



environmental sustainability

R E P O R T

AUTHOR

Thomas Benson, Political Science & International Relations, Chair of the Graduate Student Government (GSG) Sustainability Committee

CONTRIBUTORS

Contributors are titled in accordance with their contributions during the 2020-2021 Academic Year:

- **Prasanna Krishnamoorthy**, Mechanical Engineering, Student Affairs Senator in the Student Government Association Legislative Branch
- **Maryam Golbazi**, Ocean Engineering, GSG Sustainability Committee Member
- **Samantha Bingaman**, Marine Policy, GSG President (2020-2021)
- **Hannah-Marie Garcia**, Marine Policy, GSG Sustainability Committee Member
- **Jess Belliveau**, Chemical and Biomolecular Engineering, GSG Sustainability Committee Member
- **Maxwell Hope**, Linguistics & Cognitive Science, GSG Mental Health Committee co-Chair and Senator
- **Hannah Redmond**, Entomology and Wildlife Ecology, GSG Sustainability Committee Member
- **Hannah Leposa**, Music, GSG Sustainability Committee Senator
- **Bryant Cordova**, Physical Therapy, GSG Sustainability Committee Member
- **Deborah Drain**, GSG Sustainability Committee Senator
- **Nicholas Butler**, Geography and Spatial Sciences, GSG Sustainability Committee Member
- **Shashank Ravichandran**, Mathematics, GSG Sustainability Committee Member
- **Kelly Tyukody**, Physical Therapy, GSG Sustainability Committee Member
- **Kristie Arlotta**, Environmental Science with Public Policy Minor, Sustainability Senator in the Student Government Association
- **Bradie Crandall**, Chemical Engineering, GSG Sustainability Committee Member

PUBLISHER

University of Delaware Graduate Student Government

ENDORSEMENTS

- University of Delaware Graduate Student Government Sustainability Committee
- Former University of Delaware Graduate Student Government President, Samantha Bingaman
- University of Delaware Graduate Student Government President, William Repetto
- University of Delaware Sustainability Council
- University of Delaware Antiracism Initiative: Indigenous Programming Subcommittee
- University of Delaware Sustainability Council co-Chairs, Dr. Chris Williams and Dr. McKay Jenkins

CONTACT

Thomas Benson (Chair of the GSG Sustainability Committee): tsbenson@udel.edu

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FOREWORD



Established in 1742, chartered by Delaware in 1833, and officially titled the University of Delaware (hereafter “UD”) in 1921, UD has a long history. Part of this history includes efforts by UD to tackle the adverse effects of climate change and ecological degradation at varying scales – local, state-wide, and globally – through the work of its staff, faculty, and students.

Whilst efforts to date have been laudable, it is evident that many challenges lie ahead, especially in light of the unprecedented COVID-19 crisis that began in Spring 2020 and continues – at the time of publication (Fall 2021) – to impinge upon UD’s finances, faculty research, staff operations, and student activities. Nonetheless, climate change and ecological degradation continue unabated as issues that will affect UD for the foreseeable future and these effects need to be prevented and mitigated. Thus, the aim of this Sustainability Report is to enlighten readers as to the main ecological issues affecting UD and what UD can do to improve its ecological impact.

Previously, UD published its first Climate Action Plan in 2009, which was organized around four categories for action: “Green Infrastructure, Green Power, Sustainable Transport and Green Community Action” (UD 2009, 4). In 2008, UD also committed itself to achieving carbon-neutrality by 2050 and this was formally reinforced by then-UD President Harker, who signed the *American College and University Presidents Climate Commitment* (UD 2009, 1). To achieve this goal and diminish UD’s negative ecological impact, UD must devote itself to stronger, positive action. Like the initial Climate Action Plan, this Sustainability Report is a “living document with an expectation that changes will be made as new opportunities and technologies arise” (UD 2009, 1).

University of Delaware
Newark, Delaware
Established in 1743

“

Humans remain dependent on Earth’s biological and geochemical systems. By disrupting these systems—cutting down tropical rainforests, altering the composition of the atmosphere, acidifying the oceans—we’re putting our own survival in danger.

Elizabeth Kolbert

In November 2019, Newark published its sustainability plan – *Sustainable Newark: The City of Newark’s Plan for Sustainability* (City of Newark 2019). In August 2020, Delaware Department of Natural Resources and Environmental Control published its climate action plan – *Delaware Climate Action Plan Supporting Technical Greenhouse Gas Mitigation Analysis* (DNREC 2020a). Finally, in Fall 2020, UD’s Sustainability Council produced an annual report – *Annual Report FY 2020*. These collective efforts illustrate the appropriateness and timeliness of this Sustainability Report. This is further underscored by the fact that UD published its Climate Action Report in 2009.

As this report has been created primarily by students, it is in line with UD’s *Mission Statement* which highlights how “UD graduates are prepared to contribute to a global and diverse society that requires leaders with creativity, integrity and a dedication to service” (UDa). This report also reflects that UD is an “institution engaged in addressing the *critical needs* of the state, nation, and global community” and “promotes an environment in which all people are inspired to learn” (UDa; emphasis added). As of Summer 2021, UD has a total enrolment of 23,613 (UDb). More specifically, there are 18,618 undergraduate students, 4,285 graduate students, and 710 professional and continuing studies students (UDb). These students, as well as staff, faculty, guests, local residents, and ecological entities all stand to gain from a strengthened commitment to tackling climate change and ecological degradation.

The student group that embarked on the establishment of this report was the Graduate Student Government (GSG) Sustainability Committee. Efforts began in October 2020 and were concluded in Fall 2021, with monthly meetings to develop the report, alongside other tasks (e.g. creating legislation). The committee has been described as actively creating “sustainability-related (environmental, economic, social) initiatives at UD, and fosters a strong network between internal and external stakeholders to enhance sustainability efforts” (UDc). This report is a reflection of student dedication to UD and the natural environment.

Finally, in line with the Association for the Advancement of Sustainability in Higher Education’s (“AASHE”) definition of sustainability – found within its *Sustainability Tracking, Assessment & Rating System* (“STARS”) – sustainability in this report can be understood in a “pluralistic and inclusive way, encompassing human and ecological health, social justice, secure livelihoods, and a better world for all generations. Major sustainability challenges include (but are not limited to) climate change, global poverty and inequality, natural resource depletion, and environmental degradation” (AASHE STARS 2019, 34).





EXECUTIVE SUMMARY

Climate change is undeniably a central issue for everyone – individuals, universities, businesses, and governments to name a few. Navigating the effects of climate through mitigation and adaptation strategies has also been challenging, and we are currently riding a sea of change. As academics, we can utilize our creative and innovative mindsets to set sail for sunnier skies, rather than sit through the storm and hope for the best, in spite of acknowledging irrefutable, well-established climate science. Now is the time for action, and UD can be at the forefront of positive, proactive institutional change across the United States.

This Sustainability Report sheds light on new opportunities for positive intervention by UD – opportunities that will allow us to sail to those sunnier skies, to a brighter future. By acting on these opportunities, UD will be able to present itself as a more sustainable academic institution that takes climate change and ecological degradation seriously. In doing so, it will: enhance its national and international standing; increase student, staff, and faculty satisfaction, well-being, and happiness; save money; recognize the intrinsic value of the natural environment and the non-human entities that inhabit these spaces; and elevate its status as a green university. This will likely also benefit UD in appealing to prospective students, staff, and faculty by emphasizing the remarkable sustainability efforts by UD in contrast to its comparator institutions.

The opportunities enclosed within this Sustainability Report can be found in the ‘mini-reports’. The mini-reports, having been written by UD students, highlight the student-led approach to this Sustainability Report. Nonetheless, the mini-reports and their select issues present a range of problems that affect everyone at UD, as well as local residents, and those further afield, including the natural environment itself. These mini-reports were designed to provide brief overviews of these problems – overviews that were accessible to laypeople – and highlight how UD compares to peer institutions and how UD can, in some instances, emulate the success of those institutions on select issues, but also go above and beyond to stand tall and set an example for others to follow. Recommendations, informed by academic and scientific literature and the success of peer institutions, are also made.

To implement, monitor, and evaluate these recommendations, collaboration is essential. Just as collaboration was crucial in creating this Report, collaboration is important in ensuring the success of these recommendations. This means bringing together key stakeholders to tackle a variety of issues – facilities and grounds, dining services, academic services, recreation, transportation, energy, waste, Newark City Council and, where appropriate, the Delaware State Government. It also means utilizing the resources that are readily



available to UD by AASHE, the American Planning Association, Second Nature, EcoDistricts, and the International Living Future Institute, among many others. It also means actively listening to one another, to share wisdom and expertise, but to listen to insights from those from different circles, such as non-academics, and students. This is why this Sustainability Report was designed to be student-led and to be collaborative, to allow students – undergraduate and graduate – to share their knowledge and understanding of sustainability-related issues. The editing of this Report was done by the Chair of the Sustainability Committee, Thomas Benson. Further, by the end of Spring 2022, the University of Delaware’s Sustainability Council hopes to publish *The Executive Sustainability Plan*, of which Thomas will contribute to given his new role in Summer 2021 as Graduate Representative of the Sustainability Council.

Given that UD is committed to building a more sustainable future for its faculty, staff, students, guests, and local residents, there is a single significant commitment that UD ought to make:

2030

Net Zero Emissions



INDIGENOUS HISTORY AND ENVIRONMENTAL JUSTICE

The ultimate goal of this Sustainability Report is to guide and encourage the University of Delaware to consider more sustainable practices not only for the community in Newark, Delaware but for future generations of a local, national, and global community. The need to mitigate the effects of climate change and challenge current ways of thinking with regard to natural resource usage, environmental values, and what it means to build a resilient and connected community is greater than ever before. The United Nations' Secretary-General, António Guterres, stated that “making peace with nature is the defining task of the 21st century” and a large part of that involves reconciling our wrongdoings inflicted on the natural environment by recognizing the human actions that have led to this key turning point (Guterres, A., 2020, December 2). As of April 2021, the world continues to suffer from the COVID-19 pandemic, riding the waves of social unrest sparked by decades of racial injustice in the U.S. UD's community is not alone in questioning how best to move forward, with an increasing number of social and environmental justice demands being made. These demands can no longer be ignored. Therefore, this Report would be incomplete without a brief acknowledgement of environmental justice issues and the history of the land that belonged to Native American Nations long before UD was established.

The myriad of actions that are needed to combat climate change includes incorporating more sustainable practices, creating innovative infrastructure designs, developing creative community outreach efforts, and much more. These tasks require an all-hands-on-deck approach that needs to be grounded in partnerships across disciplines and communities. However, if partnerships and collaborative initiatives are to be developed effectively, institutions need to address current power dynamics that may prevent certain communities from participating in the development of climate change mitigation and adaptation plans. To do so, institutions - including UD - must work to decolonize the participation process and understand that these topics take time to address (Appleton, N.S., 2019). Nonetheless, we can “start by learning more about the relationships institutions have with nearby communities near where we live and the people with whom we interact” (Appleton, N.S., 2019). Alternatively, we can begin this process by examining the history of the physical environment in which UD sits. Working to understand how land ownership, land transfers, and land-grabs have occurred throughout time is something that peer institutions across the U.S. are investigating (see “Other University Initiatives” List Below).

Presently, UD's Anti-racism Initiative (UDARI) Indigenous Programming Subcommittee is dedicated to investigating the University's land-grant history. The mission of the UDARI's Indigenous Programming Subcommittee is to “foster respect for Indigenous peoples and awareness of our responsibilities in the ongoing legacies of colonialism [by] educating ourselves, our students and the broader community to appreciate and learn from Indigenous peoples, cultures, and land, particularly our local history and culture [to] contribute to enriching the University's scholarly, pedagogical and ecologically- and socially-engaged

relationships with our state's, region's, and global Indigenous communities" (UDARI's Indigenous Programming Subcommittee, 2021, Mission Statement, part 1). The term "land-grant college" is used to identify higher education institutions that receive federal aid under the Morrill Acts of 1862 and 1890 (Merriam-Webster Dictionary, 2021). "Today, there are 112 "land-grant" colleges and universities," including UD (Lee 2020). The Morrill Acts were issued with a simple idea: "aid economic development by broadening access to higher education for the nation's farmhands and industrial classes" (Lee & Ahtone 2020). These pieces of legislation worked to ensure equal access to education, but they also required that land be available to grant. Therefore, the Morrill Act of 1862 created opportunities for land from states and territories to be granted to existing and potential future agricultural and mechanical colleges (Lee 2020). By granting land, the institutions could profit from either the use or sale of those lands and "by the early 20th century, 52 of [the 112 "land-grant" colleges and universities] became beneficiaries of land distribution through the Morrill Acts (Lee 2020). However, the theory of the Morrill Acts is grounded in concepts of colonization, manifest destiny, and the myth that the land in the United States was unoccupied and up for the taking. These factors beg the question of who and what benefited from the Morrill Acts. For example, "there would be no higher education as we know it in the United States without the original and ongoing colonization of Indigenous peoples and lands just like there would be no United States" (Lee & Ahtone 2020).

Over the past three years, High Country News¹ investigated questions related to land-grant universities in the U.S. in order to piece together how the Morrill Acts of 1862 and 1890 resulted in "approximately 10.7 million acres [being] taken from nearly 250 tribes, bands and communities through over 160 violence-backed land cessions, a legal term for the giving up of territory" (Lee & Ahtone 2020). The landscape we see today was taken from Native American Nations and by understanding that complex history more deeply we can start to see the everyday "churches, schools, bars, baseball diamonds, parking lots, hiking trails, billboards, restaurants, vineyards, cabarets, hayfields, gas stations, airports and residential neighborhoods" from a different worldview (Lee et al. 2020). In order to begin to reconcile with historic land-grab, institutions across the nation are looking into ways to address this issue.

Ohio State University, for example, is in the process of formulating a "demonstration/ research project at the Newark Earthworks Center regarding indigenous farming practices, with attention to how traditional practices may improve food sovereignty in Native American communities today, and the incorporation of indigenous agricultural wisdom and practices into a new Sustainable Agriculture major and modern agricultural practices more broadly" (Gavazzi & Snyder). Ohio State's actions highlight the importance of incorporating diverse knowledge systems and building capacity within Native American communities and their efforts go beyond simply stating that they acknowledge their history. The University of Minnesota has developed a policy brief that assesses the possibility of providing Native American students with more scholarships and free tuition in a way that empowers the next generation of Native American leaders to graduate debt-free on their traditional homelands (Red Shirt-Shaw 2020). By examining ways to move beyond land-acknowledgement statements - which is also a practice UD should consider - the process of reconciling the history of UD's land-grabs will take time, but UD must consider some concrete actions to take so that any statements of recognition do not ring hollow.

There are a variety of ways UD can begin to take steps to trace its land-grant history, but the first action would also be to engage and communicate with the Native American communities in the surrounding area because this process needs to be collaborative and work to strengthen existing relationships. This can help to ensure that each group understands the needs and aspirations of the other. UD's Anti-racism Initiative (UDARI) Indigenous Programming Subcommittee will continue to investigate UD's land-grant history, and focus efforts on incorporating more local history and culture about the University's scholarly, pedagogical, and ecologically- and socially-engaged relationships with our state's, region's, and global Indigenous

communities. This Report outlines a series of recommendations for the University to implement and improve its environmental stewardship practices. However, many cultural, social, and environmental issues are intertwined, and UD must redefine its relationship with land, the natural environment, non-human species, and the many diverse communities that recognize these spaces as traditional homelands from time immemorial.

Additional Sources of Information can be provided by the UDARI Indigenous Programming Subcommittee.

Other University Initiatives (hyperlinked):

- [Stepping Out & Stepping Up: Toward Truth & Reconciliation with Dispossessed Native American Tribes](#), *The Ohio State University*;
- [Cornell University and Indigenous Dispossession Project](#), *American Indian and Indigenous Studies Program, Cornell University*;
- [Beyond the Land Acknowledgement: College “LAND BACK” or Free Tuition for Native Students](#), *Hack the Gates*;
- [Conference: The University of California Land Grab](#), *Centers for Educational Justice & Community Engagement, UC Berkeley and Others*;
- [LAUC Endorsement of the Black Caucus of the ALA Statement](#), *Librarians Association of the University of California (LAUC)*; and
- [Student Body Resolution Requesting that the University of Florida Assemble a Working Group](#), *University of Florida*

Bibliography

Appleton, N.S. 2019. “Do Not ‘Decolonize’...If You Are Not Decolonizing: Progressive Language and Planning Beyond a Hollow Academic Rebranding.” *Critical Ethnic Studies*
<http://www.criticaletnicstudiesjournal.org/blog/2019/1/21/do-not-decolonize-if-you-are-not-decolonizing-alternate-language-to-navigate-desires-for-progressive-academia-6y5sg> accessed 7 April 2021.

Gavazzi, S.M., and Snyder, B. “Stepping Out & Stepping Up: Toward Truth & Reconciliation with Dispossessed Native American Tribes.” *The Ohio State University* <https://discovery.osu.edu/stepping-out-stepping-toward-truth-reconciliation-dispossessed-native-american-tribes> accessed 7 April 2021.

Guterres, A. 2020. “The UN Secretary-General Speaks on the State of the Planet.” *United Nations*
<https://www.un.org/en/climatechange/un-secretary-general-speaks-state-planet> accessed 7 April 2021.

Lee, R.L. 2020. “How We Investigated the Land-grant University System.” *High Country News*
<https://www.hcn.org/articles/indigenous-affairs-education-how-we-investigated-the-land-grant-university-system> accessed 7 April 2021.

Lee, R.L., and Ahtone, T. 2020. “Land-grab Universities.” *High Country News*
<https://www.hcn.org/issues/52.4/indigenous-affairs-education-land-grab-universities> accessed 7 April 2021.

Lee, R., Ahtone, T., Pearce, M., Goodluck, K., McGhee, G., Leff, C., Lanpher K., and Salinas, T. 2020. “Land-grab Universities Overview.” *High Country News* <https://www.landgrabu.org/> accessed 7 April 2021.

Red-Shirt Shaw, M. 2020. “Beyond the Land Acknowledgement: College “LAND BACK” or Free Tuition for Native Students.” *ACCEPT & CSU RISE Center* https://hackthegates.org/wp-content/uploads/2020/08/Redshirt-Shaw_Landback_HTGreport.pdf accessed 8 April 2021.



PRESIDENT JOE BIDEN

With the inauguration of the 46th U.S. President, former UD student, Joe Biden, a newfound commitment to safeguarding the natural environment has emerged. Acknowledging that “there is no greater challenge facing our country and our world” than climate change, President Biden has committed to numerous courses of action, including: a “100% clean energy economy” and “net-zero emissions no later than 2050,” invest in smart infrastructure (buildings, water, transportation, energy), re-joining the Paris Agreement, integrate “climate change” across policymaking domains, take action against fossil fuel companies and other polluters “who put profit over people,” roll back tax incentives that “enrich corporations at the expense of American jobs and the environment,” protect biodiversity by conserving lands and waters, increasing “appliance- and building-efficiency standards,” and “decarbonizing the food and agriculture sector,” among many other plans (Biden Campaign 2021).

With such historic environmental action, UD ought to emulate the efforts by President Biden and his administration in safeguarding the natural environment by committing to similar actions and by committing to the recommendations outlined in this Sustainability Report.

“We have already waited too long to deal with this climate crisis, we can’t wait any longer ... We see it with our own eyes, we feel it in our bones.

It’s time to act.”

Joe Biden



GSG PRESIDENTS

Dear Reader,

Thank you for the time you have given to open this Sustainability Report and embrace its objectives, findings, and suggestions. As you will gather, the Report endeavors to illustrate the sustainability progress of UD since the publication of its Climate Action Plan over a decade ago. Much has been done, but much remains to satisfy the Plan's ambitious goals aimed towards substantial local and global environmental benefit.

This Report is the product of many volunteer hours of students, both graduate and undergraduate, who comprise the Graduate Student Government's 2020-2021 Sustainability Committee. I thank the Committee, led by Chair Thomas Benson, for their enterprise and stalwart devotion to sparking renewed emphasis on sustainability. Their teamwork has created a felicitous resource in a time of environmental need.

This same theme of togetherness spans these pages, and it is within them that I hope you will be inspired to take part in not only UD's sustainable future, but in that of the whole Earth, as well. While we may feel too small to tackle giant problems alone, community can make the most giant problem seem small.

With care,

Samantha Bingaman, Former President, Graduate Student Government (2020-2021)

William A. Repetto, Incumbent President, Graduate Student Government (2021-2022)

TIMELINE

2007 – UD Sustainability Taskforce created by the Academic & Students Affair Council.

2008 – UD commits to carbon-neutrality goal for 2050.

2008 – UD signs American College and University Presidents Climate Commitment.

Circa 2008 – Green Liaisons created.

2009 – UD creates its first Climate Action Plan.

2010 – Green Grants (originally UD Sustainability Fund) created.

2015 – Sustainability Manager position posted and filled.

2017 – UD Faculty Senate pass “A Resolution Concerning 100% Renewable and Carbon-Free Electricity to Power UD.”

2018 – UD GSG pass “A Resolution Concerning 100% Renewable and Carbon-Free Electricity to Power UD.”

2020 - Sustainability Council created.

2020 – Sustainability Manager position cut (COVID-19 cuts).

2021 – Establishment of First Annual Green Hen Awards.

2021 – I Heart UD Giving Day: Sustainability Committee Raise \$1,405 for Green Grants Sustainability Initiatives.

2021 – Publication of this Sustainability Report.

2030 – 45% Reduction in Carbon Dioxide Emissions from 2010 Levels (Proposed).

2030 – Net Zero Emissions Goal.



REPORT STRUCTURE

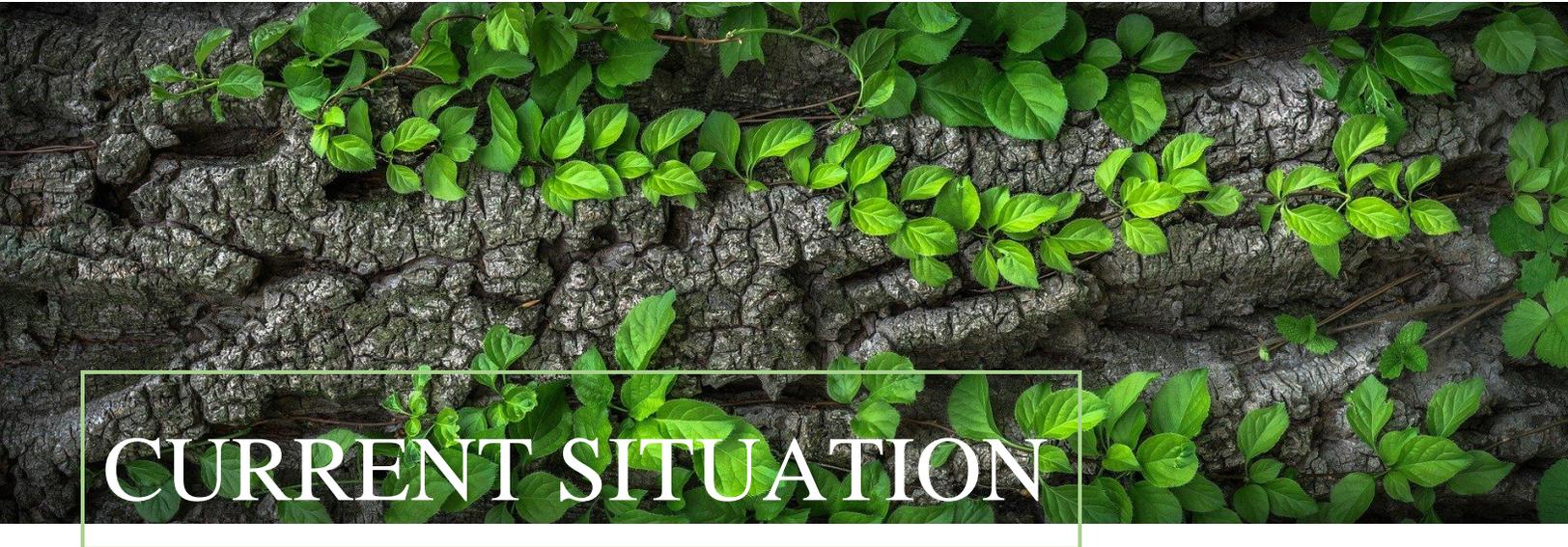
This report features a series of analytical mini-reports that, whilst complementing one another, stand independently of each other in their analyzes and recommendations. To tie-in these mini-reports that have been conducted over a period of one academic year (Oct 2020 – Jun 2021) by students – utilizing the same structure for each mini-report, where appropriate – an initial overall analysis of where UD currently stands (as of Summer 2021) is provided (including details on emissions and AASHE). At the end of this report, a summary is provided that further stresses the need for action by UD, as well as a compilation of the issues affecting UD and the solutions that could be adopted to remedy these issues.

Within each mini-report, where appropriate, the following questions are posed:

1. What is the sustainability-related issue?
2. How does this relate to UD?
3. What does scientific/academic data and literature highlight?
4. What are the possible solutions to the issue?

These subtitles are clearly structured to allow for ease of reading. Following each mini-report, the respective bibliography immediately follows for ease of access to source material. Citations in the *Foreword*, *Timeline*, *Current Situation*, and *Summary* are provided at the very end of the report. All images provided in this report were sourced from free image stocks, such as *pixabay* and *pexels*.

We – the authors – appreciate your time in reading this report as diligence, enthusiasm, and passion have been poured into this report over the period of a single academic year, thereby demonstrating the sacrifice that students have made in an effort to enhance the university they love – UD.



CURRENT SITUATION

Emissions In 2008, UD aspired to slash its greenhouse gas (GHG) emissions by 20% by 2020 (UDd). As of Summer 2021, GHG emissions have been reduced by 16.1% since 2008 (UDd). At the same time, the student body has increased by 26% since 2008, and there has been an increase of 17% in buildings square feet since 2008 (UDd).

Energy For UD’s Newark campus (excluding other campuses and facilities in Wilmington, Dover, Georgetown, and Lewes), between FY2007-2019, energy usage was the following: 72% buildings; 23% transportation (including community); 4% transmission line loss; and 1% waste and fertilizer (UDE).

Water For UD’s Newark campus, there are 970 acres which collect stormwater (UDf). Additionally, there are 22 miles of stormwater pipes, 4 creeks crossing campus, 32 outfalls (where “water is released to waterways”), 80 stormwater management areas (e.g. “ponds, bio-retention basins, bio-swales, green roofs”), and 1,000 catch basins “to corral and manage stormwater” (UDf).

Food In terms of food, UD commits to purchasing “local, seasonal and responsibly raised, grown and sourced products whenever possible” (UDg). UD also has an organic farm that is – as of Summer 2021 – currently being relocated to enhance production and allow for the implementation of the Four Seasons Garden (UDh). UD also has its own dairy farm and facilities, spanning 350 acres and consists of approximately 10 Holstein cows (UDi). About “130 acres is available for the production of corn silage and alfalfa haylage” which is subsequently fed to the cows (UDi).

Waste Recycling was initiated by UD students in the early 1990s (UDj). Unfortunately, limited data is available for recycling rates, with the “Single Stream Recycling Rate” for FY2017 being 25% (UDj).

Transportation Bicycle racks are provided at some parts of campus, though many students abandon their bicycles at the end of each semester (UDk). The shuttle buses provided freely to those who commute to campus are hydrogen-powered (UDk).

Green Spaces UD has the following: (1) Ecological Preserve (“existing virgin forest currently used for ecological research”) (UDl); and (2) Clark Garden Collections (“the first garden developed” at UD Botanic Gardens, and “consists of a lawn and a series of large specimen trees”) (UDn).

Green Spaces TBA Designs and proposals for green spaces that have yet to be established (as of Summer 2021, these remain in the conceptual stage of development) include:

(1) *South Campus Green*. This will replace the “parking lot to the East of Townsend Hall” with “[n]ative meadows and unique horticultural displays [that] will enclose the lawn and seat wall blocks” (UDm). It will also provide space for “study spaces or outdoor classrooms,” “offer shade,” “small outdoor concerts,” “Ag Day tents,” and “tailgating parties” (UDm);

(2) *Clark Garden Collections*. Clark Garden is to be improved by adding a path “around the central lawn,” a “water feature,” several “strategic view corridors,” numerous “large canopy trees,” and the “existing parking lot will be replaced with a stone plaza” (UDn). Further, the “Dunham Entry Garden” will be enhanced with “better defined paths that connect to public transportation and the proposed entry plaza” (UDn);

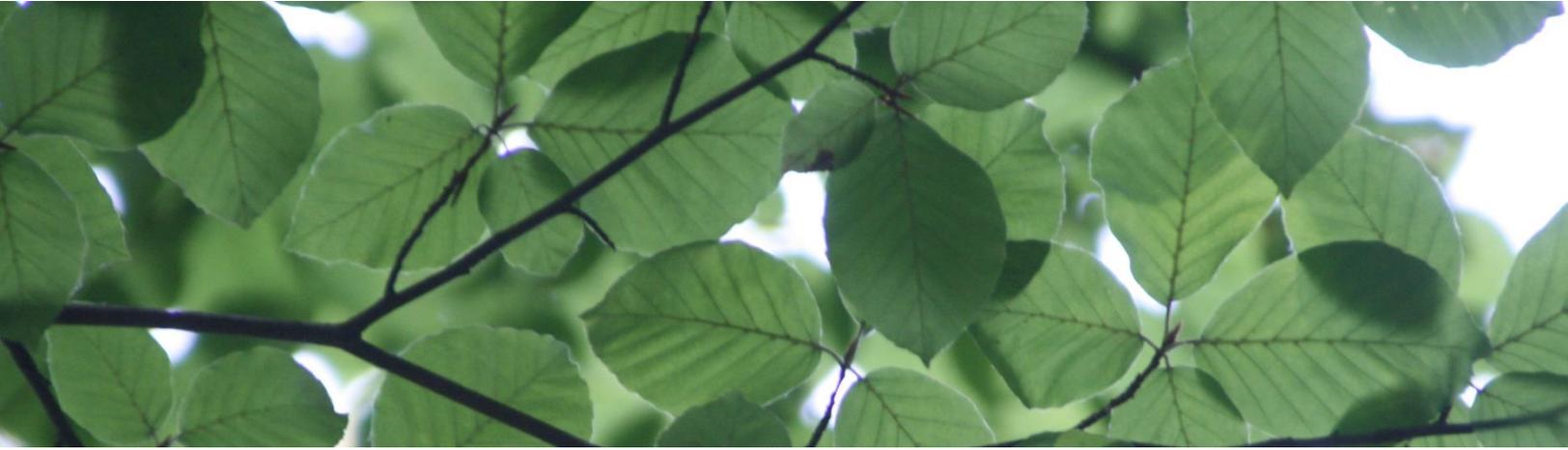
(3) *South Campus Green Gateway*. The proposal for the Green Gateway is in south Newark, where a “double row of canopy trees flanking generous pedestrian sidewalks” would be established, alongside a “low brick wall along the street” to “help to visually connect the South Campus” to the Newark campus” (UDo);

(4) *Wilson Homestead Garden*. This garden “aims to integrate the agricultural program of the [UD] Farm and increase outreach in the [UD] Botanic Gardens by leveraging the existing Historic Wilson House” (UDp). The space will feature “interpretative vegetable gardens, areas for animal husbandry displays, and a working apiary into the garden that will function to educate the public on agricultural systems, urban/suburban gardening, and university research” (UDp);

(5) *Arboretum and Pond*. The purpose of this project is to “create an organic, naturalized landscape that will promote habitat formation and increase biodiversity at UDBG [UD Botanic Gardens] by reintroducing the historic drainage patterns” (UDq). The space will serve as a “place for respite, learning, and contemplation,” and will incorporate a “native grass prairie with dispersed canopy trees,” “[m]own lawns,” “paths and boardwalks,” and “[b]ird blinds” (UDq);

(6) *Four Seasons Garden*. The garden will feature a “central, stone wall lined oval lawn surrounded by sweeping patterns of display gardens containing ornamental grasses, annual displays, and seasonal perennials” (UDr). Also, the central lawn will have the capacity to be used for “events such as Ag Day, farmers markets, sculptural displays, graduations, and tailgating events” (UDr); and





(7) *Creamery Lawn and Garden*. This space will “serve as the ‘Campus’ entry into UDBG” and will feature a “stone entry plaza surrounded by a seat wall” and, toward the South Campus Green, an “entry pavilion with way-finding and interpretative materials that will also house restrooms, the relocated Insectary, and the expanded UDBG Offices” (UDs). Between the Creamery and entry pavilion, there is a proposal for “interactive, sculptural elements for children to run around and climb” with “[c]overed decks” for “parents to watch their children play or for students to sit with an ice cream” (UDs).

Green Grants This program was established in 2010, originally as the UD Sustainability Fund, and was largely inactive since Summer 2018 but relaunched in February 2021 (UDt; UDY). The purpose of Green Grants is to “provide information and implement outreach efforts among students, faculty and staff to increase campus awareness and support for sustainability initiatives” (UDt). Importantly, Green Grants allows students (undergraduate and graduate) to apply for a grant (up to \$10,000) to “promote, educate or address issues of sustainability on the University of Delaware campus(es)” (UDt).

Green Liaisons Program The Green Liaisons Program is a group (operating since circa 2008) involves “students, faculty and staff is sustainability programming campus-wide,” and aims to “[r]aise awareness about sustainability-themed activities and behaviours,” and “[i]dentify and initiate environmental projects in academic and administrative units and within student groups across the University” (UDu).

Sustainability Taskforce This taskforce was created in Fall 2007 and was responsible for developing UD’s Climate Action Plan (2009) (UDv). It was also responsible for fostering “interdisciplinary networking,” raising “awareness” on existing sustainability practices, and building a “more sustainability community” (UDv). The taskforce joined the “Community Engagement Initiative in 2018” and this “culminated in the formation of the Sustainability Council in Spring 2020” (UDv).

Sustainability Council UD’s Sustainability Council was tasked with developing a new Sustainability Plan for UD. The Council consists of “24 members of faculty, students, staff, administration, and community members” (UDx). Due to COVID-19 financial cuts in October 2020, UD lost its Sustainability Manager, Michelle Bennett, who was the co-Chair of the Sustainability Council with Dr. Chris Williams. The Sustainability Council, as of February 2021, operates Green Grants. The meeting notes can be found here: <https://sites.udel.edu/sustainability/meetings/>

GSG Sustainability Committee Whilst a brief description of the GSG Sustainability Committee is provided earlier in this report, additional information is given here. The committee has a very active membership and is passionate about sustainability issues related to UD and beyond. Together, members bring forward their varied expertise from their respective departments to intellectually conjure potential sustainability projects to advance UD’s sustainability practices.

From Fall 2019 to Spring 2020, William Vincett and Elizabeth Davis were co-Chairs of the Committee and, alongside their members, successfully passed legislation in GSG relating to: Water Bottle Refill Stations, the Office of Sustainability, Native Plants, Hand Dryers, and Recycling Stickers. Meeting minutes and agendas are available for a total of seven meetings. Additional information relating to each piece of legislation is provided below in chronological order, from Fall 2019 onward.

- (1) (Report) *Proposal for Battery Collection and Recycling Program* (2016): This report called for the establishment of a program for battery recycling on UD campuses, allowing battery users to conveniently and quickly dispose of their batteries;
- (2) *Renewable Energy Projects* (2018): This legislation called for UD to achieve the attainment of 100% electricity (on-campus self-generation or associated renewable energy credits) by January 1, 2020, as well as the restoration of the Solar One house; and
- (3) *Elimination of Single-Use Plastics* (2019): This legislation recommended a UD audit of single-use plastics, the establishment of eco-friendly alternatives through collaboration with ARAMARK, and that plastic straws be made available only to those who need them; and
- (4) *Water Bottle Refill Stations* (2019): This legislation called for an increase in water bottle refill stations on UD campus(es) to reduce unnecessary plastic waste, and promote the use of reusable water bottles; and
- (5) *Office of Sustainability* (2019): This legislation demonstrated GSG's support for the establishment of an Office of Sustainability at UD; and
- (6) *Native Plants* (2020): This legislation called for all UD campuses to exclusively use native plants in all non-academic landscaping to save money, reduce water consumption, reduce fertilizer usage, and enhance biodiversity; and
- (7) *Hand Dryers* (2020): This legislation asserted that conventional hand dryers on UD campuses to be replaced by energy-efficient hand dryers to decrease electricity consumption, improve hygiene, and offer an improved alternative to paper towels; and
- (8) *Recycling Stickers* (2020): This legislation advocated for the placement of recycling infographics on all UD recycling receptacles in an effort to improve UD's AASHE STARS score and increase the rate of recycling.

In September 2020, the GSG Sustainability Committee elected a new Chair, Thomas Benson. Thomas has been an active member of the Sustainability Committee since Spring 2020. As of Summer 2021, the Sustainability Committee has had six meetings, and the meeting minutes and agendas are available for each

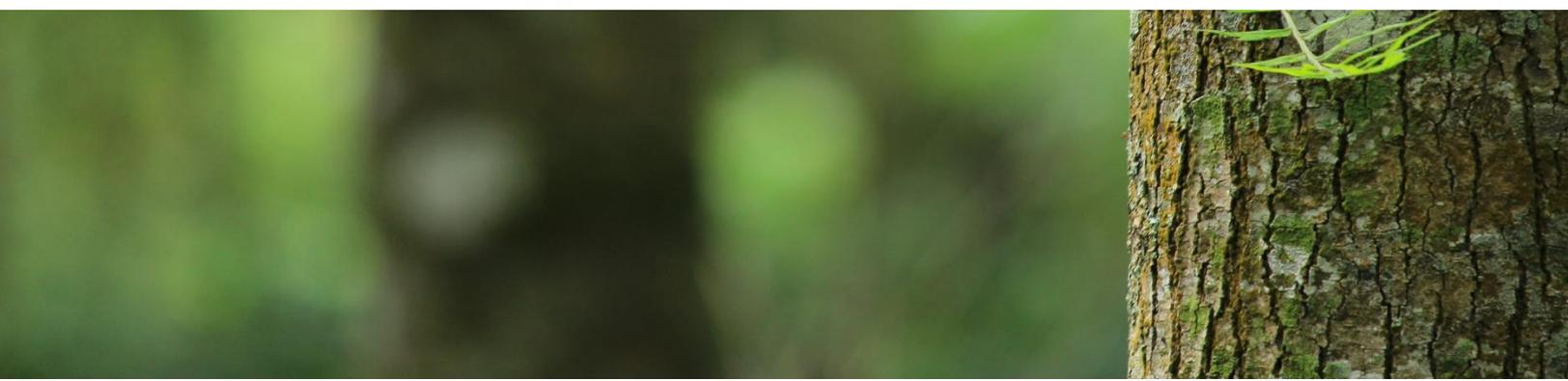


of these. Under his leadership, the Sustainability Committee committed to establishing this report, which was published in June 2020, following an intense nine-month period of research, writing, and networking.

This report primarily received input from graduate student members of the Sustainability Committee but also collaborated with: (i) undergraduate student members in Green Liaisons; (ii) undergraduate student members in the Student Government Association; (iii) the Sustainability Manager (until their departure in October 2020); (iv) the UD Graduate Fellow to the Sustainability Council (Cara Clase); (v) Newark City Council (including the Chair of the Planning Commission, Willard F. Hurd, AIA); and (vi) Delaware's Environmental Program Manager (Adam Schlachter).

