CleanEnergy States Alliance

Battery Storage for Fossil-Fueled Peaker Power Plant Replacement: A Maine Case Study

April 30, 2024

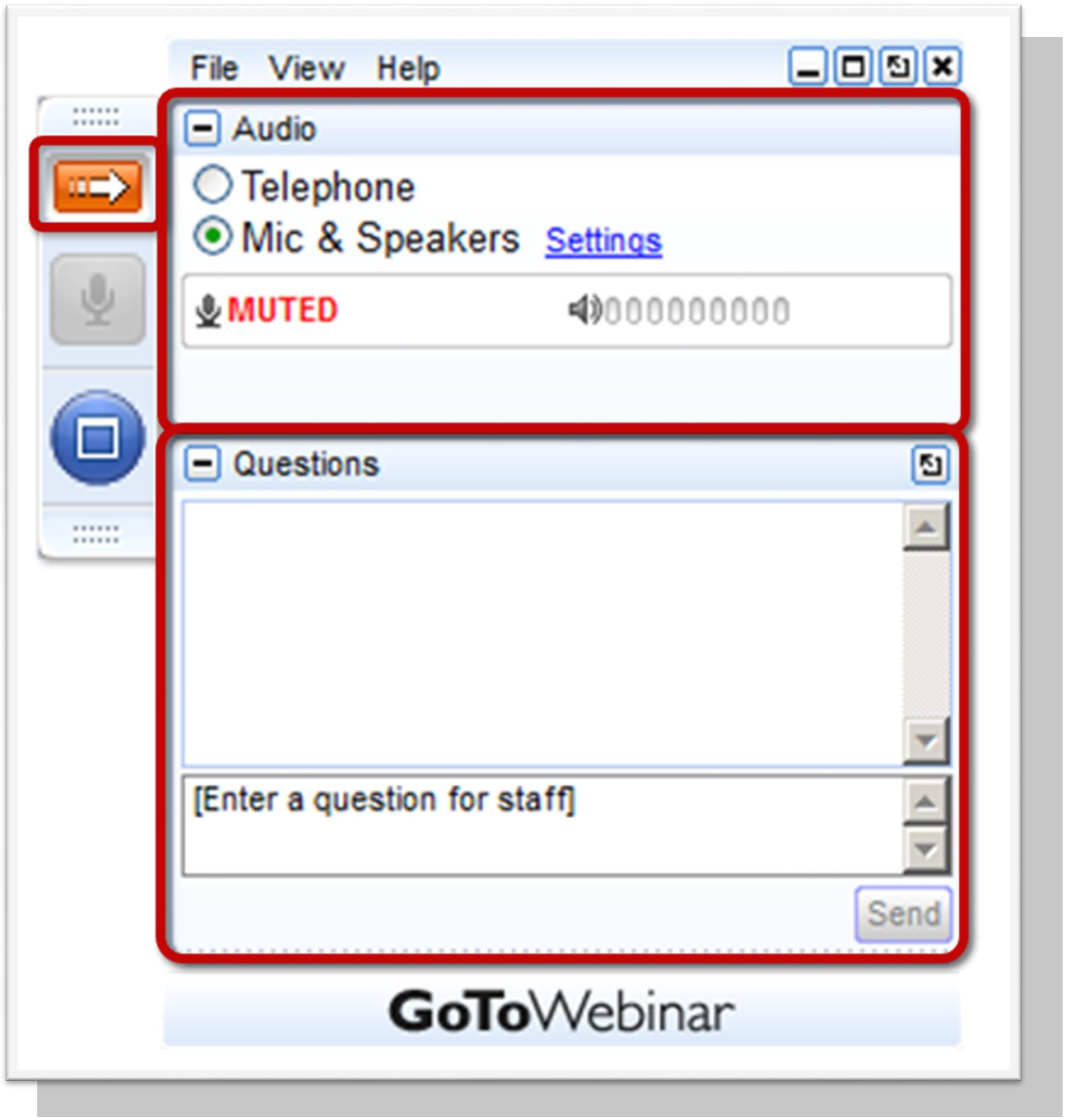
www.cesa.org

Webinar Logistics

Use the orange arrow to open and close your control panel

Submit questions and comments via the Questions panel

This webinar is being recorded. We will email you a webinar recording within 48 hours. This webinar will be posted on CESA's website at www.cesa.org/webinars



Celebrating 20 Years of State Leadership

20 CleanEnergy States Alliance

The Clean Energy States Alliance (CESA) is a national, nonprofit coalition of public agencies and organizations working together to advance clean energy.

CESA members—mostly state agencies—include many of the most innovative, successful, and influential public funders of clean energy initiatives in the country.

Clean Energy States Alliance

www.cesa.org

State of California Energy Commission

Connecticut Green Bank

Department of Energy & Environment

Energy Trust of Oregon

IPA Illinois Power Agency

Maine Governor's Energy Office

State of New Hampshire Department of Energy

Massachusetts Clean Energy Center

Maryland Energy Administration

EGLE Michigan Department of Environment, Great Lakes, and Energy

BPU New Jersey Board of Public Utilities

New Jersey's Clean Energy Program — njcleanenergy.com

New Mexico EMNRD Energy, Minerals and Natural Resources Department

New York State NYSERDA

mn Commerce Department

SMUD Powering forward. Together.

State of Rhode Island Office of Energy Resources

Vermont Department of Public Service Clean Energy Development Fund

Virginia Energy

Rhode Island Commerce Corporation

Commissioner Stephanie Garcia Richard New Mexico State Land Office

Illinois Commerce Commission ICC

OEI Wisconsin Office of Energy Innovation

Prairie Island Indian Community in the State of Minnesota

Washington State Department of Commerce

Connecticut Energy & Environment

DOER Massachusetts Department of Energy Resources

Oregon Department of Energy

Colorado Energy Office CEO

Inclusive Prosperity Capital

MassDEP

OPC-DC Office of the People's Counsel — Advocacy | Education | Protection

Energy Storage Policy for States

Providing support to CESA members engaged in developing energy storage policy, programs and regulation.

Activities include knowledge sharing, direct policy support, and independent analysis.

The project leverages other CESA and CEG efforts, including ESTAP and CEG's Resilient Power Project.

www.cesa.org/projects/energy-storage-policy-for-states/

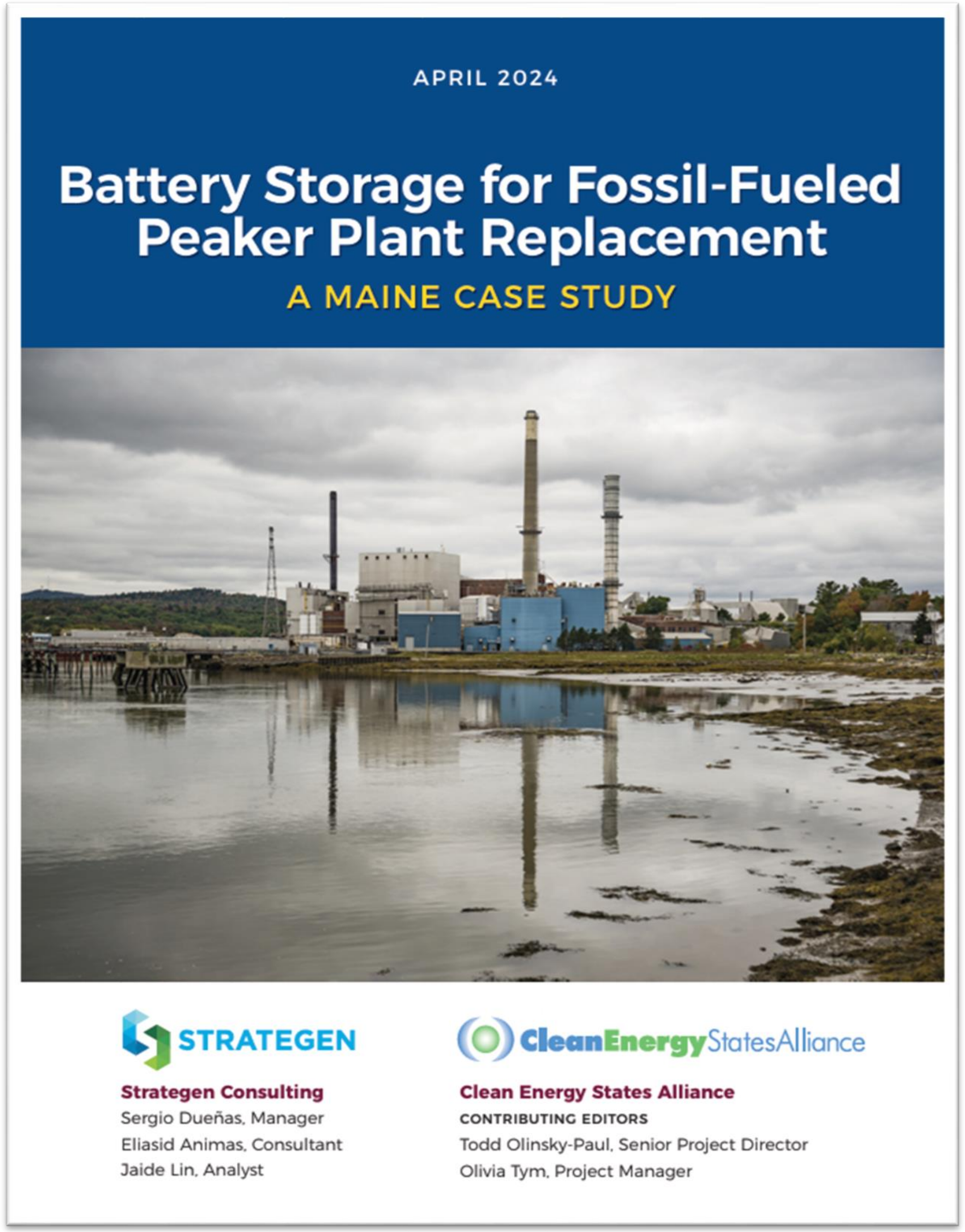
Battery Storage for Fossil-Fueled Peaker Plant Replacement: A Maine Case Study

