CALIFORNIA ENERGY COMMISSION

California Energy Commission

Clean Transportation Program

FINAL PROJECT REPORT

Northern California Center for Alternative Transportation Fuels and Advanced Vehicle Technologies (North CAT)

Prepared for: California Energy Commission

Prepared by: University of California, Berkeley

UNIVERSITY OF CALIFORNIA Berkeley
Transportation Sustainability
RESEARCH CENTER

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PREFACE

Assembly Bill 118 (Núñez, Chapter 750, Statutes of 2007) created the Clean Transportation Program, formerly known as the Alternative and Renewable Fuel and Vehicle Technology Program. The statute authorizes the California Energy Commission (CEC) to develop and deploy alternative and renewable fuels and advanced transportation technologies to help attain the state's climate change policies. Assembly Bill 8 (Perea, Chapter 401, Statutes of 2013) reauthorizes the Clean Transportation Program through January 1, 2024, and specifies that the CEC allocate up to $20 million per year (or up to 20 percent of each fiscal year's funds) in funding for hydrogen station development until at least 100 stations are operational.

The Clean Transportation Program has an annual budget of about $100 million and provides financial support for projects that:

- Reduce California's use and dependence on petroleum transportation fuels and increase the use of alternative and renewable fuels and advanced vehicle technologies.
- Produce sustainable alternative and renewable low-carbon fuels in California.
- Expand alternative fueling infrastructure and fueling stations.
- Improve the efficiency, performance and market viability of alternative light-, medium-, and heavy-duty vehicle technologies.
- Retrofit medium- and heavy-duty on-road and nonroad vehicle fleets to alternative technologies or fuel use.
- Expand the alternative fueling infrastructure available to existing fleets, public transit, and transportation corridors.
- Establish workforce-training programs and conduct public outreach on the benefits of alternative transportation fuels and vehicle technologies.

To be eligible for funding under the Clean Transportation Program, a project must be consistent with the CEC's annual Clean Transportation Program Investment Plan Update. The CEC issued PON 13-605 to develop a Center for Alternative Fuels and Advanced Vehicle Technology. In response to PON-13-605, the recipient submitted an application which was proposed for funding in the CEC's notice of proposed awards February 6, 2014 and the agreement was executed as ARV-13-021 on August 12, 2014.

ABSTRACT

This agreement was to develop the Northern California Center for Alternative Transportation Fuels and Advanced Vehicle Technologies (NorthCAT) and develop a network of locations, institutional arrangements, and virtual communications systems. The NorthCAT project under this agreement prepares for future activities such as conducting a broad range of alternative fuel and advanced vehicle technology showcase and demonstration, training and outreach, and project facilitation programs.

The agreement involved a partnership of five subcontractors along with the prime recipient, the Regents of the University of California – Berkeley Transportation Sustainability Research Center. The key additional project partners are Frontier Energy, the Center for Transportation and the Environment, Humboldt State University, Schatz Energy Research Center, the Lawrence Berkeley National Laboratory with CalCharge, Prospect Silicon Valley with the Bay Area Climate Collaborative, and the Bay Area Air Quality Management District.

This final project report documents the project goals and accomplishments as initially defined in the project work scope and schedule of deliverables. The report also includes a description of the physical and virtual management plans and procedures for operation of the NorthCAT project and a summary of the center development plan and the planned next steps for the project to continue.

Keywords: Alternative fuels, biofuels, electric vehicle, EV, plug-in electric vehicle, PEV, hydrogen, fuel cell, cars, trucks, buses

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EXECUTIVE SUMMARY

The project “Northern California Center for Alternative Transportation Fuels and Advanced Vehicle Technologies” (NorthCAT) was selected for $1,566,667 in funding under ARV-13-021. The purpose of the project was to develop a network of locations, institutional arrangements, and virtual communications systems to prepare a center for activities such as conducting a broad range of alternative fuel and advanced vehicle technology showcase and demonstration, training and outreach, and project facilitation programs.

The key NorthCAT physical spaces, with the indoor spaces linked through a communication infrastructure, include:

- Indoor learning classroom at Berkeley Global Campus Building 445 in Richmond (Contra Costa County).
- Outdoor exhibit/showcase learning kiosk at Berkeley Global Campus Building 445 in Richmond.
- Outdoor power systems display area near Building 167 in Richmond.
- Outdoor signage at the UC Berkeley 70 megapascal hydrogen fueling station near Building 192-T in Richmond.
- Outdoor exhibit/showcase learning kiosk located outside the main entrance to ProspectSV in San Jose (Santa Clara County).
- Outdoor and indoor learning spaces at the Schatz Energy Research Center in Arcata (Humboldt County).
- Indoor learning space at the California Fuel Cell Partnership building in West Sacramento (Yolo County).
- Indoor meeting space at the David Brower Center in Berkeley (Alameda County).

The NorthCAT project has successfully fulfilled its purpose by developing a useful foundation for physical locations for meetings and training events, as well as internet-based education opportunities and community engagement efforts.

CHAPTER 1: Introduction

Problem Statement and Project Background

The project "Northern California Center for Alternative Transportation Fuels and Advanced Vehicle Technologies" (NorthCAT) was proposed to the California Energy Commission under Program Opportunity Notice 13-605 and subsequently selected for $1,566,667 in funding under ARV-13-021, executed August 12, 2014. The award established the NorthCAT center with a project term from August 12, 2014, through March 31, 2018.

The NorthCAT project involves a partnership of five subcontractors along with the prime recipient, the Regents of the University of California – Berkeley (UC Berkeley) Transportation Sustainability Research Center. The key additional project partners are Frontier Energy, the Center for Transportation and the Environment, Humboldt State University – Schatz Energy Research Center (SERC), the Lawrence Berkeley National Laboratory (LBNL) with CalCharge, Prospect Silicon Valley (ProspectSV) with the Bay Area Climate Collaborative, and the Bay Area Air Quality Management District (BAAQMD). (During this project, BKi merged with four other companies and changed its name to Frontier Energy. For clarity, this report uses Frontier Energy.)

This final report documents the project goals as initially defined in the project work scope and accomplishments and schedule of deliverables. The report includes a description of the project physical and virtual management plans and procedures for operating the NorthCAT project. The report also includes a summary of the center development plan and the planned next steps for the project to continue.

The key NorthCAT spaces, with the indoor spaces linked through a communication infrastructure, include:

- Indoor learning classroom at Berkeley Global Campus Building 445 in Richmond (Contra Costa County).
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- Outdoor and indoor learning spaces at the Schatz Energy Research Center in Arcata (Humboldt County).
- Indoor learning space at the California Fuel Cell Partnership building in West Sacramento (Yolo County).
- Indoor meeting space at the David Brower Center in Berkeley (Alameda County).

The following chapters of this report describe the task goals and accomplishments for each of these main task activities first. Then, the report summarizes physical site management plans, virtual infrastructure management plans, and center development plans and future activities. Finally, the final chapter presents project conclusions.

CHAPTER 2:
Physical Improvements to Berkeley Global Campus/UC Berkeley Buildings

Task Overview

This project task consisted of making a learning classroom available to the NorthCAT project that is operated by UC Berkeley at its Berkeley Global Campus in Richmond, as well as providing audiovisual improvements to make the classroom more remotely accessible as well as for in-person meetings. The project task also consisted of constructing an outdoor learning kiosk adjacent to the existing classroom, complete with video display and static display capabilities.

Bldg. 445 Classroom

The building is located in Richmond Bay.

1301 S. 46th St.—Bldg. 445

Richmond, CA, 94804

Contra Costa County

This is an indoor classroom/training center in Richmond with capacity for up to 200 occupants. It consists of a main classroom, a breakout room, and an adjoining café. The facility experienced a major upgrade and refurbishment in 2012-2013, making it better suited for NorthCAT project education and training uses. Figure 1 below shows the inside of the classroom, including the side breakout room where the audiovisual improvements funded under this agreement took place.

