SUSTAINABLE BOWDOIN 2042:
Path to a Fossil-Fuel-Free Campus

Bowdoin

EXECUTIVE SUMMARY

Bowdoin College is launching Sustainable Bowdoin 2042, a landmark campus clean energy plan investing more than $100 million to achieve net-zero carbon emissions by the year 2042 through a comprehensive commitment to a campus that runs entirely on carbon-free clean energy, from electricity to transportation to heating and cooling. Lead by the College's Sustainability Implementation Committee and with substantial input from students faculty and staff, it sets an ambitious twenty-year path to end our dependence on fossil fuels, not by relying on purchased carbon offsets but through bold leadership and enterprising investments.

Sustainable Bowdoin 2042 cements Bowdoin as a national leader in campus sustainability, taking on the toughest challenges of reaching net-zero in one of the coldest states with some of America's oldest campus buildings. We have never shied away from tough choices on sustainability and environmental stewardship on campus, in our coastal research facilities, in our classrooms, and in the community.

Now, our path to net-zero must go even further on our electricity use, our building heat, and other sources of carbon pollution embedded in our daily campus life. Here's how we'll do it:

- **Clean Electricity**: The College already produces solar power matching 88 percent of our electricity needs and recently executed contracts to source 100 percent of current electrical usage from new solar photovoltaic (PV) projects located in Maine.
- **Clean Heat**: Our natural gas-fired central heating plant and stand-alone heating systems on the perimeter of campus are currently responsible for roughly 75 percent of the College's annual carbon emissions. We're launching a long-term initiative to transition our buildings to a more efficient hot water system. At the same time, we will invest in making our historic buildings as energy efficient as possible, while dramatically shrinking the carbon footprint of any new buildings through pioneering building practices such as passive house design and mass timber construction.
- **All Other Sources**: We'll take a comprehensive approach to making our entire campus net-zero, expanding ongoing efforts to reduce waste, improve commuting options, and making environmentally responsible procurement choices.

This work will be complex and sometimes disruptive, and it will require significant financial resources—but the physical work reminds us of our unshakable commitment to the common good and that we are part of the solution that aims to subtanstanially reduce the global use of fossil fuels in order to limit global warming.

"This plan is about securing the future for our students, and for the world beyond our campus, through living our commitment to sustainability and in the education we provide."
— President Clayton Rose, Bowdoin College

We've carefully analyzed what could replace our gas-fired central heating plant. With technology rapidly improving, it's simply too soon to say. We think it would be a mistake to go all-in now with a technology that could be outdated by the time we're ready to break ground. Therefore, we'll split this work into two phases:

- *Phase 1 (2022–2037)* will completely rebuild the infrastructure that connects most of our buildings to the heating plant. The new system will deliver low-temperature hot water to campus, requiring about 30 percent less energy than distributed steam to keep the campus warm. We'll upgrade the insulation, windows, doors, and mechanical systems of more than fifty buildings over the same timeframe to ensure the low-temperature hot water can sufficiently reach and maintain the campus set point of 68 degrees Fahrenheit.
- *Phase 2 (2038–2042)* will replace the College's natural-gas-fired heating plant with an alternative energy station. Ground-source and air-source heat pumps powered by zero-carbon electricity are the leading candidates today, but we will follow the development of climate technologies closely as we focus on the hard work of Phase 1.

As a leading liberal arts institution, Bowdoin recognizes that its biggest opportunity to make a difference is in preparing students for one of the most pressing issues of their lifetimes. Sustainable Bowdoin 2042 outlines steps the College can take to enhance the myriad academic opportunities both in and out of the classroom and to help facilitate multidisciplinary collaborations that can both cut climate pollution and adapt to changes already underway. Bowdoin students gain real-world experience in mitigation and resilience-planning through internships, work study jobs, and student-led clubs on campus.

This transition will represent an enormous and unparalleled opportunity for Bowdoin students to do hands-on work learning about renewable energy, energy efficiency, and sustainability, to be a part of the generation that will help solve our biggest global challenge. Sustainable Bowdoin 2042 is rooted in a dedicationto the common good and a recognition that climate change does not affect everyone equally. Climate change disproportionately impacts public health and financial security within historically marginalized communities both in the US and around the world.

Reaching these goals will be an unprecedented and complex challenge, but they are attainable and, when complete, will represent a monumental achievement in Bowdoin College's history. We are all-in, committed, passionate, and excited about how this work will demonstrate the Bowdoin community's commitment to leading global change.

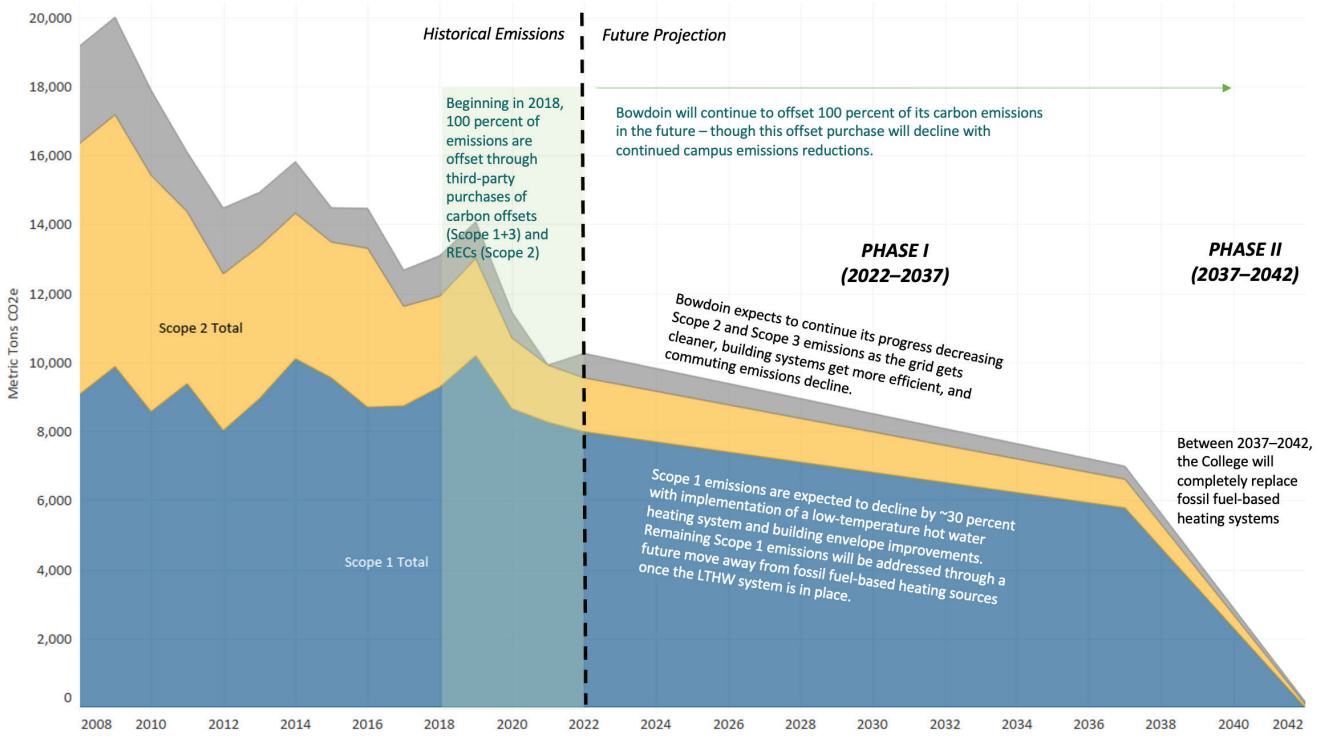
INTRODUCTION

Maine is experiencing hotter summers, more intense rain events, and winters with rain and fluctuating temperatures that make afternoon skates on the Quad increasingly less common. With indicators like an increase in tick-borne illnesses and the warming and acidification of the Gulf of Maine, the state is indeed experiencing the impacts of climate change, but we know that impacts are also being felt around the globe. The US alone has experienced raging wildfires in the West, more forceful hurricanes along the East Coast, and severe droughts in the Southwest.

