West Sussex PCT case study

Rachel Aldred, on behalf of the PCT team

Contents

Introduction

This short case study uses the Propensity to Cycle Tool (PCT: www.pct.bike) to explore cycle commuting potential in West Sussex.

West Sussex was chosen because the lead author was asked to speak at an event in the area and as part of this to share knowledge about the PCT. The case study uses the 'e-bike' to examine the potential for cycling locally and its benefits, to outline a potential priority route network for cycle commuting, and to consider a specific case study (the A264 corridor). Data for the first wave of case studies was downloaded from the Propensity to Cycle Tool (PCT) as of 1st September 2016. Some of the underlying data may change slightly in future updates to PCT. In particular, an update to be applied in October/November 2016 will improve our estimates of route hilliness, and so reduce measurement error in modelling propensity to cycle, although we do not expect this significantly to change the model results.

QGIS and Excel have been used to analyse the downloaded data.

About the PCT

The PCT is a Department for Transport-funded tool that uses information about current trip lengths and hilliness to identify trips that might be most easily switched to cycling. Currently, the tool uses data from the 2011 Census, which has origins and destinations for almost all commuters in England. The PCT provides a range of scenarios to explore cycling potential at an area or route levels. It is freely available for everyone to use and the code is open source.

Limitations

Some of the limitations of the PCT are outlined here; these tend to involve the under-estimation of cycling potential. Firstly the PCT does not take into account new developments (post-2011), and the cycling potential that these might generate. Perhaps most importantly, the PCT currently only covers commuter cycling. Commuting only represents around a sixth of all trips: based on Dutch travel patterns, if we achieved mass cycle commuting we would also have very high (sometimes higher) levels of cycling for other trip purposes. Planners should note that these trips may have different destinations (e.g. hospitals, leisure destinations, schools, etc.) but may also be very important, particularly for some demographic groups such as women and older people for whom the commute makes up a smaller proportion of trips.

Finally, and particularly relevant for commuter belt areas, we are only including the potential for trips to switch entirely to cycling – whereas based on bespoke work conducted for Tunbridge Wells, there might also be very high potential for longer-distance commuters to cycle to the station. Planners need to consider additional trip generators and how this might impact the size and spatial distribution of cycling potential. In the case of the A264, discussed below, Holmbush Farm is a major family attraction half way along the A264 and might also substantially contribute to cycling potential along this route, but this cannot currently be included within the PCT.

Why cycling matters

Increasing cycling can have a range of benefits. Health benefits are substantial and arise primarily from increases in physical activity, particularly where people are currently relatively inactive. Other health benefits stem from declines in air pollution if car trips decline, and – given substantial mode shift – falls in injury levels. Cycling is very efficient, allowing many times more people to be transported in a given space than cars. Additional benefits include the ability to increase mobility among poorer citizens and those with limited access to private motor vehicles, such as children.

However, the benefits of cycling are currently far from being realised in England. Research demonstrates that the major barrier to increasing cycling is fear of motor traffic, with a systematic review conducted for DfT (Aldred et al 2016) showing that women have a particularly strong need for cycling infrastructure away from motor traffic, such as tracks on main roads. Under-represented groups such as women and older people also benefit from such routes being direct, because they are less likely than men and younger people to cycle longer journeys.

Building 'gold standard' infrastructure for cycling is increasingly recognised as necessary to begin achieving our potential. This gold standard comprises three main types of infrastructure, all different but all providing the necessary high level of service for cycling by a range of ages and abilities (TfL 2014):

- Cycle tracks, physically protected from motor traffic, on busy roads.
- Greenway routes – cycle paths that run through parks, for example, or along rivers or disused rail lines. If direct, well surfaced and usable after dark (see for instance the Cambridge Busway Cycleway) they can be excellent contributors to a utility cycling network.
- Very quiet residential streets, with only the occasional motor vehicle even at peak. Where streets are currently insufficiently quiet, this will require removal or substantial reduction of through motor traffic.

But where should this infrastructure be built? The Propensity to Cycle Tool (PCT) can help answer this question, examining which trips are most likely to switch to cycling under specific scenarios. For this case study, we have focused on the tool's 'e-bike' scenario.

About West Sussex

West Sussex is a county in the south of England, bordering East Sussex (with Brighton and Hove) to the east, Hampshire to the west and Surrey to the north, and to the south the English Channel. Chichester in the southwest is the county town and only city, with the largest towns being Crawley, Worthing and Horsham[1]. Crawley and Worthing both have just over 100,000 inhabitants. West Sussex includes some hilly and rural areas, and over half the county is protected countryside.

[1] https://en.wikipedia.org/wiki/West_Sussex

The scenarios

The Propensity to Cycle Tool uses scenarios to identify which areas and routes might see greatest cycling uptake under different scenarios of the future. The tool currently uses Census 2011 Travel to Work data at the level of a Middle Layer Super Output Area (MSOA), a unit of population of around 7200 people, usually at least 5000. The basic concept involves using a statistical model to identify journeys that might be most likely to switch to cycle, based on trip distance and hilliness, established as being substantial barriers to cycling. The tool can then also route cyclists using Cyclestreets.net, which we use to provide estimates of scenario cycling potential along different route sections.

The graphs below show how the likelihood of cycling declines, as distance or hilliness grow:

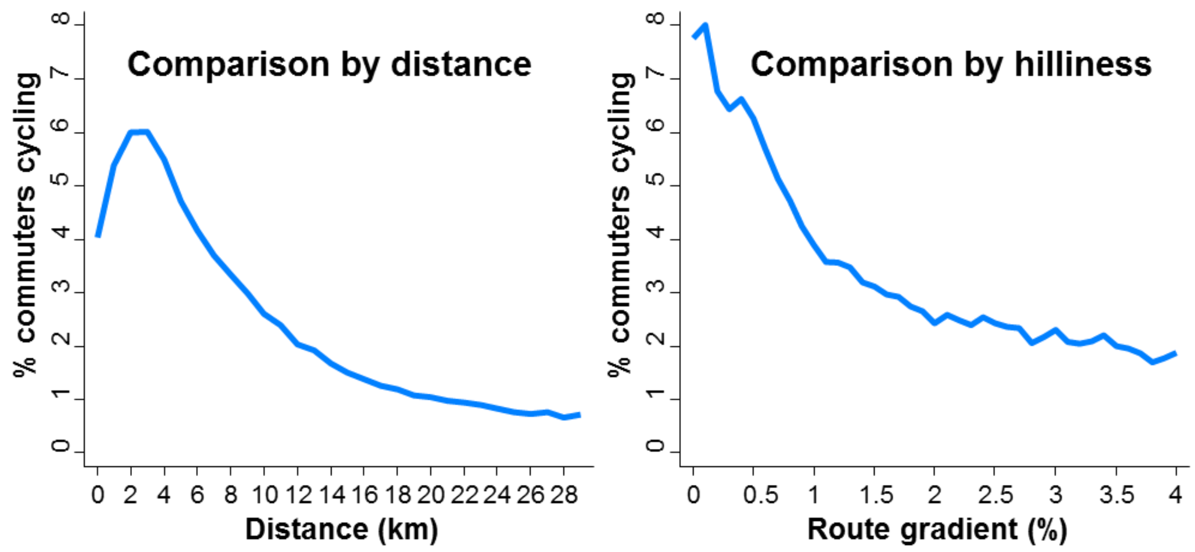

Figure 1: how cycle commuting relates to distance and hilliness (based on Census 2011 Travel to Work data)

There are four core scenarios:

1. Government Target – the target for cycling in England for 2025, involving a doubling of cycling nationally.
2. Gender Equality – women cycle at the same rate as men do now, for each origin-destination pair.
3. Go Dutch – uses the probability that each given trip would be cycled in the Netherlands, based on length and hilliness. In other words, the scenario assumes that England overcomes its infrastructural and cultural barriers to cycling, but hilliness and journey characteristics stay the same.
4. E-bikes – A kind of Go Dutch plus, based on Dutch and Swiss data, assuming that people use e-bikes for longer or hillier journeys as the Dutch and Swiss already do.

E-bikes

In this report we have chosen to focus on the E-bike scenario. In the UK e-bikes are still seen as a niche product. However, in many parts of Germany and Switzerland e-bikes make up a substantial proportion of new bike purchases: 11% of all bicycles sold in Germany are e-bikes (Schleinitz et al in press). Fishman and Cherry (2016) note that e-bikes represent one of the fastest growing segments of the transport market. E-bikes increase cycle use and have health and CO_2 benefits, with the largest market currently being China, followed by The Netherlands and Germany. In four years, sales in Europe have doubled and in the United States have almost quadrupled (Fishman and Cherry 2016).

Potentially, e-bikes could also contribute to improved age and/or gender balance, as well as enabling more cycling by disabled people. Dill and Rose (2012) identify key demographic markets for e-bikes within the United States as being ‘women, older adults, and people with physical limitations’. Reporting a Norwegian study, Fyhri and Fearnley (2015) found that giving e-bikes to study participants led to an increase both in number of trips cycled and cycled distances, with the effect larger for female than for male cyclists. Literature and data on e-bikes, while still limited, suggests that if cycling takes off, e-bikes will be increasingly popular and should help grow cycling further, particularly in hillier areas.

The quantitative and qualitative changes in cycling enabled by e-bikes may provide additional reasons why high quality infrastructure is necessary. For example, a wider range of speeds on cycle paths (and use of wider e-cycles, such as cargo bikes) implies the need for space for pass slower riders.

Area-based cycling potential in West Sussex

Current cycling and scenario-based growth

The figure below illustrates current levels of commuter cycling across all West Sussex MSOAs. It can be seen that some areas have relatively high levels of cycling for England, with the highest being 9.4% (Chichester 008). However, overall the cycle commuting rate across West Sussex is 3.4%, not much higher than the national average. A fifth of MSOAs have cycling rates of under 1.6%; these tend to be the more rural and hillier MSOAs.

