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FINAL PROJECT REPORT

MHX Intermodal Electrification Blueprint for Heavy Goods Movement

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PREFACE

Assembly Bill 118 (Núñez, Chapter 750, Statutes of 2007) created the Clean Transportation 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.
- 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 GFO-20-601 to accelerate the deployment of MDHD ZEVs and ZEV infrastructure with a holistic and futuristic view of transportation planning. In response to GFO-20-601, MHX submitted an application which was proposed for funding in the CEC's notice of proposed awards on April 8, 2021, and the agreement was executed as ZVI-21-001 on November 15, 2021.

ABSTRACT

The Ports of Long Beach and Los Angeles and their associated transportation hubs, including nearby railyards and warehouses, are an epicenter of freight movement in Southern California that connect international goods movement to the rest of the US. The concentration of toxic air contaminants and greenhouse gas (GHG) emissions in the Los Angeles air basin is known to have negative impacts on low-income communities, specifically within the vicinity of these transportation operations. To help address this problem, the CEC funded a medium and heavy-duty fleet electrification Blueprint, to facilitate planning for a zero-emission future at these hubs. The Blueprint highlights the efforts of MHX LLC, a transload and transportation service provider, to plan for and deploy zero-emission fleets and equipment while coordinating and facilitating input from key stakeholders. The Blueprint outlines strategies for integrated zero-emission vehicle (ZEV) planning and engagement processes to accelerate a cost-effective ZEV transition. The objectives of the agreement include engaging internal and external stakeholders, defining fleet operator and driver needs, identifying workforce education and training resources, advancing facility site design, developing a phased approach to infrastructure deployment, and mapping the ecosystem of strategic partners and business model innovations supported by ZEV market adoption. The report identifies several barriers to project implementation, including the lack of availability of zero-emission alternatives for certain equipment and vehicles, potential electrical capacity shortcomings, and supply chain challenges. The report stresses the need for collaboration between logistics companies, policymakers, utility companies, and other stakeholders to develop a comprehensive plan for the electrification of medium and heavy-duty fleets and proposes a replicable plan for MDHD ZEV and ZEV charging deployment, stakeholder outreach, and workforce development strategies for fleet electrification.

Keywords: Medium- and heavy-duty zero-emission vehicles, ports, railyards, warehouses, electric vehicle support equipment, electric vehicle infrastructure, disadvantaged communities.

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EXECUTIVE SUMMARY

The Final Report for the Multi-Modal ZEV Blueprint for Heavy Goods Movement project (Blueprint) focuses on outlining and describing the processes of creating the final Blueprint, as well as a summary of important findings and next steps. The goal of the Blueprint is to support and encourage adoption of Medium- and Heavy-Duty (MDHD) Zero Emission Vehicle (ZEV) and infrastructure in the heavyweight drayage sector. The geographic focus of the project is the areas of Southern CA where MHX operates, including the Counties of Los Angeles and San Bernardino California as well as the Port of Los Angeles and Port of Long Beach.

Toxic air contaminants and greenhouse gas (GHG) emissions in the Los Angeles air basin are heavily concentrated in the vicinity of the Ports of Long Beach and Los Angeles and their associated goods movement corridors. Heavy-duty diesel trucks in the area are creating particularly negative public health impacts for many low-income communities that surround the Ports and the Interstate 710 (I-710) heavy-duty corridor that connect the Ports with the Pomona Freeway (State Route 60). As a multi-modal epicenter of heavy goods movement, the Ports, the I-710 Heavy-Duty Corridor, and associated intermodal transfer facilities will require an integrated zero-emission vehicle (ZEV) blueprint planning and engagement process to facilitate an accelerated, forward-thinking, and cost-effective ZEV transition.

To help solve this problem, MHX—a premier transload and transportation service provider—is working with regional stakeholders to deploy ZEVs and ZEV infrastructure at its facilities and at the locations which it serves. Because MHX links directly with each of the key intermodal system operators (ports, railyards, and warehouses), MHX is a uniquely positioned “hub entity” to identify solutions for MDHD electric vehicle (EV) recharging and hydrogen refueling across these key nodes of California’s intermodal logistics ecosystem.

MHX already has plans to deploy ten heavy duty EVs and is in the permitting process for deploying EV charging infrastructure at its Fontana Facility. Guided by the Blueprint, MHX is developing plans for additional EV and EVI deployments at its other facilities and in partnership with intermodal system operators. The Blueprint provides thorough technical, financial, business and community considerations for transitioning these sites. Finally, the Blueprint suggests next steps and considerations for MHX to implement moving forward. The Blueprint is intended to be a replicable roadmap for heavy weight intermodal transport hubs looking to equitably transition to electric or hydrogen vehicle infrastructure.

