



Airport Ground Support Equipment (GSE) Idle Reduction



What is GSE

Air Conditioner, Air Start, Aircraft Fuel Unit, Aircraft Tow Tractor, Baggage Tractor, Beltloader, Cabin Service Lift Truck, Cabin Service Provision Truck, Cargo Tractor, Container Loader, Deice Cart, Deice Truck, Disabled Passenger Lift, Forklift, Ground Power, Heater, Lavatory Service Unit, Maintenance Boom, Mobile Lounge, Maintenance Lift Truck, Passenger Steps, Scrubber, Sweeper, Service Truck, Tractor, Vacuum and Water Service Unit



Reasons for Idling Reductions

- Improved air quality and reduced noise pollution
- Improved public health
- Federal and state mandates
- Airports mandating alternative fueled GSE
- New administration focused on alternative energy sources
- Complex legislation and bookkeeping
- Available grant funding
- End goal will always be zero emissions



Reasons for Idling

- Ensure equipment ready for arriving aircraft
- Off loading baggage and cargo
- Transferring baggage and cargo
- Provide pre-conditioned air to aircraft
- Provide ground power to aircraft
- Provide power for ancillary equipment
- Ensure equipment ready for aircraft departure



Airport Idle Reduction Technologies

- Point of use PCA and Ground Power
- Engine replacement
- Retrofit devices
- Monitoring devices
- Replace internal combustion with electric



Airport Idle Reduction Technologies

- Point of use PCA and Ground Power
 - Replace diesel powered unit with solid state
 - Larger airports converts to central chiller system
 - Installed on loading bridge where used
 - Eliminate emissions
 - Total cost of ownership significantly less
 - Available infrastructure?



Airport Idle Reduction Technologies

- Engine replacement
 - GSE niche market
 - Replacement engines lag behind other industries
 - Size issues with the new lower emitting engines
 - Cost escalation significant on new engines
 - Availability of rebuilt engines



Airport Idle Reduction Technologies

- Retrofit devices
 - Short work cycles
 - Engines very seldom reach optimum heat
 - Retrofit devices have not proven to work on GSE
 - Requires filters to be removed periodically
 - Increased maintenance cost
 - Possible operational impact
 - Customers impact



Airport Idle Reduction Technologies

- Monitoring devices
 - Asset monitoring device
 - Preset timer to shut off idling engine
 - New technology
 - Reliability in the GSE environment not proven
 - Significant capital cost
 - Increase maintenance cost



Airport Idle Reduction Technologies

- Replace internal combustion with electric
 - Site specific fleet
 - Zero emissions
 - Increased operator safety
 - Reduced noise pollution
 - Stable and predicable energy cost
 - Ability to control vehicle operating parameters
 - Minimize upcoming bookkeeping
 - Reduce reliance on foreign oil



Electric Drive Challenges

- New maintenance skill set
- Battery maintenance and watering program
- Charger maintenance
- Operator charging education
- Available infrastructure



Cost of Ownership IC vs. Electric

- Capital Cost (Baggage Tractor)

Item	Fossil Fuel High/Low Cost		Electric		
	\$1.50	\$2.00	Rapid Charge System		Conventional Charge Sys.
	per gal	per gal	1:1	2:1	
<u>CAPITAL COSTS</u>					
GSE Purchase Cost	\$25,500	\$25,500	\$30,500	\$30,500	\$30,500
GSE Rapid Charge upgrade kit	NA	NA	\$1,280	\$1,280	NA
Rapid Charge Kit Installation	NA	NA	\$160	\$160	NA
Battery Charger Cost Share	NA	NA	\$11,000	\$5,500	\$3,200
Charger Cable Cost Share	NA	NA	\$400	\$200	\$0
Electrical Infrastructure, Design and General Site Construction Cost Share	NA	NA	\$10,000	\$5,000	\$500
Sub-total	\$25,500	\$25,500	\$53,340	\$42,640	\$34,200
Cost of Capital (interest)	\$4,796	\$4,796	\$10,032	\$8,019	\$6,432
Total	\$30,296	\$30,296	\$63,372	\$50,659	\$40,632



Cost of Ownership IC vs. Electric

- Energy Cost (Baggage Tractor)

