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The University Greening Movement: Is Carbon Neutrality Enough to Avert a Climate Crisis?

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Abstract

Because of the impact that educational institutions have on the intellect of the American youth, universities play a crucial role in our nation's path towards sustainability because of their ability to guide educational focus toward the well-being of the environment. Through a unified movement among these institutions called the "University Greening Movement", or UGM, campuses are utilizing current technological breakthroughs to their advantage by implementing them into the structures and foundations of their campuses to reduce and even eliminate carbon emissions. However, as monumental as these technological advancements and this movement has been, the question arises of whether or not this is effective enough to reach carbon neutrality in the battle to lower greenhouse emissions. Is carbon neutrality enough to avert a climate crisis? Or will we need universities to set an even higher standard and reach a state of carbon negativity? Using economics, politics, technology, and design as perspectives for discussion, I will investigate the question of whether or not universities that are taking part in the UGM are being ambitious enough in their attempts to reach carbon neutrality. I discuss the case study of Middlebury College and its feat of creating a carbon neutral campus. In chapter 1, I talk about the history of greenhouse gasses and their fluctuation throughout history up to the present. I also discuss the differences between carbon neutrality and carbon negativity. Chapter 2 discusses the UGM and the general history of it. It also delves into how the emergence of the problem of climate change has affected the culture of universities. Chapter 3 delves into how the UGM affects university politics and the structure of it. It also talks about the impact that the UGM has on university finance and the student body as a result of the changing politics. In chapter 4, I discuss the implementation of green technologies, including green buildings and campus design,

and how they benefit the university. In the final chapter, I discuss the steps that can be taken to become carbon neutral on the university campus and related ways that they can become more sustainable as a whole.

Keywords: university greening movement, carbon, carbon neutrality, carbon neutral, carbon negativity, university politics, greenhouse gas.

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Middlebury College- Inspiring, But Sufficient?

As the primary institution for knowledge, education, and career preparation, it is not a surprise that universities aim to foster a healthy learning atmosphere for students in order to benefit them most in their lives and careers after their education. However, despite this desire to create a healthy learning environment for the young minds of our generation, the attention towards the health of our natural environment and its resources has been pushed out of focus in the university curriculum because career education and degrees are the main focal points. The UGM in the United States has begun to transform the mindset among students across the nation to be more focused on sustainability and the conservation of the environment and its resources. As a result of newly adopted mindsets of sustainability, administration often publicizes different goals for their campuses to become "carbon neutral" so that they are completely waste free. An example of one of these schools is Middlebury College, which achieved the feat of reaching carbon neutrality in 2016 through radical steps. Most notably, the construction of a massive biomass facility on campus co generated 15-20% of the electricity on campus, and reduced their carbon footprint by 40-50% ("Carbon Neutrality" 2016). This feat proved many things: carbon negativity was a possibility on a larger scale, the transition to green was not destructive to existing infrastructure, and the method could be adapted to fit into existing politics.

While institutions like Middlebury can be the leaders in fighting climate change by instilling a sense of sustainability of our youth, an important question surfaces as a result of this movement. Is carbon neutrality enough? While the movement is certainly benefiting the environment, is it sufficient in combating the problem of excessive greenhouse gasses that are currently wreaking havoc on our environment and bringing us closer to the point where we

cannot undo the wrong we have done? While some may argue "yes", current atmospheric levels of carbon argue against this because of constant and consistent environmental degradation from humans. These threats suggest catastrophic results to the planet, results that may not be as futuristic as we may think. Time may reveal the answers, but the UGM is working towards creating a path of sustainability as we move forward.

Chapter 1 talks about the history of environmental change in relation to the rising levels of greenhouse gasses, as well as the topics of carbon neutrality in comparison to carbon negativity. Chapter 2 discusses the history of the UGM. Chapters 3 and 4 talk about how the movement affects university structure and function, as well as how the implementation of green technologies affect the campus and overall carbon greenhouse emissions. The final chapter talks about the path moving forward and how universities can adapt their frameworks to become more sustainable. This paper discusses why drastic change is the only way that we can avert a climate crisis and why society needs to focus its path to be more sustainable and focused on the state of the environment.

The History of Greenhouse Gas

"When one tugs at a single thing in nature, he finds it attached to the rest of the world."

John Muir

Humans have escaped the food chain, become the most dominant species on the planet, and have essentially turned the Earth into our playground for capitalistic gain and personal progress. However, despite the species reigning supreme over what seems like everything else, there are more connections between the ecosystem and the well-being of humans than we can count. To look at specifics, humans are directly related to different ecosystem services, likely

being major influences of change on them. Of the four ecosystem services, supporting, provisioning, regulating, and cultural, humans alter them everyday with their lifestyles and actions.

Humans have always had major impacts on the environment. During the age of the industrial revolution, the use of fossil fuels boomed, and human intervention with the natural world increased dramatically. However, archeological and anthropological studies show that the anthropocene started not in 1750, but before the common era, or BCE. Humans have been hunting and farming for thousands of years, but it was not until the land started being altered that environmental change began. Ever since forests have been cleared to make room for agriculture, coupled with the mass expansion of the rice paddy, enough greenhouse gas may have been emitted into the atmosphere to delay the global cooldown period into an ice age starting 5,000 years ago (Biello 2015). Megafauna have been extinct since 10,000 BCE, and the agricultural and livestock introduction from that point onward has altered landscapes and changed green cover with the spreading of animals, as well as the humans that accompany their livestock (Biello 2015). In addition, intensive farming has been affecting the environment for the past 3,000 years (Biello 2015). The steady development and progress of the homo sapiens throughout time has culminated into a scale of dangerous proportions, with emissions noticeably kicking off at the start of the industrial revolution.

Atmospheric carbon levels have increased from 310 parts per million (ppm) to around 400 ppm today, the highest concentration in the last 800,000 years (Biello 2015). In his book, *The Greenhouse Effect*, Harold Bernard predicted in 1980 that CO2-produced climatic warming would begin to accelerate at the turn of the century, and that in the period from 2010-2020 we

would experience a climate warmer than anything humankind has experienced in the last 1000 years (Bernard 1981). Time has spoken, considering that the five warmest years on global record have occurred since 2010 ("Climate Central" 2018). More evidence from the International Panel on Climate Change states that the Earth has increased by one degree celsius as of 2017 from pre-industrial levels, with there being high confidence that it will continue to increase by .2 degrees celsius per decade if drastic changes are not made (IPCC).

The evidence compiled from before the common era until now shows that the increase in greenhouse gasses, which is paired with higher overall global temperatures, has been at an increase until now, where it seems to be reaching its peak. This shows that the anthropocene started thousands of years ago, and it still in effect today, despite what many may think.

Looking closely at the ecosystem services, energy used by humans is primarily a provisioning service because it is the fuel that our current society uses to progress and power itself. Fossil fuels are a form of energy. Because energy in the form of fossil fuels is used by everyone and everything, the use of them degrades the other three kinds of services. The supporting services center around the sun, and are composed of primary solar production, soil formation, and nutrient cycling. The overuse of fossil fuels degrades this service because it interrupts natural water, nutrient, and soil cycles. The regulating services are composed of climate, food, disease, and water regulation. The overuse of fossil fuels affects this service because without fossil fuels, the integrity of the ecosystem is compromised and becomes more unstable as a result of things like the trapping of heat from CO2 which impacts food production and water quality. The final service that is affected by the overuse of fossil fuels are cultural services, which are composed of education, religion, recreation, and aestheticism. Fossil fuels

are the framework of society since they are used by everything, and the overuse and scarcity of them ruins the resource that runs these aspects of society. Outcomes from over using fossil fuels and reaching a 1.5 degree increase in global temperatures would mean the destruction of the ecosystem services, resulting in more extreme weather events, the crumbling of ecosystems, a major hit to species biodiversity, food becoming a scarce resource, and cities collapsing, all resulting in the fall of civilization (IPCC).

Since the industrial age, natural resource use in the form of fossil fuels has spiked. Because growing populations have created the need for increased food production, industry and human lifestyles are consuming more and more resources each year to maintain healthy lifestyles. As a result, human degradation of ecosystem services is resulting in increasing greenhouse gas levels which is affecting global temperatures. During the 1930s, almost every spot in the US suffered record-setting extremes of weather which caused property damage and lowered agricultural production, ultimately damaging our ecosystem services (Bernard 1981). Since 1750, the atmospheric concentration of carbon has increased by 32% because of human use of fossil fuels and overall land usage, with most of this change occurring since 1959 ("Millennium Ecosystem Assessment" 2005). In addition, according to 1,360 experts from 95 countries, human activities have degraded about 60% of the earth's natural ecosystem services, again, mostly in the past 50 years (Miller and Spoolman 2015, 12-18).