Figure 1: Main Training Room and Breakout Room—Building 445

Photo Credits: Transportation Sustainability Research Center

Bldg. 445 Outdoor Kiosk

This learning kiosk is also at the Berkeley Global Campus. This is an outdoor “exhibit kiosk” to assist with center education and training, now complete. The site is adjacent to the “Site #1” classroom at Building 445, located at the edge of a grassland area of the campus. The NorthCAT team completed the kiosk in October 2016, with exterior pavement for walking areas added in early 2017. Through funds from other projects, a Level 2 electric vehicle charger has been added to the site in 2017 for both visitor EV charging, display, and learning purposes. Figure 2 shows before and after installation of the kiosk.

Figure 2: Learning Display/Exhibit Kiosk Adjacent to Building 445

Photo Credits: Transportation Sustainability Research Center

Bldg. 192-T Hydrogen Fueling Station

At this site, the NorthCAT project included adding outdoor educational signage to a preexisting hydrogen fueling station that was installed in 2011. The NorthCAT team added the signage to the refueling station in 2017 using graphics developed by UC Berkeley, along with design work and support from the Frontier Energy. Figure 3 shows the educational signage.

Figure 3: Educational Signage at Hydrogen Fueling Station in Richmond

Photo Credit: Transportation Sustainability Research Center

This overall site consists of a high-pressure (700 bar) hydrogen fueling station, featuring tube trailer hydrogen delivery and then compression, precooling to -20 °C., and dispensing in a containerized unit. The station opened in May 2011 as the first high-pressure hydrogen station to operate in Northern California. The station is capable of 8-12-minute fills of 3-5 kilograms of hydrogen and a total dispensed capacity per day of about 25 kilograms. This station was designed to meet the needs of a small fleet of fuel cell vehicles that are tested and researched. Figure 4 shows the station.

Figure 4: 700-Bar Hydrogen Fueling Dispenser at the UC Berkeley Richmond Field Station

Photo Credit: Transportation Sustainability Research Center

Task Accomplishments

This project task consisted of making a classroom available to the NorthCAT project that is operated by UC Berkeley at its Berkeley Global Campus at Richmond Bay, as well as providing audio/visual improvements to make the classroom more remotely accessible, as well as for in-person meetings for future activities that will be funded separately from this agreement. The project task also consisted of constructing an outdoor learning kiosk adjacent to the classroom, complete with video display and static display capabilities, and adding educational signage to the UC Berkeley hydrogen fueling station.

The NorthCAT team completed the project task objectives within the project timeline and budget, with some funds remaining. The team saved money by using a prefabricated kiosk design and relatively low-cost campus electrical work supplied by a campus electrician and site manager.

The NorthCAT team used the remaining funds in the budget to extend the audio/visual networking and video streaming capabilities and expand the project capabilities within the original project work scope. This expansion included validation of the project audio/visual equipment and video cameras with the new video conferencing service adopted by UC Berkeley.

Key accomplishments from this task thus include:

- Construction of an outdoor learning kiosk near Berkeley Global Campus Building 445.

- Integration of the kiosk video display with a larger audio/visual and “virtual infrastructure” network.
- Extension of audio/visual capabilities for the Building 445 and nearby NorthCAT spaces.
- Construction of educational display signage at the power systems showcase and hydrogen fueling station areas of the center.

Chapter 7 describes procedures for building availability for NorthCAT project uses and facility management.

CHAPTER 3:
Physical Improvements to Prospect Silicon Valley Facilities

Task Overview

Prospect Silicon Valley (ProspectSV) is in San Jose (Santa Clara County). The mission of ProspectSV is to accelerate the next generation of technology benefiting cities everywhere.

ProspectSV is at:

Prospect Silicon Valley

1608 Las Plumas St.

San Jose, California 95133

Santa Clara County

Description

The ProspectSV site was renovated from an old warehouse and storage building to bring together industrial shop space, shared laboratories, a co-working office space, and a vehicle lift. The building is primed to support start-up companies with pre-commercial technologies in the transportation, building efficiency, energy storage, energy generation, and smart cities (using information and communication technologies to enhance the quality and performance of urban services) sectors, with a breadth of support capability and resources. Figure 5 shows the ProspectSV site before construction for this project.

Figure 5: Prospect Silicon Valley Building—Before Learning Kiosk Construction

Photo Credit: Prospect SV

The site consists of the ProspectSV building with laboratory and office space, conference rooms, and an associated parking lot with installed plug-in electric vehicle (PEV) chargers. The

project at this site consisted of constructing an outdoor learning kiosk near entrance to the building as shown in Figure 6. The learning kiosk area construction was completed in spring 2016 and became available for use starting in June 2016. The NorthCAT team will use the kiosk for the alternative fuel and advanced vehicle technology training, outreach, and project facilitation of the center that will be funded separately from this agreement.

Figure 6: ProspectSV Learning Kiosk Site after Construction

Photo Credit: Prospect SV

Task Accomplishments

This project task consisted of constructing an outdoor learning kiosk at the ProspectSV site complete with video display and static display capabilities. The task also consisted of integrating outdoor and indoor audio-video display capabilities with the NorthCAT network. The NorthCAT team completed the project task objectives within the project timeline and budget by using a prefabricated kiosk design that proved be ideal for the project without incurring larger design and architecture expenses.

Key accomplishments from this task thus include:

- Construction of an outdoor learning kiosk at Prospect SV.
- Integration of the kiosk video display with a larger audio/visual and “virtual infrastructure” network.
- Extension of audio/visual capabilities for the indoor and outdoor meeting spaces.

Chapter 7 describes the procedures for facility availability for project uses and procedures for facility management at NorthCAT.

CHAPTER 4:
Physical Improvements to Humboldt State University Facilities

Task Overview

The Schatz Energy Research Center (SERC) at Humboldt State University in Arcata (Humboldt County) promotes the use of clean and renewable energy. A focus for SERC is helping bring low-carbon transportation technologies, such as fuel cell and battery-electric vehicles, to market. SERC staff specializes in pre-commercial technology testing, technology options analyses, local government planning, stakeholder outreach and engagement, fueling infrastructure planning and integration with the smart grid, and early market fueling infrastructure deployment.

SERC maintains the NorthCAT North State Office at Humboldt State University. This task sought to provide new office space at SERC to support NorthCAT activities, install upgraded audio/visual equipment in the conference rooms to support videoconferencing capabilities, and develop additional signage for educational purposes that will be planned and funded separately from this agreement.

SERC is at:

Humboldt State University

1 Harpst Street

Arcata, California, 95521

Description

The SERC buildings and grounds provided for the NorthCAT project included indoor office space, outdoor facilities, and educational signage. The outdoor facilities at SERC include a hydrogen fueling station and an EV charging station for demonstration and display. These stations are funded separately from this agreement.

Temporary office space within the existing SERC facility was established and used during most the project period to support NorthCAT operations. During this period, the main project task for SERC involved the design, development, and construction of a new, larger, and permanent NorthCAT project office. This office was constructed as part of a larger building annex project at SERC, where only the space devoted to support the NorthCAT was funded through this project.

SERC also features conference rooms with audio/visual amenities. The main conference room for SERC seats about 24 people and offers a computer, projector, projection screen, video camera, microphones, and speakers. The new annex for SERC features a smaller conference room with a computer, flat-screen display, video camera, microphones, and speakers provided by NorthCAT project funds. Both rooms are set up to host video conferences, and the audio/visual systems can accept inputs from any digital device (laptop, smartphone, tablet, and so forth).

Task Accomplishments

This section documents the key project accomplishments at the SERC during the project. The new SERC annex houses the NorthCAT North State Office.

This task involved:

- Developing a project plan for site improvements.
- Obtaining Humboldt State University campus approval for the site improvement plan.
- Obtaining bids and selecting a contractor.
- Constructing the annex building and completing site work.

Figures 7 and 8 show the new SERC annex under construction (left photo) and completed (right photo). The right photo in Figure 8 also shows the EV charging station that was installed in conjunction with the new SERC annex. While this charging station is available for NorthCAT activities, no CEC funds were used to install it and it was not included as the project cost match funding.

