



Air Quality Inventory

Loyola University Chicago
Lake Shore Campus
2020

Overview of Project:

The Air Quality Inventory is a collection of information indicating the sources of outdoor air quality hazards on Loyola University's Lake Shore Campus. The purpose of the project was to inventory equipment (point and nonpoint sources) and locations that add air emissions to the outdoor environment, including, but not limited to, backup generators, boilers, furnaces, fertilizers, mobile sources, and fume hoods. Recommendations to reduce emissions and improve air quality are given at the end of this report. The Lake Shore Campus inventory was conducted between January and May 2017 (adjusted February 2020).

Process:

To begin the Air Quality Inventory, Director of Sustainability Aaron Durnbaugh and three Office of Sustainability interns first discussed the different categories of air pollutants that are present on Loyola's campus. These categories include stationary sources (back-up generators & fertilizers) and mobile sources (cars, shuttles, & cigarette smoke). Our team, assisted by Assistant Chief Engineer Greg Spalding, then surveyed Loyola's Lake Shore Campus to locate each generator, document the fuel source and take photos. With this data, GIS Specialist and IES Communications Manager David Treering assisted in creating a campus map that indicates the location of each back-up generator. For questions regarding chemical storage in a laboratory setting, IES Lab Manager and Chemical Analyst Zhenwei Zhu was contacted. Additionally, research was done to determine the average daily number of cars, which CTA bus routes pass by campus and the frequency of the routes. Information regarding fertilizers administered on campus grounds was provided by the Director of Environmental Services William Curtin. Based on observational knowledge, student interns recorded locations on campus where smoking occurred most frequently. We have yet to ascertain information about air pollutants emitted by construction projects around campus (e.g., Cudahy Science Hall). After gathering and documenting the above categories, recommendations were made for strategies to decrease mobile and stationary air pollutants on Loyola's Lakeshore Campus.

Sources of Air Pollution:

The primary sources of air pollution on the Lake Shore campus are derived from generators, laboratory chemical storage, vehicles, cigarettes, and fertilizer. Ozone and PM 2.5 are not quantified for this inventory as Chicago is nonattainment for these two pollutants (<https://www.epa.gov/outdoor-air-quality-data/interactive-map-air-quality-monitors>).

Stationary Equipment

Generators (all fueled by natural gas, except Steam Plant and IES/BVM are diesel fueled).

Generator Site	Connected Buildings	Fuel Source	Model Type
Spring Hill Residence Hall	N/A	Natural Gas	Caterpillar Olympian
Regis Residence Hall	N/A	Natural Gas	Kohler
LeMoyne Residence Hall	N/A	Diesel Fuel	Caterpillar Olympian
Marquette North Residence Hall	Georgetown Residence Hall	Diesel Fuel	Cummins
Marquette South Residence Hall	N/A	Diesel Fuel	Kohler
Canisius Residence Hall	N/A	Natural Gas	Caterpillar Olympian
Messina Residence Hall	N/A	Diesel Fuel	Kohler
Xavier Residence Hall	Seattle	Diesel Fuel	Cummins
Simpson Residence Hall	N/A	Diesel Fuel	Cummins
Ignatius Residence Hall	N/A	Diesel Fuel	Cummins
DeNobli Residence Hall	N/A	Natural Gas	Kohler
Mundelein (IT Dept.)	N/A	Natural Gas	Olympian
Fordham Residence Hall	N/A	Diesel Fuel	Cummins
Bellarmino Residence Hall	N/A	Diesel Fuel	Kohler

Quinlan Life Sciences Building	Mundelein Building, Coffey Hall, Cuneo Hall, Madonna Della Strada Chapel, Main Parking Structure	Natural Gas	Caterpillar
Campion Residence Hall	N/A	Natural Gas	Kohler
Santa Clara Residence Hall	N/A	Natural Gas	Cummins
Steam Plant	Mertz Residence Hall, Centennial Forum, Norville Center, Information Commons, Dumbach Hall Data Center	Diesel Fuel	Cummins
Institute of Environmental Sustainability	BVM, San Francisco Residence Hall	Diesel Fuel	Cummins
San Francisco Residence Hall	Institute of Environmental Sustainability, BVM	Diesel Fuel	MTU Onsite Energy

Boilers and Furnaces

The primary heating source for this campus is natural gas utilized for radiant and forced air systems. In FY18, 2,022,525 therms of natural gas were combusted on the Lake Shore Campus. Primarily for space heating although this is also used for hot water and kitchen purposes. This is equal to 202 million cubic feet of natural gas that, when combusted produces the following emissions, assuming “small boiler” rates:

Pollutant	Million Cubic Feet Natural Gas	Carbon Dioxide (lbs)	Nitrogen Oxide (lbs)	Sulfur Oxide (lbs)	Carbon Monoxide (lbs)	Total Particulate Matter (lbs)	Lead (lbs)	Methane (lbs)
Unit	202	24,264,499	20,220	121	16,985	1,537	0	465

Emission from electricity generation; Grid ISO source:

<https://www.pjm.com/-/media/library/reports-notice/special-reports/2018/2018-emissions-report.ashx?la=en>

Source: <https://www3.epa.gov/ttnchie1/ap42/ch01/final/c01s04.pdf>

Laboratory Chemical Storage

Gases such as argon, hydrogen, helium, oxygen, nitrogen, and compressed air are used for instrumental operations. Only hydrogen and oxygen are considered harmless because of their flammability. These gases are stored in compressed cylinders with gas regulators. Solvents that are flammable and may be volatile are stored in designated cabinets. Because some of the strong solvents such as acetic acid and ammonium hydroxide release fumes when opened, they are always opened inside of the fume hood - therefore minimizing any risks of inhaling fumes. These fumes are vented to the outside with some filtration depending on the fume hood type. All hoods are certified annually for proper flow rates.

Mobile Sources

Vehicles

- Chicago Transit Authority (CTA) Bus Routes along Sheridan Avenue: Routes 147, 155 and 151
 - Students, faculty and staff of Loyola University are encouraged to take public transit due to the CTA U-Pass provided by the college. The U-Pass is paid for by the student's activity fee and is required of all full-time students.
- Automobiles
 - A large number of cars (~10,000+) travel on Sheridan Road daily and directly exhaust various pollutants including particulate matters although catalytic converters and overall vehicle efficiency have reduced some of these impacts.
 - On campus, one observation was the increase in idling by ride-share services such as Uber and Lyft, not to mention friends or family of students being picked up.
 - Loyola's 8-RIDE van service is also a potential source of pollution. 8-RIDE is a service for students that operates between 6pm and 4am, 7 days a week while school is in session. Students can request pick up and drop anywhere within roughly 0.5 mile radius around campus. Vans often idle while waiting for student requests.
 - Loyola has a very small fleet of mostly leased vehicles. One observation was that Loyola police cars often station themselves around campus and will idle for long periods of time. These are also not the most efficient of vehicles given their primary use of patrolling the campus and nearby neighborhood.
- Shuttles:
 - Loyola University shuttle buses commute between the Lake Shore and Water Tower campuses. Although the shuttles still emit pollution, the university adopted an anti-idling policy for the shuttle buses once the temperature reaches a specific degree. This is to save gasoline and reduce emissions when picking up students from Lake Shore Campus and Water Tower Campus.

People

- Cigarettes: Loyola is not a Tobacco-Free campus, which can be used to regulate cigarette use. Therefore, cigarettes are a contributing factor, yet minor, to air pollution on the Lake Shore campus. The following are primary locations on campus for cigarette use:
 - Main Parking Structure
Cigarette butts were found on all consecutive floors of the Main Parking Garage, located on Sheridan Avenue and Winthrop. Visitors will leave the remains of their cigarettes on the parking garage floor after they have smoked outside of their car.
 - Information Commons
Students and visitors gather around the entrance to the Richard J. Klarchek Information Commons to smoke. People will take a smoking break at this location, as they cannot smoke inside the building. Though there are cigarette disposal containers, butts are still found around the building and in the cracks of the permeable pavement.

- Main Parking Structure
Students who smoke and live inside the Loyola Residence Halls will go outside the buildings and smoke. As of January 18, 2006, Loyola adopted a Non-smoking policy, which states that no one may smoke within 15 feet of any entrance to a building designated as a non-smoking building. Although this ordinance is in place, enforcement could be displayed more efficiently.
- Mertz Terrace
Primarily freshman student's residing in the Mertz Residence Hall use the terrace as a location to relax outside. However, many cigarette butts were found around the terrace and were not properly disposed of.

Fertilizer

"The east and west quads are aerated and treated at least once a year, but depending on how beat down from foot traffic and special events it would have a second application. Loyola does not use much fertilizer, but rather gypsum or other organic products. The Super Cal Humic and Apex 10 were used in the Spring of 2015 after the west quad was aerated." (W Curtin - 2/18/2016)

Product Name	Quantity	Usage and Locations
Super Cal Humic	1,000 lbs	West Quad after aeration
APEX -10	50 gallons	West Quad after aeration
Gypsum	1,000 lbs	Used along the sidewalks turf edge where there is salt damage.
ProLinks 18-0-6	500 lbs	Used in turf areas where weeds may have sprouted and the grass needs a boost.
Woodace 14-14-14	250 lbs	Used very sparingly in flower beds as necessary.

