Public Health England

Protecting and improving the nation's health

Review of interventions to improve outdoor air quality and public health:

Principal interventions for local authorities

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Public Health England exists to protect and improve the nation's health and wellbeing, and reduce health inequalities. We do this through world-leading science, research, knowledge and intelligence, advocacy, partnerships and the delivery of specialist public health services. We are an executive agency of the Department of Health and Social Care, and a distinct delivery organisation with operational autonomy. We provide government, local government, the NHS, Parliament, industry and the public with evidence-based professional, scientific and delivery expertise and support.

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Introduction

Public Health England published Review of interventions to improve outdoor air quality and public health in March 2019. The review provides local practitioners and policy-makers with an indication of the broad range of available interventions across 5 focal areas: vehicles and fuels, spatial planning, industry, agriculture, and people's behaviour. It outlines principles for strategies and the future design and evaluation of interventions.

There is some strong evidence that interventions in each of the 5 areas (vehicles and fuels, spatial planning, industry, agriculture, and people's behaviour) can reduce emissions of harmful pollutants. Few studies directly examine the effects of these interventions on environmental concentrations or the resulting health outcomes. The health benefits of interventions must therefore be inferred from the reductions in emissions. This is a reasonable assumption, given the strength of evidence supporting the links between individual pollutants and their health impacts.

In each of the 5 areas, targeted evidence reviews were performed as part of the rapid evidence assessments. These are described in Annexes A2 to A6 of the review document.

This document is a supplement to the review. It is based on the findings of the review and summarises the general approach recommended for applying air quality interventions and the principal interventions that are available to practitioners and policy-makers when taking action on air quality.

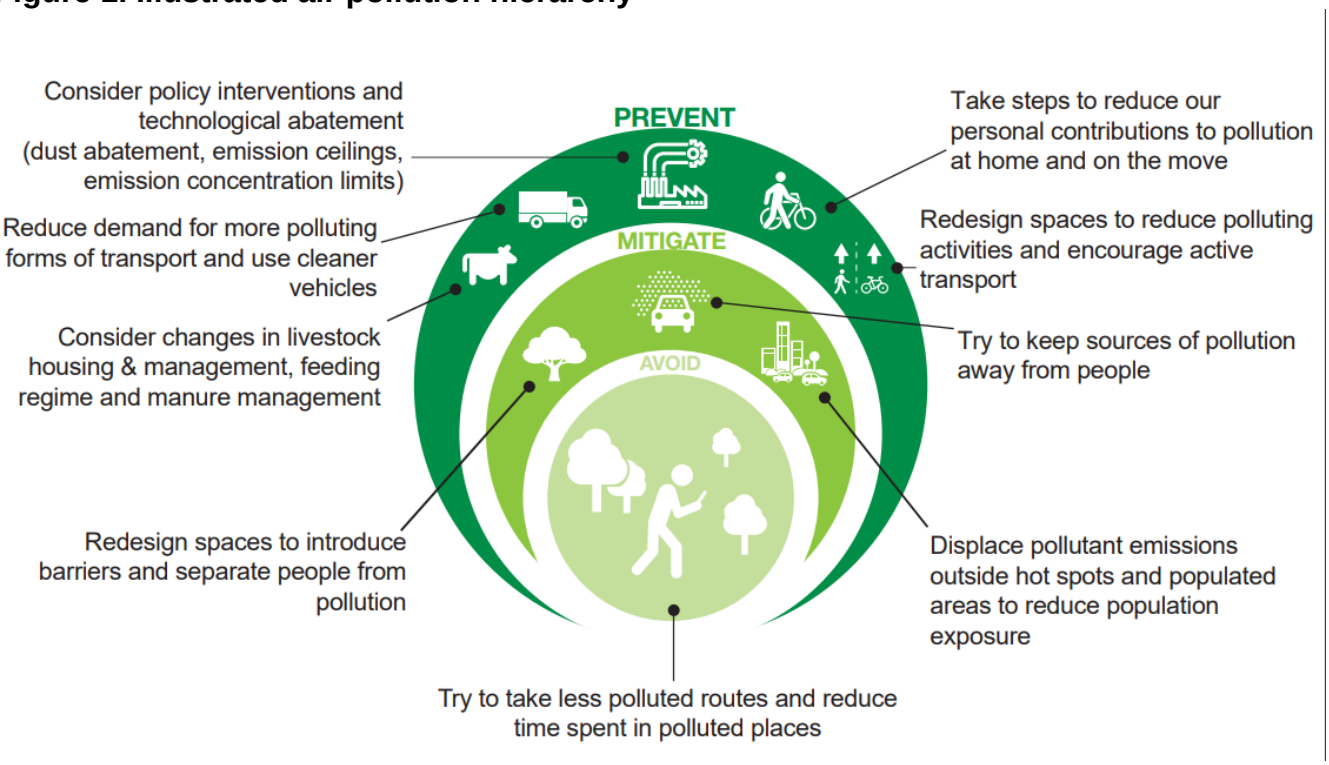
Further guidance on choosing and implementing interventions is addressed in the supplementary document Review of interventions to improve outdoor air quality and public health: A guide to using the review to help choose or plan interventions.

