Yeshiva University
Sustainability Plan 2019

ALTANOVA

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Executive Summary

This Sustainability Plan was prepared as a part of Yeshiva University's participation in the New York State Research and Energy Authority's (NYSERDA) REV Campus Challenge. This program assists colleges and universities with setting environmental goals and developing a comprehensive roadmap to reduce energy consumption and greenhouse gas emissions. Much of the data collected for this report was facilitated through David Pianko at Yeshiva University, in coordination with additional departments across the YU campus.

This plan is intended to serve as a snapshot highlighting both past and present initiatives as they relate to sustainability on campus, as well as recommendations for future solutions to consider and implement. Both current status and future suggestions in this report are separated between building energy, transportation, waste, and water. Details of the specific building energy related analysis and future recommendations can be found in the accompanying individual building audits and energy master plan document.

While limited by the amount of currently available real time data across some of these categories, Altanova estimates that by implementing the following suggested solutions/strategies, Yeshiva University's overall emissions would reduce from 16,870 MT eCO2 to 12,085 MT eCO2, a 28% reduction.

Beyond the initial scope of this project, an additional appendix outlining the potential impacts of the new Local Law 97, which will set annual emissions limits on NYC buildings, has been included.

1. Project Overview

1.1. NYSERDA –REV Challenge

The REV Campus Challenge launched in Fall 2015 with the goal of engaging the broad academic potential of New York State's colleges and universities to realize Reforming the Energy Vision (REV), a strategy to build a clean, resilient, and affordable energy system for all New Yorkers. REV Campus Challenge members include two-and four-year, public and private institutions from all regions of New York State. The REV Campus Challenge promotes clean energy efforts by recognizing and supporting colleges and universities in New York State that implement clean energy projects and principles on campus, in the classroom, and in surrounding communities.

The REV Campus Challenge provides its members with a range of services including:

- Support programs to enable member institutions to make progress toward their goals.
- Opportunities to be recognized for clean energy achievements.
- Membership in a network of like-minded institutions from all corners of the State.
- Workshops and opportunities to learn from and engage with peers.
- A library of resources to consult and draw from.

Yeshiva University reached out to Altanova to help them achieve their energy goals as part of this program.

1.2. Yeshiva University

Yeshiva University is a private, non-profit Jewish institution for higher education located in New York City. This sustainability performance scope includes the university's four campuses: Wilf Campus (500 West 185th Street), Israel Henry Beren Campus (245 Lexington Avenue), Brookdale Center (55 Fifth Avenue) in Manhattan, and the Jack and Pearl Resnick Campus in the Bronx (Eastchester Road and Morris Park Avenue).

Over the past decade, Yeshiva University has worked to build strategy surrounding its sustainability efforts, beginning with a Climate Action Plan written in 2010. This report highlights various possible measures to be implemented for potential carbon reduction across several campuses, with the primary emphasis being on reducing electrical and heating, ventilation, and air conditioning (HVAC) loads. At the time, and until fall of 2015, Yeshiva's medical campus, Einstein, was the largest contributor to their overall emissions, and many of the measures were directed at reducing the carbon emissions associated with that campus.

Similarly, in 2014 Yeshiva reported to the Campus Carbon Calculator to help create a more complete baseline picture of their carbon emissions across the multiple campuses, and

ideally help track these emissions over time. With the transfer of operational and financial control of the Einstein Campus to Montefiore in September of 2015, the overall carbon emissions of Yeshiva's portfolio have greatly decreased.

This report uses figures from the 2017 fiscal year to report to the newly revised Campus Carbon Calculator, now SIMAP (Sustainability Indicator Management and Analysis Platform), which can help serve as a framework for future reporting years as Yeshiva works to continue to reduce their campus carbon emissions. Information compiled for this reporting cycle was facilitated by David Pianko, coordinating with multiple stakeholders in numerous departments across campus.

2. Current Sustainability Status at Yeshiva University

2.1. Sustainability/GHG Reporting

2.1.1. AASHE – STARS Framework

In 2014, Yeshiva University participated in AASHE's STARS certification and received a Bronze rating under STARS version 1.2. AASHE, the Association for the Advancement of Sustainability in higher education, uses STARS (The Sustainability Tracking, Assessment & Rating System) as self-reporting framework for colleges and universities to measure their sustainability performance and leadership.

For this round of updates in 2018, Yeshiva University reported to the latest version of STARS (2.1), which contains five main categories: Academics (AC), Engagement (EN), Operations (OP), Planning & Administration (PA), and Innovation & Leadership (IN). By earning points across each of these five categories, an institution can earn a Bronze, Silver, Gold, or Platinum rating based on their overall score.

Based on their reporting of current programs and initiatives, Yeshiva received 65% of all available points in the STARS framework, just reaching the threshold to earn a Gold level rating for 2018.

Yeshiva's strongest category is Planning & Administration, where they have earned all possible points in that section. This rewards Yeshiva's efforts of having a designated sustainability officer to help advise and implement these sustainability initiatives, as well as their emphasis on supporting diversity and access for various groups across campus.

The category with the most unearned points is Academics, with only 18 of 58 possible points earned. Offering sustainability courses at both the undergraduate and graduate level as well as supporting research efforts for sustainability topics specifically, would quickly increase Yeshiva's overall STARS rating. Incorporating sustainability into the overall academic curriculum and research spheres at Yeshiva may also have a positive impact on other sustainability initiatives as students' overall awareness and education levels increase. They will hopefully carry this knowledge with them not only during their time at Yeshiva University but beyond into their own communities.

A complete copy of the STARS 2.1 worksheet is available in Appendix A.

2.1.2. GHG Emissions – SIMAP Tool

Total Greenhouse Gas (GHG) emissions are calculated by combining emissions from three different areas:

Scope 1: Direct emissions by sources owned or controlled by the University

Scope 2: Indirect emissions from the generation of purchased energy

Scope 3: All indirect emissions that occur in the value chain of the University, both upstream and downstream. Scope 3 emissions would also include travel by students and staff of the University. While partial scope 3 emissions were included in reporting in 2014, no Scope 3 emissions information was collected to be included as part of this report.

For this report, the SIMAP tool was used to help calculate both baseline GHG emissions for the 2017 fiscal year, as well as projecting emission levels following the implementation of recommended energy conservation measures. Another data point was also included to calculate potential emission totals following the implementation of suggested distributed energy resource (DER) configurations. Input amounts for these two projection scenarios were provided by energy modeling performed by the Altanova team during this project. Details of those measures and calculations can be found in the accompanying Energy Master Plan and individual building audit reports. Screenshots of the inputs and results from the SIMAP tool are also available in Appendix D.

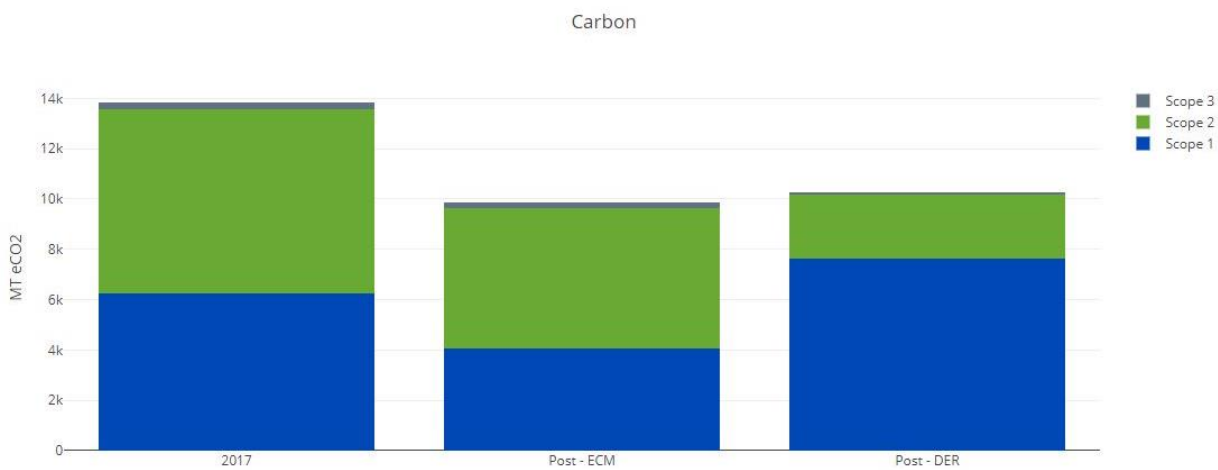

Figure 1 : Total Carbon Emissions under Three Scenarios (from SIMAP)

	Scope 1	Scope 2	Scope 3	Total
FY2017	6,238.79	7,312.29	273.54	13,824.62
Post-ECM	4,059.31	5,595.58	201.37	9,856.26
Post-ECM+DER	7,647.32	2,549.45	66.97	10,263.74

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To get a more complete picture of Yeshiva's total current emissions, our team also compiled some additional information in order to include food waste, shuttle vans, as well as some scope 3 transportation data using the most recently available data from Yeshiva's 2014 reporting. While building energy makes up the majority of overall emissions, this report also includes suggestions for reducing additional contributions from waste, transportation, and water as well.

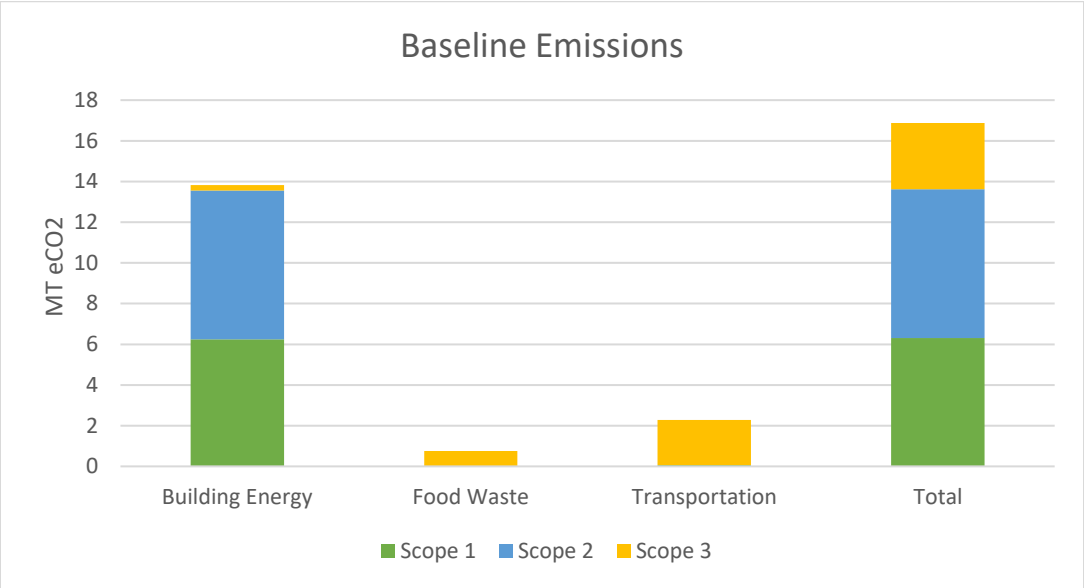

Figure 2: YU Baseline Emissions Incorporating Food Waste and Transportation

	Scope 1	Scope 2	Scope 3	Total
Building Energy	6,238.8	7,312.3	273.5	13,824.6
Food Waste			763.5	763.5
Transportation	68.4		2,214.0	2,282.4
Total	**6,307.2**	**7,312.3**	**3,251.1**	**16,870.5**

2.2. Building Energy

As part of the overall REV scope, a separate energy plan was created to go into greater detail regarding both baseline energy use by the University currently, as well as lists of recommended measures for reducing energy usage across campus. The Yeshiva University energy plan consists of three parts: a baseline energy usage analysis and building selection; energy audits of selected buildings and energy modeling to determine opportunities for energy savings; and opportunities for on-site energy generation.

A baseline energy analysis was estimated across the entire Yeshiva University portfolio for the 2017 calendar year using CONED and Direct Energy bills for electricity, gas, oil, and steam. This analysis served to determine annual energy consumption, distribution, and expenditure (by fuel type) across the portfolio and helped in determining which buildings showed the most opportunity for savings. Results of this analysis can be viewed in Table 1.

