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[Department  
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Corporate report

# Areas of research interest 2023

Updated 13 April 2023

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# Foreword by DfT's Chief Scientific Adviser and Chief Analyst

Welcome to this 2023 update of DfT's Areas of Research Interest (ARI), building on the positive reception we received from our previous ARI publications.

DfT is a strongly evidence-based department, bringing in expertise at all levels. This expertise is delivered through many different mechanisms, including project steering boards to help steer individual pieces of work, delivery of specific projects and advice through directly commissioned work or competitions, or through strategic boards such as our [Science Advisory Council](https://www.gov.uk/government/groups/dft-science-advisory-council) (<https://www.gov.uk/government/groups/dft-science-advisory-council>) or our [Joint Analysis Development Panel](https://www.gov.uk/government/groups/transport-appraisal-and-strategic-modelling-division#jadp-annual-reports) (<https://www.gov.uk/government/groups/transport-appraisal-and-strategic-modelling-division#jadp-annual-reports>).

This document covers science and analysis, which are core to DfT decision-making, helping ensure transport policies and investments meet DfT's strategic priorities, such as growing the economy and reducing environmental impacts.

DfT has 5 strategic priorities.

1. Grow and level up the economy, ensuring transport fulfils its growth potential though improving connectivity across the United Kingdom and enhancing the transport network, on time and on budget.
2. Improve transport for the user, building confidence in the transport network and improving transport users' experience, ensuring that the network is safe, reliable, and inclusive.
3. Reduce environmental impacts, tackling climate change, improving air quality, biodiversity and ensuring the transport system adapts to be resilient to the effects of climate change.
4. Increase our global impacts, boosting our influence and maximising trade by having an innovative, outward-facing approach.
5. Be an excellent department, to ensure DfT is a department that continuously improves its delivery, and where people feel well supported, are able to reach their potential, learn and enjoy working.

Scientific evidence and advice are essential to achieving these priorities, enabling us to deliver our programme of work effectively, efficiently, and at pace needed to respond to challenges along the way.

This updated ARI sets out our strategic evidence and research needs for the medium- to long-term by listing the priority research questions against each of our strategic priorities. This will support our ambition (under 'be an excellent department') for all parts of DfT to work with the wider transport research community to help meet these ambitions and successfully tackle the challenges and opportunities ahead.

This document describes both the ‘bottom up’ specific questions which have emerged directly from policy teams, and some co-designed higher level strategic questions which group these issues, aiming to influence larger, cross-cutting initiatives.

This document is the tool by which we will communicate and engage with the transport (and wider) research community. We continue to invite the UK’s research community to actively engage with us and align your research programmes with the priority areas outlined in this document.

**Sarah Sharples, Chief Scientific Adviser**

**Amanda Rowlatt, Chief Analyst**

## Executive summary

This document provides both a high-level steer and some more detailed analysis of DfT’s Areas of Research Interest. The aim is to provide an insight into DfT’s research and evidence priorities, enabling the wider R&D community to engage with DfT and target their research to have maximum impact.

Priority research questions have been identified for each of DfT’s strategic priorities. These have been created and agreed with policy and delivery leads for each area.

### Summary of the priority research questions in our areas of interest

DfT strategic priority	Priority questions
<b>Improve transport for the user</b>	How can we ensure the transport system is putting <b>users</b> at its heart?
	How do we prepare for the potential impacts of <b>emerging technologies</b> ?
	How do we ensure the transport system is <b>safe, secure, and resilient</b> ?
	How can we enable smoother multi-mode journeys, including more active travel?
	How will social and economic changes influence how people use transport?
<b>Reduce environmental</b>	What are the new <b>technological innovations</b> needed to reduced transport’s environmental impacts, including

## DfT strategic priority

## Priority questions

### impacts

decarbonisation, adaptation, air quality, and biodiversity?

How can existing technologies be **accelerated and scaled up** to achieve our environmental goals, including decarbonisation, adaptation, air quality, and biodiversity?

What **behaviour change** will be required to meet our environmental goals (decarbonisation, adaptation, air quality, and biodiversity), and how can this be achieved?

What are the **systems-level requirements** to achieve our environmental goals to ensure the transport system is both efficient and resilient?

### Grow and level up the economy

How can **investment in future transport infrastructure** (for example, high speed rail) lead to accelerated change in the economy and subsequent levelling up?

What interventions will continue to restore **traveller confidence** and drive mode shift towards public transport use?

What **incentives** encourage certain types of travel behaviour and why? How can this be utilised to achieve government levelling up objectives?

### Increase our global impact

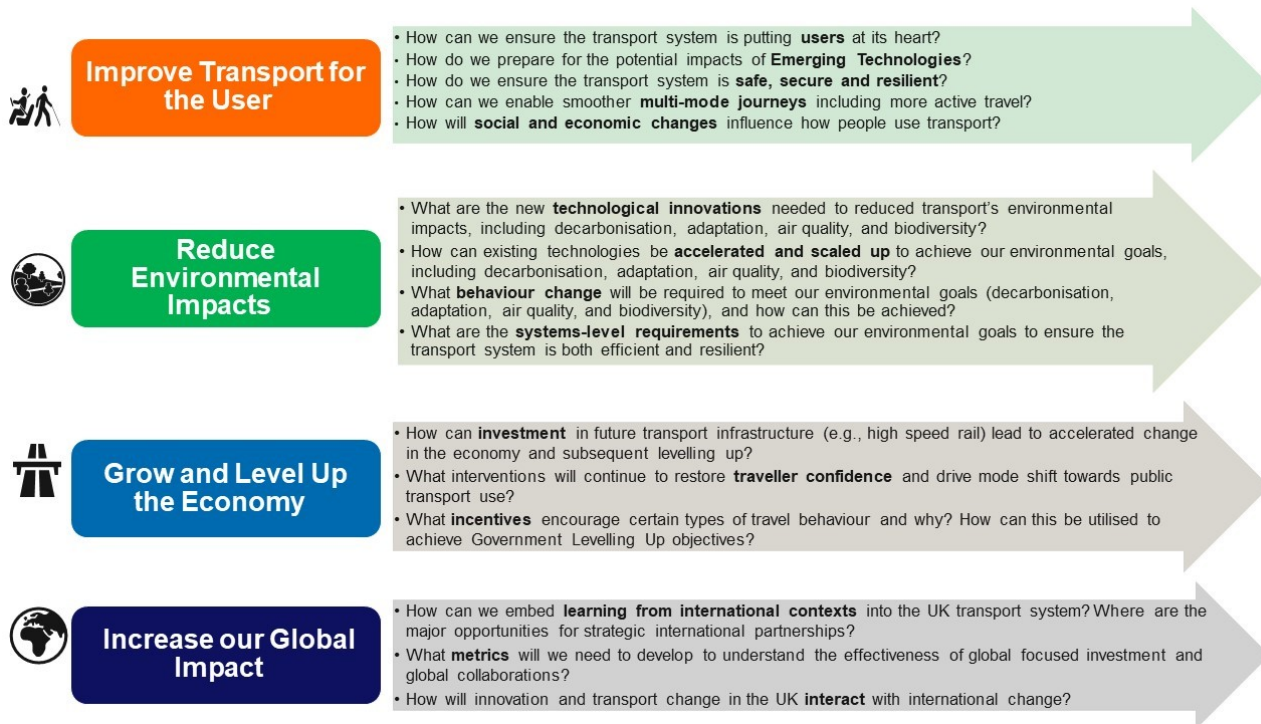
How can we embed **learning from international contexts** into the UK transport system?

Where are the major opportunities for strategic international partnerships?

What **metrics** will we need to develop to understand the effectiveness of global focused investment and global collaborations?

How will innovation and transport change in the UK **interact with international change**?

Figure 1 Summary of DfT priority research questions



DfT are keen to discuss and engage with academic and industry researchers on these questions, via the [BridgetoResearch@dft.gov.uk](mailto:BridgetoResearch@dft.gov.uk) mailbox.

## Purpose

This updated Areas of Research Interest (ARI) builds upon DfT's 2021 ARI to provide an updated account of our priority research and evidence needs. The document is not intended to be a list of projects or invitations for contracts, but a list of research themes and priorities for DfT, in particular those with a medium- to long-term focus.

The purpose of this document is to communicate a summary of DfT's research and evidence needs with researchers outside the department, providing transparency and clarity and inviting collaboration. This will enable:

- external research organisations to understand and align with DfT's priorities, maximising the opportunity for research impact and encouraging research capacity to grow in priority areas of interest
- an increase in the number, disciplinary background, and diversity of DfT's R&D delivery partners
- more partnerships with other funders and research programmes, enabling research to be delivered more collaboratively and efficiently, working together towards shared goals
- a more robust evidence base, strengthening DfT's decision-making, ensuring public money is spent efficiently, policies are well-targeted, uncertainty is reduced, and anticipated benefits are achieved

This ARI sits alongside [DfT's Science Plan](https://www.gov.uk/government/publications/department-for-transport-science-plan) (<https://www.gov.uk/government/publications/department-for-transport-science-plan>), which

sets out our ambition for the role of science in DfT strategy, policy and delivery. It identifies 3 areas for action:

- people: action to build a diverse and scientifically skilled workforce both within DfT and the broader transport sector
- partnerships: the necessity of working in partnership with policy, across government, and with the wider transport R&D sector to enable efficient and effective action at pace
- purpose: embedding science in DfT decision-making, ensuring focus on departmental purpose, and ensuring the right mechanisms to deliver impact

Please note that the shorthand ‘science’ is used to refer to the broad range of scientific activities across DfT, including natural sciences, social science, engineering, and innovation, sitting alongside analysis which includes economics, social and behavioural research, operational research, modelling, and statistics.

