Identifying Pathways toward a Carbon Neutral, Climate Resilient Rutgers

Pre-Planning Report of the President's Task Force on Carbon Neutrality and Climate Resilience

February 3, 2020

RUTGERS
THE STATE UNIVERSITY OF NEW JERSEY

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EXECUTIVE SUMMARY

The science is clear: climate change is real, humans are responsible for it, and it is having increasingly severe impacts throughout the world, including here in New Jersey. Sea-level rise associated with global warming is responsible for about 70% of tidal flooding along the Jersey Shore, and in the absence of global sea-level rise, Hurricane Sandy would have flooded about 38,000 fewer New Jerseyans. A warmer atmosphere is increasing the frequency of intense rainfall events, such as those New Jersey experienced during Hurricanes Floyd and Irene. Heat waves are becoming more intense and frequent, causing deleterious impacts on human health.

The only way to stabilize the global climate is to bring net human-caused carbon dioxide emissions to zero – meaning every amount of carbon dioxide emitted into the atmosphere must be balanced by the deliberate removal of an equal amount – and to reduce sharply emissions of other greenhouse gases. According to the Intergovernmental Panel on Climate Change, achieving the Paris Climate Agreement's most ambitious goal, that of limiting warming to 1.5°C, requires global net-zero carbon dioxide emissions by about 2050. And yet even 1.5°C of warming leaves significant residual risk to which individuals, businesses, universities, governments – and, indeed, all of society – must adapt.

It is in the context of these challenges that President Barchi established Rutgers' President's Task Force on Carbon Neutrality and Climate Resilience. The purpose of this Task Force is to develop Rutgers' strategies for contributing to achieving global net-zero carbon dioxide emissions ('carbon neutrality') and for enhancing the capacity of the university and the State of New Jersey to manage the risks of a changing climate ('climate resilience'). The objective of this pre-planning report is to examine best-practices for developing a climate change strategy, commonly known as a Climate Action Plan, and propose an approach for doing so at Rutgers.

Rutgers is already a leader in climate change research and engagement. NSF statistics show that we are among the top four Big 10 schools in research activity in the Earth, ocean, and atmospheric sciences. Our pioneering efforts over the last decade to engage broad stakeholder networks in New Jersey in climate action are at the cutting-edge of community-engaged climate research and engagement. In announcing his recent executive order on climate resilience, Governor Murphy specifically recognized Rutgers' efforts in this regard. Rutgers scientists are also key players in the science and engineering of offshore wind energy, another key state priority.

Rutgers has already taken substantial steps to reduce its carbon emissions intensity, including building what was at the time of its construction in 2013 the largest campus solar facility in the nation. A very active building program has been underway for several years now, and new facilities are built to the equivalent of a LEED Silver performance standard. The Rutgers Master Plan, released in 2015, highlights environmental sustainability as a key objective.

With its extensive history of academic excellence and return on investment to the New Jersey economy comes our next major challenge: designing and implementing our climate neutrality and resilience climate action plan across all schools and operations of this great institution of higher learning, and leveraging climate action at Rutgers to support climate-positive economic development across New Jersey. While some other universities have had inward-looking Climate Action Plans for more than a decade, Rutgers' massive size and broad, statewide community connections gives our University the opportunity to redefine the state-of-the-art of

climate action in higher education. Our broad reach – including a network of more than 500,000 alumni and a presence in every county in the state – is a critical resource in this regard.

Rutgers' climate action planning process is taking place in an active policy environment that includes a statewide commitment to achieve 100% carbon-free energy by 2050 and an active statewide planning process on climate resilience. In addition, New York State has committed to achieving carbon neutrality by 2050, and it seems plausible that New Jersey will follow suit.

As a university, Rutgers has much it can learn about climate action planning from other universities – particularly other large, public, and land-grant universities. Among the Big 10, five schools have already committed to achieving carbon neutrality by 2050, and several have reduced their emissions by 20-40% under decade-old Climate Action Plans. An ongoing climate action planning process at the University of Michigan provides some key lessons for our own efforts, as does a recently completed and well documented effort at Boston University. The NGO Second Nature coordinates two key networks for sharing best practices among universities: the Presidents' Climate Leadership Commitments and the University Climate Change Coalition (UC3). Rutgers is in the process of discussing joining UC3. Through these networks, Second Nature provides extensive resources for universities engaged in climate action planning, and we have drawn upon these extensively in developing the proposed planning process.

But, due to its unique characteristics, Rutgers can also learn from experience in other sectors. As a large public entity, it can learn from the experiences of government agencies, such as the Strategic Sustainability Performance Planning processes undertaken by federal agencies during the Obama administration. As the caretaker of a community of nearly 100,000 people, it can learn from the experiences of municipalities and other local governments. The International Council for Local Environmental Initiatives (ICLEI) provides extensive guidance for climate action planning by local governments. In many cases, there are common themes among the guidance provided to universities, federal agencies, and local governments, making clear that these common themes should be present in the Rutgers Climate Action Planning process.

As a debt issuer, Rutgers can also learn from rapidly evolving perspectives on climate risk and financial disclosures. The Financial Stability Board's Task Force on Climate-related Financial Disclosure (TCFD), chaired by former New York City Mayor Michael Bloomberg, identified several categories of private-sector climate-related risks and opportunities relevant to Rutgers. These include: risks associated with failing to account adequately for greenhouse gas emissions in a world with increasingly strong climate policy; reputational risks associated with failing to act strongly on climate; physical risks associated with extreme weather events and the changing climate; and opportunities associated with improved resource efficiency, reduced energy expenditures, technological innovation, and the ability to flexibly respond to weather events. Based on cross-sectoral recommendations of the TCFD, which are increasingly being incorporated into thinking in capital markets, it would behoove the University to develop clear governance structures for managing climate risk, clearly identify strategies to reduce climate-related risks to the University and leverage climate-related opportunities, and have clear metrics and targets for climate-related risks and opportunities.

Rutgers has not updated its greenhouse gas inventory since a memorandum of understanding with the US EPA lapsed in 2016. In October 2019, Dr. Rachael Shwom (funded by the Rutgers Institute of Earth, Ocean, and Atmospheric Sciences and the Rutgers Energy Institute) hired undergraduates Therese Appuzzo and Richard Chang to assist the Task Force in gathering data to support an emissions inventory. Preliminary analysis shows that the emissions from Rutgers-New Brunswick – including those from direct heating, electricity generation, and

transportation, and those from purchased electricity – totaled 207 thousand tonnes carbon dioxide equivalent in FY 19. (This is approximately 1/500th of all emissions in New Jersey.) Of this, about 42% comes from electricity, about 56% from heating, and about 2% from on-campus bus transportation. This preliminary analysis did not include direct sources of emissions from Rutgers-owned vehicle fleet, fertilizer use, and escaped refrigerants. It also did not include many sources of indirect emissions, such as those associated with the food supply chain and commuter travel. We were able to estimate the indirect emissions associated with the $2.1 million of FY 19 directly financed air travel for Rutgers-New Brunswick, which totals about 5,000 tonnes of CO_2 equivalent. Although we do not yet have sufficient data for a rigorous analysis, an order-of-magnitude calculation suggests emissions associated with commuter travel amount to tens of thousands of tonnes.

Table ES.1. Preliminary FY 2019 Greenhouse Gas Emissions Analysis: Rutgers-New Brunswick

Emissions Source	Tonnes Carbon Dioxide Equivalent	Notes
Co-Generation Electricity (Scope 1)	31,061 (15%)	99,602 MWh
Co-Generation Hot Water (Scope 1)	40,999 (20%)	339,841 MMBtu
Other On-Campus Stationary (Scope 1)	73,637 (36%)	1,384,261 MMBtu
Purchased Electricity (Scope 2)	56,801 (27%)	164,346 MWh
Campus First Transit (Scope 1)	4,977 (2%)	460,023 gal diesel; 24,212 gal gas
Campus Animals (Scope 1)	6 (<1%)	237 animals
*Total Quantified Scope 1 and 2**	*207,481*	
Financed Air Travel (Scope 3)	~5,000	$2,153,740
Commuter Travel (Scope 3)	~30,000	~14,000 staff

* Not including Rutgers-owned vehicles, fertilizer, refrigerants, or chemicals.

A key step for building climate resilience at Rutgers University is a comprehensive analysis of climate-related risks and vulnerabilities. Such an analysis would include: 1) identification of current and projected climate-related stresses affecting Rutgers' campuses; 2) assessment of exposures of university assets, locations, populations, and functions to these stresses; 3) examination of current capacities to respond, cope, and manage these stresses; and 4) recommendations for options and strategies to enhance resiliency. Beyond Rutgers' four campuses, the assessment should also take into account the university's field stations and research sites located throughout the state, the medical facilities at which Rutgers faculty and staff work, and the surrounding communities and commuter-shed regions. The University's response to past extreme weather events provides key insights into physical risks and vulnerabilities. Review of the status of each of the recommendations made by the Rutgers Emergency Preparedness Task Force in 2013, in the aftermath of Hurricane Sandy, would provide a useful starting point for assessment of current response capacities.

Based on the Task Force's analyses to date and investigation of best practices, we have developed a proposal for the development of a Rutgers Climate Action Plan. This Climate Action Plan would identify an ambitious, yet achievable and feasible, timeframe and pathway for achieving carbon neutrality, and would also identify key metrics for assessing the University's vulnerability to the physical impacts of climate change and a strategic approach for reducing these vulnerabilities. With respect to both carbon neutrality and climate resilience, it would identify supportive educational, research, and engagement efforts, as well as mechanisms for financing and tracking progress.

Consistent with best practices, this plan would evolve extensive public consultation, both within and without the University community. It would lead to an interim report, delivered to President Barchi and released publicly in May 2020, and a final report, delivered to the new President and the Board of Governors and Trustees, and released publicly in June 2021.

Key recommendations related to the climate action planning process include:

- Expand the current task force to include student representatives from the four Chancellor units, as well as staff representing: Strategic Planning and Operations; Finance; Facilities, Sustainability and Energy; Transportation; Procurement; Real Estate and Capital Planning; Emergency Management; and Extension. Engage Human Resources in periodic review processes.

- Establish a set of topical working groups, chaired by 1-2 Task Force members, and including Task Force members, additional staff and faculty experts, and students. These working groups should cover:
    - **Energy and Buildings:** Electricity and heat generation (including methane leakage); energy and water consumption by University owned and leased building; energy and water consumption by off-campus housing and other buildings used by the University community
    - **Transportation:** on-campus transportation, commuting, and University travel
    - **General Supply Chain and Waste Management**: approaches to reducing greenhouse gas emissions embodied in procurement and greenhouse gas emissions associated with waste management, as well as approaches to facilitating such reductions in the broader community
    - **Food System:** approaches to reducing greenhouse gas emissions embodied in food consumed on campus, as well as approaches to facilitating such reductions in the broader community
    - **Land Use and Offsets:** approaches to reducing greenhouse gas emissions associated with University land use and maintenance, approaches to increasing carbon dioxide storage in University land, and other approaches to offsetting University emissions
    - **Climate Preparedness**: resilience of the University and surrounding communities to higher temperatures, more intense precipitation, and higher sea levels
    - **Climate-Positive Economic Development:** key considerations for the Task Force and working group to take into account regarding leveraging Rutgers' action and position to catalyze climate-positive economic development, and associated equity issues, in New Jersey

- Each sectoral working group's remit should include relevant aspects of both climate mitigation and adaptation, and should also consider cross-cutting themes, related to teaching; research; campus culture, engagement, and behavior; and climate-positive economic development. For each topic, working groups should examine topics including:

    - Compelling and impactful approaches Rutgers could pursue, along with their associated greenhouse gas emissions reductions, resilience improvements, financial costs and savings, and co-benefits
    - Implementation pathways, timescales, and progress metrics
    - Roles of different parts of the University, including approaches to overcoming institutional, organizational and cultural challenges
    - Strategies for ensuring participation and accountability of the full university community and, as appropriate, external stakeholders
    - Nexus to catalyzing broader, climate-positive economic development in New Jersey and incorporating equity considerations
    - Key unknowns and gaps that require more analysis.

- Contract an external firm with appropriate expertise to undertake an energy and greenhouse gas audit of the university early in the climate action planning process.

- Provide adequate staffing to support the climate action planning process, including:
    - A high-level administrative director, capable of managing complex networks of relationships with internal and external stakeholders and ensuring the Task Force delivers its work on time,
    - A program coordinator to manage the correspondence and events associated with the Task Force's work,
    - A communications specialist at University Communications and Marketing assigned primary responsibility for sustainability and climate action efforts.

- Hold town halls early and late in the planning process and establish an online forum to solicit input from the University community. Establish school and departmental liaisons to engage the faculty and staff broadly.

