



**PRESIDENT'S
COMMISSION ON
CARBON NEUTRALITY**
UNIVERSITY OF MICHIGAN

Spring 2020 Interim Progress Report

June 4, 2020



Co-Chairs

- Stephen Forrest, Professor of Electrical Engineering & Computer Science, Physics, and Material Sci., UM
- Jennifer Haverkamp, Director, Graham Sustainability Institute; Professor from Practice in Law and Policy, UM

Commissioners

- Henry Baier, Associate Vice President for Facilities and Operations, UM
- Andrew Berki, Director, Office of Campus Sustainability, UM
- Valeria Bertacco, Vice Provost, Engaged Learning; Professor, Electrical Engineering & Computer Sci., UM
- T. Anthony Denton, Senior Vice President and Chief Operating Officer, Michigan Medicine, UM
- Austin Glass, Doctoral Student, Climate and Space Sciences and Engineering, UM
- Brandon Hofmeister, Sr Vice President of Governmental, Regulatory and Public Affairs, Consumers Energy
- Gregory Keoleian, Professor Environment & Sustainability and Civil & Environmental Engineering, UM
- Larissa Larsen, Associate Professor of Urban Planning, UM
- Jonathan Overpeck, Dean and Professor, Environment and Sustainability, UM
- Barry Rabe, Professor of Public Policy, UM
- Camilo Serna, Vice President, Regulatory Affairs, DTE Energy
- Anna Stefanopoulou, Professor of Mechanical & Electrical Engineering and Director, Energy Institute, UM
- Missy Stults, Sustainability & Innovations Manager, City of Ann Arbor
- Logan Vear, Undergraduate Student (graduated May 2020), Civil & Environmental Engineering, UM
- Lisa Wozniak, Executive Director, Michigan League of Conservation Voters

Staff

- Liz Barry, Special Counsel to the President, Office of the President, UM
- Andrew Horning, Administrative Director, PCCN and Managing Director, Graham Sustainability Institute, UM
- Lydia Whitbeck, Project Coordinator, PCCN, UM

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“Human influenced global climate change is the defining scientific and social problem of our age.”

— University of Michigan President Mark Schlissel

Introduction

Even as the University of Michigan (U-M) and the world confront the immediate crisis of the COVID-19 pandemic, climate change remains a critical challenge and a priority for U-M. The goal of the [President's Commission on Carbon Neutrality](#) (PCCN) is to contribute to a more sustainable and just world by creating approaches and solutions regarding U-M carbon emissions that are environmentally sustainable, involve the regional community, and can be scaled and replicated beyond U-M. Toward that aim, the PCCN is charged with recommending a plan for U-M (Ann Arbor, Dearborn, & Flint campuses) to achieve carbon neutrality.

Following on the PCCN's initial [Work Plan](#) and the [Fall 2019 Interim Progress Report](#), this is the Commission's third work product. The purpose of this report is to provide an update on the PCCN's progress during its second phase of work, which began in November 2019 and concludes in June 2020. The PCCN's next deliverable will be a set of draft recommendations to be published for public comment prior to being finalized and submitted to President Schlissel by the end of the 2020 calendar year.

This interim progress report provides an overview of the several streams of work that took place during Phase Two. Analyses spanned scope 1, 2 and 3 emissions categories, demand-side management, behavior and collaboration strategies, carbon sequestration and evaluation of carbon offsets, and carbon measurement. In addition, this report provides an overview of Commission meeting topics and public engagements during this period.

The Charge

U-M President Mark Schlissel launched the PCCN in February 2019 with the goal of contributing to a more sustainable and just world. The PCCN's purpose is to outline a timeline, pathway and approaches for achieving carbon neutrality that:

- are environmentally sustainable;
- involve the regional community;
- create scalable and transferable models;
- include the participation and accountability of all members of the university community; and
- are financially responsible in the context of U-M's mission of education, research and service.

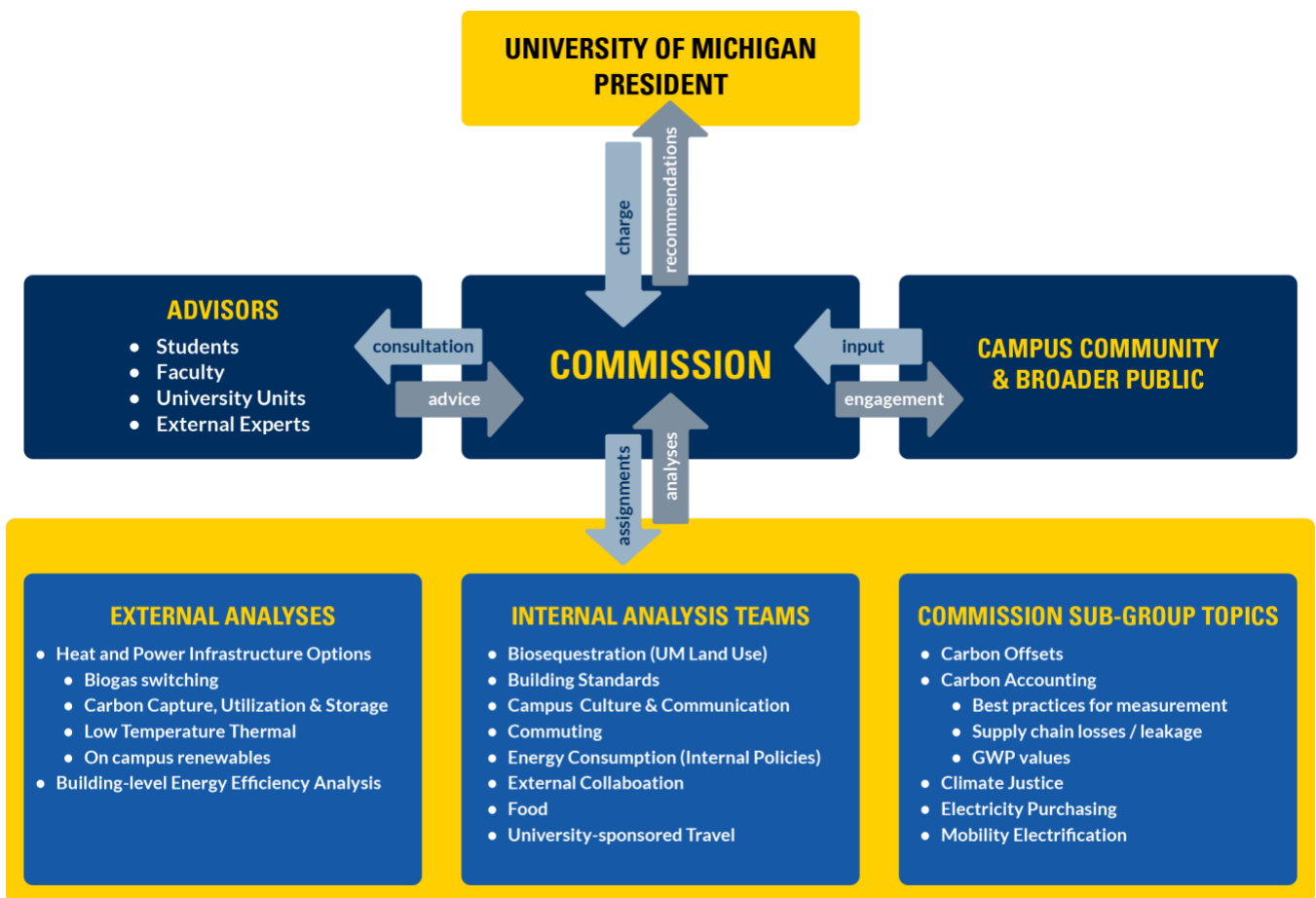
President Schlissel's full charge to the PCCN can be found [here](#).

Commission Structure

The Commission includes [17 members](#) who will collectively recommend to President Schlissel a plan for U-M to achieve carbon neutrality in accordance with the charge it was given. In developing this plan, the Commission tasked specialized teams to conduct distinct analyses, as illustrated and described below. Drawing from these analyses, and with input from advisors and stakeholders, the commissioners will construct a carbon neutrality framework that aligns with the charge.

The PCCN's charge is multifaceted and complex, which necessitates a structure comprising many coordinated groups, including the commissioners, several internal and external analysis teams and subgroups focused on specific topic areas, the campus community, and broader public. In addition, students, faculty, university administrators, and external experts have served as formal and informal advisors to an array of PCCN processes.