Numerous additional efforts were also made, most of which are centred on mini-reports that are featured in this Sustainability Report. These include, in chronological order from October 2020:

- (1) **Legislation:** *Michelle Bennett* (October 2020): Following the loss of Michelle Bennett as the Sustainability Manager, the GSG Sustainability Committee operated in conjunction with the Sustainability Council and UD Faculty Senate to urge campus leadership to reinstate Michelle Bennett and reaffirm commitments to sustainability; and
- (2) **Legislation:** *Bikeshare Program* (March 2021): This legislation called for the establishment of a bikeshare program in Newark (DE) to create a bicycle-friendly university and city, as well as to improve human health and reduce greenhouse gas emissions by encouraging residents to swap motorized vehicles for bicycles. This legislation received support from Newark's Planning Commission Chair, Willard F. Hurd (AIA); and
- (3) **Legislation:** *Sustainable Lighting* (March 2021): This legislation called for UD to commit to employing sustainable lighting practices across its campuses to enhance energy efficiency, reduce electricity consumption, and save on electricity costs; and
- (4) **Legislation:** *Phasing-out 'Cides* (April 2021): In line with the previous *Native Plants* (2020) legislation, this legislation called for the phasing-out of all 'cides (pesticides, insecticides, fungicides, etc.) in current and future groundskeeping procedures, and called for UD to design groundskeeping procedures with biodiversity in mind; and
- (5) **Legislation:** *Amendment to Elimination of Single-use Plastics* (2019; April 2021): This amendment to the previous legislation on the *Elimination of Single-use Plastics* (2019) reiterated the call for eliminating single-use plastics, in addition to proposing eco-friendly alternatives, such as bio-plastics, compostable cutlery, and/or re-usable cutlery, as well as a possible 15-cent fee for single-use plastics to assist funding sustainability initiatives; and



(6) **Legislation:** *Red Meat and Processed Meat* (May 2021): This legislation adopted a multi-pronged approach to phasing-out red meat and processed meat from campus dining and catering services in an effort to reduce greenhouse gas emissions, improve human health, diversify food options on campus, and enhance animal welfare; and

(7) **Legislation:** *Building Temperature Control* (May 2021): This legislation called for the creation of a survey for faculty, staff, and students at the end of September 2021 and end of November 2021 to assess thermal comfort during the Fall semester, and at the end of January 2022 and of May 2022 to assess thermal comfort during the Spring semester.

(8) **Legislation:** *Building Retrofitting* (October 2021): This legislation will be brought to the GSG Senate Floor in October 2021 and call for the commitment to five broad building retrofitting and energy efficiency practices: (1) metering and monitoring; (2) energy load management; (3) appliance optimization; (4) building envelope upgrades; and (5) ventilation optimization.

Throughout Fall 2021 and Spring 2022, additional legislation will be written, including: (9) *Carbon Neutrality Support*; (10) *Tree-Planting*; (11) *Phasing-out UD Fleet & Electrification*; (12) *Sustainable Fashion in Campus Shops*; (13) *Fossil Fuel Divestment*; (14) *Food Waste Management*; (15) *Endorsement of UD Botanic Garden Masterplan*; (16) *Electric Vehicle Charging Stations*; (17) *E-Waste Management*; and (18) *Lab Waste Management*.

Anticipated mini-reports and their corresponding legislation (if appropriate) that have been considered, include: (19) Additional Botanic Gardens (Newark Campus); (20) Additional ‘Green Corridors’ Surrounding UD (Newark Campus); (21) Water Usage Reduction Program (leakages, old lines, once-through-cooling); (22) Compilation of External Sustainability Awards for Students; (23) Campus Sustainability Month (October, based on AASHE); (24) Restoration of the Solar One Building; (25) Local Park Clean-ups and Collaboration with Delaware Coastal Clean-up for clean-up trips; (26) Promotion of Sustainability-related Classes; (27) Support for Delaware’s Climate Action Plan; (28) Sustainability Budget for UD; (29) Green Funds Awards; and (30) Rainwater Harvesting.

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Additionally, in the 2020-2021 academic year, the GSG Sustainability Committee: (1) re-established an active connection with Green Liaisons; (2) compiled a list of external funding opportunities for sustainability projects; (3) led successful membership drives; (4) created a partnership with the GSG Mental Health Committee and co-authored a mini-report on the intersectionality of mental health and environmental sustainability; (5) established a connection with Willard F. Hurd (AIA) (October 2020), Chair of Newark City Council’s Planning Commission; (6) received insight from Merrill St. Leger (January 2021), Principal of Urban Designing and Planning at SmithGroup and Chair of American Planning Association’s Sustainable Communities Division; (7) engaged with Adam Schlachter (Delaware’s Environmental Program Manager) regarding the Plastic Bag Ban in Delaware (October 2020); (9) the GSG Mental Health Committee and GSG Sustainability Committee co-led a virtual film screening of the 2040 documentary in March 2021; and (10) collaboration with UDARI Indigenous Programming Subcommittee regarding UD’s history with regard to indigenous peoples and environmental justice.

AASHE AASHE is the “leading association for the advance of sustainability in higher education,” and was established in 2005 (AASHE, A). As of Summer 2021, AASHE is “comprised of over 900 members across 48 U.S. states, 1 U.S. Territory, 9 Canadian provinces and 20 countries” (AASHE, A). Their mission is to “inspire and catalyze higher education to lead the global sustainability transformation” and create a “foundation for a thriving, equitable and ecologically healthy world” (AASHE, B). STARS, as aforesaid, is a “transparent, self-reporting framework for colleges and universities to measure their sustainability performance” (AASHE, C). In chronological ascending order, the available ratings (with the number of institutions in parentheses, as of Summer 2021) are: Reporter (14); Bronze (47); Silver (141); Gold (133); and Platinum (9) (AASHE, C). In February 2018, UD was rated a ‘Reporter’ and in April 2020, UD achieved ‘Bronze’ status (AASHE, D).

AASHE provides a multitude of resources (see <https://hub.aashe.org/>) for numerous sustainability-related topics, including curriculum, research, campus engagement, public engagement, air and climate, buildings, energy, food and dining, grounds, purchasing, transportation, waste, water, coordination and planning, diversity and affordability, investment and finance, and well-being and work. Accessing these resources allows UD to examine the toolkits provided, STARS data, as well as to see what comparator institutions are doing in these specific areas.

Carbon Neutrality UD has committed to carbon neutrality goal of 2050. In a mini-report featured here, the GSG Sustainability Committee calls for UD to commit to a new goal of achieving net zero emissions by 2030. This new goal comes in light of the IPCC Working Group 1 Report in August 2021 that stressed the need for more drastic action as 2050 was too late (UN 2021).



AASHE STARS REPORT

Receiving a ‘Bronze’ award, UD scored 36.07 points (AASHE, E). This rating is valid until January 30th, 2023 (AASHE, E). Below, the scores for each category have been mimicked for easy viewing.

CATEGORY	SUB-CATEGORY	CREDIT SCORE
Academics	Curriculum	14.94 / 40.00
	Research	2.00 / 18.00
Engagement	Campus Engagement	9.01 / 21.00
	Public Engagement	10.46 / 20.00
Operations	Air & Climate	6.55 / 11.00
	Buildings	0.00 / 8.00
	Energy	4.18 / 10.00
	Food & Dining	2.00 / 8.00
	Grounds	0.00 / 4.00
	Purchasing	1.25 / 6.00
	Transportation	4.54 / 7.00
	Waste	3.37 / 10.00
	Water	2.82 / 6.00
	Planning & Administration	Coordination & Planning
Diversity & Affordability		5.37 / 10.00
Investment & Finance		0.00 / 7.00
Wellbeing & Work		1.00 / 7.00
Innovation & Leadership	Exemplary Practice	0.00 / 0.50
	Innovation	2.00 / 2.00

As illustrated by the table on the previous page, UD scored zero credits in three categories: buildings, investment and finance, and exemplary practice. For *Buildings*, UD reported it was not pursuing credits for two further sub-categories, *Buildings Operations and Maintenance* (five available credits) and *Building Design and Construction* (three available credits) (AASHE, E). For *Investment & Finance*, UD reported it was not pursuing credits for three further sub-categories, *Committee on Investor Responsibility* (two available credits), *Sustainable Investment* (four available credits), and *Investment Disclosure* (one available credit) (AASHE, E). Finally, for *Exemplary Practice*, UD's *Green Athletics* program did not meet the required criteria to receive the 0.50 available credit (AASHE, E).

Out of the total 15.5 credits mentioned above, UD needs to score an additional 8.93 credits to achieve a Silver rating. The rating boundaries are in the table below (AASHE, F).

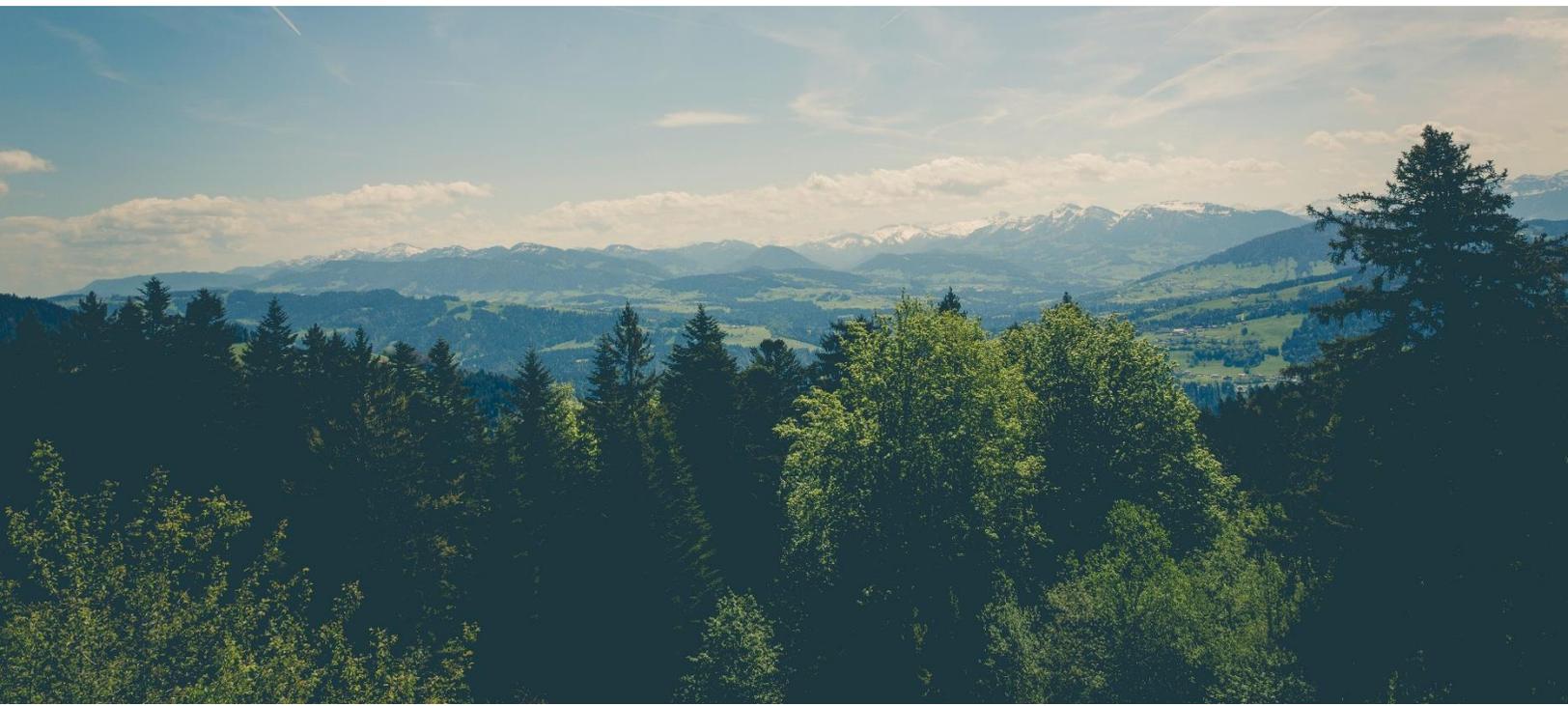
RECOGNITION LEVEL	MINIMUM OVERALL SCORE
Reporter	N/A
Bronze	25
Silver	45
Gold	65
Platinum	85

Furthermore, by enacting the recommendations provided in the mini-reports in this Sustainability Report, UD can undoubtedly achieve a rating of Gold, if not Platinum. Elevating UD's AASHE STARS rating will assist in raising UD's status and prestige, thereby attracting donations and further add to UD's allure in hiring faculty and staff, as well as in interest from prospective students.

More details on each category and sub-category are provided in a Credit Checklist:

<https://docs.google.com/spreadsheets/d/1bedIjvBrhuNAXoPxYXV02a0oOpG9QnG9oFkqu3EwqOE/edit#gid=0>.

Details on exemplary practice for all credits are provided here: <https://drive.google.com/file/d/0BzY7o-k46NLgVXdGVWRFQ0NuLUU/view>



In developing a clearer sense of how UD stands in comparison to comparator institutions, various university rankings (2020) are provided below.

RANKING INSTITUTION	GLOBAL / DOMESTIC	OVERALL SCORE
Wall Street Journal/Times Higher Education College Rankings (THE 2020a)	Domestic	148 / 600
World University Rankings (THE 2020b)	Global	251-300 / 1001+
QS World University Rankings (QS 2020a)	Domestic	111-120 / 300
QS World University Rankings (QS 2020b)	Global	491 / 1000
CWUR World University Rankings (CWUR 2020)	Global	247 / 2000
Washington Monthly (WM 2020)	Domestic	94 / 389

The authors of the report strongly recommend implementing the proposed recommendations in each mini-report to assist in enhancing the University of Delaware’s national and international status.



UD’s GHG emissions inventory (publications) dates back to 2009 and UD has provided annual (financial/academic year) data from 2011-2012 to 2018-2019. The links to the specific reports are provided below, with an analysis of the latest data provided thereafter.

2007-2008 Emissions (published 2009): <https://cpb-us-w2.wpmucdn.com/sites.udel.edu/dist/e/763/files/2017/02/University-of-Delaware-Greenhouse-Gas-Emission-Inventory-2009-2fuwsah.pdf>

2011-2012 Emissions (published 2013): <https://cpb-us-w2.wpmucdn.com/sites.udel.edu/dist/e/763/files/2017/02/UD-2011-2012-GHG-Inventory-Report-3-4-2013-1xqehag.pdf>

2012-2013 Emissions (published 2015): <https://cpb-us-w2.wpmucdn.com/sites.udel.edu/dist/e/763/files/2017/02/UD-2012-2013-GHG-Inventory-Report-6-5-2015-25s4f9s.pdf>

2013-2014 Emissions (published 2015): <https://cpb-us-w2.wpmucdn.com/sites.udel.edu/dist/e/763/files/2017/02/UD-2013-2014-GHG-Inventory-Report-6-5-2015-u1na36.pdf>

2014-2015 Emissions (published 2016): <https://cpb-us-w2.wpmucdn.com/sites.udel.edu/dist/e/763/files/2017/02/UD-2014-2015-GHG-Inventory-Report-FINAL-11-29-2016-stvusa.pdf>

2015-2016 Emissions (published 2016): <https://cpb-us-w2.wpmucdn.com/sites.udel.edu/dist/e/763/files/2017/02/UD-2015-2016-GHG-Inventory-Report-FINAL-11-29-2016-2mgg0oa.pdf>

2016-2017 Emissions (published 2018): <https://cpb-us-w2.wpmucdn.com/sites.udel.edu/dist/e/763/files/2018/04/UD-2016-2017-GHG-Inventory-Report-2ngtg4d.pdf>

2017-2018 Emissions (published 2019): https://cpb-us-w2.wpmucdn.com/sites.udel.edu/dist/e/763/files/2020/05/UD-2017-2018-GHG-Inventory-Report_FINAL.pdf

2018-2019 Emissions (published 2020): https://cpb-us-w2.wpmucdn.com/sites.udel.edu/dist/e/763/files/2015/10/UD-2018-2019-GHG-Inventory-Report_Final-V2.pdf

In the latest GHG Inventory Report (2020), an effort was made to create a “comparison to the 2007-2008 benchmark,” thereby allowing for “direct correlations between the two records while measuring the benefits of carbon mitigation actions taken during the intervening ten years” (UD & Siemens 2020, 2). Whilst there was a slight departure in the methodology from the 2007-2008 inventory, this change were considered in line with “current best practices” and did not “substantially impact the emission totals” (UD & Siemens 2020, 2). Additional details on the methodology are provided on pages two and three of the report.

This Inventory Report also provides a comparison of GHG emissions in 2007-2008 to 2018-2019. It highlights that UD’s “measured GHG emissions declined from 149,207 MT CO_{2e} during the 2007-2008 academic year to 125,078 Metric Tons of CO_{2e} during 2018-2019” (UD & Siemens 2020, 4). Thus, there was a “16.2% decline” in emissions (24,192 MT CO_{2e}) (UD & Siemens 2020, 4).

Comparing the latest findings against the Climate Action Plan, UD failed to meet 2013 (“a 5% reduction target from 2007-2008”), 2015 (10%), and 2020 (20%) reduction targets (UD & Siemens 2020, 6).



Furthermore, the Inventory Reports finds that UD’s “absolute emissions reduction was a result [of] electricity supply generation shifts from coal to natural gas and renewable resources due to state, regional, and national policy changes,” as well as changes in “community behaviours” (UD & Siemens 2020, 6). Additional data on emission sources are provided on pages 10 to 14, including energy and GHG emissions at satellite campuses.

MINI-REPORTS

Sustainability Spending and Definition

To reiterate, each mini-report is considered independent of one another, though some have explicit references to other mini-reports. Given the time constraints of those who have contributed to the Sustainability Report, this approach was considered optimal.

University of Delaware – Sustainability Spending and Definition

Definition

One of the co-Chairs for UD’s Sustainability Council, Dr. Chris Williams, tentatively proposed that UD – or, at the very least, the Sustainability Council – adopts the AASHE STARS definition of sustainability. AASHE defines:

“sustainability in a pluralistic and inclusive way, encompassing human and ecological health, social justice, secure livelihoods, and a better world for all generations. Major sustainability challenges include (but are not limited to) climate change, global poverty and inequality, natural resource depletion, and environmental degradation” (AASHE STARS 2019, 34).

For all intents and purposes, this definition has been adopted by the GSG Sustainability Committee as it adequately incorporates issues of environmental and ecological justice, albeit rather simplistically. Nonetheless, this broad definition is sufficient in encompassing these integral aspects of sustainability and contemporary issues facing both humans and the natural environment as a whole.

Sustainability Spending

Currently – as of Summer 2021 – UD commits none of its annual spending only to sustainability initiatives. Instead, Green Grants – the university’s fund for sustainability initiatives – assumes this role, separate from the budget. The mission of Green Grants is considered the following:

to “provide information and implement outreach efforts among students, faculty and staff to increase campus awareness and support for sustainability initiatives. Green Grants will attract, assess and implement high quality sustainability projects on the UD campus based on student interests, desires and academic or community service” (Green Grants).

In its vision, Green Grants:

“will facilitate an increased level of competence, engagement and a heightened sense of ownership over the University’s goals to reduce campus carbon emissions and create a culture of sustainability. By supporting sustainability projects, Green Grants will contribute to a culture that recognizes the complex interactions of people, planet, and profit” (Green Grants).

Qualifications for funding include the following for graduate students: (1) “Projects must promote, educate or address issues of sustainability on UD campus(es)”; (2) “Current University of Delaware students...may apply individually or in teams; partnerships with faculty and/or staff are strongly encouraged, and in some instances will be required to proceed with funding”; (3) “...projects would be completed by the end of Spring 2022. Multiple-year projects will be considered”; and (4) “Projects under \$5,000 are preferred, but innovative and exceptional projects above this amount will also be given consideration” (Green Grants).

According to UD’s Sustainability Council, the funding held within Green Grants derives from university alumni. In recent years, there have been two published projects that have been recipients of funding from Green Grants. In 2018, a \$7,000 native wildflower meadow was established (Green Grants). In 2011, a Colburn Green Roof was established and later received \$3,000 to assess its state and lay out a design for future maintenance upgrades and upkeep (Green Grants; UDaily 2011).

The current available funding in Green Grants (i.e. total sum of money) is not information that is available to anyone beyond the Sustainability Council. The Council successfully rebooted Green Grants in Spring 2021. Given the financial impact of COVID-19, however, the \$10,000 cap on proposed projects was reduced to \$5,000. The general advice is that successful projects include collaboration, especially with the Ground Department.

In addition to the native wildflower meadow and Colburn Green Roof, UD has illustrated its capacity for innovative sustainability projects elsewhere. Within the AASHE STARS report, UD received one credit (out of one available credit; IN-24 A) for the installation of its living wall at the STAR Tower (AASHE STARS A). The success of this project can serve as inspiration for further innovative sustainability projects on campus that can be rewarding in terms of AASHE STARS credits, but also in terms of enhancing campus aesthetic and mental and physical well-being of faculty, students (including prospective), staff, and guests.

Projects aside, UD can re-direct spending and spending-affiliated structures and plans to enhance its AASHE STARS rating from its existing Bronze status. For example, UD could achieve one credit (currently zero out of one available credit; OP-12) by purchasing “EPEAT-registered products for desktop and notebook/laptop computers, displays, thin clients, tablets/slates, televisions and imaging equipment” (AASHE STARS B). The university could also achieve one credit (currently zero out of one available credit; OP-13) by “purchas[ing] cleaning and janitorial paper products” that meet one of the listed sustainability criteria (AASHE STARS C). The same applies for the purchasing of “office paper with post-consumer recycled, agricultural residue, and/or Forest Stewardship Council (FSC) certified content” (currently zero out of one available credit, OP-14) (AASHE STARS D).

By enhancing collaborative efforts between students, staff, and faculty, including at the “highest governing body,” UD can further boost its credit score in terms of participatory governance (currently 0.5 out of three credits; PA-3) (AASHE STARS E). The university ought to continue to establish a framework for engaging external stakeholders (e.g. local government/educational organisations, private sector organisations, and civil society) in the university’s “governance, strategy and operations” regarding its

sustainability efforts (AASHE STARS E). Such collaboration could, for example, come in the form of a Newark Bike Share Program, an Anaerobic Digester, and/or an environmental sustainability information awareness campaign, among other things.

As part of UD's Climate Action Plan, several key areas ought to be addressed, such as: (1) curriculum; (2) research; (3) campus engagement; (4) public engagement; (5) air and climate; (6) buildings; (7) energy; (8) food and dining; (9) grounds; (10) purchasing; (11) transportation; (12) waste; (13) water; (14) diversity and affordability; (15) investment and finance; (16) wellbeing and work; and (17) others (e.g. arts, culture, and technology) (AASHE STARS F). These plans – enveloped within a broader Climate Action Plan or Sustainability Plan – must feature “measurable sustainability objectives” that include as many of the above listed key areas of interest as possible (AASHE STARS F). In doing so, UD can score higher than its current 0.5 credit (out of four available credits; PA-2) (AASHE STARS F). To this end, this report lays the foundation for many of these areas by accumulating research and proposing recommendations.

Furthermore, UD ought to establish a “committee on investor responsibility” that makes “recommendations to fund decision-makers on socially and environmentally responsible investment opportunities across asset classes” (thus, external investments) (AASHE STARS H). Including a mix of faculty, students, and staff on the committee would be ideal for diversity and representation, as well as conjuring ideas for the best steps forward in making progress for UD. Currently, UD has zero out of a total of two available credits for Investor Responsibility (AASHE STARS H).

In terms of Sustainable Investment, UD has zero out of a total of four available credits (AASHE STARS I). With endowments over \$1 million – as of 2019, standing at around \$1.64 billion (UDIO 2019, 11) – UD has two options to increase its score for this credit: (1) invest in sustainable industries (e.g. renewable energy or sustainable forestry), businesses with “exemplary sustainability performance,” sustainability investment funds (e.g. renewable energy or impact investment fund), community development financial institutions, or socially responsible mutual funds with positive screens; or (2) have a “publicly available sustainable investment policy,” engage in “proxy voting to promote sustainability” through its committee on investor responsibility, file or co-file “one or more shareholder resolutions that address sustainability,” have a “publicly available investment policy with negative screens,” use a “sustainable investment policy to select and guide investment managers,” and engage in “policy advocacy by participating in investor networks (e.g. Principles for Responsible Investment, Investor Network on Climate Risk, Interfaith Center on Corporate Responsibility)” (AASHE STARS I).

In conjunction with the above, UD can obtain one further credit (currently zero out of a total of one available credit; PA-10) by making a “snapshot of its investment holdings available to the public, including the amount invested in each fund and/or company and proxy voting records” (AASHE STARS J). Incremental points are available but, to obtain the full one credit, the university must make the “entire investment holdings publicly available” (AASHE STARS J). Such improved transparency can serve to depict UD leading among U.S. and international universities by engaging in good governance practices. These practices could bolster attention from prospective students and faculty, as well as enhance the university's donations and opportunities for collaboration in establishing a strong governance record.

To best coordinate these efforts, UD can obtain one credit (currently zero out of one available credit; PA-1) by establishing at least “one sustainability committee, office, and/or office tasked by the administration...to advise on and implement policies and programs related to sustainability on campus” and the “committee, office, and/or officer” must focus on “sustainability broadly...and cover the entire institution” (AASHE STARS G). This would, given the current Office of Sustainability, mean clarifying and

enhancing the Office of Sustainability's functions and responsibilities.

Recommendations

Moving forward, it would be beneficial for UD to establish a sustainability budget. Such a budget would dedicate a certain percentage of annual spending to sustainability initiatives, and projected increases in this budget could be provided. For example, it could be argued that UD ought to devote 1% of its annual spending on sustainability initiatives but, by 2025, this ought to increase to 5%. Moreover, UD ought to aim to achieve the maximum available credits outlined above by transitioning to environmentally sustainable products, improve investments, and create the appropriate committees for planning and climate action.

Bibliography

AASHE STARS. 2019. "STARS Technical Manual: Version 2.2." *AASHE STARS*

<https://stars.aashe.org/wp-content/uploads/2019/07/STARS-2.2-Technical-Manual.pdf> accessed 23 November 2020.

-- A. "University of Delaware, IN-24: Innovation A." *AASHE STARS*

<https://reports.aashe.org/institutions/university-of-delaware-de/report/2020-01-31/IN/innovation/IN-24/> accessed 24 November 2020.

-- B. "University of Delaware, OP-12: Electronics Purchasing." *AASHE STARS*

<https://reports.aashe.org/institutions/university-of-delaware-de/report/2020-01-31/OP/purchasing/OP-12/documentation/> accessed 24 November 2020.

-- C. "University of Delaware, OP-13: Cleaning and Janitorial Purchasing." *AASHE STARS*

<https://reports.aashe.org/institutions/university-of-delaware-de/report/2020-01-31/OP/purchasing/OP-13/> accessed 24 November 2020.

-- D. "University of Delaware, OP-14: Office Paper Purchasing." *AASHE STARS*

<https://reports.aashe.org/institutions/university-of-delaware-de/report/2020-01-31/OP/purchasing/OP-14/documentation/> accessed 24 November 2020.

-- E. "University of Delaware, PA-3: Participatory Governance." *AASHE STARS*

<https://reports.aashe.org/institutions/university-of-delaware-de/report/2020-01-31/PA/coordination-planning/PA-3/> accessed 24 November 2020.

-- F. "University of Delaware, PA-2: Sustainability Planning." *AASHE STARS*

<https://reports.aashe.org/institutions/university-of-delaware-de/report/2020-01-31/PA/coordination-planning/PA-2/> accessed 24 November 2020.

-- G. "University of Delaware, PA-1: Sustainability Coordination." *AASHE STARS*

<https://reports.aashe.org/institutions/university-of-delaware-de/report/2020-01-31/PA/coordination-planning/PA-1/documentation/> accessed 24 November 2020.

-- H. "University of Delaware, PA-8: Committee on Investor Responsibility." *AASHE STARS*

<https://reports.aashe.org/institutions/university-of-delaware-de/report/2020-01-31/PA/investment-finance/PA-8/documentation/> accessed 24 November 2020.

-- I. "University of Delaware, PA-9: Sustainable Investment." *AASHE STARS*

<https://reports.aashe.org/institutions/university-of-delaware-de/report/2020-01-31/PA/investment-finance/PA-9/documentation/> accessed 24 November 2020.

-- J. "University of Delaware, PA-10: Investment Disclosure." *AASHE STARS*
<https://reports.aashe.org/institutions/university-of-delaware-de/report/2020-01-31/PA/investment-finance/PA-10/documentation/> accessed 24 November 2020.

Green Grants. "The Green Grants Program." *University of Delaware*
<https://sites.udel.edu/sustainability/greengrants/> accessed 23 November 2020.

UDaily. 2011. "Roof Goes Green." *University of Delaware* <https://www1.udel.edu/udaily/2011/jun/colburn-green-roof-060611.html> accessed 23 November 2020.



MINI-REPORTS

Green Hen Awards

University of Delaware – Sustainability Awards for Faculty, Staff, and Students

Summary

As of April 2021, the Sustainability Council announced the first annual *Green Hen Awards*. This is an annual celebration of extraordinary sustainability efforts on and off-campus at UD, and is an opportunity to recognize outstanding research, curriculums, and projects that help the wider UD community move closer to a greener and more sustainable future.

Sustainability Awards

From well-known national and international awards, like the Pulitzer Award, Oscars, BAFTAs, Grammys, Nobel Prize, to lesser well-known awards, such as the James Dyson Award, and the Earthshot Award, many people like to see strong work ethic being rewarded with recognition. By creating sustainability awards for faculty, staff, and students, UD can demonstrate its recognition of important past or ongoing efforts, within its own institution, to safeguard the natural environment.

Beside rewarding individuals for their devotion to sustainability on campus, there are multiple other reasons why awards ought to be given. Frey and Gallus find in their research on awards that after award receipts, awardees are more likely to be productive (e.g. produce more "quality-weighted publications"), and more likely to be recognized (e.g. increased number of citations) (Frey & Gallus 2015). Summarizing much of the extant literature, Frey and Gallus also highlight that awards, such as a monetary sum, can significantly "increase performance" (Frey & Gallus 2015). From the increased academic performance and attention, it could be extrapolated that these developments could serve to bolster UD's reputation, nationally and internationally. Furthermore, outwardly, it demonstrates to comparator institutions that UD is taking the issue of climate change seriously and is recognizing those who sacrifice their time pursuing their own endeavors for the benefit of the collective.

In fact, comparator institutions are ahead of the curve. The Sierra Club's *Cool Schools 2020 Full Ranking* places UD 284th out of 312 universities and colleges in the U.S. (Sierra Club 2020). The

methodology for arriving to these conclusions is derived from collaborative efforts with AASHE (Sierra Club 2019). UD does not feature in Princeton's *Top 50 Green Colleges* for 2020 (Princeton Review). Within AASHE, UD received a Bronze rating – the second-lowest rating available out of a total of five ratings – in 2020 (AASHE 2020, 79). Thus, UD's recent establishment of the Green Hen Awards is a step in the right direction toward enhancing sustainability efforts and actions on campus, as well as boosting UD's prestige.

Comparisons between academic institutions in the U.S. in terms of eligibility criteria (“eligibility”), nomination process (“nomination”), award selection process (“selection”), and the award itself (“award”) are outlined in **TABLE 1** (see page 33). These comparisons provide insight into the operations of the Green Hen Awards. Texas A&M University has offered a *Sustainability Champion Award* since 2017 – one each for a member of staff, a member of faculty, an undergraduate student, and a graduate student (TAMU). To be eligible, undergraduates and graduates must have a minimum GPA of 2.5 and faculty and staff must have been employed for more than one year (TAMU). Nominees cannot have won the award within the previous two years, and they must demonstrate “excellence and commitment” to making the university “more environmentally, economically, and/or socially sustainable” by doing one of the following (or similar): “develop a sustainability project to improve campus; educate peers on sustainability issues; host a sustainability outreach event or initiative; incorporate sustainability into an organisation; conduct research on pressing sustainability issues; incorporate sustainability into curriculum and teaching; or work to make...[the university] more inclusive, diverse, and socially just” (TAMU).

Moreover, nominations (self-nominates acceptable) must be accompanied by a minimum of one and a maximum of three letter(s) of support (each a maximum of one-page at 11-point font size) (TAMU). These letters must outline the nominee's character, motivation, and accomplishments, as well as specific examples and a summary of their contributions to sustainability and how they have made an impact (TAMU). Immediate family and award selection committee members are excluded from writing letters of support (TAMU). Upon completing a document with relevant information (e.g. name, email, department, title, summary of sustainability project(s) and/or action(s), summary of benefits, and a summary of impact), these are submitted to the sustainability office by email (TAMU). An “anonymous committee of individuals with knowledge of sustainability efforts” make the selection of the awardees using a “specific scoring matrix” (no details provided) (TAMU). Finally, in receiving the award, awardee names are published on the website.

The University of Oregon (UO) launched its *Campus Sustainability Awards* in 2015 to “recognize individuals whose contributions deepen our culture of sustainability across a range of institutional activities,” and the process is managed by the campus sustainability manager (UOregon A). Each award is “sponsored and selected by a different unit or division on campus,” such as the Student Sustainability Centre, Office of the Vice President for Research and Innovation, and Division of Student Life, among others (UOregon A; UOregon B). Several awards are given each year in the following categories (sponsors in parentheses):

Student Leadership (Student Sustainability Centre): “Recognizes students who have made significant impacts towards human equity, environmental vitality, and economic well-being at the UO.”

Town and Gown (Government and Community Relations): “Recognizes individuals or groups for projects that promote, educate or enhance a more sustainable community.”

Excellence in Teaching (Office of the Provost's Teaching Engagement Program): “Recognizes faculty who have developed pedagogy and curriculum which reinforce and advance principles of sustainability through course design and instruction.”

Research (Office of the Vice President for Research and Innovation): *“Recognizes a University of Oregon researcher whose research has made significant contributions to human knowledge related to sustainability.”*

Innovation (Office of the Vice President for Research and Innovation): *“Recognizes a University of Oregon project whose innovations were developed in the course of UO research and are now offered as publicly available products or services that improve sustainability.”*

Sustainable Student Programming and Support (Division of Student Life): *“Recognizes an individual, team, or department unit for student-focused programs, projects, or initiatives related to sustainability.”*

Sustainable Campus (Office of the Vice President of Finance and Administration): *“Recognizes an employee or team for the introduction of a sustainability best practice into their department or unit’s day-to-day work or their service to campus.”*

Campus Design (Campus Planning, and Design and Construction): *“Recognizes units or individuals who have demonstrated leadership and creativity in support of the Oregon Model for Sustainable Development.”* (UOregon B).

An annual ceremony is held to “celebrate the winners” in the Spring semester, alongside publication of awardee names on the university website with a summary of their achievement (see above list) and a short video of their accomplishment(s) (as a summary or an interview) (UOregon A; UOregon B). It is unclear whether staff can be recipients of awards (although somewhat implied by some of the awards), but it is clear that faculty, undergraduate students, and graduate students can receive awards. There is one award in each category, with the exception of *Excellence in Teaching*, where two awards are available (UOregon B). Eligibility criteria are unclear, though it is implied from UO’s webpages that awards are based solely on sustainability efforts (merit) (UOregon B).

Harvard University’s *Green Carpet Awards* is a “biennial celebration of Sustainability Leaders,” which recognizes the “outstanding efforts of teams and individuals across Harvard to create a health, more sustainable campus” (Harvard). The award has been available since 2010, and the award ceremonies are held in Spring (Harvard). The eligibility, nomination, and selection criteria are unclear, but it is implied that awards are granted on the basis of merit alone (Harvard). Categories for the awards include:

Innovative/Creativity: *“Seeks out and utilizes new technology; develops and advances better processes to produce impactful change.”*

Replicable Models: *“A “first of its kind,” materials and resources from this project are made available to others across in order to create efficiencies, streamline processes, and grow sustainability projects on campus.”*

Collaboration/Engagement: *“Actively engages stakeholders within and beyond their School; engages fully in Harvard’s sustainability programming including: Green Office, Green Loan Fund, working groups, and events.”*

Energy/Greenhouse Gas Emissions Reduction: *“Creative opportunities that reduce energy and/or greenhouse gas emissions on campus and in buildings through construction, operations, engagement, technology, or new processes.”*

Waste Reduction: *“Exemplifies “reduce, reuse, recycle and compost” properties in an office, buildings, or construction settings.”*

Water Reduction: *“Explores creative opportunities to reduce water consumption on campus and in*

buildings through operations, engagement, or technology.”

Above and Beyond: *“Not only embraces sustainable practices such as the Green Building Standards, LEED, Green Office, temperature policy, etc, but continually strives to achieve more than is designated in these practices”* (Harvard).

Additionally, Yale University has annual sustainability awards for “students, faculty, [and] staff” for “outstanding service” and “impact on Yale’s environmental and social efforts” (Yale 2015). Awardees are “selected through a university-wide nomination process that considers the individuals’ contributions to enhancing sustainability at Yale,” but no further details are provided, nor about the award selection process (Yale 2015). It is also unclear when the awards began, but details are only provided for the year 2015 (Yale 2015). One award was given to a student after she “authored the school’s sustainability action plan, developed a portfolio of waste management programs, and conducted research on building-occupancy behaviour,” as well as having previously led Yale University Press “office’s green team” (Yale 2015). Another award was given to a member of faculty was the result of “internationally recognized efforts” for sustainability research (Yale 2015). Finally, a staff member received an award for leadership in several campus-related sustainability initiatives (Yale 2015).

Cornell University established the *Cornell University Partners in Sustainability Awards (CUPSA)* in 2010 and has provided awards annually to “recognize individuals and teams who have exemplified the sustainability values of Cornell, made significant and notable contributions to the sustainable development and social equity of the Cornell campus, or displayed outstanding partnership for advancing sustainability within our campus and community” (Cornell). Self-nominations are welcome for individuals and teams/groups, and students, staff, faculty, and community partners (a group or individual that works with Cornell University) can be nominated (Cornell). However, the Campus Sustainability Office is exempt from nominations (Cornell). In nominating someone or a team or oneself, contact information and information of the contributions/achievements must be provided, and can be provided anonymously (Cornell). Areas of recognition include:

Collaboration: *“The nominee has contributed to or improved the capacity of the Cornell campus community to work together, creating new connections and collaborations which spark and strengthen trust, community building, intersectional work, discovery, ideas, research, and real progress towards our climate and sustainability goals. Alternately, the nominee has helped to advance sustainability or climate goals shared by Cornell and the region, supporting solutions which benefit community members in our region and/or across New York State.”*

Education: *“The nominee has contributed to academic or co-curricular education for climate and sustainability topics through the creation or advancement of classes, campaigns, and educational experiences that make the Cornell campus a “living laboratory” for sustainability. Education may have focused on students, faculty, or staff. Nominees are helping to prepare the generation of scholars, entrepreneurs, artists, and leaders and empowering campus community members to make informed sustainable decisions at work and home.”*

Campus Progress: *“The nominee has helped advance the Cornell campus as a model of sustainable operations and experience, including specific advancements in buildings, land, water, energy, food, waste, purchasing, people, climate, or transportation. Nominee may have successfully reached a climate action plan goal, reduced campus emissions, or improved performance in a specific area (or advanced knowledge towards a specific goal). Note that research or projects which attempted progress but failed are still useful, as they teach us how to improve and accelerate performance for future work!”*

Passion: *“The nominee walks the talk - displaying passion, pride, and innovation in sustainability*

thinking and practice. Sustainability change takes time and energy which the nominee is steadfast in presenting to the Cornell community. The nominee takes initiative to put sustainability at the forefront of projects and pursuits, and empowers others in their work unit or the University to do the same.”

McGill University provides numerous awards at its Catalyst Awards Gala that recognizes achievements of three groups and three individuals “which have excelled in: Operations; Connectivity and Governance & Administration; and the Research and Education Categories of the McGill Vision 2020 Sustainability Strategy” (McGill A). Additional description highlights that awardees have made “meaningful and enduring contributions to the sustainability movement” at the university (McGill B). The range of awards include the following:

Emerald Key Award (individual): *“This award recognizes a student who has made significant and lasting contributions in furthering McGill’s culture of sustainability.”*

Distinguished Contribution Award (individual): *“This award recognizes a McGill administrative, support and/or academic staff who has made a profound and sustained contribution to advancing sustainability in the McGill community. It may be awarded to current or retired employees, or it can be awarded posthumously. The individual must also have contributed to the University for a minimum of 10 years.”*

Faculty & Staff Award (individual): *“This award recognizes a McGill administrative, support and/or academic staff who has inspired real change on McGill’s campuses, increasing the sustainability of the University.”*

Connectivity, Governance & Administration Award (group): *“This award recognizes initiatives that emphasise the need for strong connections, within both McGill and its broader communities, and/or address how the University is managed in terms of people, finance, decision-making and process implementation.”*

Operations Award (group): *“This award recognizes initiatives that work to improve the sustainability of the physical activities that support the ongoing functioning of the University.”*

Research & Education Award (group): *“This award recognizes an initiative that encompasses original research from the McGill community, and/or focuses on student, staff, faculty, and institutional learning”* (McGill B).

