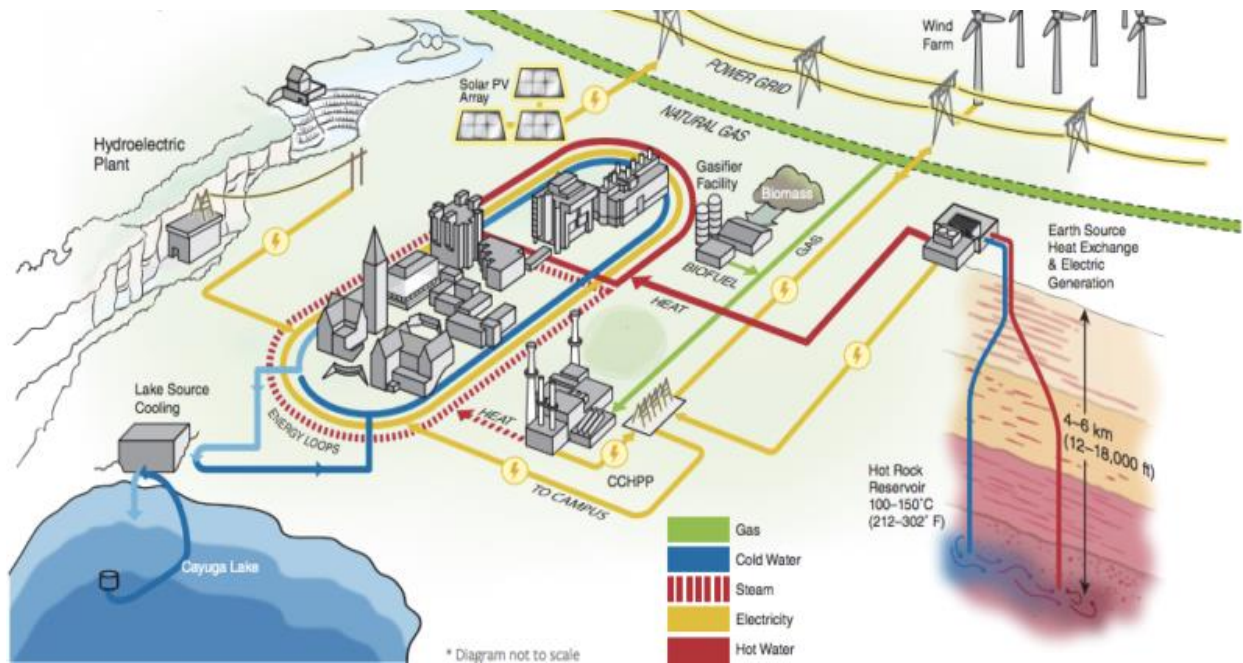


Capstone: Written Report

Environmental Leadership in Campus Sustainability



Source: Cornell University Campus Sustainability Plan, 2013-18

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Date: April 2019

1. Introduction and Overview of Campus Sustainability

Campus sustainability is an important topic for several reasons:

1. Higher Education institutions generally have a large environmental footprint, primarily because they are large users of energy in order to operate their campuses and fulfil their programmatic activities. For example, Cornell University (located in upstate New York) is one of the largest energy users in the state, with a carbon footprint of approximately 204,000 metric tons of CO₂ equivalent (MT CO₂e) annually (Cornell, 2016).
2. Due to their mission and competencies, Higher Education institutions have the capacity and responsibility to lead on climate and sustainability action for the sake of their students and society (Second Nature, 2019)

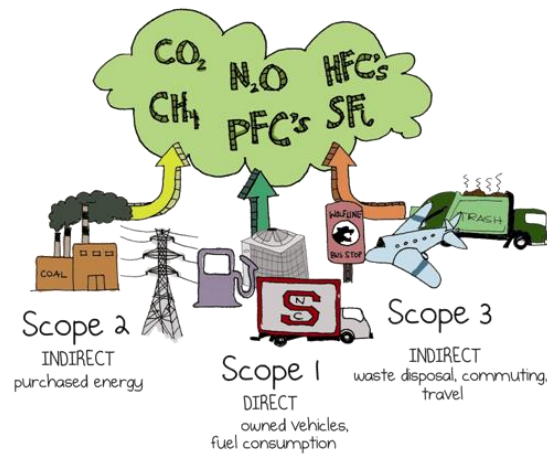
Second Nature, a nonprofit benefit corporation founded to encourage and assist climate action by higher education institutions, established the Association for the Advancement of Sustainability in Higher Education ('AASHE') in 2001 due to increasing interest in campus sustainability. However, it wasn't until the American College & University Presidents' Climate Commitments ('ACUPCC') in 2006 that a number of organizations publicly made concerted, objective, quantifiable commitments to reduce greenhouse gas ('GHG') emissions.

