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Evaluating the LNER "Just One Journey" Campaign

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Executive Summary

The report “Evaluating the LNER “Power of One” Campaign” addresses the evaluation of the impact that shifting travel/transport mode to rail for leisure trips could have on reducing emissions and saving individuals’ time. The report has been prepared for London North Eastern Railway (LNER) by UCL Energy Institute Researchers through UCL Consultants.

Background and objectives

London North Eastern Railway (LNER) aims to run a marketing campaign to illustrate the potential benefits of shifting to rail, if all, collectively, were to travel by train for one leisure trip during September and October. UCLC and specifically the authors of this report were commissioned to estimate the potential environmental benefits that such a shift could deliver. As such, the aim of this report is twofold:

(1) Devise a methodology that could cater for the estimation of the environmental benefits that such a shift could deliver
(2) Apply the devised methodology to estimate the potential environmental benefits for the specific case.

For the estimation, LNER conducted a -representative of the UK population- YouGov survey on leisure trips. This survey serves as the basis of the analysis performed, which includes:

(1) undertaking necessary steps for scaling up survey results
(2) verifying aggregated results with the National Travel Survey data
(3) estimating impact indicators (such as emissions, travel time and potential cost savings, vehicles removed, air-quality improvements).

Main findings

Emissions Reductions: We found that a ‘Power of One’ scenario, which shifts just one leisure journeys in September and October from car or bus to train for trips within England and Scotland, would save 94,000 tCO2e, resulting in a 28.4% reduction on total leisure trip emissions. There was significant variation among the emission reductions for different Origin Destination pairs. For example, the Power of One scenario applied for the London to Edinburgh would result in a 32.6% reduction on total leisure trips emissions. When applied annually, the Power of One scenario would result in a 16.6% reduction of leisure-related travel emissions.

Efficiency Benefits: This investigation found that 27.31 million hours will be spent inside a car, 8.33 million hours will be spent inside trains and 3.52 million hours will be spent inside buses during the months of September. Train-based leisure trips were the most time-efficient mode of transport, with an average train speed of 20.6 km per hour faster than the car equivalent. This investigation highlighted how this travel speed varies significantly depending on the Origin Destination pair. The example case study between London to Edinburgh, showed that the Power of One scenario would reduce total travel time by 16.8%.

1 Introduction

1.1 Background, aim and scope

Transport is currently the sector with the highest CO_2 emissions in the UK (Department for Business, Energy & Industrial Strategy, 2022) and congestion is affecting well-being and efficiency, costing the U.K. nearly 8 billion pounds annually[1]. Decarbonisation of the transport sector forms a vital step in achieving the UK's goal of cutting greenhouse gas emissions and becoming carbon neutral by 2050. Within transport, trips by cars and taxis are the largest contributors to emissions (Department for Transport, 2021a). Reduction of car dependency has been one of the topics receiving increased attention by the transport research community, practitioners, and public authorities, for many years. Yet, approximately 68% of all trips in England are still being completed by car (Department for Transport, 2021b) in either privately owned vehicles or taxis.

Leisure[2] trips constitute the most common trip purpose in the UK (23% of all trips performed in 2019) followed by shopping and commuting (Department for Transport, 2020). At the same time, according to the 2019 GB Tourist Annual Report[3], inbound tourism for leisure purposes (holidays) accounted for 60.5 million trips in 2019 (KANTAR, 2020). The vast majority of these trips are performed by car, contributing to the significant externalities caused by car-travel, such as congestion and pollution. Trips performed by public transport consistently exhibit, for most trips, lower emissions per passenger, while contributing to road network efficiency, by reducing congestion.

Against this background LNER has developed a marketing campaign aiming at highlighting the impact that shifting to rail can have for the environment. Named "Power of One", this campaign aims at showing the potential positive impact that individuals can make to the environment, if everyone were to change their mode of transport just for one trip.

This report evaluates the potential environmental impact of this single shift of transport mode. As such, the aim of this report is twofold:

(1) Devise a methodology that could cater for the estimation of the environmental benefits that such a shift from road to rail could deliver
(2) Apply the devised methodology to estimate the potential environmental benefits for the specific case.

For the estimation, LNER conducted a -representative of the UK population- YouGov survey on leisure trips. This survey serves as the basis of the analysis performed, which includes:

(1) undertaking necessary steps for scaling up survey results
(2) verifying aggregated results with the National Travel Survey data
(3) estimating impact indicators (such as emissions, travel time, vehicles removed).

