Aviation Climate Taskforce

Request for Proposals for Aviation Fuel R&D

Informational Webinar

February 12, 2024

Housekeeping items

Team Webinar is being recorded and may be posted on consortium webpage

A copy of today's presentation will be posted on the webpage for the Aviation Climate Taskforce soon - www.aviationclimatetaskforce.org.

A separate consortium website will serve as the central hub for grant applications.

All participants on listen only mode; we are taking questions in the chat area today. Further, you may submit questions to dmatuszak@aviationclimatetaskforce.org.

*The R&D consortium, preliminary named **Systemic Approaches for Aviation Research Initiative ("SAFARI")**, will be available next month at www.jetsafari.org for those who express interest to submit.*

Disclaimer

Attending this webinar and watching the recording is completely voluntary and will not impact future application selections. There is no particular advantage or disadvantage to the application evaluation process with respect to participating on today's webinar.

This document is not a rule or regulation, and the recommendations it contains may not apply to a particular situation based upon the individual facts and circumstances. If there are any inconsistencies between a specific RFP and the statements in this document or webinar, the RFP is the controlling document.

About the Aviation Climate Taskforce

RFP Motivation and Scope

Submission Guidelines & Other Details

Closing Remarks

Our purpose is to accelerate breakthroughs in critical emerging technologies

Founded by BCG and 10 of the leading airlines as a charitable non-profit organization to launch public-private partnerships

ACT will accelerate research by bringing together stakeholders from the aviation ecosystem to support the rapid scale-up and adoption of critical emerging technologies

act aviation climate taskforce

AIR CANADA

AIR FRANCE KLM

BCG

DELTA

CATHAY PACIFIC

jetBlue

Lufthansa

Southwest

virgin atlantic

3 Strategic Pillars: ACT aims to create an ecosystem of support for emerging technology with the *Collaboration Forum*

We are on track with our progress toward creating that ecosystem

2024

Expedite core R&D discoveries/ technology development

Airlines | Energy | OEMs | Scientists | Start-ups

2024

Supports the consortium by expediting adoption

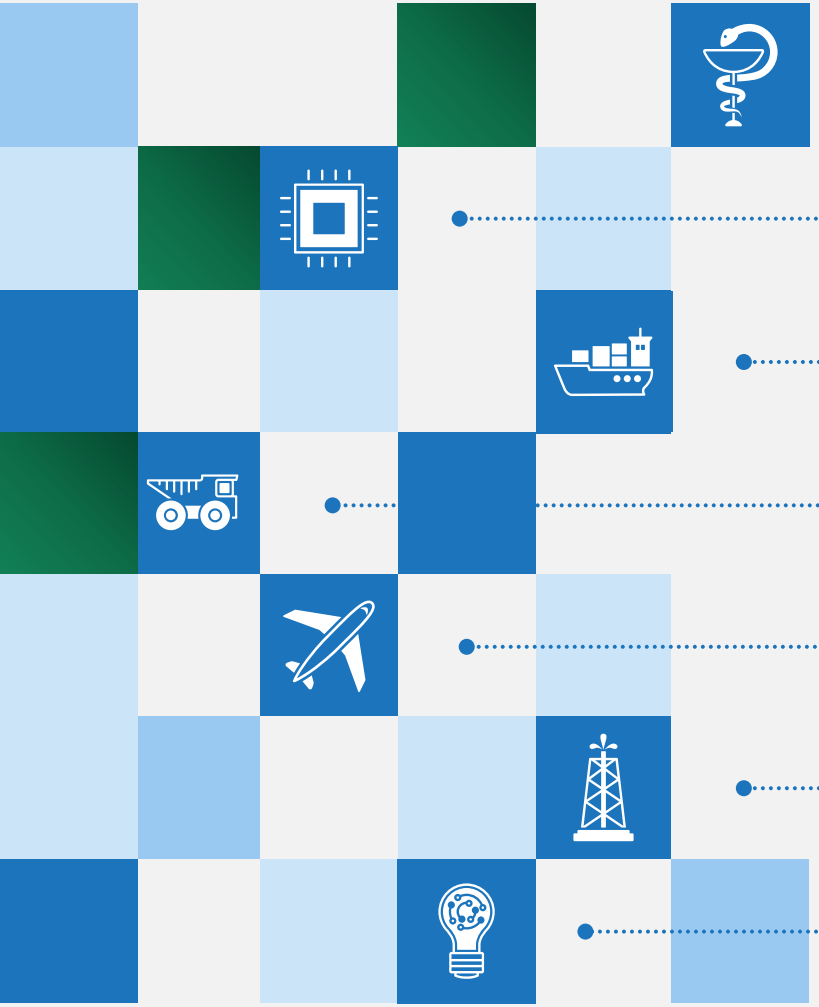
Airlines | Energy | OEMs

Separate entity
(2025; 2-3 years out)

