

ASSESSING STAKEHOLDER OPINIONS IN THE SHIFT TO ELECTRIC-POWERED AIRCRAFT

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wats2024
ORLANDO

**I DRIVE AN
ELECTRIC CAR**



**I'M BETTER
THAN YOU**

SPEAKER BIO(S)

Nicholas Wilson, PhD

- **Associate Professor, Aviation**



Andrew Leonard, PhD

- **Assistant Professor, Aviation**



A stylized map of the United States with various state icons and a red dashed line connecting Carson City, NV to Duluth, MN. A red arrow points to North Dakota. The map includes icons for major cities, state symbols, and landmarks. A legend in the bottom left corner shows icons for flight, location, and distance.



UNIVERSITY OF NORTH DAKOTA



UNIVERSITY OF NORTH DAKOTA

UND AEROSPACE FLEET HISTORY

UND AEROSPACE
UNIVERSITY OF NORTH DAKOTA

1968-2018

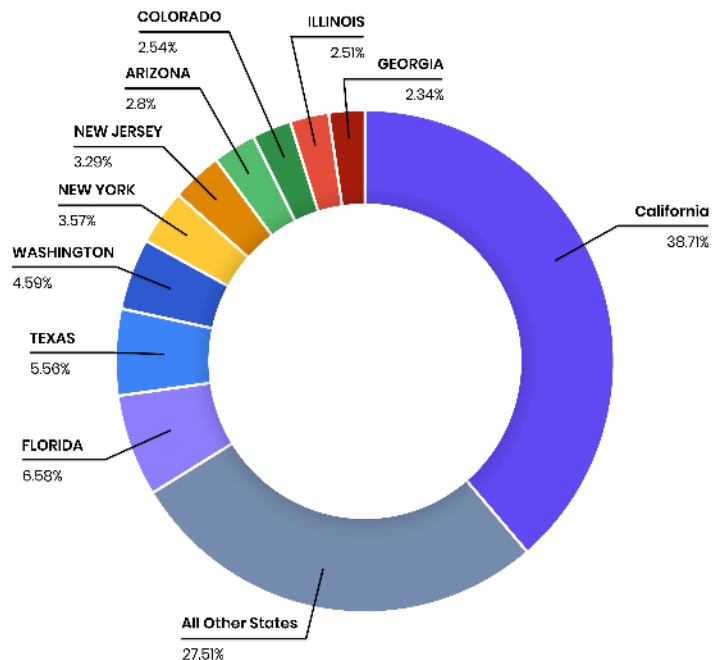


SHIFTING TO ELECTRIC...



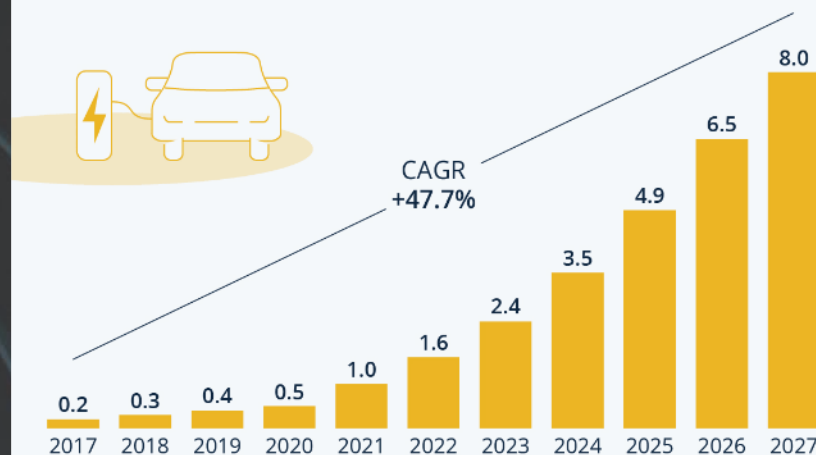
State EV Registrations

data from afdc.energy.gov, updated June 2022



Electric Vehicle Infrastructure Enters Catch-Up Mode

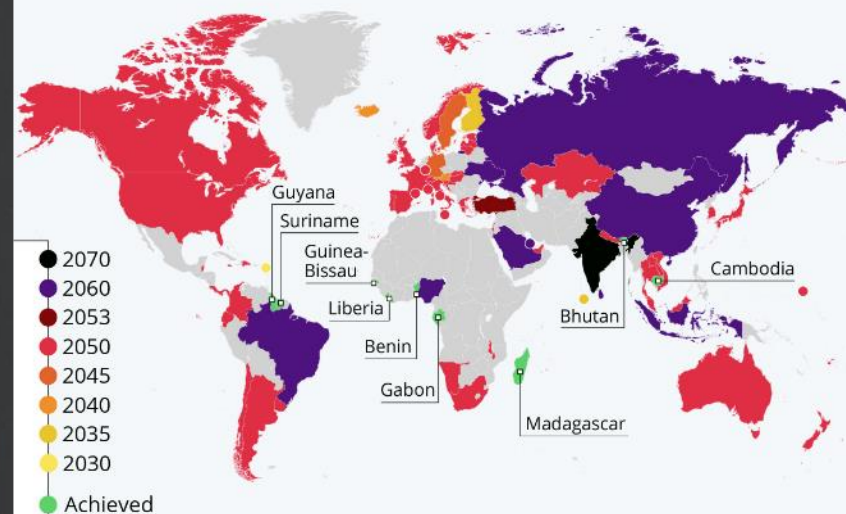
Forecast global electric vehicle infrastructure revenues (in billion U.S. dollars)



