# Cornwall Propensity to Cycle Case Study

## Cycling potential in Cornwall, focusing on Bodmin, Penzance, Truro, Falmouth and Newquay

## Contents

## Executive Summary

This report examines cycling potential in Cornwall, with a particular focus on four towns and one city – Bodmin, Penzance, Truro, Falmouth and Newquay. It explains the PCT (Propensity to Cycle Tool) and how it calculated commuter cycling potential. The report focuses on the e-bike scenario, explaining why this is relevant to the case study. Maps are produced showing how current cycling levels compare to cycling potential, and the reductions in driving, health benefits, and $CO_2$ benefits that the tool predicts would result. The focus is then shifted to the five locations and similar calculations are provided for these. Finally, the PCT's ability to map cycle commuting to the route network is drawn upon in providing schematic possible core cycle networks for the five locations. While the PCT only maps main-mode commuter cycling potential (and will not show cycling potential by students to schools or universities, for instance, or to train stations), some route sections show as much as 250-2000 cycle commuters under the e-bike scenario.

The report has been written for Cornwall Council and for the Department for Transport, which commissioned the PCT; but does not necessarily represent the views of those organisations.

## Introduction

Increasing cycling can have a range of benefits[1]. Health benefits are substantial, arising primarily from rises in physical activity among a largely inactive population. In Cornwall, for example, fewer than one in seven adults get the minimum levels of recommended physical activity (5 x 30 minutes per week). Health bodies such as NICE (National Institute for Health and Care Excellence) and PHE (Public Health England) say active travel is one of the best ways of increasing physical activity, because it can form part of everyday routines – and because it is cheap or free.

Other health benefits stem from declines in air pollution if car trips decline, and – if there is substantial shift away from driving – falls in injury levels. Mode shift to cycling can help reduce greenhouse gas (GHG) emissions from transport, which make up almost a third of all GHG emissions in Cornwall. Additional benefits include the ability to increase mobility among poorer citizens and those with limited access to private motor vehicles. Nearly a fifth of Cornish households have no car access and public transport is sparse in rural areas[2]. As Cornwall is one of the poorest parts of the UK in terms of per capita GDP and average household incomes, many car owning households would benefit from access to a cheaper form of personal transport.

While cycling can help meet health, environmental and social inclusion goals, it is also a very efficient mode of transport. Cycling allows many times more people to be transported in a given space than cars. Hence major cities where space is at a premium and congestion particularly problematic have been among the first to invest substantially in cycling.

However, the benefits of cycling are currently far from being realised in England and in Cornwall. Cycling and walking rates in Cornwall have been in decline since 2011. Research has found that the major barrier to increasing cycling is fear of motor traffic, with a systematic review conducted for DfT showing women have a particularly strong need for cycling infrastructure away from motor traffic, such as tracks on main roads (Aldred et al 2016). Providing infrastructure for cycling could thus help with equity issues because women tend to have lower car access than men.

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[1] See the British Cycling report *Benefits of Investing in Cycling*, which contains many links to reports and studies.
[2] https://www.cornwall.gov.uk/media/19743802/20160419-cycling-and-walking-investment-strategy-consultation-corporate-response-4a.pdf

## 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. It is freely available at www.pct.bike and is open source. Currently, the PCT 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 area and route levels.

Data for the first wave of case studies was downloaded from the 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.

## About this report

This report was written by Rachel Aldred on behalf of the PCT team. Analysis was conducted using the PCT data downloads feature, with the help of QGIS and Microsoft Excel.

## About Cornwall and the study locations

Cornwall has a population of 536,000 with the administrative centre and only city being Truro. Cornwall is relatively rural and hilly, both factors that might be expected to reduce cycling potential – although over two thirds of travel to work journeys by car are less than 6km. It does benefit from a sunny and mild climate, particularly along the sheltered South coast.

The report presents an overall picture of cycling potential in Cornwall, alongside a more detailed look at five locations. These are as follows:

- Bodmin, with a population of approximately 15,000, located in inland Cornwall to the South-West of Bodmin Moor
- Penzance, the most westerly major town in Cornwall, with a population of approximately 21,000
- Truro, the only city in Cornwall and the administrative capital, located in inland Cornwall and with a population of approximately 19,000
- Falmouth, a university town on the South Coast of Cornwall with a population of approximately 27,000
- Newquay, on the North Atlantic coast, with a population of approximately 20,000

Their locations can be seen below:


*Figure 1: Map of Cornwall, five locations highlighted (source: www.cornwalls.co.uk/maps)*

## Scenarios

The Propensity to Cycle Tool facilitates the generation and analysis of detailed, local patterns of travel (presently commuting only) for cycling in the event of a number of scenarios. These scenarios currently use 2011 census statistics 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 is of using a statistical model to find the journeys within and between MSOAs that might be most likely to switch to cycle. Because the 2011 Census provides origins and destinations for all commuters, we can then map potentially cycled journeys onto the route network.

With the exception of the 'gender equality' scenario (see below), the modelling of cycling potential is based around trip distance and hilliness. The figure below illustrates how distance and hilliness shape propensity to cycle to work:

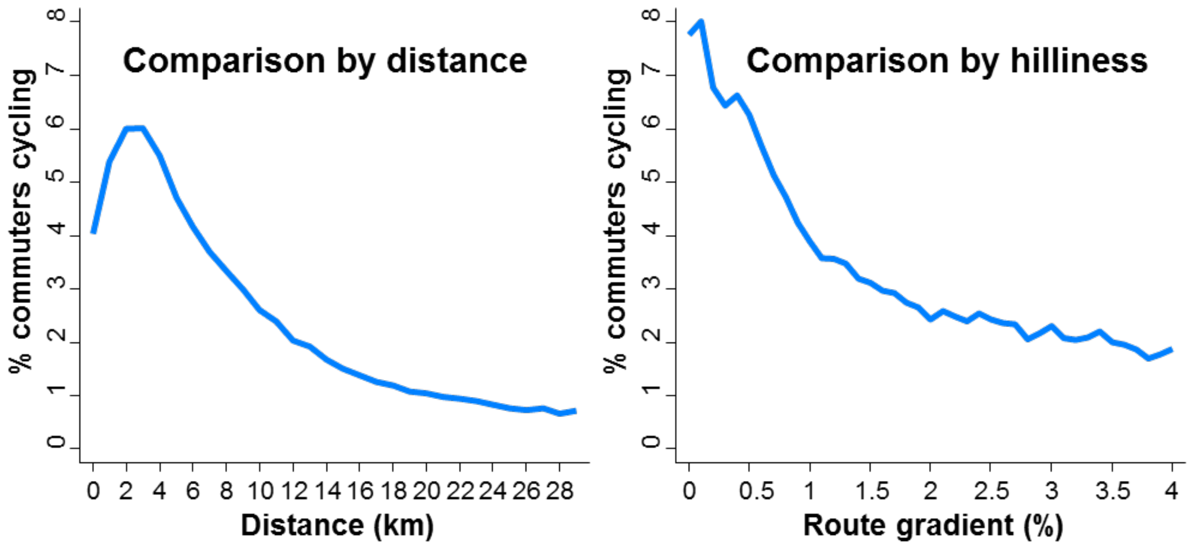


*Figure 2: How cycle commuting relates to distance and hilliness (based on Census 2011 data)*

The figure below presents a screenshot of the PCT's national results, highlighting Cornwall (and Scilly Isles) where 1.8% of commuters reported cycling to work in 2011.

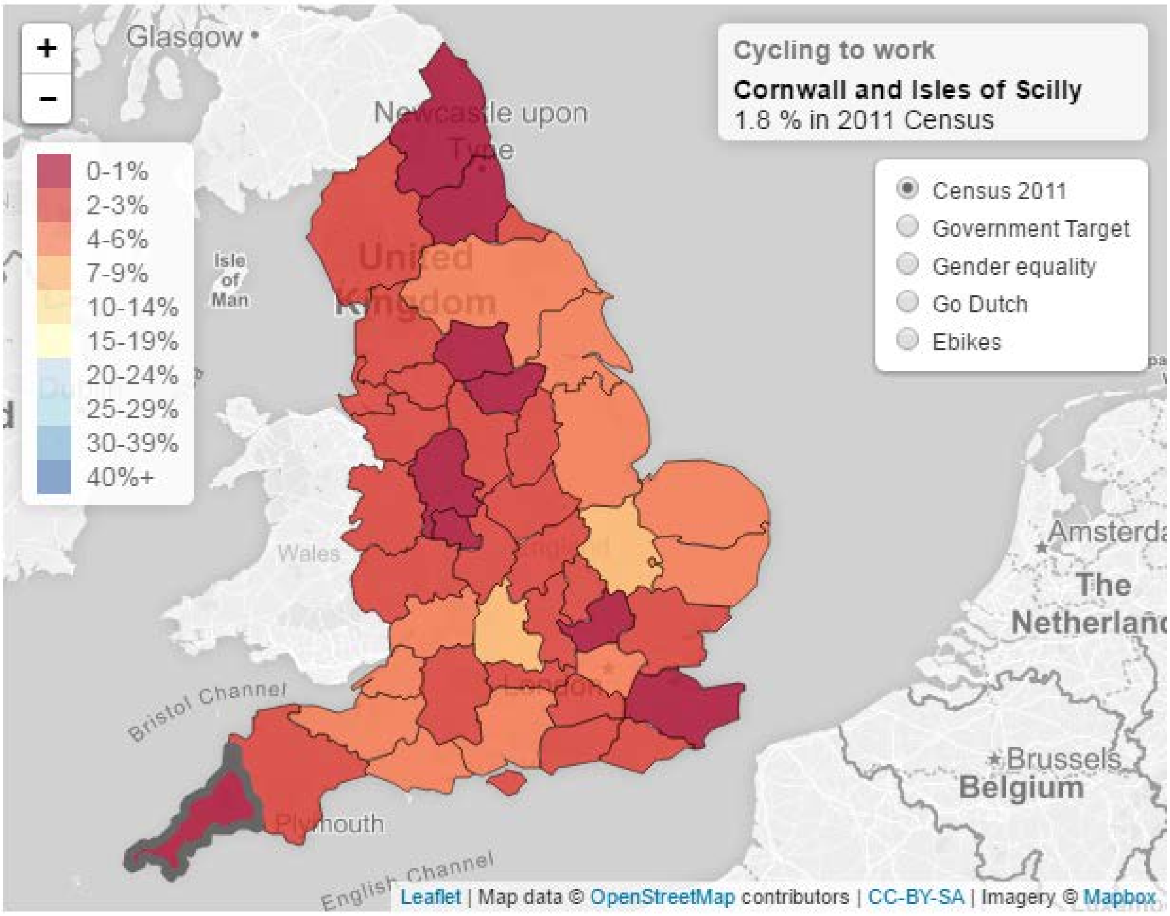


*Figure 3: Current distribution of cycling to work (source: www.pct.bike screenshot)*

Baseline data comes from the 2011 Census, which covers main mode of travel to work.
There are four core scenarios:

1. Government Target – the target for cycling in England for 2025, involving a doubling of cycling.
2. Gender Equality – women cycle at the same rate as men do now, for each origin-destination pair.
3. Go Dutch – the population has the same likelihood of cycling a trip as the Dutch would, based on distance and hilliness. In other words this scenario assumes that infrastructural and cultural barrier to cycling have been overcome, but topography and land use remain the same.
4. Ebikes – A kind of Go Dutch plus, with the additional assumption that people have access to e-bikes for hillier and longer trips, based on Dutch and Swiss data on rates of e-bike usage for these journeys.