Table 1: Energy Usage and Cost (2017)

Building	Electricity		Gas		Oil		Steam		Total
	kWh	USD	therms	USD	gal	USD	Mlb	USD	USD
Furst Hall	713,034	$113,976	372	$794	48,063	$91,319	-	-	**$ 206,100**
Glueck Education Center	837,683	$167,065	26,217	$28,326	6,516	$12,380	-	-	**$ 207,800**
Gottesman Library	1,204,938	$236,632	-	-	112,529	$213,806	-	-	**$ 450,400**
Schottenstein Hall	501,065	$75,155	23,935	$22,721	20,309	$35,908	-	-	**$ 133,800**
Zysman / Muss Halls	2,172,901	$375,467	6,101	$9,976	43,844	$83,304	-	-	**$ 468,700**
Belfer Hall	3,540,556	$614,592	203,683	$168,302	-	-	-	-	**$ 782,900**
Cardozo Hall	1,885,731	$378,167	59,001	$51,736	-	-	8,485	$357,816	**$ 787,700**
Rubin Hall / MSAC	1,008,226	$175,014	-	-	84,995	$161,491	-	-	**$ 336,500**
Stanton Hall	792,877	$127,079	2,103	$2,644	-	-	7,202	$200,748	**$ 330,500**
Stern College	1,163,011	$171,151	-	-	-	-	1,639	$81,103	**$ 252,300**
35th St. Hall	303,130	$55,278	6,312	$7,621	-	-	-	-	**$ 62,900**
36th St. Hall	223,135	$42,420	-	-	-	-	1,369	$61,229	**$ 103,600**
215 Lexington Ave.	466,682	$87,136	-	-	-	-	-	-	**$ 87,100**
Brookdale Center	481,140	$74,783	559	$1,083	-	-	3,316	$121,294	**$ 197,200**
Morgenstern Hall	433,103	$78,551	563	$1,122	35,453	$67,361	-	-	**$ 147,000**
Schottenstein Center	137,059	$31,719	13,355	$14,677	-	-	-	-	**$ 46,400**
Totals	**15,864,273**	**$2,804,185**	**342,201**	**$309,001**	**351,709**	**$665,568**	**22,011**	**$822,190**	***$4,600,900***

Additionally, greenhouse gas (GHG) emissions were calculated and show emissions in metric tons CO_2 equivalency (mt CO_2e) per fuel type (see Table 2). These and similar calculations utilized emission factors for the NPCC NYC/Westchester (NYCW) eGRID 2018 subregion[1].

[1] Environmental Protection Agency. March 9, 2018. *Emission Factors for Greenhouse Gas Inventories.* Retrieved from: https://www.epa.gov/sites/production/files/2018-03/documents/emission-factors_mar_2018_0.pdf

Table 2: GHG Emissions (MT CO2e) (2017)

Building	Electricity	Gas	Oil	Steam	Total
Furst Hall	206	2	527	-	**734**
Glueck Education Center	242	139	71	-	**452**
Gottesman Library	347	-	1,233	-	**1,580**
Schottenstein Hall	145	127	223	-	**494**
Zysman / Muss Halls	627	32	480	-	**1,139**
Belfer Hall	1,021	1,080	-	-	**2,101**
Cardozo Hall	544	313	-	672	**1,529**
Rubin Hall / MSAC	291	-	931	-	**1,222**
Stanton Hall	229	11	-	570	**810**
Stern College	335	-	-	130	**465**
35th St. Hall	87	33	-	-	**121**
36th St. Hall	64	-	-	108	**173**
215 Lexington Ave.	135	-	-	-	**135**
Brookdale Center	139	3	-	263	**404**
Morgenstern Hall	125	3	388	-	**516**
Schottenstein Center	40	71	-	-	**110**
Totals	**4,575**	**1,814**	**3,853**	**1,743**	***11,985***

These buildings were then analyzed and compared based on overall energy consumption (kBtu), source energy use intensity (kBtu/ft^2), and an energy cost index (USD/ft^2) to determine which buildings showed the most potential for energy usage and cost savings. Table 3 below shows which buildings were selected for audit.

Table 3. Portfolio Campus and Audit Summary

Building	Campus	Audited
Furst Hall	Wilf West	✓
Glueck Education Center	Wilf West	✓
Gottesman Library	Wilf West	✓
Schottenstein Hall	Midtown	✓
Zysman/Muss Halls	Wilf West	✓
Belfer Hall	Wilf East	✓
Cardozo Hall	Wilf East	✓
Rubin Hall / MSAC	Wilf East	✓
Stanton Hall	Beren	✓
Stern College	Beren	✓
35th St. Hall	Midtown	
36th St. Hall	Midtown	
215 Lexington Ave.	Midtown	
Brookdale Center	Brookdale	
Morgenstern Hall	Wilf West	
Schottenstein Center	Wilf West	

2.3. Transportation

Currently, Yeshiva University has several initiatives in practice related to transportation. As a campus in an urban setting, even with the geographic spread of academic and residential buildings around the city, much of the framework for public transportation is already available to students attending the university through the New York City MTA. To encourage staff and faculty to take advantage of the NYC public transportation system, a pre-tax MetroCard program is in place, allowing paid employees to designate a portion of their pre-tax income to pay for qualifying commuting expenses. In addition to encouraging public transportation usage, there are also racks for storing bicycles in garages and around campus in various locations.

A shuttle service is also available for students and employees needing to travel directly between the Wilf and Beren campuses, with connections also available to nearby New York City Transit stops. The shuttle service utilizes the YU App for smartphones or desktop in order to facilitate the reservation process for those wishing to ride. Depending on the location and time of day, the shuttle operates on a published schedule or an on-call basis to each of the pre-determined shuttle stops. These two main campuses are 9-10 miles apart with approximately 169 trips per week (which makes a distance traveled of 1,544.3 miles). Based on the average consumption of a gasoline shuttle van and the price of gas in New York City, Yeshiva University spends approximately $641 a week for fuel and emits 1.9 metric tons of GHG every week operating the inter-campus shuttles.

In addition to the campus shuttle service, emissions from Yeshiva University's students, staff, and faculty contributes to their Scope 3 emissions. This includes both daily commuting and traveling to and from school at the beginning and end of each academic year. While a transportation survey was not completed in 2017/18 for this report, data from 2014 was used to estimate the impact of these commuting behaviors. We estimate that Yeshiva's current Scope 3 Transport Emissions total ~2,200 metric tons of CO2e per year. To identify the most effective strategy for reducing Yeshiva's Scope 3 Transport Emissions, we:

1. Calculated the efficiency of different modes of transportation (auto, bus, light rail, commuter rail),
2. Applied these coefficients of efficiency to the data collected in the 2014 Commuter Survey to estimate the current Scope 3 Transport Emissions,
3. Adjusted the survey inputs to simulate behavioral changes,
4. Identified the combination of behavioral changes that can reasonably be achieved and will deliver high impact.

Figures 3 and 4 below show the results of our calculations, showing the distribution of users across various transportation modes, as well as the corresponding percentage of emissions resulting from these different methods.

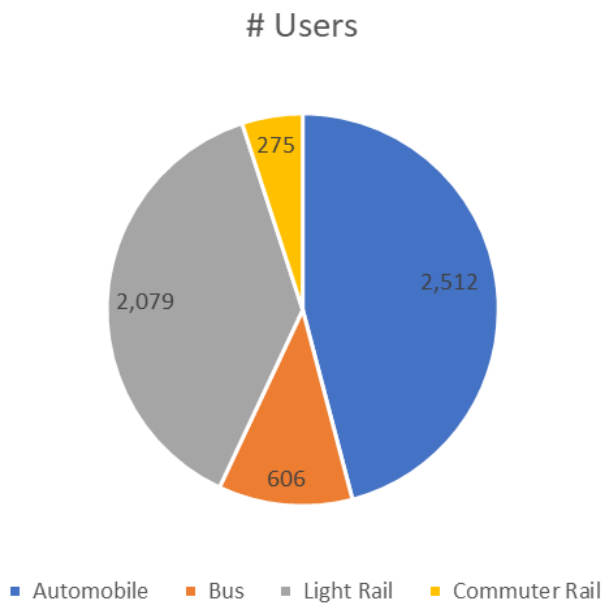

Figure 3: Distribution of 2014 Yeshiva University Community Across Transportation Modes

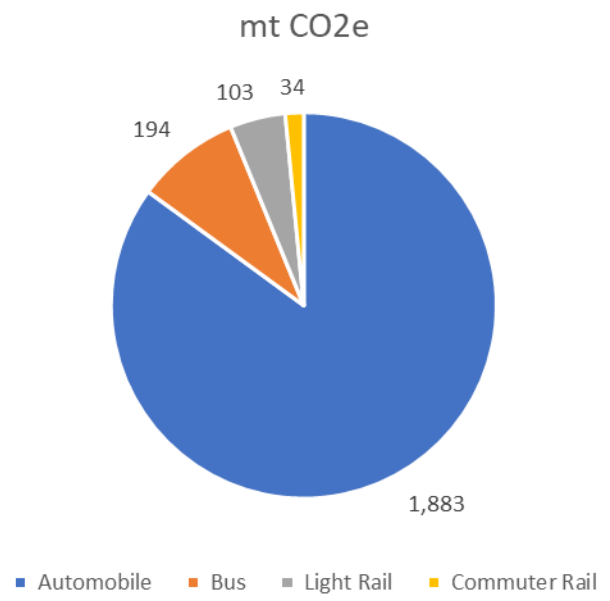

Figure 4: Corresponding Emissions Based on Reported Transportation Usage

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2.4. Waste

Yeshiva University highlights several both past and present initiatives dealing with the waste on campus. Most of these programs are focused on various recycling programs, some through partnerships with other municipal departments or organizations.

Yeshiva's paper, cardboard, plastic, glass, and metal are all recycled through the New York City Department of Sanitation, while printer cartridges and toner are collected and recycled in cooperation with Staples. Collection boxes for these ink materials are in several locations on both the Wilf and Beren campuses. To help divert waste created by single-use plastic bottles, Yeshiva has installed water refilling stations to encourage the use of re-usable water bottles.

Batteries and fluorescent light bulbs are disposed of in cooperation with the chemical waste vendor, Veolia. This collection program includes lithium, lead acid and rechargeable batteries. Other electronic waste is recycled through NYC Department of Sanitation curbside programs for the Manhattan campuses, and is available through private carters across campuses in other boroughs.

While Yeshiva University is not currently participating in any food waste composting program, they have in the past partnered with New York Restoration Project to collect food waste for composting on Wilf campus.

Without actual data from Yeshiva regarding their food waste, we are using available average data to help give an estimation for food waste. On college campuses, an average 22 million pounds of food are wasted each year, with the average college student contributing to about 142 pounds in food waste.[2] In 2017, Yeshiva University had an enrollment of 5,573 students and 1,182 FTE faculty and staff which could represent 791,366 pounds of food waste and approximately 763.5 metric tons of CO2 per year.

Composting food waste helps reduce GHG emissions and therefore reduce the impact the university has on the environment.

[2] https://recyclingworksma.com/food-waste-estimation-guide/#Jump2

2.5. Water

Looking at water usage across the Yeshiva University portfolio, just over $469k was spent on water in the 2018 fiscal year. This number represents a decrease from the $500k spent during FY17. The figure below shows a breakdown by building across these two fiscal years.