General approach

1. Hierarchy approach:

It is recommended that measures aimed at preventing or reducing pollution (emission reduction) activities are prioritised over those that reduce air pollution once it has occurred (concentration reduction) or rely on avoiding existing pollution (exposure reduction) (see Figure 1).

Figure 1. Illustrated air pollution hierarchy



2. Adoption of a ‘net health gain’ principle in any new policy or work programme which affects air pollution.

If this is adopted, then any new development or proposal for change to existing developments will intend to deliver an overall benefit to people’s public health. In effect this means that any new development should be clean by design. For example, housing and other community developments that are currently underway would be well designed to reduce pollution, support walking, cycling and clean public transport, as well as providing charging points for future ultra-low emission vehicles.

3. Systematically evaluating all interventions.

Evaluation should be embedded in the design and costing of all future interventions, from their outset, to systematically gather evidence to inform best practice in the future.

Vehicle/fuel interventions

(see page 50 of the original review[1])

The main findings are summarised below.

Air quality within urban areas is likely to be improved by any intervention that promotes the uptake of low and zero-exhaust emission vehicles, particularly electric vehicles. There is a lack of evidence of the generation and health impact of non-exhaust particulate matter (PM) emissions, which remain a potential issue.

The effectiveness of Low Emission Zones (LEZ) can be improved if combined with the newer emission standards of road vehicles (Euro 6).

Traffic management interventions, such as road pricing and access restrictions, have the potential to improve air quality and encourage the public to consider travel behaviour change and active travel options.

Active travel interventions on a limited scale do not generally improve air quality significantly, but the added physical exercise benefit makes them very effective for improving public health outcomes.

In general, road transport interventions need to be combined to achieve a greater impact, as most existing measures on their own may only generate a small reduction in road vehicle emissions.

In the aviation sector, effective actions identified include the electrification of Ground Support Equipment, reduction in Auxiliary Power Units, pushback control, take-off thrust reduction and alternative aviation jet fuels.

In the maritime sector, few evaluated interventions were identified but regulation of the sulphur content in marine fuels can lead to sulphur dioxide emission reduction, and fuel-based interventions have the potential to reduce other pollutants.

In the rail sector, the introduction of bi-mode trains (that is, diesel/electric hybrid) and the electrification of the fleet would be effective measures at reducing emissions, but cost and operational limitations are potential barriers to electrification of the rail network.

