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Perceptions and Practices of Sustainability within Keene, New Hampshire

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Abstract

This research involved a study of sustainability initiatives being employed by Keene State College and throughout the City of Keene, New Hampshire. Student perceptions of sustainability were also of interest because they make up about 20% of the total population and are a significant demographic within the community. We reviewed business practices throughout the community and interviewed citizens to ascertain what sustainable practices are currently implemented. Results from community surveys were used to inform the content of a student survey, which was designed to gauge perceptions of sustainability. The results of these surveys were related to those of business surveys to understand their relationship with one another. Specifically we sought to correlate current sustainability practices promoted by local businesses to the motivations of college students. We felt it was important to understand whether knowledge of business sustainability practices translated into an increased interest in using those businesses' services. A map was developed to highlight sustainability efforts throughout the community and across the college campus. The findings of this study were compiled into a comprehensive sustainability profile of Keene, New Hampshire. The results of this sustainability profile will inform the public of what actions are being taken within the greater Keene community and identify current strategies that can be adopted by other communities at large.

Keene Profile



Keene Profile

Keene: The Development and History of a Sustainable Community

The history of Keene begins with the enacting of four new townships by the Massachusetts legislature on July 3, 1733 (Griffen 1980; Proper N.D.). Massachusetts had authority over the unsettled territory at the time; it wasn't until King Philip officially declared the Massachusetts and New Hampshire border in 1740 that the community of Keene was resolved into New Hampshire. Sixty-three individuals bought into the initial settlement plans drawn up by Nathaniel Dwight and his scouting party. Representatives from six of those original proprietors met for the first time in the Keene area to establish what was then termed "Upper Ashuelot" on September 18, 1734. A significant attack by Native Americans on April 23, 1746 resulted in several fatalities and led to the temporary abandonment of Upper Ashuelot between 1746 and the 1750's. In 1753 the town was re-chartered to previous residents and renamed Keene by New Hampshire governor Benning Wentworth. The reclamation and reconstruction of former homes utilizing available local materials, along with the perpetual commitment to economic development by these early settlers of Keene demonstrate some of the sustainable practices that were inherent to so many communities throughout New England at that time.

According to town records, the development of transportation was of primary concern from the very inception of the city of Keene (Proper N.D.). Initial settlers of the region had to first follow the "Bay Path" from Boston, MA, to Hinsdale, NH, by foot, horse, or wagon, and then proceed an additional twenty miles on foot to reach Keene (Proper N.D.). It was

approximately fifty years before any travel other than by foot or horseback could make the last leg of the journey into Keene. Improving infrastructure, like transportation, within the community and in connection to surrounding areas, has continued to be a cornerstone in Keene's development since those earliest days. The width of Keene's Main Street for instance, once the widest paved Main Street in America, was established as early September 30, 1736 (Proper N.D.).

Road development as a primary transportation system began with settlement of the Keene area; one of the first roads in Keene was built to a local sawmill. Records indicate that the settlement of Upper Ashuelot employed a roads maintenance crew as early as 1737 (Robbins N.D.). The beginning of the 19th century saw Keene's inclusion in the development of the Third New Hampshire Turnpike, which ran from Bellows Falls, Vermont, south to Massachusetts through Keene (Robbins N.D.). Up until automobiles were accessible and popularized, early city employees used horse and carriage for the majority of tasks with many carriages and jobs associated equipment being produced by local tradesmen (Proper N.D.). Contemporary city employees however have use of a much wider assortment of vehicles. Keene's service fleet however continues to exemplify a commitment to sustainability; many of these vehicles have been using a twenty percent biodiesel and eighty percent petro diesel mixture called B20 for ten years (GSCCC 2014). The City of Keene and Keene State College began to use B20 when they became stakeholders in the Granite State Clean Cities Coalition (GSCCC).The GSCCC is an organization administered by the New Hampshire Department of Environmental Services aimed at improving air quality through promoting alternative fuel and fuel reduction strategies in both the private and public sectors (GSCCC 2014).

The first record of an automobile in Keene appeared in 1909, and as early as 1914 the city of Keene developed and enacted new rules to govern the use of automobiles within the city (Robbins N.D.). By 1925 it became apparent that gravel would no longer suffice as the sole material for road construction and other materials such as concrete were utilized (Robbins N.D.). Modern advances in road construction aim at creating pervious asphalt which allows rain water to penetrate the ground. The City of Keene and Keene State College have begun to explore the long-term durability of these materials (City of Keene 2014; Keene State College 2014). The City of Keene has begun to test pervious pavement on road shoulders and sidewalks, while the College is testing pervious pavement in their Alumni Center parking lot.

Of similar consequence to the history of transportation in the City of Keene was the development of the railroad. The first train arrived on May 16, 1848 (Griffen 1980; Proper N.D.). Shortly afterwards lines opened up north to Bellows Falls, Vermont, and Hillsboro and Manchester, New Hampshire. Cheshire Railroad continued to serve as the backbone of commuter business for Keene and surrounding areas until the early 1960's, when it ceased to operate as a result of advances in New England's highways and roads (Reynolds 2013). Similarly, there was an electric public streetcar venture established within the City of Keene in 1887, but due to costs of maintenance and advances in other means of personal transportation, the Keene Electric Railway ceased to operate in 1929 (Proper N.D.). These early initiatives into efficient public transportation and the direct linkage to economic development exemplify qualities sought after by many modern sustainability programs.

Other early developments seen in Keene relating to transportation were the construction and maintenance of several wooden covered bridges spanning the waterways

of Keene. These were replaced in the early 20th century by steel bridges. Correspondingly, several stone arch bridges were constructed during the mid to late 19th century within Keene and in terms of sustainability efforts, the stone arch keystone bridge originally constructed for the Cheshire Railroad in 1846 has been incorporated into the local bike trail system (Robbins N.D.).

Equally important to the development, and thus the heritage of Keene, NH, is the manufacturing industry. For instance, in 1736 a sawmill and a gristmill were two of the first structures built in the area (Griffen 1980; Proper N.D.). Similar ventures of industry such as blacksmithing and furniture production soon followed. Mills however remained the main form of industry throughout most of Keene's history and have helped to shape much of the existing architecture seen throughout the city. One historically notable location, the Faulkner and Colony mill originally developed in 1775, was adapted into a local shopping center and is still in use to this day. In total there are over twenty-five mill sites that were established during the 18th and 19th centuries situated within Keene, NH, illustrating the historical importance of manufacturing to this community. Similarly, global manufacturing companies like Timken and Markem Imaje, who both employ environmentally conscience business practices focused on sustainability, choose to maintain facilities within the City of Keene. By employing policies that reduce energy consumption as well as waste and greenhouse gas production, these companies are promoting the same sustainability principles detailed by the City of Keene's master plan and Keene State College's policy on sustainability (City of Keene 2010; Keene State College).

Sustainability Practices in Keene

The City of Keene, NH, joined the ICLEI in 2000 and continues to advocate for its Cities for Climate Protection Campaign (CCP). The CCP aims to develop strategies and projects that could reduce greenhouse gas emissions to 10% below 1995 levels by 2015 (City of Keene 2007). Keene is also a member of the ICLEI Climate Resilient Communities (CRC) program, which has outlined five key milestones for cities to achieve (City of Keene, 2007). These include: initiating a climate resilience effort, conducting a climate resilience study, developing and implementing a climate resilience action plan, and follow-up monitoring and reevaluation. Keene was the first ICLEI member to complete milestones one through three as a pilot city for ICLEI's CRC Program (City of Keene 2007).

The City of Keene's proactive stance regarding climate change is evidenced by their policies, implementation of a community action plan to adapt for climate change, and the incorporation of zoning districts that offer incentives for participating in the Sustainable Energy Efficient Development (SEED) program (City of Keene 2007, 2010). Under the SEED program, owners whose property falls within certain districts of downtown Keene can receive rewards, such as tax incentives, if they build or modify structures using LEED, or Leadership in Energy and Environment Design, green building standards (City of Keene 2010).

Keene: Climate and Geography

The city of Keene is the county seat of Cheshire County, located in the southwest corner of New Hampshire. It is situated in the New England region, which experiences the beauty of all four seasons. It is located in a humid continental climate and found at forty-

three degrees, north latitude. This climate generally experiences mild summers, vibrant fall foliage, and cold winters (Figure 1). With seasonally cold temperatures below fifty degrees consistent for roughly six months of the year, residents of Keene have an increased reliance on heating which results in an overall higher energy cost. This is one problem facing sustainability planners within the Keene community. By reducing energy consumption through better design practices, energy management technologies, and heating solutions, sustainability planners are promoting a healthier environment and society.

New England receives well-distributed precipitation throughout the year with varying amounts of snowfall during colder months. Keene experiences more than average amounts of annual precipitation when compared to the other U.S states with approximately forty-six inches of rain every year; higher than the U.S average by eight inches (Figure 1). The difference is most observable during the spring. Throughout the winter season Keene receives an average of seventy-two inches of snow. The humidity in Keene typically ranges from thirty-six percent (comfortable) to ninety-four percent (very humid) throughout the year. The most extreme conditions range from eighteen percent humidity to one hundred percent humidity.

Keene is located in a broad, flat, postglacial valley in the beautiful foothills of the Appalachian Mountains. These surrounding hills and mountains provide recreational opportunities including nature walking, bike riding, rigorous mountain climbing, ATV and snowmobiling, and camping. Along with the beautiful scenery, Keene offers wonderful green space for residents and visitors. Formal recreation areas are scattered across the city, including high school, middle school, and college athletic fields as well as public ball courts.

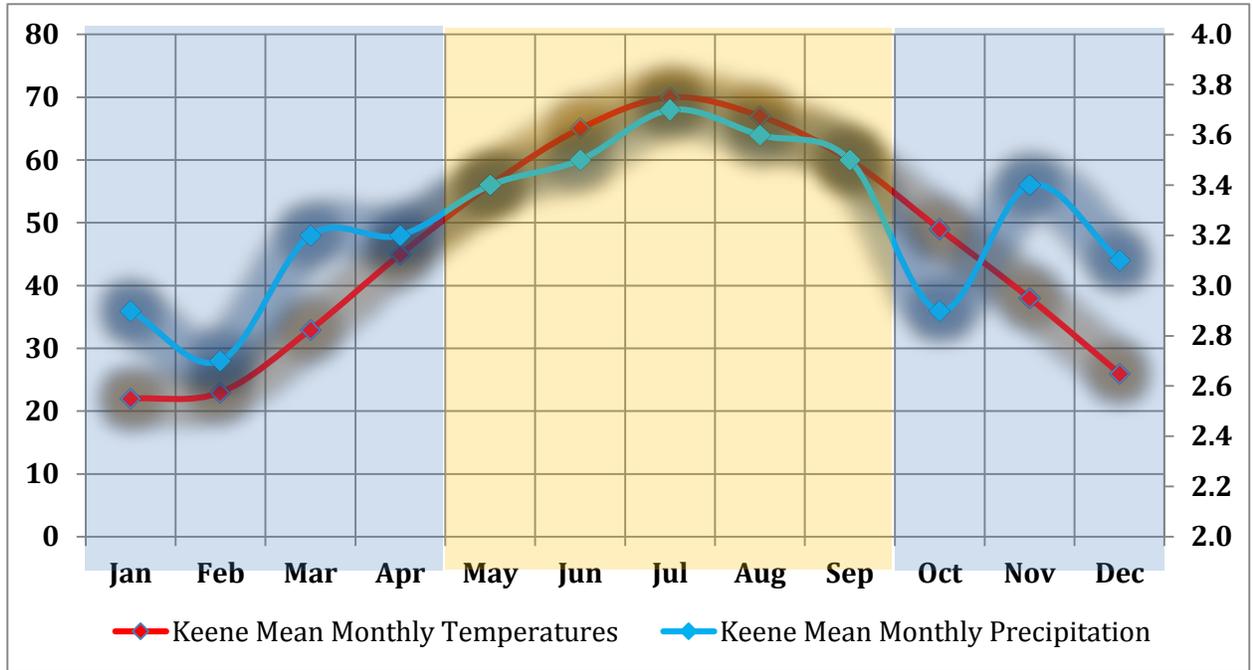


Figure 1: Monthly mean precipitation and temperature For Keene, NH, 2010. Note corresponding increases in precipitation and temperature between February and July. This increased relative humidity results in a sensation of milder temperatures contributing to a prolonged reliance on heating. Likewise, a declining of relative humidity throughout August to October result in an increased reliance on central air cooling systems which also contribute to an increased demand on energy production.

Keene: Contemporary Economies and Community Profile

Employment

With 39,120 people employed in the county, Keene has a larger number of employees than the rest of Cheshire County combined. Because of institutions like Cheshire Medical Center and Keene State College, manufacturing facilities such as Marken Imaje and Timken, and shopping centers with Walmart and Target, Keene serves as a regional center for the county drawing in workers and shoppers from a twenty to thirty mile radius. Keene has a population of approximately 23,300 people comprising approximately one-third of the 76,600 who

reside in the county (U.S. Census Bureau). Keene’s population and businesses create a regional service center for the area. The graph below portrays the top employers in the city of Keene.