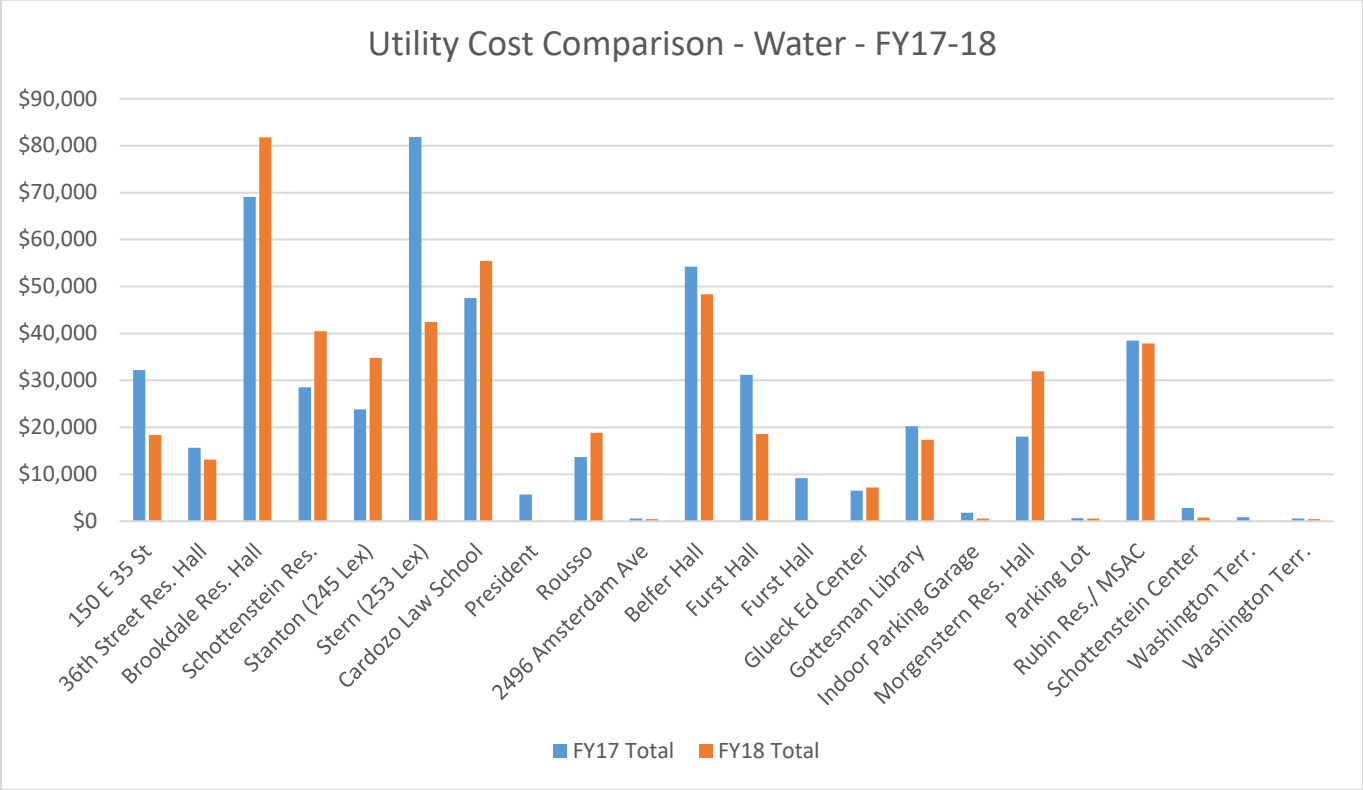


Figure 5 : Water Expenditure Across YU Portfolio

Certain water conservation initiatives and measures have already been taken across the building portfolio mentioned in the chart above to spread awareness and effectively reduce water usage at both the human and equipment levels.

These measures include signs to remind students to report leaks and encourage judicious use of water during showers, installation of new energy efficient shower and sink fixtures, and low-flow/tankless toilets.

Buildings such as 150 E 35th and Stern College for Women have reduced their yearly water consumption by more than 30% by exploring these options. A similar result can be brought about in other campus buildings such as Brookdale Residence Hall, Stanton Hall and Cardozo Law School that has seen an increase of over 15% in water consumption over the past year.

3. Suggested Solutions/Strategy

By implementing the following suggested solutions/strategies, we anticipate Yeshiva University's overall emissions would reduce from 16,870 MT eCO2 to 12,085 MT eCO2, a 28% reduction. These estimates can be further refined following more accurate baseline data regarding waste and transportation.

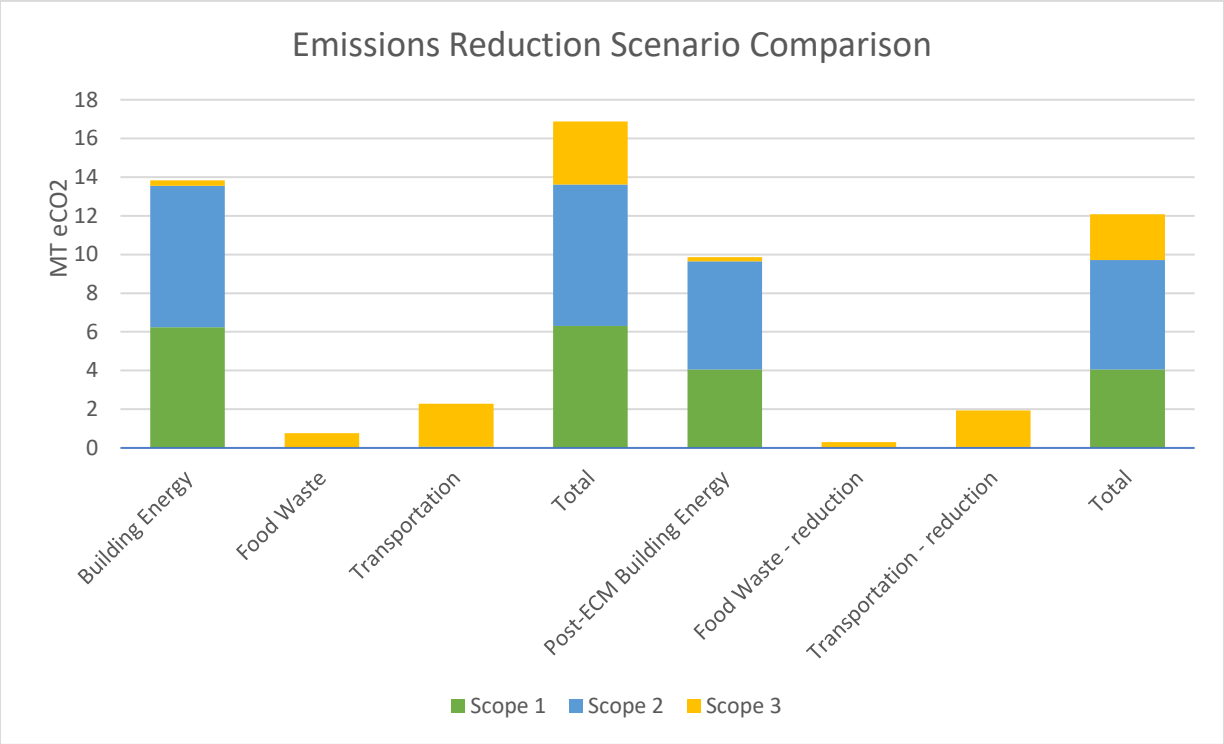


Figure 6: Comparison of Baseline to Possible Post ECM and Additional Solutions Scenario

3.1. Building Energy

Following building selection, energy audits were performed to determine operational and capital improvements via retro-commissioning (RCx) opportunities and energy conservation measures (ECM), respectively. These audits were completed in two parts: first, by Wilf Campus West (Furst Hall, Glueck Education Center, Gottesman Library, and Zysman & Muss Halls); second, Belfer Hall, Cardozo Hall, Rubin Hall/MSAC, Stanton Hall, and Stern College were audited individually.

Each building was modeled using the eQuest 3-65 software package. Wilf Campus West, however, was simulated using a single model due to the buildings' various shared systems and interconnectivity.

A FlexTech report was crafted to detail the RCx measures and ECMs recommended for Wilf Campus West. Individual energy audit reports were also written for each building included in the second phase of audits; however, no RCx measures were included in those simulations or reports.

RCx measures for Schottenstein Hall were recommended and implemented in 2016. As this and similar reports aim to explore improvements to be implemented and finalized in 2018, Schottenstein Hall will not be included.

Finally, to further energy cost savings and reduce carbon footprint, on-site generation opportunities were explored. Unfortunately, due to the urban environment of Yeshiva University's campuses, renewable energy opportunities such as solar panels and wind turbines were not determined to be economically viable. Instead, distributed energy resources (DER) and microgrid technologies were explored and simulated to determine optimum pairings of cogeneration and battery components.

Table 4. Portfolio ECM Technologies Summary

ECM	Wilf West	Belfer Hall	Cardozo Hall	Rubin Hall / MSAC	Stanton Hall	Stern Hall
Daylighting Sensors	✓		✓		✓	✓
DCV					✓	
Elevator Modernization		✓				
Energy Recovery		✓	✓	✓		
Fume Hood		✓				
Heat Recovery						✓
Improve Chiller Staging					✓	
Install New Chiller		✓			✓	✓
Install VFD			✓		✓	
Lighting	✓	✓	✓	✓		✓
Low Flow Fixture		✓		✓		
Motorized Economizer	✓					
NEMA Premium Motors		✓				
Occupancy Sensors	✓	✓	✓	✓	✓	✓
Pool Pack				✓		
Separate Condensing DHW Heater				✓		
Steam Fix/Replacement	✓		✓			✓
TRV Valves			✓			
Upgrade Fans		✓			✓	
VAV Retrofit		✓		✓		✓
Implementation Cost	$262,670	$4,816,151	$599,043	$453,615	$816,838	$499,350

A summary of energy and cost savings for ECMs as well as DER energy savings can be viewed in the two tables below.

Table 5. Portfolio ECM Savings

Building / Campus	Measure Type	Annual Energy Savings			Annual Cost Savings		GHG (mt CO_2)	
		Electricity		Gas+Oil+Steam	USD	%	Savings	Reduction
		kWh	kW	mmBtu				
Wilf West	RCx + ECM	954,745	265	12,695	$356,634	24%	1,417	36%
Belfer Hall	ECM	1,833,279	895	16,706	$532,921	52%	1,768	61%
Cardozo Hall	ECM	868,263	169	1,581	$202,276	24%	521	34%
Rubin Hall / MSAC	ECM	138,573	42	5,760	$108,871	30%	548	39%
Stanton Hall	ECM	227,616	67	2,798	$118,186	30%	295	40%
Stern Hall	ECM	406,532	140	564	$86,073	33%	233	50%
Total	-	**4,429,008**	**1,578**	**40,103**	**$1,404,961**	**28%**	**4,783**	**38%**

Table 6. DER Energy Savings

Building Set	Battery		Combined Heat & Power			Annual Energy Savings				GHG (mt CO_2)	
	Electricity		Manufacturer	Quantity	Electricity	Electricity		Gas	Steam	Savings	Reduction
	kWh	kW			kW	kWh	kW	mmBtu	mmBtu		
Wilf West	2,800	700	2G	2	265	3,927,575	647	-23,907	-	1,026	29%
Belfer + Rubin	2,400	400	ENER-G Rudox	2	160	2,589,741	387	-13,152	-	730	36%
Cardozo	400	100	2G	2	160	1,393,767	407	-15,330	5,970	255	25%
Stanton + Stern	400	100	Tecogen	2	75	1,218,113	213	-14,850	3,461	29	4%
Total	**6,000**	**1,300**	-	-	**1,320**	**9,129,196**	**1,654**	**-67,239**	**9,431**	**2,039**	**23%**

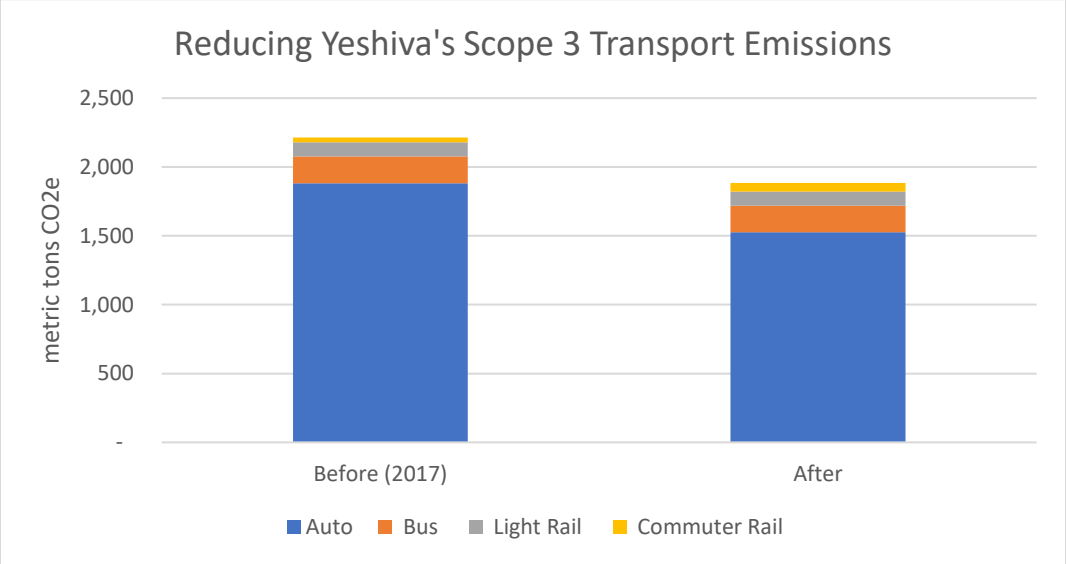
3.2. Transportation

The transportation activities for Yeshiva University are split among the shuttle service operated by Yeshiva, and the commuting habits of its students, faculty, and staff. Beyond the behaviors of Yeshiva's staff and students, it may be possible for vehicles owned by the University to switch away from gas to electric power once their current lease expires. This fleet is mostly made up of the previously mentioned shuttle vans as well as some security vehicles.

