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CWIS Active Travel Investment Models:
Model structure and evidence base

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Contents

Appendices

The following technical appendices are available as separate documents:

A1	Defining local authority baseline data for the models
A2	Defining the counterfactuals
A3	Potential effect of housing development and land use on the counterfactual
A4	Overview of evidence on increasing active travel
A5	Compendium of interventions
A6	Intervention summary tables
A7	Factors affecting walking and cycling levels, and model scaling factors
A8	Package details: quantities of interventions in each package, cumulative stages per unit of expenditure, and package costs

1. Overview and structure of the CWIS Investment Models

1.1 Overview

This paper summarises the structure and underlying evidence and assumptions of three Active Travel Investment Models, for cycling, walking and walking to school, which have been created by Transport for Quality of Life and the Arup Aecom consortium for the Department for Transport. The paper is accompanied by eight technical appendices which provide more detail.

The CWIS Active Travel Investment Models enable an estimation to be made of the impact on the level of cycling, walking and walking to school of different types of policy intervention and different levels of capital and revenue investment, over the period between 2020 and 2040.

The purpose of the models is to help assess options and costs of meeting the CWIS cycling and walking to school targets, and potentially to set a more ambitious walking target. The original targets, as set out in the Cycling and Walking Investment Strategy (2017)[1], are:

- To increase cycling from 0.8 billion journey stages in 2013 to 1.6 billion stages in 2025
- To increase walking to 300 journey stages per person per year in 2025[2]
- To increase the percentage of children aged 5-10 that usually walk to school, from 49% in 2014 to 55% in 2025.

The input assumptions to the model draw on a comprehensive assessment of the existing evidence base, including evidence from past active / sustainable travel programmes such as Sustainable Travel Towns, Cycling Demonstration Towns, Local Sustainable Transport Fund, and Cycle City Ambition; a review of the academic literature; and a review of grey literature including evaluations of active travel interventions delivered by NGOs and transport consultancies.

The Investment Models include background changes in cycling and walking as a result of committed investment and policy interventions at local and national level. They also make allowance for the fact that different levels of investment may be required in different types of areas to achieve the same result.

They enable policy-makers to explore the impact of a wide range of different scenarios in terms of how and where investment is focussed.

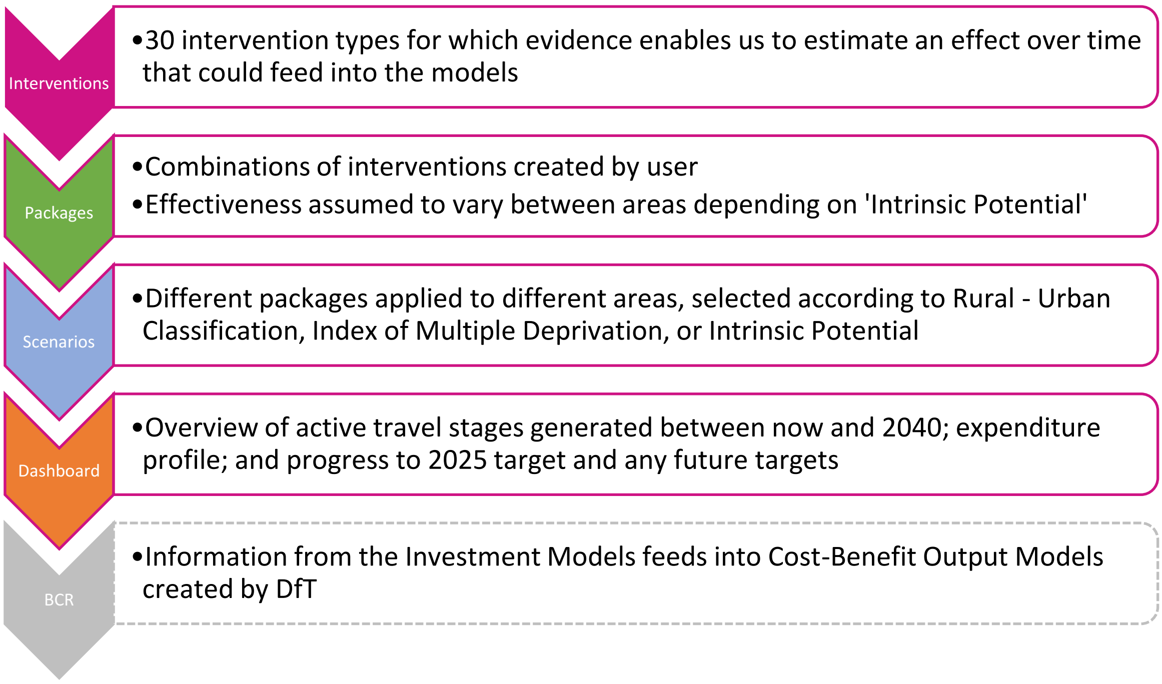
1.2 Structure of the models

There are three Active Travel Investment Models, for cycling, walking and walking to school. All of them have the same basic structure, illustrated in Figure 1.

[1] Department for Transport (2017) Cycling and Walking Investment Strategy

[2] After the walking target was set, there was a change in the way data on walk stages was collected by the National Travel Survey, leading to less under-reporting of short walks. Following this change, NTS data for walk stages per person were rebased. The Walking Investment Model uses the rebased figure for 2013, which is 303 walk stages per person per year. The Department is currently considering setting a new baseline for a revised walking target, potentially using the 3-year average of 2016-2018.

Figure 1: Overview of the structure of the Investment Models



For each **intervention type**, the current evidence base has been used to set a value or range for **cost per additional stage generated.** This is the investment required to generate one additional cycle / walk journey stage[3] per year, in the year when maximum build-up of direct effect has been reached and before that effect starts to decay. Note that it is *not* the cost per cumulative trip over multiple years.

Each intervention is also assigned a **decay rate.** This is an assumption about how many years it will take for maximum build-up of effect to be reached, and, once that full effect has been reached, how quickly (if at all) it will decay.

Interventions can be combined by the user into a number of **packages.** A package is a combination of either cycling, or walking, or walk to school interventions that could be delivered over a five year **control period** in one local authority district (LAD). The model uses control periods (rather than individual years) to reflect the fact that local authorities will in general prefer to plan their delivery of active travel investment over a number of years.

The model calculates the number of stages generated per year (covering a twenty year period i.e. four control periods) for each package, based on the cost per additional stage generated and decay rate values for each intervention in the package.

[3] A new journey stage is defined when a trip starts, or when there is a change in the form of transport (or a change of vehicle requiring a separate ticket). A 'trip' is defined by the National Travel Survey as a one-way course of travel with a single main purpose, and may consist of one or more 'stages'. So, for example, a trip that involves walking to a bus stop, catching the bus, and walking to the final destination is made up of two walk stages and one bus stage. Often the number of trips and stages is the same: for example a commuter journey by bike to and from work would be counted as two bike trips or two bike stages.

Normally, no positive interaction (synergy) is assumed between the interventions in each package. For example, it is assumed that the number of cycle stages generated as a result of cycle training plus cycle infrastructure is the sum of the number of cycle stages that would be generated by each intervention separately. However, it is possible to apply a **synergy factor** to interventions within a package, to give a total effect that is greater than the sum of its parts, in circumstances where the model user judges that this is likely to be the case. The circumstances in which this is appropriate are discussed in section 8.