April 2024

Sergio Dueñas, Eliasid Animas, Jaide Lyn / Strategen
Todd Olinsky-Paul, Olivia Tym / CESA

CleanEnergy States Alliance

STRATEGEN



https://www.cesa.org/resource-library/resource/battery-storage-peaker-plant-replacement-maine/

Webinar Speakers

Todd Olinsky-Paul
Clean Energy States Alliance

Eliasid Animas
Strategen

CleanEnergy States Alliance

STRATEGEN

Energy Storage for Peaker Plant Replacement

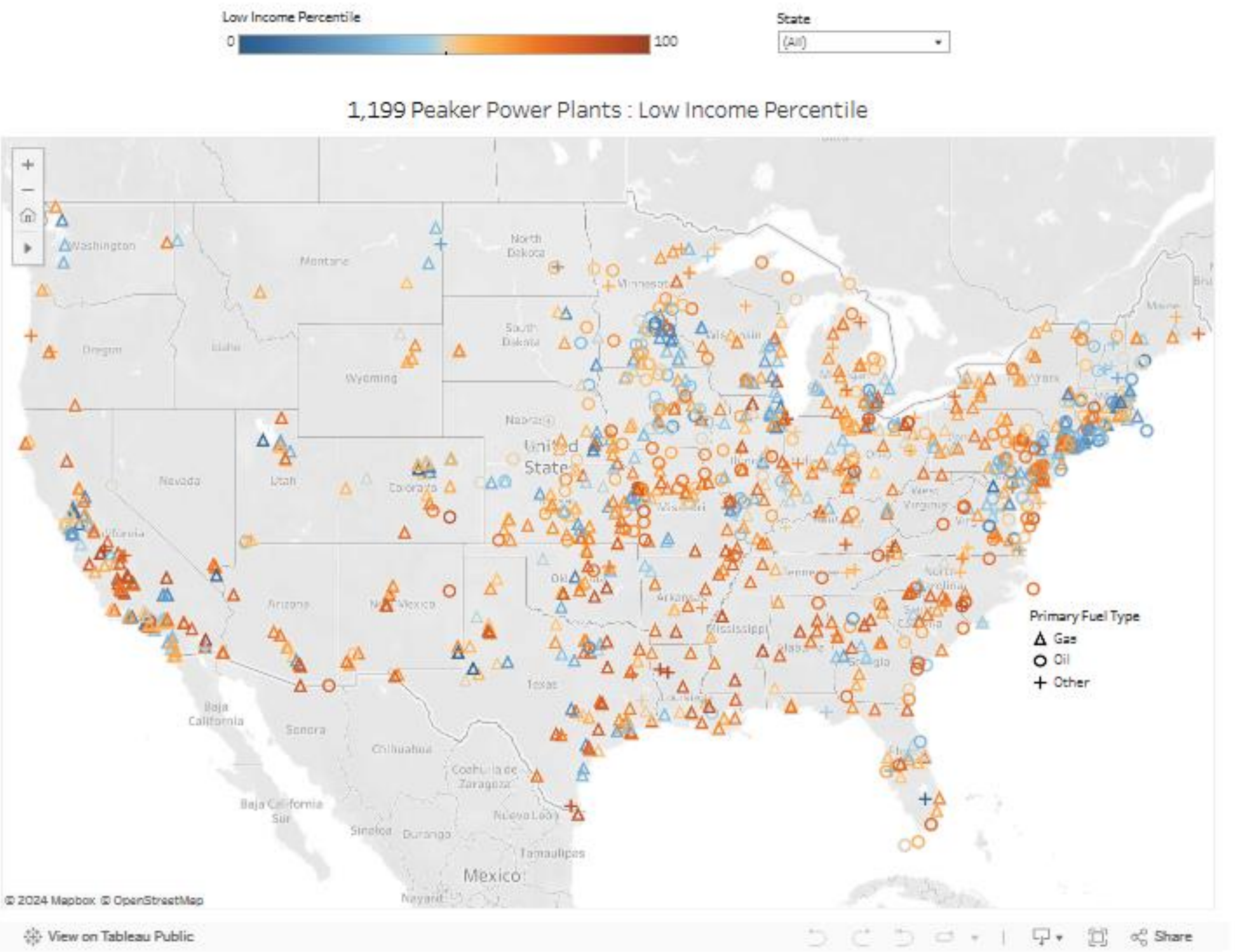
Some Context

Todd Olinsky-Paul

April 30, 2024

Fossil-Fueled Peakers:

- May run on natural gas, oil or even coal
- Run infrequently, but are very costly
- Highly polluting
  - Human health impacts
  - Environmental impacts
- Often sited in populated areas
- Disproportionately sited in poorer and underserved communities
- Cause equity concerns



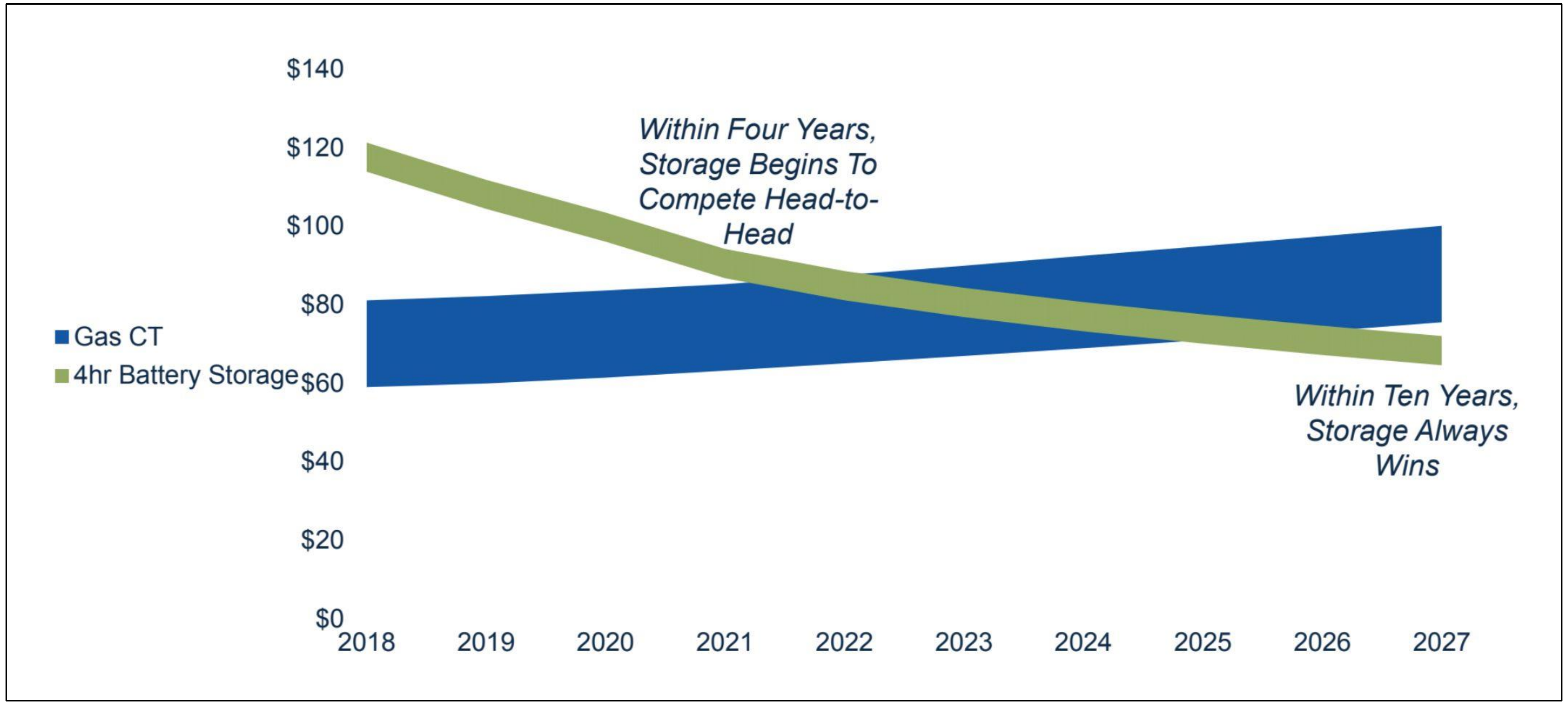
Peaker Distribution and Emissions: Low-Income Percentiles

Percentile	Number of peakers	Population within a 3-mile radius	Low-income percentage of population	Average nitrogen oxide (NOx) emission rate
0 - 25th	85	1.8 million	0 - 14%	13.2 lb/MWh
25th - 50th	334	17.5 million	14 - 28%	20.3 lb/MWh
50th - 75th	578	33.5 million	28 - 46%	30.4 lb/MWh
75th - 100th	202	10.2 million	46 - 93%	15.5 lb/MWh

