

# 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**



# UNIVERSITY OF NORTH DAKOTA



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## UND AEROSPACE FLEET HISTORY

**UND AEROSPACE**  
UNIVERSITY OF NORTH DAKOTA

**1968-2018**

**1968**  
UND starts flight training with two Cessna 170s and one Cessna 441. UND's first official flight instructor and the first and last of its kind to be hired.

**1970**  
First Cessna 441 is added to the fleet.

**1973**  
UND receives its first helicopter, a Bell 206, which is used for flight training.

**1978**  
UND receives its first Cessna 441, which is used for flight training.

**1984**  
UND starts flying the Cessna 441, which is used for flight training.

**1985**  
UND receives its first Cessna 441, which is used for flight training.

**1988**  
UND receives its first Cessna 441, which is used for flight training.

**1991**  
UND receives its first Cessna 441, which is used for flight training.

**1995**  
UND receives its first Cessna 441, which is used for flight training.

**1996**  
UND receives its first Cessna 441, which is used for flight training.

**2002**  
UND receives its first Cessna 441, which is used for flight training.

**2005**  
UND receives its first Cessna 441, which is used for flight training.

**2008**  
UND receives its first Cessna 441, which is used for flight training.

**2010**  
UND receives its first Cessna 441, which is used for flight training.

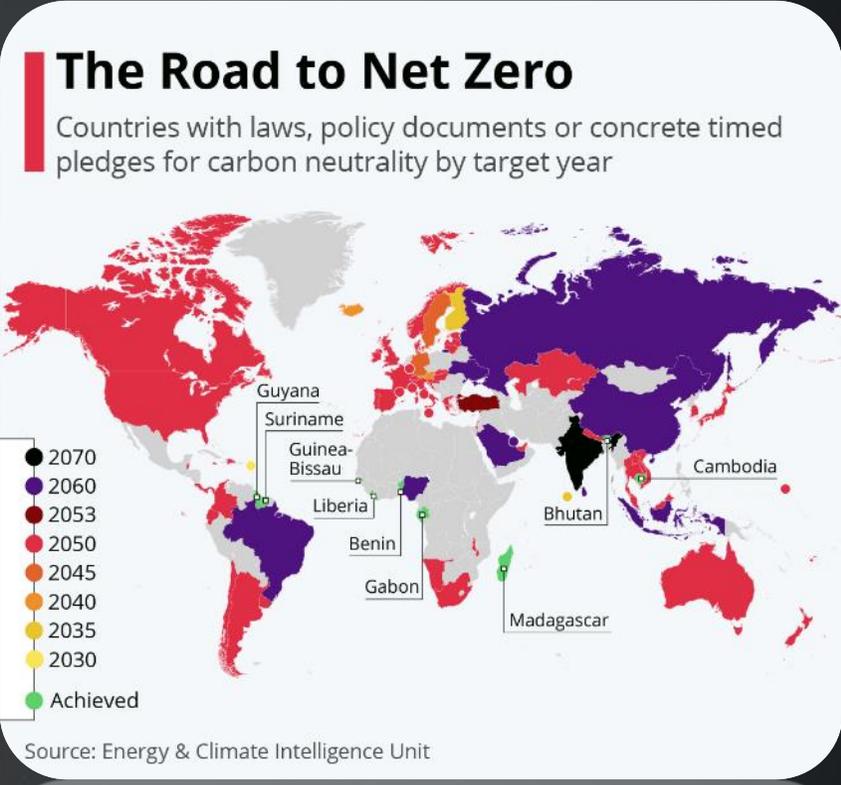
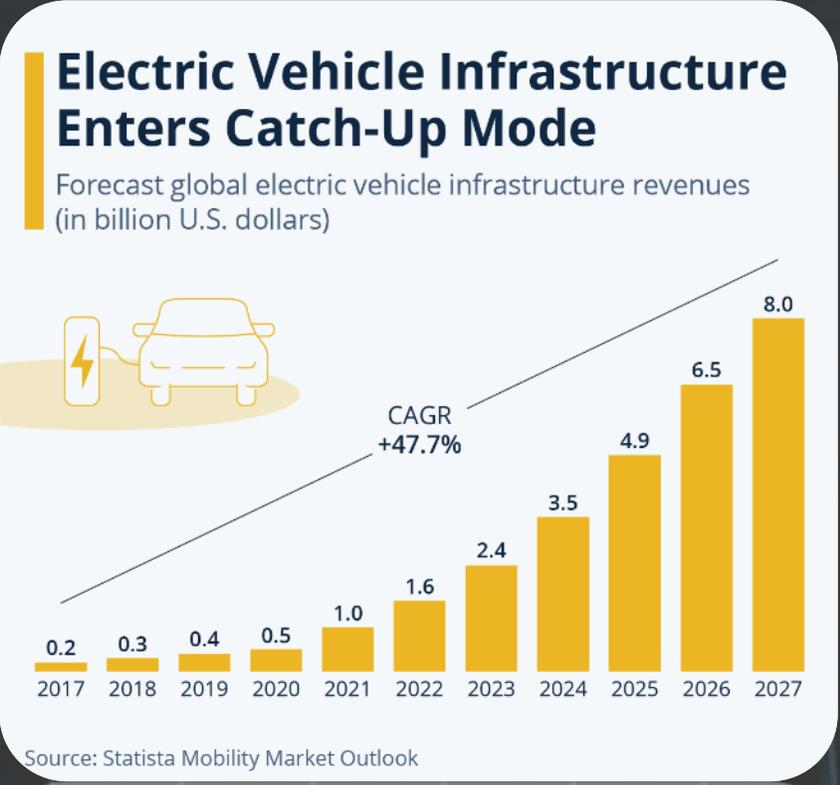
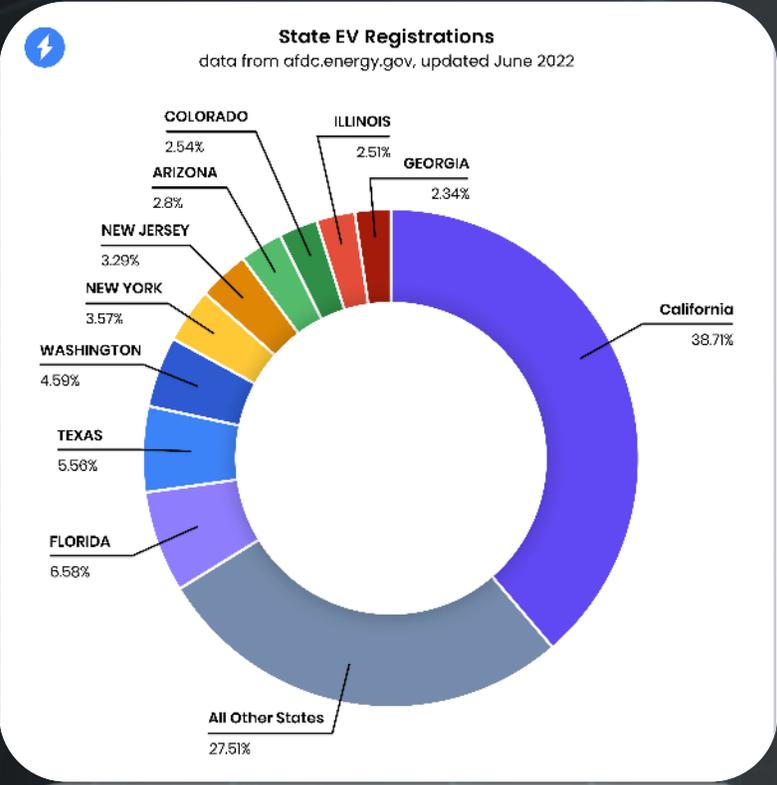
**2013**  
UND receives its first Cessna 441, which is used for flight training.

