



Strategies, Projects and Developments for Solar Technologies

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Burns & McDonnell Overview

- Founded in 1898
- 3,600+ Employee/Owners
- 2012 Revenue of \$1.4 Billion
- >\$1 Billion in Bonding Capacity
- EPC Capabilities
- 11 Diverse Global Practices
- 11 Regional Offices



#1 in Electrical Transmission & Distribution
#6 in Power



Ranked 18th
*100 Best Companies
to Work For*

Solar Project Experience

- Bank's Engineer
- Owner's Engineer
- Detailed Design
- Studies



**MidAmerican Energy
Antelope Valley Solar**
Owner's Engineer
580 MW Solar PV



**Sempra Energy
Copper Mountain I**
Owner's Engineer
58 MW Solar PV



**Sempra Energy
Copper Mountain II**
Owner's Engineer
150 MW Solar PV

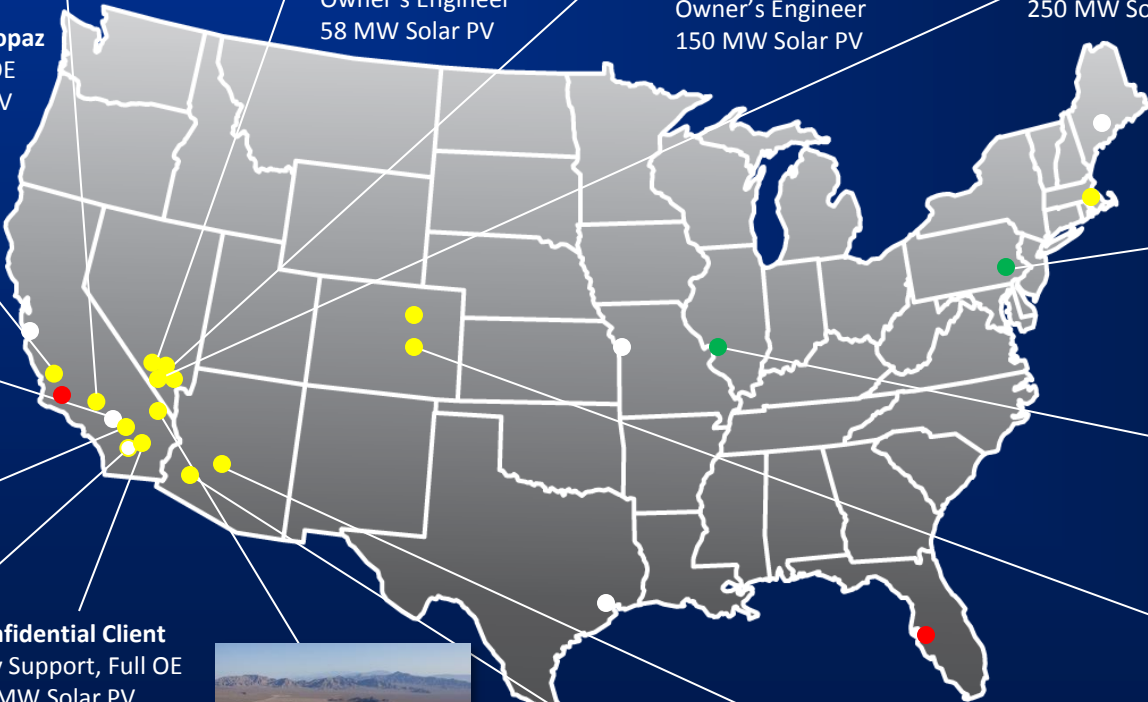
**Sempra Energy
Copper Mountain III**
Owner's Engineer
250 MW Solar PV



MidAmerican Topaz
Due Diligence, OE
550 MW Solar PV



MMR
Project Development
50 MW Solar Thermal



Confidential Client
Technology Assessment/
Performance Modeling
10 MW Solar PV

Ameren
Detailed Design
500 kW Solar PV Demonstration

Colorado Springs Utilities
Owner's Engineering
5 MW Solar PV

MMR
Conceptual Design
150 MW Solar PV

Confidential Client
Dev Support, Full OE
20 MW Solar PV



NRG Borrego 1
Detailed Design / OE
26 MW Solar PV



NRG Ivanpah
Const Manager/OE
392MW Solar Tower

NRG Aqua Caliente
Fatal Flaw Analysis
290 MW Solar PV



Mesquite Solar
Dev Support, Full OE
170 MW Solar PV

Solar Technologies

- Photovoltaic (PV)
 - The direct conversion of light to electricity
- Solar Thermal
 - The collection and use of the heat energy from the sun
 - Usually to boil water to make steam and power a turbine/generator

Photovoltaic

- Majority of all solar power systems installed in the last 5 years were PV
- Currently at its lowest cost ever
 - About \$2.40/Wac for utility scale systems
 - Evidence that costs are rising again
- Pros:
 - Cost
 - Modular
 - Relatively easy to site
- Cons:
 - No storage



Solar Thermal

- Beginning to see thermal projects emerge
- Parabolic trough
 - Nevada Solar-One (2007)
 - 280 MW Solana
- Power Tower
 - 390 MW Ivanpah
 - 110 MW Crescent Dunes
 - 150 MW Rice



Solar Thermal

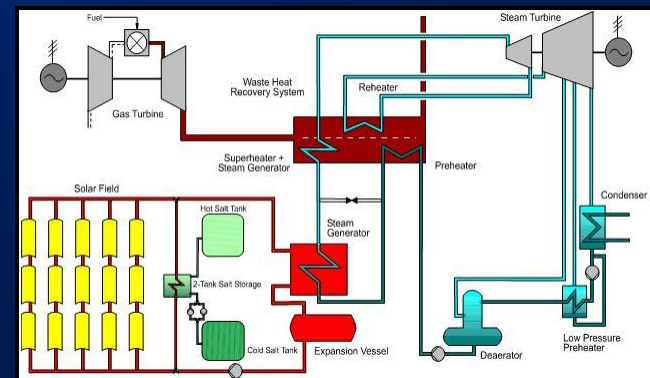
- Pros:
 - Potential for energy storage
 - Potential to integrate with fossil plants
- Cons:
 - Cost (almost 2 x PV)
 - Land area (almost 2 x PV)
 - Direct Normal Solar Insolation
 - Water for mirror cleaning and power block cooling

How do we do More?

- PV
 - Conversion efficiency
 - Currently about 14% at the system level
 - Tracking
 - Single-axis tracking can generate 20% more energy
 - Pre-assembly
- Solar Thermal
 - Increase efficiency (solar field temperature)
 - Reduce costs
 - Re-power retired fossil units
 - Hybridize

Hybrids

- Provides supplemental heat to an existing fossil power plant
 - Offsets fossil fuel consumption
 - Could be relatively “cheap” solar MWh (Power block already capitalized)
- Design for new rather than retrofit old
 - Combined Cycle
 - Turbine headroom
 - Coal plant boiler sweet spot
 - LOI, Opacity, Emissions



- Don't have to generate electricity - replace electricity
- Air conditioning load in the southwest is the largest customer and utility load
- Solar HVAC
 - Absorption chillers
 - Cochise College - 60 ton with parabolic trough solar field
 - Desert Outdoor Center - 20 ton with flat plate solar collectors



Policy Changes

- Permitting
 - SFOZ
 - Gila Bend
 - Permitting phase reduced from years to months
- DOE Loan guarantees
 - Solyndra and Evergreen were manufacturers NOT project developers
 - More independent oversight
- More transparency
 - What's working – what isn't





Thank You

