Zero-Emission Airport Shuttle Bus
WORKGROUP #2 MEETING

December 4, 2017
Sacramento, California
10:00 am – 3:00 pm (PST)
Topics for Today

1. Welcome and Introductions
2. Workgroup # 2 Goals
3. Recap
4. Meeting Infrastructure Challenges
5. New Developments
6. Survey Results
7. Cost Data
8. Regulation
9. Next Steps
Workgroup Goals

- Sharing of information that will guide and inform the measure development
- CARB Role:
  - Share progress to date
  - Ask for stakeholder input
- Stakeholder Role: Provide data and experience
RECAP

Zero-Emission Airport Shuttle Bus

Measure Goals, Zero-Emission Manufacturers, Airport Efforts, Proposed Regulatory Concept
Zero-Emission Airport Shuttle Bus Measure – Goals

1. Complement existing programs to achieve NOx and GHG emission reductions through use of zero-emission technology.

2. Increase the penetration of the first wave of zero-emission heavy-duty technology

-- 2016 State Strategy for the State Implementation Plan, March 2017
Best Applications for Zero-Emission Vehicles serving Airports

- Operational characteristics:
  - Fixed route
  - Low-mileage
  - Stop and go operation
  - Low average speeds
  - Centrally maintained and fueled
Zero-Emission Manufacturers

- Proterra
- Phoenix Motorcars
- New Flyer
- ebus
- BAE Systems
- Zenith Motors
- BYD
- Motiv
- US Hybrid
- GreenPower Bus
- ENC
- REV Group
Existing Efforts at Airports

- Land use planning efforts replacing shuttles with electric rail, walkable routes, or public transit
- FAA grants for zero-emission airport shuttles
- Cleaner vehicle encouragement programs
- Battery electric parking shuttles
  - Operational - ONT
  - Purchasing – SJC, SMF
Recap

MEASURE CONCEPT

Technology Applicability/Scope, Measure Strategy
Technology supports fixed route shuttle operation

- **Fixed destination** = vehicles that provide service along a prescribed route with few course deviations

- **Not include:**
  - Door-to-door charter service (limousine, vans)
  - Light-duty vehicles (taxis, TNCs, private cars)
  - Transit buses

- **Include:**
  - Fixed airport routes and depot housed vehicles
  - Low-mileage, stop and go operation, and low average speeds
  - Examples: Vehicles servicing parking lots, rental car facility, off-airport parking, hotels, destinations
Scope

- **Fixed route shuttles** supporting California’s **26 primary** airports
  - **3 - Large:** LAX, SAN, SFO
  - **6 – Medium:** BUR, OAK, ONT, SNA, SMF, SJC
  - **4 – Small:** FAT, LGB, PSP, SBA
  - **13 – Nonhub:** ACV, BFL, CRQ, CIC, CEC, MMH, MOD, MRY, RDD, SBP, SMX, STS, SCK

- **What is an airport shuttle?**
  - Heavy-duty vehicles class size 2b (8,501 lbs.) to 8 (>33,000 lbs.)
  - Transports travelers to airports and around airport facilities
Proposed Schedule for Fleet Transformation

• **2018-2022**: Incentives/voluntary actions
• **2023**: New purchase requirement
• **2023-2031**: Fleet turnover requirements
  ◦ **2025**: 33% fleet must be ZEV
  ◦ **2028**: 66% fleet must be ZEV
  ◦ **2031**: 100% fleet must be ZEV
## ZEV Fleet Compliance Examples

<table>
<thead>
<tr>
<th>Year</th>
<th>Milestone</th>
<th>Airport Shuttle Fleet Size</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Now-2022</td>
<td>Early Action</td>
<td>3</td>
</tr>
<tr>
<td>2025</td>
<td>33% Fleet</td>
<td>1</td>
</tr>
<tr>
<td>2028</td>
<td>66% Fleet</td>
<td>2</td>
</tr>
<tr>
<td>2031</td>
<td>100% Fleet</td>
<td>3</td>
</tr>
</tbody>
</table>
Interface with Facility Based Measures

- **CARB Board Resolution 17-7**
  - Report to the Board on facility based measure concepts for large freight facilities, and any equivalent alternatives, within 12 months (by March 2018)
  - Does not include CA commercial airports

- **SCAQMD Board Measure MOB-04**
  - Facility based measure for non-aircraft sources at commercial airports (by Feb. 2019)
  - Potentially affect all commercial airports located within air district
  - Efforts on-going – Three workgroup meetings held, three more planned

- Close interaction and coordination between CARB and SCAQMD

- Airport Shuttle Bus measure is not dependent on the outcome of these processes
Questions on Recap?