**2016**  
UND receives its first Cessna 441, which is used for flight training.

**2017**  
UND receives its first Cessna 441, which is used for flight training.



# SHIFTING TO ELECTRIC...



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

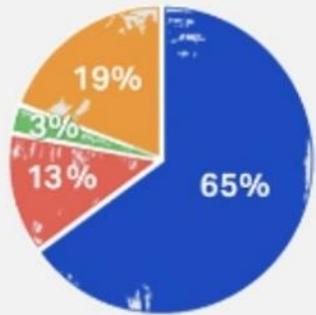
The regulation would essentially require automakers to sell more electric vehicles and hybrids by gradually tightening limits on tailpipe pollution.

Source: New York Times, 2024

# EFFORTS IN AVIATION

## Our strategy towards net zero

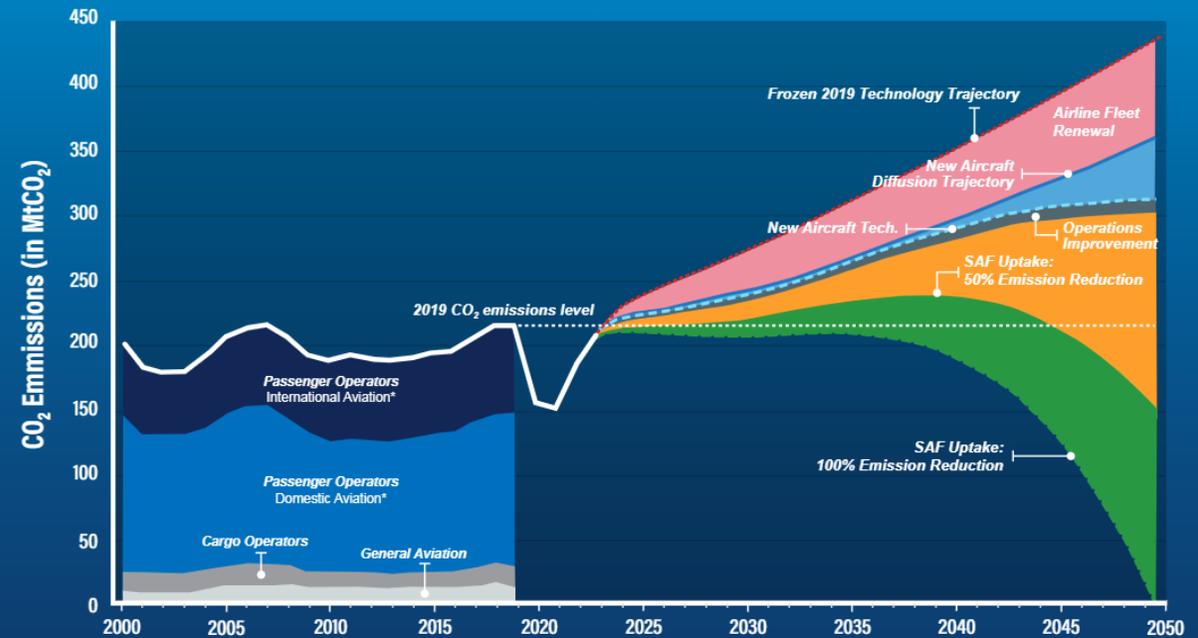
Achieving net zero by 2050 will require a combination of maximum elimination of emissions at the source, offsetting and carbon capture technologies.