Interactive maps are available at CEG's Phase Out Peakers project page: https://www.cleanegroup.org/initiatives/phase-out-peakers/

Energy Storage

- Typically lithium-ion batteries
- Can run more often to serve various applications
- Not polluting when charged from renewables or during times of excess renewable generation
- Can be sited almost anywhere (doesn't require gas pipelines)
- Cost competitive with new gas peakers (depending on how cost/benefit test is conducted)



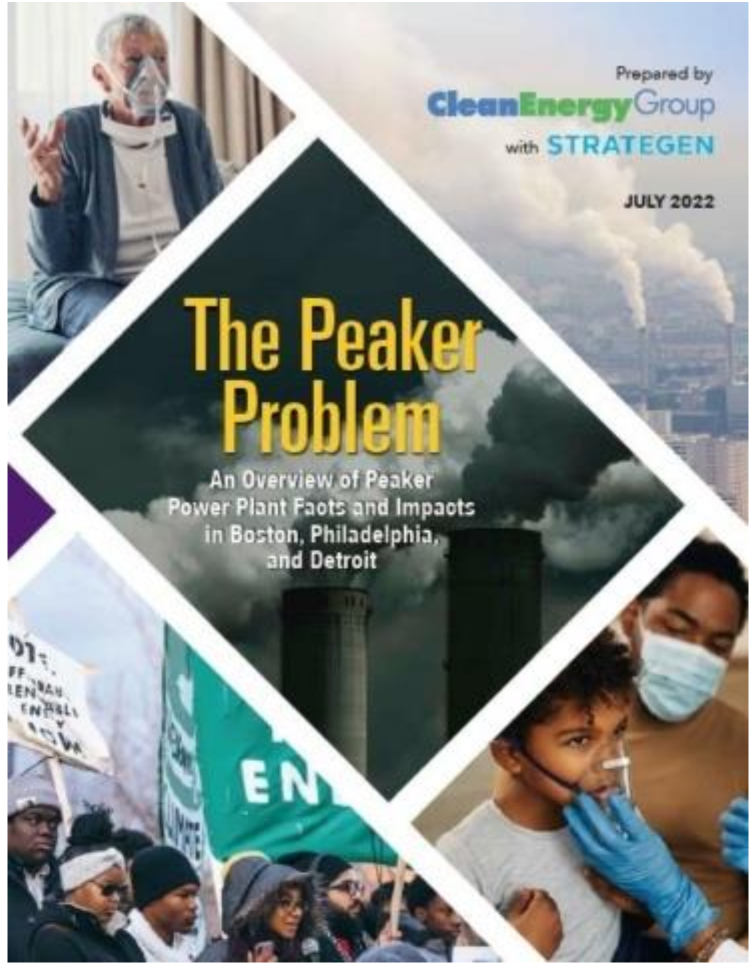
Source: December, 2017 article in GTM/Wood Mackenzie: "Have We Reached Peak Peaker? 'I Can't See Why We Should Build a Gas Peaker After 2025'"

Peaker Replacement:

A Community Issue

Clean Energy Group works with community based organizations to support peaker replacement initiatives

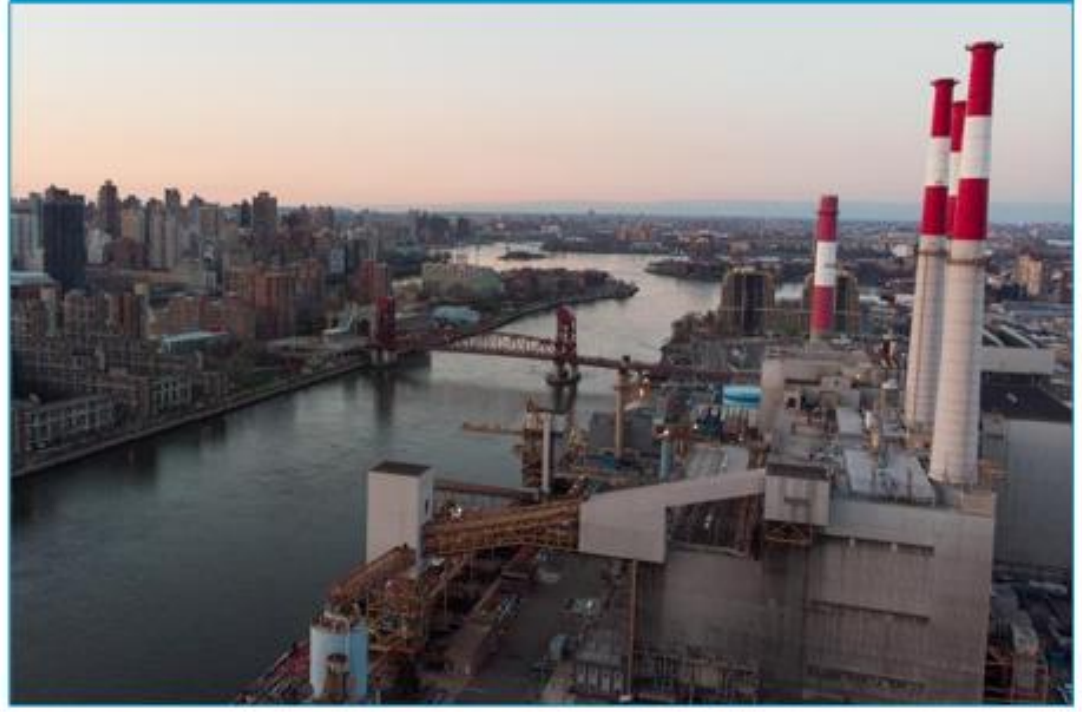
- New York City
- Philadelphia
- Boston
- Western Massachusetts
- Detroit



These reports and others are available at CEG's Phase Out Peakers project page: https://www.cleanegroup.org/initiatives/phase-out-peakers/

Successful Projects: a Few Examples

New York City

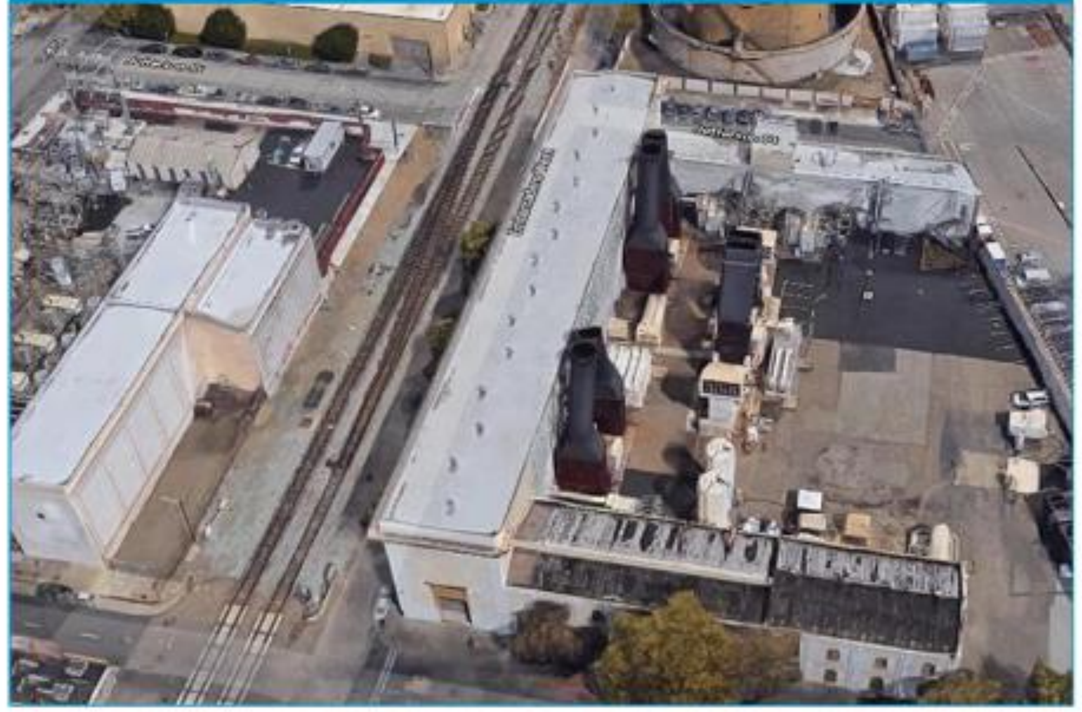


LS Power's 316 MW (8-hr) battery to replace Ravenswood oil and gas peaker plant
- Expected to be online 2022-2024
- Approved & waiting contractor

Los Angeles

SoCal Edison is using 195 MW of 4-hr batteries to replace Puente Gas Power Plant (262 MW)
- Decision followed the push-back of community & environment advocates

The Bay Area



East Bay CCA replaces Oakland peaker with 20 MW (4-hr) battery and home solar+ storage
- 2 MWh of batteries on 500 low-income units in the area before 2022.

Peaker Replacement:

A State Issue

Clean Energy States Alliance works to support state energy agencies in developing energy storage for peaker replacement

Several states have combined energy storage procurement with fossil-fueled peaker replacement initiatives:

- New York State – 1,500 megawatts (MW) of energy storage by 2025 and 3,000 MW by 2030; Regulations to phase out peakers with high nitrogen oxide emissions between 2023 and 2025.

