JPDO Environmental Working Group Operations Standing Committee's E-Workshop

Atlantic Interoperability Initiative to Reduce Emissions (AIRE) – Environmental Program Status

For: Members of EWG

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On: 28 July 2009 in NASA Ames Res Cntr

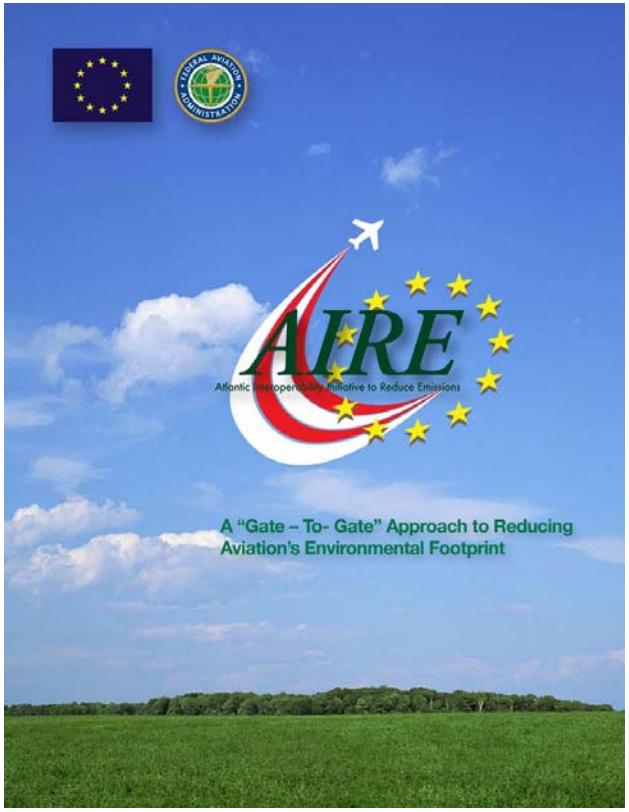
Federal Aviation Administration

Topics of Discussion

- **AIRE (& ASPIRE) – Environmental Goals**
- **Mission Segments Gains:**
  - **Arrivals**
    - **(MIA/ATL CDA, ATL1.5, MIA TAs, LAX, SDF, etc)**
  - **Oceanic (AEA)**
  - **Surface**
- **Est. Industry Cost Benefit & Environmental Mitigation Progress**
- **FY09 Integrated Oceanic & Arrival Effort**
- **Next Step**

AIRE & ASPIRE Goals *(Addressing both Oceans)*

Atlantic Interoperability Initiative to Reduce Emissions (AIRE)

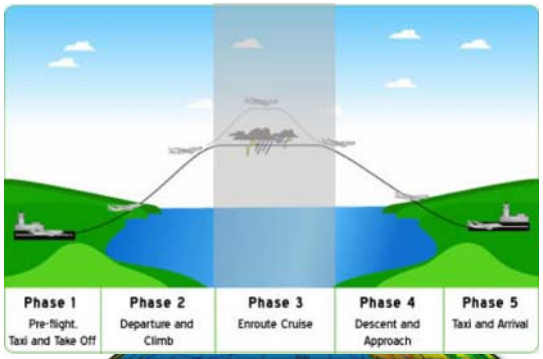


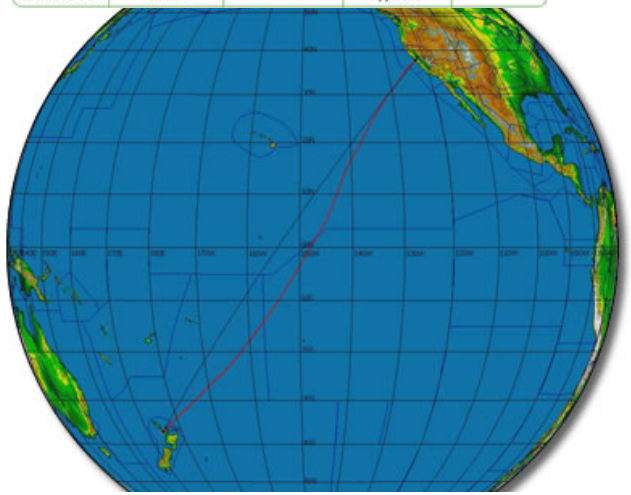
- **Reduce aviation's environmental footprint via environmentally friendly procedures**
- **All flight segments (gate-to-gate)**
  - Surface
  - Oceanic
  - Arrivals
- **Near term goals**
  - Coordinate operational demonstrations
  - Validate environmental improvements

FAA Approach:

To define and implement environmentally efficient operational activities for the NAS and support system demonstrations leading to NextGen advancements for Surface, Departure, En route/Oceanic and Arrival operations**.**

aspire ASIA & SOUTH PACIFIC INITIATIVE TO REDUCE EMISSIONS





Environmental Approach

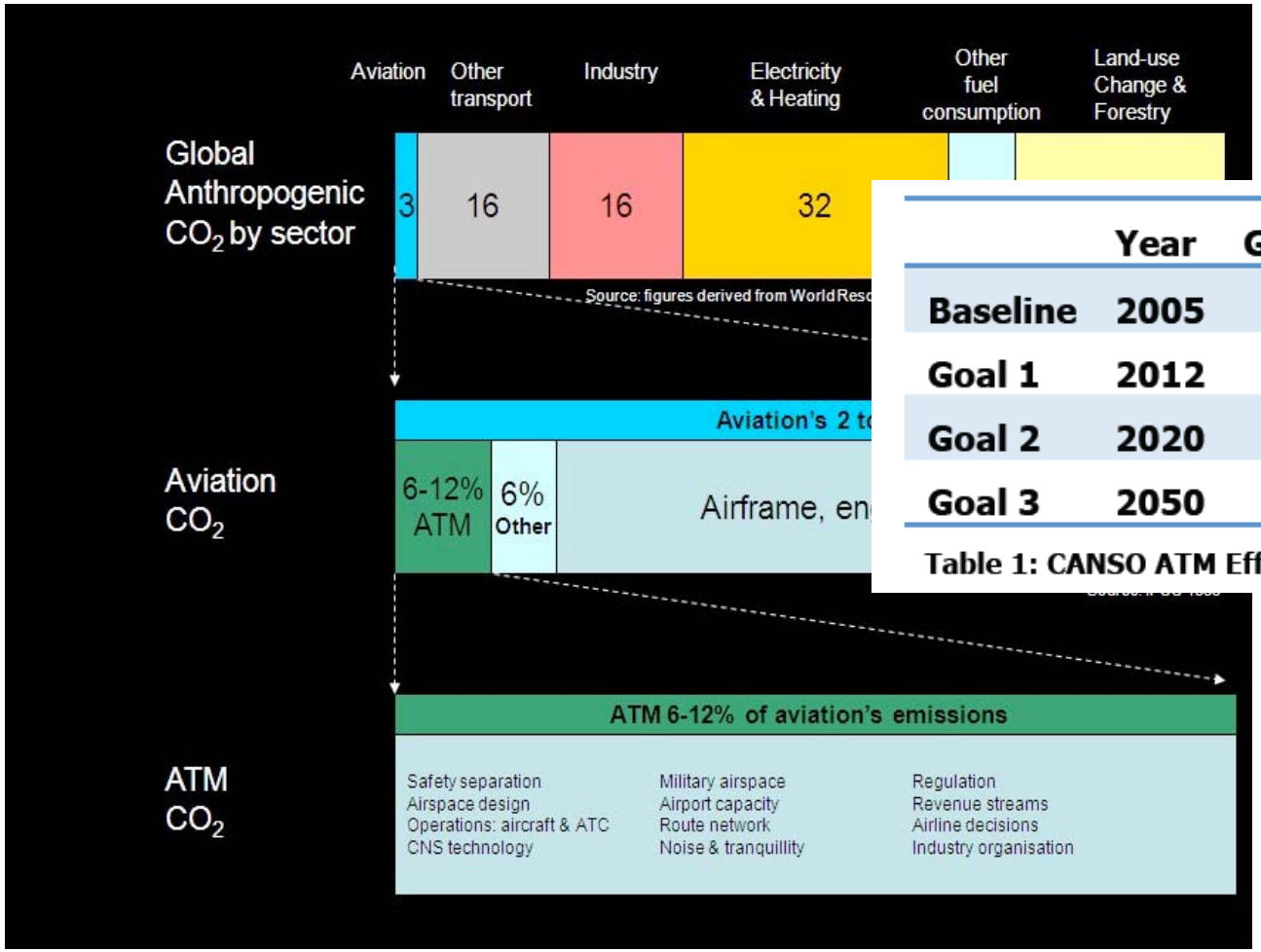
- The AIRE domain demonstrations are *proof of concept* ATM system enhancements that have been shown to offer major environmental benefits from improved operational efficiency.
- For each AIRE domain technology/technique, levels of fuel savings/emission and noise reductions will be quantified for the participating trans-Atlantic flights.
- Metrics will identify the overall potential for engine emissions and aircraft noise reduction.

AIRE Environmental Potential
(Reduce fuel burn, emissions & noise)

Domain - Demonstration Technology	Operational Metric (source)	Environmental Metric - Fuel Burn, lbs*	Est. Potential Fuel Saving (Margin of improvement non-weighted)	Baseline (rel. ops levels)
Surface	Taxi time measured	Derived using ICAO Engine Performance Data	2%	MEM historical ops & JFK ops (w/o ASDE-X) Vs Installed ASDE-X
Oceanic	Fuel burn calc/ measured	As measured by Airline participant(s)	4%	Filed Flight Plan Vs Actual Flight Profile
Arrival	Flight Trajectories measured	Derived by Aviation Environmental Design Tool (AEDT) or ICAO BADA equivalent	2%	Pre CDA/TA Operations Vs Newly developed CDA/TA