- **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 CO<sub>2</sub> Emissions

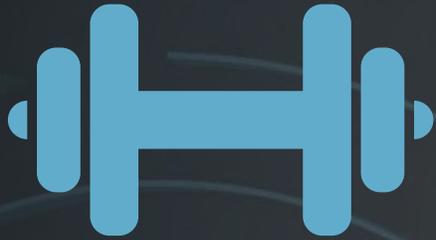


\* Note: Domestic aviation from U.S. and Foreign Carriers. International aviation from U.S. Carriers.

- Legend:**
- Historical Data (FAAAEDT / 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

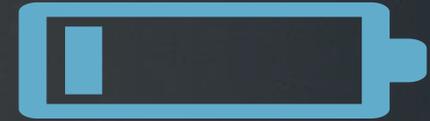
Source: Federal Aviation Administration, 2024

# BARRIERS TO ADOPTION



WEIGHT

BATTERY TECHNOLOGY



CERTIFICATION



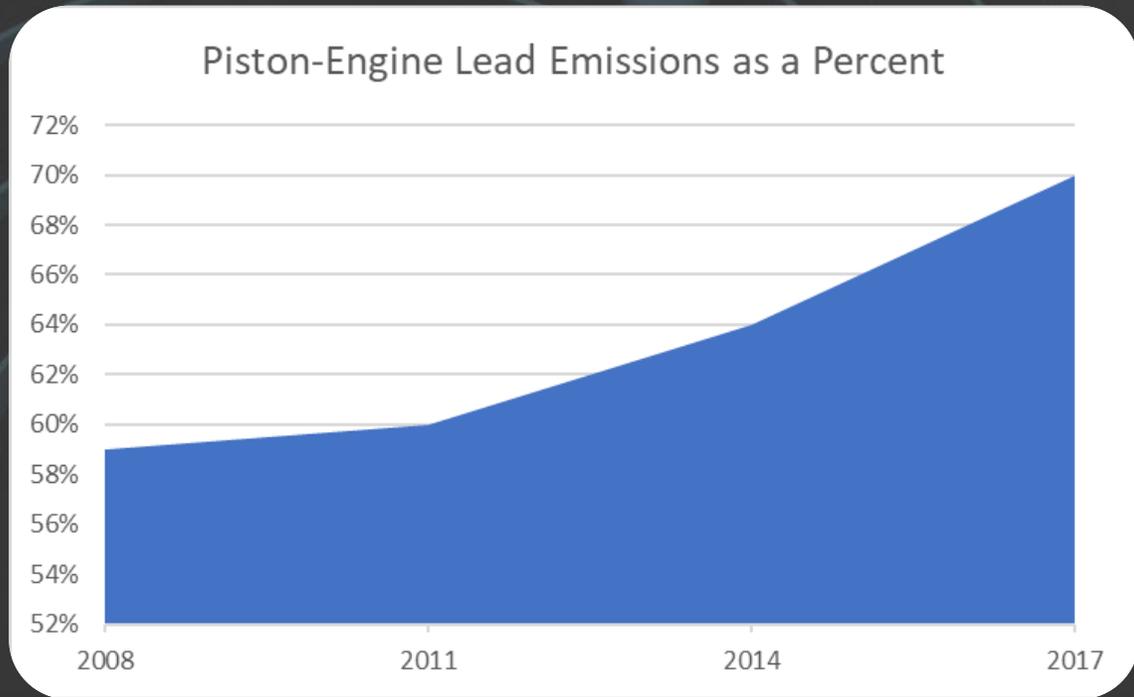
INFRASTRUCTURE

ATTITUDES?



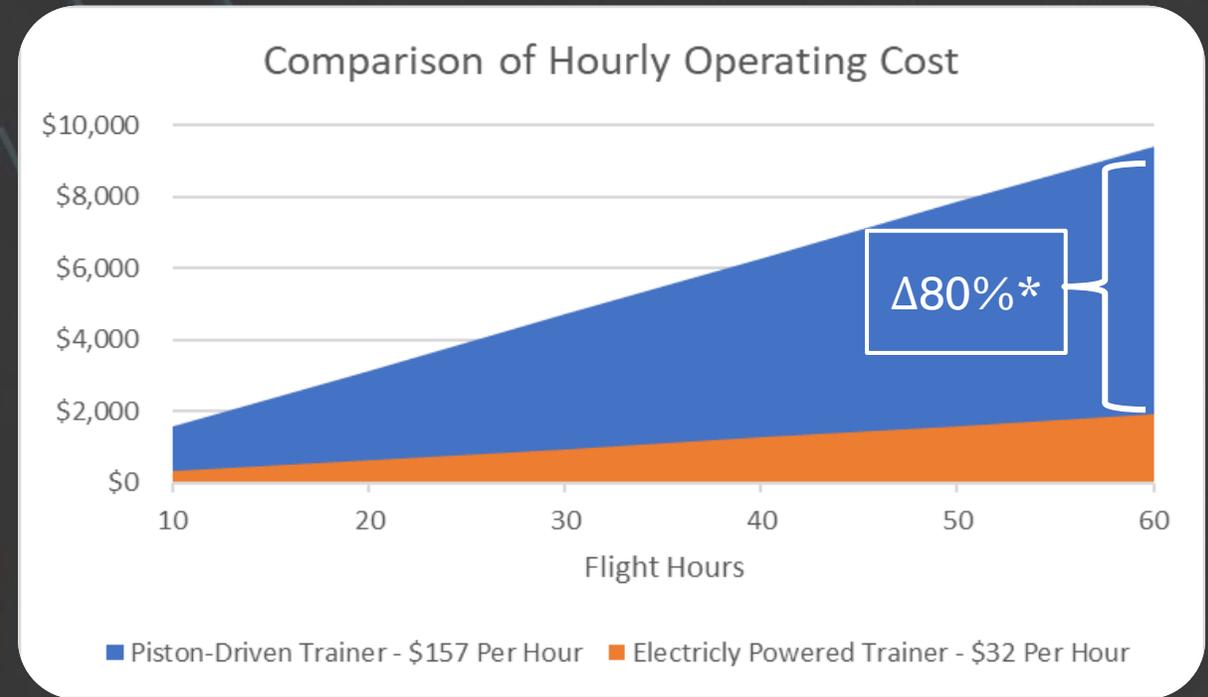
# ELECTRIC AIRCRAFT - WHY DO YOU CARE?