Prove and scale pre-commercial solutions through investment

Airlines | Energy | OEMs | Growth capital

Other industries have successfully used Innovation Networks



Healthcare

Semiconductors

Shipping

Mining

Aerospace

Oil & Gas

Multi-sectoral

Myelin Repair Foundation

SRC Semiconductor Research Corporation

Center for Zero Carbon Shipping

ICMM International Council on Mining & Metals

Innovation for Cleaner, Safer Vehicles

CARIC CONSORTIUM FOR AEROSPACE RESEARCH AND INNOVATION IN CANADA

cosia CANADA'S OIL SANDS INNOVATION ALLIANCE

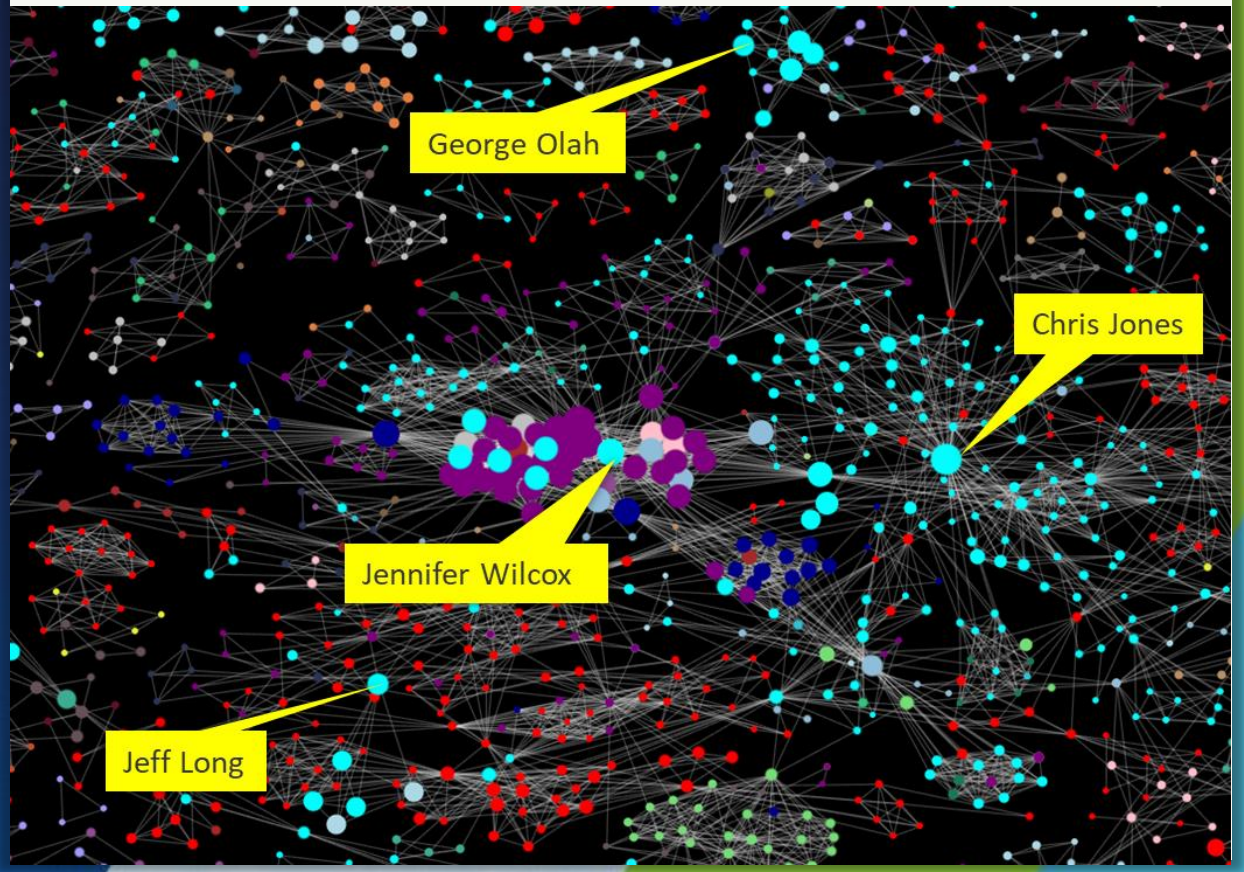
hello tomorrow

Aviation Climate Taskforce (ACT) supports precommercial R&D addressing fuel feedstocks, conversion, infrastructure

ACT

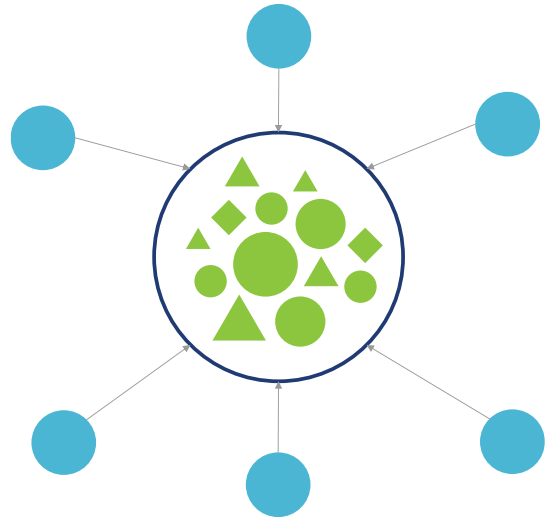
- Provides research grants up to $400k per year.
- targets R&D at TRL 2-4, to address forthcoming challenges in decarbonizing aviation.
- aims to increase scientific & institution diversity.

