Sustainable Aviation Fuels Under a Low Carbon Fuel Standard

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Limitations of the Current Fuel Policy Approaches
Non-LCFS Policies

Volumetric Targets
• Volumetric targets require strong predictive judgment by regulators regarding availability of fuels.
• Hard to overcome “thresholding” behavior to support incremental reductions in CI

Carbon Pricing or Fuel Taxes
• Create competitive advantage for low carbon fuels, but no guarantee they’ll enter market.
• Transportation elasticity tends to be low and price response is greatest among low-income people

Offsets
• Additionality usually difficult to establish
• Doesn’t solve fundamental issue of too many emissions
• Political pushback
Limitations of Opt-In Approach

Fuels above standard generate **deficits**
Which means: **pay in to** LCFS market

Fuels below standard generate **credits**
Which means: **receive support from** LCFS market

Example uses carbon intensities based on composite of gasoline and diesel fuels
The Problems:

Market Balance
• Without corresponding deficit obligation, flow of revenue is one-way
• High volumes of SAF credits could result in net oversupply, diluting effect of market incentive and dropping credit price
• Renewable diesel and SAF made from similar feedstocks (oils) through similar process (hydrogenation). Some competition or trade-off is likely

Environmental and Economic Equity
• Revenue flows into LCFS from on-road fuels, primarily gasoline and flows to alternatives.
• Opt-in status for SAF means revenue is flowing from gasoline consumers to air travel consumers
• Gasoline consumption is spread across income distribution.
• Air travel is predominantly consumed by more affluent people
Scope of the problem

Assume 200 million gal. (750 million l) of SAF, at 40 g CO$_{2e}$/MJ carbon intensity under the 2030 LCFS target, 80.36 g CO$_{2e}$/MJ. Jet Fuel energy density: 126.37 MJ/gal (33.4 MJ/l)

\[
\text{Credits(tonne CO}_{2e}\text{)} = (CI_{\text{Target}} - CI_{\text{Fuel}}) \times (\text{Energy}) \times 10^{-6} \frac{\text{tonnes}}{g}
\]

Where CI: Carbon Intensity (g CO$_{2e}$/MJ) and Energy: Total Energy Consumed (MJ)

This amount of SAF would generate just over 1 million credits. Current credit price is around $200, if no change that implies a total value of $200 million per year.

Is this politically acceptable?
Models for Expanding LCFS Support of SAF
How Would An Aviation LCFS Work?

Two options:

1. Integrate under sector-wide transportation LCFS
   1. Single CI target and credit price would apply
   2. Unrestricted trading of credits across gasoline, diesel, jet fuel pool (probably)
   3. Larger market, more credit supply options

2. Aviation-specific LCFS
   1. Separate CI target and credit market
   2. Limited, if any, trading of credits across gasoline, diesel pools
   3. Solves market balance and equity problems
Envisioning a Global Aviation LCFS

Assume: 120 Billion gal/yr (450 billion l/yr) global jet fuel market. 89.37 g CO$_2$e/MJ baseline jet fuel life cycle carbon intensity, 126.37 MJ/gal energy intensity, $200 credit price

<table>
<thead>
<tr>
<th>Target Level</th>
<th>Conventional Jet LCFS Charge per gal (per l)</th>
<th>40 g CO$_2$e MJ Jet LCFS Subsidy per gal (per l)</th>
<th>70 g CO$_2$e MJ Jet LCFS Subsidy per gal (per l)</th>
<th>Billion Gal (liter) SAF @ 55 g CO$_2$e MJ</th>
<th>Implied E-Aviation Subsidy ($/kWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1%</td>
<td>$0.023 ($0.006)</td>
<td>$1.23 ($0.33)</td>
<td>$0.47 ($0.12)</td>
<td>3.2 (12.1)</td>
<td>$0.26</td>
</tr>
<tr>
<td>5%</td>
<td>$0.11 ($0.03)</td>
<td>$1.13 ($0.30)</td>
<td>$0.38 ($0.10)</td>
<td>18 (64)</td>
<td>$0.25</td>
</tr>
</tbody>
</table>

Assuming 50 g CO$_2$e/MJ unadjusted carbon intensity of grid electricity. And EER of 4.6 (equal to new electric heavy rail)
Options to mitigate ILUC

1. More research and better modeling of international oils market and land use change.
   a. Likely very long, expensive, uncertain and controversial.
   b. Still necessary.

2. Alternative methods of ILUC limitation
   a. Sustainability criteria: Develop set of conditions or certifications that a given feedstock is made in the least ILUC-risky way possible
   b. Consequential limits: Assuming wastes and residues are lower-impact, jurisdictions limit consumption of biofuels to the amount which their generation of waste and residue would support.
   c. Natural land preservation fund: In addition to policy mechanisms, have feedstocks from high-ILUC-risk feedstocks pay small (1-2 cents per gallon?) fee, which will be used to directly mitigate land use change risk.
Thank You!

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