Carbon Copy:
A History of Greenhouse Gas Emissions at Wellesley College, 1900 and 2015

Table of Contents

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Rachael Coombes
Meredith Germano
Library and Technology Services
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AVI Fresh
Professor Jay Turner
The Wellesley College Sustainability Committee
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The Ruhlman Committee

Contributors

Academic Advisor	Monica Higgins
Project Manager	Julie Y. Rong (2016)
Project Coordinator	Sofia C. Diaz De Villegas
Data Editor	Charlotte H. Benishek
Presentation Coordinator	Alyssa N. Brody
Graphics Editor	Samantha L. Brown
Archivist	Catherine E. Burnett
Archivist	Sumner M. Hanula
Media Contact	Rita Mary Hennigan
Sustainability Coordinator	Hayley N. Jewett
Text Editor	Rebecca A. Matteson
On-Demand Editor	Leah M. Nugent
Publication Manager	Vivienne Tateyuskanskan

Photo taken by Monica Higgins, *Spring 2016*

List of Tables and Figures

Executive Summary

This spring, Wellesley College's Sustainability Committee requested that the Environmental Studies capstone course, ES 300, conduct an audit of the college's greenhouse gas (GHG) emissions. The purpose of this report is to urge Wellesley College to add its name to the growing list of universities and organizations who have committed themselves to taking action in order to reduce the role they play in contributing to anthropogenic climate change. This report details the goals and methodology of our project, provides an estimate of the carbon emissions associated with college activities, and recommends possible strategies for addressing these emissions. We calculated the college's emissions for the years 2015 and 1990, estimating 1990 emissions as a baseline in order to give context to our findings.

When collecting and analyzing our data, we classified the college's emissions into three scopes of direct and indirect emissions: Scope 1, directly operated facilities and vehicles, Scope 2, purchased energy, and Scope 3, indirect emissions such as travel, consumption of goods, waste disposal, and investments. In contrast to previous ES 300 greenhouse gas audits, we categorized emissions by scope rather than by sector in order to highlight both our direct and indirect contributions to climate change. While many colleges do not calculate the full spectrum of their Scope 3 emissions, these indirect emissions constitute a large portion of the college's total emissions, and are emitted on both an individual and institutional scale. By including Scope 3 emissions in our study, we suggested additional ways that Wellesley College can reduce emissions to meet its sustainability targets.

Including all scopes, Wellesley College emitted a total of 45,608.3 metric tons of carbon dioxide equivalents (MT $CO2_e$) in 2015. This report finds that the largest source of emissions is the college's Cogeneration plant and its production of steam, accounting for 57% of total emissions. Scope 2 accounted for 5% of total emissions, while Scope 3 accounted for 38%. Within Scope 3, student travel, student commuting, and air travel accounted for the largest sources of emissions.

This report recommends three general courses of action for the college to adopt: alter college travel and consumption patterns, divest from fossil fuel companies, and offset carbon emissions and incentivize clean energy. Recognizing that certain sources of emissions, such as student travel, are not easily adjusted, this report identifies such sources of emissions that the college is able to change. Based on the structure of Wellesley College's current GHG emissions, we believe these goals are feasible for the college to adopt.

Over the past decade, Wellesley College has made significant progress in its commitment to sustainability. However, as long as climate change remains a global problem, there will always be more work to be done. We hope that this report presents the information the college needs to commit to its sustainability goals and reduce the role it plays in contributing to climate change.

The Wellesley News, "Wellesley Students Join Record-breaking People's Climate March in NYC"

INTRODUCTION

Fossil Free Wellesley, Spring 2013

Introduction to Climate Change

Earth has gone through periods of warming and cooling for millions of years.[1] However, anthropogenic activities have drastically increased the current rate of warming. In the past century, human actions have exacerbated the greenhouse effect, causing average temperatures to increase by 1.5 degrees Fahrenheit.[2] The greenhouse effect is in itself a natural process that is necessary for the earth to remain at sustainable living temperatures. These gases trap solar radiation in the atmosphere, keeping the Earth's surface warm.[3] Some of these greenhouse gases include carbon dioxide, water vapor, and methane. Each gas traps different amounts of solar radiation and causes warming to different degrees. Water vapor and carbon dioxide are present in the highest concentrations, but more powerful gases such as methane and nitrous oxide, although present in smaller amounts, can make large contributions to global warming.[4]

There is now compelling evidence that humans have had an influence on the Earth's climate system. Each of the last three decades has been successively warmer than any previous decade since 1850, and the three decades from 1983 to 2012 were likely the warmest 30 years of the last 1400 years in the Northern Hemisphere.[5]

Human activities, such as the burning of fossil fuels, have resulted in increased concentrations of greenhouse gases in the atmosphere, which warm the atmosphere at higher rates than normal.[6] The Intergovernmental Panel on Climate Change's Assessment Report 5 states that current atmospheric concentrations of carbon dioxide, methane, and nitrous oxide are at levels that are unprecedented in the last 800,000 years. The effects of these greenhouse gases, together with anthropogenic activities, are extremely likely to be the cause of the warming the Earth has seen recently.[7]

Benefits to Addressing Climate Change at Wellesley College

For years, there has been debate over the existence and seriousness of anthropogenic climate change, despite the consensus among 97% of scientists.[8] Recent national statements and international agreements, such as President Obama's State of the Union Address and the Paris Climate Accord, respectively, have led the international community to recognize climate change as a significant global threat. It was not until the Paris Climate Accord that the international community began to make concrete emissions reductions commitments and recognize that climate change is a global issue. The accord was signed in December of 2015 by one hundred and ninety five countries, making it the first universal and legally-binding global climate agreement.[9] Participating nations agreed to a long-term goal to keep the global average temperature increase below two degrees Celsius by 2100. If the globe warms more than two degrees, it will be faced with intense heat waves, mass coral reef die-off,[10] and long droughts severe enough to disrupt the world's food supply.[11] Furthermore, sea

1 "Global Warming Natural Cycle." *Open Source Systems Science Solutions.* Accessed May 3, 2016. http://ossfoundation.us/projects/environment/global-warming/natural-cycle.

2 "Climate Change: Basic Information." *United States Environmental Protection Agency.* Accessed May 3, 2016. https://www3.epa.gov/climatechange/basics/.

3 "What is the Greenhouse Effect?." *Intergovernmental Panel on Climate Change.* Accessed May 3, 2016. https://www.ipcc.ch/publications_and_data/ar4/wg1/en/faq-1-3.html.

4 Ibid.

5 "Climate Change 2014 Synthesis Report: Fifth Assessment Report." *Intergovernmental Panel on Climate Change.* Accessed May 10, 2016. http://ar5-syr.ipcc.ch/index.php

6 "Change Indicators in the United States: Greenhouse Gases." *United States Environmental Protection Agency.* Accessed May 3, 2016. https://www3.epa.gov/climatechange/science/indicators/ghg/.

7 "Climate Change 2014 Synthesis Report Summary for Policymakers." *Intergovernmental Panel on Climate Change.* Accessed May 10, 2016. http://www.ipcc.ch/pdf/assessment-report/ar5/syr/AR5_SYR_FINAL_SPM.pdf

8 "Scientific consensus: Earth's climate is warming." *NASA: Global Climate Change.* http://climate.nasa.gov/scientific-consensus/

9 "Paris Agreement." *European Commission on Climate Action.* April 21, 2016. Accessed May 10, 2016. http://ec.europa.eu/clima/policies/international/negotiations/paris/index_en.htm

10 John Upton. "Has the Original U.N. Climate Goal Been Forgotten?" *Scientific American.* Accessed in May 15, 2016. http://www.scientificamerican.com/article/has-the-original-u-n-climate-goal-been-forgotten/

11 Gwen Ifill and William Brangham."Why 2 degrees Celsius is climate change's magic number." *PBS Newshour.* Accessed May 15, 2016. http://www.pbs.org/newshour/bb/why-2-degrees-celsius-is-climate-changes-magic-number/

level would rise over three feet.[12] While many scientists argue that two degrees Celsius itself is too high a goal to prevent major global catastrophe,[13] the two degree target acts as a political target that nations around the world can agree upon.[14]

Each country submitted thorough national climate action plans, decided to meet every five years and update plans in accordance with changing science, and agreed to carry out their climate actions with complete transparency and accountability. This international agreement signaled an encouraging shift in global politics; world leaders finally gave climate change at least a fraction of the attention such a threat deserves.

For this reason, it is important that Wellesley make a commitment to address climate change. Doing so ensures sustainability for future generations of college students and helps increase the efficiency of energy consumption, saving Wellesley College's money in the process.[15] Additionally, the effects of climate change may have an array of ecological consequences for the college, ranging from facilitating the spread of invasive species[16] to altering weather patterns and precipitation.[17] Wellesley's climate impacts also extend far beyond the college's campus. Our campus prides itself in being a diverse community, with students who not only come from all over the world, but who strive to influence the world around them after their time at Wellesley ends. Because Wellesley supports its students to make an impact on the greater global community, the college should aim to think and act globally in terms of its effect on climate, as well. The emissions that result from Wellesley's existence contribute to climate change that will undoubtedly impact people worldwide. Although we do not know exactly which impacts have, and will continue to result from our emissions, we do know that those who suffer most from our changing climate are those who have contributed the least to its escalation.[18] Wellesley should take this disproportionate distribution of climate change on poorer communities into account when evaluating how to reduce its own activities that may be contributing to this widening gap in social justice. Because of Wellesley's prestige, addressing climate change here can influence other colleges and institutions to curb their greenhouse gas emissions as well.

Wellesley College Response to Climate Change

Sustainability is defined as development that "meets the needs of the present without compromising the ability of future generations to meet their own needs."[19] Wellesley College has committed to ensuring that campus wide consumption conforms to sustainable practices. In April 2016, the Board of Trustees adopted the "Wellesley College Strategic Sustainability Plan, 2016-2026" as a response to ongoing concerns regarding campus sustainability. The following four statements are the key principles of the 2016 Sustainability Plan as written by the Wellesley College Sustainability Committee.[20]

1.) "There is an intrinsic relationship between on campus practices and broader sustainability challenges."
2.) "It benefits our students to live in an ecologically diverse, energy efficient, and healthy campus that models traditional and new approaches to environmental sustainability."
3.) "Sustainable practices are consistent with the long term stewardship of the college's assets and financial well being."
4.) "Improving our environmental sustainability will burnish Wellesley's reputation. An institution that fosters leadership and civic [sic] should lead in this work."[21]

Within the most recent decades, Wellesley College's commitment to sustainability has begun to pick up steam. Examples of past work done to fulfill this responsibility to a sustainable Wellesley include the creation of a cogeneration plant, which helped to reduce greenhouse gas emissions by 25% since 1994, and the work done to reduce potable water use by 39% since 1999.[22] There have also been other initiatives started on campus in order to help fulfill our commitment. Some of these include campus landscape restoration projects, students sales to promote recycling and reuse, the establishment of food composting in 2012,[23] the Class of 1957 Green Fund (which provides funding for initiatives to enhance sustainable practices at Wellesley such was the implementation of hybrid vehicle charging ports in the Davis parking garage), and adoption of green building standards.[24] The college also began to adopt environmental sustainability goals into its administrative activities. In 2009, the college established the Sustainability Office, and in 2007, it established the Advisory Committee on Environmental Sustainability,[25] which includes administrative, faculty, staff, and student representatives who implement institutional sustainability projects.

One of the most significant environmental actions taken at Wellesley in the past 10 years was the adoption of the college's first sustainability commitment in 2008. The Board of Trustees implemented four

Change Magazine, "A fossil Free Wellesley, Meredith Wade.

12 John Upton. "Has the Original U.N. Climate Goal Been Forgotten?" *Scientific American*. Accessed in May 15, 2016. http://www.scientificamerican.com/article/has-the-original-u-n-climate-goal-been-forgotten/

13 Ibid.

14 Gwen Ifill and William Brangham."Why 2 degrees Celsius is climate change's magic number." *PBS Newshour*. Accessed May 15, 2016. http://www.pbs.org/newshour/bb/why-2-degrees-celsius-is-climate-changes-magic-number/

15 "Sustainability Saves, Makes Money" *Hartford Business*. December 13, 2010. Accessed May 15, 2016. http://www.hartfordbusiness.com/article/20101213/PRINTEDITION/312139988/sustainability-saves-makes-money--companies-share-experiences-at-hartford-sustainability-conference

16 Hellmann, Jessica J., James E. Byers, Britta G. Bierwagen, and Jeffrey S. Dukes. "Five Potential Consequences of Climate Change for Invasive Species." *Conservation Biology* 22, no. 3 (June 1, 2008): 534–43. doi:10.1111/j.1523-1739.2008.00951.x.

17 "Climate Change Impacts." *Environmental Defense Fund*. 2016. Accessed May 10, 2016. https://www.edf.org/climate/climate-change-impacts.

18 Goldenberg, Suzanne. "Climate Change: The Poor Will Suffer Most." *The Guardian*. March 30, 2014. Accessed May 10, 2016. http://www.theguardian.com/environment/2014/mar/31/climate-change-poor-suffer-most-un-report.

19 "Our Common Future." *World Commission on Environment and Development*. Accessed March15, 2015 http://www.un-documents.net/our-common-future.pdf

20 "Wellesley College's Strategic Sustainability Plan, 2016-2026." *Wellesley College*. February 5, 2016. http://cs.wellesley.edu/~slee/sust/plan.pdf

21 "Wellesley College's Strategic Sustainability Plan, 2016-2026." *Wellesley College*. February 5, 2016. http://cs.wellesley.edu/~slee/sust/plan.pdf

22 Ibid.

23 Gaglini, Danielle. "Wellesley College Sustainability Report 2012," February 2013. http://web.wellesley.edu/sustainability/2012%20Sustainability%20Report%20Final.pdf.

24 Ibid.

25 "Wellesley College Sustainability Report 2011." *College Sustainability Report Card*. Accessed March 15, 2016. http://www.greenreportcard.org/report-card-2011/schools/wellesley-college.html

major initiatives targeted at four aspects of sustainability: landscape, water conservation, waste reduction, and energy use reduction.[26] For example, the college pledged to reduce its water consumption by 25% by 2013 and reduce energy consumption by 13%. The 2008 commitment was one of the first green institutional policies implemented by the college that had explicit numerical targets for reduction. The initiative was successful; by 2012, Wellesley reduced its water consumption by 20%, and helped the town of Wellesley achieve certification as a Green Power Partner Community by the Environmental Protection Agency (EPA) for its support of renewable energy.[27]

Sustainability
Wellesley College

Looking forward to 2026, the college released five criteria in its sustainability plan, which was passed in April 2016. The five criteria of the 2016 Sustainability Plan as written by the Wellesley College Sustainability Committee include:[28]

1.) "Academic and Co-curricular Integration"
Wellesley College prides itself on its educational mission. By bringing "sustainability into the classroom,"[29] the college hopes to give students the tools to understand the scope of Wellesley's sustainable development practices.

2.) "Data Collection and Community Engagement"
A big part of becoming more sustainable as a campus is making sure that decision-makers have the necessary data to treat the college's goals and problems with the nuance they deserve. With the implementation of monitoring systems "for primary utilities [e.g. electricity and water] at the building level for 80 percent of campus,"[30] the college can further its educational research and data collection for campus wide consumption patterns.

3.) "Energy, Buildings, and Transportation and Climate Change"
One of the college's main goals is to reduce its greenhouse gas emissions. By implementing green building standards along with improving efficiencies both in new and old buildings, the college can begin to make progress towards its CO_2 reduction goal.

4.) "Landscape, Watershed, and Water"
According to the college, Wellesley's landscape is one of its most valuable assets. In order to preserve this asset, the college has committed to creating a more "ecologically sustainable landscape,"[31] in the way that it is both maintained and modified.

5.) "Food, Dining, Purchasing, and Waste Management"
Wellesley College is a large institution, and therefore it uses a large amount of resources and disposes of a similar quantity of waste. The college intends to reuse more resources and to purchase more sustainable products. With these goals in mind, the college hopes to reduce consumption and waste.

Through this plan, the college intends to reduce its overall environmental impact both on and off campus. However, the more concrete goal set up for climate change is maybe one of the most important parts of the 2016 Sustainability Plan. The college plans on reducing CO_2 emissions by 37% by 2026 and 44% by 2036 from a 2010 baseline.[32] Before this plan was adopted, the college had not yet agreed to any concrete CO_2 emissions reduction, so the plan is a huge step forward for campus sustainability efforts. In order to achieve this goal, the college plans to increase the energy efficiency of buildings and change college infrastructure.

26 Gaglini, Danielle. "Wellesley College Sustainability Report 2012," February 2013. http://web.wellesley.edu/sustainability/2012%20Sustainability%20Report%20Final.pdf.

27 Ibid.

28 "Wellesley College's Strategic Sustainability Plan, 2016-2026." *Wellesley College*. February 5, 2016. http://cs.wellesley.edu/~slee/sust/plan.pdf

29 Ibid.

30 Ibid.

31 Ibid.

32 "Wellesley College's Strategic Sustainability Plan, 2016-2026." *Wellesley College*. February 5, 2016. http://cs.wellesley.edu/~slee/sust/plan.pdf

Wellesley College and Divestment

One significant way that Wellesley College could fulfill its commitment to sustainability is to divest from fossil fuels. Divestment is the removal of investment assets (e.g. stocks, bonds, and investment funds) from companies that are involved in the extraction of fossil fuels.[33] Those companies would then be unable to use Wellesley's capital to extract fossil fuels, which contribute greatly to climate change when burned. Colleges and universities invest billions of dollars into the fossil fuel industry; Harvard University alone invests an estimated $1 billion.[34] According to Fossil Free Indexes, a research and consulting firm, Harvard's fossil fuel investments produce approximately 100 million tons of CO_2e emissions.[35] The magnitude of carbon emissions associated with college fossil fuel investment highlights how divestment has the potential to reduce global fossil fuel production, especially if multiple colleges and universities decide to divest.

The college has already considered this option, but decided not to pursue it. On March 7, 2014, the Board of Trustees and President Bottomly released a statement saying that they did not support divesting. In this statement, they said, " [they] do not support the idea of using the College's endowment as a lever for social change and determined that such an action would conflict with the purpose of the endowment."[36] They went on to discuss how they believed that divesting would gravely harm the educational mission of Wellesley College and also determined that "the economic impact on fossil fuel companies [would be] inconsequential."[37]

In 2013, the student organization Fossil Free Wellesley (FFW) asked for a freeze on the new holdings in fossil fuel companies. The organization wanted the college to sell direct holdings for the 200 largest fossil fuel companies within 2 years and all holdings within 5 years.[38] FFW gained support among students and gathered nearly 1000 student signatures in support of divestment,[39] which is about 40% of current enrollment. The difficulty with this movement is that many colleges around the country reject divestment as a goal for sustainability.[40] Despite choosing not to divest in 2014, Wellesley College has divested in the past in the name of social justice. In 1986, students endorsed divestment from South Africa in order to protest the apartheid.[41]

Despite the benefits associated with divestment, some say it is an ineffective way to combat climate change. According to this argument, when one divests, there will always be other investors waiting to buy up the newly available stocks. When another organization purchases the shares, the total amount of money available to fossil fuel companies does not decrease, but rather changes hands. Although such a campaign brings awareness to the issue of climate change, it does not take direct action against the heart of the problem. In addition, many colleges are concerned that divesting "will speed up the necessary transition from coal to renewable or less polluted sources of energy."[42] Most colleges see the act of divestment as a social movement that makes a

33 Bottomly, Kim. "Divestment." *Wellesley College*, March 7, 2014. http://www.wellesley.edu/about/president/mytake/divestment/node/42604.

