Modular and Scalable Concentrating Solar Thermal Power (CSP)

Clyde Mallinson
eSolar Corporate Overview

- Founded in 2007, 135 employees currently
- $170 Million in capital raised to date
- Offices in Pasadena and Palmdale, California
- 3.5 GW of announced commercial partnerships and nearly 10 GW project pipeline around the world
- 5 MW Sierra SunTower commercial facility is producing clean, renewable energy to the grid – the only operating solar power tower plant in the United States
Main Concentrating Solar Power Technologies

Trough
- Most mature technology (over 350 MW installed)
- Single-axis tracking
- Synthetic oil
- Costly heat exchangers
- Low concentration
- Low maximum temp.

Linear Fresnel Reflectors
- Tubes fixed in place
- Use synthetic oil or direct steam
- Low concentration
- Low maximum temp.
- No large scale demonstration to date

Tower
- Dual-axis tracking
- High concentration
- High maximum temp.
- Demonstrated in Solar One, PS-10, and PS-20
- Current commercial facilities globally: Abengoa and eSolar

Source: eSolar analysis; Concentrating Solar Power Reports
Note: Tower photograph of current eSolar commercial demonstration plant
Solar Thermal Power Tower technology has the potential to achieve the lowest cost solar solution.
The eSolar Approach: Innovative Modular and Scalable CSP

- 2010 World Economic Forum Technology Pioneer Award
- 2009 Power Gen Renewable Energy Project of the Year Award
Curved trough mirrors and large heliostats need heavy support structures and manual labor for expensive on-site installation.

Trough mirror assembly on site with large steel support structures.

Other power tower heliostats requires a 3’ diameter steel post set 20 feet into the ground.

The actuator is large and heavily engineered.
The small pre-fabricated eSolar heliostats are low to the ground, and secured to cement pedestals with no ground penetration.

Small and flat mirrors – the size of a 46” (1.2m) TV – sit less than 2.5ft (75cm) above ground.

Using less steel with individual small motor and chipset to control each mirror automatically.

eSolar’s actuator is the size of a shoe box.
eSolar’s core innovations: small mirrors with a proprietary calibration and tracking system that enable rapid deployment

Pre-fabricated mirrors and frames arrive in standard shipping containers on site

Simple, linear design and field layout reduce high ground preparation costs

Mirror field is installed with basic hand tools and operated via fully automated system

Standard 150ft (50m) wind towers are repurposed to host receivers, expediting permitting process
Cost Reduction and Local Manufacturing Opportunities

- Small, flat heliostats require less steel, and can be manufactured locally
- Low profile installation reduces construction equipment and labor cost
- Pre-fabricated components requiring less skilled labor for assembly on site

Mirror field is installed using hand tools

- Lowest capital cost of any CSP plant
- Low O&M costs
Close-up view of the mirror field
The eSolar Calibration and Tracking System

- System of cameras
- Completely automated
- Highly parallelized
- Full calibration in <20 days
- The only fully automated calibration and tracking system
Heliostats Before and After Calibration
The Result: Pointing Accuracy
Performance

• Flux distribution measured with scanner, agrees with simulation
• Beam characterization system used to assess pointing error: 1.4 mrad
• Steam temperature, pressure, and flow rate perform to expectations
Reliability

• > 50 million heliostat operating hours
• Availability > 99.9%
eSolar is operating a 5 MW commercial facility in California; executing on a 3.5 GW of contracted projects; and developing 9 GW of proposals globally

- Small mirrors, pre-fabricated equipment, 16 towers in 46 MW
- Modular, rectangular fields, standard 46 MW and scalable to any size
- Fully automated calibration and tracking system
eSolar partners with leading companies around the world to enable complete project capabilities
Working with eSolar to deploy Solar Thermal Projects

- eSolar is seeking partners to build solar thermal power plants worldwide
  - EPC partners
  - IPPs or project developers
  - Government partners

- Customer licenses the eSolar technology, and receives:
  - Fluor preliminary 46MW power plant design
  - Site specific solar field design support
  - Heliostat field equipment (via eSolar & contract manufacturers)
  - Software license and technical know-how
  - Field installation quality control supervision
  - Heliostat field commissioning services
  - Software deployment and power plant commissioning services
eSolar Pipeline of Projects Worldwide

- 2 GW solar integrated with biomass signed in China
  - Construction of first 92 MW to start in 2010

- 1 GW signed in India
  - Construction of first plant began in 2009
  - Breaking ground of additional 46 MW in 2010

- 500 MW signed in the US
  - Construction of first 92 MW in 2010

- Projects in discussion across Europe, MENA, and APAC
eSolar’s unique value proposition provides a competitive advantage to developers

- Unique modular and scalable design
- Can be economical at < 50 MW
- Easy to deploy with < 18 months of construction
- Can be sited closer to load centers, reducing impact on grid
- Requires small land sites of 200 acres for 46 MW
- Commercially proven technology with operating power plant
- Boosts regional economies by scaling up solar generation through local manufacturing and labour resources
Thank you