The following diagram illustrates the PCCN structure:



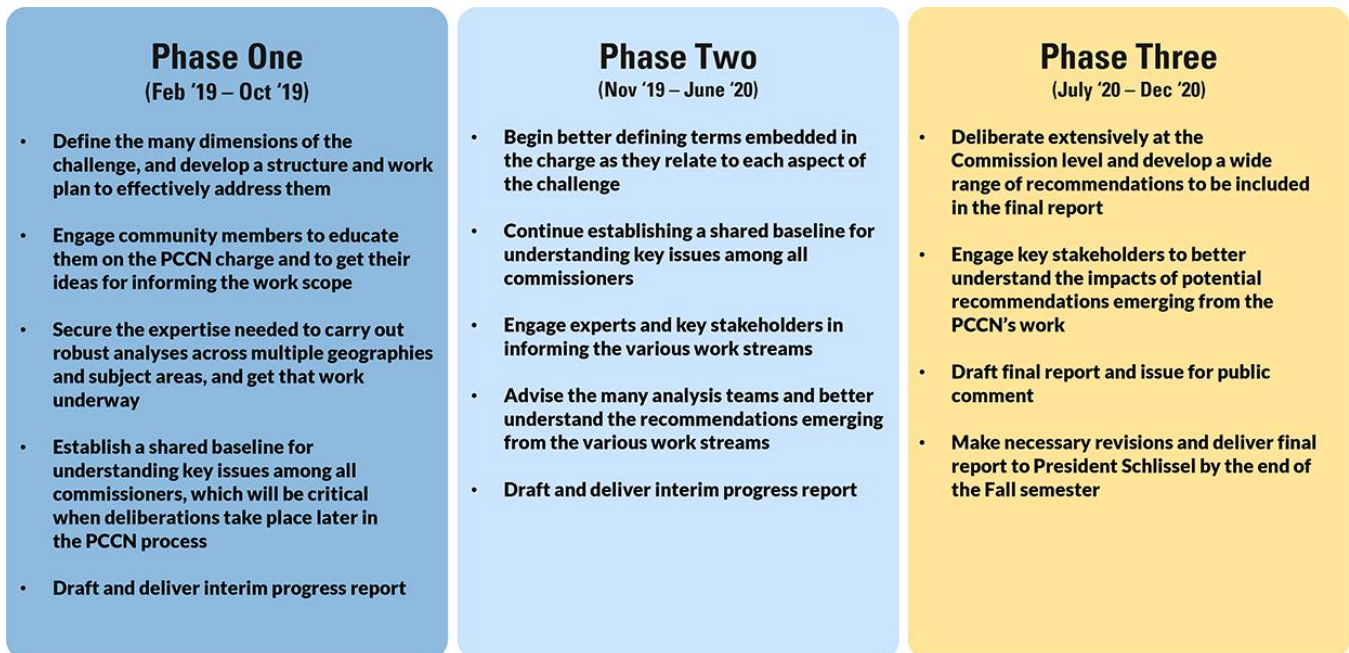
Phases of the Work

Phase One work, which took place from February 2019 through October 2019, focused on defining the dimensions of the challenge, developing a structure and work plan to effectively address them, securing the expertise needed to carry out robust analyses across multiple geographies and subject areas, and getting the analyses underway.

Phase Two work, which took place from November 2019 through June 2020, involved a range of technical analyses to inform the Commission's recommendations. Commission meetings focused on establishing a shared baseline for understanding of key issues among all commissioners. This shared knowledge informed feedback to the analysis teams and will continue to be helpful when deliberations take place during the PCCN's third and final phase.

Phase Three is scheduled to run from July 2020 through December 2020. During this time, commissioners will consider the many components of the challenge and decide upon recommendations to advance to President Schlissel for consideration. This period will also involve consultations with a wide range of advisors to explore potential ramifications associated with the various recommendations. The PCCN will write its final report during this period and plans to release a draft report containing its recommendations for public comment in October, prior to revising and submitting the final report to President Schlissel in December 2020.

The following diagram summarizes the three phases of the PCCN's work:



Commission Meetings

Commission meetings during Phase Two focused on establishing a shared baseline for understanding key issues among all commissioners and on guiding and overseeing the analysis teams. Meetings focused on U-M's budget model, interim updates from the various analysis teams, utility and state policy trends in renewable energy, carbon offsets, goal setting frameworks, and key findings from the various analysis teams. The chart below includes a detailed description of these meetings, with links to summary documents.

Date	Topic	Meeting Objectives
November 15, 2019	PCCN Process and Timeline	To achieve a broad understanding of the PCCN timeline and three phases of work, and to kick off phase two of the work.
December 13, 2019	U-M Budget Model	To gain a baseline understanding of how the U-M budget model works and how investment decisions related to capital projects and operations are made at the unit level.
January 10, 2020	Conversation with President Schlissel and Phase Three Planning	To obtain President Schlissel's perspectives on the PCCN's work thus far, and to begin gathering input to inform the Commission's deliberation, decision-making, and report writing processes that will commence in summer 2020.
January 24, 2020	Heat & Power Infrastructure Analysis Interim Update	To receive an update from an outside consultant, Integral Group, on its interim progress.
February 7 & 21, 2020	Internal Analysis Team Interim Reports	To consult with internal analysis teams regarding their interim progress reports. The internal analysis teams described their work to date, and fielded questions from commissioners.
March 27, 2020	Utility & Policy Trends in Renewable Energy	To understand CMS Energy and DTE Energy plans for utility-scale renewable energy development, including perspectives on transitioning away from natural gas as a heating fuel, and critical state and local policy considerations.
April 17, 2020	Carbon Offsets	To gain familiarity with the various types of carbon offsets, allowances, and credits, including how the market is changing over time, considerations in deciding whether to use offsets, quality variability, co-benefits, and other key issues.
April 23, 2020	A2Zero Plan	To understand the contents of the City of Ann Arbor's draft plan for carbon neutrality
April 24, 2020	Goal Setting Framework	To explore a carbon accounting framework across all emission scopes that could support the Commission in its decision-making process, and garner feedback to enhance model development.
May 1, 2020	Internal Analysis Team Reports Discussion	To consult with the campus culture & communication team and the internal energy consumption policies team regarding their final reports, which will ultimately inform Commission recommendations.
May 8, 2020	Internal Analysis Team Reports Discussion	To consult with the bio sequestration team and the commuting team regarding their final reports, which will ultimately inform Commission recommendations.
May 15, 2020	Internal Analysis Team Reports Discussion	To consult with the food team and the university-sponsored travel team regarding their final reports, which will ultimately inform Commission recommendations.



May 22, 2020	Commission Sub Group Findings Discussion	To consult with the mobility electrification sub group and the environmental justice sub group regarding their findings, which will ultimately inform Commission recommendations.
June 5, 2020	Internal Analysis Team Reports Discussion	To consult with the building standards team and the external collaboration team regarding their final reports, which will ultimately inform Commission recommendations.
June 26, 2020	Heat & Power Infrastructure Report Discussion	To consult with Integral Group regarding the contents of their final report and recommendations, which will ultimately inform Commission final recommendations.

Areas of Analysis

A wide range of teams completed analyses during Phase Two including: internal analysis teams led by U-M faculty and staffed by U-M students, two external consulting firms, and three sub groups which included commissioners, U-M students, faculty and staff. For a comprehensive list of those involved, see the appendices.

Analysis teams submitted their draft final reports and associated recommendations in spring 2020 and subsequently engaged with the Commission to discuss their reports in more detail and to identify necessary revisions. The PCCN's areas of analysis are summarized in the table below and more substantive overviews are provided in the appendices, which are linked to in the table.

Area of Analysis	Category	Scope of Work	Potential Pathways
Heat & Power Infrastructure <i>External Consultant (Integral Group)</i>	Scope 1 Emissions	Evaluate potential pathways for evolving U-M's heating and power generation infrastructure, including natural gas, toward carbon neutrality across all three U-M campuses.	Customized solutions for each of the campus districts. Potential solutions include: geo-exchange, high-, mid- and low- temperature hot water systems, thermal energy storage, bio fuels, and sequestration.
Mobility Electrification <i>Commission Subgroup</i>	Scope 1 Emissions	Identify strategies for converting internal combustion engine vehicles to grid-connected electric vehicles (EV) and for encouraging EV commuting.	Investments in new electric vehicles and associated campus infrastructure.
Electricity Purchasing <i>Commission-level Discussions</i>	Scope 2 Emissions	Will evaluate opportunities, timelines and costs to procure all grid-supplied electricity from renewable sources.	Power Purchase Agreements and Virtual Power Purchase Agreements.
Carbon Neutral Building Retrofits <i>External Consultant (SmithGroup)</i>	Demand-side Management	Deep-dive building retrofit analyses of two distinct buildings on U-M's Ann Arbor campus to inform what would be required to drive building-level emissions down as far as possible.	Specific energy reduction measures/strategies (e.g., electrical and mechanical systems and the building envelope), with estimated capital investment needs and return on investment (ROI).



