Solar and Battery Storage Permitting and Siting Requirements - Solar Prize Round 7

Cooperative Research and Development Final Report

CRADA Number: CRD-24-30367

NREL Technical Contact: Aaron Levine

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Technical Report
NRELTP-6A20-95408
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Cooperative Research and Development Final Report

Report Date: May 29, 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: 1Climate

CRADA Number: CRD-24-30367

CRADA Title: Solar and Battery Storage Permitting and Siting Requirements - Solar Prize Round 7

Responsible Technical Contact at NREL:

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Name and Email Address of POC at Company:

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Sponsoring DOE Program Office(s): Office of Energy Efficiency and Renewable Energy (EERE), Solar Energy Technologies Office**,** Solar Prize Voucher

Joint Work Statement Funding Table showing DOE commitment:

Estimated Costs	NREL Shared Resources Government In-Kind
Year 1	$37,500.00
Year 2, Modification #1	$.00
Year 3, Modification #2	$.00
Year 4, Modification #3	$.00
TOTALS	$37,500.00

Executive Summary of CRADA Work:

The purpose of this project is to identify local zoning ordinances, state permitting requirements, federal regulatory bottlenecks throughout the development process, and the potential to use Large Language Models (LLM) and aggregate permitting and interconnection data for commercial and industrial (C&I), community, and utility-scale solar photovoltaic (PV) and battery storage projects.

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CRADA benefit to DOE, Participant, and U.S. Taxpayer:

- Uses the laboratory's core competencies, and/or
- Enhances U.S. competitiveness by utilizing DOE developed intellectual property and/or capabilities.

Summary of Research Results:

The intent of this project was to identify state and municipal zoning ordinances and permitting processes for C&I, community, and utility-scale solar and battery storage projects; validate and improve the accuracy of LLMs to retrieve this data in the future iterations of the 1Climates application and provide an overall roadmap of federal statutes that can have a significant impact on development timelines. Due to the CRADA partner, 1Climate, selling its intellectual property during the execution of this CRADA, these tasks were either partially completed or not undertaken.

Task 1:

1.2 Contractor will compile data on solar and battery storage permitting and siting requirements for C&I, community, and utility-scale projects into a query-able database.

1.1 Contractor will research zoning ordinances and land use restrictions for solar and battery storage across federal, state, municipal, and utility levels.

1.2 Contractor will detail pathways to permitting for discretionary permits and other special permit requirements for solar and battery storage.

State and Municipal Permitting and Zoning Ordinances for Solar and Battery Storage

The research team began its collection of zoning ordinances and land use restrictions for solar and battery storage projects at the state and municipal levels for the following states (See Figure 1):

- Massachusetts
- Michigan
- Illinois
- Pennsylvania

This research entailed collecting state-level permitting requirements for solar and battery storage projects, identifying municipal zoning ordinances and permitting requirements for approximately 15-20 municipalities, and identifying any interactions between state-level permitting requirements and local zoning ordinances and permitting requirements. Initially, data collection was planned in at least six states; however, early termination of the CRADA agreement limited the collection to the four states identified above.

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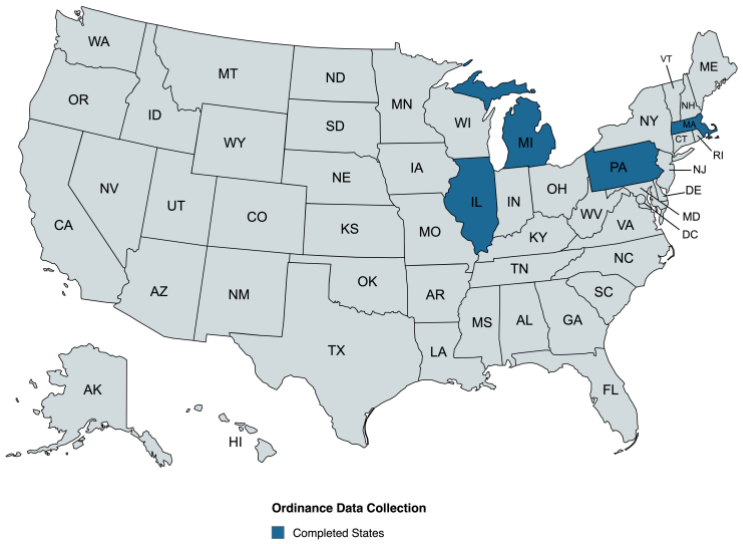

Figure 1. Completed States for Ordinance Data Collection

Task 2:

Contractor will support the Participant in validating and improving the accuracy of solar regulatory data retrieved through Large Language Models through techniques like prompt engineering.

LLM Validation of Additional State and Municipal Permitting and Zoning Ordinances for Solar and Battery Storage

The research team planned to assist 1Climate in validating additional state and municipal permitting and zoning ordinances for solar and battery storage based on the terminology and types of permits and zoning ordinances identified during the data collection in Task 1.

The CRADA was terminated before this task could be started.

Task 3:

Contractor will create a solar project development roadmap with detail on federal statutes that can have a significant impact on development timelines (e.g., NEPA, Endangered Species Act, National Historic Preservation Act) and the alternative pathways for avoiding lengthy reviews (e.g., categorical exclusions)

Solar Project Development Roadmap on Federal States Impacting Development Solar and Battery Storage Timelines

The research team planned to assist 1Climate by creating a solar project development roadmap with detail on federal statutes that can have a significant impact on development timelines (e.g., National Environmental Policy Act, Endangered Species Act, National Historic Preservation Act) and the alternative pathways for avoiding lengthy reviews (e.g., categorical exclusions).

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The CRADA was terminated before this task could be started.

Task 4: Additional Tasks

Contractor will perform other work at the direction of the Participant, consistent with the scope and subject to the availability of funding.

Task 4: Additional Tasks

The research team planned to perform other work at the direction of the 1Climate, consistent with the scope and subject to the availability of funding.

The CRADA was terminated before this task could be started.

Task 5: CRADA Final Report

The parties agreed to prepare a CRADA Final Report: preparation and submission in accordance with the terms of this agreement.

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

Subject Inventions Listing: None

ROI#: None

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