Ethan Ellis, James Harren, Emma Leither, Colleen Scallen
Environmental Ethics 215
Prof. Kim Smith

An Ethical Analysis of Carleton's Geothermal Heating and Cooling Plan

Introduction

The Carleton College Board of Trustees recently approved a plan to replace Carleton's current steam heating system with a geothermal heating and cooling system supplemented by a hot water boiler. This system will significantly reduce the college's carbon emissions and put Carleton on track to meet its Climate Action Plan. However, implementing this new system will require Carleton to retire its steam boiler halfway through its engineered lifespan. The following white paper analyzes the ethical implications of this plan on both Carleton and its stakeholders. In this paper, we will argue that the college should replace its steam boiler with a geothermal heating and cooling system because doing so fulfills Carleton's duties to its stakeholders.

The Boiler and its Fuels

The Boiler.[1]

Carleton currently uses a steam boiler system. The campus relies on three boilers to accommodate its heating and cooling needs. The boilers are from 1954, 1988, and 1995, and use 35,000, 25,000, and 50,000 pounds/hour of steam heat, respectively. While the 1995 boiler uses the most steam heat per hour, it does have an economizer --an apparatus that grabs heat off of the flue gas exiting the boiler-- which makes it more energy-efficient than the other two boilers. The 1954 boiler is currently used as a backup boiler as it is well beyond its guaranteed useful life, and the 1988 boiler is also at the end of its lifespan. Any ethical dilemma would pertain to the 1995

[1] Martha Larson, Personal Interview with Ethan Ellis, James Harren, Emma Leither, Colleen Scallen

boiler, as it is only halfway through its useful lifespan. The boilers run on steam heat, or water heated to 330℉. Something must be burned to achieve such high temperatures; Carleton currently burns fossil fuels.The burning of these fossil fuels leads to global climate change which yields a multitude of detrimental effects to humans and the biotic community. The burning of fossil fuels is directly linked with increased temperatures and more intense weather patterns.[2] Extreme temperatures and weather catastrophes are becoming a larger problem worldwide, as they kill and displace large numbers of people. The burning of fossil fuels also degrades air quality. Annually, three million people die due to poor air quality caused by air pollution.[3] By implementing a geothermal system, Carleton can weaken the impacts of climate change, as a geothermal energy system does not rely on fossil fuels.

Cost of the Boiler.

The cost to maintain the full current system is around $20 million; $500,000 of this sum is specifically spent annually on maintaining the current boiler, as it requires 24/7 in-person monitoring.

The New Boiler.[4]

Carleton's new boiler would be a hot water boiler. Such a boiler would run on hot water heated to 120℉, which requires less heat than a steam boiler and therefore reduces carbon emissions. The new boiler is a condensing boiler. Martha Larson, Carleton's Manager of Campus Energy and Sustainability, sums up the new boiler's functions when she says:

---

[2] Sommer, Burning Fossil Fuels.
[3] Sommer.
[4] Martha Larson, October 12th email to Ethan Ellis, James Harren, Emma Leither, and Colleen Scallen.

> They [the condensing boiler] send water out at 120 degrees F, it gives heat to all the rooms on campus that it passes through (your dorm rooms and classrooms, etc) and then that water comes back to the plant at about 100 degrees F. This is a temperature that is cool enough for any water vapor to condense as it passes back through the boiler - when water changes phase from a vapor to a liquid you get an extra boost of efficiency by capturing the energy embedded in that phase change.[5]

Larson's explanation illustrates how the new boiler will not only generate less carbon emissions by using hot water instead of steam, but will also incorporate an "extra boost of efficiency" by using any energy naturally generated in a water phase change.

The New Boiler and Energy Efficiency.

The new hot water boiler would rely on an in-house energy grid--that is, Carleton would be moving their energy production on campus so as not to rely on large corporations like Excel for energy needs. This is especially influential on days when drastic heating and cooling needs require Carleton to go off the Xcel Energy grid and burn diesel fuel (a component of a deal brokered with Xcel to get Carleton cheaper rates). This transition decreases campus carbon emissions by using only natural gas, which is considered to be "cleaner" pollution that burning fossil fuels.

The Geothermal System

Overview.

Carleton's new proposed energy heating and cooling infrastructure will consist not only of a hot water boiler, but also of geothermal units. These geothermal units will provide for the

[5] Larson, October 12th email.

bulk of the campus's heating and cooling needs, while the boiler will be used as a supplement during days of extreme temperatures.

How Geothermal Works.

A geothermal heating and cooling system, unlike the boiler system Carleton currently uses, is sourced from renewable energy. Geothermal energy takes advantage of the energy that is naturally produced in the earth's crust. The earth's crust holds a tremendous amount of untapped energy, as "the amount of heat within 10,000 meters (about 33,000 feet) of Earth's surface contains 50,000 times more energy than all the oil and natural gas resources in the world."[6]

The process in which energy is created in the earth's crust, hydrothermal convection, is relatively simple. Hydrothermal convection describes the way that water is heated in the earth's crust. Cooler water seeps into the earth's crust, but as it moves farther down, the crust's temperature rises, causing the water to become heated and rise to the surface of the crust.[7] To utilize this energy process for heating and cooling purposes, holes are drilled into the crust of the earth and ground source heat pumps are installed. This kind of system would be ideal at Carleton because "in regions with temperature extremes . . . ground-source heat pumps are the most energy-efficient and environmentally clean heating and cooling systems available."[8] While the temperature of the air at Carleton can reach extremes, just a few feet below the ground, the earth's crust maintains a temperature of fifty degrees Fahrenheit.[9] Ground source heat pumps consist of a loop system. Water, or water with antifreeze liquid, is pumped through these piping systems to retrieve the energy from the earth. In the winter, the air outside is colder than the air

