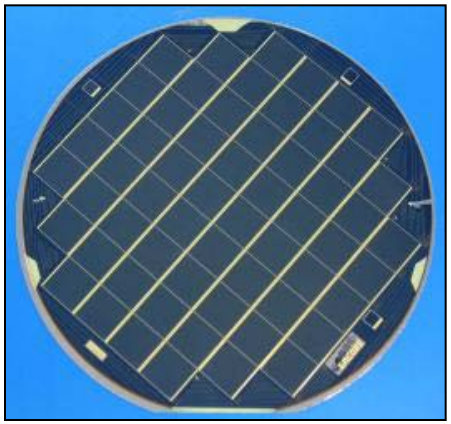
Gen II Commercial Installation

May 2008

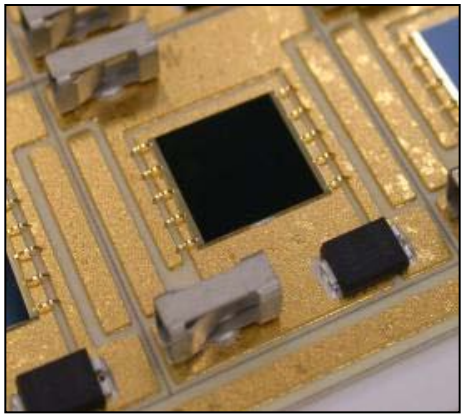
Gen III: 16kW

April 2009

EMCORE CPV Products



CPV Solar Cells



CPV Solar Cell Receivers

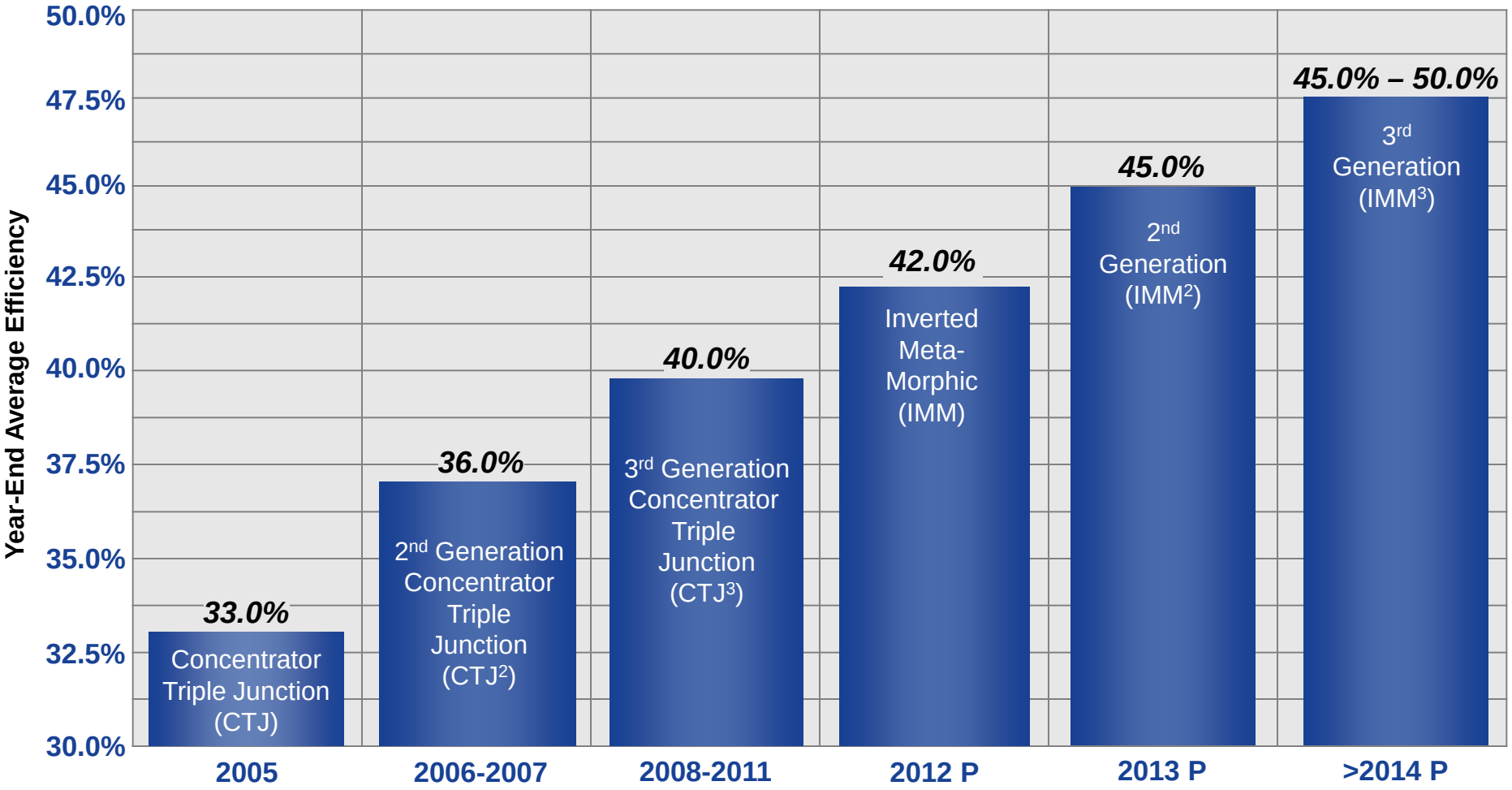
Gen-III CPV Module – 460W

Gen-III CPV System – 16.2 kW Ground Mount System w/ 36 Gen III modules

Rooftop CPV System – 350W panels for non-penetrating roof installs

CPV Solar Cell Efficiency Roadmap

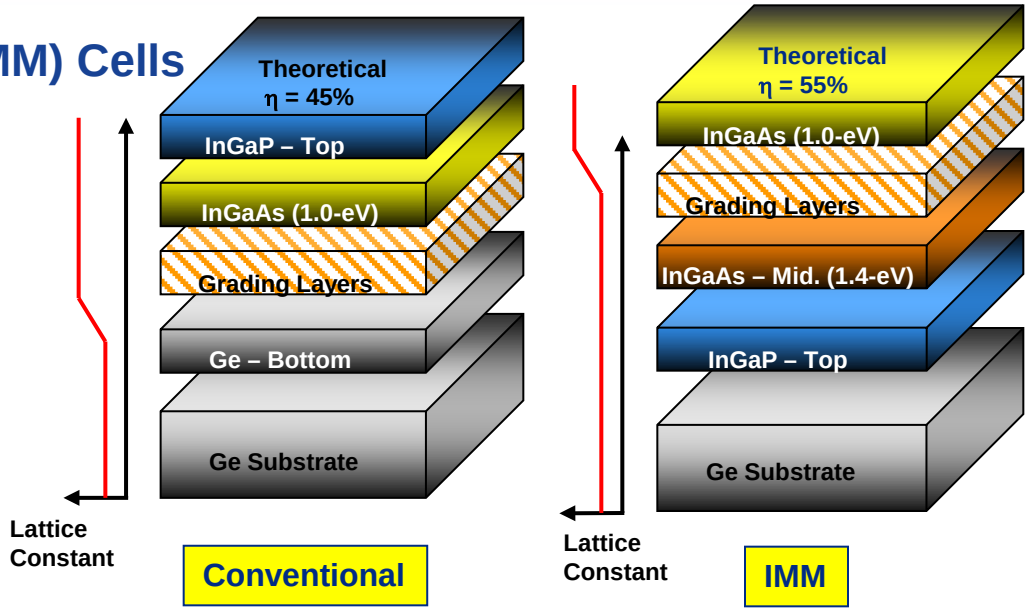
- **Solar cell efficiency improvements reduce CPV systems costs**
  - Increased Watts/cell reduces the $/Watt of the entire system proportionally
  - Increased power/energy density reduces land and BOS costs

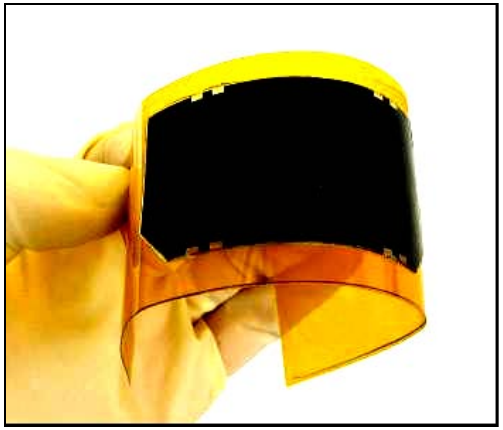


Technology Roadmap - IMM for CPV

Inverted Metamorphic Multi-junction (IMM) Cells

- Innovative manufacturing process to drastically increase cell efficiency – 50% efficiency possible
- Semiconductor grown "upside down" on germanium (Ge) substrate
- Allows higher quality development of most important semiconductor layer – blue/green radiation absorber
- Once formed, cell is removed from Ge substrate and encapsulated