Like UO, McGill hosts an annual award ceremony, and also publishes awardee names on the university website, alongside a video (McGill A). However, McGill’s videos differ in that they are shorter in length (no more than two minutes, compared to UO’s 15-20-minute videos) and feature what *could* be the faculty or staff member that nominated the awardee (McGill A). These faculty/staff members outline the achievements of the awardee, their motivations, and their ambitions (McGill A).

In summation, most of the universities listed here offer sustainability awards on the basis of merit (excellence in sustainability efforts and/or actions) alone, with few placing restrictions on this (e.g. GPA minimum for students or minimum number of years of employment for staff and faculty). Most universities appear (implied if not otherwise clear) to offer awards to students (undergraduates and graduates), staff, and faculty, with some explicitly offering awards for individuals and teams/groups, and some extend this to feature community partners too. In terms of nominations, most universities allow self-nominations (implied if not otherwise clear), whilst others require sponsorship or letter(s) of support.

Further, selection processes are, for the most part, unclear, but those that are clear, are centred on sponsorship or an anonymous committee with sustainability knowledge. For the award itself, all universities

publish the award title and awardee name on their respective university website. Thereafter, there is variation, such as a physical award, an annual award ceremony, and a video (varying in length) summary of accomplishments or interview with the nominator/awardee. Most universities grant the awards in Spring, and the categories of sustainability-related awards have overlap between universities, such as: excellence in teaching, excellence in leadership and passion, excellence in collaboration and engagement (on-campus), excellence in research, excellence in innovation and creativity, excellence in campus progress (design, operations, emissions/waste/water reduction), excellence in community partnership/outreach (off-campus), and excellence in governance and administration.

Finally, due to spatial limitations, sustainability awards by other comparator institutions are listed in **TABLE 1**, without any detailed description or analysis here. These include: Weber State University (Weber); Emory University (Emory); North Carolina State University (NCSU); Penn State University (PSU); Southern Illinois University (SIU); and the University of North Carolina Wilmington (UNCW).

Recommendation(s)

Given the above, this mini-report endorses the establishment and implementation of the Green Hen Awards to annually celebrate outstanding research, curriculums, and projects that help the wider UD community move closer to a greener and more sustainable future.

These Awards are an opportunity, according to the Sustainability Council, to give back to the people who have donated their time and efforts to sustainability projects and initiatives. In turn, Green Hen Award recipients will receive a monetary award in addition to formal recognition on the Sustainability Council's website. There are three award types:

- Student Award of Excellence: *“This award recognizes an undergraduate, graduate, or continuing education student that has demonstrated a commitment to sustainability initiatives on campus or the wider Delaware community.”*
- Staff Award of Excellence: *“This award recognizes a staff member that has demonstrated a commitment to sustainability initiatives on campus or the wider Delaware community.”*
- Faculty Award of Excellence: *“This award recognizes a faculty member that has demonstrated a commitment to sustainability initiatives on campus or the wider Delaware community.”*

More information can be found on the Sustainability Council's website, here:

<https://sites.udel.edu/sustainability/the-green-hen-awards/>

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TABLE 1. Summary of Eligibility, Nomination, Selection, and Awards for University Sustainability Awards for North American Comparator Institutions

	Eligibility	Nomination	Selection	Award
Texas A&M University	Students: 2.5 GPA Staff and Faculty: One year minimum employment	Self-nominations acceptable, 1-3 letters of support required	Anonymous committee with knowledge of sustainability efforts	Publication of award and name on university website
University of Oregon	Excellence in sustainability efforts	Sponsored by a unit/division on campus	Selected by a unit/division on campus	Publication of award and name on university website and video; annual award ceremony
Harvard University	Excellence in sustainability efforts	Unclear	Unclear	Publication of award and name on university website; biennial award ceremony
Yale University	Excellence in sustainability efforts	University-wide nomination process	Unclear	Publication of award and name on university website
Cornell University	Excellence in sustainability efforts	Self-nominations acceptable	Unclear	Publication of award and name on university website; physical award
McGill University	Excellence in sustainability efforts, some restrictions (e.g. distinguished contribution award)	Unclear	Unclear	Publication of award and name on university website and video; annual award ceremony
Weber State University	Any research project in the area of sustainability completed within the last academic year; students and faculty (2 awards each)	Self-nominations acceptable	Subcommittee of the Weber State University Faculty Senate Environmental Initiatives Committee	Monetary award (two \$500 awards)
Emory University	Excellence in sustainability efforts; 6 awards available; students, faculty, and staff eligible	Unclear	Unclear, but possibly the Office of Sustainability Initiatives	Publication of award and name on university website
NC State University	Excellence in sustainability efforts; 6 awards available; students, faculty, staff, and campus department or student organization eligible	Unclear	Unclear, but possibly the Sustainability Council	Publication of award and name on university website; award ceremony; physical award

	Eligibility	Nomination	Selection	Award
Penn State	Excellence in sustainability efforts; 5 awards available; students and student organizations eligible	Faculty, staff, and students nominate other students, self-nominates not acceptable	Unclear	Publication of award and name on university website; award ceremony; custom physical award

Bibliography

AASHE. 2020. "Sustainable Campus Index." *AASHE* https://www.aashe.org/wp-content/uploads/2020/11/SCI_2020.pdf accessed 3 December 2020.

Cornell University (Cornell). "Cornell University Partners in Sustainability Awards (CUPSA)." *Cornell University* <https://sustainablecampus.cornell.edu/programs-guides/recognition-programs/cupsa-awards> accessed 3 December 2020.

Frey, Bruno S., and Gallus, Jana. 2015. "Awards, Honours, and Ribbons: Between Fame and Shame." *Vox EU* <https://voxeu.org/article/awards-motivation-and-performance> accessed 3 December 2020.

Harvard University (Harvard). "Harvard Green Carpet Awards: Celebrating Our Sustainability Leaders." *Harvard University* <https://green.harvard.edu/campaign/harvard-green-carpet-awards> accessed 3 December 2020.

McGill University (McGill) A. "9th Annual Catalyst Awards." *McGill University* <https://www.mcgill.ca/sustainability/about/catalyst-awards/2019-awards> accessed 3 December 2020.

-- B. "The Catalyst Awards." *McGill University* <https://www.mcgill.ca/sustainability/about/catalyst-awards> accessed 3 December 2020.

Princeton Review. "Top 50 Green Colleges." *Princeton Review* <https://www.princetonreview.com/college-rankings?rankings=top-50-green-colleges> accessed 3 December 2020.

Sierra Club. 2020. "Cool Schools 2020 Full Ranking." *Sierra Club* <https://www.sierraclub.org/sierra/cool-schools-2020/cool-schools-2020-full-ranking> accessed 3 December 2020.

-- 2019. "Cool Schools 2020 Methodology." *Sierra Club* <https://www.sierraclub.org/sierra/cool-schools-2020/cool-schools-2020-methodology> accessed 3 December 2020.

Texas A&M University (TAMU). "Sustainability Champion Awards." *TAMU* <http://sustainability.tamu.edu/awards.aspx> accessed 3 December 2020.

University of Delaware (UD). "Greenest BlueHen 2020: Earth Day Challenge." *University of Delaware* <https://sites.udel.edu/sustainability/earthmonth/> accessed 3 December 2020.

University of Oregon (UOregon) A. "University Sustainability Awards." *University of Oregon* <https://cpfm.uoregon.edu/university-sustainability-awards> accessed 3 December 2020.

-- B. "2020 Sustainability Award Winners." *University of Oregon* <https://cpfm.uoregon.edu/2020-sustainability-award-winners> accessed 3 December 2020.

Yale University (Yale). 2015. "Sustainability Awards Students, Faculty, Staff for Outstanding Service." *Yale University* <https://sustainability.yale.edu/news/sustainability-awards-students-faculty-staff-outstanding-service> accessed 3 December 2020.

MINI-REPORTS

'Cides Usage

Problem Statement

Globally, biodiversity is “declining at an unprecedented rate, and the pressures driving this decline are intensifying” (CBD 2020, 2). The use of “fertilizers and pesticides” remains at high levels and they are “among the main drivers of global biodiversity loss” (CBD 2020, 7). Specifically, in Delaware, the coming decades present increased threats from climate change – such as increased flooding and droughts that can exacerbate biodiversity loss (EPA 2016, 1-2). Furthermore, the fact that many species continue to be endangered in Delaware should, in and of itself, prompt action (Delaware Gov). For these very reasons, action should be taken to reduce the amount of synthetic fertilizers and pesticides in order to help reduce the impact UD is having on biodiversity loss.

Overview

The United States Environmental Protection Agency makes it clear that biodiversity “underpins all ecosystems and their services,” thereby emphasising the significance of biodiversity conservation and preservation. The EPA defines biodiversity as the “variety of all forms of life” and highlight that “it is essential to the existence and proper functioning of all ecosystems” by maintaining the global ecosystem that we fundamentally depend on for “food, air...water security, and multiple other natural benefits” (EPA). Similarly, the World Wildlife Fund (WWF) recognizes that biodiversity is “all the different kinds of life you’ll find in one area—the variety of animals, plants, fungi, and even microorganisms like bacteria that make up our natural world” (WWF). The WWF adds that these various “species and organisms work together in ecosystems...to maintain balance and support life” and the loss of biodiversity threatens “food, clean water, medicine, and shelter” (WWF).

The World Bank states that biodiversity “provides nutritious food, supplies clean air and water, sustains livelihoods, acts as a buffer against extreme weather events and regulates the climate” (World Bank). Globally, however, biodiversity being “threatened by an unprecedented transformation and exploitation of terrestrial and marine ecosystems – driven mostly by human activities,” with one-eighth of the total animal and plant species risking extinction within the coming decades (World Bank). The EPA adds that “chemicals” and “nutrient loading” – like pesticides and their ilk – “pose serious threats to aquatic and terrestrial species,” thereby underscoring the need for action on pesticides and functional equivalents, like insecticides, fungicides, adulticides, rodenticides, and herbicides (EPA). Hereafter, these will be collectively stated as “cides.”

The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) distinguishes between direct and indirect drivers that affect biodiversity and adopt a global viewpoint in identifying these drivers. They identify pesticides and “agricultural insecticides” as being responsible for reducing “macroinvertebrate richness in rivers by up to 40%,” with “urban and agricultural herbicides”

adversely affecting non-target species like algae (IPBES 2019a, 115). Pesticides can also “exert chronic effects and have endocrine disruptive properties that affect freshwater biodiversity, and jeopardize the health of water ecosystems” (IPBES 2019a, 115). Given UD campus’s proximity to White Clay Creek, Christina River, and other major water bodies UD’s usage of ‘cides threatens local waterways and biodiversity (Donnelly 2002).

In addition to threatening non-human species and disregarding the intrinsic value and vital ecosystem services that they possess and provide, ‘cides also pose the risk of generating resistance in pathogens, pests, and crops that subsequently become “major threats to human wellbeing” (IPBES 2019b, 63). Perhaps most relevant to UD is that ‘cides usage exacerbates “land and soil degradation and erosion” and adversely affects species distribution and populations of “pollinators and other beneficial organisms” (IPBES 2019b, 91-92). Powney et al. specifically note that pesticides are a “major threat to pollinator diversity” (Powney et al. 2019, 2). This finding is echoed by the Delaware government, which highlights that the “use of certain pesticides” is partly responsible for “[d]eclines in pollinator populations” (Delaware Gov 2015a, 93).

Research in the UK has found that the loss of pollinators adversely affects human well-being and health. Pollination is crucial in “sustaining wild flowers,” it “benefits agricultural and horticultural production,” and bees and hoverflies are considered “popular insects” that “people enjoy seeing...in towns, cities and the wider countryside,” thereby emphasising the ecological value and aesthetic and cultural value of pollinators (JNCC 2019, 4).

Internationally, in championing biodiversity, the USAID argues that “[c]onservation is an American tradition that creates and sustains economic opportunity and protects the plants, animals, and natural places that communities need to thrive” (USAID). By not implementing preventative practices for biodiversity loss, UD potentially increases “risks of disease and poor nutrition,” unsustainable “food productivity,” “[e]nvironmental crime,” and “economic [dis]empowerment” (USAID). At the state level, Delaware’s government recognizes that “pesticide spraying” has contributed to the endangerment of species (Delaware Gov 2015a, 21). In the government’s 2015 report, they found that the “steady decline in monarch butterfly...numbers” was attributable to, among other factors, “the dramatic increase in the use of the herbicide Roundup (glyphosphate)” and the “widespread use of systemic insecticides such as neonicotinoids within the breeding range of the monarch” (Delaware Gov 2015a, 81).

Moreover, the Delaware government found that “[a]ll fireflies are suspected of being sensitive to pesticide application, including those that occur in urban areas” (Delaware Gov 2015a, 91). More broadly, “[p]esticides,” “fungicides and insecticides” present challenges for “many invertebrate” species of greatest conservation need (Delaware Gov 2015b, 37). Insecticides and fungicides are particularly problematic in terms of negatively affecting honey bees and bumblebees (Delaware Gov 2015b, 37). The “[w]idespread use of non-selective herbicides to treat weeds” can reduce the “diversity of native plants in the vicinity” and “may lead to increased herbicide resistance of some plant species,” possibly “including invasive” species (Delaware Gov 2015b, 37).

At a residential scale, the Delaware government recognizes that “pesticides” continue to be used on a “large scale,” especially for “mosquito control treatments” that impinge on “native invertebrate species,” including species recognized as being in greatest conservation need, such as certain species of “bees, butterflies, and moths” (Delaware Gov 2015b, 38). Unfortunately, Newark City Council’s *Sustainable Newark* plan (2019) makes no mention of localized efforts to combat ‘cides usage, and the recently-formed UD Sustainability Council, based on its 2020 (FY) report, makes no mention of ‘cides.

Currently, UD uses a broad range of ‘cides, such as *Dimension* (herbicide), *Tupersan* (herbicide), *Snapshot* (herbicide), *Gallery* (herbicide), *Freehand* (herbicide), *Dimension 2EW* (herbicide), *Powerzone* (herbicide), *Acclaim Extra* (herbicide), *Drive 75 DF* (herbicide), *Basogran T&O* (herbicide), *Merit*

(insecticide), *Tempo* (insecticide), *Orthene T&O* (insecticide), *Conserve* (insecticide), *Glyphosate* (herbicide), and *Sureguard* (herbicide) (UD Grounds). Other artificial sprays include dormant oil (effectively insecticide), *Primo* (plant growth regulator), *Atrimmec* (plant growth regulator), and indicator dye (blue dye added to sprays) (UD Grounds).

However, steps can be taken in combatting ‘cides usage to limit or altogether stop their detrimental effect on biodiversity. Some educational institutions have already limited or altogether banned ‘cides usage, such as the University of California on all its campuses (Latham 2019; Feldman 2020), Sonoma State University (SSU News 2019), all Hawaiian public schools (Essoyan 2019), all Connecticut municipal playgrounds and limitations on applications on school property (Beyond Pesticides 2015), and all New York State schools, day care centres, playgrounds, and athletic fields (NYS Gov). UD, therefore, is presented with an opportunity to intervene – to limit and phase-out ‘cides usage on its campuses and protect its students, faculty, staff, guests, and non-human inhabitants.

Rationale for Intervention

Given the growing alarm over the decline in biodiversity, there is a need for intervention *now*. Without such intervention – for business to continue as usual or to do nothing – the trend in biodiversity loss in Delaware will continue. UD can play an important role in setting an example for other educational institutions in Delaware – and the U.S. as a whole – and encourage them to follow suit. Additionally, by improving sustainability on campus, UD can utilize its improved sustainability status to attract undergraduate students and simultaneously enhance its AASHE STARS rating (Nuwer 2014; Murtagh 2019).

In 2020, the Association for the Advancement of Sustainability in Higher Education (AASHE) awarded UD, in its Sustainability Tracking and Rating System (STARS), a “Bronze” rating (AASHE STARS A). In 2018, UD received the lowest rating – “Reporter” (AASHE STARS B). In chronological ascending order, the available rating (with minimum credits in parentheses) are as follows: Reporter (N/A), Bronze (25), Silver (45), Gold (65), and Platinum (85) (AASHE STARS 2019, intro 2). In the 2020 report, there is evidently much room for UD to take positive action in enhancing campus sustainability and, subsequently, boost its AASHE STARS rating. In this mini-report, UD scored 36.07 credits (AASHE STARS A).

For example, 12 credits are available for Research and Scholarship (AC-9), in which UD scored zero (AASHE STARS B). To achieve this, UD needs to conduct an “inventory to identify the institution’s sustainability research” (AASHE STARS C). Completing this alone would increase UD’s AASHE STARS rating to Silver (48.07 credits, 3.07 above the required 45). Of course, this not as germane to ‘cides usage as some of the other credits available. For Biodiversity (OP-10), UD scored zero out of a possible 2 credits (AASHE STARS D). This requires UD to conduct an “assessment to identify endangered and vulnerable species and/or areas of biodiversity importance on land owned or managed” by UD (AASHE STARS C).

Moreover, UD scored zero out of a possible two credits for Landscape Management (OP-9), which requires UD to report on how it manages its grounds “organically or in accordance with an Integrated Pest Management (IPM) program,” which underscores the importance of limiting ‘cides usage (AASHE STARS C; AASHE STARS E). Thus, by limiting and, eventually, phasing-out ‘cides on campus, UD can enhance its own AASHE STARS rating and, subsequently, elevate its chances of prospective students being allured by UD’s world-leading sustainability efforts and status.

Recommendations

UD has already made progress toward enhancing campus sustainability in recent years and these efforts are incontrovertibly laudable, but some of the heavy-lifting remains. Based on all of the evidence cited in this mini-report, there are multiple avenues that could be pursued to bolster UD’s efforts to combat biodiversity

Loss on campus and, consequently, illustrate UD's leading efforts to challenge a globally-recognized problem.

Based on the IPBES 2019 report, grassland on campus could be transformed into "species-rich meadows and other managed cultivated systems with biodiversity objectives in mind" to have a positive impact on biodiversity (IPBES 2019b, 91). This could be tied to a possible tree-planting program supported by UD (on- or off-campus), which raises the University's engagement with the local community (EN-13 and EN-14 in AASHE STARS) and, thereby, also increases UD's AASHE STARS rating (AASHE STARS C). The organically-managed land could further enhance student, faculty, staff, and guest mental and physical well-being, and demonstrate that UD is at the forefront of innovative sustainability action. Possible funds for this project (and others) could be sourced from UD's Green Grants, in conjunction with Newark City Council or Delaware Congress, UD's endowment, donations, and/or external grants.

Building on a 1999 Environmental Law Institute report for Delaware, UD could commit to many other actions (ELI 1999, 47, 73-74, 116-117, 130). Rather than adopting a single policy intervention, however, this mini-report recommends that as many policy interventions are adopted as possible – the more, the merrier. These include:

- Clearly outline UD's definition of biodiversity, or adopt an existing, authoritative definition of biodiversity, such as one provided by the EPA or WWF;
- Develop a UD campus-wide biodiversity assessment and plan, including an established list of pests known to exist on campus (OP-9) (AASHE STARS C);
- Establish zones on campus that are earmarked for environmental protection to safeguard biodiversity and disallow land development, other than efforts to further enhance biodiversity;
- Adopt stringent environmental design standards for development projects on campus. This includes incorporating principles of biodiversity conservation and restoration into land-use management and development (e.g. consider the impact of development on natural land and minimize damage to natural ecosystems insofar as possible, such as relocating species, developing a green rooftop, planting trees and flowers to replace the environmental loss from the damage from construction);
- Exercise authority to deny Newark City Council's infrastructure projects and policies should they not be in line with stringent environmental standards. To this end, promote infrastructure projects that encourage walking, cycling, and affordable and accessible eco-friendly public transport;
- Involve students, faculty, staff, and the local community in policy planning and land-use development, ideally *in advance* of decision-making. For this, UD should utilize its social media and website presence to advertise and promote participation in sustainability and biodiversity programs;
- Tighten soil and water conservation plans to prevent soil erosion and degradation;
- Improve UD's Sustainability webpage to make visible UD's commitment to conservation of *all* wildlife and biodiversity, and UD's ongoing efforts and goals;
- Seek appropriations, donations, and external funding to create a fellowship fund for graduate students at UD to ensure efforts pertaining to UD's sustainability efforts are continued into the future and UD's commitment to biodiversity is maintained;
- Establish UD's nine projects within the Botanical Gardens Master Plan;
- Create new sustainability programs and enhance existing programs offered to students (undergraduate and graduate) to increase awareness; and
- Use an Anaerobic Digester – using food waste from UD Dining Services and, possibly, Newark as a whole – to generate compost as a natural fertilizer to replace synthetic fertilizers currently in use.

Ideally, UD ought to collaborate with local non-profits, non-governmental organisations, community groups, Newark City Council, and surrounding areas to encourage the adoption of similar policies and further illustrate UD's leadership in sustainability-related issues.

Bibliography

- AASHE STARS A. “University of Delaware Reports.” *AASHE STARS* <https://reports.aashe.org/institutions/university-of-delaware-de/report/> accessed 19 November 2020.
- B. “University of Delaware AC-9: Research and Scholarship.” *AASHE STARS* <https://reports.aashe.org/institutions/university-of-delaware-de/report/2020-01-31/AC/research/AC-9/> accessed 19 November 2020.
- C. “STARS 2.2 Credit Checklist.” *AASHE STARS* <https://docs.google.com/spreadsheets/d/1bedIjvBrhuNAXoPxYXV02a0oOpG9QnG9oFkqu3EwqOE/edit#gid=0> accessed 19 November 2020.
- D. “University of Delaware OP-10: Biodiversity.” *AASHE STARS* <https://reports.aashe.org/institutions/university-of-delaware-de/report/2020-01-31/OP/grounds/OP-10/> accessed 19 November 2020.
- E. “University of Delaware OP-9: Landscape Management.” *AASHE STARS* <https://reports.aashe.org/institutions/university-of-delaware-de/report/2020-01-31/OP/grounds/OP-9/> accessed 19 November 2020.
- 2019. “STARS Technical Manual: Version 2.2.” *AASHE STARS* <https://stars.aashe.org/about-stars/> accessed 19 November 2020.
- Beyond Pesticides. 2015. “Connecticut Bans Toxic Lawn Pesticides in Municipal Playgrounds Statewide.” *Beyond Pesticides* <https://beyondpesticides.org/dailynewsblog/2015/07/connecticut-bans-toxic-lawn-pesticides-in-municipal-playgrounds-statewide/> accessed 19 November 2020.
- Convention on Biological Diversity (CBD). 2020. “Global Biodiversity Outlook 5: Summary for Policymakers.” *Convention on Biological Diversity* <https://www.cbd.int/gbo/gbo5/publication/gbo-5-spm-en.pdf> accessed 19 October 2020.
- Delaware Government. “Delaware’s Endangered Species.” *Delaware Government* <https://dnrec.alpha.delaware.gov/fish-wildlife/conservation/endangered-species/> accessed 19 October 2020.
- 2015a. “Delaware Wildlife Action Plan 2015-2025: Delaware’s Wildlife Species of Greatest Conservation Need.” *Delaware Government* <http://www.dnrec.delaware.gov/fw/dwap/Documents/2015%20Submitted%20Documents/Chapter%201.pdf> accessed 19 October 2020, chapter 1.
- 2015b. “Delaware Wildlife Action Plan 2015-2025: Issues Affecting SGCN and Wildlife Habitat in Delaware.” *Delaware Government* <http://www.dnrec.delaware.gov/fw/dwap/Documents/2015%20Submitted%20Documents/Chapter%203.pdf> accessed 19 October 2020, chapter 3.
- Donnelly, K. 2002. “Promoting Delaware Water Quality: DNREC Goals and Achievements.” *Delaware Water Resources Center* 3(2). https://www.wrc.udel.edu/wp-content/uploads/WaterNews/Vol_3/WaterNews_Vol3_No2_Fall_2002.pdf accessed 30 October 2020.
- Environmental Law Institute. 1999. “Protecting Delaware’s Natural Heritage: Tools for Biodiversity Conservation.” *Environmental Law Institute* <https://www.eli.org/sites/default/files/eli-pubs/d9.12.pdf> accessed 19 October 2020.

Environmental Protection Agency (EPA). “EnviroAtlas Benefit Category: Biodiversity Conservation.” *EPA* <https://www.epa.gov/enviroatlas/enviroatlas-benefit-category-biodiversity-conservation> accessed 19 October 2020.

-- 2016. “What Climate Change Means for Delaware.” *EPA* <https://19january2017snapshot.epa.gov/sites/production/files/2016-09/documents/climate-change-de.pdf> accessed 19 October 2020.

Essoyan, Susan. 2019. “Herbicides Banned on Hawaii Public School Campuses, Superintendent Says.” *West Hawaii Today* <https://www.westhawaii.com/2019/06/27/hawaii-news/herbicides-banned-on-hawaii-public-school-campuses-superintendent-says/> accessed 19 November 2020.

Feldman, Mackenzie. 2020. “Banning UC Berkeley’s Use of Herbicides from Courts to Campus is a Must.” *The Daily Californian* <https://www.dailycal.org/2017/05/08/banning-herbicides/> accessed 19 November 2020.

Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES). 2019a. “Chapter 2.1. Status and Trends – Drivers of Change.” *IPBES* https://ipbes.net/sites/default/files/ipbes_global_assessment_chapter_2_1_drivers_unedited_31may.pdf accessed 9 September 2020.

-- b. “Chapter 2.2. Status and Trends – Nature.” *IPBES* https://ipbes.net/sites/default/files/ipbes_global_assessment_chapter_2_2_nature_unedited_31may.pdf accessed 9 September 2020.

JNCC. 2019. “UK Biodiversity Indicators 2019: D1c. Status of Pollinating Insects.” *JNCC* <http://data.jncc.gov.uk/data/3de3abe1-d7d1-417e-9684-1348dd8b9a5a/UKBI2019-F-D1c.pdf> accessed 5 October 2020.

Latham, Jonathan. 2019. “University of California Halts Use of Glyphosate Herbicide.” *Independent Science News* <https://www.independentsciencenews.org/news/university-of-california-system-halts-use-of-glyphosate-herbicide/> accessed 19 November 2020.

Murtagh, Alison. 2019. “Why College Campuses Are Going Green.” *U.S. News* <https://www.usnews.com/education/best-colleges/articles/2019-09-17/why-college-campuses-are-going-green> accessed 19 November 2020.

New York State (NYS) Gov. “Pesticide Use at Schools and Day Care Centers.” *NYS* <https://www.dec.ny.gov/chemical/41822.html> accessed 19 November 2020.

Nuwer, Rachel. 2014. “Do Students Really Choose Colleges Based on How Green They Are?” *The Guardian* <https://www.theguardian.com/sustainable-business/2014/jul/22/green-colleges-students-decisions-environment> accessed 19 November 2020.

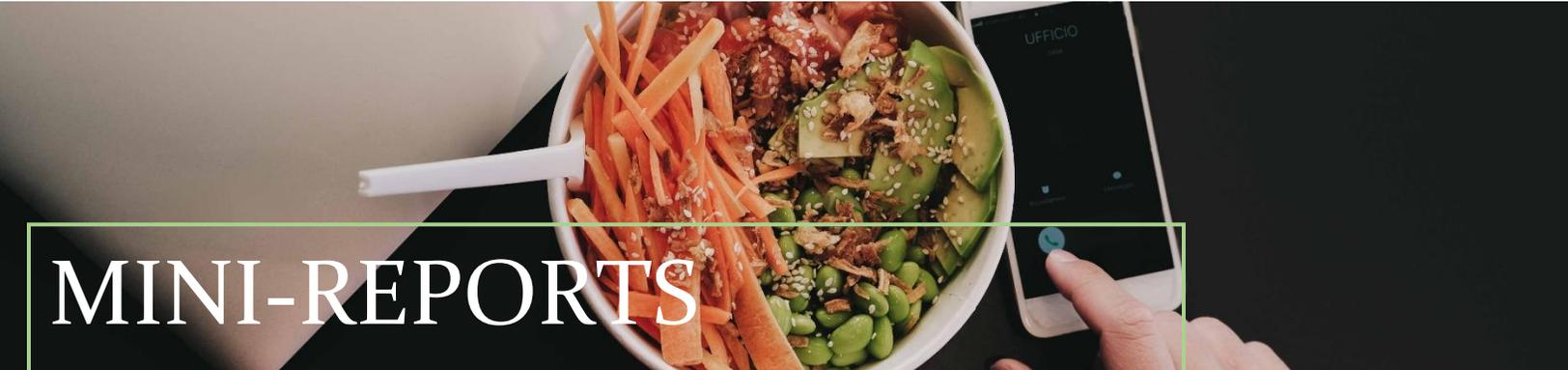
Powney, Gary D., Harrower, Colin A., Outhwaite, Charlotte., and Isaac, Nick J. B. 2019. “UK Biodiversity Indicators: D1c. Status of Pollinating Insects: Technical Background Document.” *JNCC* <http://data.jncc.gov.uk/data/3de3abe1-d7d1-417e-9684-1348dd8b9a5a/UKBI2019-TechBG1-D1c.pdf> accessed 5 October 2020.

Sonoma State University News (SSU News). 2019. “Sonoma State Bans Use of Glyphosate Products such as Roundup.” *Sonoma State University News* <http://news.sonoma.edu/article/sonoma-state-bans-use-glyphosate-products-such-roundup> accessed 19 November 2020.

UD Grounds. “Grounds Maintenance Products Available for Use on UD Campus Landscape.” *University of Delaware* <https://web.facilities.udel.edu/docs/CustodialPestControl/GroundsProducts.pdf> accessed 19 November 2020.

World Bank. 2020. “Biodiversity.” *World Bank* <https://www.worldbank.org/en/topic/biodiversity#1> accessed 19 October 2020.

World Wildlife Fund (WWF). “What is Biodiversity?” *WWF* <https://www.worldwildlife.org/pages/what-is-biodiversity> accessed 9 September 2020.



MINI-REPORTS

Red Meat and Processed Meat 🔔

University of Delaware – Phase-Out Red Meat and Processed Meat

Problem Statement

Agricultural production and livestock production are two of the several direct drivers of global biodiversity loss according to the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) (IPBES 2019a, 91, 108).

Overview

Agricultural production is responsible for “70-90% of withdrawals from rivers, lakes, and aquifers,” and “25% of global greenhouse gas (GHG) emissions from land clearing, crop production, and fertilisation” (IPBES 2019a, 91). Also, “most new agricultural lands in the tropics,” established between 1980 and 2000, “came at the expense of intact or disturbed forests” (IPBES 2019a, 91). Livestock production is especially damaging as it “uses a third of crop production for feed and three quarters of land in total,” with “animal-based foods, and especially *beef*,” requiring “more water and energy than plant-based foods” (IPBES 2019a, 92; emphasis added).

Furthermore, the IPBES reports in its fifth chapter – titled, *Pathways Towards a Sustainable Future* – that there is a need for humans, on the whole, to shift toward diets that include “less meat” (IPBES 2019b, 31). Highlighting the issue of food waste, they state that wasting “1 kg of feedlot-raised boneless beef is estimated to have ~24 times the effect on available calories as wasting 1 kg of wheat,” but this varies from country to country (IPBES 2019b, 78). For example, approximately “7 to 8 times more land is required to support this [scale of] waste in the United States than India” (IPBES 2019b, 78).

Dietary changes, ranging from “partial to complete elimination of meat,” *do* result in improved environmental conditions (IPBES 2019b, 43). Notably, such changes can diminish “land-use change,” reduce “emissions and energy demand,” and conserve unmanaged land that can be safeguarded as carbon storage (vegetation and soils), “thereby preserving some biodiversity-rich areas” (IPBES 2019b, 39, 49, 77). These dietary changes evidently lead to improvements in environmental sustainability. Unfortunately, UD

(UDSC 2020), Newark City Council (NCC 2019), and Delaware Congress (DNREC 2014) have said little about the *need* for dietary changes – whether simply raising awareness of dietary choices or taxing or reducing red meat consumption. Whilst this report supports any limitation on the consumption of meat, the focus here is on *red* meat given that it is especially environmentally destructive.

Extant scientific research on red meat consumption and animal welfare suggests that diminished red meat consumption – if not an elimination of red meat consumption altogether (and replaced by whole grains, fruits, vegetables) – is *highly likely* a source of good in terms of human health, animal welfare, and reduced greenhouse gas emissions. Ashaye et al. find that red meat consumption is associated with an “increased risk of [heart failure]” (Ashaye et al. 2011, 944). Kurbel examines numerous articles related to red meat consumption and finds that red meat is causally linked to “colorectal, lung, [o]esophageal, and gastric malignancies,” and processed meat with “colorectal, [o]esophageal, gastric, and bladder cancer” (Kurbel 2020, 2). However, these findings are more applicable to *beef* consumption, less so *pork* and *lamb* (Kurbel 2020, 2).

Furthermore, Machovina and Feeley highlight how imposing a “global dietary limit of 5% of red meat as part of a 10% maximum for all animal-based products” could lead to “more people” being “fed using less land” (Machovina & Feeley 2014, 1). They suggest that reducing livestock consumption and, instead, redirecting current crop feed from livestock to humans could “feed an extra 4 billion people,” and allow for the reduction of greenhouse gas emissions and biodiversity loss associated with land-use change (Machovina & Feeley 2014, 1). Johnston reports that, since the 1990s, Americans have become increasingly concerned about “farm animal welfare” and “quality of life” (Johnston 2013, 139). Further, Qian et al. argue that transitioning from a diet based on red meat and processed meats to plant protein sources can reduce “LDL cholesterol and other cardiometabolic factors,” as well as improve “planetary health” that also subsequently benefits the health of humans (Qian et al. 2020, 267, 269-270).

However, Newark City Council’s Sustainability Plan (2019) does, generally, mention the importance of diet. Part of Newark City Council’s sustainability pledge is to provide “access to healthy food,” reduce food waste, and address “food insecurity” (NCC 2019, 2, 10, 42). Delaware Congress, instead, takes aim at the connection between meat and climate change. In its 2014 *Delaware Climate Change Impact Assessment* – the latest at the time of writing (November 2020) – there are mentions of increased temperatures adversely affecting the supply of chicken (DNREC 2014, 7-7). References to “food” are exclusively in relation to (a) food for non-human species (e.g. availability of food) and (b) food-borne disease (resulting from climate change) (DNREC 2014, 5-11, 8-6, 8-12).

Following an inquiry into UD’s dining services in October 2020, it was unveiled that the university trialled a *Meatless Mondays* program for a single semester in Spring 2016, following pressure from students (UDaily 2016). Excluding national brands, residential and catering locations acquired 11,492 cases (‘cases’ is used as part of the original terminology, as opposed to ‘weight’ given the variation in measurements) of meat and fish products (not all-inclusive) for the 2019-2020 academic year. Of 11,492 cases, 77.8% were red meat (8,941 cases). This substantial amount of red meat undoubtedly contributes to the UD’s impact on the natural environment, as well as on the health of its faculty, students, staff, and guests.

Whilst there have been laudable efforts by the university to diversify its vegetarian and vegan options, the purchase and consumption of red meat for the university’s dining services (again, to stress, this does *not* include the likes of *Chick-fil-A*) remains problematic. Nonetheless, the university has committed to Aramark’s – a food service which has been partnered with the university for 29 years – *Plant Forward* initiative (this replaced *Meatless Mondays*). As of October 2020, 30% of the main dishes provided are either vegan or vegetarian, red meat offerings have been reduced by 12% on menus, and fruit, vegetables, and

wholegrains have increased by 20% on menus. In addition, Aramark is committing to purchasing 100% of U.S.-contracted seafood from sources that meet Monterey Bay Aquarium Seafood Watch program recommendations.

Problematically, the menus are designed not to “alienate” those who do not want to eat vegetarian or vegan foods. Whilst more options for plant-based alternatives have been provided, red meat consumption (and processed meats) – as aforementioned, which are damaging to human health, livestock, and the natural environment – have not been disincentivized. In turn, UD is missing an opportunity to cut down its greenhouse gas emissions. Even without phasing-out red (and processed) meats, the university could act to offset its environmental impact but efforts to this end have not been deliberated or enacted.

Other universities are, however, taking positive action toward combatting the adverse effects of livestock production and red meat consumption. The department for Management, Society and Communication at the Copenhagen Business School (Denmark) decided, in October 2017, to have “all meals become vegetarian by default” (with the option to opt-out for a meat-based dish) for a trial period of six months (Bauer 2018). In evaluating the results, the school found that more than “90% of the self-reported food orderings were vegetarian,” and that a majority supported expanding the policy beyond the end of the trial period (Bauer 2018). In turn, the experiment was given an additional year.

From October 2016 to September 2019, the University of Cambridge (UK) “replaced meat with plant-based products for its 14 outlets and 1,5000 annual events,” thereby “dramatically” reducing their environmental footprint (BBC 2019). In August 2019, Goldsmiths College – part of the University of London (UK) – decided to cease serving beef on campus, with a general aim of achieving carbon-neutrality by 2025 (Starostinetskaya 2019a). Additionally, they imposed a “10 pence (\$0.12) tax on plastic bottles and cups,” with the proceeds designated “eco-friendly student initiatives” (Starostinetskaya 2019a).

In November 2019, following a Meatless Mondays policy, the University of East Anglia (UK) wanted to take further action and voted to stop the sale of beef on campus, create new vegan food options, and encourage a general shift away from meat and dairy and, instead, toward plant-based options (Starostinetskaya 2019b). In January 2020, the University of Coimbra (Portugal) removed beef from “all 14 of its cafeterias,” with the aim of achieving carbon-neutrality by 2030 (Starostinetskaya 2019c). In February 2020, the London School of Economics (UK) passed a motion to ban beef products in dining services across campus (Axworthy 2020). Finally, In November 2020, Oxford University (UK) banned “beef and lamb at catering outlets with the aim of reducing greenhouse emissions” (Business Today 2020).

Elsewhere, other initiatives have taken place. Imperial College London (UK) and King’s College London (UK) created cafés with a vegan-only menu, and over half of the options on Cardiff University’s (UK) menus are vegan (PETA UK). In the U.S., the University of North Texas (Texas) has a “100% vegan dining hall on campus” and has an “hydroponic garden, where the school grows up to 800 heads of lettuce a week for the dining halls on campus” (La Jeunesse 2018). Northwestern University (Illinois) offers vegan meals throughout the day, fair-trade organic coffee, and has adopted a Meatless Mondays program (La Jeunesse 2018). Whilst UD has received an A+ in the last academic year (2019-2020) from PETA’s Vegan Report Card for Colleges and Universities, student satisfaction remains low at 43% (PETA US).

Rationale for Intervention

By taking positive action, UD can more quickly reach its greenhouse gas targets through reduction consumption of meat products and, beyond the campus, reduce the “intensification of agricultural production” (IPBES 2019b, 39). This will allow UD to follow suit of its international competitors, especially especially those in the UK, and demonstrably take the lead among U.S. educational institutions in environmental action. This will also help the university to achieve net zero emissions and further improve

the mental and physical well-being of its faculty, students, staff, and guests.

For AASHE STARS, UD scored two out of two for sustainable dining (OP-8) in 2020, it scored zero out of six for food and beverage purchasing (OP-7) (AASHE STARS A). To achieve a good credit score for food and beverage purchasing, the university must “minimize the purchase of conventional animal products” (which include “all meat, fish/seafood, poultry, eggs, and dairy products”) (AASHE STARS B). If UD aspires to attaining a higher AASHE STARS ranking (e.g. silver), then it must take steps to fulfil these available credits, among other things.

Recommendations

Based on the aforesaid IPBES (2019) report, success in changing diets and subsequently reducing greenhouse gas emissions, improving animal welfare standards, and preventing biodiversity loss (from land-use change to intensified livestock production) was achieved through “regulation, economic incentives, and information campaigns” (IPBES 2019b, 43). More specifically, “[i]mprovements in consumption patterns can likely be achieved by reducing subsidies for animal-based products,” and “increasing those for plant-based foods” (IPBES 2019b, 78). Translating national-level efforts to a local, university context, UD has the capacity to launch information campaigns through its social media platforms (blogs, email newsletter, Instagram, Facebook, Twitter, etc.). It also has the capacity to *choose* which products (e.g. plant-based over animal-based) to supply to campus dining and catering services, which businesses (e.g. predominantly plant- or animal-based) to operate on campus, and whether to subsidize healthy food options (e.g. plant-based).