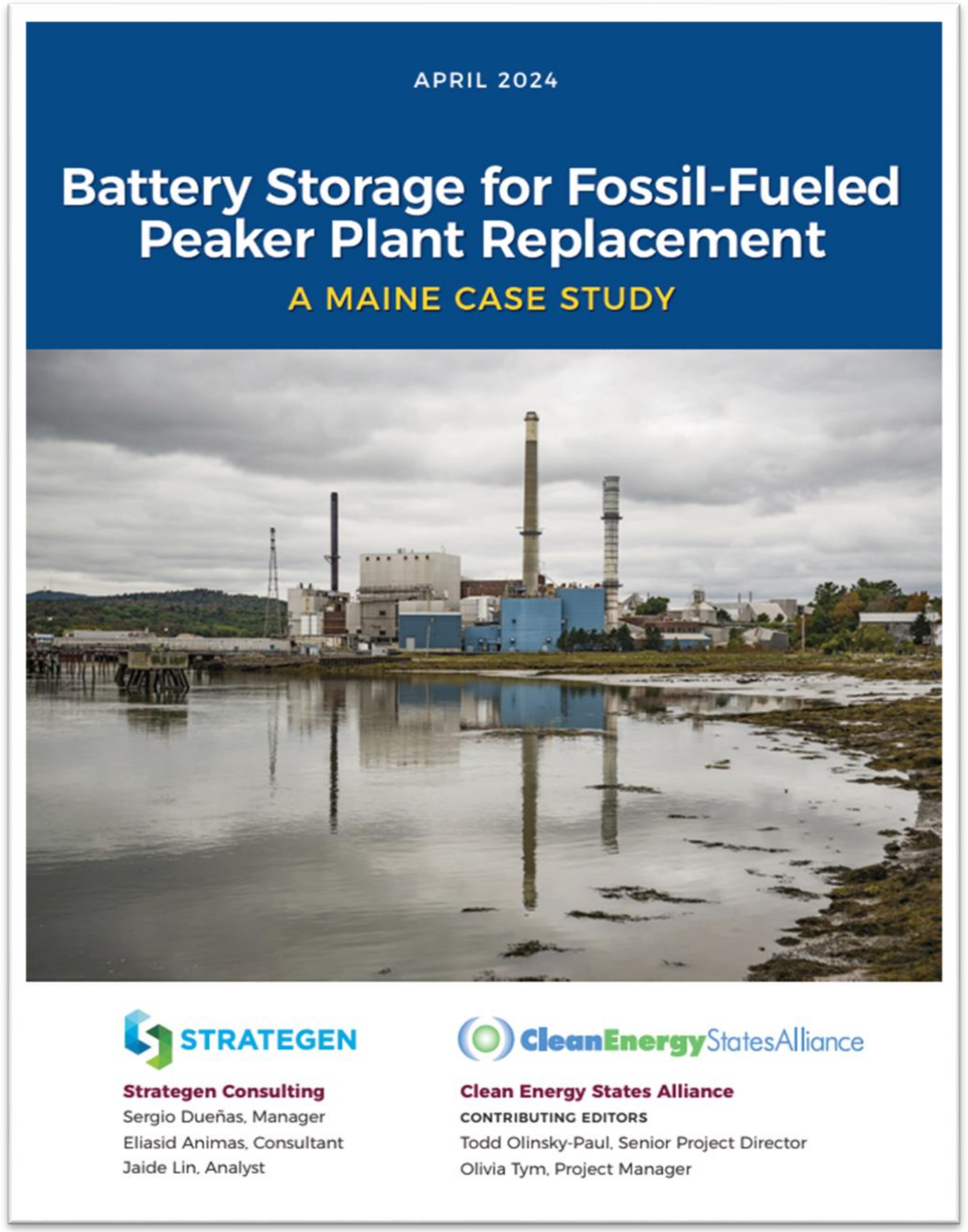
- Massachusetts – 1,000 MW of energy storage by 2025; Adopted the nation's first Clean Peak Energy Standard, which requires peak power to be increasingly sourced from renewables and storage.

Numerous states have adopted emissions caps, clean energy goals and climate plans:

- Regional Greenhouse Gas Initiative (RGGI) – 11 states
- 100% clean energy targets – 23 states plus DC and Puerto Rico
- Climate action plans – 33 states

New Report: Battery Storage is More Cost-Effective Than New Gas Peakers in Maine (and the rest of New England)

- With support from Maine Community Foundation—Seal Bay II Fund and the Barr Foundation, Clean Energy Group and Clean Energy States Alliance contracted Strategen to conduct an economic analysis of battery storage for peaker plant replacement in Maine.
- This work is intended to support Maine’s upcoming 200 MW energy storage procurement.
- Due to the nature of the regional energy capacity market, the results should be applicable across all six New England states.
- **Takeaway: When the costs of air pollution are included in the analysis, new batteries are cheaper than new gas peakers.**



Thank You

Todd Olinsky-Paul

Senior Project Director

Clean Energy States Alliance

todd@cleanegroup.org

www.cesa.org

Clean Energy States Alliance

info@cleanegroup.org

www.cesa.org

Upcoming Webinars

Equity Strategies for LA's 100% Clean Energy Transition (May 2)

Using LIHEAP and WAP to Expand Low-Income Solar Access (May 9)

Batteries 101, Part 1: An Introduction to Energy Storage and Massachusetts' Battery Storage Programs and Policies (May 15)

Micro-Financing and Locally Led Development: A Scalable Model for Resilient Power in Rural Communities (May 16)

Energy Storage Interconnection – Challenges and Solutions (May 21)

Read more and register at
www.cesa.org/webinars

STRATEGEN

Battery Storage for Fossil-Fueled Peaker Power Plant Replacement: A Maine Case Study

Methodology and Key Findings

STRATEGEN

Strategen is a globally connected, impact driven firm on a mission to decarbonize energy systems

ELIASID ANIMAS
Consultant

- Primarily works in Strategen's decarbonization strategy practice area, where he helps utilities, technology companies, governments, and NGOs to trace and achieve their clean energy and decarbonization goals.
- Previous work in the development sector focused on city planning, transportation and energy efficiency.
- B.A. in City and Regional Planning from UNAM
- Contact: eanimas@strategen.com

Key Findings

- Batteries are an economic alternative to replace the aging gas peaker fleet in Maine.
  - Favorable economics depend on multiple policy and market design factors. (e.g., tax credits, cost of carbon, level of electrification, capacity accreditation)
- New gas peakers are also viable from a market perspective, but have a higher social cost
  - Improved efficiency results in higher plant utilization in urban areas historically affected by the sector, increasing the risk of multiple illness and premature mortality associated to local pollutants.
- An expected new capacity counting framework in the ISO, tied to the growth of batteries in the system, is likely to reduce the market value of short-duration energy storage.
  - Market signals have resulted in 2-hr batteries, but longer duration is better suited for a new framework.
  - Energy storage bring other values that are not priced in the market, such as RE integration, technology flexibility, avoided T&D costs, and avoided emission damages.

Methodology

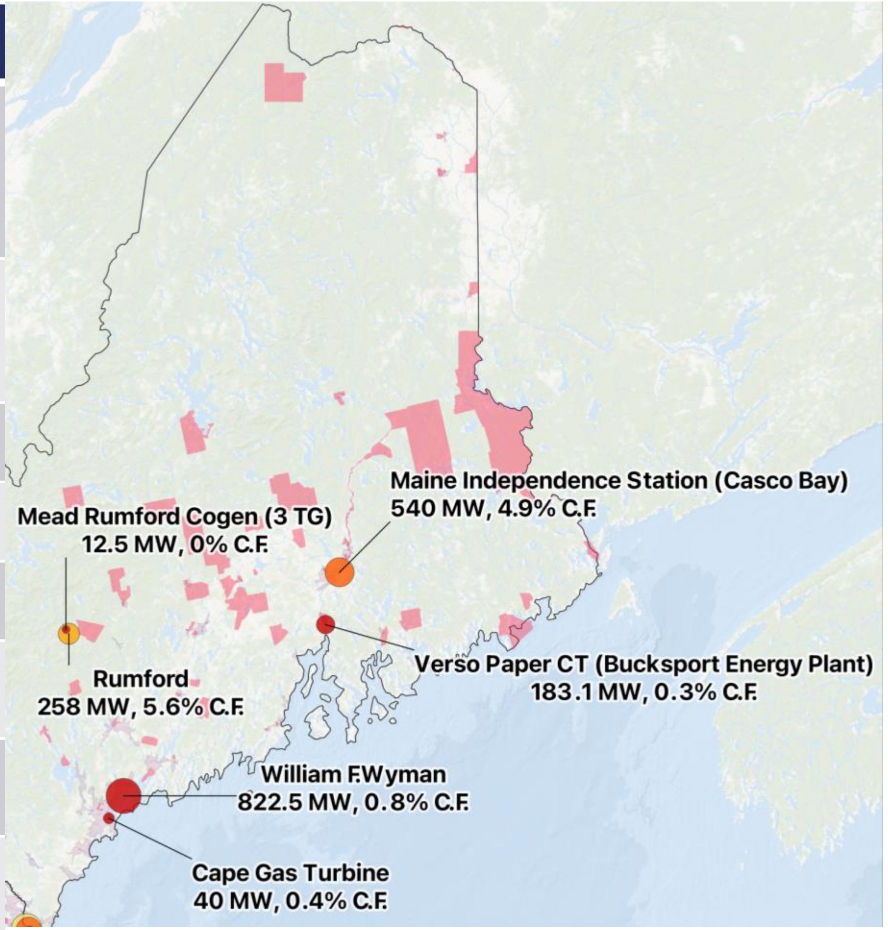
- Goal: a cost-effectiveness comparison of energy storage and gas peakers in Maine
- Two step approach:

