Trane: Improve Air Quality
VDR5

Jake Hamilton, Nicholas Holm, Andreu Santeiro, Joseph Thyer, Gavin Young

Team Introductions

Jake Hamilton
Design Engineer

Nicholas Holm
Environmental Engineer

Andreu Santeiro
Quality Control Engineer

Joseph Thyer
Project Management Engineer

Gavin Young
Fluids Engineer

Gavin Young

Sponsor & Advisor

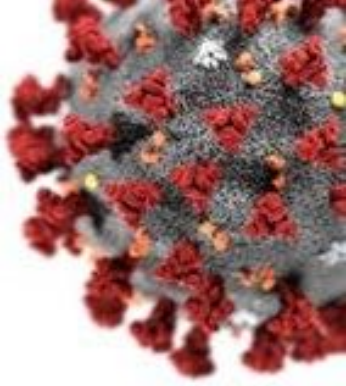
Engineering Mentor
Cameron Griffith
Trane Liaison

Academic Advisor
Juan Ordonez, Ph.D.
Energy Conversion Systems Director & Professor

Gavin Young

Objective

The objective of this project is to develop and verify an HVAC solution to improve air quality that adheres to current guidelines to combat COVID-19 while continuing to be sustainable in future markets.



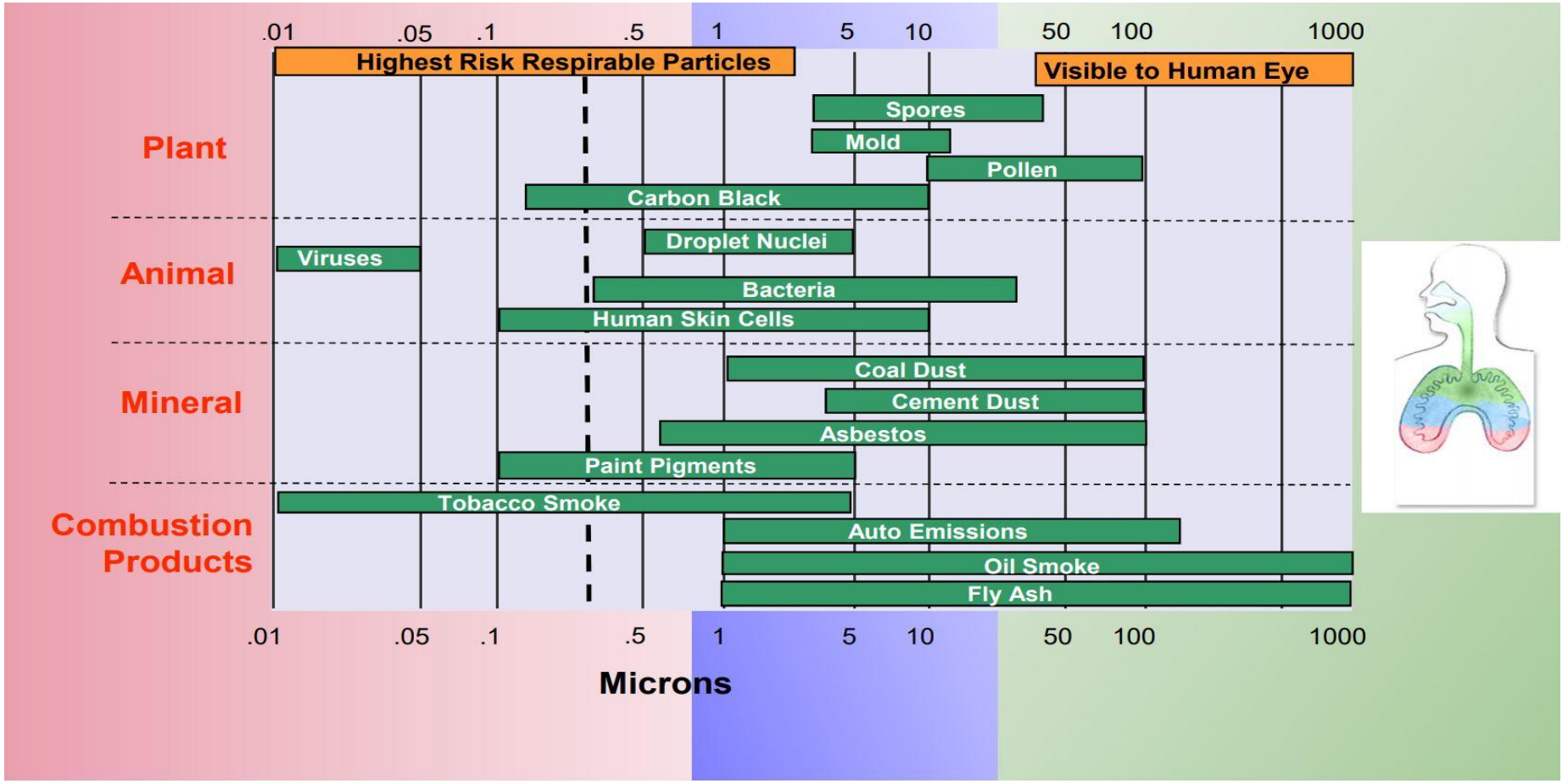
Background

Key Goals

- Improve Air Quality