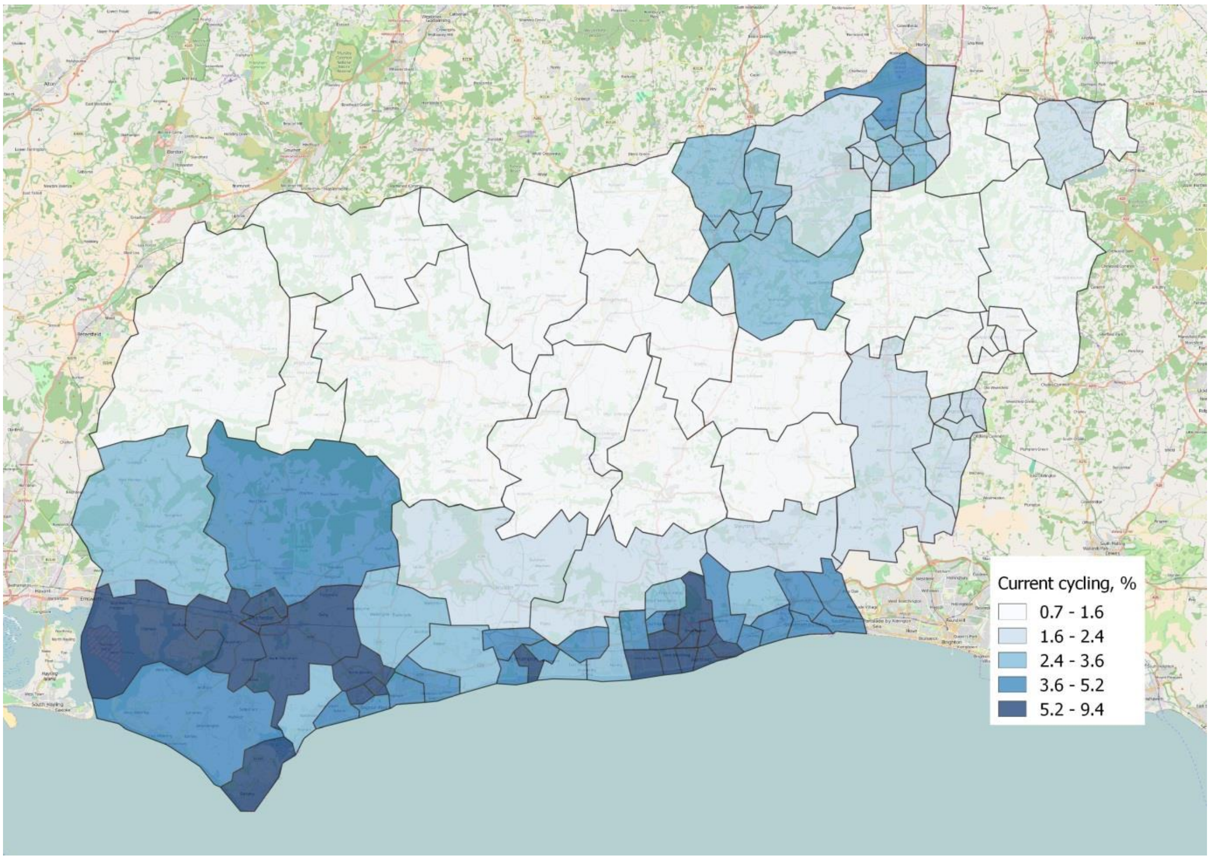

Figure 2: Current commuter cycling rates in West Sussex

The figure below shows the scenario cycling rates under the ‘Go Dutch’ scenario. This assumes that West Sussex commuters are as likely to cycle trips of particular lengths and hilliness as the Dutch are. In other words it assumes that we have overcome infrastructural and cultural barriers to cycling, and the barriers that remain are solely due to land use patterns and topography. Under the ‘Go Dutch’ scenario, West

Sussex has cycle commuting rates of 20.7%. So it can be seen that while the county may be hillier than the Netherlands, this is not in itself a barrier to high levels of cycling.

The hotspots are similar to current cycling hotspots, with Chichester and the towns on the South Coast having high cycling potential, along with Crawley and Horsham to the North-East. These relatively compact urban areas have cycling potential of around 30% of all commutes, whereas some more rural areas are nearer 5%.

It should be noted that the PCT currently only considers the potential for main-mode cycle commuting: this underestimates commuter cycling potential, particularly in places like Crawley and Horsham which form part of the London commuter belt. A related case study for Tunbridge Wells, where bespoke analysis was conducted, found that in some MSOAs cycle-to-station commuting potential topped 50%!

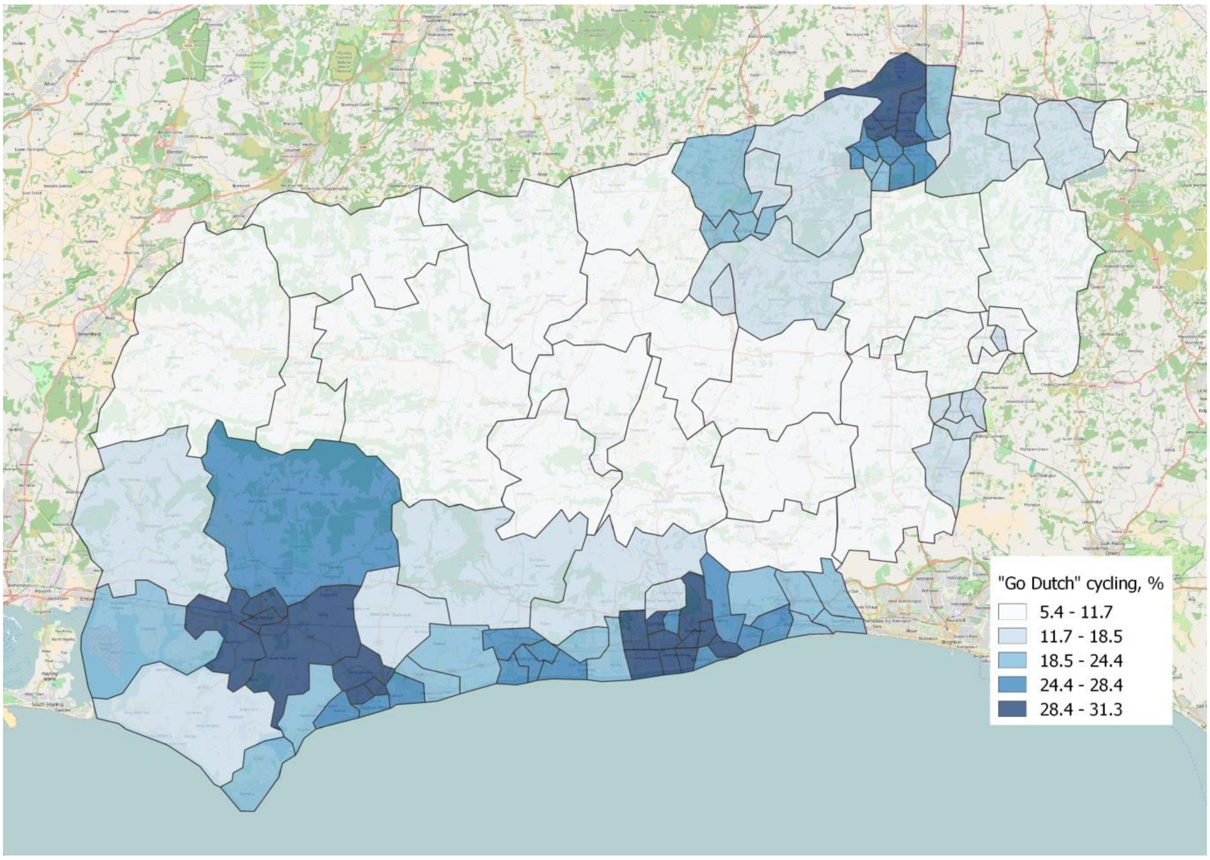

Figure 3: 'Go Dutch' commuter cycling rates in West Sussex

The figure below shows how this potential changes under the 'e-bike' scenario, which takes 'Go Dutch' and adds to it the potential represented by mass use of e-bikes. If cycles themselves become more mainstream, we can anticipate that in hilly and rural areas e-bikes may become very widely used (as in Germany or the Netherlands where a million e-bikes are sold each year).

The main contribution of the 'e-bike' scenario is to substantially increase cycling potential in the rural and hillier MSOAs. There is relatively little difference in the more urban areas, where trips are shorter. However, where under 'Go Dutch' the bottom 20% of MSOAs have cycling rates of 5.4%-11.7%, under 'e-bikes' this rises to 11.6%-19.0%. In other words, cycling becomes thoroughly normal across West Sussex, not just in the towns and cities. This is clearly an ambitious scenario, but one based on data from the Netherlands and Switzerland on the types of journeys that people there decide are suitable for cycling.

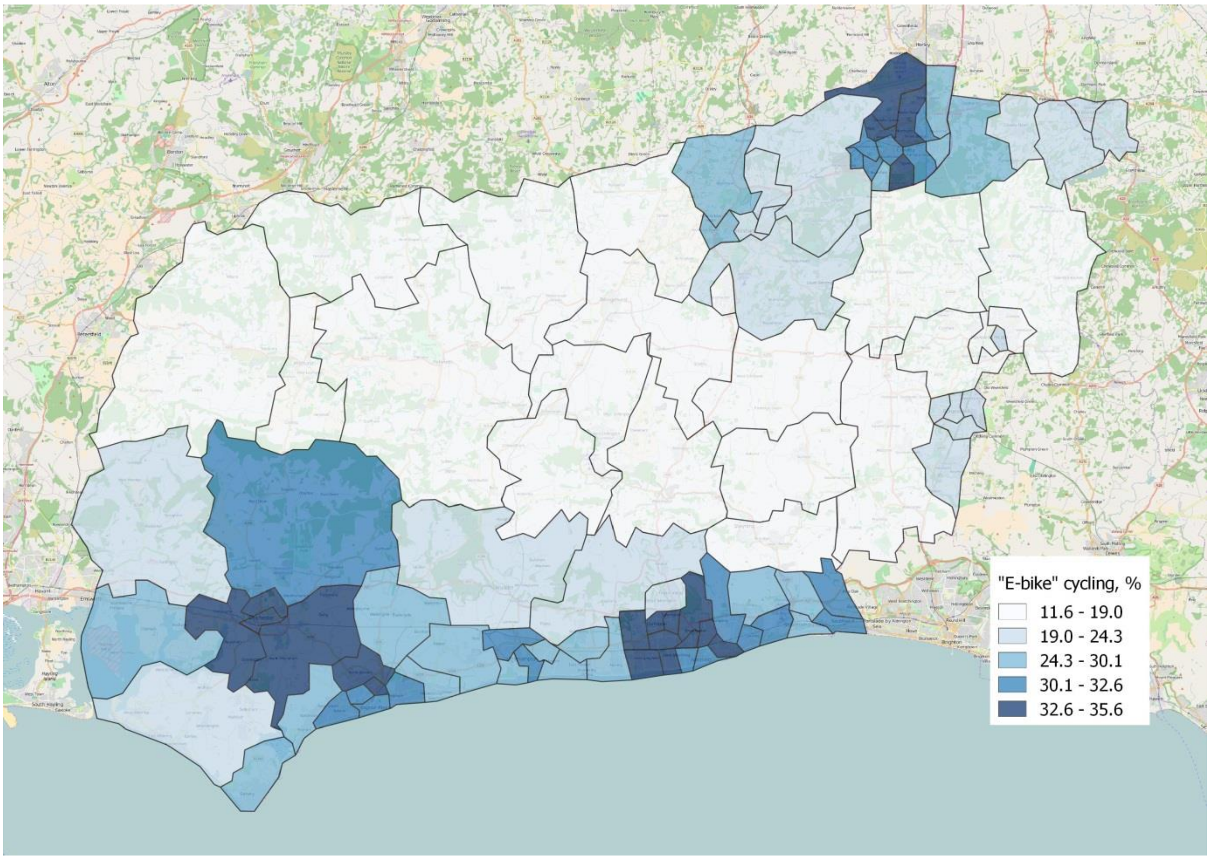

Figure 4: 'E-bike' commuter cycling rates in West Sussex

The figure below shows how the numbers of new cyclists varies between MSOAs. In some MSOAs, there are around 1000-1500 new cyclists; even for the MSOAs with lower increases, each sees at least 235 new cycle commuters.

