

Co-benefits of climate change mitigation in the UK: What issues are the UK public concerned about and how can action on climate change help to address them?

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Headlines

- Governments face a significant challenge to reduce greenhouse gas emissions while meeting competing objectives such as improving public health and reducing unemployment.
- There are multiple benefits – known as ‘co-benefits’ – to taking action on climate change that are not always adequately considered or valued in the policy and decision-making process.
- Benefits of climate change mitigation for the UK include improvements in public health, reduced NHS costs, greater energy security, growth in the low-carbon jobs market and a reduction in poverty and inequality.
- Cities and devolved administrations are best-placed to capitalise on the co-benefits of climate change mitigation as they frequently hold relevant budgets (e.g. health, transport, housing) and understand how different policy priorities impact on each other.
- Faster, deeper reductions in greenhouse gas emissions may be achieved by ensuring that public sector decision-making adequately considers the co-benefits of climate change mitigation.

Executive Summary

Limiting the global average temperature increase to 1.5°C (or well below 2°C) above pre-industrial levels, as stipulated in the Paris Agreement, will require drastic action by global economies to reduce their carbon emissions (to decarbonise). To stay below these temperature limits, governments must decarbonise while meeting other key objectives such as the provision of healthcare and public services and maintaining stable economic growth. The challenge of meeting competing objectives is often exacerbated by the nature of the political cycle where key objectives tend to be traded off against each other.

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Grantham Briefings analyse climate change and environmental research linked to work at Imperial, setting it in the context of national and international policy and the future research agenda. This paper and other publications are available from www.imperial.ac.uk/grantham/publications

Ipsos MORI survey data on what the UK public consider to be the main issues facing the country show that between 2007 and 2018, issues concerning pollution and the environment were cited as being important by a maximum of 10% of respondents in any given year. This compares to figures as high as 60% for the economy (in 2011), 49% for the common market/Brexit (in 2018) and 48% for the NHS/hospitals (in 2017) – and illustrates the importance of framing the need for action on climate change in the context of these established priorities.

This paper draws on literature from multiple academic disciplines to explore how action on climate change is relevant to UK public concern, and associated government priorities, in four broad areas: i) health and the NHS; ii) immigration and security; iii) the economy and unemployment; and iv) poverty, housing and inequality.

Numerous benefits from climate mitigation are identified for the NHS and public health – through improvements in air quality associated with the electrification of vehicles and switch from car usage to public and active transport (e.g. walking, cycling) to improvements to the energy efficiency of domestic properties (e.g. increased insulation to keep homes warmer) and moving to a lower carbon (e.g. reduced meat) diet.

In terms of immigration and security, increasing the amount of renewable energy generated in the UK reduces our reliance on the import of fossil fuels from other countries and improves our energy security. At the international level, climate action reduces the chance of forced migration from climate-related disasters, which in turn may reduce pressure on immigration into the UK.

The future low-carbon economy offers significant potential for economic growth, job creation and the opportunity for the UK to become a world leader in the development, production and distribution of new, sustainable technologies. To buffer potential negative economic consequences of the switch to clean technologies, such as job losses for those reliant on employment in the fossil fuel industry, geographically-targeted programs to redistribute jobs and re-train those affected are essential.

Energy efficiency improvements in the housing sector will help to alleviate fuel poverty and inequality while simultaneously improving the productivity of their residents, particularly those from poorer backgrounds, whose homes are more likely to contribute to illness and negatively impact their ability to work and study.

We suggest that it is at the regional and city levels that the co-benefits of climate action can be best incorporated into the decision-making process in the short-term. It is at this scale that co-benefits are most evident and where interventions can have the most immediate impact.

A specific example of the kind of project that could be rolled by local authorities using a co-benefits approach is the Seasonal Health Intervention Network (SHINE) project of Islington Council and the Greater London Authority. This project brings together health and housing practitioners to enable GPs of patients living in cold, damp homes to ‘prescribe’ double glazing, boilers and insulation to their patients in order to address the root-cause of their illness rather than dealing solely with the symptoms. The project reduces NHS costs while simultaneously reducing greenhouse gas emissions and improving the quality of the housing stock.

At the national level we suggest that greater collaboration between government departments can increase the chance of the co-benefits of climate action being adequately considered in the decision-making process. We put forward several potential national-level changes, including the establishment of a ‘co-benefits fund’, a minister for the Sustainable Development Goals and an Office for Public Health and the Environment. In the short-term, central government is likely to have a key role to play in facilitating the dissemination of good practice between cities and regions so that successful collaborative approaches can be scaled-up as quickly as possible.

At all levels, tools are needed to better quantify the co-benefits of climate action to inform the decision-making process. Considering the full benefits of policies that touch on the climate change agenda can help to bring about faster, deeper cuts in greenhouse gas emissions.

Introduction

The UK Climate Change Act of 2008 was the first piece of legislation to legally mandate a nation to reduce greenhouse gas (GHG) emissions – in this case by 80% of 1990 levels by 2050. Many countries have subsequently introduced their own equivalent legislation and in 2015 the Paris Agreement was signed by 197 countries with the aim of limiting “the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels”¹. The 2018 Special Report of the Intergovernmental Panel on Climate Change (IPCC)² on the impact of a 1.5°C rise in global temperatures above pre-industrial levels further highlighted the urgency with which GHG emissions must be reduced to avoid the worst impacts of climate change.

To avoid a rise in global temperatures above the agreed limits, governments face a significant challenge to reduce their greenhouse gas emissions (to decarbonise) while meeting other key objectives, such as the provision of healthcare and public services, growing local and national economies, managing employment rates, maintaining security and public order, and tackling poverty. The challenge of meeting competing objectives

is often exacerbated by the nature of the political cycle where key objectives tend to be traded off against each other, particularly around the time of elections. This is manifest in how economic growth is often depicted as conflicting with action on climate change, despite evidence of a decoupling of economic growth from GHG emissions in many industrialised countries³. In the UK between 1990 and 2017, for example, GHG emissions fell by 43% while the economy grew by over 70%⁴ – albeit a significant element of this was the move from coal to gas in the 1990s and a decline in UK manufacturing unrelated to climate change action/policy.

As well as the challenge of competing for attention in the political sphere, climate change is generally not a high priority for the UK public. Ipsos MORI, a market research organisation, publishes a monthly ‘issues index’ to track what the public think are the key issues facing the country⁵. Healthcare, education, immigration, housing, the economy and poverty typically rank amongst the most important issues of concern, while pollution and the environment rarely feature in the top 10.

The prioritisation of societal challenges can often be treated as a zero-sum game – where priority is given to either healthcare or the environment, with insufficient consideration of how such issues interact. The division of priorities between different government departments exacerbates this challenge, as departments compete for funding and there are often no direct incentives for departments to collaborate where priorities intersect. Considering climate change and environmental action in isolation ignores the significant benefits that action on climate change can have on other priorities, and can lead to suboptimal policy decisions⁶.

This paper discusses the benefits that climate change mitigation can have on some of the key challenges facing the UK, including improving public health, reducing NHS costs, creating jobs, boosting economic growth, and reducing unemployment, poverty and inequality. It looks at the co-benefits of climate action across a range of academic disciplines and associated policy areas, and recommends measures that can be adopted by policy and decision-makers at various levels of government.

What are co-benefits?