MHX worked with partners Build Momentum, Inc. (Momentum) and Arup Americas, Inc. (Arup) to achieve all measurable project goals, including:

1. Enable MHX to fully equip its fleet with heavy-duty ZEVs & resilient charging/hydrogen refueling infrastructure.
2. Provide replicable strategies for the deployment of zero-emission medium- and heavy-duty fleets.
3. Articulate a holistic and futuristic view of freight planning – with a special focus on heavy goods movement at intermodal terminals in California’s leading ports and railyards.

CHAPTER 1:

Background

1.1 Problem Statement

Toxic air contaminants and greenhouse gas (GHG) emissions in the Los Angeles air basin are heavily concentrated in the vicinity of the Ports of Long Beach and Los Angeles and their associated goods movement corridors. Heavy-duty diesel trucks in the area are creating particularly negative public health impacts for many low-income communities that surround the Ports and the I-710 heavy-duty corridor that connect the Ports with the Pomona Freeway (State Route 60). As a multi-modal epicenter of heavy goods movement, the Ports, the I-710 heavy-duty corridor and associated intermodal transfer facilities will require an integrated zero-emission vehicle (ZEV) blueprint planning and engagement process to facilitate an accelerated, forward-thinking, and cost-effective ZEV transition.

MHX, a premier transload and transportation service provider, worked with key subcontractors, including Momentum, Arup and the North American Council for Freight Efficiency (NACFE)—to craft the MHX Intermodal ZEV Blueprint for Heavy Goods Movement. Because MHX links directly with each of the key intermodal system operators named above, MHX is a uniquely positioned “hub entity” to identify solutions for MDHD electric vehicle (EV) recharging and hydrogen refueling across these key nodes of California’s intermodal logistics ecosystem.

The Objectives of the Agreement Included:

1. Engage internal and external stakeholders to develop a comprehensive and economic approach to rapidly deploying MDHD ZEV infrastructure. Quantitative metrics may include number of stakeholders targeted, number of stakeholders engaged, and ZEV planning processes initiated through customers and allied coalitions.
2. Define internal and third-party fleet operator and driver needs to identify critical performance specifications critical to MHX, customer, and logistics partner needs. Quantitative metrics may include refuel/recharge time, infrastructure availability, cost, and environmental impact.
3. Identify workforce education and training resources to prepare maintenance technicians for MDHD ZEVs. Quantitative metrics may include number of existing training programs and qualifications mapping of existing and new skillsets.
4. Advance facility site design to vet the design process and identify real-world operability considerations given existing utilization and smart-charging/hydrogen refueling opportunities. Quantitative metrics may include number of conceptual site designs completed, capabilities for ZEV recharging/hydrogen refueling (number of trucks served per day and range per hour of charging or refueling provided), electrical capacity upgrades (kW), and peak capacity for concurrent charging/hydrogen refueling (number trucks served at various charging or refueling rates).
5. Develop a phased approach to infrastructure deployment that maintains flexibility to react to changes to a nascent market with rapidly evolving technology. Quantitative metrics may include interoperability (e.g., charging or hydrogen refueling standards that can be used for multiple vehicle types), cost estimates, and energy modeling (e.g., power demand, energy use, energy cost).

6. Map the ecosystem of strategic partners and business model innovations supported by ZEV market adoption. Quantitative metrics include financial modeling and risk analysis.

1.2 Recipient Background

MHX LLC

MHX provides intermodal, transload and transportation services moving product between warehouses, railyards and ports via truck. It has experience in working with structural commodities, consumer products, bulk products, and hazardous materials. MHX currently has a fleet of 60+ flatbed trucks throughout the state of CA moving standard, overweight, over dimensional, and hazardous materials. MHX operates multiple rail facilities served by the Burlington Northern Santa Fe and the Union Pacific Railroad, and provides services out of the Port of Los Angeles/Long Beach and Port of Stockton. At these locations MHX handles local and long-haul dray for break bulk commodities, along with devanning and heavy weight corridor access for container movements.

Build Momentum, Inc. (Momentum)

Momentum designs, develops, and deploys innovation campaigns for forward-thinking organizations—from entrepreneurs to public agencies to Fortune 500 companies—that research, demonstrate, commercialize, and operate transformative transportation, energy, water, and manufacturing technologies. Momentum has supported the design and development of some of California’s most prominent programs, including the Low Carbon Fuel Standard (LCFS), the West Coast Electric Highway, and the California Sustainable Energy Entrepreneur Development Initiative (CalSEED).