<p>Building Standards <i>Internal Analysis Team</i></p>	Demand-side Management	Best practices regarding the adoption, implementation, and long-term efficacy of building codes to drive carbon emissions reductions.	Building performance minimums; timeframes for economically feasible net-zero emissions outcomes relative to new standards; holistic algorithm to determine optimal solutions in terms of cost per emission.
<p>Internal Energy Consumption Policies <i>Internal Analysis Team</i></p>	Demand-side Management	Evaluate potential budget & finance mechanisms to decrease energy usage across U-M's campuses.	Internal price on carbon, and revolving energy fund to be used for energy efficiency projects.
<p>Commuting <i>Internal Analysis Team</i></p>	Scope 3 Emissions	Measure the carbon impact of the commute to the three U-M campuses, and explore strategies to reduce the commute's carbon footprint.	Parking pricing system reform, enhanced rideshare and car-sharing programs, improved cycling infrastructure, emphasized central areas for future growth, on-campus housing development.
<p>University-Sponsored Travel <i>Internal Analysis Team</i></p>	Scope 3 Emissions	Evaluate GHG emissions associated with university-sponsored travel, and recommend approaches to reduce the carbon intensity.	Changes for travel-related data management systems; strategies to educate U-M community on the carbon footprint of travel; mechanisms to reduce the amount of university travel, including internal price on travel emissions.
<p>Food <i>Internal Analysis Team</i></p>	Scope 3 Emissions	Evaluate approaches to decrease the GHG footprint associated with food consumption on U-M's three campuses.	Changes to food (especially protein) sourcing through certifications, volume reduction, plant-forward and other beef consumption reduction mechanisms, and other strategies; improved food disposal mechanisms; behavior change through education strategies.
<p>Campus Culture <i>Internal Analysis Team</i></p>	Behavior & Collaboration	Evaluate existing structures and explore strategies to raise awareness, enhance personal investment, and drive behavioral change relating to carbon neutrality.	Institutional leadership office; carbon neutrality training and literacy programs; visible carbon neutrality culture on campus; sustainability strategic plans for individual units.
<p>External Collaboration <i>Internal Analysis Team</i></p>	Behavior & Collaboration	Evaluate opportunities for collaborations focused on scaling and replicating high-impact solutions.	Engagement framework outlining how the university should engage, and which stakeholders it should engage, as it moves towards carbon neutrality.
<p>Environmental Justice <i>Commission Subgroup</i></p>	Behavior & Collaboration	Explore social equity impacts arising from potential recommendations, and how these may be addressed.	Insights and example principles to guide the PCCN in incorporating justice considerations into the final recommendations.
<p>Bio sequestration <i>Internal Analysis Team</i></p>	Carbon Sequestration & Offsets	Evaluate approaches for potential large- and small-scale bio sequestration projects on and off-campus.	Protecting existing natural lands as passive carbon sinks; restoring and enhancing natural lands in lieu of external offsets; prioritizing environmentally and ecologically friendly landscaping practices on campus.

<p>Carbon Offsets <i>Commission Subgroup</i></p>	<p>Carbon Sequestration & Offsets</p>	<p>Will evaluate various options and decision-making criteria for investing in offsite mechanisms to offset emissions not yet mitigated directly.</p>	<p>Third-party validated project credits, cap-and-trade program credits, direct partnerships to develop new projects, offset project decision matrix.</p>
<p>Carbon Accounting <i>Commission Subgroup</i></p>	<p>Measurement</p>	<p>Model various targets and timelines, energy demand reduction and supply decarbonization strategies, emission permits/offsets, and implications of carbon prices.</p>	<p>A multi-dimensional model spanning all emission categories that will allow the Commission to evaluate various scenarios to inform recommendations and administrators to make decisions after the PCCN completes its work.</p>

Community Engagement

Since launching in February 2019, the PCCN has conducted numerous public engagement activities designed to educate the community on the PCCN activities and to garner input from a wide range of stakeholders. For more information on the engagement activities from Phase One, please see the [PCCN's Fall 2019 Interim Progress Report](#).

Several engagement efforts took place during Phase Two and are summarized below. Unfortunately, several planned engagements for the spring of 2020 were cancelled due to the COVID-19 crisis.

- On October 18, 2019, the PCCN co-chairs presented to faculty, staff and students at UM-Dearborn as part of their campus strategic planning process. The co-chairs introduced the Commission and its charge, and presented ways for the UM-Dearborn community to get involved.
- On February 25, 2020 the PCCN co-chairs presented to faculty, staff and students at UM-Flint on the Commission's work thus far, and on how the UM-Flint community could get involved. During this visit, the co-chairs met with representatives of city government, facilities staff, interested students, and deans and faculty.
- The PCCN's eight internal analysis teams and sub groups hosted various engagement events and shared surveys across all three U-M campuses throughout the 2020 winter term to gather input and inform their analyses and final recommendations. The activities are as follows:
 - The campus culture and communication internal analysis team hosted two student-focused town halls at U-M Ann Arbor on December 11, 2019 and February 4, 2020. The team hosted a faculty, staff and student town hall event at UM-Dearborn on February 27, 2020. The team distributed a survey to the UM-Flint campus, as the town hall planned for March 16, 2020 was cancelled due to the COVID-19 crisis.
 - The commuting internal analysis team hosted two town halls for U-M faculty, staff and students at U-M Ann Arbor on January 23, 2020 and February 27, 2020. The team also hosted a town hall at UM-Dearborn on January 22, 2020. Finally, the team distributed a survey to the UM-Flint campus, as the town hall planned for March 12, 2020 was cancelled due to the COVID-19 crisis. The commuting team used these events to discuss the current status of the commute at all

three campuses, and how it could be improved as U-M moves towards carbon neutrality. The results from these events informed the final report and recommendations.

- The external collaboration team distributed a survey which was completed by 187 stakeholders throughout the State of Michigan. This survey was used to inform the team's final recommendations.
 - The food internal analysis team hosted a U-M Ann Arbor town hall on February 5, 2020, and presented at the Washtenaw County Local Food Summit on March 9, 2020. They hosted a town hall at U-M-Dearborn on February 27, 2020. Finally, the team distributed a survey to the U-M-Flint campus in place of their cancelled town hall on March 16, 2020 due to the COVID-19 crisis. The team gathered input from students and the broader community on what they would like to see and what barriers might prevent U-M reaching a just transition to a sustainable and low-carbon food system.
 - The university travel team broadly distributed a survey to U-M faculty, staff and students who have travelled in the past year to inform the final recommendations to the Commission. The survey was completed by over 2,000 U-M faculty, staff and students which provided valuable insight for their final report.
 - In addition to formalized events and surveys, the eight internal analysis teams engaged with a variety of internal and external experts throughout their work. For more information on the groups each team engaged with, see the [appendices](#).
 - The carbon accounting sub group hosted a teach-in on Charting a Path Towards Carbon Neutrality at U-M Ann Arbor on March 10, 2020. At this event, the sub group walked through an exercise which allowed attendees to select a range of GHG emission reduction policies and strategies that would move U-M towards carbon neutrality. This teach-in both shared potential decisions that the Commission will have to deliberate over during phase three of the work with the attendees, and helped to inform the model that the carbon accounting sub group is working on to aid the Commission in its deliberations.
- The PCCN engaged with the City of Ann Arbor throughout Phase Two. Six individuals working for the Commission and its analysis teams worked closely with the City to support the development of its own carbon neutrality plan. Commissioners attended an optional PCCN session on April 23, 2020 to learn from the City about the "A2Zero" carbon neutrality plan.

In addition to these events, U-M's sustainability communications manager, working closely with the Commission and various Internal Analysis Team members, drafted several articles for the University Record on the teams' work to date. Additional articles are planned following the release of this report.

The PCCN website serves to complement and reinforce the Commission's in-person engagement efforts with [a comments portal](#) that has received 175 submissions to date. The Commission has published [a synthesized and categorized summary of all public comments to date, co-chair summaries for all Commission meetings](#), and an [FAQ page](#) which answers questions frequently posed by students and community members.

