Utility Scale Solar: Reducing Risk for Utilities

October 2009
Presentation Outline

- Corporate Overview
- Energy Challenge
- CSP Overview
- Technology (R&D)
- Development
- Environment
BrightSource Energy Snapshot

**Mission:** To design, build, own and operate the world’s most cost-effective and reliable large scale solar energy projects

- **Business:**
  - Develop and build large-scale solar power generation plants for utilities at prices that compete with fossil-fuel plants, using proprietary LPT technology
  - Develop and build solar-to-steam plants for industrial applications

- **Locations:**
  - Headquarters in Oakland, California, 52 full-time employees
  - Wholly-owned subsidiary BrightSource Industries Israel (BSII) located in Jerusalem, 112 full-time employees
  - Development offices in Phoenix, AZ and Las Vegas, NV
BrightSource Energy Highlights

- Proven technology
- Experienced management team
- Favorable market and regulatory environment
- 2.6 GWs of signed PPAs with PG&E and SCE
- Bechtel as EPC, with a project investment agreement
- Chevron solar-to-steam project under construction
- 4 GWs of active site development with a 19 GW portfolio
- $160 million from blue chip investor base
Renewable Power Market Overview
Renewable Energy Market Drivers

- **Rising long-term global energy consumption with a focus on renewable energy**
  - Solar energy is the largest renewable resource worldwide
  - Global electrical energy demand is projected to increase by 50% from 2005 to 2030\(^1\) – more if plug-in electrical cars replace gasoline-powered cars
  - Australia, India and the Middle East offer meaningful opportunities in terms of solar radiation, energy demand and transmission availability close to demand centers

- **Climate Change**
  - Significant RPS requirements
  - In order to reduce \(\text{CO}_2\) to 450ppm, the following will be required\(^2\):
    - Build 13,000 GW of carbon-free energy
    - $105+ trillion dollars of investment in \(\text{CO}_2\)-free generation

- **Energy Independence**
  - Supportive regulatory environment
    - 30% Federal Investment Tax Credit
    - ITC grant eligibility for qualifying projects
    - Expedited Department of Energy loan guarantee program
    - Renewable energy incentives as part of U.S. economic stimulus plan

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\(^1\) International Energy Outlook 2008 by Energy Information Administration  
\(^2\) World Economic Forum
Integrated Renewables Strategy to Meet U.S. Demand
World Total Installed Generating Capacity - 2030

- U.S.: 1,213 GW
- OECD Europe: 1,054 GW
- China: 1,618 GW
- India: 398 GW
- Israel/Middle East: 216 GW
- Latin America: 522 GW
- Aus/NZ: 83 GW

Concentrated Solar Power
Advantages & Technology Overview
Concentrated Solar Power Advantages: Risk Reducers

- Provides a “peak coincident”, time of use premium
- Can provide firm dispatchable output, avoiding volatility associated with other intermittent resources
  - Suitable for hybridization when combined with natural gas
  - Storage capable (thermal, compressed air)
- Uses less land than other large-scale renewable resources
- Utilities are familiar with power generation from steam technologies
- Stable, known, and decreasing costs
- Provides hedge against natural gas price volatility and carbon pricing
Concentrated Solar Power Technologies

Solar Parabolic Trough

Stirling Solar Dish

Luz Power Tower (LPT)

Tubes w/ synthetic oil

Stirling engine

Tower and Boiler

7m² heliostats

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20 Yrs Ago Luz Int’l Revolutionized the Power World…

354MW Solar Thermal Plants Built in ‘80s and ‘90s
BrightSource Energy

BrightSource Technology
A Solar Power Evolution
BrightSource’s LPT Power Tower Technology

Solar Boiler
Super-heated 550° C Steam
Power Block (Aircooled)

Solar Field
Tower
BrightSource Solution – LPT 550

- Proven Technology
- Direct Solar-to-Steam
- Higher Temp. – 550°C
- Low Parasitic Load
- Higher Operating Efficiency
- Lower Capital Cost
- Uses Commodity Materials:
  - Flat Glass
  - Minimum Concrete
  - Minimum Steel
- Air Cooled Power Block
Luz Power Tower (LPT 550)
BrightSource Development
Environment, Water Use, Siting & Permitting
BrightSource’s Environmental Commitment

- **Site Selection:**
  - Areas that have already been disturbed, and that are not critical environmental habitat
  - Close to existing roads, gas and transmission

- **Plant Design:**
  - Use of dry cooling uses 90% less water
  - Mirrors on poles eliminates concrete pads and reduces grading