People are integral parts of ecosystems. A dynamic interaction exists between us humans and the ecosystem, with the changing human condition driving, both directly and indirectly, changes in ecosystems and thereby causing changes in human well-being ("Millennium Ecosystem Assessment" 2005). The issue currently is that human lifestyles are changing in an

unsustainable way because of the goal to attain proper resources in whatever means possible. This can also be considered natural capital degradation, or the wasting, depleting, and degrading the earth's natural capital at an accelerating rate (Miller and Spoolman 2015, 12-18). Because of the connectedness of everything in the world, actions to increase one ecosystem service ultimately degrades another. As we consistently try to improve our daily culture, we harm the regulation services of the planet by creating a more unstable climate.

Although it may be difficult at times to manage ecosystems and ecosystem services effectively because of their relatively slow change, statistics and scientific evidence has proven that the environment is changing because of human interference. Anthropogenic climate change has already had a significant impact on global temperatures, biodiversity, and ecosystem services. The main issue with addressing these changes from human interference is that it is hard to reverse the changes made because of the steady need in demand for these ecosystems services to sustain human well-being ("Millennium Ecosystem Assessment" 2005). Changes have been made which show positive results in combating the degradation of ecosystems and their services, but they have not been adequate because of growing needs and demands.

On a global scale, a study by the World Wildlife Fund and the Global Footprint Network in 2008 estimated that humanity's global ecological footprint exceeded the Earth's biological capacity to support humans and other forms of life indefinitely by at least 30%, with 88% of the issue originating from high-income countries such as the United States (Miller and Spoolman 2015, 12-18). In 2003, it was recorded that the United States per capita footprint was 12 times greater than that of low income countries (Miller and Spoolman 2015, 12-18). Because attending a university to attain a degree is a large focus in current American society, these institutions are

without a doubt creating a large impact on our ecosystem. University institutions are large contributors to this statistic because of their densely populated student bodies and tightly packed campus infrastructures that require a constant influx of natural resources and energy. Ideally, if universities in the United States could teach students to care for the environment, then this would motivate change within the country that has had the greatest impact on the environment. By locating a point source of the issue, the United States, this could reduce the amount of non point sources as well and elicit the most change.

Fortunately, the emission of harmful greenhouse gasses by universities all over the country predominantly come from point sources, or single, identifiable sources that are emitting pollutants (Miller and Spoolman 2015, 12-18). Examples could be transportation exhaust or building waste on campus. The education system in America has a huge amount of funding and budgeting that can be used towards any implementations that will increase the well-being of the institutions. This is a crucial factor in the UGM because financial assets aid in making changes to positively influence our ecosystem services. Education is also a huge driver in the fight to sustain our ecosystem services because it generally provides tremendous social benefits that can help address many drivers of ecosystem degradation and educate learning minds on the need for sustainability and protection of our ecosystem ("Millennium Ecosystem Assessment" 2005).

By using natural capital in the form of fossil fuels and other unsustainable resources, American universities are wreaking havoc on the environment. Because of the changes that the university environment is causing on the natural world, human well-being is being directly affected as well. As the state of the environment weakens, so too does the state of human well-being. Both are reliant on each other. Although the American university has educated

some of the greatest minds of our time and created a steady path that a student can travel along in their journey towards the working world, their sole existence is a liability for the natural environment. Because of the huge amounts of space that these campuses require in order to sustain the student population, universities all over the country are directly affecting our planet's supporting, provisioning, regulating, and cultural ecosystem services, as discussed earlier ("Millennium Ecosystem Assessment" 2005).

Given the volatility of the state of the environment, many universities around the country are aiming to reach a more sustainable state, specifically carbon neutrality. Carbon neutrality, or having a net zero carbon footprint, refers to achieving net zero carbon emissions by balancing a measured amount of carbon released with an equivalent amount sequestered or offset, or buying enough carbon credits to make up the difference ("Carbon Neutrality" 2018). In this situation, carbon neutrality is used in the context of carbon dioxide being released into the atmosphere by humans, specifically by American university campuses. A more sustainable achievement, carbon negativity, goes beyond reaching net neutral carbon emissions to actually create an environmental benefit by removing additional carbon dioxide from the atmosphere (Anzilotti 2018).

Despite the proposed benefit that carbon neutrality could provide to our ecosystem, some believe that carbon neutrality, not to mention carbon negativity, is not a feasible way to deal with fighting rising CO2 levels. Looking beyond university campuses and to the world as a whole, some believe it is not possible at all. When viewing it from a financial perspective, removing a significant enough amount of emissions from the atmosphere to make a noticeable difference would be extremely costly and would take a long time. The cheapest, and most natural method,

would be through reforestation and afforestation. This cheap and effective method removes carbon at $0-$20 per ton and has resulted in the planting of enough trees in the United States alone to absorb about 13% of the nations carbon emissions (Cho 2019). However, this method is not sustainable given the growing population, and, as a result of the growing population, the growing need for agricultural production.

In the fight for carbon neutrality, planting trees is not an effective way to mitigate emissions because, in terms of university campuses, owning a large acreage of land around the campus is hard to come by. Another additional method that relies on usable land and ground cover is soil sequestration. This method uses ground cover in the form of cover crops and crop rotation. While this method is effective because of the ease of deploying it quickly, its removal of CO2 at 0-100 per ton, and its minimal land and water requirements, soil unfortunately becomes saturated with carbon very quickly, making this method ineffective anywhere from 10-100 years in the future (Cho 2019). Just like the issue with reforestation and afforestation, it is difficult for campuses to own enough land to make soil sequestration a possibility. For a more effective way to remove carbon from the atmosphere, we must turn to machinery, modern technology, and the inventions and breakthroughs happening every day around the globe.

The first technological method to remove carbon is through bioenergy with carbon capture and storage. The idea behind this carbon capture and storage is to burn dead plants at a power plant and then capture the resulting emissions which can be used for oil recovery or could be injected into the Earth. While this could remove .5-5 tons of carbon from the atmosphere per year, removing enough carbon to avoid the dreaded atmospheric temperature rise by two degrees celsius would require using a land mass three times the size of India in order to grow enough

plants to burn, would cause global forest cover to drop 10%, would use double the amount of water that conventional agriculture is currently using, and would cost upwards of $400 to remove just one metric ton (Cho 2019). So, while the science behind this carbon capture and storage makes sense, it is not effective enough on a large scale to be logistical. Any method would need to be cheaper, and would need to have more pros than cons in terms of how it would work in terms of land and resource usage.

Two more methods involve capturing and storing CO2 from the atmosphere are carbon mineralization and direct air capture. In carbon mineralization, CO2 reacts with materials like basaltic lava to be stored in the form of limestone which can remain for thousands of years. While this method is effective because of its essentially permanent storage of carbon, it has the potential to pollute water and maybe even contribute to earthquakes (Cho 2019). When looking at direct air capture, while it is relatively cheap compared to other methods, and is useful at removing carbon, it could eventually have environmental impacts stemming from the extraction, refining, transport and waste disposal of the minerals that capture the carbon emissions (Cho 2019).

There are other methods of eliminating carbon, and some of these are ocean fertilization or enhanced weathering of rocks. While scientifically ambitious, these could potentially have catastrophic impacts on the ocean ecosystem through changes in pH or by eventually having less of a potential to capture carbon in the long term. In a quote from Kate Gordon, a fellow at the Columbia Center on Global Energy Policy, she said, “Carbon dioxide removal alone cannot do it. If there’s one thing the IPCC report really underscores is that we need a portfolio—we need to reduce emissions dramatically, we need to come up with more renewable energy options to

replace fossil fuels, we need to electrify a lot of things that are currently run on petroleum and then we need to do an enormous amount of carbon removal" (Cho 2019).

It is clear that while technology has enormous potential, many, like Kate Gordon, see it as having massive flaws as well. When it comes down to it, whether or not we can fully become carbon neutral, we need to have carbon removal techniques. It is all about equalizing carbon emissions within our global system. Before, we looked at methods from the financial perspective, but, regardless of their cost, the potential pitfalls that these methods have on the environment could bring about more harm than good in the long run.

Some believe that carbon negativity looks promising and hopeful for our future, but when it comes down to the logistics of implementing it, it is not as spot on as we may think. David Keith, an applied physicist at Harvard and the founder of the Canadian company Carbon Engineering, says, when referring to plans to go carbon negative, that "the overhyping has become a political trick" (Gonzalez 2018). That hype, he says, makes it easier for policymakers to avoid drafting near-term mitigation strategies and exceed their carbon budgets, in hopes that the debt that they have created will be repaid at some point in the future. By using computer simulations, politicians can create a hype around becoming carbon negative with these new technologies. The instills false hope of changes that could be made by lying and making the ideas look promising to the public. The Intergovernmental Panel on Climate Change modeled more than a thousand scenarios for ways to reduce the increase in global temperatures. Of the 116 modeled scenarios found to potentially be able to reduce global warming to below 2 degrees celsius, 101 of them were reliant on carbon removal technologies (Gonzalez 2018). Policy makers and politicians can use these hypothetical scenarios and convey them in a real sense to

the public. It makes it seem as if reaching carbon negativity is an easily reachable goal, despite there being an enormous amount of work that needs to be done. As discussed earlier, this instills a false sense of hope and lies to the public about the current state of human affairs with the environment. There is very little research and time that is being focused on carbon removal technologies. The only thing worse than assuming that carbon removal will save the day is assuming it will save the day, and then not funding its development (Gonzalez 2018). The potential is there, but we just need to tap into it.