The Fifth Assessment Report of the IPCC defines co-benefits as being “the positive effects that a policy or measure aimed at one objective might have on other objectives... co-benefits are also referred to as ancillary benefits”. A significant body of international literature exists on the co-benefits of climate action, particularly in relation to public health and the economy. Studies generally focus however on one set of co-benefits based on a specific academic discipline (e.g. the co-benefits of climate mitigation for public health) and do not consider co-benefits within a wider context.

The IPCC (2014) also recognises the potential for negative impacts of climate-related policies which they refer to as ‘adverse side effects’. For example, a switch to domestic wood-burning would reduce GHG emissions, but lead to an increase in particulate matter in the air, which can have a negative impact on human respiratory disease⁸. The potential for adverse side effects underlines the need for mitigation policies to be carefully designed to avoid unintended harmful consequences⁹. In their review of the global co-benefits literature, Deng et al. (2017)¹⁰ define co-benefits as “including positive co-benefits, ancillary benefits and adverse side effects”. This briefing paper will treat co-benefits in an identical manner.

In response to concerns about the adverse side effects of action on climate change, there is a growing body of literature on the ‘Just Transition’^{11, 12, 13}. The Just Transition looks at the impact that climate mitigation will have on communities to identify where additional, pro-active policy support may be required to minimise any negative impacts. For example, communities that are reliant on fossil fuel industries for jobs and income will need additional support as society moves towards more renewable sources of energy. By considering and mitigating against such potential adverse side effects early in the decision-making process, the opportunity for maximising positive co-benefits is increased and the potential for inequalities is decreased.

While co-benefits are “often referred to and argued with, they are rarely measured, quantified, or monetized, and even less frequently do they enter the quantitative decision-making frameworks applied to climate change”¹⁴. This briefing paper will bring out the co-benefits relevant to climate mitigation in the UK and discuss how they should be incorporated in decision-making to reduce the chance of suboptimal decisions being made.

UK public opinion

The Ipsos MORI issues tracker provides an excellent resource to identify the main concerns of the UK public and how they have changed over time. Figure 1 displays Ipsos MORI opinion poll data since 2007 and shows the main issues of concern raised by respondents to the question “What would you say is the most important issue facing Britain today?”. Respondents could name more than one issue of concern. The highest percentage of respondents that raised ‘pollution/the environment’ as the most important issue in a given year was 10% in 2007 and 2018. This contrasts to ‘the economy’ which has been as high as 60% (in 2011), ‘the common market/Brexit’ (49% in 2018), ‘the NHS/hospitals’ (48% in 2017), ‘immigration’ (44% in 2015) and ‘unemployment’ (35% in 2012).

Issues of concern raised by the UK public via Ipsos MORI poll 2007-2018

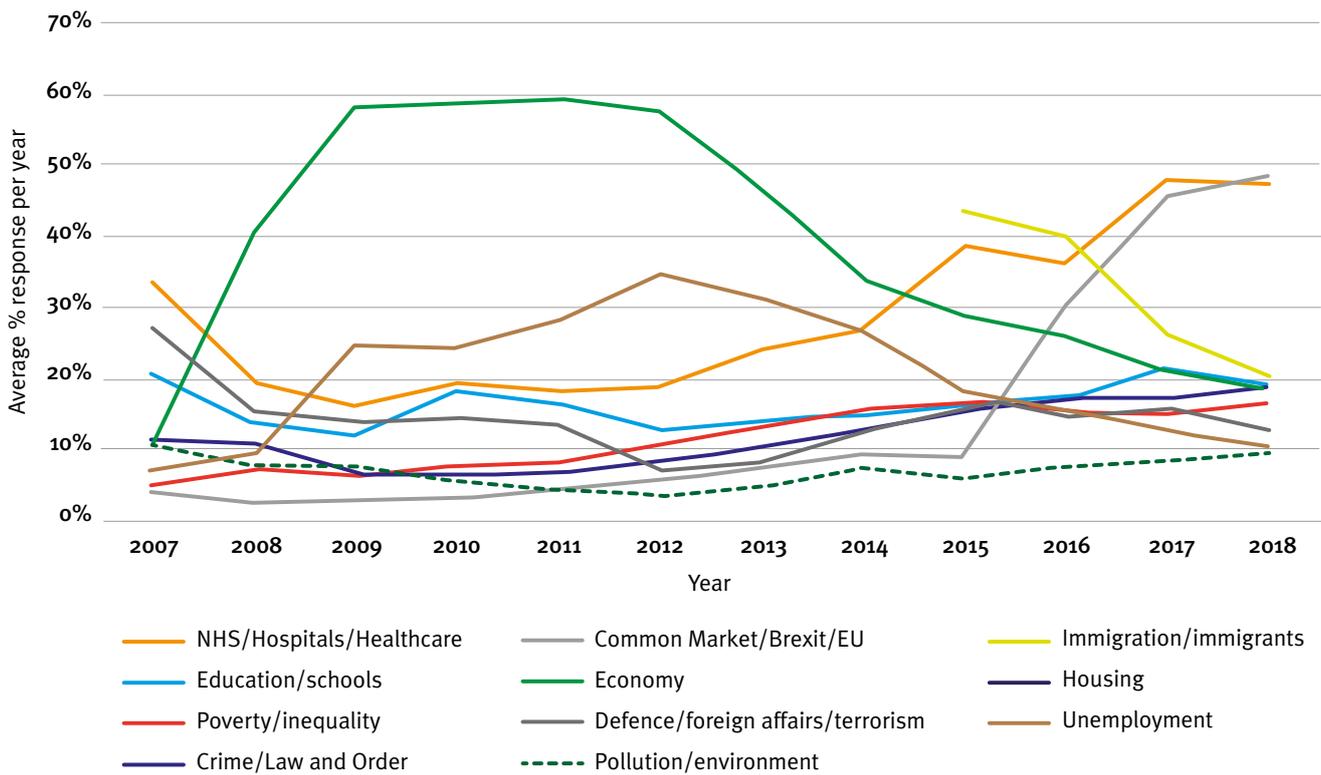


Figure 1: Issues of concern raised by the UK public in Ipsos MORI polls since 2007. N.B. ‘Immigration’ was not a response category until 2015; monthly data from IPSOS MORI has been averaged into yearly values in this figure in order to make it easier to interpret.

Policy relevance

Data on the level of public concern over issues presented in Figure 1 are important for many reasons, not least for the way in which they influence the prioritisation and allocation of public resources within government. To a large extent, such concerns reflect the remit of, and boundaries between, different government departments. This can perpetuate the way in which complex, multifaceted issues may be treated in a siloed manner as government departments are not particularly well set up to address problems that cut across departmental priorities. Climate change mitigation is an issue that is relevant to a variety of government departments.

As well as the long-term commitment to reducing GHG emissions, the UK government is also committed to the delivery of the United Nations (UN) Sustainable Development Goals (SDGs) – both supporting them internationally and achieving them in the UK. The SDGs, agreed by world leaders at the UN in 2015, aim to “end poverty, protect the planet and ensure that all people enjoy peace and prosperity”¹⁵. The seventeen SDGs cover a range of areas that are directly relevant to specific government departments but also raise many cross-departmental challenges. Adequately considering the co-benefits of climate change mitigation in the policy-making process can directly

support greater action on the SDGs – Climate Action (Goal 13) simultaneously supports action on a variety of other goals including Good Health and Well-Being (Goal 3), Affordable and Clean Energy (Goal 7) and Sustainable Cities and Communities (Goal 11).