Environmental Potential (Margin)–

IPCC estimation of Aviation CO2 influence, ref CANSO report ATM Global Environmental Efficiency Goals for 2050



	Year	Global ATM efficiency
Baseline	2005	Between 92% & 94%
Goal 1	2012	Between 92% & 95%
Goal 2	2020	Between 93% & 95%
Goal 3	2050	Between 95% & 98%

Table 1: CANSO ATM Efficiency Aspirational Goals

Global ATM Margin Range ~3 %

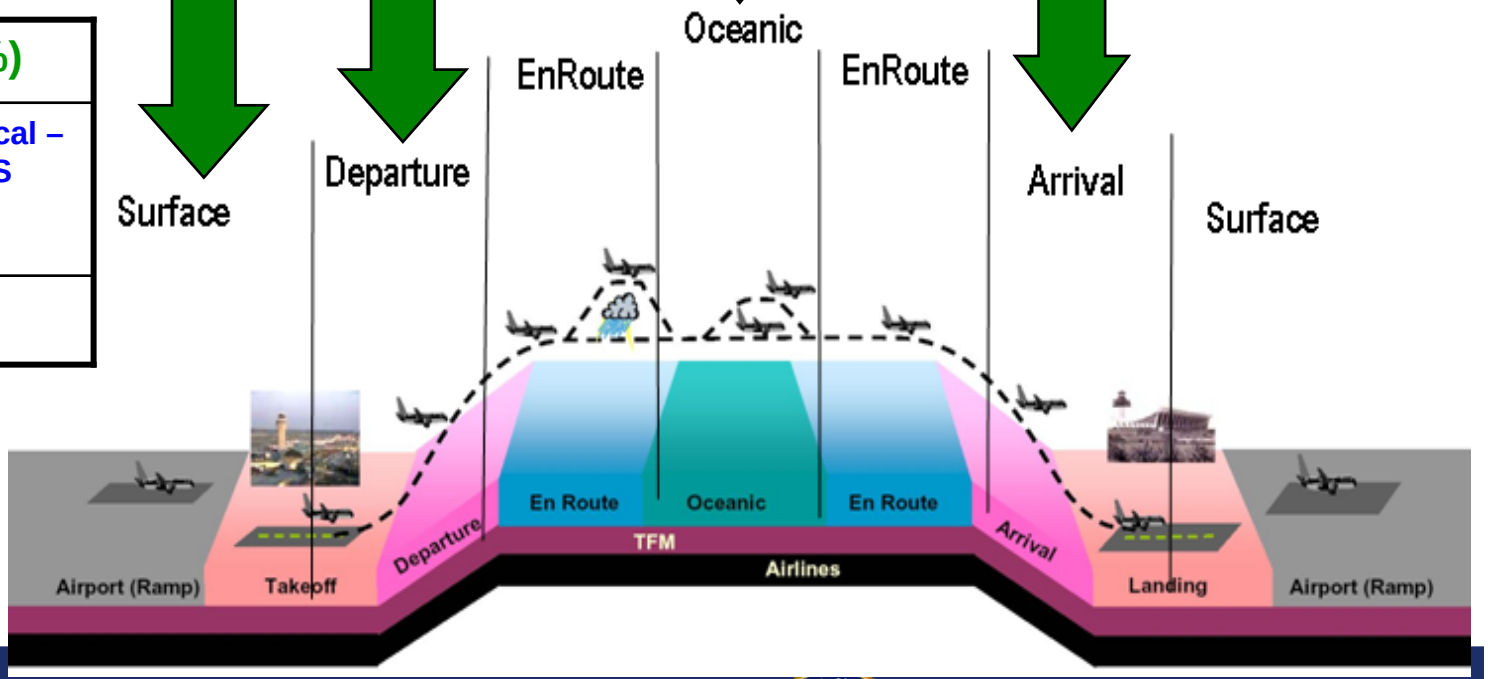
Efficiency Mechanisms

SURFACE (12%)
Min APU use or alt clean power
"just in time" refueling
Min taxi time & holds (continuous transit)

