CALIFORNIA ENERGY COMMISSION

CALIFORNIA NATURAL RESOURCES AGENCY

California Energy Commission

Clean Transportation Program

FINAL REPORT

Blueprint for Ontario International Airport Authority's Medium- and Heavy-Duty Zero Emission Vehicle Infrastructure

Prepared for: California Energy Commission

Prepared by: Build Momentum, Inc.

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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, projects must be consistent with the CEC's annual Clean Transportation Program Investment Plan. The CEC issued GFO-20-601 entitled "Blueprints for Medium- and Heavy-Duty Zero-Emission Vehicle Infrastructure" to accelerate the deployment of MD/HD ZEVs and ZEV infrastructure with a holistic and futuristic view of transportation planning. In response to GFO-20-601, Ontario International Airport Authority (OIAA) submitted Proposal #22 which was proposed for funding in the CEC's notice of proposed awards on April 8, 2021, and the agreement was executed as ARV-21-006 on September 23, 2021.

ABSTRACT

Ontario International Airport Authority is a joint-powers authority formed between the City of Ontario and San Bernardino County in Southern California. The Airport Authority is the owner and operator of Ontario International Airport. The airport is a full-service medium hub airport serving more than 5.5 million passengers per year and is a major air-cargo facility in Southern California. Ontario International Airport has nonstop commercial jet service to 26 major airports around the world. The Ontario International Airport Authority Medium- and Heavy-Duty Zero Emission Vehicle Infrastructure Blueprint details steps to accelerate the adoption and deployment of medium- and heavy-duty zero emission vehicle infrastructure and equipment throughout the airport grounds and across all airport stakeholders and operators. This transition to zero emission vehicles aligns with the Airport Authority's emission reduction goals, as well as the state of California's goal of carbon neutrality by 2045.

The Blueprint provides options for transitioning the Airport's medium- and heavy-duty vehicles to zero-emission vehicles and suggests initially focusing on ground support equipment, shuttle buses, and hotel shuttles. Community and stakeholder engagement generally yielded support across the board for the Airport's planned transition to medium- and heavy-duty zero emission vehicle infrastructure with internal stakeholders offering valuable insight for infrastructure placement and usage. Although there are initial costs associated with a zero-emission vehicle infrastructure transition, the Blueprint provides mitigation options such as funding and financing for implementation costs. The Blueprint also details technology assessments and design recommendations for infrastructure development at the Ontario International Airport Authority. Finally, the Blueprint provides Challenges and Risks, Opportunities, and Next Steps for Blueprint implementation.

The Blueprint was prepared by the Ontario International Airport Authority, together with Momentum, and subcontractors Ricondo, HNTB Corp., and the National Renewable Energy Lab.

Keywords: Elective ground support equipment, Medium- and heavy-duty zero emission vehicles, airport, airport vehicles, hotel shuttles, electric vehicle support equipment

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CEC awarded Ontario International Airport Authority $200,000 in 2021. Ontario International Airport Authority used these funds to complete the Blueprint for Ontario International Airport Medium- and Heavy-Duty Zero Emissions Infrastructure to accelerate the adoption and deployment of Medium- and Heavy-Duty Zero Emission Vehicle infrastructure and equipment throughout the airport grounds and across all airport stakeholders and operators. Its main goal was to assess the strategies for implementing and integrating medium- and heavy-duty zero emission vehicle infrastructure throughout the airport over the coming decade.

Ontario International Airport Authority worked with partners Build Momentum Inc., Ricondo & Associates Inc., National Renewable Energy Laboratory, and HNTB Corp.

Project Goals & Objectives

Between 2021 and 2023, the project team created a replicable Blueprint that lays out various scenarios for airport adoption of zero-emission ground support equipment vehicles. The project achieved all measurable objectives, including:

- Discovered new opportunities and pathways for replicable Medium- and Heavy-Duty Zero Emission Vehicle deployment at airports and transportation hubs that have potential to fundamentally disrupt airport design, city planning, and the global energy sector.
- Engaged a broad, inclusive stakeholder network and identify strategic partners to develop a comprehensive and equitable approach to rapidly deploying Medium- and Heavy-Duty Zero Emission Vehicle infrastructure.
- Understood the needs of Medium- and Heavy-Duty equipment and fleet owners and operators, including key equipment related stakeholders such as airlines, freight carriers, design and planning consultants, airport procurement divisions, and equipment manufacturers.
- Identified workforce education and training resources to prepare equipment operators and maintenance technicians for working with Medium- and Heavy-Duty Zero Emission Vehicles.
- Influenced the Ontario International Airport planning and design efforts to include Medium- and Heavy-Duty Zero Emission Vehicle infrastructure deployment strategies and design elements that consider new technologies, business models, policies, realistic timelines, technology vendors, and Medium- and Heavy-Duty fleet operators.
- Developed proactive risk mitigation strategies to overcome challenges and barriers to deployment of Medium -and Heavy -Duty Zero Emission Vehicle infrastructure at Ontario International Airport.

Project Findings

The Blueprint details findings on the challenges and risks associated with airport zero emission vehicle transitions, opportunities for the transition, and specific next steps for Ontario International Airport Authority to implement the Blueprint.

- Challenges and Risks
    - The electrical grid serving Ontario International Airport Authority and the

surrounding region will require capacity upgrades to accommodate increased loads from electrification, alongside the rapid pace of industrial and residential development.
    - Technology is not currently sufficient for some very heavy-duty zero-emission vehicles and equipment.
    - Zero emission vehicle technology is rapidly changing and generates risk of deploying equipment that will soon become inferior.
    - There are logistical and operational challenges associated with keeping electrical equipment charged within duty cycle constraints.
    - Space for zero emission vehicle charging/refueling infrastructure and available power needs to be evaluated in relation to operational needs.
    - The upfront cost of procuring medium- and heavy-duty zero emission vehicles is typically greater than conventional equipment (before grants, tax credits, and operational savings are factored).
    - Workforce will need additional training and support for Operation & Maintenance of zero emission vehicle fleets.
- Opportunities
    - Meeting and exceeding the goals of Ontario International Airport Authority's voluntary memorandum of understanding with South Coast Air Quality Management District.
    - Proactively reserving electrical capacity with Southern California Energy to ensure stable power supplies as electrification statewide draws more and more power from the grid.
    - Establishing Ontario International Airport Authority as a leader in the sustainability landscape.
    - Providing a basis to make better decisions as Ontario International Airport Authority and other airports move through the transition to zero emission vehicles.
    - Meeting regulatory requirements, such as the Advanced Clean Fleet rule, ahead of schedule while public funding for medium- and heavy-duty zero emission vehicles is plentiful.
    - Saving money on operations costs by taking advantage of the low cost of electricity compared to diesel and Low Carbon Fuel Standard credit generation.
    - Positioning Ontario International Airport Authority to receive the numerous federal and state incentives and grant funding opportunities to support zero emission vehicle transitions. Early adopters will benefit from this wealth of funding opportunities.
- Suggested Next Steps:
    - Review the electric ground support equipment and zero-emission vehicle infrastructure deployment recommendations provided by HNTB in Task 4 deliverable: Zero Emission Vehicles Technology Assessment.
    - Create a fleet inventory, energy consumption, and usage assessment that includes the following:
        - Fleet inventory and usage statistics
        - Energy breakdown by vehicle types and departments
        - Vehicle energy requirements/duty cycle analysis
        - Fleet replacement criteria – vehicle age/mileage
        - Selection of priority electrification candidates

        - Detailed data collection on priority vehicles
    - Determine a zero-emission infrastructure deployment phasing and timeline. The Blueprint team recommends starting with infrastructure for bus shuttles and electric ground support equipment, followed by fleet vehicles, and finally hotel shuttles.
    - Update license agreements between Ontario International Airport Authority and ground support equipment contractors to include a requirement to transition to zero-emission equipment, with near-term requirements to transition to widely available electric ground support equipment technology.
    - Select the placement for initial electric ground support equipment infrastructure and ownership model based on recommendations provided by HNTB in the Task 5 deliverables: Airport Design Report and Recommendations Package.
    - Evaluate recommendations for shuttle bus charging infrastructure based on HNTB's analysis provided in Task 5 deliverables, "Deploying Electric Chargers for Shuttle Buses," and in consideration of NREL's Task 4 technology assessment.
    - Determine the shuttle bus charger technology and placement. Issue a Request For Proposals for electric shuttle bus chargers and/or contract with a turnkey solution provider.
    - Select a charging station vendor for charging infrastructure. Ensure electrical charging vendors can deliver electric supply equipment on schedule. Equipment such as switchgear can have long lead times which can delay the implementation of charging systems.
    - In coordination with chosen electric vehicle supply equipment vendor, apply to Southern California Edison's Charge Ready Transport program to begin electric vehicle supply equipment installation planning and the installation process for shuttle bus chargers and electric ground support equipment charging infrastructure. The Southern California Edison Charge Ready Transport program will evaluate available electrical capacity needed for electric vehicle supply equipment deployment and schedule any needed upgrades.
    - Develop an Ontario International Airport Authority fleet transition schedule with corresponding infrastructure deployment in consideration of vehicle and equipment options evaluated by NREL and recommended by HNTB.
    - Consider a requirement for all hotel shuttles to deploy zero-emission vehicles, including updates to license agreements with shuttle operators.
    - Evaluate opportunities for pilot/first round medium- and heavy-duty fleet and hotel shuttle transitions, starting with readily available vehicles medium-duty vehicles (such as pickup trucks), to evaluate performance of vehicles and infrastructure while minimizing risks.
    - Determine charger technology and placement to support a medium- and heavy-duty fleet and/or hotel shuttle pilot. Issue a Request for Proposals for electric fleet chargers and/or contract with a turnkey solution provider.
    - Select a charging station vendor for the vehicle fleet and/or electric hotel shuttle charging infrastructure.