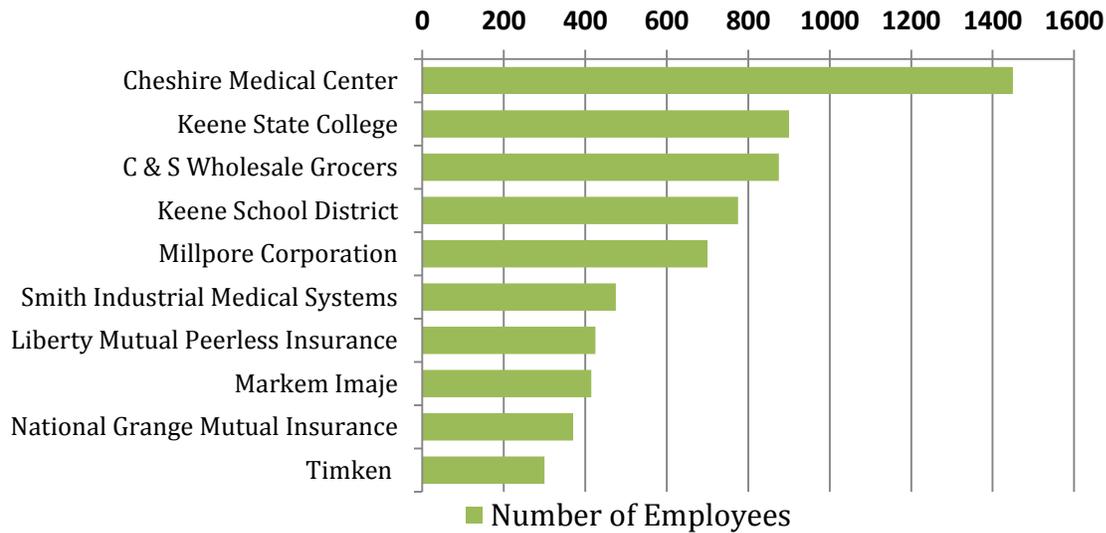


Figure 2: Top ten employers in Keene, NH.

In addition to having the region’s medical center and a major college, the city of Keene also stays true to its manufacturing roots. Five out of the top ten employers within Keene fall into the manufacturing sector. Companies like Smith Medical Systems which export goods that bring more wealth into the community are an integral part of the local economy. This can be quantified using a location quotient (LQ) equation.

LQ is used to calculate the “basic” (major) and “non-basic” (minor) industry sectors of a region as compared to a larger region, usually a state or nation. The LQ equation derives a ratio of an industry’s share of the local economy to the industry's share of the national economy (Figure 3). If the LQ result for a particular employment sector is greater than 1, than the industry is considered a “basic” (major employers) industry, if less than one, it is “non-basic.”

$$LQ = (e_i/e_t)/(E_i/E_T)$$

e_i = Region's Industry Employment
 e_t = Region's Total Employment
 E_i = U.S. Industry Employment
 E_T = Total U.S. Employment

Figure 3: Location Quotient Equation

“Basic” industries entail local production, specialization, and export of goods. A “non-basic” industry requires products to be imported and its presence is focused on providing goods and services to the community, including those working in basic industries. The LQ for Cheshire County indicates that manufacturing is a “basic” industry and thus a significant contributor to the local economy (Table 1). Companies like Markem Imaje and Timken, which fall into the manufacturing sector, are essential to the Keene community due to the jobs they provide and the financial stimulus that they bring into the area.

Table 1: Location Quotient results.

	Manufacturing Employment	Total Employment	e/E	LQ
Cheshire County	4,896	39,120	0.125	1.53
United States	10,964,361	134,259,645	0.081	

Unemployment

According to the N.H. Employment, Security, Economic and Labor Market Information Bureau, Cheshire County has an unemployment rate of 4.8%. This rate places the county fifth out of eleven counties in New Hampshire. Keene has an unemployment rate of 4.5%, not far behind Cheshire County as a whole. Keene's unemployment rate is average compared to other towns in Cheshire County (Figure 4).

Cheshire County

Un-Employment

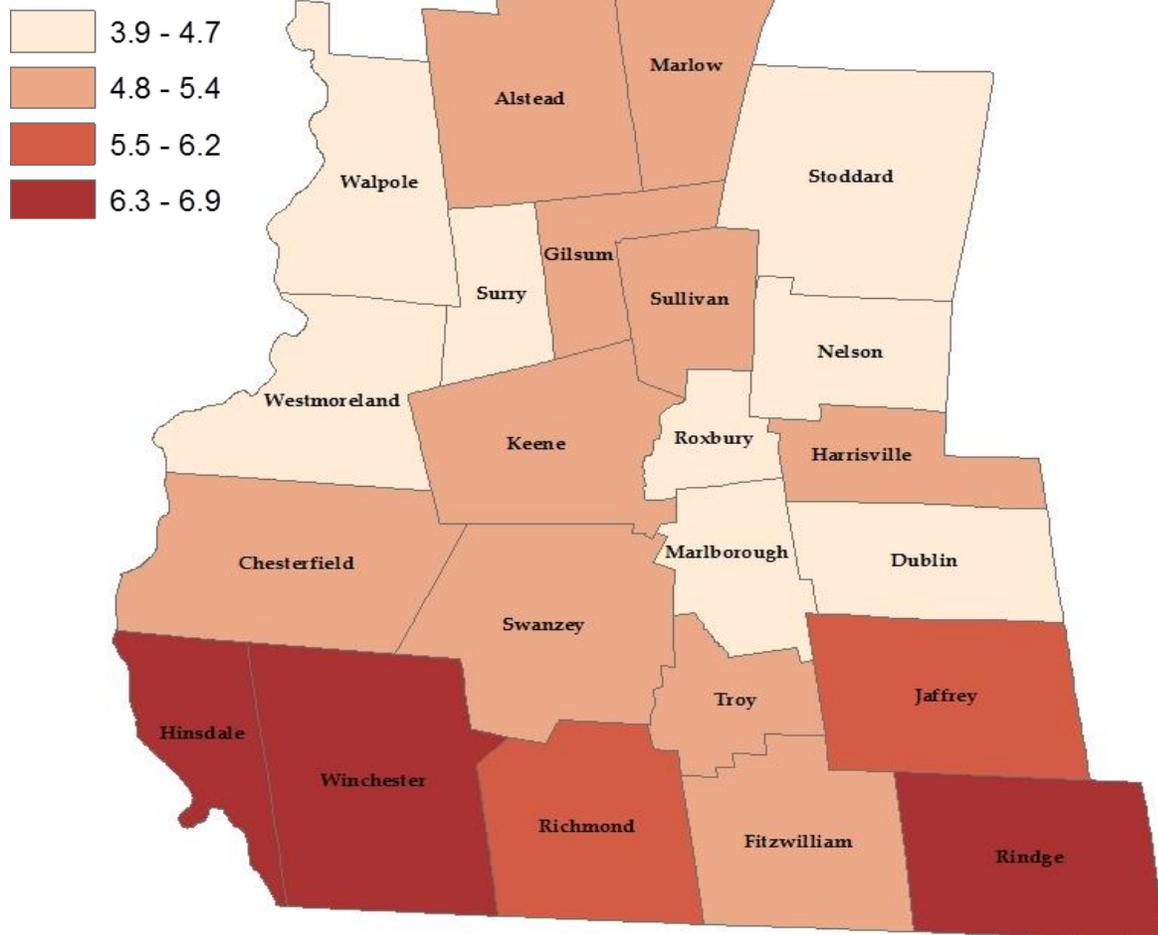


Figure 4: Unemployment rate by town within Cheshire County.

Keene Demographics

Keene, New Hampshire is a small city with a population of 23,400. (US Census 2014) Most of Keene’s population lives within a mile of the city center, opposed to the more rural or open sections. We constructed a map which visually portrays the nodes of densely inhabited areas within the city (Figure 5).

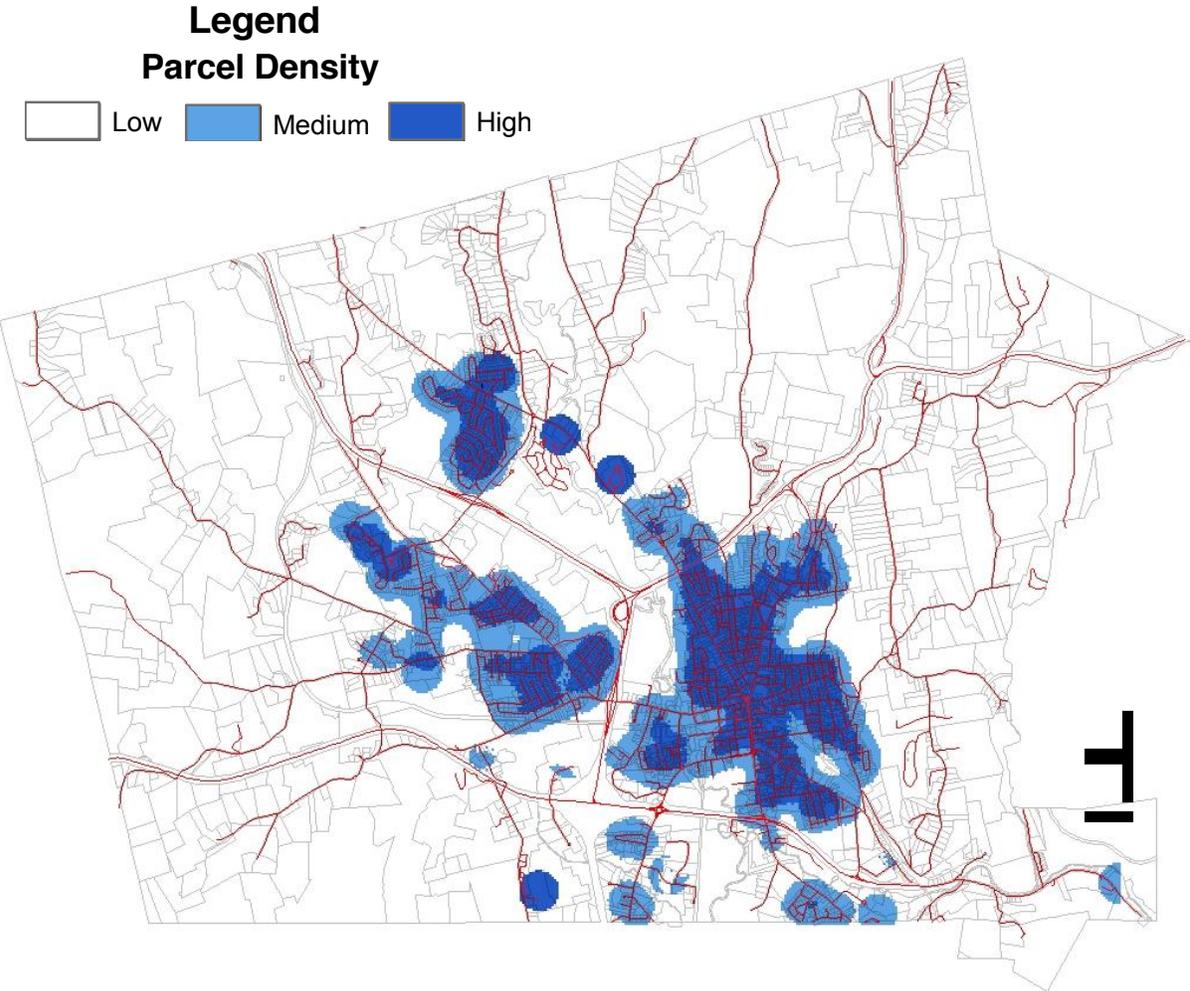


Figure 5: Point density map of land parcels portraying densely inhabited core of Keene.

This map was produced from parcel data. Using ArcGIS, we were able to convert parcel polygons into points. Then, we ran the point density tool which creates an output showing areas of clustering. To achieve a more accurate portrayal, only parcels in residential and commercial zones were selected. Using the cell count field within the attribute table, we were able to figure out the percentage of land area that coincides with each category of density. 78.5% of land in Keene falls under the low parcel density category, 12 % of land falls under the medium parcel density category, and 9.5% of land falls under the high parcel density category.

This map is also a good representation of the City of Keene's sustainable policies. Keene promotes mixed use zoning which allows overlap of residential and commercial zones. Since such a large portion of the population is densely populated within the central part of the city, this allows Keene to be a very walkable city. Being a walkable city promotes sustainability because it cuts down on environmental and economic transportation costs. This also provides a lot of space within other parts of the city for green space, conservation land, and agricultural areas.

The majority of the people who live in the city of Keene identify as White (Figure 6). African Americans, Asians, and Hispanics make up less than five percent of the population. This reflects overall population trends throughout much of the rural Northeast. Because of Keene's position as a regional service center, it exhibits a slightly higher than average racial diversity as compared to its rural regional neighbors.