34 "Harvard's Financing of CO2 Emissions from the Reserves of Fossil Fuel Companies." *Fossil Free Indexes*. Accessed March 15, 2016. http://fossilfreeindexes.com/research/harvard-emissions/.

35 "Harvard's $36 billion endowment may have a 100-million-ton carbon footprint." *Mashable*. Accessed March 15, 2016. http://mashable.com/2015/04/14/harvard-endowment-carbon-dioxide/#pQTYB_ACtuqY

36 Bottomly, Kim. "Divestment." *Wellesley College*, March 7, 2014. http://www.wellesley.edu/about/president/mytake/divestment/node/42604.

37 Ibid.

38 Emily Bary. "College Announces It Will Not Divest Endowment of Fossil Fuel Stock." *Wellesley News*. March 2014. Accessed March 15, 2016. http://thewellesleynews.com/2014/03/13/college-announces-it-will-not-divest-endowment-of-fossil-fuel-stock-2/

39 Ibid.

40 Ibid.

41 Michelle Al-Ferzly, Catherine B., Dhivya Perumal, Whitney Sheng, and Laura Wong. "Divestment Then and Now: A History of Wellesley's South African Divestment Movement." *Wellesley News*. May 12, 2014. http://thewellesleynews.com/2014/05/12/divestment-then-and-now-a-history-of-wellesleys-south-african-divestment-movement/.

42 "What They're Saying." *Divestment Facts*. Accessed May 9, 2016. http://divestmentfacts.com/category/what-theyre-saying/.

statement for the college, but does not address the problem itself. Currently investment in fossil fuels is beneficial to the educational missions of not just Wellesley but colleges and universities across the country, and the act of divesting does not look as though it will change the energy sector in its entirety.

Another obstacle to divestment is simply a logistical one. Wellesley currently invests in a wide variety of fossil fuel producing companies. Undeniably, fossil fuel production is a lucrative industry, and removing our investments in these companies might result in substantially lower investment returns, giving Wellesley less money for day-to-day operations. Another concern for Wellesley specifically is that Wellesley's endowment is currently managed by investment professionals whose decisions consistently result in returns greater than the market average.[43] These managers are not willing to divest, so in order to divest, we would have to hire new managers who might not be able to generate such consistently positive returns. For these reasons, Wellesley's Board of Trustees believed that divestment would not be a fiscally responsible decision.

Although Wellesley has formally rejected students' push for divestment, the movement still has potential to make a social impact. If even a small group of high-profile schools such as Wellesley divested from fossil fuels, it would demonstrate the feasibility of divestment and act as a challenge to similar institutions to divest. This could create a chain reaction, eventually resulting in mass divestment by educational institutions who want to send a moral message about fossil fuel production and consumption to their students and the public. Mass college divestment could significantly economically impair fossil fuel companies, the value of their stocks, and their ability to produce dirty fuels that release greenhouse gases.

Greenhouse Gas Inventories

A greenhouse gas inventory is an effort by an institution, such as a school or business, to tally all of the greenhouse gasses produced directly or indirectly as a result of the institution's activities over a discrete time period (e.g. a year). This report covers two greenhouse gas inventories of Wellesley College — one for 2015 and one for 1990. Objectives of Wellesley's greenhouse gas inventories include: To produce a high quality estimate of greenhouse gas emissions caused by the activities of Wellesley College students, faculty and staff during the calendar year 2015, to produce the most accurate estimate possible of greenhouse gas emissions caused by the activities of Wellesley College students, faculty and staff during the calendar year 1990, and to provide a detailed breakdown of 2015 greenhouse gas emissions by scope (see "Methodology Overview" below) and within scopes in order to assist Wellesley's administration in efficiently reducing the college's greenhouse gas output as part of future environmental sustainability efforts.

We chose to conduct the inventory for 2015 because it is the most recent year for which the college had complete operational data. This report is unique because it is the first Wellesley report to attempt to calculate a 1990 greenhouse gas emissions figure in addition to a contemporary figure. We chose 1990 because it is a standard year from which to create greenhouse gas emissions targets. Institutions at all levels, including nations participating in international treaties such as the Kyoto Protocol, use 1990 emissions as the basis for future emissions reductions targets.

Methodology Overview

This greenhouse gas inventory uses "scopes" as a framework for organizing the calculation of Wellesley's annual greenhouse gas emissions. The idea of scopes was initially developed by the World Resources Institute (WRI) and World Business Council on Sustainable Development as part of the Greenhouse Gas Protocol.[44] The Greenhouse Gas Protocol is an internationally standardized method of accounting for greenhouse gas emissions employed by governments, corporations, and other institutions worldwide. The Protocol defines the range of direct and indirect emissions which falls within a company or group's institutional responsibility. These emissions are divided into three categories of emissions: Scope 1, Scope 2, and Scope 3.[45] The idea of scopes is a useful way for colleges and other organizations to consider their indirect carbon emissions, which are frequently excluded from carbon audits, despite the fact that they can account for more than 1/3rd of an institution's carbon footprint (see page 15).

Scope 1 consists of direct GHG emissions resulting from sources the company owns or controls. Scope 1 emissions primarily stem from the on-site generation of electricity, heat, and steam, and from travel in company-owned vehicles. In the case of Wellesley College, emissions from on-campus power and steam generation, as well as emissions from Wellesley's own fleet of vehicles and contracted shuttles are counted in Scope 1. A second category of emissions — indirect emissions — are emissions that occur off site, but are caused by the activities of the college. Indirect emissions are broken down into two scopes. Scope 2 includes emissions associated with the purchase of energy for lighting, heating and cooling. Scope 3 encompasses indirect emissions not associated with the purchase of energy; organizations decide at their own discretion which categories they report.[46] Examples of Scope 3 emissions include: emissions produced through employee commuting, student travel to and from home, the disposal of waste, the purchasing of goods, and the college's investments. A summary of the categories of emissions-producing activities included in each scope are summarized in Table 1.

Our Tool: The Campus Carbon Calculator

In order to calculate Wellesley College's greenhouse gas emissions from 1990 and 2015, we used the "Campus Carbon Calculator" (CCC). This tool was created to help organizations and higher institutions measure their contributions to global climate change.[47] This information can help institutions understand what activities produce the most emissions and make informed decisions about how to reduce their carbon footprints. In 2001, the CCC was developed by the former non-profit Clean Air - Cool Planet and the Sustainability Institute at UNH. It was then released to the public in 2004. More than 90% of colleges and universities in the U.S. that publicly report their emissions use the CCC to do so.

This calculator is in the form of an excel sheet that requires an extensive amount of information about the college's emission patterns in order to calculate a total emission number. Data are inputted into the spreadsheet in the form of pounds, gallons, kWhs, miles etc. and then the calculator converts and calculates the data in order to produce a total emissions calculation in CO_2 equivalents. The calculator houses the conversion rates in order to unify all the data in the same unit (CO_2 equivalents). This number can be broken down to understand how many metric tons of CO_2 equivalent emissions resulted from each activity. We used this particular tool because of it is easy to use as the calculator does much of the work for you. Also because we know that many other higher institutions and organizations use this tool it means that the conversion rates are the same and therefore accurately comparable.

43 "Wellesley College strives to be a responsible investor." *Wellesley College*. Accessed May 15, 2016. http://www.wellesley.edu/investmentoffice/initiatives.

44 "About the GHG Protocol." *Greenhouse Gas Protocol*. Accessed April 16,. 2016. http://www.ghgprotocol.org/about-ghgp

45 "The Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard." *World Business Council for Sustainable Development* and *World Resource Institute*. Accessed May 15, 2016. http://www.ghgprotocol.org/files/ghgp/public/ghg-protocol-revised.pdf

46 "FAQ." *Greenhouse Gas Protocol*. Accessed April 17, 2016. http://www.ghgprotocol.org/calculation-tools/faq

47 "What is the Carbon Calculator?" *Sustainability Institute, University of New Hampshire*. Accessed April 18, 2016.

While the CCC reports emissions in CO_2 equivalents (CO_2e), not all emissions associated with the college's actions that contribute to climate change are in the form of CO_2. CO_2 equivalents is a unit of measurement that normalizes the potency of various greenhouse gases based on their global warming potential, allowing for easier comparisons between greenhouse gasses.[48] For context, carbon dioxide equivalent has a global warming potential of 1 and methane has a potential of approximately 25 (all on a 100 year time horizon). For example, every 1 ton of methane emitted causes the same amount of warming as 25 tons of CO_2 would cause.[49]

The CCC spreadsheet included such a wide assortment of variables that some did not apply to Wellesley College. For example, Wellesley College has no significant animal husbandry. Conversely, our report included variables that the CCC did not consider such as the emissions associated with transporting various goods to campus and transporting wastes off campus. The CCC also did not account for the emissions that a college indirectly allows by investing in the production of fossil fuels. In these cases, we had to calculate the associated GHG emissions using other methods.

What is Different About This Report?

Within this report, we attempted to broaden our understanding of all activities that contribute to emissions by the college. The next most recent inventory, conducted in 2008, divides emissions by sector. In this new inventory we have chosen to organize emissions by scope. By doing this, we provided a comprehensive picture of both the direct and indirect contributions to Wellesley's greenhouse gas emissions. The Carbon Campus Calculator also breaks down emissions by scopes, so it made sense to organize our inventory along these lines. The scope framework is an ideal comparative tool for understanding Wellesley College in the context of its peer institutions and beyond. By separating the direct and indirect sources explicitly we were able to get a clear picture of what goes into each. With this information we were able to get a better picture of the major sources of emissions at Wellesley. This report also contains an inventory for the year 1990 at Wellesley which provides an essential baseline. With this information we are able to see the progression and trends at Wellesley through the years.

We are pleased to report that our GHG report includes topics that other institutions tend to ignore in their inventories. Our GHG inventory discusses the emissions that a college indirectly sponsors by investing money in the fossil fuel industry. These investments, properly considered, exert a huge influence on the footprint of a college. Other unusual, but very important, considerations include travel associated with student study abroad, student travel to and from home, and travel by athletic teams and admissions officers. We also considered the carbon emitted by trucks carrying our waste off campus and the carbon emissions associated with incinerating waste.

History of ES 300

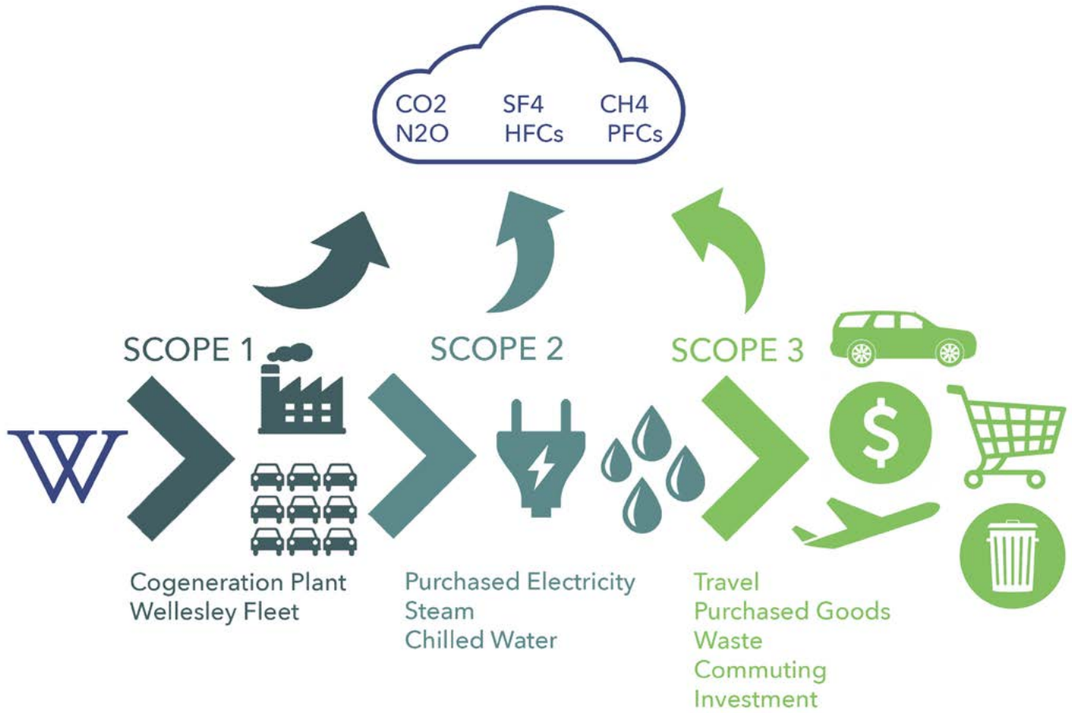
Since 2003, ES 300, one of the Environmental Studies capstone courses, has conducted a campus-wide project to assess or act upon an environmental issue at Wellesley College. Students are able to refer to skills and tools that they have developed over the course of the major, which they apply to the current issue. Past projects have included a compost initiative in 2013, a waste reduction initiative in 2012, and assessments of Wellesley's greenhouse gas emissions in 2003 and 2008. In 2016 our group returned to the topic of assessing Wellesley's greenhouse gas emissions.

The College Sustainability Committee —which consists of administration, faculty, staff, and student representatives who work to implement greener institutional policies at Wellesley—requested that this year's ES 300 class investigate greenhouse gas emissions at Wellesley College. ES 300 conducted research on emissions stemming from two years: 2015 and 1990, a benchmark year to which 2015 emissions and future reductions can be compared. With natural resource consumption and greenhouse gas emissions rising worldwide, it is important to understand how past financial and infrastructural decisions made by the College administration, staff, and students played a role in shaping the future of environmental stewardship at Wellesley College.[50] With this information, the college will be able to fulfill its responsibility to the environment.

48 "Glossary of Statistical Terms: Carbon Dioxide Equivalent." *Organization for Economic Co-Operation and Development.* Accessed May 15, 2016.

49 "What is the Difference between CO_2 and CO_2e?" *Sustainable Business Toolkit.* Accessed May 15, 2016.

50 Eric G. Olson. "Challenges and Opportunities from Greenhouse Gas Emissions Reporting and Independent Auditing." *Managerial Auditing Journal* 25, no. 9 (October 12, 2010): 934–42. doi:10.1108/02686901011080071.



RESULTS & DISCUSSION

Mapio, "Weston Road", 2015.

2015 Total Emissions

In 2015, Wellesley College emitted a total of 45,535 metric tons of carbon dioxide equivalents (MT CO_2e). A 2005 Toyota car[1] would emit about that much carbon if it circled the earth over 7.5 times.[2] Scope 1 accounted for nearly two-thirds of the whole, whereas Scope 2 accounted for only 5%. Scope 3 contributed the remaining emissions, 38% of the total. Although we tried to include every category that the Greenhouse Gas Protocol considers as a source of Scope 3 emissions,[3] we were unable to include everything that falls under this classification. Even so, the Scope 3 factors we were able to quantify exerted a huge influence on the final emissions total. In the following sections, these scopes are further broken down to paint a clearer picture of which sources of emissions drive these emission patterns.

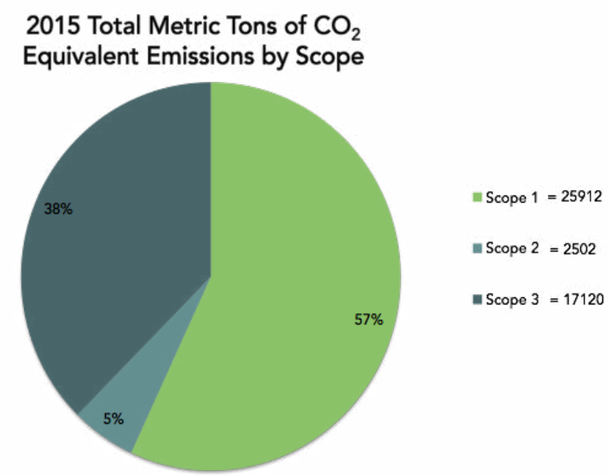
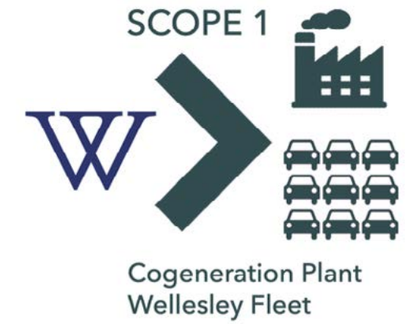


Figure 1. Total emissions from Scopes 1, 2, and 3 from 2015 at Wellesley College.

1 "Fuel Economy Guide." *U.S. Department of Energy*. Accessed May 14, 2016. https://www.fueleconomy.gov/feg/pdfs/guides/FEG2005.pdf.

2 "EPA Conversions Used in the US."*CO_2 Benchmark*. Accessed May 14, 2016. http://www.co2benchmark.com/EPA-calculations-and-conversions.

3 "Corporate Value Chain (Scope 3) Accounting and Reporting Standard." Greenhouse Gas Protocol. Accessed May 15, 2016. http://www.ghgprotocol.org/files/ghgp/public/Corporate-Value-Chain-Accounting-Reporing-Standard_041613.pdf



Scope 1 Emissions

Of all Scope 1 emissions, 96% are generated from the electricity and steam produced from Wellesley's cogeneration plant, while the remaining 4% consists of the direct transportation from the Wellesley fleet (3%) and refrigerants and chemicals (1%) used on campus.

In 1993, Wellesley College built an on-campus cogeneration plant that began running in April of 1994. Today it provides the school with its own source of electricity, hot water, and air conditioning. The plant relies on natural gas to run its five 1,400 kW high-efficiency reciprocating gas engines, which produce electricity as well as steam, a byproduct of the process.[4] This steam supplies space and water heating, in addition to chilled water, to the college's residential and academic buildings.[5] The college's reliance on the cogeneration plant has greatly reduced its dependence and spending on outside sources of energy.

Scope 1 emissions from 2015 also include emissions associated with the Wellesley fleet, a category that comprises of all college-owned vehicles. We also considered the emissions

4 "High-tech Cogen plant saves money for Wellesley College." *Power Engineering*. Accessed May 15, 2016. http://www.power-eng.com/articles/print/volume-99/issue-9/field-notes/high-tech-cogen-plant-saves-money-for-wellesley-college.html

5 Ibid.

from shuttles hired by the college, as it is a primary mode of transportation for a majority of Wellesley students. This scope takes into account emissions from the Babson/Olin/Wellesley (BOW) shuttle, the MIT Exchange shuttle, the Senate bus, and the Movie/Mall shuttle, all of which students use extensively for trips to local shopping areas, Boston, and nearby college campuses. Together, the cogeneration plant and Wellesley vehicle fleet accounted for nearly 22,000,000 kWh of energy, which corresponds to approximately 25,912.5 metric tons of CO2e.