- Establish processes for engaging (1) the student community, (2) the University's governing boards, (3) chancellors and deans, (4) the Rutgers University Senate, (5) alumni, (6) public-, private-, and NGO-sector state leaders, (7) the communities in which Rutgers' campuses are based, and associated municipal and county leadership.

- Coordinate with the New Jersey Presidents' Council, the Office of the Secretary of Higher Education, and the New Jersey Higher Education Partnership for Sustainability to advance the role of New Jersey's higher-education institutions as agents of climate action.

- Leverage the Big Ten Academic Alliance and the Association of American Universities to advance the role of public, land-grant, and large research universities as agents of climate action.

In addition, the Task Force has identified a few opportunities for action in Spring 2020 that could lead to early successes. We focused primarily on: (1) actions that seemed likely to be necessary for the implementation of any reasonable climate action plan, and (2) actions that are

by construction both climate-positive and revenue-positive and need little further analysis to establish their net benefit. These early wins include:

- Working closely with the external firm undertaking the energy and greenhouse gas audit, establish clear policies, procedures, and lines of responsibility for the regular, periodic reporting of emissions inventories.

- Establish a working group involving the Task Force, Institutional Planning and Operations, and University Finance and Administration to green the University financing and budget process to facilitate high-return-on-investment energy-saving and emissions-reducing investments.

- Work toward an in-state renewable energy power purchase agreement and/or a Green-e certified Renewable Energy Credit purchase to provide carbon-free electricity to cover a substantial portion of Rutgers' electricity consumption.

- Create an updated University inventory of climate research and teaching.

1. Climate Change is a Key Risk for the 21st Century

The science is clear: climate change is real, humans are responsible for it, and it is having increasingly severe impacts throughout the world, including here in New Jersey. Since the late nineteenth century, global average surface temperature has risen by about 1.0°C (1.8°F), predominantly as a result of emissions of carbon dioxide and other greenhouse gases.[1] In New Jersey, the rise in average temperature has been about twice as fast: average statewide temperature is now about 2°C (3.6°F) warmer than in the late nineteenth century.[2]

The climate change experienced to date is already causing substantial impacts in Rutgers' home state. Sea-level rise associated with global warming is responsible for about 70% of tidal flooding along the Jersey Shore,[3] and in the absence of global sea-level rise, Hurricane Sandy would have flooded about 38,000 fewer New Jerseyans.[4] A warmer atmosphere is also increasing the frequency of intense rainfall events, such as those New Jersey experienced during Hurricanes Floyd and Irene.[5] Heat waves are also becoming more intense and frequent, with associated deleterious impacts on human health.[6]

Climate change is not just an environmental challenge: it's also an economic challenge, an infrastructure challenge, and a public health challenge. And these challenges will keep getting more severe with every amount of greenhouse gas emitted into the atmosphere.

The only way to stabilize the global climate is to bring net human-caused carbon dioxide emissions to zero – meaning every amount of carbon dioxide emitted into the atmosphere must be balanced by the deliberate removal of an equal amount – and to sharply reduce emissions of other greenhouse gases.[7] For this reason, the Paris Climate Agreement calls for achieving net-zero greenhouse gas emissions in the second half of this century. The faster net carbon dioxide emissions are reduced, the better the odds of achieving the ambitious target laid out in the Paris Agreement of limiting global warming to well below 2°C above pre-industrial levels. According to the Intergovernmental Panel on Climate Change, achieving the Paris Agreement's most ambitious goal, that of limiting warming to 1.5°C, requires global net-zero carbon dioxide emissions by about 2050; achieving the less ambitious 2.0°C target requires this by the 2070s.[8] And yet even 1.5°C of warming leaves significant residual risk to which individuals, businesses, universities, governments – and, indeed, all of society – must adapt.

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[1] K. Hayhoe et al., "Our Changing Climate," in *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II*, ed. D. R. Reidmiller et al. (Washington, DC, USA: U.S. Global Change Research Program, 2018), 72–144, doi:10.7930/NCA4.2018.CH2.

[2] NOAA National Centers for Environmental information, Climate at a Glance: Statewide Time Series, published October 2019, retrieved on October 21, 2019 from https://www.ncdc.noaa.gov/cag/

[3] Benjamin H. Strauss et al., "Unnatural Coastal Floods: Sea Level Rise and the Human Fingerprint on U.S. Floods Since 1950," Climate Central Research Report, 2016.

[4] Kenneth G. Miller et al., "A Geological Perspective on Sea-Level Rise and Its Impacts along the U.S. Mid-Atlantic Coast," *Earth's Future* 1 (2013): 3–18, https://doi.org/10.1002/2013EF000135.

[5] Hayhoe et al., "Our Changing Climate."

[6] L. A. Dupigny-Giroux et al., "Northeast," in *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II*, ed. D. R. Reidmiller et al. (Washington, DC, USA: U.S. Global Change Research Program, 2018), 669–742, doi: 10.7930/NCA4.2018.CH18.

[7] K. Hayhoe et al., "Climate Models, Scenarios, and Projections," in *Climate Science Special Report: Fourth National Climate Assessment, Volume I*, ed. D. J. Wuebbles et al. (Washington, DC, USA: U.S. Global Change Research Program, 2017), 411–29, https://doi.org/10.7930/J0GB227J.

[8] Joeri Rogelj et al., "Mitigation Pathways Compatible with 1.5°C in the Context of Sustainable Development," in *Global Warming of 1.5°C*, ed. V. Masson-Delmotte et al. (Intergovernmental Panel on Climate Change, 2018).

It is in the context of these challenges that President Barchi established Rutgers' President's Task Force on Carbon Neutrality and Climate Resilience. The purpose of this Task Force is to develop Rutgers' strategies for contributing to achieving global net-zero carbon dioxide emissions ('carbon neutrality') and for enhancing the capacity of the university and the State of New Jersey to manage the risks of a changing climate ('climate resilience'). The objective of this pre-planning report is to examine best-practices for developing a climate change strategy, commonly known as a Climate Action Plan, and propose an approach for doing so at Rutgers.

Defining Carbon Neutrality and Climate Resilience

In scoping this report, it is important to define concepts clearly. At a global scale, *carbon neutrality* means that every tonne of carbon dioxide put into the atmosphere as a result of human activities must be counterbalanced by a tonne removed by human activities – whether by enhancing natural carbon sequestration in reservoirs like forests and marshes, or deploying novel negative emissions technology, like carbon-negative cement or advanced biofuels coupled to geological carbon sequestration.[9] Stabilizing the global climate requires both carbon neutrality and sharp reductions in emissions of other greenhouse gases, such as methane. Thus, we interpret the charge of the Task Force to include not just carbon neutrality per se, but also approaches to control emissions of other greenhouse gases.

At the level of an entity, such as a university, a key question that must be examined in developing a Climate Action Plan is where to draw the boundaries of the relevant system. For Rutgers, does carbon neutrality mean that every tonne of CO_2 emitted must be balanced by enhanced carbon sequestration in campus lands? Or can it be balanced, as many universities have, by investments in offsets – projects to reduce or capture greenhouse gas emissions off campus? An answer to this question must await the feasibility analyses undertaken in the development of a Climate Action Plan.

Climate resilience refers to the capacity of a system to minimize the impacts caused by both changing average temperature, precipitation, and sea level, and by the increased frequency and intensity of weather extremes and flooding caused by climate change. Here, too, it is important to give careful attention to systems boundaries. Rutgers is not isolated from the communities in which our campuses, extension offices, and field stations sit, so we cannot fully consider Rutgers' climate resilience without examining the resilience of these communities. Thus, it is critical to engage these communities in the development of the Climate Action Plan.

2. What Makes Rutgers Unique

As Rutgers' official history declares, *Rutgers, The State University of New Jersey, is the nation's eighth oldest institution of higher learning—one of only nine colonial colleges established before the American Revolution—and has a centuries-old tradition of rising to the challenges of each new generation.*[10] One of the most critical challenges facing current and future generations is the climate crisis. Moving towards carbon neutrality and climate resilience at Rutgers is a complex and daunting task, but also an exciting and critical opportunity in the history of the University.

[9] One tonne (equivalently, one metric ton) is equal to 1,000 kg, or 2,205 pounds. Human-caused global carbon dioxide emissions in 2018 equaled about 42 billion tonnes.

[10] https://www.rutgers.edu/about/history

Rutgers is already a leader in climate change research and engagement. The Rutgers Institute of Earth, Ocean, and Atmospheric Sciences, the Rutgers Climate Institute, and the Rutgers Energy Institute bring together over 200 faculty who are working to understand our planet, how humans interact with it, and how we can do so in a manner more sustainable and resilient. NSF statistics show that we are among the top four Big 10 schools in research activity in the Earth, ocean, and atmospheric sciences. Our pioneering efforts over the last decade to engage broad stakeholder networks in New Jersey in climate action – through networks like the New Jersey Climate Change Alliance, which is coordinated out of the Rutgers Climate Institute and the Bloustein School of Planning & Public Policy; through initiatives like the Getting To Resilience program, operated out of the Jacques Cousteau National Estuarine Research Reserve; through pioneering educational efforts like the Coastal Climate Risk & Resilience graduate traineeship – are at the cutting-edge of community-engaged climate research and engagement.[11] In announcing his recent executive order on climate resilience, Governor Murphy specifically recognized Rutgers' efforts in this regard. Rutgers scientists are also key players in the science and engineering of offshore wind energy. Our faculty are active in efforts like the Intergovernmental Panel on Climate Change, the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services, and the National Climate Assessment.

Rutgers has already taken substantial steps to reduce its carbon emissions. A highly efficient cogeneration plant was installed in 1997 on Busch Campus to provide both electricity and heat, and a wide variety of energy efficiency investments have been ongoing to the present day. In 1999, President Fran Lawrence helped create the New Jersey Higher Education Partnership for Sustainability (NJHEPS), which helps member institutions develop greenhouse gas emissions inventories for their campuses, and vetted best practices for improving energy efficiency and installing renewables. In 2005, President Richard McCormick established the University Committee for Sustainability, which delivered the university's first sustainability plan and an updated greenhouse gas emissions inventory in 2007. In 2009, the first large-scale solar array was built on the Livingston Campus, and it was significantly expanded in 2013, becoming for a time the largest campus solar facility in the nation. In 2014, President Robert Barchi re-vitalized the Rutgers University Sustainability Committee, encouraging coordination of many campus activities and convening annual forums. A very active building program has been underway for several years now, and new facilities are built to the equivalent of a LEED Silver performance standard. The Rutgers Master Plan, released in 2015, highlights environmental sustainability as a key objective.

With its extensive history of academic excellence and return on investment to the New Jersey economy comes our next major challenge: designing and implementing our climate neutrality and resilience climate action plan across all schools and operations of this great institution of higher learning, and leveraging climate action at Rutgers to support climate-positive economic development across New Jersey. While some other universities have had inward-looking Climate Action Plans for more than a decade, Rutgers' massive size and broad, statewide community connections gives our University the opportunity to redefine the state-of-the-art of climate action in higher education. Our broad reach – including a network of more than 500,000 alumni and a presence in every county in the state – is a critical resources in this regard. In addition

[11] Jen Schwartz, "Surrendering to Rising Seas," *Scientific American*, 2018, https://doi.org/10.1038/scientificamerican0818-44; Marjorie Kaplan, Lisa Auermuller, and Jeanne Herb, "Here's How to Save New Jersey from the Rising Tide," *New Jersey Star-Ledger*, June 23, 2019, https://www.nj.com/opinion/2019/06/heres-how-to-save-new-jersey-from-the-rising-tide.html.

to our existing footprint, we are also implementing the Rutgers 2030 Master Plan (2015) which provides some environmental footprint reduction strategies which should be incorporated into our overall Climate Action Plan.

The challenges we face are detailed below, and our actions must account for these challenges as we design, develop and execute our Climate Action Plan.

Our sheer size:

- More than 70,000 students and 27,000 faculty and staff
    - Diversity is one of our greatest strengths; diversity of culture, economics, and experience to name a few. Climate impacts affects all of us and our solutions will come from and will be integrated across all diverse populations of the University
    - Faculty and Students are engaged in climate, environmental and social impact research across all campus; tapping into this vast research will be incredibly valuable to the work of this Task Force.
- More than 6,163 acres (including 30 in Camden; 39 Newark; 137 RBHS; 5,100 NB; 857 Off-Campus within the 21 NJ Counties)
- More than 960 facilities across New Jersey (including 49 buildings in Camden; 630 buildings in NB; 41 buildings in Newark; 49 buildings at RBHS; and 45 buildings within the 21 NJ Counties)
- 29 million square feet of all building types -- academic, administrative, and housing (including 1.5m in Camden; 17.3m NB; 3.3m Newark; 6.3m RBHS; .6m within the 21 NJ Counties)
- Rutgers has one of the largest dining/food service operations in higher education:
    - 6.9 million meals served yearly by Rutgers Dining.
    - Gourmet Dining (a NJ-based business) provides dining services to RU-Newark and RU-Camden[12]

Our complexity:

- Rutgers–New Brunswick (nearly 16,000 beds) has one of the largest residence hall systems in the country.
- Rutgers operates one of the largest campus bus systems in the U.S. and the second largest transit system in the state, behind NJ Transit.
- Our three primary locations are all in urban areas; we also have research and administrative building locations in all 21 New Jersey counties, including our expansive New Jersey Agricultural Experiment Station (NJAES) off-campus facilities
- Rutgers–New Brunswick is geographically distributed across five campuses with land in six cities and municipalities and divided by a river.