1.3 Key Barriers

Barriers to project implementation explored in the Blueprint include lack of current market availability of zero emission alternatives for certain equipment and vehicles, potential electrical capacity shortcomings, the need for alternative sources of funding, the need to coordinate roles and responsibilities between MHX and its public and private partners (ports, railyards, warehouses), supply chain challenges and infrastructure deployment timelines challenges, and capital availability for vehicle and equipment replacement. In addition, MHX and associated stakeholders identified numerous challenges, risks, concerns, and opportunities associated with the MDHD ZEV transition including:

- Lack of current technology available for specific heavy-duty vehicles applications, such as a lightweight low range semi-truck.
- ZEV technology is rapidly changing and generates risk of deploying equipment that will soon become inferior.
- The tradeoff of weight versus range of current Medium- and Heavy-Duty equipment.
- Logistical and operational challenges associated with keeping electrical equipment charged within duty cycle constraints.
- Space for ZEV charging/refueling infrastructure and available power.
- Workforce will need additional training and support for O&M of ZEV fleets.

1.4 Project Need and Technical Merit

Project Need:

The California Air Resources Board (CARB) is developing a medium and heavy-duty zero-emission fleet regulation with the goal of achieving a zero-emission truck and bus California fleet by 2045 everywhere feasible and significantly earlier for certain market segments such as delivery and drayage applications. The medium and heavy-duty drayage fleets that provide transload and drayage services at the Ports of Los Angeles, Port of Stockton, BSNF Railway, and Union Pacific (UP) railyards, as well as warehouses along I-710 are key targets for early electrification due to the relatively small radius of their operations and outsized impact they have on regional air quality.

The electrification of medium and heavy-duty transload and drayage fleets is a crucial step in reducing emissions from the transportation sector. Drayage and transload trucks are responsible for a significant amount of air pollution in the areas surrounding ports and railyards. These emissions have been linked to respiratory illnesses, cancer, and other health problems. Moreover, the electrification of drayage fleets can lead to significant economic benefits for the logistics industry. Electric vehicles have lower operating costs and require less maintenance than traditional diesel vehicles. Additionally, the use of electricity as a fuel can reduce fuel costs and dependence on fossil fuels, which are subject to price volatility. In the long run, the electrification of drayage fleets can help reduce operational costs and increase profitability for logistics companies.

The electrification of transload fleets operating at the ports and railyards in Los Angeles, Orange and San Bernardino counties will bring several benefits to the environment, the economy, and society. First, it can reduce emissions of air pollutants, such as particulate matter, nitrogen oxides, and carbon dioxide, which contribute to climate change and harm human health. By replacing diesel-powered trucks with electric trucks, emissions of these pollutants can be significantly reduced, which can improve air quality and reduce health risks for workers and residents in surrounding areas. Additionally, electrification can create new job opportunities in the manufacturing, installation, and maintenance of electric vehicles and charging infrastructure. The ports, railyards and warehouses where MHX and similar companies operate are often characterized by high levels of air pollution, noise, and congestion, which can contribute to health problems, decreased property values, and reduced quality of life. The use of electric trucks can reduce noise levels and emissions, which can lead to a quieter and healthier environment for residents.

Despite this plurality of benefits, fleet managers face a daunting knowledge gap before electrifying their fleets. While electric passenger cars have gained significant attention and adoption in recent years, medium and heavy-duty electric trucks have received less attention and require more specialized knowledge and infrastructure. Many logistics companies are not yet familiar with the latest technologies and solutions for electrification, which can make it difficult for them to make informed decisions and plan for the transition to zero-emission fleets.

Furthermore, the high-power requirements of medium and heavy-duty zero-emission trucks present unique challenges for charging infrastructure. While charging a passenger car can be accomplished using a standard household outlet or a level 2 charger, the high-power requirements of medium and heavy-duty trucks require specialized charging infrastructure with higher power outputs. This means that the installation of charging infrastructure will require

Careful planning and coordination with utility companies to ensure adequate electrical capacity and grid stability.

To address these knowledge gaps, there is a need for these studies to provide logistics companies and industry professionals with the latest information and best practices for electrification. Additionally, there is a need for collaboration between logistics companies, policymakers, utility companies, and other stakeholders to develop a comprehensive plan for the electrification of medium and heavy-duty fleets that considers the unique challenges of these vehicles. This Blueprint helps achieve all these goals by creating a replicable plan for MDHD ZEV and ZEV charging deployment, conducting extensive stakeholder outreach and coordination and exploring workforce development strategies for fleet electrification.