Source: Statista Mobility Market Outlook

The Road to Net Zero

Countries with laws, policy documents or concrete timed pledges for carbon neutrality by target year



Source: Energy & Climate Intelligence Unit

Autos & Transportation | Climate Change | Sustainable Markets | Regulatory & Policy

EU countries approve 2035 phaseout of CO2-emitting cars

Source: Reuters, 2023

Biden Administration Announces Rule Aimed at Expanding Electric Vehicles

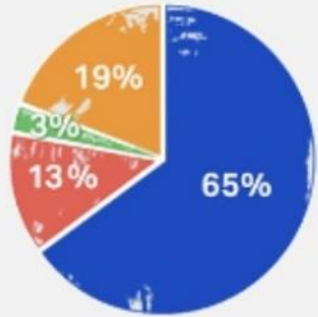
The regulation would essentially require automakers to sell more electric vehicles and hybrids by gradually tightening limits on tailpipe pollution.

Source: New York Times, 2024

EFFORTS IN AVIATION

Our strategy towards net zero

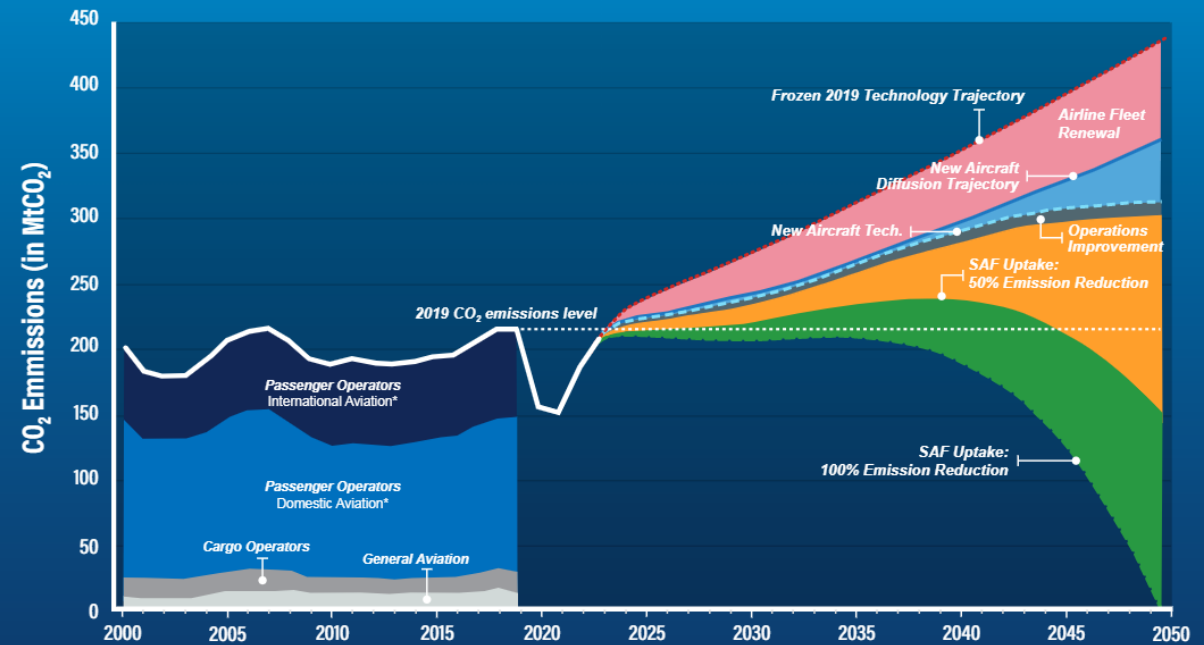
Achieving net zero by 2050 will require a combination of maximum elimination of emissions at the source, offsetting and carbon capture technologies.



- 65% Sustainable Aviation Fuel (SAF)
- 13% New technology, electric and hydrogen
- 3% Infrastructure and operational efficiencies
- 19% Offsets and carbon capture

Source: World Economic Forum, 2022

Analysis of Future Domestic and International Aviation CO₂ Emissions



* Note: Domestic aviation from U.S. and Foreign Carriers. International aviation from U.S. Carriers.

- Legend:
- Historical Data (FAA AEDT / Aerospace Forecast)
 - Frozen 2019 Technology Trajectory
 - New Aircraft Diffusion Trajectory
 - New Aircraft Technologies
 - Operations Improvement
 - SAF Uptake: 50% Emission Reduction
 - SAF Uptake: 100% Emission Reduction

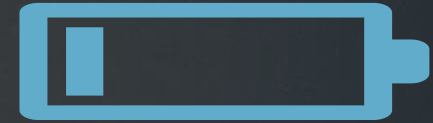
Source: Federal Aviation Administration, 2024

