A Regional ABM for Transport East

Project Summary

September 2022

Executive Summary

Executive Summary

What did we do?

Over the last six months, we have achieved a huge amount in building an Agent Based Model (ABM) of the Transport East region. This model was highly ambitious, building on the learning from the Suffolk County ABM, simulating the transport choices of individuals in the region across all modes to produce novel insights into how future behaviours would impact the region and its plan for meeting decarbonisation targets.

We produced two baseline models; one for 2019 and the other a 2040 forecast year. The first of these was benchmarked against a number of different sources and performed very well, especially given the four month build period. The future year model captured some base changes expected in the region by 2040, including demographic shifts, a shift to Electric Vehicles (EVs) and a level of working from home in anticipation of long term post-pandemic behavioural changes.

This forecast showed a region with growing travel demand being placed on a network without comparable growth in capacity. The region's roads became more congested, and more people are taking to public transport compared to 2019 in response to this.

The ABM approach creates a really detailed representation of travel and can be used to look at a number of different angles on transport in the region. This includes looking at different groups of people, different types of journey, how different people respond to changes and shift modes, and fundamentally how they use transport to access opportunities and benefit themselves.

To illustrate this depth of insight, we ran a series of scenarios on top of the 2040 model, looking at how changes in active travel, road pricing, and EV uptake could contribute to achieving a net zero future for the region. Each of our analyses were repeated for each of these outputs and have generated some core findings for the future of transport in the region.

We have worked with stakeholders throughout the process, sharing our process and getting input and feedback on the work to shape the development of the model and its future direction.

Executive Summary

What insights did we generate?

The full report goes into lots of detail on the output of the project, and so for this summary we will highlight some of the key insights that we gained through the simulations that we ran. We run through these insights in the following slides, and full detail is available in the full report.

1. **Equity** should be a key consideration within the region, as older people and those with lower incomes are much less able to adapt to change, especially in rural areas. Impacts are greater for lower income households, and these tend to be negative as we try to change travel behaviour. *One size fits all interventions should be discouraged.*

2. **Road pricing** is most successful at reducing the amount of driving, however in the most extreme cases, this can have a very negative impact on everyone in the region, including those who don't own a car. This stems from a switch to a public transport network that doesn't have sufficient capacity. *Measures to discourage people away from private cars need to be coupled with investment and expansion of alternative modes if it is to be successful.*

3. Even in the most extreme **EV uptake** scenario we looked at, we are only forecasting getting halfway to a 'net zero' future. Measures to encourage EV uptake should be pursued, but priority should be given to strategies to reduce carbon emissions from freight, especially for HGVs. *Non-car emission reduction should be a priority focus for the region.*

4. *Pricing is a key driver of* ***behaviour change for private cars****. If lower costs for Electric Vehicles persist into the future, they are likely to encourage more driving, especially at short distances. While an EV is mostly decarbonised, it is still a vehicle on the road and contributes to congestion.* Discouraging car use for short journeys should be a theme for future development, especially if prices for car use are lower.

5. **Decarbonisation** will be different for different groups of people. Higher income households tend to drive for more trips and tend to drive further, but they are most likely to decarbonise themselves through investment in an EV. Delivering equitable decarbonisation for lower income groups should be a priority.

Executive Summary

What insights did we generate?

6. Improving the appeal of **active modes** increases the number of people using public transport due to an increase in people accessing stations on bike. This is one of the few wholly positive impacts across all groups of people in the model. *Encouraging active modes will have significant whole network impacts.*
7. **Combining interventions** doesn't combine changes or benefits in a linear way. Much of the impact delivered by specific interventions can be cannibalised or undone by others. *A systems view of transport in the region needs to be taken.*

All of these observations are backed up with specific outputs and behaviours seen within the modelling. We are seeing complex second and third order effects within the model that reflect the complexities of individuals' transport choices and are the result of their interactions rather than being baked into the model inputs.

It is worth reiterating that the model is still relatively early in tis development, and has gone well beyond the original 'alpha' aspiration for this scope of work, and is now ready to support a range of different strategic planning and policy questions.

We have shown a range of insights that are useful for Transport East, its local authority partners, and wider stakeholders. At this stage understanding what levers exist that TE can pull or influence, and those that are outside of its control but fundamentally impact its desired outcomes (e.g. levels of working from home) is a valuable exercise.

It would be possible to generate even more insights from the outputs of the generated scenarios, as the scale of the analysis that is available is potentially overwhelming. Therefore we recommend that methods of sharing the output of the modelling with a wider group of organisations and stakeholders are developed. This will maximise the value that the modelling will provide to the region and open up the modelling for more detailed scrutiny. This will be key for building confidence in the approach within the industry and understanding what this modelling approach is best used for more generally.

Executive Summary

What is the future for the model?

The different components on the Transport East model have all been through a number of iterations during this project, and we expect them all to have further iteration and refinement as the model is used to answer specific questions. The way the model is architected means that these individual improvements can all feed back into the core model. Indeed, a number of potential new scenarios have been identified as part of this project.

It is worth noting the scale of the development that has been possible within a short four month period. Developing a model and getting this much insight from it in four months shows that data driven analysis is feasible at a strategic level. Future studies and scenarios will potentially be able to be turned around in as little as a month now the base model has been developed.

This kind of incremental development will help keep the model current and up to date without the need for large refresh projects. Smaller pieces of work to add in new base datasets or define new outputs can be undertaken as standalone activities if needed.

We have had good engagement from both local and national stakeholders, especially the Department for Transport, National Highways, and Network Rail. Understanding how the model can become part of a consistent evidence base to support both local and national studies will prove valuable going forward.

Finally, there are a range of opportunities to continue the engagement that has begun with the 'monthly demos' stakeholder group. This has been one of the more unexpected outcomes of the project, creating a group of interested and engaged individuals from a wide range of organisation. While continuing in-person engagement may be require a lot of resources, finding a way to continue supporting and engaging with the group is likely to be valuable.

What did we do?

The Project

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Project objectives

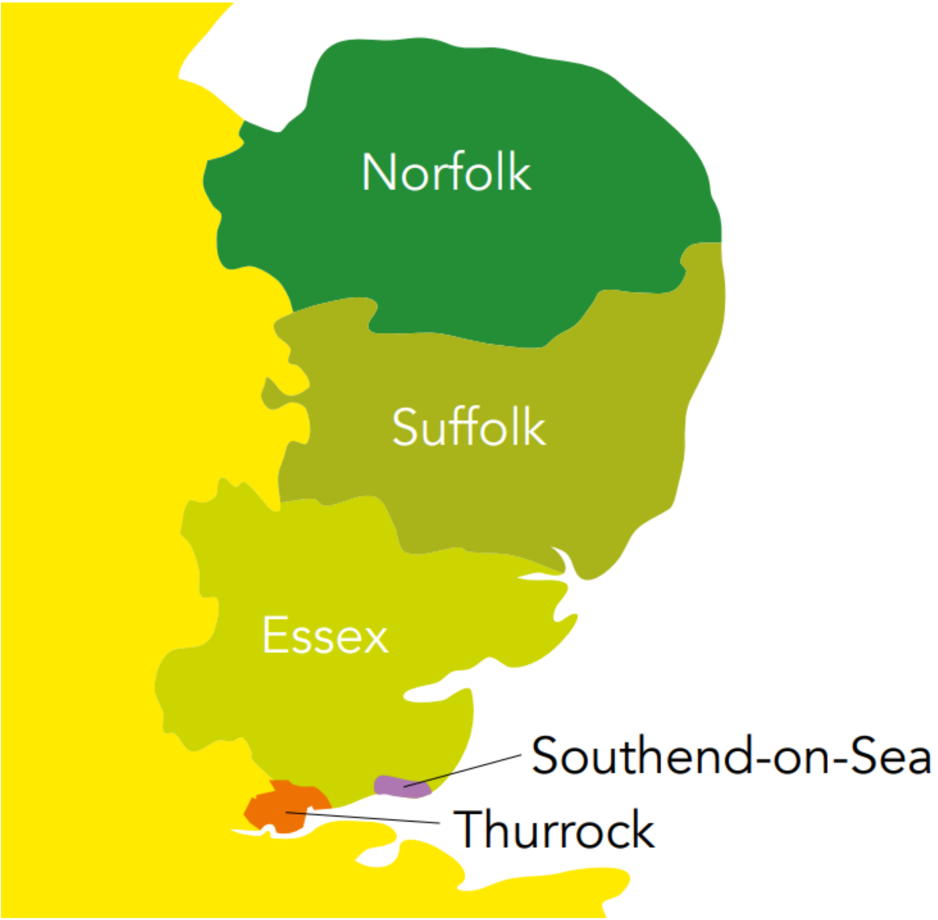
What did we set out to achieve?

We wanted to replicate the level of model maturity that was built for Suffolk across the whole of the Transport East region.

Objective: Build an agent based model of the Transport East region to support policy assessment and generate insight to support strategic decision making. This included:

- Build a baseline model of 2019
- Build a 2040 future year model
- Assess a range of high level scenarios, focusing on carbon assessment as an output
- Understand wider use cases for a range of stakeholders
- Ensure that model outputs are accessible and shareable more widely

Agile working: The core client team being integrated into the project. We worked in an agile way refining our understanding of what was of most value to Transport East and wider stakeholders. This meant that the methodology that we used and the scenarios that were being tested were able to change through the course of the project.



Transport East Region and Authorities. Source: Transport East Business Plan 2021/2022

Stakeholder engagement

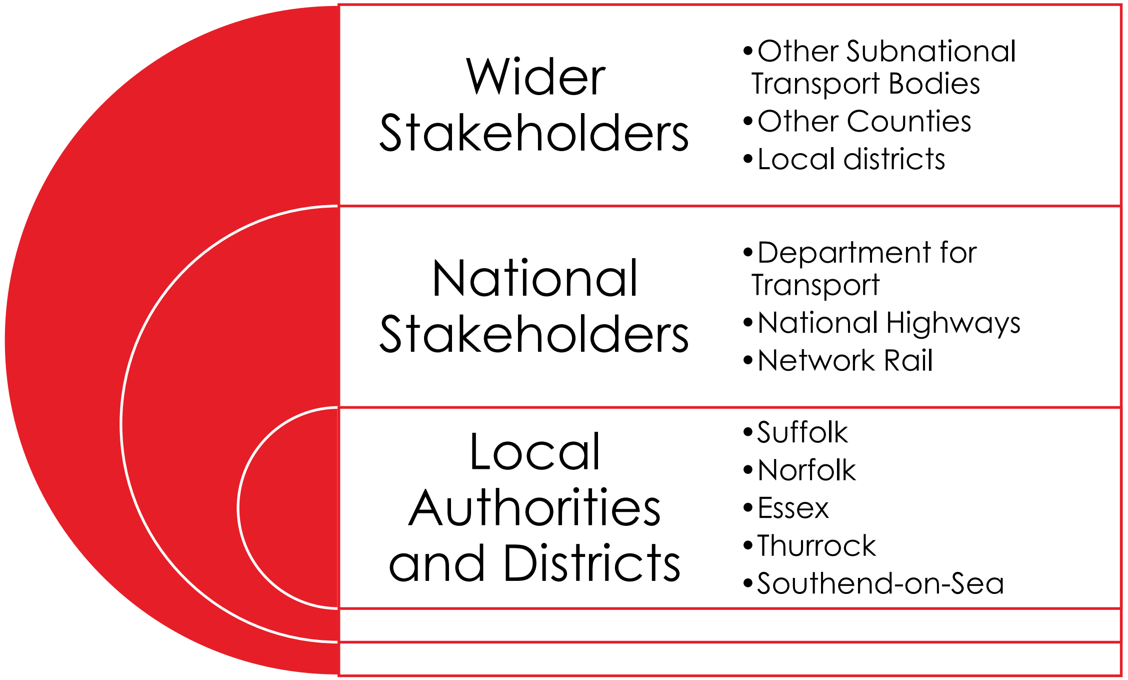
Who did we engage and why?