Next Steps

The third and final phase of the PCCN's work will begin in July 2020 and will continue through December 2020. At this time, the COVID-19 crisis has not significantly altered the PCCN's timeline, but the Commission is planning for contingencies in the event that the crisis persists in a disruptive manner. Commissioners will begin Phase Three by discussing and deliberating on the many dimensions of potential carbon neutrality recommendations for U-M. As the PCCN's recommendations begin to take shape, there will be significant value in gaining the perspectives of U-M students, faculty, and organizational units, with each bringing a unique and important voice to inform the recommendations. There will be opportunities for the broader public to comment on PCCN recommendations prior to their being finalized.

Key PCCN activities during Phase 3 are expected to include:

- Thorough examination of the analysis team reports.
- Deliberating and deciding on preliminary recommendations.
- Firming up cost estimates associated with the various recommendations.
- Engaging key constituents to gain their perspectives on emerging recommendations.
- Periodically updating the U-M Regents, Executive Officers, and key university units on progress.
- Drafting a preliminary final report for public comment.
- Revising the report in response to public comments.
- Finalizing the PCCN report, delivering it to President Schlissel, and making it public.

APPENDICES

APPENDIX A

Heat & Power Infrastructure

[The Integral Group](#) was selected by the Commission to perform an analysis on how U-M could transition its heat and power infrastructure, including natural gas, to a carbon neutral system across all three U-M campuses (Ann Arbor, Dearborn & Flint campuses). The project followed a four-stage process:

1. Developing in-depth knowledge about historic energy consumption and campus infrastructure characteristics;
2. Leveraging information to create a dynamic, iterative process to explore and analyze a range of strategies;
3. Selecting several options for conceptual design; modeling pinpoint emissions reductions; and financial analysis; and
4. Delivering a plan to the Commission in June 2020 that provides a roadmap for decarbonizing U-M's heat and power infrastructure.

The Integral Group team divided the university geographically into eight districts based on their existing cooling and heating infrastructure. Find the eight districts below.

1. Ross Athletic Campus
2. Central Campus
3. Medical Center
4. North Campus
5. North Campus Research Complex (NCRC)
6. East Medical
7. UM-Flint
8. UM-Dearborn

Across all of these districts, the Integral Group utilized the data provided by U-M Facilities and Operations to map their existing thermal infrastructure, and perform thermal energy demand intensity (TEDI) and cooling energy demand intensity (CEDI) analyses. The TEDI and CEDI analyses provided a high-level idea of how much opportunity there is to reduce energy demand and prepare the districts for carbon neutral infrastructure.

Integral Group conducted preliminary analyses for each of the districts to inform which carbon neutral infrastructure strategies would be complementary with the existing heating and cooling demand loads. Integral Group's work shows that each district is vastly different in its needs, meaning that there is not a one-size-fits-all solution. Instead the transformation towards carbon neutrality will likely require segmenting U-M's three campuses into various heating and cooling districts and employing different and diverse solutions based on their specific characteristics and needs. Among others, high-level potential strategies include: geo-exchange, high-, mid-, and low- temperature hot water systems, thermal energy storage, solar thermal heat recovery, sewage heat recovery, biofuels/biomass, and sequestration.

A component of Integral Group's charge is to produce solutions of how U-M can evolve its heat and power infrastructure, and to identify solutions that are:

1. Based on sound financials;
2. Technically sound and reliable, while providing flexible long-term solutions;
3. Resilient, practical and take into consideration external risks; and
4. Scalable and transferable to other institutions and organizations.

Integral Group has worked closely with U-M facilities and operations staff from the Office of Campus Sustainability and U-M Utilities. The Integral Group team visited the UM-Flint and UM-Dearborn campuses during Winter 2020.

The Integral Group will deliver their final report and recommendations to the Commission in June 2020.

Key Contributors

Name	Affiliation
James Adams	U-M Utilities
Malcolm Bambling	U-M Utilities
Andrew Berki	U-M Office of Campus Sustainability
Sam Brooks	Integral Group
Justin Chin	Integral Group
Greg Kats	Integral Group
Kenneth Keeler	U-M Office of Campus Sustainability
Jennie Kim	Integral Group
Sara Lappano	Integral Group
Vladimir Mikler	Integral Group
Kevin Morgan	U-M Office of Campus Sustainability
Shreshth Nagpal	Integral Group
Tom Prince	U-M Utilities
Dan Stanish	U-M Facilities and Operations
Mike Swanson	U-M Utilities
Natalie Vadeboncoeur	Integral Group
Eric Van Nus	Integral Group

APPENDIX B

Mobility Electrification

The Mobility Electrification Subgroup (formerly termed the Fleet Electrification Subgroup) addresses electrification of U-M owned and managed fleet vehicles as well as measures to encourage electric vehicle use by U-M faculty, students, staff and visitors. The subgroup is led by [Prof. Anna Stefanopoulou](#), director of the University of Michigan Energy Institute (UMEI), with members listed in the table below.

The [Mobility Electrification Scope of Work](#) includes investigating, analyzing and developing recommendations for:

1. Transitioning the campus transit (Blue Bus) fleet to electric buses
2. Encouraging electric vehicle (EV) use by U-M commuters through expansion of on-campus EV charging infrastructure as well as educational and promotional efforts

To address these objectives, the team gathered information and data on available electric vehicles, their performance and costs, current Blue Bus operations, the current commuting population and their vehicle use, EV charging equipment and costs, the status of electrification efforts by peer institutions and other entities, and transportation electrification plans by the City of Ann Arbor, with which U-M's efforts should be aligned. The team presented its draft report to the PCCN on Friday, May 22, 2020, which included findings and extensive backing analysis for its recommendations.

The team's recommendations to the commission focus on pursuing the transition to an electric Blue Bus fleet, expanding U-M charging infrastructure to support EV use by long-distance faculty and staff commuters, and developing and implementing an educational program to raise EV awareness and provide information on EV benefits, incentives, fuel savings, and charging availability.

The team will continue its work to address comments received on its draft report and pursue more in-depth analysis of mobility electrification options.

Sub Group Members and Analysis Team Researchers

Sub Group Members	U-M Campus	Affiliation
Anna Stefanopoulou	Ann Arbor	U-M Energy Institute & College of Engineering
Andrew Berki	Ann Arbor	U-M Office of Campus Sustainability (OCS)
Stephen Dolen	Ann Arbor	U-M Logistics, Transportation and Parking (LTP)
Austin Glass	Ann Arbor	U-M College of Engineering
Brandon Hofmeister	External	CMS Energy
Gregory Keoleian	Ann Arbor	U-M School for Environment & Sustainability
William McAllister	Ann Arbor	U-M Logistics, Transportation and Parking (LTP)
Camilo Serna	External	DTE Energy
Missy Stults	External	City of Ann Arbor



Analysis Team Researchers	U-M Campus	U-M Affiliation
John DeCicco	Ann Arbor	Energy Institute
Kamryn Hayes	Ann Arbor	College of Literature, Sciences, and the Arts
Jason Siegel	Ann Arbor	Energy Institute
Juan-Jie Sun	Ann Arbor	College of Engineering
Preston VanAlstine	Ann Arbor	College of Literature, Sciences, and the Arts

APPENDIX C

Carbon Neutral Building Retrofits

SmithGroup Inc. was selected by the Commission to perform a building energy and carbon impact study to analyze and find substantial reductions in Energy Use Intensity (EUI) and identify which potential energy reduction ideas could yield the greatest reduction in carbon impact on two distinct U-M buildings. The project began with the Art and Architecture building on the U-M Ann Arbor North Campus and followed a four-stage process:

1. Gathered necessary data and performed in-person building walk-throughs to evaluate building history, facilities assessment, existing building systems, floor plans, etc. and analyzed data to determine the current EUI performance of the facility and identify carbon reduction opportunities.
2. Developed a list of potential strategies to reduce building energy demand and associated carbon emissions based on major energy reduction, carbon impacts, and potential on-site renewables.
3. Iterate on the proposed strategies with the PCCN Building Standards working analysis team and U-M Architecture Engineering and Construction team and identify/evaluate the greatest carbon reduction opportunities, (proposed strategies include five architectural, two electrical, five heating ventilation air conditioning (HVAC), and two bundled strategies; shoebox models were performed for each).
4. Draft and deliver a final report to the PCCN in summer 2020 outlining the existing conditions, benchmarking, cost estimates for specific energy conservation measures, and recommended paths to achieve energy demand reduction for the building – estimated July 1.

