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Call for Evidence: Summary Report

National Transport Strategy Review Research and Evidence Working Group

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Foreword

The National Transport Strategy (NTS) Review Research and Evidence Group launched a 'Call for Evidence' during 2017. On behalf of the Group, I am very grateful for the organisations and individuals who took the time to submit a response.

66 organisations and individuals responded to the call, their submissions in total making reference to some 800 pieces of evidence. The Group was very pleased to see that responses were received from a broad range of sectors and the evidence provided in answer to our questions was similarly broad. Among other sources we received academic research; reports from local, national and international governments; and analysis and briefings from private and third sector organisations.

Research can raise more questions than it answers and this exercise is no exception. In this report, the members of the Research and Evidence Group provide a summary of what respondents to the Call believe are important themes to consider in deciding how transport can effectively support progress towards the Scottish Government's Strategic Objectives; delivering a transport systems that enables Scotland to be wealthier and fairer, smarter, greener, healthier, and safer and stronger.

But, as is documented in this report, there remain uncertainties and gaps in the evidence in many areas. Responses highlight deep uncertainty over what the future will look like given emerging drivers of social and technological change. While the Call in itself cannot answer all the questions we have with certainty, the Group believes it has been a useful exercise to help reduce uncertainty over key questions we have about our transport systems and policies. I look forward to building on the evidence reported here as the NTS Review progresses and the continuing work of the Research and Evidence Group in ensuring that the review is informed by the best evidence available.

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Executive summary

Background to the call for evidence

- The National Transport Strategy (NTS) Research and Evidence Group conducted a 'call for evidence' on seven themed question areas and invited submissions of evidence from a broad range of stakeholders to inform the NTS Review process.
- The call was issued in April 2017 and closed during July 2017. This report, authored by the NTS Research and Evidence Group, summarises the findings from the call; identifying the themes, uncertainties and gaps in the responses received for each of the seven question areas. This summary report highlights themes in the evidence *received during the call* as opposed to all evidence that exists on a given topic.

Responses received

- 66 responses to the call for evidence were received from a wide variety of organisations and sectors.
- Around 800 citations to a wide range of supporting pieces of evidence were made by respondents. This included articles from scientific journals, reports from both national and local government, and reports from the private and third sectors.

Q1: Economic growth and inclusive growth

Question: What does evidence say about the ways in which transport can best support economic growth and do so in a cost-effective way? What are the implications of this in terms of inclusive economic growth (economic growth that distributes its benefits fairly across society)?

- **Themes:** Respondents to the call shared evidence that highlighted that, while transport investment can be an enabler of economic growth, it is rarely sufficient on its own and the strength of evidence demonstrating impact differs by mode. Evidence submitted also suggested bus travel can be important for low wage staff in accessing work, and that investment to create neighbourhoods where it is easier to walk or cycle is associated with economic benefits (though as with evidence of economic impact in other areas of transport, it is unclear whether this economic effect is additional or displaced from other areas).
- **Uncertainties:** The evidence received highlighted uncertainty on the degree to which transport infrastructure investment grows the economy overall and what conditions and factors are necessary to enable this effect. The potential economic benefits of a move away from personally owned modes of transportation towards 'mobility as a service' was also highlighted as an uncertainty due to its relatively early stage of development.

- **Gaps:** Gaps identified included evidence on observed effects (rather than modelled or anticipated) of the overall economic benefits of transport investment, and evidence quantifying the relative economic impact of transport when compared to other types of public investment.

Q2: Transport mode choice and demand

Question: To what degree are travel behaviours such as mode choice (including freight transport) and demand amenable to intervention? Which policy interventions change behaviours or demand and why? What does research tell us about the types of interventions that fail to change behaviours, particularly over the long term?

- **Themes:** While there was consensus in the evidence received over the desirability of encouraging mode shift away from private vehicle use, there was less consensus on how this is best achieved. Evidence provided on personalised travel planning interventions showed a modest effect on mode shift. Some evidence demonstrated an association between certain planning policy and built environment improvements and mode shift. Respondents highlighted a mix of different factors that drive freight mode choice, including reliability/regulatory stability; capability/capacity of the mode to deliver; mode pricing and impact on wider supply chain costs.
- **Uncertainties:** The evidence received making arguments for or against regulation/deregulation of public transport (mainly bus) to encourage mode shift was relatively weak and typically based on a small number of case studies. Submissions raised the need for better analysis of 'who pays' and 'how much' when attempting to encourage mode shift away from private vehicle use.
- **Gaps:** Gaps identified included: how disruptive technology (e.g. shared mobility services such as Uber) and more integrated and intelligent transport systems will influence mode choice in the long term; and a lack of evidence on mode choice interventions in rural areas and at the local and regional level (outside of journeys within and to the main cities).

Q3: Environmental impact of transport

Question: What does evidence suggest the most effective means of reducing transport's local (air quality) and global (climate change) emissions are? How have other countries reduced the environmental impact of transport and to what degree are any such measures also likely to be successful in Scotland? When are routes to reducing carbon emissions from transport also consistent with tackling air quality issues, and when are they not?

- **Themes:** Submissions emphasised the low polluting nature of active travel modes and argued that a package of measures to facilitate these modes, along with interventions to deter private car use, were required.

Submissions received highlighted that in addition to technological improvements that will reduce vehicle emissions, demand reduction is likely to be necessary in order to have the most beneficial impact on emissions.

- **Uncertainties:** There are important uncertainties over how many motorised miles from public transport can realistically be substituted by active modes, limiting the potential for carbon savings. The evidence received on low emission zones highlighted several factors that can influence their effectiveness and that reviews of their implementation to date find only limited evidence of effectiveness in reducing urban pollution. The benefits and practicalities related to transferring road freight to other modes in Scotland is uncertain. Some submissions highlighted the uncertainty over the equality impact of the adoption of new propulsion technology, and whether increased travel costs (or other negative impacts) could be concentrated in more vulnerable groups.
- **Gaps:** Gaps identified through review of the submissions included: the magnitude of impact on emissions for given levels of active travel investment; the potential for freight mode shift to less polluting modes; and the adoption of lower emission propulsion technology for vehicles other than private cars. Mobility as a service and its potential impact on emissions was discussed by submissions but the evidence received was weak.

Q4: Active travel

Question: What does the evidence suggest are the best ways to achieve improved health outcomes from active travel? What are the most important constraining factors to the uptake of active travel that can be targeted by policy in the Scottish context?

- **Themes:** Strong evidence was received on the positive association between active travel and a variety of improved health outcomes. Many submissions emphasised the need for comprehensive approaches to encourage active travel, but in particular, that new walking and cycling routes increase the number of active travel trips. Evidence received showed differences in active travel pattern uptake across socioeconomic groups, and differences in active travel modes used within socioeconomic groups, which has implications when considering equality impacts of active travel policy.
- **Uncertainties:** While there was general consensus within the evidence base submitted by respondents that a range of factors can increase the likelihood of individuals using active travel, the evidence received also described a mixture of limited and uncertain evidence that tempers the strengths of conclusions about which specific interventions have the largest benefits in improving uptake of active travel.

- **Gaps:** Much of the evidence submitted related to cycling rather than walking. Limited evidence was presented on new active travel technologies and services (e.g. public bike sharing and e-bikes).

Q5: Safe and resilient transport

Question: What are the current and emerging risks to the safe operation and resilience of Scotland's transport network and what does evidence say about the ways in which these risks can be best managed? What does evidence tell us about what adaptation measures (in response to environmental, or other, changes) may be effective to respond to changing pressures on the network?

- **Themes:** Submissions highlighted a range of issues, many of which focussed on perceived current risks to the existing transport network. Arguments made in response to this question by respondents tended to be based on theory with limited evidence provided in support. Respondents proposed ways in which they believed safety and resilience concerns could be managed, including: multi-agency collaboration to identify critical points in the network for strengthening; analysing 'pinch point' knock-on issues that compound the effect of a critical disruption; better use of data; and technological and governance/funding solutions.

- **Uncertainties:** Uncertainties raised by the submissions included: the degree to which potential critical disruptions might be reduced if known 'day to day' issues in the network were improved; whether some modes are more resilient than others to bad weather or larger scale climate events; and what the costs or anticipated future costs of such disruptions may be in Scotland. Regarding safety, there was uncertainty over the degree to which mode shift from road to rail would result in improved road safety and to what extent different patterns in maintenance spend between authorities results in actual differences in the safety profile of the network.

- **Gaps:** Few respondents provided evidence on the relationship between demographic factors and transport safety and security or provided strong evidence on the safety profiles of different passenger and freight mode shift scenarios. Little evidence was received on the safety record of different aspects of the network during disruptions or how any adaptation by citizens around disruptions may be used for a positive effect. External threats to the transport system such as terrorism or cyber security received little attention in the submissions received.

Q6: Transport governance

Question: What does evidence say the most effective forms of governance and institutional arrangements around transport might be, in order to meet the Scottish Government's strategic objectives?

- **Themes:** Overall submissions received to this question tended to be partial with few examples supported by strong evidence, leading to no obvious consensus of opinion. Respondents tended to comment on specific aspects of governance to which they have an interest. Themes raised included: more coherent strategic planning and alignment; arguments over what appropriate remits are for national, regional and local governance and how they should be financed; and how transport regulation and degree of integration may affect performance.

- **Uncertainties:** Due to the diverse range of views submitted in this area, all the themes are uncertain to some extent. A key issue raised was the uncertainty concerning how governance arrangements contribute to transport outcomes. While there was some evidence cited in submissions that a given set of governance or funding arrangements may deliver a particular set of *outputs* (e.g. integrated ticketing, better inter-modal connections) more effectively than another, uncertainty exists over whether same set of arrangements will generate the desired *outcomes* (e.g. mode shift to public transport from private car) in different contexts.

- **Gaps:** Due to the nature of the responses received to this question, it is not possible to identify gaps across all the responses, as they were disparate in nature. However, research on the key issue raised as an uncertainty – how differing country or region contexts can influence whether a common set of transport system outputs results in desired outcomes or not – was noted as a pertinent gap.

Q7: Potential changes in society and technology

Question: In the next 20 years, what will be the most significant changes and new technologies influencing the way people live, work and consume that will impact on travel behaviour and demand? Are there examples of places that have already experienced some of this change and therefore provide evidence on how travel behaviour might change in Scotland? How can uncertainties about the future be robustly considered in transport strategy development?