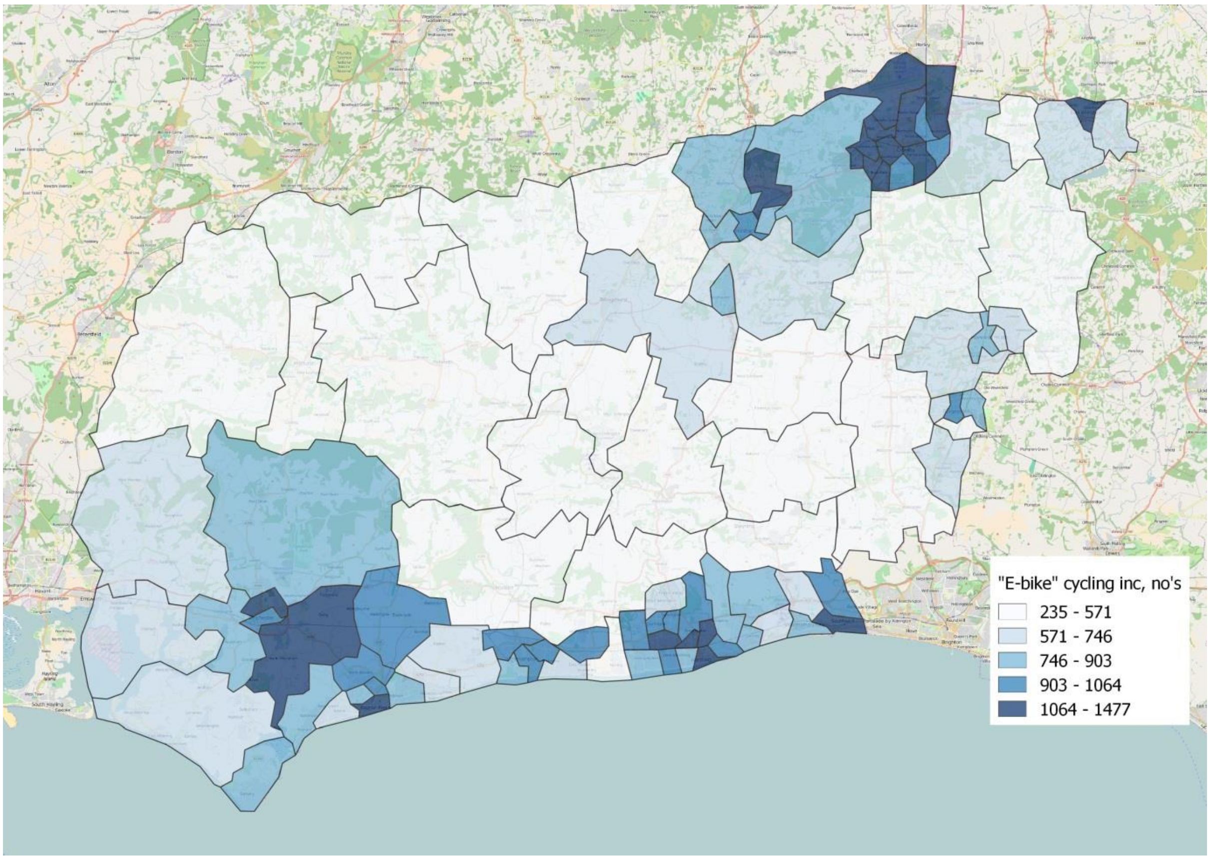

Figure 5: increase in cycling, e-bike scenario, absolute numbers per MSOA

Some statistics from the e-bike scenario:

- There are 348,421 commuters in West Sussex
- Under the e-bike scenario, 91,863 of these cycle to work (as main mode)
- This represents an increase of 80,079 cyclists – almost an eight-fold increase.

E-bike scenario benefits

Cycling has many benefits and this report can only touch on a few. Firstly, where bikes replace cars on the road this represents a more efficient use of highway capacity. The e-bike scenario results in 52,090 cars being removed from rush hour roads: this is less than the number of new cyclists because the model also allows people to shift from being car passengers, public transport users, and pedestrians, depending on current travel patterns for each commute origin-destination pair.

In West Sussex around 65% of new cyclists transfer from driving cars. The figure below illustrates how this is distributed, showing that while in each MSOA hundreds of car trips are removed, this varies by location. Clearly the cycling potential has an impact, but so also does the current level of car dependence; in city centre locations a relatively high proportion of trips may already be made by more sustainable modes.

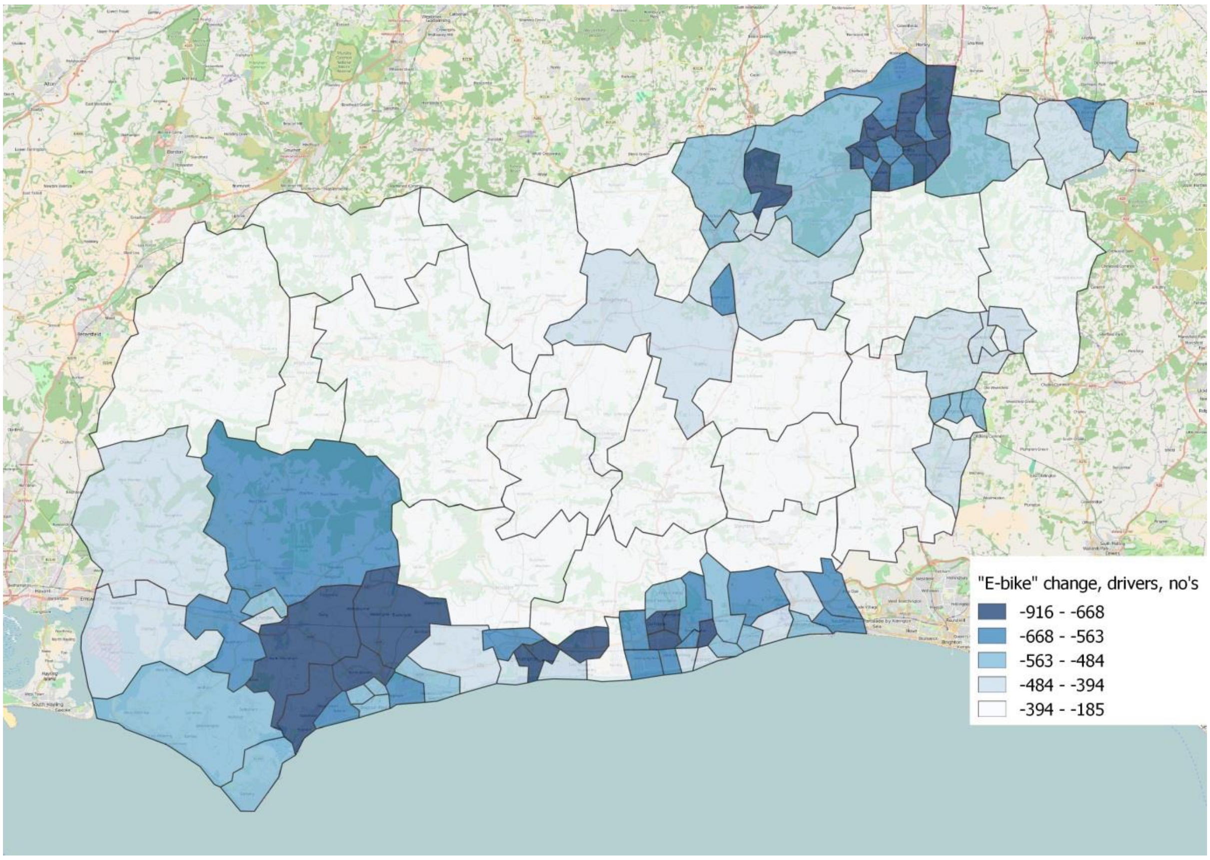

Figure 6: change in numbers of drivers per MSOA, e-bike scenario

The figure below shows the same data but in percentage form.

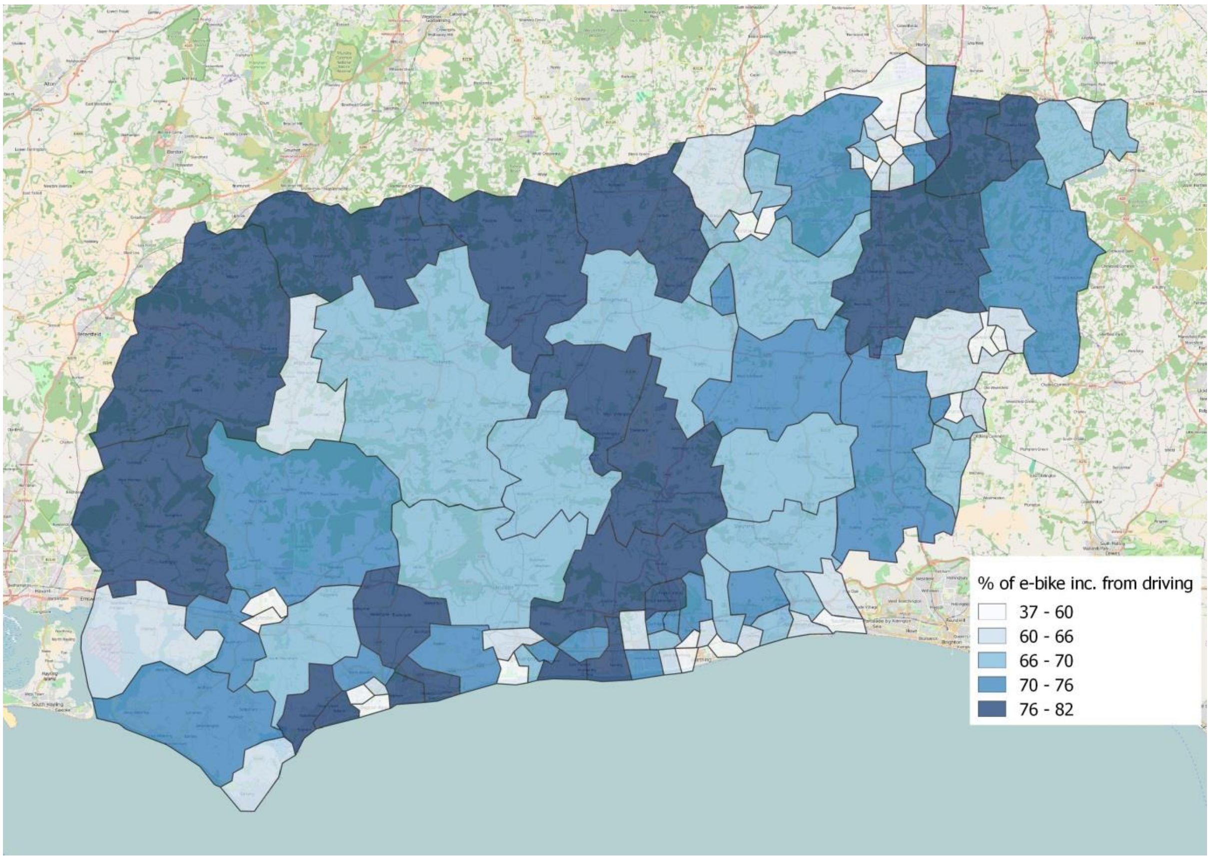

Figure 7: percentages of new cyclists coming from driving, e-bike scenario

Health benefits are an increasingly important reason to enable cycling. Across the whole of West Sussex, achieving the e-bike scenario levels of cycling would bring a health economic benefit of nearly £25 million per year (£24,775,295), compared to current levels of cycling. This is calculated using a modified version of the World Health Organization's HEAT tool, taking into account local population age structures and health status. It also depends on the length of trips and on what mode the trip is transferred from (active or inactive). It can be seen that while all MSOAs have substantial health benefits, the very highest are concentrated in the South-West and North-East of the county.

