Improving Resiliency and Decreasing Greenhouse Gas Emissions by Transitioning to Electric Vehicles

Final Report

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Acronyms and Abbreviations

Term	Definition
ACS	Army Climate Strategy
CONUS	Continental United States
COP	Common Operating Picture
CO_2	Carbon Dioxide
CTMA	Commercial Technologies for Maintenance Activities
DCS	Deputy Chief of Staff
DER	Distributed Energy Resources
DOD	Department of Defense
EO	Executive Order
EV	Electric Vehicle
EVSE	Electric Vehicle Supply Equipment
FAST	Federal Automotive Statistical Tool
FEP	Fleet Electrification Plan
GHG	Greenhouse Gas
GSA	General Services Administration
HQDA	Headquarters, United States Department of the Army
ICE	Internal Combustion Engine
IMCOM	Installation Management Command
NCMS	National Center for Manufacturing Sciences
NDAA	National Defense Authorization Act
NTV	Non-Tactical Vehicle
ODASD-MR	Office of the Deputy Assistant Secretary of Defense, Materiel Readiness
USACE	U.S. Army Corps of Engineers
U.S.	United States
ZEV	Zero-Emission Vehicle

1. Executive Summary

1.1 Problem Background and Need

The Department of Defense (DOD), the Department of the Army, and Army fleet managers respond to Administration's goals of decreasing greenhouse gas (GHG) emissions and the Army Climate Strategy (ACS) line of effort to integrate zero-emission vehicles (ZEVs) into the Army's non-tactical vehicle (NTV) fleet. By reducing fuel requirements, ZEVs will help boost energy efficiency and combat the production of carbon dioxide (CO_2) while working towards the Army's net-zero GHG goal. Fleet managers are responsible for driving forward a successful fleet transformation strategy in terms of utilizing four core components: acquisition, infrastructure, interoperability, and change management. They, in support of the Army, have an opportunity to lead national and local ZEV supply chain and economic development efforts through fleet procurement decisions.

Headquarters, United States Department of the Army (HQDA) G-9 requested a third-party to develop a high-level, Executive Order (EO) compliant transition plan for the electrification of its' NTV fleet including timing, impact, requirements, challenges, and governance needed to make the transition. The project and transition plan supported the Army's goal of developing a Fleet Electrification Plan (FEP) to integrate ZEVs into the active Army, Reserves, and Army National Guard fleet optimization planning and operations no later than 2035. The FEP will consider the Army's current conditions, desired future state, and key milestones to be achieved for facilities and vehicle fleets.

Funding was secured for the collaborative initiative through the National Center for Manufacturing Sciences (NCMS) Commercial Technologies for Maintenance Activities (CTMA) Program and the Office of the Deputy Assistant Secretary of Defense, Materiel Readiness (ODASD-MR).

1.2 Approach

The project team conducted desktop and installation site-level analyses to support achievement of the ACS and various EOs. The goal of the project was to obtain an unbiased understanding of the overall impact of ZEV adoption and integration and to develop a potential ZEV transition plan.

The project's detailed approach focused on an analysis of NTVs for the Continental United States (CONUS), Hawaii, Alaska, and U.S Territories and a site-level analysis for three CONUS Army installations. The analysis addressed the four key areas of **fleets, facilities, fuels**, and **oversight** opportunities needed to transition to a new ZEV environment while continuing to meet mission requirements.

To conduct the desktop and site level analyses the project team divided the work into the four tasks listed below:

- **Task 1: Program Design –** Develop a work plan and confirm with G-9, alignment on project scope, model assumptions, and final deliverables.
- **Task 2: Data Collection –** Collect and validate NTV fleet data and conduct site visits.
- **Task 3: Fleet Analysis –** Develop a methodology to prioritize ZEV deployment and utilize fleet data to generate modeled fleet adoption outputs. Conduct site visits to validate observations to develop an accurate ZEV transition.
- **Task 4: Fleet Assessment –** Combine desktop and site analyses and observations to develop a framework for ZEV adoption across the Army.

The project team modeled fleet data, met with relevant stakeholders, developed interview guides, and conducted site visits at three installations to interview fleet managers and Directorate of Public Works (DPW) personnel. These efforts were to understand the current state and challenges of ZEV transition and to develop the findings and recommendations presented in this report.