## E-Bikes

In this report we have chosen to focus on the E-bike scenario. For a hilly area such as Cornwall, e-bikes may have substantial potential to increase cycling, given a supportive environment and infrastructure. Under the ‘Go Dutch’ scenario, cycle commuting in Cornwall and Isles of Scilly rises to 10.1% - substantial but still lower than in many flatter areas. However, under the e-bikes scenario the figure is 19.1%, illustrating the substantial contribution that e-bikes might make, if Cornwall can overcome current infrastructural and cultural barriers to cycling.

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), reviewing a decade of e-bike research, 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 (Fishman and Cherry 2016). 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 including ‘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 help grow cycling further. This is likely to be particularly important in a place such as Cornwall.

## Cycling Potential in Cornwall

The figures below illustrate current cycling levels across Cornwall, comparing this with firstly the ‘Go Dutch’ and secondly the e-bike scenario. For each map, cycling levels are divided into ‘quintiles’, so that the darkest colour shows the top fifth of MSOAs, and the lightest colour the bottom fifth of MSOAs. At present all areas are 5.1% or below, some extremely low (i.e. 0.3%). Under ‘Go Dutch’, there appears to be considerable variation in potential by MSOA: the lowest being 2.5% and the highest 15.9%.

Under the e-bike scenario, the ‘hotspots’ change somewhat and become more concentrated in some of the more urban areas. The two MSOAs covering Bodmin clearly have high cycling potential although cycling levels now are low even by current standards. With the exception of Bude and the area West of Plymouth, the Eastern parts of Cornwall have relatively low cycling potential, although even in the lowest-potential MSOA this is nearly 8% of trips, greater than the highest level found at present (5.1%).