Bowdoin's climate commitment is rooted in a commitment to the common good and a recognition that climate change does not affect everyone equally. Climate change disproportionately impacts public health and financial security within communities of color and low-income communities both in the US and around the world. As world leaders proclaimed during the most recent United Nations climate conference, the only way to meet the goal of limiting the planet's warming to 1.5 degrees Celsius, or 2.7 degrees Fahrenheit, by 2100, is if we all increase the pace and scale of the work to which we are committed.

Figure 1 below provides a snapshot of the College's historical emissions trends and progress to date, while also providing a look at anticipated future trends as Bowdoin increases the pace and scale of work to be done over the next two decades to bring campus emissions to zero.

Figure 1. Bowdoin College's Emissions History and Future Trends

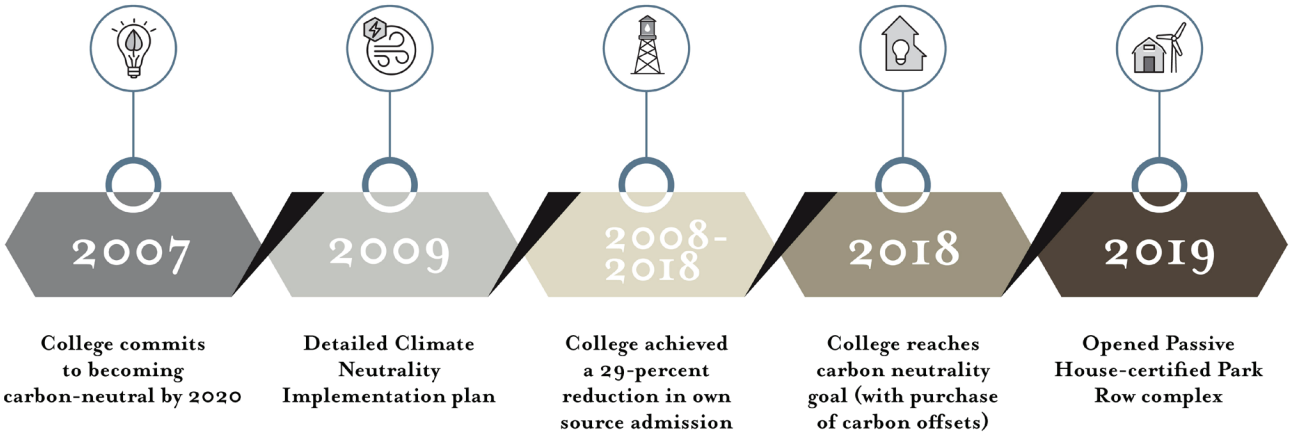


Bowdoin's 2042 Plan builds on a long history of greenhouse gas reduction initiatives. In 2007, Bowdoin College committed to become carbon-neutral by the year 2020. Bowdoin released a detailed Climate Neutrality Implementation Plan ("2009 Plan") to achieve that goal in the fall of 2009.[1] Bowdoin's first climate action plan was impressive in the breadth of projects it proposed, and it helped the College achieve a 29 percent reduction in own-source emissions within ten years (2008–2018) and declare carbon neutrality two years ahead of schedule with the purchase of carbon offsets and renewable energy credits.

The 2009 Plan focused primarily on an ambitious goal of reducing own-source emissions by at least 28 percent over the twelve years between 2008 and 2020, with the understanding that the College would need to purchase carbon offsets to achieve the goal of carbon neutrality. Own-source emissions were defined as emissions associated with the combustion of fuels on campus and in campus-owned vehicles and fugitive refrigerants (Scope 1), as well as the purchase of electricity (Scope 2).

Over the past fifteen years, the College has tracked and reported annually on its greenhouse gas (GHG) emissions relative to a fiscal year (FY) 2008 baseline. The College also established a Sustainability Implementation Committee, made up of a range of campus stakeholders, tasked with the oversight and implementation of this plan. Bowdoin has revisited the 2009 Plan about every two years to measure the effectiveness of strategies, evaluate the financial feasibility of specific projects, and incorporate new technological advances. The 2009 Plan and each update can be reviewed at https://www.bowdoin.edu/sustainability.

Figure 2. Bowdoin College's Emissions History



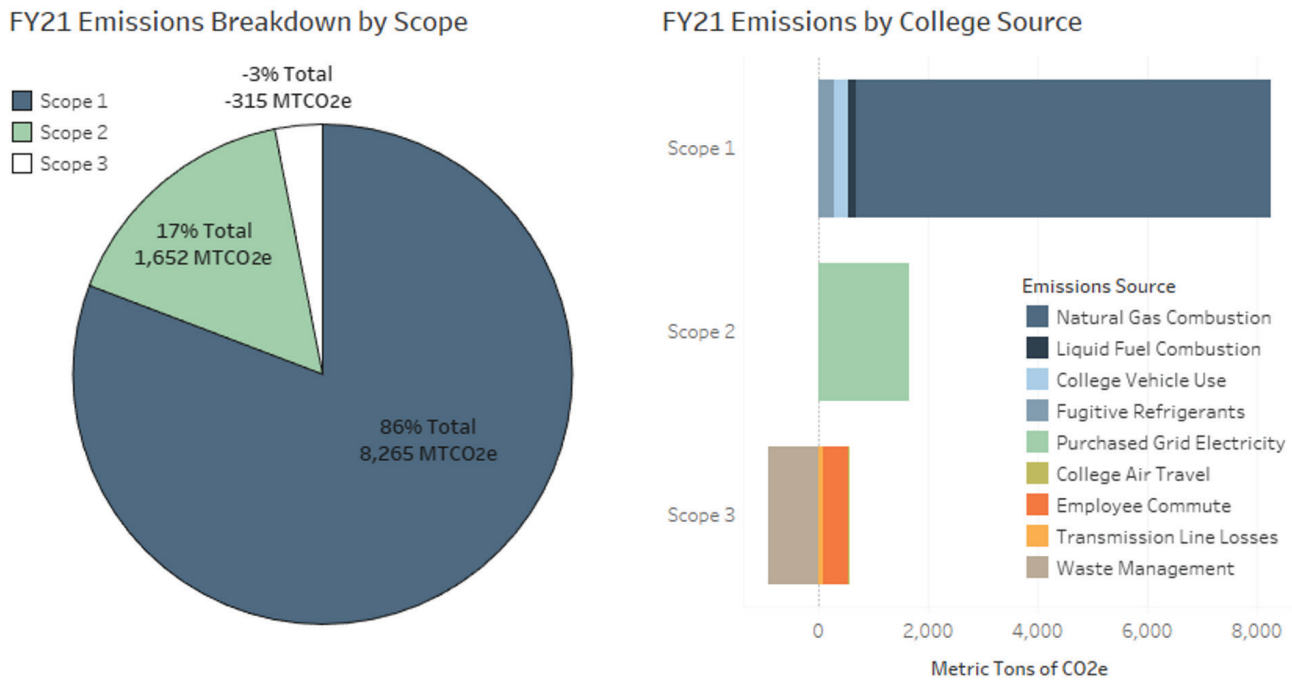
1 This initiative was formally launched in 2007, when President Barry Mills signed the American College and University Presidents' Climate Commitment.