UD could also act in partnership with Newark City Council on several initiatives. Evidently, the City Council aspires to “identify appropriate locations” for “additional community gardens” for “non-homeowners to grow their own food,” as well as to “encourage edible landscape and backyard food gardens” and establish a “Buy Local campaign” (NCC 2019, 42). Given that UD sources its food from within a 250-mile radius, it could use this as part of its information campaign to promote sustainable dining, as well as do more to promote its *Plant Forward* initiative, in addition to striving for more plant-based options as, for example, vegan options would be the *most* inclusive (available to vegans, vegetarians, pescatarians, flexitarians, and is often free from allergens and available to people from varying religious backgrounds).

Moreover, UD could follow other universities in their efforts by, most importantly, phasing-out red meat (especially beef) and processed meat. This can be achieved gradually through the *Plant Forward* initiative that is already in place and could serve to elevate student satisfaction on the university’s PETA Report Card. This would also assist the university in reducing its greenhouse gas emissions and take the lead among U.S. academic institutions. Next, the university could create an on-campus café (or transform an existing unit) to provide vegan-only food. The university’s *Vita Nova* restaurant can take the lead in always offering at least *one* vegan option on its menu, therefore enhancing its customer base.

UD could learn from the University of North Texas by expanding its Organic Farm. Although the farm “does not currently produce adequate volume to supply Dining Hall meal(s),” it could be developed to be on par – if not better – with the University of North Texas in its weekly provision of heads of lettuce (AASHE STARS C). This would create opportunities for employment, research (vertical farming, organic farming), sustainable dining, marketing to prospective and current students, and reducing greenhouse emissions (reduced transport for food, greater self-sufficiency).

Bibliography

AASHE STARS A. “University of Delaware.” *AASHE STARS*
<https://reports.aashe.org/institutions/university-of-delaware-de/report/2020-01-31/> accessed 22 November 2020.

- B. "University of Delaware, OP-7: Food and Beverage Purchasing." *AASHE STARS*
<https://reports.aashe.org/institutions/university-of-delaware-de/report/2020-01-31/OP/food-dining/OP-7/documentation/> accessed 22 November 2020.
- C. "University of Delaware, OP-8: Sustainable Dining." *AASHE STARS*
<https://reports.aashe.org/institutions/university-of-delaware-de/report/2020-01-31/OP/food-dining/OP-8/> accessed 22 November 2020.
- Ashaye, A., Gaziano, J., and Djoussé, L. 2011. "Red Meat Consumption and Risk of Heart Failure in Male Physicians." *Nutrition, Metabolism & Cardiovascular Diseases* 21: 941-946.
- Axworthy, Nicole. 2020. "London School of Economics Student Union Votes to Ban Beef." *Veg News*
<https://vegnews.com/2020/2/london-school-of-economics-bans-beef> accessed 22 November 2020.
- Bauer, Jan. 2018. "Behavioural Change in the Work Environment: A First Review on MSC's Sustainable Food Policy." *The Business of Society* <http://www.bos-cbscsr.dk/2018/06/25/behavioural-chage-in-cbs-msc-department-food-ordering/> accessed 22 November 2020.
- BBC. 2019. "University of Cambridge: Removing Meat 'cut carbon emissions'." *BBC*
<https://www.bbc.com/news/uk-england-cambridgeshire-49637723> accessed 22 November 2020.
- Business Today. 2020. "Oxford University Students Vote to Ban Beef in Campus." *Business Today*
<https://www.businesstoday.in/latest/trends/oxford-students-vote-to-ban-beef-lamb-in-university-outlets-to-tackle-climate-change/story/422257.html> accessed 22 November 2020.
- Delaware Department of Natural Resources and Environmental Control (DNREC). 2014. "Delaware Climate Change Impact Assessment." *Delaware Division of Energy and Climate*
http://www.dnrec.delaware.gov/energy/Documents/Climate%20Change%202013-2014/DCCIA%20interior_full_dated.pdf accessed 22 November 2020.
- Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES). 2019a. "Chapter 2.1. Status and Trends – Drivers of Change." *IPBES*
https://ipbes.net/sites/default/files/ipbes_global_assessment_chapter_2_1_drivers_unedited_31may.pdf accessed 9 September 2020.
- 2019b. "Chapter 5. Pathways Towards a Sustainable Future." *IPBES*
https://ipbes.net/sites/default/files/ipbes_global_assessment_chapter_5_unedited_31may.pdf accessed 19 November 2020.
- Johnston, Connie L. 2013. "Geography, Science, and Subjectivity: Farm Animal Welfare in the United States and Europe." *Geography Compass* 7(2): 139-148.
- Kurbel, Sven. 2020. "What Are the Health Risks of Eating Red Meat, and How Should We Assess Them?" *BioEssays* 42: 1-4.
- La Jeunesse, Marilyn. 2018. "Two-thirds of Colleges in the US Now Offer Vegan Meals – Here are 10 of the Most Vegan-Friendly Campuses." *Insider* <https://www.insider.com/vegan-friendly-colleges-us-2018-10#the-university-of-california-san-diego-has-an-all-vegan-restaurant-on-campus-4> accessed 22 November 2020.
- Machovina, Brian., and Feeley, Kenneth J. 2014. "Livestock: Limit Red Meat Consumption." *Nature* 508.
- Newark City Council (NCC). 2019. "Sustainable Newark: The City of Newark's Plan for Sustainability." *Newark City Council*.

PETA UK. “The Most Vegan-Friendly Universities in the UK.” *PETA UK*
<https://www.peta.org.uk/living/vegan-universities-uk/> accessed 22 November 2020.

PETA US. “Vegan Report Card.” *PETA* <https://collegereportcard.peta.org/?s=university+of+delaware>
accessed 22 November 2020.

Qian, Frank., Riddle, Matthew C., Wylie-Rosett Judith., and Hu, Frank B. 2020. “Red and Processed Meats and Health Risks: How Strong Is the Evidence?” *Diabetes Care* 43: 265-271.

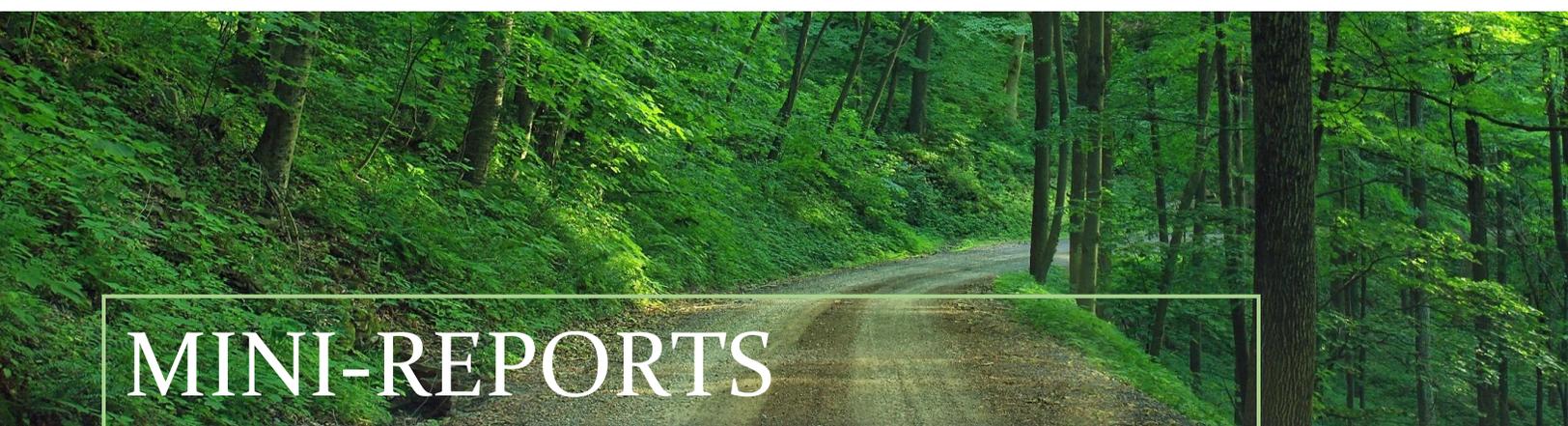
Starostinetskaya, Anna. 2019a. “UK University Bans Beef to Fight Climate Change.” *Veg News*
<https://vegnews.com/2019/8/uk-university-bans-beef-to-fight-climate-change> accessed 22 November 2020.

-- 2019b. “Another UK University Votes to Ditch Beef.” *Veg News* <https://vegnews.com/2019/11/another-uk-university-votes-to-ditch-beef> accessed 22 November 2020.

-- 2019c. “Portugal’s Oldest University Bans Beef to Fight Climate Crisis.” *Veg News*
<https://vegnews.com/2019/9/portugals-oldest-university-bans-beef-to-fight-climate-crisis> accessed 22 November 2020.

UDaily. 2016. “Meatless Monday.” *University of Delaware*
<https://www1.udel.edu/udaily/2016/feb/meatless-monday-020916.html> accessed 22 November 2020.

University of Delaware Sustainability Council (UDSC). 2020. “Annual Report FY 2020.” *Sustainability Council*.



MINI-REPORTS

Campus Lighting

University of Delaware – Campus Lighting

Introduction

This mini-report addresses UD’s current campus lighting and electricity use. While discussions around increasing the number of UD’s sustainable initiatives have increased in recent years, there is still much work to be done to reduce UD’s carbon footprint and to maintain the momentum generated by faculty, staff, and students. In 2020, UD’s Office of Communications & Marketing published an article in the UDaily newsletter titled “Flip the Switch” where concerns were highlighted about the University’s energy use during the COVID-19 pandemic, circa April 2020 (UDaily, 2020). In this case, the changes caused by the COVID-19 pandemic acted in some ways like a catalyst for motivating UD to look into ways to reduce energy costs. However, issues related to energy efficiency, electricity sources, and lighting are not new topics for UD to grapple with, but that does not discount the need to continuously re-address these concerns, especially now.

As a community, everyone had been forced to adapt to remote work or different ways of co-existing on campus as a result of the COVID-19 pandemic. For those still working on and around UD's campus, it is clear that even though “many of our buildings are [only] partially occupied” there still seems to be an excessive amount of lighting being used to power those buildings; leading many campus community members to call for action and encourage others to take “daily actions that take a minute or less [to help] reduce resource waste, costs and pollution” that can result from this excessive electricity use (UDaily 2020).

To improve UD's energy efficiency, this mini-report highlights the reasons why action is warranted by briefly discussing what steps have already been taken in relation to these issues, presenting some key findings, and concluding with a list of recommendations UD ought to adopt.

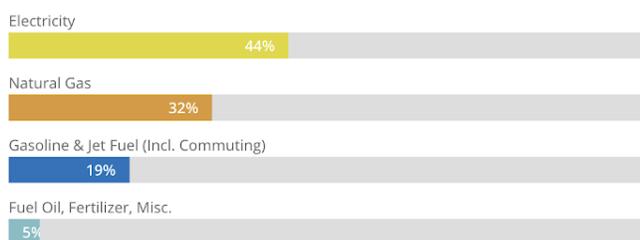
Overview

Effective and efficient use of energy resources not only helps UD reduce costs associated with purchasing power but can also help improve sustainability ratings and set the stage for UD to become a leading force in climate change mitigation efforts. Unfortunately, AASHE awarded UD with a Bronze rating (2020) in their assessment of UD’s building energy consumption, building design and construction, as well as their green laboratories initiatives. According to AASHE’s STARS rating, a bronze rating is the second to lowest level an organization can receive (AASHE STARS A). The reports and rating suggest that there is still much room for improvement.

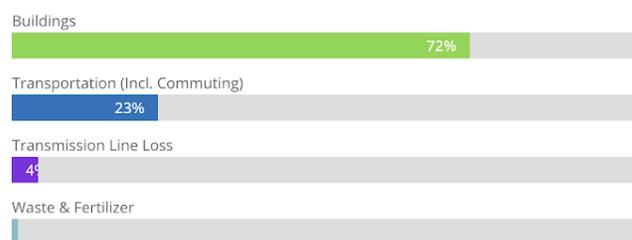
Improving energy efficiency and lighting use is a valid but complex issue, especially given the fact that about 72% of UD’s total energy use is due to buildings and that electricity represents the largest energy source (44%) used to power UD’s facilities (see **FIGURE 1**).

FIGURE 1. Breakdown of and Representation of UD’s Energy Sources and Uses from the 2007-2019 Fiscal Year Reports

UD’s Energy Breakdown:



Where UD uses energy:



*From FY2007-2019, based on Newark campus greenhouse gas inventory.

Source: (UD A).

In 2012, UD “established the Revolving Energy Efficiency Fund to support energy efficiency projects across campus” and evaluated several buildings “as part of a comprehensive lighting and mechanical systems review [where] several locations were selected for upgrade: Older section of Du Pont Hall, Sharp Laboratory, Colburn Laboratory, Lammot du Pont Laboratory, Trabant University Center, Pencader Dining Hall, Clayton Hall, Carpenter Sports Building, and the Bob Carpenter Center” (Groh 2012). While lighting upgrades were performed on these buildings, the Greenhouse Gas Inventory for the 2018 – 2019 Academic Year showed that “UD emitted a total of 96,156 Metric Tons of CO_{2e} ... during the 2018-2019 academic year [, and that the] largest emission source was purchased electricity, which accounted for 55% of the combined Scope 1 and 2 totals” (UD 2020, 3).

TABLE 1 below shows this breakdown:

TABLE 1. 2018-2019 Total Consumption and GHG Emissions by Source

Activity	Source	Scope	Consumption	Unit	Emissions (MT CO ₂ e)
Natural Gas (combustion)	Buildings	1	712,932	MCF	38,925
Fuel Oil #2 (combustion)	Buildings	1	138,483	gal	1,423
Propane	Buildings	1	3,088	gal	18
Gasoline (transportation)	Fleet	1	148,388	gal	1,303
Diesel Fuel (transportation)	Fleet	1	101,986	gal	1,041
Fertilizer	Landscaping	1	61,945	lb	248
Electricity Purchases	Buildings	2	162,893,345	kWh	53,199
Scope 1 and 2 Total		1 & 2		MT CO₂e	96,156
Mixed Solid Waste	Buildings	3	2,471	tons	865
Compost/Food Waste	Buildings	3	532	tons	53
Gasoline (commuting)	Non-UD Vehicles	3	2,539,694	gal	22,293
Jet Fuel (air travel)	Non-UD Aircraft		2,510	gal	26
Electricity (T&D Losses)	Power Grid	3	16,445,359	kWh	5,685
Scope 3 Total		3		MT CO₂e	28,922
All Scopes Total				MT CO₂e	125,078

Source: (UD 2020, 3).

Even though there has been growth in the student population and buildings (per square feet), the Greenhouse Gas Inventory report for the 2018-2019 academic year also showed that “efficiencies caused the GHG emissions rate per building square foot to outpace...[Newark campus’s] growth and emissions intensity fell by 51% for electricity (from 25.7 lbs. CO₂e per square foot to 12.5) and fell by 19% for natural gas (11.3 to 9.1 lbs. CO₂e per square foot)” (UD 2020, 4). Nevertheless, there is still room for improvement.

Given the fact that energy efficiency concerns and improvements are national level topics beyond the scope of the University, it is helpful to turn to the U.S. Department of Energy (DOE). The DOE provides a list of suggested considerations for lighting designs that include the following (DOE, B).

- More light is not necessarily better: light quality is as important as quantity;
- Match the amount and quality of light to the performed function;
- Install task lights where needed and reduce ambient light elsewhere;
- Use energy-efficient lighting components, controls, and systems; and
- *Maximize the use of daylight* (emphasis added):
 - Incorporate passive solar home design techniques to take advantage of the sun's rays; and
 - Increase and replace windows to have more energy efficiency and reduce the amount of heat and cooling energy being lost.
- And some basic methods for achieving energy-efficient indoor lighting:
 - Install fluorescent or LED light fixtures for all ceiling- and wall-mounted fixtures;
 - Consider installing fluorescent or LED fixtures, rather than using fluorescent or LED replacement lamps in incandescent fixtures;
 - Use *occupancy sensors* (emphasis added) for automatically turning on and off lights; and
 - And consider light wall colors to minimize the need for artificial lighting.

In addition to considering the lighting design strategies recommended by DOE, UD could also begin to address the less tangible side of the lighting issues around campus. For example, there are a lot of simple

actions that can help reduce electricity use, but there needs to be effort made to shift cultural norms around campus among faculty, students, and staff. The following list was recommended in the “Flip the Switch” UDaily article and were practices recommended by UD's Facilities, Real Estate and Auxiliary Services (FREAS):

- Turn off everything when you leave a room – lights, projectors, equipment, computer screens, etc. Not every room has light switches available, but electronics can be shut down to stop “vampire energy”;
- Please note that hallway and stairwell lighting usually stays on for safety purposes, so in most buildings these light switches are not accessible to custodians or building users;
- Lab fume hoods are one of the top energy hogs on campus:
 - In labs, follow safety protocols and close fume hoods when they’re not being actively used, but don’t leave inactive experiments on the bench or in the fume hood for storage; and
- And close windows before you leave, especially in air-conditioned buildings. Make sure exterior doors close when entering and exiting a building.

As noted above, most of the actions taken require the campus community to be more aware of ways they can help reduce excessive lighting use. “Individuals within the University community... play a critical role in reducing energy costs on campus.... [and by] working together, individual and departmental efforts across campus can have a positive impact on reducing energy consumption - and the associated costs - on campus” (UD 2009). Beyond the social changes that need to occur, UD’s Climate Action Plan (2009) illustrates other ways to improve energy efficiency on campus. The Climate Action Plan references illustrate campus lighting and energy-use problems (CEEP 2009):

- Plan for Green Infrastructure: Invest in Energy Efficiency, Metering, and Building Automation Systems;
 - Approximately 76% (116,000 MTCO₂) of the total University emissions stem from building operations. In order to reduce building energy usage, the University must invest in energy efficiency upgrades to HVAC systems, implement lighting retrofits and improve monitoring and metering of campus buildings.
- Although lighting efficiency has been generally addressed, there are additional opportunities to reduce energy use in this area;
 - Occupancy sensors should be installed in intermittently used areas such as restrooms and lounges, areas with excessive lighting should be de-lamped, and natural daylight should be used when possible (CEEP 2009, 5).

In addressing those concerns, UD has switched its lighting standard to “LED with 0-10V dimming where applicable” and required that “all new buildings take passive solar opportunities into account during design” and have “occupancy sensors, times, and other lighting controls [...] implemented where possible” (AASHE STARS 2020b). There is still work to be done for addressing campus culture surrounding lighting issues, and currently “UD is completing a trial behavior change study with a focus on energy efficiency in our General Services Building” (AASHE STARS 2020b). Similarly, the University of Washington used an interactive map on their community assessment lighting survey that gave decisionmakers qualitative feedback on ways to address the needs of professionals that directly engage in the design, implementation, and maintenance of campus lighting (UW 2017). UD could also conduct similar survey techniques to better engage faculty, staff, and students; especially since UD also received a Bronze from the STARS rating on assessing sustainability culture as part of the lack of community engagement (AASHE STARS 2020a). While it is encouraging to see effort put into educating and investigating the lighting culture and community consumption aspect of this issue, UD should still continue to work on improving lighting infrastructure

issues and increasing energy efficiency, metering, and building automation systems for the future.

Recommendations

Given all the information above, there are seven recommendations that can be made to help UD move beyond simply installing LEDs and encouraging individuals to turn off lights. The following recommendations are aimed at encouraging UD to move towards incorporating more sustainable changes that improve energy and lighting use on campus:

1. Increase the use of natural light in spaces when renovating and constructing buildings;
2. Continue to improve and replace outdated light fixtures with LED and more efficient technologies, including outside lightings such as streetlights and loading docks;
3. Gather more information on attitudes and opinions about lighting on campus by conducting a campus and community wide “Lighting Survey” in order to begin to assess community perceptions as well as bring awareness to energy efficiency and excessive lighting use on campus;
4. When implementing lighting improvements, develop a process that involves students and offer learning opportunities;
 - a. The University of Washington showed great success with their campus lighting project when “students explored lighting possibilities in various areas by developing technical skills and designing lighting proposals for their respective sites [that became part of the] campus planning and classroom curriculum” (UW 2017);
5. Start to decrease outside lighting and upgrade streetlights to be more energy efficient;
 - a. Decrease in outdoor lighting will also help support a comprehensive understanding of sustainability that encompasses the human experience, ecological impact, maintainability and energy efficiency;
6. Continue to require and increase the use of occupancy sensors in intermittently used areas such as restrooms and lounges; and
7. Increase renewable energy capacity and use of solar and wind energy.

Ideally, UD ought to collaborate with students, faculty, and staff to encourage the adoption of similar new lighting policies and perhaps work with other influential institutions to further illustrate UD’s leadership in sustainability-related issues.

Bibliography

AASHE STARS A. 2020. “University of Delaware Reports.” *AASHE STARS*

<https://reports.aashe.org/institutions/university-of-delaware-de/report/> accessed 19 November 2020.

-- B. 2020. “University of Delaware OP-5: Building Energy Consumption.” *AASHE STARS*

<https://reports.aashe.org/institutions/university-of-delaware-de/report/2020-01-31/OP/energy/OP-5/> accessed 19 November 2020.

Center for Energy and Environmental Policy (CEEP). 2009. “A Sustainable University of Delaware Climate Action Plan.” *University of Delaware* <https://cpb-us-w2.wpmucdn.com/sites.udel.edu/dist/e/763/files/2018/04/University-of-Delaware-Climate-Action-Plan-sj65oj.pdf> accessed 19 January 2021.

Department of Energy (DOE A). “Skylights.” *DOE* <https://www.energy.gov/energysaver/design/windows-doors-and-skylights/skylights> accessed 10 January 2021.

-- B. “Lighting Design.” *DOE* <https://www.energy.gov/energysaver/save-electricity-and-fuel/lighting-choices-save-you-money/lighting-design> accessed 10 January 2021.

Groh, T. 2012. “Energy Efficiency Fund, Lighting Retrofit Project Reduces UD's Carbon Footprint, Energy Bill.” *UDaily* <http://www1.udel.edu/udaily/2013/oct/energy-lighting-103112.html> accessed 10 January 2021.

UDaily. 2020. “Flip the Switch.” *University of Delaware* <https://www.udel.edu/udaily/2020/october/flip-the-switch/> accessed 19 January 2021.

University of Delaware (UD). 2020. “Greenhouse Gas Inventory for the 2018 – 2019 Academic Year.” *University of Delaware* https://cpb-us-w2.wpmucdn.com/sites.udel.edu/dist/e/763/files/2015/10/UD-2018-2019-GHG-Inventory-Report_Final-V2.pdf accessed 10 January 2021.

-- 2009. “UD Works to Reduce Energy Consumption.” *UDaily* <http://www1.udel.edu/udaily/2009/feb/conservation022609.html> accessed 18 February 2021.

-- A. “UD’s Energy Breakdown.” University of Delaware <https://sites.udel.edu/sustainability/energy> accessed 10 January 2021.

University of Washington (UW). 2017. “Campus Illumination a Roadmap to Sustainable Exterior Lighting at the University of Washington.” *UW Integrated Design Lab* http://idlseattle.com/wp-content/uploads/2017/10/Campus-Illumination-Roadmap_web.pdf accessed 10 January 2021.

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MINI-REPORTS

External Funding Opportunities

External Funding Opportunities for the GSG Sustainability Committee

Introduction

In light of the COVID-19 pandemic – which is, as of March 2021, ongoing – there are financial constraints imposed on UD. This includes opportunities to acquire funding from GSG itself and Green Grants. Given this, the authors of this report conducted an examination of external funding opportunities that could be used by faculty, staff, and students to obtain funding for sustainability-related projects.

External Funding Opportunities

Below, a list has been compiled of external funding opportunities. Details relating to the funding summary, application deadline (as of March 2021), the amount of funding, and eligibility criteria are outlined. Whilst some of the opportunities may be unavailable for UD as an institution, there may be room for application for the GSG Sustainability Committee a student organization or for the Committee and/or UD to partner with non-profit organizations.

Delmarva: Sustainable Communities Grant

Summary: “This funding is provided throughout the region as part of Delmarva Power’s Sustainable Communities Grant program, which was launched in November 2019 to support open space preservation, improvements to parks and recreation resources, environmental conservation and innovative community resiliency projects.”

Amount: “Delmarva Power’s Sustainable Communities Grant Program will provide \$75,000 in grants annually to fund open space and environmental projects and resiliency projects across the company’s Delaware and Maryland service area. The program will provide \$50,000 in grants of up to \$10,000 each to municipalities, recreational authorities and nonprofits for projects focusing on open space preservation, improvements to parks and recreation resources, and environmental conservation. The company also will provide one grant, totaling \$25,000, to support resiliency projects.”

Eligibility: Municipalities, recreational authorities and non-profits.

Deadline: June 20, 2021.

Link: <https://www.delawarenaturesociety.org/activities/sustainable-communities-grant/#:~:text=Delmarva%20Power's%20Sustainable%20Communities%20Grant%20Program%20will%20provide%20%2475%2C000%20in,Delaware%20and%20Maryland%20service%20area.&text=The%20company%20also%20will%20provide,%2425%2C000%2C%20to%20support%20resiliency%20projects>

Delaware Department of Natural Resources and Environmental Control (DNREC): Community Environmental Project Fund

Summary: “The fund was created by the Delaware General Assembly in 2004 ([74 Del. Laws, c. 203](#)). The legislation authorizes the Department of Natural Resources and Environmental Control (DNREC) to establish a grant fund by withholding 25% of funds collected as penalties for violations of environmental regulations. These funds are returned to the communities where the violations occurred as competitive grants to nonprofit organizations to support community environmental projects.”

“Eligible community environmental projects must mitigate pollution, enhance the environment, or create recreational opportunities.

- **Pollution Mitigation Projects** — Eliminate, minimize, or reduce environmental pollution and reduce the risks to human health and the environment.
- **Environmental Enhancement Projects** — Enhance natural resources, or improve indigenous habitats.
- **Recreational Opportunity Projects** — Enhance natural resources, improve indigenous habitat in order to create recreation opportunities.”

Eligibility: Non-profit organizations. Applicants are required to make a presentation to the Community Involvement Advisory Board (CIAC), which plays an advisory role to the DNREC Secretary in making the final determination of the amount of the grant awards and the recipients.

Amount: The grant award amount is at the discretion of the “DNREC Secretary with input from the Community Involvement Advisory Council.” In FY 2021, the maximum grant award was \$25,000.

Deadline: The application is available around September 1, with the deadline on October 30. There is a workshop for applicants on the second Wednesday and Thursday of November.

Additional Details: Newark is in the Piedmont drainage basin. UD is in Senate District 8 and David P. Sokola is the Senator, and it is also in Representative District 25 and John A Kowalko, Jr. is the Representative.

Link: <https://dnrec.alpha.delaware.gov/community-services/environmental-project-fund/>

Environmental Protection Agency (EPA): Environmental Education (EE) Grants

Summary: “Under the Environmental Education Grants Program, EPA seeks grant applications from eligible applicants to support environmental education projects that promote environmental awareness and stewardship and help provide people with the skills to take responsible actions to protect the environment. This grant program provides financial support for projects that design, demonstrate, and/or disseminate environmental education practices, methods, or techniques. Since 1992, EPA has distributed between \$2 and \$3.5 million in grant funding per year, supporting more than 3,800 grants.”

Eligibility: College or university.

Amount: The grant award amount is at the discretion of the EPA.

Deadline: 2021 Grant Competition closes on December 6, 2021.

Link: <https://www.epa.gov/education/grants>

EPA: Pollution Prevention Grant Program

Summary: “Pollution Prevention (P2) Grants provide technical assistance to businesses in order to help them develop and adopt source reduction practices (also known as “pollution prevention” or “P2”). P2 means reducing or eliminating pollutants from entering any waste stream or otherwise released into the environment *prior to recycling, treatment, or disposal*. In keeping with the Pollution Prevention Act of 1990, EPA is encouraging P2 because implementing these approaches can result in reductions in toxic pollutants, the use of water, energy and other raw materials, while also lowering business costs. P2 grants are awarded to States, colleges and universities (recognized as instrumentalities of the state), and federally-recognized tribes and intertribal consortia.”

Eligibility: College or university.

Amount: “EPA is awarding approximately \$9.3 million in total federal pollution prevention grant funding over a two-year funding cycle. EPA anticipates that it will award these individual grant projects ranging in the amounts of \$25,000 to \$498,000 once all legal and administrative requirements are satisfied.”

Deadline: Currently closed. Applications were due April 30, 2020.

Link: <https://www.epa.gov/p2/grant-programs-pollution-prevention>

EPA: Environmental Justice Small Grants Program

Summary: “The Environmental Justice Small Grants (EJSG) program awards grants that support community-driven projects designed to engage, educate, and empower communities to better understand local environmental and public health issues and develop strategies for addressing those issues, building consensus in the community, and setting community priorities.”

“These grants are for one-year projects. Given projected increases in extreme weather events and the vulnerability of underserved populations, this opportunity will emphasize projects that address emergency preparedness and increase resiliency, as well as projects that include the needs of US military veterans and homeless populations.”

Eligibility: Incorporated non-profit organisations, federally recognized tribal governments, and tribal organizations. Non-eligible organizations can partner with eligible entities on an Environmental Justice Small Grants project.

Amount: “The EJSG program will award approximately \$1.5 million nationwide for this competitive opportunity. EPA anticipates awarding approximately 50 grants (5 per EPA region) of up to \$30,000 each. “

Deadline: Currently closed. Applications were March 8, 2019, but grants were given in 2020.

Link: <https://www.epa.gov/environmentaljustice/environmental-justice-small-grants-program>

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MINI-REPORTS

Building Temperature Control 🌡️

University of Delaware – Building Temperature Control

Problem Statement

Building temperature control and its impacts on energy consumption in buildings has been discussed several times in scientific literature (Yamtraipat et al. 2004; Wang et al. 2013; Yang et. al. 2014). Building temperature control is a potential area for UD to provide thermal comfort for building occupants while saving significant amounts of energy due to the building cooling and warming set-points control. Some of the academic literature is discussed in this report to emphasize on the importance of this issue.

Overview

Occupant's Thermal Comfort

A recent literature survey of indoor environmental conditions has found that thermal comfort is ranked by building occupants to be of greater importance compared with visual and acoustic comfort and indoor air quality (Yang et. al. 2014).

Thermal comfort has been known to play a key role in determining perceived comfort level of occupants and indoor environmental quality (IEQ). Studies on the impact of high performance buildings on their occupants indicate that IEQ influences occupant comfort significantly (Golbazi & Aktas 2018).

The International Energy Conservation Code (IECC) is commonly used to improve building energy efficiency, and its multiple iterations have been adopted by numerous countries, as well as most states in the U.S. Building energy codes such as the International Energy Conservation Code (IECC), are indeed helpful for building energy consumption controls. While a necessity, these codes are not always optimal. Studies show that passive and active technologies and controls can reduce building total energy consumption by 39% in addition to and beyond the energy efficiency gains required by the 2012 IECC (Golbazi & Aktas 2018). In fact, Yun et al. conducted a survey and showed in their study that in Korea, an office occupant would feel comfortable even at 28°C depending on the previous running mean outdoor temperature, 2 °C higher than the 26°C stipulated in the Korean Standard (Yun et al. 2012).

Temperature Settings and Energy Savings

In general, in developed countries HVAC is the largest energy end-use, accounting for about half of the total energy consumption in buildings especially non-domestic buildings (Yang et al. 2014). According to the literature, building temperature set point can alter energy consumption in buildings, especially in commercial and large buildings. Chow and Lam (1992) found that in Hong Kong climate, raising the

summer set point temperature (SST) from 21.5 to 25.5 degree C, has reduced the building cooling energy by 20% (Chow & Lam 1992). Similarly, in Montreal, raised SST from 24.5 to 25.5 degree C during 9:00 to 15:00 and to 27 degree C from 15:00 to 18:00 has reduced the chilled water consumption by 40% and energy budget for HVAC system by 11% (Zmeureanu & Doramajian 1992).

In Melbourne, Roussac et al. showed that raising the office temperature by only 1 degree C has saved 6% HVAC electricity consumption in the building (Roussac et al. 2011). In another study, Sadineni and Boehm explained that raising the SST from 23.9 to 26.1 during 4-7 PM, which was the peak electrical energy demand time, has reduced the energy demand by 69% in a residential building in Las Vegas (Sadineni & Boehm 2012). Another study, in Singapore, the building cooling energy reduced by approximately 13% when they changed the SST from 26°C in average to 26°C (Sekhar 1995). **TABLE 1** (Yang et al. 2014) summarizes the aforementioned studies.

TABLE 1. Summary of Energy Savings in Cooled Buildings

City (climate)	Building Type	Measure	Energy savings
Hong Kong SAR (subtropical)	Office	Raise SST from 21.5 °C to 25.5 °C (SST = summer set point temperature).	Cooling energy reduced by 29%.
Montreal (humid continental)	Office	Raise SST from 24.6 °C to 25.2 °C (during 09:00–15:00) and up to 27 °C (during 15:00–18:00).	Chilled water consumption reduced by 34–40% and energy budget for HVAC by 11%.
Singapore (tropical)	Office	Raise SST from 23 °C to 26 °C.	Cooling energy reduced by 13%.
Melbourne (oceanic)	Office	Static (raise SST 1 °C higher) and dynamic (adjust SST in direct response to variations in ambient conditions).	HVAC electricity consumption reduced by 6% (static) and 6.3% (dynamic).
Las Vegas (subtropical desert)	Home	Raise SST from 23.9 °C to 26.1 °C (during 16:00–19:00).	Peak electrical energy demand reduced by 69%.

UD Building Temperature Control

The findings in the literature relate to UD's buildings in terms of temperature control. Several occupants in UD buildings have expressed their dissatisfaction about the building indoor temperature control especially during the summer months when Delaware experiences high summer temperatures. Despite the high outdoor temperatures, UD building temperature seems to be colder than the comfort level during the summer months and warmer than the comfort temperature during the winter months. During the summer, because of the cold indoor temperatures, some occupants use their personal electric heaters, which add up to the energy consumption of the buildings in addition to the energy consumption for cooling down the building. This issue was brought up by occupants at the Interdisciplinary Science and Engineering (ISE) laboratory on Newark campus. Later the same problem was brought up by students working in other labs such as Spencer

Lab. This is an issue worth examining because it indicates that the building cooling set point could be higher in summer and lower in winter, which would help saving a significant amount of energy in these buildings. According to Yamtraipat et al., the mean energy consumption reduction corresponding to a 1 degree C increase of the set point in summer in office buildings in Thailand is about 6.14% (Yamtraipat et al. 2004).

The steps to look into this issue in UD are:

- Searching for the right energy code that is in action in DE.
- Investigating the temperature set points given by these codes.
- Figuring out what temperatures UD considers for the buildings and why.
- Finding if UD is within the standards suggested by the regulations.
- Finding contact information for people in charge.
- Taking an action for meeting the thermal comfort and energy savings in the buildings.

Recommendations

Findings show that UD's building heating is primarily sourced from natural gas (Zhang et al. 2008). Natural gas is a safe, clean and efficient fuel for both home and business use. It is used in many areas of the Newark campus for building temperature control, hot water, and dining operations.

Cooling and Heating of Workplaces

UD has decided to save energy cost by raising the set temperature of University buildings to 76 degree F (24.4 degree C) during the summer months and lowering the set temperature of the same buildings to 68 degree F (20 degree C) during the winter months (UDEL).

According to the Delaware Department of Natural Resources and Environmental Control (DNREC): "Delaware has adopted national and international energy conservation codes to guide state-wide rules and regulations for the building sector. DNREC's Division of Climate, Coastal and Energy issues and regularly updates regulations based on these standards, which come from the International Code Council (ICC) and the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)" (DNREC). Delaware updated regulations in December 2019.

The International Energy Conservation Code (IECC) was studied to understand what standards they impose to the buildings in order to be within IECC standards. IECC has mandatory temperature settings for commercial buildings in different climate zones. Delaware is in climate zone 4A and the maximum temperature suggested is 75 degrees F for cooling and the minimum temperature is 72 degrees F for heating (IECC). With this, UD buildings are to be in the range. Another factor for automatic thermostats is the temperature dead band of 5 degree F. UD is using 68 and 76, which has a dead band of 8.

With the findings above, UD building temperature control is in agreement with the energy codes. However, based on the academic literature discussed in this report, it is clear that by revisiting the occupants comfort and the building temperature control, there is still room for UD for potential energy savings while bringing higher thermal comfort for the building occupants.

Bibliography

Chow, T., and Lam, J. 1992. "Thermal Comfort and Energy Conservation in Commercial Buildings in Hong Kong." *Architectural Science Review* 35(2): 67-72.

Delaware Department of Natural Resources and Environmental Control (DNREC). "Building Energy Codes." *Delaware Gov* <https://dnrec.alpha.delaware.gov/climate-coastal-energy/efficiency/building-energy-codes/> accessed 5 February 2021.

- Golbazi, M., and Aktas, C. 2018. "Energy Efficiency of Residential Buildings in the US: Improvement Potential Beyond IECC." *Building and Environment* 142: 278-287.
- International Energy Conservation Code (IECC). "Chapter 3 [CE] General Requirements, Section C301 Climate Zones." *UpCodes* https://up.codes/viewer/colorado/iecc-2015/chapter/CE_3/ce-general-requirements#CE_3 accessed 5 February 2021.
- Mui, K., and Chan, W. 2003. "Adaptive comfort temperature model of air-conditioned building in Hong Kong." *Building and Environment* 38(6): 837-852.
- Roussac, A., Steinfeld, J., and de Dear, R. 2011. "A Preliminary Evaluation of Two Strategies for Raising Indoor Air Temperature Setpoints in Office Buildings." *Architectural Science Review* 54: 148-156.
- Sadineni, Suresh B., and Boehm, Robert F. 2012. "Measurements and Simulations for Peak Electrical Load Reduction in Cooling Dominated Climate." *Energy* 37(1): 689-697.
- Sekhar, S. 1995. "Higher Space Temperatures and Better Thermal Comfort – a Tropical Analysis." *Energy and Buildings* 23(1): 63-70.
- University of Delaware (UDEL). "Maintenance." *University of Delaware* <https://sites.udel.edu/freas-maint/> accessed 5 February 2021.
- Wang, Nan., Zhang, Jiangfeng., and Xiaohua, Xia. 2013. "Energy Consumption of Air Conditioners at Different Temperature Set Points." *Energy and Buildings* 65: 412-418.
- Yamtraipat, N., Khedari, J., Hirunlabh, J., and Kunchornrat, J. 2006. "Assessment of Thailand indoor set-point impact on energy consumption and environment." *Energy Policy* 34(7): 765-770.
- Yang, L., Yan, H., & Lam, J. 2014. "Thermal Comfort and Building Energy Consumption Implications—a Review." *Applied Energy* 115: 164-173.
- Yun, G., Kong, H., and Kim, J. 2012. "The Effect of Seasons and Prevailing Environments on Adaptive Comfort Temperatures in Open Plan Office Indoor." *Indoor and Built Environment* 21(1): 41-47.
- Zhang, X., van Boekhold, B., Robinson, C., Veerabhadrapa, V., Broderick, C., Parsons, R., and Reese, C. 2008. "A Sustainability University of Delaware: Carbon Footprint." *University of Delaware* <https://cpb-us-w2.wpmucdn.com/sites.udel.edu/dist/e/763/files/2017/02/University-of-Delaware-Greenhouse-Gas-Emission-Inventory-2009-2fuwsah.pdf> accessed 4 February 2021.
- Zmeureanu, R., and Doramajian, A. 1992. "Thermally Acceptable Temperature Drifts can Reduce the Energy Consumption for Cooling in Office Buildings." *Building and Environment* 27(4): 469-481.