1.3 Findings

The findings for the four key areas below were obtained through modeling fleet data, conducting site visits and in-depth interviews with installation personnel. Detailed findings are presented in a subsequent section of this report.

- **Fleet** – ZEV acquisition has been slow due to supply chain constraints. Specific mission requirements may not be addressable due to potential capability limitations of current ZEV technology.
- **Facilities** – Electric Vehicle Supply Equipment (EVSE) acquisition planning has been slow due to lack of funding and contracting mechanisms.
- **Fuels** – Current utility generation, transmission, and distribution capacity need to be evaluated to assess the ability to meet the projected future increase in electricity demands.
- **Oversight** – Currently the Army has decentralized coordination and governance of the critical elements needed to support the transition to ZEVs.

1.4 Recommendations

The project team's recommendations focus on how to realistically deploy over 50,000 non-tactical ZEVs and understanding the impacts due to changes in infrastructure and daily operations of every installation. Implementing the recommendations outlined in this report will improve the Army's ability to optimize ZEV and EVSE planning and acquisition efforts in support of the transition to an electric NTV fleet. Detailed recommendations are presented in a subsequent section of this report.

- Align ZEV and EVSE procurement and installation is necessary for the transition to ZEVs.
- Conduct assessments of each installations load capacity to meet current and future EO and ACS decarbonization objectives.
- Develop overarching policy and guidance to all installations to address common concerns and unique constraints and challenges.
- Establish a cross-functional, centralized governance structure to manage the transition to ZEVs.

1.5 Invention Disclosure

☐ Yes Inventions ☒ No Inventions
DD882 Invention Report sent to NCMS ☒

1.6 Project Partners

- U.S. Army – Deputy Chief of Staff (DCS) G-9 Installations
- Guidehouse Inc.
- National Center for Manufacturing Sciences (NCMS)

2. Introduction

2.1 Background & Purpose

By responding to the Administration's goals of decreasing GHG emissions and the ACS line of effort to integrate ZEVs into the Army's NTV fleet, the Army will be afforded the opportunity to lead national and local efforts in transitioning to an all-electric NTV fleet. This requires an informed strategy and robust program architecture to efficiently use supply chains, infrastructure, partnerships, existing data systems and reporting efforts and continuous infrastructure improvement practices. This project developed a comprehensive ZEV transition plan accounting for the four key areas of **fleets**, **facilities**, **fuels**, and **oversight** opportunities for the potential electrification of the NTV fleet. Provided below is a summary of tasks for each of the key areas:

- **Fleets**
  - Recommended ideal fleet size, vehicle size, and type to meet mission requirements, policy goals, and government-wide policy goals.
  - Identified potential gaps between the fleet's current capabilities and mission requirements.
  - Proposed a prioritization methodology based on factors including mission needs, current vehicle age and usage, replacement costs, existing infrastructure, and future vehicle availability.
- **Facilities**
  - Reviewed key Army locations to assess their ability to support an electrified fleet.
  - Proposed short- and long-term options for Army locations to support an electric fleet.
  - Developed necessary training to educate the installation and operational communities on the maintenance and sustainment of ZEVs and EVSE.
- **Fuels**
  - Evaluated current energy demand at key Army locations.
  - Assessed the reliability of current energy providers (commercial and private utilities), including generation, transmission, and distribution.
  - Evaluated and proposed options for improving resilience.
- **Oversight**
  - Conducted analysis of policies, procedures, and funding mechanics for ZEV deployment.
  - Conducted analysis of the common operating picture (COP) current state and recommended future state opportunities.
  - Developed a prioritization methodology to guide the deployment of ZEVs.

3. Project Narrative

The third-party developed the transition plan by conducting a NTV desktop analysis and site level analysis at three installations. The NTV population for this project focused on General Services Administration (GSA) leased and Army-owned vehicles garaged in CONUS, Alaska, Hawaii, and U.S. Territories. From January 2023 through July 2023, the third-party team met with Army stakeholders to validate data and model assumptions. The team also met with Installation Management Command (IMCOM) and U.S. Army Corps of Engineers (USACE) personnel and aligned to their ZEV counts and EVSE to vehicle ratio master planning effort.

