

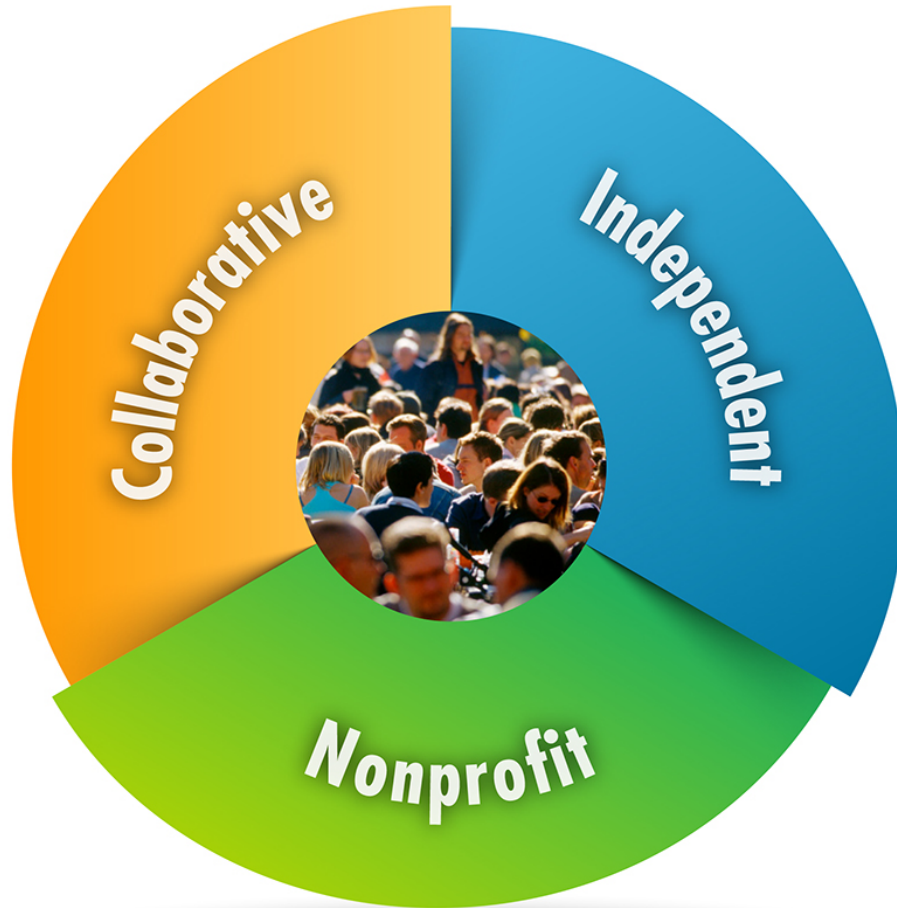
Heavy-Duty Vehicle Electrification and its Impacts

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About the Electric Power Research Institute



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Airport Ground Support Equipment (GSE)

Drivers for Electrification:

- Air quality improvements
 - Benefits of emissions produced using electricity as a fuel versus diesel fuel or gasoline
- Economic benefits
 - Reduced fuel costs
 - Reduced maintenance costs



Electric GSE equipment options

Common GSE, all available in electric options

- Bag Tugs/Bag Tractor
- Belt loaders
- Pushback Tractor/Aircraft Tractor



Electric GSE equipment options

Not typical but all available in electric options

- Container/cargo loaders
- Passenger Stairs
- Lavatory Truck
- Catering Truck
- ...golf carts



Other electric options

- **Auxiliary Power PC Air (PCA) Unit**
 - Pre-conditioned Air Units are used to cool the aircraft while it is parked at the gate
 - Southwest Airlines project objective in 2002: Provide external pre-conditioned air (heat and cool) and 400 HZ power to the Aircraft to minimize the use of the Aircraft's Auxiliary Power Units (APU) while the Aircraft is at the gate. Saving fuel and reducing emissions.



Auxiliary Power PC Air (PCA) Units - SWA Case Study

- Southwest Airlines (SWA) “Gate Services” program has the potential to save*:
 - \$124,000 per day
 - \$40-45 million per year
 - 20.5 M gallons per year
- EPRI, with airlines and GSE industry, demonstrated ground power and its benefits in 2002

* Updated numbers from SWA Advisor in 2012

* Includes 423 gates in 64 cities with 3300 domestic flights per day operation



Ground Power Units

- Ground Power Units (GPUs) are ground support equipment which provides electricity for a parked aircraft.
- The power a jet uses is very different from standard grid power. Standard grid power is 60 Hz, while aircraft require electricity at 400 Hz.
- Airports are beginning to retrofit their gates to provide bridge mounted Electric GPU capability for their airline tenants (you may hear this as providing 400 hertz power)
 - The current option is for a plane to use it's jet engine or portable diesel-powered generator (fuel usage in this scenario is estimated to be ~28 gallons per hour)



Electric GSE infrastructure requirements

The following is an example of power usage:

- Baggage tugs with 1 battery each - ~20kWh/day (10-20 kW)
- Belt loaders with 1 battery each - ~10kWh/day (5-10 kW)
- Pushback tractor with 2 batteries - ~20kWh/day (10-20 kW)
- Container loaders with 2 batteries each - ~40kWh/day (20-40 kW)

If all the vehicles were plugged in at the same time, the gate would require a minimum of 45-90 kW.

Information on Power sharing

- Passenger loading bridges or jetways, at most airports already have dedicated electric infrastructures and due to the intermittent operation, this electrical infrastructure is available to support charging stations for eGSE.



Considerations and Hurdles

- Airline GSE turn over is not all at once
- GSE simple payback is farther out for some equipment than others due to lower utilization
 - Allow phased approach so they can convert the most profitable items first, realize benefits and use the cost savings to fund the remainder
- Operating eGSE in cold weather regions is considered as a challenge citing battery issues – this is a myth – several applications in Europe, Canada and other colder regions

Considerations and Hurdles

- The airline will have a reduction in diesel and jet fuel costs, while the airport will have an increase of electricity fuel costs; a partnership to share the burden and cost benefit should be discussed
 - Agreement on how to track and bill electricity usage, or build a fixed cost into rent
- Driver inexperience with electrics will have a few hurdles as the requirement of plugging them in is different than their current gas and diesel vehicles
 - Employee charging may allow more employees to be familiar with the ease and benefits of plug in electric vehicles.
- Filing the applications on-time/ logistical issues

Conclusions

- Electric GSE and gate electrification technologies are mature and proven
 - Working in cold weather in New York (EWR, JFK, LGA, HPN, ALB), Boston Logan, Chicago, Minnesota
- Potential to eliminate site emissions and alleviate non-attainment
- Grant funding to support adoption/ conversion to electric
 - **FAA Voluntary Airport Low Emissions (VALE) Grants:**
 - In 2015, FAA VALE awarded for eGSE/Gate Electrification to: ORD, MEM, BWI, PHX, CMH, BHM, IND, HOU, CLE, BOI, IAH, ABQ totaling \$23.4 million of grant funds
 - In 2016, nearly \$40 million was awarded to 8 airports for eGSE/ PCA and GPU
 - In 2017, nearly \$10 million was awarded to 4 airports for eGSE/ PCA and GPU
 - **Clean Diesel National Grants (DERA)**
 - EPA grant money awards allocated for 2017= ~ \$34 million
 - Diesel Emissions Reductions Act (DERA) Clean Diesel Funding Assistance Program.
- Done in partnership with the Airport, your Airline tenants and your energy provider



Together...Shaping the Future of Electricity