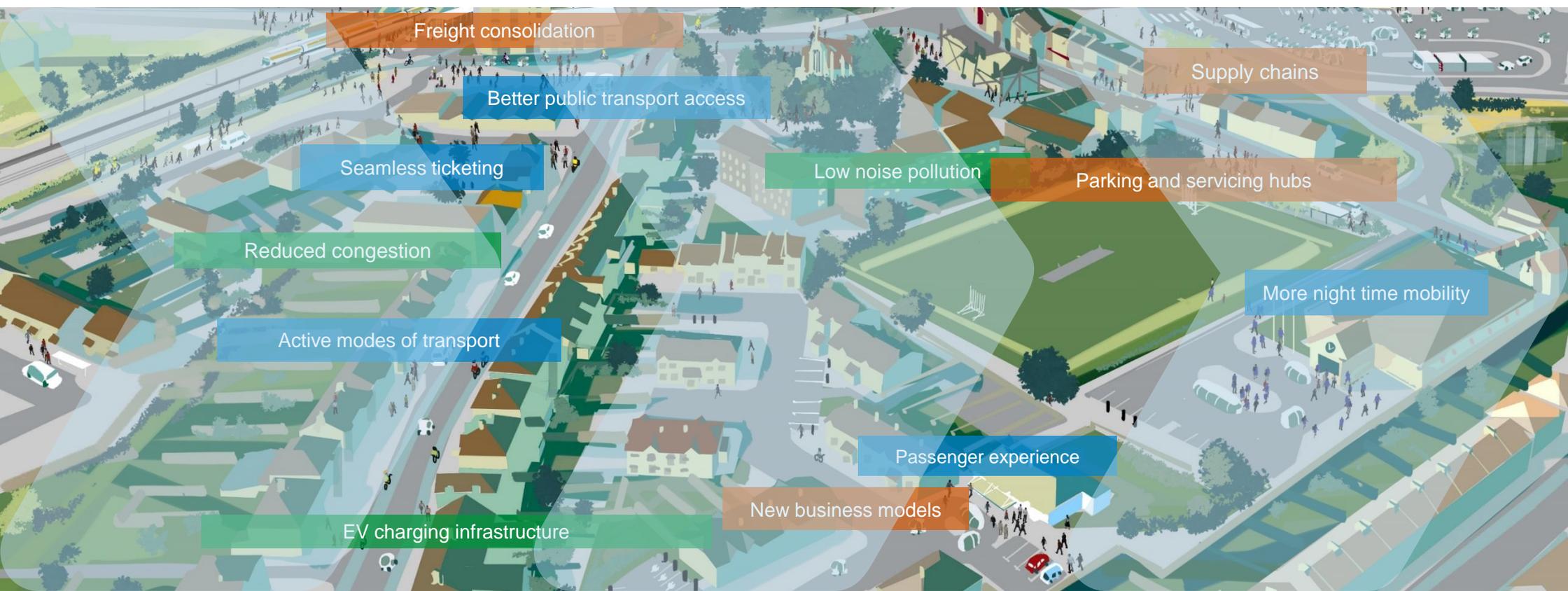# The Future of Mobility: Are the Young Professionals ready to rise to the challenge?

Prof Phil Blythe

Chief Scientific Adviser

CIHT Young Professional Conference, Manchester 14 November 2019

Being CSA: My Objectives

▸ Provide leadership on developing technology and innovation

▸ Improve the strategy for science and innovation research and future proof decision making in the DfT

▸ Position DfT as a leader in science across Whitehall and maximise value of the SAC

▸ Develop stronger links between science and internal stakeholders and provide strategic science input and evidence into analysis work programmes

▸ Join up science across Government through CSA network

▸ Identify and deliver on a number of high priority scientific issues

▸ Engage and influence research and innovation funders

▸ Support Industrial Strategy and Sector Deals

▸ Future-proof DfT investment decisions through science

The CSA: Key things I do

▸ Provide leadership on developing technology and innovation

▸ Improve the strategy for science and innovation research and future proof decision making in the DfT

▸ Position DfT as a leader in science across Whitehall and maximise value of the SAC

▸ Develop stronger links between science and internal stakeholders and provide strategic science input and evidence into analysis work programmes

▸ Identify and deliver on a number of high priority scientific issues including:
  - air quality, vehicle emissions and decarbonisation;
  - intelligent infrastructure and smart condition monitoring ;
  - older people mobility and accessibility;
  - big data/smart Cities and MaaS;
  - railway signalling/digital railways;
  - drones and future flight;
  - National Security
  - Spaceflight/spaceports;
  - engineering skills; and
  - cooperative and autonomous vehicle

▸ Support Industrial Strategy and Sector Deals

▸ Future-proof DfT investment decisions through science

De-silofication!!

Challenge to understand and join up the silos and take an integrated look at smart transport and smart cities.

For the first time digital connectivity give us the opportunity to consider how transport modes could be better joined together to provide a more seamless transport system
- new business models
- access to data
- unified payment mechanism
- what do users want?
- Quantifying benefits
- Mobility as a Service
- Agnostic Logistics

Provide leadership and make sure the 'rest of the world' knows what we are thinking

The UK transport system faces Challenges & Opportunities

Why Opportunities?

Why Challenges?

Flying cars

Electrification

Drones

Connected vehicles

Multimodal transport

Autonomous vehicles

High speed rail

and more…

Why is S&T capability important for DfT

▶ The technological development in the transport science and industry is unprecedented.

▶ Capability building is required across DfT, its agencies and its supply chain to enable us to anticipate, exploit, mitigate and lead S&T-led change.

▶ The consequences of doing nothing are that we may not have the capability to effectively provide governance and regulation of the future transport system.

▶ DfT's CSA and research leads have identified skills DfT is likely to need for the future.

Examples of likely DfT Capability Needs

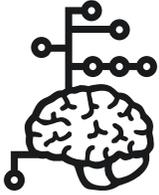| Cyber Security | Systems Engineering | Behavioural Science |
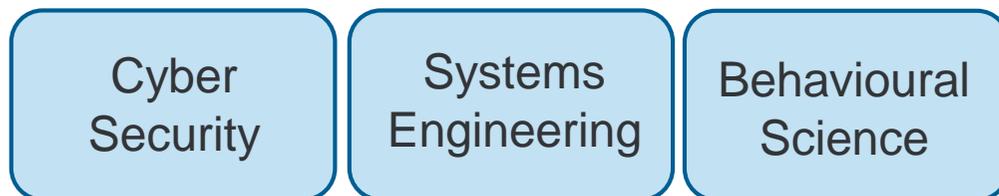
and more…

Rapid advances in technology and new business models are driving fundamental changes to the way in which we get around

Automation
Improved sensors, increased levels of computing power and data, Artificial Intelligence

Cleaner transport
Rapidly falling battery prices, improvements in energy density and electric motors, developments in alternative fuels

New modes
New ways of transporting people and goods, such as drones and e-bikes

Changing consumer attitudes
Users are expecting to be able to plan, book and pay for transport through mobile applications

Shared mobility
Models based on shared ownership or use of vehicles are becoming more prevalent

New business models
New digitally enabled models of transport provision including dynamic demand responsive transport and Mobility as a Service

Data and connectivity
Allows information to go to network operators and users in real-time and optimise fleet and network management

These changes have the potential to lead to a transport system that is safer, more responsive to user needs, more accessible, and more efficient. But there are potential downsides to manage too.