BARRIERS TO ADOPTION



WEIGHT

BATTERY TECHNOLOGY

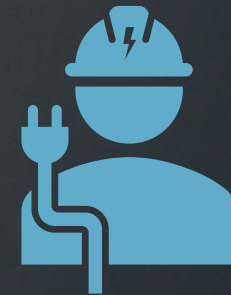


CERTIFICATION



INFRASTRUCTURE

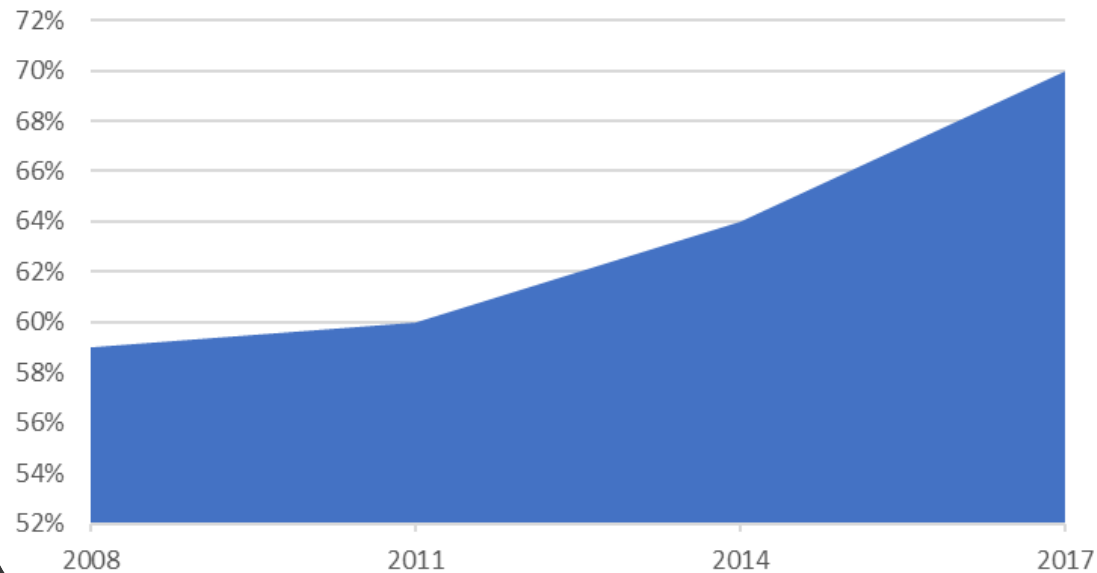
ATTITUDES?



ELECTRIC AIRCRAFT - WHY DO YOU CARE?

Environmental Impact

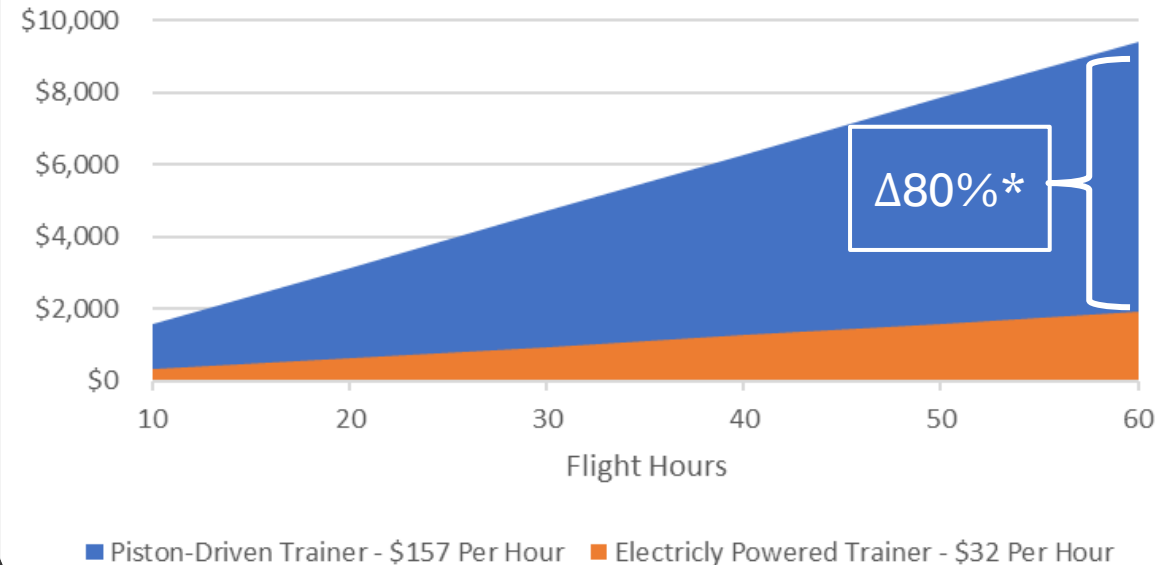
Piston-Engine Lead Emissions as a Percent



