MOTT MACDONALD

london transport museum

THALES
Building a future we can all trust

GOWLING WLG

INTERCHANGE moving thinking forward

Published as part of the London Transport Museum's Interchange Programme

London Transport Museum
Decarbonising transport

Let's get moving together

March 2023

Contents


P

Foreword

Sam Mullins OBE
Director for London Transport Museum

The elephant of decarbonisation can seem like an impossibly big animal for a city or country to digest. The only solution is to tackle the beast in bite-sized chunks, starting with our own travel patterns and behaviours, moving on from what we can influence ourselves to the major issues of policy and investment to create a sustainable future.

London Transport Museum traces the evolution of transport and how it has shaped London over the past 200 years. Our predecessors will doubtless also have been daunted by the challenges facing them, digging deep below the city to create new Underground railways, applying new technology and learning on the move. Each generation has used the expertise available to overcome engineering, political and financial obstacles to create the Underground and transport network which has improved lives and promoted the economy of the capital.

Our Interchange thought leadership events bring together experts from many different fields who may not usually find themselves in a room together. At our latest event run by Mott MacDonald, with partners Gowling WLG and Thales, we invited leaders from across the UK which included participants from industry, local councils, regional government, transport operators, law firms and consultancies, charities and campaigners to explore the latest thinking on the decarbonisation of transport.

The result of these enlightening workshops is a report brimming with ideas, insights, case studies and recommendations about how to make travel more sustainable for everybody in the country whether they live in an urban environment or in a village. Yes, further investment is vital but so is governance and structure so that organisations have the confidence to pursue low traffic neighbourhoods, a new electric battery factory which can ‘re-power’ the buses on our streets or funding research into alternative fuels for rail.

We hope you find this report informative and stimulating, and that by working together we can make it easier for local residents, industry, transport authorities and government to make the shift to net zero travel.

Executive summary

Interchange and Decarbonising Transport

London Transport Museum's Interchange programme is a thought leadership initiative facilitated by the Museum, in partnership with Gowling WLG and Thales. The Interchange agenda builds upon the Museum's role as a platform for **debate** and **creativity** for the wider transport industry.

This year, the Interchange theme is 'Decarbonising Transport'. The Museum teamed with Mott MacDonald, a global engineering, management and development consultancy certified as carbon neutral, and delivering decarbonisation projects around the world.

Mott MacDonald ran three workshops seeking insights from industry, business, local/regional government leaders in Leeds and Birmingham, as well as London. This report sets out what was learnt in those workshops and includes examples and case studies of successful approaches as well as information on how to decarbonise.

This is a call to take action – for organisations that deliver, plan, and use transport: we have a lot of work to do to create a sustainable, effective and equitable transport network and travel choices. It turns out that some of the most important things we can do are not to invent new technologies (although that plays a part) but to **communicate** and **collaborate** with each other, and be **creative** and **committed**.

Why Decarbonise Transport?

The climate emergency is now well understood and acknowledged. The transport sector is the largest contributor to UK domestic Greenhouse Gas (GHG) emissions. Transport must decarbonise. Doing so will **reduce** not just carbon and GHG levels, but congestions and car dominance, air and noise pollution. It will also **benefit** job creation and economic growth, health and wellbeing, the environment and nature, place-making and quality of life. Delivering decarbonisation as part of a wider sustainability goal means these aims for reduced environmental impacts, positive social outcomes, and economic wellbeing are also achieved.

Workshop attendees considered the transport decarbonisation challenge under three topics:

- **Re-think** – how do we shift or reduce the demand for travel?
- **Re-mode** – how do we move to more sustainable modes of transport and travel, and improve their accessibility, quality and safety?
- **Re-power** – how do we change how we power our transport, and ensure it is sustainable socially, environmentally and economically?

In doing so, they thought about governance, infrastructure, technology, the environment, and how to transition. There were some cross-cutting messages – **connected and systems thinking** – that flowed through all topics.

What we learnt, and what to do next

This report sets out the ideas, best practice, issues and opportunities workshop attendees identified.

It also includes ten recommendations for what transport, business, industry and public sector leaders need to focus on as we look to decarbonise travel and transport, summarised here:

1. **Work together outside boundaries**
   Continue to find ways to share best practice, innovation, creativity and solutions – as well as challenges and barriers – across industries, organisations, with both the public and the private sector, just as this Interchange series has successfully done.
2. **Work together inside boundaries**
   Place-based approaches can create real innovation and creativity, with wider benefits achieved from bringing neighbouring businesses, residents, organisations and services working and collaborating together. Some solutions take effort and require governance and management, but they often reduce the need for large investments or infrastructure.
3. **Governments are needed not just for investment, but for structure**
   Investment is definitely needed. But governments can also provide more certainty and structure – a roadmap to net zero – that will provide companies and households with the confidence, certainty and information to enable them to invest.
4. **Electric vehicles are part of, but not the solution**
   EVs allow people to continue travelling very similarly to now. They will be a part of the solution. But EVs are not as sustainable or low-carbon as travelling by public transport, walking or cycling. The world many attendees wanted to live in was less car dominated, and more people-and nature-focussed.
5. **More public transport for everyone**
   Public transport is very sustainable. A greater focus on public transport is needed, with low-carbon energy, better interchange, reliability, affordability, and network coverage. This may require innovative approaches to financing. Mass transport systems do not just reduce carbon emissions in the transport sector, but also congestion, air pollution and embodied carbon.
6. **More inclusive, active travel**
   Walking and cycling ('active travel') is the most sustainable form of travel, and delivers many other benefits, not least health. Many shorter journeys could be walked or cycled, instead of driven as they are now. Connecting starts and ends of public transport journeys is important. Active travel schemes need to focus on accessibility, safety and public realm.
7. **Mobility as a service**
   There is a danger the autonomous and electric vehicle revolution leads to more cars, more roads, more congestion, more exclusion and more isolation. This is not the sustainable future our attendees wanted to live in. As part of a suite of solutions, Mobility as a Service (MaaS) could change how we travel and how our transport system works. MaaS describes a digital transport service platform that enables users to plan and pay for a range of transport options (public and private), based on their needs, making journeys seamless and connected. There is still a long way to go with Maas, but it could help deliver positive social outcomes and improve access to public transport. If MaaS is not viable, greater use of on-demand services could provide some of the benefits.
8. **Home working where it works**
   Connectivity does not have to be provided by a mode of transport, but can be digital. Working from home reduces journeys and the pressure on the transport system. As not everyone can work from home, we recommend it is supported where it fits with work requirements and can be applied flexibly.
9. **Bring transport and energy together**
   We cannot decarbonise transport without seeing transport and energy together as a system of systems. Bringing specialists and investment together is key. An electricity and re-charging network is needed with advances in storing energy, and infrastructure that can accommodate new types of vehicles.
10. **Focus on the world we want to live in**
    Focus on the outcomes needed to create the world we want to live in. Social, economic and environmental sustainability are needed in the round. The transport decarbonisation revolution needs to benefit everyone and the planet – the climate crisis is everyone's problem, but we can all be part of the solution.

1. Introduction

London Transport Museum's Interchange Programme

London Transport Museum Interchange programme is a thought leadership initiative facilitated by the Museum, in partnership with Gowling WLG and Thales. The Interchange agenda builds upon the Museum's role as a platform for **debate** and **creativity** for the wider transport industry.

Interchange topics explore critically important themes of crucial relevance to society today, in the context of transport. Partnering with Mott MacDonald, the latest Interchange topic considers why and how we need to **decarbonise transport**. This report concludes a collaborative **knowledge-sharing** and **idea-generating** process with leaders from the Museum's partners and stakeholders, gathered in workshops in London, Leeds and Birmingham. It presents recommendations on how to decarbonise transport and travel, having considered how we can **re-think** travel demand, **re-mode** away from car-dependence, and **re-power** transport away from fossil-fuelled vehicles. It presents findings on how to encourage and enable more sustainable travel behaviours and choices from decision-makers, operators, businesses, and transport practitioners.

The Decarbonising Transport Series

The Decarbonisation in Transport series has taken a different approach to gathering insights compared to previous Interchange topics.

The UK, like many other countries, provides very different transport and connectivity options depending on where you live – someone living in Central London, for example, will have a very different set of transport choices available to them than someone living in a rural area in the north. This means there are different challenges, opportunities, and solutions to decarbonise transport and travel, depending on geography, socio-economic issues, and the available transport network. So the Museum's Interchange programme ventured out of London this time, seeking insights from leaders in Leeds and Birmingham, as well as London.

The Decarbonisation in Transport series has focused on the **'how'** – practical things industry, business, and government at all levels can do to take action. It is a call to arms for organisations that deliver, plan, and use transport: we have a lot of work to do to create a sustainable, effective and equitable transport network and travel choices. It turns out that some of the most important things we can do are not to invent new technologies (although that plays a part) but to **communicate** and **collaborate** with each other, and be **creative** and **committed**.

Facilitated by Mott MacDonald, each of the three workshops brought together leaders of the transport industry, businesses and local and regional government. The partners and stakeholders involved can be found in **Appendix A**, and included Transport for London, consultants, transport operators and ticketing specialists, law, communications and financial firms, city councils and Combined Authorities, and transport advocates and charities. Each workshop included a group discussion session as well as smaller group sessions considering how to re-think, re-mode and re-power transport. Attendees have also kindly provided case studies of how they are addressing the transport decarbonisation challenge. This report sets out the findings from those workshops.

Mott MacDonald's role

Mott MacDonald is an employee-owned multidisciplinary, global consultancy operating in over 150 countries. With a key presence in the UK, its transport practitioners partnered with the Museum to develop and run the stakeholder workshops and develop this report to set out some of the emerging ideas for how to decarbonise transport.

Positive social outcomes are at the heart of Mott MacDonald's purpose, and its commitment to wider sustainability and decarbonisation in particular runs through its operations, projects, infrastructure delivery and culture. It is well-placed to consider how to decarbonise transport, having been carbon neutral since 2020 (PAS 2060 certified), signed up to the Science-based Targets Initiative (SBTi) and Race to Zero Campaign, and committed to being truly Net Zero by 2040 or earlier. Having helped develop the global industry standard for carbon management in infrastructure (PAS 2080), its employees work with many clients and partners to reduce their carbon emissions, consider sustainability risks and opportunities, and develop tools to monitor and enable carbon reduction. This combined knowledge and commitment brought Mott MacDonald to the Interchange programme and Decarbonisation series. These aims are shared by the programme's additional partners, Gowling WLG and Thales, and led to the collaborative approach through which this report covering the fundamental challenges of Sustainable Transportation has been produced.

Report structure

Following this introduction, the report presents the need to decarbonise transport, and then explores the ways in which this is possible through the discussion of three key topics:

- Re-think
- Re-mode
- Re-power

The workshop findings from each of these topics are set out in Sections 4-6, before the latter section of the report set out the importance of connected thinking and action, before setting out the key recommendations and next steps.

Your role

Undertaking the workshops and developing this report is only the start of a process. This work becomes meaningful and impactful if you, the reader, turns its words into actions. Which of its recommendations can you put into place in your own organisation? How can you continue the conversation with partners in your field? How can you reach out to partners outside of your field? What support and commitments do you need from government?

Let's turn this report into a conversation.

2. Why Decarbonise Transport?

The Decarbonisation in Transport series invites thinking on why and how we need to decarbonise transport and our roles in this process. The why, is simple; the urgency of climate change is undisputable, and the effects will be wide reaching on a global scale. This report focuses on the role of transport, a sector which remains the largest contributor to UK domestic Greenhouse Gas (GHG) emissions in the UK - 27% in 2019[1].

In 2020, despite the impact of Covid-19, domestic transport produced 24% of the UK's total GHG emissions and remained the largest emitting sector in the UK[2]. The majority (91%) of emissions from domestic transport came from road vehicles. The biggest contributors to this were cars and taxis (52%), followed by heavy goods vehicles (19%) and vans (16%). The demand on the transport sector will continue to grow in the coming decades, meaning GHG emissions from transport activity are predicted to continue to increase without significant decarbonisation actions.

The degree to which our climate will change will be determined by how we act and respond to the rising emissions we produce (mitigation); the degree to which the human race (and nature) will be affected by climate change is determined by how we adapt to the change[3]:

Mitigation (reducing climate change), through reducing the flow of GHGs into the atmosphere, either by reducing sources or enhancing the "sinks" that accumulate and store these gases (such as the oceans, forests, and soil)'[4]

Adapting and adjusting the way we live to an actual or expected future climate[5], i.e. finding ways to live in a warming and more volatile environment.

Alongside mitigation and adaptation, the climate emergency is also exacerbating a biodiversity emergency. The benefits of decarbonisation to help protect and enhance the natural environment, as well as the need to develop nature-based solutions, cannot be overstated.

This report considers how to mitigate against climate change by decarbonising travel and transport, from the perspective of transport operators, organisations and businesses, as well as local and regional government. The Transport Decarbonisation Plan outlines the UK Government's approach to mitigation, highlighting the pathway to net zero transport.

The approach in the Plan highlights the need to decarbonise road vehicles and increase the share of trips taken using sustainable modes (cycling, walking and public transport), making these modes the natural choice for those who can use them[6].

Furthermore, the Plan highlights the wider benefits of decarbonising transport such as:

- Air quality improvements and education in noise pollution
- Health and wellbeing benefits
- Congestion and reduction in vehicular presence
- Place making
- Economic growth and jobs

Decarbonisation is a core element of sustainability. To be delivered in a truly sustainable way, the co-dependence between social, environmental and economic factors needs to be understood.