---

[6] Union of Concerned Scientists, "How Geothermal Energy Works," last modified December 22, 2014, http://ucsusa.org/clean_energy/our-energy-choices/renewable-energy/how-geothermal-energy-works.htm.#.V_0N4WVlmu5.
[7] Union of Concerned Scientists, "How Geothermal Energy Works."
[8] Union of Concerned Scientists, "How Geothermal Energy Works."
[9] Union of Concerned Scientists, "How Geothermal Energy Works."

in the earth's crust, so colder water and antifreeze liquid enter the piping system, are heated by the warm temperatures of the earth's crust, and then are returned via pipes to buildings at a warmer temperature, containing heat for the building. In the summer, the system is reversed. The air outside is warmer than the earth's crust, so the water in the loop absorbs heat from the building, and is transported into the earth's crust, where it is cooled and then transported back to the building to provide cooling.[10]

Once the ground source heat pump is installed, it is relatively easy to transport the heating or cooling energy with a piping system. Piping systems can be very expensive, especially within a geothermal system, because all of the energy has to come from the ground and then be piped to the various buildings. The extensive piping networks usually make up sixty percent of the total cost of installing a geothermal system.[11] Yet once installed, the piping networks work very efficiently, especially for large areas of land like Carleton's campus. Geothermal systems are "designed to provide space heating and/or cooling to multiple consumers from a single or multiple production wells or fields"[12] which is suitable for Carleton, as it hosts more than fifty buildings on its campus.

Why Geothermal Now?

Geothermal is a smart investment, as it presents the opportunity for Carleton to be fueled by renewable energy and its system design is suited well for a large campus. However, many will question why the geothermal system should be implemented now, and not in twenty years when Carleton's primary boiler will reach the end of its lifespan. The college reasons that

---

[10] Union of Concerned Scientists, "How Geothermal Energy Works."
[11] Gokchen, Gulden; Toksoy, Macit; and Yildirim, Nurdan, "Piping Network Design of Geothermal District Heating Systems for a University Campus," *Energy*, 35 (2010): 3256-3262, accessed October 11, 2016. http://www.sciencedirect.com/science/article/pii/S036054421000201X.
[12] Gokchen, Toksoy, and Nurdan, "Piping Design of Geothermal."

implementing a geothermal system will require it to dig deeply into the ground, which will likely interfere with other buildings and events on campus, as well as present significant construction costs. Currently, Carleton is planning to renovate Hulings Hall and Olin Hall, remove Mudd Hall, and add an additional science complex.[13] This large project already involves much of the digging and construction that would be necessary to create a geothermal system. If Carleton simultaneously renovates the science buildings and puts in the piping and ground source heat pump for a geothermal system, the college will save tremendous construction costs.

Ethical Analysis

Overview.

Although this transition to a new heating and cooling system may seem like a proper way to maximize efficiency, it is essential for Carleton to consider the ethical implications of this energy infrastructure transition.

Why Stakeholder Theory.

We will apply Freeman's Stakeholder Theory in outlining the college's responsibilities to its community. Stakeholder Theory is a response to the theory of corporate social responsibility proposed by Milton Friedman. Friedman argues that the only responsibility of a corporation's executives is to make money for the shareholders because these executives are hired by the shareholders and therefore "[have] direct responsibility to [their] employers."[14] Responsibilities to people other than shareholders would be unethical in his analysis because in order for the executive to provide social goods, they must act like a government and impose what Friedman

[13] Carleton College Facilities Management, "Science Building Addition and Renovation," last modified 5 Nov, 2015. https://apps.carleton.edu/campus/facilities/projects/science/.
[14] Milton Friedman, "The Social Responsibility of Business is to Increase its Profits," *The New York Times Magazine*, The New York Times Company, September 13, 1970.

would call a tax upon the shareholders' investments in the corporation. Since the executive is not elected by democratic means, this "governmental" action should not be performed by the corporate executive in Friedman's theory.[15] However, such a prescription of executive responsibilities of a corporation is inadequate because it neglects to recognize baseline corporate social responsibilities. R. Edward Freeman claims that corporations have a responsibility to stakeholders, those who have a stake in the corporation, because providing some social good exerts externalities and other moral hazards on stakeholders.[16] These realities illustrate that corporate social responsibilities exist, in addition to a corporation's implied duty to shareholders.

Freeman's stakeholder theory is a theory of corporate social responsibility that addresses these corporate externalities. To develop a stakeholder theory of corporate social responsibilities, the stakeholders, those that have a reciprocal relation with the corporation[17], and the normative core of the theory must be defined. The normative core is an ethical code of conduct delineating how corporations should be governed and how managers should act.[18] In our stakeholder theory, the normative core will be that corporations should be governed in accordance with justice. The managers then have a duty to develop and maintain just relations between the corporation and its stakeholders. Such a relationship should allow for the fullest consideration and fairest fulfillment of expectations imposed by each stakeholder so long as the corporation can provide its social good (in Carleton's case, a liberal arts education) as well as maintaining energy justice.

Who Are Carleton's Stakeholders?

Delineating the stakeholders of a corporation can be a difficult task; many people can make claims on a corporation and attention must be given to those who can make such claims.

---

[15] Friedman, "The Social Responsibility to Increase Profits."
[16] Freeman, "Stakeholder Theory," 214.
[17] Freeman, "Stakeholder Theory," 215.
[18] Freeman, "Stakeholder Theory," 217.

Andrew Crane and Trish Ruebottom claim that a failure in stakeholder identification arises from too narrow a definition in which stakeholders are chosen based solely on economic claims to the corporation. They believe this method of defining stakeholders should be broadened to include social identities as well as their economic connection.[19] Through the acknowledgement of social categories, a corporation is better able to understand the desires of its stakeholders and therefore its duties to them. An example that is pertinent to Carleton is that of the poor. Poor students have a claim on some of the monetary resources that the college has to help pay for their tuition and allow them to thrive as students, yet poor community members do not have claims to the college to help alleviate their poverty. Helping poor students contributes to Carleton's purpose of education while helping poor community members does not. Considering stakeholders in this manner will aid in better understanding their expectations from a corporation; it is also relevant for analyzing how the decisions surrounding the boiler will affect Carleton's stakeholders. The stakeholders that will be analyzed in this paper will be students, faculty, staff, donors, alumni, the local community, the local biotic community, and future stakeholders. The local biotic community includes the flora, fauna, and their relationships that make up the ecosystem on Carleton's campus as well as neighboring natural communities.

