



Sustainability Report 2019-2020



WPI

Draft Final Report
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Executive Summary

Sustainability is commonly defined as the ability to meet the needs of the current generation without jeopardizing the ability for future generations to meet their own needs. It has become a primary focus at WPI over the past 20 years, particularly with the development of WPI's Sustainability Plan and formation of the Sustainability Advisory Committee.

WPI's academic programs employ a unique project based learning model that emphasizes a combination of theory and practice for the betterment of society. This emphasis supports a focus on sustainability, which is incorporated in many courses and projects. In addition to their coursework, students address sustainability in Great Problem Seminars (GPS), Interactive Qualifying Projects (IQPs), and Major Qualifying Projects (MQPs). They can also participate in the Annual Sustainability Project Competition. Several seminars are also held throughout the year. A portion of courses, projects, and seminars are highlighted to show off the dedication and wide range of student topics.

Many faculty members conduct research throughout the year, and often focus on sustainability. These research projects are funded either via grant or an established project center. The efforts of six faculty members are depicted, as well as four books published this year.

WPI monitors a number of operational performance measures: water, electricity, emissions, natural gas, waste and recycling, transportation, and dining. Annual values for each of these topics is shown to have a sustainable trend, with water, electricity, and natural gas consumption values decreasing and emissions increasing. The Great Revolving Fund, new Sustainability Plan, and construction efforts are also examined.

Community engagement is an important part of WPI life, particularly regarding various clubs and organizations. Clubs such as the Greenhouse and Horticulture Club focus on the environmental side of sustainability, while ones such as Habitat for Humanity take a more social justice-oriented approach. Others, such as the Green Team, focus on both. WPI also participated in Recyclemania, placing in five different categories. Members of the community were also asked to complete the Literacy Assessment Survey on sustainability, revealing an increase in sustainable knowledge and conscientiousness.

While this report cannot highlight every sustainable action that has happened this year, it provides a glimpse into what has been accomplished and what to look forward to.

What is Sustainability?

Sustainability is commonly defined as the ability to meet the needs of the current generation without jeopardizing the ability of future generations to meet their own needs. While this has historically focused on environmental protection and resource conservation, it is recognized that efforts towards a sustainable lifestyle include three aspects: environmental impact, economic security, and social justice.



At WPI

Sustainability has been part of WPI's plan for decades, and has become a primary focus over the past twenty years. The focus was elevated when former President Dennis Berkey created the President's Task Force on Sustainability, an organization to focus on incorporating a Sustainability Plan into the everyday function and decisions of WPI. This group has since been renamed the Sustainability Advisory Committee whose purpose is to evaluate the performance against the Sustainability Plan.

The original Sustainability Report- completed as a student Interactive Qualifying Project (IQP) in 2010- detailed the sustainability of WPI. The report is now published annually, chronicling new projects, research, events, activities, and operations. The report focuses on four areas of the WPI community that were initially determined in the WPI Sustainability Plan:

Academics: As an academic institution, WPI's primary focus is to educate its students. By incorporating sustainability into different programs, courses, and projects, students are armed with the knowledge and understanding necessary to form sustainable solutions to various problems.

Research and Scholarship: Faculty and student members frequently engage in research, covering a wide range in topics of interest. Hundreds of projects were identified as sustainability-focused in 2020, though many others included sustainable practices.

Campus Operations: WPI strives to operate as sustainably as possible, to reduce the campus' impact on the environment. This is most often achieved through the installation of energy and resource efficient technology and practices to reduce utility consumption throughout campus.

Community Engagement: Community engagement creates a sense of purpose and connection between individuals at WPI, and WPI and communities outside campus. Including these communities in sustainable decisions encourages members to participate in sustainable activities on their own.

New Sustainability Plan

As the previous Sustainability Plan reaches its end, a new one is being created throughout the 2018-2019 and 2019-2020 fiscal years. This 2020-2025 plan will focus on the WPI campus as a living and learning laboratory, local and global leadership, and a community that is "all in" for sustainability. The report is expected to be released in Fall 2020.

Adapting to a New Normal

In mid-March, Massachusetts entered a time of quarantine due to COVID-19. As a result, WPI's final term of the 2020 academic year was completed entirely virtually. This limited the number and nature of events, and reduced the amount of utilities consumed, which will be reflected in the data represented in this report.

Academics

Courses and Degrees



WPI's curriculum focuses on project-based learning, and emphasizes the connection between theory and practice. Many undergraduate and graduate courses implement some aspect of sustainability in their curriculum, whether it be the main focus or complementary to the main subject matter. WPI offers degrees in Environmental Engineering, Environmental and Sustainability Studies, as well as a minor in Sustainability Engineering. Additionally, many other fields of study offer concentrations in sustainability. Graduate students can choose to obtain certificates in Water Quality Systems and Water Resources.

Example Courses

On this page are several examples of the many sustainability-related courses offered at WPI. They were chosen to highlight a wide variety of departments, course difficulty level, and difference in content depth.

Environmental Studies 2900 The Green Economy and Models for Alternative Forms of Developments: Current and alternative, sustainable economic models

Engineering Sciences 2800 Environmental Impacts of Engineering Decisions: The various environmental effects of engineering

Biology 1002 Environmental Biology: Human-environment interaction for non-life science majors

Biology 515 Environmental Change: Ecological reactions to environmental changes and human actions

Civil Engineering 562 Biosystems in Environmental Engineering: Water pollution, natural purification, treatment, and disinfection

Political Science, Government, and Law 2311 Environmental Policy and Law: case studies detailing the framework, impact, and restraints of environmental laws

Mechanical Engineering 5105 Renewable Energy: uses, distribution, and challenges of various renewable energy sources

Lectures and Seminars

Throughout the year, WPI hosts a variety of events with guest lecturers who discuss current societal concerns and their work to address these concerns. Students are encouraged to participate in discussions related to the topics and share their own proposals. A number of these lectures are sustainability-based, and describe how to protect the world we live in for future generations. This year's sustainable presentations focused on urban sustainability, recycling, and the effects of climate change. Some topics are included below.



Climate: The Science of Change with Sarah Strauss, Laureen Elgert, Carrick Eggleston, Robert Krueger, & Paul Mathisen, February

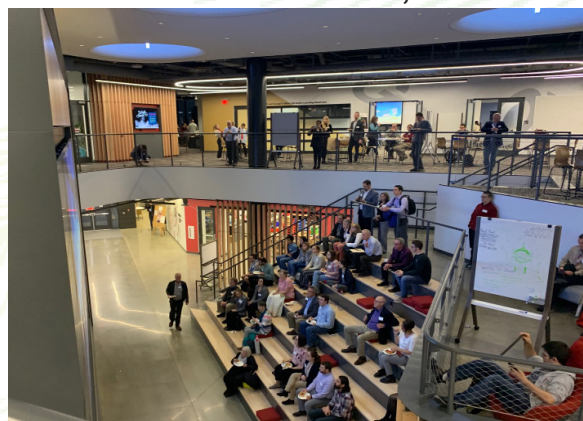


Terracycle & Loop - Eliminating the Idea of Waste with Tom Szaky, September

Climate Change Panel and Discussion with Rajib Mallick, Jennifer Wilcox, Steve McCauley, & Leslie Dodson, September

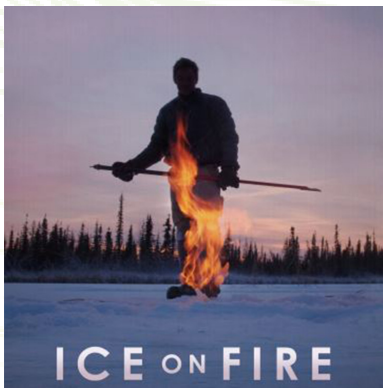


Urban Sustainability in Worcester with Luba Zhaurova, Paul Mathisen, Carrie Havey, & Susan Ceccacci, October





An Equitable, Inclusive, and Environmentally Sound Circular Economy Virtual Forum with Joseph Sarkis, May



Virtual Climate Summit 2020: This year's Climate Summit was held virtually in April, with many different speakers and organizations. A variety of events were covered, including student activities, documentary films, livestreams of movements, roundtable discussions, storytelling workshops, conferences, exhibits, and project competitions.



Projects and Research

During their WPI careers, students will complete an Interactive Qualifying Project (IQP) and Major Qualifying Project (MQP). First year students have the choice to take a Great Problems Seminar (GPS) as well. Students may enter their projects in the Annual Sustainability Project Competition at any point in their WPI career.

GPS

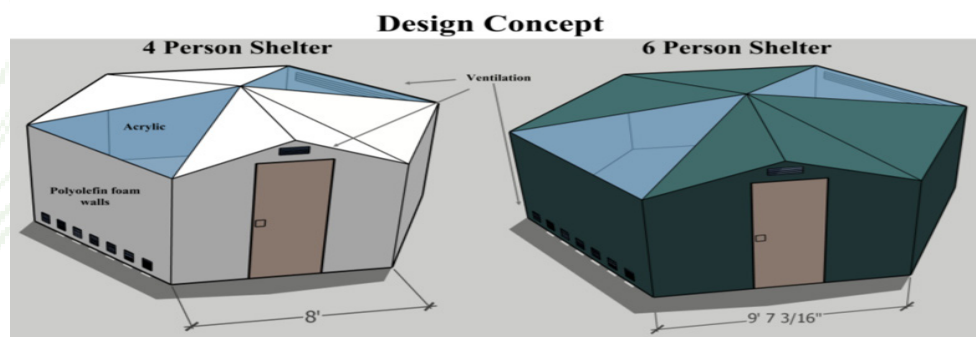
The Great Problem Seminar (GPS) is a two-term course that introduces first-year students to WPI's project-based learning style by asking them to focus on a current global concern. Their findings and solutions are presented on Annual Project Poster Presentation Days. These projects are on a variety of topics, and almost always include sustainability. Several projects are highlighted below.

Superbugs: The Silent Killer, New Methods to Fight Antibiotic Resistant Bacteria

Students: Vanesse Bussiere, Jake Mercier, Araceli Baeza Gonzalez, Olivia Wallace
Advisor: Reeta Rao
People's Choice Winner

Proposal for Redesign of Maicao, Colombia Migration Center

Students: Hailey Anderson, Payton Dean, Holly Hazelton, Lauryn Whiteside
Advisor: Courtney Kurlanska
Judge's Winner

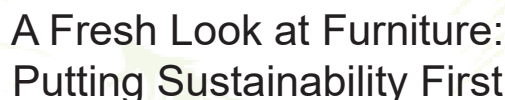


Microplastics in American Children
Students: Bronwen Chilton, Kelsey Leach, Caitlin Bonavita
Advisor: Reeta Rao

Put a Fin to Finning
Students: Gabriel Camacho, Eduardo Carrillo Diaz, Conor McDonough, Mason Miguel
Advisor: Marja Bakermans

*Students: Micheal MacGregor, James Van
Milligan, Rebekah Mendoza, Oscar
Villalonga-Vivoni, Kirsten Roethal
Advisor: Geoffrey Pfeifer*

*Students: Allyson Floria, Matthew
Liliedahl, Molly Sunray, Shelby Tweedie
Advisor: Marja Bakermans
Judge's Winner*



*Students: Christopher Demaio, Martin
Carrau, Matthew Shea, Alex Hill,
Abigail Benoit
Advisor: Svetlana Nikitina*

Students: Asha Karmen-Chan, Micheal Sposato, Luke Reid, Everett Wonson, Noah Skinner
Advisor: Geoffrey Pfeifer
Judge's Winner



*Students: Noelle Crump, Patrick Mejia, Devin Coonradt, Katrina Marsden,
Maya Angeles, Tyler Sanderville
Advisor: Svetlana Nikitina
Judge's Winner*

IQP

The IQP is a nine-credit project typically completed during a student's junior year in which student teams from different majors collaborate on relating STEM topics to the society around them. These projects can be either on campus or at one of over fifty different project sites around the globe. The President's Award is granted to students whose IQP conception, performance, and presentation has been found to be truly outstanding. Over 80 sustainability related IQPs were completed this year, with several examples shown here.