In April 2018, Bowdoin announced a very significant milestone: the College had achieved carbon neutrality two years ahead of the 2020 goal. **Emissions had been slashed from more than 19,000 metric tons in the FY 2008 baseline to about 13,000 metric tons by FY 2018.** To account for the remaining emissions in FY 2018 and in each subsequent year, Bowdoin makes annual investments in carbon offsets with regional impacts, and in renewable electricity. These tools help the College maintain a net-zero carbon footprint as it continues to actively pursue ways to further reduce its greenhouse gas emissions. When Bowdoin achieved carbon neutrality in 2018 the College promised it wouldn't stop there—the ultimate goal is to eliminate the use of fossil fuels and advance a resilient campus that models climate solutions that create educational opportunities for our students throughout the process. The remainder of this report details where we are now and the exciting path ahead.

CURRENT GREENHOUSE GAS ACCOUNTING AND TRENDS IN TOTAL EMISSIONS

Bowdoin College completes an annual accounting of greenhouse gas emissions associated with all aspects of the College's operations at the end of each fiscal year. Emissions totals are reported in metric tons of carbon dioxide equivalents (MTCO2e) and then categorized according to the scope of emissions and specific activities occurring on campus that emit or remove greenhouse gases. Bowdoin reports emissions in MTCO2e because it enables the College to use a single accounting value that recognizes the varying warming impacts of different greenhouse gas chemicals by measuring the amount of CO2 emissions equal to the quantity of each greenhouse gas produced. Bowdoin tracks emissions by scope and specific activity type to monitor progress and identify the more challenging areas for reducing the College's overall emissions total.

Figure 2. Bowdoin College's Total Reported FY 2021 Emissions by Scope and Activity Type



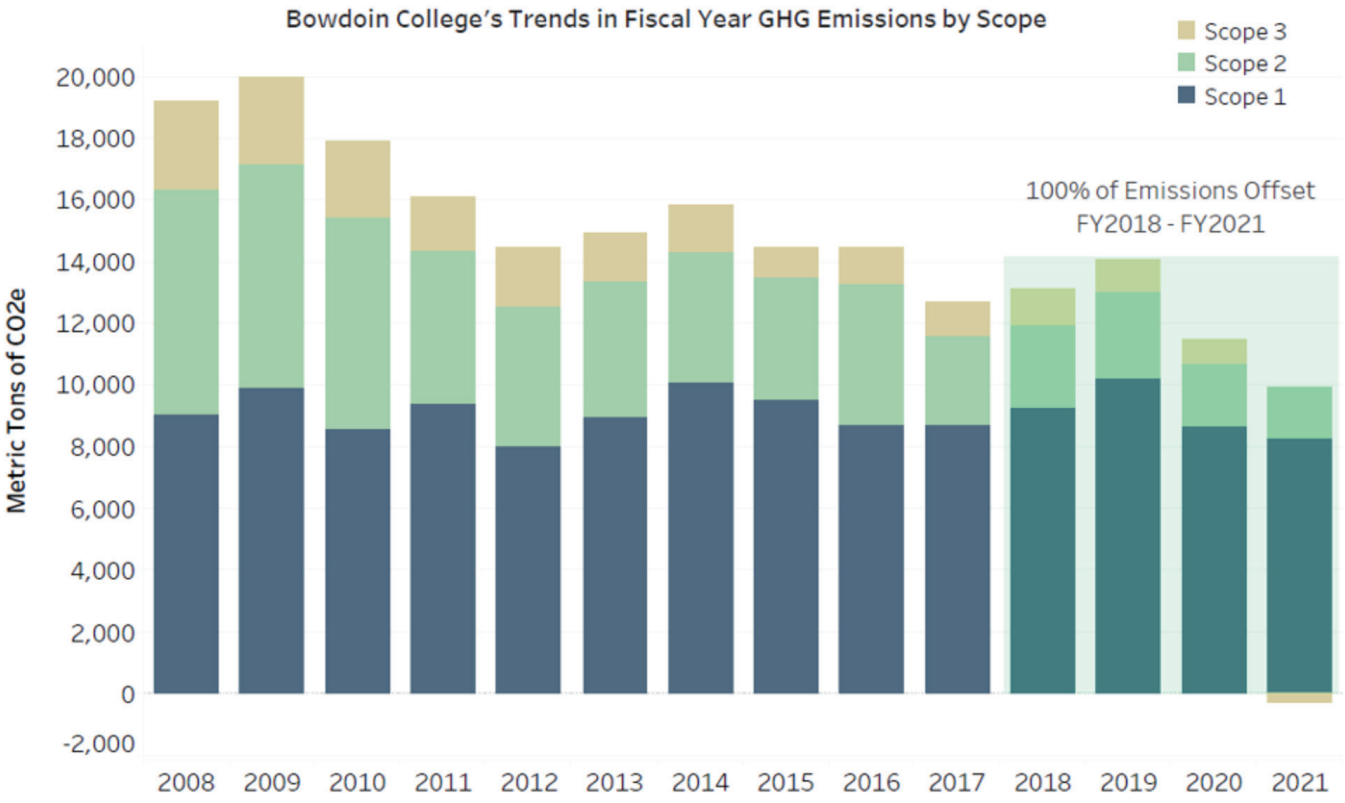
As described in Figure 3 above, Bowdoin College emitted 9,602 MTCO2e total in FY 2021. Scope 1 emissions result from activities directly owned or controlled by the College and thus include emissions associated with boiler combustion, company vehicle use, and fugitive refrigerants. Emissions from natural gas equated to 8,265 MTCO2e, a drop of 9 percent from Bowdoin's FY 2008 reporting baseline.

Scope 2 categorizes emissions from fuels or electricity purchased off-site and accounts specifically for the College's purchase of electricity from the power grid. Emissions for Scope 2 equaled 1,652 MTCO2e, a decline of 77 percent from Bowdoin's FY 2008 reporting baseline. Although the College reports Scope 2 emissions using location-based methods that account for the emissions resulting from all grid electricity purchases, it should be noted that Bowdoin has purchased Green-e certified renewable energy credits to fully offset its total 2021 reported Scope 2 emissions.

Lastly, Scope 3 emissions result from activities not directly owned or controlled by Bowdoin and thus include emissions resulting from air travel, employee commuting, transmission line losses, and waste management practices. Scope 3 emissions totaled -315 MTCO2e, a 111 percent drop from Bowdoin's FY 2008 reporting baseline, driven by lower air travel and commuting during the COVID-19 pandemic, a trend that will reverse as the pandemic concludes.

Figure 4 below summarizes Bowdoin College's total emissions by scope across all available reporting years. Bowdoin has reduced its total emissions by 49 percent, from 19,153 MTCO2e in 2008 to 9,841 MTCO2e in 2021. Scope 2 emissions have dropped significantly over time because of the phase-out of coal and oil in exchange for a higher percentage of natural gas and renewables in the New England power supply mix. In contrast, reducing the College's overall Scope 1 emissions from natural gas combustion to meet campus heating demands has proved to be challenging. Scope 3 emissions have trended downward over time and reached a record low in 2021. This decline occurred with reduced air travel and employee commute mileage during the COVID-19 pandemic. Future Scope 3 emissions will likely return closer to 2020 levels if the College's total travel mileage returns to pre-pandemic levels.