The goals of this work are to determine what it would take to drive emissions down as far as possible for a singular pre-existing building, and to establish a process for the building evaluation that could be applied to future studies of other buildings on U-M's campuses (Ann Arbor, Dearborn & Flint campuses).

Key Contributors

Name	U-M Campus	Affiliation
Steven Baumgartner	External	SmithGroup Inc.
Andrew Berki	Ann Arbor	U-M Office of Campus Sustainability
Andrew Dunlap	External	SmithGroup Inc.
Jeff Hausman	External	SmithGroup Inc.
Jana Hayford	Ann Arbor	U-M Architecture, Engineering, and Construction
Lars Junghans	Ann Arbor	U-M Taubman College of Architecture and Urban Planning
George Karidis	External	SmithGroup Inc.
David Karle	Ann Arbor	U-M Architecture, Engineering, and Construction
Deanna Mabry	Ann Arbor	U-M Architecture, Engineering, and Construction
Jen Maigret	Ann Arbor	U-M Taubman College of Architecture and Urban Planning



Greg Mella	External	SmithGroup Inc.
Kevin Morgan	Ann Arbor	U-M Office of Campus Sustainability
Mike Nowicki	External	SmithGroup Inc.
Mark Potter	External	SmithGroup Inc.
Marina Roelofs	Ann Arbor	U-M Architecture, Engineering, and Construction

APPENDIX D

Building Standards

The building standards internal analysis team was co-led by Profs. [Lars Junghans](#) and [Jen Maigret](#) from the Taubman College of Architecture and Urban Planning at U-M Ann Arbor, and the team was staffed by three undergraduate students and three graduate students. The building standards team was charged with evaluating current and emerging best practices regarding the adoption, implementation, and long-term efficacy of building code policies to improve sustainable building performance outcomes with an emphasis on achieving carbon emissions reductions. The scope of this analysis focused on improvements to new building design and construction and approaches to major renovations that have the potential to contribute significantly to carbon emissions reductions for the most affordable cost. Additionally, secondary dimensions, whose contributions to emissions are often overlooked, were considered including occupant behavior, water conservation measures, storm water management practices and alignments between site design and sequestration.

To see the team's full scope of work, see [here](#).

Through their work, the building standards team undertook a range of research inquiries intended to achieve outcomes that exceed the benefits of any specific code or standard's impact when understood within a more holistic context. The team examined efforts at comparable universities and analyzed current Leadership in Energy and Environmental Design (LEED) version 4.1 strengths and weaknesses from a net-zero emissions standpoint. They developed a more holistic framework for a multiple objective optimization algorithm that brings economic considerations to bear on the decisions regarding architectural and building systems approaches to reduce emissions. They worked with U-M facilities and operations staff to understand the existing sustainable building design strategies and standards, and defined parameters to establish situations when major renovations are significant enough to be held to the same building standards as new construction. The team worked to identify specific guidelines that possess the potential for the largest impact on carbon emissions, and explored potential adjustments to life cycle analysis to better incorporate considerations of embodied energy and emissions.

The building standards internal analysis team engaged various groups internally and externally including, but not limited to, U-M's facilities and operations, Integral Group, other various internal analysis teams, Ann Arbor 2030 District, and the City of Ann Arbor.

The team's final report submitted to the Commission focuses on building standard performance minimums; timeframes for economically feasible net-zero emissions outcomes; and holistic algorithm generation to determine optimal building standard solutions.

Building Standards Team Members and Engagement

Faculty Co-Leads	U-M Campus	U-M Affiliation
Lars Junghans	Ann Arbor	Taubman College of Architecture
Jen Maigret	Ann Arbor	Taubman College of Architecture
Student Research Assistants	U-M Campus	U-M Affiliation
McHugh Carroll	Ann Arbor	Taubman College of Architecture
Hannah Irish	Ann Arbor	College of Literature, Sciences, and the Arts
Mitch Mead	Ann Arbor	Taubman College of Architecture
Shuhaib Nawawi	Ann Arbor	College of Engineering
Nicole Rusk	Ann Arbor	Taubman College of Architecture
Kay Wright	Ann Arbor	Taubman College of Architecture
Internal and External Engagement		
U-M Architecture, Engineering, and Construction (AEC)		
U-M Center for Sustainable Systems		
U-M Office of Campus Sustainability		
U-M Sustainability Cultural Indicators Program		
U-M Taubman College of Architecture and Urban Planning		
Ann Arbor 2030 District		
Integral Group		
Michigan Dark Skies		
Robert Kerr Architecture		

APPENDIX E

Internal Energy Consumption Policies

The internal energy consumption policies analysis team was led by Prof. [Tom Lyon](#) from the Ross School of Business and the School of Environment and Sustainability at U-M Ann Arbor. It was staffed by three undergraduate students and two graduate students. The team was charged with evaluating potential budgetary and financial mechanisms to decrease energy usage and decrease carbon intensity across the university. The scope of their work considered dimensions such as an internal price on carbon and a revolving energy fund. The project took place in three main stages:

1. Understanding current U-M policies, incentive structures, and performance;
2. Gathering information about best practices at other universities and institutions; and
3. Developing a set of specific recommendations for U-M.

To read the team's full scope of work, see [here](#).

The team gathered data on historical energy conservation measures at U-M, met with internal stakeholders to understand how resources flow within the University, and benchmarked how peer institutions utilize carbon pricing and revolving energy funds in their climate action and sustainability plans.

The team comprised two subgroups, one focused on carbon pricing, and the other focused on the revolving energy fund. The two policies were seen as synergistic because an internal carbon price would provide a consistent signal across business units equal to the external harms done by greenhouse gas emissions, provide incentives for greater energy efficiency, and generate resources for the revolving energy fund. In turn, the revolving energy fund would provide loans for University units to invest in energy conservation measures.

Both sub-groups of the team spent the remainder of the analysis time thinking through the logistics and details of how their policies would operate separately, and together, as policies that feed into one another.

The team consulted with a range of external entities to gather information on best practices and considerations for the two policies. The team's work was informed by conversations with internal stakeholders from key business and auxiliary units. They collaborated with the regional energy managers in the U-M Office of Campus Sustainability.

The team's final report to the Commission focuses on an internal price on carbon and a revolving energy fund.

Internal Energy Consumption Policies Team Members and Engagement

Faculty Lead	U-M Campus	U-M Affiliation
Tom Lyon	Ann Arbor	Ross School of Business and School for Environment and Sustainability
Student Research Assistants	U-M Campus	U-M Affiliation
Jessica Carlin	Ann Arbor	College of Literature, Sciences, and the Arts
Lyanda Dudley	Ann Arbor	College of Engineering
Taylor Lind	Ann Arbor	College of Literature, Sciences, and the Arts
Larson Lovdal	Ann Arbor	College of Engineering
Katarina Nehrkorn	Ann Arbor	College of Literature, Sciences, and the Arts
Key Advisor(s)		
Kevin Morgan, U-M Office of Campus Sustainability		
Internal and External Engagement		
U-M Athletics Facilities		
U-M Clean Wolverines Research Group		
U-M Dearborn Energy and Sustainability and Facilities		
U-M Dining		
U-M Ford School of Public Policy faculty member		
U-M Flint Facilities and Operations		
U-M Life Sciences Institute		
U-M Medicine		
U-M North Campus Research Complex		
U-M Office of Campus Sustainability		
U-M Planet Blue		
U-M Provost Office		
U-M Ross School of Business		
U-M School for Environment and Sustainability faculty member		
U-M Student Life		
U-M Taubman College of Architecture and Engineering		
California State University, Los Angeles, Energy and Sustainability		
City of Montpelier, Vermont, Energy Advisory Committee		
Metrus Energy		
RentLab		
Schneider Electric		
Smith College		
Stanford University, Sustainability and Energy Management		
University of Miami Florida, Office of Sustainability		
University of Minnesota, Office of Sustainability		
University of Oregon, Office of Sustainability		
Weber State University, Campus Sustainability		

APPENDIX F

Commuting

The commuting internal analysis team was led by Prof. [Jonathan Levine](#) from the Taubman College of Architecture and Urban Planning at U-M Ann Arbor. It was staffed by three undergraduate students and two graduate students. The commuting team was charged with:

1. Developing an approach to measure the carbon impact of the commute to the three U-M campuses;
2. Studying approaches used by peer institutions to reduce the carbon of the commute and their effectiveness;
3. Adapting promising approaches used elsewhere to the specific conditions of the U-M campuses and their surrounding areas; and
4. Developing prioritized recommendations for reducing the commute's carbon footprint, including metrics and indicators for tracking progress.