Marketing Strategy to Spread Awareness for the Green Overview

Students: Eric Reardon, Sean Kane, Tyler Gundrum

Advisors: James Hanlan, Holly Ault

Budget Considerations for Meeting MS4 Requirements in Massachusetts

Students: Evan Mackie, Jeremy Branch, Joseph Tzanetos, Noah Bradlee

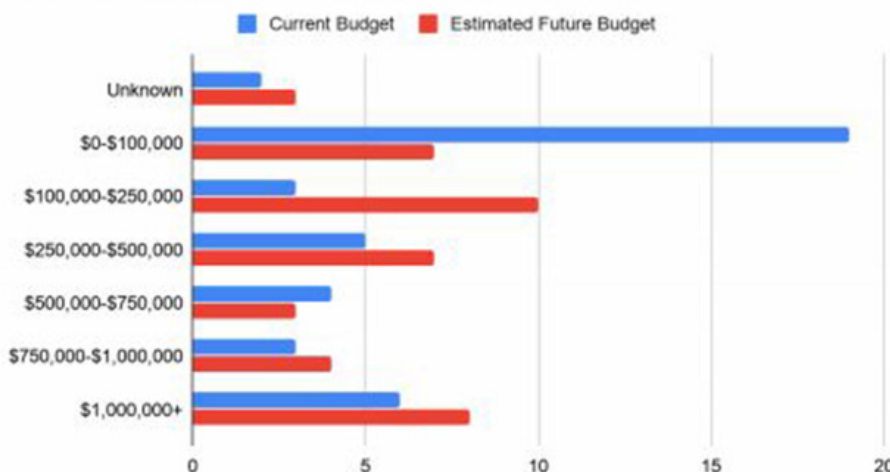
Advisor: Paul Mathisen

Understanding Water Usage at Worcester Polytechnic Institute

Students: Alan Curiel, Ellis Lenihan, Jean-Philippe Pierre, Shangjin Zhong

Advisor: Paul Mathisen

Current and Future Annual Stormwater Budget



Study of Workforce Development at WPI/QCC Lab for Education and Application Prototypes (LEAP) in Central MA- Its Role on Silicon Photonics and Electronic Industries in New England

Student: Ashley Defrancesco

Advisors: Douglas Petkie, Yuxiang Liu

Plastic-Free Venice: Quantifying and Mapping Plastic Pollution

Students: Alexander Hagedorn, Shanna Bonanno, Troy Howlett, Vivian Nguyen

Advisors: William Michalson, Fabio Carrera

An Assessment of the Preferences of Urban Residents for Green Space

Students: Isaiah Aridou, Nicholas Alescio, Rachael Mair

Advisors: Seth Tuler

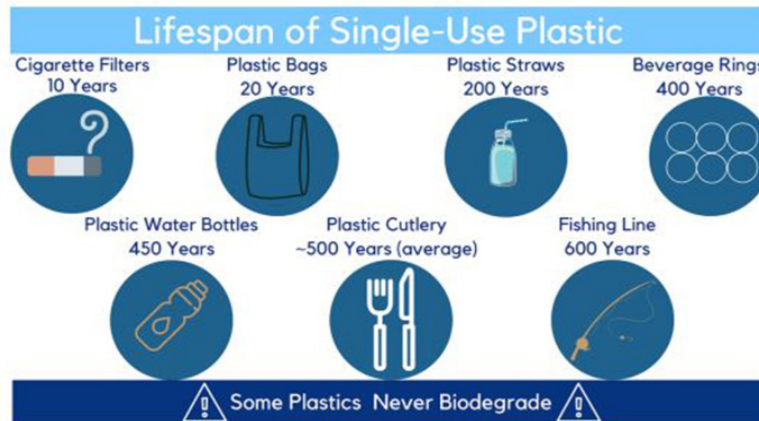


Figure 1: Lack of Biodegradability

Alternate Renewable Energy Resources: A Glance at the Energy of the Future

Student: Kaitlyn Hess

Advisors: Mayer Humi

Preparation for Implementation of the Emergency Services

Foundation's Fundraising Plan

Students: Carter Breckenridge, Lannan Jiang, Nikayla Sims

Advisors: Edward Clancy, Kristin Wobbe



Figure 27. Millan Ruka standing near a river sign warning of a health hazard (RNZ, 2014).

Ecocide: New Zealand

Legislation and Māori Culture

Students: Ariana Ly, Amanda Chan

Advisors: Gary Pollice, Leslie Dodson

Ho'omalulu na 'ako'ako'a: Designing an Interactive Application for Coral

Education in Hawai'i

Students: Danya Baron, Haley Griffin,

Kevin Krupa, Moah Puchovsky

Advisor: Lauren Mathews

MQP

An MQP is a nine-credit project during a student's senior year where individuals from the same or related majors complete a professional level research project in their field. While these projects are typically completed on campus, some are completed at global locations. MQPs that demonstrate outstanding competency in their fields are presented for the Provost's MQP Award. Several sustainability-related projects are depicted on the next page.

An Electro-Mechanical, Wind Energy System Design for the Historic Shelter Island Windmill

*Students: Carly Campbell, Anna Carriero, Alaa Hassan, Brandon Weyant,
Georgianna Wood*

Advisors: Brian Savilonis, Harold Walker, James O'Rourke



Wildlife Crossing Development for Highway 1 in Batipa, Panama

*Students: Samantha Lor, Megan Olson,
Hannah Goddard, Laura Boccio*

Advisors: Aaron Sakulich, Tahar El-Korchi
Provost's Award Winner

A Study of FAI-Based Perovskite Solar Cell Devices Under Pressure

Student: Juan Martin Hinostroza Tamayo

*Advisors: Nancy Burnham, Kenny
Oyewole, Winston Soboyejo*

Developing a Scalable, Low-Cost Prosthetic Device for Below-Knee Amputations

Students: Emily Schneider, Kristen McCrea, Nathaniel Grunbeck, Matthew Mulligan

Advisors: Pradeep Radhakrishnan, Joseph Stabile

A Study on Biologic Healing in Enzyme Modified Concrete

Students: Emma Edwardson

Advisors: Nima Rahbar

Co-Designing for Gold Mining Safety

Students: Rosa Reynoso, Van Harting,

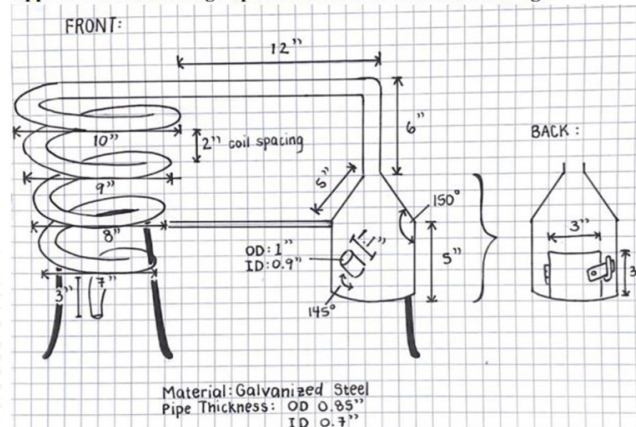
Isabel Azevedo, Madison Cunniff,

Rediet Tegegne

Advisors: Pratap Rao, Robert Krueger

Provost's Award Winner

Appendix G: Final Design Specifications and Technical Drawings



Towards A More Inclusive World: Enhanced Alternative Communications Using AI and NLP

*Students: Zachary Emil, Andrew
Robbertz, Richard Valente, Cole Winsor*
Advisors: Rodica Neamtu

Computations in Option Pricing Engines

*Students: Vital Mendoca Filho, Pavee
Phongsopa, Nicholas Wotton*
*Advisors: Qingshuo Song, Gu Wang,
Yanhua Li*



Figure E. Shred step of prototype atop basin for clean step

Onsite Recycling for Rural Places

*Students: Sarah Duquette, Ashley
Kishibay, Alexandra Miller,
Benjamin Schade*

*Advisors: John Sullivan, Stephen
Kmiotek, Jerome Schaufeld*

Growing Fungal Highways for a Synthetic Soil Microbiome

Students: Trent Jones
Advisors: Eric Young

Annual Sustainability Project Competition

The Annual Sustainability Project Competition evaluates student projects based on their ability to sustainably solve current problems without harming the ability of future generations to meet their needs. Students are encouraged to submit projects that consider one or several aspects of sustainability- environmental, economic, or social. Contestants submit in either the First Year, Undergraduate, or Graduate category.



First Year Winner- Tie

Land Use Analysis of Polar Park

Student: Tarang Shah
Advisor: Suzanne LePage

Water Consumption and Invasive Species in Cape Town, South Africa

Student: Bethany McCullars, Marcel Paolillo
Advisor: Katherine Foo, Beth Eddy

Undergraduate Winner

Developing a Sustainability Plan for Hammams in Morocco
Student: Payton Beilawski, Nathan Kaplan, Brian Preiss, Alyssa Sousa, Rebekah Vernon
Advisor: Laura Roberts, Mohammed El Hamzaoui

Graduate Winner

Realizing a World without Waste Through Catalytic Conversion of Food Waste
Student: Heather LeClerc
Advisor: Andrew Teixeira, Mike Timko

Research

WPI faculty conduct research throughout the summer and academic year on a variety of subjects. Some of these projects are sustainability-focused, while others are on different topics but include sustainable solutions. Millions of US dollars were awarded or granted to WPI research in 2019-2020 for sustainability-related projects. Much of this research is also published in books. The following section will highlight several books published this year, as well as descriptions of 6 faculty members' research. Their research covers a wide range of sustainable topics, from numerous WPI departments.

Books Published

Four sustainability-related books have been published by WPI faculty this past year, and are described below:

Who Owns Poverty? by Visiting Professor Martin Burt dives into the economic side of sustainability. Working with tens of thousands of enterprises, Burt determined how 29 different countries define what it means to be poor. From this, a measurement tool was developed for individuals to measure their level of poverty in various fields, including income, health, environment, culture, and housing.

The Sacrifice Zone by Professor Roger Gottlieb spins a fictional tale deeply rooted in his knowledge of religion, spirituality, and environmentalism. Sacrifice zones are areas considered so polluted they can never be cleaned. The novel follows the lives of Daniel and Sarah as they struggle through the dangers of environmental activism, as well as Anna's spiritual journey as she revisits her past.

Poetry collection *The Soft Path* by Associate Professor Joshua Harmon explores a more social side of sustainability. Each poem explores the environmental effects of a world focused on capitalism, and technology's relationship with the natural world. This book relates to a more artistic approach to sustainability, using the written language to convey the reality of the world around us.

Associate Professor Robert Krueger's *Adventures in Sustainable Urbanism* notes the contrast between the idea of sustainable urbanism, and its less than ideal reality. Krueger explores how lasting effects are often more disruptive than beneficial: cities are made to be greener, but this often diverts natural waterways or raises prices past an affordable limit. Krueger plans to implement his suggested changes to sustainable urbanism through student IQP projects.

Computer Science and Robotic Engineer Assistant Professor Berk Calli focuses on robotic manipulation research. Recently, the National Science Foundation awarded funding for a multidisciplinary collaboration between WPI, Yale University, University of Washington, and Boston University. The focus is using robots to sort waste and recycling in facilities, which complements human workers by increasing workplace safety and process efficiency. WPI has multiple students and an MQP working on this project, and includes installing mock recycling line on the WPI campus. Calli and Sarah Wodin-Schwartz co-advised the Reusable Cup Machine MQP centering on making reusable cups more convenient and widespread. The MQP group designed a reusable cup dispensary that receives dirty cups from a consumer and returns clean cups ready-for-use. Calli is also collaborating with the EMR Group in the U.K. on a new project for recovering metal scrap more safely from large structures such as oil rigs or ships. These structures contain valuable metals, but processing them requires dividing them into smaller chunks. This project designs robotic systems to cut large scrap metal pieces according to the metal recycling industry requirements. The start date of the project is July 1.