Source: Environmental Protection Agency, 2023

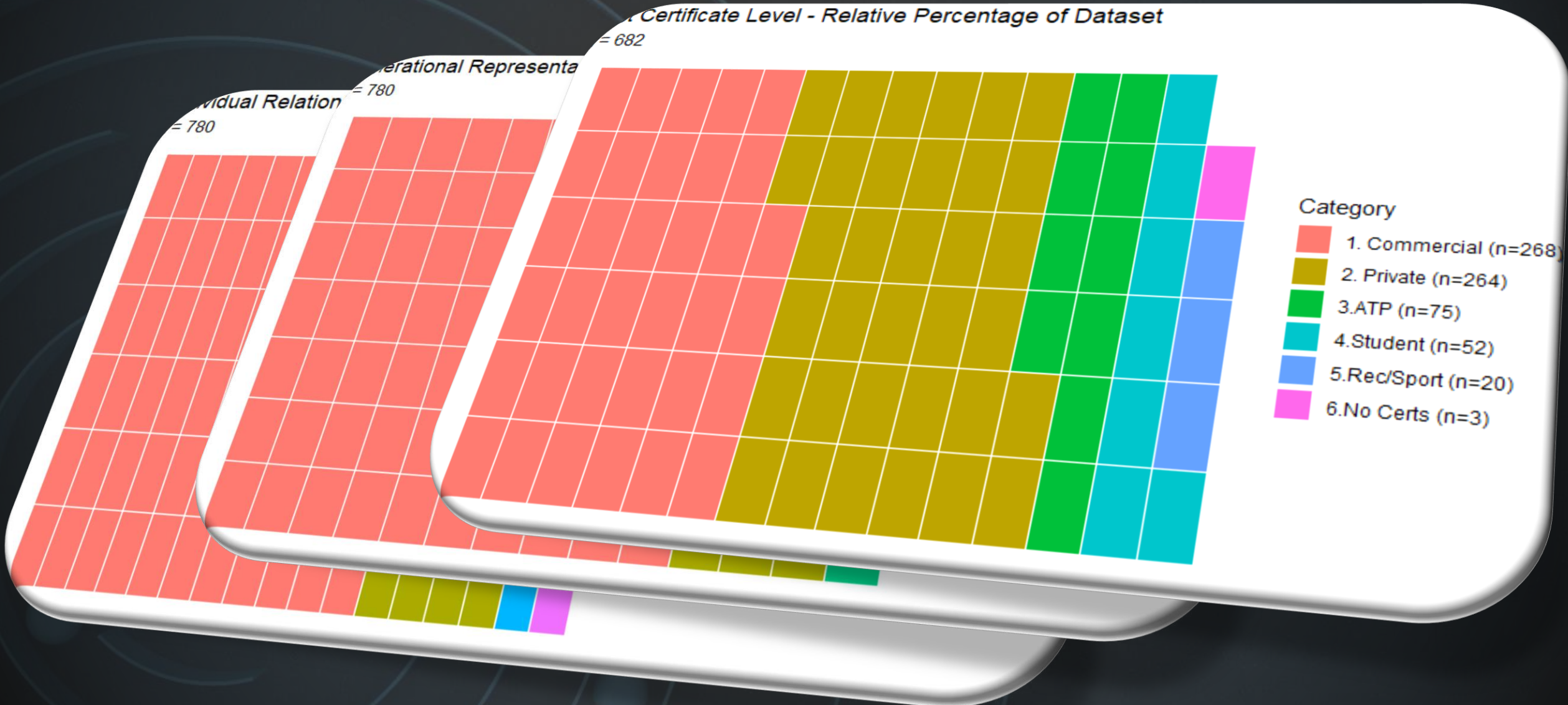
Cost of Flight Training

Comparison of Hourly Operating Cost

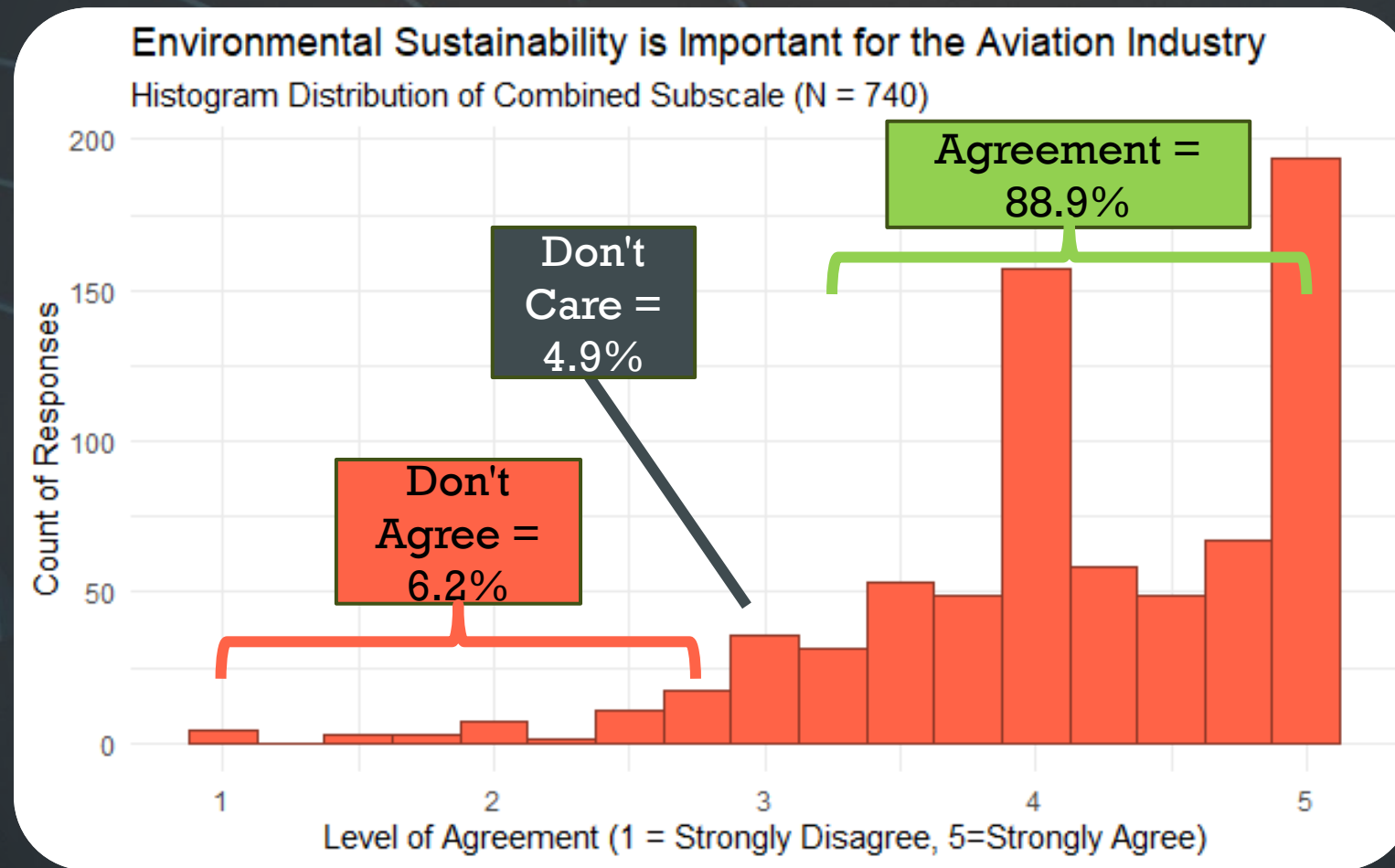