Our financial realities:

- Annual operational budget of $4.4 billion, including $245 million spent on supplies and $123 million spent on plant operations and maintenance
- A current deferred maintenance liability of $5.1 billion. This is both a challenge and an opportunity, if we can identify climate-positive ways to address it.

[12] http://food.rutgers.edu/did-you-know/

- Very thin operating margin to keep tuition costs down.
- Substantially less cash reserves than similar schools.
- New Jersey has a high cost-of-living and high prevailing wage.
- While our broad union presence strengthens the ability of faculty, students, and staff to participate in institutional governance, it also means that we have made commitments to maintaining employee standards of living that ununionized peer institutions have not. Newly signed union agreements obligate the University to 3% annual salary increases.

Our infrastructure:

- 70% of the buildings on our flagship campus were constructed at least 25 years ago; more than four out of ten buildings (42%) are over 50 years old.
- 60% of all our buildings are relatively small—under 10,000 square feet—and more difficult to retrofit in a cost-effective way.
- Rutgers maintains 60 miles of underground water and sewer lines.

3. Context for Climate Action in New Jersey

In New Jersey, public policymakers began to develop responses to climate change threats in the late 1990s, during the governorship of Christine Todd Whitman. A key landmark was establishment of a Renewable Energy Portfolio Standard (RPS) as part of the Electric Discount and Energy Competition Act of 1999. This required energy utilities to begin incorporating renewable energy sources into their supply mix. Governor Jim McGreevey established the New Jersey Clean Energy Program at the Board of Public Utilities (BPU) in 2003, providing residents and enterprises with a range of incentives to undertake renewable energy and energy efficiency projects. The administration of Governor Richard Codey in 2005 brought New Jersey into the Regional Greenhouse Gas Initiative (RGGI), a multi-state compact to support trading of greenhouse gas emissions permits among regulated entities in the Northeastern U.S.

In 2007, under Governor Jon Corzine, New Jersey passed the Global Warming Response Act, which led to the state's first comprehensive greenhouse gas inventory in 2008 and set a statewide goal of reducing greenhouse gas emissions by 80% below 2006 levels by 2050. The 2010 Offshore Wind Economic Development Act, under Governor Chris Christie, continued to accelerate renewable energy development. In 2011, Governor Christie disruptively withdrew New Jersey from RGGI but then signed the 2012 Solar Act, aggressively increasing the RPS targets.

Like his predecessors in both political parties, the current Governor, Phil Murphy, has made clean energy a policy priority. The year 2018 saw several important actions. Executive Order 7 directed New Jersey to re-join RGGI, a multi-year process that is now underway. Executive Order 8 promoted offshore wind energy and established a process leading to a current agreement with Ørsted to build the first 1,100 megawatts (MW) of wind turbines in New Jersey waters. New Jersey joined the US Climate Alliance, in solidarity with many other states, upholding the Paris Climate Agreement, from which the Trump administration has announced its intention to withdraw. Executive Order 28 directed the NJBPU to write an energy master plan and establish a path to 100% clean energy by 2050. The Clean Energy Act of 2018 increased the RPS again, established a community solar energy pilot program, set a goal of 3,500 MW of offshore wind by 2030, directed energy utilities to improve energy efficiency on customer

premises, and set a goal of 2,000 MW of energy storage by 2030. In 2019, many of these mitigation initiatives have substantially advanced.

While New Jersey has yet to adopt a statewide carbon neutrality target, several states – including, in 2019, New York State – have recently adopted statutory targets of achieving net-zero carbon dioxide emissions by 2050. As it seems likely that New Jersey will soon follow its neighbor in this regard, leading to statewide carbon neutrality by 2050, a key question for this Task Force is the extent to which Rutgers can outpace the state as a whole, and help the state more broadly achieve this goal.

In parallel with its efforts to reduce greenhouse gas emissions, New Jersey has enacted a variety of policies to improve the state's ability to adapt to a changing climate. Much of the focus is on vulnerable coastal areas, dating back to the 1914 Waterfront Development Act, the 1970 NJ Wetlands Act, and the 1973 Coastal Area Facility Review Act and its 1993 update, carried out in coordination with federal legislation establishing the National Flood Insurance Program and Federal Emergency Management Agency in 1968 and subsequent reforms, and the Coastal Zone Management Act in 1972 and its amendments. Superstorm Sandy in 2012 and the state's slow recovery heightened the salience of climate change adaptation issues and associated policies. In 2019, Governor Phil Murphy's Executive Order 89 directed DEP to appoint a Chief Resilience Officer and an Interagency Council on Climate Resilience, charged with delivering a scientific report on climate change, a statewide climate change resilience strategy, a coastal resilience plan, and an updated state development and redevelopment plan. This Executive Order also called for the Chief Resilience Office to actively engage with the state's higher education institutions in achieving these goals.

In addition to the statewide policy context, climate mitigation and adaptation planning is also happening in some of the communities in which Rutgers' campuses sits. In particular, Newark is in the middle of developing its Sustainability Action Plan 2020, which updates an original 2013 action plan. One of the key action items of the Newark sustainability planning process is to "work with technical advisers and subject matter experts to identify strategies that will allow Newark to meet or exceed climate protection targets in New Jersey's Global Warming Response Act as well as the Paris Climate Accords." Working with Jacques Costeau National Estuarine Research Reserve, the City of New Brunswick in 2015 completed a Getting To Resilience assessment, focused on the city's vulnerability to flooding.

4. Multisectoral Perspectives on Climate Action

As a university, Rutgers has much it can learn about climate action planning from other universities – particularly other large, public and land-grant universities. But, due to its unique characteristics, Rutgers can also learn from experience in other sectors. As a large public entity, it can learn from the experiences of government agencies. As the caretaker of a community of nearly 100,000 people, it can learn from the experiences of municipalities and other local governments. As a debt issuer, Rutgers can learn from rapidly evolving perspectives on climate risk and financial disclosures. This section reviews key insights on climate action planning from all of these experiences.

4.1. Higher Education Perspectives

Strategic planning to reduce, and ultimately eliminate, greenhouse gas emissions has become a common practice among higher education institutions in the last decade. Since 2007, more than 450 colleges and universities have signed onto the Presidents' Climate Leadership Commitments, and seven schools – American University, Bates College, Bowdoin College, Colby College, Colgate University, Middlebury College, the University of San Francisco – have already achieved carbon neutrality.[13]

Second Nature (secondnature.org) is a non-profit founded in 1993 to help spread principles of sustainability in higher education; it has worked with faculty and administrators at hundreds of universities and colleges toward this end. Rutgers has a long history with Second Nature; Kevin Lyons, who at the time was Chief Procurement Officer for the University, worked closely with it from its founding until about 2006. Lyons assisted Tufts University, the University Leaders for a Sustainable Future, and Second Nature in the developing capacity among university signatories in adhering the 1992 Talloires Declaration on sustainability and environmental literacy.[14] Lyons facilitated both summer capacity building sessions at Tufts and on-site capacity building in South America and the UK, and also participated in academic and operational planning around the Declaration.

In 2001, Second Nature established the Education for Sustainability Western Network, which in 2005 transformed into the AASHE, the Association for the Advancement of Sustainability in Higher Education. In 2006, twelve higher education presidents, including the presidents of Arizona State University and the University of Florida, worked with Second Nature, AASHE, and other organizations to launch the American College & University Presidents' Climate Commitment (ACUPCC). In 2011, Second Nature took on sole responsibility for coordinating ACUPCC, which in 2015 was expanded into the Presidents' Climate Leadership Commitments.

In 2018, Second Nature helped establish the University Climate Change Coalition (UC3), a coalition of leading North American research universities that exchanges best practices on reducing greenhouse gases and building community resilience. UC3 also hosts a Research for Policy Platform, which aims to "establish a unified set of principles and policies in order to directly support Higher Education Leaders in local, national, and international 1.5 degree-aligned climate policy engagement." As of September 2019, three Big 10 Schools – the Ohio State University, the University of Maryland, and the University of Michigan – were among the 21 members of UC3; in October 2019, following the establishment of the President's Task Force, President Barchi submitted a request to join UC3.

Based on its experience working with numerous institutions of higher educations, Second Nature has developed extensive guidance on the development and implementation of university climate action plans. Its most general guidance for Climate Leadership Commitment signatories is shown in Figure 4.1. After a public signing of a climate commitment and initial organization of the structures to guide the development and implementation of a plan, the next key steps are to assess the University's greenhouse gas emissions and conduct a campus-community resilience assessment, which identifies key vulnerabilities and metrics for measuring them. Once these are established, the Climate Action Plan itself is developed – characterizing specific strategies from

[13] Maya Earls, "EDUCATION: Colleges Commit to Carbon Neutrality. Getting There Is Hard," *E&E News*, October 3, 2019, https://www.eenews.net/stories/1061192375.

[14] The Talloires Declaration (TD) is a ten-point action plan for incorporating sustainability and environmental literacy in teaching, research, operations and outreach at colleges and universities. It has been signed by over 500 university leaders in over 50 countries.

emissions reductions and resilience, target dates for achieving carbon neutrality and climate resilience goals, interim targets, and tracking mechanism. Once the plan is developed, the process is not done: progress is evaluated annually, and plans are reviewed on an approximately every five years.

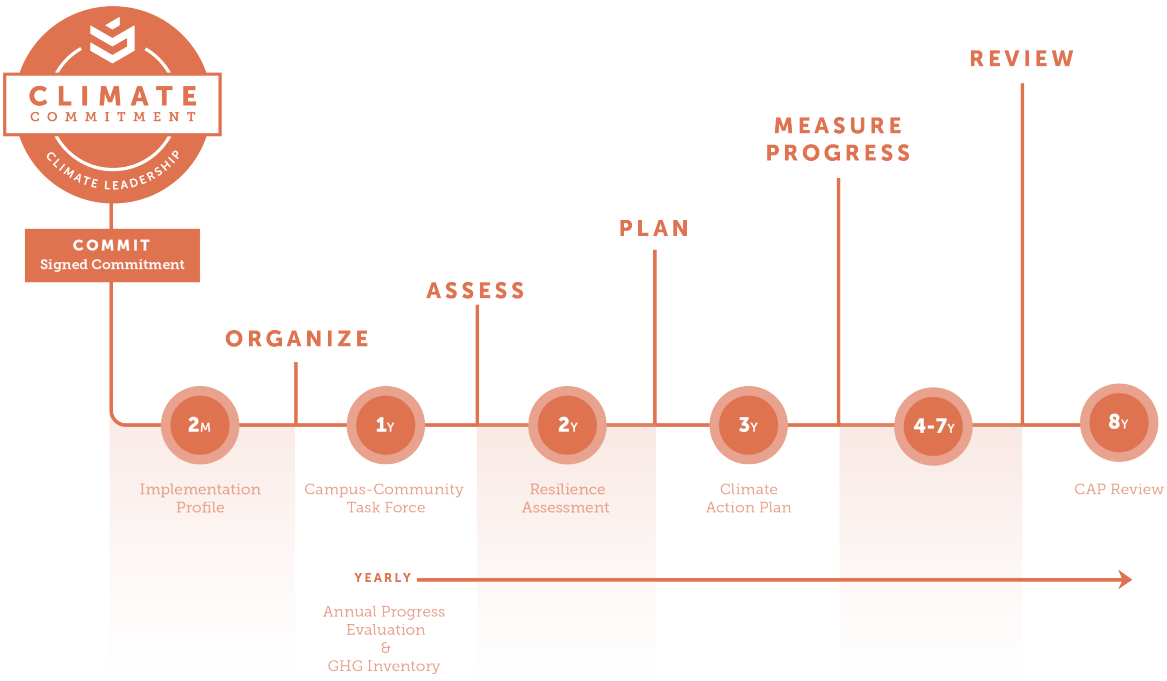

Figure 4.1. Second Nature Climate Commitment framework.[15]

Second Nature provides comprehensive resources to help an organization work through the steps for develop and implement a climate action plan, including detailed guidance on the themes that should be addressed during the development of the plan.[16] These key themes include:

1. A strategic framework, establishing the relationship of climate goals to the institutional mission
2. A characterization of campus emissions, including an inventory of current emissions, the trajectory of emissions under business-as-usual, and the trajectory under the planned pathway
3. Mitigation strategies for achieving the planned pathway
4. Resilience strategies for the campus its and surrounding community, including progress indicators
5. Educational, research, and engagement efforts
6. A financing plan
7. An implementation plan
8. A plan for tracking progress

[15] https://secondnature.org/signatory-handbook/commitments-implementation-handbook/
[16] https://secondnature.org/signatory-handbook/examples-of-climate-action-plan-structures/

CASE STUDY: University of Michigan

The University of Michigan (U-M) has a number of structural similarities to Rutgers. Like Rutgers, it is a large, public, Big-10 research university, with about 46 thousand students and 25 thousand employees. It is a three-campus 'mini-system,' with its largest campus in Ann Arbor and smaller campuses in Flint and Dearborn. Its Ann Arbor campus has about 29 million square feet of building space, comparable to all of Rutgers University.[17]

President Mark Schlissel launched U-M's President's Commission on Carbon Neutrality (PCCN) in fall 2018, roughly one year prior to the launch of the Rutgers President's Task Force.[18] The PCCN is co-chaired by Stephen Forrest, Professor of Electrical Engineering and Computer Science, Physics, and Material Sciences and Engineering and former Vice President for Research, and by Jennifer Haverkamp, Graham Family Director, Graham Sustainability Institute. The PCCN did not began with a target dates for carbon neutrality – rather, this date will be identified by the PCCN based on its technical analyses.