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MINI-REPORTS

Plastic Bag Ban

Delaware – Plastic Bag Ban

Problem Statement

The accumulation of plastic bag waste is a mushrooming problem. In 2018, the United States generated 4.20 million tons of plastic bags, sacks and wraps. Most of this waste was deposited in landfills; only 10% of the plastic bags were recycled (EPA 2020). The state of Delaware also contends with the consequences of plastic bag waste. It is estimated that Delawareans use about 434 plastic bags, per person, annually (DNREC 2020a). This rate of usage crowds landfills (annually Delaware landfills receive approximately 2,400 tons of plastic bag waste) and it also contributes to Delaware’s growing litter problem on its beaches (DNREC 2020a). In 2019, over 2,100 plastic bags were uncovered on Delaware beaches in a one-day clean up event, the Delaware Coastal Cleanup (DNREC 2020b). The Delaware Coastal Cleanup found just over 1,900 plastic bags in its day-long event the previous year so it is clear that plastic bag waste is a worsening problem for Delaware beaches (DNREC 2020b). It is evident that action must be taken to address plastic bag usage in the state of Delaware to counteract this growing problem.

Overview

In 2019, the Delaware General Assembly amended Title 7 of the Delaware Code to call for a ban on plastic carryout bags. This plastic bag ban, which went into effect January 1st, 2021, applies to stores with at least 7,000 square feet of retail space, or stores with three or more locations, each more than 3,000 square feet. Restaurants are exempt. Stores subject to the ban are still able to provide plastic bags for specified purposes (i.e. for an unwrapped food item), and they are also able to provide paper bags free of charge to the customer. In some cases, stores may even qualify for an exemption, allowing them to provide plastic bags to

their customers. In the case of an exemption, the store is still required to establish an at-store recycling program that allows customers to return their dry/clean plastic bags and film to the store after use (State of Delaware 2019).

Several countries and a number of U.S. states have benefitted from imposing plastic bag bans, along with plastic bag fees which can act as “de facto ban(s) on free bags” (Wagner 2017). In Ireland, plastic bag usage decreased by 90% per capita within the first year of a €0.15 tax on plastic bags in 2002 (Wagner 2017). The state of Maine observed plastic bag usage decrease by 267 million bags in just a year when a soft ban was introduced in 1990 (Wagner 2017). The soft ban prohibited retail establishments from providing plastic bags to their customers unless a customer explicitly asked for one. Washington DC observed a 72% decrease in the amount of plastic bags found in Potomac River watershed clean-ups in the four years following the implementation of their five-cent plastic bag tax (AFF 2014). With this plastic bag tax, businesses in Washington DC stood to benefit as well: of the 5-cent tax, one-cent to two cents was allocated to business. The rest of the tax went towards educational programs and clean up of the Anacostia river (DC DOEEa). Finally, California benefitted from implementing a plastic bag fee: six months after SB 270 (the law that introduced the 10-cent fee) went into effect there was an 85% reduction in the number of plastic bags and a 61% reduction in the number of paper bags provided to customers (CalRecycle 2019).

Delaware’s recent plastic bag ban is a step in the right direction, and an additional plastic bag fee should be considered. However, further consideration needs to be given to some of the ways in which a plastic bag ban, or “de-facto ban” via a fee, can go awry. For instance, Washington DC’s five-cent tax became controversial when news broke that “only about one-third” of the state-collected portion of the tax actually went towards clean-up efforts (Brittain & Rich 2015). Much of the tax was allocated to providing educational experiences for children and towards personnel costs (Brittain & Rich 2015). Another concern is that the initial progress seen after adoption of a plastic bag ban initiative may erode over time. For example, in Ireland, annual per capita consumption of plastic bags dropped from 328 to 21 bags in the first year after adoption of a plastic bag tax but increased to 31 bags in the second year. Researchers have seen such backsliding occur in the wake of other plastic bag bans, and refer to this phenomenon as “the rebound effect” (Wagner 2017). Plastic bag bans can result in an increase in paper bag usage. Steps can be taken to reduce the paper bag usage increase, however. Legislators can link a paper bag ban to plastic bag ban initiatives. Stores can also provide “inexpensive reusable bags (i.e. \$0.15)” which has been shown to decrease consumers’ newfound reliance on paper bags in the aftermath of a plastic bag ban (Wagner 2017).

As mentioned above, there have been a variety of approaches to plastic bag bans, or “de facto bans” in the form of a plastic bag fee. These approaches can inform the state of Delaware in future plastic bag legislation going forward because they provide blueprints for the state to model itself after. At the university level, the University of California (UC) system committed to a comprehensive plan to reduce its plastic consumption in March 2020 (Hewitt 2020). The plan seeks to eliminate all non-essential plastics from the UC school system through a sequential policy implementation (UCOP 2020). First, it banned plastic bags in retail and food service establishments on January first of this year (2021) (UCOP 2020). Later in 2021, the UC system will call for the elimination of single-use plastic dining accessories- with exceptions for accessibility needs (UCOP 2020). This step will be coupled with the implementation of reusable and compostable food service items, as well (UCOP 2020). And finally, in 2023, the UC institutions will replace single-use plastic beverage bottles with water refill stations (UCOP 2020). Ultimately, this stepwise approach has the potential to be effective because it takes full advantage of the UC school system’s purchasing power. It is also logical from an environmental impact perspective. This point was reflected by Nicole Haynes, the chapter chair for the California Student Public Interest Research Group: “We have passed the point where we should be banning plastic one-by-one through bag, bottle, and takeout container

bans. Studies continue to show us how much of a detriment plastic is to our environment and public health, so we need commitments like this that will tackle the bulk of plastic products and packaging” (CALPIRG Students 2020).

At the state-wide level, Washington DC is an applicable model. Washington DC’s five-cent plastic bag fee deters customers from using plastic bags. Additionally, the five-cent bag fee allows businesses the opportunity to benefit: of the five cents, one-cent automatically goes back to the business, and the business can keep up to two-cents of the fee if they offer a rebate to customers that bring reusable bags (DC DOEEb). These rebates, then, can incentivize customers to substitute reusable bags for plastic ones. Finally, allocating the remaining three-cents to government environmental efforts has the potential to reduce plastic bag litter, as seen with the Anacostia River. As a caveat, the state of Delaware should learn from the controversy regarding Washington DC’s assignment of the tax-collected funds. However, conceptually, Washington DC’s plastic bag tax is still a useful template.

Rationale for Intervention

A plastic bag ban is intended not only to reduce a large portion of single-use plastic in the waste stream but also to reduce the level of environmental damage and economic loss (World Economic Forum 2016). Plastic bag bans have been shown to reduce the use of single-use plastic bags by up to approximately 70% when accounting for increased sales of trash bags (Taylor 2019). In Delaware, the ban will apply to all retailers meeting inclusion criteria, resulting in a reduction of access to single-use plastic bags in and around UD campus locations as well.

Current Delaware rules allow for the provision of free single-use paper bags for free in addition to selling reusable bags (State of Delaware 2019, Chapter 166). However, while paper bags have a smaller environmental impact than plastic bags, paper bags require more water, fertilizer, and overall energy for production than plastic bags (Muthu et al. 2009). As a result, the National Resources Defense Council (2019) identifies a paper bag fee as a best practice for plastic bag bans in order to encourage the public to use reusable bags. Further, if a fee is collected by the State of Delaware for the voluntary use of single-use paper bags, then funds could be directed toward both additional coastal clean-up efforts as well as providing reusable bags for Delaware’s residents as well as college and university students living in-state. Exemptions would include recipients of food benefits such as the SNAP and WIC and any financial transactions made with purchase cards non-profit and government entities.

Coordination and support from UD with the Delaware Department of Natural Resources and Environmental Control (DNREC) has the potential to increase the institutions AASHE STARS in the Student Life category by promoting a sustainable life skill (AASHE 2020) through the use of reusable bags rather than single use bags and creating an awareness about reducing dependence on single-use plastics. By engaging the campus in the Delaware plastic bag ban the university could promote the use of reusable bags over reliance on both single-use plastic and paper bags and in the process create an awareness about additional strategies to reduce reliance on single-use plastic in general. Further, this strategy can support AASHE STARS credits related to Waste Minimization and Diversion (OP 18; AASHE 2019). A paper-bag fee from the State of Delaware, and subsequent provision of single use bags would serve as a strong reinforcement of this strategy.

Recommendations

Here is a list of recommendations, in light of all the information above, that UD ought to implement to advance its sustainability practices and initiatives:

1. UD should institute a single-use plastic fee (with exceptions for accessibility needs) by January 2022. This date will allow the University to have discussion with, for example, UD dining services and on campus retail establishments to determine any contractual barriers on instituting a ban, implementing, opening a new account for the fees and appropriating revenue accordingly; and
2. The first step should be coupled with the implementation of reusable and compostable food service items. Dining accessories as defined by any plastic utensils, plastic bags, and disposable cups; and
3. UD should collect data on the effects of a plastic dining accessory fee on student consumption of said accessories; and
4. UD should collect any revenue from a dining plastic fee to new or ongoing grants (e.g. Green Grants) or sustainable research; and
5. UD should communicate the rationale for a fee with ample notice and emphasize its intended goal of increasing sustainability campus wide to students; and
6. UD should allow for an exemption on paper bags *only* for the use of food items. All other non-food items (e.g., book, merchandise) are required to charge five cents for the paper bag or the plastic bag.

Appendix

10/30/2020: Call with Mr. Schlachter (DE Env. Program Manager) about waste management in DE.

11/04/2020: UD GSG Sustainability Committee members submitted Public Comments to DNREC.

11/18/2020: Public Comments answered.

Bibliography

Association for the Advancement of Sustainability in Higher Education (AASHE). 2020. "Sustainability Tracking and Rating System Report: University of Delaware." *AASHE*

<https://reports.aashe.org/institutions/university-of-delaware-de/report/2020-01-31/EN/campus-engagement/EN-3/> accessed 8 February 2021.

-- 2019. "STARS Technical Manual Version 2.2." *AASHE* <https://stars.aashe.org/wp-content/uploads/2019/07/STARS-2.2-Technical-Manual.pdf> accessed 25 January 2021.

Alice Ferguson Foundation (AFF). 2014. "Bag Fees at Work: An Analysis of Reduction in Plastic Bags from Potomac River Watershed Cleanups 2007-2014." *Alice Ferguson Foundation*

http://fergusonfoundation.org/wp-content/uploads/2015/05/DC_Plastic-Bag-reduction_OnePager_5-11-15-Final.pdf accessed 8 February 2021.

Brittain, Amy., and Rich, Steven. 2015. "Is D.C.'s 5-cent Fee for Plastic Bags Actually Serving Its Purpose?" *Washington Post* https://www.washingtonpost.com/investigations/nickel-by-nickel-is-the-dc-bag-fee-actually-saving-the-anacostia-river/2015/05/09/d63868d2-8a18-11e4-8ff4-fb93129c9c8b_story.html accessed 8 February 2021.

CALPIRG Students. 2020. "University of California, Berkeley, Leads the Way with the Country's Strongest Single-use Plastic Ban." *CALPIRG Students* <https://calpirgstudents.org/2020/04/16/uc-berkeley-single-use-plastic-ban/> accessed 8 February 2021.

CalRecycle. 2019. "SB 270: Report to the Legislature: Implementation Update and Policy Considerations for Management of Reusable Grocery Bags in California (DRRR-2019-1647)." *California Gov* <https://www2.calrecycle.ca.gov/Publications/Details/1647> accessed 8 February 2021.

Delaware Department of Natural Resources and Environmental Control (DNREC). 2020a. "Delaware's Plastic Carryout Bag Ban." *Delaware Gov* <https://dnrec.alpha.delaware.gov/waste-hazardous/recycling/plastic-bags/> accessed 8 February 2021.

-- 2020b. "2019 Coastal Cleanup Results." *Delaware Gov* <https://dnrec.alpha.delaware.gov/coastal-cleanup/2019-results/> accessed 8 February 2021.

DC Department of Energy & Environment (DC DOEEa). "Bag Law FAQs." *Washington D.C. Gov* <https://doee.dc.gov/page/bag-law-faqs#:~:text=The%20bag%20bill%20focuses%20on,more%20reusable%20bags%20to%20stores> accessed 8 February 2021.

-- b. "Anacostia River Clean Up and Protection Act of 2009." *Washington D.C. Gov* <https://doee.dc.gov/node/7792> accessed 8 February 2021.

Environmental Protection Agency (EPA). 2020. "Frequent Questions Regarding EPA's Facts and Figures About Materials, Waste, and Recycling." *EPA* <https://www.epa.gov/facts-and-figures-about-materials-waste-and-recycling/frequent-questions-regarding-epas-facts-and> accessed 8 February 2021.

Hewitt, Alison. 2020. "UCLA Developing Policy to Phase Out Single-use Plastics." *UCLA* <https://newsroom.ucla.edu/releases/ucla-policy-single-use-plastics> accessed 8 February 2021.

Lindwall, Courtney. 2019. "Do Plastic Bag Bans Work?" *NRDC* <https://www.nrdc.org/stories/do-plastic-bag-bans-work#:~:text=Sure%20enough%2C%20the%20study%20confirmed,70%20percent%20less%20plastic%20overall> accessed 8 February 2021.

Muthu, Subramanian S., Li, Yu., Hu, Jun-Yan., and Mok, Pik-Yin. 2009. "An Exploratory Comparative Study on Eco-Impact of Paper and Plastic Bags." *Journal of Fiber Bioengineering and Informatics* 1(4): 307-320.

Newman, Theresa. 2020. "Hearing Officer's Report: Proposed Regulation Amendments to 7 DE Admin. Code 1301 - Delaware's Regulations Governing Solid Waste New Section 14, Plastic Carryout Bag Ban and At Store Recycling Program and existing Section 3, Definitions." DNREC <http://www.dnrec.delaware.gov/Admin/Documents/dnrec-hearings/2020-R-WH-0025/Hearing-Officers-Report-20201021-2020-R-WH-0025.pdf> accessed 8 February 2021.

State of Delaware. 2019. "150th General Assembly, Chapter 166." *State of Delaware* <https://delcode.delaware.gov/sessionlaws/ga150/chp166.shtml> accessed 8 February 2021.

Taylor, Rebecca L. 2019. "Bag Leakage: The Effect of Disposable Carryout Bag Regulations on Unregulated Bags." *Journal of Environmental Economics & Management* 93: 254-271.

UC Office of the President (UCOP). 2020. "UC Moves to Scrap Single-use Plastics." *University of California* <https://www.universityofcalifornia.edu/press-room/uc-moves-scrap-single-use-plastics#:~:text=Plastic%20bags%20in%20retail%20and%20food%20service%20establishments%20will%20be,with%20exceptions%20for%20accessibility%20needs> accessed 8 February 2021.

Wagner, Travis P. 2017. "Reducing Single-use Plastic Shopping Bags in the USA." *Waste Management* 70: 3-12.

World Economic Forum. 2016. "The New Plastics Economy: Rethinking the Future of Plastics." *World Economic Forum* <https://www.weforum.org/reports/the-new-plastics-economy-rethinking-the-future-of-plastics> accessed 8 February 2021.

Intersectionality of Environmental Sustainability and Mental Well-Being

University of Delaware – Intersectionality of Environmental Sustainability and Mental Well-Being

Problem Statement

The connection between climate change and mental health has been a growing challenge that may negatively impact individuals as well as communities due to distress, depression, anxiety, addiction and suicide (Bourque & Willox 2014). Such responses to the climate crisis are related both directly to natural disasters or environmental degradation and indirectly to broader societal disruption related to economic and infrastructure strains, negative impacts on food supply chains, and demographic shifts (Clayton et al. 2017; Padhy et al. 2015; Page & Howard 2010). Further, simply understanding the extent of social and environmental impacts caused by climate crisis may precipitate distress and anxiety in some individuals (Fritze et al. 2008) and there is small but emerging evidence of its negative impacts on college and university students' hope for the future (McKie et al. 2020).

Overview

In a survey of 152 students across 10 universities in the United States and Canada it was found that many felt a sense of distress over the impact of climate change in the future for themselves and others (McKie et al. 2020). Feelings of distress ranged from hopelessness to guilt of not doing enough. Further, for university students, anxiety about climate change may compound the existing stresses of academic demands (Kluttz 2020), further compounded by the challenges and collective trauma of the ongoing COVID-19 pandemic. For students that belong to minorities or face socioeconomic challenges, these stressors may be further compounded by experiences of marginalization.

However, in general, engaging with climate solutions and eco-friendly lifestyle choices has been found to benefit mental health as they foster efficacy and optimism (Clayton et al. 2017). The American Psychological Association also recommends coupling these actions with coping strategies, finding a sense of personal meaning, as well as establishing and maintaining a sense of community through personal and broader social support (Clayton et al 2017). In turn at the level of social support, communities are called on to plan and prepare to address the physical and psychological aspects of climate change.

Among AASHE STARS Platinum-rated (STARS 2020) institutions addressing the intersection of mental health and climate crisis, efforts have been focused on coping and self-management through workshops/discussion groups, teaching and learning through academic courses, and other awareness efforts (Kluttz 2020).

Recommendations

Given the current compounding challenges mental health and logistic challenges of COVID-19, the current plan of action focuses on the dimension of coping and self-management through the use of an environmental film to spur discussion.

Goals of Proposed Events

1. Connect graduate students to their fellow peers to foster community and build support network;
2. Raise awareness about environmental issues;
3. Educate graduate students about solutions we can utilize right now to make the world better including advocating for sustainable options in our community and companies/corporations/institutions; and
4. Connect ideas of mental health and well-being to climate change and how caring for the environment can positively impact our mental health.

Event 1: Virtual Film Screening

- **What?** Screening of the 2040 documentary with an official Q&A session.
- **When?** March 11th, 2021, 6:00pm.
- **Where?** Online screening.
- **How many people?** Limited to 200 attendees.
- **Fee?** \$500 for the licence to show the film for up to 200 attendees. This was approved by the GSG and advertising for the film began in mid-February 2021.
- **Source?** <https://whatsyour2040.com/>
- **Host(s)?** GSG Mental Health Committee and GSG Sustainability Committee at UD.

Bibliography

Bourque, F., and Willox, A C. 2014. "Climate Change: The Next Challenge For Public Mental Health?" *International Review of Psychiatry* 26(4): 415-422.

Clayton, S., Manning, C., Kyrgsman, K., and Speiser, M. 2017. "Mental Health and Our Changing Climate: Impacts, Implications, and Guidance." American Psychological Association, Climate for Health, and ecoAmerica.

Fritze, J. G., Blashki, G. A., Burke, S., and Wiseman, J. 2008. "Hope, Despair, and Transformation: Climate Change and The Promotion of Mental Health and Wellbeing." *International Journal of Mental Health Systems* 2(13): 1-10.

Kluttz, J. 2020. "Climate Change and Mental Health: A Systemic Approach to Cction in Post-secondary Education." *University of British Columbia* https://sustain.ubc.ca/sites/default/files/2020-11_Climate%20Change%20and%20Mental%20Health_Kluttz.pdf accessed 29 December 2020.

McKie, D., Keogh, D., Buckley, C., and Cribb, R. 2020. "Across North America, Climate Change is Disrupting a Generation's Mental Health." *National Observer* <https://www.nationalobserver.com/2020/12/02/eco-anxiety-youth-mental-health-climate-change> accessed 9 February 2021.

Padhy, S. K., Sarkar, S., Panigrahi, M., and Paul, S. 2015. "Mental Health Effects of Climate Change." *Indian Journal of Occupational & Environmental Medicine* 19(1): 3-7.

Page, L. A., and Howard, L. 2010. “The Impact of Climate Change on Mental Health (but will Mental Health be Discussed at Copenhagen?).” *Psychological Medicine* 40: 177-180

Sustainability, Tracking, Assessment & Rating System (STARS). 2020. “Participate: Scoring & Recognition.” *Association for the Advancement of Sustainability in Higher Education (AASHE)* <https://stars.aashe.org/participate/> accessed 30 January 2021.



MINI-REPORTS

Newark Bikeshare Program

University of Delaware – Newark Bikeshare Program

Problem Statement

This mini-report details the pros and cons of having a bike-sharing system at UD, and also at making UD more bicycle-friendly. This mini-report discusses (i) bike-sharing and cycling in general, (ii) bike-sharing schemes at other universities and the bicycle friendliness of Newark (iii) and, finally, some recommendations are made.

Overview

In the 1960s one of the first bike-sharing systems showed up in Amsterdam and the UK (Marshall 2018). The main problems at the start were theft and cycling etiquette - these are still the two issues that most innovations, over time, have attempted to resolve. The year 2019 saw 136 million bike rides (NACTO 2019) in the U.S., with the younger population in the country projected to adopt bike-sharing, especially in university settings (Harris 2011).

Approximately 50% of all trips in the U.S. happen within a 20-minute bike ride. Decarbonisation, traffic decongestion, a reduced risk of cardiovascular diseases due to increased physical activity, and more, are environmentally-friendly and healthy consequences of a transition from fossil-fuel rides to fossil-fuel-free rides (Rails to Trails 2019). Although exact numbers in Newark (DE) for each of these effects are unknown, there are some popular bikeable voyages (distances and timings courtesy of Google Maps):

1. Harrington commons/Perkins/Russell Dining Hall to McDowell Hall/Carpenter Sports Building, 0.8-1 miles or 7-10 minutes on a bike or 27-30 mins by walk;
2. Gore/Smith Halls to Townsend Hall/UD Creamery, 1-1.1 miles or 8-10 minutes on a bike or 21-23 mins by walk;
3. East Main Street to Star Campus, 1.5-1.8 miles or 10-12 minutes on a bike or 34-36 mins by walk; and

- Clayton Hall/George Reading Hall to Gore Hall, 1-1.1 miles or 6-7 minutes on a bike or 18-20 mins by walk.

A publication by the World Resources Institute (2020) details studies that were conducted in China of 360 cities with dockless bike-sharing systems and records of 47 million bike rides every day (Jiang et al. 2020). Amongst other things, the publication highlights: the health benefits associated with cycling, with 60,000 fewer deaths annually amongst China’s 235 million bike-share users; 17-45% of bike rides (depending on the city) replaced miles travelled by some motorized vehicles; total CO₂ emissions in China are expected to be reduced by 4.8 million tonnes annually; and cycling is considered a popular choice of transportation, especially during a pandemic due to the ability to socially distance (unlike other methods of public transportation) as inferred from a 60% and 150% increase in cycling in Guangzhou and Beijing, respectively, since the pandemic started (Jiang et al. 2020).

Dating back, 2016 data found that at least 1,000 cities across the world had bike-sharing systems and as of 2019, at least 150 universities across the U.S. (UD is not rated) have been recognized for bicycle friendliness by the League of American Bicyclists (LAB) with many universities having bike sharing systems (as shown in **TABLE 1**) (LAB, A).

Given that cycling can foreseeably become the norm for short commutes in an urban setting, in the future educating students about cycling and promoting a cycling culture would be very useful towards helping students make sustainable decisions.

TABLE 1. Bike-sharing in Select U.S. Universities

Name	Bike Share company	Infrastructure	Comments	Cost for users
Princeton University (Knapp 2020; Kelly 2016)	Zagster	“..more than a dozen bike racks and 75 bikes”	The company expanded its operations in the area, e.g. into the Mercer county Parks system	One-time fee of \$20 which allows up to 2 hours at a time; \$2 per extra hour
University of Colorado, Boulder (UCB; Boulder Bike Sharing)	Boulder Bike Sharing (non-profit)	“..47+ stations and 300+ bikes”	“..with annual trip totals increasing year over year from 18,469 in 2011 to more than 100,000+ in 2018”	For students, no one-time fee; free for first 60 minutes; \$3 per extra 30 mins
University of Wisconsin-Madison (UWM)	Madison B-Cycle	“..300 bikes at 40+ stations throughout the capital city!”	“As of June 2019, all bikes in the Madison B-Cycle fleet are electric bikes”	\$20 monthly pass discounted for UW members. Includes 60 mins rides, \$3/ extra 30 mins
University of Arizona (UA, A; UA, B)	Tugo City Bikeshare and Cat-Wheels Bike sharing.	Tugo has 330 bikes at 36 stations in and around campus.	They have a Bike-Valet program and the Cat-wheels program is free to UA members	\$80 per year
Texas A&M (TAMU) (TAMU; Kellstedt et al. 2019)	Veo Bikes	1200+ bikes, with dozens of docks	As of 2019, has one bike per 26 TAMU members	\$70 per semester, and many other options available

Cycling in Newark and at UD

In 2018, LAB scored Delaware 6th in the *Bicycle Friendliness Rankings* amongst 50 states (LAB, B). Newark is the only city in Delaware to be rated a “Bicycle Friendly Community” with a Bronze ranking, and this is expected to increase to Silver, in the 2022 rankings, according to BikeNewark (BikeNewark).

As of Summer 2021, there is no bike sharing system in the city of Newark. Current cycling infrastructure and services include trails around and within Newark, bike racks and some repair stops near most UD campus buildings (UD), and a popular community based bike and repair shop, the Newark Bike Project.

There have been some attempts at implementing a bike share program at UD, but to no avail (Abraham 2015; Shannon 2015). According to previous Sustainability Committee minutes, initiatives in the past did not follow through because necessary collaboration with multiple stakeholders (e.g. Newark City Council) was unsuccessful, and problems regarding the safety of users and the public at large by investing in such a venture.

Recommendations

UD should apply for a rating from LAB. Students can apply for the Bicycle Friendly University (BFU) program with the help of a faculty advisor (the application cost is \$100). This would assist UD by clearly understanding how it can improve in being a more bicycle-friendly institution (LAB, A). This is also recommended by BikeNewark (BikeNewark).

As per the AASHE STARS report card (2020), UD scores 1.20 out of 2.00 credits in the “Support for Sustainable Transportation Area” (STARS). There are a total of 4 points available in this category and bicycle-friendliness ratings like those offered by LAB can help increase this score. In particular, a Silver rating through the BFU program would give UD 0.5 points in the STARS report. These ratings include bicycle-friendliness in general, not just bikeshare initiatives.

Bikeshare-wise, UD could opt for a free-floating bike-sharing system like at TAMU (Kellstedt et al. 2019). In this system, bicycles are tagged with a GPS device so that no special docks would be required (Pal & Zhang 2017). There are many companies, such as Veo Bikes, used at TAMU that provide such services. Abandoned bicycles on campus could also be used as part of the program.

Helmets should be provided by the cyclist, and first-time cyclists should be informed about cycling etiquette. To this end, UD could establish a partnership with BikeNewark as BikeNewark can help students, faculty, staff and residents enhance their awareness of safe cycling practices.

Concluding Remarks

Generally, UD ought to consider the effects of replacing foot traffic with bicycle traffic and building more cycle racks to help reduce the clutter of bikes (and the abandonment of bicycles in a free-floating system). As many media reports have highlighted in recent years, free-floating systems can be a nuisance to pedestrians. However, many cities and universities can adjust to the changes in traffic and reduce such problems through educational programs and awareness campaigns. Collaboration with Newark City Council, BikeNewark, and UD Police would, therefore, be crucial in raising awareness and providing adequate maintenance to the bikeshare program.

Bibliography

Abraham, Tony. 2015. “UD Wants to Launch a Bike-Share Program.” *Technically*
<https://technical.ly/delaware/2015/11/03/university-delaware-bike-share/> accessed 20 January 2021.

BikeNewark. "League of American Bicyclists Bicycle Friendly Community Program." *BikeNewark* <https://bikenewark.org/our-work/related-activities/> accessed 20 January 2021.

Boulder Bike Sharing. "History." *Boulder Bike Sharing* <https://www.boulderbikesharing.org/about> accessed 20 January 2021.

Harris, Kenneth W. 2011. "Bike to the Future." *The Futurist*. World Future Society. MD: Bethesda.

Jiang, Hui., Song, Su., and Lu, Lu. 2020. "Dockless Bike Sharing can Create Health, Resilient Urban Mobility." *World Resources Institute* <https://www.wri.org/blog/2020/11/dockless-bike-sharing-can-create-healthy-resilient-urban-mobility> accessed 20 January 2021.

Kellstedt, Debra., Spengler, John O., Bradley, Katie., and Maddock, Jason E. 2019. "Evaluation of Free-Floating Bike-Share on a University Campus Using a Multi-Method Approach." *Preventive Medicine Reports* 16.

Kelly, Morgan. 2016. "Expanded University Bike-share Program Enhances 'bike culture' for Campus and Town." *Princeton University* <https://www.princeton.edu/news/2016/04/05/expanded-university-bike-share-program-enhances-bike-culture-campus-and-town> accessed 20 January 2021.

Knapp, Krystal. 2020. "Zagster Cancels Princeton Bikeshare Program." *Planet Princeton* <https://planetprinceton.com/2020/06/01/zagster-cancels-princeton-bikeshare-program/> accessed 20 January 2021.

League of American Bicyclists (LAB), A. "Becoming a Bicycle Friendly University." *LAB* <https://www.bikeleague.org/university> accessed 20 January 2021.

-- LAB, B. "Award Database." *LAB* <https://www.bikeleague.org/bfa/awards> accessed 20 January 2021.

Marshall, Aarian. 2018. "Americans are Falling in Love with Bike Share." *WIRED* <https://www.wired.com/story/americans-falling-in-love-bike-share/> accessed 20 January 2021.

National Association of City Transportation Officials (NACTO). 2019. "Shared Micromobility in the U.S.: 2019." *NACTO* <https://nacto.org/shared-micromobility-2019/> accessed 20 January 2021.

Pal, Aritra., Zhang, Yu. 2017. "Free-floating Bike Sharing: Solving Real-life Large-scale Static Rebalancing Problems." *Transportation Research Part C: Emerging Technologies* 80: 92-116.

Rails to Trails. 2019. "Active Transportation Transforms America." *Rails to Trails Conservancy* <https://www.railstotrails.org/resource-library/resources/active-transportation-transforms-america/> accessed 20 January 2021.

Shannon, Josh. 2015. "Bike Share Program Coming to Newark Next Spring." *Newark Post* https://www.newarkpostonline.com/news/bike-share-program-coming-to-newark-next-spring/article_ad8e7a03-7536-5150-a3df-480df61c3dee.html accessed 20 January 2021.

Sustainability Tracking, Assessment & Rating System (STARS). "University of Delaware, OP-18: Support for Sustainable Transportation." *AASHE* <https://reports.aashe.org/institutions/university-of-delaware-de/report/2020-01-31/OP/transportation/OP-18/> accessed 20 January 2021.

Texas A&M University (TAMU). "Veo Bike Share at Texas A&M." *Texas A&M University Transportation Services* <https://transport.tamu.edu/alternative/bicycles/bikeshare.aspx> accessed 20 January 2021.

University of Arizona (UA), A. “Cat-Wheels Bike Sharing Program.” *University of Arizona Parking & Transportation Services* <https://parking.arizona.edu/bicycle/cat-wheels/#:~:text=The%20Cat%20Wheels%20Bike%20Program,%2C%20safe%2C%20and%20sustainable%20fashion> accessed 20 January 2021.

-- B. “Tugo City Bikeshare.” *University of Arizona Parking & Transportation Services* <https://parking.arizona.edu/bicycle/tugo-city-bikeshare/> accessed 20 January 2021.

University of Colorado Boulder (UCB). “Bike Sharing.” *University of Colorado Boulder Environmental Center* <https://www.colorado.edu/center/transportation/bicycle/bike-sharing/#:~:text=Bike%20sharing%2C%20provided%20by%20Boulder,stations%20on%20or%20around%20Campus> accessed 20 January 2021.

University of Delaware (UD). “Bicycle Information.” *University of Delaware* <https://sites.udel.edu/parking/bicycle-info/> accessed 20 January 2021.

University of Wisconsin-Madison (UoWM). “Bike Sharing.” *University of Wisconsin-Madison Transportation Services* <https://transportation.wisc.edu/bicycling/bike-sharing/#:~:text=Madison%20BCycle%20is%20an%20urban,UW%20students%2C%20employees%20and%20affiliates> accessed 20 January 2021.



MINI-REPORTS

Retrofitting University Campus Buildings

University of Delaware – Retrofitting University Campus Buildings

Problem Statement

Worldwide, the building sector is responsible for consuming more than a third of total generated energy and producing a third of anthropogenic CO₂ emissions (Benzar et al. 2020). The poor energy efficiency of older buildings accounts for much of this contribution to climate change (Na & Shen 2020). One way to minimize this contribution is to retrofit older buildings with more energy efficient systems, appliances, or architectural features, thereby reducing operating costs as well.

UD campuses host several centuries- and decades-old buildings, maintained and renovated over time. These older buildings contribute greatly to the >75% contribution of total building energy consumption toward University CO₂ emissions (UD 2020, 4).

Retrofitting these buildings is a feasible step toward reducing UD’s environmental impact with social and economic incentives (e.g., greater student satisfaction, improved university image, reduced long-term operating costs). Considering the wide range of retrofit options and the upgrades already recommended in

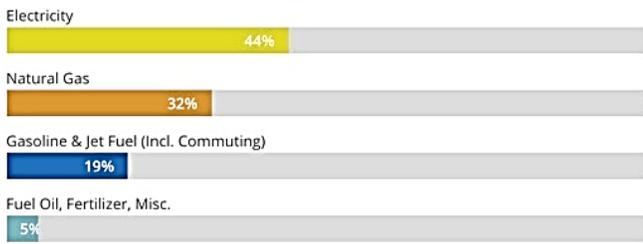
other mini-reports (e.g., lighting, temperature), this mini-report focuses on a few viable options.

Overview

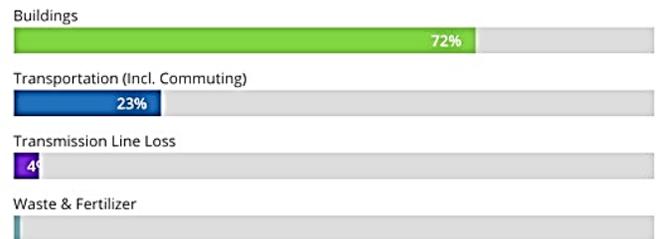
While UD has taken strong initiative to improve campus sustainability through its 2008 Carbon Footprint Initiative and comprehensive Climate Action Plan (2009), the campus is still rated Bronze by AASHE STARS (STARS). UD’s energy consumption contributes toward this rating, and **FIGURE 1** below on energy distribution across campus offers insight into areas of improvement.

FIGURE 1. Breakdown of UD Energy Sources and Application (2007-2019)

UD’s Energy Breakdown:



Where UD uses energy:

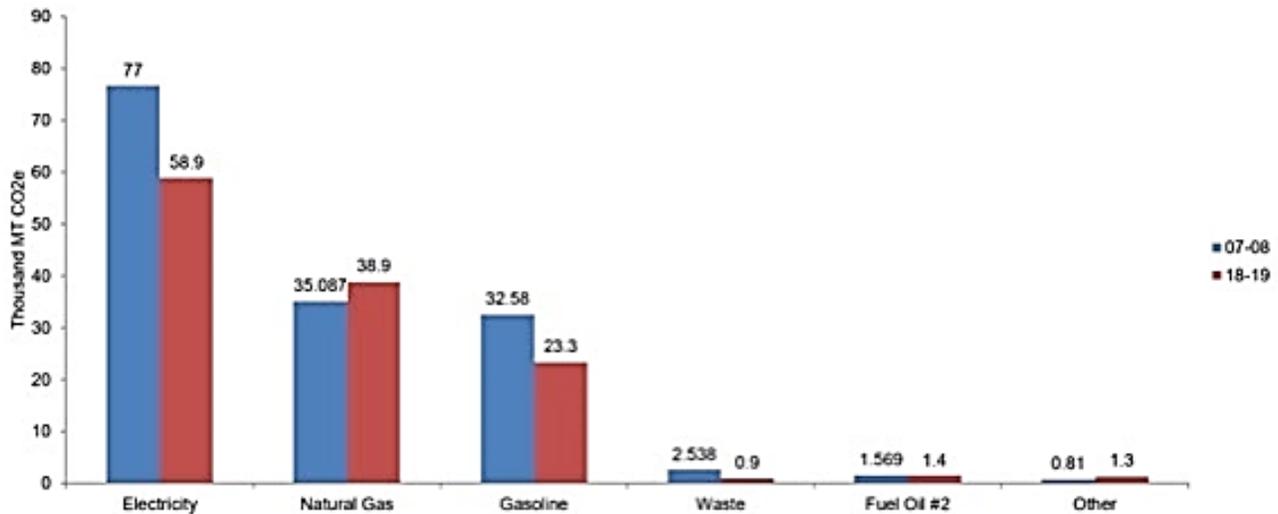


*From FY2007-2019, based on Newark campus greenhouse gas inventory.

Source: (UD, A).

Clearly, buildings are the primary source of energy consumption and related CO₂ emissions, with electricity supplying much of campus power (**FIGURE 2**).

FIGURE 2. UD GHG Emissions by Energy Commodity (2007-2008 and 2018-2019)



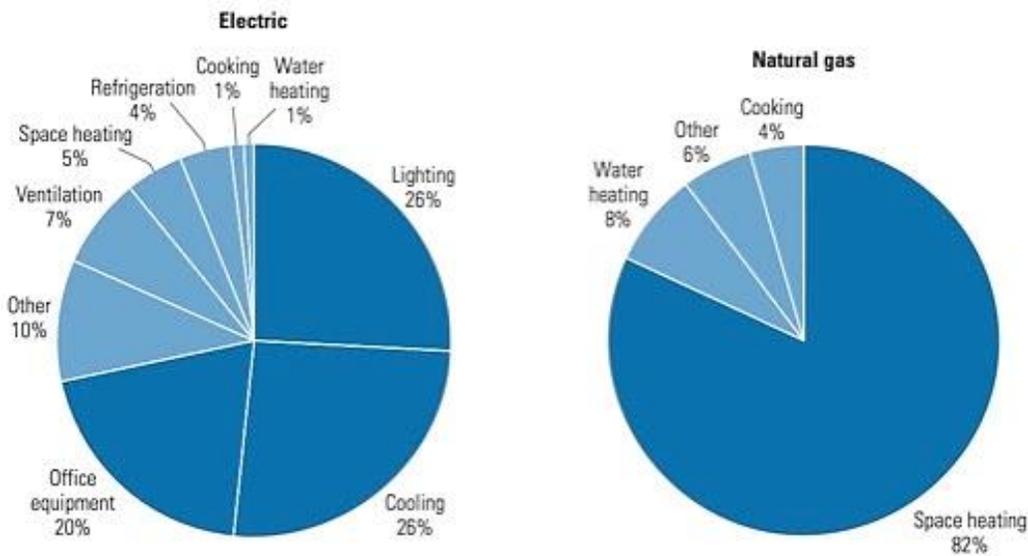
Source: (UD 2020, 5).

FIGURE 3 (see next page) displays electricity and natural gas applications. Lighting, cooling, space heating, office equipment, and ventilation are the primary energy consumers—lighting and many temperature upgrades are omitted from the scope of this report as they are covered in other mini-reports within the Sustainability Report.

UD has made progress since the publication of the Climate Action Plan (UD 2009). The plan reported UD’s intention to “establish an environmental standard for new construction and for retrofits of the

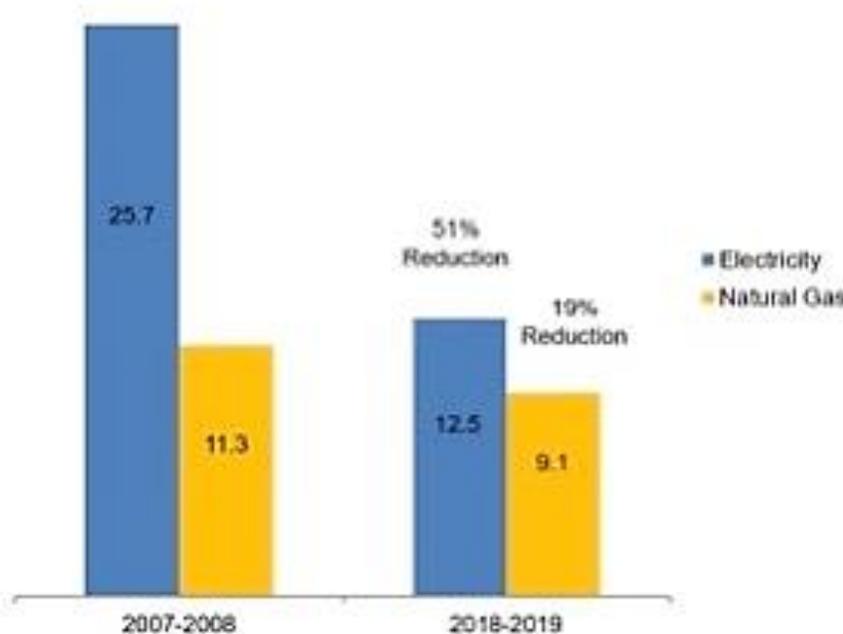
existing building stock that lowers energy requirements and carbon emissions sufficiently to meet LEED Silver,” which is the third best building performance certification by the U.S. Green Buildings Council (UD 2009, 4; LEED). While full-time student enrolment has increased by 4,537 from 2007-2008 to 2019-2020 and Newark campus building area has increased by ~36.8%, greenhouse gas (GHG) emissions have declined by ~16.2% (UD, A). An increase in building efficiency is responsible for this decline (**FIGURE 4**), a remarkable accomplishment by the university (UD 2020, 4). However, the GHG decline nevertheless fails to meet the planned 2020 target for a 20% decrease in emissions (UD 2009, 1; UD, B). Additionally, to attain the new goal of achieving net zero emissions by 2030, despite increasing enrolment and campus expansion, energy efficiency must continue to improve across UD’s campuses (UD 2020, 8; UD, B).