- Determine the capital budget required for initial infrastructure, vehicle and electric ground support equipment deployment, tenant cost share, grant, funding, finance, and low carbon fuel standard options. Evaluate the expected savings from conversion to zero-emission equipment to determine the return on investment from the transition.
- Apply for all available funding, voucher, and tax credit sources available (funding sources can be found in the Task 10 Final Blueprint).
- Plan for the deployment of hotel shuttle charging infrastructure, including consideration of wireless charging.
- Work with San Bernardino County and the City of Ontario to streamline approval processes for selected zero emission vehicle infrastructure.
- Determine the operations and maintenance plans for the deployed vehicles, bus shuttles, electric ground support equipment, and infrastructure.

CHAPTER 1: Background

1.1 Problem Statement

In 2016, ownership, management, and operation of Ontario International Airport (ONT) transferred to the Ontario International Airport Authority (OIAA), away from Los Angeles World Airports (LAWA), which controlled ONT since 1967. Critically, this newfound autonomy is a once in a generation opportunity for the State of California to promote zero-emission vehicle (ZEV) infrastructure adoption at an airport. Due to financial constraints after gaining independence from LAWA, airport modernization planning to date has been primarily focused on laying the groundwork. Only now, in 2021, is ONT entering its next phase of planning and design for the future, and the California Energy Commission (CEC) can help ensure that airport planners and designers include replicable models for medium- and heavy-duty (MHD) ZEV infrastructure from the start. Airport stakeholders such as airlines are slow to adopt new technologies if they perceive a near-term risk, and airport planning does not always include plans for ZEV infrastructure. The proposed ONT MHD ZEV Blueprint will solve this problem by including planning for ZEV adoption from the very start of airport design and planning.

1.2 Recipient Background

Situated just 35 miles east of Los Angeles in the Inland Empire, ONT is one of the fastest growing airports in the U.S. and California's second largest freight airport – in 2019, ONT served over 5.5 million passengers and over 780,000 tons of freight. Spread across 1,700 acres and two parallel runways, ONT is home to hundreds of MHD vehicles spread across multiple airlines, cargo handlers, and transportation providers.

Ontario International Airport Authority (OIAA) is a joint-powers authority formed between the City of Ontario and San Bernardino County in Southern California. The OIAA is the owner and operator of ONT and has a Commission consisting of five appointed members. ONT is a full-service medium hub airport serving more than 5.5 million passengers per year and is a major air-cargo facility in Southern California, with more than 750,000 tons being carried to and from the airport each year. ONT has nonstop commercial jet service to 26 major airports in the U.S., Mexico and Taiwan, and connecting service to many domestic and international destinations. There is an average of 72 daily departures offered by nine air carriers.

ONT is one of the fastest growing airports in the United States. During 2019, ONT passenger volume increased 9.1% to over than 5.5 million annual passengers. Domestic travel rose 8% to more than 5.2 million and the number of international passengers increased 33.4% to more than 304,000. December 2019 was the sixth straight month of double-digit gains in total passenger volume, with nearly 515,000 passengers travelling through the airport, which is an increase of 16.7% over December 2018. More than 485,000 were domestic passengers while almost 30,000 were international travelers, increases of 16.5% and 20.5%, respectively. Commercial freight also rose significantly in December 2019 to more than 88,000 tons, an increase of 18.1% over December 2018. For the year, freight shipments increased to more than 760,000 tons, up 5.1% over 2018. ONT is the West Coast air and truck hub for UPS Airlines and is a major distribution point for FedEx Express.

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 delineate roles and responsibilities between OIAA and its tenants, and capital availability for vehicle and equipment replacement. In addition, OIAA stakeholders identified numerous challenges, risks, concerns, and opportunities associated with the MHD ZEV transition including:

- Lack of current technology available for very heavy-duty vehicles and equipment, such as fuel trucks and ground power units.
- ZEV technology is rapidly changing and generates risk of deploying equipment that will soon become inferior.
- Range and power 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

OIAA has committed to pollutant reduction goals in its voluntary Memorandum of Understanding (MOU) with the South Coast Air Quality Management District (SCAQMD). The ZEV Infrastructure Blueprint provides a roadmap for OIAA to achieve and exceed MOU requirements, while also staying ahead of forthcoming California Air Resources Board clean fleet regulations, reducing operations costs through fuel savings and Low Carbon Fuel Standard (LCFS) credit programs, and establishing itself as an industry leader.

CHAPTER 2:
Community and Stakeholder Engagement

The goal of this task was to bring together industry participants, stakeholders, and advocates to foster productive and thoughtful dialogue around the deployment of alternative fueling infrastructure supporting the concrete supply chain, including off-road material handling and on-road MHD ZEVs.

Contains material from:

- Task 2.2 Community and Stakeholder Engagement Plan
- Task 2.3 Community and Stakeholder Engagement Report

2.1 Summary of Outreach and Engagement

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.

Each stakeholder group had a different relationship to ZEV planning with overlapping goals and objectives. Understanding the roles, responsibilities, and approach of each stakeholder created a stronger, more dynamic heavy-duty ZEV planning effort. Much of what the team learned in outreach and engagement was described in detail in various technical tasks and deliverables required to develop the Blueprint; therefore, this section summarizes outreach efforts and findings but may point to other sections of the report for more in-depth information as appropriate.

Internal Stakeholders

OIAA and Momentum designed a survey to foster outreach and gather data to form a baseline understanding of the awareness and interest the stakeholders have with respect to OIAA's transition to zero emission technologies and operations. OIAA and Momentum began planning and preparation for outreach with internal stakeholders and airlines. Work included the development of stakeholder-specific surveys and coordinating outreach meetings.

On Tuesday, April 5 OIAA and Momentum held an outreach meeting for internal airport stakeholders. Sixteen OIAA participants joined the meeting where a real-time survey was conducted, followed by a discussion, to gather perspectives on the airport transition to zero emissions technologies and operations. All participants are involved in a range of OIAA operations, including facilities, fleet, finance, environmental compliance, and management. OIAA operates its own fleet of MHD vehicles for maintenance, police, fire, facilities, landscaping, and shuttle services.

Participants raised concerns about whether ZEV equipment has the power to perform necessary tasks for OIAA operations. There was a notable difference in views of the adequacy of electric vs. hydrogen equipment. The results were mixed on the question of whether "zero emission equipment will be as dependable as the equipment we use today." Other concerns expressed during this session included the upfront costs of ZEV equipment, safety risks with hydrogen equipment, and whether qualified maintenance personnel are available. Operation

concerns included the time needed to recharge electric equipment, consequences of staff forgetting to plug-in charging equipment, space for charging/refueling infrastructure, and whether there is a ZEV solution for the heaviest duty equipment, such as fire engines and fuel trucks. Environmental concerns included rare earth minerals used in battery production. Participants shared that they were unsure of how to select the best ZEV application among options available in the marketplace.

Another participant concern was sorting through zero-emission equipment options to determine the best choice. On the benefits side, internal stakeholders think that customers will strongly support the transition and that ZEV solutions for customer-facing fleets, including shuttles, are a good application. Stakeholders expressed that it would be best for OIAA to define a common ZEV equipment standard and provide common infrastructure. There was very strong support for the overall economic and environmental benefits of OIAA's conversion to zero-emission vehicles and equipment.

Airlines Stakeholders

On Thursday, May 5, 2022, OIAA and Momentum held an outreach meeting for airline stakeholders with 27 participants representing various roles from six passenger airlines and two cargo companies based at OIAA. Staff from HNTB Corp. (HNTB) also participated and helped facilitate the conversation to inform their ZEV design concepts recommendations (Task 5 deliverable).

The meeting participants discussed several topics around transitioning to zero emission MHD ground equipment at OIAA. The majority of OIAA airline tenants rely on a contractor (Menzies Aviation) to operate their ground support equipment (GSE) except for one, which owns and operates its own GSE. There was some reluctance at the onset of the meeting to discuss detailed operational issues, given concerns about competitive advantages. However, participants opened up as the meeting progressed.

The issue of fairness (commercial equity) was raised, related to investment in charging equipment. The concern is that late adopters will benefit from investments of early adopters which underscores the overwhelming support for EVSE investments to be made by the airport.

There was a discussion about the ideal locations for charging infrastructure. Representatives from two major airlines agreed that the most effective location is at or near gates that they operate. Others concurred that it is critical to have infrastructure at each gate.

