Energy Prices in California

Natural Gas CA Citygate, $/MCF
Energy Prices in California

Natural Gas CA Citygate, $/MWh heat
Energy Prices in California

Competitive price for solar **electricity**

Competitive price for solar **heat**
Energy Mandates in California

Mandatory Renewable Purchase Fraction

Mandated purchase % for solar electricity

Mandated purchase % for solar heat

0% 10% 20% 30% 40% 50% 60%
Starting the Virtuous Cycle

• VOLUME VOLUME VOLUME
  • Solar thermal technologies will come down in cost with volume
  • Learning curve similar to PV but deployment volumes to date are tiny

• No mandates: it must be cheaper from the beginning (very hard)
• Competitive energy cost is much lower (very hard)
• Solar heat projects must be co-located with end user (hard)
• Land costs and permitting costs are much higher at industrial sites
• Solar heat projects serve only one plant, maybe <20y plant life
A New Type Of Solar Energy
A New Type of Solar Energy
Mirrors <1.5 kg/m$^2$

1/6 the weight of reinforced glass mirror
>6,000,000 Worker Hours LTI Free
Meet Miraah
Thermal Enhanced Oil Recovery (EOR)

Heat lowers heavy oil viscosity and allows pumping to surface
Solar Energy Replaces Combustion of Natural Gas

- SOLAR FIELD
- WATER SUPPLY
- Feed Water
- OTSG
- Steam
- INJECTOR WELLS
- Wellhead Chokes
## GlassPoint

10 year old company started in California
Operations in California, Oman, China, and Chile
Initial 100% focus on EOR to drive volume
Now serving broader range of industrial markets

<table>
<thead>
<tr>
<th>Name</th>
<th>Customer</th>
<th>Location</th>
<th>Size (MW)</th>
<th>Status</th>
<th>Operation Date</th>
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<tr>
<td>21Z Pilot</td>
<td>Berry</td>
<td>California USA</td>
<td>0.3</td>
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<td>PDO</td>
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<td>PDO</td>
<td>South Oman</td>
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<td>300 MW online</td>
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<td>Aera (Shell/Exxon)</td>
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<td>Contract Signed</td>
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<td>2022</td>
</tr>
</tbody>
</table>
Energy Prices in California

Competitive price for solar **electricity**

Competitive price for solar **heat**
Energy Policy in California

California 2014 Emissions By Sector

- Transportation, 37%
- Industrial, 24%
- Electricity, 20%
- Agriculture, 8%
- Residential, 6%
- Commercial, 5%

Transportation & fuels >50%
Energy Policy in California

California 2014 Emissions By Sector

- Commercial, 5%
- Residential, 6%
- Agriculture, 8%
- Electricity, 20%
- Industrial, 24%
- Transportation, 37%

LCFS >50% transportation reductions

2030 Scoping Plan

- All Transportation (53) 31%
- Other Transportation (28) 16%
- Cap and Trade (40) 23%
- Electricity (52) 30%
- Industrial (16) 9%

Low Carbon Fuel Standard (25) 15%
Solar Heat: Credits per ton avoided CO2

DEFICITS
CREDITS

Refinery Improvements
- renewable H2
- refinery investment

Conventional Fuels
- gasoline
- diesel

Biofuel Blending
- ethanol
- biodiesel
- renewable diesel

Vehicle Replacement
- light duty
- heavy duty
- electricity
- hydrogen
- natural gas

Non-Road Electrification
- Off-road

Solar Steam
Solar PV
Innovative Crude

extraction
refining
Multi-Million Ton CARB Forecast
$190/t, $13/MMBTU, $55/MWh

![LCFS ARB Average Closing Price Chart](chart.png)
Challenges / Opportunities

• Unlike cap & trade, no “floor”, but hard “cap”

• Repeated regulation changes create concern re future changes

• Solar heat is all capex, very low opex
  • 20-year credit price and program stability are critical to investment

• No measures have been put in place to address these risks
  • Dairy digester projects have “contract for difference” in development
  • “Green bank” and other underwriting programs have been proposed
Fully Automatic Washing With Water Recovery