In preparation for the ensuing site visits, HQDA G-9 personnel assisted the third-party team by providing contextual knowledge, vehicle data, other supporting documents, and identified installation key personnel for interviews. The project team developed an interview guide to utilize during the interviews and site visits which were conducted between May – July 2023. The interview guide was designed to ask questions focused on providing additional clarification and insight for the four key areas of fleets, facilities, fuels, and oversight.

The team conducted the desktop and site level analyses by completing the four tasks below:

- **Task 1: Program Design** – Developed a work plan and confirmed with HQDA G-9 alignment on project scope, model assumptions and final deliverables.
- **Task 2: Data Collection** – Collected and validated NTV fleet data for all three Army compos. Conducted installation site visits to gather first-hand experience of teams working to deploy ZEVs and to understand the current state, specific challenges, and unique situations at the installation level tied to the Army's ZEV transition.
- **Task 3: Fleet Analysis** – Modeled ZEV adoption in compliance with EO 14057 and EO 14008 and developed model inputs and assumptions to determine a methodology to transition ZEV deployment. Calculated incremental electric load, ZEV cost, and GHG savings for three different scenarios of ZEV transition. Model inputs and assumptions were as follows:
  - Data Sources – 2022 Federal Automotive Statistical Tool (FAST) Report (received on January 19, 2023), USACE Interim Report (received on May 30, 2023), and Fleet Drive Thru (received on May 15, 2023).
    - Determined the 2022 FAST Report as the baseline data set.
    - Aligned FY23 and FY24 ZEV counts to the USACE Interim Report.
    - Utilized Fleet Drive Thru data to augment 2022 FAST Report data.
  - Vehicle Populations – Army-owned vehicles, GSA leased vehicles, and Army Compos.
  - Location – Vehicles garaged in CONUS, Alaska, Hawaii, and U.S. Territories.
  - Excluded Populations – Tenant organizations and personally-owned vehicles.
  - Rate Assumptions – Electric rates, vehicle gas rates, maintenance rates, GSA rates, emission factors, and GHG factors (as of March 2023).
- **Task 4: Fleet Assessment** – Combined desktop analysis with site validation to develop framework for ZEV adoption to

provide recommendations and a prioritization methodology to guide the deployment of ZEVs. The key focus areas were defined as follows:

- Fleet – Focused on paths of transitioning the Army's NTV fleet to ZEVs.
- Facilities – Focused on observations from the three Army installations visited which includes needed infra-structure upgrades and relationships to successfully transition.
- Fuels – Focused on the decommissioning of gas and diesel and the transition to electricity as the new major source of fuel.
- Oversight – Considered centralized, decentralized, and/or hybrid management operating structures.

3.1 Findings

3.1.1 Fleets

The third-party review examined the transition of over 50,000 Army NTVs to ZEVs. The large deployment of electric non-tactical ZEVs will change the infrastructure and daily operations of every installation. The findings from this category were:

- GSA performs most fleet management functions for the Army and internal controls are focused on controlling fleet size.
- Army-owned vehicles (~10% of fleet) are migrating to GSA where possible (exception: medium and heavy-duty vehicles).
- Installation level fleet managers and DPWs need time and assistance to build new partnerships with local towing companies and ZEV service and maintenance providers.

3.1.2 Facilities

The facilities findings focused on installations and their specific infrastructure needs for transitioning to ZEVs. Transition readiness varied based on unique constraints and challenges at each installation. The findings from this category were:

- System, building, and equipment electric load management will be required given the current infrastructure and projected load increases.
- Upgrades to the sub-transmission system will be costly and take several years to complete. Utility transformer delivery times of 70 weeks will impact site infrastructure upgrade plans and ZEV deployment plans.
- EVSE maintenance, networking, load management, billing, and cybersecurity needs are unclear and largely unassigned.

3.1.3 Fuels

Changing landscape from mature marketplace of gas and diesel to new vendors of EVSE will require significant infrastructure investment, electric load growth, and new stakeholder engagement. The findings from this category were:

- Relationships with gasoline and diesel fuel providers are trusted and mature relationships.
- Electricity is provided by mature providers where load is stable, and infrastructure is managed internally or by a third party.
- Utility constraints require consideration of distributed energy resources (DER) in ZEV deployment planning.