For this model to add value to decision making, we need to acknowledge that there are a number of key challenges and opportunities we need to address:

1. Transport East as an organisation is trying to bring a regional perspective and support its membership
2. This modelling approach is new and innovative, and is complementary to existing approaches
3. There is a diverse range of needs for use of the model across different authority levels, (Transport East, Local Authorities, and district councils)

It was therefore a core part of the project to engage with a wide group of stakeholders to ensure that each of the Transport East Local Authorities, national stakeholders, and as wide an audience as possible were appraised of progress and consulted as part of the project.

Details of how we engaged are on the next page, and feedback from stakeholders will be key in how the model is developed and used going forward.



Stakeholder groups engaged during the project

What did we build?

The model
The scenarios

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Simulating travel behaviour

How does an agent based model work?

The Transport East ABM is a model built by Arup on the open source simulation framework MATSim (matsim.org).

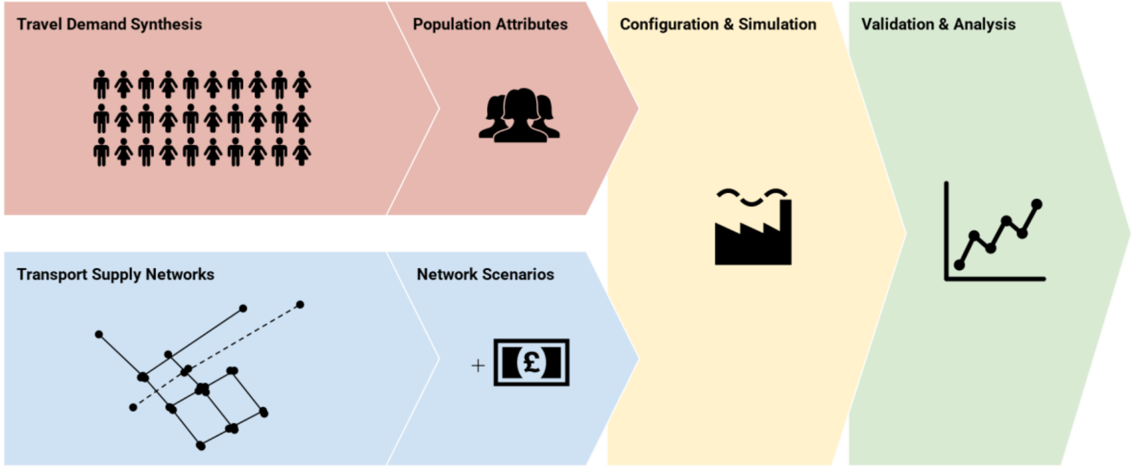
The simulation brings together a population of synthetic agents that is representative of the people living in the Transport East region. These agents are given activity plans that are designed to be representative of real people's days, comprising of the activities that they undertake with locations for those activities.

These agents are then simulated through a full 24 hour day as they try to fulfil their plans. They choose when to travel, which mode to use, and the route they take. Within our simulation, agents can choose between driving a private car, using a taxi, using public transport, or using active modes (walking and cycling).

At the end of each day, the agents work out how well they were able to succeed in fulfilling their plans, and calculate an overall utility for the day. They then can 'innovate' and try something different. We simulate the same day over and over so the agents can learn what works and doesn't work for them, while every other agent is trying to do the same thing.

At the end of hundreds of iterations of this day, agents have optimised their transport choices and optimised their utility. This gives us a set of emergent behaviour across all agents, showing how busy different modes of transport are, what choices agents are making and why, and how outcomes vary across different segments of the agent population.

This gives us unprecedented granularity with which to generate insights to support decision makers shape future policy.



Structure of an Agent Based Model

The modelled network

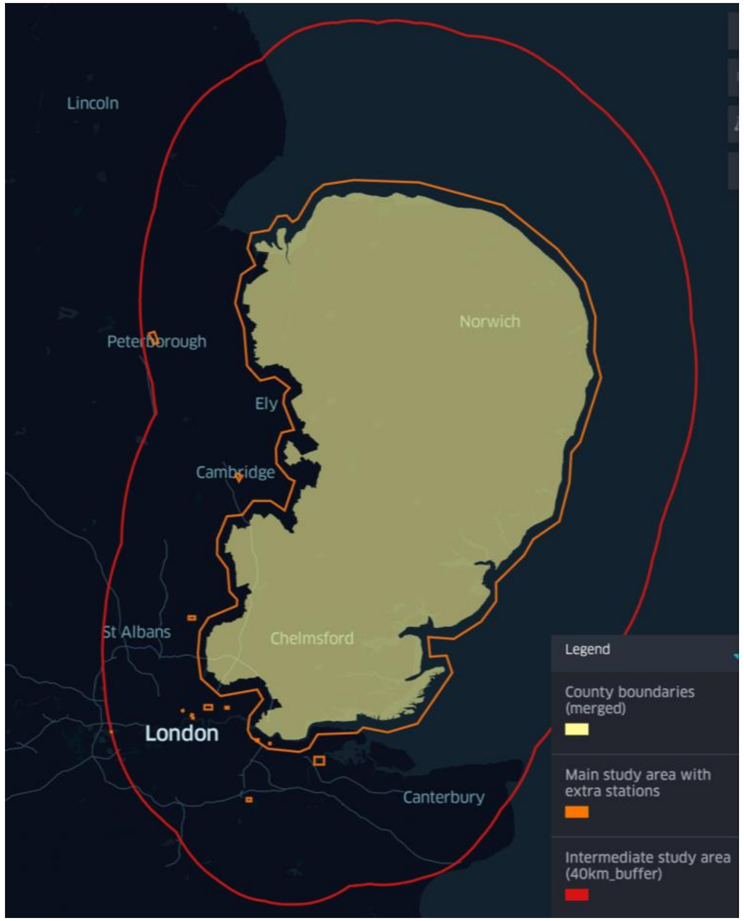
We use the whole GB network at different resolutions

We consider a number of boundaries when building the model, characterised by the level of network detail.

The boundary for the main study area for Transport East was defined by combining the boundaries for Norfolk, Suffolk, Essex, Southend-on-Sea, and Thurrock (*yellow area*), buffering the boundary by 3km and simplifying to make the polygon line simpler (*orange boundary*). This area is where we have the highest level of network detail.

The intermediate study area is a further 37km (*red boundary*) buffer around the orange boundary. This distance was chosen to include Cambridge as a key origin and destination that is outside of the formal TE region.

Outside of this area we have full mainland Great Britain strategic road network to allow long distance freight trips and is considered the buffer network.



Study area bounds (left) and full network extent (right)

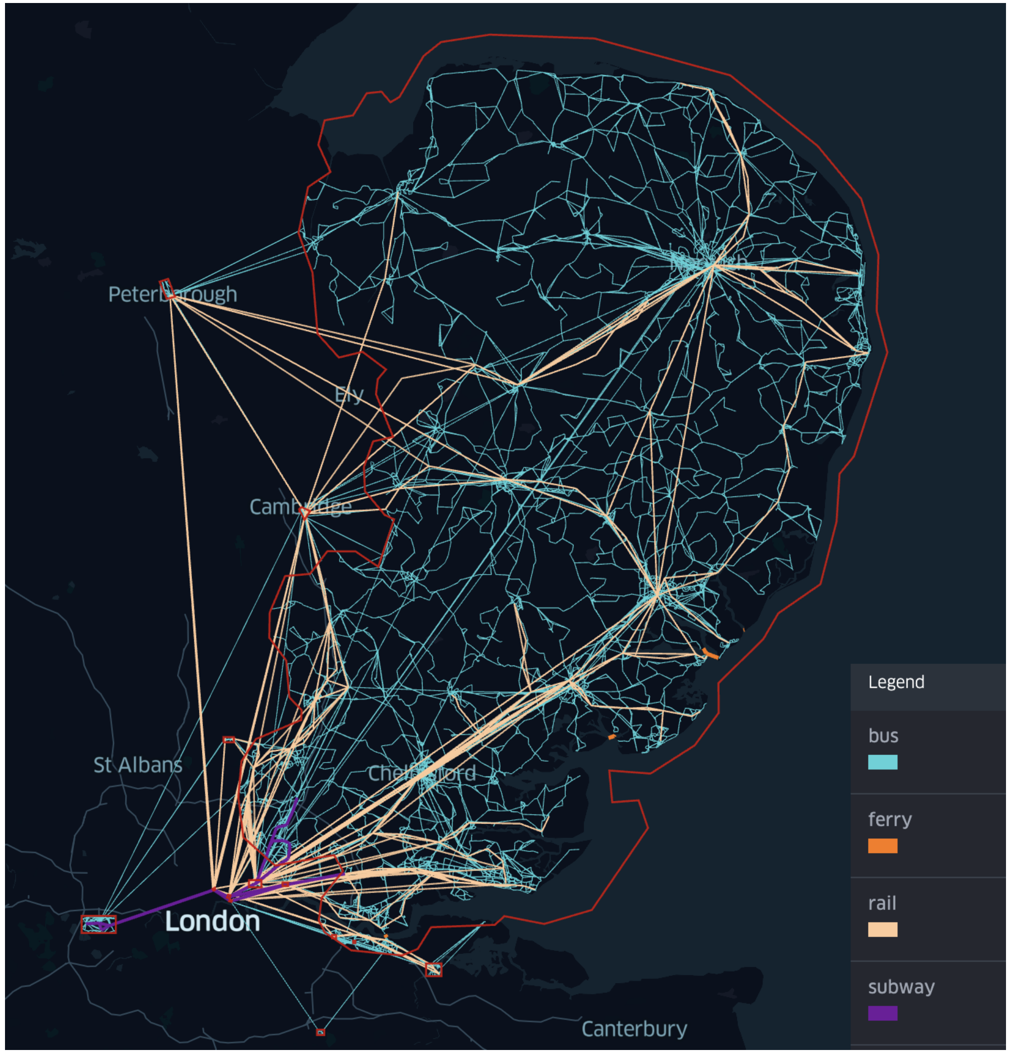
The modelled network

We have a very granular network and all PT services

The road network is generated from Open Street Map based on the tags on each link. We include links with the following tags; trunk, motorway, primary, secondary, tertiary, living street, residential, service, cycleway. This means we have full detail across all five local authorities in our fully modelled area.