An early question for the PCCN was to determine the scope of its remit. In addition to Scope 1 (direct on-campus) and Scope 2 (purchased electricity) emissions, the PCCN took an expansive view of Scope 3 (indirect) emissions, including *intra alia* emissions from commuting, business travel, and procurement. The only Scope 3 topic deliberately excluded from the PCCN's deliberation is emissions associated with the U-M endowment's ownership of fossil fuel assets. The timeline associated with action on different Scope 3 emissions is tied to how quickly these can be measured: for example, the PCCN sees more immediate prospects for action on commuting than for action on emissions from off-campus student housing.

The PCCN is taking an expansive view of the U-M properties within its remit. These include the U-M Health System, which is the single largest emitter at U-M, responsible for about 60% of CO_2 emissions although constituting only about a quarter of building area. In addition to properties directly owned by U-M, the PCCN is also examining almost all properties leased by the University.

Structurally, the 17-person PCCN is composed of eight faculty drawn from relevant disciplines, three staff members (the Director of Campus Sustainability, the Associate Vice President for Facilities and Operations, and the Chief Operating Officer of the U-M Health System), two senior executives from public utilities, one government official (the sustainability manager for the City of Ann Arbor), one NGO representative (from the Michigan League of Conservation Voters), a graduate student, and an undergraduate student.

The Commission has established several internal analysis teams, which are faculty-led, and largely staffed by students who work closely with U-M operational staff. The President's office provides funding to support for faculty and student analysis time. These internal analysis teams cover: Building Standards, Energy Consumption, Commuting, University Travel, Food, Bio sequestration, Campus Culture and Communication, and External Collaboration. In addition, the PCCN has constituted deliberative subgroups to address a few focused topics, including Carbon Accounting, Fleet Electrification, and Social Justice.

The PCCN also has a substantial contract with Integral Group, an international 'Deep Green engineering' consulting firm, which is working with campus architecture and engineering

[17] https://en.wikipedia.org/wiki/University_of_Michigan

[18] Thanks to Stephen Forrest, co-chair of the U-M PCCN, for providing much of the detail in this case study via personal communication to R. Kopp. Additional information is available at http://sustainability.umich.edu/carbonneutrality.

staff to assemble a coherent, University-wide inventory of carbon emissions and identify strategies for reducing Scope 1 emissions.

In parallel with the more technical analysis work, the PCCN is also closely examining operational characteristics, such as the structure of the university budget model, to ensure that the recommendations presented to the Board of Regents will be informed by them.

The PCCN is engaging the broader community through several channels. They have held several town halls with the U-M community, some of which involved President Schlissel. They have an online form for submitting comments, and an email list for updating interested parties. The PCCN has established advisory panels representing key stakeholders groups, including a student advisory panel managed by the two student commissioners, and an ad hoc group of relevant faculty experts.

As part of the PCCN process, U-M has joined the University Climate Change Coalition (UC3). An early win for the process was the signing of a 200,000 megawatt-hour/year renewable-energy power purchase agreement with DTE Energy, which will cover roughly half the electricity consumption of the Ann Arbor campus.[19]

The Commission is administratively supported by two staff members – a highly experienced Administrative Director for the Commission, who also serves as Managing Director and Chief of Staff of the Graham Sustainability Institute, and a full-time Project Coordinator who is a recent alumna with a degree in environmental science. In addition, the President's Special Counsel serves as Liaison to the President, and the U-M Office of Communications & Marketing recently hired a specialist focused on sustainability and climate action, who is working closely with the PCCN. In addition to the support provided by the central administration to the PCCN and its internal and external analysis teams, a donor has provided the Graham Sustainability Institute with a budget to conduct longer-term research in support of climate action.

The PCCN aims to submit a final report to President Schlissel in fall 2020. To achieve this ambitious timeline, the co-chairs currently meet multiple times per week on tasks related to the PCCN, and the full PCCN has been meeting 1-2 times per month since its establishment.

CASE STUDY: Boston University

Boston University's Climate Action Plan was developed by a Climate Action Task Force of 26 members. It was presidentially appointed with the advice of the associate vice president for sustainability. It was faculty-led, chaired by Tony Janetos (Director of the Pardee Center for the Sustainable Future). It included 6 staff members, 12 faculty members, a postdoc, 5 graduate students, and 2 undergraduates. Staff members included a Climate Action Plan Program Manager, the associate vice president for university sustainability and the director of university sustainability, the vice president of auxiliary services, and two representatives of facilities. Participating faculty included leadership of two relevant centers/institutes (the Institute for Sustainable Energy and the Pardee Center for the Sustainable Future), as well as a cross-section of faculty in Earth system sciences, public health, engineering and urban planning. Staffing support was provided by the individuals who are now the associate vice president for university sustainability and the director of university sustainability.

[19] https://record.umich.edu/articles/u-m-cut-emissions-through-renewable-energy-purchase-dte-energy/

The BU Climate Action Task Force organized itself into subgroups, addressing energy, transportation, supply chain & waste, and climate preparedness. Education and research were treated as cross-working group topics. The process began with a charge in December 2016. Working groups met multiple times per month for the first several months. Public updates happened in campus meetings in January and February 2017. The report was synthesized in spring 2017, and a public draft released late summer 2017.

In a personal communication, Dennis Carlberg, BU's Associate Vice President for University Sustainability, emphasized that a commitment to climate action was an investment in both the university's long-term financial and reputational well-being, with substantial payoff, and that it required a real upfront investment. For plan development, BU hired external consultants to assist plan development. For implementation, it has hired 6 FTEs and is making a $141 million dollar capital investment.

Big 10 Schools with Climate Action Plans or other Climate Strategies

University	Plan Date	Neutrality Target	Actual Reduction
Michigan State University	2012	-	28% from 2010-2016
Northwestern University	2017	2050	
Ohio State University	2011	2050	6% from 2006-2018
Pennsylvania State University	2002	-	32% from 2005-2019
University of Illinois at Urbana-Champaign*	2010, 2015	2050	32% from 2007-2018
University of Maryland-College Park	2009, 2017	2050	28% from 2005-2016
University of Michigan	2015, ongoing	Under evaluation	8% scope 1 & 2 from 2015-2018
University of Minnesota-Twin Cities	2010	2050	37% from 2008-2018

Other Selected Institutions with Climate Action Plans

University	Plan Date	Neutrality Target	Actual Reduction
Arizona State University*	2009, 2018	2035	27% from 2007-2018
Boston University	2017	2040	
Columbia University	2017, ongoing	Under evaluation	29% scope 1 & 2 from 2006-2016
Cornell University	2009, 2014	2035	36% from 2008-2018
Georgia Institute of Technology	2009	2050	26% from 2008-2018
New York University*	2010	2040	29% from 2006-2011
North Carolina State University	2010	2050	25% scope 1 & 2 from 2008-2018
Oregon State University	2009	2025	12% from 2007-2018
Princeton University	2008, 2019	2046	9% from 2008-2018
San Diego State University	2017	2050	14% scope 1 & 2 from 2015-2017
Temple University*	2010	2050	10% from 2006-2018
University of Arizona*	2012	2050	7% from 2009-2015
University of California*	2008, 2019	2025	Relative to 1990 ranges from 32% reduction (UCR) to 13% increase (UCLA)
University of Central Florida	2010	2050	36% from 2007-2017
University of Florida	2009	2025	2% scope 1 & 2 from 2005-2018
University of New Hampshire*	2009, 2014	2099	41% from 2001-2017
University of Pennsylvania	2009, 2014, 2019	2042	22% from 2014-2019
University of Washington	2009	2050	1% from 2005-2015

Data taken from school websites or the Second Nature Reporting Platform.

** indicates institutions that have also done a resilience assessment.*

4.2. Public Sector Perspectives

The climate action planning guidance provided by Second Nature for higher education institutes shares considerable similarities with approaches used by public entities outside of academia. Given its size (nearly 30,000 employees, and a total population of nearly 100,000) and extensive geographic scope, Rutgers shares more characteristics with federal agencies, state agencies, and mid-sized cities than do most universities, so the Task Force also examined planning approaches used by these entities.

Under ***Executive Order 13514***, during the Obama administration, Federal agencies were required to develop plans for increasing energy efficiency, reducing greenhouse gas emissions, conserving and protecting water resources, managing waste; and promoting sustainable technologies. Each agency's Strategic Sustainability Performance Plan set percentage reduction targets for greenhouse gas emissions, to be achieved by a combination of energy efficiency measures, renewable energy procurement, and reduction in the use of fossil fuels for transportation. Agencies were also required to set targets and develop strategies for reducing indirect emissions associated with vendors, contractors, and travel. Agencies were also directed to work with the communities in which they sat, through measures such as engaging in regional transportation planning processes and promoting locally generated renewable energy. Agencies were directed to set targets for building design, including achieving zero-net-energy consumption in all new buildings by 2030. The agencies' Strategic Sustainability Performance Plan were monitored by the Office of Management and Budget and the Council on Environmental Quality, and plans were to be updated annually, with actions prioritized based on lifecycle return on investment. Later in the Obama Administration, under ***Executive Orders 13653 and 13693***, these plans were also required to include strategies to increase agency resilience.

Established in 1990, the ***International Council for Local Environmental Initiatives (ICLEI)*** is a global network of more than 1,750 subnational governments to advance sustainable development. Among ICLEI member governments in New Jersey are Glen Rock, Hoboken, Jersey City, and Princeton. ICLEI guidance on mitigation planning is based on the Five Milestones framework, which is highly analogous to the iterative approach recommended by Second Nature. ICLEI places a strong emphasis on broad, public stakeholder engagement in Climate Action Plan development. It notes that "most plans include timeline, a description of financing mechanisms, an assignment of responsibility to departments and staff, and public awareness and education efforts," and also notes that governments are increasingly including equity elements in their plans.[20] The ICLEI framework for adaptation planning parallels that for mitigation planning.

Broadly, the general structure of the federal Strategic Sustainability Performance planning process and the ICLEI's Five Milestones framework for local planning are structurally similar to that recommended by Second Nature for higher education institutions. Thus, we feel comfortable recommended that Rutgers' approach be broadly based upon the Second Nature guidance. A few specific elements of the federal and local approaches – such as prioritization based in part on lifecycle return on investment and the inclusion of an equity lens – also seem worth considering for integration into Rutgers' climate action planning framework.

[20] ICLEI-Local Governments for Sustainability USA, "Localizing the Paris Agreement" (he, 2017).