## Scope

This 2023 ARI has taken each of DfT’s strategic priorities and identified the key priority questions that sit under them. This provides a clear picture of DfT’s priorities and identified where we believe we can best work with the external research community to deepen our understanding and provide the evidence required to deliver real progress against our strategic priorities.

Alongside these research questions, the ARI continues to [list more detailed questions that have emerged directly from teams across DfT](#). These tend to be slightly more short-term and represent the topics where further research is most likely to have an immediate positive impact on policy.

The purpose of this ARI is not to constrain the research done but to provide clarity and guidance on our priorities. DfT’s research and evidence requirements are extensive and continue to evolve. Neither the priority research questions, nor the more detailed questions represent an exhaustive list of our needs; it is simply intended to open conversations. Research outside the areas outlined below may still be relevant to DfT policy or delivery.

## DfT’s use of evidence

Research and evidence are critical to robust policy and delivery and DfT has a strong history in the use of evidence to support policymaking.

## How DfT generates and uses research evidence and expertise

Of all the evidence DfT uses, the smallest proportion is directly commissioned. We also work with the broad transport R&D sector to influence and collaborate on



external research programmes, and most importantly we identify, understand, and exploit existing research and expertise.

## 1. Exploit existing evidence, research and expertise

This stage forms the basis for our understanding and largest proportion of our research activity. We do this via:

- DfT's [Science Advisory Council \(https://www.gov.uk/government/groups/dft-science-advisory-council\)](https://www.gov.uk/government/groups/dft-science-advisory-council)
- direct engagement and calls for evidence
- literature reviews

## 2. Influence and collaborate with others

In this stage we identify existing areas of research and engage external colleagues via:

- DfT's [Transport Research and Innovation Board \(https://www.gov.uk/government/groups/transport-research-and-innovation-board\)](https://www.gov.uk/government/groups/transport-research-and-innovation-board)
- partnership with UK Research and Innovation
- shared priorities with other funders
- engagement with academic consortia and external events

## 3. Commission research

And finally, the smallest proportion of our research are commissions. We do this through:

- directly commissioning via open competitions or framework agreements
- grants to enable long term partnerships
- sponsorship of individuals through fellowships, internships and PhDs
- in-house research and analysis

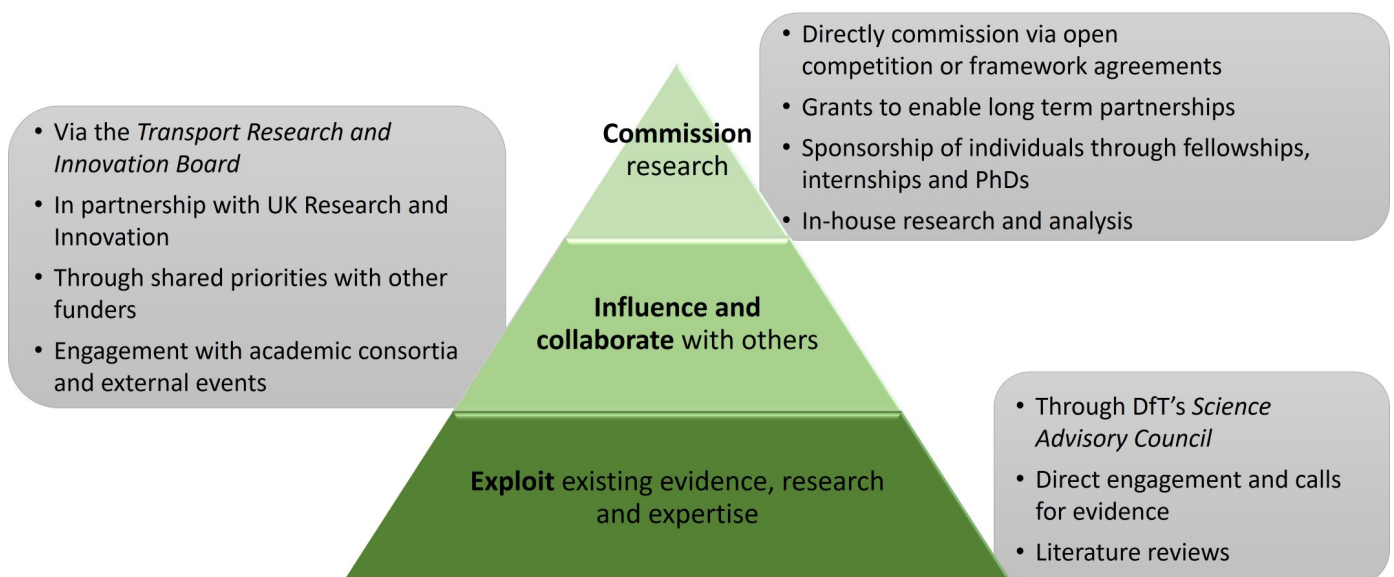


Figure 2 - graphic of how DfT generates and uses research evidence and expertise



DfT covers an extensive range of policy areas, so the evidence we use is varied and requires a breadth of methodologies, including:

- reviewing and synthesising existing evidence, research, and expert knowledge
- conducting secondary analysis / meta-analysis of existing data sources
- new evidence generation, both qualitative and quantitative
- developing analytical tools for modelling and forecasting
- evaluating policies and investment programmes
- monitoring and surveillance
- data analytics and data visualisation
- research and development projects to prove concepts and test ideas
- trials, pilots, living labs and demonstrators

There is much transport can learn from other parts of the transport system (for example, sharing learning across modes) and from other disciplines beyond the transport realm. Innovations in methodologies, processes and techniques often come from adjacent or even completely unrelated fields. We are therefore keen to engage and work with disciplines beyond traditional transport research and analysis providers, and to work with inter-disciplinary groups which can better reflect the increasing interconnectedness of the transport system's evidence needs.

## Role of DfT arm's length bodies

DfT arm's length bodies (ALB) are a critical element to the effective delivery of DfT's ambitions and the smooth running of the transport system. While our ALBs have their own considerable research and development needs and activities, we work closely together to understand each other's challenges, R&D priorities and to identify potential synergies. Their evidence and research needs are not captured in this ARI as they have their own processes for engaging the community. To find out further details on their research priorities, please use the links below:

[Active Travel England - about page](https://www.gov.uk/government/organisations/active-travel-england/about)

(<https://www.gov.uk/government/organisations/active-travel-england/about>)

[DVLA - about page](https://www.gov.uk/government/organisations/driver-and-vehicle-licensing-agency/about) (<https://www.gov.uk/government/organisations/driver-and-vehicle-licensing-agency/about>)

[Research at DVSA](https://www.gov.uk/government/organisations/driver-and-vehicle-standards-agency/about/research) (<https://www.gov.uk/government/organisations/driver-and-vehicle-standards-agency/about/research>)

[National Highways innovation and research](https://highwaysengland.co.uk/industry/innovation/)  
(<https://highwaysengland.co.uk/industry/innovation/>)

[HS2 contact](https://www.hs2.org.uk/in-your-area/contact-us/) (<https://www.hs2.org.uk/in-your-area/contact-us/>)

[ORR contact](https://www.orr.gov.uk/contact-us/) (<https://www.orr.gov.uk/contact-us/>)

[MCA about page](https://www.gov.uk/government/organisations/maritime-and-coastguard-agency) (<https://www.gov.uk/government/organisations/maritime-and-coastguard-agency>)

## [Network Rail, Research Development and Innovation](https://www.networkrail.co.uk/industry-and-commercial/research-development-and-technology/)

[\(https://www.networkrail.co.uk/industry-and-commercial/research-development-and-technology/\)](https://www.networkrail.co.uk/industry-and-commercial/research-development-and-technology/)

[VCA Get in touch \(https://www.vehicle-certification-agency.gov.uk/get-in-touch/\)](https://www.vehicle-certification-agency.gov.uk/get-in-touch/)

## Work with us

We welcome engagement from across the R&D community in the UK and beyond to discuss opportunities to work together on the research interests set out here. Please contact the 'Bridge To Research' mailbox ([BridgetoResearch@dft.gov.uk](mailto:BridgetoResearch@dft.gov.uk)) to get in contact with the relevant policy leads. Note: the address is not for queries relating to open procurements, research competitions or for those seeking unsolicited funding.

## DfT's strategic priorities

Transport is fundamental to where people live, where they work, where they socialise; it is an essential enabler of business. DfT plans and invests in transport infrastructure to keep the UK on the move.

DfT has 5 strategic priorities that sit at the heart of DfT decision-making. The plan for achieving these is outlined in DfT's [Outcome Delivery Plan \(https://www.gov.uk/government/publications/department-for-transport-outcome-delivery-plan/dft-outcome-delivery-plan-2021-to-2022\)](https://www.gov.uk/government/publications/department-for-transport-outcome-delivery-plan/dft-outcome-delivery-plan-2021-to-2022).

### Our 5 strategic priorities

#### **Grow and level up the economy**

Grow the economy and improve connectivity across the United Kingdom by enhancing the transport network, on time and on budget.

#### **Improve transport for the user**

Build confidence in the transport network and improve transport users' experience, ensuring that the network is safe, reliable, and inclusive.

#### **Reduce environmental impacts**

Tackle climate change and improve air quality by decarbonising transport, mitigating wider environmental impacts, and ensuring the transport system is resilient to climate-related change.