Despite the knowledge that negative emissions could save the environment, it all begs the question: is it worth it? Should we be investing in green technology and exploring methods of carbon removal from the atmosphere and "go green", or should we simply promote safer sustainable practices like reforestation and more efficient agricultural practices to try to remove carbon the natural way? As of now, many things can be seen as a gamble, but now is not the time to avoid risks. The more research that is done, the more it seems we are going down a path of no return. Unless we explore and push for effective ways to be greener and avoid increasing emissions, then it may be too late for humanity. The only way for us to explore and push is to educate about how to be sustainable both in lifestyle and use of technology, and to learn from our mistakes.

However, what if people do not agree with climate change? What if people think that it is all a political hoax and do not support the movement for change? While the criticisms of climate change are a massive topic to review, the basis of the argument and how it applies to and impacts the UGM is threatening its legitimacy and intention for good. If people do not believe in climate change, then it is certain that they would not support the UGM and its efforts to be sustainable.

To start, within the United States alone, only about 69% of the population believes global warming is happening and recognizes it as a problem that needs to be faced head on (Ballew et al 2019). However, Americans on average believe that only 54% of people think global warming and climate change is real, 15% less than the true number (Ballew et al 2019). This discrepancy is a result of something called pluralistic ignorance. This results in a barrier to the discussion of the topic and makes it harder for change to be made. If these misconceptions about the public are not corrected, then it will be impossible for changes in the form of public or university wide policy to ensue.

Within this climate change argument and behind a lot of disbelief among Americans in relation to the movement is skepticism about commonly publicized facts about how the Earth and the natural environment are changing from human interference. Many ask the question, "Is climate change even real?" As with any issue in science, while there are things that are unknown, there are many things that are known. The main known facts are that CO2 levels are rising, this CO2 traps heat, and that human industry and lifestyle releases a lot of this chemical. The consistent rise of this greenhouse gas has been closely matched with human emissions starting from the industrial revolution.

Other questions that are common in the argument about climate change are "Couldn't the sun have caused the warming", and "Hasn't the climate changed in the past?" While these questions sound logical and could discredit believers, science proves them wrong. While the sun releases an enormous amount of energy, a lot of which reaches the Earth, the amount does not change much, especially over a time period as short as a few centuries, which is the period when the dramatic climate changes have been occurring (Berkeley Earth 2014). In relation to the

climate changing in the past, we know that CO2 has been steadily released by humans over the past two and a half centuries, and the unique carbon fingerprint shows that today's warming is human related. This is the central dogma of the climate change argument. Whether or not critics of climate change believe in the side effects that go along with increased CO2 levels, it has been scientifically proven that greenhouse emissions are rising and these emissions are impacting the environment through the trapping of heat. Changes are happening that would not occur without increased CO2 levels. Fighting to reduce these emissions is a fool proof way to limit the changing natural environment. It is this problem that is pushing and fueling the UGM.

Circling back to the university campus and responding to criticisms of the climate change theory, there is no doubt that pushing to limit CO2 emissions through carbon neutrality would provide numerous benefits to the environment. However, the issue we now face is whether carbon neutrality in itself is enough to salvage the ecosystem as well as rebuild the damaged foundation of our ecosystem services. While 90 universities across the country are setting goals to become carbon neutral, the same question surfaces again: is it worth it (Miller 2017)? With the steady rise of atmospheric greenhouse gas levels since the Anthropocene era a few thousand years ago, it is possible that carbon neutrality will not cut it, and universities will need to reach towards achieving carbon negativity. They will have to deploy strategies that use the methods of carbon removal discussed earlier. If the UGM is the solution, then the change that we need for the good of the planet may just come from these little havens of knowledge that we have spotted across the country. As students are taught about sustainability and as it is implemented more and more into their daily lifestyles, our nation's universities may be spreading a green wave across the country through the minds and hearts of the youth. This could very well be the change we

need to create a world that makes sustainability the norm and that educates minds that could one day foster the innovation that steers the world clear from entering an environmental crisis mode.

History of the University Greening Movement

> "To sustain an environment suitable for man, we must fight on a thousand battlegrounds. Despite all of our wealth and knowledge, we cannot create a redwood forest, a wild river, or a gleaming seashore."
>
> Lyndon B Johnson

Just like the institution a university itself, the UGM did not start overnight. This movement that is sweeping across campuses nationwide is adapting and transforming the mission statements that these educational centers have. Despite this uniformed movement, all have their own statements. Whether the institutions have sustainability formally stated in a document, a minimal 8%, or they simply have sustainability as a goal in mind, many are implementing technologies and practices on campus to make a difference (Velazquez 2006). This is essentially what a green campus is. It is not necessarily one that is carbon neutral, but one that has some sort of framework implemented into their goals to become more sustainable. Steps can be taken to transform a campus into a green one, which include: developing a sustainability vision for the university, establishing a mission statement, establishing a sustainability committee, that establishes policies and objectives, and creating sustainable strategies (Velazquez 2006). The important point within this framework is that campuses can be considered green campuses whether they are at the forefront of sustainability or not. Intentions and actions, no matter how significant or insignificant, are the focal points of the movement.

The origin of the movement is debated by many. One of the earliest proposed dates for the start of the United States environmental movement comes from Steven Stoll, writer of *U.S.*

Environmentalism since 1945, A Brief History with Documents. After the atomic bomb was dropped on Japan and the world began to realize the effects of human progress on the environment after WWII, the relationship between Americans and nature changed dramatically. Stoll pinpoints the birth of American environmentalism from these changes to be in 1945 (Stoll 2007). After American environmentalism started to grow, more issues started to surface, such as the politics of preservation of the environment, population growth, biological interdependence, ecodefense, climate change, ethical consumption, and environmental justice (Stoll 2007). With this newfound mindset after the war, it was clearly shown that Americans began to consciously reflect on how their relationship with the environment was affecting the ecosystem, and just how destructive civilization was becoming.

Another possible origin of the movement could have been a result of the first Earth Day in 1970 (Rappaport 2008). The initial inspiration was to create change among student groups, staff, and faculty in relation to how they treated the environment and how sustainable their lifestyles were. Ideally, this was to create change within schools and campus grounds. These initiatives have undoubtedly taken root to drive recent movements, which have been fueled by the concern for global warming. These motives for change have the potential to establish new thinking about infrastructure development, research programs, investment decisions, and learning (Rappaport 2008). With the realization that students are now coming into universities loaded with electronic devices and a habitual lifestyle to consume more energy than ever before, these institutions need to figure out ways to combat this and create more environmentally sustainable campuses.

An additional reason that universities had the desire to become more sustainable was to be more efficient with energy usage to reduce their costs. They spend about two billion dollars per year on energy usage, meaning that even gradual improvements can save these institutions a lot of money (Rappaport 2008). Some changes throughout history have been easy for universities to make, like purchasing the most energy efficient equipment and technology. Some changes have been harder, like managing campus space, implementing green technologies into existing infrastructure, and utilizing it to be the most energy efficient. Whether the task is easy or difficult, the UGM has undoubtedly been impacted by the original drive for sustainability in educational institutions when the first Earth Day started in 1970.

Another viewpoint pins the first major steps to the movement to be in 1990. Tufts University formed "The Role of Universities in Environmental Management and Sustainable Development", which was the first official statement made by university administrators towards a commitment to sustainability in higher education (ULSF 2015). This global movement affected over 125 universities all over the world within the first year, with many of them being in the United States (ULSF 2015). It initiated a plan which has 10 steps that universities can use to implement sustainability into their campus frameworks. The plan is applicable in any area of the world.

As the UGM has progressed, "sustainability" has begun to become a common buzzword for many universities. After the realization that living sustainably will save many institutions money, administrations have figured out that they can do well, while also doing good for the environment. Many economists predict that the oil age will come to an end in the next decade,

and this opens the door for the implementation of green technology and all the potential positives it may bring.

Sustainable technology on a university campus is essentially a living model for the young minds of our generation, showing how sustainable practices can exist within our human framework. Institutions are continually adapting as well as adopting practices of sustainability to become greener and more efficient within this existing framework. At a school like Emory in Atlanta, the movement has started relatively recently, seven years ago, because of rising energy prices and the desire to put sustainable ideas into practice (Egan 2006). Overall, although this movement is impacting everyone, there are no true leaders. The UGM is very often a student led movement, all thanks to the push towards a sustainable framework that has embedded green thinking into campuses and the population.

Looking no further than Fordham, there are practices and plans set in place to promote sustainability and care of the natural environment on its campus. One example of this is the "Tree Advisory Committee" that Fordham has established and promoted as a result of joining the "Tree Campus USA" program. Started in 2008 by the Arbor Day Foundation, the goal is to help universities promote tree conservation and be a catalyst for fostering student engagement with the environment ("Tree Advisory Committee 2015). Being a part of this program requires Fordham to establish an official committee, have plans and initiatives to promote sustainability and conservation on campus, and establish learning projects for students. Over the past 11 years since its start, organizations like the Arbor Day Foundation have helped to motivate universities to be more sustainable as well as helping to boost the UGM's impact.

