The mission of ICCT is to dramatically improve the environmental performance and efficiency of cars, trucks, buses and transportation systems in order to protect and improve public health, the environment, and quality of life.

- Non-profit research institute
- Air pollution and climate impacts
- Focus on regulatory policies and fiscal incentives
- Activity across modes including aviation and marine
- Global outreach, with special focus on largest markets
Disclaimer

The International Council on Clean Transportation (ICCT) is a consultant to the Department of Business, Economic Development, and Tourism (DBEDT) under contract number 63188: Professional Services for Transportation Industry Analyst.

The views and opinions expressed in this presentation are that of the ICCT, and may not necessarily represent the position of the DBEDT.
Core strategies under consideration for transportation energy roadmap

- Light- as well as heavy-duty vehicle efficiency improvements
- Transition to electric drive vehicles (EVs and FCVs)
- Alternative fuels including biofuels and natural gas
- Vehicle demand management/promotion of transit and non-motorized transport
- Improving aviation efficiency
- Improving marine efficiency
Work has focused on policies to promote aircraft and airline fuel efficiency

- Reducing petroleum use from airport ground to be covered elsewhere
  → GSE electrification, LD/HD efficiency, etc.
- Aviation is not expected to compete with other modes for biofuels in the foreseeable future
  - Drop-in jet fuel requires more complicated processing than biodiesel and ethanol, increasing capital and production costs.
  - Example production costs (NREL 2013)
    - Biodiesel: $2.00-$2.50/gallon
    - Renewable jet fuel (conventional/cellulosic): $4.00-$6.00/gallon
    - Algal-based fuels: $17.00/gallon
  - Implies that state subsidies would be most economical if benefit is directed elsewhere
Most policymaking related to aircraft efficiency happens elsewhere

- **International activities**
  - ICAO global CO₂ (efficiency) standard for new aircraft anticipated in 2016
  - ICAO market-based measure (MBM) for international aviation – proposal possible in 2016 for implementation by 2020
  - EU Emissions Trading Scheme (2012) – currently covers intra-EU flights only, may introduce international routes in 2017

- **National activities**
  - EPA to release “endangerment” finding on GHG emissions plus thoughts on how regulation may occur under the Clean Air Act – expected by spring of 2015

- **State action on aviation is constrained due to the strong role of ICAO and federal pre-emption of aviation**
Aviation fuel efficiency improvement tactics under consideration (not in any particular order)

1. **Financial support for retrofits**
2. Financial support for fleet renewal
3. Increase in the barrel tax
4. Fuel efficiency-based landing charges
5. Airport infrastructure support (e.g., ground power)
6. Consumer information (e.g., airline efficiency ranking)
Top 5 airlines flying out of Hawaii and their winglet technology penetration rate in 2013

<table>
<thead>
<tr>
<th>Airline</th>
<th>Share of RPMs</th>
<th>Winglet penetration rate (% of total fleet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hawaiian Airlines</td>
<td>24%</td>
<td>19%</td>
</tr>
<tr>
<td>United Air Lines</td>
<td>20%</td>
<td>51%</td>
</tr>
<tr>
<td>Delta Air Lines</td>
<td>13%</td>
<td>29%</td>
</tr>
<tr>
<td>Alaska Airlines</td>
<td>10%</td>
<td>75%</td>
</tr>
<tr>
<td>American Airlines</td>
<td>7%</td>
<td>63%</td>
</tr>
</tbody>
</table>


- Winglet technology has resulted in about 3% fuel savings for airlines
- A weighted average of these winglet penetration rates for Hawaii flights is ~41%; large airlines like Hawaiian Airlines can more aggressively pursue aircraft retrofits
- If remaining aircraft were retrofitted with winglets, fuel savings could be about 4 MGY
- Very cost effective at about −$0.04 per gallon fuel
Aviation fuel efficiency improvement tactics under consideration (not in any particular order)

1. Financial support for retrofits
2. **Financial support for fleet renewal**
3. Increase in the barrel tax
4. Fuel efficiency-based landing charges
5. Airport infrastructure support (e.g., ground power)
6. Consumer information (e.g., airline efficiency ranking)
Retiring aircraft early and replacing them with more efficient aircraft

