



Port Authority of New York and New Jersey (PANYNJ) Distributed Energy Resource (DER) Techno-Economic Comparison

Cooperative Research and Development Final Report

CRADA Number: CRD-21-18244 (Project 3)

NREL Technical Contacts: Jonathan Morgenstein and Akhil
Magal

NREL is a national laboratory of the U.S. Department of Energy
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Technical Report
NREL/TP-7A40-95614
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Cooperative Research and Development Final Report

Report Date: June 3, 2025

In accordance with requirements set forth in the terms of the CRADA agreement, this document is the CRADA final report, including a list of subject inventions, to be forwarded to the DOE Office of Scientific and Technical Information as part of the commitment to the public to demonstrate results of federally funded research.

Parties to the Agreement: New York Power Authority

CRADA Number: CRD-21-18244 (Project 3)

CRADA Title: Port Authority of New York and New Jersey (PANYNJ) Distributed Energy Resource (DER) Techno-Economic Comparison

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Sponsoring DOE Program Office(s):

U.S. Department of Energy (DOE), Federal Energy Management Programs

Joint Work Statement Funding Table showing DOE Commitment:

No NREL Shared Resources

Executive Summary of CRADA Work:

To support NYPA's efforts in delivering a feasibility study to advise PANYNJ on future distributed energy resource (DER) deployments at their facilities.

CRADA benefit to DOE, Participant, and US Taxpayer:

- Assists laboratory in achieving programmatic scope
- Enhances the laboratory's core competencies
- Uses the laboratory's core competencies

Purpose:

To assist the New York Power Authority (NYPA) with delivering a feasibility study to advise the Port Authority of New York and New Jersey (PANYNJ) on future Distributed Energy Resource (DER) deployments at its facilities.

Task 1: The National Renewable Energy Laboratory (NREL) will do a high-level literature review of commercially viable DER technologies in New York City (NYC) and New York State (NYS) based on past projects and available online resources. This should include but is not limited to the below table listing various technologies with their applicable use cases (ownership models) as appropriate, Levelized Cost of energy, operation and maintenance (O&M) costs, and average installed costs, benefits, and drawbacks.

Deliverable: A spreadsheet with parameters filled out for each technology type and commercial structures (ownership model as listed in the techno-economic analysis)

DER Type	Commercial Structures
Solar Photovoltaics (PV)	Power Purchase Agreement
Solar PV	Direct Purchase
Solar PV	Tax-exempt Financing
Battery Storage (Lithium-Ion)	Power Purchase Agreement
Battery Storage (Lithium-Ion)	Direct Purchase
Battery Storage (Lithium-Ion)	Tax-exempt Financing
Battery Storage (Lithium-Ion)	Energy Services Agreement
Battery Storage (Lithium-Ion)	Commercial Land Lease (Direct Market Participation)
Battery Storage (Non-Lithium)	
Kinetic Energy Storage	
Thermal Energy Storage	
Natural Gas Fuel Cell	
Hydrogen Fuel Cell	
Vertical Axis Wind Turbine	
Horizontal Axis Wind Turbine	

NREL experts identified a list of commercially viable DER technologies in the New York City and New York State regions based on past projects and online resources. Expanding on the table in the task, the analysis included a comprehensive review of additional technologies as included in the table in the prior “Summary of Research Results” section.

NREL experts delivered the literature review to NYPA and PANYNJ in a Word document report format.

NREL provided support to New York Port Authority (NYPA) to assess the techno-commercial landscape of advanced energy technologies that can be deployed in NYPA’s jurisdiction. The research project examined state-of-the art energy technologies such as solar photovoltaics (PV), wind and storage. It also looked at a plethora of business models under which these technologies may be deployed, such as, rooftop PV, community solar, utility-scale solar, thermal energy storage, chemical storage, and others.

A complete list of the technologies examined and studied is listed in the table below. For each technology, the following parameters were reported: (1) General description, (2) General “pros and cons” (3) Capital cost, (4) Operating cost, (5) Levelized Cost of Energy (LCOE).

#	Technology Studied
I	Solar PV
1	Solar PV Community – No ITC grants
2	Solar PV Community – With ITC grants
3	Solar PV - Rooftop Residential – No ITC grants
4	Solar PV - Rooftop Residential – With ITC grants
5	Solar PV – Rooftop – Commercial & Industrial (C&I) – No ITC grants
6	Solar PV – Rooftop – Commercial & Industrial – With ITC grants
7	Solar PV – Utility Scale – No PTC
8	Solar PV – Utility Scale – With PTC grants
9	Solar PV – Utility Scale – Global prices
10	Solar PV – Utility Scale – USA prices
11	Solar PV – Utility Scale – Power Purchase Agreements (PPA)
12	Solar PV - New York specific data- Utility Scale
13	Solar PV - New York specific data- Residential, C&I
II	Energy Storage
14	Thermal Storage – Sensible Heat Storage – Indirect Storage
15	Thermal Storage – Sensible Heat Storage – Direct Storage (2 tanks)
16	Thermal Storage – Sensible Heat Storage – Direct Storage (1 tank)
17	Solar Thermal Electricity - Latent Heat Storage
18	Solar Thermal Electricity - Thermo-Chemical Storage
19	Concentrated Solar Power (CSP)
III	Wind
20	Onshore Wind – No ITC credits
21	Onshore Wind – With ITC credits
22	Onshore Wind – Global Projects
23	Onshore Wind – USA Wide Projects

24	Offshore Wind – No ITC Credits
25	Offshore Wind – Global Projects
26	Offshore Wind – USA Wide Projects
27	Small Scale Wind – 100kW – Commercial Projects
28	Small Scale Wind –20kW – Residential Projects
29	Offshore Vertical Axis Wind
IV	Fuel Cell & Hydrogen
30	PEM Electrolyzer
31	PEM Fuel Cell
32	Natural Gas Solid Oxide Fuel Cell + PV
V	Kinetic Energy Storage
33	Kinetic Energy Storage - Flywheel - Composite Rotor
34	Kinetic Energy Storage - Flywheel - Steel Rotor
35	Kinetic Energy Storage - Flywheel
VI	Hydro
36	Pumped Hydro – USA
37	Pumped Hydro – Global
VII	Other Technologies
38	Biopower
39	Geothermal

Task 2: CRADA Final Report: Preparation and submission in accordance with Article X.

This report serves to meet the requirement for the CRADA Final Report with preparation and submission in accordance with the agreement’s Article X.

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ROI#: None.