Another Fordham initiative was the creation of the university's Sustainability Committee. Taking on Mayor Bloomberg's challenge years ago for all New York City institutions of higher education to reduce emissions by 30% by 2017, Father McShane collaborated with Great Forest, an independent sustainability consultant, in order to foster a university wide discussion among all members of the Fordham community ("Sustainability Council" 2015). Members of this community, whether they be faculty, administration, or students, meet periodically throughout the year to discuss key issues such as improving the recycling program, reducing university-wide energy usage, and reducing greenhouse gas emissions, as well as starting initiatives focused on conservation of the natural campus environment ("Sustainability Council" 2015).

Although there is no specific start date for the UGM, it has undoubtedly kicked off in the last decade. A scientific analysis of energy usage and carbon emissions data from 343 U.S. universities found that emissions per square foot declined by 13 percent between 2007 and 2014 ("Campus Carbon Emissions" 2016). Unfortunately for the movement, many universities are increasing campus and living quarters space because of the increase in student enrollment. This has resulted in the increase of carbon emissions. Campus size, density, age profile, and capital investment portfolios are the four key drivers of carbon emissions and energy consumption, most of which are increasing because of the increase in the student body and need for sufficient campus size and amenities for these students ("Campus Carbon Emissions" 2016). However, this increase in emissions is being combated by implementing green technologies into infrastructures to offset the increase in the size of the student body. Many campuses have implemented more advanced and efficient HVAC systems into their buildings, as well as better utility foundations to become more efficient ("Campus Carbon Emissions" 2016). Furthermore, an astounding 550

North American campuses, mostly from the United States, have adopted a web-based program called the Carbon Management and Analysis Platform CarbonMAP to measure and manage energy use and greenhouse gas emissions ("Campus Carbon Emissions" 2016). This way, they can track their resource use, make sure that they do not exceed their carbon emission cap, and make sure they are as sustainable as they can be given factors like population and energy needs.

Although many universities in North America have established goals to be more sustainable, these motives have been shared all over the world, most notably in Europe. The European University Association's (EUA) foundational belief is that universities are crucial to global sustainable development. The association is an active part of the United Nations' Sustainable Development Goals. The EUA believes that through research and education in a wide array of academic disciplines, that universities all over the world are the contributing factors to sustainable development. The association realizes that there are many contributing factors in being sustainable, like knowledge, research, innovation, and citizen involvement. While these may be essential, EUA strongly believes that "the Sustainable Development Goals clearly need strong societal actors, like universities, to ensure their success" ("Sustainable Development Goals").

Looking at the United States, its universities track their emissions and use management tools to be as sustainable as possible. Similarly, the EUA follows sustainable development goals to do things like establish sustainable cities and communities as well as affordable and clean energy. While it is clear that the EUA views universities as the key to sustainable development, American universities seem to only view these institutions as a minor contributing factor to the path towards sustainability. This change could exist because of cultural differences. Regardless

of the origin, there is clearly a difference between North America and Europe in relation to the implementation of sustainable technologies and practices. There is also a discrepancy between how these movements are promoted by these institutions of higher education.

Despite all of the progress that has been made by American universities taking part in the UGM, one debate that is derailing and almost ruining the notoriety that this movement deserves is the topic of "greenwashing". Some say that universities all over the country are toting themselves as being "sustainable" and having "green campuses" to gain publicity and attention, despite having no right to call themselves this. In other words, they state a mission for their campus that does not line up with their practices. Realistically, this would boost the reputation of the institution dramatically, especially considering that many people seem to be attracted to words like "green" and "sustainable". Take Michigan State University as an example. In 2012, the board of administration declared that they were shooting for and were close to becoming a leader in sustainability and running their campus on 100% renewable energy. However, they had a coal burning power-plant on campus that burned over 250,000 tons of coal each year, putting the facility at number 25 for the largest sources of pollution in the state of Michigan (Jones 2013). Without investigation, incoming students interested in sustainability would likely be tantalized by Michigan's statement of being green. Greenwashing is a problem that is progressing right alongside the UGM itself. It has had unfortunate success as it too often delegitimizes the progress that some universities are actually making towards sustainability.

Unfortunately for Fordham, it is a common criticism that its administration greenwashes. Around the campus and in its dorms and buildings, there are defined and separated trash and recycling bins. While Fordham claims to have recycled and diverted over 208,000 lbs. of paper,

cardboard, plastic, glass and metal from the University's waste stream in 2015, many students are skeptical of whether or not Fordham actually recycles ("Campus Recycling"). Students claim to have seen Fordham workers "put trash and recycling in the same truck" for disposal and removal, as well as even putting trash and recycling in the same bags as well. Although Fordham claims to comply with regulations and standards in relation to recycling and trash removal, skepticism by students shows that the university does not publicize their actions and efforts enough. In relation to Fordham and all other universities around the country, whether they greenwash or not, doubt from those in their respective communities puts their reputations in jeopardy.

Despite the promising rise in the UGM over the past couple of decades, there are many threats to the sustainability of higher education that could impact the success of the movement's future. As student enrollment declines, tuition is discounted through scholarship, and state support dwindles, institutions are struggling to cover long term investments because of the lack of monetary surplus. Looking at specifics, in 2016, only 29% of public universities and 41% of private universities were meeting enrollment goals, with most institutions reporting cascading declines in undergraduate enrollments year-on-year since 2011 (Zewald 2018). In addition, international student enrollment is plummeting, and more students are leaning towards professional STEM programs in large metropolitan schools, leaving liberal arts programs in smaller rural universities desperately searching for funding (Zewald 2018). For schools like Fordham, this makes a steady surplus of revenue from tuition difficult to maintain, which ultimately is the sustenance for growth and expansion and what provides the ability to invest in newer and greener technology.

Furthermore, the middle class is shrinking, and as a result, universities are forking out scholarships and grants to allow students to attend their institution, ultimately pulling money away from growth and sustainable expansion (Zewald 2018). State budgets have also been impacted, with nearly every state cutting funding for higher education post-2007, resulting in public universities being forced to become more dependent on tuition revenue, and on students to become more reliant on loans through private banks (Zewald 2018). With all of these issues that universities are facing that ultimately pull revenue and channel it elsewhere, less focus can be placed on developing green technology and sustainable practices, which hurts the UGM's progress.

Fortunately for those campuses legitimately and wholeheartedly taking part in the movement, they are making great strides. By using a plethora of state of the art technologies and innovations, they are becoming greener and more sustainable. Many universities are paving the way for the future, and are aiding in the continued progression of the UGM.

The Greenhouse Effect on Campus Politics

> "If you think the economy is more important than the environment, try holding your breath while you count your money."
>
> Dr. Guy McPherson

While the UGM has brought about great change to many campuses and provided numerous benefits and positive impacts, it undoubtedly brings with it a long list of to-do's that administration must consider when making changes on campus. When an institution is truly committed to going green and dedicated to become more sustainable, a very significant portion of funding and attention must go into the ever changing campus atmosphere. However, this

funding and focus is very beneficial to our nation. Higher education in the United States is a $300 billion industry with the active audience, intellectual resources, and research related infrastructure to drive positive change at the local level, and most importantly, to transfer the knowledge, skills, ideas and values needed to usher in a new era of environmental sustainability in the 21st century (Harnisch 2017). The university campus is a breeding ground for change and advancement in this increasingly sustainable world. Without it, a significant driver toward the improvement of our nation's well being would be removed.

The UGM causes change through renovations to infrastructure and the establishment of different programs that unfortunately require a pretty penny to manage. However, many of these campus initiatives can effectively reduce campus operation costs. Campuses use a huge amount of natural resources to construct and maintain buildings because of the consumption of energy at an astounding rate, and the emission of a large amount of greenhouse gasses as a result of campus travel or students that regularly commute to and from campus. These three sectors of energy usage results in a large amount of money being allocated towards paying these bills. By creating LEED certified buildings, investing in methods to naturally harvest energy, like windmills, and providing campus friendly methods of transportation, resource, and energy use, campus energy bills would drastically decrease (Harnisch 2017). Take the University of Minnesota, Morris as an example. It invested in a wind turbine in 2005 that has effectively cut its energy bill in half each year (Harnisch 2017). Methods to decrease energy usage are undoubtedly an investment, but they would effectively decrease natural resource use and the cost that comes along with it in the long run.

With all of the funding that is required to participate in the UGM, it is sometimes difficult for the administration and board of a university to randomly decide to invest in green alternatives and practices on campus. Many campuses have been fortunate enough to take advantage of federal programs, loans, and grants that aid in the funding of a green technology. For example, the Energy Independence and Security Act of 2007 allows for a $250 million annual allocation in grants and $500 million in loans for renewable energy and energy efficiency projects to be used for sustainability efforts on university campuses each year (Harnisch 2017). In addition, many schools have benefitted from donations and collective funding from alumni and donors to the school. Looking at Fordham specifically, they recently installed solar panels on the roof of the parking garage and library through the help of alumni and other donations.