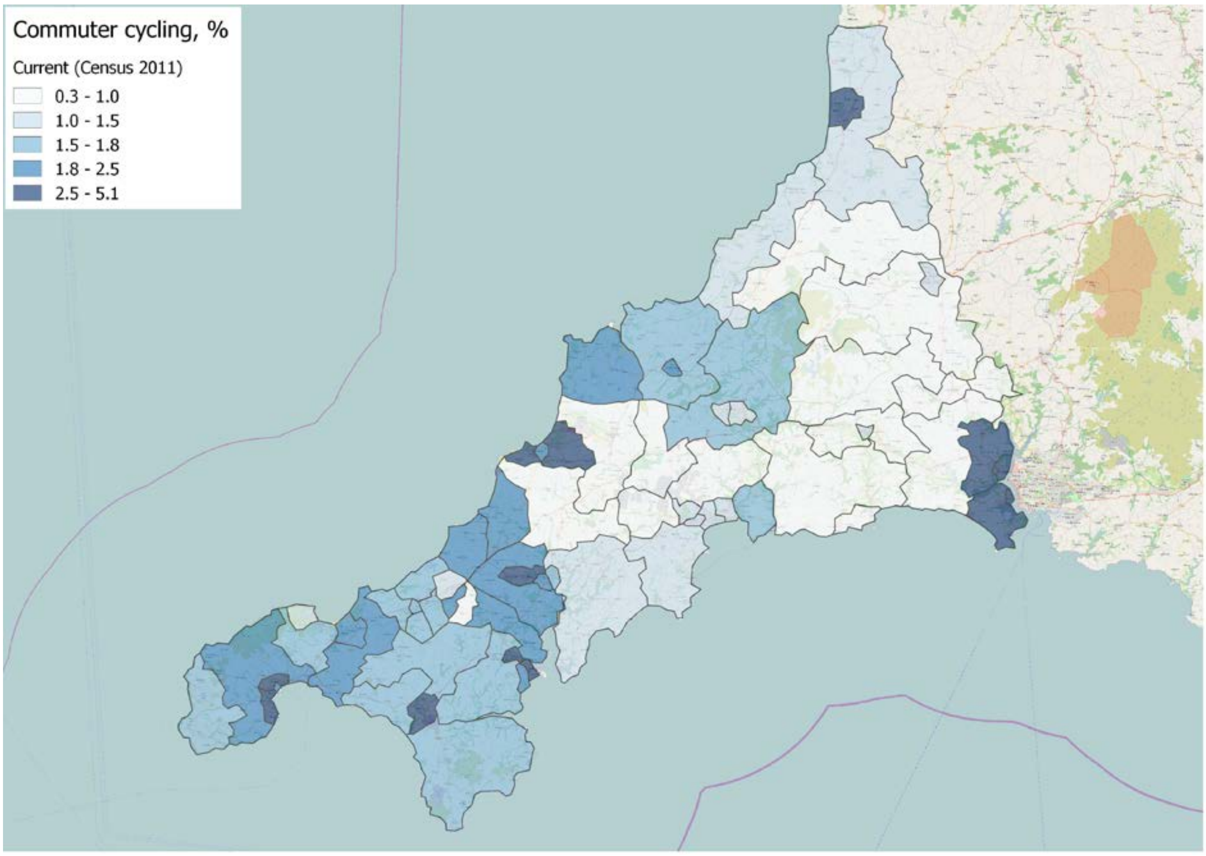


*Figure 4: Current cycling levels in Cornwall*

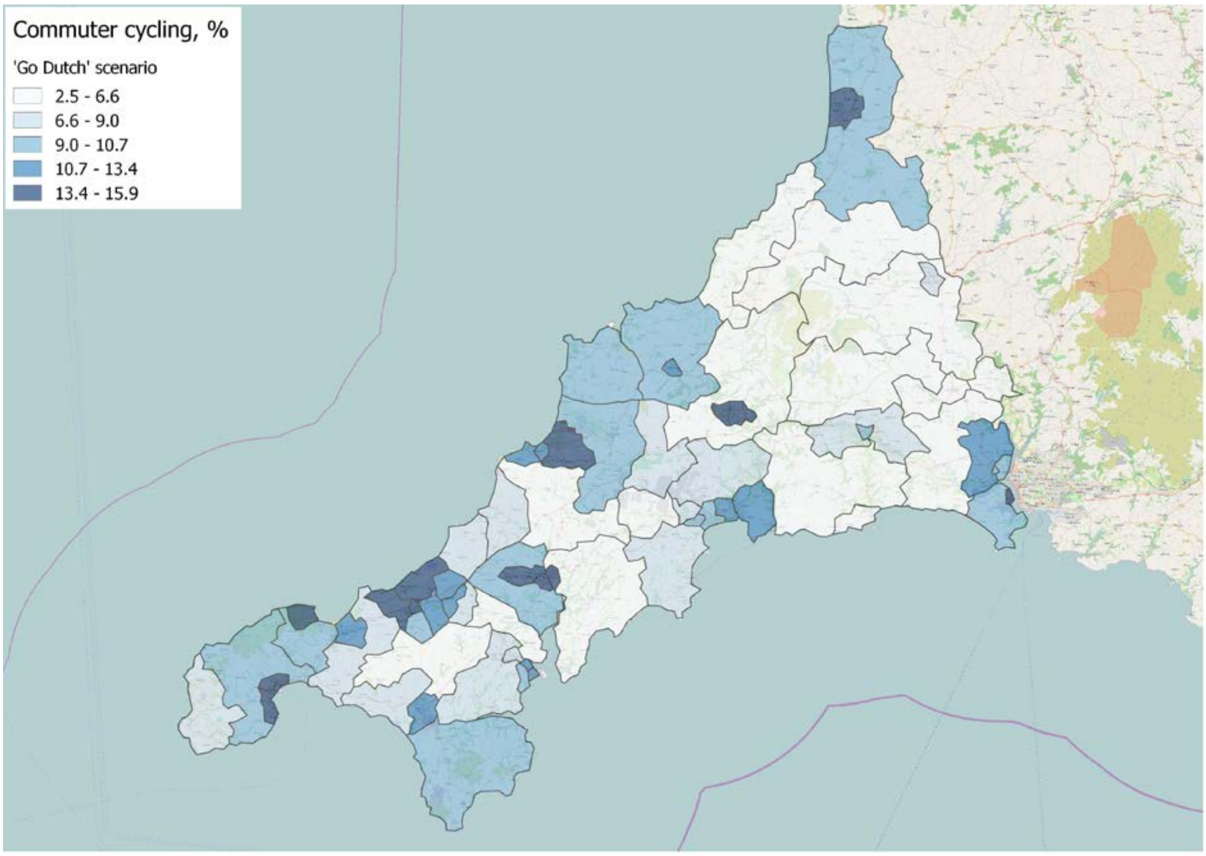


*Figure 5: Cycling potential in Cornwall, Go Dutch scenario*

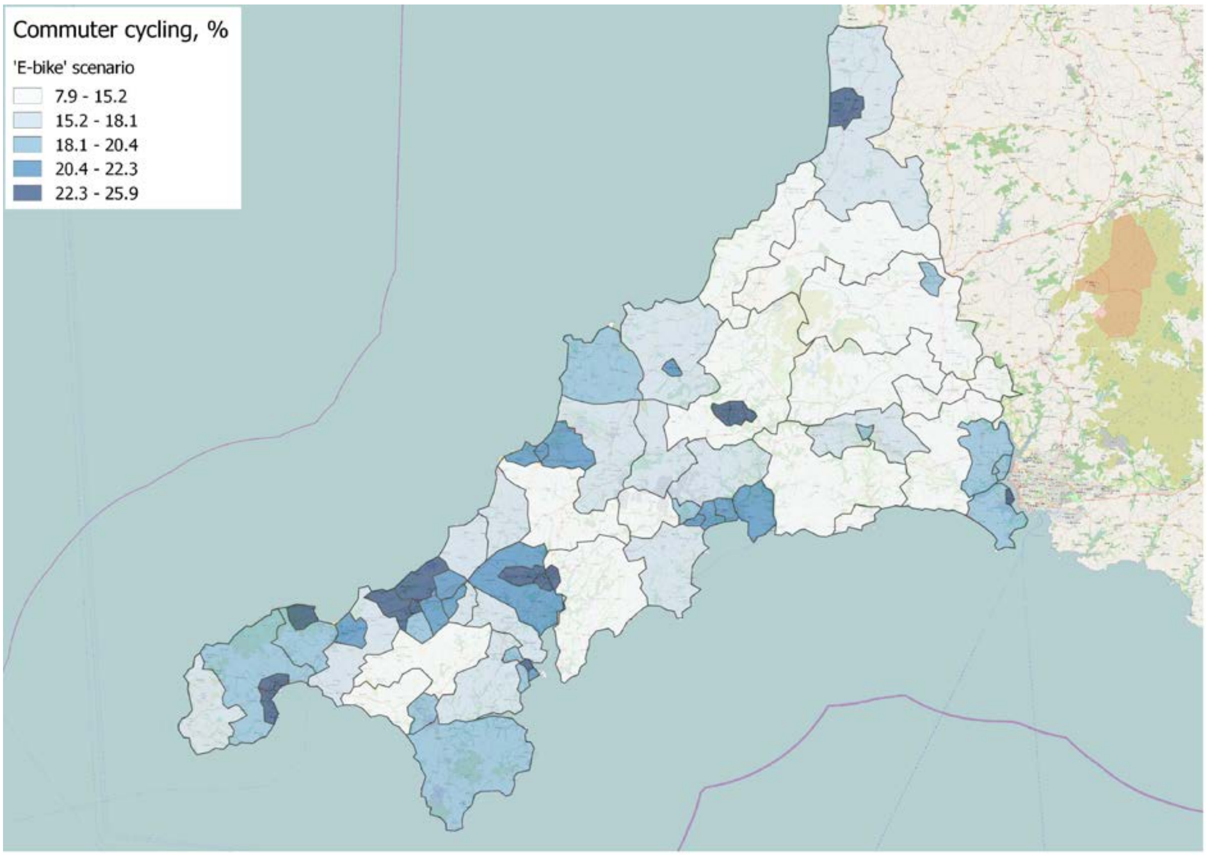


*Figure 6: Cycling potential in Cornwall, e-bike scenario*

Planners may also be interested in where trips come from, and in particular the extent to which cycle trips might replace car-driver trips. This is directly linked to important policy goals including air quality, reducing $CO_2$ emissions, and cutting congestion. The figure below illustrates the extent to which cycling growth reduces car-driver trips in each MSOA, for the e-bike scenario. In all the MSOAs there is at least a 5% cut in car-driver trips, but for some areas this is as high as 15% or more. In many areas this would be comparable to achieving the reduction in motor traffic seen during school holidays, with obvious implications for congestion.

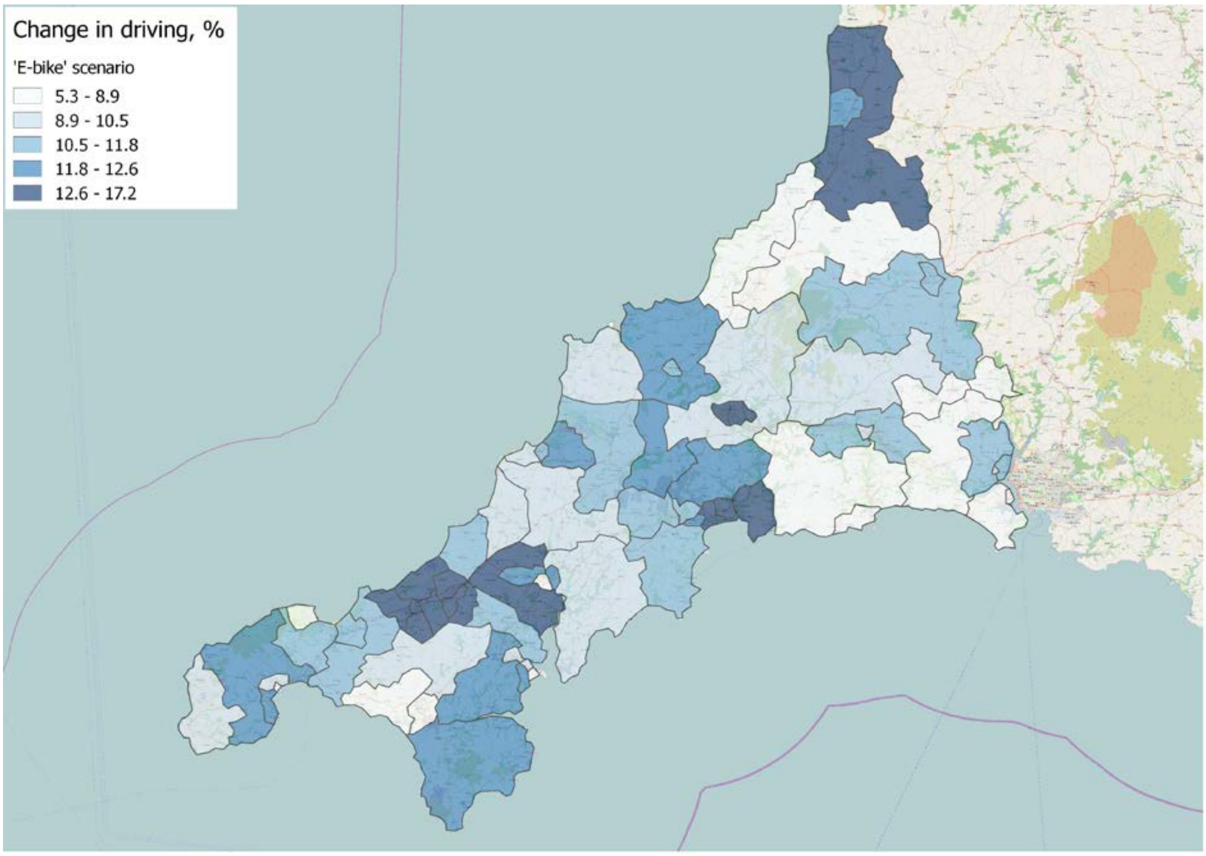


*Figure 7: Percentage reduction in driving, e-bike scenario*

The next figure illustrates the health benefits from the shift to e-bike cycling per MSOA. This is calculated using a modified version of the World Health Organization's HEAT tool, taking into account the age structure and health status of local populations. The areas with the greatest health benefits are not necessarily those with the greatest cycling potential: this depends upon the absolute numbers of new cyclists, the length of the new cycle trips, the population characteristics (e.g. older commuters gain more health benefits) and the proportion of trips transferred from walking.