Network effects. *How communities are designed has a major impact on scientific and technological progress.*



A consortium approach aligns with a commitment to scientific/institutional diversity and accelerated learning…

Normal paradigm. *An administrator manages an R&D portfolio. Members govern.*



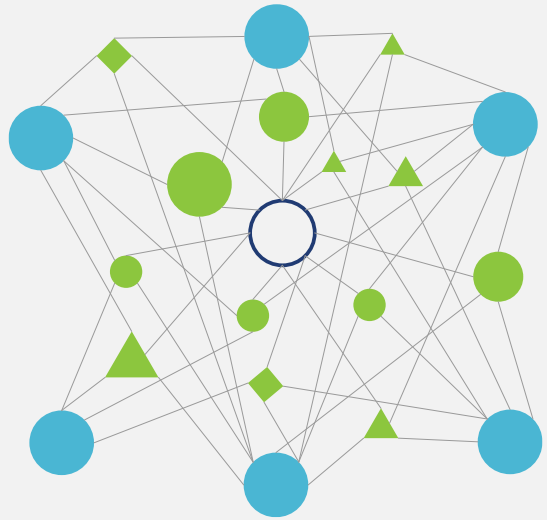
Administrator

Members

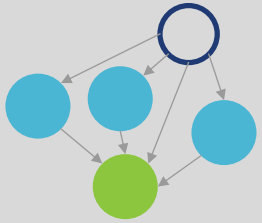
R&D projects

Support

Consortium paradigm. *An administrator facilitates. Members participate.*



Support



Teaming Principles

Skill-sharing is essential for maximizing innovative potential.

Each project lead has at least one R&D partner with complementary technical capabilities or expertise.

About the Aviation Climate Taskforce

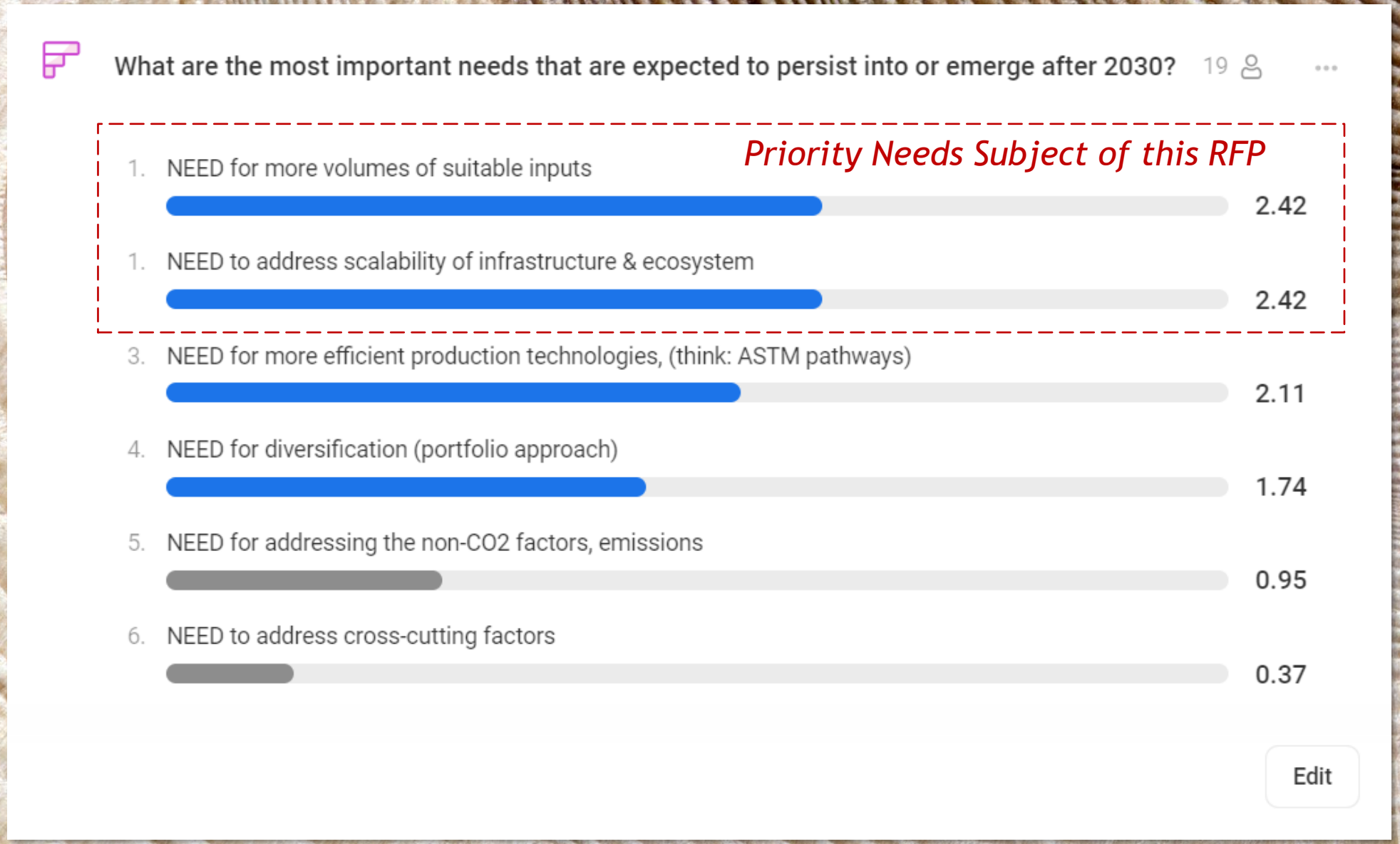
RFP Motivation and Scope

Submission Guidelines & Other Details

Closing Remarks

Community prioritization of future needs.

