Hawaii Transportation Energy Analysis: Aviation Efficiency Options

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- 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

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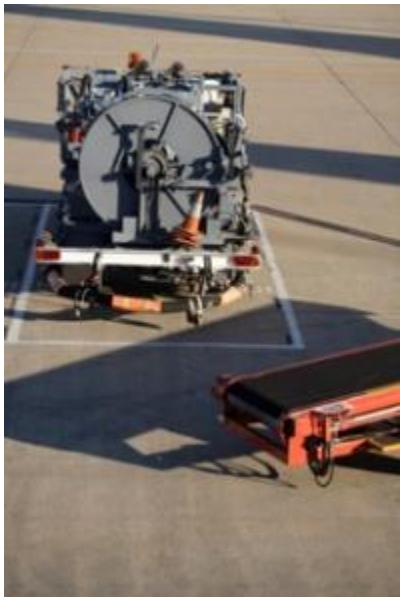
Core strategies under consideration for transportation energy roadmap

- 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 CO_2 (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

Airline	Share of RPMs	Winglet penetration rate (% of total fleet)
Hawaiian Airlines	24%	19%
United Air Lines	20%	51%
Delta Air Lines	13%	29%
Alaska Airlines	10%	75%
American Airlines	7%	63%

Source: U.S. DOT BTS (2014), Ascend Online Fleets (2014)

- 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

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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

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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***

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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_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

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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

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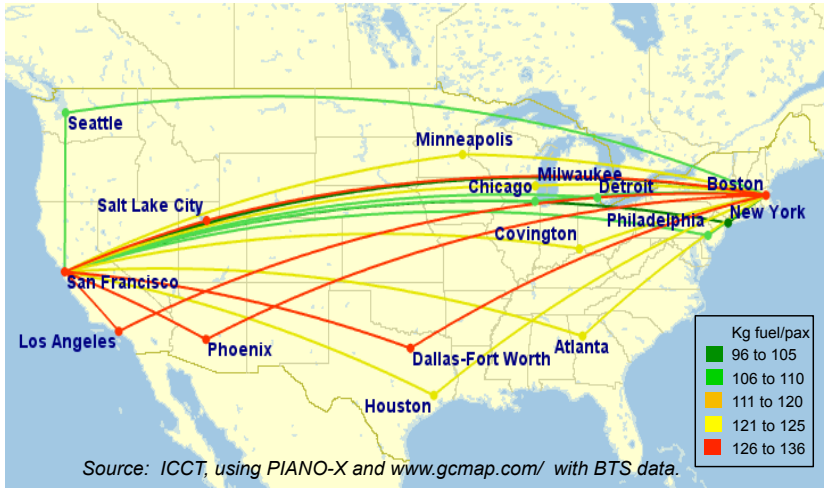
Providing consumers information on airline fuel efficiency to make greener choices

- 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

Example flight: SFO-BOS (one way)



