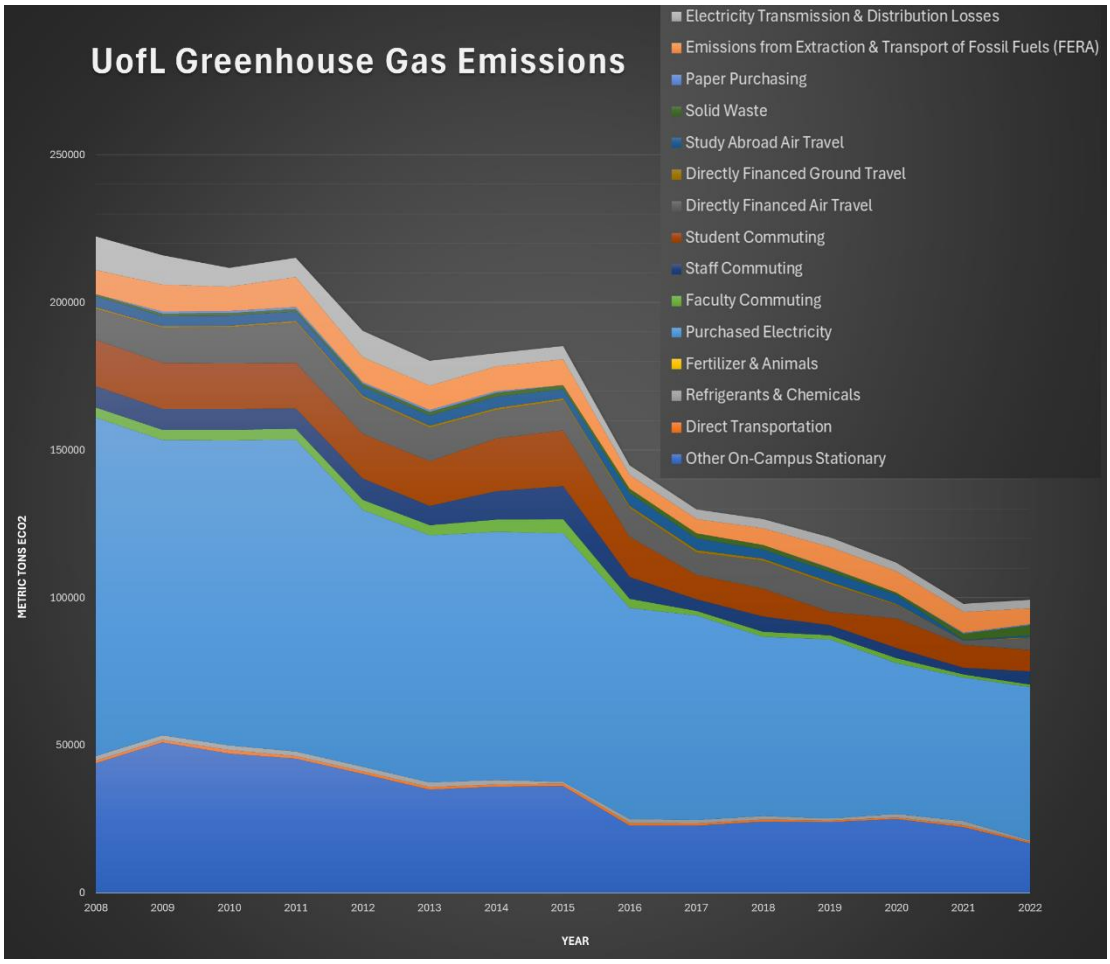
UNIVERSITY OF LOUISVILLE



GREENHOUSE GAS EMISSIONS INVENTORY 2008 – 2022

This work supports our CARDINAL principles:
Community of Care, Accountability, Integrity & Transparency, Noble Purpose, Agility, and Leadership.

UofL Sustainability

Commitment to a Sustainable Future.

louisville.edu/sustainability

ACKNOWLEDGEMENTS

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Data-Analysis Instruments:
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UNH Campus Carbon Calculator v8.0

Report Prepared For:
Carbon Commitment (formerly American College & University Presidents' Climate Commitment)

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EXECUTIVE SUMMARY

This report documents the progress the University of Louisville (UofL) has made in reducing our greenhouse gas (GHG) emissions, even as the university grows. Efforts to implement our Climate Action Plan (CAP) are continuing to yield results as we navigate changes wrought by the COVID-19 pandemic and changes in university leadership.

In the current reporting year, UofL took the opportunity to change our carbon accounting and reporting platform, transitioning from the no longer supported UNH Campus Carbon Calculator to the online Sustainability Indicator Management and Analysis Platform (SIMAP), in line with our Carbon Commitment, as managed by Second Nature. The shift to SIMAP offers enhanced data transparency, both carbon and nitrogen accounting, and improved tracking and strategizing for emissions reduction. As a part of this transition, however, we wanted to be sure we weren't radically altering our estimates, so we conducted this analysis using both the old and the new platforms. A comparative analysis between the two showed only a 2% variance in emissions estimations, reinforcing our confidence in exclusively using the SIMAP platform going forward.

As of 2022, UofL reports a 55% reduction in carbon emissions from our 2008 baseline, vastly exceeding the initial goals set out in our 2010 Climate Action Plan and setting us up to achieve our updated 2030 goal of a 60% decrease. Initially, the pandemic resulted in a noteworthy reduction in carbon pollution, estimated at 11.85% from 2020 to 2021, which was indeed a positive development. However, there was a subsequent increase of 1.41% in emissions between 2021 and 2022 as the institution started operating in a fuller capacity. Nevertheless, by 2022, we have still managed to achieve an overall decrease of 10.61% from 2020 to 2022. This progress underscores the University's unwavering dedication to implementing effective sustainability measures.

From 2008 to 2022, we estimate that UofL's net carbon emissions have declined by 55% from 221,604 to 99,189 metric tons of carbon dioxide equivalent per year.

Despite our impressive progress in emissions reduction, it is worth noting the challenges that we still face. The two greatest relate to transportation and energy consumption. While we continue to see an expansion of student housing on and around our main Belknap campus, the housing options at our Health Sciences Center have decreased and many UofL students, faculty, and staff continue to commute using single-occupancy vehicles, contributing to pollution, traffic congestion, and higher education costs. While students are more likely to walk, bike, carpool, or use transit, the vast majority of students (72%) and employees (87%), are choosing to drive alone and the university still has no plan to change those behaviors. Additionally, air travel by faculty and staff has surged by 43% since 2020. We have also seen an increase in our overall electricity usage (7%), with no additional renewable energy sources since 2020. This underscores the need for a more sustainable approach to energy management, and the newly released Campus Master Plan sets us on better path in that regard as we move toward our 2050 neutrality goal.

Our achievement in emissions reduction is a beacon of hope in our journey towards sustainability. Yet, as we adapt to navigating life post-pandemic and we see emissions beginning to climb once more, it's a crucial reminder for us to fortify our resolve. This moment is not just a call to action but an opportunity to rekindle our collective ambition. We stand on the brink of change, armed with determination and the

power to make a difference. Together, we must channel our efforts, resources, and ingenuity to accelerate our march toward climate neutrality as soon as possible.

We must continue to invest in emissions reduction, to innovate solutions that work in our unique urban setting, and to prioritize efficiency, behavior change, transportation alternatives and renewable energy.

The most important steps that UofL needs to take in the near term are:

1. **Invest in large-scale renewable energy,** both on-campus (as in an anaerobic biodigestor) and off-campus (as through a virtual power purchase agreement).
2. Develop a **Transportation Demand Management Plan** that caps parking, incentivizes alternatives (including remote work/learning), and transitions UofL from subsidizing annual parking permits to market-rate, pay-per-use parking that subsidizes alternatives.
3. **Promote alternative options to air travel**, by implementing strategies like investing in virtual technologies and providing incentives for eco-friendly ground transportation. This could diminish travel necessity and ensure minimal emissions when it is necessary. UofL ought to consider the development of a sustainable travel portal to facilitate low-carbon travel planning, and offer a convenient, reliable way for travelers to offset their emissions at the time of purchase.

INTRODUCTION

This inventory represents UofL's on-going effort to track greenhouse gas (GHG) emissions for the purpose of developing and refining strategies to reduce the pollution that results from our activities. Due to variations in methodologies, scales and contextual settings, this report is not intended to be used for comparison to other higher education institutions nor for any regulatory requirements.

You will find herein a summary of the estimated GHGs for which UofL was responsible during the years 2008 through 2022, with some estimates back to 2006, two years prior to UofL making the Carbon Commitment. This is the 9th inventory update (now conducted annually) since our baseline GHG inventory, submitted in 2009. It follows the release of UofL's 2020 Greenhouse Gas Emissions Report, in May 2021. We were unable to produce a separate 2021 report due to staffing shortages and the transition to reporting through SIMAP, but this report includes that data as well.

This inventory provides an estimate of greenhouse gas emissions resulting from the activities of some 31,058 people who share our campuses as students, faculty and staff, as well as the operation of 10.2 million gross square feet of buildings on all three of the university's campuses, including the Belknap, Health Sciences Center, and Shelby campuses.

BACKGROUND

On August 1st, 2008, former University of Louisville President, James R. Ramsey, took the bold step of signing the American College & University Presidents' Climate Commitment. His successor, President Neeli Bendapudi re-signed the Carbon Commitment on August 4th, 2021, and UofL's current President,

Kim Schatzel, followed suit on February 1st, 2024. This pledge expresses UofL's long-term commitment to tackling the greatest crisis facing humanity and shifting toward climate neutrality as part of our broader efforts to center sustainability as a core policy and practice.

UofL's Carbon Commitment is now firmly rooted in fifteen years of work as we first developed a baseline inventory of greenhouse gas emissions in 2009 and then crafted a comprehensive Climate Action Plan in 2010. The Plan acts as a living document for UofL and serves as comprehensive roadmap to achieve net climate neutrality by 2050. As part of this process of adaptive management, in 2021-22, UofL's Sustainability Council produced an updated Climate Action Plan as a component of our new UofL Sustainability Plan: Pathway to Platinum. The updated Plan was shared with the campus population for comment in January 2022 and a final draft was submitted to the administration on May 27, 2022. Now, under the leadership of our current President, Dr. Kim Schatzel, and new Provost, Gerry Bradley, we must continue organizing and investing to meet our commitment.