## Environmental Impact



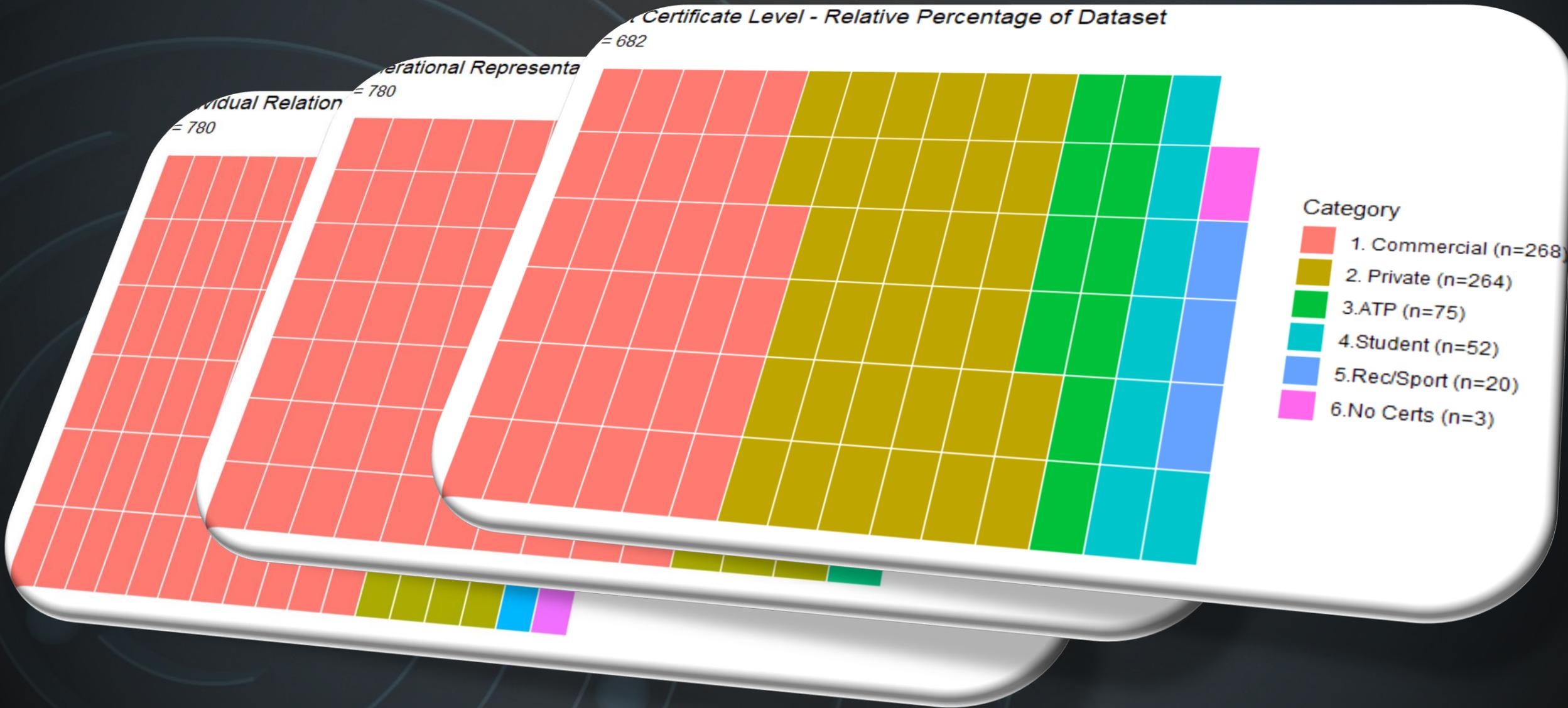
Source: Environmental Protection Agency, 2023