Figure 7: NorthCAT Office Space at SERC Annex

Photo Credits: SERC

Figure 8: NorthCAT Office Space at SERC Annex With Electric Vehicle Charging Station

Photo Credits: SERC

Figure 9 shows the interior of the new NorthCAT office space at SERC. Two to four desk spaces are available for NorthCAT use on an as-needed basis. The left photo in Figure 9 shows the NorthCAT North State Office sign mounted on the wall on the interior office space.

Figure 9: Interior of NorthCAT Office Space at SERC Annex

Photo Credits: SERC

Figure 10 shows the main SERC conference room equipped with new audio/visual equipment that provides the capability for video conferencing.

Figure 10: Main SERC Conference Room With Video Conferencing Amenities

Photo Credit: SERC

In addition to the construction of the new NorthCAT office space and the conference room upgrades, NorthCAT signage was developed. The original plan was to install a static exterior sign at the EV charging station location. However, the long-term value of a static sign did not seem to offer sufficient value and utility. Instead, four digital display screens were designed that can be used in a myriad of ways and can be easily updated so that the information they convey is current and relevant.

The digital files and images will be displayed on an outdoor flat screen monitor mounted on the east exterior wall of the SERC building. This display will be in a high traffic area and readily accessible to the university student and staff population, as well as to the public. The display will feature rotating messages about the work carried out by SERC in clean and renewable energy. The display will be purchased and installed without the use of CEC funds and is expected to be deployed in 2018.

The four NorthCAT digital display screens will be featured as part of the outdoor rotating display. Key messages conveyed by the NorthCAT screens cover:

- The transportation sector's impact on greenhouse gas (GHG) emissions and climate change.
- The role of PEVs and fuel cell electric vehicles (FCEVs) in electrifying transportation and reducing GHG emissions.
- SERC's efforts in the North State with regard to PEVs and FCEVs.
- NorthCAT’s mission and purpose.

Key accomplishments from this task include:

- Construction of new NorthCAT project office space as part of a SERC Annex.
- Integration of the news space with audio/visual improvements and the “virtual infrastructure” network.
- Design and planning for additional educational display capabilities.

Chapter 7 describes procedures for room availability for NorthCAT project uses and procedures for building management.

CHAPTER 5:
Physical Improvements to UC Berkeley/LBNL Facilities

Task Overview

This task sought to establish an advanced power systems showcase area at the NorthCAT Richmond buildings at Berkeley Global Campus. UC Berkeley and LBNL manage these buildings jointly. After the NorthCAT team considered various sites with regard to accessibility and support for the electrical power requirements, the NorthCAT team identified an ideal site adjacent to Building 167 at the campus facility, immediately across the street from the UC Berkeley Transportation Sustainability Research Center office building. The location allows for direct control of the power systems display area using a power regulation system inside the building, as well as remote control of a Wi-Fi-based EV charger from Transportation Sustainability Research Center Building 190 (where the Wi-Fi EV charger part of the display area is separately funded).

As described below, the NorthCAT team completed the project task in 2017. The NorthCAT team has been using the power systems showcase area for displaying "vehicle-grid integration concepts." The power systems showcase area is capable of supporting various types of advanced power systems and vehicle-grid integration (VGI) and vehicle-to-grid demonstrations.

NorthCAT Power Systems Exhibit/Display Near Building 167

This power systems showcase area is at the Berkeley Global Campus. Building 167 site is also located in Richmond Bay.

1301 S. 46th St. – Bldg. 167

Richmond, California, 94804

Contra Costa County

Description

This is an indoor and outdoor power systems display area that assists with center education and training activities. The site consists of an indoor power systems test station and an outdoor showcase area. The NorthCAT team completed construction in October 2016 with final electrical wiring and switchgear being installed in early 2017. The NorthCAT team added educational signage to the site in 2017, as shown in Figure 11. A Level 2 (220 volts and 32 amps, for 7 kilowatts [kW] of charging power) "smart" PEV charger has also been added to the center recently with funding from a different UC Berkeley grant, which originates from an organization other than the ARFVTP. Figure 12 shows the power systems complete with panel and remote visualization capability inside Building 167.

Figure 11: Richmond Bay Building 167 – Power Systems Showcase Area

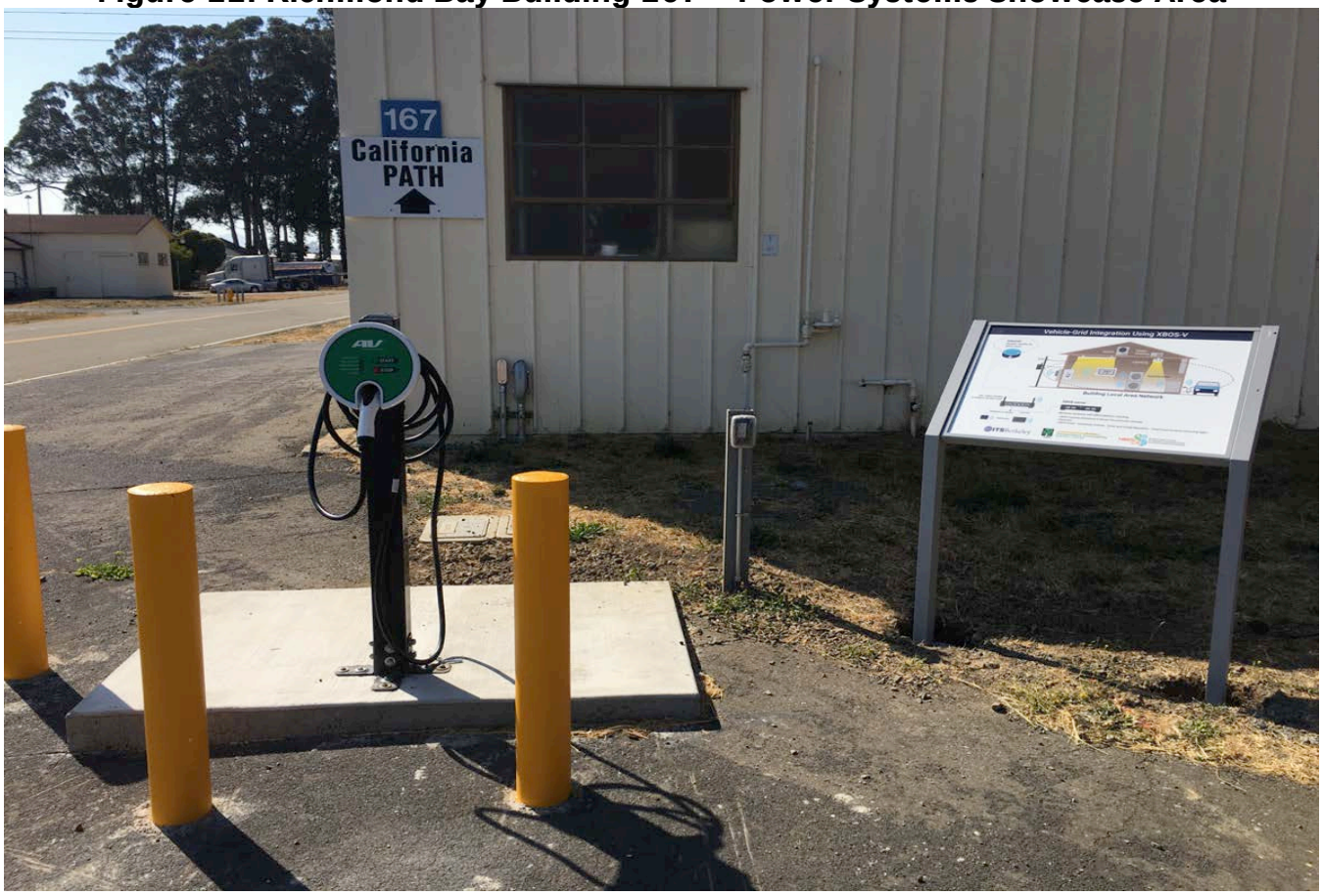


Photo Credit: Transportation Sustainability Research Center

Figure 12: Richmond Bay Building 167 – Power Systems for Outdoor Display Area

Photo Credit: Transportation Sustainability Research Center

Task Accomplishments

This task objective was to establish a power systems display area at a building controlled by UC Berkeley and LBNL at Berkeley Global Campus. The NorthCAT team completed the project within the project timeline and budget with completion in 2017. A Level 2 “smart” EV charging

unit was installed at the site for EV charging demonstrations using separate Transportation Sustainability Research Center project funds.