At the national level, the budget and responsibility for climate change mitigation sits primarily with the Department for Business, Energy and Industrial Strategy (BEIS) but the benefits of many mitigation policies may be accrued by other departments. For example, the increase in electric vehicles on the streets will reduce exhaust-related air pollution, and consequently help reduce health impacts. It is therefore encouraging to see that the UK Government’s Clean Growth Strategy (a document outlining proposals for decarbonising all sectors of the UK economy through the 2020s)¹⁶ shares responsibility between government departments for leading on various aspects of the Strategy. BEIS and the Ministry of Housing, Communities and Local Government (MHCLG), for example, jointly lead on improvements to the energy efficiency of the housing sector. Considering cross-departmental co-benefits in all decision-making processes is important – if they are not adequately considered, suboptimal policy decisions may miss opportunities to address some of the more intractable issues faced by the government.

The public opinion data shown in Figure 1 also highlights how governments, organisations and individuals communicating the urgency of climate change action to the public need to frame the issue as something that can have positive benefits for non-climate issues, such as the NHS, the economy and poverty, rather than being solely an issue of tackling pollution or reducing environmental damage.

The next sections provide detail on how climate change mitigation can contribute to addressing many of the issues that influence government priorities and concern the UK public. Issues have been grouped into four main areas based on their interrelations. The four areas are provided below and each is followed by the central government department(s) who primarily accrue the co-benefits of climate action. In many cases these departments can be mapped down to equivalent departments at the city and regional level.

- **Health and the NHS:** Department for Health and Social Care; Ministry of Housing, Communities and Local Government
- **Immigration and security:** Home Office; Foreign and Commonwealth Office; Department for Business, Energy and Industrial Strategy
- **The economy and unemployment:** The Treasury; Department for Business, Energy and Industrial Strategy; Department of Work and Pensions
- **Poverty, housing and inequality:** Department of Work and Pensions; Ministry of Housing, Communities and Local Government

Health and the NHS

Health and transport

Decarbonising the transport sector by making vehicles more fuel efficient and moving from petrol and diesel to electric or hydrogen-powered vehicles has the potential to make considerable improvements to air quality across the UK and consequently, reduce strain on the NHS. Diesel vehicles in particular are responsible for high levels of particulate matter (PM) and nitrogen oxides (NOx) which are known to cause and exacerbate respiratory-related illness¹⁷. The Royal College of Physicians estimate that PM and NOx contribute to around 40,000 air pollution-related deaths per year in the UK¹⁸ and the World Health Organisation (WHO) found that more than 40 towns and cities in the UK reach or exceed air pollution limits¹⁹. Another WHO report²⁰ estimated that the economic cost to the UK economy of premature deaths from air pollution is approximately £54bn a year, while separate work suggests that 60% of deaths related to the combustion of fossil fuels are caused by the transport sector and that this proportion increases to 70% in London²¹.

Air pollution has been linked to a significant range of negative health impacts²² including cardiovascular and respiratory diseases such as heart attacks, strokes and asthma²³, various types of cancer (particularly lung cancer²⁴), diabetes²⁵, autism²⁶, and eye²⁷, kidney²⁸ and liver disease²⁹. A recent study has also found that living close to an area of regularly heavy traffic is associated with a higher incidence of dementia³⁰ and that particulates from vehicle emissions (particularly diesel) may be linked to neurodegenerative diseases such as Alzheimer's³¹. Given that the UK has an aging population, these associations are particularly pertinent – both from the perspective of the wellbeing of individuals and the associated strain that it puts on the NHS. A report by Public Health England³² estimates that between 2017 and 2035 there will be approximately 2.5 million air pollution-related cases of disease including diseases with emerging evidence such as dementia and diabetes. The cumulative cost to the NHS and social care of those cases is predicted to be over £18bn³².

Sleep efficiency is negatively affected in the most polluted areas through a combination of factors including inflammation of the upper airways from particulate matter and exacerbation of asthma and other chronic obstructive pulmonary diseases (COPD) such as emphysema³³. Poor quality sleep, in turn, contributes to a variety of health problems including muscle pain, mood disorders, and cognitive, memory, and performance deficits³⁴.

Children are particularly impacted by air pollution because their lungs are still developing and they breathe in more air per unit body weight than adults. Greater exposure to pollutants such as PM, ozone and NOx is associated with higher rates of infant mortality and lower birthweight^{33, 35}. Exposure to air pollution during pregnancy is also associated with pregnancy complications and lower birth weights – a review of over 13,000 pregnancies in Scotland found that increased exposure to PM and NOx during pregnancy led to reduced head size of infants during pregnancy and at birth³⁶. Childhood exposure to PM has also been shown to have negative impacts on child intelligence³⁷.

An alternative to petrol and diesel-powered vehicles are electric vehicles, which emit no exhaust fumes, and hydrogen vehicles which only emit water vapour. Their widespread use could have significant benefits on local air quality. It is essential that the electricity/hydrogen used by these vehicles is produced from low-carbon sources, however, as GHG emissions and air pollution may otherwise be geographically relocated rather than reduced overall. Non-exhaust emissions, such as those from brake and tyre wear, road surface wear and resuspension of road dust, are not expected to decrease for alternatively powered vehicles³⁸ – this can only be achieved by a move away from personal vehicles towards public and active transport.

It is worth noting that part of the current air pollution problem in the UK has been caused by a shift from petrol towards diesel engines, which was promoted by European and UK government policies in the early 2000s, motivated by a desire to reduce GHG emissions. It has subsequently become clear that while diesel engines may emit less carbon dioxide compared to an equivalent journey using petrol, the emission of gases such as NOx are comparatively high. This example illustrates the importance of fully understanding the potential side effects of climate-related policies, particularly where the scale of take-up or behaviour change is uncertain. In this case government advice led to a greater switch to diesel vehicles than was expected – the percentage of cars powered by diesel increased from 12.9% to 39.1% between 2000 and 2016, and diesel-powered light goods vehicles increased from 76.9% to 96.2% in the same period³⁹.

In the long-term, traffic-related emissions can only be reduced in a meaningful way if car journeys are reduced and people switch to active forms of transport such as cycling and walking. Active forms of travel have a multiplier effect in terms of benefits to public health – they help to reduce local air pollution while improving the physical and mental health and wellbeing of those adopting active forms of transport⁴⁰. An increase in physical activity in the UK (based on scenarios of increasing the amount of walking and cycling relative to 2010 levels) has been estimated to save the NHS £17bn (in 2010 prices) within 20 years by reducing the prevalence of type-2 diabetes, dementia, heart disease, cerebrovascular disease and cancer⁴¹. This calculation includes an adjustment for the increased risk of road traffic accidents associated with active transport and illustrates the scale of the potential benefits to the NHS that are particularly relevant amidst increasing rates of obesity and associated illnesses such as type-2 diabetes⁴². It also illustrates the importance of the integration of active transport into urban and transport planning to make it as easy as possible for members of the public to walk or cycle⁴³.

Health and housing

Improving the energy efficiency of the UK housing sector provides an opportunity to reduce the strain on the NHS while tackling inequality and improving the productivity of the UK workforce. Approximately 75% of the houses that will be in use by 2050 were already built in 2010⁴⁴ – this emphasises the importance of improving the energy efficiency of existing properties as well as the need for strong energy efficiency standards for new properties. In the 2016/17 winter period, there were an estimated 34,300 excess winter deaths (EWD)⁴⁵, of which approximately a third were estimated to be attributable to living in a cold home⁴⁶. EWD was calculated to be three times higher in the coldest quarter of homes compared to the warmest quarter⁴⁷, and children living in inadequately heated households were found to be more than twice as likely to suffer from conditions like asthma and bronchitis than those living in warm homes⁴⁷. These illnesses are exacerbated or brought on by exposure to moulds and dampness that are more likely to be present in cold homes⁴⁸.