FIGURE 3. Survey Results of Electricity and Natural Gas Distribution in Educational Facilities by Utility (1999)



Source: (Energy Star 2008, 178).

FIGURE 4. Pounds of CO_{2e} Per Building Square Feet in 2007-2008 and 2018-2019



Source: (UD 2020, 5).

Focusing these improvements on retrofitting key older buildings offers: economic benefits, as demonstrated by the Climate Action Plan's (UD 2009) projected \$6 million savings through sustainable initiatives (UD 2017); presents clear environmental benefits (e.g., reduced energy consumption, thereby reducing demand); and establishes UD's collegiate and national reputation as an innovative leader in campus sustainability, especially by showcasing expertise in green technology.

LEED certification standards in the area of Operations and Maintenance, the Energy Star Building Upgrade Manual, and a number of practical sustainability studies offer guidance into retrofitting existing constructions. This mini-report identifies several possible retrofit options for UD campuses, incorporating respective economic and environmental incentives. These options also coincide with UD's plans to undertake deferred infrastructure maintenance projects throughout the next decade (UD 2017).

Findings and Recommendations

Viable retrofit options include metering and monitoring, energy load management, appliance optimization, building envelope upgrades, and ventilation optimization. Out of these options, UD is already prepared to improve metering (UD 2009, 4, 11, 21). Detailed options are below.

1. Metering & Monitoring

The first step in the campus retrofit process is identifying the least energy efficient buildings and sections within them. While building age and maintenance records offer insight, a sustainable option to ensure long-term efficiency is metering. Meters and submeters are devices that measure electricity, gas, water, steam and other utilities, with the latter being devices that can record data from building subsystems or specific appliances (Energy Star 2008, 19). Submeters also allow measurement of instantaneous or interval data, a far more informative measure than the aggregate monthly data offered by utility meters alone (Porst & Winter, 6).

Meters can reveal the least efficient buildings. To identify energy drains within these buildings and consumption schedules, submeters can ideally be installed to each building's electricity and heating, ventilation, and air conditioning (HVAC) systems. If immediate costs are too high, a single submeter can be installed to the utility main meter (Porst & Winter, 22).

Additional submeters can be installed in individual appliances whose energy consumption may be significant.

Metering benefits include quickly flagging system inefficiencies (e.g., unnecessary equipment usage), identifying wasteful operating hours, and benchmarking energy consumption across facilities (WU).

This data enables targeted energy use regulation, either manual or automated, by UD facilities; one study recorded kilowatt hour reductions of 12% to 20% across multiple buildings (ICLEI & IMT). Such decreased energy consumption is environmentally and economically beneficial, resulting in long-term cost reductions for UD.

The oldest constructed or maintained buildings on UD's Newark campus are viable targets for initial metering.

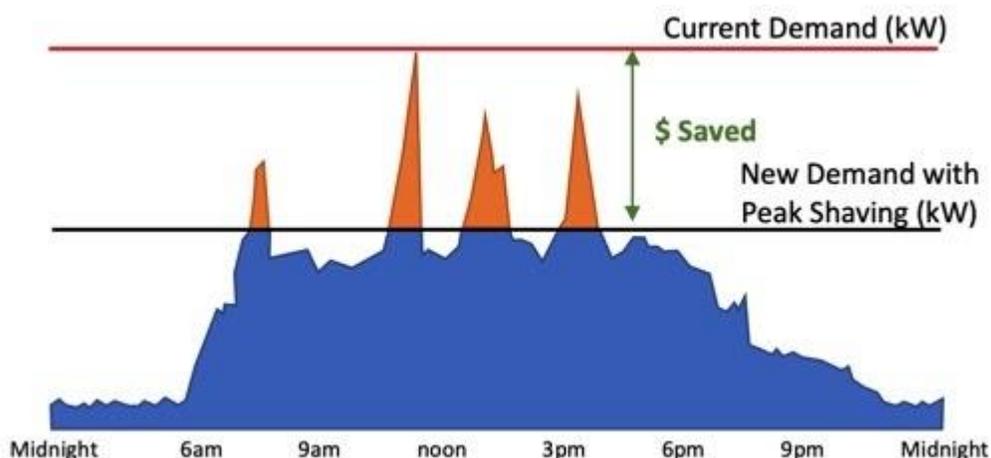
2. Energy Load Management

A rewarding application of metering is identifying wasteful operation and reducing both energy consumption and utility bills through corrective load management.

Electricity for non-residential buildings often charge based on consumption, the total amount of monthly energy consumption, and demand, the highest rate of consumption during a 15-minute peak each month.

Demand charges can account for 30-70% of electricity bills. Utility companies enforce demand charges due to excessive demand on their power supply and reducing building energy consumption during peak periods can greatly reduce both utility costs and energy emissions (Kutkut, 1-4). This is known as peak shaving, whose daily savings are exemplified in **FIGURE 5** below.

FIGURE 5. Illustration of Energy and Utility Cost Savings by Implementing Peak Shaving



Source: (Kutkut, 5).

Peak shaving can be implemented through load shedding or on-site generation.

Load shedding involves first monitoring wasteful systems in inefficient buildings through metering or electronic data loggers, identifying peak demand conflicts, and installing automatic controllers or software to reduce system energy use during peaks. HVAC appliances are prime candidates for load shedding due to inefficient operating hours, as well as batch-type processes. Cost analysis can be utilized to determine whether controller installment cost can be recouped by energy savings in an acceptable time frame (Mort).

On-site generation of electricity during peak hours to avoid demand charges is a more expensive option but can be implemented where UD already uses or plans to use renewable energy sources. Solar arrays with battery storage energy systems can be configured to discharge into targeted buildings at optimal peak times (Ideal Energy).

3. Appliance Optimization

With office equipment contributing to approximately 20% of building electricity consumption, identifying wasteful appliance operations can significantly reduce energy emissions and costs.

Replacing old office equipment with Energy Star-labeled equipment that costs the same as unlabeled versions can reduce electricity consumption up to 50%.

Recommendations in the temperature and lighting mini-reports are also useful to this end.

Installing Energy Star or third-party power management software onto applicable building-wide computer networks will automatically power-down unused devices and can save between \$10 and \$45 per desktop computer annually (Energy Star 2008, 185). UD may be able to save thousands of dollars by installing such cheap software, receiving near instant payback.

4. Building Envelope Upgrades

Besides indoor active energy consumption, a building's external envelope, consisting of "windows, doors,

walls, the roof, and the foundation,” is a major source of energy inefficiency (Energy Star 2008, 61). Temperature dissipation is the primary cause, requiring proper insulation, sealing, and maintenance to minimize. Many technological options are also available to retrofit aging envelopes on UD’s campus. Major areas of envelope upgrades include air infiltration, windows, and roofs—retrofit suggestions for each are listed below.

- **Air infiltration:** typical savings after resolving leaks are approximately 5% for large buildings.
 - Seal all observed air leaks in windows, doors, roofs, and walls;
 - Encourage occupants to log building air leaks, either via website or clipboards—occupants will likely be incentivized by uncomfortable temperatures caused by leaks;
 - Calibrate automatic doors (at little programming cost) to minimize air loss during occupant entries and exits;
 - Install revolving doors if cost-permissive (Energy Star 2008, 61).
- **Windows:** even the best windows offer less insulation than the poorest insulated walls, resulting in the greatest building heat dissipation.
 - Install window films (thin layers of polyester, metallic coatings, and adhesives) on existing windows that limit solar radiation into the building and external heat loss;
 - Replace old windows with spectrally selective glass, low-e systems, gas filled windows, or electrochromic windows (Energy Star 2008, 117).
- **Roofs:** uninsulated or inefficient roofs can reduce building insulation efficacy by up to 20%.
 - Add thermal insulation to the inside of roof surfaces;
 - Implement “cool roofs”—highly reflective surfaces that significantly reduce internal building temperatures and general campus temperatures via the “heat island effect,” with typical energy savings around 20% and short payback periods.
 - Cool roof coatings can be laid on existing older buildings at lower costs, also increasing roof longevity due to decreased thermal expansion and ultraviolet degradation;
 - Can be installed cost-effectively when replacing existing roofs or older HVAC systems (Energy Star 2008, 117).
 - Green roofs—roofs consisting of soil layers and vegetation, offering remarkable insulation, roof longevity, and pleasant campus aesthetics; while UD has completed a green roof on Colburn Laboratory (Thomas 2012), the costs may be excessive for common implementation.
- **Photovoltaic (PV) panels:** current solar cell technology combined with UD’s commitment to advancing solar innovation may offer PV panel roofs as viable retrofit options; 1-3 kilowatts of peak power generation per 10 square meters may reasonably offer payback within a few years (Energy Star 2008, 121).

5. Ventilation Optimization

With ventilation contributing to nearly 7% of building electricity consumption, installing efficient fan motors and matching system size to energy loads offer further retrofit efficiency improvements.

Adding ventilation controllers to monitor and automatically regulate operation is a viable retrofit

option for many ventilation systems. Low-occupancy spaces (e.g., administrative offices, libraries) will see the greatest energy savings, while use in classrooms has also proven cost-effective (Energy Star 2008, 187).

Demand-controlled ventilation is most energy-efficient in high-occupancy areas (e.g., halls, auditoriums, gyms) (Energy Star 2008, 187).

Bibliography

- Benzar, Bianaca-Elena., Park, Moonseo., Lee, Hyun-Soo., Yoon, Inseok., and Cho, Jongwoo. 2020. "Determining Retrofit Technologies for Building Energy Performance." *Journal of Asian Architecture and Building Engineering* 19(4): 367-383.
- Energy Star. 2008. "ENERGY STAR Building Upgrade Manual." *Environmental Protection Agency* <https://www.energystar.gov/buildings/facility-owners-and-managers/existing-buildings/save-energy/comprehensive-approach/energy-star> accessed 30 January 2021.
- ICLEI & IMT. "Commercial Energy Policy Toolkit - Fact Sheet for Local Governments: Submetering." *IMT* https://www.imt.org/wp-content/uploads/2018/02/Commercial_Energy_Policy_Fact_Sheet_-_Submetering.pdf accessed 1 February 2021.
- Ideal Energy. "Peak Shaving with Solar and Energy Storage." *Ideal Energy* www.idealenergysolar.com/peak-shaving-solar-storage/ accessed 1 February 2021.
- Kutkut, Nassar. "Energy Management Through Peak Shaving and Demand Response: New Opportunities For Energy Savings at Manufacturing and Distribution Facilities." *Advanced Charging Technologies* act-chargers.com/wp-content/uploads/2017/03/ACT-White-Paper-Energy-Management-through-Peak-Shaving-and-Demand-Response.pdf accessed 1 February 2021.
- LEED. "Leadership in Energy & Environmental Design." *LEED* leed.usgbc.org/leed.html accessed 30 January 2021.
- Mort, Thomas. "Seven Sustainability Projects: Demand Control." *Air Best Practices* www.airbestpractices.com/sustainability-projects/bill-mgmt/demand-control/seven-sustainability-projects-demand-control accessed 1 February 2021.
- Na, Ri., and Shen, Zhigang. 2020. "Assessing Cooling Energy Reduction Potentials by Retrofitting Traditional Cavity Walls into Passively Ventilated Cavity Walls." *Building Simulation* doi:10.1007/s12273-020-0740-0.
- Porst, Kinga., and Winter, Fred. "High Performance Buildings Submetering." *U.S. General Services Administration* https://www.gsa.gov/cdnstatic/GSA_HPGB_Submetering_Building_Sustainability_Network_2015.pdf accessed 3 February 2021.
- Sustainability Tracking, Assessment & Rating System (STARS). "University of Delaware." *Association for the Advancement of Sustainability in Higher Education (AASHE)* reports.aashe.org/institutions/university-of-delaware-de/report/2020-01-31/ accessed 30 January 2021.
- Thomas, Adam. 2012. "Green Roof." *UDaily* www1.udel.edu/udaily/2013/oct/colburn-green-roof-100212.html accessed 1 February 2021.
- University of Delaware (UD). 2020. "Greenhouse Gas Inventory for the 2018-2019 Academic Year." *University of Delaware* https://cpb-us-w2.wpmucdn.com/sites.udel.edu/dist/e/763/files/2015/10/UD-2018-2019-GHG-Inventory-Report_Final-V2.pdf accessed 1 February 2021.

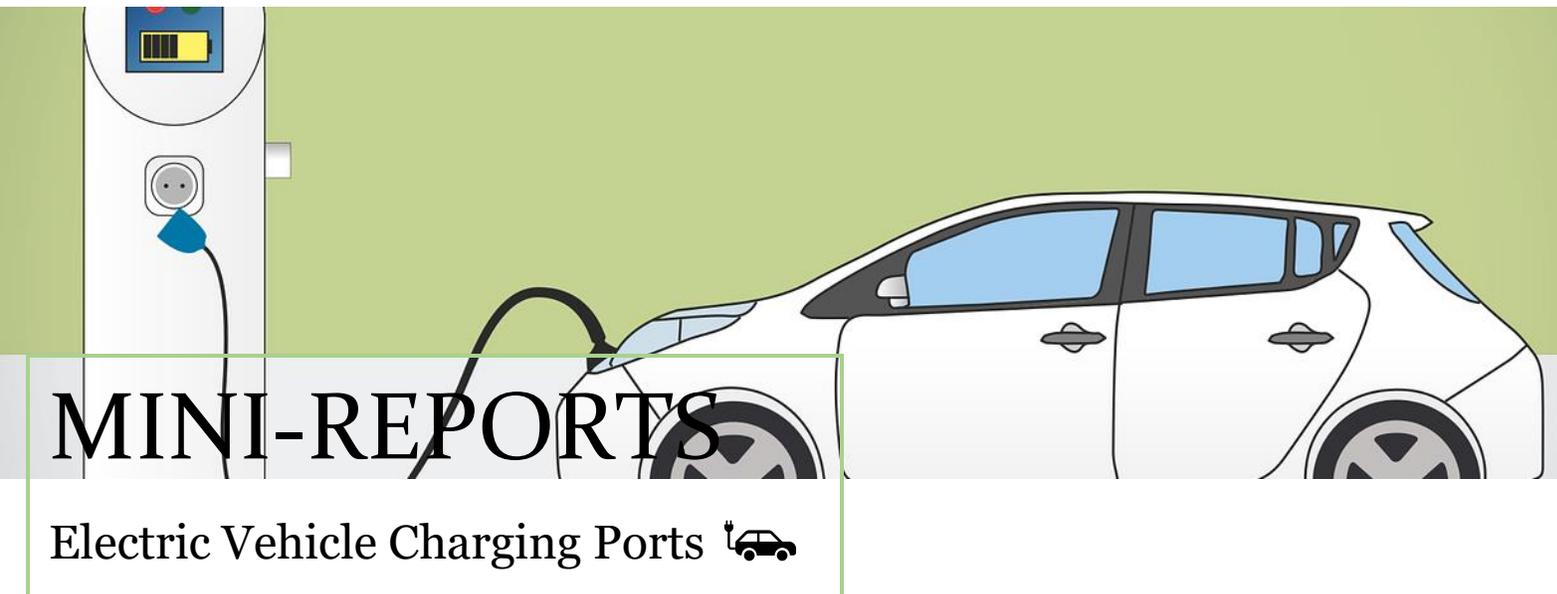
-- 2017. "Opportunities for the Delaware Construction Industry." *University of Delaware* cpb-us-w2.wpmucdn.com/sites.udel.edu/dist/c/6291/files/2017/11/2017_ContractorEvent-2hrwxq2.pdf accessed 30 January 2021.

-- 2009. "University of Delaware Climate Action Plan." *University of Delaware* cpb-us-w2.wpmucdn.com/sites.udel.edu/dist/e/763/files/2018/04/University-of-Delaware-Climate-Action-Plan-sj65oj.pdf accessed 30 January 2021.

-- A. "Energy." *University of Delaware* sites.udel.edu/sustainability/energy/ accessed 30 January 2021.

-- B. "Sustainability." *University of Delaware* <https://sites.udel.edu/sustainability/> accessed 1 February 2021.

Washington University (WU). "Energy Metering." *Washington University in St. Louis* sustainability.wustl.edu/vision-progress/energy-emissions/energy-metering/ accessed 30 January 2021.



University of Delaware – Electric Vehicle Charging Ports

Problem Statement

The infrastructure for electric vehicle ("EV") charging is currently an emerging market across the U.S. (Baresch & Moser 2019, 188). The number of automobiles on the road have continued to rise over the past decade, and hybrid vehicles and EVs continue to take an increasing portion of market share as consumers look towards sustainable alternatives to traditional vehicles (Castrol 2020). The momentous rise of Tesla within the past five years, along with the Chevrolet Volt and the Nissan Leaf, are some of the indications of the staying power of EVs in the automotive marketplace (Baresch and Moser 2019). These vehicles have become more attainable within the past decade, especially as production prices for EV batteries have fallen by over 65% over the past five years (EIA 2020).

With the gradual shift from internal combustion engines to more ecologically-friendly vehicles, such as solar power and hydrogen, the global environment gains an opportunity for healing. However, to fulfill this vision, EV infrastructure is needed. On a more local scale, in Newark (DE), this infrastructure is lackluster. This mini-report examines the feasibility of expanding the current infrastructure of EV charging ports across UD's campuses. While a costly investment, the expanded presence of this infrastructure would be beneficial in the long-term for faculty, staff, and students (including prospective), as well as for local and global ecology. By reducing greenhouse gas emissions from transportation – of which UD produces many – UD's campuses can be healthier for all and enhance quality of life.

Overview

One of the most critical components to expanding service is understanding the variety of plug types for different vehicles. In the U.S., the most popular plug, with an 85% market share, is the SAE J-1772 EV charging connector, which utilizes alternating current (AC) energy. The remaining 15% of plugs utilize direct current (DC) electrical charging for fast charging. DC plugs include Tesla chargers, the CCS charging port, and the CHAdeMO charging port (AFDC). In many countries in the European Union, the CCS port is the standard for quick charging (Mu and Yamamoto 2019). Public charging outlets are also be designated by their charging rate. Level-1 for J-1772, for example, has the slowest rate of recharge at 5 miles of range per hour (AFDC). Most charging ports in the U.S. are Level-2, however, which offer a recharge rate of 20 miles of range per hour of charging (AFDC).

Currently, there are three stations for EV charging ports on UD campuses. Two are located in the Drake Hall parking lot, and they are solely in operation for UD-owned vehicles. The third port is located on the second floor of the parking garage at the Perkins Student Center (UD 2014). This is the only location available to the public on UD campuses, as of Summer 2021. Each of these ports utilize the J-1772 EV charging plug, and were installed in 2014-2015 during the “Charging Up Delaware” project (UD 2016). A collaboration between UD and the Delaware Department of Natural Resources and Environmental Control (DNREC), this initiative expanded the vehicle-to-grid (V2G) infrastructure throughout campus (Bayram and Tاجر 2017). UD has expressed interest in continuing to expand but, as of Summer 2021, plans to expand the number of ports have been temporarily halted indefinitely due to funding shortages since Spring 2020 (a consequence of the COVID-19 pandemic that initially affected UD in Spring 2020 and continues at the time of writing, February 2021).

Other EV charging port locations exist within the Newark area outside of the campus grounds to service vehicles (see Table 1). A prominent group is a recently installed system of 10 ports accepting the J-1772 plug at the Newark train station (Plugshare). The only non-J-1772 plug near the Newark campus is a CCS plug beside Homewood Suites, across from the UD football stadium. It only allows for one car to charge at 24kWh (kilowatts-per-hour), though public user reports have suggested the average charging rate is around 10kWh (Plugshare).

Other car charging locations are dispersed amongst the Ford, Chevrolet, Nissan, and Porsche car dealerships along Cleveland Avenue and Ogletown Road (see **TABLE 1**). These contain the DC fast charging CSS plugs and CHAdeMO plugs. Both the UD Lewes Campus and Wilmington campus no ports on university-owned property, though some are located as a part of public parking lots or car dealerships within two miles of campus grounds (Plugshare).

Additionally, in February 2021, Willard F. Hurd (AIA) – Chair of Newark's Planning Commission – informed the Graduate Student Government Sustainability Committee, in response to an inquiry, that Newark Council approved the purchase of EV charging stations to be installed in the Municipal Building Lot and in Lot 1 behind the Galleria. However, as of Summer 2021, there are no plans for future installations within Newark (Newark City Council 2019).

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TABLE 1. Electric Vehicle Charging Point Locations, Numbers, Types, and Optimized Charging Rates (as of Summer 2021)

Charging Ports Near UD Campus	# of Units	Plug Types	Charging Rates (Sorted by Plug Type)
UD - Perkins Garage	1	J-1772	16 kWh
UD - Drexel Lab	2	J-1772	15 kWh
Newark - Train Station	10	J-1772	7.5 kWh
Newark - Homewood Suites	1	CCS	24 kWh
Newark - Nissan	3	J-1772, CHAdeMO	10 kWh, 50 kWh
Newark - Chevy	1	J-1772	7 kWh
Newark - Ford	2	J-1772	6 kWh
Newark - Porsche	2	J-1772	6 kWh
Lewes - Ferry Terminal	2	J-1772	15.6 kWh
Lewes - Otis Smith Park	2	J-1772, Tesla	11.04 kWh, 18.4 kWh
Lewes - Shelley Avenue	2	J-1772, Tesla	11.52 kWh, 19.2 kWh

Notes: (Plugshare); charging rates are reported at perfect conditions but are frequently lower. Tesla charging ports are specifically Tesla Destination chargers, not Tesla Superchargers. Charging rates are calculate by the average charging rate (Voltage x Amp) and sorted by the plug type available at each location.

In contrast to comparator institutions, UD ranks in the middle of the pack with respect to concentration of EV charging ports around its campus. **TABLE 2** illustrates the comparisons between UD and comparator institutions throughout the Northeast, Mid-Atlantic, and Mid-Western US. Most institutions only have 2-4 EV charging stations. The point of drastic divergence is the number of ports external to the campus jurisdiction, though this can mostly be attributed to the broader urban environment surrounding some colleges and universities (e.g. Pittsburgh, Boston, Philadelphia, Towson). However, the J-1772-type plugs have the largest install base by far within this dataset, with access to Tesla locations and CCS locations commonly nearby at an off-campus location.

TABLE 2. University of Delaware and Comparator Institutions in their Electric Vehicle Charging Ports (as of Summer 2021)

College / University	EV Ports on Campus (within 2 mi. radius)	J-1772 Plug Types Supported (2 mi.)	Tesla Plug (2 mi.)	CCS Plug (2 mi.)	CHAdEMO Plug (2 mi.)
University of Delaware	2 (7)	Yes	No (Yes)	No (Yes)	No (Yes)
Drexel University	4 (25)	Yes	No (Yes)	No (Yes)	No (Yes)
Elon University	3 (3)	Yes	Yes	No	No
William & Mary	0 (5)	No (Yes)	No (Yes)	No (Yes)	No (Yes)
College of Charleston	0 (8)	No (Yes)	No (Yes)	No	No
Hofstra University	2 (6)	Yes	No (Yes)	No (Yes)	No (Yes)
Towson University	4 (15)	Yes (+ Wall)	No (Yes)	No (Yes)	No (Yes)
James Madison	1 (3)	Yes	No	No	No
Northeastern University	1 (22)	Yes (+ Wall)	No (Yes)	No	No
University of Pittsburgh	4 (18)	Yes	No (Yes)	No	No
University of North Carolina-Wilmington	0 (3)	No (Yes)	No	No	No
Salisbury University	3 (4)	Yes	No	No	No
University of Maryland - College Park	8 (13)	Yes (+ Wall)	No	No	No

Source: (Plugshare).

Rationale for Intervention

According to UD's *Greenhouse Gas Inventory for the 2018-2019 Academic Year* (2020), in the 2018-2019 academic year, students, faculty, and staff consumed "approximately 2.5 million gallons of gasoline" (UD 2020, 5). Including "2.5 thousand gallons of jet fuel," this equates to "22,319 metric tons CO_{2e}, which is down 27% from the 2008 total of 30,609 metric tons" (UD 2020, 5). While there has evidently been an improvement from 2008, the emissions emanating from internal combustion operated vehicles by UD students, faculty, and staff remains high. This understanding of emissions by UD is consistent with data from the U.S. Environmental Protection Agency (EPA), which notes that the "combustion of fossil fuels such as gasoline and diesel to transport people and goods was the *largest source* of CO₂ emissions in 2018, accounting for about 33.6 percent of total U.S. CO₂ emissions and 27.3 percent of total U.S. greenhouse gas emissions" (EPA, B; emphasis added).

In an ICF Report submitted to the Delaware DNREC Division of Climate and Coastal Energy, EVs can help in the reduction of transportation emissions. Notably, from 2005 to 2025, "transportation emissions are projected to decrease by 13% (0.7 MMTCO_{2e}), likely due to improved fuel efficiency, as well as increased availability and use of electric vehicles" (ICF 2020, 17). Although the ICF recommends that regulations are implemented to require vehicle manufacturers to make available specific quantities of EVs, UD could incentivize the purchase and use of EVs by relegating specific car-parking spaces for EVs-only (ICF 2020, 20). A transition to EVs is "expected to benefit air quality and urban livability," thereby enhancing the attraction of Newark as a place to live and work for prospective faculty, staff, and students coming to UD (ICF 2020, 40). The implementation of these measures – which could be done in partnership with Newark City Council – may "provide new employment opportunities related to program administration and construction of EV infrastructure" (ICF 2020, 40).

Furthermore, the EPA highlights that, in addition to carbon dioxide (CO₂), non-EV "automobiles produce methane (CH₄) and nitrous oxide (N₂O) from the tailpipe and hydrofluorocarbon emissions from leaking air conditions" (EPA, A). These emissions are fewer in number compared to CO₂, but the impact of these emissions is, nonetheless, important given that they have a "higher global warming potential...than CO₂" (EPA, A). On the other hand, EVs do not "emit any tailpipe emissions," but the production and distribution of EVs does produce emissions (EPA, A). This is why, as indicated in the Bikeshare Program mini-report, creating an infrastructure that promotes walking and cycling, is integral to the advancement of an ecologically-sustainable city, university, and an enriched quality of life for residents, faculty, staff, and students.

Diesel engines are not any better. In fact, the EPA has recognized that, environmentally, fine particulate matter from diesel engines contributes to "haze," "ozone formation," "acid rain," and "global climate change" (EPA 2003, 3). People with "existing heart or lung disease, asthma or other respiratory problems are most sensitive to the health effects of fine particles, as are children and the elderly" (EPA 2003, 2). More specifically, at "relatively high acute exposures," diesel can "cause acute irritation to the eye and upper respiratory airways and symptoms of respiratory irritation which may be temporarily debilitating" (EPA 2002, 9-24). Such exposure may also "induce allergic responses (some of which are also typical of asthma) and/or exacerbate existing respiratory allergies" (EPA 2002, 9-24). Moreover, long-term exposure to low levels can pose a risk. Low levels can lead to "chronic inflammation and pathological changes in the human lung," and diesel is "judged to be a "probable" human carcinogen" (EPA 2002, 9-24).

In terms of the Association for the Advancement of Sustainability in Higher Education (AASHE), UD was recognized in 2020 as a Bronze-ranked institution (Atuegbu 2020). AAHSSE's rating system, STARS, awarded UD 1 credit (out of a total of 1 available credits) for its Campus Fleet. This was the result

of 135 of its campus fleet being primarily hybrid (120 gasoline-electric, non-plug-in hybrid; 10 diesel-electric, non-plug-in hybrid; two 100 percent electric; and three hydrogen fueled) (AASHE). When these hybrids do not use electricity, however, they continue to produce tailpipe emissions, but this is dependent on the battery capacity and how it is driven (EPA, A).

Key Findings and Recommendations

More EV charging stations are needed to allow for EVs to run well. Americans, on average, live approximately four minutes away from a gas station, whereas EV supercharging stations are dispersed at an average of 31 miles/person (Castrol, 2018). There are nearly 1,000 supercharging stations within the U.S., most of them under Tesla (Baresch and Moser 2019). Furthermore, there are approximately 3,845 non-Tesla stations are interspersed around the U.S. (Tesla 2021).

While the cost of implementing new EV charging ports is undoubtedly an issue, location of the new EV charging ports is less controversial (Moniot et al. 2019). Notably, there are ample car parks across UD campuses that would incontrovertibly benefit from EV charging points. At a minimum, three new charging ports should be installed with the capacity to cater to the predominant plugs types that serve different vehicles on the market currently. Ideally one Tesla Supercharger, one Level-2 CCS charger, and one Level-2 J-1772 charger would be preferred. UD should also consider the installation of a Tesla Destination charger if Tesla's Supercharger ports are too expensive. Conversely, UD could consider using CHAdeMO ports to cover the variety of vehicles that can charge on the campus.

The current rate for the most efficient Tesla supercharging station, as of Summer 2021, can run at \$25,000, and a 250kWh station can be upward of \$50,000. More cost-effective ports can be found with lower recharge rates, and the state of Delaware does offer a generous rebate for installation of Level-2 Charging Ports (DNREC 2020). Ideally one Tesla Supercharger, one Level-2 CCS charger, and one Level-2 J-1772 charger would be preferred. With respect to charging power, to prepare for the increase in driving range for future electric vehicles UD ought to seek a higher minimum rate for charging vehicles. A charging rate of at least 15kWh for charging at minimum would be acceptable, although a quicker rate of charge for vehicles with more storage capacity in the future, a rate within the range of 25-50kWh would be preferred (Genikomsakis et al. 2018).

For the satellite campuses, a single J-1772 on each campus would be an excellent start, with the intention to implement upgrades in the future. Moreover, to promote the adoption and use of EVs, UD could establish EV-only parking spaces across its campuses – this can be achieved by placing notices or paint to car parking spaces.

Finally, UD ought to transition toward a 100% EV campus fleet and shift away from hybrids that continue to produce harmful emissions.

Bibliography

AASHE. "OP-15: Campus Fleet." *AASHE* <https://reports.aashe.org/institutions/university-of-delaware-de/report/2020-01-31/OP/transportation/OP-15/> accessed 11 February 2021.

Alternative Fuels Data Center (AFDC). "Developing Infrastructure to Charge Plug-In Electric Vehicles." *U.S. Department of Energy* https://afdc.energy.gov/fuels/electricity_infrastructure.html accessed 14 February 2021.

Atuegbu, Chioma. 2020. "UD Recognized by AASHE as STARS Bronze Institution." *UDaily* <https://www.udel.edu/udaily/2020/april/ud-recognized-by-aashe-as-stars-bronze-institution0/> accessed 11 February 2021.

- Baresch, M., and Moser, S., 2019. "Allocation of E-Car Charging: Assessing the Utilization of Charging Infrastructures by Location." *Transportation Research A: Policy and Practice* 124: 388-395.
- Bayram, I.Ş., and Tajer, A. 2017. *Plug-in Electric Vehicle Grid Integration*. Publisher: Artech House, pp. 61–81.
- Castrol. 2018. "Accelerating the Evolution: The tipping points to mainstream electric vehicle adoption". *Castrol* https://www.castrol.com/content/dam/castrol/master-site/en/global/home/technology-and-innovation/electric-vehicle-adoption/accelerating_the_evolution_global_infographic.pdf accessed 13 February 2021.
- DNREC. "Electric Vehicle Charging Equipment Rebates." *Delaware Gov* <https://dnrec.alpha.delaware.gov/climate-coastal-energy/clean-transportation/ev-charging-equipment-rebates/> accessed 14 February 2021.
- U.S. Energy Information Administration (EIA). "Electricity Explained: Electricity in the U.S." *EIA* <https://www.eia.gov/energyexplained/electricity/electricity-in-the-us.php> accessed 14 February 2021.
- Environmental Protection Agency (EPA). 2003. "Diesel Exhaust in the United States." *EPA* <https://nepis.epa.gov/Exe/ZyPDF.cgi/P1001T82.PDF?Dockey=P1001T82.PDF> accessed 11 February 2021.
- 2002. "Health Assessment Document for Diesel Engine Exhaust." *EPA* <https://nepis.epa.gov/Exe/ZyPDF.cgi/300055PV.PDF?Dockey=300055PV.PDF> accessed 11 February 2021.
- A. "Greenhouse Gas Emissions from a Typical Passenger Vehicle." *EPA* <https://www.epa.gov/greenvehicles/greenhouse-gas-emissions-typical-passenger-vehicle> accessed 11 February 2021.
- B. "Overview of Greenhouse Gases: Carbon Dioxide Emissions." *EPA* <https://www.epa.gov/ghgemissions/overview-greenhouse-gases> accessed 11 February 2021.
- Genikomsakis, K.N., Gutierrez, I.A., Thomas, D., Ioakimidis, C.S., 2018. Simulation and Design of Fast Charging Infrastructure for a University-Based e-Carsharing System. *IEEE Trans. Intell. Transp. Syst.* 19, 2923–2932. <https://doi.org/10.1109/TITS.2017.2767779>
- ICF. 2020. "Delaware Climate Action Plan Supporting Technical Greenhouse Gas Mitigation Analysis Report." *ICF* <https://www.capegazette.com/sites/capegazette/files/2020/09/field/attachments/DNREC%20technical%20analysis%20report.pdf> accessed 11 February 2021.
- Moniot, M., Rames, C.L., Wood, E.W., 2019. Meeting 2025 Zero Emission Vehicle Goals: An Assessment of Electric Vehicle Charging Infrastructure in Maryland (No. NREL/TP-5400-71198, 1496855). <https://doi.org/10.2172/1496855>
- Mu, R., Yamamoto, T., 2019. Analysis of traffic flow with micro-cars with respect to safety and environmental impact. *Transp. Res. Part Policy Pract.* 124, 217–241. <https://doi.org/10.1016/j.tra.2019.03.013>
- Newark City Council. 2019. "Sustainable Newark: The City of Newark's Plan for Sustainability." *Newark City Council* https://newarkde.gov/DocumentCenter/View/12803/SustainableNewark_FINAL_30OCT19?bidId= accessed 13 November 2020.

University of Delaware (UD). 2020. “Greenhouse Gas Inventory for the 2018-2019 Academic Year.” *University of Delaware and Siemens* https://cpb-us-w2.wpmucdn.com/sites.udel.edu/dist/e/763/files/2015/10/UD-2018-2019-GHG-Inventory-Report_Final-V2.pdf accessed 11 February 2021.

-- 2016. “EV Infrastructure Improvements.” *UDaily* <http://www.udel.edu/udaily/2016/sep/EV2G091815.html> accessed 29 October 2020.

-- 2014. “EV Charging Station Expansion.” *UDaily* <https://www1.udel.edu/udaily/2014/feb/ev-charging-stations-021914.html> accessed 29 October 2020.

PlugShare. “EV Charging Station Map.” *Plugshare* <https://www.plugshare.com/> accessed 15th November 2020.



MINI-REPORTS

Carbon Neutrality and Greenhouse Gas Emissions

University of Delaware - Carbon Neutrality and Greenhouse Gas Emissions

Problem statement

As global carbon dioxide emissions continue to rise, the looming threat of an anthropogenic climate crisis is becoming a growing concern. To avoid ecological collapse and the exacerbation of the climate-conflict nexus, carbon neutrality must be aggressively pursued. In 2018, the United Nations Intergovernmental Panel of Climate Change (IPCC) set a warming threshold of 1.5 °C above pre-industrial levels to prevent the most severe irreversible consequences of climate change (IPCC 2018). The planet has already warmed by ~1°C since the industrial revolution due to the burning of fossil fuels (IPCC 2018). The UN Secretary-General has warned, in August 2021, that there is “no time for delay and no room for excuses,” and fossil fuels – especially coal – must be phased-out as soon as possible (UN 2021). For the sake of both human and non-human inhabitants of Earth, UD must do more. This can be achieved by committing to a new goal of achieving net zero emissions by 2030, in line with the IPCC Working Group 1 Report in August 2021 (UN 2021).

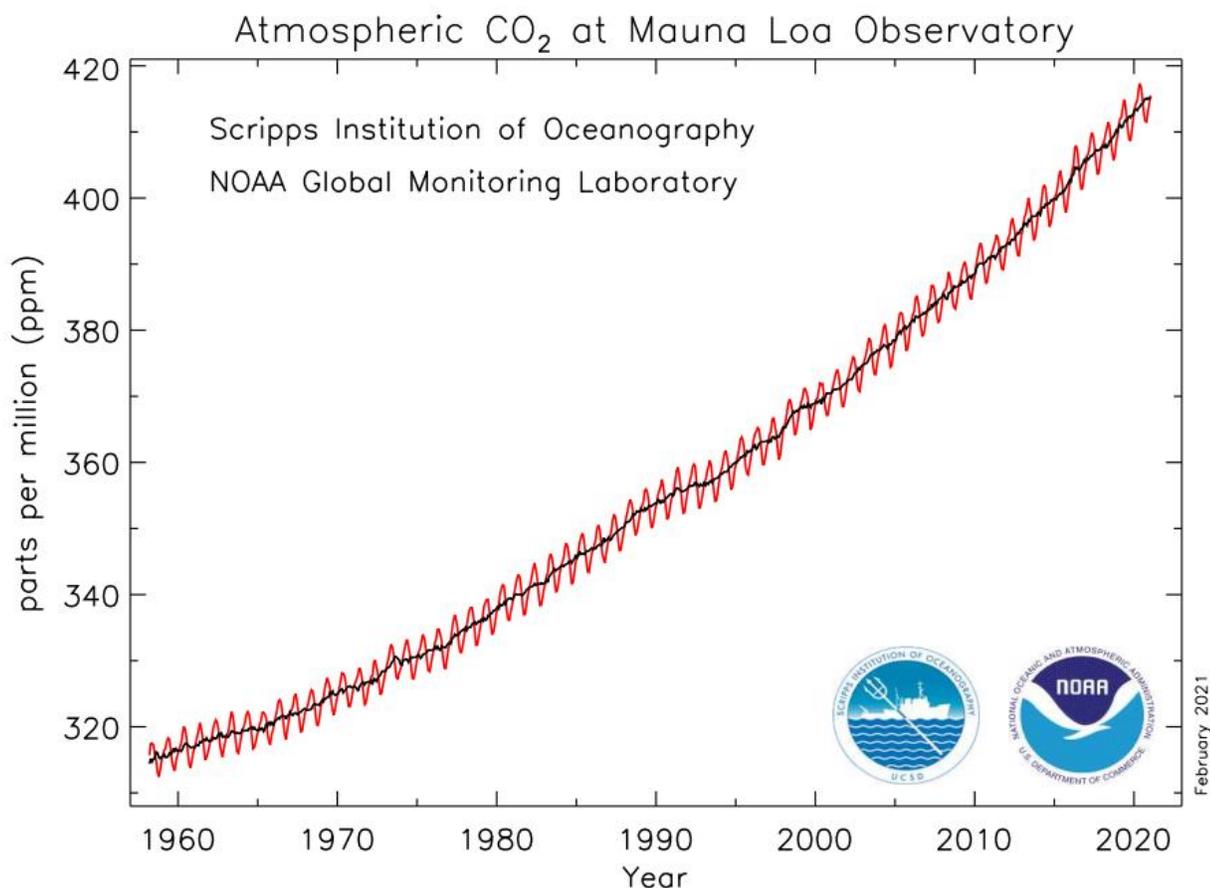
Overview

Carbon neutrality is defined as net zero carbon dioxide (CO₂) emissions achieved via the balancing of anthropogenic CO₂ emissions by anthropogenic CO₂ removals, or offsets, over a specified period (IPCC

2018). Carbon dioxide enters the atmosphere through the combustion of fossil fuels (coal, natural gas, and oil), solid waste, trees and other biological materials, and also as a result of certain chemical processes (e.g., manufacture of cement). Carbon dioxide is naturally removed from the atmosphere (or "sequestered") when it is absorbed by plants as part of the biological carbon cycle (Cunha-e-Sá et al. 2013). With proper accounting, this naturally occurring sequestration can be used to offset carbon dioxide emissions. Some examples of ways to take advantage of naturally occurring carbon sequestration strategies include reforestation and improved land use practices (Cunha-e-Sá et al. 2013).

