



Department
for Transport



Transport Research and Innovation Grants

Department for Transport

Transport Research and Innovation Grants Programme 2021 Grant Specification

This document outlines the scope of this grant programme. Please read this carefully before completing your application.

Contents

1. Introduction	2
DfT Strategic Priorities and Innovation Needs	3
2021 TRIG Competition Calls	5
2. Eligibility	6
3. Call Scope	7
Open Call	7
COVID Recovery and Resilient Transport Systems	8
Maritime Decarbonisation	10
Future of Freight	13
4. Broad Innovation Needs.....	15
Reducing the Environmental Impacts of Transport:	15
Improving Transport for the User:	17
Growing and Levelling up the Economy	20

1. Introduction

The Transport Research Innovation Grants (TRIG) Programme 2021 will launch on the 7th October. We are looking to run four separate calls offering grants of up to £30K, and piloting awards of up to £100k in Future of Freight.

TRIG is a scheme that enables the Department for Transport (DfT) to fully fund proof-of-concept research projects in support of innovative ideas or concepts that facilitate a better transport system. TRIG aims to:

- Foster innovation to improve UK transport.
- Generate growth in the transport sector.
- Build links between policy teams in DfT and innovators.

This document provides details of the scope of the funding calls within the 2021 TRIG competition. Applicants are advised to consider these specifications along with the guidance document to ensure the application questions are addressed appropriately. The scope and size of TRIG competitions varies with each round of funding to remain in line with the Department's needs. Generally, it is formed of an open call and one or more targeted calls in specific areas.

Proposals should clearly highlight the innovative and novel aspects of their potential transport solution. The competition is designed to offer small amounts of funding via a low-burden process to suit time-poor SMEs and micro-companies taking their first steps. Proposals should all prove an innovative concept, taking an idea typically from TRL 2 (basic research) to TRL 4 (proof of concept/small scale prototype).

The solution could well be a completely novel idea or approach. However, approaches or innovations from transport or other areas, applied in a novel way to the transport system are also be of interest.

Pilot of £100k TRIG awards within the Future of Freight theme

Under the TRIG 2021 call we intend to pilot the offer of £100k TRIG awards, **only available** to applications against the Future of Freight challenge. To be eligible for a larger award, freight proposals should:

- Progress beyond initial proof of concept;
- be more complex; include time, expertise, equipment and testing facilities for advanced prototypes and pilots;
- and/or bring together broader multi-disciplinary collaborations that these later stages of development require.

Further details can be found in the Future of Freight section, later in this document.

DfT Strategic Priorities and Innovation Needs

DfT supports the transport network that helps the UK's businesses and gets people and goods travelling around the country. Transport is fundamental to where people live, where they work, where they socialise; it is an essential enabler of business. We plan and invest in transport infrastructure to keep the UK on the move.

Five Strategic Priorities sit at the heart of DfT decision-making and the plan for achieving these priorities is outlined in the Department's [Outcome Delivery Plan](#).

DfT's Strategic Priorities are:

Grow and Level Up the Economy: Improve connectivity across the United Kingdom and grow the economy by enhancing the transport network, on time and on budget.

Improve Transport for the User: Build confidence in the transport network as the country recovers from Covid-19 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.

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.

This document arranges innovation needs which DfT sees against three DfT Strategic Priorities – 'Reduce Environmental Impacts', 'Grow the Economy', and 'Improve Transport for the User'.

Two remaining strategic priorities: to 'Increase our Global Impact' of 'Be an Excellent Department' set the context for TRIG. TRIG aligns strongly with these priorities by helping innovators develop new solutions which can be exported and shows that DfT is open to innovation as supporting the Prime Minister's ambition of the UK being a Science Superpower.

2021 TRIG Competition Calls

The 2021 TRIG scheme will comprise of four separate calls, as outlined below. While the competition encourages applications with innovative ideas across all areas of transport, some grant funding has been ringfenced for projects addressing COVID-19 Recovery and Resilient Transport Systems, Maritime Decarbonisation and Future of Freight challenges.