In 2015, Second Nature expanded and rebranded the ACUPCC to form the Presidents' Climate Leadership Commitments. As part of that change, the ACUPCC was rebranded as the 'Carbon Commitment'. Today, the Climate Leadership network comprises over 600 higher education institutions who have made a commitment to act on climate (Second Nature, 2019).

At many of these institutions, a formal commitment has been made to reductions in GHG emissions; these commitments (typically incorporating a series of percentage reductions in GHG emissions by certain target dates) are a core component of Second Nature. Those commitments are reported through Second Nature's reporting platform (<http://reporting.secondnature.org/home/>), which acts as a central hub for the monitoring and evaluation of progress against these commitments (Second Nature, 2019).

As part of the agreed protocol for reporting their emissions under the Second Nature program, institutions use the Greenhouse Gas Protocol ('GHGP') (GGP, 2019) a partnership between the World Resources Institute and the World Business Council for Sustainable Development. GHGP establishes a comprehensive, global, standardized framework for measuring and managing

emissions from private and public sector operations, value chains, products, cities, and policies (WRI, 2016). GHGP divides emissions into 3 categories or 'Scopes':



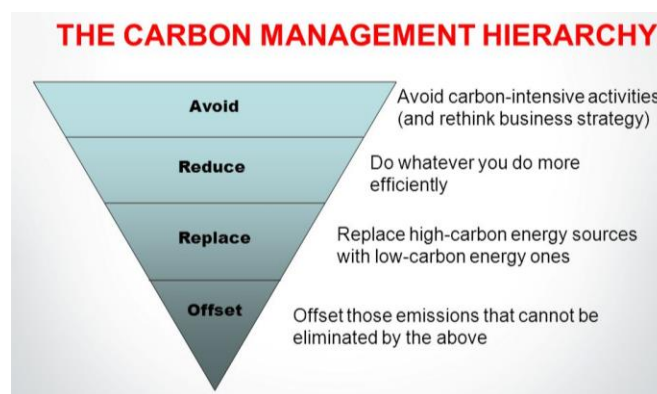
Source: NCSU, www.ncsu.edu/sustainability/cap.php

Scope 1: Direct GHG emissions: this covers all direct GHG emissions by an institution including the generation of electricity / heat / steam, direct transportation (e.g. company vehicles) and fugitive emissions.

Scope 2: Electricity indirect GHG emissions: this covers the GHG emissions from the consumption of *purchased* electricity, heat or steam by the institution.

Scope 3: Other indirect GHG emissions: these emissions are optional, but cover the extraction and production of purchased materials and fuels, transport-related activities in non-owned vehicles, outsourced activities, waste disposal, etc. (GGP, 2016)

In order to address these targets, institutions have generally followed the Carbon Management Hierarchy as a practical operational framework for their emissions reduction projects:



Source: NCSU, modified from "Getting to Zero: Defining Corporate Carbon Neutrality" by Clean Air – Cool Planet'

The framework directs organizations to prioritize those actions which have the most impact; **Avoiding** activities that are carbon-intensive and hence generate high emissions first, then **Reducing** activities where possible, **Replacing** those energy sources with a high carbon footprint, and finally Offsetting those remaining emissions which cannot be avoided, reduced, etc. (Burtis, 2008)

In this report I have focused on five Higher Education institutions which have made objective commitments (see table on the following page for their targeted reductions), and for whom data is available through the Second Nature reporting portal. These include Colgate, Cornell, Duke, Middlebury (College) and New York Universities, all of whom are members of the Carbon Commitment initiative. Additionally, the five were chosen because although they have all made quite meaningful progress against their commitments, they have taken quite different routes to secure their reductions.