<u>Fuel/Energy Costs</u>					
Fuel Cost (per US GAL)	\$1.50	\$2.00	NA	NA	NA
Electrical Power Cost (per KWH)	NA	NA	\$0.10	\$0.10	\$0.10
Clock Hours per Operational Day	5.9	5.9	3.0	3.0	3.0
Fuel Consumption per day (gal)	11.8	11.8	NA	NA	NA
Charger Efficiency	NA	NA	88%	88%	60%
KWH Consumption per day	NA	NA	62.0	62.0	91.0
Daily Fuel/Energy Cost	\$17.70	\$23.60	\$6.20	\$6.20	\$9.10
Annual Fuel/Energy Cost	\$6,461	\$8,614	\$2,263	\$2,263	\$3,322
Life Cycle Fuel/Energy Cost	\$116,289	\$155,052	\$40,734	\$40,734	\$59,787



Cost of Ownership IC vs. Electric

- Maintenance Cost (Baggage Tractor)

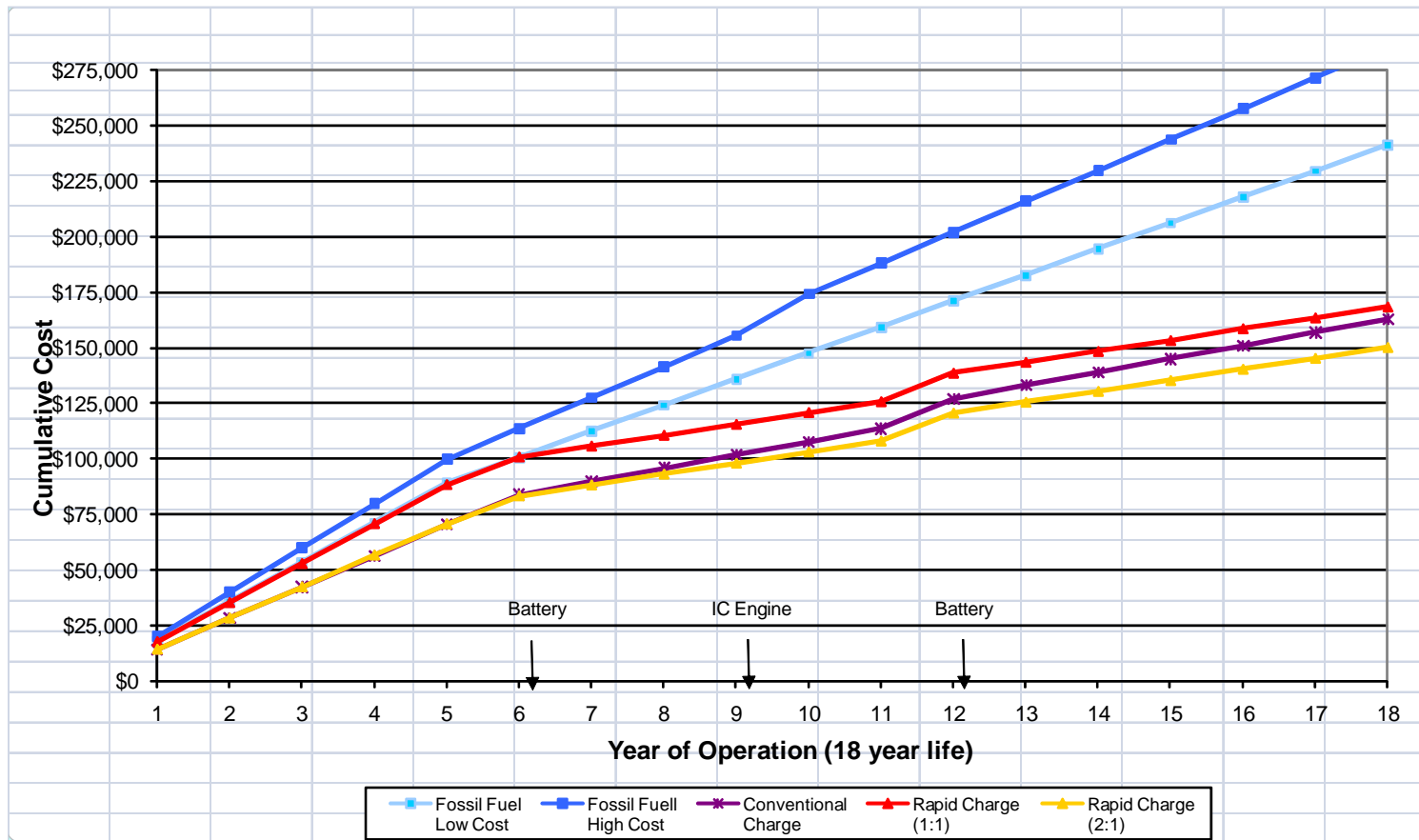
<u>GSE Maintenance Costs</u>					
Maintenance Labor Rate per Hour	\$40	\$40	\$40	\$40	\$40
Maintenance hours per year	84.0	84.0	38.0	38.0	38.0
Annual Labor Cost	\$3,360	\$3,360	\$1,520	\$1,520	\$1,520
Annual Parts Cost	\$1,900	\$1,900	\$1,100	\$1,100	\$1,100
Annual Maintenance Cost	\$5,260	\$5,260	\$2,620	\$2,620	\$2,620
Life Cycle Maintenance Cost	\$94,680	\$94,680	\$47,160	\$47,160	\$47,160
<u>Charger Maintenance Costs</u>					
Maintenance Labor Rate per Hour	\$40	\$40	\$40	\$40	\$40
Maintenance hours per year	NA	NA	0.50	0.25	0.25
Annual Labor Cost	NA	NA	\$20	\$10	\$10
Life Cycle Maintenance Cost	NA	NA	\$360	\$180	\$180



