The History of Heating at Colgate University

Exploring Social, Economic, and Environmental Sustainability

ENST 390: Community-based Study of Environmental Issues

Julia Marchetti, Yukun Xu, Kylie Armo
Colgate University

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1. EXECUTIVE SUMMARY

With Colgate University's target carbon neutrality date of 2019 rapidly approaching, it is important to reflect on the sustainability of our past in order to encourage a more inclusive and mindful approach in the future. This report examines the history of heating at Colgate by developing a timeline of utilized energy sources and corresponding facilities from 1819 to present. As heating accounts for 21% of Colgate's energy consumption, our research explores an integral component of Colgate's carbon footprint. Applying the 3 pillars framework, we analyze how social, environmental, and economic components of sustainability were prioritized in the decision-making process. We define the social pillar as considerations of student and staff comfort, the environmental pillar as the level of emitted pollutants, and the economic pillar as associated financial costs. Through the investigation of archival and newspaper sources, as well as the conduction of an interview, we identified key transition periods in the history of Colgate's heating system. From the founding of the University in 1819 throughout the rest of the century, Colgate was primarily heated by individual coal and wood stoves. In 1907, a central heating plant was constructed, which ran on coal until the adoption of fuel oil #6 in 1966. In 1981 Colgate transitioned to a woodchip boiler, and in 2014 natural gas was integrated into the heating system. In analyzing this data through the lens of the 3 pillars, we found that financial cost has consistently been the driving force and rationale behind decision-making. From the social perspective, student comfort and convenience have been historically valued, while the harsh working conditions of heating plant workers were generally neglected. In regards to environmental considerations, the administration became concerned about pollutant emissions only in recent decades due to the rise of the popularity of sustainability in American society. We conclude with a few recommendations regarding how to ensure the comprehensive sustainability of Colgate's heating system moving forward, as we hope this report will serve as an informational resource for university decision-makers. We recommend that the infrastructure of the woodchip boiler be updated to accommodate the needs of workers and maintaining energy efficiency. Additionally, we believe that Colgate should sell our supply of fuel oil #2 because it is a polluting and unneeded backup energy source. The gained funds from this sale could be redirected towards investing in heating plant infrastructure and establishing renewable energy in the Village of Hamilton.

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2. INTRODUCTION

With 160 buildings encompassing over 2.3 million square feet of ground space, providing energy to Colgate University has a significant impact on our budget and carbon footprint. (Colgate Sustainability and Climate Action Plan, 2011, p. 35). This report on the history of Colgate's heating systems is being written because as Colgate's target carbon neutrality date of 2019 rapidly approaches, it is important to reflect on the sustainability of our past to encourage a more inclusive approach in the future. Our report primarily examines how Colgate as an institution has traditionally valued social, economic, and environmental factors of sustainability over the past 200 years. The report begins with a review of the relevant literature and our methodology and then transitions into our collected data. Our results have divided into sections that reflect major historical transitions in Colgate's heating system, from the use of coal and wood stoves in the 1800s, to the construction of a central heating plant in 1907, to the adoption of fuel oil #6 in 1966, to the construction of a woodchip boiler in 1981, to the integration of natural gas in 2014. We then analyze the sustainability of this history in terms of the 3 pillars framework, whose criteria is specified in the methodology section.We conclude with a few recommendations regarding how to ensure the comprehensive sustainability of Colgate's heating system moving forward, as we hope this report will serve as an informational resource for university decision-makers.

3. LITERATURE REVIEW

3.1 The Three Pillars of Sustainability

Before understanding the intricacies of sustainable energy, or more particularly sustainable energy within the sphere of higher education, one should begin with an understanding of what sustainability is. According to the 1987 Brundtland Report, sustainable development is "meet[ing] the needs of the present without compromising the ability of future generations to meet their own needs" (Theis & Tomkin, 2012, p.6). Furthermore, sustainable development is conceptualized and organized through economic, environmental, and social pillars (Boström, 2012). The economic branch refers to flows of capital and commerce, and the growth and development of the economy (Theis & Tomkin, 2012). As Theis & Tomkin see it on a broad societal scale, "economic interests define the framework for making decisions" (2012). The environmental pillar speaks to the diversity, interconnectedness, and services of ecosystems, and recognizes the impact of human waste and pollution (Theis & Tomkin, 2012). The social branch refers to the values, well-being, and decisions of individuals, institutions, and communities (Theis & Tomkin, 2012). Unfortunately, the social pillar is often overlooked in the implementation of sustainable development (Boström, 2012). The sustainable development lens is one way to analyze the history of energy types and systems on both macro and micro scales throughout the United States, New York, higher education as a whole, and Colgate University.

3.2 A History of Energy Resources in the U.S.

A variety of energy types have been consumed throughout the U.S. history, and each energy type has a different trend of development based on its peak and decline of consumption, accessibility, financial costs, energy efficiency, and environmental consequences (King, n.d.).

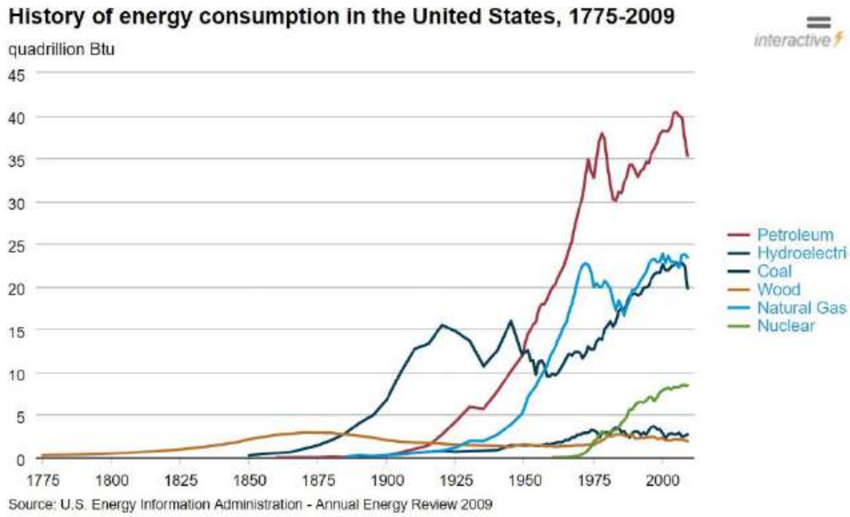


Figure A.From Energy Information Administration. A graph demonstration of the history of energy consumption in the United States from 1775 to 2009.

From the 1700s to the late 19 century, wood was the primary energy resource, mainly burned for heating and power generation (EIA, 2011a; King, n.d.). People utilized wood for energy because it was easy to obtain and transport, which guaranteed its accessibility (King, n.d.). However, in the late 19th century, coal usage exceeded wood usage and became the dominant energy source (EIA, 2011a). Coal was even more portable and provided more heat per pound than wood (King, n.d.). Due to its accessibility and energy efficiency, coal was in high demand by industries, and the coal industry played a significant role in American Industrialization in the late 19th century (Adams, 2003).