This high-level list narrows the scope of suitable R&D at TRL 2-4.



Priority Needs

I. Greater volumes of suitable inputs.

This pertains to the availability of a range of carbon, hydrogen, and energy sources. Suitability relates to GHG accounting by lifecycle assessment as main motivation.

II. Enhanced scalability of infrastructure and ecosystem.

This pertains to the addition of new production capacity, including retrofitting and anchoring at existing facilities as well as the construction of greenfield facilities. This also includes the logistical aspects of transportation and the aggregation of feedstocks and intermediates.

Topics of Interest

1. Pathways for Hybridization of Feedstocks and Intermediates at Existing Facilities
2. Approaches for Amplification of Products and Valuable Byproducts

Pathways for Hybridization of Feedstocks and Intermediates at Existing Facilities

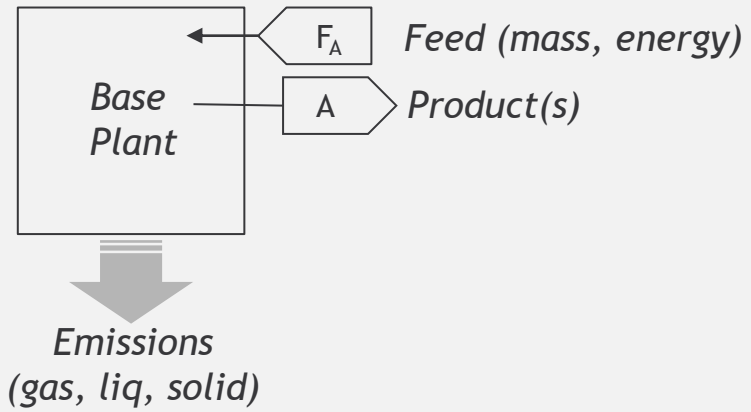
Topic 1

Challenge: it can be difficult to construct new facilities due to permitting, infrastructure logistics, *etc*.

Approach: Increase the diversity of feedstocks and intermediates directed at existing facilities (i.e., hybridization).

Examples of Hybridization Approaches

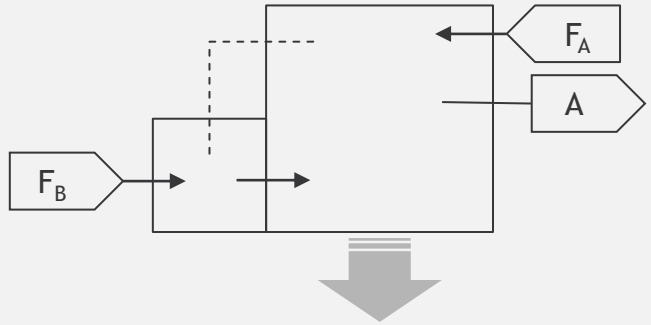
Base Case: an existing facility that will be subject to modification by retrofitting or anchoring.



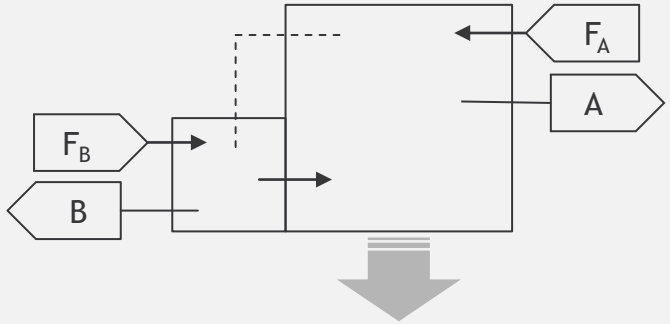
Base plant examples may include but are not limited to

- *Biorefineries*
- *Petrochemical plants*
- *Chemical plants*
- *Facilities at the nexus of transport, water, and energy infrastructure*

Case A1. The concept includes a new feedstock (F_B) and may transfer intermediates (dashed).



Case A2. Same as Case A1 and includes a new fuel product (stream B).



----- *potential mass or heat exchange(s)*

Potential Hybridization Approaches

More specific examples of potential hybridization approaches include but are not limited to the following:

a) For alcohol-to-jet (ATJ) pathways, hybridization of feedstocks and intermediates may include insertion of a wider range of alcohols or olefins that are externally sourced.

b) For pathways that rely on hydroprocessing for decarboxylation or decarbonylation, hybridization may include the use of renewable carboxylic acids, aldehydes, or ketones with suitable carbon numbers.

Additional hybridization examples may be envisioned by considering the aviation fuel pathways that completed or are undergoing ASTM qualification. [For a perspective, see Kramer et al., Front. Energy Res. 9:782823. doi: 10.3389/fenrg.2021.782823]

Topic 2

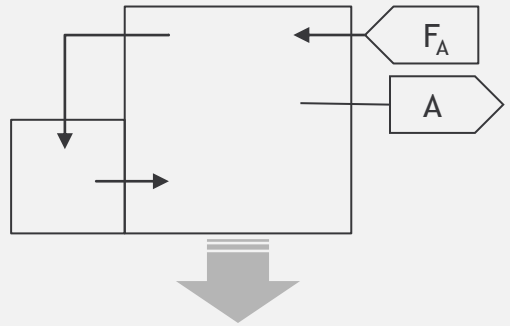
Approaches for Amplification of Products and Valuable Byproducts

Challenge: Fuel pathways experience losses through generation of byproduct gases or solids.