2. Assessment of Progress Against Goals

Second Nature captures three key metrics in order to monitor progress against the stated reduction targets:

1. Current Emissions, measured in metric tons of carbon dioxide equivalent (note: CO₂ equivalent ('CO₂e') is the "concentration of CO₂ that would cause the same level of radiative forcing as a given type and concentration of greenhouse gas (such as methane, perfluorocarbons, and nitrous oxide") (Wikipedia, 2019)
2. Per Full-Time Enrollment, measured as the Current Emissions divided by the enrolled number of students
3. Per 1,000sf, measured as the Current Emissions divided by the square footage of the institution's campus buildings

The duration measured is from 2007 thru to the most recent data available (generally 2017). For the 5 colleges identified the results are as follows:

University	STARS rating	Gross Current Emissions (MTCO ₂ e)	Reductions to Date (2007-2017)	Per Full-Time Enrollment (MTCO ₂ e)	Per 1,000sf (MTCO ₂ e)	Targeted Reductions
Cornell	Gold	204,200	36.14%	8.87	12.94	20% by 2012, 50% by 2025, 100% by 2035
Duke	(Reporter)	258,581	23.68%	17.43	16.01	10% by 2010, 21% by 2015, 45% by 2020, 88% by 2050
Colgate	Gold	14,697	15.31%	5.13	6.27	35% by 2015, 40% by 2020
Middlebury	Gold	(1,646)	60.40%	4.41	4.93	40% by 2011, 60% by 2015, 100% by 2016
NYU	(N/A)	145,223	39.58%	3.93	11.32	30% by 2017, 50% by 2020, 100% by 2040

Source: <http://reporting.secondnature.org/home/> (NB: 'STARS' rating is the Sustainability Tracking, Assessment & Rating System™; a self-reporting framework for colleges and universities under AASHE (AASHE, 2019). 'Reporter' status effectively means an institution's sustainability efforts are recorded but not scored, whereas a Gold score recognizes those Institutions securing 65 points or more. NYU was recorded as N/A because they did not submit the full 10-years of data)

Generally, the targeted institutions have achieved their first phase targeted emission reductions, except for Colgate (which had relatively low emissions as a starting point). The average reduction in gross emissions across the 5 institutions studied has been 35.0% and reductions have varied from as low as 15.3% to as high as 60.4% (on a gross basis, over 10 years), and it is clear from the data above that there is huge variability between GHG emission rates. For example, on a MTCO₂e per full-time enrollment basis, NYU emits only 3.93 metric tons, whereas Duke emits 17.43 metric tons, more than 4x higher. Similarly, on an emissions per

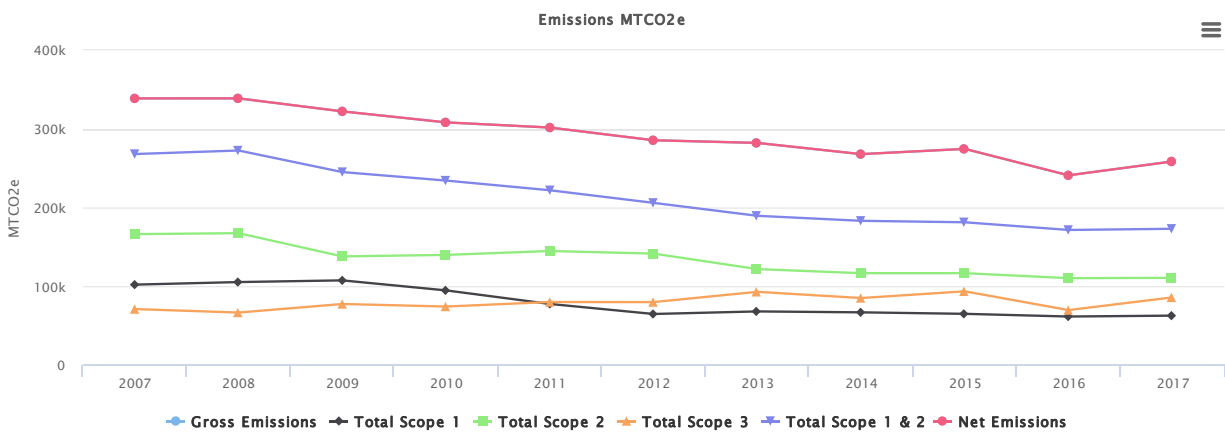
thousand square foot basis, Middlebury is very low at 4.93 metric ton per 1,000sf, while Cornell and Duke are much higher, at almost 12 metric tons and 16 respectively.