The rise of petroleum and natural gas occurred due to another technological advance, drilling technology, which allowed people to discover valuable oil and natural gas (King, n.d.). The two resources were found to be quite ample, and thus, became competitive in terms of economic cost. As oil and natural gas emit fewer pollutants and are even more portable than coal, they replaced coal and became dominant in the mid 20th century (King, n.d.). These two energy resources continued to be dominant until the late 1970s when the Iranian revolution occurred and caused the price rise of oil (Graefe, 2013). As there was a surplus of oil stock in the 1980s, rates of consumption and demand resurged. Generally, the price of natural gas was positively correlated to the price of oil. One explanation for the correlation was that they were substitutes — if one has a high price, the consumers will buy the other resource. (Seth, 2015). A high level of demand would also boost the price of the substitute energy resource. However, the correlation abruptly stopped during the financial crisis of 2008 (EIA, 2011a). The demand for and consumption of oil dropped, but the usage of natural gas continued to grow due to its availability and low cost.

Renewable energy resources, such as nuclear energy and hydroelectric energy, have played an important role in the recent history of U.S. energy. Drivers of these sources are mainly the increasing prices of fossil fuels and expectations of high energy capacity (Sesto. 1982). However, growth is still restricted for various reasons, such as construction costs and investment risks, and thus only accounted for around 10% of total energy consumption in 2011 (EIA, 2011b). Fortunately, renewable resources have a fast growth rate and a promising future due to the decreasing cost per BTU and the increasing embrace of sustainability in our modern society (King, n.d.).

3.3 A History of Energy Resources in New York State

New York State (NYS) has had a more progressive movement which directed it away from fossil fuels earlier than the rest of the United States. After 1960, the U.S. had a steady growth of coal consumption, and by 2008 still had similar levels of coal consumption to 1960 rates (EIA, 2011a). In contrast, NYS reduced its coal usage in 2014 to less than 10 percent of the usage level in 1960 (EIA, 2016). Additionally, although the usage of oil in the U.S. declined in the late 1970s, it grew steadily until the mid-2000s. However, after 2010, its consumption declined significantly, and the usage level fell below the level of 1960 in 2014 (EIA 2016).

Among cleaner energy resources, natural gas in NYS overall has a very similar trend with the nation's trend of usage except that the turning points are earlier than the nation's (EIA, 2012; EIA, 2016). Unlike coal and oil, the usage of natural consumption in 2014 was about three times as high as its usage level in 1960 (EIA, 2016).

3.4 Sustainability In Higher Education

The issue of sustainable energy is particularly pertinent within the sphere of higher education. This is the case because universities would be hypocritical if they were to teach sustainability, implore other institutions to practice it, and then fail to do so themselves. A push for more sustainable campuses began in the early 1990s (Sharp, 2009, p.1). This movement has struggled to affect deep structural change. For example, several institutions of higher learning have achieved isolated success in terms of conservation projects, while managing to miss the 'big picture'(Sharp, 2009,p. 2). Cost has been a major obstacle. However, both cost and time are typically reduced as processes become more efficient with repetition (Sharp, 2009, p.5). Sharp advocates for increased dialogue, participation, and a bottom-up collaboration in order to achieve sustainable and equitable campuses (2009, p.7-8). Scholars such as McNamara believe that higher education is uniquely positioned to tackle social, environmental, and economic issues because of the ability to enact radical change through pedagogy (2010, p. 48).

Energy efficiency is considered one of the most cost-effective ways for society to reduce carbon emissions along with other pollutants while growing in energy security (Dahle & Neumayer, 2001). Campus "greening" not only serves as a means of testing new environmental strategies but helps to create a culture of sustainability among young people (Barata et al,.2011). Sustainability within the context of higher education has the ability to influence students' current behaviors and long-term patterns of consumption (Soares et al.,2 015). In fact, campus classes and lectures on energy efficiency and conservation frequently have a greater impact on students environmentalism than other outlets such as television campaigns. This is largely due to the ability of higher education to engage students in multi-disciplinary and highly participatory activities. Although they may seem like unlikely leaders in sustainability, small liberal arts schools are valuable and unique in their research, promotion, and implementation of sustainable energy projects (Finley-Brook, 2012, pp.22). Because of their size, liberal arts schools, such as Colgate, allow students to engage with sustainability on both an interdisciplinary and community level.

The issue of energy efficiency in higher education has been incorporated into many curricula around the globe (Soares et al., 2015). Particularly, notable efforts have been made in the UK (Altan 2010), Portugal (Soares et al., 2015), Canada (Maiorano & Savan, 2015) and

Australia (Desha & Hargroves, 2010). In the United States, California has taken the lead. One salient example of a concerted effort towards sustainable energy in higher education is the Higher Education Energy Efficiency Act. This bill allows for the University of California and California State University campuses to gain financial assistance in order to build retrofits to reduce energy demands (US Official News, 2014).

4. METHODOLOGY

4.1 Archival & Interview-Based Research

Our methods consisted primarily of archival and newspaper research. We began our research under the broad framework of Colgate's energy systems, but soon narrowed our subject to focus solely on Colgate's heating system. Heating accounts for 21% of Colgate's energy usage, while electricity only counts for 10%, and is thusly an integral component of Colgate's carbon footprint to explore (Taylor, 2009a, p.3).

The main archival material utilized included Buildings and Grounds files and Board of Trustees minutes. The Building and Grounds files were examined in pursuit of technical information about the construction plans and upgrades, as well as for photos of the facilities themselves. The Board of Trustees minutes were examined in pursuit of the human perspective and rationale behind the administration's decision-making processes, as we were looking for insight into how issues of economic cost, student welfare, and environmental health were weighed when transitioning between energy systems.

The digital elements of the archives — namely the student newspapers — have been another significant source of information. Using search terms such as "heating", "coal", "furnace", and "oil", we searched through decades of Colgate newspapers, spanning from the *Madisonensis* of the early 1800's to the *Colgate Maroon News* of today. We specifically sought to identify key dates in which Colgate switched energy sources or installed a new type of heating facility in order to create a timeline of Colgate's heating systems. We also sought out student perspectives towards Colgate's heating system from the newspapers, as well as numerical data regarding emissions reductions and financial savings from system upgrades.

However, archival and digital collections alone could not provide sufficiently rich insight into the history of Colgate's heating system. We, therefore, conducted an interview with John Pumilio, Colgate's Director of Sustainability, to learn more about the environmental aspects of Colgate's heating systems — both in terms of what existed in the past as well as what he envisions and recommends for the future. After receiving written consent from John Pumilio, we conducted and audio-recorded an interview for approximately 45 minutes. Notes were taken during the interview for later analysis, but the interview was not fully transcribed. This was the only interview we conducted, as we were intentionally selective with who we interviewed, choosing to only reach out to those we knew would have a basis of knowledge that was both historical and environmental in focus. We also accompanied John Pumilio on a one-hour tour of the heating plant alongside Boiler Operator Tom Martin and Mechanical Trades and Energy Manager Howard Lewis, in order to gain first-hand knowledge of Colgate's current heating operations.