Participants discussed the degree of flexibility in airline contracts to encourage or require adoption of zero emission equipment by contracts. The general understanding was that contacts are based on staffing models/equipment needs. It was assured that an updated license agreement between OIAA and the GSE contractor will include requirements to transition to zero emission equipment (primarily electric). OIAA has a general breakdown by airline of their current emissions and suggested changes they need to make to meet the goals.

Airline reps said significant electric equipment exists at every airport in the country, so they all have experience with electric GSE. One participant said the biggest hurdle is always about space and available power – for example, there is no room at a gate to park a lavatory truck. Technology availability is another hurdle. Maintenance is a non-issue.
The San Antonio airport was offered as an example, where the airport partnered with UPS to put in infrastructure in exchange for UPS deploying zero emission equipment. The working

model is to have the airport apply for money to install the charging infrastructure, while the airlines commit to deploying electric or hydrogen equipment. The charging hub at Seattle airport was also referenced, where 24/7 opportunity charging is provided. Ramp agents are instructed to charge whenever they have the opportunity. Both airlines and cargo companies said operational feasibility is a larger challenge than commercially available equipment. UPS has a 16-to-18-hour operating span, which does not give enough time to charge equipment. Range per charge is limited by the amount of weight being pulled. A representative from ExpressJet said that where they have deployed electrical equipment, it is crucial to take advantage of every opportunity to charge between operations.

Following the May 5 meeting, Momentum followed up with a 20-question survey to 39 airline stakeholders. The survey provided OIAA input from nine airlines stakeholders on their familiarity with, views on, and preparedness for ZEV airport infrastructure.

Notable results from the airline survey include:

- 78 percent of respondents said their airline has a corporate goal to accelerate the adoption of zero emission GSE. 0% disagree.
- Like internal stakeholders, most airlines stakeholders favored having the airport provide a common equipment standard and common infrastructure. Conversely, a slim majority of respondents said it's better for each airline to choose and supply its own infrastructure. This seeming contradiction needs more research to understand the difference between these perspectives.
- Zero percent of respondents answered that Medium- and Heavy-Duty equipment have the range and power for current operations, while just over half of respondents believe that ZEVs will have the range and power necessary in the future.
- Two out of three respondents would like the GSE contractor to provide more ZEV options.
- Seven of nine respondents preferred to have charging infrastructure at each gate, while only one voted for a centralized location.
- The majority of respondents view ZEV equipment as reliable as gas-powered equipment.
- The top three concerns with ZEV equipment were, in order: Cost, effect on operations, and reliability.
- Airline stakeholders were asked the question, "Is there any specific equipment within your fleet that you don't believe will be able to do the necessary work if converted to Zero Emission electric and/or hydrogen?" Answers included:
    - Supertugs/high-speed tow tractors do not have the power in an electric version to support our operation. Deicing trucks, ground power units, pre-conditioned air units, and air starts could be others.
    - We need a handful of fossil-fueled equipment to respond to emergencies or maintenance issues that electric equipment cannot achieve. These situations can be located a long distance away which electric equipment can't handle.
    - We need additional technology and equipment from original equipment manufacturers (OEMs) for full transition (like an air start, remote power).
    - Tanker fuel trucks. Currently there is nothing in prototype or design that is being developed as an electric fuel truck. The range and power needed from the batteries to move a vehicle that can carry that much weight doesn't currently exist without costing a fortune.

- Tanker Refuelers.

Local Jurisdictions

Momentum and OIAA held two meetings to engage with Local Jurisdictions on Thursday, July 14, 2022, and Tuesday, July 19, 2022. The Associate Planner at the City of Ontario joined one meeting to discuss the process of permitting ZEV infrastructure at OIAA. She explained that the City currently does not have separate permitting processes for EV infrastructure projects and other standard projects. All standard projects follow the City's plan check process through the Buildings Department.

After hearing a summary of the Blueprint project, the Associate Planner stated that OIAA's Blueprint plans will likely fall under this plan check process as "tenant improvements" or an otherwise similar category. Although there are no existing fast-track permitting options for OIAA or other applications, the City Buildings Department works closely with OIAA and so often prioritizes its permit applications. In the future, the airport would not receive special fast-track permitting options, but would be able to take advantage of the planned general fast-track option.

The City of Ontario's Sustainability Program Manager joined the second meeting. She described the city's existing 2020 Climate Action Plan (CAP) and the CAP updates currently underway (updates for post-2020 requirements have not been published yet). The existing CAP[1] has several sections pertinent to the OIAA Blueprint, including the City's plans to reduce greenhouse gas (GHG) emissions from 2008 to 2020. The Program Manager suggested incorporating an energy-self-sufficiency plan into OIAA's next master plan to demonstrate how the airport will address limited grid issues. She believes that with some energy self-sufficiency, the airport is primed to be an excellent hub for ZEV infrastructure. Kim stated a desire to see more big-picture collaboration between the City and OIAA.

Community-Based Organizations (CBOs)

OIAA and Momentum held a meeting for CBOs outreach on Tuesday, July 12, 2022. Two participants joined: the Director of Robert Redford Conservancy and Professor of Environmental Analysis at Pitzer College, and a representative from the Coalition for Clean Air and Center for Community Action and Environmental Justice. During the meeting, participants engaged in a live survey to foster discussion. The discussion had three main focuses:

1. The participants' work, how it overlaps with OIAA's ZEV infrastructure efforts, and future potential areas for collaboration,
2. Ways the airport and City of Ontario are looking to decrease overall emissions in a meaningful way,
3. How OIAA will continue to engage the community into the future.

Both attendees brought up the concern that the City and surrounding region is not doing enough in general to reduce emissions. The discussion also included ways OIAA can continue to engage the community and continue to get CBO input in the future. Both participants mentioned a desire to collaborate with OIAA on workforce/education development.

[1] Climate Action Plan, available at https://www.ontarioca.gov/Planning/Applications

Native American Tribes

Momentum held a Tribal outreach meeting on Wednesday, July 13, 2022. Momentum invited two tribes that OIAA is already in contact with: the Gabrieleno Band of Mission Indians' Kizh Nation and the Agua Caliente Band of Cahuilla Indians. Unfortunately, neither invitee nor their representatives were able to join. Despite a lack of participation in the meeting and survey, OIAA is hopeful to continue their existing relationships with these Tribes and keep them informed of this Blueprint project as it moves forward.

Policymakers and Regulatory Agencies

OIAA and Momentum coordinated with OIAA's lobbyist and legislative team to create an outreach plan for elected officials in the region. OIAA's team network reached out to members of the Southern California Congressional Delegation and several state officials. In mid-July 2022, the project team sent an information sheet (attached as Appendix 5.4) describing the basic elements of the OIAA MHD ZEV Blueprint. The team sent tailored updates highlighting the impact of the Blueprint on surrounding communities within the Southern California Congressional Delegation's jurisdiction. Although participants preferred to remain anonymous, feedback was generally supportive about the project, particularly the potential value to the community.

Voluntary MOU

In 2019 OIAA signed a voluntary MOU with the South Coast Air Quality Management District regarding OIAA's air quality improvement plan. This voluntary MOU intends to address the region's need for emission reductions.

OIAA's participation in the voluntary MOU is significant because emissions associated with operations at commercial airports contribute to adverse air quality in the Basin. The sources of these emissions include cargo trucks, ground support equipment (GSE), shuttle buses, and passenger vehicles.

The purpose of the voluntary MOU is to set forth how OIAA and SCAQMD intend to quantify the emission reduction benefits in the Basin through the implementation of voluntary airport strategies. OIAA and SCAQMD are working together under the voluntary MOU to develop inventories of airport emission sources and the development of future AQMPs. OIAA is responsible for Air Quality Improvement Plan (AQIP) Implementation measures agreed upon in the MOU, monitoring and reporting the implementation of AQIP measures, and supporting grant funding efforts.

The contents of the MOU require that all ground support equipment associated with commercial operations achieve fleet average NOx emission factors of 2.2 and 1.0 g/bhp-hr in 2023 and 2031 respectively. OIAA is responsible for:

1. Implementing the MOU by working with airport tenants to achieve the performance targets by the specified dates through accelerated turnover to cleaner equipment,
2. Providing SCAQMD an annual list of ground support equipment operating at the airport,
3. Providing SCAQMD an annual emission inventory for all ground support equipment associated with commercial operations at the airport, including methodology and calculations.

Financial Partners/Investor Partners

Momentum researched the best options for OIAA to finance and fund the Blueprint implementation, such as:

- Existing financing programs that are available for the ZEV transition, including loan guarantee programs, loan loss reserve programs, collateral support programs, bond issuance and others,
- Potential adjustments to existing programs to increase the attractiveness for ZEV infrastructure and vehicles,
- Potential new programs which could help accelerate deployment of ZEV infrastructure and vehicles,
- Requirements to access existing and new financing programs,
- Mechanisms to reduce the perceived risk of ZEV financing.

