Royal College of Physicians

RCPCH
Royal College of
Paediatrics and Child Health
Leading the way in Children's Health

Every breath we take: the lifelong impact of air pollution

What it means for you
February 2016

Why the RCP and the RCPCH

Each year in the UK, around 40,000 deaths are attributable to exposure to outdoor air pollution, with more linked also to exposure to indoor pollutants.

Air pollution plays a role in many of the major health challenges of our day, and has been linked to cancer, asthma, stroke and heart disease, diabetes, obesity, and changes linked to dementia.

Neither the concentration limits set by government, nor the World Health Organization's air quality guidelines, define levels of exposure that are entirely safe for the whole population.

When our patients are exposed to such a clear and avoidable cause of death, illness and disability, it is our duty as doctors to speak out.

How we approached the task

This report is a joint effort by the Royal College of Paediatrics and Child Health (RCPCH) and the Royal College of Physicians (RCP).

The two colleges assembled experts in medicine and environmental sciences to discuss the evidence and draw up recommendations. We searched the literature and heard detailed evidence from experts and key organisations. A draft of the report was circulated to a wide range of stakeholders for comment.

Full details of the scientific references, evidence heard and stakeholders consulted are available on the RCP website.[1]

Effects across a lifetime

This damage occurs across a lifetime, from a baby's first weeks in the womb all the way through to the years of older age.

Gestation, infancy and early childhood are vulnerable times because the young body is growing and developing rapidly. We know that the heart, brain, hormone systems and immunity can all be harmed by air pollution. Research is beginning to point towards effects on growth, intelligence, and development of the brain and coordination. Harm to babies and children will have an impact that lasts far into the future. For the same reason, any air quality improvements we make now will have long-lasting benefits.

Older people, and adults with long-term conditions, are also vulnerable to the effects of air pollution. Improving air quality will help them to stay independent and well, benefiting individuals and easing the pressure on our NHS and social services.

are tackling this issue

The most vulnerable suffer the most harm

Air pollution is harmful to everyone. However, some people suffer more than others because they:

> live in deprived areas, which often have higher levels of air pollution

> live, learn or work near busy roads

> are more vulnerable because of their age or existing medical conditions.

Some chemicals in air pollution may be implicated in the development of obesity. It may be a vicious circle, because we also know that obese people are more sensitive to air pollution.

These vulnerabilities are heightened among those living in the most deprived communities. This is due to poor housing and indoor air quality, the stress of living on a low income, and limited access to healthy food and/or green spaces. Moving away from an area of high outdoor air pollution may be unaffordable for local residents. Some people may not want to leave their homes – and they should not have to.

Costs of air pollution

The annual mortality burden in the UK from exposure to outdoor air pollution is equivalent to around 40,000 deaths. To this can be added further impacts from exposure to indoor air pollutants such as radon and second-hand smoke.

The health problems resulting from exposure to air pollution also have a high cost to society and business, our health services, and people who suffer from illness and premature death. In the UK, these costs add up to more than £20 billion every year.

Vulnerable people are prisoners of air pollution, having to stay indoors and limit their activity when pollution levels are high. This is not only unjust; it carries a cost to these individuals and the community from missed work and school, from more health problems due to lack of exercise, and from social isolation.

Taking action will reduce pain, suffering and demands on the NHS, while getting people back to work, learning, and an active life. The value of these benefits far exceeds the cost of reducing emissions.

Air pollution and climate change

Air pollution plays a key role in the process of climate change, which places our food, air and water supplies at risk, and poses a major threat to our health.

Several pollutants that cause this environmental damage are also toxic to our bodies. Therefore, many of the changes that would decrease air pollution to protect our health – especially using energy more efficiently and burning less solid fuel and oil – would also help to slow down the overheating of our planet.

Recommendations for action a

Everyone has some responsibility for reducing air pollution. Real change will only occur when everyone accepts this responsibility, and makes a concerted effort. This includes European, national and local government, business and industry, schools and the NHS, as well as individuals in society at large.

1 **Act now, think long term.** As a community, we must act now, and with urgency, to protect the health, wellbeing and economic sustainability of today's communities and future generations. Government must empower local authorities and incentivise industry to plan for the long term.

2 **Educate professionals and the public.** The NHS and patient charities must educate health professionals, policymakers and the public about the serious harm that air pollution causes. Health professionals, in particular, have a duty to inform their patients.

3 **Promote alternatives to cars fuelled by petrol and diesel.** Government, employers and schools should encourage and facilitate the use of public transport and active travel options like walking and cycling. Active travel also increases physical activity, which will have major health benefits for everyone. Local transport plans, especially in deprived areas, should:

- expand cycle networks
- require cycle training at school
- promote safe alternatives to the 'school run', based on walking, public transport and cycling instead of cars
- encourage employers to support alternatives to commuting by car
- promote leisure cycling
- develop 'islands' of space away from traffic, for safer walking and cycling.

European, national and local policies should also encourage the use of hybrid electrical and hydrogen-powered vehicles.

4 **Put the onus on the polluters.** Polluters must be required to take responsibility for harming our health. Political leaders at a local, national and EU level must introduce tougher regulations, including reliable emissions testing for cars. They must also enforce regulations vigorously, especially in deprived areas where pollution levels are higher and people are more vulnerable.

5 **Monitor air pollution effectively.** Air pollution monitoring by central and local government must track exposure to harmful pollutants in major urban areas and near schools. These results should be communicated proactively to the public, in a clear way that everyone can understand. When levels exceed EU limits or World Health Organization guidelines, local authorities must immediately publish serious incident alerts.

6 **Act to protect the public health when air pollution levels are high.** When these limits are exceeded, local authorities *must* have the power to close or divert roads to reduce the volume of traffic, especially near schools.

7 **Tackle inequality.** Our most deprived communities are exposed to some of the worst outdoor and indoor air quality, contributing to the gap in life expectancy of nearly 10 years between the most and the least affluent communities. Regulators, local government and NHS organisations must prioritise improvements in air quality in our most deprived areas, setting high standards of emission control across all sectors of industry.

8 **Protect those most at risk.** Children, older people, and people with chronic health problems are among the most vulnerable to air pollution. Public services must take account of this disproportionate harm through local tools such as planning policies for housing and schools, equalities impact assessments, and joint strategic needs assessments. At an individual level, healthcare professionals should help vulnerable patients protect themselves from the worst effects of air pollution.

9 **Lead by example in the NHS.** The NHS is one of the largest employers in Europe, contributing 9.1% of the UK's gross domestic product (GDP). The health service must no longer be a major polluter; it must lead by example and set the benchmark for clean air and safe workplaces. In turn, this action will reduce the burden of air-pollution-related illness on the NHS. As pointed out in two earlier reports,[2,3] the Department of Health, NHS England and the devolved administrations must give commissioners and providers incentives to reduce their emissions, and protect their employees and patients from dangerous pollutants.[4]

nd research – what must be done

10 Define the economic impact of air pollution. Air pollution damages not only our physical health, but also our economic wellbeing. We need further research into the economic impact of air pollution, and the potential economic benefits of well-designed policies to tackle it.

11 Quantify the relationship between indoor air pollution and health. We must strengthen our understanding of the relationship between indoor air pollution and health, including the key risk factors and effects of poor air quality in our homes, schools and workplaces. A coordinated effort among policymaking bodies will be required to develop and apply any necessary policy changes.

12 Determine how global trends are affecting air quality. From increased energy production and consumption to global economic development and urbanisation, we need to improve our understanding of how major social and economic trends are affecting air quality and its twin threat, climate change.

13 Develop new technologies to improve air pollution monitoring. We need better, more accurate and wider-ranging monitoring programmes so that we can track population-level exposure to air pollution. We also need to develop adaptable monitoring techniques to measure emerging new pollutants, and known pollutants that occur below current concentration limits. We must develop practical technology – such as wearable 'smart' monitors – that empower individuals to check their exposure and take action to protect their health.