The NorthCAT team completed the project without significant difficulties, although the team needed a transformer to upgrade the building power from 208 volts alternating current to 480 to provide power to the key power flow visualization system. This transformer upgrade was provided using separate Transportation Sustainability Research Center project funds, which originates from an organization other than the ARFVTP, allowing this project element to be completed within the original project budget.

Key accomplishments from this task thus include:

- Construction of a power systems showcase area near Berkeley Global Campus Building 167, capable of demonstrating the operation of electric power systems such as EV chargers and vehicle-to-grid power systems of up to 12 kW.
- Installation of computer software to allow the power systems flow visualization system to be monitored remotely and potentially video-streamed for display outside and remotely.
- Addition of educational display signage to the site, initially depicting a concept for VGI.
- Chapter 7 describes procedures for building availability for NorthCAT project uses and procedures for building management.

CHAPTER 6:
Physical Improvements to California Fuel Cell Partnership Facility

Task Overview

The California Fuel Cell Partnership (CaFCP) location is the organization headquarters site managed by Frontier Energy. During this project, BKi merged with four other companies and changed its name to Frontier Energy. For clarity, this report uses Frontier Energy. The building has been occupied since November 2000.

The CaFCP main office site is at:

California Fuel Cell Partnership

3300 Industrial Blvd.

West Sacramento, California 95691

Yolo County

This task consisted of improving the gallery space with better audio/visual and virtual networking capabilities, as well as adding NorthCAT project displays and display capabilities.

Description

The West Sacramento building includes a gallery with technology displays, a conference room, offices, and a large storage area. The site is just off Interstate 80 and is about 10 minutes by car from downtown Sacramento.

Figure 13: CaFCP Building in West Sacramento and Updated Gallery Space

Photo Credit: CAFCP

Task Accomplishments

This task sought to make key improvements to the CaFCP-occupied part of the building to make them more functional and appropriate for use in the NorthCAT effort, which included installing displays and information regarding the NorthCAT project and team capabilities. The

Frontier Energy team provided project graphics support, including designing the NorthCAT logo, fact sheets, presentations, display sign graphics, and other materials.

The NorthCAT team completed all the project elements within time and project budget. The CaFCP main office in West Sacramento receives frequent groups of visitors, and Frontier Energy staff members are now fully aware of the NorthCAT team and capabilities where active collaborations are underway.

Key accomplishments from this task include:

- Construction of a video informational display for NorthCAT project uses.
- Installation of additional audio/visual capabilities in the main conference room.
- Addition of displays and educational materials related to the NorthCAT project effort in the gallery area.

Chapter 7 describes procedures for building availability for NorthCAT project uses and procedures for building management.

CHAPTER 7:
NorthCAT Infrastructure and Project Management Plans

Task Overview and Accomplishments

This task sought to develop the project physical and virtual management plans and procedures for operating the NorthCAT project. The development of these plans was included in the original project proposal and scope of work as a means to define and monitor project progress in key areas of:

- NorthCAT physical infrastructure development, maintenance, and "terms of use."
- NorthCAT virtual infrastructure development, including project website and audio/visual networking capability.

The content of these plans helps guide the maintenance and operation of these buildings, as well as streamlining the process of making them available for project uses through extension grants and other collaborative activities beyond the scope of work of this agreement.

The task also included an effort to develop a *center development plan* that:

- Identifies strategic center development and leveraging opportunities.
- Develops an advisory group outreach and engagement plan.
- Executes initial center outreach for development by attending and operating a booth at the annual ACT Expo conference and additional conferences and workshops related to alternative fuels and advanced vehicle technologies.

Chapter 8 includes a summary of the center development plan activity.

The key physical NorthCAT spaces, with the indoor spaces linked through virtual communication infrastructure, include:

- An indoor learning classroom at Berkeley Global Campus Building 445 in Richmond.
- An outdoor exhibit/showcase learning kiosk at Berkeley Global Campus Building 445 in Richmond.
- An outdoor power systems showcase area near Building 167 in Richmond.
- Outdoor signage at the UC Berkeley 70 MPa hydrogen fueling station near Building 192-T in Richmond.
- An outdoor exhibit/showcase learning kiosk outside the main entrance to ProspectSV in San Jose.
- Outdoor and indoor learning spaces at SERC in Arcata.
- Indoor learning space at the CaFCP main office in West Sacramento.
- Indoor meeting space at the David Brower Center in Berkeley.

During the agreement, a physical infrastructure management plan, a virtual infrastructure management plan, and a center development plan were developed and revised twice to reflect the project progresses.

Virtual Infrastructure

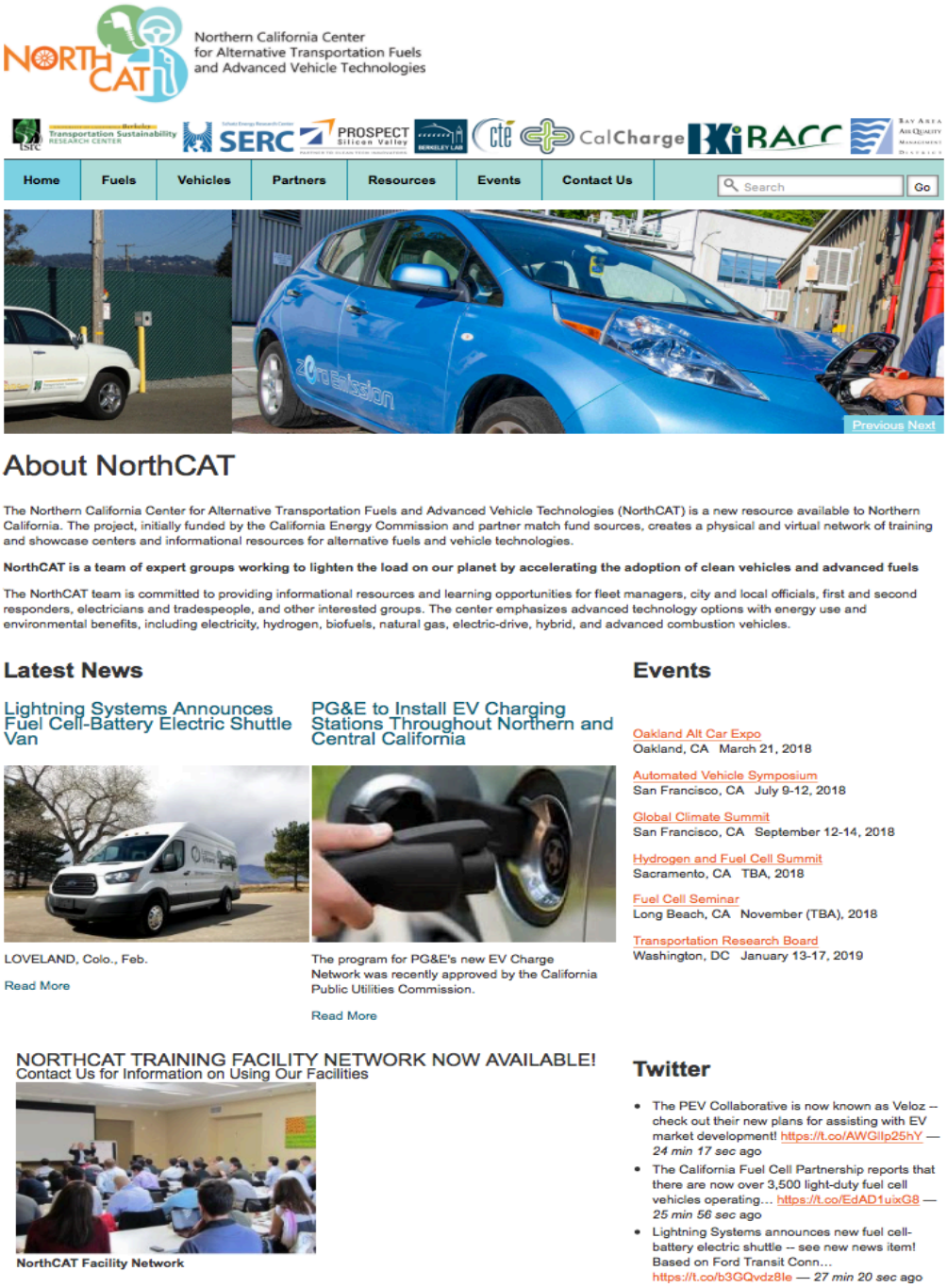
In addition to physical infrastructure for learning and demonstrations, the NorthCAT project also includes virtual infrastructure consisting of two key elements:

- The project website located at http://www.northcat.org.
- A network of audio/visual infrastructure that provides networking among the center locations

NorthCAT Virtual Infrastructure: Project Website

The NorthCAT project website has the domain “NorthCAT.org” and is in beta test development mode. The website formally launched in June 2015. The website provides contact information for NorthCAT locations; information about NorthCAT project resources and services, alternative fuels and advanced vehicle technologies, and upcoming conferences and other events; and links to training and information portals and additional resources.

Figure 14: Top Portion of Website Home Page at NorthCAT.org



Source: NorthCAT.org

Procedures for Project Website Management

The NorthCAT website uses a Drupal™-based structure, allowing NorthCAT staff to add and edit website text and resources links and documents. Drupal™ is a website development language that offers a multilevel user interface, where key structure and functionality is established at the deeper level and user content can be edited readily using an interface that sites on top of the structure. Content is edited by adding key resources to feature (such as document resources and pictures) and then publishing them through the Drupal™ interface, as well as through direct text edits using a “what you see is what you get” interface.

The NorthCAT team adds featured news events, upcoming event listings, and periodic content updates to the website monthly. Every three months, the NorthCAT team reviews the website content thoroughly and updates as appropriate in a more thorough revision cycle. As the project next phases develop, additional needs for website structural development may emerge. In addition, periodic maintenance steps may be required if Web-based security vulnerabilities are identified. These security vulnerabilities will require small additional steps by Ricochet Web Solutions to implement the requested changes, under an existing "blanket purchase order" in place at the UC Berkeley Institute of Transportation Studies.

NorthCAT Virtual Infrastructure: Audiovisual Communication Networking System

The NorthCAT project sites are networked with audiovisual communication infrastructure, including conference camera systems, audio microphones and speakers, and digital whiteboards. These systems will allow interactive education and training sessions to occur simultaneously at multiple locations, for example, with an instructor in one classroom in Richmond but "satellite audiences" in one or more other NorthCAT locations.

The NorthCAT team uses a call subscription service for webinar-style project meetings, and this service can be extended for more users on a situational basis for potential NorthCAT partner groups wishing to hold education and training events (separately funded from this agreement). The NorthCAT team continues to identify and evaluate the most appropriate and cost-effective technology solutions to meet these needs, including other potential services.

All the key NorthCAT center sites have basic video projection capabilities. Microphones and speaker systems are in place in all center sites based on preexisting hardware and additional hardware provided by the NorthCAT project as described in this report. Most of the sites have conference cameras to allow visual networking with remote sites, and portable cameras such as the one stationed in Richmond/Berkeley can be shared among sites for specific events. This more fully capable and interactive virtual networking and conferencing capability is a useful aspect of the NorthCAT center infrastructure, where reaching remote audiences is desirable.

The NorthCAT team has procured the conference video camera shown in Figure 15 as the best current market offering. It is featured at the Richmond/Berkeley and West Sacramento locations. Other types of similar video cameras (previously purchased) are in place in San Jose and Arcata.

Figure 15: Video Camera System for NorthCAT Facility Networking

Source: VDO 360 Inc.

The infrastructure system requires only minor and typical maintenance and upkeep considerations. These include:

- Securing the video cameras between uses and occasionally removing dust and carefully cleaning the camera lens.
- Securing audio devices between uses and periodically testing for quality and function.
- Securing digital white boards between uses and cleaning as needed.
- Maintaining subscription service for Web-based virtual networking service.

These virtual networking arrangements are designed to be flexible, accommodating larger or smaller audiences and one or more project locations. The functionality of these arrangements is periodically "bug-tested" by NorthCAT staff between project uses to assure continued and effective functionality.

Along with the project Web-based and audio/visual capabilities discussed above, the NorthCAT team has integrated a dedicated PC server (repurposed from a previous grant) into the NorthCAT project virtual infrastructure network. This Mac-mini server will be able to loop and "on demand" serve video broadcasts to the various NorthCAT sites, as needed.

NorthCAT Center Development Plan

The NorthCAT team has developed a marketing and outreach strategy based on the project website, outreach and networking opportunities, conferences and meetings, and media opportunities. The NorthCAT effort has two primary objectives to:

- Provide physical and virtual training and education space for NorthCAT members and nonmembers.
- Leverage the strengths and knowledge of the members to identify and respond to project and grant opportunities to continue to advance and expand the NorthCAT mission.

Outreach and marketing for these two objectives take different angles. Throughout several meetings during the project term, the NorthCAT members have addressed project development elements, including:

- Developing a flyer that lists the capabilities of each location, including room sizes, availabilities, and amenities, such as catering or video projection.
- Identifying target clients that are conducting advanced vehicle and fuel trainings and tools using various funding sources.
- Working with Clean Cities Coordinators in Northern California to advance the use of the NorthCAT resources and training centers.
- Participating in targeted outreach events that reach training coordinators and other community engagement leaders.

The NorthCAT Center covers a broad and diverse region across the northern part of the state. Because of this, outreach needs to be targeted to reach specific stakeholder groups. For example, the needs and desires of stakeholders in the rural regions north of the San Francisco Bay and the Sacramento areas differ significantly from those of their metropolitan counterparts. To respond to this need, the NorthCAT team is working to build a network of stakeholders in the rural North State and is planning to hold targeted outreach events to inform these stakeholders about NorthCAT and solicit their input regarding what is needed to promote alternative fuel vehicles in their communities.

In the major urban areas of Northern California (San Francisco Bay Area and Sacramento area), targeted stakeholder groups include metropolitan planning organizations and regional

transportation planning agencies, local municipalities (planners, city managers, elected officials, and code officials), and local air districts. They also include economic development agencies, climate action groups, the California Department of Transportation regional offices electric utilities, automobile manufacturing groups, fuel providers, and fleet managers that serve the region.

Targeted stakeholder groups within the more rural North State (including Eureka/Arcata, Redding, Ukiah, and Willits) include the Redwood Coast Energy Authority, local leaders (planners, city managers, elected officials, and code officials), local air districts, metropolitan planning organizations and regional transportation planning agencies (via the North State Super Region alliance), economic development agencies, climate action groups, the California department of transportation regional office, electric utilities, car dealerships, fuel providers, and fleet managers that serve the region.

The NorthCAT partners also identified strategies to respond to funding opportunities that include:

- Each member group defining core competencies and interest areas that identify its unique capabilities and interests in new projects.
- A small sub team focusing on project funding that should be pursued by NorthCAT from various funding organizations such as the CEC, United State Department of Energy (U.S. DOE), California Air Resources Board (CARB), the Bay Area Air Quality Management District, Metropolitan Transportation Commission, and so forth.
- Template language describing procedures that NorthCAT that members can use in proposals and funding opportunities.