Why Should Carleton Apply Stakeholder Theory?

This stakeholder theory is in the interest of Carleton College for several reasons. Primarily, there are many laws that force a just relationship between Carleton and its stakeholders. For example, Carleton must allow some level of privacy to its students who live on campus. Additionally, maintaining a respectful relationship with stakeholders outside of the law is in the interest of Carleton. If Carleton does not fulfill a duty to a stakeholder, this stakeholder

[19] Andrew Crane and Trish Ruebottom, "Stakeholder Theory and Social Identity: Rethinking Stakeholder Identification," *Journal of Business Ethics* 102 (2011): 77-8.

has the power to retaliate. For example, if the college decides to stop heating its dorms, then students have the power to transfer or drop out of Carleton, thus costing the college millions of tuition dollars and therefore diminishing its ability to provide a liberal arts education. Also, if Carleton does not keep its local biotic community healthy, then students would not have as good an opportunity to engage with the natural world, an important element of a quality education. Respect for the stakeholder's expectations of their reciprocal relations with Carleton is in the college's desire for self-preservation.

Additionally, as a non-profit corporation, Carleton has an interest in outlining its stakeholders and its duties to them because it can be a way to maximize the social benefit that it provides. Luk Bouckaert and Jan Vandenhove question the need to outline corporate duties in the nonprofit sector through stakeholder theory since the nonprofit sector's "origin and mission has already a strong social dimension."[20] Yet, they come to conclude that outlining these duties through stakeholder theory could help end the "struggle surrounding the distribution of the social profit and the determination of its content."[21] Stakeholder theory then allows for a conceptualization of duties that leads to the most proper dissemination of social goods.

Energy Justice.

In order to fulfill its duties to stakeholders based on its normative core of justice, Carleton must act in accordance with energy justice. An energy system that is just "fairly disseminates both the benefits and costs of energy services."[22] While it might seem relatively simple for Carleton to ensure that its stakeholders equally share the benefits and costs of the energy system,

---

[20] Luk Bouckaert and Jan Vandenhove, "Business Ethics and the Management of Non-Profit Institutions," *Journal of Business Ethics* 17, no. 9/10 (1998): 1073.
[21] Bouckaert and Vandenhove, "Management of Non-Profit Institutions," 1075.
[22] Dworkin, Michael H., and Benjamin K. Sovacool, "Energy Justice: Conceptual Insights and Practical Applications," *Applied Energy* 142 (2015): 436.

it can actually become quite difficult, as different stakeholders gain benefits and suffer from costs in many different ways.

Energy justice consists of a prohibitive principle and an affirmative principle.[23] The prohibitive principle states that energy systems cannot be made in a manner that will interfere with anyone's right to obtain basic goods.[24] As mentioned in previous sections, Carleton's current heating and cooling system contributes to climate change. Climate change already affects many people around the globe, but it will yield the largest effects on future humans and the future biotic community. With regards to the prohibitive principle, Carleton's heating and cooling system will likely interfere with the future generation's right to obtain basic goods, as climate change is likely to decrease the amount of livable land, limit available drinking water, and cause many natural disasters. Studies have also found "that the effects of global warming . . . can be linked to extreme and prolonged cold weather patterns in mid-latitudes."[25] These extreme cold temperatures can be disastrous to those without access to adequate heating systems, as "energy related disparities increase the sensitivity of low-income and other vulnerable households to extreme temperature exposure resulting in detrimental health implications."[26] People with lower incomes do not have the access to some basic goods, like adequate shelters and general health, because of the impacts of unsustainable heating and cooling systems. Carleton's current boilers decreases many people's rights to basic goods by contributing to climate change. If Carleton transitioned to a geothermal system, it would reduce its carbon emissions, decreasing the level at which it contributes to climate change and interferes with

---

[23] Jones, Benjamin R., Benjamin K Sovacool, and Roman V. Sidortsov, "Making the Ethical and Philosophical Case for 'Energy Justice,'" *Environmental Ethics* 37 (2015): 162-167.
[24] Jones, Sovacool, and Sidortsov, "Ethical and Philosophical Case for Energy Justice," 162.
[25] Reames, Tony Gerard, "Targeting Energy Justice: Exploring Spatial, Racial/Ethnic and Socioeconomic Disparities in Urban Residential Heating Energy Efficiency," *Energy Policy* 27 (2016): 557.
[26] Reames, "Targeting Energy Justice," 557.

people's abilities to obtain basic goods. Therefore, the prohibitive principle of energy justice makes the case that Carleton has an ethical responsibility to transition away from a reliance on fossil fuels, and transition to a geothermal system and retire the steam boiler early because if the college does not, then Carleton would not treat future generations with justice.

The affirmative principle of energy justice maintains that if energy is necessary to obtaining basic goods, then people have a right to an energy system, as well as the basic goods. Regardless of whether Carleton chooses to fuel campus with a steam boiler or a geothermal system, the college will provide heating and cooling to Carleton students, faculty, and staff. These are Carleton's only stakeholders that have just claim to its energy services.

Under the principle of energy justice, it is also important to maintain discussions of both distributive justice and procedural justice. Distributive justice "is the idea that all members of society have the right to equal treatment, and that outcomes should be fairly distributed."[27] In this case, distributive justice maintains that the benefits and burdens of Carleton's heating and cooling system need to be distributed equally among Carleton's stakeholders. Currently, the benefits of the boiler, heating and cooling, go only to Carleton students, faculty, and staff. The financial burden of the system is carried by Carleton, but the ecological burdens are disproportionately placed on the future stakeholders and the present biotic community. For example, when the pipes are installed, some members of the biotic community living in the Bald Spot will be negatively impacted. However, the digging will occur on areas that have already been shaped for human use. We recognize the potential harm of this digging, but we believe the overall ecological benefits of a geothermal system outweigh the ecological harms. While it is impossible to equally distribute the benefits of Carleton's heating and cooling system between future generations or the biotic community, it is possible to minimize the costs these stakeholders

[27] Reames, "Targeting Energy Justice," 550.

pay for the present heating and cooling system. The geothermal system is a sustainable option. Therefore, the geothermal system is Carleton's best method to maintain distributive justice among its stakeholders.