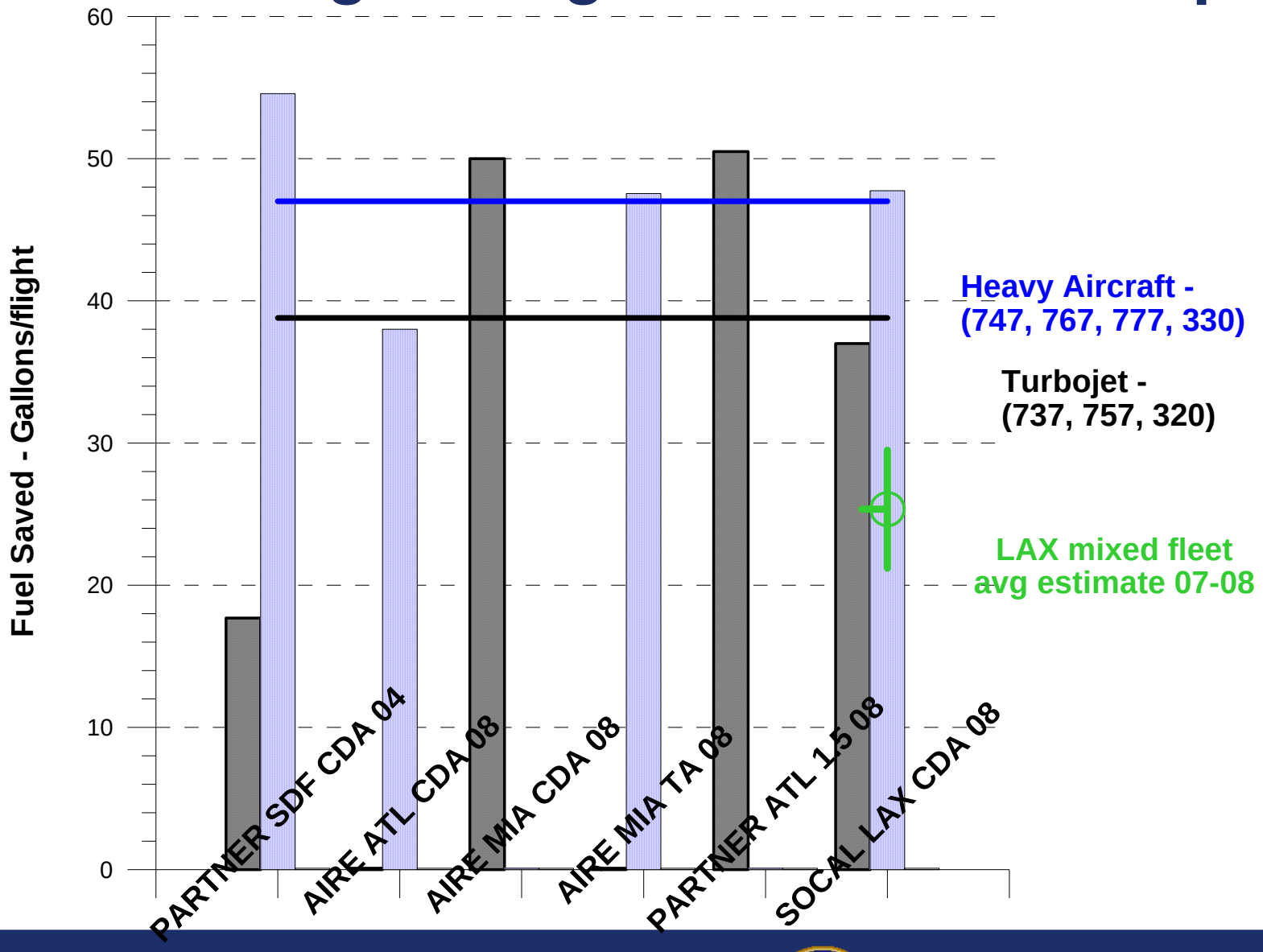
DEPARTURE (3%)
use of Maximum climb power

OCEANIC (60%)
use of UPR-User Preferred Routes–updated winds
Use of DARP - Dynamic Airborne Reroute Procedure - shorten path
operate at optimum altitude/flt level
Cost Index (economy speed)

