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Policy Memo

Boise State University is in a unique position when it comes to future growth. There is currently a master plan that includes ideas to develop areas around the campus that are currently under private ownership. This plan includes many new housing projects as well as campus buildings intended for academic use. In order to save money and promote energy efficiency, I believe it is in Boise State University's best interest to use geothermal heating for these buildings. This memo is intended for the committee that is in charge of the Boise State University Campus Master Plan.

Geothermal Background

Geothermal heating has been widely adopted by many countries across the world. This form of energy is sustainable and is considered by the EPA and the Department of Energy to be the most environmentally friendly way to heat and cool a home (Benefits of Geothermal, 2018). Geothermal heating is also a great way to save money in the long run. Different than a gas furnace, geothermal heating does not require the burning of a material to generate energy, instead geothermal heating transfers that energy (Benefits of Geothermal, 2018). This transfer of energy leads to a 400% efficiency rating which significantly lowers the energy bill up to 70% (Benefits of a Geothermal, 2018). A low operating cost will save a significant amount of money because the cost of geothermal heating and cooling does not change once implemented. Currently, most buildings in America use natural gas as the source of heating which is cost efficient as long as the price of natural gas stays low. When the price of natural gas begins to increase this will raise the amount of money being spent on heating a building. Natural gas prices are subject to outside market forces and could change rapidly if there were to ever be a shortage. Another benefit of geothermal heating systems is their long lifetime. Typically, the system lasts for 15+ years while a typical furnace lasts 7-10 years with regular maintenance (Benefits of a Geothermal, 2018). This helps ensure the longevity of the system and removes the need to constantly replace the heating source.

Planning Alternatives

In order for Boise State University to receive these benefits, it must commit to using geothermal heating for the new buildings that are planned. This requires a change in the Campus Master Plan of Boise State's expansion. In order to implement this type of heating system, the Campus Planning Committee would need to conduct further research. Specifically, further

research would need to cover changing building designs to accommodate geothermal heating, as well as how one gallon of geothermally heated water could provide multiple uses. Conducting further research on these topics would prove invaluable as it would show the benefits of using a geothermal heating system.

Analysis of Geothermal Heat Pump vs Natural Gas furnace

Benefits of using a geothermal heating system range from economic to environmental. There was a study conducted in Canada comparing different heating sources, their cost and CO2 emissions. The study used 3 different provinces; Alberta, Ontario and Nova Scotia. The capital cost of the geothermal heat pump system was valued at $9000 with monetary units being 2009 Canadian dollars (Self, 2013). The capital cost was significantly more than a mid-efficiency natural gas furnace that came in at $1500 (Self, 2013). However once installed the geothermal heat pump system annual heating costs were much lower than the natural gas furnace. In Alberta, the geothermal heat pump cost $601 annually while the natural gas furnace was $1276 annually (Self, 2013). This trend continued in Ontario and Nova Scotia as the operating cost for them were $328 and $649 respectively (Self, 2013). Ontario's natural gas furnace annual cost was $2344 and Nova Scotia's was $1885 (Self, 2013). Geothermal heat pump users in Ontario experienced the greatest savings at $2016. With such great savings, the citizens of Ontario that invested in geothermal heat pumps would see a return on their investment after only 5 years of use. This study shows the cost-effectiveness of using a geothermal heat pumping system. For each annual cost, the geothermal heat pump was either 2 to 3 times cheaper than the natural gas furnace cost. With such a high-cost effectiveness geothermal heating would help save thousands of dollars throughout the years.

