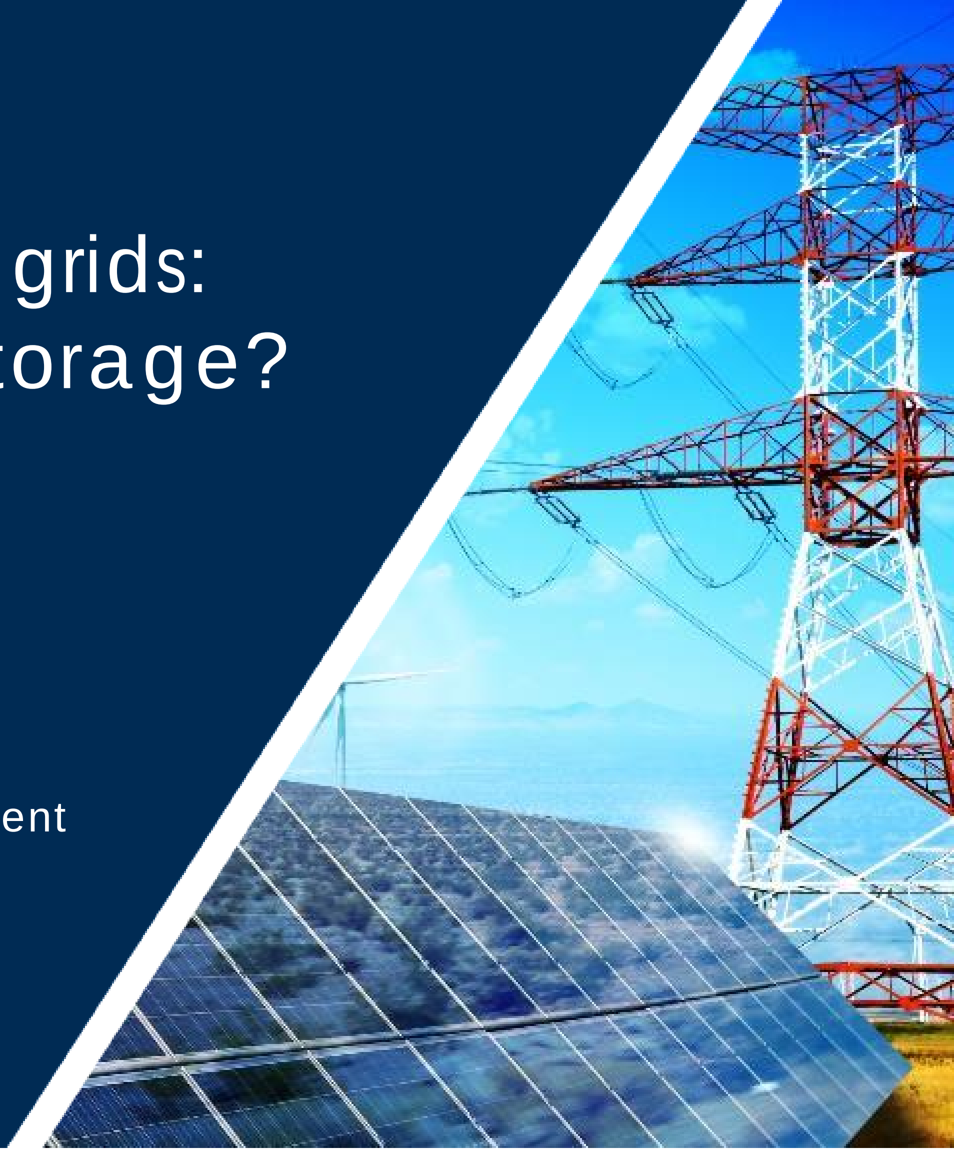
Decarbonizing Microgrids: What is the Role of Storage?