We have already seen that UofL can exceed our reduction goals even earlier than planned. Our new estimates this year, based on a correction in the way our carbon emissions had been reported in the past three years (from estimates based on a projection to actual data), show that by 2016 UofL had already blown past our initial goal of a 20% reduction by 2020. We are steadily approaching our 2030 carbon reduction target of 60%, having already achieved a commendable 55% reduction.

Unfortunately, we have also seen how easy it is to stall out in the fight to reduce carbon pollution. The COVID-19 pandemic has had a profound impact on global activities, including those related to carbon emissions. As a result, we observed a temporary reduction in pollution, evident in the estimated 11.85% decrease in emissions from 2020 to 2021. However, there was a subsequent 1.41% increase in emissions between 2021 and 2022. While the pandemic inadvertently contributed to a temporary reduction in carbon emissions, it should not be viewed as a solution but rather as a catalyst for deeper reflection and more robust action toward climate goals. To ensure a resilient recovery that aligns with long-term climate objectives, we need to leverage the lessons learned during this period to accelerate the transition to reduced driving and flying, enhanced efficiency, and a shift away from fossil fuels entirely.

METHODOLOGY

The enclosed findings are estimates only, based on an admittedly imperfect system of data gathering. We do continue to refine and improve our estimates, however, and this reporting represents a significant step forward in the accuracy of both data gathering and emissions estimates. We continue to strive to improve data collection methods and to more accurately track emissions.

GHG emissions are typically broken down into three categories and defined as scope 1 (on-campus sources), scope 2 (off-campus sources for which we are responsible), and scope 3 (indirect sources). All three categories are included in this report.

For the current reporting year, our institution has transitioned away from utilizing the UNH (formerly Clean Air-Cool Planet®) Campus Carbon Calculator v8.0 and adopted the online Sustainability Indicator Management and Analysis Platform (SIMAP). This shift aligns with our commitment as a Carbon Commitment signatory and enhances the partnership between our institution and Second Nature, the

non-profit organization which supports universities' climate commitments. The decision to move away from the Campus Carbon Calculator was motivated by the comprehensive capabilities offered by SIMAP, which provides a robust carbon and nitrogen-accounting platform. SIMAP enables us to effectively track, analyze, and improve our campus-wide initiatives to minimize the pollution that is driving global climate chaos. By leveraging SIMAP, we can capture a broader spectrum of data and implement more targeted strategies toward reducing our environmental footprint and advancing sustainability efforts.

As a part of this transition, however, we wanted to be sure we weren't radically altering our estimates, so we conducted this analysis using both the old and the new platforms and performed a comparative analysis of the resulting emissions estates from the Campus Carbon Calculator and SIMAP. We were reassured to find a minimal 2% difference between the total emissions calculated by the two platforms. With the slight variance, our confidence in fully embracing the SIMAP platform has been solidified. This transition marks a significant step forward in our commitment to accuracy and transparency in tracking and reporting UofL's carbon emissions.

The data summarized herein includes utilities data for all three UofL campuses, encompassing some 138 buildings owned by the University, comprising approximately 10.1 million gross square feet of building space on 716 acres of land. The data encompasses all the University's academic, health science, medical, dental, athletic, dormitories, research, and office buildings and grounds. However, several buildings that are associated with the University but not directly owned or operated by UofL are not included in this report. Examples of these include fraternity and sorority houses, residence halls operated by third parties, UofL Hospital and UofL Health facilities, UofL Foundation properties, and off-campus leased space.

The report also tracks emissions from some of the key university-induced behaviors of our total campus population of 31,058 students, faculty and staff, no matter where they live, work, or study. The transportation choices of this community have been particularly impactful on our collective carbon emissions. We have tracked commuting habits since 2010 using a university-wide commuter survey that has evolved considerably over time as we have refined our methods.

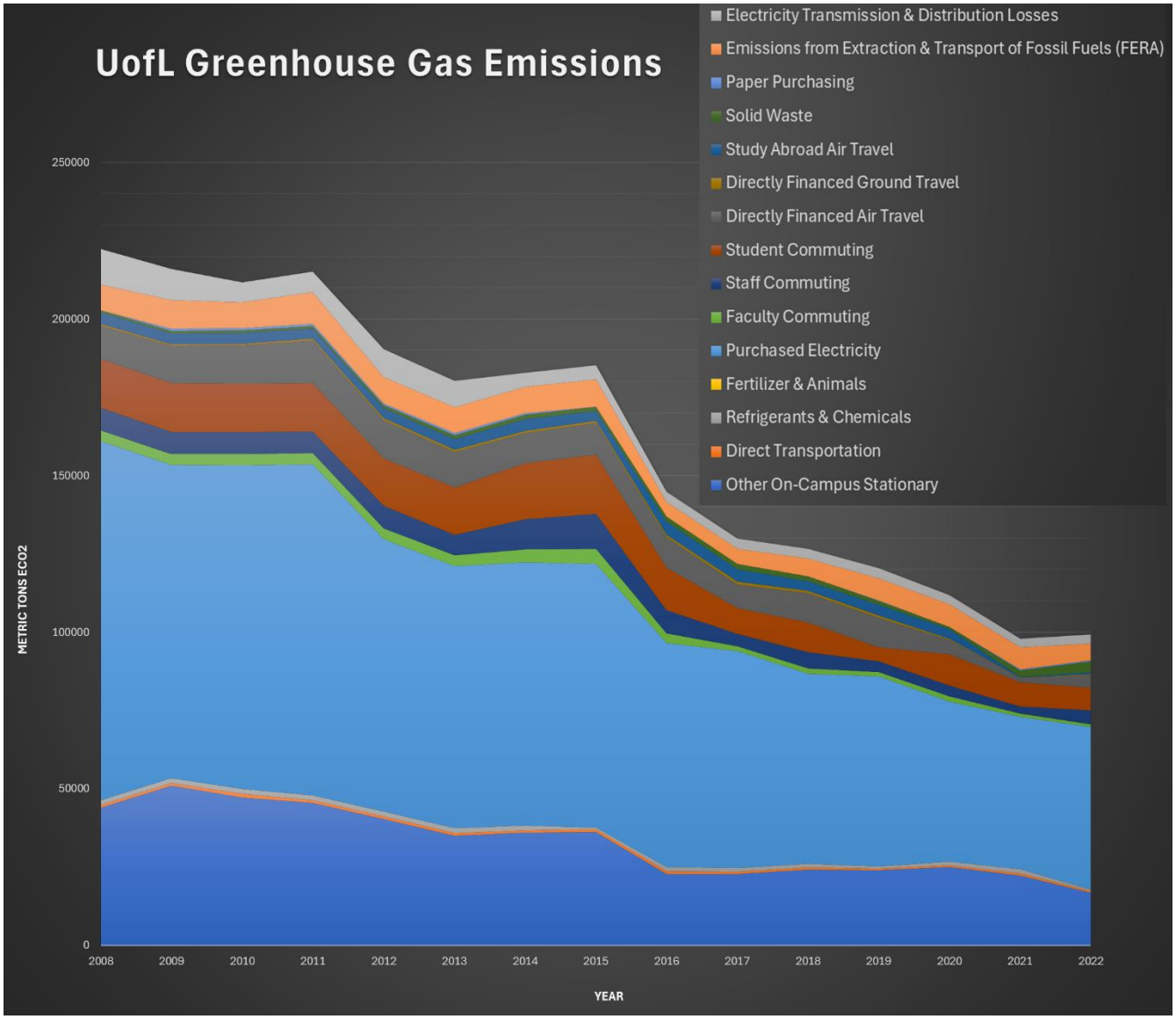
This report utilizes a continuous commuter survey conducted throughout the year, encompassing the academic periods of 2020-2021 and 2021-2022 (from September 2020 to August 2021) with a sampling protocol designed to get more accurate year-round data. Before 2018, we surveyed a subset of the university population during one month in the fall (with relatively good weather) and asked them a variety of questions related to their commute. In those early years, we calculated mode-share based upon self-reported "most frequent" means of getting to campus. In 2018 we began surveying the entire university population, one fraction at a time during each week of the year, asking fewer questions about their most recent trip to campus. This gives us much more accurate data about year-round behaviors, especially in light of extreme situational changes such as the pandemic lockdown.

Our commuter surveys reveal that despite progress in some years, we have struggled over the last decade to significantly reduce the number of individuals driving alone to campus. The COVID-19 pandemic launched a new era of remote learning and work, but as we adjust to a post-pandemic era, there is an increase in the desire for travel, highlighting the urgency for UofL to adopt a more proactive and strategic approach to altering transportation habits.

Emissions not reported because levels were considered to be *de minimus* include nitrous oxides used in the medical and research facilities, perflurocarbons used in eye surgeries and MRIs, and sulfur hexafluorides used in ultrasound imaging.

Sources of emissions not reported due to the lack of accurate, attainable data or trends on which to base projected estimates include wastewater and UofL's portion of the natural gas, oil, and electricity consumed at the shared Louisville Medical Center Steam Plant. That Plant supplies steam and chilled water to the entire downtown medical center, including our Health Sciences Center, but it is an independent, non-profit entity that we struggle to get detailed present and historical fuel mix data from. UofL recognizes these flaws in our GHG accounting and that these are not insignificant sources of carbon emissions.