Webcast email address: coastalrm@calepa.ca.gov
INFRASTRUCTURE

Power Needs,
Reliability,
Charging Technology

Lunch Break
Electric Utilities’ Presentations

- Link for presentations: https://www.arb.ca.gov/msprog/asb/asbmtgs.htm
Discussion on meeting infrastructure challenges

Webcast email address: coastalrm@calepa.ca.gov
Meeting will resume after break

Zero-Emission Airport Shuttle Bus
WORKGROUP MEETING
NEW DEVELOPMENTS

Recent ZEV Deployment, Outreach Efforts, Cost Sharing Opportunities, Airports Clean Vehicle Programs, Powertrain Certification for ZEV
ZEV Developments Near Airports
Outreach to Potentially Impacted Sectors

- **Lodging**: CA Hotel & Lodging Association, CA Lodging Industry Association, Asian American Hotel Owners Association, Hotel Council SF, Gateway to LA, LAX Costal Chamber

- **Airports**: Individual airports, CA Airport Council, CA Airport Clean Air Vehicle Working Group

- **Parking**: National Parking Association, American Ground Transportation Association, International Parking Institute, CA Public Parking Association

- **Technology and Equipment Manufacturers**
Direct Messaging

Do you have a shuttle* that transports passengers to airports? If you do, CARB invites you to participate in an upcoming survey.
Cost Sharing Opportunities

*Updated* Cost Share document:

[link](https://www.arb.ca.gov/msprog/asb/asbmtgs.htm)
Powertrain Certification of ZEV

- Current efforts underway for certification and testing procedures for zero-emission powertrains
- Certification process would include performance and durability requirements on zero-emission drive trains.

- Lead Staff Contact:
  - Matthew Diener, Matthew.Diener@arb.ca.gov or (626) 575-6684

- Program meeting and events webpage:
Airports Clean Vehicle Programs

- **SFO**: Roger Hooson on hotel consolidation and other efforts
- **SAN**: Chad Reese slides on Ground Transportation Vehicle Conversion Incentive-Based Program
- **LAX**: Tamara McCrossen-Orr on Alternative Fuel Vehicle Requirements
Airports’ Presentations

- Link for presentations: https://www.arb.ca.gov/msprog/asb/asbmsgs.htm
Questions/Comments on Airport Programs?

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coastalrm@calepa.ca.gov
Airport Shuttle Bus Operators

SURVEY

Part 1 & 2 Results
Purpose of Survey

- Better understanding of airport shuttle buses and off-airport transportation shuttles
- Analysis of results will help refine the proposed measure strategy
- Part I: Survey of On-Airport Shuttle Buses
- Part II: Survey of Off-Airport Passenger
- Shuttles Surveys posted: https://www.arb.ca.gov/msprog/asb/asbsurvey.htm
## Part 1 Survey Results - Airport Fleet General Information

<table>
<thead>
<tr>
<th>Survey Reporting Percentage</th>
<th>100%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total Number of Vehicles</strong></td>
<td>264</td>
</tr>
<tr>
<td><strong>Average Useful Life</strong></td>
<td>12 years</td>
</tr>
<tr>
<td><strong>Average Miles per Day/Year</strong></td>
<td>95/34,573</td>
</tr>
<tr>
<td><strong>Average Model Year</strong></td>
<td>2010</td>
</tr>
<tr>
<td><strong>Top Factors in Purchasing</strong></td>
<td>Capitol Cost, Total Cost of Ownership, Safety, Reliability</td>
</tr>
</tbody>
</table>
Airport Shuttle Vehicle Types

![Bar Chart]

Number of Vehicles

- **Transit/Low Floor**
  - Class 7-8: 180
  - Class 4-5: 0
  - Class 3: 0

- **Cutaway**
  - Class 7-8: 70
  - Class 4-5: 80
  - Class 3: 0

- **Van**
  - Class 7-8: 5
  - Class 4-5: 0
  - Class 3: 0
Airport Fleets: Fuel Type & Annual Vehicle Miles

- CNG: 74%
- DIESEL: 14%
- LPG: 3%
- Biodiesel: 6%
- EV: 1%

- 2,000-9,999 miles: 45%
- 10,000-29,999 miles: 43%
- 30,000-49,999 miles: 2%
- 50,000-70,000 miles: 10%
## Airport Route Characteristics - Excellent Applications for ZEVs

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Number of Routes per Airport</td>
<td>2.5</td>
</tr>
<tr>
<td>Route Average Distance (miles)</td>
<td>3.5</td>
</tr>
<tr>
<td>Number of Routes &gt; 5 Miles</td>
<td>8</td>
</tr>
<tr>
<td>Number of Average Stops</td>
<td>7</td>
</tr>
<tr>
<td>Average Speed (mph)</td>
<td>17</td>
</tr>
<tr>
<td>Maximum Average Speed (mph)</td>
<td>34</td>
</tr>
</tbody>
</table>
## Part 2 Survey Results – Off-Airport Fleet General Information