Some packages are pre-loaded in the model, and these can be adapted (or new ones created)**.** Some expert judgement is required in designing packages: in particular, judgement is needed about the relative proportions of investment in different types of scheme that a typical local authority might choose. The packages pre-loaded into the model are of varying scale (and cost), designed to be suitable for rural LADs, urban LADs and conurbations. This enables the user to assign different packages to different groups of LADs.

Each LAD is assigned an **Intrinsic Cycling Potential (ICP)** (and **Intrinsic Walking Potential, IWP** and **Intrinsic Walk to School Potential, IW2SP**) score. This is converted into a scaling factor which is used to adjust the number of stages generated by any intervention package that is applied to the LAD, i.e. it indicates how effective investment will be in that local authority. (For example, investment in a local authority that is hilly might be expected to generate fewer additional cycle stages per unit of expenditure than investment in a local authority that is flat.) Section 5 and Appendix 7 provide further information about the ICP / IWP /IW2SP scores and scaling factors.

The user can create a variety of different **scenarios**. These are combinations of different packages in different groups of LADs. LADs can be selected for scenarios on the basis of their Intrinsic Potential, Index of Multiple Deprivation, Rural-Urban Classification, whether they have received high levels of investment in the recent past, and (for the Walk to School Model) their level of child obesity.

The results of each model 'run' are displayed on a **Dashboard.** This shows how many cycle / walk stages will be generated at different expenditure levels, between now and 2040, relative to the counterfactual (the change in the absence of additional investment). Results, and funding allocations, are also displayed according to rural-urban area type, and for each region.

The results of each model can also be fed into a linked Cost-Benefit Output Model that has been created by the Department.

2. Baseline data

All three Investment Models have the same baseline year of 2013, in order to make it straightforward to compare their outputs[4].

The data on which the CWIS aims and targets are based is drawn from the National Travel Survey (NTS), but NTS sample sizes are insufficient to enable LAD-level baselines for cycle and walk stages, and walk mode share for travel to school, to be calculated for the Investment Models. Significant data manipulation was therefore required in order to generate LAD-level baselines. The approach used to generate LAD-level baseline data for the Investment Models is described in Appendix 1 and the main points are summarised below.

2.1 Cycling and Walking Investment Models

LAD-level data on levels of cycling and walking is available from the Active Lives Survey (ALS). This includes data on the average *number of days* cycled and walked per person. Partly due to methodological differences, the NTS and ALS data do not produce cycling and walking estimates of similar magnitude[5].

In order to calculate a LAD-level baseline for walk and cycle stages per person per year, the LAD-level ALS data for average number of days cycled / walked per person was scaled so that in aggregate, it matched the number of cycle / walk stages per person per year in England as recorded by NTS for the baseline year of 2013. In doing this, it was assumed that *relative* cycling and walking levels in LADs remained the same between the baseline year of 2013 and 2015/16, which is the first year for which ALS data are available.

2.2 Walk to School Investment Model

LAD-level estimates of the percentage of primary school children who walked to school were derived from school-level data collected in the School Census. This data was for 2011, which was the last year in which the School Census collected pupil travel data.

The School Census data suggests 60% of primary school pupils in England usually walked to school in 2011. In comparison, the NTS value for that year for the proportion of all trips to school by primary school pupils that were walked is 50-51.5%. This difference is assumed to be due to different survey methods[6].

In order to create a baseline that matches the target, the values derived from the School Census were scaled to produce an England average of 49% (the NTS walk to school mode share in the *target's* baseline year of 2014), and these were treated as the values for the Walk to School Investment Model's baseline year of 2013.

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[4] Note that this means that the baseline year in the Investment Models is not the same as the baseline year for the walk to school target (2014).

[5] NTS estimates suggest that, on average, people cycle about 7.7 days per year in England, whilst ALS figures suggest an average of 11.4 days cycling for travel; 11.5 days cycling for leisure; and (up to) 22.9 days for any cycling. Similarly, NTS estimates suggest that, in 2013, people made 303 walk trip stages per year in England, which is estimated to be equivalent to walking on 112 days per year, whilst ALS figures suggest an average of 80 days walking for travel; 83 days walking for leisure; and (up to) 163 days for any walking.

[6] The School Census question is about the 'usual' mode of travel to school, and hence would overestimate the amount of walking if some pupils walk on most days but are driven one or two days a week.

This assumes that relative walking levels in LADs have remained the same between 2011 and the baseline year and that differences in survey methods do not lead to distortion in the relative positioning of the local authorities.

3. Counterfactuals in the models

The CWIS Investment Models all include a counterfactual – that is, an assessment of what change in levels of cycling, walking and walking to school would be expected if there was no additional investment in active travel, other than that which is already committed.

Sections 3.1 and 3.2 explain the assumptions behind the counterfactuals and section 3.3 summarises the counterfactual results.

3.1 Cycling and Walking Investment Models

In most LADs in England, evidence from the Census suggests that there was rather little change in levels of cycling and walking (for travel to work) between 2001 and 2011. In fact, 80% of the gross uplift in cycling to work between 2001 and 2011 was due to change in just 30 (9%) of LADs, of which 17 were London boroughs. Similarly, more than half (56%) of the gross uplift in walking to work over the same period was due to change in 30 boroughs, of which six were in London.

This pattern of most *change* occurring in just a few places, and most *places* seeing little change, was used to inform the development of the counterfactual for the Cycling and Walking Investment Models. Local authorities were divided into three groups: non-London LADs where there was significant growth in cycling and/or walking between 2001 and 2011; London LADs; and all other LADs.

3.1.1 Non-London LADs which had seen significant growth in cycling / walking

For non-London LADs which had seen significant growth in cycling and/or walking between 2001 and 2011, contact was made with local authority officers and recent data was analysed, to establish whether historic cycling / walking growth had been maintained since 2011, and to find out whether the level of investment in cycling / walking in the next five years was expected to stay the same, or go down, or go up. Based on the information received and other data sources (as outlined below), the counterfactual in these LADs combines the following elements:

- **From 2013 to 2019**: Increase in cycle / walk stages per person per year relative to the 2013 baseline, based on projections of growth rates shown by automatic and manual cycle counts[7] (for the Cycling Model) and Census walking to work data (for the Walking Model)
- **From 2019 to 2025**: Forecast growth in cycle / walk stages per person per year, based on comparison of planned investment with historic investment
- **2025 onwards:** No change in cycle / walk stages per person per year (since LADs did not have committed funding beyond that date)
- **Population growth,** using Office for National Statistics population projections[8] (note that the cycling target is expressed as an increase in the total number of stages, whereas the walking target is expressed as an increase in the number of stages per person[9]).

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[7] Automatic and manual cycle count data, or analysis of it, had previously been supplied to the project team by local authorities for the evaluation of the Local Sustainable Transport Fund and Cycle City Ambition.
[8] Office for National Statistics (2018) Subnational population projections for England 2016-based
[9] The Walking Model works in a similar way to the Cycling Model in that it calculates the counterfactual increase in total walk stages (including increases due to population growth), but results are converted to stages per person.

