Hybrid Solar System
ARPA-E FOCUS PROJECT | DE-AR0000464

TECHNOLOGY

- Transforms concentrating solar power parabolic trough into spectrum splitting receiver
- Integrates high temperature thermal transfer and storage
- Generates variable electricity and up to 600°C dispatchable heat

<table>
<thead>
<tr>
<th>Metric</th>
<th>State-of-the-Art</th>
<th>Estimated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity Cost</td>
<td>&gt;&gt;$1/W_e</td>
<td>$2-3/W_e</td>
</tr>
<tr>
<td>Collector Cost</td>
<td>-</td>
<td>$0.4-0.7/W_e</td>
</tr>
<tr>
<td>Energy Efficiency</td>
<td>38%</td>
<td>42-45%</td>
</tr>
<tr>
<td>Cogenerated Heat</td>
<td>&lt;200°C</td>
<td>≥600°C</td>
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</tbody>
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ADVANTAGE

Hybrid Solar Collector
- Significantly upgrade the value of parabolic troughs
- Non-imaging optics
- Novel thin film GaInP or GaInP/GaAs cells
- Straightforward and low cost retrofit procedure

Thermal Storage
- Inert particles as combined heat transfer and storage media
- Low cost (16 $/kWhth)
- Potential to achieve T>1000°C

Power Block
- Air turbine cycle
- Thermal efficiency 32%
- Capital cost <$1M for 1MWe power plant

TEAM

Thermal Storage Design
- Heat transfer/transport
- Particle laden gas
- Store and recover heat at >600°C

Hybrid Solar Collector Design
- Non-imaging optics
- Deliver electricity from PV cells
- Deliver thermal energy at 600°C

High Temperature PV Cell
- Spectral splitter concentrator
- Selective thermal receiver (200°C)
- Electric receiver (GaInP or GaInP/GaAs Cell)

Integrated Spectrum-Splitting Solar Collector
- Dual Junction GaInP/GaAs as secondary reflector provides ~1.13X additional concentration on absorber
- ~60X concentration of photons below GaAs bandgap (compare 22X for today’s trough)
- Light from primary parabolic reflector to secondary at ~52X

Continuous Electric Power

<table>
<thead>
<tr>
<th>SOLAR FIELD</th>
<th>THERMAL STORAGE</th>
<th>POWER BLOCK (Air Turbine Cycle)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1MW_e</td>
<td>1MW_e</td>
<td></td>
</tr>
<tr>
<td>(Day/Sun)</td>
<td>(Night/No Sun)</td>
<td></td>
</tr>
</tbody>
</table>

CONTACT: David Cygan, GTI R&D Manager (david.cygan@gastechnology.org, 847-768-0524)