14 Study the effects of air pollution on health. To appreciate fully the risk to health, we need further research on air pollution's effects on the body. In addition to lung and cardiovascular disease, research into the adverse health effects of pollution should accommodate systemic effects such as obesity, diabetes, changes linked to dementia, and cancer, as well as effects on the developing fetus and in early childhood.

What can I do?

Everyone can help by:

- trying alternatives to car travel or preferably taking the active option: bus, train, walking and cycling
- aiming for energy efficiency in our homes
- keeping gas appliances and solid fuel burners in good repair
- asking their local council and MP to take action
- learning more about air quality and staying informed.

The collective effect of actions by a large number of individuals, together with action by local councils and governments, can make a significant difference to pollutant exposure.

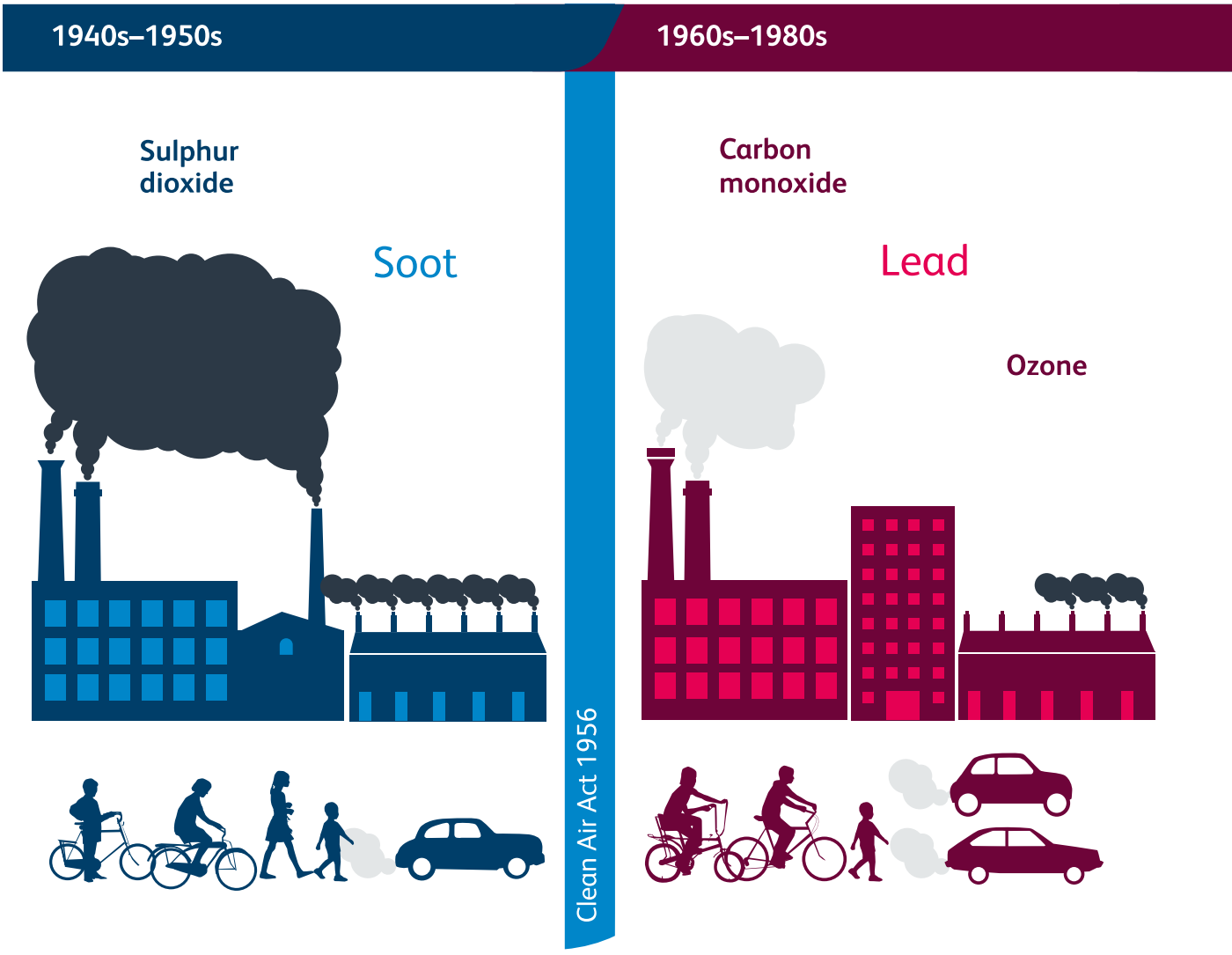
1 www.rcplondon.ac.uk/projects/outputs/every-breath-we-take-lifelong-impact-air-pollution
2 www.nihr.ac.uk/policy-and-standards/nihr-carbon-reduction-guidelines.htm
3 www.sduhealth.org.uk/documents/Carbon_Footprint_summary_NHS_update_2013.pdf
4 Tomson C. Reducing the carbon footprint of hospital-based care. *Future Hosp J* 2015;2:57–62.

Air pollution in our changing

Air pollution is not a new problem in the UK. The London smog of 1952 killed 12,000 people. Since then, changes in the way we live have also changed the air pollution that we breathe. Coal burning has fallen dramatically, but today increased road transport and the failure to control some exhausts from diesel vehicles has led to us being exposed to new air pollutants.

Looking at different generations tells the story. As children, today's grandparents were exposed to soot and sulphur dioxide from coal burning. Those now in middle age breathed in emissions from leaded petrol. Today's children walk and cycle much less, and they inhale nitrogen dioxide and the tiny particulates from diesel-fuelled vehicles.

Around the world, there are many examples where reducing air pollution has improved public health. It now seems likely that childhood exposure to air pollution has a lasting influence on health, so the gains from tackling air pollution today will be felt throughout the decades to come.



world

Key facts

- In 2012, road traffic in the UK was ten times higher than in 1949. Total distance walked each year decreased by 30% between 1995 and 2013.
- Growth in pollution has not always been as fast as growth in traffic, thanks to tighter exhaust controls. Modern cars produce very little carbon monoxide and hydrocarbons, and the sulphur and lead in diesel and petrol must meet tight regulations.
- Nitrogen dioxide and particulates from diesel engines have been poorly controlled and these remain a problem. In the UK today, about half of cars run on diesel. This is the trend across Europe, but not in the USA or Japan. Nearly all buses, vans and lorries, forms of water transport, and many trains, use diesel in the UK, along with construction and farm machinery.
- Each year, inhaling particulates causes around 29,000 deaths in the UK, which, on recent evidence, may rise to around 40,000 deaths when also considering nitrogen dioxide exposure.
- Home heating has changed, too. Compared with coal fires, modern gas boilers produce very little particle pollution – but they do give off nitrogen dioxide. Cooking, especially with gas, is also an important source of nitrogen dioxide and particles.
- Air pollution can stay around for days or weeks after it's created. One type of chemical may interact with others in the atmosphere, to cause even more pollution. Air pollution also crosses cities, counties and even countries, so local action is not enough on its own.