Public transit stations outside the main study area for key commuting routes including Cambridge, Peterborough, London terminals, and Heathrow (only subway and rail stations from T2 & T3) are included.

We adjust some agent activities to be located at these transit stops (i.e. London work trips happen at a terminus station) to remove the need for representing onward local journeys outside of the study area, meaning that the full tube or London bus network doesn't need to be included in the network.



Public Transport Services

The population

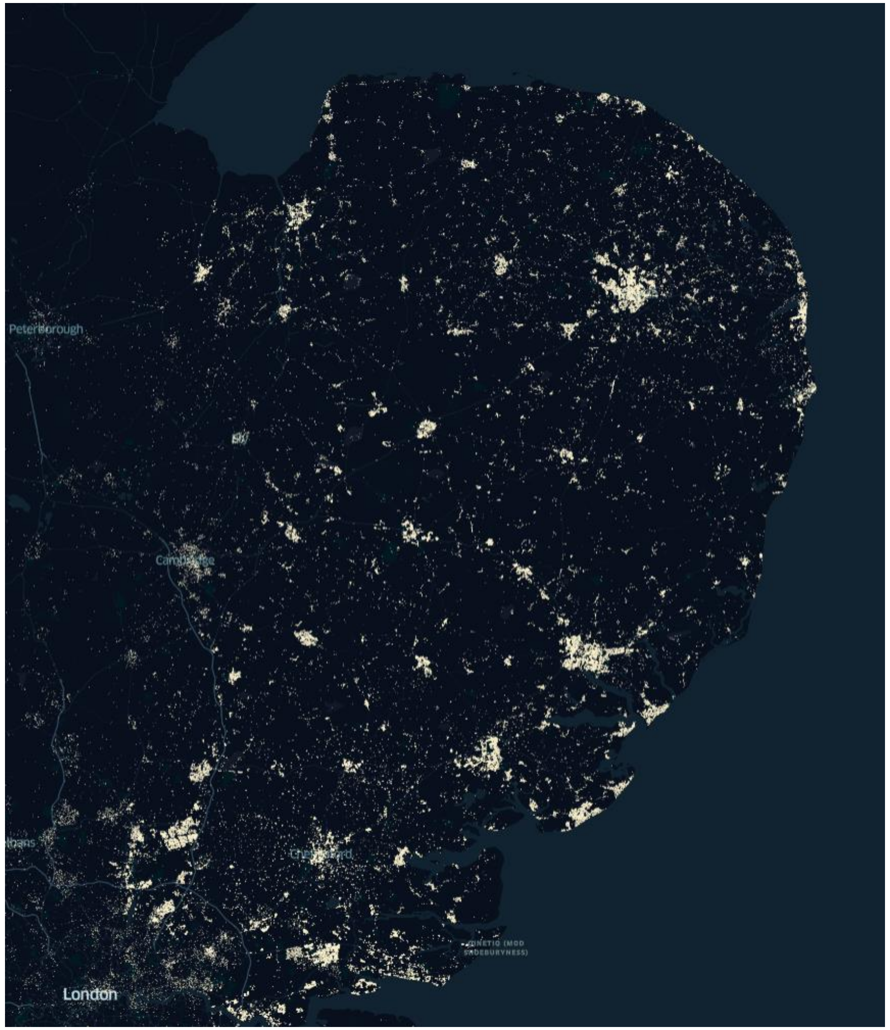
We consider journeys from across the UK that interact with the region

With a bounded network, we next need to generate the agent activity demand. Within the model there are two key types of demand; individuals travelling and freight vehicles.

For the first type of demand, a synthetic population is created consisting of agents whose activities mean they interact with the study area. This may be people with journey origins or destinations within the region, or trips that pass through the region, taking up capacity on the network. In simulation, we allow these agents to change their time, mode, and route choice.

The freight demand is generated in a similar way, however, freight tours are more complex as we generate multiple drop offs and stops for freight agents. Freight agents aren't able to make as many choices as the individual agents (they are locked to using roads).

Finally, it is worth noting that the model uses a 'ten percent' population. In this, one agent represents ten individuals. This helps reduce simulation runtime without a major impact on observed behaviour. To compensate for this, the network is adjusted to provide realistic capacities.



Agent Home Locations

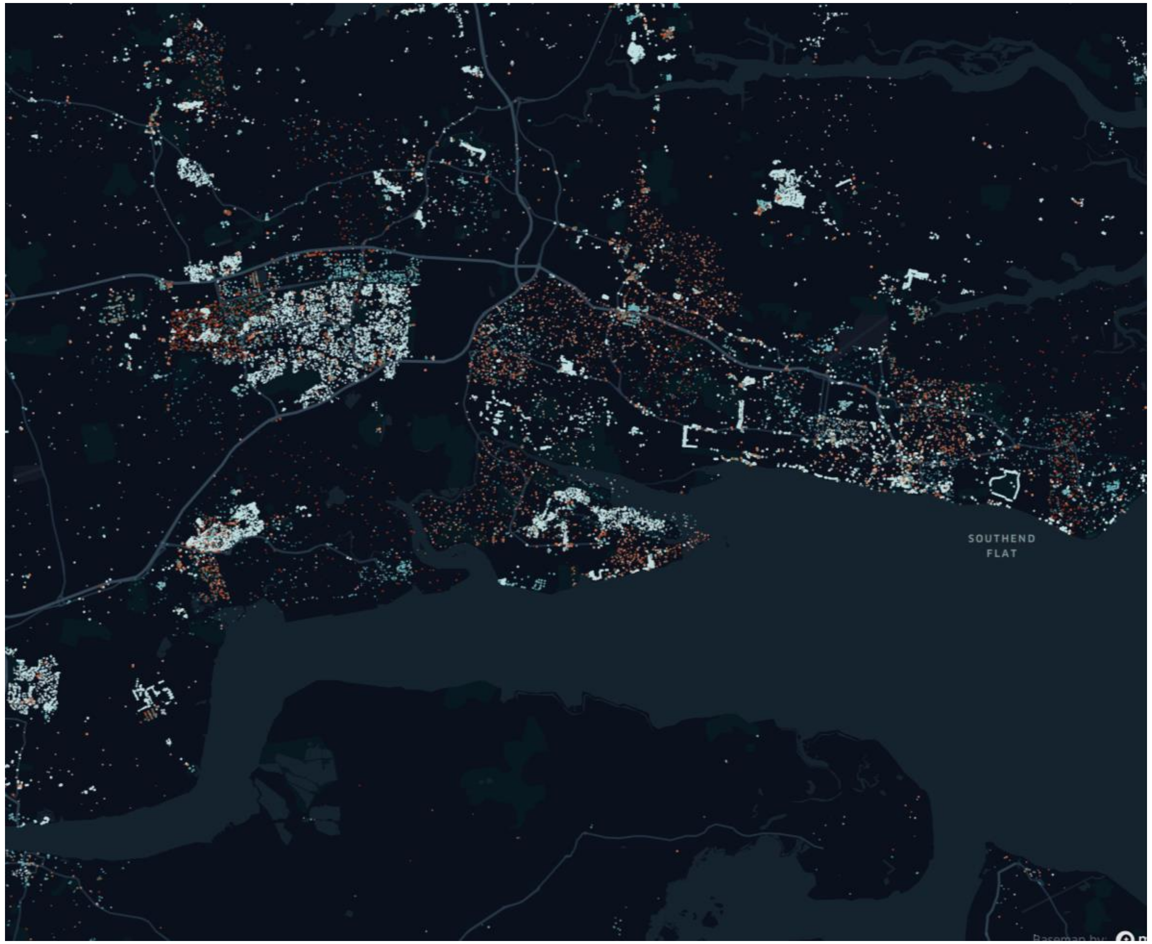
Baseline models

We have built models to represent 2019 and 2040

Our two baseline models are intended to provide different insights and outcomes. We chose a **base year of 2019**, as this is the year where we have the ability to use most data, as it was before the COVID-19 pandemic. This means that we can use a variety of different benchmarking data from different sources to judge the performance of our model. This is especially important when we are using data from a wide range of different sources across the five separate local authorities that make up Transport East.

The future year we selected to model was **2040**, to align with decarbonisation targets. This means that there are a number of key outcomes to be achieved by this date, but also that there are publicised assumptions and future forecasts that can be used. We are not trying to create a formal 2040 forecast – we want to understand the behaviour of the future network so that we can understand agent responses as we change things.

We have therefore created a 2040 Baseline model which incorporates some expected changes, to serve as a basis for comparison with future scenarios.



Southend-on-Sea Facility Locations

2040 Baseline

We built a 2040 model to represent changes expected by 2040

We have seen over recent years that large scale behavioural changes are likely to be a feature of our society as we go forward. Assuming that people in the future will behave in the same way as people do today is fundamentally wrong. This poses a challenge with modelling as we don't have data to represent these changes. We have embodied different changes into our 2040 population using a range of methods and assumptions.

Working from Home: We believe that working from home will be a substantial and long lasting change to people's travel behaviours. Our agent population has an employment category (from NTS). We assumed a 40% working from home rate (two days a week full time) for agents tagged to "managerial and technical", "professional", and "skilled non-manual" occupations. We then used our PAM tool to assign 40% of agents in these categories to have work activities at the same locations as their homes, and gave the agents a 'wfh' tag. This resulted in 76,498 work trips being relocated across the whole population (421,455 agents).

Driving costs: Agents with vehicles are divided into two sub-populations, those tagged as 'EV' and those with traditional cars. This means that the groups can have different costs of car travel, and these costs were updated for the 2040 population based on the TAG Databook.