1. Selection of target peakers
   - Location relative to urban areas
   - Fuel intake and efficiency
   - Age
   - Emission levels and permits
   - Total capacity under 200 MW

2. Cost-benefit comparison
   - Capital and operations cost
   - Market revenues: energy, capacity, grid services
   - Environmental and health costs
   - Over 10 Sensitivities affecting costs and benefits

1. Selection of target peakers

	Wyman	Cape Gas	Bucksport	Casco Bay	Rumford
Technology	Steam turbine, residual fuel oil	Gas turbines, distillate fuel oil	Gas turbine, ng and distillate fuel oil	**Combined cycle**, natural gas	**Combined cycle**, natural gas
Units (MW)	Two units (114 and 605 MW)	Two units (20 MW each)	1 unit (183 MW)	1 unit (540 MW)	1 unit (258 MW)
Age	59 and 46 yrs	54 years old	23 years old	24 years old	24 years old
Owner	NextEra	NextEra	JERA	Vistra	Carlyle Group
Utility	CMP	CMP	CMP	Versant Power	CMP
Heat Rate (Btu/kWh)	10,990	20,730	12,300	~7,500	~7,500
2022 Capacity Factor (%)	3.3	0.1	0.6	14	19
Variable O&M Costs ($/MWh)	83	300	-	-	-



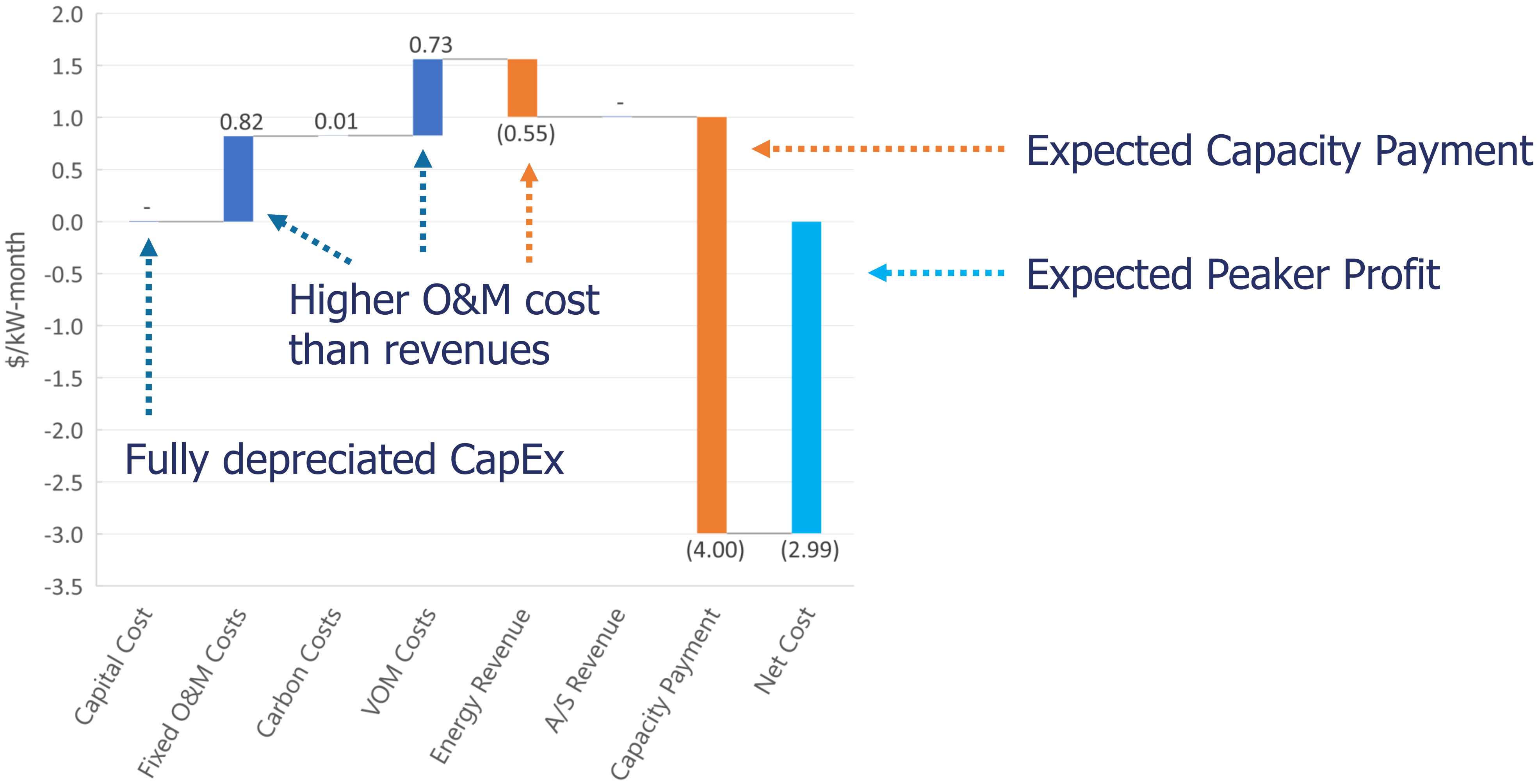
Wyman, Cape and Bucksport are likely candidates for replacement; all plants are at least 3-miles away from a community

2. Cost-benefit comparison

- In-house model to assign annual costs and revenues by unit of peaking capacity
- Economic dispatch modules for gas peaker and battery alternatives (based on historical prices)
  - Major limitation of the analysis is the omission of an hour-by-hour energy price forecast, likely to lead to larger energy arbitrage profits for energy storage.
- Sensitivities:
  - Replacement year, capacity accreditation framework, cost of carbon scenario, ITC monetization, battery duration, future asset and fuel cost scenario, electrification levels.
  - Qualifying capacity (QC) vs. Effective load carrying capability (ELCC)
  - All input values assessed in sensitivities are public data: NREL, EIA, EPA.

