ENERGY INFORMATION TOOL

Duke UNIVERSITY | BASS CONNECTIONS

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Bass Connections in Energy & Environment

Introduction and Background

Currently, across the Duke campus, there is a growing emphasis on student-led sustainability efforts. However, students do not have access to transparent data on energy usage and waste.

- Natural gas: 49% of Duke's campus energy with carbon emissions levels; unaffected by grid decarbonization.
- **Energy Information Tool:** steam and hot water used primarily for sterilization and building heating
  - analyzes the past nine months of Duke's steam use data for each building
  - model predicting steam consumption for any building, day, or time
  - presents this on a website accessible to the Duke student body.

The project's engineering component collects data on **energy loss from automatic doors** using WiFi-compatible sensors linked to the web tool.

Objectives

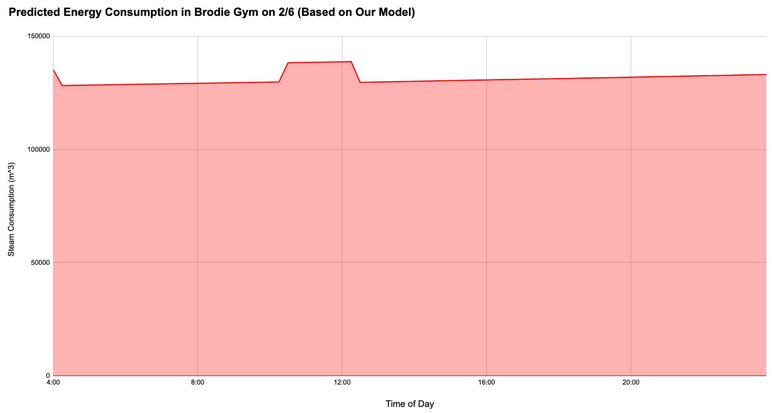
The Energy Information Tool was developed to

- **Democratize** energy usage data.
- **Empower** students, student groups, activists, and community members
- **Find better solutions** to energy waste at Duke.

SCAN ME

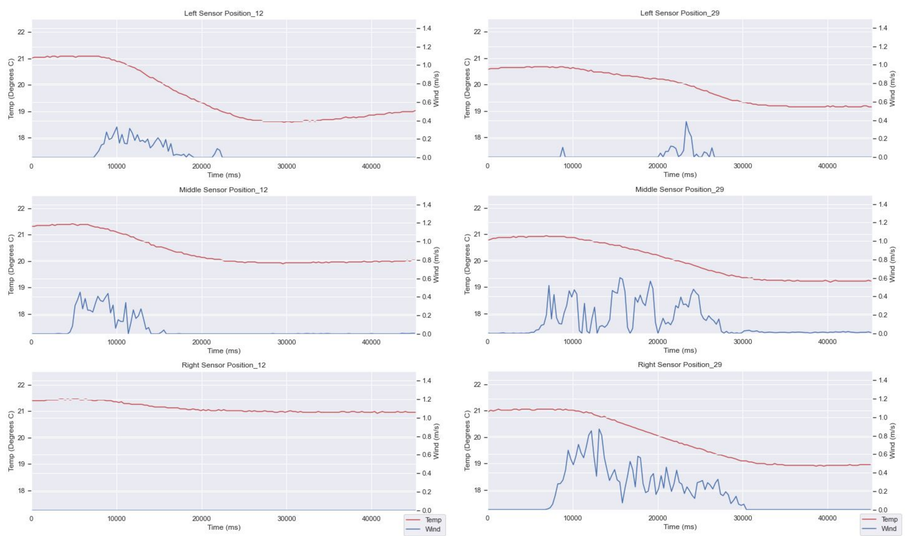
Our data module tool aims to assess and find appropriate solutions to energy wastes through automatic doors at Duke.

Energy Information Tool



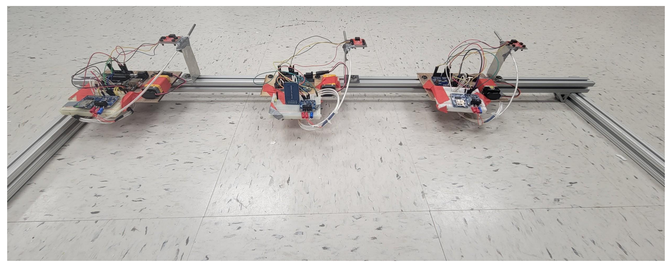
Example output from our steam use model for Brodie Gym on a given day. Our predictive model and analysis of steam use trends will give our website's users insight into how steam use could be more efficient and reduce Duke's natural gas-related emissions.

Energy Loss from Automatic Doors



Experimental data gathered across **lateral** sections of a door. The difference in gradients are affected by the positioning while opening and distance from the door.

Process and Results



- Developed sensor packs with **wind sensor** and **RTD thermocouple** to gather experimental data for model
- Model is used for **real-time energy loss calculations** with our final sensor pack
- This separate real-time sensor pack uploads data over Duke Visitor WiFi, into the web tool

Conclusion

Our work on this project will provide a platform for **policy advocacy and action** at Duke through cooperating on projects with campus-affiliated environmental and conservation groups.

On the engineering side, while our model does not have a high level of robustness, it has been demonstrated that modular data tools can be incorporated into the website, making it **customizable** for multiple scenarios in the future.

References

Albright, Elizabeth. "Response to Duke Climate Commitment." The Chronicle, October 12, 2022.

Duke Climate Commitment. "The Duke Climate Commitment," March 20, 2023.

Encyclopedia Britannica. "Climate - Atmospheric Pressure and Wind," March 29, 2023.

Goubran, Sherif, Dahai Qi, Wael Saleh, Liangzhu Wang, and Radu Zmeureanu. "Experimental Study on the Flow Characteristics of Air Curtains at Building Entrances." *Building and Environment* 105 (August 15, 2016): 225–35.

Riffat, S.B. "A Study of Heat and Mass Transfer through a Doorway in a Traditionally Built House," 1989.

Xing, Menglin, Xi Luo, Xiaojun Liu, Zhenchuan Ma, and Na Li. "Impacts of Building Energy Consumption Information on Energy-Saving Intention of College Students." Buildings 12, no. 6 (June 5, 2022): 769

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