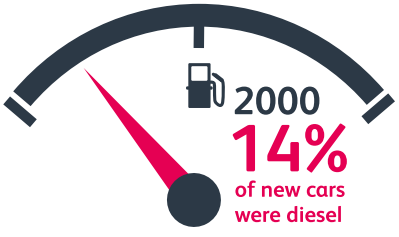
1980s–2000s

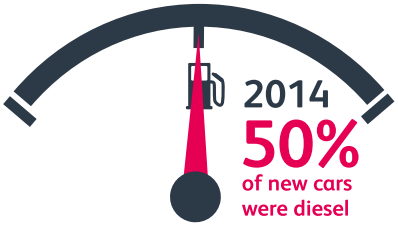
Across this period in time:

Lead in fuel restricted 1998

Nitrogen dioxide

Particulates





The air we breathe

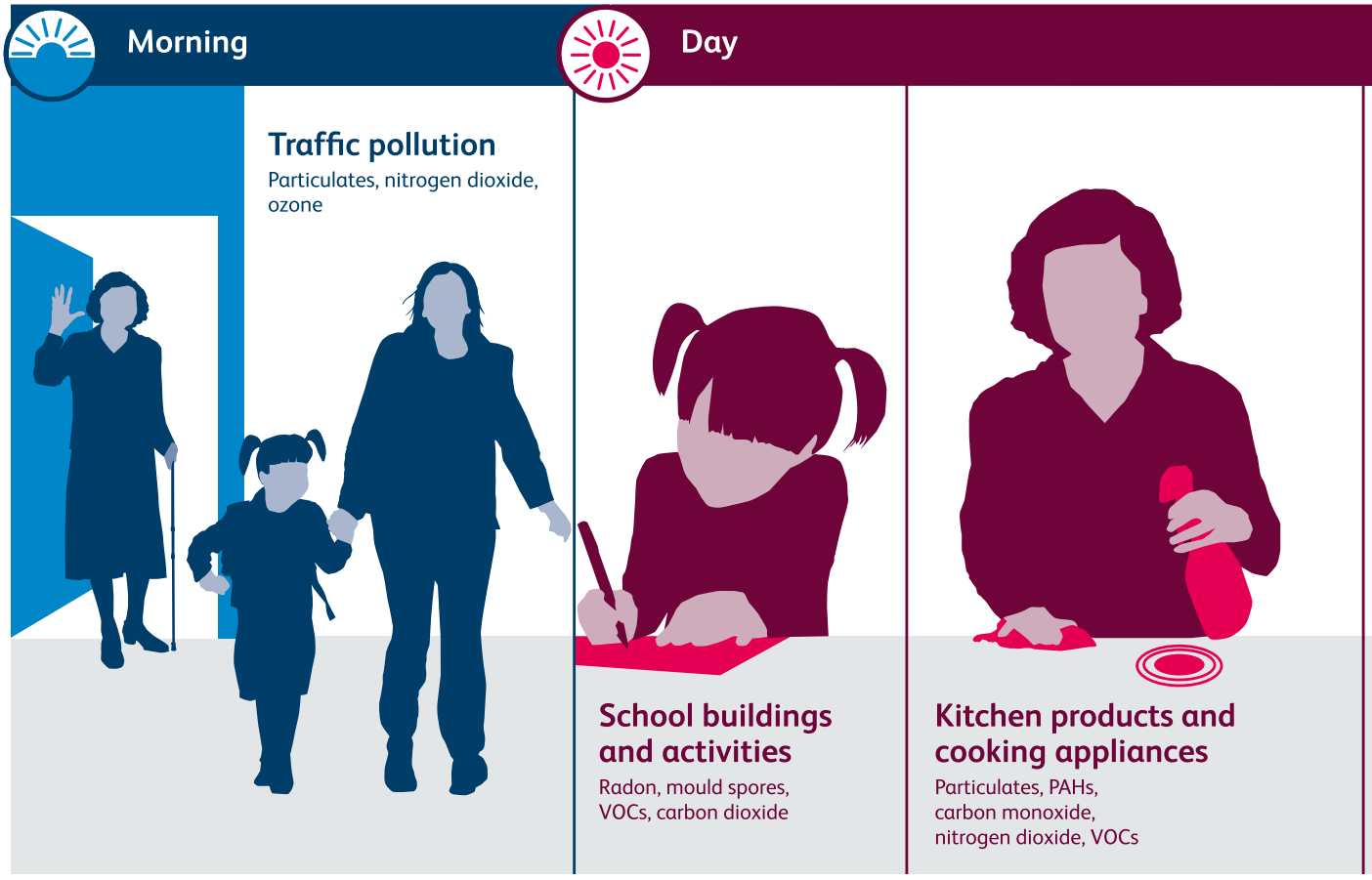
We tend to think of the environment as the wide outdoor world. But it includes indoor spaces too. Each day we move through a series of micro-environments as we make journeys, go to work or school, or stay in our homes. The air we breathe is different in each place.

Outdoors, we are exposed to a range of pollutants, many of which come from vehicles. These include particulates (mostly soot particles from diesel engines) and nitrogen oxides (exhaust gases). We also breathe in ozone, which is produced by chemical reactions in the atmosphere.

The quality of air indoors is important too, because we spend so much time inside. So we need to consider things we use every day, from our gas cookers and cleaning and personal care products, to materials for DIY. Pets and insects can also affect some people, as can damp and mould. A few substances, such as cigarette smoke and carbon monoxide, are very serious hazards.

Key facts

- **The most important chemical pollutants in our outdoor air are:**
  - **particulates – small specks of matter such as soot, which can be natural but are primarily from traffic (especially diesel engines)**
  - **nitrogen oxides – gases generated by vehicles, or by chemical reactions in the atmosphere**
  - **ozone – this gas is formed when other pollutants react in the atmosphere.**



- Regulations to control outdoor air pollution work in two ways. They may target the source (such as requiring cleaner cars and transport vehicles), or set concentration limits for the pollutants in our air – although it is difficult to say what levels are really safe.
- Increased road traffic, and higher energy use to heat and cool our buildings because of climate change, could make the problem worse.
- According to 2012 figures, indoor air pollution may have caused or contributed to 99,000 deaths in Europe.
- There are few regulatory controls on indoor pollution, apart from building regulations. The drive to reduce energy costs, by creating homes with tighter ventilation, could be making the situation worse.
- Indoors, tobacco smoke is probably the most serious cause of harm.
- Carbon monoxide from faulty boilers and heaters can be fatal.
- Volatile organic compounds (VOCs) are chemicals that start off as solids or liquids, but readily evaporate.

They can arise from many common items, including air fresheners and some personal care, DIY and cleaning products. Although they are very common in the air, their health effects are generally minor.

- Formaldehyde vapour can be emitted by certain furniture, furnishings, fabrics, glues and insulation, and can cause irritation of the lungs.
- Asbestos was used as a building material in the 20th century, peaking in the 1960s. It can cause serious damage to the lungs if it is disturbed, which is most likely to happen during maintenance work.
- Particulates and nitrogen oxides from heating and cooking appliances can damage the lungs and/or heart.
- Biological materials that can harm health include house-dust mites, mould and animal dander.