Tufts University, which I already talked about in the previous chapter, is a great school to examine to look at how taking part in the UGM impacts the very foundation of a school. Tufts was chosen by the EPA in 1990 to receive a grant to aid in the purchase and implementation of green technology to eliminate the environmental impact of the university's own operations (Creighton 1999). In other words, they were going green. More specifically, they were going carbon neutral. The realization of the waste and harmful emissions that the campus was emitting spurred them to start the Tufts "CLEAN! Act". They learned that to maximize the effectiveness of their teaching at the campus, greening had to be at the core of their focus, and environmental efforts had to complement rather than clash with the educational mission of the university. Fortunately for Tufts and universities alike, sustainability is beginning to spread to every aspect of society, from art and literature to science, math, business, economics, and law as well.

Without a surprise, this systematic change at Tuft's campus had a huge impact on the trustees, administration, staff, and students. The trustees have the responsibility to select and manage the president of the school and to determine the institutions mission, plans, and educational programs (Creighton 1999). Overall, these trustees control and maintain the well being and health of the university. The administration, the president, vice president, and deans handle the day to day demands that go along with running an institution. The staff handles more defined roles in relation to academic and residential life. Finally, the students are essentially the products of all of these roles since they adapt and literally live within the framework established in the university from the trustees, administration, and staff. Because of the shift to going green, the campus changed from the top down as well as from the bottom up. Legislation from the trustees and deans impact the daily lives of the students, just as the feedback and demands from the students impact the decision making of these trustees and deans.

Given the layout and normal framework of an institution just described, we can examine how decisions focused on sustainability can drastically change the environment of a university campus. The first step taken by universities is to create a policy/mission statement that is a public declaration to the commitment of environmental protections which serves as the framework for decision making and goals (Creighton 1999). It is common for universities, which Fordham is one of, to create offices or centers for sustainability on campus comprised of administration, faculty, and students that monitor the impacts and changes that ensue from creating a mission based on sustainability.

After the groundwork is formed to pursue sustainability on campus, administration actively incorporates their mission statement into the day to day demands of the institution to

align themselves with sustainability. From here, the staff enforces this mission on a smaller scale where the students then experience first hand the changes that originated from the decisions to go green from the trustees. Of course, there are always situations that differ from the typical top down process. For example, students at Tufts led a movement that pressured administration to change utility companies because its planned hydroelectric plant threatened sensitive ecosystems and indigenous people (Creighton 1999).

Specifically looking at the UGM, it has historically been a grassroots, or bottom up, movement that has started with the students of universities, like those at Tufts mentioned in the paragraph above. When environmentalism was not a huge focus for the administration, the students were usually the driving factors in the movement, advocating for change and pushing for sustainability on campus. However, in the last decade or two, the popularization of the UGM has resulted in more of a focus among administration. Change has, as it should be, been primarily top down from the university administration in consultation with the trustees and stakeholders of the institution. With administration supporting sustainability, it is much more likely for a sustainable focus to percolate into the minds of the students, as opposed to students pushing for sustainability and the administration not supporting actions towards this. Fortunately, the movement seems to have reached a point where a unanimous push for sustainability has resulted in changes within the code and agenda of the institutions administration, from the top, as well as from students and advocate groups that these students have created, the bottom. As discussed earlier, Fordham's Sustainability Committee and United Student Council have advocated for and publicized movements in favor of sustainability on campus amongst the student population. Going along with this, the administration has funded

projects like the installation of solar panels as well as creating a focus towards things like natural conservation on campus with plans like the Tree Advisory Committee. When administration and the students are pushing for the same things, it creates a much more effective force in creating change on campus, and provides a much greater sense of hope that changes will be made that could help us to avoid a dreaded environmental crisis.

In 2007, the "Green Report Card" was created to evaluate hundreds of universities across the nation in regards to their sustainability on campus and how students and administrations were functioning in working together for a greener campus (Green Report Card 2011). Data taken for the report card showed that most universities were not taking advantage of the economic and social benefits that sustainable upgrades on campus could bring. However, it was surveyed that there was a dramatic increase on 52 different green indicators since the report card was started in 2007. Overall, it showed a 64% increase in the commitment to reduce carbon emissions, a 70% increase in the creation of a campus garden or farm, a 79% increase in the creation of green building policy, and a 95% increase in creating a sustainability committee on campuses (Green Report Card 2011). Fordham is one of these schools that has been evaluated, scoring a C+. This indicated the need for major improvements to be made. The biggest areas of improvement are endowment transparency, and shareholder engagement, both of which the school has scored an F in (Green Report Card 2011).

Another valuable organization that is evaluating and monitoring our nation's universities to ensure sustainability is "The Association for the Advancement of Sustainability in Higher Education", or AASHE. This association encourages higher education faculty, administrators, staff, and students to be effective change agents and drivers of sustainability innovation ("About

AASHE"). By fighting to make sustainable practices the norm in education, creating missions and visions for administrations, and creating a strategic plan of guidance, the association is a helping hand of guidance to make sustainability more easily reachable.

Making these administrative changes that turn the focus of a university campus towards sustainability undoubtedly changes the whole dynamic of the institution. For starters, a healthier campus allows for better mental and physical health of those on campus, and, of course, for a better and cleaner environment. It also affects things like housing, and resource usage on campus. By retrofitting structures to have better windows, lighting, and HVAC systems, the integrity of the buildings are increased and they run more efficiently ("Going Green at School: A Guide to Sustainability in College and in Life", 2018). In addition, campuses produce large amounts of carbon emissions and waste in the form of trash. This trash unfortunately ends up either in landfills, or in the atmosphere, both of which are very harmful to the environment. Wind and solar power are both becoming very popular on university campuses because of the positive gain that they provide to campuses by helping them save money on electricity ("Going Green at School: A Guide to Sustainability in College and in Life", 2018). These methods are often a big investment, but they pay off for the institution in the long run. Wind energy, for example, produces no greenhouse gas emissions during operations, and produces up to 80 times more energy than is used to build, install, maintain, and decommission it (EWEA 2011).

While some universities are afraid of change because of the unknowns that may come along with it, big industry, which education is one of, thrives on change and innovations that lead to new technologies, products, and opportunities. Often referred to as free enterprise, these changes can lead to higher living standards (Miller and Spoolman 2015, 640-641). For

universities that realize the benefits that may come from change, investing in new technologies, products, or opportunities are often recipes for both success and recognition. An additional benefit, and arguably one of the reasons why the UGM started, is that students within the university where changes are taking place will likely have their mindsets changed in relation to sustainability. It is very likely that students enrolled in a university that creates a mission for sustainability and stresses this on campus will experience a change in their mindsets to want to become more sustainable. Universities are then following both the precautionary and prevention principles of environmental policy by taking steps to try to reduce environmental harm from human interference and by making decisions to prevent an environmental problem from occurring or becoming worse (Miller and Spoolman 2015, 640-641). In the educational sense, administration is creating mission statements for sustainability to try to prevent the youth generation from being careless in regards to the environment. When it comes down to it, creating awareness in our nation's youth is one of the most effective ways to become more sustainable, and American universities are a great place to start.

With all of the changes that administration is pushing for, a pessimistic mindset is bound to wonder what the motivations behind the changes are. Is it only to save money? For publicity? For recognition? Or is it because the university genuinely has the desire to be sustainable and help the environment? It is hard to tell, as those that believe that it is genuinely for the good of the environment could be getting greenwashed. Regardless of the motive, changes make change. If universities say they are taking part in the UGM and are investing in sustainable practices, are saving energy, are using less resources, and are conserving the natural environment, then that is

what truly matters, as the delicate state of the environment is being helped. Agree with the motive or not, this change is an environmentalists dream!

Fighting Back: Green Technology and Design

"You cannot protect the environment unless you empower people, you inform them, and you help them understand that these resources are their own, that they must protect them."

Wangari Maathai

With an ecological tipping point on the horizon, humans need to fight back. Fortunately, we have the means to do this. Society has reached the point where it could very well function normally without the use of any non renewable resources like fossil fuels. With natural resources beginning to deplete, more sustainable technologies that use renewable energy from sources like solar and wind power are becoming very important in the UGM. This technology is becoming more and more accessible, and implementing it into existing structures and areas around campuses is becoming easier as well. Universities around the country are taking advantage of this easy accessibility of green technologies and making an impact as a part of the UGM. Administration is realizing that using green technologies to reduce energy usage and emissions not only is more sustainable and eco friendly, but it is saving them money as well.

By making use of natural lighting, passive solar heating, solar cells, solar hot water heaters, recycled wastewater, and energy-efficient appliances and lighting, buildings become much more energy-efficient and save a lot of money (Miller and Spoolman 2015, 404). Green building certification is now becoming more popular in the form of LEED (leadership in energy and environmental design) silver, gold, and platinum certification which awards buildings for meeting a certain standard of efficiency (Miller and Spoolman 2015, 404). By implementing

more efficient appliances, lighting systems, heating and cooling systems, and insulation, universities are striving to become LEED certified and attract the eye of potential students. Despite the government doing a poor job at encouraging the reduction of energy waste and reduced emissions, the UGM has spurred institutions to make moves of their own to make advancements in the move toward sustainability.

