Tailored Arrival
Environmental Benefits
Harmonization Status

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AEDT Fuel Consumption Methods
- Integrated Noise Model – based performance below 10,000 feet
  - Data from manufacturers
- Base of Aircraft Data (BADA) above 10,000 feet – and fuel consumption data
  - Data from EUROCONTROL
- Aviation Environmental Design Tool methods for in-production Boeing aircraft fuel consumption below 10,000 ft

Atlantic Interoperability initiative to Reduce Emissions (AIRE)
- Tailored Arrivals
  - Miami arrivals from Europe (Lufthansa and Air France)

Asian and South Pacific Initiative to Reduce Emissions (ASPIRE)
- Tailored Arrivals
  - San Francisco arrivals from Australia and New Zealand (United, Qantas, Air New Zealand)
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Atlantic Interoperability Initiative to Reduce Emissions

- Tailored Arrivals reduce fuel consumption by keeping the aircraft higher before starting the en-route descent

![Graph showing example flights and arrival profiles.](chart.png)
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Fuel Consumption per unit of time

A320 Fuel Consumption per second in cruise

John A. Volpe National Transportation Systems Center
U.S. Department of Transportation
Research and Innovative Technology Administration
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Fuel Consumption per unit of distance

A320 Fuel Consumption per nautical mile

- --- 20000 ft
- --- 35000 ft

Mach Number

Kg/mi
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### Aircraft Fuel Consumption

<table>
<thead>
<tr>
<th>Aircraft Type</th>
<th>SUMRS Standard Arrival</th>
<th>Tailored Arrival</th>
<th>Difference</th>
<th>Difference (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>747-400 (carrier A)</td>
<td>4171 kg (9196 lb)</td>
<td>3820 kg (8422 lb)</td>
<td>-351 kg (-774 lb)</td>
<td>-8.2%</td>
</tr>
<tr>
<td>747-400 (carrier B)</td>
<td>4425 kg (9754 lb)</td>
<td>4027 kg (8878 lb)</td>
<td>-398 kg (-877 lb)</td>
<td>-9.0%</td>
</tr>
</tbody>
</table>

The fuel consumption represents flights from the SUMRS waypoint; 1 nm track distance savings.
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AIRE - MIA
• Fuel savings on the order of 700 – 800 lb

ASPIRE - SFO
• Fuel savings on the order of 2000 lb

Why the differences?
• Modeling comparison started to look at the differences in detail
AIRE/ASPIRE Model Comparison

AEDT
• AEDT is intended for radar or simulator data inputs (TAAMS, ACES, SIMMOD, etc)
  – The current Alpha & Beta version has no tools to allow the user to build profiles

Boeing Tools
• Boeing Performance Software (BPS) is intended for user inputs
  – The user defines the state parameters of the aircraft during the modeled approach

Steps to run the comparison
• Tools written for AEDT to over-ride the radar data with user-defined profiles

• Common flights parameters for comparison:
  – Cruise at 37,000 MSL
  – Descent speeds of 280 knots above 10,000 ft, 240 knots below
  – Level segments of 15 nm, at 20,000 and 8,000 MSL for the baseline
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Dist (nm) vs Alt (ft)

- AEDT Output 8000 ft
- AEDT Output 20000 ft
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### Modeling results for 747-400

<table>
<thead>
<tr>
<th>Nominal flight</th>
<th>AEDT</th>
<th>BPS</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline 1 (8,000’ level)</td>
<td>1311 kg (2890 lb)</td>
<td>1347 kg (2970 lb)</td>
<td>-36 kg (-80 lb)</td>
</tr>
<tr>
<td>Baseline 2 (20,000’ level)</td>
<td>1229 kg (2709 lb)</td>
<td>1236 kg (2724 lb)</td>
<td>-7 kg (-15 lb)</td>
</tr>
<tr>
<td>Tailored Arrival</td>
<td>1077 kg (2374 lb)</td>
<td>1163 kg (2563 lb)</td>
<td>-86 kg (-189 lb)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Difference</th>
<th>AEDT</th>
<th>BPS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline 1 – Tailored Arrival</td>
<td>234 kg (516 lb)</td>
<td>185 kg (408 lb)</td>
</tr>
<tr>
<td>Baseline 2 – Tailored Arrival</td>
<td>152 kg (335 lb)</td>
<td>73 kg (161 lb)</td>
</tr>
</tbody>
</table>
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Lessons learned
• Methods document
  – Common definition of starting point
  – Common weight of aircraft
  – Report track distance differences between non-TA and TA flights

• For the SFO/MIA comparison, SFO has an average of 15 nm of vectoring (additional track distance)
  – The SFO vectoring contributes about 1000 lb of fuel consumption to the baseline
  – At MIA, the TA baseline contains no vectoring

Next Steps for AEDT
• FAA/Boeing agreement to exchange models
  – Expand current model to include more aircraft types (e.g. 777-200 performance data below 10,000 ft)
  – Improve modeling of Boeing aircraft above 10,000 (all are currently based on EUROCONTROL, not directly from Boeing tools)