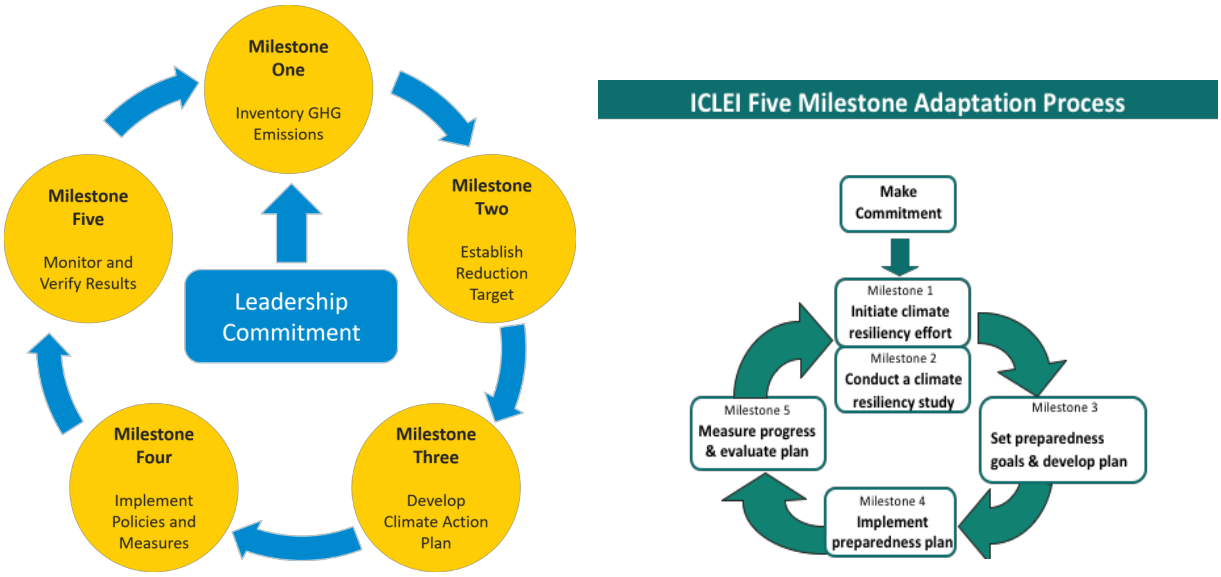

Figure 4.2. The ICLEI Five Milestones framework for mitigation (left) and adaptation (right) by local government.[21]

4.3. Market Sector Perspectives

Rutgers is not just a university or an instrumentality of the State of New Jersey – it is also a market actor. We compete in the market for higher education students, and we finance large-scale projects by selling debt into capital markets. From the perspective of market actors, the taxonomy provided by the Financial Stability Board's Task Force on Climate-related Financial Disclosure (TCFD) provides a useful guide.[22] The TCFD, chaired by former New York City Mayor Michael Bloomberg, divides climate risk into two categories: transition risk and physical risk. Transition risk refers to the policy, legal, technological, and market risks associated with the transition to a low-carbon economy, while physical risk refers to the risks due to climate change itself, either through changes in the average climate state or through its effects on extreme weather events. While not all the subtypes of transition and physical risks are relevant to Rutgers, a number of them are.

In terms of transition risk, Rutgers is vulnerable to policy risks associated with the broader climate policy context in New Jersey and the United States. As described in Section 3, New Jersey currently has a statutory goal of reducing its greenhouse gas emissions by 80% below 2006 levels by 2050, while our neighboring state of New York has set a statutory goal of achieving net-zero carbon dioxide emissions by 2050. If Rutgers makes capital investments without taking into consideration the existing statutory and regulatory context in New Jersey – and the potential for it to become more stringent, as in New York State – it risks underperformance on the part of these investments. If it assumes low fuel costs inconsistent with these policy targets, it risks unexpectedly large fuel expenditures in future years. These unexpectedly large costs and underperforming investments may hurt Rutgers' fiscal health, credit rating and performance on capital markets.

[21] ICLEI-Local Governments for Sustainability USA.
[22] Task Force on Climate-related Financial Disclosures, *Recommendations of the Task Force on Climate-Related Financial Disclosures*, 2017, https://www.fsb-tcfd.org/publications/final-recommendations-report/.

Figure 4.3. TCFD's framework for climate-related risks, opportunities, and financial impact.[23]

Rutgers is also vulnerable to reputation risk if it fails to act aggressively on climate change. Public opinion research shows that concern about climate change is rising rapidly, particularly among young people[24], yet at the moment, Rutgers does not participate in U.S. and international higher education rankings based on its sustainability and climate action. By contrast, Big Ten peers like Ohio State University, Penn State, the University of Maryland, the University of Michigan, and the University of Illinois participate in sustainability- and climate action-based rankings, like the *Times* Higher Education University Impact Rankings[25] and the Sierra Club Cool Schools ranking.[26] If Rutgers does not keep pace with its peer institutions in climate action, it risks making the university a less attractive place for potential enrollees and employees.

In terms of physical risk, Rutgers is vulnerable both to acute risks associated with extreme weather events and to chronic risks, associated with factors such as rising seas, higher temperatures, and intensifying precipitation. As discussed in Section 6, the effects of past acute events on Rutgers' operations highlights some of our vulnerabilities. Rutgers incurred real and measurable costs associated with these events, and failure to proactively manage these events can hurt Rutgers' fiscal health, credit rating, and performance.

The TCFD also identified several climate-related opportunities, many of which apply in some manner to Rutgers. Improved resource efficiency can both reduce emissions and leads to direct cost savings, and efforts to increase resource efficiency must necessarily constitute a substantial fraction of the strategies examined in developing a Climate Action Plan. As the TCFD noted, decentralized clean energy sources – such as the solar farm on Livingston Campus – likewise have the potential to reduce energy expenditures, especially as the capital costs of such investments continue to plummet. Climate action can be a source of opportunities related to

[23] Task Force on Climate-related Financial Disclosures.
[24] Matthew Ballew et al., "Do Younger Generations Care More about Global Warming?," *Yale Program on Climate Change Communication* (blog), June 11, 2019, https://climatecommunication.yale.edu/publications/do-younger-generations-care-more-about-global-warming/.
[25] https://www.timeshighereducation.com/rankings/impact/2019
[26] https://www.sierraclub.org/sierra/cool-schools-2019/cool-schools-2019-full-ranking

products and services, and Rutgers has been developing technologies like carbon-negative cement and services like climate risk analysis that could provide sources of revenue. Finally, investing in resilience can in many cases not only reduce down-side risk, but also increase the ability of the university to flexibly respond to new opportunities.

Since the TCFD issued its recommendations in 2017, private-sector reporting on climate-related risks and risk governance has become modestly more common, and this trend is expected to accelerate. In April 2019, the Network for Greening the Financial System, including 34 central banks, encouraged all companies issuing public debt to disclose their climate risk in line with the TCFD recommendations.[27] Also, in April, the investment management company BlackRock – building upon research undertaken by the Climate Impact Lab, in which Rutgers is a collaborator – issued a report looking at the physical risks associated with US assets.[28] Credit rating agencies have begun to move more actively in this space, with Moody's buying the climate data firm Four Twenty Seven in July 2019.[29] Reporting has noted the increasing prevalence of climate risk disclosure by underwriters of municipal bonds.[30] It is thus reasonable to expect that investors in Rutgers bonds will be increasingly influenced by assessments of Rutgers' exposure to climate risk.

Accordingly, although the specific TCFD recommendations are not targeted at the higher-education sector, it would behoove Rutgers to prepare to disclose the sort of information TCFD recommends across sectors, and to develop the institutional structures to do so in a manner that sheds a positive light on the University's management of climate risk. This implies that the Climate Action Plan must recommend clear governance structures for managing climate risk, clearly identify strategies to reduce both transition and physical risks to the University and leverage climate-related opportunities, and have clear metrics and targets for climate-related risks and opportunities.

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[27] Network for Greening the Financial System, *A Call for Action: Climate Change as a Source of Financial Risk*, 2019, https://www.banque-france.fr/sites/default/files/media/2019/04/17/ngfs_first_comprehensive_report_-_17042019_0.pdf.

[28] BlackRock Investment Institute, *Getting Physical: Scenario Analysis for Assessing Climate-Related Risks*, 2019.

[29] Christopher Flavelle, "Moody's Buys Climate Data Firm, Signaling New Scrutiny of Climate Risks," *The New York Times*, July 24, 2019, sec. Climate, https://www.nytimes.com/2019/07/24/climate/moodys-ratings-climate-change-data.html.

[30] Danielle Moran, "Muni Bonds Contain New Fine Print: Beware of Climate Change," *Bloomberg Businessweek*, November 5, 2019, https://www.bloomberg.com/news/articles/2019-11-05/how-serious-is-the-climate-change-risk-ask-a-banker.

Governance	Strategy	Risk Management	Metrics and Targets
Disclose the organization's governance around climate-related risks and opportunities.	Disclose the actual and potential impacts of climate-related risks and opportunities on the organization's businesses, strategy, and financial planning where such information is material.	Disclose how the organization identifies, assesses, and manages climate-related risks.	Disclose the metrics and targets used to assess and manage relevant climate-related risks and opportunities where such information is material.
Recommended Disclosures	**Recommended Disclosures**	**Recommended Disclosures**	**Recommended Disclosures**
a) Describe the board's oversight of climate-related risks and opportunities.	a) Describe the climate-related risks and opportunities the organization has identified over the short, medium, and long term.	a) Describe the organization's processes for identifying and assessing climate-related risks.	a) Disclose the metrics used by the organization to assess climate-related risks and opportunities in line with its strategy and risk management process.
b) Describe management's role in assessing and managing climate-related risks and opportunities.	b) Describe the impact of climate-related risks and opportunities on the organization's businesses, strategy, and financial planning.	b) Describe the organization's processes for managing climate-related risks.	b) Disclose Scope 1, Scope 2, and, if appropriate, Scope 3 greenhouse gas (GHG) emissions, and the related risks.
	c) Describe the resilience of the organization's strategy, taking into consideration different climate-related scenarios, including a 2°C or lower scenario.	c) Describe how processes for identifying, assessing, and managing climate-related risks are integrated into the organization's overall risk management.	c) Describe the targets used by the organization to manage climate-related risks and opportunities and performance against targets.

Figure 4.4. TCFD recommended disclosures for all sectors.[31]

[31] Task Force on Climate-related Financial Disclosures, *Recommendations of the Task Force on Climate-Related Financial Disclosures*.

5. Preliminary Analyses of Rutgers' Emissions

Rutgers has begun an analysis of its baseline emissions and construct methods to collect the data needed to track greenhouse gas emissions. In October 2019, Dr. Rachael Shwom (funded by the Rutgers Institute of Earth, Ocean, and Atmospheric Sciences and the Rutgers Energy Institute) hired undergraduates Therese Appuzzo and Richard Jang to assist faculty in gathering data. The goal is to undertake greenhouse gas emission data collection for Rutgers's New Brunswick, Newark, Camden, and RBHS campuses. We are starting with New Brunswick, while identifying contacts for the other campuses, since much of the data is not collected centrally.

The team has selected SIMAP (Sustainability Indicator Management and Analysis Platform) to track emissions. SIMAP is a carbon and nitrogen accounting platform that can track, analyze, and improve campus sustainability. This system has been used extensively by universities for meeting greenhouse gas emissions goals. The program's algorithms, calculations, and assumptions are transparently documented and built on peer reviewed published literature. SIMAP is utilized by Second Nature members to track greenhouse gas emissions. SIMAP can assist Rutgers in creating a baseline, benchmarking our performance, creating reports, setting goals, and analyzing progress year to year.

SIMAP uses a standard greenhouse gas accounting concept, called scopes, that helps entities understand and structure decisions about the boundaries of its emissions. The scopes framework also helps address the problem of "double counting" in greenhouse gas accounting. There are three scopes or level of responsibilities for emissions. Scope 1 emissions are most directly within the university's control and decision-making, where scope 3 emissions are indirect consequences of the university's decisions (Figure 5.1). *Scope 1 emissions* are direct emissions from sources that are owned and/or controlled by Rutgers. This includes combustion of fossil fuels in college-owned facilities or vehicles, fugitive emissions from refrigeration, and emissions from on-campus agriculture or livestock husbandry. *Scope 2 emissions* arise from purchased electricity. These are direct emissions from sources that are not owned nor operated by Rutgers, but whose production are directly linked to on-campus energy consumption. Finally, *Scope 3 emissions* come from sources that are not owned nor operated by Rutgers, but are either directly financed (e.g., food and product supply chain emissions, commercial air travel paid for by the institution) or are otherwise linked to the campus via influence or encouragement (e.g., air travel for study abroad programs, regular faculty, staff, and student commuting). Since Scope 1 and 2 emissions are easy to both measure and reduce, many institutions with carbon neutrality target have chosen to set an earlier target date for Scopes 1 and 2 than for Scope 3.

Preliminary analysis of Scope 1 and 2 emissions provides a baseline to start to understand Rutgers greenhouse gas emissions. (This preliminary analysis is based only on emissions at Rutgers-New Brunswick.) Excluding Rutgers-owned vehicle fuel usage, fertilizer use, and annual fluorocarbon emissions, Rutgers-New Brunswick's scope 1 and 2 emissions total 207,281 thousand tonnes carbon dioxide equivalent.[32] Forty-two percent of emissions are associated with electricity, either purchased from a utility (27%) or generated at the campus co-generation facility

[32] Carbon dioxide equivalent (CO_2e) emissions are calculated using 100-year global warming potentials, which measure the ratio of the average radiative forcing caused by a molecule of a given gas over a century to the average radiative forcing of CO_2 over the same period.

