Vehicle Charging Innovations for Multi-Unit Dwellings (VCI-MUD) Project

Vehicle Technologies Office Annual Merit Review

June 2, 2020

Principal Investigator: Kevin Wood, Center for Sustainable Energy

Project ID: ti092

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ENERGETICS

FORTH

Center for Sustainable Energy™

Overview

Timeline

- Start: April 2019
- End: June 2022
- 33% Complete
- BP1: 4/2019-6/2020
- BP2: 7/2020-6/2021
- BP3: 7/2021-6/2022

Budget

- Total project funding: $3M
  - DOE share: $1.5M ($75K FFRDC)
  - Contractor share: $1.5M
- Funding for BP1: $1.2M

Barriers Addressed

- Limited availability plug-in electric vehicle (PEV) charging stations for multi-unit dwelling (MUD) residents
- High costs of installing and managing PEV charging stations for MUD residents
- Lack of awareness of how to successfully procure and manage PEV charging stations for MUD residents

Overview (continued)

Partners

- Center for Sustainable Energy (Project lead)
- Energetics (Data/Demonstration Lead)
- Forth (Outreach Lead)
- Idaho National Laboratory
- National Association of State Energy Officials
- EV Charging Technology Providers
- Utilities
- State and Local Government Agencies
- Clean Cities Coalitions (12)

Project Objectives

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- Engaging stakeholders across the country to determine the barriers they experience with MUD charging
- Demonstrating innovative technologies that address the barriers
- Compiling project findings in an easy-to-use toolkit
- Disseminating the toolkit across national, regional, state, and local channels.

Tech Integration Goals

•National Security – Increase availability of PEV charging to facilitate fuel diversity and domestic fuel sources

•Economic growth – Demonstrate innovative PEV charging technology to spur business opportunities

•Affordability – Educate MUD owners and residents on ways to reduce costs related to PEV charging

Impact on Barriers

•Collect data on existing MUD PEV charging stations and analyze current utilization to identify scenarios for addressing barriers with innovative technology

•Demonstrate technologies to reduce MUD PEV charging costs and ease management barriers

•Create an outreach tool and conduct PEV charging outreach to MUD owners and residents

Project Approach

Task 0: Project Management and Coordination

Task 1: Baseline Residential MUD and Curbside EVSE Evaluation

Task 2: Charging Infrastructure Innovations Demonstration Planning

Task 3: Pilot Demonstrations and Evaluation

Task 4: Partner Engagement, Toolkit Development, and Technology Transfer/Market Transformation Plan

Project Task Descriptions

Task 1: Baseline Evaluation

- Characterize current MUD and curbside residential EVSE deployments by:
  - Establishing data sharing agreements with existing relevant EVSE
  - Collecting and analyzing baseline installations to determine the current state of practice and to identify areas of improvement.

Task 2: Demonstration Planning

- Determine final list of innovative PEV charging technology
- Engage technology innovators for project participation and technology sharing
- Develop/execute agreements for innovative technology demonstrations agreements
- Develop demonstration plan.

Task 3: Pilot Demonstrations and Evaluation

- Implement the approved innovative technology demonstration plan
- Install the innovative technologies
- Demonstrate innovation in real world use
- Collect and analyze operational and business case data.

Task 4: Partner Engagement and Toolkit Development

- Capture stakeholder input on barriers and motivations
- Compile existing resources on a user-friendly roadmap
- Develop a MUD and Curbside Residential Charging Toolkit
- Disseminate Toolkit and lessons learned through webinars, presentations, publications, in-person workshops

Milestones

0.0: Completed Project Management Plan (May 2019)

1.2 Completed Baseline Infrastructure Assessment (June 2020)

2.1.1: Completed Additional Innovative Technologies Assessment (November 2019)

2.2.1: Approved Innovative Technologies Demonstration Plan (June 2020) **GO/NO GO**

4.3: Develop and implement project communication strategy (August 2019)

4.5.4: Updated project results presentation at Roadmap 2020 / EVS33 conference (Canceled)

Future Milestones

3.1: Completed Pilot Demonstrations and Evaluation GO/NO GO

4.4.1: Complete Five (5) Fact sheets

'Milestone 4.4.2: Complete Five (5) Stakeholder Toolkits tools

4.5.4: Updated project results presentation at Roadmap 2021 or other conference

Any proposed future work is subject to change based on funding levels

Project Accomplishments and Progress

Administration

- Contracting and coordination with more than two dozen partners

Outreach and Engagement

- PAC meetings & member engagement
- Shared project design and process at multiple conferences, radio interview, news article