Through united and aligned effort, decarbonisation of the transport sector could – and should – be delivered through a wider focus on sustainability, bringing about multiple legacy benefits such as reducing socio-economic disparity, enhancing wellbeing, promoting health, enhancing and protecting biodiversity, and being delivered democratically.

So, what do we mean by decarbonisation?[7]

'Decarbonisation is not just some technocratic process. It is how we fix some of that harm. It is how we make sure that transport shapes the country and the economy in ways that are good. It's about taking the filth out of the air and creating cleaner, quieter, healthier places. It's about a second, green, industrial revolution, creating hundreds of thousands of new, skilled jobs, in some of the proud towns and cities that were the cradle of the first one. It's not about stopping people doing things: it's about doing the same things differently' The Rt Hon Grant Shapps MP.'

How can you help?

This report places onus on the reader – consider what you can do to decarbonise transport and consider what help, infrastructure, and conditions you need to make sustainable, decarbonised transport a reality.

3. Thinking about how to Decarbonise Transport

We understand why we need to decarbonise transport.
The key challenge is now to identify how to decarbonise transport. All those in the sector are grappling with this – governments and organisations have provided guidance and route maps; standards have been set; practitioners have developed approaches.

Climate change is not a new phenomenon and has been growing in urgency over the last decade. With each Climate Change Conference of the Parties (COP) come new policies, priorities, and urgency. There is no denying that globally, we must mitigate against (and adapt to) the volatile and changing climate; the reasons for decarbonisation are therefore evident and clear. Attention must, therefore, be placed on how we achieve this and succeed in our efforts to decarbonise.

We can think about decarbonising transport in many ways, including the Governmental and policy approach, standards like PAS 2080 (the global industry standard for carbon management in infrastructure) and its impact, and through a transport planning practitioner lens. These all help frame the approach we take to how to decarbonise.

Policies and plans

A growing number of policies, governmental guidance, and strategies are available that outline how to decarbonise transport. For example, the UK Government has published:

- The Ten Point Plan for a Green Industrial Revolution[8]
- Decarbonising Transport: A Better, Greener Britain[9]
- Bus Back Better: the National Bus Strategy for England[10]
- The Transport Decarbonisation Plan[11]
- Taking Charge: the Electric Vehicle Infrastructure Strategy[12]
- Cycling and Walking Plan for England[13]
- Gear Change: A Bold Vision for Cycling and Walking[14]

Standards

Standards are also emerging, including PAS 2080 (currently being updated) which provides a framework by which to decarbonise infrastructure. PAS 2080 tells us that in terms of the carbon in a building or structure, the lowest carbon solutions are not to build at all, and if something needs to be built, the industry should 'build less', 'build clever', and finally 'build efficiently'.

Transport often needs infrastructure – stations and stops, tracks and routes, tunnels and bridges. Building more of these can help encourage people out of higher carbon modes (e.g. the petrol/diesel car) and into lower carbon ones (e.g. trains, buses and trams, or even better, cycling/walking). But the assets we already have can be used and maintained better, and efforts to use higher-carbon transport modes less, reduces the need to build infrastructure for it. To reduce the carbon impact of infrastructure, new infrastructure must be carbon resilient and seek to reduce carbon in both delivery and operation[15].

Transport planning

Transport planners consider the options and develop the plans for transport and travel. This is much wider than delivering infrastructure – transport planning considers whether and what infrastructure is needed, the case for investments, and behaviour change. The behaviours and options for travel choices can encourage and enable people to use more sustainable transport, affecting ways we move around and use our places. Transport planners often consider the need to prioritise and shift towards more sustainable transport choices through an inverted pyramid.

Many versions exist (see Figure 3.2 for ours), always with the most sustainable options at the top.

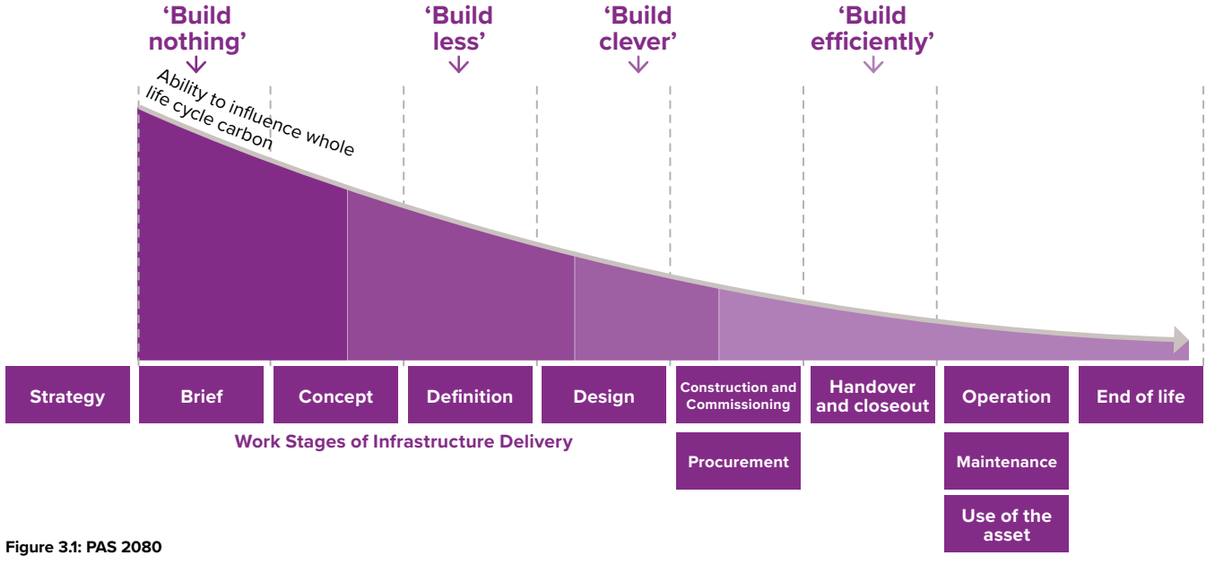
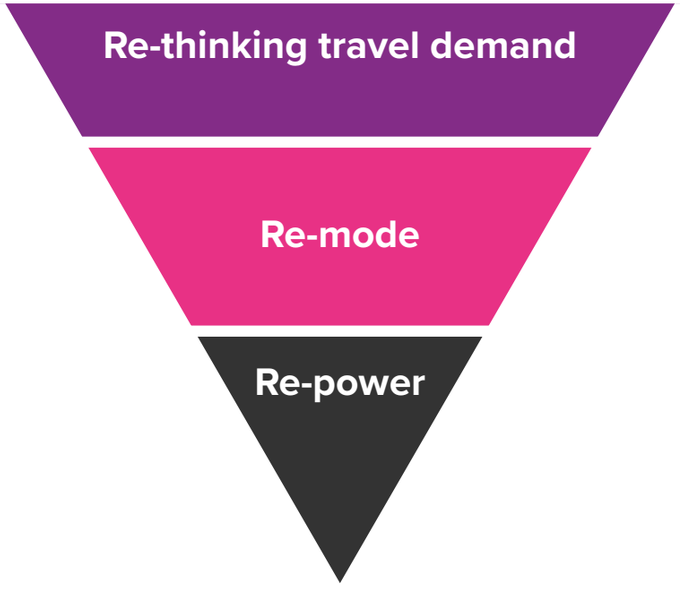


Figure 3.1: PAS 2080

Figure 3.2: Prioritising Sustainable Travel and Transport



Re-think

First, can we re-think travel demand? This approach invites people to ask themselves whether they need to:

- Travel at all?
- Travel now?
- Travel so far?

It also requires the transport, digital and planning sectors to enable and create the conditions for these choices through sustainable spatial planning, inclusive digital accessibility, and (potentially) more localised service provision. Digital advances enable many people to work from home. Travelling outside of the peak hours can reduce congestion and free up capacity on sustainable modes. Access to more local services and jobs can reduce the need to make longer journeys.

Re-mode

If re-thinking is not an option, can people re-mode?
This means switching a journey in a private vehicle to:

- Car sharing or car clubs,
- or, even better, to public transport,
- or, better still, to cycling or walking,
- and micro-mobility modes such as e-scooters are available too.

The more sustainable the mode choice people make, the more carbon can be reduced in the transport system. But this is reliant on having the infrastructure, services, information and accessibility required. New housing developments that are only accessible by car, public transport that is unaffordable or unreliable, cycling routes that feel unsafe, and buses that cannot be accessed by people with disabilities are all examples that could hinder people's ability to re-mode.

Re-power

If re-thinking and re-moding are not options, people can re-power their journeys by switching from fossil fuelled to electric modes. Re-powering is also a way for operators of public transport modes to reduce their emissions. More sustainable, 'cleaner' sources include hydrogen, electrification, and hybrid solutions.

Re-power is reliant on sustainable sources of energy and power being available, affordable and accessible to users.

Taking us forward

The ideas surrounding re-think, re-mode, and re-power shaped the discussion in the Decarbonising Transport workshop groups, and comprise the following three chapters of this report. Five key focus areas emerged as the key impactors and influencers of the ability to re-think, re-mode and re-power. These are therefore reflected within each chapter, and they are:

Government: the ability of policy drivers to influence, impact and encourage a modal shift and change travel behaviour, as well as our response to uncertainty in an ever-changing societal context.

Infrastructure: the role of infrastructure in ensuring a safe, useable and well-designed transport network, which is appealing and accessible for all users.

Technology: the role of technology is ultimately changing the ways we think about and use transport, particularly public transport services.

Environment: the increasing awareness and understanding of our individual and societal impact on the environment and climate change.

The transition: the ability and speed with which a transition to decarbonisation can be progressed, in the context of re-think, re-mode and re-power.

Location matters

The responses of workshop attendees are taken together in the next sections of this report. Key messages emerged from all three workshops, and there was much more commonality than disparity. But there were some particular differences between the London workshop and the two in Leeds and Birmingham.

Public transport was more of an obvious option for the London workshop attendees, to the point that it was almost taken for granted. Londoners are very used to decades of investment and management of an interconnected network, such that public transport is viewed as frequent, ubiquitous, and often seamless. There are still issues, but sustainable transport options in the capital are available to a much greater extent than the rest of the UK.

By contrast, more attendees in Leeds and Birmingham talked about issues of disconnected bus networks where tickets do not work between operators, where many areas (especially rural areas) are not served by buses, and services can end in the early evening. Public transport was not a given in the same way, and life without a car is much less common. The default option for many is the car. And there was a sense that the same investment and cohesive management of transport does not occur outside of Greater London, or at least not as much.

4. Re-thinking transport and travel

What is re-thinking?

There are opportunities to reduce the demand for car travel and to enable journeys to shift to lower carbon modes of transport, through governance, infrastructural, technological, environmental and transitional changes.
In this section, we explore the current state and future trends of 're-thinking' for our transport system. Re-think predominantly refers to questioning **why**, **when** and **how** people travel, with the aim of causing a shift from the conventional needs and reasons to travel. We asked workshop attendees to consider:

- Do I need to travel?
- Do I need to travel now?
- Do I need to travel so far?

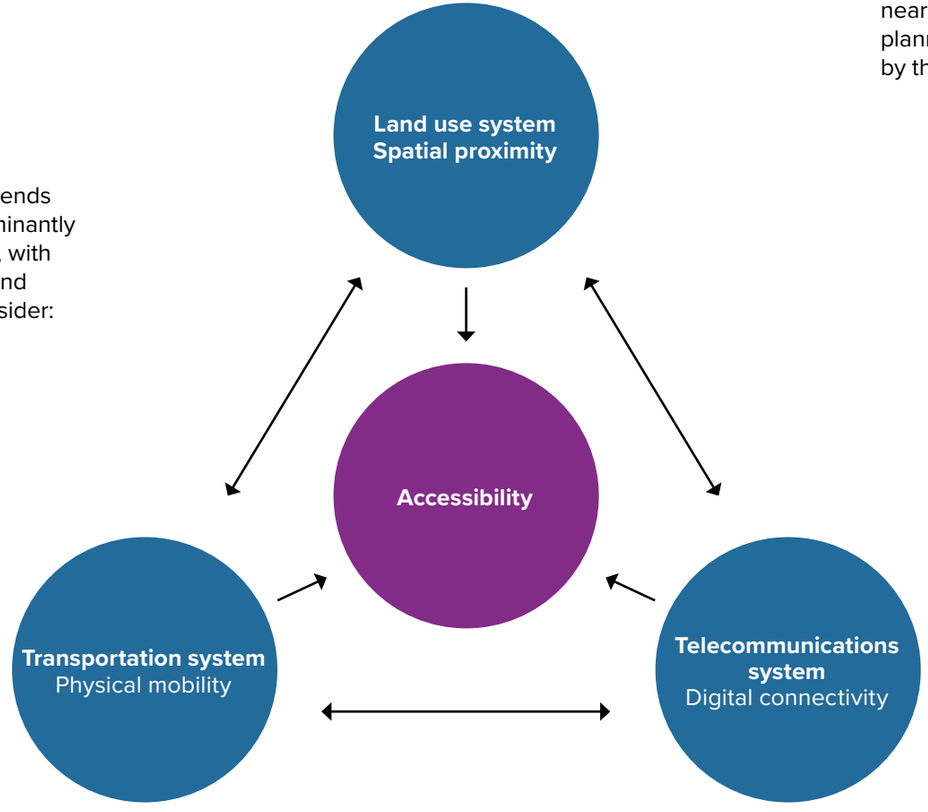


Figure 4.1: Triple Access Planning – a new approach to connectivity
Source: Prof. Glenn Lyons, Mott MacDonald & University of the West of England

Re-Thinking Transport: Now and the future

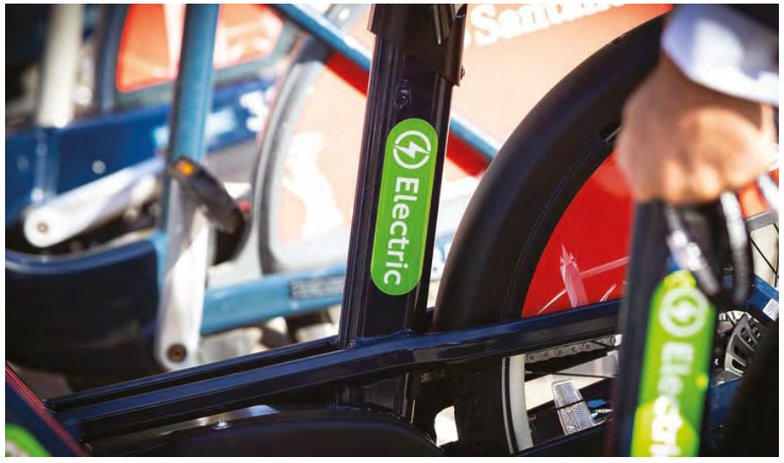
The pandemic changed the way people think about and use transport, with developments that have both positive and negative consequences for the sector. The impacts by mode will be discussed in Section 5.