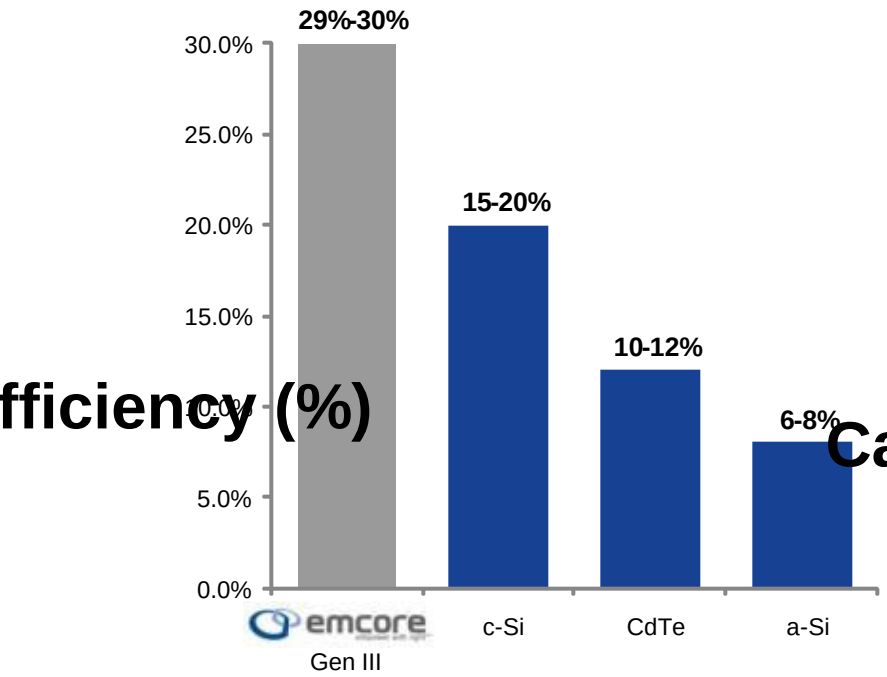
Flexible IMM Cell

Winner of the 2008 "R&D TOP 100" Award

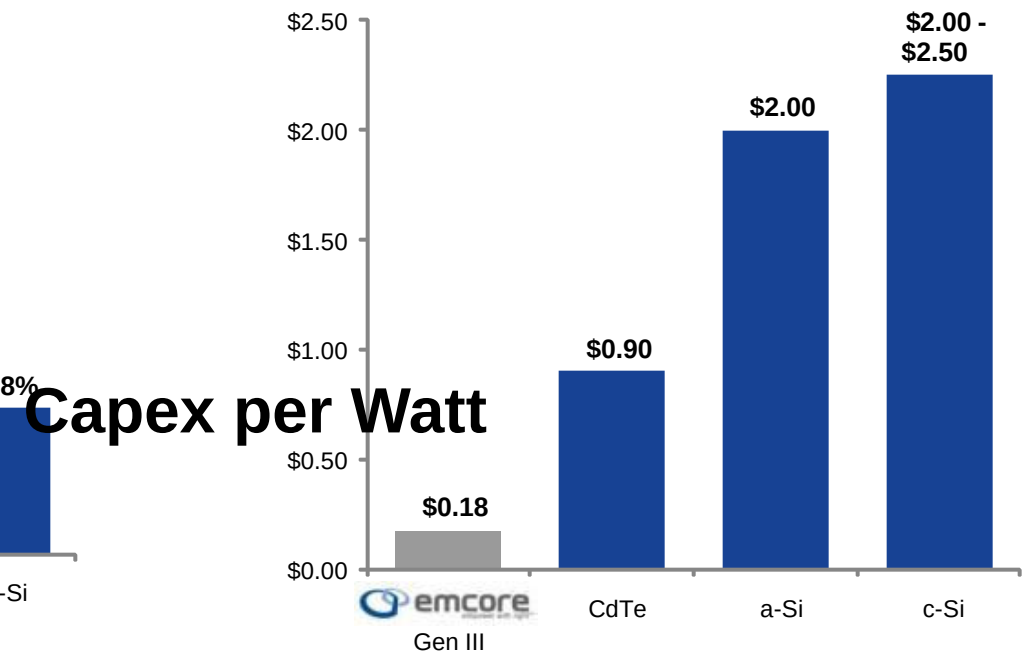
Key Advantages of CPV Technology

- **EMCORE Solar's leading efficiencies increase energy density, which lowers per watt land acquisition and preparation costs and can limit BOS costs**
- **EMCORE Solar's capex expansion costs are a fraction of competitive technologies**