These changes will emerge in unpredictable ways and will pose major questions for transport policy

Timing

- Predictions for when new transport services will come to market vary wildly
- This complicates policy that is reliant on forecasting

Trust

- Different groups in society respond to technology differently
- Involving people in the design of new transport services is likely to help public acceptance

Infrastructure

- New infrastructure will be needed, but we do not yet know what
- Wrong decisions could mean investing in infrastructure that is obsolete before it is useful
- Need to engage closely with the market

Data/security

- All networked devices are vulnerable to cyber attack
- A framework will be needed to enable data sharing while protecting privacy and preventing anti-competitive behaviour

Regulation

- Transport regulation has grown up piecemeal over many years and could hamper innovation
- Setting a framework for technology that is not yet established is challenging

Employment

- Approx. 1.6m people work in the transport sector in the UK
- Greater automation will influence the labour market, create new jobs and remove current ones

Emerging Transport Technology brings both opportunities and risks

- Technology and wider changes have the potential to radically alter how the transport system operates.

- The FoM Grand Challenge was designed to ensure we optimise the benefits and manage the risks of electrification, automation, new business models and new modes of transport.

- Transport Technology innovations go beyond FoM, and impact on all aspects of DfT's business, bringing both opportunities and risks.

Risks

The level of risk associated with technological innovation increases over time as *uncertainty* becomes greater.

Risks cover all aspects of our business:

- The value for money of our investments
- The deliverability of schemes and outcomes
- Unintended consequences, e.g. increased inactivity; lack of accessible transport; inefficient/monopoly markets
- Being left behind and no longer in charge of meaningful regulatory levers

Opportunities

Technology also brings the opportunity to improve the way we travel, lower costs, and facilitate economic growth.
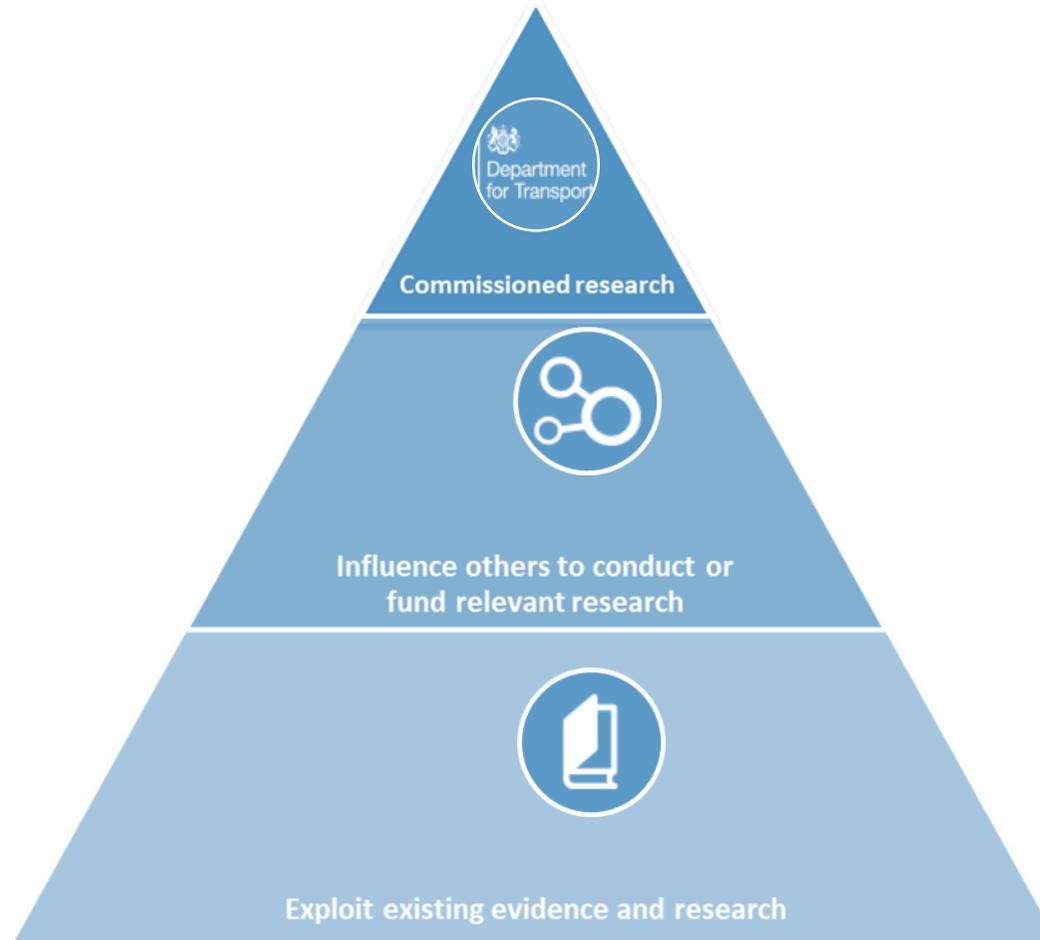
For example there are opportunities for:

- Industry: potential to improve efficiency and productivity in the UK and to gain a UK competitive advantage.
- Individuals: a safer, cleaner, more accessible, more usable transport system.
- Freight: a cleaner, more efficient system.
- Cross-government challenges: solving cross cutting issues such as health and land use.

Commissioned research

Influence others to conduct or fund relevant research

Exploit existing evidence and research

Emerging Transport Technology affects DfT's work

Technological innovation can influence our work in two ways:
1. Can change the way we deliver current policy aims
2. Can create new opportunities and new policy direction
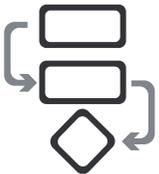
Horizon scanning

To anticipate potential technology-driven changes, allowing us to stress-test existing thinking and consider new opportunities.

Supporting innovation

Technological innovation should be built into the way we work.

Planning

Consideration of technological innovation needs to be built into all stages of policy development.

Delivery

Considering technology in our delivery models could increase efficiency.

Procurement

Building technological innovation into procurement models builds resilience in the face of technological change.

Leadership

Help industry and the research community focus on our priorities and in areas we would like to see technological solutions.