3.1.2 London LADs

For London LADs, it was possible to benchmark the LAD-level growth rate in cycling and walking to work, as recorded by the Census between 2001 and 2011, against overall growth in cycling and walking in London as recorded by data published by Transport for London in the 'Travel in London' reports.

The counterfactual in London LADs combines the following:

- **From 2013 to 2019**: Increase in cycle / walk stages per person per year relative to the 2013 baseline, based on projection of growth trends shown by Census cycling and walking to work data, scaled to match actual London-wide trends
- **From 2019 to 2025**: Forecast growth in cycle / walk stages per person per year, based on projection of growth trends shown by Census cycling and walking to work data, scaled to match the TfL Business Plan forecast
- **2025 onwards**: No change in cycle / walk stages per person per year (since London boroughs and TfL do not have committed funding beyond that date)
- **Population growth**

3.1.3 All other LADs

In all other LADs, it was assumed that the factors affecting cycling and walking growth would be:

- **From 2013 to 2025:** Effect of new housing development, which was expected to be somewhat less walkable than existing residential stock (Walking Model only, since less evidence is available on the effect of housing design and location on levels of cycling)
- **From 2015 to 2021:** Growth in cycle / walk stages as a result of Local Growth Fund (LGF) investment
- **Population growth**

Assumptions about how new housing development might affect levels of walking are described in Appendix 3. In brief, our evidence review (Appendix 4) found that levels of walking are strongly influenced by various built environment characteristics, such as density, proximity to public transport, and proximity to shops and services: at a sub-LAD level (e.g. at the scale of a large housing development), the amount of walking for travel varies by about a factor of two as a result of these characteristics. The main walking counterfactual makes the assumption that new housing development in 'other' LADs will be less walkable than existing housing. This reflects the evidence that densities of new housing outside London are low compared to typical densities of existing dwellings, and evidence that new edge-of-town and greenfield housing is often highly car-dependent[10]. However, there are two alternative counterfactuals loaded into the model which assume that residents of new housing will walk the *same* amount as residents of existing housing, and that they will walk *more* than residents of existing housing. These alternative counterfactuals enable scenarios in which changes to land use and housing policy can be explored.

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[10] Average density of new housing stock in 2017/18 in all other LADs was 27 dwellings (addresses) per hectare (MHCLG 2019 Land use change statistics 2017-18 residential address based change table P331). Existing housing stock typically includes some housing with considerably higher densities (e.g. Victorian/ Edwardian terraces at around 80-100dph; 1930s housing estates at around 30-40dph), so average density of existing housing stock is likely to be significantly higher than that of new housing. Foundation for Integrated Transport (2018) Transport for New Homes documents the lack of provision for walking in new edge-of-town and greenfield housing.

3.2 Walk to School Investment Model

For the Walk to School Investment Model, no LAD-level data were available to enable a forecast to be made of the change in walking to school that would happen in the absence of additional investment.

The model therefore simply assumes a counterfactual in which walking to school remains constant over time, in all LADs.

3.3 Counterfactual results for cycling and walking

The Cycling Investment Model predicts that cycling will increase from 800m stages in 2013 to 1,139m stages in 2025. This means that 42% of the target to double cycling from 0.8b to 1.6b stages is predicted to be met, in the absence of any additional investment in cycling.

The Walking Investment Model predicts that walking will increase by 5 stages per person between 2013 and 2025. This is a consequence of high growth in walking in London and some areas outside London, partially offset by falling walking levels in 'other' LADs.

As noted in 3.2 above, in the absence of suitable LAD-level data to enable a forecast to be made, the model assumes mode share for walking to school will remain unchanged in the counterfactual.

4. Interventions in the Investment Models

4.1 Interventions, cost per additional stage generated, and decay rates

The 30 interventions for which evidence was gathered and analysed are listed in Table 1. Only those marked as ✓ are included in the Investment Models. Interventions for which the available evidence (at the time of our study) was too limited to enable inclusion in the models are shown as (✓).

Appendix 4 describes the evidence that was gathered on the relationship between cycling and walking investment and changes in cycling and walking levels. This updated a previous rapid evidence assessment of the costs and benefits of different cycling and walking investment options[11]. For the current work, over 200 sources of evidence were used to develop summaries of over 100 individual interventions, packages of interventions and national programmes across the 30 types of intervention. The interventions included both capital and revenue schemes ranging in costs from a few tens of thousands to tens of millions of pounds. For some categories there were only one or two sources of evidence while for others there were more, allowing greater confidence in the range of costs estimated.

Appendix 5 describes our analysis of cost per additional stage generated, and cost per 'unit of delivery' for each intervention that was considered for the model. In the model, 'units of delivery' are defined at a large scale, where possible approximating to the actual scale of expenditure in a typical local authority.

Appendix 6 is a set of summary tables for the interventions that are included in each of the models.

Table 2 lists the different decay rate options that are used in the model[12].

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[11] Brook Lyndhurst (2016) Investing in cycling and walking: rapid evidence assessment

[12] Although a number of studies have made assumptions about plausible decay rates, there is little empirical evidence. Typically, studies have used conservative decay rates in order not to over-estimate benefits of investment. The CWIS models retain this conservative approach. A key issue is that it is difficult to disaggregate the long-term effects of individual interventions, because real-world programmes usually involve a combination of interventions (both revenue and capital). Assumptions in key studies are as follows: a) Cairns et al. (2004) Smarter Choices - Changing the way we travel assumed a 40% decay rate for the effect of *individual* revenue interventions; b) Sloman et al. (2010) The effects of smarter choice programmes in the Sustainable Travel Towns assumed a programme-level 33-40% decay rate for sustainable travel *packages* that involved a combination of revenue and capital expenditure; c) Cairns and Jones (2016) Sustainable Travel Towns: an evaluation of the longer term impacts concluded that for sustainable travel packages involving both revenue and capital expenditure, effects do *not* decay rapidly (and therefore that the assumed programme-level decay of 33-40% in Sloman et al. (2010) was pessimistic). However, it noted that for school travel revenue interventions, significant decay of effects occurred when funding was withdrawn, suggesting a decay rate of 40% or more could be appropriate; d) Sloman et al. (2017) Meta-analysis of outcomes of investment in the 12 Local Sustainable Transport Fund Large Projects suggested a programme-level decay rate of 15% for packages that involved a combination of revenue and capital expenditure, and a programme-level decay rate of 30% for packages that were largely composed of revenue interventions.

Table 1: Interventions for which evidence was gathered

Reference	Intervention type	CYCLING MODEL	WALKING MODEL	WALK TO SCHOOL MODEL
A	Area-wide cycle networks	✓		
B	Town centre walking infrastructure schemes		✓	(✓)
C	Flagship cycling and walking links	✓	✓	(✓)
D	Neighbourhood traffic calming schemes (20mph zones)	(✓)	✓	(✓)
E	Cycle parking at stations	✓		
F	Adult cycle training	✓		
G	Child cycle training	✓		
H	Conventional bike loans/subsidies	✓		
I	On-street cycle hire (of conventional bikes)	✓		
J	Bike refurbishment	✓		
K	Bike purchase via salary sacrifice	✓		
L	Electrically assisted bikes (grants to individuals)	✓		
M	Secure cycle parking (with associated facilities)	✓		
N	Mass cycle rides/festivals/events	✓		
O	Cycle inclusion schemes	✓		
P	Led walks		✓	
Q	Walking promotion		✓	(✓)
R	Household personalised travel planning	✓	✓	(✓)
S	Workplace personalised travel planning	✓	(✓)	
T	Workplace travel challenges	✓		
U	Community based initiatives (multi-stranded approaches)	(✓)	(✓)	(✓)
V	Workplace travel initiatives	✓	✓	
W	School travel initiatives (walking/cycling promotion)		(✓)	✓
X	Links to schools	(✓)	(✓)	✓
Y	Bus route enhancements		✓	
Z	Concessionary fares		✓	
AA	School streets closures / parking restraint		(✓)	✓
AB	Built environment*		✓*	
AC	School travel plans		(✓)	(✓)
AD	Shared e-bike schemes	(✓)		

* This category has been built into the Walking Investment Model via the differing counterfactual scenarios for new housing.