These statistics show that poor energy efficiency in housing is having a direct effect on the physical health of those living in the worst quality housing. Evidence also suggests that the mental health of residents of cold homes is being negatively affected by their property⁴⁹ – individuals living in homes with a bedroom temperature below 15°C are 50% more likely to suffer from mental health problems compared to those whose bedrooms are heated to 21°C⁴⁷.

The impacts of cold homes on the physical and mental health of residents also have a financial cost to the NHS. The charity Age UK⁵⁰ estimates that cold homes cost the NHS in England £1.36bn/year due to the impact they have on elderly people experiencing cold-related illnesses including respiratory problems, strokes and heart-attacks. When considering the whole UK population and including estimates of the cost of GP consultations, associated treatments, days in hospital and referrals caused by housing-related factors, the cost of cold homes to the NHS is estimated at up to £2.5bn/year⁵¹. Annual spending on the NHS in the UK in 2016/17 was £144bn (£120bn in England, £7bn in Wales, £13bn in Scotland and £4bn in Northern Ireland)⁵² so the financial benefit to the NHS of improving the energy efficiency of housing across the UK is significant – particularly as those savings would be made year-after-year once energy efficiency improvements are implemented, and as the benefits would be spread across the UK.

These financial cost estimates of cold homes to the NHS do not include consideration of economic losses through missed work due to cold-related illnesses, the impact on productivity or educational attainment – we will return to these aspects later, along with a discussion of the personal financial benefits of energy efficiency to the general public.

There are local examples of good practice in the nexus between health and housing, but they need to be much more widespread to fully realise the wellbeing, cost-saving and carbon benefits of energy efficiency measures. Of particular note is the Seasonal Health Intervention Network (SHINE) (<https://shine-london.org.uk/>) set up by Islington Council that has subsequently been rolled-out across all London Boroughs via the Greater London Authority. SHINE engages a network of organisations including GPs and health visitors who refer vulnerable householders to the SHINE team. The SHINE team then provide vulnerable customers with advice on energy efficiency, accessing grants for new boilers, and reducing their fuel bills. This type of approach has been replicated in other areas of the UK, including in the ‘Boilers on Prescription’ project run by Gentoo Group and Sunderland Clinical Commissioning Group (CCG). In this project NHS patients living in cold, damp homes were ‘prescribed’ double glazing, boilers and insulation by their GP in an attempt to reduce their need for readmission. The ‘Boilers on Prescription’ project had a small sample size but nevertheless reported a 60% reduction in the number of GP appointments needed by patients taking part in the scheme along with Accident and Emergency attendance being reduced by 30%⁵³. Investing £1 in keeping homes warm is

estimated to save the NHS £0.42 pence in direct health costs⁵⁴ and with an aging population in the UK, the financial cost of cold homes is likely to increase in the absence of meaningful action to improve the energy efficiency of the housing sector.

In advocating an improvement in the energy efficiency of the UK housing stock we are mindful that there can be negative health impacts of certain types of installations that reduce ventilation as they can exacerbate indoor air pollution^{55, 56} – so energy efficiency regulation needs to protect householders against any unexpected negative health consequences. It is also essential that the cost of policies to improve the UK housing stock does not fall disproportionately on lower income households.

Health and food

The health benefits of a diet lower in GHG emissions are largely derived from a reduction in red meat consumption. Diets with relatively high amounts of beef, lamb and pork are associated with higher risks of cardiovascular disease, stroke and certain types of cancer⁵⁷. Beef and lamb in particular are responsible for a disproportionate amount of GHG emissions from the food sector because, unlike pigs and chickens, cows and sheep ruminant (their food ferments in their multi-chambered stomach), which leads to the production of relatively large amounts of the potent greenhouse gas methane. Worldwide, the livestock sector is responsible for approximately 14.5% of all GHG emissions⁵⁸ and approximately half of these emissions come from beef and lamb⁵⁹.

If the average dietary intake in the UK complied with the dietary recommendations of the World Health Organisation, a 17% reduction in GHG emissions could be achieved compared to existing diets⁶⁰. The WHO diet in question would contain less red meat, dairy products, eggs and sweet and savoury snacks, and more cereals, fruit and vegetables⁶⁰ – so wouldn't require a drastic change to existing dietary patterns. This diet would simultaneously increase average life expectancy at birth by over 8 months and save almost seven million years of life lost prematurely in the UK in the next 30 years⁶⁰. As with the healthy transport options discussed above, the health benefits of a lower carbon diet can also help to reduce the incidence of obesity and type-2 diabetes⁶¹ thereby reducing the strain on the NHS and saving public money.

Health and green space

As well as absorbing carbon dioxide and mitigating climate change, the presence of green space such as parks and gardens provide multiple benefits to public health, particularly in urban areas. Research suggests that green spaces should be treated as a fundamental health resource⁶² as it helps to regulate temperature and water flow and can reduce the energy consumption of buildings. Following the strategic placement of trees in a development at Zagreb University, for example, indoor summer temperatures in adjoining buildings were measured to be 4°C lower and indoor winter temperatures were 6°C

higher, compared to a situation with no trees⁶³. The regulation of temperature by these trees led to a 26% drop in energy consumption in the adjoining building. Green roofs and green walls have been shown to have a similar impact on regulating the temperature of buildings⁶⁴ with an associated benefit for reducing energy consumption.

Green space can play an important role in the mental health of individuals – those living closer to green space in urban areas have been found to experience lower rates of anxiety or mood disorder treatment⁶⁵ while a number of studies have shown the link between access to green space and reduced levels of stress^{66, 67}. One particular study⁶⁸ looked at the experience of members of the public in the UK and Italy who used green spaces during periods of high temperatures and found that longer and more frequent visits to green spaces led to improvements in wellbeing and helped to alleviate the perception of thermal discomfort during periods of heat stress. Climate change is expected to bring more extreme weather events to the UK, like longer periods of high temperatures⁶⁹. The elderly and those with existing medical conditions are most susceptible to heat stress⁶⁹, so the integration of green space into urban areas can play an important role in helping to reduce temperature extremes and associated admissions to the NHS, while simultaneously reducing GHG emissions.

The relationship between green space and air pollution is complex. In general, green spaces and trees are associated with lower levels of air pollution^{70, 71}, but in certain situations trees can act as a barrier to the dispersion of traffic-related air pollution^{72, 73}. Increasing the amount of green space can also increase concentrations of allergenic pollen from certain tree species and the associated allergies⁷⁴. Considering any potential negative effects of urban greening in the planning phase is essential to maximise the overall positive health benefits that green space can bring⁷⁵.

Immigration and security

As illustrated in Figure 1, immigration has been relatively high on the public agenda for the last four years, having not been included as a category in the Ipsos MORI poll until 2015. Shifting climatic zones, extremes of temperature and rainfall have the potential to increase conflict over natural resources and prompt migration – although separating the climate-related aspect of any conflict is exceptionally difficult given the range and intangibility of many of the causal factors. What is clear is that, for low-lying nations in particular, climate change and the associated rise in sea levels will make areas uninhabitable and force populations to migrate. The scale and timing of this migration and whether these people will seek asylum in the UK is unknown, but it stands to reason that higher levels of climate change are likely to be associated with greater numbers of people forced to seek refuge in the UK due to climate-related factors.

