



BUS DOWN: Minimizing the Effects of Bus-Related Air Pollution in Irvine Campuses

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Background

- Air pollution has become a pressing and persistent public health concern for suburban and city communities, such as the City of Irvine
- Despite efforts made in Irvine City to transition to more eco-friendly forms of transport, many citizens and students rely on lower-cost bus services, which unfortunately exacerbate air particle pollution.
- Particulate matter (PM) is produced primarily from combustion processes, such as those occurring in fuel powered vehicles
- PM comes in a variety of shapes and small sizes, consisting of hundreds of different chemicals. Two major categories are PM_{2.5} and PM₁₀, which measure 2.5 and 10 micrometers respectively, and pose significant health hazards
- 2% of all heart and lung diseases are caused by air contamination, to which PM largely contributes. Due to its minuscule size, PM is inhaled by humans exposed to it and are therefore prone to develop respiratory diseases, cardiovascular problems, and lung cancer due to its carcinogenic effect

Hypothesis

Daily bus traffic and idling times contribute a substantial impact on air quality, within Irvine City School campuses.

Methods

- General data collection was conducted using a Temtop P600 Air Quality Monitor to evaluate air quality near Irvine Valley College bus stops
- PM_{2.5} data was recorded from car traffic and bus traffic in low and high frequencies.
- Additional data was collected at the campus of University of California, Irvine, the University Town Center bus stop, and Irvine High School's bus stop



- For each test, the Temtop portable monitor was activated for approximately 3 minutes. Readings were recorded for idling and stopping.
- The data was then cross referenced with the City of Irvine's air quality index data over the past week to account for daily (and hourly) natural fluctuations in air quality.

