

2020:
Our
Air in
Review

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Contents

In a year where so much has happened, it is inevitably hard to cover everything we would like to. However, we have tried to cover as many topics as possible in order to give a broad overview of the year.

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A note from our CEO



“The choices we make now, in this unexpected moment of opportunity, have the real potential to make an enormous difference.”

The air around us, both indoors and outdoors, is integral to human health, our comfort and productivity, and is a barometer for the state of our planet.

Yet in a recent survey commissioned by AirRated, only 22% of respondents stated that they are knowledgeable about air quality.

Allow me to deliver some hard facts: the WHO estimates that as many as 7 million people a year die prematurely as a result of air pollution. A recent report approximates that 15% of COVID-19 deaths could be attributed to poor air quality. The British Heart Foundation offers the grim prediction that air pollution could cause an excess of 160,000 heart attack and stroke deaths by 2030 unless immediate action is taken.

These, I know, are hard pills to swallow, especially when they are paired with the equally bitter pill of climate change and what we are doing to our planet.

So how can we reduce these shocking figures? The first step is education. In the aforementioned AirRated survey, only 40% and 45% of respondents said they understood the sources of indoor and outdoor air quality respectively. Furthermore, 62% of business owners said that the reason why they hadn't made changes to the air quality in their buildings was due to a lack of information. Awareness and understanding of air quality holistically, although growing, is still low.

Our goal is to help to remedy this. Our report, 2020: Our Air in Review, looks back on this astonishing year with a focus on air quality, both indoor and outdoor. We haven't covered everything to do with air quality here – we couldn't possibly – but we have endeavoured to provide a broad overview of some of these issues to help spread awareness, to contribute to educating where we can, and to amplify the voices of those who have been doing the work for years.

There are themes covered in this report that are close to my heart. I have always believed that buildings should help human health rather than hinder it. But if 2020 has taught us one thing about healthy buildings, it's that they should be a line of defence for us, too. Further, healthy buildings can no longer be allowed at the expense of sustainability.

But the onus cannot just be on building owners, developers and occupiers: as you'll see in many of our interviews in this report, experts from all reaches of our industry are calling on the Government to set clearer, stricter and more ambitious standards and regulations on building development and air quality, as well as associated climate issues. True evidence of this was seen last week with the Government's Future Buildings Standard. This proposal outlines improvements for ventilation, filtration and air cleaning for new offices and commercial properties, whilst maintaining a sustainable approach to building design.

Finally, we need to look to the future. It's widely accepted in the industry that 80% of buildings that will still be around in 2050 have already been built. When building, renovating and occupying spaces, we need to be thinking ahead – way ahead – to a future that, despite the best efforts of brightest minds, remains unclear. The choices we make now, in this unexpected moment of opportunity, have the real potential to make an enormous difference.

If you have any thoughts, questions or feedback about this report or air quality in general, please feel free to get in touch with me or the AirRated team: our details are at the back of the report. We'd love to hear from you.

Thank you,

A handwritten signature in black ink, appearing to be 'Francesca Brady', with a long horizontal flourish extending to the right.

Francesca Brady
27th January 2021

01

Introduction

What is this report?

This report covers the remarkable year of 2020 from the perspective of air quality. It is a comprehensive source of information for anyone who would like to learn more about both indoor and outdoor air pollution and the impact it is having on us all.

We have selected some of the most significant events that have occurred over the course of the year, and looked at some of the key changes that have taken place, predominantly as a result of the COVID-19 pandemic. We have also conducted our own research to gain a greater understanding of the way in which perceptions related to air quality are shifting.

We touch on a wide range of subjects, including promising progress that has been made, change that is worth celebrating, and instances where a lack of progress still prevails. There are also sections outlining measures that we can all take to help in our fight against the global health crisis that is air pollution.

The main focus for this inaugural report is the UK, particularly London, but we have also explored several global air quality issues that are affecting us all.

What does it aim to achieve?

As a company, our goal is to raise awareness of all aspects of air quality. We want to ensure that we are all more conscious of the quality of the air we are breathing and how this may be impacting our health. We truly believe that education is one of the most powerful tools we have in our fight against poor air quality.

It goes without saying that we cannot achieve this alone. There are so many individuals and groups that are doing incredible work, and we want to come together and be part of the change and the solution. Look for the signpost sign to direct you to the work, resources and tools done by other groups and individuals working to improve air quality.

Access to clean air should be a human right, and we need to act now to create conditions for us, and generations to come, to lead long, healthy and productive lives.

02

Air pollution: the
silent killer

Air pollution: the silent killer

Poor air quality is the largest environmental risk to public health in the UK and around the world. Nine out of ten people breathe polluted air every day, and this causes as many as 8.9 million premature deaths worldwide each year.

Air pollution reduces mean life expectancy by 2.9 years, making it responsible for shortening people's lives on a scale far greater than tobacco smoking, HIV/AIDS and all forms of violence, including wars, put together.

What are the causes?

Pollutants are emitted from a range of natural sources, including smoke from wildfires, ash from volcanoes, and salt from sea spray. Most air pollution, however, is anthropogenic and a great deal of this comes from the burning of fossil fuels including coal and gasoline.

Air pollution is often considered in relation to outdoor sources and spaces, but there are also many types of indoor air pollution. For a deeper understanding of the indoor-outdoor air pollution continuum, please refer to page 14.

What are the effects?

When pollutants enter the body, they impact various organs and systems, including:

- The eyes, nose and throat
- The lungs and respiratory system
- The heart

Emerging evidence also suggests that air pollution may affect the brain and could be linked to dementia and cognitive decline.

Air pollution can affect anyone at any stage of their life, causing a wide and complex range of health issues. In some cases, damage can be gradual and may not become apparent for many years.

Short-term effects include:

- Respiratory illnesses like pneumonia or bronchitis
- Irritation to the nose, throat, eyes, or skin
- Headaches, dizziness, and nausea
- Coughing, sneezing, shortness of breath
- Exacerbation of asthma

Long-term effects include:

- Strokes and cardiovascular diseases
- Respiratory diseases like emphysema
- Lung cancer
- Reduced life expectancy



Air pollution and health inequalities

Although air pollution can be harmful to everyone, some people are more affected than others. This may be because they live in a particularly polluted area, are exposed to higher levels of air pollution in their day-to-day lives, or are more susceptible to health problems caused by air pollution.

Groups that are more affected by air pollution include:

- Older people
- Children
- Individuals with existing cardiovascular or respiratory disease
- Pregnant women
- Communities in areas of higher pollution, such as close to busy roads
- Low-income communities

What needs to be done to improve air quality?

Improving air quality is crucial in order to reduce the health impacts discussed above and, in turn, help people live longer, healthier lives.


Over 80% of the UK's outdoor air monitoring sites are recording levels of PM2.5 above the WHO guideline limit, and the current UK limit is also more than double that recommended by the WHO.

In March 2020, MPs voted not to introduce the WHO guidelines, and the current Environment Bill includes only a commitment to set a target by 2022 with no certainty over what this target will be. It is going to be essential to outline bold targets with a detailed plan to bring down PM2.5 emissions.

The UK Health Forum and Imperial College London, in collaboration with Public Health England (PHE), developed a modelling framework and estimated that a 1 $\mu\text{g}/\text{m}^3$ reduction in fine particulate air pollution in England could prevent the following over an 18 year period:

- 50,900 cases of coronary heart disease
- 6,500 strokes
- 9,300 cases of asthma
- 4,200 lung cancers

Anybody can take steps to reduce air pollution, and it's clear that acting now needs to become an urgent priority. For more information on how you can help on a personal level, see our section on air quality and the planet on page 71.



If you would like to learn more, visit Global Action Plan's [Clean Air Hub](#), the one-stop shop with everything you need to know about air pollution.



03

2020 summary:
the year the world
stood still

2020

2020 summary

The 1st January 2020 marked the beginning of a completely new decade that many looked at with a sense of optimism and hope. However, it has transpired to be a strange and unexpected year, that no one could have predicted. There have been record-breaking wildfires, the devastating Beirut explosion, biblical locusts swarms, and of course one overriding challenge: the COVID-19 pandemic.

The year has also seen some significant things happen in terms of air quality. When it comes to Indoor Air Quality (IAQ), the biggest change that has taken place is that it has finally started to gain more recognition. The pandemic has made us all more aware about the importance of healthy indoor spaces with good air quality.

There have also been considerable changes in outdoor air quality across the globe. Following the outbreak of COVID-19, cities around the world reported noticeable reductions in air pollution as daily life came to a grinding halt. A third of the world's population was under lockdown in March, and as human activity was restricted, the natural world seemed to thrive. Emboldened wild animals roamed empty streets, nature reclaimed many urban areas, and skies looked clearer than ever before.



However, these striking short-term effects were regrettably fairly short-lived. As restrictions began to lift around the world, levels of pollutants quickly returned to normal, in some cases exceeding pre-lockdown levels.

This isn't to say that the reductions in pollution were futile. In fact, they acted as a clear indication that we can rapidly and dramatically improve air quality if we take action. Sir David Attenborough summed it up perfectly in his speech broadcasted on BBC One on New Year's Day:

“It has been a challenging few months for many of us, but the reaction to these extraordinary times has proved that when we work together, there is no limit to what we can accomplish.”

The pandemic has revealed what human ingenuity is capable of in the face of adversity. It has spurred us on to be more agile, creative and inventive than before, and there have been plenty of lessons learned along the way.

While the pandemic is far from over, there is nevertheless a sense that we have emerged from 2020 strengthened, refocused and better equipped to tackle future issues. Many of us have come to the realisation that even small actions can make a big difference, and that we are all capable of contributing to change.

After a year of uncertainty, one thing that we can be sure of is that we will look back on 2020 as a momentous year. There are so many things to reflect upon: the challenges, the successes, the lessons, and the opportunities for improvement. Perhaps when people look back on the pandemic in years to come, it will be seen as the catalyst for improving air quality for generations to come.

04

The indoor/outdoor continuum



The indoor/outdoor continuum

When people think about poor air quality, they tend to focus on outdoor air pollutants such as car exhausts or factory fumes. And if Indoor Air Quality (IAQ) is discussed, it is usually treated as a separate issue.

However, the two are very much linked, and a great deal of our exposure to air pollution actually occurs when we are inside. The trappings of modern life mean that we spend more than 90% of our time indoors, making us what many are calling ‘the indoor generation’. It’s likely that in 2020 this figure will have been considerably higher as a result of lockdown restrictions.

Indoor spaces are often much more polluted than we realise, with concentrations of some pollutants often 2 to 5 times higher than typical outdoor concentrations. Due to the fact we are indoors so much, prolonged exposure to indoor air pollution at any level can result in significant long-term health impacts.

It is abundantly clear that steps need to be taken to increase awareness of the threats which are presented by indoor air pollution.

“When it comes to the indoor-outdoor connection of pollution exposure, we live on a continuum.”

Ran Korber, CEO and Co-founder of BreezoMeter



What is the relationship between indoor and outdoor air?

Concentrations of outdoor pollutants rise and fall constantly because of changes in weather, climate, and human activity. For example, outdoor pollutants can build up in the lower atmosphere as a result of temperature inversions. During periods of cold weather, warm air rises into the upper atmosphere and traps cold air beneath it, causing pollutants to build up at low altitudes. Concentrations can also rise quickly in the mornings during rush hour traffic, but subside once traffic diminishes and wind and heat clear the air of excess pollutants. The Earth essentially has its very own natural air-purifying technology that spreads outdoor pollutants far and wide.

Unfortunately for humans, indoor pollutants are not always exposed to any similar processes to reduce their concentrations. Ventilation brings in outdoor air, often referred to as 'fresh air', to dilute indoor contaminants, but this can inadvertently introduce even more pollutants to the inside environment. Outdoor air pollutants can also infiltrate indoor air in ways that may not be immediately obvious, through open windows and doors, and cracks in walls, doors and window sealants. In a [2019 study](#) published in the International Journal of Environmental Research and Public Health, long-range wildfire plumes were found to have elevated average indoor PM2.5 concentrations by up to 4.6 times higher than those found outdoors.

Ralph James, FM & Technical Services Manager at the Met Office, explains: "There is often a naive assumption that fresh air from the outside will be better

than that inside, but this is often not the case. On one occasion, sensors within our HQ in Exeter picked up on a very high dust event, and this transpired to be a Saharan dust cloud hitting the UK. This just shows how easily polluted air can infiltrate indoor spaces and have a detrimental impact on indoor air quality."

To make matters worse, there are also many indoor sources that create more pollution, including everyday items like carpets, furniture, and cleaning products. James went on, "When it comes to creating healthy indoor spaces there are two key phases. You need to think about the air that you're bringing in, as well as limiting indoor sources that are going to pollute the air."

A staggering [3.8 million people](#) die prematurely each year worldwide from illness attributable to the household air pollution. This is mostly caused by the inefficient use of solid fuels and kerosene for cooking. Something that is not always considered is that the exchange of air pollution works both ways. Household air pollution can serve as a major source of outdoor air pollution in both urban and rural areas.

However, when it comes to indoor air pollution, it is certainly not all doom and gloom. Your building can act as a great buffer against outdoor pollution, and there are many simple things you can do to improve your IAQ. To find out more about creating a healthier indoor environment, see our healthy homes section, page 34.

Is the invisible becoming visible?

The outbreak of the COVID-19 pandemic in 2020 started to make us much more acutely aware of the quality of the air we breathe. People are finally starting to acknowledge and understand the value of both good outdoor quality, and good IAQ.

A look at Google Trends shows the development of interest in IAQ since 2011, with a significant peak in September 2020. It is clearly a topic that is now at the forefront of our minds, and it is likely that this trajectory will continue in the coming years.

However, in our recent survey, respondents still said they were still more concerned about outdoor air quality.

In order to shift the balance, we need to improve education about the dangers of indoor air pollution, while demanding greater transparency when it comes to gaining access to all types of air quality data.

There are already several easily accessible sites which are a great source of outdoor air quality data:

1. [BreezoMeter](#)
2. [addresspollution.org](#)
3. [DEFRA Air Information Resource](#)
4. [London Air](#)
5. [Air Quality in England](#)

To learn more about the work BreezoMeter are doing to provide real-time data and help billions of people to reduce their exposure to air pollution, read our interview with CEO Ran Korber on page 105.

▲ **57%**

Despite a 57% increase in awareness about IAQ, there is still more concern about outdoor air quality



In addition to such sources of data, a range of fairly inexpensive products which are able to test air quality have also come to market in recent years. Many of these devices are portable, so you can measure the surrounding air quality wherever you are.

Andrew Teacher, founder at Blackstock Consulting and an executive committee member at the Urban Land Institute explains:

“The step change has been driven by the rise of consumer products that present air quality data in an accessible and dynamic way. There’s a proliferation of sensors, data and technology, which means it’s getting cheaper to understand how healthy both indoor and outdoor spaces are.”

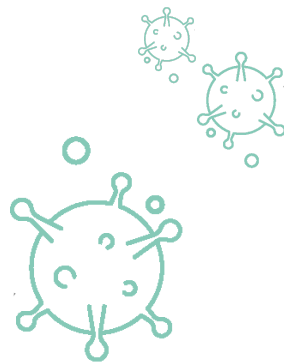
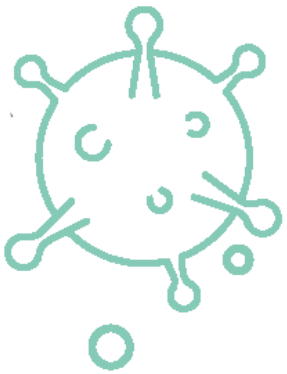
One of the most popular on the market is the Flow sensor, developed by the Paris-based company, Plume Labs. It is a portable pollution device that uses a tiny fan to suck air in while a combination of lasers and membranes detect a range of pollutants.

Edwin Wealend, Head of Research and Innovation at Cundall and Chair of the Air Quality Working Group at CIBSE, spoke to us about the need to ensure quality and accuracy amongst these types of sensors. “The sheer number of devices available to consumers and businesses is a little overwhelming and the quality of technologies within the devices varies wildly. I hope we will see a significant levelling out in the quality of devices, as manufacturers compete to provide accurate information to their customers.”

Once air quality sensors are incorporated into smartphones and watches, there will be even closer scrutiny. Rather like a fitness watch that monitors heart or sleep function, the act of checking air quality will become second nature.

In January 2020, the British Engineering Services Association (BESA) urged the Government to introduce radical indoor air quality legislation to make measuring and monitoring air quality in buildings mandatory. Perhaps as air quality data becomes more accessible to all, this pressure will mount, encouraging the Government to introduce proper standards of measurement and monitoring, and to ensure that the improvement of air quality is enshrined in legislation.

05 COVID-19: danger in the air



COVID-19 transmission: the great debate

WHO and the COVID-19 pandemic

All eyes have been on the World Health Organisation (WHO) since the pandemic began in late 2019, and their daily briefings and tireless answering of public questions brought comfort to people across the globe.

However, the WHO has not been free of criticism, even from within its ranks. Many in the scientific community have condemned the agency as slow to act: the WHO didn't endorse mask-wearing until June 2020, much later than many national governments. In fact, they initially published a list of reasons not to wear a mask, including 'difficulty with communicating clearly' and 'potential discomfort'. Critics have encouraged the WHO to act more swiftly upon the worst possible assumptions of the virus, advising the strictest precautions.

Whilst defendants of the WHO have described how the organisation works 'slowly and deliberately', Dr. Soumya Swaminathan, the WHO's chief scientist, has welcomed challenges from journalists and other scientists, acknowledging that they 'need to do better'.

The transmission debate

Perhaps the most enduring debate is how the virus is transmitted. The first port of call for many countries, notably the UK, was a strict hand washing campaign, indicating fears that the virus was spread through direct contact with fomites.

However, from the early days of the pandemic, droplets were seen as the culprit: these larger (> 5 microns) aqueous bodies are spread through coughing, sneezing and even talking.

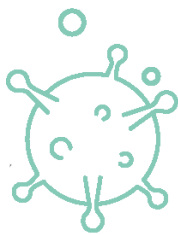
By comparison, aerosols are miniscule. Droplets, due to their size and volume, are heavier and fall to the ground relatively quickly. Aerosols, on the other hand, can hang in the air for a much longer period of time, and are considered by many scientists to be far more infectious as they are much harder to avoid.

Part of the reason the debate is so heated and varied is because scientists are weighing in from a number of different disciplines: of 239 scientists who penned a letter to the WHO, only five were representatives of the medical field, whilst the majority were engineering professionals, many of whom study airflow in contained environments such as aeroplanes.

Since October, the WHO's [website](#) mentions aerosols, droplets and also alludes to fomite transmission, but maintains that 'current evidence suggests that the main way the virus spreads is by respiratory droplets among people who are in close contact with each other'.

In the spirit of 'assuming the worst, using common sense and recommending the best possible protection', at AirRated we are continuing with handwashing, social distancing and mask-wearing. Whatever

the means of transmission, optimal ventilation of indoor spaces is imperative to limiting the spread of this virus, as well as other pathogens in our built environments. See our section on healthy spaces on page 26 for more information.





The link between poor IAQ and COVID-19 susceptibility

The link between COVID-19 and long-term exposure to air pollution was made plain in October 2020 when a [study](#) estimated that 15% of COVID-19 deaths worldwide could have been exacerbated by poor air quality. The study is also the first to make a clear distinction between air pollution from fossil fuels and that from other sources when looking at the effects of poor air quality on public health.

Global data

The study was published in *Cardiovascular Research* and looked at every country in the world, using epidemiological data from the COVID-19 pandemic (up to the third week of June 2020) as well as epidemiological data from previous US and China studies on air pollution, data from the 2003 SARS outbreak and additional data out of Italy. They then used satellite data showing global exposure to PM2.5 (fine particulate matter), ground-based pollution monitoring sites and atmospheric data to create the model that calculated these numbers.

The researchers wrote that these estimates show “the fraction of COVID-19 deaths that could be avoided if the population were exposed to lower counterfactual air pollution levels without fossil fuel-related and other anthropogenic [caused by humans] emissions”.

Professor Jos Lelieveld, one of the authors of the paper, used the UK as an example: “In the UK there have been over 44,000 coronavirus deaths and we estimate that the fraction attributable to air pollution is 14%, meaning that more than 6,100 deaths could be attributed to air pollution.” These numbers were correct in October when the study was published, however at the time of writing this report (January 2021), UK deaths have exceeded 75,000: it remains very difficult for the researchers to give exact numbers as the pandemic still continues.

How does air pollution link to COVID-19?


It is important to understand that these fractions do not imply a direct cause and effect between air pollution and COVID-19 deaths, the researchers say. “Instead it refers to relationships between two, direct and indirect, i.e. by aggravating co-morbidities [other health conditions] that could lead to fatal health outcomes of the virus infection.”

Professor Münzel, another of the paper’s authors, further explained: “When people inhale polluted air, the very small polluting particles, the PM2.5, migrate from the lungs to the blood and blood vessels, causing inflammation and severe oxidative stress, which is an imbalance between free radicals and oxidants in the body that normally repair damage to cells. This causes damage to the inner lining of arteries, the endothelium, and leads to the narrowing and stiffening of the arteries. The COVID-19 virus also enters the body via the lungs, causing similar damage to blood vessels, and it is now considered to be an endothelial disease.

“If both long-term exposure to air pollution and infection with the COVID-19 virus come together then we have an additive adverse effect on health, particularly with respect to the heart and blood vessels, which leads to greater vulnerability and less resilience to COVID-19. If you already have heart disease, then air pollution and coronavirus infection will cause trouble that can lead to heart attacks, heart failure and stroke.”