Research was focused on a select cross-section of potential financial/investor partners in order to conduct a market sounding exercise including:

- Traditional financial institutions,
- Alternative financial institutions and non-traditional lenders,
- Local, state economic development experts and possibly other financing experts.

In the Community and Stakeholder Engagement Report, Momentum also discusses a variety of applicable public and state agency funding programs such as the Low Carbon Fuel Standard (LCFS) Program run by CALSTART and a variety of funding opportunities from CARB.

Vehicle and Equipment Manufacturers

Momentum conducted outreach to a wide variety of OEMs and service providers through meetings, calls, webinars, and face-to-face engagement at the Advanced Clean Transportation (ACT) 2022 Expo. Some of the most pertinent OEMS engaged were:

- Astus, fleet management solutions for vehicle and ground support equipment
- Shuttle bus and vehicle companies, such as:
    - BYD Motors
    - Daimler
    - SEA Electric
    - Lightning eMotors
    - Zues Electric Chassis
    - Lion Electric
- Charging companies such as
    - Chargepoint
    - Electrify America

MHD ZEVs

Except for Southwest Airlines, the airport's ground support equipment is leased to airlines by Menzies Aviation. They offer electric models for most of their ground support equipment, but uptake is limited by available charging infrastructure and uncertainty over ZEV capabilities. Southwest Airlines began its conversion to electric GSE in 1999. Their expertise and experience

with electric GSE make them a crucial resource for informing the rest of the airport's fleet transition.

MHD Charger Manufacturers and Distributors

Charger OEMs and service providers are working to develop faster and higher-powered chargers but are limited by current vehicles' ability to accept high charge rates. Most charger OEMs have expressed that their on-market products are available for installation on-demand. Vehicle-grid-integration capabilities are not yet widely available on the market. However, multiple charging companies indicated that they are either developing or undergoing pilot programs utilizing this technology with fleets. Southwest Airlines uses eight Minit-Altus 22 kW model chargers to charge its GSE at OIAA. For EVSE installation at airport facilities, the OEMs and vendors should expect to coordinate extensively with OIAA and SoCal Edison (the utility).

Education and Workforces Development Partners

Momentum conducted outreach with potential Education and Workforce Development partners to explore:

- What training programs exist to support the needed workforce?
- What opportunities exist to partner with apprentice programs?
- What kind of opportunities exist to partner with high school Career and Technical Education (CTE) programs, as well as relevant workforce development programs at California community colleges?
- What are the top skills for trades sought by ZEV technology installers, maintainers, and operators?

Key Stakeholders engaged:

1. Regional Community Colleges
2. Internal Stakeholders
3. Vehicle and Equipment OEMs and Suppliers
4. Workforce Development Organizations
5. Local Labor Unions

Regional Community Colleges

The California Community College System is the largest and most accessible higher education system in the country. There are 10 community colleges in the Ontario region that provide certificates, degrees, and short-term training in trades related to automotive technologies and electrical infrastructure. Electric vehicle and infrastructure training are considered supplemental to most programs. Automotive programs are more likely to offer dedicated coursework on electric vehicle technologies, while electricians learn about electric vehicle infrastructure through post-graduate work and apprenticeships. Below is a list of the 10 community colleges:

- San Bernardino Valley College (Transportation and Electrical)
- Mt. San Jacinto College (Transportation)
- Citrus College (Transportation)
- Chaffey College (Transportation and Electrical)
- Riverside City College (Transportation)

- East Los Angeles College (Transportation)
- Rio Hondo College (Transportation and Electrical)
- Victor Valley College (Transportation and Electrical)
- Norco College (Electrical)
- Pasadena City College (Transportation and Electrical)

Momentum's analysis of survey data, interviews, and coursework found that of those 10 colleges with transportation and electrical programs, eight included zero emissions technology in some coursework. Interviews found that most of the programs, with some exceptions, focused on light duty vehicles with some emphasis on transferable skills to other equipment types. None of the electrical degrees in the area offered EVSE-specific training. Interviews with union and school representatives indicated that EVSE specific expertise is typically learned through post graduate programs or at on-the-job training.

OEMs and Suppliers

Most Charger OEMs indicated they have or will create programs that host customers and relevant industries to showcase the technology as well as O&M practices. A select few charger companies, such as Electrify America, have indicated their products will come with required warranty and O&M contracts for their products. Operations of EV charging equipment are generally straightforward and easily learned. Nearly all charger OEMs provide diagnostic and support software that can help identify maintenance needs. Warranties and O&M contracts are encouraged to ensure that charging equipment can be safely and adequately managed. Vendor representatives expressed that maintenance burdens of their equipment are typically lower than diesel equipment.

Workforce development

The San Bernardino County Workforce Development Board is a body of volunteers who supervise the allocation of federal funding to strengthen the skills of the local workforce. The Board is led by local business owners and includes public partners, educators, labor leadership and community-based organizations. Their programs include job training and a suite of events and services designed to connect job seekers with employers in the region. This organization does not have an existing relationship with the airport but is open to exploring workforce development opportunities.

Workforce gaps for ONT are primarily installation, operations, and maintenance related. Charger installation expertise is expected to be provided by utility companies (SoCal Edison) and vendors. Broadly, workforce managers agree that competencies need to be enhanced in battery technologies and electrical and charging equipment as well as general electrical and ZEV knowledge.

Labor Unions

International Brotherhood of Electrical Workers (IBEW) Local Union 11 and 477 represents more than 12,000 electrical construction industry professionals in the LA and Inland Empire region. Local 11 is formally affiliated with Engineers and Architects which represents more than 4,800 City employees across the greater LA region. IBEW trains apprentices as well as retraining and upskilling existing members of the union at the Electrical Training Institute. IBEW offers an Electric Vehicle Infrastructure Training Program (EVITP), an industry

collaborative that trains and certifies members in the installation of electric vehicle infrastructure. The program partners with vehicle OEMs, and regional utilities to teach electric vehicle chargers and other equipment installation and support. IBEW representatives estimate that around 50% of their journeymen are EVITP certified.

IBEW representatives expressed confidence that while there may be a nationwide shortage of certified electricians, there are more than enough in the LA and Inland Empire region. Of LA's 11,500 IBEW electricians, 9000 are certified in infrastructure and traffic, 7000 are inside wiremen and 2000 are apprentices. IBEW can be contacted to host EVIPT courses for licensed non-IBEW electricians which can be held on short notice if necessary.

Electricity and Hydrogen Providers

Southern California Edison (SCE) is OIAA's electric utility provider. Momentum has held numerous conversations with SCE regarding its offerings available to support the conversion of Medium- and Heavy-duty (MHD) infrastructure and fleet, including GSE, to ZEVs. Outreach was also done to hydrogen fleet and fuel companies to inform understanding of this ZEV option, and OIAA is currently participating in a "Hydrogen-Enabled Airport Ecosystem" study.

Momentum held an in-person meeting with SCE's Charge Ready Medium- and Heavy-Duty Transportation Electrification Sr. Advisor at the ACT Expo in Long Beach on May 10, 2022, and on video calls May 16, and May 20, 2022. Momentum has subsequently held several additional meetings and been in frequent contact by email and phone with the Sr. Advisor and other SCE staff. Outreach to hydrogen industry representatives was conducted at the ACT Expo, May 9-12, 2022, and at the California Hydrogen Leadership Summit on June 7, 2022.

SCE's Charge Ready Transport Program was one major element of discussion with these representatives. Momentum and SCE discussed how OIAA could potentially implement the program and continued to include the Sr. Advisor and SCE staff in future outreach and design discussions. SCE presented on the Charge Ready Transport Program at OIAA's Knowledge Transfer event, and discussed its applicability to hotel shuttles at ONT. SCE remains an important partner for future Blueprint implementation.

2.2 Outcomes of Outreach and Engagement

Community engagement and outreach with the airline stakeholder group was particularly challenging, as airlines seemed concerned that survey answers they provided may either divulge company proprietary information or negatively affect their airline in some way. OIAA changed its outreach approach from an in-person meeting to an online survey. It also altered outreach language to assure airlines stakeholders that all information would be anonymous and only used to inform the ZEV Blueprint. Survey responses then increased by the response deadline.

OIAA staff and key stakeholders share a strong interest in making a rapid transition to zero emission MHD vehicles and equipment. While stakeholders hold varying views on the feasibility of ZEVs for all operational needs and the date by which a full transition can occur, there is uniform agreement that utilization of MHD ZEVs will bring numerous benefits, from air quality improvements and GHG reduction to job and economic benefits.

OIAA stakeholders identified numerous challenges, risks, concerns, and opportunities associated with the MHD ZEV transition including those listed below.

<u>Challenges and Risks:</u>

1. Grid upgrades to accommodate increased loads from electrification, alongside the rapid pace of industrial and residential development
2. Technology unavailability for very heavy-duty vehicles and equipment, such as fuel trucks and ground power units
3. Rapidly changing ZEV technology with risk of deploying inferior equipment
4. Range and power of current Medium- and Heavy-Duty equipment
5. Logistical and operational challenges associated with keeping electrical equipment charged within duty cycle constraints
6. Space for ZEV charging/refueling infrastructure and available power
7. Upfront cost of procuring MHD ZEVs
8. Additional workforce training and support for O&M of ZEV fleets.