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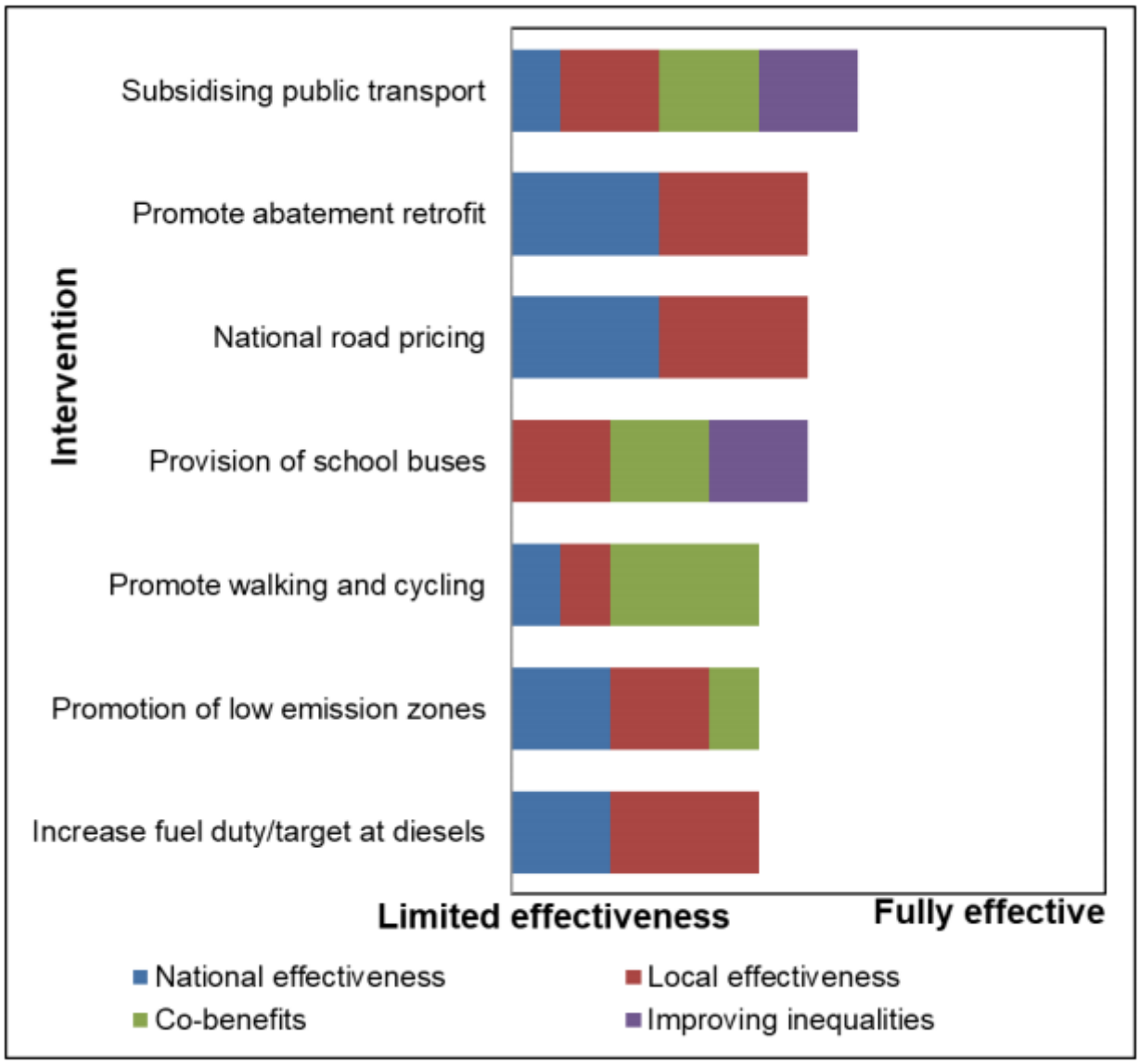
[1] *Review of interventions to improve outdoor air quality and public health*

Promising transport interventions (page 184)

The evidence suggests that the greatest impact on reducing emissions from road transport and improvement in public health outcomes is from the co-implementation of a package of policy measures (transport and non-transport related interventions) designed according to the local area's requirements. For example, a low emission zone can be co-implemented with appropriate retrofit or scrappage schemes (though noting cost and potential misuse of the schemes as potential barriers) to meet vehicle emission compliance, as well as with actions investing in and promoting active travel and public transport. The interventions within the transport domain, assessed to have a higher potential to deliver overall health benefits, are presented in Figure 2.

Figure 2. Selected transport interventions' evaluated public health impact
(The method use for evaluating interventions is detailed in annex A8 of the review document).



Planning/structural design interventions

(page 71)

The main findings are summarised below.

The interventions with the highest potential to be effective both at national but mainly at local level are related to traffic. Driving restrictions produced the largest and most consistent reductions in air pollution levels.

For all the interventions assessed, the effectiveness strength was low, and the uncertainty range was high, with only 1 exception: driving restrictions. However, the paucity of evidence of effectiveness should not be confused with or assumed to be evidence of ineffectiveness.

Measures, such as LEZ and road pricing, produced reductions in traffic, but not necessarily great improvements in air quality, perhaps due to localisation of emissions, for example by displacement. LEZ are potentially effective at reducing air pollutant levels (more effective for particulate matter, PM10 than for nitrogen dioxide, NO2) in cities[2]. They are expected to work better for NO2, if combined with interventions that incentivise the use of Euro 6 standards for both heavy and light duty vehicles.

Potential to improve air quality and public health outcomes is associated with the co-implementation of a mix of various measures that provide/improve green and active travel infrastructure, prioritise road safety, provide public transport and discourage travel in private cars, together with policies focussing on reducing the emissions of vehicles.

Green infrastructure is potentially effective not only to improve air quality related public health outcomes, but also to improve health inequalities in urban areas and promote health and well-being. Green infrastructure has also the potential to impact positively on urban heat islands and reduce the negative impacts of flooding.