Evening/night

Personal care products
VOCs

Flowers
Pollen, mould spores from soil

Open fire
Carbon monoxide and nitrogen dioxide

Cigarette smoke
Hundreds of hazardous compounds

Cat
Dander

Carpets and sofa cushions
House-dust mites, VOCs

Vapours from chipboard furniture
Formaldehyde

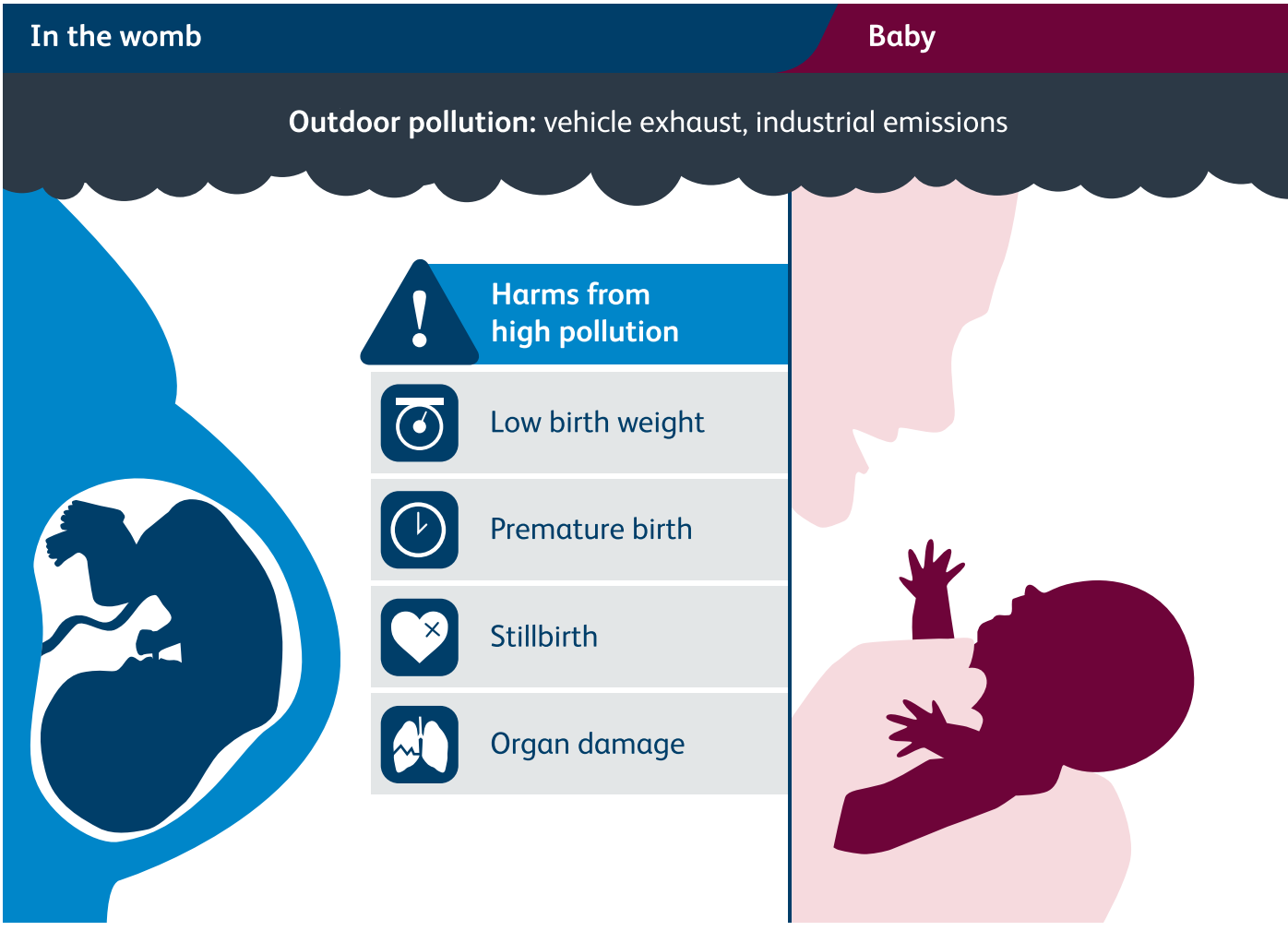
In the beginning: protecting

Pregnancy, infancy and early childhood are critical times when all the body's systems are formed, and start maturing. This process happens at a lightning pace. It is controlled by genes, which must switch on and off at just the right time, in just the right order.

Therefore, it is clearly a vulnerable phase of life. The developing heart, lung, brain, hormone systems and immunity can all be harmed by pollution. Environmental effects on the embryo, fetus, baby and toddler may last a lifetime, but may take years or even decades to become apparent.

Smoking in pregnancy is probably the most serious source of harm, causing slow fetal growth, prematurity and stillbirth.

There is also clear evidence that early exposure to air pollution can damage the lungs, and increase the risk of lung infections that may be fatal. It is known to have an effect on heart health in adult life. Research is beginning to point towards effects on growth, intelligence, asthma, and development of the brain and coordination.



*Includes exhaust gases from cooking, heating and burning solid fuels, use of household cleaners and other chemicals, VOCs, etc

our future generations

Key facts

Before birth, the health of the baby is tied closely to the health of the mother.

- Smoking in pregnancy is linked to slow fetal growth, premature birth and stillbirth. It can also cause the placenta to break away (abruption), which is very dangerous to both mother and baby. The mother's risk of high blood pressure is increased.
- Some pollutants, when breathed by the mother, can cross through the placenta to the developing baby. Particulates and heavy metals are two examples.
- Air pollution can affect growth of the unborn baby and may be linked to premature birth.

Development in the womb is rapid.

- By 3–4 weeks of pregnancy, the heart is beating.
- The major organs are formed by 12 weeks, and the endocrine (hormone) system is functioning.
- At 16 weeks, the main tube system of the lungs (the bronchial tree) is formed.
- By 6 months, most of the brain, spinal cord and nerves are in place.
- Around 7 months, the lungs' air sacs (alveoli) begin to form. Half of them are completed by the end of a full-term pregnancy.
- These are all critical points where air pollution or exposure to smoking could cause harm.

Toddler

Indoor pollution: tobacco smoke, household fumes*

Harms from high pollution

- More lung infections
- Increased infant mortality

Harms from high pollution

- More coughs and wheezing
- More A&E visits
- Decreased lung function

Health effects of air pollution

Exposure to air pollution has health effects at every stage of life, from before birth into old age. The damage is sometimes gradual, and may not be apparent for many years.

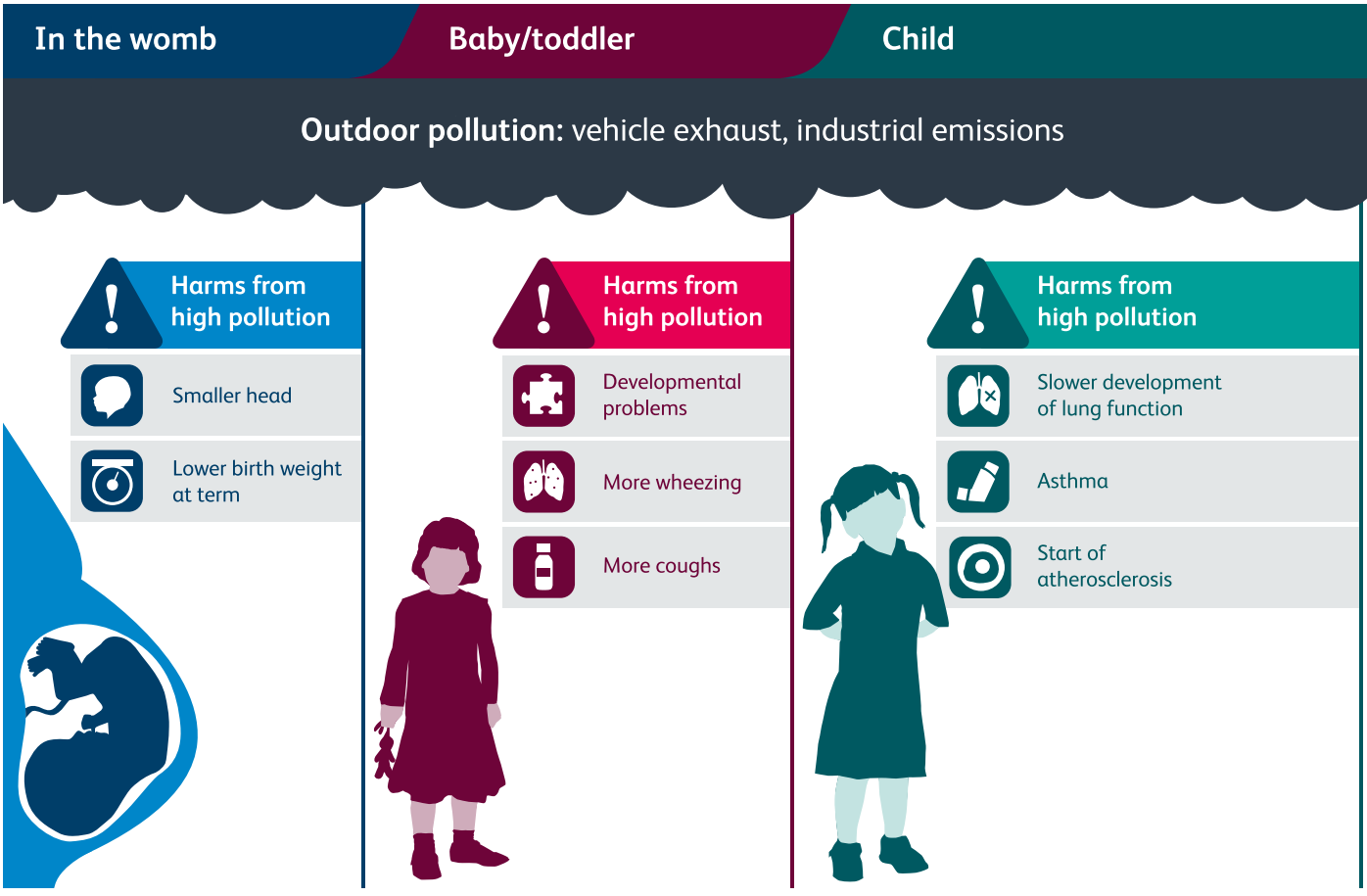
Lung function naturally develops throughout childhood, and there is clear evidence that long-term exposure to outdoor air pollution suppresses this process.