Vehicle fleet update: We have future projections for EV uptake in 2040, however, we needed to assign these to agents. We used existing NTS data on EV owners and TAG forecasts to model future uptake and assigned vehicles in line with the table below. For our carbon analysis, we also aged the existing vehicle fleet, assuming that future combustion engines would be more efficient than the current fleet.

mode	household income	2019 Baseline	2040 Baseline	2040 EV Double	2040 EV High
car	low	0.8%	25%	50%	79%
car	medium	0.8%	27%	54%	86%
car	high	1.4%	48%	95%	100%
lgv	N/A	0%	19%	38%	81%

Probability that a household with a car, has an EV (given income)

2019 Baseline model performance

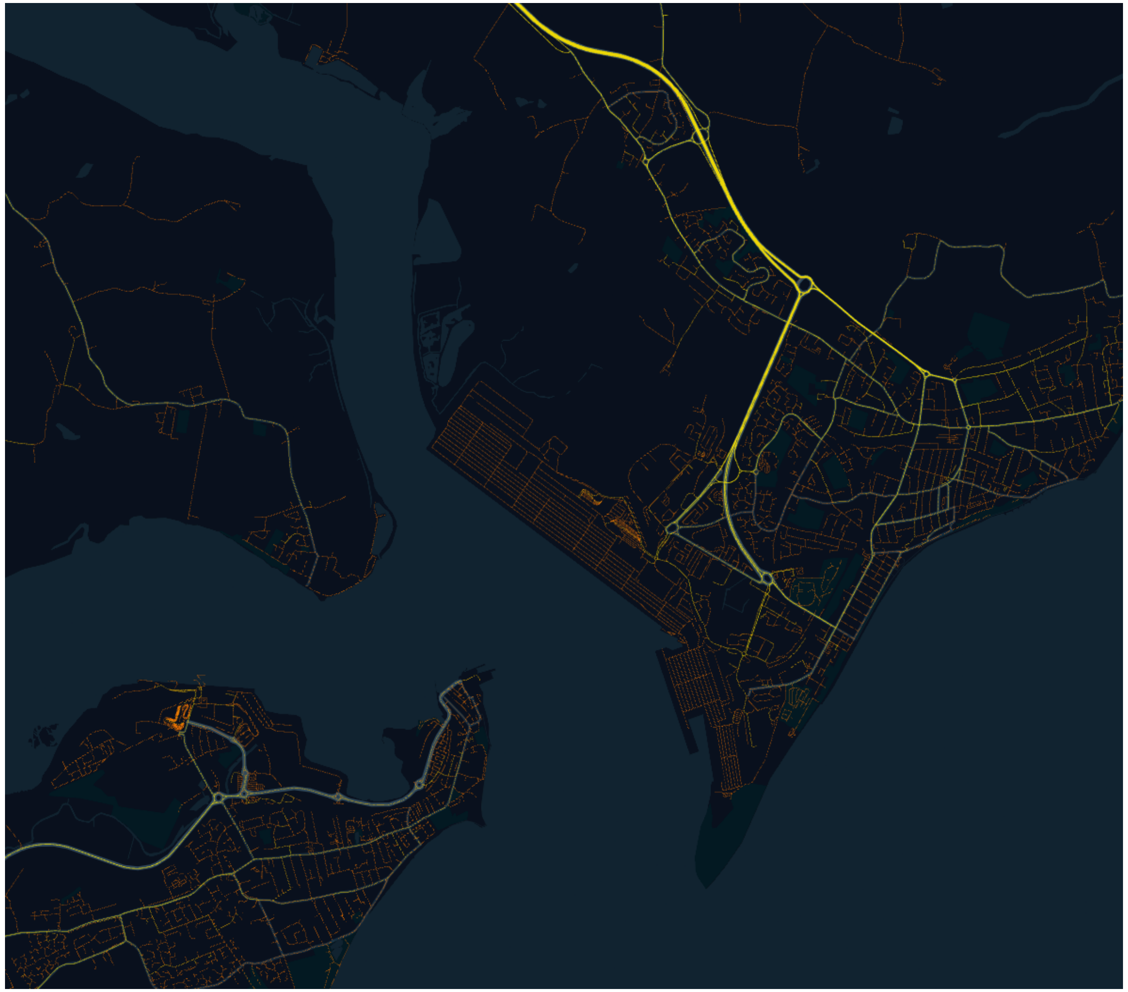
Overall commentary on model performance

This 2019 Baseline model was examined across each mode of travel to demonstrate that the supply of transport infrastructure combined with the demand generated by the agents completing their daily activities are interacting with each other produces sensible behaviours at an aggregate level.

The outputs show that total trips by mode, time of day, distance and travel time are realistic and align with typical expectations for transport networks.

Car outputs show that main trunk roads corridors within the model, along with urban centres and ring roads are all well represented with speed reductions in and around busy centres. Rail and bus movements replicate known key demands and corridors in the region and are profiled through the day aligned to logical expectations for the types of trips.

The level of performance for a model at this stage of development is very good, and is appropriate for the level of question that the model is currently targeted at.



9am hourly traffic flow – Felixstowe and Harwich

Scenario assessment

What did we test with the model?

The stakeholder engagement identified a large number of different scenarios and impacts that we would want to test with the model. Given the timeline and scope for this project, we have focused on some of the key factors that we believe will impact the decarbonisation of the Transport East region by 2040. These simulations were run in addition to the 2019 and 2040 baselines.

Scenario	Research Question	Changes to Baseline
2040 - Road Pricing Scenarios	What is the impact of increasing per km costs on driving?	Cars, LGVs, and HGVs have their per-km charges increased. This will be across combustion and electric vehicles. Increases; Low: 1.5x, Medium: 2x, High: 3x. These are applied across different vehicle types based on their base 2040 cost per km in the TAG Databook (so EVs remain cheaper to run than combustion cars, but cost more than in the 2040 baseline).
2040 - EV Uptake Scenarios	What is the impact of different levels of EV uptake?	The 2040 Baseline has 33% of private vehicles as Electric Vehicles based on TAG Databook data. We have a scenario at 66% uptake and one at 88% uptake (based on the Vehicle Led Decarbonisation assumptions in the TAG Common Analytics Scenarios). Different EV proportions applied to LGVs, and HGVs assumed to be all combustion (as per TAG data book).
2040 – Active Travel	What would happen if active modes were twice as appealing?	We halved the utility cost of walking and cycling (representing agents having a more positive attitude to these modes). This isn't saying how this could be achieved, but rather considering the impacts from this improvement.
2040 - Combined Scenario	If we combine scenarios, how close do we get to net zero?	This final scenario combines the highest level of road pricing used above, with the highest level of EV uptake, and the active travel utility boost.

What did we find?

The insights

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The Insights

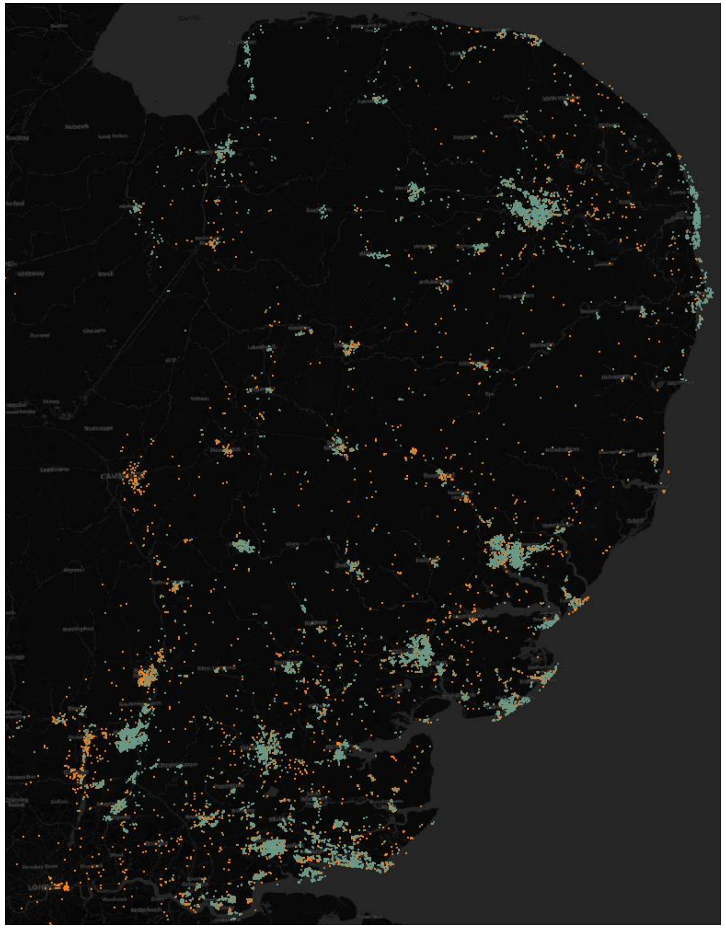
Each model run creates a huge potential for insight

At the end of the simulation stage of the model, we have a full record of each agent's choices, and their activities within the day. These outputs can be very large and unwieldy, and the analysis of the outputs is a challenge in itself.

We are able to look at a level of detail that means a structured, question and hypothesis driven approach is needed to understand what is going on within the model. For this project, we focused on analysis in a number of categories:

- Short trip analysis: How many short trips are undertaken by active modes?
- Mode shift: How do people's mode choices change in the scenario?
- Carbon: How much carbon is being emitted in the scenario?
- Equity: Who is impacted by changes and how fair are the impacts?
- Agent utility: How much do people suffer if they have to adapt their behaviour?

We used these analysis lenses to draw conclusions across the different types of scenarios (active, EV uptake, and road pricing), as well as observations about the region as a whole. The key insights are summarised on the following pages with examples of some of the model output. More detail is available in the full report.



Agents with unselected public transport options (orange – rail, green – bus)

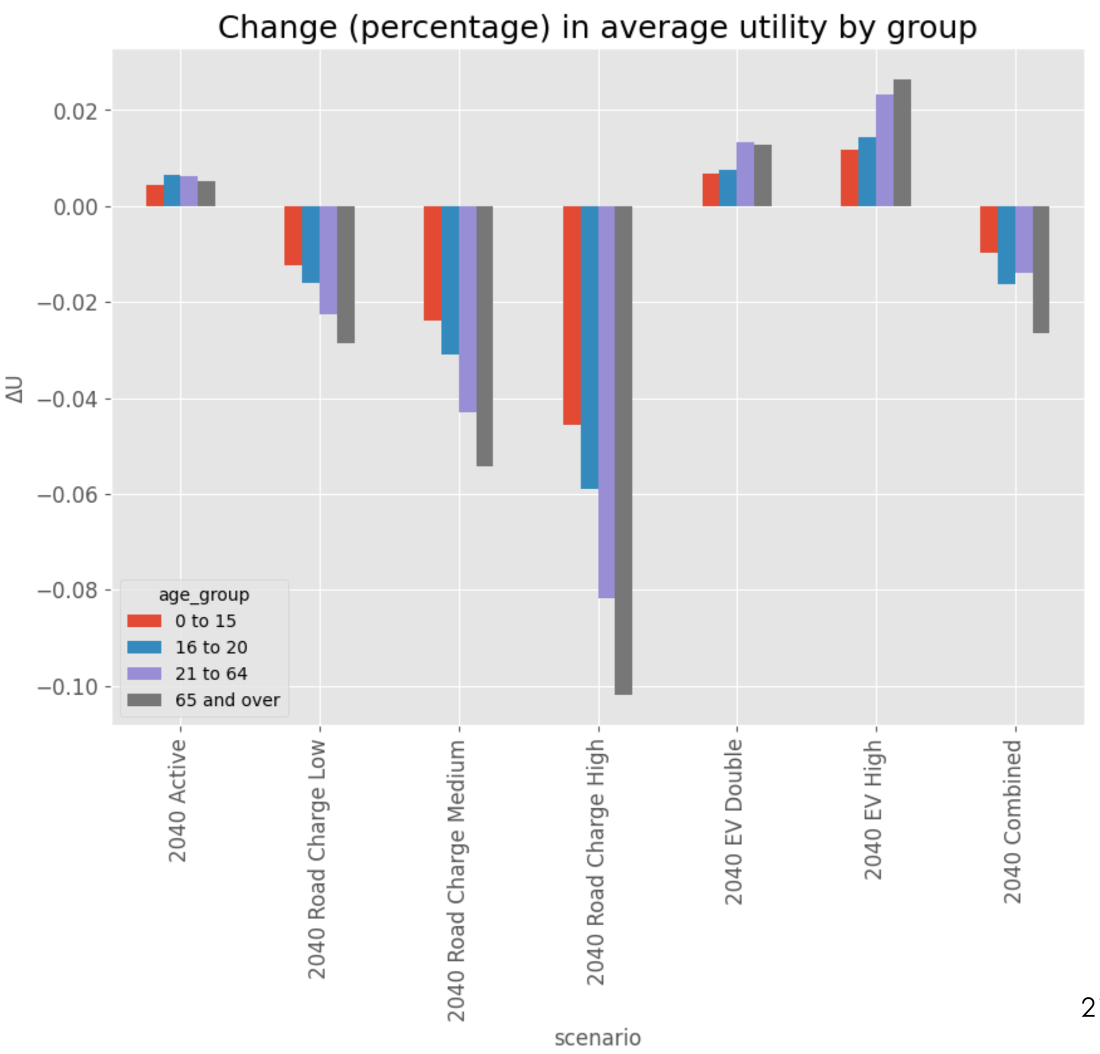
The Insights

1. Equity

Summary: Equity should be a key consideration within the region, as older people and those with lower incomes are much less able to adapt to change, especially in rural areas. Impacts are greater for lower income households, and these tend to be negative as we try to change travel behaviour. *One size fits all interventions should be discouraged.*

Discussion: The chart to the right shows how utility changes in each different scenario. Utility is a measure of how well groups of individuals were able to go about their day. It incorporates positive utility for completing activities, and disutility for financial costs and cost of time for travel.