Blanks are interventions that are assumed not to be relevant to the mode (and model) in question.

Table 2: Build-up and decay effects assumed in the Investment Models

Decay type	Description	Examples	Rationale
Revenue TYPE A	Effect is greatest immediately after the intervention, but it decays quite rapidly (40% per year), with a very small residual effect after 10 years	Workplace travel challenges (cycling); Led walks (walking); School travel initiatives (walking to school)	Cairns et al. (2004) Smarter Choices - Changing the way we travel assumed 40% decay rate for effect of *individual* revenue interventions. Cairns and Jones (2016) Sustainable Travel Towns: an evaluation of the longer term impacts noted decay of effects of school travel revenue interventions when funding ceased and suggested decay rate of 40% or more could be appropriate
Revenue TYPE B	Effect is greatest immediately after the intervention. It decays slowly (7% per year), when people's circumstances change e.g. they move house or jobs	Adult cycle training, bike loans / subsidies (cycling)	Equivalent to ~a third of the ~20% people who move house / change jobs in any one year completely stopping cycling at that time. Analysis of the British Household Panel Survey (Dargay J and Hanly M (2004) Volatility of car ownership, commuting mode and time in the UK) showed nearly 20% of individuals change jobs or move house (or both) in any one year. Amongst those who change jobs or move house, just under a third also change commute mode. A two-year after survey of cycle training participants in Greater Manchester showed that increases in cycle training had been sustained (Appendix 5).
Revenue TYPE C	Significant effect immediately after the intervention, then gradual build up to full effect about two years after the intervention. Once effect has built up (and commercial viability has been reached), effect stays at the same level indefinitely. Model treats all investment as taking place in Year 1, but in practice this investment would be spread over three years.	Kick-start investment in more frequent bus services which reach commercial viability, and generate new walk trips	Sloman et al. (2017) Meta-analysis of outcomes of investment in the 12 Local Sustainable Transport Fund Large Projects demonstrated that many new bus services that received public investment saw sufficient patronage growth to reached commercial viability within 2-3 years.

Decay type	Description	Examples	Rationale
CAP_1YrDelay	Impact is rapid, with full effect achieved in the year after the completion of the intervention. Effect then stays at the same level indefinitely, but annual maintenance costs (1% of original capital investment) are incurred.	Cycle parking at stations (cycling); Neighbourhood traffic calming schemes (walking); Infrastructure links to schools (walking to school)	Evidence on rate of build up to full effect for different interventions summarised in Appendix 4 section 3 and/or Appendix 5.
CAP_2YrDelay	Build up to full effect takes about two years after completion of intervention. Once impact has built up, it stays at the same level indefinitely but annual maintenance costs (1% of original capital investment) are incurred.	Area-wide cycle networks (cycling); Town centre walking infrastructure schemes (walking)	Evidence on rate of build up to full effect for different interventions summarised in Appendix 4 section 3 and/or Appendix 5.
CAP_3YrDelay	Build up to full effect takes about three years after completion of intervention. Once impact has built up, it stays at the same level indefinitely but annual maintenance costs (1% of original capital investment) are incurred.	On-street cycle hire (cycling)	Evidence on rate of build up to full effect for different interventions summarised in Appendix 4 section 3 and/or Appendix 5.

In general, **revenue** interventions were found to have quite low figures for the cost per additional stage generated, mostly in the range of <£1-£5, but with three higher values in the range of £10-30. Maximum effect appeared to be achieved soon after the intervention took place. We assumed that if investment ceased, the effect would (in most cases) be likely to diminish over time, but that if investment was sustained, the effect would build up to a steady-state level and then remain at that level[13]. The rapidity of the decay in effect if investment ceases probably varies according to the type of intervention: for example, we assumed that the decay rate for interventions that only provide information and encouragement (such as workplace travel challenges) might be quite rapid, but that the decay rate for interventions that changed the conditions for walking or cycling (for example by providing cycle training or access to a bicycle), would be slower. One special case amongst the revenue interventions is funding to 'kick-start' new or more frequent bus services. A proportion of services funded in this way will achieve commercial viability, and this is likely to result in a long-term improvement in bus services, leading some people to shift from driving to travelling by bus (with a walk stage before and afterwards). We assumed that this effect would not decay over time.

Capital interventions had substantially higher figures for the cost per additional stage generated (for the year when full effects are achieved), mostly in the range of £10-£70, but with three values below £10. There was evidence to suggest that it could take at least one year, and sometimes several years, for maximum effect to be reached, but once this had happened, there was no evidence that the effect decayed over time. This means that costs per stage would be substantially lower if assessed over multiple years. The cost per additional stage should therefore not be taken as a measure of the overall value for money of an intervention (for which the cumulative cost divided by the cumulative additional trips is the more relevant measure). However, capital interventions are likely to have ongoing maintenance costs, and the model factors in 1% of the capital investment per year to allow for this.

[13] In line with the capital interventions, there might be a logic for having a 'maintenance budget' for some revenue initiatives, since several – for example, work with schools on walking promotion – have periods of intensive engagement and then budgets for lower-scale 'maintenance' type work in subsequent years. However, insufficient evidence was available to be able to include this in the model this at this stage.

5. Variation in effect of investment between local authorities

A key feature of the Investment Models is that the effectiveness of each intervention package is varied according to the characteristics of the LAD in which it is applied. In other words, the models recognise that some areas may be more fertile territory for investment than others. The method used to generate the adjustment factors for each LAD is described in Appendix 7, and summarised below.

5.1 Cycling Investment Model

The Cycling Investment Model includes two LAD-level adjustment factors for the effectiveness of investment.

The first is generated from the Intrinsic Cycling Potential (ICP) score. This combines data from the Propensity to Cycle Tool[14] on the anticipated proportion of people who might cycle (which is itself a function of hilliness and journey distances); age data (the proportion of the population that is aged 0-15 or 65+); and the Index of Multiple Deprivation. This combination of variables was found by regression analysis of a larger number of variables[15] to provide the greatest explanatory power for the observed variation between LADs in cycle stages per person at baseline.

The second is a 'traffic conditions' factor, which is based on levels of car ownership.

For the majority of LADs, the combination of these two factors changes the effectiveness of investment by a factor that varies between about 0.5 and 4, although there are a small number of LADs where the combination of the two factors is greater, and these are capped at 5.

5.2 Walking Investment Model

The combination of factors that provides the greatest explanatory power for variation in the amount of walking between LADs is different for walking for transport and walking for leisure. As a general rule, residents of urban areas tend to have higher levels of walking for transport, and residents of rural areas tend to have higher levels of walking for leisure.

