Healthy environment, healthy people

Impact

NERC science supports policy delivery and action that improves the quality of the environment we live in, benefitting human health, the UK economy and our net zero journey

NERC investment delivers:

- Skilled people
- Climate and atmosphere models
- Long-term data on pollutants
- Environmental monitoring technologies
- Knowledge exchange and collaboration
- Infrastructure

Used by: national and local government, businesses, industries, communities, civil society

Healthier people due to less exposure to:

- **Pollutants:** cutting exposure to air pollutants, thereby reducing respiratory and cardiovascular disease

- **Diseases:** combatting environmental drivers of wildlife-borne diseases, antibiotic resistant infections and food pathogens

- **Climate extremes:** mitigating and adapting to extreme weather reduces climate change-induced nutrition, heat and disease stressors

Healthier economy due to:

- **Cost savings** e.g. £billions by avoided air pollution health impacts

- **Business growth** e.g. £53.2 million in revenue for UK air quality sensor firm

- **Increased productivity** e.g. improved pollen forecasting tackles the 29 million working days lost annually to hay fever

- **Protected industries & jobs** e.g. £20m-a-year UK shellfish industry

Healthy numbers

4 million people are breathing cleaner air in London

96% decrease in antimicrobial use in beef cattle, to combat AMR

2 million cases of skin cancer prevented by 2030 thanks to ozone recovery

Pollen forecast
GOOD

Learn more

Why it matters

The quality of our environment is central to our health, wellbeing, and ability to thrive. From the cleanliness of our air and water, to the temperatures in which we live and work, to our relationship with nature and the positive effect that has on our mental health.

Harm to the environment, comes with significant threats to our economy, society, and health. Climate change is at the forefront of these threats, predicted to cause an additional **250,000 deaths globally by 2030 to 2050**. In the UK, air pollution claims **43,000 lives a year** and without action, will amount to **£18.6 billion in NHS and social care costs by 2035** in England alone. Environmental degradation increases human exposure to pathogens in the environment, leaving us more vulnerable to infections, such as those derived from wildlife, like COVID-19, or from drug-resistant bacteria, like E. coli.

Cutting-edge environmental science, supported by NERC, enables governments, businesses and communities to identify and tackle these environmental challenges, supporting government priorities to protect health, achieve net zero emissions by 2050, and to level-up life expectancy and opportunities across the UK.

By improving understanding of harm to the environment and human health, NERC science informs policymakers and the public of the need for change and guides effective interventions.

Find out how in the NERC Strategic Delivery Plan

Contributing towards multiple Sustainable Development Goals, including:

NERC science also contributes to the UN decade on ecosystem restoration to 2030

Impact: cutting air pollution

Air pollution is the UK's biggest environmental public health threat. NERC-funded air pollution research informs policy and action to combat sources of indoor and outdoor air pollutants, by monitoring and measuring trends in key pollutants, and providing detailed analysis and independent advice on causes, impacts and mitigation strategies. Cutting air pollution benefits human health by reducing respiratory and cardiovascular disease and improving longevity, mental health and wellbeing. These impacts in turn reduce healthcare costs and boost productivity, benefitting the economy. Indeed, meeting UK air pollution targets is predicted to avoid £5.3 billion in population health costs per annum by 2030. Reducing air pollution also delivers societal benefits, for example tackling place-based health inequalities, as deprived communities experience higher air pollution levels.

Air Pollution Policy

The UK's Clean Air Strategy 2019 prompted policy interventions on volatile organic compounds (VOCs), indoor air pollutants, wood burning, domestic coal, ammonia emissions from farming, and new standards for tyres and brakes. Proposals within the strategy are expected to reduce the death toll from exposure to fine particles by 25%, and will help meet UK government legally-binding targets to reduce human exposure to particulate matter (PM2.5) by 35% by 2040, set in the 2021 Environment Act.

Decades of NERC and UKRI-funded research to measure, model and forecast air pollution supported the delivery of the Clean Air Strategy 2019, with expert communication and partnerships playing a key role. For example, modelling explaining how ammonia emissions from agriculture are damaging to public health, prompted the government to legally commit to reducing ammonia emissions by 16% by 2030, following its inclusion in a Department for Environment, Food & Rural Affairs' (DEFRA) Air Quality Expert Group report.