FINDINGS & RECOMMENDATIONS

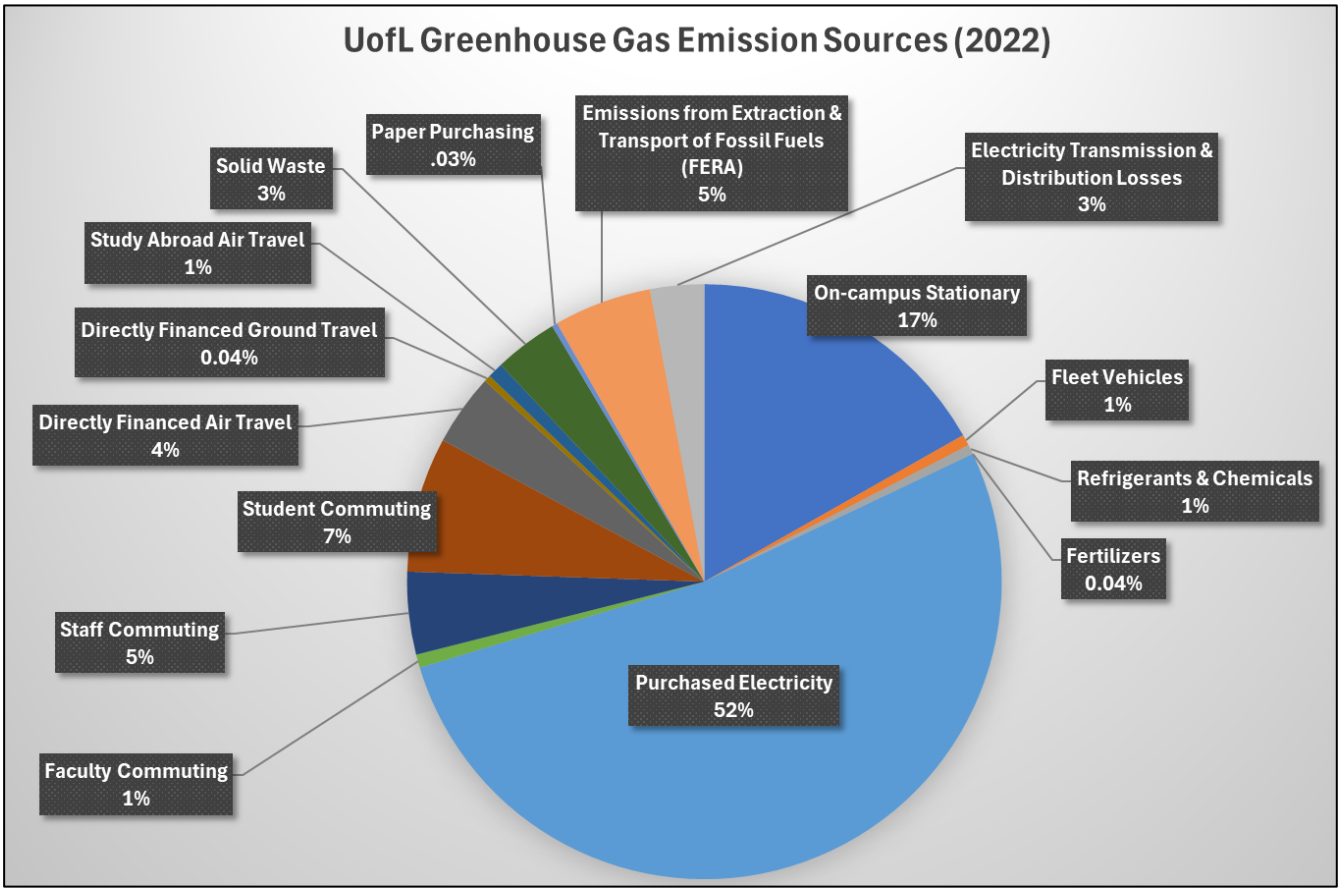


Over the period spanning from 2008 to 2022, our updated calculations indicate that the University of Louisville maintained an average annual net emission of 175,108 metric tons of carbon dioxide equivalent (MT CO2e) across all emission sources. We now estimate that, by the year 2017, we had already surpassed our initial objective of achieving a 20% reduction by 2020. At that juncture, our estimates indicated a total reduction of 33% from the 2008 baseline. As of 2022, our projections indicate that we are steadily approaching our 2030 carbon reduction target of 60%, having already achieved a commendable 55% reduction.

From 2008 to 2022, our estimates indicate a total reduction in greenhouse gas emissions of approximately 122,415 metric tons of CO2 equivalent per year. This amounts to cutting carbon emissions each year by an average of 8,744 metric tons per year. This represents a significant decline in net carbon emissions by 55%.

Had we not taken steps to reduce our carbon emissions they would surely have risen from 2008, but even if we simply compare our 2008 annual emissions to those of 2022, we see the incredible impact of these choices. According to the EPA's greenhouse gas equivalencies calculator, if we compare our baseline emissions to 2022, our reduction in emissions translates to the following in annual savings:

- Taking 29,135 cars off the road, or over 313M miles of driving, or 13.8M gallons of gas burned;
- 42,505 tons (or 6,072 garbage trucks) of waste recycled instead of landfilled;
- Emissions from 15,964 average U.S. homes' annual energy use;
- 673 rail cars worth of coal burned;
- Over 8 billion smartphones charged;
- Carbon sequestered by 142,923 acres of U.S. forests in one year; or over 2 million tree seedlings grown for 10 years; or 785 acres of U.S forests preserved from conversion to cropland in a year.