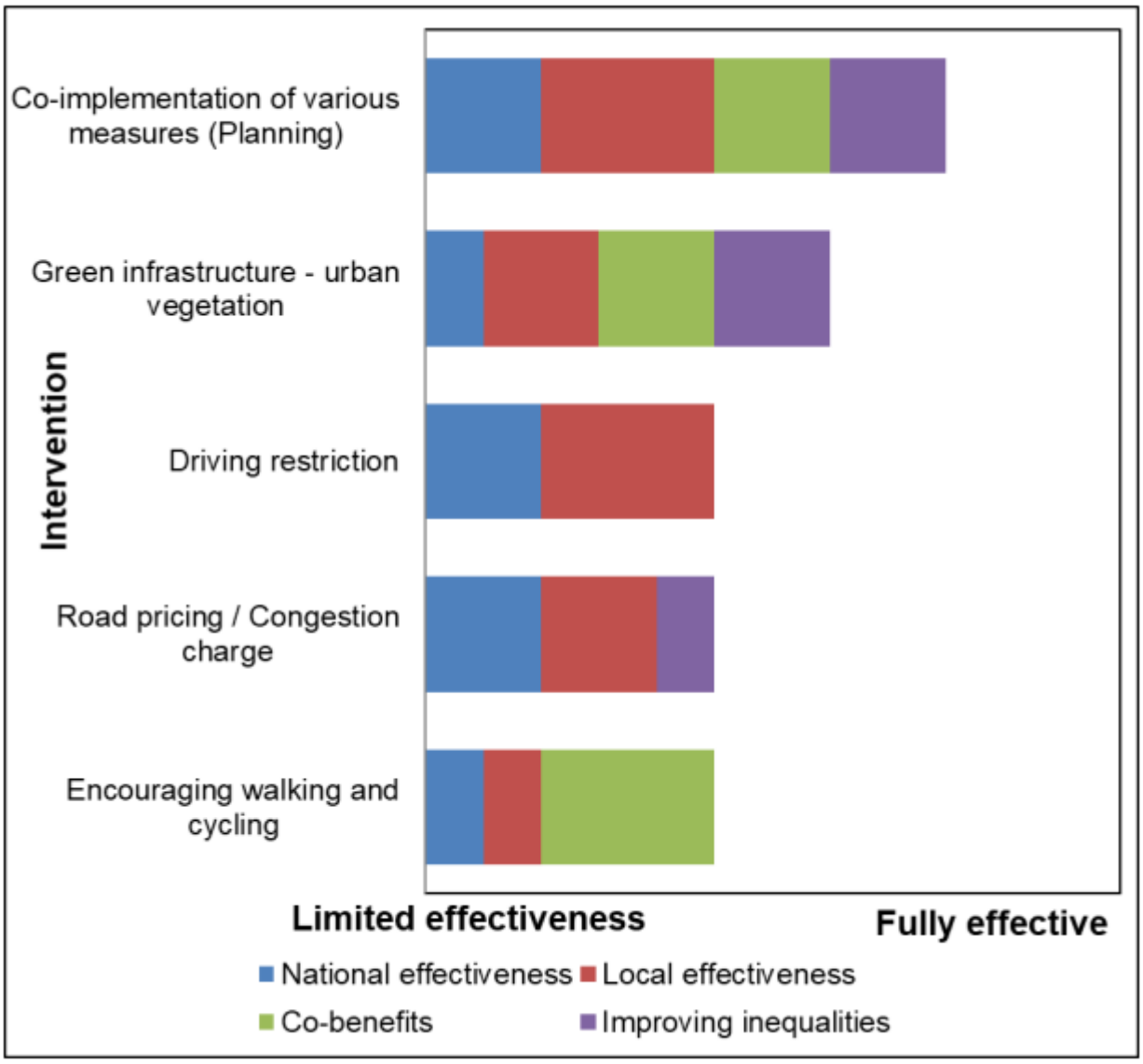
For speed limitations (traffic calming measures) and encouraging active transport, the public health ‘co-benefits’ are larger than benefits associated with reduction of exposure to air pollution alone, as speed limitations are associated with a reduced risk of pedestrian injury and traffic collisions, and increased physical activity is associated with multiple public health benefits (improved cardiovascular outcomes and improved weight status among children, adults and older adults).

[2] Ferreira F, Gomes P, Tente H, Carvalho AC, Pereira P, Monjardino J. Air quality improvements following implementation of Lisbon's Low Emission Zone. Atmos Environ. 2015;122:373-81.