Opportunities:

1. Establish OIAA as a leader in the ZEV transition in the Ontario region, including the potential to include publicly accessible charging for regional MHD drivers in a land constrained area that is heavily impacted by the logistics industry
2. Deepen and strengthen relationships with external stakeholders, including community-based organizations, tribes, and local jurisdictions
3. Focus on key opportunities for OIAA, including public funding sources and programs
4. Incentivize OEMs and Vendors to support new technology adoption through additional support and mitigated risk
5. Generate long term costs savings through the energy transition
6. Lower maintenance cost for ZEV equipment
7. Access to a ZEV capable workforce from LA and the Inland Empire.
8. Opportunity for environmentally and socially inclusive development.
9. Ability to meet and exceedregulatory requirements.

Continued stakeholder engagement will help address these challenges and opportunities. However, the disparate nature of the stakeholders presents a challenge for timely and frequent engagement. Airports that are initiating the switch to ZEV fleets should make sure to identify key stakeholders and include them in an advisory council to enable regular and coordinated engagement.

CHAPTER 3:
ZEV Assessment Framework

The goal of this task was to leverage planning activities that are just starting at the airport to develop a ZEV Assessment Framework that will capture all major considerations for implementing ZEV infrastructure at ONT. The ZEV Assessment Framework informed the gaps and opportunities analysis and serves as a checklist to ensure the project team has considered the implications of all potential recommendations or strategies. The project team included Ricondo & Associates Inc. (Ricondo), airport planners with significant experience planning airport expansions, upgrades, and redevelopments that include energy efficient elements, emissions reductions strategies, and advanced technologies.

Includes material from or regarding:

- Task 3.1 Final ZEV Assessment Framework submitted on March 11, 2022.

Task Partners:

- Ricondo & Associates, Inc.

3.1 Key Considerations

Ricondo assessed the major planning considerations for deploying ZEV infrastructure like electrical charging stations and hydrogen refueling stations. With this assessment, they created a ZEV Assessment Framework that captures major planning considerations for implementing ZEV infrastructure at ONT. The ZEV Assessment Framework functions as a checklist to help ensure that the Blueprint Team has considered all major planning elements and implications. The final assessment included the following considerations for Blueprint Evaluation:

1. Existing Technology/Determining the Baseline
2. Type of ZEV Technology: Electric vehicles vs hydrogen fuel cell vehicles
3. Financial Obligations: Cost
4. Operating Considerations
    a. ZEV Performance
    b. Recharge Time
    c. Range
    d. Maintenance
    e. Training
    f. Insurance Requirements
5. ZEV Manufacturers Consultation
    a. Manufacturer's Warranty
    b. Experience with Implementation
    c. Safety/Security Concerns
6. Implementation Logistics
    a. Retrofit

    b. Implementation
7. Infrastructure
    a. Charging Stations
    b. Power Grid
    c. Hydrogen Refueling
8. Regulatory Considerations
9. Airport Layout Plan Considerations
    a. Airside
    b. Landside
10. Funding Sources/Credits
    a. FAA Voluntary Airport Low Emissions Programs
    b. FAA Airport Zero Emission Vehicle Infrastructure Pilot Program
    c. California Air Resources Board Programs
    d. Airport Incentive Programs
    e. Airline Partnerships
    f. Tax Credits
    g. Air-Quality Credits
    h. SCAQMD and ONT's AQIP

3.2 Gaps Identified

OIAA or other airports looking to adopt the MHD ZEV Infrastructure Blueprint can use the Task 3 ZEV Infrastructure Planning Factors table to assess whether there are gaps in their knowledge and plan to develop infrastructure. NREL and HNTB used this table to address gaps within their scope including but not limited to MHD ZEV equipment, charging, and refueling stations, and software solutions. At the Final Blueprint stage, every gap that could have feasibly been addressed has been. Barriers to addressing remaining gaps include limited fleet data from OIAA Operations, lack of clarity around the Airport/Airline cost for certain funding programs, and the determination that hydrogen is not a preferred option for ONT infrastructure development currently.

Generally, the assessment was useful for identifying the broad range of factors that need to be taken into consideration when transitioning airport fleets to ZEVs. The factors taken into consideration had a high degree of overlap with other Blueprint activities, and subsequent airport ZEV transition efforts would benefit from incorporating the findings of the Task 3 assessment.

CHAPTER 4:
ZEV Technology Assessment for Energy Optimization

The goal of this task was to evaluate ZEV infrastructure technology solutions and innovations that can address the baseline gaps identified in Task 3.

Includes material from or regarding:

- Task 4.1 Final ZEV Assessment Framework submitted on September 30, 2022.

Task Partners:

- National Renewable Energy Laboratory (NREL)

4.1 Summary of ZEV Technology Assessment

The findings of this task are presented in a Technology Outlook Presentation created by NREL, that outlines the various technologies available for ONT's ZEV transition. Beginning in July 2022, OIAA, Momentum, NREL, and HNTB held bi-weekly meetings to a) make sure there was consistent collaboration between all technical tasks, and b) provide NREL and HNTB chances to communicate directly with OIAA and each other to complete their deliverables on time. These meetings were also a time to invite external participants or interested parties to collaborate, like Southern California Edison (SCE) to discuss their Charge Ready Transport Program, e-Mission Control (eMC) to learn more about ONT while they help Momentum on the 7.1 Financial Ecosystem Landscape Presentation, and WAVE Wireless Charging to present their new technology to the team. OIAA and its partners—Momentum, NREL, and HNTB—steadily worked on the studies, reports, and recommendations for this Task that helped establish the Blueprint's foundation.

Recommendations from the presentation include the gathering of additional fleet/vehicle data collection and analysis to better define load profiles and deployment priorities that are based on duty cycles. The report also included findings on the following:

Fleet Inventory Energy Consumption and Usage

- Fleet inventory and usage statistics
- Energy breakdown by vehicle types and departments
- Vehicle energy requirements / duty cycle analysis
- Fleet replacement criteria – vehicle age / mileage
- Selection of priority electrification candidates
- Detailed data collection on priority vehicles

Infrastructure Requirements

- Available EV support equipment models
- Priority charging locations
- Vehicle dwell times and fleet parking locations
- Utility rates / rate structures

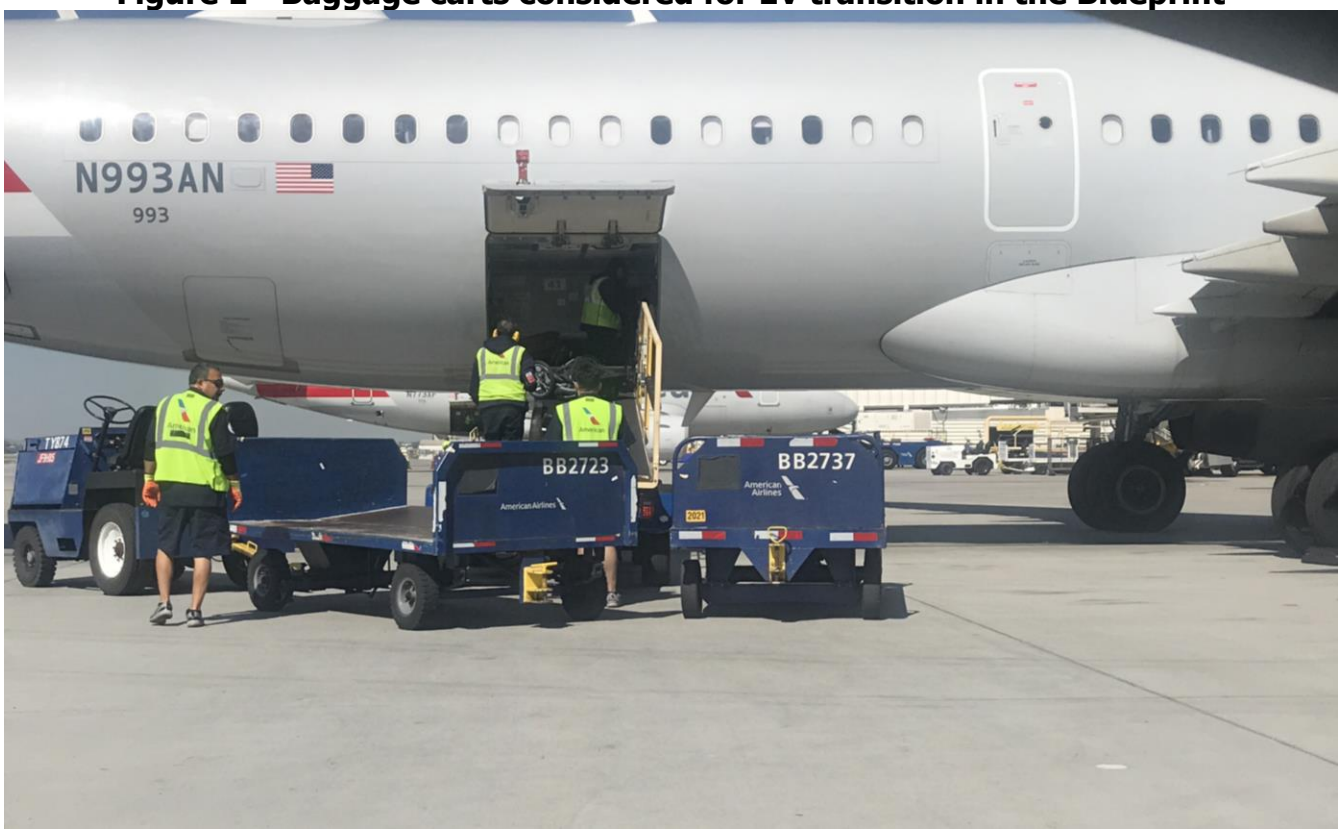
Cost of Operation / Ownership Evaluation

- Cost data collection (fleet) – fuel cost, electricity cost, maintenance
- Cost data collection (market) – fuel cost, electricity cost, maintenance
- Cost calculations – e.g., Vehicle Infrastructure Cash-Flow Evaluation (VICE) tool

The Technology Outlook Presentation provided useful information for determining the optimal composition of ZEV technologies implemented at the airport. The deliverables associated with

this task had significant overlap with Task 5 of the Blueprint and could be integrated in future Blueprint efforts.