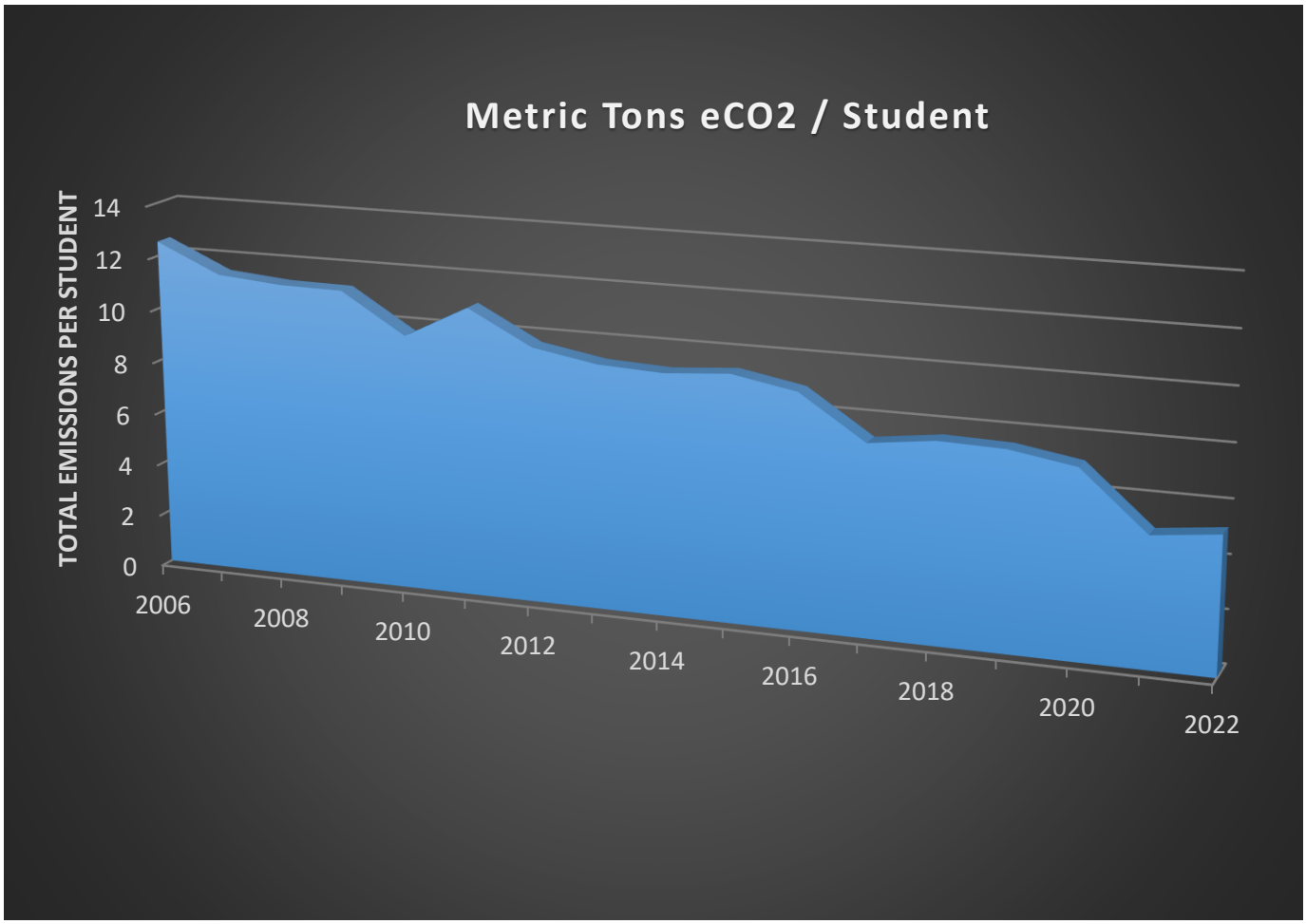


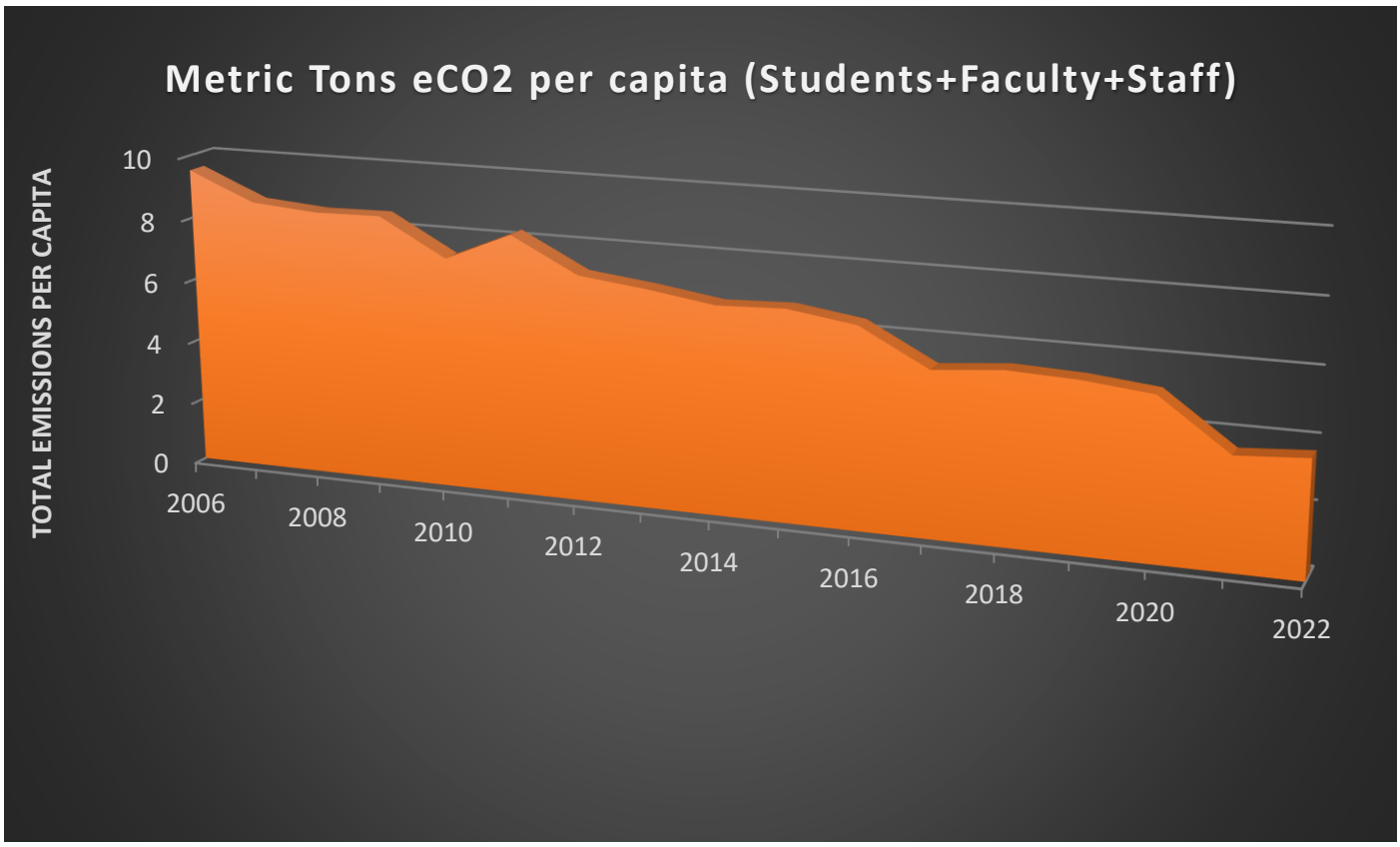
Our net emissions for 2022 continue a downward trajectory, both in absolute terms and relative to growth in the size of the University. Over the years, we have continued to reduce emissions per student, per capita, per square foot of building space, and per annual operating budget. Furthermore, we continue to cut emissions no matter what the weather, as our emissions per heating and cooling degree days (HDD and CDD) have shown a consistent decline over time, with an 11.54% decrease in HDD and an 11.56% decrease in CDD since 2020 alone.

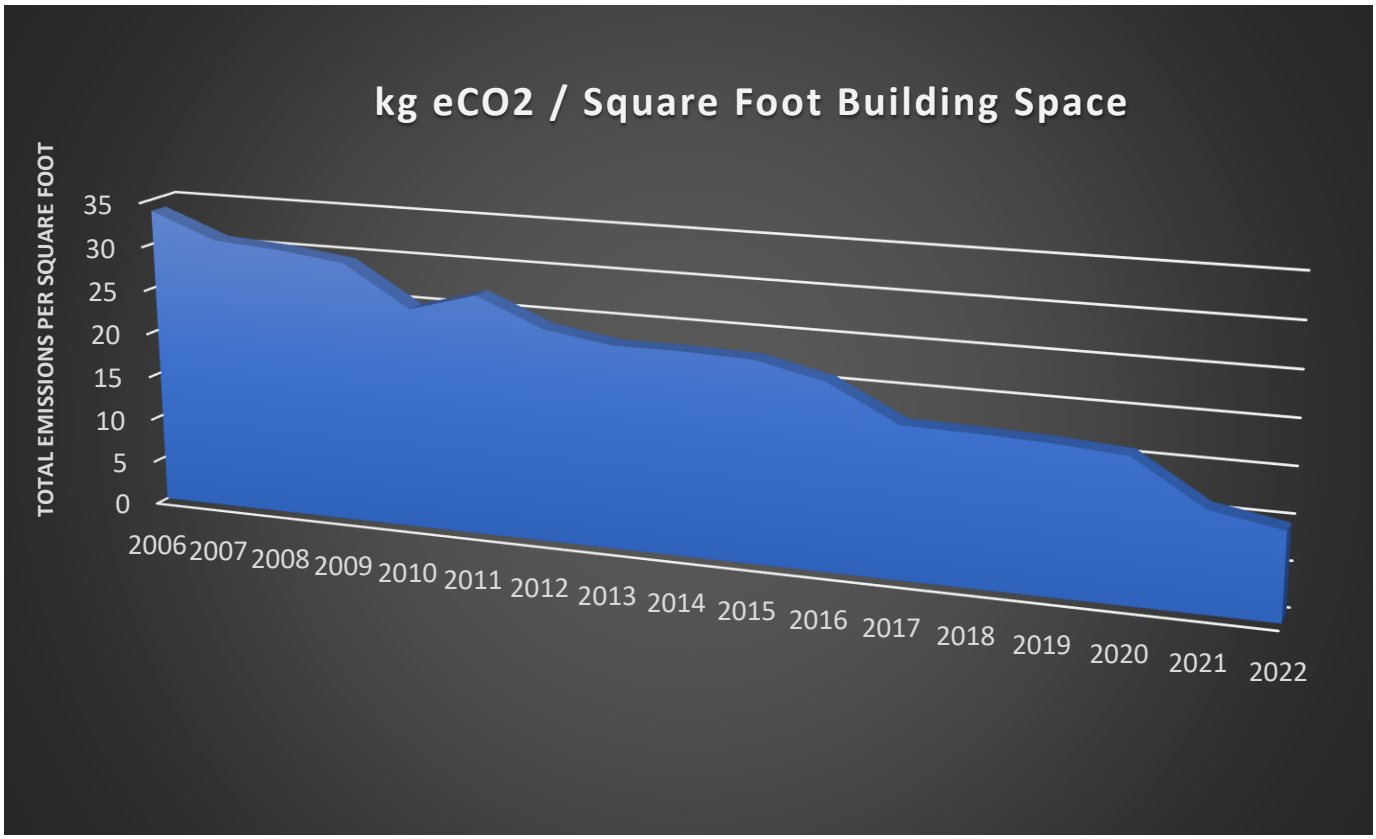
In relative terms, despite the expansion of UofL's building space, population, and operating budget, impressive reductions have been achieved. This reflects a significant strengthening of efficiency measures from our earlier years.

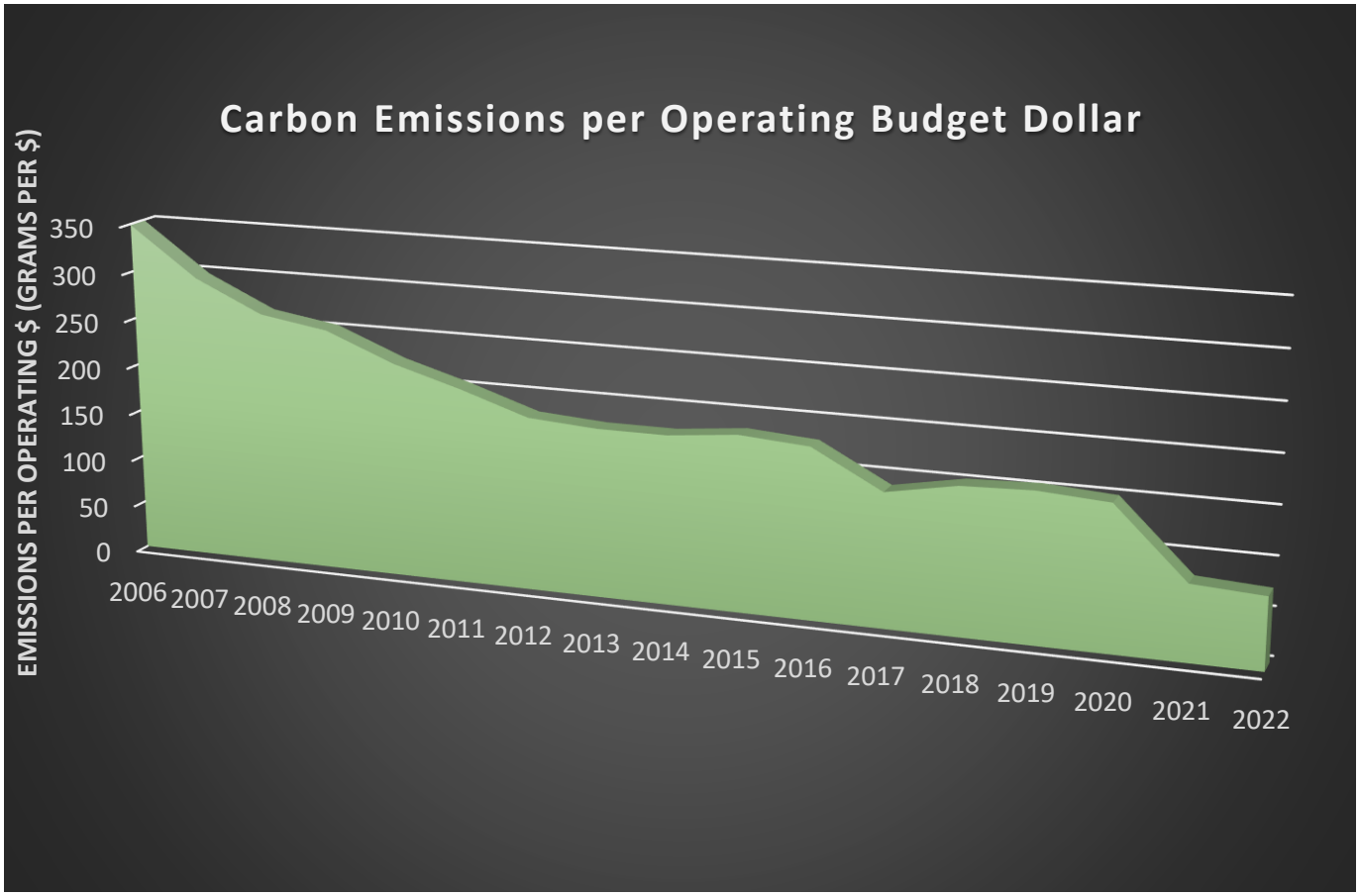
	Per sq. ft. of building space	**Per Capita (Students + Employees)**	**Per Operating Budget Dollar**
Emissions Reduction 2008-2022	69%	58%	73%