For the operation of the inter-campus shuttle service, by switching to leasing an electric shuttle van (for this example we took the Lighting Systems Ford E450[3]) rather than the current gasoline vehicles, savings could be evident in both operational costs and GHG emissions over the course of a school year. The annual GHG emissions from the operation of this service would reduce by about 26% with only $418 of electricity to recharge the shuttles per week, a roughly 34% saving over the cost of gasoline for the same distance traveled.

[3] https://lightningsystems.com/ford-e450-shuttle-bus

To provide greater insight into the commuting behaviors of Yeshiva University students, staff, and faculty, we recommend distributing an updated survey to the entire YU community. The survey should cover how students travel to and from school from their homes each year, as well as how they commute to classes daily. These survey responses will not only assist in calculating Scope 3 emissions from transportation but may also help provide insight for any gaps in the University's current sustainability initiatives related to transportation.



For example, if 20% of the students, faculty, and staff who currently commute by car switch to the commuter rail, GHG emissions could be reduced by 330 metric tons of CO2e per year. This is an overall reduction of Yeshiva's Scope 3 Transport Emissions by 15%.

This switch can be encouraged by offering subsidized or free transport tickets. For a more interactive and innovative approach, consider boosting sustainability engagement on campus through a program like Ducky[4]. Organize school championships, in which students, faculty, and staff compete to save carbon emissions through everyday activities, such as taking public transportation.

Citibikes can also be considered a valid option for student and staff transportation around the Yeshiva campuses in downtown Manhattan. While Citibike does not yet reach to Yeshiva's uptown campus, the program is still expanding, including a new zone of dock-less bikes in the Bronx, and may be worth revisiting in the future[5].

[4] https://www.ducky.eco/en/schools
[5] https://www.citibikenyc.com/

3.3. Waste

Participating in a program to reduce food waste or composting food can also help reduce Yeshiva's overall GHG emissions. The current facilities department at Yeshiva has expressed interest in potentially restarting a composting initiative, which may also be possible through the NYC Department of Sanitation, as their curbside composting program expands. While it has not yet passed as official legislation, draft versions of organic waste composting requirements for larger institutions including universities has been included in draft budgets for New York State as recently as 2018.

Using available average information, if Yeshiva is able to reduce food waste by 25% with signage in the dining halls and information to increase awareness in the residence halls, as well as directing the remainder of food waste to compost, total emissions could lower from 764 MT eCO2 to 294 MT eCO2, a reduction of 61%.

Yeshiva could look into continuing their previous efforts in food waste management by enrolling in programs that accept certain types of food waste at drop-off locations across NYC through several organizations[6].

To mention a few, BK ROT collects organic food waste from businesses for composting at their Brooklyn plant.

Yeshiva could work with Food Recovery Network to establish a YU Chapter and contribute towards their efforts in diverting food waste into area non-profits that feed those in need. The Food Recovery network is the largest student-led movement in the United States addressing hunger through food waste diversion.

The Lower East Side Ecology Center has their Community Compost Program which serves as a model for other organizations interested in starting food waste collection programs. They also provide e-waste and composting services.

In addition to partnering with above mentioned organizations, Yeshiva could explore several technologies to further tackle food waste management through on-site composting. Two products in particular – The Earth Flow Custom Vessel Composting System[7] and The Earth Cube[8] - could be relevant to the whole Yeshiva campus especially due to their size, ease of installation and operation.

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[6] https://foodtank.com/news/2018/09/27-organizations-in-new-york-city-combating-food-waste/

[7] https://compostingtechnology.com/in-vessel-composting-systems/earth-flow-custom-vessel/#1460580994335-67416e0c-6d474ef9-6f3b

[8] https://compostingtechnology.com/in-vessel-composting-systems/earth-cube/#1447187556584-88c9da4a-2d6d

The university could take advantage of The Food Waste Reduction and Diversion Reimbursement Program[9] (partnership between New York State and Rochester Institute of Technology) that incentivizes the reduction of food waste by providing reimbursements to large businesses, municipalities and other organizations to purchase equipment and technology like the ones mentioned above that help divert food waste from landfill.

Awareness for any of these initiatives are vital to their success. Colorful bins and signage are currently placed around campus to encourage everyday recycling participation by students and staff, as well as targeted reminder communications for recycling and e-waste sent out a few times per year.

To better track participation and effectiveness of any of these programs and initiatives, we recommend that the University gathers specific baseline metrics for their waste stream, including recycling. These metrics will allow the University to set their own internal waste reduction and diversion goals and track their actual behavior against these goals.

One way to measure these metrics is by bringing composting indoors that would help measure food waste at a more granular level. It is also a great way to complement on-site composting. A product that Altanova has personally tested and approved is the Vokashi EcoSmart kitchen waste bins[10] that could be installed on every floor, especially in residence halls for collection of fruit peels, pantry food waste etc.

Organizations like The Cornell Waste Management Institute (CWMI) can provide training and spread awareness among faculty, students and building personnel about both on and off-site composting. Excess NYC works with small businesses and schools to change their food waste disposal practices as well.

3.4. Water

Altanova believes the positive water conservation trend that has begun in specific buildings mentioned above can be leveraged to induce similar savings across other buildings in the Yeshiva portfolio, strategically.

Setting a practical water consumption reduction goal by exploring what additional measures can be implemented is a good starting point. Based on this strategy, certain additional steps have been identified that Yeshiva will benefit from.

[9] https://www.rit.edu/affiliate/nysp2i/food-reimbursement
[10] https://vokashi.com/

First, low-flow sink fixtures with energy efficient aerators should be standardized in buildings that still use conventional fixtures. This alone can potentially reduce water consumption by 20%.
For example, a conventional sink tap fixture has a flow rate of 2.5gpm (observed in Rubin residence hall) whereas a low-flow fixture will have a lower flow rate of around 2.2gpm, conserving water for the same amount of time used which depends on user behavior.

Using similar energy efficient shower fixtures is a great addition to the water conservation strategy. Smart shower fixtures (ex: Orbital fixtures[11]) can save up to 90% in water and 80% in energy by continuously recirculating and purifying an appropriate amount of water required per shower. This could have a huge impact in residence halls where students may be less careful with water usage.

Toilet flushing is a major consumer of water. Each flush uses more than a gallon of water to remove human waste. Tankless toilets are a good option to optimize this usage and should replace conventional toilets in all facilities. Toilets generally have tanks to ensure enough water is collected and discharged at the right pressure to remove human waste in one flush. This is seen mainly in residential spaces where the supply line pressure is not enough requiring collection of flush water in a tank. Yeshiva buildings have a supply pressure of 15-20 psi which is enough to operate tankless toilets which effectively reduces the amount of water required per flush. This combined with hands-free flush technology will increase hygiene and judicious use of water.

Greywater integration is a great way to further optimize water conservation. By reusing waste water generated from streams without fecal contamination i.e. waste water from sinks, showers, baths, washing machines or dish washers we can reduce usage of city water for applications such as toilet flushes and landscape irrigation that do not have any particulate matter requirements.

This would require source separation which is a common principle in ecological sanitation approaches. A small-scale treatment plant similar to sewage treatment facilities will be required to reduce pathogen level in incoming greywater before it is supplied for toilet flushes.
Compact biological systems such as membrane bioreactors or mechanical systems based on UV filtration or sand filtration can be used to prepare incoming greywater for reuse.

Classic rainwater harvesting using rainwater barrels is an effective way to collect rainwater for irrigation and greywater applications.

Combining such energy efficient measures with an informative and inspiring campaign to improve user behavior especially in residence halls will affect equipment operations thereby amplifying water savings.

[11] https://orbital-systems.com/product/

Informing students, faculty and other personnel regarding the different initiatives taken and why they were taken is a good way to let the movement gain traction. Digital means of communication, for example – a dynamic display showing gallons of water saved per shower/sink use or having WaterSense[12] labels on fixtures will encourage environmentally friendly behavior and sustain user engagement.

Yeshiva should also focus on their buildings' HVAC systems for additional high impact water conservation opportunities which are generally overlooked. For example, replacing water-cooled chillers with air-cooled chillers will eliminate the need for a cooling tower which is a major consumer of water. Water-to-water chiller/heat pumps can also be installed to dump chiller heat into the plant's heating system instead of the cooling tower.

In cases where the chiller cannot be replaced, the existing cooling tower operations can be optimized to save water. There are several ways to do this. Increasing the number of cycles of concentration (COC[13]) from 2-4 cycles to 6-8 by reducing (treating) the make-up water's mineral content through chemical free side-stream filtration technology is an effective method. Installation of flow meters and conductivity meters can help track the ratio and meet the target cycles of concentration. This can reduce cooling tower blowdown by 50% and reduce use of makeup water by 20%. Using other methods such as acid treatment to reduce the pH of the recirculated water to prevent scale formation is effective. Installing covers on open distribution decks on top of these towers can reduce the amount of sunlight hitting these surfaces. This will slow bio-film formation and algae growth. Float control equipment need to be checked to ensure correct basin levels are maintained and no leaks exist.

Please check with the water utility if it provides sewer credits for evaporative losses which can be measured as the difference between make-up water minus metered blowdown water.

Focusing on the water distribution system of the building is also necessary. For example, reducing a primary/secondary pumping set to a primary variable by considering some piping rework can show substantial savings. This reduces energy used for water transportation by the building system which essentially reduces the water used. Some measures targeting these buildings' HVAC systems have been proposed in the ECM package detailed in the audit reports attached to this plan.

Additionally, water can be reused from these HVAC systems for greywater applications mentioned above. Air-handler condensate is particularly appropriate for reuse due to its low mineral content.

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[12] EPA WaterSense program - https://www.epa.gov/watersense

[13] Cycles of Concentration (COC) = blowdown concentration/makeup water concentration

Keeping all these potential measures for water conservation in mind, the New York Department of Environmental Protection has made extensive efforts to manage the increasing demand for water through several programs[14]. A few of these programs that Yeshiva could explore and take advantage of are the Municipal Water Efficiency Program, New York City Water Challenge to Universities and the On-site Water Reuse Grant Pilot Program.

[14] https://www1.nyc.gov/html/dep/html/ways_to_save_water/index.shtml

Conclusions

Yeshiva University has a wide range of past, present, and potentially future sustainability initiatives across its campus. This report undertook to serve as a touchpoint in cooperation with the individual building audits and energy master plan also performed under the NYSERDA REV Campus Challenge scope.

While the majority of Yeshiva's GHG emissions come from its buildings, and the greatest reductions may be achieved through improvements in this sphere, there are a number of other opportunities for Yeshiva to have an impact on the behavior of students and faculty during their time at the University and hopefully beyond. Setting sustainability goals at a higher University level will help provide opportunities and framework for students to more carefully consider their transportation habits, water usage, and waste generation. By implementing the suggested solutions/strategies outlined in this report, we anticipate Yeshiva University's overall emissions would reduce approximately 28%.

This report benefitted from more complete and current baseline information regarding building energy and water usage. We strongly suggest collecting additional baseline data especially regarding waste and transportation to assist in setting more specific sustainability goals for Yeshiva University in the future. Tools such as SIMAP and STARS may help provide useful frameworks for collecting and analyzing this data moving forward.

