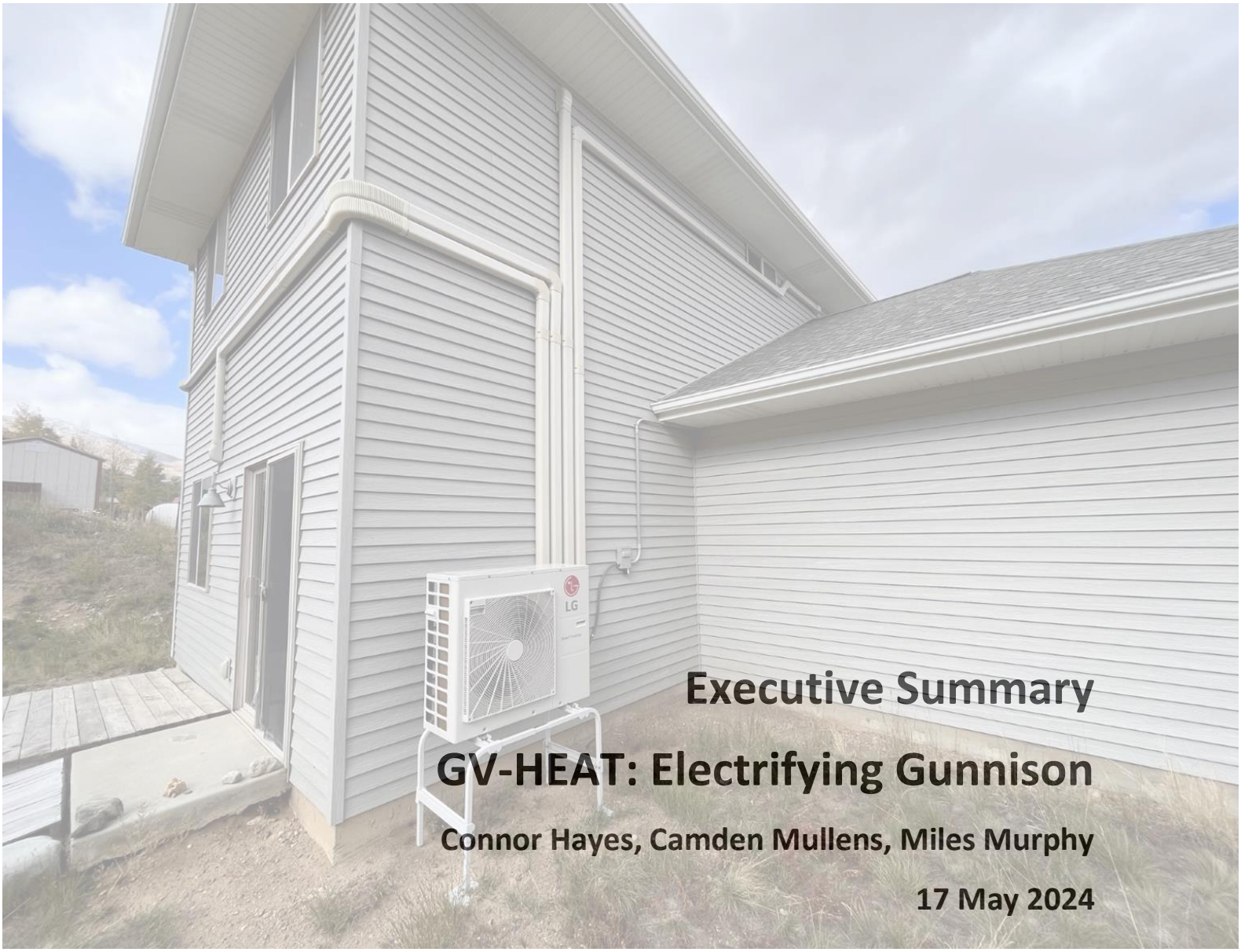

Executive Summary

GV-HEAT: Electrifying Gunnison

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17 May 2024

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Introduction

For our project our team of three mechanical engineering Capstone students of the CU Boulder / Western Colorado University Partnership Program worked with Gesa Michel of the Gunnison Valley Home Energy Advancement Team (GV-HEAT) to provide income qualified homes with energy efficiency upgrades. GV-HEAT is a local government agency in the Gunnison Valley that works to provide income qualified homes with energy efficiency assistance. Specifically, our team was looking at detailing the installation process of cold climate air source heat pumps (ccASHP) into these homes. This project is a continuation of the Building Electrification Implementation Plan that was published in spring of 2023.

Goals & Final Deliverables

Goals

- Provide cold climate air source heat pump upgrades to income qualified homes
- Improve quality of life for homeowners
- Secure federal, state, and local funding
- Reduce greenhouse gas emissions

Final Deliverables

- Five step-by-step implementation plans
- A general implementation plan
- An informational video explaining the project

Unit Selection

From our previous work on the Building Electrification Implementation Plan we knew that we would be looking for a cold climate air source heat pump mini-split system. We wanted a ccASHP mini-split system for a few reasons. First, these systems were designed to work in cold climates like Gunnison County. Second, with a mini-split system the installation wouldn't require ductwork to be installed or repaired. Finally, by using a mini-split system it made it easy to leave the existing heating system as a backup heating option for these homes. However, other than the type of system we did not know the heat pump size and what brand we should choose. We researched online identifying brands that appeared to be good choices like Mr. Cool and Fujitsu. Eventually we decided that it would be beneficial to get advice from contractors that have previously installed ccASHP systems. In October 2023, we shadowed Justin Wiseman of Wise Owl Energy in Alma, Colorado. Justin is a heat pump installer for the Weatherization Assistance Program (WAP)

and has been working in the HVAC field for over 8 years. During our site visit with Justin, he provided us with information on how to determine heat pump sizes, best practices when installing a heat pump, and general costs of installation.