- Promote Sustainability

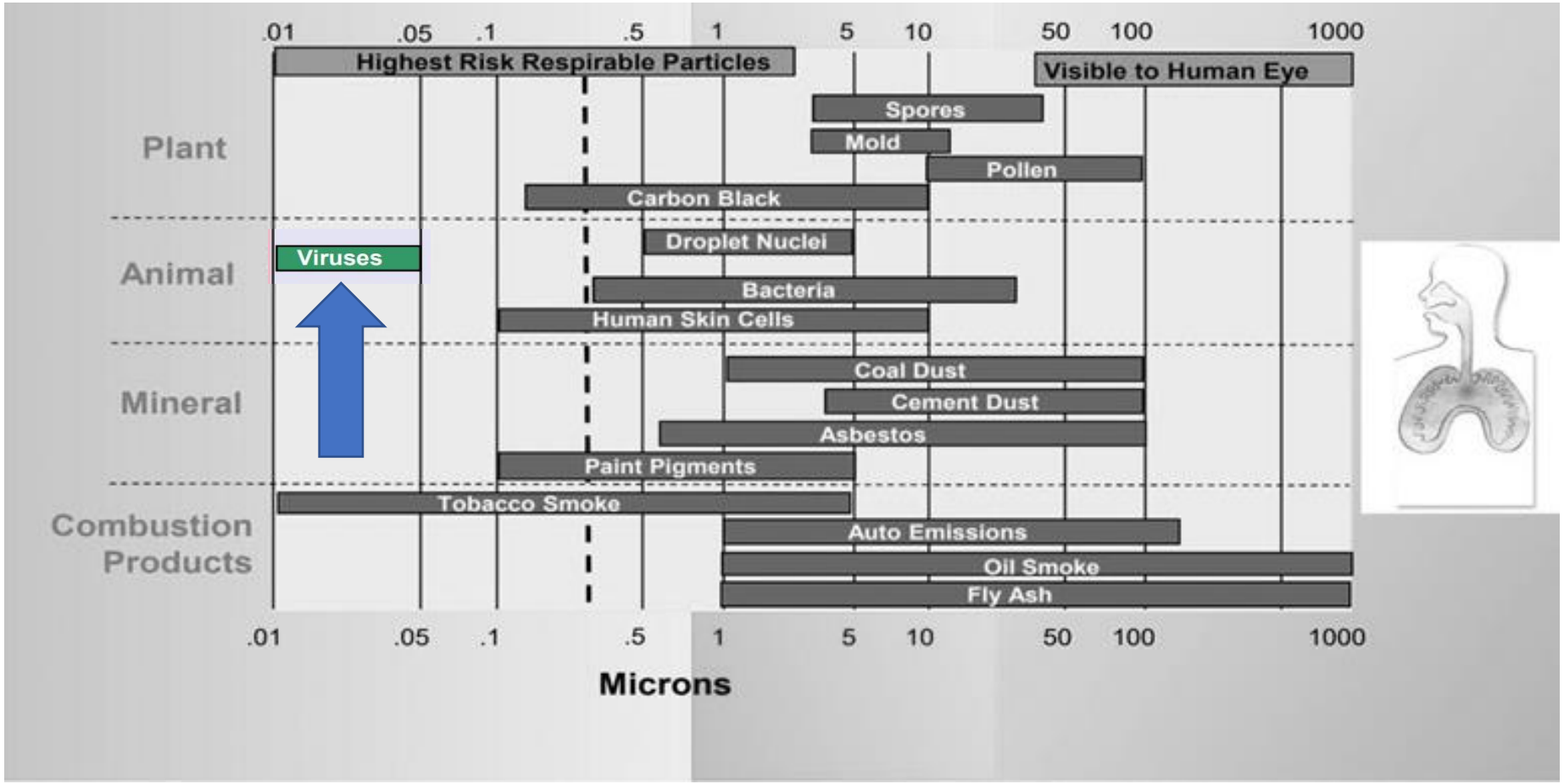
Gavin Young

Particulate Sizes



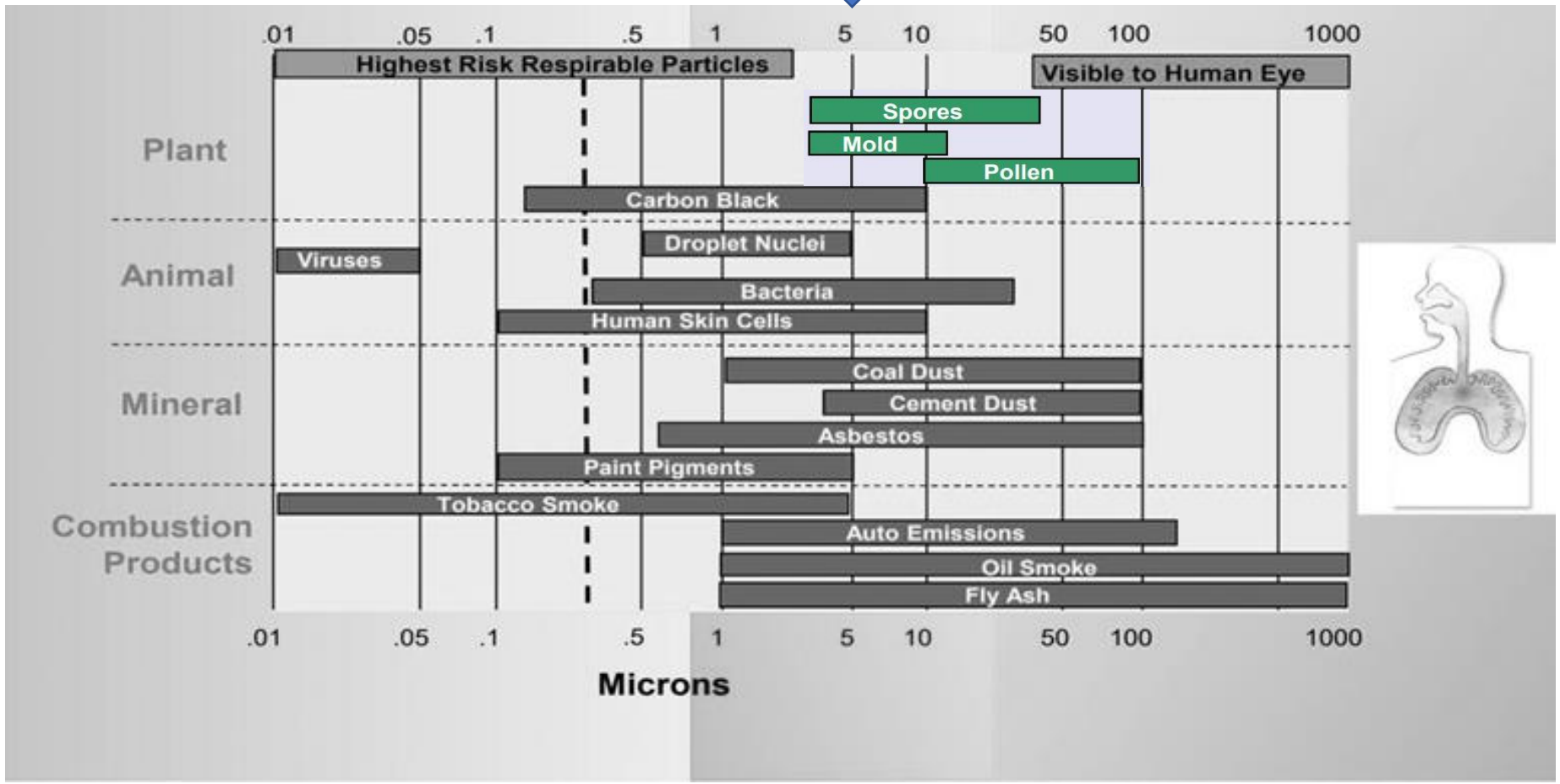
Gavin Young

Particulate Sizes



Gavin Young

Particulate Sizes



Gavin Young

Concept Generation & Selection

Gavin Young

ASHRAE Recommendations

Dilute: Making sure plenty of fresh outdoor air dilutes the buildup of indoor contaminants through proper ventilation.