The Future Mobility Grand Challenge is an opportunity to focus effort and cement the UK's place at the forefront of transport innovation

Department for Transport

The Industrial Strategy established Grand Challenges to "put the UK at the forefront of the industries of the future, ensuring that the UK takes advantage of major global changes, improving people's lives and the country's productivity"

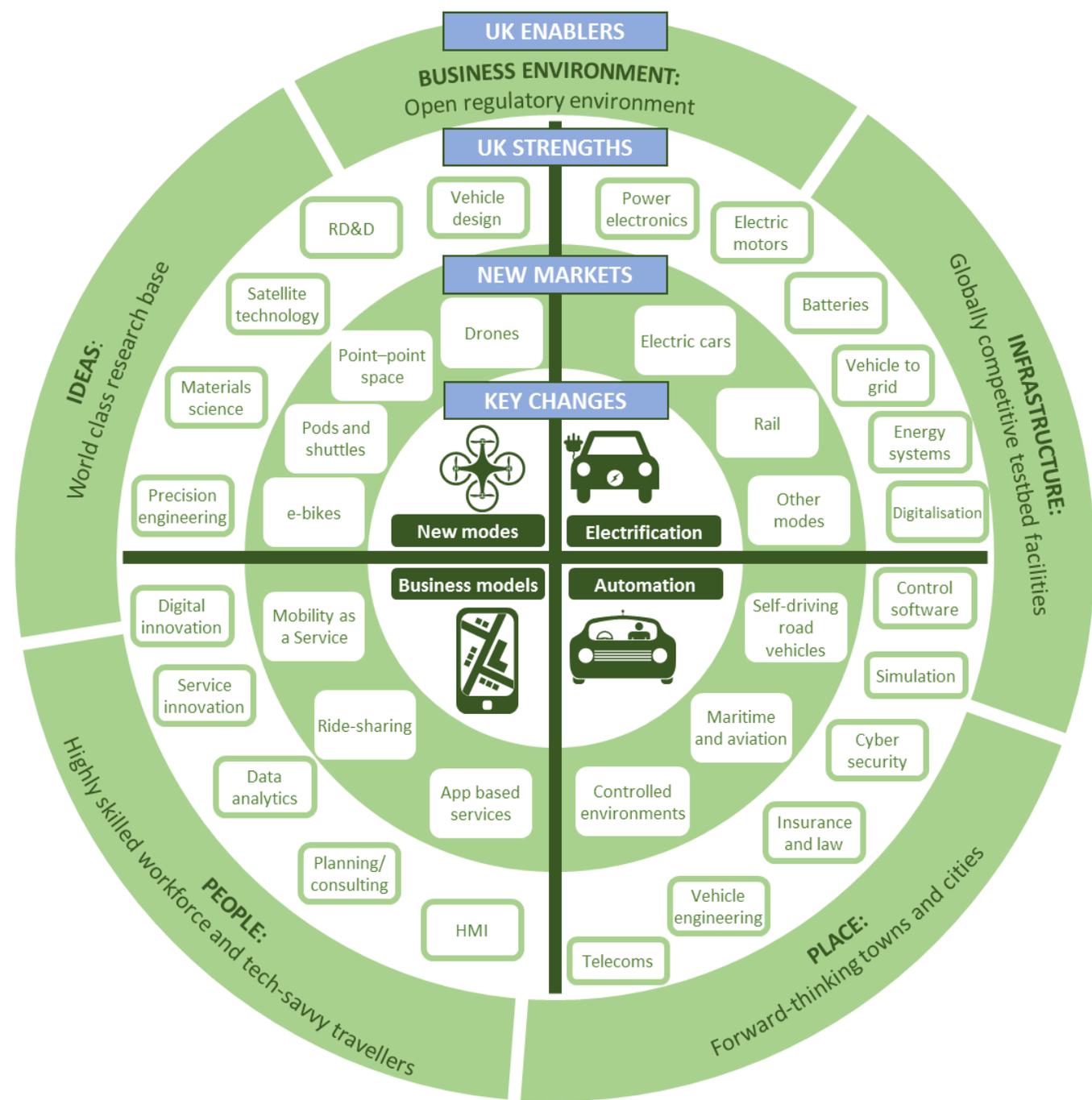| **Future of Mobility**	**Clean growth**	**Ageing**	**Artificial Intelligence**
We will become a world leader in the way people, goods and services move	We will maximise the advantages for UK industry from the global shift to clean growth	We will harness the power of innovation to help meet the needs of an ageing society	We will put the UK at the forefront of the AI and data revolution.

What is changing?

▸ For many years advances in transport services have been incremental and predictable. Fixed infrastructure, a legacy regulatory framework, and lack of access to data created high barriers to entry for innovators.

▸ This is no longer true. Advances in data science, artificial intelligence and sensing technology have increased the clock speed of transport innovation.

▸ On roads and rail, in the air and in the sea, automation, electrification and demand-led transport services promise to improve safety, reduce emissions and improve user experiences.

▸ The UK was at the cutting edge of previous transport revolutions and is well placed to lead this one too.

UK ENABLERS

BUSINESS ENVIRONMENT:
Open regulatory environment

UK STRENGTHS

NEW MARKETS

KEY CHANGES

IDEAS:
World class research base

INFRASTRUCTURE:
Globally competitive testbed facilities

PEOPLE:
Highly skilled workforce and tech-savvy travellers

PLACE:
Forward-thinking towns and cities

RD&D

Vehicle design

Power electronics

Electric motors

Satellite technology

Drones

Batteries

Electric cars

Point–point space

Vehicle to grid

Materials science

Rail

Energy systems

Pods and shuttles

Precision engineering

e-bikes

Other modes

Digitalisation

New modes

Electrification

Digital innovation

Mobility as a Service

Business models

Automation

Self-driving road vehicles

Control software

Service innovation

Ride-sharing

Simulation

Data analytics

App based services

Maritime and aviation

Cyber security

Planning/consulting

Controlled environments

Insurance and law

HMI

Vehicle engineering

Telecoms

14

Five Pillars of future ITS/Intelligent Mobility

Connected

Moves as part of **system**…in time, multi-modal

DATA: The key to new network management – people and freight

Automated

FULLY automated – can **move when empty**

HIGHLY automated – needs a « driver »

Pricing

Electric

Ideally **electric** or other future energy source

Shared

Increased interest in shared fleets and use of "**mobility as a service**"