Source: University of North Dakota & BYE Aerospace, 2024
*Expected hourly costs of electric aircraft are engineering design forecasts, which may change.

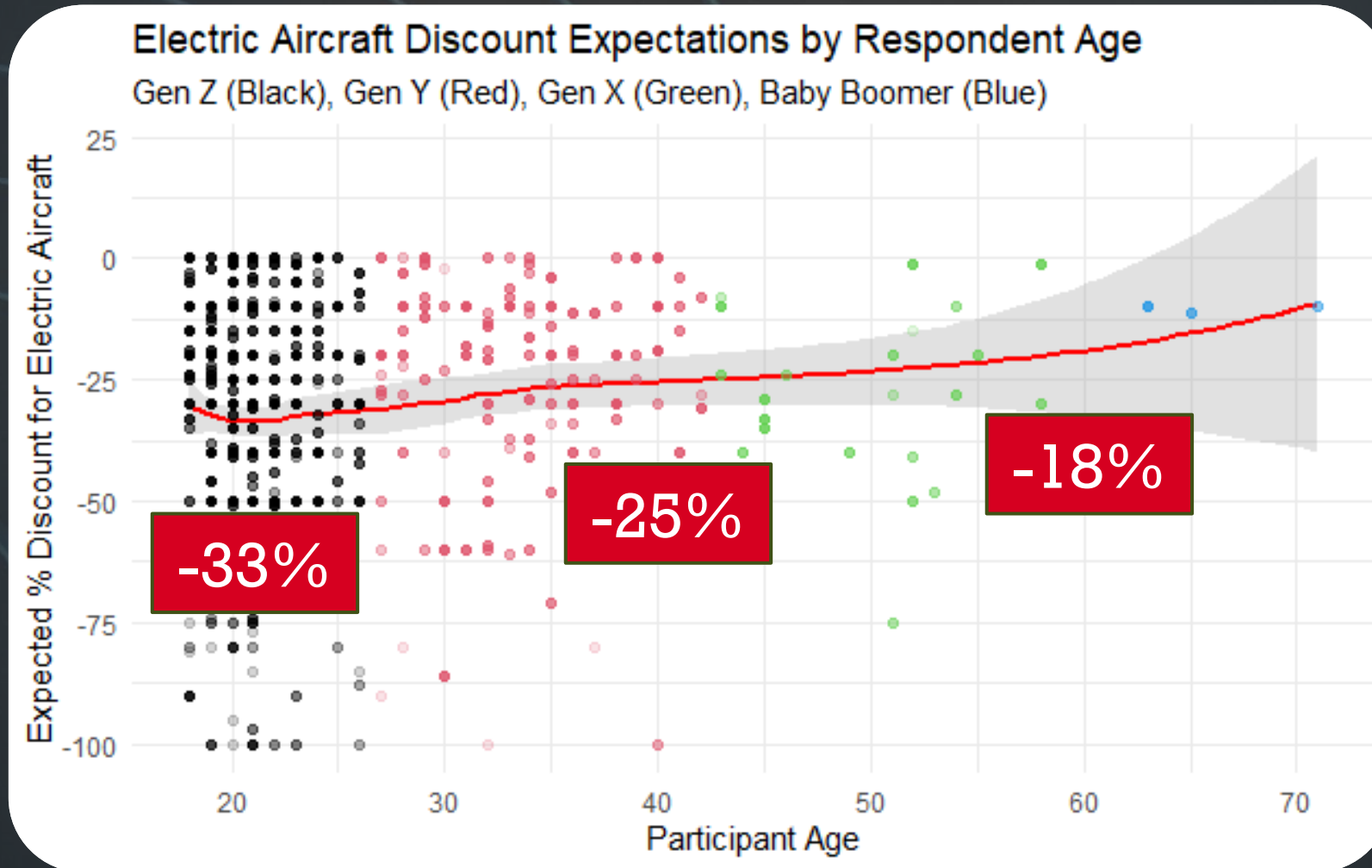
SUSTAINABILITY SURVEY: WHO RESPONDED?



