UNIVERSITY OF DELAWARE®

2024 Sustainability Report

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Graduate Student Government
Sustainability Committee

GSG
Graduate Student Government

Preface

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CONFLICTS OF INTEREST

There are no conflicts of interest to report.

CONTENTS

Introduction

sus·tain·a·bil·i·ty

/səˌstānəˈbilədē/

Noun

1. Meeting the needs of the present without compromising the ability of future generations to meet their own needs, while balancing social, economic, and environmental considerations.
2. The key to a better future.

Executive Summary

The purpose of this document is to provide direct policy recommendations to the University of Delaware's Office of Sustainability. This is an effort to accelerate action after the establishment of the Office of Sustainability in Spring 2023. While we fully recognize the difficulty of onboarding a new university office, we hope that the contents of this policy report may help ease the burden and allow for more immediate action.

Within this report, the newly established Office of Sustainability will find recent policy recommendations made by the Graduate Student Government Sustainability Committee. It should be noted that these recommendations do not capture all the environmental challenges faced by the university. However, each recommendation has been supported by the graduate student body through their passage via majority vote by elected representatives in Graduate Student Government. The contents of this report have been endorsed by both graduate and undergraduate student leaders and student organizations. Each of the recommendations contained in this report should be thoughtfully implemented while keeping environmental justice, diversity, equity, and inclusion at the forefront of all efforts.

Net Zero 2030

The impacts of climate change are anticipated to severely affect Delaware with an additional 9-30 days per year above 100 °F (37.7 ˚C) expected by late-century under a business-as-usual scenario. These increased temperatures will place additional strain upon electric utility providers to meet demand during peak hours, causing power outages that could adversely affect the University of Delaware (UD) and residents of Newark. Rainfall in Delaware is expected to dramatically increase with more frequent and intense heavy rainstorms, which could cause septic system failure that could lead to significant damage to UD campus infrastructure. Coupled with rising sea levels, increased rainstorm frequency could flood the chemical industry along the Delaware River – which is worth nearly $1 billion and provides a significant amount of financial support to UD.

The United Nations Intergovernmental Panel on Climate Change (IPCC) has set a warming threshold of 1.5 ˚C above pre-industrial levels to avoid the most severe of these climate impacts. Anthropogenic emissions have already led to a 1.1 ˚C warming above the pre-industrial baseline global average surface temperature. In 2008, UD committed to achieving carbon neutrality by 2050. However, the IPCC Sixth Assessment Report demonstrated that net zero by 2050 is not ambitious enough to avoid a 1.5 ˚C global warming average. Peer universities have established more ambitious emissions targets than UD in line with avoiding 1.5 ˚C warming. Thus, the graduate student body calls upon the University of Delaware and the newly established Office of Sustainability to commit to net zero greenhouse gas emissions by 2030. We offer the policy tools contained within this report to achieve this ambitious, but vital goal.

Land Acknowledgement

This is a living land acknowledgement developed in consultation with tribal leadership of Poutaxet, what is now known as the "Delaware Bay," including: the Lenape Indian Tribe of Delaware, the Nanticoke Indian Tribe, and the Nanticoke Lenni-Lenape Tribal Nation in 2021. We thank these leaders for their generosity.

The University of Delaware occupies lands vital to the web of life for Lenni Lenape and Nanticoke, who share their ancestry, history, and future in this region. This interactive map shows that the Lewes, Georgetown, Dover, Newark, and Wilmington campuses are located in these Indigenous homelands. UD has financially benefited from this regional occupation as well as from Indigenous territories that were expropriated through the United States land grant system since the institution was established in 1743. We acknowledge that the centuries of harm to Indigenous people and their homelands are beyond repair. Yet, we pledge a sustained commitment to accountability.

We honor that the Nanticoke and Lenni Lenape have lived in harmony with one another and this land since ancient times. The ancestors of the Lenni Lenape, translated as "the Original People," were farmers and diplomats throughout their homeland, Lenapehoking, which includes present-day New Jersey, most of Delaware, and the eastern parts of New York and Pennsylvania. The ancestral Nanticoke, known as the "Tidewater People" because their livelihood depended upon the bounty of the land, ocean, and rivers, lived along the present-day Delmarva Peninsula. We express our appreciation for ongoing Indigenous stewardship of the ecologies and traditions of this region, despite the centuries of colonial-capitalist plunder.

We commit to learning the stories of all those who have, and have not, survived genocide, ecocide, displacement, slavery, and ongoing occupation. In the 16th, 17th and 18th centuries, the Dutch, Swedes, and British established settler colonies in this region, resulting in Indigenous epidemics and warfare. In parallel, the trans-Atlantic slave trade had devastating consequences for people of African descent, Indigenous communities, and their shared kin. European nations and eventually the United States forced some

Nanticoke and Lenni Lenape westward and northward. Others never left their homelands or returned from exile when they could. Many survived by forming tribal congregations in Christian churches and controlling segregated Native American public schools in the 1800s and 1900s, while maintaining much of their traditional spirituality. They persist today as the Lenape Indian Tribe of Delaware, the Nanticoke Indian Tribe, the Nanticoke Lenni-Lenape Tribal Nation, the Ramapough Lenape and other continuing tribal communities throughout the eastern seaboard. Other Nanticoke and Lenni Lenape form the Delaware Nation in Anadarko, Oklahoma, the Delaware Tribe of Indians in Bartlesville, Oklahoma, the Stockbridge-Munsee Band of Mohican Indians in Bowler, Wisconsin, the Munsee-Delaware Nation near St. Thomas, Ontario, the Delaware Nation at Moraviantown near Chatham-Kent, Ontario, and the Delaware of Six Nations near Brantford, Ontario. We will foster right relationships going forward through tangible and actionable institutional steps elaborated in collaboration with tribal leadership. The future viability of the University of Delaware necessitates reparations for Indigenous people. With this living land acknowledgement, UD commits to building relationships with Indigenous people based on respect, relevance, reciprocity, and responsibility to redress centuries of harm.

President Joe Biden

Joseph R. Biden, University of Delaware alumnus and 46th President of the United States, has set the standard for federal environmental sustainability policy. This is best illustrated by the passage of the 2022 Inflation Reduction Act, the largest investment into fighting climate change in U.S. history. Upon taking office, President Biden appointed the first White House National Climate Advisor and committed the U.S. to 100% clean energy production and net zero greenhouse gas emissions by 2050. Under his leadership the U.S. ratified the Kigali amendment for an 85% reduction in the use of hydrofluorocarbons, a potent greenhouse gas, by 2036. As President Biden's alma mater and home of the Biden Institute along with the Joseph R. Biden, Jr. School of Public Policy & Administration, the University of Delaware should strive to match his administration's ambition towards promoting environmental sustainability.

"This is the decisive decade…This is the decade we must make decisions to avoid the worst consequences of the climate crisis."

-Joseph R. Biden, 46th President of the United States

Progress Indicators

Each recommendation made in this report has been marked with one of the following progress indicators to provide information on the status of planning and implementation as reported by the UD Sustainability Council or Office of Sustainability:

Effort implemented or actively being implemented

Effort publicly announced, but implementation not yet begun

No current effort publicly announced

Energy

"We are like tenant farmers chopping down the fence around our house for fuel when we should be using nature's inexhaustible sources of energy-sun, wind, and tide."

-Thomas Edison

Fossil Fuel Divestment

Background:

- The United Nations estimates that because of global carbon emissions, the world will warm by approximately five degrees Fahrenheit by 2100 with devastating climate effects
- Just 100 fossil fuel companies are responsible for the emission of roughly 71% of the world's carbon dioxide
- For reasons both moral and financial, American colleges and universities are among a growing list of institutions that have already committed to divesting some $40 trillion from coal, gas, and oil stocks
    - This includes University of Delaware comparator peer institutions,[1] and prominent institutions[2]
- Black Rock's investment experts have concluded that it is increasingly financially irresponsible to invest in the fossil fuel energy sector
    - Over the last five years, the overall market has increased at an annual rate of 16%, but the oil and gas sector has fallen at an annual rate of 3%
    - Investors in clean energy have seen annual return rates of 22% over the same period
- The University of Delaware is increasingly committed to becoming a leader in sustainability (across academics, research, and operations) but has not formally committed to reducing fossil fuels from its investment portfolio

Resolution:

- **The University of Delaware's Graduate Student Governments supports the Faculty Senate in respectfully requesting the Board of Trustees Finance Committee bring forth a resolution recommending the Investment Office work with the University of Delaware Sustainability Office to create an official divestment from fossil fuel strategy in 2024 (with the goal of executing full divestment by 2030)**

[1] For example, Boston University, Rutgers, University of California system, University of Illinois, University of Maryland, University of Massachusetts, University of Michigan, and the University of Minnesota

[2] For example, Columbia, Cornell, Dartmouth, Georgetown, Harvard, Johns Hopkins, Princeton, Stanford, and Yale

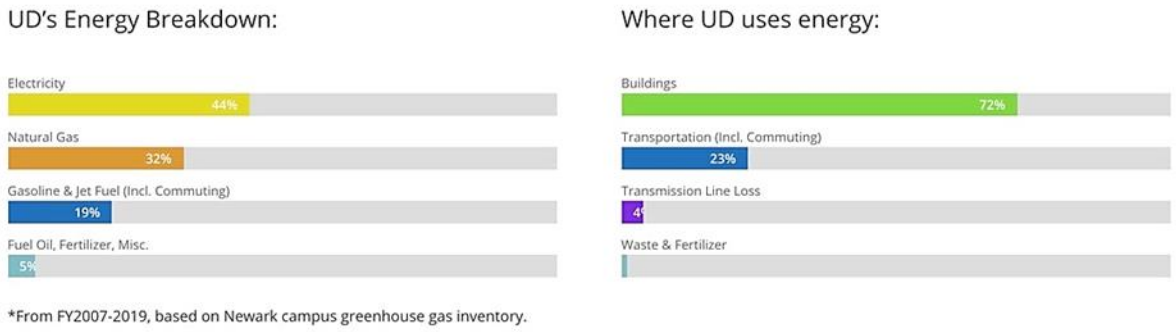
Sustainable Campus Lighting

Background:

- **By the University of Delaware's own admission in a UDaily post, there are "daily actions that take a minute or less [to help] reduce resource waste, costs and pollution" pertaining to electricity consumption[3]**
- **According to AASHE STARS[4], UD received low scores in building energy consumption, and building design and construction – both reflecting UD's Bronze rating awarded to it in 2020[5]**
- **Approximately 72 percent of UD's total energy use (FY2007-2019) is from buildings across UD campuses (Figure 1)[6]**
- **Approximately 44 percent of power used by UD's buildings and facilities (FY2007-2019) comes from electricity sources, which can be reduced by following Department of Energy suggestions (see Resolution)**
- **By UD's own admission, its "largest emission source was purchased electricity" between 2018 and 2019[7]**
- **UD's Climate Action Plan (2009) highlighted the persistent issue of lighting efficiency and that there are "additional opportunities to reduce energy in this area"[8]**
- **In 2012, UD established the "Revolving Energy Efficiency Fund" to support energy efficiency projects across UD campuses, including some lighting upgrades[9]**

[3] UDaily. 2020. "Flip the Switch." *University of Delaware* https://www.udel.edu/udaily/2020/october/flip-the-switch/ accessed 19 January 2021.
[4] The Association for the Advancement of Sustainability in Higher Education (AASHE); The Sustainability Tracking & Rating System (STARS).
[5] AASHE STARS. 2020. "University of Delaware Reports." *AASHE STARS*
[6] University of Delaware. "UD's Energy Breakdown." University of Delaware https://sites.udel.edu/sustainability/energy accessed 10 January 2021.
[7] University of Delaware. 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, p. 3.
[8] 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, p. 5.
[9] 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.

Figure 1. Breakdown of UD Energy Sources and Applications



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

Resolution:

- **UD commits to employing sustainable lighting practices across its campuses to enhance energy efficiency, reduce electricity consumption, and save on electricity costs by:**
  - **The adoption of a bi-annual university-wide social media and email informational campaign that promotes energy efficiency (in line with the recommendations outlined in the UDaily article, above) among faculty, students, and staff**
  - **The implementation of occupancy sensors to automatically turn on and off lights needs to become more widespread**
  - **Once in disrepair, old light fixtures and lamps (including streetlights and loading docks) are to be replaced by LED fixtures and lamps**
  - **Old, inefficient windows are to be replaced by energy efficient windows in accordance with ENERGY STAR-certification[10]**
  - **Light-colored paint ought to be strongly considered in all future modifications to interior spaces**
  - **Take stronger consideration of passive solar opportunities into account during design and construction of new buildings on UD's campuses**
  - **Increase renewable energy capacity through the development of on- or near-campus facilities, or through the purchase of renewable energy credits**
  - **Collaborate with Newark City Council in the widespread adoption of these recommendations, where applicable and appropriate (e.g. in council-owned and operated buildings, alongside new development strategies, including private property)**

[10] Energy Star. "Residential Windows, Doors and Skylights." *Energy Star* https://www.energystar.gov/products/building_products/residential_windows_doors_and_skylights accessed 1 February 2021. Energy Star is affiliated with the U.S. Green Building Council's standards relating to LEED. For more, see https://www.usgbc.org/credits/homes/v4-draft/eac9?view=resources

- UD's Climate Action Plan (2009) noted that "[o]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
- The U.S. Department of Energy (DOE) also provides suggestions for lighting designs, such as:
  - 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
  - Maximize the use of daylight
  - Incorporate passive solar design techniques
  - Increase and replace windows to improve energy efficiency and reduce the loss of heating and cooling energy
  - Install LED light fixtures for all ceiling- and wall-mounted fixtures
  - Use occupancy sensors for automatically turning on and off lights
  - Use light-colored paint for walls to reflect natural sunlight, thereby minimizing the need for artificial lighting
- The UDaily (2020) article encourages the following:
  - Turning off lights, projectors, equipment, computer screens, etc., whenever faculty, staff, or students leave a room for some time (e.g. hours, overnight) to stop "vampire energy"
  - Lab fume hoods consume a lot of energy and ought to be closed when they are not in active use
  - Windows and doors ought to be closed before faculty, staff, or students leave a room for some time (e.g. hours, overnight)

Campus Building Retrofitting

Background:

- **Old buildings across University of Delaware campuses contribute greatly to UD's total energy consumption and toward UD's CO_2 emissions[11]**
- **Previous improvements in building efficiency across UD campuses have assisted in the decline of greenhouse gas (GHG) emissions**
- **UD's current AASHE STARS[12] rating (2020) is Bronze, and improving its energy efficiency by retrofitting old buildings will enhance its AASHE STARS rating[13]**
- **UD ought to commit to greater environmental action if it intends to meet its carbon neutrality goal of 2050[14]**
- **UD failed to meet its 2020 target of reducing GHG emissions by 20% between 2007-2008 and 2019-2020, with a, nonetheless, successful decline of approximately 16.2%[15]**
- **The Energy Star Building Upgrade Manual, a part of LEED certification standards within the area of Operations and Maintenance, provides several solutions that can assist UD in its pursuit of building retrofitting**
- **UD's Climate Action Plan stated that UD intended 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[16]**

Resolution:

- **UD commits to five broad building retrofitting and energy efficiency practices:**

  (1) Metering and Monitoring:

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[11] 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, p. 4.

[12] The Association for the Advancement of Sustainability in Higher Education (AASHE); The Sustainability Tracking & Rating System (STARS)

[13] 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.

[14] See fn 1, p. 8; UD. B. "Sustainability." *University of Delaware* https://sites.udel.edu/sustainability/ accessed 1 February 2021.

[15] UD. 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; see fn 4, UD B.

[16] LEED. "Leadership in Energy & Environmental Design." LEED leed.usgbc.org/leed.html accessed 30 January 2021.

- identify the least energy efficient buildings on campus and the sections therein. Building age and maintenance records offer insight
    - Campus buildings without meters should have them installed by 2025
- Submeters should be installed where possible to allow for more informative measures
- (Sub)meters should measure each building's electricity, heating, ventilation, and air condition (HVAC) systems

(2) Energy Load Management

- Engage in load shedding by monitoring wasteful systems in inefficient buildings (through metering), identify peak demand conflicts, and install automatic controllers or software to reduce system energy use during peaks
- Promote on-site electricity generation during peak hours to avoid demand charges from service providers to achieve long-term savings

(3) Appliance Optimization

- Replace old, inefficient office equipment with Energy Star-certified equipment that is similar in cost and can reduce energy consumption by up to 50%
- Install Energy Star or third-party power management software onto applicable building-wide computer networks to power-down unused devices and save between $10 and $45 per desktop computer annually

(4) Building Envelope Upgrades

- Air infiltration: seal observed air leaks in windows, doors, roofs, and walls; calibrate automatic doors to minimize air loss during occupant entries and exits; and install revolving doors, if cost-permissive
- Windows: install window films (thin layers of polyester, metallic coatings, and adhesives) on existing windows; and replace old windows with spectrally selective glass, low-e systems, or electrochromic windows
- Roofs: add thermal insulation to the inside of rooftops; and add green roofs (soil layers and vegetation), as in the case of Colburn Laboratory
- Photovoltaic (PV) Panels: add PV panels to rooftops, where viable

(5) Ventilation Optimization

- Add ventilation controllers to monitor and automatically regulate ventilation. Low-occupancy spaces will benefit the most in terms of energy savings, but studies demonstrate that monitors in classrooms have also been shown to be cost-effective
- Demand-controlled ventilation is most energy efficient in high occupancy areas (e.g. halls, auditoriums, gyms)

Heat Pump Implementation

Background:

- **Campus buildings have historically accounted for the majority (64%) of the University of Delaware's (UD) greenhouse gas emissions[17]**
- **Nearly 1/3 of the greenhouse gas emissions from campus buildings result from the burning of oil or natural gas for heating (Figure 2)**
- **A 75-85% reduction in greenhouse gas emissions is achievable using geothermal heat pumps in comparison to natural gas and oil heating[18]**
- **Geothermal heat pumps use the constant temperature of the earth to provide heat to buildings in the winter and remove heat from buildings in the summer (Figure 3)**
- **Geothermal heat pumps offer a 25-50% savings on heating costs in large buildings in comparison to traditional fossil-based utility systems[19]**
- **The Department of Energy reports a payback period of 5-10 years for geothermal heat pumps[20]**
- **Geothermal heat pumps were identified as one of the most cost-effective solutions to reduce campus emissions in UD's 2009 Climate Action Plan[21]**
- **UD's current AASHE STARS rating (2020) is Bronze and implementing geothermal heat pumps to improve energy efficiency will help enhance this rating[22]**
- **UD ought to commit to greater environmental action if it intends to meet its carbon neutrality goal of 2050**
- **UD Buildings and Grounds has plans in place to incorporate a sustainability ranking system into all new construction plans**
- **Multi-sector electrification coupled with renewable electricity production is widely regarded as the most viable pathway to averting climate catastrophe**

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[17] UD. 2020. "Greenhouse Gas Inventory for the 2018-2019 Academic Year." 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 3 November 2022.

[18] Dandelion Energy. "Environmental Benefits of Geothermal Heat Pumps." 21 February 2020. https://dandelionenergy.com/environmental-benefits-of-geothermal-heat-pumps accessed 8 November 2022.

[19] Energy Sage. "How much does a geothermal heat pump cost?" 3 May 2022. https://www.energysage.com/clean-heating-cooling/geothermal-heat-pumps/costs-benefits-geothermal-heat-pumps accessed 8 November 2022.

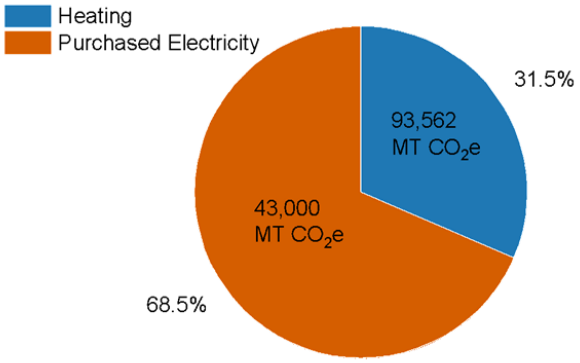
[20] Department of Energy. "Geothermal Heat Pumps" https://www.energy.gov/energysaver/geothermal-heat-pumps accessed 8 November 2022.

[21] UD. 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 3 November 2022.

[22] AASHE STARS (n.d.). "University of Delaware." *AASHE STARS* https://reports.aashe.org/institutions/university-of-delaware-de/report/2020-01-31/ accessed 3 November 2022.