- **Themes:** The volume of evidence provided in response to this question was limited, and few respondents to this question provided examples in the form of places that had already experienced the change in society or technology. Submissions placed most emphasis on changes in vehicle propulsion

technology, more commonly in relation to private cars than public transport or freight. Respondents emphasised the role of technology as a means to an end, not an end in itself, stressing the importance of setting strategic objectives for what the technology will enable or achieve. The need to consider the equality implications of technological innovations across a whole range of societal objectives was highlighted. Submissions provided some evidence on expected changes in social and demographic trends that will influence travel demand (e.g. an aging population with a greater prevalence of potentially mobility limiting conditions).

- **Uncertainties:** Uncertainty was highlighted around the economic and social trends we are likely to see in Scotland in the future. This uncertainty is not only around what the population *will be*, and what they will be doing, but where it *needs to be*, given projected structuring of the economy and priority capacity and capability sectors. The question of who benefits and who may lose out in the event of continued expansion of shared mobility services, and how governance can help maximise benefits and minimise risks, was a further uncertainty arising from the responses. With regards to freight, the uncertainty in responses received to the call highlights the need to open up discussion on what the particular technological challenges and solutions are in this context, including road, shipping, and rail.
- **Gaps:** In essence, all the themes and uncertainties identified in response to this question are gaps as they require some concerted evaluation of the evidence (such that it exists) in the Scottish context in order to understand the issues. Looking beyond the evidence received to the call, there is evidence in the form of modelled and theoretical literature across all the technological areas discussed in this section. However, to make use of this evidence requires matching it with what is thought to be the main demographic and economic issues and future population trends in Scotland.

Introduction

The National Transport Strategy (NTS) Review

The National Transport Strategy (NTS) sets the long term vision for transport policies in Scotland. It was first published in 2006 and a refresh in 2016 recommended that a full and collaborative review of the NTS should take place.

The current review of the National Transport Strategy builds upon the original 2006 NTS and the 'refreshed' 2016 NTS and will produce and publish 'NTS2', setting the strategic direction for transport across the whole of Scotland over the next twenty years.

This collaborative review will look at the strategic challenges facing our transport system and identify opportunities to successfully address these. The NTS review will inform an update to the Strategic Transport Projects Review (STPR) by setting out the national outcomes we want to achieve from our investment when reviewing recommendations for strategic infrastructure priorities across Scotland. The review and resultant NTS2 will be aligned with other aspects of the emerging policy and legislative landscape in Scotland including developments in planning, climate change, enterprise and skills, and city and region growth deals.

The NTS review Research and Evidence Working Group

The call for evidence was conducted by the Research and Evidence Working Group of the NTS Review. The Research and Evidence Group comprises independent academic specialists in transport and Transport Scotland officials. Its remit is to ensure the NTS Review is informed by the best available evidence.

The call for evidence

A call for evidence document inviting submissions of evidence on seven question areas was issued by the NTS Review Research and Evidence Group on 5 April 2017 and closed on 14 July 2017. The aim of the call was to invite submissions from individuals and organisations on what the evidence says about transport policy, land use, and technological developments and directions that are most likely to achieve the Scottish Government's strategic objectives. The Research and Evidence Group defined the types of evidence of interest broadly, recognising that submissions from the academic, private, public and third sectors all have value in informing the NTS Review process. This report summarises the findings from the call by providing a general overview of the number and type of responses received, followed by a more detailed look at responses in each question area, identifying themes, uncertainties and gaps in the responses received.

Methodology

Responses to the call were initially logged and reviewed by analysts within Transport Analytical Services in Transport Scotland, for each of the seven question areas:

1. Economic growth and inclusive growth
2. Transport mode choice and demand
3. Environmental impact of transport
4. Active travel
5. Safe and resilient transport
6. Transport governance
7. Potential changes in society and technology

The arguments and points made by each respondent under each area were summarised. For each area addressed by each respondent, an attempt to locate the evidence the respondent cited was carried out by Transport Analytical Services via an internet and database search.

Each piece of evidence referenced was logged, noting its source (e.g. a scientific journal article, a policy paper produced by a charity) and a brief analytic commentary on each piece of evidence cited was recorded, including features such as:

- The type of evidence (e.g. the results of a household survey, a review of the transport/scientific literature on a given topic)
- Any important methodological features (e.g. important strengths or limitations, applicability to the Scottish context)
- Noting cases where the conclusions of each individual piece of evidence being cited do not align with how they were being used in the response.

Due to the large number of individual references to evidence in the submissions and the wide variety of different types of evidence received it was not feasible to formally appraise each piece of evidence cited against an established methodological standard or checklist. Some individual pieces of evidence cited by respondents were unable to be located in full by Transport Analytical Services (either due to insufficient detail being provided by the respondent, or citations that required authorisation from/membership of a particular publication or organisation to access).

This process created summaries of the arguments made by each respondent, under each area, alongside a list of evidence used by each respondent and accompanying commentary. These summaries were provided to the academic members of the Research and Evidence Group to review to give their assessment of:

- The main themes emerging in the evidence received and highlight examples of important evidence received
- Areas of uncertainty (e.g. where points are contested, or evidence is conflicting)
- Gaps in the evidence

Overview of responses received

Number and type of responses

66 responses to the call for evidence were received from a variety of different types of organisations and a small number from members of the public. Table 1 below provides a summary of the number of responses by organisation type.

Table 1: Number of responses received to the call by organisation type

Type of respondent	Number
Academic	11
Action or Campaign Group	2
Local Authority	5
Other Public Bodies	14
Private Sector	8
Regional Transport Partnership	5
Third Sector Delivery Bodies	5
Voluntary, Social Economy or Community Groups	2
Individual	3
Other*	11
Total	**66**

* *Includes mixed-membership professional bodies, trade unions, and non-university research organisations. See Annex 1 for a complete list of responding individuals/organisations.*

As respondents could choose to answer as many or a few of the question themes as they wished, Table 2 provides a summary of the number of responses that cover each theme. Most themes show a similar number of respondents choosing to answer them, with slightly fewer respondents choosing to respond to the 'safe and resilient' theme.

In addition, Table 2 provides the number of individual citations to evidence used by respondents in their response to each theme. Overall, across all themes, there were around 800 pieces of evidence cited by respondents; this total includes cases where the same piece of evidence was cited by more than one respondent to make different points, or by multiple respondents and so is not the total number of 'unique'

references. The volume of references to evidence was greatest for the 'active travel' theme, and least for the 'potential changes in society and technology' theme.

Table 2: Summary of the number of responses that covered each theme and the number of individual pieces of evidence cited under each theme

Call for evidence theme	**Number of responses addressing theme**	**Total number of pieces of evidence cited under each theme by those who responded to it***
Economic growth and inclusive growth	45	150
Transport mode choice and demand	47	127
Environmental impact of transport	37	87
Active travel (e.g. walking and cycling)	45	232
Safe and resilient transport	27	83
Transport governance	35	72
Potential changes in society and technology	40	66
Other^	8	11

** for the purposes of calculating totals, an individual piece of evidence cited may be counted twice (or more) if it was used at different points in a submission to support different arguments, or by multiple respondents.*
^ A minority of respondents introduced other arguments that could not be easily associated with one of the question themes, or did not make an argument but signposted to evidence/resources in a general manner; these are counted here.

Nature of evidence received

The 66 responses received varied widely in terms of length, style, and the volume and nature of evidence cited. Only a minority of responses (six) were assessed as not providing any formal evidence at all in support of arguments made. At the opposite end, a similar number (eight) provided references to 25 or more individual pieces of evidence in their submissions.

Responses cited evidence from a wide range of sources. Among the most common forms of evidence cited were government reports (from international, national and local government); articles from peer-reviewed scientific or transport journals and academic books; private and third sector consultancy reports; and policy briefings and fact sheets produced by the respondents themselves. Relatively few responses cited evidence 'second-hand' (e.g. by providing a link to a media report) or in a manner in which it could not be located at all.

In the initial call document, respondents were told that certain kinds of submissions would be particularly welcomed, including responses that consider the quality and applicability of the evidence being cited; the relevance of international evidence to

the Scottish context; and those that discuss whether interventions have the potential to have differential impacts across the social gradient (e.g. those considering issues of equality and inclusion) or by geography (e.g. rural versus urban).

Most responses did not comment explicitly on the quality of evidence being cited in terms of technical features of the research (e.g. sample size, length of follow-up) or contextual issues that might limit its applicability to Scotland (e.g. cultural or institutional differences). Some responses did discuss equality considerations around the impact of interventions, however this tended to be in general and theoretical terms rather than relating to impacts that are quantified by analysis of some kind. Few responses considered geographic (or other) issues of contextual applicability; those that did tended to consider this issue as it applies to a particular interest (e.g. rural roads access for the freight sector).

1. Economic growth and inclusive growth

Question: What does evidence say about the ways in which transport can best support economic growth and do so in a cost-effective way? What are the implications of this in terms of inclusive economic growth (economic growth that distributes its benefits fairly across society)?

1.1 Themes in the evidence received for economic growth and inclusive growth

Submissions cited evidence that highlighted that, while transport investment can be one of the enablers of economic growth, it is rarely sufficient on its own.

Example: The Eddington Transport Study. Main report: Transport's role in sustaining the UK's productivity and competitiveness. 2006. Available from: http://webarchive.nationalarchives.gov.uk/20090115123436/http://www.dft.gov.uk/162259/187604/206711/volume1.pdf

Some respondents referred to evidence that highlighted the limitations of what is known about the impact of transport investment on local economic growth. They noted that evidence on observed (rather than anticipated, e.g. through modelled estimates) impacts of transport investment is mixed and even when a beneficial impact is reported (for example, a finding that road projects can positively impact local employment) it does not explain whether the benefit is additional, or a relocation of economic activity from elsewhere. They also highlighted that there are differences in the strength/availability of evidence by mode; more conclusions can be drawn from existing evidence on road projects, while less is available for other modes.

Example: What works centre for local economic growth. Evidence Review 7: Transport. 2015. Available from: http://www.whatworksgrowth.org/policy-reviews/transport/

Considering other economic effects of travel, respondents cited evidence demonstrating that bus travel is important for low wage staff in accessing work. However, no systematic evidence was received to show or quantify whether additional bus services have increased access to work and therefore employment opportunities.