2015 Scope 1 Metric Tons of CO_2 Equivalent Emissions

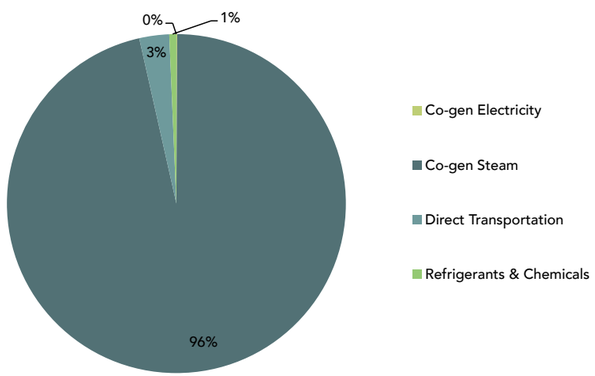


Figure 2. Total 2015 emissions from Scope 1 emissions at Wellesley College.

Scope 2 Emissions

The source of all Scope 2 emissions from 2015 was the electricity the college purchased from the town of Wellesley. Since 2012, 5% of the college's total electricity is renewable energy bought from Town of Wellesley.[6] Wellesley College agreed to this measure in order to help the Town meet its collective sustainable energy goal. In 2015, we purchased total of 7,570,460 KWh of electricity from the own supply, the same number of KWh that 90[7] average Americans might use in a year. ince the college's cogeneration plant produces ufficient chilled water and steam on-site, Vellesley College did not purchase either.

2015 Scope 2 Metric Tons of CO_2 Equivalent Emissions

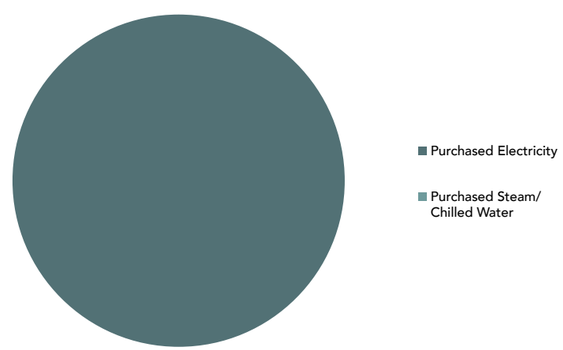


Figure 3. Total 2015 emissions from Scope 2 emissions at Wellesley College.

6 "Energy: Statistics." *Wellesley College*. Accessed May 15, 2016. http://www.wellesley.edu/sustainability/what-we-re-doing/energy

7 "How Much Electricity Does an American Home Use?" *U.S. Energy Information Administration*. Accessed May 14, 2016. https://www.eia.gov/tools/faqs/faq.cfm?id=97&t=3.

Scope 3 Emissions

Scope 3 accounted for 38% of all emissions in 2015 for Wellesley College. Transportation and travel-oriented activities dominated greenhouse gas emissions, comprising over 96% of the total. Student travel to and from home by car, bus, plane, and train, contributed roughly 60% of total Scope 3 emissions, making it the largest category within this scope. Because the effort to "expand awareness of the impacts of college-funded travel" is a primary goal of the college's Sustainability Commitment,[8] it is important to measure and draw attention to the greenhouse gas emissions associated with this type of travel. However, the college should not directly decrease the number or distance of student trips home, because Wellesley College prides itself on its diverse population. In 2015 alone, our student body included people from all fifty states, and thirty-one countries.[9] In addition to student travel to and from home, other travel categories, including directly financed air travel, contributed a significant amount of emissions to Scope 3. Once again, Wellesley should not directly limit this type of travel, since on average, nearly 50% of Wellesley College juniors[10] choose to study abroad, and this travel provides students with valuable alternative learning experiences.

2015 Scope 3 Metric Tons of CO_2 Equivalent Emissions

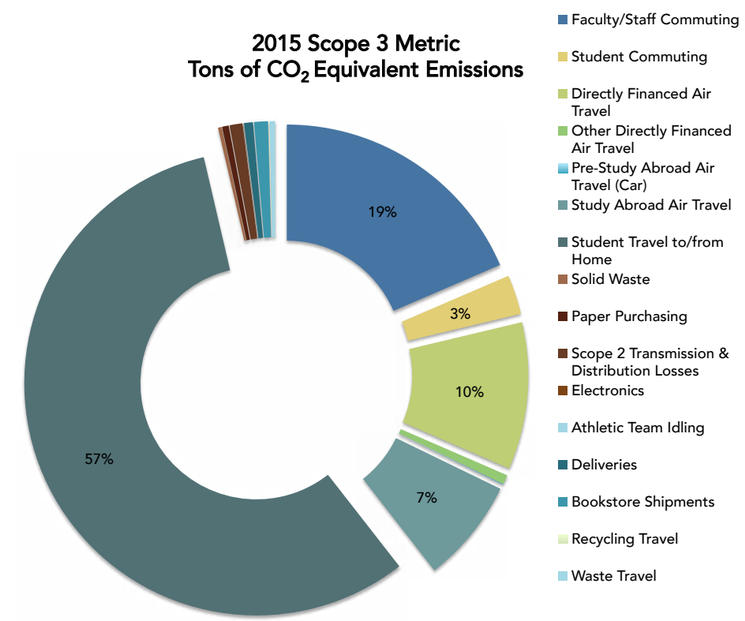


Figure 4. Total 2015 emissions from Scope 3 emissions at Wellesley College.

The figure below highlights categories of indirect emission sources that the college could focus on reducing without compromising the academic opportunities it offers to the student body. Disregarding travel or transportation, the category with the highest carbon emissions was food. We evaluated the carbon emissions associated with the life cycle of the three food products with the highest carbon footprints:

8 "Wellesley College's Strategic Sustainability Plan, 2016-2026." *Wellesley College*. February 5, 2016. http://cs.wellesley.edu/~slee/sust/plan.pdf

9 "Class of 2019 Admissions Statistics." *Wellesley College*. Accessed May 14, 2016. http://www.wellesley.edu/admission/facts/node/49916.

10 "Students Who Wish to Study Abroad May Choose from More than 160 Programs." *Wellesley College*. Accessed May 14, 2016. http://www.wellesley.edu/ois/node/27380.

meat, cheese, and eggs. Life cycle analysis refers to the environmental impacts of a product from "cradle to grave," including resource extraction, manufacture, transportation, use, and disposal.[11] Although emissions from other food products could have been included in the inventory — such as from vegetables, grains, and other dairy products — the fact that only three of the highest emission-producing foods contributes nearly 10% of total Scope 3 emissions for 2015 highlights their large impact. Since these meat, cheese, and eggs have the highest carbon emissions associated with them, the college should prioritize them when cutting emissions in this sector.

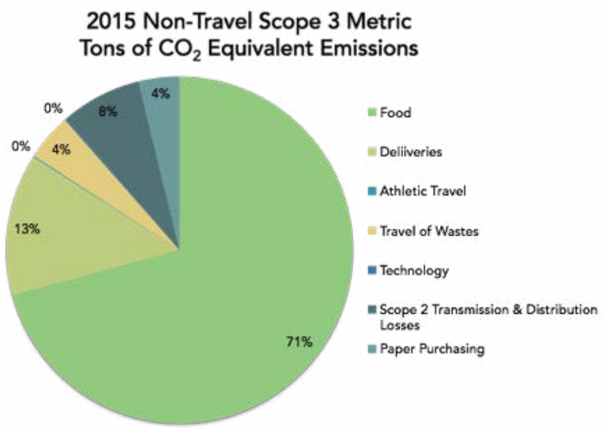


Figure 5. Scope 3 emissions from 2015 that are not associated with student or faculty travel categories.

Another primary source of Wellesley College's 2015 non-travel Scope 3 emissions is purchases and deliveries. This sector makes up 13% of the non-travel Scope 3 emissions. The majority of deliveries on campus can be divided into four categories: office supplies, IT, science center purchases, and facilities. Of these four categories, only office supplies comes to campus through the on-campus Purchasing Office. This office alone receives goods from six off-site vendors, which made nearly 900 deliveries to the college in 2015.

11 Adia Sefic Williams. "Life Cycle Analysis: A Step by Step Approach." *Illinois Sustainable Technology Center*, December 2009. http://www.istc.illinois.edu/info/library_docs/tr/tr40.pdf.

Together, these delivery trucks traveled 32,888 miles, or twelve times the horizontal length of the United States.[12] While the Purchasing Office received most of its office supplies from relatively local sources within the state of Massachusetts, other deliveries, such as those from the bookstore, came from across the United States. Unsurprisingly, deliveries to the bookstore produced four times more carbon emissions than the Purchasing Office did. While the Purchasing Office presumably receives a larger quantity of items than the College Bookstore, the inefficiencies of transportation routes associated with the Bookstore produced a greater amount of carbon emissions.

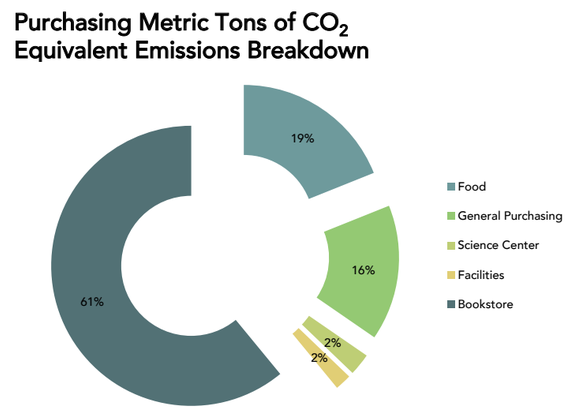


Figure 6. Scope 3 emissions associated from purchasing and deliveries at Wellesley College in 2015.

1990 Total Emissions

In 1990, Wellesley College emitted a total of 37,657.8 metric tons of carbon dioxide equivalents (CO_2e). A 2005 Toyota car[13] would emit about that much carbon if it circled the earth over 4 times. Of the total, Scope 1

12 "Geography Statistics of United States of America." *World Atlas*. Accessed May 14, 2016. http://www.worldatlas.com/webimage/countrys/namerica/usstates/uslandst.htm.

13 "Fuel Economy Guide." *U.S. Department of Energy*. Accessed May 14, 2016. https://www.fueleconomy.gov/feg/pdfs/guides/FEG2005.pdf.

accounted for 716.8 tons (3%), Scope 2 accounted for 25,043.4 tons (43%), and Scope 3 accounted for 11,897.6 tons (53%). The 1990 and 2015 data are sometimes not directly comparable, especially in Scope 3. Some data on these indirect emissions were either lost or non-existent. Even with less data available, Scope 3 still makes up about a third of the college's overall 1990 emissions. In the following sections, these scopes will be further broken down so as to paint a clearer picture of which sources of emissions drove these emissions patterns.

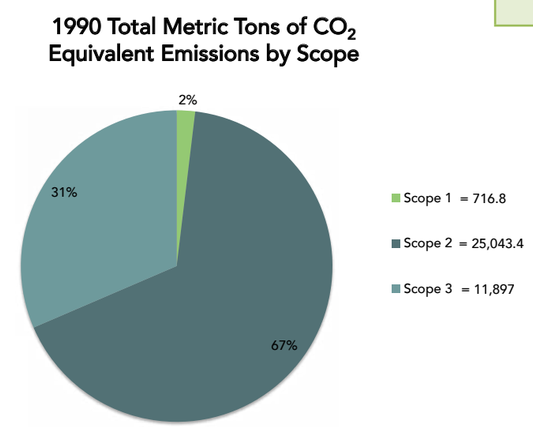


Figure 7. Total emissions from Scopes 1, 2, and 3 from 1990 at Wellesley College

		1990	2015
Scope 1	Co-gen Electricity/Steam	N/A	✔
	Direct Transportation	✔	✔
	Refrigerants/Chemicals	x	✔
Scope 2	Purchased Electricity	✔	✔
	Purchased Steam/Chilled Water	✔	N/A
Scope 3	Student, Faculty/Staff Commuting	x	✔
	Directly Financed Travel (e.g. reimbursed, study abroad)	x	✔
	Student Travel To/From Home	✔	✔
	Solid Waste	✔	✔
	Paper Purchasing	x	✔
	Deliveries	x	✔

Key: ✔ = included x = not included N/A = not applicable

Table 1. Categories considered by scope in the Wellesley College 1990 and 2015 greenhouse gas inventory.

Scope 1 & 2 Emissions

During 1990, the Wellesley-owned fleet of vehicles was the only source of Scope 1 emissions. The Wellesley College vehicle fleet in 1990 was half the size of the 2015 fleet.[14] Furthermore, the Babson-Olin-Wellesley Shuttle and the Movie/Natick Mall shuttle did not exist.[15][16] As such, Scope 1 represents only 2% of total 1990 carbon emissions.

Campus has changed greatly since 1990; for example, the college did not have a cogeneration plant until 1994. At the time, the college purchased all of its electricity from the town of Wellesley's grid. As such, while the majority of carbon emissions associated with

14 Wayne Bouchard, *Wellesley College Motorpool*, email message to author. April, 2016.

15 Ibid.

16 Peter Eastment, *Wellesley Department of Transportation*, email message to author. April, 2016

electricity generation in 2015 came from the cogeneration plant (Scope 1), the entirety of these emissions came from purchased electricity (Scope 2) in 1990.

The only sources of Scope 2 emissions in 1990 were purchased electricity and purchased steam. The college no longer purchases steam, because the on-campus cogeneration plant produces this steam as a byproduct. Scope 2 constituted 67% of total 1990 carbon emissions.

The college's co-generation plant runs on natural gas (which is much less carbon intensive than coal or oil), and is relatively energy efficient compared to the town's electricity generation. In 1990, electricity generation produced 44 metric tons more carbon emissions than generation did in 2015 (including on-campus and purchased electricity). The reason for this change is most likely because the college's energy use was more efficient in 2015 than in 1990.

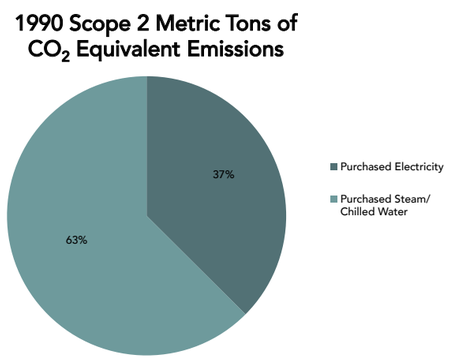


Figure 8. Total 1990 emissions from Scope 2 emissions at Wellesley College.

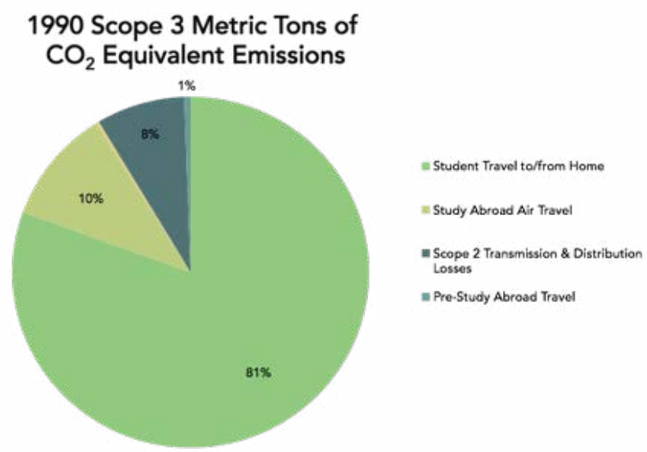


Figure 9. Total 1990 emissions from Scope 3 emissions at Wellesley College.

Scope 3 Emissions

Student travel, both for study abroad and transportation between Wellesley and students' homes, comprised approximately 88% of Scope 3 emissions in 1990. While the number of miles traveled to and from home by car and bus have increased only slightly since 1990, student air miles have doubled. This difference is most likely because Wellesley College had a far smaller international student body in 1990. In addition, according to the 1990 student directory, approximately 20% of the student body lived within 200 miles of the college.

Transmission and distribution losses of heat and electricity were the only other significant factor in our accounting of 1990 Scope 3 emissions, contributing 8% of total Scope 3 emissions. These emissions are negligible in 2015, because the majority of electricity and heat generation occurs on campus.

Due to a lack of available data, Scope 3 emissions for 1990 are likely underestimated. After about seven years, most data for college expenditures are destroyed since it is no longer necessary for tax purposes[17] and we do not have the space or time to keep track of all these documents. So while much of the data about our purchases, reimbursed travel, admissions travel, athletic travel, and student, faculty and staff commuting for 2015 were easily accessible, the necessary data for our 1990 Scope 3 estimates were uncertain or nonexistent (see Table 1).

17 Dorothy A. Koulalis (Controller's Office), interview, February 23, 2016.

1990 and 2015 Formal Comparison

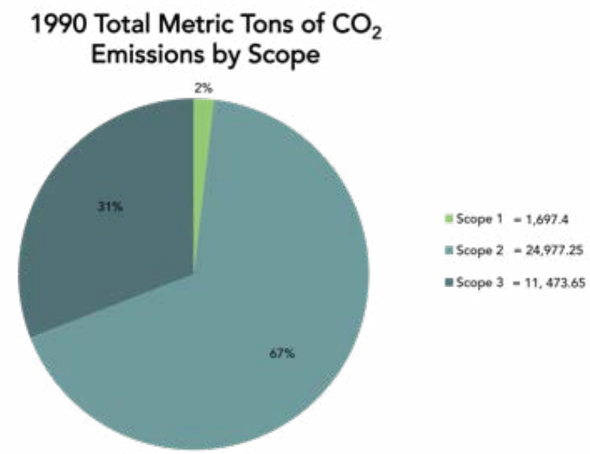


Figure 10. Chart of 1990 total emissions

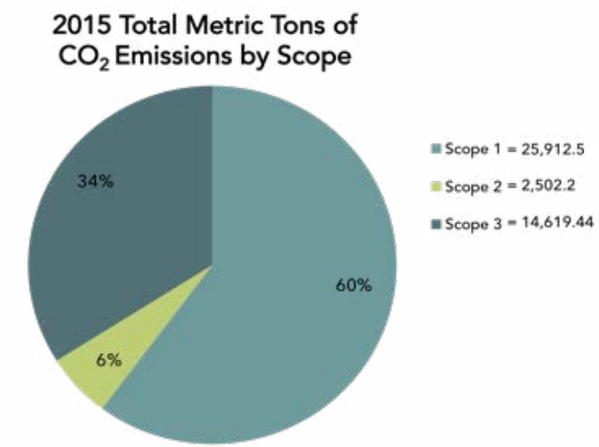


Figure 11. Chart of 2015 total emissions

Our report found that Wellesley College's total emissions for 2015 came out to 45,608.3 MT CO_2e. This is compared to 1990 total emissions of 37, 657.8 MT CO_2e, demonstrating a 82% increase. In 2015, 60% of emissions were Scope 1, 6% of emissions were Scope 2, and 34% of emissions were Scope 3. This compares to 1990, in which 2% of emissions were Scope 1, 67% were Scope 2, and 31% were Scope 3. Compared to 1990, there were only incremental increases in total emissions per scope.