Promising planning interventions (page 190)

The planning interventions determined to be the most effective in terms of their impact on health locally and nationally were complementary to the transport domain interventions above (for example, co-implementation of various measures, driving restrictions and road pricing/congestion charges). Co-benefits associated with greening infrastructure include social, environmental, ecological and hydrological aspects. They include mitigation of the urban heat island effect, carbon sequestration, and enhancement of mental health, well-being, social cohesion and possibly encouragement of physical activity. The interventions within the planning domain, assessed to have a higher potential to deliver overall health benefits, are presented in Figure 3.

Figure 3. Selected planning interventions' evaluated public health impact
(The method use for evaluating interventions is detailed in annex A8 of the review document).



Industrial interventions

(page 86)

The main findings are summarised below.

There is a clear distinction between policy-level interventions that set overarching targets and have the potential to widely reduce industrial air pollutants, and technological interventions implemented at the individual installation level (to meet policy-level intervention targets) that have potential benefits for local air quality and national air quality if implemented at scale.

The evidence mainly related to evaluations of interventions' effects on emissions (sources), from which consequent benefits to air quality and health are inferred. Few interventions directly evaluated effects on environmental concentrations, and fewer still directly evaluated health outcomes. Therefore, more evidence is needed to identify the links between specific interventions, air quality and improved health outcomes.

For some aspects of interventions, little or no evidence was found. For example, there was little evidence of industrial interventions' effects on health inequalities or of co-benefits.

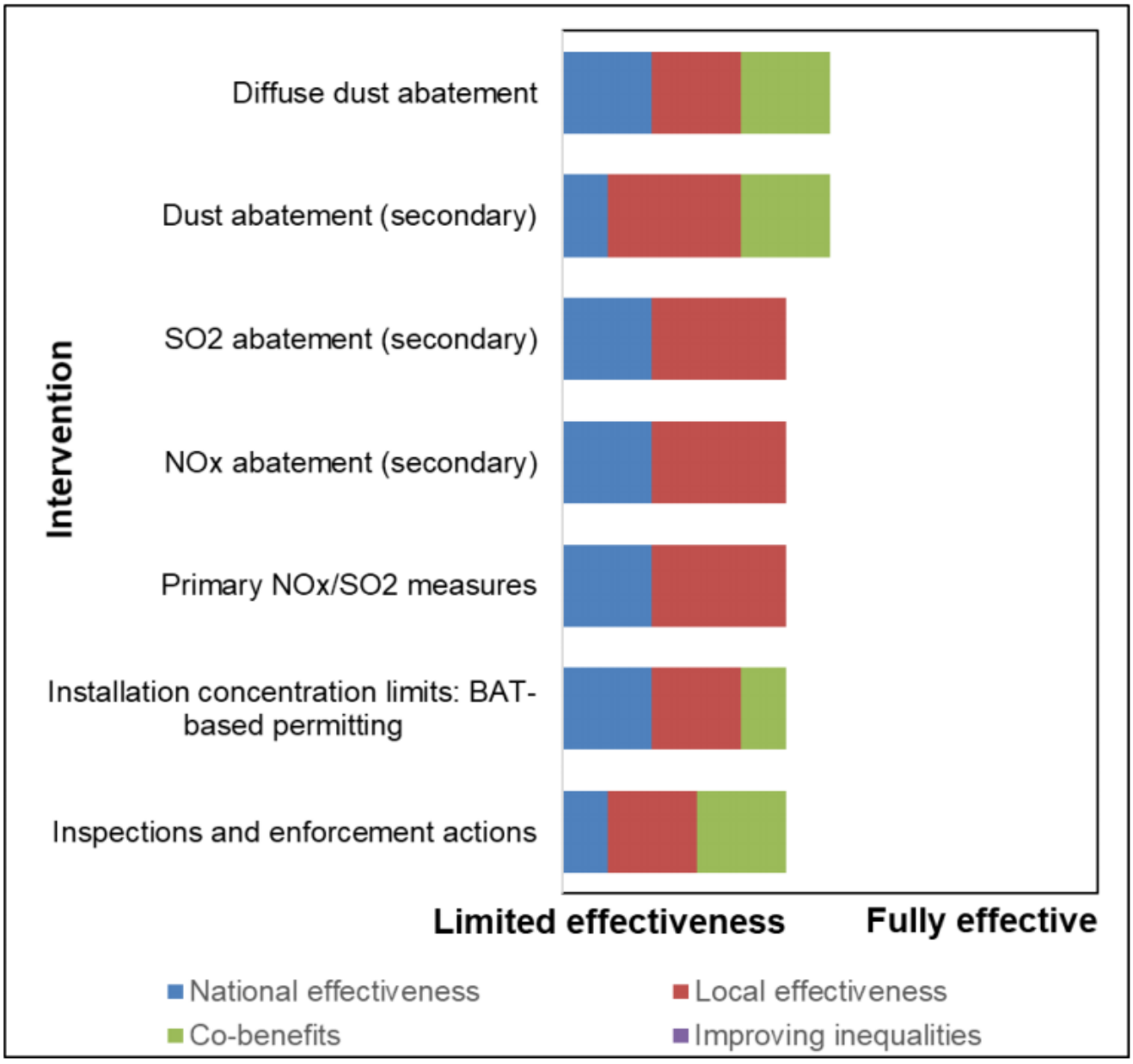
For technological interventions, each had a range of potential cost: benefit ratios, which could be estimated using Defra's established damage costs methodology.