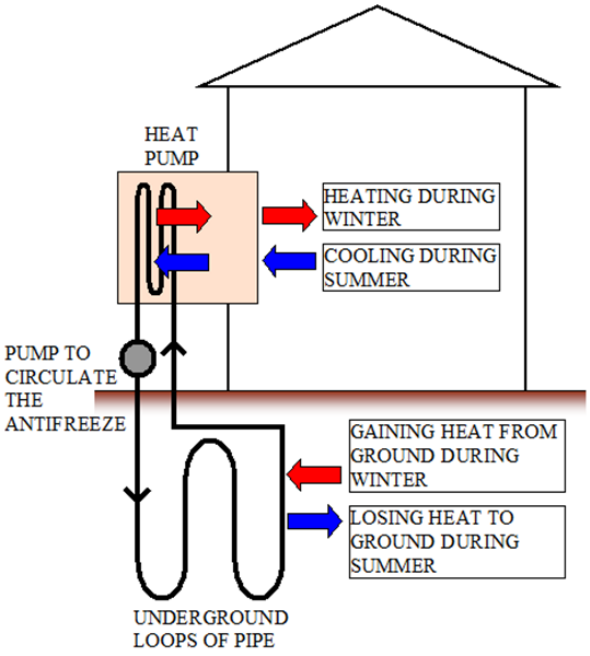
- **The electrification of utilities with the aid of heat pumps is a critical step to achieving multi-sector electrification**

Figure 2. Campus building emissions breakdown (academic year 2021-2022)



*Data provided to Sustainability Council Climate Action Plan Subcommittee by Ted Socha, UD Director of Sustainability, Energy, and Engineering
**Data from 2021 used to project out to 2022

Figure 3. Geothermal heat pump schematic[23]



[23] "How Heat Pumps Work" https://www.real-world-physics-problems.com/how-heat-pumps-work.html accessed 8 November 2022.

Table 1. Geothermal heat pump techno-economic considerations

Cost per emissions avoided (USD/MT CO^2)	Initial Cost (USD/kWh)	Annual Savings (USD)
14	0.097	245,000

Resolution:

- **UD Buildings and Grounds immediately incorporates a requirement for a detailed payback period assessment of technologies to improve energy efficiency in campus buildings to ensure reduced operation costs associated with these technologies are accounted for in decision-making**
- **Beginning in 2023, all new campus buildings shall be equipped with a heat pump to provide heating and cooling**
- **Beginning in 2023, previously constructed campus buildings will be retrofitted with heat pumps when their fossil-based HVAC systems reach the end of their life**
- **The implementation of heat pumps into buildings campus-wide shall be integrated into the updated Climate Action Plan to be put forth by the UD Office of Sustainability**

Campus Building Temperature Control

Background:

- **Building temperature control provides an opportunity for the University of Delaware ("UD") to create comfortable environments for faculty, staff, students, and visitors, and can save energy and cut greenhouse gas emissions (Table 2)[24,25,26,27,28]**
- **Thermal comfort is often considered more important by occupants than visual and acoustic comfort, and indoor air quality[29,30]**
- **During the Summer period, UD sometimes uses excessive cooling that results in many occupants experiencing discomfort and raising energy consumption by resorting to use of personal electric heaters**
- **It has been demonstrated that a 1 °C increase during Summer in office buildings resulted in a 6.14% reduction in mean energy consumption[31]**
- **UD's building heating is primarily sourced from natural gas**
- **UD's building temperature control is currently in compliance with the energy codes outlined by the International Energy Conservation Code (IECC), but UD needs to revisit the question of comfort by occupants and to further explore ways to reduce energy consumption**

[24] 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

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

[26] 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 Rev*iew 54: 148-156.

[27] 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.

[28] Sekhar, S. 1995. "Higher Space Temperatures and Better Thermal Comfort – a Tropical Analysis." *Energy and Buildings* 23(1): 63-70.

[29] Yang, L., Yan, H., & Lam, J. 2014. "Thermal Comfort and Building Energy Consumption Implications–a Review." Applied Energy 115: 164-173.

[30] Golbazi, M., and Aktas, C. 2018. "Energy Efficiency of Residential Buildings in the US: Improvement Potential Beyond IECC." Building and Environment 142: 278-287.

[31] [31] 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.

Table 2. 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%.

Resolution:

- **UD creates a survey for faculty, staff, and students at four separate points between Summer and Spring. This will allow for a representative view of thermal comfort throughout the calendar year and among different seasons**
- **UD establishes the Anaerobic Digester with support of Newark City Council to combat food waste in Newark and create natural gas to heat UD's campuses and Newark city-operated buildings for where heat pumps are unsuitable**

Gas Stove Electrification

Background:

- The hazards associated with air pollutants emitted from gas stoves and ovens have been well reported for many years, consisting of pollutants such as nitrogen oxides (NO_x), carbon monoxide (CO), carbon dioxide (CO_2), and methane gas (CH_4)[32]
- Gas stoves are estimated to be responsible for 21-31% of indoor CO air pollution[33]
- It's estimated 6.2 million metric tons of CO_2 per year and a methane emission equivalent to 500,000 gas-powered vehicles can be attributed to gas stoves[34]
- UD maintains gas stoves and ovens within the kitchens of multiple dining centers including, but not limited to Perkins Student Center, the Trabant Food Court, and the Food and Nutrition Education Laboratory
- Electric stoves are generally more affordable than their gas counterparts
- Electric stoves typically offer superior performance for both low heat and high heat applications[35]

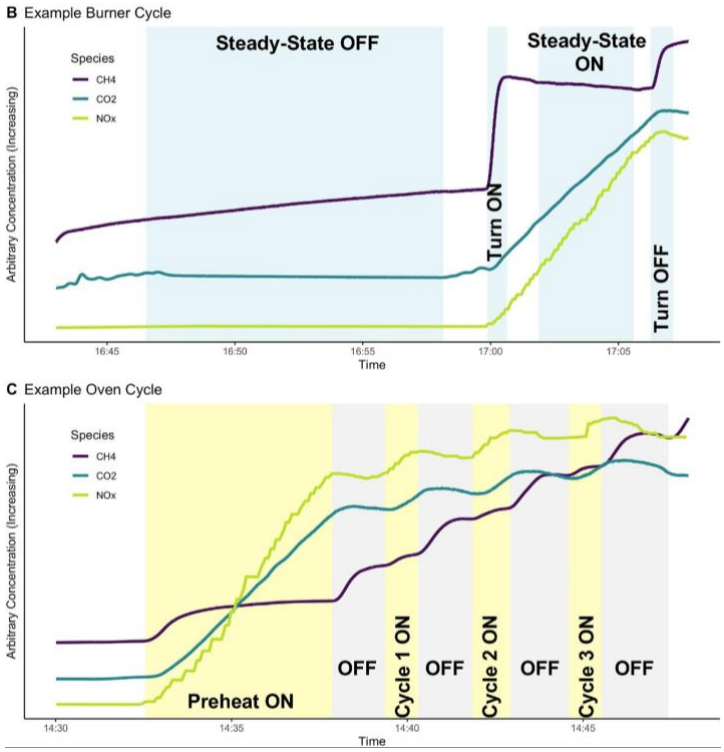
[32] E. D. Lebel, C. J. Finnegan, Z. Ouyang, and R. B. Jackson, "Methane and NO_x Emissions from Natural Gas Stoves, Cooktops, and Ovens in Residential Homes," *Environ. Sci. Technol.*, vol. 56, no. 4, pp. 2529–2539, Feb. 2022, doi: 10.1021/acs.est.1c04707.

[33] W. Nicole, "Cooking Up Indoor Air Pollution: Emissions from Natural Gas Stoves," *Environ. Health Perspect.*, vol. 122, no. 1, Jan. 2014, doi: 10.1289/ehp.122-A27.

[34] Scott, Tracy "Gas vs. Electric Range: How to Choose" *Nerd Wallet*. 2 Dec. 2020. https://www.nerdwallet.com/article/mortgages/gas-vs-electric-range-how-to-choose accessed 1 March 2023.

[35]Hope, Paul "Gas vs. Electric Range: Which is Better?" *Consumer Reports*. 4 Dec. 2022. https://www.consumerreports.org/ranges/gas-or-electric-range-which-is-better-a1142956590/accessed 1 March 2023.

Figure 4. Pollutant Concentrations in the air from gas stoves and ovens in operation[32]



Resolution:

- **The University of Delaware shall replace all gas stoves and ovens at the end of their life cycle with more energy-efficient electric equivalents, reducing the risk of harm to students and staff, mitigating the environmental impact of dining operations at the university, decreasing stove cost, and improving stove performance**
- **All food vendors operating within the University of Delaware's facilities shall replace all gas stoves and ovens with energy-efficient electric equivalents at the end of their life cycles**
- **Any current gas stoves or ovens used on UD campus are equipped with proper ventilation and maintain annual emissions reports**

Electrification of Grounds Maintenance Equipment

Background:

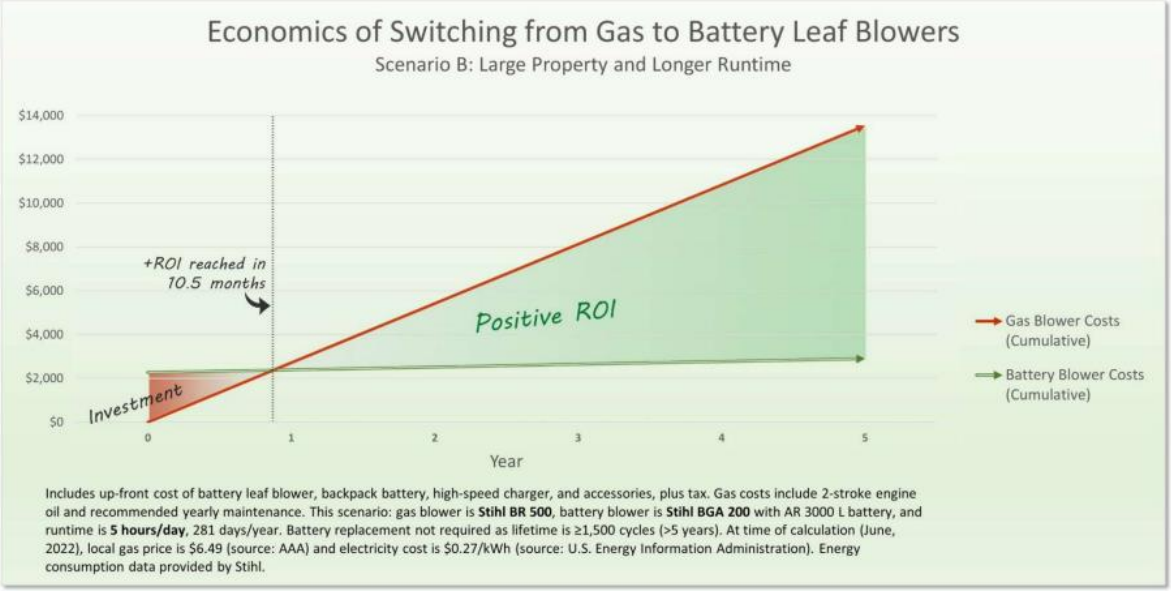
- **Gasoline powered leaf blowers emit 11 lbs. of CO_2 per hour leading to 15 million tons of CO_2 emitted per year in the US, with higher rate of production of carbon monoxide and hydrocarbon emissions than cars and trucks due to their engine design[36,37]**
- **Particulate matter emissions from gasoline powered leaf blowers are reported to lead to cardiovascular and respiratory diseases yet they are not regulated to the same standard as car engines[38]**
- **Gasoline powered leaf blowers produce high noise pollution (80-90 decibels) which require hearing protection for those in the vicinity according to OSHA threshold of 85 decibels[39,40]**
- **Electric leaf blowers produce significantly less noise pollution (65-70 decibels) than gasoline powered leaf blowers and reduced emissions leading to more than 100 cities around the nation banning gas powered leaf blowers**
- **Electric leaf blowers have been shown to have a payback period of less than a year by using electricity for energy as opposed to more expensive gasoline[41]**
- **UD maintains an AASHE STARS, OP-1: Greenhouse Gas Emissions score of 5.55/10.00 with the potential for improvement via reduction of emissions from "Mobile sources including…lawn care equipment…"[42,43]**

[36]Leaf Blower's Emissions Dirtier than High-Performance Pick-Up Truck's. Edmunds. 2011.
[37]Gas Powered Leaf Blower Noise and Emissions Factsheet. Quiet Clean PDX. 2019 https://www.quietcleanpdx.org/leaf-blowers-dangers-pollution/
[38]National Emissions from Lawn and Garden Equipment. EPA. 2015. https://www.epa.gov/sites/default/files/2015-09/documents/banks.pdf
[39]Why Leaf Blower Bans Are On the Rise. Leaf Score. 2022.
[40]Occupational Noise Exposure. OSHA. https://www.osha.gov/noise/hearing-programs
[41] The Economics of Switching to Battery-Powered Leaf Blowers: A Cost Comparison https://chasesantacruz.org/gas-vs-battery-power-which-is-more-expensive
[42]The Sustainability Tracking, Assessment & Rating System University of Delaware Report. 2020. https://reports.aashe.org/institutions/university-of-delaware-de/report/2020-01-31/OP/air-climate/OP-1/
[43]Stars Technical manual Version 2.2. AASHE. June 2019. https://stars.aashe.org/wp-content/uploads/2019/07/STARS-2.2-Technical-Manual.pdf

Table 3. Emissions Comparison of Gas Leaf Blowers and Gas Vehicles[36]

Engine	Non-Methane Hydrocarbons	Nitrous Oxides	Carbon Monoxide
2011 Ford Raptor	0.005 g/min	0.005 g/min	0.276 g/min
2012 Fiat 500	0.016 g/min	0.010 g/min	0.192 g/min
Ryobi 4-Stroke Leaf Blower	0.182 g/min	0.031 g/min	3.714 g/min
Echo 2-Stroke Leaf Blower	1.495 g/min	0.010 g/min	6.445 g/min

Figure 5. Economics of Adopting Battery Powered Leaf Blowers over Gas[41]



Resolution:

- **UD and the Office of Sustainability immediately works with landscapers to set forth a transition to electric leaf blowers and other handheld lawn care equipment to be completed by 2025 in line with ongoing efforts in Lewes, Delaware**
- **UD and the Office of Sustainability immediately works toward building a collaborative relationship with the City of Newark for a transition to all-electric powered lawn care equipment**
- **UD and the Office of Sustainability immediately works toward gathering data to report usage of all gasoline powered lawn equipment and electric lawn equipment by lawn care workers to show progress toward sustainability initiatives and programs**

Addition of Smart Charging Study Stations

Background:

- **Third places[44], also known as the communities where students can spend time between their homes (the first place) and schools (the second place) and network with others, are becoming increasingly rare in today's digitalized world**
- **Outdoor studying benefits the health of the students and, besides the access to oxygen or vitamin D absorption, allows them to "improve calmness and mental clarity, promote relaxation and emotional exuberance, and get a stronger harmony with nature"[45] and**
- **Studying outdoors provides many physical and psychological benefits to students including reduced depression and stress, as well as improved creativity and problem-solving skills[46]**
- **Universities across the US adopt the sustainable strategy to maximize the number of smart benches on their campuses to promote a healthy environment for their students and to optimize energy output for learning purposes[47]**
- **Such universities as the University of Maryland, Georgetown University, and many others use more than 50% of green power of total electricity use on their campuses to provide services for students[48]**
- **UD lacks behind these competitive institutions while facing persistent demand for sustainable workspaces that meet the needs of modern students and technologically reliant pedagogy**

[44] Brookings: https://www.brookings.edu/articles/third-places-as-community-builders/

[45] The University of Arizona: https://www.uagc.edu/blog/studying-outside-vs-inside-the-pros-cons

[46] The University of Arizona: https://www.uagc.edu/blog/studying-outside-vs-inside-the-pros-cons

[47] Duke University: https://researchblog.duke.edu/2017/11/13/dukes-solar-benches-can-charge-your-phone/ and WMU: https://scholarworks.wmich.edu/honors_theses/3102/

[48] UD Environmental Protection Agency: https://www.epa.gov/greenpower/green-power-partnership-top-30-college-university

Figure 6. Smart Charging Stations (left) and benches (right) for Implementation[49,50]

Resolution:

- **UD adopts the plan to install smart charging stations by 2025 that consist of benches, tables, and solar panels on the rooftop for independent solar power generation. The university pledges to convert 50% of the available outdoors seating on the Morris Library patio to smart charging workstations and 10% of the total number of conventional benches on campus will be replaced with solar benches.**

[49]https://www.bgsu.edu/news/2021/09/bgsu-introduces-new-solar-charging-table-as-eco-friendly-way-to-power-devices-on-campus.html

[50]https://seedia.city/mysterious-bench-main-square-boleslawiec/

Annual Accounting of Greenhouse Gas Emissions

Background:

- **In academic year (AY) 2007-2008, UD put forth a climate action plan for a 20% reduction in greenhouse gas emissions by 2020;[51]**
- **Prior to AY 2019-2020, the University of Delaware (UD) contracted Siemens to perform an annual greenhouse gas inventory. Siemens demonstrated that UD failed to meet their climate action plan and no formal greenhouse gas emission accounting had been conducted by the university [52]**
- **UD produced 125,078 metric tons of CO_2e during AY 2018-2019 and ought to be held responsible for reducing these greenhouse gas emissions;[33]**
- **In academic year (AY) 2021-2022, the passage of SR-2122-03 supported the creation of an updated climate action plan for UD to strive for net 0 emissions[53]**

SIMAP Information:

SIMAP is a carbon footprinting software platform designed for higher education institutions. Originally created by the University of New Hampshire, it publicly launched for use at other universities as a subscription service in 2017. 194 colleges and universities currently report their emissions on SIMAP.[54] The use of SIMAP is already being actively explored by the Sustainability Council Climate Action Plan Subcommittee at UD.

Scope 1 emissions are defined by SIMAP as greenhouse gas emissions resulting from the use of stationary fuels.[55]

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[51] UD. 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 3 November 2022.
[52] UD. 2020. "Greenhouse Gas Inventory for the 2018-2019 Academic Year." 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 3 November 2022.
[53] UD Graduate Student Government. "For the Establishment of Net Zero Campus Emissions by 2030" SR-2122-03.
[54] SIMAP. "Emission Reports" https://unhsimap.org/public/emissions accessed 3 November 2022.
[55] SIMAP. "Carbon References: Scope 1: Stationary Fuels" https://unhsimap.org/CarbonReferenceStationaryFuels accessed 3 November 2022.

Scope 2 emissions are defined by SIMAP as greenhouse gas emissions resulting from the production of purchased electricity.[56]

Resolution:

- **Upon the establishment of the UD Office of Sustainability, this office shall coordinate and prioritize annual greenhouse gas emissions accounting using the Sustainability Indicator Management & Analysis Platform (SIMAP) for at least scope 1 and 2 emissions**
- **Branches of UD including but not limited to Operations and Transportation Services shall be required to cooperate with the requests of the UD Office of Sustainability by gathering and sharing greenhouse gas emissions data**
- **The results of the annual greenhouse emissions accounting shall be used to inform an updated climate action plan and to improve UD's AASHE STARS rating and UD's progress towards meeting the emission targets to be set in the updated UD climate action plan shall be monitored and shared to the public**

[56] SIMAP. "Scope 2: Purchased Electricity version 2019, 2020" https://unhsimap.org/cmap/resources/scope2 accessed 3 November 2022.