Reducing the potential number of climate-related immigrants is one long-term co-benefit of climate action, but a much shorter-term benefit is improving our energy security. Increasing the proportion of energy generated by renewable technologies, such as wind and solar (coupled with the growth in energy storage technologies) and improving the energy efficiency of domestic and commercial buildings increases the energy security of the UK by reducing our reliance on imports of oil and gas. Given the volatility of international oil prices and our reliance on oil supplies from areas of the world that have historically been politically unstable, increasing our energy security can provide a more stable foundation for members of the public and businesses to budget for their energy expenditure, while reducing our vulnerability to wider geopolitical events.

The economy and unemployment

Over the last ten years, annual growth of the UK Gross Domestic Product (GDP) has been between 1.5% and 3.1% while the green economy has consistently grown at around 5%⁷⁶. In 2016 the low-carbon and renewable energy (LCRE) sector in the UK was worth £42.6bn and accounted for 208,000 full-time equivalent jobs⁷⁷. This rises to 430,000 UK jobs when the full supply chain is taken into account⁷⁶. These values represent significant growth for this sector of the economy, and the expectation is that it will accelerate. In fact, the UK Clean Growth Strategy¹⁶ suggests that the low-carbon sector has the potential to grow 11% per year between 2015 and 2030.

The UK has already developed world-leading expertise around a number of areas of low-carbon technology. Continuing to invest in research, development and innovation in this area provides the opportunity for job creation, economic growth, increased exports and decarbonisation. The offshore wind sector in particular has been a huge success, with over 10,000 jobs created⁷⁸ – the UK currently has the highest installed capacity of offshore wind of any country in the world (6,836MW in 2017 compared to 5,355MW in Germany, the second highest country)⁷⁹. There is also an equity benefit here, as many jobs in the offshore wind industry have been created in more marginalised areas of the UK, such as the Humber and Solent. One in five of the electric vehicles driven in Europe are now made in the UK⁸⁰. The global trajectory towards low-carbon development means that the UK is well positioned to further develop expertise and take advantage of the associated economic growth and job creation.

One of the most intractable challenges for the economy highlighted by the UK Industrial Strategy⁸¹ is that of productivity – the output per hour per worker. In comparison to the rest of the G7, the UK had a nominal productivity gap in output per worker of 16.6% in 2016⁸² and this gap has been present since the financial crisis of 2008. The health co-benefits of carbon reduction could also benefit the economy by helping to address some of this productivity gap.

The Healthy Homes Barometer 2016⁸³ estimates that minor illnesses such as coughs, colds, flu and illnesses can be attributed to 27 million lost working days a year in the UK, which affect morale and productivity. The direct cost to the UK economy due to these absences was estimated at £1.8bn in 2013⁸³. Thus, the quality of housing in the UK is having a significant impact on public health, which impacts on direct NHS expenditure and has knock-on impacts on the wider economy by reducing labour productivity. A similar chain of impact exists with air pollution – it negatively impacts public health which costs the NHS money directly and reduces the productivity of people at work^{84,85} thereby having further negative impacts on the UK economy.

Productivity can also be raised by improving the efficiency of resource use by UK businesses. A 2013 study found that while many companies had increased their energy efficiency by 10-15% over the previous ten years, the most energy efficient companies had achieved over 50% reductions in the same timeframe⁸⁶. Achieving higher energy efficiency savings across the board would save businesses money, allowing them to invest in staff, technology or further efficiency savings while also reducing GHG emissions⁸⁷.

Green Alliance and the Waste and Resources Action Programme (WRAP)⁸⁸ make a strong case for moving towards a more circular economy as a way to improve the efficiency of resource use and improve productivity. WRAP define the circular economy as “an alternative to a traditional linear economy (make, use, dispose) in which we keep resources in use for as long as possible, extract the maximum value from them whilst in use, then recover and regenerate products and materials at the end of each service life”⁸⁹. If the UK follows the current trajectory of growth in the circular economy, it is expected that by 2030 there will be 204,000 jobs in the sector and overall unemployment will have reduced by 54,000⁸⁸. The reduction in unemployment is predicted to particularly benefit areas of the country where job losses from automation and globalisation are expected to be highest (e.g. the Midlands and North-East England). It is estimated that job growth in the circular economy has the potential to offset approximately seven per cent of the expected decline in skilled employment to the year 2022. While this offers the potential to facilitate an equitable transition to a low-carbon economy by offsetting some of the expected decline in skilled employment, the impact of globalisation and automation still need to be carefully managed.

From the examples given above and the statistics in the introduction, it is apparent that economic growth and carbon reduction should not be seen as incompatible with each other but rather as mutually reinforcing if managed appropriately. Decarbonisation of the UK economy can create jobs, encourage innovation, increase our international competitiveness, improve resource and economic efficiency, and increase productivity.

Poverty, housing and inequality

The experience of being unable to afford to adequately heat your own home is referred to as fuel poverty. The Hills Review (2012)⁹⁰ defines fuel poverty as affecting individuals who have below median income and who spend a high proportion of their income on energy. The energy efficiency of individual properties has a significant impact on how much it costs to heat them and the UK government Fuel Poverty Strategy⁹¹ aims to ensure that as many fuel-poor homes as reasonably practicable achieve a band C Energy Performance Certificate (EPC) by 2030 (band A is the best energy efficiency rating, band G is the worst). A particular area of focus for the government is the private-rented sector (PRS) because a disproportionate number of individuals who experience fuel poverty live in the PRS, and rented accommodation has the worst average energy efficiency rating of any housing sector⁹².

Over 320,000 fuel-poor households in England live in properties rated below a band E EPC rating (F and G ratings) and these properties cost an average of £1,000 more per year to heat⁹¹ compared to a typical home. Increasing the energy efficiency of properties can therefore save a significant amount of money for those living in fuel poverty, while also reducing GHG emissions. As a result, energy efficiency measures can help to lift people out of poverty – if those measures are funded appropriately.

Tackling fuel poverty can also have a multiplier impact on climate change action as stated by Hills: “Not only is the energy inefficiency of the homes of those living in fuel poverty a direct concern in terms of reducing carbon emissions, but fuel poverty also acts as a barrier to the implementation of other policies to mitigate climate change, since those on low incomes are least able to afford any increase in prices that may result from them”⁹⁰. In this case, a co-benefit of carbon reduction may be further pro-environmental action – or at least increasing the acceptability of climate change policies and the capacity of individuals to make pro-environmental choices in the future.

Cambridge Econometrics (an independent consultancy) and E3G (a climate change think tank) suggest that making energy efficiency a national infrastructure priority would tackle the issue of fuel poverty, create jobs across all the regions, upskill the workforce and improve productivity⁹³. They estimate that a national programme of domestic energy efficiency measures would have a cost benefit of ratio of 2.27: 1 which would classify it as a ‘high’ value-for-money infrastructure programme. As energy efficiency improvements disproportionately benefit those on lower incomes it would be a socially progressive policy that would put money back in the pocket of those who can least afford to heat their homes. The employment benefits are estimated to be a gain of up to 108,000 jobs per annum over the period 2020-2030, focused in the service and construction sectors and spread across the whole of the country. As well as addressing energy efficiency, this proposal offers the potential to up-skill significant numbers of workers with transferable skills that are useful to the low-carbon economy more generally.