Individual Assessments: Net, After Offsets (all data from <http://reporting.secdnature.org/home/>)

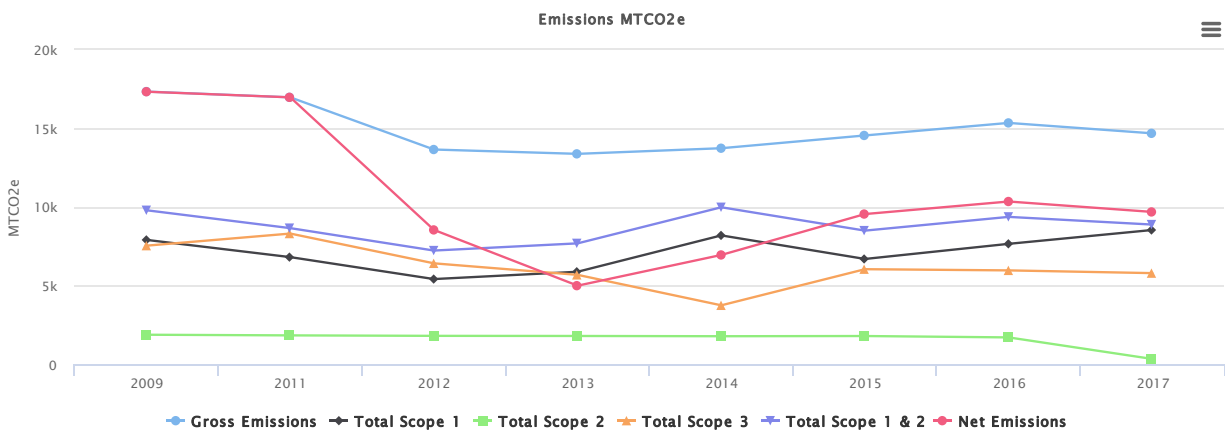
Cornell University



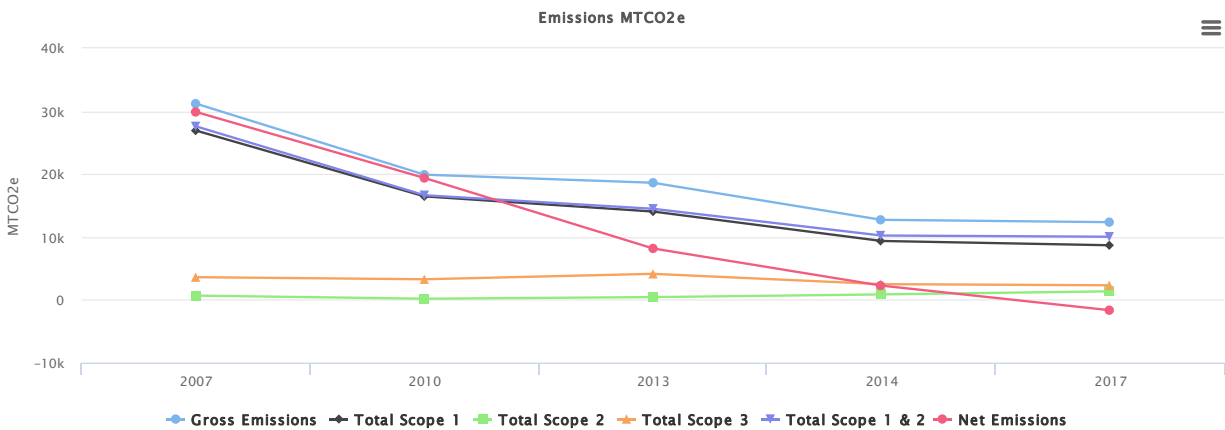
Duke University



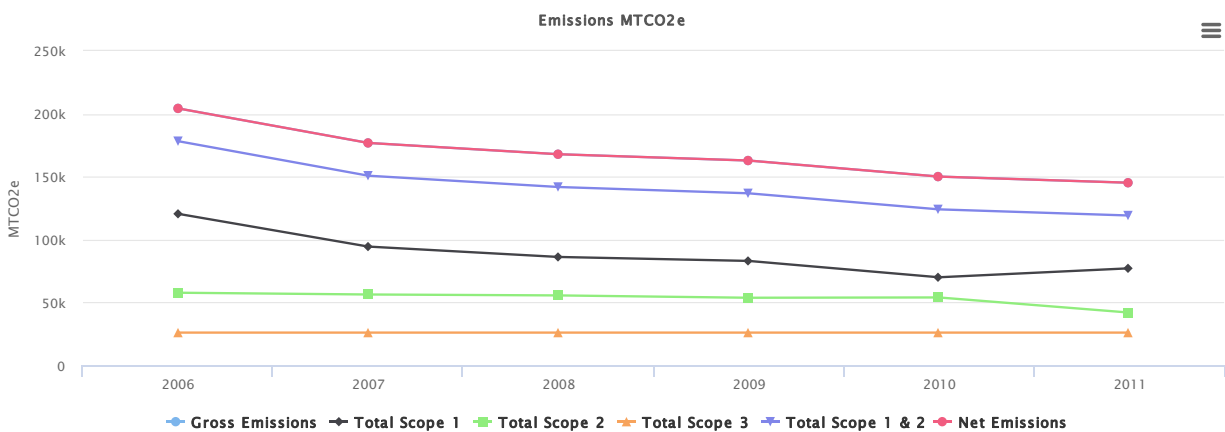
Colgate University



Middlebury College



NYU

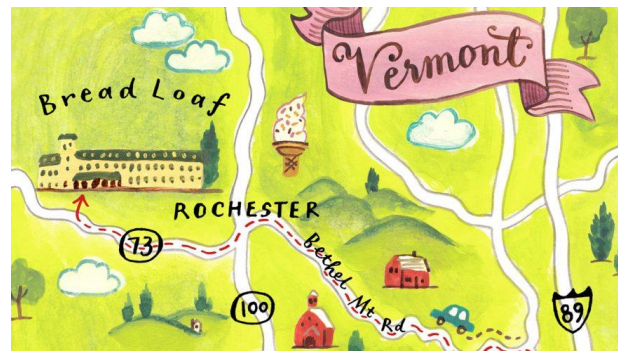


On a Net Emissions basis, clearly Middlebury stands out with Net Emissions falling below zero in 2017. This is primarily due to the large forest offset program initiated in 2016 (see section 3), but they have also invested in various efficiency projects and converted their main heating & power plant to biomass sourced locally.

Unsurprisingly, Scope 3 emissions have generally not shown the same reductions that institutions have been able to achieve with their Scope 1 & 2 emissions (i.e. their direct emissions and indirect electricity emissions). Given that Scope 3 are indirect non-electricity related emissions not under the direct control of the institution, this exemplifies the challenge of driving change across diverse supply chains.

3. Spotlight on Leadership Progress and the Enabling Initiatives

Middlebury College: Bread Loaf Carbon Offset Initiative

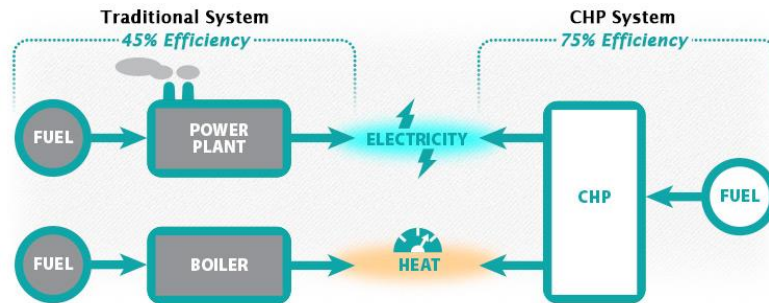


The primary driver for Middlebury reaching carbon neutrality was their Bread Loaf Campus carbon offset initiative, whereby they agreed to a 40-year restrictive forest management plan in order to generate Renewable Energy Credits ('RECs') that they use to offset. This project arose out of a conservation easement for Middlebury's Bread Loaf campus that was put in place by their Trustees to recognize the contributions of a departing President and was funded by an alumnus who had hunted and recreated there and was willing to fund the cost of the easement. The easement was granted to the