Connectivity and accessibility is not always a question of a transport link, but increasingly is a question of access to nearby services, the connectedness of the transport and planning systems, and digital connectivity – as represented by the Triple Access Planning concept (Figure 4.1).

In the early stages of lockdown, more people were walking and cycling, with summer weekends seeing over three times as many cyclists as pre-pandemic levels[16]. In addition, air travel fell and many discovered holiday locations closer to home. People were travelling to work less, travelling less far, and recognising the health and wellbeing benefits of active travel.

With this, the shift to remote working has provided fresh perspectives on the future of work and commuting, with video conferencing reducing the need for business trips. However, since the pandemic, cycling has since fallen and private car use quickly returned to pre-pandemic levels, with London bus and Underground use returning to below pre-pandemic levels; perhaps making the drive to shift away from cars to public transport more challenging. Despite this, the balance between leisure and commuting trips has changed, with leisure travel up on Mondays and Fridays, while public transport is noticeably less busy with commuters on these days.

The pandemic accelerated a trend towards more digital accessibility. For some people, geographical access to jobs has become less critical. People are more used to ordering shopping, goods and services to come to them. Some of these trends, while reducing personal journeys, have negative as well as positive consequences. The rise in online shopping, for example, risks increasing pollution from heavy goods vehicles[17] if they are not electrified, and increases movements of light goods vehicles. Looking into the future, how people use transport and the type of transport they use will change. Workshop attendees were aware of this as they considered what was needed to re-think transport and travel.



What did we learn about re-thinking?

Reducing demand for car travel can reduce emissions, but also brings benefits for congestion, air quality and health. Workshop attendees told us about the governance, infrastructural, technological, environmental and transition needs to re-think journeys, as well as existing barriers and how to overcome them.

Governance

All attendees were influenced by multiple layers of governance. How businesses operate, the services provided by local authorities, the decisions of regional and national governments – and their investment choices – were all discussed.

Many attendees felt that key, radical decisions are required in order to make meaningful shifts in societal behaviours around decarbonisation and travel demand and that the ultimate impacts of climate change are long term and catastrophic, and are not fully reflected in current risks assessments, analysis and mitigation measures.

Taxing and pricing on the motorist

Workshop attendees suggested one possibility in disincentivising private car use is dynamic pricing for road users. This is the practise of varying the price of the tax on a vehicle that reflects the time of day, congestion on the network, road type and other possible factors such as financial situation for that individual. This reform to the existing road taxation system could assist in managing traffic flows and could be a great opportunity to develop a fairer road funding system, that remains **accessible** and **affordable** for those who have no choice but to use a private vehicle.

In addition to this, parking permits which incentivise vehicles that emit the lowest levels of pollution and carbon emissions, and disincentivise a second car, already exist in several Local Authorities throughout the UK. However, workshop attendees felt a more linked up approach to pricing based on carbon emissions, vehicle type and a stronger, location-adapted policy on second car permits is required.

Finally, the introduction of ‘Clean Air Zones’ across cities in the UK has enforced motorists with vehicles that exceed emission standards to pay a charge, with the overall aim of improving air quality and delivering its associated health benefits, as well as congestion. While workshops attendees did not talk about this government scheme, it is a useful example of how to facilitate uptake in low emission vehicles, as well as encouraging alternative modes of transport inside these zones.

> “Political will and impetus is needed to drive solutions. For example, the creation of the London Sewer System in 1859 in response to the cholera epidemic.”
>
> **Phil Davies**
> Co-founder and Commercial Director, Magway

(It is believed that MPs’ worries about their own health may have finally encouraged them to commission the new system[45].)

Controlling and improving our transport network

Andy Burnham's bus reforms in the Greater Manchester region are an example of improving the **ease** and **connectivity** of the transport network. Buses on the local network are still run by private companies but the Greater Manchester Combined Authority will be taking control of fares, timetables, routes and ticketing. This means simpler fares and ticketing, and joined up timetables between buses and trams, making modal changes easier, more connected and quicker. This reform should also aim to improve speed and punctuality of buses, making them an attractive option for travel. Workshop attendees thought this approach could work in other cities too.

"Mobility as a Service" (MaaS) was also discussed. MaaS enables users to plan and pay for multiple types of mobility services (types and modes of travel) and enables a shift away from private vehicle use. Essentially, it takes the way we travel now and shifts it to a system where we do not own cars, but access the modes we need to make an A-to-B journey in a seamless, connected and digital way – much in the way the music industry has moved from selling significant numbers of CDs to accessing music on demand via a 'cloud' on an app.

Schemes like this can be a driver for young people to engage with public transport. So can improving the attractiveness of the service. By improving the aesthetic appearance of buses, for example, and incorporating accessible features such as free Wi-Fi, we can tap into the passionate and positive enthusiasm that young children and teenagers have for the environment and create a norm for using public transport services.

> "Making green impacts measurable and digestible to the end user, like nutritional information, is a way to drive incentives."
>
> **James Comley,**
> Senior Consultant
> Transport Subject Matter Expert, CGI

Awareness

Workshop attendees considered how to make carbon easier to understand and more of a direct driver in decision-making.

Simplifying and demystifying **carbon** should be a key focus for government and transport authorities. Sustainability needs to be more visible in public life, and impacts of sustainable decisions should be **measurable** and **digestible** to the user, like the red, amber, green nutritional information on food packaging.

Such schemes and visibility would allow more people to make the link between their behaviour and climate change. This awareness could be implemented through personal carbon allowances – a concept that would see every person or household given a limited emissions quota to spend on heating, energy, travel etc. Although radical, it reflects the severity of the **climate crisis** we find ourselves in, and this would encourage consumers to seek greener energy, fuel and goods to stretch their allowance further and make decisions based on carbon, alongside cost and ease. Although there is no agreement on how this scheme would work, workshop attendees suggested it could be mandatory and cover energy and transport at the very least; allowances would be tradable to reward lower use and over time, the quotas would be reduced to reach **net zero**, in line with government targets.

Infrastructure

Infrastructure also affects the travel choices people make. In terms of re-thinking whether you need to travel at all, re-timing a journey, or re-considering the distance travelled, people need:

- Digital infrastructure to enable them to work from home, with fast and effective access to the internet.
- Transport at the right times and frequencies, coupled with reliable travel information. The existing transport infrastructure is always there to use, but journeys can only be retimed if services run early and late enough, with good frequency, and capacity. This means infrastructure is required to provide enough capacity on rail lines and bus routes, and the network needs to be available to serve the needs of shift workers as well as '9 to 5' employees.
- To shorten distances people need to travel, spatial proximity is essential – locating facilities near each other (e.g. the 15-Minute Neighbourhood concept[18]), and providing services locally. New housing developments which are only accessible by car, with health, education, retail or cultural services also in out-of-town car dominated areas (or in city centres but not in local town centres) mean people need to make long journeys. By aligning spatial planning and local transport decisions more closely, to provide more services within accessible local centres and encourage sustainable and car-free developments, we can enable people to consider shorter and more sustainable trips.

Electric Vehicles

Electric vehicles (EV) are a key part of decarbonising the transport sector. For cars and vans, battery-electric vehicles are now widely available, and likely to be cost saving by the late 2020s[19].

We talk about EVs later when re-powering transport, but they also came up frequently when considering re-thinking travel.

Workshop attendees talked about balancing accessibility of charging with demand and affordability. To consider EVs, people need to know they can access EV infrastructure if they work shifts, if they need it at peak times, and if they need it in a hurry.

At the workshops, behaviour change campaigns were also discussed, not just to shift to EVs but also to use existing vehicles more efficiently. While there is a gradual shift to electric vehicles, marketing can help to speed this up. Due to affordability, accessibility and charging infrastructure, a campaign to use current cars more efficiently, as was done in the 1973 oil crisis, would ultimately reduce the amount of carbon produced per litre of petrol or diesel. There is an urgent need to cut Greenhouse Gas emissions, and efficiencies of petrol cars at 55-60mph as opposed to 70mph, result in petrol consumption falling by 17%[20], not only saving energy, but also carbon emissions.

"There is a risk of industry considering solutions in isolation without decision makers' or public buy in. The key to making greener choices is by making them the cheapest and most convenient. We cannot rely solely on 'green tipping' alone."

Stephen Bennett
Director, Transport Consulting, Arup

Working patterns, home working and their impacts

The National Travel Survey shows that:

- In 2019, 25% of car mileage was for commuting purposes and 11% for business[21].
- In 2020, overall car mileage decreased by 27% (from 2019), however, 24% still accounted for commuting purposes and 9% for business.
- In 2021, overall car mileage decreased by 4% (from 2020), however, 25% still accounted for commuting and 7% for business.

In addition to these statistics, in 2021, it was found that 71% of people work from home less than once a year or never, in comparison to 77% in 2019[22]. Therefore, despite the pandemic and increased home working, there is still a large proportion of the UK work force who do not work from home – and many who work in jobs that cannot be done from home. For some, the car may be their only way of getting to work – for example, if they work shifts at times when public transport is not available.

Homeworking can be more beneficial for caring duties or mental health, but for others office-working may work better for the same reasons. Clearly flexibility and equitability are key considerations.

Workshop attendees suggested funding and governance priorities could change to encourage more home working. The public sector could lead the way offering more flexible working, and government could divert some investment to super-fast broadband from road network expansions. But the attendees also acknowledged that some companies or organisations may need employees in the office for collaboration, client-engagement, for wellbeing, or even because leasing arrangements meant employers did not have the flexibility to downsize.

The benefits of homeworking have to be balanced with other objectives. Workshop attendees talked about the need to encourage people into the city to use services such as cafes and bars, to boost the economy. They considered the true carbon cost for home working activities, for example, whether heating many homes as opposed to one office was better for carbon. With the trend for part- or full-time home-workers to relocate out of urban centres, they wondered if improvements in community offices or office space in dormitory towns could be the compromise between office and home working. This would benefit local cafes and shops, and having offices nearer people's homes would mean an **active travel mode** (walking or cycling) for commute is possible. It is important to consider the influence that travelling less has on the economy, and the economic impact of home working on smaller, locally-owned shops and amenities, rather than just considering city centre economic impacts. This could support a more localised-solution to hybrid working and encourage an overall reduction in the transit of goods and people.

Technology

Technology has the power to improve our transport networks in terms of reliability, understanding and communicating travel patterns, and advancing new areas such as autonomous vehicles. But it also improves other aspects such as virtual environments (enhancing home working capabilities and our ability to collaborate in an efficient and beneficial way), scenario and uncertainty planning, communicating with citizens, and collaborating online on scheme development and delivery. When re-thinking journey times, needs and distances, these are all relevant.

Reducing the need to travel

Digital technology and advancements in areas such as **virtual** reality and the metaverse opens opportunities for a more distributed and diverse workforce to collaborate in a virtual office from home. This can be extended to other areas such as training centres and employee socialising where authentic interaction is still possible without the need to travel. Workshop attendees felt these advances would further increase homeworking and decrease the need to travel for work but also for social reasons.

Improving public transport networks

In addition to this, technology has a role to play in improving the ease of planning journeys and relying on public transport. Sourcing live, accurate, reliable information from all modes of transport in one place like an app not only helps planners identify busier routes and times, and therefore improve their operations, but also encourages people to use public transport as it becomes easier to understand, more reliable, more convenient, and more interconnected. Information such as which coaches on the train are less busy, where electric scooters and bicycles can be found, and which walking routes are well-lit or less polluted roads, can all help people re-think their travel.

Technology will also assist in implementing on-demand services and MaaS. When minimum wait times are below 6 minutes for public transport modes, people are more likely to choose that mode of transport and embark on their journey with minimal planning. If live data could assist with determining a minimum level of demand to make a journey viable for a transport provider, then modes of transport could respond to this. Monitoring and using this data to understand travel patterns for commuting, the weekend and leisure travel will help services in meeting demand.