Figure 1: Temtop P600 Air Quality Monitor

Results

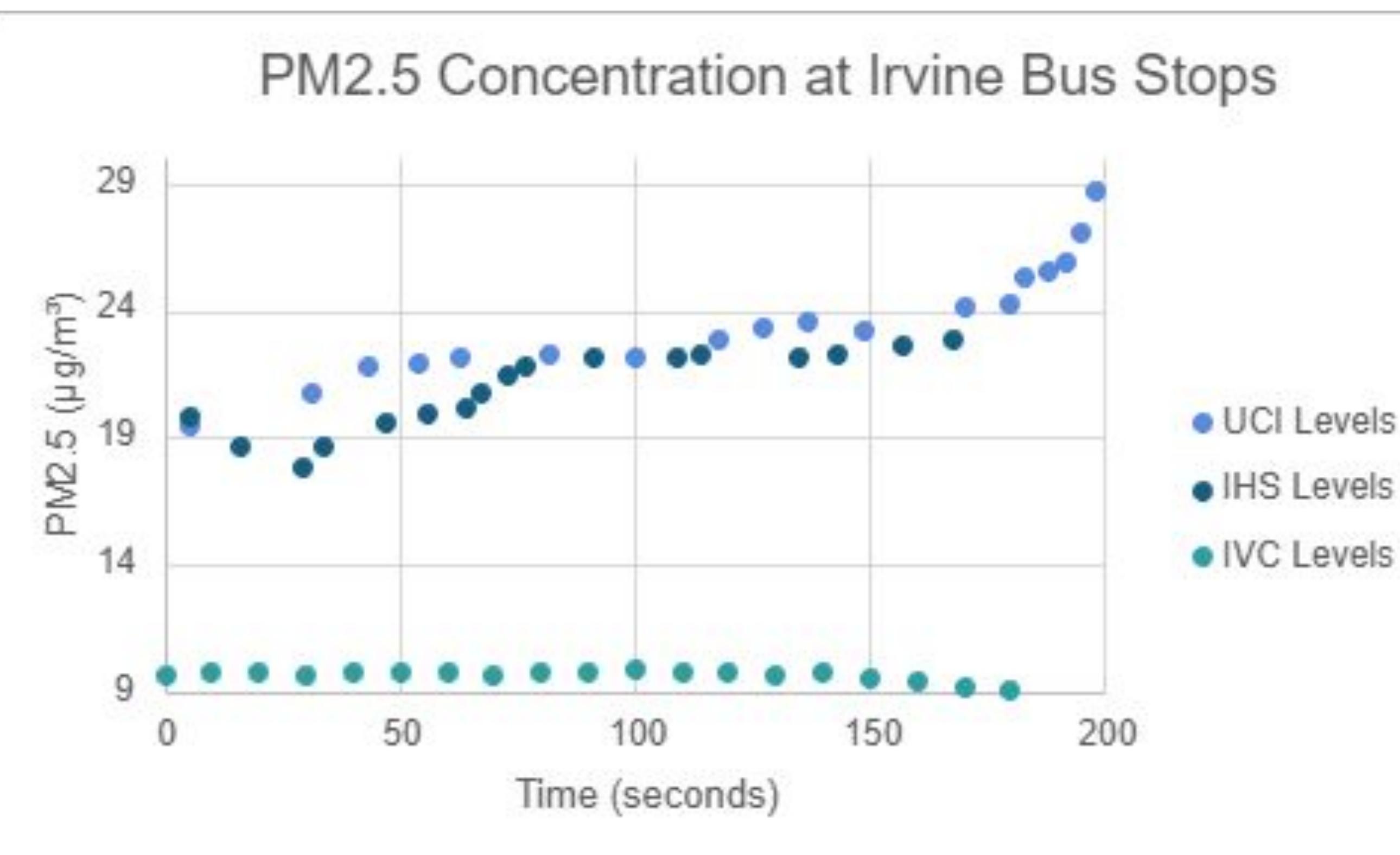


Figure 2: Results of PM_{2.5} levels on Irvine campuses

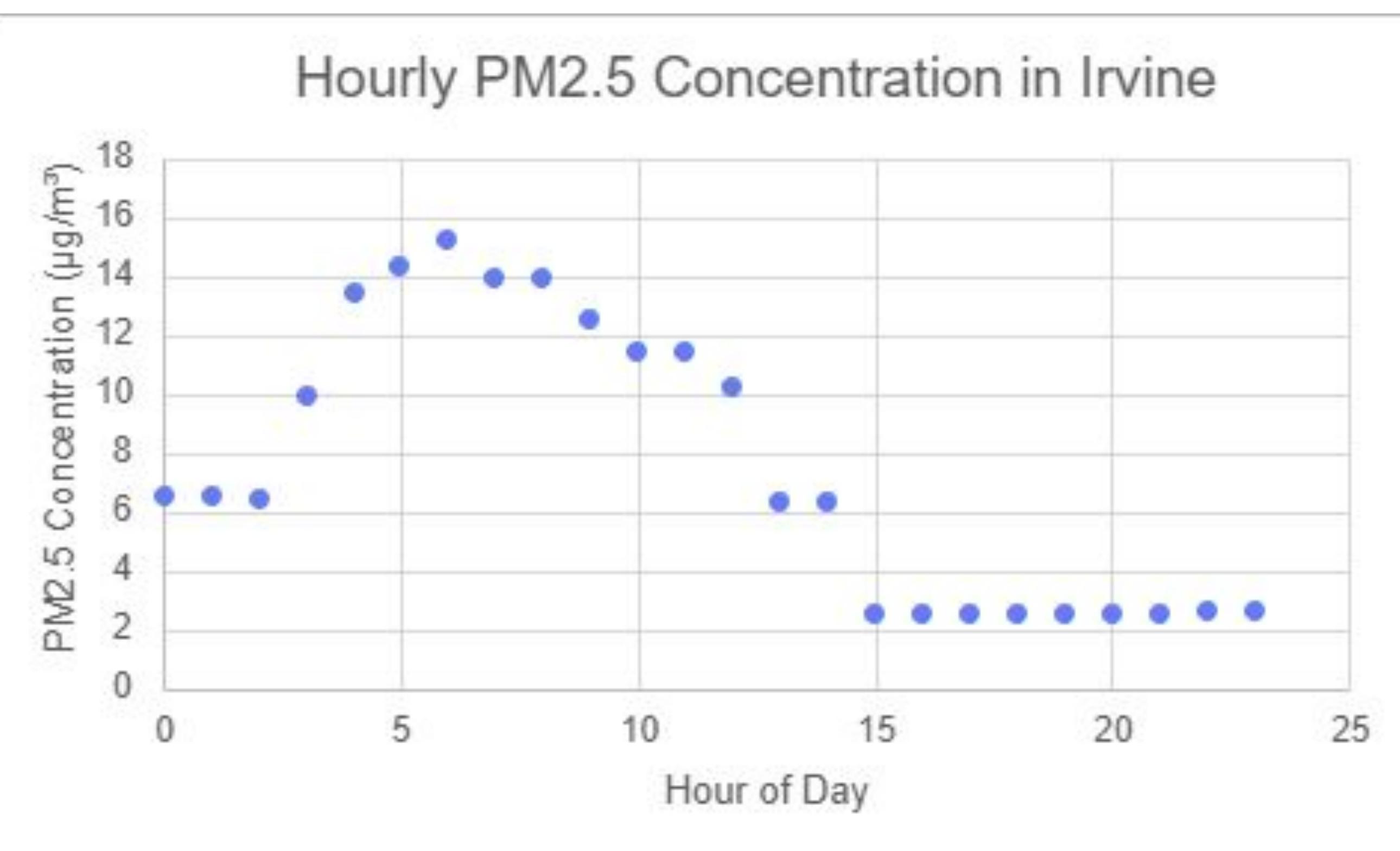


Figure 3: Hourly concentration of PM_{2.5} in Irvine (Nov 9, 2025) from IQAir

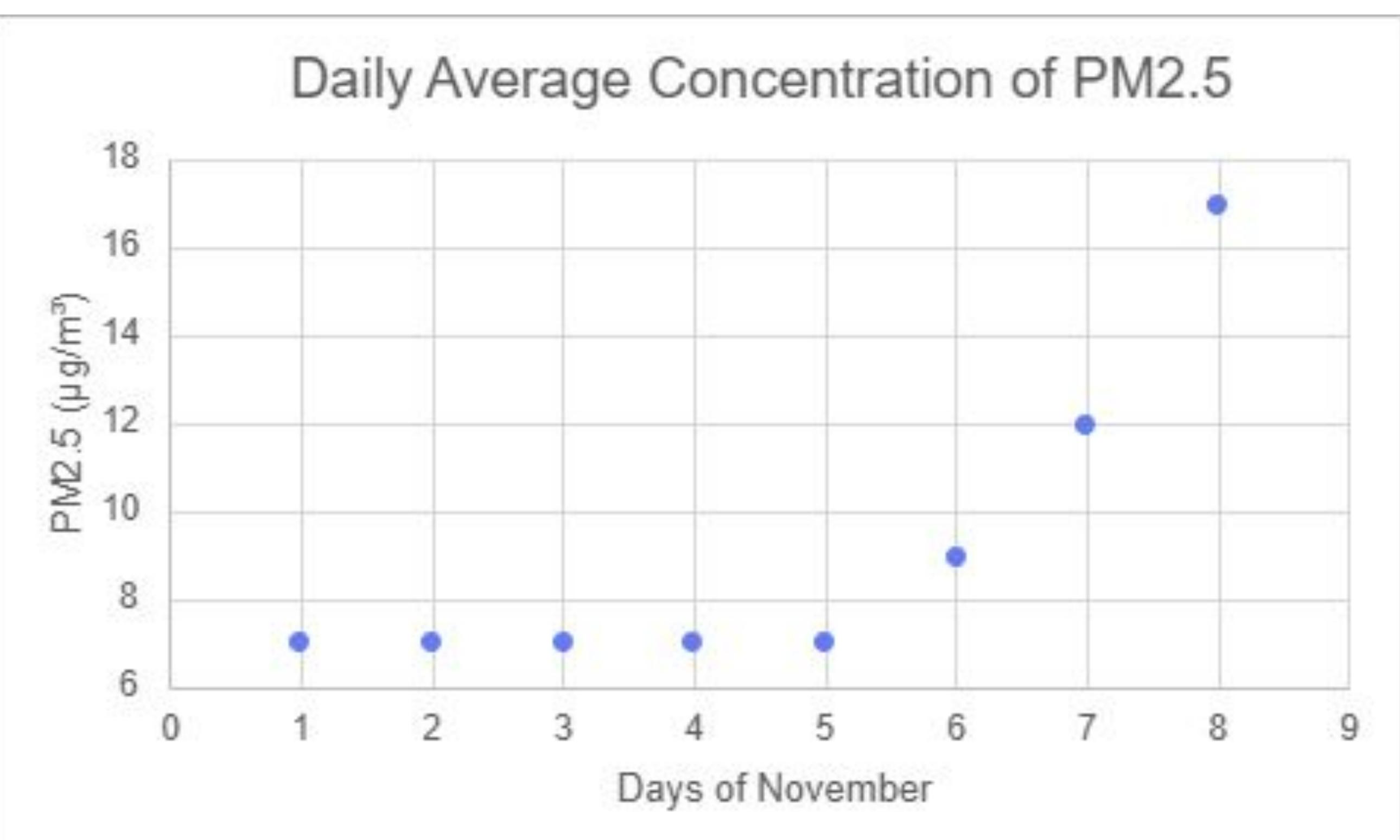


Figure 4: Daily Concentration of PM_{2.5} in Irvine during the first week of November

Implications/Future Work

- There are various temporary solutions that can be implemented before the OC bus line switches to entirely electric fleets in 2040
- The implementation of a hybridized air filter as proposed by Rotrueder Chotigawin in "Next-Generation Eco-Friendly Hybrid Air Purifier: Ag/TiO₂/PLA Biofilm for Enhanced Bioaerosols Removal" has been successfully developed and hypothesized to help filter PM_{2.5} and other pollutants from the air