PRESENTED BY

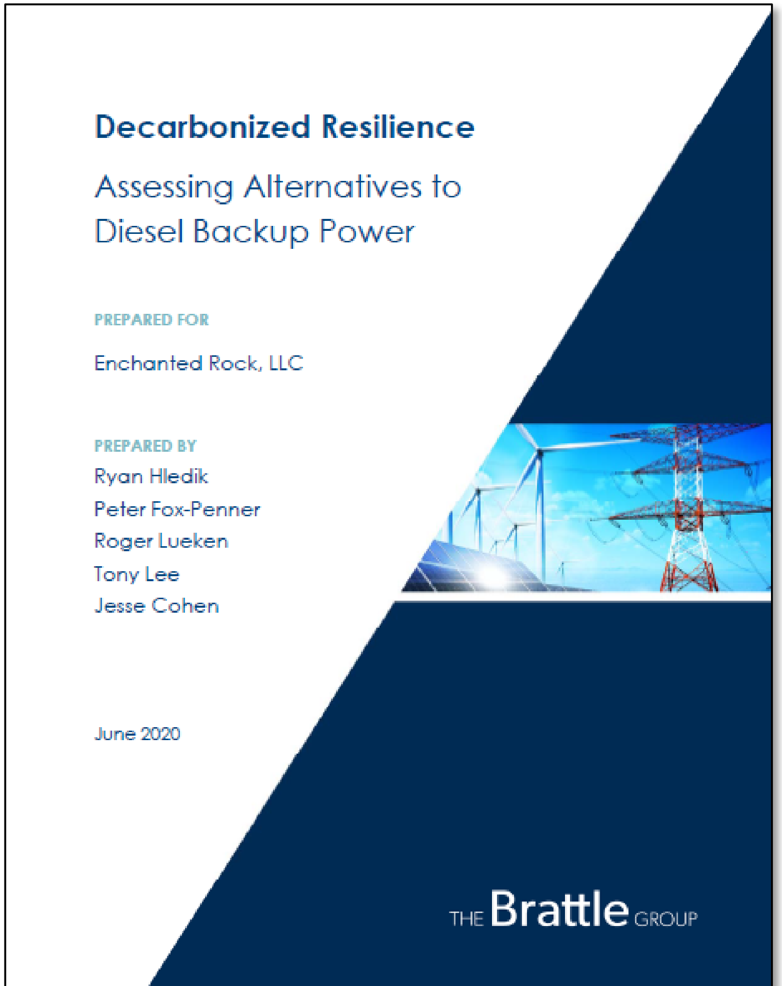
Ryan Hledik

ESA Webinar:
Energy Storage in Microgrid Development

August 4, 2020

THE Brattle GROUP

Let's think beyond diesel...