For policy interventions to be effective, appropriate proven technological interventions need to be available for implementation.

Promising industrial and regulatory interventions (page 196)

A shift in emphasis from compliance with nationally set limit values is required. The benefits to public health of improved air quality occur even when ambient air pollutants are reduced below air quality standards. Approaches that account for changes in population-level exposure rather than changes in emissions is desirable. This would embed the principle that efforts to reduce exposure by smaller amounts may be justified if larger numbers of people are benefited. The interventions within the industrial domain, assessed to have a higher potential to deliver overall health benefits, are presented in Figure 4.

Figure 4. Selected industrial and regulatory interventions' evaluated public health impact (NOx: nitrogen oxides (nitric oxide, NO and nitrogen dioxide, NO2). BAT: Best Available Techniques). (The method use for evaluating interventions is detailed in annex A8 of the review document).



Agricultural interventions

(page 101)

The main findings are summarised below.

Several promising opportunities for reducing ammonia (NH3) emissions at farm-level were identified:

- urease inhibitors and slow-release nitrogen (N) fertilisers
- slurry acidification
- low NH3 emission storage and spreading
- air filtration systems
- low protein feeding

The impact of such interventions, however, will depend on the extent of uptake on farms as current mitigation strategies rely on voluntary uptake. Understanding the current level of uptake of mitigation measures will be necessary for monitoring progress in reducing emissions against emission targets.

It was not possible to evaluate the interventions' potential impact at a national scale. This was primarily because limited information was available on the existing uptake of these measures.

A combination of regulations, incentives, and awareness-raising measures will be needed to overcome the barriers to widespread adoption.