4.2 Operationalization of Sustainability

Throughout our research, we were intentional in our search for heating-related material that related to sustainability, specifically that would relate to one or more of the three pillars.

Based on our findings, we operationalized the economic pillar as financial cost, the social pillar as the comfort of students and laborers, and the environmental pillar as the level of pollutants emitted. We developed these criteria under the framework of emergent theory, in which theories and concepts emerge through data collection and analysis (Human, n.d.). Indeed, the criteria for our economic came from the frequent mentions of the financial cost of heating needs in our studied data, as well as from our knowledge that in our capitalistic society, matters of monetary cost are highly valued (Theis & Tomkins, 2012). Not only are heating systems inherently aimed to ensure the comfort and well-being of humans, but our archival research also portrayed a heavy administrative focus on matters of student comfort, so for our social pillar dealt with the criteria of student comfort. Later on, the comfort of laborers was added to our social pillar, as we felt that it would be unjust to focus merely on the warmth provided to privileged Colgate students and ignore the welfare of the working laborers managing the heating system itself. For our environmental pillar, we chose to focus on the release of pollutants, as the production of fossil-fuel based energy is significantly associated with the release of hazardous pollutants. We specifically chose not to focus on carbon dioxide emissions as such emissions were not recognized or understood during the time of Colgate's founding, and we wanted to use criteria that could be equally applied across the history of the university.

5. RESULTS

5.1 Wood & Coal Stoves

From the founding of the university —then the Madison Theological Seminary — in 1819, and throughout the rest of the century, the original heating source on Colgate's campus was individual stoves. Each dorm room and classroom was heated by its own wood-fired stove (Student Association, 1855). In 1855, the Student's Association sent a petition to trustees requesting that stoves suitable for burning coal as well as wood be placed in academic spaces. They cited frustration with the "trouble and expense to procure wood", the lack of compliance from the individual contracted to supply wood, and the fact that "many of the stoves now in use are more or less unsafe, and render us liable to loss by Fire" (Student Association, 1855). Soon after, coal-burning stoves were supplied across the University. Professor William Langworthy, Class of 1887, described the usage of coal stoves during his undergraduate years in the mid-1880s:

> "On wintry mornings, the men would arise shivering and start a coal fire. Lamps would be lighted, and the student got ready for the day's washing in a hand basin. The coal was kept locked in bins in the halls each of which held a ton. These were filled by carrying buckets of coal from the heap outside. No wonder the ground floors were preferred" (Betzig, 1934, p.1).

The bangs of coal shuttles and ashcans often reverberated throughout the stairways and hallways of the dorms (Sussman, 1976, p.16). The janitors were the ones who managed the dormitory's coal supplies and were responsible for lighting the stoves in communal areas. Describing the tough working conditions, Colgate custodian Jack Johnson stated that "There were 56 [stoves] in all, and you can bet it was a job to keep 'em all going" (Wilcox, 1935, p.3).

The use of coal stoves was visible in various aspects of campus life. The *Madisonensis*, the student newspaper from 1868 to 1898, featured student commentary regarding the efficiency and cleanliness of various wood box stove polish paste brands (Madisonensis, 1877, p.11). Purchases of new stoves were often noteworthy events funded by donations, mentioned in newspaper articles as being “tokens of comfort and elegance”, and contributing to the “pleasing appearance” of rooms (Madisonensis, 1871, p. 3; Madisonensis, 1898, p. 2).

Students occasionally expressed frustration with how administrators and janitors managed the stoves, however. Reminiscing on his time at Colgate during the late 1870's, alumni Charles Evan Hughes reported that "When I was at Colgate we didn’t have any heat or plumbing worth mentioning. Our only heat in Alumni Hall was from a little coal stove they always forgot to light” (Donahue, 1939, p.1). Complaining about the chilliness of the Chapel, one student argued that “an extra stove in the Chapel [would] afford a needed warmth to our bodies while we engage in our morning devotions.” He went on to joke about the administration’s reluctance to purchase this extra stove, postulating that “the additional expense involved in furnishing the extra amount of caloric [would] so deplete our treasury” (Madisonensis, 1876, p.11).

Other student protests were quite physical and extreme. In the fall of 1876, students “hoist[ed] a stove to the roof of West Hall as a protest against the shortage of coal in classrooms”(Sussman, 1976, p.16). Colgate student E.F. Waite describes how in 1879, after the janitor “let the fire in the stove at our end of the chapel go out, a portion of the class in revenge carried the stove outdoors, and by dint of much strain upon our muscle and our ingenuity, placed it on top of the coal house. Then hiding every ladder in the neighborhood we left the poor custodian of the premises to get it down best he could" (Waite, 1880, p.4). After that, officials reportedly did their best to keep the buildings warmer (Donahue, 1939, p.1).

5.2 Central Power Plant

In 1890, a steam heating apparatus was introduced, and the stoves began to be phased out (Madisonensis, 1890, p.10). Only 6 years later, the university stated that “the steam heating plant has always been inadequate to heat properly the classrooms and also the chapel. An indirect radiator has now been put in, by the aid of which it is expected the chapel can be kept at proper temperature” (Madisonensis, 1896, p.9). The heating system continued to pose challenges, however. Cited issues included "the trouble and cost of getting and carting coal on the hill, the old fashioned and highly disagreeable stove heating of Alumni Hall, the requirements which will soon arise for modern heating in East and West Colleges, the waste of valuable space and other disadvantages now installed” (Madisonensis, 1907, p.12). Therefore, in January of 1907, a plan for the installation of a central heating plant for the University was submitted to the Board of Trustees. The proposal was quickly approved by the Executive Committee (Madisonensis, 1907, p. 12). Student needs were cited as a key consideration behind this decision, with administrators stating that “the growth of the Seminary requires increased facilities for student purposes”, and that a central plant would “add materially to the comfort and convenience of the students” (Madisonensis, 1907, p. 12; Madisonensis, 1907, p.4).

The installation of the central heating system came at a time of relative prosperity. By 1907, the university had an annual income ranging from $2,000 - $7,000, an endowment of more than $100,000, and was enrolling 30 to 75 new students each year (Madisonensis, 1907, p. 12). It was “at this time of its sudden enrichment, the Society is expending no more than usual on itself, but is devoting its whole income and energy to the betterment of the Seminary and the aiding of the University”, in part by “offering to take the initiative in establishing a Central Heating Plant for the benefit of all the departments of the University” (Madisonensis, 1907, p. 12). The Education Society’s contribution of $20,000 was a critical component that made the construction of the plant financially feasible (Board of Trustee Minutes, 1907, p. 5). While the plant was being constructed, other improvement plans, such as for a new chapel, were put on hold and were set to "materialize as soon as financial conditions permit" (Madisonensis, 1907, p.4).

Work on the central heating plant began in February of 1907, as surveyors were requested to lay out a proposed route for the plant.