Environment

At present, there is more awareness and understanding of the impact that **human behaviour** has on the environment and climate change than ever before. Alongside this, there is a generation of young people who are enthusiastic and passionate about seeing change and conscious of making more sustainable decisions.

Lifestyle changes

Workshop attendees talked about how the charge on single use plastic bags in major supermarkets is an example of how a change in policy, which affects everyday lives, can make a huge difference in a short space of time. The charge was first introduced in October 2015 and prior to this, single use plastic bags were free in England in all major supermarkets. It is estimated around 140 bags per person were given to customers in 2014. Since introducing the scheme, the number of bags used has reduced by more than 95% in England, such that the average person now buys just 4 bags a year. The pandemic's influence on homeworking was also talked about in the same context: entrenched habits can be changed. Mechanisms that help transport users understand – in monetary values – the impact of their choices can shift their choices. Charging and fares are examples where this could be used in practice.

Personal health

Since the pandemic, there has been an increased concern for personal health and wellbeing alongside climate conscious, sustainable decision-making. Some attendees talked about the wellbeing benefits of home working, walking and cycling. Although not discussed as much by attendees, there is increasing evidence that the perceived health, quality of life, wellbeing and life-expectancy benefits of active travel can be a greater driver of sustainable travel choices than carbon/environment. The physical and mental health benefits of increased active travel, improving road safety, and accessibility to open spaces are also well-evidenced.

The Transition

To help people think about reducing travel, technology emerged as the key theme from the 're-think' workshops to help enable the transition. People need access to digital connectivity to reduce their need to make a journey for work or to access services. They need access to accessible, easy-to-use, and integrated apps or websites with up-to-date and detailed information sources, to enable them to re-time and re-consider journeys. Technology can make public transport more viable, convenient and user-friendly. And technology is also making public transport greener as modes shift to greener fuels.

Demand

More demand-responsive services could emerge as MaaS becomes operational. If bus networks are struggling to be economically viable outside of towns and cities, workshop attendees wondered if demand-responsive services or automated, driverless vehicles could provide viable alternatives to private car ownership for rural areas.

The changing nature of travel demand was also discussed. Post-pandemic, Mondays and Fridays are less busy on public transport for commuting, but leisure travel is up[23]. Train operators still operate services with reduced Sunday running – which is often further reduced by engineering works – but a more frequent Sunday service could better provide for the growth in leisure trips and provide an easy and efficient alternative to the car.

> "Businesses are stuck without demand or policy, as most solutions are not financially viable."
>
> **Graham Davies**
> Commercial Director, Arriva

Modes of transport

Increase in car occupancy, such as shared cars and trips is another form of mobility as a service, and something which has been successful with app-based demand-responsive services entering the taxi market. Users on a similar route may share vehicles for a cheaper price, and this model can extend to larger, minibus vehicles. This mode of transport would create a hybrid of public and private transport, and better investment and awareness in this area would help reduce the statistic that two-thirds of car journeys are currently only undertaken with just the driver in the vehicle[24].

Social pressure to increase car occupancy could be encouraged through methods such as companies encouraging car sharing schemes for commuters, as well as car clubs and ridesharing apps.

Case studies

Attendees at the workshops shared how they, their companies and organisations are re-thinking travel, or helping transport users to do so.

Transport for the West Midlands (TfWM) – Commonwealth Games Travel Demand Management Programme

The Birmingham 2022 Commonwealth Games had unique transport challenges with much of the planning impacted by the global pandemic. The ambition to put on a sustainable Games came at a time when confidence in the use of mass transit was at an all-time low. It was further impacted by rail industrial action during the Games.

TfWM and partners successfully delivered a comprehensive and effective Travel Demand Management (TDM) programme that ensured the continued functioning of the transport network during the 2022 Commonwealth Games.

A proportionate and targeted TDM programme was vital to keep one of the most congested regions in the UK moving, supporting reliable journeys for athletes and spectators, whilst helping residents and commuters understand how, when and where to travel. Data and intel were used to form the “Core Narrative”; a single source of truth document, used to develop the messaging matrix to inform wider communication and engagement.

- Engagement from 834 businesses and 261,000 employees
- 91% of businesses had thought about travel planning for their staff
- 711,950 spectators used the Journey Planner, receiving tailored travel advice.
- 50,081 spectators saved travel plans to be kept updated about their journey.
- The Games journey planner was one of the most used sources of travel information for the Games with 48% of spectators using the Games journey planner to access travel information.

TDM delivered the right message to the right people at the right time helping to provide sufficient capacity across the transport network to cope with the unprecedented demand resulting from the Games. The programme helped to achieve:

- More than 650,000 spectator journeys on shuttle buses and 54% of spectators used public transport.
- Birmingham New Street train station recording its busiest day, with over 255,000 passengers on August 6th.
- West Midlands Metro patronage doubling its pre-covid numbers.
- West Midlands Cycle Hire doubled the number of bike hires - 28,000 during the Games.

The TfWM TDM programme demonstrated, as the London Olympics TDM programme had before it, that significant strides can be made in encouraging people to re-think travel by using data, intelligence and science to apply targeted marketing and advice.

In addition to the TDM programme, the Organising Committee (OC) legacy report sets out the carbon reduction actions taken across the Games including transport. The carbon footprint for the Games was 201,800 tCO2e with spectator travel accounting for 52%. Furthermore, TfWM Games journey planner included a carbon calculator allowing the promotion of carbon literacy giving an insight how people could reduce their carbon footprint and be advocates for change.

Midlands Connect Carbon Baseline Tool

Midlands Connect is a voluntary partnership Sub-national Transport Body (STB). Midlands Connect researches, develops and progresses transport projects that will benefit the region, its people and its businesses. The Carbon Baseline Tool provides an estimate of the region’s transport tailpipe carbon emissions in Carbon dioxide equivalent (CO2e). It uses a combination of transport models from across the region to create a bottom-up estimate of vehicle kilometres and emissions. The calculation is a best estimate for an annual amount of carbon for the current situation (2019) and a horizon forecast for 2050, using published government trends on aspects such as vehicle fleet changes and fuel efficiency. The emissions are “sliced and diced” into modes, trip distance, trip purpose and so on, giving insight into the types of trips we should focus our decarbonisation interventions on.

Impact

The Baseline forms a starting point in the journey to reduce carbon emissions in the region and enables authorities to target the right segments of transport emissions in their forthcoming Local Transport Plans. It also showed a further need to collaborate, and to aid this we are creating opportunities for this, for example through our quarterly Midlands Transport Decarbonisation Forum and Centre of Excellence Work.

Carbon Literacy

Transport for London (TfL) has introduced a one-day Carbon Literacy course for colleagues, accredited by the Carbon Literacy Project. Through this course, TfL employees increase their awareness about their individual and collective role in reducing TfL’s carbon emissions and supporting the Mayor of London’s ambition of London becoming a net zero carbon city by 2030. To date, more than 500 colleagues across the business have taken the training and the aim is to significantly increase this number in 2023.

TfL has also announced a regular intake of Sustainability Graduates and Apprentices will commence from this year to help develop a strong pipeline of new talent. TfL received a record-breaking number of applications, showing the high level of interest in working for an organisation committed to expanding its work in sustainability.

CPCS Tool for assessment of financing opportunities for municipal transport decarbonisation projects

Similarly, CPCS (a global management consulting firm working in transport, power and public-private partnerships), recently advised a national funding organisation in Canada on the options for financing transport decarbonisation projects at the municipal level, with a focus on the potential for use of loans.

CPCS assessed a long list of over 40 different approaches for transport decarbonisation in terms of environmental impacts, municipal influence / jurisdiction, and business or economic case. The short-listed opportunities were then assessed for financing options, using an innovative approach based on both the certainty of the solution (likelihood of achieving Greenhouse Gas impacts) and the ability to monetise the solution (through revenues or cost savings). The matrix shown in Figure 4.2 illustrates the tool used to assess opportunities and could help inform the financial strategies municipalities can take for various decarbonisation solutions. Engagement with municipal authorities across Canada helped inform the study results, though the approach is broadly transferrable to any developed country.

Safe, sustainable travel for young Londoners

On behalf of Transport for London (TfL) London Transport Museum delivers the STARS (Sustainable Travel: Active, Responsible, Safe) programme. Through a range of engaging interventions the Museum promotes active, safe, responsible and sustainable travel to 100,000 young Londoners each year. Resources provided include a pop-up street scene, which help children to learn about choosing active or sustainable travel, as well as ticketing, staff recognition and how to keep themselves safe.

STARS Accreditation encourages more than 1,400 schools, nurseries and colleges to swap car journeys for active travel. Since the accreditation scheme started in 2007, STARS accredited schools have replaced over 22 million kilometres of car journeys with active travel. That's an incredible step towards a healthier, less congested London.

Our STARS Secondary Challenge team also delivers an in-depth support programme that helps schools improve and maintain their Accreditation level. The programme focuses on student leadership, so that young people are empowered and recognised for their work to change travel behaviours for the better in their own communities. This activity supports the Mayor of London's transport strategy, particularly Vision Zero which aims to reduce traffic related accidents and deaths, and the Healthy Streets approach.

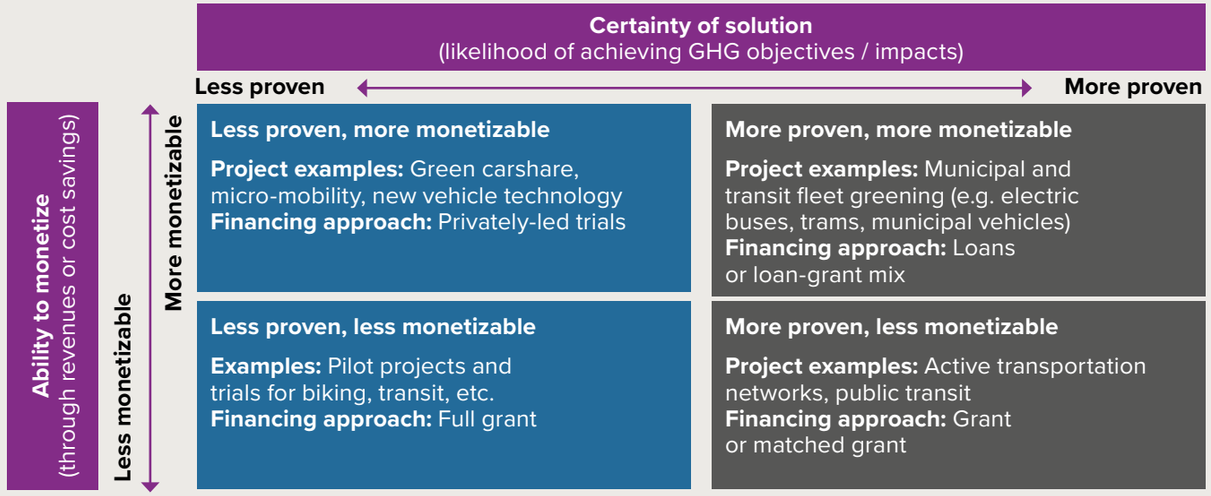


Figure 4.2: Matrix Tool for assessing decarbonisation opportunities
Source: CPCS

5. Re-moding transport and travel

What is re-moding?

Re-moding is making a journey by a more sustainable mode. The private, fossil-fuelled car is the least sustainable way to travel (especially with only one person in it); walking is the most.

Least sustainable
- Private motor vehicles
- Low emission vehicles, e.g. EVs
- Public transport
- E-mobility
- Cycling and walking

Most sustainable

Cars and taxis accounted for over half of the UK's GHG emissions in the transport sector in 2019; when heavy and light goods vehicles and motorcycles are added to cars and taxis, they accounted for nearly 9/10th's.
We asked workshop attendees to consider re-moding as a way to decarbonise transport, questioning:

We asked workshop attendees to consider re-moding as a way to decarbonise transport, questioning:

- How can we encourage and enable people and businesses to shift from using less sustainable to more sustainable modes?
- And can we do so while safeguarding (and improving) their accessibility, quality, and safety?'

This section considers re-moding, how people currently travel and future trends, and highlights the key messages and themes that emerged from the workshop discussions on the opportunities and challenges to make sustainable transport modes attractive, safe, accessible and high quality.