29%

of respondents do not understand how IAQ is linked to COVID-19.



Coronavirus
Vaccine
COVID-19
For In-Office Use Only

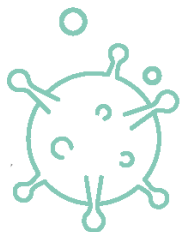
Air pollution and transmission

The link between climate change and health is becoming ever clearer. In this case, the link between poor air quality and COVID-19 was not just limited to the effect on the body, but also in the actual transmission of the virus. Earlier studies have suggested that fine particulates like PM2.5 may enable infectious viruses to travel further in the air, so much so that Professor Lelieveld stated: "It's likely that particulate matter plays a role in 'super-spreading events' by favouring transmission."

The authors close the report with a stark reminder:

"The pandemic ends with the vaccination of the population or with herd immunity through extensive infection of the population. However, there are no vaccines against poor air quality and climate change. The remedy is to mitigate emissions. The transition to a green economy with clean, renewable energy sources will further both environmental and public health locally through improved air quality and globally by limiting climate change."

“There are no vaccines against poor air quality and climate change.”



The effect on the environment

The COVID-19 pandemic's devastating effects have been far-reaching and will take years to recover from. But the pandemic also acted as an unexpected natural experiment. As countries locked down all over the world, factories shut, cars stayed in their drives and aeroplanes remained earthbound. Though many of the effects have sadly proved temporary, for a brief period of time in 2020, we saw widespread lower levels of air pollution, noise pollution and greenhouse gas emissions.

There was one particular manifestation of the clearer air that caught the attention of the world: in a number of towns in India, the Himalayas could be seen for the first time in over 30 years. And it's no wonder – a [report](#) found that a total of 85 Indian cities saw a decrease in air pollution in just the first week of the national lockdown. The pictures are striking in and of themselves, but are particularly poignant as [21 of the 30](#) worst polluted urban areas in the world are in India, with six in the top ten.

Head to our [section on air quality and the planet](#) on page 72 to find out more about the pandemic's effect on the environment.



06

Healthy spaces: homes, schools and offices

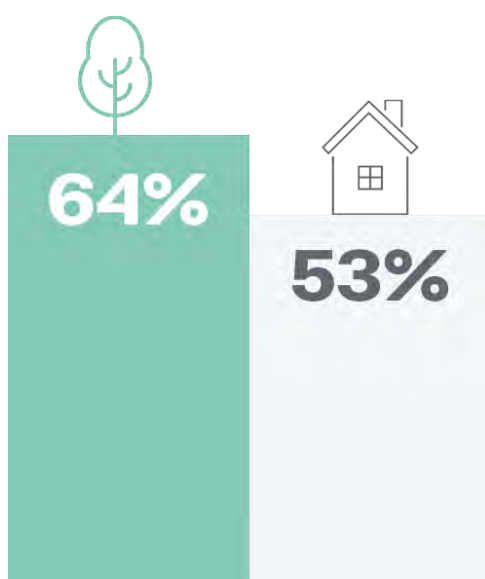


Healthy spaces

The COVID-19 pandemic has accentuated the need for healthier buildings, particularly in terms of better ventilation and improved Indoor Air Quality (IAQ). This has recently been reflected in government plans to introduce a new requirement for additional ventilation and IAQ monitoring in high-risk non-domestic buildings like offices and gyms (see more on this in our 2021 section on page 108).

With so many of us spending more time inside as a result of various restrictions and national lockdowns, buildings are at the centre of our lives more than ever before.

In a recent survey commissioned by AirRated, 64% of respondents said they are extremely or quite concerned about outdoor air quality, while only 52% said they are extremely or quite concerned about IAQ. It is clearly a topic that is rising on the agenda, but we still need to improve education about the ways in which air quality impacts our health.



When asked whether they were more concerned about the quality of their air indoors or outdoors, people said:

We spoke with Aaron Lapsley, Founder of System2 Consulting: “The biggest challenge in making a building smart and healthy is getting occupants and real estate leaders to see the unseen. People naturally care most about what they experience directly. This is why implementing technology to make indoor air quality more visible is so important. Having data on air quality is the first step, but the real game changer is making that part of occupants’ experience in the building. From personal experience I can say that once the information is made available to people, they will start to change their behavior and expectations.”

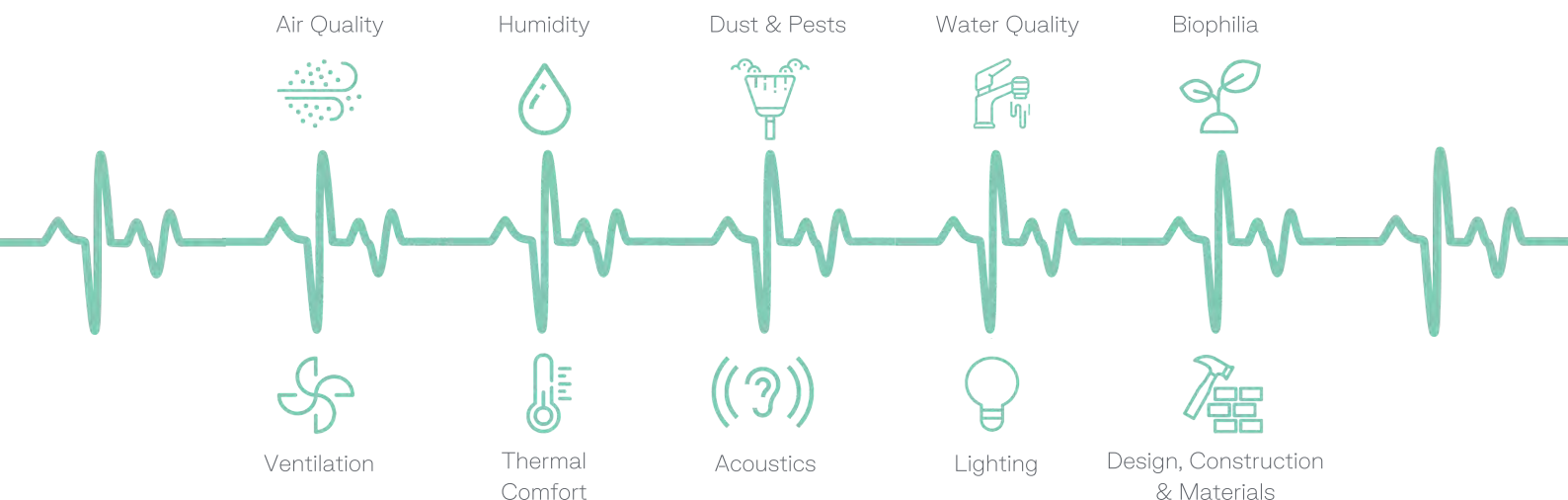
Going forwards, the built environment will need to be designed with a clearer focus on the health and wellbeing of occupants. Even once this pandemic ends, memories of the devastation it has caused will remain, and the fear of future infectious viruses will be a very real concern. The need for healthy spaces is here to stay, and for good reason.

“Implementing technology to make indoor air quality more visible is so important. Having data on air quality is the first step, but the real game changer is making that part of occupants’ experience in the building.”

Aaron Lapsley, founder of System2 Consulting

What makes an indoor space healthy?

The quality of a building’s indoor environment can significantly impact our physical and mental health, wellbeing and productivity. There are a wide range of factors that contribute to making indoor spaces healthy, as shown in the image below.



When it comes to creating a healthy indoor space, it is essential to consider the entire lifecycle of a building, from design and construction, to operation and maintenance. It is all about continually monitoring and measuring key factors and addressing any issues proactively. Henry Pelly, Sustainability Consultant at Max Fordham explains that “designing for wellbeing in buildings is all about addressing a balanced scorecard. Too much sunlight is glare, not enough light means a building is gloomy. Equally,” he continues, “too much air is a draught, while too little air makes a space feel stuffy. It is important to find a balance across a wide range of factors rather than focusing on just one thing in particular.”

The healthy buildings movement

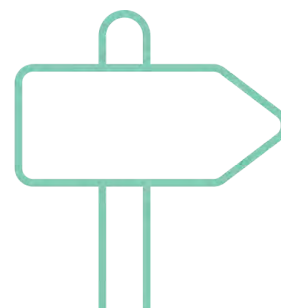
Healthy buildings have been high on the agenda since the outbreak of COVID-19, with people realising that incorporating health concerns into a building’s design is not a luxury, but a necessity. However, despite the recent surge in interest, it is a trend that has been around for longer than you may imagine. Tomáš Jurdák, Head of Real Estate at MiddleCap, reveals: “The shift towards healthy buildings happened around 8-10 years ago, when the focus, which was originally on the investment quality of a space, moved towards the quality provided to occupiers. So this trend has actually been around for a very long time, but the importance is only being fully realised now with the COVID-19 pandemic.”

The need for healthy buildings has always been there, the pandemic has simply accelerated the movement by placing health and wellbeing at the forefront of our minds. Jurdák emphasises the way in which making buildings healthier helps with long-term value creation and risk mitigation:

“Developers and investors are realising that the future-proofing and resilience of buildings is not just based on profitability, it is also based on the benefits a space brings to its occupiers.”

Tomáš Jurdák, Head of Real Estate at MiddleCap

Creating a truly healthy building is not an easy task, but there are many experts that have dedicated time and research to this topic. ‘Healthy Buildings: How Indoor Spaces Drive Performance and Productivity’ by Joseph G. Allen and John D. Macomber makes for essential reading for anyone interested in healthy environments.



The balance between human health and sustainability

The need for buildings that are good for human health has always been eclipsed by a need for buildings that are good for the environment, and achieving both in tandem is certainly a challenge.

Buildings and construction are responsible for 39% of global carbon emissions, with energy used to power buildings accounting for 28%. The Committee on Climate Change has noted that reducing energy waste is critical to meeting the UK's net zero emissions target for 2050.

Implementing smart technology can help to make buildings more intelligent and responsive, ultimately improving their performance. IoT technologies can monitor performance, detect inefficiencies, make automatic adjustments, and facilitate better decision making.



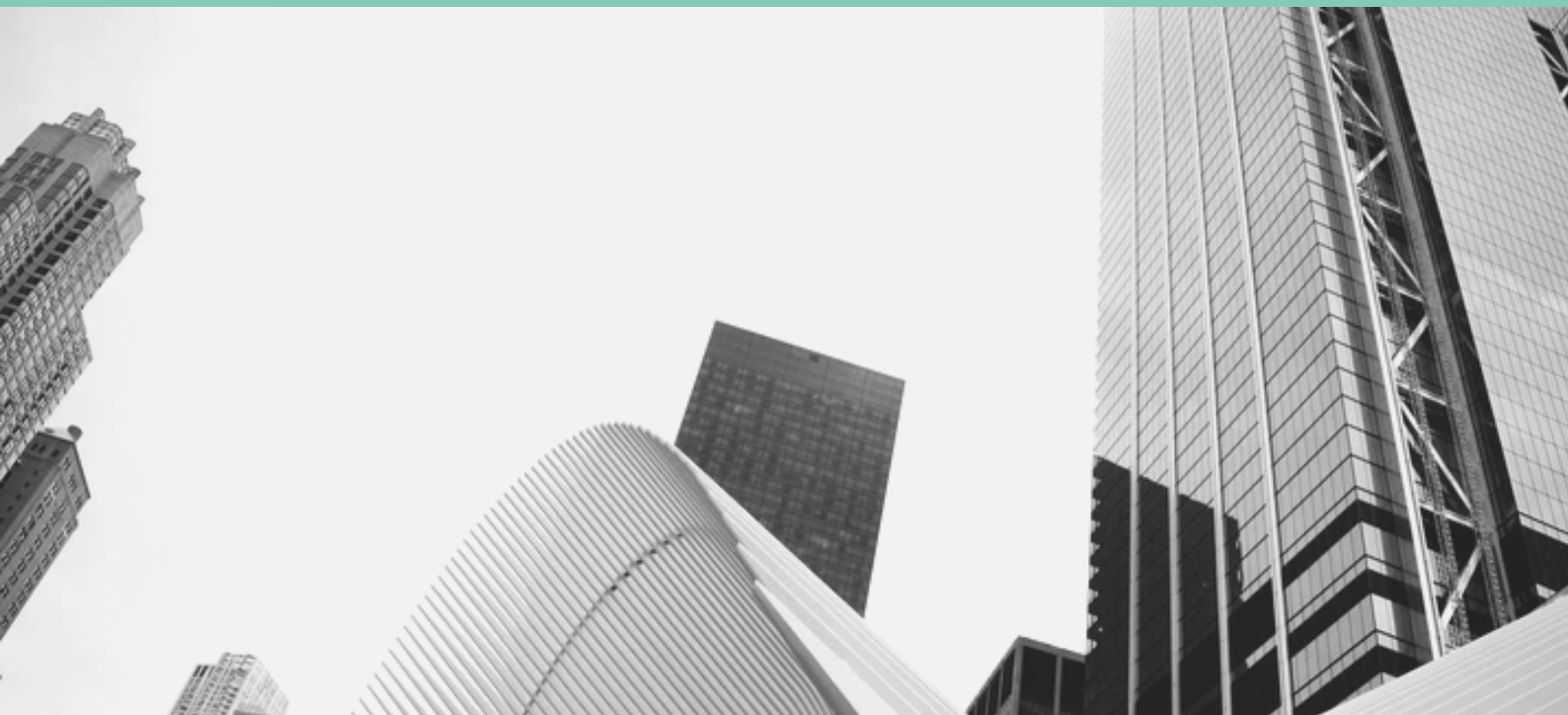
However, finding a balance between buildings that are healthy both for us and the planet is not necessarily an easy task.

'There is not a one-size fits all answer'

We spoke to Catriona Brady, Director of Strategy and Development at World Green Building Council, who explains: “The number one thing we need to not do as a sector is to pretend this is too easy. There are definitely co-beneficial synergies where health and sustainability go hand in hand. There are also many new technologies that can help us to address this challenge. However,” she warns, “there is not a one-size fits all answer, and there are undoubtedly some areas where there are tensions. This is particularly relevant as we battle the COVID-19 pandemic, and see conflicting priorities around air filtration, ventilation and indoor air quality, versus operational energy use and working towards our net zero goals. We are encouraging people to take a bespoke approach, inspired by best practice and case studies, and to find adaptable and creative solutions to achieve that balance. And to align with WorldGBC’s strategy, our work always puts into practice our three key impact areas: health, climate and resource use.”

Going forwards, our goal must be to create spaces that are healthier for us and better for the environment. It is certainly a challenge, but it is going to be key as we work towards creating a healthier and more sustainable future. There are so many spaces, both private and public, that require our attention. For the purposes of this chapter, we have chosen three areas we tend to spend a large majority of our time: homes, schools and offices.

In the next three sections, we’ll dive deeper into the places we spend so much of our times: homes, schools and offices.





In conversation with Catriona Brady,

Director of Strategy and Development at World Green Building Council

The World Green Building Council (WorldGBC) catalyses the uptake of sustainable buildings for everyone, everywhere. They work with businesses, organisations and governments to drive the ambitions of the Paris Agreement and UN Global Goals for Sustainable Development. Through a systems change approach, their network aims to lead the industry towards a net zero carbon, healthy, equitable and resilient built environment. We spoke to Catriona Brady, Director of Strategy and Development, to learn more about their work.

You recently launched your Health & Wellbeing Framework. What is the purpose of this framework, and how will it redefine the scope of health and wellbeing?

We wanted to release expert guidance that challenges the market and changes the often misinformed perceptions of what a healthy building is. The Framework is about taking a much broader and less direct approach to the health and wellbeing of people. This involves looking at the impact that buildings have on people as individuals; not just in the operational phase, but across the entire building life cycle. This includes the human rights of those working in the material extraction, anyone in the supply chain, construction workers, and those who may be impacted by the emissions from the building once it is in operation. The Framework is intentionally very ambitious but also flexible, and people around the world will undoubtedly use it in very different ways. Over the next few years, we will be continuing to roll it out and provide more resources to support people in adopting this wider consideration of health and wellbeing.

What policy changes do you think need to be brought in to enact real change when it comes to making our buildings greener?

To put this into context, only 62 countries worldwide actually have energy codes that relate to buildings, while only around half the countries that committed to the Paris Agreement have made commitments to improving energy efficiency in buildings. For me, the dream policy changes would be related to that. Every country would have mandatory commitments around improving energy efficiency, moving towards electrification, phasing out of fossil fuels and bringing in total adoption of renewable energy. There is a huge amount of work going on within our network when it comes to advancing this policy change, particularly under our [Advancing Net Zero](#) global project. We also strongly believe that in order to bring in regulatory change and drive a mass movement, we need organisations and businesses to be taking the lead themselves. Policies aren't going to be brought in if it's going to destroy businesses or create too many

barriers, so we need business to show that this can be done. Once the market starts to shift, policy will be incentivised to catch up.

How can we find a balance and create buildings that are healthier for people, and better for the environment?

The number one thing we need to not do as a sector is to pretend this is too easy. There are definitely co-beneficial synergies where health and sustainability go hand in hand. There are also many new technologies that can help us to address this challenge. However, there is not a one-size fits all answer, and there are undoubtedly some areas where there are tensions. This is particularly relevant as we battle the COVID-19 pandemic, and see conflicting priorities around air filtration, ventilation and indoor air quality, versus operational energy use and working towards our net zero goals. We are encouraging people to take a bespoke approach, inspired by best practice and case studies, and to find adaptable and creative solutions to achieve that balance. And to align with WorldGBC's strategy, our work always puts into practice our three key impact areas: health, climate and resource use.

The COVID-19 pandemic has clearly made us all more aware about the importance of healthy indoor spaces. What changes have you seen take place? Do you think it will lead to long-term change in the built environment?

There is so much more awareness, interest and investment in good indoor air quality. Last year, we held a webinar series about air quality. It was relatively technical and we didn't think it would be a mass market education opportunity.

However, we were completely taken aback by how many people joined it live and have watched it since. I think it's undoubtedly an issue that isn't going to go away. Generally, as a culture, we are moving towards more of an awareness of cleanliness, hygiene, and personal space. Interest in indoor air quality has spiked tremendously, and hopefully awareness of outdoor air quality and the emissions from our sector that contribute to that will come along with it.

Reaching net zero by 2050 is undoubtedly a big challenge. How can we prepare for this challenge now? Are you seeing more businesses and organisations commit to decarbonising the built environment?

Our [Net Zero Carbon Buildings Commitment](#) has been signed by 94 businesses, 28 cities, and 6 states and regions, and we hope that this will continue to grow in the coming years. We are continuing to see the trajectory of major organisations signing up to this commitment, or wanting information about how to get started. When it comes to reaching net zero, we believe the key principles are awareness, measurement, disclosure and reporting. Whether you are an individual or a large corporation, we can all use these principles to make an action plan of what we can do better and make a shift towards more sustainable choices. For individuals, it might be as simple as installing a smart meter or using a clean energy provider. It is the exact same process if you are a business, but just on a much larger scale with more ambitious targets. It is certainly a big challenge, but it's important to remember that we all have a crucial role to play in reducing our carbon footprint.

Homes: creating healthy havens

We will never forget the year we all stayed home. Similarly to how offices and workplaces will be forever changed by the pandemic, our relationship with our homes has also shifted. Often synonymous with safety and comfort, many are now beginning to understand that good Indoor Air Quality (IAQ) is of utmost importance when it comes to living in a healthy space. As the NHS says, 'good health starts at home'.

But how many of us really understand what contributes to our IAQ? The charity [Shelter](#) found that 'around three in ten people live in bad housing (3.6 million children, 9.2 million working age adults and 2 million pensioners)', largely due to such housing being situated in areas with worse outdoor air quality and being built with cheaper and more polluting materials. Despite 57% of respondents in our recently commissioned research saying their awareness of IAQ increased in 2020, awareness of how IAQ impacts health remains relatively low. Furthermore, many people are now working from home, but only 33% of respondents said they understood how IAQ impacts their productivity.



33%

of respondents said they understood how IAQ impacts their productivity

The rise of the sealed boxes

Since the 1970s, buildings have been designed with energy efficiency in mind, and many modern buildings are now hermetically sealed boxes. While there are economic, environmental and health benefits to these insulated homes, information about how to ventilate these air-tight spaces has been inadequate.

However, it has become increasingly clear that neither research nor awareness has developed at the same rate as our indoor environments, and homes are now at risk of having such poor IAQ that it negatively impacts our health. And whilst new developments can rightly place a priority on IAQ, social housing often falls woefully short of dignified standards.

“Outdoor air has been regulated for decades, but emissions from daily domestic activities may be more dangerous than anyone imagined.”

The New Yorker, 2019

Everyday activities such as cooking, burning candles or incense, drying laundry, cleaning and even exercising can contribute to poor IAQ, especially when there's a lack of ventilation. The symptoms of this poor IAQ include headaches, skin complaints, nausea and

dizziness, fatigue, difficulty in concentrating and irritation in the eyes, nose and throat amongst many others.

Easy and cost-effective changes you can make today

There are of course many fancy, expensive things that you can buy and have installed, but these aren't always accessible to everyone. Equally, the very materials used to build homes may be contributing to the problem, and addressing these issues can be very difficult if you don't own your home.

Clean air is a human right deserved by all, not just those with the means, and this is an issue that many groups are pushing on for new legislation (see our 2021 section on page 108). In the meantime, there are a number of easy steps that can be taken to ensure the environment you're living (and potentially working) in is as healthy and productive as possible: we've rounded up our top 7 on the following pages.