The remainder of this report is structured as follows. Section 2 provides an overview of the methodology and data used during the writing of this report, Section 3 presents the results from the analysis performed and finally, Section 4 presents conclusions, limitations and future work.

[1] https://inrix.com/press-releases/scorecard-2018-uk/
[2] According to the definition used in the National Travel Survey that includes the trip purposes "Visit friends at home and elsewhere, entertainment, sport, holiday and day trip"

2 Our methodology and data

This section presents an overview of the methodology used. Firstly, the overview of the approach is presented (Section 2.1). followed by the description of data used, the related data sources as well as the presentation of the necessary assumptions and simplifications (Section 2.2). Remaining sections (Section 2.3 – 2.6) present in more detail the process followed.

2.1 Overview of our approach

The analysis presented in this report follows three main stages, shown in Figure 2-1. The first stage focuses on extracting leisure trips. This includes the disaggregation to smaller areas and the scaling up of leisure trip counts to reflect trips performed by England and Scotland population, using publicly available external datasets (e.g. UK Tourism Survey, National Travel Survey and Population Census) and the YouGov survey. The second stage involves the specification of trip alternatives based on shortest path routes (using data from the Google Directions API, and Trainline) for all Origin Destination pairs. The final stage involves the estimation of environmental impact using conversion factors.

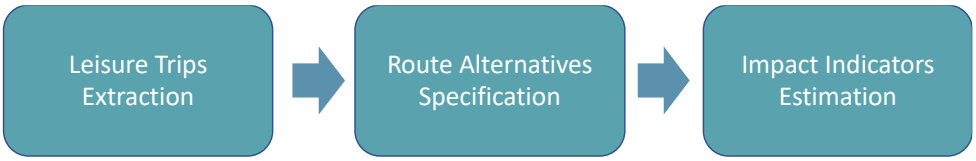

Figure 2-1: Overview of our approach

2.2 Data Sources and Data Analysis Process

The work performed is primarily based on secondary anonymised data, which for all but the YouGov survey are openly available. These data are summarised below in Table 2-1.

Table 2-1: Secondary Data Sources

Data Source	Description of data use
YouGov Survey	This survey has been conducted using an online interview administered to members of the YouGov Plc UK panel of 800,000+ individuals who have agreed to take part in surveys. Emails are sent to panellists selected at random from the base sample. The e-mail invites them to take part in a survey and provides a generic survey link. Once a panel member clicks on the link they are sent to the survey that they are most required for, according to the sample definition and quotas. (The sample definition could be "GB adult population" or a subset such as "GB adult females"). Invitations to surveys don't expire and respondents can be sent to any available survey. The responding sample is weighted to the profile of the sample definition to provide a representative reporting sample. The profile is normally derived from census data or, if not available from the census, from industry accepted data. All figures, unless otherwise stated, are from YouGov Plc. Total sample size was 2006 adults. Fieldwork was undertaken between 1st - 4th July 2022. The survey was carried out online. The figures have been weighted and are representative of all GB adults (aged 18+).

National Travel Survey (NTrS)	The openly available (safeguarded) version of the National Travel Survey has been used for the verification of results in terms of evaluating the quantities of leisure trips.
UK Tourism Survey (NTuS)	The 2019 version of the UK Tourism Survey (performed yearly by KANTAR) has been used to scale up results from the YouGov survey. This includes the disaggregation to subregions based on the distribution of trips from the regional level to the subregional level.
Population Census	Population census data has been used to scale up the survey to the population (from the 2006 participants representative of the population sample to the UK population).
Google Maps Directions API data	The google directions Application Programming Interface (API) was queried to extract travel alternatives for each origin and destination pair.

Assumptions and Simplifications

It should be noted that the estimation approach followed is based on average numbers and is, given the nature of the investigation, based on simplifications and assumptions. Specifically:

- The YouGov survey defined leisure trips as "[…] any trip of any length to a destination in the UK, including day trips". This definition is assumed to partially refer to what is described as leisure trips in the National Travel Survey, which includes the trip purposes "Visit friends at home and elsewhere, entertainment, sport, holiday and day trip" (respondents are asked to provide information on every trip performed every day for a set period of time) and also to what is referred to in the UK Tourism Survey as a holiday trip (trip with one or more stays overnight - respondents are asked about any overnight trips taken in the last four weeks).
- The survey referred to large administrative regions in the UK (e.g. Scotland is one region) which poses a strong limitation for both the Leisure Trips Extraction and the Trip Alternatives Specification process (a trip from London to Glasgow would be the same as a trip from London to Aberdeen). As such we chose to distribute trips of every region in smaller administrative regions (subregional level) for the trips attractions (destinations) and the Population Census data for the trips productions (origins). This distribution took place using a simple weighted function for each sub-region.
- The area of analysis that this report focuses on is England and Scotland. The choice to focus on these regions was motivated by the LNER area of operation and the fact that the use of the extraction of travel alternatives for Wales and Northern Ireland presented significant discrepancies regarding the ability to extract routes (many Origin Destination pairs were not able to be estimated).
- The Trip Alternatives Specification uses the Google Directions API to query the distance travelled and the modes of transport used. The Google Directions API provides a selection of alternative routes for the same origin and destination pair, within mode-specific categories such as car-based travel or public transport-based travel. The trip origin and destination is the administrative centre of each subregion. This essentially entails the assumption that people would want to travel to destinations which are in most cases better connected than many remote areas which might attract seasonal holiday trips.
- The selection of the trip alternative within each category took place based on shortest travel time. Although this is believed to broadly represent the alternatives available to travellers, it is also affected by the time of the query (departure time). Every effort was taken to query using during-the-day departure times to ensure high availability, this does not necessarily reflect

travellers' choices for leisure trips and there could be (faster, cheaper, more convenient) alternatives which are not captured. As such this iterative planning process for maximising travel utility based on individual users' choices is not captured, since we aim at capturing the potential benefits/drawbacks if everyone was shifting one trip.

- Where available, the -shortest travel time- unimodal trip was selected. Where a unimodal trip alternative was not available (i.e. trip only possible when using more than one mode of transport, such as car and train or bus and train), it was assumed that the additional non-primary mode was assigned to the primary mode.
- Trips reported are essentially tours that include both the trip from the origin to the destination and the trip from the destination to the origin. The report assumes that the mode used for travelling to the destination would be the same as the mode used to return to the origin, following the same route. This also assumes that the trips performed start and end in September and October (for the Power of One Autumn scenario below).
- Impact Estimation: the conversion factors that have been used are presented in Section 2.5. There are two factors which could affect the accuracy of estimation. Firstly, car-related emissions per passenger are estimated using the average occupancy rates (1.6 passengers per vehicle). This could be lower than the occupancy expected for long- distance travel, given the fact that families often travel together. Secondly, emission factors for train-related emissions are estimated using annual ridership. However, with an increase of ridership, emissions per passenger are expected to reduce. It should also be noted that the carbon intensity for LNER trips, was provided by LNER and the difference to the average carbon intensity for trains is due to the different network electrification rate.

2.3 Leisure trips extraction

The number of leisure trips and their Origin-Destination distribution were extracted combining the LNER-sponsored YouGov survey and the UK Tourism Survey. In the LNER-sponsored YouGov survey Origin Destination (OD) pairs were given at a regional level with a corresponding count of 'mode of transport' responses to the question as to how the respondent would get to their destination. Respondents were asked how many leisure trips they planned to take for the months of September and October with the given options 1, 2, 3 or more. Based on this data, the percentage of people performing at least one leisure trip was extracted and was subsequently used for the definition of the number of people per region for whom the campaign would be applicable. The LNER-sponsored YouGov survey was also used to extract the percentage of all trips between each OD pair (percentage of trips between a given pair of regions to the total number of trips). Given discrepancies regarding the definition of a leisure trip (see Section 2.2), the total number of trips was extracted from the UK Tourism Survey for 'Holiday' and 'Visiting Friends and Relatives' trips per sub region, which, for this investigation defines a leisure trip. This resulted to a regional OD matrix for leisure trips in September and October, for England and Scotland. The regional OD matrix was then disaggregated into more granular sub-regions through matching those regional levels to the sub-regions specified in the UK Tourism Survey. The share of the trips for each sub region within the larger region, was then matched to scaled total trips per sub-region accordingly based on the total trips for England and Scotland. These trips are disaggregated to match the specified sub-region based on the relative population of that sub-region compared to that total region.

