The History of Heating at Colgate University

ENST 390: Community-based Study of Environmental Issues
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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-

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2. INTRODUCTION

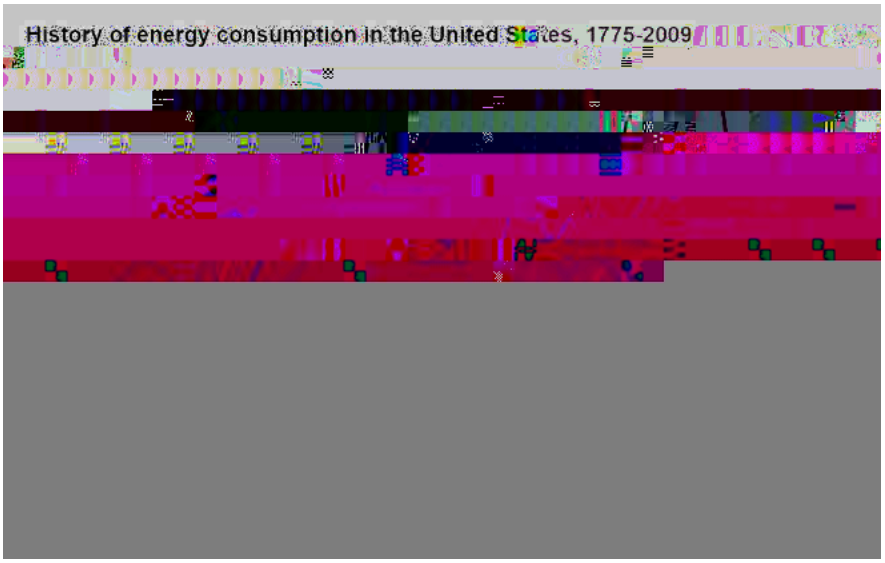


Figure A.From Energy Information Administration. A graph demonstration of the history of energy consumption in the United States from 1775 to 2009.

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.).

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).

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

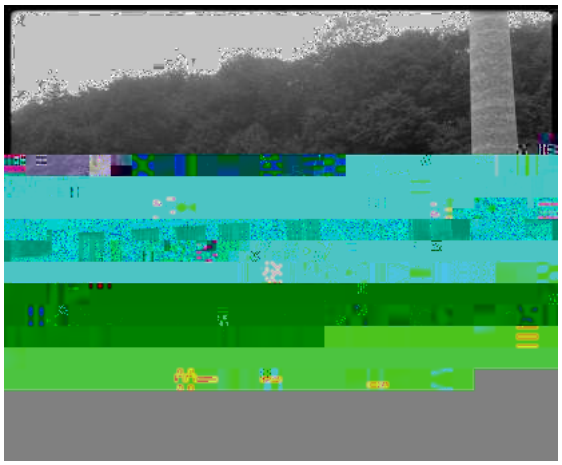
Based on our findings, we operationalized the economic pillar as financial cost, the social pillar as the comfort of students and laborers, and the environmental pillar as the level of pollutants emitted. We developed these criteria under the framework of emergent theory, in which theories and concepts 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

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-

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.



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

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).

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

[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 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 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.

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 , "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

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, 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

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.

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

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 favoruolleosse

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