Vermont Land Trust, placing the use of the Campus under a restrictive Forest Management Plan ('FMP') that was an integral component to enable 3rd Party certification of the RECs. The FMP utilizes the 'Improved Forest Plan' protocol as set out under the American Carbon Registry ('ACR') scheme. To enable Middlebury to seek formal accreditation, they partnered with Bluesource (<http://www.bluesource.com/>) to provide 3rd Party accreditation for the carbon offset credits. The plan is to sell the credits but buy back enough for their own offsetting needs. Given the way the protocol works, they get very high credits for the first 7 years (as harvesting of that forest has and will be very low), which enabled them to get to campus neutrality. After 7 years, the number of credits drop down to a lower amount equivalent to the annual growth of the forest. Over a 7-year time frame they expect to make a profit of \$100-120,000 in total, and they had to agree to a 40-year commitment to ACR to stay in the scheme.

The use of offsets to meet emission reduction targets is acceptable within the GHGP, however, as the Carbon Management Hierarchy details, such offsets should be the last action taken and are judged to have the least real-world impact. Partly due to such feedback from internal and external stakeholders, Middlebury has announced a further emissions reduction plan focused on 'Replacement', with the focus on moving to a Combined Heat and Power Plant ('CHP') fueled by renewable natural gas (potentially sourced from local landfills) (Middlebury, 2019).

Cornell University: CHP and Earth Source Heat

Cornell exceeded its 2012 emissions goal with a reduction in emissions of 32% between 2008 and 2012. However, much of that decline (although not all) came from a fuel conversion to the highly-efficient CHP from coal to gas (see diagram below).