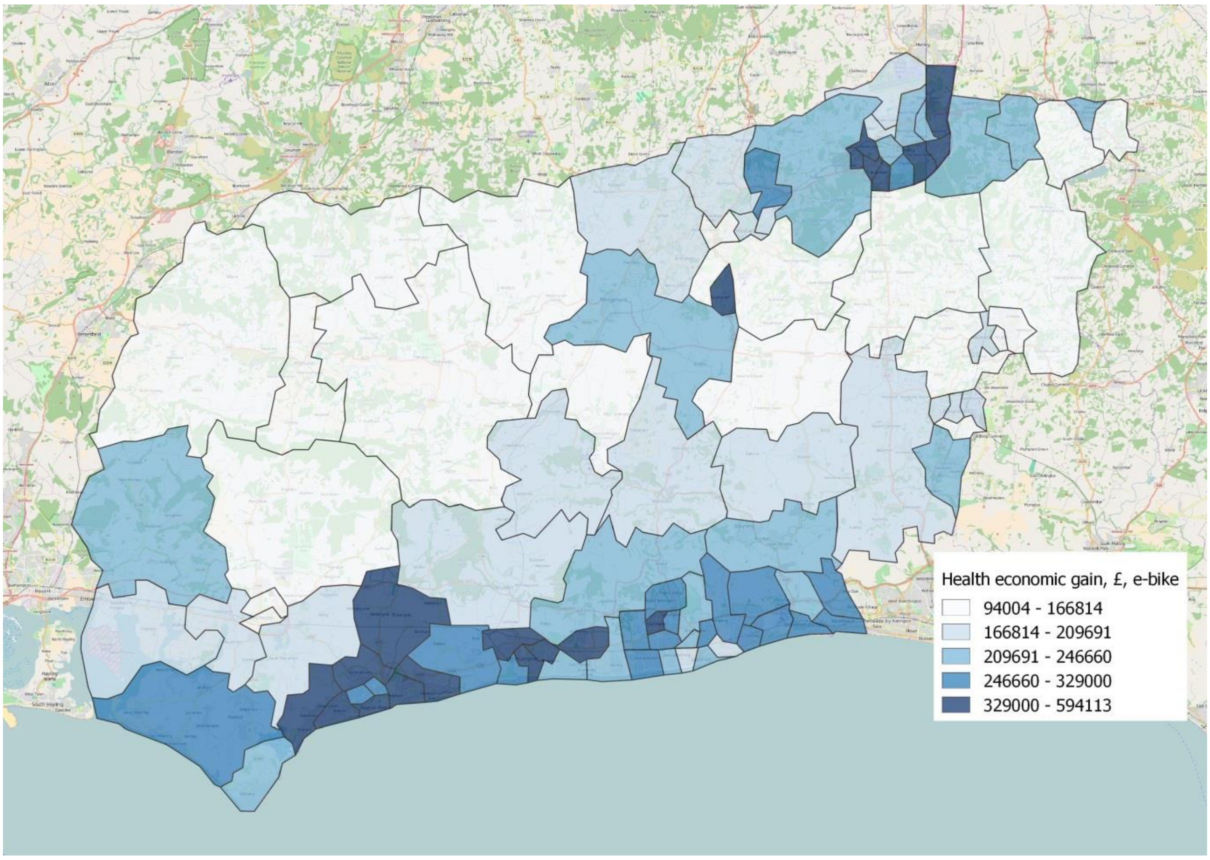

Figure 8: Health economic gain per MSOA, e-bike scenario

Carbon reduction is another potentially important benefit of cycling growth. The PCT calculates this using the numbers of trips (and their length) transferred away from the car. For West Sussex as a whole the e-bike scenario reduction in CO_2 (compared with current cycling) is 15,930,516kg/yr.

MSOAs with the highest potential scenario health gain are often not the same ones as those with the highest potential carbon reduction. This is the case here to some extent, with some relatively car-dependent MSOAs in the centre of the county showing relatively high carbon benefits, despite the numbers of trips transferred being lower than in some MSOAs with higher absolute cycling potential.

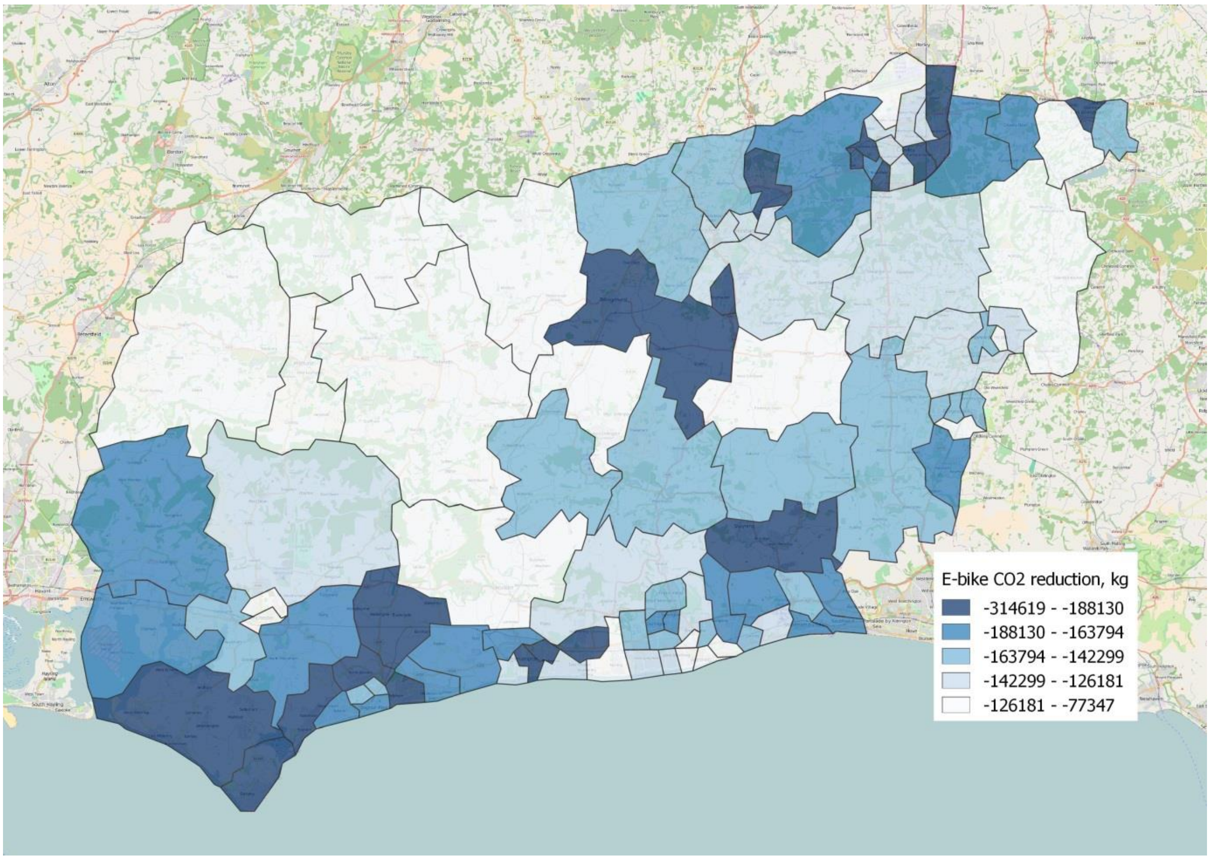

Figure 9: Carbon reduction per MSOA, e-bike scenario

Route-based cycling potential

The next section of the report looks at route-based cycling potential. It should be remembered that while area-based potential includes all commuters, the route-based potential cannot include them all: for instance, some people commute wholly within an MSOA zone and hence cannot be routed here to the network, while others do not have a fixed place of work.

From the pct.bike's 'Model Output' page for West Sussex:

> In West Sussex there are 1588 between-zone flows that a) start and end in West Sussex, b) have a straight-line (Euclidean) distance of less than 20km and a fast-route distance less than 30km, and c) contain more than 10 commuters (by any mode, counting commuters in both directions). These 1588 between-zone flows are visualised as **Straight Lines**, **Routes** (fast and quiet) and the **Route Network** on the interactive map, and account for 49% of all commuters living in West Sussex.

The image below shows all included origin-destination pairs within West Sussex:

Figure 10: all included flows within West Sussex

The figure below shows only the top 20% of flows, by scenario numbers of commuters (here as before using the e-bike scenario). As with the area-based potential, the highest flows are concentrated along the South Coast and around Chichester, or towards the North-East of the county.

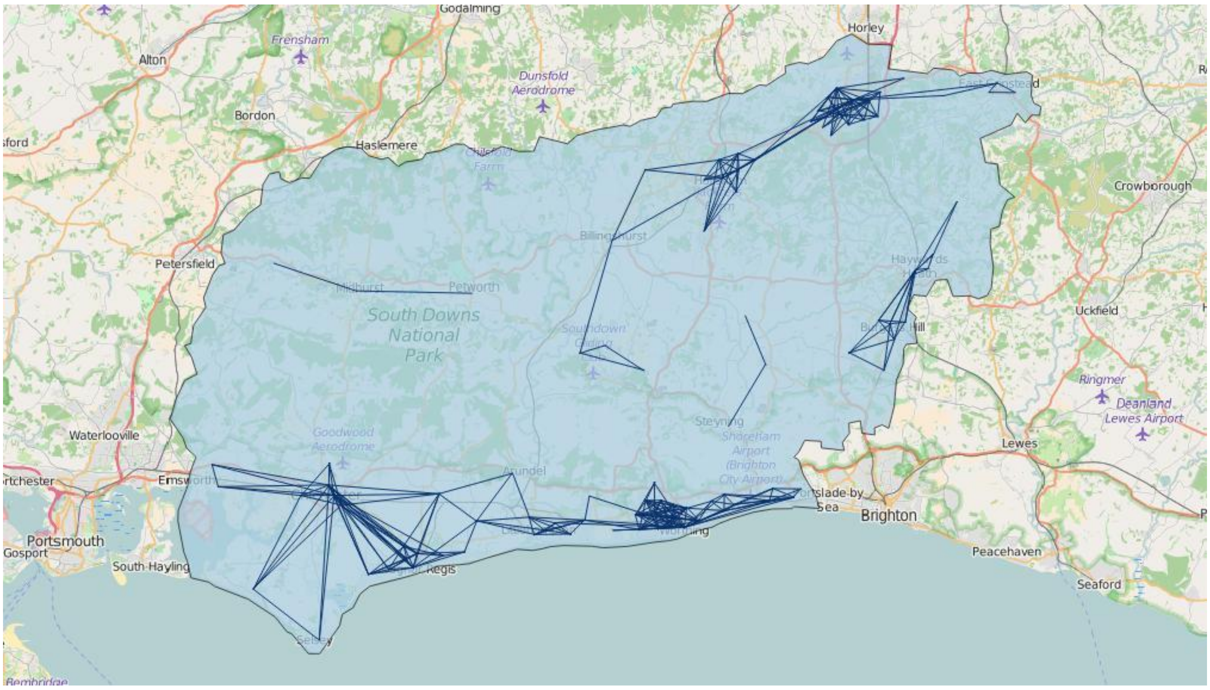

Figure 11: Top 20% of flows, West Sussex

The figure below similarly shows the top 20%, but this time in terms of the health benefits. This has a tendency to highlight some of the longer trips, as well as those that are more likely to switch from inactive (primarily car-based) transport.