Loyola's 2015 Greenhouse Gas Inventory data finds that there were 2,750 lbs of synthetic fertilizer used with 18% Nitrogen and 526 lbs of organic fertilizer used. Although minimal in overall contribution to the air pollution on the Lake Shore campus, fertilizer still plays a role.

Off-Campus Emissions

In FY18 Loyola purchased 56,909,888 kWh of electricity, which was consumed on campus. While this inventory primarily focuses on sources of air pollution within Lake Shore Campus boundaries, emissions should be taken into account at the source of off-site energy production as well.

	kWh (Lakeside AU2018)	EF (lbs/MWh)	lbs	tons
Carbon dioxide	56,909,888	888	50,535,981	25,268
Sulfur dioxide	56,909,888	0.64	36,422	18.2
Nitrogen oxide	56,909,888	0.49	27,886	13.9

Recommendations

In order to continue to reduce Loyola Lake Shore campus air pollution impact and how we might address or reduce emissions going forward, there are several things Loyola University Chicago should keep in mind.

- The primary impact to air quality directly would be from vehicle transportation, especially diesel vehicles, however, at over 22 million pounds of carbon dioxide and 425 pounds of methane (which has 100 times the global warming potential of CO2), we shouldn't discount the role of natural gas combustion on climate change. Making our buildings more energy efficient and looking for alternatives to natural gas are part of Loyola's Climate Action Plan and should be continued.
- With about 20 generators located on the Lake Shore campus it is important to test the generators to see if they are performing to their fullest capacity and most efficiently. If there are alternative generators in the market that will ultimately provide Loyola with cost savings, this could be an investment worth considering. Do the generators require monthly testing? Could this regime be reduced?
- To address cigarette pollution, students and faculty have been working on making Loyola Lake Shore a smoke-free campus. Currently, the Student Government of Loyola Chicago (SGLC) is working on a piece of legislation called Tobacco Free. This legislation, if passed, will not automatically make Loyola smoke-free campus, but it will be a statement from the student body supporting a policy addressing cigarette use.
- It is important that the landscape and campus facilities staff only use the amount of fertilizer necessary, thus reducing the exposure of chemicals in the air and water. Additionally, switching from synthetic to organic products may be beneficial as well.
- The university may want to consider an anti-idling policy for on Loyola property to align with the City's policy of no more than three minutes for on-road diesel vehicles. The exemption below 32 or above 80 degrees Fahrenheit. Also, educate Campus Safety Officers and 8-RIDE Drivers on idling emissions and encourage them to decrease their idling time.
- The university should consider transitioning its own fleet (owned or leased vehicles) to electric or otherwise alternatively fueled vehicles.

- To step away from non-renewable sources of energy, Loyola should consider on-site installation of solar thermal and photovoltaics, and integrate it with facility operations. Wind turbines may be beneficial as well due to the lakeside location.
- To address student responsibility, Loyola should encourage students, especially on-campus residents, to follow energy saving practices such as keeping windows closed and sealed tight during cold season and limiting hot water usage.

Acknowledgements:

A special thank you to the following faculty and staff who assisted in retrieving the information for this air quality inventory for Loyola's Lake Shore campus. The sustainability interns of Loyola's Office of Sustainability, Christie Kochis and Stephen Tuscher were responsible for contacting, gathering, and documenting the information relative to this inventory.

Aaron Durnbaugh, Director of Sustainability at the Institute of Environmental Sustainability (IES), was the staff member who initiated this inventory and provided guidance and connections throughout the semester. He was also the person who set up the meeting with Ted Ruswick, the Chief Engineer in the Facilities Department of Loyola.

Ted Ruswick and Greg Spalding, the Chief and Assistant Chief Engineers, were helpful in acquiring information about the campus generators, boilers, furnaces, steam plant, fire pumps and their capacities. Mr. Spalding gave a tour of the main generators on the Lake Shore campus to gather accurate data and photographs.

William Curtin, the Director of Environmental Services in the Facilities Department, assisted in providing data for the fertilizers.

Zhenwei Zhu, IES Lab Manager and Analytical Chemist, provided information for the laboratory chemical storage.

Finally, David Treering, Geographic Information Systems Specialist and IES Communications Manager, worked with the sustainability interns to gather information from the inventory and created an interactive map of the Lake Shore campus indicating the sources of air pollution throughout the campus. He utilized the ArcGIS Webmap software to create this map inventory.

The 2020 update of this report was conducted by Alexis Enright and Bilguun Delgerssaikhan.