In addition, NorthCAT, in partnership with carbonBLU, has recently acquired a database of fleet contacts that can be used for outreach and fleet turnover support with future project funding. This database may be used to inform market stakeholders of key developments occasionally and potentially engage them more directly through future NorthCAT extension projects.

NorthCAT Regional Outreach Meetings

The NorthCAT project team has held outreach meetings to help publicize the emergence of the center and identify potential partners for future project activities, typically in the context of Clean Cities group meetings. Meetings where the NorthCAT effort have been discussed include:

- North State outreach meeting (Eureka): February 2016.
- East Bay outreach meeting (Oakland Alt Car Symposium): May 2016, May 2017, and March 2018.
- Silicon Valley outreach meeting (San Jose): June 2016.
- Sacramento outreach meeting (West Sacramento): September 2016.
- San Francisco outreach meeting (San Francisco): March 2017.

These outreach meetings sought to make regional stakeholders aware of the existence of the NorthCAT center and opportunities for future collaboration. An additional opportunity has been to support related efforts and find synergies with them for extension projects moving forward, such as with programs sponsored by the U.S. DOE Clean Cities teams, regional air districts such as BAAQMD and the Sacramento Air Quality Management District, and nonprofit groups

such as the National Resources Defense Council, Union of Concerned Scientists, the Greenlining Institute, among others.

On February 24, 2016, the NorthCAT team led by SERC held a strategic networking event that was simulcast from Eureka to Redding and Ukiah. The goals of the event were to:

- Bring local stakeholders up to speed on state and local efforts to accelerate the adoption of low-carbon transportation fuels and vehicles.
- Explain the federal Clean Cities program, outline the potential benefits of this program for the region, and pursue stakeholder interest, commitments, or both to forming a Clean Cities coalition.
- Acquaint stakeholders with the NorthCAT project team capabilities and mission.

On May 20, 2016, the NorthCAT team participated in the AltCar Expo in Oakland that included a stakeholder meeting followed by a public expo day on May 21. The NorthCAT team had booths on both days, indoors in Oakland City Hall on May 20 and outdoors in Frank Ogawa Plaza on May 21. The NorthCAT director participated in a panel moderated by Clean Cities Coordinator Richard Battersby and mentioned the NorthCAT effort and booth presence. Considerable networking related to the NorthCAT project and future opportunities were enabled during the two-day event. The panel session was repeated on May 11, 2017, where the NorthCAT director again presented information on NorthCAT capabilities during a panel session moderated by Richard Battersby. Then, on March 21, 2018, the NorthCAT director participated in an Oakland AltCar Expo panel led by Suzanne Loosen, the SF Clean Cities Director, on hydrogen and fuel cells for transportation. The NorthCAT director included mention of the NorthCAT center in his panel remarks and presentation slides.

On June 16, 2016, ProspectSV, a NorthCAT partner, held a strategic networking and planning event called the “Innovation Showcase” in San Jose. The project provided high-level networking opportunities for clean fuel vehicles and infrastructure and advanced concepts based on connected vehicles and smart charging. The event used the NorthCAT project outdoor learning kiosk as part of its displays and additional networking space.

NorthCAT Resource Development Plan

The overall NorthCAT resource development plan is to use initial grant funds and the associated cost match and related projects to provide the initial basis for the center, but to expand the actual center activities over time through the addition of external grant funds and additional private sector contributions.

The NorthCAT team is working to expand the center by pursuing additional opportunities relative to alternative fuel and advanced vehicle technology training, outreach, and showcases, and to accommodate external requests that come in if mutually agreeable terms can be reached. The team envisions various types of additional growth opportunities beyond the initial connections that are being made through ongoing activities among the project partner groups.

Expected additional NorthCAT activities (primarily separately funded from the ARV-13-021 project) in the future include:

- Hosting workshops, meetings, and vehicle displays for stakeholder groups.
- Establishing formal alternative fuel and advanced vehicle education and training programs with federal, state, or stakeholder funding or a combination.

- Conducting hands-on vehicle and alternative fuel infrastructure showcases and training sessions.
- Assisting fleet managers with alternative fuel vehicle deployment.
- Linking start-up companies with resources.
- Considering the rollout of alternative fuel vehicles in rural areas and assisting with infrastructure planning and deployment, stakeholder engagement, and program development and implementation.

NorthCAT Technical Advisory Committee

The NorthCAT team developed a technical advisory committee with members from various organizations, to help guide the development of the center, expand the scope and effectiveness of the center, and explore opportunities for continued project activity and opportunities to work with their home organizations. The following advisory members were included. Technical advisory committee meetings were held as quarterly Web conferences with additional opportunities to provide feedback and advice.

NorthCAT project Technical advisory committee members are:

- Karen Schkolnick—BAAQMD.
- Richard Battersby—East Bay Clean Cities.
- Keith Leech—Sacramento Clean Cities (alt. Tim Taylor).
- Suzanne Loosen—San Francisco Clean Cities.
- Viet Vu—Silicon Valley Clean Cities.
- Brent Jameson—deputy director, California Department of General Services.
- Matthew Marshall—Redwood Coast Energy Authority.

The NorthCAT team formally organized the Technical advisory committee in spring 2016 and has held several advisory calls for the project, most recently on October 16 2017. Following these first “get acquainted with NorthCAT” calls, subsequent more strategic and center development focused calls have been held to gain input into various aspects of the NorthCAT project operations including preparation of the revised center development plans.

CHAPTER 8:
NorthCAT Project Next Steps

As summarized in Chapter 7, the NorthCAT project effort consisted of developing a center development plan as part of the agreement. This chapter describes the ideas generated between the project and technical advisory committee team for future efforts beyond the initial grant effort that will be funded separately from this agreement.

Key Areas for NorthCAT Center Development Efforts

As introduced above, the NorthCAT team has identified the following areas as key areas for focusing future NorthCAT project efforts:

- Vehicle electrification through batteries and plug-in hybrid technologies across vehicle types from light-duty to heavy-duty
- Hydrogen fuel and fuel cell vehicles across vehicle types from light-duty to heavy-duty
- Biofuels and renewable diesel especially for medium-duty and heavy-duty vehicles
- Opportunities for integration of EVs with utility grids or VGI to take advantage of low-cost times for vehicle recharging and the potential for other grid services to lower fleet operating costs
- New mobility patterns and potential for connected autonomous vehicles in the future with interactions with alternative fuels, especially vehicle electrification

The following sections describe these opportunities and relevant NorthCAT project plans.

Vehicle Electrification

With its transportation sector being the largest relative GHG emitter, comprising 40 percent of total state emissions, California has long been a leader in supporting clean-vehicle policies to reduce GHG emissions and localized pollution. These policies largely started with the CARB's zero-emission-vehicle (ZEV) mandate in 1990, which required that by 1998, 2 percent of vehicles sold by the major automotive manufacturers would be ZEVs, ratcheting that goal up to 10 percent by 2003.[1] The ZEV mandate was modified in the intervening years — due to legal challenges and constraints in vehicle costs, battery technology status, and other technical problems — including allowing partial ZEV credits to update for later model years and combining the control and standards of smog, soot and GHG in Advanced Clean Cars Standards.[2]

In 2012, Governor Edmund G. Brown Jr. issued Executive Order B-16-2012, setting a state target of 1.5 million ZEVs on the road by 2025, which include full battery-electric vehicles and FCEVs. The order also included ordering state agencies and stakeholders to work together to

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1 "Zero-Emission Vehicle Legal and Regulatory Activities." California Air Resources Board. Available at https://www.arb.ca.gov/msprog/zevprog/zevregs/zevregs.htm.

2 Advanced Clean Cars - Introduction Page. Available at https://www.arb.ca.gov/msprog/consumer_info/advanced_clean_cars/consumer_acc.htm.

integrate EV charging into the electric grid.3 The order also targeted lowering transportation-related GHG emissions by 80 percent below 1990 by 2050. Following the executive order, the ZEV Action Plan was developed in 2013 to lay out strategies for addressing the intermediate milestones and final goals of planning and completing infrastructure, expanding consumer awareness and demand, transforming fleets, and increasing jobs and private investment through deployment of ZEVs.