3.1.4 Oversight

Installations affirm the need for a programmatic and centralized approach to ZEV and EVSE deployments. Successful deployment of ZEVs will require new partners, updated relationships, and active change management. The findings from this category were:

- Army stakeholders seek a unified statement of policy and leadership requirements to meet the requirements of EO 14057, ACS, and the National Defense Authorization Act (NDAA).
- Currently, Army has decentralized coordination of critical initiatives and installations seek guidance and support from HQDA in the following categories:
  - Acquisition and Sustainment – ZEV and infrastructure acquisition and sustainment business processes, budgeting, funding sources, and customer billing changes may impact installation operations.
  - Human Capital – Added maintenance, day-to-day operations, and technical expertise required for ZEV/EVSE could expand current human capital constraints.
  - Operations – Current ZEV technology may impact installation operations due to mission-specific challenges; clear and transparent exemption rules would be welcomed.
  - Change Management – Clarity around over-arching policies and governance that will influence acquisition and sustainment, operations, human capital, and human behavior is the highest priority.

4. Recommendations

A comprehensive and well-coordinated set of activities are required to successfully deploy the Army's non-tactical ZEVs and to achieve EO requirements. Based on the desktop analysis, the Army will need to transition over 50,000 NTVs at a purposeful pace that aligns to supply chain constraints and EVSE acquisition while achieving EO and ACS objectives. Based on FAST 2022 data, the most viable recommendation to achieve the EO, would be transitioning between 3,000 and 5,000 ZEV units annually through 2032 and transitioning all remaining NTVs by 2039. To support this growth in ZEV population, the Army will need to procure the EVSE and infrastructure to support the addition of 255 GWh across its footprint. The site assessments, noted as of the close of FY23, all three installations have completed site-specific ZEV master planning, installed some EVSE infrastructure, and received a few ZEVs. Additionally, each installation shared with the project team similar critical policy concerns exist for charging both government-owned and personally-owned vehicles.

Detailed recommendations include the following:

- **Fleets**
  - The Army needs to understand capabilities of ZEVs and how they align to mission parameters.
  - Allocate resources for workforce development and training to support ZEV maintenance.
- **Facilities**
  - EVSE construction and maintenance will require a close, working relationship with fleet to confirm that EVSE is available and support daily mission needs.
  - Actively manage new EVSE partners and evolving technologies to facilitate NTV readiness.
- **Fuels**
  - The Army needs to understand and optimize new supply chains due to the increase in demand for electricity.
  - Installations need to assess their load capacity and ability to meet future EO or ACS objectives.
- **Oversight**
  - Implementing a centralized governance structure will be critical to the success of current and future ACS objectives.
  - Establish a cross-functional, centralized governance structure to manage the investment, construction, and change management required to successfully transition to ZEVs.

5. Project Benefits

5.1 Benefits for the General Public

- **Cost Savings**: Transitioning internal combustion engine (ICE) to electric vehicles (EV) will provide taxpayers with a significantly less tax burden than maintaining an ICE fleet. The cost of an EV is significantly less than its ICE counterpart in both up-front costs and yearly operating maintenance and sustainment costs. This allows the taxpayer's money to be used for more beneficial amenities in the local community, such as education, infrastructure, and other public services that people rely on in their municipality.
- **Sustainability**: Reducing the consumption of gasoline and diesel fuels will reduce the need to burn fossil fuels. This reduced consumption of fossil fuels will lead to improved environmental conditions around Army facilities, including reduced particulate (e.g., NOx, CO_2) emissions and noise pollution.
- **Technology Innovation**: The EV is a catalyst in the transformation of the transportation sector, enabling technologies such as fast charging (fill your EV with electricity just about as fast as you fill up your car with gas), autonomous driving technology (your car takes you where you want to go with limited interaction on your part), and long-lasting rechargeable batteries.

5.2 Benefits for DOD

- **Fleets**: Decreases maintenance and sustainment time/cost – The powertrain of an EV is more durable than its ICE counterpart. An EV does not require oil and filter changes, spark plugs, or belts. Further, EVs require less frequent brake maintenance.
- **Fuel**: The reduced need of fossil fuel can be achieved by the energy used to propel an EV from the onboard battery pack. This battery pack can be charged using electricity generated from solar, wind, hydro, natural gas, and nuclear sources.
- **Facilities**: Improves installation resiliency through necessary facility upgrades. The inclusion of EVs at an Army facility will further increase its ability to overcome disruptions to its power supply, thus improving its operational readiness.