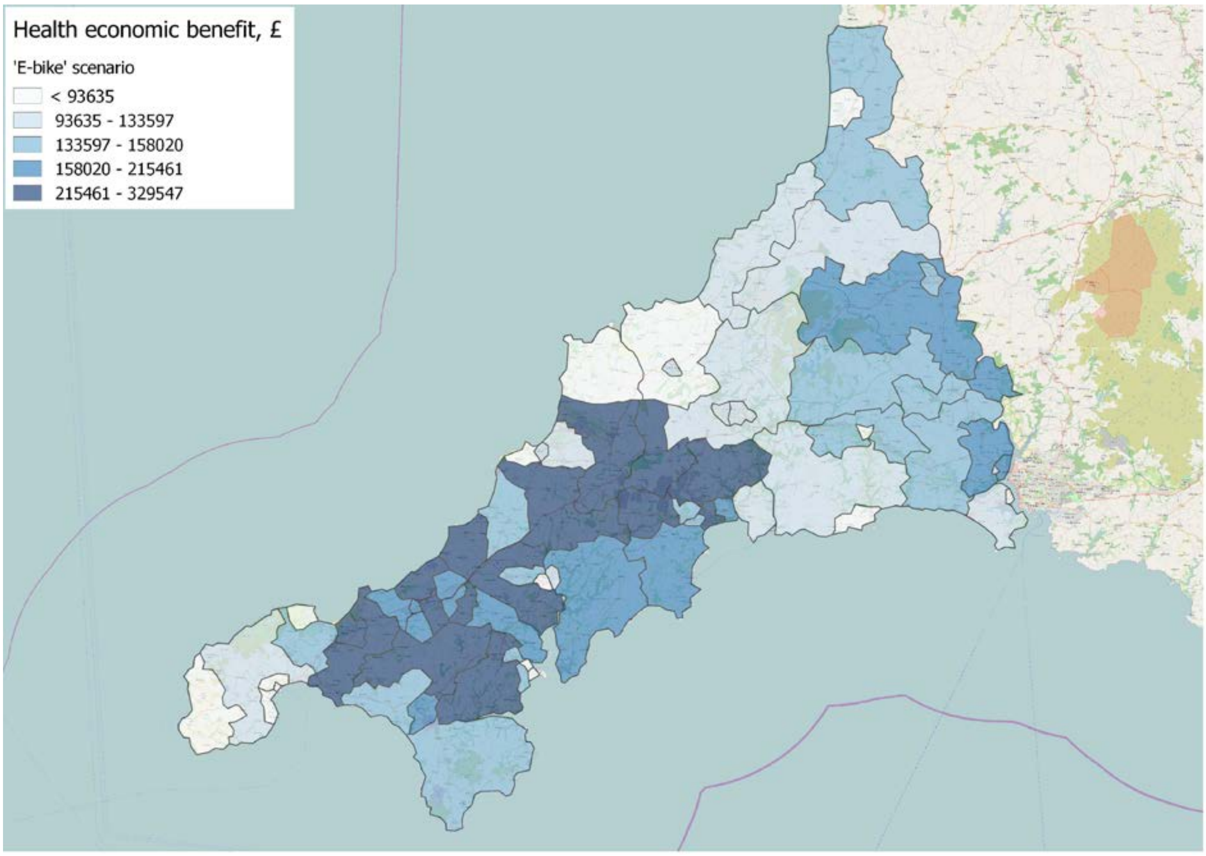


*Figure 8: Health benefits, e-bike scenario*

The next figure illustrates the $CO_2$ reduction achieved in different areas under the e-bike scenario cycling levels. Like health benefits, the carbon reduction benefits tend to be concentrated just outside the urban cores where cycling potential is highest. This highlights the need to think about not just those commuting very short trips within urban areas, but also routes that allow the slightly longer (and hillier) commutes one might expect with e-bike take-up. This will help maximise health and carbon benefits of cycling, as well as providing for more people who do not have the option of walking to work due to longer distances.

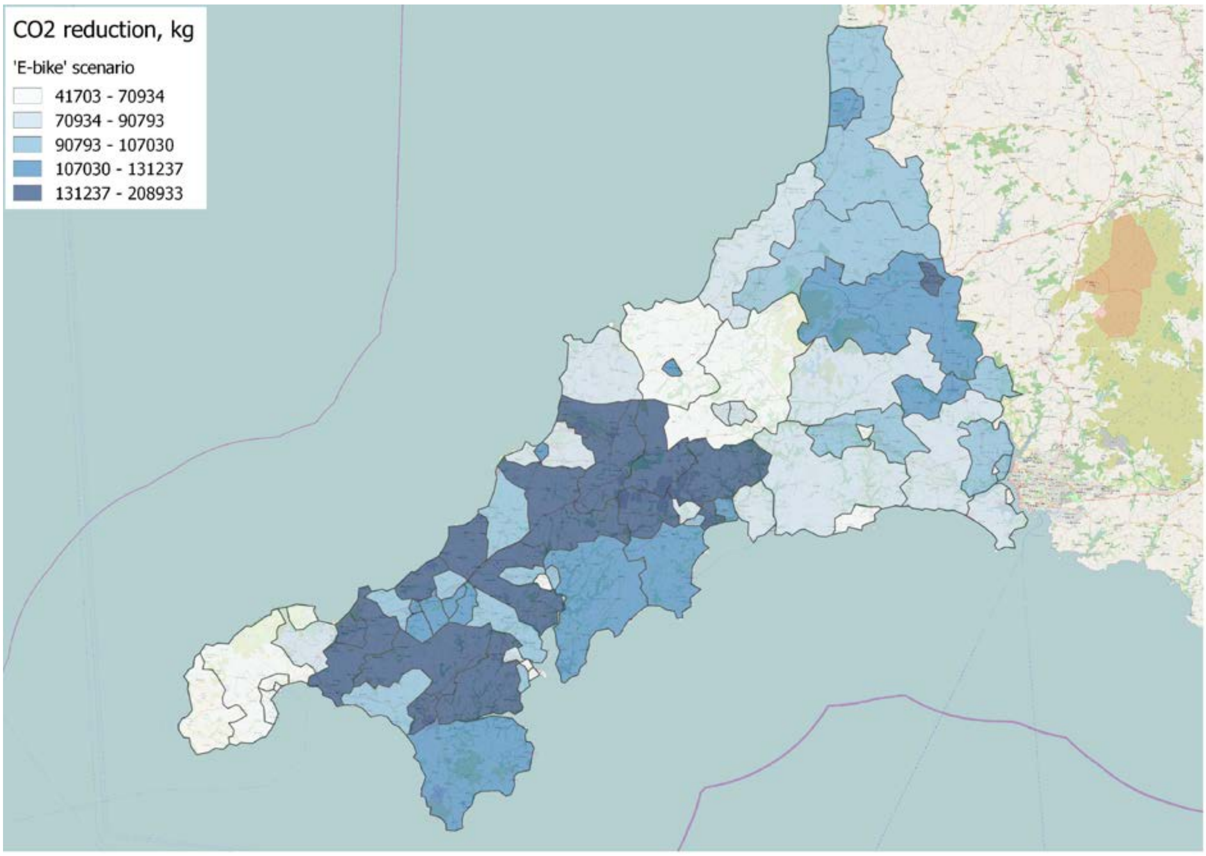


*Figure 9: CO2 reduction, e-bike scenario*

## Cycling Potential: five locations

The map below illustrates how the five locations have been defined. This is based on the MSOAs local to that town/city. For Falmouth, the originally chosen area has been increased to ensure the university area is covered. Note that because we are using Census 2011 data, this will not include student cycling potential but will include cycling potential for those employed at the university.

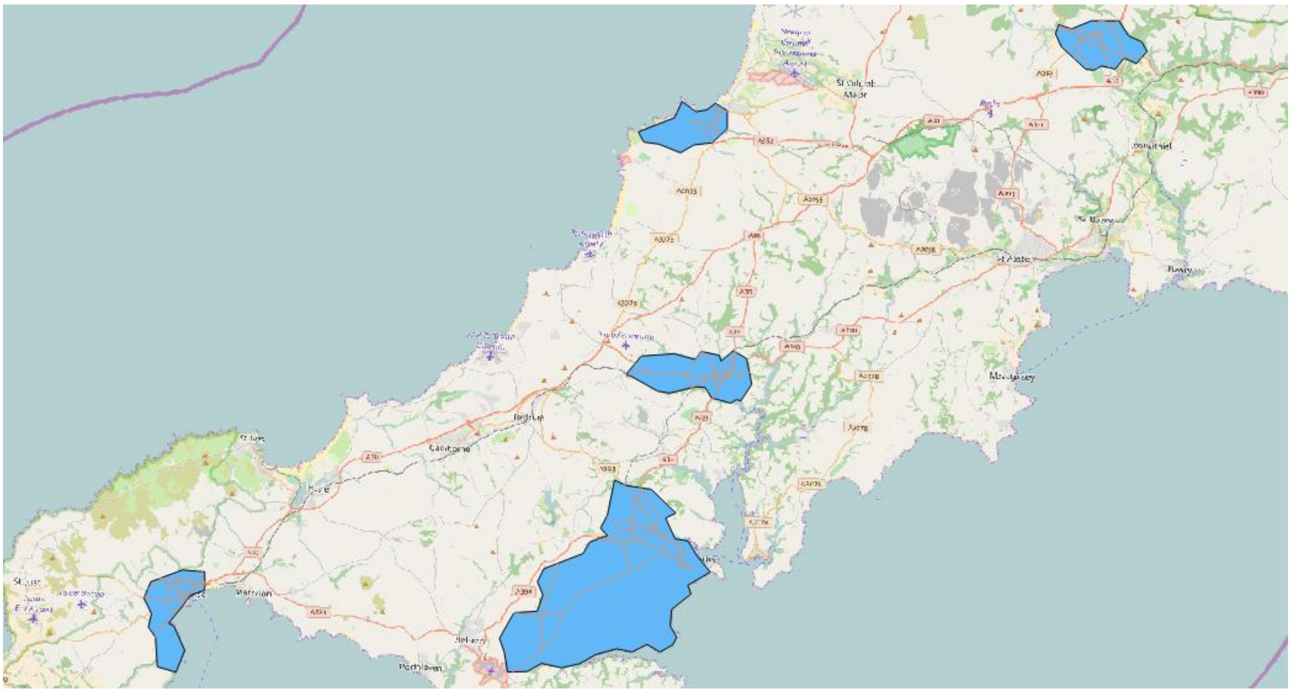

*Figure 10: current cycle commuting, five locations*

The pie charts below show the five locations in the context of cycling levels across Cornwall. Currently the locations account for over a quarter of all bike commutes, with Falmouth having the largest share – 10% of all cycle commutes in Cornwall begin in Falmouth.

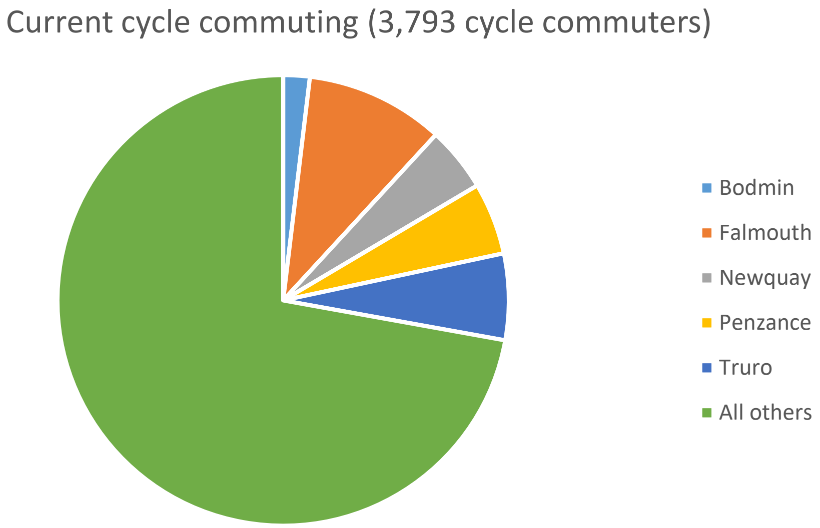


*Figure 11: current cycle commuting, five locations*

If the e-bike scenario cycling levels were realised, the five locations account for just under a quarter of all cycle commutes, with the absolute number of commutes growing ten-fold. Bodmin doubles its share – from one in fifty Cornish cycle commutes now, to one in twenty-five, despite its small size. Falmouth by contrast becomes somewhat less dominant, and Truro increases proportionally. However, in all locations there is substantial absolute increase – for example, in Falmouth from 377 to 2,907 cycle commuters.