Two LAD-level scores were therefore developed: Intrinsic Walking Potential for Transport (IWP-T) and Intrinsic Walking Potential for Leisure (IWP-L). IWP-T combines a measure of housing type; the proportion of women; car ownership per person; and the Index of Multiple Deprivation. IWP-L combines the proportion of households without cars; the proportion aged 65+; car ownership per person[16]; and journey times to key shops and services.

The Walking Investment Model only uses IWP-T for the scaling factor, on the basis that most of the interventions in the model are intended to stimulate walking for transport rather than for leisure. For the majority of LADs, an IWP-T scaling factor changes the effectiveness of investment by a factor that varies between about 0.5 and 1.5, although, as before, there are a few LADs where the effect is greater.

[14] https://www.pct.bike/

[15] 16 variables were investigated in all.

[16] Interestingly, car ownership per person is negatively correlated with the amount of walking for transport, but positively correlated with the amount of walking for leisure.

5.3 Walk to School Investment Model

The Walk to School Investment Model uses an Intrinsic Walking to School Potential (IW2SP) score, which combines measures of the proportion of 5-10 year olds living close to a primary school (within ‘reasonable travel time’ by public transport / walking); car ownership per person; population density; traffic congestion (journey times on A roads); and the Index of Multiple Deprivation.

For the majority of LADs, the IW2SP scaling factor changes the effectiveness of investment by a factor that varies between about 0.8 and 1.2, but as before there are a small number of LADs where the effect is greater.

6. Packages in the Investment Models

6.1 Rationale for the packages

Any combination of interventions can be put together to form a package for use in the Investment Models. However, the model only enables each LAD to be assigned one package in each five-year Control Period. This means that it is not possible to assign different packages to different groups of LADs and then to additionally assign another package to all of them.

So far, all packages in the Investment Models have been designed with the same amount of each intervention in all 20 years (four five-year control periods), but it would be possible to create packages that 'ramp up' over a five year period, or to design different packages for different control period.

The Cycling and Walking Investment Models have 12 pre-loaded packages, summarised in Tables 3 and 4. For conurbations, larger towns and small towns / rural areas, there are versions of the following:

- A 'capital only' package, including capital interventions only;
- A 'cost-effective' package, made up of revenue and capital interventions that tend to have lower cost per additional stage generated, quicker build-up of effects and slower decay;
- An 'all social groups' package, made up of revenue and capital interventions that would feature in a programme that targeted people who are less physically active;
- A 'comprehensive' package that contains a large number of revenue and capital interventions, typical of a highly committed local authority.

The Walk to School Investment Model has nine pre-loaded packages, summarised in Table 5. For conurbations, larger towns and small towns / rural areas, there are versions of the following:

- A 'capital only' package;
- A 'revenue only' package
- A package with both capital and revenue interventions.

The interventions included in the packages are informed by experience of the sorts of active travel programmes that local authorities have delivered in the past[17]. Packages that are pre-loaded in the model have been designed so that they are a 'soft maximum' for the amount of each intervention that could feasibly be delivered by a LAD over a five year period.

[17] In practice, any local authority would design its own programme, using different combinations of the interventions described here, such that they would all probably be slightly different.

6.2 Cycling packages

Table 3 summarises the interventions included in the packages in the Cycling Investment Model.

Table 3: Packages in the Cycling Investment Model

	CONURBATIONS	LARGE TOWNS	SMALL TOWN / RURAL
CAPITAL ONLY	**PACKAGE 1: "CAPITAL CONURBATION"** Area-wide cycle networks Flagship cycling links Cycle parking at stations On-street cycle hire Secure cycle parking hubs	**PACKAGE 2: "CAPITAL TOWN"** Area-wide cycle networks Flagship cycling links Cycle parking at stations	**PACKAGE 3: "CAPITAL SMALL TOWN & RURAL"** Flagship cycling links
COST-EFFECTIVE	**PACKAGE 4: "COST-EFFECTIVE CONURBATION"** Area-wide cycle networks Cycle parking at stations Adult cycle training Child cycle training Mass cycle rides / events Workplace travel initiatives	**PACKAGE 5: "COST-EFFECTIVE TOWN"** Same as Package 4, but in smaller quantities	**PACKAGE 6: "COST-EFFECTIVE SMALL TOWN AND RURAL"** Cycle parking at stations Adult cycle training Child cycle training
ALL SOCIAL GROUPS	**PACKAGE 7: "ALL SOCIAL GROUPS CONURBATION"** Area-wide cycle networks Flagship cycling links Adult cycle training Child cycle training Bike loans / subsidies Bike refurbishment Inclusive cycling schemes E-bike grants	**PACKAGE 8: "ALL SOCIAL GROUPS TOWN"** Same as Package 7, but in smaller quantities	**PACKAGE 9: "ALL SOCIAL GROUPS SMALL TOWN AND RURAL"** Flagship cycling links Adult cycle training Child cycle training Inclusive cycling schemes E-bike grants
COMP-REHENSIVE	**PACKAGE 10: "COMPREHENSIVE CONURBATION"** Area-wide cycle networks Flagship cycling links Cycle parking at stations Adult cycle training Child cycle training Bike refurbishment Mass cycle rides / events Workplace travel challenges Workplace travel initiatives E-bike grants	**PACKAGE 11: "COMPREHENSIVE TOWN"** Same as Package 10, but in smaller quantities	**PACKAGE 12: "COMPREHENSIVE SMALL TOWN AND RURAL"** Same as Package 10, but in smaller quantities

6.3 Walking packages

Table 4 summarises the interventions included in the packages in the Walking Investment Model.

Table 4: Packages in the Walking Investment Model

	CONURBATIONS	LARGE TOWNS	SMALL TOWN / RURAL
CAPITAL ONLY	**PACKAGE 1: "CAPITAL CONURBATION"** Town centre walking infrastructure schemes Flagship walking links Neighbourhood traffic calming schemes	**PACKAGE 2: "CAPITAL TOWN"** Same as Package 1, but in smaller quantities	**PACKAGE 3: "CAPITAL SMALL TOWN & RURAL"** Same as Package 1, but in smaller quantities
COST-EFFECTIVE	**PACKAGE 4: "COST-EFFECTIVE CONURBATION"** Town centre walking infrastructure schemes Neighbourhood traffic calming schemes Walking promotion Workplace travel initiatives Bus route enhancements Concessionary fares	**PACKAGE 5: "COST-EFFECTIVE TOWN"** Same as Package 4, but in smaller quantities	**PACKAGE 6: "COST-EFFECTIVE SMALL TOWN AND RURAL"** Neighbourhood traffic calming schemes Walking promotion Bus route enhancements Concessionary fares
ALL SOCIAL GROUPS	**PACKAGE 7: "ALL SOCIAL GROUPS CONURBATION"** Flagship walking links Neighbourhood traffic calming schemes Led walks Walking promotion Bus route enhancements Concessionary fares	**PACKAGE 8: "ALL SOCIAL GROUPS TOWN"** Same as Package 7, but in smaller quantities	**PACKAGE 9: "ALL SOCIAL GROUPS SMALL TOWN AND RURAL"** Same as Package 7, but in smaller quantities
COMP-REHENSIVE	**PACKAGE 10: "COMPREHENSIVE CONURBATION"** Town centre walking infrastructure schemes Flagship walking links Neighbourhood traffic calming schemes Led walks Walking promotion Personalised travel planning Workplace travel initiatives Bus route enhancements Concessionary fares	**PACKAGE 11: "COMPREHENSIVE TOWN"** Same as Package 10, but in smaller quantities	**PACKAGE 12: "COMPREHENSIVE SMALL TOWN AND RURAL"** Flagship walking links Neighbourhood traffic calming schemes Led walks Walking promotion Personalised travel planning Bus route enhancements Concessionary fares

6.4 Walk to School Packages

Table 5 summarises the interventions included in the packages in the Walk to School Investment Model.