Example: Department for Transport. The value for money of tendered bus services. 2016. Available from: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/500158/Value_for_Money_of_Tendered_Bus_Services.pdf

Greener journeys/KPMG. The true value of local bus services. 2017. Available from: https://greenerjourneys.com/publication/true-value-local-bus-services/

Submissions highlighted that, for some industries, transportation costs are a small proportion of their overall costs and hence will be a limiting factor in terms of any productivity benefits of transport investment. However, this is not uniform and submissions highlighted certain industries (e.g. the forestry sector) for which transport is a larger proportion of overall costs and where limitations in the transport system may be a more significant constraint on their growth or competitiveness.

Respondents highlighted evidence showing that investment to create neighbourhoods in which it is easier to walk or cycle is associated with greater local economic growth (especially in retail) when compared to those where there is no such investment. However, as with investment in other transport infrastructure discussed above, it is unclear whether this economic growth is additional or displaced from other areas. They also cited analysis that quantified the health benefits of active travel .

Example:
Designed to Move: Active Cities report. 2015. Available from: http://e13c7a4144957cea5013-f2f5ab26d5e83af3ea377013dd602911.r77.cf5.rackcdn.com/resources/pdf/en/active-cities-full-report.pdf

Department for Transport. Value for money assessment of cycling grants. 2016. Available from: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/348943/vfm-assessment-of-cycling-grants.pdf

1.2 Uncertainties in the evidence received for economic growth and inclusive growth

As discussed above, responses to the call under this theme highlighted uncertainty on whether transport infrastructure investment grows the economy overall (and raised related questions around what other conditions and factors are necessary or sufficient to enable this effect). Submissions made arguments for and against the proposition of whether transport investment results in overall economic growth, but the more rigorous evidence received shows a more complex and nuanced picture described in the section above.

Submissions also raised more speculative evidence or theorised explanations of the potential benefits of ‘Mobility as a Service’ (MaaS); an umbrella term for a move away from personally owned modes of transportation towards mobility options and solutions consumed as a service. MaaS transportation options are generally in early stages of piloting and roll-out and, in addition, the term encompasses a wide variety of different service models or consumer offerings, each with widely differing potential impacts. As MaaS is not yet fully operating, it is not possible to observe empirically the economic impacts of MaaS, and, due to the range of things that MaaS could end

up becoming, it is also challenging to model or anticipate its benefits with any accuracy.

1.3 Gaps in the evidence received for economic growth and inclusive growth

Gap in evidence received	Commentary of the nature of gap
Observational (rather than modeled/anticipated) evidence on the overall economic benefits of transport investment.	Call submissions highlighted the limitations of the existing evidence in this area.
The additionality benefits (the net change occurring above that which would occur anyway) of transport investment.	Evidence received in the submissions discusses the limitations of existing research in adequately addressing this.
Quantification of the relative impact of transport infrastructure investment versus other types of public investment in generating economic growth and/or inward investment.	Evidence of this nature was not received during the call and could be important for informing broader public investment decisions.
Quantification of the number/value of jobs per pound generated directly in constructing different types of transport infrastructure.	A small number of submissions highlighted this for particular projects, however there was no comprehensive assessment of the job creation impact of different infrastructure types.
Evidence of agglomeration (the economic benefits obtained by locating companies closer to each other) effects of transport investment.	In the view of academic NTS Research and Evidence Group members, there is some evidence demonstrating that certain industries show higher productivity where they are clustered and job density is high. However, how much job density will increase as a result of a new piece of transport infrastructure is not known.

2. Transport mode choice and demand

Question: To what degree are travel behaviours such as mode choice (including freight transport) and demand amenable to intervention? Which policy interventions change behaviours or demand and why? What does research tell us about the types of interventions that fail to change behaviours, particularly over the long term?

2.1 Themes in the evidence received for transport mode choice and demand

Many submissions discussed interventions and measures to promote public and active transport improvement in order to facilitate mode shift away from private vehicle ownership and use, covering issues such as level/frequency of service; infrastructure provision; modal integration; and alternative fuels. There was a general consensus that mode shift to active travel and public transport should be encouraged and supported, and that evidence supports a variety of benefits (environmental, public health) of such a shift. There was less consensus among responses as to how this mode shift is best achieved.

The role of a range of financial instruments in influencing transport mode choice and demand was discussed by respondents. These included arguments for further expansion of incentives to encourage shift to a particular mode (e.g. bike-to-work schemes, dedicated public transport corridors) and action to limit disincentives to travellers (e.g. reducing public transport fares). Responses also discussed demand management measures such as workplace parking levies, though little UK evidence was presented demonstrating the benefits of such a scheme on mode choice outcomes.

Example: Currie G, Wallis I. Effective ways to grow urban bus markets – a synthesis of evidence. Journal of Transport Geography. 2008. Available from: https://www.sciencedirect.com/science/article/pii/S0966692308000306

Evidence supporting Personalised Travel Planning (PTP) policies was widely mentioned, particularly by Councils and Regional Transport Partnerships where this can be an actively supported policy. Evidence cited by respondents shows a modest but reliable effect of PTP interventions on reducing private car use. Relating to a wider theme in responses received, submissions often emphasised that any particular mode shift intervention (such as PTPs) work most effectively as part of a wider, coordinated set of policy and practice actions, rather than in isolation.

Example: Department for Transport. Making Personal Travel Planning Work: Research Report. 2007. Available from: http://www.ratransport.co.uk/images/MakingPTPworkResearch.pdf

There was strong interest in how to encourage shifts to active travel with relevant links made between active travel and the built environment and a strong link between active travel and health outcomes.

Example: Glasgow Centre for Population Health. Active travel in Glasgow: What we've learned so far. 2017. Available from: http://www.gcph.co.uk/assets/0000/6007/Active_travel_synthesis_final.pdf

A range of responses provided substantive arguments relating to freight interventions, originating primarily from organisations working within the sector. These tended to reinforce the benefits of the sector (e.g. making the case for the economic or environmental benefits of modal shift for freight away from road). Respondents highlighted a mix of different factors that drive freight modal choice: reliability/regulatory stability; capability/capacity of the mode to deliver; mode pricing and impact on wider supply chain costs. A small number of organisations discussed the potential for alternative fuels within the freight sector to encourage mode shift while also serving environmental outcomes, though these tended to be based on theory or a small number of proof-of-concept pilots.

Example: Network Rail. Long Term Planning Process: Freight Market Study. 2013. Available from: Available from: https://cdn.networkrail.co.uk/wp-content/uploads/2016/11/Freight-Market-Study.pdf

A number of responses discussed how planning policy can influence modal choice. Issues raised included the effectiveness of planning decisions, infrastructure, and affordability and inequalities. Respondents highlighted that differential impacts on socio-economic groups are likely for many interventions, though it is an area which is under-studied. Submissions (typically from public health organisations) provided links to evidence that suggested interventions that are based around voluntary behaviour change (for example, media campaigns) may themselves generate inequalities by being more effective in more affluent groups, whose circumstances mean they are more likely to change behaviour as a result.

Example: Lorenc T et al. What types of interventions generate inequalities? Evidence from systematic reviews. Journal of Epidemiology & Community Health. 2013. Available from: http://jech.bmj.com/content/67/2/190

2.2 Uncertainties in the evidence received for transport mode choice and demand

A range of arguments were put forward by respondents in relation to models of (de)regulation and privatisation of transport services as influencing mode choice for rail, ferries, and, chiefly, bus. These were largely based from opinion or a small number of case studies used to argue that a particular regulatory model does/does not perform well, rather than more systematic analysis.

With regards to freight, respondents that discussed attempts to shift freight from road to rail argued that since there are track access charges for rail freight, but not road, there is a case for some form of rebalancing. However, this argument was presented largely from the perspective of freight organisations. Around the issue of 'who pays' (and 'how much') when attempting to increase the uptake of alternative modes, there was a call for more comprehensive research to estimate the costs of transport (to the user, taxpayer, environment etc.) and the degree to which these costs are covered by the users as compared to other parties.

2.3 Gaps in the evidence received for transport mode choice and demand

Gap in evidence received	**Commentary of the nature of gap**
How disruptive technologies and shared mobility will end up influencing modal choice.	Only a small number of submissions made mention of disruptive technology with respect to mode choice and those that did tended to provide arguments based on a theory of how these services *could* influence mode choice rather than evidence on the probable ways in which they will.
Evidence on mode choice interventions in rural areas.	While a relatively small number of responses discussed issues specific to rural mode choice, these tended to be limited to particular localities and not easily generalisable .
Evidence on mode choice/demand at the local and regional level (outside of inter/intra city connections).	Some responses identified a gap in policy focus and evidence on how mode shift is encouraged at a local/regional level (i.e. getting people to and from key services locally), believing that often there is too great a focus on travel between, to, and from, the main cities in Scotland.
The effect of integrated/'smart' ticketing on modal shift.	It was suggested that integrated/'smart' ticketing could be a means to encourage shift to public transport and other shared modes, however this was largely argued from opinion.

3. Environmental impact of transport

Question: What does evidence suggest the most effective means of reducing transport's local (air quality) and global (climate change) emissions are? How have other countries reduced the environmental impact of transport and to what degree are any such measures also likely to be successful in Scotland? When are routes to reducing carbon emissions from transport also consistent with tackling air quality issues, and when are they not?

3.1 Themes in the evidence received for environmental impact of transport

Respondents answering this question provided comment and cited evidence on technological, behavioural (e.g. mode choice, active travel and working from home), and both global and local environmental factors. To some extent, submissions also covered wider issues relating to the distributional environmental impacts of policies across various societal groups and, to a limited extent, resilience of the network to environmental challenges.

Submissions that highlighted the low polluting nature of active modes emphasised the net beneficial health effects of these modes, even after poor air quality exposure is considered. Some mentioned that in addition to personal travel for work or leisure, this could include cargo-bikes for moving freight in urban areas.

Example: Tainio M et al. Can air pollution negate the health benefits of cycling and walking? Preventive Medicine. 2016. Available from: https://www.sciencedirect.com/science/article/pii/S0091743516000402

However, it was acknowledged in many responses advocating active travel that the net impact on emissions reduction is dependent on the total amount of mode shift to active travel from the car, and rather than any particular single intervention, this requires a package of measures to facilitate cycling and other active modes with other infrastructure and interventions to deter private car driving (frequently mentioned were parking charges and low emission zones).

Example: Ricardo-AEA. Cycling and urban air quality: Report for European Cyclists Federation. 2014. Available from: https://ecf.com/sites/ecf.com/files/150119-Cycling-and-Urban-Air-Quality-A-study-of-European-Experiences_web.pdf

Many submissions stressed the need to focus not only on technological change, but also overall demand reduction, traffic speed reduction and congestion reduction in order to have net beneficial impact on emissions. Encouraging mode shift (see

previous section), working from home and reducing short journeys by car were also highlighted.