Data Collection / Analysis

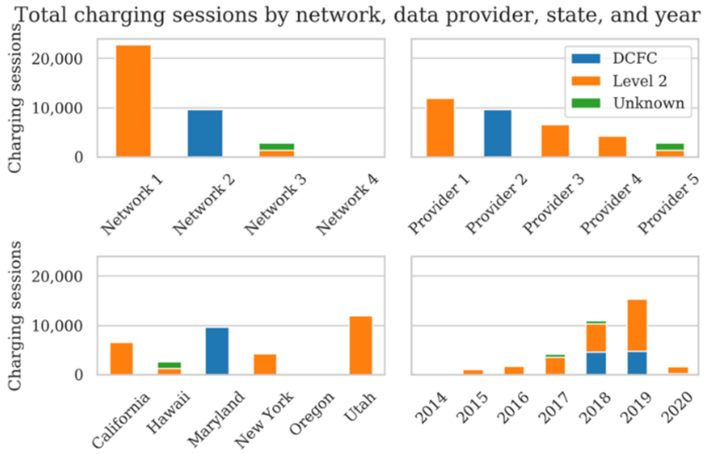
- Barriers review
- Established large, diverse data set

Accomplishments: Barriers & Data collection

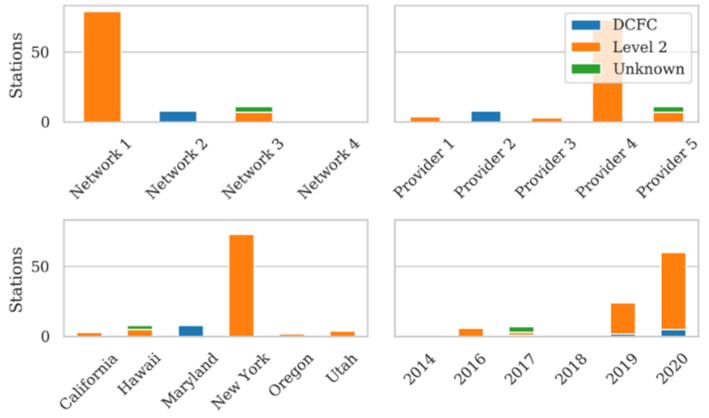
- **Barriers Review**
  - Compiled barriers from PAC, survey, literature review, and interviews
  - Documented in table to serve a reference ensuring demonstrations and toolkits are addressing all barriers.
- **Data Gathering**
  - Some committed partners provided data as expected, others had less useful data than expected, others decided to not participate.
  - Leveraged PAC members and data partner connections to expand collected dataset
  - In most cases, MUD EV charging infrastructure not known to utility or local Clean Cities Coalitions. So, identifying additional potential data providers has proved difficult

Accomplishments: Baseline Data results

- **Data Summary**
  - 6 data providers as of April 1, 2020
  - ~606,000 charge sessions (~24,500 port-months); ~40% from committed data partners
  - Includes 914 locations, with at least 2,286 charging stations
  - Only MUD data were requested. Data filters developed/applied to verify/screen data not known to be MUD. → Result – Currently 10% of data MUD data.
  - Finalizing development of filters/logic to identify MUD resident sessions at nearby off-premises "MUD-adjacent" charging stations
  - No charging information at other locations (work, retail, other networks, etc.)



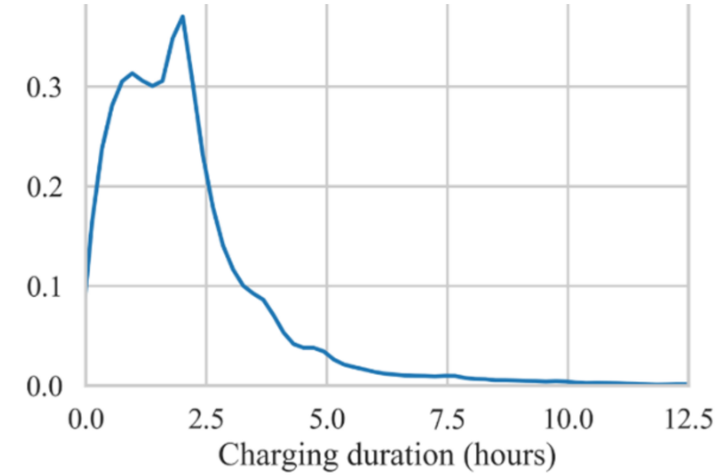
Total charging stations by anonymized network, anonymized data provider, state, and year