- For example, replacing a 10- to 20-year old A320ceo with an A320neo
- Over a 15-year time period, fuel savings could be 0.08-0.2 MGY
- High cost: about $0.70-$1.00 per gallon jet fuel
- Maximum benefit from replacement of single aisle aircraft with turboprops for intra-Hawaii flights
  - ~20% lower fuel burn than comparable regional jet
  - Down-gauging could require additional operations, leading to potential cost increases
Aviation fuel efficiency improvement tactics under consideration (not in any particular order)

1. Financial support for retrofits
2. Financial support for fleet renewal
3. **Increase in the barrel tax**
4. Fuel efficiency-based landing charges
5. Airport infrastructure support (e.g., ground power)
6. Consumer information (e.g., airline efficiency ranking)
Fuel savings from a reduction in aviation demand due to barrel tax

- Although a barrel tax is a relatively infeasible option and unlikely to be implemented, it is worthwhile to address.
- Assuming aviation elasticity of demand ~2, fuel at 30% of operating costs, and a 10% fuel price increase due to $0.20/gallon tax:
  - Demand would be reduced by about 6% and fuel consumption by about 15 MGY.
  - Simultaneously, increase in barrel tax would reduce imports, thus reducing supply.
- *Not a recommended option given anticipated impacts on tourism.*
Aviation fuel efficiency improvement tactics under consideration (not in any particular order)

1. Financial support for retrofits
2. Financial support for fleet renewal
3. Increase in the barrel tax
4. **Fuel efficiency-based landing charges**
5. Airport infrastructure support (e.g., ground power)
6. Consumer information (e.g., airline efficiency ranking)
Fuel savings from a fuel efficiency-based landing charge

- Airport landing fees are an important operating cost for airlines
- Some airports worldwide apply differentiated landing fees to reward cleaner/quieter fleets
- Use ICAO’s 2013 CO\textsubscript{2} certification procedure to identify and decrease landing fees for fuel efficient aircraft, while increasing for less efficient models (revenue neutrality)

Challenges
- Certified data will not be generated for many years, and perhaps not for all aircraft types
- Relatively small incentive relative to underlying fuel cost

*Untested idea, unlikely to be implemented*
Aviation fuel efficiency improvement tactics under consideration (not in any particular order)

1. Financial support for retrofits
2. Financial support for fleet renewal
3. Increase in the barrel tax
4. Fuel efficiency-based landing charges
5. **Airport infrastructure support (e.g., ground power)**
6. Consumer information (e.g., airline efficiency ranking)
Ground power to replace APU usage for parked aircraft

- Aircraft APU usage can be replaced with electricity via ground power and pre-conditioned air units
- Reduces both fuel burn and pollution from aircraft at gate

Example projects

- FAA’s Voluntary Airport Low Emissions (VALE) program has funded
  - 12 electric gates and seven pre-conditioned air units at Dallas-Fort Worth ($2 million)
  - Seven gate power units and pre-conditioned air units at Yeager Airport ($3.7 million)
- HNL to replace existing 400Hz converters (or ground power units) with more energy-efficient ones
  - Cost is at least $150,000 per gate pre-conditioned air unit, with an estimated 2 to 4 years payback
  - 39,000 gallons of fuel, or about $116,000 in fuel cost, to be saved per gate per year

Assuming only 25% of operations at Hawaii airports currently use electricity at gate, potential fuel savings is about 3 MGY
Aviation fuel efficiency improvement tactics under consideration (not in any particular order)

1. Financial support for retrofits
2. Financial support for fleet renewal
3. Increase in the barrel tax
4. Fuel efficiency-based landing charges
5. Airport infrastructure support (e.g., ground power)

6. **Consumer information** (e.g., airline efficiency ranking)
Providing consumers information on airline fuel efficiency to make greener choices

