Office of the President
TASK FORCE ON CARBON NEUTRALITY AND CLIMATE RESILIENCE

Solutions Assessment: Transportation

Report of Working Group 2

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Working Group Membership

Robert Noland *Co-Chair, Bloustein School of Planning and Public Policy, New Brunswick*
Jack Molenaar, *Co-Chair, Transportation Services, New Brunswick*

Angie Bonilla, *Office of Housing and Residence Life, Newark*
Jon Carnegie, *Alan M. Voorhees Transportation Center, New Brunswick*
Amy Davidow, *School of Public Health, Rutgers Biomedical and Health Sciences*
Anne Gutsick, *University Travel and Card Programs University Finance and Administration*
Robert Laumbach, *Rutgers School of Public Health, Rutgers Biomedical and Health Sciences*
RJ Palladino, *NJ Transit*
Jeff Perlman, *North Jersey Transportation Planning Authority*
Benedetto Piccoli, *College of Arts and Sciences, Camden*
Kelcie Ralph, *Bloustein School of Planning and Public Policy, New Brunswick*
Mike Smart*, Bloustein School of Planning and Public Policy, New Brunswick*
Jenn Stuart*, Institutional Planning and Operations*
Hao Wang, *School of Engineering, New Brunswick*
Sicheng Wang, *Bloustein School of Planning and Public Policy, New Brunswick*
Ellen White, *Bloustein School of Planning and Public Policy, New Brunswick*

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EXECUTIVE SUMMARY

This report summarizes our analysis of transportation CO2 emissions from all three Rutgers campuses and includes an analysis of various policies to reduce those emissions. The analysis is mainly derived from a survey that was sent to all faculty, staff, and students in late August, closing out in early September after classes began. Baseline CO2 emissions were estimated for commute travel to campus, university fleets including buses, emissions associated with business travel, undergraduate study abroad trips, and athletic travel. Fleet data was only available for the New Brunswick campus and for business travel we did not have a breakdown by campus. Athletics travel data was likewise only available for the New Brunswick campus.

Our estimate of total annual baseline emissions is 91,974 metric tonnes of CO2. This comes to a per capita rate of 1.23 metric tonnes per person. The bulk of these emissions are attributable to commute travel to campus, which accounts for 77,831 metric tonnes of CO2 or 1.04 metric tonnes per capita. This value is low compared to peer institutions that have produced similar estimates and generally find that per capita emissions are about 3.5 metric tonnes.[1] We are uncertain why Rutgers performs better and it could be that other universities did not account for the frequency of traveling to campus (which our estimates do). Staff per capita emissions (at least on the New Brunswick campus) are 3.23 per capita; staff generally travel most days of the week suggesting our estimates are reasonable. For further comparison, total transportation emissions in New Jersey are 80 million metric tonnes,[2] thus Rutgers accounts for 0.11% of this statewide total, while representing 0.89% of the population. Commute travel is typically only about 25% of all travel, so this suggests our estimates are reasonable.

Other transportation emissions at Rutgers include university fleets (4,889 metric tonnes), business travel (9,057 metric tonnes), undergraduate study abroad travel (7.19 metric tonnes), and athletics travel (10.00 metric tonnes).

We list a variety of policies for reducing emissions, but only analyzed three potential policy approaches for reducing commute emissions, given that this is the largest share of total transportation emissions. These were an increase in working at home and remote instruction (reduction of 21,191 metric tonnes); parking fee reductions of 25% and 50% to encourage the purchase of electric vehicles (reduction of 3,678 metric tonnes for a 25% fee reduction, and 10,378 metric tonnes for a 50% fee reduction); and, subsidizing free public transit for commuters (reduction of 5,145 metric tonnes).

We also estimated the cost of purchasing carbon off-sets for all business travel. Assuming an off-set price of $25/tonne of emissions this comes to about $9 million. We have not estimated the costs of the policies to reduce commuter emissions.

All the estimates are subject to limitations and assumptions which are described in detail in the report.

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[1] Based on estimates derived from: https://reporting.secondnature.org/

[2] New Jersey Department of Environmental Protection, 2020, New Jersey's Global Warming Response Act, 80x50 Report, https://www.nj.gov/dep/climatechange/mitigation.html

2.1. Rutgers' current baseline

2.1.1. Rutgers' greenhouse gas emissions in Transportation

Carbon emissions for each campus have been estimated based on our survey of faculty, staff, and students. The estimates are as follows and include driving to campus and driving to transit stations. There are various assumptions that we have used in this analysis that will be detailed in future work. Our emissions factor is based on 404 gm/mile per EPA estimates.[3] These are slightly larger than what SIMAP[4] uses and for consistency these will be estimated in follow up reports.

Total CO2 emissions from transportation are estimated to be 91,974 metric tonnes annually leading to a per capita rate of 1.23 metric tonnes per person. Commuting is the largest contributor to these emissions and accounts for approximately 85% of the total. Business travel by faculty, students, and staff is the next largest share of Rutgers transportation emissions at about 9.8%. The University fleet, including campus buses, is only responsible for a little over 5% of transportation emissions. Rutgers transportation emissions are roughly 0.11% of statewide emissions attributable to transportation. Rutgers employees and students total 75,469 and out of a total NJ population of 8.5 million account for 0.89% of that population. Transportation emissions in NJ are estimated to be 80 million metric tonnes[5] , thus transportation emissions at Rutgers account for 0.11% of total statewide transportation emissions. This does not account for transportation emissions from employees and students that are not directly connected to Rutgers (specifically non-commuting trips by car and air, which typically are much greater sources of emissions than commute trips). Thus, our rough estimate of baseline emissions appears reasonable, but does not include all sources of transportation emissions. Specifically, some data for the Newark and Camden campuses were not provided and we do not have information on how frequently and how far students travel to their original home (including for our overseas students).

