

## ICF INTERNATIONAL

# Reducing Greenhouse Gases and Energy from Airport GSE and Vehicles

Airports Council International – Latin America  
Second Annual Aviation Environmental Seminar  
Quito, Ecuador  
November 24, 2010

David Ernst  
dernst@icfi.com

ICF International. Passion. Expertise. Results. icfi.com



## ICF International

- Over 40 years of experience – founded in 1969
- End-to-end management, technology, and policy services – advise, implement, improve
- More than 3,500 employees
- Global presence with more than 50 offices including Rio de Janeiro, headquarters in Washington, DC
- **SH&E** acquired by ICF in 2007
  - World's largest and most experienced aviation consulting firm
  - Nearly 100 aviation professionals with deep experience and expertise
  - Proven methodologies to create sustainable shareholder value
  - Unmatched resources including proprietary aviation databases

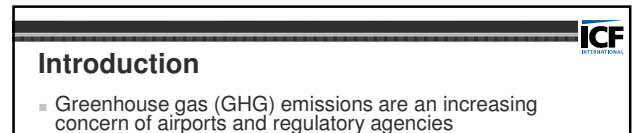
ICF International. Passion. Expertise. Results. icfi.com



## SH&E Assists Airport Owners, Managers, Developers, Operators, Service Providers, and Airlines in Making Effective Decisions

- Demand Forecasting
- Air Service Marketing and Route Development
- Strategic & Master Planning
- Airport System Planning – Commercial and GA
- Capacity & Delay Analysis
- Environment/Noise Analyses
- Economic Impact Studies
- Airport Privatisation
- Operational Restructuring
- Airport Finance, Rates & Charges
- Cargo Marketing
- Cargo Facility & Business Planning
- Safety & Security Evaluations
- Air Traffic Control Infrastructure Planning
- Airport Concession & Lease Structure
- Ground Handling & Other Airside Related Assessments
- Bilateral & Regulatory Advice

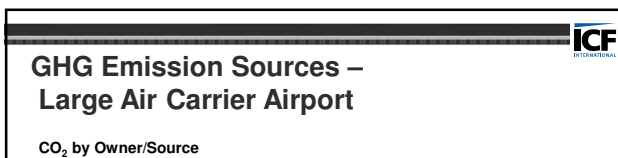
ICF International. Passion. Expertise. Results. icfi.com



## Introduction

- Greenhouse gas (GHG) emissions are an increasing concern of airports and regulatory agencies
- Energy is a significant operating cost for most airports – usually 10-15% of total operating budget
- There are many options for reducing GHGs that also increase energy efficiency
- Higher first or capital cost, but lower operating and maintenance (O&M) costs
- Reduced GHG emissions and energy cost over life cycle
- GSE and vehicle projects are widespread at large airports, increasing at smaller airports
- Planning for GHG/energy projects

ICF International. Passion. Expertise. Results. icfi.com



## GHG Emission Sources – Large Air Carrier Airport

### CO<sub>2</sub> by Owner/Source

Airlines/Tenants	91%
Public Access (Ground Transport)	8%
Airport Operator	1.4%

Airlines/tenant GHGs: Aircraft + APU + GSE

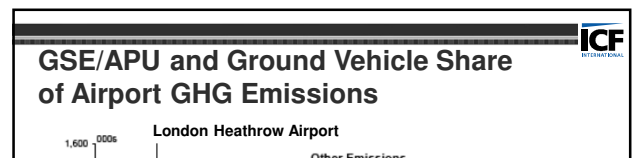
APU + GSE typically ~5% - 15% of airline/tenant GHGs

### Airport Owned or Controlled CO<sub>2</sub>

Electricity/Boilers/Generators	61.1%
Passenger Vehicles	31.9%
Fleet Vehicles/Equipment	4.1%
Hotel & Parking Shuttles	2.4%
Airport Employee Commuting	0.4%

Source: Vigilante 2009

ICF International. Passion. Expertise. Results. icfi.com



## GSE/APU and Ground Vehicle Share of Airport GHG Emissions

### London Heathrow Airport

Other Emissions

Heathrow's 2008 Carbon Inventory shows a total carbon footprint of around 2.1 mt CO<sub>2</sub>. Approximately 0.6 mt CO<sub>2</sub> (30%) comes from aircraft on the ground.