57%

Despite a 57% increase in awareness about IAQ, there is still more concern about outdoor air quality

1. Let fresh air in

When it comes to IAQ, ventilation is key. It is really important to open your windows as regularly as possible (when it is safe to do so) to increase indoor airflow. Drawing in outdoor air dilutes pollutants inside your home, it's also the cheapest and easiest way to improve your home's IAQ, especially if you have pets.

In the winter, many people worry that opening the window is going to let all the warm air out and waste precious energy. However, throwing a window open for a few minutes while vacuuming or dusting won't drastically change the temperature but could have a significant impact on your IAQ.

There's one caveat to this though: if you live in a traffic-heavy area, be mindful of how long you leave your windows open. This also applies if you suffer from pollen allergies: looking into what trees and grass aggravate allergies and then planting an allergy-free garden may go a long way to help with this. In any case, it's always a good idea to use background ventilation like trickle vents, and mechanical ventilation systems like extractor fans.

2. Keep an eye on humidity levels

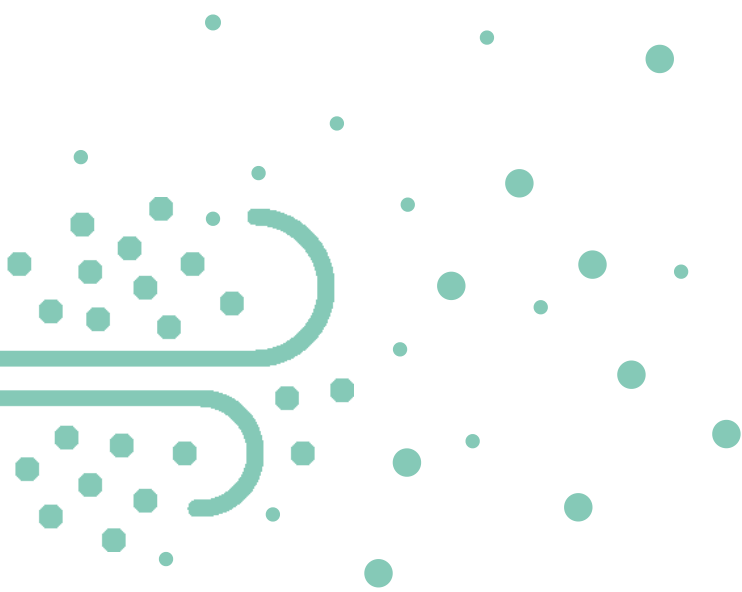
Many of us live with high humidity levels in our homes, especially during the winter months. By turning heating on and closing doors and windows, we reduce air circulation, causing moisture to become trapped indoors.

High humidity can damage both our homes and our health. It's vital to try and keep relative humidity levels between the optimal range of 40-60%.

A wide range of household activities can cause excess moisture in the air, from cooking, to running baths, to air-drying laundry. While it's impossible to avoid doing these things completely, it's a good idea to increase ventilation in the appropriate areas to reduce the impact when you can. Ventilation removes this warm, moist air and helps prevent condensation - the main culprit of damp and mould.

If your house is particularly humid, or has a damp area like a basement, it could be a good idea to invest in a dehumidifier. Using extractor fans and cleaning wet areas like kitchens and bathrooms can also help to limit any issues with mould.

Equally, low humidity areas can dry out the mucus membranes in our airways and make us more susceptible to bacteria and viruses. You can purchase a humidifier to help with this, but keeping a pot of water boiling can also help.



3. Control indoor pollution sources

When it comes to creating a healthier home, it's also worth considering how you can control indoor sources of pollution.

An easy way to prevent high levels of PM_{2.5} is to avoid using open solid-fuel fires, unvented space heaters or paraffin heaters. It is also helpful to limit your use of candles and to ensure you always turn on your extractor fan whilst cooking. Unpleasant smells in the home are often caused by poor IAQ, so if the problem is solved at the source, it mitigates the need for candles or air fresheners.

VOCs comprise a wide range of chemicals, which are emitted by things like furniture, sealants and paints. While it might not be possible or practical to change existing materials, it's a good idea to choose products that emit fewer VOCs if your furniture or flooring needs replacing. This article provides some great non-toxic furnishings at different price points. Another cost-effective alternative is to look at second-hand furniture, as this is better for your home and the environment.

4. Be careful when cooking

As well as using an extractor fan when cooking, there are other steps that can be taken to ensure making delicious meals doesn't compromise your IAQ. Closing doors and opening windows can discourage pollutants from moving to other rooms.

Many new build residential developments are moving towards using electricity for appliances instead of gas, which is a great way to lower NO₂ emissions.

Self-cleaning ovens can also be a great choice if you're changing appliances (just ensure you stay out of the kitchen while it's doing the job). If you don't have a self-cleaning oven, the next point goes into more detail about cleaning products that don't contribute to pollutants in the air.



5. Clean regularly and with the right products

Another simple method to optimise your Indoor Air Quality is to clean your home more regularly. Pollutants often become attached to surfaces, so your cleaning efforts should focus on reducing the accumulation of pet dander, mould, and dust lurking in your home.

Many regular household cleaning products release VOCs into the air, so it's helpful to opt for natural and non-toxic products when you can. [This article](#) features ten great natural cleaning products that actually work, including the Ecoegg laundry egg, Ecover toilet power cleaner, Method antibacterial bathroom cleaner, and KINN Living kitchen cleaner.

You should try to vacuum carpets and rugs at least once or twice a week with a vacuum cleaner equipped with a HEPA (high efficiency particulate air) filter, as many vacuums can actually resuspend particles in the air as they 'clean'. It's also important to clean things like bedding and curtains regularly, again, especially if you're a pet owner.



6. Beware of dust mites

Dust mites are microscopic insects found in the dust around the house, including in cushions, carpets and curtains, and mattresses where they feed off the skin we shed while we sleep. There can be millions of dust mites in any one home.

Approximately 70% of asthmatics are allergic to dust mites – specifically, people are allergic to their faeces, which cause the reaction when inhaled. In fact, dust mite allergy is the number one trigger for asthma worldwide.

However, there are a lot of steps that can be taken to limit the presence of dust mites and reduce allergic reactions.

Cleaning soft furnishings, cushions and soft toys regularly is important – this can be done either by vacuuming or washing on a high heat. Choosing fittings and furnishings that can be easily cleaned is another option, such as swapping carpets for wood and swapping upholstered furniture for leather, or low-VOC synthetic materials. When cleaning, wiping surfaces with a clean, damp cloth is preferable to dry dusting which can just end up spreading dust around the air.

Allergy UK recommends anti-dust mite bedding, shown in a [2016 study](#) to reduce hospitalisation for asthma in dust mite allergic children. Using vacuums with HEPA filters and a sealed bag can be very effective at removing dust mites and other sources of poor IAQ.

As always, ventilation is very important: dust mites thrive in moisture, so airing beds, washing sheets and cushion covers at 60°C for over an hour and throwing the windows open are all good ways to limit the presence of these unwanted house guests.

And if your budget stretches far enough, it is great to opt for an air purifier with a fan so that clean air is circulated around the entire room. Smaller, less expensive air purifiers can still be very effective. If you do go for this option, we'd recommend you move them around from time to time

7. Invest in an air purifier

It's not always possible to control sources of pollution. This means that portable air purifiers can be a helpful tool when it comes to improving your IAQ.

The best air purifiers can trap and remove almost 100% of pollutants by drawing in dirty air, filtering it and releasing clean air back out into the room. Keep an eye out for air purifiers with HEPA filtration technology and a high CADR (clean air delivery rate): the higher the number, the faster the unit will filter the air.

Many purifiers emit ozone, a gas which has myriad negative health effects, including respiratory problems. Make sure your purifier has the UL 2998 validation badge – this confirms zero ozone emissions.

'I understand how Indoor Air Quality impacts my health'

25%
neither
agree
nor
disagree

44%
agree

31%
disagree

Easy ways to make your air healthier at home



1. Let the fresh air in

Cheapest and easiest way to improve IAQ but be mindful of the outdoor air you're letting in



2. Keep an eye on humidity levels

Both high and low humidity can be problematic: optimal humidity range is between 40% and 60%



3. Control indoor pollution sources

Choose non-toxic materials to limit VOCs in the air



4. Be careful when cooking

Always cook with the extractor fan on and keep internal doors shut



5. Clean regularly and with the right products

Not all cleaning products are created equal – opting for non-toxic to avoid contributing to indoor pollutants



6. Beware of dust mites

Invest in anti-dust mite bedding and use a vacuum with a HEPA filter regularly



7. Invest in an air purifier

A purifier with a HEPA filter and a high CADR can rid rooms of pollutants quickly

Schools: children and poor air quality

We believe that clean air is a human right, but sadly, we are not yet at the point where clean air is available for all. Poor Indoor Air Quality (IAQ) affects everyone, especially our children. Babies and children are extremely susceptible to the effects of air pollution as their bodies, and the organs within them, are still growing: it can stunt their lung development, and seriously worsen chronic illnesses such as asthma, lung disease and heart disease. We also now know that poor IAQ is a serious risk factor for contracting COVID-19. Children in urban areas are especially vulnerable, as they spend the majority of their time inside in their schools and homes.

In this section, we'll take a look into why the quality of the air in and around schools is so important, and the people and groups working to make a positive change.

A study commissioned by the Mayor of London Sadiq Khan reported in 2017 that tens of thousands of children and young people from over 800 nurseries, schools and colleges were being exposed to illegal levels of air pollution. While this number has been drastically reduced in the intervening years, there is still a lot of work to do, and the COVID-19 crisis has revealed further problems.

Furthermore, despite bringing these numbers down, there is actually no safe level of exposure to the main pollutants (NO₂ and particulate matter, PM), meaning that a continued effort to bring these concentrations below [air quality standards](#) is imperative to the health of children and young people.



Traffic and schools

Children and babies in prams are extremely vulnerable to pollution from traffic as they have a low breathing height. While exhaust pipes on vehicles usually sit around a metre above road level, children are usually between 0.55m and 0.85m above ground level. This proximity to exhaust severely increases their vulnerability to air pollution: in fact, they could breathe up to 60% more polluted air than adults during school runs.

Recent data from air quality monitoring project Breathe London showed that road transport accounted for almost 40% of the NO_x pollution at London schools. Of that group, diesel cars are the single biggest contributor to the pollution levels. From 2030, the sale of new diesel and petrol cars will be banned in the UK but many parents, including Jeffrey Young, founder of [Camden Clean Air Initiative](#), say that it's far too late. "I wish it were sooner," says Young of the ban, "we don't need to use all the cars we do." Read our full interview with Jeffrey Young on page 84.

It's worth noting that pollution from traffic is worst in the mornings, when drop offs coincide with rush hour. Pick up times have significantly less pollution, due to staggered departures from schools, better dispersion conditions in the afternoon and less general traffic.

Mums for Lungs have a wealth of [resources](#) to help support parents, schools and communities in their efforts to make local environments safer for babies and children. Visit their website for flyers, posters and campaign letter templates, and to find out more about how you can get involved.

[The Clean Air for Schools Framework](#) by Global Action Plan details essential actions that can be taken by schools to improve air quality in around their area.



Change may be coming. Groups like Mums for Lungs have been campaigning relentlessly for School Streets, where roads around schools are closed around drop off and pick up time. The Mums for Lungs website states that ‘A School Streets trial at a primary school in Eltham resulted in a 54% reduction in cars driving to school, a 27% increase in cycling and 9% increase in scooting,’ showing that this initiative doesn’t just reduce pollution from traffic, but encourages exercise too.

As of November 2020, there were 383 School Streets in London, with 68 coming soon. In recent research commissioned by AirRated, 96% of respondents supported the creation of clean air zones around schools.

Head to page 51 to see recommendations for how schools, children and their guardians and local communities can make changes to improve the air children breathe in and around their schools.

96%

of respondents
support the creation
of ‘Clean Air Zones’
around schools



Schoolchildren, airborne allergies and asthma

Asthma and allergies are unfortunately two very common ailments for school children, but many of us don't fully understand the link between the two.

When a child is allergic to nuts, dairy or gluten, great care is taken to avoid cross-contamination. But there's much less understanding when it comes to airborne allergens rather than food allergens: many people don't even know they have them. And allergies are particularly dangerous for school children. [A 2007 position paper](#) from the European Academy of Allergology and Clinical Immunology found that the risk of anaphylaxis is higher in school settings.

Meanwhile, asthma and its exacerbations are a leading cause of hospitalisation in children, especially when combined with viral infections. Although asthma is a common problem in children, with the right interventions it can become much more manageable into adulthood, and while there is no cure, it does sometimes simply disappear as the child grows older. However, allergies can aggravate asthma and hamper the chances of the condition lessening. One [2006 study](#) found that a cold virus infection combined with an allergen sensitivity in the presence of an allergen makes hospitalisation for asthma twenty times more likely.

Many children suffer from a combination of both of these ailments, but Catherine Sutton, Director of Airborne Allergy Action (full interview on page 45) says that the link between airborne allergens and asthma is woefully under-communicated, which could be leading to many children having aggravated symptoms which could be fairly easily rectified. In fact, uncontrolled asthma is the highest risk for anaphylaxis: a [UK cohort study](#) found that 'the incidence rate of all-cause anaphylaxis in asthmatics is more than double of the rate in non-asthmatics... this frequency increased with the severity of asthma'

There are lots of possible airborne allergic triggers for children, including cat and dog dander, dust mites, many varieties of tree pollen, grass pollen, feathers, and mould (including tree mould). Though the link between asthma and airborne allergens is undeniable, says Sutton, allergen avoidance isn't always recommended for asthmatics. Sutton insists that doctors need to be explicitly telling people about this.

“Asthma is a public health issue – schools, hotels and other public places need to realise that asthma triggers are on their premises and need removal.”

Catherine Sutton, Director of Airborne Allergy Action



In conversation with Catherine Sutton,

Director, Airborne Allergy Action

Airborne Allergy Action is a community interest company set up to raise awareness of the role in inhaled allergens – such as house dust mite allergen, indoor/outdoor moulds, specific tree pollen, grass pollen, animal dander, and more – within the scope of both indoor and outdoor air quality.

How did you first become aware of the issues surrounding airborne allergies and air quality?

When my son Edward was little, he couldn't stop coughing. He would get very poorly, had to have an inhaler and antibiotics. When he was about five, I noticed that he was sneezing in a very allergic way – blood tests showed that he was allergic to house dust mite allergen (the waste from house dust mites which live in bedding and furnishings), grass pollen, moulds and cat and dog dander to varying degrees. His house dust mite sensitivity was the highest possible level so he was very much a 'canary in the coal mine'.

What changes did you make to help Edward?

I took Allergy UK's advice and began to systematically avoid the things Edward was allergic to reduce his exposure to them. A 2016 study had shown that anti-dust mite bedding can reduce hospitalisations for asthma in dust mite allergic children: when I changed his bedding, his symptoms improved. An alternative is to wash bedding regularly at 60 degrees Celsius to remove house dust mite allergen.

Also in accordance with this advice, I updated the HEPA filter in my vacuum cleaner. I hadn't realised but a HEPA (high efficiency particulate air) filter, has over 99.97% filtration, and coupled with a sealed bag meant that Edward would not come into contact with the dust any longer.

I also started removing surface dust regularly with a damp cloth. As time went by I got rid of all the cushions and changed the sofas to leather. Vacuuming the curtains helped too. I kept Edward away from the dusty loft and the bunk bed, both of which seemed to aggravate him. All these changes made a drastic difference to his symptoms. As time went and he grew bigger his reactions to non allergic substances like chemicals, perfumes and outdoor air pollution also improved by themselves.

What about when Edward was outside of your home?

To avoid asthma attacks and allergic rhinitis (nasal irritation), I started to bring anti-dust mite bedding and my HEPA vacuum on holiday with us if we're going to be away for more than a few days in the UK, and that really helped.

Alternatively, some hotels did have the right type of vacuum cleaner that would not resuspend particles into the air.

A bigger problem was at school. When Edward started secondary school, the cough returned very forcefully. I immediately went to the school and asked if they could change the vacuum used on his block to one with a HEPA filter and sealed bag. The school complied and his symptoms improved quickly and dramatically – and that was just by changing one vacuum cleaner.

People also don't necessarily realise the small number of specific things that cause inhaled allergies. For example, many schools have planted silver birch trees on their grounds despite many children having a very high sensitivity to that pollen in April time. In Denmark, there are silver birch-free areas for this very reason. Indoor mould, arising from flooding, can also be associated with severe asthma.

How important do you think it is for people to make improvements to their IAQ even if they don't suffer from allergies?

I think it is very important to be aware of the problems associated with indoor and outdoor air quality because these issues are not always obvious but can still be badly affecting your health. If you're waking up coughing and sneezing, it may well be that you are being affected by house dust mite allergen which is, in fact, the number one trigger for asthma worldwide. I didn't know that I had a dust mite allergy until Edward was diagnosed but following the changes I made, I could feel the difference to my health too.

Make sure you open the windows whilst vacuuming and to ventilate. Opening the windows quickly to purge the house can make a big difference and it won't make the whole house cold. You can also invest in air quality monitors to keep track of air quality inside your home or use HEPA air purifiers.

What can be done to raise awareness of the links between asthma, airborne allergens and air quality?

There are lots of groups doing great work. However, awareness and action needs to come from the top. As a minimum, national and global asthma and other respiratory disease guidelines need to replicate the recommendations of the [Royal College of Paediatrics report into Indoor Air Quality and Child Health](#) which undertook a systematic review of the evidence. Allergen avoidance for asthma and allergic rhinitis was recommended in this report.

Uncontrolled asthma is a major risk factor for anaphylaxis, but the links between asthma and inhaled allergies are still widely unknown. Airborne allergies are very misunderstood and unknown, especially when compared to food allergies, even though they are a major factor for asthma and other respiratory illnesses. The [Working Party](#) who undertook this review have now produced some resources for schools and parents about improving indoor air quality, too.

A great example of effective action is the [Alameda County Study](#) in California, where more than one million children suffer from asthma. This project which began in 2001 focused on the home, the place where children spend a lot of their time.

A team of cleaners who specialised in asthma trigger remediation would visit the homes of children suffering from asthma and give their home a deep clean, removing mould, providing anti-dust mite bedding and even carrying out minor repairs. They also offered low income families HEPA filter vacuums and medics helped families to understand asthma medication, too.

Families reported fewer and less aggressive symptoms, and a data review in 2012 showed that health care costs for children in the programme were cut in half in the 12 months after they took part. Alameda County officials believe they might be able to save up to \$16 million a year in paediatric hospitalisation costs through such projects.

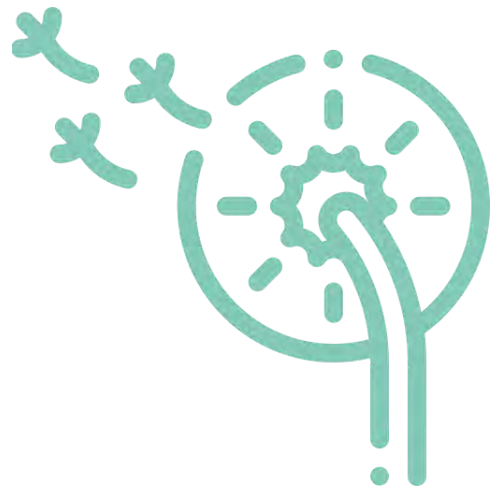
So I think awareness is the key. Once there is awareness about how poor air quality can be and what are the components of poor air quality, including inhaled allergens, you can really start to tackle it.



Hay fever

Another worrying airborne allergy within schools is hay fever, or allergic rhinitis. A [2007 study](#) found that hay fever was associated with a significant increased risk of unexpectedly dropping a grade in summer examinations. This was also explicitly linked to hay fever medications that can induce drowsiness: these pills have also been found to affect attention span, working memory, vigilance and speed. They can also cause lower levels of activity and motivation. Symptoms of hay fever itself can also cause disrupted sleep, putting further pressure on suffering students.

Recommendations from the study included using non-drowsy medication and the more extreme suggestion of moving exams from their traditional summer slot to 'remove the current bias against those with hay fever'. While a change in exam timetables is unlikely to come any time soon, schools can make changes to cleaning methods, using natural cleaners and HEPA filtered vacuums.



If you or your child is suffering from an allergy, be it airborne, food, chemical, material or another type, [Allergy UK](#) has plenty of helpful information and advice, and runs a [helpline](#): you can reach them at 01322 619898 and at info@allergyuk.org depending on the day and time of your inquiry.

Airborne Allergy Action is also an excellent resource. They have a page on their website dedicated to [articles and research](#), as well as a page on [avoidance tips](#) and [links to other helpful websites](#).

[The Indoor Air Quality Working Party](#) too provides a wealth of information about from tips for a healthier home to resources for primary school children.

The legacy of Ella Roberta Adoo Kissi-Debrah

Ella Roberta Adoo Kissi-Debrah was just nine years old when she died of a severe asthma attack in February 2013. Seven years later, and after a fortnight-long inquest, Southwark Coroner's Court ruled that "Ella died of asthma, contributed to by exposure to excessive air pollution." Ella Roberta became the first person to have this stated on her death certificate in what government adviser on air pollution Professor Gavin Shaddick called "a landmark decision".