Total annual CO2 emissions (metric tonnes) attributable to commuting are 77,831 metric tonnes or 1.04 metric tonnes per capita. This is based on 404gm per vehicle-mile per EPA estimates[6]. The table below breaks this down by campus and for Undergraduate, Graduate, Faculty, and Staff. On average, Rutgers commuting related emissions are quite good compared to peer universities as shown by the per capita emissions estimates (others have estimates typically above 3.5 metric tonnes/person).[7] This could be due to limitations in our data, especially if those who completed the survey were more likely to drive less. Or it may be that other universities did not have good estimates of driving distances and frequency of traveling. The share of students and faculty not driving may be higher at Rutgers.

Table 2.1. Annual miles, CO2 emissions, and per capita CO2 emissions from commuting to campus

	Percent driving to campus	Annual miles (1000s)	CO2 emissions (metric tonnes)	Per capita CO2 emissions (metric tonnes/person)
New Brunswick				
Undergraduate	21.95%	29,349	11,857	0.39
Graduate	51.23%	16,698	6,746	0.94
Faculty	76.47%	17,402	7,030	1.85
Staff	92.60%	62,107	25,091	3.23
Total		**125,557**	**50,725**	**1.03**

[3] https://www.epa.gov/greenvehicles/greenhouse-gas-emissions-typical-passenger-vehicle
[4] Sustainability Indicator Management and Analysis Platform, https://unhsimap.org/home
[5] New Jersey Department of Environmental Protection, 2020, New Jersey's Global Warming Response Act, 80x50 Report, https://www.nj.gov/dep/climatechange/mitigation.html
[6] https://www.epa.gov/greenvehicles/greenhouse-gas-emissions-typical-passenger-vehicle
[7] https://reporting.secondnature.org/

Newark				
Undergraduate	40.19%	12,193	4,926	0.69
Graduate	48.59%	11,675	4,717	0.98
Faculty	68.82%	7,876	3,182	1.83
Staff	77.38%	21,982	8,881	2.84
Total		**53,727**	**21,706**	**1.29**
Camden				
Undergraduate	43.59%	6,832	2,760	0.69
Graduate	49.11%	2,145	867	0.88
Faculty	57.97%	1,161	469	1.23
Staff	85.85%	3,230	1,305	2.49
Total		**13,368**	**5,401**	**0.92**
Total all campuses		**192,652**	**77,831**	**1.04**

University fleets include vehicles for workers that typically have to do work on other campuses as well as maintenance staff, such as plumbers, etc. Fleets also include buses. These vehicles run on both diesel fuel and gasoline. We had data on gallons of fuel used but only for the New Brunswick campus. We based conversions on Energy Information Administration (EIA) estimates.[8] These were cross-checked with SIMAP and were nearly identical. Total emissions are 4889 metric tonnes.

Table 2.2. Fuel consumption and CO_2 emissions from university fleet vehicles

	Gallons (US)	Emissions factor (kg CO2/gallon)	Total CO2 emissions (metric tonnes)
Diesel fuel	460,023	10.16	**4,674**
Gasoline	24,212	8.89	**215**
Total			**4,889**

Business travel by faculty, staff and students was based on air travel and personal car mileage and does not include buses, trains, or car rental mileage and taxis. This data was estimated with SIMAP which uses total expenditures. We supplemented this analysis with our survey data which asked about the amount of travel not funded by the university (i.e., self-funded or reimbursed by others). This amounted to 19.96% of additional travel and total emissions of 9057 metric tonnes.

Table 2.3. Estimate of CO_2 emissions associated with business travel using SIMAP

	Data in SIMAP	CO2 emissions (metric tonnes)
Air	$2,241,330	6,962
Bus	$17,790	
Train	$237,301	
Taxi and Car Rental	$414,087	
Personal Car Mileage (miles)	1,628,836	
All non-air travel		588
Total based on reimbursed travel		**7,550**
Total with unreimbursed travel		**9,057**

[8] https://www.eia.gov/environment/emissions/co2_vol_mass.php

Study abroad data for students was provided for all three campuses. This data included the number of students traveling to each country, but did not indicate the city they traveled to. We used a calculator available at https://engaging-data.com/airplane-emissions/ to determine CO2 equivalent emissions per passenger. For air travel CO2 equivalents are needed due to the large non-carbon impacts at high altitude (high altitude NOx, contrails and cirrus-contrail formation). Most use a factor of 2.7. Total emissions are relatively small compared to other sources amounting to 7.19 metric tonnes of CO2eq.

Table 2.4. CO2 emissions generated by air travel for undergraduate study abroad trips

Campus	CO2eq (metric-tonnes)
New Brunswick	5.19
Newark	0.60
Camden	1.40
Total	**7.19**

Athletic travel is another source of emissions. Both surface and air travel are used to attend events elsewhere. We only have data for New Brunswick. Air travel accounted for 1.45 tonnes of CO2 emissions. This estimate assumed chartered B737 at 85 mpg and 9.57 kg CO2/mile derived from EIA estimates.[9] We assumed 10mpg for bus/van travel as we have no data on the split between buses (at 6.5 mpg) and vans (about 14 mpg). Travel by bus and van accounted for 8.44 metric tonnes of CO2 emissions, bringing athletic travel to 10 metric tonnes of CO2 emissions.