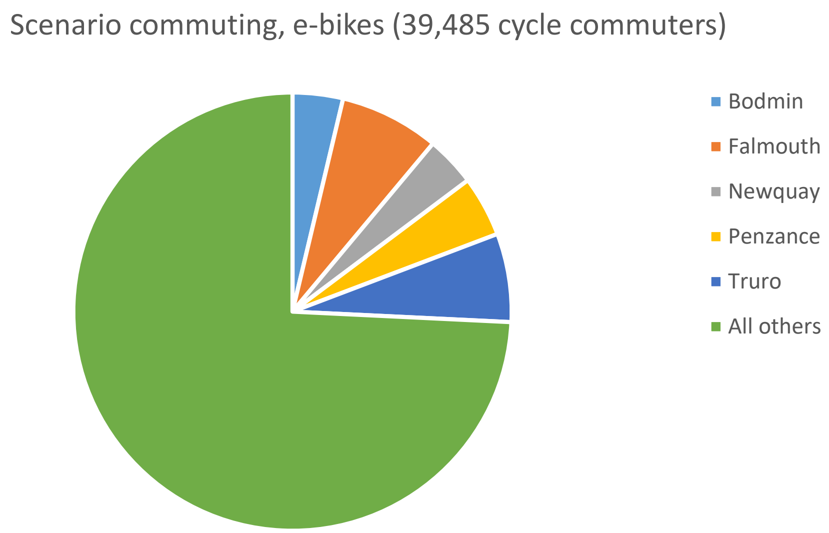


*Figure 12: scenario cycle commuting, five locations*

The figure below show the cycling potential (e-bike scenario) for the five towns included in this study. Note that the areas shown do not map exactly to electoral geographies, as we have used the MSOAs corresponding most closely to the areas covered by each town or city.
There is relatively little difference between the areas in terms of percentages: all MSOAs have between around 20-25% cycle commuting potential. It should be noted that this will underestimate the potential for cycling as part of the commute: for instance, Bodmin has a main line rail station about 3.5 miles outside the town centre, so one might expect substantial potential for people with longer commutes to cycle to that station, given good cycle infrastructure connecting the town and station. However, this potential is not included in these calculations.

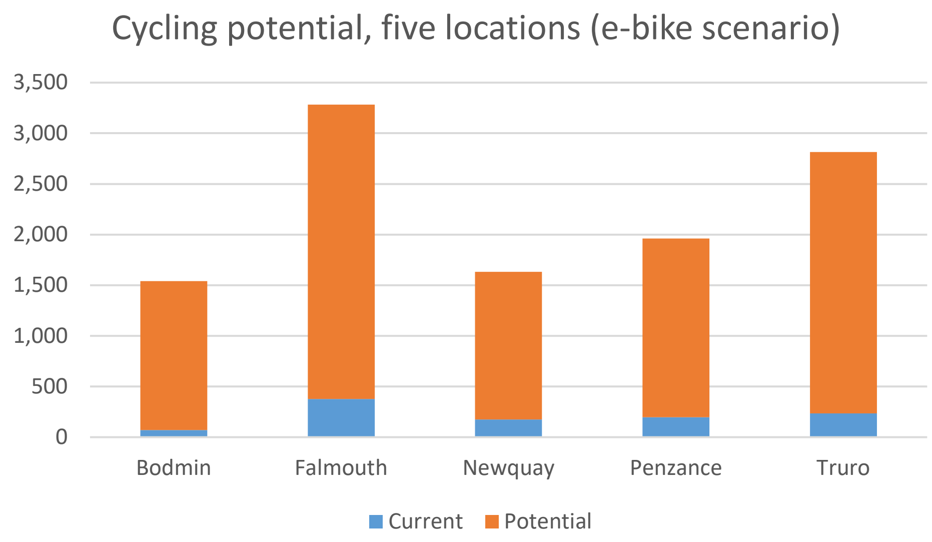


*Figure 13: e-bike scenario potential, five locations*

The figure below illustrates the annual health benefits from achieving the scenario levels of commuter cycling in the five locations (NB that this is main mode commuter cycling and does not include potential health gain from growth in mixed mode commutes or from cycling for other purposes or for leisure).

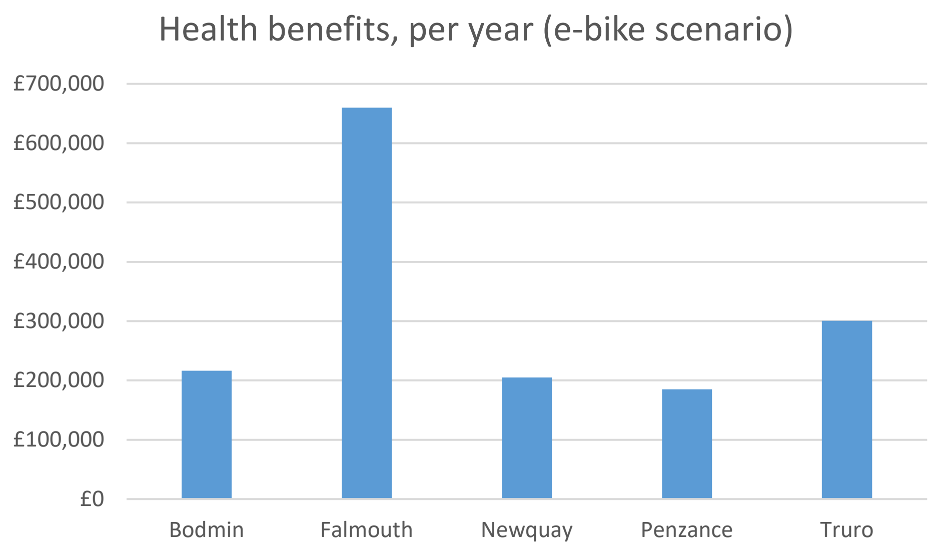


*Figure 14: Health economic benefits, five locations*

Below the carbon reduction potential of the e-bike scenario is presented. Again Penzance has the lowest (but still substantial, given the high proportion of Cornish emissions that come from transport) savings, while this time Falmouth has the highest emissions savings. The emissions savings are a function of the absolute reduction in car-driver trips, but also of the length of the trips replaced.

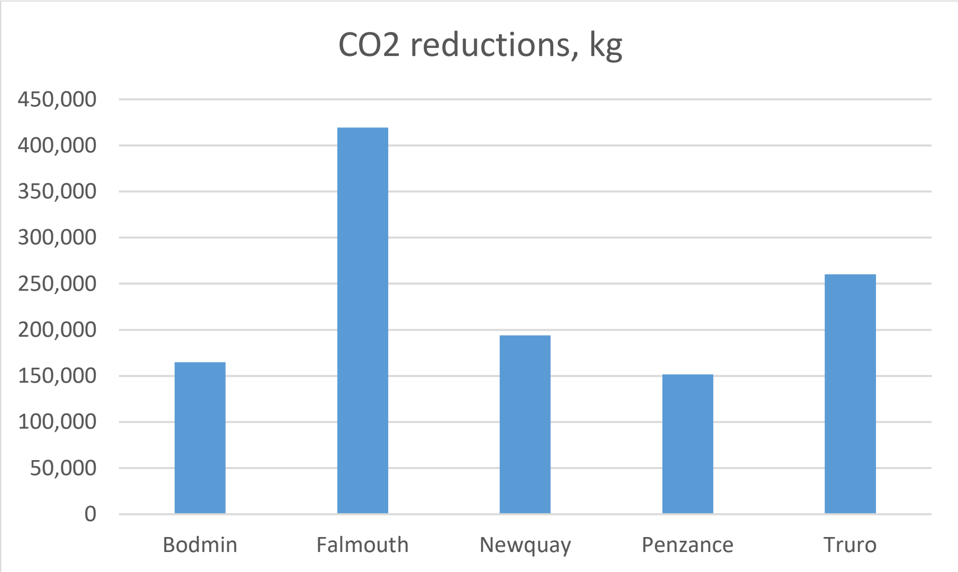


*Figure 15: Carbon savings, five towns*

## Route-based potential and impacts

The image below illustrates cycling ‘desire lines’ across Cornwall, using the population weighted centroid of each MSOA.