Figure B

Figure C

(B) *Heating plant, circa 1907*
(C) *Men in coveralls in front of heating plant, circa 1907 - 1910*

Underground pipes were to carry steam from the heating plant to campus buildings. The Boiler House was a one-story stone building 83 by 58 feet and comprised of an engine room, a pump pit, a large coal pocket, and a boiler room with the capacity for 5 boilers (Madisonensis, 1910, p. 8). It was placed to the south of Whitnall field, an advantageous position because condensation was able to return to the Boiler House by gravity as it was lower down the hill than most other campus buildings (Madisonensis, 1910, p. 8). To ensure the heat source was dependable, each building was to “receive steam from two directions, in case of a break or leak [a] section can be shut off and all the buildings heated perfectly until the damage is repaired”. The plant was up and running by October of 1907, and cost around $29,000 to complete (Madisonensis, 1907, p. 12). In “The History of Colgate”, Howard Williams writes that “the last major building project of the Merrill administration was the central heating plant which represented a significant advance in efficient maintenance and comfort. The financial assistance of the Baptist Education Society Trustees...made it possible” (Williams, 1969, p. 250).

The heating system did not initially cover all of campus, but plans were made for the mains to ultimately extend to Eaton Hall, Alumni Hall, West and East College, Lathrop Hall, the Chemical Laboratory, and the Library. In his annual report in 1907, President Merrill expressed a desire that the system “be extended to cover Alumni Hall, in which most of the recitations and lecture rooms of the College are situated. These rooms are still heated by stoves, with poor ventilation and with much danger from fire” (Board of Trustees, 1907, p. 5). Following President Merrill’s retirement, the acting president in 1908 echoed similar sentiments, stating that the conditions in Alumni Hall “with reference to heating and ventilation are decidedly primitive. It is no exaggeration to say that the health of faculty and students is endangered every winter by cold rooms and foul atmosphere. No one who has not suffered from them can appreciate how bad the conditions are at many times” (Board of Trustee Minutes, 1908, p. 25). By 1910, the plant was expanded, and connected from Eaton Hall to West College.Stillman Hall was constructed in 1922, and Lawrence Hall in 1925, and both were connected to the central heating plant. Plans were also made in 1925 to connect all buildings, and it was proposed that the library, the old gym, and the chapel “all abolish their individual systems [to] insure a more even temperature for each one” (Colgate Maroon, 1925, p.4).

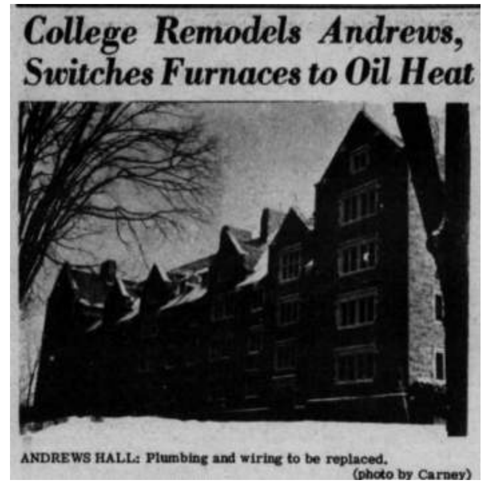
The entirety of the central heating system was overhauled and enlarged in 1937, and the five original boilers which generated 150 horsepower were replaced by two Bigelow boilers generating 500 horsepower each (Colgate Maroon, 1937, p. 2). The change was “necessitated by the added load placed on the heating system by the James C. Colgate student Union Building”, completed in October of 1937 (Colgate Maroon, 1937, p. 2). The total estimated cost of the new system was approximately $85,000 (Colgate Maroon, 1937, p. 2). At the same time, other small upgrades were being completed around campus that insulated buildings better. In the Chapel, an accousti-celtex — a perforated material, which covered the whole ceiling — was installed to minimize sound reverberation and improve the heat retention of the building (Colgate Maroon, 1937, p. 2). This was the last major renovation to campus heating system for the next few decades.

5.3 Transition to Fuel Oil

In 1965, the addition of new buildings and the renovation of old buildings were necessary for educational and livability purposes. More specifically, “Stillman and Andrews Hall as well as the Upperclass Residence Halls [would] require renovations in the near future if they [were] to compare in quality and livability to the new residence halls. Lathrop Hall require[d] renovation and the entire electrical and heating system of the university [would] have to be studied” (Colgate University, 1965a, p.2). In Mcgregory Hall “the sub-basement before renovation was almost uninhabitable, since the exposed heating lines and the lack of adequate ventilation kept temperatures above 80 degrees at all times” (Colgate University, 1965b, p.5).

The University wanted to increase the energy capacity of the heating system to support both the renovated buildings, listed above, as well as additional buildings including Shepardson and Brigham Houses, Creative Arts House, and Alumni Hall (Colgate University, 1965c, p.9). To improve the campus’s energy capacity, the University asked for suggestions from engineers. They “ha[d] recommended two approaches to the solution of this problem, the least expensive requiring one new boiler at a cost of approximately $100,000. On motion made and duly seconded, it was voted to recommend to the Executive Committee that plans for increasing the size of the plant be initiated immediately and that the decision as to the best approach to towards the solution of this problem as well as the type of fuel to be burned in the future, be further studied with the engineers before a final decision is made” (Colgate University, 1965c, p.9). Thus, instead of purchasing one more boiler, the University decided to change the overall size of the plant and consider an alternative energy resource.

The school ultimately decided to switch from coal to fuel oil. Another reason behind this switch was the newfound lack of coal supplies, as “the train lines that were used for transporting the fuel stopped running, [so] it was necessary to find another fuel source” (Sussman, 1976, p.16). Choosing fuel oil as the replacement of coal was the only feasible economic decision. At that time, “natural gas [was] unavailable in the area, and the school was forced to make the changeover to oil in 1966, a time when that fuel alternative was selling at comparatively reasonable prices” (Sussman, 1976, p.16).


College Remodels Andrews, Switches Furnaces to Oil Heat

ANDREWS HALL: Plumbing and wiring to be replaced. (photo by Carney)

Figure D. From the Colgate Maroon Vol.94 No.18 (02/24/1966). A newspaper marking the shift from coal furnaces to oil furnaces for Colgate's heating system in 1966

The school anticipated no difficulty of meeting campus heating needs with the new heating plant (Colgate University, 1966d, p.11). Before finalizing the renovation plan of the heating plant, the school analyzed budget considerations, deciding that “if the total cost is within the $170,000 budget already approved, the contracts will be awarded” (Colgate University, 1966e, p.3). The Building and Grounds Committee finally granted an additional $5,000 to the budget due to a need to replace the coal boilers with two new oil boilers. The construction cost was covered in part by the school’s reserve for renewals, funds, and gifts from alumni (Colgate University, 1965b, p.5). The University finally switched from coal to oil in the summer of 1966 (Buck, 1966, p.5).