Though there was relatively limited direct discussion of the differential impact of policies (by geographic or demographic groups), evidence received suggests the uptake and impact of technological changes to meet environmental objectives will not be uniform across society and could exacerbate inequality if private modes are focused on at the expense of collective modes.

Example: Morton C. The Geographical Variation in the Market for Electric Vehicles in Scotland: The 2015 Outlook. Policy Briefing from Climate X Change centre. 2017. Available from: http://www.climatexchange.org.uk/files/6814/4465/9453/Exploring_the_Spatial_Demand_for_Electric_Vehicles_in_Scotland.pdf

Many submissions emphasised that technological improvements in mass transit systems (buses, rail and ferries) should not be forgotten in favour of an emphasis placed on technological improvements in private cars. A focus on public transport in this way was also seen as a means to rejuvenate the attractiveness of these modes as well as to mitigate against the possibility that cleaner (alternative fuel) passenger cars will not be affordable for everyone for some time to come.

Buses meeting Euro 6 standards were highlighted for their extremely favourable NOx emissions compared to diesel passenger cars. Rail electrification was generally supported by responses that covered this area, and hybrid ferries were also mentioned as worthy of policy support. Given the difference in emissions profiles by vehicle type, one suggestion for effective monitoring of progress towards environmental objectives was to focus on emissions on a per-passenger, not per-vehicle basis.

Example: International Council on Clean Transportation. NOx emissions from heavy-duty and light-duty diesel vehicles in the EU: Comparison of real-world performance and current type-approval requirements. 2017. Available from: https://www.theicct.org/publications/nox-emissions-heavy-duty-and-light-duty-diesel-vehicles-eu-comparison-real-world

A number of submissions cited the need for a strategy that focused on decarbonising HGV traffic as this mode has a high individual contribution to Scotland's transport sector carbon emissions. The submissions called for either mode switch to rail (as potentially less carbon intensive than road freight) or an acceleration of HGV technological development such as hybridisation and hydrogen.

Example: Department for Transport. Rail Freight Strategy. 2016. Available from: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/552492/rail-freight-strategy.pdf

Several respondents cited evidence from car club member surveys to demonstrate a reduction in carbon emissions due to net a lowering of car ownership, and the use of less polluting vehicles than might otherwise be the case.

Example: Carplus bikeplus. Annual survey of car clubs 2015/16. Available from: https://www.carplus.org.uk/tools-and-resources/annual-survey-of-car-clubs/

Tourism traffic and travel was highlighted by a small number of submissions as both a cause of environmental problems but also as a potential opportunity to promote, invest in and increase the visibility of sustainable travel, as well as accelerating the introduction of ultra-low emission vehicles (ULEVs) via minimum sustainability requirements.

Example: International Transport Forum/OECD. Tourism facilitation as part of transport policy. 2015. Available from: https://www.itf-oecd.org/sites/default/files/docs/dp201515.pdf

Resilience (in an environmental context) was mentioned by some responses, but in a fragmented way, covering a number of different issues, including: that flooding should be considered in the planning of all new transport infrastructure; that transport authorities need to be more responsive to new innovations; and the vulnerability of the electricity grid as more ULEVs come in to the fleet.

In addition, a number of more specific issues and suggestions were raised in individual submissions, including: an argument that support is needed for local traffic management schemes targeted at improving air quality; improving air quality around airports; a carbon trading system to stimulate uptake of low emission vehicles; and increased support to accelerate the transition of the taxi fleet to ULEVs.

3.2 Uncertainties in the evidence received for environmental impact of transport

Review of the submissions revealed several uncertainties which relate to some of the issues highlighted in the main themes and, in addition, some specific further questions.

While there was consensus that active travel is a low polluting mode of transport, there remains an important question about how many motorised miles can realistically be substituted by walking and cycling, limiting the potential for carbon savings from mode switch to active travel. However, it was also suggested that as part of a package of measures directed at reducing overall traffic, cycling improvements can lead to a reduction in car trips and therefore improvements to local air quality.

Example: Pooley et al. The Role of Walking and Cycling in Reducing the Impacts of Climate Change. Chapter 7 in in Ryley and Chapman (eds) Transport and Climate Change. 2012. Emerald, Bingley UK. Available from: http://www.emeraldinsight.com/doi/abs/10.1108/S2044-9941(2012)0000002010

Calls for increased home working and improvements in digital infrastructure as a means to achieve reduced demand for transport through reducing the need to travel were typically argued from principle or theory and not substantiated by evidence. The broader evidence base on this issue is mixed and findings depend on the breadth of the study and the timescales considered.

The potential effectiveness of Low Emission Zones (LEZs) in achieving their intended outcome of improving urban air quality was called in to question by at least two submissions, both of which provided evidence (reviews of studies comparing environmental pollutants before/after LEZ implementation) in support of this questioning. Factors highlighted that influence LEZ effectiveness include whether HGVs are included in the restrictions or not, and whether the effect of such schemes can persist over the long-term, or whether they are one-off following introduction.

Example: Holman C, Harrison R, Querol X. Review of the efficacy of low emission zones to improve urban air quality in European cities. Atmospheric Environment. 2015. Available from: https://www.sciencedirect.com/science/article/pii/S1352231015300145?via%3Dihub

Morfeld P, Groneberg DA, Spallek MF. Effectiveness of Low Emission Zones: Large Scale Analysis of Changes in Environmental NO2, NO and NOx Concentrations in 17 German Cities. PLoS One. 2014. Available from: http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0102999

This issue is related to submissions which urged the need to consider the potential improvements to be gained from accelerating new technology into bus fleets (with some uncertainty as to the relative benefits of Euro 6 standard buses versus electric buses) and considering evaluating interventions using a 'per passenger' emissions metric.

While the balance of submissions suggested that a transfer of road freight to rail would be beneficial, the absolute and relative volumes that could be diverted to rail in Scotland is uncertain. In relation to alternative fuels for private vehicles, submissions highlighted uncertainty over the speed with which electric vehicles could realistically penetrate the fleet and to what extent this will be possible without further subsidy. On a similar topic, a few submissions emphasised the uncertainty around what the equality impact of the adoption of new propulsion technology will be, and whether it could increase travel costs for particular vulnerable groups.

3.3 Gaps in the evidence received for environmental impact of transport

Some gaps in the evidence in this area are implicit in the uncertainties highlighted above. In addition to these, limited evidence was received in submissions relating to the issues below.

Gap in evidence received	Commentary of the nature of gap
The impact on emissions of investing in walking and cycling.	The scope of impact was raised as an uncertainty by some responses, and limited evidence was received attempting to quantify this impact depending on size/type of investment.
The environmental impact on emission reduction of promoting working from home and other 'digital' means to reduce the need to travel.	A shift to digital communication reducing the need for travel (or changing the need, e.g. in the case of online shopping) was raised in responses as a factor to consider, but little evidence was presented that attempted to quantify this impact.
The potential to switch freight from road to rail in Scotland.	While submissions raised this as a measure to reduce freight road emissions, little evidence was provided quantifying the magnitude of environmental benefit compared to degree of investment required, considering practical factors.
The potential for low/ultra-low emission propulsion technology to be adopted for vehicles other than cars (particularly freight).	While some submissions highlighted the potential of low/ultra-low emissions for buses and alternative fuels (e.g. hydrogen) for freight, these were often based on evidence from pilots or trials, with limited evidence attempting to quantify the environmental outcomes of large scale adoption.
The role of land use planning in reducing emissions.	Submissions often highlighted the need for land use planning and transport planning to be better integrated in order to maximise opportunities for environmental benefits (by enabling active travel or public transport links). However, relatively little evidence was received that demonstrated the benefits or compared different approaches for doing this.
The best strategy for reducing noise pollution from transport modes in Scotland.	Little evidence was received on noise pollution overall, either on its impacts or interventions to reduce it.
The potential for new vehicle technologies to increase the cost of travel for some groups.	Evidence received highlighted to some extent the potential for differential economic or social impacts of new technology, however there was little which quantified this.
The potential impact on emissions of increased uptake of shared mobility services (e.g. via 'Mobility as a Service' MaaS).	As with previous sections, submissions on shared mobility such as MaaS discussed how it may change environmental emissions, rather than presenting convincing evidence as to how it will, reflecting high uncertainty in this area.

4. Active travel

Question: What does the evidence suggest are the best ways to achieve improved health outcomes from active travel? What are the most important constraining factors to the uptake of active travel that can be targeted by policy in the Scottish context?

4.1 Themes in the evidence received for active travel

The active travel question elicited the highest number of citations to further sources of evidence by respondents of all questions in the call. These included detailed submissions from organisations with a population or public health focus, often making reference to high quality evidence.

Many respondents provided strong evidence on the positive associations between active travel and selected physical health outcomes. One recent high quality study cited by several respondents used a large sample of data from the UK Biobank and found an association between active commuting and a lowered risk of cardiovascular disease, cancer and overall mortality for cycle commuting and a lower risk of cardiovascular disease for walking commuting. The broader literature cited by respondents is also generally supportive of such benefits.

Example: Celis-Morales CA. Association between active commuting and incident cardiovascular disease, cancer, and mortality: prospective cohort study. British Medical Journal. 2017. Available from: http://www.bmj.com/content/bmj/357/bmj.j1456.full.pdf

Xu H, Wen LM, Rissel C. The Relationships Between Active Transport to Work or School and Cardiovascular Health or Body Weight: A Systematic Review. Asia Pacific Journal of Public Health. 2013. Available from: http://journals.sagepub.com/doi/abs/10.1177/1010539513482965

Saunders LE et al. What Are the Health Benefits of Active Travel? A Systematic Review of Trials and Cohort Studies. PLoS One. 2013. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3744525/

Some respondents also cited evidence that suggested active travel, particularly in natural environments, could be relevant in promoting mental as well as physical wellbeing; though the evidence base is less well developed for the former compared to the latter.

Example: National Institute for Health and Care Excellence (NICE). Physical activity: walking and cycling. Public Health Guidance PH41. 2012. Available from: https://www.nice.org.uk/guidance/ph41/chapter/1-Recommendations#benefits-of-walking-and-cycling

Mitchell, R. Is physical activity in natural environments better for mental health than physical activity in other environments? Social Science and Medicine. 2013. Available from: https://www.ncbi.nlm.nih.gov/pubmed/22705180

As also discussed by respondents under other question areas in the call, submissions highlighted the need for a comprehensive set of approaches to encourage active travel (rather than individual measures in isolation), but frequently respondents referred to the need for well-designed, dedicated, and safe infrastructure for high levels of active travel to be realised.