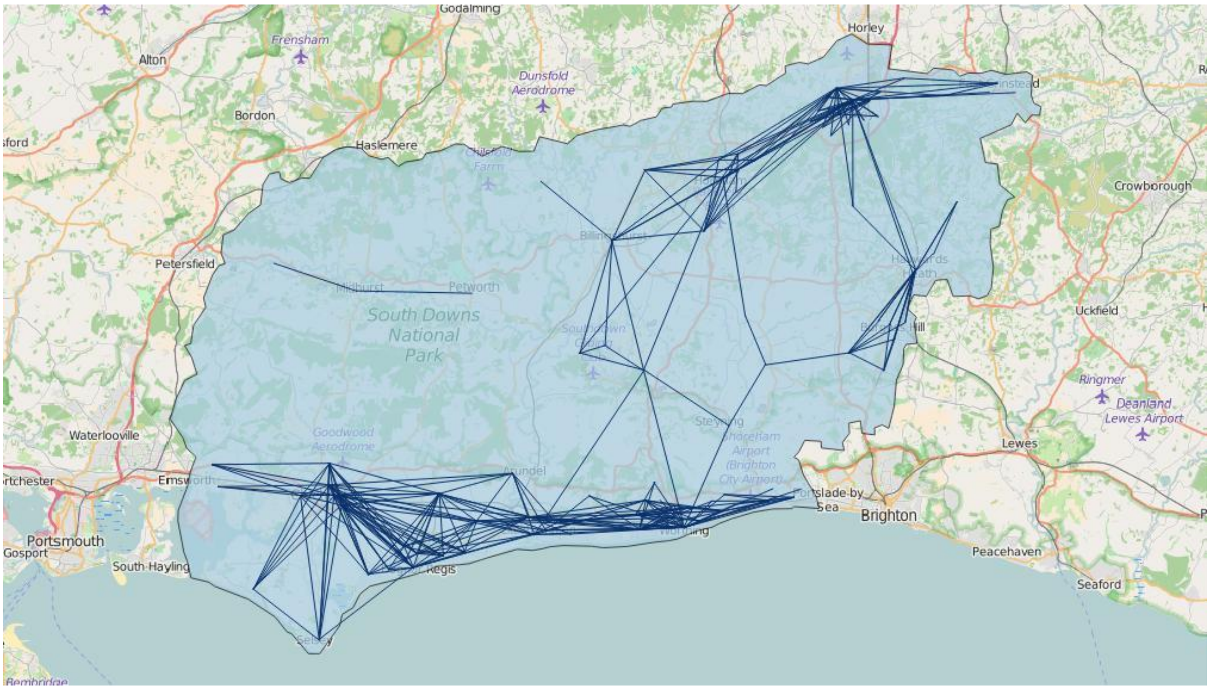

Figure 12: Top 20% of lines for health benefits, e-bike scenario

The figure below highlights the top 20% of lines for carbon reduction benefits. Again the map shifts to some extent away from the denser towns with higher absolute cycling potential, and towards some of the longer trips that have a greater impact on kilometres driven.

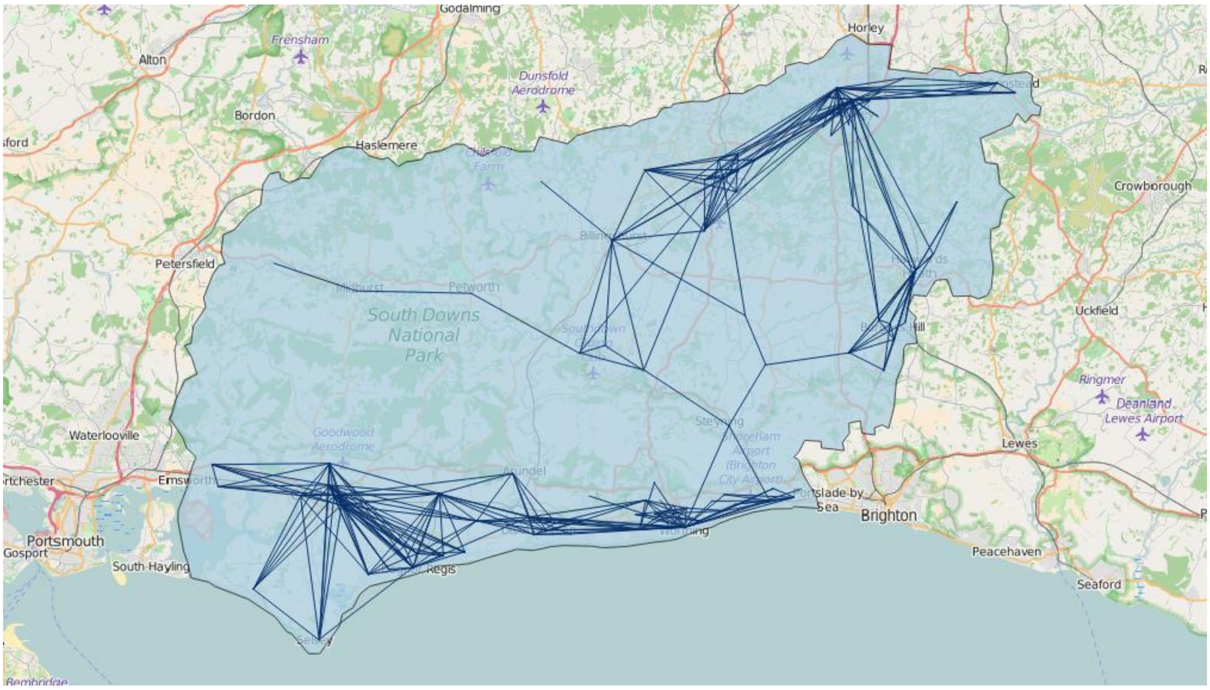

Figure 13: Top 20% of lines for carbon reduction, e-bike scenario

The figure below superimposes fastest cycling routes onto all the straight line flows. In this report and elsewhere, we tend to look first at the fastest routes, because these tend to maximise cycling potential, if they can be made safe and inviting for cycling. This is because every increase in distance (over around 2km) or hilliness results in a decrease in cycling potential.

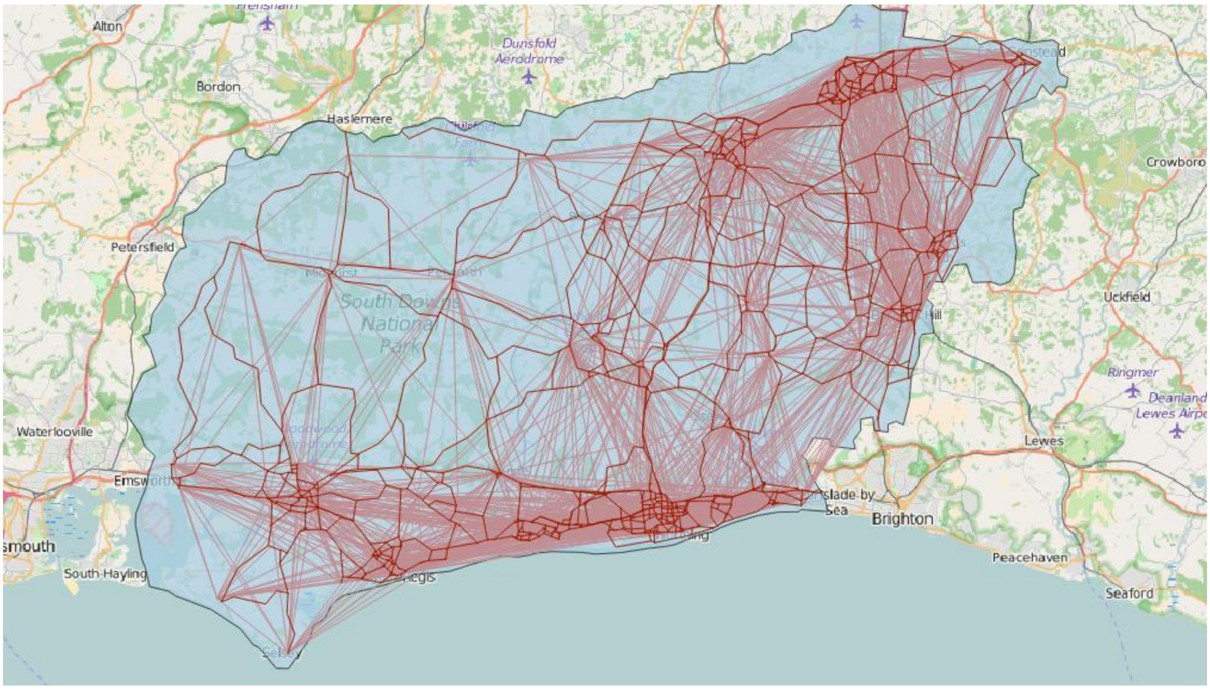

Figure 14: straight lines and fastest routes, West Sussex

The figure below, by contrast, aggregates all modelled cycling flows to the route network, showing which routes have the highest numbers of cyclists under the e-bike scenario. This represents an approximate outline of a potential route network for commuter cycling, indicating which routes might be prioritised for high quality cycle infrastructure. In the map below the thicker lines represent the higher priority/higher potential routes, and the thinner lines routes that be improved as a lower priority. It should be remembered, however, that some of the higher flows may depend substantially on feeder routes, and that – for example – improving only the routes that are very near a city centre may not be sufficient to realise all or most of the cycling potential along those routes.

