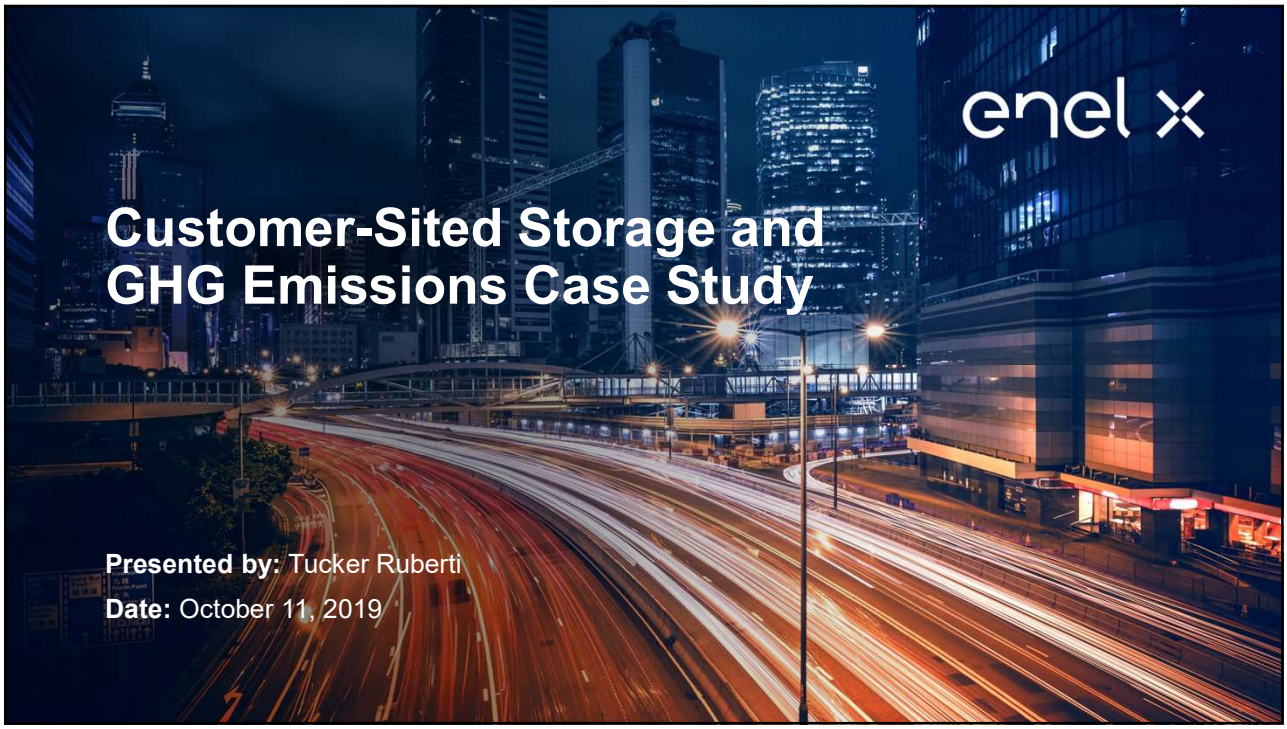


The Enel Group Worldwide

The world's largest utility, changing the way the world uses energy

enel x

Publicly Committed to UN Sustainable Development Goals

$84 B
Annual Revenue

65,000
Employees

31
Countries

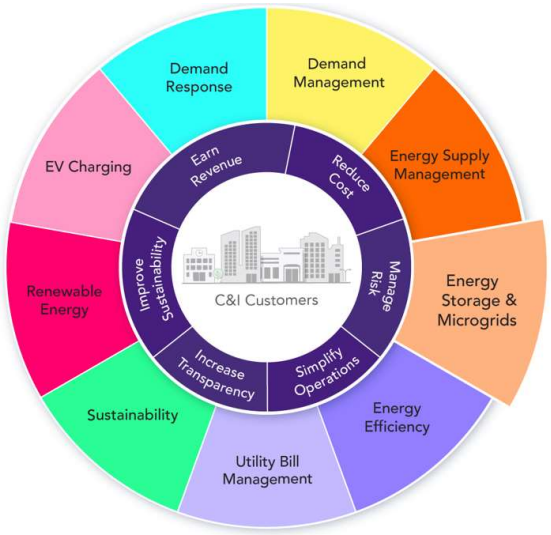
42 GW
Renewable Capacity