For the commuting team's full scope of work, see [here](#).

To fulfill its four charges, the group analyzed the carbon impact of the commute to all three U-M campuses for faculty, staff and students. This analysis guided the streams of work, and was used to evaluate and prioritize their final recommendations.

A major analysis area was researching and assessing various parking policies as a potential direction of reform based on practices at peer institutions. In addition to parking policy reform, the group worked to understand the current land-use planning and housing policies across all three campuses, and considered the impact that increasing affordable on-campus housing could have on the carbon footprint of the commute. The team explored current public transit routes and evaluated ways the University could improve access to public transit for the community. The group investigated current provisions for cycling and researched ways to improve bike safety and convenience on the U-M campuses to allow more community members to choose cycling for their commute.

The work was informed by engagement with a variety of external and internal stakeholders to understand the existing policies surrounding transportation and commuting through town halls on the U-M Ann Arbor campus, and on the U-M Dearborn campus. Unfortunately, a planned town hall at U-M Flint had to be cancelled due to the COVID-19 crisis. A survey was distributed to U-M community members across all three campuses to inform their recommendations.

The final report focuses on parking policy reform, housing policy, public transit options, and alternative means of commuting such as ridesharing and vanpooling.

Commuting Team Members and Engagement

Faculty Lead	U-M Campus	U-M Affiliation
Jonathan Levine	Ann Arbor	Taubman College of Architecture and Urban Planning
Student Research Assistants	U-M Campus	U-M Affiliation
Griffin Barron	Ann Arbor	College of Engineering
Samuel Maves	Ann Arbor	College of Literature, Sciences, and the Arts
Abas Shkempi	Ann Arbor	College of Literature, Sciences, and the Arts
Gwyndolyn Sofka	Ann Arbor	School for Environment and Sustainability
William Van Geest	Ann Arbor	School of Music, Theatre and Dance
James Wooldridge	Ann Arbor	Taubman College of Architecture and Urban Planning
Key Advisor(s)		
Susan Grasso, Biden School of Public Policy & Administration, University of Delaware		
Internal and External Engagement		
U-M Housing		
U-M Logistics, Transportation, and Parking		
U-M Office of Campus Sustainability		
U-M Real Estate Office		
Ann Arbor Transit Authority		
City of Ann Arbor		
MIT Parking and Transportation Office		
Stanford University Faculty Staff Housing		
The University of Chicago Housing		
UC Santa Cruz Employee Housing Program		
University of Rutgers Transportation Services		

APPENDIX G

University-Sponsored Travel

The university-sponsored travel internal analysis team was co-led by Prof. [John Williams](#) from the Medical School, and Prof. [Ming Xu](#) from the School for Environment and Sustainability. The team was staffed by one undergraduate student and five graduate students. The team's work was guided by six different goals:

1. To compile published literature on travel footprints, footprints of academic meetings, university and other travel policies;
2. To determine quantitatively the amount of University travel and its associated carbon footprint;
3. To understand why University personnel travel;
4. To propose ways to educate the University community to consider the carbon footprint when deciding whether travel is warranted and how to carry it out to minimize the carbon footprint;
5. To propose a system of offsets for travelers to use; and
6. To propose changes for travel-related data management systems.

For the team's full scope of work, see [here](#).

The team established methods to calculate greenhouse gas emissions for university travel using great circle distance and emissions factors from the Environmental Protection Agency (EPA) for air, rail, and bus travel. For light-duty vehicle travel, the team established a method to calculate greenhouse gas emissions using average fuel economy combined with emissions factors from the EPA.

The team prepared a survey to determine the reasons for University travel, understand the effects of travel on the environment, and to assess willingness to reduce and mitigate travel. This survey was sent to U-M faculty, staff and students who had traveled for the University in the past year.

They engaged internal U-M stakeholders to gather data and identify potential methods for calculating the carbon footprint of university sponsored travel. The survey informed the team's work and recommendations.

The university-sponsored travel team's final report submitted to the Commission focuses on developing a standard system to book travel with carbon footprint information, educational material to help faculty, staff and students make decisions on when to travel, and suggestions on how to mitigate essential travel through carbon offset programs.

University Travel Team Members and Engagement

Faculty Co-Leads	U-M Campus	U-M Affiliation
John Williams	Ann Arbor	Medical School
Ming Xu	Ann Arbor	School for Environment and Sustainability
Student Research Assistants	U-M Campus	U-M Affiliation
Hyo Sub Choi	Ann Arbor	Rackham Graduate School
William Chown	Ann Arbor	College of Literature, Sciences, and the Arts
Jiangzhou Fu	Ann Arbor	Rackham Graduate School
Nate Hua	Ann Arbor	School for Environment and Sustainability
You Lyu	Ann Arbor	Rackham Graduate School
Monica Yen	Ann Arbor	Rackham Graduate School
Internal and External Engagement		
U-M Athletics		
U-M Institute for Social Research		
U-M Office of Financial Aid		
U-M Procurement Services		
U-M Provost's Office		
U-M Rackham Graduate School		
U-M Shared Services Center		
Concur Lab		

APPENDIX H

Food

The food internal analysis team was co-led by Prof. [Lesli Hoey](#) from the Taubman College of Architecture and Urban Planning, and Prof. [Andy Jones](#) from the School of Public Health. It was staffed by two undergraduate students and three graduate students, and had five advisors from various U-M Ann Arbor units. The team was charged with evaluating and recommending approaches to decrease the greenhouse gas emissions footprint associated with the U-M food system. Key considerations of their work included food procurement, loss and waste, dietary behavior change, contract language, sustainability certifications, and plant-forward diets.

For the food team's full scope of work, see [here](#).

The team created a food system map for all three U-M campuses that included dining operations, retail, catering, and other food operations; studied processes at 33 peer institutions through online resources and document review; interviewed dining and sustainability directors at 11 of these institutions; collected relevant research that had previously been conducted on U-M's food system; gathered perspectives from 39 relevant U-M researchers and operational staff; and performed a literature review to understand the state of science that theorizes why and which particular institutional actions would lead to the greatest reductions to food systems-related GHG emissions. The team also explored request for proposal (RFP) and contract language that could be used to improve GHG emissions related data tracking and sustainability practices of food vendors and operators. Town halls were held on the Ann Arbor campus, at the Washtenaw County Local Food Summit, and the U-M Dearborn campus.

The primary analysis focused on assessing UM's current GHG emissions associated with food procurement and consumption, food waste, and waste management practices generally. Data on MDining Sustainable Mondays (during which less red meat is served) were compared to a typical menu day to assess the carbon emissions associated with food procurement and cost implications. Substitution analyses were conducted to examine how emissions and costs would change under various scenarios replacing beef and other red meat with alternative animal proteins and plant-based proteins. These analyses along with data on food spending from other UM food operators were used to estimate the overall carbon footprint of U-M's food procurement system. The team calculated GHG emissions associated with UM's current composting, recycling and landfill waste streams. In both cases, scenarios were modeled to determine the impact of particular interventions UM could pursue.

The team's final report submitted to the Commission focuses on the topics listed above, including but not limited to, proposed changes to food procurement, food waste reduction and diversion, behavior change through education strategies, and institutional capacity building strategies.

Food Team Members and Engagement

Faculty Co-Leads	U-M Campus	U-M Affiliation
Lesli Hoey	Ann Arbor	Taubman College of Architecture and Urban Planning
Andy Jones	Ann Arbor	School of Public Health
Student Research Assistants	U-M Campus	U-M Affiliation
Caroline Baloga	Ann Arbor	College of Literature, Sciences, and the Arts
Sarah Bellaire	Ann Arbor	School for Environment and Sustainability
Rebecca Harley	Ann Arbor	College of Literature, Sciences, and the Arts
Marc Jaruzel	Ann Arbor	Ford School of Public Policy
Nathalie Lambrecht	Ann Arbor	School of Public Health
Key Advisor(s)		
Alex Bryan, U-M Sustainable Food Program		
Martin Heller, U-M Center for Sustainable Systems		
Steve Mangan, Michigan Dining		
Jeremy Moghtader, U-M Campus Farm		
Keith Soster, Michigan Dining		
Internal and External Engagement		
U-M Athletics		
U-M Dearborn		
U-M Dining		
U-M Flint		
U-M Medicine		
U-M Office of Campus Sustainability		
U-M Penny W. Stamps School of Art & Design		
U-M Procurement		
U-M Ross School of Business		
U-M School for Environment and Sustainability		
U-M Sustainable Food Systems Initiative		
U-M Sustainable Living Experience		
U-M University Unions		
11 Dining and Sustainability Directors from Peer Institutions		

APPENDIX I

Campus Culture and Communication

The campus culture and communication internal analysis team was co-led by Prof. [Samer Ali](#) from the College of Literature, Sciences, and the Arts, and Prof. [Joseph Trumpey](#) from the Stamps School of Art and Design. Staffed by three undergraduate students and three graduate students, the team was charged with evaluating existing communicative structures and exploring new strategies to raise awareness, enhance personal investment, and drive behavioral change relating to carbon neutrality.