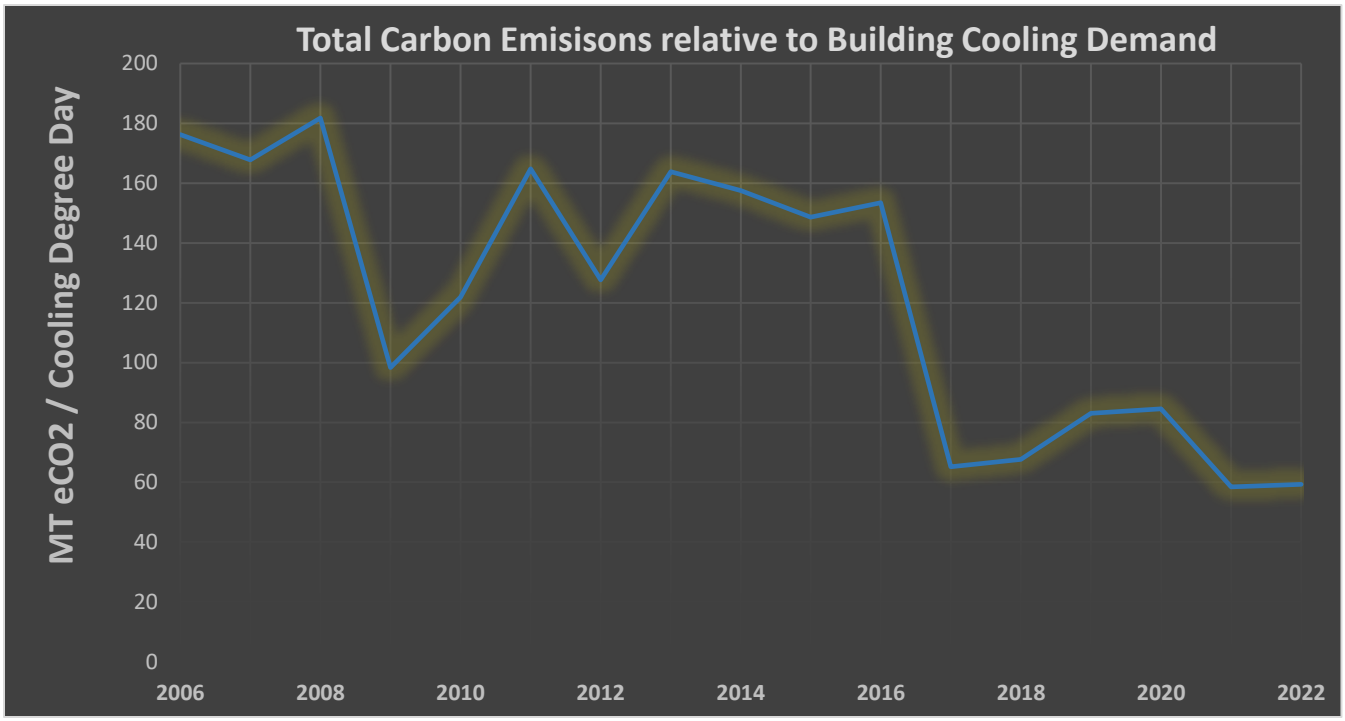
Year	Net Emissions	Per Student	Per Capita (Students + Faculty + Staff)	Per Sq. Ft. of Building Space	Per Annual Operating Budget	Per Number of Heating Degree Days	Per Number of Cooling Degree Days	**Percent Reduction in Emissions from 2008 Baseline**
	MT CO_2e	MT CO_2e / Student	MT CO_2e / Person	kg CO_2e / ft^2	g CO_2e/ $	MT CO_2e / HDD	MT CO_2e / CDD	
2006	191,657	10.2	7.7	27.4	283.3	45.4	143.0	**-14%**
2007	217,208	11.5	8.7	31.0	299.0	49.6	168.6	**-2%**
2008	221,604	11.7	8.8	31.7	276.2	50.7	189.6	**0%**
2009	215,162	11.2	8.5	29.4	253.3	46.1	98.3	**-3%**
2010	210,880	10.8	8.2	27.6	249.9	51.4	135.5	**-5%**
2011	214,100	10.9	8.2	26.9	203.8	46.1	164.6	**-3%**
2012	189,439	9.7	7.1	23.8	180.5	51.0	127.5	**-15%**
2013	179,150	9.0	6.7	22.2	171.6	39.0	159.8	**-19%**
2014	181,871	9.1	6.6	22.7	175.4	36.6	157.2	**-18%**
2015	184,347	9.3	6.7	22.5	183.3	37.4	148.9	**-17%**
2016	144,051	7.2	5.2	16.9	144.2	32.8	124.5	**-35%**
2017	129,043	6.5	4.7	15.3	125.8	31.5	59.0	**-42%**
2018	125,802	6.4	4.6	14.2	129.5	30.7	57.5	**-43%**
2019	119,579	6.1	4.3	13.4	126.6	29.2	67.9	**-46%**
2020	110,965	5.5	4.0	12.5	117.8	30.7	66.3	**-50%**
2021	97,810	4.9	3.5	11.1	78.6	27.0	58.4	**-56%**
2022	99,189	5.2	3.7	9.7	74.3	27.4	59.3	**-55%**

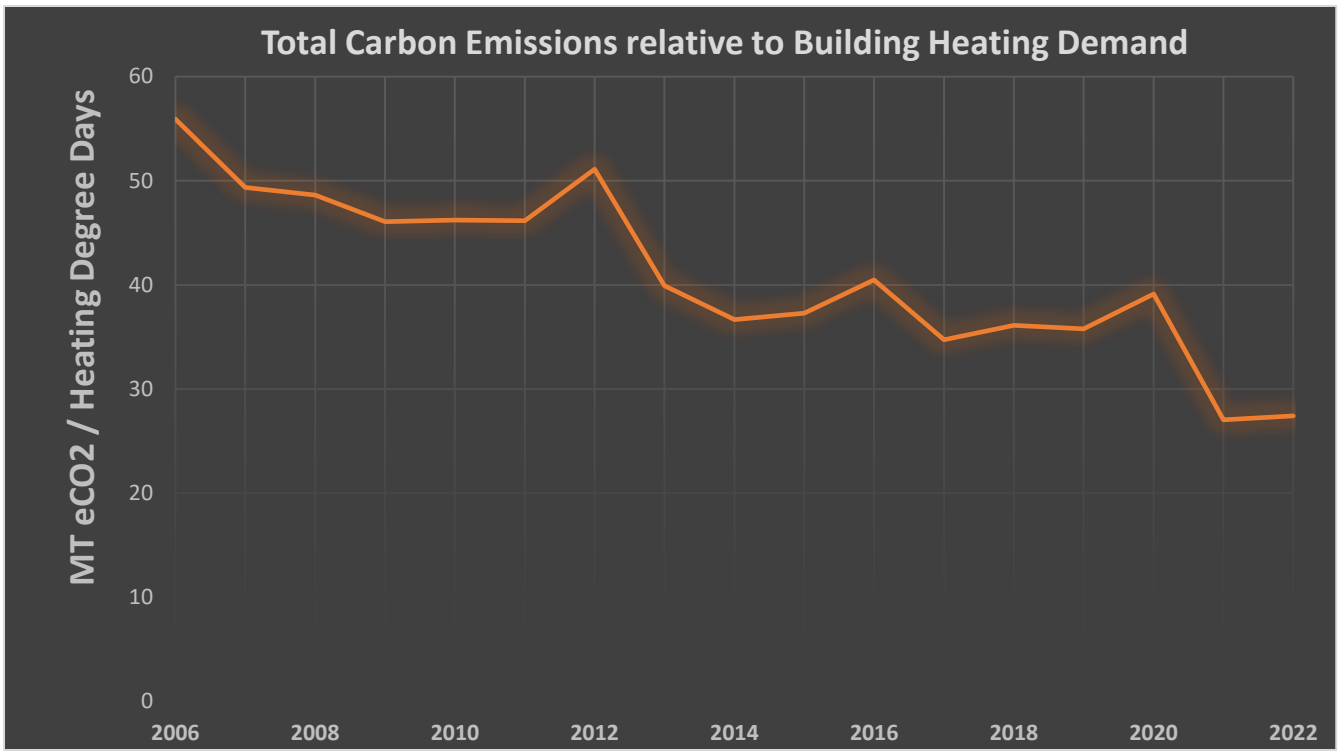

Metric Tons eCO2 / Student
TOTAL EMISSIONS PER STUDENT
14
12
10
8
6
4
2
0
2006
2008
2010
2012
2014
2016
2018
2020
2022


Metric Tons eCO2 per capita (Students+Faculty+Staff)
TOTAL EMISSIONS PER CAPITA
10
8
6
4
2
0
2006
2008
2010
2012
2014
2016
2018
2020
2022


kg eCO2 / Square Foot Building Space
TOTAL EMISSIONS PER SQUARE FOOT
35
30
25
20
15
10
5
0
2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022


Carbon Emissions per Operating Budget Dollar
EMISSIONS PER OPERATING $ (GRAMS PER $)
350
300
250
200
150
100
50
0
2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022