#### **Increase our global impact**

Boost our influence and maximise trade by having an innovative outward-facing approach.

## Be an excellent department

Be a well-run department that focuses on delivery, demonstrating excellence in transport policy, driving value for money, and embodying our values in all that we do.

# DfT's priority research questions

Research and evidence are crucial to driving progress against these strategic priorities. Working with the senior responsible owner for each strategic priority, we have identified the priority research questions for each. These are the strategic, medium- to long-term questions that will be crucial to their successful delivery.

## Improve transport for the user

Improve Transport for the User



The improve transport for the user strategic priority is critical in ensuring the department delivers and maintains a transport system that meets the needs of the public and addresses what they care about most.

It puts the needs and expectations of current and potential users (both passengers and freight customers) at the heart of the operation of the transport system and considers about end-to-end journeys, not just individual transport modes. It is focused on ensuring that our infrastructure and the services which use it meet the varied needs of businesses and the public, are attractive, affordable, sustainable, and resilient is a crucial goal for the department.

### Question 1. How can we ensure the transport system is putting users at its heart?

For example:

- How do we best understand and measure user experience and accessibility and embed this into decision-making?
- How can we understand how new solutions work in a local, real-world setting including considerations around how the general modern-day workforce will look?
- How do we design the transport system to work for users in urban, peri-urban and rural areas?
- How can we effectively consider end-to-end journeys to ensure the system is designed for the user?

- How do we ensure development of transport systems considers the needs of the business community and the supply chain?
- How do we ensure equity within the transport system, including enabling fair access to novel technologies and environmentally sustainable options?

## **Question 2. How do we prepare for the potential impacts of emerging technologies?**

For example:

- How should we prepare the transport system to both incorporate beneficial new technologies and become resilient to those that pose risk?
- How can we harness AI and Machine Learning to deliver improved transport services nationally and locally?
- How do we effectively transition new technologies into the transport system, so they benefit and are accepted by users?

## **Question 3. How do we ensure the transport system is safe, secure, and resilient?**

For example:

- How can we best understand and improve the safety of vulnerable users, including women, on the transport system?
- How should we continue to enhance the safety of operators of vehicles and the transport system?
- What are the security and resilience threats we face; how can we better anticipate these and what evidence do we need to inform decision-making? For example, those from Position Navigation and Timing, digitisation/cyber, artificial intelligence and autonomy, security systems, and climate change.
- How can we improve the resilience of the transport system while maintaining efficiency?

## **Question 4. How can we enable smoother multi-mode journeys, including more active travel?**

For example:

- How can we encourage more active travel? What are the safety barriers to this and how can they be overcome?
- How can we ensure the transfers between modes (for example, from rail to bus, or from public transport to active travel) are smoother?
- How can user's accessibility needs be adequately catered for in transfers between modes?

## **Question 5. How will social and economic changes influence how people use transport?**

For example:

- What changes are likely to produce behaviour change and how are these likely to impact the user (including the public, businesses, and supply chains)?
- How should government best anticipate and monitor societal and economic changes and their impact in the future?

## Reducing environmental impacts

**Reduce Environmental Impacts**



The reducing environmental impacts strategic priority is in recognition that there is an environmental aspect to all transport, and therefore almost all the work of DfT. Transport is the largest emitting sector of greenhouse gases in the UK, contributing 27% of domestic emissions in 2019. Our transport system must change to deliver the government's Net Zero ambition and DfT will drive forwards that change through our longer-term green transport agenda.

On decarbonisation specifically, we published our [Transport decarbonisation plan \(TDP\)](https://www.gov.uk/government/publications/transport-decarbonisation-plan) (<https://www.gov.uk/government/publications/transport-decarbonisation-plan>) in July 2021, which sets out the steps we will take to deliver the necessary carbon reductions across every form of transport. Sustainability will be at the heart of levelling-up. People everywhere will feel the benefits – villages, towns, cities, and countryside will be cleaner, greener, healthier and more prosperous and pleasant environments in which to live and work

### **Question 1. What are the new technological innovations needed to reduce transport's environmental impacts, including decarbonisation, adaptation, air quality, and biodiversity?**

For example:

- What are the best-fit and cost-effective technology pathways to meet our [Transport decarbonisation plan](https://www.gov.uk/government/publications/transport-decarbonisation-plan) (<https://www.gov.uk/government/publications/transport-decarbonisation-plan>) and our adaptation, air quality, and biodiversity goals?
- Where are there potential synergies and/or conflicts between our different environmental goals and how can they be overcome?
- What innovation is required to support more difficult to decarbonise modes, such as HGVs, maritime, and aviation?
- How can new technologies be used and integrated to ensure the removal of embodied carbon in transport infrastructure?

**Question 2. How can existing technologies be accelerated and scaled-up to achieve our environmental goals, including decarbonisation, adaptation, air quality, and biodiversity?**

For example:

- What is the capacity of these technologies to be scaled up/accelerated/moved up the TRL scale?
- What are the challenges, including regulatory barriers, and how can they be overcome?
- What can the government do to support commercialisation?
- What regulation, safeguarding, or guidance is required to embrace new technologies into the existing network?
- What are the challenges of implementing technology solutions at scale, and how can they be overcome?

**Question 3. What behavioural change will be required to meet our environmental goals (decarbonisation, adaptation, air quality, and biodiversity), and how can this be achieved?**

For example:

- What are the driving factors that encourage uptake of new technologies?
- How do people's behaviour and technology interact?
- How can people be encouraged and supported to make green choices when it comes to transport?
- How can technologies make lives better through changing the journeys people need to make?

**Question 4. What are the systems-level requirements to achieve our environmental goals to ensure the transport system is both efficient and resilient?**

For example:

- What are the demands by mode and as a system and how is this likely to change over time?
- What reduction is required and how can this best be achieved across the system?
- How best can transport be fully integrated into the energy system?
- What are the implications for our energy networks and how can these challenges be overcome?
- How can resilience to climate change be built into the transport system?

**Grow and level up the economy**

# Grow and Level Up the Economy



The grow and level up the economy strategic priority is at the heart of the government's agenda to spread opportunity across the UK. Transport has a crucial role to play, whether it be through improving connectivity across the United Kingdom and growing the economy by enhancing the transport network, on time and on budget. DfT has a number of specific interests in this space, notably our infrastructure projects, Places for Growth and our apprenticeships and skills work.

## **Question 1. How can investment in future transport infrastructure (for example, high-speed rail) lead to accelerated change in the economy and subsequent levelling up?**

For example:

- How can we build on current evidence bases to best ensure transport infrastructure projects are efficient, effective, and innovative?
- What transport interventions in both disadvantaged and left-behind places will make the biggest difference?
- What are the likely impacts of inter vs intra city transport investment on the wider economy?
- What impact does transport have on local skills and jobs?
- What can we learn from existing major infrastructure schemes?
- How can major infrastructure projects stimulate and support innovation?
- What impact does transport have on wellbeing and what are the conditions where new transport investment would have the biggest impact?
- What are the major economic opportunities in improving transport infrastructure?

## **Question 2. What interventions will continue to restore traveller confidence and drive mode shift towards public transport use?**

For example:

- How does this differ between different types of areas (for example, rural, urban, coastal, and peri-urban)?
- What is likely future demand for public transport in different areas, and what will influence this demand?
- What is the likely impact of emerging technologies on demand for public transport?



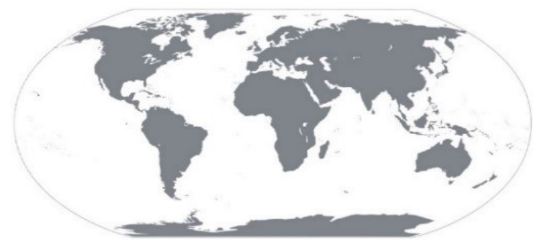
### **Question 3. What incentives encourage certain types of travel behaviour and why? How can this be utilised to achieve government levelling up objectives?**

For example:

- What are the options for funding public transport, especially larger projects and rail, to both ensure maintenance of key services and fair public access?
- How can price signals drive behaviour change? How do they relate to other potential levers?
- How do financial levers sit alongside other incentives? What is the right package of interventions to achieve desired outcomes?
- How does this differ between different user groups (public vs business)?

### **Increase our global impact**

**Increase our Global Impact**



Increasing our global impact recognises the UK's opportunities in the world and the importance of DfT contributing effectively toward the government's vision of a global Britain. Operating and engaging globally will play a vital role in assisting the department in maintaining and extending its influence with international partners, including ensuring high standards of transport safety, security, and environmental protection and boosting UK trade, exports, and inward investment.

UK science and innovation has the potential to develop transport-related exports and inward investment, thereby helping grow and level up the economy. Our R&D around climate change mitigation and adaptation can help influence the international community to take progressively stronger action.

### **Question 1. How can we embed learning from international contexts into the UK transport system? Where are the major opportunities for strategic international partnerships?**

For example:

- What are technologies being accelerated internationally that we will be able to adopt and adapt in the UK?
- Where do we need bespoke solutions for the UK setting?
- What opportunities do we have to lead internationally in transport science and innovation?
- How can we use UK evidence to influence international vehicle standards?
- How do we maximise the UK's trade exports from the investment in UK innovation and technologies as well as encourage inward investment?

- How can we utilise R&D in the transport sector to be a facilitator of international engagement and trade?