For the campus culture and communication team's full scope of work, see [here](#).

The team divided into subgroups focused on behavioral and organizational issues, and on the U-M Diversity, Equity and Inclusion (DEI) strategy as a potential model for carbon neutrality at U-M.

The team benchmarked against sustainability initiatives and campus sustainability culture best practices at peer institutions. The team explored potential sustainability course requirements, orientation modules and ongoing professional development programs as a way to increase sustainability literacy across U-M's three campuses among faculty, staff and students. The team's research focused on understanding the merits, challenges, and daily operations of U-M's DEI initiative, in order to replicate its effectiveness for campus sustainability and carbon neutrality.

The team engaged with over 30 campus culture stakeholders including, but not limited to, the U-M Office of Campus Sustainability, U-M Student Life, U-M Office of Diversity, Equity and Inclusion, and Michigan Medicine. The team hosted two student town halls on the U-M Ann Arbor Campus, one town hall on the U-M Dearborn campus, and solicited responses to a survey on the U-M Flint campus, as COVID-19 disruptions prevented the team from engaging with the U-M Flint campus in person.

The team's final report focuses on utilizing U-M's three campuses as living learning laboratories, expanding educational modules and climate literacy programs, applying the DEI model and structure to carbon neutrality, creating a higher office for sustainability in the structure of the University, and decarbonizing University endowment and employee retirement account investments.

Campus Culture and Communication Team Members and Engagement

Faculty Co-Leads	U-M Campus	U-M Affiliation
Samer Ali	Ann Arbor	College of Literature, Sciences, and the Arts
Joe Trumpey	Ann Arbor	Penny W. Stamps School of Art & Design
Student Research Assistants	U-M Campus	U-M Affiliation
Jude Boudon	Ann Arbor	Penny W. Stamps School of Art & Design
Meg Czerwinski	Ann Arbor	School of Nursing
Ben Ingall	Ann Arbor	College of Literature, Sciences, and the Arts
Lisa Maillard	Ann Arbor	School for Environment and Sustainability
Chris Merchant	Ann Arbor	School for Environment and Sustainability
Madeline Peery	Ann Arbor	College of Literature, Sciences, and the Arts



Internal and External Engagement

U-M Alumni Association
U-M Campus Farm
U-M Human Resources, Benefits Office
U-M LSA National Center for Institutional Diversity
U-M Office of Campus Sustainability
U-M Office of Diversity, Equity and Inclusion
U-M Planet Blue
U-M School for Environment and Sustainability
U-M Student Life
U-M Sustainability Cultural Indicators Program

APPENDIX J

External Collaboration

The external collaboration internal analysis team was co-led by Prof. [Andy Hoffman](#) in the Ross School of Business, and Prof. [Trish Koman](#) from the School of Public Health and College of Engineering. It was staffed by three undergraduate students and five graduate students. The external collaboration team was charged with evaluating opportunities for collaborations focused on scaling and replicating high-impact solutions. Examples of this collaboration may include local and regional partnerships, collaborative education initiatives, and mitigation and resilience policy. The team's key priorities guiding its work were as follows:

1. To bring the proper skills, knowledge and support into the carbon neutrality effort to assure success of the various components of the project (e.g., buildings, food, commuting, operations);
2. To create an inclusive process that allows impacted and vulnerable communities to be aware of this effort and have a voice in its implementation;
3. To flesh out collaboration opportunities and identify potential obstacles which can be overcome; and
4. To create an environment in which all relevant stakeholder concerns and objections are addressed and accounted for throughout the project in order to ensure the delivery of viable solutions for the overall long-term success of the project.

To read the team's full scope of work, see [here](#).

The team engaged with stakeholders on all three U-M campuses, coordinated across all eight internal analysis teams to understand each team's external engagement needs, and benchmarked peer institutions to identify best practices in the collaboration space. The team utilized in-person interviews with key University of Michigan stakeholders, phone interviews with administration officials at peer universities, workshops and trainings with University of Michigan personnel and community-engaged learning experts, an online survey to an initial list of over 150 recipients and an ultimate yield of 214 responses, and literature reviews.

The team's research and engagement throughout the analysis process culminated in a final report which outlined the answers to the following questions: 1) Who should the University engage; 2) What should the University engage about; and 3) How should the University engage?

The final report focuses on the need for organizational capacity for external engagement; targeted network mapping; tailored carbon neutrality communication and engagement strategies for stakeholder groups of varied interests; and the need for expanded opportunities for external input into U-M's carbon neutrality initiatives.

External Collaboration Team Members and Engagement

Faculty Co-Leads	U-M Campus	U-M Affiliation
Andy Hoffman	Ann Arbor	Ross School of Business
Trish Koman	Ann Arbor	School of Public Health and Coll. of Engineering
Student Research Assistants	U-M Campus	U-M Affiliation
Gopichand Alla	Dearborn	College of Engineering and Computer Science
Amelia Brinkerhoff	Ann Arbor	Ross School of Business and School for Environment and Sustainability
Zoie Chang	Ann Arbor	College of Literature, Sciences, and the Arts
Wenjie Liu	Ann Arbor	Ford School of Public Policy
Erin O'Shaughnessy	Ann Arbor	College of Literature, Sciences, and the Arts
Mara Page	Ann Arbor	Rackham Graduate School
Joseph Samulski	Dearborn	College of Engineering and Computer Science
Anya Shapiro	Ann Arbor	Ross School of Business and School for Environment and Sustainability
Internal and External Engagement		
U-M Alumni Relations		
U-M Business Engagement		
U-M Dearborn, Facilities		
U-M Foundation Relations		
U-M Government Relations		
U-M Graham Sustainability Institute		
U-M Ginsberg Center		
U-M Office of Campus Sustainability		
U-M Sustainability Cultural Indicators Program		
Arizona State University, Sustainability Office		
City of Ann Arbor, Sustainability and Innovations Office		
City of Dearborn, Sustainability Office		
University of Maryland, Office of Sustainability		
Yale University, Office of Sustainability		

APPENDIX K

Environmental Justice

The environmental justice subgroup is led by Prof. [Larissa Larsen](#), a PCCN commissioner from the Taubman College of Architecture and Urban Planning. The group was charged with exploring the social equity impacts arising from potential Commission recommendations, and how these may be addressed in efforts to achieve carbon neutrality.

The group's work has been informed by a variety of sources, including, but not limited to:

- historical climate justice movements' bundling of social and environmental issues into a single movement;
- benchmarking of 31 peer institutions, localities, states, and nations to understand how social equity and justice considerations are included in climate action and sustainability plans; and
- a climate justice and community-based environmental justice literature review.

The subgroup provided an overview of climate and environmental justice considerations as they relate to carbon neutrality to the Commission on May 22, 2020. This level-setting session served to gather feedback from the Commission on preliminary environmental justice findings and thoughts.

Following this session, the subgroup plans to use its benchmarking, literature review, and feedback from the Commission to create concrete principles to guide the PCCN in thoughtfully incorporating justice considerations into the final recommendations and report.

Key Contributors

Name	U-M Campus	U-M Affiliation
Larissa Larsen	Ann Arbor	Taubman College of Architecture and Urban Planning
Roshan Krishan	Ann Arbor	School for Environment and Sustainability
Daphne Onsay	Ann Arbor	School for Environment and Sustainability
Ifeoluwa Owolabi	Ann Arbor	Taubman College of Architecture and Urban Planning

APPENDIX L

Bio Sequestration

The bio sequestration internal analysis team was co-led by Profs. [Heather Dawson](#) and [Rebecca Tonietto](#) from the College of Arts and Sciences at UM-Flint, and was staffed by two undergraduate students and four graduate students. The bio sequestration team was charged with evaluating and recommending optimal approaches for potential biological sequestration projects on and off-campus. The scope of work was defined with three overarching goals:

1. assessment of current U-M landholdings,
2. categorization of land use on these properties, and
3. evaluation of land-use changes, where possible, that would maximize bio sequestration potential.