Procedural justice mandates that Carleton has an ethical obligation to ensure that the procedure of determining Carleton's heating and cooling systems is fair and includes a discussion involving all stakeholders. Fossil fuel industries are large and powerful, as they own the world's primary source of energy. Power "harbors a potential for domination."[28] Currently, large fossil fuel companies are the most powerful players in the energy market. They spend large sums of money lobbying against regulations, working to ensure that fossil fuels remain the world's primary source of energy. They make it appear that a reliance on fossil fuels is the only way to provide enough energy, especially for a large institution like Carleton, but this is not true. Carleton's decision regarding a heating and cooling system does not need to be decided by the fossil fuel industry. Stakeholders can and should help make the decision, as "encouraging greater stakeholder and public participation is critical to addressing procedural justice concerns within sustainability transitions."[29] Carleton's stakeholders need a way to express their attitudes regarding the possible early retirement of the boiler and transition to a geothermal system. Currently, the Board of Trustees is the sole actor in the decision process. To ensure energy justice, Carleton needs to create a way for students, faculty, staff, Northfield residents, and the biotic community to determine a collaborative decision-making procedure. One important aspect of energy justice is providing knowledge of decisions regarding energy systems.[30] According to the aforementioned survey, 73% of Carleton students had not heard of Carleton's proposed plan

---

[28] Jones, Sovacool, "Ethical and Philosophical Case for Energy Justice," 147.
[29] Bickerstaff, Karen, Harriet Bulkeley, and Gordon Walker, *Energy Justice in a Changing Climate: Social Equity and Low-Carbon Energy* (New York: Zed Books, 2013), 60.
[30] Dworkin and Sovacool, "Energy Justice."

to transition to a geothermal system.[31] While Carleton students do not have the same opportunity to vote on the decision as Carleton's trustees, they have the ability to communicate their opinions about Carleton's heating and cooling system with the Trustees. In order to maintain the integrity of procedural justice, Carleton needs to educate the students about its upcoming heating and cooling system decisions so that the students can participate in the decision process as stakeholders. Other stakeholders, such as faculty, staff, and the Northfield residential community need broader education about Carleton's possible transition so that they can voice their opinions. The biotic community has no audible voice, yet they are stakeholders, and their needs are relevant to this decision. Carleton needs to take the biotic community's needs into account, understanding that a sustainable energy system that limits carbon emissions is best for preserving the natural properties of the biotic community. If Carleton is to ensure procedural justice, they are to consider the voices of all of Carleton's stakeholders during the decision process.

Individual Issues Affecting Stakeholders

Overview.

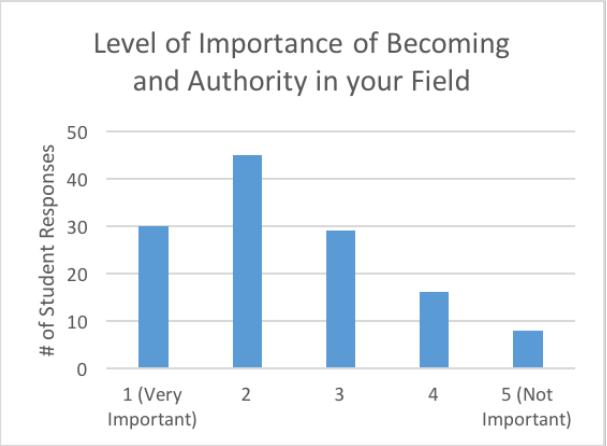
It is imperative to analyze each of the consequences of this transition to a new heating system and see if duties to stakeholders are being fulfilled or neglected. In this section, the following issues will be analyzed: prestige, cost, jobs, the waste stream, climate change, and energy justice.

Prestige.

One of the reasons why Carleton is choosing to make the switch to geothermal heating now is because this construction will coincide with the renovation of the science complex, so the

[31] This data comes from the aforementioned survey conducted by the ENTS 215 course. Students surveyed were asked the following question: "Are you familiar with Carleton's plan to install a geothermal heating and cooling system?" The allowed responses were yes or no.

ethics of the geothermal heating system are tied to the science complex. New facilities, such as the renovated science complex or the Weitz Center for Creativity, increase the college's carbon footprint regardless of how efficient the new facilities are. While the Weitz Center for Creative is a LEED gold certified building, the college still had to choose to expand its footprint to include another block of land and another building that has to be powered.[32] A new, fresh, and aesthetically pleasing center for creativity, like a shining new science complex, is not necessary for a liberal arts education, however they are powerful recruiting tools that helps the college to attract top students and maintain rankings. So, this begs the question: to what extent should Carleton strive to be prestigious for prestige's sake? We are consistently ranked one of the top liberal arts schools in the country, with our peers mostly being on the east coast and having larger endowments.[33,34] To what extent should we feel like we must compete with them in order to achieve our goals as an institution?