Challenge	Number of Projects	Funding Per Project	Total Funding
Open Call	20	£30k	£600k
COVID-19 Recovery and Resilient Transport Systems	5	£30k	£150k
Maritime Decarbonisation	13	£30k	£400k
The Future of Freight	5	£100k	£500k
	10	£30k	£300k
Total	53	n/a	£1.95m

All funding calls will use the same application form and assessment criteria. Projects must clearly articulate what challenge or unmet need is being addressed. The solution to this challenge must be innovative and have a strong science, engineering, or technology focus.

A fully competent team should be able to deliver the aims and objectives of the study. Each individual application can only be submitted to one call, although applicants can submit different bids under the different competition calls. Please note that applicants making more than one application will need to demonstrate an ability to deliver the projects concurrently. A credible project plan and risk assessment should be presented. Risk mitigation measures should be suitably identified.

Clear consideration should be given to the broader impact of the work and how additional funding to take the product to the next level will be achieved.

Applicants should consider and incorporate accessibility within their project specifications.

2. Eligibility

TRIG provides 100% grant funding and is open to all businesses (including micro, small and medium-sized enterprises) and universities to support research and pilot projects. Organisations must be based in the UK but are welcome to outsource work to overseas contractors. However, projects and technologies must be fully delivered and deployed in the UK.

3. Call Scope

Open Call

Background

The purpose of the open funding call is to seek innovative ideas that have the potential to address a UK transport challenge, across all modes and technology areas. It should be noted that although the open funding call is available to solutions to all transport challenges, applicants should consider their proposals within the context of DfT's priorities and innovation needs laid out in this grant specification document.

Scope

The department is specifically seeking innovations that have the potential to address the DfT strategic priorities and are not suited to any of the three targeted calls.

Please refer to the "DfT Strategic Priorities and Innovation Needs" section on p3 for an overview of the priorities. A more detailed list of priority innovation needs across the transport sector are outlined in Annex A.

We will consider any science or technology that could contribute to improving the transport system. For example, this could include:

- Investigating the performance of a new low carbon fuel.
- Exploring new ways of exploiting DfT and other transport datasets to improve services e.g. Bus Open Data.
- Designing new tools to increase the safety of women on public transport.
- Creating tools for encouraging mode shift and active travel.

Please note this is by no means an exhaustive list and we are keen to hear from applicants developing technology in other areas of transport innovation. A Broad Innovation List of areas where DfT recognises the need for new solutions found on page 13 of this document. This list is not exclusive and is included to help stimulate ideas. It will not be used as part of the bid assessment process.

Budget and Bidding

The total budget available for the open call is approximately £600k. We are looking for up to 20 projects; however, the final number of projects funded will depend on

the number of quality applications received, value-for-money, and the policy needs of DfT. Under this call, applicants can apply for a project grant of up to £30k.

COVID Recovery and Resilient Transport Systems

Background

We must put the needs and expectations of current and potential users at the heart of the operation of the transport system. As stated in the DfT Strategic Priorities, ensuring that our infrastructure and the services which use it are resilient and meet the varied needs of businesses and the public is a crucial goal for the department.

The COVID-19 pandemic continues to have an impact on many aspects of life, including transport. Transport plays a key role in ensuring people and businesses can continue to thrive during this uncertain time. There is a necessity to increase active travel options, while ensuring that public transport remains safe and accessible.

In addition to COVID-19 and other health risks, the transport sector faces growing risks in a number of areas. The frequency and severity of severe weather events have already increased as a result of climate change, and the transport sector must prepare for impacts increasing further. Increased automation and autonomy, miniaturisation of electronics, and reliance on Position, Navigation and Timing (PNT) technologies bring new challenges and new opportunities to ensure resilience in the event of system failures. Disruption of transport, even for short periods of time, has significant economic and social implications. The transport sector must adapt to these trends to ensure sufficient levels of resilience, reducing the risk of major disruption.