Increasing Green Energy Share of Campus Energy Consumption

Background:

- **Nearly 90% of all CO_2 emissions driving climate change result from the combustion of fossil fuels to produce energy, thus alternative methods of energy production are necessary to mitigate climate change[57]**
- **The combustion of fossil fuels to produce energy is responsible for about 1 in 5 deaths globally due to particulate matter air pollution[58]**
- **The Intergovernmental Panel on Climate Change (IPCC) recently stated in their 6th synthesis report that, "delayed mitigation action will further increase global warming and losses and damages will rise and additional human and natural systems will reach adaptation limits" with a high degree of confidence[59]**
- **The United States has committed to 100% zero-carbon electricity production by 2035;[60]**
- **State law mandates that by 2035, the state of Delaware's utilities must derive 40% of their energy from renewable sources to reduce reliance on fossil fuels[61]**
- **In contrast the direction of public policy and the dire need, in academic year '21-'22, UD purchased 176 million kWh of electricity from PJM and with only 7.9% of this electricity supplied from renewables[62,63]**

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[57] "Causes and effects of climate change" United Nations. https://www.un.org/en/climatechange/science/causes-effects-climate-change accessed 26th, March 2023.
[58] Vohra, K. et al. "Global mortality from outdoor fine particle pollution generated by fossil fuel combustion: Results from GEOS-Chem" *Environ. Res*. 195, 110754 (2021). DOI: 10.1016/j.envres.2021.110754.
[59] Intergovernmental Panel on Climate Change Sixth Assessment Report. United Nations. 2023. https://www.ipcc.ch/report/ar6/syr/ accessed March 26th, 2023.
[60] "The Long-Term Strategy of the United States: Pathways to Net-Zero Greenhouse Gas Emissions by 2050" United States Department of State and the United States Executive Office of the President. November, 2021. https://www.whitehouse.gov/wp-content/uploads/2021/10/US-Long-Term-Strategy.pdf accessed 26th, March 2023.
[61] "Governor Carney Signs Legislation Raising Renewable Portfolio Standard (RPS)" Feb. 10, 2021. https://news.delaware.gov/2021/02/10/governor-carney-signs-legislation-raising-renewable-portfolio-standard-rps/ accessed March 26th, 2023.
[62] This data was sourced from an audit conducted for UD by Siemans that was shared with the Sustainability Council by UD Facilities.
[63] Regional Transmission Expansion Plan. PJM. March 14, 2023. https://www.pjm.com/-/media/library/reports-notices/2022-rtep/2022-rtep-report.ashx accessed April 2, 2023.

- **UD received a score of 0/4 for clean and renewable energy when last evaluated for AASHE Stars in 2020[64]**
- **UD had an AASHE STARS rating of "bronze-expired," but UD could gain additional credits to improve this rating upon reapplication by increasing its share of energy supplied by renewables[65]**
- **The U.S. Environmental Protection Agency (EPA) offers a Green Power Partnership to colleges and universities that provides market supply options and information for green power, procurement assistance and guidance, and public recognition for green power leadership and use[66]**

Table 4. University of Delaware Comparator Institution EPA Green Power Partners[67,68]

Boston University	University of Maryland
Iowa State University	University of Michigan
Pennsylvania State University	University of Minnesota
Purdue University	University of Pittsburgh
University of Arizona	University of Utah
University of Illinois	University of Virginia

[64] Sustainability Tracking, Assessment & Rating System (STARS). "University of Delaware." *Association for the Advancement of Sustainability in Higher Education (AASHE).*
[65] The Association for the Advancement of Sustainability in Higher Education (AASHE); The Sustainability Tracking & Rating System (STARS)
[66] "EPA's Green Power Partnership: Partnership Requirements" U.S. Environmental Protection Agency. May 2019. https://www.epa.gov/sites/default/files/2016-01/documents/gpp_partnership_reqs.pdf accessed 26th, March 2023.
[67] "Benchmarking at UD" University of Delaware. https://ire.udel.edu/comparators-dashboard/ accessed 26th, March 2023.
[68]"Meet our partners" Environmental Protection Agency. https://www.epa.gov/greenpower/meet-our-partners accessed 26th, March 2023.

Figure 7. Steps to Join the EPA Green Power Partnership[69]

Steps to Join the EPA Green Power Partnership (detailed)[3]:

1. **Connect with EPA to learn more – Contact us to learn about a range of resources available to help you use green power. Learn about strategies and common market practices. Get answers to your most pressing questions.**

[69]"Green Power Partnership Organization" Environmental Protection Agency. https://www.epa.gov/greenpower/green-power-partnership-organization. Accessed 26th, March 2023.

2. **Purchase qualifying green power – Learn more about EPA's minimum eligibility requirements. Understand several key best practices for buying green power and learn how to best ensure that your investment will meet your goals.**
3. **Submit a Partner Reporting Form – Download, complete, and submit a Partner Reporting Form.**
4. **Meet your assigned account manager – Upon successful acceptance into the Partnership, your organization will be assigned an account manager. Your assigned account manager will be your main point of contact for the Green Power Partnership.**
5. **Review your application and green power data – As part of your onboarding process with your assigned account manager, you will review and go over your Partner Reporting Form. This will be an opportunity for both parties to ask additional questions and talk about next steps.**
6. **Communicate your organization's success – Now that you are a Green Power Partner, you will have the opportunity to work with EPA to communicate your green power use and leadership. EPA offers a range of communications support to assist you in sharing your Partnership and green power use success.**
7. **Report annually to EPA – Partners are required to update EPA annually on their ongoing use of green power. Partners will receive an annual Partner Reporting Form from their account manager asking for updates and changes based on their next twelve-month reporting period.**

Resolution:

- **UD's Office of Sustainability shall apply for UD to join the EPA Green Power Partnership by the end of 2024**
- **UD's Office of Sustainability shall take advantage of the offerings of the EPA Green Power Partnership procurement assistance and guidance to implement a UD renewable portfolio standard that will meet the U.S. promise of 100% carbon-free electricity by 2035**
- **The UD renewable portfolio standard shall include intermediate goals in 2025 and 2030 to keep UD on track for 100% carbon-free electricity by 2035**
- **The UD Office of Sustainability shall include a commitment to 100% carbon-free electricity by 2035 with intermediate targets in 2025 and 2030 in an updated UD Climate Action Plan.**

Food

“Nothing will benefit human health and increase the chances for survival of life on Earth as much as the evolution to a vegetarian diet.”

-Albert Einstein

Plant-Based Dining

Background:

- **Livestock production is one of the most significant drivers of global biodiversity loss according to the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES)[70]**
- **Current research demonstrates that the "partial to complete elimination of meat"[71] significantly improves the natural environment, as well as human health, animal welfare, and the reduction of greenhouse gas emissions[72,73,74]**
- **A dietary shift from animal-based foods to plant-based foods can reduce annual agricultural emissions by 61% (Figure 8)[75]**
- **UD currently holds a contract with Aramark who has recently partnered with Beyond Meat, Eat JUST, and Ocean Hugger Foods to gain the ability to offer high protein plant-based alternatives to a variety of animal products[76]**
- **UD's partnership with Aramark – a food service which has partnered with the university for 29 years – led to a commitment to the *Plant Forward* initiative (approximately in Fall 2016). 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 since Fall 2016, and fruit, vegetables, and wholegrains have increased by 20% on the menus since Fall 2016**

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[70] Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES). 2019a. "Chapter 2.1. Status and Trends – Drivers of Change." *IPBES*

[71] 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, pp. 91, 108.

[72] 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, p. 944.

[73] Kurbel, Sven. 2020. "What Are the Health Risks of Eating Red Meat, and How Should We Assess Them?" *BioEssays* 42: 1-4, p. 2.

[74] 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, pp. 267, 269-270.

[75] Z. Sun et al. Dietary change in high-income nations alone can lead to substantial double climate dividend. *Nat. Food* 3, 29-37 (2022).

[76] "Aramark and Veganz Sign Partnership of Exclusive Cooperation." *Vegconomist.* Jan. 10, 2022. https://vegconomist.com/gastronomy-food-service/food-service/aramark-and-veganz-sign-partnership-of-exclusive-cooperation/ accessed Nov. 23, 2022.

- **Aramark reports that 79% of college students strive to reduce their meat consumption and 85% of college students are likely to order plant-forward meal options[77]**
- **The University of Delaware ("UD") acquired 11,492 cases of meat and fish products for the 2019-2020 academic year, of which 77.8% were red meat**
- **Comparator institutions have successfully implemented initiatives to reduce or altogether eliminate red meat and processed meat from dining and catering services**
    - **University of North Texas, University of Arizona, Imperial College London, King's College London, and Cardiff University have created cafés and dining halls with 100% vegan menus**
    - **Arizona State University has partnered with Aramark's *Plant Forward* initiative to create an entirely plant-based dining station available at all campus dining halls**
    - **Northwestern University has committed to offering vegan meals throughout the day**
    - **Copenhagen Business School provides vegetarian options as default for all catering**
    - **University of Cambridge replaced meat with plant-based products for all dining services and annual events**
    - **Goldsmiths College has ceased serving beef products on campus and has created new vegan options**
    - **University of Combria has removed beef from all cafeterias to achieve carbon neutrality by 2030**
    - **London School of Economics has removed beef products from all dining services across campus**
    - **Oxford University has banned beef and lamb products at catering outlets**
- **Minimizing the "purchase of conventional animal products" (including "all meat, fish/seafood, poultry, eggs, and dairy products") will allow UD to score a higher sustainability rating from AASHE STARS[78]**

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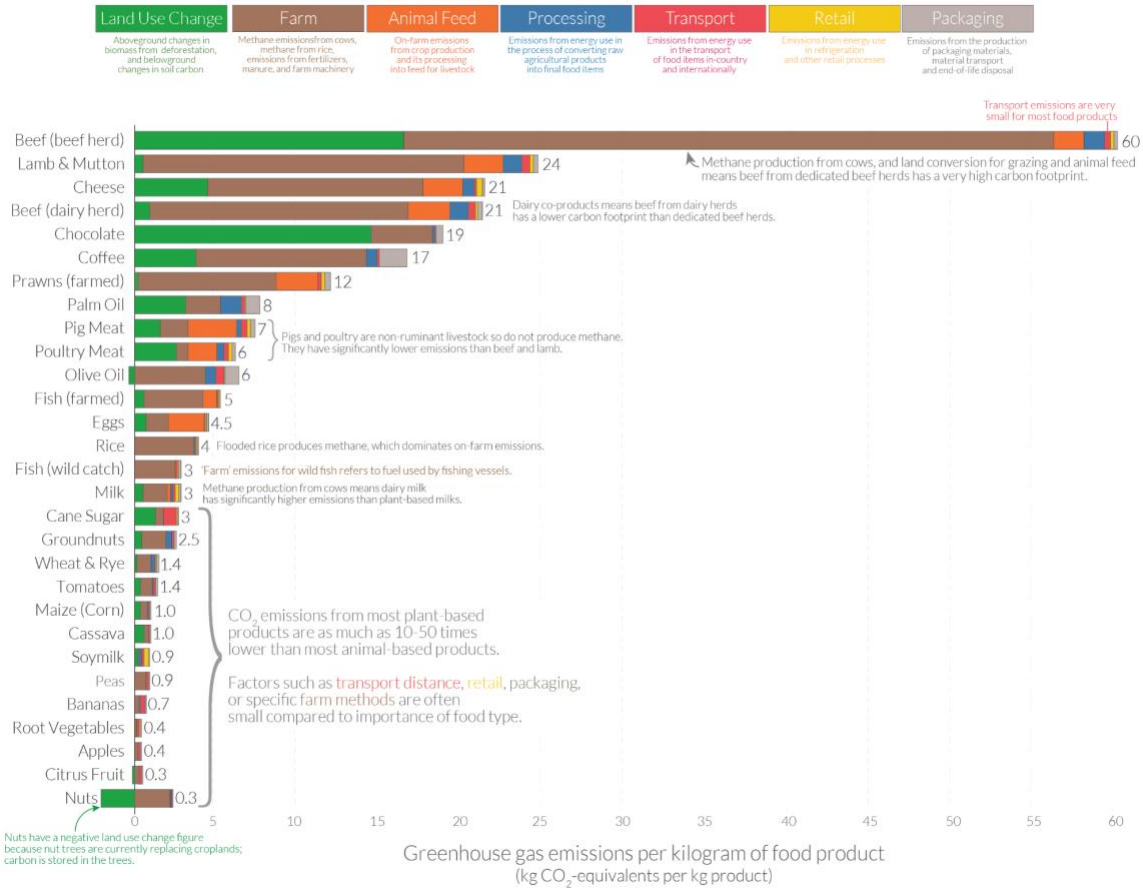
[77] "Plant-forward dining on higher-education campuses." Aramark Higher Education Team. https://campusinsights.aramark.com/resources-blog/plant-forward-dining-on-higher-education-campuses accessed Dec. 9, 2022.

[78] The Association for the Advancement of Sustainability in Higher Education (AASHE); The Sustainability, Tracking, Assessment & Rating System (STARS); 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; AASHE STARS 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; The Association for the Advancement of Sustainability in Higher Education.

- **Research has shown that consumers are generally unaware of how to reduce the carbon-impact associated with their diet and could benefit from improved communication surrounding the environmental impact of their food choices[79]**

Figure 8. Greenhouse gas emissions across the supply chain[80]



[79] A. Kause et al Public perceptions of how to reduce carbon footprints of consumer food choices. Environ. Res. Lett. 14, 114005 (2019).

[80] Hannah Ritchie. "You want to reduce the carbon footprint of your food? Focus on what you eat, not whether your food is local" Our World in Data. Jan.24, 2020. https://ourworldindata.org/food-choice-vs-eating-local accessed Nov. 23, 2022.

Resolution:

- **UD adopts a multi-pronged approach to phasing-out red meat and processed meat from campus dining and catering services**
- **The UD Sustainability Office includes a sustainable food roadmap in their updated Climate Action Plan that contains a plan to phase out red and processed meat**
- **UD Dining Services immediately commit to making a 100% plant-based vegan alternative available as an option for each meal for all dining halls, marketplaces, and catered events with a comparable protein density**
- **UD seeks to establish a 100% plant-based dining hall in partnership with Aramark's *Plant Forward* menu innovation program**
- **UD provide a quantification of greenhouse gas emissions in carbon dioxide equivalents (CO_2e) to students of each food item offered on dining hall menus while implementing Aramark's "Cool Foods Meal"[81] badge to identify low carbon footprint meals and ensures at least one of these meals is always available at each dining hall**

[81] "Aramark Rolls Out Cool Food Meals On Residential Dining Menus, Identifies 350 Lower Carbon Footprint Dishes." Aramark. Jan. 3, 2022. https://www.aramark.com/newsroom/news/aramark-cool-foods-residential-dining-1221 accessed Dec. 9, 2022.

Access to Local and Organic Foods

Background:

- **Organic farming is a sustainable agricultural system that uses fertilizers of organic origin such as compost manure, and places emphasis on techniques such as crop rotation and companion planting[82]**
- **Organic food can have numerous environmental and societal benefits (creating higher biodiversity and improving soil and water quality per unit area, increasing profitability, and improving nutritional quality)[83]**
- **Regularly held farmers markets can improve student access to both organic and whole plant-based foods while supporting local farmers and reducing food transportation distances**
- **The University of Delaware currently holds a student-run farmers market ("Fresh to You") that only operates in the summer at UDairy Creamery (28-minute walk from The Green according to Google Maps)[84]**
- **Emory University, University of Pittsburgh, and James Madison University host weekly farmers' markets on campus**
- **James Madison University provides labels on foods to indicate whether it is local and/or organic**

Resolution:

- **UD increases the farmers' market frequency to a weekly event held as close to year-round as possible at a location near central campus and invites local vendors to expand the variety of sustainable foods offered**
- **UD expand their dining hall food labelling system to include labels for locally sourced and organic food using information already provided to them by Aramark**

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[82] J. P. Reganold, J. M. Wachter, Organic agriculture in the twenty-first century. *Nat. Plants* 2, 15221 (2016).
[83] C. Badgley, J. Moghtader, E. Quintero, E. Zakem, M. J. Chappell, K. Avilés-Vázquez, A. Samulon, I. Perfecto, Organic agriculture and the global food supply. *Renew. Agr. Food Syst.* 22, 86–108 (2007).
[84] https://www.udel.edu/academics/colleges/canr/about/sustainable/fresh-to-you/ accessed Jan. 20, 2023.

Mandate for Equitable Access to Fresh Water

Background:

- **Inequitable access to clean water drinking water on campus is evident by the high availability of disposable water bottles for purchase versus the availability of public water bottle refilling stations.**
- **The average 20-ounce water bottle is priced at approximately $1.50 or $9.60 per gallon, placing the cost on the consumer[85]**
- **Estimates project that for a total cost of $2.10, 4,787 reusable bottles can be filled with safe tap water, an amount easily absorbed by the university. The considerable cost disparity emphasizes the need to reduce the price burden on students and provide equitable access to drinking water with low-cost barriers**
- **Despite the intrinsically high recyclability of single-use plastic bottles, a mere 20% of water bottles undergo recycling processes. In return, nearly 2 million tons of discarded single-use plastic water bottles end up in landfills, highlighting the severe environmental impacts of these unnecessary consumer plastics.**
- **As of Jan. 31st, 2020, the Sustainability Tracking, Assessment, & Rating System (STARS), a program of AASHE, provided UD a Waste Minimization and Diversion score of 2.87/8.00, giving rise to the dire need for a reduction in plastic waste.[86]**
- **Traditional water fountains are impractical for refilling water bottles due to inherent design limitations, whereas improved fountains such as the Elkay ezH2O water filler stations emerge as a favorable and sustainable alternative.[87,88]**
- **UD currently maintains stations that are well-used by students, faculty, and staff, which has caused a reduction in plastic water bottle usage on the order of thousands according to station metrics (Table 5), however most academic buildings on campus lack these stations.**

[85]The True Cost of Bottled Water. *Optimum Water Solutions, Water.* 2022
[86]Williams, C. University of Delaware OP-19: Waste Minimization and Diversion. *The Sustainability Assessment & Ranking System*. 2020
[87]U.S. Reusable Water Bottle Market Size, Share & Trends Analysis Report By Type (Stainless Steel, Plastic), By Distribution Channel (Supermarkets & Hypermarkets, Online), And Segment Forecasts, 2023 - 2030. *Grand View Research.* 2021
[88] Sustainable Choices For a Better Tomorrow. *Elkay.* 2020

Table 5. 2020 list of Water Bottle Refill Stations and Locations on UD Campus

Asset	Description	Location	Description
6739	BOTTLE FILLING STATION (RINK) - FRED RUST ICE ARENA (O&M)	NS77-99-0000	FRED RUST ICE ARENA
6742	BOTTLE FILLING STATION (LOCKER ROOM) - FRED RUST ICE ARENA (O&M)	NS77-99-0000	FRED RUST ICE ARENA
6744	BOTTLE FILLING STATION (LOCKER ROOM) - GOLD ICE ARENA	NS75-99-0000	GOLD ICE ARENA
6746	BOTTLE FILLING STATION (POOL) - GOLD ICE ARENA	NK-PL	NEWARK PARKING LOTS
6747	BOTTLE FILLING STATION (WEIGHT ROOM) - BOB CARPENTER CTR (BCC)	NS76-99-0000	BOB CARPENTER CENTER (BCC)
6749	BOTTLE FILLING STATION (RESTROOM) - HARRINGTON COMMONS (HOUSING)	NE30-99-0000	HARRINGTON COMMONS
6751	BOTTLE FILLING STATION (1ST FLOOR HALLWAY) - HARRINGTON HALL A (HOUSING)	NE31-99-0000	HARRINGTON HALL A
6753	BOTTLE FILLING STATION (1ST FLOOR HALLWAY) - HARRINGTON HALL B (HOUSING)	NE32-99-0000	HARRINGTON HALL B
6754	BOTTLE FILLING STATION (1ST FLOOR HALLWAY) - HARRINGTON HALL C (HOUSING)	NE33-99-0000	HARRINGTON HALL C
6756	BOTTLE FILLING STATION (1ST FLOOR HALLWAY) - HARRINGTON HALL D (HOUSING)	NE34-99-0000	HARRINGTON HALL D
6758	BOTTLE FILLING STATION (1ST FLOOR HALLWAY) - HARRINGTON HALL E (HOUSING)	NE35-99-0000	HARRINGTON HALL E
6765	BOTTLE FILLING STATION (RM 009B) - PERKINS STUDENT CTR	NE01-99-0000	PERKINS STUDENT CENTER
6766	BOTTLE FILLING STATION (RM 019F) - PERKINS STUDENT CTR	NE01-99-0000	PERKINS STUDENT CENTER
6768	BOTTLE FILLING STATION (RM 119) - PERKINS STUDENT CTR	NE01-99-0000	PERKINS STUDENT CENTER