<table>
<thead>
<tr>
<th>Survey Reporting Percentage</th>
<th>15%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Number of Vehicles</td>
<td>255</td>
</tr>
<tr>
<td>Average Useful Life</td>
<td>10 years</td>
</tr>
<tr>
<td>Average Miles per Day/Year</td>
<td>104/37,925</td>
</tr>
<tr>
<td>Average Model Year</td>
<td>2011</td>
</tr>
<tr>
<td>Top Factors in Purchasing</td>
<td>Reliability, Total Cost of Ownership, Safety, Capitol Cost</td>
</tr>
</tbody>
</table>
Off-Airport Shuttle Vehicle Types

Number of Vehicles

Coach  Cutaway  Mini Bus  Van

Class 2b-3  Class 4-5  Class 6  Class 7-8
Survey Part 2 - Fuel Type & Annual Vehicle Miles

- **CNG**: 2% of respondents use CNG for their vehicles.
- **Gasoline**: 8% of respondents use gasoline.
- **DIESEL**: 45% of respondents use diesel.
- **Biodiesel**: 25% of respondents use biodiesel.
- **EV**: 19% of respondents use electric vehicles (EV).

**Annual Vehicle Miles Distribution**

- **2,000-9,999**: 34% of respondents fall into this category.
- **10,000-29,999**: 16% of respondents fall into this category.
- **30,000-49,999**: 16% of respondents fall into this category.
- **50,000-70,000**: 6% of respondents fall into this category.

- **6%** of respondents fall into the highest annual vehicle miles category (50,000-70,000).
### Off-Airport Route Characteristics – Applicable for ZEVs

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Number of Routes per Business</td>
<td>1</td>
</tr>
<tr>
<td>Total Number of Unique Routes</td>
<td>27</td>
</tr>
<tr>
<td>Number of Routes &lt;15 Miles</td>
<td>17</td>
</tr>
<tr>
<td>Number of Routes &gt;100 Miles</td>
<td>7</td>
</tr>
<tr>
<td>Number of Average Stops</td>
<td>5</td>
</tr>
<tr>
<td>Average Speed (mph)</td>
<td>41</td>
</tr>
<tr>
<td>Maximum Average Speed (mph)</td>
<td>51</td>
</tr>
</tbody>
</table>
Comments/Questions on Survey Results?

Webcast email address:
coastalrm@calepa.ca.gov
COST DATA

Capital
Operational & Maintenance
## Capital Vehicle Reported Costs: ICE to ZEV

<table>
<thead>
<tr>
<th>Vehicle Type</th>
<th>Incremental Cost Ranges</th>
</tr>
</thead>
<tbody>
<tr>
<td>Van</td>
<td>$70,000 - $80,000</td>
</tr>
<tr>
<td>Cutaway</td>
<td>$60,000 - $120,000</td>
</tr>
<tr>
<td>30ft Transit Bus</td>
<td>$50,000 - $100,000</td>
</tr>
<tr>
<td>35ft Transit Bus</td>
<td>$100,000 - $175,000</td>
</tr>
<tr>
<td>40ft Transit Bus</td>
<td>$100,000 - $350,000</td>
</tr>
<tr>
<td>60ft Transit Bus</td>
<td>$300,000 - $525,000</td>
</tr>
<tr>
<td>Coach</td>
<td>Collecting data</td>
</tr>
</tbody>
</table>
Capital Infrastructure Costs

• Infrastructure costs vary depending on fleet requirements
  o Number of electric vehicles
  o Charging strategies (i.e. inductive, overhead, depot)
  o Voltage capacity
  o Amount/length of trenching needed for conduit

• Reported Infrastructure Costs (not including construction costs)

<table>
<thead>
<tr>
<th>Device</th>
<th>Depot</th>
<th>In-Route</th>
</tr>
</thead>
<tbody>
<tr>
<td>Charger Type</td>
<td>Level 2</td>
<td>DC 50kW</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Overhead Charger</td>
</tr>
<tr>
<td>Cost</td>
<td>$2,500</td>
<td>$25,000-$50,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$400,000</td>
</tr>
</tbody>
</table>
Capital Infrastructure Costs

• Current Airport Shuttle Bus Projects

<table>
<thead>
<tr>
<th>Location</th>
<th>Sacramento International Airport</th>
<th>San Jose International Airport</th>
<th>Off-Airport Parking Company</th>
<th>Off-Airport Parking Company</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of Vehicles</td>
<td>5</td>
<td>10</td>
<td>16</td>
<td>19</td>
</tr>
<tr>
<td>No. of Chargers</td>
<td>5 DC 50 kW 1 Overhead</td>
<td>10 DC 50 kW</td>
<td>5 DC 50 kW 3 Level 2</td>
<td>6 DC 50 kW 6 Level 2</td>
</tr>
<tr>
<td>Total Cost of Charging Equipment</td>
<td>$610,000</td>
<td>Collecting data</td>
<td>$130,000</td>
<td>$240,000</td>
</tr>
</tbody>
</table>