Scope

The department is seeking innovations that seek to aid the continued COVID-19 recovery within the transport sector and support transport modes, passengers and staff to improve preparedness and resilience for future pandemic and biosecurity threats. These innovations may focus on:

- Ventilation and filtration
- Decontamination
- Remote bio-detection for transport
- Changing public perception about using public transport and encouraging active and outdoor travel alternatives
- Demand management, crowd control and optimising and managing passenger flow

- Managing and monitoring transport capacity
- Transport network resilience
- Increasing and monitoring compliance and safety
- Increasing safety in taxis and private hire vehicles

Also in scope for this funding call are new technologies and approaches to improve transport systems resilience to disruption from other growing risks, including from climate change. These innovations may focus on:

- Reducing impact and improving recovery from fluvial, coastal, and surface water flooding on transport systems, including assessing and repairing damage, improving drainage and flood defences, and reducing flood-related delays.
- Reducing impact and improving recovery from heatwaves and extreme heat events on transport systems, including mitigating heat-related failure, maintaining services in hot conditions, and protecting staff and passenger health and comfort.
- Reducing impact and improving recovery from single points of failure (e.g. bridges, tunnels, embankment failure, subsidence), including reducing vulnerability of key sites, and assessing, repairing, and clearing locations affected.
- Reducing impact and improving recovery from storms, high winds and lightning.
- Reducing transport sector reliance on space-based Position, Navigation and Timing (PNT) systems, including development of ground-based technologies using existing infrastructure.
- Improving transport sector resilience to power and communication outages.
- Improving air quality on and around transport systems and hubs.

The following examples are out of scope for this funding call:

- Capability demonstrations of currently marketed or existing technology.

Projects must have an innovative aspect, although this does include products being used in innovative ways, outside of their original intended use.

Budget and Bidding

Applicants can apply for a project grant of up to £30,000.

The budget available for the COVID Recovery and Resilient Transport Systems funding call is approximately £150,000. We are looking for up to 5 projects; however, the final number of projects funded will depend on the number of quality applications received, value-for-money, and the policy needs of DfT.

Applicants are encouraged to consider the scoring matrix in the development of their proposal to ensure the development of credible bids.

Applicants may only submit one application to the COVID Recovery and Resilient Transport Systems call.

Maritime Decarbonisation

Background

Within transport, maritime emissions are significant: UK domestic shipping alone emits more GHGs than buses and rail combined, and without intervention, domestic shipping emissions will continue to rise. Intervention is needed now, as the lifespan of vessels (approx. 30 years) means that fleet renewal must start now to achieve Net Zero by 2050 in maritime. Although we proceed with implementing the Transport Decarbonisation Plan, evidence suggests that regulation alone won't work, because of sectoral market barriers to innovation investment. Target technologies for investment have been identified, but the presence of market failures means that zero emission vessels and refuelling infrastructure for alternative fuels remain precommercial, hampering the successful implementation of carbon reduction regulation. Investment is needed to develop, demonstrate and deploy clean maritime technologies, boosting UK manufacturing and jobs.

Scope

Alongside interventions such as the Clean Maritime Demonstration Competition, focused on pre-commercial solutions, the Department is also seeking to support early-stage proof of concept innovation which support maritime decarbonisation, accelerating the implementation of the [Clean Maritime Plan](#) and the [Transport Decarbonisation Plan](#), including:

- Decarbonised maritime energy vectors and fuels
- Portside and or floating/tethered energy and refuelling systems
- Efficiency innovations including maritime automation
- Novel approaches to decarbonise short-sea and inland waterway shipping

On vessel low and zero emission technologies:

- vessel propulsion (battery, fuel cell, hybrid, or engines using low carbon alternative fuels such as hydrogen, methanol or ammonia)

- propulsion systems using internal combustion engine technology capable of using multiple fuels including zero carbon options (such as hydrogen, methanol, ammonia)
- wind propulsion, including soft-sail, fixed-sail, rotor, kite and turbine technologies, targeting a range of ship types from small vessels to large cargo carriers, both as primary and auxiliary propulsion
- on-vessel power generation and fuel production to reduce GHG's e.g. wind turbines, solar panels, synthetic fuel production
- low carbon energy storage and management
- physical connections to shore-side power, including fuelling lines
- enabling technologies such as motors, drives and power electronics

Port and shore-side solutions:

- shore-side low and zero carbon fuelling including bunkering of such fuels
- charging infrastructure and management
- low and zero emission shore-side power solutions, such as enabling docked vessels to turn off their conventional power supply for ancillary systems
- shore-side renewable energy generation at the port to supply vessels
- zero emission shore-side power supply as vessels are in harbour for the vessel's main propulsion system, including grid or renewable energy supply
- low carbon fuel production (such as hydrogen, methanol, ammonia)
- zero emission infrastructure, including stationary assets for freight handling and port operations
- Investigating green shipping corridors between the UK and other trading partners:
- assessing the potential of specific technologies in decarbonising trade routes between the UK and trading partners, geographically both near and far
- exploring barriers to the decarbonisation of trade routes
- exploring how innovative technologies or the novel application of existing technologies will address the barriers, enabling the creation of green corridors between the UK and its trading partners

Smart shipping technologies:

- autonomy, digitisation and better journey efficiencies directly and indirectly, delivering quantifiable energy efficiency savings and, therefore, GHG emission reductions
- other smart shipping technologies, including the control of the emission reduction systems including but not limited to wind propulsion

The following examples are out of scope for this funding call:

- Capability demonstrations of currently marketed or existing technology.
- Projects that focus only on increasing the efficiency of current conventional fossil fuels and powertrains of maritime vessels
- projects involving aqua culture
- projects focused on marine conservation and ecology, such as mapping the sea floor etc
- capital investment only projects
- projects investigating the feasibility of financial products, including green finance
- projects focused on biofuels, except for projects strictly focused on inland waterway vessels and Non-Road Mobile Machinery (NRMM), which includes port-side machinery
- projects focused on nuclear propulsion
- projects dependent on export performance - for example giving a subsidy to a baker on the condition that they export a certain quantity of bread to another country
- projects dependent on domestic inputs usage - for example if they insisted that a baker use 50% UK flour in their product

Projects must have an innovative aspect, although this does include products being used in innovative ways, outside of their original intended use.

Budget and Bidding

Applicants can apply for a project grant if up to £30,000.

The budget available for the Future of Freight funding call is approximately £400,000. We are looking to fund up to 13 projects, however the final number of projects funded will depend on the number of quality applications received, value-for-money, and the policy needs of DfT.

Applicants are encouraged to consider the scoring matrix in the development of their proposal to ensure the development of credible bids. Where applicants submit more than one bid, evidence should be presented as to the deliverability of both projects side by side.

Future of Freight

Background

If we can futureproof our freight sector now, we'll be reaping the rewards for generations to come. Beyond economic success measured in pounds and pence, levels of emissions, congestion and air quality will also impact the wellbeing of the country and for the freight sector this will require government and industry to work in partnership. We now have an opportunity, as we build back better from the pandemic, to create a truly sustainable economic future, with freight at its heart.

The Future of Freight programme is working collaboratively with the freight sector to develop a long-term plan that looks across the modes and sees freight as a system which supports all our domestic and international supply chains. Freight and logistics touch every aspect of life in the UK. A long-term plan for the freight sector is critical to achieving the Government's strategic objectives.

Scope

The purpose of the Future of Freight call is to support innovative ideas that have the potential to address the opportunities and challenges that face the Freight and Logistics sector and its ancillary/supporting services. Areas including but not exclusive to:

Sustainability

- decarbonisation,
- the circular economy,
- traffic congestion,
- air quality,
- waste management,
- freight packaging,
- sustainable energy sources
- changing skills requirements

Technology and innovation

- testing and implementation of emerging technologies (e.g. automation)
- adaptation of business models to align with rapidly changing patterns of consumer behaviour
- efficiency and optimisation of cross modal freight and logistics systems
- management of capacity in a congested system
- use of data and data sharing between private actors and public and private sectors to design and optimise systems

The following examples are out of scope for this funding call:

- Capability demonstrations of currently marketed or existing technology.

Projects must have an innovative aspect, although this does include products being used in innovative ways, outside of their original intended use.

Budget and Bidding

The budget available for the Future of Freight funding call is approximately £800,000. We are looking for up to 5 projects costing ≤£100k each and 10 projects costing ≤£30k each; however, the final number of projects funded will depend on the number of quality applications received, value-for-money, and the policy needs of DfT.