- Travelers choose flights for a variety of factors, including cost, scheduling, routing, loyalty programs, amenities, etc.
- Interest growing in making travel decisions based upon environmental criteria, but little public information available
- Program could be developed to gather fuel efficiency data from airlines serving Hawaii airports and disseminate to flyers, ideally at the point of purchase
- Based upon HNL-NRT route, we estimate an average 7% variation in airline efficiency between airlines flying direct routes out of Hawaii
- Assuming that consumer information leading to better purchasing decisions could close at most 10% of the efficiency gap, up to 2 MGY jet fuel could be saved
- Likely to be implemented, cost varies based on format of outreach
Airline fuel efficiency ranking, 2013

- Alaska Airlines: 1.11
- Spirit Airlines: 1.11
- Frontier Airlines: 1.11
- Southwest Airlines: 1.07 (+4%)
- Hawaiian Airlines: 1.02 (+9%)
- United Airlines: 1.01 (+10%)
- JetBlue Airways: 0.99 (+13%)
- Delta Airlines: 0.98 (+14%)
- Virgin America: 0.97 (+15%)
- US Airways: 0.97 (+15%)
- Sun Country Airlines: 0.93 (+20%)
- Allegiant Air: 0.92 (+21%)
- American Airlines: 0.88 (+27%)

In-Use Fuel Efficiency Score (longer bars = more efficient); FES = 1.00 represents industry average.
<table>
<thead>
<tr>
<th>STRATEGY</th>
<th>MAJOR CRITERIA</th>
<th>CO-BENEFITS</th>
<th>LIKELIHOOD OF IMPLEMENTATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Petroleum reduction potential</td>
<td>Cost effectiveness</td>
<td>Capital/operating costs</td>
<td>Local jobs</td>
</tr>
<tr>
<td>Financial support for retrofits</td>
<td>Low (~4 MGY)</td>
<td>High (typically 1.5 to 3 year payback)</td>
<td>Medium</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Financial support for fleet renewal</td>
<td>Moderately low</td>
<td>Low (7+ years payback)</td>
<td>High</td>
</tr>
<tr>
<td>Increase in the barrel tax</td>
<td>Moderately low?</td>
<td>Medium?</td>
<td>N/A</td>
</tr>
<tr>
<td>Fuel efficiency-based landing charges</td>
<td>Low</td>
<td>High</td>
<td>N/A</td>
</tr>
<tr>
<td>Airport infrastructure support (e.g., ground power)</td>
<td>Low (~3 MGY)</td>
<td>Medium to High (~2 to 4 payback)</td>
<td>Medium</td>
</tr>
<tr>
<td>Consumer information (e.g., airline efficiency ranking)</td>
<td>Low (~ 2 MGY)</td>
<td>High</td>
<td>N/A</td>
</tr>
</tbody>
</table>
## Summary of estimated fuel savings from aviation efficiency tactics

<table>
<thead>
<tr>
<th>Airline</th>
<th>Fuel savings</th>
<th>Cost effectiveness in $/gallon (payback period in years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Financial support for retrofits</td>
<td>4 MGY</td>
<td>-0.04 (1.5 to 3)</td>
</tr>
<tr>
<td>Financial support for fleet renewal</td>
<td>0.08 to 0.2 MGY</td>
<td>0.70 to 1.00</td>
</tr>
<tr>
<td>Increase in the barrel tax</td>
<td>15 MGY</td>
<td></td>
</tr>
<tr>
<td>Fuel efficiency-based landing charges</td>
<td>Difficult to quantify</td>
<td>Difficult to quantify</td>
</tr>
<tr>
<td>Airport infrastructure support (e.g., ground power)</td>
<td>3 MGY</td>
<td>(2 to 4)</td>
</tr>
<tr>
<td>Consumer information (e.g., airline efficiency ranking)</td>
<td>2 MGY</td>
<td></td>
</tr>
</tbody>
</table>
For more information...


- Hawaii Clean Energy Initiative Website: http://www.hawaiicleanenergyinitiative.org/

- Two question HCEI survey: http://tinyurl.com/HCEI-trans

- ICCT website: http://www.theicct.org/

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