## Cost of Flight Training



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

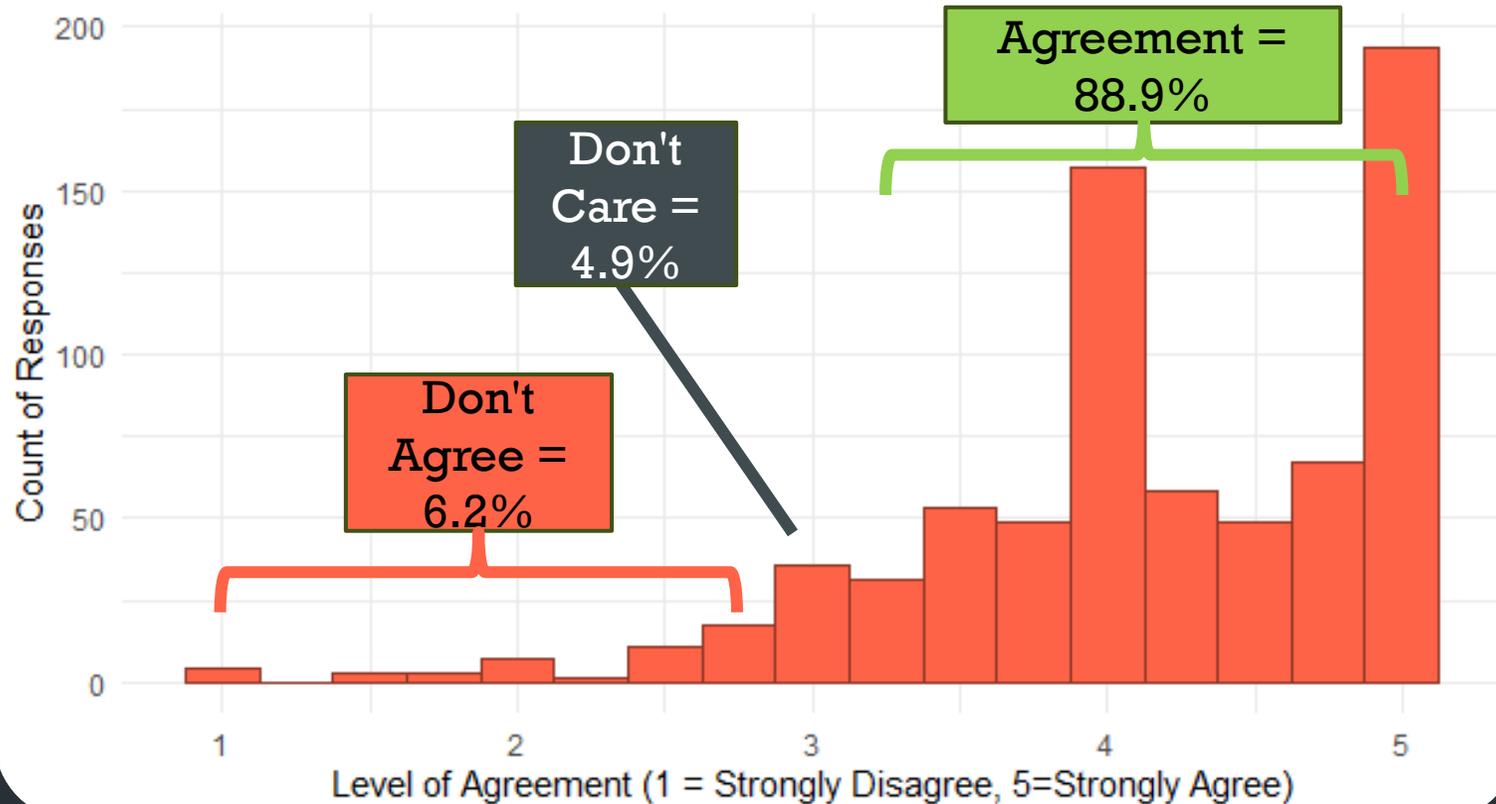
# SUSTAINABILITY SURVEY: WHO RESPONDED?



# GENERAL OPINION ON SUSTAINABILITY AND THE AVIATION INDUSTRY

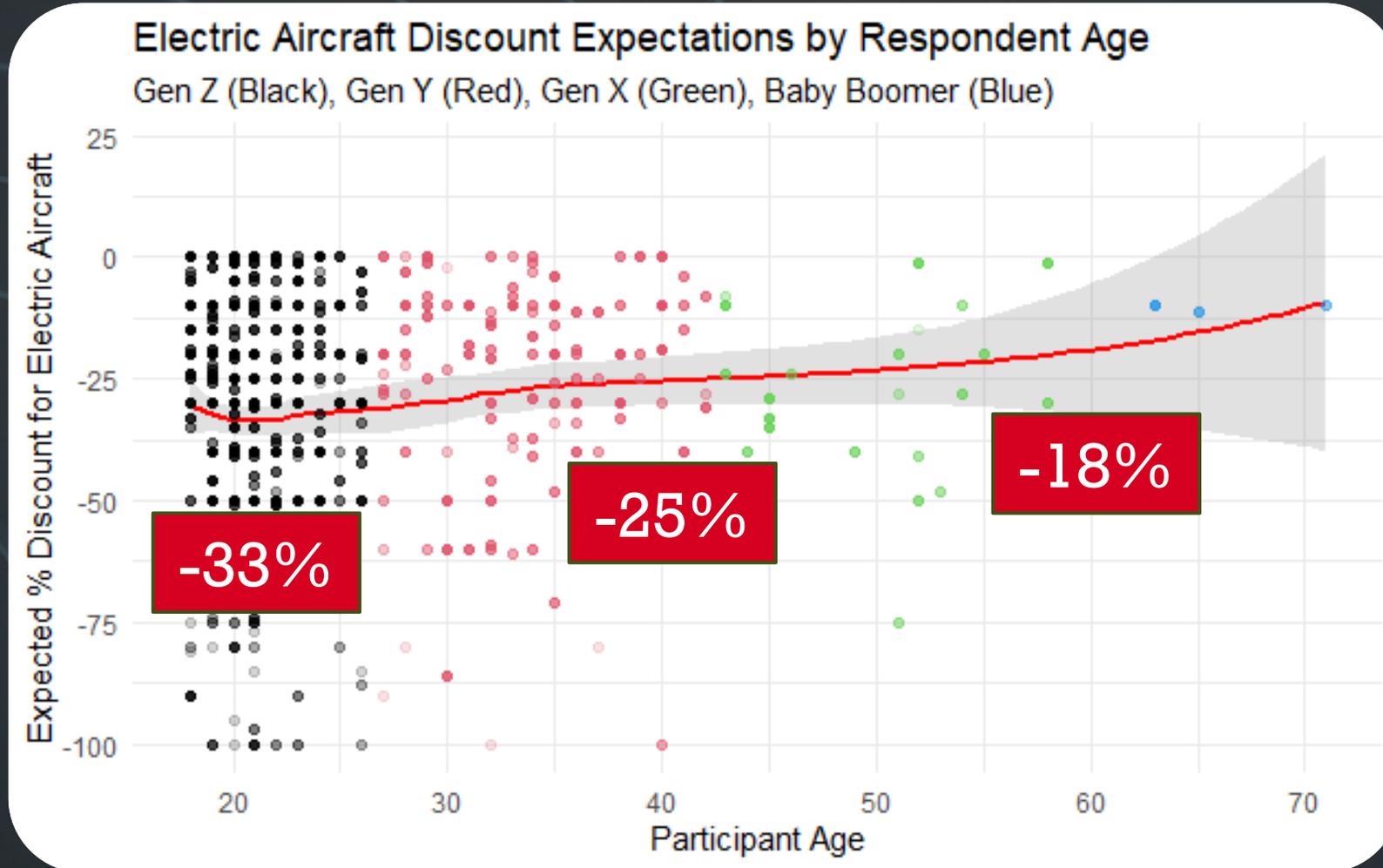
## Environmental Sustainability is Important for the Aviation Industry