In addition, it may speed up the decline of lung function through adulthood and into older age. There is also good evidence that outdoor air pollution causes lung cancer.

It is likely that long-term exposure to air pollution is linked to the development of asthma. For people who already have asthma, there's strong evidence that air pollution can make it worse.

We still need more research, but it's possible that exposure to air pollution could be associated with the appearance of diabetes, and may also damage the brain's thinking abilities (cognition) in subtle ways that build up over time.

Large studies have shown a strong link between air pollution and cardiovascular disease (heart disease and strokes).

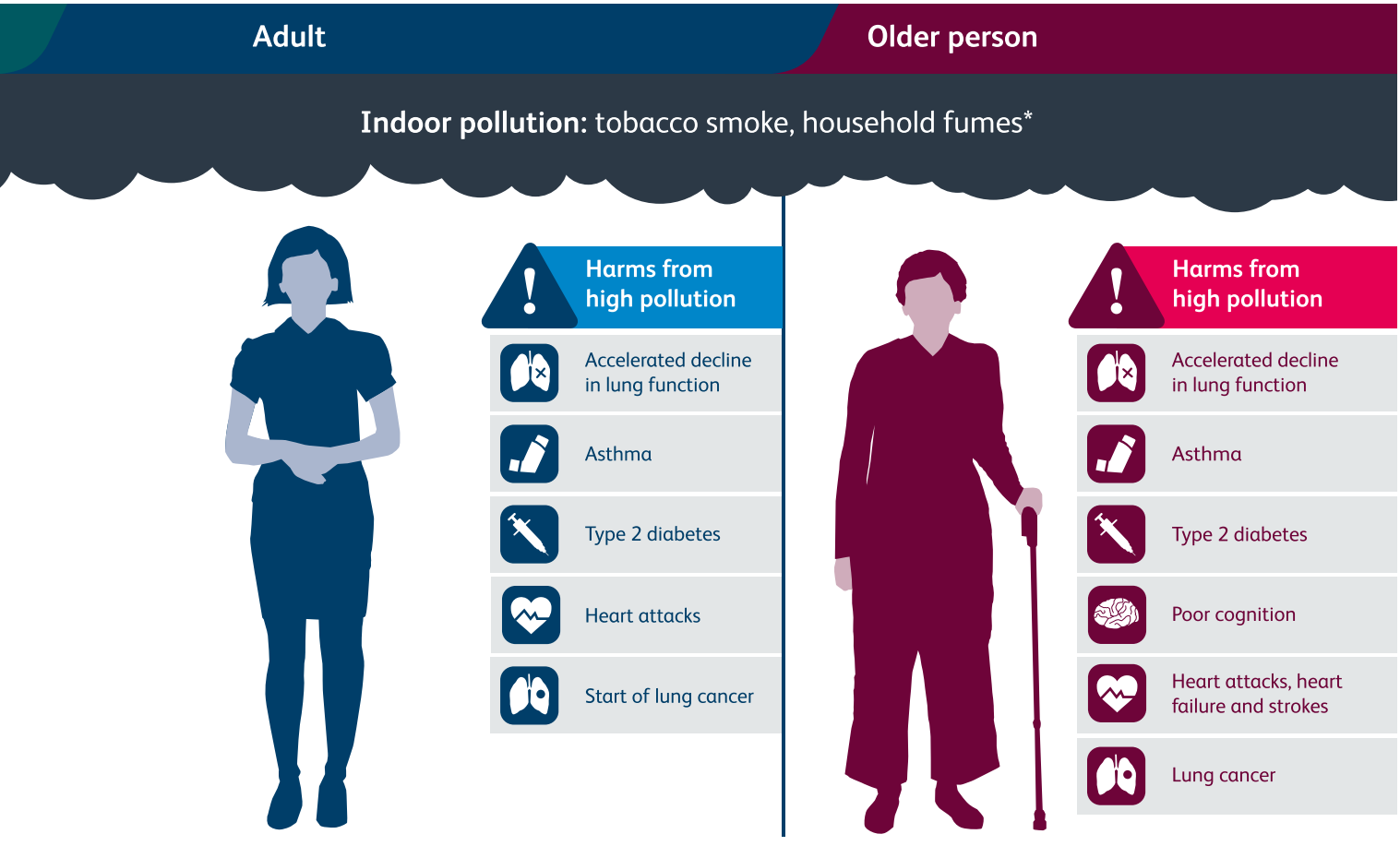


*Includes exhaust gases from cooking, heating and burning solid fuels, use of household cleaners and other chemicals, VOCs, etc

over our lifetime

Key facts

- As the levels of air pollution increase, so does the harmful effect on lung function.
- Children living in highly polluted areas are four times more likely to have reduced lung function in adulthood. Improving air quality for children has been shown to halt and reverse this effect.
- For older people, living near a busy road speeds up the rate of lung function decline that is associated with ageing.
- Young children who live in polluted areas have more coughs and wheezes.
- The evidence is so convincing that the International Agency for Research on Cancer has classified air pollution as a known cause of lung cancer. This condition is thought to take many years to develop. Therefore, exposure in childhood could be linked to lung cancer in adults.
- Exposure to air pollution may affect mental and physical development in children, and thinking skills (cognition) in older people.
- Over the long term, breathing air pollution is linked to the development of cardiovascular disease in adults, including atherosclerosis (furring of the arteries). Once people have a heart condition, spikes in air pollution can make their symptoms worse, leading to more hospital admissions and deaths.