Figure 4. Trends in Bowdoin College's Total Greenhouse Gas Emissions by Fiscal Year



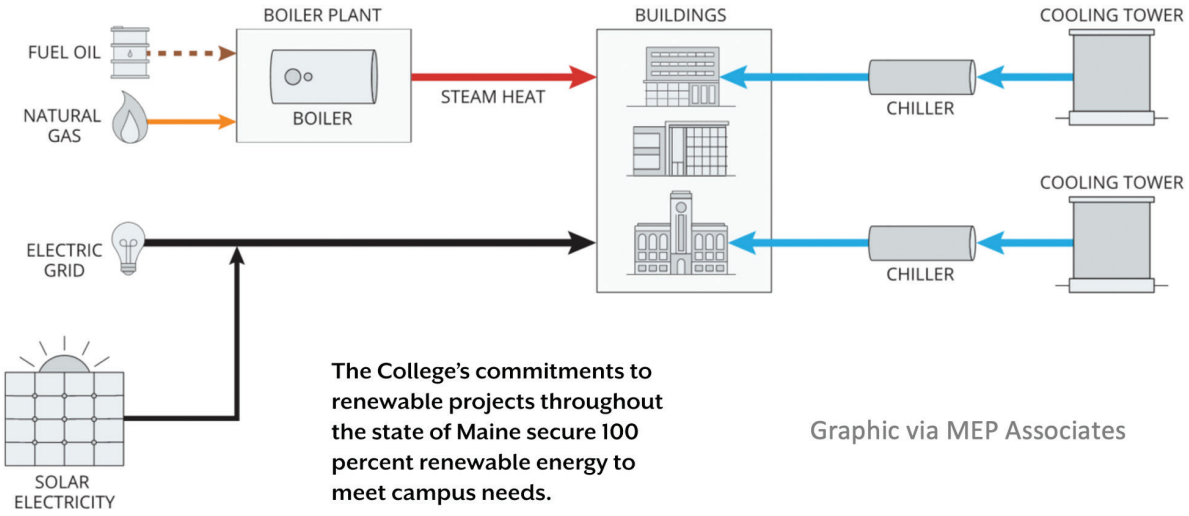
SECTION 1.0
A ROADMAP TO FOSSIL-FREE DISTRICT HEATING

SCOPE 1, PHASE 1: FISCAL YEARS 2022–2037

Given the rapid greening of the New England grid and the College's significant progress toward meeting its current electricity needs through entirely Maine-based renewable sources, the primary focus of the 2042 Plan will be addressing the College's Scope 1 emissions. These are emissions generated through the combustion of fuels on campus and in campus-owned vehicles and infrastructure. Given Maine's cold climate, the vast majority of Bowdoin's Scope 1 emissions are the result of meeting campus heating requirements. Since the conversion of campus heating systems from reliance on fuel oil to cleaner burning natural gas, historical Scope 1 emissions have not changed significantly beyond annual fluctuations in weather.

The College currently relies primarily on the combustion of natural gas to heat the campus, and most of the College's gas is consumed at the central heating plant, where steam is generated and distributed to heat approximately 65 percent of campus square footage. Bowdoin's current energy system is represented through the diagram in Figure 4 below.

Figure 5. Existing Campus Energy System



The College's commitments to renewable projects throughout the state of Maine secure 100 percent renewable energy to meet campus needs.

Graphic via MEP Associates

District Heating through Low-Temperature Hot Water

To transition the campus to a decarbonized form of heating will require replacing the existing district heating steam infrastructure with a low-temperature hot water (LTHW) system. Rather than relying on steam and high-temperature hot water (~180°F+) to meet heating requirements, which generally requires fuel combustion, LTHW (~130°F) can be generated through a variety of low- or zero-carbon sources, such as heat pumps, waste heat, solar

thermal, or some yet-to-be-developed advanced systems. Transitioning to LTHW also reduces efficiency losses throughout the district heating system when compared with steam, meaning that the College will be able to reduce the amount of energy required to heat campus.

The College plans to phase in this transition to LTHW over the next fifteen years by identifying sub-districts on campus and replacing steam infrastructure with new LTHW distribution piping and updating and/or replacing building-level heating systems. This endeavor will require surveying the heating systems in all fifty-two buildings currently utilizing district steam (plus additional stand-alone buildings that may be added) to assess their condition, identify options for renovation work, and determine building infrastructure requirements to support this conversion. The scope of work will vary by building; some buildings will require extensive renovation work, especially those using direct steam heating, while others will only need minor upgrades. This will be a time-consuming effort due to the number of buildings and complexity of the heating systems. Simultaneously, the College will implement efficiency improvements to building envelopes to ensure buildings can comfortably meet heating and future cooling needs through a LTHW system. Some examples include exterior recladding, interior insulation retrofits, and triple-glaze window upgrades, among other strategies, which will lead to a significant reduction of air leakage, heating and cooling energy savings, and improved occupant thermal comfort. Similar to the heating system scope of work, the strategies applied will vary by building and will be determined through a comprehensive assessment and investigative tests, as well as the historical significance of building exteriors. The envelope renovations will increase building energy performance, will facilitate the transition to a low temperature hot water heating system, and will leverage the existing steam system and heating plant assets as the College works to phase out fossil fuels.

The resulting work plan developed from the building assessments will require significant capital investment and time to implement. Essentially, each building connected to the district heating system will at one point or another be an active construction site. As building upgrades are completed, options for generating low-temperature hot water will be assessed to determine the most suitable alternative. It is likely that growing interest in this type of work will lead to technology breakthroughs and the development of new systems, providing other options beyond the current generation of ground-source and air-source heat pumps.

Based on an energy study performed in 2020, it is estimated that with the transition away from a steam heating system to a LTHW system (with accompanying building efficiency upgrades), Bowdoin could greatly reduce the amount of fuel it takes to heat campus. This means that even before replacing natural gas as the primary heating fuel, the College could substantially reduce its reliance on natural gas and reduce total Scope 1 emissions, which have remained

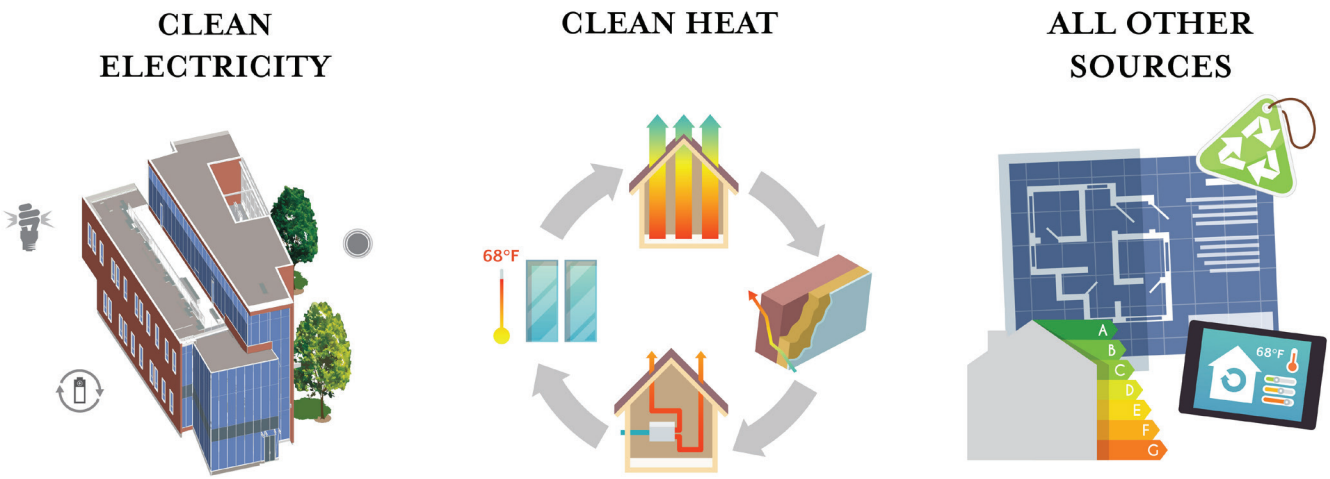
basically unchanged since 2008, by 30 percent.

Carbon Offsets

While transitioning campus heating systems to LTHW and moving toward electrification strategies, the College plans to remain carbon neutral through the purchase of voluntary, supplemental carbon offsets. The College began purchasing offsets to match its total Scope 1 and Scope 3 emissions when Bowdoin declared carbon neutrality in 2018. Carbon offset purchases fund carbon reduction projects that are tracked, verified, and certified, either through policy compliance markets (such as the Regional Greenhouse Gas Initiative, or "RGGI") or voluntary markets established through national registries and reporting standards. These projects can range from landfill methane gas capture to reforestation projects. The College is exploring opportunities to acquire forested land or to partner with Maine's woodlot owners to maximize local carbon sink benefits, which coincides with a major goal outlined in the State of Maine's 2020 climate action plan. As the College improves efficiency and reduces the need for fossil fuel combustion, it will continue to reduce the number of offsets needed each year until fossil fuel use on campus can be eliminated.