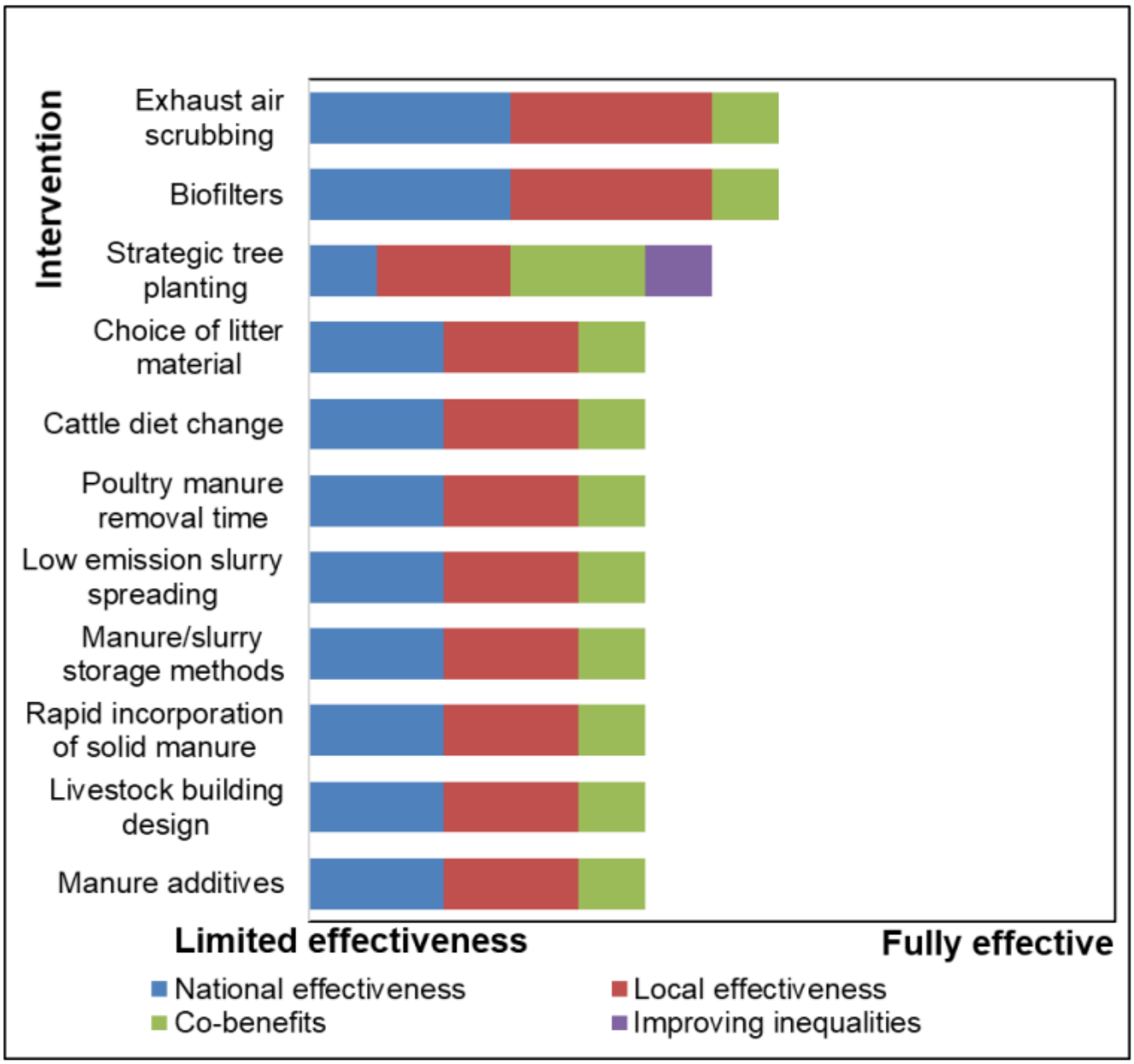
No studies evaluated the health and cost impacts related to these interventions. We are therefore unable to advise on which intervention has the highest health and economic impact – this is an area requiring further work.

To maximise co-benefits and minimise negative trade-offs, it will be important to align agricultural interventions with other sector strategies and policies.

Promising agricultural interventions (page 202)

In terms of the implementation of a combination of interventions, bio-filters and exhaust air scrubbers scored the greatest in terms of effectiveness (locally and at wider spatial scales). If combined with livestock building design and strategic tree-planting, these interventions were thought to have high potential to benefit air quality and public health outcomes. The interventions within the agriculture domain, assessed to have a higher potential to deliver overall health benefits, are presented in Figure 5.

Figure 5. Selected agricultural interventions' evaluated public health impact
(The method use for evaluating interventions is detailed in annex A8 of the review document).



Behavioural interventions

(page 116)

The main findings are summarised below.

Behavioural interventions comprised educational or awareness-raising initiatives. Other approaches highlighted in the studies included incentivisation and training.

The highest potential to improve air quality and public health outcomes is associated with combining behavioural interventions with other policy or infrastructure-based interventions (for example, improving public transport or cycling infrastructure and then using behavioural interventions to maximise its use). In this way, behavioural interventions can be used in parallel with other interventions and maximise their potential effectiveness.

For all the behavioural interventions identified, the effectiveness to reduce emissions of air pollution was low and the uncertainty range was high, except for 2 interventions (eco-driving training and large-scale national events, for which the rapid evidence assessment considered of medium effectiveness and uncertainty). However, the paucity of evidence of the behavioural interventions' effectiveness should not be taken as evidence of ineffectiveness.

Little evidence was identified of behavioural interventions that promote alternative methods of transport as having a direct impact on air pollution or health outcomes. However, they should not be discounted, as there is a wealth of evidence showing that removing vehicles from the road can reduce emissions. There is also strong evidence for the health benefits of physical activity associated with active travel, such as walking and cycling.