Our vulnerable groups

Air pollution is harmful to everyone. However, some people suffer more because they are:

> more likely to live in polluted areas

> exposed to higher levels of air pollution

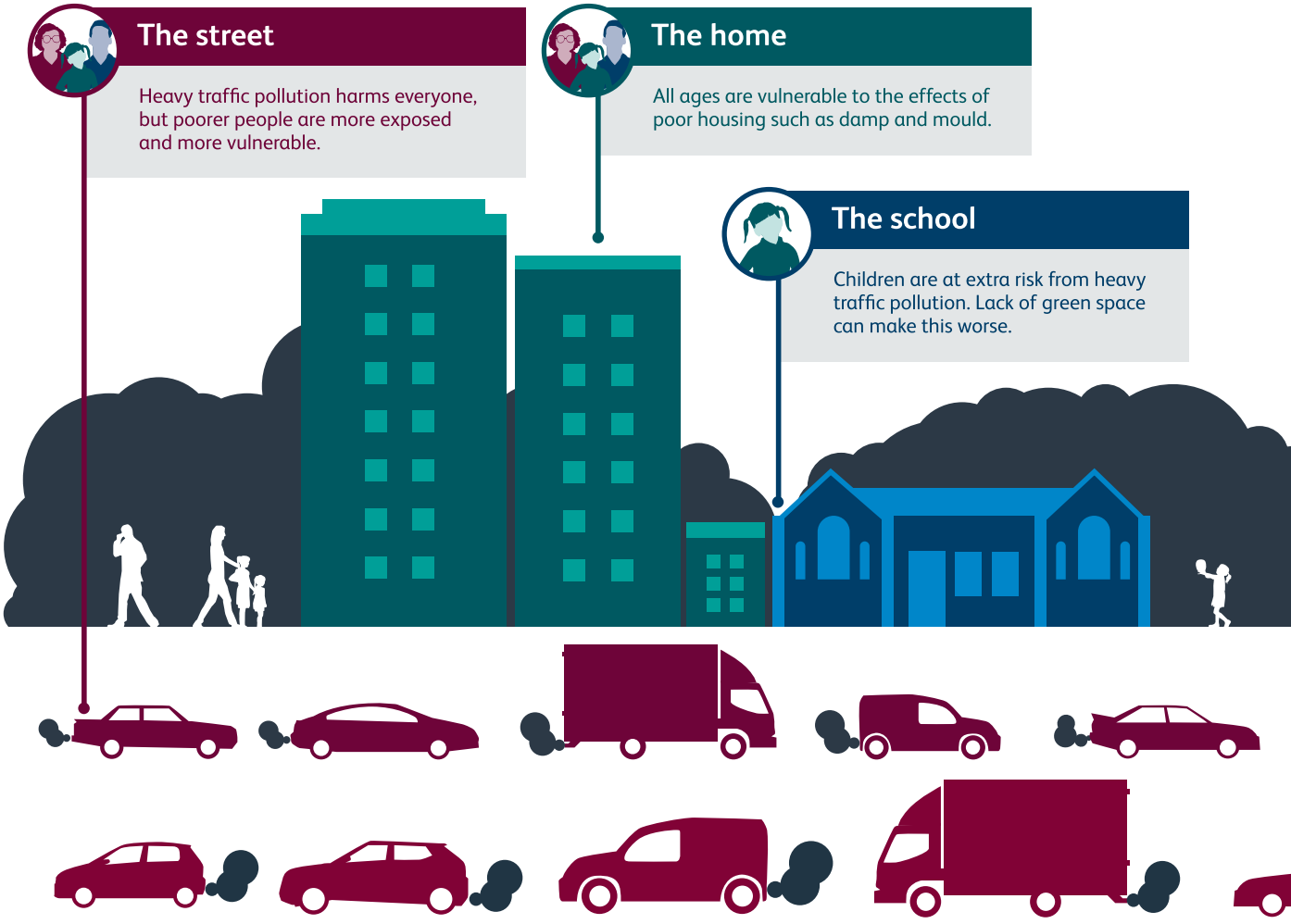
> more vulnerable to health problems caused by air pollution.

Some face all of these disadvantages.

Low income is one factor that can have such multiple effects. Poorer people are more likely to have existing medical conditions, and tend to live in areas where the outdoor and indoor environments – including the quality of the air – are not as healthy. Less access to decent housing, green spaces, jobs and healthy food all contribute to poor health. These stressful conditions may also affect the body's response to air pollution.

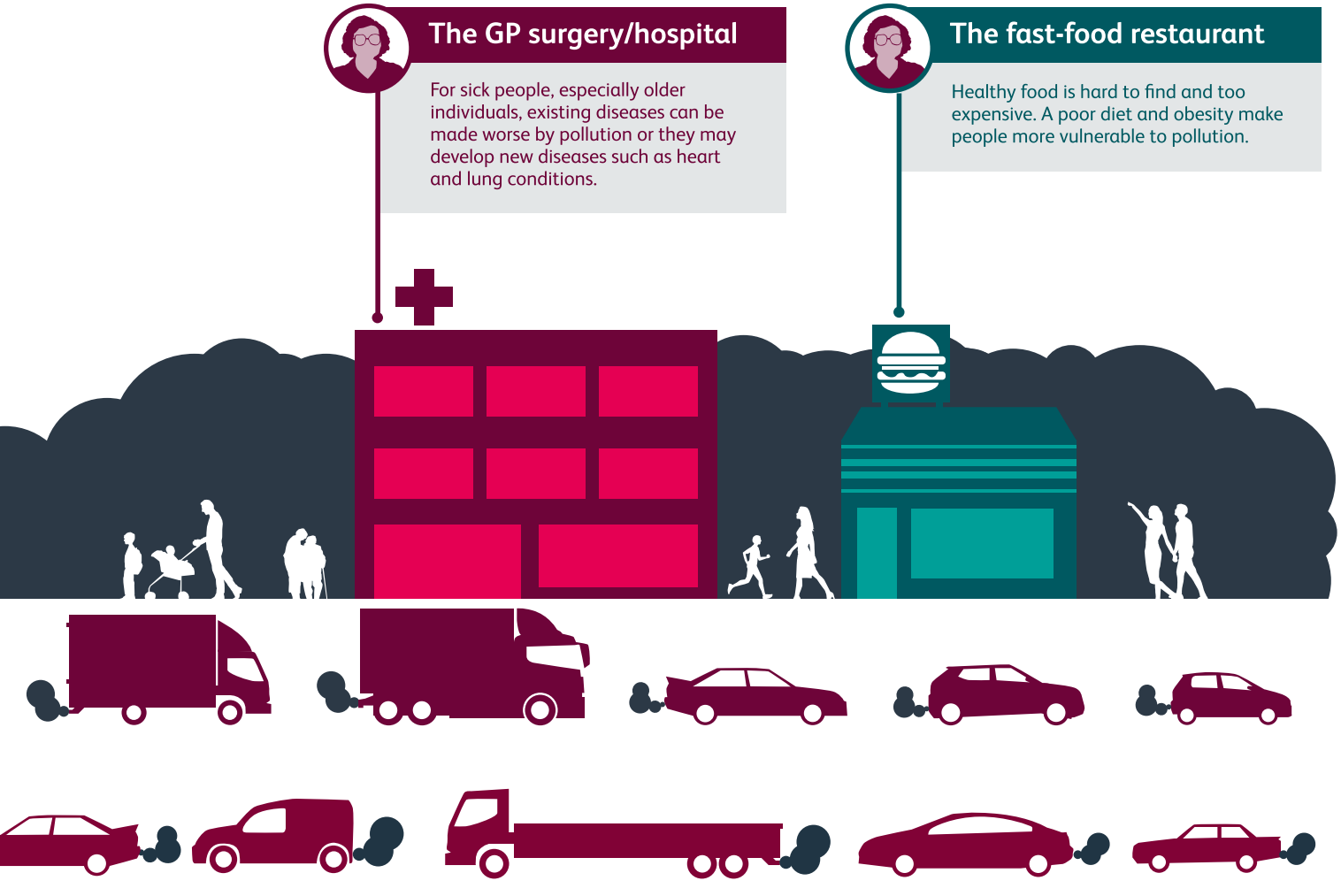
In some ways, it is a vicious circle. For example, research suggests that some chemicals in air pollution may be implicated in the development of obesity – and we also know that obese people are more sensitive to air pollution.