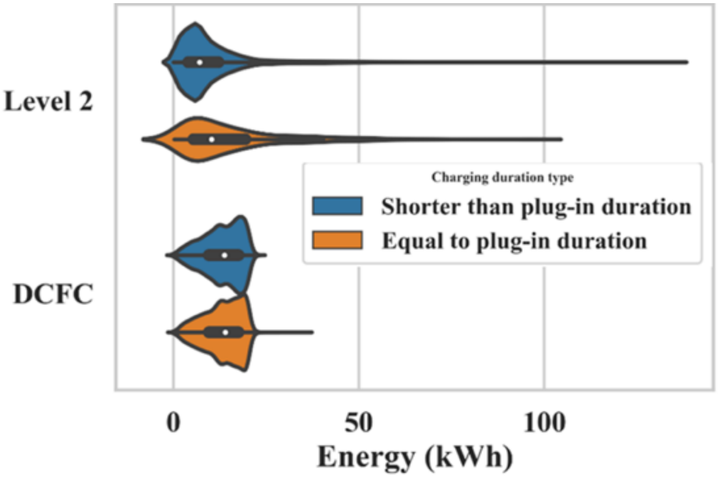


Unique stations by anonymized network, anonymized data provider, state, and year

Accomplishments: Baseline Data results

- **Data Analysis Summary**
  - 90% of :2 charging sessions were between 0-5 hours/ 50% were 1-2.5 hours. → Shorter than expected.
  - Evaluating timing of charge sessions.
  - Average energy provided per charge session is ~10 kWh. Lower than expected.
    - Perhaps: 1) indicates need for more data, 2) vehicles are also charged at locations other than home, 3) mileage is just low.





Demonstration Planning

- **Innovative Technology providers:**
  - Committed: OpConnect, Liberty Plugins, CyberSwitching, Electric Vehicle Institute, PowerFlex, and Freewire Technologies
  - Additional(pending final agreements): Xeal Charge, ampUp, and EverCharge
- **Combined technology functionality set includes** (each system has 1+ functions):
  - 1) manages load on electric line to maximize utilization (scheduling, throttling, rotational) and minimize costs (kWh and demand charges), 2) SW added functionality to “dumb” stations (control, access control, billing, data collection, analytics) for dedicated and shared EV charging stations, 3) turnkey management to eliminate property manager labor, 4) DCFC and curbside charging, 5) battery energy storage system for demand charge management, 6) mobile L2 EVSE.
- **Demonstration plan being developed & sites secured**

Any proposed future work is subject to change based on funding levels

Collaboration and Coordination Among Project Team

Sponsor: US DOE VTO

Monthly Meetings; Fall 2019 Site Visit;
Quarterly Project Advisory Committee Meetings

Project Team Leads

Prime: Center for Sustainable Energy™

Subs: ENERGETICS, FORTH

Bi-Weekly Meetings
DropBox File share

Project Advisors

Quarterly Online Meetings & Newsletters

- Idaho National Laboratory *(Analysis Advisor)*
- National Association of State Energy Officials *(Outreach Partner)*
- Utilities
- MUD Developers / Property Managers
- EV Charging Technology Providers
- State and Local Governments

Logos used with permission

Clean Cities Coalition Outreach Partners

Monthly Conference Calls

Project subs:

Western WA Clean Cities

Wisconsin Clean Cities

Columbia - Willamette Clean Cities

South Shore Clean Cities, Inc. Northern Indiana

Virginia Clean Cities

Greater Washington Region Clean Cities Coalition

Chicago Area Clean Cities

Tulsa Area Clean Cities

Clean Communities of Central New York www.CCofCNY.com

Project advisors:

Massachusetts Clean Cities

Accelerating Maryland's Clean Cities Transportation Future

Clean Cities Los Angeles

Hosted in Prime:

San Diego Regional Clean Cities Coalition

Advisors and Technology Partners

EVSE Evaluation/Demonstration Site Stakeholders

- **ComEd** – Utility installing curbside EVSE in Chicago area
- **OpConnect** – Technology provider with potential MUD EVSE site in San Diego
- **Electric Vehicle Institute** – Technology provider with MUD EVSE sites in Maryland
- **Bozzuto** – Developer with MUD sites in DC Metro Area
- **LA Bureau of Streetlighting** – MUD and curbside EVSE sites in Los Angeles
- **GIV Group** – Developer with EVSE MUD sites in Utah
- **Xeal** – Technology provider with potential MUD EVSE sites in CA
- **EverCharge** – Technology provider with potential MUD EVSE sites