- Another, more feasible solution is to incorporate a higher efficiency bus system known as "Bus Lots," as shown in Figure 5.
- This system would create larger parking lots near populated areas. Buses would line up in designated zones to pick up and drop off passengers safely. Commuters would be able to park their cars at the "Bus Lot" and take the bus to their respective destinations. This allows for more efficient transportation.
- Future work will be more solution-oriented, and more extensive data trials will be taken.
- Further research will seek to propose additional solutions before 2040 with further data collection.



Figure 5: Santa Ana train station Bus Lot

References

- Chotigawin, Rotruedee & Bhuvaneswari Kandasamy, et al. "Next-Generation Eco-Friendly Hybrid Air Purifier: Ag/TiO₂/PLA Biofilm for Enhanced Bioaerosols Removal." *International Journal of Molecular Sciences*, Vol. 26, Iss. 10, 2025, <https://www.mdpi.com/1422-0067/26/10/4584>.
- Jaworski, Artur, & Vasyl Mateichyk, et al. "Towards Cleaner Cities: An Analysis of the Impact of Bus Fleet Decomposition on PM and NOX Emissions Reduction in Sustainable Public Transport." *Energy Transition and Environmental Sustainability*, Vol. 16, Iss. 19, 2023, <https://www.mdpi.com/1996-1073/16/19/6956>.
- Larson, Thomas. "FEDERAL TRANSIT BUS TEST. Performed for the Federal Transit Administration U.S. DOT." *Pennsylvania Transportation Institute*, Vol. 7, 2014, <https://www.pa.gov/content/dam/copapwp-pagov/en/penndot/documents/programs-and-doing-business/transit/procurement/documents/new-flyer-of-america-model-xn40.pdf>.
- Ngoc, Le This Nhu & Minjeong Kim, et al. "Particulate Matter Exposure of Passengers at Bus Stations: A Review." *International Journal of Environmental and Public Health*, Vol. 15, Iss. 12, 2018, <https://www.mdpi.com/1660-4601/15/12/2886>.