To make the injustice worse, poorer people often can't afford to move away and leave the problem to someone else – and they may not want to. People in low-income areas need more resources and opportunities to create a healthy local environment.



Key facts

- The body's defences against hazards like air pollution are partly controlled by our genes.
- Older people are more vulnerable to the harmful effects of air pollution.
- There is evidence that air pollution can also harm the health of children, starting from the time they are in the womb.
- Some health problems, such as heart and lung conditions, can make a person more vulnerable to harm from air pollution.
- Being overweight can also make people more vulnerable to the harmful effects of air pollution, while a diet that is rich in antioxidant nutrients (such as many vitamins), or which includes vitamin and mineral supplements, may give some protection.
- Poorer people can often find it easier to buy cheap, unhealthy foods than a healthy diet, which puts them at a significant disadvantage.
- Poorer people also tend to live in environments where they are more exposed to air pollution, for example from busy roads or in unhealthy housing.
- All of these disadvantages add up, so poorer people are at a greater risk from air pollution and its damaging health consequences.

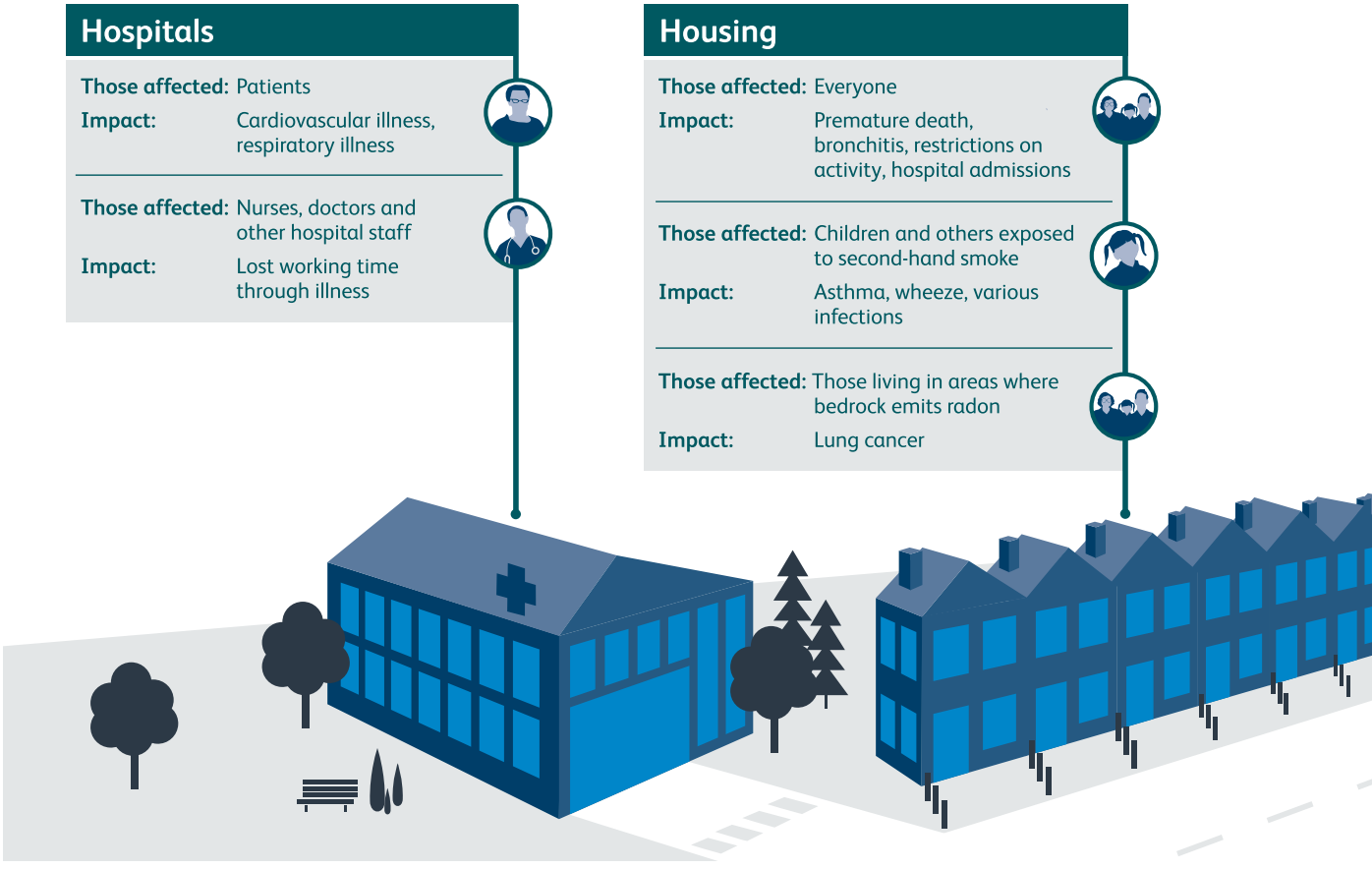


The heavy cost of air pollutio

Putting numbers on the harmful effects of air pollution allows policymakers to compare the costs of action with the benefits that will follow. This helps them to develop cost-effective plans, ensuring that we get the greatest benefit from investments in cleaning up air pollution.

Calculating the impact of air pollution also highlights areas where the evidence base is weak, and where further research would be most useful. For example, we have a lot of information about the impact of outdoor air pollution, but much less knowledge about indoor air pollution. We also know very little about the long-term health and economic effects of childhood illness caused by air pollution.

However, we already have clear evidence that air pollution is costing society dearly. It is forcing people to miss work and school, and to change their lifestyles to avoid exposure on high-pollution days. Exposure to fine particles, nitrogen dioxide and other pollutants in the air we breathe is causing pain and suffering – and additional healthcare costs – through increased illness. It has been estimated to cause 44,750–52,500 early deaths every year. Emerging evidence suggests a slightly lower figure, and therefore we have opted for a best estimate of around 40,000 attributable deaths per year with a range of ±25%.