Middlebury College in Vermont is one school that has set the standard for going green, and has done it perfectly. As early as 2001, administration of the school realized the threat that carbon emissions had on the planet, and made a commitment to reduce their carbon footprint to limit their contribution to the emissions problem and inspire others to do the same ("Carbon Neutrality" 2016). The original aim was to reduce emissions to 8 percent below 1990 levels by 2012, but they soon changed their goal to net neutrality by 2016 ("Carbon Neutrality" 2016). How did they do it? A large part of the success can be attributed to their enormous, yet carbon neutral, biomass gasification plant which meets most of the heating and cooling needs on campus, co generates 15-20% of the electricity on campus, and reduced their carbon footprint by 40-50% ("Carbon Neutrality" 2016). Another contributing factor was the approval from the board of trustees in 2014 to conserve 2,100 acres of the surrounding Bread Loaf Forest landscape which provides carbon credits to offset the remaining portion of emissions from campus that the biomass facility and other carbon reducing changes on campus could not cover ("Carbon Neutrality" 2016).

An example of some of the other changes that the university has made is in relation to their transportation system. In 2001, they introduced its Yellow Bikes Cooperative where students can pay a fee of $6 per year to have access to any bikes stored in bike racks around

campus as a way to reduce automobile emissions on campus (King 2018). Since 2016, Middlebury has remained carbon neutral, and continues to track its progress through inventory checks and emission tracking.

Something that is important to take note of for the universities making goals to cut certain carbon emission levels in comparison to previous years is that the effectiveness of carbon neutrality depends on when and at what level the baseline for carbon emissions is set. Baseline emissions refer to the production of greenhouse gases that have occurred in the past and which are being produced prior to the introduction of any strategies to reduce emissions ("Baseline Emissions" 2018). This is important because it acts as a benchmark to evaluate subsequent efforts to reduce emissions. Without baseline emissions, it is impossible to judge the success of remediation efforts. Baseline emissions information is also valuable when nations or industries seek to negotiate to trade emissions so that both parties can meet their overall emission-reduction targets ("Baseline Emissions" 2018). The Kyoto Protocol, written in 1997, established this crucial baseline at 1990 on the national level, stating that countries trying to reduce their carbon emissions had to aim to reduce them by x% in comparison to 1990 levels ("Kyoto Protocol - Targets for the First Commitment Period.").

While Middlebury has set a very high standard for carbon neutrality among university campuses around the nation, there has been a significant number of schools that have joined the trend and implemented their own modifications to campus to become more sustainable. The Princeton Review recently created its own "green rating" where they judge universities on their policies and sustainability measures. Some schools have earned top honors and have joined the "Green Rating Honor Role". Stanford has one of the coolest efforts, by replacing plastic dining

utensils with cutlery made of potato starch and salad bowls made of sugar cane, both of which can be collected in a compost bin which is then composted and used as fertilizer for the dining gardens in the Stanford Community Farm (King 2018). Another ingenious method was by Ball State University. They drilled 3,750 400 foot wells on campus to tap into the Earth's temperature. This heated and cooled the buildings on campus, allowing them to do away with their outdated coal-fired boilers, which eliminated 85,000 tons of carbon dioxide emissions, and created 870 jobs (King 2018). Universities like Stanford and Ball State may have had a greater impact on sustainability and emissions than schools who have only been able to make smaller-scale changes, but they set the bar high and have proved to universities all over the country that the UGM is accessible to all campuses and any change is both progress and something to be proud of.

Regardless of how a university plans to become greener and reduce their emissions, it is probable that any implementation of a sustainable technology will both help the environment, and cut back on energy costs. Stonehill College in Massachusetts is a great example to show the financial assets of green technology. Prior to going solar, Stonehill used 15,974,455 kilowatts per hour in electricity, which resulted in them paying $2,002,551 for electricity alone per year (Messier 2018). However, after the implementation of their solar field, which is comprised of 9,152 solar panels, Stonehill saved over $185,000 per year and provided up to 20 percent of the campus's electricity (Messier 2018). This is proof that while fighting back with different implementations of green technology and design on campus not only combats environmental problems from harmful emissions, it is also worth it for the university in the long run.

Looking at the home front, Fordham's implementation of solar panels on campus has had a huge impact. In April of 2019, A 963-kilowatt solar panel array, composed of 2,790 panels, was installed atop the five-story parking garage on Fordham's Rose Hill campus, the second array of solar panels on campus after the installation on top of the Walsh library in 2010 (Verel 2019). In addition, in July 2019, Fordham signed a 20-year agreement with the solar developer EnterSolar to purchase electricity generated at a 10-acre, 9,000 solar panel installation just east of the Arthur Kill waterway in Staten Island that generates up to 2.6 megawatts of solar power annually (Verel 2019). The new solar power sources help to provide up to 20% of the total electric energy consumption used by the university when operating at maximum production, making Fordham the largest user of locally installed solar technology of any institution of higher education in New York City and greatly decreasing the school's carbon output (Verel 2019). Just like Stonehill College, the solar installation helps to save an enormous amount of money, over $200,000 per year.

Many other universities have planned their mission to be sustainable, just like Middlebury and Stonehill. Their achievements and breakthroughs have been captured by the Sierra Club's ranking of universities on their sustainability, naming the successful ones "Cool Schools". This ranking has helped to shed light on those schools that have wholeheartedly committed themselves to being sustainable and reducing emissions for the sake of the environment. The "cool" winners are so dedicated to greening every level of their operation, whether that be in relation to energy usage, recycling, food sourcing, or the curriculum, that sustainability has become woven into their culture. Through an in depth questionnaire, schools were ranked based off a sustainability rubric, and were called or visited for follow up

information, if need be (Andrews 2018). This questionnaire and rubric were created as a result of the collaboration of 4 organizations: The Sierra Club, The Association for the Advancement of Sustainability in Higher Education (AASHE), the Sustainable Endowments Institute (SEI), and the Princeton Review (Andrews 2018).

The University of California Irvine, the winner of the "Cool Schools" ranking in 2014, had unbelievable achievements in the realm of sustainability. After vowing in 2008 to reduce emissions by 20% by 2020, the school hit its goal early, so early that they decided to shoot for another 20% reduction in emissions by 2020 (Andrews 2018). Three on-site solar power projects, a 19-megawatt cogeneration plant with turbines powered by combustion and steam, a water-recycling program that saves more than 210 million gallons per year, and the creation of an immersive Summer Institute for Sustainability Leadership program all combined to create a powerful change towards sustainability on campus (Andrews 2018). Overall, 173 schools have submitted the questionnaires to be ranked, proving the growth of the UGM and the potential benefits that can come from it.

Amory Lovins, author of the book *Reinventing Fire: Bold Business Solutions for the New Energy Era*, believes that when motivated by profit, supported by civil society, and sped by smart policy, the US could completely eliminate their use of fossil fuels by 2050 (Lovins et al 2013). He believes that using new solutions for transportation, buildings, electricity, and manufacturing are possible with the use of new energy supplies and new energy plans. About 78% of human activity is fueled by the use of fossil fuels, yet we have modern energy alternatives that eliminate the need to use these ancient fuels (Lovins et al 2013). In 2012, wind and solar power attracted more private capital than all fossil fuels and nuclear plants combined,

proving both the benefit and prowess of using renewable and sustainable sources of energy (Lovins et al 2013). Society has the ability to be sustainable, but it just needs to realize the benefits and successfully make the transition. UC Irvine is a living example of the power that creating multiple sustainability projects has on reducing emissions, saving money, and helping the environment.

Although these campuses are already using many different types of green technologies, there are still new innovative methods that are being developed that continue to make carbon neutrality, and even carbon negativity, a more attainable possibility. One notable example in recent news is the invention of liquid thermal fuel, or "liquid sun", by swedish engineers and scientists. This thermal fuel is essentially like a rechargeable battery, a huge breakthrough considering that there have not been any cheap or efficient methods of long term storage of solar energy in recent years. Scientists have been working on a special molecule for over a year that, when activated by sunlight, turns into an energized isomer of itself, steadily holding potential energy. When energy is needed, this liquid is pulled through a catalyst and it is then returned to its original form, releasing heat and giving energy to any systems. The energized molecule can be stored in a stable form for up to 18 years, and, even after 125 cycles through a test system, displayed no signs of damage or deterioration (Cassella 2018). Although there is still much work to be done, developers believe that this method could be available commercially in 10 years. Its place of testing was at the perfect place, a university in Sweden. Its potential to heat buildings and other machinery like dishwashers and other mechanical equipment has attracted a huge number of investors. More importantly, it has established itself as a method to capture energy in the effort to go carbon neutral.