The group also evaluated the opportunities and challenges of different methods for changing land use, at multiple scales, to increase carbon sequestration.

To read the team's full scope of work, see [here](#).

The team utilized land use and land cover classification methods using ArcGIS and aerial imagery of all off-campus U-M properties, including the SEAS off-campus land holdings, the U-M Biological Station, the Matthaei Botanical Gardens, and the Camp Davis field station in Wyoming. They worked to obtain an understanding of current carbon storage and bio sequestration potential below ground to inform their recommendations to improve bio sequestration. Historic dominant vegetation cover data from pre-European colonization and settlement contributed to their analysis of above-ground systems. This work assisted the team in developing an appropriate historic land cover baseline which informed their final recommendations for habitat restoration. The team utilized a mixture of pre-existing tree data and data collected by student members through vegetation surveys to calculate the carbon storage of trees on all three U-M campuses. The team compiled research on bio sequestration methods, including those used by comparable institutions.

Small scale projects were explored as a potential way to bring the likely unfamiliar ideas of bio sequestration to U-M's three campuses in a more tangible and visible way.

The bio sequestration team engaged over 30 stakeholders who had been or were currently involved in bio sequestration-related projects. This includes internal facilities and operations experts from all three U-M campuses; municipal representatives from Ann Arbor, Dearborn and Flint; land managers and research scientists from the major U-M landholdings; faculty and staff across all three campuses; and some members from the internal analysis teams.

The bio sequestration team's final report focuses on conservation of existing natural lands; natural land restoration and management; and re-thinking current campus landscaping practices.

Bio sequestration Team Members and Engagement

Faculty Co-Leads	U-M Campus	U-M Affiliation
Heather Dawson	Flint	College of Arts and Sciences
Rebecca Tonietto	Flint	College of Arts and Sciences
Student Research Assistants	U-M Campus	U-M Affiliation
Nicole Blankertz	Flint	College of Arts and Sciences
Hannah Mosiniak	Ann Arbor	School for Environment and Sustainability
Lara O'Brien	Ann Arbor	School for Environment and Sustainability
Caleb Short	Flint	College of Arts and Sciences
Chenyang Su	Ann Arbor	School for Environment and Sustainability
Cyrus Van Haitsma	Ann Arbor	School for Environment and Sustainability
Internal and External Engagement		
U-M Biological Station		
U-M Center for Sustainable Systems		
U-M Dearborn Facilities		
U-M Ann Arbor Facilities and Operations		
U-M Flint Facilities		
U-M Matthaei Botanical Gardens and Nichols Arboretum		
U-M Office of Campus Sustainability		
U-M School for Environment and Sustainability Facilities		
City of Ann Arbor, Sustainability and Innovations		
City of Dearborn, Sustainability Office		
Eastside Improvement Association of Flint		
Golden Drake Realty		
Keep Genesee County Beautiful		
University of Maine, Urban Tree Plan		
University of Pittsburgh, faculty specialist		

APPENDIX M

Carbon Offsets

The PCCN is forming a Commission sub group, led by [PCCN Co-chair Jennifer Haverkamp](#), focused on the role carbon offsets might play as U-M charts its course towards carbon neutrality. The group's work is being informed by a variety of sources, including, but not limited to:

- history of the carbon offsets market, lessons learned regarding offset integrity and additionality, and recent international developments that have significant implications for that market;
- benchmarking of 26 peer institutions to understand how they are incorporating carbon offsets into their climate action plans and counting them toward their neutrality objectives; and
- consultations with UM and external experts.

To date the Commission has conducted benchmarking research into how peer institutions are incorporating offsets into their carbon neutrality goals, and identified available resources for developing an offsets approach (e.g., Duke University's Carbon Offsets Initiative's guide to offset program development). The PCCN held a level-setting session on April 17, 2020, with presentations from external and UM experts, that was designed to give Commissioners a basic familiarity with carbon offsets, a sense of how the market is changing over time, an idea of important considerations in deciding whether to use offsets to help meet UM's carbon neutrality goals, and an understanding of different sources of high-quality offsets.

This sub-group is expected to help the Commission develop a framework that will help it make recommendations on the effective use of offsets. The dimensions of this framework would likely include considerations such as local- vs. non-local; on-campus vs off-campus; third party verification; additionality; duration of offset projects; potential co benefits; measurability; purchasing offsets vs. developing U-M offset projects; potential carbon removal projects; and financial considerations.

Sub Group Members and Engagement (Tentative)

Name	U-M Campus	Affiliation
Jennifer Haverkamp	Ann Arbor	U-M Graham Sustainability Institute
Austin Glass	Ann Arbor	College of Engineering
Brandon Hofmeister	External	CMS Energy
Jonathan Overpeck	Ann Arbor	School for Environment and Sustainability
Missy Stults	External	City of Ann Arbor
Lisa Wozniak	External	Michigan League of Conservation Voters
Resources and Experts Consulted (partial list)		
Kelley Kizzier, Environmental Defense Fund		
Richard Saines, Pollination Group		
Michael Moore, U-M School for Environment and Sustainability		
Sam Stolper, U-M School for Environment and Sustainability		
Second Nature		
Duke University Carbon Offsets Initiative		

APPENDIX N

Carbon Accounting

The carbon accounting subgroup is led by [Prof. Gregory Keoleian](#), a PCCN commissioner from the School for Environment and Sustainability and the Center for Sustainable Systems. During the fall 2019 semester, the group verified appropriate emissions accounting methods on current scientific knowledge of global warming potentials, performed a 20- vs. 100-year impact analysis, and studied the impacts of supply chain losses. As part of the supply chain analysis, the subgroup was specifically tasked with examining fugitive methane emissions from natural gas supplies from their point of origin to delivery on the U-M campus. At President's Schlissel's request, the group compiled information on this issue, and a memo presenting their analyses can be found in the [PCCN's Fall 2019 Interim Report](#).

The subgroup met with the PCCN's Internal Analysis Teams (IATs) to identify data and analysis gaps and to help them apply best practices for carbon accounting in their work in preparation for integrating their work into the carbon accounting framework. The subgroup met with the External Analysis Team (EAT) at Integral Group to understand how to disaggregate heating, cooling, and electricity services provided to the University by the combination of natural gas and purchased electricity. The meeting with Integral Group also served to convey what alterations to the physical plant of the University are being explored, since these will need to be modeled by the subgroup. The team will continue to interact with Integral Group their analysis is integrated into the carbon accounting framework.

The team prepared and delivered an Earth Day 50 celebration Teach-In on Carbon Accounting at the University of Michigan on March 10, 2020 to ≈25 attendees. A preliminary version of the Excel carbon accounting model was developed for and used at the Teach-In. The team modeled a simplified set of demand strategies for carbon reduction and supply (fuel) decarbonization strategies and estimated their potential to affect U-M emissions as well as their likely deployment timelines. Working with the U-M Office of Campus Sustainability (OCS), the group began to characterize the current emission baseline by end use activity (e.g., transportation or building heating). The model supports goal setting and evaluation of strategies' carbon reduction effects, and also incorporates characterization of demand by end use, energy supply options, and permits/offsets for U-M's Scope 1 and 2 emissions. Attendees made group decisions about which carbon reduction strategies to deploy, and the extent and rate of deployment. At the end of the session, the model displayed the carbon reduction trajectories resulting from the groups' decisions.

The preliminary carbon accounting model is being further developed to be the engine of an overall planning and decision-making framework to guide PCCN deliberation sessions throughout phase three of the work. This framework and the accompanying algorithm developed by the team were presented to the PCCN on April 24, 2020. The subgroup is constructing the model to evaluate scenarios of demand reduction and energy supply decarbonization strategies, and to illustrate the resulting carbon reduction trajectories for U-M. This modeling effort will continue through Summer 2020 and will include a more comprehensive characterization of the U-M emission baseline and the reduction potential of carbon reduction strategies.

Model development, compilation and integration of model parameter inputs, and model simulations of select strategies/scenarios will require close coordination and collaboration with the PCCN, IATs, EATs, OCS, U-M Facilities, and the City of Ann Arbor.

Subgroup Members and Contributors (Phase 2)

Name	U-M Campus	Affiliation
Greg Keoleian	Ann Arbor	School for Environment and Sustainability
Michael Mazor	Ann Arbor	School for Environment and Sustainability
Geoff Lewis	Ann Arbor	School for Environment and Sustainability
Kenneth Keeler	Ann Arbor	Office of Campus Sustainability
Austin Glass	Ann Arbor	College of Engineering