Pamela Weathers is a Biology and Biotechnology professor well known for her research addressing sustainability in biology and human health. Much of her research focuses on *Artemisia annua* (*A. annua*), a medicinal plant commonly known as Sweet Wormwood, and artemisinin, an extract often obtained from the leaves of this plant. Artemisinin and its derivatives are known for being potent antimalarial drugs.



In one project, Weathers and her team compared the effectiveness of dried *A. annua* leaves (DLA) and pure artemisinin, considering metabolism, tissue distribution, and inflammation attenuation. The results indicated DLA increases the bioavailability and anti-inflammatory potency of artemisinin. Weathers is also exploring the potential of this plant to fight new, multidrug-resistant strains of *Mycobacterium tuberculosis*. These strains cause longer treatment regimens and often treatment failure, creating an urgent need for new options. For this research, Weathers compared *A. annua* and *Artemisia afra* (*A. afra*), an African Wormwood known for its anti-tubercular properties. Both plants were found to have enormous potential for fighting tuberculosis, with *A. annua* having a higher rate of killing bacteria and inhibiting bacteria growth. This indicates *A. annua* may be used to fight tuberculosis alone or combined with additional treatments. Because the plant is easy to grow and produce at low costs, it has great potential to support local economies and populations.

Mechanical Engineering Associate Professor Adam Powell has several projects focusing on reducing greenhouse gas emissions. He collaborates with Jagannath Jayachandran to combine jet fuel with magnesium hydride. When burned, it reacts with carbon dioxide in the air, resulting in fewer emissions and allowing aircraft to travel 5-10% farther. In another project, Powell partners with Brajendra Mishra, Department of Energy laboratories, and Magna International. They seek to reduce corrosion in magnesium-aluminum welds to create lighter weight vehicles. Powell is also developing low-cost silicon for solar cells with Yu Zhong. Silicon is obtained and purified in an inefficient chemical process requiring large amounts of energy and releasing lots of emissions. His research focuses on electrochemically removing impurities in a zero-emissions, one-step method that uses 80-90% less energy. Mohammad Asadikiya in Powell's group is forming the startup company SilarTek to scale this up and reduce costs. Another project with Mishra focusing on recycling rare magnets and other products was finalized and scheduled to begin in October 2020. Rare earth element magnets are used in many devices, such as electric car motors and wind turbines. However, there are only a small number of suppliers, and rare earth elements lack economical solutions. Powell's group will perform a survey and develop new recycling processes for these elements.



Humanities and Arts Professor Kristin Boudreau has research interests that include literature and culture, integration of humanities with STEM, and engineering education. Boudreau is particularly interested in social justice for marginalized populations and broadening access to high-impact education, and she often collaborates with engineers and other humanists to advance these areas. Recently, she has collaborated with Chemical Engineering Professor David DiBiasio on research focusing on environmental sustainability and economic or social justice. Their main project involves creating hands-on STEM-and-humanities projects for middle- and high- school students. Professional development is being designed to raise teacher's confidence in implementing these projects as well. These integrative projects focus on reaching individuals who may not see themselves as potential STEM professionals, such as girls, people of colour, or people from low-income families. They design these projects for WPI students (GPS, Humanities, and Chemical Engineering) as well. Boudreau and DiBiasio also have projects involving climate change refugees in Alaska, climate change mitigation, and collaborating with graduate student Caleb Woodall to research carbon mineralization for carbon capture.



Schwab Professor Harold Walker conducts research to better understand surface chemical processes in natural and engineered systems, with particular consideration to clean water. He and his colleagues are currently exploring nanocellulose as a sustainable feedstock for the development of nanotechnologies. Nanocellulose is an abundant, naturally hydrophilic material obtainable from multiple plant sources. Over the past year, his research team



has demonstrated the synthesis of novel water treatment membranes based on nanocellulose. These membranes have proven to have superior water flux and membrane fouling compared to conventional membranes. Walker is also researching nitrogen contamination of ground and coastal waters by onsite wastewater treatment systems. This is a critical issue in United States communities, but existing onsite wastewater treatment systems remove little to no nitrogen. When wastewater effluent is discharged and nitrogen enters the groundwater, it contaminates local drinking supplies and aids eutrophication. To combat this problem, Walker and his colleagues are involved in a large study to research, develop and pilot-test an innovative system called a “Nitrogen Removing Biofilter”, or NRB. These systems are relatively simple, inexpensive and are based on widely available, natural woodchips. Multiple years of monitoring show NRBs consistently reduce influent nitrogen in wastewater to less than 10 mg/L, substantially less than competing systems.

Ingrid Shockey, an Associate Teaching Professor in the Environmental and Sustainability Studies and International and Global Studies Division (IGSD), is an environmental sociologist with interests in climate change, environmentally and socially appropriate design, and human/wildlife conflict. She is currently combining inter-



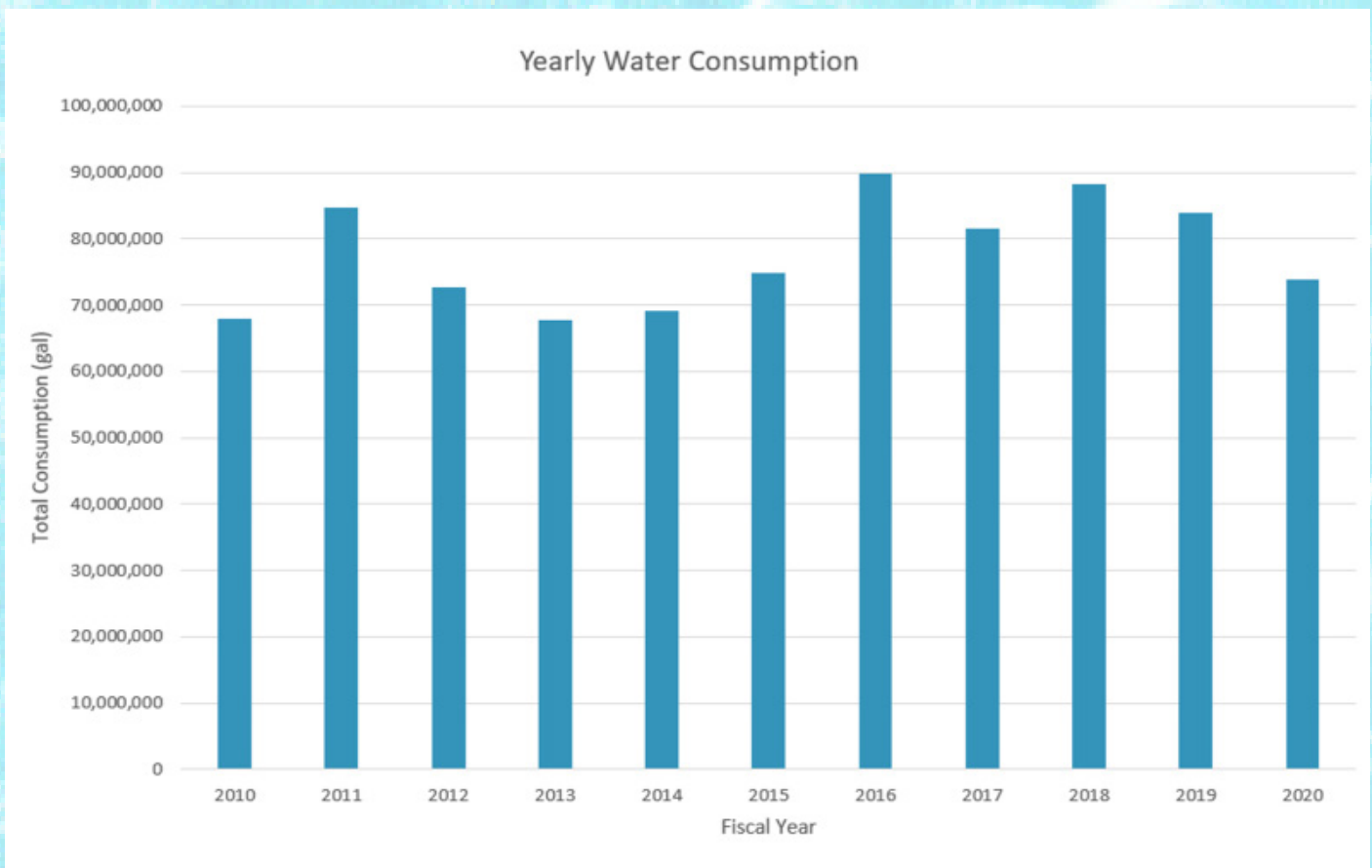
views revolving around climate change that were obtained from student projects around the globe. Climate change is often viewed broadly in relation to policies or planning to address vulnerability and adaptation. As a result, the real on-going effects of climate change on people are often overlooked. These projects focus on interviewing individuals around the globe to investigate their perceptions of climate change: Have they noticed the effects of climate change? If so, how has this affected their daily lives, and how they are combating these effects? Are they are hopeful about the future? Shockey and members of the Global Lab are compiling these stories into a website to catalog them and illustrate their perspective on these effects. When completed, this website will contain a map showing the location of each story, along with a page dedicated to each project's results.

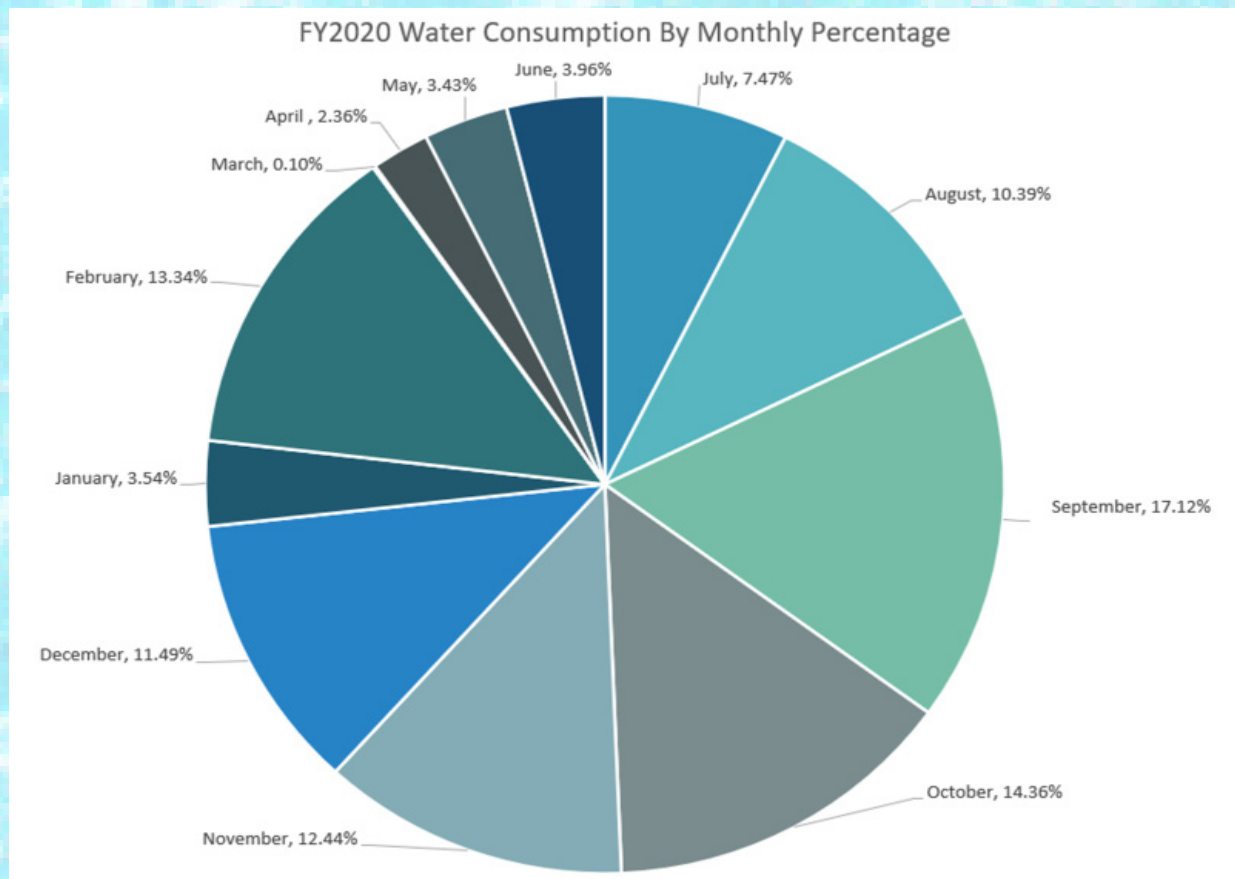
Campus Operations

WPI tracks the yearly consumption of water, electricity, and gas, as well as greenhouse gas emissions. This section will examine each of these topics individually in regards to consumption/emissions and sustainability. Transportation, dining services, recycling, and notable sustainable features around campus are also reviewed. Note that the trends for 2019-2020 may differ from those of previous years due to the unique conditions resulting from the COVID-19 pandemic.