In the early 1970s, the school suffered from fuel shortages caused by the oil embargo of 1973, which lead to skyrocketing prices. Uncertain of how much oil would be available and what the new price of oil would be, University officials became concerned and initiated the adoption of energy conservation measures. One *Maroon News* article stated that “in response to the national energy dilemma and its effect on the Chenango Valley, a number of steps have been taken within the past decade to reduce energy consumption at Colgate...energy saving measures have taken place, rather, as the money situation has allowed”(Moody, 1979, p.3). Indeed, as President Nixon called for ‘voluntary cutbacks’, “the University reset the thermostats in all campus buildings from 72 degrees to 68 degrees” (Lohr, 1973, p.1). Infrared photos of various academic buildings and residence halls were taken in order to determine where significant heat loss was occurring. It was resolved that in order to maximize energy efficiency, each floor needed individual thermostats, rather than the two per building allotted. However, this renovation was deemed as expensive and logistically inconvenient. In addition, the administration began “restricting the nighttime use of academic buildings”, “reducing building temperatures sharply during the Christmas break, consolidating classroom use in January, and temporar[ily] closing unused buildings”(Lohr, 1973, p.1). However, heating waste was not entirely eradicated, as there were still plenty of windows on campus consistently left open. Additionally, academic buildings, such as the science buildings, also posed a problem as “energy hogs” because of their required environmental and temperature conditions (Lohr, 1973, p.1).

A 1974 *Colgate Maroon* article, citing the impact of the 1973 embargo, wrote that “fuel oil consumption at Colgate’s main heating plant was 82% of the total burned in February a year ago, [and] the university stayed within its allocation of number 6 fuel oil” (Colgate Maroon, 1974, p.2). Even after the embargo, oil prices continued to rise, and by 1976 “the estimated heating budget for 1977-78 [was] between $450,000 and $½ million, an increase of $64,000 over [the 1976] budget. This jump is largely explained by the five-fold increase in the price of oil since 1971, from six to thirty-two cents a gallon" (Colgate Maroon, 1976, p.10). Furthermore, some buildings could not utilize the full potential of the heating system, for "although classroom buildings such as Lathrop, Olin, and Alumni which [were] either new or recently renovated [had] been restructured to maximize heating potential, the older buildings such as Lawrence and McGregory [were] understandably a tax on the heating system" (Colgate Maroon, 1976, p.10). Similarly, dormitories such as Andrews and Stillman required "a great amount of fuel to sufficiently heat the rooms" (Colgate Maroon, 1976, p.10).

Within this precarious energy climate, with the 1973 oil embargo being followed by the 1979 oil crisis, students began to question the efficiency and usage of fuels on campus. One student was quoted in the *Maroon News* as saying, "We cannot help but ask how much fuel oil is being used unnecessarily...we feel that Colgate could avoid such large tuition increases by taking a closer look at the steam generating plant" (Colgate University, 1979, p.4). Major pushes for energy conservation were limited by economic considerations throughout the 1970's however. When questioned on the topic of sustainability, Robert Wilhelm, a member of the Colgate administration, responded that "until energy conservation becomes as financially certain as it is intellectually and morally appealing, it will be unfeasible to undertake large energy programs" (Moody, 1979, p.3). According to *Maroon News* contributor Mike Moody, a major "reason why there has not been a concentrated energy conservation push is that fuel and electricity prices have been fairly low. If prices were high, the money garnered from fuel saving would offset the expenses of renovation. While the prices are low however, any new steps would not pay for themselves" (Moody, 1979, p.3). At this time, electrical prices had not increased in the Chenango Valley area since 1961 (Moody, 1979, p.3). Financial concerns regarding the price of fuel only continued to increase however. In 1979, the cost of oil and heating increased by 20%. Even small pricing increases had a big impact on cost, as more than 1.3 million gallons of fuel oil were burned each winter. The cost of the winter supply of fuel oil was projected at more than six hundred thousand dollars that same year.

5.4 Construction of Woodchip Boiler

In the wake of the energy crisis of 1979 and resulting financial concerns, The Board of Trustees approved the woodchip burning project on May 16th, 1981. As of September 15th, 1981, ground had been broken behind the existing heating plant for the construction of the new woodchip boiler facility (Colgate Maroon News, 1981, p.7**)**. The total cost of this project with purchase and installation was approximately $840,000. Colgate received a federal grant in the amount of $480,000 and needed to pay the remaining balance (Colgate University, 1981). The cost of this project was offset by the savings that would accompany the replacement of woodchips with oil, however. According to the *Colgate Scene*, "even with care and conservation, the cost of keeping warm with oil last year was more than $800,000. Cost estimates for the wood-burning operation are less than half that figure, or $360,000 for 18,000 tons of wood chips per year" (1982).

Figure E. Image of the Woodchip Boiler in the Heating Plant Facility. 2014.

During his interview, Director of Sustainability John Pumilio recalled the transition from fuel oil to woodchips. Though a renewable source of energy, Pumilio noted that the switch to woodchips “really wasn’t for environmental reasons”, and that the project progressed primarily because “there was enough cost savings involved to move forward”. When questioned about the role that student comfort plays in modern heating considerations, Pumilio said the transition to the woodchip boiler held “an element of risk” in that regard, as it was questionable whether or not “we were going to be able to get all that quantity of wood when it’s needed”, and “you don’t want to have cold buildings”.

Today, the woodchip boiler burns roughly 80 tons per day of hardwood chips from tree waste and tree tops. The chips are procured from logging sites in central New York (Sturgeon, 2006). This boiler is considered a carbon-neutral form of energy because the woodchips come from trees that removed carbon from the atmosphere while they were alive. The trees are then replanted at the same rate that the woodchips are harvested in order to avoid adding extra CO_2 to the atmosphere. Burning woodchips, unlike fossil fuels, releases carbon that was already in the atmosphere before it was sequestered by the trees. Thus, growing trees specifically for burning balances out the emissions released when they are burned (Taylor, 2009b, p.6). Emily Kennedy, Class of 2011, frames the 1981 installation of the woodchip boiler as an intentional stride towards environmental friendliness (2008, p.8).

Seventy-six percent of Colgate’s domestic heating and hot water needs are met by converting 20,000 tons of harvested woodchips to heat per year. In 2009 alone, this renewable, carbon neutral energy source prevented Colgate from consuming 1.17 million gallons of fuel oil, producing 13,757 tons of emissions, and spending $1.8 million in heating costs (Taylor, 2009a, p.3). To contextualize, the total amount of emissions for the 2008-2009 fiscal year were 18,975 tons.

Although the shift from fuel oil to the woodchip boiler has saved our university a great deal of money, the rising price of woodchips is becoming an increasing concern. Between 2002 and 2009, the per ton price of woodchips has increased from $20 per ton to $40 per ton (Campus Ecology Files, 2010). Another shortcoming of the woodchip boiler is the transportation factor. While the woodchip boiler itself may be carbon neutral, the transportation of the chips is not. In order to mitigate this issue, a group of Environmental Studies students spearheaded the Willow Plantation project in 2008 (Taylor, 2009b, p.6). Located less than a mile from campus, this location grows four varieties of willow on a 7 ½ acre lot. Colgate planted 60,000 8-inch willow shoots in May 2009 (Taylor, 2006a, p.3). The projected amount of woodchips that will be produced over the next twenty years is approximately 900 dry tons. However, this amount is only a small fraction of what is needed by our institution, as the woodchip boiler can easily use over 100 tons of chips within a single winter day in Hamilton. Hopeful individuals believe that this project could inspire local farmers to plant willows and sell them to Colgate, or for Colgate to simply purchase more land to grow willows on (Taylor, 2009b,p.6).