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

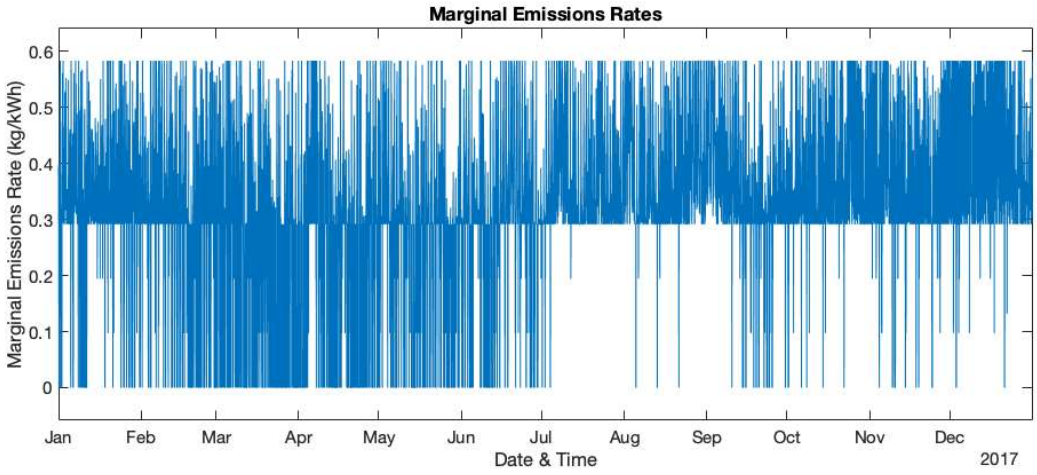


Modeling Input Values

- 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

4

GHG Emissions Rates



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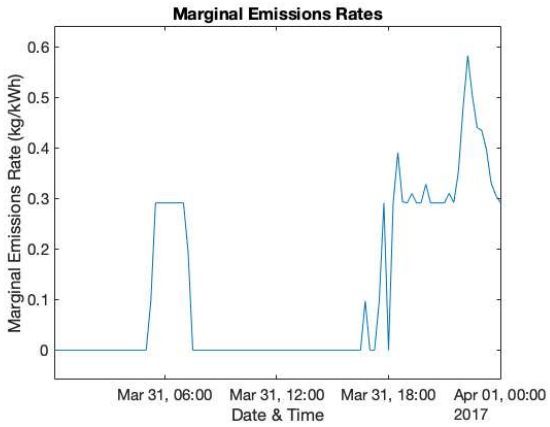
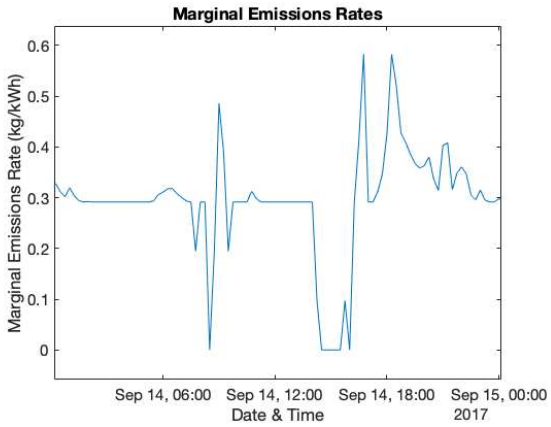
GHG Emissions Rates – Sample Days