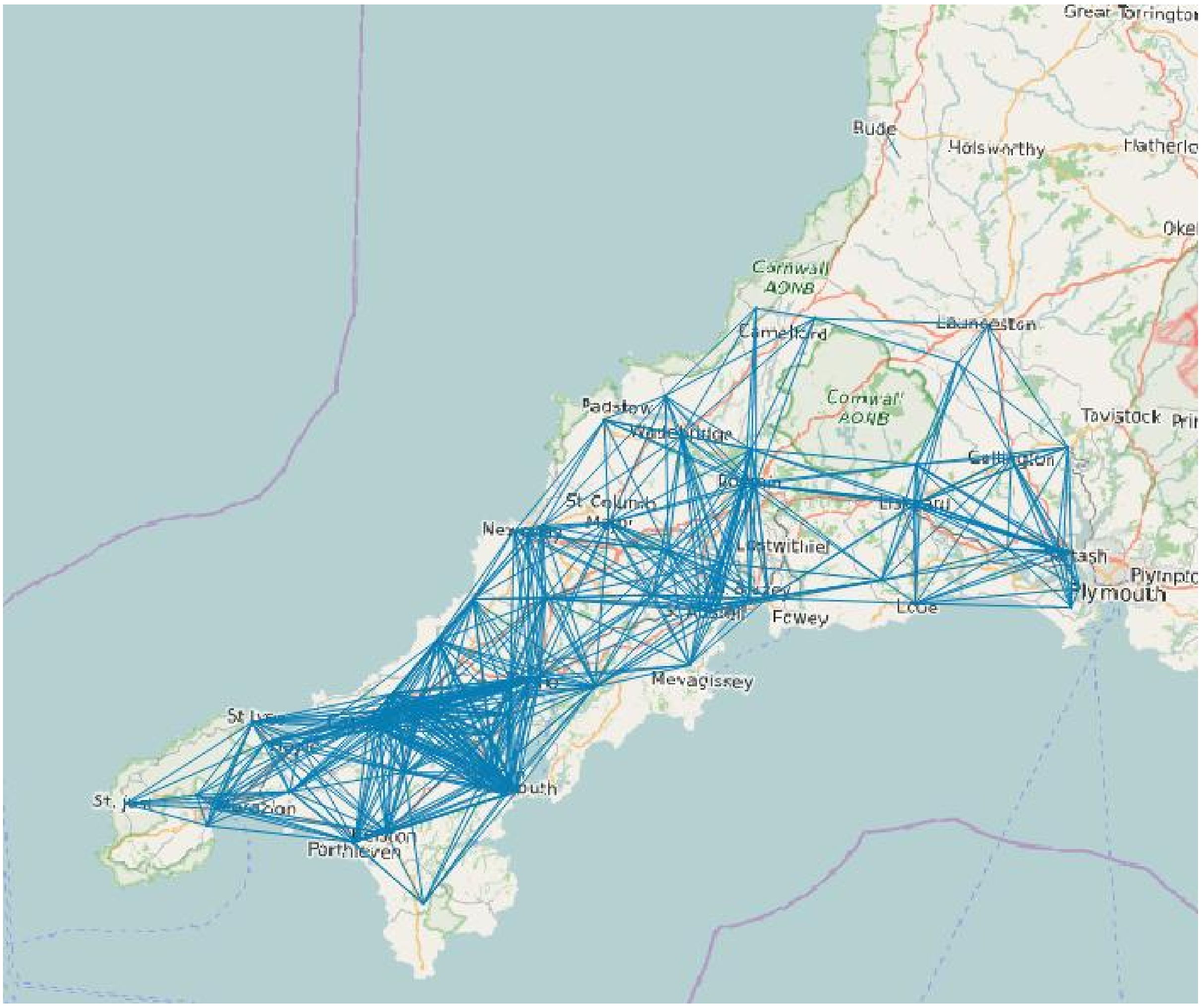


*Figure 16: Desire lines, cycle commuting, Cornwall*

These lines are unsurprisingly sparser around the less populated, hillier North-East of Cornwall. We should note that not all commutes can be included in the route network. From the PCT's 'Model Output' page:

> In Cornwall and Isles of Scilly there are 628 between-zone flows that a) start and end in Cornwall and Isles of Scilly, 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 628 between-zone flows are visualised as **Straight Lines**, **Routes** (fast and quiet) and the **Route Network** on the interactive map, and account for 48% of all commuters living in Cornwall and Isles of Scilly. Between-zone flows exclude **within-zone travel**, when the zone of origin is the same as the zone of destination. Within-zone travel is represented by red points on the map when the lines are shown, and accounts for 19% of commuters in Cornwall and Isles of Scilly. The between-zone flows visualised as lines and routes on the map also exclude commuters travelling outside Cornwall and Isles of Scilly and people with no fixed place of work.

Flows within an MSOA may be particularly important in less densely populated parts of Cornwall, and cannot be mapped to the route network. To give one example, the table below shows the number of within-zone commutes in the Launceston MSOA, and the cycling potential related to those (which will appear in the area-based data, but not in the route mapping).

| | |
|---|---|
| Zone: | Cornwall 005 (Launceston area) |
| Total 'within-zone' commuters: | 1519 |
| Cyclists (baseline): | 26 (2%) |
| Drivers (baseline): | 769 (51%) |
| Cyclists (e-bike scenario): | 487 (32%) |
| Change in drivers: | -238 |

The image below maps these current cycling flows to the route network (including all roads on which cycling is legal, plus other legal routes such as bridleways). These are mapped to the 'fastest route' on the Cyclestreets journey planner.

Based on those cycle commutes which can be included within the flow routing, even the currently busiest routes have a maximum of 210 commuter cyclists, with much of the route network likely to see very low numbers of cyclists.

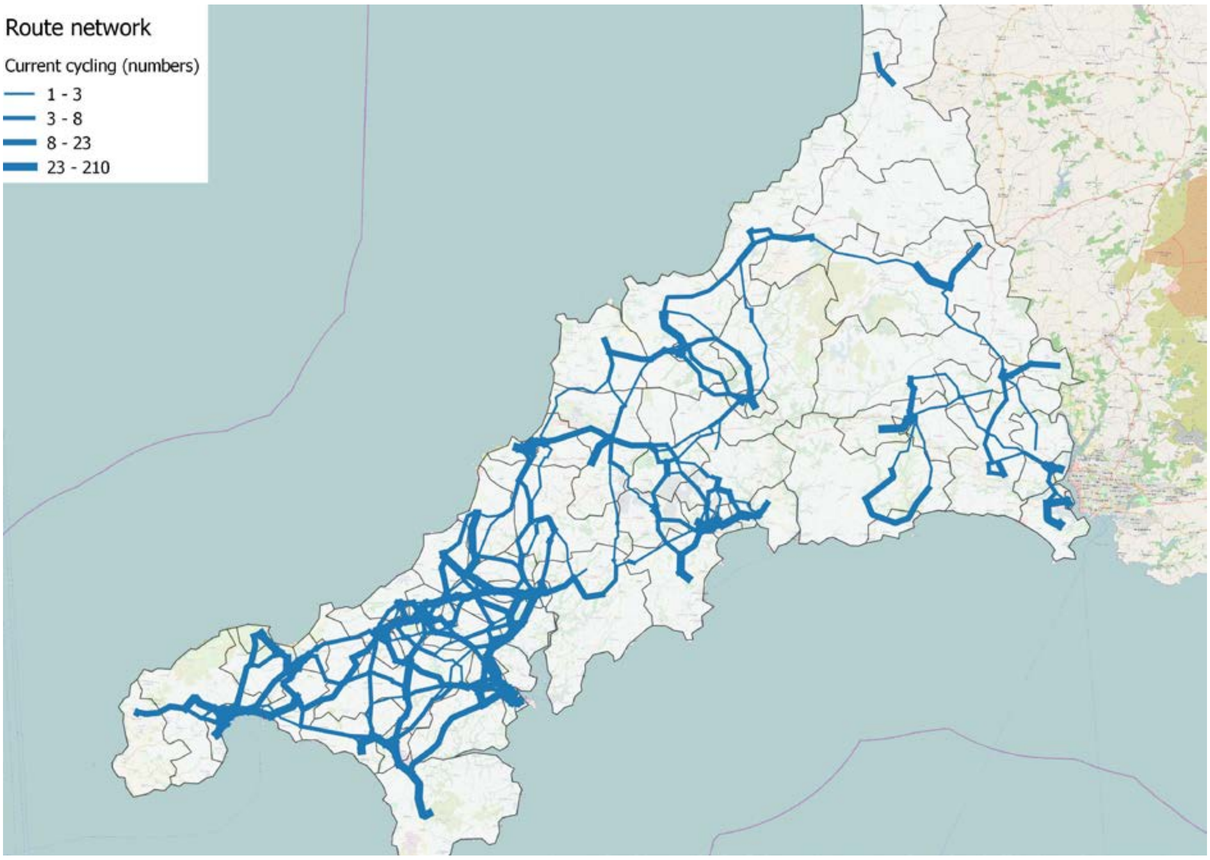


*Figure 17: Route network, current cycle commuting (assuming direct routes)*

By contrast the figure below shows potential flows under the e-bike scenario, this time only including routes with 15 or more cyclists. The busiest routes now see cycling flows in the region of 250-2000, rather than 25-100. The top two categories (106-253 and 253-1949 modelled commuter cyclists respectively) might then be seen as constituting a potential priority commuter cycling network for Cornwall, with the caveats about within-zone flows and public transport-cycling combinations mentioned above. These caveats imply the need to also focus closely on town centres where we will be under-estimating commuter cycling potential, and on routes to rail and long-distance bus or coach terminals.