In this example, we can see that older people are more sensitive to changes in their utility than younger groups. This is the effect of some correlations between age and income, but also because older people tend to have fewer activities, so changes to a single trip have a bigger impact on them overall. With an ageing population in the region, this is worth further consideration.



The Insights

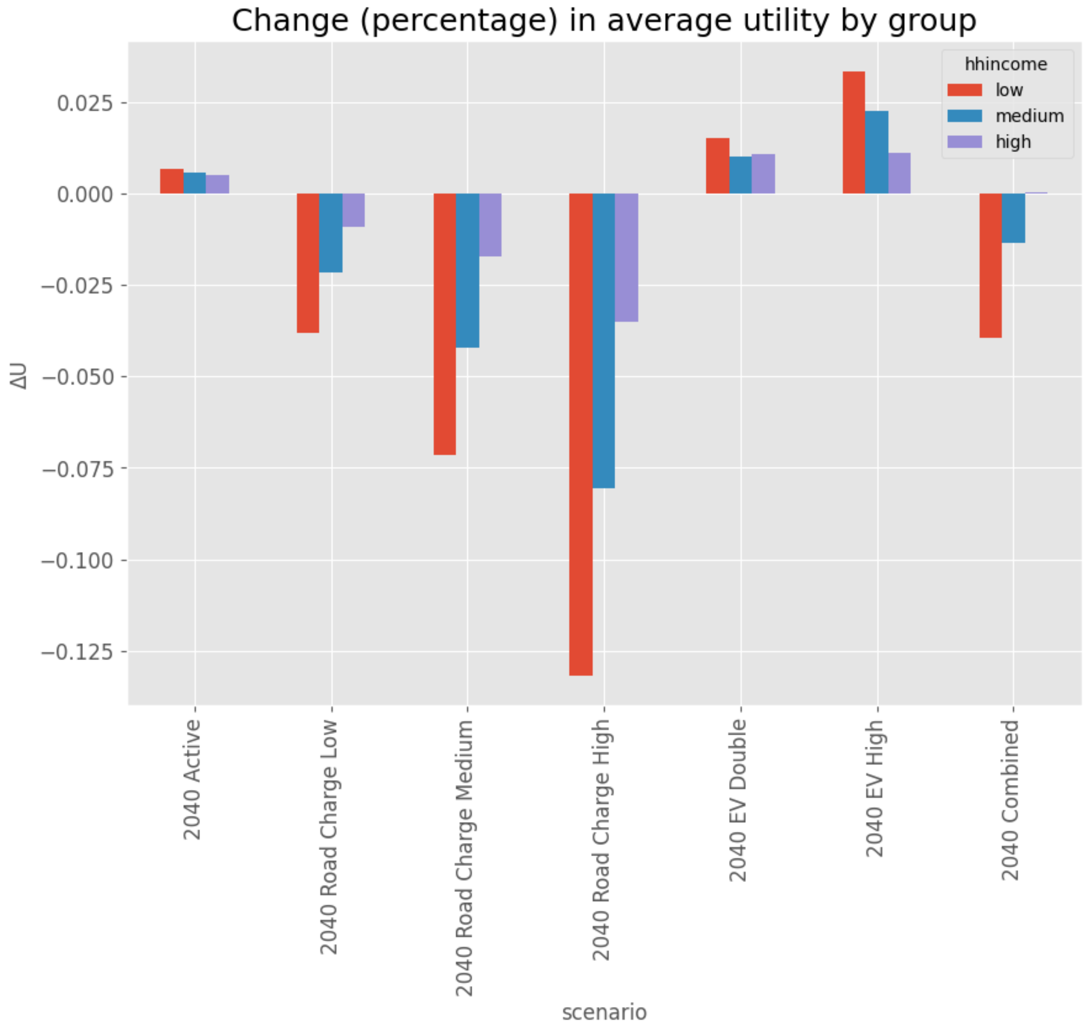
1. Equity

A lot of our analysis looked at different income groups. Here we see that, without exception, the lowest income group is hit hardest by changes to the network. In the road charging scenarios this is due to their higher price sensitivity.

With this equity viewpoint, we can see that the active and increased EV scenarios all have positive utility across all groups. This essentially says that active modes are really valuable to all groups, as is improved (and cheaper) access to car. This is a slightly worrying result, but further reinforces the level to which car dominates the transport network (and therefore transport choices) within the region.

Looking at the road pricing outcomes, it is clear that flat road pricing is very inequitable and more targeted, differential road pricing schemes (charging based on time of day, activity type, vehicle emissions etc.) may have a more desired outcome in terms of equity.

We discuss some of the other factors seen in this chart later in this section, specifically the change for the combined scenario.



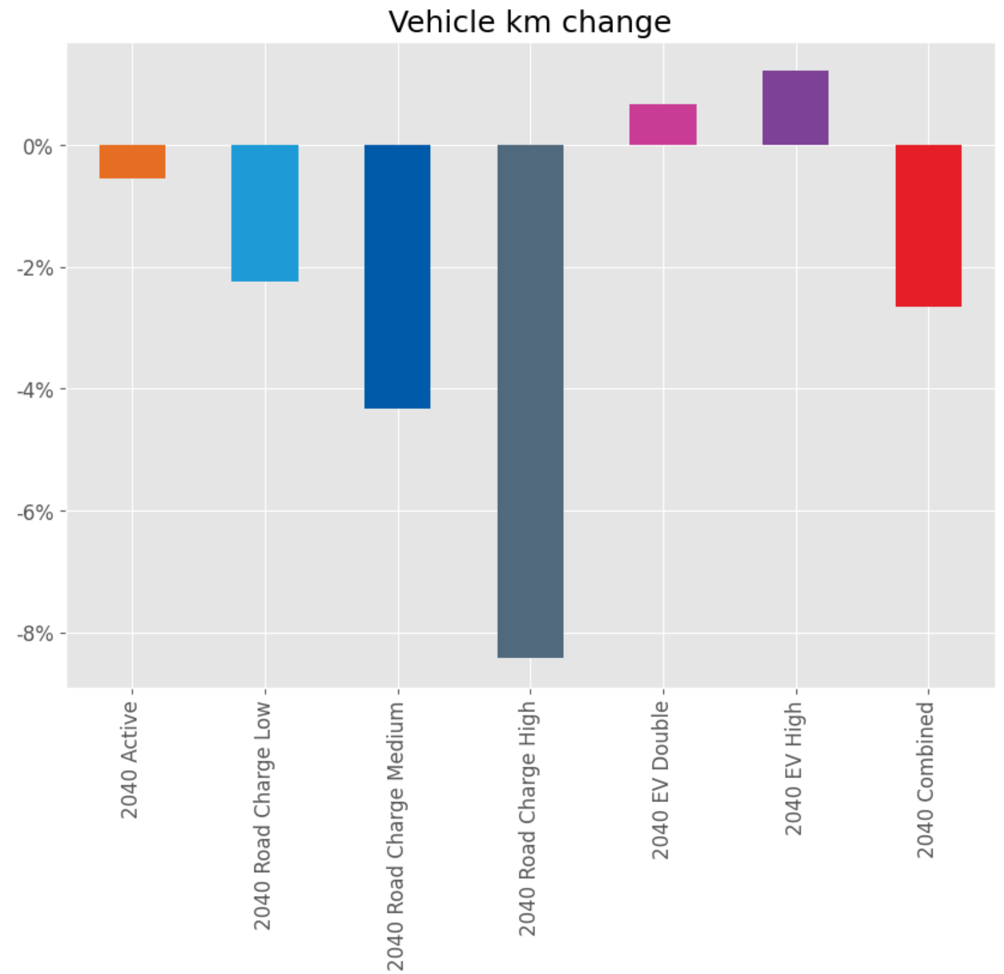
The Insights

2. Road pricing

Road pricing is most successful at reducing the amount of driving, however in the most extreme cases, this can have a very negative impact on everyone in the region, including those who don't own a car. This stems from a switch to a public transport network that doesn't have sufficient capacity. *Measures to discourage people away from private cars need to be coupled with investment and expansion of alternative modes if it is to be successful.*

We can see that the total distance travelled for the road charging scenarios decreases as the level of the charge increases. This is very positive in that it shows that charging can create behaviour change and move people away from their private vehicles. However, the car dominance in the region is really visible here, with only a little more than an 8% reduction in vehicle km in the most extreme case (a tripling of the cost of driving).

We discuss how the relative pricing of combustion and electric vehicles is also a key factor in a subsequent section.