6769	BOTTLE FILLING STATION (RM 202) - CAESAR RODNEY COMMONS (HOUSING)	NC61-99-0000	CAESAR RODNEY COMMONS
6771	BOTTLE FILLING STATION (RM 309) - CAESAR RODNEY COMMONS (HOUSING)	NC61-99-0000	CAESAR RODNEY COMMONS
6776	BOTTLE FILLING STATION (ENTRANCE) - 200 ACADEMY ST	NC16-99-0000	200 ACADEMY ST
6778	BOTTLE FILLING STATION (1ST FLOOR) - TRABANT UNIVERSITY CENTER	NW22-99-0000	TRABANT UNIVERSITY CENTER
6779	BOTTLE FILLING STATION (BASEMENT) - TRABANT UNIVERSITY CENTER	NW22-99-0000	TRABANT UNIVERSITY CENTER
6780	BOTTLE FILLING STATION - 120 E DELAWARE AVE (WASHINGTON HOUSE)	NE103-99-0000	WASHINGTON HOUSE
6783	BOTTLE FILLING STATION - PURNELL HALL	NW35-99-0000	PURNELL HALL
6784	BOTTLE FILLING STATION (RM B002) - CARPENTER SPORTS BLD	NN07-99-0000	CARPENTER SPORTS
6786	BOTTLE FILLING STATION (RM 172) - CARPENTER SPORTS BLD	NN07-99-0000	CARPENTER SPORTS
6787	BOTTLE FILLING STATION (RM 127) - CARPENTER SPORTS BLD	NN07-99-0000	CARPENTER SPORTS
6788	BOTTLE FILLING STATION (RM 159) - CARPENTER SPORTS BLD	NN07-99-0000	CARPENTER SPORTS
6790	BOTTLE FILLING STATION (BASEMENT) - CARPENTER SPORTS BLD	NN07-99-0000	CARPENTER SPORTS
6791	BOTTLE FILLING STATION (2 ND FLOOR) - CARPENTER SPORTS BLD	NN07-99-0000	CARPENTER SPORTS
6793	BOTTLE FILLING STATION (BASEMENT) - CARPENTER SPORTS BLD	NN07-99-0000	CARPENTER SPORTS
6794	BOTTLE FILLING STATION (POOL DECK) - CARPENTER SPORTS BLD	NN07-99-0000	CARPENTER SPORTS

6796	BOTTLE FILLING STATION (RM 108D) - CLAYTON HALL (O&M)	NN18-99-0000	CLAYTON HALL
6798	BOTTLE FILLING STATION - CHRISTIANA COMMONS BLD (HOUSING)	NN38-99-0000	CHRISTIANA COMMONS
6801	BOTTLE FILLING STATION (RM 027) - MORRIS LIBRARY	NC31-99-0000	MORRIS LIBRARY
6804	BOTTLE FILLING STATION (RM 106) - MORRIS LIBRARY	NC31-99-0000	MORRIS LIBRARY
6805	BOTTLE FILLING STATION (RM 124) - MORRIS LIBRARY	NC31-99-0000	MORRIS LIBRARY
6806	BOTTLE FILLING STATION (RM 220) - MORRIS LIBRARY	NC31-99-0000	MORRIS LIBRARY
6808	BOTTLE FILLING STATION (RM 101) - 501 S COLLEGE AVE	NS111-99-0000	501 SOUTH COLLEGE AVE
6810	BOTTLE FILLING STATION (RM 155C) - 501 S COLLEGE AVE	NS111-99-0000	501 SOUTH COLLEGE AVE
6811	BOTTLE FILLING STATION (RM 131) - 501 S COLLEGE AVE	NS111-99-0000	501 SOUTH COLLEGE AVE
6812	BOTTLE FILLING STATION (RM 144) - 501 S COLLEGE AVE	NS111-99-0000	501 SOUTH COLLEGE AVE
6968	BOTTLE FILLING STATION - HULLIHEN HALL	NC01-99-0000	HULLIHEN HALL
7003	BOTTLE FILLING STATION - LOUIS L. REDDING HALL (HOUSING)	NE105-99-0000	REDDING HALL
7004	BOTTLE FILLING STATION - ELIPHALET W. GILBERT HALL (HOUSING)	NE106-99-0000	GILBERT HALL
7005	BOTTLE FILLING STATION - DE BIOTECHNOLOGY INST (DBI)	NE82-99-0000	DE BIOTECHNOLOGY INST
7006	BOTTLE FILLING STATION - HULLIHEN HALL	NC01-99-0000	HULLIHEN HALL
7007	BOTTLE FILLING STATION - DELAWARE FIELD HOUSE	NS65-99-0000	DELAWARE FIELD HOUSE

BOTTLE FILLING STATION - SMITH HALL	SMITH HALL
BOTTLE FILLING STATION - AMY. E. DU PONT MUSIC BUILDING	AMY E DU PONT MUSIC BUILDING

Resolution:

- **The University of Delaware will replace traditional water fountains or implement a new water filler station with a standard minimum of one filling station per academic building on campus by 2028.**

Transportation

"The reality about transportation is that it's future-oriented. If we're planning for what we have, we're behind the curve."

-Anthony Foxx, Former U.S. Secretary of Transportation

Bikeshare Program

Background:

- **Current research suggests increased cycling and corresponding drops in vehicles on the road to be associated with reduced CO_2 emissions, and improved human health[89]**
    - **This research also highlights that the establishment of a bikeshare program can encourage cycling**
- **Universities and colleges across the world, including over 150 in the U.S., have been recognized for bicycle-friendliness and their bike-sharing programs[90]**
- **The League of American Bicyclists scored Delaware 6th out of 50 states for Bicycle Friendliness in 2018[91]**
- **Newark is the only city in Delaware to be rated as a "Bicycle Friendly Community" with a Bronze ranking by BikeNewark[92]**
- **The University of Delaware ("UD") currently has a Bronze rating from AASHE STARS (2020)[93] and stands to gain additional credits by successfully implementing a sustainable transportation structure and network[94]**
- **UD does not currently operate a bike-sharing program, nor does Newark City Council**

[89] 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.
[90] League of American Bicyclists (LAB), A. "Becoming a Bicycle Friendly University." *LAB* https://www.bikeleague.org/university accessed 20 January 2021
[91] League of American Bicyclists (LAB), B. "Award Database." *LAB* https://www.bikeleague.org/bfa/awards accessed 20 January 2021
[92] BikeNewark. "League of American Bicyclists Bicycle Friendly Community Program." *BikeNewark* https://bikenewark.org/our-work/related-activities/ accessed 20 January 2021
[93] The Association for the Advancement of Sustainability in Higher Education (AASHE); The Sustainability, Tracking, Assessment & Rating System
[94] 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.

- **A bike-sharing program was planned in 2015 and to be completed in Spring 2016, but there were failures in collaboration between stakeholders and issues regarding the safety of users[95,96]**
- **In 2022, Thomas Benson published a Bikeshare Report in collaboration with The Newark Partnership to layout an action plan for the University of Delaware and the City of Newark[97]**

Resolution:

The following resolutions come with the full support of the Newark City Council's Planning Commission Chair

- **UD becomes a bicycle-friendly university by creating a bikeshare program for students, faculty, staff, and guests to use**
- **UD will complete an application for the League of American Bicyclists, costing $100, for an assessment of its bicycle-friendliness**
- **UD will conduct an informational campaign about transportation safety, specifically regarding cycling, and will host a series of in-person and/or virtual workshops for faculty, staff, and students in bicycle safety. UD Police, BikeNewark, and Newark City Council representatives will be strongly encouraged to attend to share valuable insights**
- **Bicycles in the Bikeshare Program will feature GPS devices to monitor their location and ensure the bicycle stock is maintained**
- **To the best of its ability, UD will collaborate with Newark City Council and the Newark Bike Project in ensuring adequate infrastructure is established to create a truly bicycle-friendly city**

[95] 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

[96] 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.

[97] Benson, Thomas. 2022. "Bikeshare Report" https://thenewarkpartnership.org/2022/08/18/bikeshare-report/ accessed 5 February 2023.

Bike Infrastructure Improvement

Background:

- **The transportation sector represents the largest share (28%) of greenhouse gas emissions contributing to climate change in the United States[98]**
- **Numerous reports on sustainable modes of transport such as biking demonstrate benefits including reduced carbon emissions, improved public health, decreased traffic congestion, and fewer vehicle-related fatalities[99]**
- **UD's Transportation Survey 2023 (for the year 2022) underscore significant barriers to bicycle use among students, faculty, and staff including:[100]**
  - **Safety concerns about sharing roads with cars and pedestrians**
  - **Inadequate and poorly maintained bike lanes**
  - **Gaps in connectivity between existing infrastructure**
- **UD holds an AASHE STARS rating of "bronze-expired," scoring 1.2 out of 2.0 in support for sustainable transportation during the last AASHE Stars evaluation in 2020.[101]**
- **Previous reports highlight the critical need for a secure and robust biking infrastructure via initiatives focused on:[102,103]**
  - **Expanding current bicycle lanes**
  - **Improving existing bicycle tool stations**
  - **Enhancing bicycle safety measures**
  - **Providing secure and sheltered bicycle storage options around campus**

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[98] Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2021. U.S. Environmental Protection Agency, EPA 430-R-23-002. (2023).
[99] https://bikeleague.org/ acsessed 28th March 2024
[100] https://bpb-us-w2.wpmucdn.com/sites.udel.edu/dist/e/763/files/2023/06/Transportation-Survey-Analysis-2023.pdf
[101] AASHE STARS (n.d.). "University of Delaware." *AASHE STARS* https://reports.aashe.org/institutions/university-of-delaware-de/report/2020-01-31/ accessed 27th March 2024.
[102] University of Delaware-Sustainability Report https://sites.udel.edu/sustainability/plans/accessed 27th March 2024.
[103] The Newark Partnership. (2022, August 18). Bikeshare Report. Retrieved from https://thenewarkpartnership.org/2022/08/18/bikeshare-report

Table 6. List of Bike Storage Hotspots on Campus

All Student Residence Halls	Pencader Dinning Hall
The Green	Russel Dinning Hall
UD Parking Garages	Morris Library
Perkins Student Center	STAR Campus
Lil Bob Gym	Delaware Stadium
Bob Carpenter Sports Center	Harker-ISE

Figure 9. Examples of Advanced Bicycle Storage. Bicycle storage pod in Jersey City, NJ (left)[104]. Oonee Bicycle Storage Pod (right)[105]

Resolution:

- **UD shall convert at least 50% of their existing bike racks, specifically from identified hotspots in Table 6 into sheltered bike racks equipped with green or white rooftops and/or solar canopies for bike shelters by 2025**
- **To further promote adoption of biking across campus, UD commits to providing safe bicycle storage solutions including options such as advanced bicycle lockers like Oonnee bicycle pods, Figure 9, and begins a pilot project at an identified hotspot in 2025.**

[104] https://jcitytimes.com/bicycle-storage-pods-coming-to-transit-hubs-around-jersey-city/ accessed 4th April 2024
[105] https://www.bicycling.com/news/a20049897/oonee-bike-pods-parking/ accessed 4th April 2024

Electrification of University Fleet

Background:

- **The internal combustion engine vehicles (ICEV's) in UD's vehicle fleet produced 1,014 MT of CO_2e in academic year 2018-2019 (Table 7);[106]**
- **Battery electric vehicles (BEV's) reduce fuel-cycle emissions by 69% in comparison to ICEV's on Delaware's current grid;[107]**
- **Cradle-to-grave life cycle analysis (includes mineral mining, vehicle manufacturing, and electricity or fuel usage) demonstrates that on average, BEV's reduce emissions by over 50% relative to ICEV's using the current grid mix;[108]**
- **BEV's can provide financial benefits with a typical payback period of a BEV (when a BEV becomes cheaper than an ICEV) of about 5-6 years due to cheaper maintenance (26% cheaper) and fueling costs (54% cheaper);[109,110]**
- **Delaware's Department of Natural Resources and Environmental Control (DNREC) has proposed that all new vehicles sold in Delaware shall be electric starting in 2035 which would make Delaware the 15th state to adopt this measure;[111]**

[106] Information provided by Sieman's who was contracted to perform an energy audit at UD in 2020.
[107] "Emissions From Electric Vehicles" Department of Energy Alternative Fuels Data Center. https://afdc.energy.gov/vehicles/electric_emissions.html accessed 22 April 2023.
[108] Comparative life-cycle greenhouse gas emissions of a mid-size BEV and ICE vehicle. International Energy Agency. https://www.iea.org/data-and-statistics/charts/comparative-life-cycle-greenhouse-gas-emissions-of-a-mid-size-bev-and-ice-vehicle accessed 22 April 2023.
[109] Baik, Y., Hensley, R., Hertzke, P., Knupfer, H. "Making electric vehicles profitable" McKinsey and Co. 8 March 2019. https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/making-electric-vehicles-profitable accessed 22 April 2023.
[110] True Cost of Electric Vehicles. American Automobile Association. https://www.aaa.com/autorepair/articles/true-cost-of-ev accessed 22 April 2023.
[111] Barrish, C. ''War without guns' or protecting 'health and our climate'? Del. debates proposed electric vehicle mandate for new cars in 2035" *WHYY*. 6 April 2023. https://whyy.org/articles/delaware-electric-vehicle-mandate-2035-debate/ accessed 22 April 2023.

Table 7. University of Delaware's 2021 Vehicle Fleet

Year	Make	Model	Fuel	Gross Vehicle Weight Rating
1989	Peterbilt	Tractor 379 w/Sleeper	Diesel	80,000
2015	International	7400 Refuse Truck	Diesel	58,000
2019	Freightliner	M2106 - Heil Body Refuse Truck	Diesel	56,000
2019	Freightliner	M2106 - Heil Body Refuse Truck	Diesel	56,000
2000	Freightliner	FL112 Tractor	Diesel	52,000
1995	Ford	L9000 Truck Tractor	Diesel	46,300
2006	Freightliner	Drilling Rig	Diesel	40,600
2011	Gillig	35FT Low Floor Bus	Diesel	39,600
2011	Gillig	35FT Low Floor Bus	Diesel	39,600
2011	Gillig	35FT Low Floor Bus	Diesel	39,600
2011	Gillig	35FT Low Floor Bus	Diesel	39,600
2011	Gillig	35FT Low Floor Bus	Diesel	39,600
2011	Gillig	35FT Low Floor Bus	Diesel	39,600
2011	Gillig	35FT Low Floor Bus	Diesel	39,600
2018	Eldorado	EZ-Rider II Bus	Diesel	34,250
2018	Eldorado	EZ-Rider II Bus	Diesel	34,250
2018	Eldorado	EZ-Rider II Bus	Diesel	34,250
2019	Eldorado	EZ Rider II Bus	Diesel	34,250
2019	Eldorado	EZ Rider II Bus	Diesel	34,250
2019	Eldorado	EZ Rider II Bus	Diesel	34,250
2019	Eldorado	EZ Rider II Bus	Diesel	34,250
2018	Eldorado	EZ-Rider II Bus	Diesel	34,250
1990	GMC	7000 Utility	Diesel	32,000
1974	Chevy	Dump Truck	Diesel	30,000
2019	Eldorado	Passport- HD 30ft Bus	Diesel	28,700
2019	Eldorado	Passport- HD 30ft Bus	Diesel	28,700
2016	Ford	F-750 w/Versa Lift 2-Man Bucket	Diesel	25,999
2005	Chevy	Goshen Bus (24Pass)	Diesel	25,500
1998	Ford	F-800 Cab & Chassis - Boxed Bed	Diesel	24,500
2006	Ford	F-550 Flat Bed Custom	Diesel	19,000
2014	Ford	F-350 Crew Cab 4X4 Pick Up	Diesel	14,000
2001	Dodge	C-25 Stake Body	Diesel	11,000
1996	Dodge	R2500 Pick Up	Diesel	10,000
2003	Ford	Utility Body	Diesel	9,900
2019	Mercedes	Sprinter 2500 Crew Van	Diesel	8,550
2005	Ford	E-250 Converted Electric V2G Cargo Van	Electric	10,000
2006	Ford	E-250 Converted Electric V2G Cargo Van	Electric	10,000
2013	Nissan	Leaf Electric Car	Electric	4,193

2006	Toyota	Scion Xbox - Electric V2G	Electric	3,084
2006	Toyota	Scion Xbox - Electric V2G	Electric	3,084
2006	Toyota	Scion Xbox - Electric V2G	Electric	3,084
2008	BMW	Mini Cooper - Converted Electric V2G	Electric	3,084
2005	Toyota	Scion Xbox - Electric V2G	Electric	3,084
2005	Toyota	Scion Xbox - Electric V2G	Electric	3,084
2006	Toyota	Scion Xbox - Electric V2G	Electric	3,084
2004	Toyota	Scion Xbox - Electric V2G	Electric	3,084
2015	E-Tuk	Vendor Trike	Electric	2,907
2017	Zero	Electric Motor Cycle	Electric	218
2017	Zero	Electric Motor Cycle	Electric	218
2018	Zero	Electric Motor Cycle	Electric	218
2018	Zero	Electric Motor Cycle	Electric	218
2019	Ford	F-750 Dump w/ Plow & Spreader	Gas	33,000
1994	Ford	F-600 Flat Bed	Gas	26,000
2015	Ford	F-650 Box Truck w/Lift	Gas	25,999
2012	Ford	F-650 Box Truck 26' w/Lift	Gas	25,999
2007	Chevy	C5500 Dump Truck	Gas	19,500
2020	Ford	F-550 Box Truck	Gas	19,500
2011	Ford	F-550 Bucket Truck	Gas	19,500
2013	Ford	F-550 Step Van - Ice Cream Truck	Gas	19,500
2018	Ford	F-550 Supreme Freezer Truck	Gas	19,500
2004	Ford	F-550 Cab & Chassis Flat Bed	Gas	17,500
2013	Ford	F-450 4X4 Dump Plow & Spreader	Gas	16,500
2017	Ford	F-450 Refridgerator Truck W/Lift	Gas	16,500
2010	Ford	F-450 Arbor / Plow Body	Gas	16,500
2015	Ford	F-450 4x4 Dump & Plow	Gas	16,500
2016	Ford	F-450 Box Truck	Gas	16,500
2013	Ford	F-450 4X4 Dump Plow & Spreader	Gas	16,500
2019	Ford	F-450 4x4 Plow & Spreader	Gas	16,500
2011	Ford	F-450 Kold King Box Truck w/Lift	Gas	16,500
2019	Ford	F-450 Flat Bed Dump w/ Plow & Spreader	Gas	16,500
2019	Isuzu	NPR-HD 16' Box Truck	Gas	14,500
2014	Ford	E-450 Forrest River ADA	Gas	14,500
2014	Ford	E-450 Forrest River ADA	Gas	14,500
2003	Ford	E-450 Custom Van	Gas	14,500
2012	Ford	E-450 Class III Life Line Ambulance	Gas	14,500
2019	Isuzu	NPR-HD 16' Box Truck	Gas	14,500
2016	Ford	F-350 Box Truck w/Lift	Gas	14,000
2020	Ford	E-350 Commercial Cutaway	Gas	14,000
2012	Ford	F-350 Plow & Spreader on Stake Body Dump	Gas	13,300
2009	Ford	F-350 Box Truck w/Lift	Gas	13,000

2017	Ford	E-350 Cube Van	Gas	12,500
2006	Chevy	Comm. Cutaway Emergency Response Vehicle	Gas	12,000
2012	Ford	E-350 Commercial Cutaway with Lift	Gas	11,500
2007	Ford	E-350 Cube Van	Gas	11,500
2013	Ford	F-350 4X4 Utility Body	Gas	11,500
2011	Ford	E-350 Box w/Lift	Gas	11,500
2016	Ford	E-350 Box Truck	Gas	11,500
2012	Ford	E-350 Commercial Cutaway with Lift	Gas	11,500
2011	Ford	F-350 4X4 Snow Plow & Spreader	Gas	11,100
2019	Dodge	Ram 3500 w/Plow	Gas	11,000
2014	Ford	F-350 Crew Cab 4X4 Pick Up	Gas	11,000
2011	Ford	F-350 Crew Cab 4X4 Pick Up	Gas	10,800
2019	Ford	F-350 Utility Body w/Lift	Gas	10,700
2019	Ford	F-350 Utility Body w/Lift	Gas	10,700
2015	Ford	F350 Ext Cab 4x4 Utility Body w/Lift	Gas	10,700
2018	Ford	F-350 Utility Body w/Lift	Gas	10,700
2001	Dodge	R3500 Quad Cab Pick Up	Gas	10,500
2012	Ford	F-350 Plow & Spreader	Gas	10,400
2012	Ford	F-350 4x4 Plow & Spreader	Gas	10,400
2008	Ford	F-350 4x4 Plow & Spreader	Gas	10,100
2007	Ford	F-350 XL Pick Up	Gas	10,100
2019	Ford	F-250 4X4 Plow & Spreader	Gas	10,100
2013	Ford	E-350 Commercial Cutaway	Gas	10,050
2015	Ford	Transit Box Truck - 12ft	Gas	10,000
2015	Ford	F-350 4x4 Pick Up, Plow & Spreader	Gas	10,000
2017	Ford	F-250 Ext Cab 4WD Pick Up w/ Ladder Rack	Gas	10,000
2017	Ford	F-250 Ext Cab 4WD Pick Up w/ Ladder Rack	Gas	10,000
2016	Ford	F-250 SD Crew Cab 4WD Pick Up	Gas	10,000
2015	Ford	F-250 4x4 Pick Up	Gas	10,000
2012	Ford	F-250 Utility Body Truck	Gas	10,000
2016	Ford	F-350 Utility Body w/Lift	Gas	10,000
2017	Ford	F-250 4X4 Pick Up	Gas	10,000
2016	Ford	Transit 350 Box Truck 12ft.	Gas	10,000
2013	Ford	F-250 Pick Up w/Tool Box	Gas	10,000
2013	Ford	F-250 Utility w/Ladder Rack	Gas	10,000
2011	Ford	F-250 Utility Body Truck	Gas	10,000
2017	Ford	F-250 Utility Body 4x4 w\Liftgate	Gas	10,000
2012	Ford	F-250 Utility Body w/Lift	Gas	10,000
2011	Ford	F-250 Utility Body Truck	Gas	10,000
2015	Ford	F-350 4X4 Pick Up, Plow & Spreader	Gas	10,000
2015	Ford	F-250 Crew Cab 4x4 Pick Up	Gas	10,000