The key to **place-making** benefits

Source: WSP, ITS Montreal

Making Sense of the Road Environment
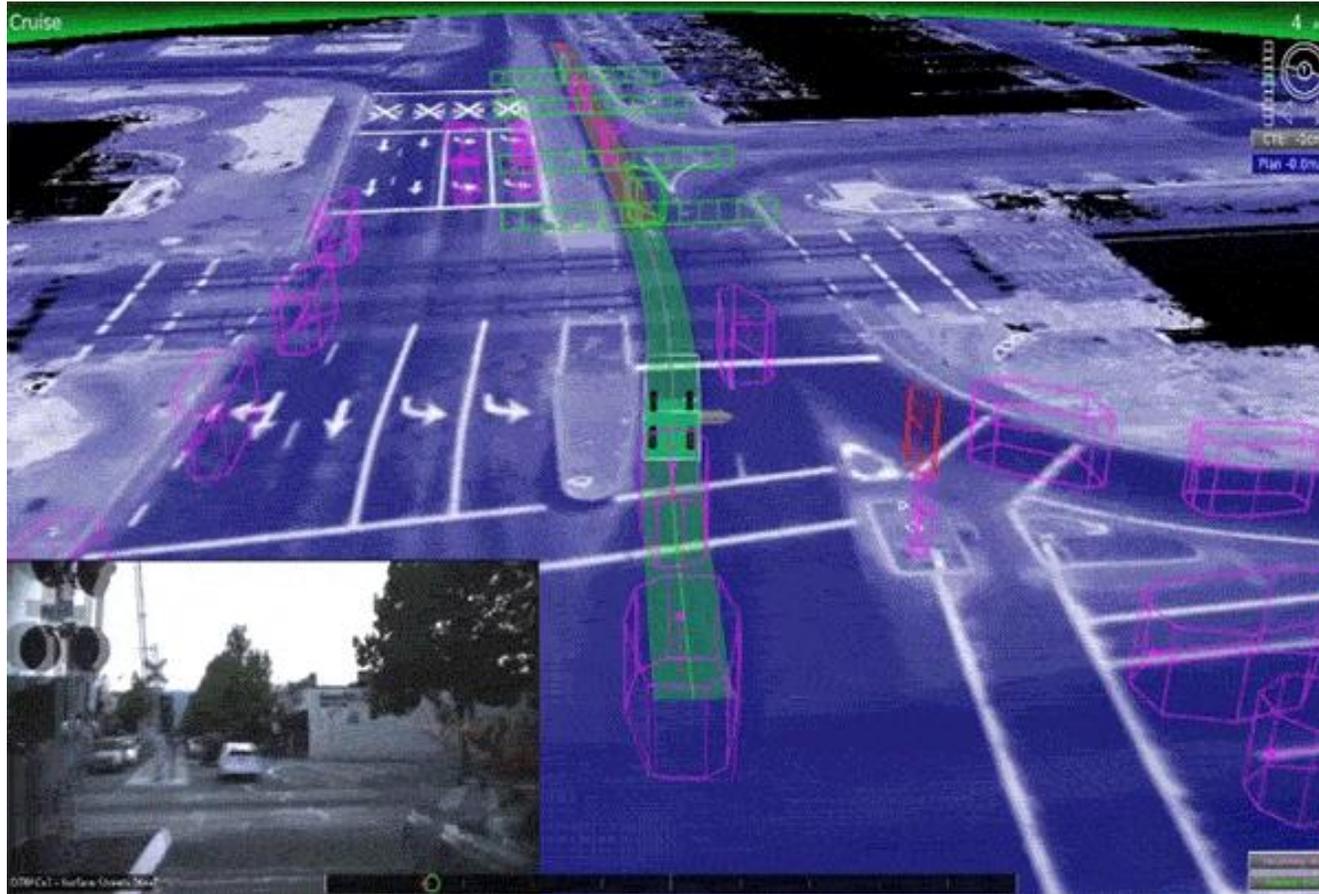
Trends in automation

▶ Not limited to cars: new technologies such as last mile delivery pods, drones, moving in to areas of traditional transport such as trains, ships and agriculture

▶ Changing consumer perceptions. Consumers are increasingly expecting information to be available readily and easily. The smart phone is the only thing some people need to consume transport.

▶ A move toward a sharing economy. Asset ownership (cars) could be diminishing. Ride sharing and car sharing could lead to a shift away from private car ownership.

▶ UK ambition to be a world leader with over £500m invested or committed

▶ Not clear whether this will lead to more or less vehicles on the road and thus the demand for energy
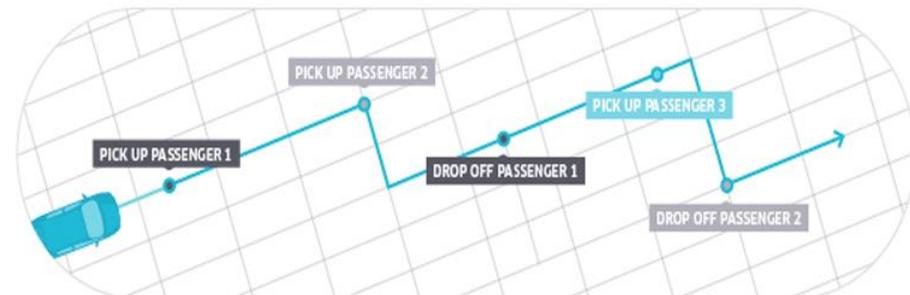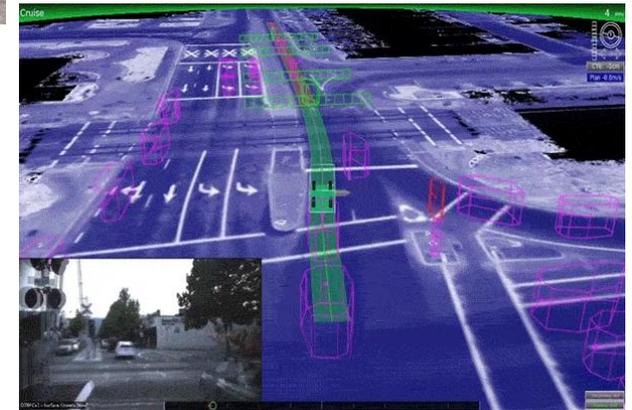
PICK UP PASSENGER 1
PICK UP PASSENGER 2
PICK UP PASSENGER 3
DROP OFF PASSENGER 1
DROP OFF PASSENGER 2

CIHT Young Professional Conference, Manchester

Decarbonisation

Road to Zero Strategy

▸ Published July 2018. Sets out how Government will support the transition to zero emission vehicles

▸ Ensure the UK is well placed to capitalise on new economic opportunities and drive down emissions from conventional vehicles.

▸ Considers GHG and air quality in parallel for the first time

▸ Brings together a range of policy initiatives into a single strategy that provided certainty to consumers and industry about Government's position and priorities.