Projects bidding for a £100k award will need to justify an enhanced award on the basis of complexity of challenge; ability to reach higher levels of technology maturity; or the necessity to form a wide consortium of collaborators to achieve success. These larger projects will also need to submit an Independent Accountant's Report at the end of the project (we do not require this of £30k projects). We expect the competition to be more intense for the larger grants and applicants should think carefully as to whether proof of concept can be achieved with a smaller grant.

Applicants are encouraged to consider the scoring matrix in the development of their proposal to ensure the development of credible bids. Where applicants submit more than one bid, evidence should be presented as to the deliverability of both projects side by side.

4. Broad Innovation Needs

The Department for Transport publishes an annual list of the research and evidence that the department needs to complete with external researchers, known as the Areas of Research Interest (ARIs). The [latest DfT ARIs](#) were published in May 2021. Much of the ARIs discuss social or operational research needs, which directly support policy making. We have pulled out the innovation needs from the 2021 ARIs to help applicants to TRIG 2021 understand where DfT sees the need for new solutions. This is primarily aimed at applicants to the Open Call.

Sections are organised under the headings of:

- Reducing the Environmental Impacts of Transport
- Improving Transport for the User
- Growing and Levelling up the Economy

We are especially keen to hear proposals which can prevent Violence Against Women and Girls (VAWG) and build people's confidence to travel.

To note, this is not an exclusive list and is included here to help spark ideas. Other ideas which can improve the transport system will be given equal weighting during the bid assessment process under the Open Call.

Reducing the Environmental Impacts of Transport:

Tackle climate change and improve air quality by decarbonising transport.

Context

Transport is the largest emitting sector of greenhouse gases (GHG) 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. 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.

Key areas of focus are:

- Decarbonisation of road vehicles
- Accelerating modal shift to public and active transport
- Decarbonising how we get our goods

- Place based solutions and environmental impacts
- UK as a hub for green transport, technology and innovation
- Reducing carbon in a global economy

The [Transport Decarbonisation Plan \(TDP\)](#) sets out the steps we will take to deliver the necessary carbon reductions across every form of transport. DfT's progress towards a decarbonised transport system has a vital role in delivering net zero across the wider economy by 2050 and science, engineering, innovation and research are essential in driving this change.

Innovation needs

Decarbonisation of vehicles

1. Technologies to eliminate all vehicle exhaust and non-exhaust emissions (e.g. brake dust) before 2050.
2. Technologies to minimise nitrogen oxides (NOx) emissions of hydrogen internal combustion engines (ICE).
3. Improvements to electric vehicle charging technology.
4. Battery recycling, battery design for recycling and improvements in battery performance, including battery health monitoring.
5. Vehicle to Grid and other innovations which allow vehicles and transport infrastructure to play more beneficial roles in the energy system.

Decarbonising how we get our goods

6. Freight decarbonisation through sharing in advance of deployment of ZE technologies like hydrogen and battery-powered HGVs.
7. Solutions to decarbonise domestic freight – from port, airport or rail freight hub to door, including new delivery models and digitalisation of the last mile.
8. Innovative use of rail and domestic maritime to contribute to zero carbon transportation of goods and services.

Decarbonisation of international connectivity and the global economy

9. Advances in Sustainable Aviation Fuel (SAF).
10. Better tools to model and forecast aviation GHG.

Place based solutions and environmental impact of transport

11. Innovative place-based solutions to support every place in the UK having its own zero emission transport network before 2050.
12. Innovations which reduce the impact of the transport system on biodiversity, including new planning tools.
13. Innovative mitigations to noise and air pollution (non-GHG) issues in places.

Accelerating modal shift to public and active transport

14. Innovations which help make public transport and active travel the natural first choice for daily activities.

15. Innovations which decrease the barriers presented by poor weather when it comes to choosing active travel.
16. Innovations which move us closer to a cohesive, connected and integrated zero emission public transport network that will empower users to make sustainable end-to-end journeys.
17. Data-driven business models for transport which facilitate modal shift towards mass transit and active/other low carbon travel modes.
18. Improvements to the whole-life carbon costs of e-scooter schemes including supply chains, maintenance and other secondary sources of emissions.