In purchasing offsets, the College requires that every offset be certified, verifiable, and comply with evolving greenhouse gas reporting guidance. Bowdoin's Sustainability Implementation Committee prioritizes additionality and proximity to the College when assessing project options, though it must weigh the price of these offsets against alternative projects that such a purchase may otherwise fund on campus. While carbon offsets can be a critical tool to make sure the College maintains net carbon neutrality as it transitions fully away from fossil fuels, Bowdoin will remain flexible to ensure that every dollar spent is having the greatest long-term impact on the College's emissions.

Figure 6. Path to a NetZero Future



SCOPE 1, PHASE 2: FISCAL YEARS 2038–2042

As the campus transitions to an LTHW system, the College plans to continue to utilize the central heating plant, converting steam to low-temperature hot water for distribution. Once buildings and district infrastructure are fully converted by the end of fiscal year 2037, the College will assess options to generate LTHW from low- and zero-carbon sources.

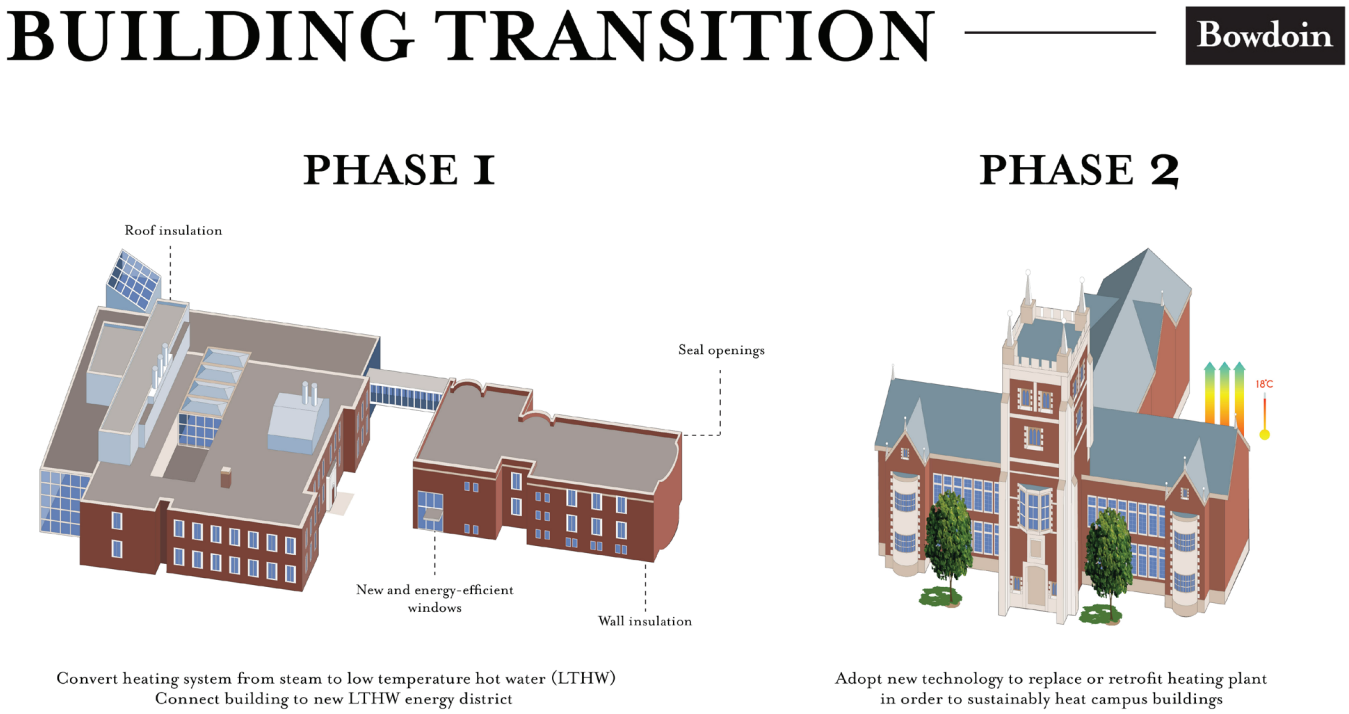
The College worked with an engineering firm (MEP Associates) in late 2019 and throughout 2020 to examine and assess less carbon-intensive alternatives to heat campus over the next twenty years. While several possible options were considered, including biomass and biofuels, the energy study ultimately recommended a conversion of the campus heating system to a geothermal system that could rely on electricity to move and heat air and/or water through ground-source heat pumps. In fact, the MEP study identified the geothermal exchange system as the only solution currently available with an appropriate scalability for a project of this size, considering the geographic location, environmental objectives, and physical campus constraints. This system uses electricity to pump water through underground wells, where the water is warmed by temperatures below ground before being distributed throughout campus. This system has the dual benefit of also providing district cooling to campus, by pumping higher-temperature water out of buildings and back into the ground during the hot summer months. This not only maintains critical balance in the geothermal system, but also expands campus cooling, which will be increasingly necessary as Bowdoin adapts to a changing climate. This electrification strategy has appeal, as it allows the College to take advantage of existing technologies and the increasingly renewable electricity grid, and to avoid any localized emissions associated with the combustion of a carbon-based fuel.

The design calls for an array of 651 closed-loop geothermal heat exchangers drilled 800 feet deep across 6.5 acres of land that is within close proximity to the center of campus. The Pickard Athletic Fields at the south end of campus were identified as the only location that met all of the requirements. More details on this geo-exchange system may be found in the MEP Study.

A geothermal energy system has been a common centerpiece of climate action plans released by many colleges and universities in recent years. For those, like Bowdoin, who are concerned by the sustainability case for biomass, biofuel, and other solutions that require combustion at some point in the sourcing process, geothermal is the best of very limited options available right now. The underlying assumption of the 2042 Plan is that the College is better served by first preparing its buildings and district system to take advantage of either new or existing technologies through a more efficient, low-temperature hot water network. By holding off on implementing a geothermal solution today, the College will be well prepared

to take advantage of innovative solutions coming to market over the next decade. There is a possibility that geothermal systems remain the optimal solution for Bowdoin in fifteen years, and we will proceed aggressively with installation if that proves to be true. If nothing else, geothermal technology will have almost certainly evolved to a point where costs are reduced and efficiencies in the design, equipment, and installation process are realized.

Figure 7. Building Transition



Building Design Standards

The heating systems and envelopes of the buildings connected to the central steam plant will be a major focus over the next fifteen years, but the remaining existing campus buildings will also need attention in order to bring the entire campus into the decarbonization effort. Whenever renovation work is happening in an existing building, the goal of becoming a fossil-fuel-free campus needs to be included as part of the decision-making process. In 2009, Bowdoin published the College's first "Building Design Standards for Renovation Projects" to provide architects and contractors with a framework for helping us reach our goal of building efficient and environmentally friendly buildings. The 2009 Plan set a target that would gradually increase efficiency requirements in new buildings so that all new construction would be 48 percent more efficient than the 2008 building stock by 2020. In the fall of 2019, Bowdoin opened its most ambitious energy efficient construction project with the opening of the nearly

48,000-square-foot Passive House-certified Park Row apartment complex, which is more than 50 percent more efficient than Bowdoin's 2008 building stock. Two additional Passive House-designed construction projects have been built since the fall of 2019, resulting in a total of 112,000 square feet of super-high-efficiency building space. A goal for the 2042 Plan is to update the College's Building Design Standards using the lessons learned from the Passive House projects, as well as eight buildings certified by the US Green Building Council. The design standards will be updated to reflect our goal of decarbonizing the campus and will include some newer concepts not considered in the previous standards, such as lowering the embodied carbon of building materials and utilizing proxy carbon pricing strategies for planning purposes.