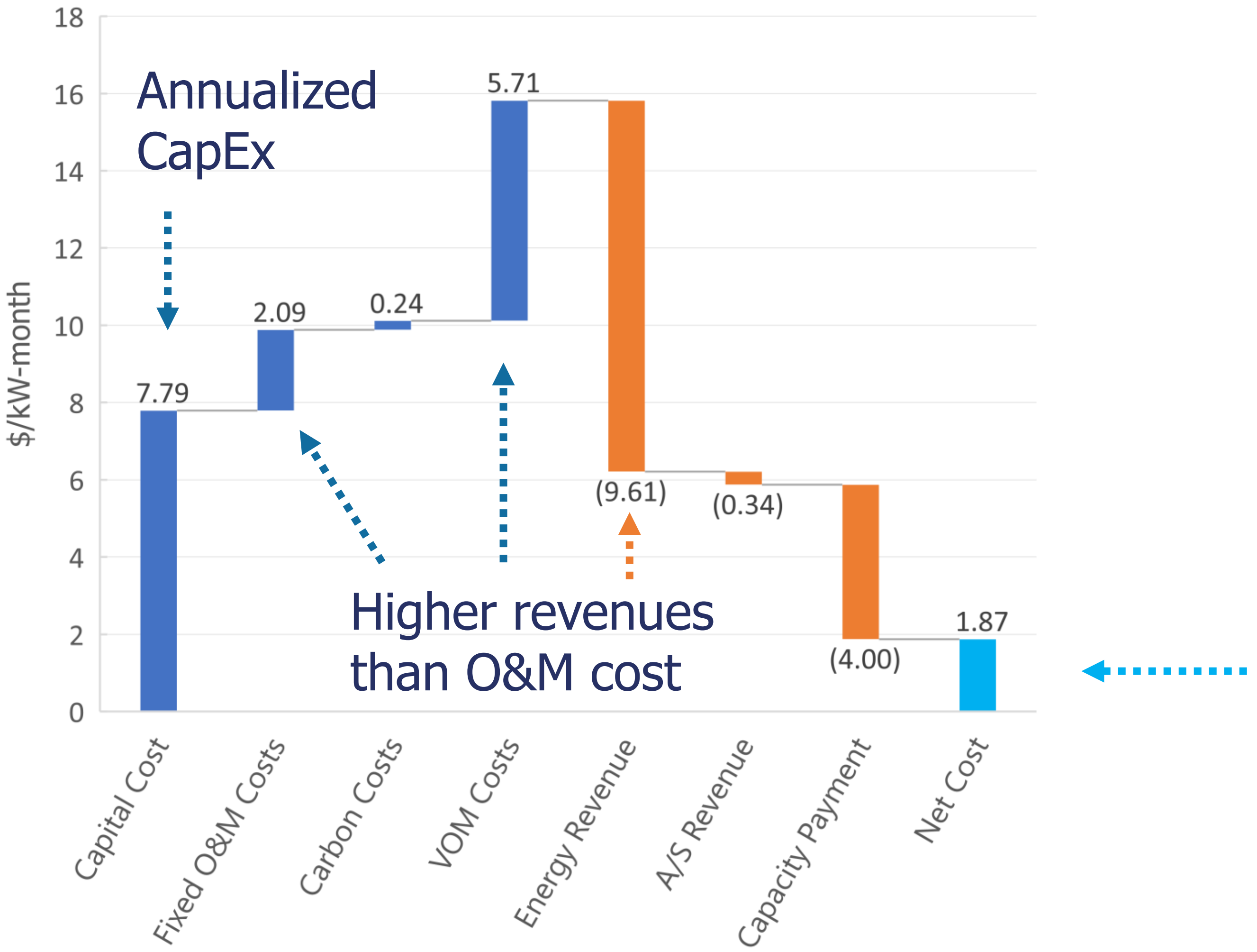
2. Cost-benefit comparison

Existing Peaker: Wyman 3



2. Cost-benefit comparison

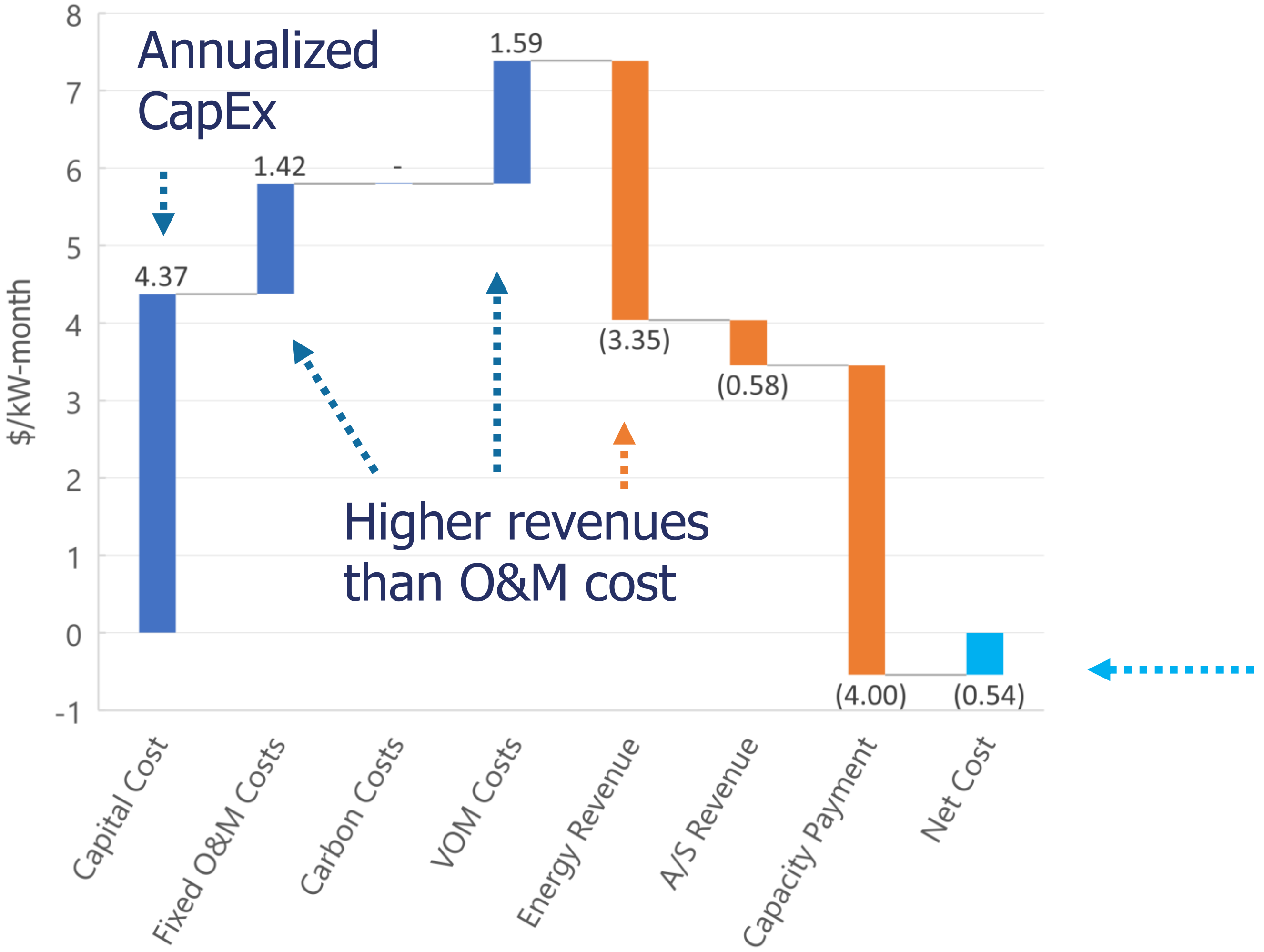
New NG Peaker



Expected peaker cost above current market prices

2. Cost-benefit comparison

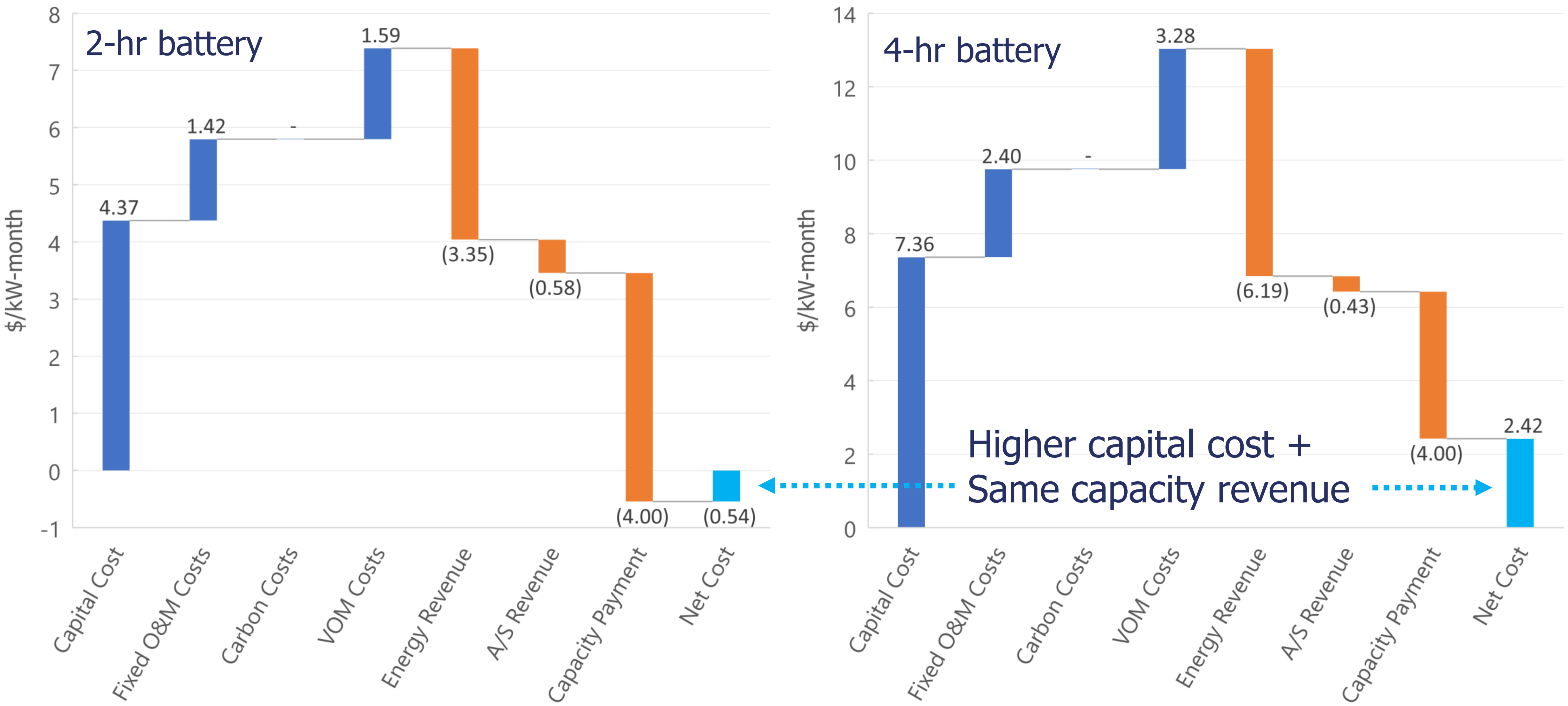
New 2-hr Battery (QC)