Approaches: separate/convert low-value byproducts, recycle unreacted compounds, change reaction conversion and selectivity, generate valuable byproducts.

Examples of Amplification Approches

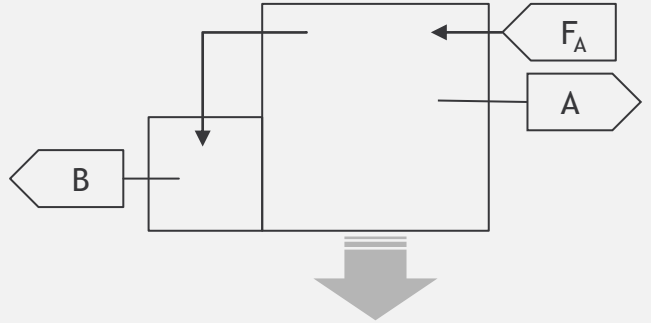
Case B1. A recycling approach creates the benefit of an intermediate that yields more product A



Considerations

- *Product A includes jet fuel components.*
- *The Base Plant may already include recycling.*
- *The additional operation uses a new approach.*

Case B2. A recycling and conversion approach yields a new product B.



Reference Case: A competitive approach that modifies the base case, thereby attaining the same technology benefit, albeit with different costs.

Example: Case B1 can serve as a reference case for Case B2 if products A and B are aviation fuel components.

Potential Amplification Approaches

More specific examples of potential amplification approaches include but are not limited to the following:

a) Fischer Tropsch (FT) facilities that capture and convert byproduct alkanes or CO_2 to expand their own output

b) Fermentation pathways that convert residues to fuel or to high-quality resins

c) Olefin-to-jet (OTJ) pathways with improved selectivity and conversion

---

Additional hybridization examples may be envisioned by considering the aviation fuel pathways that completed or are undergoing ASTM qualification

Concept = Enabling Technology + Context of Topic 1 or 2

Concepts sought under this RFP are enabling technologies such as systems (processes, unit operations, components), materials, and methods that align with either Topic 1 or 2.

Potential Enabling Technologies

(May serve both Topics 1 & 2)

Enabling technologies include <u>but are not limited to</u> the following:

1) the synthesis of suitable alcohols, olefins, carboxylic acids, aldehydes, ketones, isoparaffins, cycloparaffins, or aromatics from waste carbon oxides, atmospheric CO_2, biogas, hydrocarbon byproducts or fugitive emissions

2) alkane dehydrogenation approaches, such as dehydrogenation using CO_2 as soft oxidant

3) tandem or hybrid catalysts with enhanced selectivity and conversion

4) redox-active materials for deoxygenation of biomass, CO_2, or H_2O

5) alcohol transformation strategies such as the conversion of lower alcohols to higher alcohols

6) advanced chemical separation approaches for feedstocks, intermediates, and products

7) modular systems that can be mass produced, that have high durability and recyclable components, and that operate on clean power

Technologies not of interest

Technologies not of interest include but not limited to the following:

- those that operate commercially at present
- combinations of existing commercial technologies

Novel technology pairings tend to reduce the TRL of the combination and may merit further review or support depending on the presence of a synergy or potential for impact.

Desired Technology Benefits

(Topics 1 & 2)

Concepts should aim to deliver two or more of the following benefits:

A. **Improved Production Rate.** A minimum increase of 10% in the production rate of aviation fuels or fuel blendstocks, for a conceptual industry-scale operation relative to a suitable base case. Further, for Topic 1 only: a maximum increase greater than 100% in the production rate relative to the base case.

B. **Reduced Carbon Intensity.** A minimum of 50% GHG reduction compared to a jet fuel baseline of 89 gCO_2e/MJ, as determined by LCA methodologies, for incremental amounts of produced fuel. A reduction of 80% is preferred, with 100% as a realizable stretch goal.