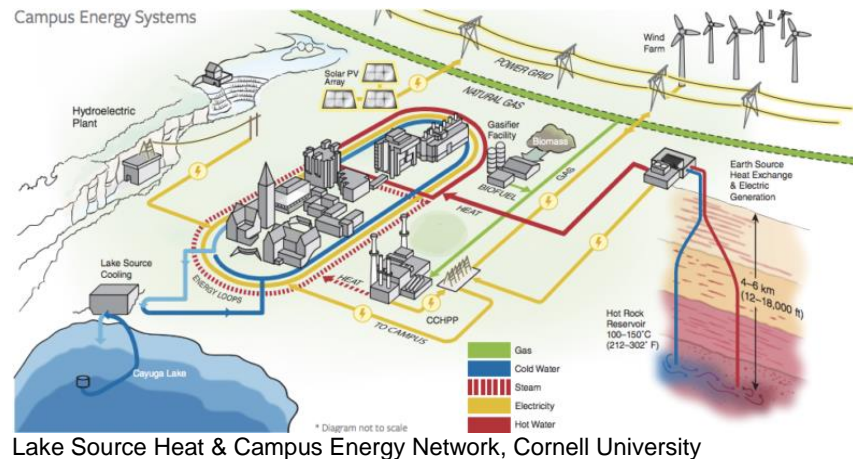
Source: energycenter.org

(Note: before the 2007 baseline, Cornell had installed an innovative 'Lake Source Cooling' plant to cool most campus buildings using cool water circulation (through a system of heat exchangers) from adjacent Cayuga Lake (Cornell, 2019)).

Although the burning of natural gas releases less carbon than coal (US EIA), and the switch to this fuel has enabled Cornell to achieve a 36% reduction by 2017, this approach to reducing emissions is not without controversy. Due to the release of methane during the production & transportation of that gas (so-called 'fugitive emissions' of methane, which has higher insulating properties than CO₂, although it is shorter-lived in the atmosphere), critics argue that the protocol undercounts the true emissions.

Robert Howarth, a Cornell Professor of Ecology & Environmental Biology, was a lead author on one of the first peer-reviewed research papers investigating lifecycle emissions of methane from shale gas production (Howarth, 2011). That research suggested that such fugitive emissions were much higher than generally accepted, and higher than assumed in the calculation of emission reductions detailed above. Although subsequent research (Alvarez, 2018) has suggested a lower fugitive emissions rate, when the full complement of CO₂e emissions is included, Cornell's emissions likely actually went up during that period. (Note; there are other benefits to switching to natural gas: emitted particulates (such as soot) would have gone down and natural gas mining is arguably less damaging to the landscape than coal mining (NRDC, 2018))

Looking forward, the largest planned initiative within Cornell's 'Achieving a Carbon Neutral Campus by 2035 - Analysis of Solutions' report is the development of a campus-wide heating system labeled Earth Source Heat ('ESH') (Cornell, 2016).



ESH is somewhat like geothermal heating in principle but differs in that the heat being utilized is found much deeper, approximately 2-4 miles beneath the surface. It is a 'cutting-edge' renewable technology and engineering challenge as although such systems have been used in locations with supportive geology (areas with hot springs, volcanic activity, etc.) they have not been deployed in areas of moderate geology (which underpins the Ithaca, NY campus of Cornell and the North East of the US). Therefore, If Cornell can develop and implement this technology on / around campus it could have a major impact on future energy options in the North East more generally.

Enhanced Geothermal solutions like ESH are not without their critics, primarily due to the operational similarity between ESH and fracking in that both involve digging wells, inserting fluid to open fissures, and returning that fluid to the surface (although clearly ESH is focused on 'drilling' for heat rather than for fossil fuels), and there is some community concern despite the goal of the initiative (carbon-free heating) being diametrically opposed to the goals of 'fracking' (Cornell, 2017).

New York University: Electrification, Simultaneous Heating & Cooling

95% of the NYU's GHG emissions come from their buildings (they are an urban campus with one of the smallest sf / per student ratios in the country). 2/3rds of the 40% reductions achieved to date came from conservation & efficiency initiatives across campus buildings. These included lighting retrofits, HVAC improvements, etc. but also sheer efficiency initiatives through lobbying

with the various colleges to accept scheduling changes to their buildings. For example, libraries were often set to heat / cool 24 hours per day and by persuading the administrations to turn-off the systems between (say) 1-5am, they were able to make meaningful savings.