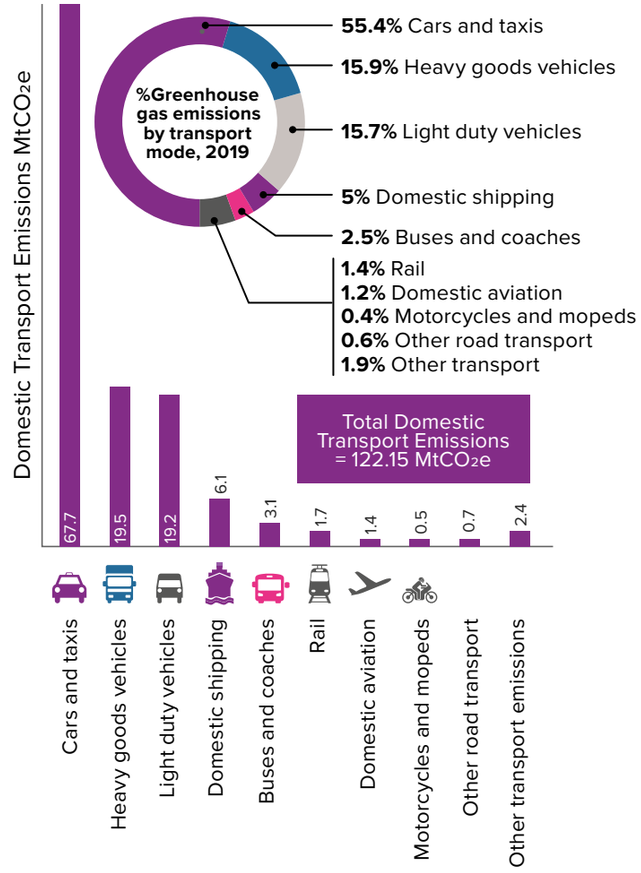


Figure 5.1: UK domestic transport emissions 2019
Source: Decarbonising Transport – A Better, Greener Britain, DfT, 2021, using 2019 data from BEIS

Re-moding transport: Now and the future

Journeys made by passenger cars, vans and taxis rapidly increased from 1960 to 1990 (see Figure 5.2), before increasing at a slower rate until the pandemic hit. Meanwhile, bus and coach use has gradually decreased over the same time period, and rail use began to gradually increase over the past two-three decades, until the lockdowns began.

From 1990, Greenhouse Gas (GHG) emissions from private cars gradually increased before gradually decreasing from the late 2000's (around the same time that emissions from heavy and light goods vehicles began to increase) (see Figure 5.3). The greatest change in the proportion of GHG by mode from 1990 to 2018 was a significant increase in van and international aviation emissions.

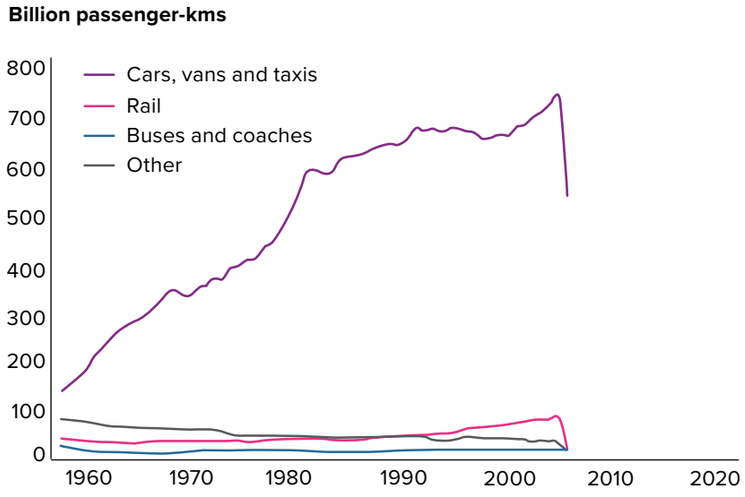


Figure 5.2: Passenger kilometres by mode, Great Britain, 1960 to 2020
Source: Transport Statistics Great Britain, 2021, ONS

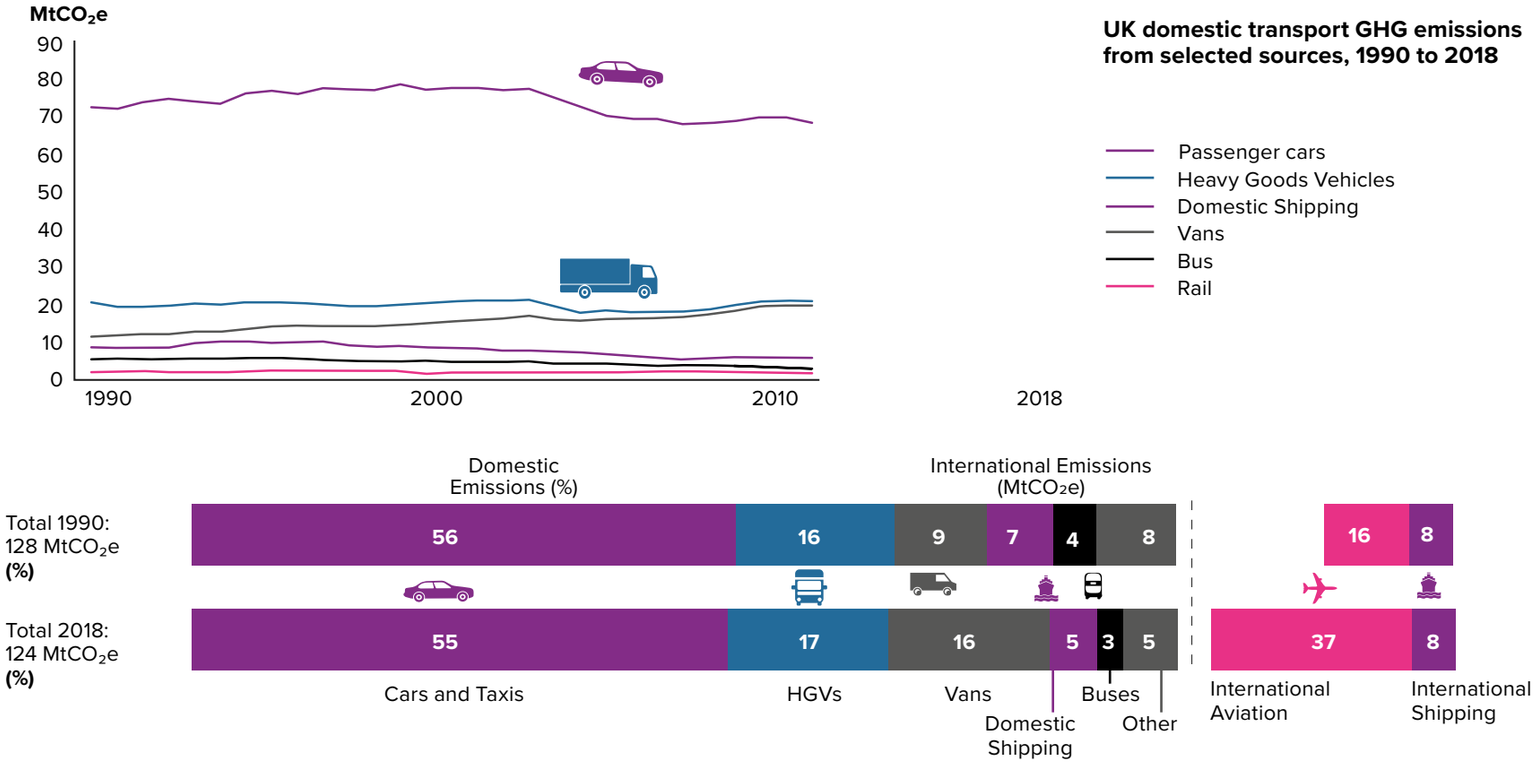


Figure 5.3: UK domestic and international GHG emissions, 2018
Source: Decarbonising Transport: Setting the Challenge, 2020, using 2018 UK GHG emissions from DfT (2018) Transport Statistics Great Britain 2018

Covid-19 drastically changed the way we move around, the mode of transport we choose and the reasons we travel. The pandemic initially caused a reduction in demand for public transport whilst under restrictions; as these restrictions began to ease and travel patterns started to change, old trends started to re-emerge with private car use recovering quicker than expected[25] and significantly more than other modes, as can be seen in Figure 5.4. To avoid a car-led recovery back to overdependence on fossil-fuel powered vehicles, there needs to be a shift in travel choices as well as demand.

Re-moding presents both an opportunity and an approach to changing travel behaviour to support a modal shift away from the private cars to public transport, active travel, and more sustainable modes of transport for all journeys and to build back greener. It can be done, with the right mix of 'carrots' and 'sticks'. The travel restrictions implemented due to Covid-19 profoundly impacted travel behaviour and saw a significant rise in the popularity of cycling and walking[26]. During the pandemic, there was a 100% increase in weekday cycling and up to 200% on weekends. Furthermore, the percentage of walking trips has been steadily increasing since 2014, and in 2018, 27% of all trips were made by walking[27].

It is unclear how long it will take for public transport to ‘catch up’ to its pre-Covid levels (and indeed, if it will), as car and van use have been able to do. The rise in popularity of electric and hybrid SUVs (sports utility vehicle) and the emergence of EVs and e-mobility (e.g. e-bikes and electric scooters) could disrupt future trends and erode the benefits of reduced car travel; MaaS potentially also lies ahead and modes we can only dream of may exist in our lifetimes. Workshop attendees acknowledged these uncertainties, but recognised the impact ‘carrots’ and ‘sticks’ can make to encourage and enable more sustainable transport use in the future.

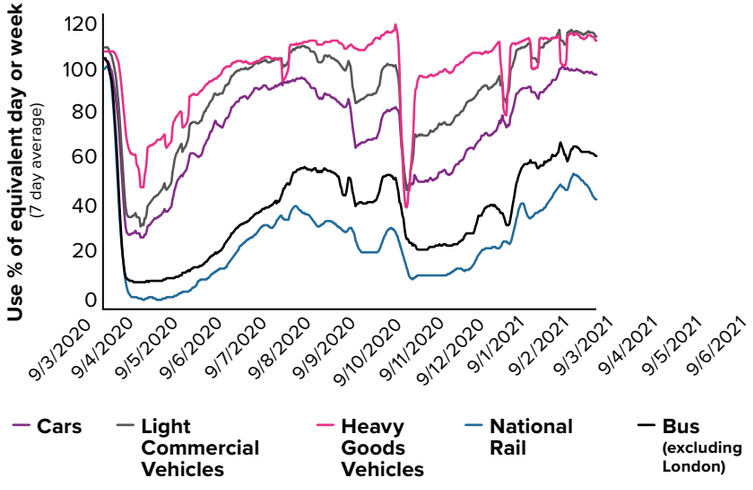


Figure 5.4: Transport usage (%) by mode, March 2020-June 2021
Source: Decarbonising Transport – A Better, Greener Britain, DfT, 2021, using data from DfT (2020 & 2021) Transport use during the coronavirus (COVID-19) pandemic

What did we learn about re-moding?

Workshop attendees told us about the challenges and opportunities their employees, customers and residents faced in choosing to use public transport or active travel, the challenges faced by people who are disadvantaged or from marginalised groups, and those experienced by operators and decision-makers. Barriers to using EVs are covered later in ‘Re-Power’.

Governance and policy

Behaviour change and convenience

Governance and policy can significantly impact and influence travel behaviour and patterns; policy drivers have the potential to both encourage, and hinder progress towards a modal shift away from private cars.

Behaviour change is often significantly shaped by **convenience** and **safety**, both of which affect mode choice; the transport sector has the ability to influence travel behaviour, but place-making can support the outcomes beyond, helping to shape the landscape in a way which makes different modes more accessible, safe and easy to use. Workshop attendees recognised that cars are often thought to be the most convenient mode for most people; this is particularly true for some societal groups more than others, such as adults and families needing to do the school run and then travel on to work on time. These different commitments can mean multiple trips and modes are needed. Attendees said such trips are often not considered to be practical by bike or on foot, especially if multiple stops are needed before a journey into work.

Furthermore, cars were viewed as more convenient for older people who may find active travel and plublic transport difficult or inconvenient to access compared to driving a car that is parked outside the house and has no timetable, especially for those who find walking difficult. The provision of school bus services can reduce the number of private car journeys made by parents, whilst also ensuring pupils have access to **a safe, reliable and affordable bus network**. Free bus travel for older people has worked well to incentivise its use, but an increase in on-demand services could help those with mobility issues or living in rural locations to reduce car use.

Policy interventions, for whom?

Workshop attendees talked about who policies target, and the **fairness** of that. They recognised that, for young people, learning to drive and having a car is often seen as a rite of passage, a possession, and status symbol. Starting to drive is as much about convenience as it is about independence, freedom and the status that comes with owning a own car.

This is particularly true for those living in rural areas where the availability and frequency of public transport is often significantly less than in cities, and cars are depended upon for freedom, independence, and to access services and education. Workshop attendees wondered if policy should aim at older teenagers to prevent car dependence before it becomes their primary mode of transport, and encourage habitual use of active modes and public transport the natural travel choice. It was recognised that young people are increasingly moving away from owning ‘things’ (e.g. music, as discussed before), but that encouraging public transport could only work if public transport is available for the journeys people need to make.
For older age groups, workshop attendees said policy interventions need to break **the car-convenience barrier**, both by disincentivising car use and by making public transport more attractive and easier to use. Ideas to disincentivise car use included:

- Restricting parking in town centres, and at schools during the pick-up and drop-off time to deter people driving their children to school.
- Tolls and zonal charging to deter drivers from certain areas in cities and towns that experience particularly bad air pollution from transport emissions.
- Pedestrianizing centres, restricting vehicular access to reduce vehicle presence in town and city centres; by reducing the volume of traffic the appeal of walking and cycling in these areas is vastly improved.

There is a need for good quality, accessible alternatives to enable the transition away from driving and reduce our dependence on cars. The role of policy in encouraging the uptake of active modes lies in providing incentives such as tax relief and reward programmes including the cycle to work scheme. However, incentives must be implemented alongside efforts to overcome the barriers to cycling which largely centre around road safety concerns and lack of adequate infrastructure[28].

However, it cannot be ignored that walking and cycling is not accessible to everyone and by making it harder to drive and park in town/city centres, it may socially isolate those who cannot easily use other modes. Policy interventions must meet the needs of all users, particularly those with restricted mobility, or those who live more rurally with limited services.