Technical Merit:

The project leverages MHX's unique strengths, including strategic fleet analytics, strategic partnerships and influence, and strategic locations. MHX operations support the movement of high value commodities such as aluminum, steel, lumber, consumer products, bulk products, and hazardous cargo, and the Blueprint will serve to inform its' peers in this field. In addition to serving the Ports of Los Angeles and Long Beach, MHX serves the Port of Stockton and transloads freight to BNSF Railway and UP railcars. Operating out of the three Ports, seven major depots, and dozens of customer facilities, MHX dispatches over 300 short-haul truck trips daily, utilizing a fast-growing fleet of 71 Class 8 trucks, 49 heavy-duty forklifts, two-yard hostlers, and two rail car movers. Because of its connection to these industry segments, MHX is uniquely positioned to become a leader of electrification efforts among all these stakeholders.

MHX has extensive experience with supply chain management and is well positioned to seamlessly integrated mixed electric and diesel fleets. The project will disseminate these integrated E-fleet management tools to partner fleets across the MHX intermodal ecosystem, creating additional efficiencies for electrified goods movement.

MHX's strategic locations are another key strength of the project. MHX owns and operates seven depots and transshipment facilities, six of which are located in disadvantaged communities. The project's focus on these locations will help accelerate MDHD EV adoption across the heart of California's intermodal goods movement system, in the communities which are most impacted by it.

CHAPTER 2:

Community and Stakeholder Engagement

The overarching goal of this task is to bring together industry participants, stakeholders, and advocates to foster productive dialogue and action to advance the deployment of MDHD ZEV infrastructure and vehicles.

2.1 Summary of Engagement Plan

The goal of this task is to bring together industry participants, stakeholders, and advocates to foster productive dialogue around the deployment of MDHD ZEV infrastructure and vehicles to support a new paradigm in clean transportation.

Contains material from:

- List of Outreach Targets
- Community and Stakeholder Engagement Plan
- Community and Stakeholder Engagement Report
- Multi-Language Outreach and Education Materials

The purpose of community and stakeholder engagement was to gather the perspectives, opinions, and input of community members and stakeholder groups for use in the development of the final Blueprint. Outreach was designed to create a flexible and adaptable approach that meaningfully fostered a two-way dialogue to share perspectives about challenges, risks, concerns, and opportunities.

Outreach efforts began in March 2022, with the submission of the List of Outreach Targets and the Community and Stakeholder Engagement Plan in late February. The project team facilitated outreach with key stakeholders on an ongoing and regular basis. In May, outreach efforts advanced significantly at the Advanced Clean Transportation Exposition. This laid the groundwork for follow-up meetings that “cold-calling” might otherwise not have. Meetings were held with vehicle and equipment manufacturers to learn about their product lines as well as charging-as-a-service providers and others.

Generally, private stakeholders and key business partners were the most motivated to engage, with Original Equipment Manufacturers (OEM) being very happy to meet as often as necessary to paint a complete picture of the ZEV landscape. Many stakeholders shared information about existing and anticipated government policies and regulations to support early adoption of ZEVs which guided their zero-emission strategies. MHX specifically asked manufacturers about the creation of specialty short range ZEV truck. This would help MHX trucks carry additional weight per vehicle and would not impact performance because of the short distance its vehicles typically travel. Most manufacturers of heavy-duty vehicles shared that the development of specialty ZEVs would follow a wider-scale deployment and commercialization of MDHD ZEVs. The Blueprint team also had frequent, productive engagement with business partners and stakeholders including the ports and railyards and was in frequent contact with utility providers throughout the Blueprint. Throughout the Blueprint process, MHX struggled to coordinate a timely review of its energy supply and charger deployment plans from utilities, which has slowed its deployment of purchased electric trucks. Charger manufacturers and installers were relied on heavily to inform the deployment of ZEV charging technology at MHX’s locations that will be electrified in the coming year.

In contrast, community-based organizations showed some signs of outreach fatigue in their lack of enthusiasm to meet with the project team. This left the team struggling to gather meaningful community-level perspectives. Despite this, community organizations indicated they are generally supportive of ZEV transitions due to the various noise and pollution benefits of electric trucks so long as it doesn't increase truck traffic in communities.

2.2 Summary of Replicable Models for MDHD ZEV Fleet Transformation

The MHX Blueprint strategies and initiatives will be highly replicable for other fleets and geographies. To foster replication, MHX Blueprint team members captured all the key elements in fleet transition planning in several products to provide replicable models for ZEV fleet transformation in the MDHD segment, including the following:

- ZEV Fleet Planning for Heavy Goods Movement: Case Study of MHX – A Regional Intermodal Logistics Provider
- Accelerating Intermodal Sustainability: A Guide to the ZEV Transformation of Intermodal Freight Terminals
- Fleet Finance Symposium Presentation (webinar format) to provide information on financing innovations relevant to the Blueprint process.