Table 5: Packages in the Walk to School Investment Model

	CONURBATIONS	LARGE TOWNS	SMALL TOWN / RURAL
CAPITAL ONLY	**PACKAGE 1: "CAPITAL CONURBATION"** Links to Schools School Streets	**PACKAGE 2: "CAPITAL TOWN"** Same as Package 1, but in smaller quantities	**PACKAGE 3: "CAPITAL SMALL TOWN & RURAL"** Same as Package 1, but in smaller quantities
CAPITAL AND REVENUE	**PACKAGE 4: "CAP & REV CONURBATION"** Links to Schools School Streets School travel initiatives	**PACKAGE 5: "CAP & REV TOWN"** Same as Package 4, but in smaller quantities	**PACKAGE 6: "CAP & REV SMALL TOWN AND RURAL"** Same as Package 4, but in smaller quantities
REVENUE ONLY	**PACKAGE 7: "REVENUE CONURBATION"** School travel initiatives	**PACKAGE 8: "REVENUE TOWN"** Same as Package 7, but in smaller quantities	**PACKAGE 9: "REVENUE SMALL TOWN AND RURAL"** Same as Package 7, but in smaller quantities

7. Scenarios

7.1 Selection of LADs in scenarios

Table 6 lists the selection options that are available in the models to choose sub-groups of LADs for inclusion in scenarios.

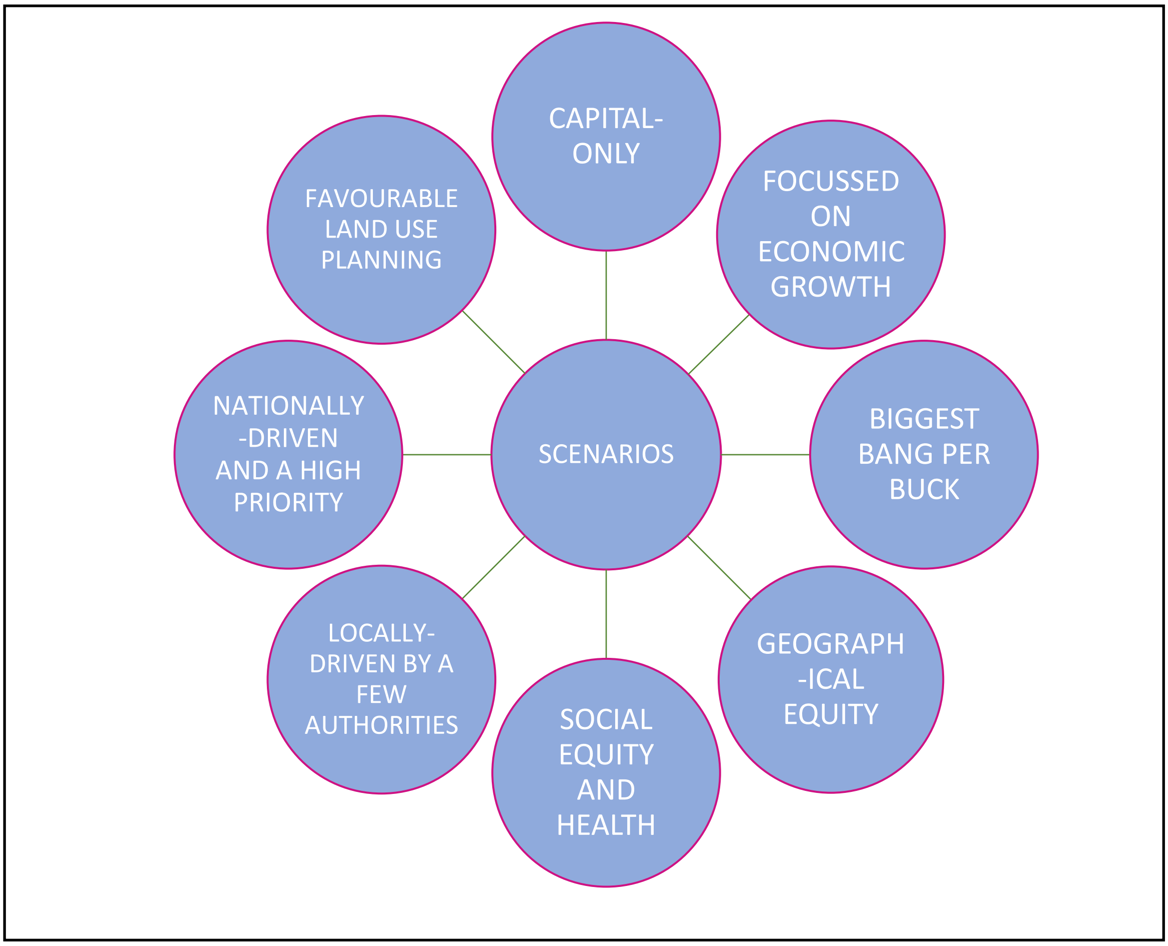
Table 6: Selection criteria to choose sub-groups of LADs for investment scenarios

Selection criteria	Available in which models	Selection options
Rural-Urban Category	All Investment Models	All London Urban with Major Conurbation (RUC6) Urban with Minor Conurbation (RUC5) Urban with City and Town (RUC4) Urban with Significant Rural (RUC3) Mainly Rural (RUC2) Largely Rural (RUC1)
Index of Multiple Deprivation	All Investment Models	All Lowest IMD (0-25%) Mid-low IMD (25-50%) Mid-high IMD (50-75%) Highest IMD (75-100%)
Intrinsic Cycling Potential	Cycling Investment Model only	All High ICP >1.2 Mid ICP 0.8-1.2 Low ICP<0.8
Intrinsic Walking Potential (for transport)	Walking Investment Model only	All High IWP >1.2 Mid IWP 0.8-1.2 Low IWP<0.8
Intrinsic Walk to School Potential	Walk to School Investment Model Only	All High IW2SP >1.1 Mid IW2SP 0.9-1.1 Low IW2SP <0.9
Forecast Investment Category	Cycling and Walking Investment Models	All LADs which have experienced significant growth in walking/cycling in the recent past (including London) Others
Child Obesity Category	Walk to School Investment Model Only	All High (>22% of children overweight) Medium (18-22% of children overweight) Low (<18% of children overweight

7.2 Description of scenarios

The scenarios in the Investment Models are shown in Figure 2 and described in more detail below.