HM Government   INDUSTRIAL STRATEGY

The Road to Zero
Next steps towards cleaner road transport and delivering our Industrial Strategy

July 2018
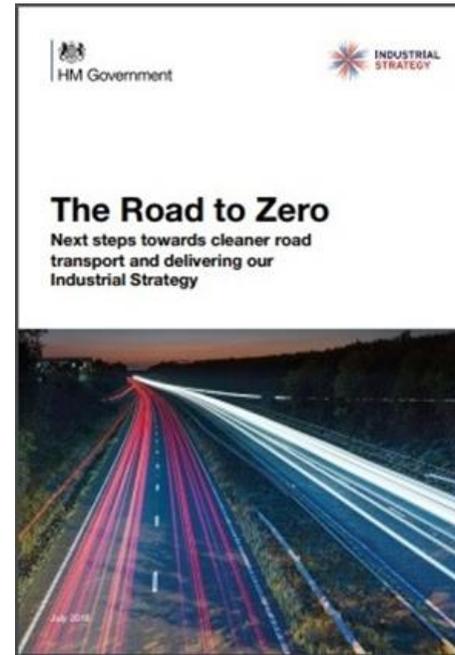
Strategic priorities are to:

• By **2050** almost every car and van to be zero emission

• By **2040** to end the sale of new conventional cars and vans

• By **2030** at least 50%, and as many as 70%, of new car sales and up to 40% of new van sales to be ULEV

• By **2025** to review progress, seeking to maintain the UK's leadership position and meet our ambitions.

Clean Growth Plan

▸ Published October 2017.

▸ Primarily road-focused.

▸ Also provided funding to reduce the CO_2 from domestic shipping and aviation.

The Clean Growth Strategy
Leading the way to a low carbon future

Building our Industrial Strategy

Department for Environment Food & Rural Affairs
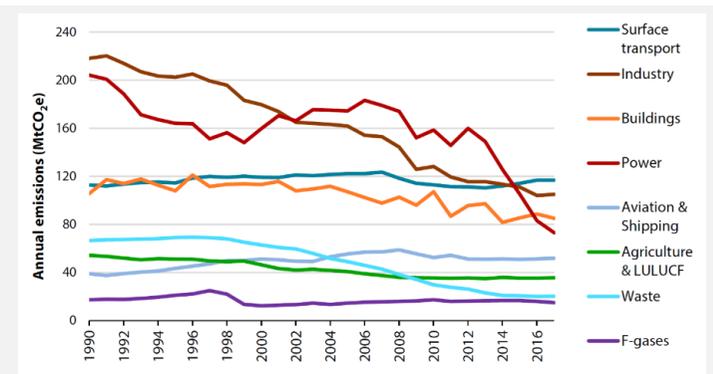
CLEAN AIR STRATEGY 2019

Clean Air Strategy

▸ Published 2019.

▸ Sets out the actions required across government and society to improve air quality.

▸ Includes how we will:

▸ protect health

▸ protect the environment

▸ secure clean growth & innovation

▸ reduce emissions from transport, homes, farming and industry

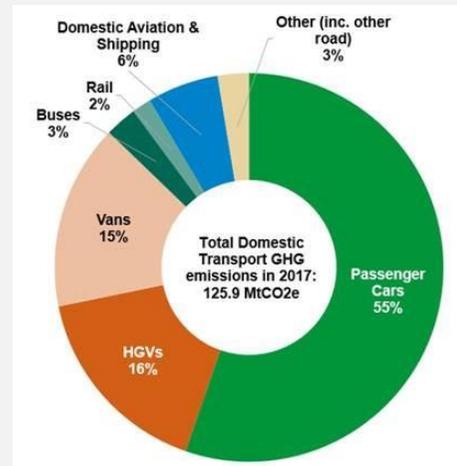IPCC INTERGOVERNMENTAL PANEL ON climate change
Global Warming of 1.5°C

Committee on Climate Change

Greg Clark
Secretary of State for Business, Energy & Industrial Strategy

"To continue the UK's global leadership we asked the CCC to advise the government on how and when we could achieve net zero. This report now sets us on a path to become the first major economy to legislate to end our contribution to global warming entirely."

HM Government / INDUSTRIAL STRATEGY

Net Zero
The UK's contribution to stopping global warming
Committee on Climate Change
May 2019

UK Prime Minister @10DowningStreet   Following

The government has taken action to tackle climate change, but there is still more to do.

AND WE INTEND TO LEGISLATE FOR NET ZERO EMISSIONS

30.1K views   0:15 / 0:29
6:54 AM - 1 May 2019

▸ Transport is the largest emitting sector, accounting for **33%** of the UK's 2018 greenhouse gas emissions. Whilst other sectors have reduced emissions dramatically since 1990, transport has only fallen 3%. Transport emissions had **risen three years in a row before levelling in 2017** at their highest level since 2009 – before falling 3% in 2018.


Domestic Aviation & Shipping 6%
Rail 2%
Buses 3%
Vans 15%
HGVs 16%
Other (inc. other road) 3%
Passenger Cars 55%
Total Domestic Transport GHG emissions in 2017: 125.9 MtCO2e

Surface transport · Industry · Buildings · Power · Aviation & Shipping · Agriculture & LULUCF · Waste · F-gases

