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Connecting Tomorrow's Dots

Breakthrough Cities Briefing | Urban Air Quality | November 2017

This briefing has been developed as a pre-read for participants in the Breakthrough Cities workshop convened by Volans and Innovate UK in Nottingham on 22 November 2017.

The workshop will explore the business and engagement models needed to help solve the air quality crisis in our cities. We will share insights from the day post-event.

Part 1: Context

Air pollution is one of the biggest killers on the planet. According to a landmark study published in *The Lancet* last month, it's responsible for 6.5 million premature deaths a year worldwide. That makes it deadlier than war and hunger. Deadlier even than malaria, AIDS and tuberculosis combined.

Those in low- and middle-income countries are worst affected, but even here in the UK, some 40,000 deaths a year are attributed to poor air quality. In the city of Nottingham, it's estimated that 5.9% of all adult mortality (equivalent to 127 deaths) was attributable to air pollution in 2014.

These numbers represent a major public health crisis. And while the impact may not be equally distributed across society, it is universal: nobody is immune to the effects of air pollution. Your health has suffered – and so has mine.

So what are the causes of this crisis – and what is being done about it?

According to the Healthy Air Campaign, up to 70% of air pollution in the UK is caused by road traffic. This includes both nitrogen dioxide (NOx) – most associated with diesel vehicles, but petrol vehicles emit NOx too – and particulate matter (PM10 and PM2.5). The latter is at least in part caused by tyre and brake wear, so is an issue even with electric vehicles. Other sources of NOx, PM10 and PM2.5 include aviation, trains, gas boilers, farming, construction and wood burning.

Measures like London's recently introduced T-Charge are baby steps in the right direction. But, given the scale of the crisis, the response of all levels of government to date is inadequate. The legal NGO ClientEarth has already twice successfully sued the UK Government over its air quality plans – and has recently announced it will be going for the hat trick.

Even before ClientEarth announced it was once again taking legal action, the Government's most recent air quality plan, published in July, had been widely criticised by campaigners and city leaders. Its headline proposal – to ban the sale of any new petrol or diesel vehicles by 2040 – sets a deadline too far in the future to be of any material difference today.

As Stanford Professor Tony Seba said of France's plan to do the same: "banning sales of diesel and gasoline vehicles by 2040 is a bit like banning sales of horses for road transportation by 2040: there won't be any to ban." (Tony is a co-founder of RethinkX, a think-tank that has predicted a dramatic shift towards autonomous electric vehicles and transport as a service during the 2020s.)

As part of the latest air quality plan, the Government has shifted the onus for coming up with solutions onto local authorities, requiring them to come up with their own plans by March 2018. In particular, five UK cities – Nottingham, Derby, Birmingham, Leeds and Southampton – are under pressure to come up with local strategies for bringing down emissions in order to comply with legal limits for nitrogen dioxide by 2020.

Significantly, in the most recent iteration of its air quality plan the UK Government has broadened the mandate for these five cities. Initially, the guidance from DEFRA focused on the implementation of Clean Air Zones in the city centres. Now the City Councils have a looser brief: to reduce air pollution to within legal limits by any means that can realistically and cost-effectively be implemented by 2020.

ClientEarth has been critical of this perceived 'backtracking' on the previous commitment to Clean Air Zones – as well as the focus on just 5 cities, when there are 45 other local authorities around the UK with illegal levels of air pollution.

But, notwithstanding these concerns, there's a positive dimension to this approach. Tackling the air quality crisis requires holistic, bottom-up, innovative solutions that involve public and private sectors – *as well as* strong national policies. In this context, empowering local authorities to come up with solutions that make sense in their context is a welcome opportunity to foster innovation and cross-sector collaboration.

Part 2: The solution landscape

So what can city authorities and the private sector do to address this crisis? There is no one-size-fits-all approach to cleaning up the air we breathe, but here we outline some of the most promising levers for change – as well as some examples drawn from across the UK and beyond. This is by no means a comprehensive list!

A. Reducing the number of polluting vehicles on the road

As transport is the leading cause of air pollution in cities, it's a good place to start. Clean Air Zones certainly make a difference, as numerous studies have shown. For example, when temporary traffic controls were put in place during the 1996 Olympics in Atlanta, this led to a dramatic overnight reduction in the number of people admitted to hospital as a result of asthma attacks.

Project ACCRA in Leeds (a collaboration between the City Council, Cenex, the Transport Systems Catapult, Earthsense, Dynniq, and Tevva Motors) is taking a more tech-driven approach. The team is working to develop vehicle-to-infrastructure technology that will enable them to use live air quality data to identify where in the

city pollution levels are too high at any one time. Participating hybrid vehicles that enter that zone will then automatically be switched to fully electric.

Some cities and companies are focusing on developing the infrastructure (and business models) needed to incentivise and help citizens switch to using electric vehicles. Singapore has announced its first electric vehicle (EV) car-sharing scheme with a fleet of 1,000 EVs and 2,000 charging points across the country to be installed by 2020.

Companies too are pushing ahead. Nissan, for example, is offering its EV customers a whole suite of integrated ecosystem services such as a home charging system for EVs that doubles up as an energy storage system for the home. Riversimple, meanwhile, has developed a 'mobility as a service' business model for its hydrogen fuel-cell cars – where customers pay a fixed monthly cost for using the car (which includes insurance, maintenance, etc.) instead of owning the car.

Other approaches focus on reducing highly polluting traffic by making alternatives more attractive – whether that's using public transport, cycling or walking. The increasing prevalence of car-sharing platforms such as BlaBlaCar and Liftshare is also promising for air quality (so long as it doesn't undermine public transport).