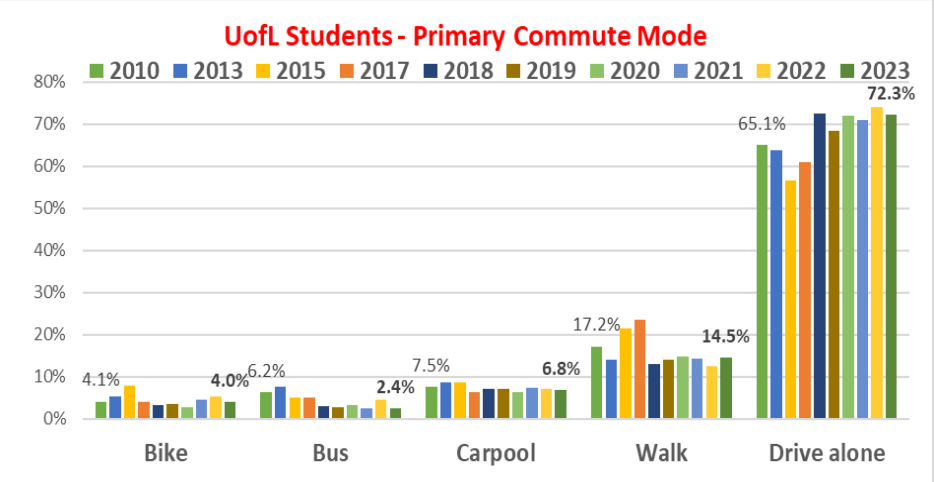

Total Carbon Emisisons relative to Building Cooling Demand
MT eCO2 / Cooling Degree Day
200
180
160
140
120
100
80
60
40
20
0
2006
2008
2010
2012
2014
2016
2018
2020
2022

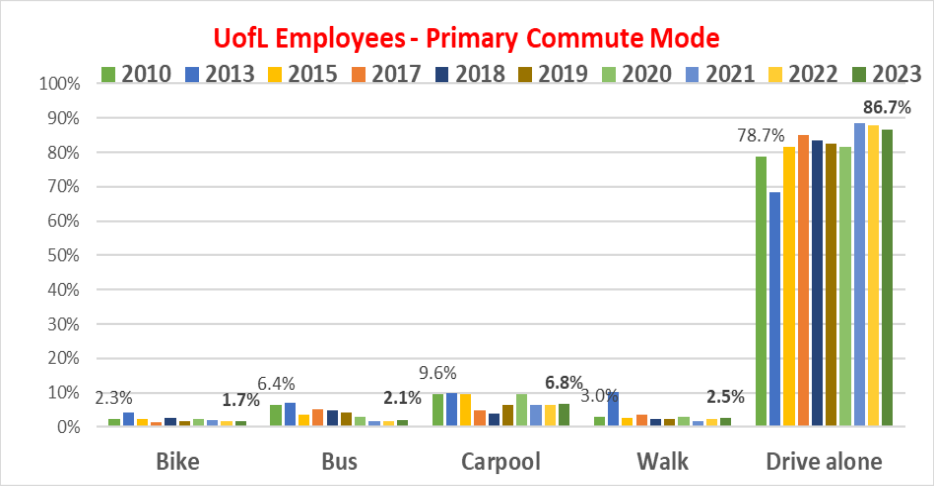

Total Carbon Emissions relative to Building Heating Demand
MT eCO2 / Heating Degree Days
60
50
40
30
20
10
0
2006
2008
2010
2012
2014
2016
2018
2020
2022

Year	Carbon Emissions													Offsets		NET
	On-Campus Stationary	Fleet Vehicles	Refrigerants	Fertilizer	Purchased Electricity	Faculty & Staff Commuting	Student Commuting	University Financed Air Travel	University Financed Car Travel	Study Abroad Air Travel	Solid Waste	Paper	Transmission & Distribution Losses	Sequestration due to composting & trees	Green Energy Certificates	Net Emissions
	MT eCO2	MT eCO2	MT eCO2	MT eCO2	MT eCO2	MT eCO2	MT eCO2	MT eCO2	MT eCO2	MT eCO2	MT eCO2	MT eCO2	MT eCO2	MT eCO2	MT eCO2	MT eCO2
2006	37,770	811	1,561	8	134,394	12,943	19,229	10,841	757	3,784	677	676	13,292	(641)	0	236,100
2007	39,457	895	1,561	8	114,293	13,430	19,391	10,723	761	3,663	720	607	11,304	(641)	0	216,170
2008	42,267	927	1,561	8	114,784	13,443	18,563	10,630	758	3,548	691	650	11,352	(641)	0	212,487
2009	49,471	1,009	1,561	8	100,142	13,246	18,602	11,832	758	3,373	821	574	9,904	(642)	0	215,266
2010	44,858	1,246	1,561	8	103,474	13,502	18,447	12,218	761	3,308	803	559	6,395	(650)	0	189,617
2011	45,339	876	1,561	8	105,988	12,929	17,975	13,642	737	3,264	747	579	6,551	(749)	0	214,452
2012	40,087	866	1,561	8	87,274	13,222	17,730	13,087	734	3,409	595	503	5,394	(671)	(127)	189,732
2013	34,894	829	1,561	8	83,982	12,329	17,745	11,800	735	3,521	768	515	5,191	(736)	0	183,607
2014	35,714	844	1,561	9	84,059	16,808	20,590	10,220	823	4,028	814	499	5,196	(661)	0	182,248
2015	36,523	858	605	5	84,189	19,848	22,534	10,787	794	3,309	855	492	5,204	(651)	(7)	184,001
2016	23,536	843	1,434	8	71,641	12,630	15,978	10,636	783	4,635	853	400	4,428	(663)	0	177,594
2017	23,980	760	1,204	8	69,421	6,569	9,550	8,301	932	4,319	1,028	521	4,291	(650)	0	142,523
2018	25,528	660	1,230	8	60,775	8,318	10,797	10,292	858	3,456	884	223	3,756	(639)	0	148,091
2019	24,861	628	770	8	60,714	5,627	5,077	10,390	732	3,808	812	361	3,753	(647)	0	146,337
2020	26,067	626	1,389	8	58,296	6,513	11,822	2,545	430	1,747	391	289	3,603	(669)	0	141,517
2021	32,597	654	1,525	6	55,668	3,462	8,639	1,111	107	75	453	280	3,441	(722)	0	97,856
2022	15,596	628	546	6	59,428	6,042	8,040	4,304	405	937	743	266	3,673	(708)	0	99,240

TACKLING TRANSPORTATION

As we noted in our previous GHG inventories, **UofL has made disproportionately good progress in reducing electricity and on-campus stationary fuel consumption compared to a notable lack of progress reducing emissions from transportation sources** (commuting, university financed air travel, and study abroad air travel).





COMMUTING – REDUCING VEHICLE MILES TRAVELED

With a new infusion of Climate Action Plan Implementation funding ($182,000/year), in 2012 the UofL Sustainability Council prioritized commuting behavior change and aggressively expanded the diversity and scope of transportation initiatives available on campus. Our work gained national recognition and we began to make a positive impact, but there was never any long-term commitment by the University to transportation demand management. With the onslaught of a financial crisis and a transition in leadership beginning in 2017, funding for these popular initiatives was eliminated and our transportation alternatives began to contract. The first significant blow was the loss of our extremely popular and nationally recognized Earn-A-Bike program through which

students and employees willing to give up their right to a UofL parking permit for at least two years could earn a $400 bike shop voucher. Then, in 2019, UofL lost its carshare system, and in 2023 we witnessed the demise of the city-wide LouVelo docked bikeshare system that used to serve our campuses directly.

For the time being, UofL continues to offer students and employees free access to the entire Louisville transit system, free carpool-matching through the Cardinal Directions online platform, and a free internal bikeshare program. But this is vastly insufficient to address the crisis of car-dependency, especially as the University does nothing to address the structural incentives that continue to encourage driving alone to campus (i.e. super-abundant, convenient, subsidized parking for all; insufficient affordable and attractive housing close to our campuses – especially for faculty and staff; and an annual parking permit system rather than market-rate, pay-as-needed parking). This erosion of alternatives, lack of a comprehensive plan to address unsustainable commuting, and social changes resulting from the pandemic have all contributed to the increase in driving alone to campus that is documented in our 2017-2023 commuter surveys.

Despite the ongoing expansion of student housing both on and around campus, a significant portion of students, faculty, and staff are not choosing to reside nearby. Instead, they commute to UofL in increasing numbers of single-occupancy vehicles. This presents challenges in reducing pollution, exacerbates traffic congestion, diminishes health and wellness, adds pressure on expensive parking, and raises the overall costs associated with a UofL education. While UofL students are proportionally more likely to commute via foot, bike, carpool, or bus, UofL employees' transportation habits more closely resemble those of the broader Louisville community, which relies heavily on driving alone. According to our latest 2022-2023 UofL Commuter Survey, 72% of students and 87% of employees still choose to drive alone to campus.

To reverse this trend, **UofL needs to develop and implement a strategic, comprehensive Transportation Demand Management Plan,** which must not only provide ease of access to safe alternatives and incentives for using them, but more importantly, **UofL needs to eliminate all parking subsidies and actively discourage driving to campus.** An overabundance of parking combined with parking costs that are well below market-rate and a pervasive campus culture built on the expectation of driving makes it extremely difficult for alternative modes to gain significant traction. The rationalization of parking prices implemented in FY20 was a step in the right direction, but it is insufficient. We believe that a market rate pricing approach should be considered so that people can pay market-rate prices for parking only when they truly need it rather than investing in an annual permit that makes daily driving the rational norm.

Thia shift need not represent a financial burden on the University. In fact, the additional revenue generated by shifting away from subsidized to market-rate parking could be used to help fund transportation alternatives, including free transit, our Cardinal Directions carpool-matching platform, subsidies for carshare, bikeshare, and vanpools, incentives for commuter challenges, the reestablishment of a “parking cash-out” program akin to our former Earn-A-Bike program, and a Sustainable Transportation Coordinator staff position to actively work on supporting efforts to reduce the number of cars on campus.