Appendix A – STARS Scoring Checklist

Yeshiva University - STARS 2.1 Scoring

Sustainability Measures					2014 Yeshiva Score		2018 Yeshiva Score	
Category	Subcategory	Credit Number and Title		Points available	Measure in place as of 2014	Points to Yeshiva	Measure in place as of May 2018?	Points to Yeshiva
	Institutional Characteristics	IC 1	Institutional Boundary	Required	N/A	0	N/A	N/A
		IC 2	Operational Characteristics	Required	N/A	0	N/A	N/A
		IC 3	Academics and Demographics	Required	N/A	0	N/A	N/A
Academics (AC)	Curriculum	AC 1	Academic Courses	14	Y	14	Y	14
		AC 2	Learning Outcomes*	8	N	0	N	0
		AC 3	Undergraduate Program*	3	N	0	N	0
		AC 4	Graduate Program*	3	N	0	N	0
		AC 5	Immersive Experience*	2	N	0	N	0
		AC 6	Sustainability Literacy Assessment	4	Y	4	Y	4
		AC 7	Incentives for Developing Courses	2	N	0	N	0
		AC 8	Campus as a Living Laboratory*	4	N	0	N	0
	Research	AC 9	Research and Scholarship*	12	N	0	N	0
		AC 10	Support for Research*	4	N	0	N	0
		AC 11	Open Access to Research*	2	N	0	N	0
Engagement (EN)	Campus Engagement	EN 1	Student Educators Program*	4	Y	4	Y	4
		EN 2	Student Orientation*	2	Y	2	Y	2
		EN 3	Student Life	2	N	0	N	0
		EN 4	Outreach Materials and Publications	2	Y	2	Y	2
		EN 5	Outreach Campaign	4	Y	4	Y	4
		EN 6	Assessing Sustainability Culture	1	N	0	N	0
		EN 7	Employee Educators Program	3	Y	3	Y	3
		EN 8	Employee Orientation	1	Y	1	Y	1
		EN 9	Staff Professional Development	2	Y	2	Y	2
	Public Engagement	EN 10	Community Partnerships	3	Y	3	Y	3
		EN 11	Inter-Campus Collaboration	3	Y	3	Y	3
		EN 12	Continuing Education*	5	N/A	0	N/A	0
		EN 13	Community Service*	5	Y	5	Y	5
		EN 14	Participation in Public Policy	2	N	0	Y	2
		EN 15	Trademark Licensing*	2	N	0	N	0

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Operations (OP)	Air & Climate	OP 1	Greenhouse Gas Emissions	10	Y	10	Y	10
		OP 2	Outdoor Air Quality	1	N	0	N	0
	Buildings	OP 3	Building Operations and Maintenance*	5	N	0	N	0
		OP 4	Building Design and Construction*	3	N	0	N	0
	Energy	OP 5	Building Energy Consumption	6	Y	6	Y	6
		OP 6	Clean and Renewable Energy	4	N	0	N	0
	Food & Dining	OP 7	Food and Beverage Purchasing*	6	Y	6	Y	6
		OP 8	Sustainable Dining*	2	N	0	N	0
	Grounds	OP 9	Landscape Management*	2	N	0	N	0
		OP 10	Biodiversity*	2	N	0	N	0
	Purchasing	OP 11	Sustainable Procurement	3	N	0	N	0
		OP 12	Electronics Purchasing	1	Y	1	Y	1
		OP 13	Cleaning and Janitorial Purchasing	1	Y	1	Y	1
		OP 14	Office Paper Purchasing	1	Y	1	Y	1
	Transportation	OP 15	Campus Fleet*	1	Y	1	Y	1
		OP 16	Student Commute Modal Split*	2	Y	2	Y	2
		OP 17	Employee Commute Modal Split	2	Y	2	Y	2
		OP 18	Support for Sustainable Transportation	2	N	0	N	0
	Waste	OP 19	Waste Minimization and Diversion	8	Y	8	Y	8
		OP 20	Construction and Demolition Waste Diversion	1	N/A	0	N/A	0
		OP 21	Hazardous Waste Management	1	Y	1	Y	1
	Water	OP 22	Water Use	6	N	0	Y	6
		OP 23	Rainwater Management	2	N	0	N	0

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Planning & Administration (PA)	Coordination & Planning	PA 1	Sustainability Coordination	1	Y	1	Y	1
		PA 2	Sustainability Planning	4	N	0	Y	4
		PA 3	Participatory Governance	3	N	0	Y	3
	Diversity & Affordability	PA 4	Diversity and Equity Coordination	2	Y	2	Y	2
		PA 5	Assessing Diversity and Equity	1	Y	1	Y	1
		PA 6	Support for Underrepresented Groups	3	Y	3	Y	3
		PA 7	Affordability and Access	4	N	0	Y	4
	Investment & Finance	PA 8	Committee on Investor Responsibility*	2	N/A	0	N/A	0
		PA 9	Sustainable Investment*	4	N/A	0	N/A	0
		PA 10	Investment Disclosure*	1	N/A	0	N/A	0
	Wellbeing & Work	PA 11	Employee Compensation	3	Y	3	Y	3
		PA 12	Assessing Employee Satisfaction	1	Y	1	Y	1
		PA 13	Wellness Program	1	N	0	Y	1
		PA 14	Workplace Health and Safety	2	N	0	Y	2

Subtotal				**182**		**97**		**119**
%				**100%**		**53%**		**65%**

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Appendix B – Calculations and Assumptions

***Automobile Efficiency**:*

The miles per gallon (mpg) of personal vehicles is the average mpg of all cars (sedans, wagons, car SUVs) over the last 8 years, the average life expectancy of a car. The mpg values come from the EPA.

***Bus Fuel Efficiency**:*

The number of passenger miles by bus was recorded using 2017 data from the Metropolitan Transportation Authority (MTA). That number was divided by the sum of gallons of diesel and natural gas used annually for the MTA New York City Transit buses and the MTA Bus Company. These values came from 2017 data from the Federal Transit Administration.

Light Rail Efficiency

The number of passenger miles by subway was recorded using 2017 data from the Metropolitan Transportation Authority (MTA). That number was divided by the sum of kilowatt-hours used annually for the MTA New York City subway. These values came from 2017 data from the Federal Transit Administration.

Commuter Rail Efficiency

The number of passenger miles by subway was recorded using 2017 data from the Metropolitan Transportation Authority (MTA).

The commuter rail uses both diesel and electricity. To calculate the diesel efficiency, the number of passenger miles was multiplied by 0.04, since only 4% of miles traveled by the commuter rail are powered by diesel. Then that value was divided by the sum of gallons of diesel and natural gas used annually for the Metro North Commuter Railroad Company and the Long Island Rail Road.

To calculate the electric efficiency, the number of passenger miles was multiplied by 0.96. Then that value was divided by the sum of kilowatt-hours used annually for the Metro North Commuter Railroad Company and the Long Island Rail Road. These values came from 2017 data from the Federal Transit Administration.

Appendix C – Specific Technology Recommendations

Electric Shuttle Bus – Ford e450
https://lightningsystems.com/ford-e450-shuttle-bus

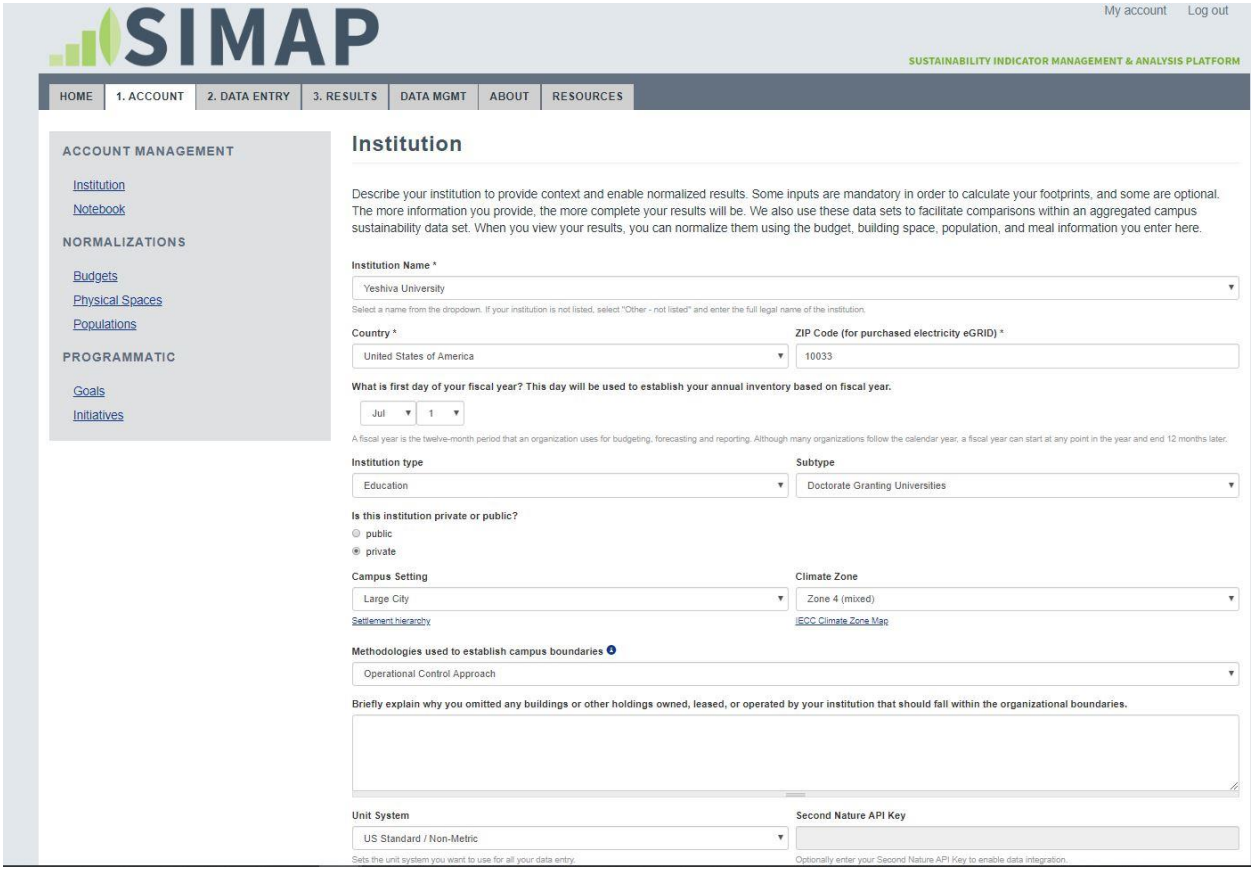
Composting – Earth Flow Custom Vessel
https://compostingtechnology.com/in-vessel-composting-systems/earth-flow-custom-vessel/#1460580994335-67416e0c-6d474ef9-6f3b

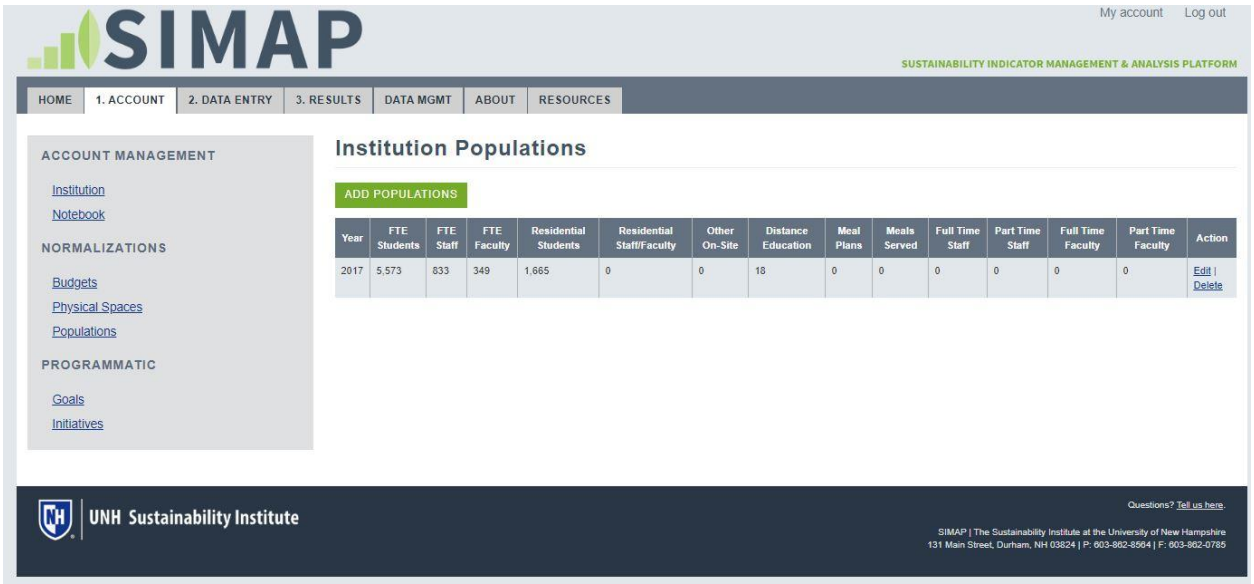
Composting – Earth Cube
https://compostingtechnology.com/in-vessel-composting-systems/earth-cube/#1447187556584-88c9da4a-2d6d