Several universities and institutes across the UK contributed to the research, including the National Centre for Atmospheric Science, and the universities of York, Leicester, and Birmingham.

Clean Air Zones

Four million people are breathing cleaner air in London, and the UK is set to comply with international legal roadside nitrogen dioxide (NO2) levels five years earlier than anticipated, thanks to pioneering traffic control schemes. Schemes that reduce vehicle emissions are critical to protecting health, and have already cut cardiovascular disease and road traffic injuries.

London's Ultra Low Emission Zone (ULEZ) has seen a fall in pollution across the city; -50% in NO2, -41% in Particulate Matter (PM2.5), and -800,000 tonnes of carbon dioxide (CO2)*. Clean air zones now successfully operate across the UK; Birmingham's NO2 levels dropped by 13% within the first six months of operation.

Atmospheric science research measured pollution in UK cities and used predictive modelling to advise policymakers on effective traffic control options, including low emission zones. This informed the Mayor of London's London Environment Strategy 2018, which led to the ULEZ.

The research at King's College London was funded by NERC.

*Reductions for NO2 are in central London, for PM2.5 are for central and inner London, and CO2 is city-wide.

Air Quality Sensor Spinouts

New technologies for monitoring air pollution have driven local air quality clean-ups, generated over £50 million in revenue, and supported job growth for UK-based companies.

Leicester-based SME Earthsense has addressed local air-pollution hotspots, provided dozens of jobs, and supported hundreds of thousands of property sales via air pollution risk reports to conveyancers. The company develops unique, high-resolution maps of air pollution from country-scale right down to street corners, as well as air pollution sensors. This has revolutionised access to detailed air pollution data for local authorities and the public; its product MappAir® powers the BBC Pollution Postcode Checker air pollution forecasts, and its Zephyr® sensor has been used by 17% of UK local authorities.

Lead air-pollution sensor manufacturer Alphasense, commercialised an Optical Particle Counter (OPC) which has been used in air pollution monitoring schemes across the UK and in over 70 countries, generating £53 million in revenue and 32 new jobs. Its low cost has empowered communities to set up citizen-led air-monitoring projects.

The technologies were underpinned by environmental science research and development, at the Universities of Leicester and Hertfordshire, funded by NERC and EPSRC.

NERC capital investment has delivered air pollution urban supersites for long-term urban air quality monitoring in Birmingham, London and Manchester.

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Impact: tackling infections

Infectious diseases pose a huge burden on the UK's health and economy, causing 7% of deaths and costing £30 billion annually. By understanding how climate, water quality and biodiversity interact with diseases, NERC research informs action by governments and businesses to combat environmental drivers of ill-health such as wildlife-borne diseases, antibiotic resistant diseases, and pathogens in food. Monitoring biodiversity, pathogens in the environment, pollution, and the influence of climate change on disease transmission, enables researchers to provide both real-time information on trends of infectious agents. It also enables horizon-scanning for future threats, to inform effective decision making. This protects UK industries from closure, promotes healthy workforces, and delivers environmental co-benefits.

Pathogen Monitoring

Pioneering environmental surveillance tools have delivered a step-change in the detection of dangerous pathogens in aquatic systems, underpinning the UK's national wastewater monitoring programmes for tracing COVID-19.

By providing real-time information on the levels of virus circulating in major towns and cities, the monitoring enabled government and industry to react quickly to COVID-19 outbreaks, and introduce control measures in communities and workforces, protecting health and national supply chains.

The monitoring programmes have since expanded to further public health indicators, for instance, reporting to government on levels of antibiotics in wastewater, and supporting public health settings through early detection of Norovirus in hospitals to prevent ward closures.

The monitoring tools also benefit the UK's £20 million-a-year shellfish industry. More accurate aquatic testing, has reduced the risk of contamination of shellfish by pathogens like Norovirus and E-coli, minimising food-borne disease outbreaks in people. This prevents unnecessary shellfish industry closures, thus reducing risks to businesses and protecting thousands of jobs.