ALTERNATIVES TO FLYING

During this reporting period, we observed a significant decline in study abroad travel between 2020 and 2022, reflecting a 46% decrease of air travel, which we attribute to the impact of the pandemic. Unsurprisingly, however, faculty and staff air travel has rebounded by 43% since 2020.

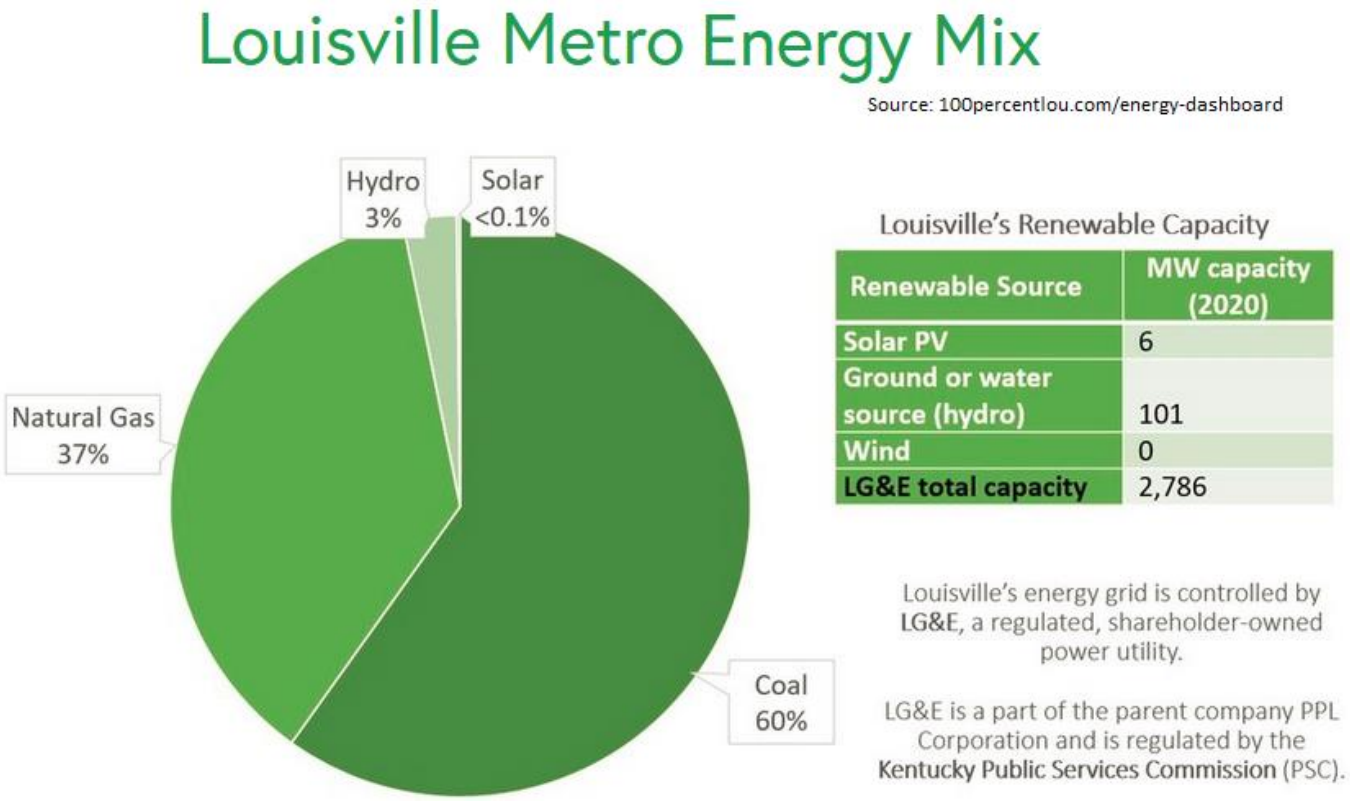
Flying is the most polluting, carbon-intensive option for achieving the goals of inter-city travel. The university needs to consider ways to encourage lower-impact options such as:

- **Virtual meetings** using Microsoft Teams, Blackboard Collaborate (free to UofL employees), and other virtual options that have become the norm in professional life;
- **Carpooling** with fellow travelers through Cardinal Directions - UofL's trip-finding and carpool-matching system;
- **Taking the Bus** – Louisville is served by Greyhound, Megabus, and Miller Transportation but UofL has no established relationship with any of these daily service providers (e.g. to offer discounts or preferred status) and none of these can be booked through UofL's travel agent;
- **Taking the Train** - Amtrak trains depart from Indianapolis, Cincinnati and other regional cities, with bus connector service to/from Louisville. In March 2020, Amtrak announced long-term plans to restore passenger rail service directly to Louisville. Now is the time to prepare ourselves for new, low-carbon, ground-based travel habits. Employees can easily book Amtrak trips through Anthony Travel, by clicking on the train tab in the Concur booking portal, but there is little awareness of this, no discount, and no University policy to encourage its use.

Additionally, the university must take steps to make carbon offsetting a standard, convenient part of the travel booking process for university business. Services such as Carbon Footprint Ltd, Native Energy, CarbonFund, and TerraPass, already make carbon offsetting simple and affordable. Use of such services should be the default option for anyone booking university-financed travel.

INVESTING IN RENEWABLE ENERGY & EFFICIENCY

Given that UofL is dependent on a 97% fossil-fueled, profit-driven, monopoly energy utility, if we want to reduce our carbon emissions and utility costs, it is essential that we invest heavily in both energy efficiency and renewable energy.



In fact, much of our success in reducing emissions and our utility costs to date has come from a $52 million investment in energy efficiency upgrades through a performance contract with Siemens 2009-2017. As technological efficiencies continue to improve and our existing building systems continue to age, there is still more work to be done in that regard. Some of the pay-back periods may be longer and uncertainties may be higher, especially as we refocus attention on behavior change and personal accountability for utility use on campus. Nonetheless, it is imperative that UofL continue to invest in behavior change programs and energy efficiency measures beyond the scope of the original performance contract.

One major area for future progress that UofL has yet to seriously pursue is **investment in a large-scale renewable energy project**. Conversations which began during the Bendapudi administration about partnering with local industries to convert distillery wastes and other organics to methane in an anaerobic biodigestor have stalled. That one project alone held the potential to produce 20% of UofL's energy needs renewably from a reliable local waste stream. Off-campus options have been discussed, whether through LG&E's now imperiled plans for a solar farm, or via a virtual power purchase agreement (perhaps best pursued in a consortium model with other universities or entities such as through our Partnership for a Green City), but nothing concrete has been achieved yet.

Such an investment has the potential to save the university money through bulk energy procurement and to reduce risk through avoiding future hikes in utility rates. It would also provide a much-needed boost to our efforts to achieve the other key initial 20% by 2020 goal established in our first Climate Action Plan – i.e. sourcing 20% of our energy needs from renewable sources by 2020. Sadly only 3.67% of our current power is from renewable sources. Since 2020, our total purchased electricity consumption has increased while the total amount of solar retained has remained the same. Given the educational and operational value, we must continue to incorporate renewable energy into our on-campus construction and renovation projects, but **the time has come for us to pursue multiple agreements for renewable energy sourcing from new large-scale projects.**

UofL's goal is to achieve climate neutrality by 2050. We have made tremendous progress toward this goal, but we need to step up our efforts and accelerate progress to achieve that target. Current rates of reduction will not get us there by 2050, and failure to do so is dangerous for the institution and our planetary future.

Our plan for making progress toward climate neutrality is dynamic and multifaceted. We recognize that sustainability demands progress on multiple fronts and that lasting change cannot be achieved without coordinated, university-wide efforts. As such, we recommend a variety of steps to lead UofL down a path toward climate neutrality.

DATA LIMITATIONS

It must be stressed that these findings are *estimates* of GHG emissions, not actual measurements. The accuracy of these estimates is limited by the quality and extent of the data gathered. Actual emissions are likely to vary from the calculated estimates.

Limitations to the data used in this survey include:

- **Purchased Steam & Chilled Water:**
  The Health Sciences Center at UofL relies on purchased steam (amounting to 209,517.98 MMBtu in FY15) and purchased chilled water (amounting to 235,715.79 MMBtu in FY15) from the Louisville Medical Center Steam Plant, an independent, non-profit entity located adjacent to HSC. This plant serves the entire downtown hospital and medical center by supplying steam and chilled water. Due to our lack of direct ownership of the LMC Plant, we were unable to collect data for 2021-2022. Instead, we employed a linear projection based on previous usage.

  Each year, we have estimated scope 1 steam coal emissions by determining UofL's portion of the total coal burned at the shared plant. These figures are reported in lieu of MMBtu of purchased steam and chilled water because it's impossible for us to ascertain the complete fuel mix at that plant. While we know that coal wasn't the sole fuel source, inaccessible records prevented us from providing a comprehensive breakdown. UofL acknowledges this limitation in our GHG accounting, unable to report our portion of natural gas, electricity, or other fuel sources consumed at the plant. The good news is that the LMC Plant finally stopped burning coal in 2021 and we will not only be responsible for much less pollution from that facility, but we will also be able to begin accurately estimating those emissions going forward.

- **Facilities UofL Does Not Own:**
  The University recognizes that its true carbon footprint includes emissions from facilities that it does not own (such as private residence halls, leased off-campus space, and facilities owned by separate affiliated entities such as UofL Health, and UofL Foundation). However, these emissions are not included in our reporting, as it is not possible for the University to track or control these emissions. We chose to focus our inventories on facilities we have direct control over.

- **Paper:**
  In 2021-2022, we were not able to collect a comprehensive dataset of purchased paper. As a result, we extrapolated the data by utilizing existing data points (years 2006-2020) to forecast trends for 0%, 30%, 50%, and 100% recycled paper for 2021 and 2022. UofL acknowledges that this method of estimating emissions is not ideal and is actively working to enhance our data collection methods for paper.