The same study also conducted research on the amount of CO2 that was emitted for each heating system at various locations. The annual fuel use (kWh) for the geothermal heat pump was 6080 kWh while the natural gas furnace used 28,475 kWh (Self, 2013). In Alberta, the CO2 emitted by the geothermal heat pump was 6826 kg while the natural gas furnace emitted 5410 kg of CO2 (Self, 2013). For Ontario, the geothermal heat pump emitted 1143 kg of CO2 while the natural gas furnace emitted 5410 kg of CO2, this may be due to Ontario receiving over 50% of its electricity production from nuclear energy and the remainder divided between natural gas power plants and hydroelectric plants (Self, 2013). Nova Scotia experienced results similar to Alberta with their geothermal heat pumps emitting 6346 kg of CO2 and the natural gas furnace emitting 5410 kg of CO2 (Self, 2013). Although the geothermal heat pump used significantly less kWh than the natural gas furnace we saw similar carbon emissions when the province provided electricity for the heat pump using fossil fuels. However, geothermal heat pumps offer the greatest emission reduction relative to conventional electrical heating devices and natural gas-fired systems when the electricity used by the heat pumps is delivered from a renewable energy source (Self, 2013). The analysis of various heating systems showed that geothermal heat

pumps are economically viable and when coupled with other renewable energy sources it provides a reduction in carbon dioxide emitted.

Tradeoffs

If Boise State University were to implement geothermal heating into the new buildings there would be tradeoffs that come with that decision. Although the heating system would be a higher capital cost the university would see savings annually in the operating cost when compared to a natural gas furnace. However, the capital cost might be reduced as the City of Boise currently has a geothermal water pipe the runs underneath University Drive. With the geothermal pipe already in place, Boise State University would simply need to ensure the building is able to connect to the system already there.

When it comes to the amount of carbon emitted when using a geothermal heat source Boise has an advantage because Idaho generates over 50% of our electricity using hydroelectric power plants with the rest coming from natural gas plants and other renewable sources (U.S. Energy Information, 2018). This means that almost any electricity required to use the geothermal heat pumps would come from a sustainable source and we would see a reduction in the amount of CO2 emitted. This would help Boise State University become more sustainable. One negative tradeoff as a result of using geothermal heating is a reduction in the quality of the water being used. This is due to water being lost when it changes phase to steam. As a result, extra water needs to be added to the reservoir and in some cases the water added is non-potable treated wastewater (Environmental Impacts of Geothermal, 2018). This addition reduces the water quality of the reservoir.

Due to prices of natural gas fluctuating based on outside market forces, it presents a system with a low resiliency to change. However, because of how geothermal energy is constantly being produced and it is an independent system it has a high resiliency (Geothermal Heating, 2018). This makes geothermal heating a dependable source of energy and ensures use in the future.

Implementation

Boise State University currently has 6 buildings that are using geothermal energy to heat them. These buildings include the Morrison Center, the Multipurpose Building, the Interactive Learning Center, the Administration Building and the Student Union Building. Because Boise State already has these buildings in the City of Boise's Geothermal Heating District they are aware of the requirements necessary to use this source of heating. In order to receive the most efficient use of geothermally heated water Boise State University would need to plan exactly how each building can maximize its use. For example, the Owyhee building uses the same gallon of water for 3 different uses before it leaves their system (Gunnerson, 2018). First, they use the water to heat the building, after that the water's temperature is still high enough that they use it to

preheat the water for all of the local taps within the building (Gunnerson, 2018). Finally, the water goes outside and is used to warm the sidewalks outside of the building which melts any snow or ice on the sidewalk (Gunnerson, 2018). Even though the Owyhee building pays for each gallon of water used individually they get 3 different benefits from the one gallon.

Boise State University could implement the same if not very similar systems within the new buildings. If Boise State were to use the water to heat sidewalks this would help during the harsh winters and reduce the amount of money being spent on de-icing chemicals. De-icing chemicals can have a negative impact on the surrounding environment by infiltrating groundwater and surface water sources (Environmental Impacts of Road salt, 2017). Implementing sidewalk warmers would decrease the amount of de-icing chemicals needed by the university and have a positive impact on the environment.

Conclusion

In order for Boise State University to become a more environmentally conscious university, these are the types of changes that need to occur. By implementing a geothermal heating system within new buildings being constructed Boise State would save money on operating costs and reduce their carbon emissions. They would also ensure that they are not subject to changes in the price of natural gas and any effects that could occur due to the high prices. Being environmentally sustainable could attract new students as well as companies that want to partner with a sustainable university. This is also another step in Boise's quest to become an environmentally conscious city that cares about people, the environment and economic sustainability.

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