Category	Carbon Emissions (t/a)
HAL's Direct Emissions	~350
Aircraft In LTO	~1350
Passenger Transport	~250
Staff Transport	~100
Airside Fuel Use - Third Party	~50
Waste & Water	~50
Business Travel	~50

Figure: Heathrow Airport's Carbon Footprint 2008

Source: Sustainable Aviation/UK Airport Operator's Association

ICF International. Passion. Expertise. Results. icfi.com

**ICF**  
INTERNATIONAL

## Two Basic Strategies

- **Technological Changes** – Equipment replacement or conversion to reduce energy and emissions for the same amount of activity
- **Operational Changes** – Accomplish the same work or services with less equipment/vehicles or more efficient usage of same fleet

ICF International. Passion. Expertise. Results. 7 icfi.com

**ICF**  
INTERNATIONAL

## Typical Projects

- Replace fossil-fueled GSE with electric units
- Provide 400 Hz power and preconditioned air at gate
- Replace diesel/gasoline vehicles with alternative fuel, hybrid-electric, or electric
- Encourage alternate travel modes for airport employees and passengers
- Reduce vehicle idling
- Consolidate shuttles
- Information, education, signage

ICF International. Passion. Expertise. Results. 8 icfi.com

**ICF**  
INTERNATIONAL

## Developing Options

- Direct relationship between fuel use and CO<sub>2</sub> emissions
- Actions that reduce fuel consumption
- Emissions to generate electricity at power plant are lower than from on-airport fuel combustion to do same work
- Actions that replace diesel, gasoline, or jet fuel with alternative fuels or electricity
- Actions that reduce the number of vehicles needed or distance traveled
- Short payback periods
- Sensitivity to fuel and electricity prices, cost of capital
- Financial incentives/grants

ICF International. Passion. Expertise. Results. 9 icfi.com

**ICF**  
INTERNATIONAL

## GSE Electrification

- If building anew, infrastructure to deliver electricity costs less than for gasoline/diesel
- Advantages
  - Reduced fuel cost
  - Reduced maintenance costs
  - Possibly longer life than gas/diesel units
  - Reduced GHG emissions
  - Reduced pollutant emissions at apron
- Disadvantages
  - Charging requirements
  - Capital cost
  - Cost of electricity
  - Electric units not available for some GSE






Photo: PHL Airport

ICF International. Passion. Expertise. Results. 10 icfi.com

**ICF**  
INTERNATIONAL

## GSE Electrification

- Who should own the equipment?
  - Airport
  - Airlines/FBO
  - Airport owns chargers, airlines own GSE
  - Leasing and lease/purchase agreements
- Easiest for belt loaders, baggage tractors, aircraft tugs
- Charging
  - On service ramp
  - In maintenance area
  - At jet bridge
  - Electrical service upgrade
- GSE economic modeling tool:  
U.S. Idaho National Laboratory <http://avt.inel.gov/groundsupport.shtml>

Photos: EPRI 2004

ICF International. Passion. Expertise. Results. 11 icfi.com

**ICF**  
INTERNATIONAL

## Example – Electric Baggage Tractor

Description (\$US)	Gasoline	Electric	Difference
Purchase	\$40,000	\$52,000	\$12,000
Annual. cap. cost (15yr @7%)	\$4,392	\$5,709	\$1,318
<b>Operation &amp; Maintenance (annual)</b>			
Fuel	2,053 gal \$5,564	0	(\$5,564)
Electricity	0	17,520 Kwh \$2,102	\$2,102
Batteries	0	\$1,200	\$1,200
Maintenance	\$2,000	\$750	(\$1,250)
Subtotal	\$7,564	\$4,052	(\$3,512)
Total annual cost	\$11,956	\$9,762	(\$2,194)
Simple payback period on purchase	5.5 years		
CO <sub>2</sub> emissions (MT/year)	18.1	10.6	-7.5 (41%)
CO <sub>2</sub> reduction cost effectiveness (capital \$/MT)	\$175		

Cost of charger not included. Photo: airport-technology.com (Volk)

ICF International. Passion. Expertise. Results. 12 icfi.com

## Gate Services

- Reduces APU and GPU usage – significant fuel savings
- Point-of-use or centralized system
- Lower emissions at apron
- Emissions at power plant
- Ownership
- Electric upgrade may be needed
- 400Hz power alone may not be economic

Photo: SMF Airport

ICF International. Passion. Expertise. Results. 13 icfi.com

## Example – 400 Hz Power & PC Air Services

Description (\$US/gate, 21 gates in project)	Impact	
Purchase (~1/3 for 400Hz, ~2/3 for PCA)		\$299,513
Annual. cap. cost (15yr @7%)		\$32,885
Operation & Maintenance (annual)		
Jet Fuel	-54,711 gal	(\$122,006)
Electricity	160.8 Mwh	\$19,291
Maintenance	APU	(\$4,915)
	400Hz & PCA	\$11,091
O&M Subtotal		(\$96,538)
Total annual cost		(\$63,653)
Simple payback period on purchase		4.7 years
CO <sub>2</sub> emissions (MT/year)		
Jet Fuel		-535.5
Electricity		96.9
Total CO <sub>2</sub> Impact		-438.5 (-82%)
CO <sub>2</sub> reduction cost effectiveness (capital \$/MT)		\$75

