

# Exploring Hand Drying Alternatives to Paper Towels

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04/20/2020

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BASS  
CONNECTIONS

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# Motivation

## Problem

- Duke primarily uses paper towel dispensers, which generate **628.5 football fields** of paper towel waste and costs **\$581,653.68 per year**

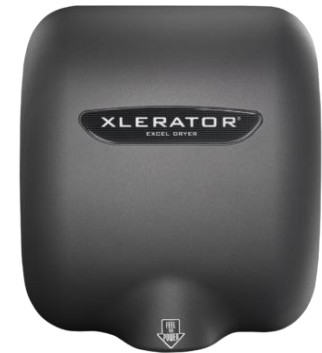
## Goals of this project

1. Outline problems with business as usual with paper towels
2. Research alternative and select best-fit solution
3. Detailed life cycle analysis (LCA), environmental benefit analysis, and benefit cost analysis (BCA)
1. Recommendations



## Concepts Considered

- Different hand drying technologies:
  - Electric-air hand dryer
    - Dyson Airblade dB
    - XLERATOR
  - Cloth towel dispenser
- Mix of chosen solution + paper towels



# Alternatives Assessment

- Pugh matrix (based on 5 qualities)
  1. Up-front cost
  2. Cost per dry
  3. Environmental impact
  4. Time to dry
  5. Work to maintain
- **Dyson Airblade**
  - On campus, used in LCA literature
- Cloth towel pilot



*Dyson Airblade*

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# Environmental Benefit Analysis: Carbon Calculations

## Goal:

Relative carbon emissions of Airblade and paper towels

## Details:

- Wannamaker dorm
- 5 yrs
- 20 Airblades





# Key Environmental Inputs

Environmental Data	Value
Airblade lifetime carbon WITHOUT use phase (g CO eq/pair of hands)	1.9
Paper towel lifetime carbon (g CO eq/pair of hands / two paper towels)	15.5
Carbon Intensity of Electricity in NC (lb/MWh)	814

Analyzing uncertainty in a comparative life cycle assessment of hand drying systems

[Jeremy R. Gregory](#) , [Trisha M. Montalbo](#) & [Randolph E. Kirchain](#)



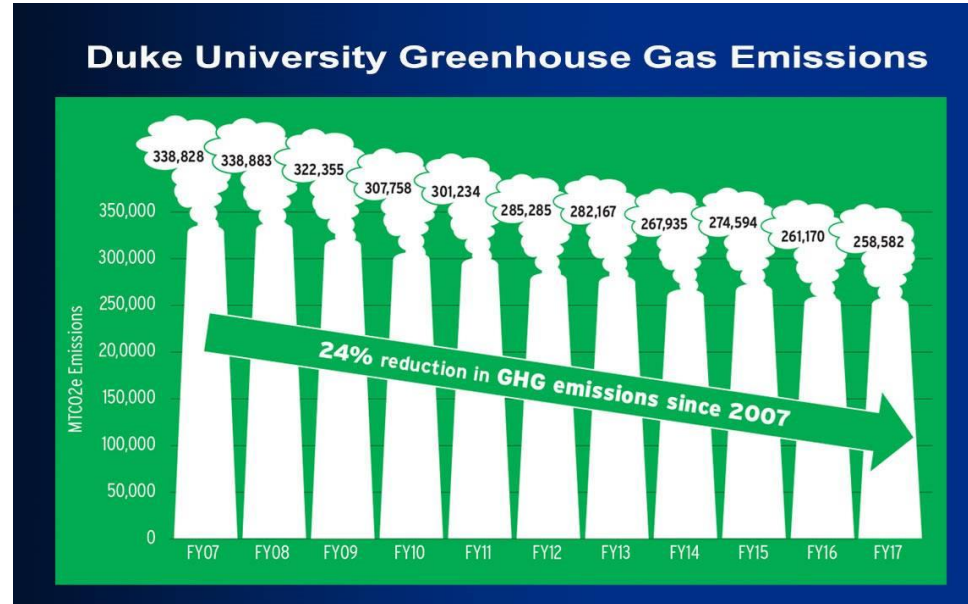
## Key Assumptions

1. Proportionality of student pop and paper towel use
2. Two towels / dry
3. Drying time + energy consumption as reported

<b>Wannamaker Hand-drying Calculations</b>	<b>Value</b>
Wannamaker Annual Paper Towel Usage (rolls/year)	1157
Wannamaker pairs of dried hands per year	404950
Total Energy Consumed by Airblade over lifetime (MW)	18.195335