Changes in the climate have occurred naturally throughout Earth's history. However, since the coming of the industrial age, the Earth's climate has been changing drastically due to human activity at an unprecedented rate. Humanity has come to rely on fossil fuels and these fossil fuels have produced, en masse, carbon dioxide, particulate matter, carbon monoxide, sulfur dioxide, and methane, and these collectively inflict serious damage on humans, non-human species, and the natural environment (IPBES 2019, 6). Prior to industrialization, CO₂ levels were between 180 and 300 ppm (ESRL 2021). Current levels are now around 415 ppm (see **FIGURE 1**). As a direct result of rapidly rising atmospheric CO₂ concentrations from fossil fuel combustion and average surface temperatures will continue to rise over the next century and beyond under a "business as usual" scenario (see **FIGURE 2**).

FIGURE 1. Atmospheric Carbon Dioxide Concentration at Mauna Loa Observatory, Hawaii (1960-2021)

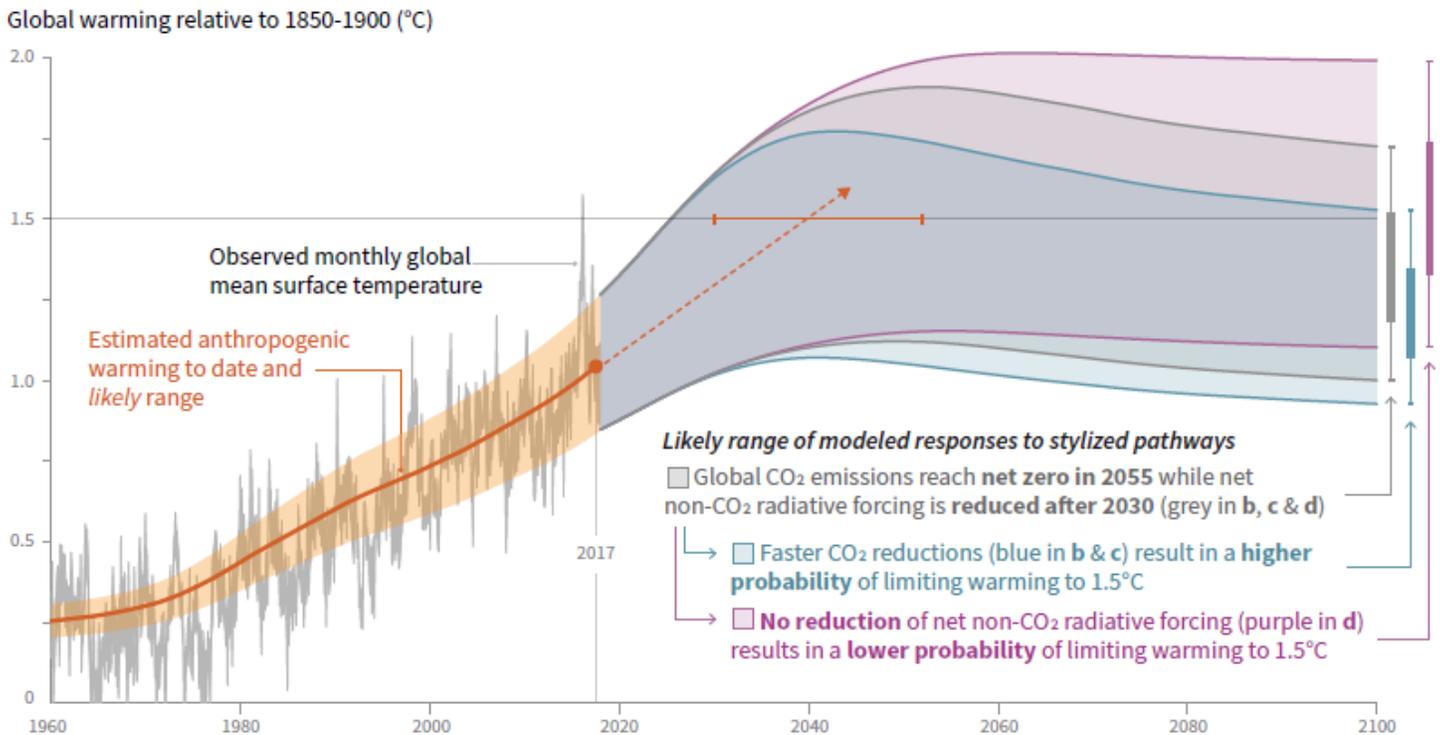


Source: (ESRL 2021).

Due to the spike in carbon dioxide emissions, the Earth is witnessing rising temperatures. According to the IPCC, global mean surface temperature change for the decade 2006–2015 was 0.87°C (likely between 0.75°C and 0.99°C) higher than the average over the 1850–1900 period (IPCC 2018). Overall, the planet has warmed by about 1°C since the industrial revolution (IPCC 2018). On the current trajectory, global

temperatures are increasing by 0.2°C per decade due to past and ongoing emissions. This trend is captured by **FIGURE 2**, below.

FIGURE 2. Observed Global Temperature Change and Modeled Responses to Stylized Anthropogenic Emission and Forcing Pathways (2018)

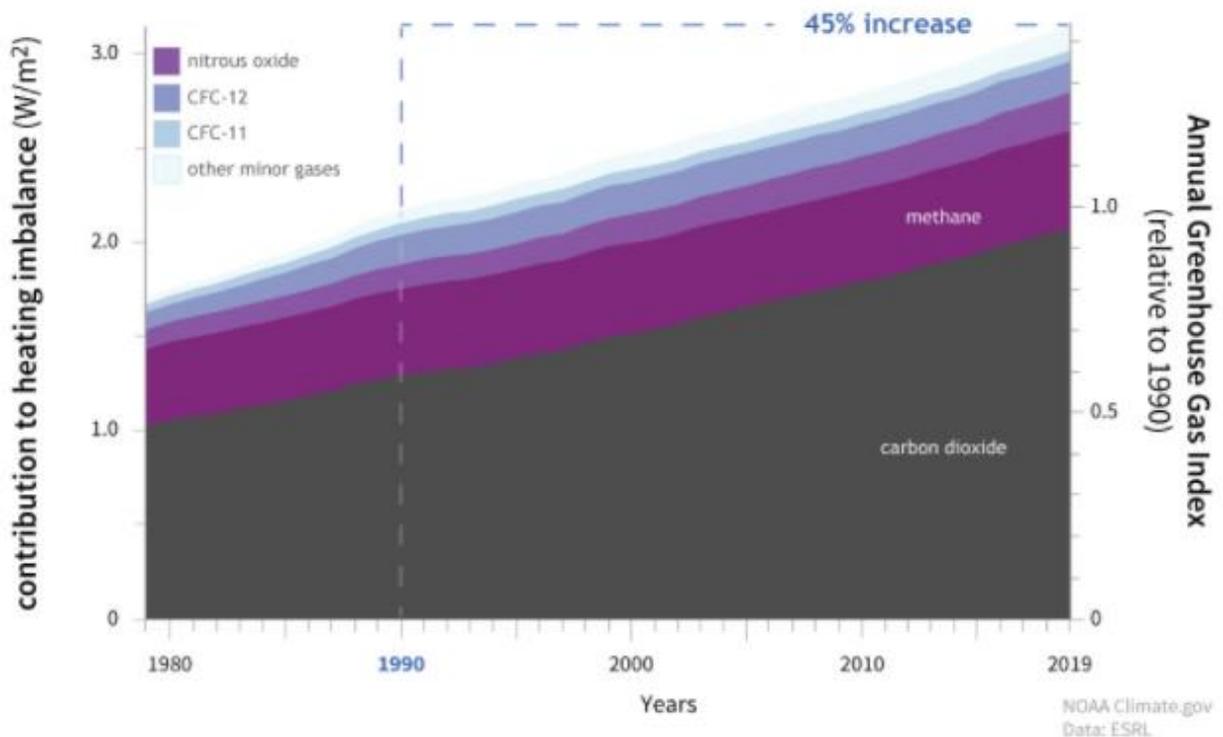


Source: (IPCC 2018).

In **FIGURE 2**, the IPCC provides a variety of potential pathways for future warming that depend upon future anthropogenic activities. The model pathways demonstrated that global net anthropogenic CO₂ emissions must decline very rapidly if the goal of net zero emissions (or carbon neutrality in this instance) is to be achieved by 2030 (IPCC 2018). Anthropogenic carbon dioxide emissions are the primary contributor to the warming being experienced today (see **FIGURE 3**). The current amount of carbon dioxide in the atmosphere is the highest it has been in 3 million years, before humans walked the earth (ESRL 2021). Even more alarming, carbon dioxide levels in the atmosphere are increasing over 100 times faster than the rise observed at the end of the last ice age, quicker than has ever been recorded in earth’s history (University of California 2013).

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FIGURE 3. Combined Heating Influence of Greenhouse Gas Emissions (1980-2019)



Source: (ESRL 2021).

The extent to which climate change will impact global society remains unclear. However, sufficient evidence exists to identify the following outcomes: temperature rise, ocean acidification, sea level rise, loss of biodiversity, arctic sea ice loss, increase in extreme weather events, increase in drought frequency, more heat waves, extreme changes in precipitation patterns, and increased forest fire activity (GCRP 2017). These outcomes will have wide-ranging geopolitical consequences and will act as conflict intensifiers that pose serious threats to national security. Over the next 20 years, the effects of climate change have the potential to lead to global perturbations, increased risk of political instability, heightened tensions between countries for resources, a growing number of climate-linked humanitarian crises, emergent geostrategic competitive domains, and adverse effects on militaries (House Intelligence Committee 2019). In this sense, environmental stress works as a ‘threat multiplier’, exacerbating ongoing social strife by adding further strain to actors already facing existing pressures, such as food and water insecurity (Scheffran et al. 2014; von Uexkull et al. 2016; and Koren & Bagozzi 2017). Climate change is current, and its effects are already being observed across the globe in real-time. Scientific consensus has concluded that human activity, primarily the emission of carbon dioxide from fossil fuel combustion, is the driving force behind climate change.

The economic cost of climate change to the U.S. is difficult to quantify, but the Environmental Protection Agency (EPA) predicts it will exceed \$500 billion annually (EPA 2017). This cost is likely a gross underestimation since a variety of factors including the potential for an outbreak of conflict, the true value of human life, mass migration events, infrastructural damage due to intensified natural disasters, and the need for foreign humanitarian aid cannot be predicted (Koubi et al. 2018, 905; von Uexkull et al. 2016, 12395). However, the EPA’s estimation provides an indication that climate change will have a significant impact on the U.S. economy.

Locally, the impacts of climate change on the state of Delaware are anticipated to be severe and will both directly and indirectly impact UD. Without significant efforts to achieve carbon neutrality, an

additional 4-8 days of temperatures over 100 °F are expected by mid-century and an additional 9-30 days above 100 °F are expected by late-century (DNREC 2014). These conditions are potentially fatal for vulnerable Delaware citizens including infants, the elderly, those suffering from asthma, and impoverished disadvantaged communities with limited access to air conditioning (DNREC 2014). Increasing temperatures will also place a heavier burden upon utility providers to meet electricity demand during peak hours, potentially causing increased power outages that could affect UD (DNREC 2014). Additionally, as temperatures increase, ground-level ozone concentrations will grow, intensifying respiratory illnesses (Wilson et. al 2014). Rainfall in Delaware is also expected to increase significantly with heavy rainstorms becoming more frequent and intense (DNREC 2014). These conditions could lead to the failure of septic system drain fields, and significant damage to infrastructure (DNREC 2014). Coupled with rising sea levels, increased rainfall could also inundate the chemical industry along the Delaware river that is the backbone of Delaware's economy and provides a significant amount of funding to university research (DNREC 2014).

In the academic year 2007-2008, UD pledged a 20% CO₂ equivalent (CO₂e) reduction by 2020. This was one of the most ambitious commitments of a major university at the time (Manser). In 2015, a Sustainability Manager position was established at UD, though the full-time manager position was lost in October 2020 due to COVID-19 budget cuts. As of FY19, UD has reduced greenhouse gas emissions by 16% from their 2007-2008 academic year baseline (UD 2020, 7). UD reported that the largest component of their emission reductions was “a result of electricity supply generation shifts from coal to natural gas and renewable resources due to state, regional, and national policy changes” (UD 2020, 6).

- UD received a bronze AASHE STARS rating in 2020 (Atuegbu 2020), falling behind other comparator universities.
- In 2020, UD formed a new Sustainability Council, spearheaded by the Sustainability Manager and faculty, with the objective to write and implement a new sustainability plan for the university (UDaily 2020).

TABLE 1 demonstrates that UD is behind its comparator institutions. However, by pledging an ambitious goal of achieving net zero emissions by 2030, UD can enhance its national and international prestige.

When examining other universities that have achieved carbon neutrality, the American University (AU) provides a good example of some effective solutions that reduce campus emissions. Their three goals were to (1) reduce overall emissions, (2) use renewable energy, and (3) offset the small remainder of emissions (American University). Emissions were measured in three categories. The first scope focused on reducing natural gas used for heating and hot water. For this, they utilized solar panels and a switch to a low temperature hot water system. They offset the rest of natural gas usage by investing in landfill gas capture and use. Methane produced from anaerobic processes is captured and used as fuel (American University).

The second scope involves reducing electricity use, “AU decreased electricity use per square foot by more than 20% from 2005 to 2017. This reduction was achieved through individual actions, like turning off lights and unplugging chargers, efficiency upgrades like using LED bulbs on campus, and by using a building automation system that allows Facilities management to monitor buildings for unusual activity” (American University). Emissions were reduced further with on campus and off campus solar, as well as by purchasing Green-e certified renewable energy credits to match the remaining electricity used on campus. The third scope focused on decreasing waste and offering alternative transportation. For the remaining emissions AU used several different offset projects: energy efficient cookstoves in Kenya through the Paradigm Project, local tree plantings in DC with the Anacostia Watershed Society and Urban Offsets, and wind power in India to match emissions from commuting (American University). University-related travel is tracked and offset by efficient trucking technologies and landfill capture is used to address campus waste. In

light of their AU's success, UD should emulate their approach (American University).

TABLE 1. University of Delaware Comparator Institution Sustainability Goals

School	Carbon Goal	Presidents' Commitment Signatory	AASHE STARS Rating
Boston College		No	Reporter
Brown University	Zero Carbon by 2040	No	No
Carnegie Mellon University		No	Gold
College of William and Mary		No	Silver
University of Delaware	Zero Carbon by 2050	Yes	Bronze
Georgia Institute of Technology	Zero Carbon by 2050	Yes	Gold
Lehigh University		No	Silver
Pennsylvania State University	35% by 2020	No	Gold
University of Maryland	25% by 2020; 35% by 2030; 50% by 2040	Yes	Gold
University of North Carolina	Zero Carbon by 2050	Yes	Silver
University of Notre Dame	83% by 2050	No	Silver
University of Pittsburgh		No	Silver
University of Virginia	25% by 2025	No	Gold
Case Western University	Zero Carbon by 2050	Yes	Silver
Indiana University	80% by 2050	No	Gold
Iowa State University	65% by 2030	No	Gold
Michigan State University	65% by 2030	No	Silver
NC State University	Zero Carbon by 2050	Yes	Gold
Ohio State University	Zero Carbon by 2050	Yes	NA
Purdue University		No	Silver
Rutgers University		No	NA
Stony Brook University	Zero Carbon by 2050	Yes	Reporter
Texas A&M University		No	Gold
University of Arizona	Zero Carbon by 2050	Yes	Gold
University of Connecticut	Zero Carbon by 2050	Yes	Gold
University of Illinois Urbana-Champaign	Zero Carbon by 2050	Yes	Gold
University of Massachusetts Amherst	Zero Carbon by 2050	Yes	Gold
University of Michigan	25% by 2025	No	Gold
University of Minnesota	Zero Carbon by 2050	Yes	Gold
University of North Carolina Chapel Hill	Zero Carbon by 2050	Yes	Gold
University of Utah	Zero Carbon by 2050	Yes	Silver
Virginia Polytechnic Institute and State University	80% by 2050		NA
Temple University	Zero Carbon by 2050	Yes	Silver
George Washington University	Zero Carbon by 2050	Yes	Gold
Virginia Commonwealth University	Zero Carbon by 2050	Yes	Silver
George Mason University	Zero Carbon by 2050	Yes	Gold
Towson University	Zero Carbon by 2050	Yes	Bronze

Source: (UD 2020, 8).

Recommendation(s)

It is recommended that UD publicly commits to a net zero emissions goal by 2030. The achievement of this goal will help ensure that the university is meeting the pacing required to prevent a catastrophic 1.5°C temperature increase. Several options to achieve the 2030 target are listed below in the order that they ought to be pursued:

1. The most cost effective method for reducing carbon dioxide emissions is to reduce energy usage. This can be accomplished through measures to improve campus energy efficiency. Many energy efficiency improvements will have significant capital costs but, over time, the energy savings will pay for themselves. Other methods to reduce energy consumption such as minimizing campus building heating/cooling usage has no associated costs. Practical energy efficiency improvements such as this should take priority in the short-term to help UD recover from the economic burden of the COVID-19 pandemic. Specific recommendations for energy efficiency for UD can be found in other mini-reports presented in this Sustainability Report, including: Campus Lighting, Building Temperature Control, and Retrofitting University Campus Building.

2. The incorporation of additional renewable energy sources such as wind, solar, and hydro into the campus grid have the potential to significantly reduce carbon dioxide emissions. A larger renewable contribution to UD's energy mix can be accomplished through negotiations with the campus utility provider(s) or by establishing rooftop solar systems on campus buildings.
3. Carbon dioxide emissions associated with university transportation can be greatly reduced by transitioning UD's vehicle fleet to electric vehicles, increasing busing route efficiency, and replacing campus vehicle usage with bike sharing programs where possible. Specific recommendations for an improved infrastructure in Newark can be found in other mini-reports presented in this Sustainability Report, including: Newark Bikeshare Program, and Electric Vehicle Charging Ports.
4. Natural photosynthetic carbon dioxide capture and storage in soil provides a method to offset carbon dioxide emissions that cannot be eliminated by the first three methods. This can be achieved through the direct support of reforestation programs and by increasing the presence of on-campus plant life. To this end, UD's Ecological Preserve ought to be continually safeguarded - as is currently the case - and UD ought to implement its Botanic Garden Master Plan (UD A).
5. The final method to achieve net neutrality would be the purchase of carbon offset credits from a reputable provider. Carbon offset credits are transferable instruments which represent investments in a variety of carbon sequestration projects.

Bibliography

- American University. "Greenhouse Gas Emissions Inventory." *American University* <https://www.american.edu/about/sustainability/tracking-progress.cfm> accessed 21 February 2021.
- Atuegbu, Chioma. 2020. "UD Recognized by AASHE as STARS Bronze Institution" *UDaily* udel.edu/udaily.com accessed 21 February 2021.
- Cunha-e-Sá, Maria A., Rosa, Renato, and Costa-Duarte, Clara. 2013. "Natural Carbon Capture and Storage (NCCS): Forests, Land Use and Carbon Accounting." *Resource and Energy Economics* 35(2): 148-170.
- DNREC. 2014. "Delaware Climate Change Impact Assessment." *Delaware Department of Natural Resources and Environmental Control* <https://dnrec.alpha.delaware.gov/climate-coastal-energy/climate-change/> accessed 21 February 2021.
- Earth System Research Laboratory (ESRL). 2021. "Trends in Atmospheric Carbon Dioxide." *National Oceanic and Atmospheric Administration* <https://www.esrl.noaa.gov/gmd/ccgg/trends/> accessed 21 February 2021.
- Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES). 2019. "Chapter 2. Status and Trends; Indirect and Direct Drivers of Change." *IPBES* https://ipbes.net/sites/default/files/ipbes_global_assessment_chapter_2_1_drivers_unedited_31may.pdf accessed 19 February 2021.
- Intergovernmental Panel on Climate Change (IPCC). 2018. "Global Warming of 1.5°C." *IPCC* <https://www.ipcc.ch/sr15/> accessed 21 February 2021.
- Koren, Ore., and Bagozzi, Benjamin E. 2017. "Living Off the Land: The Connection Between Cropland, Food Security, and Violence Against Civilians." *Journal of Peace Research* 54(3): 351-364.

- Koubi, Vally., Bohmelt, Tobias., Spilker, Gabriele., and Schaffer, Lena. 2018. "The Determinants of Environmental Migrants' Conflict Perception." *International Organization* 72 (Fall): 905-936.
- Manser, A. 2009. "University Announces Plans to Reduce Carbon Emissions." *University of Delaware* <https://www1.udel.edu/udaily/2009/apr/green042209.html#:~:text=4%3A45%20p.m.%2C%20April%2022,special%20Earth%20Day%20program%20Wednesday> accessed 21 February 2021.
- Scheffran, Jurgen., Ide, Tobias., and Schilling, Janpeter. 2014. "Violent Climate or Climate of Violence? Concepts and Relations with Focus on Kenya and Sudan." *International Journal of Human Rights* 18(3): 369–390.
- House Intelligence Committee. 2019. "The National Security Implications of Climate Change: Hearings before the Committee on Intelligence." *Congress* <https://www.congress.gov/event/116th-congress/house-event/109197> accessed 21 February 2021.
- UDaily. 2020. "Sustainability Council Launched." *University of Delaware* <https://www.udel.edu/udaily/2020/april/sustainability-council-sustainability-plan/> accessed 21 February 2021.
- University of Delaware (UD). 2020. "Greenhouse Gas Inventory for the 2018-2019 Academic Year." *University of Delaware and Siemens* https://cpb-us-w2.wpmucdn.com/sites.udel.edu/dist/e/763/files/2015/10/UD-2018-2019-GHG-Inventory-Report_Final-V2.pdf accessed 14 February 2021.
- A. "Charging the Path into the Future." *University of Delaware* <https://canr.udel.edu/udbg/capital-campaign-news/> accessed 14 February 2021.
- Environmental Protection Agency (EPA). 2017. "Multi-Model Framework for Quantitative Sectoral Impact Analysis." *EPA* https://cfpub.epa.gov/si/si_public_record_Report.cfm?Lab=OAP&dirEntryId=335095 accessed 21 February 2021.
- Global Change Research Program (GCRP). 2017. "Fourth Climate Assessment." *Global Change* <https://www.globalchange.gov/nca4> accessed 21 February 2021.
- von Uexkull, Nina., Croicu, Mihai., Fjelde, Hanne., and Buhaug, Halvard. 2016. "Civil Conflict Sensitivity to Growing-Season Drought." *Proceedings of the National Academy of Sciences* 113(44): 12391–12396.
- Wilson, A., Rappold, A., Neas, L. M., Reich, B. J. 2014. "Modeling the Effect of Temperature on Ozone-related Mortality." *The Annals of Applied Statistics* 8: 1728-1749.

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MINI-REPORTS

Tree-Planting Campaign

University of Delaware – Tree-Planting Campaign

Problem Statement

Deforestation is a well-recognised and established issue that negatively affects quality of life for humans and biodiversity (IPBES 2019, 37). The City of Newark – including UD – stand to gain by committing to reforestation efforts, and the ‘greening’ of the city. By greenifying the city, the university can hope to attract new faculty, staff, and students, as well as increased donations to enhance and maintain the university’s green status. This is partly reflected by extant research that indicates that students appreciate the integration of greenery in the university environment (van den Bogerd et al. 2018). UD also stands to gain by committing to tree-planting efforts as it is a relatively unique effort among comparator institutions in improving campus life, biodiversity, and tackling the climate crisis.

Overview

The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) makes it abundantly clear – improved land management can reduce emissions, especially from deforestation and forest degradation (IPBES 2019, 41). In turn, the IPBES advocates a selected target as part of its sustainable development goals, which stipulates that there is a need to “sustainably manage and restore degraded forests and halt deforestation” (IPBES 2019, 36). The U.S. Forest Service adds that “America’s richly, diverse forests provide vital products and amenities to our society including quality habitat for wildlife, biodiversity of plant and animal communities, clean water, aesthetic benefits, and recreational opportunities” (US FS, B). Whilst there is not a forest *in* Newark (e.g. Main Street), UD can support its existing Ecological Preserve, and further demonstrate its commitment to sustainability practices by planting more trees in Newark. This would help convey to faculty, staff, and students UD’s visible commitment to improving the natural environment and quality of life for all. By engaging in such tree-planting campaigns, UD can also highlight its stewardship ethic to prospective staff, faculty, and students.

By UD’s own admission, “Trees are important to people” as “access to nature plays a significant role in life satisfaction,” and they also “improve the physical environment” by “trapping dust particles and replenishing oxygen” (UD, A). Trees can also “reduce air conditioning needs by 30 percent and save to 20 to 50 percent on fuel costs for heating,” “improve water quality by reducing the impact of raindrops,” “provide habitat for animals and birds,” and “add beauty to the environment” (UD, A). UD even has its own *Trees for Delaware Guide* and this guide features a long list of the benefits of tree-planting (UD, B). In Newark’s Sustainability Plan (2019), one of its goals, among many others, include increasing the tree canopy to 34% by 2025 and 36% by 2030 (CoN 2019, 10). Thus, UD and Newark City Council can join forces to enhance their efforts to green the city and campus and make it a better place for humans and non-human species.

Comparator Institutions

An examination of comparator institutions with regard to their tree-planting efforts unveils that few universities and colleges engage in tree-planting. In the U.S., there are several institutions that are noteworthy. Washington University in St. Louis has an annual Tree Planting Day on November 7th and is operated by its Grounds and Maintenance unit. This event provides an opportunity for students, faculty, and staff to plant trees, and the annual event has been running since 2014 (WUSTL 2019). In December 2020, the University of Louisville Sustainability Council partnered with the Old Louisville Neighborhood Council to restore the urban canopy on the northern edge of UofL's Belknap Campus. In total, 31 street trees were planted, and volunteers were invited to help (UofL 2020).

Additionally, in October 2019, the University of Hawai'i planned to plant 11,000 trees and eventually scale up to planting 100,000 trees in 2020 and 1,000,000 tree plantings annually from 2021 onward. To prevent the threat of weeds, weed-blocking mats were placed around each planted tree, and this resulted in a 50% survival rate for the saplings. With the addition of a novel watering system, survival rates for the saplings were expected to rise to approximately 90%. For the initial 11,000 trees – including mats and watering – the University launched a crowdfunding campaign with a goal of \$55,000. Volunteers were encouraged to participate, and all of this was part of the University of Hawai'i's efforts to achieve its Carbon Neutrality Challenge (UoH 2019).

In February 2021, Mississippi State (MSU) faculty, staff and students celebrated Arbor Day by planting trees on campus. Given the climate in February in southern states, this allows for the newly planted trees to have an increased survival rate. Particular emphasis was placed on the economic impact that the trees would make given their prominence to visitors, they are long-lived, and tree-planting as an opportunity for campus engagement. The MSU Tree Campus Higher Education Advisory Committee, Campus Services and the Division of Finance and Administration collaborated to realise this vision (MSU 2021).

In May 2019, the University of Illinois Chicago, through a collaboration with Openland's TreePlanters program, aimed to plan multiple trees on its campus that were intended to replace old trees that had become infected and had to be removed. Volunteers were encouraged to help in the planting of trees (UIC 2019).

Given the above, it is clear there are ample opportunities for UD's students, faculty, and staff to be engaged in tree-planting on or near its campuses. At the existing virgin forest – the Ecological Preserve – opportunities could be identified for students to assist in planting new trees or replacing diseased/dead trees (UD CANR). More broadly, these same stakeholders can help throughout planting efforts (including flowers, shrubs, vegetables, fruit, etc.) in other UD Botanic Garden Master Plan efforts. Annual tree-planting, even if off-campus, could be very beneficial for students, faculty, and staff. Given the collaborative efforts highlighted at other universities, it is evident that this is part of what constitutes a successful tree-planting campaign. This could mean partnership with Newark City Council in greening the city, including off-campus (e.g. Newark Main Street) locations. To achieve this, the expertise of UD's Facilities and Maintenance will need to be consulted.

Rationale for Intervention

Whilst UD has a number of green spaces on its main Newark campus, it needs to do more in providing greater access to nature and this vision has already been encapsulated by UD in its Botanic Garden Master Plan (UD CANR). This Plan would see the establishment of multiple new green spaces that would provide crucial benefits to faculty, staff, students, and visitors. Of the many designs within the Plan, there are opportunities for UD to engage its employees and students in its sustainability practices.

Scholars have noted the significance of green spaces, especially in urban environments. Beatley writes that “human beings need contact with nature and the natural environment” and they “need it to be healthy, happy, and productive and to lead meaningful lives” (Beatley 2016, 3). Cities will, according to Beatley, “need to take significant steps to enhance and regrow local and regional nature...but also serve as leaders in helping other cities to do the same and to provide leadership in global conservation” (Beatley 2016, 4). It is this normative assertion that highlights an important opportunity for UD to be a leader in environmental action by partnering with Newark City Council. Such calls to action for urban areas to safeguard the environment are not new and can be found in famous pieces like Ebenezer Howard’s *Garden Cities of To-morrow* (1898). This underscores the fact that nature requires *constant* safeguarding. It is not a one-time investment but, at the same time, it is not without enormous returns.

Such returns on investment in urban nature include a “wide range of positive mental and physical benefits,” such as reducing stress (cortisol) and boosting cognitive performance and the immune system (Beatley 2016, 5-6). Japan is utterly convinced by the benefits that they established a “series of Forest Therapy Bases in and around Japanese cities,” reflecting the importance they place on Shinrin-yoku (forest bathing) because of its healing capacity (Beatley 2016, 6). Additional research suggests that exposure to urban nature can help to “curtail brooding” (precursor to depression), provide an escape from the modern lifestyle that involves a lot of sitting, reduce crime, lower rates of hypertension, increase happiness, and increase creativity (Beatley 2016, 7).

Shanahan et al. also acknowledge the number of health benefits, including reduced all-cause mortality and mortality from cardiovascular disease, reduced asthma prevalence, and enhanced general or self-reported health (Shanahan et al. 2015, 4). Increased access to green spaces which can be used for exercise also results in improved physical well-being (Shanahan et al. 2015, 4).

Increased access to nature likely also means that there will be increased value – economically and emotionally – attributed to UD and Newark. Improvements in environmental working conditions have been attributed to reduced absenteeism in schools, reduced crimes, improved productivity, and reduced need for mental health services (Beatley 2016, 10-11). In turn, the argument is made that returns on investments in nature exceed the cost of initial investment.

Furthermore, the U.S. Forest Service stresses how urban green spaces can assist in building resilient cities. Given the increased frequency and intensity of climate change (e.g. heatwaves, flooding, extreme storms, and poor air quality), urban green spaces can help “to cool cities during the summer, control storm water, and capture air pollutants” (US FS, A). The US FS also echoes earlier claims that green space can reduce stress and crime, lead to healthier and happier people, and can also assist in building social cohesion (US FS, A).

Lastly, UD’s AASHE STARS (as of 2020) rating is Bronze. In terms of Engagement - which is divided in Campus Engagement and Public Engagement - UD does not perform particularly well. Notably, for Campus Engagement, UD scored 9.01 out of 21 credits and, for Public Engagement, UD scored 10.46 out of 20 credits (AASHE STARS). By engaging faculty, staff, and students more in sustainability practices - such as planting trees - UD can boost its engagement credits, thereby edging closer to achieving a Silver Rating. UD’s Bronze rating is a result of its total 36.07 credits. If it were to obtain the additional total credits (21.53) that are available through Engagement, UD would achieve Silver (minimum of 45 credits needed) and would be on the road to obtaining Gold (minimum of 65 credits) (AASHE STARS 2019, 2).

Recommendations

Trees are, evidently, very significant. They play a crucial role in human and planetary well-being. Thus, this mini-report puts forth the following recommendations: (1) endorsement of the UD Botanic Garden Master

Plan, in addition to the incorporation of opportunities for faculty, staff, and students to engage in sustainability initiatives and practices (e.g. tree-planting); (2) collaboration with Newark City Council in ‘greening’ Newark in off-campus locations (e.g. green corridors); and (3) advertisement of UD’s sustainability practices to assist in elevating its national and international status.

Bibliography

Association for the Advancement of Sustainability in Higher Education, Sustainability Tracking & Rating System (AASHE STARS). “University of Delaware.” *AASHE STARS* <https://reports.aashe.org/institutions/university-of-delaware-de/report/2020-01-31/> accessed 5 March 2021.

-- 2019. “STARS Technical Manual: Version 2.2.” *AASHE STARS* <https://stars.aashe.org/wp-content/uploads/2019/07/STARS-2.2-Technical-Manual.pdf> accessed 5 March 2021.

Beatley, Timothy. 2016. “The Power of Urban Nature: The Essential Benefits of Biophilic Urbanism.” In *Handbook of Biophilic City Planning and Design*. Springer, chapter 1.

City of Newark (CoN). 2019. “Sustainable Newark: The City of Newark’s Plan for Sustainability.” *City of Newark* https://newarkde.gov/DocumentCenter/View/12803/SustainableNewark_FINAL_30OCT19?bidId= accessed 10 March 2021.

Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES). 2019. “Summary for Policymakers of the IPBES Global Assessment Report on Biodiversity and Ecosystem Services.” *IPBES* https://www.ipbes.net/sites/default/files/2020-02/ipbes_global_assessment_report_summary_for_policymakers_en.pdf accessed 10 March 2021.

Mississippi State University (MSU). 2021. “MSU Celebrates Arbor Day with Tree Planting on Drill Field.” *Mississippi State University* <https://www.msstate.edu/newsroom/article/2021/02/msu-celebrates-arbor-day-tree-planting-drill-field> accessed 5 March 2021.

Shanahan, Danielle., Bush, Robert A., Fuller, Richard A., Lin, Brenda B., and Gaston, Kevin J. 2015. “The Health Benefits of Urban Nature: How Much Do We Need?” *BioScience* 65(5): 476-485.

United States Forest Service (US FS) A. “Urban Research: Providing Knowledge and Tools for Resilient Communities.” *USDA Forest Service Research & Development* <https://www.fs.fed.us/research/docs/urban/urban-resilience.pdf> accessed 4 March 2021.

-- B. “Reforestation Overview.” *USDA Forest Service* <https://www.fs.fed.us/restoration/reforestation/overview.shtml> accessed 10 March 2021.

University of Delaware (UD) A. “Trees for Delaware.” *University of Delaware* <https://www.udel.edu/academics/colleges/canr/cooperative-extension/fact-sheets/trees-for-delaware/> accessed 10 March 2021.

-- B. “Tree Selection Guide.” *University of Delaware* <https://www.udel.edu/content/dam/udelImages/canr/pdfs/extension/factsheets/trees-for-delaware-guide.pdf> accessed 10 March 2021.

University of Delaware College of Agricultural and Natural Resources (UD CANR). “Charting the Path into the Future.” *University of Delaware* <https://canr.udel.edu/udbg/capital-campaign-news/> accessed 2 March 2021.

University of Hawai‘i (UoH). 2019. “Projects Aims to Make Hawai‘i the First Carbon-Neutral State.” *University of Hawai‘i* <https://www.hawaii.edu/news/2019/09/03/carbon-neutrality-challenge/> accessed 5 March 2021.

University of Illinois Chicago (UIC). 2019. “Tree Planting.” *University of Illinois Chicago* <https://sustainability.uic.edu/events/tree-planting/> accessed 5 March 2021.

University of Louisville (UofL). 2020. “Old Louisville Tree Planting.” *University of Louisville* https://events.louisville.edu/event/old_louisville_tree_planting accessed 5 March 2021.

van den Bogerd, N., Dijkstra, S. C., Seidell, Jacob C., and Maas, J. 2018. “Greenery in the University Environment: Students’ Preferences and Perceived Restoration Likelihood.” *PloS ONE* 13(2).

Washington University in St. Louis (WUSTL). 2019. “6th Annual Tree Planting Event.” *Washington University in St. Louis* https://sustainability.wustl.edu/calendar_event/6th-annual-tree-planting-event/ accessed 5 March 2021.



MINI-REPORTS

Fossil Fuel Divestment

University of Delaware – Fossil Fuel Divestment

Introduction

The number of institutions committing to fossil fuel divestment (FFD), or divesting assets from fossil fuel producers, is rising across the world; currently, FFD enjoys the support of more than 1300 global institutions, 15% of which are educational. Together, these commitments total to over 14.5 trillion USD (Go Fossil Free 2021a).

Overview

Since 2011, FFD has been generally borne of bottom-up campaigns in higher education as university students urge administrators to redirect university endowments and investment portfolios away from energy sources contributing injuriously to climate change and overall environmental degradation (Gibson & Duram 2020). More than 388 active campaigns currently exist on college campuses across the US, including at UD comparator institutions like West Chester University, Villanova University, the University of Pennsylvania, and Drexel University (Go Fossil Free 2021b). As many universities take steps to improve sustainability within the campus arena, FFD is built upon the tenet that it “is a reasonable next step” and that “it makes no sense to green the campus and not the portfolio” (Go Fossil Free 2021b).

The movement is driven on a deeper, moral level, with many citing Lenferna (2018) as to why FFD is an ethically-necessary step:

- a. “Investing in fossil fuels contributes to grave, substantial, and unnecessary harm and injustice.
- b. Divesting from fossil fuels helps fulfill our moral responsibility to promote climate action;

- c. Investing in fossil fuels morally tarnishes those who do so by making them complicit in the injustices of the fossil fuel industry.”

Scholars ascribe FFD’s largest impact to its social outcomes (Bergman 2018; Ansar et al. 2013). The movement has triggered stigmatization of fossil fuel companies, contributing to a paradigm shift away from the cultural norm of conventional energy sources and instead to the budding renewable energy industry. Direct financial impacts “pale in comparison” to this stigmatization (Ansar et al. 2013 13).

In 2020, the University of California (UC) became the largest institution in the US to completely divest from fossil fuel sources, directing 1 billion USD worth of fossil fuel investments toward renewable energy sources (UC Office of the President 2020). UC’s shift has empowered the renewables sector to accelerate 9.2 gigawatts in utility-scale wind and solar sources. Regarding the divestment and reinvestment in cleaner energy sources, Richard Sherman, chair of the UC Board of Regents’ Investments Committee, stated:

“As long-term investors, we believe the university and its stakeholders are much better served by investing in promising opportunities in the alternative energy field rather than gambling on oil and gas.” (UC Office of the President 2020).

Recommendations

FFD is on track to become a new norm in US higher education given its growth in the last decade; additionally, the nation is now working toward ambitious climate goals, led by UD-alum President Joe Biden (White House, 2021). The impetus and precedent for FFD makes 2021 an appropriate time for UD to consider FFD, but to the authors’ knowledge, few serious conversations have been had about the subject among key UD decision-makers. As a result, UD scored zero out of seven points in the ‘Sustainable Investments’ category on its scorecard, which requires the university applicant to make transparent, positive sustainability investments. Achieving full points in just this category could qualify UD for a Silver rating (AASHE Stars 2019).

Though financial implications of the coronavirus pandemic may seem to dissuade many entities from seeking divestment opportunities, UD has achieved a current and promising financial future that makes the opposite case: in a March 2021 Town Hall, President Dennis Assanis announced that UD has recovered 71-77% of the projected deficit for FY2021 (Stopyra 2021), while the most recent Investment Report touts a current +6.4% annual return on the University endowment, plus a projected +7.4% return over the next decade (UD Investment Office 2020).