More recently, in January 2018, the Governor raised the ZEV target level to 5 million ZEVs in California by 2030, along with a significant commitment to support PEV charging and hydrogen refueling infrastructure. An eight-year program was proposed with $2.5 billion in funding, to bring 250,000 PEV charging stations and 200 hydrogen-refueling stations to California by 2025.[4]

The NorthCAT team is pursuing the following thrust-area concepts as opportunities to use the center capabilities for advancement of vehicle electrification based on ZEV technology:

- ZEV infrastructure planning support for state, local, and private sector interests including the CEC Northern California air quality management districts (AQMDs), Pacific Gas and Electric, Electric Vehicle Charge Network program, and Volkswagen Electrify America
- Promotion of the SERC "EV Charging Station" selection guide
- Helping fleet owner and operators better understand the latest market offerings, vehicle economics and total cost of ownership, infrastructure considerations, and lessons learned from previous fleet adoptions
- Electrification of medium-duty and heavy-duty vehicles, especially where diesel fuel can be displaced
- EV infrastructure development such as multiunit dwellings and disadvantaged communities
- Low Carbon Fuel Standards credit values from biofuels implementation
- Key identified partner groups to work with moving forward include:
- Veloz (formerly the California PEV Collaborative).
- The California Energy Commission.
- California Electric Transportation Coalition.
- U.S. DOE Vehicle Technology Office.
- Clean Cities Coalitions.
- Northern California AQMDs.
- Metropolitan Transportation Commission.

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3 *ZEV Action Plan: A Roadmap Toward 1.5 Million Zero-Emission Vehicles on California Roadways by 2025,* Governor's Interagency Working Group on Zero-emission Vehicles, 2013.

4 Office of the Governor. January 2018. "Governor Brown Takes Action to Increase Zero-Emission Vehicles, Fund New Climate Investments." California Executive Order B-48-18.

- Silicon Valley Leadership Group.
- Electric Power Research Institute.
- Local electric utilities.

Hydrogen and Fuel Cells for Transportation

Hydrogen fuel cell technology uses hydrogen to produce electricity through an electrochemical reaction that does not involve any combustion. FCEVs are ZEVs that do not produce any tailpipe pollution, supporting efforts to reduce GHG emissions per California's overall Cap-and-Trade Program. The GHG emissions over the total life cycle of an FCEV can be reduced to zero when the hydrogen is generated from solar or wind electrolysis.

Focusing on the light-duty market, many automotive manufacturers have FCEVs on the road, and many of the firms are planning to upscale the manufacturing and bring them to a high-volume manufacturing stage within the next few years. Some leaders in this area are Toyota and Honda with the Mirai and Clarity vehicles, respectively, being available to be purchased or leased.

The NorthCAT team identified the following key area concepts as opportunities to use the center capabilities for advancement of vehicle electrification based on hydrogen fuel cell technology:

- Vehicle and system orientation and operator training
- Fleet economics issues
- Preventive maintenance best practices
- Electrical systems training
- Fuel cell systems characteristics
- Hydrogen fuel characteristics and station siting
- Hydrogen safety, detection, and fire suppression
- Hydrogen vehicle cooling systems
- Low Carbon Fuel Standards credit values from hydrogen fuel implementation

Key identified partner groups to work with moving forward include:

- CaFCP.
- The California Energy Commission.
- U.S. DOE Fuel Cell Technology Office.
- California Hydrogen Business Council.
- Fuel Cell and Hydrogen Energy Association.
- Silicon Valley Leadership Group.
- H2USA.
- Clean Cities Coalitions.
- Sacramento Metro AQMD.

Biofuels and Renewable Diesel

Ethanol is a renewable fuel made from corn and other plant materials. The use of ethanol is widespread — almost all gasoline in the United States contains some ethanol. Ethanol is available as E85, a high-level ethanol blend containing 51 to 83 percent ethanol, depending on

season and geography, for use in flexible-fuel vehicles. The Environmental Protection Agency defines E15 as a blend of 10 to 15 percent ethanol with gasoline. It is an approved ethanol blend for vehicles of Model Year 2001 and newer.

Biodiesel is a domestically produced renewable fuel that can be manufactured from vegetable oils, animal fats, or recycled restaurant grease for use in diesel vehicles. The physical properties of biodiesel are similar to those of petroleum diesel, but it is a cleaner-burning alternative. Using biodiesel in place of petroleum diesel, especially in older vehicles, can reduce emissions.

Renewable diesel is an emerging drop-in replacement for fossil diesel fuel using biological feedstocks. Producing renewable diesel starts with plant oil triglycerides and turns them into alkanes, also removing oxygen. It is chemically similar to conventional diesel and requires no engine modifications for use. Some have claimed that Renewable diesel can reduce GHG emissions by 40 to 60 percent compared with typical diesel.[5]

The NorthCAT team identified the following project extension concepts:

- Vehicle and system orientation and operator training
- Biofuel and renewable diesel fleet economics issues
- Maintenance issues for biofuels use
- Biofuel fuel characteristics and station siting
- Low Carbon Fuel Standards credit values from biofuels implementation

Key identified partner groups to work with moving forward include:

- The California Energy Commission.
- CARB.
- U.S. DOE and national labs.
- Advanced Fuels Association.

Electric VGI

EVs with significant battery storage offer the opportunity for them to work as flexible loads for utility grids in ways that can benefit grid operation. As mentioned above, the concept of VGI encompasses various ideas for managed charging of EVs to help with various types of local and larger grid operational issues. The further concept of vehicle-to-grid power involves bidirectional flow of power, where the EV battery is actually discharging power to the grid. Other VGI concepts involve simpler managed battery charging (such as charge power-level modulation) without bidirectional power flow, but with many potential implications for distribution and wholesale level grid operations.

The NorthCAT team is considering following key concepts for future work:

- Value propositions for EV fleets from potential VGI concepts
- Charger station design and configuration for VGI
- Advanced concepts such as communications between EV and electric vehicle supply equipment using, for example, ISO 15118

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5 Institut für Energie und Umwelt. June 2006. *An Assessment of Energy and Greenhouse Gases of NEXBTL* Final report on behalf of Neste Oil Corporation.

- Local utility and larger wholesale market programs available through aggregation services

Key identified partner groups to work with moving forward include:

- California VGI Working Group.
- U.S. DOE and national labs.
- The California Energy Commission.
- California Independent System Operator.
- Public and private electric utilities (for example, Pacific Gas and Electric, Sacramento Municipal Utility District, City of Palo Alto).
- Electric Power Research Institute.
- Silicon Valley Leadership Group.
- Volkswagen Electrify America.

Connected and Autonomous Vehicles

Though not yet available to average consumers, fully autonomous vehicle technology (also known as connected autonomous vehicle technology) has already raised serious discussion and controversy regarding the related deployment and use. Representatives of government, media, and industry have all put forward plans for the outcome of autonomous technology, but to date, only tentative steps have been taken to create autonomous transportation for the public or to educate people about the nature of the technology. The technology in particular is being explored for future fleets of ride sharing and taxi-type vehicles that could be centrally dispatched, much as Uber and Lyft are today, but without human drivers in at least some geofenced areas.

The NorthCAT team identified the following project extension concepts:

- Local and regional implications of Connected autonomous vehicle development
- Individual and fleet driver education
- Integration of connected autonomous vehicles into ridesharing and taxi fleets—economics and operational considerations
- Policy implications of connected autonomous vehicle development, especially regarding electrification and occupancy requirements
- Energy use and emissions implications of connected autonomous vehicle technology as deployed in certain market settings

Key identified partner groups to work with moving forward include:

- ITS California.
- ITS America.
- UC Berkeley PATH program.
- U.S. DOE and national labs.
- The California Energy Commission.
- CARB.
- Contra Costa County Transportation Authority.
- Silicon Valley Leadership Group.