Additional Innovative EV Charging Technology Providers

- Cyber Switching Solutions, Inc.
- Liberty Plugins
- Power Flex Systems
- FreeWire Technologies

State and Local Government Project Advisors

- New York State Energy Research and Development Authority
- City of Seattle
- Chicago Department of Transportation
- Maryland Energy Administration
- Indian Nations Council of Governments
- National Association of State Energy Officials

Market Impact and Sustainability

MUDs are a growing portion of the housing stock nationally

Project engagement has confirmed that MUD EV infrastructure installations are difficult from both a site host perspective and an EV service provider perspective

Reaching MUD properties has been challenging

Documenting successful approaches to reach MUD stakeholders

Project will result in technologies and tools that help MUDs adopt EV infrastructure

Clean Cities Collations and others can help MUDs through the process. Market actors are not currently meeting this need.

Any proposed future work is subject to change based on funding levels

Summary

Goal

- Address barriers/market need for MUD residents
- Will promote widespread, equitable access to EV Charging

Approach

- Coordinate strong national team
- Entering critical phase of innovative technology deployments

Achievements

- On schedule and under budget
- Data Analysis and demonstration planning
- Promotion: Project landing page, Presentations, FuelsFix article, radio interview

Technical Back-Up Slides

Project Timeline and Milestones

DOE Budget Period 1 Schedule	Status	Lead	2019 Q1			2019 Q2			2019 Q3			2020 Q4			2020 Q5		
			April (M1)	May (M2)	June (M3)	July (M4)	Aug (M5)	Sept (M6)	Oct (M7)	Nov (M8)	Dec (M9)	Jan (M10)	Feb (M11)	Mar(M12)	April (M13)	May (M14)	June (M15)
Task 0 - Project Management and Planning																	
Milestone 0.0: Completed Project Management Plan	Complete	CSE		✓													
DOE Kick-off meeting	Complete	CSE			✓												
CCC Kick-off meeting	Complete	CSE					✓										
Partner Contracting	In progress	CSE														X	
Task 1 - Baseline Residential MUD and Curbside EVSE Evaluation																	
Milestone 1.1: Executed Data Sharing and Facility Use Agreements	Complete	Energetics					✓										
Draft Data Use Agreement	Complete	Energetics					✓										
Data Use Agreement Review	Complete	CSE/INL					✓										
Data Use Agreement Finalization and Distribution	Complete	Energetics					✓										
1.2 - Complete baseline infrastructure assessment																	
T1.2a1 Coordinate with INL on Data Use Agreeement and data gathering/storage (mtg.1)	In progress	Energetics/CSE													X		
T1.2a2 Coordinate with INL on data analysis (mtg.2)	In progress	Energetics													X		
T1.2b Engage Project Partnes & secutre data/usage agreements	In progress	Energetics													X		
T1.2c Develop a Draft Baseline Data Collection Protocol	In progress	Energetics													X		
T1.2d Collect data from partners (6-12 months)	In progress	Energetics													X		
T1.2e Analyze Data from partners	In progress	Energetics														X	
T1.2f Present findings to project team	Not Started	Energetics														X	
T1.2g Present findings to DOE & project stakeholders	Not Started	Energetics															X
Milestones 1.2 Completed Baseline Infrastructure Assessment	Not Started	Energetics															X
Task 2 – Charging Infrastructure Innovations Demonstration Planning																	
2.1 - Identify Additional Innovative Technologies																	
Milestone 2.1.1: Completed Additional Innovative Technologies Assessment	Complete	All									X						
Engage and secure agreements for innovative technologies	In progress	Energetics													X		
2.2 - Develop Demonstration Plan																	
Milestone 2.2.1: Approved Innovative Technologies Demonstration Plan	Not Started	Energetics															X
Determine innovative technology installation requirements, approach design (outline)	Complete	Energetics								✓							
Draft Plan	In progress	Energetics													X		
Draft Plan Review (Leads & Select Group)	Not Started	CSE/Forth														X	
Draft Plan Review (PAC)	Not Started	PAC															X
Task 3 – Pilot Demonstrations & Evaluations																	
Go/No-Go/Milestone 3.1: Completed Pilot Demonstrations and Evaluation																	

Milestones (DOE Approval)

Milestone 0.0: Completed PMP
Milestone 2.2.1: Approved Innovative Technologies Demonstration Plan
Milestone 3.1: Completed Pilot Demonstrations and Evaluation

