The Role of Hydrogen in Aviation Decarbonization

REASONS FOR HYDROGEN

Supply Chain Readiness
Used commercially since 1970s with a high TRLs across supply chain

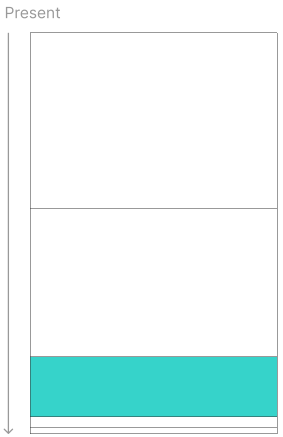
Economy-wide Decarbonization
Heavy-duty trucks, industry, and shipping all decarbonize from H2

Federal Funding Availability
The Inflation Reduction Act and Infrastructure Bill subsidize H2 costs

Aircraft Performance
Quick fueling and aircraft range projected to be up to 2,000 miles

In-Flight Emissions Reduction
Cuts greenhouse gas pollution to zero or near-zero tailpipe emissions

AVIATION DECARBONIZATION LEVERS



44% **Sustainable Aviation Fuel**

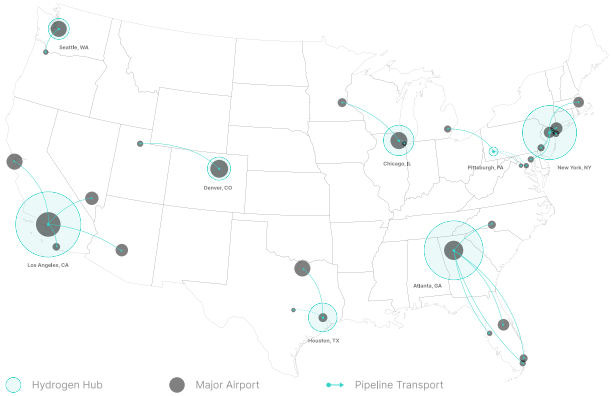
37% **Efficiency Improvement**

15% **Hydrogen Fuel**

3% **Carbon Credits**

1% **Other Fuels**

POTENTIAL HYDROGEN HUBS



Hydrogen Hub — 500 million kg
The size of the circle is based on the annual quantity of H2 produced.

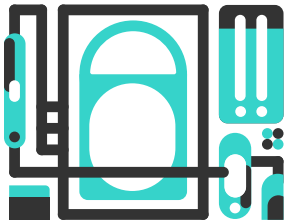
Major Airport — 500 million kg
The size of the circle is based on the demand of H2 for each airport.

Pipeline Transport
Truck Transport
We aim to connect hydrogen produced at DOE Hydrogen Hubs with the nation's thirty largest airports through new and retrofit pipelines, diesel and zero-emissions trucks.

HYDROGEN SUPPLY CHAIN

[1] MAKE

Produce green, pink, and blue H2 at all the Department of Energy H2 hubs



2023 - 2034
DOE H2 hubs are constructed and become operational at this stage

2035 - 2044
H2 hubs production at full capacity and carbon capture technology is fully commercialized to the market

2045 - 2050
H2 produced in sectors like aviation, industry, trucking, and shipping

[2] MOVE

Transport H2 in diesel and zero-emission trucks, and new and retrofit pipelines

2023 - 2034
Construction of new pipelines, pipeline retrofitting, and public education begins

2035 - 2044
Large increase in dedicated H2 pipelines

2045 - 2050
Transport pathways are well established and are optimized to minimize the costs

[3] STORE

Store H2 as a liquid near airports and liquify from a gaseous state if necessary

2023 - 2034
Improvements in liquid H2 storage and liquefaction, while airport H2 storage construction begins at major US airports

2035 - 2044
Airport H2 storage facilities beginning to dispense H2 to aircraft, ground support equipment, and airport backup power

2045 - 2050
Many airports have H2 storage for the use of aircraft fueling and backup power

[4] LAST MILE

Transport H2 from storage to airports for aircraft fueling via zero emissions trucks

2023 - 2034
Zero-emission trucks begin transporting H2 to major airports and fueling planes

2035 - 2044
Zero-emission trucks begin transporting H2 to major airports and fueling planes

2045 - 2050
The process of fueling planes with H2 becomes as quick and reliable as jet fuel

[A] AIRLINES

Deploy short and mid-range commercial H2 aircraft across the United States

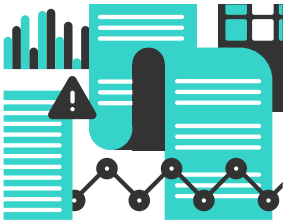
2023 - 2034
Pre-commercial testing continues, H2 aircraft are awarded FAA Airworthiness Certificates for commercial flights, and airports are selected for first H2 flights

2035 - 2044
Short/mid-range commercial H2 flights

2045 - 2050
Hydrogen is able to serve a substantial portion of short and mid-range flights

[B] POLICIES

Accelerate H2 aviation with subsidies, demonstrations, and regulations



2023 - 2034
Funding awarded for H2 aircraft demonstration projects along with potential H2 transport subsidies

2035 - 2044
Subsidies for the upfront cost of H2 aircraft, state and/or federal regulations established for and around aviation decarbonization

2045 - 2050
Achieve net zero aviation in the US

H2 MARKET SHARE OF US FLIGHT MILES IN %

MILLION TONS OF H2

OUR TEAM

Competition Title NASA's Gateways to Blue Skies: Clean Aviation Energy Competition
Student Team Jon Gordon, Jaih Hunter-Hill, Anna Cobb, Xiaohan Wu, Dorothy Li
Faculty Advisors Dr. Peter Zhang, Dr. Jared Cohon