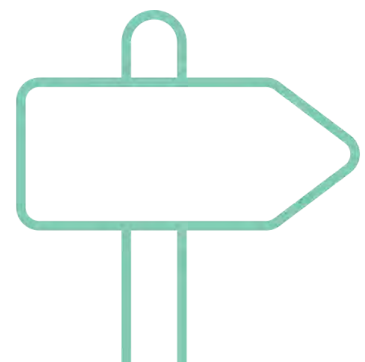
Ella lived near the busy South Circular Road in Lewisham where levels of nitrogen dioxide (NO₂) exceeded both European Union and WHO guidelines. "The whole of Ella's life was lived in close proximity to very busy roads", coroner Phillip Barlow said. In the three years prior to her death, Ella was admitted to hospital 27 times having suffered from multiple seizures. 'Ella's Law' has been proposed to replace the Clean Air Act of 1956 which hasn't been updated since 1993 and is, in the opinion of many experts, no longer fit for purpose.

Speaking to the [New Scientist](#) in December 2020, Ella's mother Rosamund Adoo Kissi-Debrah said that she was angry at the possibility that 'inaction by authorities to cut toxic nitrogen dioxide (NO₂) gas levels had "possibly contributed to her [daughter Ella Roberta's] death"'.

"It does make you angry," Adoo Kissi-Debrah said. "When you are sitting in court and you realise all the failures where people were meant to act and they didn't. It's just that the public health emergency wasn't there. It has similarities with covid sometimes. I think "come on, you're too slow". People knew [air pollution was a problem]. But where was the urgent action?"

Again speaking to the [New Scientist](#), Rosamund Adoo Kiss-Debrah, who campaigns tirelessly in her daughter's name, says that she supports Ella's Law, saying it would be a 'deep honour' to her daughter's memory, and that Ella would like that something named after her could save lives.

Ella's mother Rosamund set up the [Ella Roberta Family Foundation](#) in her memory. Visit their website to learn more about the foundation, their work and events you can get involved in. You can also donate to support their work through the Ella Roberta Family Foundation [JustGiving page](#).



What children want

It is becoming increasingly clear that children and young people are growing ever more invested in their health and the environment. In a [2020 report](#) from the Royal College of Paediatrics and Child Health, children voiced their opinions through the microphone of #TeamCleanAir&Us:

“We want to know what the risks are from poor indoor air quality and what we can do to reduce them. Information needs to be scary enough for us to take notice but with enough information about what we can do that we feel we have some control and clear actions we can take.”

The young people quoted in the report highlighted the need for information to be accessible to different groups of people, including themselves, schools and their parents, and the importance of it being presented in ways that speak to them: through clear information, a better environmental education, and through creative storytelling, using media like video, social media and work with celebrities.



32,000
schools in the UK



10.3million
pupils in the UK



3.6million
children living in
poor quality housing



68minutes
outdoors per day

Changes that can be made to improve air quality in and around schools

What schools can do

- Clean dusty surfaces with damp, wet cloths rather than dusting to avoid spreading dust particles further around classrooms.
- Invest in vacuums with HEPA filters
- Encourage children to walk, scoot or cycle to school through accreditation schemes
- If classrooms face the main road, keep outward facing windows shut in the mornings when traffic is heaviest, be sure to open internal doors to mitigate carbon dioxide build up
- If playgrounds are near to a main road, avoid outdoor activities until the afternoon when dispersal conditions are better
- Plant low-allergy hedges between roads and playgrounds to help mitigate traffic impacts

What children and their guardians can do

- Minimise travelling to school in the car – walking, cycling or scooting to school is better for both health and the environment
- Encourage the school and council to implement School Streets – Mums for Lungs have lots of resources to help with this sort of campaign and recommended parents grouping together to push for these clean air zones
- Switch off the engine if you're waiting in the car, even if it's not for long
- Make use of carpool clubs to limit the number of cars on the roads around school

What our communities can do

- Avoid using routes near schools at pick up and drop off time
- Show support for School Streets and Clean Air Zones around schools by writing to the school, the council or your local MP
- For people who live near schools, consider planting or leaving spaces for low-allergy green barriers such as hedges to help absorb pollutants and reduce traffic impacts

We are grateful to the work of Professor Prashant Kumar and the Global Centre for Clean Air Research at the University of Surrey for many of these recommendations. Please refer to their document, [Mitigating Exposure to Traffic Pollution In and Around Schools: Guidance for Children, Schools and Local Communities](#) for a full list of facts and recommendations.



Insights from the Royal College of Paediatrics and Child Health

A [2020 report](#) from the Royal College of Paediatrics and Child Health (RCPCH) made a number of recommendations for improving IAQ in order to improve children's health, acknowledging that 'the Government has an important role to play':

- Strict regulations about indoor air quality should be in place and should be monitored by the Government.
- Social housing should have high standards for indoor air quality and this should be enforced.
- There should be clear information and warning systems developed for labelling products that can create poor air quality, so parents, carers and young people can make better purchasing choices.
- A 'clean air' house check-up system should be developed so that when families are thinking about buying a house it has a rating (like an energy certificate) to help them assess the air quality inside a building. There could also be an app for mobile phones that people could use to assess indoor air quality.

Improving building regulations and ensuring that materials used in construction, maintenance and repair of buildings is another crucial point. The RCPCH also noted that government advice about air quality should be tailored for different groups, including children with asthma, architects and building professionals, and landlords amongst others.

What is markedly clear is that both information and incoming legislation needs to be made more available and more accessible to people throughout society, not just those with backgrounds that makes the information easily understandable. These steps, they say, would go some way to reducing the potential for inequality.



[The inside story: Health effects of indoor air quality on children and young people](#), published in January 2020 by the Royal College of Paediatrics and Child Health, looks into the sources of air quality, the impacts on children's health, current legislation and recommendations in great depth. We highly recommend referencing this document for more detail on these topics.



In conversation with Jemima Hartshorn, Founder of Mums for Lungs

Mums for Lungs is a grassroots action group on a mission to improve air quality for all of us, especially babies and children.

We spoke to Jemima Hartshorn, founder of Mums for Lungs and former human rights lawyer, about School Streets, the Environment Bill and the highs and lows of grassroots campaigning.

What was your starting point?

I started Mums for Lungs about four years ago when I was living on Coldharbour Lane – a very busy road (a big reason why we later moved to a quieter and less polluted road). My son was four and half months old and the level of air pollution just didn't seem right: I wanted to do something about it. I spoke to some other parents and they all felt the same. It started off as a parent and baby group on Wednesday afternoons: one afternoon it was eight mums and eight babies in a back garden with two paddling pools!

What has been the biggest success for Mums for Lungs so far?

We have really raised awareness around School Streets and air pollution – we now have a Facebook group with over 1,100 parents. We have been liaising with them and supporting them with campaigning for School Streets in their schools. Lots of school streets have come up under COVID-19 measures, so we've been supporting parents with materials and resources. For example, we have a draft letter

for parents to email councils and headteachers as to why they wanted a School Street. We have also got a campaign guide and a really nice video – wherever you are in your journey to getting a School Street, we can provide support. Our coordinator also often puts parents in touch with each other to help them campaign together, as it's much easier to get what you need when there are a few of you working together.

We have also run our Ditch Pollution poster campaigns, once in July and again in September. Each time we put out over 2,000 posters, mainly in London but also around the rest of the country. We wanted them to look nice and be a friendly reminder of the issues, for example that walking with your child helps you all get active and it can also be quality time spent exploring. We had over 150 people putting them up in their free time which was a great level of engagement.

We are currently updating our idling flyers. There needs to be big changes with that:

awareness amongst drivers about how bad idling is is far too low – it's a habit and people need to be reminded how to change these habits. There's also not enough enforcement about it, as stationary idling is actually an offence against the Highway Code. The air pollution caused by idling isn't a massive contributor to the pollution to cities like London, but for the people walking by, it's terrible.

Mums for Lungs have also been doing work around the Environment Bill – can you tell us more about that?

We recently coordinated with 107 organisations who all signed a letter to the Secretary of State for the Environment, George Eustice, petitioning the government to set legally binding targets in tone with World Health Organisation (WHO) guidelines.

Currently, it only requires government to agree on a legal limit for pollutants by October 2022. They don't even have to have achieved the limit by then, just set the limit – it's so frustrating and utterly disappointing and far too late. Neil Parish (MP for Tiverton and Honiton, and chairman of the Environment, Food and Rural Affairs (EFRA) Select Committee) has been calling for an amendment. Michael Gove seemingly promised these changes in 2019, but nothing happened. We've also had a really disappointing response from Rebecca Pow (Parliamentary Under Secretary of State at the Department for Environment, Food and Rural Affairs). It is just unconscionable to me that grassroots groups have to spend their day campaigning for the benefit of children during a respiratory pandemic – you couldn't make this up.

And Brexit is another problem: previously, when the UK messed up really badly, at least the European Commission could do something. The body that is meant to come in is the Office for Environmental Protection (OEP): it says it's going to be an independent office but the Chair was appointed by the Environment Secretary and the budget will be chosen by him, too: that's not what I call independent. The Environment Bill is returning to Parliament on 26th January and the current draft form is just not good enough.

What's been the hardest thing about your work, both for you personally and for Mums for Lungs as an action group?

The reason I campaign and set up Mums for Lungs is because I'm worried about children's health, both mine and everyone else's. It's unfair that children are born into a city and a life with air pollution, leading to all sorts of problems including reduced lung capacity.

The hardest thing for me is not being able to provide people with immediate change. There are things happening in 2021, like Birmingham's Clean Air Zone, like the ULEZ (Ultra Low Emission Zone) expansion coming in later this year, like more people cycling – it's all hopeful, but these things take time and incremental changes.

The hardest thing for Mums for Lungs is keeping positive when things are happening slowly. People email us all the time saying 'I can't visit London anymore because my asthma gets so bad,' or 'I couldn't take my asthmatic child out today as it was such a high pollution day' and they ask if there's a law against it and there isn't.

I invite people to join and campaign with us, but it takes energy and time to move the needle a bit, while children's health is at stake.

It's also hard raising awareness about something people know so little about. Take my brother for example: he's 26, he's sporty, and he lives in London. It wasn't until the first lockdown that he realised his wheeziness was from pollution – he thought he was just a wheezy person. People also don't know that bad, polluted air from traffic is shut inside your car when you shut the door, and it's the same with houses. Wood burning stoves are another problem. Awareness is super low and again, there's completely inappropriate, inadequate, and ineffective laws. We've just started some campaigning around this to try and tackle this issue.

What's next for Mums for Lungs? Do you have any new projects lined up?

I would love to say that's it for Mums for Lungs come 2022, air pollution is low and I can look for a new issue of injustice to campaign on, but I doubt it... So the big things are continuing campaigning on the Environment Bill and pushing for governmental action to give powers to councils on wood burning for example. The list we have of ideas and issues we want to do is endless. For example, Amazon prime shouldn't be £7.99 a month if you ask me, how much do we really need delivered that quickly? We all need to be thinking about all of this holistically, but with the time and resources Mums for Lungs has, we have to focus really strongly and for now that is School Streets, the Environmental Bill, ULEZ expansion, mayoral election, and woodburning.

We've got lots of collaboration in the pipeline, too. Our work isn't measurable, but we're another group adding to everything. There's loads of great groups and it's always particularly good when those great groups come together, like our letter for the Environment Bill. I'm excited for 2021 and we have some fun things in the works.

“people now know how much better and healthier they can feel, and we won't settle for less.”

What do you think are the main improvements that the government needs to make in 2021 to improve the air we and our children breathe?

We've been pushing for a real air quality campaign from the national government and Greater London Authority. We should have a campaign you can't avoid, like how we all know not to smoke or drink when you're pregnant. This information should be put in with council tax for example, so it's not something that can be ignored.

And then there's wood burning: we emailed every council in London, said this is the information that's available on woodburning, you need to tell your residents that you shouldn't be burning anything during a respiratory pandemic – but it's just not cutting through. It's just not enough, the government should have been leading on this. From 2010 onwards, the UK was not meeting the legal

obligation for air pollution standards. It's estimated that air pollution in the UK is responsible for premature 40,000 deaths every year: if this was Tesco or Thames Water, there would be uproar, they'd be closed down, but with air pollution it is just not known, doubted or accepted.

The UK has the highest level of youth asthma, which is a real concern. But change has to come from the top – schools and councils are already so busy, especially now, and cannot be asked to do anymore. It really is the government's responsibility to provide resources and powers for all institutions that can reduce air pollution and hence safeguard children's health. Running assemblies is actually something Mums for Lungs wanted to do, but obviously it's not something we're able to do right now.

We have a real opportunity with the Environment Bill and with the council and mayoral elections this year, where candidates can make commitments to reduce air pollution across London and the UK. With the reduction of air pollution in April and May, people now know how much better and healthier they can feel, and we won't settle for less.

Offices: rebirth and recovery

Why is indoor air quality often a problem in offices?

In recent decades, offices around the world have become increasingly airtight. The opening of windows now tends to be highly controlled, and the quality of indoor air is heavily reliant on ventilation and air conditioning. It is assumed that openable windows in an office building is a bad idea for a variety of reasons:

- Energy efficiency concerns
- Cost concerns
- They allow unfiltered air, noise, rain and insects to enter
- They make the owner liable should people fall out
- They are unfashionable, as they disturb the lines of modern architecture

However, buildings becoming airtight has led to some unintentional issues when it comes to Indoor Air Quality (IAQ). A lack of sufficient ventilation often means that the indoor environment quickly becomes stale. According to the American Society of Heating, Refrigeration and Air-Conditioning Engineers, 1000ppm is the threshold at which a room starts feeling stuffy for most people, and levels in offices routinely exceed this.

This build-up of excess moisture and CO₂ can result in illness, and the growth of mould in the building. Air conditioning, or the lack thereof, also allows for an increase in humidity and can leave unfiltered particles suspended in the air.



There are also a wide range of things in our offices that generate VOCs and pollute the air:

- Cleaning products
- Solvents
- Dust
- Carpet fibres
- Furniture
- Photocopiers and printers
- Building materials

A [survey](#) commissioned by the Building Engineering Services Association (BESA) found that almost 70% of office workers believed poor air quality had a negative impact on their day-to-day productivity. 68% of these experienced lapses in concentration whilst 67% reported suffering from fatigue whilst at work.

Jeroen van Straten, Founder of IndoorCare, told us:

“We have assessed many offices over the years, and the vast majority of the time the inside air is unhealthy, regardless of whether the building is old or new, modern looking or not. Unfortunately, indoor air quality is simply not taken care of.”

We cannot afford to continue to ignore the issue of poor IAQ in the workplace, particularly in light of the COVID-19 pandemic.



Why are healthy offices so important?

Poor IAQ can have a significant impact on our health, but we often fail to recognise when we're suffering the effects of indoor air pollution.

Sick Building Syndrome (SBS) is a phenomenon which is becoming increasingly prevalent amongst employees. One of the first signs can be multiple team members complaining about similar, vaguely defined symptoms. While manifestations can differ from case to case, headaches, skin irritation, dizziness and an inability to concentrate are among the most common. Symptoms tend to increase in severity while in the office and improve or disappear when away from this environment.

Keeping employees healthy is paramount to the success of business, as SBS is estimated to cost the British economy a staggering £24.6 million lost working days every year.

While the exact underlying causes of the phenomenon have proven difficult to identify, research suggests that it is most likely caused by a combination of factors related to the health of buildings, including:

- Poor ventilation with an insufficient volume of air change
- Low humidity
- High temperatures or constant changes in temperature throughout the day
- Airborne pollutants, such as dust, carpet fibres or fungal spores
- Poor standards of cleanliness in the working environment
- Poor lighting that causes glare or flicker on visual display units



53%

of people said they would consider not working for a company if they couldn't prove the quality of their indoor air.

The vast majority of these sources could contribute to poor air quality. If several of these factors co-exist, there will undoubtedly be a negative impact on employee health and productivity.

We spoke to Andrew Teacher, founder of Blackstock Consulting and an Executive Committee Member at the Urban Land Institute, where he discussed the increasing demand for healthy offices: “The broader healthy living agenda has had a clear impact on the workplace. There was a period where you wouldn’t see a plant in an office unless it was plastic, but that,” he states, “has certainly changed quite considerably. People have started to take employee health seriously, and things that used to be a perk are now a normal part of any office.”

Our survey found that 53% of respondents would possibly not work for a company if they couldn’t prove the quality of their indoor air. As employees begin to expect more of the workplace, companies will need to take the necessary steps in order to compete with others. Teacher explains:

“Companies that are competing for talent are going to need to spend money to make their offices healthier. There is going to be a polarisation between high quality offices that are newly specced with best-in-class interiors, and cheaper spaces with less of a focus on health and sustainability.”

How can we make offices healthier?

When it comes to making offices healthier, a good place to start is with the principles we outlined on page 28. We have also outlined five elements that have an important role to play in creating a healthier workplace.

1

Ventilation

Effective ventilation should be the starting point when it comes to achieving good indoor air quality. Whether by natural or mechanical means, ventilation is essential in order to remove stale and humid air, improve indoor airflow and use outdoor air to dilute indoor pollutants.

2

Filtration

Using air filters can also be extremely effective in removing unavoidable pollutants. By capturing dust and allergen particles as well as some VOCs, air purifiers equipped with HEPA filters can improve IAQ drastically.

Particle filters on building ventilation systems need to be the appropriate grade according to external particulate levels in the building's location, but they also need to be well maintained. As well as filtration on the building's ventilation units, local filtration (i.e. portable air purifiers) can be used to supplement these systems and improve air quality further.

3

Air quality monitoring

Installing sensors is key in order to enable us to monitor the quality of the air we are breathing, and in order to make any necessary adjustments to create an optimal indoor environment. With the addition of a smart building platform, it may be possible for changes to be made automatically via your Building Management System (BMS).

4

Plants and biophilia

Indoor plants have long been thought to purify the air, but a [2019 study](#) published in the Journal of Exposure Science & Environmental Epidemiology revealed that in order to make a substantial difference, you would need to fit between 10 and 1000 plants per metre squared in a room. However, they are a great addition to any indoor space, and biophilic office design has been shown to increase wellbeing by [13%](#) and productivity by [15%](#).

5

Raising awareness

Finally, it is important to raise awareness of the importance of IAQ amongst building owners, employers and employees. The greater the awareness, the more likely it will be that changes will be implemented.

When the appropriate steps are taken, a great working environment can be achieved. We spoke to Ralph James, FM & Technical Services Manager at the Met Office, who is passionate about providing a healthy environment for employees.

It is vital to have a working environment in which our people can thrive as they're at the cutting edge of science and research," he explained. "We want to have a world-class facility for our world-class scientists. By having good indoor air quality, we can reduce the amount of sick days and seriously impact our employees' cognitive performance." James makes it clear that working towards healthier offices is a constant learning process:

“We’ve become inquisitive about our working environment, which means we’re always looking to learn more. And the more we learn, the more we can influence the future.”

Ralph James, FM & Technical Services
Manager at the Met Office

How can we make offices more productive?

Even a seemingly insignificant rise in CO2 can make an important difference to our productivity.



- A British Council for Offices [study](#) showed that with lower CO2 levels, employees' test scores improved by up to 12%. In one of the buildings tested, people worked 60% faster with reduced CO2 concentrations, completing tests in a mean time of 8.2 minutes, compared with 13.3 minutes with more CO2 in the atmosphere
- Another [study](#) by the World Green Building Council found that by increasing ventilation and lowering levels of CO2 in the workplace from 1000 ppm to 500-600 ppm, there was an 8-11% improvement in productivity
- A [2018 study](#) by Harvard University showed that a cost of \$40 (about £30) per head enabled ventilation to be doubled, helping CO2 levels to fall from 1000 ppm to 600 ppm. This improved the performance of workers by 8%, translating to \$6,500 (approximately £4,750) per employee per year

The benefits of CO2 monitoring

In addition to these productivity gains, CO2 monitoring delivers a host of other benefits. It is often assumed that it will simply reveal the need for higher ventilation rates, and that this will make buildings less energy efficient. However, optimising and examining indoor environmental control usually leads to energy-saving opportunities.

When offices feel stuffy, it is often mistakenly put down to high temperatures. As a result, air conditioning is turned up and energy is used unnecessarily. This stuffy feeling is more commonly down to the CO2 levels and it is a change in the air quality that is needed, not a change in temperature. A [2018 study](#) commissioned by the British Council for Offices showed that by carefully monitoring CO2 levels, fan speeds could be significantly decreased. In this instance, they were reduced by up to 50% without adversely affecting the CO2 levels in the workspace.

CO2 monitoring can also help to indicate how effective your ventilation is, and this is key in dealing with infectious viruses like COVID-19. By monitoring CO2, you can ascertain if enough outside air is getting in to dilute indoor air pollutants and pathogens, or if your room is filling up with potentially infectious exhalations. If levels exceed 800 ppm of CO2, it is an indication that your space might need more ventilation.

One interesting [2019 study](#), published in the International Journal of Indoor Environment and Health looked at the effect of ventilation improvement during a tuberculosis outbreak at Taipei University. Many of the rooms at the university were under-ventilated, with CO2 levels above 3,000 ppm. When engineers improved air circulation and reduced CO2 levels to less than 600 ppm, the outbreak stopped completely.

According to the research, the increase in ventilation was responsible for 97% of the decrease in transmission. It is therefore clear that monitoring CO2 levels can be extremely effective in helping to identify the risk of the spread of infectious diseases.

“Before the pandemic, the office was an all-purpose space. Now it is very clear that the office is there for specific purposes: for people to collaborate, for people to meet.”