Decarbonized Resilience

Assessing Alternatives to Diesel Backup Power

PREPARED FOR

Enchanted Rock, LLC

PREPARED BY

Ryan Hledik
Peter Fox-Penner
Roger Lueken
Tony Lee
Jesse Cohen

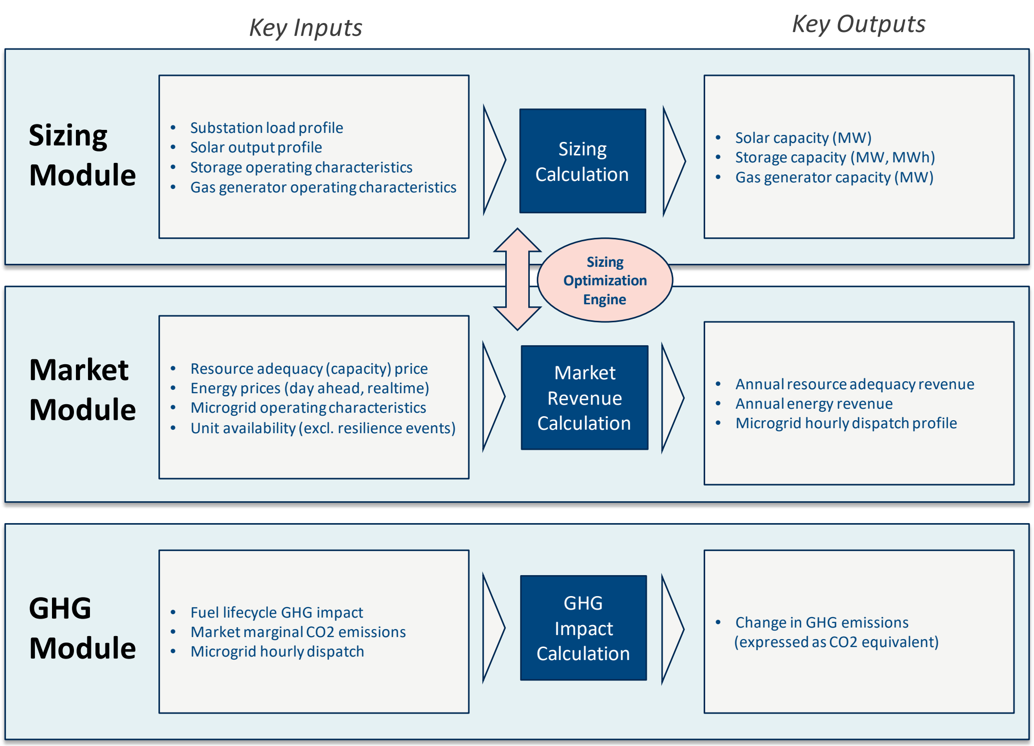
June 2020

THE Brattle GROUP

- Analyzed 4 microgrid options
  - Natural gas engine
  - Renewable natural gas (RNG) engine
  - Solar + storage (community scale)
  - "Hybrid" gas + solar + storage
- 10 MW representative California substation (w/hourly load pattern)
- Reliability requirement: *100% of substation load must be served by microgrid during outage event of up to 4 consecutive days, with a few hours of advance notice*

We analyzed net costs of the microgrid options

Brattle's MiRiAD Model



Source: The Brattle Group.
Notes: Applicability of individual inputs & outputs depends on type of microgrid analyzed.
MiRiAD = Microgrid Resilience Assessment and Design

- Economic analysis accounts for CA **market revenue** potential (outside of reliability events)
  - Energy sales
  - Resource adequacy
- Microgrid sizing is **optimized** to minimize system cost - net of market revenue - while fully satisfying the reliability requirement

The feasibility of solar+storage as a 10 MW standalone microgrid option is limited

Some days, the sun just doesn't shine…

Providing **100% reliability** to the 10 MW substation would require

- 20 MW of solar PV (90 acres of land)
- 90 MW / 350 MWh of storage (i.e., one of the largest batteries in the US)
- Transmission-level interconnection
- Outage notice periods
- Very robust resource adequacy needs/prices

However, there are many other opportunities for solar and storage to play an important role in microgrid deployment…

Incorporating solar+storage can reduce the cost of gas microgrids and improve GHG benefits

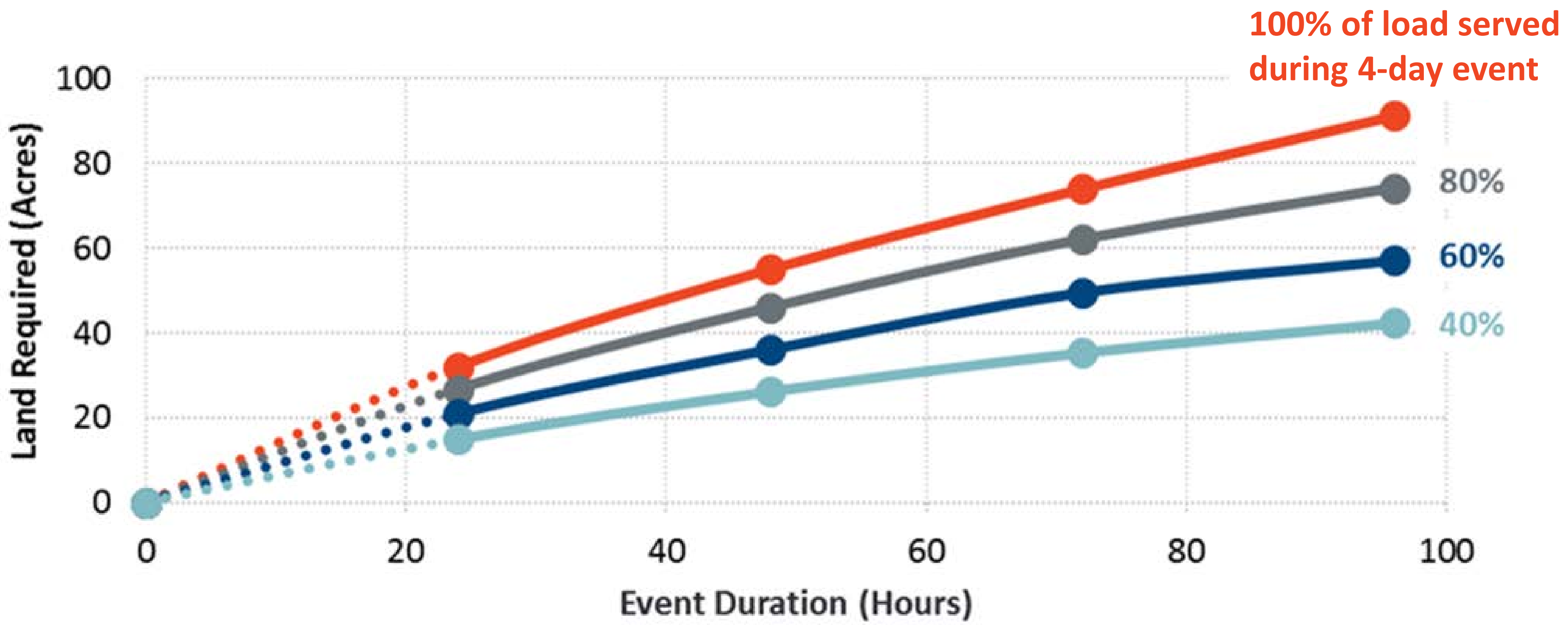
System	Annual Net Cost ($2021/yr)	Annual GHG emissions (million MT CO^2 e/year)	Land Required
Natural gas engine burning pipeline gas	$68,000	+1.7	<< 1 Acre
Natural gas engines burning Renewable Natural Gas (RNG)	$453,000	-4.6 to +0.8	<< 1 Acre
Hybrid solar (1 MW) + Storage (4 MWh) + RNG engine	$405,000	-5.9 to -0.8	~ 5 Acres
Hybrid solar (5 MW) + Storage (20 MWh) + RNG engine	$373,000	-10.3 to -7.4	~ 20 Acres

