Heat Pump Calculator – Web Application

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Abstract

- The City of Calgary wishes to provide homeowners with the information required to determine the economic feasibility and emission reductions of heating their homes with heat pump setups instead of gas furnaces.
- To make this information accessible to the average consumer, a web application that asks for general household information and returns a measure of its viability is needed.
- The information presented needs to be easy to obtain and presented in layman's terms, i.e. useful and usable by someone without technical proficiency.
- By creating a web application calculator, we were able to make achieve these goals by prioritizing a friendly user-interface and simplified usage of the calculations.

Introduction

- The City of Calgary has set a target of net zero emissions by 2050, which requires a large emissions reduction from building heating. Heat pumps are an alternative to gas furnaces that often use less emissions and save on energy costs, but would they still be economically and environmentally effective given Alberta's cold climate?
- Is it worth it for the average homeowner to invest in a heat pump for their home or is the technology not economically viable? How can we let everyday consumers make an educated decision based on their needs and circumstance?
- By creating an accessible web application that gives homeowners a general idea of the economic viability of heat pumps, we can inform their decision and bring transparency to the viability of heat pumps in Calgary.

Challenges

- Scope creep – stay focused to the goal at hand, prioritize main "must-have" requirements and leave out "nice-to-have" ones for future development
- Concurrent team development – unifying design decisions, integrating application components into cohesive final product, cleaner code
- Implementing calculations – implementing excel formula into web application vs. communicating directly with excel

Design Decisions

- Backend – Excel communication via Python, JSON/CSV format API calls
- Frontend – React + MaterialUI components, reusability/modularity
- Overall – Documented, readable code, methodology document

Conclusion

In conclusion, our capstone project successfully developed a user-friendly web application designed to calculate the economic viability and emission reduction potential of heat pumps for residential heating. By leveraging a client-server architecture and an intuitive interface, the application provides homeowners with an accessible tool for informed decision-making regarding sustainable heating solutions. This project not only facilitates a shift towards greener technology but also supports the City of Calgary's commitment to reducing net emissions. The provided methodology documentation along with proper coding practices and component construction will allow for a smooth transition into the cities IT department environment. Future developments may include expanding the calculator's functionality as well as expanding the criteria of selection for users when selecting a heat pump for better accuracy.

Methodology & Technologies Used

The web application uses a client-server software architecture where calculations are done on the server side and results are read and displayed on the client side. Many technologies were employed:

- React – allows for a dynamic front-end with interactive components that change dynamically within a page
- Express – standardized HTTP server protocol decoupled from front-end, used for clean API calls
- XLWings – python library that allows for communication with an excel process, used to perform calculations on the sheet itself
- Node.js – runs the web server in a JavaScript runtime
- NPM – package manager that ensure easy, consistent deployment in a reproducible environment
- MaterialUI – CSS library to enable cohesive and mobile-responsive component styling

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