Water

Water is essential for human life. Humans require it to survive, as do animals and plants. Water is also used in cleaning, cooking, agriculture, and industrial processes. As a result, the water available to us must be conserved. WPI students are encouraged to reduce water consumption by shortening shower and hand washing times, and well as turning the faucet off while brushing their teeth or cleaning dishes. WPI also employs energy saving methods such as low flush toilets and automatic faucets.





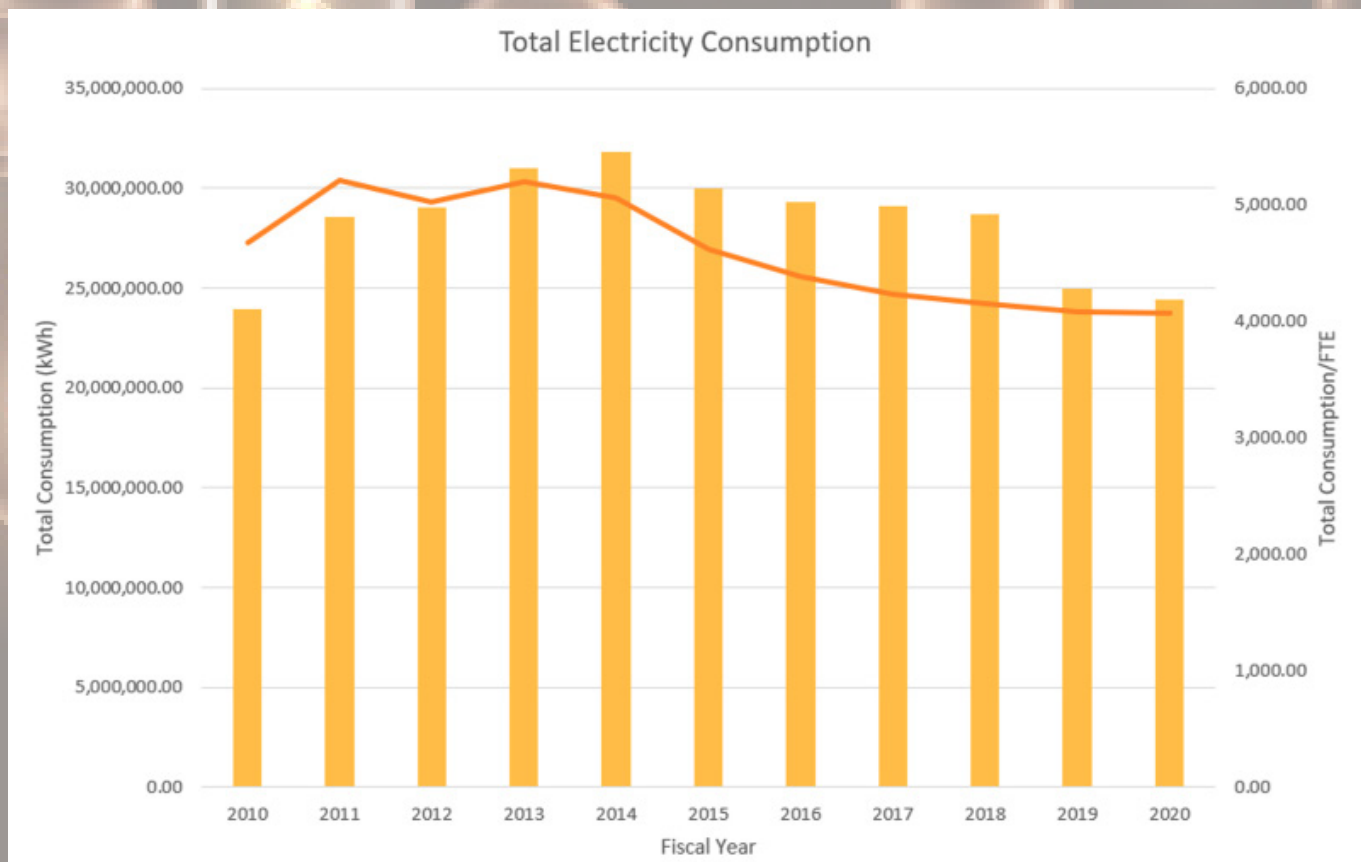
This section includes two graphs, showing the yearly water consumption over the past decade and the monthly consumption for 2019-2020.

The first graph highlights the past year's water use in relation to total water use over the past decade. WPI consumed roughly 10,000,000 gallons less in 2020 than in 2019, corresponding more closely to values from the beginning of the decade. The second graph shows water consumption for each month of the fiscal year. The least amount of water was consumed in April, with May, June, and January closely following. September and October have the highest amount of water consumed. There are a variety of factors that may have caused these trends, the most notable being: weather; the presence of students, faculty, and staff; increased sustainability; when the data was collected; infrastructure use; and landscape water needs, such as watering the grass on the Quad.

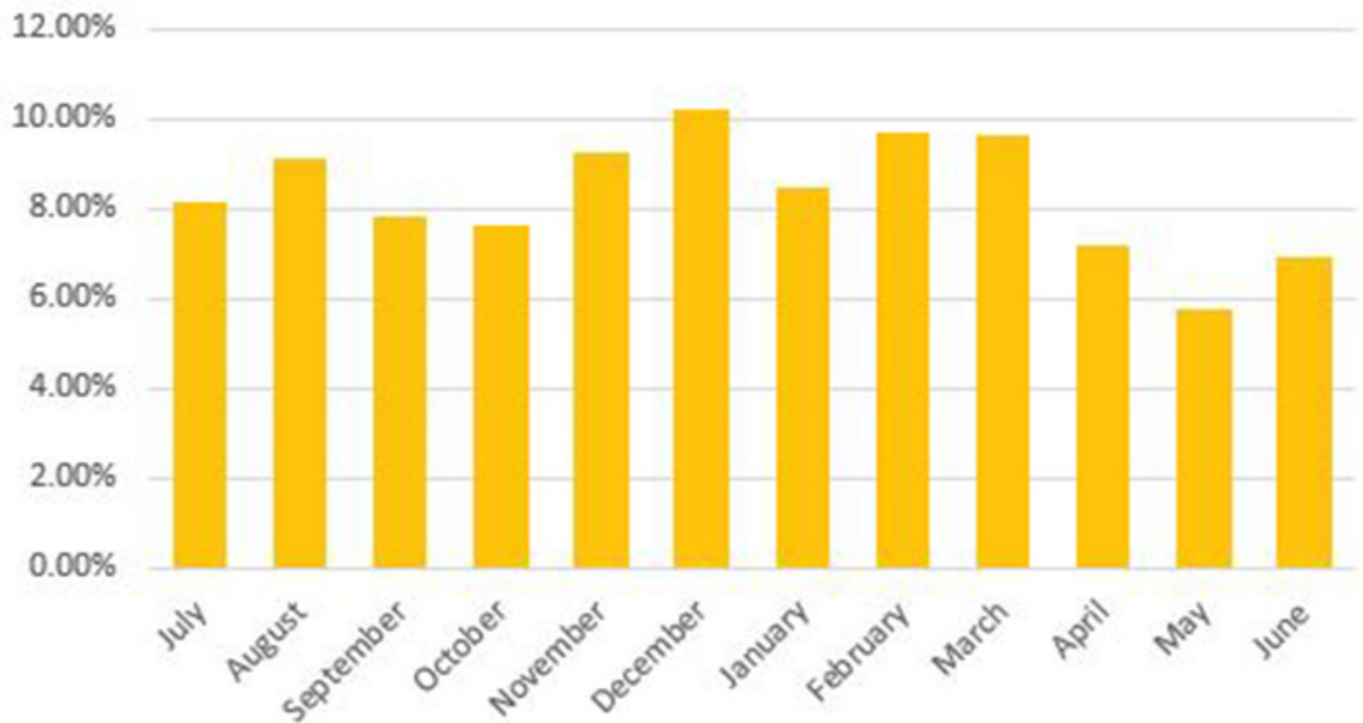
Electricity

Today's society is increasingly dependent on technology, and subsequently electricity. Electricity powers our computers, lights the up the night so we can see, allows us to communicate with people too far away to see in person, and provides countless other benefits. To support these applications, energy must be harnessed. In many places, the majority of this energy comes from non-renewable sources that must be burned, releasing greenhouse gases and depleting the Earth's resources. To combat this, WPI has been taking measures to reduce its impact on the environment, through measures such as LED lights, motion sensors on room lights, and equipment controls.

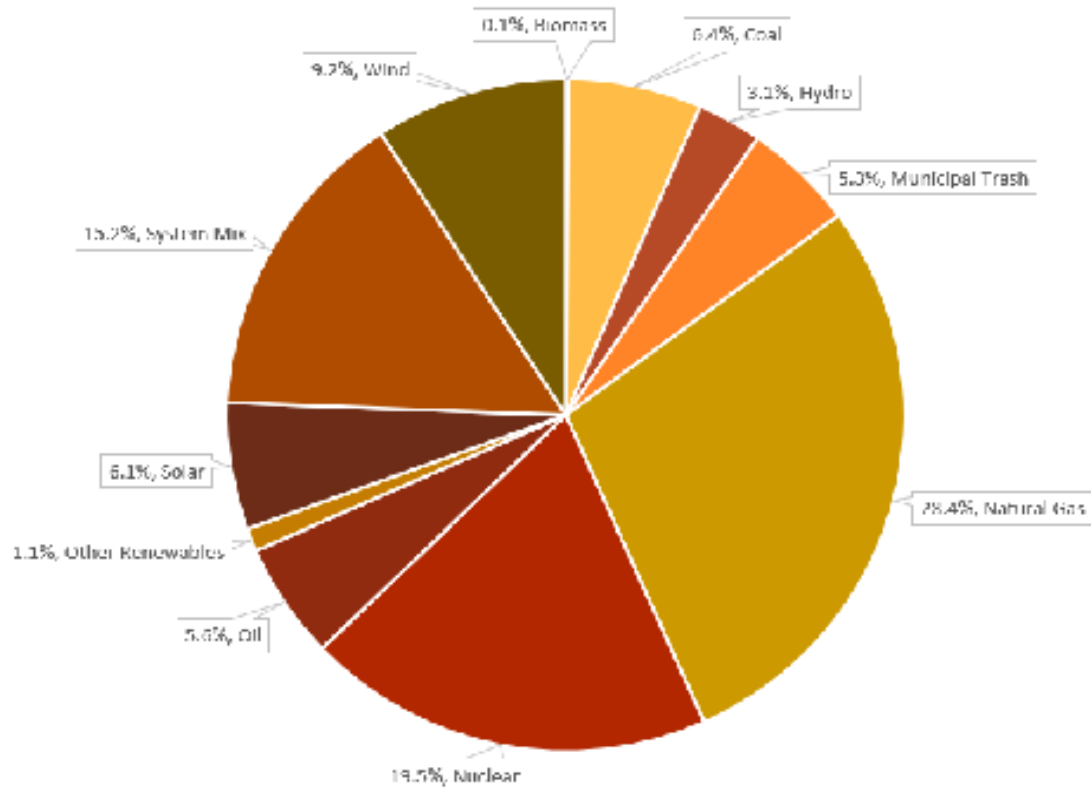
The first graph in this section details the total year's consumption compared to the past decade and total consumption per full time equivalent (FTE), while the second graph shows monthly usage for fiscal year 2020. This year's total consumption is very similar to 2019's consumption levels, with a higher FTE. This implies a possible positive trend for sustainability, as similar amounts of electricity are consumed with more people present. Almost 20% of WPI's power is gained through renewable sources, with the majority being from wind and solar.