Figure 1 - Baggage carts considered for EV transition in the Blueprint



Source: Ontario International Airport Authority

4.2 Key Technology Assessment Takeaways

The technology assessment summarized the key takeaways for OIAA as they move forward with MDH ZEV infrastructure development:

- Selection of the correct EVSE depends on an in-depth analysis of the usage characteristics of the EVs.
- Correct EVSE is not only a selected brand but also the part of an architecture that provides expansion without locking into a particular vendor. That involves number of ports, port capacity, and possible communication architecture that allow for demand side management.
- Selected station architecture should provide enough space and capacity for future expansion.
- It is highly encouraged to use simulation-based analysis to identify optimal selection of port number, power level and type.
- Data collection is of high priority for long term EV charging station monitoring and data sharing.

CHAPTER 5:
Design Concepts for Airport ZEV Integration

The project team's airport designer (HNTB) leveraged their extensive experience designing Leadership in Energy and Environmental Design (LEED) certified airports and developing energy efficient airport design concepts to help ensure the ONT MHD ZEV Blueprint considers trends and opportunities for airport design.

Includes material from or regarding:

- Task 5.1 Airport Design Concepts Report
- Task 5.2 ZEV Design Concepts Recommendation Package

Task Partners:

- HNTB

5.1 Summary of the Airport Design Concepts Report & Summary of ZEV Design Concepts Recommendation Package

The Design concepts report and recommendations included several recommendations summarized here. The recommendations included airport design concepts that may be applicable to ONT and that consider energy efficiency, carbon mitigation strategies, and advanced technologies and major design considerations for deploying ZEV infrastructure like electrical charging stations and hydrogen refueling stations.

HNTB evaluated existing electrical infrastructure at the airport using ONT Record Drawings, the SoCal Edison DRPEP GIS tool, which shows power stations and circuits, and load studies that determined electrical capacity at the airport. Using this information, HNTB provided recommendations for deploying chargers at each location of the airport where ZEV fleets would be implemented, including the available and required electrical capacity and layouts of charging stations.

When creating the recommendation package, HNTB reviewed feedback from internal (ONT) and airline stakeholders. HNTB participated in a discussion with the OIAA on May 17, 2022, to gather input on the airport design concepts that are relevant to ONT. The stakeholders expressed that it would be best for the OIAA to define a common ZEV equipment standard and to provide common infrastructure. When discussing eGSE implementation at other U.S. airports, the stakeholders indicated that the airlines typically prefer to have charging infrastructure in place at each gate. However, this is often hindered by the lack of existing electrical infrastructure available to support the necessary charging infrastructure. As a result, airports would typically provide chargers for the eGSE at every five to ten gates, or at a centralized location located adjacent to the gate area (where existing electrical infrastructure is available).

In addition, HNTB convened a separate meeting with JBT Aerotech and the OIAA Facilities team on August 10, 2022 to discuss available electrical infrastructure at Terminals 1, 2, and 4 to support future eGSE implementation at ONT. JBT indicated that three tenants currently operate eGSE at ONT and that there is existing charging infrastructure in place at both Terminals 2 and 4. JBT indicated the existing Terminal 1 electrical infrastructure is heavily loaded and is inadequately rated to support additional chargers for the eGSE.

HNTB facilitated an outreach meeting with the airline stakeholders on May 4, 2022, with participants representing both the commercial air carriers and cargo carriers. HNTB and Momentum also forwarded a survey to the stakeholders after the outreach meeting with additional follow-up questions related to the airport design concepts for ZEV integration. 77% of the airline stakeholders indicated that they would prefer to have charging infrastructure for eGSE at each gate rather than at a centralized location, or at a designated maintenance area. Representatives from two airlines added that this is common practice at other airports in the U.S. and referenced Seattle-Tacoma International Airport as an example. Additionally, the airline stakeholders also expressed that space constraint on the ramp area is often a challenge in transitioning to eGSE as well. Overall, the stakeholders favor having the airport define a common ZEV equipment standard and provide common infrastructure.

The Task 5 Report and Recommendation Package provided input on most of the elements of the comprehensive planning needs assessment described in Task 3. Broadly, the Airport Design Concepts Report and Recommendations provide a nearly complete concept for implementing electric vehicles and EVSE at the airport. Table 1 summarizes the recommended electric charger models along with their key specifications for application at ONT. These recommendations will guide deployment of EVSE at the airport upon purchase of the equipment described in the Task 4 and Task 5 reports.

Table 1 – Recommended Electric Charger Models at ONT

Application	Model	Input Power Required	Number of Ports
eGSE Charger (at gate)	PosiCharge DVS400	40 kW	2
eGSE Charger (at charging hub)	PosiCharge MVS800	80 kW	16
Low-output Fleet/Employee/Public Charger	ChargePoint CT4000	7.2 kW	2
Fleet Charger	Clipper Creek CS	19.2 kW	2
Heavy-duty Fleet DC Fast Charger	Eaton Green Motion	100 kW	1 or 2
Heavy-duty Fleet DC Fast Charger (for Crash Trucks)	Eaton Green Motion High Power	350 kW	1 or 2
Electric Shuttle Bus DC Fast Charger	WAVE 500 kW Charger	500 kW	1

Source: HNTB, Task 5 Design Concepts Recommendation Package

CHAPTER 6:
Gaps and Opportunities Analysis

The goal of this task was to develop a prioritized set of recommendations that address electric charging and hydrogen refueling infrastructure, MHD vehicle selection, renewable hydrogen production, microgrids, distributed energy resources, fast charging, charging and refueling logistics, economic and business implications, operational implications, and integration with airport expansion and improvement planning, among other areas.

Includes material from or regarding:

- Task 6.1 ZEV Implementation Case Study
- Task 6.2 Gaps and Opportunities Brief

6.1 Gaps and Opportunities Brief

The Gaps and Opportunities Brief was derived from the findings outlined in Task 3, 4, and 5 of the Blueprint, as well as additional analyses that address community benefits of ZEV implementation at the airport. Although the results of the analyses conducted in support of the Blueprint are comprehensive, several gaps need to be addressed before the deployment of ZEV infrastructure begins. For example, technical details on the duty cycles (daily use patterns) and operational requirements of airport vehicles, and GSE, still need to be determined. This information will help airport planners choose the appropriate ZEVS and supporting infrastructure.

Uncertainty over the readiness of new ZEV technologies is a knowledge gap for ONT and others planning MHD transitions to ZEVs. Because ZEV and charging/hydrogen refueling infrastructure technology are rapidly developing, some stakeholders are wary of investing in existing equipment. These concerns were addressed by NREL's comprehensive accounting of available ZEV technology in Task 4.

The energy impacts of the ZEV transition outlined in Task 5 are summarized in Task 6. With these in mind, along with other analyses conducted to support the Blueprint's production, ZEV infrastructure actions and milestones necessary to implement the Blueprint were identified. During Blueprint meetings, SCE provided estimated timelines of 12-18 months from project start to finish for electric vehicle charger installation. A significant factor is the current long lead times for acquiring switchgear necessary to deploy electrical infrastructure. Subsequent engagement with an electric vehicle charger vendor and installer, InCharge, yielded a similar timeline. Before charger installation, OIAA has determined the following milestones and expected timeframes for pre-infrastructure installation activities.

- Review duty cycle information: three months
- Finalize placement and number of EVSE: three months
- Issue RFPs for charging infrastructure: six months

The Gaps and Opportunities Report also identifies a wide variety of tools, software, and training available for MHD ZEV infrastructure planning. There are 18 tools, 31 trainings, and three programs that can be utilized for MHD ZEV Infrastructure planning.

The primary technical challenges of planning and implementing MHD ZEV technologies are assessing feasibility and determining optimized strategies. MHD ZEV feasibility needs to be

assessed at multiple levels before planning ZEV infrastructure or vehicle purchases. The highest level of feasibility assesses whether available equipment, vehicles, and infrastructure can satisfy the airport's operational requirements. Momentum developed a decision tree tool that can be used to evaluate the risks associated with implementing ZEV technologies.