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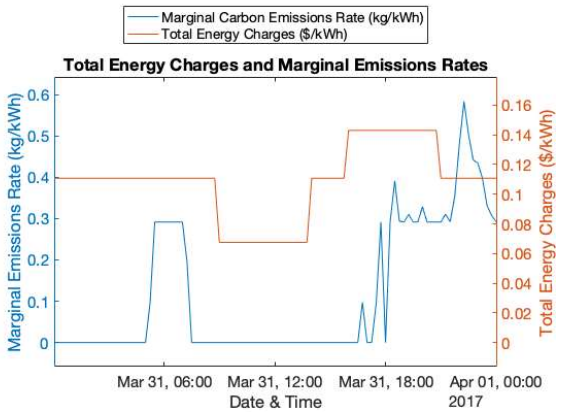
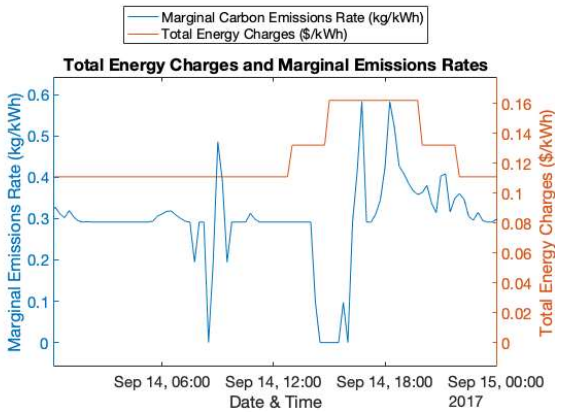
PG&E B-19S – Energy Charges





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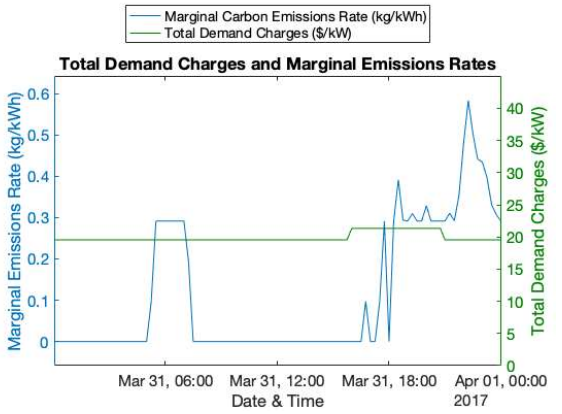
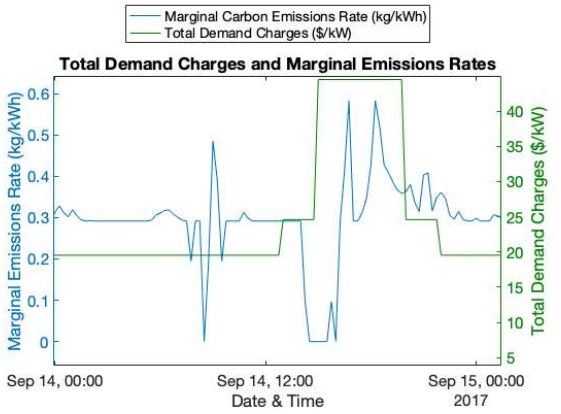
PG&E B-19S – Demand Charges





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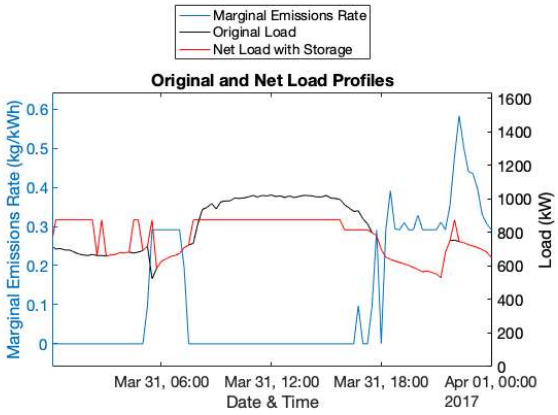
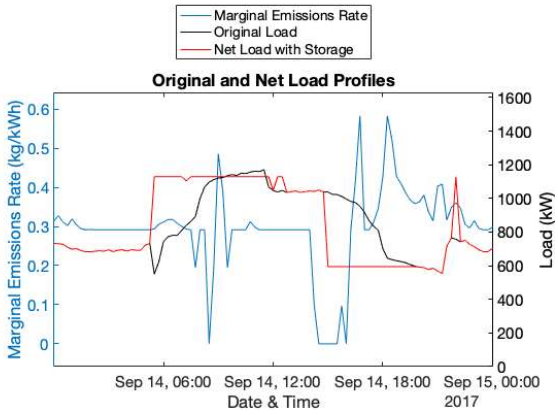
PG&E B-19S – Storage Dispatch