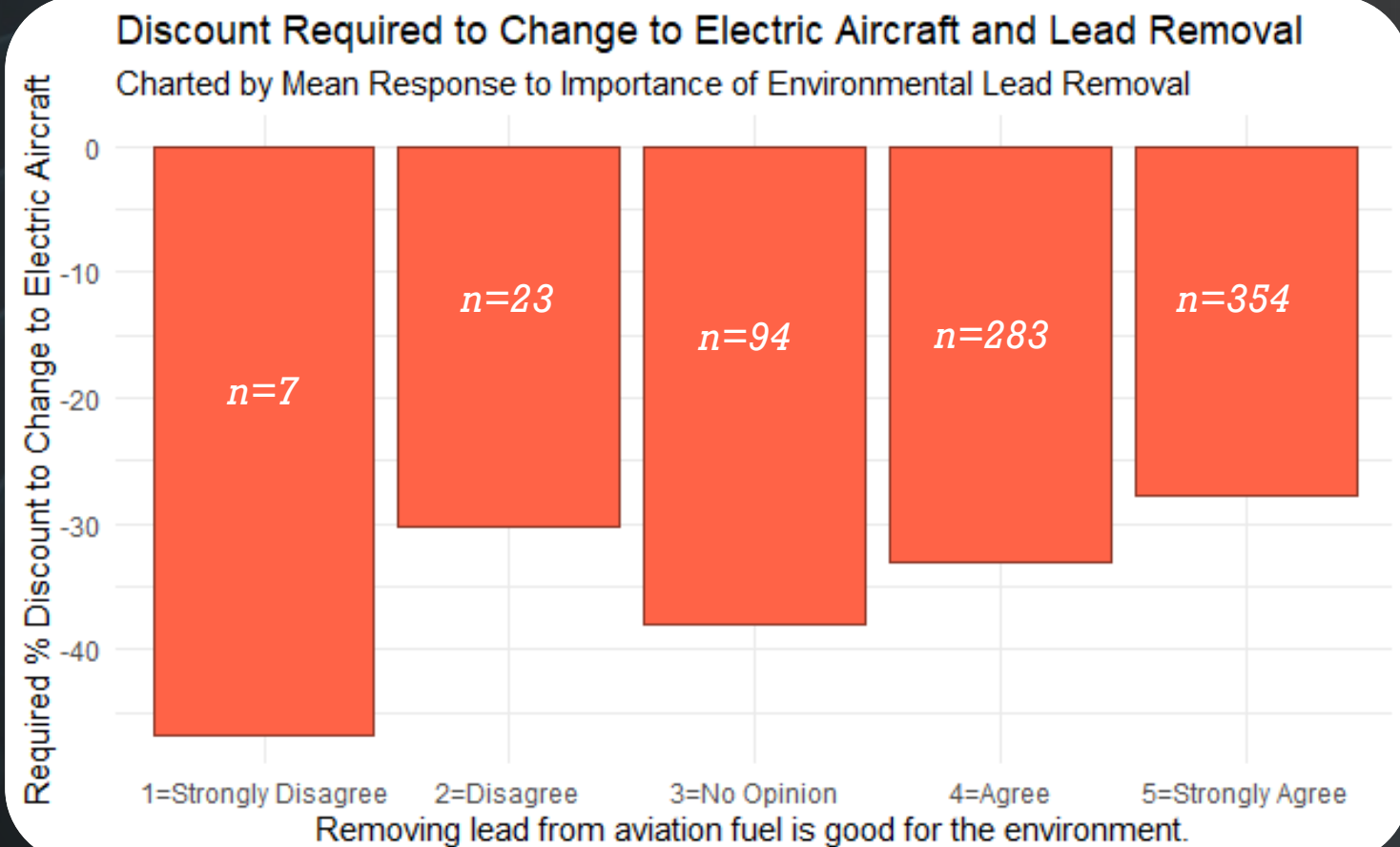
GENERAL OPINION ON SUSTAINABILITY AND THE AVIATION INDUSTRY



AT WHAT DISCOUNT % WOULD YOU SHIFT TO ELECTRIC AIRCRAFT? (AGE)