Cost Summary & ROI Analysis

<u>SUMMARY</u>					
Initial Capital investment	\$25,500	\$25,500	\$53,340	\$38,640	\$34,200
Total Annual Cost of	\$11,721	\$13,874	\$4,904	\$4,894	\$5,950
Total Life Cycle Cost	\$246,266	\$285,030	\$168,637	\$149,993	\$162,732
<u>ROI Analysis</u>					
Year	<u>Fossil Fuel Low Cost</u>	<u>Fossil Fuel High Cost</u>	<u>Rapid Charge (1:1)</u>	<u>Rapid Charge (2:1)</u>	<u>Conventional Charge</u>
1	17,780	19,933	17,578	14,075	14,076
2	35,559	39,867	35,156	28,150	28,153
3	53,339	59,800	52,734	42,225	42,229
4	71,119	79,733	70,712	56,500	56,306
5	88,899	99,666	88,290	70,575	70,382
6	100,619	113,540	100,694	83,169	83,832
7	112,340	127,415	105,597	88,063	89,782
8	124,060	141,289	110,501	92,956	95,732
9	135,781	155,163	115,405	97,850	101,682
10	147,502	174,037	120,708	102,944	107,632
11	159,222	187,911	125,612	107,837	113,582
12	170,943	201,785	138,416	120,431	127,032
13	182,663	215,659	143,319	125,325	132,982
14	194,384	229,533	148,223	130,218	138,932
15	206,104	243,407	153,126	135,112	144,882
16	217,825	257,281	158,430	140,205	150,832
17	229,546	271,156	163,334	145,099	156,782
18	241,266	285,030	168,237	149,993	162,732

IC vs. Electric GSE Life Cycle Cost





Sources of Funding

- Airport VALE funding
- Airport infrastructure projects
- Power companies
- Federal funded initiatives
- State and local environmental organizations



Case Study – Delta Shuttle LGA

- **Project Partners**
 - Clean Air Communities/Queens Clean Air Project
 - Delta Air Lines, Inc.
 - New York Power Authority
 - Port Authority of New York and New Jersey
- **Project Objective**
 - Reduce harmful emissions
 - Reduce dependence on fossil fuel
- **Technology**
 - Replace internal combustion GSE with electric
 - Computer controlled rapid battery charging



Case Study – Delta Shuttle LGA

- Emissions and Fuel Benefits
 - Reduce local emissions by 98%
 - Removed 19.2 tons of harmful emissions annually
 - 12.4 tons of nitrogen oxides
 - 0.8 tons of particulate matter
 - 4.6 tons carbon monoxide
 - 1.4 tons of hydrocarbons
 - Removed 256.4 tons over the life of the vehicles
 - Reduced 61,840 gallons of diesel fuel usage annually

Why Electric Drive GSE

- Improved air quality and reduced noise pollution
- Improved public health
- Meet or exceed current and future regulations
- Stable and reduced energy cost
- Reduce reliance on foreign oil
- Increased safety
- Reduced maintenance cost
- Minimize pending bookkeeping
- Available grant funding
- Total Cost of ownership



- Electric GSE technologies including vehicles, batteries, chargers, and testing/maintenance equipment
- Fleet management technologies
 - Better management of assets
 - Idle reduction
 - Location & usage tracking
- Aircraft parking systems
 - Faster parking of aircraft
 - Reduce engine and APU emissions
 - Ability to park aircraft during inclement weather