Evidence was provided in submissions that providing new walking and cycling routes increase new active travel trips, particularly in the longer terms and for those unable to access a car. However, reviews of existing evidence cited by respondents also identified that there are policies and interventions relating to active travel where the evidence on overall impact of physical activity and potential differential socio-demographic effects are unclear, and require more rigorous evaluation.

Example:
Goodman A, Sahlqvist S, Ogilvie D. New Walking and Cycling Routes and Increased Physical Activity: One- and 2-Year Findings From the UK iConnect Study. American Journal of Public Health. 2014. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4151955/

Yang L. Interventions to promote cycling: systematic review. British Medical Journal. 2010. Available from: http://www.bmj.com/content/341/bmj.c5293

Fraser S, Lock K. Cycling for transport and public health: a systematic review of the effect of the environment on cycling. European Journal of Public Health. 2011. Available from: https://academic.oup.com/eurpub/article/21/6/738/493197

Several respondents discussed and provided evidence on the uptake and prevalence of active travel by demographic factors, notably the patterning of active travel by affluence. This discussion highlighted some of the subtleties of this issue. Evidence provided in submissions noted that some forms of active travel are more prevalent in less affluent groups (e.g. commuters from less affluent households are more likely to walk to work), while the reverse is true for other forms (cycling being more prevalent for both transport and recreation in more affluent groups). As noted by submissions addressing other question areas in the call, this patterning has implications when considering strategic policy options to address inequalities.

Example: Glasgow Centre for Population Health. Active travel in Glasgow: What we've learned so far. 2017. Available from: http://www.gcph.co.uk/assets/0000/6007/Active_travel_synthesis_final.pdf

Rind E et al. Are income-related differences in active travel associated with physical environmental characteristics: A multi-level ecological approach. International Journal of Behavioral Nutrition and Physical Activity. 2015. Available from: https://ijbnpa.biomedcentral.com/articles/10.1186/s12966-015-0217-1

Evidence received also emphasised the specific challenges of securing investment in active travel, which reflected the need for 'revenue' funding for activities such as

promotion and user training, as well as 'capital' funding for infrastructure. In addition due to the complexity of holistic interventions being called for, the need for partnership working between different agencies and different levels of government was also highlighted as a particular challenge.

However, the importance of overcoming such barriers was emphasised by respondents and evidenced by the strong performance of such projects when subject to cost-benefit analysis, due to the relatively low investment costs but high value of safety and health improvements.

Example:
Department for Transport. Value for money assessment of cycling grants. 2016. Available from: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/348943/vfm-assessment-of-cycling-grants.pdf

Whilst the majority of the evidence received related to active travel in urban areas, and often in relation to commuting, some respondents referenced the attraction of Scottish natural resources as a potential opportunity and driver for active travel tourism.

Example:
Visit Scotland. Insights: Trends 2017. Available from: http://www.visitscotland.org/pdf/VisitScotland%20Insight%20Trends%202017.pdf

4.2 Uncertainties in the evidence received for active travel

Whilst there is acceptance within the evidence base received that factors such as built environment enhancements and improvements in safety can promote active travel, there is a mixture of limited and uncertain evidence defining which specific interventions have benefits for achieving greater levels of and/or safer active travel.

For example, a 2010 review of interventions to promote cycling emphasised the need for better quality research methodologies before it could be concluded that the potential of the interventions is being realised. Similarly, a 2003 review of area-wide traffic calming measures for the prevention of injury (that, due to limitations in the evidence available at the time was not able to break down results by different categories of road user) found that these measures have the potential to reduce injury and death but that more and better evaluations are needed.

Example: Yang L. Interventions to promote cycling: systematic review. British Medical Journal. 2010. Available from: http://www.bmj.com/content/341/bmj.c5293

Bunn et al. Area-wide traffic calming for preventing traffic related injuries. Cochrane Database of Systematic Reviews. 2003. Available from: http://onlinelibrary.wiley.com/doi/10.1002/14651858.CD003110/full

4.3 Gaps in the evidence received for active travel

Gap in evidence received	Commentary of the nature of gap
More cycling-related evidence than walking-related evidence was cited by respondents	The submissions tended to emphasise evidence on cycling over walking. While some evidence was presented on walking, it tended to be statistics reporting the prevalence of the activity and trends, rather than analysing the impact of interventions. Due to the short nature of most walking trips, respondents may have detected a greater potential for physical activity and the substitution of car trips for cycling compared to walking.
Wellbeing and the built environment as it relates to active travel	Whilst some evidence was received that exposure to natural environments is good for wellbeing, there is also emerging evidence that high quality built environments may have similar effects, but this aspect was not included in the evidence submitted.
New active travel technologies	With a few exceptions, there was limited evidence presented on the effects of new technologies. For example, public bike-sharing for which there is emerging evidence of trip transference from car, or the effect of e-bikes. As is highlighted elsewhere in this report there are questions over the equality impact of such technologies and approaches, given the current patterns of cycling being more prevalent in more affluent groups.
Specific measures to enhance active travel safety	There was little high quality evidence received through the call on specific safety interventions, e.g. on cycle lanes versus cycle paths, or the effect of other interventions to improve safety and reduce injury.

5. Safe and resilient transport

Question: What are the current and emerging risks to the safe operation and resilience of Scotland's transport network and what does evidence say about the ways in which these risks can be best managed? What does evidence tell us about what adaptation measures (in response to environmental, or other, changes) may be effective to respond to changing pressures on the network?

5.1 Themes in the evidence received for safe and resilient transport

Submissions highlighted a range of issues focussing on current or potential safety and resilience concerns and emerging risks to the network, including: increasing frequency of disruptions due to weather-related events and critical capacity issues; ageing of particular aspects of infrastructure; inconsistent levels of investment on infrastructure maintenance between local authorities; reduction of relevant civil engineering and analytical expertise within local authorities and beyond; HGV involvement in local collisions; poor perceptions of personal safety hindering active travel; the safety of workers carrying out repairs on the network; and the specific challenges faced by island communities to maintain fragile infrastructure.

Respondents often supported these concerns with citations to different forms of broadly relevant evidence (e.g. statistical reviews of the numbers of casualties, frequency of disruptions, or reports of case studies and particular incidents). However, the evidence provided supporting recommended solutions to these concerns was relatively weak and, whilst reasonable arguments were made in submissions, they did not tend to command a critical mass of evidence or opinion.

Ideas proposed by respondents in the ways in which concerns can be managed and policies be adapted were as follows:

- Suggestions that Scotland could learn from the review of the resilience of England's transport network to extreme weather events by the Department for Transport and suggestions that Transport Scotland and infrastructure owners collaborate to define a critical network of railways, highways, ports and airports which should be prioritised to strengthen resilience. Similar arguments were suggest learning from Transport for London's approach to adaptation.

Example: Department for Transport. Transport Resilience Review; A review of the resilience of the transport network to extreme weather events. 2014. Available from: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/335115/transport-resilience-review-web.pdf

Transport for London. Providing Transport Services Resilient to Extreme Weather and Climate Change. 2015. Available from: http://content.tfl.gov.uk/tfl-adaptation-report-may-2015.pdf

- Suggestions were made that rail disruptions due to climate incidents are often likely to be caused by knock-on critical capacity issues (i.e. the inability to adapt quickly enough) than the initial disruption itself. Hence, giving priority to analysing these 'pinch point' knock-on issues alongside the locations and causes of primary disruptive events was recommended.
- In relation to rural poverty and inequality, respondents suggested that resilience, adaptive capacity and vulnerability issues need to be addressed through improved accessibility via public transport availability and improved perceptions of the safety of active travel.
- In relation to management of resilience, suggestions were made around how innovative uses of data by local authorities could significantly enhance efficiency and disruption response times and effectiveness. Respondents suggested there is much room for improvement with regard to the analytical capacity and utilisation of available data at the local authority level, including respect to data analysis of network performance during weather disruption. Similarly, it was noted that there is a need for a thorough understanding of network vulnerabilities to weather and geological disturbance and planning of emergency and diversionary routes.

Example: NESTA. Wise Council: Insights from the cutting edge of data-driven local government. 2016. Available from: http://www.nesta.org.uk/publications/wise-council-insights-cutting-edge-data-driven-local-government

- Various types of new technology (e.g. 4G cameras on trunk roads to improve response time to incidents; virtual reality training for maintenance workers) were recommended by respondents to monitor major roads; carry out safety inspections and maintenance to enable more rapid response; and improve efficiency and reduce the risk exposure of highway workers.
- A Scottish Local Authority response suggested common/strategic targets regarding maintenance levels by local authority. A public transport operator suggested that maintenance of the existing network should be prioritised and ring-fenced funding for the roads budget should be considered. A greater concern seemed to be the need to incentivise collaboration across boundaries: shared maintenance services (e.g. road surfacing) was suggested, as was the need for a cross-border strategy for refuelling electric/hydrogen vehicles.
- There were surprisingly few submissions relating specifically to casualties/collisions/fatalities on the transport network. Some submissions focussing on active travel offered many, often high-quality, evidence reviews on specific interventions including 'safety in numbers' for cycling, cycling helmets, seat belt wearing, information campaigns, speed cameras,

improvements to walking and cycling through controlled speed environments, and other built environment improvements. Whilst there were good evidence reviews presented here, each of the interventions have a wealth of conflicting and often context-specific evidence to consider and thus require a balanced assessment of the evidence using a wider set of sources and more up to date sources than received here. Some evidence from Scotland was presented on the relationship between junction design and pedestrian and cycling casualties, finding that T staggered junctions and roundabouts were hot spots.