ICF International. Passion. Expertise. Results. 14 icfi.com

## Solar Power – Can Complement Electric GSE and Gate Services

- Solar power on airport + Electric GSE + Gate services + Renewable grid power = Carbon near-neutrality
- Photovoltaic arrays have very low operating cost
- Requirements:
  - Adequate land or roof area
  - Sufficient sunlight
  - Electric infrastructure
- Visible support for sustainability

Photo: DEN Airport

ICF International. Passion. Expertise. Results. 15 icfi.com

## Vehicle Alternative Fuels

- Vehicles
  - Airport vehicle fleet
  - Hotel and rental car shuttles
  - Rental cars
  - Transit buses
- Facilities and Infrastructure
  - Fueling stations
  - Electric chargers

Photos: ADEMA, PSP Airport

ICF International. Passion. Expertise. Results. 16 icfi.com

## GSE/Vehicle Alternative Fuel Options

- CNG/LNG
- LPG (Propane)
- Hybrid Electric
- Battery Electric (also NEVs for low-speed on-airport)
- Ethanol/Methanol (E85/M85)
- Biodiesel (e.g., B20)
- Hydrogen
- Fuel cell (various fuels)

ICF International. Passion. Expertise. Results. 17 icfi.com

## Example – CNG Bus

Description (\$US)	Diesel	CNG	Difference
Purchase	\$432,000	\$456,000	\$24,000
Ann. capital (12yr@7%)	\$54,390	\$57,411	\$3,022
Operation & Maintenance (annual)			
Fuel	6,906 gal	7,597 DGE	691 DGE
	\$20,374	\$10,864	(\$9,510)
Maintenance	\$7,260	\$7,669	\$410
Subtotal	\$27,633	\$18,533	(\$9,100)
Total annual cost	\$82,023	\$75,944	(\$6,079)
Simple payback period on purchase			3.9 years
CO <sub>2</sub> emissions (MT/year)	70.1	40.3	-29.8 (-42%)
CO <sub>2</sub> reduction cost effectiveness (capital \$/MT)			\$102

Capital cost of fueling station not included. Photo: NABI

ICF International. Passion. Expertise. Results. 18 icfi.com

## Vehicle Operations & Facilities – Common Examples

- Taxi staging area
- Queue priority for alternative fueled vehicles
- Cell phone lot
- Consolidated rental car facilities
- Hybrid-electric rental cars
- No-idle policy
- Airside hydrant fueling system
- Fueling stations for alternative fuels (airport fleet & public)
- Charging stations for electric vehicles (airport fleet & public)
- Pay-on-foot parking

ICF International. Passion. Expertise. Results. 19 icfi.com

## Airport Employees and Passengers

- Encourage use of buses, subways & trains instead of cars to access airport
- Improve intermodal connections to rail/subway/bus
- Discounted fees for shuttles, taxis, and commercial vehicles that use alternative fuels
- Pricing strategies – parking, fares, discounts
- Information, education, signage

ICF International. Passion. Expertise. Results. 20 icfi.com

## U.S. FAA’s Voluntary Airport Low Emission (VALE) Program

- GSE electrification is most cost effective option for emission reduction
- Gate services (400 Hz & PCA) are a close second
- Next most cost effective:
  - On-road vehicles
  - Renewable energy sources
  - Terminal HVAC and other stationary facilities
- As gasoline and diesel vehicles get cleaner, benefits of alternative fuel conversions decline
- Then infrastructure options may be preferable
- Age of your vehicle fleet may affect selection of options

ICF International. Passion. Expertise. Results. 21 icfi.com

## Comparison to Other Airport Options

ICF International. Passion. Expertise. Results. 22 icfi.com

## Planning GHG Reduction/Energy Efficiency Projects

- Audit current energy use and emissions to establish baseline
- Identify and involve stakeholders
- Reach first for “low hanging fruit” – projects that are easy to achieve, with incremental expenses paid through energy savings
- Identify financing mechanisms – internal or external debt, lease or lease-purchase, energy performance contracts, utility or government incentives, etc.
- Conduct rigorous, life-cycle financial analysis – every airport is different

ICF International. Passion. Expertise. Results. 23 icfi.com

## Planning GHG Reduction/Energy Efficiency Projects II

- Create a plan with targets and timetables you can live with under most economic circumstances
- Incorporate environmental goals into long-term plans – especially new construction
- Don’t reinvent the wheel – learn from other airports
- Measure results to demonstrate benefits
- Communicate continuously

ICF International. Passion. Expertise. Results. 24 icfi.com

***Thank you!***

**For more information:**

David Ernst  
ICF International  
00-1-781-676-4048  
[dernst@icfi.com](mailto:dernst@icfi.com)