BEIS (2019) Final UK GHG emissions national statistics

▸ Cars, vans and trucks are the most significant sources, accounting for 86% of domestic transport emissions in 2017. Road transport emissions have increased by 3% since 1990. Improvements in the fuel efficiency of these vehicles have only partially offset the emissions generated by increased traffic volumes. Van traffic has doubled, car traffic has increased by 22% and HGV traffic by 10%.
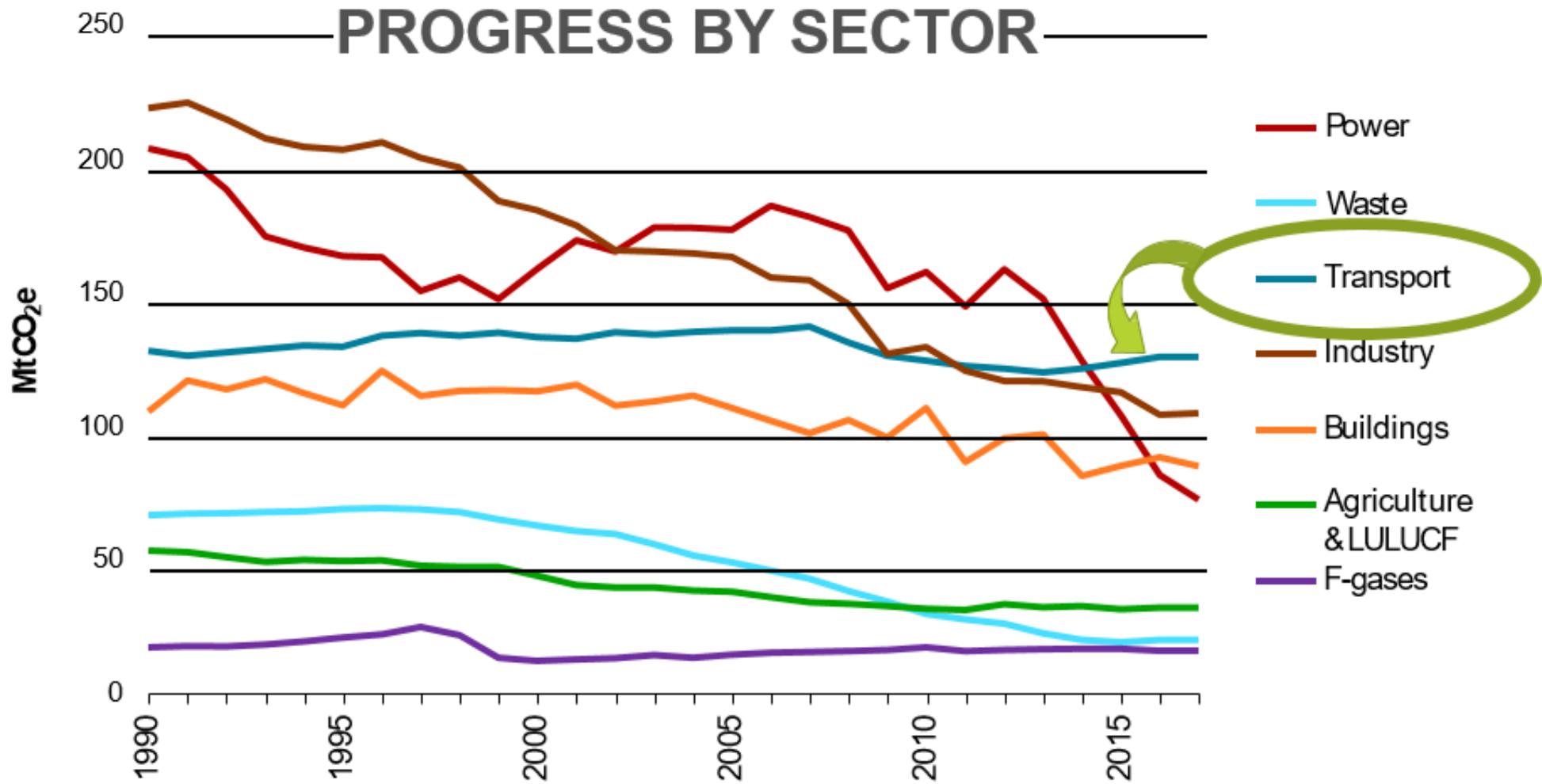
# Recently we've written (or are writing) individual modal strategies and supported many others
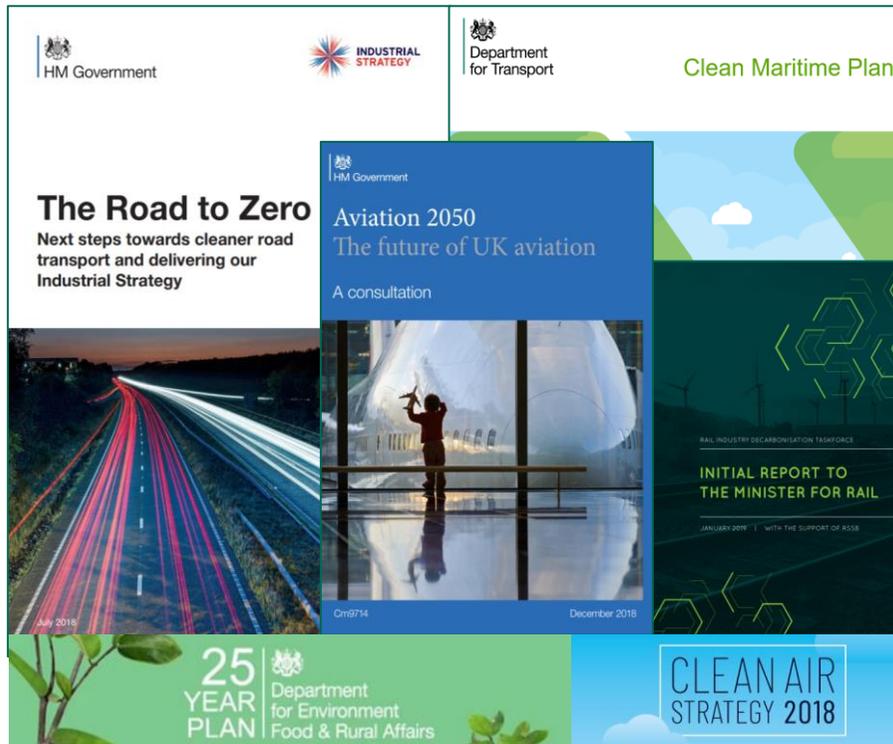
Since the 2017 Clean Growth Strategy we've published:

- **Road to Zero**;
- **Maritime 2050**;
- **Light Rail** and other rapid transit call for evidence
- **E10** petrol, consumer protection and labelling
- The **Last Mile** – delivering goods more sustainably
- **Future of Mobility**: urban strategy; and
- **Aviation 2050** Green Paper

And led international negotiations at ICAO and IMO.

In 2019 we are due to publish:

- **Carbon Offsets** for Transport call for evidence
- The **Clean Maritime Plan**; and
- The **Aviation White Paper**
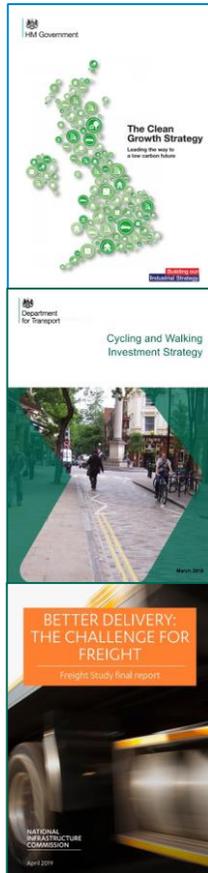
▸ This week – a Transport Decarbonisation Plan was announced which will see the Department meet it's part in net-zero 2020.

Department for Transport

News

DfT announces UK's first transport decarbonisation plan
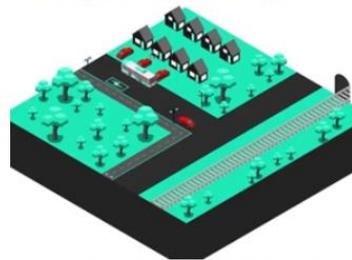
Tue 15 October 2019 | Back to news list

The Government has announced plans for the full decarbonisation of the transport sector by 2050. The announcement follows four months after the UK legislated for net zero emissions by 2050 and is published as a formal response to the latest progress report from the Committee on Climate Change.