A few different factors explain the similarity of the total emissions in 1990 and 2015. Scope 1 represents the cogeneration plant and the Wellesley fleet. The cogeneration plant was built in 1993 and began operation in 1994, therefore the 1990 emissions do not include cogeneration as a source of emissions. With regards to the college's fleet, although it has grown significantly since 1990, the efficiency of its vehicles has improved markedly by 2015. Therefore, the emissions of a much smaller, less efficient fleet, can be seen as similar to the emissions of today's larger, but more efficient fleet. Finally, there were no accounts for refrigerants and chemicals in 1990 that could be compared to those collected for 2015. Nevertheless, the change in Scope 1 emissions between 1990 and 2015 had a lot to do with improvements made in the efficiency of how Wellesley gets and uses energy.

Scope 2, which is comprised of purchased electricity, steam, and chilled water saw a reduction in 2015 as we produced more than we purchased. Our study accounts for purchased electricity in 1990 and 2015, but chilled water/ purchased steam numbers were only available in 1990. In 2015 Wellesley saw a significant decrease in Scope 2, due to a change from purchasing electricity from the grid to producing its own electricity through the cogeneration plant.

Scope 1 and 2, while separated in much of our analysis, represent similar needs of the college. As stated previously, the main reason that Scope 1 has increased by so much in the past years, and why Scope 2 has fallen a corresponding amount, is that the college no longer relies on off campus sources to the

same degree. Therefore, it is fruitful to combine Scopes 1 and 2 and compare them if we want to examine differences in needs as well as sources. In 2015, Scope 1 and 2 combined represented 66% of total CO_2e emissions, whereas in 1990, Scope 1 and 2 represented 69% of total CO_2e emissions. The similarity between 1990 and 2015 combined Scope 1 and 2 carbon emissions is notable, given that energy generation is much more efficient in 2015. This number suggests that as Wellesley's energy efficiency increased, so too did its energy consumption.

Finally, in Scope 3, which involves travel, purchased goods, waste, and commuting, there was an increase from 1990 to 2015. It is important to note that this study was unable to collect numbers regarding student and faculty commuting, directly financed travel (i.e. reimbursed or study abroad), paper purchasing,

1990 Scope 3 Comparisons in Metric Tons of CO_2 Equivalent Emissions

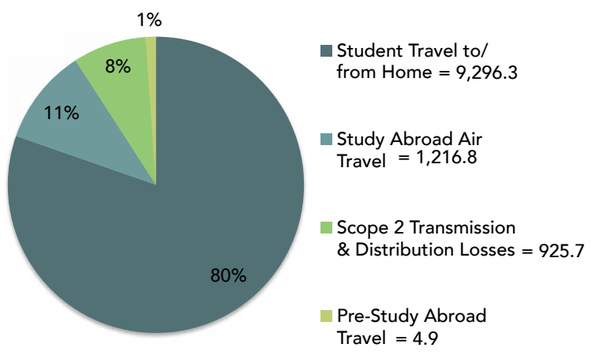


Figure 12. Chart of 1990 Scope 3 Emissions for Comparison with 2015

or deliveries for 1990. For certain categories such as waste disposal and fleet, we estimated 1990 carbon emissions based on 2015 data and from our understanding of college-wide changes between 1990 and 2015. For other categories, including athletics travel, admissions travel, reimbursed travel, and deliveries (see Table 1), we were unable to determine carbon emissions at all. Our data show an increase from 1990 Scope 3 to 2015 Scope 3; this increase could be the result of an increase in international students, an increase in professors living off campus and thus an increase in their commuting emissions, or an increase in students studying abroad. For a comparison of 1990 Scope 3 and 2015 Scope 3 emissions in categories that were only available in 1990, see below.

2015 Scope 3 Comparisons in Metric Tons of CO_2 Equivalent Emissions

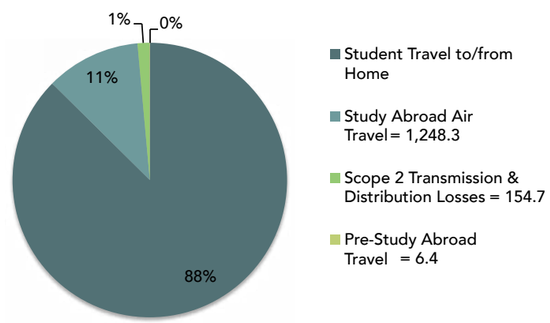


Figure 13. Chart of 2015 Scope 3 Emissions for Comparison with 1990

Peer Institution Comparison

As shown in Figure 14, Wellesley's 2015 overall emissions were very high compared to its peer institutions. By our calculation, Wellesley emitted at least twice as much CO_2 equivalents annually as Carleton College,[18] Babson College,[19] Colby College[20] or Middlebury College[21] — schools of similar size

18 Jason Lord. "Carleton's Green House Gas Emissions at Carleton College: A Complete Inventory for 2004-2005 with Extrapolations Back to 1990." September, 2005. https://apps.carleton.edu/curricular/ents/assets/Carleton_GHG_emissions_inventory.pdf

19 "Energy and Greenhouse Gas Emissions." *Babson College*. Accessed May 15, 2016.http://www.babson.edu/about-babson/sustainability/green-campus/Pages/energy-greenhouse-gas.aspx

20 "Colby College Climate Action Plan." *Colby College*. May 14, 2010.https://www.colby.edu/administration_cs/vpadmin/documents/upload/Climate-Action-Plan-July-2010.pdf

21 Hanley et al. "Carbon Neutrality at Middlebury College: A Compilation of Potential Objectives and Strategies to Minimize Campus Climate Impact." *Middlebury College*. July 19, 2003. https://www.middlebury.edu/media/view/262585/original/es010_report.pdf

in areas with a similar climate. Wellesley's Scope 1 and 2 emissions were comparable to those of Brandeis[22] and Smith.[23] However, Wellesley had much higher Scope 3 emissions than either of these colleges, which contributed to a substantially larger comprehensive total

Comparison of Wellesley and Peer Institutions

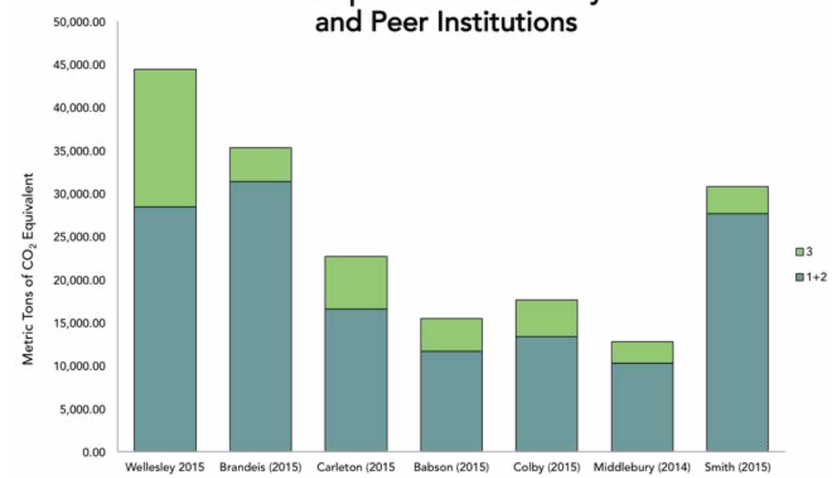


Figure 14. Comparison of most recent emission audits by scope between Wellesley College and its peer institutions.

It is important to note that in making this comparison, we used numbers provided by each school's internally prepared greenhouse gas inventory. Since it is generally advantageous to appear more environmentally friendly, it is possible that these numbers are conservative estimates of each school's emissions. While we only compared Wellesley to other schools that included Scope 3 sources of emissions in their estimates, the selection of items included in most school's Scope 3 calculations was not as comprehensive as in Wellesley's 2015 inventory. For example, Brandeis University, Carleton College, Babson College, Colby College, and Smith College did not consider student travel to and from home, a category that makes up 60% of Wellesley's 2015 Scope 3 emissions. Five of the six schools (excluding Carleton) did not include study abroad travel emissions, and none considered the carbon costs associated with purchased goods. Smith College did not even consider reimbursed travel in their Scope 3 calculations, the second largest source of Wellesley's Scope 3 emissions. Considering that travel constituted such a large proportion of Wellesley's Scope 3, the other colleges probably emitted more greenhouse gases than they reported, and Wellesley's CO_2 emissions were not significantly higher than those of its peer institutions.

That being said, even when we compared each institution's Scope 1 and 2 combined emissions, Wellesley College had the third highest CO_2 emissions. One of the reasons that Wellesley's Scope 1 emissions may have been higher than those of other peer institutions is that the college has its own on-campus power plant. Half of the peer institutions we considered purchased electricity off-site. Middlebury College[24] and Colby College[25] constructed biomass power plants in the past ten years that rely on renewable energy, which may account for their comparatively lower Scope 1 carbon emissions. However, Scope 1 and 2 combined emissions includes both on-campus and off-campus electricity generation and consumption, and Wellesley College's emissions related to electricity generation appear much higher than those of other peer institutions. Wellesley's peer institutions did not consider as many factors as we did when compiling their carbon

22 "GHG Report for Brandeis University." *Brandeis University*. Accessed May 15, 2016. http://reporting.secondnature.org/ghg/3810/

23 "2010 Sustainability and Climate Action Management Plan (SCAMP)." *Smith College*. Accessed May 15, 2016. http://www.smith.edu/green/docs/SmithCollegeSCAMP.pdf

24 "Testing the Feasibility of Willow as Biomass." *Middlebury*. Accessed May 14, 2016. http://www.middlebury.edu/sustainability/carbon-neutrality/willow/willow_feasibility.

25 "Biomass Plant Under Construction at Colby." *Colby*, December 28, 2010. https://www.colby.edu/news/2010/12/28/biomass-plant-under-construction-at-colby-4/.

reports, and we encourage them to do so in the future. The limited nature of their reports does in part explain Wellesley's relatively poor carbon footprint. However, these differences in reporting do not fully explain the differences in emissions and Wellesley College must hold itself accountable and try to close this gap.

As shown in Figure 15, Wellesley's per student emissions also compared unfavorably to other schools' per capita emissions. Wellesley's per capita emissions were roughly double those of its peer institutions. However, Wellesley's per capita emissions were slightly lower than the average per capita emissions caused by the activities of a typical American. Wellesley produced approximately 18.4 MT CO_2e per student in 2015, while the average American's actions caused the emission of approximately 20 MT CO_2e each year.[26]

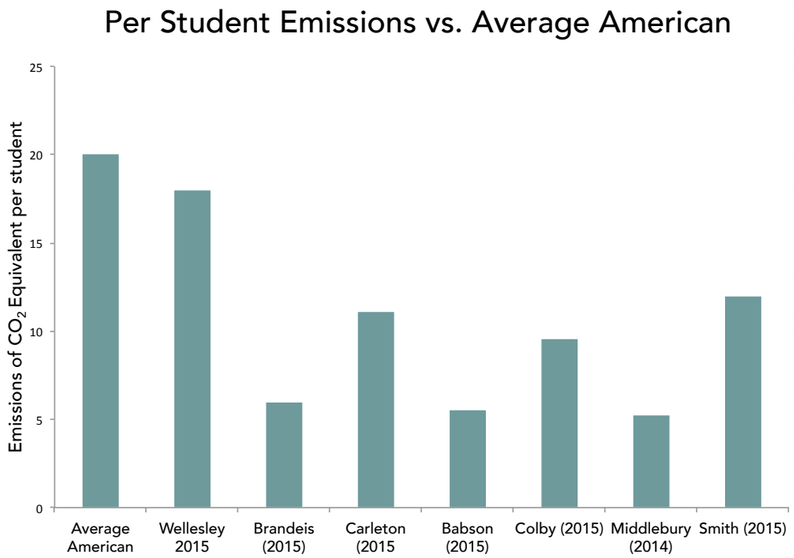


Figure 15. Comparison of total emissions per student between the average American, Wellesley College student, and student from other peer institutions.

Investments

While the college's exact investments are confidential, we were able to estimate Wellesley's fossil fuel investments based on what percentage of our endowment the college invests in public equity and national statistics (see the Methodology section for a more complete description of the process).[27] The Wellesley College endowment is a billion-dollar financial asset that has been created over a long period of time.[28] In contrast, our 1990 and 2015 greenhouse gas inventories were limited to the carbon emissions associated with a singular calendar year. The carbon footprint of the endowment did not neatly fit into a single-year carbon audit of the college. That being said, the amount of investment money available to fossil fuel companies each year includes money invested from previous years. As such, we estimated 1990 and 2015 carbon emissions associated with the total endowment's fossil fuel investment in 1990 and 2015.

While our methodology for determining the carbon emissions associated with Wellesley's investments involved some guesswork, our results are similar to those of other colleges. For example, if the size of Wellesley's endowment were scaled to match Harvard University's endowment, our estimate would be comparable to estimates by independent research groups.[29]

26 "Carbon Footprint Of Best Conserving Americans Is Still Double Global Average." *Science Daily*. Accessed May 15, 2016. https://www.sciencedaily.com/releases/2008/04/080428120658.htm

27 "Wellesley College Annual Report 2012–2013." *Wellesley College Investment Office*. December, 2016. http://www.wellesley.edu/sites/default/files/assets/annual_report_2013_1219b_web.pdf

28 Ibid.

29 "Harvard's Financing of CO2 Emissions from the Reserves of Fossil Fuel Companies." *Fossil Free Indexes, LLC*. Accessed May 14, 2016. http://fossilfreeindexes.com/research/harvard-emissions/.

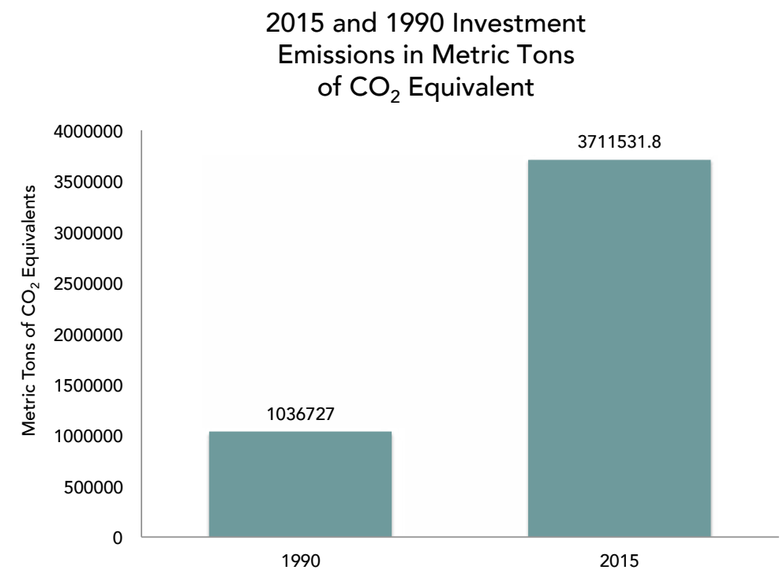


Figure 16. Total 1990 and 2015 emissions including those associated with Wellesley College investments.

Since this independent study and our work yielded similar numbers, we are fairly confident in our results.

While our report found that the college itself emitted around 40 thousand metric tons of CO_2 last year, emissions from investments alone were upwards of 3.7 million MT CO_2e in 2015 and almost 1.03 million MT CO_2e in 1990. The emissions associated with Wellesley College's investments are over 100 times larger than all other factors considered in this report combined. While we did not include investments in many of our graphs for simplicity, we urge the administration to consider this overwhelmingly large component of Wellesley College's emissions.


Wellesley College Greenhouses, Wikimedia

METHODOLOGY


Wellesley College Campus Center, Flickr

Scope 1

Fleet

The fleet refers to all cars, trucks, and heavy-duty work vehicles owned by the college. The college's Motor Pool Office provided information on the Wellesley-owned fleet's 2015 fuel consumption organized by fuel type. The fleet used three types of fuels in 2015: unleaded gasoline, diesel, and a B5 blend of biodiesel, which is a mixture of 5% ethanol and 95% diesel. Each of these fuel types has a different carbon intensity. Therefore, we entered each fuel type into the Campus Carbon Calculator (CCC) separately. In 2015, the fleet used a total of 38,464.20 gallons of gasoline, 7267.6 gallons of diesel, and 1,830.5 gallons of B5. After we entered these numbers into the CCC, they required no further analysis.

Wayne Bouchard, the acting head of the Wellesley Motor Pool, estimated that in 1990, Wellesley's vehicle fleet numbered roughly half the 116 vehicles owned by the college today.[1] We assumed that the proportion of gasoline versus diesel burning vehicles was the same as it is today, since the nature of the work that Wellesley's vehicles are used for has not changed substantially since 1990. Based on these assumptions, we estimated that Wellesley owned forty-five gasoline vehicles and five diesel vehicles. Since the 1990 fleet numbered about half the 2015 fleet, we assumed that the 1990 fleet drove twice as many miles as the 2015 fleet. We assumed an average fuel economy of 17.5 MPG for diesel vehicles and 16 MPG for gasoline vehicles, based on a median model year of 1983 for the 1990 fleet.[2] We assumed that fuel consumption by non-vehicle machinery such as lawn mowers and leaf blowers was constant between 1990 and 2015, since the size of Wellesley's campus and the nature of landscape work have not changed substantially between the two years.

1 Wayne Bouchard, *Wellesley College Motorpool*, email message to author. April, 2016.

2 Ibid.

Shuttles

We took the four Wellesley-sponsored shuttles into account in the Scope 1 inventory: the Babson/Olin/Wellesley (BOW) shuttle, the MIT Exchange shuttle, the Senate bus, and the Movie/Mall shuttle.

We calculated that the BOW shuttle travels 1,162 miles per week and assumed that the shuttle ran thirty-three weeks out of the 2015 school year. The 2015 BOW shuttle is a 2010 Ford E350 Wagon. We could not determine the average fuel economy for the 2010 model, so we used the average fuel economy for a 2012 model of the same vehicle, which is 10 MPG.[3] This fuel economy number allowed us to calculate the total number of gallons used by the BOW shuttle in a year (3,837 gallons).

We determined that the MIT Exchange shuttle travels 2,812 miles per week, and again assumed that it operates for thirty-three weeks per year. Because this shuttle is a Peter Pan coach bus, and because exact fuel economy of this bus was difficult to come by, we used an average fuel economy for coach buses of 6.4 MPG[4] to calculate that this shuttle uses 15,467 gallons of diesel fuel per year.