As influential as green technology, design, and new potential breakthroughs like "liquid sun" can be at reducing emissions to reach carbon neutrality, it is possible that carbon negativity, or the net effect of removing carbon dioxide from the atmosphere, will be the only hope at reducing carbon dioxide levels to a healthy and livable level. Carbon dioxide is a molecule that is considered a long lived pollutant, or a pollutant that will remain in the atmosphere for a long time since it does not decay (Deich 2015). Carbon Dioxide has a half life of 27 years, which is equivalent to a residence time of 39 years in the atmosphere (Mearns 2014). Essentially what this means is that once the gas is emitted into the atmosphere, it will reside for approximately 39 years unless removed. This leads to a difficult problem. The UGM could successfully sweep across the nation, every collegiate institution could become carbon neutral, and all other waste could be eliminated from campuses, but it could still not be enough. We could face consequences of climate change decades into the future, even if carbon neutrality is reached today.

The issue with going carbon negative lies in the fact that it is extremely difficult to even reach carbon neutrality, a less impressive feat than negativity. It is difficult to measure carbon emissions, setting reduction timelines is challenging, and given the state of current developments of carbon removal approaches, finding and generating scalable and effective carbon removal techniques that can be tracked is both expensive and is relatively unknown to our current technological world (Deich 2015). However, one university across the globe in Maribor, Slovenia assessed it environmental performance on a life cycle basis, and found amazing results. Through the analysis of day to day resource use of water and energy by buildings, they were able to determine that the heating and construction of buildings were the factors that were most

heavily impacting the environment. This resulted in a change in the layout of buildings in relation to the technological systems. In addition, they also addressed the issues with the use of plastics and papers, and discovered the most effective and sustainable way to eliminate the waste they produced on campus. They successfully found the most impactful carbon removal technique that is also trackable. This method was to recycle 70% of waste, incinerate 29% of it, and divert 1% of it to a landfill (Lukman 2009). Although this breakthrough is on a relatively small scale, this university's findings could shed light on the most effective carbon removal approaches that can be both tracked and measured in order to determine the best way towards eliminating emissions in other places worldwide.

Although The University of Maribor provided the potential to track and measure emissions, the main issue lies in the fact that the environment is deteriorating quickly, and, as a result, requires dramatic change to start happening more quickly. Looking back to Middlebury College, it took 15 years to reach carbon neutrality through the reliance on a formal plan and administration that was dedicated to reaching the goal of carbon neutrality ("Carbon Neutrality" 2016). Many universities are slowly implementing green technologies and sustainable designs into their campus, but they have not created a set plan with a goal date for reaching carbon neutrality like Middlebury did. This agonizingly slow journey towards neutrality means that carbon dioxide will continually be emitted into the atmosphere.

How can we design buildings that produce their own energy and emit no waste? How can we use natural resources in a way that is sustainable and does not destroy the surrounding ecosystem? The answer is through design and innovation. It is only through these two things that we can continue to push towards a more sustainable world. No matter how imperfect these

processes and designs may be, we must continue to innovate and change. In the book *Ecological Design,* the authors argue that the easiest way to innovate and change is by modeling and mimicking the natural landscape around us. When thinking of lasting sustainability, "the only long term approach to building a sustainable world is to redesign the details in the products and landscapes around us…… something grounded in the texture of our everyday lives" (Ryn, Sim Van der, and Stuart Cowan 2007). By modeling our design and technology off of nature, also known as biomimicry, we can copy the processes that have been used naturally in nature for millions of years and have successfully stood the test of time.

Van Der Ryn and Cowan have an amazing outlook on how design is intertwined with our world, and the reason why it is so important. They said, "In many ways, the environmental crisis is a design crisis. It is a consequence of how things are made, buildings are constructed, and landscapes are used. Design manifests culture, and culture rests firmly on the foundation of what we believe to be true about the world" (Ryn, Sim Van der, and Stuart Cowan 2007). To them, the current construction of our modern world is incompatible with nature. It is this belief that has resulted in so many hardships in relation to our environment. Humans have attempted to use nature and exploit it by the use of force and degradation. Living a life that harmoniously lives along with, and not against, nature is the key to living sustainably.

To be sustainable is to live with nature. In our fight against rising emissions, we are quickly nearing the point of no return. Reaching the point where all carbon dioxide is eliminated from the atmosphere, while taking into account its 39 year atmospheric life, will be continually pushed further into the future if we do not quickly invest both our money and our minds into the problem. We cannot afford to allow carbon dioxide to linger in the atmosphere for much longer.

For this very reason, the UGM needs to shoot for and promote carbon negativity, not carbon neutrality. Carbon neutrality is not enough to avoid an environmental catastrophe.

Following the Green Brick Road

"Education is the most powerful weapon which you can use to change the world " - Nelson Mandela

Education is one of the most coveted resources in the world, something that millions around the globe fight and strive for everyday. It is something that students can take for granted and coast through without absorbing the hidden benefits, or it can teach students morals and the true meaning behind what it means to educate yourself for others. The UGM teaches the latter. By teaching our nation's youth the true meaning behind what it means to be an advocate for others and our society, this movement is pushing to educate students about the need to care for the environment. Students need to be shown why it is a necessity to protect the integrity of the natural world so that it can prosper, and in turn, allow our man made world to harmoniously prosper alongside it. Universities in the United States that are taking part in this movement are utilizing education as a weapon to fight as a part of a movement to change the world.

The important thing to realize is that individuals matter, and by corralling the masses of individuals that are educated in the United State's universities every year, a huge wave of activism has been created that is sweeping across the nation and advocating for change. This "bottom-up grassroots action" is the main reason why changes are becoming successful, because the individuals in the movement are creating a social change. Because of this, advocacy for these movements needs to happen for change to continue to occur. Two important factors that are allowing for the success of the UGM are that it takes only 5-10% of the population to bring

about a major social change, and this change can occur in a much shorter time period than most people think (Miller and Spoolman 2015, 26). Some believe that if we start now, it is estimated that we have about 50 to 100 years to start making the shift from unsustainable to more sustainable living, given the fact that many changes take about 50 years to fully implement themselves into society and become a norm of action or thought (Miller and Spoolman 2015, 26). A proper education and mindset that is focused on sustainability is something the UGM is stressing. This is crucial because its students are the future working generation of our nation. It is important for these universities to take note of the fact that because carbon dioxide is a long lived pollutant and will remain in the atmosphere for up to 40 years after it is emitted, the focus needs to be on reaching carbon negativity, not carbon neutrality. Universities need to incorporate a curriculum that focuses on sustainability. Whether this be through environmental studies core classes or focusing on a particular realm of sustainability within different disciplines, education should cater to the environment. Creating classes that allow students to be taught material based off their interests, while allowing it to be focused around how this field relates to the environment, is necessary to ensure that students shape their educations around sustaining and conserving the natural environment.

One major problem that is preventing society from experiencing a massive shift and reaching all of these goals of carbon negativity is friction in the marketplace. The fortunate thing about all the wrong that is happening is that most people do want to help the environment. Of those that responded to an Energy Pulse National Survey, it found that 9 out of 10 Americans want to help the environment, but do not know how to do it (Shelton Group 2018). What these people do not realize is that a huge part of emissions in the United States are from inefficient and

unsustainable technology that we use in our infrastructures and homes. Sure, buying a Tesla is great for the environment because it does not use gas. However, despite the fact that 30% of emissions result from generating electricity, only about 6% of Americans realize that this electricity that powers their homes is the number one man made cause of climate change (Shelton Group 2018). The survey also found that 84 percent of Americans say they know only a little or nothing about what to do to improve their home's energy efficiency (Shelton Group 2018). What would change this problem? Education about the issue and how to successfully fight climate change, both individually in homes, or collectively through social movements and social change, like the UGM.

Overall, the most effective way for humans to become sustainable is to mimic nature, something called "biomimicry". This is because nature has been successful at adapting to the environment and living with the environment, as opposed to humans living alongside the environment, occasionally going against it, and causing major problems. Where did the idea from a plane come from? It was not a randomly made up invention from an idea that sparked in the Wright brothers' minds. It was mimicked after a bird. Universities need to create new buildings on campus or modify old buildings on campus to be more in tune with nature that stand with the elements instead of trying to go against them and avoid them. We have to create a much more sustainable infrastructure on our campuses with carbon negative buildings.

To make the buildings themselves become carbon neutral, we can create something called a "living building" that is built around four main design goals: taking into account natural forces like climate to keep the building from trying to interfere, make the building capable of using only renewable resources, including a system for capturing and maintaining all water used

in the building, and make the building highly energy efficient and aesthetically pleasing (Miller and Spoolman 2015, 609). By only investing in these carbon friendly resources, constant maintenance and construction on university campuses would assure that extra, unnecessary carbon is not leaking into the atmosphere. In addition, well known technologies like solar panels and wind turbines, for campuses that have the space, are economically beneficial technologies and need to be employed. These technologies are more easily implemented into campuses and are more simple to install because they do not require the intensive modifications to buildings that the previously mentioned methods do.