Figure 2: Scenarios in the Investment Models



Note that as presently modelled, none of the scenarios include additional investment in London (beyond that already assumed in the counterfactual). However, for longer time periods, it is worth noting that a number of London LADs have high Intrinsic Cycling, Walking and Walk to School Potential, suggesting that investment in these areas after 2025 would be good value for money.

Capital-Only Scenario

Investment takes place in all LADs except London, but only capital funding is available. For cycling, this would be like broadening the Cycle City Ambition programme to be implemented nationally. Packages P1, P2 and P3 are used in all three Investment Models.

Focussed on Economic Growth Scenario

All investment is concentrated in conurbations outside London. This is based on the assumption that these are the places where a high quality public realm is most likely to attract employers to locate, bringing jobs and inward investment. Only capital funding is used (Package P1). This is similar to adopting a programme like London's Healthy Streets programme in other conurbations. About a quarter of the England population (and of primary school pupils) would benefit under this scenario.

Biggest Bang per Buck Scenario
In this scenario, investment is targeted at areas outside London with more favourable conditions for cycling and walking, as these are the places where each £ spent has more impact. Focussing only on areas with the most potential (highest ICP / IWP / IW2SP) would limit the scope for investment, as (outside London) these areas only represent a small proportion of the population (9% for cycling, 6% for walking and 14% for walking to school). So the model assumes that there is also investment in areas with medium potential. This means that about 40-50% of the population benefit from investment (42% for cycling, 42% for walking, and 50% of primary school pupils). Packages of interventions with a low cost per additional stage (P4, P5 and P6) are used in the Cycling and Walking Models, and packages of 'capital and revenue' (P4, P5 and P6) in the Walk to School Model.

Geographical Equity Scenario
All local authorities outside London receive investment. Packages of interventions with a low cost per additional stage generated (P4, P5 and P6) are used in the Cycling and Walking Models, and packages of 'capital and revenue' (P4, P5 and P6) in the Walk to School Model. This scenario is comparable to expanding the Local Sustainable Transport Fund to take place over a longer time period, in more areas.

Social Equity and Health Scenario
Investment is targeted at areas with high or mid-high Index of Multiple Deprivation (excluding London). This means that 38% of the England population benefits from investment. These places have higher child obesity[18]. They may also be places where the proportion of the population which is unemployed or in routine / semi-routine jobs is higher, and since these groups are more likely to be physically inactive this scenario will to some extent target physical inactivity. Packages P7, P8 and P9, aimed at 'all social groups', are used in the Cycling and Walking Models. These include funding for interventions to encourage cycling and walking by women, people with disabilities, people on low incomes, older people and people with health problems. Packages of 'capital and revenue' (P4, P5 and P6) are used in the Walk to School Model. Most investment is in urban areas: of the 38% of the population that benefits, 19% is in conurbations outside London (RUC5/6); 15% is in other urban areas (RUC3/4); and only 4% is in rural areas (RUC1/2).

Locally-Driven by a Few Authorities Scenario
Urban areas with active travel high on the local agenda lead the way. These are conurbations and large urban areas outside London (RUC4/5/6) where conditions for cycling and/or walking are favourable (ICP, IWP and IW2SP are high or medium). Around a quarter of the England population (27%) receives cycling investment, 37% receives walking investment, and 50% receives walk to school investment. Because these local authorities are strong advocates for active travel, the package of interventions is comprehensive, including a wide range of capital and revenue measures (P10 and P11 for Cycling and Walking Models, and P4 and P5 for Walk to School Model). In this scenario, there may be some synergistic effects as interventions to promote active travel may be taking place in the context of traffic restraint policies.

Nationally-Driven High Priority Scenario
Growing concern about climate change leads to introduction of strong demand management measures for cars in all areas, coupled with investment in all sustainable modes. The package of active travel interventions is comprehensive, including a wide range of capital and revenue measures, in order to maximise the benefits to all groups (P10, P11 and P12 in Cycling and Walking Models, and P4,

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[18] Alternatively, it is possible to select LADs on the basis of the level of child obesity (high or medium) for the Walk to School Model. If this is done, 48% of the population (outside London) benefits from investment.

P5 and P6 in Walk to School Model). There are synergistic effects as interventions to promote active travel are taking place in the context of traffic restraint.

Favourable Land use Planning Scenario

This scenario is only used in the Walking Model. It is a variant of the Biggest Bang per Buck Scenario, but with different assumptions about the walkability of new housing development.

7.3 Allocation of expenditure

Expenditure for each five year Control Period can be allocated to selected sub-groups of LADs in any way the user of the model chooses. However, the Scenario Builder sheet in the models includes a column showing the proportion of the England population that is in each sub-group of LADs, and this enables the user to allocate expenditure to sub-groups in proportion to their population, if desired.

7.4 Maximum expenditure cap

As noted in section 6.1, packages that are pre-loaded in the models have been designed so that each constituent intervention is at about the maximum size that could be delivered by a LAD over a five year period.

For runs of the models at low to moderate expenditure levels, each individual LAD will receive funding for less than one complete package, so there is no risk of more funding being allocated to a LAD (or to individual interventions within a LAD) than it would be feasible to spend.

However, at higher levels of expenditure there is a risk that the amount of funding allocated to some interventions in some LADs may exceed the feasible level. This can be checked, and a decision made about whether expenditures and resulting outputs are realistic, by referring to the table of 'Outputs delivered' in the Cost-Benefit Outputs Models created by the Department to sit alongside the Investment Models.

As a further check to prevent the user allocating an unrealistically high amount of expenditure to a group of LADs, the models flag up per capita levels of expenditure that may be too high to be delivered. The threshold is set at £40 per person per year in the Cycling and Walking Investment Models and £200 per pupil per year in the Walk to School Model. Expenditure at this level is somewhat above expenditure in countries where active travel is a high policy priority. For example, per capita expenditure on cycling is about £35 per year in Copenhagen (3-year average 2014-2016, according to 2018 Copenhagen Bicycle Account), and estimates of average per capita expenditure on cycling for the whole of the Netherlands are about £24 - £27 (figures for 2013 and 2010 respectively, not adjusted for inflation).

8. Synergy effects

It is possible that under certain conditions, the effectiveness of active travel interventions will be higher because of synergistic effects.

There is relatively little evidence that enables the size of any synergistic effect to be quantified. However, it is plausible that synergistic effects may occur:

- In places where a combination of measures are implemented, including measures to restrain car use, capital investment to create a better walking and cycling environment (e.g. traffic calming) and revenue investment to stimulate behaviour change.
- When investment is continuous, since this enables revenue investment to promote walking (for example) to be targeted to places where the physical environment for walking has recently been improved, and provides continuity of staff, retaining expertise and reducing the costs of recruitment.

The model allows the user to create individual packages which include a 'synergy factor' for some or all interventions, and which can be applied to certain groups of LADs (e.g. only to LADs in urban areas).

Alternatively, the model allows the user to apply a 'sensitivity factor' uniformly across all investment in all LADs. This is applied on a sliding scale on the model Dashboard, and takes effect once the model is re-run from the Scenario Builder.

At this stage, in the absence of more evidence, we think it would be reasonable to apply a synergy factor of up to about 30% either to interventions in some packages (e.g. just to packages for urban areas), or to whole scenarios, where all of the following conditions are met:

- Both revenue and capital are available
- Investment takes place in the context of strong traffic restraint policies such as road user charging, higher motoring costs and parking restrictions
- Funding is continuous across all four control periods, so that local authorities can develop permanent in-house expertise and a strategic approach.