The Senate bus travels 1,637 miles per week. We multiplied this number by thirty-three weeks per year. This shuttle is also a Peter Pan coach bus, and so again, we used an average coach bus fuel economy of 6.4 MPG to determine that the Senate bus consumes 8,859 gallons of diesel fuel per year.

The Movie/Mall shuttle, which runs between the college and the Natick Mall and the movie theater on Saturdays, runs 73.2 miles per week. We assumed the shuttle ran thirty-three weeks out of the year, and again we used the average coach bus fuel economy of 6.4 MPG. This gave us a final number of 396 gallons of diesel fuel used per year. We added all of these numbers based on fuel type and

3 "Compare Side-By-Side: Fuel Economy." *U.S. Department of Energy*. Accessed May 15, 2016. https://fueleconomy.gov/feg/Find.do?action=sbs&id=31885.

4 "Bureau of Transportation Statistics Publications, National Transportation Statistics: Bus Profile." *United States Department of Transportation*. Accessed May 15, 2016. http://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/publications/national_transportation_statistics/html/table_bus_profile.html.

subsequently entered them into the CCC.

In 1990, the BOW shuttle and the Movie/Natick Mall shuttle did not exist. The coach bus shuttles to Boston (Exchange and Senate buses) operated in 1990, on similar schedules to today's shuttles.[5] We assumed that the buses took the same route and operated for the same portion of the year as the current shuttles do. We obtained gas mileage for coach buses in 1990 from the U.S. Department of Transportation. We calculated total fuel consumption for shuttles in 1990 based on the route, schedule, and mileage of the buses.

There were various sources of uncertainty that may have reduced the reliability of our data. For example, we assumed that in 2015 and 1990 the MIT Exchange and Senate shuttle routes were similar. It is possible that the routes were not the same, and so the data we generated based on this assumption may be flawed. We also assumed that semesters were the same length in 1990 and 2015. We also assumed that the 1990 fleet was approximately half the size of the 2015 fleet, and that the 1990 fleet drove twice as many miles as the 2015 fleet.[6] We assumed that the average fuel economy of the vehicles remained the same in both years. We do not believe that these assumptions significantly impacted our data, but they still added uncertainty. Additionally, in our calculations about the BOW shuttle, we assumed that the fuel economy of a 2012 Ford E350 is similar to that of a 2010 Ford E350, which is the actual model year of the shuttle that currently runs. The possibility that the fuel economy of the 2010 vehicle is not similar to the fuel economy of the 2012 vehicle is another source of uncertainty, but we do not expect that such a difference would be consequential.

Refrigerants

We used Wellesley College's refrigerant use for the year 2014 from the greenhouse gas data provided by Patrick Willoughby of the Wellesley College Office of Sustainability. The 2015 data were not available at the time of this report. The refrigerants the college used were: R-404a, R-407c, R-408a, R-410a, and HFC-134a. The quantity of refrigerants used was given in metric tons, which we then converted to pounds to fit into the CCC. We assumed that there would not be a significant difference in the college's use of refrigerants in the years 2014 and 2015, adding uncertainty to our calculations. We do not anticipate any major difference between the totals.

Power Plant Data

We obtained data regarding the electricity and steam output of Wellesley's cogeneration plant directly from Wellesley College's Office of Sustainability.[7] Wellesley also has some ten kilowatt solar panels,[8] whose electricity output is tracked on a publicly accessible website.[9] We used 2013 output data in the CCC, because the reported data for 2014 and 2015 were incomplete, due to a solar panel system malfunction.

We assumed that the solar panels received a similar quantity of solar radiation in 2013 and 2015, an assumption that we are reasonably certain is valid. Since the cogeneration plant data came directly from the plant's instruments, there are very little uncertainty in the steam and electricity generation data.

Scope 2

In 1993, Wellesley College built an on-campus cogeneration plant that began running in April 1994. For this reason, Wellesley College did not purchase the majority of its electricity after 1994. In order to find out how much electricity Wellesley College purchased in 2015, we contacted Patrick Willoughby, the Sustainability Director. He reported that the college did in fact purchase electricity from the town of Wellesley in 2015. As of 2012, the Environmental Protection Agency (EPA) named Wellesley College, as well as Babson College and Olin College of Engineering, partners of its Green Power Community.[10] This made the town of Wellesley one of the first communities in the nation with all of its institutions of higher education named as partners in the Green Power Community. As part of Wellesley College's commitment to this initiative, the school has pledged to purchase 5% of its total electrical consumption as renewable energy from the town. Mr. Willoughby informed us that Wellesley College purchased more electricity over the past few years, because the college recently overhauled its engines, and because one engine is not currently in operation. In the calendar year 2015, 19,086,432 KWh were produced and 7,570,460 KWh were purchased from the town. In 2015, the college generated its own steam and chilled water from the cogeneration plant.

Before 1994, when the cogeneration plant was not yet in operation, the college purchased all of its electricity from the town of Wellesley. We consulted with Patrick Willoughby, the Sustainability Director; Katie McLean, the Administrative Assistant for Facilities Management; Jill Donahue, the college's Business Manager; and Dick Joyce, a contact at Wellesley for Municipal Light and Power in an effort to find information regarding purchased electricity in 1990. After speaking with these sources, we were unable to find any energy purchases for 1990, including electricity, oil, chilled water, or steam. They directed us to look through the power plant's operation reports (e.g. statistics and outputs) to see if there might be information to help us estimate the amount of electricity purchased in 1990. Unfortunately, these efforts did not result in any findings. All of our sources speculated that the archives containing 1990 electricity data were either misplaced or disposed of. In a review of documents from Patrick Willoughby, we found one labelled "Cogen Feasibility Study 5-1992" that provided us with an estimate of the approximate electricity purchased from the town in 1990.[11] This estimate amounts to 20,002,949 kWh.

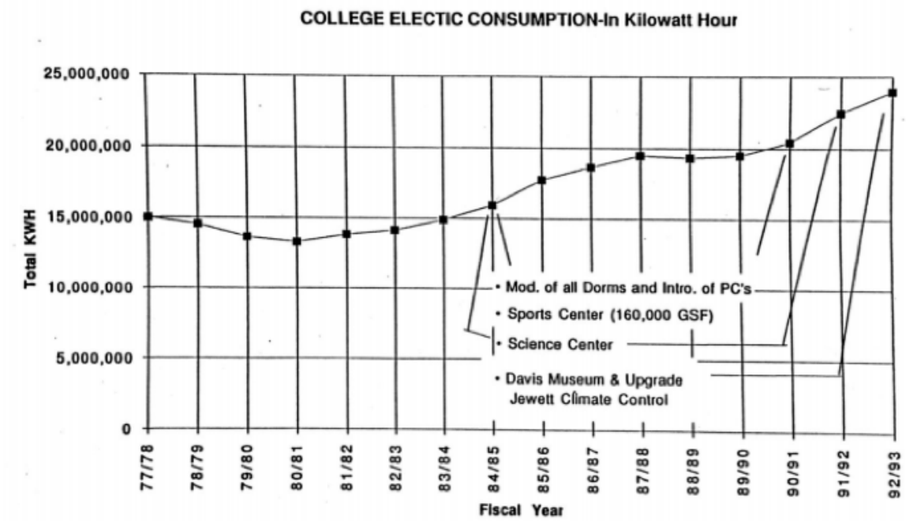


Figure 17. Total electrical consumption on the Wellesley College campus from 1978 to 1993 in kilowatt hours.

5 Peter Eastment, *Wellesley Department of Transportation*, email message to author. April, 2016.

6 Wayne Bouchard, *Wellesley College Motorpool*, email message to author. April, 2016.

7 Patrick Willoughby, *Director of Sustainability*, email message to author. April, 2016.

8 "Energy." *Wellesley College*. Accessed May 14, 2016. http://www.wellesley.edu/sustainability/what-we-re-doing/energy/node/78771.

9 "Wellesley College's Dashboard." *SunWatch Meter*. Accessed May 14, 2016. http://www.sunwatchmeter.com/home/day/wellesley-college.

10 "Wellesley One of the Only Communities in U.S. with City-Wide College Participating in EPA's Green Power Partnership." *Wellesley College*. Accessed May 14, 2016. http://www.wellesley.edu/news/wellesley_news/node/26379.

11 "Cogen Feasibility Study 5." *Wellesley College Archives*. 1992.

Scope 3

Deliveries

Campus Deliveries

In order to estimate CO_2 equivalents for Scope 3 deliveries to campus, we calculated the number of delivery miles traveled per year for each source of deliveries. In 2015, the average fuel economy for delivery trucks was 6.64 miles per gallon.[12] We used the following EPA formula to convert miles traveled to metric tons of CO_2e emitted:[13]

The purchasing and delivery of goods at Wellesley College is fairly decentralized. Most deliveries fall into four categories: office supplies, information technology (IT), Science Center, and Facilities. In contrast to previous years in which most deliveries to campus came through the Purchasing Office, the Purchasing Office's focus today is limited to campus-wide contracts for primarily office supplies. In 2015, the Purchasing Office received deliveries from six off-campus vendors – W.B. Mason, Grainger, Staples, Gov Connection, B&H, and CDW - who collectively made 880 deliveries to campus between September 2015 and February 2016.[14] We doubled this number in order to extrapolate to the entire year. In the course of these deliveries, vehicles travelled roughly 32,888 miles per year, and produced up to 42.75 metric tons of CO_2e.

The Science Center receives daily deliveries of USPS, UPS, and FedEx packages from Wellesley College's Distribution Center. In addition, they receive their own deliveries of scientific supplies from WB Mason, Dynamex, Clean Uniforms, and Airgas. All of these suppliers are located in Massachusetts, and they deliver once a week for roughly 45 weeks per year.[15] We estimated that trucks delivering to the Science Center traveled a total of 5,357 miles, producing 6.96 metric tons of CO_2e.

AVI Fresh is Wellesley College's on-campus dining provider. AVI receives regular deliveries from nineteen locations in the Northeast U.S. Seventeen of these nineteen locations are based in Massachusetts.[16] With information on the source of delivery, delivery frequency, and mode of delivery, we estimated that over the course of 2015, AVI's delivery trucks traveled roughly 38,107 miles, the equivalent of 51.67 metric tons of CO_2e.

Facilities receives deliveries for two main categories: maintenance needs and custodial supply needs. Maintenance needs include goods used for maintenance operations, such as plumbing, HVAC (heating, ventilation, air conditioning), and the tech shop. Of the maintenance needs, roughly 50% of orders are delivered on a regular basis to the Distribution Center, and 50% are ordered as-needed. FW Webb, Standard Electric, and Grainger provide the majority of Wellesley College's maintenance needs, and deliver supplies once a week, from within Massachusetts, for about 40 weeks per year.[17] Custodial supply needs also constitute a large portion of deliveries to Facilities. All custodial supplies are delivered regularly through the Distribution Center, 52 weeks per year.[18] The two largest suppliers, Xpedx and AmSan, are based in Massachusetts. Altogether, regular deliveries to Facilities account for 3,964 miles per year, or 5.15 metric tons of CO_2e. However, this number would likely increases dramatically if we included the numerous as-needed deliveries that arrive on an irregular basis. Because 50% of maintenance supplies are ordered as-needed,[19] we estimated that emissions for this category would double the current total if these irregular deliveries were included.

Finally, the college receives deliveries of IT supplies. The Purchasing Office buys many of the smaller items. The office buys larger electronics such as computers and projectors on a four-year cycle, as described later.

While the college receives a large number of deliveries, most deliveries come from companies based in Massachusetts. Therefore, the total 2015 emissions stemming from deliveries to campus were reasonably low.

Bookstore Deliveries

Wellesley College receives books from three main sources: Texnet inter-store transfers, MBS wholesaler, and publishing companies. Wellesley College also sends books off-campus to MBS wholesaler, Texnet inter-store transfers, publishing companies, and Bnn.com marketplace. All books arrive at campus via ground transport.

We looked at excel documents from October 26, 2015 to February 22, 2016 in order to determine an average carbon footprint from the transfer of textbooks per semester.[20] We assumed that the period from October to February represented an average number of incoming and outgoing books for one semester. Therefore, we multiplied the resulting metric tons of CO_2e for one semester by two to estimate data for an entire calendar year.

The excel documents listed the number of shipments that arrived at or came from each of over 350 stores between these dates.[21] We inputted distances from each store to Wellesley College into an excel chart and multiplied by the number of shipments from each store to determine total miles traveled. All shipments were delivered by either UPS or FedEx ground transport, whose fuel efficiency averaged 6.64 miles per gallon.[22] We calculated the number of gallons of gasoline required for inter-store transfers per semester. To make total emissions more accurate, we divided the number of cartons per order by the total number of cartons in a UPS truck per delivery (on average 150 boxes delivered to Wellesley each day) and multiplied that by the total number of gallons. Using conversion information provided by the EPA,[23] we established that inter-store transfers alone contributed to 73.49 metric tons of CO_2e per year. We used the same procedures and assumptions while calculating the total yearly metric tons of CO_2e for the MBS wholesaler and the publishing companies. These transactions accounted for 7.75 and 26.65 metric tons of CO_2e, respectively. The Wellesley College Bookstore documented their purchases from publishing companies based on the 2015 calendar year; in contrast, they recorded MBS wholesaler information between the period of October 28, 2015 to February 22, 2016. We could not calculate the carbon emissions associated with Bnn.com marketplace deliveries from the Wellesley College bookstore, because individual consumers placed the orders, and therefore we could not track the books.

We used similar methods to calculate the GHG emissions associated with the transportation of College Bookstore merchandise (e.g. Wellesley apparel and gifts). The bookstore maintained invoice records regarding all current companies that sell products to the college. Using these records, we determined the location of the distributing companies and their distances from Wellesley College via Google Maps. We calculated total mileage by multiplying the distance of the company from the college by the number of shipments in the year 2015. Again, we used the average of 6.64 MPG as our estimated fuel efficiency for standard delivery trucks, which yielded a total of 58.47 metric tons of CO_2e per year from vendor purchases. Because the college returns less than 1% of merchandise to vendor companies, we assumed that outgoing merchandise shipments were negligible.[24]

We did not consider the carbon emissions associated with the production of books, however these emissions, while off the record, are worth considering. Most of the books that are delivered to and shipped from the Wellesley College Bookstore are used copies that are transferred directly between college

12 "Alternative Fuels Data Center: Maps and Data." Accessed April 1, 2016. http://www.afdc.energy.gov/data/10310.

13 US EPA, OAR. "GHG Equivalencies Calculator - Calculations and References." Data and Tools. Accessed May 14, 2016. https://www.epa.gov/energy/ghg-equivalencies-calculator-calculations-and-references.

14 Christina Dolan, *Purchasing Manager*, email message to author. April, 2016.

15 Martha Robbins, Science Center Buyer and Stockroom Manager, email message to author. April, 2016.

16 Ann Madzar, *Wellesley Fresh Office Manager*, email message to author. April, 2016.

17 Christina Dolan, *Purchasing Manager*, email message to author. April, 2016.

18 Ibid.

19 Ibid.

20 Leva, Joseph. Interview, "Bookstore Merchandise Information," February 16, 2016.

21 Cashman, Jeanne. Interview, "Bookstore Textbook Information," February 16, 2016.

22 "Alternative Fuels Data Center: Maps and Data." Accessed April 1, 2016. http://www.afdc.energy.gov/data/10310.

23 "Light-Duty Automotive Technology, Carbon Dioxide Emissions, and Fuel Economy Trends: 1975 through 2014." *United States Environmental Protection Agency*, October 2014. https://www3.epa.gov/fueleconomy/fetrends/1975-2014/420s14001.pdf.

24 Leva, Joseph. Interview, "Bookstore Merchandise Information," February 16, 2016.

bookstores.[25] Used books have a smaller carbon footprint than new books, because they do not need to be printed or transferred to delivery outposts. However, books that Wellesley orders from publishing companies are new copies, so they produce additional greenhouse gases. Future Wellesley carbon audits should consider the carbon footprints associated with new and old books.

Additionally, we could not include some deliveries in the calculations listed above because they were placed online and sent to individual customers off-campus. These deliveries constitute approximately 20-25% of all bookstore purchases, and were not included in our 2015 carbon audit. Therefore, our calculations significantly underestimated carbon emissions associated with campus bookstore deliveries.[26]

Purchases

Electronic purchases

In order to estimate the carbon footprint for Wellesley College's purchased electronics in 1990 and 2015, we met with members of Library and Technology Services (LTS), who reported on the number of computers and projectors on campus. While 2015 numbers were readily available, 1990 numbers were unavailable, and no members of LTS were comfortable providing an estimate of how many computers would have been purchased that year.

Though Wellesley College is home to an increasing number of electronic tools purchased for use on campus, we decided to estimate the college's technology-related carbon footprint based on computers and projectors, since these items represent the most significant technology purchases.

LTS reported that there is a computer in every Wellesley classroom, with an additional fifteen desktop computers per lab classroom. In total, there are 316 Macs and 368 PCs in Wellesley's classrooms and labs. In addition to these computers, the library has multiple programs involving Wellesley-purchased laptops that are loaned to students, faculty, and staff. These programs add sixty-five Chromebooks, sixteen Macbook pros, and thirty-five PC laptops to Wellesley's total purchased computers.

While Wellesley is home to nearly eight hundred Wellesley-purchased and owned computers on campus, it is important to note that not all eight hundred of these computers were purchased in 2015. Rather, each of the computers on Wellesley's campus runs on a four year life cycle. Should a computer begin to malfunction in its second or third year, LTS devotes significant resources to attempting to revive the computer so the college can avoid having to buy a new one before it reaches its four year term.

However, for the sake of providing a look at the overall life cycle of technology purchases on campus, we decided that rather than arbitrarily taking ¼ of this total number, we would consider all 800 computers, given that this is a snapshot of 2015 and all 800 continue to function year round.

Apple[27] and Dell[28] made life cycle costs of their products easily available through Product Carbon Footprint Information Sheets:

316 Macs: 1010 kg CO_2e (49% production, 41% customer use) = 908 kg CO_2e
368 PC: Monitor: 1033 kg CO_2e (percentages are estimates based off of other breakdowns, assuming 60% production, 30% customer use) = 928 kgCO_2e

65 chromebooks: 400 kg CO_2e (64% production, 27% customer use) =364 kg CO_2e
16 macbook pros: 870 kg CO_2e (81% production, 14% customer use) = 825 kg CO_2e
35 PC laptops: 400 kg CO_2e (64% production, 27% customer use) = 364 kg CO_2e

Computers purchased: 3,371 kg CO_2e emissions

While this information provides a useful look at the carbon footprint related to Wellesley's technology purchases, it is not entirely complete. Due to a lack of information we were unable to also account for projectors, media towers, phones, and other pieces of purchased technology that are on campus.