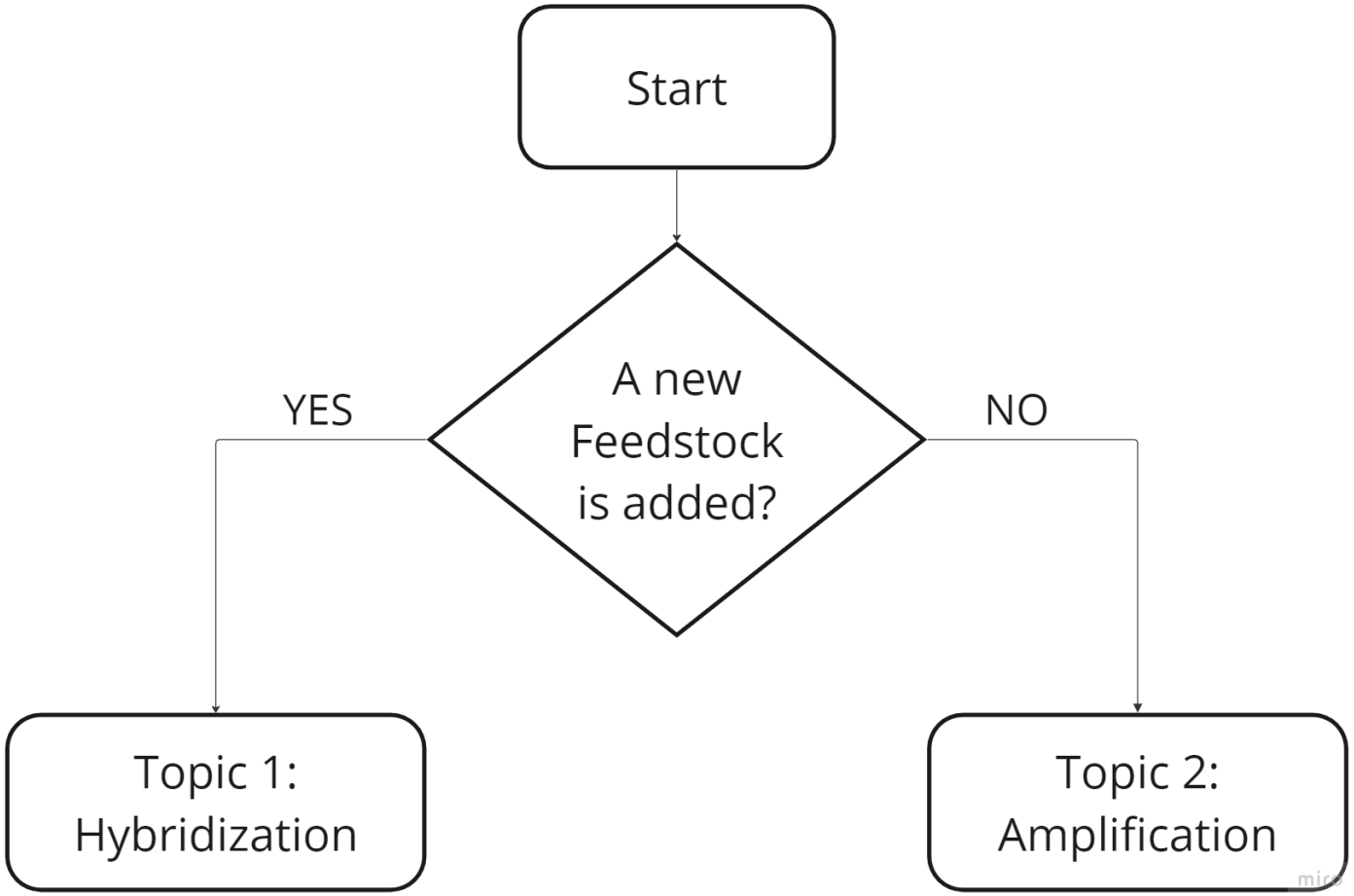
C. **Co-Benefits.** Enhanced management of non-CO_2 radiative forcing effects and biogeophysical effects, using fuel composition, feedstock choice, supply chain logic, or other reasoning to advance a semi-quantitative appreciation of impact.

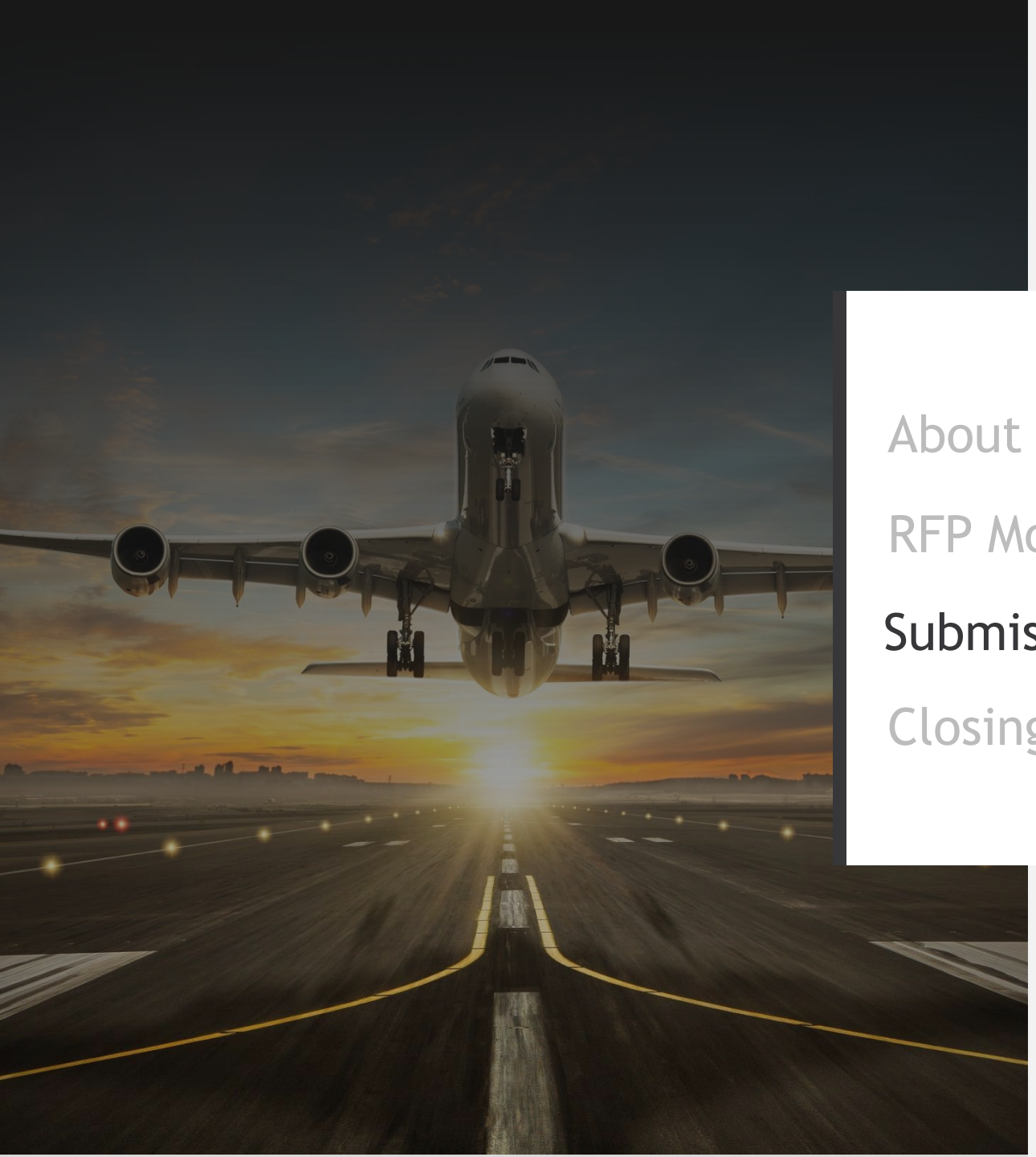
The concept should envision a facility with a minimum aviation fuel output of 25 million gallons per year.