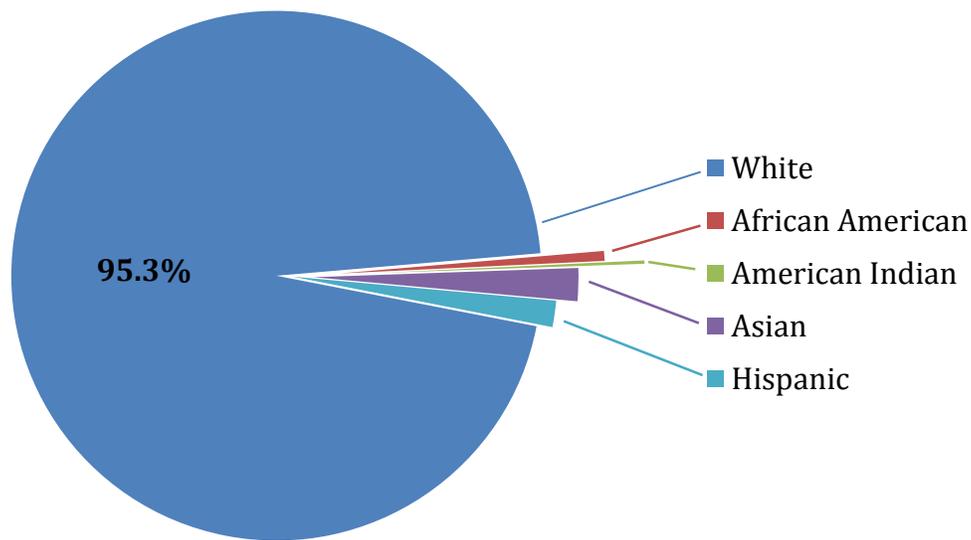


Figure 6: Racial composition of Keene.

The percent of females slightly exceeds the percent of males at 53.5% to 46.5% (US Census 2014). The age distribution among the Keene population is moderately even across all age cohorts with the exception of the college age population (Figure 7). People between the ages of fifteen and twenty-four, along with those over sixty-five make up nearly one-third of Keene’s entire population rate (City of Keene 2014). Between 1960 and 1970, the average annual growth rate was 1.5 percent. Between 2000 and 2007, the average annual growth rate was a mere 0.6 percent (City of Keene 2014). Note that age cohorts fifteen to nineteen, and twenty to twenty-four, are the largest. This is due to the large number of college students that are present within the city of Keene. The third largest cohort is the elderly population of Keene. Since 1990, the elderly population has increased by 5.2 percent and now constitutes 15.2 percent of the population.

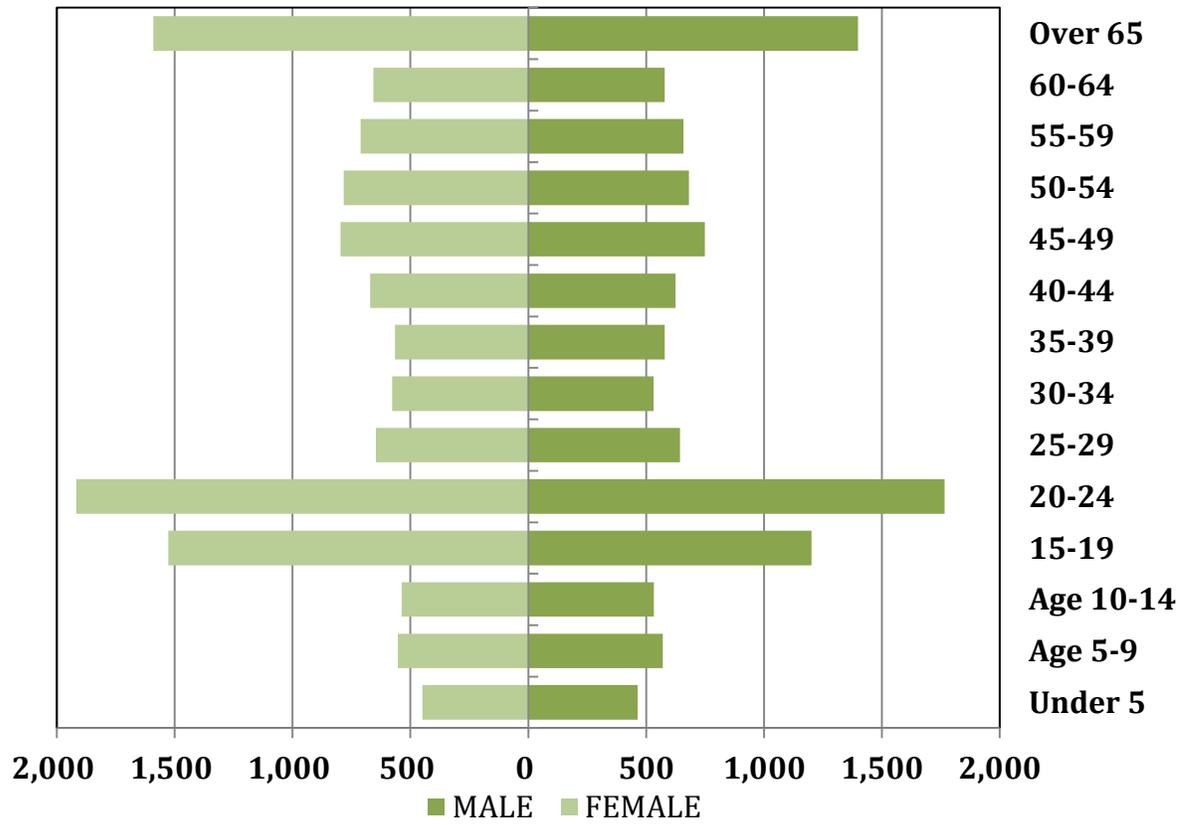


Figure 7: Age distribution of Keene population.

Literature Review



Literature Review

Humans are a dominant force in shaping Earth's landscape. This is evidenced by the countless modifications humans have made to the environment throughout history. The ancient pyramids of Giza and the modern Three Gorges Dam for instance, both illustrate mankind's capacity to modify the environment. The mentality of environmental ownership appears to be shifting towards a collaborative approach, as the effects of global climate change, human population growth, and industrialization are increasingly understood. Many of these effects have been exacerbated through practices such as large-scale forest clearing, energy production by burning coal or oil, increases in transportation infrastructure, as well as poor land development strategies. Evidence of climate change varies globally and the observable effects are influenced in part by local geography (WCED 1987; United Nations 2008).

The Intergovernmental Panel on Climate Change (IPCC), established by the United Nations Environment Program (UNEP) and the World Meteorological Organization (WMO), has outlined in their 2014 assessment of climate change many of the observable changes occurring throughout the world today. They list the increased frequency of extreme weather events and measurable increases of air pollutants as two forms of environmental change affecting humans (IPCC 2014). In response to these changes, considerable research is being done into ways to mitigate human impact on the environment, while still advancing an economically viable and socially equitable society (Jackson, 2005; Snell & Haq, 2014; Stern, 2006).

Sustainability is generally referred to as a practice that emphasizes the preservation and conservation of available resources while concurrently promoting economic

development and social equity (Hopwood, Mellor, and O'Brien 2005; Redcliff 2005). Many government bodies and private organizations have incorporated this philosophy into their long-range plans using terminology such as 'sustainable development', 'environmental sustainability', and 'social sustainability' (City of Keene 2010). Each of these terms is representative of various aspects of sustainability; the term "sustainable development" however, is used most often to encompass all of these ideals.

Sustainable development was first defined by the United Nations World Commission on Environment and Development (WCED) as satisfying "the needs of the present without compromising the ability of future generations to meet their needs" (WCED 1987, p43). One of the key goals to sustainable development is to protect and preserve the natural world. It has developed largely as a response to the over-development and poor planning strategies historically imposed upon the natural landscape. Organizations like the United Nations (1972) and the International Council for Local Environmental Initiatives Studies (ICLEI) (2014) have argued that public education and engagement is critical to the success of sustainability efforts. Cities like Keene, have taken a proactive stance by adopting policies representative of the most recent comprehensive research surrounding sustainability. We examine this research using five categories: Sustainability Policies, Sustainability in Communities, Sustainability in Colleges and Universities, Sustainability in Architecture, and Sustainability Practices.

Sustainability Policies

Considerable research has explored ways to promote development while emphasizing environmental responsibility and social justice (Hopwood, Mellor, and O'Brien

2005; Redcliff 2005). This literature has helped to inform initiatives such as sustainable development and community growth through intelligent design practices, as well as environmentally conscience designs focused on mitigating the ecological impacts of occupied landscapes (Hopwood, Mellor, and O'Brien 2005; Redcliff 2005; WCED 1987; United Nations 2008). Furthermore, this line of inquiry has amassed enough influence to direct discussions within national governments, provinces, states and cities, nongovernmental organizations, as well as independent institutions (City of Keene 2007, 2010; Mabry 2011; WCED 1987; UN 2008). For example, WCED wrote the Brundtland report in 1987 advocating for future growth to incorporate strategies that mitigate environmental degradation while promoting social equity through sustainable development (WCED 1987).

The ambiguity of the definition of sustainable development has led to debate as to what the term means (Connelly 2007; Hopwood, Mellor, and O'Brien, 2005; Redcliff 2005). Connelly (2007) asserts there are three primary approaches to discussing sustainability and sustainable development in the literature today. The foremost is to bypass debates concerning terminology because the core values of sustainable development are straightforward. Alternatively, some choose to select a specific definition that is favorable to their purpose and point of view. The final approach detailed by Connelly (2007) is to illustrate the outcomes of sustainable development graphically by demonstrating them on a gradient, such as in the center of a triangle with the three main concepts of sustainability (environmental integrity, social equity, and economic development) placed at each corner (Figure 8). The location of specific outcomes can be represented at different positions around the center of the triangle, depending on the specific core value[s] given precedence.

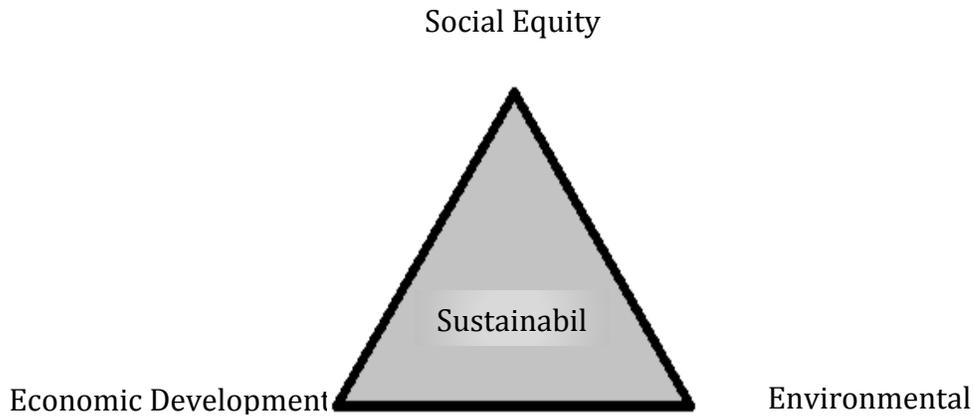


Figure 8: Connelly's (2007) model of sustainability.

Another common derivative of Connelly's (2007) approach is the use of the triple bottom line approach, or Venn diagram, as the paradigm in illustrating how sustainable development is where social justice, environmental consciousness, and economic development intersect (Figure 9) (City of Keene 2010; Mabry 2011; United Nations 1987, 2008). This diagram illustrates each core value as a separate circle overlain on one another. The area created by the overlap of the three circles represents sustainability, the balance of core values necessary to achieve a sustainable community. Schjeldahl (2013) states that recognizing the connection between sustainability and economics is necessary to successfully develop a sustainable community. The author utilizes the "triple bottom line model" to illustrate what constitutes a sustainable community. For example, if there is a stronger focus on social and economic factors, then the environment could become exploited. Conversely, if the focus is primarily on the environment and the economy, then social equity could suffer.

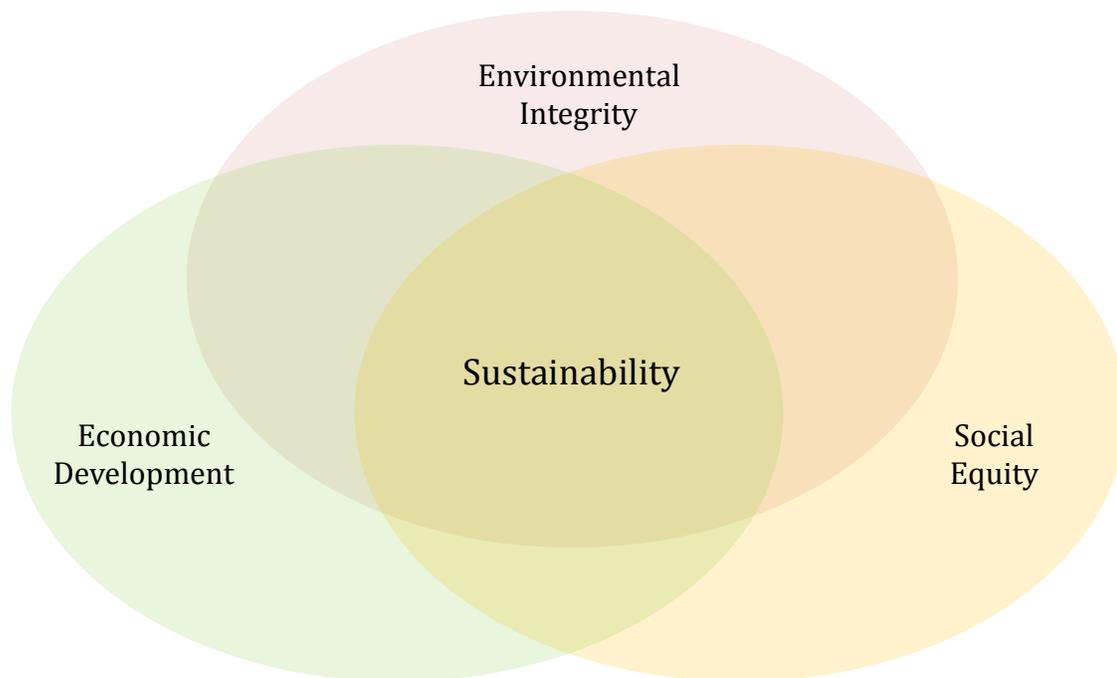


Figure 9: Triple bottom line approach to illustrating sustainability as the synthesis of environmental integrity, economic development, and social equity.