Paper Purchases

In an effort to find the amount of paper Wellesley College purchased in the year 2015, we contacted Tina Dolan, the Purchasing Manager.[29] She supplied us with a usage report of paper purchased in the fiscal year 2015, which runs from July 1, 2014 to June 30, 2015. We reviewed the usage report to see what types of paper Wellesley College purchased in the greatest amounts and in what unit the quantity was represented. We identified the top five types of paper that Wellesley College purchased. The types include: Staples 8.5 x 11 copy CS, Staples 8.5 x 11 30% recycled copy CS, Sustainable Earth 8.5 x 11 case 51LB, Xerox 8.5 x 11 copy/print CS, pastels 8.5 x 11 Salmon Paper RM. The usage report quantified each type of paper product in the units known as reams and cartons. There are five hundred sheets of paper per ream, ten reams per carton and a ream of letter sized paper is five pounds. We converted reams and cartons into pounds of paper, which is the unit that the Campus Carbon Calculator (CCC) requires. The amount of purchased paper based on the five paper types is 61,400 lbs.

Wellesley College buys several different grades of paper, based on the paper's percentage of post-consumer content. We found that the paper fell into three categories: 0%, 30%, or 100% recycled.[30] After we found these preliminary results, we did further analysis to see how the input of more paper products would affect the total number of pounds of paper by percentage recycled. We then looked for the next ten most common paper products.[31] We used the same process as we did for the previous five paper products (converting to ream and then to pounds) to find the number of pounds per paper type by amount recycled. These extra ten categories of paper weighed 1,350 lbs. The total amount of purchased paper is 62,750 lbs. Together, these fifteen common paper products create a more accurate representation of the paper purchases in the year 2015.

We contacted Vicki Mutascio, the Copy Center Manager at Wellesley College, to acquire data regarding paper purchases from the year 1990.[32] She estimated that in 1990, paper purchases were at an all time high, with around 8 million sheets bought and used. After receiving this information, we looked through past Wellesley College greenhouse gas inventories to see if trends of paper use were in line with this estimated number. Overall, trends show that over time, the college has purchased less paper and a higher percentage of that paper has been recycled. Therefore it is possible that in 1990, paper purchases were quite a bit higher and likely around Vicki Mutascio's estimate. We converted these eight million sheets into reams and those reams into pounds. If a ream weighs five pounds, then Wellesley purchased eighty thousand lbs of paper in 1990.

The next step was to find out what the post-consumer content of paper products was in 1990. State environmental agencies were just beginning to promote the use of recycled paper products in 1990s. Environmentally progressive states like California were promoting the purchase of recycled paper products within their own agencies.[33] As of 1990, Massachusetts did not have rules or regulations for purchasing recycled paper. It is possible that Wellesley was purchasing some recycled paper, but for the purposes of this report, we assumed that the majority was still virgin.[34] For that reason, we estimated that the college purchased 40,000

25 Cashman, Jeanne. Interview, "Bookstore Textbook Information," February 16, 2016.

26 Cashman, Jeanne. Email correspondence, "Bookstore Online Purchases," April 6, 2016.

27 " 27-Inch iMac with Retina 5k Display Environmental Repost," October 2015. http://images.apple.com/environment/pdf/products/desktops/27inch_iMacR5K_PER_Oct2015.pdf.

28 "Carbon Footprints of Dell Desktops, Laptops, Mobile Devices and Servers | Dell." Accessed May 14, 2016. http://www.dell.com/learn/us/en/vn/corp-comm/environment_carbon_footprint_products.

29 Tina Dolan (Wellesley College Purchasing Manager), email communication, March 10, 2016.

30 "Campus Carbon Calculator." *University of New Hampshire*. Accessed May 14, 2016. http://campuscarbon.com/Calculator.aspx.

31 These paper products include: Staples 11 x 17 30% recycled copy CS, Staples 8.5 x 11 30% recycled copy RM, Staples 11 x 17 copy CS, Staples 8.5 x 11 100% recycled copy CS, Recycled GW WHT 20# CS, Pastels 8.5 x 11 Green Paper RM, Pastels 8.5 x 11 Blue Paper RM, Pastels 8.5 x 11 Canary Paper RM, Staples 8.5 x 11 Multiuse 20/96 CS, Laser Tent Card Large 50PK 1 UP.

32 Vicki Mutascio (Wellesley College Copy Center Manager), email communication, March 8, 2016

33 "State Mandates on the Purchase of Recycled Content Paper." *Practice Greenhealth*, 2010. https://practicegreenhealth.org/sites/default/files/upload-files/state_mandates_on_the_purchase_of_recycled_content_paper.pdf.

34 "General Laws: CHAPTER 7, Section 22." Accessed May 14, 2016. https://malegislature.gov/Laws/GeneralLaws/PartI/TitleII/Chapter7/Section22.

lbs of 0% recycled paper and 40,000 lbs of 25% recycled paper in 1990. It is possible that the college purchased some variation between 5%-25% of recycled paper in this year.

Food Purchases

To determine carbon dioxide emissions associated with food products on campus, we spoke with Keith Tyger, the executive chef at Wellesley College's contracted food provider, AVI Fresh. He provided two separate data sheets that listed food purchases from the college's direct campus deliveries, which are provided by both Niman Ranch and the Sysco Corporation.

We divided college food purchases into two separate categories of meat and dairy products, based on the fact that these two food groups have distinctly higher carbon intensities than other food types. Within the meat category, we broke down purchases into groups according to the type of meat. The calculated carbon footprint for Wellesley meat purchases included carbon associated with beef, pork, seafood, turkey, and chicken. We calculated each carbon dioxide equivalent by converting the food's weight from pounds into kilograms, and multiplying that number by a predetermined carbon equivalent per kilogram of consumed food, provided by the non-profit organization, the Environmental Working Group.

The dairy category consisted of both egg and cheese products purchased by the college. We used the same method that we used for calculating meat carbon equivalents for dairy products. For both meat and dairy purchases, we converted kilograms of carbon dioxide equivalents into metric tons of CO_2e.

Wellesley College did not contract with AVI Fresh until mid-2009, and therefore the company did not have any records regarding the amount of food purchased during 1990.[35] After speaking with Patrick Willoughby and current dining hall employees, we were unable to find information on food consumption or distribution for that year.

35 Cherie Tyger, email communication. February 25th, 2016.

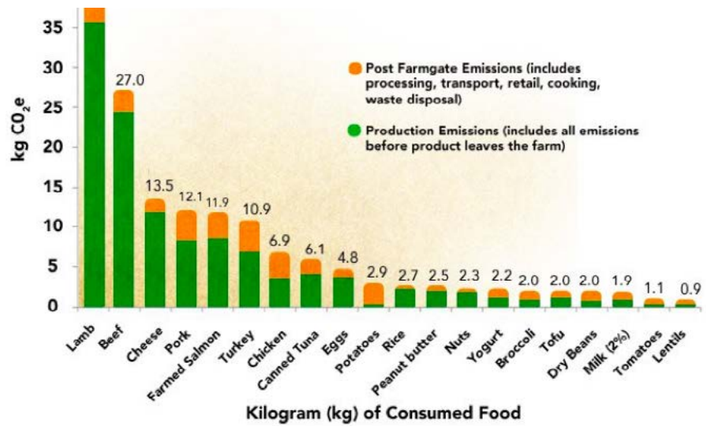


Figure 16. Graph that illustrates the full lifecycle of greenhouse gas emissions from common proteins and vegetables that were used to calculate carbon dioxide emissions from Wellesley College's various meat and dairy purchases during 2015.[36]

Travel Sector

We estimated various kinds of travel indirectly sponsored by the college, including student, faculty, and staff commuting, reimbursed travel, admissions office travel, study abroad, wintersession travel, student travel to and from home, travel by athletic teams, and travel associated with transporting waste, recycling, compost, and hazardous materials off-campus. As part of the process, we estimated carbon dioxide emissions separately for various modes of travel, including plane, train, bus, and car.

When estimating distances travelled by car, we used Google Maps' estimated distance.[37] When we estimated the distances travelled by plane, we used the "Get Directions" function of Google Earth. We then selected the nearest airports, and used the ruler tool to estimate the distance between the two airports. Unless we were specifically told otherwise (such as in the

36 "Climate and Environmental Impacts." *Environmental Working Group*, 2011. http://www.ewg.org/meateatersguide/a-meat-eaters-guide-to-climate-change-health-what-you-eat-matters/climate-and-environmental-impacts/.

37 "Google Maps." *Google Maps*. Accessed May 14, 2016. https://www.google.com/maps.

admissions data), we assumed all flights were direct. Therefore, we probably underestimated total air miles.

We also calculated the car travel associated with travel to and from airports. We added 28.8 car miles for each singular air trip. 20.8 miles is the distance between Wellesley College and Boston Logan Airport. We used Google Earth to approximate the distance between the foreign airports and the specific locations where individuals were traveling. We chose eight miles as representing a conservative estimate for number of miles traveled. Overall, we added 28.8 car miles to each air trip. This assumption may have been a source of error.

When a person travelled by train, we started by finding the nearest train station to the locations mentioned, and found the shortest distance between those two stations using the ruler tool in Google Earth. We then found the distance from the train stations to the actual locations using Google Maps, and assumed the traveller finished the trip by car.

The specific methodologies for each type of travel are listed below. Unless otherwise noted, we estimated the number of miles traveled for each mode of transportation (e.g. car, air, train), and used a carbon dioxide conversion factor in the CCC to calculate the emissions associated with that particular form of travel.

Student, Faculty, and Staff Commuting

In order to estimate the 2015 total student commuting miles, we sent out a survey to find out how many miles any given student drove in an average week. Wellesley College Parking informed us that there are 350 registered drivers on campus[38]. We received thirty-seven responses to our survey[39]. Using an average calculated from the numbers given in the survey form, we estimated the yearly carbon emissions as 1,292.89 metric tons of CO_2e for all students who have registered cars on campus. Only about 11% of the total student drivers responded to our survey. This low response rate may have led to error in our final calculation. Based on the survey, we assumed that all student drivers commuted 39.4 miles per week. While this average may not account for individual variation, we believe that this average represents the number of miles in a Wellesley student's commute.

For faculty and staff in 2015, we went through the Wellesley College Directory and found home towns of all faculty and staff members in order to calculate total commuting miles.[40] We calculated the distance between faculty and staff hometowns and Wellesley College using Google Maps.[41] We assumed that faculty and staff only commuted by train if the travel time was not excessively longer than travel by car, as determined by Google Maps. We also made the assumptions that faculty members traveled to campus four times a week and staff five times a week. We found that the total carbon emissions from commuting by cars was 2,215.50 MT CO_2e. The total train carbon emissions from commuting in 2015 was 213.22 MT CO_2e. Overall, we think that the faculty and staff commuting data are more robust than the student commuting data are, because we knew that faculty and staff consistently traveled between Wellesley College and their homes. In contrast, student commuters traveled to and from a variety of locations, including Boston, Worcester, and Natick.

For the year 1990, we used directories from the Archives to determine how many faculty and staff members were at Wellesley College in that year. Because faculty and staff are listed in the directories by academic year as opposed to calendar year, we assumed that the home addresses of faculty from the 1990-1991 directory were also representative of faculty from the 1989-1990 school year. We assumed that faculty and staff commuted four and five times per week, respectively. We assumed that faculty came to campus only four times a week, because most professors do not hold class five times a week. We determined the average fuel efficiency of a 1990 vehicle and used conversion to arrive at a total of 202.7 MT CO_2e.

38 Wellesley College Parking, email communication, March 9, 2016

39 "Student Driving Trends," survey. March 1, 2016.

40 "Wellesley Directory." *Wellesley College*. Accessed May 14, 2016. https://webapps.wellesley.edu/directory/.

41 "Google Maps." *Google Maps*. Accessed May 14, 2016. https://www.google.com/maps.

Reimbursed Travel

Reimbursed travel included all faculty, student, and staff transportation related to academic and college activities that was financially reimbursed by the college. Examples of reimbursed transportation included academic conference airfare and research-related travel. We estimated the amount of reimbursed travel for 2015, based on the data available in Wellesley College's reimbursement slips, located in the Controller's Office in Green Hall. Due to the large quantity of data, we chose to analyze reimbursement data from two months, April and October, and extrapolated the data for the remaining months in the year. We chose these months based on the ES 300 2008 report ("Climate for Change: A Look at Wellesley's Greenhouse Gas Emissions").[42] We believed these months were relatively representative of the year, since they contained no major school vacations. Unlike the 2008 report, we analyzed reimbursement slips for people whose travel took place in April and October, as opposed to slips that were submitted to the Controller's Office in these months. This was a significant point of divergence, because in many cases, slips submitted in April refunded travel that had occurred three months beforehand.

Our data were subject to a large amount of uncertainty. For example, sometimes the only record of a trip was a parking receipt, or a receipt for a taxi without an estimated distance recorded. In these cases, we were unable to estimate the distance associated with the reimbursement slips. Also, since reimbursement slips were sometimes filed long after the travel takes place, some slips may have been buried in a file we did not read. We also assumed that data collected from April to October were representative of travel in other months. However, during certain parts of the year such college-related travel may increase. For example, more academic conferences may have occurred at the beginning or end of the school year than in our chosen months. For these reasons, the numbers for reimbursed travel should be understood as conservative estimates that underrepresent the total number of reimbursed miles.

Unfortunately, the Controller's Office only maintains its reimbursement records for the past seven years, as required by the IRS.[43] 1990 reimbursement data were unavailable, because the documents were shredded. We did not attempt to estimate the missing 1990 reimbursement travel data.

Admissions Travel

Since the admissions office sent us a spreadsheet listing every trip they made in 2015, we did not have to make assumptions about the number of trips.[44] Otherwise, we used the same methodology as in the reimbursed travel. Admissions also told us explicitly what method of travel they used, so we did not have to make assumptions. The data for admissions travel in 1990 were unavailable since they had been recorded on documents that have since been shredded.[45] We did not attempt to estimate the missing 1990 admissions travel.

Study Abroad Travel

The 2015 study abroad data came from the Office of International Study's Wellesley Students Abroad spreadsheets, which are publicly available to all college-affiliated individuals.[46] The spreadsheet included a list of all students who were abroad in a given year, the length of their trips (semester or year), and the universities where they were studying.

In order to estimate the carbon dioxide emissions associated with study abroad travel in 2015, we made several assumptions. First, we assumed that all students traveled by plane, and that they began their journeys from Wellesley College. We also assumed that students who went abroad for a semester made two trips (i.e. a round trip) from Wellesley College to their study abroad location, whereas students who were abroad for a full year made only one trip, because they returned to the college during the following calendar year. In order to calculate total miles traveled for study abroad, we calculated the distance to each individual study abroad location from Boston Logan Airport, and multiplied this number by the accompanying number of trips. We also estimated that each trip was associated with 28.8 car miles of travel, as explained earlier.

The Office of International Study did not maintain study abroad documents for 1990. Instead, we used Wellesley College Student Abroad information from the 1990-1991 academic year from the Wellesley College Archives.[47] However, we lacked statistics regarding Spring 1990 and year-long 1989-1990 study abroad programs. We assumed that the number of students studying abroad in Fall 1990 was approximately equal to the number of those studying in Spring 1990. So we multiplied the total round-trip distances of Fall 1990 by two and single-trip distances of 1990-1991 study abroad by two to account for Spring 1990 and 1989-1990 study abroad travel. Otherwise, our 1990 methodology was the same as our 2015 methodology.

Our study abroad estimates are quite sound, because we had data for every individual who studied abroad, and knew the exact locations to which each student traveled. For one-third of the 1990 study abroad data, we only had information regarding the particular city that the students traveled to. In addition, we assumed that we could extrapolate data from the 1990-1991 class year for Spring 1990, and year-long 1989-1990. However, students may have traveled less in 1990 for various reasons. The largest source of uncertainty in our data was the assumption that students traveled from Wellesley College to their study abroad location. In many cases, students travel directly from their homes, instead of from the college. In addition, students in year-long programs may come home for the winter holidays. We did not have a way to estimate the percentage of students who traveled to their study abroad locations from their homes, as opposed to from the college, or to estimate the number of trips they took home. Therefore, while our statistics were a good indicator of study abroad travel undertaken by the entire student body, they at best roughly estimated the total number of air miles traveled.

Wintersession Travel

In order to estimate the travel associated with study abroad during wintersession of 2015, we used the Wellesley course browser to look up all wintersession abroad programs and the number of students enrolled in them.[48] Like all study abroad programs, we assumed the students went abroad via air, since all students went to places more than 500 miles away from Wellesley, and added car miles to account for travel to the airport. In 1990 there was no study abroad during wintersession.[49]

Student Travel to and From Home

We estimated 2015 student travel to and from home using a Survey Monkey survey.[50] Three hundred students responded. We asked students what cities or towns they called home, what methods they used for travel, and how often they returned home. We also asked each student for their class year, since it seemed likely that students from different class years would have different travel habits. We then extrapolated the survey data for each class year to the rest of the college, based on the total number of students in each class as compared to the number of students from each class who responded. The methods for finding the distances were similar to those used in study abroad. On our survey, we allowed students to check more than one box when recording what method they used to get home. When students selected more than one type of travel (such as Car/Bus or Train/Car), we divided up their trips evenly between all the methods they

42 Amy Harrington, Alexander Jenko, Samantha Jones, Monisha Khurana, Courtney Streett, Amanda Tai, Margaret Weirich, Anli Yang, and Dr. Elizabeth DeSombre. "Greenhouse Gas Audit Wellesley College." *Wellesley College*, 2008. https://www.wellesley.edu/sites/default/files/assets/departments/environmentalscience/files/es300-2008-wellesley-ghg-audit.pdf.

43 Dorothy A. Koulalis (Controller's Office), interview, February 23, 2016

44 Kathy Xie (Admissions Office), spreadsheet via email communication, February 29, 2016.

45 Lauren Dennis (Admissions Office), email communication, February 16, 2016

46 "Wellesley College." *Wellesley College*. Accessed May 14, 2016. http://www.wellesley.edu/ois/forms_resources/node/28179.

47 "Wellesley college students abroad fall 1990" and "wellesley college students abroad year 1990-1991," october 1 1990, Wellesley College Archives, File: 4d/1984-1998 Dean of Students: Foreign Study 1989-1991

48 "Course Browser." *Wellesley College*. Accessed May 14, 2016. https://courses.wellesley.edu/.

49 "Wintersession 1990 non-credit course offerings,"wellesley college archives, 4D/ 1984-1998 Dean of Students. Wintersession 1988-91

50 "Student Transportation, " survey. February 22, 2016.

mentioned. If a student responded with Air/Car, but lived more than one thousand miles from Wellesley, we interpreted this answer as meaning that the student travelled primarily by air, with a car trip to and from the airport, since a one thousand mile drive would take more than fourteen hours of nonstop travel at 70 mph. If the student answered Air/Car but lived within one thousand miles, we divided the trips evenly between car and air. Some local students answered a question about the number of trips made with vague answers like "Many." We assumed these students travelled home once a week, resulting in a total of thirty five round trips.