2.4 Route Alternatives Specification

The process followed to extract route alternatives was derived based on a 52x52 matrix that resulted in 2,704 unique Origin Destination pairs for England and Scotland. For each of these pairs the Google Directions API was queried to collect travel alternative information (car, train, bus). This process was automated to use a morning departure time that would allow for increased availability of alternative

modes and routes. The produced outcome included distance matrices for each alternative mode (main mode + modes to reach stations) which were then used for the estimation of the impact indicators.

2.5 Estimation of Impact Indicators

The estimation of the impact indicators was based on the distance matrices produced by the route alternative specification, using the following assumptions:

- The average petrol car trip had a carbon intensity of 0.11 kgCO2e per passenger per kilometre
- The average train trip had a carbon intensity of 0.0355 kgCO2e per passenger per kilometre
- The average LNER train trip had a carbon intensity of 0.0295 kgCO2e per passenger per kilometre (carbon intensity provided by LNER, difference due to the electrification rate)
- The average bus trip had a carbon intensity of 0.103 kgCO2e per passenger per kilometre

3 Results

This chapter presents an overview of the report's results and findings. Firstly, the high-level results of leisure trips are summarised (Section 3.1). Secondly, the emissions derived from the different modes of transport are analysed (Section 3.2), followed by the effects of transport mode on travel time (Section 3.3). This section concludes with an analysis of the London to Edinburgh travel corridor presenting the key benefits to modal shifts towards trains (Section 3.4)

3.1 Leisure trips in September and October:

Overall, for September and October the investigation found that without intervention and based on the scaling up methodology, 10.25 million leisure tours will take place, of which 6.1 million will be from cars, 2.2 million will be from trains, 0.5 million will be from buses and 1.45 million trips will be performed by "other" modes (air-travel, motorbikes, walking, cycle). This would result in approx. 656 million kgCO2e emissions emitted from cars, trains, and buses for leisure trips, based on the extracted leisure trips. Cars will contribute 85% of these emissions and are estimated to emit 549 million kgCO2e while making up 60% of trips. Trains will only contribute 10% of these emissions and are estimated to emit 67 million kgCO2e while comprising about 21% of all leisure trips. Finally, buses will contribute 6% of these emissions and are estimated to emit 41 million kgCO2e. The investigation also found that without intervention, 39 million hours will be spent travelling on cars, trains and buses. Considering just these three transport modes, Cars will contribute 70% of time spent while making up 69% of trips. Trains will only contribute 21% of total travel while comprising of 25% of trips. Buses comprise of 9% of travel time, while comprising 6% of trips. Significantly, the investigation found trains to be the most time-efficient mode of transport, as it was shown to be 20.6 km per hour faster than the car equivalent.

Key Findings

- 10.25 million leisure tours (round trips) estimated for England and Scotland, of which 6.1 million will be from cars, 2.2 million will be from trains and 0.5 million will be from buses, and the rest would be with "other" modes (e.g. air-travel, motorbikes, walking, cycle)
- 147.48 million hours will be spent travelling on these tours, with cars and trains representing 54.6 and 16.6 million of those hours respectively.
- 8,590 million kilometres will be travelled, with cars and trains representing 5,036 million and 1,878 million of those distances respectively.

3.2 Power of One Scenario

The Power of One scenario represents the scenario where it was assumed that those who completed a leisure trip in September and October by car or bus, would shift just one of those trips from the modes of transport bus or car to rail. This would result in a shift of 48% percent of car and bus-based forms of transport to rail. This 48% is the percentage value that represent the total quantity of car and bus trips that would shift to cars in the power of one scenario, which is equivalent of everyone travelling, shifting one trip towards rail. The 'Power of One' scenario demonstrates the significance of shifting towards low carbon forms of transport. Overall, this scenario modal shift away from cars results in a reduction of approx. 2.9 million cars travelling for leisure. This would result in a **28.4% reduction of total leisure trip emissions** from the key modes of transport (car, bus, rail) for these months. The 50% uptake of this scenario represented a 14.2% reduction in total emissions.

The Power of One 50% scenario represents the case in which half of the journeys (Power of One scenario) were shifted from car or bus-based modes of transport to rail. Overall, the 'Power of One 50%' scenario signified that if a campaign had a 50% adoption, 24% of all leisure trips completed by car and bus would be shifted to rail.

The relevant changes to the emissions from the respective mode are presented above in Figure 3-1.