Table 2.5. CO2 emissions generated by surface and air transportation for athletic travel

	Total miles	CO2 emissions (metric tonnes)
Bus/van travel	8,863	8.44
Air travel	12,903	1.45
Total		**10.00**

We do not have estimates for student travel to home but have some data in the survey that will allow this to be estimated. This will be done in the near future.

2.1.2. Ongoing activities to reduce emissions and vulnerabilities

The 2030 Master Plan outlines the University's goals for future development. A significant component involves continuing to focus future development around transit hubs and existing transportation infrastructure. Improvements to University owned infrastructure incorporate the accommodation of or enhancement to the bicycle and pedestrian network, where feasible. Additionally, the University continues to work with external agencies to ensure that enhancements to connectivity around and in between the campuses remains a priority.

2.1.3. Related ongoing educational, research, and service activities

The Masters in City and Regional Planning at the **Bloustein School** has a concentration in Transportation Policy and Planning that attracts a large plurality of Bloustein School graduate students. Within this concentration there are various courses that provide an opportunity for students to learn about approaches and policies to reduce vehicle travel and carbon emissions. Among these courses are: Transportation and the Environment, Transportation and Land Use, Methods of Transportation Planning, Public Transit

[9] https://www.eia.gov/environment/emissions/co2_vol_mass.php

Planning and Management, and Bicycle and Pedestrian Planning. Several students in the doctoral program in **Planning and Public Policy** conduct research on a wide variety of transportation planning and policy topics.

The **Alan M. Voorhees Transportation Center (VTC)** is a national leader in the research and development of innovative transportation policy. VTC leads an informed public discussion of transportation policy issues. In the context of New Jersey as a living laboratory, VTC is committed to conducting research and finding innovative approaches to transportation problem solving. Through its research, VTC identifies and explores transportation linkages to other public policy areas, such as economic development, land use, the environment, political governance, finance and social policy, among other areas.

VTC provides transportation expertise to citizens and policy makers on a range of transportation issues; convenes forums, conferences, and seminars on critical issues involving transportation, focusing especially on the complex interrelationship with other sectors of society and the long-term implications of short-term choices; and maintains a communications function with a commitment to disseminating information related to critical transportation issues, and simplifying and clarifying transportation data and information for popular understanding, leading to improved quality of choices made by voters and public officials.

Two primary activities of VTC are the Bicycle-Pedestrian Resource Center and the Safe Routes to School Resource Center, both funded by the NJ DOT and provide both service-oriented work to the community and research on non-motorized transportation policy.

In addition, multiple faculty at the university conduct research in a broad range of transportation-related areas with much of that focused on policy analysis to solve critical transportation problems including the mitigation and impact of climate change.

The **Department of Civil and Environmental Engineering** at the School of Engineering offers sustainability related courses in the areas of transportation, geotechnical, and water resource engineering. These courses are intended to educate students on the importance of climate change and sustainability and inspire innovative engineering solutions to mitigate and adapt to climate change. The MS and PhD program in transportation engineering provides an opportunity for students to learn about design of intelligent transportation systems and green infrastructure to reduce carbon footprints and air pollution from the transportation sector.

The **Center for Advanced Infrastructure and Transportation (CAIT)** has been a University Transportation Center (UTC) - an elite group of academic research institutions sanctioned and supported by the U.S. Department of Transportation. It was named one of only five National UTCs in 2013 and selected to lead the Region 2 UTC in 2018. The researches at CAIT fall within several broad areas: assessing and monitoring the health of transportation assets; creating revolutionary technologies, materials, and tools; formulating strategies to prolong the service life of infrastructure; and, provide training for the current and future workforce. CAIT develops practical tools and processes that can be applied—not in theory, not on paper, not five years in the future—but as mainstream tools in the hands of transportation professionals solving real-world problems right now.

The following transportation-related research activities for improving environmental sustainability and reducing emissions have been conducted at CAIT: 1) development of intelligent traffic operation and management practices to reduce congestion and increase mobility; 2) development of cost-effective pavement maintenance strategies to reduce resource consumption and improve durability; 3) fostering of electrified transportation infrastructure and transit; 4) development of green infrastructure solutions to mitigate climate change impacts and examine adaptive strategies.

2.2. Overview of potential climate solutions

2.2.1. Potential solutions

There are multiple means in which the university can reduce the impact of transportation to, from and within Rutgers campuses on the climate. Some approaches, such as electrifying the university bus fleet and enhancing infrastructure that encourages walking and bicycling, will require upfront expenditures by the University whereas others may be implemented via changes in university policy, e.g., expanding telecommuting to non-academic staff. Incentivizing Rutgers faculty, students, and staff to make use of more planet-friendly transit will require a mix of carrot and stick approaches which will require an ongoing stream of financial incentives, e.g., increasing parking fees and parking cash-outs for persons who forego parking on campus and also providing incentives for faculty, staff, and students to purchase EVs. Reducing the effects of air travel on the climate may be mitigated by purchases of carbon offsets and incentivizing less emissions-producing travel modes, such as trains. An analysis of the net cost to the university will need to be undertaken. The following is a list of actions that together can bring about a reduction in vehicle emissions.

Emissions can be reduced by:

1. Expanded telecommuting (working at home and remote instruction)
2. Incentives for purchasing battery-electric vehicles (EVs)
3. Reduce business travel and/or purchase carbon off-sets
4. Create safe bicycle and pedestrian infrastructure
5. Enhance public transit discount programs or free transit
6. Electrifying the University's bus fleet and other University-owned or operated vehicles
7. Provide a cash out to Rutgers faculty, staff and students who do not use parking

2.2.2. Early opportunities for action

There are a few transportation solutions with low financial costs and institutional barriers.