As mentioned above, it is essential that the cost of energy efficiency measures does not fall disproportionately on those with lower incomes. Energy efficiency schemes aimed at benefitting those on lower incomes (such as the Energy Company Obligation (ECO)) are currently funded via levies applied to household energy bills. It has been argued⁹⁴ that the current approach for funding energy efficiency is highly regressive for two reasons. Firstly, energy bills make up a higher proportion of disposable income for the poorest households (10% of disposable income) compared to the richest households (3% of disposable income)⁹⁴. Secondly, applying the levy at the household level ignores the energy costs embedded in the supply chain of goods and services. If the full supply chain energy embodied in all goods and services is considered, the lifestyles of the richest require nearly four times more energy than the poorest (because the richest consume more), but the richest only pay 1.8 times more towards the energy policy costs because the levies are raised at the household level⁹⁴. Raising money for energy efficiency via general taxation has been suggested to be a fairer way to pay for the measures⁹⁴.

In response to a national UK survey, 40% of low-income respondents stated that they faced the choice between ‘heating or eating’⁹⁵ while nearly a fifth of all parents responding said that they regularly go without food to ensure that their children have enough to eat⁹⁶. Energy consumption and expenditure can have significant knock-on impacts on nutrition and household relationships. Improving the energy efficiency of housing in the UK is also essential in helping to improve equality of opportunities for those from lower-income groups. Poor quality housing negatively affects the ability of young people to learn at school and study at home – leading to lower educational attainment⁹⁷, which in turn increases their chance of unemployment and poverty and reduces their opportunities for social mobility. A household energy efficiency intervention programme in New Zealand led to children experiencing on average 21% fewer days of absence from school over the winter months⁹⁸, as well as fewer visits to the GP⁹⁹ – the non-climate benefits of energy efficiency are clear.

From an asset management perspective, insufficient heating of domestic properties also poses a significant problem as it increases the incidence of damp and mould, which increases the frequency and cost of repairs¹⁰⁰. These costs inevitably get passed on to the tenant, thereby perpetuating the problem of the unaffordability of housing and energy for the poorest members of society. A component of the social inequality manifest in UK housing can therefore be addressed via energy efficiency improvements while providing co-benefits to carbon mitigation, food security, poverty alleviation, educational attainment and social mobility. Figure 2a provides an illustration of how the experience of living in poverty interacts with housing, health, education, work and the wider economy. Figure 2b then illustrates how a climate-related policy, in this case improving the energy efficiency of UK housing stock, can help to break some of this pernicious cycle.

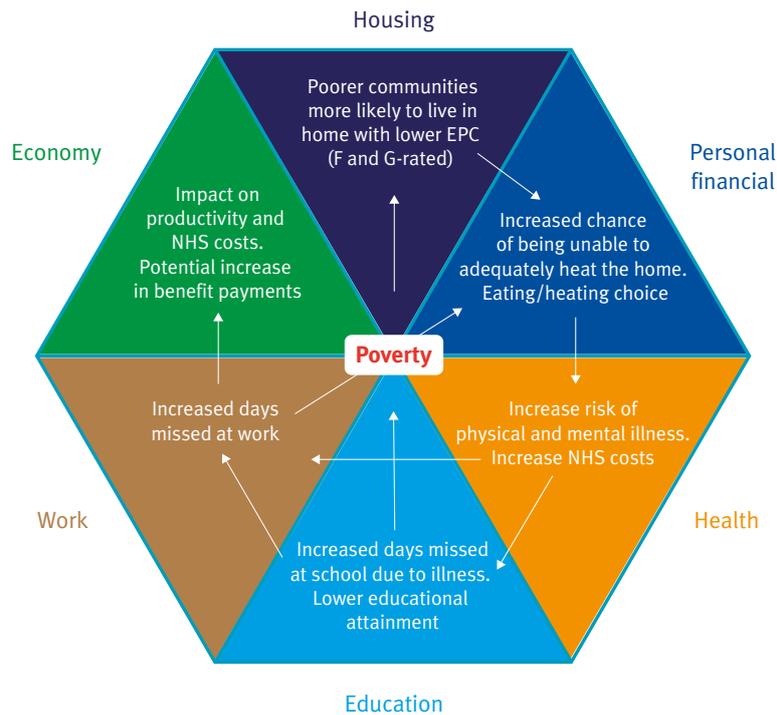


Figure 2a: How the experience of living in poverty interacts with housing, health, education, work and the wider economy

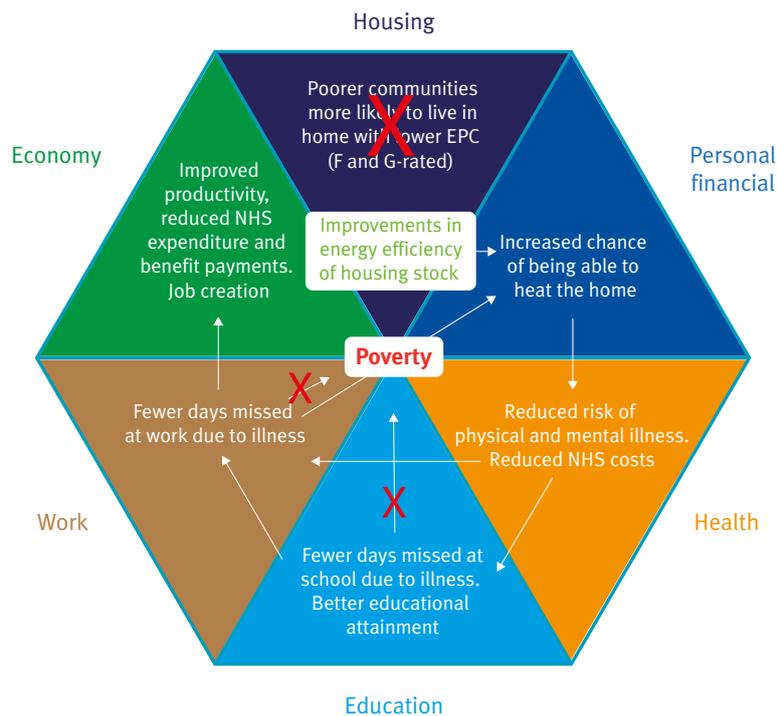


Figure 2b: How a climate change-related intervention (improving energy efficiency of the housing stock) can help to break some of the pernicious cycle of poverty outlined in figure 2a

Inequality and transport

There is a significant link between transport, air pollution and inequality¹⁰¹. Air pollution levels in the UK have been shown to have strong associations with deprivation (deprived neighbourhoods tend to have higher air pollution levels) and ethnic composition of neighbourhoods (neighbourhoods with a larger proportion of non-white residents tend to have higher

air pollution levels), particularly in urban areas¹⁰². In an analogy to the impact of climate change at the international level, those most affected by air pollution in the UK (deprived communities) are often those least responsible for producing it – it is vehicles passing through their neighbourhoods that are primarily responsible for causing the pollution rather than travel by those living within the area, as low-income communities are more likely to use public transport than private vehicles¹⁰³. The link

between air pollution from transport and child cognition³⁷ means that the educational outcomes of children from more deprived areas may be curtailed – potentially perpetuating the cycle of deprivation. Decarbonising the transport sector can therefore provide health benefits that save the NHS money, while also addressing health and educational inequalities.