Hopwood, Mellor, and O'Brien (2005) suggest that the WCED may have left a certain level of ambiguity in their definition of sustainability to broaden its applicability. However, they conclude that this ambiguity has also afforded it to be used as a political and business catchphrase. Connelly (2007) similarly asserts that the definitional ambiguity of terminology like sustainable development makes it possible for groups to utilize it in promoting "extremist" agendas. Environmentalists may use it to promote initiatives solely focused on the environment at the expense of local economies or social programs; similarly, corporations could potentially conflate the core values of sustainability to promote policies targeted at rewards at the expense of the environment or social well-being. Critics of sustainable development have argued that sustainability's focus on human needs as

paramount does not represent other organisms, and is inherently flawed as a result (Hopwood, Mellor, and O'Brien 2005).

The topic of climate change has fueled public debate concerning sustainability. While there are many perspectives on this topic, some argue that climate change does not exist or that human presence has no impact on changes in climate. Much of the scientific evidence overwhelmingly concludes that humans have the largest influence on climate change and without a change in human behavior, the result will be catastrophic. Sustainability Policy promotes the development of adaptive strategies to address long-term effects while also working to improve societal conditions (City of Keene 2007, 2010; Hopwood, Mellor, and O'Brien 2005; WCED 1987; UN 2008). In response to climate projections, some local governments, communities, and organizations have begun to implement sustainability-minded climate action plans (City of Keene, 2007). Multinational organizations like the ICLEI are developing strategies in partnership with municipalities that focus on “building sustainable, resilient, resource efficient, biodivers[e], low-carbon communities” (ICLEI 2014).

Sustainability in Communities

There is a consensus of opinion among researchers at academic institutions and those working for organizations like the International Council for Local Environmental Initiatives Local Governments for Sustainability (ICLEI) that a greater emphasis needs to be placed upon community planning and design. Development practices can have a significant influence on sustainability. For example, when community development focuses on in-growth, like that occurring in areas near existing commercial districts, the community can

reduce transportation costs and lower a project's overall environmental impact. This is one step towards creating sustainable communities (Schjedahl, 2013).

Zook et al. (2011) argue that municipal zoning and urban design are both integral to a sustainable community. The authors stress the importance of the environment to community development, emphasizing the incorporation of urban design characteristics such as walkability and green space with local natural features like rivers and forested space. The City of Keene's consideration of features such as these is demonstrated through local features such as the river walk connecting Wheelock and Ashuelot city parks, as well as the extensive biking and walking paths that cross town. Zook et al. (2011) further suggest that incorporating public participation by municipalities during new development and redesign phases is vital to a sustainable community.

Sustainability in Colleges and Universities

The 1972 United Nations Conference on the Human Environment put forth the Stockholm Declaration officially recognizing the intimate relationship between our ability to create new environments through technological advances and our ability to evoke harm to the environment through these same advances. Alshuwaikhat and Abubaker (2008) suggest that the Declaration was the first step towards making sustainability a focal point within higher education. Over the four decades since the declaration hundreds of educational institutions, organizations, and governments from across the globe have voiced support of the reports' recognition of human and environmental interdependence. Further demonstrating the support and acceptance of the ideals set forth by the 1972 declaration is the integration of sustainability coursework and degree programs within higher education

(AASHE 2014; Alshuwaikhat and Abubaker 2008). Additional campus wide initiatives, like the ROCKS recycling program at Keene State College which educates and employs students, also demonstrate a college's commitment to sustainability.

As outlined above, public outreach and community-based approaches are important to the success of sustainability efforts. Similarly, implementing educational programs focused on sustainability in college communities is a critical step. Demonstrating the growing awareness of sustainability, representatives from more than three hundred universities and colleges from over forty countries came together to form the University Leaders for a Sustainable Future (ULSF) while signing the Talloires Declaration in 1990. It specifically calls for the incorporation of sustainability into their educational programs (Alshuwaikhat and Abubaker 2008). In 2000, the United States Environmental Protection Agency (EPA) enforced a policy that held all universities and colleges responsible for the same human and environmental health standards as industries. The policies and practices detailed in publications by organizations such as the ULSF and the EPA, among others, have helped to pave a road for educational institutions to become more involved and conscious of environmentally safe and sustainable practices within their respective communities.

Ullman (2008) argues that educational institutions that are committed to sustainability must begin by incorporating the ideals of sustainability in their mission statement. This sets the groundwork for sustainable practices to become ingrained in all aspects of a college's activities and facilities. Examples encompass everything from engaging students in the classroom, sponsoring school activities with sustainability themes, to providing community outreach programs. By practicing, educating, and promoting a

sustainable lifestyle, colleges can have a greater positive impact on surrounding communities.

Mabry (2011) discusses the importance of teaching sustainable business practices in universities. The author suggests that recent research demonstrates that strategic sustainable practices are vital to becoming and remaining competitive. She asserts that students should become “cognitively, behaviorally, and emotionally involved” in sustainable practices, and that “it is important that students make the issue their own.” The author laments that coverage of sustainable issues taught in most universities is quite limited, and many students are unprepared to fill emerging professional positions in today’s workforce. The worldwide trend in academia is to encourage more curricula related to sustainability, but there are regional differences to what is considered important. Universities in Europe, Australia, and New Zealand for instance, are more active than those in the United States in teaching sustainability (Mabry 2011).

With increasing numbers of students attending colleges and universities across the United States there is increased pressure on educational institutions to develop comprehensive sustainability strategies. The Massachusetts Office of Energy and Environmental Affairs (2008) compiled a list of sustainability resources and ideas specific to college campuses to assist in sustainability efforts. Topics included within this document range from energy efficiency and renewable energy practices to waste and clean water management (Bowles, Murray, Patrick 2008).

Another resource that colleges and universities can use to compare their individual sustainability practices to other educational institutions is the Sustainability, Tracking, Assessment and Rating System (STARS). STARS is operated by the Association for the

Advancement of Sustainability in Higher Education (AASHE) and is described as a “transparent self-reporting” platform designed to engage colleges and universities at every scale and phase of sustainability practices (AASHE 2014). The STARS report divides and scores each schools’ sustainability practices into eighteen separate sections, each with several tiers based on content: co-curricular education, specific sustainability focused curriculum, research, operations, grounds, maintenance, and energy, to name a few (AASHE 2014). Keene State College was given a silver rating according to the 2012 AASHE report, while UNH achieved a gold rating in the 2014 AASHE report.

Resources such as the STARS program are aimed at informing and engaging college and university staff in sustainability efforts on their respective campuses. Some of the sustainable practices being adopted by colleges include the use of alternative energy systems like solar panels, water harvesting and water reduction, as well as recycling programs and the use of high efficiency light bulbs (Bowles et al. 2008). Keene State College has adopted some of these strategies with its on-campus recycling program and LEED platinum-certified TDS building, which upon opening in 2012 made Keene State College “the third largest producer of solar energy” under the Public Service of New Hampshire at the time (Mulhere 2013).

Sustainability in Architecture

LEED, or Leadership in Energy and Environmental Design, is a rating given by the United States Green Building Council (USGBC) to buildings that meet standards and building codes for green building construction (USGBC 2014). These certifications currently serve as one of the most visibly recognizable statements of achievement in sustainable development

with new construction or redevelopment. The clout that is associated with “Green Globe” certifications offered by the USGBC make them highly sought after by educational institutions when renovating or constructing campus buildings.

Although LEED certified building design is one of the most high profile ways to promote sustainability through architecture, it is not without its critics. Matisoff, Noonan, and Mazzolini (2014) conducted an analysis comparing the marketability of a LEED Certified building to its reported sustainable performance. Their results show that a majority of the buildings that are LEED certified have the lowest score for the particular level of certification they achieved. For example, Gold certification ranges from 39-49 points received. In this particular study the majority of the buildings that received a Gold certification had a score of 39. This means the building gains much more marketability because of its LEED certification but promotes the minimal return within that category.

Architecture is a very large component of environmental sustainability and there are alternatives to the LEED certification. Green architecture is a way of characterizing the building’s ability to conserve water and energy. One type of green-architecture associated with sustainability is called bioclimatic architecture, which is defined by the USGBC as “a building design that embraces and responds to the local environment rather than thwarting it with mechanical systems” (USGBC, 2014). This type of structural design uses principles based upon natural features and processes to achieve energy saving objectives (Budescu and Tundrea, 2013). One goal of bioclimatic architecture is to incorporate passive solar technologies into building design and functionality (Tzikopoulos, Karatza, and Paravantis, 2005). Passive solar technologies are design characteristics that focus on inertly absorbing the sun’s energy for heating and cooling purposes without utilizing moving parts.

There are several basic bioclimatic principles to consider when building a sustainable structure. The most important factor is natural ventilation (Budescu and Tundrea, 2013). Intake vents should be placed in low shady areas usually covered by shrubs or other plants. Vents should be placed in high elevation areas within the structure to expel warm stagnant air. This aids the interior climate of the structure. The use of a planted perimeter aids in the absorption of solar radiation, which will keep the structure much cooler in summer months. This practice encourages environmental health through the reduction of energy consumption, and through better air quality by increasing vegetation (Budescu and Tundrea, 2013).

LEED certified green buildings generally place an emphasis on efficiency through technology, like actively collecting solar energy using photovoltaic (PV) panels, and have become the standard within the United States. However, other design methods are beginning to be implemented. The bioclimatic architecture principles previously described have been popular throughout Europe and in parts of Asia for over a decade, and are now being used in skyscraper design in U.S. (Ali 2008). Contemporary examples include The Conde Nast Building and The Solaire in New York City. These skyscrapers incorporate bioclimatic construction through including features like glass curtain walls with surface coatings that reduce ultraviolet penetration; passive solar technologies that facilitate natural air flow and increased air quality; active solar technologies like PV to reduce energy reliance and carbon output; as well as sophisticated management systems that reduce energy waste through increased appliance efficiency in areas like lighting (Ali 2008). The Solaire also uses a wastewater and storm water reuse system, or grey-water system, which reduces occupants' demand on public water utilities through water conservation.

The economic benefits of bioclimatic architecture can be difficult to estimate but they can be organized into three different categories: direct-cost savings, indirect gain, and reduced environmental externalities (Kwong 2014). Direct-costs represent the economic advantages of these projects and include initial savings, utility savings, maintenance savings, and deferred replacement costs. Indirect gains represent the social equity benefits through health care cost reduction and improved quality of life. These gains come from improved air quality within the structure, which promotes better health and overall well-being. Finally, the environmental advantages are exemplified by such things as reduced energy dependence and greenhouse gas output. For instance, Tzikopoulos, Karatza, and Paravantis (2005) suggest that reducing energy consumption through incorporating bioclimatic design principles could equal a 60% reduction in carbon output, which when considering “4.5 billion out of the 6 billion tones (~4.6 billion out of the 6.6 billion US tons) of carbon emitted worldwide from human activities may be attributed to industrialized countries,” could translate into an overall reduction of “1.35 billion tones (~1.5 billion US tons) of carbon” globally.

Sustainable Practices

There is a growing international voice encouraging an increased commitment to sustainability practices. The resounding positive attitude towards sustainability has convinced many governments, such as Canada, to initiate new development strategies. An integral part of this, Plummer (2006) argues, is the participation of local agencies and major community stakeholders willing to invest in new sustainable policies. The importance of community partnership is far overlooked; most sustainable development strategies involve

the concept of partnerships (Plummer 2006).

There had been much criticism over the early implementations of sustainability because of its ambiguity; for example, common early policies were forced to work within the capacity of local and/ or regional governments (Plummer 2008). In response to this, a second “generation” of sustainable development strategies was created which incorporated recognizable efforts by federal government and local agencies, with a clear framework linking issues, approaches and anticipated outcomes (Plummer 2008).

Dewan (2013) proposes that the implementation of community based sustainability projects is not directly representative of the level of happiness within a community, which is an essential aspect of social sustainability. Happiness is essential to sustainability because a happy community encourages more economic and social activity (Dewan 2013). A happy population of people can greatly improve a local or large scale economy as well as the local physical environment. One example of this is in the city of Kamloops, British Columbia, Canada where natural occurrences such as wildfires affect air quality every year. The Kamloops community’s response to the excessive trans-boundary pollution they are subjected to provides an excellent example of the importance of incorporating sustainability ideas throughout schools’ curricula as Ullman (2008) and Mabry (2011) both discuss. As part of their sustainable development plan, the city’s aim is to reduce greenhouse gasses by forty percent by 2020, increase alternative transportation to thirty percent, achieve municipal corporate carbon neutrality by 2012, use carbon neutral energy in all city buildings by 2035, and to generate ten percent of the city’s energy needs through alternative energy sources by 2020.

Along with this, Kamloops is facing a proposed copper and gold mine. This mine

would create jobs. However it would negatively affect air quality, the water table of the area, tourism, real estate, and local migration patterns. Because of the physical landscape and wind patterns, it is estimated that ninety thousand people will be subject to airborne toxins from the mine. The city's response to these issues is divided into a four-phase process. Phase one involves gathering information in order to create an overall vision for the community. Step two is identify and understand the underlying challenges to make the community vision goal possible. Phase three is the development of plans and strategies to overcome the previously identified issues, and phase four is to develop management tools to continue the encouragement of sustainable development (City of Kamloops 2014).