Example: Elder R et al. Effectiveness of mass media campaigns for reducing drinking and driving and alcohol-involved crashes: A systematic review. American Journal of Preventive Medicine. 2004. Available from: http://www.sciencedirect.com/science/article/pii/S0749379704000467

Streets Ahead Edinburgh. Edinburgh Road Casualties Annual Trend report 2014. Available from: http://www.streetsaheadedinburgh.org.uk/streetsahead/downloads/file/169/edinburgh_road_casualties_annual_trend_report_2014

Sustrans. Cycling safety in Scotland: Cycle collision hotspots. 2016. Available from: http://www.sustrans.org.uk/sites/default/files/file_content_type/cycling_safety_in_scotland_cycle_collision_hotspots_v0_6.docx?platform=hootsuite

- With regards to freight, some respondents highlighted the increased likelihood of HGVs to be involved in fatal accidents, encouraging suggestions for modal shift to rail to reduce fatal collisions.
- Similarly, bus operator submissions noted that model shift to bus from private car use could result in improved safety due to differences in the safety profile of travel between the two modes. It was also noted, separately, that the greatest safety issue on the railways is suicide and provides evidence as to how training of personnel has be associated with a reduction in suicide rates.

Example: Network Rail. Life-saving interventions on rail network up 40 per cent in one year. 2017. Available from: https://www.networkrail.co.uk/feeds/life-saving-interventions-on-rail-network-up-40-in-one-year/

- Evidence from a Scottish Regional Transport Partnership initiative was cited as helping to alleviate personal security issues on public transport. The 'Thistle Assistance Card' was presented as helping to reduce anxieties and complexities faced by disabled travellers when boarding public transport, in combination with other measures such as real time passenger information. Other measures to improve safety by reducing discrimination and crime were referenced by respondents, such as the Edinburgh 'Hate Crime Charter' for Public Transport which aims to promote hate free travel and give confidence to victims of hate crimes on transport to report them.

Evidence on built environment improvements, such as improved street lighting, was also cited as a means to reduce crime rates and any anxieties that users of transport many experience.

Example: SEStran. The Thistle Assistance Card & App. 2017. Available from: http://www.sestran.gov.uk/projects/the-sestran-thistle-assistance-card/

Welsh B, Farrington D. Effects of improved street lighting on crime. 2008. Available from: https://campbellcollaboration.org/library/effects-of-improved-street-lighting-on-crime

5.2 Uncertainties in the evidence received for safe and resilient transport

Given the diversity of issues covered by respondents across submissions under this theme, there were no real contested issues . Nevertheless, some issues were identified by respondents that were not accompanied by a clear evidence base and raised a series of further questions:

Resilience

- What is known about the vulnerability to and resilience of different aspects of Scotland's transport system to future potential natural and man-made disruptions? How might the scale of potential disruptions be reduced if known 'day to day' pinch-points in these systems are alleviated?
- Is safety compromised during disruptions, and if so, to what degree?
- Are some modes more resilient in bad weather than others and to what extent?
- What are the costs or anticipated future costs of such disruptions on businesses, tourism and the economy?

Safety

- Would freight mode shift (e.g. road freight on to rail) improve safety on the roads?
- To what extent are maintenance investment patterns uneven between local authorities? Does this inconsistency result in differential safety records i.e. what is the relationship between road maintenance and safety? Would common strategic objectives assist in reducing any difference that exists? What are the models for allocating responsibility for maintenance to ensure consistency and collaboration across borders?
- Will budget cuts to transport maintenance compromise safety?

5.3 Gaps in the evidence received for safe and resilient transport

Gap in evidence received	Commentary of the nature of gap
Relationship between social deprivation and safety, security as it relates to transport.	While there is a large evidence base on socio-demographic patterns in safety, crime and other adverse events, little was cited by responses in the call under this theme.
Safety implications of different passenger and freight mode shift scenarios.	Discussion of these issues in the submissions received was inferred from existing patterns (i.e. evidence one form of transport currently is less risky than another), rather than changes in safety outcomes following modal change.
Will budget cuts in transport spend/maintenance compromise safety?	This was raised by several submissions as a potential issue, however it is unclear from evidence received what the relationship is between spend and safety (e.g. is there a 'minimum acceptable' safe spend for a given area or issue?)
What do we know about how social adaptability to disruptions and how to increase this to positive effect?	Few responses discussed how people and groups respond and adapt in the event of disruption.
The relationship between day-to-day pinch points in the transport system and the impacts of disruptive events.	Some responses argued that the transport impact of critical disruptive events is as much a result of knock-on capacity impacts in the rest of the system as the event itself. Little evidence was received on how this relates to routine capacity issues, or how interventions to improve routine issues also improves resilience.
Safety records during disruptions.	Little evidence was received quantifying how critical or routine disruption affects safety.
The role of different modes during different types of disruptions.	While there was some comment on this from some mode-focused responses, there was little evidence received providing an overview of the patterns of modal choice during any kind of disruptive event.
Overlap between interventions to mitigate environmental impacts versus improving resilience.	Responses to the safety and resilience theme, in general, did not make connections (or provide evidence) that link policies and actions aimed at improving environmental outcomes to resilience issues.
Evidence on external threats to the transport system (terrorism, cyber security)	Aside from a small number of submissions that mentioned cyber security concerns in relation to connected and autonomous vehicles, there was little formal evidence received on how best to strategically prepare and respond to these kind of new and emerging threats.

6. Transport governance

Question: What does evidence say the most effective forms of governance and institutional arrangements around transport might be, in order to meet the Scottish Government's strategic objectives?

6.1 Themes in the evidence received for transport governance

Overall, the submissions received on this question area tended to be partial (focussing on a respondent's specific interests rather than considering governance more holistically) and there were few examples where arguments were supported with strong evidence.

In order to capture the main themes raised while reflecting the nature of the responses, an attempt has been made to gather the themes raised under general headings below. In comparison with the rest of this report, summarising of respondent views under this question area features more direct referencing of individual submission positions (often taken from the submissions themselves) in order to fairly present the range of views received.

When considering submissions in this area, it is also important to note that it can be difficult to disentangle comment by respondents on the effects of legislation or funding from those of governance structures since they frequently occur as one package.

<u>Strategic planning, investments and alignment</u>

In general, respondents addressing these kind of themes noted that different types of infrastructure (economic, residential, social) are becoming more interconnected and have increasing interdependence; a situation which it was argued the reviewed NTS needs to acknowledge. Respondents noted that 'future-proofing' society will require greater attention and coordination as to how as a country we organise and use land; use transport; live and work in communities; and generate and distribute energy – all of which must be coherent at the national, regional and local levels.

- Several respondents commented that better integration of transport and land use planning is needed and reiterated that the NTS review should align carefully with the Scottish Government Planning Review process and the recently published Scottish Government 'Position Statement' on the Planning Review. In a similar manner, alignment was urged with other Transport Scotland or Scottish Government programmes of work, e.g. the Enterprise and Skills Review.

- Some respondents highlighted specific issues that they had encountered with integration between transport and land use planning in the past, e.g. the Timber Transport Forum's view was that the Land Use Strategy takes insufficient account of transport infrastructure despite the fact that many forms of land use are dependent on transport infrastructure.
- The Royal Town Planning Institute cited a paper that examines the consequences of taking a spatially insensitive approach to policymaking, and case studies where a greater consideration and understanding of spatial impacts could have made a policy or initiative more effective. It also reflected on the tools available to policymakers which can assist spatial thinking in decision-making. The use of tools such as Geographic Information Systems (GIS) and impact assessment has become more widespread in recent years, but the RTPI reports that barriers remain which prevent the use of these tools more widely.

Example: Royal Town Planning Institute. Planning horizons no.1: Thinking Spatially. 2014. Available from: http://www.rtpi.org.uk/media/1004403/rtpi_thinking_spatially.pdf

- An academic respondent, Dr Kate Pangbourne, cited her own research on transport governance in Scotland, which – through an analysis of policy and strategy documents and interviews with stakeholders – concluded that progress in governance of strategic transport issues hinges on closer integration between spatial planning and transport planning processes. The research found evidence of 'over-stuffing' of Scottish transport governance structures – the creation of more layers of governance that can lack integration leading to difficulties in effectively tacking action on transport issues. It highlights that some consolidation of local government could enable regional transport partnerships to be reformed, and, where there are still partnerships of multiple local authorities, they would be more efficient were they to have fewer constituent local authorities. The research also notes that the work of Regional Transport Partnerships was hampered by political cycles at both the local and national levels.

Example: Pangbourne K. The Changing Geography of Scottish Transport Governance. A thesis submitted for the degree of Doctor of Philosophy at the University of Aberdeen. 2010. Available from: http://ethos.bl.uk/OrderDetails.do?uin=uk.bl.ethos.531896

- SESPlan (Strategic Development Planning Authority for Edinburgh & South East Scotland) stated that clarity must be provided on the hierarchy and relationship between plans and programmes produced by different bodies. They believed that this is critical with regard to Regional Transport Strategies which they argue currently offer limited delivery-focussed funding and can be weak in terms of links to local or national agendas. They also

argued that a longer-term view and national commitment to future funding for Scotland's strategic transport infrastructure is required both within and between city regions; believing that while inter-city connections are rightly seen as a priority, movements within and around city regions must also be enhanced.

- Network Rail raised questions around to what extent industry structure and governance issues across transport markets in Scotland are an opportunity or a threat to the strategic planning of transport networks (i.e. what are the ways in which market failures in one transport market lead to the development of interventions in other transport markets?)
- In terms of the alignment of governance bodies, Professor Iain Docherty highlighted a study that he co-authored which compared Aberdeen with two European cities. It argues that institutional misalignment was responsible for carbon targets being missed in Aberdeen compared to European counterparts.

Example: Gray D, Laing D, Docherty I. Delivering lower carbon urban transport choices: European ambition meets the reality of institutional (mis)alignment. Environment and Planning. 2017. Available from: http://journals.sagepub.com/doi/abs/10.1177/0308518X16662272

Regional Transport Partnerships and investment, financing

In this area several respondents put forward the view that governance arrangements emerging from the NTS Review could be the driver in delivering a more coherent and joined up approach to national, regional and local transport. There were some suggestions that this could particularly benefit Regional Transport Partnerships (RTPs) in rural local authorities where there may be more limited strategic infrastructure planning capacity and resources. On a related topic, arguments were made that decisions with high local impact but lower strategic impact are better devolved to the local level. It was suggested that local forums bringing together businesses, community groups and representatives from across infrastructure sectors are better placed to understand local transport requirements.

