



# Ground Support Equipment (GSE) and Emissions Reductions

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# Overview of Topics

- GSE Fleet Management
- Special needs of GSE
- Pros/Cons of Alternatively Fueled GSE

# GSE Fleet Management

- The opportunity to upgrade to a cleaner technology does not occur often
- Crucial to make space in GSE planning for new technologies
- Long term planning is key
- Avoid replacing GSE before end of useful life

# GSE Fleet Management

- Effects of the 2001 downturn
- Long term planning
  - Financing
  - Operational necessity
- Holistic approach to planning
  - A/C fleet changes
  - Airport development
  - Environmental requirements

# GSE Fleet Management

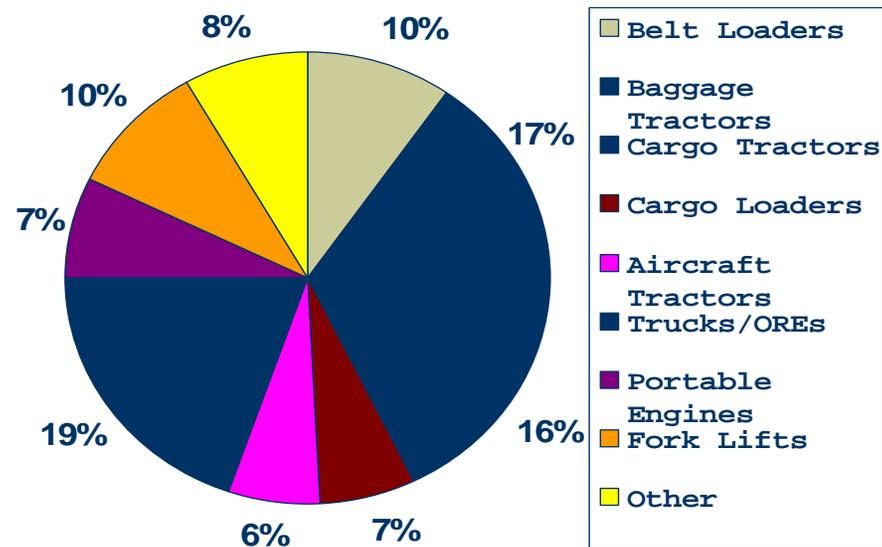
- Life span of GSE
- What's needed over what's wanted (determining the minimum GSE for a station)
- Connecting the dots between GSE and a/c emissions (deploying heaters, Pre-Conditioned Air, Ground Power Units)
- Local bills v. Corp. bills (GSE v. a/c)

## Special Needs of GSE

- 23 categories of GSE
- 100% zero or near zero emissions is NOT possible for entire GSE fleet
- Difficulty to bring new technologies to the GSE market
- Duty cycles very different from other types of equipment

# Types of GSE

Example of typical GSE Fleet at large airport – based on LAX data



## High Level Considerations of Alternative GSE

- Infrastructure considerations
- Operational requirements
- Initial cost and Return On Investment
- Maintenance
- Training (operators and maintenance)

## Pros/Cons of Alternative GSE

- Bio-fuels
- Electric
- Compressed Natural Gas (CNG)
- Liquid Petroleum Gas (LPG)
- Particulate Filters

## Bio-Fuels - Pro

- May be less costly than diesel
- Less dependence on fossil fuels
- Lower emissions of CO, HC, and PM\*

\*Soybean oil; will differ slightly with rapeseed and animal fat based bio-fuels

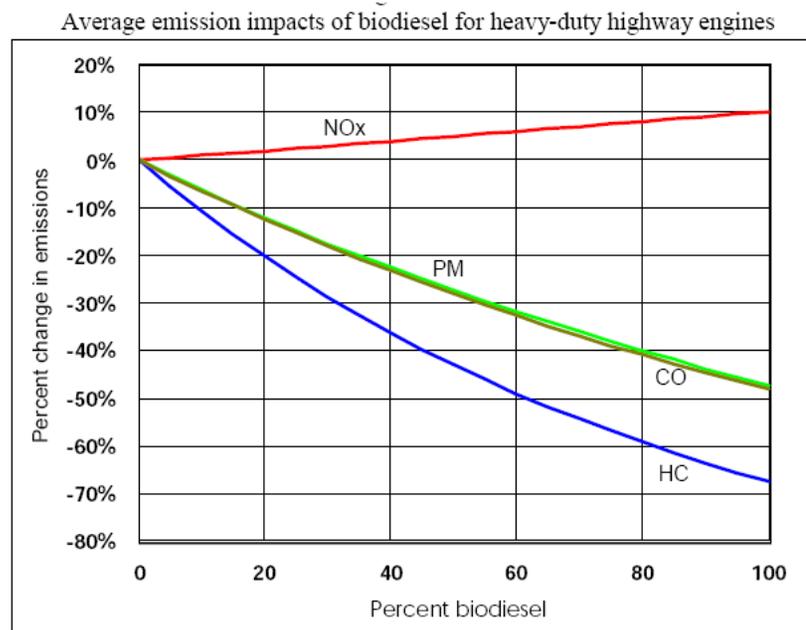
## Bio-Fuels - Con

- ↗ Increased NOx emissions\*
- ↗ CO<sub>2</sub> benefit varies
- ↗ 4.6% reduction in fuel efficiency
- ↗ Fuel may gel at lower temperatures (<40F)
- ↗ Power penalty