• Ongoing research
  • We need additional data from On-Airport and Off-Airport shuttles to gather more real world cost examples
Battery Electric Shuttle: Maintenance and Fuel Savings

- Savings depend on several factors
  - Duty Cycle
  - Fuel and electricity costs (depends on charging strategy and utility provider)
  - A/C Usage
  - Fuel type of baseline vehicle
  - Fuel economy
  - Driving “style” of operator

- Potential savings vary among vehicle types

<table>
<thead>
<tr>
<th>Vehicle</th>
<th>Van - Class 2-3</th>
<th>Cutaway - Class 4-5</th>
<th>Bus - Class 6-8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maintenance Savings</td>
<td>$0.06 - 0.10/mile</td>
<td>$0.09 - 0.13/mile</td>
<td>$0.19 - 0.25/mile</td>
</tr>
<tr>
<td>Fuel Savings*</td>
<td>$0.10 - 0.24/mile</td>
<td>$0.18 - 0.40/mile</td>
<td>$0.17 - 0.48/mile</td>
</tr>
<tr>
<td>Total</td>
<td>$0.16 - 0.34/mile</td>
<td>$0.27 - 0.53/mile</td>
<td>$0.36 - 0.73/mile</td>
</tr>
</tbody>
</table>

*Not including LCFS credits totaling $10,000 per year for a transit-style bus operating 50,000 annual miles
Discussion on Cost Data

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coastalrm@calepa.ca.gov
REGULATION

Environmental Analysis,
Guiding Principles,
Discussion on Current Proposal
Environmental Analysis

- Environmental Analysis (EA) being prepared analyzing potentially significant adverse impacts caused by reasonably foreseeable actions.
- Meets requirements of CARB’s certified program under the California Environmental Quality Act (CEQA).
- The CEQA Environmental Checklist (CEQA Guidelines Appendix G) is used to identify and evaluate potential indirect impacts.
- The EA will be an appendix to the Staff Report.
Environmental Analysis to be Prepared

- The EA will include:
  - Description of reasonably foreseeable actions taken in response to the proposed regulation.
  - Programmatic level analysis of potential adverse impacts caused by reasonably foreseeable actions.
  - Beneficial impacts.
  - Feasible mitigation measures to reduce/avoid significant impacts.
  - Alternatives analysis.

- Input invited at this early stage on appropriate scope and content of the EA.
- Draft EA will be released for 45 day public comment period.
Regulatory Guiding Principles

- Fair and equitable requirements
- Keep it simple
- Opportunity to achieve air quality goals and the greatest deployment of ZEVs
- Enforceability of requirements
- Assurance that real emissions reductions are achieved
Key Inputs

- 12-year shuttle useful life for all vehicle types
- Assume flat vehicle growth throughout the regulatory schedule
- Voluntary early action period since incentives may be limited once regulation implementation schedule starts
- 2023 start of regulation with 11% annual fleet turnover (100% by 2031)
CA Airport Council Comments

- Prefer voluntary agreements to achieve necessary emission reductions
- Willing to commit to use FAA funds for ZEVs and infrastructure
- Suggest exempting nonhub airports that handle only ~10% of State’s passenger traffic
- Concern of limited ZEV product availability and private fleet access to high power
Discussion Points

• Many shuttles operate almost around the clock. How can this regulation maximize ZEVs while accommodating this operation?

• Shuttles include many vehicles types and sizes. Some vans are light-duty and others are heavy-duty; does it make sense to include all vans in the regulation scope?

• How can the regulation address the need for continuing passenger ground travel during emergency power outages?

• How can the regulation support expansion of the heavy-duty ZEV market to ensure greater consumer choices?
Feedback on Proposed Regulation

Webcast email address:
coastalrm@calepa.ca.gov
Next Steps

• Workshop #2 Series
  ◦ January 30, 2018 (LAX airport)
  ◦ February 2, 2018 (Sacramento)
  ◦ Staff will present:
    • Regulatory options
    • Cost of regulation
    • Draft regulatory language

• CARB Board Hearing June 28, 2018
Additional Comments or Questions

Please contact:

Katherine Garrison, Lead Staff
Katherine.Garrison@arb.ca.gov
(916)322–1522

Web Page: https://www.arb.ca.gov/msprog/asb/asb.htm

Sign up for the Airport Shuttle Bus list-serve to receive updates!