(15%), and about 56% are associated with heat production. Despite the campus's massive bus system, it constitutes a small (2%) share of emissions. While, of Scope 3 emissions, we have so far only examined Rutgers-financed air travel, preliminary analysis suggests that this amounts to about 5,000 tonnes for Rutgers-New Brunswick travel, an amount comparable to emissions from on-campus buses. Although we do not yet have sufficient data for a rigorous analysis, an order-of-magnitude calculation suggests emissions associated with commuter travel are of the order of tens of thousands of tonnes.

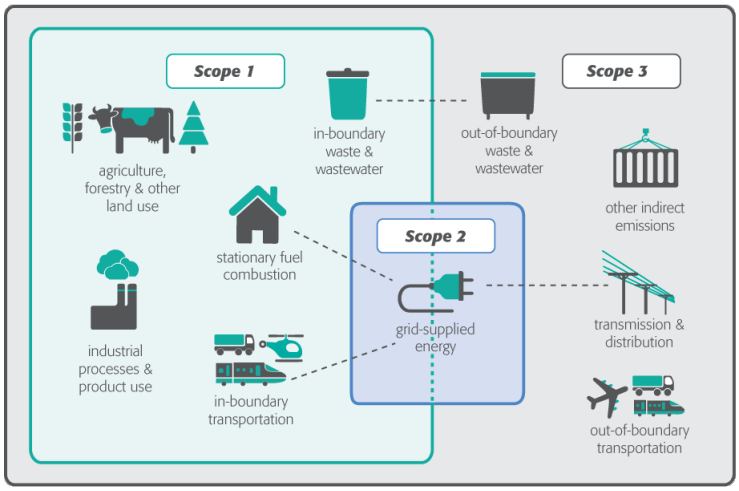

Figure 5.1. Emissions sources.[33] Scope 1 emissions are physically produced by campus facilities, scope 2 are associated with grid electricity procured by the university, and scope 3 covers other induced off-campus emissions.

Table 5.1. Preliminary FY 2019 Greenhouse Gas Emissions Analysis: Rutgers-New Brunswick

Emissions Source	Tonnes Carbon Dioxide Equivalent	Notes
Co-Generation Electricity (Scope 1)	31,061 (15%)	99,602 MWh
Co-Generation Hot Water (Scope 1)	40,999 (20%)	339,841 MMBtu
Other On-Campus Stationary (Scope 1)	73,637 (36%)	1,384,261 MMBtu
Purchased Electricity (Scope 2)[34]	56,801 (27%)	164,346 MWh
Campus First Transit (Scope 1)	4,977 (2%)	460,023 gal diesel; 24,212 gal gas
Campus Animals (Scope 1)	6 (<1%)	237 animals
*Total Quantified Scope 1 and 2**	*207,481*	
Financed Air Travel (Scope 3)[35]	~5,000	$2,153,740
Commuter Travel (Scope 3)[36]	~30,000	~14,000 staff

* Not including Rutgers-owned vehicles, fertilizer, refrigerants, or chemicals.

[33] Wee Kean Fong et al., "Global Protocol for Community-Scale Greenhouse Gas Emission Inventories" (World Resources Institute, 2014).
[34] Converted assuming 527 lbs (0.239 t) CO_2 emitted per MWh (https://www.eia.gov/electricity/state/newjersey/). Consistent with NJDEP's previously used methodology, we applied an adjustment factor of 1.006304 to account for emissions of CH_4 and N_2O.)
[35] Approximate conversion based on assumption of 8 cents per passenger km, and UK Government GHG Conversion Factors (2019) estimate of 0.19 kg CO_2e per passenger km for long-haul flights. Includes only Rutgers-New Brunswick (not RBHS facilities).
[36] Assume average staff member commutes 30 miles/day in a car that gets 30 miles/gallon, for annual consumption of 250 gal gasoline/staff member, amount to ~2.3 tonnes CO_2/staff member.

Table 5.2. Information required for SIMAP emissions analysis.

Category of Data	Data Variables	Contact (s)	Next Steps
Institutional	Budget (research, energy, operations) Population Physical Size	Brian Ballantine	Complete.
Scope 1			
On Campus Cogeneration Plants	Stationary Co-generation	Mike Kornitas	Complete.
Other Campus Stationary Sources	Other	Mike Kornitas	Complete.
Direct Transportation (University fleet)	Fuel from SG vehicles	James Koch (state vehicles)	Requested.
	Fuel from public transit system	Jack Molenaar via First Transit	Complete
Refrigerants and Chemicals	Pounds Purchased/EPA reported releases (C2F6, C3F8, C4F10, C5F12, C6F14, C3F6)	Nimish Patel and Wes Coleman Glenn Vliet	Purchasing data provided but needs additional analysis EPA Fluorocarbon release data requested
Agricultural Sources	Fertilizer Application (Synthetic and Organic N fertilizer)	Nimish Patel and Wes Coleman	Purchasing data provided but needs additional analysis
	Animal Husbandry	Clinton Burgher	Compete
Scope 2			
Purchased steam, electricity and chilled water	Other	Mike Kornitas	Complete.
Scope 3			
Commuter	Staff	Jack Molenaar	Survey needed to collect appropriate data
	Faculty	Jack Molenaar	Survey needed to collect appropriate data
	Students	Jack Molenaar	Survey needed to collect appropriate data
Directly Financed Outsourced Transportation	Students (miles or $), Air travel, taxi/ferry/rental car, Bus, personal mileage reimbursement	Ann Gutsick	Data received; analysis needed
	Faculty/Staff (miles or $), Air travel, taxi/ferry/rental car, Bus, personal mileage reimbursement	Ann Gutsick	Data received; analysis needed
Study Abroad Travel	Passenger miles, $ spent	Lauren R Winogron	Data received; analysis needed
Solid Waste Incinerated	Short tons	David DeHart	Not Requested
Landfilled Waste	Short tons	David DeHart	Not Requested
Paper Purchased	Lbs of (10, 20, 30% recycled) paper	Nimish Patel Wes Coleman	Data received; analysis needed
Food	Lbs/Gallons of 18 categories of food	Joe Charette, Lisa Tenore (food buyer)	Preliminary data received; additional data and analysis needed

6. Vulnerability Lessons from Past Extreme Events

A key step for building climate resilience at Rutgers University entails a comprehensive analysis of climate-related risks and vulnerabilities. Such an analysis would include: 1) identification of current and projected climate-related stresses affecting Rutgers' campuses; 2) assessment of exposures of university assets, locations, populations, and functions to these stresses; 3) examination of current capacities to respond, cope, and manage these stresses; and 4) recommendations for options and strategies to enhance resiliency. Beyond Rutgers' four main campuses, the assessment should also take into account the university's field stations and research sites located throughout the state, the clinical facilities at which Rutgers faculty and staff work, and the surrounding communities and commuter-shed regions.

Stakeholder-based investigation of critical climate exposures, response capacities, and resiliency options and strategies is a commonly-used method for vulnerability assessments.[37] For Rutgers, stakeholders include representatives from emergency management and risk planning, and other individuals with direct responsibility for university operations including energy systems, communication, transportation, water supply and waste-water systems, dining, housing, athletics, facilities, police, labor relations, and information services, among others. Stakeholders also include representatives of key constituency groups such as students, faculty, staff, and administrators, and members of local communities in each campus region. Ensuring broad and inclusive participation from all three campuses is critical for an effective stakeholder-based process.

Examination of the impact of past extreme weather events on Rutgers campuses and operations offers important insights into critical exposures, vulnerabilities, and areas where resilience-building is needed. Over the past several decades, Rutgers' campuses have experienced numerous extreme climate events. In the case of Rutgers-New Brunswick, for example, significant flooding of the Raritan River has occurred on many occasions over the past several decades. The top 15 Raritan River flood crest events since 1970 are documented in Table 1. These include "named events" such as Tropical Storm Floyd in 1999 and Hurricane Irene in 2011, as well as large Nor'easters and other "unnamed storms." Two such events (April 2007 and May 2014) are illustrated in Figures 1 and 2. The impacts of major flood events include disruption of campus functions due to loss of road access between campuses and from the surrounding region, loss of power, telephone service, and internet access, and disruption of water supplies and waste-water systems.

Table 6.1. Top 15 Flood events on the Raritan River at Bound Brook, the closest gauge to the New Brunswick campus. Flood stage is considered 28 feet and major flood stage 33 feet.
Source: Data supplied by the Office of the New Jersey State Climatologist, Rutgers University.

(1) 42.13 ft on 09/17/1999 (Tropical Storm Floyd)
(2) 41.90 ft on 08/28/2011 (Hurricane Irene)
(3) 38.38 ft on 04/16/2007 (see Figure 1)
(4) 37.47 ft on 08/28/1971 (Tropical Storm Doria)

[37] Robin Leichenko et al., "Economic Vulnerability to Climate Change in Coastal New Jersey: A Stakeholder-Based Assessment," *Journal of Extreme Events* 01, no. 01 (August 2014): 1450003, https://doi.org/10.1142/S2345737614500031.

(5) 36.04 ft on 03/14/2010
(6) 35.58 ft on 10/20/1996
(7) 34.65 ft on 05/01/2014 (see Figure 2)
(8) 33.34 ft on 01/20/1996
(9) 33.18 ft on 01/25/1979
(10) 33.14 ft on 09/09/2011 (Tropical Storm Lee)
(11) 32.00 ft on 07/07/1984
(12) 31.84 ft on 04/16/1983
(13) 31.73 ft on 12/21/1973
(14) 31.33 ft on 01/26/1978
(15) 31.10 ft on 04/17/2011

Figure 6.1. Left: View of New Brunswick and Route 18, April 16, 2007 (Photo credit: John Munson, *Star Ledger*). Right: Landing Lane Bridge, May 1, 2014. (Photo credit: Office of the New Jersey State Climatologist, Rutgers University.)

Beyond flood risks, Rutgers' three campuses have also been subject to other extreme weather events including damaging wind events, snowstorms, and extreme heat. The most significant climate event affecting Rutgers campuses in living memory is Hurricane/Superstorm Sandy, which occurred in late October 2012. Sandy's impacts were widespread, affecting operations at all three Rutgers campuses.[38] In New Brunswick, loss of power severely compromised university operations, resulting in cancellation of classes for a week. Along with loss of power, IT and email systems, water supplies and bathroom facilities, security and swipe card access, and food service on and around campus were also disrupted. As a result of power outages on Cook-Douglass, several thousand residential students were relocated to temporary housing on Livingston and Busch campus. Other damage included loss of refrigeration of laboratory samples due to failure of back-up power, leading to destruction of data for numerous experiments. Operations at Newark campus were also significantly disrupted by Sandy. While Newark's campus did not endure direct physical damage from the storm, power outages and loss of

[38] Rutgers Emergency Preparedness Task Force, "Emergency Preparedness Task Force Report: Hurricane Sandy 2012" (Rutgers, the State University of New Jersey, 2013).

telephone service on campus in combination with loss of public transit and widespread road closures in the region, led to cancellation of classes for a full week. Rutgers-Camden experienced relatively less disruption to operations from Sandy. Camden did not lose power during Sandy and was able to resume classes within a few a days after the storm, despite roof damage to the library and downed/damaged trees. However, Camden's off-campus populations from the Brookdale, Monmouth and Atlantic Cape campuses were significantly affected by storm damage and loss of power.

A report by the Rutgers Emergency Preparedness Task Force (2013) documented key lessons from Sandy and made a number of recommendations for enhancing preparedness at Rutgers (see Table 2). Review of the status of each of these recommendations would provide a useful starting point for assessment of current response capacities. In addition to enhanced capacity for responding to extreme storm events, there is also a need to prepare for other types of climate risks that may affect university facilities and populations in the future such as extreme heat events, climate-related infectious disease outbreaks, or wildfires. There is also a need to begin to incorporate longer-term changes in environmental baselines, such as sea level rise, rising temperatures, and changing water availability, into climate-forward development plans for all four campuses.

Table 6.2. Recommendations from Emergency Preparedness Task Force (2013)

1. Develop a university policy for business continuity planning;
2. Identify locations that need emergency generators and re-architect RU-NET;
3. Designate emergency work sites;
4. Procure a Rutgers private IT cloud;
5. Improve IT infrastructure;
6. Identify mission critical research operations;
7. Mandate adequate staffing of Emergency Operations Center (EOC) and all operational areas;
8. Develop a university policy for emergency management;
9. Revise Policy 60.3.16 *Attendance During Adverse Weather Conditions*;
10. Expand the co-generation plant;
11. Clarify communications procedures.

Projections of Climate and Sea-Level Change In New Jersey

The magnitude of future climate change depends on the amount of future greenhouse gas emissions. Here, we summarize key projections for New Jersey under three climate scenarios that have been widely used by the climate science community over the last decade, the Representative Concentration Pathways (RCPs). RCP 8.5 is a *high emissions* pathway, consistent with robust sustained growth of global fossil fuel consumption. RCP 4.5 is a *moderate emissions* pathway, consistent with stabilized global carbon dioxide emissions through the middle of the century and a gradual decline in emissions thereafter. RCP 2.6 is a *low emissions* pathway, consistent with a rapid reduction in global greenhouse gas emissions, including net negative global carbon dioxide emissions in the last quarter of this century.[39] Current policies around the world place the planet on a trajectory above RCP 4.5 but below RCP 8.5.[40] Only RCP 2.6 is consistent with the ambitious goals laid out in the Paris Climate Agreement.