Histogram Distribution of Combined Subscale (N = 740)

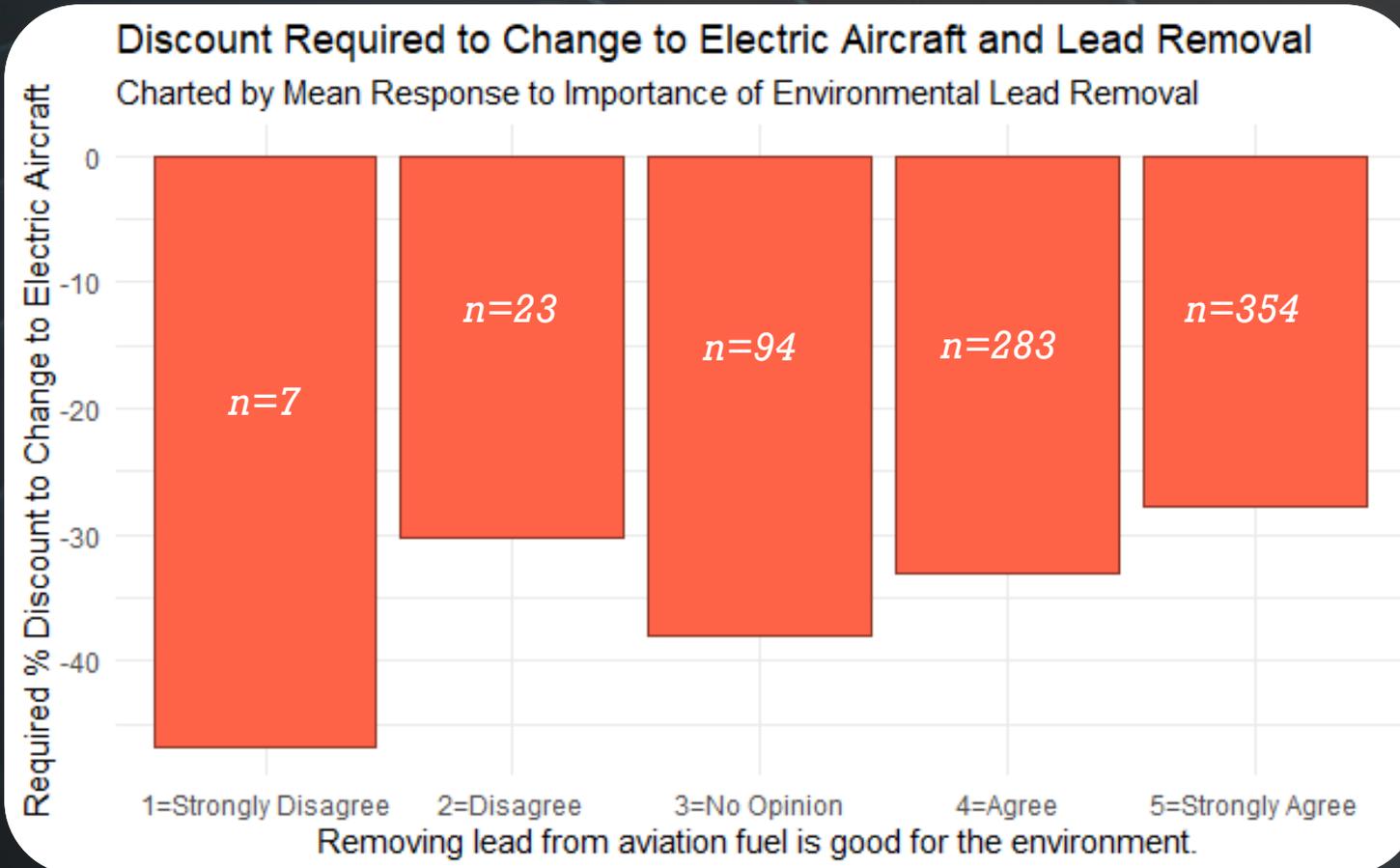


Level of Agreement (1 = Strongly Disagree, 5 = Strongly Agree)