The numbers for 1990 are less straightforward. We found the students' hometowns using the Portrait Directories for classes 1990 through 1994.[51] Any time the student's hometown was less than 350 miles away from Wellesley by air, we assumed the student travelled by car. Since car-trips are less direct than air travel, some of these trips were longer than 350 miles by car, but less than 350 by air. In these cases we assumed the student travelled by car.

Since we could not survey 1990 students, we had to make assumptions about how often they went home based on how far away they lived from school. If students lived less than twenty miles from Wellesley we assumed they took twenty car trips home. If they lived anywhere from thirty one to two hundred miles from school, we assumed they took ten car trips home. If students lived more than two hundred miles from home, we assumed they only went home by car four times a year, meaning we assumed they went home for every major break. These estimates are based on patterns in the survey results from 2015. These numbers represent a conservative number of trips, since we used the bottom of the range for our numbers. Since driving habits may have changed since 1990, we cannot be sure that we were reasonable in assuming that we could use data on trip frequency from 2015 to estimate trip frequency in 1990. This assumption may have been a source of error.

If students lived more than 350 miles from campus, we assumed they travelled by air. In this case, we assumed that students in 1990 took two round trips each year. This assumption probably resulted in an underestimate of students' travel. Since air travel was more difficult in 1990 than it was in 2015, it seemed unwise to use the number of trips in 2015 as an estimate. For air travel, we calculated distances between a town's closest airport and Boston Logan Airport. To account for travel to and from the airport, we added eight car miles to each flight. We chose eight miles as the approximate mean of driving distance to airports, which ranged from four to sixteen miles. For travel between Wellesley and Boston Logan Airport, we added an additional 20.8 car miles. All together, one air trip also includes 28.8 car miles (one way).

As for 1990 international students, we ran into some trouble estimating distance travelled, since the Portrait Directories mentioned only the countries in which the students lived and not their cities, towns, or provinces. We calculated air travel assuming that the student came from the country's largest city and added fifty miles of car travel.

Athletics Travel and Idling

To estimate travel by athletic teams in 2015, we used a spreadsheet provided by Marni Friedman in the Athletics Department, which listed the number of trips teams made and to what locations.[52] Sometimes the locations listed were vague, and we had to use our best judgement in guessing which location a spreadsheet entry represented. We assumed that trips which were shorter than 350 miles by plane were car trips, regardless of whether the car trip itself ended up being more than 350 miles.

Some teams with regular off-campus practices were not included on the spreadsheet, such as crew, golf, and squash. In these cases we multiplied the number of practices in a week by the number of weeks in a season to estimate the number of trips to the practice

51 "Wellesley College Portrait Directory, New Students Fall 1986-1990," Wellesley College Archives. File: 6AD Portrait Directory: Class of 1990-1994

52 Marni Friedman (Associate Director For Facilities & Operations), spreadsheet via email communication, March 3 2016.

site. The squash team sometimes practiced at Dedham, and sometimes at Weston,[53] so we took an average of the two distances and used that number in our calculations. The crew and golf teams went to Boston and Dana Hall, respectively.[54]

We got in touch with two members of the crew team who informed us that the bus idles every day for the duration of each three hour practice.[55] We estimated the total number of hours idled and multiplied that number by the 0.97 gallons of gas wasted every hour by idling.[56] We then used this number to calculate the resulting CO_2e emissions. We calculated emissions associated with idling for only this team.

The Wellesley Athletic Office did not have information about athletics travel in the year 1990,[57] and we were unable to calculate 1990 athletic travel carbon emissions for this carbon audit.

Transportation of Waste, Recycling, Compost, and Hazardous Materials

Each year, Wellesley College produces over one thousand tons of waste, recycled goods, compost, and hazardous waste products.[58] The majority of these products are taken off-campus for treatment in specialized facilities. We estimated the CO_2e emissions associated with the transport of Wellesley College's waste to off-campus treatment facilities.

Wellesley sent its wastes to several different facilities in 1990 and 2015, depending on the type of waste in question. The disposal facilities were anywhere from 2.4 to 226 miles away from the college (see Table 1).[59] In order to account for the differences in facility location, we estimated carbon emissions separately for waste types that went to separate facilities. For example, we calculated paper recycling separately from unconventional recycling (e.g. chairs, toner cartridges, computers), because one facility was four miles further away from Wellesley.

Year	Type of Waste	Recycling Facility	Distance to Facility (Miles)[1]
1990[2]; 2015[3]	Household Waste	Covanta Recycling Center	50.5
1990[4]	Recycling	El Harvey & Sons	17.8
2015[5]	Paper Recycling	Wellesley Recycling and Disposal Facility	2.4
2015[6]	Compost	We Care	12.8
2015[7]	Unconventional Recycling	Conigliaro Industries	6.4
2015[8]	Hazardous Waste	Resource Recovery Corporation; CSWD Environmental Depot	53.1; 226

Table 2. Waste treatment facility locations. *Note: Wellesley did not compost until 2013.[60] We could not determine reliable 1990 hazardous waste data.

53 Mindy Mangels (associate athletic director), email communication, February 19, 2016.

54 Ibid.

55 Anonymous former crew team members, interview, March 8, 2016

56 "Fact #861 February 23, 2015 Idle Fuel Consumption for Selected Gasoline and Diesel Vehicles." *Energy.gov*, February 23, 2015. http://energy.gov/eere/vehicles/fact-861-february-23-2015-idle-fuel-consumption-selected-gasoline-and-diesel-vehicles.

57 Bridget Belgiovine (director of athletics), email communication, February 14, 2016.

58 Office of Sustainability, "Recycling, Compost, and Trash Data.". 21 February 2016. Microsoft Excel File.

59 Patrick Willoughby (sustainability director), Email Communication, February 21, 2016.

1 "Google Maps." Google Maps. Accessed May 14, 2016. https://www.google.com/maps.

2 Tony Oteri. "RE: recycling task force, 1990-1992." email memo to Will Reed, December 1992.

3 Patrick Willoughby (sustainability director), Email Communication, February 21, 2016.

4 Wellesley College Recycling Task Force, February 21, 1991, "Mixed paper recycling beginning march 21," Wellesley College

60 Evelyn Taylor-Mcgregor, and Grace Bennett-Pierre. "Office of Sustainability Implements Second Phase of Composting Program: 42 Percent of Waste to Be Composted | The Wellesley News." Accessed May 14, 2016. http://thewellesleynews.com/2013/10/30/office-of-sustainability-implements-second-phase-of-composting-program-42-percent-of-waste-to-be-composted/.

Archives. File: "recycling 193-1991"
5 Patrick Willoughby (sustainability director), Email Communication, February 21, 2016.
6 Ibid.
7 Ibid.
8 Justin Finne, interview meeting, March 4th, 2016.

After determining the location of the disposal facilities, we estimated the number of trips that a truck would take to transport wastes during the calendar year. We assumed that the average school year is thirty-four weeks long. For 2015 waste, recycling, composting, and hazardous waste, the Office of Sustainability and Office of Health and Safety provided us with estimates for the number of times per week that trucks came to campus.[61] We did not consider pickups for recycling, composting, and hazardous waste during vacations, because they were negligible. We included waste pickups during vacation (nineteen weeks), based on estimates by the Office of Sustainability. We assumed that waste pickups were the same in 1990, because we did not have data regarding waste pickups. Wellesley's 1990 recycling program was small, and an Archives document informed us that the college needed only five recycling pickups per year.[62] For each waste stream, we identified the number of trips taken to the disposal facility, and the distance to the facility in question. We calculated the total number of miles traveled to each disposal facility for the entire calendar year.

In order to calculate the carbon emissions associated with these miles, we determined the miles per gallon (MPG) of the waste trucks. We assumed that the MPG was the same in 1990 and 2015, because mileage regulations in the U.S. like the CAFE standards do not apply to large vehicles such as trucks.[63] We took into account the fact that the MPG of filled and empty waste trucks is different (2.5 MPG and 6 MPG).[64] Using the aforementioned numbers, we calculated the number of gallons needed for waste trucks to travel the total number of miles.

Gallons spent in Transport (filled waste truck) = [(distance to disposal facility / mpg of filled waste truck) * trips per week] * (# of school weeks)

We used the same equation to estimate the gallons spent transporting the empty waste trucks. We converted the gallons of diesel spent in the transport of waste into kg CO_2e, based on the emissions factor provided in the spreadsheet.

We could not find out which facilities hazardous wastes go to, partly because this information is confidential,[65] so estimating the carbon footprint attached to transporting these wastes was difficult. The fact that facilities dealing with both hazardous wastes and recyclable materials sometimes sent inputs to a secondary facility compounded this problem, especially since batteries could travel as far as North Carolina, hazardous wastes as far as Texas,[66] and some unconventional recyclables as far away as China.[67] We have no way to determine how much CO_2e these trips would have added to our total, but since these locations are far away, we can only assume a substantial amount of carbon is missing from our audit.

Waste

The Office of Sustainability provided information on the number of tons of waste, recycling, and composting Wellesley produced in three representative months in 2015.[68] The STARS program provided a full-year number for waste.[69] The three-month waste number provided by the Office of Sustainability multiplied by four was similar to the twelve month STARS program number, so we decided the numbers were trustworthy. The Office of

61 Justin Finne, interview meeting, March 4th, 2016

62 "Recycling Task Force End Of the Year Report" September 11 1990 in archives "recycling task force, 1990-1992" folder

63 "Corporate Average Fuel Economy (CAFE) Standards." Text. *Department of Transportation*. Accessed May 14, 2016. https://www.transportation.gov/mission/sustainability/corporate-average-fuel-economy-cafe-standards.

64 "Heavy Trucks." *Oak Ridge National Laboratory*, 2015. http://cta.ornl.gov/vtmarketreport/pdf/chapter3_heavy_trucks.pdf.

65 Justin Finne, interview meeting, March 4th, 2016

66 Ibid.

67 Conigliaro Industries, phone interview, February 21, 2016

68 Office of Sustainability, "Recycling, Compost, and Trash Data.". 21 February 2016. Microsoft Excel File.

69 Patrick Willoughby. "OP-23: Waste Diversion | Wellesley College." *Stars*. Accessed May 14, 2016. https://stars.aashe.org/institutions/wellesley-college-ma/report/2015-12-24/OP/waste/OP-23/.

Environmental Health and Safety (EHS) provided our information on 2015 hazardous waste.

In order to estimate 1990 waste, we started with our 2015 numbers. We assumed that Wellesley produced the same amount of waste as compared to the rest of the country in 1990 as it did in 2015. We then used these numbers to solve for Wellesley's 1990 waste as a proportion. Since we were only able to find numbers on total US municipal waste for 2013,[70] we used that information in the following equation.1100.24 (Wellesley waste 2015) / 254,000,000 (2013 municipal waste[71]) = x (wellesley waste 1990) / 208,270,000 (1990 municipal waste[72]).

We assumed that Wellesley's contribution to the US's total national waste would be the same proportion in 1990 as it was in 2015. We have no way to know how true this assumption is, and this assumption may have taken away from our data's reliability.

From these calculations, we estimated that Wellesley disposed of 902 tons of waste in 1990, and 1100 tons of waste in 2015. Wellesley disposes of its waste by incinerating it for electricity, so we plugged these waste numbers into the incineration section of the Campus Carbon Calculator (CCC) in order to determine the CO_2e emissions associated with waste disposal.

We also calculated the amount of items that the college recycled and composted in 1990 and 2015 in tons. In 1990, Wellesley was only beginning to recycle, and our recycling program was limited to white paper. Documents in the Archives claimed that Wellesley recycled fifty tons of paper in 1990.[73] That year, there were no data available on composting and hazardous waste. For 2015, the Office of Sustainability had detailed accounts of the amount of recycled and composted wastes.[74] These numbers are 179.014 tons of recycled material and 52.85 tons of composted material.

While we were able to calculate the amount of recycled and composted waste in 2015, we were unable to determine the carbon emissions associated with the disposal of these wastes. When recycling is first taken off Wellesley's campus, the majority of it is sent to the Wellesley Recycling and Disposal Facility where it is sorted and baled, but otherwise not processed.[75] The facility then sends these bales to locations around the world, making it impossible for us to find out what the treatment processes were or to estimate the carbon associated with transporting the bales to those facilities. We had similar problems when calculating carbon emissions for the transport and disposal of hazardous wastes. The school's Office of Environmental Health and Safety could give us a vague idea of where the waste is sent initially, but after that they were less sure.[76] We calculated the carbon emissions associated with the travel of recycled, composted, and hazardous waste to an initial facility. However, since wastes were seldom processed at the first facilities to which they were sent, and were sent to secondary facilities for disposal, we were unable to determine the carbon emissions associated with the actual processes behind recycling and hazardous waste disposal. These recycling processes were probably diverse, given that Wellesley College recycles everything from printers, to paper, to chairs.

The initial facility where Wellesley's composted wastes were sent also processes the waste. We may have been able to estimate the carbon emissions associated with the composting process. However, the carbon footprint of composting is negligible, because the equipment used in this specific composting facility releases air pollutants indoors, and are not emitted directly into the atmosphere.[77] Even if the equipment releases carbon dioxide, several sources[78] suggest that

70 "Advancing Sustainable Materials Management: 2013 Fact Sheet." *United States Environmental Protection Agency*, June 2015. https://www.epa.gov/sites/production/files/2015-09/documents/2013_advncng_smm_fs.pdf.

71 Ibid.

72 Ibid.

73 Wellesley College Recycling Task Force, February 21, 1991, "Mixed paper recycling beginning march 21," Wellesley College Archives. File: "recycling 193-1991."

74 Office of Sustainability, "Recycling, Compost, and Trash Data.". 21 February 2016. Microsoft Excel File.

75 Mike Stewart, and Tobias Froehlich. *Recycling at the RDF*, n.d. http://wellesleyma.virtualtownhall.net/Pages/FOV1-0001FDB3/rdf/Recycling_Vid.wmv.

76 Justin Finne, interview meeting on March 4th, 2016.

77 Joseph crowley, northeast regional manager of WeCare composting facility, phone interview, march 15

78 "Composting at Ole Miss." *The University of Mississippi*.

the composting process actually produces net positive carbon benefits that offset the carbon cost of processing compost wastes. We did not consider net carbon benefits in the report, so we excluded this effect from our calculations.

	Waste	Recycling	Compost
1990	902.1534835	50	N/A
2015	1100.24	179.014	52.8523

Table 3. Weight in tons of Wellesley's waste, recycled goods, and compost in 1990 and 2015.

Investments

Wellesley College's investments are highly classified and handled by outside investors, so direct data for investments could not be found.[79] However, total endowments for 1990 and 2015 is publically available, so we were able to estimate fossil fuel investments from this data. We used the financial investment breakdown from 2015 to determine what percentage of the endowment is invested in public equity.[80] Average fossil fuel investment estimates from We Are Power Shift[81] helped us calculate what percentage of our investments are likely funding domestic and international fossil fuel production. We converted these estimates into a dollar amount for how much we invested in fossil fuels in 1990 and 2015.

We did not have statistics regarding total global investments in specific types of fossil fuels, including coal, natural gas, and oil. Instead, we used data from the International Energy Agency that estimated global fuel production for all fuel types.[82] From this data, we estimated that in 2015, coal, oil, and natural gas accounted for 19.3%, 35.7%, and 25.6% of global fuel production, respectively. The percentages do not add up to a total of 100%, because global fuel production also includes renewable energy sources and alternatives such as hydroelectric power and biofuels. In 1990, coal, oil, and natural gas accounted for 22.09%, 45.3%, and 23.26% of global fuel production.[83] For the 1990 fuel production percentages, we acquired numbers by extrapolating based on pre-made graphs or charts, since we were unable to find raw numbers. This method added to our margin of error. We assumed that the aforementioned percentages were representative of the amount of money Wellesley invested in the production of each fuel type. We multiplied Wellesley College's total fossil fuel investments by the percentage of coal, oil, and natural gas production. For example, Wellesley College's total coal investments in 2015 were:
$71,025,048 [Total Wellesley 2015 fossil fuel investment] * .357% = $25,355,942.14 [Wellesley College investments in coal production].

Wellesley College's investments in different fossil fuel types may not be representative of global fuel production. We do not have any data on how Wellesley investors made decisions regarding which fossil fuels they financed. The college may even have disproportionately invested in cheaper fuels such as coal, as opposed to oil. As such, our monetary estimates of Wellesley investments in each fossil fuel type are relatively speculative, and at best approximate the relative magnitude of CO_2e emissions associated with investments.

In order to translate investment dollars into CO_2e emissions, we divided Wellesley investments in each fuel type by the cost of producing one pound of coal, one barrel of oil, and one cubic foot of natural gas in 1990 and 2015. In 2015, Wellesley College's investments equated to 637,573,686 pounds of coal,[84] 891,245 barrels of oil,[85] and 68,226,687 cubic feet of natural gas.[86] In 1990, Wellesley College's investments equated to 158,415,311 pounds of coal,[87] 315,413 barrels of oil,[88] and 19,057,481 cubic feet of natural gas.[89]

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81 Ibid.

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86 "U.S. Natural Gas Wellhead Price." *U.S. Energy Information Administration*. Accessed May 14, 2016. https://www.eia.gov/dnav/ng/hist/n9190us3m.htm.

Year	Coal	Oil	Natural Gas
1990	0.0194	20	0.0016975
2015	0.0215	28.45	.002665

Table 4. Production costs by fossil fuel type in US dollars for the years 1990 and 2015.
*Note: We used the production costs in this table to calculate Wellesley's 1990 and 2015 carbon emissions. They are not necessarily representative of average international production costs.

Production costs vary greatly for each fuel type, depending on the method of fuel production (e.g. oil fracking vs. wells) and the location of the production operations. For example, the cost of oil production in 2015 ranged from $8.50 in Kuwait to $52.50 in the United Kingdom.[90] For our calculations, we used the median production cost of each fuel type. In the case of 2015 oil production costs, this number was $28.45. Due to a lack of data, we could only find coal and natural gas production information for facilities in the United States. Overall, our data for the average cost of fuel production are not very representative of the diversity of fuel production methods worldwide.

Finally, we used greenhouse gas equivalence statistics from the EPA to estimate the CO_2 emissions associated with each fuel type.[91] Conversion factors were in units such as metric tons CO_2 per pound of coal.

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Wellesley College News

RECCOMENDATIONS

Explore Martha's Vineyard, 2015

In light of the information we have gathered throughout this semester, our class would like to propose a number of recommendations for future carbon policies. However, it is important to recognize that the college is already taking concrete steps to reducing its carbon emissions. The Wellesley College Strategic Sustainability Plan, proposed on February 5, 2016, suggested that the college reduce its greenhouse gas emissions produced by on-campus activities by 37% by 2026 and 44% by 2036 from a 2010 baseline.[1] This plan was a significant milestone, because before its adoption, the college had had no carbon reduction goals at all. This plan is the first step towards the goal of achieving carbon neutrality, as well as other sustainability goals such as waste reduction, energy efficiency, and improved stormwater management.