TRL	Definition	Description
1	Basic principles observed and reported	Lowest technology readiness. Scientific research begins to translate into applied R&D. Activities include paper studies of a technology's basic properties.
2	Technology concept or application formulated	Invention begins. Practical applications are invented, after basic principles are observed. Applications are speculative and there may be no proof or detailed analysis to support assumptions. Activities are mainly analytical.
3	Analytical and experimental critical function or proof of concept	Active R&D is initiated. Analytical and laboratory-scale studies are conducted to validate predictions of separate portions of the technology.
4	Component or system validation in a laboratory environment	Bench-scale prototypes are developed and validated in the laboratory. Prototype is defined as less than 5% of final scale.
5	Lab-scale validation in a relevant environment	Technological components are integrated so the system matches the final application in most respects. Prototype is less than 5% of final scale.

Adapted from DOE/NETL, "2014 Technology Readiness Assessment—Overview" (Jan 2015); URL: https://www.netl.doe.gov/sites/default/files/2019-04/DOE-NETL-20151711-2014-Technology-Readiness-Assessment-Overview.pdf

“Which topic best suits my technical approach?”





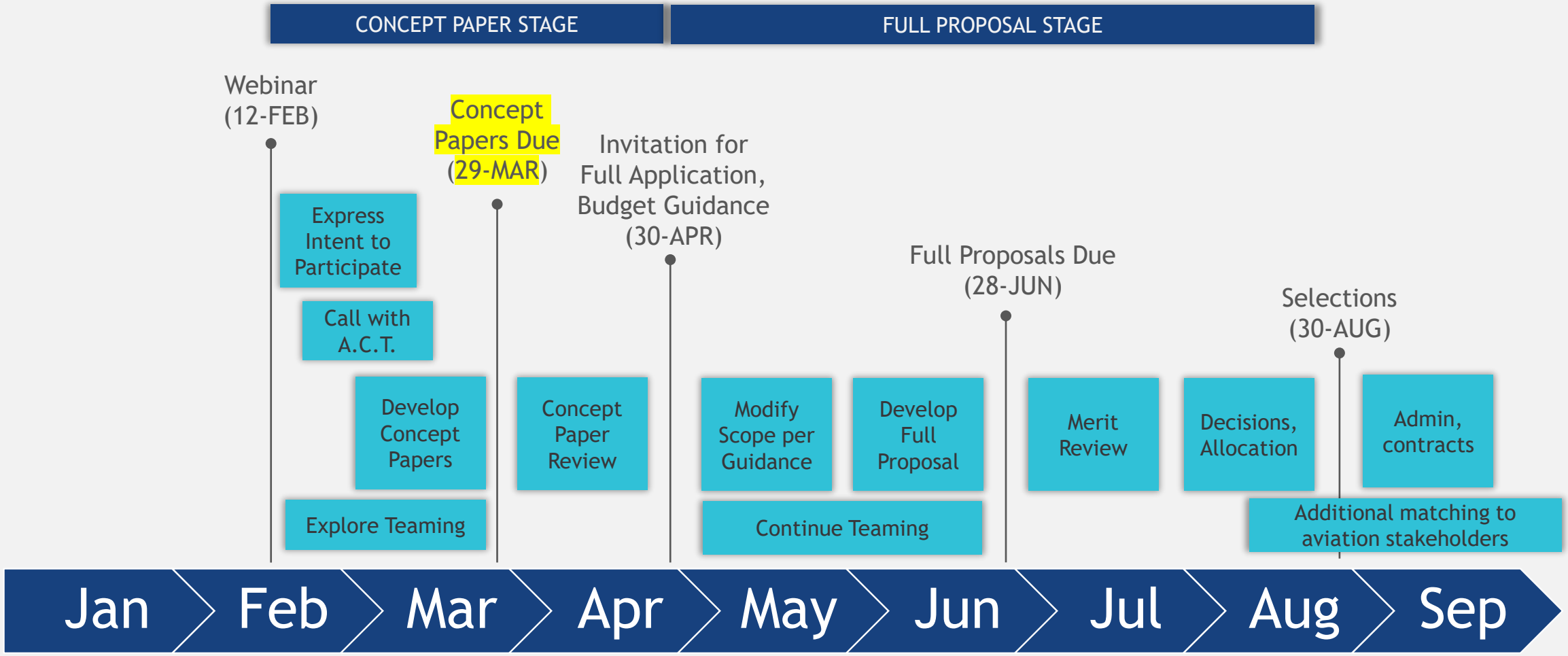
About the Aviation Climate Taskforce

RFP Motivation and Scope

Submission Guidelines & Other Details

Closing Remarks

Stages & Timing



Concept Paper

Section	Limit	Comments
Cover Page	1 page	Project title, Topic Area addressed (1 or 2), Desired benefits targeted (A, B, or C), starting TRL Prime applicant, Principal Investigator, Other Points of Contact Identified project team partners and/or desired project team partners and expertise (if known)
Technology description	4 pages	The enabling technology, its basic operating principles, how it is unique/innovative, target level of performance (if available), a reference case description for comparison, base case description. The current state of the art in the field; key shortcomings, limitations, and challenges; a description of how the technology will overcome the shortcomings, limitations, and challenges in the relevant field and application. A description of other solutions to solve the problem. Potential impact on the field and application.
Addendum	5 pages	Literature cited, qualifications, experience, capabilities of the project team.

Concept Paper Submission Guidelines

A web portal will be used to submit concept papers and summary slides. Notifications will be sent.

Constraints:

- Single spaced
- 1-inch margins
- 11-point Arial font
- PDF files

Summary Slide Content

(1 slide, template)

- Prime applicant, Lead Investigator, Team Member Names and Organizations
- Desired project team partners and expertise (if known)
- Summary of proposed technology
- Key graphics (illustrations, charts and/or tables, if available)
- A description of the solution’s impact
- Project goals
- Ability for cost sharing

Budget