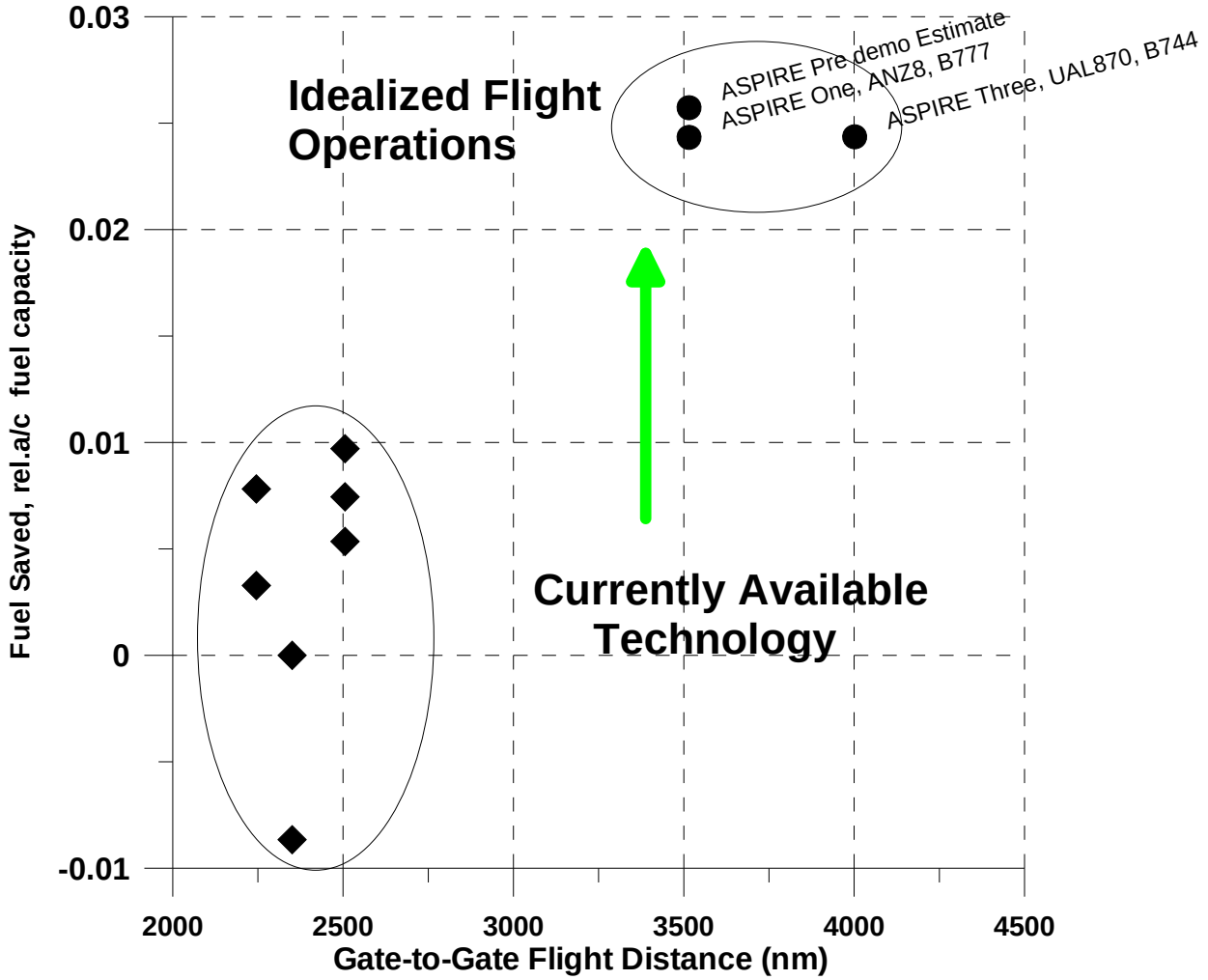
ARRIVAL (25%)
Request optimal vertical – CDA/OPD/TA/TAPS
Delayed flaps



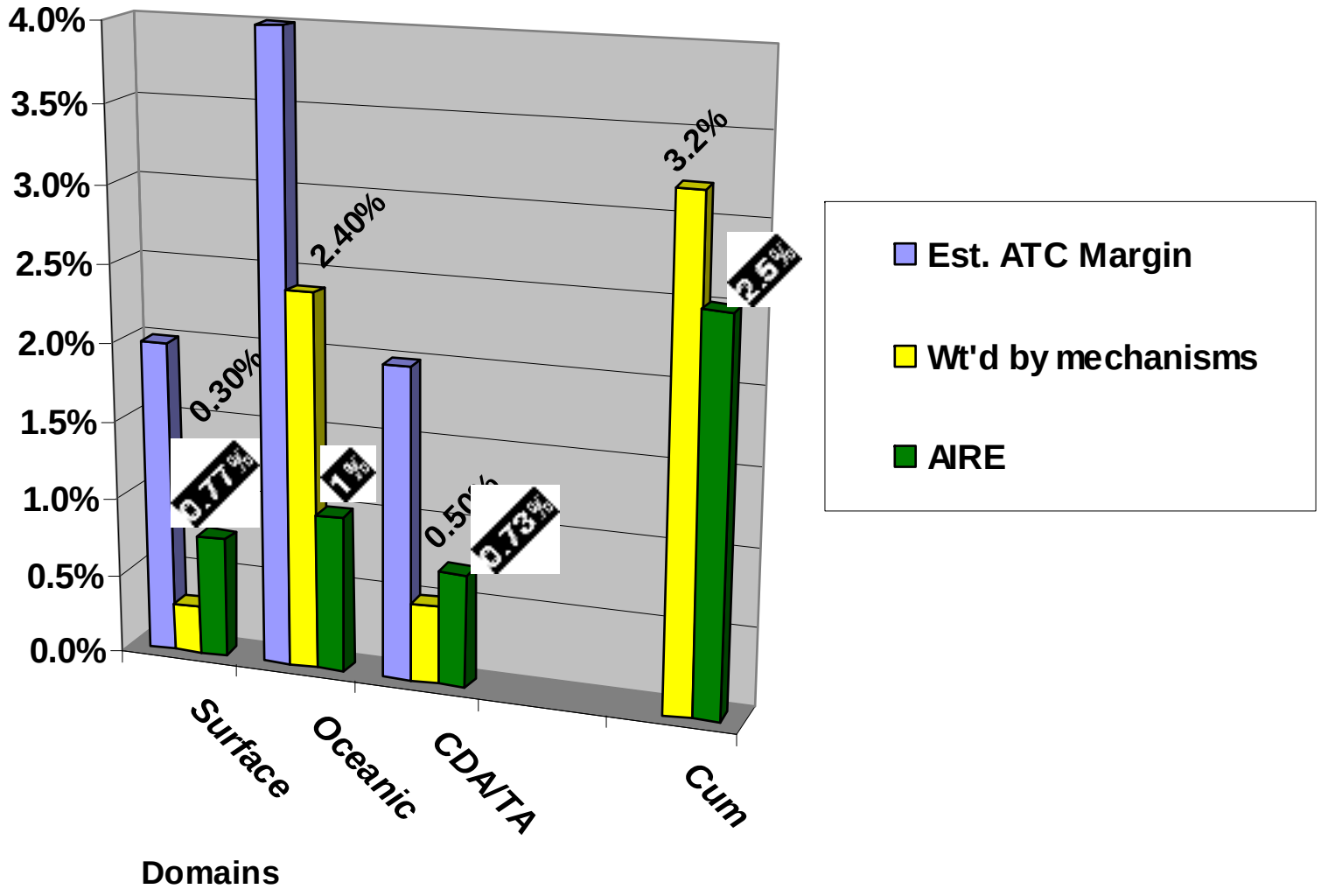
Arrivals Savings – Flight Trials/Demos/Ops