Without Emissions Co-Optimization





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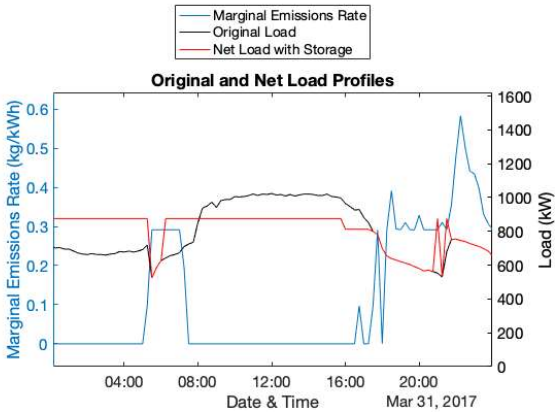
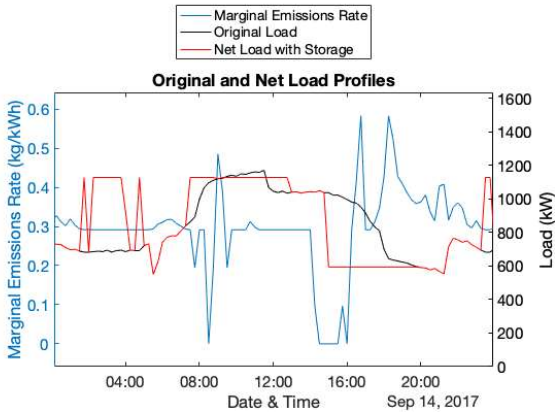
PG&E B-19S – Storage Dispatch

With Emissions Co-Optimization ($1/metric ton CO2)





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SF Office - Annual Performance Comparison

Carbon Adder Value	Annual Bill Savings	Annual Storage Cycling	GHG Emissions Reduction
$0/metric ton	$111,316/year	174 cycles/year	14.6 metric tons/year increase
$1/metric ton	$111,242/year	174 cycles/year	13.7 metric tons/year decrease

- 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.

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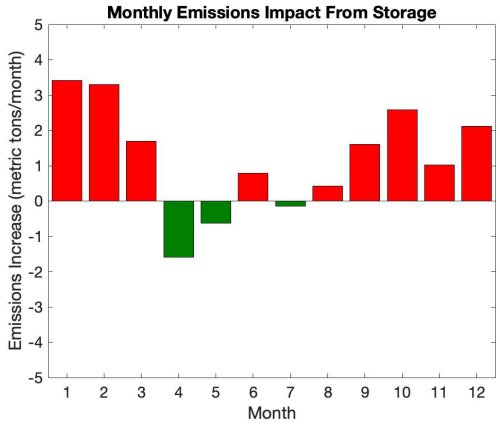
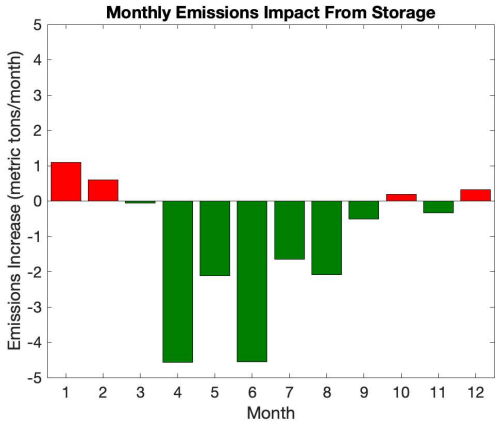
Monthly Emissions Impact Comparison

Without Emissions Co-Optimization



With Emissions Co-Optimization



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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.

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Back-Up

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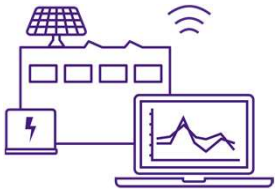
Optimization Modeling 101

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)

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