We do not recommend assuming a synergy factor in packages or scenarios unless <u>*all three of these criteria are met.*</u> It should also be noted that because evidence about synergistic effects is limited and largely qualitative, findings about their magnitude should be treated with caution.

The rationale for a synergy factor of up to about 30% under the conditions listed above is summarised in Table 7.

Table 7: Rationale for a synergy factor

Conditions	Rationale
Both revenue and capital are available	At programme level, availability of both capital and revenue funding enables local authorities to choose the most effective combination of measures in each category, according to local circumstances, and hence to optimise their investment package. At intervention level, Sloman et al. (2014) Finding the Optimum - revenue/capital investment balance for sustainable travel found that: a) employment areas in Exeter benefitting from a combination of cycle infrastructure (capital) and behavioural interventions in workplaces (revenue) saw more growth in cycle commuting than areas benefitting from cycle infrastructure only (average annual change in cyclists at commuting times of +7% versus +2.5%). b) revenue investment following cycle route development around schools appeared to enhance impact. Schools receiving Links to Schools (cycle infrastructure) and Bike It (cycle promotion) saw an increase in cycling mode share of 0.7 - 1.8%-points, while schools that only received Links to Schools saw an increase in cycling mode share of 0.4%-points. c) revenue funding for higher bus service frequencies in Bristol doubled the BCR, from about 2 for a capital-only programme of bus infrastructure to >5 for infrastructure + more services. Cairns et al. (2004) Smarter Choices - Changing the way we travel cites examples where a combination of public transport infrastructure (capital) and public transport promotion or personalised travel planning (revenue) achieved around double the effect of public transport infrastructure alone. A combination of bus infrastructure improvements and personalised travel planning in Bristol achieved an increase in bus mode share of 4%-points, with an accompanying fall in car mode share (and hence, an increase in walking); whereas bus infrastructure improvements alone only achieved an increase in bus mode share of 2%-points (with no reduction in car use, and some mode shift from walk to bus: hence, a decrease in walking).
Investment is in context of strong traffic restraint	Evidence that interventions to encourage modal shift are more effective when implemented in the context of traffic restraint includes: a) Cairns et al. (2002) Making travel plans work - research report: found that workplace travel plans supported by parking reduction achieved average reductions in car commuting of 24%, whereas workplace travel plans not supported by parking reduction achieved average reductions in car commuting of 10%. b) Newson et al. (2010) Making school travel plans work: found that school travel plans implemented in the context of car parking reduction and infrastructure improvements achieved greater increases in walking and cycling. c) Chatterjee et al. (2017) Local Sustainable Transport Fund case study evaluation - strategic employment sites and business parks: found that restricted parking was a main motivator for employers to engage with sustainable transport initiatives. d) Goodman et al. (2011) How and why do people commute by car? A mixed-methods investigation J. Epid. & Comm. Health. Volume 65, Issue Suppl 2: found that car commuters were much more likely to walk or cycle for part of their journey if their workplace restricted parking or charged for it. e) Petrunoff et al. (2015) Carrots and sticks vs carrots: Comparing approaches to workplace travel plans using disincentives for driving and incentives for active travel Journal of Transport & Health Volume 2, Issue 4, December 2015, Pages 563-567: in a comparison of two adjoining hospitals in Australia, found 42% reduction in driving at one hospital which combined carrot and stick measures to encourage sustainable travel. This was 8 times higher than the change at the other hospital which only used carrots. The key measure at the former was the restriction of parking places and the introduction of paid parking.

Conditions	Rationale
Funding is continuous	At programme level, most funding programmes for walking and cycling have so far been short-term (e.g. 3-4 years for Local Sustainable Transport Fund; 4.5 years for Cycle City Ambition). Hiblin et al. (2016) What Works? Learning from the Local Sustainable Transport Fund 2011 – 2015 (report and appendices) found that short-term programmes result in considerable inefficiencies due to the need to recruit staff and build expertise, and due to the loss of staff in the final year of the programme. Indicatively, continuous funding for 10 years might be expected to result in effective delivery for about 8 years (with a year of less effective delivery at the beginning and the end), whereas two periods of funding each of 5 years (with a gap in between) might be expected to result in effective delivery for about 6 years (with a year of less effective delivery at the beginning and the end of each programme).

9. Limitations of the Investment Models

9.1 Evidence quality

Over the last two decades, a fairly large body of evidence has been built up as to what types of interventions are effective in increasing levels of cycling, walking and walking to school, their cost, and their effectiveness.

However, a key challenge is that evidence from the academic literature, while typically methodologically robust, was often less useful because it lacked data on costs and was less up-to-date; while evidence from local authorities tended to be less robust, but was more recent, was UK-specific and was more likely to include relevant cost and outcome data.

Some limitations of the available evidence are:

- A tendency to compare ‘before’ and ‘after’ levels of active travel rather than comparing change relative to a counterfactual (what would have happened in the absence of investment);
- Substantially different reporting conventions in different evaluations, making comparison (even of similar schemes) problematic, and lack of key details to enable comparable data to be generated;
- Some sample sizes are small, and some survey response rates are poor;
- It is unclear whether results from small-scale interventions could be replicated if the interventions were delivered on a large scale or in areas with very different characteristics;
- Interventions rarely, if ever, take place in isolation, and this makes attribution difficult or uncertain.

As further active travel interventions are implemented, it will be therefore be worthwhile to collect monitoring data in a way that would enable the estimates used in the CWIS Investment Models to be refined.

9.2 Evidence interpretation: cost per additional stage generated

It was necessary to make a number of assumptions in order to translate evaluation evidence into estimates of cost per additional stage generated. In the Appendices, we mostly refer to ‘costs per trip’, because this is the evidence that is most commonly available (although we have used evidence about trip ‘stages’, rather than simply one-way journeys, in the few cases where this was available.)

The reported cost of an intervention varied in terms of whether it included hidden costs, such as officer support time, general promotional support or costs spread over other projects. This may contribute to the variability in costs between interventions in the same category.

Evaluations which included both cost and outcome data potentially allowed estimation of the cost per additional stage generated. However, outcomes were commonly reported in terms of a change in modal share or percentage of participants who increased their levels of walking and cycling. Assumptions had to be applied to convert these outcomes into an annual number of stages. We have generally used conservative assumptions (e.g. assuming an increase in cycling following an intervention will be lower or not sustained in the winter months).

9.3 Build-up and decay effects

For capital schemes, the available evidence suggested that the full effect could take several years to build up. For revenue schemes, we have assumed that the effect is more likely to peak quickly and then diminish over time (although with some exceptions).

However, as discussed in section 4.1, our evidence on rates of build-up and decay is limited, and our assumptions may be overly conservative. There are two particular respects in which the assumptions in the model err on the side of caution:

- For revenue interventions that only involve provision of information or encouragement, we have conservatively assumed a decay rate of about 40% per year (and no allocation of 'maintenance' activity to sustain outcomes).
- For capital interventions, the evidence available may underestimate the scale of use once full build-up of effect has been reached, because evaluations typically take place relatively soon after an intervention is complete, and impacts after 2-4 years are rarely reported.