The following partner and stakeholder responsibilities were identified in the report:

- Energy Infrastructure: Energy Infrastructure partners can help assess existing and predicted energy requirements as well as the capacity for onsite power generation. These partners can offer microgrids, onsite energy storage, solar array, or other distributed energy resources installation services.
- EVSE Vendors: EVSE partners sell and install electric vehicle charging and support equipment and software and can also offer equipment management services. EVSE companies typically visit facilities and partner with logistics companies to design and install charging infrastructure best suited for company operations.
- Utilities: The utility company which provides fleet facilities with electricity can help assess if the existing grid infrastructure is sufficient to power the facility post-EV transition. Information from utilities can also help predict electricity expenses associated with the transition.
- Airlines: Outside of the airport, airlines will constitute the primary user organization of ZE vehicles and equipment. Airlines must be consulted to ensure that ZEV fleets satisfy their operational requirements, and that ZEV infrastructure is sufficient for operations, without impeding operations. Airlines can provide useful information on duty cycles, use patterns, and infrastructure placement.

After these partners' responsibilities are identified, the report outlines which types of data are required for each partner to achieve their tasks. These include information on vehicles, energy requirements, existing infrastructure, and other considerations. From there, the report identifies what kind of job opportunities will increase in response to the Airport's electrification efforts, which broadly fall into seven categories:

1. Maintenance
2. Wholesale
3. Electricity Generation
4. Grid Reinforcement
5. Installation
6. Operation
7. Grid Connection

Transitioning to ZEVs has the potential to substantially contribute to OIAA's greenhouse gas, air pollutant, and air contaminant goals. The report outlines OIAA's existing emissions inventory and reduction goals as are outlined in the MOU with the SCAQMD. The report also identifies the benefits to California priority populations and identifies those in the area surrounding the airport.

6.2 ZEV Implementation Case Study

The ZEV Implementation Case Study examines the opportunity to transition hotel operated shuttles that travel to the airport to zero-emission vehicles using wireless charging methods.

Ontario International Airport Authority (OIAA) permits hotels located in the vicinity of Ontario to drop off and pick up passengers at two designated areas at the airport. The shuttles are prime candidates for conversion to ZEVs, as all hotels deploying the shuttles are located within 2 miles of the airport, well within existing electric vehicles ranges if provided convenient charging solutions. For this reason, the Blueprint team explored wireless (inductive) chargers and conventional, plug-in chargers as options for charging shuttle buses.

Wireless chargers, like those provided by EVSE Manufacturer, Wave Wireless, are automated, hands-free electric vehicle chargers with low profiles, low visual impact, and no moving parts. Wireless chargers remove physical labor associated with plug-in chargers, which can enable buses with nearly round-the-clock run times to maintain battery life without downtime. The lack of moving parts and handling required for wireless chargers also reduces maintenance costs. Wave Wireless has installed inductive chargers which have lasted more than eight years without requiring maintenance.

The Blueprint team and Wave Wireless identified the Zeus 400 electric shuttle bus, which can be configured with a charging plate to utilize wireless charging technology, as a strong candidate replacement vehicle for the existing ICE fleet.

Figure 2 – Zeus 400 Electric Shuttle Bus

Source: Zeus Electric Chassis, Inc.

Hotel shuttle buses have relatively low-duty cycles and operate short routes, making them an ideal candidate for wireless charging solutions. While enroute wireless charging offers significant operational benefits, more analysis is required to determine grid impacts at ONT to determine feasibility.

CHAPTER 7:
Financial Models and LCFS Impacts

The goal of this task was for the project team to assess financial models that will facilitate the deployment of MHD ZEV infrastructure and equipment at ONT.

Includes material from or regarding:

- Task 7.1 Financial Ecosystem Landscape Presentation

Task 7 included an overview of OIAA finance structure and an exploration of existing financial tools, potential financial innovations, and the role of carbon credits, primarily the Low Carbon Fuel Standard (LCFS). OIAA finances its projects through a capital improvement plan, in which costs are shared with passenger airline, cargo and other tenants. OIAA also seeks out funding opportunities from a variety of sources, including but not limited to:

- Targets for ZEV Investments:
- Charging equipment for GSE (tugs, baggage loaders, ground power units)
- Vehicles for airport operations: maintenance trucks, fire, police
- Hotel shuttles: wireless or plug-in charging

The primary funding and financing mechanisms identified include the following federal and state opportunities:

- Infrastructure Investment and Jobs Act (IIJA) Funds
- Inflation Reduction Act Funds and Incentives
- Dept. of Transportation, Federal Aviation Administration (FAA) Funds
- California Energy Commission Funding Programs
- California Air Resources Board Funding Programs
- Air Quality Management District Funds and Funding Programs
- Utility (SoCal Edison) finance and funding programs

The Task 7 financial stakeholder workshop occurred as part of the Clean Air Day event (discussed in Chapter 8). Here the Blueprint Team presented the Task 7.1 Financial Ecosystem Landscape Presentation to meeting attendees that included Blueprint partners, ONT internal and airline stakeholders, City Planning officials, and members from other airports.

CHAPTER 8:
Knowledge Transfer

As the technical tasks were completed, OIAA conducted outreach to key stakeholders that can benefit from the blueprint analysis and recommendations – this is critical to ensuring that the OIAA MHD ZEV Blueprint is replicable across other airports, transportation hubs, and city centers.

Includes material from or regarding:

- Task 8.1 List of Knowledge Transfer Outreach Targets
- Task 8.2 Knowledge Transfer Engagement Plan
- Task 8.3 Knowledge Transfer Engagement Report

8.1 Knowledge Transfer Outreach Targets

The List of Knowledge Transfer Outreach Targets was derived in part from the Scope of Work (SOW). Momentum and OIAA worked together to create a list of organizations and individuals, including contact information, that fulfilled the SOW requirements. Many Knowledge Transfer Outreach Targets were directly pulled from interested CBOs and Stakeholders engaged with during the Community Outreach part of the project.

8.2 Knowledge Transfer Activities

The project's knowledge transfer activities consist of a Knowledge Transfer event, follow up to the event, and providing interested community members and stakeholders with final blueprint information after publishing.

8.2.1 Clean Air Day Knowledge Transfer Event

Momentum led the Knowledge Transfer Event for the Blueprint on October 5, 2022—Clean Air Day. Clean Air Day is a nationwide event sponsored by the Coalition for Clean Air. The event encourages multiple states, governmental organizations (such as Cities), NGOs, and individuals to participate in its "Clean Air Pledge," which encourages the pledge taker to engage in certain behaviors that improve air quality. OIAA had already taken the "Clean Air Day Pledge," and wanted to use this opportunity to showcase the Blueprint and how it would help them achieve the goals in their Clean Air Pledge.

Nicole Walker from OIAA introduced the Airport, the Blueprint, and purpose of this meeting, as well as discussed OIAA's Clean Air Pledge. Momentum presented a condensed version of the Task 7 Financial Ecosystem Landscape presentation, which highlighted ways other organizations could benefit from blueprint financial findings. NREL then presented a condensed version of its Task 4 Technology Outlook Presentation, outlining the Airport's existing infrastructure and ZEV capabilities or faults. Next, HNTB presented a condensed version of its Task 5 deliverables findings, highlighting opportunities and recommendations for future Blueprint adoption. Finally, Ramiro Lepe presented on SoCal Edison's Charge Ready Transport program, which is featured in the Blueprint.

Meeting attendees included representatives from other airports, City of Ontario officials, and previously engaged community members and stakeholders.

Figure 1 - Screenshot of HNTB's Presentation at Clean Air Day

Source: Build Momentum, Inc.

8.2.2 Other Methods of Knowledge Transfer

Momentum followed up with interested attendees to send copies of presentations or contact information for presenters. Momentum will also notify interested stakeholders from the Community and Stakeholder outreach and the Knowledge Transfer event when the Final Blueprint is publicly accessible.

8.3 Knowledge Transfer Outcomes

The Knowledge Transfer event, held serendipitously on Clean Air Day, was by any measure a success. It allowed project partners to come together and coordinate their findings. It provided an opportunity to continue to engage with the individuals and organizations that OIAA and Momentum had formed working relationships with, such as SoCal Edison, an employee of the City of Ontario, and a representative from Coalition for Clean Air. It also helped to solidify OIAA's goal of not only becoming a major player in reduction of airport GHG emissions, but also ensuring the community they can be relied on as such.

CHAPTER 9: Blueprint

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

Include material from or regarding:

- Task 10.2 Draft Blueprint
- Task 10.3 Final Blueprint

9.1 Summary of Blueprint

For the Final Blueprint, the project team synthesized the significant outcomes and information derived from all technical tasks (tasks 2-7). The Blueprint includes important takeaways from outreach, gaps identified in Tasks 3 and 6, technological and design recommendations from Tasks 4 and 5, and financial considerations from Tasks 2 and 7 (all summarized in Chapters 2-7 above). Ultimately, the Blueprint determines that eGSE, shuttle buses, and hotel shuttles are currently the best options for ONT's initial MHD ZEV infrastructure development.