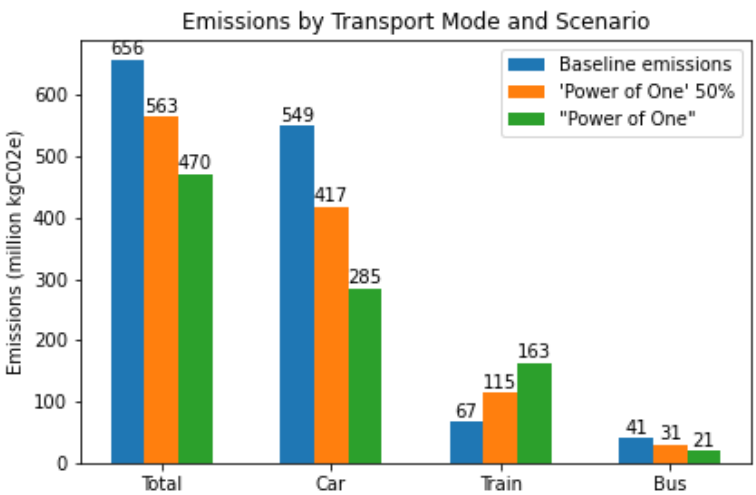

Figure 3-1: Emissions by Transport Mode, England and Scotland results

In terms of Vehicle Kilometres saved the Power of One scenario would save 1209 million vehicle kilometres which is equivalent to the 51% of the annual vehicle kilometres completed in the local authority Manchester in 2019 (https://roadtraffic.dft.gov.uk/local-authorities/85).

The effects of the 'Power of One" scenario on time savings was also investigated. This scenario demonstrated the significance of shifting towards faster forms of transportation (please note assumptions on Origin-Destination estimations). Overall, this 48% modal shift away from cars and buses, resulted in a 7.0% reduction in total time spent travelling from these key modes of transport. In normal terms this represented a time saving of approx. 6 million hours for leisure trips taken in September and October.

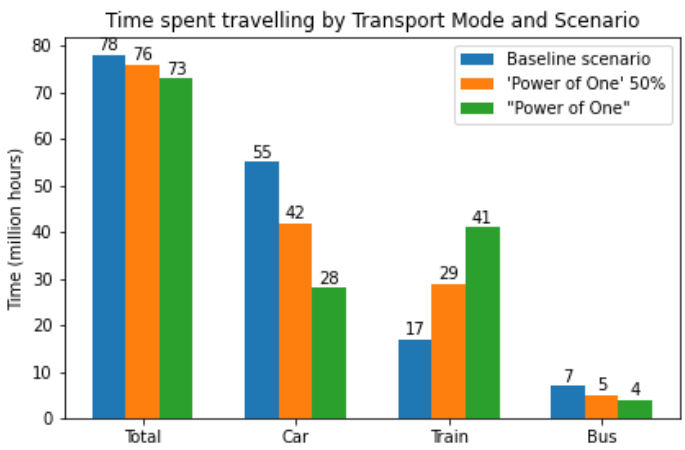

Figure 3-2 Total Travel time spent travelling, England and Scotland results

3.3 Annual "Power of One"

This investigation also estimated the annualised value of the "Power of One" scenario. To extract annual values, the Origin-Destination matrices (containing the number of trips from any origin to any destination considered in this study) were scaled up based on a weighting factor that preserve Origin-Destination distribution of trips and transport mode share. The weighting factor used to scale up trips was estimated based on the annual number of trips from the UK Tourism Survey (i.e. annual number of trips divided by number of trips in Sept/Oct). The total number of tours performed yearly is 103.34 million (206.69 million trips) matching the number of trips for 'Holiday' and 'Visiting Friends and Relatives' for the whole UK. Assuming the September/ October transport mode share and travel destinations in England and Scotland, 123.34 millions of these trips will be from cars, 44.27 millions will be from trains and 20.16 million will be from bus trips. This would result to approx. **6613.55 million kgCO2e emissions** emitted from cars, trains and buses for leisure trips, based on the extracted leisure trips. Cars will contribute 84% of these emissions and are estimated to emit 5531.29 million kgCO2e while making up 69% of trips. Trains will only contribute 10% of these emissions and are estimated to emit 672.1 million kgCO2e while comprising approximately 25% of all leisure trips. Finally, buses will contribute 6% of these emissions and are estimated to emit 410.16 million kgCO2e. The investigation also found that without intervention, 789.61 million hours will be spent travelling on cars, trains and buses. Cars will contribute 69% of time spent among the key modes of transport, while trains will only contribute 21% of total travel time.