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



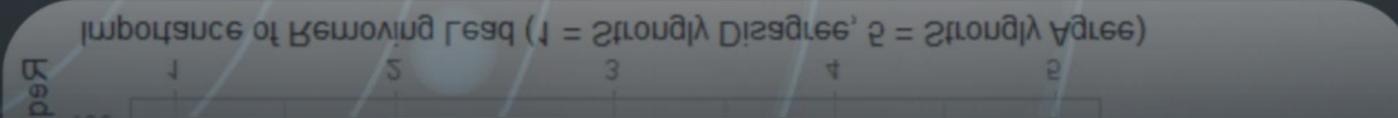
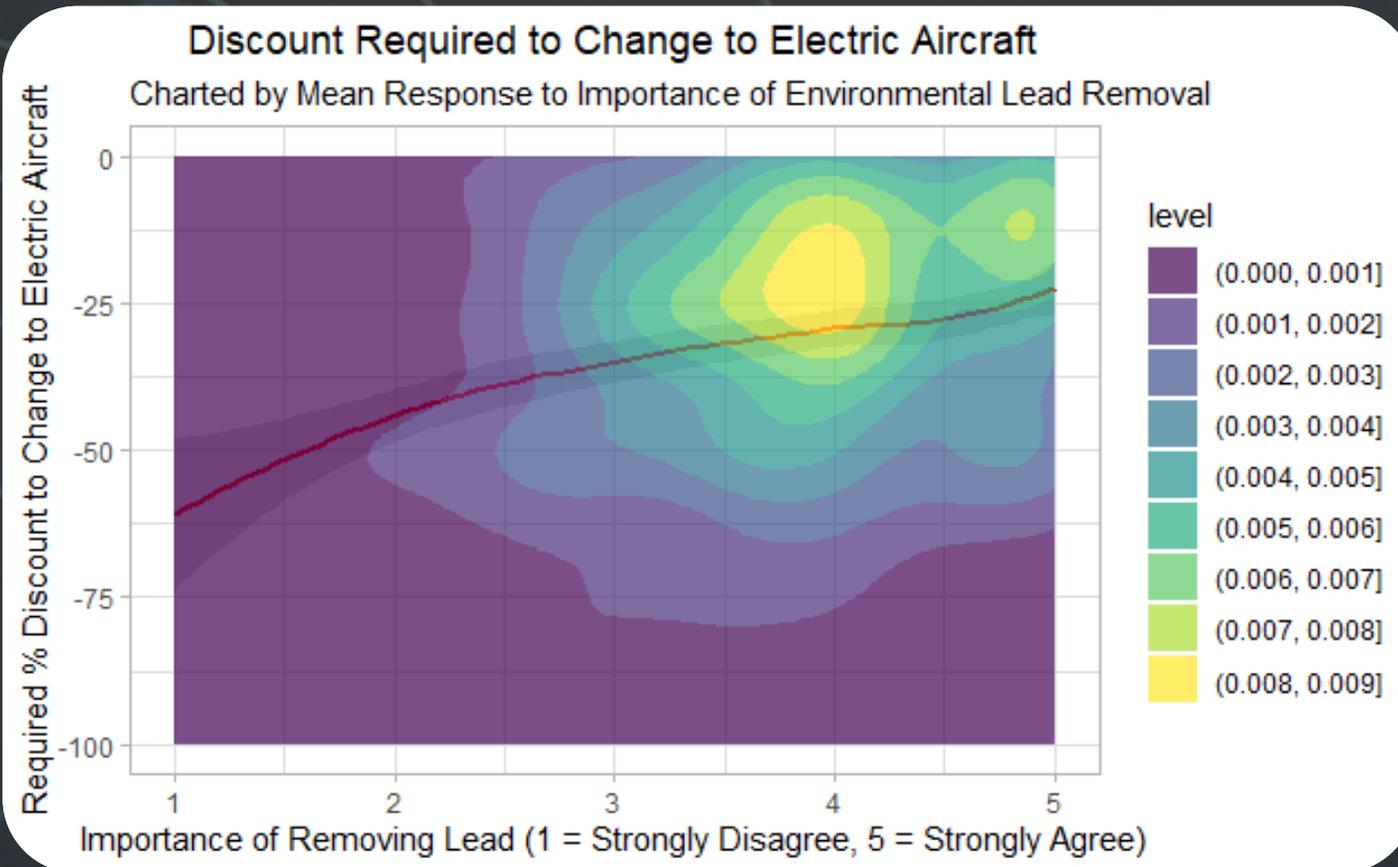
# DISCOUNT NEEDED TO SWITCH GROUPED BY ENVIRONMENTAL IMPORTANCE OF REMOVING LEAD EMISSIONS

