

DOCKETED	
Docket Number:	24-ALT-01
Project Title:	2024–2025 Investment Plan Update for the Clean Transportation Program
TN #:	266075
Document Title:	Robert L Freerks Comments - E-SAF Realities for Europe and California
Description:	N/A
Filer:	System
Organization:	Robert L Freerks
Submitter Role:	Public
Submission Date:	9/19/2025 8:33:30 AM
Docketed Date:	9/19/2025

Comment Received From: Robert L Freerks

Submitted On: 9/19/2025

Docket Number: 24-ALT-01

E-SAF Realities for Europe and California

e-SAF Realities for Europe

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15 Sept 2025

E-SAF, Sustainable Aviation Fuel produced from power alone, is mandated to be 35% of all European jet fuel consumption by 2050. Jet fuel consumption in 2050 in the EU will grow to 10.2 million metric tons (MT)/yr. The e-SAF requirement at 35% of total jet fuel is 3.57 MT/yr. As electrolysis of water to produce hydrogen is only 57.81% thermally efficient on a Lower Heating Value basis and correcting for efficiency losses for reverse Water Gas Shift of CO₂ to CO, Fischer-Tropsch synthesis of hydrocarbons from CO + H₂, and upgrading to SAF, net efficiency of conversion of electric energy into fuel is only 30%.

Producing the mandated 3.57 MT of e-SAF will require continuous output of 16.6 TW of power. The EU expects that the deserts of North Africa will be used to produce this power using solar panels. However, solar energy is only available 25% of the day meaning that 66.5 TW of installed solar power combined with the same amount of electrolyzer capacity must be available to produce the mandated amount of e-SAF for just the EU.

Electrolyzer cost is estimated by the DOE Clean Hydrogen Program to be \$2,000/kW-h. Thus, the cost of electrolyzers alone will be \$132 trillion. Cost of solar is estimated at \$1.45 to \$1.56 per watt, or \$1.45 to \$1.56 Million/MW. The CapEx for solar power is therefore estimated at \$99 trillion. The plant to convert CO₂ into e-SAF is estimated to cost \$1 million/bbl/day capacity. With 7,14 million bbl/day capacity needed, this cost would be \$7.14 trillion.

The UK has a buyout price for e-SAF of £4.70 per liter SAF and £5/liter for e-SAF which equates to \$25.74/gal. This is \$239 billion/yr. As e-SAF will in all likelihood cost far more than the buyout price to produce, this represents the minimum additional cost airlines will face to meet the ReFuelEU Aviation mandates.

There are only two logical potential outcomes for this scenario. Either the mandates will be changed, or airlines and fuel producers will go bankrupt or not participate in that market segment. Either way, airlines cannot exist and meet the economic challenges presented by e-fuel mandates.