Inequality in the impacts of the transport sector is particularly acute in air and noise pollution from air travel – 70% of all international flights by UK residents are taken by just 15% of the population¹⁰⁴. Air pollution levels at a number of monitoring stations around Heathrow consistently breach EU limits for nitrogen dioxide emissions (NO₂) – this is a combination of airline activities (aircraft, ground support equipment), road traffic and urban emissions¹⁰⁵. The decision to build a third runway at Heathrow includes recognition of the need to reduce local air and noise pollution to safe levels¹⁰⁶. This is essential to ensure that those benefitting from air travel (those likely to have a higher income) don't negatively affect the health of those living in proximity of the airport (who are more likely to come from lower income and ethnic minority groups¹⁰⁷).

Discussion

The evidence above illustrates that there are considerable co-benefits of climate change mitigation for the UK – from improving public health and reducing NHS expenditure to increasing productivity, stimulating economic growth, creating jobs, improving security, and reducing poverty and inequality. The statistics on excess winter deaths due to cold homes (circa 10,000/year) and premature deaths from air pollution (circa 40,000/year) suggest that the current system is failing to adequately address issues that cut-across multiple departmental remits. A key question then is how can co-benefits be better considered in the policy and decision-making process, and at what scale?

Considering the co-benefits of climate action across multiple government departments

Figure 3 shows how considering the co-benefits of a policy to multiple departments creates a much stronger case for action than considering the benefit to one department in isolation. It illustrates how a policy can simultaneously touch on the remit of a variety of departments – providing combined benefits that would make justifying that policy significantly easier.

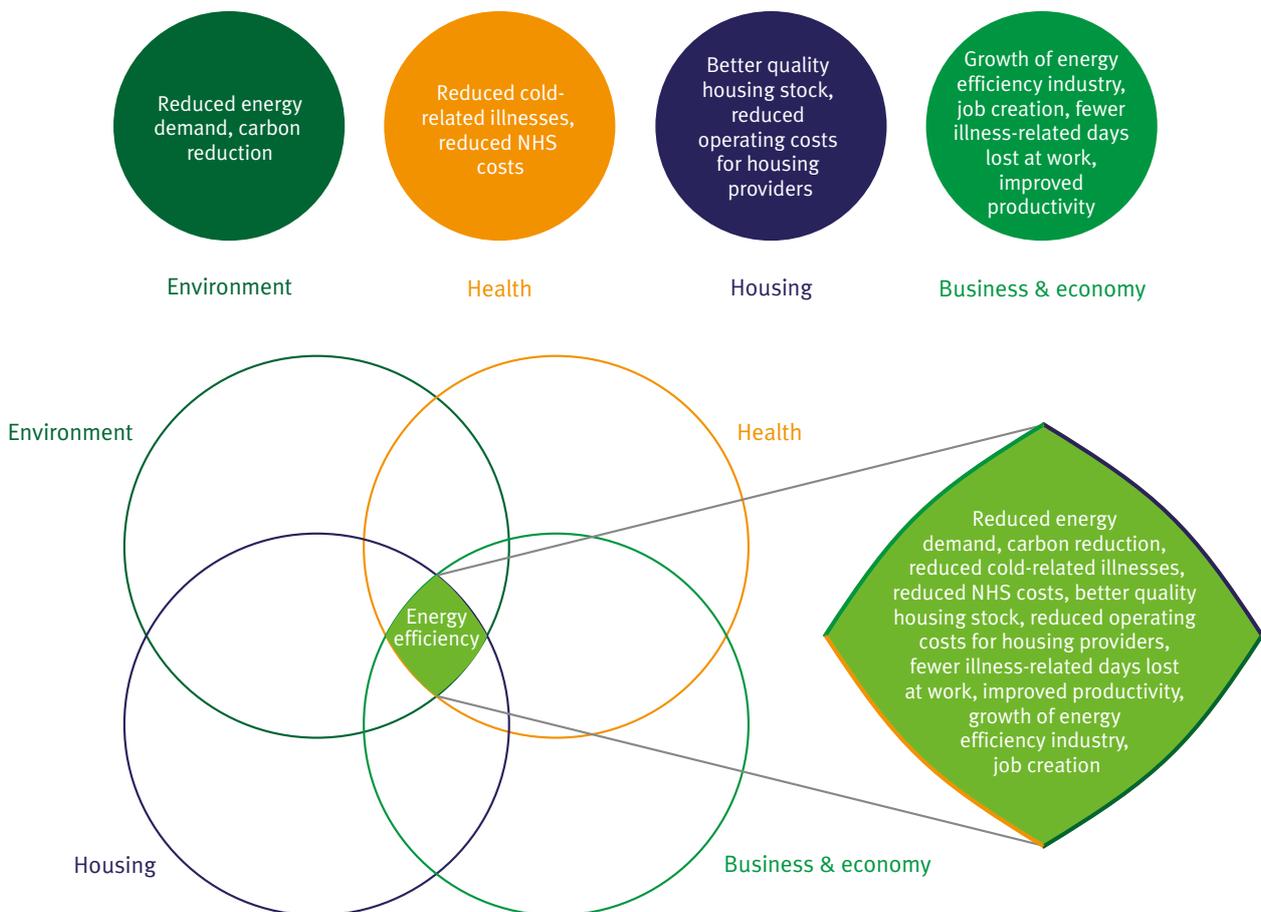


Figure 3: Benefits of improving the energy efficiency of the housing sector to different departments (top) and how considering the benefits of a policy (improved energy efficiency in the housing sector) from a cross-departmental perspective can strengthen the case for policy action (bottom).

Figure 4 provides an illustration of how incorporating co-benefits into the decision-making process can help to achieve greater reductions in GHG emissions. The baseline scenario shown on the left involves a housing department contributing £10m for a project that aims to deliver X tonnes of carbon dioxide savings via an energy efficiency scheme. In this case the sole concern is to deliver carbon reductions. The co-benefits scenario #1 shows that by considering how other benefits (in this case health) can be achieved alongside carbon reduction, the focus of the housing project could be revised (e.g. to focus on reaching those in fuel poverty) in such a way as to encourage another department (health) to contribute £2m to the costs of the project due to the benefits and savings it will offer them. This would leave the housing department with £2m to spend on other housing-related projects that may achieve additional carbon reduction. The co-benefits scenario #2 shows how the housing department could pay the same amount (£10m) but with the addition of £2m from the health department, the overall scope of the project and the associated carbon reduction would be larger (X*1.2). In such an example, economies of scale would likely mean that the total carbon saving would in fact be greater than X*1.2.

City-scale action

We suggest that it is at the regional and city level that the co-benefits of climate action can be best incorporated into the decision-making process in the short-term. It is at this scale that co-benefits are most clearly manifest, and where interventions can have the most immediate impact (e.g. in identifying and addressing the impacts of poor-quality housing on poverty, health and educational attainment). It is worth noting that many of the co-benefits outlined above do not just achieve immediate benefits, but have long-term advantages – for example, improving the energy efficiency of the housing stock or reducing air pollution from transport would likely reduce NHS expenditure year-after-year.

The appointment of six Metro Mayors in May 2017 (covering Cambridgeshire and Peterborough, Greater Manchester, Liverpool City Region, Tees Valley, West Midlands and the West of England) and the devolution of more powers to the regional/city level is very relevant to how co-benefits can be incorporated into the decision-making process. The Metro Mayors have a range of budgets and responsibilities. They all have control over devolved transport funding and skills funding with some going further still. The Mayor of Greater Manchester, for example, currently oversees a £6bn health and social care budget, and many of the mayors have strategic planning powers.