2017	Ford	F-250 Crew Cab Short Bed Pick Up	Gas	10,000
2018	Ford	F-250 4x4 Pick Up w/Cap & Ladder Rack	Gas	10,000
2012	Ford	E-350 Comm. Cutaway Utility Van	Gas	9,900
2004	Ford	F-350 Flat Bed Truck	Gas	9,900
2011	Ford	F-250 Utility Body Truck	Gas	9,800
2011	Ford	F-250 P/U w/Lift & Ladder Rack	Gas	9,800
2018	Chevy	Express 3500 Cargo Crew Van	Gas	9,600
2008	Ford	F-250 4x4 Pick Up	Gas	9,600
2011	Ford	E-350 Commercial Cutaway Van	Gas	9,600
2011	Ford	F-250 Ext Cab 4x4 Pick Up	Gas	9,600
2011	Ford	E-350 Extended Cargo Van	Gas	9,500
2011	Ford	E-350 Cargo / Crew Seat (Removed)	Gas	9,500
2010	Ford	F-250 Crew Cab 4x2 Pick Up	Gas	9,400
2017	Ford	Transit 250 Medium Roof Crew Van	Gas	9,250
2005	Chevy	Silverado 4X4 Pick Up	Gas	9,200
2008	GMC	Sierra Crew Cab 4x4 Pick Up	Gas	9,200
2006	Chevy	Silverado Crew Cab 4x4 Pick Up	Gas	9,200
2009	Ford	E-350 15 Passenger High Top Van	Gas	9,100
2010	Ford	E-350 Ext 15 Passenger	Gas	9,100
2009	Ford	E-350 15 Passenger High Top Van	Gas	9,100
1991	Ford	E-350 15-Passenger Van	Gas	9,100
2005	Ford	E-350 15-Passenger Van	Gas	9,100
2020	Ford	Transit 250 Cargo Van	Gas	9,070
2017	Ford	Transit 250 Cargo Van	Gas	9,000
2018	Ford	Transit 250 Cargo Van	Gas	9,000
2015	Ford	Transit 250 Medium Roof Cargo	Gas	9,000
2005	Ford	F-250 4x4 Pick Up	Gas	9,000
2016	Ford	Transit 250 Medium Roof Gen Serv Package	Gas	9,000
2015	Ford	Transit 250 Cargo Van	Gas	9,000
2018	Ford	F-350 4x4 Super Cab Ladder Rack Cap and Bed Glider	Gas	9,000
2015	Ford	Transit 250 Medium Roof Cargo	Gas	9,000
2017	Ford	Transit 250 Cargo Van	Gas	9,000
2018	Ford	Transit 250 Medium Roof Cargo	Gas	9,000
2011	Ford	E-250 Cargo Van	Gas	9,000
2011	Ford	E-250 Cargo Van	Gas	9,000
2017	Ford	Transit 250 Low Roof Cargo Van	Gas	9,000
2011	Ford	E-250 Cargo Van	Gas	9,000
2008	Ford	E-250 Cargo Van	Gas	9,000
2011	Ford	E-250 Cargo Van	Gas	9,000
2015	Ford	Transit 250 Cargo Van	Gas	9,000
2017	Ford	Transit 250 Cargo Van	Gas	9,000

2008	Ford	E-250 Cargo Van High Top	Gas	9,000
2011	Ford	E-250 Cargo Van	Gas	9,000
2011	Ford	E-250 Cargo Van w/Hitch	Gas	9,000
2011	Ford	E-250 Cargo Van w/Rack & Hitch	Gas	9,000
2017	Ford	Transit 250 Cargo Van	Gas	9,000
2017	Ford	Transit 250 Cargo Van	Gas	9,000
2011	Ford	E-250 Cargo Van	Gas	9,000
2015	Ford	Transit 250 Cargo Van	Gas	9,000
2015	Ford	Transit 250 Low Roof Cargo Van	Gas	9,000
2016	Ford	Transit 250 Cargo - Medium Roof	Gas	9,000
2011	Ford	E-250 Cargo Van	Gas	9,000
2015	Ford	Transit 250 Cargo Van	Gas	9,000
2015	Ford	Transit 250 Cargo Van	Gas	9,000
2011	Ford	E-250 Cargo Van	Gas	9,000
2015	Ford	Transit 250 Cargo Van	Gas	9,000
2017	Ford	Transit 250 Cargo Van	Gas	9,000
2018	Ford	Transit 250 Medium Roof Cargo Van	Gas	9,000
2011	Ford	E-250 Cargo Van	Gas	8,900
2011	Ford	E-250 Crew Cargo w/Rear AC (YoUDee)	Gas	8,900
2011	Ford	E-250 High Top Cargo Van	Gas	8,900
2007	Ford	E-250 Cargo Van	Gas	8,900
2011	Ford	E-250 Cargo Van	Gas	8,900
2011	Ford	E-250 Cargo Van	Gas	8,900
2011	Ford	E-250 High Top Cargo Van	Gas	8,900
2009	Ford	E-250 Cargo Van	Gas	8,900
2011	Ford	E-250 Cargo / Crew Van	Gas	8,900
2011	Ford	E-250 Cargo Van	Gas	8,900
2010	Ford	E-250 Cargo Van w/Lift	Gas	8,900
2002	Dodge	Pick Up	Gas	8,800
2001	Dodge	Pick Up	Gas	8,800
2004	Ford	F-250 4X4 Pick Up	Gas	8,800
2007	Ford	F-250 Pick Up	Gas	8,800
2017	Chevy	Express 2500 Cargo & Ladder Rack	Gas	8,600
2012	Chevy	Express 2500 Cargo & Ladder Rack	Gas	8,600
2008	Chevy	Suburban 2WD	Gas	8,600
2009	GMC	Savana 2500 Cargo (Racks & Bins)	Gas	8,600
2018	Chevy	Express G2500 Cargo Van	Gas	8,600
2017	Ford	Transit 250 Cargo Van	Gas	8,600
2009	GMC	Savana 2500 Cargo (Racks & Bins)	Gas	8,600
2019	Chevy	Express 2500 Cargo Van	Gas	8,600
2013	Chevy	Express 2500 Cargo & Ladder Rack	Gas	8,600
2013	Chevy	Express 2500 Cargo & Ladder Rack	Gas	8,600
2018	Chevy	Express G2500 Cargo Van	Gas	8,600

2019	Chevy	Express 2500 Cargo Van	Gas	8,600
2018	Chevy	Express G2500 Cargo Van	Gas	8,600
2020	Chevy	Cargo Van	Gas	8600
2008	GMC	Savana 2500 Cargo Van w/Roof Rack	Gas	8,600
2013	Chevy	Express 2500 Cargo & Ladder Rack	Gas	8,600
2018	Ford	Transit 150 Van (10-Passenger)	Gas	8,550
2016	Ford	Transit Wagon 10 Passenger Van	Gas	8,550
2017	Ford	Transit 150 8-Passenger Van	Gas	8,550
2017	Ford	Transit 150 8-Passinger Van	Gas	8,550
2018	Ford	Transit 150 Van (10-Passenger)	Gas	8,550
2017	Ford	Transit 150 8-Passenger Van	Gas	8,550
2019	Ford	Transit 150 8-Passenger Van	Gas	8,550
2017	Ford	Transit 150 8-Passenger Van	Gas	8,550
2018	Ford	Transit 150 Van (10-Passenger)	Gas	8,550
2018	Ford	Transit 150 Van (10-Passenger)	Gas	8,550
2016	Ford	Transit 150 Wagon (8 Pass)	Gas	8,550
2013	Ford	E-150 / 8 Passenger Van	Gas	8,520
2013	Ford	E-150 / 8 Passenger Van	Gas	8,520
2000	Dodge	B2500 / 9-Passenger Van	Gas	7,700
2016	Chevy	Suburban 4x4	Gas	7,500
2012	Ford	Expedition 4x4	Gas	7,500
2016	Chevy	Suburban 4X4	Gas	7,500
2016	Chevy	Suburban 4X4	Gas	7,500
2016	Chevy	Suburban 4X4	Gas	7,500
2018	Ford	Explorer Police Interceptor Utility PPV	Gas	7,500
2014	Ford	F-150 XL 4x4 w/Ladder Rack	Gas	7,350
2011	Chevy	Tahoe LS 4x4	Gas	7,300
2016	Chevrolet	Tahoe 4WD Police Pursuit Vehicle	Gas	7,300
2020	Chevy	Tahoe 4x4 Special Service Vehicle	Gas	7,300
2015	Chevy	Tahoe 4x4 PPV	Gas	7,300
2015	Chevy	Tahoe 4x4 PPV	Gas	7,300
2016	Chevy	Tahoe Police Pursuit Vehicle	Gas	7,300
2018	Chevy	Tahoe Police Pursuit Vehicle	Gas	7,300
2010	Chevy	Tahoe SE 4x4 SUV	Gas	7,300
2017	Chevy	Tahoe SSV 4X4	Gas	7300
2018	Chevy	Tahoe SSV 4X4	Gas	7,300
2018	Chevy	Tahoe PPV 4x4	Gas	7,300
2019	Chevy	Tahoe 4x4 SSV - Patrol	Gas	7,300
2011	Ford	F-150 4WD Pick Up	Gas	7,200
1998	Ford	E-250 Cargo Van	Gas	7,200
2009	Ford	F-150 4x4 Pick Up	Gas	7,200
2017	Chevrolet	Silverado 1500 Crew Cab 4X4	Gas	7,200
2009	Ford	F-150 Regular Cab Pick Up	Gas	7,200

2019	Chevy	Tahoe SSV 4X4	Gas	7,100
2019	Chevy	Tahoe PPV 4x4	Gas	7,100
2020	Ford	Police Interceptor Utility - Black	Gas	7,100
2011	Ford	F-150 Pick Up w/Ladder Rack	Gas	7,050
2011	Ford	F-150 Pick Up w/Ladder Rack	Gas	7,050
2016	Ford	F-150 Crew Cab 4WD Pick Up	Gas	7,050
2020	Ford	Ranger Crew Cab 4WD w/cap & Ladder Rack	Gas	7,000
2020	Ford	F-150 Pick Up	Gas	7000
2016	Dodge	R1500 Crew Cab 4WD Pick Up	Gas	6,800
2011	Ford	F-150 Pick Up w/Cap	Gas	6,750
2007	Ford	F-150 Pick Up	Gas	6,700
2011	Dodge	R1500 Quad Cab 4X4 w/Cap	Gas	6,700
1992	Ford	F-250 Pick Up	Gas	6,600
2003	Dodge	Ram 1500 Pick Up	Gas	6,550
2013	Jeep	Grand Cherokee Laredo 4x4	Gas	6,500
2016	Dodge	Durango SXT AWD	Gas	6,500
2019	Dodge	Durango SXT AWD	Gas	6500
2017	Ford	Explorer Police Interceptor Utility 4WD	Gas	6,465
2016	Ford	Explorer Police Interceptor Utility 4WD	Gas	6,465
2021	Ford	Police Interceptor Utility - White	Gas	6,465
2021	Ford	Police Interceptor Utility - White	Gas	6,465
1998	Dodge	Pick Up	Gas	6,400
2001	Dodge	Pick Up	Gas	6,400
2001	Dodge	Pick Up	Gas	6,400
2004	Chevy	Silverado Pick Up	Gas	6,400
1998	Dodge	Ram C1500 Pick Up	Gas	6,400
1999	Dodge	Quad Cab Pick Up	Gas	6,400
2011	Chevy	Silverado 4X4 Pick Up - Reg Cab	Gas	6,400
2005	Chevy	Silverado 1500 Reg Cab Pick Up	Gas	6,400
2005	Chevy	Silverado 1500 Reg Cab Pick Up	Gas	6,400
2018	Ford	Explorer Police Interceptor Utility 4WD	Gas	6,342
2018	Ford	Police Interceptor Utility 4x4	Gas	6,342
2015	Ford	Explorer Police Interceptor Utility 4WD	Gas	6,342
2018	Ford	Police Interceptor Utility 4x4	Gas	6,342
2016	Ford	Explorer Police Interceptor Utility AWD	Gas	6,342
2018	Ford	Explorer Police Interceptor Utility 4WD	Gas	6,342

2016	Ford	Explorer Police Interceptor Utility 4WD	Gas	6,342
2017	Ford	Explorer Police Interceptor Utility 4WD	Gas	6,342
2019	Toyota	4Runner SR5 4WD	Gas	6,300
2015	Ford	Explorer Police Interceptor Utility AWD	Gas	6,300
2015	Ford	Explorer Police Interceptor Utility AWD	Gas	6,300
2015	Ford	Explorer Police Interceptor Utility 4WD	Gas	6,300
1999	Ford	F-150 Pick Up	Gas	6,250
2008	Ford	Explorer 4X4	Gas	6,180
2014	Ford	Explorer	Gas	6,120
2020	Chrysler	Voyager Minivan	Gas	6,055
2016	Dodge	Caravan SV	Gas	6,050
2016	Dodge	Grand Caravan SE	Gas	6,050
2019	Dodge	Grand Caravan ADA Entervan	Gas	6050
2016	Dodge	Caravan SE	Gas	6,050
2016	Dodge	Grand Caravan SE	Gas	6,050
2016	Dodge	Grand Caravan SE	Gas	6,050
2016	Dodge	Grand Caravan SE	Gas	6,050
2014	Dodge	Grand Caravan	Gas	6,050
2014	Dodge	Grand Caravan	Gas	6,050
2016	Dodge	Grand Caravan	Gas	6,050
2014	Dodge	Grand Caravan	Gas	6,050
2006	Dodge	Caravan	Gas	6,050
2007	Dodge	Caravan	Gas	6,050
2013	Dodge	Grand Caravan	Gas	6,050
2014	Dodge	Grand Caravan	Gas	6,050
2014	Dodge	Grand Caravan	Gas	6,050
2014	Dodge	Grand Caravan	Gas	6,050
2018	Chrysler	Pacifica Minivan	Gas	6,050
2016	Dodge	Grand Caravan SE	Gas	6,050
2017	Dodge	Grand Caravan	Gas	6,050
2016	Dodge	Grand Caravan SV	Gas	6,050
2016	Dodge	Caravan SV	Gas	6,050
2008	Dodge	Caravan	Gas	6,050
2013	Dodge	Grand Caravan SE	Gas	6,050
2014	Dodge	Grand Caravan	Gas	6,050
2014	Dodge	Grand Caravan SE	Gas	6,050
2017	Dodge	Grand Caravan	Gas	6,050
2018	Dodge	Grand Caravan	Gas	6,050
2019	Dodge	Grand Caravan SE	Gas	6,050

2016	Chevy	Colorado Crew Cab 4x4	Gas	6,000
2019	Ford	Escape 4WD	Gas	6,000
2018	Ford	Escape 4x4 SE	Gas	6,000
2018	Ford	Escape 4x4 SE	Gas	6,000
2018	Ford	Escape 4x4 SE	Gas	6,000
2017	Ford	Escape SE 4X4	Gas	6,000
2019	Chevy	Colorado 4x4 WT Crew Short Box Pick Up	Gas	6,000
2019	Chevy	Colorado 2x4 WT Crew Short Box Pick Up	Gas	6,000
2016	GMC	Canyon Crew Cab 2WD	Gas	5,800
2015	GMC	Canyon Pick Up	Gas	5,700
2015	GMC	Canyon Pick up	Gas	5,700
2014	Nissan	Frontier Pro-X w/Plow & Spreader	Gas	5,690
2018	Toyota	Tacoma TRD Super Cab 4x4	Gas	5,600
2013	Nissan	Frontier King Cab	Gas	5,589
2008	Ford	Edge AWD Crossover	Gas	5,540
2002	Dodge	Caravan	Gas	5,400
2012	Chevy	Colorado Ext Cab 4x4 Plow & Spreader	Gas	5,300
2012	Chevy	Colorado Pick Up	Gas	5,300
2014	Ford	Transit Connect Wagon	Gas	5,280
2014	Ford	Transit Connect Wagon	Gas	5,280
2016	Ford	Transit Connect Wagon	Gas	5,280
2016	Ford	Transit Connect Wagon LWB	Gas	5,280
2015	Ford	Transit Connect - Small Cargo Van	Gas	5,270
2017	Ford	Transit Connect Cargo Van	Gas	5,270
2018	Ford	Transit Connect	Gas	5,270
2019	Ford	Transit Connect XLT Wagon	Gas	5,200
2017	Ford	Transit Connect Cargo Van	Gas	5,005
2012	Ford	Transit Connect Utility Van	Gas	5,005
2012	Ford	Transit Connect Utility Van	Gas	5,005
2020	Ford	Transit Connect Utility Van	Gas	5,005
2011	Ford	Transit Connect Utility Van	Gas	5,005
2011	Ford	Transit Connect Utility Van	Gas	5,000
2011	Ford	Transit Connect Utility Van	Gas	5,000
2016	Ram	Pro Master City (Small Cargo Van)	Gas	5,000
2004	Ford	Taurus S/W	Gas	4,921
2003	Chevy	S-10 Pick Up	Gas	4,700
1997	Ford	Ranger Pick Up	Gas	4,700
2010	Chevy	Impala Sedan	Gas	4,636
2019	Chevy	Equinox LS AWD	Gas	4,630
2010	Dodge	Avenger Sedan	Gas	4,600
2008	Dodge	Avenger Sedan	Gas	4,600

2000	Chevy	S-10 Pick Up	Gas	4,600
2016	Jeep	Patriot 4WD	Gas	4,575
2020	Ford	Escape SUV	Gas	4,500
2020	Ford	Escape SUV	Gas	4,500
2017	Ford	Focus Sedan - 4Door	Gas	3,990
2017	Ford	Focus Sedan - 4Door	Gas	3,990
2017	Ford	Focus Sedan - 4Door	Gas	3,990
2012	Ford	Focus 4DR SE	Gas	3,990
2018	Ford	Fusion Sedan	Gas	3,681
2008	Chevy	Impala Sedan	Gas	3,555
2000	Ford	Taurus Sedan	Gas	3,340
2017	West	Go-4 Parking Enforcement Vehicle	Gas	2,285
2020	Chevy	Express 2500 Cargo Van	Gas	
2018	Dodge	Caravan Paratransit	Gas/Hybrid	6,050
2020	Toyota	Rav4 AWD Hybrid	Gas/Hybrid	4,610
2020	Toyota	Rav4 AWD Hybrid	Gas/Hybrid	4,610
2017	Ford	C-Max Hybrid	Gas/Hybrid	5,000
2017	Ford	C-Max Hybrid	Gas/Hybrid	5,000
2009	Mercury	Mariner Hybrid 4X4	Gas/Hybrid	4,880
2020	Toyota	Rav4 AWD Hybrid	Gas/Hybrid	4,610
2022	Toyota	Prius	Gas/Hybrid	4,255
2010	Mercury	Mariner Hybrid 4x4	Gas/Hybrid	3,728
2000	E-Bus	Fuel Cell Bus / 45-Passenger	Hydrogen	27,520
2009	E-Bus	Fuel Cell Bus / 37-Passenger	Hydrogen	20,500

Resolution:

- **UD shall transition its vehicle fleet to 100% electric vehicles by 2030 through the leveraging of publicly available programs such as the DNREC Electric Vehicle (EV) and Plug-In Electric Hybrid (PHEV) Rebate program**
- **The UD Office of Sustainability shall oversee that the above resolutions are implemented within the provided timeframes produce an updated Climate Action Plan containing the above resolutions.**

Electric Vehicle Charging Stations

Background:

- **In 2022, the U.S. crossed the 5% market share tipping point for electric vehicle sales, at which point mass-adoption typically occurs and technological preferences rapidly flip putting the U.S. on track for ¼ of all new vehicle sales to be electric by 2025;[112]**
- **Many major vehicle manufacturers including General Motors, Bentley, Mercedes-Benz, Volvo, Cadillac, Honda, Jaguar Land Rover, and Volkswagen have committed to producing exclusively electric vehicles between 2026-2040;[113]**
- **Delaware's Department of Natural Resources and Environmental Control (DNREC) has proposed that all new vehicles sold in Delaware shall be electric starting in 2035 which would make Delaware the 15th state to adopt this measure;[114]**
- **Only 0.08% of total parking spaces (9/10,711 parking spaces) at UD are equipped with publicly available charging stations (Table 8)**
- **Including installation, level 2 chargers which provide ~25-30 miles of range/hour typically cost ~$4,000-$13,000 (Table 9), but can pay for themselves within ~3 years through usage fees;[115,116]**

[112] Randall, T. "US Crosses the Electric-Car Tipping Point for Mass Adoption" *Bloomberg*. 9 July 2022. https://www.bloomberg.com/news/articles/2022-07-09/us-electric-car-sales-reach-key-milestone#xj4y7vzkg accessed 22 April 2023.
[113] Motavalli, J. Every Automaker's EV Plans Through 2035 And Beyond. *Forbes.* 4 Oct. 2021. https://www.forbes.com/wheels/news/automaker-ev-plans/ 22 April 2023.
[114] Barrish, C. ''War without guns' or protecting 'health and our climate'? Del. debates proposed electric vehicle mandate for new cars in 2035" *WHYY*. 6 April 2023. https://whyy.org/articles/delaware-electric-vehicle-mandate-2035-debate/ accessed 22 April 2023.
[115] EV Charging Station Cost. Ohm Home. https://www.ohmhomenow.com/electric-vehicles/ev-charging-station-cost/ accessed 23 April 2023.
[116] Electric Car Charging Stations: Costs, Payback and Funding Models. Wallbox. https://blog.wallbox.com/en/electric-car-charging-stations-costs-payback-and-funding-models/ accessed 23 April 2023.