Deliverables

D1: Annual Programmatic Progress Report
D2: Summary of accomplishments and project work report will be prepared for inclusion in the annual programmatic progress report.
D3:Final Toolkit posted on a user-friendly online portal and in Final Technical Report
D4: Final Toolkit, Final Technical Report/Final Technology Transfer/Market Transformation Plan

Project Timeline and Milestones

40	Task 4 – Partner Engagement, Toolkit Development, and Technology Transfer/Market Transformation Plan													
41	**4.1 - Project Advisory Committee Stakeholder Engagement**													
42	PAC Meeting 1	Complete	CSE			✓								
43	PAC Meeting 2	Complete	CSE				✓							
44	- PAC Survey on Barriers (Design)	Complete	CSE/Forth					✓						
47	PAC Meeting 3	Complete	CSE						✓					
48	PAC Meeting 4	Complete	CSE								✓			
49	PAC Meeting 5	Not Started	CSE											x
50	-Planning	Not Started	All										x	
51	**4.2 - Document innovative deployments and pilot demonstrations**													
52	-Collect relevant information on the innovative deployments and pilot demonstrations	Not Started	Forth											
53	**4.3 - Develop and Implement Project Communication Strategy**													
54	-Draft Communication Strategy submitted to Team	Complete	Forth				✓							
55	-Team Input/Feedback to Forth	Complete	All					✓						
56	-Draft Communication Strategy submitted to Team	Complete	Forth				✓							
57	-Team Input/Feedback to Forth	Complete	All					✓						
58	*Milestone 4.3: Develop and implement project communication strategy*	Complete	Forth						✓					
59	**4.4 - Toolkit Development and Testing**													
60	-Initial Ideation	Complete	Forth				✓							
61	-Team Input/Feedback to Forth	Complete	CSE/Energetics					✓						
62	-Toolkit Gaps Analysis/Ranking/Review (Team)	Complete	All					✓						
63	-Toolkit Gaps Analysis/Ranking/Review (PAC)	Complete	PAC						✓					
64	Milestone 4.4.1: Complete Five (5) Fact sheets	Not Started	Forth											
65	Milestone 4.4.2: Complete Five (5) Stakeholder Toolkits tools	Not Started	Forth											
66	**4.5 - Information Dissemination**													
67	Milestone 4.5.1: Delivery of three (3) webinars to stakeholders and identified groups	Not Started	Forth/CSE											
68	Milestone 4.5.2: Submission of three (3) relevant trade journal articles regarding the project findings	Not Started	Forth/CSE											
69	Milestone 4.5.3: Initial project results presentation at Roadmap 2019 conference	Complete	Forth/CSE						✓					
70	Milestone 4.5.4: Updated project results presentation at Roadmap 2020 / EVS33 conference	Not Started	All											
71	Milestone 4.5.5: Final project results presentation at Roadmap 2021 conference	Not Started	All											
72	Milestone 4.5.6: Delivery of three (3) additional webinars with stakeholders and identified groups	Not Started	All											
73	Milestone 4.5.7: Six (6) additional presentations at industry-specific conferences or venues	Not Started	All											
74	**4.6 - Final MUD and Curbside Residential Charging Toolkit Development**													
75	-Develop final toolkit with most updated version of project technical information	Not Started	Forth											
76	Milestone 4.6/Deliv.4.1: Final Toolkit posted on user-friendly online portlan and in Final Technical Report	Not Started	Forth											
77	**4.7 - Technology Transfer/Market Transformation Plan**													
78	-Draft Technology Tranformation Outline/Plan submitted to Team	Not Started	Forth				✓							
79	-Team Input/Feedback to Forth	Not Started	All											
80	-Finalize Market Transformation Plan	Not Started	Forth											
81	Milestone 4.7/Deliverable 4.2: Final Technology Transfer / Market Transformation Plan	Not Started	All											

Milestones (DOE Approval)

Milestone 0.0: Completed PMP
Milestone 2.2.1: Approved Innovative Technologies Demonstration Plan
Milestone 3.1: Completed Pilot Demonstrations and Evaluation

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Reviewer-Only Slides

Presentations

- EVs and the Grid: Los Angeles, October 2018 (pre-award)
- Green Transportation Summit and Expo: Tacoma, WA May 2019
- EUEC Transportation Electrification Expo: San Diego, CA October, 2020
- Charge Expo: San Diego, CA November 12, 2020
- Green Transportation Summit and Expo: Tacoma, WA April 2020 (Canceled)
- EV Roadmap 2020/ EVS 33, Portland, OR (Canceled)