Oceanic Savings- AIRE & ASPIRE



FY08 AIRE Fuel Savings



Industry Benefit

CY2008 Activities	Demonstration	AIRE/ASPIRE Benefits	Cost Saving@ $3.08/gal (10/3/08)
Oceanic TBO	May Demo- Completed	~ 47 gals/flt	~$145/flt
CDAs @ ATL/ MIA	May Demo- Completed	~38-50 gals/flt	~$150/flt
ASD-X@MEM/JFK	Recently activated	est~ 50 gals/flt	~$150/flt

Current Spain to Caribbean Islands	AIRE Cumulative Total:	Est. 150 gal/flt X 40 flts/wk	$960K/ annually

Ideal Gate to Gate Australia/ NZ-US/Can	ASPIRE Cumulative Total:	Est. 1174 gals/flt X 156 flt/wk	$29M/ annually

Projected Annual Environmental Benefits

AIRE Current Spain to Caribbean Islands

CO_2 Emissions Equivalencies for ASPIRE Demo:

Can potentially save 3K metric tons CO_2 = (40 flt ops/wk)

- Annual greenhouse gas emissions from **500** passenger vehicles

Energy:

- CO_2 emissions from **312,000** gallons or **6,400** barrels of oil consumed
- CO_2 emissions from the electricity use of **365** homes for one year

Off-set Mitigation:

- Carbon sequestered by **70,500** tree seedlings grown for 10 years

Relative to Nature's Cycle:

- Carbon sequestered annually by **625** acres of pine or fir forests

Conservation:

- CO_2 emissions avoided by recycling **1,000** tons of waste instead of sending it to the landfill

Projected Annual Environmental Benefits

ASPIRE Pacific Flts between Australia/New Zealand to USA/Canada

CO_2 Emissions Equivalencies for ASPIRE Demo:

Can potentially save 83K metric tons CO_2 = (Optimal 154 flt ops/wk)

- Annual greenhouse gas emissions from **15,000** passenger vehicles

Energy:

- CO_2 emissions from **9,442,000** gallons or **194,000** barrels of oil consumed
- CO_2 emissions from the electricity use of **7,340** homes for one year

Off-set Mitigation:

- Carbon sequestered by **2M** tree seedlings grown for 10 years

Relative to Nature's Cycle:

- Carbon sequestered annually by **19,000** acres of pine or fir forests

Conservation:

- CO_2 emissions avoided by recycling **29,000** tons of waste instead of sending it to the landfill

AIRE Airline Partners

AirEuropa.com

AIRE Oceanic Flights

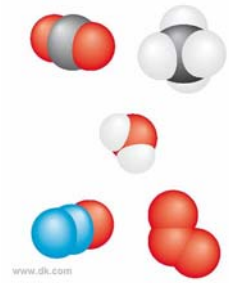
AIRFRANCE

AIRE Oceanic/TA Flights

Lufthansa
AIRE Oceanic/TA Flights

Next Step

Metrics: Data Collection & Analysis



Storing & Sharing Flight Measures

Record actual:

- **Fuel Burn (lbs or gals) – PRIMARY Metric**
- **Payload**
- **Trajectory**
- **Meteorological – winds/temp**

Compute prediction:

- **CO2 emissions - convert from fuel use**
- **Noise in terminal area (optional)**