Design and urban planning matter too. As Jeff Speck eloquently argues in his 2013 TED talk, "walkability" should be the goal of city planners everywhere, since cities that are more walkable enjoy better health, environmental *and* economic outcomes than their more car-orientated counterparts.

And of course, it's not just passenger vehicles that pollute city centres: keeping non-electric vans and trucks out is just as important. Greener, cleaner last mile logistics fulfilment – as pioneered by companies like Gnewt Cargo, WEGO and Hubl – is therefore critical.

B. Capturing better data – and turning it into actionable insights

Most of what we know about the quality of air in specific locations is based on modelling rather than monitoring. Access to truly localised, real-time data on air quality is, for now, extremely rare. But that is changing fast as sensor technology improves and costs come down. The proliferation of connectivity between devices (the Internet of Things) and our increasing ability to mine vast quantities of data for insights also open up new avenues of possibility.

A number of companies are already playing into this space, including Airnode (which promises 'X-ray specs for air quality'), EarthSense (which uses static and airborne sensors, as well as satellite data, to monitor pollution levels), Plume Labs (which has developed a smart air quality tracker for individuals) and Spot Sensors (which offers high precision air quality monitoring devices designed for industrial sites and cities).

At a city level, Chicago's Array of Things (AoT) project is installing a network of interactive, modular sensors across the city to collect real-time data on air pollution (among other things) and share this via an open data platform. By sharing this data

openly the goal is to stimulate academic and commercial R&D, inform policymakers and empower citizens to minimise their exposure to harmful pollution.

Similarly, Helsinki is building an air quality IoT system and open data platform that will map air pollution in real time and project this information to screens on trams and the metro. Many other cities globally have integrated sensors into existing features of the urban landscape – including park benches (Boston), Google Street View cars (Denver), bicycles (Dublin) and even pigeons (London).

This is an emergent field with a lot of promise. Once smart sensors are deployed at scale and are generating streams of high quality, real-time, actionable data and insights that can inform the choices of individual citizens, companies and public authorities, we can expect impact to go exponential.

C. Filtering, capturing and recycling pollutants

Airlabs has developed a range of products that filter out pollutants for both individual consumers and cities. Its pollution-fighting bus shelters are an eye-catching example of the latter (though, for now, only on a very small scale: the initial pilot saw air cleaning units installed at 3 bus stops in central London).

German start-up Green City Solutions has developed a plant-based air filter – CityTrees – that is as powerful as 275 normal trees. CityTrees have been installed in a number of European cities, including Brussels, Glasgow and Paris. Real trees, too, are a critical part of cities' public health infrastructure, as The Nature Conservancy argues.

Graviky Labs has gone one step further than merely filtering the air. They've developed a retrofit technology for diesel generators, trucks and cars that can capture pollutants and turn them into ink. Since 2013, Graviky claims to have cleaned 1.6 trillion litres of air.

Part 3: Creating sustainable business models to solve our air quality crisis

6.5 million premature deaths a year worldwide represents a clear moral imperative to act. Alleviating human suffering on this scale is the kind of 'Massive Transformative Purpose' that should motivate innovators everywhere.

However, experience tells us that in order to implement solutions at the requisite speed and scale, we need not just a moral imperative but sound business and economic models. We need to be able to translate this challenge – or, rather, multiplicity of challenges, since air quality is a complex, multifactorial problem – into opportunities.

A good place to start is to look at the costs associated with the status quo. According to The Grantham Research Institute, air pollution deaths in the UK cost the equivalent of 4.6-7.1% of national GDP. In other countries, the figures are higher. In China, for example, they estimate the economic cost of the 1.23 million air pollution related deaths in 2010 at 9.7-13.2% of the country's GDP.

The negative impact of air pollution is a result both of lost productivity and increased healthcare and welfare costs. *The Lancet* Commission on pollution and health estimates that productivity losses due to pollution-related diseases can be as high as 2% of GDP in low- to middle-income countries. And pollution-related diseases account for 1.7% of annual health spending in high-income countries, rising to 7% for middle-income countries that are heavily polluted and rapidly developing.

In total, they estimate the total hit to the global economy at $4.6 trillion per year, equivalent to 6.2% of global economic output. This estimate, they add, is likely to rise as we learn more about the link between pollution and different diseases.

Then there are the potential co-benefits of certain solutions. Congestion on the roads, for example, causes a further significant loss of output. The Centre for Economics and Business Research estimates that over the period from 2013 to 2030, road congestion in the UK will cost £307 billion in wasted time and petrol.

In short, the costs incurred as a result of air pollution nationally and globally are gargantuan, which means the potential economic upside of cleaner air is also huge. The key for those who want to contribute to solving this crisis is to figure out how to capture some of that economic value.

A key first step is to identify who stands to benefit most from a particular solution – and therefore who your potential customer is. That might be a healthcare provider that's incurring massive costs treating people with respiratory conditions. It might be a company that's fed up with productivity lost to road congestion simply being a cost of doing business. Or it might be individual citizens concerned about the impact on their family's health and wellbeing. And yes, occasionally it might even be a Government – like the UK's – in dire need of help to comply with existing regulation on air quality.

The next step is to develop a business model – and the necessary partnerships – that will enable a solution to be implemented at scale and deliver a social, environmental and economic return.

For more on business models, see Volans' 2016 report, Breakthrough Business Models: Exponentially more Social, Lean, Integrated and Circular and our subsequent work on The Six Features of Breakthrough Business Models.