1. Micro-Mobility - During Fall of 2020, an E-Scooter share program was introduced in New Brunswick. Ridership has been high and shows that there was a latent demand for this type of transportation mode. This program came at no cost to Rutgers and is being provided by a private vendor.
2. Installation of more EV charging stations for our on-campus residents would encourage this type of vehicle and come at a reasonable cost overall to the University.
3. Reconfiguring of the bus routes in New Brunswick. For Fall of 2020 a brand-new bus system with fewer stops was introduced. Since in-person classes were suspended the routes were only in place for one month because of lack of riders. The goal of the routes and reduction in stops is to encourage walking trips where appropriate and for users only to use the buses to get between campuses and not around a single campus. This change was at no cost to the University and could potentially save money in fuel costs while lowering emissions.

2.2.3. Cross-cutting issues arising in the exploration of potential solutions

Cross-cutting issues potentially involve changes in parking structures (including installing EV charging) and installation of way-finding signage. Changes in telecommuting behavior can have implications for how much office space is required.

2.3. Assessments of potential climate solutions

2.3.1 Expanded telecommuting (working at home and remote instruction)

Lessons learned from COVID should be applied after the pandemic to reduce the on-campus workforce. Our results suggest that large fractions of employees and students are satisfied with work at home options that they have experienced. Assuming some of these employees and students will not drive to campus in the future, there is an opportunity to achieve emissions reductions.

Responses to a question on whether working or studying at home has been feasible suggests that only a small proportion have been unable to do so. Details for each campus are as follows:

Table 2.6. Have you been able to effectively work or study from home during the COVID-19 crisis?

	Yes, I have been able to without difficulty		Yes, but occasionally it has been difficult		No, I have not been able to		I don't wish to answer	
	n	%	n	%	n	%	n	%
New Brunswick (n=5,852)								
Faculty	196	36.16%	305	56.27%	36	6.64%	5	0.92%
Staff	759	57.59%	416	31.56%	119	9.03%	24	1.82%
Student	615	15.41%	2,804	70.24%	556	13.93%	17	0.43%
Newark (n=1,252)								
Faculty	64	35.16%	96	52.75%	18	9.89%	4	2.20%
Staff	190	58.28%	102	31.29%	26	7.98%	8	2.45%
Student	142	19.09%	488	65.59%	108	14.52%	6	0.81%
Camden (n=676)								
Faculty	22	33.85%	37	56.92%	6	9.23%	0	0
Staff	61	58.65%	35	33.65%	7	6.73%	1	0.96%
Student	104	20.51%	329	64.89%	67	13.21%	7	1.38%
Total	**2,153**	**27.67%**	**4,612**	**59.28%**	**943**	**12.12%**	**72**	**0.93%**

Faculty, staff, and students were queried on the likelihood and frequency of their desire to continuing working at home or taking remote classes, post-COVID. In all cases, well over 50% reported a desire to work at home several times per week.

Table 2.7. Response to working at home (note: staff were asked “if given the opportunity to work at home”)

	No		Yes, once per week		Yes, several times per week	
	n	%	n	%	n	%
New Brunswick (n=1,699)						
Faculty	97	19.72%	100	20.33%	295	59.96%
Staff	266	22.04%	180	14.91%	761	63.05%
Newark (n=427)						
Faculty	44	28.39%	21	13.55%	90	58.06%
Staff	41	15.07%	39	14.34%	192	70.59%
Camden (n=154)						
Faculty	6	8.96%	13	19.40%	48	71.64%
Staff	20	22.99%	11	12.64%	56	64.37%
Total	**474**	**20.79%**	**364**	**15.96%**	**1,442**	**63.25%**

Table 2.8. When the COVID-19 crisis is over and it is safe for in-person classes to begin, would you enroll in on-line or remote classes, if given the option?

	No, I would not enroll in remote or on-line classes		Yes, I would enroll in remote or on-line instruction		I will have graduated or left Rutgers, so will not be taking classes	
	n	%	n	%	n	%
New Brunswick	1,578	45.46%	1,317	37.94%	576	16.59%
Newark	228	34.44%	317	47.89%	117	17.67%
Camden	168	40.10%	191	45.58%	60	14.32%
Total	**1,974**	**43.37%**	**1,825**	**40.09%**	**753**	**16.54%**

Based on these responses we estimated the reduction in vehicle travel and associated emissions. We adjusted for the pre-COVID frequency of traveling to campus; that is, if they previously work at home one day a week and state that they will continue to, there is no reduction in VMT and emissions. For students intending to attend remote classes we assumed they would travel only two days a week (or two days less if they currently travel to campus less than four days a week). Estimates were done for those using a vehicle to drive to campus and those who drive to a train station. Total emissions reductions are 21,012 metric tonnes for the former and 179 metric tonnes for the latter for a total of 21,191 metric tonnes which would be a reduction of 27.23% in emissions associated with commuting to campus.

Table 2.9. Annual vehicle miles and CO2 emissions reduction from increased working at home and remote classes

	New Brunswick	Newark	Camden	TOTAL	CO2(metric tonnes)
Faculty	4,727,967	1,341,458	305,609	6,375,034	2,576
Staff	21,687,017	7,658,450	990,260	30,335,727	12,256
Students	8,856,743	4,695,995	1,743,294	15,296,032	6,180
Total	**35,271,727**	**13,695,903**	**3,039,163**	**52,006,793**	**21,012**

Table 2.10. Annual vehicle miles and CO2 emissions reduction from increased working at home and remote classes (for train commuters driving to station)

	New Brunswick	Newark	Camden	TOTAL	CO2(metric tonnes)
Faculty	17,336	26,880	3,543	47,759	19
Staff	57,364	99,936	11,411	168,711	68
Students	56,161	94,225	78,551	228,937	92
Total	**130,861**	**221,041**	**93,505**	**445,407**	**179**

2.3.1.1. Emissions reductions and resilience improvements
Emissions associated with transportation could be reduced by about 23%.