The embodied carbon of building materials considers the greenhouse gas impact of a building material's entire life cycle. It can include extraction, processing, and transportation of the material as well as future disposal. As new buildings become more efficient and require less energy to run (like Bowdoin's Passive House projects), the embodied energy of the construction materials become a larger portion of the buildings' total carbon footprint. The architects for Bowdoin's newest building project, Barry Mills Hall and the John and Lile Gibbons Center for Arctic Studies, did an embodied carbon analysis of utilizing a mass timber frame structure versus a steel structure and found that the mass timber frame alternative reduced the embodied carbon of the structure by 75 percent relative to a traditional steel frame. These buildings are the first pure mass timber commercial buildings to be constructed in Maine. The building sector is recognizing the importance of addressing embodied carbon of building materials, and resources such as life cycle analysis tools and environmental product declarations are now available to calculate the embodied energy of products like insulation, floor slabs, and framing materials and will be incorporated into the updated design standards.

A proxy carbon price, also called a shadow carbon price, sets a price on carbon that can inform future risks associated with carbon-intensive fuel costs under a potentially regulated carbon market. When comparing multiple options, the proxy carbon price can inform design decisions that favor lower carbon building operations—a practice that will be incorporated into the updated design standards. This practice was piloted as part of the life-cycle cost analysis for the heating systems of Mills Hall and the Center for Arctic Studies. Comparing a traditional system connected to the central steam plant versus an electric boiler combined with a heat recovery chiller, the long-term energy savings combined with the modeled carbon price savings brought the investment for fully electrified buildings down to a five-year payback.

Integrating resiliency planning into the goals of future building projects can ensure we are thinking forward and addressing issues that a changing climate is anticipated to bring. Considering issues like storm water management, drought-tolerant plantings, the need for standby power, and occupant comfort during cooling season are all items that should be addressed in future building projects as part of a larger campus resiliency plan.

Finally, it is important to note that, unlike the 2009 Plan, the 2042 Plan is intentionally noncommittal with regard to achieving LEED designations on new buildings and renovations going forward, or any specific certification from a recognized agency. Such certifications are often more useful in the marketing of accomplishments than in adding value to the sustainability of a building design. The College has demonstrated its commitment to the pursuit of designs that are industry leading in environmental attributes, and it will remain so, without paying fees to third parties to assert that this is the case.

SCOPE 1 RECAP – KEY OBJECTIVES

Phase 1 (2022–2037)

Achieve a 30 percent reduction of Scope 1 emissions by achieving the following objectives:

- Measure and inventory the airtightness of all campus buildings connected to the heating plant that are more than ten years removed from construction or comprehensive renovation by performing blower door tests and/or other diagnostics.
- Use results from the building assessments to tighten building envelopes of any buildings identified as insufficient through added insulation, window and door replacements, sealing of gaps and cracks, etc.
- Replace or retrofit HVAC systems to match the performance of the improved building envelope to ensure an optimum level of health and thermal comfort for building occupants.
- Systematically replace distributed steam lines with distributed low-temperature hot water piping to all buildings connected to the central heating plant.
- Continue to offset Scope 1 emissions through the annual purchase of carbon offsets.
- Evaluate new offset strategies, such as the sequestration of carbon via active management of the forested areas owned by the College or in partnership with other large landowners in Maine or beyond.
- Update campus building design guidelines that commit to no new fossil-fuel-reliant infrastructure.
- Adopt a carbon proxy price when evaluating financial payback periods for new building designs.

Phase 2 (2038–2042)

- Eliminate Scope 1 emissions by 2042 without the purchase of carbon offsets for Scope 1 emissions.
- Decommission or retrofit the existing heating plant in favor of a new energy station powered by 100 percent renewable energy to eliminate all Scope 1 emissions.
- Adopt optimal next-generation technologies to support clean power generation for campus.
- Co-locate a generator with the new energy station that is sufficiently sized to power the entire campus in the event of power outages, thus eliminating the reliance on stand-alone generators to power selected buildings.

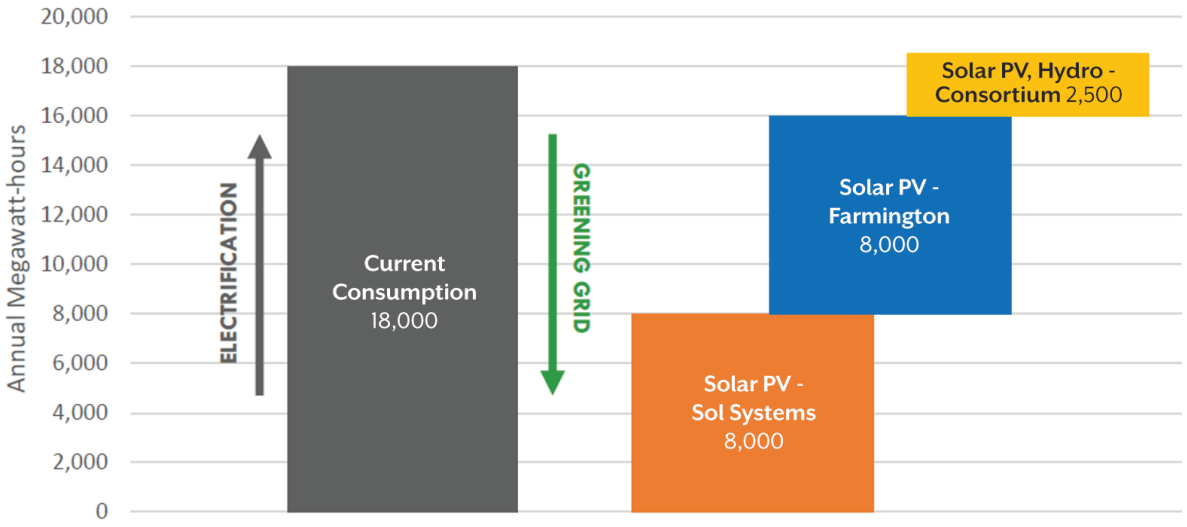
SECTION 2.0
GREENING OF BOWDOIN'S ELECTRICITY CONSUMPTION AND THE MAINE GRID

Scope 2 Electricity Emissions

The College has taken action in recent years to procure local renewable energy to reduce the College's Scope 2 GHG emissions. Through the College's participation in a virtual power purchase agreement with a large-scale solar project in Farmington, ME, development of an on-campus solar array with partner Sol Systems, and participation in a consortium to purchase small shares of multiple solar and run-of-river hydroelectric projects across Maine, the College has secured long-term purchase agreements for renewable energy equivalent to more than 100 percent of the College's current electricity emissions when these projects are completed[2]. See Figure 7.