UK as a hub for green transport, technology and innovation

19. Innovations which contribute to a mature transport hydrogen supply chain in the UK.
20. Innovations which help green hydrogen play in a role in a fully decarbonised transport sector.
21. Innovations which enable maximal carbon savings from employment low carbon fuels across different transport modes, including future feedstocks and the adaptation of existing infrastructure for future production and distribution.

Infrastructure

22. Innovations which make transport infrastructure more sustainable both to construct and operate.

Social and behavioural innovation

23. Innovations which encourage people and organisations to make more sustainable travel choices.
24. Innovations which help increase car occupancy and sharing.

Improving Transport for the User:

Build confidence in the transport network as the country recovers from Covid-19 and improve transport users' experience, ensuring that the network is safe, reliable, and inclusive.

Context

We must put the needs and expectations of current and potential users at the heart of the operation of the transport system, especially given the significant impact Covid-19 has had on both usage and perceptions of public transport. 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.

Key areas of focus are:

- Building confidence and improving the public transport experience
- Improving the experience for road users
- Building a transport network that works for everyone
- Continually improving the safety, security and resilience of the transport system

Innovation needs below support initiatives such as the National Bus Strategy, William-Shapps Plan for Rail, and the Inclusive Transport Strategy. This is more important than ever as the risks from COVID-19 reduce, people build the confidence to return to public transport and new travel patterns emerge. Social and behavioural science and research is core to the delivery of all our programmes, including R&D. This is critical to ensure that the development of new solutions takes into account the needs of all groups, especially those often marginalised.

Innovation Needs

Building confidence and improving the public transport experience

1. Innovations which improve reliability, punctuality and variance in journey time, and decrease overall journey times.
2. New technologies, digitalisation and data analytics to improve transport networks, user experience and create more effective and cost-efficient transport systems.
3. Emerging technologies in tracking human experience provide such as activity tracking, eye-tracking, heart rate, bio-markers, and neurological sensors.
4. Innovations which help optimise the impact of investments on transport users and communities, including vulnerable and protected groups.
5. Advances in demand responsive transport (DRT), Mobility as a Service (MaaS) and bus rapid transit (BRT) which improve the transport system.
6. Innovations which reduce Violence Against Women and Girls (VAWG) on the transport system, reinforces the confidence of female travellers and helps people travel safely on their own.

Road safety for users

7. Road safety innovations which can enable greater numbers of older people to stay safe on our roads as our population ages
8. Ways of improving the safety (and perceptions of safety) of cyclists and pedestrians (particularly, child and older adult pedestrians who are at greater risk.
9. Innovations which reduce the risks faced by motorcyclists, who are the most vulnerable to death on our roads including novel personal protective equipment (PPE).
10. Traffic technology innovations which can benefit the wider community.
11. Innovations in efficiency of maintenance and management of our roads.
12. Solutions for emerging vehicles like personal electric vehicles and automated shuttles which enable their safe and secure use on roads.

Transport Accessibility

13. Innovations which boost transport accessibility and inclusivity and help build a transport system that works for everyone – including protected characteristics such as gender, age, ethnicity, physical, hidden & mental disability, and maternity & pregnancy – particularly those that provide audible and visual transport accessories on public transport.
14. How can we support UK innovations which boost accessibility of transport to deliver growth as well as making transport more accessible around the world.
15. Innovations in digital and cashless payment methods which minimise exclusion for people who don't use smart phones, online banking, other digitally enabled tools, or are unbanked.

Continually improving the safety, security and resilience of the transport system

16. Safe and secure deployment of emerging technologies to enhance the protective security and resilience of transport systems.
17. Integration of innovations in data science, data analytics and sensor technology (including innovative deployment) with wider security systems to enhance security in transport systems.
18. New approaches and technologies to enhance the detection of threat materials and items that could harm transport systems.
19. New approaches and technologies to perform targeted screening of specific areas of the body.
20. New approaches and technologies to perform targeted screening of groups of people.
21. New approaches and technologies to deter, detect and disrupt the misuse of drones.
22. Better public messaging on transport systems to safeguard transport users following a security incident or natural hazard disruption.
23. Innovations to increase the throughput of goods and people through transport security systems in a cost-effective manner.
24. Novel approaches to quality assuring of security systems and processes.
25. Better models to understand and respond to security and resilience risks regarding transport systems.
26. New technologies and approaches to improve transport systems resilience to disruption from natural hazards.
27. New technologies and approaches to enhance the cybersecurity and -resilience of transport systems, including points of interconnection, autonomous transport and commercial space flight.
28. Innovations which reduce our reliance on space-based Position, Navigation and Timing (PNT) systems.

