Customer-Sited Storage and GHG Emissions Case Study

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The Enel Group Worldwide
The world’s largest utility, changing the way the world uses energy

Publicly Committed to UN Sustainable Development Goals

$84 B
Annual Revenue

65,000
Employees

31
Countries

42 GW
Renewable Capacity

50+ Yrs
Experience

No. 20
Fortune’s Change the World List
Enel X focuses on delivering energy management solutions to C&I customers

Enel X Products & Services

Modeling Input Values

• Load Profile: EnerNOC San Francisco Office (from EnerNOC Open Data 2012)

• Rate: PG&E Proposed B-19S (from 2019-09-10 Advice Letter)

• Storage-Only: 750 kW x 1500 kWh

• GHG Data: 2017 CAISO NP15 (SGIP Implied-Heat-Rate Methodology)

• Energy Storage Dispatch Model: Open-Source Energy Storage Model from SGIP GHG Working Group
GHG Emissions Rates

Marginal Emissions Rates

GHG Emissions Rates – Sample Days

Marginal Emissions Rates

Marginal Emissions Rates
PG&E B-19S – Energy Charges

Total Energy Charges and Marginal Emissions Rates

- Marginal Carbon Emissions Rate (kg/kWh)
- Total Energy Charges ($/kWh)

Mar 31, 06:00
Mar 31, 12:00
Mar 31, 18:00
Apr 01, 00:00
Date & Time
2017

Sep 14, 06:00
Sep 14, 12:00
Sep 14, 18:00
Sep 15, 00:00
Date & Time
2017

PG&E B-19S – Demand Charges

Total Demand Charges and Marginal Emissions Rates

- Marginal Carbon Emissions Rate (kg/kWh)
- Total Demand Charges ($/kW)

Mar 31, 06:00
Mar 31, 12:00
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2017
PG&E B-19S – Storage Dispatch
Without Emissions Co-Optimization

PG&E B-19S – Storage Dispatch
With Emissions Co-Optimization ($1/metric ton CO2)
SF Office - Annual Performance Comparison

<table>
<thead>
<tr>
<th>Carbon Adder Value</th>
<th>Annual Bill Savings</th>
<th>Annual Storage Cycling</th>
<th>GHG Emissions Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>$0/metric ton</td>
<td>$111,316/year</td>
<td>174 cycles/year</td>
<td>14.6 metric tons/year increase</td>
</tr>
<tr>
<td>$1/metric ton</td>
<td>$111,242/year</td>
<td>174 cycles/year</td>
<td>13.7 metric tons/year decrease</td>
</tr>
</tbody>
</table>

- Over the course of the year, 304,540 kWh-AC flows into the energy storage system. This charging energy carries an emissions impact of 88.2 metric tons/year.
- 14.6 tons/year increase is consistent with ~20% efficiency losses and no optimization for GHG.
- Co-optimization with a small carbon value results in a 32% improvement in charging emissions.
- This co-optimization only reduces savings by <0.1% ($74/year) for the host site.

Monthly Emissions Impact Comparison

Without Emissions Co-Optimization

With Emissions Co-Optimization
Conclusions

• A current assumption of the upcoming SGIP GHG rules is that customer-sited storage does not induce greater renewables deployment, and therefore only marginal operational emissions impacts are considered.

• As storage is increasingly deployed with PV to improve economics under updated TOU rate structure (4 pm – 9 pm peak), this assumption may need to be revisited.

• In the meantime, co-optimizing for emissions and financial performance will be the primary approach employed to meet SGIP program goals.

• Further reforms to retail rate structures are still needed to better align customers’ economic incentives with grid and environmental costs.
A Navigation App will factor in:
- Speed limits and constraints (stoplights, etc.)
- Current traffic
- Changes along the way (accidents/surprises)
- Goals- quickest, most highways, etc…

To maximize storage benefits, use an optimization model, which will factor in:
- Facility requirements
- Value streams (utility bill, revenues, GHG)
- Constraints (solar production, battery life, etc)