# Carbon Calculations: Results

Final Carbon Calculations over 5-year Lifetime	Value
Airblade (kg CO2 eq)	13300.03
Paper Towels (kg CO2 eq)	31383.63
Total Difference (kg CO2 eq)	18,083.6





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# Physical Waste Reduction

- 30.50 MT / 5 years
- Zero Waste Gameday → 19 MT





# Financial Analysis

- Completed cost projections for status-quo and hypothetical retrofit of Wannamaker with hand-dryers
- Projected associated costs over 5-year period based on lifespan of Dyson AirBlade dB
- Total five-year costs (discounted)
  - Status-quo: \$135,175
  - Retrofit: \$38,959

Year	0	n	5	NPV
<b>Hand Dryers</b>				
Cost of Hand Dryers	\$24,300.00	\$0.00	\$0.00	(24,300.00)
Installation Cost	\$1,250.00	\$0.00	\$0.00	0.00
Electricity Cost	\$0.00	\$ 3,020.31	\$ 3,020.31	(14,658.85)
<b>Total Cost</b>	<b>\$25,550.00</b>			<b>(38,958.85)</b>
<b>Paper Towels</b>				
Annual Paper Towel Cost	0	\$8,773.92	\$8,773.92	(42,161.98)
Cleaning Costs	0	\$18,250.00	\$18,250.00	(87,698.14)
Cost of Liners		\$1,095.00	\$1,095.00	(5,314.51)
<b>Total Cost</b>				<b>(135,174.63)</b>



# Financial Analysis: Methods

- **Capital Cost**
  - # of Hand Dryer \* Cost / AirBlade
- **Paper Towel Cost**
  - # of Rolls for Wannamaker \* Cost / Roll
- **Maintenance Cost**
  - Duke Min. Wage, Hours of cleaning / dispenser and 365 days / year
  - Assumes proper restaffing of displaced custodial staff
- **Electricity Cost**
  - Average NC electricity cost, dry time, wattage in use, standby wattage, uses / day, days of use / year
- **Liner Cost**
  - Estimate of Cost / Liner, Estimate of Liners / Day

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## Financial Analysis: Further Sources of Gain

- Cost of storing 30.5 MT of waste over 5 years in landfills
- Financial benefit of carbon-reductions at scale
- Social and health benefit to students
- Improved custodial staff efficiency

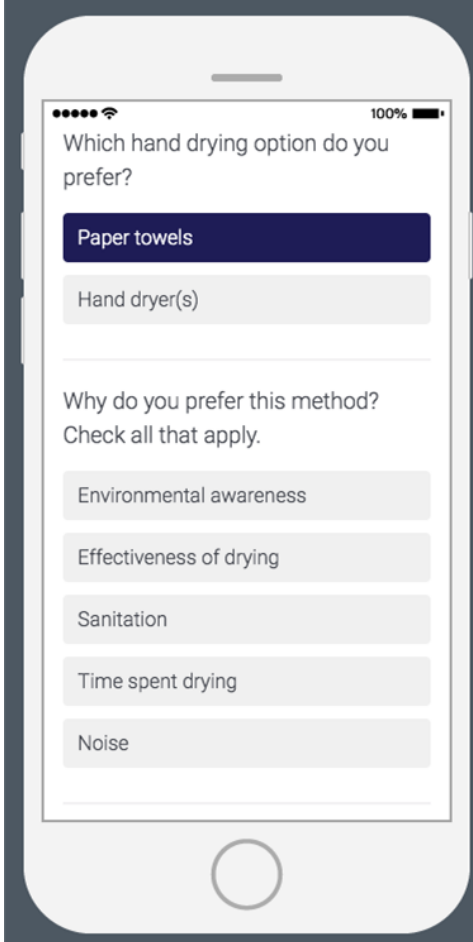


*Craven VO bathroom  
(renovated 2019)*



# Final Survey

- “Bathroom Exit Survey”
  - Locations: Bryan Center, Gross Hall, West Union
- Goal: understand student preferences
- 125 responses



Which hand drying option do you prefer?

Paper towels

Hand dryer(s)

Why do you prefer this method?  
Check all that apply.