Henry Pelly, Sustainability Consultant at Max Fordham

The death of the office?

Since the outbreak of the pandemic, many have been quick to deem physical workplaces obsolete. However, the [Metrikus Occupancy Index](#) has shown that while working patterns are undoubtedly shifting, it is too soon to herald the death of the office just yet.

Throughout April, May and June, occupancy remained below 10%, with the large majority of employees working remotely. By the end of August, it had climbed to 15%, and this leaped to 33% by the second week of September. Furthermore, in spite of guidance to work from home where possible, office occupancy during the second national lockdown in the UK was substantially higher than the first.

Despite our newfound acceptance of working from home, there remains a need for companies to provide space for their employees to collaborate and learn from one another. The Metrikus Occupancy Index has shown a significant increase in meeting usage, showing the value placed on face-to-face meetings. Before the outbreak of COVID-19, 48% of people came to the office even when they weren't using a meeting room, but since then, 96% of people coming in are making use of face-to-face meetings.

Offices still have a purpose, with only 8% of employees wanting to work from home five days a week. Going forwards, there will be a real need to create workplaces that are focused on collaboration and wellbeing. “Most people design buildings with cost in mind,” Ralph James from the Met Office says. “Going forwards we need to shift the balance and design with health in mind. To do this we need evidence, and we need data that shows the value of healthy buildings. Things are shifting, and COVID-19 has amplified that shift. Creating a space in which people can feel well and thrive has got to be the next big piece on the agenda.”

We are certainly not experiencing the ‘death of the office’, but rather an opportunity for rebirth. As and when people are able to return to work, we will need to come together to make offices smarter, healthier, and more productive.



In conversation with Chris Rush, Air Quality Group Lead at Hoare Lea and a committee member of the Institute of Air Quality Management (IAQM)

Adam Taylor, Chief Innovation Officer at AirRated, sat down with Chris Rush, who says that we need to make sure we're always thinking about IAQ in the long-term rather than a short-term solution.

Have you noticed a difference in what clients are asking for recently?

It used to just be 'we need to do an air quality assessment,' but clients didn't really know what precisely they were asking for and how this could be used beyond providing a report. In the last few years that's been changing. People are now asking more questions – how can we harness air quality to provide reassurance and demonstrate high design standards to our end users. Corporate clients are starting to realise that they need a differentiator, especially now with COVID-19, and many are focusing on air quality as an element of the building that can be invested in to not only offer returns in the short but also long term.

What do you think has caused that change?

It's down to awareness, and not just in corporate environments. We're seeing more interest in IAQ in both residential buildings and education environments like schools and universities. As individuals and organisations are becoming increasingly more attuned to the benefits of good air quality (and negatives of poor air quality) it means people are asking what can be done.

The constraining factor as always, which is particularly true for schools, is the cost can be prohibitive. These things require an investment in terms of time and money - both of which parents, teachers and schools as a whole have a limited amount of. It's all about awareness to keep these things going.

What are you seeing through the lens of IAQM?

There's been a big shift towards focusing on indoor as well as outdoor air quality. It's great that there's lots of different groups doing the work but it is undeniably siloed. The IAQM has been working on a document on IAQ, a sort of line in the sand, that aims for a level of cohesion. It's a culmination of a lot of research that's out there, with contact being made with groups like the UK Indoor Environment group and CIBSE. But we've found that there's massive gaps and things are falling through the net: mainly it's because many of the regulations don't match up and this inconsistency means that things get missed. What's needed is firm and clear regulation, so it's not just voluntary schemes like WELL, BREEAM and AirRated setting the standard.

How can people get into air quality, for example into groups like the IAQM, if they don't have a prerequisite like an environmental sciences degree?

The air quality space is growing, but it's still a relatively small pool of people involved. Engineering is absolutely a way in – you can't have healthy buildings without building services engineers – but there also have to be people with other skills. We need to be working together: more diversity can only be a good thing. I think people seem to forget that air quality is a necessity, and policy change is something that's desperately needed. Legislation and policy can fill the gap between grassroots groups and the more science-backed people so that we can make real change together.

The property market: a year of shifting demands

As this report has explored, 2020 saw a marked shift in societal values, and this has also started to influence the decisions that renters and buyers make when it comes to choosing a property.

With greater awareness of the dangers of air pollution, air quality data becoming more readily available, and the pandemic making us spend more time at home, living in a healthy space has risen on our agenda.

Changing priorities

During national lockdowns in the UK, it has become extremely apparent how important space, particularly outside space, is to us all. 2020 saw increased demand for larger homes or homes with a garden, with enquiries for village properties rising by 126% in June and July compared with the same period in 2019.

Another key change has been the increased focus on air quality, both inside and surrounding our homes. In May, property finder SearchSmartly partnered with addresspollution.org to become the first housing website to display local air quality ratings on every listing. They provide a free report that reveals the annual average levels of air pollution at a given address, and the potential impact that these levels can have on human health.



If tenants can see that they are being exposed to high levels of pollutants, it seems likely that they will demand that steps be taken to remedy this, to ensure that they are living in a space with a healthy indoor environment. A range of new requirements are becoming increasingly popular, including the implementation of air-filtration systems, access to ongoing air quality monitoring, and certifications to prove that certain air quality standards are being met.

Our survey found that 53% of people think that good Indoor Air Quality (IAQ) is a desirable factor when looking for a new property,

while 75% would possibly pay more in rent or house prices to live somewhere that demonstrated good IAQ.

Healthy homes can be a product differentiator for leasing, letting and sales campaigns. Now more than ever, it is imperative for developers to take steps to create healthy spaces with good indoor air quality in order to attract and retain renters and buyers. Those that fail to make changes undoubtedly risk falling behind the competition.



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The UK housing market

Despite the COVID-19 pandemic causing unprecedented disruption in 2020, the property market has shown its resilience. During the first national lockdown in March, the market remained closed for two months, with building sites also closing temporarily.

However, when this lockdown eased, there was a significant spike in UK house prices. According to the [Halifax House Price Index](#), the average price of a property in the UK in October 2020 was £250,457. This represents a 7.5% increase over the October 2019 figure, the largest jump in house prices since the end of 2016. There were several reasons for this increase:

- 1 Pent-up demand due to inactivity during the initial lockdown
- 2 The stamp duty holiday introduced by the Government
- 3 Demand for larger properties with more outdoor space

During the second lockdown in November, the housing market remained open and people were allowed to move and undertake property viewings as long as social distancing measures were followed. The market typically faces a seasonal slowdown at the end of the year, but the second lockdown seemed to confirm people's desire to move, with a markedly busy December. According to ARLA PropertyMark, the number of prospective buyers was the highest it has been over the past 10 years, with demand for housing up by 55% compared to 2010.

What does 2021 hold?

If there is a further downturn in the UK economy, as many are predicting, then the housing market is not going to come out of the pandemic unscathed.

The Government is doing a huge amount to try and support the economy, but this can't continue indefinitely. Growth in house prices may slow down due to the ending of the furlough scheme by the Government, an increase in unemployment, and the end of the stamp duty holiday.

The general consensus is that house prices across the UK will remain flat in 2021, but it is undoubtedly hard to make accurate predictions as there are so many factors that could potentially affect property values throughout the year.

However, there is an undeniable sense of positivity, with Boris Johnson pledging to "build, build, build" to help get the country's economy back on track. This year of adversity has proven that the property market is strong and adaptable, and will bounce back no matter what is thrown at it.



07

Air quality and the planet: our fragile world



Air quality and the planet: our fragile world

Today we are experiencing environmental change as never before, and the need to take action has never been more urgent.

Fortunately, there is now a growing understanding of the deep connection between the climate and our health, and it is becoming increasingly apparent that both of these interconnected issues require our attention and action.

In 2020, the COVID-19 pandemic and resulting restrictions provided some short-term positive impacts. This included temporary improvements in air quality, lower greenhouse gas emissions and decreased levels of noise pollution. However, there have also been negative consequences, such as an increase in single-use plastics and a reduction in recycling. Furthermore, a temporary reduction in greenhouse gas emissions is not a positive substitute for sustained climate action. CO₂ concentrations at key reporting stations remain at record levels.

However, the pandemic certainly presented an opportunity to pause, reflect and improve. It has forced us to acknowledge the immediate need to better prepare our people and our planet for future healthcare and climate change risks. It has also shown us that a large-scale, comprehensive response to a global crisis is possible, when we all fully commit to it.

The COVID-19 crisis could potentially lay the groundwork for the radical changes we need as we look to rebuild our economies. The question is, can we resist the temptation to jump back to our failing system as soon as the pandemic fades away? Or can we rebuild a system that looks after both people and our planet?

Air pollution and climate change: our ever-warming Earth

In the words of Mark Carney, former Governor of the Bank of England,

“We can’t self-isolate from climate change.”

NASA’s data has revealed that 2020 tied with 2016 for the hottest year on record, a clear sign of a planet in distress. Despite a 7% drop in carbon emissions from fossil fuels in 2020, driven by COVID-19-related disruptions, humans still added 40 billion metric tons of CO₂ to the atmosphere. Under that sustained pressure, global average temperatures continued to rise.

The fact that 2020 was as hot as 2016 is particularly concerning because during the latter year, the planet experienced a powerful El Niño event, which is known to temporarily increase global temperatures by a few degrees. In 2020, a mild La Niña (which usually cools the planet slightly) developed late in the year, but even that was unable to offset the extra greenhouse effect of additional CO₂.

Climate change has already started to change the character, intensity, and risk from various natural hazards. In 2020, the number of weather and climate disasters in the U.S. hit an all-time high, with 22 separate catastrophes that cost more than \$1 billion each, and at least 262 lives.

It is abundantly clear that we need to rethink the future of our environment and tackle climate change and environmental degradation with ambition and urgency.

Why is the planet warming?

Global warming is an environmental phenomenon caused by natural and anthropogenic air pollution. It refers to rising air and ocean temperatures around the world.

CO₂ plays a pivotal role in controlling our climate, as it is one of the atmospheric greenhouse gases (GHGs) which keeps the Earth's surface about 33 degrees warmer than it would be if they were not present. In the present climate, the most effective GHGs are water vapour, which is responsible for about two-thirds of the total warming, and CO₂ which accounts for about one quarter. Other gases, including methane, nitrous oxide and ozone, make up the remainder.

The overall increase in global temperature of about 1°C over the past 150 years is almost solely due to the human activities that have produced increasing amounts of atmospheric GHGs. CO₂ levels have been rising exponentially with a doubling time of about 35 years since the beginning of the Industrial Revolution. This is mostly due to the combustion of fossil fuels, but also a consequence of large-scale tropical deforestation.

In 2015, levels passed 400ppm, more than 40% higher than their pre-industrial value of 280ppm. If global energy demand continues to grow and to be met mostly with fossil fuels, atmospheric CO₂ is projected to exceed 900ppm by the end of this century.

Increases in atmospheric CO₂ not only lead to an increase in air temperature, but also cause the oceans to warm and expand. This contributes to rising sea levels, which is further exacerbated by the melting of land-based ice, such as glaciers and ice sheets.



The warmer atmosphere is also causing more extreme weather patterns across the world, including floods and droughts.

If human emissions of GHGs continue to rise at their current rate, the global temperature will continue to increase and the associated weather impacts will become ever more severe. In [Paris in 2015](#), 195 countries agreed to limit global heating 'well below 2°C', striving towards 1.5°C. This was an extraordinary political achievement, which suffered a disappointing blow on the 4th November, 2020, when the U.S. formally withdrew from the agreement, after President Donald Trump began the process in 2017.

Thankfully, on the 21st January 2021, in one of his first acts in the Oval Office, President Joe Biden signed an executive order to rejoin. This is an act of great political significance, as it means that the U.S. will once more have to follow the rules, showing that it is no longer 'America First'. It is also a move that signals to the world that President Biden is serious about addressing climate change again, and will hopefully pave the way for drastic steps to be taken to address the escalating crisis.

However, it does not take away from the fact that meeting the Agreement's target is going to be an extremely demanding task. The U.S. is the second-largest producer of carbon emissions, and has contributed more to global climate change over time than any other country. The entire world needs an urgent transition from fossil fuels to renewable energy.

Data shows that this energy transition is happening far too slowly, with the [Production Gap Report](#) showing that the world is currently on track to produce 120% more fossil fuels by 2030 than is compatible with a 1.5°C increase in temperature.

Our understanding of how to flatten the COVID-19 curve is growing every day. We need to apply these learnings to flatten the emissions curve, by working towards a substantial reduction in carbon emissions in line with the Paris Agreement.



5

Mental health and trauma

Climate change and related disasters can cause anxiety-related responses as well as chronic and severe mental health disorders. Flooding and prolonged droughts have been associated with elevated levels of anxiety, depression and post-traumatic stress disorders. Extreme weather events have also been associated with increases in aggressive behaviour and domestic violence. In turn, all of these psychological damages have an impact on our physical health, and this has repercussions for all aspects of our lives.



What can we do to help?

To address climate change, post-COVID-19 recovery plans need to trigger long-term systemic shifts that will change the trajectory of CO₂ levels in the atmosphere.

The UN Secretary-General has proposed the following six climate-positive actions for governments to adopt once they start to rebuild their economies and societies:

- 1.Green transition: Investments must accelerate the decarbonisation of all aspects of our economy.
- 2.Green jobs and sustainable and inclusive growth.
- 3.Green economy: making societies and people more resilient through a transition that is fair to all and leaves no one behind.
- 4.Investment in sustainable solutions: fossil fuel subsidies must end and polluters must pay for their pollution.
- 5.Tackling all climate risks
- 6.International cooperation – no country can succeed alone.

It is certainly not an easy challenge, but it is not too late to slow the pace of climate change, as long as governments take urgent and drastic action.

There are also many simple things that we can do ourselves to have a positive impact on climate change.



Things you can do to reduce your carbon footprint



1. Food

- Eat items which are low on the food chain. This means eating mostly fruits, vegetables, grains, and beans
- Choose organic and local foods that are in season. Transporting food from far away uses fossil fuels both for fuel and cooling to prevent foods in transit from spoiling
- Reduce your food waste by planning meals ahead of time, freezing the excess and reusing leftovers. Compost your food waste if possible

2. Clothing

- Try to avoid fast fashion and opt for quality clothing that will last. Cheap items that go out of style quickly get dumped in landfills where they produce methane as they decompose
- Even better, buy vintage or recycled clothing
- Best of all: the most sustainable item you can wear is one you already own!
- Wash your clothing at a lower temperature where possible

3. Shopping

- Buy less 'stuff', and purchase used or recycled items whenever possible. Take your own reusable bag when you shop and try to avoid items with excess packaging
- If shopping for appliances, lighting, office equipment or electronics, look for Energy Star products, which are certified to be more energy efficient
- Support and buy from companies that are environmentally responsible and sustainable

4. Home

- Change incandescent light bulbs to LEDs, which use a quarter of the energy and last up to 25 times longer. Switch lights off when you leave the room and unplug your electronic devices when they are not in use
- Turn your water heater down and install a low-flow showerhead to reduce hot water use. Taking shorter showers helps, too
- Sign up to get your electricity from clean energy through your local utility or a certified renewable energy provider

5. Get politically active

- Finally, and perhaps most importantly since the most effective solutions to climate change require governmental action, vote!
- Become politically active and let your representatives know you want them to take action to phase out fossil fuels use and decarbonise the country as quickly as possible. In the UK, you can make use of www.writetothem.com/ to quickly write to your local and national politicians

Transport: the problems with getting from A to B

Over the past decade, both people and goods have been on the move more than ever before, and this has come at a great cost to the environment. Emissions from the transport sector are a major contributor to climate change, accounting for approximately 14% of annual emissions. At a time when global emissions need to be decreasing, transport emissions are generally on the rise. Unfortunately, any improvements in vehicle efficiency tend to be more than offset by greater overall volume of travel.

Around 72% of global transport emissions come from road vehicles, and these accounted for 80% of the rise in emissions between 1970 and 2010. Emissions have also increased in other transport areas such as aviation and shipping. Energy use in the transport sector is likely to continue to increase across the world, so transport's reliance on fossil fuels needs to shift dramatically.

In 2020, the COVID-19 pandemic demonstrated the huge impact transport has on air quality, when much of the sector came to a grinding halt due to lockdown restrictions. It was undoubtedly encouraging to see significant drops in pollution around the world, but in many cases it quickly returned to pre-pandemic levels. It is also clear that those sorts of reductions were neither sustainable nor a long-term solution. We need to take steps to decarbonise the transport sector in order to create a cleaner and healthier future for us all.



The impact of COVID-19

During the first national lockdown in the UK, there was a 42% decrease in surface-level nitrogen dioxide (NO₂) pollution. News reports focused on the benefits that the fall in vehicle traffic was having on air quality, and it seemed that the pandemic may have a silver lining after all. However, while it was promising to see lower levels of NO₂ being recorded, the change in atmospheric composition and reactivity resulted in a shift in our exposure to different pollutants

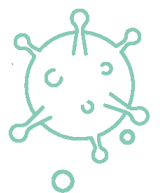
Various pollutants in our atmosphere lie in a delicate chemical balance, which means that if one is disturbed, there will be alterations in the other. Due to the rapid decline of nitrogen oxides (NO_x), the atmosphere became more reactive, and there was a marked increase in ground-level ozone. This was far above what would usually be expected during the uncharacteristically sunny weather that we experienced during the first lockdown.

As a result, the atmosphere in urban locations shifted to a 'hydrocarbon limited ozone production regime', whereby NO_x declined but non-methane hydrocarbons (NMHC) prevailed. Emissions of NMHCs usually come from industries like manufacturing, which were able to operate throughout lockdown as they constitute essential business. The shift in atmospheric composition enabled ozone production to increase with

concentrations up by as much as 15%. A more reactive atmosphere also has the potential to increase our exposure to pollutants such as Ultra Fine Particulate Matter (UFPs), which can form when VOCs react with ozone.

This is not to say that the reductions in NO₂ were not beneficial. It just shows that we need to recognise that there are many different sources of pollution, and that we need to address the situation holistically. If not, we are in danger of causing atmospheric imbalances that could cause a rise in other toxic air pollutants.

COVID-19 has given us the opportunity to take a step back and assess the current state of play. Now, we need to emerge from the pandemic with a comprehensive plan to create more sustainable, efficient, and responsive transport systems.



What is being done in London?

Sadiq Khan's Transport Strategy sets out his plans to transform London's streets, improve public transport, and create opportunities for new homes and jobs. This involves encouraging more people to walk, cycle and use public transport. Khan has said that:

“At its heart is a bold aim for 80% of all trips in London to be made on foot, by cycle or using public transport by 2041. This is a big task and achieving it won't be easy.”

Khan is certainly right: we face a huge challenge when we come to reducing the environmental impact of transport, and it requires commitment from us all.

The Transport Strategy uses the 'Healthy Streets Approach', which makes health and personal experience the priority as we plan transport across our city. Action plans to support the strategy include:

1. [Walking action plan](#)
2. [Vision Zero action plan](#)
3. [Freight and servicing action plan](#)
4. [Cycling action plan](#)

In addition to this, there are also plans to extend the existing Central London Ultra Low Emission Zone (ULEZ) from 25 October 2021. This will expand to create a single larger zone bounded by the North Circular Road (A406) and South Circular Road (A205).

Cars, motorcycles, vans and other specialist vehicles and minibuses will need to meet the required ULEZ emissions standards when driving within and into the expanded zone, or pay a daily charge. Four out of five cars already meet the ULEZ emissions standards, but owners of older, polluting cars, motorcycles, lighter vans and minibuses, will need to take action.

In addition to action taken by the Government, there are also various councils, organisations and individuals that are playing a vital role in addressing the air pollution caused by transport. There are far too many to name them all, but we were able to speak to some of the key players who are leading the way in raising awareness and pushing for change.

Go to page 84 to read our interview with Jeffrey Young, founder of Camden Clean Air Initiative, and page 53 to hear from Jemima Hartshorn, founder of Mums for Lungs.





In conversation with Jeffrey Young,

Founder of Camden Clean Air Initiative and CEO at Allegra Group

The Camden Clean Air Initiative is an ambitious, not-for-profit action group working to increase the quality of air in the borough of Camden. Their aim is to transform Camden into a haven for walking and cycling, work with local government and major Camden-based companies, and champion borough-wide initiatives and policy change.

We spoke to Jeffrey Young, founder of the initiative to understand what made him decide to take action, what challenges Camden is facing, and what he'd like to see happen in 2021.

What made you decide to take action?

There are several things that led to the creation of the Camden Clean Air Initiative. Firstly, with our kids at school, we noticed that their playground was being heavily polluted by car emissions. There is a bit of a dip in the road and bad air tends to sink, which unfortunately means that that specific spot is particularly bad. I realised that we need to do something to address the scale of the air pollution crisis in London, and create a healthier future for our kids. I also fundamentally believe that this moment of COVID-19 is making us stop and think. Not long ago, I was walking to work and got to the top of Primrose Hill and noticed that I could see further than I had ever seen before. It made me realise that we can't just return to the way we were living pre-lockdown. Those of us who have the time, energy and resources need to make a change, because now is the time that you will be listened to. We really don't have the time to waste, we need to maintain these improvements, tackle the air pollution crisis, and spark behavioural change.

What projects are the Camden Clean Air Initiative working on?