Covid-19 pandemic

29. Innovation which improves ventilation / air cleanliness and or supports social distancing on public transport.
30. Innovations which help overcome confidence related barriers to returning to public transport post pandemic.
31. Structural design changes which can be made to vehicles/infrastructure to reduce the transmission risks of future pandemics and increase resilience including scenarios where a contagious agent spread through mechanisms different to those seen in Covid-19.
32. Innovations which help people with disabilities travel effectively, efficiently and confidently in and post Covid-19 world.

New and emerging technology

33. New technologies to detect and improve enforcement against vehicles with high noise emissions.

34. New technology to assist in the operation, maintenance and renewal of the Strategic Road Network.
35. Internet of things / remote sensors / hyperconnectivity advances to improve the transport system in any way.

Growing and Levelling up the Economy

Improve connectivity across the United Kingdom and grow the economy by enhancing the transport network on time and on budget

Context

Government is committed to ‘levelling up’, so that every corner of the country can benefit and share in future prosperity. Transport connectivity is an essential input into the efficient functioning of markets, reducing the costs of doing business and supporting linkages between key sectors of the economy. More efficient and faster delivery of major projects are fundamental to job creation and so a key lever for economic growth and our recovery from Covid-19. We are therefore enhancing the national strategic transport network, shifting the focus of DfT investment towards major projects that link the towns, cities and left behind places outside of London and the South East.

Key areas of focus are:

- More productive cities and towns
- Support local growth and regeneration
- Support jobs and skills
- Improve networks between major economic centres, and with international gateways
- Strengthening the Union

Delivery of major programmes such as HS2, the Integrated Rail Plan, TransPennine Route Upgrade, the Williams-Shapps Plan for Rail and the Roads Investment Strategy are fundamental to job creation and a key lever for economic growth and our recovery from Covid-19. Further commitments are outlined in the UK R&D Place Strategy which is being published this year as part of the [UK R&D Roadmap](#). The research and evidence needs set out below are critical to supporting DfT deliver these major programmes and key areas of focus to grow and level up the economy.

Innovation needs

Local connectivity, growth and regeneration

1. Innovations which boost productivity and connectivity through improving transport linkages within local economies.
2. Improvements in rail, cycling, walking and the bus network to improve connectivity within small towns and cities, and enable access to economic opportunities by connecting people with employment centres and key services at a local level.
3. Improvements for longer term resilience .

International connectivity

4. Improvements to maritime and shipping infrastructure, skills and careers to support the evolution of international trade.
5. Models of and tools to manage change in UK port to improve capacity and efficiency.
6. Innovative solutions for wreck retrieval, including where challenges legacy munitions are present (e.g. the SS Richard Montgomery).

New and emerging technology

7. Innovative retrofit technologies to reuse existing transport vehicles and infrastructure without having to embed carbon in fabrication from scratch.
8. New and emerging aviation technologies, services and supporting infrastructure.
9. Innovations making use of emerging space-based technology to support and improve the transport system.
10. Autonomy on land, at sea and in the air.

Analysis, modelling and prediction of transport demand

11. Novel/real time data sources and data driven tools to boost understanding of what is happening in the transport system at local or national levels, both now and in the future.

Freight and logistics

12. Innovative solutions for all elements of the freight system.

Dangerous goods

13. Solutions to assess the resilience of tank vehicles, tank waggons, portable tanks and tank containers after they've suffered an accident or impact.
14. Methods to inspect physical joints of various types to identify flaws that could compromise the safety of tanks.
15. Improvements in the safety and weight of dangerous goods tanks.