The desire to go green and incorporate nature and sustainability into our open spaces shows that humans want to be connected with nature and want green and environmentally friendly spaces around them. During the industrial revolution, people were horrified of the "dreadful night" that was associated with the smog and pollution that plagued both urban and rural areas (Brantz et al 2011). City planning was soon associated with the lack of or absence of nature as a result of over development and intensely concentrated pollution. Some views depicted nature as savage and something that was in the way of human progress, while the contrary opinion was that the severing of the human and nature link was the root of human misery. Nature has been seen as the lungs to human civilization, and the continued implementation of green technology and practices into university campuses and civilization as a whole can be seen as an attempt to heal and bring back nature's damaged lungs.

The idea of incorporating nature into a city had a prominent breakthrough in Germany during the mid 1900's that likely spread to cities around the globe and further pushed for the incorporation of green technology in buildings. When Berlin was divided in 1948 by the Berlin

Wall, it physically divided the city and the surrounding democratic areas around it, but also severely impacted green space and the role that nature played in the city (Brantz et al 2011). Ecologists, biologists, and citizens of the city and surrounding areas began to push for more green space so that nature had more of a distinct role in their lives, both for lifestyle and for the health of the city. This is very similar to the push for healthier air during the industrial revolution. In "Greening the City", the authors said, "How people react to their environment, what they consider a problem, and how they search for solutions are always mediated by the meanings they attribute to their natural surroundings" (Brantz et al 2011). Nature has an enormous impact on our daily lives.

Those in both rural and urban areas during the industrial revolution compared cities to an eternal "night" because of the pollution and the overall feeling of being disconnected from nature. Being able to connect our developed society with nature and provide adequate green space has kept civilizations grounded while helping to instill a sense of security and overall well being by maintaining healthy "lungs". This new perspective on the importance of nature's role in our built environment can be seen as a contributing factor to the spread of green technology and the desire to keep nature interwoven with our progressive development.

Looking at the scientific perspective, the central belief of ecology has been that organisms form interdependent systems that are determined by the specific conditions of their spatial environment (Brantz et al 2011). This definition often excludes humans, but the push for a more inclusive environment between nature and human civilization is changing this central tenet of ecology to refer to all organisms, humans included. Through further research of how animals, humans, and plants tie together in nature, the need for green space and the

implementation of green technology into our infrastructure is becoming more of the norm. In addition, our need to allocate green space among our man made structures is becoming increasingly important given the fact that natural space is depleting quickly and the demand for food is steadily increasing as a result of a rising world population. By using green technology and practices, we can successfully help man and nature reconnect to lower our emissions and use land more efficiently. Humans want to be connected, and they want to avoid eliminating nature from our man made spaces.

Looking at Middlebury College once again, it is an example of a carbon neutral campus that successfully established an interdependent relationship between nature and their campus infrastructure and brought nature's "lungs" back to their developed space. It has sustainable technologies to make buildings very efficient, and then additional technologies to offset extra carbon emissions and help the campus reach carbon neutrality. They have a 2,100 acre plot of land in the surrounding Bread Loaf Forest landscape. This forest acts like functional lungs by providing carbon credits to offset the remaining portion of emissions from campus that their biomass facility and other carbon reducing changes on campus could not cover ("Carbon Neutrality" 2016). They also have their "Yellow Bikes Cooperative" where students can pay a fee of $6 per year to have access to any bikes stored in bike racks around campus as a way to reduce automobile emissions on campus and generate further carbon credits to offset emissions (King 2018). These implementations are ingenious ways to utilize the space that they have and reconnect their campus with nature.

One example of compact technology that can be used by university campuses is the Climeworks Carbon Capture Device, also known as a "tree". Originating in Zurich, Switzerland,

these trees have fans that pull air into collectors that soak up carbon dioxide like a sponge that is then heated to release the CO2 into a pure form that can be sold, made into products, or buried underground (Peters 2017). The CO2 that can be sold to consumers could be a source of revenue for universities if they were to incorporate these trees into their campuses. Just as significant as their ability to remove CO2, these machines can be installed on top of buildings and do not require a large amount of space that some green technologies, like solar panels, do.

America's neighbor to the north, Canada, is also researching and toying with the idea of technology very similar to that of the "trees" in Switzerland. As discussed in chapter 1, the Candian company Carbon Engineering believes that carbon removal from the atmosphere is the most effective way to reduce rising emission levels. The technology they use sucks carbon from the atmosphere. However, the main difference between Carbon Engineering's technology and Switzerland's "trees" is that Carbon Engineering does not collect the CO2 to be sold, buried, or used for commercial products. Scientists and engineers plan to use the CO2 that is collected and chemically combine it with hydrogen to create a completely clean fuel for cars and other machinery (Gonzalez 2018).

After a building itself becomes carbon neutral from using these different techniques mentioned, additional technologies or practices can be implemented into and around campus to make the buildings and the area carbon negative and to offset any potential carbon emissions. Of course, planting real trees on campus would be a huge benefit to take carbon dioxide out of the atmosphere, but technology is a helpful boost to do this.

There are many ways to make a building itself carbon negative, which would make carbon offsetting technologies like these "trees" from Zurich even more effective, since they

would not be offsetting any carbon emitted from campus, but rather taking CO2 straight out of the atmosphere and avoiding any worry about emissions from campuses themselves. Some of these methods are to assure that the total emissions from materials, construction, and the demolition of a building are carbon negative. What this means is that we should reduce the use of fossil fuels during creation and construction, use materials that store atmospheric carbon in them, make the structure airtight yet breathable, make it weather resistant and low maintenance, incorporate a large amount of insulation, and encourage the capture, generation, and even export of renewable energy (Thorpe 2016). These implementations do things like hold heating and air conditioning in the building to save money, allow for minimal fossil fuels to be used by the building, reduce the necessity for maintenance on the building, and most importantly, use a very small amount of resources when creating the materials and constructing the building. This last point is significant because a building may be sustainable, but it could be created/constructed in a very unsustainable way. This would reduce the impact that the building was created to have on the environment, which was to be sustainable.

Furthermore on building in a sustainable manner, a company called “Lignacite” has created a slab of brown building materials called the “Carbon Buster”. This is the first carbon negative building block made from carbon dioxide, sand, cement, water, glass, shells and wood shavings (Laskow 2013). While these are the typical components that buildings are made with, the special thing about the Carbon Buster is where the materials came from. More than 50% of the materials in the product are recycled, which results in the amalgamate containing more carbon than the creation of it emits (Laskow 2013). By reusing materials that have already gone

through the production system, they may have to be re-processed to take form, but this takes far less energy than taking raw materials out of the ground and processing them from scratch.

If universities all around the country were to incorporate trees into or around their campuses, and were to build buildings that used the technologies and methods of construction mentioned above, their campuses would become much greener, likely making them carbon neutral, or potentially even carbon negative. To do this, administrations needs to measure and track their carbon emissions, update old and inefficient technologies and buildings to new green ones, and incorporate technologies or practices to offset extra emissions to make the campus carbon negative. Incorporating bikes onto campus that students can ride to avoid using unsustainable forms of transport, like Middlebury did, and using materials and technologies to remove carbon from the atmosphere are ways that universities can reach a carbon negative campus. Using building materials like the Carbon Buster can prevent huge amounts of materials from being used to create the massive buildings on university campuses.

Given the fact that it takes at least 50 years and huge investments to phase in new energy alternatives, the UGM needs to take precedence at the top of every administration's to-do lists in order for a change to occur, and fast. Our future with the environment and the path of sustainability that we choose depends on what we decide to promote in society, and ultimately, the mindset that we are given in regards to sustainability. Education can instill within students a sense of urgency and the desire to care for the environment that can be used to reach a sustainable state. In order to create change, we need to know what to do. You cannot blame someone for not doing something that they were never taught how to do. Marketing and advertising in our country is too often focused on capital growth, and rarely about the

environment and how to help it. We are too focused on profit instead of caring for the source and reason we are able to profit, the Earth. To create change, there needs to be a new status quo that creates massive social change and helps us to tap into the potential that we have to save our planet.

If we continue down the wrong path, educational institutions can simply run through the motions of education and fail to instill in students a sense of passion and the desire for change. If we are given the resources from higher education to understand the current environmental issues we are facing, then we stand a fighting chance against the threat of an environmental meltdown. Hundreds of years of degrading the environment from careless actions driven by the motives of economic success cannot stop in a day, month, or even a year. It will take many years to achieve the necessary means to become a sustainable society that lives with the environment, rather than destroying it.

We cannot push to simply to become carbon neutral. Rather, we need to push for carbon negativity to right the wrong that we have created over the course of human history. There are endless amounts of ways that universities can essentially customize their campuses to be green and reduce their amount of emissions and waste. The possibilities that come with all the technology that has been mentioned throughout this thesis as well as the new technology that is being invented every day are endless. The innovation to save the state of the environment and right the wrongs that we have created over the past 250 years can be undone through the UGM and educational institutions all over the world. While technology has the potential to make this easier, steadily increasing emissions makes it even harder every day. With education as the most powerful weapon to elicit change, the UGM needs to be at the forefront of sustainability to create

green campuses that can be the prominent force of change in society, and ultimately our saving grace. As Nelson Mandela said, “Education is the most powerful weapon which you can use to change the world.” Whether or not we use it to its fullest potential remains to be seen. Only time will tell.

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