The research at Bangor University was funded by NERC and EPSRC.

Anti-Microbial Resistance Policy and Practice

Human health is better protected from the risks of rising antibiotic-resistant infections thanks to new national and international antimicrobial resistance (AMR) policy and practice. Every year AMR kills 2,000 people in the UK and costs the NHS £95 million. It's predicted to cause 10 million global deaths a year by 2050, if no action is taken.

Research at the University of Exeter informed the UK government's five-year AMR strategy 2019 to 2024, contributed to EU regulation on hazardous substances through inclusion of antimicrobials to their watchlist, and influenced global AMR policy via the United Nations. The work investigated the development and spread of drug-resistant microbes to humans from the environment, and their negative health impacts, to contribute to the policy evidence base.

University of Bristol research has led to a dramatic fall in the use of antibiotics in UK livestock farming, underpinning, for example, new Red Tractor certification guidance, that contributed to 87% and 96% decreases in antimicrobial use in dairy and beef cattle. The research advanced understanding of antimicrobial use in agriculture and veterinary practice, and identified interventions to reduce it.

The research at the Universities of Exeter and Bristol was funded by NERC, UKRI, BBSRC, MRC and EPSRC.

Avoiding Wildlife Disease Outbreaks

UK and international governments and agencies have strengthened pandemic prevention policies, improved disease outbreak responses, and have channelled funding into wildlife disease prevention, thanks to pioneering research. Spillovers of wildlife-borne diseases, like Ebola and COVID-19, known as zoonoses, can have devastating consequences for human health and economies. The COVID-19 pandemic cost the UK over 200 thousand lives, and £410 billion in public spending.

New research linking emerging wildlife diseases (zoonoses) with land use and climate change indicators, has provided insight into the transfer of diseases into human populations. This has guided policy priorities at international bodies including the United Nations, Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), and WWF, as well as the UK government - informing zoonotic risk evidence in HM Treasury's Dasgupta Review, and the UK Foreign and Commonwealth Development Office's (FCDO) Ebola response planning.

The research also prompted major investments globally into pandemic prevention; the FCDO channelled £millions into its Zoonoses and Emerging Livestock Systems programme, to tackle disease emergence via livestock systems, and the US Government invested $1.5 billion in aid to countries at high risk of emerging diseases.

The work at Birkbeck College, the Institute of Zoology, and University College London was funded by NERC and MRC.

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Find out more about the expansion of wastewater monitoring to spot epidemics

Impact: curbing climate damage

Climate change is the single biggest health threat facing humanity, with the World Health Organization predicting that 250,000 deaths a year will be caused by climate change-induced nutrition, disease and heat stressors between 2030 and 2050. Decades of NERC-funded research underpins national and international policies to curb and adapt to climate change. Action on climate change improves human health by mitigating and informing adaptation to extreme weather, reducing air pollution, and curbing the spread of diseases. Meanwhile actions to clean up the environment, like tackling air pollution, deliver climate co-benefits such as faster greenhouse gas removal, thus accelerating our journey to net zero.

Government Response to Hotter Weather

Policymakers now identify high temperatures as the second most important climate-change risk faced by the UK, following new evidence on the threat to public health, wellbeing and productivity posed by rising temperatures. 2% of global working hours are predicted to be lost in 2030 due to rising temperatures, and heatwaves in the UK are increasing in temperature, frequency, intensity and deadliness - killing 4,500 people in England in 2022.

The new evidence has shaped current UK national policy on overheating buildings, outlined in the 2017 UK Climate Change Risk Assessment and 2018 National Adaptation Programme. These include the need for construction practices and building regulations that help prevent overheating in a climate-changed UK. By combining indoor thermal monitoring of homes, with models for indoor environments in UK housing stock, the researchers produced predictive models that show how changes in indoor temperature exposure adversely impacts human health for various scenarios of climate change, energy retrofit, and build-stock growth.

The research at University College London was funded by NERC and EPSRC.

Ozone Action

NERC scientists discovered the ozone hole above Antarctica which prompted the Montreal Protocol international treaty, leading to rapid worldwide reductions in the production of ozone-depleting substances (ODS).