Proposed Data Collection Methods

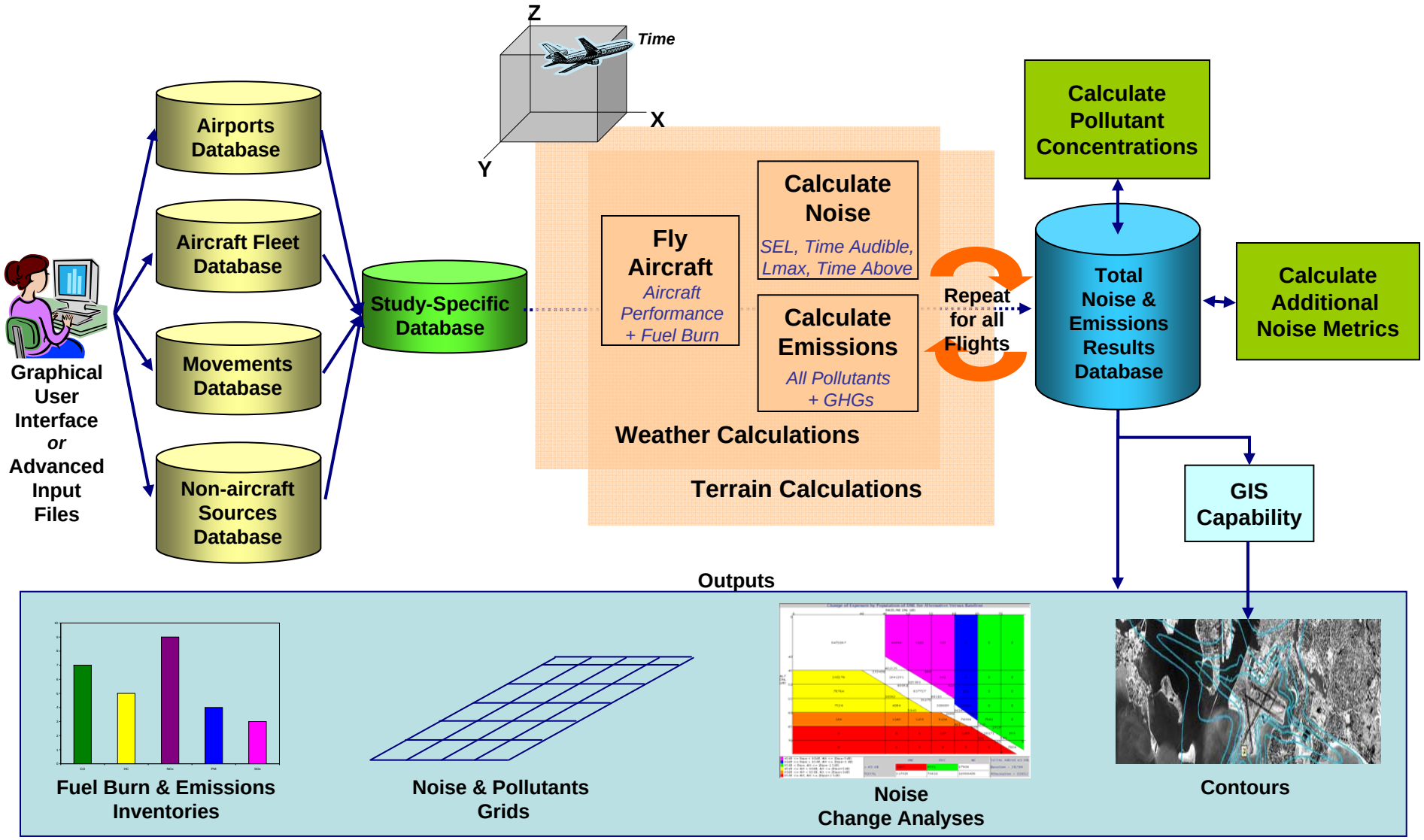
- **Pilot/flight crew Data Log recording**
  - Baseline (prior 1-month ops)
  - Demo flights (as scheduled)

OR

- **Cockpit Flight Data Recorder/Flight Operations Quality Assurance system**
  - Baseline (prior 1-month ops)
  - Demo flights (as scheduled)

- **Airline Operations Center and Aviation Navigation Service Provider(s) System data**
  - Filed Flight Plans information/data
  - Simultaneous AOC data of flight Baselines & Demo flights

AEDT overview



AEDT Performance Improvement

- Boeing and the FAA recently exchanged software tools – the Boeing Climb-Out Program (BCOP) and the FAA's Integrated Noise Model (INM).
  - FAA provided Boeing an executable version of the INM for inclusion in the next version of BCOP and in next generation performance tools
  - Boeing provided the FAA a copy of BCOP
- BCOP contains terminal area fuel burn data, for both departure and arrival

AEDT Fuel Burn Methodology

- Using BCOP, we developed two fuel consumption methods

Departure:

$$TSFC / \sqrt{\theta} = k_1 + k_2 M + k_3 h_{MSL} + k_4 F / \delta$$

Arrival:

$$TSFC / \sqrt{\theta} = \alpha + \beta_1 M + \beta_2 e^{-\beta_3 \left(\frac{F}{\delta} / F_0 \right)}$$

AEDT Model v. Actual: Miami, Sept 2008, 777-200ER

Tailored Arrival Flight	Arrival Runway	Fuel Burn FDR	Fuel Burn AEDT	Delta (kg)	Delta (%)
1	08L	3112 kg	2942 kg	-170 kg	-5.5%
2	08R	3278 kg	3367 kg	+89 kg	+2.7%
3	08L	3029 kg	3063 kg	+34 kg	+1.1%

Potential effects contributing to the Wide Range fuel savings idenitified (SFO 200 gals vs MIA 50gal)

Factor contributing:

- **Lateral track length (ref. way pt/fixes)**
- **Accountability of typical vectored paths in SA**
- **Characteristics unique to each airport envir**
- **no. of data samples**
- **Modeling assumptions, i.e., BADA, INM/BCOP, etc**

ACTION:

Explore an approach/metric that reflects saving in generic manner for national comparison as well as qualify with variability range/bars when available.