Okubo (2010) studied the sustainability efforts of three local governments: El Paso, Texas, Chapel Hill, North Carolina, and Mankato, Minnesota. In 2007, El Paso "practically overnight" established one of the top twenty recycling programs in the U.S. In the first month of implementation, the recycling participation rate was more than eighty-five percent. In 2008, El Paso city counselors required that all new buildings must meet LEED silver standards. This requirement is similar to initiatives found within other communities, like Keene, NH (City of Keene 2007).

El Paso is also interested in energy-saving technologies. New solar heaters were installed in all of the city's pools saving approximately \$47,000 throughout each pool's expected lifetime. Lone Star energy donated money to El Paso to replace every single light bulb with LED bulbs at more than 5,000 intersections. As a result of these partnerships, the city now sees a savings of about 50,000 dollars on energy consumption every month.

Chapel Hill, North Carolina is home to the nation's oldest public University, UNC. Both students and citizens share the city's main corridor, and the university partnered with the

city to develop sustainable initiatives in the community. Students noticed that low-income residents had to pay for a local bus service while students could ride free. In response, UNC students voted to place a fee on themselves to pay for the transit so it would benefit the whole community.

Other sustainable initiatives included hiring student interns to help monitor and reduce harmful emissions. Like El Paso, Chapel Hill decided that all new buildings must meet LEED standards. They also created a 'grow local, buy local' campaign. Chapel Hill does not have many large chain stores like Wal-Mart; instead they have mostly locally owned businesses. Many local restaurants buy their products from local farmers. The community feels strongly that this movement has saved the local economy from declination (Okubo 2010).

With the help of local community partners, UNC students voted to install new toilets in five student dorms. Top of the line toilet fixtures that use less than three and a half gallons of water were installed, resulting in a thirty percent decrease in water consumption. "The decrease translates into cost savings and ultimately impacts home affordability," explained John Richardson, head of the city's office of sustainability.

Mankato, Minnesota has a population of fifty thousand people and is home to Minnesota State University. In 2000, a new gas-fired turbine power plant required water for cooling. The city took a sustainable approach by collecting and treating wastewater, which is now mostly being used for cooling and irrigation. The city additionally invested forty million dollars in domestic water treatment technologies in an effort to save local aquifers.

In 2006, Mankato implemented an 'Envision 2020' community project. It includes local initiatives to protect areas along the river, maintain open space, and to promote

environmentally- friendly development approaches and green buildings. According to the director of community development, this demonstrated a commitment by the community and a contribution to other efforts that have snowballed. Like Chapel Hill and El Paso, the significant community participation and support from local officials encourages a community to strive for an improved home for future generations.

Overview of Methods



We employed a mixed-methods approach that combines the collection of qualitative and quantitative data to develop a profile of the sustainable practices implemented at Keene State College and within the larger Keene community. This approach included interviewing sustainability advocates at Keene State College, surveying Keene State College students, surveying local businesses, and using GIS to map the results of the business survey. These methods were implemented in a sequence, as initial data collection influenced subsequent data gathering. The interviews of sustainability advocates aided in framing questions for the business surveys. The goal of the business surveys was to see what local businesses are doing in order to be more sustainable, such as having energy efficient appliances, composting, and recycling materials. The business surveys also informed the production of paper and online maps that comprise a major component of project outreach. Once the business surveys were collected, the results informed the student survey which looked at how Keene State College students perceive and practice sustainability.

Interviews



Interviews

Methodology

One of the first steps of our research was to interview sustainability advocates and Keene State College faculty. We used a semi-structured format in which all interview subjects are asked the same overarching questions, but conversations are permitted to venture off onto other topics. The primary goal was to compile specific information in order to produce a survey to give to local and commercial businesses in downtown Keene. A second goal was to identify additional information sources, including additional people to interview. We chose to interview individuals associated with Keene State College and the City of Keene in order to gain a variety of viewpoints on the topic of sustainability.

The interview participants included Heather Greenwood, who is the director of Recycling On Campus at Keene State (ROCKS). ROCKS is a college organized recycling program that offers on-campus jobs for students. The program covers all aspects of recycling including: paper, plastic, and compost in fifty buildings across campus. By interviewing Heather Greenwood we hoped to gain insight on the goals and initiatives of the ROCKS program and see where the program was headed in the future.

A second interview participant was Dr. Peter Temple, a professor in the architecture department at Keene State College who specializes in green building design. Dr. Temple believes that, compared to other impacts, the built environment has the strongest effect on the natural environment. His main focus of work is on creating buildings that improve the surrounding physical environment.

The third interview participant was Jim Duffy, a city councilor who is also a member of the board of sustainable initiatives for the City of Keene. Jim Duffy has been involved in Keene civic activities and is a strong advocate of sustainable cities. Each interview participant was asked similar questions about their background in sustainability, their perceptions of sustainability and their thoughts on sustainability efforts within the community, along with any other general suggestions that would help with our study.

Results

The results of our interviews were beneficial in understanding local perceptions of sustainability along with the active roles that these leaders play in helping Keene become more sustainable. The interviews gave us a better grasp on how others view sustainability, since it is a potentially broad topic with many interpretations. From the interviews, we derived five categories of sustainable practices that local and commercial businesses in Keene could be implementing. The categories were derived from answers each interviewee gave to questions that dealt with what sustainable practices Keene currently implements and those it could implement in the future. From the answers to these questions we derived these categories: water conservation, energy conservation, waste management, purchasing local goods, and community involvement.

Heather Greenwood gave us insight on the history of the ROCKS program, including how the program was started in the 1970's by a group of students. This initiative revealed to the entire student body that recycling on campus was important. Over the years ROCKS has been improved and the coverage of the program has grown tremendously. The goal of the program is to show the student body why recycling on campus is important and how

students can participate. In the future, Heather and the rest of the ROCKS team would like to see more student awareness of recycling along with higher participation rates from students in ROCKS sponsored awareness events. The more people know about the program and recycling on campus, the more motivated they will be to participate.

The ROCKS team makes it their goal to have recycling and trash bins placed next to one another and easily accessible in every building on campus. If students can find the receptacles, they will be more inclined to use them properly. Heather informed us that, as a whole, the ROCKS program is profitable when considering cost avoidance related to trash hauling. This means that when trash needs to be picked up on campus, it costs the college \$120 per ton. When recycling needs to be picked up, it only costs the college \$10 per ton. The more materials that are recycled on campus, the more money the college saves on hauling.

We asked Dr. Peter Temple about his perception of sustainability, how he felt the city of Keene was doing with its sustainable efforts, the types of sustainable projects he has been a part of, and his involvement in the building of the TDS center on campus. The TDS center is a classroom and office building that opened in October 2012 and houses programs in technology, design and safety. The TDS center includes sustainable features such as: sensor windows that maximize heating and cooling opportunities; twenty percent recycled building material; low flow water fixtures, and a 20,000 square foot photovoltaic solar panel on the roof that has the capacity to provide half of the annual energy needed for the building. This is the most sustainable building on the Keene State College campus.

Dr. Temple's main focus is finding ways that buildings can have less impact on the physical environment. In Dr. Temple's opinion, there are ways to build cities and towns that contribute less to climate change, by reducing the use of carbon emitting sources. A

sustainable city is one that can maintain itself into the future. In Dr. Temple's opinion, the number one issue that Keene and surrounding areas should be dealing with is climate change. Reducing the amount of fossil fuel use is a key issue in his mind, and he feels that buildings need to be made more energy efficient and run on renewables in order to counteract impacts of climate change. Dr. Temple would like to see more businesses and homes using renewable resources in the future.

The interview with Jim Duffy focused on his perception of sustainability, what sustainability initiatives he has participated in, and what obstacles he feels are facing Keene. When asked about his perceptions of sustainability, Mr. Duffy stated that he "equates it [sustainability] largely to ecological [and] environmental concerns" and feels a big part of it is simply trying to live within one's means. Similarly, he feels that it is important to try and "give as much back as you take" in both an environmental and social manner. Having served as a city council member, Mr. Duffy also discussed how the City of Keene has incorporated these concepts into their master plan with a stated emphasis on the "three E's:" social equity, environmental integrity, and economic opportunity.

Mr. Duffy highlighted some specific policies that the City of Keene has implemented regarding sustainability. One policy in particular that Mr. Duffy had personally been involved in was the hillside ordinance, which was aimed at regulating and guiding development in the areas surrounding Keene. Due to the City of Keene's location in a valley surrounded by tall steep hills, it historically has had trouble with surface runoff, erosion, and flooding. All three of these are projected to be exacerbated by climate change. Specifically, the hillside ordinance limits the type and extent of development on any slope that is between

fifteen and twenty –four degrees and prohibits any development on a slope that is twenty-five degrees or more.

Another zoning policy Mr. Duffy was involved with that Keene adopted in 2012 is the surface water protection overlay district. This ordinance prohibits the development or disturbance of wetlands and vernal pools by requiring a buffer around these features of no less than twenty-five feet in urban areas and seventy-five feet in rural areas. The SEED district is another aspect of Keene’s sustainability policy that was discussed and ratified while Mr. Duffy was a member of the city council. As previously discussed, it centers largely on development within downtown Keene, and promotes sustainable development by offering developers incentives for employing accepted green building standards.

All three of these approaches to sustainability are aimed at mitigating Keene’s environmental impact. Likewise, they all target land development construction practices, which both Dr. Temple and Mr. Duffy have expressed as essential to contemporary sustainability policy. These policies also influence economic growth by guiding current development within the city of Keene. By promoting these policies, Keene directly and indirectly encourages urban growth to support the commercial core of the city. However, these policies do not address the social equity aspect of sustainability that Mr. Duffy had also mentioned was central to Keene’s sustainability policy. This was one area where Mr. Duffy felt more could be done within the city. One example is promoting the development of small affordable homes that are approximately 1,000 square feet, which would also provide the benefit of energy reductions.

Mr. Duffy considers issues with homelessness to be one obstacle facing Keene right now. The geographic location of Keene and the availability of social services within the city,

contribute to the homeless population. There are known homeless camps on city-owned land where people live year round. At this time, the city's human services department works with individuals in need, and the city also provides financial support to local organizations like The Hundred Nights Shelter to assist in the social wellness of the community.

Business Survey



Business Survey

Methodology

We developed a paper survey to better understand current sustainable practices of Keene businesses. This survey was essentially a sustainability “checklist” designed to reveal specific activities and practices. Using the five categories of sustainable practices we derived from our interviews, we developed the survey checklist. Within each of the five categories were listed two to three things we looked for in each business, such as: what type of heat source they use, if they recycled or composted, and if they had a community bulletin board (Appendix 1).

The businesses we surveyed were selected to cover many different types of establishments including regional and national chains, independently owned businesses, and businesses offering several major types of services. We surveyed restaurants, retail stores, and a hotel. Each member of our team surveyed four businesses. Surveys involved visiting the establishment and visually observing any sustainable efforts being made, such as recycling or renewable packaging. We also spoke with the store or shift manager, and sometimes completed part or all of the survey while on site. We surveyed sixteen businesses in the downtown area of Keene.

The last part of the business survey asked each respondent to evaluate three definitions of sustainability and choose the best one. The three definitions are:

- 1.** To lower greenhouse gas emissions and increase community resiliency to the expected impacts associated with a changing climate.

2. The use of various strategies for employing existing resources optimally so that a responsible and beneficial balance can be achieved over the longer term.

3. Sustainability is the ability to continue a defined behavior indefinitely.

All three definitions are drawn from different perspectives of sustainability. The first definition emphasizes environmental sustainability, the second emphasizes economic sustainability, and the third is a very general definition. The selected definition gave us more insight about which perspective of sustainability the businesses felt most strongly about.

Results

The survey results were entered in an Excel spreadsheet for further analysis. We are interested in what sustainable practice is most common among these Keene businesses, and which businesses implement the largest number of sustainable practices. We are also interested in which category of sustainable practices is best represented among the locally-owned businesses compared to the chain businesses that were surveyed. Finally we are interested in which definition of sustainability was chosen the most and which was chosen the least, and if this varied among the chain and locally-owned businesses.

As stated in the business survey methods, each business was asked a series of checklist questions in order for us to understand the sustainable initiatives they practice. The Co-Op, The Works, and the Marriot Hotel had the most sustainable initiatives checked off, with twelve each (Figure 10). Two of these businesses are locally owned, the Co-Op and The Works, and the other is part of an international corporation, the Marriot Hotel. As a group, we were presuming that the locally owned businesses would have more sustainable features because they tend to have more leeway with decisions about the businesses,

compared to large corporations. That presumption proved to be true as Brewbakers, Prime Roast, and Ted's, all locally-owned, are the next three businesses with high scores.