We have 10 long-term projects:

1. No Car Tuesdays
2. Block roads off to cars and vehicles and fill the space with trees and eateries, creating safe and beautiful places
3. Convert 100 car parking spaces into parklets with space for benches, plants, and bike lock-ups
4. Policy change such as a ban on parking in front of schools or idling outside of shops
5. Convert 500 cars in Camden to electric
6. Push for the construction of safe bike lock-ups
7. Distribute 100 air pollution monitors across the borough
8. Increase electric charging infrastructure around public housing estates
9. Convert our Routemaster bus to electric with the support of our community to advertise our mission
10. Transform Camden into a centre of excellence in the environmental and technological landscape, creating high-tech and high-value jobs

Sometimes, long-term really does mean long-term, but we're working away on as many of these as possible. For example, increasing electric charging infrastructure: we're working with taxi companies on this one. One of the barriers to getting more electrification of vehicles is taxi drivers not having a place to plug in overnight because in fancy neighbourhoods they can just pay for private charging points themselves. A big goal is the Routemaster – I'd love to convert this to electric, get sensors on it and use it as a billboard displaying the air quality as it's driven around Camden: but obviously that's a lot of money. A barrier to progress is working through the councils. There's a lot of discussion that has to be had to get anywhere. And then you see things like the fact that Primrose Hill has parklets, but there's no process through the council to implement more. That's what we're trying to do, to make it more straightforward. We're just trying to accelerate what's going to happen eventually by working together.

What is the main challenge Camden is facing at the moment?

There are undoubtedly lots of challenges coming our way. One of the big ones at the moment is that the Ultra Low Emission Zone is expanding into Camden this October. This is a really exciting opportunity for clean air, but there is either going to be a mass of cars that won't be able to be used, or people are going to have to pay a huge fee to keep their cars on the road. There will also be some vehicles that need to be replaced by electrics and hybrids, which means there is a massive need for more electric charging points. The big question out there that

no one yet knows the answer to seems to be hydrogen or electric? We need to think very seriously about a hydrogen economy, and put the greatest minds together to find the best answer for vehicles going forwards. We want to provide solutions that are open to everyone, and to do that there needs to be a lot of investment in new infrastructure.

What is one thing you'd like to see happen in 2021?

One thing I'd love to see happen in 2021 would be tighter restrictions on the usage of cars. The fact of the matter is, we don't need to use all the cars that we do, and we will live longer if we walk and cycle more! We definitely need to make spaces friendlier for cyclists and pedestrians to help facilitate this change. And more generally, our cities need to become greener and cleaner, with more nature and respect for the environment. In the borough of Camden specifically, I would love to put some resources towards getting a proper dialogue with all the stakeholders in Camden who have a vested interest in making this place better. Instead of endless debate, I want something that allows us to come together and make some quick and meaningful decisions.

What is being done around the world?

The extensive emissions from transport are a major issue in cities across the world. Here we look at two cities that have found innovative solutions and achieved great results.

1 Barcelona

In 2016, Barcelona introduced its first 'superblocks', which are neighbourhoods of nine blocks, where traffic is restricted to major roads outside these districts. The aim is to reduce pollution from vehicles, give residents much-needed relief from noise pollution, and create more open space for pedestrians and cyclists.

A 2019 study carried out by the Barcelona Institute for Global Health estimates that if, as planned, 503 potential superblocks are put in place across the city, journeys by private vehicles could fall by 230,000 a week, as people switch to public transport, walking or cycling. This could reduce ambient levels of NO₂ by a quarter, bringing levels in line with WHO recommendations. The study estimates that as many as 667 premature deaths from air pollution, noise and heat could be prevented each year.

It is clear that further investments in local infrastructure, such as improving surrounding roads to enable them to deal with more traffic, or installing smart traffic management systems may be required to prevent issues with congestion. However, this is a great example of an initiative that can be replicated in other areas.

The principles of creating superblocks and valuing pedestrians, cyclists and high quality public spaces and transport over motor vehicles, could be applied in many cities, even if some adjustments were necessary to take into account the specific nature and requirements of individual conurbations.

2 Copenhagen

Copenhagen is on track to become the world's first carbon-neutral city by 2025, and is setting a green standard for urban centres worldwide. It is known to be the world's most bike-friendly city, with over 675,000 bicycles and just 120,000 cars.

Almost one third of all journeys across the city, and 41% of commutes to work or study are taken by bike. For people living as well as working or studying in Copenhagen, this proportion is even higher, an impressive 62%. In 2016, Copenhagen's cyclists covered a daily total of 1.4 million km, an increase of 22% since 2006.



The city's traffic lights are synchronised with the average speed of cyclists to keep cycle traffic flowing and, there is a 'pre-green' light to give cyclists a five-second head start over cars at junctions or crossings. Cyclists also benefit from cyclist-only bridges and superhighways that provide traffic-light-free travel between the city centre and neighbouring municipalities. There has been a huge investment in infrastructure, which is thought to have cost in the region of \$155 million since 2005.

While this level of investment is not economically viable for all cities, it is nevertheless a clear indication that encouraging cycling is extremely valuable. Even small changes to existing infrastructure can make a big difference to improve safety and promote a shift away from cars. When it comes to schemes like this, one of the most important things is to get buy-in from citizens, through continuous engagement with local government officials.

The role of green infrastructure

While the primary means of reducing air pollution from the transport sector involve actively reducing source emissions, there are also things we can do to limit our exposure. One measure that has been shown to have a positive impact is the implementation of green infrastructure, often referred to as GI.

We spoke to Professor Prashant Kumar, the founding Director of the Global Centre for Clean Air Research, who told us more about the role GI has to play in reducing the air pollution exposure of those living, working or travelling near busy roads.

“GI is a passive intervention for air pollution exposure reduction, which works by modifying the pathways of air pollutants from source (e.g. a car) to receptor (e.g. a pedestrian). A vegetation barrier is a type of GI that enhances pollutant dispersion, leading to dilution of air pollutant concentrations and thus a reduction in human exposure when compared to the free flow of these pollutants from source to receptor. GI can also capture some of these air pollutants, by presenting a high surface area for deposition and via biochemical interactions between healthy vegetation and the ambient air.”



Professor Kumar recently worked on a [research paper](#) which evaluated the impact green infrastructure has on air quality in open-road conditions.

In our Schools section, we shared advice recommending 'green barriers' such as hedges around schools. Professor Kumar explained to us why low-level hedges are extremely effective at catching pollutants:

“Due to dispersion, pollutant concentrations decrease with distance from the source, and low-level hedges are often close to tail-pipe emissions from vehicles. Because of this proximity to high concentrations of freshly emitted air pollutants, the leaves of low-level hedges can capture high quantities of pollutants when compared to tree canopies at greater heights from the roadside.”

However, as is the case with many initiatives discussed in this report, there cannot be a one-size-fits-all approach. The context of the proposed planting site needs to be assessed before designing and implementing GI for improved air quality. Professor Kumar explains: “The effectiveness of any form of GI is extremely site-specific. There is no one answer on which plant is more suitable than others as there is a trade-off between various parameters such as biogenic volatile organic compounds and pollen emissions, and the tolerance of various plants.”

It is clear that when it comes to addressing the emissions from transport, we need to take a broad approach. Going forwards, it seems likely that GI solutions will gain increased attention from policy-makers and citizens alike, as they have the potential to bring about environmental, social, and economic benefits.

What more needs to be done?

In order to transition to zero-emission transport, we need to emerge from the COVID-19 pandemic with a comprehensive collection of measures in place. This includes addressing issues such as the use of clean fuels, vehicle efficiency, how we build cities, and how we move people and goods. Taking effective local action is invaluable, but coordination between different areas is vital in order to align approaches and avoid displacement of pollution from one region to another.

While it is a broad and complex topic, on the next page, we have tried to break it down to five key actions that need to be taken around the world to reduce transport emissions.

1

Increase electrification

Expand the use of electricity in transportation, in order to eliminate exhaust emissions, optimise the use of the energy grid, and enhance the integration of renewable energy resources.

2

Introduce more stringent fuel efficiency standards

Introduce more stringent fuel efficiency standards, not only for passenger cars but also for heavy-duty vehicles such as buses and trucks.

3

Accelerate the implementation of Clean Air Zones

Accelerate the implementation of Clean Air Zones to discourage the most polluting vehicles from entering particularly polluted areas.



4

Improve public transport

Take steps to ensure public transport is clean, safe, and efficient, and increase electrification within the sector.

5

Promote cycling and walking

Promote the benefits of cycling and walking and invest in infrastructure to make these options safer and more accessible.

What can we do to help?

While government measures are essential, they can only go so far. In order to significantly reduce the volume of emissions from transport, we all need to be prepared to make changes to the way in which we travel.

Tips for driving

1. **Drive less**

Where possible, use public transport, walk or cycle. When walking or cycling, try to avoid polluted routes such as main roads to reduce your exposure.

2. **Drive sensibly**

If driving is the only option, congestion can be reduced if people are able to avoid travelling during morning and evening rush hours. Using traffic apps can help you to avoid getting stuck in traffic jams. Accelerating gently and adhering to speed limits will also help to reduce fuel consumption.

3. **Take care of your car**

Keeping your tyres properly inflated and ensuring that your car is properly maintained can increase your fuel efficiency.

4. **Stop idling**

Reduce pollution by turning off your engine when waiting, especially when other people are nearby or when waiting for children during the school run.

5. **Consider lower-emission alternatives**

If you need a new car, do some research and consider purchasing a hybrid or electric vehicle.



Tips for flying

1. **Avoid flying where possible**

If you fly for work or pleasure, air travel is probably responsible for the largest part of your carbon footprint. On shorter trips, driving may emit fewer greenhouse gases. Flying non-stop is also preferable as landings and take-offs use more fuel and produce more emissions.

2. **Go economy class**

For long haul flights, carbon emissions per passenger are about three times higher for business class and four times higher for first class.

3. **Offset the carbon emissions of your travel**

If you can't avoid flying, offset the carbon emissions of your travel. You can either do this via your airline, or pick one of the growing number of stand-alone organisations that run carbon offsetting schemes.

As with so many things when it comes to helping the planet, we all need to ensure we understand the issues at stake and do our very best to address them. Certain actions are unavoidable, some options will be too expensive, and other measures that are in place are not accessible to us all. However, if we all come together, we can be part of the solution.





In conversation with Ruth Duston OBE,

Owner of Primera Corporation, and CEO and Executive Director, Northbank BID, Victoria BID and Cheapside Business Alliance

Ruth's career spans over 25 years working within regeneration, having worked with some of the most deprived communities in the country to shape redevelopment schemes across central London. She is one of the UK's leading experts in the development and implementation of business-led partnerships and Business Improvement Districts. Ruth was awarded an OBE for Services to business in London in 2018.

You are responsible for some of London's largest BIDs. What are the key challenges you have faced in the past year?

The key challenges have been communicating with our BID members in a remote capacity; switching a lot of our interventions across to digital, lobbying on behalf of business and despite being reactive, trying to be forward thinking around recovery. The core function of BIDs is around people and collaboration. However, our BID community has been resilient and supportive as they see BID at the front and centre of recovery.

As and when the pandemic begins to ease, how can we mobilise the London workforce and kickstart the economy?

The most important sector to kickstart the economy will be the office workers, as this will reignite the city ecology. However we must be realistic in that as lockdowns ease, it will be a trickle back to a 'new normal'. We need business leaders to come together with a clear narrative that will incentivise employees back.

The other hurdle is the transport network – there will be a level of rehabilitation on encouraging people back onto the transport infrastructure. We need to work towards becoming Smarter Cities and what key drivers will aid this outcome – digital and the green recovery.

What policy changes do you think need to be brought in to enact real change when it comes to recovering from the pandemic? And how will BIDs help to support this challenging process?

Planning and licensing will be the biggest area in terms of enabling business and local authorities to respond and work together on re-purposing their districts to adapt to the "new normal". Social and economic policy will also be key drivers – reskilling, attracting and retaining talent and promoting growth sectors such as the tech sector, co-working space and business start ups.

What steps do you think need to be taken in order to improve outdoor air quality in our cities, as well as indoor air quality within our buildings?

The biggest challenge for the outdoor environment has always been traffic – this is the conundrum for how we move towards promotion of outdoor space, the important role it will play in recovery and mental health vs the congestion and pollutants from traffic. I suspect we will have some challenges here with people driving in as opposed to using the transport network. Office buildings targeted at those smaller businesses and older office buildings will be paramount – ventilation is an important part in the fight against transmission of COVID – I can't use my Primera office because we can't open the windows and there are no facilities for air filtration. This will be a big issue for some landlords with smaller assets when marketing space, so this all needs to be explored further.

Wildfires: our burning planet

Throughout 2020, many countries experienced their worst wildfires in decades, if not in all of recorded history. These devastating fires are caused by a variety of factors, but there is one key factor that has undoubtedly contributed to the scale and intensity of wildfires across the globe: human-caused climate change.

The extreme temperatures and severe droughts caused by climate change have made our planet more susceptible to burning, and more severe weather conditions mean that once these fires have begun, they tend to burn more intensely and widely than they have in the past.

Wildfires have a wide-reaching impact, wreaking havoc on local economies, our health, and the environment. With such a vast array of short-term and long-term consequences, it is hard to ascertain just how much damage the fires of 2020 may have caused.

Before we explore some of these impacts, it seems apt to begin by looking at some of the worst wildfires of 2020.



Siberia

In recent years, Russia's vast Siberia region has become a climate hotspot, heating up much faster than the rest of the planet. In 2020, the fire season started earlier than usual following a particularly hot winter and spring. On the 17th June, Verkhoyansk, a town in the Arctic region of Siberia, recorded a reading of more than 38°C, the highest temperature ever documented north of the Arctic Circle.

According to Greenpeace International, fires have burnt through 20 million hectares of the Russian landscape since the beginning of 2020. This is an area bigger than Greece, and includes around 10.9 million hectares of forest. The Arctic wildfires in Siberia this summer have also set an alarming record: for releasing more pollution into the air in a single month than any other in 18 years of record keeping.

This is partly due to the fact that the substances that burn release extremely high concentrations of pollutants into the atmosphere. Melting tundra permafrost, peat buried in bogs and resin-rich boreal forest, all create large quantities of CO₂, methane and toxic contaminants like mercury. However, it is also undeniably a result of the record-breaking heat waves at the start of the summer, which thawed parts of the tundra and made it more susceptible to burning.

Smoke from the Siberian wildfires affected citizens in nearby cities for months, with smoke spreading across the Pacific Ocean to reach Alaska. It was even responsible for creating hazes as far away as Seattle in August.



Australia

As is the case in Siberia, Australia's fires have been starting earlier and becoming more rampant in recent years. In June 2019, the Queensland Fire and Emergency Service Acting Director warned of the potential for an early start to the bushfire season, which normally starts in August. This was due to the exceptionally dry conditions and lack of soil moisture, combined with early fires in central Queensland.

Throughout the summer, hundreds of fires burnt, mainly in the south-east of the country, with a peak between December and January last year. The monstrous flames engulfed 18.6 million hectares of land, claiming the lives of 34 people, destroying thousands of homes, and killing or displacing three billion animals. Economists believe that the bushfires may have cost Australia over A\$100 billion, and NASA estimated that by the 2nd January, 306 million tonnes of CO₂ had already been emitted by just the New South Wales and Queensland bushfires. This is equivalent to nearly half of Australia's total greenhouse gas emissions from the previous year.

Researchers from Canada's University of Saskatchewan measured smoke in the upper atmosphere in the wake of pyrocumulonimbus storms (PyroCBs), which are fire-generated thunderstorms. They found that the cloud caused by Australia's bushfires was three times larger than anything previously recorded globally. It measured 1,000km across, remained intact for three months, travelled 66,000km and soared to a height of 35km above Earth.

Smoke from the fires was carried to New Zealand, where it impacted air quality and eerily darkened the snow on glacier-covered peaks. The plumes were so thick that a NASA satellite was able to capture images of it from space.



California

This extraordinary year of wildfires reached another new distressing milestone in California – the first ‘gigafire’ (a blaze spanning 1 million acres) in modern history. At 1.03 million acres, the fire spread across seven different counties and covered an area larger than Rhode Island. It began following a series of separate fires that were sparked by lightning strikes in August.

The ‘August Complex’ follows a long list of fires that destroyed 4 million acres of California last year, which is double the previous annual record. The 2020 fire season has also produced five of the six largest wildfires in state history, resulting in several dozen deaths and thousands of lost buildings.

To make matters worse, it is not just California that has been affected, with several major blazes occurring in other Western parts of the U.S. including Oregon and Washington.

The threat of travelling wildfire smoke

It is extremely worrying to see just how far the smoke from wildfires can travel. It can remain in the atmosphere for days, weeks or even months depending on how long the fires burn. PyroCBs provide a pathway for smoke to reach the stratosphere, enabling it to travel thousands of miles from its source and affect global atmospheric conditions.

What is even more alarming is that the toxicity of smoke particles also appears to increase as they get further away from the site of a fire. As smoke travels through the air, the methoxyphenols within it react with ozone and hydroxyl radicals to become oxidized. This converts the particles into highly reactive compounds that have an even greater capacity to damage cells and tissue than when they were first produced at the source of the fire.

A [2019 study](#) published in the Environmental Science & Technology Journal showed that the toxicity of smoke compounds can double in the hours after they are first emitted from a fire, and can become up to four times as toxic throughout the following days. Professor Athanasios Nenes, an atmospheric chemist who led the study explained:

“Even if someone is far away from a fire source, they may still experience adverse health outcomes from the inhalation of highly diluted and oxidised smoke. We have seen that the oxidative potential of wildfire smoke can be up to four times higher when smoke has been atmospherically processed.”

Professor Athansios Nenes

The short-term impacts wildfire smoke has on our health

Wildfire smoke is made up of a variety of gases and particles from the materials that fuel the fire. This includes ozone, carbon monoxide, polycyclic aromatic compounds and nitrogen dioxide (NO₂). The smoke also contains particulate matter, including PM_{2.5} and even finer nanoparticles. These particles are particularly harmful when inhaled, as they can penetrate into our lung membranes, damage our respiratory system, and pass into our bloodstream.

In the short-term, particulate matter causes coughing and shortness of breath, and can exacerbate existing health conditions such as asthma. A 2017 study published in *Epidemiology* estimated that between 2004 and 2009, around 46 million people in the western US were exposed to at least one wave of smoke from wildfires. On days where smoke caused high PM_{2.5} levels, there was a 7.2% increase in hospital admissions due to respiratory illnesses.

Similarly, during the bushfires at the end of 2019 in Australia, hospital admissions due to breathing problems increased by 34% in the state of New South Wales.

The concerning long-term health issues

There are also some significant long-term health issues to consider. Particulate matter has been linked to a range of problems, including chronic inflammatory response, and a greater risk of heart disease and strokes.

Wildfire smoke itself also carries unique risks, as it is filled with reactive chemical compounds that can be carcinogenic, which can also lead to premature births. Exposure to the smoke is thought to be shortening the life expectancies of populations that experience fire seasons regularly.

A 2011 study found that particulate matter from wildfire smoke was especially harmful to a type of immune cell in our lungs called macrophages. Researchers found that wildfire particulates were four times more toxic than particulate matter from other types of air pollution.

It is estimated that wildfire smoke causes over 339,000 premature deaths a year globally. People with pre-existing respiratory conditions tend to be the ones who are most affected by wildfire smoke, and it is thought that some may never completely recover after experiencing just one severe wildfire season. However, it is new-born babies that may face the most life-altering impacts, as their lungs are still developing, making them particularly vulnerable to smoke toxicity.

When wildfires and a global pandemic combine

The health risks associated with wildfire smoke have been exacerbated with the unwelcome addition of COVID-19. This is because smoke can stress the respiratory tract, leaving it more vulnerable to respiratory pathogens. Sarah Henderson, from the British Columbia Centre for Disease Control, explains that “your body perceives that smoke as a foreign threat, the same way it would perceive a virus or a bacterium. And it mounts an immunological response against the smoke, trying to kill it, basically. And what this serves to do is kind of distract your immune system.”

The smoke also makes cilia – tiny hair-like organelles that help keep our lungs and airways clean – less effective. This makes our bodies more vulnerable and less able to fight off viruses such as COVID-19. It is estimated that a moderate episode of wildfire smoke could potentially increase the effect of a COVID-19 outbreak by approximately 10%.

While the virus remains a global health threat, it is more important than ever for people in fire-prone regions to take precautions to minimise their exposure to smoky air as much as possible.

The general recommendation when wildfires are raging outside is to stay indoors to avoid the smoke. However, as we discussed earlier in this report, indoor spaces can be problematic too, and it is thought that around 80% of total exposure to particles from wildfires will occur indoors. This means that we need to do everything we can to optimise IAQ, including closing windows during these high pollution events, investing in air purifiers with HEPA filters, and avoiding activities that create more pollution indoors.



Climate change and wildfires: a vicious cycle

Wildfires not only have a long-term impact on human health, but also on the health of our planet. These destructive blazes are not only a result of climate change, but also contribute to it. Burning forests release enormous amounts of CO₂ and other greenhouse gases (GHGs) into the atmosphere. This leads to a vicious cycle: GHGs emitted by fires feed climate change, which in turn brings warmer, dryer summer conditions that create the perfect conditions for more fires.