- 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

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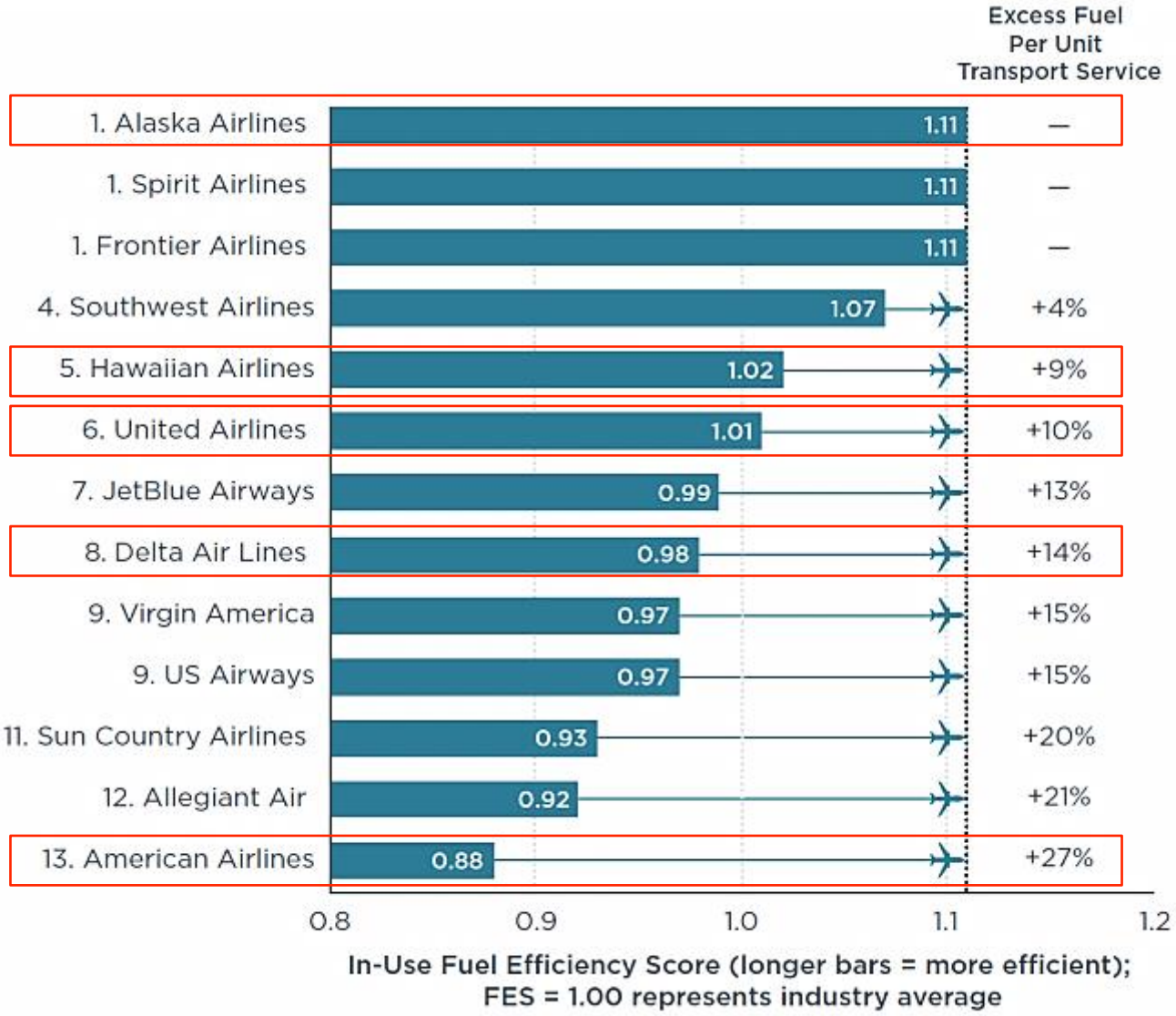
Airline fuel efficiency ranking, 2013



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Qualitative assessment of aviation efficiency alternatives

STRATEGY	MAJOR CRITERIA			CO-BENEFITS			LIKELIHOOD OF IMPLEMENTATION
	Petroleum reduction potential	Cost effectiveness	Capital/operating costs	Local jobs	Social acceptability	Lifecycle emissions	
Financial support for retrofits	Low (~4 MGY)	High (typically 1.5 to 3 year payback)	Medium	Minimal	High	Low	Medium
Financial support for fleet renewal	Moderately low	Low (7+ years payback)	High	N/A	High	Moderately low	Low
Increase in the barrel tax	Moderately low?	Medium?	N/A	Potentially negative impact on tourism	Low	Moderately low	Low
Fuel efficiency-based landing charges	Low	High	N/A	N/A (if revenue neutral)	Medium	Low	Low
Airport infrastructure support (e.g. ground power)	Low (~3 MGY)	Medium to High (~2 to 4 payback)	Medium	Minimal	High	Low	High
Consumer information (e.g., airline efficiency ranking)	Low (~ 2 MGY)	High	N/A	N/A	Medium	Low	High

Summary of estimated fuel savings from aviation efficiency tactics

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

For more information…

- Hawaii State Energy Office Facebook page: https://www.facebook.com/HawaiiStateEnergyOffice
- 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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