The ZEV Fleet Planning Case Study explores MHX's plans to deploy charging infrastructure at its Fontana, California, facility for 10 Kenworth T680E electric trucks. The project is being funded by a \$1.8 million grant from the Mobile Source Air Pollution Review Committee and \$1.5 million in vouchers from California's Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project. The case study explores the challenges encountered during the implementation of the project, including analysis of required electrical capacity upgrades, supply chain issues, rate considerations, cost estimate, and energy modeling. The charging infrastructure for the electric trucks was deployed through the Rule 29 option, and MHX opted for a traditional route for upgrading electrical service, in which MHX will be responsible for costs on both sides of the meter. The report also discusses rate considerations and the use of Time of Use (TOU) rates for electric truck charging. The report provides replicable strategies for the deployment of zero-emission medium- and heavy-duty fleets.

The Guide to Zev Transformation of Intermodal Freight Terminals includes electrification strategies for truck-to-ship and truck-to-rail intermodal transfer, as well as electric charging and hydrogen refueling MDHD over-the-road trucks, drayage equipment, and forklifts. It provides an overview of fleet infrastructure and how to scope fleet electrification projects. This includes a breakdown of the key partnerships and information requirements for fleet managers looking to electrify, including, fleet data & terminal data, infrastructure planning, fleet power requirements, onsite power generation and storage. The guide also includes a case study of MHX's electrification efforts and guidance for powering fleets with hydrogen. The report provides this information within the context of intermodal transportation and with considerations for each hub of transportation within the port, railyard, warehouse and delivery ecosystem.

The Fleet Finance Symposium brought together industry stakeholders to discuss diesel versus electricity fuel costs, charging infrastructure costs, EV vs. diesel truck costs, MDHD ZEV electricity rates, return on investment, and MDHD ZEV incentives.

2.3 Technical Advisory Council

The project team formed a Technical Advisory Council (TAC) consisting of community and industry leaders with knowledge of freight logistics, transportation electrification, and related environmental issues. The TAC consisted of representatives from MHX, Momentum, the CEC, Bluescope, Rio Tinto, The Pasha Group, Plastic Express, Union Pacific, and the Port of Los Angeles. The MHX TAC convened its first meeting on October 21, 2022, to deliberate the deployment of ZEVs for heavy goods movement. The council emphasized the importance of electrical infrastructure for charging equipment since ZEVs increase the power usage of a typical business. The council considered several deployment scenarios based on different truck-miles per day and compares the fuel costs of diesel versus electricity. The TAC discussed strategies for optimizing the benefits of the transition.

The second TAC meeting continued the progress made in the MHX Multi-Modal ZEV Blueprint for Heavy Goods Movement Project. The focus was to inform the TAC of updates to the charging node network and to discuss challenges, opportunities, and areas of collaboration. The TAC members discussed the importance of an opportunity charging node network to avoid excessive electrical demand at specific sites, reduce demand charges and stress on the grid. The attendees also considered possible solutions such as minimizing battery weight, raising roadway weight limits, using hydrogen fuel cell technology, or minimizing the battery size and doing frequent opportunity charging at every location.

The reports and discussions held in the two meetings of the MHX TAC highlight the importance of implementing a robust electrical infrastructure and charging network for zero-emission heavy goods movement. The reports provide valuable insights into deployment scenarios and key strategies for ensuring a successful ZEV transition.

CHAPTER 3:

Blueprint Development

The goal of this task is to gather the information necessary to develop a replicable and actionable Blueprint that guides future investment into MDHD ZEV infrastructure.

3.1 MDHD ZEV and ZEV Infrastructure Analysis and Goals

The project team developed quantitative goals and specific, realistic timelines and goals for installation and implementation of MDHD EV charging infrastructure within the project.

Include material from or regarding:

- List of MDHD ZEV Goals and Installation Timeline
- Zero-Emission Infrastructure Plans

The Blueprint team, through its transition scoping, has developed accurate estimates of vehicle and infrastructure deployment that depend on the infrastructure funding option that MHX pursues. MHX has already secured orders for 10 MDHD battery-electric vehicles (BEVs), which became available in February 2023, but have not yet been deployed due to delays in charger installation. MHX is currently debating between two EV Infrastructure (EVI) funding approaches which lead to different EVI deployment timelines.

1. The first option is to apply for Southern California Edison's (SCE) Charge Ready Transport Program. This program will likely take a minimum of one year for equipment installation, however, provides coverage for a majority of the costs.
2. The second option is to pursue deploying EVI through an electric vehicle supply equipment (EVSE) provider, such as EVgo. This will be more expensive (around \$250,000), however there will be no delays associated with deployment. EVSE provider estimates indicate that charger deployment would begin within six weeks of signing a contract, with four to six weeks of installation work.
 - a. If this option is pursued the next immediate goal for Blueprint implementation will be to map the vehicle and EVSE CapEx plan.