2 More details about these actions can be found in Bowdoin's Plan for 100 Percent Maine-Based Renewable Electricity: https://www.bowdoin.edu/sustainability/energy-solutions/index.html

Figure 7: Maine Solar PV Procurements



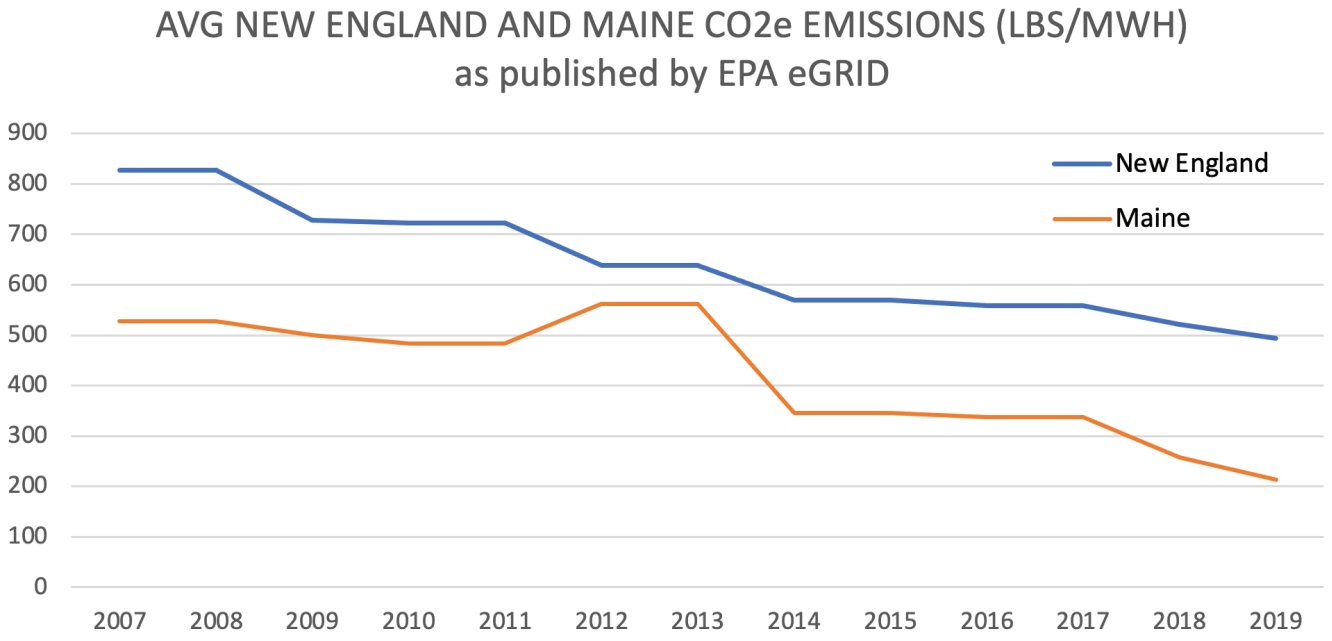
Project	Location	Est. Online Date	Annual Est. Gen. Purchased (MWh)	Bowdoin REC Ownership	% of Current Electricity
Tesla	Campus	Online 2014	1,300	NO	0%
Nextera	Farmington	Sep–21	8,000	YES	44.4%
Sol Systems	Campus	Dec–21	8,000	YES	44.4%
Maine Solar Consortium	Maine	2021–2022	2,500	YES	13.9%
TOTAL					**103%**

The Renewable Energy Credits (RECs) generated by these Maine-based projects have significant monetary value in state and regional compliance markets. The College may use these Maine Solar RECs to offset emissions produced by the generation of electricity delivered to Bowdoin's campus from the grid, and thereby replace national Green-E RECs that Bowdoin has been purchasing to maintain carbon neutrality. Alternatively, the College may choose to monetize some or all of these high-value Maine Solar RECs and invest 100 percent of the proceeds in on-site carbon mitigation projects. To the extent that the College can identify on-site carbon mitigation projects that have a lower overall cost of avoided CO_2e, compared to retiring the Maine Solar RECs directly, the College may be able to accelerate its progress toward reducing Scope 1 emissions.

Just as the College has made strides to procure and promote local renewable energy, so too has the state of Maine, as well as the greater New England region. A rapid fall in the cost of solar and wind energy technologies combined with state renewable energy mandates across the region substantially reduced electric emissions rates in the 2010s. Per EPA reporting, electricity produced in Maine in 2019 had an emissions content of 214 lbs CO_2e /MWh, down from 509

lbs CO2e /MWh in 2009.[3] Similarly, the entire New England region has experienced a decline in emissions per MWh over the last decade. These trends are represented in Figure 6 below.

Figure 8. CO2e Emissions per MWh in New England and Maine[4]



Through legislation called Renewable Portfolio Standards (RPS), states in New England and around the country have set mandates for a percentage of electricity supplied to customers in the state to come from renewable sources. These mandates escalate over time, driving toward grids that are at least 80 percent renewable by the 2030s, in some cases. In 2019, Maine

passed an amendment to its RPS to increase the total amount of renewable energy consumed in Maine from 40 percent in 2019 to 80 percent by 2030, to accelerate the state's transition to renewable energy and support Maine's goals to achieve state carbon neutrality by 2045. Maine is not alone in implementing aggressive renewable energy targets; five of the six New England states have targeted over 50 percent renewable energy by 2030, ensuring a transition away from fossil-fuel electricity generation across the New England grid.

Bowdoin is a beneficiary of these aggressive state and regional policies, which will drive continued declines in Scope 2 electricity-related emissions.

With higher percentages of renewables in the electricity supplied from the grid, the College's additional voluntary actions to procure local renewable energy will result in an excess of

3 Emissions factors are calculated and reported through the EPA eGrid tool: https://www.epa.gov/egrid

4 EPA egrid only available through 2019–2020. New data expected in February 2022.

renewable energy compared to current campus electricity requirements. As the College looks to 2030 and beyond, the greening of the grid and the long-term solar PV contracts allow the College to shift its focus to reducing other sources of emissions, including the potential conversion of Scope 1 emissions to Scope 2 through electrification.

SECTION 3.0
EMISSIONS FROM TRANSPORTATION AND WASTE

Scope 3 emissions result from activities not directly owned or controlled by Bowdoin and thus include emissions resulting from air travel, employee commuting, transmission line losses, and waste management practices. For the sake of combining all transportation into one section, we have also included college vehicle use here, which is technically part of Bowdoin's Scope 1 emissions.

Transportation emissions from FY 2021 make up a very small percentage of Bowdoin's greenhouse gas emissions, with college vehicle use at 2 percent, employee commute at 4 percent, and college air travel at less than 1 percent. While 2021 was not a typical year due to the pandemic, even in a more typical fiscal year like 2019, transportation generated a small portion of overall emissions, with employee commute comprising 9 percent, air travel 5 percent, and college vehicle use 3 percent. Despite being a small contributor to overall campus emissions, transportation will be important for the College to address as it looks to eliminate fossil fuels. Bowdoin's approach to transportation will be two-fold, focusing on reduction of miles traveled, when possible, and electrification of vehicles currently powered by renewable energy.

Campus-Owned Vehicles and Equipment

Bowdoin's fleet is almost entirely gasoline-engine vehicles, with a small number of hybrid sedans and one plug-in hybrid electric sedan. As the College looks ahead to the next ten years, it predicts that the growth of the electric vehicle market and the likely economies of scale associated with mass production will allow for a dramatic transformation of our fleet toward all electric vehicles. The fleet will be entirely replaced with hybrid or 100 percent electric vehicles by 2027.

In addition to considering electric fleet vehicles, Bowdoin's geographically compact campus has allowed Bowdoin's security department to invest in security officers patrolling the campus on bicycles, a practice the College could expand to other departments. The College has made an investment in encouraging a bicycle- and pedestrian-friendly campus by moving the majority of student vehicle parking away from the center of campus and providing secure

bicycle parking next to all Bowdoin's buildings. Piloting a rental fleet of bicycles to departments located on the edges of campus will allow interested employees to efficiently attend meetings or visit job sites without the need of an automobile.

The Bowdoin grounds department, which maintains the 205-acre campus landscape, has begun to transition from gas-powered to electric-powered maintenance equipment. Starting with electric trimmers, an electric snow blower, and an electric utility vehicle, the department is committed to transitioning to all electric mowers over the next eight years as equipment is replaced, and to electric leaf blowers as soon as products have the capacity to perform the heavy work a 205-acre campus requires without frequent recharging.

Employee Commute

Employee commute, which is part of Bowdoin's Scope 3 emissions, requires a bigger-picture approach because of the large number of employees and the varied directions and distances that employees travel. The College has historically promoted programs such as the GO MAINE Commuter Challenge that encourages employees who live near campus to walk or bike and those who live further away to carpool and utilize public transit. The College plans to continue to encourage employees to use these alternative modes of transportation.