Module Efficiency



Capex per Watt



Source: Wall street research, company filings, EMCORE Solar management estimates

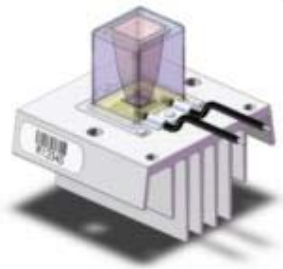
Typical Gen III Installation

- **Recent Commercial Installation of Gen III Completed in December 2010**
  - Air Force Research Lab (Maui, HI)
  - Schafer was the prime contractor
  - Total of 98kW installed
  - Installation grid connected

Acquired Soliant Assets for Rooftop Applications

- **Product design specific to commercial rooftops:**
  - Light weight & non-penetrating
  - Highly accurate closed-loop dual-axis tracker
  - Low profile & wind-tolerant
  - Low cost

High efficiency III-V cells: 38% => 42%

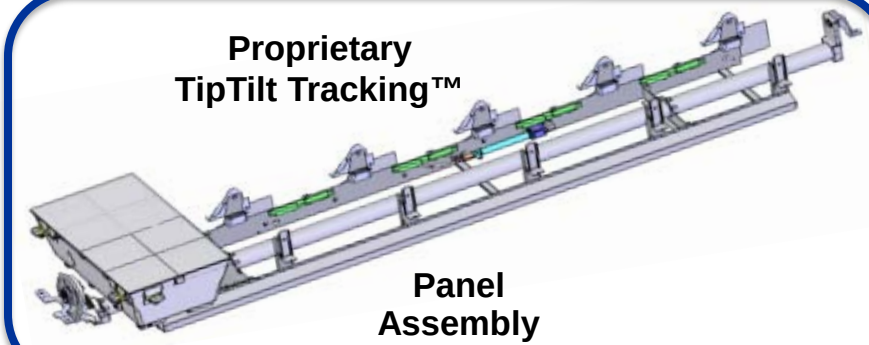


Receiver Assembly

Module Assembly

High optical concentration:

1000X concentration



Proprietary TipTilt Tracking™

Panel Assembly

Caltech Pilot Installation

Alverca, Portugal Rooftop Installation

CPV Joint Venture – Suncore

- **CPV Joint Venture Supported by Chinese Government Grants**
  - $75M cash grant for CapEx for CPV manufacturing lines
  - 263 acre land grant – valued at ~$40M
  - Sales rebate for products produced: ~15%
  - Other incentives and subsidies will further improve our cost position
- **Business scope**
  - Manufacture EMCORE-designed CPV components and systems in high-volume to supply EMCORE and its own business needs
  - Develop solar power business in China.
- **Ownership and management**
  - EMCORE owns 40% and San'an Optoelectronics Co, Ltd owns 60%
  - Initial registered capital: $30M
  - EMCORE's EVP, Charlie Wang, serves as General Manager of Suncore
  - EMCORE has completed the $12M (40% of registered capital) contribution to the JV, and we do not expect further capital contribution

EMCORE Solar Business Summary

- Significant global large-scale and utility-scale solar markets – 120 GW by 2020
- Commercial rooftop segment represents a $6B market over the next 3 years
- Only company fully-integrated from cells to systems
- Significant solar IP position with substantial barriers-to-entry
- Proprietary, ultra-high efficiency concentrator cells (40% avg. efficiency cells in production, 42%+ avg. efficiency cells to be introduced in 2012)
- Leader in space solar cells and panels (1 of only 2 viable providers)
- Joint-venture in China for low-cost manufacturing of CPV components and systems
- Scalable business model
  - Manufacturing CapEx costs significantly less than competing PV technologies

emcore

EMCORE Solar Power

Ardour Capital Energy Tech Conference

November 21, 2011

Christopher Larocca

Chief Operating Officer

Mark Weinswig

Chief Financial Officer