## **Question 2. What metrics will we need to develop to understand the effectiveness of global focused investment and global collaborations?**

For example:

- What data and information should be collected to deliver a solid evidence base and support policy decisions?
- What is the role of Environmental, Social and Governance (ESG) measurement in central and local government decision-making?
- To what extent do international indexes/ranking systems reflect the role of transport and its global impact/importance? Where are the opportunities, investments and interventions that could alter UK performance?
- How do we measure the success and impact of international science and innovation partnerships (including both quantifiable and not quantifiable)?

## **Question 3. How will innovation and transport change in the UK interact with international change?**

For example:

- When do we need to work with international colleagues to achieve our goals (for example, Net Zero)?
- What activities/contexts internationally do we need to understand to make significant progress in UK (for example, maritime, aviation)?
- How do we ensure we are aligned with changes internationally that will impact the transport system (for example, Energy systems and demand)?

## **Be an Excellent Department**

Our strategic priority of 'Be an Excellent Department' drives the way DfT works and determines the way in which we integrate analysis, science, and innovation into all our thinking and use the evidence base we develop, both directly, and through working with partners on the back of the ARI and other engagement activities. Being an excellent department extends to the work we commission and collaborate on externally and provides the evidence we are delivering value-for-money for the taxpayer.

Our strategic priorities cannot be delivered without effective supportive processes, technology, and people, in a way that works collaboratively with our partners and focuses delivery. Working closely and productively with the wider transport research community is an important part of this ambition.

# Detailed research and evidence need by DfT directorate

Beyond the priority research questions set out in the main body of the ARI, this section lists detailed research questions identified across a number of DfT's directorates. This is a long list, designed to give an insight into the evidence needs of the whole department in more of a "bottom-up" fashion and complement the more strategic questions already presented.

Please use the [BridgetoResearch@dft.gov.uk](mailto:BridgetoResearch@dft.gov.uk) mailbox if you would like to engage further on any of these questions.

All questions are presented next to the strategic priority they primarily relate to.

This list is also [available as an ODS spreadsheet on the GOV.UK landing page for this document \(https://www.gov.uk/government/publications/dft-areas-of-research-interest\)](https://www.gov.uk/government/publications/dft-areas-of-research-interest).

## Analysis Directorate

Number	Detailed research and evidence need	Strategic priority
1	What conditions need to be in place for transport investments to transform local economies? These conditions may relate to demographic factors, complementary investments, or government policies for example. What are the micro mechanisms that underpin how workers move across space due to better transport connections?	Grow and level up the economy
2	What are the micro mechanisms that underpin how workers move across space due to better transport connections?	Grow and level up the economy
3	How can we better capture the impacts of transport, including improvements to the appraisal of active modes, freight, and values of time in congested conditions and how these vary for different groups?	Improve transport for the user
4	Are the modelling techniques used in appraisal current and robust? Is this reflected in the department's guidance and tools that it provides to users?	Grow and level up the economy
5	How can we best develop the uncertainty tools and products referenced in the Uncertainty Toolkit? These will primarily be publication of the common analytical	Grow and level up the economy

Number	Detailed research and evidence need	Strategic priority
	scenarios in TEMPro, the revision of TAG Unit M4 and improving future proofing decision-making processes and their guidance across the department.	
6	What is the best way to maintain and develop the software suite that supports the development of business cases, such as Transport Users Benefit Appraisal (TUBA) and Wider Impacts in Transport Appraisal (WITA)? What is the best avenue to communicate the Department's methodologies to stakeholders?	Improve transport for the user
7	How do people perceive reliability, punctuality, and variance in journey time?	Improve transport for the user
8	How can we embed better evidence into our investment decisions, the impacts of investment on transport users and communities (including vulnerable and protected groups)?	Improve transport for the user
9	How can we ensure technologies and technology-based services are both developed around users and realise their wider social and economic benefits? Including autonomous vehicles; Mobility as a Service; new shared services; new business models for car ownership; and the use of data in transport.	Improve transport for the user
10	How are EVs changing the nature of the 'kerbside'; what technologies are available to meet the needs of parking, charging, home-deliveries, rideshare pick-ups/drop-offs, pedestrian, and cycle lanes?	Reducing environmental impacts
11	How far does journey time matter? Are their social interventions that enable public and active transport to compete with faster car transport alternatives?	Improve transport for the user
12	What are the key behavioural influences (either drivers or barriers) on active travel?	Reduce environmental impacts
13	How much does active travel for recreational purposes lead to people using active travel for work and other non-recreational purposes?	Reduce environmental impacts

<b>Number</b>	<b>Detailed research and evidence need</b>	<b>Strategic priority</b>
14	Do people who switch to active travel see benefits in broader health and wellbeing? Can longitudinal research establish or disprove a connection between outcomes?	Reduce environmental impacts
15	How can behavioural science be used to encourage people and organisations to make more sustainable travel choices?	Reduce environmental impacts
16	How can we encourage more sustainable travel behaviours?	Reduce environmental impacts
17	Which demographic groups are most car reliant? And which are public transport reliant?	Reduce environmental impacts
18	How do we reduce dependence on cars among demographic groups which are most reliant on them, through, for example, increasing access to public transport?	Reduce environmental impacts
19	What role does international travel play in people's understanding of their personal carbon footprint? How do people think about occasional large-emitting activities versus day-to-day small changes?	Reduce environmental impacts
20	How can we robustly model and value changes in land-use arising from transport interventions?	Grow and level up the economy
21	What tools can we best use to reflect Levelling Up objectives within transport appraisal: for example, improved data visualisation, local prosperity metrics, place-based analysis, or distributional weights.	Grow and level up the economy
22	What is the best way to capture the value to transport users and the wider population from improvements in the quality of the urban realm?	Improve transport for the user
23	What evidence is there of the value of Government or transport operator investment in transport data assets or data projects?	Grow and level up the economy

<b>Number</b>	<b>Detailed research and evidence need</b>	<b>Strategic priority</b>
24	What is the evidence of the emerging use and impact of novel/real time data sources to address transport issues at local or national levels, such as decarbonisation and levelling up?	Grow and level up the economy
25	With respect to journeys, what is the relative value for people of speed, cost, journey experience, well-being benefits, social interactions, and other factors?	Improve transport for the user
26	What can be learnt from experiences in the pandemic that informs the design and operation of future transport investment?	Improve transport for the user
27	What can we learn from the pandemic to help inform responses to future pandemics? And what are the implications of the pandemic for people's current and future travel behaviour?	Improve transport for the user
28	How have people's expectations and demands of public transport, active travel, road transport and aviation changed due to the pandemic and how durable are these changes? Is there a cohort effect – are young people's aspirations and values different to older generations?	Improve transport for the user
29	How can we develop a better understanding of what people want and need from their entire journey – their end-to-end journey from the moment they leave the house to the moment they arrive at their destination – covering rail, road and bus, parking, ticketing, etc? What are the implications for the transport system?	Improve transport for the user
30	What has the overall impact of COVID-19 been on sustainable travel behaviour? And what are the implications of more flexible/hybrid working and reduced commuting patterns; how can this work best for part-time commuters?	Reduce environmental impacts
31	How do people think about their environmental transport footprint? Are their perceptions of carbon emissions for different journeys accurate? What role does local air quality play in sustainable transport perceptions? How can the provision of information/knowledge about the environmental	Reduce environmental impacts

<b>Number</b>	<b>Detailed research and evidence need</b>	<b>Strategic priority</b>
	impact of travel choices bring about behaviour change?	
32	Are younger people deferring car use or are many of them never going to become drivers, unlike older generations? Are social norms for younger age groups changing?	Improve transport for the user
33	What are public expectations about changing costs and affordability of EVs relative to other cars and how are these changing over time? What are the social and distributional impacts around EV adoption?	Reduce environmental impacts
34	What is the user experience of charging infrastructure (and how does this interact with the decision to opt for an EV)? What are the social and distributional issues around access to charging?	Reduce environmental impacts
35	How are models of shared transport developing and evolving? What are the motivators for people to share transport?	Reduce environmental impacts
36	How are/should place-based programmes focus on improving active and sustainable travel infrastructure to improve town centres?	Reduce environmental impacts

## Aviation

<b>Number</b>	<b>Detailed research and evidence need</b>	<b>Strategic priority</b>
37	How are consumer and business attitudes and confidence towards international travel changing in the post-pandemic world and how will their behaviour evolve?	Improve transport for the user
38	What are the health impacts from aviation environmental emissions (for example, noise and air quality)?	Reduce environmental impacts
39	How do we ensure that the aviation sector is accessible and diverse - in terms of workforce skills	Improve transport for the



<b>Number</b>	<b>Detailed research and evidence need</b>	<b>Strategic priority</b>
	and the passenger experience?	user
40	How important is transport to trade flows? How might international trade evolve and how might this affect our transport network requirements?	Increase our global Impact
41	How can aviation best facilitate trade?	Increase our global Impact
42	How has COVID-19 impacted the financial resilience of UK aviation companies as well as the wider aviation supply chain, and what impact will this have on the Government's strategic objectives? Have these impacts modified the market structure or associated labour markets?	Grow and level up the economy
43	How should the way airports slots be allocated be reformed to make more efficient use of constrained airport capacity and support achievement of the Government's wider objectives?	Grow and level up the economy
44	How can we develop a more detailed understanding of the benefits that modernising UK airspace will bring, including carbon reductions, noise impacts, reduced delays, increased resilience, and increased capacity to allow for growth?	Reduce environmental impacts
45	What is the economic value of the different parts of the aviation sector, including 'general aviation', and what Government intervention will enable the sector to support innovation and skills development as the "grass roots" of the aviation sector?	Grow and level up the economy
46	How can we improve the provision of information; set standards; and use new technologies to improve aviation safety and security?	Improve transport for the user
47	How can we best use passenger charters and passenger representation to improve standards of service and improve passenger experience for aviation?	Improve transport for the user
48	What are the relative merits of existing, emerging, and future technologies in helping to decarbonise aviation? What adaptations will be required for the	Reduce environmental impacts