The remaining 1/3rd came from the transition from oil to gas with a cogeneration plant in 2009 that was far more efficient than their previous separate heating and energy generation (see Cornell above).

The future for NYU is to move to all-electric systems with the use of heat pumps and using Power Purchase Agreements to source all their power as renewable power. They will continue with reduction initiatives (60% of their buildings are over 60 years old and there is a great deal of opportunity for efficiency improvements through retrofits, etc.), and indeed are still implementing some new gas-based projects, however, they are designing them to be 'heat-pump ready' and 'electrification-ready' so that they can be straightforwardly upgraded in the future.

Even in their northerly climate, they expect to find large overlaps between heat / cool cycles within buildings (for example when a server room needs to be cooled whilst the remainder of the building is being heated) and have just initiated a project to investigate this opportunity. They are particularly focused on the inefficiencies in dehumidification, whereby humid air is being cooled solely to reduce the humidity but then must be re-heated before it can be re-circulated, when all they really want to do is circulate less humid air.

NYU cited Stanford as having done a great deal of work on this simultaneous heating and cooling opportunity (ENR, 2016). Stanford cut campus energy use by 50% and dropped their GHG emissions by 68% through the implementation of a 125,614-sq-ft Central Energy Facility ('CEF'), located on the west side of the campus. This facility includes three heat-recovery chillers that literally chill the campus's chilled-water loop system and use the heat generated as a side effect of that process to heat the same 155 campus buildings via a hot-water loop system.

4. Personal Leadership - How These Reduction Initiatives Were Led and Managed

The development of my Capstone project included interviews with the internal sustainability teams for 3 of these 5 organizations (Cornell (x2), Middlebury and NYU) plus a specialist 'Higher Ed' sustainability consultancy that advises such institutions on their climate action plans (<https://www.foveaservices.com/>). During those interviews several leadership themes emerged that appear to offer 'best practice' and fertile ground for addressing environmental challenges generally.

I have categorized and summarized these themes below:

Organizational Design: The importance of harnessing organizational design in effectively enabling environmental change was one of the first themes to emerge. The intellectual construct here is that where an individual 'sits' within the organizational hierarchy of a large bureaucracy (such as a Higher Ed institution) has a direct correlation with the degree of impact that individual can have.

For example, at Cornell the sustainability group sits within the broader energy sourcing & management team inside the influential 'Facilities & Campus Services' organization. This organizational design allows that team to be viewed as 'insiders' when it comes to energy and engineering initiatives. Robert ('Bert') Bland is Associate Vice President for Energy at Cornell, and under their organizational design the Sustainability team reports in to him: therefore, the same individual is responsible for sourcing both renewable and non-renewable energy to meet the organization's needs and must source accordingly. This has allowed Bland to take advantage of this position to prioritize the importance of decarbonization and sustainability. This would likely not have been possible without him being an Associate Vice President overseeing all the campus's energy needs. In a way, he has been able to use his position to drive an agenda that he believes is in the best interests of the University but is also one that is deeply interesting and important to him.

Similarly, Jack Byrne, Director of Sustainability Integration at Middlebury College, is clearly very well integrated at that institution – with long and strong relationships with students, faculty, administration and Trustees. This fact, together with his intimate knowledge of how to secure decisions through complicated approval processes across multiple levels of organization, provided him with an almost unique ability to navigate both between the different constituents and across approval processes and was a cornerstone of his leadership and effectiveness.

Credibility / Influence: To effect change within a large bureaucracy, a leader must be able to find ways to establish credibility and then use that credibility to influence that organization to take steps toward the direction and goals envisaged. A clear example was Cecil Scheib, AVP for Sustainability at NYU who during our interview volunteered that a successful early project, which had both reduced emissions and saved money very early on in their sustainability initiative, gave him great credibility within the organization. He was subsequently able to ‘trade’ off that credibility and use it as ‘currency’ to achieve change. It allowed him to secure resources and show leadership in setting solutions to the complex problems that all such large organizations face.

Similarly, Bland at Cornell is a recognized leader on energy micro-grids, and I observed that, as an engineer, his leading development of technical skills and subject-matter depth enabled him to both demonstrate leading insight, which established his influence, and to secure a leadership position. This allows him to both secure the confidence of his peers, and to drive forward and set a responsible and enlightened agenda.