- **Air Quality**
  - 100 MW plant production avoids 103,000 tons of CO2 annually
  - Significant avoidance of NOX, SOX, CO, and VOC

- **Regulatory Compliance:**
  - Work closely with all federal / state environmental agencies to ensure strict compliance with all applicable laws and regulations.
Water: Wet Cooling vs. Dry Cooling

**Wet Cooling:**
- Up to 90% more water use
- Highly mineralized water

**Dry Cooling:**
- Up to 90% reductions in water use
- Equipment cost and Efficiency trade-off
Wet CSP/Conventional Cooling vs. Dry CSP Cooling

*Source: California Energy Commission

Siting Criteria

- **Siting Key Criteria:**
  - Focus on “previously disturbed” areas
  - Large, contiguous tracts that allow for future expansion
  - Close to existing infrastructure (roads, transmission and natural gas lines) to minimize off-site infrastructure impacts
  - Rural, away from major population areas
  - Existing water rights/access not a major concern
  - Flexibility regarding site agreements, purchase or lease (>30 yrs)
  - Permitting timeline (ability to qualify for state/federal incentives)
  - Diversified portfolio regarding ownership (private, state, federal)

- **Siting Key Concerns:**
  - Critical environmental habitat for protected species
  - Military / FAA flight restrictions (tower height)
  - Floodplain issues (insurability)
Permitting

- **Comprehensive Permitting Plan**
  - Depends on ownership type, incentive qualification, local and state requirements
  - Outsource to competent, proven entities with track-record of successful power-plant permitting in the region
  - Focus first on “fatal flaw” review
  - Phase 1 environmental review
  - Implement full permitting plan
    - 18 to 30 months
BrightSource Energy

BrightSource Development
Current Projects
Project Scale-Up

- **Solar Energy Development Center**
  - 2Q/2008
  - 6 MWth

- **Solar Thermal Chevron EOR Demo Plant**
  - 4Q/2010
  - 29 MWth

- **Ivanpah Solar Power Complex**
  - 1Q/2012
  - 400 MWe
# Projects: Solar Energy Development Center

## Key Design Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Details</th>
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<tbody>
<tr>
<td>6MWth production capacity</td>
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<tr>
<td>60 meter receiver tower</td>
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<tr>
<td>1,640 heliostats</td>
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<tr>
<td>12,000 meters of reflecting area</td>
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<td>Commissioned: June 2008</td>
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## Key Demonstration Accomplishments

- World’s highest temperature and pressure solar thermal steam production known to be achieved
- Independent verification by RW Beck
- 13 months of operations
- Optimization of mirror synchronization
Projects: Chevron Solar Thermal Plant

- 29 MWth
- Construction started June 2009
- 3,750 Heliostats - 14 m² each
- Lower temperature and pressure
- Closed loop boiler water feed
- Heat exchanger for injection water
- Worldwide potential, thousands of MWth
## Projects: Ivanpah Solar Energy Generating System

<table>
<thead>
<tr>
<th>Ivanpah Facts</th>
<th>World-class Partners</th>
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<tbody>
<tr>
<td>Three plants – 2x110 MW, 1x220 MW</td>
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<tr>
<td>Contracts with PG&amp;E and SCE</td>
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<td>Negotiating final terms for US DOE Loan Guarantee</td>
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<td>Bechtel Selected as EPC contractor; equity owner in all three projects</td>
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<td>123MW Siemens turbine purchased</td>
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<td>CEC and BLM permitting scheduled approval for early 2010</td>
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<td>1st Plant COD scheduled for late 2011</td>
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<td>Accessible Transmission</td>
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Ivanpah Economic and Environmental Benefits

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<th>Economic Benefits</th>
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<tr>
<td>CO₂ Emissions avoided: 25 million tons*</td>
<td>Total Economic Benefits: $3 billion</td>
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<td>Water use: 100 acre feet – 30x less than competing technologies</td>
<td>1,000 construction jobs at peak</td>
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<tr>
<td>CO₂ Avoidance: 450,000 tons annually</td>
<td>86 permanent jobs</td>
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<td>Air Pollutants Reductions: 85% of natural-gas fired plants</td>
<td>Total employee earnings: $800 million*</td>
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<td>*40 year plant life-cycle</td>
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BrightSource’s Announced Development Site Map

- BrightSource site (private lands)
- BrightSource site (BLM lands)
- BrightSource site (State lands)

1 - Ivanpah, CA
2 - Mormon Mesa, NV
3 - APEX, NV
4 - Coyote Springs, NV
5 - Quartzsite, AZ
6 - Huron, AZ
7 - Dateland, AZ
8 - Deming, NM
9 - Lordsburg, NM