Project Cost: $100K-400K per year

- 3 years max, with stage gate at Y1

- upper limit depends on additional fundraising (A.C.T.) and cost sharing

- invitation for full application will include budget guidance

Anticipated projects: 8-12

Cost Sharing

Our convention: A.C.T. has fully funded its projects and can be a cost-share contributor to larger efforts.

Recommendation:

- Do indicate to what extent you can bring cost share for projects proposed under this RFP (*in concept paper and summary slide*).
- Additional cost share will be viewed favorably when deciding on final funding allocations.

Teaming List

A teaming list will be generated to facilitate exploration of capabilities and skillsets.

We encourage teams to opt-in.

Instructions will be relayed.

IP rights, disclosures

Our convention: teams retain ownership of their patents or other IP.

Expectation:

- disclosures of patent filings
- disclosure of exciting results (without revealing proprietary information)
- disclosure of unforeseen barriers, such as thermodynamic limits, that the community should be made aware of

Next Actions

By email or otherwise,

1) Communicate Intent to Submit.
2) Opt-in to the Teaming List.
3) Schedule an initial conversation about your concept(s).

SCHEDULE

EVENT	DATE
Concept Paper Stage	**February - April**
Informational Webinar	February 12, 2024
Teaming, independent & facilitated	Ongoing after February 12
Concept Papers Due	March 29 at 5pm ET
Concept Paper Review	March 29 – April 24
Invitation for Full Proposal	April 30
Budget Guidance	April 30
Submission Guidance	April 30
Full Proposal Stage	**May - August**
Award Decisions	Early September

More Information

For updates
https://aviationclimatetaskforce.org/consortium/

For a discussion on concepts, email:
dmatuszak@aviationclimatetaskforce.org

RFP documentation is forthcoming to those that communicate Intent to Submit.

About the Aviation Climate Taskforce

RFP Motivation and Scope

Submission Guidelines & Other Details

Closing Remarks

act
aviation climate taskforce

WELCOME OUR APPROACH PEOPLE CONSORTIUM LAUNCH - FEB 12 RESOURCES JOIN US

Systemic Approaches for Aviation Research Initiative ("SAFARI")

Shaping the Future of Sustainable Flight

Acknowledgements for Member Support

ACT unites a global group of industry leaders committed to decarbonizing the aviation sector.

Acknowledgements for Consortium Design

Acknowledgements for Strategic Input

Members

Southwest

CATHAY PACIFIC

jetBlue

BCG

DELTA

USG Agencies & National Labs

U.S. DEPARTMENT OF ENERGY | Office of ENERGY EFFICIENCY & RENEWABLE ENERGY
BIOENERGY TECHNOLOGIES OFFICE

NREL
NATIONAL RENEWABLE ENERGY LABORATORY

arpa·e

Pacific Northwest
NATIONAL LABORATORY

Not-for-profits

Breakthrough Energy Fellows

CAAFI
COMMERCIAL AVIATION ALTERNATIVE FUELS INITIATIVE

Bauhaus Luftfahrt

For Profits

JM Johnson Matthey
Inspiring science, enhancing life

T.EN
TECHNIP ENERGIES

8 RIVERS

Susteon

TOPSOE

Academia

ALABAMA CRIMSON TIDE

WASHINGTON STATE UNIVERSITY

HERIOT WATT UNIVERSITY

MIT


act
aviation
climate
taskforce