Number	Detailed research and evidence need	Strategic priority
	aviation sector to successfully adopt new zero-emission technologies?	
49	How can policy action best support decarbonisation of aviation? What is the most appropriate role for market-based measures compared to other policy measures? How should market based measures and other policy measures be designed to mitigate the risk of unintended consequences?	Reduce environmental impacts
50	What evidence exists to enable the DfT to further enhance its ability to forecast aviation GHG emissions and non-CO2 impacts and model the impact of potential policy action?	Reduce environmental impacts
51	How are the local environmental impacts of aviation evolving through time (for example, noise and air quality) and how can they best be mitigated?	Reduce environmental impacts
52	What are the long-term drivers for aviation demand as we recover from COVID-19 and are they different from pre-pandemic drivers?	Improve transport for the user
53	What are the definition and groups of new and emerging aviation technology? How will or could new and emerging aviation technology change travel patterns and demand, and fit in with the wider future of transport scenarios of seamless connectivity and living local?	Improve transport for the user
54	How can drones and other new technology be used safely and securely to open new opportunities; develop new markets; and deliver aviation services to realise their full potential in the UK and to deliver economic growth?	Grow and level up the economy
55	What are the benefits and risks of new and emerging aviation technology (for example, unmanned aircraft, advanced air mobility, etc.) to transport users?	Improve transport for the user
56	How will new and emerging aviation technology such as unmanned aircraft, advanced air mobility, provide environmental benefits or disbenefits and what environmental assessment techniques should be applied?	Reduce environmental impacts

<b>Number</b>	<b>Detailed research and evidence need</b>	<b>Strategic priority</b>
57	What is the market outlook for emerging aviation technologies and where should DFT prioritise its efforts to enable the UK's role in aviation?	Increase our global Impact
58	What are the infrastructure, airspace, regulatory and skills requirements for the emerging aviation technologies and what are the impacts of existing government interventions?	Grow and level up the economy
59	What are public/industry perceptions of emerging aviation technologies/services and how can these help inform government interventions?	Improve transport for the user
60	How is spaceflight in the UK developing and what evidence exists to inform DfT's role in the National Space Strategy?	Increase our global Impact
61	What is the potential for commercial human space travel in the long-term?	Grow and level up the economy
62	What is the space market outlook and where should DFT prioritise its efforts to enable the UK's role in the space industry?	Increase our global Impact
63	What are the infrastructure, airspace, regulatory and skills requirements for the UK space industry and what are the impacts of existing government interventions?	Grow and level up the economy
64	What are public/industry perceptions of space technologies/services and how can these help inform government interventions?	Improve transport for the user
65	What are the interdependencies between addressing different environmental impacts (for example, CO2 and noise)?	Reduce environmental impacts
66	How can we best model and understand the impacts on a global level of environmental policy actions?	Reduce environmental impacts

## **Future Transport Systems and Environment**

<b>Number</b>	<b>Detailed research and evidence need</b>	<b>Strategic priority</b>
67	What evidence exists about the role of transport related air pollution (NOx and PM2.5) and social inequality in England, with consideration for social, economic, and geographic factors?	Reduce environmental impacts
68	What are the most effective and equitable transport related actions that can be taken to reduce emissions of (and exposure to) transport related air pollution (from particulates and NOx) in vulnerable communities, while helping growth, access to jobs and accessibility in more deprived areas?	Reduce environmental impacts
69	What is the role of roadway design and traffic management on local PM2.5 concentrations?	Reduce environmental impacts
70	How could technology and data be better utilised to identify, classify and monitor biodiversity alongside transport infrastructure? What can asset managers in the transport sector learn from other sectors in this area.	Reduce environmental impacts
71	How can the vulnerability and role of habitats alongside transport infrastructure be better understood regarding climate change, pests, and disease? How can we increase resilience?	Reduce environmental impacts
72	Where are the skills and capabilities missing within the infrastructure construction and maintenance industry to effectively conserve and enhance biodiversity and implement biodiversity net gain?	Reduce environmental impacts
73	What impact do linear transport infrastructures have on the connectivity and genetic diversity of species, how can we quantify and map this impact and are there any benefits of linear transport infrastructure as corridors for urban biodiversity?	Reduce environmental impacts
74	How will changes in the UK's climate including frequency of extreme weather events impact the operation of the transport network?	Reduce environmental impacts
75	What is the current role of material/construction innovation in adapting transport infrastructure to extreme weather events and are these solutions	Reduce environmental impacts

<b>Number</b>	<b>Detailed research and evidence need</b>	<b>Strategic priority</b>
	readily available? What future developments are anticipated in material/construction innovation and how long before these may become mainstream?	
76	What data and evidence are required to support risk-based investment in transport infrastructure to ensure the industry is sufficiently prepared for extreme weather events? Are there any evidence gaps in the existing data?	Reduce environmental impacts
77	How can monitoring and weather forecasting techniques be improved and implemented to reduce the impacts of climate change on transport infrastructure?	Reduce environmental impacts
78	How can the effectiveness of adaptation programmes within the transport infrastructure industry be measured and evaluated?	Reduce environmental impacts
79	Where do interactions exist between climate adaptation in transport infrastructure and other net zero or natural environment policies? Are there any co-benefits/trade-offs and how can we implement solutions that deliver on all these priorities?	Reduce environmental impacts
80	What are the skills, capabilities, and knowledge gaps within the transport infrastructure industry to effectively implement adaptation to climate change now and in the future?	Reduce environmental impacts
81	What behaviour change will be required by the public and industry to adapt to the impacts of climate change on transport infrastructure.	Reduce environmental impacts
82	What interventions are most effective to increase average rate of road vehicle occupancy?	Reduce environmental impacts
83	How can we incentivise greater use of shared transport modes?	Reduce environmental impacts
84	What are the impacts of shared mobility, for example on congestion, productivity, and cost to the user?	Improve transport for the user

<b>Number</b>	<b>Detailed research and evidence need</b>	<b>Strategic priority</b>
85	How can we support businesses and employers to take action on decarbonising the commute?	Reduce environmental impacts
86	How can we support enhanced access to public transport, shared mobility, and active travel in rural areas?	Reduce environmental impacts
87	How lasting is behaviour change on transport mode choice over time?	Reduce environmental impacts
88	What is the effect of planning apps (or Mobility as a Service) on transport mode choice?	Reduce environmental impacts
89	How are attitudes to car ownership changing over time?	Reduce environmental impacts
90	What are the most effective technologies that will reduce collisions on the UK road network (vehicle to vehicle and vehicle to other road users)?	Improve transport for the user
91	Could autonomous vehicle shuttles be used on legacy transport, such as a replacement for closed rail lines?	Improve transport for the user
92	What injuries are sustained by road users in collisions and how can the information be used to improve the safety of new vehicles?	Improve transport for the user
93	What are the risks associated with new vehicle lighting technologies and can these be mitigated? What are the risks and benefits of allowing the use of red flashing lamps by road recovery operators?	Reduce environmental impacts
94	What are the practical benefits and are there and risks associated with allowing HGV platooning on the UK strategic road network?	Reduce environmental impacts
95	How can information on the safety of motorcycle helmets and new cars be used to assist consumers to make better choices and choose safer products? Which regulatory compliant motorcycle helmets and	Reduce environmental impacts

<b>Number</b>	<b>Detailed research and evidence need</b>	<b>Strategic priority</b>
	cars on the UK market offer the best, and which offer the poorest levels of safety in the event of a road collision?	
96	What are the strengths and limitations of advanced and emerging vehicle designs and technologies, from personal electric vehicles through to automated shuttles, and how can we enable their safe and secure use on roads?	Reduce environmental impacts
97	What are the options and new technologies to detect and improve enforcement against vehicles with high noise emissions?	Reduce environmental impacts
98	What are the real-world pollutant emissions of road vehicles, including non-exhaust emissions, and what are the technologies that can be used to reduce them?	Reduce environmental impacts
99	What are the specific health impacts of transport related particulate matter such as that caused by tyre and brake wear? Do different types of particulate pose different risks?	Reduce environmental impacts
100	What are the impacts on nitrogen oxides of using hydrogen in internal combustion engines? Can they be mitigated? Are there any other emissions of concern?	Reduce environmental impacts
101	What future electric vehicle charging technology will be available? What are the advantages and disadvantages? And what groups of electric vehicle users will it mostly benefit?	Reduce environmental impacts

## Group Communications

<b>Number</b>	<b>Detailed research and evidence need</b>	<b>Strategic priority</b>
102	What are the audience insights across Secretary of State and Government priorities as well as ongoing marketing projects (Build Back Better, etc.)?	Improve transport for the user



<b>Number</b>	<b>Detailed research and evidence need</b>	<b>Strategic priority</b>
103	What is the current audience understanding and levels of awareness, attitudes and claimed behaviour of the THINK! road safety campaign, as well as brand recognition. How has campaign activity impacted on KPIs?	Improve transport for the user
104	What is the current audience understanding and levels of awareness, attitudes and claimed behaviour of the It's everyone's Journey campaign? How has campaign activity impacted on KPIs?	Improve transport for the user