Exhaust: Getting exhaust air out is equally important, especially air from kitchens, restrooms and combustion systems.

Contain: Keeping indoor humidity levels within the ASHRAE-recommended range maximizes occupant comfort and reduces the risk of microbial growth.

Clean: Reducing particles, odors, or microorganisms (such as mold, bacteria and viruses).

Gavin Young

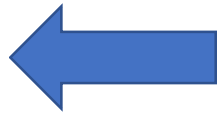
ASHRAE Recommendations

Dilute: Making sure plenty of fresh outdoor air dilutes the buildup of indoor contaminants through proper ventilation.

Exhaust: Getting exhaust air out is equally important, especially air from kitchens, restrooms and combustion systems.

Contain: Keeping indoor humidity levels within the ASHRAE-recommended range maximizes occupant comfort and reduces the risk of microbial growth.

Clean: Reducing particles, odors, or microorganisms (such as mold, bacteria and viruses).



Increase ventilation rate

Gavin Young

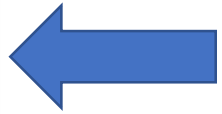
ASHRAE Recommendations

Dilute: Making sure plenty of fresh outdoor air dilutes the buildup of indoor contaminants through proper ventilation.

Exhaust: Getting exhaust air out is equally important, especially air from kitchens, restrooms and combustion systems.

Contain: Keeping indoor humidity levels within the ASHRAE-recommended range maximizes occupant comfort and reduces the risk of microbial growth.

Clean: Reducing particles, odors, or microorganisms (such as mold, bacteria and viruses).



Decrease air recirculation

Gavin Young

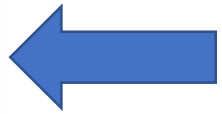
ASHRAE Recommendations

Dilute: Making sure plenty of fresh outdoor air dilutes the buildup of indoor contaminants through proper ventilation.

Exhaust: Getting exhaust air out is equally important, especially air from kitchens, restrooms and combustion systems.

Contain: Keeping indoor humidity levels within the ASHRAE-recommended range maximizes occupant comfort and reduces the risk of microbial growth.

Clean: Reducing particles, odors, or microorganisms (such as mold, bacteria and viruses).



Contain clean, conditioned air

Gavin Young

ASHRAE Recommendations

Dilute: Making sure plenty of fresh outdoor air dilutes the buildup of indoor contaminants through proper ventilation.

Exhaust: Getting exhaust air out is equally important, especially air from kitchens, restrooms and combustion systems.

Contain: Keeping indoor humidity levels within the ASHRAE-recommended range maximizes occupant comfort and reduces the risk of microbial growth.

Clean: Reducing particles, odors, or microorganisms (such as mold, bacteria and viruses).

Actively clean indoor air through purification and filtration

Gavin Young

Top 8 Concepts

- Bipolar ionization
- Smart HVAC system
- Geothermal heat exchangers
- Higher rated filters
- Antimicrobial duct lining
- Photohydro-ionization
- Photocatalytic oxidation
- Increase fan speed

Nicholas Holm

Top 8 Concepts

- Bipolar ionization
- Smart HVAC system
- Geothermal heat exchangers
- Higher rated filters
- Antimicrobial duct lining
- Photohydro-ionization
- Photocatalytic oxidation
- Increase fan speed