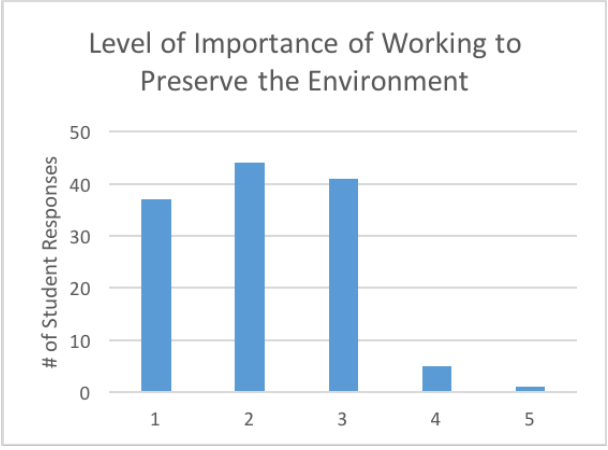


Figure 1
Source: Carleton College ENTS 215 Environmental Ethics Survey Fall 2016

While rankings should not be seen as ends in and of themselves, it is undeniable that they can help Carleton to achieve its and its stakeholder's goals. In looking at the goals of Carleton

[32] "Weitz Center for Creativity," Carleton College, November 3, 2016, https://apps.carleton.edu/weitz/about/facility/
[33] "Carleton College," U.S. News and World Report, 2016 http://colleges.usnews.rankingsandreviews.com/best-colleges/carleton-college-2340
[34] Corey Bunje Bower, "Endowments of Top 25 Liberal Arts Colleges," Thoughts on Higher Education, January 31, 2012.

students, 61% of the 128 Carleton students that took a 2016 survey responded that becoming a leader in their field was either very important or one ranking below very important or important (see *figure 1*).[35] While these numbers are not as high as the numbers for the importance of preserving the environment (see *figure 2*), this does not mean we can ignore the fact that Carleton students generally want to be highly successful in their lives beyond Carleton. Those rankings technically do not directly affect the quality of the liberal arts education that students receive, however they do affect the significance of a Carleton degree. The rankings indicate prestige, and employers and graduate schools are cognizant of the prestige of the undergraduate institutions of their potential employees and graduate students. Thus, Carleton maintaining its prestige is critical to students that want to become leaders in their field. Furthermore, there is a feedback loop that is created when Carleton students become highly successful in their post-Carleton lives as these students will be more capable of giving back to Carleton. Carleton can then use this money to continue trying to become more sustainable or improve the quality of education of its future students. So, we cannot say that Carleton should completely disregard its prestige in making policy decisions.

Caring about prestige can also lead the college to being more sustainable. In the climate action plan Steven Poskanzer notes, "Being a signatory to the American College and University Presidents' Climate Commitment furthers the dedication to environmental stewardship demonstrated by our predecessors and aligns Carleton with more than 670 other higher educational institutions."[36] In other words, it could have reflected poorly on Carleton for us to

---

[35] This Survey was performed in Fall 2016 by Kim Smith's ENTS 215 course in accordance with the Institutional Review Board's standards for social and behavioral studies. An email was sent to 400 students (100 in each class year), containing a link to this survey which measured the values and thoughts regarding environmental issues of Carleton students. The survey responses above are in response to the following question: "Using a scale from 1 to 5, where 1 is very important and 5 is not important, please indicate how important the following general life goals are to you personally."

[36] Carleton Steering Committee, "Climate Action Plan."

not have a climate action plan in place. By following through with the transition to the new geothermal system, and therefore lessening the campus carbon footprint, the college is adhering to its commitment to mitigating climate change, thus growing in the prestige of being an environmentally sound institution. So, we can ethically justify switching to a geothermal system while getting a new science complex that will improve the education of Carleton science students and boost the prestige the college. Prestige helps the college fulfil its duties to its students, future students, alumni, and over time will trickle into the local community.

Cost.

Economically, the facts look to be in favor of Carleton's switching to a geothermal heating system. While Carleton has not used geothermal heating before and therefore there is a level of uncertainty regarding the new system, analysis done thus far has indicated that Carleton will not only break even, but actually save money over the course of the next thirty years. *Figure 1* shows that indeed replacing the steam system (base case) with a geothermal system (alternative #2) will require a