Future NorthCAT Activity Concepts

As described above, opportunities for alternative vehicle fuels and technologies to reduce emissions and petroleum use are expansive and continue to develop as key technologies improve. However, these technologies and systems cannot simply be introduced and expected to succeed without associated workforce training, policy maker education, local official and

planner education, and associated efforts to guide and support future developments and provide feedback from actual market settings.

Identified future activity concepts for the NorthCAT project include:

- Workforce training and education programs.
- University and community college curricula and “train the trainers” activities.
- Application of lessons learned from real-world pilot and larger deployment projects.
- Policy maker and local official and planner education sessions regarding the use of best practices and lessons learned from early adopter municipalities and regions.
- Advanced fueling infrastructure development support efforts.
- Continued maintenance and expansion of the NorthCAT Web page.
- Continued collaboration with regional Clean Cities coalitions.

The project team has already pursued additional opportunities in these areas and plans to continue to do so to move the project into a next phase of operation.

Summary of NorthCAT Future Development Effort Concepts

The rapidly evolving area of alternative fuels and advanced technologies for transportation provides a critical need for expert groups to help educate and train stakeholder groups and practitioners and provide policy development guidance. The NorthCAT project efforts included engaging the project team and advisory members in identifying emerging development efforts for the center. This resulted in the project center development plan.

As described above, there is an exciting and challenging set of opportunities around several emerging areas for cleaner vehicle and fuel systems to replace the still dominant conventional gasoline and diesel combustion engine technologies. These opportunities include those thrust areas around vehicle electrification, hydrogen and fuel cells, biofuels and renewable diesel, VGI, and connected autonomous vehicles, as described above. The project team has a well-coordinated and engaged team across Northern California to pursue these opportunities moving forward. The team expects to work particularly closely with the CEC, Clean Cities groups, and regional AQMDs and transportation agencies. This work includes helping implement the state ZEV action plans, regional infrastructure planning and execution, and associated workforce training and development efforts.

CHAPTER 9: Conclusion

The NorthCAT project team has successfully completed the initial ARV-13-021 project objectives and work scope, as documented in this report. Based on the team formed through this partnership among alternative fuel and advanced vehicle technology organizations in Northern California, the NorthCAT partner groups have pursued project opportunities as extension efforts. The project has developed a useful foundation for physical locations for meetings and training events, as well as internet-based education opportunities and community engagement efforts.

Summary of Agreement Goals

The goal of the NorthCAT project grant agreement was to develop the Northern California Center for Alternative Transportation Fuels and Advanced Vehicle Technologies and develop a network of physical locations, institutional arrangements, and virtual communications systems. These are designed to provide a physical and virtual network of centers to conduct a broad range of alternative fuel and advanced vehicle technology showcase and demonstration, training and outreach, and project facilitation programs.

The project team has achieved this goal as described in this report.

Completion of Agreement Objectives

The specific objectives of grant agreement were to develop infrastructure and capabilities needed to provide alternative fuel and advanced vehicle technology showcase, training, outreach, and project facilitation at specified locations in Northern California (Richmond, San Jose, West Sacramento, and Arcata). The objectives also include developing virtual communications and institutional arrangements for these locations to operate the NorthCAT network. As explained in this report, the project team has completed these objectives fully.

The project team expects to continue, based on funding from other sources, carrying out activities that are enabled by this grant agreement. The project team expects to work with a range of public institutions and agencies, industry groups, vehicle and fuels companies, Clean Cities groups, AQMDs, municipal transportation agencies, and other stakeholders to continue the activities of the NorthCAT center. This effort is very timely and important and aligns with state goals for ZEV and other clean fuels implementation, as well as air pollution and GHG emission reduction. The project team is committed to moving the NorthCAT project forward into a second phase of operations and is working on those plans and activities.

GLOSSARY

AIR QUALITY MANAGEMENT DISTRICT (AQMD)—Air districts issue permits and monitor new and modified sources of air pollutants to ensure compliance with national, state, and local emission standards and to ensure that emissions from such sources will not interfere with the attainment and maintenance of ambient air quality standards adopted by the California Air Resources Board (ARB) and the U.S. Environmental Protection Agency (U.S. EPA).

BAY AREA AIR QUALITY MANAGEMENT DISTRICT (BAAQMD)—Tasked with regulating stationary sources of air pollution in the nine counties that surround San Francisco Bay: Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, southwestern Solano, and southern Sonoma counties. It is governed by a 24-member Board of Directors composed of locally elected officials from each of the nine Bay Area counties, with the number of board members from each county being proportionate to its population.

CALIFORNIA AIR RESOURCES BOARD (ARB)—The "clean air agency" in the government of California whose main goals include attaining and maintaining healthy air quality, protecting the public from exposure to toxic air contaminants, and providing innovative approaches for complying with air pollution rules and regulations.

CALIFORNIA DEPARTMENT OF TRANSPORTATION (Caltrans)—Responsible for the design, construction, maintenance, and operation of the California State Highway System, as well as that portion of the Interstate Highway System within the state's boundaries.

CALIFORNIA FUEL CELL PARTNERSHIP (CaFCP)—The California Fuel Cell Partnership is an industry/government collaboration aimed at expanding the market for fuel cell electric vehicles powered by hydrogen to help create a cleaner, more energy-diverse future with no-compromises to zero emission vehicles.

FUEL CELL ELECTRIC VEHICLE (FCEV)—A zero-emission vehicle that runs on compressed hydrogen fed into a fuel cell "stack" that produces electricity to power the vehicle.

GREENHOUSE GAS (GHG)—Any gas that absorbs infrared radiation in the atmosphere. Greenhouse gases include water vapor, carbon dioxide (CO2), methane (CH4), nitrous oxide (NOx), halogenated fluorocarbons (HCFCs), ozone (O3), perfluorinated carbons (PFCs), and hydrofluorocarbons (HFCs).

LAWRENCE BERKELEY NATIONAL LABORATORY (LBNL) — is a multi-program science lab in the national laboratory system supported by the U.S. Department of Energy through its Office of Science. It is managed by the University of California and is charged with conducting unclassified research across a wide range of scientific disciplines.[6]

NORTHERN CALIFORNIA CENTER FOR ALTERNATIVE TRANSPORTATION FUELS AND ADVANCED NORTHCAT VEHICLE TECNOLOGIES (NorthCAT) — coalition of seven organizations that are devoted to the education, training, demonstration, and full-scale

[6] Lawrence Berkeley National Laboratory Website (https://www.lbl.gov/about/).

deployment of alternative transportation fuels and advanced vehicle technologies in the Northern California region.[7]

PLUG-IN ELECTRIC VEHICLE (PEV)—A general term for any car that runs at least partially on battery power and is recharged from the electricity grid. There are two different types of PEVs to choose from—pure battery electric and plug-in hybrid vehicles.

SCHATZ ENERGY RESEARCH CENTER (SERC) —Partnered with Humboldt State University's Environmental Resources Engineering program, the research center engages undergraduate and graduate students across multiple disciplines with hands-on experience in emerging energy technologies.[8]

UNITED STATES DEPARTMENT OF ENERGY (U.S. DOE)—The federal department established by the Department of Energy Organization Act to consolidate the major federal energy functions into one cabinet-level department that would formulate a comprehensive, balanced national energy policy. DOE's main headquarters are in Washington, D.C.

VEHICLE-GRID INTEGRATION (VGI) — Helps align electric vehicle charging with the needs of the electric grid. To do this, electric vehicles must have capabilities to manage charging or support two-way interaction between vehicles and the grid.

ZERO EMISSION VEHICLE (ZEV)—Vehicles that produce no emissions from the on-board source of power (e.g., an electric vehicle).

[7] NorthCAT CTE Website (http://cte.tv/project/northern-california-advanced-vehicle-technologies-program-north-cat/).

[8] Schatz Center Website (http://schatzcenter.org/about/).