Monthly Electricity Consumption by Percentage



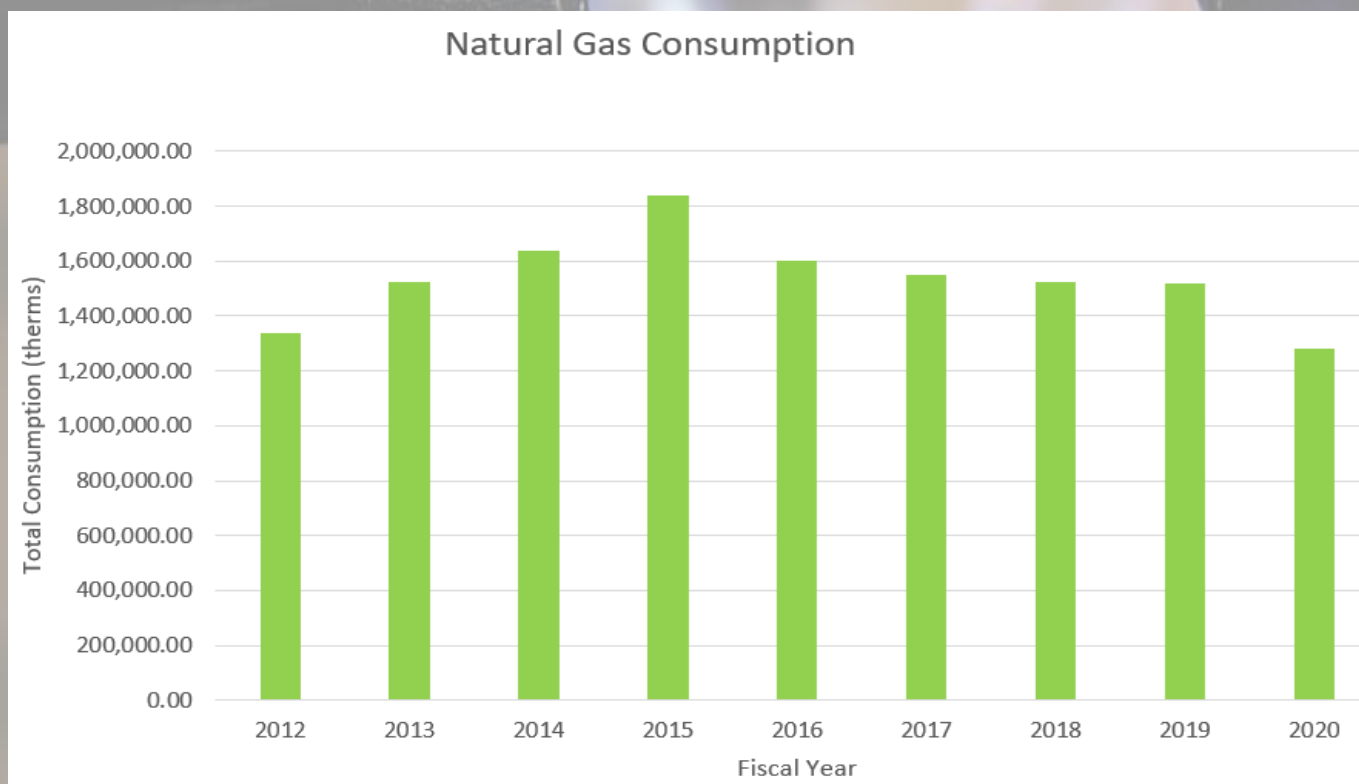
Fiscal Year 2020 Power Sources By Percentage



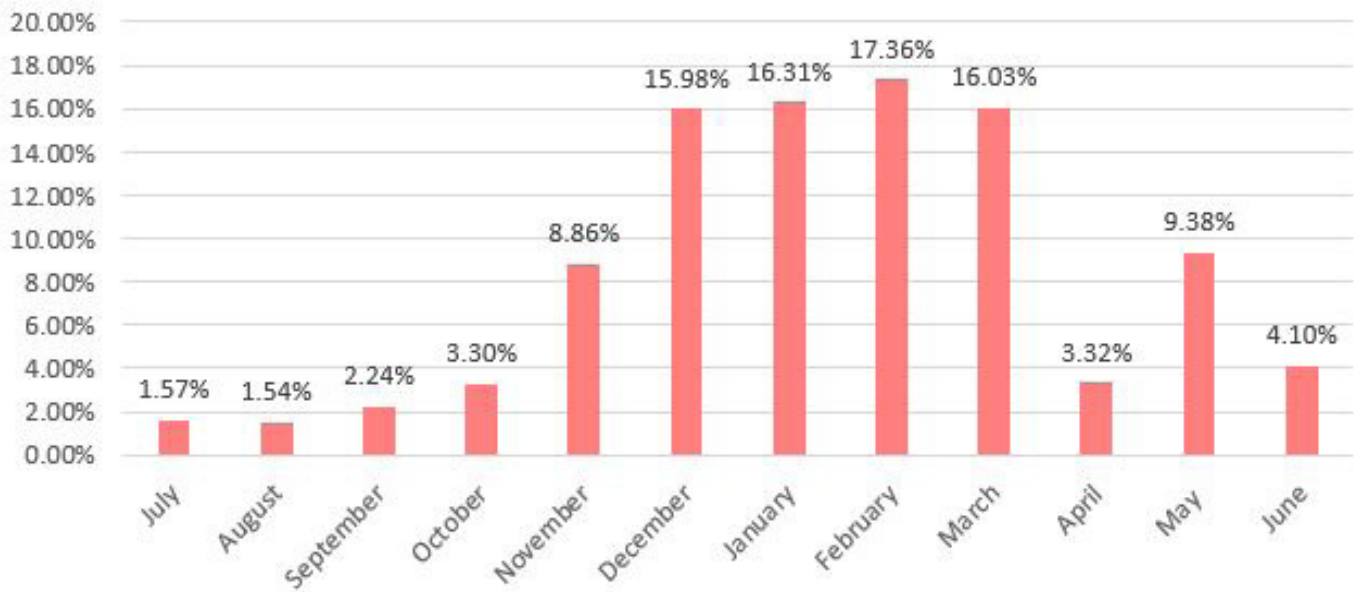
Natural Gas

Natural gas is a popular alternate energy source to traditional fuels such as oil. Although it is a fossil fuel, natural gas produces less potentially harmful particulates than oil, and burns more cleanly, reducing the emissions released. It is naturally abundant and easy to use, increasing its popularity. In the past seventeen years, WPI has converted its heating methods from oil fuels to natural gas. This will help reach WPI's goal of reducing overall emission by 20% by 2025.

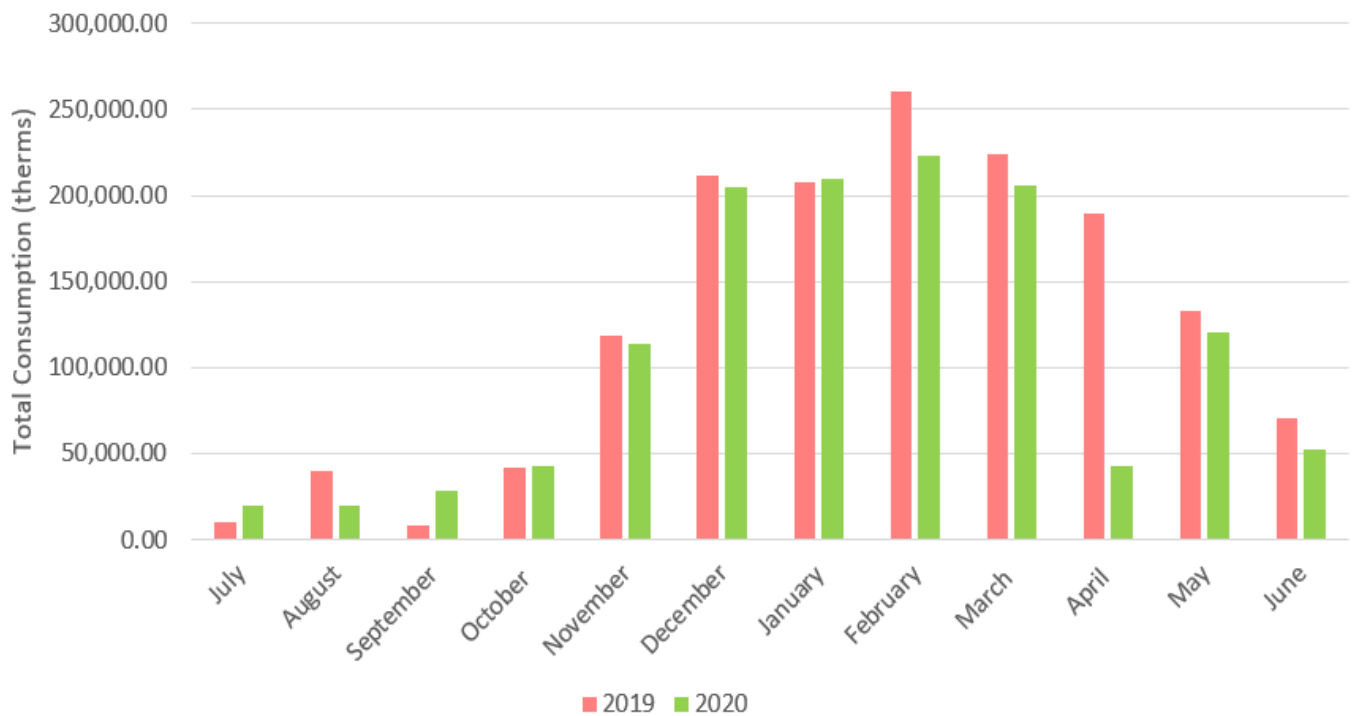
The graphs below detail the 2020 natural gas consumption in a comparison on yearly totals for the past decade, a monthly comparison for 2020, and a monthly comparison for the past decade. In 2020, 1,282,906 therms were consumed, the lowest amount throughout the decade. This may be due to a variety of factors, such as changing temperatures, number of individuals on campus, when the meters were read, or increased sustainability. The majority of this natural gas was consumed between December and March. Every month in 2020 consumed an equal amount as or less than the same month in 2019, with the exception of September. It should be noted that April 2020 is unusually low, suggesting an outside factor may be influencing this value. Possible factors include unusually warm temperatures, or the meter combined April's values with March or May.