In addition to uncertainty in emissions, there is scientific uncertainty in how strongly the climate will respond to rising greenhouse gas concentrations. Below, we focus primarily on *likely* ranges (with at least a 2-in-3 chance of containing the correct value). (This likelihood language is based upon that of the Intergovernmental Panel on Climate Change.[41]) Quantitative numbers for temperature and precipitation change come from the Climate Impact Lab's analysis of global climate models.[42] Quantitative numbers for sea-level change come from the work of a Science and Technical Adaptation Panel convened by Rutgers in 2019 on behalf of the New Jersey Department of Environmental Protection.

Projected changes in temperatures and in hot and cold days in New Jersey[43]

	1981-2010	2020-2039	2040-2059			2080-2099		
			Emissions					
***Likely* annual values**			**Low**	**Mod.**	**High**	**Low**	**Mod.**	**High**
Avg. summer temp. (°F)	73°F	74-76°F	75-77°F	75-77°F	76-79°F	75-77°F	76-79°F	79-84°F
Avg. winter temp (°F)	33°F	34-37°F	35-37°F	36-38°F	37-39°F	34-37°F	36-40°F	39-45°F
Avg. days above 95°F	4	6-11	7-12	8-18	10-25	7-13	9-28	23-65
Avg. days below 32°F	96	73-93	73-90	67-82	59-80	73-96	55-77	27-57

[39] Detlef P. Van Vuuren et al., "The Representative Concentration Pathways: An Overview," *Climatic Change* 109 (2011): 5–31.
[40] "Temperatures - Climate Action Tracker," accessed November 7, 2019, https://climateactiontracker.org/global/temperatures/.
[41] M. D. Mastrandrea et al., "Guidance Note for Lead Authors of the IPCC Fifth Assessment Report on Consistent Treatment of Uncertainties," *Intergovernmental Panel on Climate Change (IPCC)*, 2010, http://www.ipcc.ch/pdf/supporting-material/uncertainty-guidance-note.pdf.
[42] Trevor Houser et al., *Economic Risks of Climate Change: An American Prospectus* (New York: Columbia University Press, 2015); D. J. Rasmussen, Malte Meinshausen, and Robert E. Kopp, "Probability-Weighted Ensembles of U.S. County-Level Climate Projections for Climate Risk Analysis," *Journal of Applied Meteorology and Climatology*, 2016, https://doi.org/10.1175/JAMC-D-15-0302.1.
[43] Houser et al., *Economic Risks of Climate Change: An American Prospectus*.

Precipitation: Over the course of this century, average annual precipitation is *likely* to increase under moderate or high emissions, and *more likely or not* to increase under low emissions. This change is more robust in the spring season, where it is most likely to be in the range of 10-20% by 2070-2099, relative to the 1976-2005 average.[44]

Sea-level rise: In 2019, at the request of NJ DEP, Rutgers convened a Science and Technical Advisory Panel to update sea-level rise projections for the state.[45] These are summarized below. Sea-level rise is of relevance to all tidally influenced areas of the Rutgers campus, not just facilities located directly on the coast. New Brunswick (on the Raritan River), Camden (on the Delaware River), and Newark on Newark Bay are all tidally influenced. Field facilities including the Meadowlands Environmental Research Institute, the Rutgers Marine Field Station, and the Haskins Shellfish Research Laboratory, and the New Jersey Aquaculture Innovation Center are also exposed to the effects of sea-level change.

New Jersey Sea-Level Rise above the year 2000 (1991-2009 average) baseline (ft)*[46]

		2030	2050	2070			2100			2150		
				Emissions								
	Chance SLR Exceeds			Low	Mod.	High	Low	Mod.	High	Low	Mod.	High
Low End	> 95% chance	0.3	0.7	0.9	1	1.1	1.0	1.3	1.5	1.3	2.1	2.9
Likely Range	> 83% chance	**0.5**	**0.9**	**1.3**	**1.4**	**1.5**	**1.7**	**2.0**	**2.3**	**2.4**	**3.1**	**3.8**
	~50 % chance	**0.8**	**1.4**	**1.9**	**2.2**	**2.4**	**2.8**	**3.3**	**3.9**	**4.2**	**5.2**	**6.2**
	<17% chance	**1.1**	**2.1**	**2.7**	**3.1**	**3.5**	**3.9**	**5.1**	**6.3**	**6.3**	**8.3**	**10.3**
High End	< 5% chance	1.3	2.6	3.2	3.8	4.4	5.0	6.9	8.8	8.0	13.8	19.6

*2010 (2001-2019 average) Observed = 0.2 ft

Notes: All values are 19-year means of sea-level measured with respect to a 1991-2009 baseline centered on the year indicated in the top row of the table. Low and high emissions scenarios correspond to global-mean warming by 2100 of 2°C and 5°C above early Industrial (1850-1900) levels, respectively, or equivalently, about 1°C and 4°C above the current global-mean temperature. Moderate (Mod.) emissions are interpolated as the midpoint between the high- and low- emissions scenarios and approximately correspond to the warming expected under current global policies. Rows correspond to different projection probabilities. There is at least a 95% chance of SLR exceeding the values in the 'Low End' row , while there is less than a 5% chance of exceeding the values in the 'High End' row. There is at least a 66% chance that SLR will fall within the values in the 'Likely Range'. Note that alternative methods may yield higher or lower estimates of the chance of low-end and high-end outcomes.

[44] D. R. Easterling et al., "Precipitation Change in the United States," in *Climate Science Special Report: Fourth National Climate Assessment, Volume I*, ed. D. J. Wuebbles et al. (Washington, DC, USA: U.S. Global Change Research Program, 2017), 207–30, https://doi.org/10.7930/J0GB227J.
[45] R. E. Kopp et al., "New Jersey's Rising Seas and Changing Coastal Storms: Report of the 2019 Science and Technical Advisory Panel" (Trenton, New Jersey: Rutgers, The State University of New Jersey. Prepared for the New Jersey Department of Environmental Protection, 2019).
[46] Kopp et al.

7. Proposal for the Development of a Rutgers Climate Action Plan

Based on the Task Force's analyses to date and investigation of best practices, we have developed a proposal for the development of a Rutgers Climate Action Plan. This Climate Action Plan would identify an ambitious, yet achievable and feasible, timeframe and pathway for achieving carbon neutrality, and would also identify key metrics for assessing the University's vulnerability to the physical impacts of climate change and a strategic approach for reducing these vulnerabilities. With respect to both carbon neutrality and climate resilience, it would identify supportive educational, research, and engagement efforts, as well as mechanisms for financing and tracking progress.

The development of Rutgers' Climate Action Plan requires broader expertise and representation than reflected in the pre-planning task force. In particular, the task force needs to be expanded to include students and to include operational and administrative staff with deep expertise in the university systems we are examining. In addition to student representatives from each Chancellor unit, key areas include:

- Strategic Planning and Operations
- Facilities, Sustainability and Energy
- Transportation
- Procurement
- Real Estate and Capital Planning
- Emergency Management
- Research and Economic Development
- Extension

Some of this expertise may be added directly to the Task Force; other expertise may be best added to specific working groups. We will also seek periodic review from Human Resources.

The Task Force considered two alternative models for its operations. In the University of Michigan model, the Task Force establishes faculty-led teams of student analysts, who, with staff support, investigate key areas such as building standards, energy consumption policies, and university travel. In the Boston University model, the Task Force establishes working groups with a mix of faculty, staff, and students, who may then procure internal or external analysis on a tightly defined, as-needed basis. The Task Force concluded that the working group model will provide greater efficiency in developing a Climate Action Plan and recommends this approach.

To undertake the planning process, the Task Force should establish several working groups, including Task Force members, additional staff and faculty experts, and students. It is critical that operational staff with key expertise be actively engaged in the relevant working groups and be involved in conducting relevant analyses as needed. Key working group topics (to be revisited in the course of execution) include:

- **Energy and Buildings:** Electricity and heat generation (including methane leakage); energy and water consumption by University owned and leased building; energy and water consumption by off-campus housing and other buildings used by the University community

- **Transportation:** on-campus transportation, commuting, and University travel
- **General Supply Chain and Waste Management**: approaches to reducing greenhouse gas emissions embodied in procurement and greenhouse gas emissions associated with waste management, as well as approaches to facilitating such reductions in the broader community
- **Food System:** approaches to reducing greenhouse gas emissions embodied in food consumed on campus, as well as approaches to facilitating such reductions in the broader community
- **Land Use and Offsets:** approaches to reducing greenhouse gas emissions associated with University land use and maintenance, approaches to increasing carbon dioxide storage in University land, and other approaches to offsetting University emissions
- **Climate Preparedness**: resilience of the University and surrounding communities to higher temperatures, more intense precipitation, and higher sea levels

Each working group's remit should include relevant aspects of both climate mitigation and adaptation. In addition, each working group should consider cross-cutting themes, related to:

- Teaching
- Research
- Campus culture, engagement, and behavior
- Climate-positive economic development

We will also establish a cross-cutting working group on **Climate-positive economic development** to ensure that this concept, and associated equity concerns, are understood and employed in a uniform manner across topical working groups.

For each topic, working groups should examine questions including, but not limited to:

- What universities or other comparable institutions are leading on this topic, what strategies are they employing, and what progress have they made?
- What are the most compelling and impactful approaches Rutgers could pursue? What are their associated greenhouse gas emissions reductions, resilience improvements, financial costs and savings, and co-benefits?
- How would the proposed approaches be implemented, and on what timescale?
- How would progress be evaluated?
- What are the roles associated with University leadership, chancellor-level units, and other key players?
- Beyond financials, what are the institutional, organizational and cultural challenges associated with implementation, and how might we overcome them?
- For each of the proposed approaches, what strategies should be employed to ensure the participation and accountability of the full university community?
- To what extent would each approach engage Rutgers' external stakeholders and catalyze broader, climate-positive economic development in New Jersey?
- What equity considerations need to be addressed and managed, how will this be done, and who needs to be involved?

- What are the unknowns and gaps that require more analysis?

External analysis will also be needed to ensure the options considered by the working groups are rigorously assessed in the context of Rutgers operations and financing. Thus, the Task Force should contract with a firm with appropriate expertise to undertake an energy and greenhouse gas audit of the university early in the process.

It is critical that the Task Force be provided with adequate staffing to support its work. Based on other universities' models, this should include:

- A high-level administrative director, capable of managing complex networks of relationships with internal and external stakeholders and ensuring the Task Force delivers its work on time,
- A program coordinator to manage the correspondence and events associated with the Task Force's work,
- A communications specialist at University Communications and Marketing assigned primary responsibility for sustainability and climate action efforts.

Ideally, the administrative director should be recruited internally, so that they: have considerable awareness of university policy and structure; bring extensive internal and external stakeholder connections; and can begin work relatively promptly.

Stakeholder engagement is a key part of the Climate Action Planning process. Key stakeholder groups include:

- Students and student organizations
- Faculty and staff
- Chancellors and deans
- Rutgers University Senate
- Governing boards
- Alumni
- Public-, private-, and NGO-sector state leaders, including public utilities serving Rutgers campuses, NJ Transit, and key businesses like RWJBarnabas, Johnson & Johnson, Devco, and Prudential
- Local communities in the New Brunswick area (New Brunswick/Piscataway/Highland Park), Newark, and Camden
- County leadership in Middlesex, Essex, and Camden counties

The Task Force should hold town halls early and late in the planning process. It should also establish an online forum to solicit input, primarily from students, and the student members of the Task Force should be charged with establishing and liaising with a broader student community. A network of school and departmental liaisons could help foster broad engagement of faculty and staff. The Task Force should work with the mayors of the greater New Brunswick, Newark, and Camden areas to ensure broader community input.

In addition, in its role as the State University of New Jersey, Rutgers should coordinate with other institutions of higher education in New Jersey – both to learn from the efforts of other institutions and to advance the state's higher-education sector as a whole as an agent of climate action. In this regard, Rutgers should coordinate with the New Jersey Presidents' Council, the Office of the Secretary of Higher Education, and the New Jersey Higher Education Partnership for Sustainability.

Rutgers should also work with other schools in the Big Ten Academic Alliance to advance public and land-grant universities as agents of climate action. We have begun preliminary discussions with members of the University of Michigan's President's Commission on Carbon Neutrality about a peer-review workshop for carbon neutrality planning to be held in late spring 2020. In our application to join UC3, Rutgers also proposed to focus the Fall 2020 Rutgers Climate Symposium on leveraging public and land-grant universities to advance climate action. In addition, Rutgers should work the Association of American University to advance a broader sectoral effort by leading research universities.