After the site visit, we determined the heat pump sizes needed for each home. For this, we learned how to perform heat load calculations. Heat load calculations determine the required amount of heat energy that needs to be removed or added to a space to maintain a comfortable temperature. To perform these calculations, Andy Tocke of Little Foot Building, the local energy auditor in the Gunnison Valley, assisted us. Andy provided us with the energy audits and walked us through the heat load calculations answering questions about the construction of the home, the current insulation, the condition of the attic and crawl space, and the blower door value of the home. After determining that our systems would all either need 2- or 3-ton heat pumps, we defined what brand and specific unit would be ideal for our project. Since we were planning on using multiple rebates and funding sources, our units needed to meet specifications like being ENERGY STAR certified, and having high values for the SEER, HSPF, and EER ratings. Justin Wiseman recommended that we use the BOSCH Climate 5000 Max Performance Model Mini-Split because these units meet all the rebate and funding requirements, their newest model can function down to -22 Fahrenheit, and local contractors have experience installing them.

Funding Opportunities

One of the neat aspects of our project is that the homeowners will not have to pay for the purchase and installation of the ccASHP systems. To make this feasible for GV-HEAT, we had to utilize both local utility and federal rebates and incentives. To determine what rebates and incentives were available to us, we worked closely with Alantha Garrison, an energy use advisor at Gunnison County Electric Association (GCEA). Alantha was instrumental in helping us determine what GCEA and Tri-state rebates would be applicable to our project. She also helped us locate other rebate and incentive opportunities like the Municipal Energy Association of Nebraska (MEAN) rebate for homes in the City of Gunnison and the Quality Installer Program for heat pump installs with GCEA. We were able to meet with Loren Ahonen, a climate ready building lead at the Colorado Energy Office (CEO). Loren helped us to make sense of the upcoming Home Electrification and Appliance Rebate (HEAR) program and explained how the CEO tax credit for heat pumps works. The HEAR program rebate is expected to come out in late 2024 and will play a huge role in the success of this project. Overall, we were able to identify roughly $50,000 of total funding that would be available for the five homes. This means we would be able to reduce the total project costs per home from roughly $16,000 to $5,000.