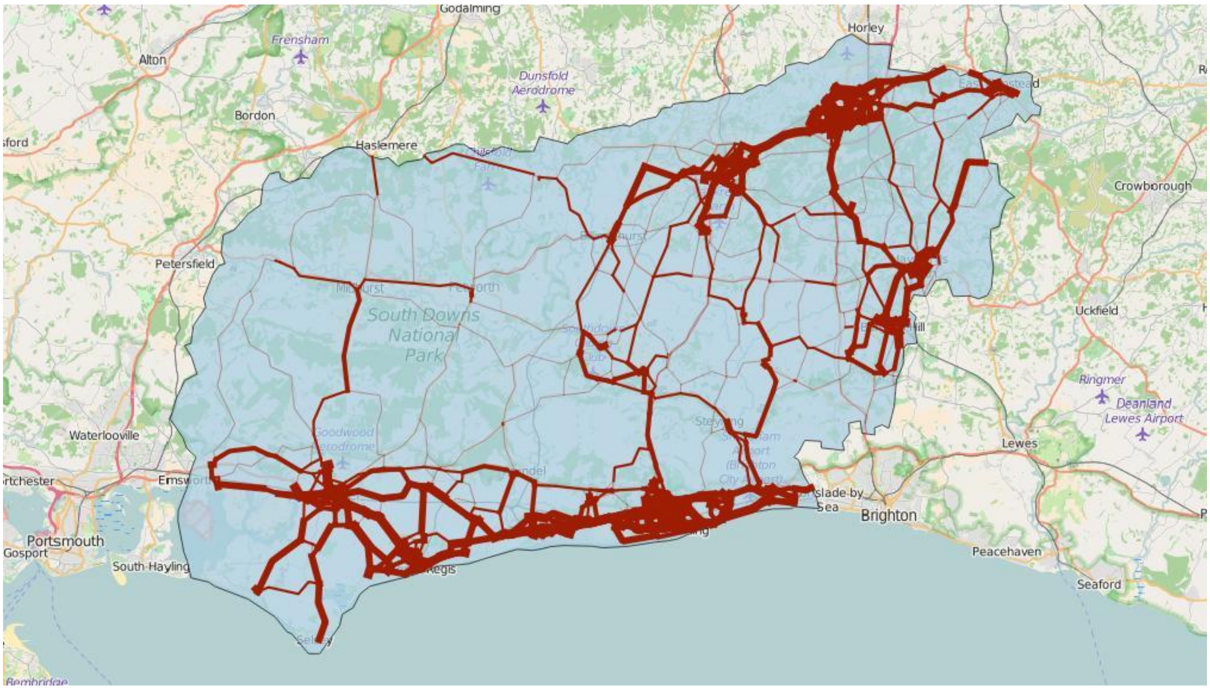

Figure 15: scenario commuter cycling in West Sussex: potential priority route network

The next two images are close-ups of Chichester, the county town, showing where a priority route network there might be:

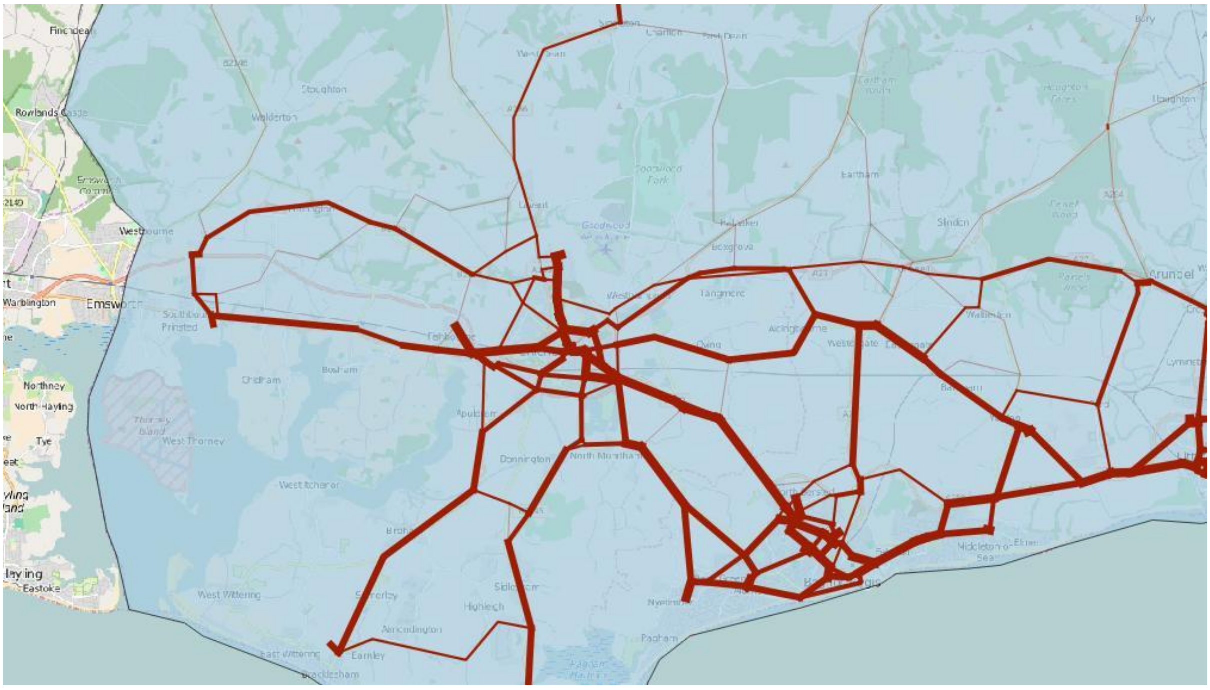

Figure 16: scenario commuter cycling in Chichester: potential priority route network (1)

Figure 17: scenario commuter cycling in Chichester: potential priority route network (2)

The figure below gives an example of the level of increase one might see along a specific route section. In Chichester, the A259 (Bognor Road) currently has 93 cycle commuters (assuming they are all following the most direct route), while under the e-bike scenario this rises more than ten-fold to 1,143.

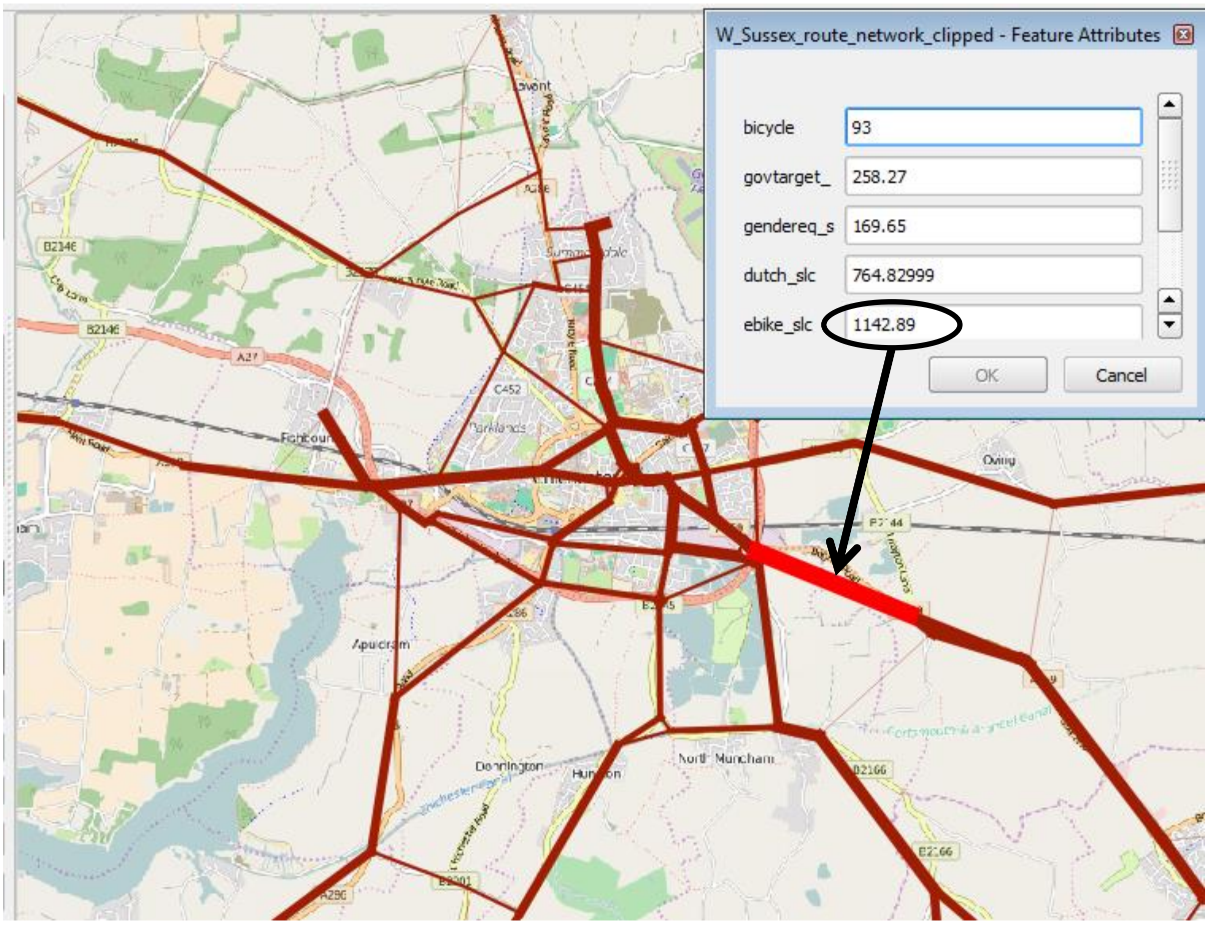

Figure 18: illustrative cycling potential, A259 Bognor Road

The A259 Bognor Road does already have a cycle path. As with many such paths quality is currently poor: for example, it is narrow (no overtaking, wide cycles, or commuting two abreast), only on one side of the road (crossing over part way along), and has problems at junctions (especially at roundabouts, but cyclists are also required to give way at side roads and lay-bys). While it does not have the capacity to handle the scenario increase in cycling it presents an opportunity to improve an existing facility, rather than build one entirely from scratch.

Figure 19: the A259 Bognor Road

Case Study: the A264 corridor

This last section of the report presents a brief case study of the A264 corridor between Crawley and Horsham, and in particular to compare the fastest and quieter routes generated by the Cyclestreets journey planner. First, the figure below highlights the route network potential for this corridor, with the A262 having e-bike scenario cycling potential of over 1250 main mode commuters, as opposed to 55 currently (assuming all commuters use this challenging but more direct route).

Please note that this does not take account of additional housing built since 2011, or currently planned. Some such developments are substantial and likely both to increase cycling potential overall, and to shift the spatial distribution of top cycling potential in West Sussex. While the Southern coastal strip is indicated as having very high potential based on the Census data, it is already relatively built-up so the potential is less likely to increase further in the coming years.

It should also be noted that while building routes along A roads outside of built-up areas may be necessary to increase cycling, a route is only as good as its weakest link – it should not be assumed that improving the A264 would be the only thing needed to increase cycling between the two towns.