Environmental awareness

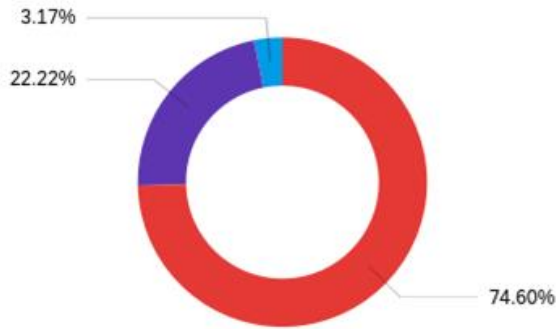
Effectiveness of drying

Sanitation

Time spent drying

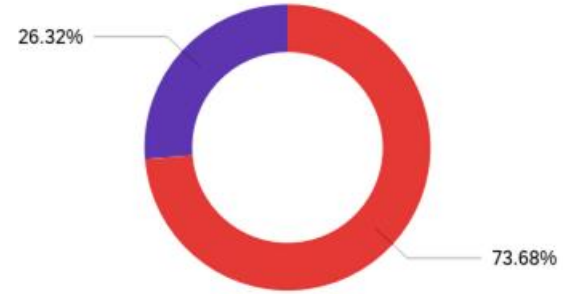
Noise

# Final Survey Insights



■ Paper towels ■ Hand dryer(s) ■ Did not dry

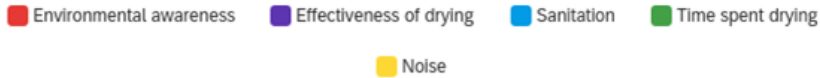
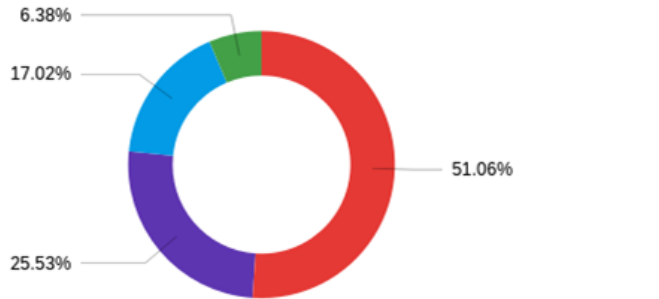
*Hand drying method used*



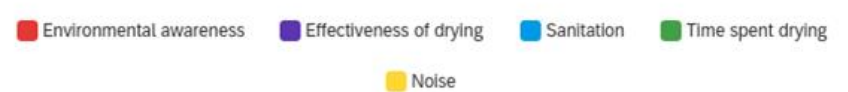
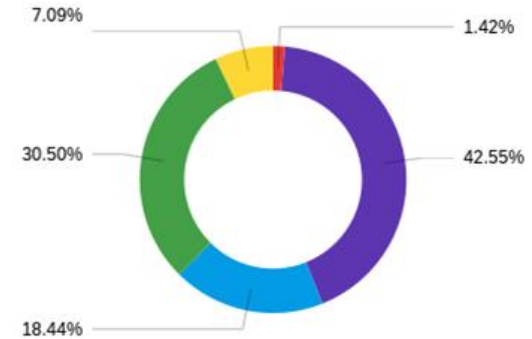
■ Paper towels ■ Hand dryer(s)

*Preferred hand drying method*

# Final Survey Insights



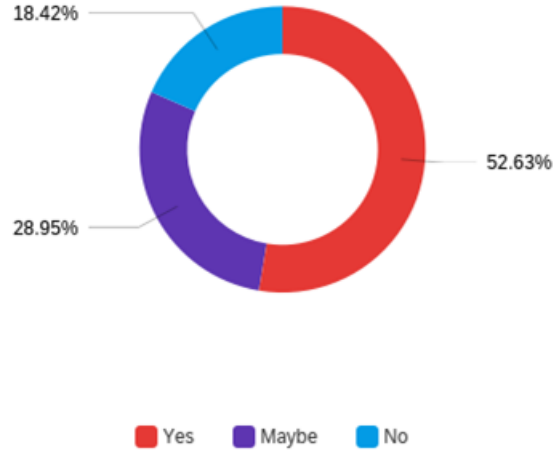
*Reasons people preferred hand dryers*



*Reasons people preferred paper towels*



# Final Survey Insights



*Whether people would support an initiative to replace paper towels with hand dryers*





## Final Remarks and Next Steps

- A switch to hand dryers makes sense environmentally, economically and socially
- Duke students and faculty would likely support an initiative
- Decision-makers may be unaware of the inefficiencies in hand-drying
- Proper communication with responsible parties around campus (Campus Sustainability Committee, Duke Facilities, etc.) will be vital