Perhaps most impressively, the Investment Report notes that UD was recognized as an institution that will thrive during the pandemic (Galloway 2020). Given UD’s financial position and clear ability to manage assets in times of change, in addition to the aforementioned drivers of burgeoning FFD and climate change proactivity, UD is encouraged to explore trajectories that result in FFD, preferably within five years.

Bibliography

- AASHE STARS. 2019. “STARS Technical Manual: Version 2.2.” *AASHE STARS*
<https://stars.aashe.org/wp-content/uploads/2019/07/STARS-2.2-Technical-Manual.pdf> accessed 28 March 2021.
- Ansar, A., Caldecott, B., and Tilbury, J. 2013. “Stranded Assets and the Fossil Fuel Divestment Campaign: What Does Divestment Mean for the Valuation of Fossil Fuel Assets?” *University of Oxford*
<https://tcdfossilfree.files.wordpress.com/2015/09/smith-school-stranded-assets.pdf> accessed 28 March 2021.

Bergman, N. 2018. "Impacts of the Fossil Fuel Divestment Movement: Effects on Finance, Policy and Public Discourse." *Sustainability* 10(7): 2529.

Galloway, S. 2020. "US Higher Education: Value vs. Vulnerability." *Google Docs* https://docs.google.com/spreadsheets/d/1CU3HrqtC2oV3CF3_di4yW6Y4K_ClrUJNEEHCCKo7A/edit#gid=0 accessed 28 March 2021.

Gibson, D., & Duram, L. 2020. "Shifting Discourse on Climate and Sustainability: Key Characteristics of the Higher Education Fossil Fuel Divestment Movement." *Sustainability* 12(23).

Go Fossil Free, A. 2021. "1200+ Divestment Commitments." *Go Fossil Free*. <https://gofossilfree.org/divestment/commitments/> accessed 28 March 2021.

-- B. "Fossil Free Divestment: Colleges and Universities." *Go Fossil Free*. <https://campaigns.gofossilfree.org/efforts/fossil-fuel-divestment-colleges-universities> accessed 28 March 2021.

Stopyra, D. 2021. "Looking to a Robust Fall." *UDaily* <https://www.udel.edu/udaily/2021/march/dennis-assanis-town-hall-president-fall-semester-in-person-classes/> accessed 28 March 2021.

The White House. 2021. "Fact Sheet: President Biden Takes Executive Actions to Tackle the Climate Crisis at Home and Abroad, Create Jobs, and Restore Scientific Integrity Across Federal Government. White House." *The White House* <https://www.whitehouse.gov/briefing-room/statements-releases/2021/01/27/fact-sheet-president-biden-takes-executive-actions-to-tackle-the-climate-crisis-at-home-and-abroad-create-jobs-and-restore-scientific-integrity-across-federal-government/> accessed 28 March 2021.

UC Office of the President. 2020. "UC's Investment Portfolios Fossil Free; Clean Energy Investments Top \$1 Billion." *University of California*. <https://www.universityofcalifornia.edu/press-room/uc-s-investment-portfolios-fossil-free-clean-energy-investments-top-1-billion> accessed 28 March 2021.

UD Investments Office. 2020. "University of Delaware Investments Office Annual Report 2020." *The University of Delaware* <https://cpb-us-w2.wpmucdn.com/sites.udel.edu/dist/4/3439/files/2021/02/Endowment-Annual-Report-2020.pdf> accessed 28 March 2021.

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MINI-REPORTS

Food Waste Management

University of Delaware – Food Waste Management in Catering Events

Introduction

According to the definition from the Environmental Protection Agency (EPA), the concept of *food waste* refers to “food such as plate waste (i.e., food that has been served but not eaten), spoiled food, or peels and rinds considered inedible that is sent to feed animals, to be composted or anaerobically digested, or to be landfilled or combusted with energy recovery” (EPA, B). Approximately 40 percent of food in the U.S. is never eaten while one in ten (10.5 percent) of households in the U.S. experience food insecurity (FRAC). Food waste management and its important benefits have been discussed several times in the scientific literature (Hall et al. 2009; Kantor et al. 1994; LaPenta 2018; Gunders 2012; Griffin et al. 2009). Preventing excess food waste during large events is a potential area for UD to prevent food from ending up in the landfills. The proposal here is that UD extends the sustainability efforts on food waste management from dining halls to the catering events. Some of the academic literature is discussed in this report to emphasize on the importance of this issue.

Overview

Americans throw out more than 400 pounds of food per person, annually (Buzby et al. 2014). The EPA estimates that in 2018 in the U.S., more food ended up in the landfills and combustion facilities than any other material. Estimations show that 24 percent of the wasted food landfilled and at 22 percent of the amount combusted with energy recovery (EPA, A). By keeping healthy food in our communities instead, we can help address the 35.2 million Americans that are in need of food (Coleman-Jensen et al. 2020). Food waste contributes to excess consumption of freshwater and fossil fuels. These factors along with methane and CO₂ emissions from decomposing food impacts global climate change. Hall et al. (2009) found that U.S. per capita food waste has progressively increased by approximately 50 percent since 1974. Food waste now accounts for more than one quarter of the total freshwater consumption and approximately 300 million barrels of oil per year (Hall et al. 2009).

On September 16, 2015, the U.S. Department of Agriculture and EPA announced the first ever domestic goal to reduce food loss and waste (FLW) by half by the year 2030. According to EPA, 2010 was selected as a baseline with 218.9 pounds of food wasted per person. The 2030 FLW reduction goal aims to reduce food waste by 50 percent to 109.4 pounds per year per person (EPA, A).

In another study, Cuéllar et al. (2010) concluded that the food wasted in the U.S. in 2007 represents approximately 2030 trillion British Thermal Unit (BTU) of embedded energy. The energy discarded in wasted food is more than the energy available from many efficient energy sources, such as the annual production of ethanol from grains and annual petroleum available from drilling in the outer continental shelf.

They found that the food categories with the greatest embedded energy in their waste are dairy and vegetables. This is because of the greater proportional waste of dairy and vegetables, 32% and 25.3%, respectively as compared to meat, 16% wasted annually (Kantor et al. 1994), in addition to their high-energy requirements (Cuéllar & Webber 2010).

Scientists believe that the local efforts in minimizing food waste are more effective than non-specific, large-scale efforts (Lam 2010). Controlling food waste can promote environmental sustainability through energy and water conservation because energy is used during food production, distribution, and waste processing (Griffin et al. 2009). Food waste can be reused through composting. However, composting is a costly process, and requires energy, i.e. transporting food waste to composting sites. It is not possible to eliminate food waste in entirety, but it can be reduced through effective strategies. Lam (2010) conducted a survey at the University of California, Berkeley, to study the reasons why students did not finish their food in dining halls. She found that 210 students out of 490 respondents (43 percent) reported that they did not finish 30 percent of the initial amount of food they had in every meal. Additionally, 50 percent of students explained that the poor food quality was the reason why they did not finish their food. Further, 28 percent of the students thought that taking too much food or being served too much were reasons they did not finish their meal. Only 2% of the students mentioned that they did not waste food (Lam 2010).

UD Food Waste Management

According to UD's website (UD), UD does have a food waste management program through the Sustainability Council. According to the report on this website:

“We reduce food waste across our operations with the dual goals of conserving resources and keeping food out of landfills. Our practices include back of house operational practices to reduce waste before it's generated, programs to help consumers decrease food waste, feeding those in need during instances of excess safe, unserved food, and finally implementing composting programs wherever possible.”

This is a significant effort taken by the Sustainability Council at UD. The proposal here is that UD extends the sustainability efforts on food waste management that is happening in dining halls to catering events, such as graduate networking events and graduation ceremonies. The food prepared/catered for these events seem to be according to the number of registered students. At the events however, number of attendees are usually much less than the number of registrants.

To connect this to Newark City Council's efforts, its Sustainability Plan (2019) highlighted that the City seeks to provide “access to healthy food,” possible partnership with UD in its consideration for an Anaerobic Digester for “creating energy from food wastes,” “Increase backyard composting through educations and giveaways or discounts, focusing on food-waste composting,” and to partner with “the Food Bank of Delaware by providing yard wastes to the food bank's farm” (Newark City Council 2019, 2, 11, 37, 38). This demonstrates that efforts by the local city council is engaging in practices aimed at combatting food waste. Thus, UD is not alone in tackling this crucial issue that affects both humans and the natural environment.

Findings and Recommendations

The findings in the literature relate to UD's food waste management. UD often hosts large events at the University level that require catering services. In addition, a significant number of internal events take place in the university that provide food for participants. Some of these events require pre-registration and some do not. Several events end up having excess unserved food from the event due to a lower number of

internal events take place in the university that provide food for participants. Some of these events require pre-registration and some do not. Several events end up having excess unserved food from the event due to a lower number of participants than expected prior to the events. There is no document on UD's website nor in previous sustainability reports that these foods are used in useful ways such as being fed to people in need.

The most efficient way to reduce foodservice and consumer food waste is not to generate it at the first place (Kantor et al. 1994). One solution to this problem is reconsidering event organization methods. Event organizers can consider strategies to help them have a more precise number of participants in the events. Normally, prior to events, an invitation email is sent to potential participants and requires those who are interested in the event to complete a form that notifies event organizers know about their participation. There are no consequences in not showing up to the events while registering for it. This may cause more people to register to the events and not feel any responsibility in attending events. In addition, since the catering in these events is based on the number of registrants, a significant amount of food is wasted.

The proposal here is to consider strategies to avoid people from unnecessary registration while not being confident about their attendance. For example, a small fee could be considered for registered people who do not show up to the events without a reasonable reasoning. Alternatively, event organizers could manage the catering in a way that they can make sure that the unserved food is safe to be fed to people in need rather than being wasted. Like Newark City Council, such food could be arranged to be donated to the Food Bank of Delaware, or caterers could come with containers to give leftover food to attendees, prioritizing students. The planning and decision-making on these strategies are out of the scope of this report and only a few ideas are suggested.

Another effective plan could be increasing awareness among the students and the university population about the rate of food loss and waste on campus, while more than 35 million Americans live in households that struggle with hunger (FRAC). Making students, faculty, and staff more aware of these issues may help them consider what they put on their plates in dining halls and at catered events. For instance, University of Illinois Urbana-Champaign, takes an interesting approach to reduce their food waste through raising food waste awareness among the diners by displaying the real-time, post-consumer food waste information at the dining hall main door (UoIUC).

The steps to look into this issue in UD are:

- Explore state-of-the-art food waste management plans in academic literature.
- Implement an Anaerobic Digester in partnership with Newark City Council.
- Investigate and update UD's food waste management plans and strategies.
- Amend catering strategies to better anticipate the amount of food that ought to be served to reduce food waste at catered events.

Bibliography

Buzby, Jean C., Hodan Farah-Wells, and Jeffrey Hyman. 2014. "The Estimated Amount, Value, and Calories of Postharvest Food Losses at the Retail and Consumer Levels in the United States." *USDA-ERS Economic Information Bulletin* 121.

https://www.ers.usda.gov/webdocs/publications/43833/43680_eib121.pdf?v=1508.7 accessed 7 April 2021.

Coleman-Jensen, Alisha, Christian Gregory, and Anita Singh. 2020. "Household Food Security in the United States in 2019." *USDA-ERS Economic Research Report* 173

<https://www.ers.usda.gov/webdocs/publications/99282/err-275.pdf?v=6575.5> accessed 7 April 2021.

Cuéllar, Amanda D., and Michael E. Webber. 2010. "Wasted Food, wasted Energy: the Embedded Energy in Food Waste in the United States." *Environmental Science & Technology* 44(16): 6464-6469.

Environmental Protection Agency (EPA), A. "United States 2030 Food Loss and Waste Reduction Goal." *EPA* <https://www.epa.gov/sustainable-management-food/united-states-2030-food-loss-and-waste-reduction-goal> accessed on 2 April 2021.

-- B. "What is Wasted Food and Where Does it Come From?" *EPA* <https://www.epa.gov/sustainable-management-food/sustainable-management-food-basics> accessed on 2 April 2021.

Food Research and Action Center (FRAC). "Hunger and Poverty in America." *FRAC* [https://frac.org/hunger-poverty-america#:~:text=Hunger%20Quick%20Facts&text=One%20in%20ten%20\(10.5%20percent,percent%20compared%20to%2010.3%20percent\)](https://frac.org/hunger-poverty-america#:~:text=Hunger%20Quick%20Facts&text=One%20in%20ten%20(10.5%20percent,percent%20compared%20to%2010.3%20percent)) accessed 7 April 2021.

Griffin, Mary, Jeffery Sobal, and Thomas A. Lyson. 2009. "An Analysis of a Community Food Waste Stream." *Agriculture and Human Values* 26(1): 67-81.

Gunders, Dana. 2012. "Wasted: How America is Losing up to 40 Percent of its Food From Farm to Fork to Landfill." *Natural Resources Defense Council* 26: 1-26.

Hall, Kevin D., Juen Guo, Michael Dore, and Carson C. Chow. 2009. "The Progressive Increase of Food Waste in America and Its Environmental Impact." *PloS One* 4(11): e7940.

Kantor, Linda S., Kathryn Lipton, Alden Manchester, and Victor Oliveira. 1994. "Estimating and Addressing America's Food Losses." *Food Review/National Food Review* 20(1): 2-12.

Lam, Yuting. 2010. "Why Do UC Berkeley Students Waste Food at Dining Halls?" *University of California Berkeley* https://nature.berkeley.edu/classes/es196/projects/2010final/LamY_2010.pdf accessed 2 April 2021.

LaPenta, D. 2018. "Combating Food Waste." *University of Delaware* <https://www.udel.edu/udaily/2018/march/food-waste-in-delaware/> accessed on 2 April 2021.

Newark City Council. 2019. *Sustainable Newark: The City of Newark's Plan for Sustainability*. Newark City Council https://newarkde.gov/DocumentCenter/View/12803/SustainableNewark_FINAL_30OCT19?bidId= accessed 2 April 2021.

University of Delaware (UD). "Our Priorities and Practices." *University of Delaware* <https://udel.campusdish.com/Sustainability.aspx> accessed on 2 April 2021.

University of Illinois Urbana-Champaign (UoIUC). "Sustainability in Dining." *University of Illinois* <https://housing.illinois.edu/dining/about-dining/sustainability> accessed 4 April 2021.

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DELAWARE ACTION PLAN

Delaware Climate Action Plan Survey (2019)

In 2019, Delaware conducted a survey of Delawareans on their attitudes toward climate change to assist in constructing the Delaware Climate Action Plan (DNREC 2019). Some of the facts and figures are presented below.

General

- 3 out of 4 are convinced that climate change is happening.
- 77% think climate change will harm future generations.
- 56% say they have personally experienced or observed local impacts of climate change.
- 47% say they have personally experienced or observed local impacts of sea level rise, up from 28% in 2014.
- 70% agree that we should take immediate action to reduce the impacts of climate change.
- 64% say they can personally take action to reduce the impacts of climate change.

Policies

- 83% support increasing conservation of forested and agricultural lands.
- 80% support requiring stronger air pollution controls on business and industry.
- 74% support requiring that an increasing percentage of electricity used in Delaware come from renewable sources.
- 73% support requiring stronger energy efficiency standards on household appliances.
- 53% support requiring that an increasing percentage of vehicles sold in Delaware be powered by electricity.
- 82% support preserving undeveloped land and natural features to allow for sea level rise to occur.
- 79% support changing building codes and regulations to reduce risk in flood prone areas.
- 77% support avoiding construction of new buildings in areas at risk from sea level rise.
- 74% support avoiding construction of new roads and infrastructure in areas at risk from sea level rise.

Throughout 2020, Delawareans participated in public workshops to provide comments on Delaware's Climate Action Plan, and the Plan itself is expected to be completed and released in Winter 2021 (DNREC 2020b). By implementing the Plan, the Delaware government anticipates that it will protect and strengthen "agricultural and tourism economies," the "natural places we enjoy for recreation," "infrastructure," the "health of our residents and visitors," and access to "clean energy and transportation all Delawareans" (DNREC 2020b). Climate change is already understood by the Delaware government as adversely affecting the state, with heatwaves projected to become longer and more frequent, sea levels to continue to rise, and extreme temperatures to exacerbate (DNREC 2020b).



RECENT DEVELOPMENTS

The below list highlights important developments – at various levels of governance – that are important to consider in light of all the recommendations made in the mini-reports outlined above.

Invasive Plants: In March 2021, Delaware Governor John Carney signed Senate Bill No. 22 (SB22) into law, which bans the sale and import of 37 invasive plant species in Delaware. For more, see:

<https://udreview.com/where-are-your-native-plants-delaware-bans-sale-and-import-of-invasive-plants/>

Zero Net Energy Buildings: Given Senate Bill No. 59, Amendment No. 3 – which came into effect in July 2010 – all new residential building construction, from December 31, 2025, in the State of Delaware shall be zero net energy capable. As of December 31, 2030, all new commercial building construction must also be zero net energy capable. For more information, see:

<https://legis.delaware.gov/SessionLaws/Chapter?id=17328>

Executive Report: By the end of Spring 2022, the University of Delaware Sustainability Council hopes to complete *The Executive Sustainability Plan*.

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DDAMULIRA REPORT

In early 2021, Dr. Robert Ddamulira – founder and CEO of GreenPesa – completed a report for the University of Delaware, titled “Best Practices in U.S. University Sustainability: Lessons for University of Delaware” (Ddamulira 2021). In this report, Ddamulira focused on several areas of significance, reflecting the topics highlighted by AASHE, including AASHE score, academia, engagement, operations, planning and administration, and financing. Below, each of his recommendations are succinctly provided.

AASHE Score: It is important to identify distinctive aspects of UD that serve to promote its uniqueness among other universities and colleges striving to attain recognition for their sustainability practices and record. Two distinct points of significance for Ddamulira are: (1) UD’s Solar House; and (2) UD’s Energy and Environmental Policy (ENEP) Program (Ddamulira 2021, 4).

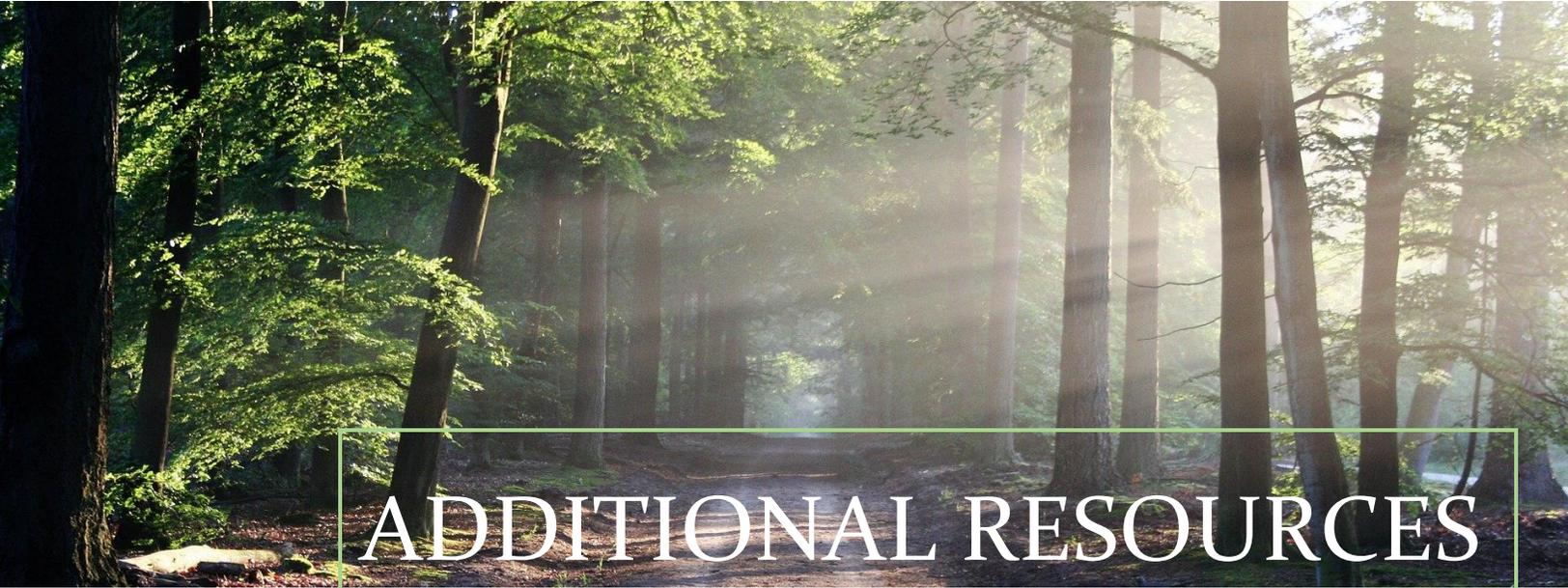
Academia: For academia, UD ought to assess the feasibility of integrating sustainability across its academic programs and this is of particular importance in increasing engagement among young people, as well as in recruiting and retention of students, faculty, and staff (Ddamulira 2021, 4-5).

Engagement: Ddamulira recommends that UD creates a campus-wide sustainability culture survey including a proportional sample of students, faculty, and staff. Recommendations also include collaboration between the UD Sustainability Council and Chief Diversity Officer, Fatimah Conley, and the Office of Institutional Equity, Diversity, and Inclusion. Additionally, Ddamulira recommends that exploration is made into enhancing the community engagement initiative in the Biden School for an additional opportunity for collaboration (Ddamulira 2021, 5-7).

Operations: There is evidently a need to improve energy efficiency across UD’s campuses, and this can be done by installing occupancy sensors and auto-switch power-strips. In 2019, nearly half of UD’s buildings had an Energy Use Intensity (EUI) higher than the average Higher Education institution in the U.S. (Ddamulira 2021, 7-8).

Planning and Administration: Generally, there ought to be an improved line of communication between the University President and sustainability groups, especially the Sustainability Council. Furthermore, Ddamulira recommends that UD takes advantage of the possibility of creating temporary working committees, such as a Sustainability Design Team, tasked with long-term objectives to improve UD’s sustainability practices (Ddamulira 2021, 10-12).

Financing: This aspect is undoubtedly the most challenging, but Ddamulira advises that UD engages in a Green Revolving Fund (GRF). Such a fund, established by UD, could be managed by an oversight committee that meets monthly and approves sustainability projects, for example, approving projects up to \$100,000 (Ddamulira 2021, 16).



ADDITIONAL RESOURCES

In January 2021, the Chair of the GSG Sustainability Committee, Thomas Benson, contacted the Chair of the American Planning Association's Sustainable Communities Division (Merrill St. Leger) to reach out to its Sustainability Champion for Delaware. However, as of January 2021, the Sustainability Champion program is being rebooted, according to Merrill. In place of this contact, Thomas collaborated with Merrill and established a list of additional resources. In the list below, there are several resources, each with a short description of the resource.

Second Nature (<https://secondnature.org/>)

This website features a litany of resources available to UD, including a link to the *Presidents' Climate Leadership Commitments*, which was the commitment that UD's President [name], in 2008, signed.

More information can be found here: <https://secondnature.org/signatory-handbook/the-commitments/>

There is also a University Climate Change Coalition (UC3) that features North American research universities committed to climate action and cross-sector collaboration. The collaborative coalition leverages relationships and expertise to accelerate local climate solutions and build community resilience.

More information can be found here: <https://secondnature.org/initiative/uc3-coalition/>

International Sustainable Campus Network (<https://international-sustainable-campus-network.org/>)

Another collaborative network between higher education institutions is the International Sustainable Campus Network (ISCN). This network is international in scope and is committed in exchanging information, ideas, and best practices for achieving sustainable campus operations and integrating sustainability in research and teaching.

EcoDistricts (<https://ecodistricts.org/protocol/>)

Whilst predominantly aimed at municipalities, this resource can, nevertheless, provide utility to UD. It gives insight into how cities – such as Newark – may operate in terms of sustainability practices, and it also shines a light on the collaboration needed between different stakeholders to achieve optimal sustainable outcomes.

EcoDistricts also emphasizes the importance of neighbourhoods – UD could attempt to emulate this on its campuses or on a campus by showcasing a green campus that could act as a trial whereby other campuses would eventually follow suit.

International Living Future Institute (<https://living-future.org/lcc/>)

Perhaps the most interesting of the resources listed here, the International Living Future Institute features several ‘petals’, each depicting a crucial aspect of sustainability. Like EcoDistricts, this source is more focused on cities but still has important messages for universities (which could be part of informational campaigns on UD’s social media platforms and in university-wide emails), which are outlined here (and tweaked for university-related purposes).

- **Place Petal:** food is locally-sourced; building development occurs only on greyfields or brownfields; walkable, pedestrian-orientated communities are established in conjunction with public transit linkages; public bike storage is conveniently distributed and ample in supply; and at least one electric vehicle charging station is present.
- **Beauty Petal:** create and meaningfully integrate public art and design features on every block, street, and plaza, intended solely for human delight; an educational webpage exists that shares information about the design and operation of the university; a simple brochure that describes the design and environmental features of the university is provided on open days; and interpretive signage is established that teaches visitors and occupants about the university and its environmental goals and features.
- **Equity Petal:** prioritize the concept of “citizen” above that of “consumer,” and elevate the notion of “community” above that of “self”; promote narrower roads (or, alternatively, incorporate bicycle paths that are physically separated); construct (and/or retrofit) eco-friendly student accommodation; establish equally-accessible modes of transportation (e.g. ramps on campus to allow wheelchair access); provide adequate access to fresh air, sunlight and natural waterways and appropriately address any disruptive noise (e.g. retrofit windows for maximum sunlight, improve ventilation, and improve lighting); and engage in transparent disclosure of investments and donations.
- **Materials Petal:** create a university that is nontoxic; account for the total embodied carbon impact from the construction of all university infrastructure (built or projected) and university-owned facilities (built or projected) through a one-time carbon offset within the project boundary; strive to reduce or eliminate the production of waste during design, construction, operation, and end of life in order to conserve natural resources; and find ways to integrate waste back into either an industrial loop or natural nutrient loop.
- **Health and Happiness Petal:** focus on the major conditions that must be present to create robust, health students, faculty, and staff that are happy and productive people, e.g. by establishing a local food program, a car and bike sharing program, a transit information centre, and art and recreation programs; actively protect buildings considered to have historical significance and create an inventory of local heritage sites or facilities, as well as maintaining a current preservation plan; create a health and wellness education plan that is applicable to every member of the university and is kept current on the university website; require all facilities to have a working back-up generator or battery back-up for emergency power (safe from flooding); create and renew annually a disaster response plan for faculty, students, and staff with the incorporation of emergency contacts and shelter locations; assign and train “block captains” for every 500 residents (highly versed in disaster response, first aid and general safety procedures); and ensure that all sensitive infrastructures (e.g. lift stations, sub-stations, sewage treatment, communal centres) are out of the flood plain.
- **Energy Petal:** create a safe, reliable and decentralized power grid, founded on renewable energy that supplies incredibly efficient buildings and infrastructure without the crutch of combustion; and 105% of the university’s energy needs must be supplied by university-generated renewable energy on a net annual basis, including all energy for water and waste conveyance.

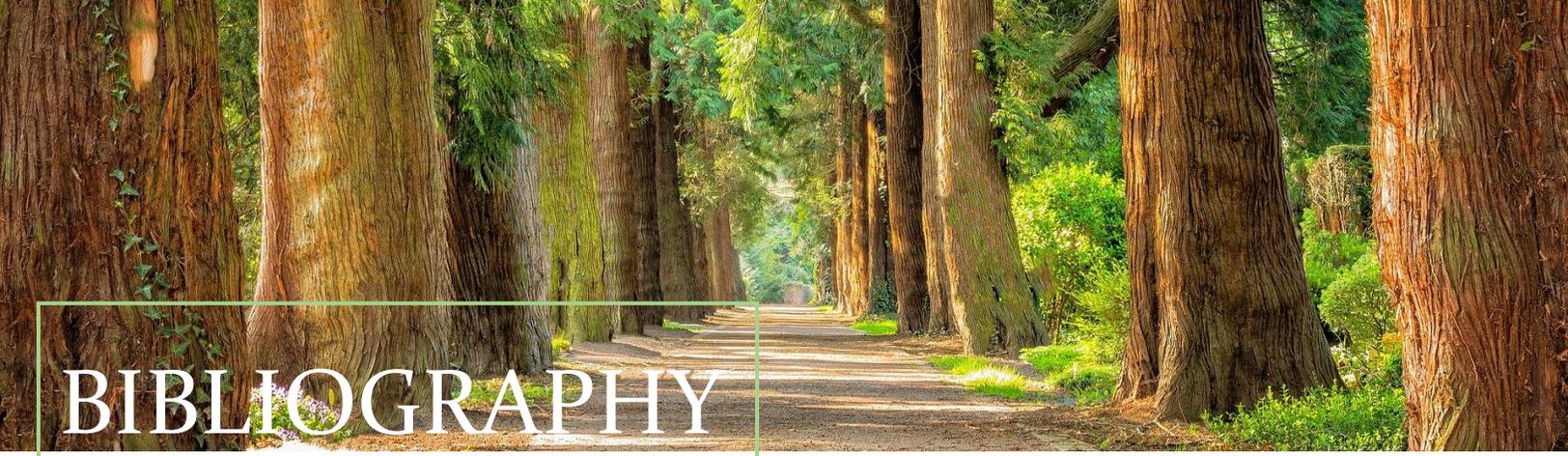
- **Water Petal:** realign how faculty, staff, and students use water and redefine “waste” in the built environment, so that water is respected as a precious resource; capture precipitation or other natural closed loop water systems and make efforts to purify these without the use of chemicals; and all stormwater and water discharge, including grey and black water, must be treated.

U.S. Green Building Council, LEED for Cities and Communities (<https://www.usgbc.org/leed/rating-systems/leed-for-cities>)

The LEED framework encompasses social, economic and environmental performance indicators and strategies with a clear, data-driven means of benchmarking and communicating progress. The program is aligned with the United Nations Sustainable Development Goals. There are several categories.

- **Natural Systems and Ecology:** ecosystems protect and even regenerate natural systems, thereby increasing the ecosystem services they provide and creating ecologically resilient communities. These are better able to withstand and recover from episodic floods, droughts, wildfires, and other catastrophic events.
- **Transportation and Land Use:** the transport sector is responsible for a quarter of energy-related GHG emissions worldwide. Land use is the key driver of mobility in a city, and rapid urbanisation has disrupted land use patterns, resulting in urban sprawl and increased dependency on personal, motorized vehicles. Universities and municipalities ought to adopt an integrated approach towards urban planning through mixed-use development, efficient transportation, better connectivity, and engagement with stakeholders.
- **Water Efficiency:** water demand has been constantly increasing in urban and peri-urban areas and is stressing freshwater reserves, creating a perennial shortage of water. There is a need to meet demand, maintain water quality, reduce water losses, capture stormwater, and manage urban floods. Universities and municipalities ought to adopt an integrated approach toward water use management and planning and move towards a net zero water city.
- **Materials and Resources:** cities are large aggregators and consumers of materials and nutrients, accounting for the highest natural resource consumption affecting the environment and human health. Cities and universities ought to move towards net zero waste through recycling, reuse, and reduction of waste generation.
- **Quality of Life:** communities must equitably address the needs of all people, irrespective of gender, ethnicity, socio-cultural and economic status in their pursuits of livability and sustainability. Leaders should assess their socio-economic and demographic conditions and make improvements to their communities that support social equity, public health, affordability, education, prosperity, and community engagement.

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BIBLIOGRAPHY

AASHE. 2019. “STARS Technical Manual: Version 2.2.” *AASHE STARS* <https://stars.aashe.org/wp-content/uploads/2019/07/STARS-2.2-Technical-Manual.pdf> accessed 23 November 2020.

-- A. “Who We Are.” *AASHE* <https://www.aashe.org/about-us/who-we-are/> accessed 2 January 2021.

-- B. “Mission, Vision & Commitments.” *AASHE* <https://www.aashe.org/about-us/mission-vision-commitments/> accessed 2 January 2021.

-- C. “The Sustainability Tracking, Assessment & Rating System.” *AASHE* <https://stars.aashe.org/> accessed 2 January 2021.

-- D. “University of Delaware Reports.” *AASHE* <https://reports.aashe.org/institutions/university-of-delaware-de/report/> accessed 5 January 2021.

-- E. “University of Delaware.” *AASHE* <https://reports.aashe.org/institutions/university-of-delaware-de/report/2020-01-31/> accessed 3 January 2021.

-- F. “Participate.” *AASHE* <https://stars.aashe.org/participate/> accessed 5 January 2021.

Biden Campaign. 2021. “The Biden Plan for a Clean Energy Revolution and Environmental Justice.” *Joe Biden* <https://joebiden.com/climate-plan/> accessed 20 January 2021.

Center for World University Rankings (CWUR). 2020. “CWUR – World University Rankings 2019-2020.” *Center for World University Rankings* <https://cwur.org/2019-2020.php> accessed 5 January 2021.

City of Newark. 2019. “Sustainable Newark: The City of Newark’s Plan for Sustainability.” *City of Newark* https://newarkde.gov/DocumentCenter/View/12803/SustainableNewark_FINAL_30OCT19?bidId= accessed 29 January 2021.

Ddamulira, Robert. 2021. “Best Practices in U.S. University Sustainability: Lessons for University of Delaware.” *University of Delaware Sustainability Council*.

DNREC. 2020a. “Delaware Climate Action Plan Supporting Technical Greenhouse Gas Mitigation Analysis Report.” *DNREC* https://decaptransfer3.wpengine.com/wp-content/uploads/2020/09/DNREC-Technical-Report_FINAL-9-3-20-CLEAN.pdf accessed 29 January 2021.

-- 2020b. “Delaware’s Climate Action Plan.” *DNREC* https://decaptransfer3.wpengine.com/wp-content/uploads/2020/07/Delaware-Climate-Action-Plan-One-Pager-v07_2020.07-Update.pdf accessed 17 February 2021.

-- 2020b. “Delaware’s Climate Action Plan.” *DNREC* https://decaptransfer3.wpengine.com/wp-content/uploads/2020/07/Delaware-Climate-Action-Plan-One-Pager-v07_2020.07-Update.pdf accessed 17 February 2021.

- 2019. "Delaware's Climate Action Plan." *DNREC* <https://decaptransfer3.wpengine.com/wp-content/uploads/2020/06/Delaware-Climate-Action-Plan-Infographic-v07.pdf> accessed 17 February 2021.
- Kolbert, Elizabeth. 2014. *The Sixth Extinction: An Unnatural History*. New York: Picador.
- QS. 2020a. "QS World University Rankings: USA 2020." *QS Top Universities* <https://www.topuniversities.com/university-rankings/world-university-rankings/2020> accessed 5 January 2021.
- 2020b. "Who Rules?" *QS Top Universities* <https://www.topuniversities.com/university-rankings/world-university-rankings/2020> accessed 5 January 2021.
- Times Higher Education (THE). 2020a. "Wall Street Journal/Times Higher Education College Rankings 2020." https://www.timeshighereducation.com/rankings/united-states/2020#!/page/0/length/-1/sort_by/rank/sort_order/asc/cols/stats accessed 5 January 2021.
- 2020b. "World University Rankings 2020." *Times Higher Education* https://www.timeshighereducation.com/world-university-rankings/2020/world-ranking#!/page/0/length/-1/sort_by/rank/sort_order/asc/cols/stats accessed 5 January 2021.
- University of Delaware (UD). 2009. "A Sustainable University of Delaware Climate Action Plan." *Center for Energy and Environmental Policy*: 1-40.
- UDa. "About UD." *University of Delaware* <https://www.udel.edu/about/> accessed 29 December 2020.
- UDb. "Enrollment." *University of Delaware* <https://www.udel.edu/about/facts-figures/> accessed 29 December 2020.
- UDc. "Committees." *University of Delaware* <https://sites.udel.edu/gsg/committees/> accessed 03 October 2021.
- UDd. "Sustainability." *University of Delaware* <https://sites.udel.edu/sustainability/> accessed 30 December 2020.
- UDe. "Energy." *University of Delaware* <https://sites.udel.edu/sustainability/energy/> accessed 30 December 2020.
- UDf. "Water." *University of Delaware* <https://sites.udel.edu/sustainability/water/> accessed 30 December 2020.
- UDg. "Sustainability." *University of Delaware* <https://udel.campusdish.com/Sustainability.aspx> accessed 30 December 2020.
- UDh. "Organic Farm and Gardens." *University of Delaware* <https://canr.udel.edu/udbg/capital-campaign-news/organic-farm-gardens/> accessed 30 December 2020.
- UDi. "The Dairy." *University of Delaware* <https://www.udel.edu/academics/colleges/canr/about/facilities-labs/dairy-farm/> accessed 30 December 2020.
- UDj. "Waste." *University of Delaware* <https://sites.udel.edu/sustainability/waste/> accessed 30 December 2020.
- UDK. "Transportation." *University of Delaware* <https://sites.udel.edu/sustainability/transportation/> accessed 30 December 2020.

- UDI. "Ecological Preserve." *University of Delaware* <https://canr.udel.edu/udbg/capital-campaign-news/ecological-preserve/> accessed 30 December 2020.
- UDM. "South Campus Green." *University of Delaware* <https://canr.udel.edu/udbg/capital-campaign-news/south-campus-green/> accessed 30 December 2020.
- UDN. "Clark Garden Collections." *University of Delaware* <https://canr.udel.edu/udbg/capital-campaign-news/clark-garden-collections/> accessed 30 December 2020.
- UDO. "South Campus Green Gateway." *University of Delaware* <https://canr.udel.edu/udbg/capital-campaign-news/south-campus-green-gateway/> accessed 30 December 2020.
- UDP. "Wilson Homestead Garden." *University of Delaware* <https://canr.udel.edu/udbg/capital-campaign-news/wilson-homestead-garden/> accessed 30 December 2020.
- UDQ. "Arboretum and Pond." *University of Delaware* <https://canr.udel.edu/udbg/capital-campaign-news/arboretum-and-pond/> accessed 30 December 2020.
- UDR. "Four Seasons Garden." *University of Delaware* <https://canr.udel.edu/udbg/capital-campaign-news/four-seasons-garden/> accessed 30 December 2020.
- UDS. "Creamery Lawn and Garden." *University of Delaware* <https://canr.udel.edu/udbg/capital-campaign-news/creamery-lawn-garden/> accessed 30 December 2020.
- UDT. "Green Grants." *University of Delaware* <https://sites.udel.edu/sustainability/call-for-green-grant-proposals-2021/> accessed 26 March 2021.
- UDU. "About." *University of Delaware* https://sites.udel.edu/green/?page_id=2 accessed 31 December 2020.
- UDV. "Sustainability Taskforce." *University of Delaware* https://sites.udel.edu/green/?page_id=163 accessed 31 December 2020.
- UDX. "Sustainability Council." *University of Delaware* <https://sites.udel.edu/sustainability/meet-the-members/> accessed 31 December 2020.
- UDY. "Call for Green Grants Proposals – 2021." *University of Delaware* <https://sites.udel.edu/sustainability/call-for-green-grant-proposals-2021/> accessed 2 March 2021.
- UD Investments Office (UDIO). 2019. "Investments Office Annual Report 2019." *University of Delaware* <https://cpb-us-w2.wpmucdn.com/sites.udel.edu/dist/4/3439/files/2019/12/Endowment-Annual-Report-2019%C6%92.pdf> accessed 29 January 2021.
- UD & Siemens. 2020. "University of Delaware: Greenhouse Gas Inventory for the 2018-2019 Academic Year." *University of Delaware* https://cpb-us-w2.wpmucdn.com/sites.udel.edu/dist/e/763/files/2015/10/UD-2018-2019-GHG-Inventory-Report_Final-V2.pdf accessed 1 January 2021.
- United Nations (UN). 2021. "Secretary-General's Statement on the IPCC Working Group 1 Report on the Physical Science Basis of the Sixth Assessment." *United Nations* <https://www.un.org/sg/en/content/secretary-generals-statement-the-ipcc-working-group-1-report-the-physical-science-basis-of-the-sixth-assessment> accessed August 2021.
- Washington Monthly (WM). 2020. "2020 National University Rankings." *Washington Monthly* <https://washingtonmonthly.com/2020college-guide/national> accessed 5 January 2021.