Expected cost, lower than both peaker options and the current market price

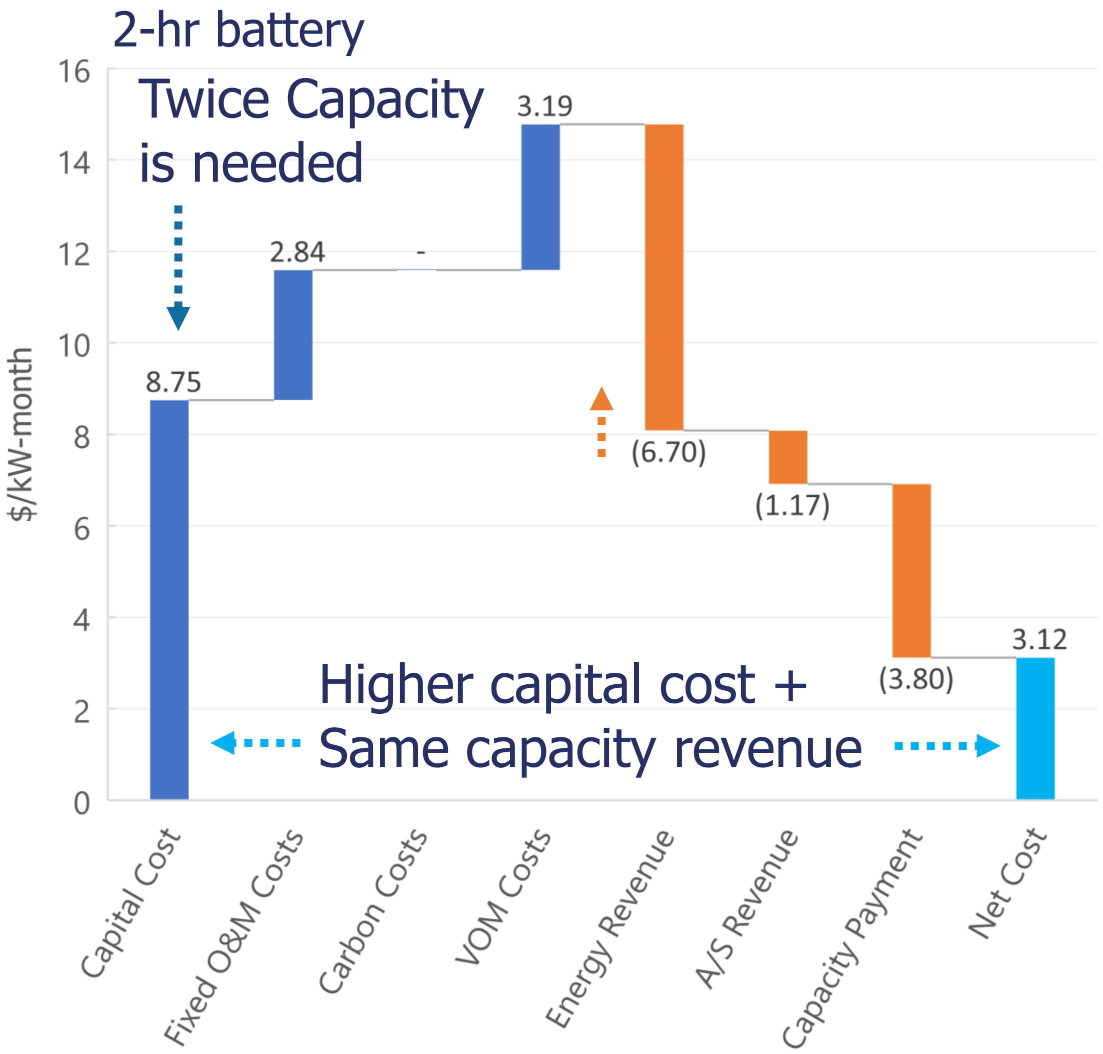
2. Cost-benefit comparison

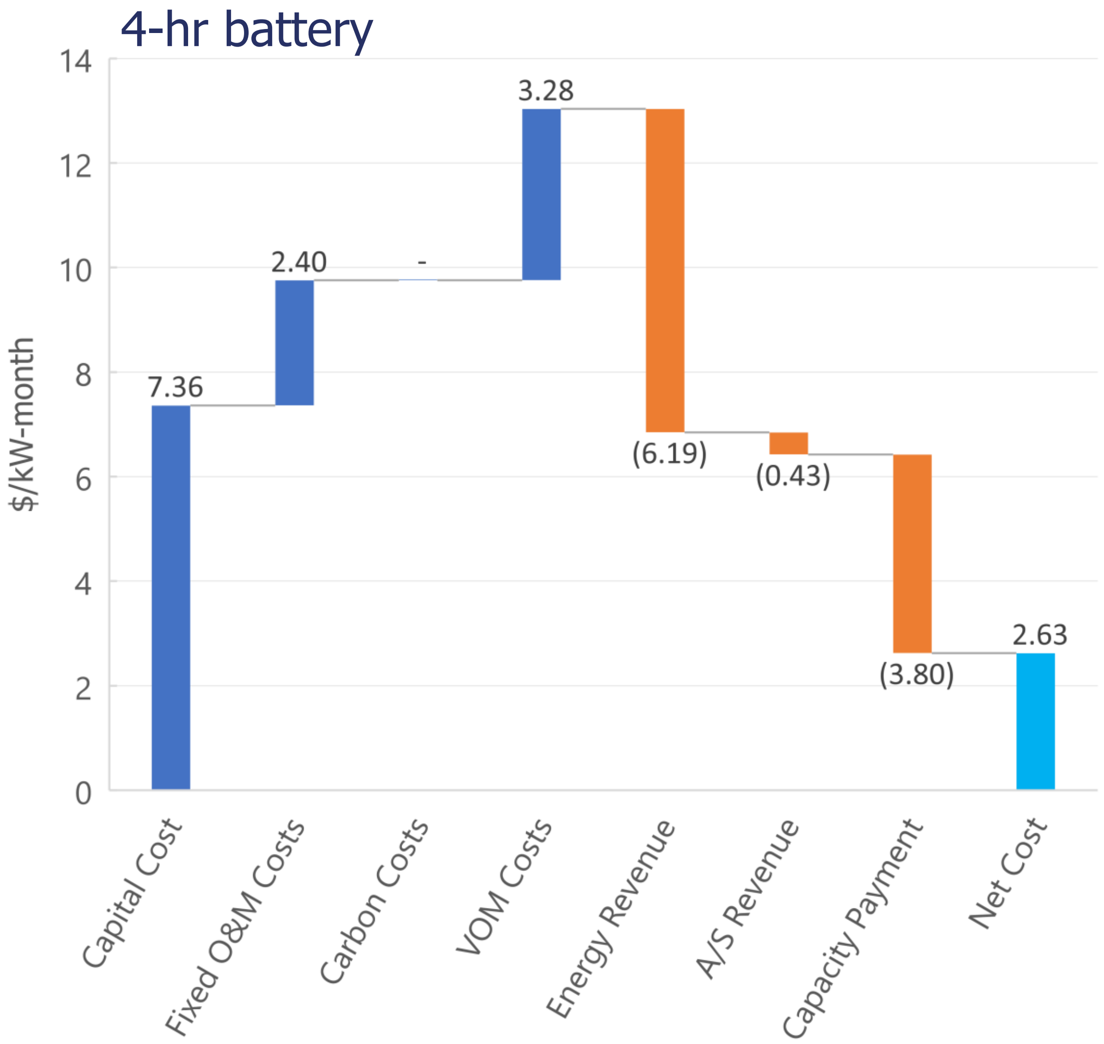
New 2-hr and 4hr Battery (QC)



2. Cost-benefit comparison

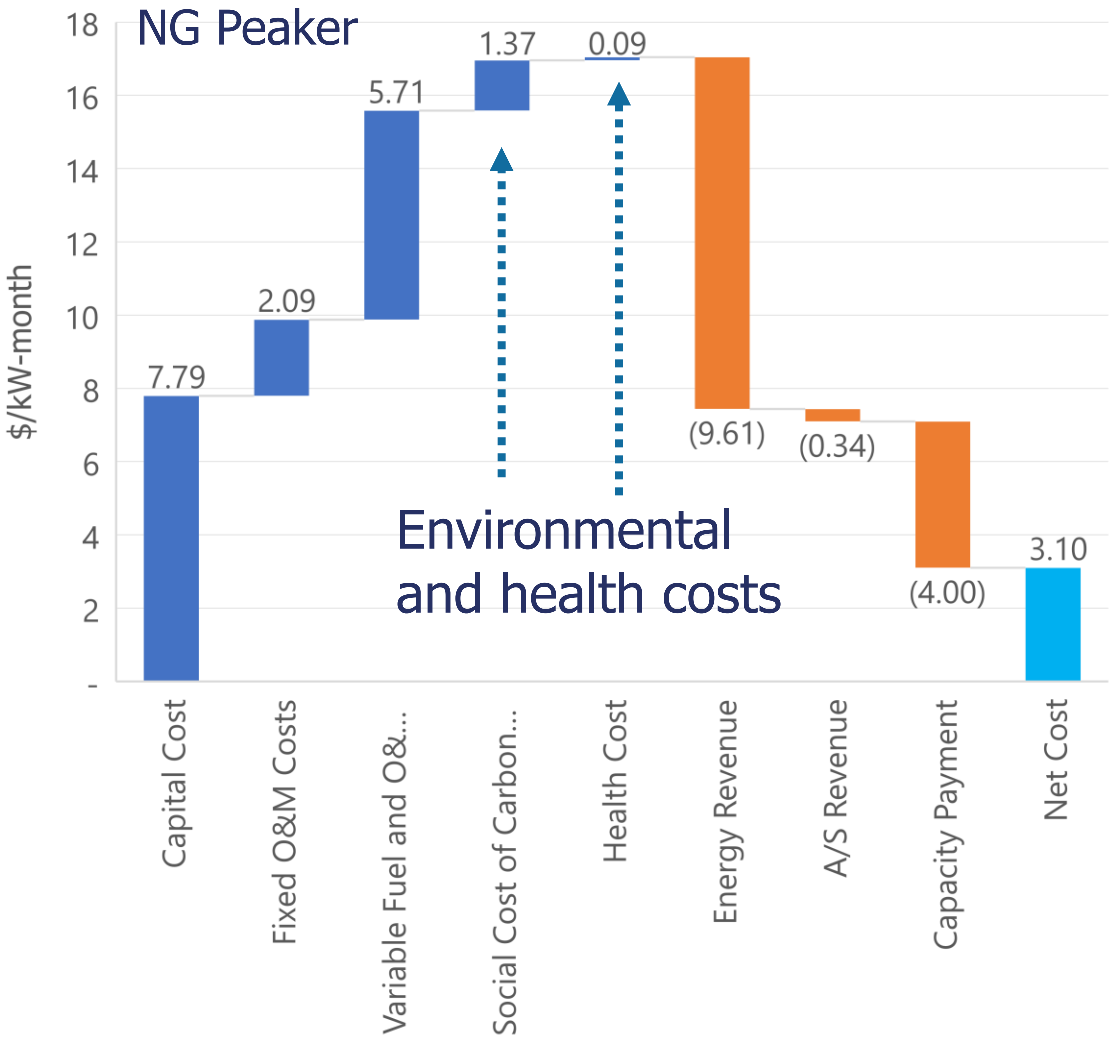
New 2-hr and 4hr Battery (ELCC)

