# Healthy cities start with chemistry

## Air pollution data are essential for sustainable growth—but they're not the only factor

**HIND A. AL-ABADLEH,** SPECIAL TO C&EN

The World Health Organization recognizes air pollution as an "invisible killer," a major ongoing public health issue, and a contributor to climate change. Cities are critically important for understanding air pollution: while cities occupy only 2% of the world's landmass, they consume two-thirds of the world's energy, and they're responsible for more than 70% of global carbon dioxide emissions.

Extensive data analyses by organizations such as the Intergovernmental Panel on Climate Change (IPCC) have focused only on relatively large metropolitan centers and megacities. Midsize cities—those with populations between 150,000 and 500,000—outnumber large metropolitan centers, yet little to no information exists on their air quality and carbon footprint. The absence of data for midsize cities hinders efforts to assess the public's response and engagement with information about air quality and climate change.

**Hind A. Al-Abadleh's group established an air quality–monitoring project in Kitchener, Ontario, a part of the Waterloo Region, the third-fastest-growing region in Canada.**

To address this need, my group launched a pilot air quality–monitoring project in 2020 in Kitchener, Ontario, the largest city in the Waterloo Region and about 100 km from Toronto. With a population of 619,000 in 2019, Waterloo is growing at a rate of 1.6% per year, making it the third-fastest-growing region in Canada. The region has only one air quality–monitoring station—located in a Kitchener city park—which measures nitrogen oxides, ozone, and fine particulate matter ($PM_{2.5}$). Data collected by the station are used to calculate the region's air quality health index. But traffic and other sources of pollution disproportionately impact different sites throughout the region, making it difficult to quantify the impact of population growth and fast development on urban air quality and greenhouse gas emissions.

We installed a network of five multisensor air quality–monitoring pods near schools in Kitchener in fall 2020 within areas of high industrial and traffic emission sources. Our aim was to directly measure pollutant levels at these locations to compare them with the data from the regulatory station. Our first publication measured elevated $NO_2$ and $PM_{2.5}$ from the 2021 summer wildfires and identified a hot spot downwind of a highway with $PM_{2.5}$ levels two to six times as high as those measured by the provincial station (*Atmosphere* 2022, DOI: 10.3390/atmos13010083).

But collecting these data was only the start. According to the IPCC report on climate change adaptability, a community's vulnerability to climate change depends not only on its exposure—calculated using climate and air quality data—but also on its pollution sensitivity, which is impacted by demographics and income, and on its adaptive capacity, which depends on factors such as access to health and social care facilities, local green space, and the proportion of dwellings needing repair. Fast-growing regions and midsize cities around the world need to embrace an evidence-based approach that integrates physical sciences and health data with socioeconomic indicators to enhance community resilience in the face of climate change.

With these factors in mind, we put our data to work in the community. Our team aimed to increase public education and engagement and promote long-term behavioral changes related to environmental sustainability. We conducted numerous media interviews and delivered outreach presentations to over 350 students at the schools close to our monitoring network. These presentations encouraged teachers to enhance the air quality content in their science lesson plans and develop new living lab experiments that link chemistry and physics with meteorology and mathematics. This outreach was intended to highlight to schoolchildren how a fundamental understanding of chemistry helps university researchers design and execute projects that benefit society, allow the students an opportunity to ask questions about their lived experience with air quality, and provide leadership opportunities to the university students in community engagement.

This public engagement component is critical. To instill proactiveness, support, and optimism and enhance the resilience of different groups working to adapt to climate change impacts, researchers should share data from quantitative studies promptly with schools, city councils, regional and federal governments, and local media. All levels of government must invest in monitoring and engage with the public on open-access data interpretation to help citizens visualize changes to the quality of the air we breathe during extreme weather events and the impacts of our collective lifestyle choices aimed at lowering $CO_2$ levels. Ultimately, these efforts will help us build sustainable cities and consciously and proactively adapt to the climate crisis.

As chemists, we are uniquely qualified to address environmental challenges at a molecular level. If you are interested in starting a similar project, reach out to your sustainability officers and school boards. Show your community that chemistry is central to explaining how behavioral changes affect pollutant levels in the short and long term.

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Do you have a story you want to share with the chemistry community? Send a submission of about 800 words to **cenopinion@acs.org**.

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