Understanding Early Retirement of CHP Systems: Going Beyond First Year Evaluations

William Marin

2015 IEPEC Conference — Long Beach, California
What is Combined Heat and Power

BASELINE

Energy Services

Electrical Load

Power Grid

Electric Chiller

Cooling Load

Gas Boiler

Heat Exchanger

Heating Load
What is **Combined Heat and Power**

**Photo Credits:** Caterpillar, General Electric Power Generation, ClearEdge Power
Why use CHP

- Increased efficiency / environmental benefits / savings
- Reliability / resilience
- Deferral of distribution system upgrades
California’s **Self Generation Incentive Program**

- Originally created in 2001
- 552 projects* / 260 MW capacity
- Behind the meter, < 10 MW

* As of 12/31/2014, non-renewable projects only
SGIP Evaluation History

- Twelve annual impact evaluation reports
- Four process evaluation reports
- Numerous other technical reports
  - Cost effectiveness
  - Market transformation
  - DG optimization

http://www.cpuc.ca.gov/PUC/energy/DistGen/sgip/sgireports.htm
Technologies in the SGIP

- Advanced Energy Storage
- Fuel Cell (CHP and Electric-Only)
- Gas Turbine
- Internal Combustion (IC) Engine
- Microturbine
- Pressure Reduction Turbine
- Wind Turbine
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Impact Evaluation: Focus on Utilization

- How much are SGIP CHP systems being utilized?

- Metered Data
- Operation Status Surveys

Utilization
Metered Data: Annual Capacity Factor

<table>
<thead>
<tr>
<th>System Type</th>
<th>Number of Systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuel Cell – CHP</td>
<td>88</td>
</tr>
<tr>
<td>Fuel Cell – Electric Only (Elec.)</td>
<td>83</td>
</tr>
<tr>
<td>Gas Turbine</td>
<td>9</td>
</tr>
<tr>
<td>IC Engine</td>
<td>187</td>
</tr>
<tr>
<td>Microturbine</td>
<td>109</td>
</tr>
</tbody>
</table>

\[
CF = \frac{\sum_{h=0}^{8,760} NGO_h (kWh)}{System Size (kW) \cdot 8,760 \text{ hrs}}
\]

Where \( NGO_h \) is the hourly electrical generation of a CHP system.
Operation Status Surveys

- Intended to *supplement* metered data with binary (yes/no) operational information
- Not a representative process evaluation sample
- Captures *anecdotal* information about CHP system operation
Annual (2013) Capacity Factor

Impacts from all non-renewable projects during calendar year 2013
Portion of Capacity Online

![Graph showing the portion of capacity online over time for different types of equipment (FC - CHP, FC - Elec., GT, ICE, MT). The graph plots the percentage of capacity online against age (in years) from 1 to 11.]
Operational Status Surveys

Responses from offline systems
Capacity Factor of Online Projects

![Graph showing capacity factor over age for different projects: FC - CHP, FC - Elec., GT, ICE, MT.](Image)
Discussion

- Emerging technologies, emerging markets
  - Your mileage may vary

- Periodic overhauls
  - Not a typical efficiency measure
  - Cannot “set it and forget it”
Conclusions

- SGIP CHP system retirement rates are much less than typical economic lifetimes

- CHP system retirements have a direct impact on program evaluation
Recommendations

- Evaluate CHP programs yearly and calculate savings each year

- Process evaluations provide significant value

- Eligibility criteria and incentive payment mechanisms should encourage long-term operation
Thank You

William Marin
(530) 632-2103
William.Marin@itron.com