Composting – Vokashi Buckets
https://vokashi.com/

Water – Orbital Shower Fixtures
https://orbital-systems.com/product/

Appendix D – SIMAP Tool: Inputs and Results





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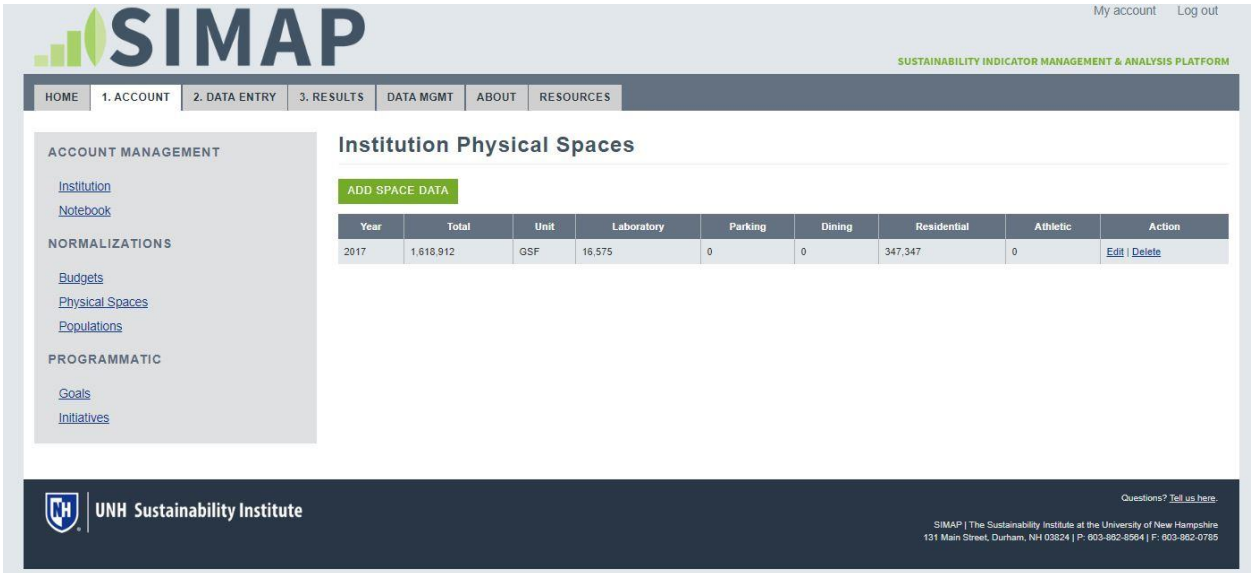
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2. DATA ENTRY
3. RESULTS
DATA MGMT
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RESOURCES
ACCOUNT MANAGEMENT
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NORMALIZATIONS
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Physical Spaces
Populations
PROGRAMMATIC
Goals
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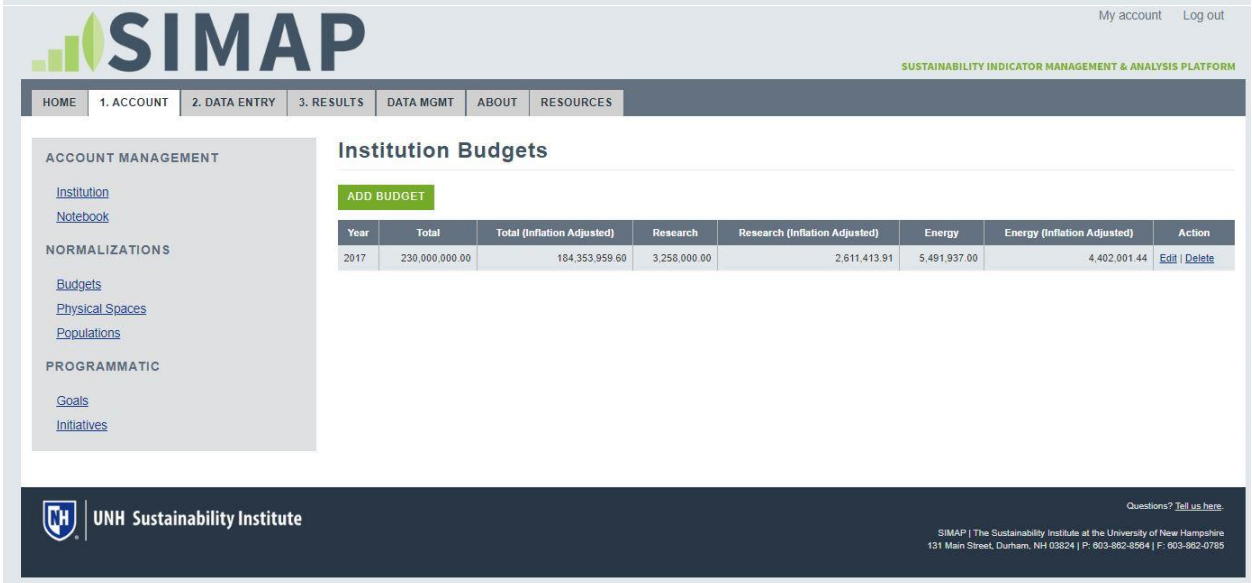
Institution Physical Spaces
ADD SPACE DATA
Year | Total | Unit | Laboratory | Parking | Dining | Residential | Athletic | Action
2017 | 1,618,912 | GSF | 16,575 | 0 | 0 | 347,347 | 0 | Edit | Delete
UNH Sustainability Institute
Questions? Tell us here.
SIMAP | The Sustainability Institute at the University of New Hampshire
131 Main Street, Durham, NH 03824 | P: 603-862-8564 | F: 603-862-0785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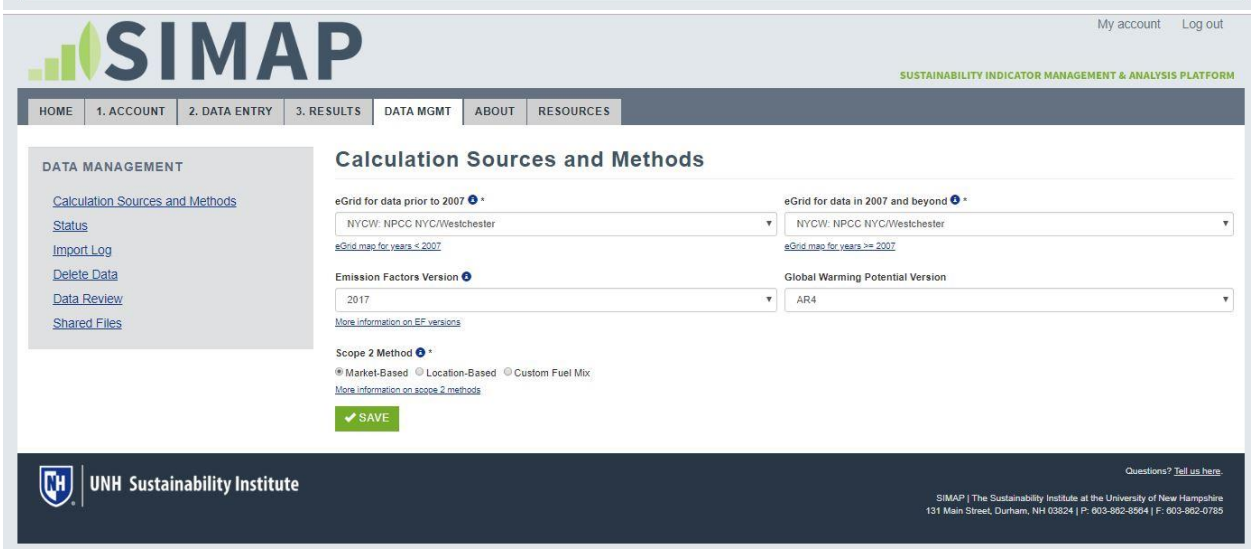
Budgets
Physical Spaces
Populations
PROGRAMMATIC
Goals
Initiatives
Institution Budgets
ADD BUDGET
Year | Total | Total (Inflation Adjusted) | Research | Research (Inflation Adjusted) | Energy | Energy (Inflation Adjusted) | Action
2017 | 230,000,000.00 | 184,353,959.60 | 3,258,000.00 | 2,611,413.91 | 5,491,937.00 | 4,402,001.44 | Edit | Delete
UNH Sustainability Institute
Questions? Tell us here.
SIMAP | The Sustainability Institute at the University of New Hampshire
131 Main Street, Durham, NH 03824 | P: 603-862-8564 | F: 603-862-0785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Import Log
Delete Data
Data Review
Shared Files
Calculation Sources and Methods
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NYCW: NPCC NYC/Westchester
eGrid map for years < 2007
eGrid for data in 2007 and beyond *
NYCW: NPCC NYC/Westchester
eGrid map for years >= 2007
Emission Factors Version
2017
More information on EF versions
Global Warming Potential Version
AR4
Scope 2 Method *
Market-Based
Location-Based
Custom Fuel Mix
More information on scope 2 methods
SAVE
UNH Sustainability Institute
Questions? Tell us here.
SIMAP | The Sustainability Institute at the University of New Hampshire
131 Main Street, Durham, NH 03824 | P: 603-862-8564 | F: 603-862-0785