Infrastructure

The transition away from cars and towards more sustainable transport modes is not possible without the infrastructure to both support and encourage it; this infrastructure must be **accessible, inclusive, high-quality and safe**. Without this, the appeal of such modes will not match that of driving.

Safety and accessibility

Safety is a crucial aspect of progressing towards both active modes and public transport, particularly with regards to walking and cycling. The Government's Cycling and Walking Investment Strategy (2018) suggests that the safer users feel, the more they will choose to use active modes and the fear of road traffic is a major deterrent, despite having an equal right to the road; physical safety and the perception of safety is a significant factor in determining how far people will travel using these modes[29]. These issues cannot be ignored and must be challenged, to provide better quality, safer active travel infrastructure.

Walking and cycling will feel and be safer if the volumes of traffic on the road are reduced. Evidence suggests that provision of cycle infrastructure such as segregated cycle-lanes and other measures e.g. low-traffic neighbourhoods can drive the uptake of cycling whilst also reducing vehicular traffic[30]. There is a 'chicken and egg' issue, but cities such as Amsterdam on the continent show that where vehicular traffic can be reduced and cycling prioritised, a **virtuous cycle** can be created whereby more people choose to cycle (especially short journeys) and traffic therefore reduces.

The ability to walk the last or first part of a public transport journey while feeling safe was also discussed. Perceptions of unsafe, dark areas for these home-to-station/stop trips – especially at night, and especially for women, marginalised and vulnerable people, can disincentivise making trips by public transport.

The 'First/Last Mile'

Making the start and end of public transport journeys (known as the 'first/last mile') easy, safe, accessible and connected requires infrastructure, e.g. good lighting, CCTV, good interchanges, cycle parking at stops and stations, accessible routes, places for people to stop and rest if walking is difficult for them. Routes also have to take people where they want to go – linking key destinations and residential areas. A virtuous cycle can also come into play here – the more people who are around walking and cycling, the safer it will feel to walk and cycle. Accessibility and inclusivity should be at the forefront of policy decision-making for transport, for the whole end-to-end journey.

Accessible developments and streets

Infrastructure is both an obstacle and solution to shifting users to choose public transport services. Poorly designed, car dominated developments are common throughout the UK, with new developments failing to take enough consideration of how they can be serviced by the various modes of public transport and encouragement of active travel. However, initiatives which have repurposed high streets and restricted traffic volumes, such as low traffic neighbourhoods, have improved safety and mobility of residents, helped local restaurants and other business capitalise on the additional space for outdoor dining for example, and encouraged people to walk or cycle rather than travel by car. Studies have also shown where retail areas are pedestrianised, the number of people shopping and spending time in them increases[31].

Technology

Technological advancements can improve the accessibility of alternative modes. Earlier in this section the convenience of the car was discussed, as was the accessibility of active travel modes and public transport. Accessibility can be a barrier to the uptake of alternative transport modes for some, but improvements in technology are beginning to help overcome this. The development of e-bikes has been revolutionary in improving the appeal of cycling. However, the cost of e-bikes means this is a mode that is not currently accessible to all. A similar challenge has been seen with the EV revolution, with EVs having an image-change to become high-status vehicles. This has significantly increased the take-up of EVs ("More than a quarter of a million EVs now travel on UK roads and sales of plug-in vehicles have reached all-time highs, with 327,000 registered last year alone – a 77% rise compared to 2020."[32]), but they are perceived to be an option which is unaffordable to most.

Technology is working to reduce fossil fuelled-public transport, as discussed in the next section. Workshop attendees talked about how **good quality, up-to-date, user-friendly data** is essential to encourage and enable public transport use, e.g. real-time information, travel apps, and/or tracking the next bus or tram. Technology and data are also important for operators to increase the reliability of services and act quickly to deal with problems. It should be noted that technology can also encourage walking, such as 'Walking as a Service'[33], e.g. using real-time geospatial apps to plan walking routes.

Environment

Active travel (and particularly walking) is the most sustainable form of transport. Public transport is the next-most sustainable.

When workshop attendees talked about re-moding and the environment, they talked about the impact modal choices could have on the environment – e.g. choosing to cycle rather than take the car. They talked about the impact the environment could have on modal choices – e.g. how rainy, snowy, or windy days make choosing to cycle less likely. But it must also be acknowledged that car travel affects the environment by increasing pollution, severance, and making car-dominated towns and cities. New roads and rail lines can be carefully designed to reduce or minimise the impact on the environment and nature, but some impact will occur. Conversely, there are opportunities to mitigate negative effects on the environment when designing infrastructure, such as bus stations with green roofs, rail lines with biodiversity corridors, and tree planting alongside roads. There are also fitness benefits to public transport – people who commute by bus, rail or tram walk more than those who drive[34].

The Transition

Significant progress is being made in transitioning from fossil fuelled-vehicles to EVs (and e-bikes and e-scooter use is also rising). However, although the shift towards EVs is promising, it has some way to go. Workshop attendees talked about the challenges re-charging buses, finding (and worrying about finding) EV charging for cars, and the possibility that the focus on EVs would lead to more vehicles on the road and less public transport use.

The UK Government is seeking to **fast-forward the transition** to more walking and cycling. There are three key delivery targets (by 2025) set out in the UK Cycling and Walking Investment Strategy:

- Double cycling from 0.8 billion stages in 2013 to 1.6 billion stages in 2025.
- Increase walking to 300 stages per person per year in 2025.
- Increase the percentage of children that usually walk to school, from 49% of children aged 5 to 10 in 2014, to 55% in 2025[35].

Journeys that can easily shift to walking and cycling are shorter, more local journeys, and those at the start and end of a longer public transport trip. Not all journeys can be made by walking or cycling, but improving active travel infrastructure and facilities such as segregated lanes and cycle storage, improving public spaces and making them greener, can all help the Government reach its target for half all journeys in towns and cities to be walked or cycled by 2030.

The Transport Decarbonisation Plan outlines the Government's approach and commitment to decarbonising transport and modal shift is a key part of this. Accelerating modal shift to public and active transport is priority one in the plan, and aims to 'increase the share of journeys taken by cycling and walking' emphasise that through the provision of better-quality infrastructure, dedicated routes and networks, people will feel safer and more confident choosing active travel for shorter journeys[36].

In Wales, the Transport Strategy's 'Sustainable Transport Hierarchy' (Figure 5.5) is now used to guide decisions about investment in new infrastructure. The hierarchy gives priority to interventions that support active travel, then public transport, and finally ultra-low emission vehicles over private motor vehicles[37]. The Welsh Government is reviewing all road investment plans and is expected to report in 2023. Its policy-led approach seeks to ensure the transition from more car-based travel to more sustainable travel is put into practice.

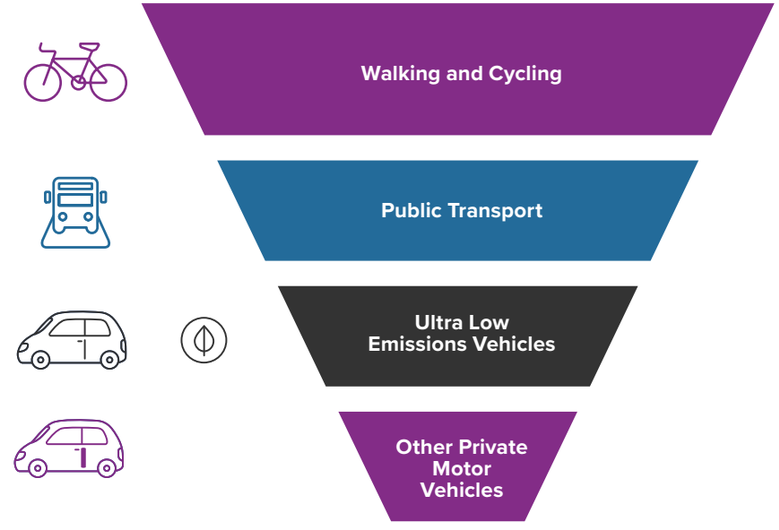


Figure 5.5: The Welsh Government's Sustainable Transport Hierarchy
Source: Llwybr Newydd: the Wales Transport Strategy 2021

Case studies

Workshop attendees shared their case studies to demonstrate best-practice in helping people to choose more sustainable modes of transport.

Rebel Group – Amsterdam alternatives to the car

To encourage city residents towards travel modes that reduce congestion and the need for street parking, Rebel worked with the Municipality of Amsterdam to develop a tool to calculate the impact of shared car usage on private car ownership. Like many European cities, Amsterdam has a limited amount of public space available, and parked private cars claim a disproportionate amount of urban landscape. The number of inhabitants is expected to increase by 10%, to one million people by 2030; at the same time, 50% of public space is already taken up by cars, of which 80% are privately owned. Rebel developed simple formulas that the Municipality of Amsterdam can use to drive how shared cars can replace privately-owned cars and lower the city's parking pressure. Rebel provided a checklist for making data-driven decisions regarding the optimal number of vehicles in each neighbourhood.

In a world's first, Rebel tested each area within the city, providing detailed information to policymakers at the neighbourhood level. To achieve this, Rebel combined resident and shared car user surveys on car ownership, shared car trips data, census data, and a simulated population of the city. This enabled the estimation of the impact of a single shared car on car ownership, parking pressure, and the projected demand for more shared cars in each neighbourhood. These learnings are exceptionally valuable when designing new neighbourhoods and setting parking minimums.

The analysis developed by Rebel will help the Municipality implement new data-driven policies to govern the distribution of (new) shared car permits across the city neighbourhoods based on these calculations and formulas. Rebel aims to assist other municipalities with the growing issue of limited public space.

West Yorkshire Combined Authority – Stourton Park and Ride, Leeds

Stourton Park and Ride, opened in September 2021, is the UK's first solar powered 'park and ride' site. The scheme was funded through the Leeds Public Transport Investment Programme (LPTIP), made up of £173.5m of devolved funding from the Department for Transport, £1m from the West Yorkshire Combined Authority, and £9m from Leeds City Council. The purpose of the funding was to increase the use of public transport in a manner which contributes to carbon reduction by encouraging modal shift away from the private car, and to support inclusive growth by making it easier to access education, employment and public services.

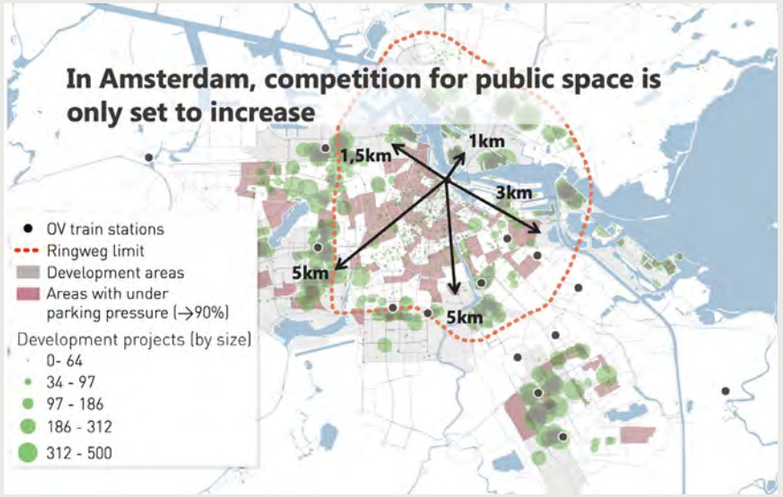
The site, adjacent to the M621 Junction 7 roundabout, provides 1,200 car parking spaces (and 26 electric vehicle charging units[38]) and offers a high quality, all-electric, 10-minute frequency bus service along the A61/A639 corridor to and from Leeds City Centre. The scheme delivered a 1MW array of solar panels which generate electricity to power the whole site. The Stourton Smart Energy Grid (part funded by ERDF) also includes battery storage to reduce the need for exporting solar power to the National Grid, providing a reduction of around 470t of greenhouse gas production per year.

The site including electric vehicle charging points, family and disabled parking bays, motorcycle parking, cycle lockers/ stands, and mobility scooter lockers. Inbound bus lanes from Leeds Valley Park to the M621 J7 approach have been delivered, improving bus journey times and reliability of existing buses using the corridor, as well as park and ride services entering and exiting the facility.

The scheme also has additional, dedicated walking and cycling facilities and provides enhanced cycle connectivity to/from the south of Leeds, via the park and ride site and the Leeds Cycle network.

Midlands Connect – Barriers to Rail Market Research

Having identified that modal shift to more sustainable modes of transport is the main pathway to decarbonisation, Midlands Connect has undertaken a research project to establish public perception to rail and what the barriers are to using it. As well as obvious findings such as distance to the nearest station and frequency of services, Midlands Connect has established that there are other basic needs that rail does not necessarily meet – namely cost, reliability and convenience. Midlands Connect has developed a Hierarchy of Rail Needs, and an initial set of traveller personas in terms of how they respond to rail, and will be using this research to identify interventions to improve the rate of modal shift.



Source: Rebel Payments, Mobility & Insights

6. Re-powering transport and travel

What is re-powering?

If a journey cannot be avoided or made by a more sustainable mode, can the mode taken be powered more sustainably? Since the times when our transport was mainly horse-powered, we have had over a century of transport vehicles mostly powered by fossil fuels. Beginning with the electrification of trains, **more modes are now electrifying** (although the sustainability of electric-powered transport is dependent on that electricity being generated by renewable sources), and hydrogen and hybrid solutions are also being pursued.