Proposed Timeline

January 2020	Initial full task force and working group meetings
Feb-Mar 2020	Initial town halls
Apr 2020	Draft first-order working group reports released for public comment Outreach events around Earth Day and Rutgers Day Possible survey at Rutgers Day to collect broader input
May 2020	Public release of interim report
June-Sept 2020	Continued work on working group analyses
Oct-Dec 2020	Report integration Additional townhalls Rutgers Climate Symposium focused on leveraging large public universities to advance climate action
Jan-Feb 2021	Public comment on report
Mar-May 2021	Report revision
June 2021	Public release of final report Present Task Force report to Boards of Governors and Trustees

8. Opportunities for Early Successes

In addition to developing a plan for the development of a Climate Action Plan, the Task Force has also sought to identify opportunities for action in Spring 2020 that could lead to early successes. We focused primarily on: (1) actions that seemed likely to be necessary for the implementation of any reasonable climate action plan, and (2) actions that are by construction both climate-positive and revenue-positive and need little further analysis to establish their net benefit.

Develop a System for Monitoring and Reporting of Emissions

From 2009 to 2016, Rutgers operated under a Memorandum of Understanding (MOU) with US EPA on reducing its greenhouse gas footprint. Under this program, Rutgers produced semiannual reports on its efforts. Since the program this MOU operated under was discontinued, Rutgers has not maintained a systematic accounting of its greenhouse gas emissions. One of the priority tasks needed to support the Climate Action Planning process is the development and maintenance of a system for monitoring and reporting emissions. We have already begun this task (see section 5), but it is clear that this needs be to a regular, sustained activity of Institutional Planning and Operations (IPO) for any effort to achieve carbon neutrality to be successful. Thus, in the Spring 2020 term, the University could establish clear policies, procedures, and lines of responsibility for the maintenance and reporting of emissions inventories. This should be closely coordinated with the external analysis group hired to do a greenhouse gas and energy audit.

Green the Finance and Budgeting Process

There are a number of mechanisms used at universities to incentivize greenhouse gas emissions reductions by decisionmakers.

Green Revolving Funds are a cost-saving, emissions-reducing measure with nearly a decade of successful implementation examples at US universities. In a Green Revolving Fund, a certain initial allocation of funds is set aside for revenue-positive, climate-positive on-campus investments (e.g., energy conservation measures). The revenue from these investments (e.g., the money saved on energy) is returned to the fund, allowing the available pool to grow. Among the funds participating in the Sustainable Endowment Initiative's Billion Dollar Green Challenge in 2016, the median annual ROI on Green Revolving Funds is about 28 percent, with an average project payback time of about 4.4 years. Currently, Green Revolving Funds are employed by at least 58 institutions, with $122 million committed.[47]

An internal carbon price is a term incorporated into benefit-cost or return-on-investment decisions to reflect both the societal damages associated with greenhouse gas emissions, as well as the potential that those societal damages will lead to greenhouse gas regulation and thus higher costs associated with carbon-intensive activities. Users of an internal carbon price project the emissions associated with different action options and add the product of these projected emissions and the price to the cost side of the ledger. Numerous corporations use an internal carbon price in order to factor the effects of climate change into their decisions. Increasingly, internal carbon pricing mechanisms are being used by universities as well. Yale, Arizona State,

[47] See www.greenbillion.org for more information.

Swarthmore, and UBC have worked with Second Nature and others to develop the Internal Carbon Pricing in Higher Education Toolkit. At Yale, economist Bill Nordhaus, who won the 2018 Nobel Memorial Prize in Economics for his work on climate economics, played a key role in the implementation of this mechanism. Rutgers has substantial expertise in internal carbon pricing policies as well: Task Force co-chair Bob Kopp was involved in the establishment of the US government's social cost of carbon in 2010 and in a 2017 National Academies report on the topic. Rutgers' Climate Impact Lab collaboration is focused in part on advancing the estimation and use of the social cost of carbon, and the Center for Energy, Economic, & Environmental Policy has considerable experience using internal carbon pricing in benefit-cost analyses it has conducted for the state.

At Rutgers, a Green Revolving Fund should not in principle be necessary to finance revenue-positive measures. The University Bank provides loan financing to Responsibility Centers at a rate reflecting Rutgers' access to funds on capital markets (currently 4.75%). Accordingly, if incentive and information flows in the University's budget model were suitably aligned, the University would be investing extensively in revenue-positive, energy-saving investments with ROIs comparable to those of investments financed by Green Revolving Funds. However, in practice, it is not clear this is happening to the extent that a full benefit-cost analysis would recommend; to the extent that it is happening, information about cost, energy, and emissions savings is not being systematically collected in a manner that would be facilitated by a Green Revolving Fund.

Therefore, in Spring 2020, Task Force representatives, IPO, and Finance should work to develop a clear system for financing investments in energy and greenhouse gas savings that is consistent with the incentive structure of the current university budget model. In addition, this working group should identify a mechanism to capture data on energy and greenhouse gas savings arising from investments. Once such mechanisms are in place, further discussions could examine the feasibility of an internal greenhouse gas price. Preliminary discussions with University Treasury suggest that it is feasible this process could lead to workable recommendations by the end of Spring 2020.

Establish an In-State Renewable Energy Power Purchase Agreement or Purchase Renewable Energy Credits

Power Purchase Agreements (PPAs) are financial agreements between developers of renewable energy supplier and customers. The customer (in this case, the University) enters into a long-term (typically, 15-20 year) contract with a supplier, reducing the risk to the supplier of making new investments in renewable energy generation. A PPA, while not necessarily a replacement for on-campus renewable energy resources, would allow the University to expand its renewable energy supply more rapidly and without the land-use restrictions associated with further development of on-campus renewable energy resources. (PPAs can also be used as financing mechanisms to support the development of on-campus resources.) The 'early win' would be to partner with a supplier to procure solar or wind energy to cover a substantial fraction of University electricity consumption, thereby eliminating the carbon dioxide emissions associated with that electricity consumption.

PPAs are widely used by Universities. Harvard was among the first to enter into such a contract, entering into an agreement with the Stetson II wind project in Maine.[48] Georgetown University is similarly using a PPA with Origis Energy to procure solar energy to cover about half

[48] https://green.harvard.edu/topics/climate-energy/site-emissions-reduction

of campus electricity.[49] As noted previously, U-M has entered into a PPA with DTE to procure off-campus renewable energy, produced in Michigan, to cover about half the consumption of its Ann Arbor campus.

An alternative approach to a PPA is to purchase Green-e Energy Certified renewable energy credits (RECs) to displace an amount of fossil-fuel-based-power on the electric grid comparable to the fossil-fuel based power purchased or produced for consumption at Rutgers. This was done with the new Chemistry and Chemical Biology building as part of its LEED Certification, at a cost of about $1/MWh (about $1,200 per year to cover all the electricity consumed by this building.)

In Spring 2020, IPO could begin work toward the establishment of an in-state renewable energy PPA or REC purchase to cover a substantial portion of Rutgers' electricity consumption.

Update the University Inventory of Climate Research and Teaching

Rutgers faculty, staff and students are engaged in a wide-variety of climate-related research and teaching activities that are relevant to the mission of the Task Force. Some of these efforts have been inventoried in recent years by entities including the Rutgers Climate Institute, the Rutgers Energy Institute, and the Rutgers Institute of Earth, Ocean, and Atmospheric Sciences. A compilation and update of climate-research and teaching at Rutgers should occur during Spring 2020. The updated research inventory will help to ensure that the Task Force membership includes relevant faculty and staff expertise from Rutgers schools, departments, and institutes that are currently conducting mitigation and adaptation studies. The updated teaching inventory will provide a comprehensive listing of climate-related courses and programs at Rutgers at both the undergraduate and graduate level. The research and teaching inventories will also permit identification of critical gaps, where additional expertise or programming might be needed.

[49] https://www.georgetown.edu/news/new-off-site-solar-project-to-provide-nearly-half-of-georgetowns-electricity-needs/

9. Key Recommendations

The Task Force recommends the formal launch of a climate action planning process that would lead to an interim report in May 2020 and a final report in June 2021. Key recommendations related to the climate action planning process include:

- Expand the current task force to include student and staff representatives
- Establish a set of topical working groups – covering Energy and Buildings; Transportation; General Supply Chain and Waste Management; Food System; Land Use and Offsets; and Climate Preparedness – as well as a cross-cutting working group on Climate-Positive Economic Development.
- Contract an external firm with appropriate expertise to undertake an energy and greenhouse gas audit of the university early in the climate action planning process.
- Provide adequate staffing to support the climate action planning process, including: a high-level administrative director and a program coordinator working directly for the Task Force, and a communications specialist at University Communications and Marketing focused on climate and sustainability.
- Establish processes for engaging (1) the student community, (2) the University's governing boards, (3) chancellors and deans, (4) the Rutgers University Senate, (5) alumni, (6) public-, private-, and NGO-sector state leaderships, (7) the communities in which Rutgers' campuses are based, and associated municipal and county leadership.
- Advance the higher-education sector as an agent of climate action, both in New Jersey in coordination with the New Jersey Presidents' Council, the Office of the Secretary of Higher Education, and the New Jersey Higher Education Partnership for Sustainability, and more broadly through the Big Ten Academic Alliance and the Association of American Universities.

In addition, the Task Force has identified a few opportunities for action in Spring 2020 that could lead to early successes. We focused primarily on: (1) actions that seemed likely to be necessary for the implementation of any reasonable climate action plan, and (2) actions that are by construction both climate-positive and revenue-positive and need little further analysis to establish their net benefit. These early wins include:

- Establish clear policies, procedures, and lines of responsibility for the maintenance and reporting of emissions inventories
- Establish a working group involving the Task Force, IPO, and Finance to green the University financing and budget process to facilitate high-ROI energy-saving and emissions-reducing investments.
- Work toward an in-state renewable energy power purchase agreement and/or a Green-e certified Renewable Energy Credit purchase to provide carbon-free electricity to cover a substantial portion of Rutgers' electricity consumption
- Create an updated University inventory of climate research and teaching

APPENDIX: Committee Charge

Human-caused climate change is a scientifically validated reality that is already harming lives and livelihoods in New Jersey and around the world. The nations of the world have agreed to take actions to limit further warming, including bringing net global carbon dioxide emissions to zero in the second half of this century. Achieving these objectives requires active participation from all major institutions. Rutgers is already a national leader in the scholarly study of climate change, but as a university community, we can and must do more. It is our duty to leverage our collective expertise as scholars and educators to address the climate crisis in New Jersey and around the world, including in our own operations.

Today I am announcing the creation of the President's Task Force on Carbon Neutrality and Climate Resilience. I am charging this task force to develop a comprehensive climate action plan for the university to consider. It will analyze greenhouse gas emissions at Rutgers University and advise the university on solutions to reduce the University's greenhouse gas footprint that are environmentally sustainable, fiscally responsible, scalable, and engage the broader community.

I expect this task force to develop and recommend a plan for Rutgers to achieve carbon neutrality across our institution. The task force must first define carbon neutrality within the context of the university community. Then, it is tasked with outlining scenarios, timelines, and key benchmarks for achieving this goal on as rapid a timeframe as is possible.
In addition, the Task Force will examine Rutgers' own exposure to climate change impacts. I expect it to look especially for approaches to reducing the university's vulnerability to these impacts.

As representatives of the State University of New Jersey, this task force is also charged with engaging the broader community in its work. Scholars, students, staff, state and local government, alumni, and business partners—all these groups present insight and perspectives that can contribute to achieving the goal of carbon neutrality and enhancing Rutgers' contribution to climate-positive economic development in New Jersey.

In developing its recommendations, this task force must give careful consideration to fiscal responsibility and to achieving our goal in a manner that balances the urgency of emissions reduction against the viability of our educational mission as a public university.

The committee will be responsible for recommendations across the scope of greenhouse gas emissions reduction, including carbon emissions, sources of energy, institutional practices, facilities, transportation, and behavioral change. Its work will consider greenhouse gas emission reductions at all university locations.

To lead this important task force, I have appointed Professors Robert Kopp and Kevin Lyons as co-chairs. Dr. Kopp is a professor in the Department of Earth and Planetary Science at the School of Arts and Sciences—New Brunswick and director of the Rutgers Institute of Earth, Ocean, and Atmospheric Sciences. Dr. Lyons is associate professor of professional practices at Rutgers Business School–Newark and New Brunswick and an associate director of the Rutgers Energy Institute. They will work closely with Senior Vice President for Academic Affairs Barbara Lee and Executive Vice President of Planning and Operations Tony Calcado to constitute the membership of the Task Force. I have requested that they report back on their preliminary findings by Spring 2020.

Robert Barchi, President
September 24, 2019