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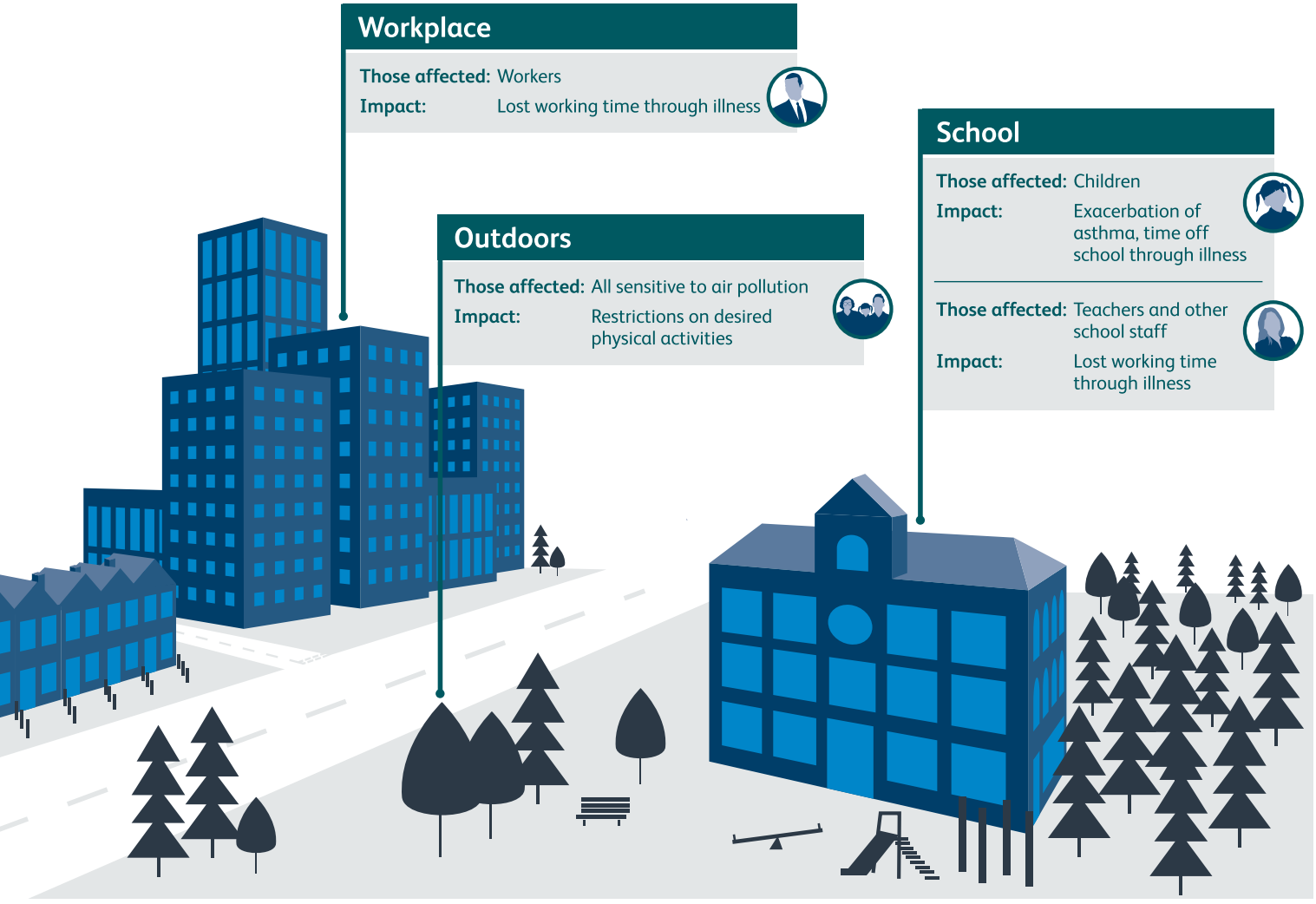
The European Commission, the US Environmental Protection Agency and various other bodies have concluded that further measures to control air pollution are economically justified. The costs of cutting emissions are outweighed by the benefits of action, because it would reduce pain and suffering, lower healthcare costs and get people back to work. Countries across Europe, including the UK, have already paid a high price for failing to act more strongly earlier. The longer action is delayed, the more this damage will mount up.

Key facts

- **Exposure to particulates and nitrogen dioxide is linked to around 40,000 early deaths in the UK each year.**
- **Air pollution is also linked to illness. For an individual, this can range from a minor illness that requires some medication, to a very serious situation – such as admission to hospital caused by a stroke, heart attack, lung condition or a range of other diseases.**
- **The health problems caused by air pollution impose many costs on society, through reduced productivity and an added burden on the health service.**
- **Overall, the estimated cost to individuals and society is more than £20 billion annually for the UK.**
- **According to 2010 estimates, the economic impact of exposure to air pollution across the European Union is more than €240 billion each year.**
- **We have less evidence about the costs of indoor air pollution. However, second-hand tobacco smoke and radon gas also cause deaths, and impose a significant burden on the NHS.**



Changing our future

In the first chapter of this report, we explained how our economy, industries and way of life have changed over recent generations, and how these trends have affected air pollution over that time.

We close the report by looking at the effect that these developments will have on our environment and the air we breathe in the years ahead.

We are using up natural resources at an unprecedented rate. Our pollution of the environment harms the delicate global ecosystems on which we rely. The air pollution we generate plays a key role in this damage, not least in the process of climate change, which places our food, air and water supplies at risk and threatens our health and wellbeing.

Many of the pollutants that cause this environmental damage are the same ones that are toxic to our bodies. These health problems will get worse if we continue on our current course.

There is hope, though, if we act quickly. Many of the changes that would decrease air pollution to protect our health – especially using energy more efficiently and burning less solid fuels and oil – would also help to slow down the overheating of our planet. If we take steps now to save lives by cleaning up our air, we may also protect the future of our home on Earth.

Key facts

> **By 2013, the concentration of carbon dioxide in the atmosphere had increased by about 42% over the levels before the Industrial Revolution, and the concentration continues to rise. Carbon dioxide is one of the main gases causing the Earth to overheat.**

Smart thinking on climate change can benefit our health

Reducing carbon dioxide emissions will limit the direct and indirect health effects of a changing climate...

Direct benefits
Damage to physical and mental health from flooding, extreme weather and rising temperatures will be reduced.

Indirect benefits
Harm due to food insecurity will be reduced, so will the difficulties that affect everyone when large populations are forced to move because of floods, droughts and extreme weather.

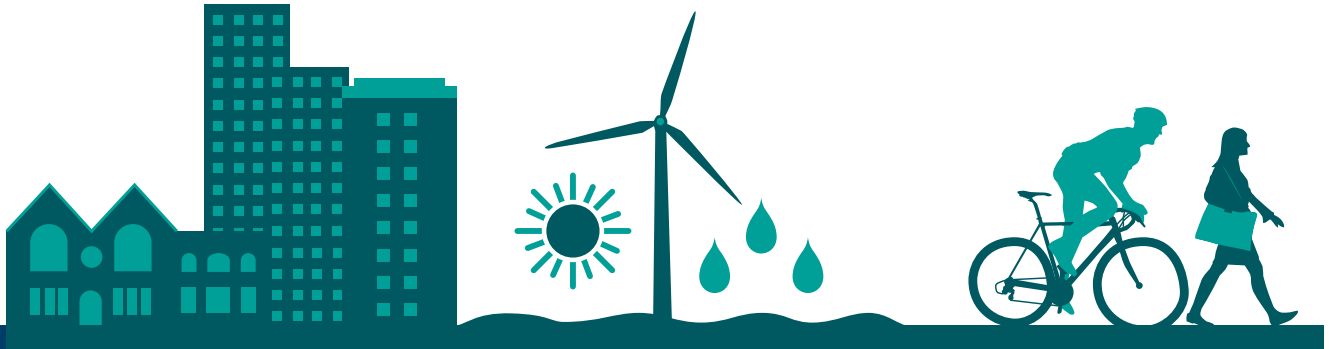
- Air pollution and climate change are intertwined. For example, the shifts in weather patterns due to climate change may cause more ozone to be produced at ground level, which harms our health. Increased ozone levels then contribute to more warming.
- Sometimes what is good for one of these problems is bad for the other. Diesel-fuelled vehicles cut down on carbon dioxide but they increase pollution from particulates, which damage health.
- On the other hand, many strategies to decrease air pollution are also ways to slow down climate change. We can make this happen by:
  - using less energy
  - using energy more efficiently
  - burning less oil, gas, coal and wood, while making more use of renewable energy sources
  - using hybrid and low emission vehicles
  - developing and using technology that captures carbon from power plants and factories, before it is released into the air.

If we act now to reduce greenhouse gas emissions to target levels by 2050, we can have a real impact. An analysis for the European Commission suggests that, each year in the UK, this would prevent the following impacts related to local and regional air pollutant exposure:

- 5,700 deaths
- 1,600 hospital admissions for lung and heart problems
- 2,400 new cases of bronchitis.

Reducing air pollution would also allow vulnerable people to be more active, take less medication, and live longer.

The economic value of these benefits would add up to €3.9 billion per year.



...but with smart thinking we can reduce carbon dioxide emissions *and* deliver further benefits for our health and wellbeing.

How we live	How we produce our energy	How we get around
Being energy efficient in the places we live, learn, work and socialise	Generating electricity from sources other than fossil fuels	Using public transport, walking and cycling

All of these steps will also reduce pollution, its health effects, and demands on health services. Energy efficiency will mean less illness and fewer deaths caused by energy poverty. Active transport will make us all fitter people, with huge gains for health.

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