Pollution league tables for UK urban areas reveal the expected and unexpected

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The Bedfordshire town of Luton has come bottom of a league table of predicted city-wide air pollution concentrations among UK cities, according to new analysis by the Universities of Birmingham and

Lancaster.

Although Luton's air pollution emissions are about as expected for its population, the town's compactness limits dispersal of pollution, meaning it drops to last place among the 146 most populous UK places in terms of predicted air pollution concentrations.

At the other end of the scale, Milton Keynes and Stoke on Trent fare much better than expected, for their respective sizes, with average-to-poor emissions of air pollution mitigated substantially by better dispersal of pollution into less compact city spaces.

The new study, published in *Environmental Research Letters*, was carried out by researchers in the Birmingham Institute for Forest Research and colleagues in Lancaster University's Environment Centre. The team used government statistics to build relationships between a city's population, built-up area, air pollution released, and expected city-wide pollution concentrations.

The resulting relationships predict what emissions and concentrations are expected for an urban area of any population in the UK.

The team then compared the 146 most populous urban areas across the UK with their predictions to find which settlements were performing relatively better or worse than expected.

The league table for emissions measures how efficiently a city moves people and heats homes compared to the UK average for its population-size. The league table for city-wide concentrations shows how the area of a city modifies the effect of its emissions to give better- or worse-than-expected pollution concentrations across the urban area.

The study looked at a range of air pollutants but focused on traffic-

generated nitrogen oxides, which are a major health concern in cities. The relationship converting government emissions statistics into city-wide pollutant concentrations was shown to be consistent with that derived for other cities from satellite measurements.

Key findings included:

- Many cities across the Midlands are performing worse than expected, both in terms of emissions and expected concentrations; both Royal Leamington Spa and Coventry start poor in terms of emissions and slide further, towards the bottom of the league, when considering expected concentrations of city-wide pollution
- Other cities performing worse than expected include Crawley, Cardiff and Stevenage
- London is just outside the top 20 for emissions, i.e. doing much better than expected for its size, but is only mid-table for city-wide pollution concentrations
- Weybridge, Aldershot and Macclesfield, in England, along with Livingston in Scotland, benefit greatly from having space to disperse their pollutants, as do Milton Keynes and Stoke-on-Trent

Lead author Professor Rob MacKenzie explains: "What we're interested in is not just how much pollution is produced, but how much is in the air. Our new study shows how effective the particular urban form of a city—its layout and the types of building—is in dispersing the pollution.

"For example, Milton Keynes is at the top of our list, doing much better than we would expect with the biggest gap between the amount of pollution produced and the concentrations in the air we breathe. The town's middling rank for emissions reflects personal transport choices and the town's traffic management; it's much better-than-expected

performance for concentrations reflects the way the city is laid out, with its distinctive mix of grids and roundabouts, and the inclusion of parks and green spaces, which all contribute to this overall effect.

"In contrast, we have Luton right down at the bottom. This is a more densely populated urban area doesn't gain much benefit from its compactness in terms of emissions and its compactness works against dispersion of pollution resulting in worse-than-expected city-wide concentrations."

Dr. Duncan Whyatt of Lancaster Environment Centre added: "London appears right in the middle of our pollution concentration table, having done well in terms of lower emissions for its size. The lower-than-expected emissions may be to do with the intense concentration of effort in moving high volumes of people through and around the city. Its well-developed public infrastructure, means that, for its size, it produces less pollution emissions than, say, Birmingham, which is still very heavily car-dependent."

This study offers valuable insights for urban planners who can start to take a closer look at the cities that do particularly well for pollution dispersal and analyse what elements should be prioritised to improve overall air quality in future city design.

"Using this type of analysis will help planners make those important decisions that find the right balance between spreading out urban development and providing sufficient green spaces, but also managing emissions by transporting people efficiently and heating homes efficiently," says Professor MacKenzie.

More information: Rob MacKenzie et al, Urban form strongly mediates the allometric scaling of airshed pollution concentrations, *Environmental Research Letters* (2019). DOI:

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