Green 'Gate

Colgate University and Hamilton Township Discuss Natural Gas Utility

BY CASSIDY HOLAHAN

Colgate University's interest in switching to natural gas as ...

... near future via an ongoing Village of Hamilton initiative to bring natural gas to the area."

The plan suggested the change because, when burnt, ...

... environmental assessment that is required by the New York State Environmental Quality Review Act before a new utility can be established.

... troversial energy source. Natural gas is, for the most part, extracted from shale using hydraulic fracturing, or fracking, in which companies fracture ...

Figure. F. Screenshot of 2012 *Maroon News* Article Discussing the Pros and Cons of Natural Gas

5.5 Natural Gas

As of 2010, natural gas became a highly discussed topic at Colgate. On September 15th, 2011, “Colgate University’s Sustainability and Climate Action Plan” was published. In terms of energy, the plan references switching Colgate's second fuel source from the polluting fuel oil #6 to natural gas. According to John Pumilio, "it's a fiscally sound plan that will help reduce energy costs while adding academic value from student involvement and research" (Holahan, 2011, p. 3). The shift to natural gas from fuel oil #6 would "greatly reduce Colgate's carbon footprint, and help the University become carbon neutral by 2019", as natural gas produces fewer greenhouse gas emissions than other fossil fuels (Holahan, 2011, p. 3). In January of 2012, stakeholders in the Hamilton community began making strides towards the implementation of natural gas pipelines at Colgate. The university's utility would connect a pipeline in Hamilton to one of the two major pipelines within a ten-mile radius. It was planned to achieve this fuel switch by 2014.

On January 10th, 2012, the Hamilton Village Board of Trustees voted to begin the environmental assessment that is required by the New York State Environmental Quality Review Act. This assessment had to be passed in order to continue with the pipeline. The natural gas utility was considered feasible at this time because of the support of multiple major stakeholders such as Colgate, Hamilton Central School, and Community Memorial Hospital. However, *Maroon News* contributor Cassidy Holahan notes the controversial nature of natural gas, for "although abundant in New York, natural gas is also a controversial energy source. Natural gas is, for the most part, extracted from shale using hydraulic fracturing, or fracking… however, many people oppose hydraulic fracturing because of the associated environmental and health hazards, especially when concerning water contamination." (Holahan, 2012a, p.3)

In 2012, an energy forum discussing the pros and cons of a transition to natural gas was held. Assistant Professor Jessica Graybill commented on the topic saying, "Colgate has been pushing towards natural gas because it is highly economically feasible. But we need to understand that there are many aspects of sustainability beyond economics — especially environment and community sustainability — where I don't think we are doing as well as we should be" (Holahan, 2012b, p. 3) Professor Peter Klepeis noted the importance of including all stakeholders in the decision-making process by saying, "We knew there were other faculty members and students who were concerned about the risks but didn't have an opportunity to voice their concerns." (Holahan, 2012, p.1). Klepeis also voiced his own fear that by building the connecting pipeline, Colgate would be tacitly supporting natural gas and the environmental degradation that accompanies its usage (Holahan, 2012b, p. 3). Despite this pushback, natural gas was implemented in 2014 as scheduled (Pumilio, 2017, personal communication).

6. ANALYSIS

6.1 Economic Pillar: Financial Cost

From her founding in 1819 onwards, Colgate University's primary consideration when making decisions regarding campus heating needs has been financial cost. Between 1800 and 1850, over 200 higher education institutions were founded in the U.S., most of whom were highly dependent on funds from student tuition and local donors (Thelin, n.d.). Due to this heavy dependence on funds, educational institutions faced economic insecurity and high closure rates (Thelin, n.d.). Colgate University was merely one of many institutions focused on ensuring her own financial survival. To avoid severe economic risk, a cost-focused decision-making model was typical of collegiate institutions during this time. Thus, energy sources for heating systems were only feasible if the associated financial costs were reasonable.

Between 1870 and 1910 however, commercial and industrial booms heralded in increasingly generous philanthropic donations to universities, and the blossoming societal ideal of education lead to a surge in interest from prospective students (Thelin, n.d.). It was during this period that Colgate became sufficiently enriched with the funds and donors necessary for the construction of a central heating plant. The central heating plant was also able to provide economic benefits, eliminating the need to pay for coal to be carted up the hill. The centralization of heating systems was reported by other higher education institutions to reduce labor and staffing costs, and to have a lower installed cost per given unit of energy capacity compared to dispersed stoves and radiators (Sanitation and Heating Age, 1915). It was this availability of funds and accompanying financial benefits that truly drove the transition to the central heating plant.

The decision to shift to fuel oil #6 was also primarily made based on the financial considerations. Colgate decided to replace coal with fuel oil #6 because it was less costly. Though the price of coal was only half that of oil due to technologically advanced operations, the overall cost was still higher when transportation costs were taken into account (EIA, 2012; EIA, 2016). Unlike other coal heating plants which could save a decent amount of money because they were adjacent to coal mines, the University's central heating plant was fuelled by remote coal suppliers, so they had to spend a significant proportion of money on the transportation of coal. As the coal industry shrunk in the market, the oil industry became more competitive and accessible. Thus, choosing fuel oil seemed to be the most reasonable decision for the University at that time. The shift to oil also increased the capacity and efficiency of the heating plant, as it allowed space for the utilization of more oil furnaces, demanded less labor from the workers, and reduced labor cost (Buck, 1966).

Economic considerations were also a critical factor in the decision to shift from fuel oil #6 to woodchips in 1981. Cost is referenced repeatedly in the discussion of the woodchip boiler; various dollar amounts are listed in terms of how much will be saved and how much will be necessary for the upkeep of this utility. In 1973, oil exporting Arab countries launched an oil embargo in response to the U.S.'s military support for Israel, who was fighting with Egypt and Syria (Myre, 2013). As a result, oil supplies were limited and prices were soaring, hitting the American economy hard. The administration, the Board of Trustees, and Colgate students all expressed a concern for these increases in cost. As the price of oil rose, woodchip boilers became an increasingly appealing energy alternative (Abel, 2004, p.46).

The recently rising price of woodchips fueled considerations of natural gas, however, the adoption of which would be a financially sound decision on behalf of the University. John Somerhalder, the chairman of the American Gas Association, underscores the abundance of natural gas, stating that the resource is not located in remote areas, but "near existing pipeline infrastructure, meaning these new supplies of domestic gas are getting to market reliably, cost effectively end quickly" (Somerhalder, 2011, p.4). The abundance of oil in New York guarantees the availability and accessibility of natural gas. In sum, adopting natural gas is economically feasible choice due to its low cost and reliability.