Monthly Gas Consumption By Percentage

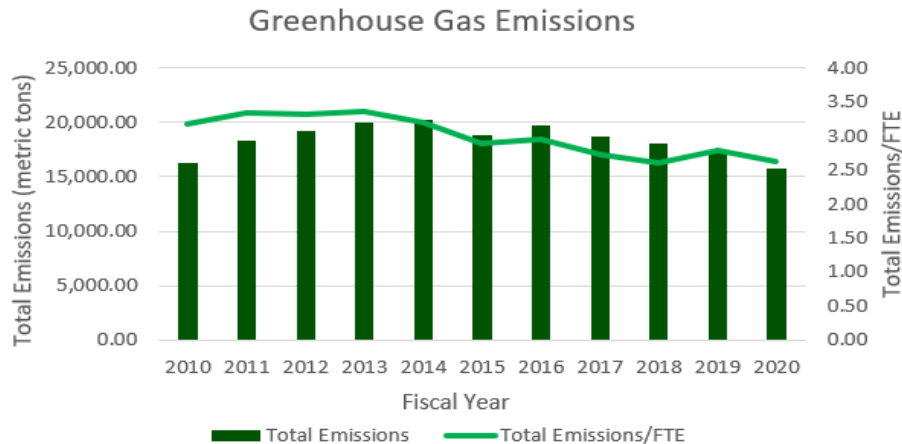


FY2019 vs FY 2020 Monthly Comparision



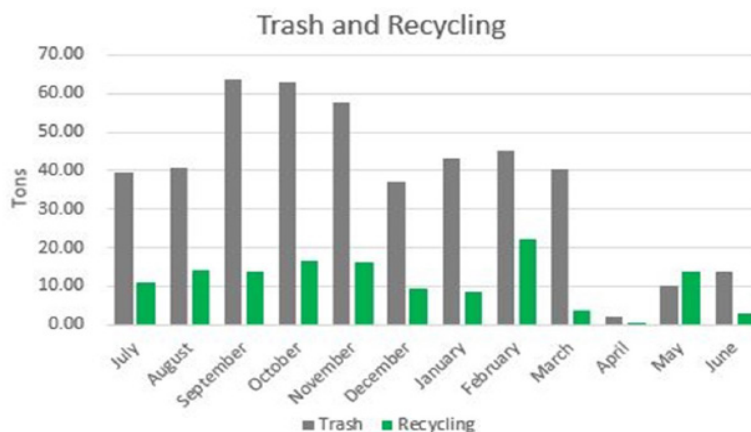
Emissions

Emissions are gases and particles released into the air by various sources, raising the earth's temperature by adding greenhouse gases that trap heat. The graph below shows WPI's emissions over the past decade, which is estimated by combining electricity, natural gas, refrigerants, and vehicle gas values. Lower electricity and natural gas consumption resulted in less emissions released this year. Continuing to improve these aspects of WPI, as well as their refrigerants and vehicle gasoline consumption, will continue to lower emission releases in the future.



Waste and Recycling

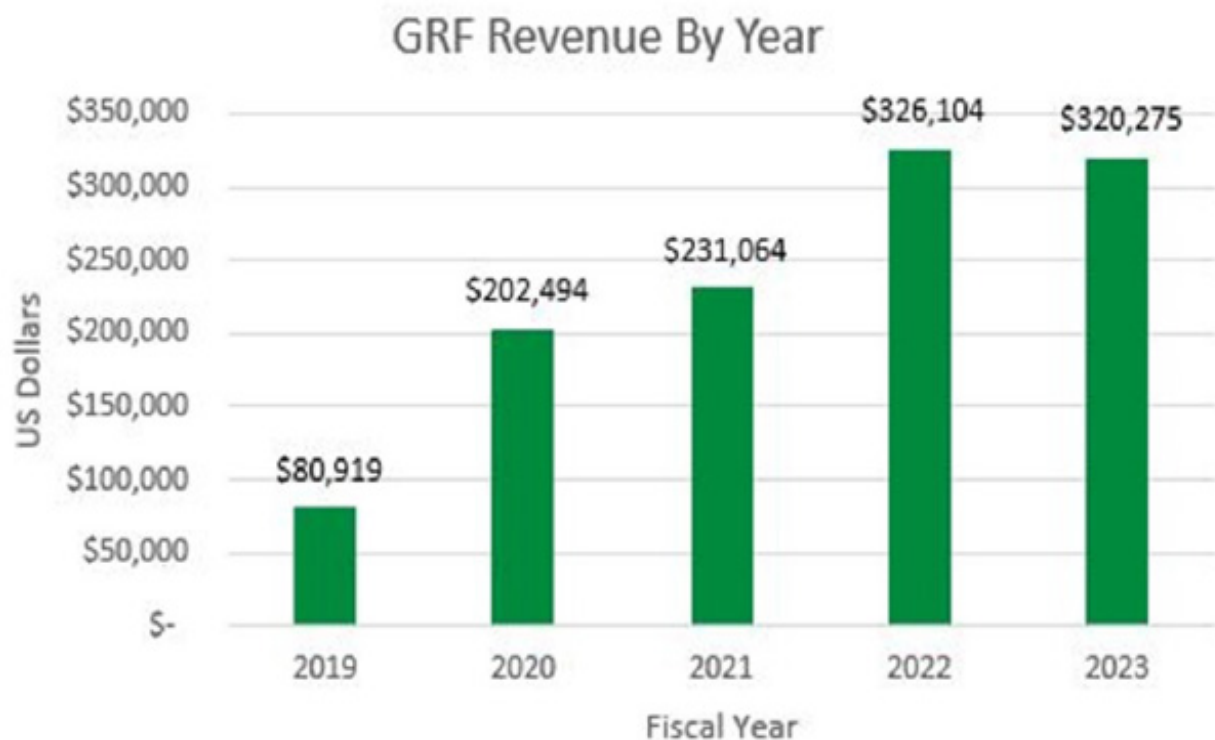
Recyclables at WPI are plastic, paper, cardboard, glass and aluminum products that can be converted into other usable products. There are multiple receptacles for waste and recycling throughout the campus, and the community is encouraged to reuse materials before disposing of them. Overall, the amount of recycling was one third the amount of trash, though it did increase to half in February. The amount of recyclables reduces dramatically in March, and rises again in May. This may be due to WPI changing its waste collection dates, so March and April values were recorded with February and May instead.



Green Revolving Fund

The Green Revolving Fund (GRF) began in 2017 as a capital fund with a \$1.5 million seed invested over 3 years to increase WPI's efficiency and sustainability. The savings provided by projects that reduce resource consumption and increase efficiency are cycled back into the GRF, ensuring the Fund's continuation and providing opportunities for additional projects. The first projects were completed in the 2018-19 academic year, returning an annual cost savings of \$80,919 back into the fund this past year. Ongoing projects for the 2019-2020 year include lighting upgrades at Harrington Auditorium and Founders Hall, and lighting upgrades and retro-commissioning of the HVAC system in East Hall. An engineering study is also being completed for a cogeneration facility for Goddard Hall, and is anticipated to be completed in 2020-21.

The following graph shows the estimate projected savings from the GRF based on current plans. By reinvesting these savings into new projects, the GRF can be maintained in the future. WPI also plans to continue to engage the community by maintaining a GRF Community Fund for innovative projects. The Community Fund is currently on hold due to COVID-19 related delays.



Transportation

WPI is within walking distance to many amenities and venues in Worcester, including food markets, pharmacies, and a train station. The campus itself offers students and faculty a variety of safe, sustainable, non-walking methods of traveling around and off the main campus. The majority of these methods are free to use.

Student Night Assistance Patrol (SNAP): These WPI-marked vans are run by WPI police, and operate during night hours.

Gompei's Gears Bike

Share: WPI students can rent a bike from campus for up to eight hours using the Movatic app. This bike share was originally a

Zipcars: WPI partnered with Zipcars in 2008, a company that allows licensed drivers to rent a



Carpoolworld: Carpoolworld is a website that allows students to input their information for traveling locally or around the country, and find potential carpoolers.



EV Chargers: WPI is one of many universities in Central Massachusetts with free electric vehicle (EV) chargers.

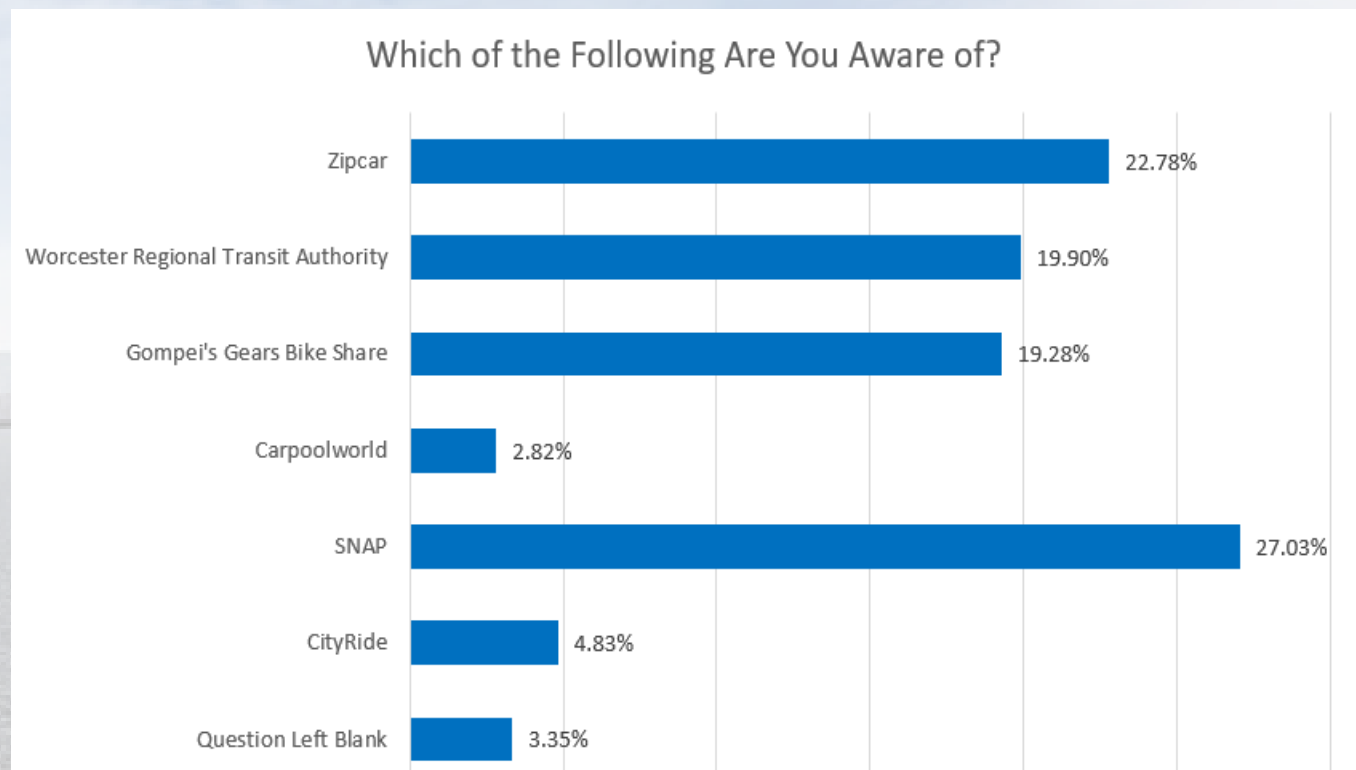
Gateway Shuttle: Managed by Valet of America, this daytime shuttle travels to and from the main campus to Gateway Park, Salisbury Estates, and Faraday Hall.

CityRide Shuttle: This evening shuttle runs between WPI, Assumption College, Union Station, and Blackstone Valley Shopping Center/Cinema.