Regardless of which deployment option is chosen, the goal is to have fully deployed battery-electric fleets by 2029. The only caveat is that utility hardware lead times could have a negative effect on this interconnection milestone.

3.2 Technology and System Analysis

The project team facilitated and conducted a Technology and Systems analysis to support the Blueprint development process.

3.2.1 Summary of System and Technology Presentation

To support subsequent Blueprint efforts, the Blueprint team conducted preliminary research conducted on zero-emission heavy-duty transportation technologies. The Blueprint covers key considerations such as battery specifications, range limitations, and charging infrastructure, including cutting-edge technologies such as vehicle-to-grid integration, megawatt charging standards, and automated charging solutions. The report provides a detailed overview of available technologies and deployment strategies for businesses, including consideration of environmental and economic impacts. These insights can be used to help organizations like

MHX make informed decisions about which technologies to adopt to meet their specific business needs while reducing their carbon footprint. Overall, the Blueprint emphasizes the importance of careful planning and strategic thinking when transitioning to zero-emission heavy-duty transportation to maximize the benefits of these technologies and mitigate potential challenges.

3.2.2 Summary of Microgrid Scoping Analysis

The Blueprint team conducted a microgrid and smart charging scoping analysis to determine best energy and cost management practices for a heavy weight drayage fleet. The analysis shows that the pricing for vehicle fueling can change significantly based on existing and new electricity rate schedules, compared to today's diesel costs. Mitigating risks in fluctuating EV prices can be done with additional investment in Distributed Energy Resources (DERs). The report analyzed different rate options under the Charge Ready Transport (CRT) program, Rule 16, and solar-powered microgrid scenarios. The analysis included utility bill assessment, site assessment, battery energy storage system sizing calculation, solar site assessment, and the value of solar. MHX can benefit from deploying solar onsite, which will reduce demand charges, time-related demand charges, and high Time of Use (TOU) rates. The analysis shows that MHX can charge no more than two Kenworth T680E trucks at one time, each at a rate of 120 kW, to keep the total demand under 500 kW. MHX can benefit from the TOU-8-E rate for business customers that deploy onsite solar, with total demand over 500 kW. MHX can also benefit from the TOU-8-D rate if the total demand for both its Fontana facility plus electric truck charging is kept under 500 kW. Finally, the report shows that NEM 3 could drastically reduce the value proposition to MHX for deploying onsite solar, doubling or tripling the number of solar panels needed to achieve the same return on investment. Overall, MHX can benefit from investing in DERs to reduce costs and mitigate risks in fluctuating EV prices.

3.2.3 Summary of Smart Charging and Hydrogen Refueling Assessment

The Blueprint team used MHX's plans and ongoing process to deploy charging infrastructure at its Fontana, CA facility for 10 Kenworth T680E electric trucks as a case study for EVI deployment. The analysis included required electrical capacity upgrades, supply chain issues, rate considerations, cost estimates, and energy modeling to provide replicable strategies for the deployment of EVI.

During the process, MHX explored utilizing the Southern California Edison (SCE) CRT program. Tradeoffs of this option include significantly reduced upfront costs but lengthy deployment time and opportunity costs of delayed implementation. MHX then explored using Rule 29, authorized by the California Public Utilities Commission (CPUC) but found that the lead time to obtain switchgear may be too long. The team is now considering opting for a traditional route for upgrading electrical service, in which MHX will be responsible for costs on both sides of the meter. Ultimately MHX will make its decision based on the most efficient and cost-effective approach that is available.

The Blueprint team's study also included a smart charging assessment that identifies key strategies for minimizing electricity costs associated with the deployment of electric vehicles and EV infrastructure. This includes avoiding charging electric trucks during high time of use (TOU) rate times and scheduling charging to minimize the number of trucks charging at one time. The company plans to distribute charging among facilities in its charging node network and limit depot charging to no more than two trucks at a time using smart charging software.

3.3 Zero Emission Vehicle Impacts and Benefits

The project team developed a ZEV Impacts and Benefits Report to explore possible community effects of the ZEV transition. The report is divided into workforce and employment impacts and community benefits.

The team found that the transition of MHX to zero-emission vehicles (ZEVs) will require new training and educational efforts to equip the workforce with the necessary skills and knowledge. The Blueprint identifies several knowledge gaps that need to be addressed to encourage participation in zero-emission transportation. By upskilling its workforce proactively, MHX can prepare its employees for the ZEV transition and create new, well-paid electrical jobs.