\*Soybean oil; will differ slightly with rapeseed and animal fat based bio-fuels

# Bio-Fuels

(Taken from 2002 EPA study on Bio-fuels and Emissions)

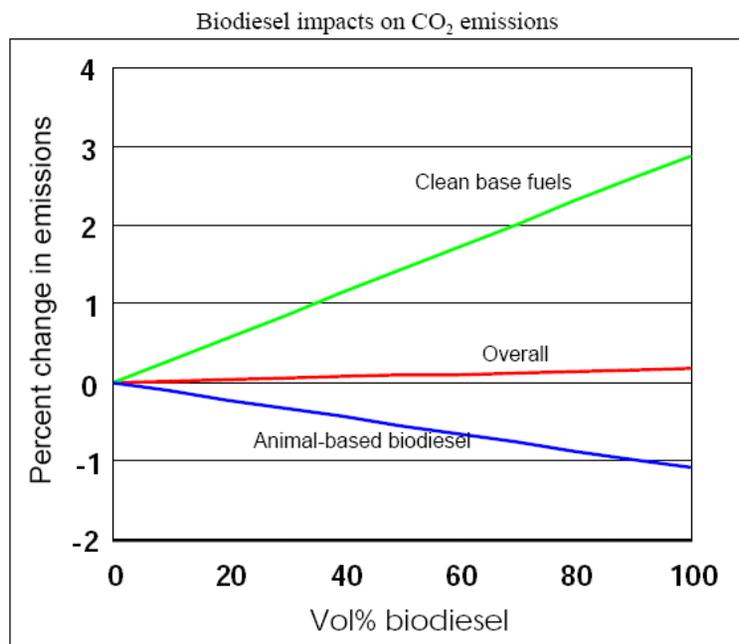


## Specific Bio-fuels

- **Ethanol** - Alcohol-based liquid distilled from corn. Fuel availability limited generally to the Midwest US.
- **Methanol** - Alcohol-based liquid extracted from natural gas. Generally blended with gasoline. Highly corrosive and produces formaldehyde when burned. No commercial products available. Fuel availability very limited.
- **Bio-Diesel** - Vegetable oil derivative with properties similar to diesel. Higher NO<sub>x</sub> emissions than diesel, but lower particulate matter (soot).

# Bio-Fuels

(Taken from 2002 EPA study on Bio-fuels and Emissions)



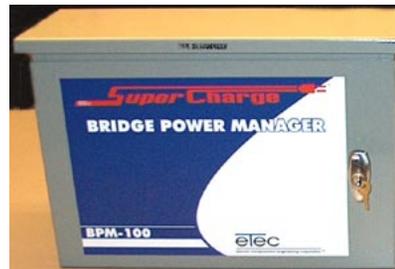
## Electric GSE - Considerations

- Infrastructure and GSE efficiencies are strongly linked
- Airlines cannot achieve conversion independent of airports

Conventional  
Charger  
\$3000



Bridge Power  
\$4000



Fast Charger  
\$21,000



## Electric GSE

### ➤ Pro

- Zero emissions
- Lower maintenance costs
- Reliability
- ROI 12-18 months depending on fuel prices

### ➤ Con

- Costly to purchase
- High infrastructure cost (<ROI by up to 5yrs)
- Additional ramp space needed for charging
- Inappropriate for some GSE (air start, cargo tractor)

## CNG

### ➤ Pro

- Lower emissions when compared to gas



Start up cost ~ \$700K

### ➤ Con

- Higher emissions when compared to diesel\*
- Infrastructure costs
- Limited to large engines

\*CO and HC

## LPG

### ➤ Pro

- Lower emissions when compared to gas
- Readily available



Start up cost ~\$200K

### ➤ Con

- Higher emissions when compared to diesel\*
- Safety concerns (employee injury)
- Limited to small to medium size engines
- Cost

\*CO and HC

# Particulate Filters

## ↗ Pro

- 85% reduction in PM

## ↗ Con

- Cost
- Maintenance
- Life span
- Not certified for all GSE
- Run time

## Summation

- No magic bullet
- Solutions must be multifaceted
- Long term planning is key
- Work with the airport to build infrastructure that will support clean GSE
- Financial commitment is required from all parties



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