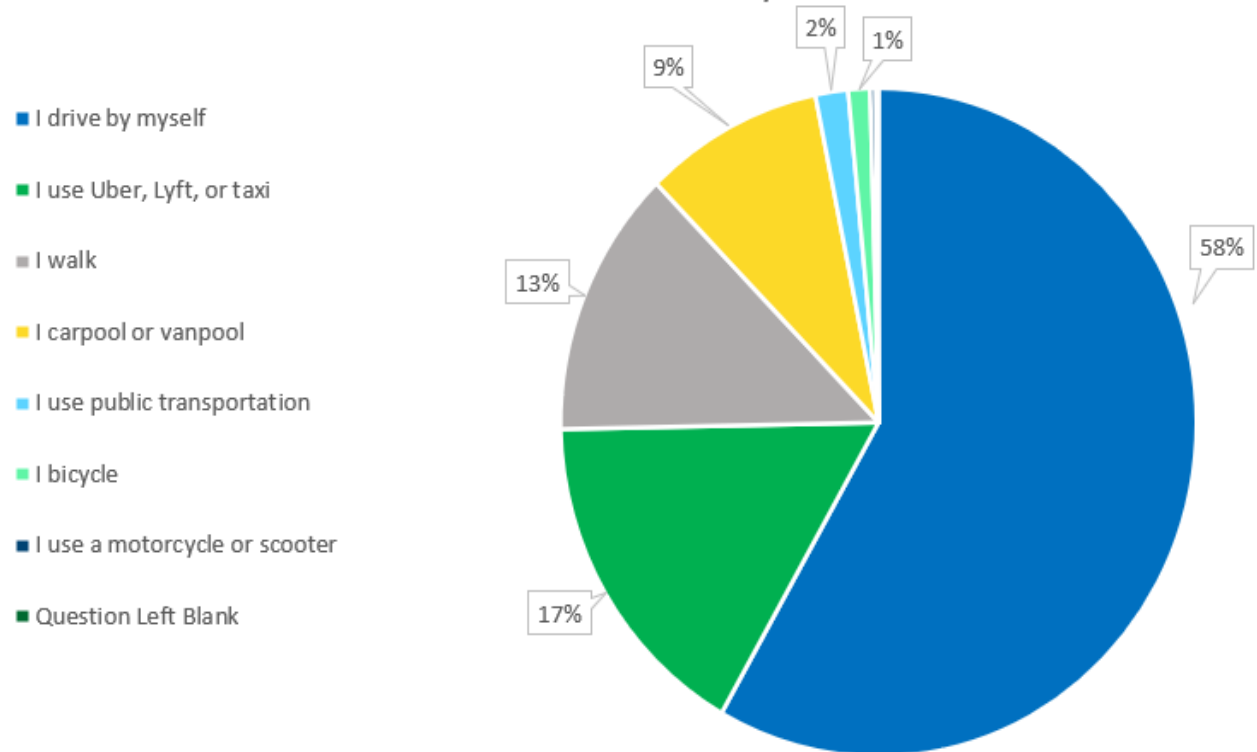
Worcester Regional Transit Authority buses: This city bus system has stops throughout the city, including WPI, and offers college students a discounted ticket price.

Price Chopper Shuttle: This shuttle runs between four residential buildings and Price Chopper throughout the early evening.

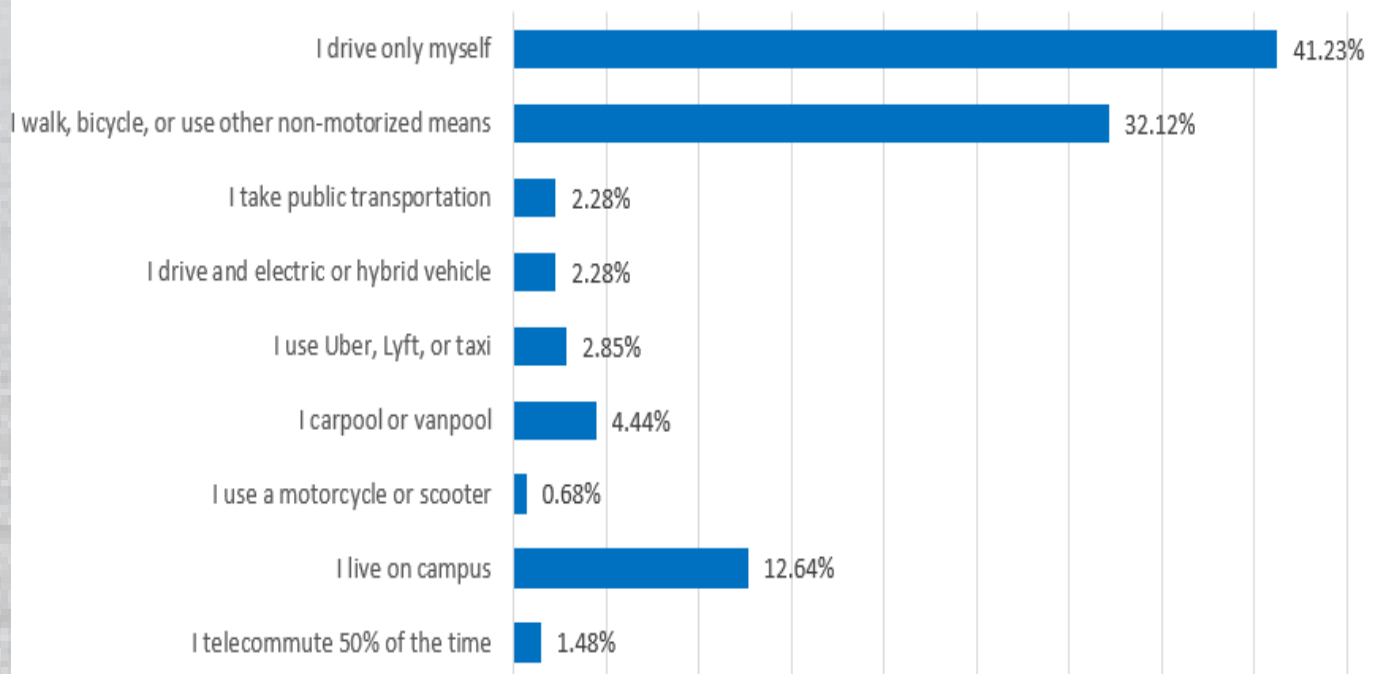
The 2020 Transportation Survey asked WPI students, staff, and faculty how they usually commuted and what sustainable travel options they were aware of, with 723 individuals responding. Each participant could choose multiple answers. The majority of responders were found to travel alone both to campus and from campus around Worcester, indicating an opportunity for WPI to improve its sustainability.



How Do You Commute Most of the Time from Campus to Venues Around the City?



How Do You Commute Most of the Time?



Dining Services

There are five dining options on WPI's campus catered by Chartwells: Morgan Hall Pulse on Dining (POD), Campus Center Food Court, Goat's Head Restaurant, Library Café, and the Quorum. Chartwells is dedicated to serving nutritious, healthy food that was produced sustainably while reducing food waste. This section focuses on sustainable purchases and initiatives of individual dining options.

At WPI

Sustainable Practices:

rBGH Free Milk and Yogurt
Sustainable Seafood Cage Free Shell Eggs
Zero Trans Fat Oils Local Food Sourcing
Restricted Antibiotic Poultry Fair Trade
Carbon FoodPrint Program Stop Food Waste Program
Waste Not program
Equipment maintenance, reduced temperatures, and reduced preheating times to encourage energy conservation

Food Certifications:

Mbay Yellow
Mbay Green
HFAC Certified
Rainforest Alliance
USDA Organic
MSC
Fair Trade
rBGH Free Milk



Morgan Dining Hall

extensive vegan choices
modified meals optional
organic food
Plant Based Mondays to encourage a more plant based diet
sustainable effects of portion size

Campus Center Food Court

meat and animal product alternatives
vegetable proteins



Goat's Head Restaurant

vegetarian/vegan options
modified meals optional

Community Supported Agriculture (CSA): money is exchanged with a local farmer for a season's worth of fresh produce



Uneaten canned foods are brought to the Worcester Friendly House by members of Greek Life
Leftovers are re-served

Food waste is collected in special bins and the amount recorded weekly and monthly

Food waste is also picked up by a local pig farmer and used as feed

Throughout Campus

This section covers sustainable aspects of the WPI campus that don't fit into the previous categories, including LEED certifications, refillable water bottle stations, and physical attributes.

Bartlett Center: LEED

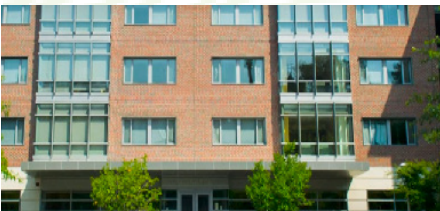
Foisie Innovation Studio/
Messenger Residential Hall:
LEED Gold



East Hall: LEED Gold

Faraday Hall: LEED Silver

Recreation Center:
LEED Gold



East Hall: green roof

Faraday Hall:
reclaimed brownfield



53 Water Bottle
Filling Stations



729,776 Single Use
Water Bottles Saved



Quad: stormwater
collection cisterns

Recreation Center:
solar heating of
swimming pool



energy efficient LED
lights



at Faraday Hall, East Hall,
and outside



Higgins House:
bioswale and formal
garden



New Construction

In October 2019, on the hill behind Gordon Library, WPI broke ground on the New Academic Building. The New Academic Building will be a combination of learning, research, collaborative, and office spaces. A number of sustainable elements have been incorporated in its creation, including:

Two wheel energy system to reuse heating/cooling exhaust

Forest Stewardship Council certified wood products

Low flow, automatic plumbing features

Highly recycled and acoustic indoor materials



Higher window insulation and reduced solar heat gain

Highly efficient LED lighting tied to daylight sensors to encourage natural lighting

One hundred locally sourced new trees planted around the area

Renovations

WPI has renovated a portion of its older buildings in prior years to be more environmentally friendly, such as updating lighting in East Hall and Founders Hall in 2018-2019. Renovating Kaven Hall and building new a residential space at Salisbury Estates was originally planned for the 2019-2020 fiscal year, but is now scheduled to begin in May 2021.

Community Engagement

WPI's community is heavily involved in various sustainable events and activities. This section summarizes a selection of activities and initiatives from sustainability related clubs, organizations, and individuals from the past year.

Green Team

The Green Team is an organization dedicated to increasing sustainability on campus. It hosts multiple events throughout the year to promote and educate individuals, and works closely with the Office of Sustainability. Some of its more popular events are the Energy Efficient Lighting Fair, Annual Waste Audit, EarthFest, Gompei's Gears Bike Share, and the E-Waste Drive. Trivia nights are also held at the Goat's Head, as well as projects like Skip the Straw. Most recently, the Green Team has begun the Divest WPI campaign to encourage WPI to move away from fossil fuels.



Sustainability Ambassadors

Originally formed by the Office of Sustainability as the Eco-Reps, the group has reformed this year and become the Sustainability Ambassadors. They focus on using peer-learning to educate the WPI community about a more sustainable lifestyle. The goal is to encourage students to identify needs in the community and address them together. One ambassador collaborated with a local pig farmer to begin composting at the Phi Sigma Sigma sorority house. During the spring, the Sustainability Ambassadors focused on training new members.

The background image shows the interior of a greenhouse. In the foreground, there are several plants, including a tall one with large, pointed, light-green leaves on the right and some smaller, leafy plants on the left. In the middle ground, there is a long, light-colored wooden table or counter. Behind the table, more plants are visible, and the background shows the structure of the greenhouse with its translucent panels and support beams.