Overall, economic considerations have always been the primary factor determining the adoption of new energy resources at Colgate. In transitioning between fuel types the University primarily weighs associated costs, which usually were influenced top-down from the national markets. The price of each energy resource was inevitably affected by events such as the shrinking market of coal and the oil crises of the 1970s. The University gained more autonomy and power to choose fuel types as it became wealthier and less vulnerable to external factors affecting the costs and availability. Economic considerations thus shifted in focus from pragmatic feasibility to financial affordability. Although the University truly began committing to reducing its greenhouse gas emissions in the mid-2000s, it still made decisions regarding energy resources based on financial considerations (Colgate University, 2017). Therefore, throughout decisions made regarding utilized energy resources, Colgate always regarded economic factors as essential, but there was a shift in focus from feasibility to affordability.

6.2 Environmental Pillar: Pollutant Levels

Considerations of environmental contaminants were not explicitly considered in Colgate's utilization of heating facilities and fuel types during the 1800's and early 1900's. However, this lack of deliberate and comprehensive environmentalism was in line with societal values and knowledge of the time. The usage of coal as a fuel source was extremely prevalent during this time period, fueling over half the energy consumed between the 1880's and 1940's, and over 3/4 of consumed energy between 1906 and 1920 (The U.S. Census Bureau, 1960). There was not a strong foundation of knowledge or awareness about the environmental implications of coal combustion among the general population. The first state policies regarding air pollutants were enacted in Massachusetts and Rhode Island between 1910 and 1912, but dealt with smoke abatement as a public nuisance rather than an environmental harm (Stern, 1982). It wasn't until 1955 that the U.S. formalized strict policies on the many environmental pollutants emitted by the coal industry (Coal Age News, 2012). Though issues of high mortality and extremely "dense" or "black" smoke emerged as increasingly problematic, this was largely seen as an environmental concern for urban centers that would not have been a priority for a rural campus such as Colgate (Stern, 1982).

Despite a lack of scrutiny, Colgate's coal-run stoves and central heating plant released significant pollutants. In coal fired stoves used to heat residences, methane, ethane, sulfur dioxide, carbonyl sulfide, and nitrogen oxides emissions have all been detected (Cooke, 1984). Such emissions contribute significantly to air pollution. Furthermore, it is difficult to completely combust coal in simple household devices such as stoves, and this incomplete combustion results in the release of carbon monoxide and other volatile gases (MacKay, 2003). Burning coal can also release elements and compounds such as arsenic, mercury, and lead that are particularly harmful to human health (World Health Organization, 2015). So although pollutant emissions were not a concern of Colgate's when dealing with heating system, they were certainly a very real and present issue.

From the environmental aspect, the shift from coal to fuel oil # 6 in the 1960s was a significant move. Compared with coal, fuel oil # 6 emits much fewer greenhouse gases, which are composed of carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). Compared with coal, which emits over 90 kg of CO_2 per MMBtu, 11 g of CH_4 per mmBtu, and 1.6 g of N_2O per mmBtu, fuel oil # 6 emits 75 kg of CO_2 per MMBtu, 3.0 g of CH_4 per mmBtu, and 0.60 g of N_2O per mmBtu (EPA, 2014). Coal also emits carbon monoxide (CO), nitrogen oxides (NO_x), sulfur dioxides (SO_2), and particulates. In contrast, oil's CO emissions are less than 20 % of coals, its SO_2 emission is less than half of coals, and its particulates emission is less than 5 % of coals (EIA, 1998). Though fuel oil #6 is considered as a heavy fuel oil and emits more pollutants than other oils, it still emits comparatively fewer pollutants than coal.

However, it is important to note that though the transition from coal to fuel oil was environmentally sustainable, it was not intentionally so. The transition to fuel oil was pushed by a lack of availability of coal and price feasibility, and no consideration was given to the differences in pollutant levels between the two fuel sources. This is unsurprising, as the concept of sustainability was not introduced until 1987 with the Brundtland Report, and national public support for the environmental movement did not take hold until 1970 with the first Earth Day (Theis & Tomkin, 2012; "The History of Earth Day", n.d.)

Intentional energy conservation at Colgate began in the late 1970s through the lens of cost and consumption, rather than level of pollutants. It was the oil shortages and rising prices driven by the oil embargo that drove the transition to the use of renewable woodchips, not a dedication to lowering pollutant emissions. Colgate newspaper articles from the era note reductions in fuel oil use and annual cost, not in pollutants. The concept of the woodchip boiler as emission reducing is not introduced in published Colgate records until 2006 (Sturgeon, 2006). Nonetheless, as a renewable and carbon-neutral source, the woodchip boiler was a much more environmentally-friendly heating source than either fuel or coal.

The adoption of natural gas, however, was an action taken in deliberate pursuit of environmental sustainability. Natural gas produces fewer greenhouse gas emissions than other fossil fuels, and its adoption was heralded in Colgate's 2011 Climate Action Plan as an act that would reduce Colgate's carbon footprint and help the University achieve their carbon neutrality goal. Natural gas is a cleaner energy source than both coal and the notoriously polluting fuel oil #6, but releases more emissions than woodchips. According to the Annual Review of Environment and Resources,

> "Unconventional energy generates income and, done well, can reduce air pollution and even water use compared with other fossil fuels. Alternatively, it could slow the adoption of renewables and, done poorly, release toxic chemicals into water and air. Primary threats to water resources include surface spills, wastewater disposal, and drinking-water contamination through poor well integrity. An increase in volatile organic compounds and air toxics locally are potential health threats, but the switch from coal to natural gas for electricity generation will reduce sulfur, nitrogen, mercury, and particulate air pollution." (Jackson et al., 2015)

It is clear that natural gas comes with both environmental benefits and drawbacks. Still, the environmental benefits combined with relatively low labor and financial requirements is what attracted many University officials to natural gas.

To conclude, emissions of environmental pollutants have clearly been present throughout the history of Colgate's heating system, with both coal and fuel sources being highly polluting forms of energy. Considerations of limiting these emissions only began being considered on campus in the 1970's with the start of the modern U.S. conservation movement and in the 1980's with the adoption of carbon neutral woodchips. Ever since, factors of environmental sustainability have only gained traction among students and the administration, and today's ongoing debate about the usage of natural gas at Colgate is heavily due to the mixed environmental benefits natural gas brings. Overall, despite decades of neglecting the emission of pollutants from our heating sources, such emissions and their impact on our carbon footprint have become increasingly prioritized at Colgate over the past few decades.

6.3 Social Pillar: Student & Staff Comfort

In making the transition to a central heating system, the administration placed significant weight on socially-oriented considerations of how energy reliability and accessibility would affect student comfort. During most of the 1800s, employers seldom required college degrees, and families had difficulty sparing their sons' labor to allow them to attend college, so universities faced a challenge in recruiting students (Thelin, n.d.). Retaining men could also be a difficult, and Colgate trustees cited a worrying trend in 1905 of student losses across northeastern colleges, and declared a need to "create conditions favorable to [men] remaining at Colgate" (Board of Trustee Minutes, 1903-1906, p. 8) Therefore, universities did their best to address student concerns and provide a satisfactory experience. This was demonstrated in the administration's attentiveness to student heating and warmth needs. Protests from students regarding cold temperatures secured administrative attentions, the importance of ensuring the comfort and convenience of students with the installation of the central heating plant was consistently highlighted, and contingency plans were incorporated into the plant to ensure reliable heat.