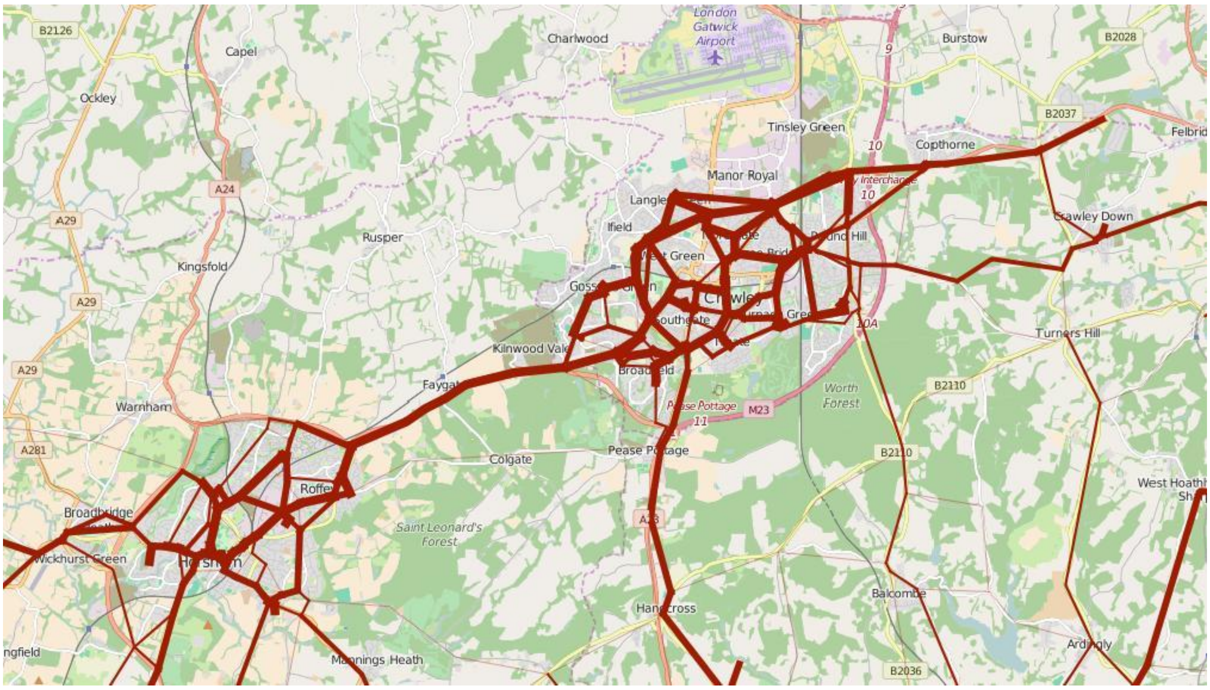

Figure 20: route network potential, A264 corridor

The route network aggregation allocates cyclists to the fastest legally cycleable route: as discussed above, this is because there is a decline in cycling potential as distance and hilliness grow. However, as the figure below illustrates, the A264 is a busy and intimidating road, despite being legally cycleable.

Figure 21: the A264

Currently, it is likely that many cyclists making the trip between Horsham and Crawley would use an alternative, quieter route. This case study examines the difference between faster and quieter routes, and what difference this makes to potentially cycled journey times and distances. The figure below illustrates straight line journeys considered as part of this section. These represent 1,127 potentially cycled commutes (10% lower than the route aggregation figure for the A264, which includes slightly more OD pairs).

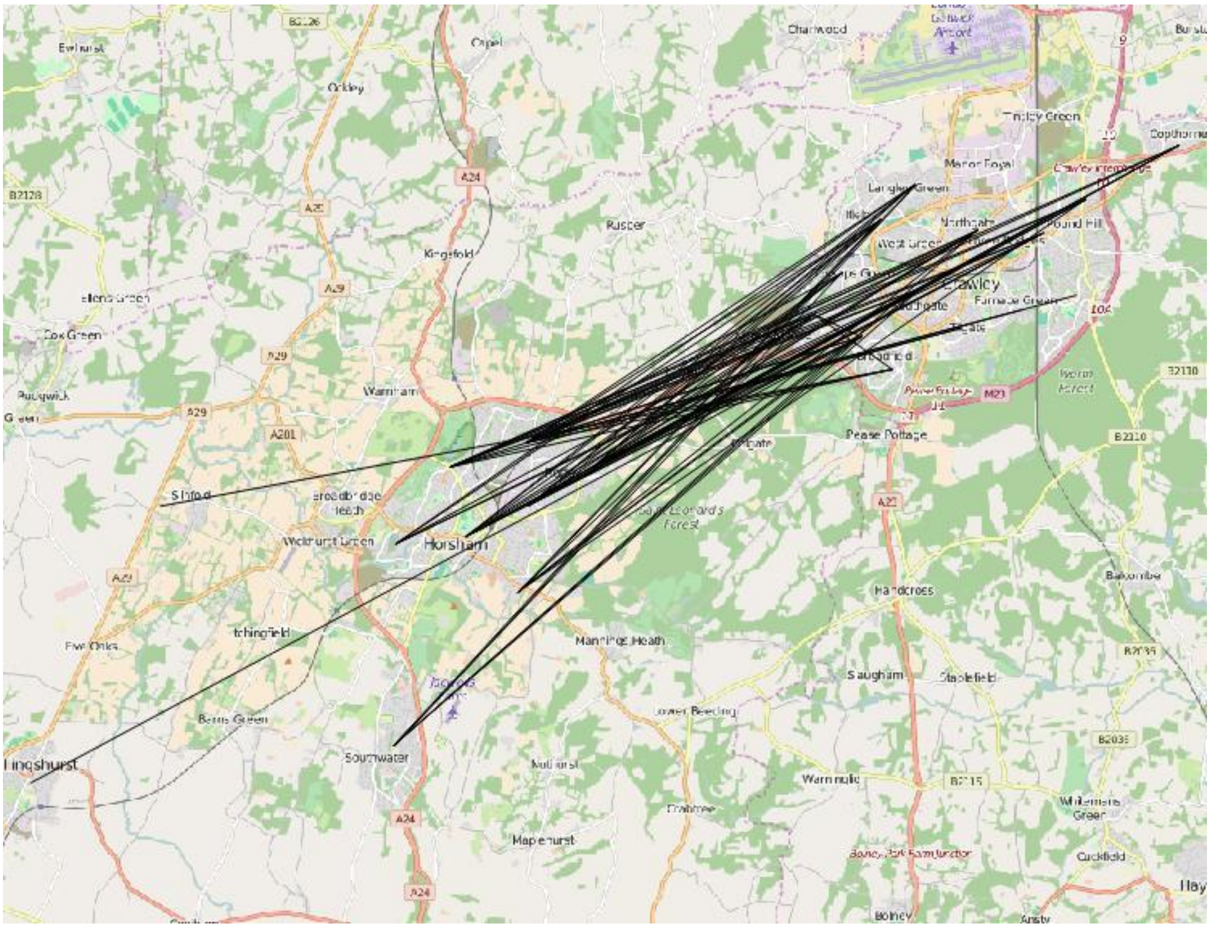

Figure 22: extent of A264 corridor case study

The figure below maps the fastest (blue) and quieter (green) routes corresponding to these 'desire lines'. The 'quieter' routes are those identified by the Cyclestreets journey planner as alternatives to the fastest routes which may often be hostile for cycling (as is the case for the A264). A couple of general caveats should be noted in relation to the comparison of fastest and quieter routes:

- 'Quieter' routes may differ in the extent to which they are 'quiet'. Many will still include what Cyclestreets describes as 'very busy sections', so it should not be assumed that a 'quiet' route is necessarily a high quality cycle route. It may follow a street used as a 'cut through' by high volumes of motor traffic, for instance, or involve difficult crossings of major roads.
- In some cases, there is no reasonable quieter alternative. In those cases the 'quieter' route shown will simply be the same as the direct route.

The quieter route representing the alternative to the A264 between Crawley and Horsham can be seen in green. It should be noted that this route is not fully complete, having a 'missing link' at the Horsham end. From the perspective of maximising cycling potential, completing this missing link is a good thing to do in any case, meaning that an attractive route (which is mostly complete, following earlier investment) is properly connected rather than ending in an unsafe crossing of a dual carriageway. However, what we are considering here is whether that missing link will adequately serve the more than 1,250 potentially cycled commute trips whose fastest link would be the A264.

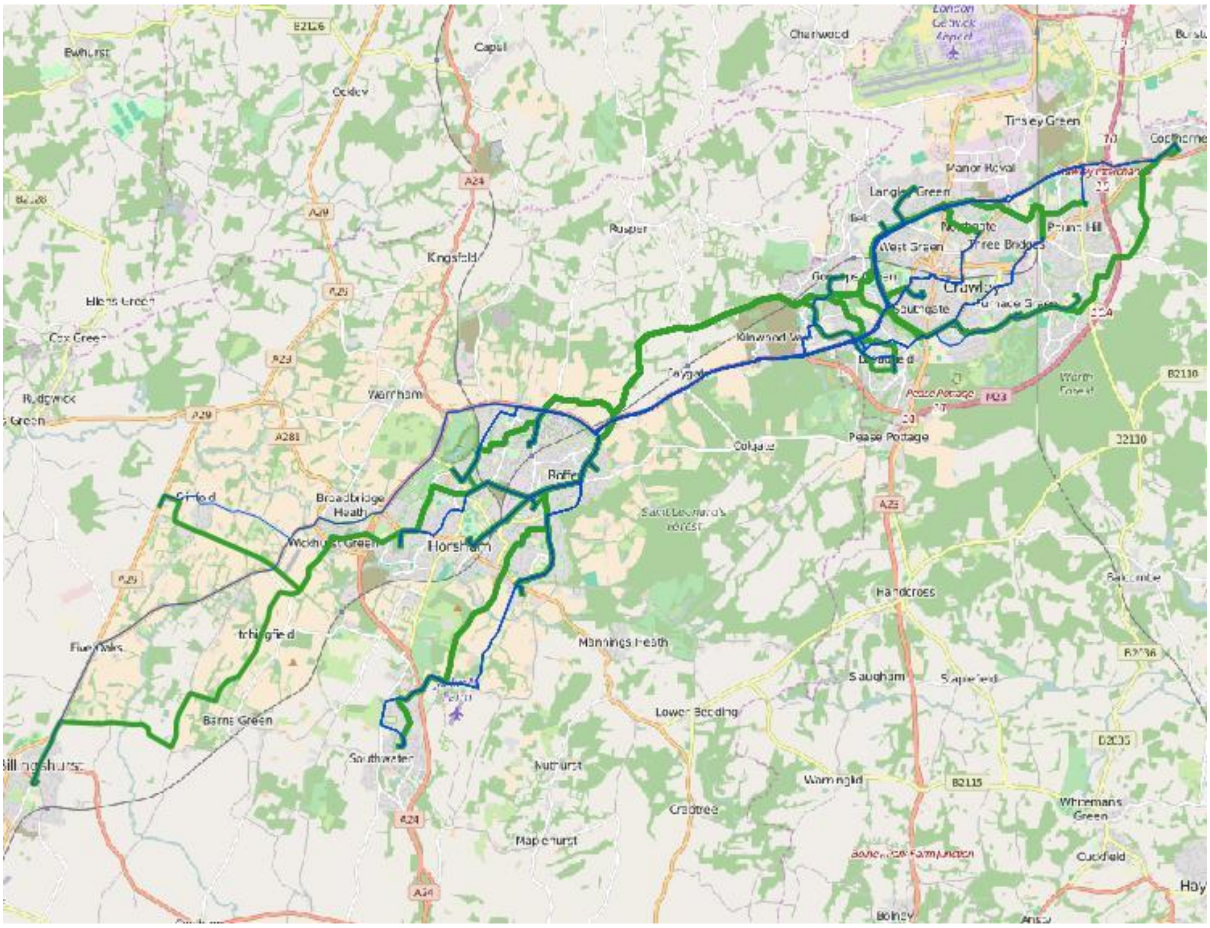

Figure 23: Fastest and quieter routes, A264 corridor

The figure below illustrates one particular origin-destination pair, and the quieter and faster routes to which it corresponds:

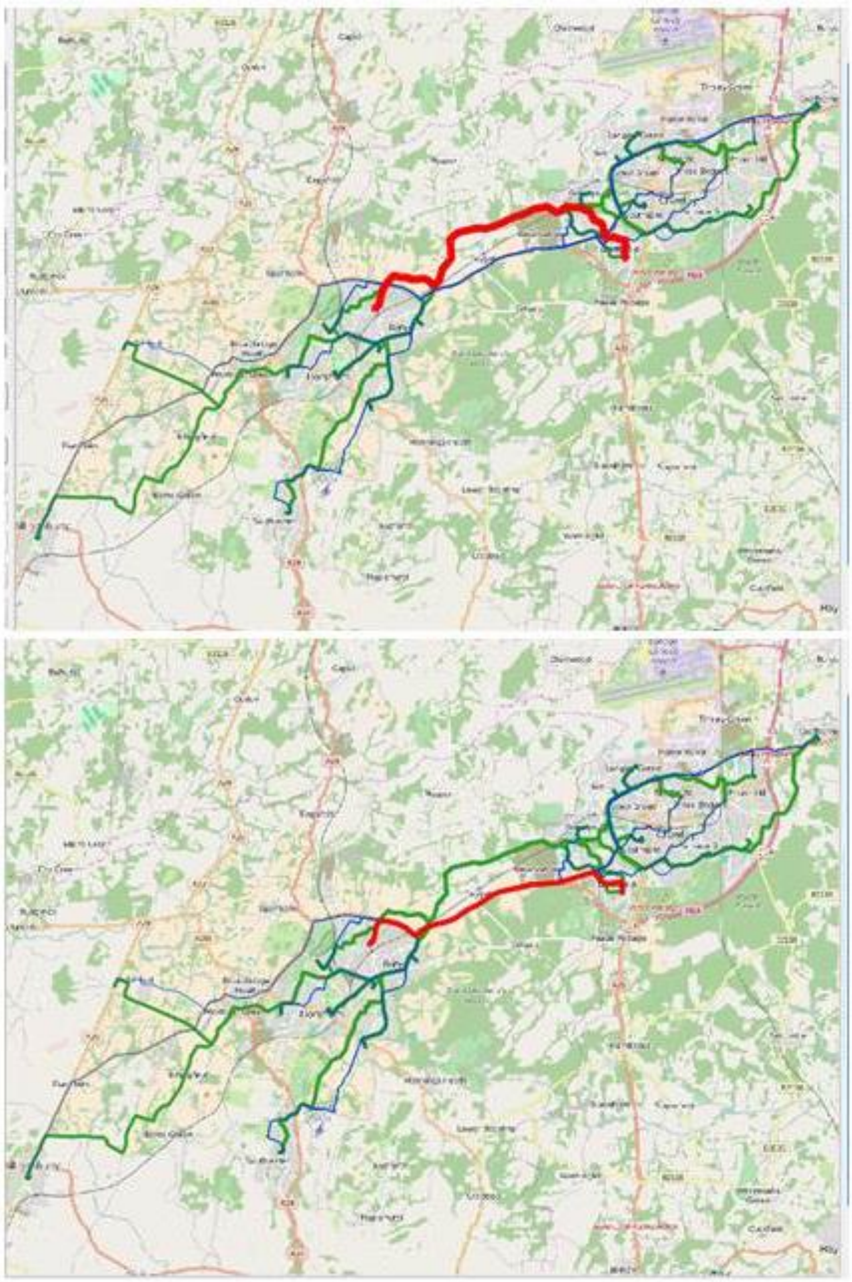

Figure 24: quieter route (above) vs. faster route (below)

The two graphs below illustrate the penalties that following the quieter routes imposes upon potential cycle commuters, in terms of distance. The distance penalties are lower than the time penalties are likely to be, because the quieter route is hilly, while the A264 is largely flat. Hence, while it might be possible to improve speed on the quieter route, by for example improving surfacings and crossings, the time penalty would still be larger than the distance penalty. The graph below shows that while 38% of potential cycle commuters would find the quieter route no longer, or only very slightly longer, almost half would be travelling a distance that is 10% longer or more.

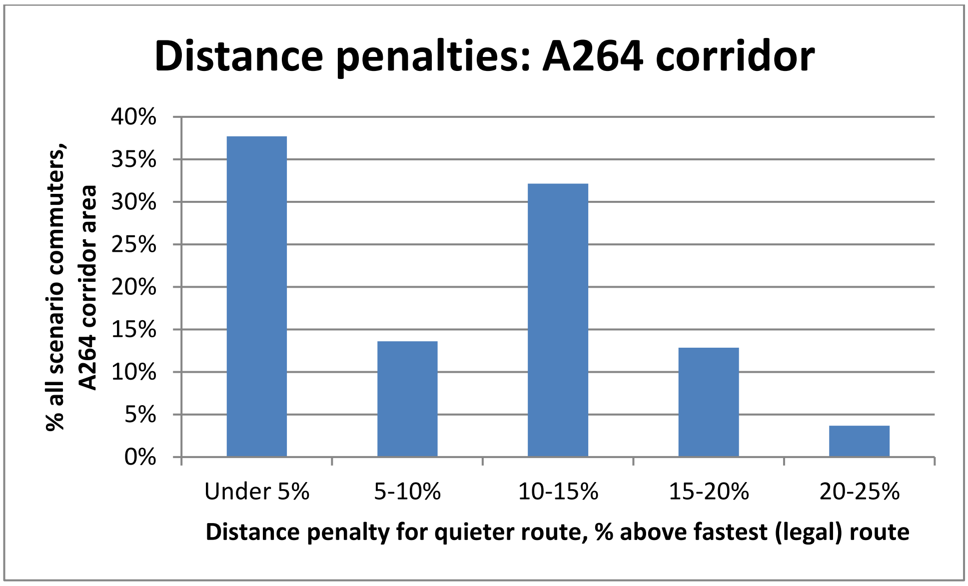

Figure 25: Distance penalties, A264 corridor

The figure below shows time rather than distance penalties. Here the impact of the additional hilliness is highlighted – as also indicated on the Google map below showing elevation profiles.

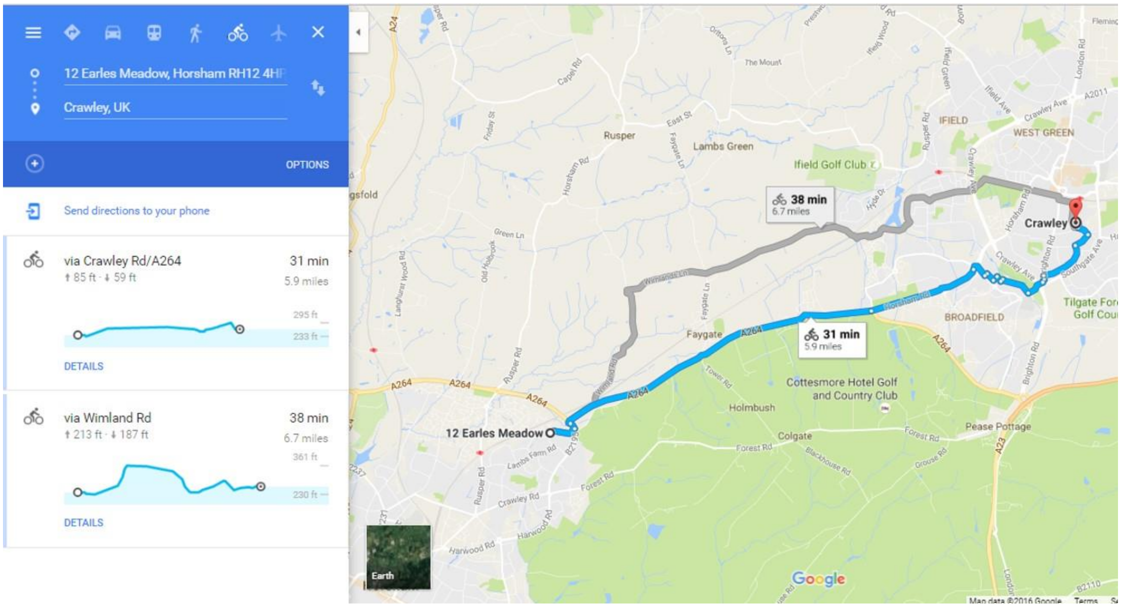

Figure 26: comparison of time and hilliness profiles, edge of Horsham to Crawley

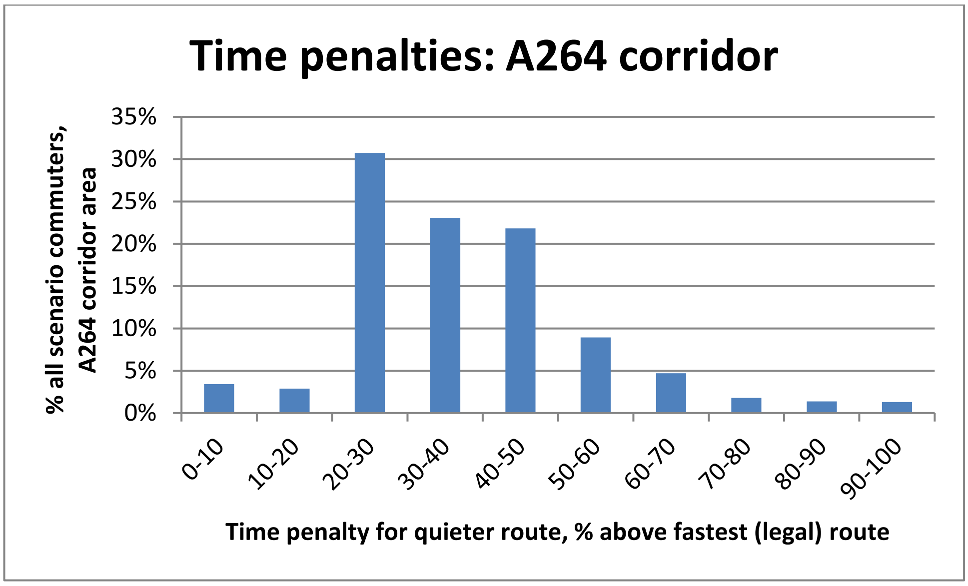

Figure 27: time penalties, A264 corridor

Another way of looking at benefits related to the A264 corridor is to examine the health benefits of achieving the scenario cycling potential, for those commutes already selected which would potentially use the route. The annual health benefits, compared to current levels of commuter cycling among those commuters, is calculated as being £839,503. (It should be noted that these commutes would not *only* use the A264.)

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