The "Annual Power of One" scenario is examining the scenario, where each average individual would shift one leisure trip from car to train. This is being implemented by shifting one car trip per individual from the population of every region examined to a train trip, based on the derived trip rate per region. This shift is uniformly applied for all OD pairs. Significant savings have been identified. The total emissions after applying the "Annual Power of One" scenario are reduced to 5513.92 million kgCO2e emissions signifying a potential 16.6% reduction of annual leisure travel emissions (1099.63 million kgCO2e). This emissions reduction from leisure trip tours would translate to the annual sequestration potential of 52.36 million trees. The area required to plant this many trees would translate to 39911 football pitches. This would mean that there could be the potential of 37.3 million car trips that could be avoided, meaning that 18.65 cars would not be travelling at least one leisure tour keeping cars stationed for the duration of the leisure trip and not contributing to congestion. In terms of Vehicle Kilometres saved the Power of One campaign could save 82.38 million vehicle kilometres. Assuming that the average car drove annually 10943 km, this then transfers to an average of 7528 cars off the road at any time during the year.

3.4 London to Edinburgh: A case study

The results for the London to Edinburgh case study are detailed below and highlight the environmental and time efficiency advantages of train-based travel.

3.4.1 Emission Effects

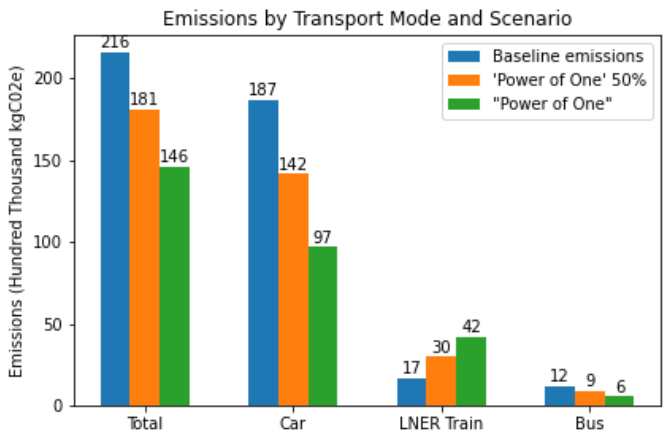

Figure 3-3 Edinburgh case study emission results

This investigation found that on the specific London to Edinburgh route that if all travellers shifted one leisure trip from cars and buses to LNER trains there would be 32.6% reduction in total emissions. In real terms this translates to 7,043.4 thousand kgCO2e saved.

3.4.2 Time Effects

Furthermore, this report found that the 'Power of One' scenario would result in a 16.9% reduction in total travel time. If these results were scaled annually, this would result in the time saving of 420,000 hours which is equivalent to 17,500 human days. From the google API the fastest possible train trip from London to Edinburgh was 4 hours 33 minutes while the average car journey was 7 hours and 41 minutes. Further results from our analysis can be seen on the graph 3-4.

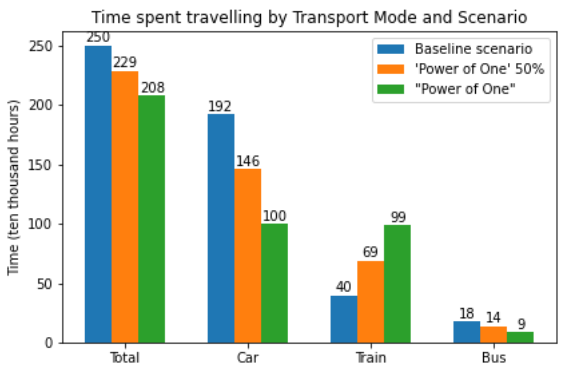

Figure 3-4 Edinburgh case study travel time results

4 Conclusions

This study estimates the potential benefits, in terms of reductions in carbon emissions and travel time, of a shift to rail from cars and buses, in inform a campaign run by LNER. It is shown that these benefits could be very significant. The 'Power of One' scenario estimated the time savings and emissions reductions if all leisure travellers shifted one leisure trip from cars and buses to rail in the months of September and October. Through modelling for this scenario based on a number of data sources, the

study found that a 48% modal shift away from cars and buses to trains resulted in a 28.4% reduction on total leisure trip emissions from the key modes of transport. Furthermore, it was found that this same modal shift away from cars, resulted in a 7.0% reduction in total time spent travelling from the key modes of transport, which translated to 6 million hours of time saved from leisure trips taken in September and October.

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