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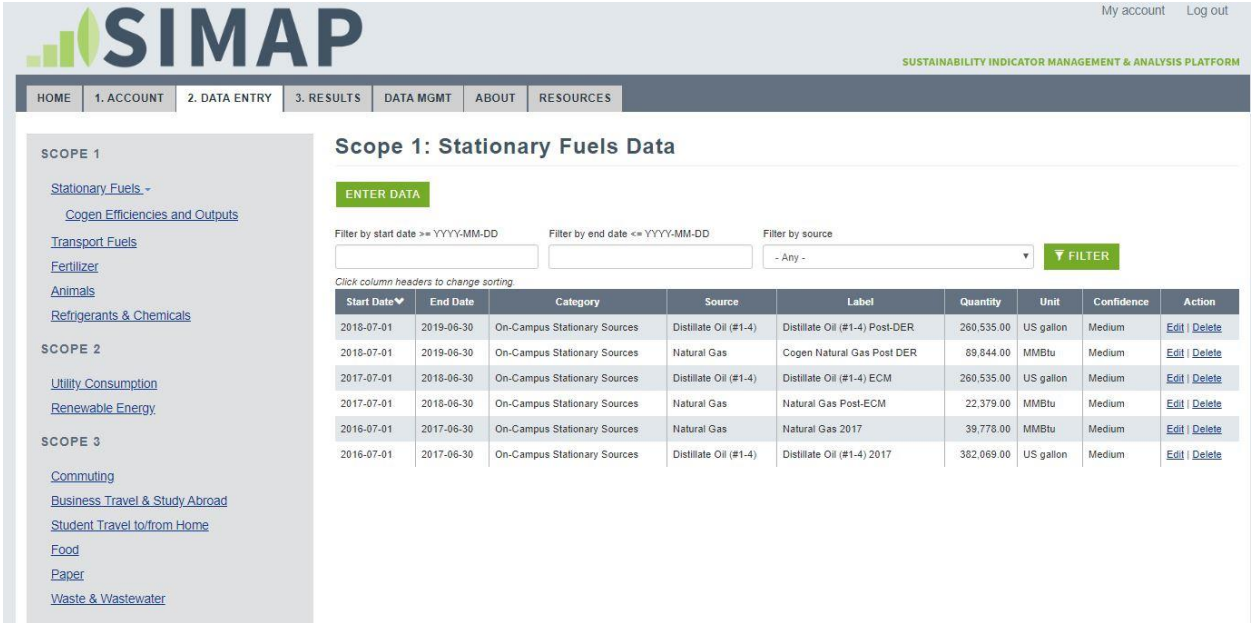
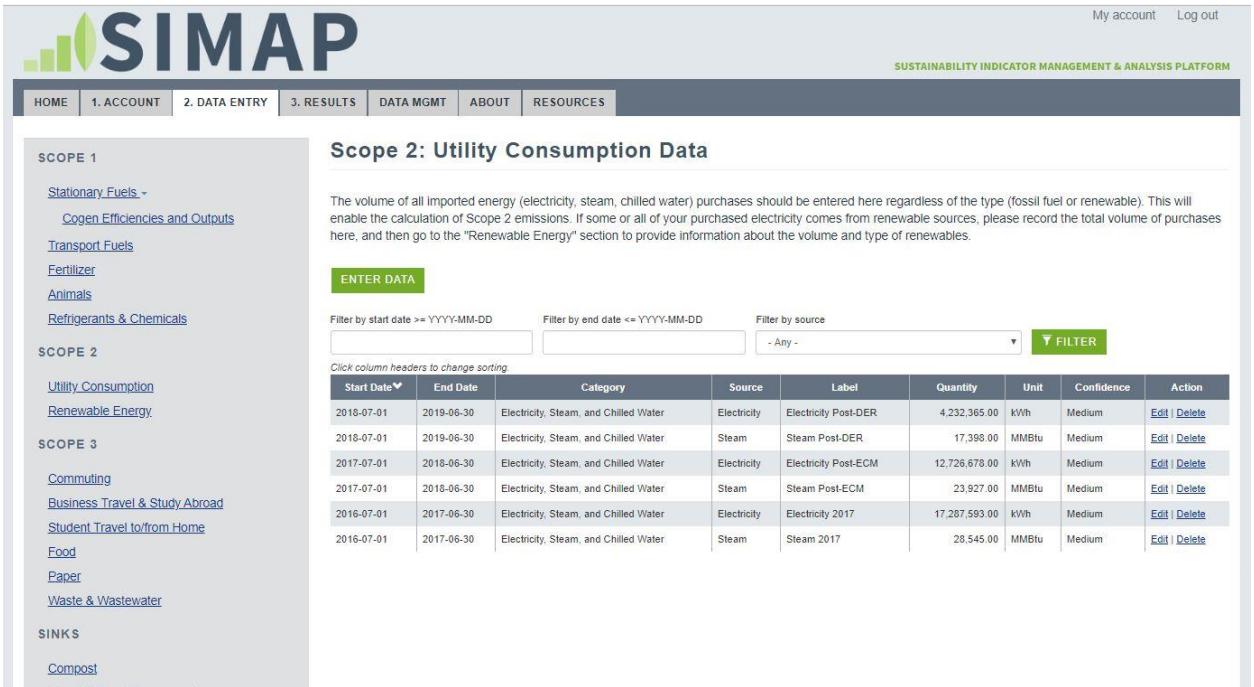


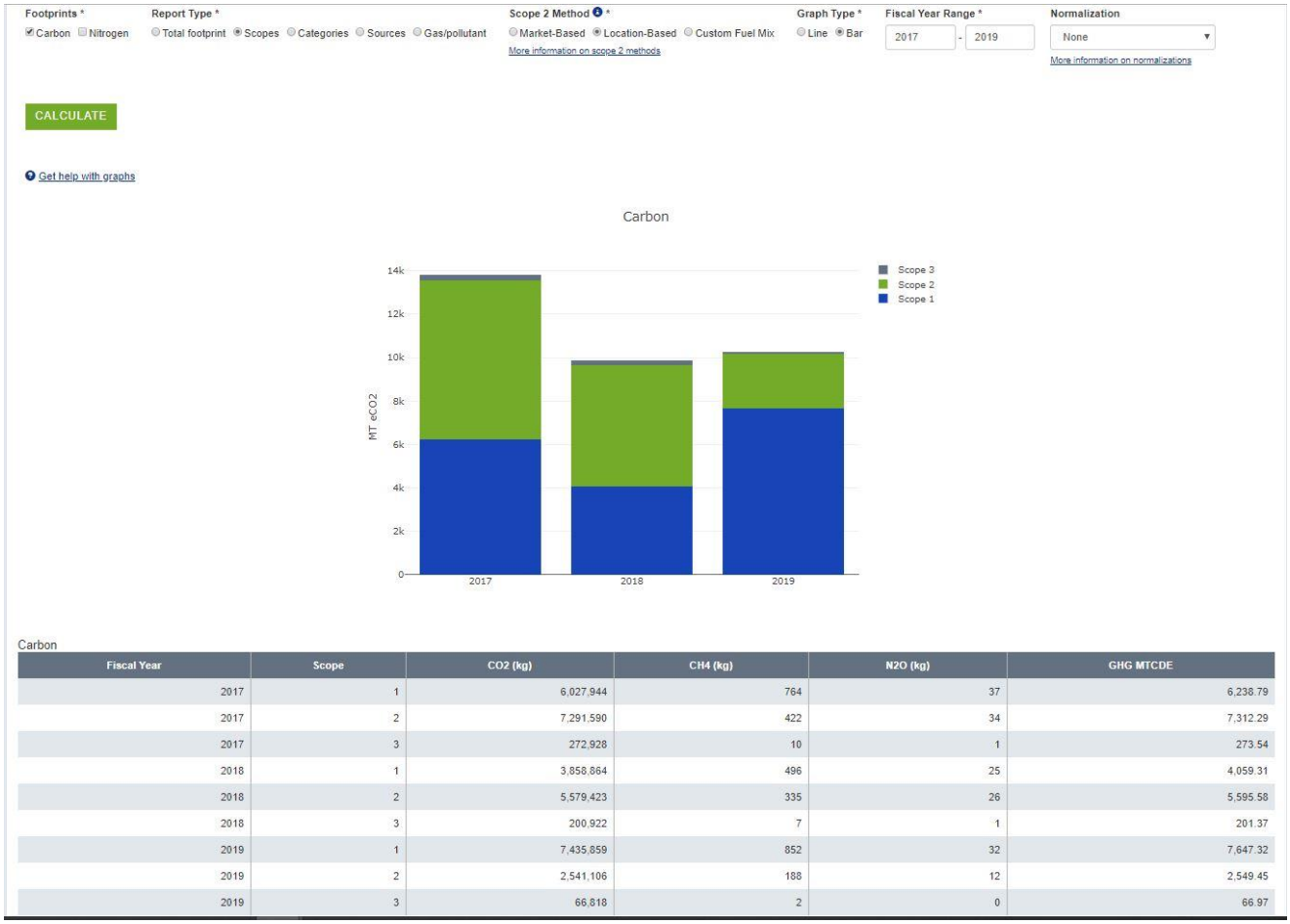
Start Date	End Date	Category	Source	Label	Quantity	Unit	Confidence	Action
2018-07-01	2019-06-30	On-Campus Stationary Sources	Distillate Oil (#1-4)	Distillate Oil (#1-4) Post-DER	260,535.00	US gallon	Medium	Edit | Delete
2018-07-01	2019-06-30	On-Campus Stationary Sources	Natural Gas	Cogen Natural Gas Post DER	89,844.00	MMBtu	Medium	Edit | Delete
2017-07-01	2018-06-30	On-Campus Stationary Sources	Distillate Oil (#1-4)	Distillate Oil (#1-4) ECM	260,535.00	US gallon	Medium	Edit | Delete
2017-07-01	2018-06-30	On-Campus Stationary Sources	Natural Gas	Natural Gas Post-ECM	22,379.00	MMBtu	Medium	Edit | Delete
2016-07-01	2017-06-30	On-Campus Stationary Sources	Natural Gas	Natural Gas 2017	39,778.00	MMBtu	Medium	Edit | Delete
2016-07-01	2017-06-30	On-Campus Stationary Sources	Distillate Oil (#1-4)	Distillate Oil (#1-4) 2017	382,069.00	US gallon	Medium	Edit | Delete



Start Date	End Date	Category	Source	Label	Quantity	Unit	Confidence	Action
2018-07-01	2019-06-30	Electricity, Steam, and Chilled Water	Electricity	Electricity Post-DER	4,232,365.00	kWh	Medium	Edit | Delete
2018-07-01	2019-06-30	Electricity, Steam, and Chilled Water	Steam	Steam Post-DER	17,398.00	MMBtu	Medium	Edit | Delete
2017-07-01	2018-06-30	Electricity, Steam, and Chilled Water	Electricity	Electricity Post-ECM	12,726,678.00	kWh	Medium	Edit | Delete
2017-07-01	2018-06-30	Electricity, Steam, and Chilled Water	Steam	Steam Post-ECM	23,927.00	MMBtu	Medium	Edit | Delete
2016-07-01	2017-06-30	Electricity, Steam, and Chilled Water	Electricity	Electricity 2017	17,287,593.00	kWh	Medium	Edit | Delete
2016-07-01	2017-06-30	Electricity, Steam, and Chilled Water	Steam	Steam 2017	28,545.00	MMBtu	Medium	Edit | Delete

ALTANOVA

Carbon by Scope



Carbon

Fiscal Year	Scope	CO2 (kg)	CH4 (kg)	N2O (kg)	GHG MTCDE
2017	1	6,027,944	764	37	6,238.79
2017	2	7,291,590	422	34	7,312.29
2017	3	272,928	10	1	273.54
2018	1	3,858,864	496	25	4,059.31
2018	2	5,579,423	335	26	5,595.58
2018	3	200,922	7	1	201.37
2019	1	7,435,859	852	32	7,647.32
2019	2	2,541,106	188	12	2,549.45
2019	3	66,818	2	0	66.97

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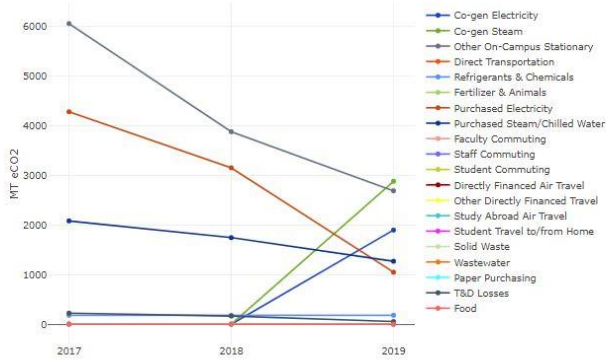
Carbon by Category



Carbon

Fiscal Year	Scope	Source	CO2 (kg)	CO2 (MTCDE)	CH4 (kg)	CH4 (MTCDE)	N2O (kg)	N2O (MTCDE)	GHG MTCDE
2017	1	Other On-Campus Stationary	6,027,944	6,027.94	764	19.10	37	11.16	6,058.20
2017	1	Refrigerants & Chemicals	0	0.00	0	0.00	0	0.00	180.59
2017	2	Purchased Electricity	4,269,309	4,269.31	191	4.78	23	6.94	4,281.03
2017	2	Purchased Steam / Chilled Water	2,073,015	2,073.02	231	5.79	11	3.20	2,082.00
2017	3	T&D Losses	223,282	223.28	10	0.25	1	0.36	223.89
2018	1	Other On-Campus Stationary	3,858,864	3,858.86	496	12.40	25	7.46	3,878.72
2018	1	Refrigerants & Chemicals	0	0.00	0	0.00	0	0.00	180.59
2018	2	Purchased Electricity	3,142,955	3,142.95	141	3.52	17	5.11	3,151.58
2018	2	Purchased Steam / Chilled Water	1,737,643	1,737.64	194	4.85	9	2.68	1,745.17
2018	3	T&D Losses	164,374	164.37	7	0.18	1	0.27	164.83
2019	1	Co-gen Electricity	1,891,928	1,891.93	188	4.71	4	1.12	1,897.76
2019	1	Co-gen Steam	2,871,601	2,871.60	286	7.14	6	1.70	2,880.45
2019	1	Other On-Campus Stationary	2,672,330	2,672.33	378	9.45	23	6.75	2,688.53
2019	1	Refrigerants & Chemicals	0	0.00	0	0.00	0	0.00	180.59
2019	2	Purchased Electricity	1,045,216	1,045.22	47	1.17	6	1.70	1,048.09
2019	2	Purchased Steam / Chilled Water	1,263,490	1,263.49	141	3.53	7	1.95	1,268.96
2019	3	T&D Losses	54,664	54.66	2	0.06	0	0.09	54.81

