Parametric Study of Solar Thermal Power Plant Configuration Utilizing System Advisor Model (SAM)

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Bio

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Presentation plan

• Introduction
• Objective
• Procedure
• Results
  – ORC
  – Steam cycle
• ORC VS Steam cycle
• Conclusion
Introduction

• Solar trough system
• Levelized cost of energy (LCOE)

\[ LCOE = \frac{\sum_{i=1}^{n} \frac{\text{cost}_\text{year}_i}{(1+d)^t}}{\sum_{i=1}^{n} \frac{\text{energy}_\text{produced}_\text{year}_i}{(1+d)^t}} \]
Objective

- Minimize LCOE
- Project feasibility
- ORC VS Steam cycle
Procedure

- Scenarios (location+plant type)
- Parameterized study
- Visualization of data (Matlab)

<table>
<thead>
<tr>
<th>ORC</th>
<th>California</th>
<th>Arizona</th>
<th>Louisiana</th>
</tr>
</thead>
<tbody>
<tr>
<td>Empirical</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Steam cycle</td>
<td>Empirical/physical</td>
<td>Empirical/physical</td>
<td>Empirical/physical</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Plant size (MW)</th>
<th>Solar multiple</th>
<th>Hours of storage (h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organic Rankine cycle</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Range</td>
<td>0.02 to 20.02</td>
<td>1 to 5</td>
</tr>
<tr>
<td>increment</td>
<td>0.5</td>
<td>0.2</td>
</tr>
</tbody>
</table>

| Steam Cycle    |
| Range          | 10 to 200      | 1 to 2              | 0 to 10            |
| Increment      | 30             | 0.2                 | 1.5                |
ORC Results

Hours of storage (h)

Louisiana  California  Arizona

Plant location
Steam cycle Results

Hours of storage (h)

Louisiana    California    Arizona

Plant location
ORC VS Steam cycle

- Effect of location
- Why consider ORC
- Project feasibility in Louisiana

![Minimum LCOE chart]

<table>
<thead>
<tr>
<th>Plant Location</th>
<th>ORC (c/kWh)</th>
<th>Steam cycle (c/kWh)</th>
<th>LCOE difference (c/kWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arizona</td>
<td>14.34</td>
<td>9.49</td>
<td>4.85</td>
</tr>
<tr>
<td>California</td>
<td>18.77</td>
<td>11.27</td>
<td>7.62</td>
</tr>
<tr>
<td>Louisiana</td>
<td>15.4</td>
<td>3.37</td>
<td>12.04</td>
</tr>
</tbody>
</table>
Conclusion

• Importance of plant design
• Solar energy in Louisiana
• Future physical ORC model (SAM)
Acknowledgement

- Dr. Terrence Chambers
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Questions