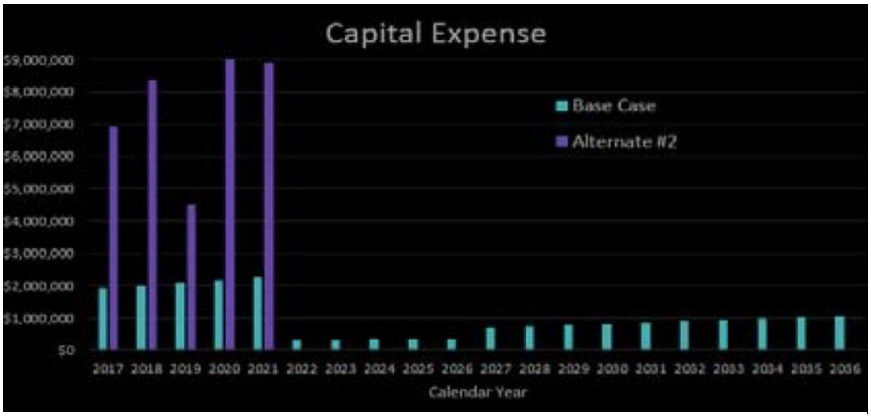


Figure 3
Source: Carleton College Energy & Sustainability

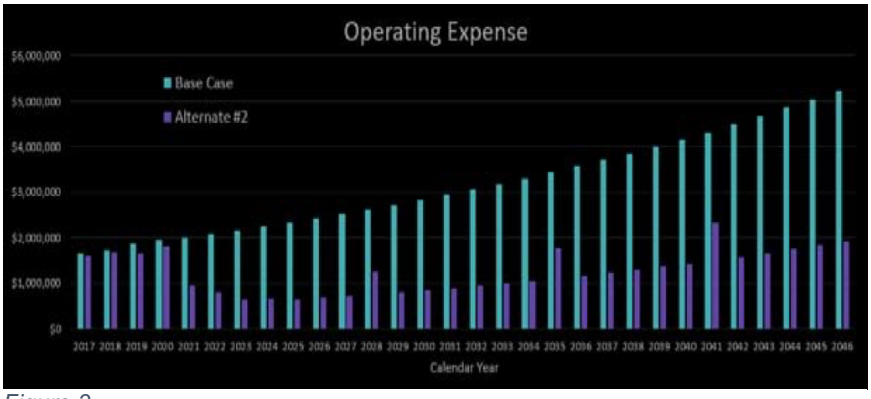


Figure 3
Source: Carleton College Energy & Sustainability

large, $37.7 million, initial capital investment.[37] This upfront cost can be covered through relatively low-interest loans for which Carleton should be easily qualified, due to its Aa2 credit rating.[38] While these capital costs do look very high over the next five years, one must also consider that keeping the steam system will require increasing capital costs ad infinitum. Further, when looking at operating costs, the fiscal benefits of the geothermal system become clear. As you can see in *Figure 2* the operating costs of the steam system are significantly higher than the geothermal system's. These results total to the 30 year costs that can be seen in *Figure 3* which is the composite of *Figures 1 and 2* and indicates the geothermal system will save Carleton approximately $40 million over the next thirty years in comparison to the steam system.

Oftentimes cost is a barrier to colleges' ability to become more sustainable. However, this project, while costly over the next five years, is projected to save the college money in the long term and because of Carleton's high credit rating, the initial cost should not affect the college's ability to function in any way. Thus, the cost of this system will not impede upon the

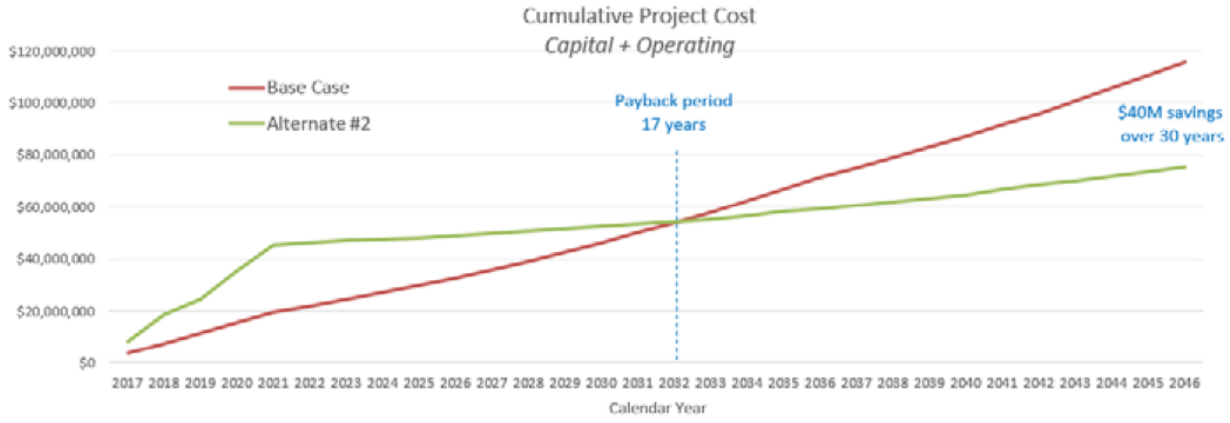


Figure 4
Source: Carleton College Energy & Sustainability

[37] Martha Larson, "Utilities Master Plan," Presentation at Carleton College Board of Trustees Meeting, Northfield, MN, October 14, 2016.
[38] "Moody's Affirms Carleton College's (MN) Aa2/VMIG 1; Outlook Stable," Moody's Investors Service, Inc., April 15, 2014.

college's ability to fulfill its duties to justice, and the cost savings might allow the college to fulfill these duties better.

Jobs.

If Carleton cares about being just to its stakeholders, it must be just to its employees and contractors. A capital project of this scale will create numerous jobs and provide an economic stimulus to Carleton's local community, as infrastructure projects tend to do. Thus, Carleton is fulfilling economic duties to the Northfield community through this project. One of the drawbacks of the geothermal system is that it will result in the elimination of Carleton's four boiler operator positions.[39] However, we have been assured that three of the boiler operators are close to retirement and will remain hired by the college up until retirement. The fourth boiler operator we be retrained to run the new system. All of the boiler operators have also "expressed excitement to stick around and see [facilities] through to the next system."[40]

The Waste Stream.

By transitioning to a geothermal system, Carleton will cause some negative environmental impacts, despite many of the beneficial impacts stemming from a geothermal system. The boiler purchased in 1995 will be retired only halfway through its lifespan. It is unlikely that Carleton will be able to resell the boiler, as it is rather old.[41] The boiler is mostly made of steel, which can be recycled, but some parts of the boiler will be discarded as waste and therefore contribute to Carleton's waste stream. Granted, the boiler will be disposed of at some point in time either way, but the early disposal means that Carleton is contributing a boiler to the waste stream without utilizing the boiler to its fullest potential. While it is important to

[39] Larson, Interview.
[40] Martha Larson, November 15th email to Ethan Ellis, James Harren, Emma Leither, and Colleen Scallen.
[41] Larson, Interview.

understand that the early retirement of the boiler has negative consequences for the environment around the globe, it does not affect Carleton's stakeholders. There are no landfill sites on Carleton's campus or in the neighboring community so Carleton's close biotic community is unlikely to be directly affected by the disposal of the boiler. The early retirement of the boiler therefore maintains the college's just relationship with the its stakeholders, but illustrates a limitation of our theory as it forces us to disregard an outcome that we know poses an environmental threat. Regardless, a geothermal system remains the best method of ensuring that Carleton's energy system follows its normative core and works to ensure the best situation for all of its stakeholders.