## Local Transport

<b>Number</b>	<b>Detailed research and evidence need</b>	<b>Strategic priority</b>
105	How do different models of funding, planning and decision-making result in different outcomes for transport e.g., centralised vs. devolved; public vs. private operation of networks/asset management; short vs. long-term?	Grow and level up the economy
106	What role can transport play in levelling up left-behind places in the context of changing travel/commuting patterns?	Grow and level up the economy
107	What is the relationship between transport improvements and local economic growth?	Grow and level up the economy
108	Where have bus services been a success (either in the UK or internationally) and why were they successful? How is it related to history, socio-economic and demographic factors, alternative travel modes and financial and other incentives?	Improve transport for the user
109	How does the capability and capacity of Local Transport Authorities influence the delivery of transport policy developed by central government?	Grow and level up the economy
110	How can transport investment release additional land for housing and deliver wider economic benefits?	Grow and level up the economy

Number	Detailed research and evidence need	Strategic priority
111	How can technologies such as demand responsive transport (DRT) and bus rapid transit (BRT) support the delivery of effective bus services?	Improve transport for the user
112	What is the relative effectiveness of different incentives to promote active travel?	Reduce environmental impacts
113	Why do other countries have higher levels of cycling? How is it related to history, socio-economic and demographic factors, and financial and other incentives? What is the role of culture in facilitating / obstructing shift towards active travel (and particularly cycling)?	Improve transport for the user
114	What are good policies, interventions, and strategies to improve the capability and capacity of local authorities to deliver transport provision?	Grow and level up the economy
115	What are user needs and expectations for making bus stations and stops accessible?	Improve transport for the user
116	What is the impact of long COVID on transport accessibility?	Improve transport for the user
117	How do we increase cycling and walking in groups who cycle less?	Improve transport for the user
118	How can we quantify wider health benefits from active travel beyond what's already quantified in DfT's Active Mode Appraisal Toolkit -including morbidity benefits, health benefits to children and cost savings to the NHS.	Improve transport for the user
119	What is the causal relationship between loneliness and transport/travel?	Improve transport for the user
120	What are the enablers and barriers to travel for disabled people and those with long-term health conditions -including those who fall into other protected characteristic groups?	Improve transport for the user

<b>Number</b>	<b>Detailed research and evidence need</b>	<b>Strategic priority</b>
121	How can we best measure the value of interventions to increase the accessibility of transport?	Improve transport for the user
122	How do needs, attitudes, and behaviours towards travel and transport vary between individuals with a disability/long-term health condition and those without?	Improve transport for the user
123	How can we improve the design of vehicles, and other transport modes, to meet the needs of disabled people better? Including those who fall into other protected characteristic groups	Improve transport for the user
124	What is the impact of the digitisation of information on transport services on disabled passengers?	Improve transport for the user
125	What local transport interventions are the most cost effective in reducing carbon?	Reduce environmental impacts
126	What is the relationship between bus usage and walking?	Improve transport for the user
127	What works to increase mode shift towards bus usage? How does this differ by region or across different demographic groups?	Improve transport for the user
128	What are the impacts of introducing zero-emission buses (for bus operators, passengers, and areas)?	Reduce environmental impacts
129	How have local transport needs changed as a result of the COVID-19 pandemic? How can we expect them to change going forward?	Improve transport for the user
130	What are the enablers of building and maintaining an integrated local transport system? How does this benefit local communities?	Grow and level up the economy
131	What works to increase light rail usage? What are the enablers and barriers to this? How and why has	Reduce environmental impacts

<b>Number</b>	<b>Detailed research and evidence need</b>	<b>Strategic priority</b>
	this differed across geographic regions, including internationally?	

## Maritime

<b>Number</b>	<b>Detailed research and evidence need</b>	<b>Strategic priority</b>
132	What will be the impact on maritime and shipping infrastructure, skills and careers as international trade evolves? What are the opportunities for UK costal shipping?	Increase our global Impact
133	How can we best support and grow the UK Maritime Sector, innovation in maritime and potential related green jobs? What roles do maritime sectors play in the wider productivity of the UK economy?	Increase our global Impact
134	What works in terms of increasing the diversity of people choosing maritime careers? Which are the most valuable and transferable lessons from other STEM led sectors in identifying barriers and solutions to make maritime careers highly desirable for all?	Grow and level up the economy
135	How can we improve modelling of UK port activity and the impacts of possible policy measures on the maritime sector?	Grow and level up the economy
136	How do we ensure UK continues to be recognised as the global leader in maritime safety? What is the safety culture in the industry as it stands?	Increase our global Impact
137	What are the key disruption risks to UK maritime? What are the most effective mitigations at the local and global level to ensure the safe and reliable passage of goods and passengers to, from and around the UK?	Increase our global Impact
138	What is international maritime best practice and precedent for wreck retrieval?	Increase our global Impact

<b>Number</b>	<b>Detailed research and evidence need</b>	<b>Strategic priority</b>
139	How do we best survey and monitor underwater wrecks and waterlogged munitions (including the SS Richard Montgomery)?	Grow and level up the economy
140	What are the most relevant emerging technologies for maritime and shipping (e.g., autonomous vessels)? What are the risks and opportunities for the UK across economic, social, and environmental dimensions?	Grow and level up the economy
141	What are the future scenarios for demand at UK ports and how might the behaviour of passengers and freight users change over time?	Improve transport for the user
142	What are maritime passenger views and experiences on board ferries, accessing to ports, passenger safety perceptions and confidence to travel?	Improve transport for the user
143	Do passenger experiences and/or perceptions prevent people with disabilities from using maritime modes (ferries and cruises)? What areas of the passenger experience that are problematic for people with all types of disabilities?	Improve transport for the user
144	What are seafarer's attitudes towards safety on board, reporting damage or faults, wearing of PFDs, and motivations towards a safety-first culture on board?	Improve transport for the user
145	How can maritime and shipping contribute to the UK goal of net zero GHG emissions by 2050 and the goals of the UK Clean Air Strategy, while capturing the green-growth potential?	Reduce environmental impacts
146	What are the most cost-effective measures for reducing shipping emissions both domestically and internationally? What are their costs, benefits, risks, technological readiness, and applicability? What are the barriers and other challenges to reducing maritime emissions?	Reduce environmental impacts
147	What is the current level of maritime emissions and how is this expected to change in the future?	Reduce environmental impacts

<b>Number</b>	<b>Detailed research and evidence need</b>	<b>Strategic priority</b>
148	What are the current and future clean maritime growth opportunities for the UK (including green jobs)? What is the expected growth for green shipping in the UK and what are the environmental and economic implications?	Reduce environmental impacts
149	What are public and industry attitudes to reducing maritime emissions? What factors influence industry decision-making on whether to reduce maritime emissions?	Reduce environmental impacts
150	What are the key routes for UK trade? What makes them key routes?	Increase our global Impact
151	What are the main barriers of the UK's bilateral trade with partner countries? How do non-tariff and tariff barriers impact trade?	Increase our global Impact
152	What is the expected growth of the UK's maritime autonomy and remote operations sector and what impact will this technical change have on the workforce?	Grow and level up the economy
153	How does the UK transport infrastructure compare to the infrastructure of other countries?	Increase our global Impact
154	How has COVID and EU exit affected the movement of goods between Ireland, the UK and the rest of the EU? Are these impacts short or long term?	Grow and level up the economy
155	What factors influence haulier choice between UK ports?	Grow and level up the economy
156	What are the rationales for both passengers and those moving freight when choosing different modes of transport? Is it simply cost or are environmental and security concerns considered? What could be done to influence which modes are chosen?	Improve transport for the user

## Motoring and Freight

<b>Number</b>	<b>Detailed research and evidence need</b>	<b>Strategic priority</b>
157	What is the best way to assess the resilience of tank vehicles, tank waggons, portable tanks, and tank containers under conditions representative of typical impact situations?	Improve transport for the user
158	What is the best way to inspect traditional and modern joining methods to identify flaws that could compromise the safety of tanks constructed using such methods?	Improve transport for the user
159	How could modern materials and construction techniques be used to improve both the safety and, through weight reduction, the productivity of dangerous goods tanks?	Improve transport for the user
160	What is the relationship between road safety interventions, including enforcement and reductions in casualties and killed or seriously injured (KSI)?	Improve transport for the user
161	What would happen to casualty trends if there were no policy interventions?	Improve transport for the user
162	Which road safety interventions have had the greatest impact in casualties in recent years?	Improve transport for the user
163	Which policies and interventions have the greatest potential to reverse the lack of progress in road casualty reduction since 2010?	Improve transport for the user
164	How can we reduce casualties when there are greater numbers of more vulnerable older adults using our roads? How can we enable greater numbers of older people to stay safe on our roads? How can and should existing interventions be adjusted to cater for an ageing population?	Improve transport for the user
165	What are the most effective ways of improving the safety (and perceptions of safety) of cyclists and pedestrians (particularly, child and older adult pedestrians who are at greater risk)? How should DfT work with external organisations to support these interventions?	Improve transport for the user