Bowdoin supports a Metro Breez bus stop on campus that services Brunswick, Freeport, Yarmouth, and Portland, and plans to use this opportunity to encourage managers to work with employees to balance work shifts around the bus schedule. The College has been supporting employees' transition to electric vehicles by providing EV charging stations on campus. There are currently six charging ports available to the college community and, using data from the ChargePoint dashboard and an employee commuting survey that is performed every three years, Bowdoin will continue to assess the use and need for additional stations as the EV market share increases. Over the coming decade, the College expects that a number of employees will transition to electric vehicles along with the broader market. This transition will drive continued reductions in emissions related to commuting.

While the above efforts are encouraging on their own, the pandemic also brought to light the ability of many employees to effectively work from home. The College is currently exploring the future of hybrid and remote work options that may have a long-term impact on reducing emissions associated with the commutes of Bowdoin employees.

Student Travel

Bowdoin is a compact campus, which makes walking and bicycling the most convenient modes of travel within the community. With over 90 percent of Bowdoin students living on

campus, and with the availability of a grocery store, restaurants, and shops on Brunswick's Maine Street less than a mile away, there is infrequent need for automobiles once students arrive on campus. At Maine Street Station, less than a half mile from the center of campus, students can access Concord Coach Lines, the Amtrak Downeaster, the Metro Breez, and the Brunswick Explorer. These services connect students to Boston and Bangor with numerous stops in between. Students have expressed interest in electric transportation opportunities within Brunswick and Topsham, such as an improved shuttle system or electric trolley that travels down Maine Street and out toward the Topsham Fair Mall. Students have also expressed interest in a Bowdoin RideShare App that can assist students in finding rides for trips off campus and in getting to and from home during academic breaks. The College plans to continue to facilitate and advocate for these student-led initiatives to improve low- and zero-carbon transportation options.

Air Travel

The pandemic has caused many conferences, presentations, and meetings to transition to online formats like GoToWebinar and Zoom, resulting in a dramatic decline of faculty and staff air travel. While it is assumed that, over time, some of these events will transition back to in-person gatherings, the College will encourage opportunities to utilize online video formats for certain activities where in-person interaction is not necessary, allowing for an overall decline in academic and business air travel.

The College will also explore how to attach the purchase of carbon offsets to the price of a college-sponsored airline ticket, transferring the cost to the department booking the flight, rather than the current method of offsetting all air travel as part of a onetime annual campus carbon offset purchase conducted by the sustainability office. Assigning the carbon offset price to the individual ticket purchase is an opportunity for education and conversation about the impact of air travel, while applying an economic incentive to limit air travel when possible.

Waste Reduction and Disposal

Bowdoin's GHG emissions from waste management are a small portion of Bowdoin's total emissions profile, generating a negative number in recent years. Bowdoin's high relative rate of composted and recycled waste has driven this number negative as recycled materials help reduce lifecycle carbon costs associated with the extraction and processing of new materials. Further non-recycled waste on campus is sent to a waste-to-energy facility that displaces generation from other power plants (that primarily burn natural gas), which results in a lower emissions factor than a standard landfill.

While the impact of campus waste is minimal on overall greenhouse gas accounting, any actions that reduce waste and increase reuse, recycling, and composting will continue to remain a campus priority. Recent successful examples include the establishment of Bowdoin's Office Supply Reuse Shop, the College's Give and Go Move Out effort, and the Freecycle program. Freecycle redistributes popular dorm room and school supplies from Move Out to new students the following fall, with priority given to students receiving financial aid or students who travel to campus by train, bus, or taxi.

As the College continues to develop ways to reduce all categories of waste, suggestions from focus groups have centered on the creation of a permanent donation center/free store on campus to encourage upcycling and redistribution of goods; increase campus compost opportunities, including at medium to large events; and encourage more e-books and online resources.

SECTION 4.0
EDUCATING THE NEXT GENERATION OF LEADERS – CLIMATE CHANGE IN THE CURRICULUM

The academic program represents the core mission of the College. For that reason, the College curriculum and support for research and programming are essential components of Bowdoin's 2042 Climate Action Plan. Educating the next generation of leaders about climate change is fundamental to the College's purpose—and a liberal arts education is uniquely suited to the challenges of understanding climate change and addressing sustainability.

The insights of multiple disciplines and the talents of passionate scholars mobilizing different forms of knowledge are necessary to meet the climate challenge. Addressing climate and sustainability requires rigorous scientific research. But as we see, even innovative and meticulous science is insufficient to tackle the challenges that require collective action toward a common purpose. Instead, climate challenges engage all aspects of human understanding.

- We need **literature and the visual arts** to stimulate our curiosity and compassion to convey the beauty and the fragility of the natural world and to help us imagine alternative futures.
- We need to learn from **history**—from the migration of peoples long ago and from more recent struggles—in order to deepen our understanding of this moment.
- We need **ethics** and the humility to examine our ideas of what constitutes **justice** as we make hard choices.
- We need to engage **diverse communities**, reaching beyond those who share our experiences

or our opinions.

- We need the **linguistic skills and cultural sensitivity** to collaborate with and learn from others.
- We need **policy options and legal opinions, persuasive arguments, mathematical models and economic analysis coupled to the science and ethics** to better understand the merits
  of alternative paths.

Many Bowdoin faculty, staff, and students are already deeply engaged in climate and sustainability work. Beyond the contributions of individual departments and programs to our broader conversation about climate change, the Climate Action Plan can further strengthen innovations in teaching at the College. To grapple with possible trade-offs in any action to address climate change and to best identify co-benefits in how we enhance sustainability, interdisciplinary and collaborative learning across traditional divides is needed.

Whether in the form of new courses, new topics on syllabi, or learning outside the classroom, there are numerous opportunities for:

- Place-based and community-based learning among coastal communities and those in Maine's natural resource economies on the frontline of a changing climate;
- Integrated learning that encourages multidisciplinary approaches;
- New approaches to data collection and digital analysis, to allow us to better visualize the ecological, economic, and social impacts;
- Broader training in ethics, regardless of discipline.

With intentional facilitation of synergistic cross-campus actions, the College's academic mission can be integrated with its effort to address climate change over the next ten years. More specifically, there are many exciting ways that individual faculty, academic departments and offices across campus can collaborate to achieve the following goals:

Academic Goals:

1. **Raise visibility of our existing climate and sustainability curriculum, scholarship, events and action on campus.**
2. **Facilitate curriculum development on climate and sustainability topics.**
3. **Facilitate interdisciplinary research and outreach on climate and sustainability issues.**
4. **Facilitate data availability in digestible form.**

Ensuring overall cohesion and vitality of the academic plan.
The Academic Component of the Climate Action Plan has been shared with the Office of the Dean of Academic Affairs, and work has already begun toward the academic goals. One means by which to continue the momentum and facilitate cross-campus action with cohesion and synergy would be to create a new position of faculty sustainability fellow to work with the Office of Sustainability. Alternative approaches to coordinating sustainability education across campus and creating academic opportunities to engage with campus sustainability actions can be found at some of our peer institutions.[5]

Figure 9. Academic focus

> **Classroom learning opportunities on sustainability across all study areas**
> **New curriculum on climate and sustainability**
> **Research**
> **Collect and share data**

5 Amherst College is creating a new Center for Sustainability with a full-time director assisted by a full-time staff member. Dickinson has a Center for Sustainability Education (https://www.dickinson.edu/info/20052/sustainability/2278/center_for_sustainability_education) with a director, assistant director, learning coordinator, and administrative assistant. At Smith this work is done by the Center for the Environment, Ecological Design, and Sustainability (https://www.smith.edu/about-smith/sustainable-smith/ceeds). The center has a faculty director, an administrative director, an assistant director, a curriculum and research coordinator, and an administrative assistant.