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<tr>
<th><strong>Docket Number:</strong></th>
<th>19-IEPR-03</th>
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<tbody>
<tr>
<td><strong>Project Title:</strong></td>
<td>Electricity and Natural Gas Demand Forecast</td>
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<td><strong>Document Title:</strong></td>
<td>Off-road Transportation Electrification</td>
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<tr>
<td><strong>Description:</strong></td>
<td>Presentation by Marshall Miller of CEC and Aspen Environmental Group</td>
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<td><strong>Filer:</strong></td>
<td>Raquel Kravitz</td>
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Off-road Transportation Electrification

2019 IEPR Workshop on Transportation Energy Demand Forecast

Marshall Miller
and
Aspen Environmental Group
July 22, 2019
Outline

• Study summary
• Methodology
• General changes from 2015 study
• Preliminary results for categories
  – Inputs
  – Specific changes from 2015
  – Electricity plots
CEC Study Purpose

• Estimate total electricity demand for off-road vehicles and applications from 2019 – 2030
• Add new categories to the 7 old categories
• Produce Low, Medium, and High scenarios for electricity usage for each category for years 2019-2030
2015 Study Off-Road Transportation Categories

- Truck Stop Electrification (TSE)
- Trailer Refrigeration Units (TRUs)
- Industrial Forklifts
- Port Cargo Handling Equipment (CHE)
- Airport Ground Support Equipment (GSE)
- Utility Work Trucks
- Shore Power
New Study Categories

- Locomotives (Class 1)
- Construction, Mining, Industrial
- Commercial Harbor Craft
- Motorcycles (?)
- Likely complete a subset of the above
Methodology: Inputs

• Present fleet stock (# vehicles/applications)
  – Separate category for each vehicle type (e.g. airport baggage tug, airport belt loader, forklift classes)
  – Data from ARB Orion database in most cases
• Estimate population growth through 2030
• Estimate vehicle/application activity (VMT or hours) and fuel economy (mi/kWh, kWh/hour)
  – Data from Orion Database in most cases
• Estimate % of electrified vehicles/applications in fleet
  – Generally assume linear increase through 2030
  – Data from current reports, recent activity, and regulations
  – Discussions with stakeholders
Methodology: Calculations

• Vehicles
  • Electricity usage = \# \text{veh} \_e \times \text{VMT} / \text{(mi/kWh)}

• Applications (Truck stops, shore power, etc.)
  – Electricity usage = \# \text{equipment} \times \text{hours usage (elec)} \times \text{(kWh/hr)}

• Some cases data includes total energy usage (e.g. airport GSE)

• Variation of inputs by year
  – Population increases
  – % electrified increases (dominates)
  – Fuel economy/usage, activity held constant
Scenarios: Low, Medium, High  
(Range of Estimates)  

• Electrification demand mostly determined by % adoption of electrification (dominates range)  
• Project Low, Medium, and High scenarios stock growth  
  – data from U.S. Bureau of Economic Analysis; Moody's Analytics (CA counties) for projected economic growth from 2019 – 2030  
• Low  
  – Close to lower bound, extrapolate from 2019 with present regulation  
• Medium  
  – Best estimate and roughly in middle of Low and High  
• High  
  – Aggressive assumptions
General Changes from 2015

- Orion database
  - Reporting of all vehicles/equipment with emissions
  - No electric vehicles/equipment
  - Assume large difference in accuracy

- ARB regulations
  - 2015 vague planning stage
  - 2019 specific targets
Airport Ground Support Equipment

• LAX study 2013 – economically beneficial
• Airports and airlines push to electrify
• 2019 high percentage of equipment already electrified
• Mid-range of projected electrification
  – A/C wide body tug: 30%
  – Baggage tug, belt loader: 80%
AIRPORT GSE ELECTRICITY DEMAND FORECAST

GWH

2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030

Mid  High  Low
Port Cargo Handling Equipments

- Lower population from Orion
- ARB might start requirements in 2026
- Port of Long Beach and Port of Los Angeles have goals of being 100% electric on port by 2030
- Significant uncertainty especially in large forklifts (can be electrified soon?)
Industrial Forklifts

- Largest electricity demand category (~2/3 total)
- Class 1-3 electric (~55% of population)
- Class 4-5 fossil fuel (~45% of population)
- ARB may require all < 8000 lb class 4-5 forklifts to be electric by 2035
- Percent electrification class 4-5 (43 – 64% in 2030), some forklifts will be fuel cell
- Higher electricity demand due to ARB regs
INDUSTRIAL FORKLIFTS ELECTRICITY DEMAND FORECAST

GWH

2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030

Mid    High    Low
Transport Refrigeration Units (TRUs)

• ARB strong regulations
  – 100% electrification of > 25 hp TRUs by 2025 including out-of-state
  – Potential issue: infrastructure
  – 100% electrification of < 25 hp TRUs by 2031

• 2015 high scenario ~ 50-60% electrification in 2026 (20% out-of-state)

• Much higher electricity demand
Shore Power

- ARB Inventory for Ocean-Going Vessels
  - Incredibly detailed data (berthings, hours, kW)
- Added 4 vessel types
  - Old: container, reefer, cruise, tanker
  - New: auto, bulk, Ro-Ro, general
- Percent electrification similar 2015 to 2019
- Slightly lower electricity demand due to lower population of some vessel types
Utility Work Trucks

• Battery provides power at work site through PTO
• Edison Electric Institute study
  – Electricity demand
• California utilities
  – Bucket truck populations
  – Percent electrification
• 2015 and 2019 results similar
Truck Stop Electrification

• Electrify cabin and connect to grid at truck stop parking space
• Estimate percent of trucks with cabin electrified
• Estimate capacity factor (% time parking space is utilized for electricity)
• 2015 and 2019 results similar
TRUCK STOPS ELECTRICITY DEMAND FORECAST

GWH

2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030

Mid  High  Low
Harbor Craft

• ARB has no present plans to require electrification in regs
• Possible vessel type suitable for ZEV operation is ferries
• Norway has commercial ZEV ferries – fuel cell rather than battery electric
• Some companies want to skip Tier 4 regulation and move to lower emissions
Construction and Mining

• ARB has no present plans to require electrification in regs
• Demo projects
  – High capacity forklift Port of Stockton
  – Mobile charging for Agricultural tractors
• Possible electrification of rough terrain forklifts
• Australia has fully electric mines
• Mining depends strongly on operations
Locomotives (Class 1)

• ARB has no authority to regulate rail (US regulations)
• Class 1 – freight
• Some demonstrations scheduled
  – GE/BNSF Stockton/Barstow demo late 2020
    • Battery powered paired with diesel locomotives
    • Operating strategy TBD
  – Port of Los Angeles switcher locomotive 2019-2020
• Unlikely to see electricity demand
Thank You

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