The Final Blueprint includes key information from each technical task, including:

- Key stakeholder and CBO engagement takeaways from Task 2 (see Chapter 2.2 of this report)
- Key technological takeaways from Task 4 (see Chapter 4.2)
- A summary of design and implementation recommendations from Task 5 (see Chapter 5 and Table 1)
- A summary of the initial and remaining gaps and opportunities for ONT MHD ZEV infrastructure development from Task 6 (see Chapter 6.1)
- A discussion of the shuttlebus electrification and wireless charging case study with implementation suggestions from Task 6 (see Chapter 6.2)
- A summary of the financial models and LCFS impact summary from Task 7 (see Chapter 7), as well as funding and financing opportunities from Task 2 (see Chapter 2.2)
- A summary of next steps and lessons learned (see Chapter 10)

CHAPTER 10:
Blueprint Lessons Learned and Next Steps

This chapter will discuss substantive next steps for Blueprint implementation at ONT and lessons learned during the Blueprint development process.

10.1 Lessons Learned

The Blueprint team learned valuable lessons during the Blueprint development process and captured them to share with other potential Blueprint developers and/or adopters.

- Timing of deliverables: It is helpful to track the waterfall nature of deliverables. A challenge that the project faced this quarter was the issues with the Schedule of Products (SOP). The way the schedule was originally written did not allow for beneficial and sometimes necessary collaboration between task deliverables and team members. Many of the deliverables in the SOP have a waterfall effect: what is presented in Task 3 needed to be incorporated into Task 4, what is presented in Task 4 needs to be incorporated into Task 5, and so on. While this was not true for all deliverables in the project, it was true to many of the important technical tasks that serve as the backbone of the Final Blueprint.
- Airport information sharing**:** HNTB needed specific information about the quantity and model of chargers that Southwest Airlines implemented at Ontario to inform the Blueprint about the technologies and associated power needs for long term eGSE development at Ontario. Southwest needed to know what the charger information would be used for before divulging it because that information is generally considered company proprietary information. In response to this need, we assured Southwest that any specific information it divulged would be kept out of the public domain and would not be shared with other airlines. Knowing what Airports and Airlines will consider sensitive or proprietary information can help prepare outreach coordinators to plan for extra time in receiving information from them, as well as to prepare any information to share that will alleviate concerns.
- Community and stakeholder outreach: Start outreach early. Ontario's legal checks took time and affected outreach. Also, a goal of the outreach was to build relationships and trust, and that takes time. Future Blueprint adopters should be sure to provide future outlets for successful outreach; CBOS and stakeholders don't want to feel like they were used to check off a box on the grant checklist, they want to have some assurance that their participation can continue throughout the life of a project. How can we build in long-term and meaningful community engagement and participation into future grant agreements to facilitate early engagement?

10.2 Next Steps

The Blueprint considered all technical tasks and each set of recommendations to synthesize a final list of suggested next steps. These next steps take into consideration OIAA preferences and HNTB's Task 5 Recommendations Package, as well as information received during stakeholder and community outreach.

- Review the electric ground support equipment and zero-emission vehicle infrastructure deployment recommendations provided by HNTB in Task 4 deliverable: Zero Emission

Vehicles Technology Assessment.

- Create a fleet inventory, energy consumption, and usage assessment that includes the following:
    - Fleet inventory and usage statistics
    - Energy breakdown by vehicle types and departments
    - Vehicle energy requirements/duty cycle analysis
    - Fleet replacement criteria – vehicle age/mileage
    - Selection of priority electrification candidates
    - Detailed data collection on priority vehicles
- Determine a zero-emission infrastructure deployment phasing and timeline. The Blueprint team recommends starting with infrastructure for bus shuttles and electric ground support equipment, followed by fleet vehicles, and finally hotel shuttles.
- Update license agreements between Ontario International Airport Authority and ground support equipment contractors to include a requirement to transition to zero-emission equipment, with near-term requirements to transition to widely available electric ground support equipment technology.
- Select the placement for initial electric ground support equipment infrastructure and ownership model based on recommendations provided by HNTB in the Task 5 deliverables: Airport Design Report and Recommendations Package.
- Evaluate recommendations for shuttle bus charging infrastructure based on HNTB's analysis provided in Task 5 deliverables, "Deploying Electric Chargers for Shuttle Buses," and in consideration of NREL's Task 4 technology assessment.
- Determine the shuttle bus charger technology and placement. Issue a Request for Proposals for electric shuttle bus chargers and/or contract with a turnkey solution provider.
- Select a charging station vendor for charging infrastructure. Ensure electrical charging vendors can deliver electric supply equipment on schedule. Equipment such as switchgear can have long lead times which can delay the implementation of charging systems.
- In coordination with chosen electric vehicle supply equipment vendor, apply to Southern California Edison's Charge Ready Transport program to begin electric vehicle supply equipment installation planning and the installation process for shuttle bus chargers and electric ground support equipment charging infrastructure. The Southern California Edison Charge Ready Transport program will evaluate available electrical capacity needed for electric vehicle supply equipment deployment and schedule any needed upgrades.
- Develop an Ontario International Airport Authority fleet transition schedule with corresponding infrastructure deployment in consideration of vehicle and equipment options evaluated by NREL and recommended by HNTB.
- Consider a requirement for all hotel shuttles to deploy zero-emission vehicles, including updates to license agreements with shuttle operators.
- Evaluate opportunities for pilot/first round medium- and heavy-duty fleet and hotel shuttle transitions, starting with readily available vehicles medium-duty vehicles (such

as pickup trucks), to evaluate performance of vehicles and infrastructure while minimizing risks.

- Determine charger technology and placement to support a medium- and heavy-duty fleet and/or hotel shuttle pilot. Issue a Request for Proposals for electric fleet chargers and/or contract with a turnkey solution provider.
- Select a charging station vendor for the vehicle fleet and/or electric hotel shuttle charging infrastructure.
- Determine the capital budget required for initial infrastructure, vehicle and electric ground support equipment deployment, tenant cost share, grant, funding, finance, and low carbon fuel standard options. Evaluate the expected savings from conversion to zero-emission equipment to determine the return on investment from the transition.
- Apply for all available funding, voucher, and tax credit sources available (funding sources can be found in the Task 10 Final Blueprint).
- Plan for the deployment of hotel shuttle charging infrastructure, including consideration of wireless charging.
- Work with San Bernardino County and the City of Ontario to streamline approval processes for selected zero emission vehicle infrastructure.
- Determine the operations and maintenance plans for the deployed vehicles, bus shuttles, electric ground support equipment, and infrastructure.

In the end, OIAA is well positioned to proceed with the implementation of recommendations provided from the Blueprint to transition medium and heavy-duty equipment, including vehicles and ground support equipment, to zero-emission options supported by new charging infrastructure.

GLOSSARY

CALIFORNIA ENERGY COMMISSION (CEC)—The state agency established by the Warren-Alquist State Energy Resources Conservation and Development Act in 1974 (Public Resources Code, Sections 25000 et seq.) responsible for energy policy. The Energy Commission's five major areas of responsibilities are:

1. Forecasting future statewide energy needs
2. Licensing power plants sufficient to meet those needs
3. Promoting energy conservation and efficiency measures
4. Developing renewable and alternative energy resources, including providing assistance to develop clean transportation fuels
5. Planning for and directing state response to energy emergencies.

eGSE—Acronym for electric ground support equipment. eGSE are service and maintenance equipment used at an airport to support aeronautical operations and related activities, such as forklifts, cargo loaders, etc.

Electric Vehicle Supply Equipment (EVSE)—Infrastructure designed to supply power to electric vehicles.

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

Low Carbon Fuel Standard (LCFS)—The Low Carbon Fuel Standard is designed by CARB to decrease the carbon intensity of California's transportation fuel pool and provide an increasing range of low-carbon and renewable alternatives, which reduce petroleum dependence and achieve air quality benefits.[3]

MHD—Acronym for Medium- and Heavy-Duty vehicles. MHD 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]

ONT—Refers to the Ontario International Airport.[6]

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[2] IBEW Ninth District, available at http://www.ibew.org/9thdistrict

[3] Low Carbon Fuel Standard, available at https://ww2.arb.ca.gov/our-work/programs/low-carbon-fuel-standard

[4] Medium- and Heavy-Duty Zero-Emission Vehicles in California, available at 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] NREL, available at https://www.nrel.gov/

[6] ONT, available at https://www.flyontario.com/

OIAA—Refers to Ontario International Airport Authority, which manages ONT.[7]

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 Ontario, CA region.[8]

SCAQMD—Acronym for South Coast Air Quality Management District.[9]

Zero Emission Vehicle (ZEV) and—Vehicles which produce no emissions form the on-board source of power (e.g., an electric vehicle).

[7] OIAA, available at https://www.flyontario.com/airport-authority/airport-leadership#executive-team

[8] SCE, available at https://www.sce.com/

[9] AQMD, available at http://www.aqmd.gov/