2.3.1.2. Financial costs and savings
In the long run, office space could be reduced. In the short run, some staff may need additional equipment at home to work effectively. Costs and savings are uncertain.

2.3.1.3. Benefits to the University's educational and research mission and to campus culture
Cost savings overall could leave more funds available for instruction and student benefits. The downside is that collaboration among faculty may be affected and networking opportunities for students may be diminished. This could have adverse impacts on the campus culture.

2.3.1.4. Other Co-Benefits
Reductions in vehicle miles traveled have many co-benefits, including reductions in traffic crashes (and casualties), reduced air pollution, reduced noise from traffic, and time savings.

2.3.1.5. Implementation Plan and Timescale
Implementation is largely subject to changes in remote class offerings and the ability of individuals to work at home (despite their desires). Union negotiations would be needed to allow some staff the flexibility to work at home. Faculty were not surveyed on views towards remote teaching and this may be a barrier to widespread adoption.

2.3.1.6. Needed research and planning
Additional surveys focused on these issues are needed.

2.3.1.7. Evaluation plan
Total staff on-site post pandemic compared to pre should be collected in order to monitor progress

2.3.1.8. Management roles
University leadership, chancellor-level units, and others should ensure each area hits the target percentage of off-site.

2.3.1.9. Institutional, Organizational and Cultural Challenges to Implementation
N/A

2.3.1.10. Participation and Accountability
N/A

2.3.1.11. Contribution to Climate-Positive, Equitable, Sustainable Economic Development
N/A

2.3.1.12. Equity Concerns
The main equity issues concern the ability of students to engage with remote learning. Staff working at home need to have assurances that they will not be exploited by managers (i.e., working outside of regular assigned hours).

2.3.2. Incentives for purchasing battery-electric vehicles (EVs)
In order to reduce emissions associated with commuting, the university can provide incentives for faculty, staff, and students who need to drive to campus to purchase EVs. The primary policy instrument available is to provide parking discounts. To this end we surveyed faculty, staff, and students to determine their responsiveness to this type of policy.

Respondents were surveyed on whether they would purchase an electric vehicle if parking permits were either 25% or 50% less expensive. More are likely to purchase an EV when the parking discount is larger and over 25% of faculty report doing this at the 50% parking fee discount. This is followed by staff (slightly lower rates) with students below that.

Table 2.11. Number of parking permit holders in sample indicating they would purchase an EV

	25% parking price reduction/purchase EV				50% parking price reduction/purchase EV			
	New Brunswick	**Newark**	**Camden**	**Total**	**New Brunswick**	**Newark**	**Camden**	**Total**
Faculty	41	17	3	61	116	36	9	161
Staff	91	16	5	112	265	63	15	343
Student	58	12	7	77	144	30	14	188
Total	**190**	**45**	**15**	**250**	**525**	**129**	**38**	**692**

Table 2.12. Percent of parking permit holders in sample indicating they would purchase an EV

	25% parking price reduction/percent of permit holders			50% parking price reduction/percent of permit holders		
	New Brunswick	**Newark**	**Camden**	**New Brunswick**	**Newark**	**Camden**
Faculty	10.17%	15.45%	8.57%	28.78%	32.73%	25.71%
Staff	7.84%	6.90%	5.81%	22.84%	27.16%	17.44%
Student	6.72%	5.13%	5.30%	16.69%	12.82%	10.61%

Assuming that these commuters would use an EV for their commute trip we estimated the annual CO2 reductions based on the annual VMT of these commuters. EV's are dependent on the emissions from the state electrical grid. Using estimates from the DOE[10] of 2754 lbs CO2eq for EVs and 11,435 lbs CO2eq for gasoline, we estimated that the CO2eq emissions for an EV are 97.30 gm/mile. Based on this a 25% parking fee reduction could result in an emissions reduction 3,678 metric tonnes of CO2 and a 50% parking fee reduction in a reduction of 10,378 metric tonnes of CO2 across all three campuses. Details are in the tables below.

Table 2.13. VMT associated with those purchasing EVs with a 25% and 50% reduction in parking fees

	25% parking price reduction/annual VMT			50% parking price reduction/annual VMT		
	New Brunswick	**Newark**	**Camden**	**New Brunswick**	**Newark**	**Camden**
Faculty	1,651,545	943,813	98,795	4,672,664	1,998,662	296,385
Staff	4,498,066	1,279,395	213,047	13,098,765	5,037,618	639,141
Student	2,247,602	784,916	275,755	5,580,254	1,962,291	551,510
Total	**8,397,214**	**3,008,124**	**587,597**	**23,351,683**	**8,998,571**	**1,487,037**

Table 2.13. CO2 reductions associated with EVs and parking price reductions

	25% parking price reduction (CO2 metric tonnes)				50% parking price reduction (CO2 metric tonnes)			
	New Brunswick	**Newark**	**Camden**	**Total**	**New Brunswick**	**Newark**	**Camden**	**Total**
Faculty	507	289	30	826	1,433	613	91	2,137
Staff	1,380	392	65	1,837	4,017	1,545	196	5,758
Student	689	241	85	1,015	1,711	602	169	2,482
Total	**2,575**	**923**	**180**	**3,678**	**7,162**	**2,760**	**456**	**10,378**

Note: estimates of CO2 emissions for EVs derived from: https://afdc.energy.gov/vehicles/electric_emissions.html

[10] https://afdc.energy.gov/vehicles/electric_emissions.html

2.3.2.1. Emissions reductions and resilience improvements
Research is needed to determine resiliency effects. Emissions reductions are about 4 – 11% of total transportation-related emissions.