Community benefits include improved air quality in low-income and disadvantaged communities, which are ubiquitous in the regions where MHX operates. Using publicly available tools provided by National Renewable Energy Laboratory (NREL), the team found that when MHX converts its full fleet of 54 trucks, its ZEV transition will reduce CO₂ emissions by 2854 tons, or 5,707,369 pounds, per year. The initial replacement of ten diesel trucks will eliminate 12 pounds of PM_{2.5}, 50 pounds of carbon monoxide, and 94 pounds of PM₁₀ per year.

CHAPTER 4:

Blueprint

The goal of this task is to formalize the information gathered through the Task 2 and Task 3 into a formal Blueprint that can be shared with key stakeholders.

5.1.1 Blueprint Overview

The Blueprint is intended to compile the information gathered over the duration of the project and present it in an accessible manner that can serve to inform fleet managers and other interested parties about fleet electrification. The Blueprint provides an outline of intermodal freight transportation at the ports, railyards and warehouses of Los Angeles and San Bernardino Counties. It includes a discussion of stakeholders and their input, ZEV technologies, vehicle and equipment deployment strategies, community benefits and impacts and next steps.

5.1.2 Blueprint Takeaways

The final Blueprint process proceeded as follows:

- Integrate findings from the Technical Tasks into the Blueprint Outline.
- Complete Draft Blueprint.
- Incorporate feedback as provided by the Commission Agreement Manager (CAM).
- Prepare Final Blueprint.

For the Final Blueprint, the project team synthesized the significant outcomes and information derived from all outreach and technical tasks listed in the Scope of Work (SOW). The Blueprint includes important takeaways and lessons learned from outreach, technical analysis, and financial planning (summarized in Chapters 2-4 above). The Blueprint also provides a set of recommended activities for MHX to pursue, to ensure it and its stakeholders successfully overcome the hurdles and barriers to fleet electrification that the Blueprint identifies. These recommendations include the following:

- Lobbying/coalition building
- Knowledge transfer
- Coordinating charging infrastructure deployment
- Energy infrastructure deployment planning
- EV pilot program review, an operations assessment
- Cost analyses
- Technology and fuel type analysis
- Funding capture, workforce development
- Collaboration with research and development partners
- Advocacy
- Strategic planning for fleet EV phase-in

MHX is well positioned to proceed with the recommendations provided in the Blueprint to transition drayage and intermodal facility vehicles and equipment to zero-emission options

supported by new charging infrastructure. The roadmap can also serve as an implementation guide to facilitate electrification of other fleets or ports.

CHAPTER 5:

Data Collection

The goal of this task is to collect data from the project and include this in regular progress reports and the Final Report, if applicable under statutory requirements.

Include material regarding:

- Any relevant data collected pertaining to the blueprint project, as required by statute

The Blueprint team collected and synthesized various data sets to inform decision making. This includes fleet routes and duty cycles, estimated electricity consumption of a MHX EV fleet, potential energy generation and value of onsite DERs (from solar panels and onsite battery storage), estimated costs of vehicles, equipment, microgrid and energy for fuel, estimated loss of revenue from additional weight of EVs, and other data as necessary. This data is referenced in the relevant sections of each chapter and throughout the final Blueprint.

GLOSSARY

ALTERNATING CURRENT (AC) -- Flow of electricity that constantly changes direction between positive and negative sides. Almost all power produced by electric utilities in the United States moves in current that shifts direction at a rate of 60 times per second.

BATTERY ELECTRIC VEHICLE (BEV) -- Also known as an "All-electric" vehicle (AEV), BEVs utilize energy that is stored in rechargeable battery packs. BEVs sustain their power through the batteries and therefore must be plugged into an external electricity source in order to recharge.

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.¹

CALIFORNIA ENERGY COMMISSION - The state's primary energy policy and planning agency. The agency was established by the California Legislature through the Warren-Alquist Act in 1974. It has seven core responsibilities:

- Developing renewable energy
- Transforming transportation
- Increasing energy efficiency
- Investing in energy innovation
- Advancing state energy policy
- Certifying thermal power plants
- Preparing for energy emergencies

CAM – Acronym for Commission Agreement Manager.

COMPRESSED NATURAL GAS (CNG) - Natural gas that has been compressed under high pressure, typically between 2,000 and 3,600 pounds per square inch, held in a container. The gas expands when released for use as a fuel.
CALIFORNIA PUBLIC UTILITIES COMMISSION (CPUC) - A state agency created by constitutional amendment in 1911 to regulate the rates and services of more than 1,500 privately owned utilities and 20,000 transportation companies. The CPUC is an administrative agency that exercises both legislative and judicial powers; its decisions and orders may be appealed only to the California Supreme Court. The major duties of the CPUC are to regulate privately owned utilities, securing adequate service to the public at rates that are just and reasonable both to customers and shareholders of the utilities; including rates, electricity transmission lines and natural gas pipelines. The CPUC also

¹ [Department of Transportation glossary webpage](https://dot.ca.gov/az.html) https://dot.ca.gov/az.html

provides electricity and natural gas forecasting, and analysis and planning of energy supply and resources. Its main headquarters are in San Francisco.