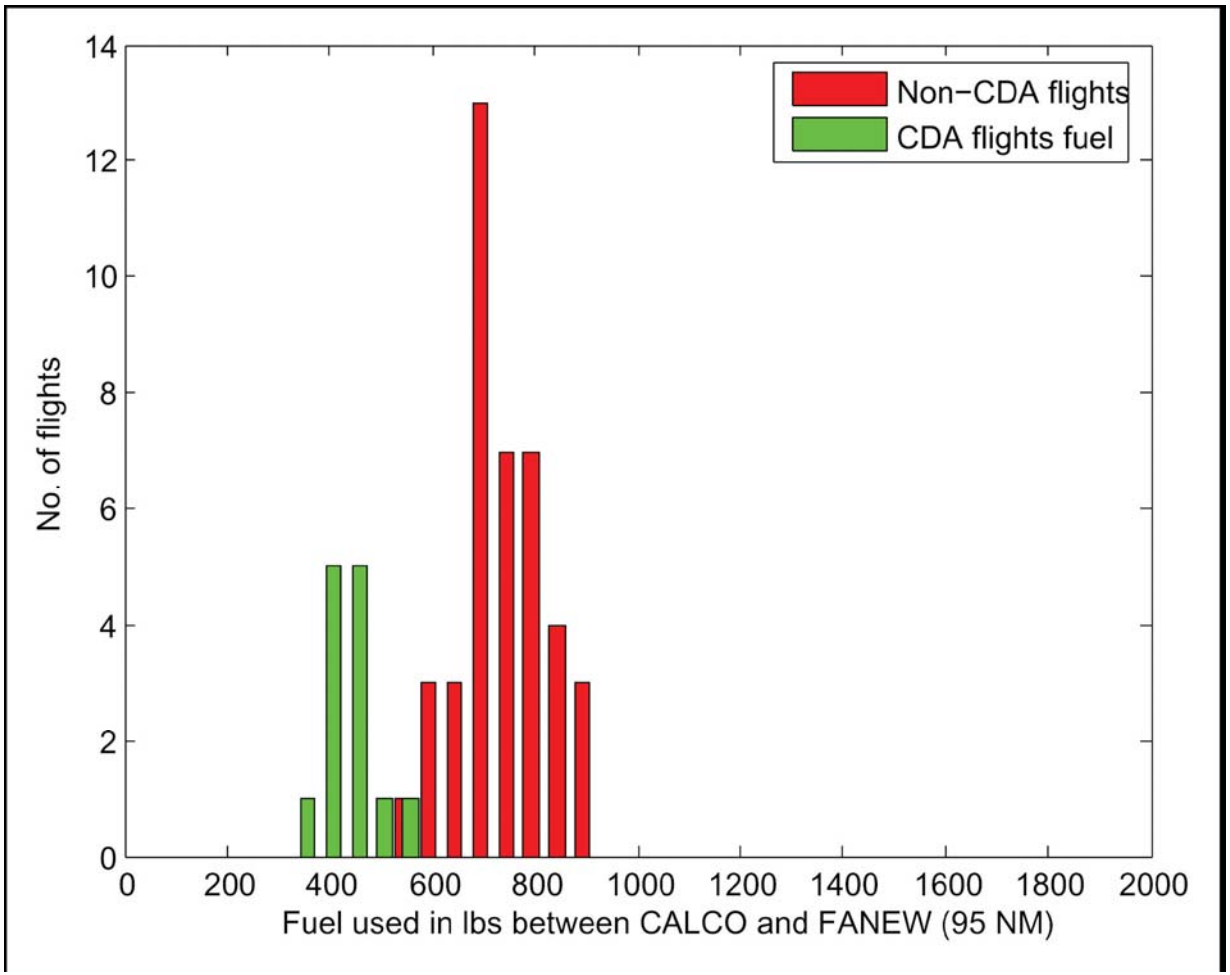
airport	SA	TA	savings
SFO	ineff	eff	high
MIA	eff	ineff	low

Summary

- **Exploring major segments of flight for efficiency gains. More on surface and departure needed.**
- **Modeling capability is maturing and more data flowing to support benefits.**
- **Incremental buildup of NextGen is progressing positively for Environment. But many questions to answer…**
- **Environmental ATM mitigation has started.**

Back-up slides

OPD-CD into ATL Notre (West ops)



Total Samples:

CD – 75 flts

Std- 290 flts

Savings:

794 lbs - 435 lbs =

359 lbs (165 kg)

55 gals

1150 lbs CO2/flt