Climate Change

It is also in the interest of Carleton's stakeholders to limit the college's contributions to anthropogenic climate change. Switching to a geothermal heating system will meet these interests by reducing Carleton's emissions by 38%.[42] The stakeholders that climate change will affect the most are future students; however, one could make the argument that because future generations do not currently exist, we do not have an ethical duty to them. Derek Parfit's essay "Energy Policy and the Further Future: The Identity Problem" explores this question of our duties to future generations.[43] Parfit recognizes that it is problematic to establish a policy that affects a victimless crime (victimless in the sense that we cannot identify a victim because that person does not currently exist). In our case, we do not know how Carleton's heating and cooling policies will affect who exists in the future or what future generations will value. However, Parfit comes to the conclusion that we must do our best to ensure that future generations do not have

[42] Larson, "Utilities Master Plan."
[43] Derek Parfit, "Energy Policy and the Further Future; the Identity Problem," *Environmental Ethics: Readings in Theory and Application* (1994): 289-296.

worse lives than they otherwise possibly could have had. With this in mind, we must recognize that Carleton has an ethical duty to future generations (of Carleton students and otherwise) to mitigate its contributions to climate change.

On a local scale, Carleton has duties to its Minnesotan neighbors to mitigate climate change. While students may only be in Minnesota for four years, our neighbors will be here for much longer. Climate change is starting to have a tangible effect on Minnesotan culture. Winter sports such as Nordic Skiing, a sport with unique popularity in Minnesota, are becoming compromised by shorter winters.[44] Case studies have been done exploring how evident the effects of climate change have been on Minnesota wildlife.[45] Northfield, Minnesota has seen two hundred-year flooding events in the past 6 years. These flood events caused significant property damage to Carleton's neighbors, and even to Carleton itself, as several houses and athletic facilities were subject to flood damage.[46] This tangible evidence of climate change detrimentally affecting our neighbors and ourselves should be an impetus for more aggressively addressing our contributions to climate change. It would be unjust to knowingly contribute to something that is causing damage to our neighbors and masochistic to knowingly contribute to something that is causing damage to ourselves.

Conclusion

In this paper, we analyzed how different aspects of Carleton's plan to replace its steam heating system with a geothermal heating and cooling system will affect Carleton's various

---

[44] Robert B. Richardson and John B. Loomis, "Adaptive recreation planning and climate change: a contingent visitation approach," *Ecological Economics*: Volume 50, Issues 1-2 (2004): 83-89.
[45] J. Platt Bradbury and Walter E. Dean, *Elk Lake, Minnesota: evidence for rapid climate change in the North-Central United States*, (Boulder: The Geological Society of America, 2006).
[46] Catharine Richart, "Southeastern Minnesota still swamped after a deluge of rain," Minnesota Public Radio, September 23rd, 2016, http://www.mprnews.org/story/2016/09/23/southeastern-minnesota-still-swamped-after-reluge-of-rain.

stakeholders. In order to determine how Carleton should make this decision, we outlined a stakeholder theory of corporate social responsibility, with a normative core focused on justice. We conclude that Carleton's duties to ensure justice to its stakeholders are fulfilled in this transition, although there is a problematic lack of knowledge among the students and other stakeholders, as well as some repercussions to future generations regarding the waste stream. In spite of any concerns, a thorough analysis of the various costs and benefits of this transition with regard to stakeholders concludes that the new heating and cooling system is the best option for maintaining Carleton's commitment to justice in relation to its stakeholders.

Bibliography

Bickerstaff, Karen, Harriet Bulkeley, and Gordon Walker. *Energy Justice in a Changing Climate: Social Equity and Low-Carbon Energy*. New York: Zed Books, 2013.

Bouckaert, Luk and Jan Vandenhove. "Business Ethics and the Management of Non-Profit Institutions." *Journal of Business Ethics* 17, no. 9/10 (1998): 1073-1081.

Bradbury, J. Platt and Dean, Walter E. *Elk Lake, Minnesota: evidence for rapid climate change in the North-Central United States*. (Boulder: The Geological Society of America, 2006).

Carleton Climate Action Plan Steering Committee. *Climate Action Plan.* May 2011. Accessed October 2016. https://apps.carleton.edu/sustainability/assets/11.06.13_CarletonClimateAction Plan.pdf.

Carleton College Facilities Management. "Science Building Addition and Renovation." Last Modified 5 Nov, 2015. https://apps.carleton.edu/campus/facilities/projects/science/.

Crane, Andrew and Trish Ruenbottom. "Stakeholder Theory and Social Identity: Rethinking Stakeholder Identification." *Journal of Business Ethics* 102 (2011): 77-87.

Cross, Stan, David J. Eagan, and Paul Tolmé. "Going Underground on Campus: Tapping the Earth for Clean, Efficient Heating and Cooling." *National Wildlife Federation's Campus Ecology: Climate and Sustainability Series (2011):* 11-17, 24-36. Accessed October 6, 2016.

Dworkin, Michael H., and Benjamin K. Sovacool. "Energy Justice: Conceptual Insights and Practical Applications." *Applied Energy* 142 (2015): 435-444.

Freeman, R. Edward. "A Stakeholder Theory of the Modern Corporation: Kantian Capitalism." In *Business Ethics: People, Profits, and the Planet*, edited by Kevin Gibson, 212-221. McGraw-Hill, 2006.

Friedman, Milton. "The Social Responsibility of Business is to Increase its Profits." *The New York Times Magazine*. The New York Times Company. September 13, 1970.

Gokchen, Gulden, Macit Toksoy, and Nurdan Yildirim. "Piping Network Design of Geothermal District Heating Systems for a University Campus." *Energy*, 35 (2010): 3256-3262. Accessed October 11, 2016. http://www.sciencedirect.com/science/article/pii/S036054421000201X.

"Historic dorms get energy makeover with VRF, geothermal." *Engineered Systems*, June 2015, 16+. *Expanded Academic ASAP* (accessed October 6, 2016).

Jones, Benjamin R., Benjamin K. Sovacool, and Roman V. Sidortsov. "Making the Ethical and Philosophical Case for 'Energy Justice'." *Environmental Ethics* 37 (2015): 145 - 168.

Larson, Martha. Email to Ethan Ellis, James Harren, Emma Leither, and Colleen Scallen, November 15, 2016.

Larson, Martha. Email to Ethan Ellis, James Harren, Emma Leither, and Colleen Scallen, October 12, 2016.