- SESplan suggested that RTPs should be strengthened in terms of role and funding and noted that the Scottish Government Planning Review outlines the potential for revised regional working and proactive governance.
- On a related theme, SEStran suggested that effective regional partnership working requires statutory powers and duties, and a joint organisation such as a Passenger Transport Authority could offer this.
- The Scottish Association for Public Transport recommended devolving urban transport to city regions, noting the formation of Transport for Edinburgh as a good practice example and recommended changing transport governance in Scotland to match this model.
- The Society of Chief Officers of Transportation in Scotland (SCOTS) noted that there are many methods of setting up regional partnership working. One means they proposed was a requirement for the regional body to produce a

regional economic strategy, a regional development plan or a regional transport strategy. SCOTS also proposed that regional partnerships identify their own priorities for joint working and the geography and scale of such co-operation, rather than national identification of priority areas where regional partnership working should take place. They did not agree that regional plans should be removed from the system.

- Glasgow City Council responded to this question highlighting that in their view, current policies have led to a fragmentation of transport services within the Glasgow City Council area split between Transport Scotland, Strathclyde Partnership for Transport (SPT) and Glasgow City Council. They stated that this causes challenges for delivering an integrated service for the population of Glasgow. They further suggest the German model of 'Verkehrsverbund' as an alternative option. A Verkehrsverbund is a form of alliance within the public transport sector that brings together rail, metro, tram, bus and ferry operators together with the respective governance bodies to provide a more integrated public transport system. The various operators continue to be distinct companies but work within an overarching alliance that is also set up as a separate company.

<u>Transport regulation & performance, integration and ticketing</u>

Respondents raised issues around the degree to which governance arrangements in Scotland affect the ease with which multi-modal journeys can be made and also the degree to which regulatory structures (chiefly in relation to bus) affect performance.

- The Institution for Civil Engineers Scotland stated in their response that a joined-up approach to transport planning is often lacking at the local level, with little appreciation of the multi-modal nature of travel crossing local authorities boundaries. Because of this they argue that many relatively short journeys take an unnecessarily long amount of time to complete and are increasingly more expensive due to poor connectivity and the lack of integrated ticketing.
- NHS Grampian highlighted an aspect of good practice in active travel, stating that there is increased joint working in the North East driven by an active travel partnership. They state that this has led to increased co-operation and collaboration in aspects of travel planning, with a transport and public health sub-group facilitating joint working between local authorities and the NHS in Grampian.
- As discussed under other call for evidence question areas, arguments were again made for and against different models of bus regulation. Those in favour of more publically owned services (e.g. Unite Scotland) made their case that the current market is skewed towards advantaging a small number of large operators who service the more profitable routes while leaving the socially necessary but less profitable routes under-served. Counter-arguments in this area (e.g. Confederation of Passenger Transport Scotland) argue that services run by a municipality can also fail, and that the currently regulatory model should be largely retained but with better

partnership between bus operators and regulators (supported by other interventions to create a more 'pro bus' environment). First Group argued that bus operators want one single authority in each area to be responsible for transport and land use issues, and to have sufficient funding, empowerment and expertise. They stated that such authorities should set strategic objectives including to engage with bus operators in partnership, and to set targets to increase average bus speeds and reduce variability in service.

- SPT cited a Scottish Executive cross-national comparative study (from 2003) of best practice in transport policy delivery which found the key mechanisms and factors that underlie effective transport policy to be: the availability of appropriate levels of capital and revenue funding for public transport; lower public transport fares; the availability of an integrated multimodal ticket at the regional level; and integration of public transport services (delivered through some form of regional transport body). SPT argues that these findings were only partially adopted in Scotland leading to less progress than would have been possible had they been fully applied.

Example: Scottish Executive. Transferability of Best Practice in Transport Policy Delivery Final Report. 2003. Available from: http://www.gov.scot/Resource/Doc/47133/0031335.pdf

- A related, but more recent analysis was highlighted by the Transport Research Institute at Edinburgh Napier University. It showed that a higher level and quality of public transport service is secured in Sweden, Norway and Denmark compared to metropolitan England at a public sector cost per inhabitant between 50 and 100% higher, but with the result that ridership per head is substantially higher and fares are lower.

Example: Urban Transport Group / Transport Research Institute at Edinburgh Napier University. The Scandinavian way to better public transport. 2017. Available from: http://www.urbantransportgroup.org/system/files/general-docs/UTG%20Scandinavian%20Transport%20Report_Final.pdf

- The Transport Research Institute submission also cites evidence that comments on port systems It notes that even if the system is highly privatised (as in the UK), there can still be regulation of performance, and sanctions can be applied if it fails to meet a defined level.

Example: Monios J. Port governance in the UK: Planning without policy. Research in Transportation Business & Management. 2017. Available from: https://www.sciencedirect.com/science/article/pii/S2210539516300311

Appraisal processes

- Network Rail highlighted what they believed to be the strengths of the Scottish Transport Appraisal Guidance (STAG): its focus on consideration of transport problems rather than transport solutions. They state that although this can be frustrating for stakeholders who may be concerned with promoting a particular scheme or transport solution, it is nevertheless an excellent process operating in the public interest. They add that a key question for the NTS Review is the appropriate level of scrutiny and governance of Scottish Government schemes.
- Fife Council commented that they believed the transport appraisal process in Scotland should be amended to ensure a higher weighting is given to carbon savings in comparison to other savings such as time savings. The Timber Transport Forum believed that current appraisal guidance does not support rural infrastructure modernisation and hence will not support delivery of an inclusive Scottish economy.

Freight

- The Road Haulage Association commented that, overall they found the current Governance structure effective and accessible, though they believed a more national approach to Scotland's road network is required in order to create a shared standard. They further suggest creating institutional arrangements to allow equal funding for roads to achieve a consistent approach and standard across the country.
- Providing a sector-specific comment, the Timber Transport Forum argued that forestry and agriculture strategies are set nationally but rely on local roads which are a local authority responsibility. They believe there is not a sufficient formal mechanism to relate the two. They describe a scenario where proposals for forestry planting schemes to meet national objectives are declined because the local infrastructure does not support them.

Disruptive technologies

- The Scottish Taxi Federation stated that there are many levels of national and local authority that duplicate effort in terms of strategy development, with little observable real-world change. They highlight their own area of traditional public hire taxis versus the more recent shared economy app operator model (e.g. Uber) as one where the regulatory approach is slow-moving and lags far behind reality.
- SESplan highlight that there are opportunities through improved regional transport planning arrangements to improve access to and integration of multi-modal transport networks, but that consideration needs to be given as

to how the management of transport network and promotion of modal options will align with digital developments.

6.2 Uncertainties in the evidence received for transport governance

The themes highlighted above to some extent all represent uncertain areas with limited compelling evidence provided to support the arguments made. However, there are some specific areas that were contested or where particular uncertainties were themselves highlighted by respondents in their submissions:

- In the most general sense, submissions received during the call have highlighted considerable uncertainty as to how governance arrangements can contribute to transport outcomes (e.g. what models of governance encourage modes to operate efficiently and in an integrated manner, ensure that the infrastructure operates efficiently, or make best use of private sector innovations to realise gains). There was more evidence apparent from submissions received in the call that a given set of governance, legislation or funding arrangements will deliver a set of desired *outputs* more effectively or efficiently than another, but uncertainty exists over whether the same set of conditions will generate the desired *outcomes* in different contexts.
- Some submissions highlighted the way in which transport governance and finance has been reformed in England, where transport is now planned and funded by Strategic Transport Boards (beneath these Boards a two-tier local government structure still exists). The effect of these new arrangements on outcomes – or what Scotland could learn from this restructuring – is not yet clear.
- As discussed in relation to other question areas, uncertainties over the degree of regulation applied to public transport (chiefly, bus) which best supports desired transport outcomes was disputed between responses.
- There were some references to the idea that there is no one-size-fits-all solution to transport governance. This is particularly evident with respect to island jurisdictions where a key question raised was whether they could do more to achieve the local outcomes they want were they able to manage their own resources and have additional powers as a transport operator.

6.3 Gaps in the evidence received for transport governance

Due to the nature of the responses received to this question area, it is not possible to easily highlight the gaps in governance evidence in the same manner as has been done for other questions in the call.

Overall, the most pertinent gap in evidence received in this area can be characterised as a lack of evidence that reviews what governance and institutional arrangement have/have not worked well in achieving transport outcomes before, why they have worked (or not), and what could be done to make them work better.
As already noted, there is some evidence that shows that cities and regions that deliver certain outputs effectively (for example, integrated multimodal public transport) tend to have a common package of governance with a resourced public

sector body that has legal powers to plan, procure, or directly provide that transport. However, even then, outcomes can differ depending on context and whether outcomes are realised is dependent on existing travel patterns. Formal research on some of these questions on differing governance contexts is something that researchers have highlighted as receiving insufficient attention in the transport literature.

Example: Marsden G, Reardon, L. Questions of Governance: Rethinking the Study of Transportation Policy. Transportation Research Part A: Policy and Practice. 2017. Available from: http://eprints.whiterose.ac.uk/116788/

7. Potential changes in society and technology

Question: In the next 20 years, what will be the most significant changes and new technologies influencing the way people live, work and consume that will impact on travel behaviour and demand? Are there examples of places that have already experienced some of this change and therefore provide evidence on how travel behaviour might change in Scotland? How can uncertainties about the future be robustly considered in transport strategy development?

7.1 Themes in the evidence received for potential changes in society and technology

Submissions received that responded to this question theme were limited in the volume of evidence they provided (e.g. few respondents provided examples in the form of places that had already experienced change) and primarily took the form of statements and arguments over possible future directions for society and technology.

The submissions placed most emphasis on vehicle propulsion technology, specifically electric vehicles (from micro hybrid to full battery) and some mention of hydrogen fuel cells. Typically, less was received on freight and public transport vehicles, service innovations (such as MaaS, shared autonomous vehicles or digital services) or on societal changes.

Nevertheless, some submissions did respond to this theme to emphasise that new technology should not just concern vehicle technology, but also concern new ways of using data, for example: to plan and promote active travel and e-bikes; digital railways; smart parking; car clubs; guided bus schemes; autonomous public transport; and cleaner, autonomous ships.

Example: van Duivenbooden, T, Little C. Delivery of Cycling Infrastructure: using geospatial information to identify and prioritise projects. 2017. Scottish Transport Applications and Research Conference. Available from: http://www.starconference.org.uk/star/2017/Little.pdf

Fraifer M, Fernstrom M. Investigation of smart parking systems and their technologies. 37th Int. Conf. on Information Systems, Dublin. 2016. Available from: http://iot-smartcities.lero.ie/wp-content/uploads/2016/12/Investigation-of-Smart-Parking-Systems-and-their-technologies.pdf

Submissions emphasised that the technology is only a means to an end, not an end in itself, and stressed that it was important to set strategic objectives for what the technology will enable. Electric propulsion and autonomous vehicles may not in themselves address congestion, for example.