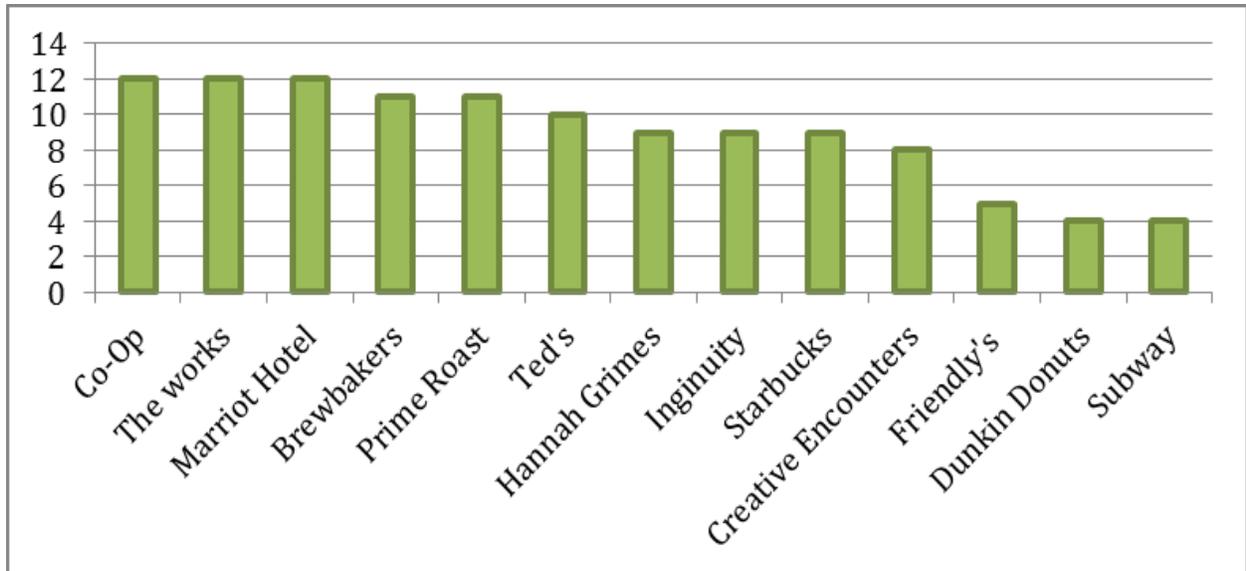


Figure 10: Rank of Businesses Based on Number of Sustainable Initiatives

We compared the sustainability practices of locally-owned businesses and chain-businesses. The locally-owned businesses had a higher total score in all but one category: water consumption (Figure 11). The main water consumption practice we asked about was whether the business had low flush toilets or hands free sinks. Both commercial and local businesses scored low in this category. The practices that fall under energy consumption include the use of energy efficient appliances or dimmer and motion lights. Recycling and composting were the main emphasis of waste management habits, and locally-owned businesses scored significantly higher. For re-usable materials, we asked about businesses' use of biodegradable packaging either on shipments of products or everyday use such as food containers. Locally-owned businesses scored the highest for community involvement by implementing things like community bulletin boards for local advertisements and being

a part of any community organizations such as sponsoring softball teams, local marathons, and school fundraisers.

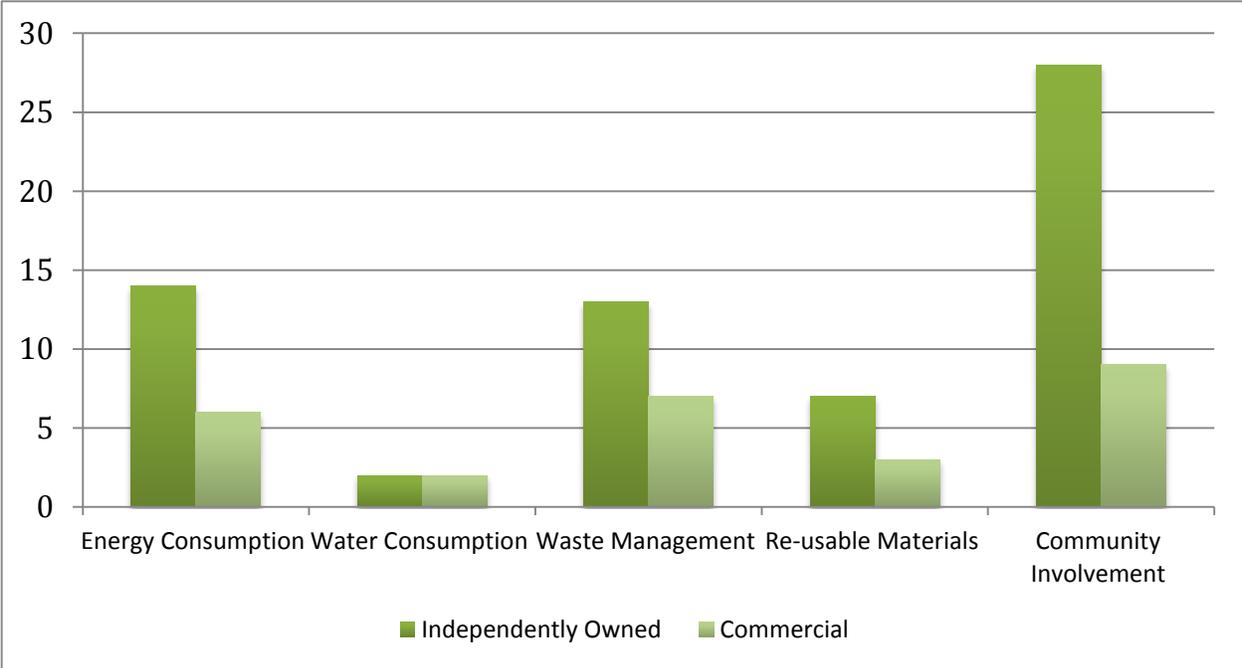


Figure 11: Percentage of locally-owned vs. chain businesses five categories of sustainability practices.

Student Survey



Methodology

We administered a survey to Keene State College undergraduates to explore perceptions of sustainability among students. This survey began with general questions about the subject's age, year in school, gender, whether they live on or off campus, and their major. The survey was administered to 224 students in a range of classes. The courses included introductory to upper level classes. This provided a sample that is likely to include as many freshmen as seniors. The survey was administered to classes in a number of departments including: Geography, Management, Environmental Studies, and Safety. Using classes from different disciplines gives the potential of incorporating a wider range of perspectives within the relatively homogenous population of Keene State College undergraduates.

The first series of survey questions covers the topic of sustainable practices that Keene businesses are implementing (Appendix 2). Students were first asked to rank in importance the five categories of sustainable practices that businesses are implementing. These include: water conservation, energy conservation, waste management, purchasing local goods, and community involvement. The ranking system is based solely on their opinion of the relative importance of the categories. The next two questions ask the student whether they would spend more or less money at a restaurant or retail shop in Keene if they knew the business was implementing any of the five categories of sustainable practices.

The second part of the student survey covers the topic of sustainable initiatives on the Keene State College campus. Students are first asked to rank eight sustainable practices found on campus. These eight practices were taken from AASHE website. We chose to use practices listed by AASHE because our review literature demonstrated a serious

commitment to informing the public on what type of sustainable practices are currently being implemented in specific colleges and universities around the United States. The eight sustainable practices we asked the students to rank include: sustainability campus events; sustainability courses offered; reusable “to-go” containers; LED lighting in buildings; composting and recycling; the bicycle share plan; water metering in buildings; and the College’s sustainability plan of action. All of these practices or resources can be found under the Keene State College listing on the AASHE website.

Two subsequent questions asked students how they feel the Keene campus is doing with its sustainability efforts and if students would be willing to pay more to the school if sustainable practices were more prevalent. The last question on the student survey is identical to the business survey, as we asked students to choose the best of the three definitions of sustainability.

Results

A Pearson’s chi-square test was performed on question one from the student survey to determine the strength of relationship between the respondent’s academic class (upper or lower-classmen) and their individual preferences for ranking selected business sustainability practices. This test resulted in asymptotic significance values for all possible ranking categories greater than our confidence interval 0.05 (95%), which failed to reject our null hypothesis of no difference in ranking preference between groups (Figure 12). Validation of results were achieved by chi square values totaling less than chi square critical values, also failing to reject the null hypothesis of no difference.

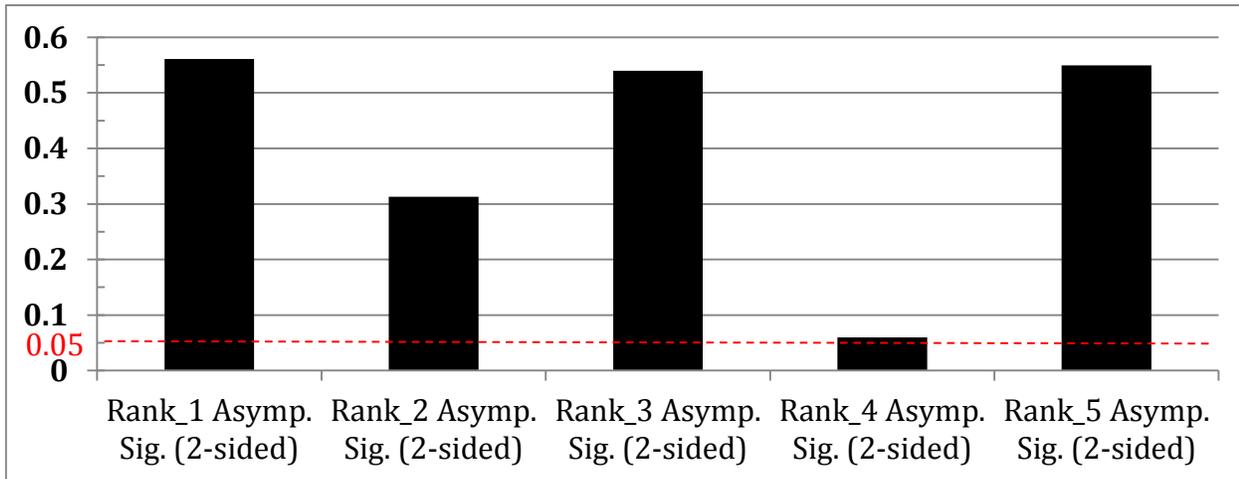


Figure 12: Chi square asymptotic significance values for ranking preferences one through five of business sustainability practices by upper and lower-classmen surveyed at Keene State College.

We observed that thirty-four percent of all respondents ranked energy consumption as their number one sustainable practice and all other categories were marginally similar around sixteen percent (Figure 13). Similar trends in preference were observed when looking upper and lower-classmen as separate groups. The majority of all students surveyed responded similarly to their top three ranking preferences (Figure 14). This demonstrates some continuity to the perceptions of students regarding what is perceived to be most important in business sustainability initiatives.

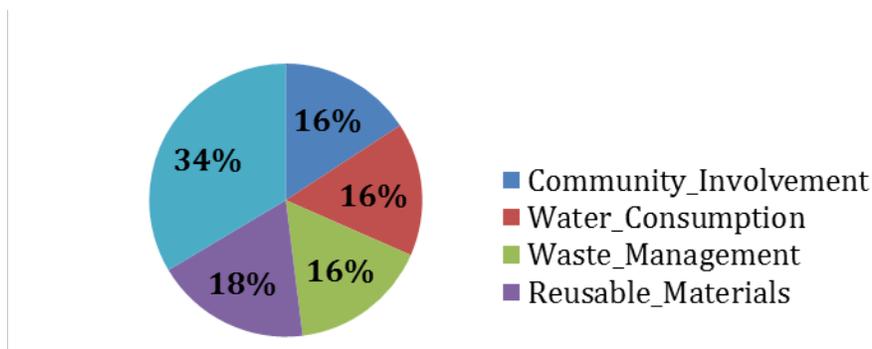


Figure 13: Total Rank one business sustainability initiatives preferences of surveyed Keene State College students. Note Energy Consumption was ranked number one thirty-four percent of the time.

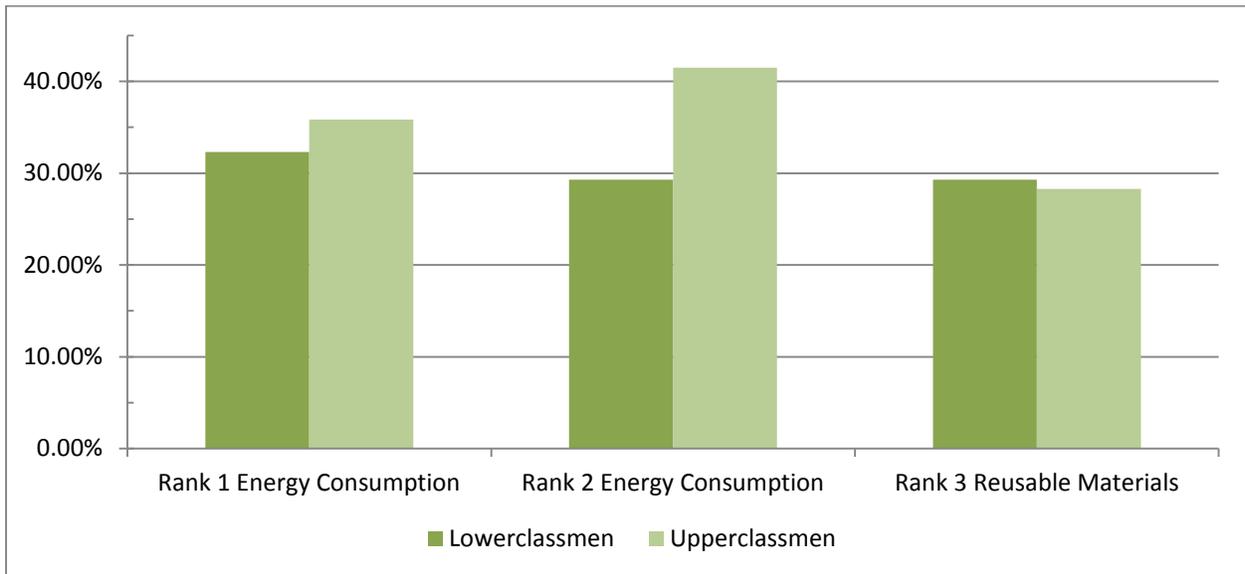


Figure 14: Top three ranking preferences for upper and lower-classmen. Note redundancy of energy consumption; this resulted from the majority of students from each group choosing this practice most often either as their rank one and rank two preference. It underscores the perceived importance of energy management to students as a whole.