We're working towards a cleaner, greener transport network by:

The Government says that the groundwork for the Transport Decarbonisation Plan will start immediately, with the Department for Transport (DfT) publishing a document setting out the challenge later this year. Due to be completed next year, the plan will set out in detail what government, business and society must do to deliver the emissions reductions needed from all modes of transport. In particular, the Government says, it will consider how UK technology and innovation can be implemented to encourage major changes to the way people and goods move across the UK.

DfT has recently published sector strategies to cut carbon emissions across transport, including the Road to Zero, Maritime 2050 and the Clean Maritime Plan as well as the Aviation 2050 green paper, and upcoming aviation strategy, scheduled for publication early next year.

The Government says: "...with the move to net zero, there is a need to go further and faster to reduce emissions. The Transport Decarbonisation Plan will take a coordinated, cross-modal approach to deliver the transport sector's contribution to our decarbonisation targets."

https://www.lowcvp.org.uk/news,dft-announces-uks-first-transport-decarbonisation-plan_4009.htm

Great Britain's Energy Vectors – in GWh per day
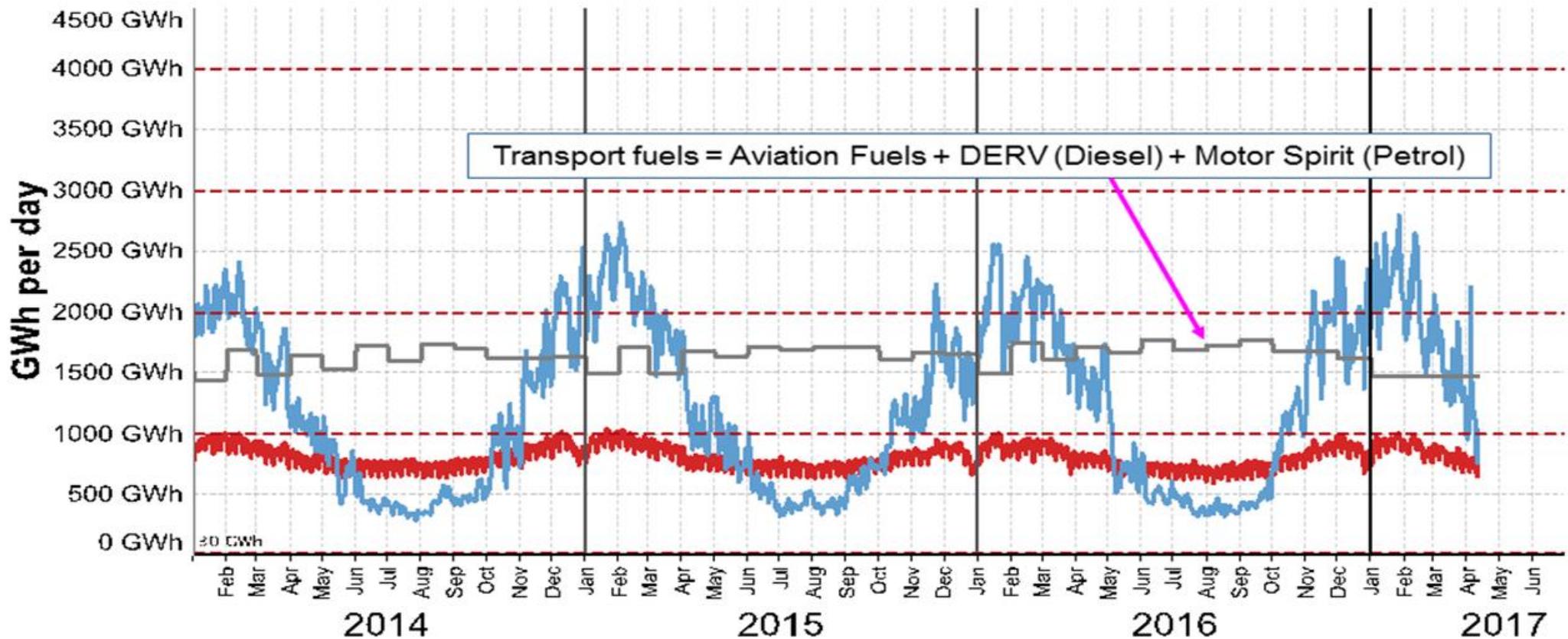
Modal Hydrogen Opportunities

- Commuter rail services and gaps in electrification are good opportunities
- Hydrogen is less suited for freight or high speed rail due to storage volume requirements

- Road freight is a relatively small proportion of transport emissions, but is difficult to decarbonise by other means.

- The back-to-depot duty cycle of buses make them amenable to hydrogen powertrains

- Maritime presents big opportunity, but can be a difficult place to innovate due to its fragmented nature and long life cycles. Hydrogen and ammonia could be very beneficial here.

Our approach for the future of transport

It is essential DfT builds its capability to use technological, demographic and social evidence.

Transport Futures

Futures community: Bringing together DfT staff to develop skills, share good practice and a consistent approach

Future of Mobility Foresight: Cross-government report focusing on governance, user decisions and freight in relation to future technology

Future-proofing decision-making: Ensure that science, technology, innovation and futures thinking are embedded into business planning and delivery to build resilience in DfT's decision-making

External funding

Strategic Priorities Fund:
Trustworthy Autonomous Systems
Clean Air
National Timing Centre
Space Weather Innovation

Industrial Strategy Challenge Fund
Driving the Electric Revolution
Future Flight
The Faraday Battery Challenge

External Engagement

Science Advisory Council (SAC):
DfT's SAC brings together academic and industry experts to provide independent advice and challenge to DfT through scrutinising emerging technologies in detail, bringing together experts in the field, and publishing position papers

Transport Research & Innovation Board (TRIB)
TRIB brings together transport research and innovation funders and leaders to build the sector and focus on DfT's and ALB's priorities. Their initial priorities are:
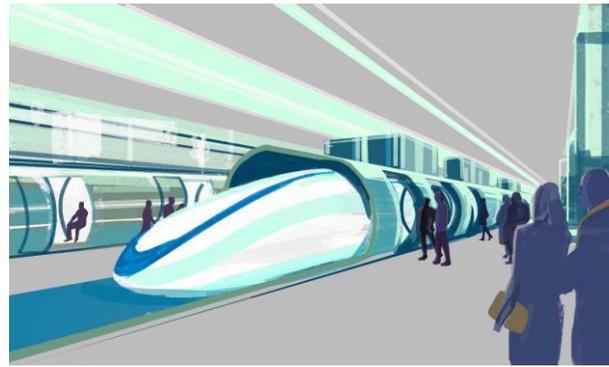
- Transport integration
- Health, wellbeing and inclusivity
- Data (sharing, interoperability and cyber security)
- Infrastructure (including smart and digital infrastructure)

Futureproofing our decision making

We are working to future-proof decisions in key areas such as the Williams Rail Review and Transforming Cities Fund

- Using scenarios to 'stress test' policy options for the Williams Rail Review to make them resilient to future change.
- Working with cities to future-proof investment plans as part of the co-development phase of the Transforming Cities Fund.