Table 8. Publicly Available Electric Charging Stations at the University of Delaware

Location	Number of Chargers
Lot 53 Pearson	2
Lot 35 Hulihen	1
Lot 4C Perkins Garage	1
Lot 14C CFA Garage	1
Lot 39 Wyoming Maintenance Complex	4

*note: an additional 3 chargers have been ordered for STAR Campus as of Oct. 2022

Table 9. Estimated Costs of New Charging Station Construction[66]

Itemization	Level 2 (Home)	Level 2 (Parking Garage)	Level 2 (Curb-side)	DC Fast Charging
Hardware	$450-$1000	$1,500-$2,500	$1,500-$3,000	$12,000-$35,000
Electrician Materials	$50-$150	$210-$510	$150-$300	$300-$600
Electrician Labor	$100-$350	$1,240-$2,940	$800-$1,500	$1,600-$3,000
Other Materials	N/A	$50-$100	$50-$150	$100-$400
Other Labor	N/A	$250-$750	$2,500-7,500	$5,000-$15,000
Transformer	N/A	N/A	N/A	$10,000-$25,000
Mobilization	$50-$200	$250-$500	$250-$500	$600-$1,200
Permitting	$0-$100	$50-$200	$50-$200	$50-$200
Total	$650-$1,800	$3,550-$7,500	$5,300-$13,150	$29,650-$80,400

*It is estimated that it will cost ~$2-5 million to ensure 5% of UD's parking spaces are equipped with charging stations.

**Assumptions: UD constructs 524 new publicly available level 2 electric vehicle charging stations to reach 536 total publicly available electric vehicle charging stations by 2025. Half of the new charging stations be constructed in parking garages and half be constructed curbside.

Resolution:

- **UD shall equip at least 5% of their parking spaces (536/10,711 parking spaces) with publicly available charging stations by 2025 to be in line with the U.S. Green Building Leadership in Energy and Environmental Design (LEED) Building Design and Construction (BD+C) recommendation and to match the share of new vehicle sales that are BEV's**
- **The on campus charging stations shall be Level 2 or Level 3 chargers to provide students, faculty, and staff with charging rates that are useful on an 8-hour workday timescale; and**
- **UD shall take advantage of the offerings of the EPA Green Power Partnership procurement assistance and guidance to provide 100% carbon-free electricity to on-campus charging stations by 2035 in line with U.S. goals**
- **The UD Office of Sustainability shall oversee that the above resolutions are implemented within the provided timeframes and produce an updated Climate Action Plan containing the above resolutions**

Waste

"We don't need a handful of people doing zero waste perfectly. We need millions of people doing it imperfectly."

-Anne-Marie Bonneau, Author/Zero-Waste Chef

Elimination of Single-use Plastics

Background:

- **Plastics present a major challenge for society today with less than 10% of all plastics produced actually being recycled**
- **Plastic packaging (or single use-plastics) takes a large share of the plastics market, as of 2019 plastic packaging was responsible for nearly 44.6% of consumer plastic consumption and 46% of plastic waste was comprised of plastic packaging/single-use plastics**
- **Governments at all levels including federal, state, and municipalities are acting in direction of reducing single-use plastic waste such as the State of Delaware implementing a single-use plastic bag ban January 1st, 2021[117]**
- **UD currently does not supply compostable or bio-plastic cutlery in its dining services and has yet to formulate a long-term plan to reduce single-use plastics on campus**
- **In 2018-2019, UD produced 2,471 short tons of mixed solid waste (excluding food) and was, therefore, responsible for approximately 865 metric tons of CO2e emissions[118]**
- **Successful precedent exists for other institutions such a Duke University, Lehigh University, the University of Hawaii, the University of Portland, and Johns Hopkins University, who have instituted measures to successfully phase-out single-use plastics on campus**

Fact Sheet Accompaniment

1. From 2019, UD offers disposable napkins that are made from 100 percent recycled materials and these are available in all its dining services.[119] All dining and catering locations across UD campuses "participate in the University's single-stream recycling program" too.[120]

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[117] Delaware Department of Natural Resources and Environmental Control (DNREC). "Delaware's Plastic Carryout Bag Ban." *Delaware Gov* https://dnrec.alpha.delaware.gov/waste-hazardous/recycling/plastic-bags/ accessed 14 February 2021.

[118] University of Delaware. 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, page 3.

[119] Gilreath, Stefanie. 2019. "Reducing Single-use Plastics." *UDaily* https://www.udel.edu/udaily/2019/april/dining-services-waste-minimization-earth-month/ accessed 14 February 2021.

[120] See fn 5.

2. The statutory definition of "solid waste," according to RCRA Section 1004(27), is "any garbage, refuse, sludge from a waste treatment plant, water supply treatment plant, or air pollution control facility and other discarded material, including solid, liquid, semisolid, or contained gaseous material resulting from industrial, commercial, mining, and agricultural operations, and from community activities."[121]

3. The regulatory definition of "solid waste" is any "discarded material" that is "abandoned," "inherently-waste-like," "military munitions," or "recycled."[122]

4. Leveraging fees on single-use plastic products have been demonstrated to reduce overall single-use plastic consumption.[123] For example, in England, a 0.05 charge (equivalent of $0.07)[124] was introduced (per bag) for single-use plastic bags. In six months, the number of single-use plastic bags provided to customers dropped from 7 billion to 500 million in the first six months of the charge.[125]

5. Exemptions for the State of Delaware plastic bag ban include: (1) plastic wrapping for frozen foods, meat, fish, flowers, or potted plants; (2) bags sold in packages containing multiple bags intended for use as garbage, pet waste, or yard waste; (3) bags used to contain live animals (e.g. fish or insects) sold in pet stores; (4) bags used to transport chemical pesticides, drain-cleaning chemicals, or other caustic chemicals; (5) non-handled bags used to protect a purchased item from damaging or contaminating other purchased items when placed in a recycled paper bag or a reusable grocery bag; (6) bags provided to contain an unwrapped food item; and (7) non-handled bags that are designed to be placed over articles of clothing on a hanger.[126]

6. In the AASHE STARS category of 'Waste', UD scored (2020) 3.37 out of 10 credits. Within this category, there are three subcategories: (1) Waste Minimization and Diversion; (2) Construction and Demolition Waste Diversion; (3) and Hazardous Waste Management. Respectively, UD scored 2.87/8, 0/1, and 0.5/1 credits in these subcategories.[127] Of particular importance is the first subcategory, which assesses universities in relation to three criterion: (1) the university has "implemented source reduction strategies to reduce the total amount of waste generated"; (2) the university's "total annual waste generation (materials diverted and disposed) is

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[121] U.S. EPA. 2017. "Definition of Solid Waste and Recycling." *EPA* https://19january2017snapshot.epa.gov/sites/production/files/2016-02/documents/soliddef.pdf accessed 14 February, page 3.
[122] See fn 6, page 4.
[123] National Conference of State Legislatures. "State Plastic Bag Legislation." *NCSL* https://www.ncsl.org/research/environment-and-natural-resources/plastic-bag-legislation.aspx accessed 14 February 2021.
[124] FX Convert. "0.05 GBP to USD." *FX Convert* https://fxconvert.net/converter/gbp-usd/0.05 accessed 14 February 2021.
[125] Smithers, Rebecca. 2016. "England's Plastic Bag Usage Drops 85% Since 5p Charge Introduced." *The Guardian* https://www.theguardian.com/environment/2016/jul/30/england-plastic-bag-usage-drops-85-per-cent-since-5p-charged-introduced accessed 14 February 2021.
[126] Delcode. "Title 7: Conservation, Natural Resources, Chapter 60. Environmental Control, Subchapter IX. Recycling and Waste Reduction." *Delaware Gov* https://delcode.delaware.gov/title7/c060/sc09/index.htmlSection, (e)(3)a-g.
[127] See fn 3.

less than the minimum performance threshold of 0.50 tons (0.45 tonnes) per weighted campus user"; and, most importantly, (3) the university "diverts materials from the landfill or incinerator by recycling, composting, donating or re-selling."[128]

7. Furthermore, UD scored (2020) 1.25 out of 3 credits for 'Sustainable Procurement, which assesses, among other things: (1) whether the university has a "stated preference for post-consumer or bio-based content or to otherwise minimize the negative environmental impacts of products and services"; and (2) whether the university has "published sustainability criteria to be applied when evaluating products and services in one or more of the following categories" (one relevant category is "food services" and includes "sustainability objectives in contracts with on-site franchises").[129]

Resolution:

- **UD commits to eliminating single-use plastics from campus, in favor of eco-friendly alternatives such as biodegradable bio-plastics, compostable items, or replacement with their reusable counterparts.**
- **UD disseminates a university-wide email to all its students, faculty, and staff, in addition to posts on UD social media platforms and blog, that promotes and educates on the reduction of single-use plastics**
- **Where elimination of single use plastics is unfeasible implement a small fee on single-use plastic products sold on its campuses, including in its dining and catering services, whereby the subsequent pool of funds would assist in the establishment of sustainability initiatives across UD's campuses including proper recycling and end of life management.**

[128] AASHE STARS. "University of Delaware: OP-19: Waste Minimization and Diversion." *AASHE* https://reports.aashe.org/institutions/university-of-delaware-de/report/2020-01-31/OP/waste/OP-19/documentation/ accessed 14 February 2021.
[129] AASHE STARS. "University of Delaware: OP-11: Sustainable Procurement." *AASHE* https://reports.aashe.org/institutions/university-of-delaware-de/report/2020-01-31/OP/purchasing/OP-11/documentation/ accessed 14 February 2021.

Battery Recycling Program

Background:

- **If placed in a landfill, the toxic materials inside household batteries can leak into the soil and polluting water supplies**
- **UD currently lacks the infrastructure or initiatives to address end of life battery usage on campus while clear solutions exist since most batteries are recyclable.**
- **There is a dire need for recycling stations in physical spaces on campus to provide students accessible means of recycling Alkaline 9 volt, AA, AAA, C, D or other small Alkaline Batteries**
- **For students attending UD, household alkaline and rechargeable batteries can be recycled at selected Delaware Solid Waste Authority (DSWA) drop-off centers**
- **However, DSWA drop-off centers are not walkable and require a vehicle to transport (Table 10)**

Table 10. Available DWSA Drop off Locations

Location	Distance from The Green
The Delaware Recycling Center	16.3 miles
Newark Recycling Center	5.2 miles
Pine Tree Corners Transfer Station	23.5 miles

Resolution:

- **UD and the Office of Sustainability immediately works towards a Battery Recycling Program in collaboration with Call2Recycle[130], a non-profit organization, to create battery recycling stations across the university's campuses in high-traffic areas**
- **In collaboration with the GSG, UD and the Office of Sustainability work towards building a collaborative relationship with the City of Newark for the long-term and sustainable funding of battery recycling stations accessible to students, staff, and faculty as well as the local community**
- **UD and the Office of Sustainability promotes recycling a awareness program to help educate students, staff, and faculty about the importance of recycling batteries and where they can locate battery recycling stations on-campus**
- **UD begins gathering data to report on the battery recycling progress and status across the university campuses and the local community**

[130] Call2Recycle is a non-profit public service organization and over the last twenty-five years the organization has been operating a recycling program working with various companies and municipalities to provide effective and efficient, sustainable and green methods for battery recycling. For more information, history and background, see link1 and link2. In addition, Call2Recycle has been collaborating with many other academic institutions (e.g., Stony Brook University, University of Illinois Urbana-Champaign, Yale University, and University of Houston) and has established battery recycling programs on campus across the US.

Clear and Concise Waste Labeling

Background:

- **Many studies have highlighted the importance of effective labeling on recycling bins to improve the fraction of waste diverted to recycling facilities on college campuses;[131]**
- **In 2020, 34.17% of total waste was diverted from landfills through recycling at the University of Delaware (UD),[132] well below the 60% target set in 2016 for 2020[133] and below the 45% average found across other U.S. universities;[134]**
- **UD maintains an above average rate of putting non-recyclables in recycling bins has previously received a score of just 2.88/8 for waste minimization and diversion when last evaluated for AASHE in 2020[135,136]**
- **A 164% increase in campus recycling bin use has been demonstrated upon implementing effective labels that are consistent, concise, clearly readable, and offer examples of acceptable recyclables with the use of icons**
- **Many recycling bins at UD are unlabeled, difficult to read, offer no examples, are overcrowded, or have labels that predate the 2009 switch to single stream recycling and thus provide incorrect information (Figure 10)**
- **The lack of accurate, accessible, and clear instructions on recycling bins reduces student confidence in recycling and results in less recyclables being diverted as well as higher contamination rates;**

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[131] Save, D. (2019, July 5). *Recycling labels increase campus waste diversion*. CleanRiver. Retrieved February 15, 2023, from https://cleanriver.com/recycling-labels-campus-waste-diversion/

[132] Posted by Megan Smalley | April 12, 2021. (n.d.). *RRS examines university recycling, sustainability activities*. Waste Today. Retrieved February 15, 2023

[133] *University of Delaware op-19: Waste minimization and diversion*. Waste Minimization and Diversion | University of Delaware | Scorecard | Institutions | STARS Reports. (n.d.). Retrieved February 15, 2023

[134] Kubitz, L. (2016, November 29). *University to use grant money to bolster recycling on campus*. The Review. Retrieved February 23, 2023, from https://udreview.com/university-to-use-grant-money-to-bolster-recycling-on-campus/

[135] The Association for the Advancement of Sustainability in Higher Education (AASHE); The Sustainability Tracking & Rating System (STARS)

[136] Sustainability Tracking, Assessment & Rating System (STARS). "University of Delaware." *Association for the Advancement of Sustainability in Higher Education (AASHE)*

Figure 10. Current UD recycling bins maintaining inconsistent and unclear guidance

a. **b.** **c.** **d.**

(a) unlabeled recycling bins in Colburn Laboratory, (b) ineffective recycling label due to excessive text and lack of images found in dorms, (c) ineffective label due to the small text, and lack of images (d) outdated recycling label in Colburn Laboratory predating the switch to single stream recycling in 2008; it falsely asserts that cans / plastics / cardboard / newspaper cannot be recycled.

Resolution:

- **By the end 2024, a recycling bin sticker label that provides legible text, icons, and clear examples of recyclables shall be implemented across all UD recycling bins**
- **Custodial staff shall receive training to prevent recycling waste from being combined with landfill waste; and**
- **The UD Office of Sustainability shall coordinate this labelling effort and custodial staff training program as well as informational emails to students, faculty, and staff on proper recycling hygiene**

Intelligent Waste Collection

Background:

- **UD's unsustainable waste management has been clearly evidenced within recent years. As of Jan. 31st, 2020 the Sustainability Tracking, Assessment, & Rating System (STARS), a program of AASHE, provided UD a Waste Minimization and Diversion score of 2.87/8.00, highlighting the dire need for improvement.[137]**
- **UD's current waste management approach relies on conventional commercial trash cans for collection of single stream recycling and waste in outdoor spaces. It is also important to note that these waste receptacles do not maintain detailed labeling, which have demonstrated a 164% increase in campus waste diversion at other universities.[138]**
- **Efforts in sustainable waste management have given rise to innovative solutions such as the "smart" solar-compacting waste bins developed by the leading waste and recycling solutions company, Bigbelly. These fully enclosed bins are configurable to meet waste and recycling needs in large public settings leading to cleaner outdoor spaces, reduced rats and pests, decreased collection efforts, and accessible recycling.[139]**
- **Iowa State University found the implementation of BigBelly's across campus led to a 90% cut in the costs associated with waste collection in comparison to their previous trash cans. The initiative that began in 2009 was found to be so successful the university continued to expand and maintain their efforts. As of 2013, there were a total of 53 solar compactors on the 1900-acre campus.[140,141]**

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[137] Williams, C. University of Delaware OP-19: Waste Minimization and Diversion. *The Sustainability Assessment & Ranking System*. 2020

[138] Save, D. Recycling Labels Increase Waste Diversion. *Clean River Recycling Solutions*. 2019

[139] BigBelly. Universities: Case Study UC Berkeley. *BigBelly. 2023*

[140] Iowa State Office of Sustainability. BigBelly Solar: Iowa State University. *Iowa State Live Green. 2011*

[141] Pounds, D. Solar-powered Recycling Units Join Trash Compactors. *Inside Iowa State for Faculty and Staff*. 2013

Figure 11. Full Range of BigBelly product line customizable to campus needs[139]

Resolution:

- **The University of Delaware in conjunction with the Office of Sustainability, replace all existing outdoor waste and recycling receptacles with BigBelly compactors or an equivalent solar-compacting bin by 2026.**
- **A standard for outdoor waste and recycling bins is established at one pair of solar-compacting bins per 35 acres of campus and implemented by the year 2030.**

Campus Food Waste Management

Background:

- **Americans, on average, throw out more than 400lbs (181.4kg) of food per person;[142]**
- **The U.S. Environmental Protection Agency (EPA) defines food waste 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";[143]**
- **The EPA (2018) estimates that food waste accounts for the contents of landfills and combustion facilities more than any other material;[144]**
- **UD has taken some steps to address food waste by up-cycling cooking oils into biofuel, converting food waste into water via mechanical digesters, utilizing a 'Lean Path' system and utilizing a system that tracks pre-consumer waste, implementing trayless dining,[145]**
- **UD donates perishable goods to the Food Bank of Delaware each semester, and partnered with the Aramark Green Thread project to establish food waste management and recycling programs;[146]**
- **These measures in UD waste management efforts only pertain to student dining and does not include steps to further combat food waste produced from on-campus events with catering services while also lacking data transparency on food waste**

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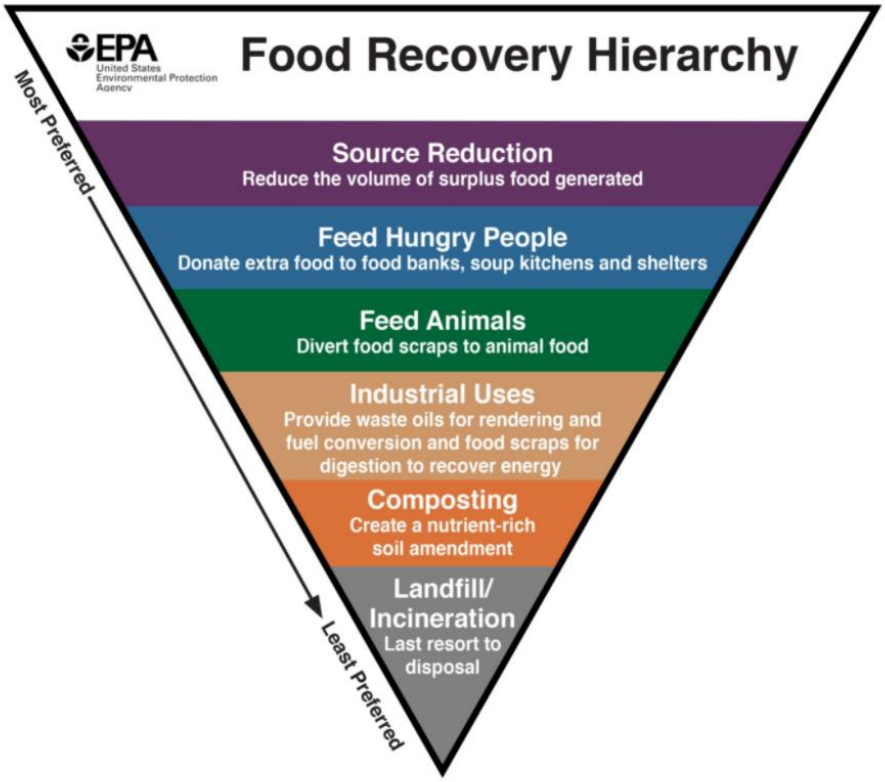
[142] Buzby, Jean C., Hodan Farah-Wells, and Jeffrey Hyman. 2014. "The Estimated Amount, Value, and Calories of Postharvest Food Losses at the Retail and Consumer Levels in the United States." *USDA-ERS* Economic Information Bulletin 121. https://www.ers.usda.gov/webdocs/publications/43833/43680_eib121.pdf?v=1508.7.
[143] Environmental Protection Agency (EPA), C. "What is Wasted Food and Where Does it Come From?" *EPA* https://www.epa.gov/sustainable-management-food/sustainable-management-food-basics.
[144] 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.
[145] Association for Advancement for Sustainability in Higher Education. (n.d.). *University of Delaware op-8: Sustainable dining*. Sustainable Dining | University of Delaware | Scorecard | Institutions | STARS Reports. Retrieved December 2, 2021, from https://reports.aashe.org/institutions/university-of-delaware-de/report/2020-01-31/OP/food-dining/OP-8/.
[146] Gilreath, S. (2019, April 8). *Reducing single-use plastics*. UDaily. Retrieved November 8, 2021, from https://www.udel.edu/udaily/2019/april/dining-services-waste-minimization-earth-month/.