Larson, Martha. Interview by Colleen Scallen, Emma Leither, and Ethan Ellis. Personal Interview. Carleton College, Northfield, MN, September 29, 2016.

Larson, Martha. "Utilities Master Plan." Presentation at Carleton College Board of Trustees Meeting, Northfield, MN, October 14, 2016.

Miller, Mitch. Email to Ethan Ellis. October 20, 2016.

Parfit, Derek. "Energy Policy and the Further Future: The Identity Problem." In *Environmental Ethics: Readings in Theory and Application*. Edited by Louis P. Pojman, Paul Pojman, and Katie McShane, 289-296. Boston: Cengage Learning, 2016. Originally published in *Energy and the Future,* ed. Douglas MacLean and Peter G. Brown (Totowa, NP: Rowman & Littlefield, 1983).

Sommer, Alfred. "Burning Fossil Fuels." *International Journal of Health Services* 46, no. 1 (2016): 48-52.

Richart, Catharine. "Southeastern Minnesota still swamped after a deluge of rain." Minnesota Public Radio. September 23, 2016. http://www.mprnews.org/story/2016/09/23/southeastern-minnesota-still-swamped-after-reluge-of-rain.

Reames, Tony Gerard. "Targeting Energy Justice: Exploring Spatial, Racial/Ethnic and Socioeconomic Disparities in Urban Residential Heating Energy Efficiency." *Energy Policy* 27 (2016): 549-558.

Richardson, Robert B. and Loomis, John B. "Adaptive recreation planning and climate change: a contingent visitation approach," Ecological Economics: Volume 50, Issues 1-2 (2004): 83-89.

Stern, Nicolas. "2.4 The long-run impacts of climate change: evaluation over time and discounting." *Stern Review on the Economics of Climate Change*: 31 - 33. Released October 30, 2006.

Union of Concerned Scientists. "How Geothermal Energy Works." Last modified December 22, 2014.http://ucsusa.org/clean_energy/our-energy-choices/renewable-energy/how-geothermal-energy-works.htm.#.V_0N4WVlmu5.

U.S. Environmental Protection Agency. "Available and Emerging Technologies for Reducing Greenhouse Gas Emissions from Industrial, Commercial, and Institutional Boilers." *Office of Air and Radiation*, 5-23, October 2010.

Watersense at Work: Best Management Practices for Commercial and Institutional Facilities (U.S. Environmental Protection Agency, 2012), 25-31.

Appendix A

Multiple institutions across the nation have begun or completed the implementation of geothermal systems across some or all of their respective campuses. In this appendix, we will address projects from four different colleges: Miami University in Oxford, Ohio; Land Lake College in Mattoon, Illinois; Ball State University in Muncie, Indiana; and Harvard University in Cambridge, Massachusetts. While the initial cost has been the general complaint, these projects have been successful overall. The general success of these cases can be used to show support for any risks taken in installing Carleton's new system.

Miami University Case.

Miami University redid a previously inefficient system in their dormitories. The university switched from a combination of a central heating system and two chillers to a VRF (Variant Refrigerant Flow) system, which is a mix of geothermal and steam heat. The geothermal side of the system involved the installation of 1,700 six hundred-foot wells in the sidewalk surrounding the old dormitories. The new system, spurred by the school's personal version of Carleton's 2050 Climate Action Plan, resulted in a 61% decrease in carbon emissions from the year 2010-2011. The Miami University case is helpful in comparison to Carleton as the school is located in a somewhat similar climate to Minnesota and the old buildings were kept and restored, as are most of Carleton's buildings, with the exception of the new science wing.

Land Lake College Case.

The next two cases will be examples of full-campus systems, or geothermal heating systems that take responsibility for campus-wide heating needs instead of being specific to one area or building, as in the Miami University case. Land Lake College, located in Mattoon,

Illinois, decided to revamp their systems due to aging infrastructure. The college chose to install 470 boreholes to implement a closed-loop system. The project's initial cost was $16.8 million, but the only real worry the college faced was the potential disruption to campus during construction. This fear led them to only update one building at a time, as well as to operate only during the summer, so the project's timeline was much longer than needed. Land Lake's project is similar to Carleton's. The colleges exist in comparable climates, have similar reasons for undertaking the project initially, and both decided to implement a closed-loop system. The struggles surrounding campus disturbance and construction actually support Carleton's decision to implement their system concurrently with the science building's construction, as doing both at the same time will minimize campus disturbance.

Ball State University Case.

Ball State University's project, once completed, will be the single largest geothermal system in the country, as it entails the use of 4,200 individual boreholes. Once the campus fully transitions to the new system and off of coal use for heating and cooling purposes, the University will experience a 50% decrease in greenhouse gas emissions. The initial cost--$45 million--and the projected cost--$65 to $70 million-- is obviously a challenge for the school, as well as the worries of disrupting not only the campus, but also the city, as it is an urban campus, during construction. The Ball State case is a helpful frame of reference for Carleton's decision in both the cost and the construction worries. Carleton has a very stable financial status, so the money issue for Ball State may not deter Carleton in the same manner. Ball State's construction problems also support Carleton's decision to undertake concurrent construction/installation, and Carleton's rural location gives it an advantage over installing a system at an urban institution like Ball State.

Harvard University Case.

Harvard University's geothermal project is slightly different than the previously mentioned projects in that it is a retrofitted system; that is, it is modifying the previously existent energy systems of some and not all of previously existent buildings. Harvard chose to retrofit five of eight possible buildings with an open-loop system. Such a system results in a 20-50% reduction in energy costs, making it a prime choice for fiscal purposes. The risks of Harvard's project, however, are that open-loop systems are much more prone to brackish water contamination. Given Harvard's rather urban locale, the University had little choice but to opt for an open-loop system to minimize city disturbance. Harvard's case highlights how Carleton's decision to choose a closed-loop system is beneficial given the contamination risks of open-loop systems. It also shows, like Ball State's case, that Carleton's rural location makes it a prime candidate for geothermal systems.