2.3.2.2. Financial costs and savings
No cost or savings to university unless it is determined that in order to encourage it's use that each user gets a reduction in parking cost. Could be a cost in marketing materials.

2.3.2.3. Benefits to the University's educational and research mission and to campus culture
The University could market itself as the EV campus

2.3.2.4. Other Co-Benefits
Reductions in other air pollutants.

2.3.2.5. Implementation Plan and Timescale
Dependent on what incentives, if any, will be used.

2.3.2.6. Needed research and planning
N/A

2.3.2.7. Evaluation plan
A count of total EV vehicles should be done after campus is opened to set a base. After which, high, medium and low targets should be created of total percentage of EV vehicles at 5, 10 and 15 years out. These could be tracked against New Jersey targets for new EV purchases.[11]

2.3.2.8. Management roles
Leadership of the University should all purchase EV vehicles to commute to campus as a way to encourage the rest of the University.

2.3.2.9. Institutional, Organizational and Cultural Challenges to Implementation
A form of vehicle has never been promoted as the preferred mode of motorized vehicle before. Could be legal questions to this promotion. However, it will be consistent with New Jersey's Global Warming Response Act.[12]

2.3.2.10. Participation and Accountability
See above

2.3.2.11. Contribution to Climate-Positive, Equitable, Sustainable Economic Development
Rutgers would serve as a model of how to push the change to EVs for personal vehicles.

2.3.2.12. Equity Concerns
EV's may be more costly to purchase, however costs are rapidly declining and parking savings will offset part of the increased purchase cost.

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[11] New Jersey Department of Environmental Protection, 2020, New Jersey's Global Warming Response Act, 80x50 Report, https://www.nj.gov/dep/climatechange/mitigation.html
[12] New Jersey Department of Environmental Protection, 2020, New Jersey's Global Warming Response Act, 80x50 Report, https://www.nj.gov/dep/climatechange/mitigation.html

2.3.3. Reduce business travel and/or purchase carbon off-sets

Reducing air travel and other business trips can lead to emissions reductions. Some of this may be facilitated by video conferencing, but other trips may still be needed. We have not analyzed this in detail beyond rough estimates of baseline emissions. Based on our estimates and an off-set price of $25/tonne of emissions, the total cost is about $9 million.

2.3.3.1. Emissions reductions and resilience improvements

This is dependent on how much is invested in carbon off-sets.

2.3.3.2. Financial costs and savings

Purchasing carbon off-sets for travel would add to travel costs or detract from funds available in grants.

2.3.3.3. Benefits to the University's educational and research mission and to campus culture

N/A

2.3.3.4. Other Co-Benefits

Co-benefits include reduced emissions of other pollutants associated with air travel, buses, and trains, if trips are reduced.

2.3.3.5. Implementation Plan and Timescale

Would require off-set purchases to be written into grants and supported by funders. University would need to allocate funds as needed for staff travel.

2.3.3.6. Needed research and planning

Additional research is needed to better estimate all university-related business travel.

2.3.3.7. Evaluation plan

Evaluation could involve assessing compliance with any requirement to purchase off-sets.

2.3.3.8. Management roles

N/A

2.3.3.9. Institutional, Organizational and Cultural Challenges to Implementation

N/A

2.3.3.10. Participation and Accountability

Off-set purchases could be required as a condition of reimbursement for travel.

2.3.3.11. Contribution to Climate-Positive, Equitable, Sustainable Economic Development

N/A

2.3.3.12. Equity Concerns

N/A

2.3.4. Create safe bicycle and pedestrian infrastructure

The university master plan has components that call for more pedestrian connectivity. But more is needed including integration with our surrounding communities. New Brunswick now has e-scooters which will also benefit from protected bicycle lanes. Newark would benefit mainly from slower streets with reductions in the number of travel lanes. As an initial step, there will be a Bloustein School studio course in Spring 2021 that will focus on improvements on the New Brunswick campus and surrounding areas.

2.3.4.1. Emissions reductions and resilience improvements
Research needed to determine this.

2.3.4.2. Financial costs and savings
There will be costs to the university to create safer infrastructure. Any savings might come from a reduction in bus riders and it may free up parking lots to be decommissioned. But most importantly it will make the campuses more attractive to potential students boosting the competitiveness of the university and possibly leading to increased tuition revenue.

2.3.4.3. Benefits to the University's educational and research mission and to campus culture
More bike lanes should encourage a safer walking environment and change the campus culture away from motor vehicles and bus travel between campuses

2.3.4.4. Other Co-Benefits
Reductions in traffic crashes and casualties are the main co-benefit. Reductions in bus use.

2.3.4.5. Implementation Plan and Timescale
Funding (total amount dedicated to this plan) would determine implementation and timescale. Could be coordinated with the development of a new University master plan.

2.3.4.6. Needed research and planning
Studio courses are a first step and more will be needed.

2.3.4.7. Evaluation plan
Total lane miles created would be used as a benchmark to compare against current total.

2.3.4.8. Management roles
Leadership should be using bikes and E-Scooters to move between campuses to serve as an example.