Many submissions identified shared transport as having potential to 'unlock underused capacity' as well as address supply constraints in less densely populated areas and for the first and last mile of trips.

Responses emphasised the need to consider the equity implications of technological solutions across a whole range of societal objectives. As also mentioned under the environment theme, one submission provided analysis using recent data to show how geographically uneven the uptake of electric vehicles has been in Scotland to date.

Example: Morton C. The Geographical Variation in the Market for Electric Vehicles in Scotland: The 2015 Outlook. Policy Briefing from Climate X Change centre. 2017. Available from: http://www.climatexchange.org.uk/files/6814/4465/9453/Exploring_the_Spatial_Demand_for_Electric_Vehicles_in_Scotland.pdf

Although strong supporting evidence was not provided, concerns were expressed about policies to accelerate the uptake of electric vehicles and the necessity of considering the impact on public transport use if such technology (potentially supported by shared 'on demand' services) alters the relative attraction of individual transport for those that can afford it, at the expense of public transport. However, it was also noted that connected and autonomous vehicles have the potential to bring mobility to those who would not be mobile otherwise.

While e-bikes were raised as a technological advance that may enable more active travel journeys, they were also noted as potentially unaffordable and unattractive in more deprived areas, reflecting a broader concern that technological innovations have the potential to concentrate benefits in already advantaged and wealthier population groups.

Submissions highlighted several social and demographic trends that will influence travel demand. This included an ageing population with more individuals living longer with a greater prevalence of potentially mobility-limiting conditions (leading to increased transport demand related to social care); more general pressures of increased population growth; and changing societal preferences leading to an increased demand for a variety of transport, including freight to support preferences for online shopping.

7.2 Uncertainties in the evidence received for potential changes in society and technology

By definition, all the themes that emerged on future technologies and societal trends are uncertain. Due to the range and nature of the responses to this question area, there was little that was directly contested between submissions. Few submissions were accompanied by a strong evidence base and hence tended to be speculative in relation to what changes we are likely to see.

Research and Evidence Group members are aware that there are many journal articles (outside of those received during the call for evidence) on the 'theory' of smart parking, digital railway, shared services and a wide range of other technological developments. All of these new technologies need to be assessed in the light of the specific context in Scotland with respect to geography, future population and employment patterns, global tourism trends, and social and demographic trends. There were specific requests in the submissions received to look at and evaluate areas of population growth strategically at the national level and not leave this to Local Authorities and developers. There is some uncertainty about where this population growth will be but also where it needs to be given projected structuring of the economy and priority capacity and capability sectors.

Example: Royal Town Planning Institute. Planning and Tech: Planning for the growth of the technology and advanced manufacturing sectors. 2016. Available from: http://www.rtpi.org.uk/media/1720882/Planning%20and%20tech%20-%201.3.16.pdf

An area that attracted a lot of attention in the submissions received in this area was the sharing economy and the need to assess how Scotland can enable disruptive services without harming existing ones, though little high quality evidence was provided.

Example: PWC. Shared benefits: How the sharing economy is reshaping business across Europe. 2016. Available from: http://www.pwc.co.uk/issues/megatrends/collisions/sharingeconomy/future-of-the-sharing-economy-in-europe-2016.html

Enablement of shared taxis, on demand delivery services and other MaaS approaches may be to the detriment of existing services. However, the argument for and against protecting conventional services in the face of a new future of mobility services needs to be assessed alongside an evaluation of geographical and social specific contexts. Submissions asserted that such services may be used to improve access to less accessible communities, although other submissions caution that services may accumulate benefits in more advantaged communities. How to maximise benefits and minimise these risks is subject to uncertainty and brings a range of challenge around governance, integration and inclusivity and accessibility. Beyond the evidence received to the call, these issues are receiving growing international focus and as a result, research is emerging on the different ways such services may be enabled, governed and accelerated.

Freight transport was identified in many ways as a challenging sector for technological improvements, and perhaps especially so in Scotland given the rural network that supports many freight movements. The uncertainty in responses received to the call highlights the need to open up discussion on what the particular technological challenges and solutions are in this context, including road (including the size and length of vehicles), shipping, rail and logistics.

Example: International Energy Agency. The Future of Trucks: Implications for Energy and Environment. International Energy Agency. 2017. Available from: https://www.iea.org/publications/freepublications/publication/TheFutureofTrucksImplicationsforEnergyandtheEnvironment.pdf

Responses also highlighted the uncertainty caused by changed and changing preferences in consumer behaviour, including the increasing role of internet shopping. Questions were raised over the role policy can play in shaping trends in the market and what future scenarios with substantially different consumer preferences will mean for transport (e.g. will preferences for online shopping continue to exacerbate bus decline and increase light goods vehicle movement).

Some submissions discussed a range of uncertainties surrounding the role of autonomous vehicles: their infrastructure requirements; consumer acceptability; ethical and legal issues (e.g. in the event of collisions); and security and safety risks relating to the vulnerability of automated systems being compromised.

Example: Transport Research Laboratory Fellows. TRL Academy, Transport 2020: Addressing Future Mobility Needs. A Report on the Discussion help by the TRL Fellows in December 2016. Available from: https://regmedia.co.uk/2017/07/14/trl_fellows_whitepaper.pdf

Finally, as noted in the previous section, less evidence was received on alternative propulsion technology for vehicles other than the private car. With respect to bus technology in particular, there is uncertainty over the affordability of electric and hydrogen systems, their value for money and performance compared new diesel technology, and whether such new technology might attract people back to the bus.

Example: Low Carbon Vehicle Partnership. Any journey is greener by bus: Passenger experiences of modern bus services. 2017. Available from: https://greenerjourneys.com/wp-content/uploads/2017/02/LowCVP-Green-Bus-Dec-WEB.pdf

7.3 Gaps in the evidence received for potential changes in society and technology

In essence, all the themes and uncertainties identified in sections 7.1 and 7.2 are gaps as they require some concerted evaluation of the evidence (such that it exists) in the Scottish context in order understand the issues. Looking beyond the evidence received to the call, there is evidence in the form of modelled and theoretical literature across all the technological areas discussed in this section. However, to make use of this evidence requires matching it with what is thought to be the main demographic and economic issues and future population trends in Scotland. Hence, for the purposes of the NTS Review, the most significant gap in this area appears to be thinking through what kind of strategic support is required to enable (and accelerate, where it is considered appropriate) the uptake of these services while considering how to ensure accessibility, equity, and security and safety.

Annex 1: List of respondents to the call

Respondent	Respondent type
Adrian Davis (Associate Research Fellow, Transport Research Institute, Edinburgh Napier University)	Academic
Andrew Fraser	Individual
Caroline Mullen (Institute for Transport Studies, University of Leeds)	Academic
Carplus Bikeplus	Third Sector Delivery Bodies
CH2M	Private Sector
Chris De Gruyter (Institute of Transport Studies, Monash University)	Academic
Citizens Advice Scotland (CAS)	Third Sector Delivery Bodies
City of Edinburgh Council	Local Authority
Clare Linton (Urban Transport Studies Group)	Academic
Community Transport Association Scotland	Voluntary, Social Economy or Community Groups
Confederation of Passenger Transport UK - Scotland	Private Sector
Craig Morton (Institute for Transport Studies, University of Leeds)	Academic
Cycling Scotland	Third Sector Delivery Bodies
David Ogilvie (MRC Epidemiology and UKCRC Centre for Diet and Activity Research (CEDAR), University of Cambridge)	Academic
Delting Community Council	Voluntary, Social Economy or Community Groups
Fife Council	Local Authority
FirstGroup plc UK Bus Division	Private Sector

Respondent	Respondent type
Freightliner Group Limited	Private Sector
Glasgow Centre for Population Health	Other Public Bodies
Glasgow City Council	Local Authority
Grant Thornton LLP	Private Sector
Helen Cairns (Youth Development Officer, Golspie High School)	Individual
HITRANS	Regional Transport Partnership
Iain Docherty (University of Glasgow)	Academic
Institute of Economic Development	Other
Institution of Civil Engineers - Scotland	Other
jogscotland	Other
Kate Pangbourne (Institute for Transport Studies, University of Leeds)	Academic
Lee Woods (University of Portsmouth)	Academic
Lothian Buses	Other
MRC/CSO Social and Public Health Sciences Unit (SPHSU), University of Glasgow	Academic
Network Rail	Other Public Bodies
NHS Ayshire and Arran Public Health	Other Public Bodies
NHS Grampian	Other Public Bodies
NHS Greater Glasgow & Clyde Travel Plan Office	Other Public Bodies
NHS Health Scotland	Other Public Bodies
North Ayrshire Council	Local Authority
North of Scotland Public Health Network	Other Public Bodies

Respondent	Respondent type
Office of the Chief Economic Adviser, Scottish Government	Other Public Bodies
Officers of the Seven RTPs of Scotland	Regional Transport Partnership
Paths for All	Third Sector Delivery Bodies
RMT (National Union of Rail, Maritime and Transport Workers)	Other
Road Haulage Association	Private Sector
Royal Geographical Society with IBG and the Association of Geographic Information	Other
Royal Town Planning Institute	Other
Scottish (Managed) Sustainable Health Network (SMaSH), Scottish Directors of Public Health (SDsPH) and the Scottish Health Promotion Managers (SHPM)	Other Public Bodies
Scottish Association for Public Transport	Action or Campaign Group
Scottish Health and Inequalities Impact Assessment Network	Other Public Bodies
Scottish Hydrogen and Fuel Cell Association	Other
Scottish Natural Heritage (SNH)	Other Public Bodies
Scottish Taxi Federation	Private Sector
Scottish Transport Studies Group (STSG)	Other
SESplan (Strategic Development Planning Authority for Edinburgh & S.East Scotland)	Other Public Bodies
SESTran	Regional Transport Partnership
Society of Chief Officers of Transportation in Scotland (SCOTS)	Local Authority
SPT	Regional Transport Partnership
Sustrans Scotland	Third Sector Delivery Bodies
Timber Transport Forum	Private Sector

Respondent	Respondent type
Tom Hart	Individual
Transform Scotland	Action or Campaign Group
Transport for the North	Other Public Bodies
Transport Research Institute, Edinburgh Napier University	Academic
Transport Systems Catapult	Other
Unite Scotland	Other
Visit Scotland	Other Public Bodies
ZetTrans / Shetlands Islands Council	Regional Transport Partnership

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