Energy Savings and Greenhouse Gas Emissions

Before we recommended that any of these homes be outfitted with ccASHP systems, we wanted to make sure that it made sense in terms of energy savings for the homeowners. To determine this, we took their annual energy usage data for both electric and propane (if applicable) and compared this data to what their energy bills may look like after primarily using the ccASHP for heating. We were able to identify that homes on propane would see potential savings of up to $1,500 per year by not having to pay for propane. For the homes on electricity, the cost savings would look more like $200 - $300 a year. These findings led us to believe that this project makes sense to move forward with and it would be sustainable for the selected homes.

We also wanted to determine the greenhouse gas (GHG) emissions savings from installing ccASHP's into the homes. To perform these calculations, our project advisor Emily Artale helped. Emily walked us through how to perform these calculations and when to make necessary assumptions based on the limited information available. Overall, we determined that homes in GCEA territory would see GHG savings of roughly 761.69 lbs/mwh (pounds per megawatt hour) of CO2. The homes served by MEAN in the City of Gunnison would see savings of 869.18 lbs/mwh.

Summary of Findings and Recommendations

We were able to identify that four of our five selected homes should be outfitted with ccASHP systems. These homes were identified as good candidates due to the projected energy savings, the relative ease of installation, the willingness to participate by the homeowners, and the available funding opportunities. We also were able to identify that the BOSCH Climate 5000 model would be a suitable system that would be able to withstand the harsh conditions that people face in Gunnison County.

For the future, we recommend that GCEA and GV-HEAT work together to get the four installations completed in the fall or once the HEAR program funding becomes available. It is recommended that the two form a joint task force that will work to continue selecting homes and providing installations for the valley. It is not yet known whether this project will continue to be collaborated on by the University, either through the Western Colorado University's Master in Environmental Management program, or through the University of Colorado Boulder partnership engineering program, but it is recommended that Emily Artale maintains her position as main contact on the engineering side as she has an in-depth knowledge of the project and a true passion for the work.

There were certain elements that this three-person Capstone project was unable to complete such as examining the health benefits of removing propane heating systems from homes, particularly for children and elderly individuals. Due to time constraints homes with wood heating systems were considered carbon neutral as recommended by the EPA, but this should be examined further regarding the concept of biogenic CO2 emissions to determine if these types of heating systems would benefit from the upgrade to ccASHP when it comes to emissions. Workforce development in this field is also recommended as there are very few contractors willing or trained to do this sort of work, and most of the electricians in the Gunnison Valley are stretched to the limit of what they can accomplish with their limited availability. Another recommendation is to get more awareness for this project. This will likely help to attract funders. For example, we had the chance to participate as guest speakers in a 'Lunch and Learn Webinar' with GCEA and we were featured in the Gunnison County Times newspaper.

Overall, we believe that the installation of ccASHP's in the Gunnison Valley does make sense, especially for homes currently on propane heating. Additionally, as technology advances, these systems will likely become even more efficient and reliable in cold climates.

Disclaimer

This project document was prepared by three mechanical engineering students from the Western Colorado University and University of Colorado Partnership Program, not your qualified technician. The information provided in this document is a preliminary estimate for illustration purposes and does not serve as a binding agreement or obligation. Actual system efficiency or savings is not guaranteed. A qualified contractor will create the system design based on an engineering site audit. A cold climate air source heat pump (ccASHP) is selected based on the specific airflow, size, climate, and heating system of the home so its pricing, actual system efficiency, and savings will vary based on the final location, system size, design, utility rates, and applicable rebates. *Tax credits, incentives, savings, and rebates if any at the time of installation, are not guaranteed*.