2.3.4.9. Institutional, Organizational and Cultural Challenges to Implementation
Cultural challenges of a car focused community are still the toughest obstacle to overcome.

2.3.4.10. Participation and Accountability
Any master plan developed by the university should include outreach to the university community and to residents of surrounding areas.

2.3.4.11. Contribution to Climate-Positive, Equitable, Sustainable Economic Development
Would encourage more bicycle usage which should spill over to adjoining communities.

2.3.4.12. Equity Concerns
N/A

2.3.5. Enhance public transit discount programs or free transit
In order to reduce single occupancy vehicles being used as a commute option, the University should give financial assistance to reduce the cost of public transit. Currently, if a vehicle is owned, it is cheaper to drive

the vehicle than to use public transit. A major obstacle is that most faculty, staff, and students have never considered using public transit to travel to campus, as shown below.

Table 2.14. Have you ever used or considered using public transit to travel to campus in the past? (for non-transit travelers)

	Yes		No	
	n	%	n	%
New Brunswick (n=5,563)				
Faculty	223	45.79%	264	54.21%
Staff	408	32.25%	857	67.75%
Student	1,616	42.40%	2,195	57.60%
Newark (n=722)				
Faculty	72	51.06%	69	48.94%
Staff	142	50.90%	137	49.10%
Student	33	55.76%	269	44.24%
Camden (n=589)				
Faculty	46	79.31%	12	20.69%
Staff	62	63.27%	36	36.73%
Student	207	47.81%	226	52.19%
Total	**2,809**	**40.86%**	**4,065**	**59.14%**

Large fractions of the campus population would not use public transit, even it was fully subsidized and was free, although students would be more likely to use it either all the time or some of the time.

Table 2.15. Would you use public transit to travel to campus if it were free? (for non-transit travelers)

	Yes, all the time		Yes, some the of time		No	
	n	%	n	%	n	%
New Brunswick (n=4,709)						
Faculty	64	16.04%	157	39.35%	178	44.61%
Staff	139	13.80%	356	35.35%	512	50.84%
Student	1,187	35.94%	1,445	43.75%	671	20.31%
Newark (n=910)						
Faculty	23	18.85%	39	31.97%	60	49.18%
Staff	43	18.45%	90	38.63%	100	42.92%
Student	204	36.76%	200	36.04%	151	27.21%
Camden (n=457)						
Faculty						
Staff	26	29.89%	34	39.08%	27	31.03%
Student	166	44.86%	101	27.30%	103	27.84%
Total	**1,852**	**30.48%**	**2,422**	**39.86%**	**1,802**	**29.66%**

We surveyed reasons that transit is not considered based on those who reported that they would not use transit, even if it were free. The primary reasons are that it takes much longer than driving and is not feasible from the location they are traveling from. Some of these effects are lower for the Newark campus which is relatively accessible using various transit modes. Our results for Camden are inconclusive due to the small sample reporting that they never use transit. Some also report the need for a vehicle at work, suggesting other ways to get around campus are needed.

Table 2.16. Stated reasons for not using public transit

	much longer than driving		infeasible at my location		infeasible at the times I travel		need a vehicle at work		worry about COVID	
	n	%	n	%	n	%	n	%	n	%
New Brunswick (n=2,286)										
Faculty	98	55.06%	90	50.56%	23	12.92%	52	29.21%	30	16.85%
Staff	266	51.95%	235	45.90%	39	7.62%	155	30.27%	128	25.00%
Student	415	61.85%	226	33.68%	85	12.67%	187	27.87%	257	38.30%
Newark (n=445)										
Faculty	29	48.33%	18	30.00%	8	13.33%	7	11.67%	9	15.00%
Staff	55	55.00%	25	25.00%	9	9.00%	22	22.00%	30	30.00%
Student	90	59.60%	34	22.52%	15	9.93%	40	26.49%	54	35.76%
Camden (n=224)										
Faculty	13	76.47%	8	47.06%	1	5.88%	3	17.65%	5	29.41%
Staff	18	66.67%	5	18.52%	3	11.11%	4	14.81%	7	25.93%
Student	55	53.40%	29	28.16%	9	8.74%	32	31.07%	32	31.07%
Total	**1,03**	**35.16%**	**670**	**22.67%**	**192**	**6.50%**	**502**	**16.99%**	**552**	**18.68%**

Based on the stated response to using free transit we estimated VMT and CO2 reductions that are feasible. We assumed faculty travel 40 weeks/year, staff 48 weeks/year, and students 30 weeks/year, similar to previous estimates. We also assumed that all travel four days a week to campus (this is a simplification as more detail on reported frequency is available in our survey). For those that stated they would use free transit "some of the time" we assume 10 days/year for faculty/staff and 20 days/year for students. Across all of Rutgers, potential CO2 reductions come to 5145 metric tonnes of CO2, this is roughly 6.6% of total emissions attributable to commuting travel and 5.6% of total transportation-related emissions.

Table 2.17. VMT and CO2 reduction for those stating that they would use free transit

	Yes, all the time (VMT reduction)	Yes, some the of time (VMT reduction)	CO2 reduction (metric tonnes)
New Brunswick			
Faculty	2,291,774	323,033	1,056
Staff	3,066,840	299,510	1,360
Student	3,333,069	332,672	1,481
Total	**8,691,682**	**955,216**	**3,897**
Newark			
Faculty	481,234	49,346	214
Staff	648,632	58,677	286
Student	587,079	50,894	258
Total	**1,716,944**	**158,917**	**758**
Camden			
Faculty	298,449	12,089	125
Staff	461,397	26,498	197
Student	394,100	19,115	167
Total	**1,153,947**	**57,703**	**490**
Total for all campuses	**11,562,574**	**1,171,836**	**5,145**

2.3.5.1. Emissions reductions and resilience improvements
As noted, some fraction will shift to transit and this will result in emissions reductions, potentially up to 5145 metric tonnes, or 5.6% of transporation-related emissions.