Figure 12. EPA Food Recovery Hierarchy



Environmental Protection Agency (EPA), B. "Food Recovery Hierarchy" *EPA* https://www.epa.gov/sustainable-management-food/food-recovery-hierarchy.

Program Outlines and Definitions

Pre-consumer food waste: "Food waste discarded by staff within the control of the foodservice operator. This includes all waste in the back of the house including overproduction, trim waste, expiration, spoilage, overcooked items, contaminated items, and dropped items. It also includes all waste in the front of the house that has remained under the control and custody of the foodservice operator, including items on cafeteria stations such as salad bars, steam wells, self-serve deli stations, misordered product (e.g. erroneous grill orders never served), and expired grab & go items. Leftover catering items would be pre-consumer waste if they remain on the catering line and have not been received by an individual customer. If an item has been sold or served to a customer and is then discarded it is no longer pre-consumer waste. Pre-consumer waste offers opportunities for waste reduction and cost savings."- LeanPath. *A short guide to food waste management best practices*.

Post-consumer food waste: “Food waste discarded by customers/guests/students/patients/ visitors after the food has been sold or served. This waste is sometimes referred to as "plate waste" or "table scraps" and the decision to discard it (or leave the food on the plate) is made by the consumer rather than the foodservice operator.” LeanPath. *A short guide to food waste management best practices*.

Lean Path Program: Lean Path offers tools to prevent the accumulation of food waste when food is being prepared for customers/students. It offers scales and touchscreens that allow food waste to be weighed and tracked. Some Lean Path packages include tools that photograph food waste as well. Alongside this, Lean Path offers software that allows users to create visual datasets for further analysis of food waste (e.g., pie chart depicting the main reasons for wasted food). More information on the Lean Path program is available here: https://www.leanpath.com/solutions/

Aramark Green Thread: The Aramark Green Thread project is an initiative to “integrate environmentally responsible principles and practices into the services” that Aramark provides to universities, hospitals, municipalities, and businesses. Some of the project’s strategies for integrating environmentally responsible principles include aims to:

- Increase procurement of local and seasonal food;
- Introduce recycling and reuse practices for food and other waste; and
- Implement water and energy conservation efforts.

More on the Aramark Green Thread Project is available here: https://www.aramark.com/about-us/news/aramark-general/green-thread-environmental-sustainability-platform

Resolution:

- **UD reports data collected from the *Lean Path* system and pre-consumer waste tracking on the UD Dining Website[147]**
- **Collects data on post-consumer food waste in-line with standardized food waste quantification methods and reports it on the UD Dining Website[148]**
- **Expands current dining hall food waste management practices to on-campus events with catering services to the extent possible**
- **Considers registering attendees for catered events in which non-attendees are charged a small fee (exceptions included, such as emergencies)**

[147] See: http://www.udel.edu/dining
[148] See: http://www.udel.edu/dining

Promotion of Sustainable Textiles and Fashion

Background:

- **The fashion industry is rife with environmental degradation and human rights abuses due to an opaque global supply chain; a lack of accountability; corporations placing profit over people and planet; a lack of standardized auditing, oversight, and sustainability metrics; and little-to-no government regulation;**
- **In the academic setting alone, Roughly 100 million polyester gowns in the U.S. have been discarded in the last 30 years, but prior to that commencement regalia was commonly laundered and re-rented;**
- **Roughly 4 million students graduate in the United States annually, which frames the high environmental cost of regalia within higher education institutions that perpetuate unsustainable business models, and these institutions have the power to make positive environmental change; and**
- **To ensure environmental sustainability and social responsibility, oversight and supply chain transparency is necessary;**
- **Production transparency[149] can create a sustainable and socially responsible supply chain at the University of Delaware ('UD') by enabling students, staff, faculty, and visitors to assess the University's manufacturing practices and hold UD, and their partner Barnes & Noble, accountable through purchase power;**
- **The University of Delaware ('UD'), which has over 185,000 alumni around the world, requires each graduating class (of roughly 6,000 students) to purchase commencement regalia exclusively from the B&N UD Bookstore, which is sourced from the company Oak Hall;**
- **Oak Hall offers solutions such as the Take Back Program and the option to rent commencement regalia[150], in which the former allows students to place unwanted gowns in recycling bins provided at commencement whereby "regalia that is recycled will be reprocessed into new product"[151]**

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[149] The University of Delaware does not provide data on their production process including the "vendors/suppliers" (companies who create the merchandise) and brands they partner with. The only exceptions are Nike, Adidas, Champion, and Under Armour who also appear in Fashion Revolution's Transparency Index.

[150] Oak Hall uses carbon-based dry cleaning which "is one of the most efficient and sustainable methods of dry-cleaning fabrics in mass production."

[151] See https://oakhalli.com/about/sustainability/.

- **UD stated in 2021 that "all regalia for associate, bachelor, and master candidates is keeper regalia and not available to rent";[152]despite scoring 1.25 points out of a total of 3.00 points for Sustainable Procurement, 2.87 points out of a total of 8.00 points for Waste Minimization and Diversion, 5.37 points out of a total of 10.00 points for Diversity & Affordability, and 0.00 points out of a total of 0.50 points for Exemplary Practice in the 2020 AASHE star report;[153]**
- **In addition to regalia, UD utilizes the global fashion supply chain and acts as a distribution agency for students, staff, faculty, and guests (like that of a retailer or brand that purchases merchandise from vendors/suppliers) for UD branded merchandise;**

Resolution:

- **UD, in partnership with the Office of Sustainability becomes transparent and publishes their vendor/supplier list (including the brands they license) on the Bookstore website;[154]**
- **Publishes their University Licensing approval standards and guidelines so buyers can examine how UD decides which vendors/suppliers to use**
- **The university adopts new sustainable wholesale vendors;**
- **Provides weblinks to available vendor's Corporate Responsibility Report (CSR) and/or Impact Report provide UD's community with convenient access to relevant data to allow for informed purchasing decisions, publishes any CSR or worker Codes of Conduct they receive from Barnes & Noble, if any;**
- **UD establishes a vendor code of conduct or equivalent policy, if there is none currently, that sets expectations about the social and environmental responsibility of the institution's business partners (i.e., product and service providers), such as labor and human rights standards that suppliers must meet**
- **UD immediately utilizes Oak Hall's commencement regalia rental option for all associate, bachelor, and master candidates, as it does with doctoral students**
- **The university allows for Oak Hall's Take Back Program or instead partner with outside recycling agents to minimize and divert waste**
- **Offers free or affordable commencement regalia, in addition to hardship support for student**

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[152] See https://www.udel.edu/students/commencement/graduates/academic-regalia/

[153]See https://reports.aashe.org/institutions/university-of-delaware-de/report/2020-01-31/OP/purchasing/OP-11/documentation/

[154] See https://udel.spirit.bncollege.com

- **All recommendations are implemented no later than 2030, which echoes the United Nation's call for Better Fashion through its Sustainable Development Goals (SDGs).**

Biodiversity

"We can allow satellites, planets, suns, universe, nay whole systems of universe, to be governed by laws, but the smallest of insect, we wish to be created at once by special act."

-Charles Darwin

Phase-out Artificial Sprays, Fertilizers, and "-*cides*"

Background:

- **Biodiversity" is defined by the U.S. Environmental Protection Agency (EPA) as the "variety of all forms of life" and is "essential to the existence and proper functioning of all ecosystems" (EPA);**
- **"'Cides" can be understood as including pesticides and functional equivalents, like insecticides, fungicides, adulticides, rodenticides, and herbicides;[155]**
- **The use of 'cides can cause considerable harm to biodiversity, especially in terms of threatening human access to "food, clean water, medicine, and shelter," in addition to the intrinsic value of non-human species, and pose the risk of generating resistance in pathogens, pests, and crops;[156]**
- **The proximity of UD's campuses to White Clay Creek, Christina River, and other major water bodies implicates UD's usage of a broad range of 'cides as a threat to local waterways and biodiversity, as well as terrestrial non-human species;[157]**

Fact Sheet Accompaniment

[155] Environmental Protection Agency (EPA). "EnviroAtlas Benefit Category: Biodiversity Conservation." *EPA* https://www.epa.gov/enviroatlas/enviroatlas-benefit-category-biodiversity-conservation accessed 19 October 2020.
[156] IPBES. 2019b. "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, pp. 62, 91-92.
[157] 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.

I. The World Wildlife Fund highlights 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," and biodiversity is needed because it "maintain[s] balance and support[s] life" (WWF).[158]

II. The use of 'cides can cause considerable harm to biodiversity, especially in terms of threatening human access to "food, clean water, medicine, and shelter," in addition to the intrinsic value of non-human species.[159] According to the U.S. Environmental Protection Agency (EPA), 'cides "pose serious threats to aquatic and terrestrial species."[160] The World Bank states that biodiversity is being "threatened by an unprecedented transformation and exploitation of terrestrial and marine ecosystems – driven mostly by human activities," with one-eight of the total animal and plant species risking extinction within the coming decades."[161]

III. The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) identifies pesticides and "agricultural insecticides" as being responsible reducing "macroinvertebrate richness in rivers by up to 40%," with "urban and agricultural herbicides" adversely affecting non-target species like algae.[162]

IV. 'Cides pose the risk of generating resistance in pathogens, pests, and crops that subsequently become "major threats to human wellbeing," and exacerbates "land and soil degradation," thereby adversely affecting species distribution and populations of "pollinators and other beneficial organisms."[163] Pesticides are specifically a "major threat to pollinator diversity," and this finding has been echoed by the Delaware government.[164] The Delaware government also found that "[a]ll fireflies are suspected of

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[158] World Wildlife Fund (WWF). "What is Biodiversity?" *WWF* https://www.worldwildlife.org/pages/what-is-biodiversity accessed 9 September 2020.
[159] See fn 155
[160] See fn 155.
[161] World Bank. 2020. "Biodiversity." *World Bank* https://www.worldbank.org/en/topic/biodiversity#1 accessed 19 October 2020.
[162] 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, p. 115.
[163] IPBES. 2019b. "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, pp. 62, 91-92.
[164] 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, p. 2; Delaware Government. 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, p. 93.

being sensitive to pesticide application, including those that occur in urban areas" and pesticides, fungicides, and insecticides present challenges for many species of greatest conservation need.[165] Honey bees and bumblebees are especially negatively affected.[166]

V. Herbicides can reduce, according to the government of Delaware, the "diversity of native plants in the vicinity" and "may lead to increased herbicide resistance of some plant species."[167]

VI. UD currently uses a broad range of 'cides, including *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).[168] Other artificial sprays include dormant oil (effectively insecticide), *Primo* (plant growth regulator), *Atrimmec* (plant growth regulator), and indicator dye (blue dye added to sprays).[169]

VII. Other academic institutions have successfully taken action to limit or altogether phase-out 'cides, including the University of California on all its campuses,[170] Sonoma State University,[171] all Hawaiian public schools,[172] all Connecticut municipal playgrounds and school properties,[173] and all New York State schools, day care centers, playgrounds, and athletic fields.[174]

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[165] Delaware Government. 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, p. 37.
[166] See fn 164.
[167] See fn 164.
[168] 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.
[169] See fn 168.
[170] Latham, Jonathan. 2019. "University of California Hals 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; 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.
[171] 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.
[172] Essoyan, Susan. 2019. "Herbicides Banned on Hawaii Public School Campuses, Superintendent Says." *West Hawaii Today* https://www.westhawaiitoday.com/2019/06/27/hawaii-news/herbicides-banned-on-hawaii-public-school-campuses-superintendent-says/ accessed 19 November 2020.
[173] 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.
[174] 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.

VIII. Based on the IPBES 2019 report, grassland on campus could be transformed into "species-rich meadows and other managed cultivated systems with biodiversity in mind," and this could be tied to a possible tree-planting program supported by UD and its students, faculty, and staff.[175] Such organically-managed land could enhance mental and physical well-being and help to demonstrate that UDis at the forefront of innovative sustainability action. Green Grants could act as a source of funding. Additionally, this legislation endorses the establishment of UD's Botanical Gardens Master Plan, which features nine projects.[176]

Resolution:

- **In line with comparator institutions, UD takes action to phase-out 'cides usage in all current and future groundskeeping procedures and design these procedures with biodiversity in mind**
- **Based on a 1999 Environmental Law Institute Report for Delaware,[177] UD could adopt the following additional solutions:**
  - **Clearly define biodiversity;**
  - **Develop a campus-wide biodiversity assessment and plan, including a list of established pests known to exist on campus;**
  - **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, including biodiversity conservation and restoration;**
  - **Promote infrastructure projects that encourage walking, cycling, and affordable and accessible eco-friendly public transport;**
  - **Involve students, faculty, staff, and local residents in policy planning and land-use development in advance of decision-making;**
  - **Tighten soil and water conservation plans to prevent soil erosion and degradation;**
  - **Improve UD's Sustainability webpage to make visible its commitment to conservation of wildlife and biodiversity, with updates regarding the university's ongoing efforts and goals;**

[175] See fn 162, p. 91.
[176] University of Delaware. "Charting the Path into the Future." *University of Delaware* https://canr.udel.edu/udbg/capital-campaign-news/ accessed 18 January 2021.
[177] 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, pp. 47, 73-74, 116-117, 130.

- **Seek donations to create a fellowship fund for graduate students at UD to ensure efforts pertaining to UD's sustainability efforts are continued into the future;**
- **Create new sustainability programs and enhance existing programs offered to students (undergraduate and graduate) to increase awareness of sustainability-related and biodiversity-related issues; and**
- **Create an anaerobic digester to generate compose as a natural fertilizer.**

Mitigation of Bird Strikes

Background:

- **The population of North American birds has declined by 71% since 1970[178]**
- **Birds serve multiple essential roles in a healthy ecosystem working as pollinators and promoting seed dispersal while keeping insect populations in check**
- **Window strikes are a leading cause of avian deaths being responsible for up to ~1 billion avian deaths annually (see Supplementary Information);[179,180]**
- **The University of Delaware (UD) owns and operates multiple low and medium-rise buildings with relatively high areas of glass including Canon Lab, STAR Campus, and ISE Lab, which are well documented to have an increased incidence of bird strikes[181]**
- **There is a statistically significant positive correlation between bird window strikes and window surface area, a lack of tall vegetation in building surroundings, and build year (more collisions associated with newer buildings) at UD (See Supplementary Information) including fatal strikes of imperiled species on campus**
- **The application of commercially available window films has demonstrated a 94-98% reduction in bird window strikes;[182,183]**

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[178] Rosenberg, K. V. et al. (2019). Decline of North American avifauna. Science. 366 (6461), 120-124. DOI: 10.1126/science.aaw1313

[179] Sovacool, B. K. (2013). The avian benefits of wind energy: A 2009 update. *Renewable Energy*. 49, 19–24. DOI: 10.1016/J.RENENE.2012.01.074

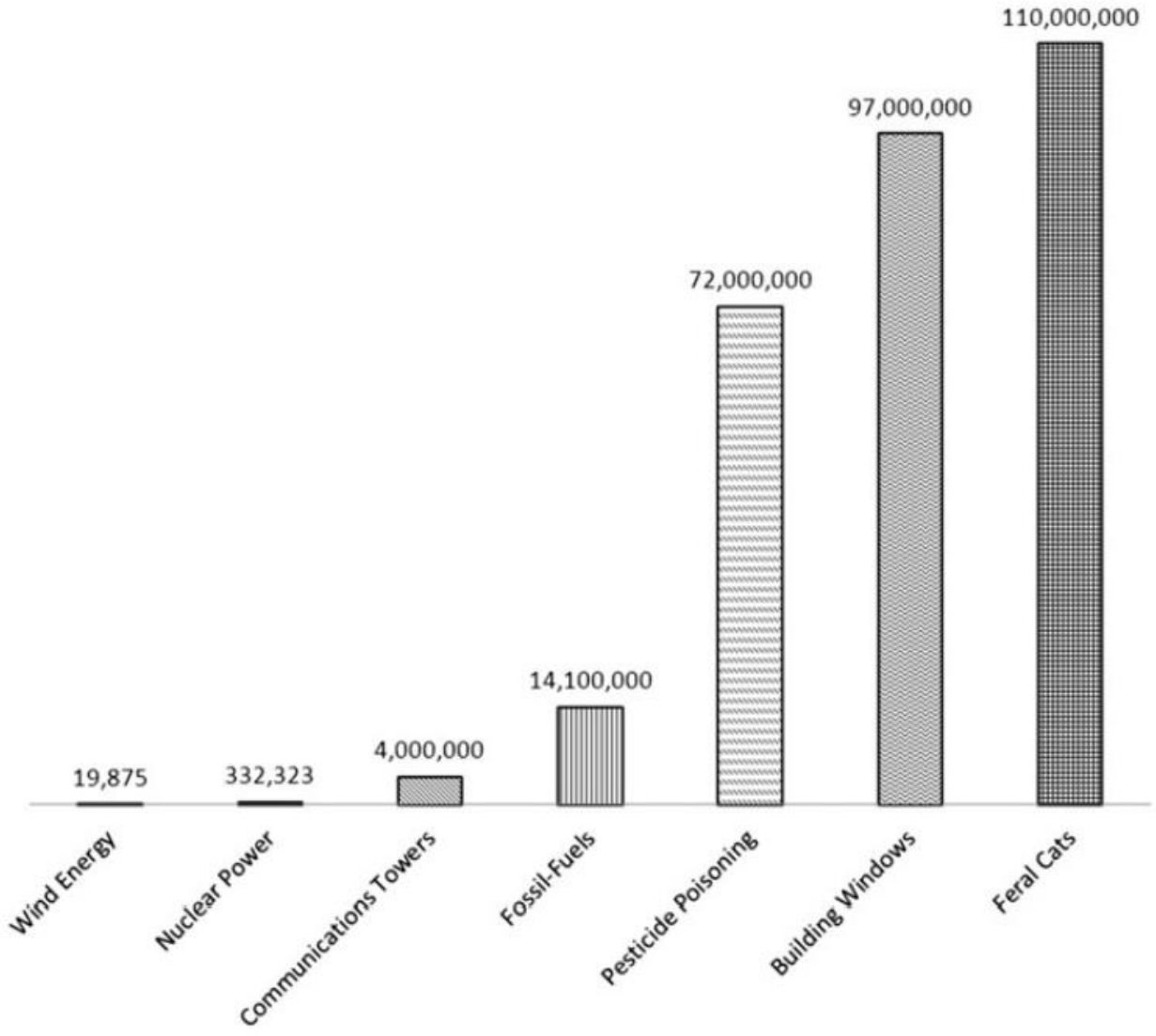
[180] Loss, S. R., Will, T., Loss, S. S., & Marra, P. P. (2014). Bird–building collisions in the United States: Estimates of annual mortality and species vulnerability. *The Condor*. 116 (1), 8–23. DOI: 10.1650/condor-13-090.1

[181] Ocampo-Peñuela, N., Winton, R., Wu, C., Zambello, E., Wittig, T., & Cagle, N. (2016). Patterns of bird-window collisions inform mitigation on a university campus. *PeerJ*. 4 (2). DOI: 10.7717/PEERJ.1652

[182] Helzer, D., Coolidge, M., & Ujcic-Ashcroft, J. (2020). Avian Collisions at the Columbia Building.