ALTANOVA

Carbon by Source

SIMAP

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3. Results

Footprints * ☑ Carbon ☐ Nitrogen

Report Type * ○ Total footprint ○ Scopes ○ Categories ◉ Sources ○ Gas/pollutant

Scope 2 Method * ◉ Market-Based ○ Location-Based ○ Custom Fuel Mix
More information on scope 2 methods

Graph Type * ◉ Line ○ Bar

Fiscal Year Range * 2017 - 2019

Normalization None
More information on normalizations

CALCULATE

Carbon

Fiscal Year	Scope	Source	Quantity	Unit	CO2 (kg)	CO2 (MTCDE)	Biogenic (MTCDE)	CH4 (kg)	CH4 (MTCDE)	N2O (kg)	N2O (MTCDE)	GHG MTCDE
2017	1	On-Campus Stationary Sources: Distillate Oil (#1-4)	382,069	US gallon	3,918,914	3,918.91	0.00	554	13.85	33	9.91	3,942.67
2017	1	On-Campus Stationary Sources: Natural Gas	39,778	MMBtu	2,109,030	2,109.03	0.00	210	5.25	4	1.25	2,115.53
2017	1	Refrigerants & Chemicals: Other	173,047	kilogram	0	0.00	0.00	0	0.00	0	0.00	180.59
2017	2	Electricity, Steam, and Chilled Water: Electricity	17,287,593	kWh	4,269,309	4,269.31	0.00	191	4.78	23	6.94	4,281.03
2017	2	Electricity, Steam, and Chilled Water: Steam	28,545	MMBtu	2,073,015	2,073.02	0.00	231	5.79	11	3.20	2,082.00
2017	3	Electricity, Steam, and Chilled Water: T&D Losses	17,287,593	kWh	223,282	223.28	0.00	10	0.25	1	0.36	223.89
2018	1	On-Campus Stationary Sources: Distillate Oil (#1-4)	260,535	US gallon	2,672,330	2,672.33	0.00	378	9.45	23	6.75	2,688.53
2018	1	On-Campus Stationary Sources: Natural Gas	22,379	MMBtu	1,186,535	1,186.53	0.00	118	2.95	2	0.70	1,190.19
2018	1	Refrigerants & Chemicals: Other	173,047	kilogram	0	0.00	0.00	0	0.00	0	0.00	180.59
2018	2	Electricity, Steam, and Chilled Water: Electricity	12,726,678	kWh	3,142,955	3,142.95	0.00	141	3.52	17	5.11	3,151.58
2018	2	Electricity, Steam, and Chilled Water: Steam	23,927	MMBtu	1,737,643	1,737.64	0.00	194	4.85	9	2.68	1,745.17
2018	3	Electricity, Steam, and Chilled Water: T&D Losses	12,726,678	kWh	164,374	164.37	0.00	7	0.18	1	0.27	164.83
2019	1	On-Campus Stationary Sources: Distillate Oil (#1-4)	260,535	US gallon	2,672,330	2,672.33	0.00	378	9.45	23	6.75	2,688.53
2019	1	Cogeneration: Natural Gas	89,844	MMBtu	4,763,529	4,763.53	0.00	474	11.85	9	2.82	4,778.20
2019	1	Refrigerants & Chemicals: Other	173,047	kilogram	0	0.00	0.00	0	0.00	0	0.00	180.59
2019	2	Electricity, Steam, and Chilled Water: Electricity	4,232,365	kWh	1,045,216	1,045.22	0.00	47	1.17	6	1.70	1,048.09
2019	2	Electricity, Steam, and Chilled Water: Steam	17,398	MMBtu	1,263,490	1,263.49	0.00	141	3.53	7	1.95	1,268.96
2019	3	Electricity, Steam, and Chilled Water: T&D Losses	4,232,365	kWh	54,664	54.66	0.00	2	0.06	0	0.09	54.81

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Appendix E – Impact of Local Law 97 (Emissions Limits) on Yeshiva University Portfolio

	Baseline			After ECMs & RCx			After ECMs & RCx & DER		
Building	**Emissions (Tons CO2e /SF)**	**2024 LL97 Fines ($)**	**2030 LL97 Fines ($)**	**Emissions (Tons CO2e /SF)**	**2024 LL97 Fines ($)**	**2030 LL97 Fines ($)**	**Emissions (Tons CO2e /SF)**	**2024 LL97 Fines ($)**	**2030 LL97 Fines ($)**
Furst Hall	0.00693	-	77,394	0.00549	-	36,673	0.00590	-	48,095
Glueck Education Center	0.00758	-	54,080	0.00614	-	31,090	0.00655	-	37,538
Gottesman Library	0.01124	18,834	264,670	0.00982	-	211,206	0.01022	-	226,363
Schottenstein Hall	0.00707	-	53,688	0.00563	-	26,784	0.00603	-	34,331
Zysman / Muss Halls	0.00745	-	133,143	0.00601	-	74,240	0.00642	-	90,761
Belfer Hall	0.00829	-	278,262	0.00449	-	19,771	0.00526	-	72,446
Cardozo Hall	0.00723	-	147,554	0.00653	-	113,419	0.00728	-	149,697
Rubin Hall / MSAC	0.01020	-	192,189	0.00631	-	67,657	0.00709	-	92,455
Stanton Hall	0.00830	-	82,950	0.00627	-	41,810	0.00770	-	70,843
Stern College	0.01294	19,307	76,745	0.01227	13,400	70,838	0.01370	26,000	83,438
35th St. Hall	0.00304	-	-	0.00304	-	-	0.00304	-	-
36th St. Hall	0.00686	-	14,335	0.00686	-	14,335	0.00686	-	14,335
215 Lexington Ave.	0.00141	-	-	0.00141	-	-	0.00141	-	-
Brookdale Center	0.00365	-	-	0.00365	-	-	0.00365	-	-
Morgenstern Hall	0.00714	-	56,815	0.00714	-	56,815	0.00714	-	56,815
Schottenstein Center	0.00210	-	-	0.00210	-	-	0.00210	-	-
Total	**-**	**38,140**	**1,431,825**	**-**	**13,400**	**764,636**	**-**	**26,000**	**977,117**

Property Type	**2024-2029 CO2 Emissions Limits (Metric Tons CO2e/SF)**	**2030-2034 CO2 Emissions Limits (Metric Tons CO2e/SF)**
College/University	0.01074	0.00420
Residence Hall /Dormitory	0.00987	0.00526

Overview of Local Law 97

On May 19, 2019, a series of groundbreaking bills were passed by the New York City Council, collectively known as the Climate Mobilization Act, compelling NYC building owners to combat global warming. Local Law 97 of 2019 (LL97) is the centerpiece of the Act and sets forth annual building emissions limits that effectively require large building owners (>25,000 SF) to reduce greenhouse gas (carbon) emissions. The City aims to decrease carbon emissions 40% citywide by 2030 and 80% by 2050 by using LL97 to target the worst carbon-intensive buildings.

LL97 establishes two compliance periods: 2024-2029 and 2030-2034. Buildings must comply with the initial emissions limit by January 1, 2024, with the first compliance report is due by May 1, 2025 (with filings due on May 1 of every year thereafter). The compliance report must be filed online, certified by a "registered design professional," and state that either: (a) the building was in compliance for the previous calendar year or (b) the building was not in compliance for the previous calendar year and list the amount by which the building exceeds such limit.
The maximum fine for noncompliance is the difference between the actual annual building emissions and the annual building emissions limit (as measured in metric tons), multiplied by $268. This formula is designed to be an extremely steep fine to compel an owner to comply.

Assumptions in Calculating Yeshiva University Emissions

GHG Accounting
The GHG emissions accounting system used for assessing LL97 compliance uses different emissions factors (measure of carbon per unit of energy source) than the EPA eGrid values used in Yeshiva University's existing SIMAP platform. The main difference between the systems is the relatively "cleaner" values assigned to both electricity and district steam in the LL97 system. In all other sections of this report, we have used the EPA's accounting system to calculate emissions in line with Yeshiva's SIMAP reporting.

Energy Source	LL97 Emissions Factors		EPA eGrid Emissions Facors	
Electricity	0.00028896	mtCO2e/kWh	0.00048158	mtCO2e/kWh
Natural Gas	0.00005311	mtCO2e/kBtu	0.00005300	mtCO2e/kBtu
Oil #4	0.00007529	mtCO2e/kBtu	0.00001096	mtCO2e/kBtu
District Steam	0.00004493	mtCO2e/kBtu	0.00006633	mtCO2e/kBtu

Distribution of Savings from Grouped ECMs and DERs
In the case of recommended ECMs and DERs shared between buildings (e.g. a CHP system covering both Belfer Hall and Rubin Hall), we have distributed the energy savings proportionally to the size of each building, in order to assess LL97 compliance for each building individually.
Compliance Outlook for Yeshiva University
Although Yeshiva University will have to adhere to new standards of energy reporting, the portfolio will be minimally affected financially by Local Law 97 during the 2024-2029 compliance.

However, the portfolio will be liable for approximately $1.4M in annual fines between 2030-2034 if energy consumption does not change materially. This represents an equivalent increase of over 30% from the current annual energy expenditure. If our complete suite of energy efficiency (ECM +RCx) recommendations are implemented, this liability will be reduced by around 50% to approximately $735,000 per year.

If our on-site generation and storage (DER) recommendations are implemented in addition to the energy efficiency measures, the compliance liability will increase to approximately $1M. This is due to the increased level of natural gas used by the CHP systems in order to provide cost-effective and resilient energy. However, cost savings from CHP implementation far exceed this increase in LL97 fines, as explained in the main body of this report.

Fines will continue to increase from 2035 onwards but have yet to be agreed on by the city council.

Potential Deductions and Adjustments

The fines outlined above can be reduced or avoided by decreasing building energy consumption further. However, in addition to traditional retrofits, an owner may reduce its emissions by (1) purchasing greenhouse gas offsets; (2) purchasing renewable energy credits ("RECs"); or (3) using clean distributed energy resources (i.e., generating or storing clean energy) located at the building.

Due to the cost-effective nature of purchasing offsets, the City Council purposely limited this deduction to only 10% of a NYC building's emissions limit. Offset deductions are also only authorized for calendar years 2024 through 2029, so an owner cannot rely upon this for very long.

Yeshiva University can also purchase RECs to reduce emissions, as long as they are produced within the NYC grid. There is no limitation on how many RECs can be purchased so theoretically the university can deduct 100% of their annual emissions limit. There is also no time limit on REC deductions.

Yeshiva University should also explore the final deduction option for clean distributed energy resources (i.e. rooftop solar panels) although the law currently limits this deduction method to calendar years 2024 through 2029.

Adjustments to the emissions limit may be granted for landmarked buildings, buildings under financial hardship or buildings with special circumstances, exceeding emissions limits by over 40%. Several Yeshiva University buildings may qualify for adjustments in the 2030-2034 compliance period, however rules have yet to be established concerning adjustment levels and application process.

Carbon Trading Program

The law tasks the mayor's office to study and develop an implementation plan for carbon trading by January 1, 2021. Carbon trading rests on the premise one building's excess emissions capacity may be "traded" to another in order for both buildings to comply.

As the majority of the Yeshiva University portfolio will be under the 2024-2029 limits, this presents an exciting opportunity for the university to profit from its energy efficiency success. It will also positively impact the economic analysis of recommended energy efficiency measures by shortening the expected payback period.

Conclusion and Recommended Next Steps

We believe Yeshiva University to be in a satisfactory position for the 2024-2029 Local Law 97 compliance period. In the lead up to the first reporting deadline in May 2025, a strategy should be developed to assign responsibility for compliance management, ensure accurate reporting capabilities, and extract maximum value from the yet-to-be-announced Carbon Trading program.

However, we believe significant action must be taken to prevent significant financial penalties during the more stringent 2030-2034 compliance period. Several years prior to start of the compliance period, an assessment should be made, once the compliance regulations are fully established, on the optimal compliance strategy between energy efficiency measures, REC purchasing and Carbon Trading.