Nicholas Holm

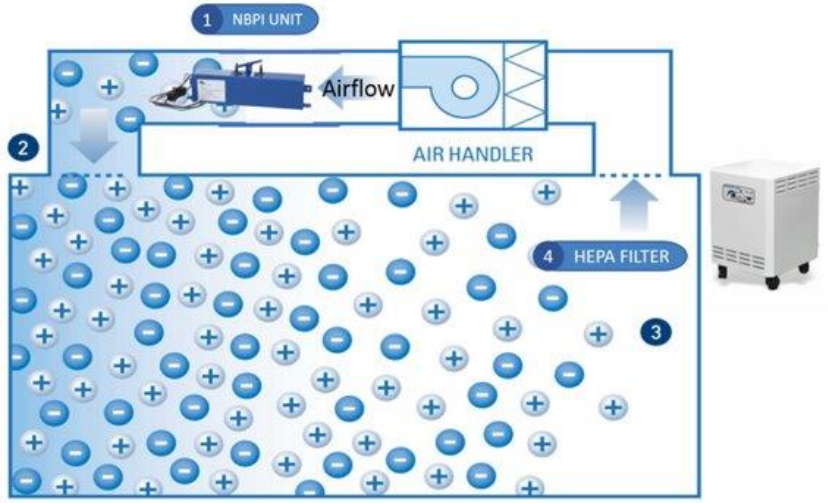
Ionization

- Creates positive and negative ions
- Two functions:
  - Attach to contaminants, rendering them inactive
  - Makes particulate easier to filter
- Needlepoint bipolar ionization (NPBI) does not produce ozone
- Used on industrial scale

Nicholas Holm

Advantages of Ionization

1. Low pressure drop
2. Easy installation
3. Works on particulate of all sizes
4. No chemicals involved
5. Energy savings



Nicholas Holm

Validation

Why Test?

- Ionization technology has been used to filter particulate for some time
- Its effectiveness against bioaerosols is not validated
- Tests were conducted with questionable procedures
- It's being used to combat COVID-19

Nicholas Holm

Significant Design Considerations

- Multiple dependent variables
- Working with organic particulate
- Test chamber to mimic air duct
- Measuring air quality

Dependent Variables

- Particulate concentration
- Viability of biological sample
- Ozone production
- Energy usage

Nicholas Holm

Virus Testing

- Extremely specialized equipment
- Extremely high safety concerns

Nicholas Holm

Mold Testing

- Closest approximation to virus
- Health risks
- Market sustainability

Nicholas Holm

Test Chamber for Lab Testing

- Mimic air duct conditions
- Contain potentially harmful substances
- Maintain controlled environment

Jake Hamilton

Measuring Air Quality

- Multiple types of air quality sensors
- Technical limitations

Jake Hamilton

Test 1

- Testing the filtration effects of the device
- Conducted on-site at FSU
- Procedure
  - Initial data collection
  - Final data collection
  - Test results
  - Reporting

Jake Hamilton

Test 2

- Testing the effects of the ionizer on organic particles
- Conducted in a controlled lab setting
- Mold spores will be exposed to the ionizer and viability will be compared to a control group.

Jake Hamilton

Equipment

Jake Hamilton

Ionizer

- In contact with Tom Barrow Company
- We don't if it will be NPBI or not

Jake Hamilton

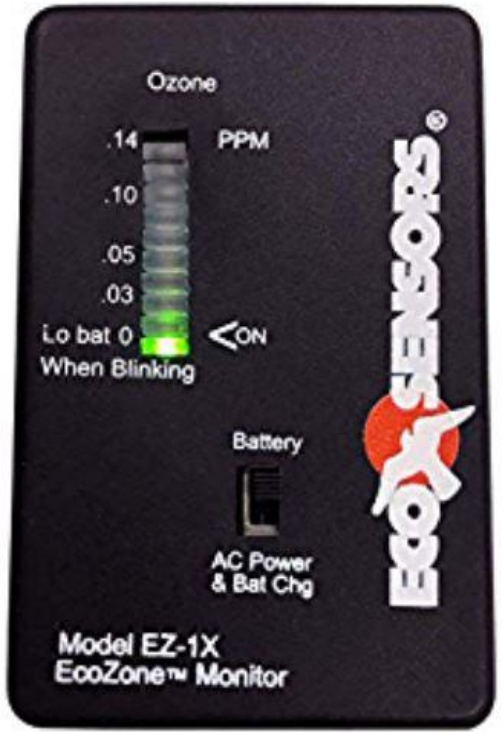
Particulate Analyzer

- Measures the quantity and size of particles in the air
- Particles are not identified
- A particle counter will be rented in order to access the IAQ and filter quality

Jake Hamilton

Ozone Monitor

- Two Functions:
  - Ensure safety
  - Test for ozone generation
- Rented or bought