Thanks to the treaty, the ozone hole is healing, and its recovery will have prevented at least two million cases of skin cancer by 2030, as well as other health costs associated with UV exposure, such as eye damage and negative impacts on the immune system.

NERC scientists continue to inform protocol amendments with updated science on the detection of a wider range of ODS. As ODS are also potent greenhouse gases, action to control them also fights climate change, while protecting health; indeed, it is estimated that the removal of ODS as a result of the treaty will have averted 2.5°C of climate warming by 2100.

This work was underpinned by decades of observations and research at NERC-research centres British Antarctic Survey and National Centre for Atmospheric Science.

Natural Environment Research Council

Read more about how decades of NERC climate science underpins Global and UK Climate Policy: NERC's Climate Timeline

Skilled People

NERC also delivers impact by developing people. Our funding for postgraduate training produces highly trained environmental science experts working to improve human health by solving environmental problems

Dr Sarah Moller
Brokering Knowledge for Clean Air Policy

Sarah is a Senior Research Fellow at the University of York, and the National Centre for Atmospheric Science. With a NERC Knowledge Exchange Fellowship based at Defra she informs the development of government strategy to tackle air pollution.

Her NERC-funded PhD saw her develop skills in atmospheric chemistry measurements and presenting data to senior stakeholders to inform decisions. She now uses this expertise in her work to ensure policy, like the Clean Air Strategy, is underpinned by the best science.

Dr Clare Heaviside
Protecting human health in an increasingly urbanised and warming world

As a NERC Independent Research Fellow at University College London, Clare Heaviside researches how to protect people from the health ramifications of climate change, such as those imposed by heatwaves and urban overheating.

Clare produces and communicates evidence that is used by government to build policies that protect people's health amidst a changing climate. She credits her NERC-funded PhD with building the modelling and climate data analysis skills needed to provide this expertise.

Dr Roland Leigh
Commercialising technology to tackle air pollution and protect health

Roland is Chief Technical Officer at Earthsense, where he leads a team developing tools used by millions of people globally to reduce public and personal exposure to harmful air pollution. Poor air quality is the largest environmental risk to public health in the UK and is linked to shorter lifespans and chronic diseases like asthma.

Roland's expertise in applying new technologies to societal issues, built during his NERC-funded PhD, steers Earthsense towards producing solutions that empower customers to tackle poor air quality and protect health.

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Investing for the future

NERC continues to work with partners to support research, training, and infrastructure to diagnose environmental problems, and deliver solutions for a healthy environment, people and economy. Recent investments include:

Realising the health co-benefits of the transition to net zero: a £30 million UKRI Building a Green Future programme, to deliver research hubs that address health-focussed interventions towards the net zero agenda. Funded by NERC, AHRC, BBSRC, ESRC, EPSRC, MRC, STFC, and the Department of Health and Social Care, through the National Institute for Health and Care Research.

Clean Air Programme: a £42.5 million UKRI Strategic Priorities Fund programme, delivered by NERC, the Met Office, and Innovate UK that is delivering practical solutions to tackle air quality challenges.

Collaborative community research to tackle health inequalities: a £25 million programme to integrate cultural, community and natural environment assets into health and care systems, to create healthy communities and environments across the UK. Funded by NERC, AHRC, ESRC, MRC and BBSRC and the National Centre for Creative Health.

Centre for Doctoral Training: environmental solutions to zoonoses: £4.8 million of funding, to deliver a new cross-council Centre for Doctoral Training to provide researchers with the skills researchers to understand and prevent the emergence and transmission of animal-borne diseases from environmental reservoirs. Funded by NERC, BBSRC and MRC.

UKRI-Defra One Health approach to vector borne diseases: a £6.5 million programme, to forecast, understand, mitigate and avoid vector (arthropod) borne disease threats to the UK. Funded by DEFRA, BBSRC, NERC and MRC.

The Environmental Data Service: Hosting the largest collection of environmental science data in the UK, this NERC-funded service ensures that environmental data are made available, accessible and re-usable for the long-term, in order to fully realise their value.

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