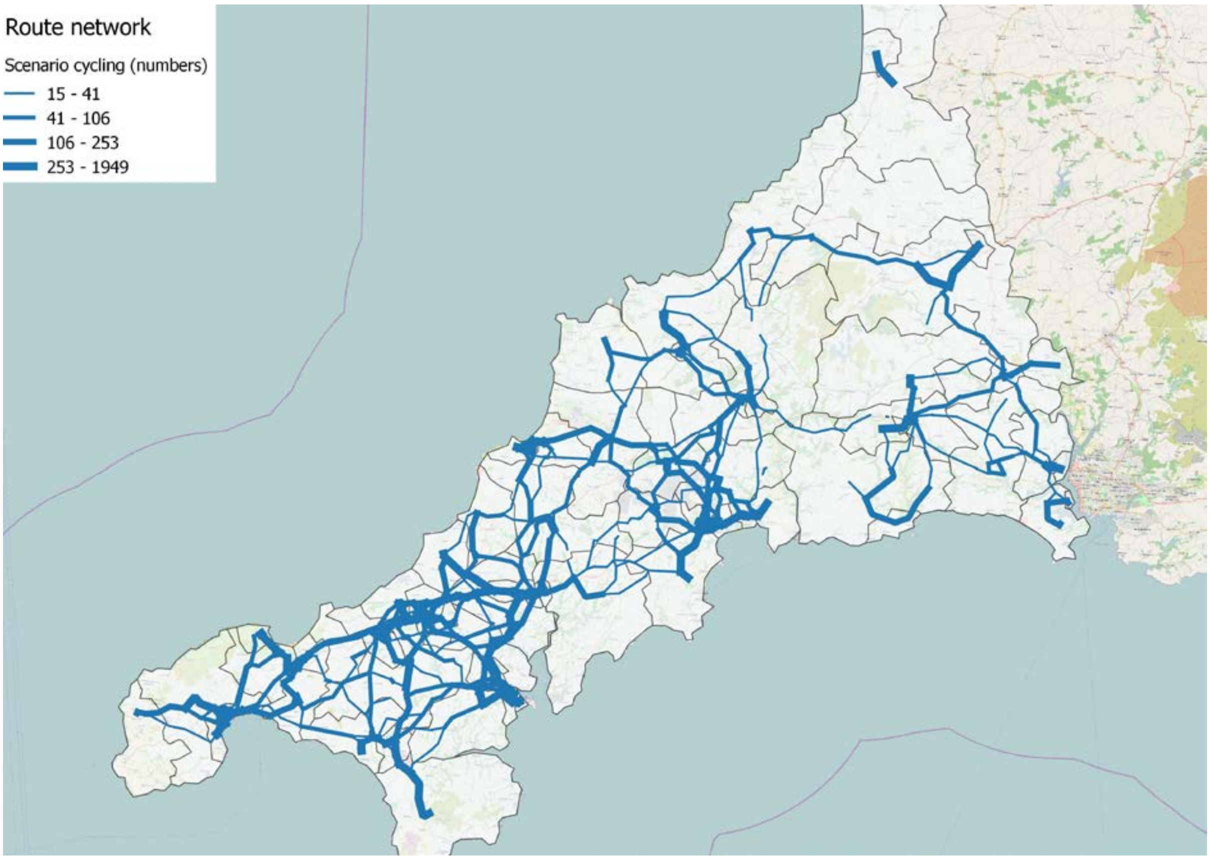


*Figure 18: scenario cycle commuting (e-bike scenario)*

## Route-based potential, five locations

The figure below illustrates in outline form the highest potential commuter cycle routes in the five locations, based on the fastest routes available to cycle. Some of these routes would be busy and hostile roads, which to achieve this scenario cycling potential might require substantial intervention. This must be balanced against the loss of cycling potential involved in diverting cyclists along quieter but less direct alternative routes: the PCT's model tells us that any additional distance or hilliness will reduce cycling potential.


*Figure 19: Scenario route network, five towns*

Below more detailed maps are given for each location, showing the highest potential routes according to the PCT. This does always require interpretation, and caveats are noted in some sections; for instance, in Falmouth one would be sensible to consider student cycling as also very important, while in Bodmin the relocation of Council and other offices may increase cycling potential on nearby roads. Planners will also wish to consider where other types of cycling potential may stem from; for instance, to schools, especially since school children will be travelling at the same time as many morning commuters, with capacity implications. The presence of school children also makes it particularly important that routes have a high level of separation from motor traffic without gaps in provision.

## Bodmin

The section presents a possible core commuter cycle route network for Bodmin as suggested by the PCT. As mentioned above, we only include some commuter cycling potential; and Census data from 2011 will also not reflect the substantial increase in employment at the Beacon Technology Park since that date, which could further increase cycling potential along the A389, for instance.

*Figure 20: The current A389, near Beacon Technology Park (with council and NHS employment)*

In Bodmin, one would also want to consider rail-cycle commutes (and other trips) that would head South-East to the station. 3.5 miles is a relatively cycleable distance, particularly with e-bikes, and providing a direct, high quality route to the station could further increase cycling potential.

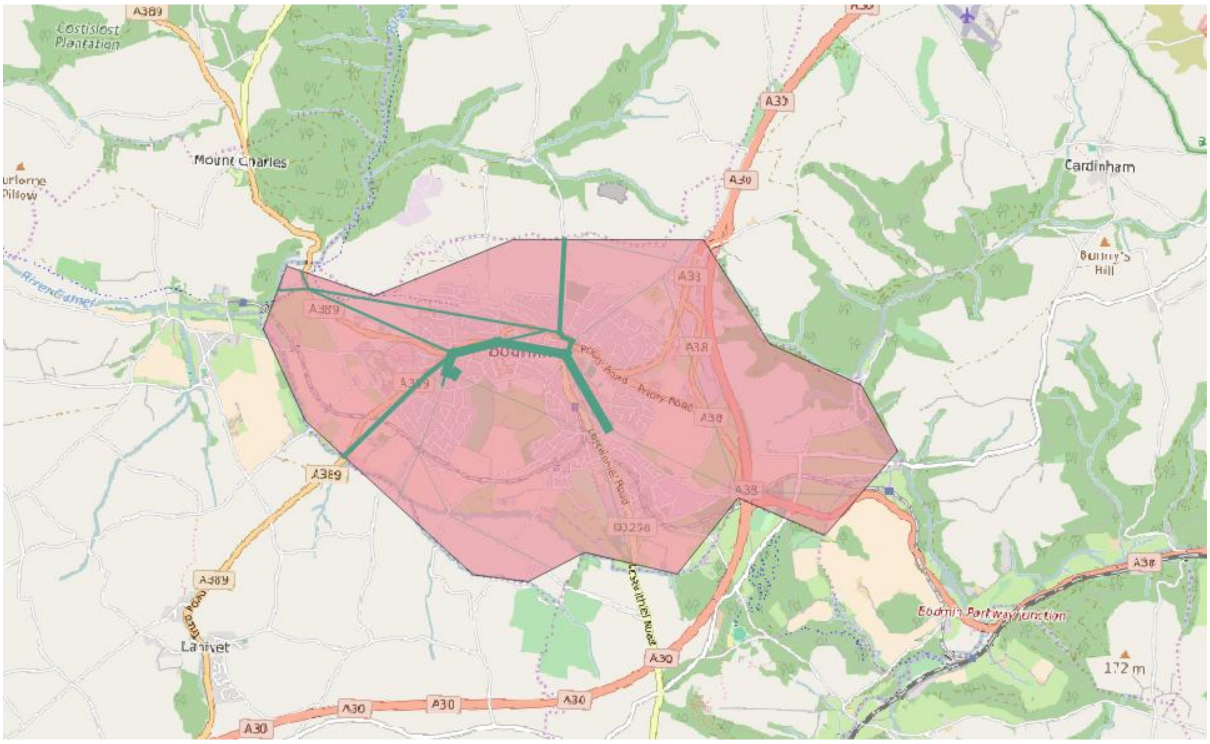


*Figure 21: Bodmin possible core commuter route network*

## Falmouth

The image below shows a possible core cycle route network for Falmouth. It should be noted that in the context of the geographically large Western MSOA, the network should be viewed as more than usually schematic; the routing of some flows along Hillhead Rd rather than the A39 (likely in practice to be more direct) may be a function of the MSOA centroids.

The MSOA cut-off includes the university; however, students would not be included in commuter calculations. Therefore, one would want to also consider the additional demands from student cycling. For example, the most direct cycle route from Falmouth Marine School to the University is 3.3 miles along Falmouth Road, currently a busy road with patchy cycle infrastructure.


*Figure 22: Falmouth Road*

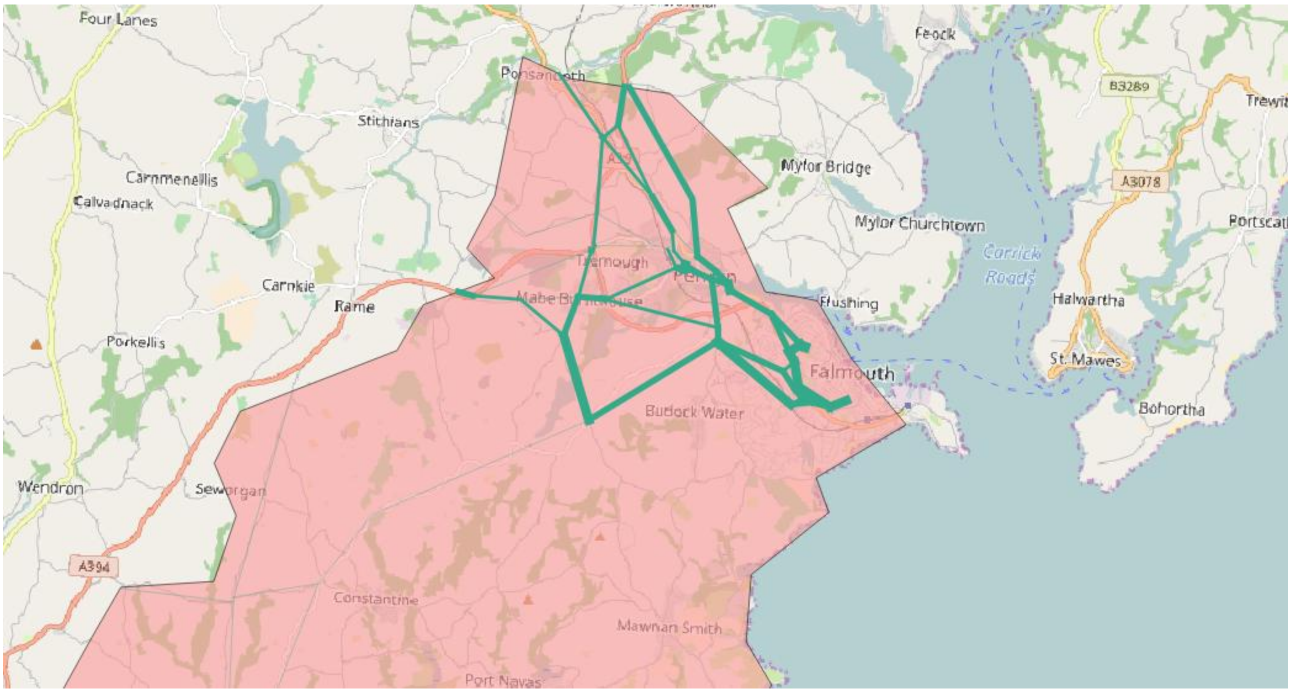


*Figure 23: Falmouth possible core cycle commuter network (see caveats)*

## Newquay

Below we illustrate a possible core commuter route network for Newquay as highlighted by the PCT. This includes Narrowcliff, where a route separated from motor traffic is currently planned along the side of the Barrowfields:

*Figure 24: Visualisation of Barrowfields cycle path next to Narrowcliff (cornwall.gov.uk, 2016)*