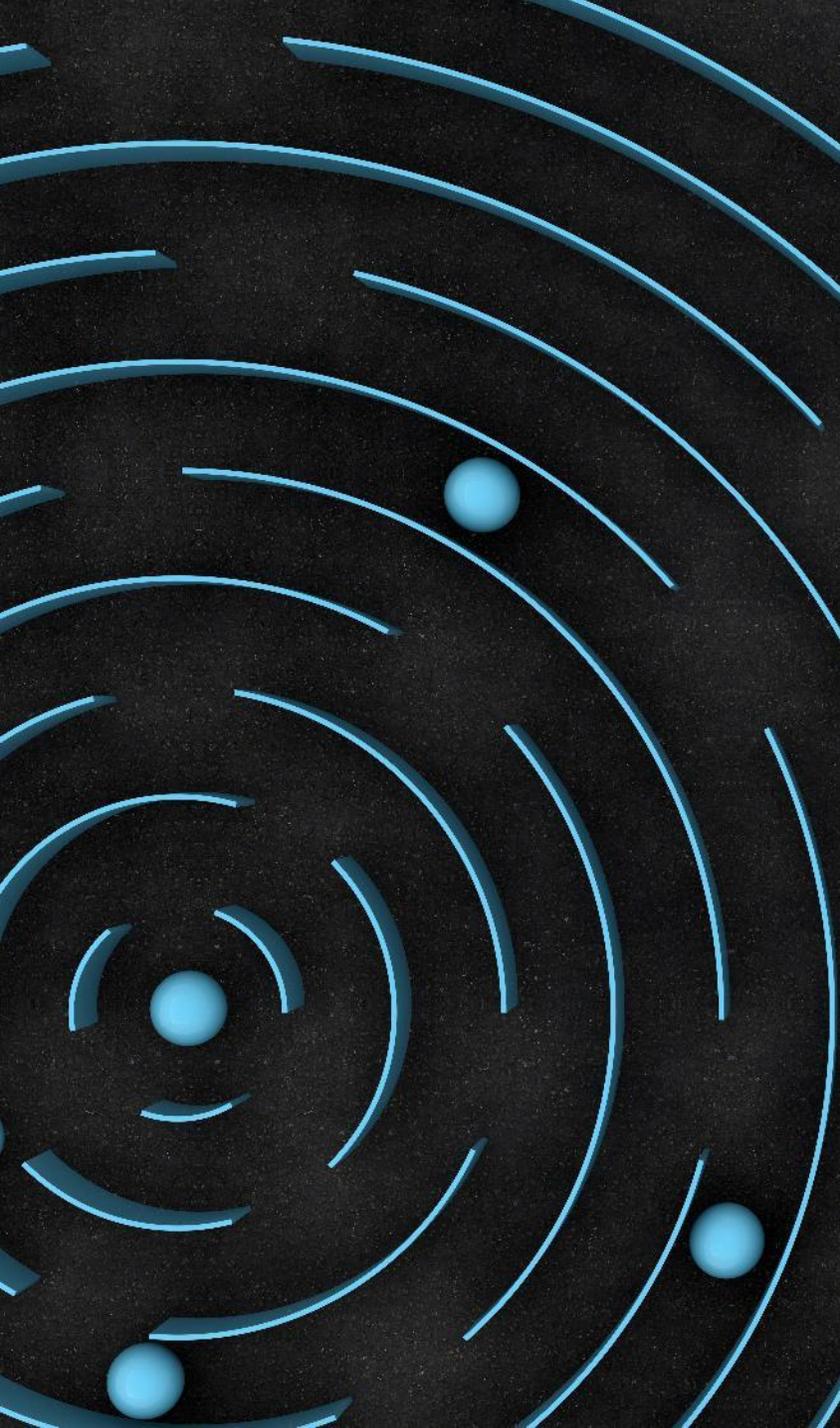


Individuals who believe removing lead emissions is important for the environment are willing to switch to electric with a smaller discount expectation.

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"



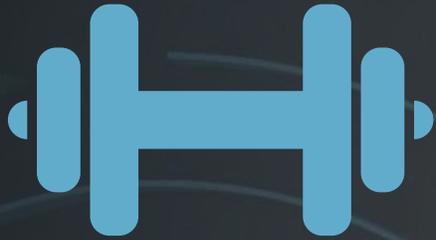
- "I think that **it is a necessity** for the future of aviation."
- "Making any move to **sustainability is of great benefit to the aviation community** and future world."
- "I think we should **do it as fast as we can!**"
- "It'll **happen eventually**. Better to bite the bullet and **get it over with**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

# "GUILT" & "FRUSTRATION"



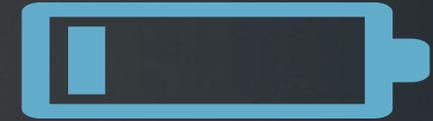
- "I believe that the aviation industry **needs more environmentally sustainable options** for flying as I have seen many articles about public figures and their private jet usage. These articles **put aviation in a bad light** by talking about emissions of these aircraft."
- "Aviation is already seen 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.**"

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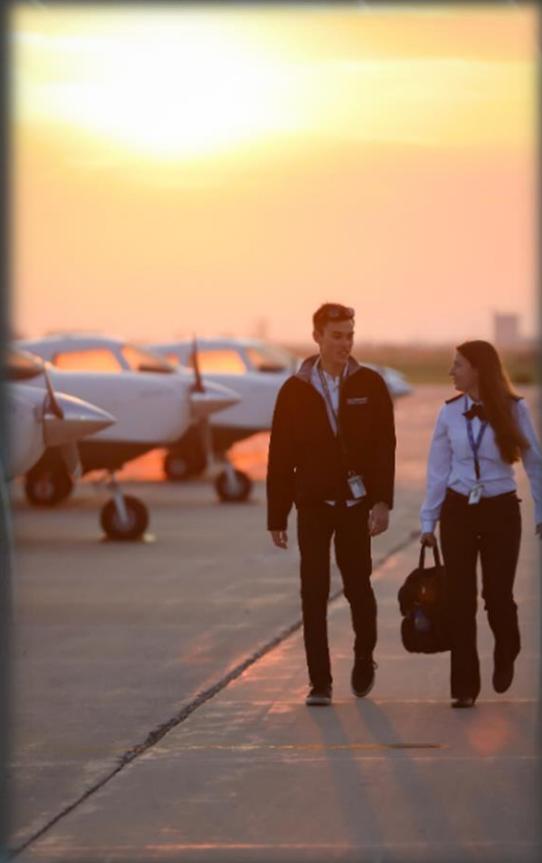
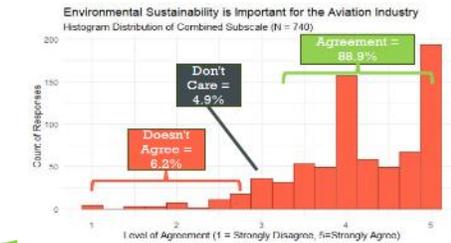
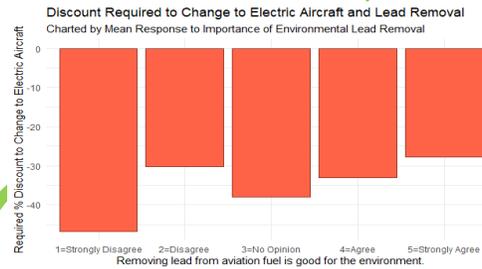


INFRASTRUCTURE

ATTITUDES?



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# COMMENTS & QUESTIONS

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- Andy Leonard, PhD ([Andrew.leonard@und.edu](mailto:Andrew.leonard@und.edu))
  - University of North Dakota



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