The Insights

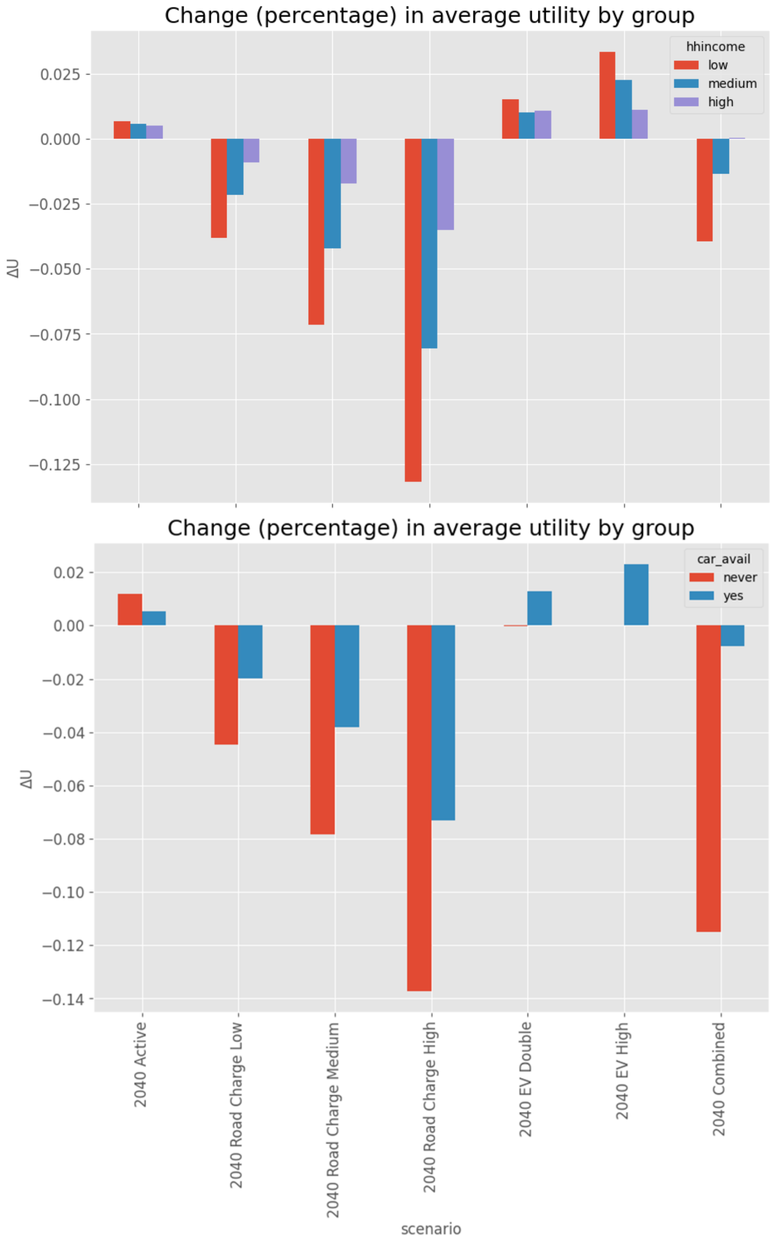
2. Road pricing

While we see the increasing road pricing charge decreasing the amount of driving on the network, we can see in the utility plots opposite that this is felt much more by the lower income group within the model.

In all of the scenarios, the biggest relative impact of changes is for those in the low income group. This is driven by the relative values of time and money between the different groups discussed in the previous section.

The lower chart opposite does pose an unintuitive question: “Why are people without cars negatively impacted by road pricing?” Intuitively, we feel that these agents shouldn’t be impacted by cars.

However, there are two different ways that a non-driving agent may be impacted in the model. The first is that an agent without access to a car can still choose to drive, but the costs are that much higher to represent the option of a taxi. This makes sense that we may see this choice happening in the model, but the scale of the impact seen makes it unlikely to be the majority of the impact. So what is happening?



The Insights

2. Road pricing

The answer is that non-car owning people are dependent on public transport to fulfil their daily plans. In the highest road pricing scenario, lots of car owners are dissuaded from driving due to the higher costs. These people then switch to public transportation, which is capacity constrained, meaning that those without cars are pushed off of the services that they depend on. The map to the right shows where agents aren't able to get on the service that they planned to use because of crowding.

The bus capacities in the model are generous, which means we are underestimating how often this is happening. We also see shifts to active modes in this scenario, which will contain people switching from car to bike, but also those who wanted to take a short bus trip, but were unable to due to overcrowding, so switched to bike.

This unintended effect showcases the strength of the model in modelling behavioural responses in a multimodal world.

The Insights

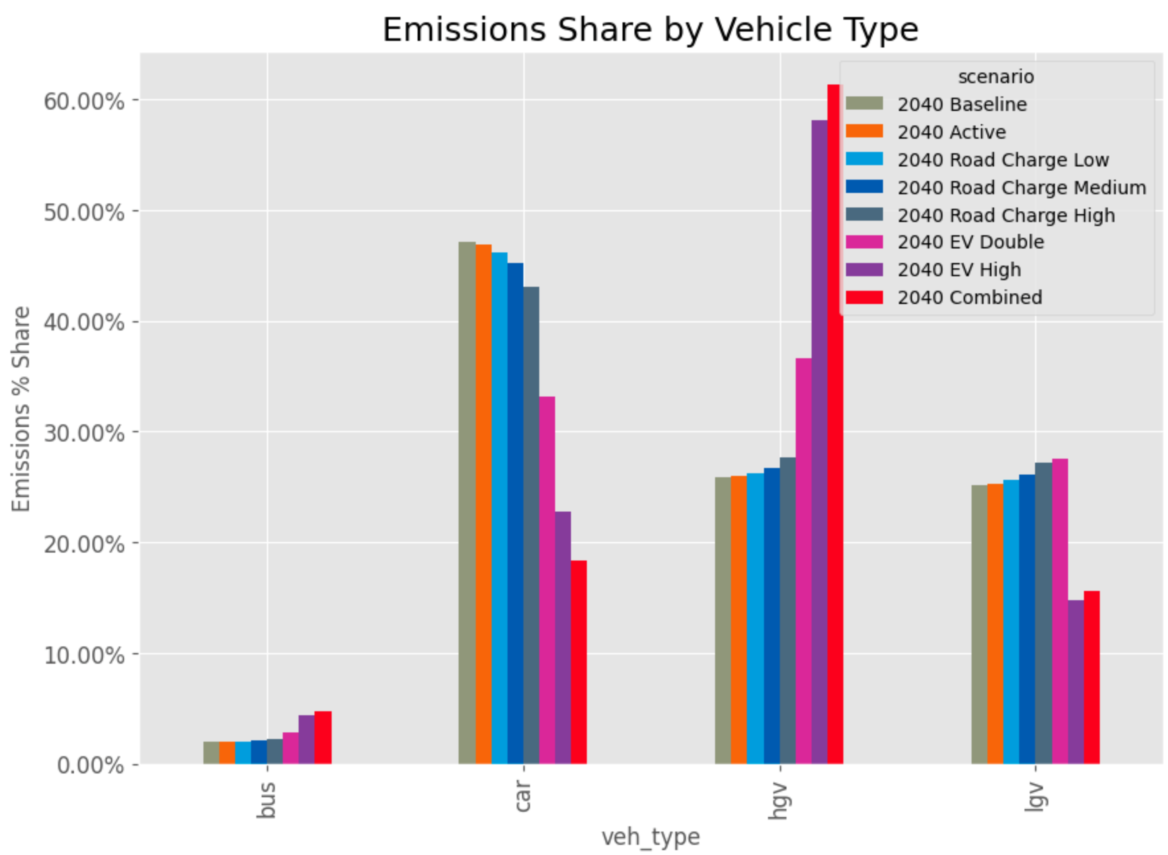
3. EV Uptake

Even in the most extreme **EV uptake** scenario we looked at, we are only forecasting getting halfway to a 'net zero' future. Measures to encourage EV uptake should be pursued, but priority should be given to strategies to reduce carbon emissions from freight, especially for HGVs. *Non-car emission reduction should be a priority focus for the region.*

The char opposite shows the proportion of emissions in each scenario across different vehicle types. Being able to disaggregate these emissions by vehicle type is another desirable feature of the model. We can see that in the EV Double and EV High scenarios, the proportion of emissions that come from HGVs goes up significantly.

This is due to the fact that there is currently no assumed decarbonisation pathway for these vehicles in the model. Overall, the high EV scenario reduces the carbon emissions by 56% compared to the 2040 baseline, showing that there is still a long way to go to get to a 'net zero' network in terms of operational carbon emissions.

We look at some of the other impacts of the High EV scenario in the next section.



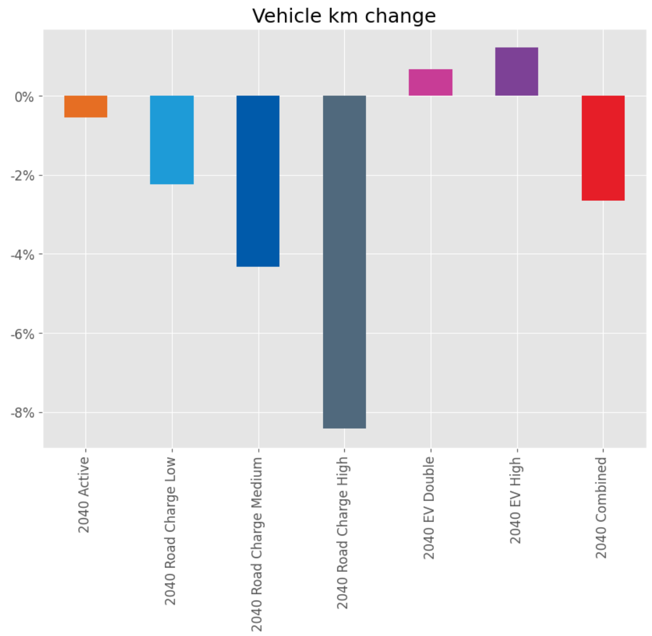
The Insights

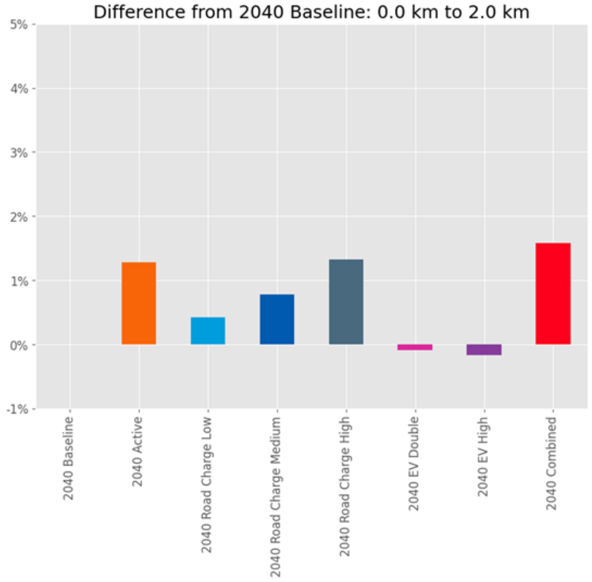
4. Behaviour change for private cars

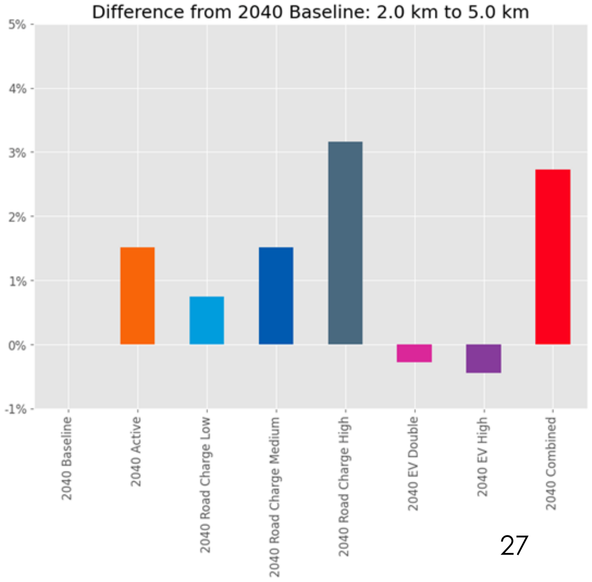
Pricing is a key driver of **behaviour change for private cars**. If lower costs for Electric Vehicles persist into the future, they are likely to encourage more driving, especially at short distances. While an EV is mostly decarbonised, it is still a vehicle on the road and contributes to congestion. *Discouraging car use for short journeys should be a theme for future development, especially if prices for car use are lower.*

While the higher EV scenarios are very impactful in terms of the carbon emissions, they actually increase the number of vehicle km travelled. This is because the current assumptions for EV costs have them as being significantly cheaper than combustion vehicles. This has the reverse effect than we are looking for – increasing the amount that people are travelling in their cars.