[183] Klem Jr., D. (2009). Preventing Bird—Window Collisions. *The Wilson Journal of Ornithology*. 121 (2), 314–321. DOI: 10.1676/08-118.1

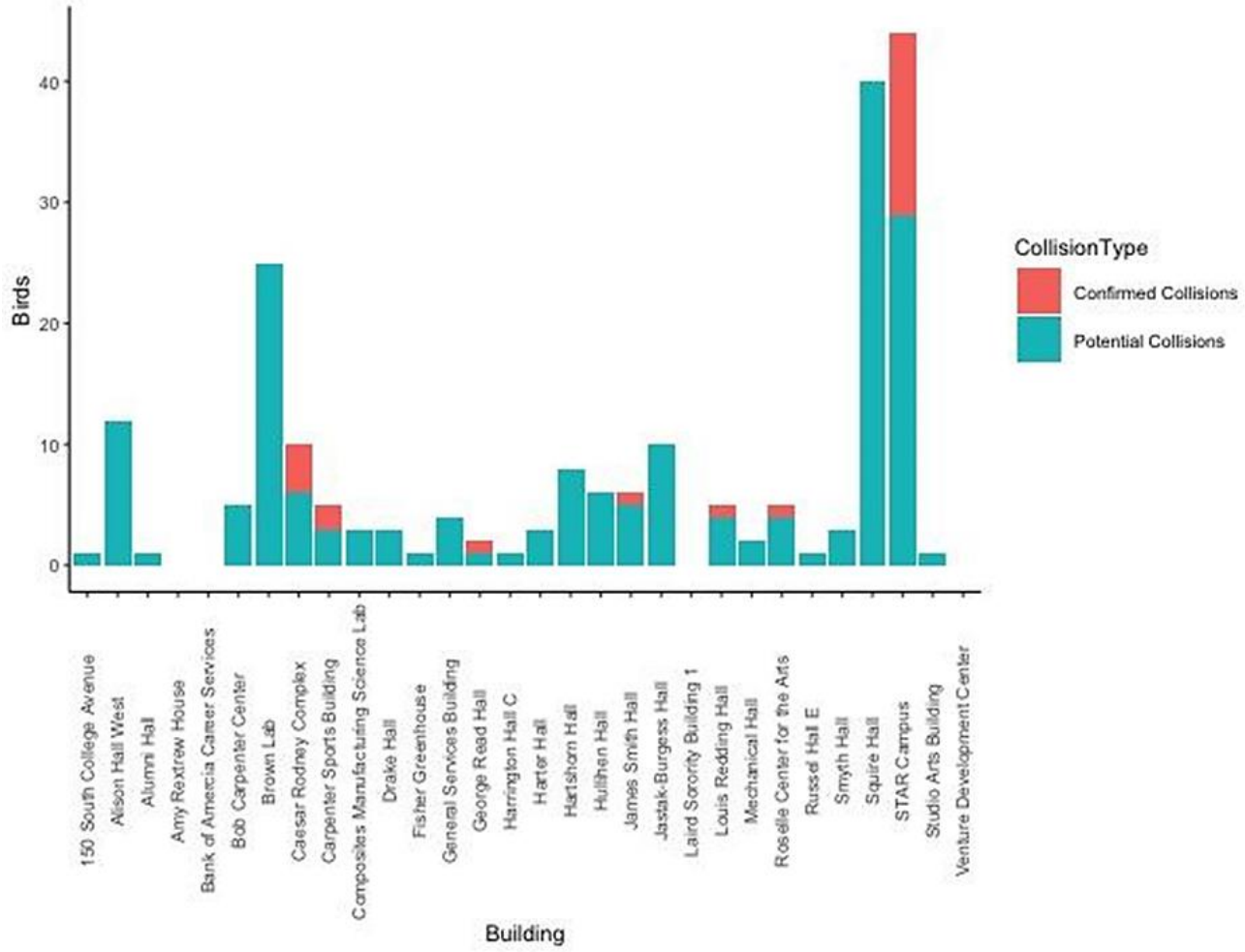
Figure 13. Causes of Aviation Mortality in the U.S.



*Numbers represent minimum estimates; the maximum estimate for annual bird mortality due to windows is 975.6 million.

Figure 14. Sample of bird species that likely suffered from window collisions with the University of Delaware buildings

Figure 15. Confirmed and potential aviation collisions with campus buildings (2022 survey)[184]



[184] Kirk, H. (2023). Evaluating potential risk factors in bird-window collisions at the University of Delaware. *In Preparation.*

Figure 16. Total collisions as a function of window surface area

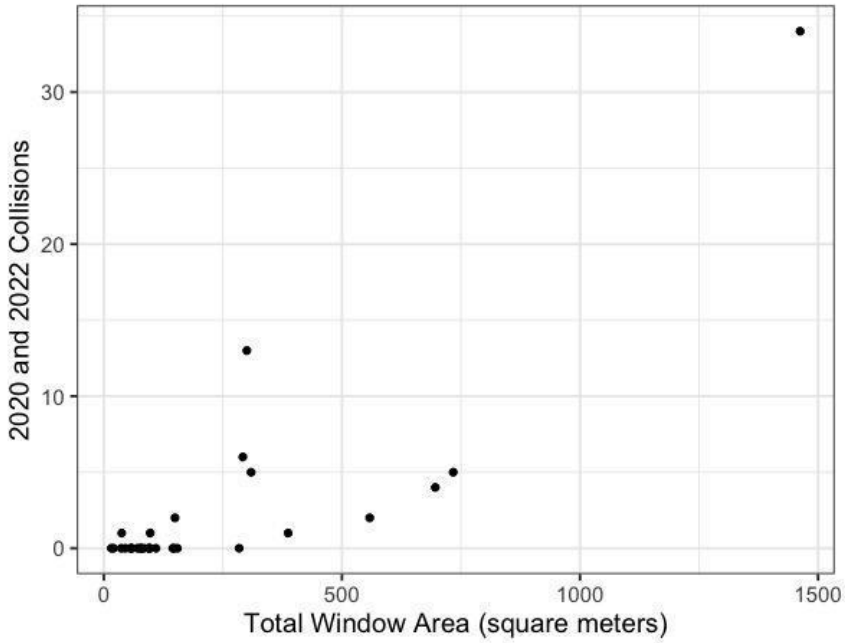


Figure 17. Total collisions as a function of building façade without tall vegetation

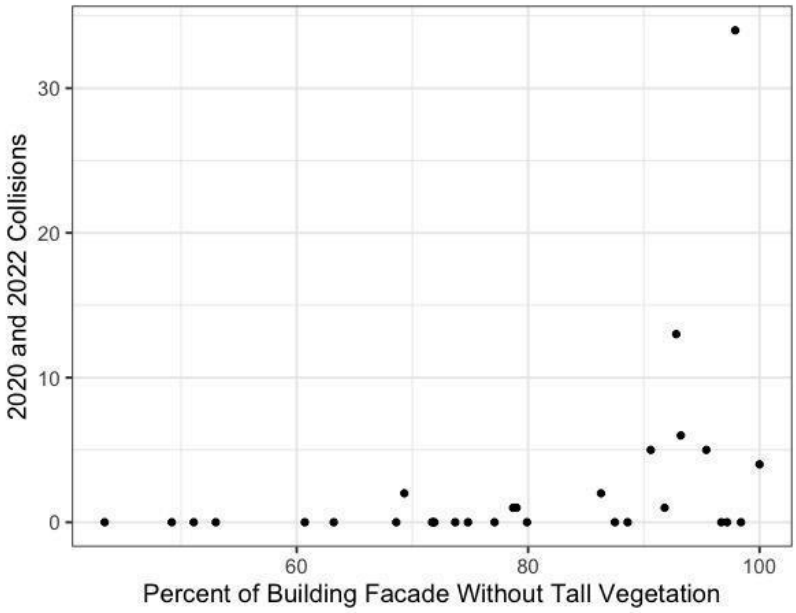


Figure 18. Total collisions as a function of build year

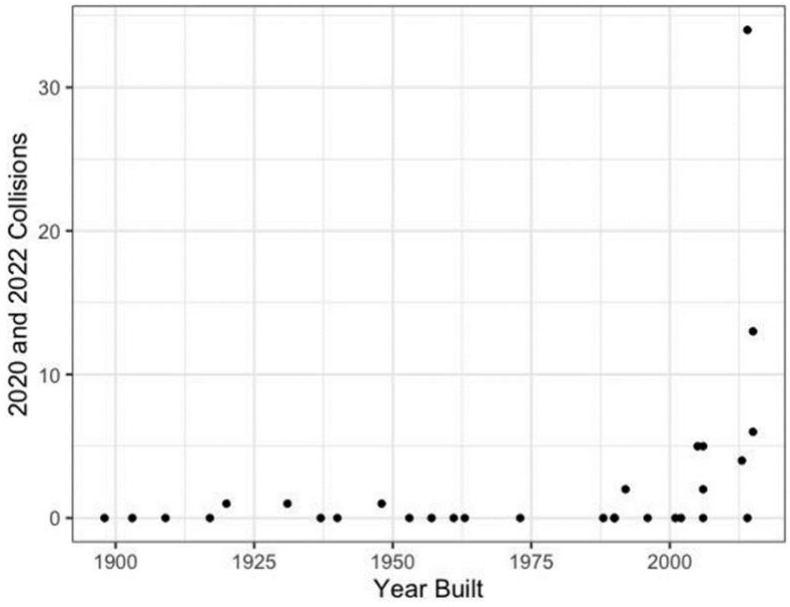


Figure 19. CollidEscape high performance bird tape applied to windows. Dot patterining (left). Stripe pattering (right).[185]

[185] CollidEscape. https://www.collidescape.org accessed 22 January 2022.

Table 11. Case study of outfitting Cannon Lab with CollidEscapes bird window strike prevention tape[185]

Coverage	2" Apart	3" Apart	4" Apart
All Windows	143 rolls - $2480.10	105 rolls – $1830.70	76 rolls - $1328.95
½ of Windows	72 rolls - $1261.15	53 rolls - $939.10	38 rolls - $675.35
¼ of Windows	36 rolls - $641.45	27 rolls - $486.10	19 rolls - $347.00

Resolution:

- **the UD Office of Sustainability shall coordinate the implementation of a solution to reduce bird window strikes on campus**
- **Bird window strike prevention tape or decals shall be applied to windows including, but not limited to those found on buildings at Canon Lab, STAR campus, and ISE Lab to reduce the incidence of bird strikes**
- **UD shall rely only upon motion sensing triggered lighting indoors throughout the night and shall only use continuous lighting outside of buildings at night to both reduce energy costs and reduce the incidence of bird strikes**
- **UD shall use any automated window shade systems already installed to close blinds from dusk to dawn to reduce the incidence of bird strikes**
- **UD shall plant tall native vegetation in building surroundings to slow avian flight speeds near buildings**
- **The proposed construction of new buildings at UD shall take bird window strike prevention into consideration to receive a high sustainability score from the UD Trustee Committee on Buildings and Grounds**

Native Plantings for Well Supported Ecosystems

Background:

- **The University of Delaware's Grounds Management focuses on planting non-invasive species, rather than striving for exclusively native species[186]**
- **Native plantings attract more insects, which in turn provide a food source for native bird species and support population growth[187]**
- **Birds are integral members of a healthy ecosystem, acting as pollinators and promoting seed dispersal**
- **Planting native species and reducing the amount of grass cover saves water which is ordinarily used for lawn maintenance and provides reductions in noise and carbon pollution**
- **UD received a score of 0.00/2.00 for Biodiversity when last evaluated for AASHE STARS, and marked the area as "Not Pursuing" in the self-reporting materials[188]**
- **Comparator Institutions such as the University of Maryland, College Park, which has a score of 2.00/2.00 for Biodiversity from AASHE STARS, have made concerted efforts towards biodiversity and the protection of local species[189]**
- **The New Castle County Department of Public Works already has an environmental initiative, GreenNCC, which supports sustainable practices, including the planting of native plant species, and increasing the percentage of native plant species on campus would align UD with this county-wide initiative, and would additionally bring UD into alignment with the state-wide goals of the Delaware Native Species Commission;[190]**
- **The Cooperative Extension of UD's Department of Agriculture and Natural Resources, a public partnership program, maintains a comprehensive list of trees and shrubs native to**

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[186] The Sustainability Council, "The University of Delaware Sustainability Plan," *The University of Delaware* (2022): 24.
[187] Marina Richie, "Why Native Plants Are Better for Birds and People," *National Audubon Society*, April 6, 2016, https://www.audubon.org/news/why-native-plants-are-better-birds-and-people; Stewart and White, "The use of non-native plants," 67; Desirée L. Narango, Douglas W. Tallamy, and Peter P. Marra, "Nonnative plants reduce population growth of an insectivorous bird," *PNAS: Proceedings of the National Academy of Sciences* 115, no. 45 (October 2018): 11549–11554. DOI: 10.1073/pnas.1809259115.
[188] The Association for the Advancement of Sustainability in Higher Education (AASHE), The Sustainability Tracking, Assessment & Rating System (STARS), "University of Delaware: OP-10: Biodiversity," https://reports.aashe.org/institutions/university-of-delaware-de/report/2020-01-31/OP/grounds/OP-10/
[189] AASHE STARS, https://reports.aashe.org/institutions/university-of-maryland-college-park-md/report/2022-02-27/OP/grounds/OP-10/
[190] https://dnrec.alpha.delaware.gov/delaware-native-species-commission/

Delaware, but UD does not fully utilize its own resources and guidance for campus' landscaping;[191]

Resolution:

- **The Office of Sustainability defines the planting of native plant species and the protection of regional birds as core elements of its objectives regarding landscaping;[192]**
- **UD shall revise its current policy of planting non-invasive species, and instead more holistically integrate native flora into its landscaping across its campuses, with the goal of having 90% of new plantings consist of native plants by 2030;[193]**
- **UD's Office of Sustainability partner with Grounds, the College of Agriculture and Natural Resources, and the UD Botanic Gardens to plan the redevelopment of green spaces and cultivate seedlings for planting**
- **UD set aside currently undeveloped land on the STAR Campus and replace existing areas of turf on each of its campuses with native species that support local birds and other fauna. Crucially, these areas should be removed from nearby structures, especially low- to medium-rise buildings with high areas of glass, to minimize the risk of bird strike deaths.[194]**

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[191] "Native Plants for Delaware Landscapes," College of Agriculture and Natural Resources, University of Delaware, https://www.udel.edu/academics/colleges/canr/cooperative-extension/fact-sheets/native-plants-for-delaware-landscapes/

[192] Beth Miller, "Ready to Roll: New leaders of UD's Office of Sustainability gearing up to tackle urgent agenda." *UDaily*, April 8, 2023, https://www.udel.edu/udaily/2023/april/sustainability-earth-environment-climate-jeffrey-summerhays-chris-williams/. The Office of Sustainability lays out nine essential areas of focus.

[193] This goal reflects the aspirations set forth by the Sustainability Council in their 2022 report while acknowledging that existing trees and shrubs on campus should remain in place. Stewart and White note that non-native species offer valuable nesting habitat for birds, as well as protection from various predators. The Sustainability Council, "The University of Delaware Sustainability Plan," 25; Stewart and White, "The use of non-native plants," 67.

[194] Natalia Ocampo-Peñuela, et al. "Patterns of bird-window collisions inform mitigation on a university campus," PeerJ 4, no. 2 (2016). DOI: 10.7717/peerj.1652.

Installation and Maintenance of Green Roofs

Background:

- **Green roofs are effective in removing particulate matter improving air quality, they absorb and purify stormwater while also mitigating excessive runoff by retaining up to 90% of the water that falls on them[195,196]**
- **A shallow extensive green roof is capable of maintaining the roof's surface at ambient temperature while traditional roofs frequently reach 90°F above ambient temperature, this heat mediation lessens the burden of cooling and can reduce energy demand during summer months by over 75% resulting in reduced carbon emissions;**
- **When provided with a view of a green roof, students show improved attention, productivity, retention of information, and improved response rates, direct physical access to green roof spaces is correlated with stress reduction, and increased creativity;[197,198]**
- **By protecting the roof from high temperatures, UV damage, and harsh weather green roofs last twice as long as traditional rooftops benefits resulting in a national average payback period of just 6.2 years;[199,200]**
- **UD received a 4.18/6 for building energy consumption, and a 0/2 for biodiversity, these underperforming categories could gain credits with the addition of green roofs to new and existing building; [201]**
- **Green roofs require minimal maintenance, weeding once in spring and again in autumn improves their appearance and fertilizing biannually improves the green roofs health; [202]**

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[195] Dowdey, S. (2023, September 8). What is a green roof?. HowStuffWorks Science. https://science.howstuffworks.com/environmental/green-science/green-rooftop.htm }

[196] Davis, C. (2015, July 13). 4 reasons green roofs do a building good. Sustainability. https://sustainability.ncsu.edu/blog/changeyourstate/4-reasons-green-roofs-do-a-building-good/

[197] American Psychological Association. (n.d.). Nurtured by nature. Monitor on Psychology. 5

[198] Perspectives on understanding and measuring the social, cultural and ... National Environmental Science Programme. (2020, September). https://nespurban.edu.au/wp-content/uploads/2020/09/Perspectives-on-understanding-and-measuring-the-social-cultural-and-biodiversity-benefits-of-urban-greening_Sept-1.pdf

[199] The Association for the Advancement of Sustainability in Higher Education (AASHE); The Sustainability Tracking & Rating System (STARS)

[200] *Green roofs. General Services Administration. (2011, May.).* https://www.gsa.gov/governmentwide-initiatives/federal-highperformance-green-buildings/resource-library/integrative-strategies/green-roofs

[201] Sustainability Tracking, Assessment & Rating System (STARS). "University of Delaware." *Association for the Advancement of Sustainability in Higher Education (AASHE)*

[202] *Sempergreen. (n.d.).* https://www.sempergreen.com/en/solutions/green-roofs/maintaining

Resolution:

- **The university pledges to retrofit 50% of capable buildings with extensive green roofs by 2030 and 100% retrofitted by 2050.**
- **The Office of Sustainability will oversee the installation and maintenance of extensive or intensive green roofs on all new buildings starting in 2025**

Outlook

Sustainability is the key to ensuring the quality of life for future generations and provides an incredible opportunity for unification around collective environmental challenges. The University of Delaware finds itself positioned to be a leader in sustainability through the holistic development and implementation of sustainable practices in the environment, economic, and social aspects of the UD campus.

Significant strides were made with the establishment the UD Office Of Sustainability; however, there is much left to be accomplished. Prioritizing the outlined resolutions across the broad topics of Energy, Transportation, Food, Waste, and Biodiversity provides direction for this newly established office to efficiently serve the community with high impact.

The recommendations presented in this document demonstrate the magnitude of the diverse solutions required to address the ever-pressing environmental issues we face. We hope the readers are inspired by the wealth of opportunities for improvement and utilize them to bring sustainability to the forefront of the University of Delaware's legacy.