Opportunism: In a somewhat inverse way, other interviewees expressed the importance of opportunism and being able to react to events not necessarily under their control. For example, McKenna, a Principal at Fovea Services, shared that originally Fovea was a more traditional engineering firm that consulted to a wide variety of Institutions across various sectors to provide advice and support on energy-sourcing issues. Fovea became involved in a project back in the late 90’s with four Californian universities as clients that ‘morphed’ to a focus on energy sustainability. During that project, he identified this direction as a major growth area where Higher Ed institutions needed outside expertise and Fovea Services was born.

As another example, in discussing their Bread Loaf Campus carbon offset initiative (whereby they agreed to a 40-year restrictive forest management plan to generate RECs), Byrne at Middlebury mentioned that this initiative arose out of a conservation easement for Bread Loaf that was put in place by their Trustees to recognize the contributions of their departing President, and funded by an alumni who had hunted and recreated there and was willing to fund the impact of the easement. He opportunistically realized that by conserving such a forest in perpetuity, it presented the opportunity for Middlebury to benefit from a carbon offset scheme which would enable the College to meet its aggressive neutrality ambition.

Collaboration: Zemanick, Director of the Campus Sustainability Office at Cornell, stressed the collaborative nature of sustainability initiatives within Cornell, and the need to work inclusively due to the very well-informed and active local stakeholders within and without that institution.

Organizationally, Cornell has a tradition of relative autonomy within the different Colleges and Departments and is physically located in a City and County (Ithaca in Tompkins County, Upstate New York) with a long tradition of ‘back-to-the-land’, a longstanding ecovillage and other sustainability initiatives (Turner, 1969). Any requests for zoning approvals, permitting, etc. tend to gather a great deal of public awareness and interest. Accordingly, any major projects involve careful outreach and inclusion initiatives; including those targeting specialist faculty, engaged local citizens and increasingly environmentally-aware students.

Communication: A clear takeaway from the interviews was that effective communication of *why* sustainability was important, and *how* the institution was organizing their efforts was highly correlated with the success of that initiative. For example, Scheib emphasized their use of the Carbon Management Hierarchy at NYU as both an organizing, prioritizing and communication tool (see first section of this report). At Cornell, Zemanick frequently referred to their ‘Quadruple Bottom Line’ approach (‘Purpose, People, Prosperity, and Planet’) as being integral to how they approach their work and relied upon to communicate their activities and evidence their decision-making across the larger organization.

Continuous Improvement: Often referred to as ‘Kaizen’ after the Japanese word for ‘improvement’, a continuous focus on iteration and improvement came across during several interviews. A particularly strong example was in the interview with Middlebury, where we discussed at length about how the team there had learnt to run their combined heat and power plant more efficiently each year. Not only that, but they were focusing on a further step-change in improvement by converting it to ‘renewable’ natural gas (landfill gas) and setting-off on a further episode of iteration and improvement (despite being the one institution that had achieved net neutrality). A clear message communicated was that the status quo was not an environment of stasis but for them one of evolution and constant change. This came across as a vital leadership attribute and one identifiable in all the interviewees to a greater or lesser degree.

4. Conclusion & Discussion

Concerns over campus sustainability at Higher Ed institutions has been a priority since at least 2001, with increasing concern over GHG emissions leading to the formation of what is now the Carbon Commitment initiative and the adoption of discrete, concrete reduction goals by many institutions in 2006.

In the US those institutions generally measure their emissions using the GHGP protocol and report and monitor their progress against targets through the Second Nature reporting platform. Initial progress has generally been strong. Institutions in the group selected have reduced their gross emissions by between 15.3% and 60.4% in the first 10 years, with an average reduction of 35.0%.

This progress has primarily been achieved through the switch to Combined Heat and Power plants utilizing natural gas. However, such improvements have generally been incremental and future progress will likely require more meaningful change through identifying initiatives that can secure major efficiency and de-carbonization objectives. Further, institutions will have to find ways to address or mitigate their Scope 3 emissions, over which they have less control.

Several institutions have also demonstrated leadership in decarbonization through innovative initiatives and a 'whole-organization' focus on the goal. These initiatives range from forest carbon offset programs through to investments in revolutionary heating and cooling systems, as well as the basic 'blocking-and-tackling' of efficiency improvements and improving building usage patterns.

Such initiatives are challenging, expensive and uncertain, and securing the necessary support within and across these institutions has required admirable individual leadership. Demonstrated behaviors in securing such progress have included a focus on harnessing organizational design, establishing credibility through technical prowess, and adopting highly effective communication practices.

These observations about leadership are likely highly universal, and present examples of best practice that should apply in many different environmental contexts. Given the extent of the environmental challenges facing both Higher Ed institutions and the Earth more broadly, they will be in strong demand for the foreseeable future.

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