The lower two charts show that we are actually seeing a drop in the number of trips under 5km that are using active modes (bike and walking). While the reduction in emissions is desirable, the additional vehicles on the road and increased congestion is most certainly not.







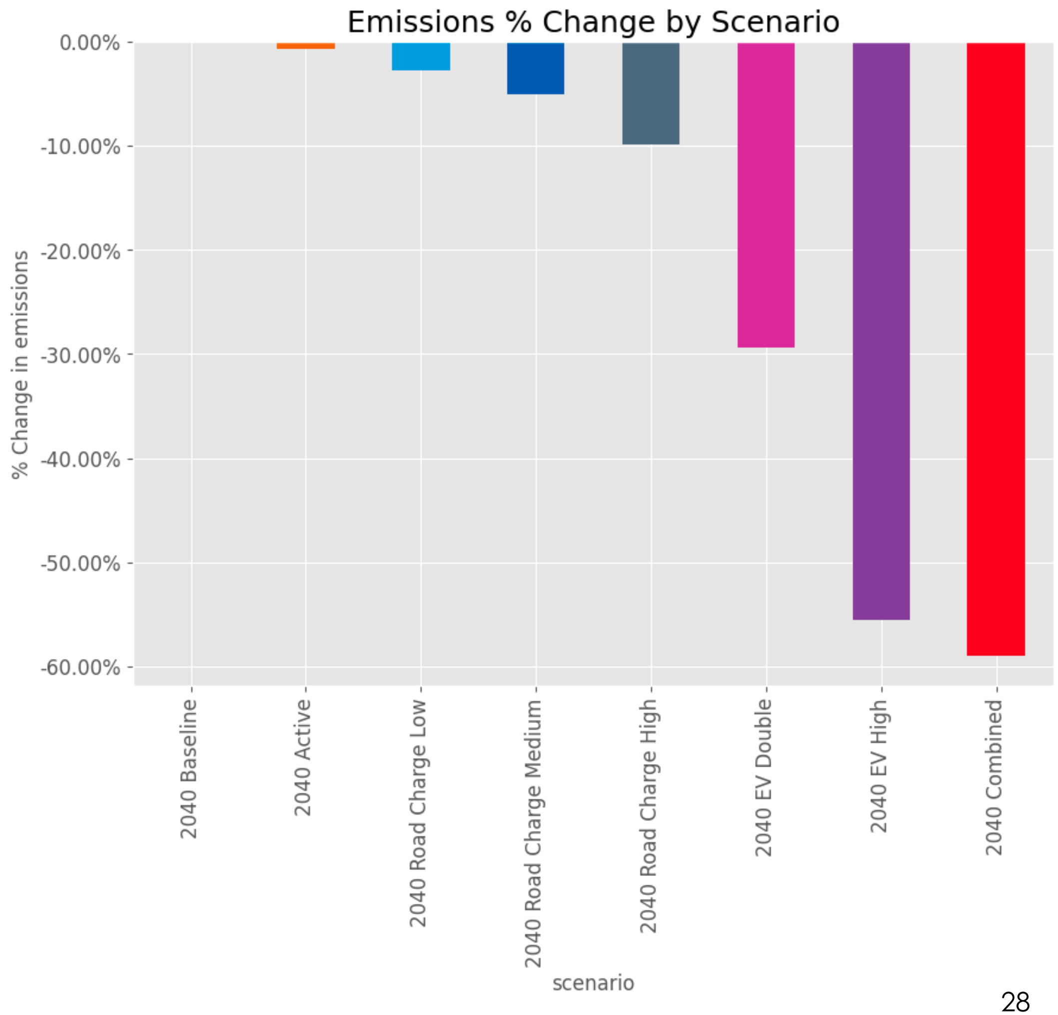
The Insights

5. Decarbonisation

Decarbonisation will be different for different groups of people. Higher income households tend to drive for more trips and tend to drive further, but they are most likely to decarbonise themselves through investment in an EV. *Delivering equitable decarbonisation for lower income groups should be a priority.*

All of our scenarios reduce the operational carbon of the network, but the quantum of reduction shows that decarbonising the private vehicle fleet should be the priority for the region if the net zero ambition is to be met.

On the next page we look at how emissions change for different income groups. This is a more complex picture, with those in high and medium income groups fundamentally changing their contribution to carbon emissions. These groups drive for more trips, and tend to drive further. In addition, they are more likely to be able to buy a more expensive electric vehicle. This results in them essentially decarbonising themselves.



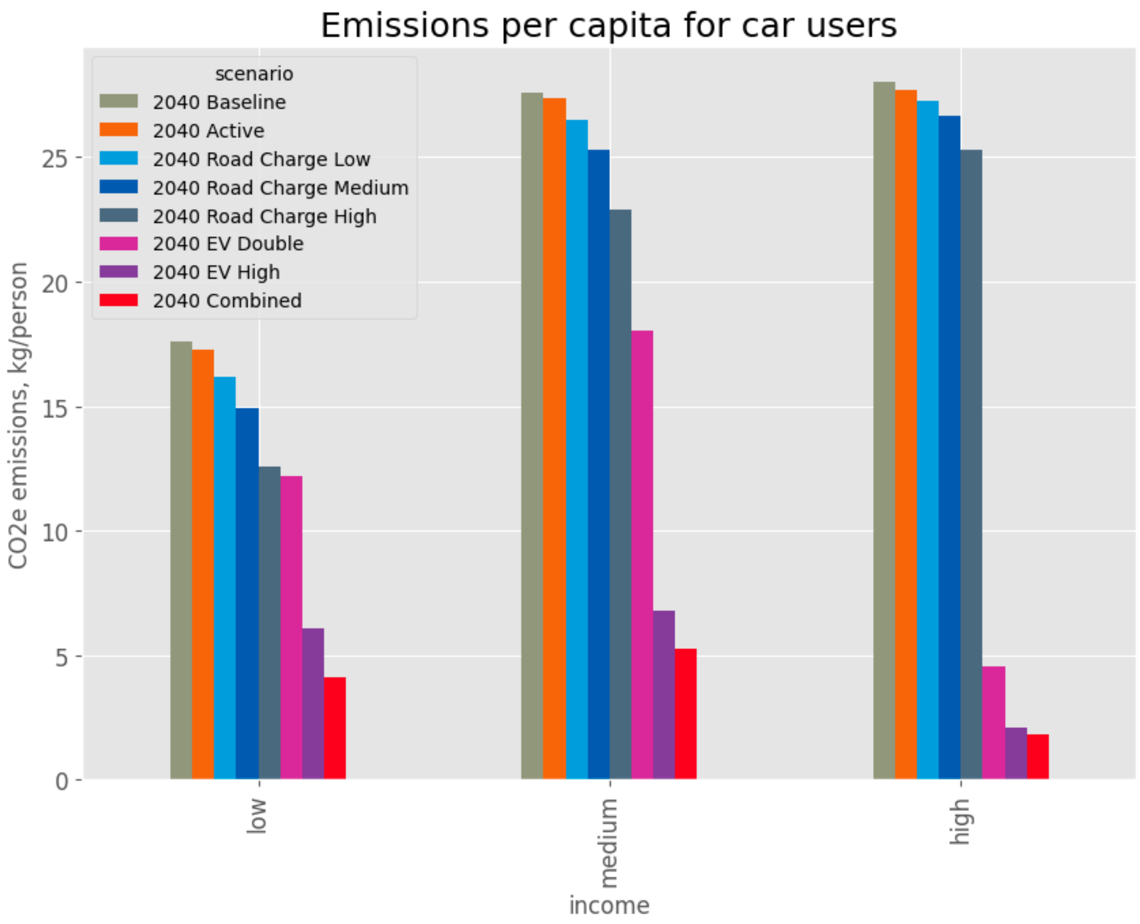
The Insights

5. Decarbonisation

When we look at the High EV and combined scenarios, medium income indivudals emit most carbon per capita. If we think about combining the High EV scenario with the high road charging as we see in the combined scenario, we are seeing significant reduction in emissions per capita.

However, if we remember the previous equity impacts, the lower income group is likely to be suffering significantly in this scenario, whereas the high income group is on a par with the baseline.

This is placing the future burden for decarbonisation on those who are least able to adapt to the change. Supporting those on low incomes with their transition to electric vehicles should be a priority, while ensuring that road charging is more equitable. For example, road charging that charges more polluting vehicles more has the potential to be a 'double whammy' for low income households who are forced to hold onto older and more polluting vehicles.



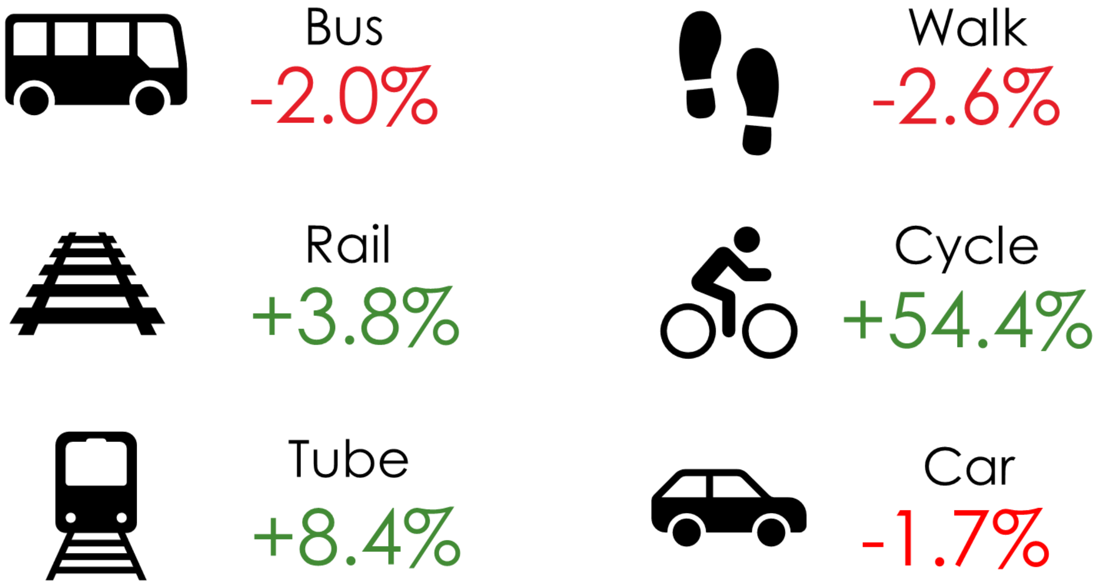
The Insights

6. Active Modes

Improving the appeal of **active modes** increases the number of people using public transport due to an increase in people accessing stations on bike. This is one of the few wholly positive impacts across all groups of people in the model. *Encouraging active modes will have significant whole network impacts.*

The graphic on the right shows how the boost in cycling has some interesting knock on effects – with cycling receiving the biggest boost to number of trips. However, we can see that the rail modes are also boosted in this scenario. This is due to stations having improved accessibility. It is worth noting that there are no other improvements in this scenario – the rail and tube services are running with the exact same schedule as in the baseline. Therefore this uplift is purely from the improved accessibility.