- **Wastewater:**
  UofL's wastewater volume is not measured, nor is freshwater input as the water utility does not provide the University with annualized gallon data. In the future, gallons of water consumed by the University could be calculated based on average costs, but currently there is no central repository for the information and the University receives some 150 different water bills each month. We recognize that scope 3 emissions from the University's sewage are not insignificant and would like to find a way to include these figures in future reports.

- **Athletics Events:**
  Though we now capture Athletics travel in our annual reporting, we are not able to include an accounting of emissions resulting from on-campus Athletics events (such as fan travel), other than the utilities consumed (as these are paid out of general funds).

- **Rental Car Mileage:**
  For 2021 and 2022, total rental car mileage was unavailable. Consequently, we derived a simple proportion using our historical data, excluding student air mileage due to their lower likelihood of renting cars. Analyzing the ratio of faculty/staff air miles to rental car mileage from 2017 to 2020 (47,223,695 to 5,408,633), we established a reliable metric. As a result, we applied this proportion by multiplying our current total faculty/staff air miles by 0.1145321855903059 to estimate our current rental car mileage.

- **Study Abroad Air Travel:**
  The air miles for Study Abroad trips not booked through UofL travel agents have to be estimated for each leg of each flight using webflyer.com. For a small percentage of these trips, the exact itineraries between home and destination cities was not known and had to be assumed. Study Abroad data prior to 2011 is not available and had to be roughly estimated based on trend.

- ***De Minimus* Emissions:**
  In calculating our carbon footprint, the University used rough, upper-bound estimates to designate as *de minimus* (or materially insignificant) emissions sources that collectively comprised less than 5% of the University's total GHG emissions. Some emissions considered *de*

minimus for this report include nitrous oxides used in the medical and research facilities, perfluorocarbons used in eye surgeries and MRIs, sulfur hexafluorides used in ultrasound imaging, and fugitive emissions from laboratory animals used in medical research.

INSTITUTIONAL DATA

Founded by decree of city council on April 3rd, 1837, with roots stretching back to 1798, the University of Louisville is today a premier metropolitan research university with two campuses in downtown Louisville and one on the urban fringe. UofL is a state supported institution located in Kentucky's largest metropolitan area. It was a municipally supported public institution for many decades prior to joining the statewide university system in 1970.

The University has three campuses. The 287-acre Belknap Campus is three miles from downtown Louisville and houses seven of the University's 11 colleges and schools. The Health Sciences Center is situated in downtown Louisville's medical complex and houses the University's health related programs and the University of Louisville Hospital. The 243-acre Shelby Campus is located in eastern Jefferson County.

The University of Louisville is committed to teaching, research, and service to its community and the advancement of educational opportunity for all citizens thereof. With a total enrollment of 22,288, and a growing number of residential students, UofL's academic programs continue to attract students from every state and from countries all over the world.

Now employing 6,669 FTE personnel and operating with a budget of $1.3 billion (2022 dollars), UofL is a major economic force in the community, lending even greater import to its policies with respect to environmental stewardship.

The University owns and maintains a fleet of roughly 200 road vehicles in addition to a number of pieces of heavy machinery used for grounds maintenance (backhoes, tractors, etc.). Physical Plant is responsible for maintaining the majority of these, as well as over 138 buildings (10.2 million gross square feet) and 660 acres of land on all three campuses. Physical Plant also operates and maintains a central steam and chilled water plant on the Belknap campus and a 13,800-volt distribution system at the Health Sciences Center and Belknap campuses.

A Growing University

Year	Employees			Students			Total Campus Population	Operating Budget (adjusted for inflation 2005 $)
	Faculty	Staff	Total	Full Time	Part Time	Total		
2006	2,074	3,875	5,949	15,804	6,037	21,841	27,790	$0.676 b
2007	2,130	4,008	6,138	16,061	5,628	21,689	27,827	$0.726 b
2008	2,124	4,050	6,174	16,027	5,734	21,761	27,935	$0.802 b
2009	2,125	3,961	6,086	16,377	5,654	22,031	28,117	$0.849 b
2010	2,188	4,087	6,275	16,818	5,472	22,290	28,565	$0.844 b
2011	2,309	4,103	6,412	16,924	5,325	22,249	28,661	$1.051 b
2012	2,316	4,585	6,901	16,963	5,330	22,293	29,194	$1.050 b
2013	2,381	4,356	6,737	17,198	5,331	22,529	29,266	$1.044 b
2014	2,383	5,333	7,716	17,317	5,282	22,599	30,315	$1.037 b
2015	2,401	5,461	7,862	17,125	5,242	22,367	30,229	$1.006 b
2016	2,439	5,500	7,939	17,406	5,234	22,640	30,579	$0.999 b
2017	2,370	5,332	7,702	16,951	5,508	22,459	30,161	$1.025 b
2018	2,540	5,273	7,813	16,780	5,691	22,471	30,284	$0.972 b
2019	2,650	5,336	7,986	16,464	6,220	22,684	30,670	$0.944 b
2020	2,723	5,089	7,812	16,774	6,472	23,246	31,058	$0.942 b
2021	2,789	5,066	7,855	16,777	6,517	23,294	31,149	$1.245 b
2022	2,889	5,044	7,933	16,127	6,161	22,288	30,221	$1.335 b

DATA GATHERING

The university's Assistant to the Provost for Sustainability Initiatives served as the primary contact, author, data compiler and analyst for this report. The data was gathered from across the university by collaborators with the university-wide Sustainability Council, in conjunction with the following units:

- Office of Institutional Research
- Business Operations
- Physical Plant
- Department of Environmental Health and Safety
- University Planning, Design and Construction
- Office of Study Abroad and International Travel
- Contract Administration & Procurement Services

Year	Heating Degree Days	Cooling Degree Days
2006	4222	1340
2007	4379	1288
2008	4370	1169
2009	4671	1021
2010	4773	1556
2011	4646	1301
2012	3712	1486
2013	4599	1121
2014	4970	1157
2015	4934	1238
2016	4386	1157
2017	3558	1881
2018	4102	2188
2019	4089	1761
2020	3618	1674
2021	3974	1481
2022	4233	1625

Faculty and graduate students in the Department of Urban & Public Affairs took a lead role in developing the commuter survey and analyzing the data. Strategies for gathering the necessary data have been refined over the years since UofL's baseline emissions inventory. The commuter data for this year's report was gathered through a year-round survey of the entire campus population from September 2020 – August 2022. It, thus, represents a mix of pre- and post-

pandemic behaviors, though the majority of the time period represented by this data saw “normal” pre-pandemic commuting habits.

The GHG emissions included in this report include:

Scope 1 emissions occurring from sources owned or controlled by the University. These consist of direct operations on campus that produce greenhouse gases, such as on-site fuel consumed (i.e. natural gas burned for heat and fuel consumed by campus fleet vehicles).

Scope 2 emissions produced off-site by the electric utility as part of the generation process. The University purchases electricity from Louisville Gas & Electric, which has coal- and natural-gas powered generating stations located on the Ohio River, along with a small percentage of renewable energy (hydropower and a solar array).

Scope 3 indirect emissions generated off-site by commuter travel, business travel, waste transported to landfills, and some university purchases (notably paper). These emissions, although not produced directly on campus, are a result or consequence of university activities.

Emissions were estimated using both the **UNH (formerly Clean Air-Cool Planet®) Campus Carbon Calculator v8.0** software and the online Sustainability Indicator Management and Analysis Platform (SIMAP), utilizing annual facility data. These were used for university data collection, storage and conversion into a common greenhouse gas emission unit, metric tons of carbon dioxide equivalent (MT CO_2e). In the conversion process, these systems use scientifically based factors for specific activities leading to GHG emissions (e.g., commuter miles traveled, tons of waste disposed, gallons of fuel burned, etc.). These conversion factors have been modified as more is learned about the global warming effects of various greenhouse gases.

The default emissions coefficients supplied in the UNH Campus Carbon Calculator v8.0 were used in preparing this report for all emissions factors other than automobile fuel efficiency. The GHG Reporting Team was able to find more accurate, local estimates of automobile fuel efficiency. The version of the Carbon Calculator we employed uses a global warming potential (GWP) factor from the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC). GWP is the ratio of the degree of warming to the atmosphere that would result from the emission of one unit of a given GHG compared to one unit of carbon dioxide over a specified time period. This is used to convert emissions of other GHGs into units of carbon dioxide equivalents (CO_2e).

This year’s report updates GHG emissions estimates which were previously reported for the last three years. Due to an unnoticed glitch in the formulas used to estimate emissions in these previous reports (2017-2019), we had unknowingly been reporting estimates based on projections rather than actual data. While the source data was accurate in previous reports, the carbon emissions estimates were not. We apologize for the error.

CONCLUSION

With this update to our greenhouse gas emissions inventory, UofL is proud to uphold its climate commitment and to continue tracking its emissions. While we recognize that these numbers are merely estimates and not a complete and precise accounting, we remain focused on the primary purpose of this effort – to continue developing and refining strategies to ***reduce*** our emissions, as laid out in our Climate Action Plan. The University recognizes the need to further refine our techniques for gathering more and better data about our climate impact and we continue working on strategies to do so.

Given that the social cost of carbon is now estimated to be $185/ton of carbon emissions (or $51/ton as estimated by the Biden Administration)[i], UofL's emissions in 2021-2022 were responsible for something on the order of **$5-18 million/year in damage to our planet and its people**. It is not acceptable or in line with our CARDINAL principles to continue externalizing these costs and imposing such a debt on the future generations for whom UofL ought to be a source of hope and flourishing.

UofL's mission is to teach the next generation and research solutions to our pressing problems. In striving for climate neutrality as an institution, and making our progress known and our processes visible to all, UofL is leading by example and providing our students and employees vital lessons in stewardship and responsibility. We invite you to learn more about and get involved through our UofL Sustainability website: louisville.edu/sustainability.

[i] The discount rate applied accounts most of the difference in estimates and Prest, B.C., Rennert, K., Newell, R.G., and Wingenroth, J. (2022) from Resources for the Future offer a valuable discussion and Social Cost of Carbon Explorer tool.