To anticipate the future and achieve the best outcomes from emerging technology, we have created Visions of the Future for 2030 for key future technologies

- Hypothetical but plausible, aspirational futures for passenger and goods transport in the UK in 203
- Based on:
  - Mobility as a Service,
  - smart infrastructure & construction
  - hybrid aviation
  - Hyperloop.
- They provoke discussion on what sort of transport system we would like to deliver and how DfT might achieve these positive outcomes.

Other technologies that might surprise us

▶ **Smart infrastructure and construction**

▶ The tides of technology are flowing in many other areas too, driven by

   ▶ **AI, robotics, sensing and battery technology, and**

   ▶ **the need of big companies create new markets and take dominant positions in those.**

▶ **Hybrid and electric aviation**

▶ I'm going to talk about smart **infrastructure & construction, hybrid aviation and hyperloop.**

▶ All three have recently been reviewed by **DfT's Science Advisory Council.** At least one of these is already here, one is pretty certain and one is at least technologically plausible

▶ **Hyperloop**

▶ I'll review the core concepts and will suggest some potential policy implications.

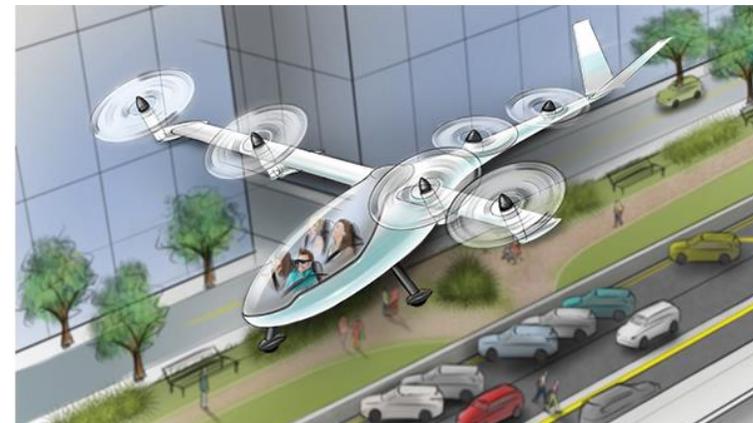# At least 19 companies are developing short range flying cars

Volocopter

Airbus modular car/UAV concept

Terrafugia (a Geely group company)

Uber Elevate

Skills

- Work in inter-disciplinary project teams

- Help deliver credible evidence for decision making and investment

- Have a wide overview of a projects wider objectives and context

- Systems thinking and systems engineering skills (should be embedded in all S&T undergrad degrees)

- Have time for life long learning as the way we do transport and the technologies available will rapidly change

- Understand risk

Understanding users

Public Attitudes tracker:
Bi-annual monitoring of the public's awareness, understanding and acceptance/appetite for new technologies
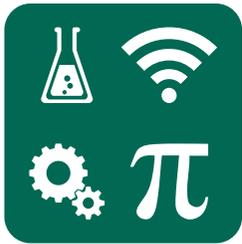
Think People programme:
Working across DfT to ensure people are at the heart of the design and operation of transport system

Using evidence:
Identifying, synthesising and generating evidence to feed into the decision-making process. The Think People interactive Dashboard is a key tool

Think People

Fostering innovation

Central Innovation Programme
T-TRIG is a cross-DfT, cross-modal innovation programme designed to encourage and support early-stage innovation and prototyping. Over half of funded grants have gone on to further collaborations with some major success stories

Group-led innovation
Technology innovation is being built in across modes including: innovation in franchising; digital rail; low carbon maritime, high speed rail technology; future roads technology; CCAV; OLEV; aviation; infrastructure

Future of Mobility Grand Challenge

Regulatory Review
To identify and address regulatory barriers to deploy emerging technologies and facilitate innovation

Capability Building
Build capability across DfT, its agencies and its supply chain to enable us to anticipate, exploit, mitigate and lead S&T led change

Experimentation & trialling
New mobility services trialled at scale in UK, drawing on public/private funding. Showcasing innovation for ISCF
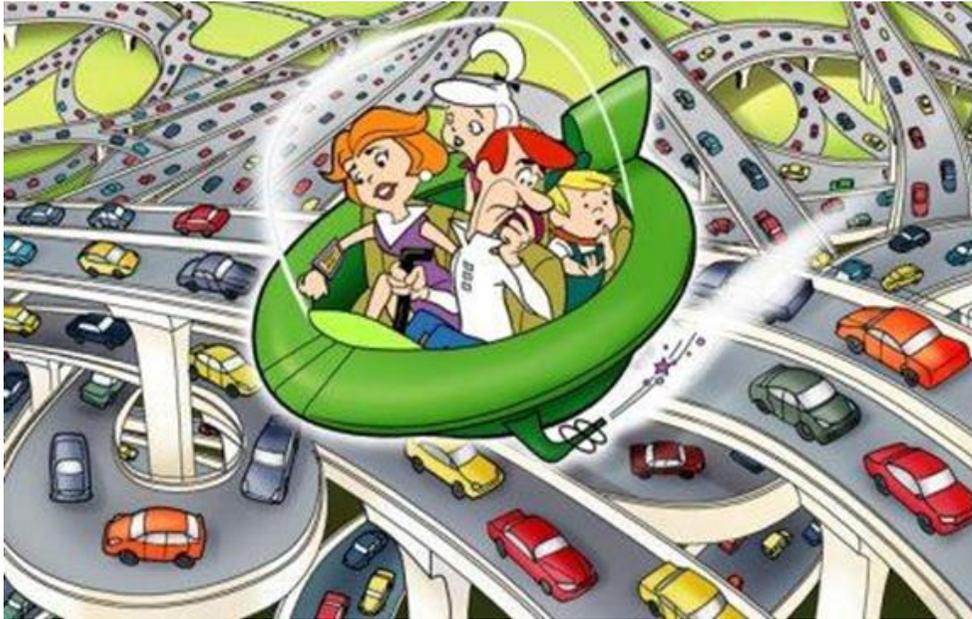
Evidence & Analysis
To ensure interventions are made with the best possible information by filling key evidence gaps

The future and beyond….

- we are on a cusp with the unprecedented rapid advancement of technology.

- vehicles, infrastructure, travellers and cities will be fully connected.

- How do we do this?

- What is the vision?

- What does society want, what does it expect?

- What skills and capabilities do we need to deliver this. We certainly don't have enough data science or new civil engineering and planning skills within government and the ability to have a systems view of the problems

- How can the CIHT help DfT deliver its strategies and also address my 3 CSA priorities?

Department for Transport

THANK YOU

Any questions please contact me on:

Phil.Blythe@dft.gov.uk