In Re-power, we asked workshop attendees:

- What they needed to re-power their journeys, and those generated by their businesses or fleets.
- What they needed to re-power journeys, and those generated by their businesses or fleets.
- How they could play a part in the re-powering revolution.
- How re-powering could be done in a socially, economically, and environmentally sustainable way.

Re-powering transport can also include making better use of the power we already have. It can include **efficiency of operation, service, and delivery**. Workshop attendees naturally talked about behaviour change again – the challenge to decarbonise transport is not only met by building or running sustainable transport modes and infrastructure, but by encouraging them, raising awareness, addressing barriers, increasing accessibility, and making less sustainable modes more expensive or less desirable – ultimately, **making sustainable transport the obvious and easy choice**.

There was a recognition of the sustainable transport ‘hierarchy’ in many workshop attendees’ discussions: transitioning everyone’s journeys to EVs was seen as less sustainable than transitioning more people onto public transport, walking, cycling, and digital connectivity.

Re-Powering Transport: Now and in the future

Rail electrification has existed for over a century in various formats, hybrid road-vehicles have operated since the late 1990s, and boats, predominantly fossil fuel powered, are looking once again to wind for hybrid power39. Bicycles have also started to become electric-powered rather than just leg-powered.

While these re-powering solutions are positive, the majority of our journeys are still overwhelmingly fossil-fuelled as a whole. Workshop attendees thought that **more change is needed**, and **more innovation is needed**.

The re-powering transition (brought about by both public policy and private business) is most notable and visible in our everyday lives through the uptake of EVs for private mobility and the development of charging infrastructure in our car parks and driveways. The questions and scepticism about their capabilities, operation and impact on both environment and utilities are all valid considerations, though sometimes exaggerated. We are seeing oil companies and petrol stations pivoting their business to the EV market, creating new 'clean' power generating divisions and creating charging hubs in forecourts.

The electric revolution has been underway in the rail sector for much longer. Without full electrification, railways companies have sought pragmatic solutions such as the introduction of bi-modal trains that will run on both existing electrified and non-electrified sections (switching from electric to diesel power). While providing flexibility, it also creates a complex system due to the provision of two types of large traction systems on one vehicle.

Hydrogen fuel cells are also in branch line use in Germany, with the Coradia iLint surpassing performance expectations on its daily workings of the local line, being fuelled from one of the largest hydrogen refuelling sites at Bremervörde, capable of refuelling 14 trains per day. There is still a way to go for hydrogen power to be regularly seen on our railways, though.

Small commercial passenger aircraft have also been electrified, though with very limited passenger and reduced weight, a long way from the requirement of long or even short haul commercial flight. However organisations are seeing the need and potential, such as Air Canada's investment in Heart Aerospace's 30-passenger zero-emission aircraft. In the UK, businesses and innovators are working to create Sustainable Aviation Fuels (SAFs) to transition aviation – long seen as the worst polluting form of transport – to a more sustainable future.

This Transport Decarbonisation initiative considered the barriers, challenges and opportunities to making a more sustainably powered transport system.

What did we learn about re-powering?

While workshop attendees naturally focused on EVs, sustainable power for buses, trains and planes was also discussed.

Governance

Governance and standards can shape how we develop infrastructure, and how we use existing infrastructure and assets. The 1973 oil crisis is a good example of this – the UK Government implemented a 50mph speed limit to reduce fuel consumption due to the increase in engine efficiency[40]. The Welsh Government has implemented a similar tactic recently with their 20mph limit on some restricted roads, down from 30mph, as well as targeted 50mph limits in areas of severely poor air quality[41].

Using policy, charging, and enforcement can be politically sensitive. **People value freedom of choice** and cars give them more perceived control over their journeys. Workshop attendees discussed some of these difficulties and sensitivities. Sometimes governments take a softer approach by providing guidance instead, such as the 2022 UK Government's advice on home heating and electricity use efficiency, in the cost-of-living and Ukraine war crisis. This guidance informed and allowed people the choice to take control of their emissions and costs.

Private business also needs governance to re-power. **Operators need confidence** in the development, speed, and type of energy supply and infrastructure in the future. Barrie Cottam from Hitachi Rail Europe explained how train rolling stock, as well as assets such as buses and aeroplanes, have life expiry dates which may come to maturity during the transition, and confidence is needed so that large capital expenditure decisions can be made on the right solution for the planet, the business, and its customers/passengers. In turn, the fuel supply and energy industry also need to understand the direction so they too can invest and facilitate the transition.

Standards are needed to provide fuels, charging facilities and charging interfaces in vehicles that all work with each other. The risk exists that solutions will be invested in that become obsolete, or that there are lost opportunities for technology and behaviour changes if risks are not taken or investments and plans are made too late.

In transport, governments are currently focusing more on operational carbon emissions than embodied carbon – e.g. the pollution from a car's exhaust pipe more than the carbon impacts of creating the car. Such a focus not only neglects a large part of the picture in terms of climate change, but also fails to address some of the environmental and societal issues caused by the transition – think cobalt mining for car battery components in parts of Africa.

To make a truly sustainable product, workshop attendees suggested mandates should be made on the whole life assessment of a re-powered mode, considering benefits and costs around the planet and for its people and nature, not just the air quality in richer nations. Standards such as PAS 2080 (Carbon Management in Infrastructure Verification) could be adapted for assessing the carbon front, or a minimum ESG (environmental, social, and corporate governance

Infrastructure

Infrastructure and supporting technologies are required to enable the transition to **a new way of powering transport systems** in an accessible and efficient manner. Ports and airports will need new charging or refuelling infrastructure, and this will need to be available at both ends of the journey. This means countries and aviation/shipping companies need to work together and develop in partnership and parallel.

The same goes for EVs – workshop attendees agreed people needed to be able to charge their vehicles at ends and stages of their journeys, and this could not just focus on motorways and town centres. Rural sites and more deprived high-density areas have different challenges, but both run the risk of being left out in **an unjust transition**.

Infrastructure is most likely to be provided by private companies in areas where demand is high and thus the charging sites are economically viable. Governments may need to step in to fill in the gaps, or other organisations can do so creatively – some remote tourist attractions have boosted their business by providing charging locations which bring in customers who would have otherwise not visited. Infrastructure is not only needed above ground. The electricity grid needs the capacity and network to serve an EV-dominated future. If EV chargers are constructed to mimic the fast-fuelling petrol station, few high-capacity chargers may be available per site because of grid capacity. More locations with moderate chargers and slow charging will provide flexibility. Slow charging at home has already changed the habits of 'refuelling' a vehicle, with 80% of owners charging at home[42], where they have off-street parking.

Workshop attendees shared anecdotes of EV charging spaces that are blocked by 'normal' cars, or cars that have charged and blocked the space while their owners are elsewhere, for example in retail parks and service stations. They also talked about the importance of reliability, giving users and potential users the confidence to switch to EVs.

The attendees had novel ideas about how **working in partnership, reducing barriers, or being innovative and creative** could solve some of these challenges. Abellio's Jon Eardley talked about bus depots being located near to other industries to cluster charging and grid connection needs, where the daytime usage of residents in flats is mirrored by the night time charging needs of depots. They were keen to solve problems by working together.

Technology

Technology has been the great enabler of the re-powering transition, through the development of new forms of transport or new ways to power existing forms of transport. Some simple efficient solutions could be adopted to make these re-powered modes more sustainable. **'Right to repair'** could be adopted to allow owners to explore the upgrade of batteries, fuel cells or other new technologies to more up-to-date versions which allow even greater efficiencies, without having to procure an entire new asset. Julia Meek from Zenobe Energy Ltd. explained how EV batteries were being cascaded from intense traction systems to less demanding home and grid systems, explaining that fleet operators set battery performance criteria before the battery packs are replaced. Technology creators could build in longevity instead of obsolescence, shifting finance models towards 'Technology as a Service'.

The re-power of existing assets can be (and already is) in place with the likes of bus operators implementing hybrid systems on typically diesel buses, bringing incremental gains with fuel and cost efficiencies. While not as good for the environment as a fully electric bus, it does not require a mid-life retirement of assets (with the embodied carbon impacts of manufacturing a whole new bus). The aforementioned hybrid-trains result from a similar intent.

In a similar vein, the removal of the worst polluters in the transport system with lesser polluting second-hand assets has the potential to bring down whole life carbon significantly as well as maintain jobs for mechanics who continue the upkeep of these vehicles. The second-hand asset will eventually need replacing – either mechanically or through policy – but in the meantime the market may have developed to create even more sustainable models, and the carbon costs of creating many new vehicles have been reduced. As well as whole vehicles, this approach applies to batteries. It was reported that battery cells in EVs are already being taken from vehicles where the overall capacity has dropped below usable levels for vehicles, but not to a level unsuitable for grid-level storage. The cells are used in grid or home energy storage, helping other sectors, such as construction and entertainment events, in the net-zero transition.

New technologies can also improve efficient use, run-times, distances travelled, re-charging times, or reduce battery weights (a particular problem for the transition of heavy goods vehicles, given some road infrastructure is not designed for even heavier-weight vehicles).

Workshop attendees recognised that change is already underway across modes and technologies, and it is speeding up, but there are many **technological uncertainties.** They remembered the format-war of VHS and Betamax for videos in the 1980s, where those people who chose Betamax eventually found themselves in a VHS-dominated world. Workshop attendees also talked about the later obsolescence of videos as a whole, and then DVDs, as media is now consumed as a service rather than owned physically. They thought private transport could potentially go through a similar transition with the advent of MaaS. But equally, an alternate future with very little public or hired-transport, and an explosion of private EV and even autonomous vehicles was thought possible. The need for governments and organisations to plan for and direct change, and for the decarbonisation challenge to be seen in the context of economic, social and environmental impacts was considered of great importance.

Environment

The easily understood, key driver for transport decarbonisation is the improvement of air quality in our towns and cities. But going beyond the immediate exhaust emissions and particulates, a sustainable system needs to address the 'fuel' and vehicle supply also.

Securing the energy supply for a re-powering shift is one challenge, but ensuring the generation of the 'fuel' is done in a sustainable and low-carbon way is also paramount. Workshop attendees talked about the arguments over biofuels, with the potential for biofuels to use up quality arable land and lead to a lack of food security and availability, and this concern can also be applied to SAFs with their need for feedstock from both bi-products and crops.

Hydrogen has been commercially produced for decades, though typically from gas reformation, also known as 'Grey hydrogen'. This process is still highly carbon intensive and polluting, but there is the potential for 'Blue' (reformation with carbon capture) and 'Green' hydrogen (electrolysis from renewable energy sources). However this depends on the ability of manufacturers to secure the relevant supplies, and not jump to what is simply convenient, as this may negate the zero-emission operation of a hydrogen fuel cell.

Electricity production plays a large part in the overall carbon intensity of a vehicle's operation. Regional grid mixes around the globe will heavily impact the actual 'emissions' of a vehicle. Many workshop attendees think it is a **government's long-term responsibility** to ensure an energy transition to cleaner sources which will benefit owners and operators.

Workshop attendees were aware of the balances and decisions between different modes and different types of power. One attendee asked whether focus and finance should be spent on re-powering road vehicles, which are responsible for so many emissions (see Figure 5.3 earlier), rather than focusing on less polluting modes (e.g. rail, trams and buses)? Would de-carbonising all vehicles be more impactful than making public transport more attractive with more capacity?

The Transition

The Government's commitment to end the sale of new petrol and diesel cars in the UK by 2030 has given a clear target and momentum to the EV transition. But there is still some way to go to provide the EV charging infrastructure to facilitate this considerable change to how we all mostly travel. While rail is further along the track to electrification, the finance and plans for full electrification appear to have slowed.

While larger and richer organisations, fleet operators, and individuals may be able to afford new technologies and vehicles, there is **a risk that poorer people and organisations may be left behind**. This would make them vulnerable to regulation changes. Without careful planning and schemes to enable all parts of the industry and society to change, local emission standards and 'clean air zones' could prevent social mobility, and some have argued the fines for more polluting vehicles could disproportionately impact those who can least afford to pay them. Bus operators with less capital available may not be able to meet mandated targets or adjust to customer demand, potentially resulting in the collapse of business and loss of transit links. These types of threats are echoed in air and maritime travel in respect of passenger and freight services.

Inability to serve locations due to regulation change may drive a monopoly to organisations who are able to afford such new technology and therefore provide less quality choice for the customer. There will eventually be a second-hand market for re-powered modes, but it may be too late for some organisations, and opportunities for growth may be missed. We can expect technology to get more affordable, but perhaps not quickly enough. These types of challenges and concerns were raised by workshop attendees.

Governments, both national and local, have the responsibility to develop mechanisms to ensure the transition works for everyone and brings everyone with it. Assistance on financing, access to alternative modes of transport and concessionary arrangement are some of the ways government can help those in the transition. Mechanisms also need to be put in place so that the transition in one geographic are does not export previous problems to other regions, such as shifting millions of conventional vehicles from developed to developing nations.

Case studies

The following case studies were provided by workshop attendees to illustrate the re-powering challenge and opportunity in a real context, demonstrating progress and efforts towards re-powering our transport systems.