The sustainability plan was accepted on April 2016. In addition to providing concrete goals, this plan sets an example for other institutions. We hope this precedent will encourage our peers to take similar measures to fight climate change. We ask that the college consider our following recommendations in its implementation of this 37% emissions reduction. As we have seen in our results, the college's GHG emissions have risen steadily since 2003 and 2008, the last two years ES 300 conducted GHG emissions audits.

From the results of our greenhouse gas inventory, we generated the following set of recommendations for the college. In developing these recommendations, we have tried to focus on areas that address the largest contributors to emissions as well as on areas in which we think change is most viable. Our recommendations are organized into three categories: alter college travel and consumption patterns, divest from fossil fuels, and offset carbon emissions that cannot be changed.

Alter College Travel and Consumption Patterns

1 "Wellesley College's Strategic Sustainability Plan, 2016-2026." *Wellesley College*. February 5, 2016. http://cs.wellesley.edu/~slee/sust/plan.pdf

Change Transportation Incentives

As discussed previously, our results show that travel-related sources of emissions are by far the largest contributors to Scope 3 emissions, accounting for 85% of Scope 3 emissions. Travel-related emissions included student travel to and from home, study abroad travel, reimbursed travel, and student, faculty, and staff commuting. The college can make significant emissions reductions by altering the ways in which transportation to and from campus is incentivized.

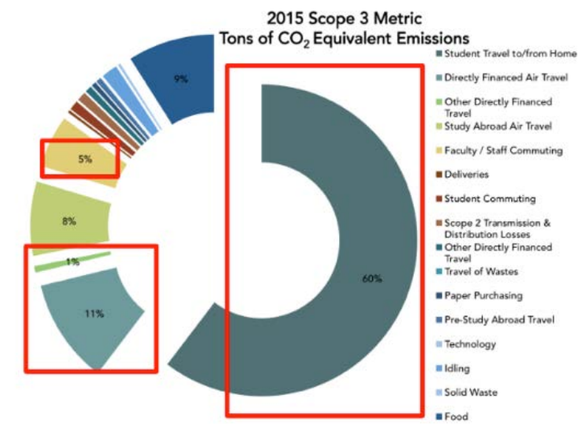

Figure 18. 2015 Scope 3 Travel-Related Carbon Emissions That Could Be Reduced via Differences in Travel Incentives.

The college can change transportation incentives by further subsidizing the use of public transportation for faculty and staff commuters. While the college already incentivizes public transportation for faculty and staff via a payroll deduction,[2] the subsidies offered are not enough to significantly alter transportation behaviors. Another way to discourage inefficient commuting is to increase the cost of parking on campus. Alternatively, Wellesley College could decrease the number of parking spots on campus, and use the newly acquired space for various carbon sequestration purposes (i.e. planting trees). These policy

2 Sharon Bort. "Wellesley College -- OP-21: Support for Sustainable Transportation." *Stars*. Accessed May 14, 2016. https://stars.aashe.org/institutions/wellesley-college-ma/report/2015-12-24/OP/transportation/OP-21/.

changes may collectively incentivize students against bringing cars to campus and would encourage the use of bikes or public transit.

The college could also incentivize train travel over more carbon intensive bus travel (and potentially even plane travel) for student trips to and from home and for reimbursed travel (e.g. conference and research-related travel). Subsidies for train travel could be distributed as part of financial aid packages or through a lottery system.

One challenge associated with subsidizing public transit is securing and allocating college funding. Some faculty, staff, or students may also push back against parking policies, which they may see as an inconvenience. If we disincentivize parking through fees, this policy would put an unfair pressure on economically disadvantaged students. While these challenges mean that the policies will have to be constructed carefully, a well-considered approach to these ideas may prove useful when reducing the college's carbon emissions.

Change Food Consumption Patterns

The second largest source of emissions in Scope 3 is food. We based our estimate of the emissions associated specifically with the production of cheese, egg, and meat products. One recommendation that addresses this issue is "meatless Mondays," since meat is the most carbon-intense of food groups. However, we recognize that some students require that meat be available for dietary reasons. So that Wellesley College can continue to accommodate students' needs, we recommend that one dining hall provide meat on Mondays, while the rest would go meatless.

Another recommendation is that the dining halls lower the quantity of the meat that is provided. This could be accomplished by limiting the serving of meat to one station in the dining halls. This would lower the amount of meat being served and would also keep it available for students who need it.

While it is important for the college to make changes, we also recognize that change must also come from the students. They must be made aware that they too have a role to play in making the college a more sustainable place. Informing them that their choices have consequences will encourage them to change their behavior.

Divest From Fossil Fuel Companies

The second recommendation is divestment, which is the withdrawal of endowment investments from fossil fuel companies. We recommend divestment because, as shown in the results section, all other sources of emissions combined are dwarfed when emissions from investments are included. Even if the actual emissions associated with investments were a half, a quarter, or even a tenth of our estimate, these emissions would still account for more CO2e than all other emissions considered in this report combined.

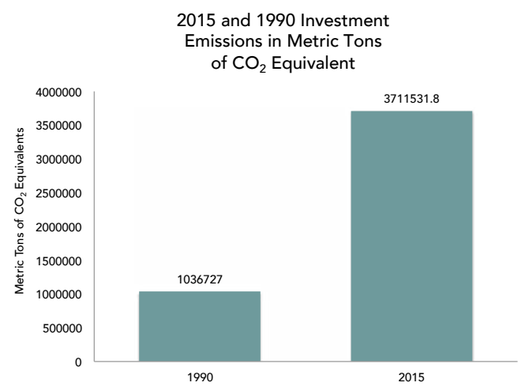

Figure 18. Total 1990 and 2015 emissions including those associated with Wellesley College investments.

The college has considered the possibility of divesting from fossil fuels once before. In 2013, the student organization Fossil Free Wellesley asked that the college refrain from buying new fossil fuel stocks,[3] sell its direct holdings in the 200 largest fossil fuel companies within two years, and sell all holdings within five years. The group gathered 1,000 signatures supporting divestment, which accounts for 40% of the entire student body.[4] Ultimately, the Board of Trustees decided against divestment on March 7, 2014,[5] because it did not wish to use the endowment as a lever for social change.[6]

If Wellesley College did choose to use the endowment as a social lever, it would not be the first time. In 1986 Wellesley students protested investments in companies that supported South African apartheid.[7] The process of achieving divestment was a long one, marked by initial rejection from the Board of Trustees, followed by a great rally of protest from students. Despite initial resistance from college administration, pressure from students ultimately resulted in Wellesley's divestment from all companies that failed to adhere to anti-segregation policies in the workplace.[8] The success of this historical movement for divestment gives us a premise upon which to build our current recommendation for divestment. Though the President and Board of Trustees continue to argue that the Wellesley campus has no grounds for acting in support of political causes through the endowment, we argue, as did the students in the 1980s, that by not divesting the college is going against its educational mission by indirectly supporting a socially unjust practice.[9]

One concern about this recommendation is that if Wellesley removes the endowment investments in fossil fuel companies, the stocks in these companies will simply be purchased by another entity. Thus, by divesting, the actual amount of emissions would not be reduced, but rather the responsibility for these emissions would be shifted from Wellesley to the new purchaser. Another concern is that divesting could result in monetary losses from Wellesley's endowment. If Wellesley were to divest from fossil fuel companies, that money would likely be invested in something else in which the college already invests. This shift in the portfolio would result in a less diversified set of investments, which is riskier and could result in overall greater financial losses.

While these concerns are valid, we believe that the positive consequences of divestment outweigh the negative consequences. Despite the fact that ultimately, our withdrawal of investments in fossil fuel companies may not result in fewer emissions from these companies, we believe that the political statement that Wellesley's divestment could send to other colleges would be a significant benefit of adopting this strategy. Wellesley's divestment could serve as an example for other colleges, and so the impact would be greater than Wellesley's divestment alone.

Offset Carbon Emissions and Incentivize Clean Energy

Carbon offsets finance projects that reduce greenhouse gas emissions in other locations so as to compensate for emissions created by a specific activity or institution.[10] Examples of carbon offsets include energy efficiency projects and forestry projects (i.e. planting trees to reduce atmospheric CO_2). Institutions usually take this step to address emissions that they would not be able to reduce in any other way. For example, approximately 45% of Wellesley College juniors choose to study abroad,[11] and the resulting travel emitted 8% of our Scope 3 carbon emissions in 2015. Because study abroad is an extremely valuable aspect of a Wellesley education, it is in the interest of neither the college nor the students

3 Emily Bary. "College Announces It Will Not Divest Endowment of Fossil Fuel Stock | The Wellesley News." Accessed May 14, 2016. http://thewellesleynews.com/2014/03/07/college-announces-it-will-not-divest-endowment-of-fossil-fuel-stock/.

4 Ibid

5 Ibid

6 H. Kim Bottomly. "Divestment." *Wellesley College*.

7 Michelle Al-Ferzly, Catherine B., Dhivya Perumal, Whitney Sheng, and Laura Wong. "Divestment Then and Now: A History of Wellesley's South African Divestment Movement | The Wellesley News." Accessed May 14, 2016. http://thewellesleynews.com/2014/05/12/divestment-then-and-now-a-history-of-wellesleys-south-african-divestment-movement/.

8 Michelle Al-Ferzly, Catherine B., Dhivya Perumal, Whitney Sheng, and Laura Wong. "Divestment Then and Now: A History of Wellesley's South African Divestment Movement | The Wellesley News." Accessed May 14, 2016. http://thewellesleynews.com/2014/05/12/divestment-then-and-now-a-history-of-wellesleys-south-african-divestment-movement/.

9 Ibid.

10 "Carbon Offsetting Explained." *Carbon Neutral*. Accessed May 14, 2016. http://www.carbonneutral.com/resource-hub/carbon-offsetting-explained.

11 "Office of International Study." *Wellesley College*. Accessed May 14, 2016. http://www.wellesley.edu/ois/node/27380.

to change Wellesley's current study abroad culture. Instead of limiting study abroad travel, the college should purchase carbon offsets so that the college can address the carbon emissions associated with study abroad without harming students' educations. Other types of reimbursed travel to other locations such as conferences are also a valuable part of a Wellesley education, and so carbon offsets may also be a desirable alternative to limiting this travel.

A variation on the carbon offsets strategy is the purchase of Renewable Energy Credits (RECs).When an institution buys a REC, the money the institution spent subsidizes one megawatt hour (MwH) of renewable energy generation. The energy may be consumed and produced remotely but the credit is given to the purchaser of the RECs. RECs contribute to the development of renewable energies by providing power companies the incentive to invest in these energies where possible. Renewable energy sources that are eligible for RECs include: solar, wind, geothermal, hydropower, and biomass and biofuels. By investing in RECs, institutions lower greenhouse gas emissions beyond the borders of their institution and thereby compensate for carbon emissions.[12]

RECs and carbon offsets differ in that RECs produce low-carbon energy instead of fossil fuels, whereas carbon offsets reduce or avoid GHG emissions. That being said, RECs and carbon offsets both reduce the college's carbon footprint without having to change on-campus behavior.

There are a number of challenges related to the purchase of carbon offsets. Who is responsible for the purchase of carbon offsets - students or college administration? If Wellesley College administration decides to place the cost of carbon offsets onto students in the form of increased tuition costs, they may disproportionately and unintentionally burden disadvantaged students. In contrast, study abroad carbon offsets that shift costs onto the students may discourage financially struggling students from studying abroad. Offsetting one metric ton of carbon dioxide through the company TerraPass costs $13.12.[13] A student taking a round-trip flight to London would have to pay approximately $67 to offset the trip's carbon.[14] If the college had purchased carbon offsets for all 2015 study abroad travel, the total cost would have been approximately $16,300. These calculations show that it is financially feasible for Wellesley College to offset its travel-related carbon emissions, but the administration should exercise caution when deciding who will pay for the offsets.

Conclusion

Our report finds that Wellesley College's total 2015 emissions were 44,383 metric tons CO_2e. This is an increase of 107% over the college's 1990 emissions, which totaled 21,402 metric tons CO_2e. Wellesley College has changed dramatically since 1990, and the subsequent campus-wide changes in land use, buildings, consumption, and energy use account for the increase in CO_2 emissions between the two years. The largest source of 2015 emissions was Scope 1, which accounted for 25,912 metric tons CO_2e, or 60% of the college's total emissions. In 2015, 97% of Scope 1 emissions came from the College's co-generation plant. Therefore, the majority of Wellesley College's greenhouse gas emissions resulted from energy production and consumption. Scope 2 and Scope 3 emissions for 2015 comprised 6% and 34% of emissions, respectively. 2015 Scope 2 emissions consisted entirely of electricity and steam purchased from the town of Wellesley, a dramatic difference from the emissions structure in 1990 in which all of the energy consumed by the college was purchased from the town of Wellesley. The largest output from 2015 Scope 3 emissions resulted from transportation, primarily student travel to and from home. Although energy and transportation constituted the largest portion of Wellesley College's emissions, the many smaller, indirect sources of emissions at the college also contribute significantly to emissions, and must not be overlooked in mitigation strategies. It is also important to consider that our audit of Scope 3 emissions is not exhaustive for either 2015 or 1990, as some items classified under Scope 3 were unmeasurable or beyond the reach of this project (e.g. the full supply chain of certain products). In other cases, the data we needed did not exist or were confidential (e.g. shredded reimbursement forms, investment records).

This report provides a number of recommendations for the college to reduce its carbon footprint, taking into account the distribution of emissions within Scope 1, Scope 2, and Scope 3. We make these recommendations with the intention of helping the college to achieve the reductions set by the Wellesley College Strategic Sustainability Plan, which was proposed in February 2016 and accepted by President Bottomly in April of the same year. This plan suggests that the college reduce its greenhouse gas emissions produced by on-campus activities by 37% by 2026 and 44% by 2036 from a 2010 baseline.[15] To achieve these goals and bring Wellesley College closer to net zero emissions, our report suggests three main categories of changes: first, changing transportation incentives and consumption patterns, second, divestment, and third, offsetting carbon emissions and incentivizing clean energy through the purchase of carbon offsets and renewable energy credits.

We conclude this report with three main take-aways. First, including Scope 3 in future audits is crucial for gaining a comprehensive view of Wellesley's emissions sources. For example, Scope 3 accounted for nearly ⅓ of the 2015 emissions represented in this report. Indirect emissions reveal the hidden costs of our consumption patterns and present further opportunities to reduce our emissions, and thus are crucial for future reports and gaining a complete view of where Wellesley College's GHG emissions originate.

Second, this report found that Wellesley emits more GHGs than its peer institutions, on a total and per-student basis, even after accounting for differences in the categories included in Scope 3. While ultimately the purpose of this report is to urge Wellesley College to change on the institutional level, the changes students make at the individual level can also play a role in lowering Wellesley's total GHG emissions.

Finally, we insist that Wellesley College take comprehensive steps to lower its GHG emissions, which will require a serious change in the status quo. We urge President Bottomly, upcoming President Johnson, and the Board of Trustees to recognize the responsibility they have as the leaders of an institution with so much political clout to tackle issues of climate change head on. As long as climate change has effects beyond Wellesley College and as long as the negative effects are unevenly distributed around the world, it is the college's responsibility to act on climate change as an institution that has the power and privilege to create meaningful change.

12 "Renewable Energy Credits Explained." *Triple Pundit: People, Planet, Profit*, October 26, 2011. http://www.triplepundit.com/2011/10/renewable-energy-credits-explained/.

13 "Business Carbon Offset." *TerraPass*. Accessed May 14, 2016. http://www.terrapass.com/shop/busines-carbon-offsets/.

14 "Campus Carbon Calculator." *University of New Hampshire*. Accessed May 14, 2016. http://campuscarbon.com/Calculator.aspx.

15 "Wellesley College's Strategic Sustainability Plan, 2016-2026." *Wellesley College*. February 5, 2016. http://cs.wellesley.edu/~slee/sust/plan.pdf

Appendices

Appendix A - Acronyms

BOW: Babson/Olin/Wellesley
CCC: Campus Carbon Calculator
CO_2 : Carbon Dioxide
CO_2e : Carbon dioxide equivalent
EHS : Office of Environmental Health and Safety
FFW: Fossil Free Wellesley
HVAC: Heating, ventilation, air conditioning
GHG: Greenhouse gas emissions
IT: Information technology
kWh: Kilowatt hours
MT: Metric tons
MPG: Miles per gallon

Appendix B Data Inputted into the Campus Carbon Calculator (CCC)

	Input	Units	2015	1990
Scope 1	Residual Oil (#5-6)	Gallons	X	
	Distillate Oil (#1-4)	Gallons	X	
	Solar - Electric	kWh	X	
	Electric Efficiency	%	X	
	Steam Efficiency	%	X	
	Natural Gas	MMBtu	X	
Fleet	Gasoline Fleet	Gallons	X	X
	Diesel Fleet	Gallons	X	X
	B5 Fleet	Gallons	X	
Refrigerants	HFC-134a	Pounds	X	
	R-404a	Pounds	X	
	Other	Pounds	X	
Scope 2	Electricity	kWh	X	X
Scope 3	Automobile	Miles	X	X
Faculty Commuting				
	Commuter Rail	Passenger Miles	X	
Student Commuting	Automobile	Miles	X	
	Student Air Travel	Miles	X	
	Train	Passenger Miles	X	
	Bus	Passenger Miles	X	
	Personal Mileage Reimbursement	Miles	X	
Study Abroad Travel	Air	Passenger Miles	X	X
Student Travel to / from Home	Automobile	Miles	X	X
	Bus	Passenger Miles	X	
	Train	Passenger Miles	X	
	Air	Passenger Miles	X	X
Incinerated Waste	Mass Burn	Short Tons	X	X
Paper	0% Recycled	Pounds	X	X
	25% Recycled	Pounds	X	X
	100% Recycled	Pounds	X	

Appendix C Carbon Dioxide Emissions Per Category

		1990	2015
Scope 1	Co-gen Electricity	0.0	19.4
	Co-gen Steam	19.4	24980.1
	Direct Transportation	697.4	738.6
	Refrigerants & Chemicals		174.4
Scope 2	Purchased Electricity	9359.4	2502.2
	Purchased Steam / Chilled Water	15684.0	0.0
Scope 3	Faculty / Staff Commuting	234.1	3185.7
	Student Commuting		471.6
	Directly Financed Air Travel		1761.2
	Other Directly Financed Travel		110.4
	Pre-Study Abroad Travel (Car)	5.0	6.4
	Study Abroad Air Travel	1216.8	1248.3
	Student Travel to/from Home	9310.7	9782.1
	Solid Waste	-36.1	-44.0
	Paper Purchasing	103.3	78.8
	Scope 2 T&D Losses	925.7	154.7
	Electronics		3.4
	Idling (Crew Team Only)		1.9
	Deliveries		106.5
	Investments	1036727.0	3711531.8
	Bookstore Shipments		166.3
	Recycling Travel	0.5	6.9
	Waste Travel	65.4	65.4

All units are MT CO2e. A blank space denotes emissions that would have occurred but were unable to be accounted for. A zero indicates that emissions did not occur in that category in that year.

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