<b>Number</b>	<b>Detailed research and evidence need</b>	<b>Strategic priority</b>
166	How does the use of telematics improve road safety and how can it be used to help both safer and more fuel-efficient driving?	Improve transport for the user
167	What are the implications (for both safety and insurance) of people continuing to drive with high numbers of penalty points or immediately after serious offences (as only the courts can disqualify someone from driving)?	Improve transport for the user
168	What is the feasibility, benefits and road safety risks of relaxing driving licence regulation and training qualifications so people can drive certain heavy vehicles with less additional testing or professional development?	Improve transport for the user
169	How can we reduce the risks faced by motorcyclists, who are the most vulnerable to death on our roads? What role can the use of personal protective equipment have (including innovations in this equipment) in reducing the risk of serious injury and death among motorcyclists?	Improve transport for the user
170	What are the needs of road users, and how can existing and new traffic systems be utilised/ developed to respond to these needs?	Improve transport for the user
171	Are traffic standards and guidance still appropriate and relevant considering technological and environmental changes?	Improve transport for the user
172	What is the potential market and benefits (emissions savings, fewer journeys, etc) from longer and heavier vehicles (>44 tonnes GVW) and how do we manage technical concerns and safety risks?	Reduce environmental impacts
173	How effective are current Local and Central Government planning systems and planning officers in shaping the efficiency and environmental impacts of road freight and what future improvements may be needed, including to capability, to ensure the planning system supports road freight to contribute to meeting Government ambitions?	Reduce environmental impacts

<b>Number</b>	<b>Detailed research and evidence need</b>	<b>Strategic priority</b>
174	What environmental and logistical improvements, including those related to road freight emissions, urban air quality and congestion, could we expect to see if the planning approval decision-making process were more technocratic and gave more weight to wider improvements?	Reduce environmental impacts
175	What approach should central Government take to best manage and organise road freight / logistics in the UK to make it more efficient, resilient and reduce its environmental impact and what would be its likely impact on costs and competition in the supply chain?	Grow and level up the economy
176	How can we encourage those who have begun walking and cycling more during the pandemic (when traffic levels were lower) feel safe as traffic levels return to normal?	Improve transport for the user
177	What is the best way to collect and analyse, and promote reporting of, incident data to inform technical and policy development concerning the safety of dangerous goods transport?	Improve transport for the user

## Rail Strategy and Analysis

<b>Number</b>	<b>Detailed research and evidence need</b>	<b>Strategic priority</b>
178	What journey-related mobile connectivity needs do passengers have now and in the future? How best can these needs be met, and what role could government play to support delivery of these outcomes?	Improve transport for the user
179	What determines how safe passengers feel on the railways? What concerns do passengers have in relation to personal safety? How can personal safety and perceptions of personal safety on the railways be improved?	Improve transport for the user
180	What is the experience of the end-to-end journey for adults with learning disabilities?	Improve transport for

Number	Detailed research and evidence need	Strategic priority
		the user
181	What evidence is there on the impact of initiatives to encourage greater use of rail, or grow rail's share of journeys, including freight volumes?	Improve transport for the user
182	What are the key priorities for increasing rail resilience, including freight and supply chains?	Improve transport for the user
183	What are the opportunities for improving cost efficiencies and enhancing financial sustainability of rail?	Grow and level up the economy
184	What is the profile of rail use following COVID-19? Will observed changes to travel behaviours, and particularly commuting, endure?	Improve transport for the user
185	Have perceptions of crowding on public transport, including rail, changed following COVID-19? How and to what extent is this likely to change passenger behaviour?	Improve transport for the user
186	How do new or improved rail services and stations affect employment, numbers of businesses, and property prices? What are the impacts of new or improved rail services for towns and smaller cities?	Grow and level up the economy
187	What are passengers' needs and priorities e.g., ticketing options, accessibility? How well are these being met?	Improve transport for the user
188	How much flexibility do commuters expect to have in their travel behaviours in future e.g., to commute at off-peak hours? How will that affect their travel choices, if at all?	Improve transport for the user
189	What is the latest evidence on how passengers respond to changes in services and fares?	Improve transport for the user
190	What are the wider economic benefits of rail travel to urban centres?	Grow and level up the economy

<b>Number</b>	<b>Detailed research and evidence need</b>	<b>Strategic priority</b>
191	What represents good value for money to passengers and potential passengers? How does the perception of value for money vary across passenger groups and how are different factors prioritised?	Improve transport for the user

## Roads Strategy

<b>Number</b>	<b>Detailed research and evidence need</b>	<b>Strategic priority</b>
192	How will new and emerging technology assist in reducing construction costs for road schemes?	Grow and level up the economy
193	What role could the theory underpinning social welfare functions play in analysis associated to the Government's levelling-up agenda? What role could new census data play in the analysis of levelling-up?	Grow and level up the economy
194	What new environmental techniques should be utilised in the analysis of road schemes that are not currently set out in Transport Analysis Guidance?	Reduce environmental impacts
195	How can we better monitor and evaluate the impacts of road schemes, and other large-scale infrastructure projects, on the local environment and those who use and live in that that environment e.g., on cultural heritage sites in the area; on local residents, in terms of well-being and on local biodiversity?	Reduce environmental impacts
196	How should the lifespan of a new road enhancement be measured?	Grow and level up the economy
197	How do standards in appraisal and modelling practices of road schemes in the UK compared to international practices?	Grow and level up the economy
198	What needs to be true of demand modelling for the estimates produced to capture long run changes in demand for road schemes that may change the spatial distribution of economic activity? To what extent do estimates from conventional user benefits approximate the total welfare impacts of transport	Grow and level up the economy

<b>Number</b>	<b>Detailed research and evidence need</b>	<b>Strategic priority</b>
	schemes on users, considering the impacts of changing land use?	
199	How will new and emerging technology change travel patterns and demand on the Strategic Road Network?	Improve transport for the user
200	How is freight demand likely to change in the future? What impact will reduce transport costs of delivery have?	Grow and level up the economy
201	How will new and emerging technology assist in the operation, maintenance, and renewal of the Strategic Road Network?	Grow and level up the economy
202	How can new technologies, digitalisation and data analytics be utilised to improve transport networks, user experience and create more effective and cost-efficient transport systems?	Improve transport for the user
203	How have the introduction of new technologies such as micromobility impacted transport users and the requirements of the broader transport system?	Improve transport for the user
204	How can we best share the research being conducted on traffic technology investments with the wider community?	Improve transport for the user

## Science, Innovation and Technology

<b>Number</b>	<b>Detailed research and evidence need</b>	<b>Strategic priority</b>
205	What are the options for reducing our reliance on space-based Position, Navigation and Timing (PNT) systems? What is the most cost-effective way of ensuring adequate resilience and redundancy of PNT across transport systems?	Improve transport for the user
206	How do we ensure that autonomous mobility is accessible and equitable?	Improve transport for the user

<b>Number</b>	<b>Detailed research and evidence need</b>	<b>Strategic priority</b>
207	What frameworks can we use to ensure proportional, safe, and trusted applications of AI in the transport sector?	Improve transport for the user
208	What are sustainable business models for autonomous/highly automated transport for each mode?	Grow and level up the economy
209	How can we use digital twins to increase resilience, responsiveness, and integration of our network (cross modally)?	Grow and level up the economy
210	What are the key considerations for sustainable (all three pillars) and lawful deployment of pavement robots?	Improve transport for the user
211	What are the opportunities and challenges in deploying off-road automation in construction?	Grow and level up the economy
212	How can/should network management for each mode develop to also communicate with autonomous mobility?	Improve transport for the user
213	What are the public needs for explainability in AI?	Improve transport for the user
214	What are the human-machine interface (HMI) requirements for AI applications such as machine vision? How can we limit overreliance?	Improve transport for the user
215	What training needs to be delivered to interact and challenge meaningfully AI algorithms? How can we prevent skills deterioration?	Improve transport for the user
216	Can we have AI learn “on the job” safely? For example, in machine vision applications.	Grow and level up the economy
217	In security applications, how can we rely on AI to show us all the possible threats (not seeing what we are not shown)?	Increase our global impact
218	How do we account for AI-first assumptions/errors (that humans would not make)?	Improve transport for the user

<b>Number</b>	<b>Detailed research and evidence need</b>	<b>Strategic priority</b>
219	What is substantial change to trigger re-evaluation of AI?	Grow and level up the economy
220	How can a Whole Life Carbon Assessment for AI be established?	Reduce environmental impacts
221	How do we design public-serving autonomous systems to be fair and inclusive?	Improve transport for the user
222	What is the role of remote operation (assistance, decision-making and control)? What are the skills and requirements for such operation for autonomous systems?	Grow and level up the economy
223	What is appropriate time and notification for a transition event? How could that impact different demographics?	Improve transport for the user
224	What are the key factors regarding public trust on autonomous systems?	Improve transport for the user
225	How do we define a near-miss?	Improve transport for the user
226	Should there be specific parking/waiting/docking areas for micro goods vehicles?	Grow and level up the economy
227	What is the predicted impact of micro goods vehicles to congestion, accidents, and accessibility?	Improve transport for the user
228	What is the role of local government or cities in autonomous aviation?	Grow and level up the economy
229	How should autonomous aviation systems communicate with ground control and each other?	Grow and level up the economy
230	What are aviation autonomy maturity levels?	Increase our global impact



<b>Number</b>	<b>Detailed research and evidence need</b>	<b>Strategic priority</b>
231	How can we ensure Situational Awareness for different human in the loop actors in autonomous aviation?	Improve transport for the user
232	What are functional and operations performance and training requirements for remote-control/operation centre/station - with a focus on Human Element?	Grow and level up the economy
233	If/what/how existing standards should be modified to ensure acceptable levels of safety and environmental protection from highly automated control systems in maritime?	Reduce environmental impacts
234	What are the connectivity performance and protection requirements in ports and on sea? Can there be specific international connectivity corridors?	Grow and level up the economy
235	What is the necessary port infrastructure needed for the safe operation of MASS in Smart Ports and as part of a multi-modal transportation chain? For example, sensor validation and docking.	Grow and level up the economy
236	How do surveyors and inspectors interact with MASS whether through Port State Control or regular survey?	Grow and level up the economy
237	What is the potential decarbonisation benefit that maritime autonomy can offer?	Reduce environmental impacts
238	What communication standards between vessels and infrastructure need to be standardised?	Grow and level up the economy
239	How can maritime information (including navigation) be digitalised to allow machine reading alongside human inter-operability, is different information required by autonomous systems?	Grow and level up the economy
240	How can the operational safety performance of a maritime autonomous surface ships (MASS) or its elements be confirmed?	Grow and level up the economy
241	What requirements should apply to navigation bridge sensors and controls for use in MASS, in particular	Grow and level up the economy