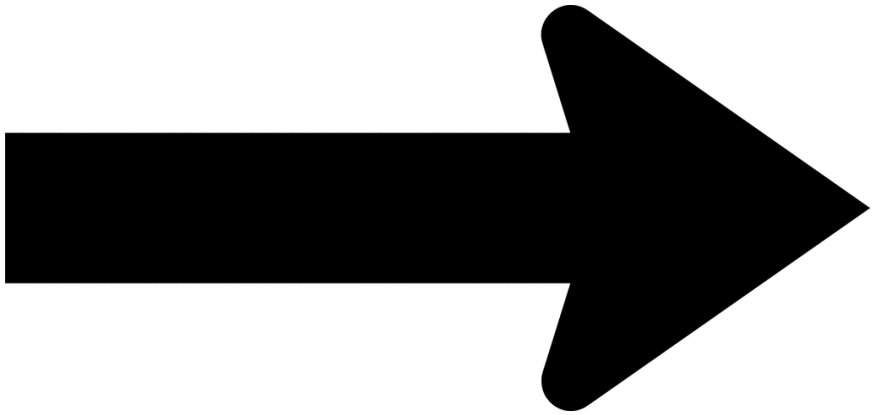
Jake Hamilton

Impactor

- Multiple jets of air direct any airborne particles on to the surface of the collection plate
- The collection plate must be refrigerated and sent into a lab to test the contents
- FSU EHS can provide an impactor

Jake Hamilton

Moving Forward



- Over the next few weeks
  - Finalize experimental design
  - Confirm with biosafety officer
  - Order components

Jake Hamilton

Conclusion

1. We need to improve air quality in a way that affects COVID but is useful independent of COVID.

2. Particle Ionization is the selected concept.

3. A test will be designed, built, and conducted to validate the technology.

Jake Hamilton

Questions?

Reference

Air Quality. (2019, December 24). Retrieved October 15, 2020, from https://morpc.gohio.com/commute-resources/air-quality/

Corson, S., & Vargas, M. (2020, August 19). TRANE: Indoor Air Quality (IAQ)- Related HVAC Guidance from ASHRAE® and the CDC. Retrieved October 13, 2020.

Danziger, P. (2020, May 20). Lowe's Is Narrowing The Gap Between Its Chief Rival Home Depot. Expect Its Surge To Continue. Retrieved October 15, 2020, from https://www.forbes.com/sites/pamdanziger/2020/05/20/lowes-narrows-the-gap-between-its-chief-rival-home-depot-and-why-its-surge-will-continue/

Hampshire, K. (2020, April 29). First American Home Warranty vs. American Home Shield. Retrieved October 15, 2020, from https://www.usnews.com/360-reviews/home-warranty/first-american-vs-american-home-shield

Hanania, J. (2018, September). Energy Education: Electrostatic precipitator. Retrieved November 13, 2020, from https://energyeducation.ca/encyclopedia/Electrostatic_precipitator

Housh, W. (2020, February 28). Mold in HVAC System: Clean HVAC Ductwork: HVAC.com®. Retrieved January 18, 2021, from https://www.hvac.com/blog/what-are-the-effects-of-mold-in-my-hvac-system-and-how-do-i-know-if-i-have-it/

Image Library. (2020, February 10). Retrieved October 15, 2020, from https://www.cdc.gov/media/subtopic/images.htm

Reference cont.

Lower, A. (2020, November). Will a higher MERV filter affect my airflow?
Retrieved November 10, 2020, from https://www.secondnature.com/blog/higher-merv-air-filter-affect-air-flow

Marsden, J., & Fink, R. (2020, May). Hydro-Peroxide for Indoor Air Quality.
Retrieved November 10, 2020, from https://www.rgf.com/article/hydro-peroxide-for-iaq/

Seo2-512. (n.d.). Retrieved October 15, 2020, from http://www.parkcontrols.com/homepage/seo2-512/

Man in face mask. (n.d.). Retrieved October 14, 2020, from https://www.vectorstock.com/royalty-free-vector/man-in-face-mask-line-icon-pictogram-disease-vector-31740115

MIT. (2020, June 23). Covid-19 Updates. Retrieved January 19, 2021, from https://medical.mit.edu/covid-19-updates/2020/09/air-conditioning-risks

Pappas, S. (2020, March 31). Coronavirus testing is ramping up. Here are the new tests and how they work. Retrieved January 20, 2021, from https://www.livescience.com/coronavirus-tests-available.html

Rich, S. (2011, October 3). IT Projects Improve Air Quality, Receive Grant Funding. Retrieved January 18, 2021, from https://www.govtech.com/budget-finance/IT-Projects-Improve-Air-Quality-Receive-Grant-Funding.html