Greenhouse

In WPI there is a space filled with bright foliage and warm temperatures- the Biology and Biotechnology greenhouse. Built in 1996, the greenhouse is a moveable structure on the second floor of Salisbury Labs. The space is used as a research and experimental classroom area, where students taking Plant Diversity with Professor Pamela Weathers and members of the Greenhouse and Horticulture Club can get a close up look at the 30 species of succulents and cacti. There are also several water plants, ferns, sundews, and tropical plants including a white pineapple.

Plant Parenthood

Begun in 2014 and revived in 2018 by Barbara Milanese, Plant Parenthood is a popular program that invites students to learn about plant care and propagation. They can also take home a plant they or another student propagated. The program is especially popular during the winter months, as the space is kept warm to accommodate the tropical plants.

Greenhouse and Horticulture Club

Students who are part of this club enjoy helping care for the greenhouse plants, as well as visiting local botanical gardens and nurseries.

Food Recovery Network

This association brings surplus food from WPI dining locations and events to those in need around Worcester.

Habitat for Humanity

In this non-profit organization, students advocate, fundraise, and build to provide adequate housing for individuals worldwide.

Global Humanitarian Alliance

The Global Humanitarian Alliance encourages diversity with engaging discussions and project opportunities.

Outing Club

The Outing Club promotes and organizes safe, environmentally respectful outdoor activities and expeditions from WPI.

Vegetarian Club

Students promote the benefits of vegetarianism and veganism, while supporting those who currently live or wish to try these lifestyles.

Engineers Without Borders

Engineers Without Borders orchestrates various projects to help global communities sustainably meet basic human needs and solve challenges.

American Academy of Environmental Engineers and Scientists

This organization aims to provide WPI Environmental Engineers access to programs and benefits, professional development, and a sense of community.

Students For A Just and Stable Future

To help move towards a peaceful, sustainable future, students organize on campus events that address topics such as climate change, eliminating plastic bottle waste, and environmental concerns involving ExxonMobil.

Gordon Library

The library hosts many events throughout the year, such as stress-relief during finals, workshops, inclusive readings, and event announcements/results. One continuous practice is Food for Fines, where patrons can donate nonperishable food items in lieu of monetary payment for fines.

Recyclemania 2020

Recyclemania began in 2001 as a challenge to motivate students from the Ohio and Miami universities to recycle more. Over time, Recyclemania has partnered with the United States EPA WasteWise program and expanded to include over 1000 universities and colleges. It is also managed by the National Wildlife Federation, dedicated to reducing plastic waste to protect wildlife. WPI was one of 177 schools participating in Recyclemania 2020.

WPI's Placings

Diversion Recycling Rate

43.29% 87/177

Per Capita Classic

106/208 10.16lbs/capita®

Waste Minimization

77/173 32.78lbs/capita

Total Recycling

107/221 94930lbs

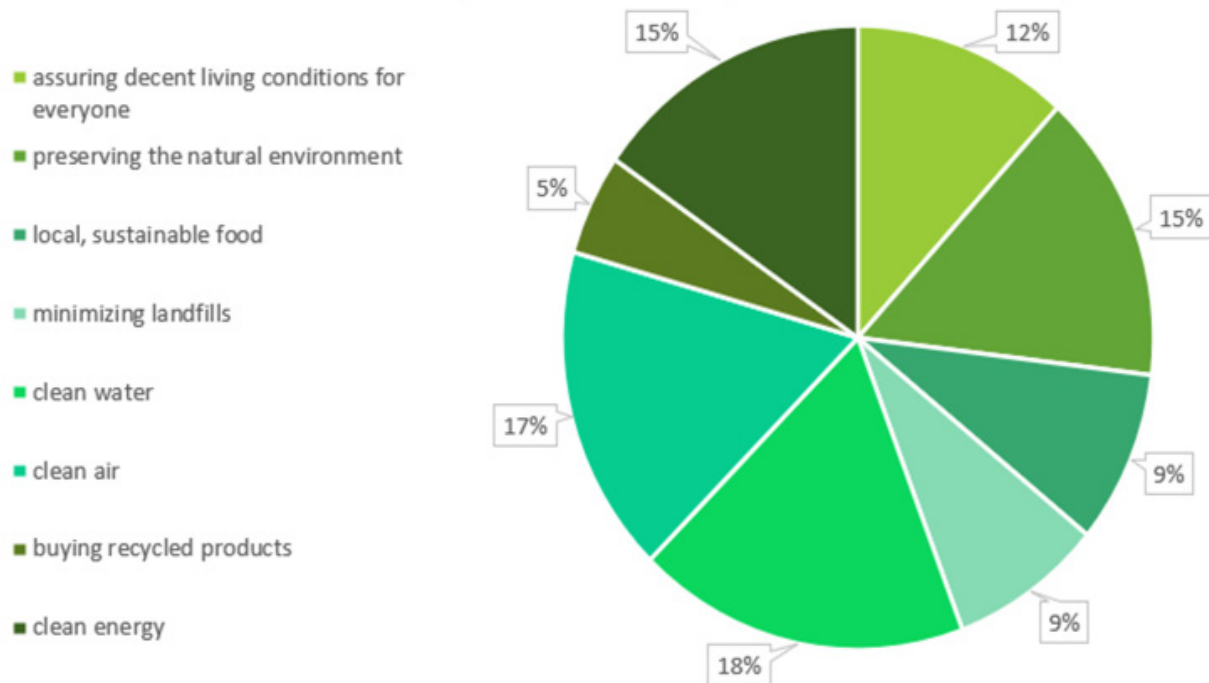
Food Organics

63/139 26950lbs/capita

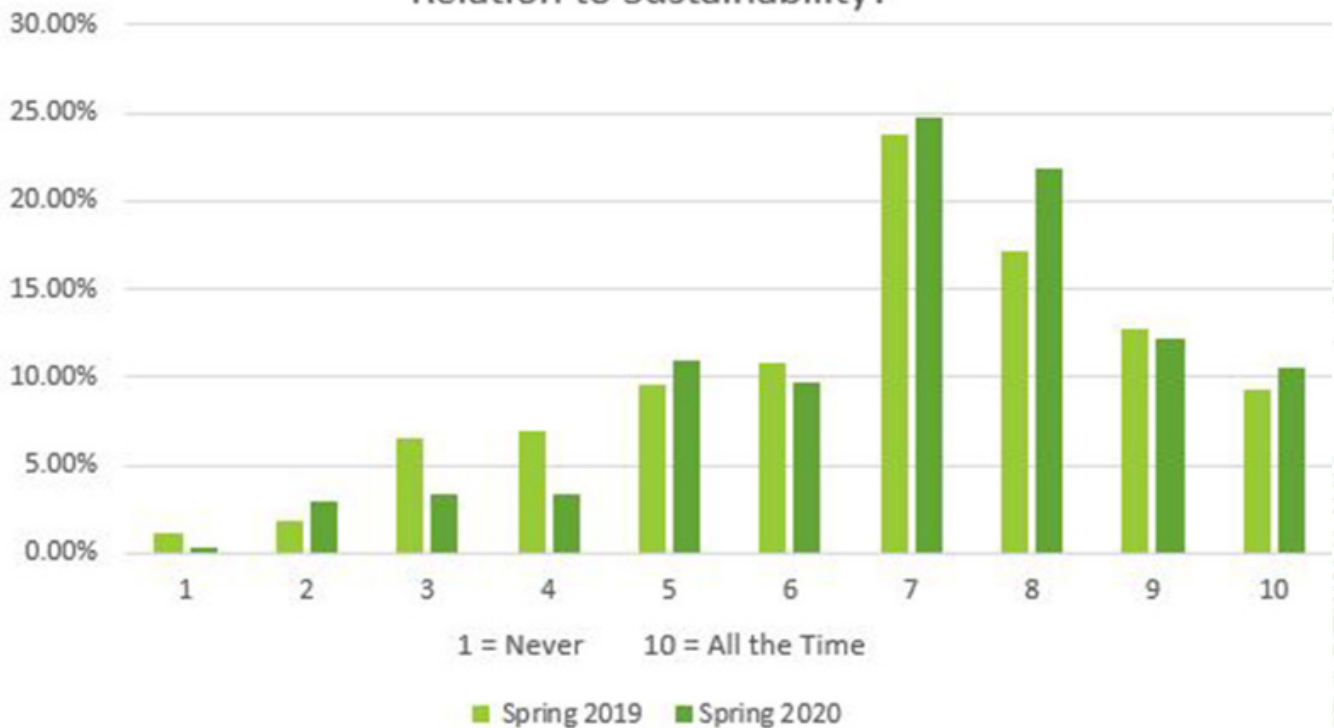
Literacy Assessment Survey

The Literacy Assessment Survey has been sent biannually in the fall and spring since 2017 to gauge the WPI community's understanding of sustainability. Overall responses showed a higher percentage of correct answers in 2020 than 2019, indicating better knowledge of sustainability. The first chart below displays the answers to the question "which is most important with respects to sustainability?". The majority of responders felt that clean water, clean air, and preserving the natural environment were the most important parts of sustainability listed, while buying recycled products was the least important. The bar graph highlights the responses to responders being asked how often they consider the effects of their actions in regards to sustainability for Spring 2019 and 2020. The graph shows how more individuals reported being more sustainability conscious in their actions this year, indicated by the higher amount of responses in the categories 5 and above, and less in 1 through 4.

Which is Most Important with Regards to Sustainability?



How Often Do You Consider the Effects of Your Actions in Relation to Sustainability?



2019 responders: 332
2020 responders: 238

COVID-19 Related Activities

COVID-19 has affected everyone's lives in countless ways, from health concerns to job insecurity and remote working/learning. In response, WPI has dedicated time, energy, and resources towards medical supplies, researching the effects and structure of the virus, and raising public awareness.

Donating:

Masks- sewn cloth, N95, surgical with/out face shields, clean room

Nitrile gloves

Safety glasses

Protective gowns

Surgical caps

Shoe covers

Surgical drapes

Cotton-tipped swabs for testing

Biohazard bags



Worcester Stitchers for Health:

WPI and Worcester community group sewing and sterilizing masks for healthcare and social services providers



3D Printing Medical Supplies



New IQPs

Using Dynamic Models and Empirical COVID-19 Data to Showcase Pandemic Prevention Measures

Transitioning During COVID-19: Student Perspectives

Analyzing the Effectiveness of Remote Labs at WPI

Recording Human Stories in a Time of Crisis

Coronavirus Global Stories

Evaluating Impacts of COVID-19 on the Dairy Industry

The Many Faces of COVID

In Conclusion...

WPI takes many steps to encourage sustainability in all aspects of life. Over the past year WPI has experienced a decrease in resource consumption and an increase in sustainability awareness and participation through courses, projects, and events. While this report cannot highlight every sustainable action that occurred this year, it provides a glimpse into what has been accomplished and what to look forward to. Sustainability is an essential part of the future that presents many unique challenges, and WPI rises to meet them.



Acknowledgements

I would like to thank the following people for all their help in the creation of this report:

Adriana Alvarado Blanco Uribe, Claire Barrameda, Mihail “Mike” Bocka, Kristin Boudreau, Berk Calli, Shavaun Cloran, Samuel Hopkins, Lisa Jano, Kristy Jones, Paul Mathisen, Kevin McLellan, Emily Perlow, Adam Powell, Amy Rajotte, Ali Rangwala, Yvette Rutledge, Ingrid Shockey, Elizabeth “Liz” Tomaszewski, Harold Walker, Pamela Weathers, and Lee Yaworski.

I would also like to congratulate Liz on her retirement. She has been a part of the Office of Sustainability for 17 years at WPI, bringing her passion and ideas to various sustainable events and initiatives.

Finally, thank you, reader, for taking the time to learn about how WPI encourages sustainability. If you would like to learn more, feel free to visit the website <https://www.wpi.edu/offices/sustainability> or email green@wpi.edu.

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Sustainability Intern
Environmental Engineer 2021

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