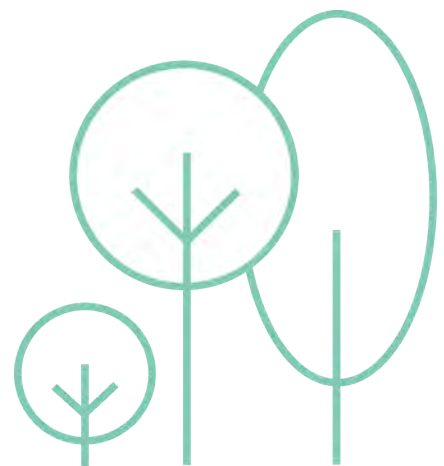
Peat fires have an especially adverse impact on the environment as they emit legacy carbon which has been built up over thousands of years in a matter of hours or days. A [2016 study](#) published in Proceedings of the National Academy of Sciences estimated that during the 2015 fire season in Indonesia, biomass fires that included a significant amount of peat, released 1.5 billion tonnes of CO₂ into the atmosphere. The soil in places like Russia, Alaska and Canada contain around 30 times the amount of peat found in Indonesia's soil. As climate change causes these Arctic territories to warm faster than the rest of the planet, the number of peat fires releasing huge quantities of CO₂ will only increase.

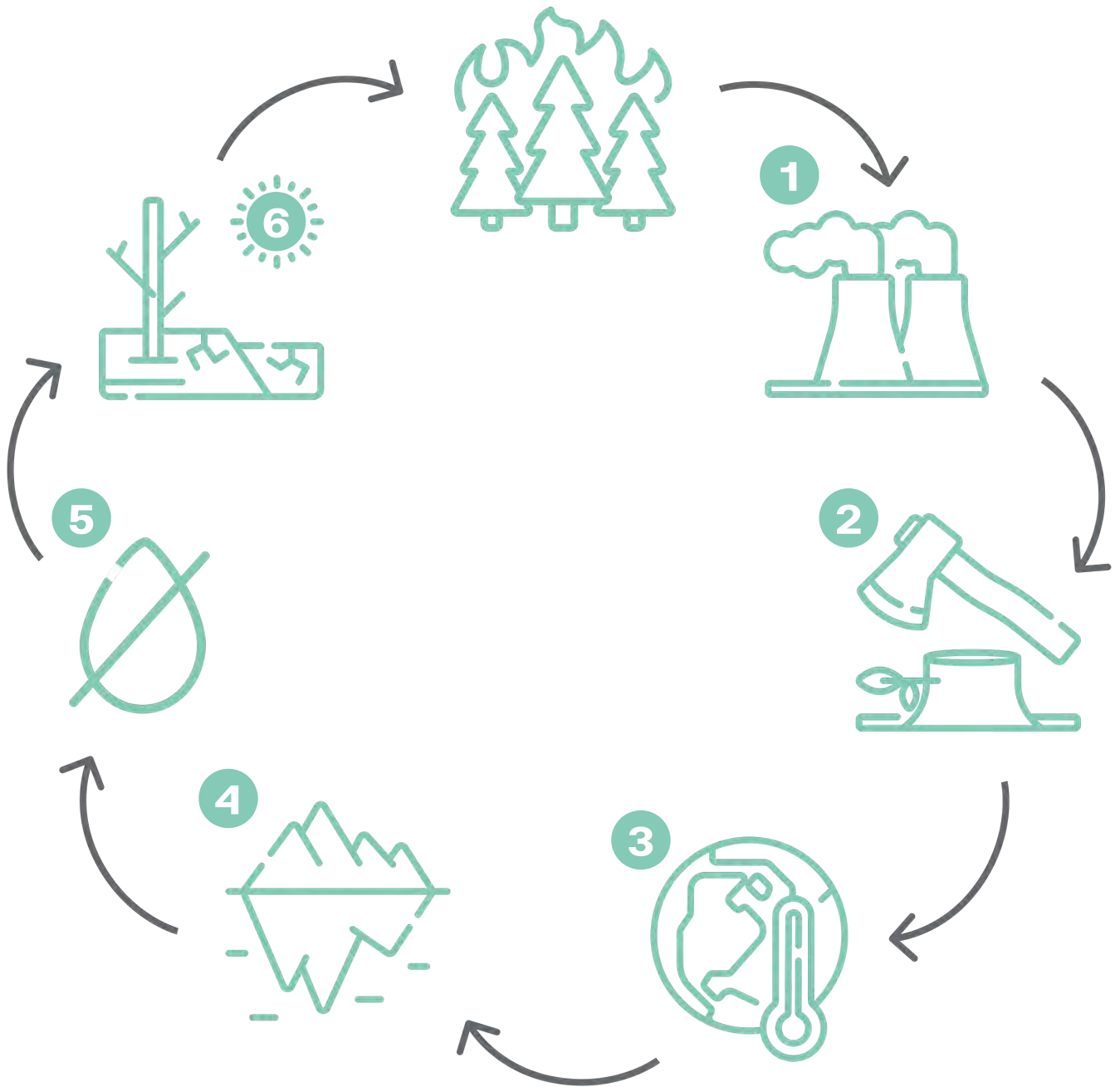
These areas also regularly experience 'zombie fires', which are fires from a previous growing season

that smoulder under the ground for long periods of time. When the weather warms, they can quickly roar back to life, as seen in Siberia last year.

More recently, NASA researchers have also discovered another effect wildfire smoke may be having on the climate. They found that the Earth is surrounded by a haze of old smoke that hangs in the troposphere over places like Antarctica. On a global scale, these smoke particles cool the Earth slightly. But on a regional scale and in places like the Arctic that are especially sensitive to climate change, these particles can cause a regional warming effect.

One reason for this is that the black and brown carbon found in smoke absorbs heat, and causes the air temperature to rise and warm the area below. In areas like the Arctic, this could serve to make wildfires even more likely to occur.





- 1** Increasing pollution from industry and traffic leads to increased CO₂ emissions
- 2** Deforestation means that less CO₂ is absorbed and less oxygen is produced
- 3** Rise in CO₂ levels and other greenhouse gases leads to higher global temperatures
- 4** Rise in global temperatures melts Arctic ice and reduces Rossby waves
- 5** Higher global temperatures lead to less humidity and less rain
- 6** Hotter, drier climates cause snowpacks to melt months earlier, reducing natural moisture levels in high-risk areas

Can we break the cycle?

In this ever-warming world, wildfires are only going to become more frequent and devastating. The climate-driven threats that experts thought would escalate in the coming decades are already much worse than anticipated. Wade Crowfoot, the California Secretary for Natural Resources, explains:

“Frankly, we’re alarmed because this wildfire destruction that we’re seeing in 2020 is the type of destruction that we anticipated experiencing later in the century.”

It is safe to say that it is truly worrying to consider what the coming years hold for fire-prone regions. However, what we need to do now is to focus on the things we can do to make a difference. To have any chance of restricting the rise in global temperatures in line with the Paris Agreement, more needs to be done to cut carbon emissions from governments, businesses, communities and individuals. In order to reduce the ferocity of wildfires, we need to reinvest in prevention, clarify governance and coordinate policies, and use a science-based approach to risk and interventions.

There are no two ways about it: we need to come together as a matter of urgency to fight wildfires and climate change. If we act now, we have the power to break the cycle and move towards a more sustainable future.



In conversation with Ran Korber, CEO and Co-founder of BreezoMeter

BreezoMeter provides real-time air quality information including air pollution, pollen, and active fire intelligence. Their data has inputs from more than 47,000 sensors worldwide, as well as meteorological data, satellite information, active fires, sandstorms, traffic, and connected cars.

We spoke to CEO, Ran Korber, to find out more about how they are helping billions of people worldwide to reduce their exposure to air pollution.

You provide real-time air quality data, which is essential when it comes to accurate wildfire reporting. What challenges do wildfires pose for air quality providers?

Live air quality reporting through a wildfire can be very challenging and being in the wrong area can yield dire health consequences for those most at risk from smoke exposure. Sources of air quality information worldwide are growing but many providers still rely heavily on the information provided by government monitoring stations. As a result, wildfires pose significant air quality reporting challenges for many of these providers.

Government sensors are extremely accurate at their precise location but there can be huge distances between the location of the stations, affecting the reliability of air quality information when no station is available. As fire smoke moves so unpredictably, it gets frequently missed by monitoring stations.

Not all stations report every pollutant, including particulate matter, which means that these stations will not reflect the high air pollution levels at the time of the fire. The information provided by government station sensors is usually reported as averages over time. This is extremely reliable and accurate for their original purpose – for regulatory planning and trends over time – but can be dangerously misleading during times of erratic air pollution changes. When air quality information gets delivered as an average over time, real-time exposure to rapidly moving smoke frequently goes unreported.

In addition to the usual delays and coverage issues associated with station-only reporting methods, station sensors themselves can become damaged during a wildfire outbreak, causing them to fail to report accurately or not to report at all. During a blackout, station sensors can also stop reporting information altogether (this happened during the California wildfires of 2019 and again in June 2020 during the huge Arizona wildfire).

How have you overcome these challenges to provide such accurate and comprehensive data?

BreezoMeter's multi-data and multi-model approach means we're uniquely placed to provide accurate information even when sensor information or one data layer becomes unavailable. We factor information from numerous data sources such as real-time traffic satellites, active fires, meteorological input, and more.

In order to ensure accurate wildfire reporting and reliable wildfire smoke maps, we also use a sophisticated smoke model:

- Satellites that measure different light bandwidths to detect the presence of fire on earth, the stage of a fire & type of particulate matter that is emitted
- Land cover information to understand the type of vegetation that is being burned
- Meteorological conditions like rain and wind to learn about the direction and amount of smoke in a particular area
- Chemical processes that might alter the types of pollutant, and pollutant levels downwind of a fire

People can now access your data through the Yahoo Weather app as well as the Apple Weather app: what does this mean for people around the world?

There are now far more people that have access to accurate, real-time air quality data, and can make healthier decisions based on this information. And it is as easy as opening up your phone, or checking the weather – all activities that we habitually do anyway throughout the day.

The other way to see it is that those who have been less aware of the air they breathe, or how much their health is affected by exposure to air pollution, will now see a very personal reading of the air quality around them, perhaps prompting small changes in daily living to increase exposure to healthier air.

It is also worth mentioning that the Yahoo partnership came on the heels of a great many requests from Yahoo Weather App users for air quality data. More and more people want to track the air that they are breathing. This is not something that we have knowledge about when it comes to Apple, but it can be understood that investing in the air quality feature is a sign of the times and the users.

As air quality data becomes more accessible we can start to manage our exposure to poor air quality. Do you think it will become more commonplace for people to use this data to avoid pollution?

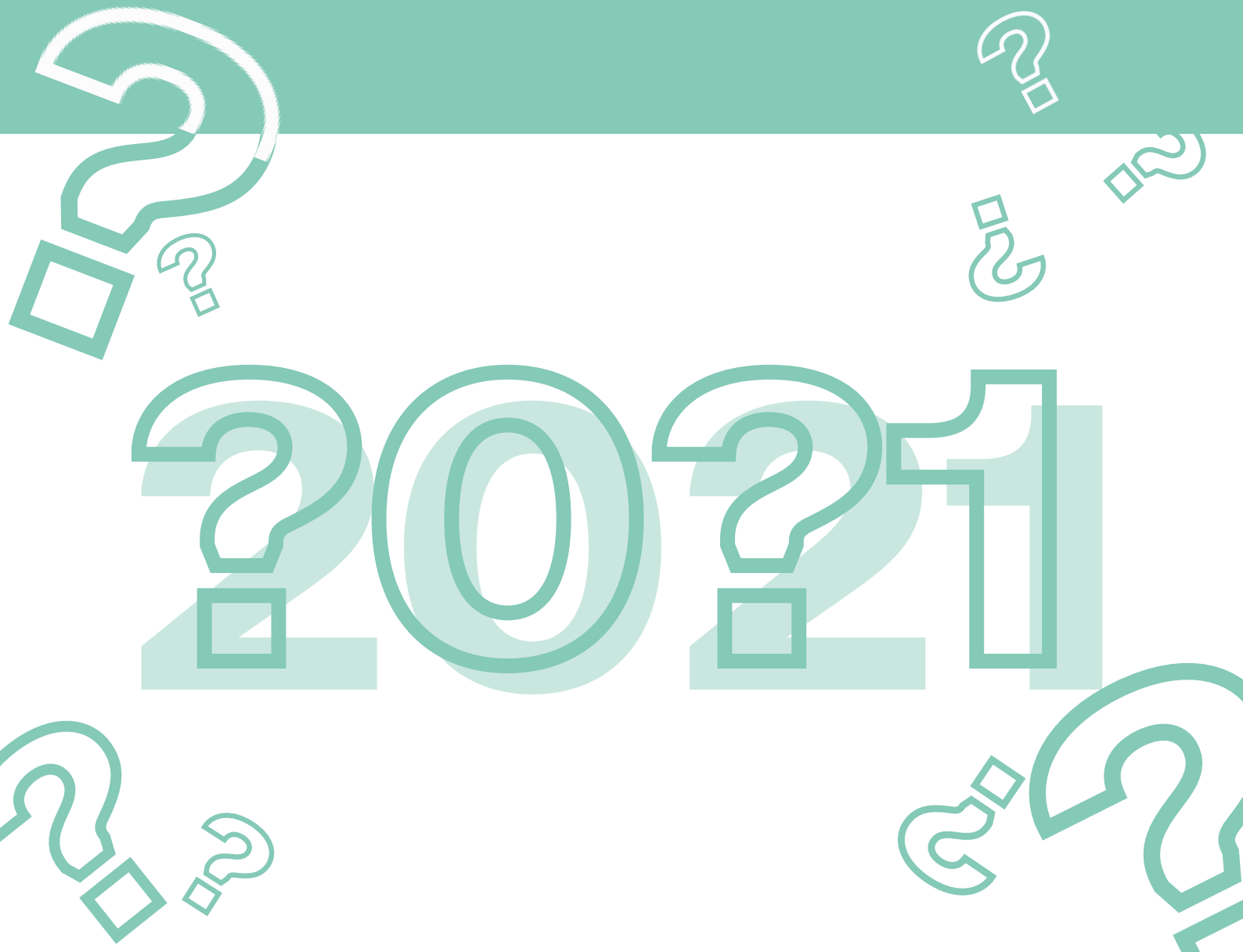
This follows the above answer. Awareness about the air around us increased. Whether this is due to changes in environmental events, such as worsening fire and pollen seasons, or the pandemic, or just better education, people are beginning to understand that the air they breathe has an effect on their health, and moreover that being aware of what is in the air empowers them to make healthier decisions.

A great example of this is knowing when to open the window. When it comes to the indoor-outdoor connection of pollution exposure, we live on a continuum. What is the benefit of opening the window to clear out the indoor air if the air quality is poor on any given day?

On the reverse, knowing that there is poor pollution outdoors, one can make the decision to close the windows and turn on their filtration system or product.

08

2021: future forecast



2021: future forecast

For many of us, 2021 signifies hope: as vaccines are rolled out, many hope the new year will bring an end to the coronavirus and allow us to move forward with our lives. Wildfires and the COVID-19 pandemic – along with the fleeting environmental peace it brought – have all served as catalysts for change when it comes to the air we breathe in 2021.

But what could 2021 look like? We consider the rise of ESG, look at what legislation and policy changes we can expect (and those we can't), and turn to industry experts to hear their thoughts.



The exponential rise of ESG

ESG stands for environmental, social and governance criteria. It is integral to the way in which today's businesses operate, and plays an important role in many investment decisions. In 2021, ESG will be more important than ever.

One of the main reasons for the exponential growth of ESG is the fact that the related issues are becoming an increasing priority across the world, and encompass many of the greatest challenges we face, including some discussed in this report such as air pollution and climate change, and a wide range of others including racial inequality, data security, and poor working conditions.

As awareness about these challenges continues to increase, many of us feel compelled to take action. This is particularly true of younger generations, who tend to be more concerned about ESG factors. We can undoubtedly make a meaningful difference with our individual actions, as highlighted by several sections of this report. However, it is apparent that larger organisations and companies have a decisive role to play in working towards sustainable development. ESG investing offers individuals the opportunity to vote with their money and make a positive impact.

Research has repeatedly demonstrated that ESG factors can contribute to long-term sustainable financial performance. By looking closely at ESG issues, institutional investors can identify companies that are well-managed and likely to succeed, and flag companies with business models that are likely to face issues in the near future.



In recent years, the global investment community has shown a clear focus on environmental and governance factors. However, social aspects have proven much more difficult to define and measure. Monitoring and improving Indoor Air Quality (IAQ) is an easily quantifiable step that can improve occupant health and wellbeing and have a positive impact on society. Making buildings healthier not only helps with long-term value creation and risk mitigation, but can also play a pivotal role in creating a better standard of living for generations to come.

Going forwards, the rise in ESG investing will continue to be facilitated by improved data accessibility and accuracy, and advanced analytics. This, accompanied by increasing action from governments, companies and investors, makes it inevitable that ESG considerations will continue to play an important role in investment decisions in 2021 and beyond.

By incorporating environmental, social and governance factors into the way we operate, we can help to tackle some of the biggest challenges of our time, and work towards a more resilient and sustainable future.

“ESG is becoming ever more important, but it’s impossible for companies to truly show their ESG commitments without monitoring their indoor air quality and energy and water usage.”

Michael Grant, COO at Metrikus

ESG

Legislation and policy

A common point made by many of our contributors is that whilst great work is being done by action groups and other bodies, their work is often siloed and takes a huge amount of time, energy, money, and volunteers. The missing link is policy, regulation and legislation change.

For example, many, such as [Clean Air in London](#) campaigner Simon Birkett, are calling for a new Clean Air Act akin to the Clear Air Act of 1956 which has not been updated since 1993. Birkett proposes this updated version be called '[Ella's Law](#)', to honour Ella Roberta Adoo Kissi-Debrah (to read more about her story go to page 49).

In this section, we give you an overview of the 25 Year Environmental Plan, the Environment Bill and the 'Rigorous new targets for green buildings' revolution. Refer to our signposting section at the end to find resources to help you to go deeper into any of these topics.

What is the 25 Year Environmental Plan (25 YEP)?

In 2011, the Government published a whitepaper entitled '[The Natural Choice](#)', in which they committed to being "to be the first generation to leave the natural environment of England in a better state than it inherited".

The Natural Capital Committee (NCC) was established, with the purpose of advising on how to achieve this. The 25 Year Environmental Plan (25 YEP) was proposed by the NCC, and, eight years later in 2018, the Government published the Plan. The 25 YEP is a statement of the Government's plan to improve the environment, and has been hailed as a world-class achievement.

The 25 YEP has ten goals:

- Clean air
- Clean and plentiful water
- Thriving plants and wildlife
- Reduced risk of harm from environmental hazards such as flooding and drought, using resources from nature more sustainably and efficiently
- Enhanced beauty, heritage and engagement with the natural environment
- Mitigating and adapting to climate change
- Minimising waste
- Managing exposure to chemicals
- Enhancing biosecurity

The 25 YEP has proposed, and the Environment Bill mandates, an annual Progress Report, inspecting the Government's progress against the goals of the 25 YEP. This is currently scrutinised by the NCC but likely to be undertaken by the Office for Environmental Protection (OEP) in the future.

So far, however, NCC reports responding to 25 YEP Progress Reports have repeatedly mourned a distinct lack of action. In 2019, NCC chairman Professor Dieter Helm wrote: "the Progress Report does not in fact tell us very much about whether and to what extent there has been progress. On the contrary, the Progress Report provides a long list of actions, and presents very little evidence of improvements in the state of our natural capital. This is especially disappointing since 8 years have now passed since the White Paper set its objective."

The Environment Bill

The much-anticipated Environment Bill is now (January 2021) entering the report stage.

What is the [Environment Bill 2019-2021](#)? 'A Bill to make provision about targets, plans and policies for improving the natural environment; for statements and reports about environmental protection; for the Office for Environmental Protection; about waste and resource efficiency; about air quality; for the recall of products that fail to meet environmental standards; about water;

about nature and biodiversity; for conservation covenants; about the regulation of chemicals; and for connected purposes.'

Neil Parish, MP for Tiverton and Honiton, and chairman of the Environment, Food and Rural Affairs (EFRA) Select Committee, has been [calling for amendments](#) to be made to the Bill to hold the Government to higher standards, such as committing to 2005 World Health Organization (WHO) guideline limits for PM2.5 by 2030. He also believes that if the Government doesn't want to adopt these, they should have to state why.

Why do we need an Environment Bill?

ClientEarth, an environmental charity, [summed up the need for an Environment Bill](#):

"The UK has now left the EU. As a result, we have lost access to important EU bodies that monitor and enforce our environmental laws as well as overarching environmental principles that guide law and policy. Without an ambitious and effective UK Environment Bill, we risk weaker protections for our environment."

Back in 2019, the then-Environment Secretary Michael Gove said, "In the past we have failed properly to live up to our obligations to improve air quality. There is much more to do to protect people from harmful air pollution." He continued, "We have got to ensure our Environment Bill includes a legally binding commitment on particulate matter so that no part of the country exceeds the levels recommended by the WHO".



by the WHO". Unfortunately, it quickly became clear that Gove's points were more 'personal ambitions' than binding measures. As Caroline Lucas, former leader of the Green Party stated at the time, "where was this ambition when you had the power to act?"

When it comes to air pollution specifically, the UK has been exceeding legal limits of air pollution since 2010 in over 75% of the country. The governance gap left by Brexit means that now, more than ever, stricter regulations are needed with an independent body to oversee them – the OEP.

However, even the OEP has drawn criticism as the chair, Dame Glenys Stacey, was chosen by the Environment Secretary, George Eustice. Whilst Dame Stacey went through a regulated public appointments process and a pre-appointment scrutiny hearing, and Schedule 1 of the Bill requires the Secretary of State to have regard to the need to protect the OEP's independence, many campaigners don't believe this counts as truly independent.