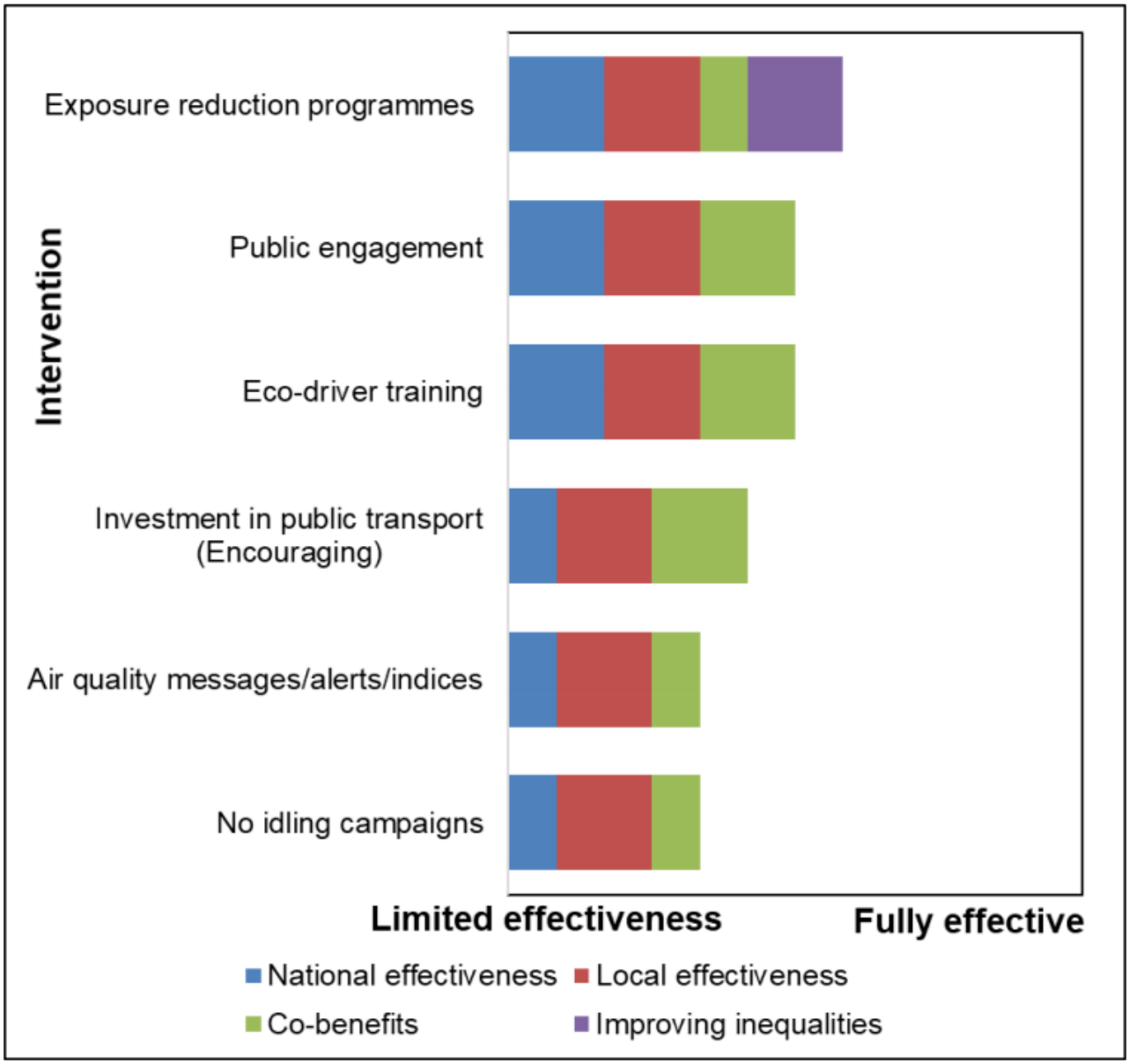
Raising awareness in itself is not enough to effect change: it must be done in conjunction with other behavioural and non-behavioural interventions.

Promising behavioural interventions (page 206)

Exposure-reduction programmes scored highly in terms of strong potential benefits to vulnerable groups, especially in providing advice on how to reduce personal exposures to air pollutants. These interventions included educational programmes to inform the most vulnerable, with wider potential to help people make better choices about their lives. Such programmes can be targeted to specific groups, with local tailoring of national advice. A lack of stakeholder engagement was identified as a key barrier to their feasibility – there is a need to improve public awareness of air quality and public

health and strengthen the role and awareness of health care professionals for this to be successful. The interventions within the behavioural domain, assessed to have a higher potential to deliver overall health benefits are presented in Figure 6.

Figure 6. Selected behavioural interventions' evaluated public health impact
(The method use for evaluating interventions is detailed in annex A8 of the review document).



Where can those in the public sector find out more about PHE work related to air quality and health?

To find out more about PHE's work to develop health evidence and support our stakeholders' actions to improve air quality and health, readers registered on Knowledge Hub can subscribe to PHE's Air Quality and Public Health Group, which signposts information and provides a platform to share expertise.