Questions two and three inquired whether knowledge of particular business sustainable practices would influence student decisions to spend money at those establishments. Question two emphasized restaurants and question three focused on retail businesses. To permit the use of an ordinal chi-square test on the proportions of students selecting to spend more or less money, student responses were limited to: significantly more, somewhat more, same, somewhat less, and significantly less. Results of chi-square testing failed to reject the null hypothesis demonstrating that there was no significant difference between the responses of upper and lower-classmen to their likelihood of spending more or less money (Figure 15).

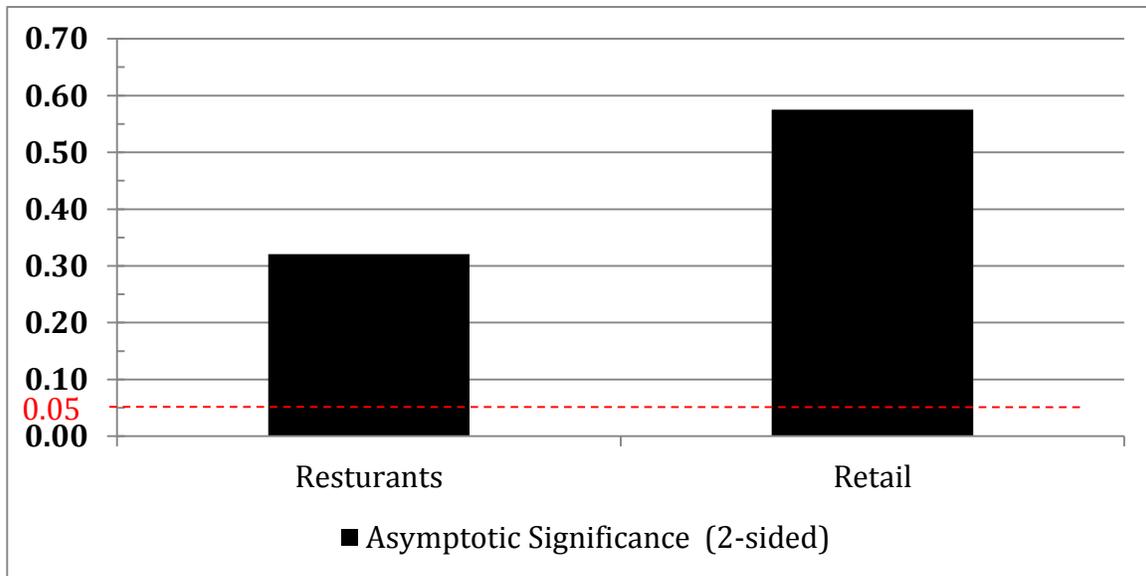


Figure 15: Asymptotic Significance results for chi-square test demonstrating strength of relationship between student respondents and their likelihood to spend more or less money. These results illustrate a failure to reject the null hypothesis stating no difference in preference between upper and lower-classmen.

Looking at only the proportions of responses to question two and three by student survey respondents we can deduce that students would be more likely to spend money at establishments they knew were employing sustainable practices (Figure 16). Survey results to these two questions indicated that students would either be more likely spend money or neutral in their spending habits with knowledge of establishment’s sustainable practices. Because all responses to these questions were either a positive value indicating a willingness to spend more money, or neutral value indicating no change in spending habits, we chose to lump all positive values together when illustrating these results.

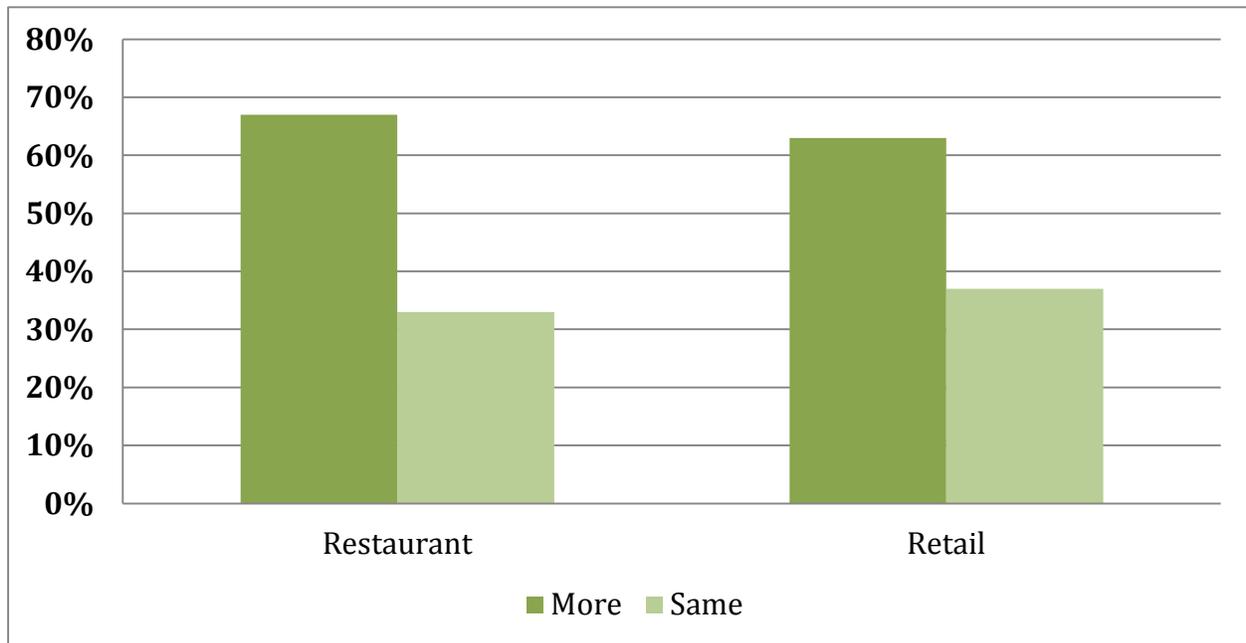


Figure 16: Influence of sustainable practices knowledge on student spending habits. Student respondents were shown to be twice as likely to spend more money at establishments they knew were employing sustainable practices.

A Pearson’s Chi Square test was performed on student survey question five to determine the strength of relationship between the respondent’s academic class (upper or lower-classmen) and their individual preferences for ranking selected sustainability initiatives enacted by Keene State College. Respondents ranking preferences had to be grouped together into three categories in order to achieve valid statistical results due to the sample size and number of variables. Originally there were eight categories derived from the AASHE website, these were grouped together into three categories based upon the fundamental sustainable practice they emphasized (Table 2).

Table 2: Grouping of ranking preference variables by sustainability focus.

Energy management	Waste Management	Sustainability Policy
Led lights	Reusable to go containers	Sustainability action plan
Water metering	Composting recycling	Sustainability campus events
		Sustainability Courses Offered
		Bike Plan

Results of the chi-square test show that there is no statistically significant difference between the proportions of students from each group selecting ranking preferences one and three (Figure 17). Ranking two preferences differentiated by approximately thirty-five percent between upper and lower-classmen (Figure 17). We suggest that this discrepancy in similarity between groups is because of the grouping of data related to problems with sample size. The greatest disparities between academic groups are observed within the sustainability policy category, which is comprised of subcategories: a bike plan, a sustainability action plan, sustainability campus events, and sustainability courses offered.

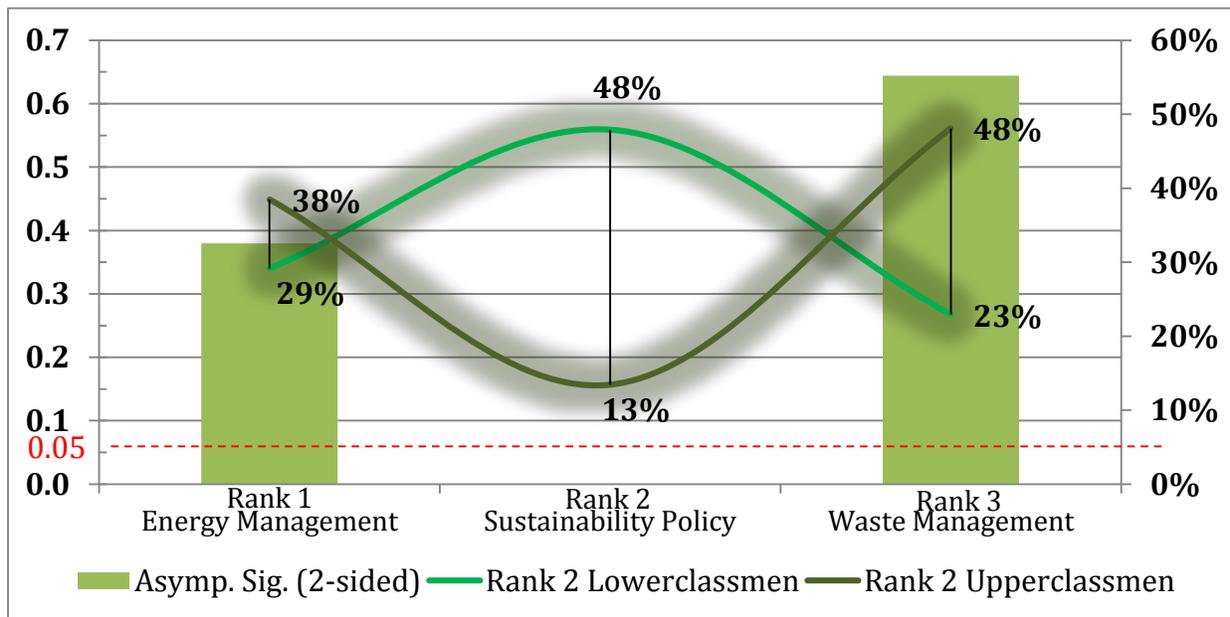


Figure 17: Chi-square asymptotic significance values with percent of rank two preferences for surveyed Keene State College students. Note the largest discrepancy between upper and lower-classmen is in the perceived importance of sustainability policy.

Question 9 of the student survey was used to determine how students defined sustainability. We used the same definition selection as in the business survey so that we could relate them to one another. Using a Chi Square test, we were able to see that there was no significant difference between the definition preference of upper and lower-classmen, or businesses. Overwhelmingly businesses as well as upper and lower-classmen chose definition two (Figure 18). The second definition of sustainability listed on our surveys was rooted in economic sustainability. This demonstrates surveyed students and businesses parallel one another at least in terms of what they perceive sustainability to mean (Figure 18).

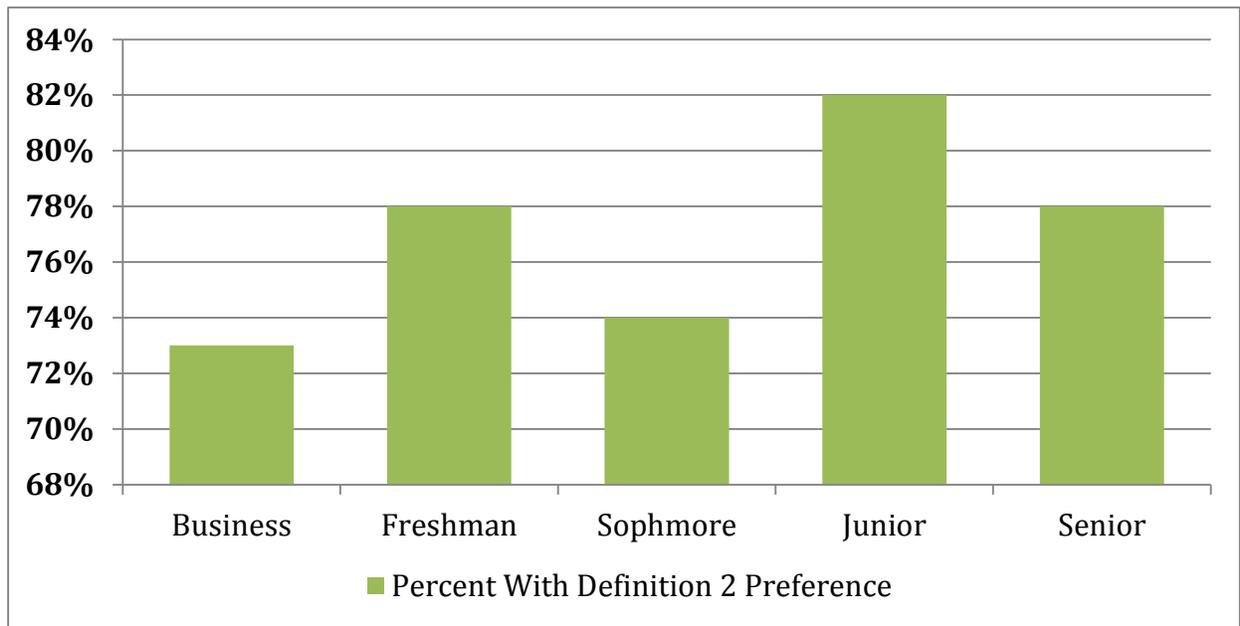


Figure 18: Percent of businesses and students surveyed that chose the definition rooted in economic sustainability. Demonstrates parallel between businesses and students in their perceived definition of sustainability.