Rigorous new targets for green building revolution

On 19 January 2021, the Housing Minister Chris Pincher announced 'Rigorous new targets for green building revolution'. Responding to a consultation on the Future Homes Standard, the Government set out plans to improve the energy performance of homes and businesses, helping to protect the environment. The AirRated CEO Francesca Brady was recently quoted in The Times

commenting on these targets: "This has the potential to be hugely significant – the buildings we build today have to be resilient to a future which is increasingly uncertain. The building regulations we currently use have fallen behind de facto industry best practice and could be considered outdated – certainly at the top end of the market. The guidance within this new proposal is pivotal as it considers unpredictable changing climates, carbon net-zero goals and occupant health."

To ensure industry is ready to meet the new standards by 2025, new homes will be expected to produce 31% lower carbon emissions from 2021. Existing homes will also be subject to higher standards, with a significant improvement on the standard for extensions, making homes warmer and reducing bills. Pincher said: 'Improving the energy performance of buildings is vital to achieving net-zero emissions by 2050 and protecting the environment for future generations to come'.

Will this be more expensive to install? "There may be some additional cost in terms of equipment," Brady says, "but as this is being applied at the design and construction phase of new buildings, the whole-life costs are insignificant, compared to the cost of retrofitting and altering existing systems. Any extra costs that are incurred with improved ventilation are completely outweighed by the positive benefits, both in increased occupant health and also through productivity gains, as proven by academic research."



The Government plans also include measures to tackle a new requirement for additional ventilation and IAQ monitoring in high-risk non-domestic buildings like offices and gyms. There will also be a new overheating mitigation requirement in the Building Regulations.

It is encouraging to see such measures being introduced, as they not only recognise the vital role that energy efficient buildings have to play in achieving net zero by 2050, but also recognise the importance of indoor air quality.

However, these new standards are being introduced rapidly, into an industry that is still struggling with the impact of COVID-19. In order to be successful, the industry has to work together and there needs to be support in place to help deliver on government aims.

A step in the right direction

Despite some concerns about specifics, in general these recent movements in regulation and policy have been celebrated by campaigners, committees and working groups as a step in the right direction from the Government to improving health, wellbeing and the environment.

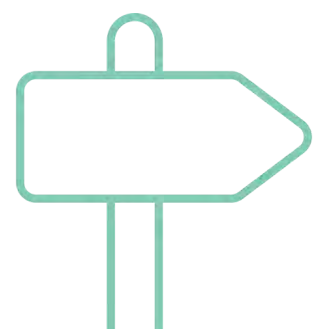
“We can be green and prosperous, but it will not happen by default. The huge opportunities, both economic and environmental, should be grasped by this government.”

Professor Dieter Helm, Chairman,
Natural Capital Committee (NCC
interim report, July 2020)

As Neil Parish MP surmised: ‘We need to work further and faster, across government, to improve air quality... it is only with joined-up, cross-governmental support that we can seize the chance to be world leaders on this issue’.

If you’re interested in how legislation and policy are developing, please see the documents below:

- [Environment Bill 2019-21](#)
- [A Green Future: Our 25 Year Plan to Improve the Environment](#), Her Majesty’s Government
- [25 Year Environment Plan Progress Report April 2019 to March 2020](#), Her Majesty’s Government
- [Interim response to the 25 Year Environment Plan Progress Report & advice on a green economic recovery](#), Natural Capital Committee
- [End of Term Report To the Domestic and Economy Implementation Committee of the Cabinet](#), Natural Capital Committee



Three big predictions for 2021 from our CEO

We've spoken to industry experts about what they see in 2021 (more on that in a moment), but we wanted to throw our hat into the ring, too. Our CEO Francesca Brady recently spoke to Property Week about her three key predictions for 2021:

1

“As we move into 2021, more people will be returning to the office after working from home for the best part of 2020. Offices will be competing with what is, for many people, their favourite place: home. There's an element of control that comes with our homes that is lost in the office, so I believe in 2021 people will demand more of offices, and will need to gain confidence that they're working in spaces that are as healthy, safe and productive as their homes.” In fact, our research found that 67% of respondents said they would possibly pay to have real-time IAQ data and alerts in their business properties, showing just how important this issue has become.

67%

of respondents said they would possibly pay to have real-time IAQ data and alerts in their business properties'

2

“I think 2021 will see buildings becoming healthier – but not at the expense of sustainability. While there is often a surprising disconnect between these two things, it is possible to prioritise sustainability whilst also creating healthy spaces, but we all need to commit to it.”

3

“2020 has seen the general public become more informed about air quality, but it's come at a devastating cost: between COVID-19 and wildfires, our learning curve has been a steep one. However,” Francesca writes, “I think that people will continue to become more empowered and informed about air quality: as occupier expectation changes, this will put pressure on developers for healthier buildings – it's a very positive cycle.”

What do other experts think?

Industry experts round up their thoughts, hopes and dreams and predictions for 2021 and beyond.

Michael Grant, COO, Metrikus

“I always talk about how smart buildings don’t need to be decked out with bells and whistles to be smart, and more and more people are realising this and adopting smart but meaningful technologies for their buildings, something I believe will only accelerate in 2021.

Landlords are beginning to see just how much of a competitive advantage smart buildings are, and will need to be forward-thinking and proactive to provide their tenants with the best possible experience. However, I also believe that as buildings become smarter, demand amongst occupiers will also grow: people will want to see occupancy, capacity and air quality data displayed in real time to help them make decisions about how they exist in those spaces.”

Jemima Hartshorn, founder of Mums for Lungs

“We have a real opportunity with the Environment Bill and with the council and mayoral elections this year, where candidates can make commitments to reduce air pollution across London and the UK. With the reduction of air pollution in April and May, people now know how much better and healthier they can feel, and we won’t settle for less.”

Larissa Lockwood, Director of Clean Air at Global Action Plan

“In 2021 air pollution will no longer be the silent public health crisis. Concern over the connection between poor air quality and the contraction and exacerbation of COVID-19 symptoms as well as the recent first-time ruling that air pollution was a cause of the death of nine-year-old Ella Kissi-Debrah will continue to firmly put air quality top of the agenda.

The result of the Environment Bill provides the opportunity of a generation to enshrine WHO air quality limits into law to help safeguard the health and life outcomes of our children from dirty air. As a movement we must come together - academia, health sector, city planners, business, schools, charities – so that these WHO limits are enshrined in law.

I also hope to see that from 2021 air quality will no longer be singularly characterised as an environmental issue, but as a humanitarian one. Underpinned by social justice, the air quality movement must work towards building a more intersectional and inclusive movement for low-income and BAME communities who disproportionately bear the burden of poor air quality.”

Mark Tyson, Head of Property Operations at Legal & General

“We need to move away from the notion that sensors are only for high quality/ expensive properties, they will become part of our everyday life in whichever space we are in. This will come via increased use of wearables but most importantly through the COVID pandemic an understanding that ventilation is critical to personal health. This creates a huge opportunity for the property and facilities management industry to redefine its service through simple health base metrics such as temperature, humidity, CO2 and particulates. In 10 years time we will look back and be amazed that we used to manage buildings without these metrics clearly visible and driving value for the building users.”

Jeffrey Young, founder of Camden Clean Air Initiative and CEO of Allegra Group

“One thing I’d love to see happen in 2021 would be tighter restrictions on the usage of cars. The fact of the matter is, we don’t need to use all the cars that we do, and we will live longer if we walk and cycle more! We definitely need to make spaces friendlier for cyclists and pedestrians to help facilitate this change. And more generally, our cities need to become greener and cleaner, with more nature and respect for the environment: the solutions can’t come fast enough.”

Catherine Sutton, Director of Airborne Allergy Action

“Awareness and action [about airborne allergies and asthma] needs to come from the top. As a minimum, national and global asthma and other respiratory disease guidelines need to replicate the recommendations of the Royal College of Paediatrics report into Indoor Air Quality and Child Health which undertook a systematic review of the evidence.”

Catriona Brady, Director of Strategy and Development at World Green Building Council

“Of the countries that committed to the Paris Agreement, only half have made commitments to improving energy efficiency in buildings. For me, the dream policy change would be related to that. Every country having mandatory commitments around improving energy efficiency, the move towards electrification, the phasing out of fossil fuels, bringing in total advancement of renewable energy... Policies aren’t going to be brought in if it’s going to destroy businesses or create too many barriers, so we need business to show that this can be done. Once the market starts to shift, policy will be forced to catch up.”

Andrew Teacher, founder at Blackstock Consulting and an executive committee member at Urban Land Institute (ULI) UK

“Companies that are competing for talent are going to need to spend money to make their offices healthier. There is going to be a polarisation between high quality offices that are newly specced with best-in-class interiors, and cheaper spaces with less of a focus on health and sustainability.”

Rory Bergin, Partner for Sustainable Futures at HTA Design

“Regulation has helped us get to a certain point, but we need to go beyond regulation and look at a more holistic and sophisticated approach to design. We need to create spaces that have a positive impact on our wellbeing and health.

“Once we conceive the pandemic to be over, there is going to be a considerable amount of analysis and soul-searching. Have we been doing the right things? Are our current design standards and regulations fit for purpose? We need to leave some time for the dust to settle, and take a good thorough look at our current approaches. It seems likely that there will be some fairly serious changes to our thinking, which is a good thing and will stand us in good stead going forwards.”

Ben Cross, Development Associate at General Projects

“The last 12 months have seen an unprecedented acceleration in the concept of healthy buildings – and we are excited about a future where wellbeing is top of the agenda. However, we cannot be complacent. Building health is unquestionably significant but so too is environmental sustainability and we continue to face unprecedented challenges to achieve net-zero carbon by 2050.

“It is well-known that 80% of the buildings that will be around in 2050 have already been built and we are fully committed to radically reimagining existing buildings to demonstrate what CAN be achieved. We believe that sustainability, wellbeing and first-class experiences are not mutually exclusive concepts but recognise it's a complex process getting everything right – take something as simple as introducing openable windows. On one hand, occupants gain greater control of their environment and it's great for reducing energy demand. But, for most cities, you risk comprising air quality with pollutants and in effect reduce productivity and, potentially, physical health. So that's why at General Projects we love working with innovators, disrupters and ultra-specialists to ensure the decisions we make are the right ones.

“If 2020 was a year of revolution I hope, by 2050, we'll look back on this year as a catalyst to a decade of seismic change. A year when we all started thinking differently and worked together to put our best ideas into practice...”



Ed Wealend, Head of Research and Innovation at Cundall and Chair of the CIBSE Air Quality Group

“Policy is moving in the right direction in the UK, particularly in terms of clean air and ultra-low emissions zones – these are starting to show benefits where they have been applied. More broadly, as the electrification roll out continues, and outdoor air quality priorities shift, policy will need to better address the future indoor air quality challenge.

“I personally would like to see mandatory VOC labelling on construction products, stricter control of wood-burning in smoke control zones, and a proper consideration of health based ventilation standards written into building regulation. Finally, in the wake of COVID-19, a commitment to improving ventilation in existing buildings has to be a priority, and should go hand in hand with the drive towards energy efficiency.”

Professor Prashant Kumar, Chair in Air Quality & Health, Founding Director of Global Centre for Clean Air Research and Adjunct Professor, Trinity College Dublin

“Air pollution is one of the top ten environmental health risks posed to human beings. Changes to combat this is coming but it will be most impactful when all parties take ownership and accountability for their respective roles in creating healthy outdoor and indoor environments. While controlling emissions at the source, and replacing them with zero-emission green technologies, is the most effective solution, education and awareness is one of the most important drivers for an effective change and research is key to helping develop our understanding and guiding best practise. The collaborative global vision of ‘clean air for all’ can be achieved by understanding the impact of air pollutants on quality of life, developing internationally-validated engineering-driven solutions and implementing regulatory strategies.”

Chris Rush, Air Quality Group Lead at Hoare Lea and a committee member of the Institute of Air Quality Management (IAQM)

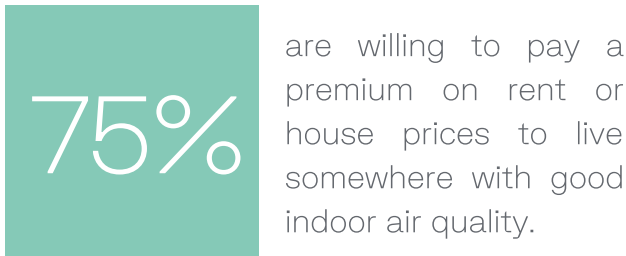
“Corporate clients are starting to realise that they need a differentiator, especially now with COVID-19, and many are focusing on air quality as an element of the building that can be invested in to not only offer returns in the short but also long term.”



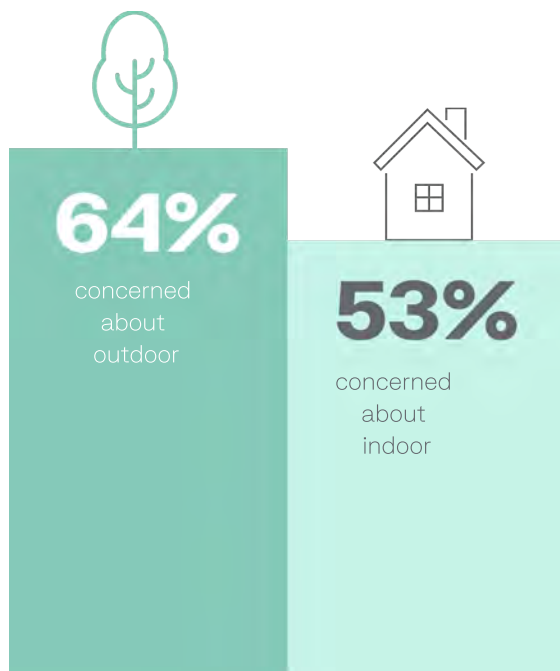
Research

AirRated commissioned a survey to find out the public's perception of both indoor and outdoor air quality in 2020. We surveyed 350 consumer and business decision makers UK wide and found the following:

Consumer response

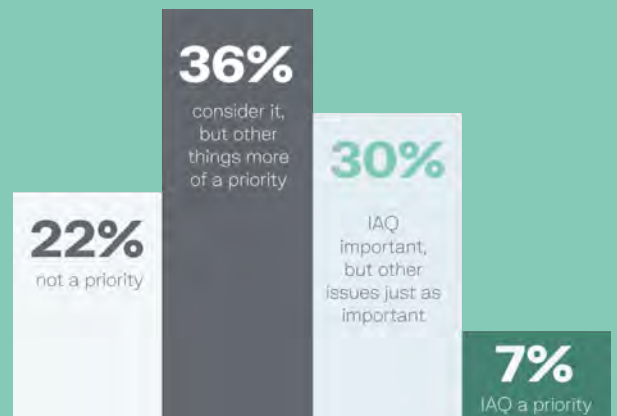


When asked 'how concerned are you about indoor vs outdoor air quality?' respondents said;

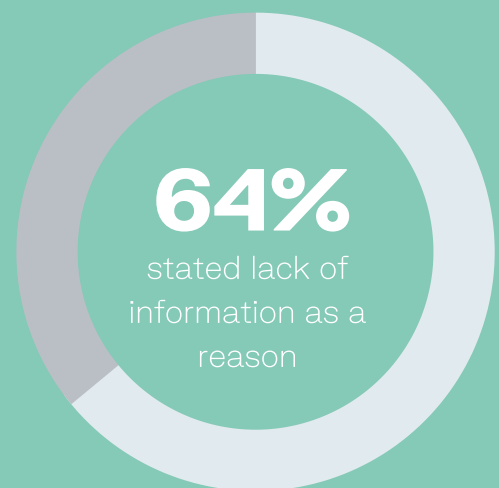


Business response

When asked, 'to what extent does air quality affect your decision to rent or buy a workspace for your business?' respondents said:



When asked, 'Why haven't you done anything about your Indoor air quality (IAQ) as a business?'



HAPPY AIR QUALITY NEWS

New report shows that more than

50

of the world's leading cities are on track to cut their greenhouse gas emissions and tackle the worst impacts of the climate crisis.

TreeCard is the world's first debit card that plants trees.

80%

of the profits from your everyday payments are reinvested in reforestation projects around the world.

” Developers and investors are realising that the future-proofing and resilience of buildings is not just based on profitability, it is also based on the benefits a space brings to its occupiers. ”

Tomáš Jurdák, Head of Real Estate at MiddleCap

A record-level ozone hole over the Arctic (the biggest since 2011) has now healed and closed

New study shows that switching from eating 'land-hungry' meat and dairy to a more plant-based diet could remove up to

16 years

worth of CO2 emissions

'In a bid to stop deforestation, several Amazon tribes in Brazil have been trained to operate drones to watch over the rainforests and spot illegal activities.'

'After centuries of decline, Britain's woodland cover as returned to 'medieval levels' thanks to 20th-century forestry and the rewilding trend.'

Ecosia

the search engine that plants trees, have just planted their

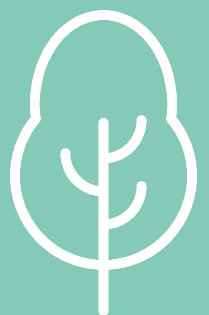
100

millionth tree.

All these trees will remove

1771

tonnes of CO2 every day!



The end of plastic?

A Dutch company is developing a 100% plant-based bottle that breaks down within a year (plastic takes 450 years)

09 Glossary

abc

Please note that due to software and typography capabilities, there are a number of scientific formulae that should have superscript numbers but do not, for example CO₂.

Ambient air: Outdoor air.

Anthropogenic pollution: Pollution produced directly by human activities, such as the burning of fossil fuels.

Carbon dioxide (CO₂): A colourless and non-flammable gas at normal temperature and pressure. Although much less abundant than nitrogen and oxygen in Earth's atmosphere, CO₂ is an important constituent of our planet's air. A molecule of CO₂ is made up of one carbon atom and two oxygen atoms.

Carbon monoxide (CO): A pollutant gas found released in road vehicle exhausts. When breathed in, CO affects the blood's ability to carry oxygen around the body.

Carbon neutrality: Refers to achieving net zero carbon dioxide emissions by having a balance between emitting carbon and absorbing carbon from the atmosphere in carbon sinks.

Greenhouse gases (GHGs): Any gas that has the property of absorbing infrared radiation emitted from Earth's surface and reradiating it back to Earth's surface, thus contributing to the greenhouse effect. Carbon dioxide, methane, and water vapour are the most important greenhouse gases.

Indoor Air Quality (IAQ): The quality of air within enclosed buildings and structures, which influences the health, comfort and wellbeing of occupants.

Nitric oxide (NO): One of the oxides of nitrogen formed in combustion processes. NO is not harmful to human health but combines with oxygen to form nitrogen dioxide.

Nitrogen dioxide (NO₂): One of the oxides of nitrogen formed in combustion processes. At high concentrations NO₂ is an irritant to the airways. NO₂ can also make people more likely to catch respiratory infections and react to allergens.

Nitrogen oxides (NO_x): Compounds formed when nitrogen and oxygen combine. NO_x, which comprises nitric oxide (NO) and nitrogen dioxide (NO₂), is emitted from combustion processes. Main sources include power generation, industrial combustion and road transport.

Ozone (O₃): A pollutant gas which is not emitted directly from any source in significant quantities, but is produced by reactions between other pollutants in the presence of sunlight. O₃ concentrations are greatest in the summer, and it can travel long distances and reach high concentrations far away from the original pollutant sources. O₃ is an irritant to the airways of the lungs, throat and eyes, and can also harm vegetation.

Particulate Matter (PM): Small airborne particles. PM may contain many different materials such as soot, wind-blown dust or secondary components, which are formed within the atmosphere as a result of chemical reactions. It can be harmful to human health when inhaled, and in general, the smaller the particle the deeper it can be inhaled into the lung.

PM10: Particles which pass through a size-selective inlet with a 50% efficiency cut-off at $10\ \mu\text{m}$ aerodynamic diameter, as defined in ISO 7708:1995, Clause 6. This size fraction is important in the context of human health, as these particles are small enough to be inhaled into the airways of the lung – described as the ‘thoracic convention’ in the above ISO standard.

PM2.5: Particles which pass through a size-selective inlet with a 50% efficiency cut-off at $2.5\ \mu\text{m}$ aerodynamic diameter, as defined in ISO 7708:1995, Clause 7.1. This size fraction is important in the context of human health, as these particles are small enough to be inhaled very deep into the lung – described as the ‘high risk respirable convention’ in the above ISO standard.

Secondary pollutant: A pollutant which is formed by chemical reactions from other pollutants in the atmosphere.

Volatile organic compounds (VOCs): Organic chemicals that have a high vapour pressure at room temperature. High vapour pressure correlates with a low boiling point, which relates to the number of the sample’s molecules in the surrounding air, a trait known as volatility.

Total volatile organic compounds (TVOCs): A common term used when measuring and eliminating VOCs is ‘Total VOCs’ or TVOCs. TVOCs means the total concentration of multiple VOCs present simultaneously in the air.

Ultra fine particulate matter (UFPs): Aerosols with an aerodynamic diameter of $0.1\ \mu\text{m}$ (100 nm) or less.

And finally

We'd like to thank all our contributors for their generosity with their time and words. No money exchanged hands for contribution to this report, except for commissioned research.

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Get in touch

If you have any feedback or questions about this report or about air quality in general, we'd love to hear from you. Drop us an email or connect with us on LinkedIn.

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