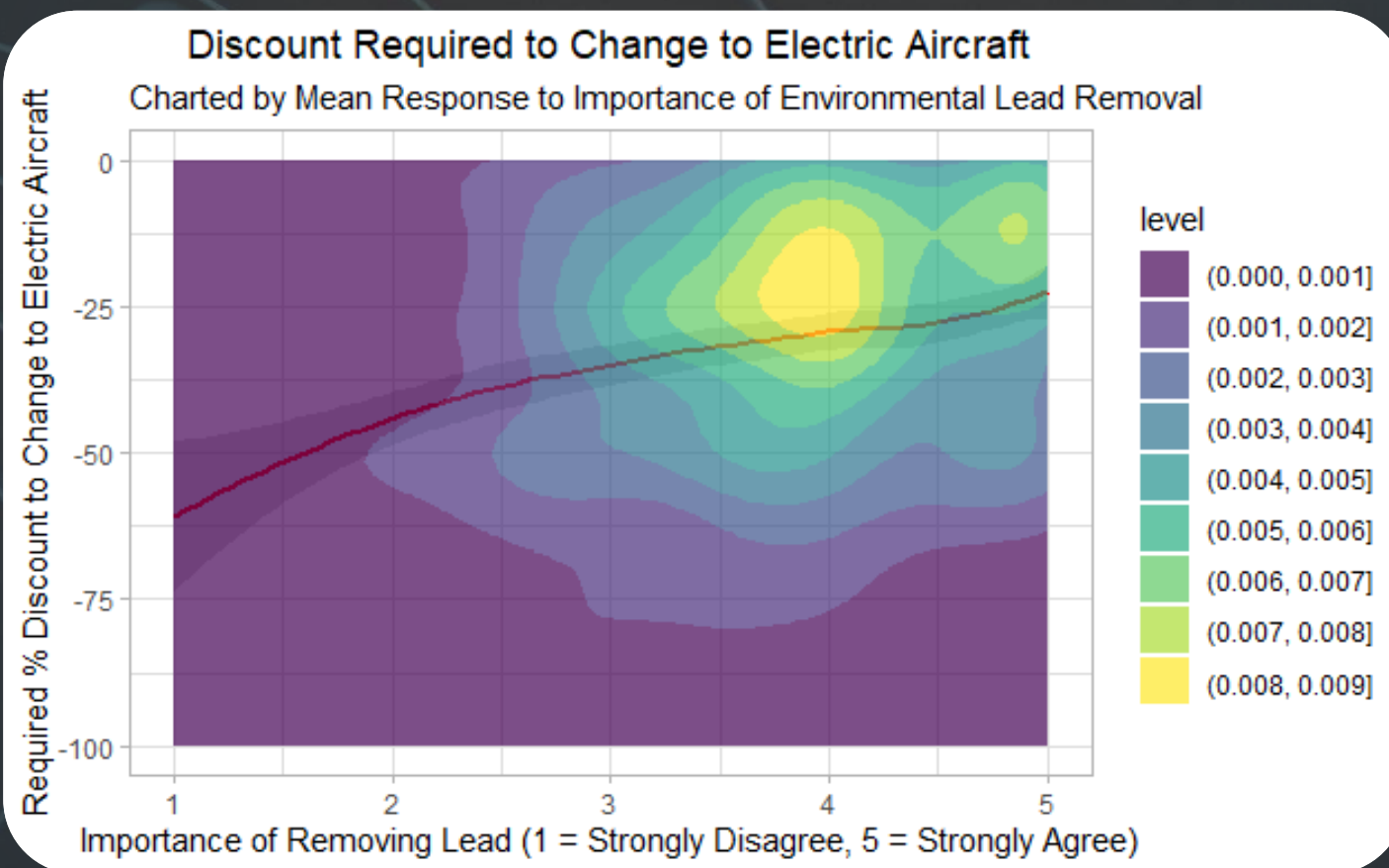
DISCOUNT NEEDED TO SWITCH GROUPED BY ENVIRONMENTAL IMPORTANCE OF REMOVING LEAD EMISSIONS