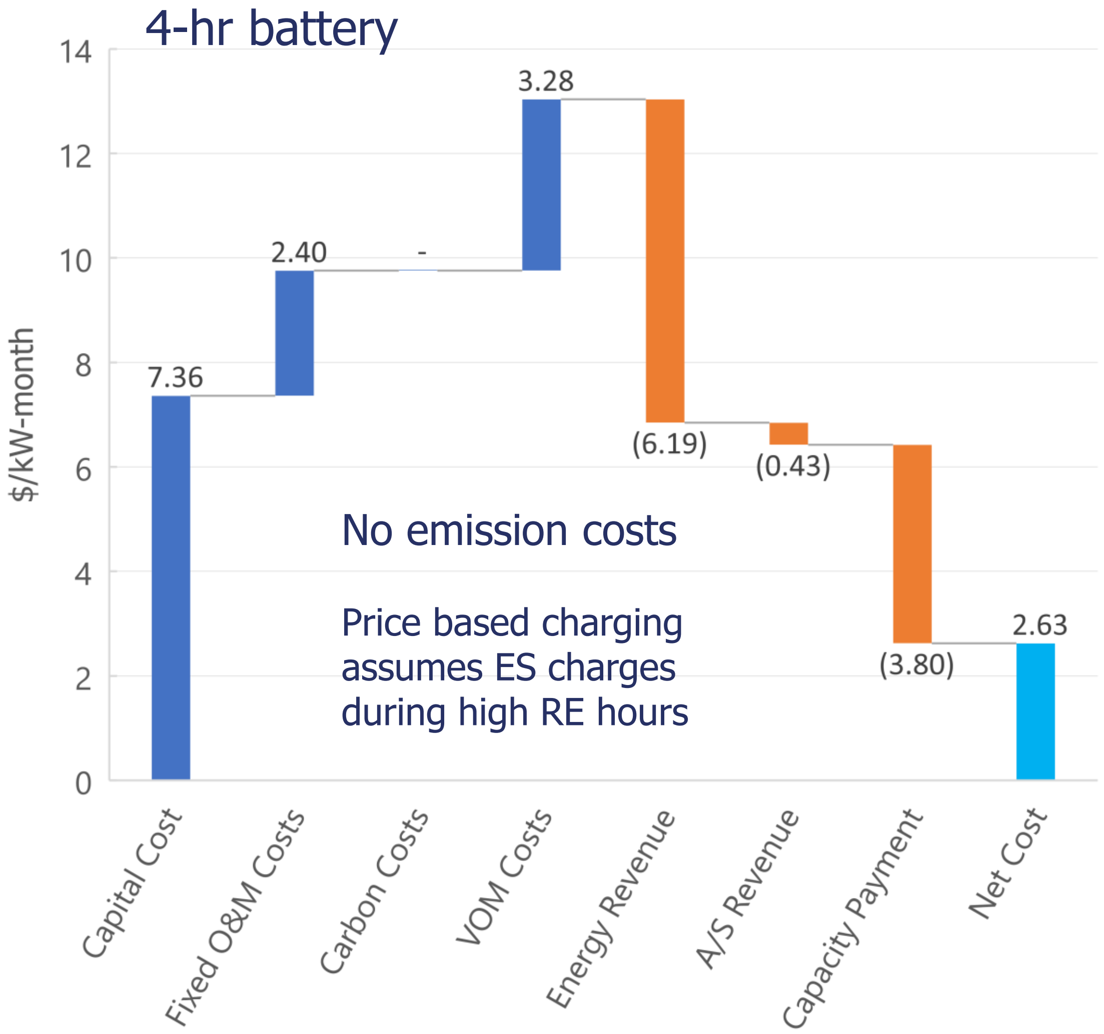




2. Cost-benefit comparison

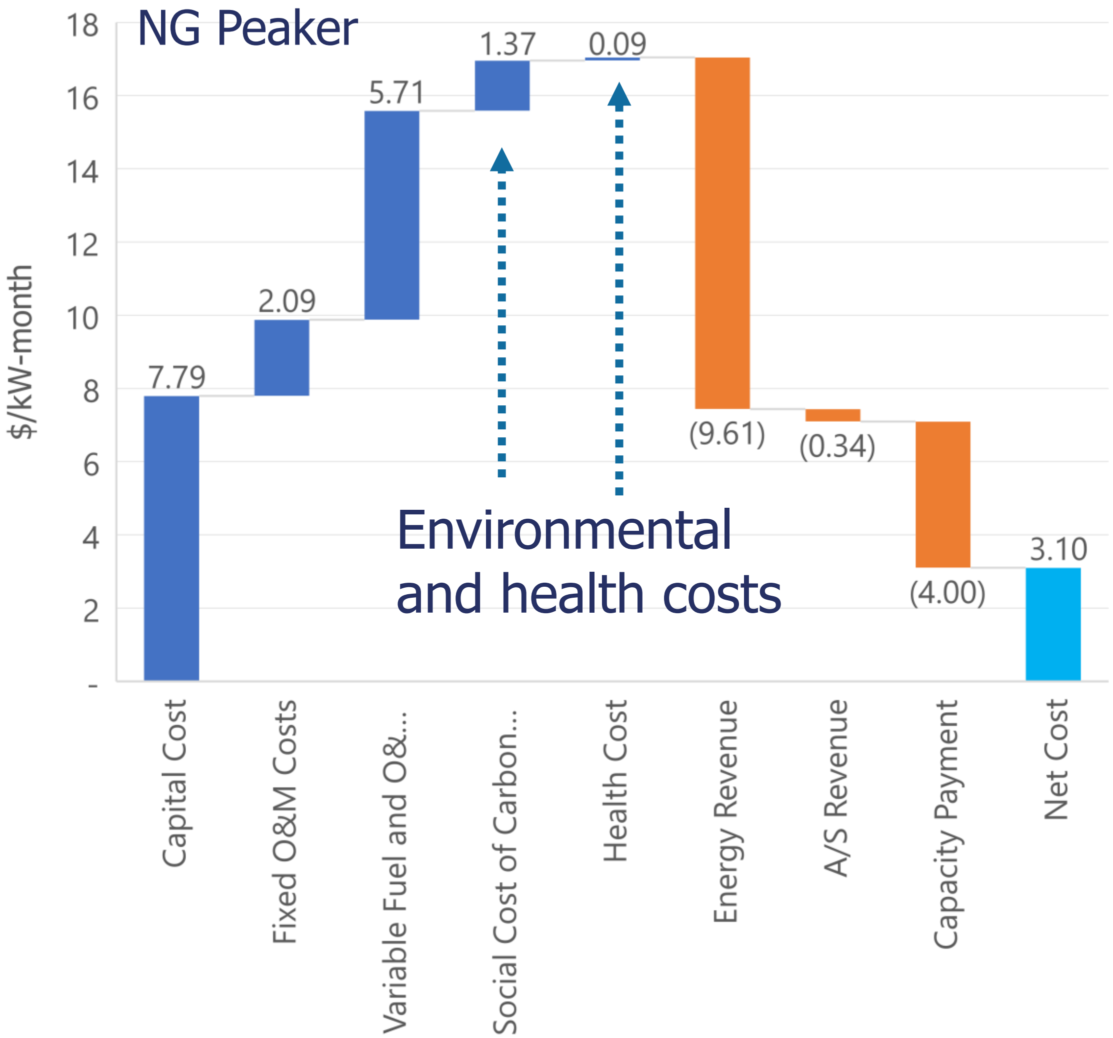
New NG Peaker and 4-hr Battery + Social Cost





2. Cost-benefit comparison

New NG Peaker + Social Cost



Replacing fossil-fueled peaker plants with battery storage would avoid this increase in emissions, resulting in environmental and human health benefits including lower risks of respiratory illness, cancer, disease, and premature mortality associated with the emission of greenhouse gases (GHG) such as CO2 and local pollutants such as SO2 and NOX.

These emissions reductions would save Maine an estimated $7.1 million annually by 2030 based on the morbidity and mortality of NOX and SO2 and precursors of fine particulate matter (PM2.5)

+ All costs accounted for, inclusive of societal costs, energy storage is the best alternative

Table 4

Comparison of New Peaking Alternatives' Net Costs Under QC and ELCC Cases, Inclusive of Health and Societal Costs ($kW-month)

QC		ELCC	
Asset	Net Cost	Asset	Net Cost
BESS, 2-hr	(0.54)	BESS, 4-hr	2.63
BESS, 4-hr	2.42	New F-Frame	3.10
New F-Frame	3.10	BESS, 2-hr	3.12

Source: Strategen Consulting

STRATEGEN

Strategen is a globally connected, impact driven firm on a mission to decarbonize energy systems

ELIASID ANIMAS
Consultant

+ Primarily works in Strategen's decarbonization strategy practice area, where he helps utilities, technology companies, governments, and NGOs to trace and achieve their clean energy and decarbonization goals.

+ Previous work in the development sector focused on city planning, transportation and energy efficiency.

+ B.A. in City and Regional Planning from UNAM

+ Contact: eanimas@strategen.com

STRATEGEN