Sustainability Maps



Sustainability Maps

The results of the business and student surveys will aid in creating a sustainability map of the downtown Keene area and the Keene State College campus. The map of downtown Keene will highlight businesses on Main Street and West Street in Keene. Each surveyed business has at least one symbol indicating a sustainable practice they currently implement. The symbols stand for varying sustainable features that the businesses are currently practicing. These symbols include; a solar panel, a bicycle, a recycle symbol, a water spigot, a green building, a fuel symbol, and an earth symbol (Appendix 4).

The map of the Keene campus highlights various sustainable features that the campus has to offer. Similar to the map of the downtown Keene area, the symbols on the map are then defined in detail in the legend. The highlighted buildings and campus areas include: the TDS Center, the Science Center, Mason Library, the Student Center, the Zorn Dining Commons, Elliot Hall, Pondsides III, the Alumni Center Parking Lot, and the Co-generation Heat Plant (Appendix 5).

The TDS center is the newest building on campus and is also considered the most sustainable, as indicated by its LEED platinum certification. On the map, the TDS center is highlighted for the solar panel array atop the building; automatic windows that help with



Figure 19: Solar Panels atop the TDS Center on the Keene State College campus

heating and cooling of the building; and the use of recycled building material that comprises twenty percent of the structure. The Science Center is highlighted on the map for its ROCKS



Figure 20: Green Bikes program located outside the Mason Library

trash and recycling receptacles located in all hallways of the building and at the entrances and exits. Mason Library is acknowledged on the campus map for its Green Bikes Program where campus members are allowed to check out a bike from the front desk for up to two weeks. At the Mason Library there is also a media recycling station that collects old phones, DVDs,

or floppy discs that are no longer of use.

The Student Center is featured on the map for its water refill stations, low flush toilets, and ROCKS trash and recycling receptacles located at all entrances and exits of the building. The Zorn Dining Commons is highlighted on the map for its rotating indoor plants; its collection of grease waste, which is then converted to a biodiesel product that helps power campus vehicles; and lastly the Dining Commons composts pre plate food waste in order to reduce the amount that is thrown away.



Figure 21: Recycling stations located in buildings around the Keene State College campus

Elliot Hall is included on the campus map for its sustainable efforts including: the office of the Reusable Office Supply Exchange (ROSE), where you can find used items that others no longer have a use for, such as binders and room decorations. Pondside III, an underclassmen dorm building, is LEED certified silver and acknowledged on the campus map for several efforts including: the use of recycled materials in the buildings' countertops and floors; all rooms in the building have motion sensor lights in order to reduce the amount of

wasted electricity; and the energy efficient washers and dryers.

The Alumni Center Parking Lot is a permeable surface, that allows rainwater and snowmelt to percolate, leading to fewer flooding events in the area. Another area of campus



Figure 22: Co-generation heat plant located on the Keene State College campus

that is highlighted on the map is the Co-generation heat plant. The plant system produces both heat and electricity for the campus. This plant reduces campus energy costs by about \$12,000 a year, while also reducing greenhouse gas emissions.

Discussion & Conclusion



Discussion

Overall it was found that the Keene community is implementing a variety of sustainable practices. These practices can be found throughout the businesses located downtown and in the buildings located across the Keene State College campus. With only sixteen weeks to complete the project, we feel that parts could have been changed or done differently for a better outcome. The interviews that were conducted were effective in understanding local perceptions about Keene's sustainable actions. However, with a wider variety of interviewees more perceptions about sustainability could have been gathered and synthesized.

The business surveys gave good insight into the types of sustainable practices currently being implemented within Keene businesses. A larger sample size of businesses would have been helpful in creating a more detailed profile of sustainability in the Keene business sector. Also surveying businesses with more employees such as the Cheshire Medical Center, Markem- Imaje, and C&S Wholesalers, would have allowed us to understand sustainable practices in these larger service and manufacturing environments. Creating a Qualtrics survey and distributing it online may have led to a larger number of responses received. Modifications that could have been made to the survey would have included targeted questions about the businesses energy consumption habits because energy consumption was the primary concern from the student survey.

The survey that Keene State College students completed allowed us to understand their personal perceptions of sustainability and what aspects of sustainability are most

important. It was felt that the overall number of surveys completed was reasonable but a more even number of upper to lower classmen would have given more balanced results. Now that we understand that students feel energy consumption is a top priority when it comes to sustainability, making more questions pertaining to energy habits would have allowed for more connections to be made between perceptions and practices.

With more time, a residential survey that looked at household sustainability practices would have allowed for a more holistic representation of the Keene community. On the survey we could have asked households to answer questions pertaining to their current sustainable initiatives. The results of the survey would have been beneficial to our analysis since residents represent a large sector of the Keene community that is not currently represented in the profile.

Conclusions

The major sections that this profile addressed include: interviews of sustainability advocates; a business survey to understand current sustainable practices of downtown Keene businesses, a student survey to understand perceptions and personal habits of sustainability; and the production of three maps that highlight current sustainability practices on the Keene State College campus and within downtown Keene.

The five major sustainable categories that were found throughout the businesses include: water consumption, energy consumption, waste management, community involvement, and re-useable materials. Within each of these categories we found that businesses were implementing a variety of practices. These included but are not limited to:

energy efficient lights and appliances; active compost programs; community bulletin boards; and water conservation.

After analyzing the results of the student survey, we learned the majority of students felt that energy consumption was the highest concern when it came to sustainability efforts within businesses. In regards to campus initiatives, students responded that waste management was of highest concern. This is possibly because of the awareness of waste management on campus. The ROCKS program acts as a marketing catalyst for waste management. There are also many recycling receptacles that are clearly visible throughout campus that act as a reminder to think sustainably when ridding of waste.

In regards to the buying habits section on the student survey, upperclassmen were more likely to choose a business that uses sustainable practices over a business that doesn't. This could be due to Keene State College implementing sustainability into their coursework. In conclusion, after reviewing the analysis portions it shows that both the college and the city of Keene are both effectively implementing sustainable practices. Although there is always room for improvement, the respondents show that they believe that sustainability is an important part to the community and strive to contribute to achieving a sustainable city as a whole.

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Appendices



Appendix 1: Business Survey

Business Name: _____

_____ Energy efficient appliances

_____ What type of heat source do you use?

Oil Gas Electric Renewable

_____ Dimmer lights or motion lights?

_____ Low flush toilets? Hands free sinks?

_____ Recycling?

_____ Composting?

_____ Biodegradable packaging?

_____ Community bulletin board

_____ Local sponsorships

_____ Are you a part of any community organizations?

_____ Other community involvement?

_____ Do you buy local?

_____ Do you sell appliances when buying new ones or do you throw them away?

_____ Do you have employee incentives? Ride your bike to work, low emission cars?

_____ What do you feel like is the most sustainable initiative you practice in your business?

Sustainability Definitions:

_____ To lower greenhouse gas emissions and increase community resiliency to the expected impacts associated with a changing climate.

_____ The use of various strategies for employing existing resources optimally so that that a responsible and beneficial balance can be achieved over the longer term.

_____ Sustainability is the ability to continue a defined behavior indefinitely.

Appendix 2: Student Survey

Sustainability Perceptions Survey

Hello, we are senior seminar students for the Department of Geography. We are conducting this survey in order to understand KSC students' perceptions of sustainability. Please take a moment to fill out this survey in order to help us gather data and compile a finalized sustainability profile of Keene State College



Age: _____

Gender: Male Female

Class: Freshman Sophomore Junior Senior

Do you live: On Campus Off Campus

What is your major? _____

1) Please rank the following sustainable practices with 1 being most important and 5 being least important.

_____ Water Consumption Management

_____ Waste Management

_____ Community Involvement

_____ Energy Consumption Management

_____ Reusable Materials

For the following statements please check your choice.

2) If a restaurant in Keene implemented any of the sustainable practices listed above, I would be motivated to spend _____ money.

Significantly more Somewhat more Same Somewhat less Significantly Less

3) If a retail store in Keene implemented any of the sustainable practices listed above, I would be motivated to spend _____ money.

Significantly more Somewhat more Same Somewhat less Significantly Less

4) In Keene, what businesses do you feel are taking the most initiative to implement sustainable practices?

5) Please rank the following sustainable practices that are currently implemented on the KSC campus, 1 being most important and 8 being least important.

- _____ Sustainability campus events
- _____ Sustainability courses offered
- _____ Reusable to-go containers
- _____ LED lighting in buildings
- _____ Composting and recycling
- _____ Bicycle plan
- _____ Water metering in buildings
- _____ Sustainability plan of action

For the following statements please check your choice.

6) Keene State College is taking strides to become a more sustainable campus environment.

-
- Strongly Agree Agree Neutral Disagree Strongly Disagree

7) If the school created more environmentally friendly alternatives, I would be willing to pay an additional fee.

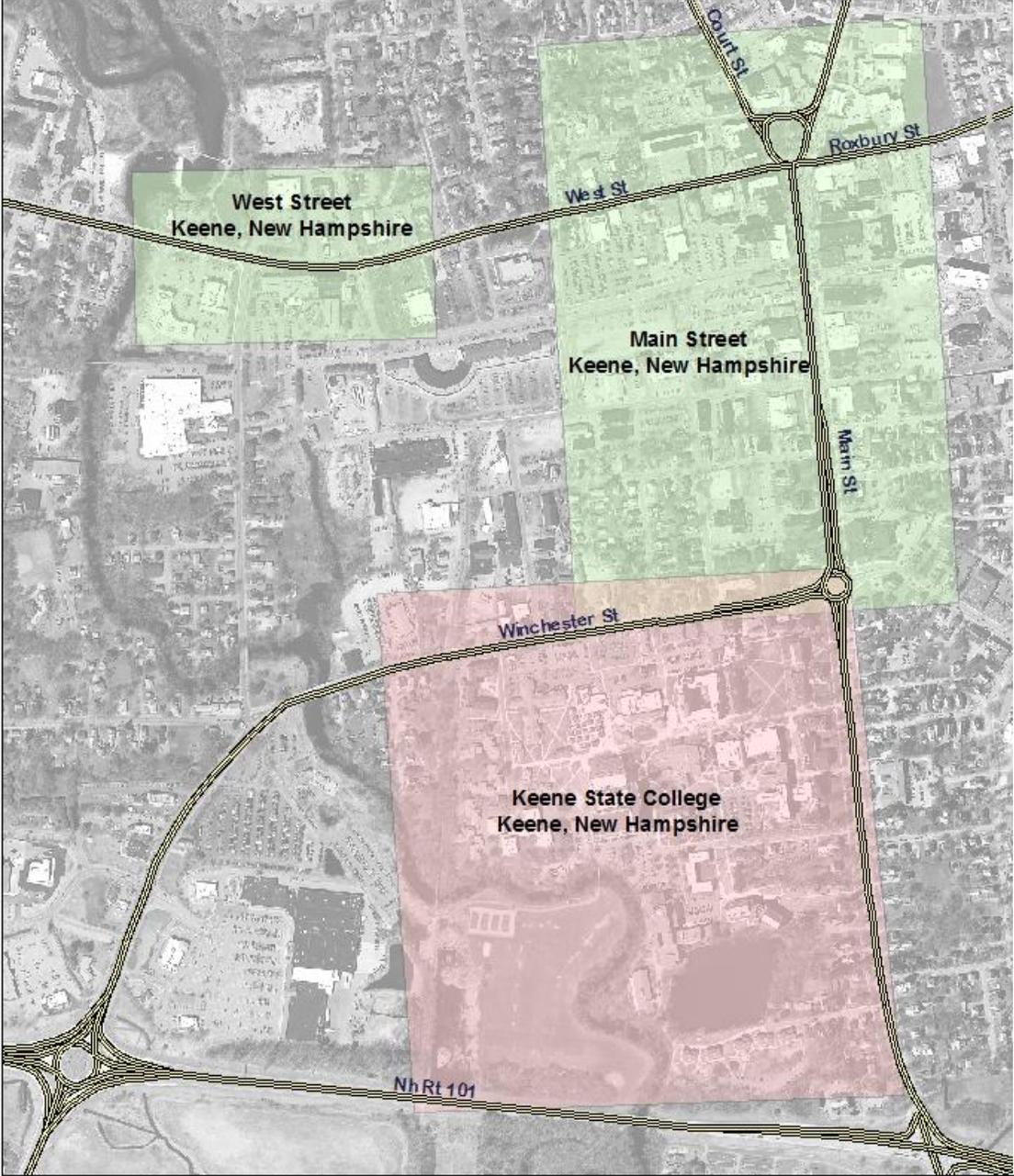
-
- Strongly Agree Agree Neutral Disagree Strongly Disagree

8) Do you make any sustainability choices when you are at KSC? If so, what choices?

9) Which definition do you believe best describes sustainability? Please check off your answer.

- _____ To lower greenhouse gas emissions and increase community resiliency to the expected impacts associated with a changing climate.
- _____ The use of various strategies for employing existing resources optimally so that a responsible and beneficial balance can be achieved over the longer term.
- _____ Sustainability is the ability to continue a defined behavior indefinitely.

Appendix 3: Location of Maps



Appendix 4: Downtown Keene Sustainability Maps