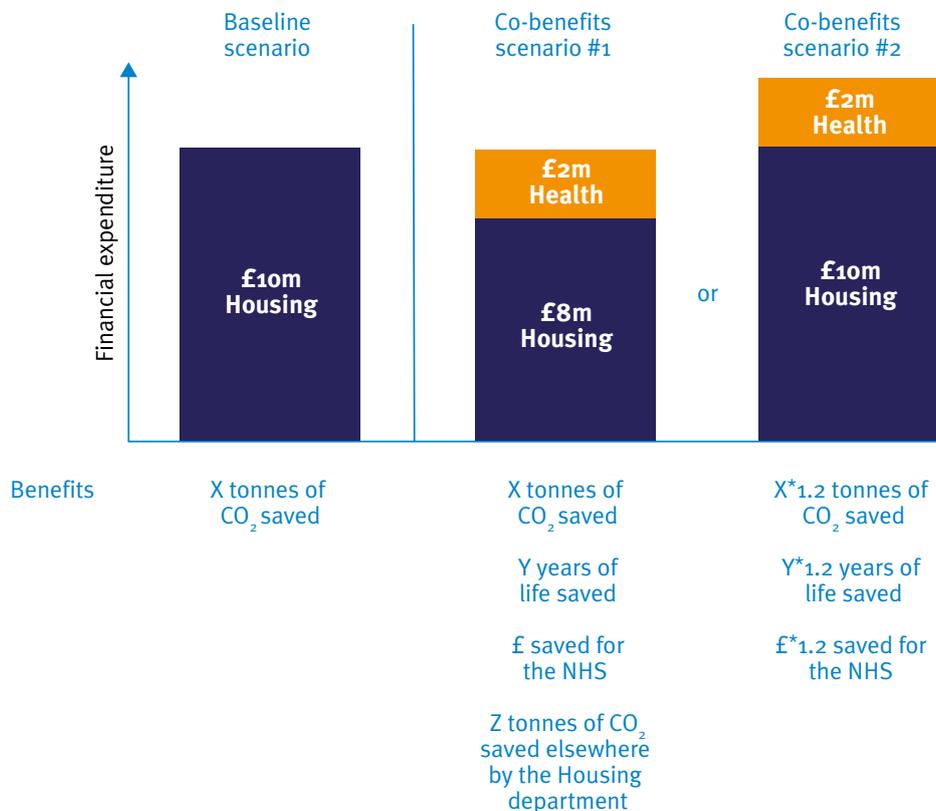


Figure 4: An example of how considering the co-benefits of climate mitigation can lead to deeper cuts in GHG emissions

The devolution of such power allows mayors to take a long-term view over a number of policy areas and budgets, and to harness the financial reward and benefit to citizens of adequately considering co-benefits - as a housing intervention targeting the energy efficiency of residential buildings results in a reduction in health and social care expenditure, for example.

It is also relevant that many UK cities and regions have set ambitious carbon reduction targets – Greater Manchester have set a target to be carbon neutral by 2038, while Bristol are aiming to achieve this by 2030, and Nottingham by 2028. To maximise the chance of meeting those targets, considering the co-benefits of climate mitigation is advisable. It will help make limited budgets go further by identifying policies that provide benefits to multiple objectives simultaneously. Such objectives may often be held across multiple departments so a co-benefits approach explicitly encourages cross-departmental collaboration.

National level action

While we see the regional and city level government as being most capable of taking advantage of the co-benefits of climate action in the short-term, there are potential changes at the national level that could facilitate action in the medium-term. For example, the forthcoming government spending review provides an opportunity to introduce new approaches that encourage cross-departmental collaboration. One approach could be the establishment of a **'co-benefits fund'**, administered by the Cabinet Office, that departments bid into for cross-departmental collaborations.

Another approach could be the establishment of an **'Office for Public Health and the Environment'** (OPHE), co-funded by the Department for Health and Social Care and the Department for Business, Energy and Industrial Strategy. Such an office could help to develop, identify and scale-up projects across the UK that improve public health while simultaneously reducing GHG emissions and improving environmental conditions such as air quality. The cross-departmental approach suggested here is similar to that used by the Office of Low Emission Vehicles (OLEV) that is co-funded by the Department of Transport and the Department for Business, Energy and Industrial Strategy.

The UK government's commitment to deliver the Sustainable Development Goals could also provide a suitable focus for developing a co-benefits approach to climate action. In November 2017, leaders from the Christian, Jewish, Sikh, Hindu, Muslim, and Buddhist faiths called on the UK Prime Minister to appoint a dedicated **Minister for the SDGs** in order to address poverty, inequality, and environmental issues across the country. The appointment of such a minister could increase the chance of climate action co-benefits being adequately considered in the decision-making process – particularly if coupled with a **SDG Fund** that acts in the same way as the co-benefits fund described above.

There is also an important role for central government to play in helping to facilitate the dissemination of good practice between cities and regions, so that successful collaborative approaches to incorporate co-benefits in decision-making can be scaled up as quickly as possible.

Decision-support tools

To support decision-making that considers co-benefits, it is essential that tools are available to quantify the benefits. Public Health England published such a tool¹⁰⁸ in May 2018. It enables local authorities to quantify the financial benefits of improving local air pollution (specifically in reducing levels of nitrogen dioxide and particulate matter) to the health and social care sector. The tool allows local authorities to test 'what if' scenarios for the reduction of air pollution to estimate the health cost savings of low-carbon transport projects, for example. Similar tools for other co-benefits would aid the incorporation of co-benefit considerations in the decision-making process – e.g. a tool to quantify the estimated health and social care savings of energy-efficiency improvements.

Conclusions

The evidence presented in this paper illustrates that there is a myriad of reasons why reducing GHG emissions in the UK is good for society, the economy and the environment. Within the policymaking community, it is essential that the co-benefits of potential policies are adequately considered. The differentiation of expertise and areas of focus between departments poses a potential barrier to decisions being made that benefit various departments simultaneously. This paper illustrates that, despite potential organisational barriers, the benefits of adequately considering co-benefits in the decision-making process can be significant. We suggest that, in the short-term, city- and regional-level governments are best-placed to incorporate co-benefits into the decision-making process, and that central government can have a key role to play in the medium-term and in disseminating examples of best-practice between cities and regions.

Widening the rationale for climate action may help to gain more traction in terms of political and public support for carbon reduction by tapping into non-environmental priorities that resonate with public concern. This is particularly relevant given Ipsos MORI data showing that the environment/pollution ranks relatively low on the list of concerns among the UK public. Widening the evidence base of the benefits of climate action may ultimately help bring about faster, deeper cuts in GHG emissions and reduce the UK's impact on climate change.

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Acknowledgements

The authors would like to thank Dr Ajay Gambhir, Dr Alex Koberle and Alyssa Gilbert (Grantham Institute – Climate Change and the Environment), Jane Burston (Clean Air Fund), Alex White (Aldersgate Group), Dustin Benton (Green Alliance), Rob Gould (Office of Low Emission Vehicles), Dr Maria Carvalho (LSE), David Demeritt (KCL), Ed Mathew (E3G), Edward Hadley (Treasury), Tom Wells (Go-Science), Ben Taylor (Go-Science), Mark Sinclair (University of Sheffield) and the Ashden Awards team (Faye Scott, Simon Brammer, Cara Jenkinson) for their detailed and helpful comments in the development of this paper.

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