Finally, boosting utilities for walking and cycling actually reduces the amounf of walking trips. While counterintuitive, this is due to lots of walking trips switching to cycling (40% of the increase in cycling is from walking trips moving to bike).



Changes in trips for active scenario: Car trips in 2040 Baseline are approximately 7 million, so 123,000 trips shift away from car

The Insights

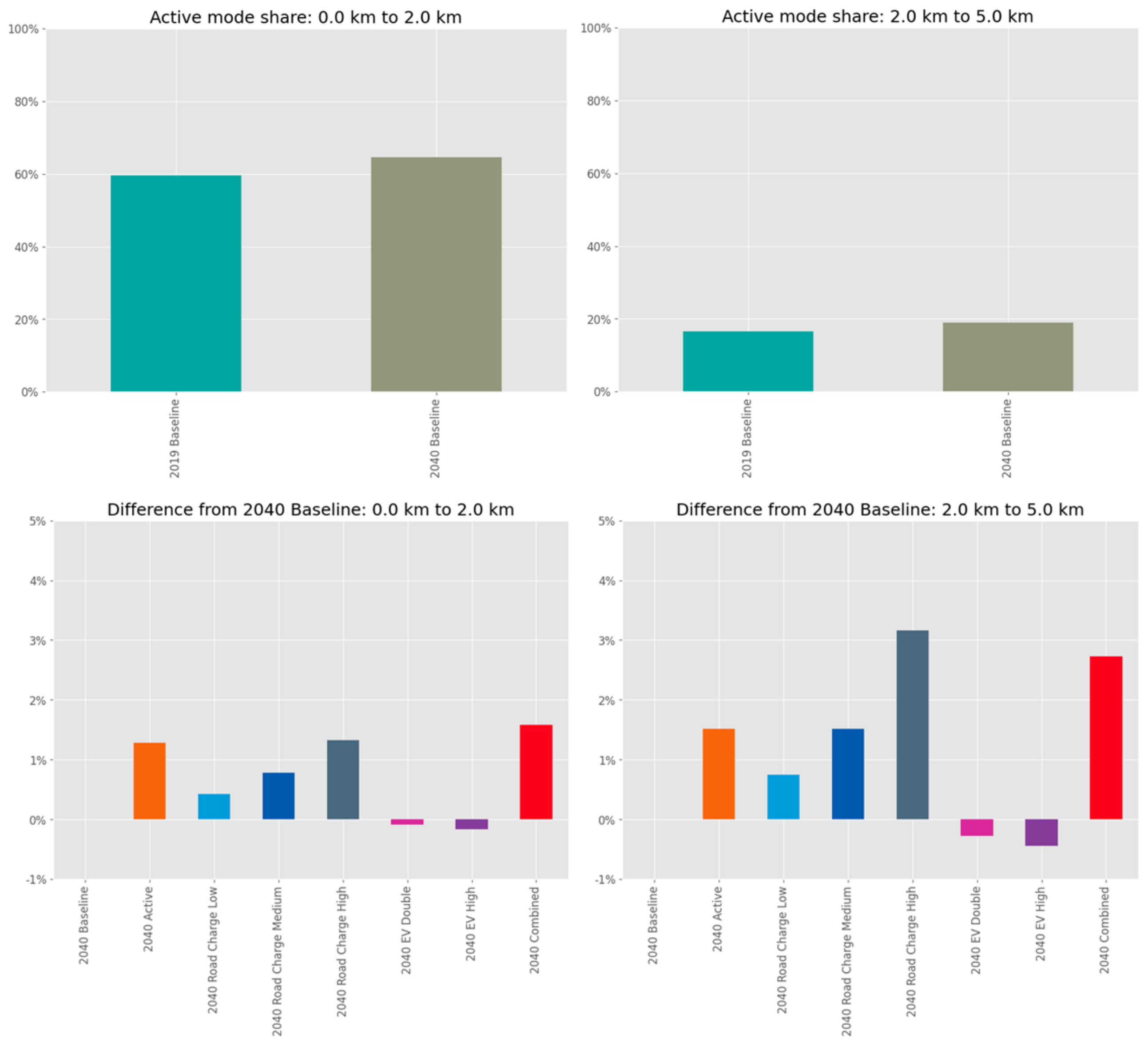
6. Active Modes

When we look at short trips, we would hope to see active modes dominating as these are the most feasible trips to undertake on foot or by bike. For this analysis we looked at trips between 0-2km and 2-5km separately, the former being focused on walking, and the latter on cycling.

We see that active modes are very dominant in the baselines, with an increase in 2040 due to the higher congestion on the network due to the increase in demand from population growth.

For the 0-2km distance walking is very dominant, whereas within 2-5km active modes drop off in favour of cars. This shows a very large opportunity for encouraging cycling for trips 2-5km long.

The EV uptake scenarios are the only runs that reduce the use of active modes at short distances, which is consistent with the previous analysis of EV trips.



The Insights

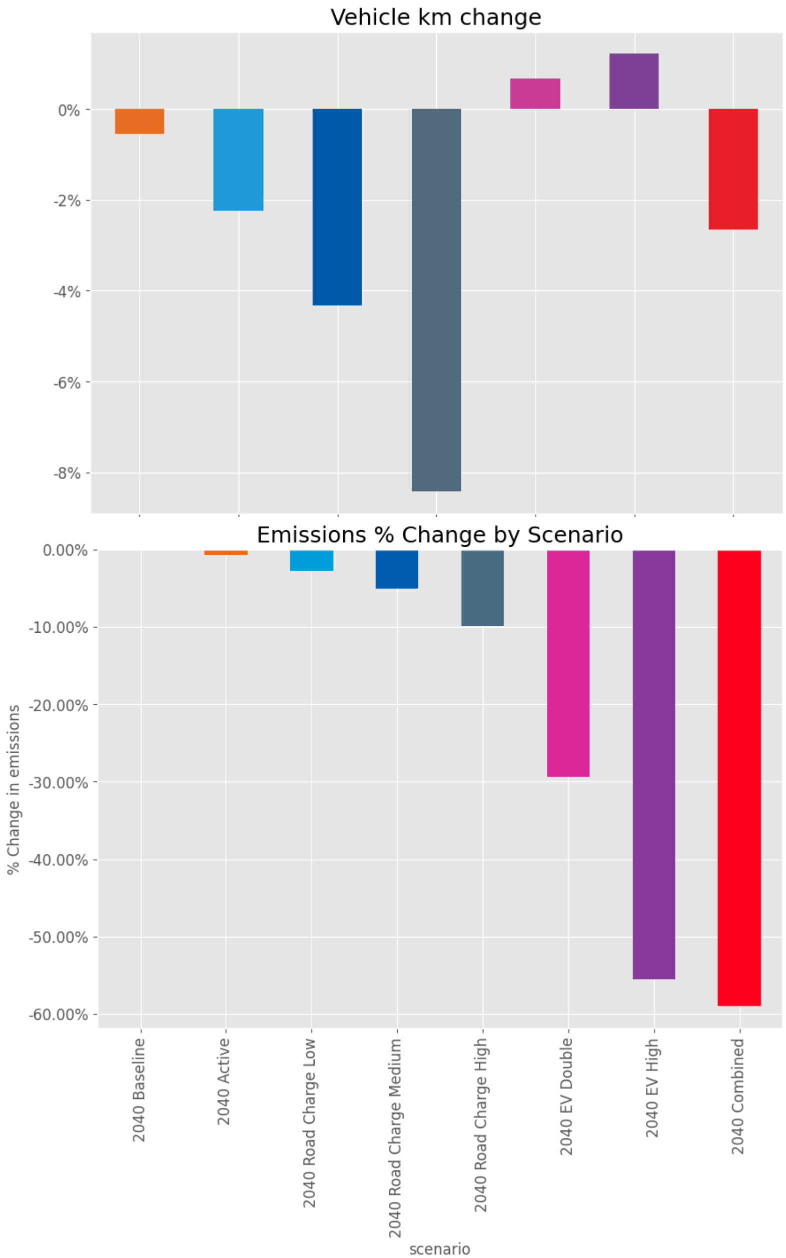
7. Combining Interventions

Combining interventions doesn't combine changes or benefits in a linear way. Much of the impact delivered by specific interventions can be cannibalised or undone by others. *A systems view of transport in the region needs to be taken.*

One of the benefits of the agent based modelling approach is the ability to combine different inputs and changes to create complex interaction effects between policy, behaviour, and network changes. For the combined scenario we combined the highest level of road pricing, highest level of EV uptake, and the boost to active modes.

We can see that a lot of the drop in vehicle km from the high road charging is negated by some of the other changes in the scenario – primarily the lower cost of running an EV in the assumptions.

The lower chart shows that this pattern of nonlinear combination also applies to the carbon reduction. We see this as being exceptionally valuable as we develop more complex policies and packages of policies for future scenarios.



What next?

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What next?

What is the future for the model?

The different components on the Transport East model have all been through a number of iterations during this project, and we expect them all to have further iteration and refinement as the model is used to answer specific questions. The way the model is architected means that these individual improvements can all feed back into the core model. Indeed, a number of potential new scenarios have been identified as part of this project.

It is worth noting the scale of the development that has been possible within a short four month period. Developing a model and getting this much insight from it in four months shows that data driven analysis is feasible at a strategic level. Future studies and scenarios will potentially be able to be turned around in as little as a month now the base model has been developed.

At the moment we have focused on showcasing the regional impacts of the scenarios. There is still a lot of opportunity to look at local impacts of the current scenarios.

This kind of incremental development will help keep the model current and up to date without the need for large refresh projects. Smaller pieces of work to add in new base datasets or define new outputs can be undertaken as standalone activities if needed.

We have had good engagement from both local and national stakeholders, especially the Department for Transport, National Highways, and Network Rail. Understanding how the model can become part of a consistent evidence base to support both local and national studies will prove valuable going forward.

Finally, there are a range of opportunities to continue the engagement that has begun with the 'monthly demos' stakeholder group. This has been one of the more unexpected outcomes of the project, creating a group of interested and engaged individuals from a wide range of organisation. While continuing in-person engagement may be require a lot of resources, finding a way to continue supporting and engaging with the group is likely to be valuable.

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