On the other hand, the harsh working conditions of the janitors and staff who supported the running of both individual stoves and the central heating plant went largely unheeded. Because the coal-fired boilers needed regular maintenance, workers were plagued with the ashes and dust released from the burning of coals (Haney, 2014). Working conditions in boiler rooms involved heavy physical activity, a high risk of accidents, and a significant degree of noise and dirt (Rodrigues, 2012). Furthermore, workers were exposed to a variety of pollutants which have different and insidious impacts on health: exposure to mercury could result in neurological and developmental issues; nitrogen oxides could harm lungs, affect the respiratory system and even lead to asthma; and particulate matters could affect respiratory systems and trigger heart attacks (Schaffer, 2012). Harsh working conditions were quite prevalent in the 1800's and the early 1900's however, with the legality of unions in question until 1842, and with child labor not being regulated by Congress until 1938 (Arnesen, 2007). It is therefore not surprising that the working conditions of the laborers handling the coal stoves and working in the boiling room were not an administrative priority. In addition, the general unpleasantness associated with coal — the smoke, the ash — was also quite typical of the era, and viewed as a largely unavoidable cost that was outweighed by the industrialization that coal enabled (Reitze, n.d.). In contrast, after the switch from coal to fuel oil, the heating plants emitted lower levels of dust and pollutants, which decreased the likelihood of health issues among workers (F.E. Moran SHS, 2012).

The importance of heat for student and staff comfort is never directly mentioned in discussions and documents related to the woodchip boiler. However, it is heavily implied that the level of comfort sustained with fuel oil as an energy source should not dwindle with the implementation of the woodchip boiler. Student and staff comfort continues to be a major priority of the heating plant. Pumilio addressed workers issues when he noted the amount of labor that the woodchip boiler required. The plant workers would prefer that Colgate abandons the woodchip boilers and switches entirely to natural gas, in order to minimize their own labor. However, the issue of labor is prioritized far below financial considerations and pollutant levels. Plant workers do not appear to have been recognized as stakeholders during the decision to switch from fuel oil to the woodchip boiler, although this decision must have affected their working conditions. This omission is not shocking as Boström notes that the social pillar is often neglected (2012). Were plant working conditions improved or worsened with the implementation of the woodchip boiler? According to a 2011 Dutch study, "working with biofuel at an energy plant does not generally enhance the prevalence of respiratory symptoms. However, the exposure level to micro-organisms has an impact on the occurrence of respiratory symptoms among biofuel workers" (Schlünsse et al., p 474).

The Colgate administration appears to be neglecting the social pillar in two aspects. For one, not all stakeholders appear to be included in the decision-making process. Natural gas is supported by Hamilton Central School, Community Memorial Hospital, the Colgate administration, and, broadly, members of the village. Yet, professors, along with students, are not being included in the decision-making process. Using staff and student comfort as the criteria for the social pillar, natural gas may appear more socially equitable because it saves plant worker's labor. However, this lens neglects to take into account the social issues that stem from hydraulic fracturing. Lave and Lutz voice concerns for social and environmental justice issues stemming from fracking, as "the rise of fracking has redistributed environmental injustices beyond traditional national sacrifice zones, such as Appalachia, and towards regions that in many cases are wealthier than Appalachia and have not recently borne the brunt of energy production, causing profound social, cultural, and economic shocks" (2014, p.739).

In summation, considerations of the social pillar in decision-making processes have been largely dominated by a concern for student comfort, rather than staff comfort. Moreover, considerations of the social pillar frequently intersect with the economic pillar. Student comfort ensured a steady population of students and the continuation of financial donations of the part of parents and alums. Although Colgate currently seeks to ensure the safety of the heating plant workers, considerations of their comfort appear to be missing.

7. CONCLUSION & RECOMMENDATIONS:

In conclusion, we found that financial costs have always been the essential consideration in decision-making processes. From the environmental perspective, the administration became concerned about the pollutant emissions only in recent decades due to the rise of the popularity of sustainability in American society. Additionally, from the social perspective, the University has been continuously concerned about the comfort of students, while workers conditions appear to have been perpetually overlooked.

Our recommendations regarding the future sustainability of Colgate's heating system are largely inspired by the information we gained from Howard Lewis, Tom Martin, and John Pumilio on our tour of the heating plant. First of all, we believe that an update of infrastructure in the heating plant will help to bolster the social and environmental pillars of sustainability on campus. The current infrastructure of the woodchip heating system demands an inordinate amount of labor from workers. Whenever a clog occurs, workers need to turn off the entire system and remove sticks manually. This process is time-consuming and frustrating because of the limited number of access points to reach said blockage. Furthermore, workers also need to manually haul large quantities of ash out of the system with heavy metal rods. This process can take several hours and is backbreaking work. Furthermore, the current load-in system for the woodchips is a major inconvenience not only for our plant workers but also for the truck drivers delivering the chips as well. In many instances, expensive trucks have been damaged because of our inefficient infrastructure.

Because of this serious manual labor and inconvenience involved with the current woodchip boiler system, the majority of workers prefer natural gas, as it requires virtually no labor (Pumilio, 2017, personal communication). However, natural gas emits higher levels of GHGs and has serious social repercussions as far as the implicit condonement of fracking and its resulting health risks (Holahan, 2012b, p. 3).Thus, we recommend avoiding dependency on this fossil fuel. If improving the infrastructure of the heating plant was able to ease some of the burden for the workers, perhaps they would more favorably regard carbon neutral woodchips. We believe integrating workers as stakeholders by responding to their needs will lead to a more inclusive approach to sustainability.

Additionally, we recommend the discontinuation of fuel oil #2 as a backup energy source. Though not as polluting as fuel oil #6, fuel oil #2 still releases a relatively high level of pollutants. Furthermore, this particular type of fuel has a limited shelf life and must be used relatively quickly. However, the use of fuel oil #2 as a backup to woodchips and natural gas has never been rendered necessary, and the maintenance of its supply is thusly a needless expense. (Pumilio, 2017, personal communication). Therefore, we propose selling this fuel oil to another institution. In doing so, we would lower our potential emissions while increasing our monetary funds. Perhaps this saved money could be redirected towards updating our heating infrastructure and investing in renewables. As John has mentioned, Colgate could potentially collaborate with the village to usher in renewable energy in Hamilton (Pumilio, 2017, personal communication).

In summation, to help the campus become more sustainable, the decision makers of the University should avoid their traditional prioritization of economic considerations, and place more emphasis on environmental and social factors. We encourage Colgate to think deeply and critically about the social and environmental implications of the decisions they make regarding the heating system, rather than how they look ‘on paper’. Sustainability should be an ethos, not a marketing tool (Polonsky et al., 2010, p.51).

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