2.3.5.2. Financial costs and savings
The actual price point needed per commuter has not yet been determined nor has the funding stream.

2.3.5.3. Benefits to the University's educational and research mission and to campus culture
N/A

2.3.5.4. Other Co-Benefits
Less traffic on the roads.

2.3.5.5. Implementation Plan and Timescale
Longer timeframe since funding needs to be identified

2.3.5.6. Needed research and planning
Additional survey work is needed to assess what alternative commute options might be useful to consider and what is feasible for employees. Financial estimates of costs are needed.

2.3.5.7. Evaluation plan
Survey should be done pre and post to assess total transit ridership.

2.3.5.8. Management roles
Promote the program and/or take part

2.3.5.9. Institutional, Organizational and Cultural Challenges to Implementation
N/A

2.3.5.10. Participation and Accountability
N/A

2.3.5.11. Contribution to Climate-Positive, Equitable, Sustainable Economic Development
More transit use is better for all.

2.3.5.12. Equity Concerns
N/A

2.3.6. Electrifying the University's bus fleet and other University-owned or operated vehicles
A long run goal is to convert the university fleet to electric vehicles. For many smaller service vehicles the technology is already available, but additional charging points would be needed. For diesel buses (subcontracted to First Transit), there are more difficult implementation issues, not least that the technology is not suitable for the climate in New Jersey. NJ Transit will be having a pilot program of electric buses in Camden, starting in 2021, and this will provide useful information for the readiness of the technology. However, the load which the current Rutgers buses carry and the time in service, may make this infeasible for some time.

2.3.6.1. Emissions reductions and resilience improvements
100% reduction of diesel fumes from the fleet.

2.3.6.2. Financial costs and savings
If the technology is feasible, there could be substantial cost savings as EVs tend to have 3-5 year payback periods. Electricity is more efficient and cheaper than diesel or gasoline. However, for the bus fleet, there may be added costs to build dedicated recharging stations and to obtain the most advanced technology when available.

2.3.6.3. Benefits to the University's educational and research mission and to campus culture
Would provide a good setting to test out e-buses for research

2.3.6.4. Other Co-Benefits
As with all our policies, co-benefit are reductions in other vehicle pollutants.

2.3.6.5. Implementation Plan and Timescale
Funding would have to be dedicated to this prior to implementation.

2.3.6.6. Needed research and planning
Continual evaluation of e-bus technology is needed to assess the feasibility of implementation.

2.3.6.7. Evaluation plan
Percentage of fleet electrified should be tracked.

2.3.6.8. Management roles
Upper management would need to be dedicated to the transition and identify funding for implementation.

2.3.6.9. Institutional, Organizational and Cultural Challenges to Implementation
N/A

2.3.6.10. Participation and Accountability
N/A

2.3.6.11. Contribution to Climate-Positive, Equitable, Sustainable Economic Development
N/A

2.3.6.12. Equity Concerns
N/A

2.3.7. Parking cash-out
Parking cash-out is a policy aimed at reducing single-occupant commuting to work and provides equity for those who currently do not drive. Rutgers employees and students who park on campus are heavily subsidized, though they may not realize it. Parking garages are expensive to build and maintain, especially any structured parking. What this means is that employees are not paying the parking fees they would be charged if they parked at private garages. For example, if a faculty member pays $400/year to Rutgers, but would have to pay $200/month for a private garage, that is a subsidy of $2000/year for that employee. This indirectly penalizes those who do not drive to campus.

A parking cash-out policy would provide all employees with a tax-free commuter benefit. Some may opt to pay for parking with this amount, while others will take the cash. This basically puts an opportunity cost on the parking that employees use. Students could also be brought into this program, though may not be able to receive tax-free payments (per Federal tax law).

2.3.7.1. Emissions reductions and resilience improvements

Less parking would allow for removal of impervious surfaces that can lead to flooding. Emissions reductions are possible if employees opt not to drive and park.

2.3.7.2. Financial costs and savings

This is dependent on the structure of the program. It can easily be structured to increase revenue or at least be made revenue-neutral.

2.3.7.3. Benefits to the University's educational and research mission and to campus culture

N/A

2.3.7.4. Other Co-Benefits

Less driving to campus with associated reductions in pollutants. Reductions in surface parking has aesthetic benefits.

2.3.7.5. Implementation Plan and Timescale

Would need to have agreement of unions to implement. Timescale could be long to decommission and remove existing parking as it is no longer needed. Would need to work with surrounding communities so there is no overflow to free street parking, perhaps by implementing a permit system for those communities.

2.3.7.6. Needed research and planning

Full cost assessment of current parking costs borne by the university to determine subsidy levels. More assessment of how many would opt not to drive and park.

2.3.7.7. Evaluation plan

Reductions in purchase of parking permits would need to be evaluated and sensitivity to variation in cash-out offered.

2.3.7.8. Management roles

Would need to implement the new policy.

2.3.7.9. Institutional, Organizational and Cultural Challenges to Implementation

N/A

2.3.7.10. Participation and Accountability

N/A

2.3.7.11. Contribution to Climate-Positive, Equitable, Sustainable Economic Development

N/A

2.3.7.112. Equity Concerns

Would enhance the equity of those who currently do not drive to campus by removing subsidy for those who do.