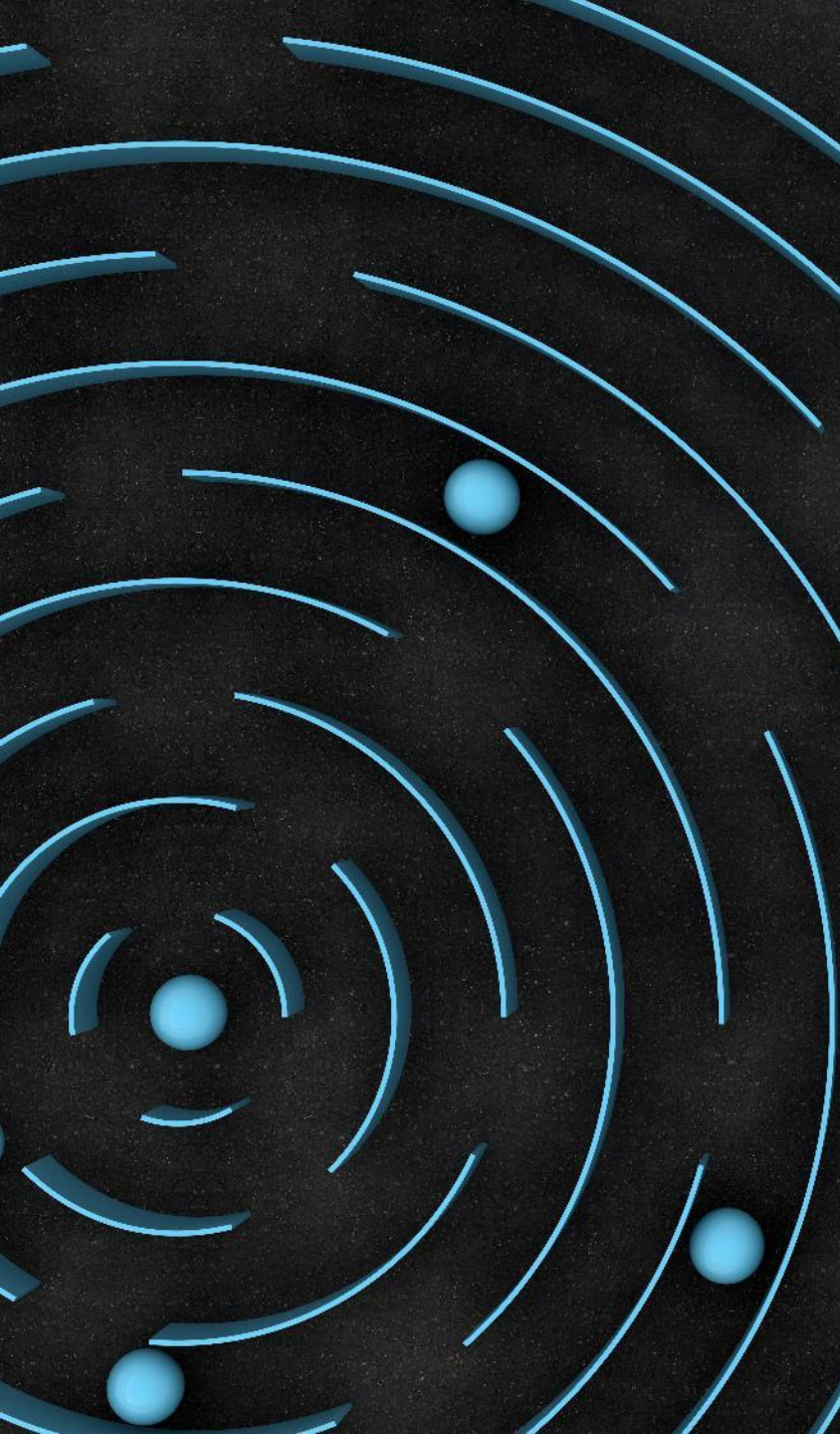


Individuals who believe removing lead emissions is important for the environment are willing to switch to electric with a smaller discount expectation.

Conversely, those who do not believe removing lead emissions are important, generally would require a greater cost differential to switch to electric aircraft.

RELATIONSHIP BETWEEN IMPORTANCE OF REMOVING LEAD AND EXPECTED DISCOUNT TO CHANGE TO ELECTRIC AIRCRAFT





QUALITATIVE COMMENTS

"ROW 39" - "INDIFFERENCE"



- **"I don't have any comments or concerns at the moment,** but this seems really interesting and I will look into it in the future."
- **"I don't mind being more environmentally friendly,** as long as it does not cause me to take on unnecessary risk."

"TOO MUCH, TOO FAST" & "RESISTANCE TO CHANGE"



- "Just no electrical airplanes **that scares me.**"
- "If something's **not broken**, don't fix it."
- "I believe pilots should stick to what we know because **change can cause problems.**"
- "Electric planes are **not going to happen any time soon.** As it stands I can barely get a gas-powered aircraft. Electric planes to me mean longer turnover times and **less flight slots.**"

"OBLIGATION" & "BE A LEADER"



- "I think that **it is a necessity** for the future of aviation."
- "Making any move to **sustainability is of great benefit to the aviation community** and future world."
- "I think we should **do it as fast as we can!**"
- "It'll **happen eventually**. Better to bite the bullet and **get it over with** earlier."

"GUILT" & "FRUSTRATION"



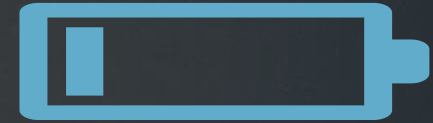
- "I believe that the aviation industry **needs more environmentally sustainable options** for flying as I have seen many articles about public figures and their private jet usage. These articles **put aviation in a bad light** by talking about emissions of these aircraft."
- "Aviation is already seen as a **not very environmentally friendly** industry so anything that can **help the image** of aviation's environmental impact helps."
- "That we're not investing in more sustainable equipment **already**."

BARRIERS TO ADOPTION



WEIGHT

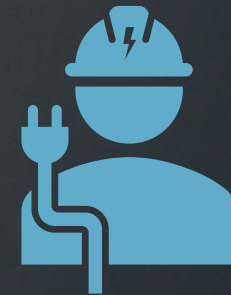
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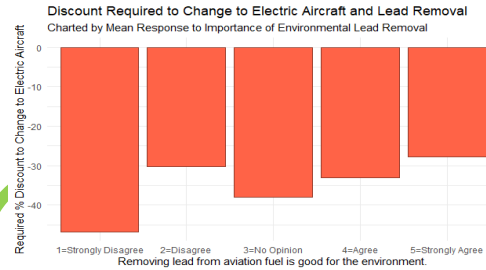
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COMMENTS & QUESTIONS

- Nick Wilson, PhD (Nicholas.Wilson@und.edu) &
- Andy Leonard, PhD (Andrew.leonard@und.edu)
- University of North Dakota



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O R L A N D O