<b>Number</b>	<b>Detailed research and evidence need</b>	<b>Strategic priority</b>
	human and machine interfaces, update rates, and data representation?	
242	What data sharing platforms, protocols and operational practices are needed to enable MASS? How could this be regulated/standardised?	Grow and level up the economy
243	What are the possible costs and benefits to urban tram solutions?	Grow and level up the economy
244	What are safe speed profiles for trains that optimise capacity, comfort, and energy efficiency?	Grow and level up the economy
245	How can quantum based cyber security systems protect the transport sector beyond that of current classical cyber security?	Improve transport for the user
246	What is required to ensure quantum technologies (i.e., gravity sensors) can provide a reliable alternative to GNSS for maritime and other modes of transport?	Grow and level up the economy
247	Can quantum optimisation algorithms improve efficiencies/provide optimal routes for public transport and fleet operators?	Grow and level up the economy
248	How can quantum processing benefit analytical approaches to modelling and simulation of transport data?	Grow and level up the economy
249	Can quantum hydrogen image and gas sensors provide a safer operating environmental for hydrogen vehicles and H fuel storage and conveyance?	Reduce Environmental Impacts
250	Can Germanium on Silicon SPADS be introduced to LIDA systems for CAVs, providing greater accuracy when identifying surrounding attributes and over greater distances (using QKD to ensure a secure system)?	Improve Transport for the User
251	Can quantum computing approaches to advanced material development provide lighter, stronger, safer, and more efficient batteries and hydrogen storage systems?	Reduce environmental impacts

<b>Number</b>	<b>Detailed research and evidence need</b>	<b>Strategic priority</b>
252	What are the risks of avoiding early adoption of quantum technologies in UK transport?	Grow and level up the economy
253	How can quantum sensors contribute to improved road traffic management and maintenance?	Grow and level up the economy
254	How can we achieve a state of quantum readiness throughout the transport sector?	All

## Strategy and Private Office

<b>Number</b>	<b>Detailed research and evidence need</b>	<b>Strategic priority</b>
255	Has the role of transport in economic growth changed with increased digital substitution? What type of transport interventions are most effective from an economic stimulus / job creation perspective?	Grow and level up the economy
256	To what extent do we have evidence on the impacts of transport investment on specific areas such as the spatial distribution of productivity or social mobility and inclusion?	Grow and level up the economy
257	How can the social and economic disparities from the impact of the COVID-19 pandemic be mitigated through transport investment schemes?	Grow and level up the economy
258	How will societal and economic changes vary regionally and how will they affect the financial health of the transport system? What do these changes mean for the funding model of public transport? Will a fundamentally different approach be required to funding public transport?	Grow and level up the economy
259	What are the benefits and barriers for devolved transport policy? How do we build on our current devolution policy to further maximise effective working practices?	Grow and level up the economy
260	How can government intervention promote UK trade and exports?	Increase our global impact

Number	Detailed research and evidence need	Strategic priority
261	To what extent has the UK's competitiveness in transport infrastructure changed relative to other countries? And what lessons can we learn from short-term changes internationally that can be implemented long-term domestically? For example, how has UK's transport WEF Competitiveness Index scores increased/decreased compared to other countries?	Increase our global impact
262	What will be the appetite and ability of future transport sectors to invest in innovation/R&D?	Grow and level up the economy
263	What are the economic and societal impacts of potential lower service levels?	Grow and level up the economy
264	What does recent data tell us about possible long-term demand for private cars, electric vehicles, carpooling or public transport as a substitute and how might this impact decarbonisation?	Improve transport for the user
265	How has the delivery of goods changed and what is the impact of this?	Improve transport for the user
266	What is the impact of trends in key societal and economic changes on the future transport system? Including travel patterns, working from home, attitudes to the high street, the distribution of population i.e., dispersed vs concentrated living decisions. How do these changes affect the demand for transport and how have the needs of the user changed?	Improve transport for the user
267	What are the best ways we can support the opinions ensure the views of non-users and vulnerable groups are properly understood and built into the planning and design of new forms of transport such as e-scooters and connected and autonomous vehicles? How can we ensure that changes to transport (for example through e-scooters and autonomous vehicles) are realised safely?	Improve transport for the user
268	How will consumer preference and demand for sustainable modes and products develop?	Improve transport for the user

## Transport Decarbonisation

<b>Number</b>	<b>Detailed research and evidence need</b>	<b>Strategic priority</b>
269	How much ground-level ozone does transport produce from electric vehicle motors, pantographs and other electrical devices which can generate arcs (electrical discharges in air)?	Reduce environmental impacts
270	What factors, if any, may prevent households with private driveways installing home chargers?	Reduce environmental impacts
271	How are energy and fuel price trends affecting people's purchasing intentions, attitudes to EVs and driving behaviours?	Reduce environmental impacts
272	To what extent will changes in behaviour as a result of COVID-19 (e.g., remote work, online grocery shopping) affect EV charging routines?	Reduce environmental impacts
273	How does access to off-street parking vary by local areas? What proportions of households regularly park their vehicle off-street, in front of their house, on their street and how does it vary by local authorities?	Reduce environmental impacts
274	What information do consumers find most helpful at the purchase point of a new vehicle?	Reduce environmental impacts
275	How has consumer purchasing behaviour towards new vehicles changed in the last five years?	
276	How is the transition to net zero transport impacting the jobs market and how can we ensure the Government continues to maximise the employment opportunities available, including through monitoring green jobs as they are delivered and providing the workforce with the necessary skills to drive progress?	Grow and level up the economy
277	What is the potential for battery recycling and how can this potential be reached?	Reduce environmental impacts

<b>Number</b>	<b>Detailed research and evidence need</b>	<b>Strategic priority</b>
278	What are the factors that affect electrified vehicle battery performance and degradation? What are the methods for assessing battery health?	Reduce environmental impacts
279	How will 'vehicle to grid' reverse charging impact on electric vehicle battery life?	Reduce environmental impacts
280	What is the best way(s) to solve the issue of electric vehicle charging for those without off-street provision?	Reduce environmental impacts
281	How can we best support the scale up of the Sustainable Aviation Fuel (SAF) industry and DfT's chosen strategic ambitions for the UK SAF sector?	Reduce environmental impacts
282	What are the opportunities and constraints for maximising carbon savings from low carbon fuels across different transport modes? This could include in-depth research into potential future feedstocks and their competing uses across the economy or how existing infrastructure might need to be adapted for future production and distribution.	Reduce environmental impacts
283	What are the key drivers / barriers to consumers' adoption of technology that adds stability for the grid? How do these differ by consumer groups?	Reduce environmental impacts

## Transport Security

<b>Number</b>	<b>Detailed research and evidence need</b>	<b>Strategic priority</b>
284	How can emerging technologies be deployed in a safe and secure way to enhance the protective security and resilience of transport systems?	Improve transport for the user
285	How can the risks that emerging technologies pose to transport systems be identified and quantified?	Improve transport for the user

<b>Number</b>	<b>Detailed research and evidence need</b>	<b>Strategic priority</b>
286	How can innovations in data science, data analytics, sensor technology (including innovative deployment) be used and integrated with wider security systems to enhance security in transport systems?	Improve transport for the user
287	How can new approaches and technologies be applied to enhance the detection of threat materials and items that could harm transport systems?	Improve transport for the user
288	How can new approaches and technologies be applied to perform targeted screening of specific areas of the body?	Improve transport for the user
289	How can new approaches and technologies be applied to perform targeted screening of groups of people?	Improve transport for the user
290	What are the evolving risks to transport posed by the malicious or negligent use of drones?	Improve transport for the user
291	How can new approaches and technologies be applied to deter, detect, and disrupt the misuse of drones?	Improve transport for the user
292	How can public messaging on transport systems be used to best effect to safeguard transport users following a security incident or natural hazard disruption?	Improve transport for the user
293	How can throughput of goods and people be increased cost-effectively through transport security systems?	Improve transport for the user
294	How can the quality assurance of security systems and processes be improved?	Improve transport for the user
295	How can models be used better to understand and respond to security and resilience risks regarding transport systems?	Improve transport for the user
296	Which new technologies and approaches can be applied to improve transport systems resilience to disruption from natural hazards?	Improve transport for the user



Number	Detailed research and evidence need	Strategic priority
297	How will future global trends such as climate change and biodiversity loss impact the security and resilience of UK and global transport systems?	Reduce environmental impacts
298	How can new technologies and approaches be applied to enhance the cyber security of transport systems, including points of interconnection, autonomous transport, and commercial space flight? How does increased cyber-reliance in transport systems reduce our resilience to or increase the impact of an attack or major catastrophe?	Improve transport for the user
299	How can behavioural science be applied to enhance the capability and capacity of transport system workers to deliver improved security outcomes and transport experience?	Improve transport for the user
300	How can behavioural science be applied to deter, detect, and disrupt terrorists using or targeting transport systems?	Improve transport for the user

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