*Figure 25: Narrowcliff as it currently exists*

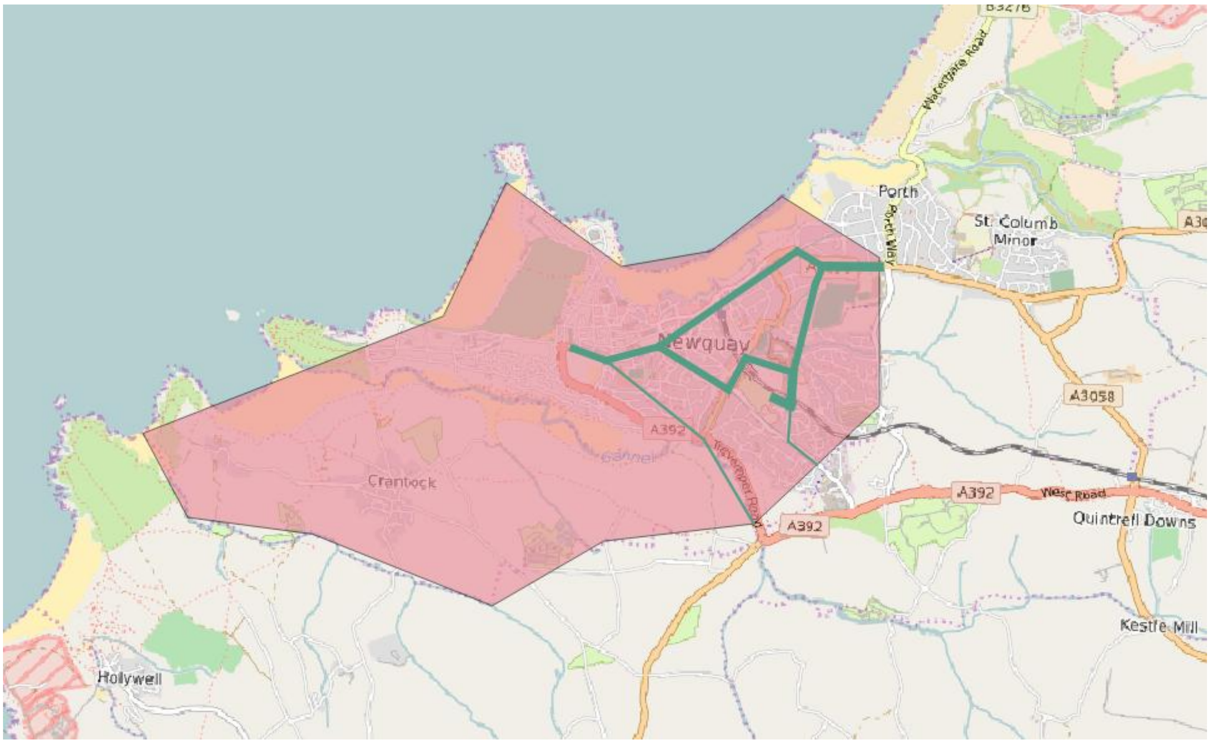


*Figure 26: Newquay route network*

## Penzance

The image below illustrates a possible core cycle commuter network for Penzance. This highlights, along with cycling potential along a number of roads, the potential for the South West Coast path to connect to utility destinations in the town.

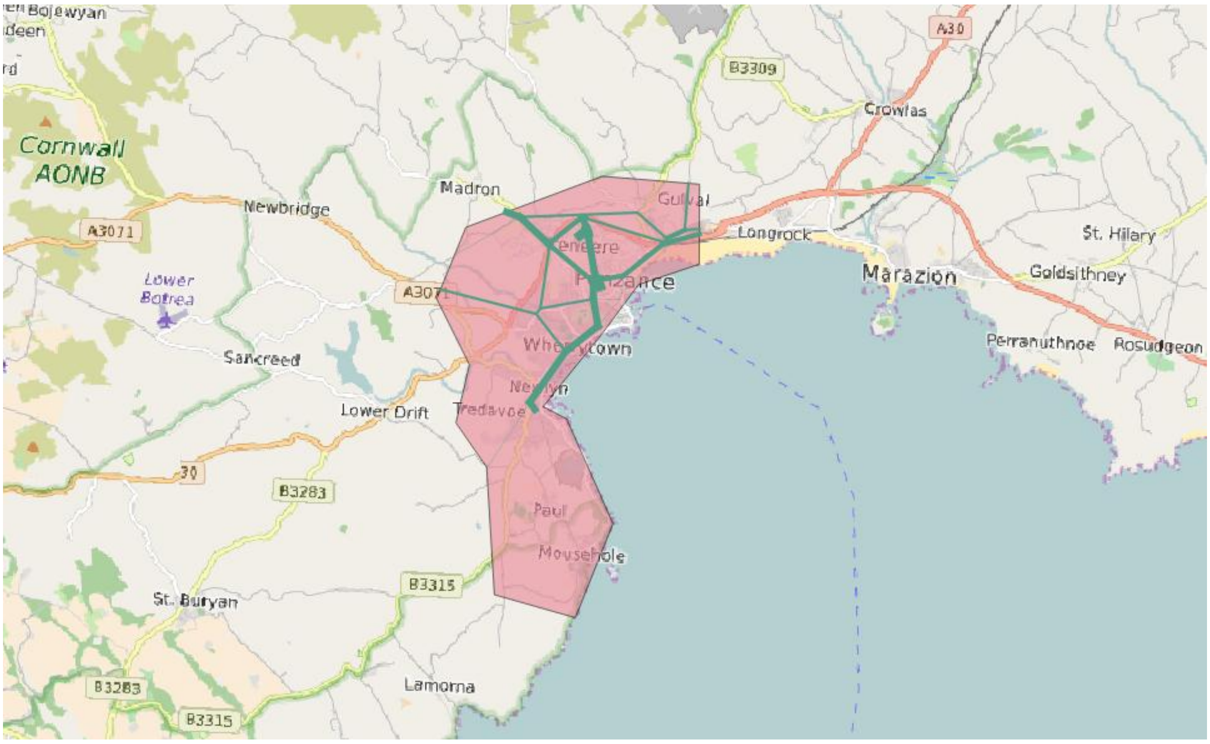


*Figure 27: Penzance route network*

## Truro

Finally, the image below highlights a possible core cycle commuter network for Truro. The East-West axis appears particularly strong, with the A390 highlighted through Threemilestone (and further West) as a direct corridor into the heart of the city, also passing major employers such as the hospital.


*Figure 28: The A390 near Threemilestone*

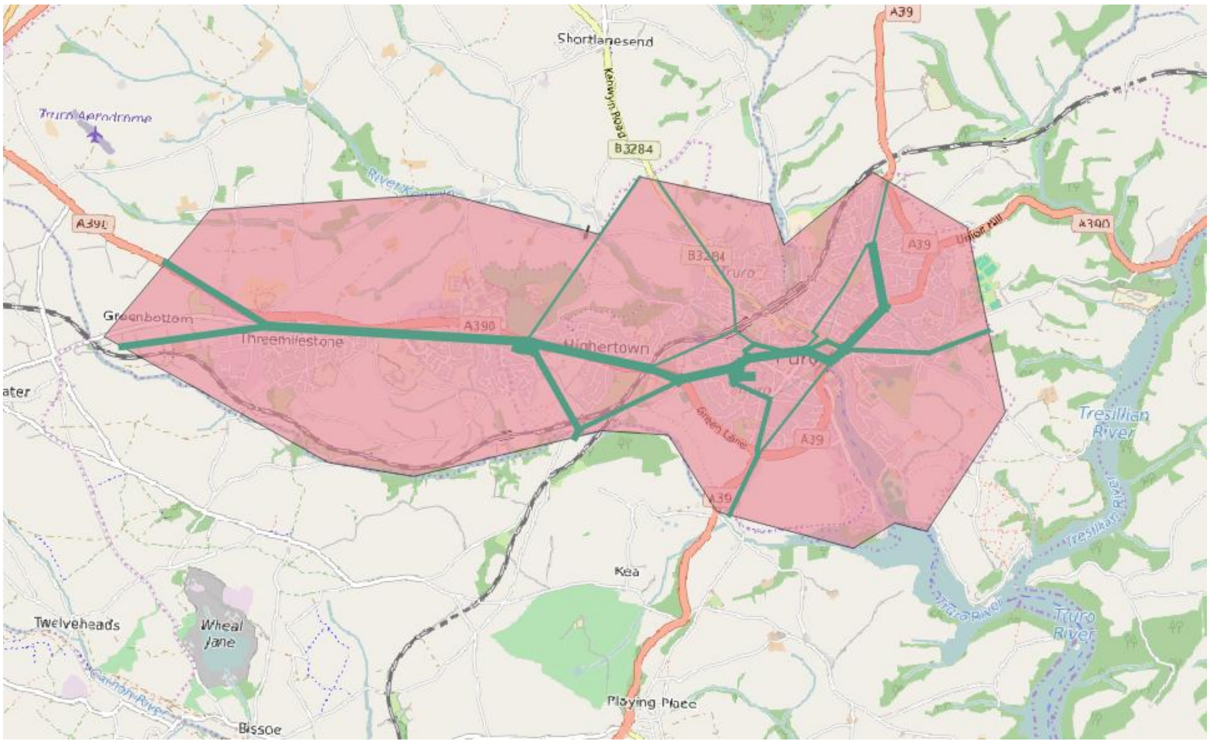


*Figure 28: Truro route network*

## Conclusion

Despite Cornwall's hilly and rural nature, the PCT demonstrates that there is still substantial potential for commuter cycling, especially as e-bikes become mainstream. The five locations studied here account for around a quarter both of current cycling and cycling potential in Cornwall, so could contribute much to an overall mode shift. Health and carbon benefits are also large, although their distribution varies.

While the route network maps above are limited to main mode cycle commuting potential and must be subject to interpretation (for instance, the PCT cannot highlight potential new Greenway routes away from roads where none currently exist), they do illustrate that along many high potential routes, the scenario would see high hundreds or even thousands of cycle commuters. Were Cornwall to achieve substantial increase in cycle commuting, this would likely be matched by similar increases in cycling for other journey purposes. This has implications both for where to build and what to build (in terms of track capacity, for instance).

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