CRT – Acronym for Charge Ready Transport.

DIRECT CURRENT (DC) - Electricity that flows continuously in the same direction.

DISTRIBUTED ENERGY RESOURCES - Small-scale power generation technologies (typically in the range of 3 to 10,000 kilowatts) located close to where electricity is used (for example, a home or business) to provide an alternative to or an enhancement of the traditional electric power system.

ELECTRIC VEHICLES (EV) -- A broad category that includes all vehicles that are fully powered by Electricity or an Electric Motor.

EVI – Acronym for electric vehicle infrastructure.

ELECTRIC VEHICLE SUPPLY EQUIPMENT (EVSE) -- Infrastructure designed to supply power to electric vehicles.

GHG – Acronym for greenhouse gas. Any gas that absorbs infra-red radiation in the atmosphere. Greenhouse gases include water vapor, carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), halogenated fluorocarbons (HCFCs), ozone (O₃), perfluorinated carbons (PFCs), and hydrofluorocarbons (HFCs). (EPA)

IBEW -- Acronym for International Brotherhood of Electrical, a labor union with a local chapter in the Ontario, CA region.²

LOW CARBON FUEL STANDARD (LCFS) -- A set of standards designed to encourage the use of cleaner low-carbon fuels in California, encourage the production of those fuels, and therefore, reduce greenhouse gas (GHG) emissions. The LCFS standards are expressed in terms of the "carbon intensity" (CI) of gasoline and diesel fuel and their respective substitutes. The LCFS is a key part of a comprehensive set of programs in California to cut greenhouse gas emission and other smog-forming and toxic air pollutants by improving vehicle technology, reducing fuel consumption, and increasing transportation mobility options.³

MDHD -- Acronym for Medium- and Heavy-Duty vehicles. MDHD vehicles have a gross vehicle weight rating of more than 10,000 pounds and include vans, buses, and trucks.⁴

MOU -- Acronym for Memorandum of Understanding.

NREL -- Acronym for National Renewable Energy Laboratory.⁵

² [International Brotherhood of Electrical website](http://www.ibew.org/9thdistrict) http://www.ibew.org/9thdistrict

³ [California Air Resources Board Low Carbon Fuel Standards website](https://ww2.arb.ca.gov/our-work/programs/low-carbon-fuel-standard) https://ww2.arb.ca.gov/our-work/programs/low-carbon-fuel-standard

⁴ [Medium- and Heavy-Duty Zero-Emission Vehicles in California website](https://www.energy.ca.gov/data-reports/energy-almanac/zero-emission-vehicle-and-infrastructure-statistics/medium-and-heavy#:~:text=Medium%2D%20and%20heavy%2Dduty%20vehicles,during%20the%20previous%20calendar%20year) https://www.energy.ca.gov/data-reports/energy-almanac/zero-emission-vehicle-and-infrastructure-statistics/medium-and-heavy#:~:text=Medium%2D%20and%20heavy%2Dduty%20vehicles,during%20the%20previous%20calendar%20year

⁵ [National Renewable Energy Laboratory website](https://www.nrel.gov/) https://www.nrel.gov/

Original Equipment Manufacturer (OEM) --refers to the manufacturers of complete vehicles or heavy-duty engines, as contrasted with remanufacturers, converters, retrofitters, up-fitters, and re-powering or rebuilding contractors who are overhauling engines, adapting or converting vehicles or engines obtained from the OEMs, or exchanging or rebuilding engines in existing vehicles.

SCE -- Refers to Southern California Edison, an electric utility company in the Los Angeles, CA region.⁶

SCAQMD -- Acronym for South Coast Air Quality Management District.⁷

SOW – Acronym for Scope of Work.

TAC – Acronym for Technical Advisory Council

TIME-OF-USE (TOU) RATES -- The pricing of electricity based on the estimated cost of electricity during a particular time block. Time-of-use rates are usually divided into three or four time blocks per twenty-four hour period (on-peak, mid-peak, off-peak and sometimes super off-peak) and by seasons of the year (summer and winter). Real-time pricing differs from TOU rates in that it is based on actual (as opposed to forecasted) prices which may fluctuate many times a day and are weather-sensitive, rather than varying with a fixed schedule.

UP – Acronym for Union Pacific.

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

⁶ [Southern California Edison website](https://www.sce.com/) https://www.sce.com/

⁷ [South Coast Air Quality Management District website](http://www.aqmd.gov/) http://www.aqmd.gov/