Reduced cost due to positive market economics of solar+storage

Largest CO_2 savings due to year-round solar production

A less stringent reliability requirement also improves the feasibility of solar+storage

Standalone Solar+Storage Land Requirement (10 GW Substation)



Note: Assumes 1-to-4 solar-to-storage capacity (MW) ratio. Dotted line indicates extrapolation to zero.

Several interesting questions still beg to be explored…

- What about the economics of **behind-the-meter** options?

- What is customer tolerance for less than 100% reliability… and to what extent could coupling with **demand response** improve the feasibility of solar+storage?

- Does the feasibility of solar+storage improve for **smaller applications** (i.e., <10 MW)?

- Are these findings from California applicable in **other jurisdictions**?

Presenter Information

RYAN HLEDIK

Principal | San Francisco, CA

ryan.hledik@brattle.com

415.217.1029

Ryan Hledik specializes in regulatory and planning matters related to the emergence of distributed energy technologies.

Mr. Hledik has consulted for more than 50 clients across 30 states and 9 countries. He has supported his clients in matters related to energy storage, load flexibility, distributed generation, electrification, retail tariff design, energy efficiency, and grid modernization.

Mr. Hledik's work has been cited in regulatory decisions establishing procurement targets for energy storage and demand response, authorizing billions of dollars in smart metering investments, and approving the introduction of innovative rate designs. He is a recognized voice in debates on how to price electricity for customers with distributed generation. He co-authored Saudi Arabia's first Demand Side Management (DSM) plan, and the Federal Energy Regulatory Commission's landmark study, A National Assessment of Demand Response Potential.

Mr. Hledik has published more than 25 articles on retail electricity issues and has presented at industry events throughout the United States as well as in Brazil, Belgium, Canada, Germany, Poland, South Korea, Saudi Arabia, the United Kingdom, and Vietnam. His research on the "grid edge" has been cited in *The New York Times* and *The Washington Post*, and in trade press such as *GreenTech Media*, *Utility Dive*, and *Vox*. He was named to *Public Utilities Fortnightly's* Under Forty 2019 list, recognizing rising stars in the industry.

Mr. Hledik received his M.S. in Management Science and Engineering from Stanford University, where he concentrated in Energy Economics and Policy. He received his B.S. in Applied Science from the University of Pennsylvania, with minors in Economics and Mathematics. Prior to joining Brattle, Mr. Hledik was a research assistant with Stanford's Energy Modeling Forum and a research analyst in Charles River Associates' Energy Practice.