Midlands Connect Alternative Fuels for Rail

Midlands Connect has recently undertaken some research that looks beyond Network Rail's Traction Decarbonisation Network Strategy (TDNS), to identify the applicability of a variety of alternative fuels for rail within the region. Emerging findings have suggested that a combination of battery, and battery electric hybrids have the potential to be a faster and cheaper way of decarbonising the regional rail network than relying on electrification alone. Midlands Connect has examined some specific routes/corridors to compare full electrification with battery/electric hybrids and established the extent of electrification that would be required to recharge batteries. Work is progressing towards a business case for the East Midlands regional network.

Transport for the West Midlands Electric Buses in Coventry

In Coventry, supported by DfT funding, Transport for the West Midlands is in the process of delivering the UK's first fully electric bus city. Every single bus operating to and within Coventry will be fully electric by the end of 2025 – about 300 vehicles in total. This is also having benefits in improving the image of bus services and growing passenger numbers. Delivery has been challenging in a deregulated environment with the various infrastructure challenges too, but the work is well underway.

Midlands Connect Decarbonisation Policy Playbook

Midlands Connects Carbon Baseline work demonstrated the need for a benchmarking tool to help Local Transport Authorities assess what impact their policies can make, and which interventions would have the biggest impact taking into consideration the nature and characteristics of their areas. Working in collaboration with England's Economic Heartland Sub-transport Body (STB) and the Department for Transport, Midlands Connect is developing the Decarbonisation Policy Playbook. The Playbook is a benchmarking tool which collates all evidence of the impact of transport interventions in a range of area types. This will help Local Transport Authorities to estimate the carbon impacts of their forthcoming Local Transport Plans and to respond to the forthcoming guidance on developing LTPs and the Quantifiable Carbon Reduction guidance which will accompany it.

The Process

The project involves a large-scale review of evidence relating to 56 transport interventions identified using the Avoid, Shift, Improve framework. An initial rapid assessment found 132 pieces of evidence, but also concluded that there is limited evidence for many interventions, and evidence relating to non-urban areas is lacking. Of the 56 interventions, 30 were taken forward for consideration, prioritising those with more and better-quality evidence, and within the control of a local transport authority. Analysis of National Travel Survey diaries helped fill some of the gaps by creating estimates of impacts across different area types and trip purposes.

All the evidence is compiled in a first "minimum viable product" spreadsheet tool which helps the user add a timeline of interventions and assess their Plan's impact on reducing transport related carbon emissions.

Impact

The Decarbonisation Policy Playbook will provide Local Transport Authorities with a useful tool to develop their local transport plans and assess the impact of those plans on reducing carbon emissions, as required by the forthcoming guidance. Going forward, we hope to identify and include more evidence and to make the tool available in a more accessible and robust format than a spreadsheet.

West Yorkshire Combined Authority Carbon in Decision Making

West Yorkshire Combined Authority (WYCA) worked with Mott MacDonald to refine their investment pipeline to focus it on achieving a net zero economy by 2038. The WYCA long-term strategic sustainability goals and investment decisions were not previously well-enough reflected in decision-making about schemes to develop and seek funding for.

A robust assessment methodology was created to ensure all new projects passing through the assurance framework consider carbon and sustainability impacts using a standardised approach. Through using the methodology, it was identified that the current WYCA investment programme did not yet provide significant emissions reductions. The project provided guidance on how delivery of the **right project** is done in the **right way** to deliver decarbonisation targets.

7. Connecting our thinking

Cross-cutting messages

Throughout the Interchange Decarbonisation workshops series, there were reoccurring themes that emerged from all three topics of discussion. It was also noticeable how often discussion of one topic (be it re-think, re-mode or re-power) would come up when discussing the issues of another. The challenges and opportunities are interconnected. So are the solutions.

Behaviour change

All workshop attendees talked about the need to not only build transport networks and infrastructure, and provide modes and services, but also to **encourage, enable, and sometimes enforce behaviour change**. The transport decarbonisation transition requires societal shifts in how we conduct our lives, how (and whether) we move around, and what we own. Very recently, during the global pandemic, we have seen that **people can change travel behaviour more than we expect, and better than we think**. We also know that improved health and wellbeing can be a driver of sustainable travel choices. As an example of how behaviour change campaigns can work, workshop attendees talked of how we have relatively quickly shifted away from using disposable plastic shopping bags and plastic straws – long-term habits quickly becoming obsolete. We have also seen that behaviours can change back again, and not always in ways that we might want: Figure 5.4 showed us that road-based private and commercial vehicle use is back to (or nearly back to) pre-Covid levels, while public transport still has some way to go before it returns to 2019 levels.

Workshop attendees recognised that increased home working reduced the carbon-impacts of travel, but that some people cannot work from home. The change in rail use with leisure travel particularly increasing offers an opportunity to focus on rail-based days out and holidays in a decarbonised future, just as people did half a century ago. **Flexibility is also key** to enable people to find a way to fit decarbonised travel in with their daily lives and commitments. Obviously pricing is also key if opportunities like this are to be realised.

There are increasing proportions of people – and particularly young people – for whom environmental concerns are influencing or even guiding their behaviour. However, effective intervention is needed on a large scale to bring about a mass alteration in modal choice and reduce both car use and dependence.

Ease, convenience and cost

Ease and convenience cut through all conversations – more sustainable modes need to be both of these things in order to be the mode of choice over the car. To break the convenience barrier, policy enforcement may be required to shift behaviour. This may mean we need to make car use more difficult – e.g. with less parking or with road user charging – but we need to consider the impact of such policies on people with mobility issues, who are marginalised, vulnerable, can less afford sustainable alternatives, or need to access healthcare. **Accessibility and affordability** were therefore also cross-cutting themes.

Lasting sustainable transformation will come about in **a transport system that users can rely on** to be frequent and on time, to be safe and feel safe, to be accessible by all, and to be affordable. Knowing the bus will be on time means people are more likely to use it for their work journeys. Knowing a charger will be available where and when needed means logistics drivers can confidently switch to EV light goods vehicles. Knowing a bus will be easy to step onto and has a seat means someone with mobility issues will feel confident to use it. Knowing a train station can be accessed by a well-lit and safe route home, or a train has space for bikes on it, means people will consider train travel and walk or cycle the last part of the journey home. Knowing there is somewhere to charge your vehicle even if you live in a block of flats with no driveways means an EV could be a mode for you.

Information is also central to ease and convenience. The rise in app-based journey planning, including safe and accessible walking routes, and real-time public transport service information can only be beneficial to decarbonisation efforts. It can also help manage demand, maintenance issues, and operations.

Collaboration and partnerships

It was remarkable how often workshop attendees heard ideas from other sectors, operators or modes that could also work for them, and how often they identified solutions that could help other people's problems. Partnering with similar organisations, across sectors, and/or in geographies can help co-develop solutions efficiently and **give partners greater power and voice in decision-making**. One workplace's EV charging in their work-hours car park could be used by residents who have nowhere to charge vehicles overnight. Joined-up thinking on spatial planning for new and existing schemes could bring great efficiencies in infrastructure and improve accessibility on a number of fronts. And TDM strategies like that used for the Commonwealth Games could be applied to dealing with construction congestion.

Collaborative planning brings efficiencies and innovation, such as in the Greater Manchester Combined Authority's (GMCA) partnership with Energy Systems Catapult and ten local authorities to develop Local Area Energy Plans (LAEP). The 10 LAEPs explore the localised characteristics including buildings, infrastructure and transport systems, and help guide investment in measures such as energy generation and storage, heating, retrofits and EV charging using a common approach across the areas.

Commitments and financing

The future is uncertain. But **businesses need some form of certainty and commitment to make investments**. Without it, uncertainty can lead to increased costs and missed opportunity. Transport decarbonisation plans from all layers of government, complete with delivery plans for both transport and energy, provide the environment that allows companies to invest. For example, train companies will not plan for and invest in electric trains if they cannot rely on an electrified railways being funded and built, and in the expected timescales. Certainty is needed in good time to allow organisations to commit to investing and selecting the right equipment for the challenges ahead.

Inevitably, the need for investment in our public transport system, EV charging infrastructure and active travel infrastructure was a frequent discussion point.

Flexibility

Flexibility is also needed in the face of uncertainty. Transport operators and the government need to hedge their bets with a range of transport modes, powered in different ways, to provide a mix that could still deliver decarbonisation, and operations, in a range of futures. Again, the future is uncertain, and while governments need to provide some certainty, businesses and operators need to be nimble in responding to opportunities, changing market conditions, and the needs of the travelling public.

People need flexibility to help them get around, especially when their trips are a chain of shorter journeys – e.g. from home to school, on to a station and into work, back home via the shops. The information and app revolution will help with this, but travel hubs, good interchanges, local shops and services, effective MaaS solutions, on-demand transport and interoperable ticketing could also be key tools and initiatives to help people travel sustainably in their everyday lives.

Equality

Many workshop attendees were aware that some decarbonisation solutions – particularly the focus on EVs – run the risk of being economically/socially unsustainable or irresponsible. While not everyone has the same travel or accessibility needs, work needs to be done to make sure everyone can benefit from and access the green transport revolution. Should everyone have access to EVs? Is public transport truly a better alternative for many? If EVs are unaffordable, is app-based on-demand transport a better alternative? Equality is also a geographical issue. Many workshop attendees felt that sustainable transport is much less available and convenient outside of major towns and cities. The decline in bus services in the UK has particularly hit rural communities, and has reduced social mobility, economic opportunity, and led to a reliance on car-based travel. On-demand, MaaS, more walking and cycling, and more local services were all thought to be options for rural areas, as well as investment in the bus network. Conversely, sustainable transport can also bring people into rural communities, benefitting the local economy.

8. How to Decarbonise Transport

There are many forums where business leaders come together; there are conferences and workshops for transport professionals; local/regional authority leaders share insights and learning. But the London Transport Museum Transport Decarbonisation sessions offered something much less common – bringing these groups together to learn from each other and develop solutions together.

Emerging from these sessions are ideas, needs and plans. But there is also momentum and conviction that a systemic change is needed for our transport network to decarbonise, and that this can only be achieved by working together. At the start of this report, we said:

This work becomes meaningful and impactful if you, the reader, turns its words into actions. Which of its recommendations can you put into place in your own organisations? How can you continue the conversation with partners in your field? How can you reach out to partners outside of your field? What support and commitments do you need from government?

Let's turn this into a conversation.

Here are the ideas, needs and plans our workshop attendees had to turn this report into a conversation, and to turn those words into actions:

1. **Work together outside boundaries**
   Continue to find ways to share best practice, innovation, creativity and solutions – as well as challenges and barriers – across industries, organisations, with both the public and the private sector. We would like this to go further than these workshops, with transport providers talking to transport users, commuters of all types and including children – the commuters of tomorrow. Some of the best ideas we heard were simple "why didn't I think of that?" ideas from outside of our usual silos and echo-chambers. Some of the biggest challenges are the ones felt in the real world, outside of transport practitioners talking to each other. Workshop attendees gave examples of where this has been done well:

   - Safe, sustainable travel for young Londoners (STARS programme)
   - Midlands Connect Decarbonisation Policy Playbook.

   And of course, the 'Decarbonisation in Transport' workshop series that lead to this report is another good example of cross-sectoral collaboration.

2. **Work together inside boundaries**
   Place-based approaches can create real innovation and creativity. If you are a retail park with EV chargers in the day, make an income from sharing them with your neighbouring high-density residential areas overnight. If you cannot fill a minibus, work with other businesses to share the service and make it viable. All these solutions take effort and require governance and management. But they are often efficient solutions that reduce the need for large investments or building new things (and building less is often better). Bringing neighbouring businesses, residents, organisations and services together also has spin-off benefits for localities and social interactivity. Existing mechanisms like residents' associations, business improvement districts could be harnessed to create net zero coalitions.

   Examples of where governance and management between different businesses has been successful include:

   - The Transport for the West Midlands (TfWM
   - Commonwealth Games Travel Demand Management Programme

3. **Governments are needed not just for investment, but for structure**
Increasingly, specialists are proving that the large costs required for decarbonisation are less than the larger costs of not decarbonising. Investment is definitely needed. But governments (including regional and local governments) can also provide more certainty and structure – a roadmap to net zero. Companies are more likely to invest with more certainty. People and households are more likely to commit to investing too. Decarbonisation does not fit within a five-year political cycle. Workshop attendees wanted government to commit to electricity grid upgrades, rail electrification, car travel disincentives, bus investment, renewable energy, and the scope of the alternative fuel market (e.g. hydrogen) as a framework within which to invest in decarbonisation.

   Examples of where decarbonisation targets have been used to refine investment pipelines include:

   - West Yorkshire Combined Authority Carbon in Decision Making
   - CPCS Tool for assessment of financing opportunities for municipal transport decarbonisation projects.

4. **Electric vehicles are part of, but not the solution**
EVs allow people to continue travelling very similarly to now. They will be a part of the solution, as there will always be some journeys where the easy, convenient option continues to be the car. But a full-scale focus on EVs as the answer may decarbonise, but may not be truly sustainable. Workshop attendees were worried about affordability, about the space needed to charge a country full of EVs, whether the electricity grid could cope, the embodied carbon in a new EV car with a high-carbon battery, and the raw materials needed to manufacture them. EVs still bring traffic, congestion, severance, and some pollution. The world many of our attendees wanted to live in was less car-dominated, more people and nature-focussed.

   Examples of where data and initiatives have been used to encourage alternative travel modes to the car and street parking include:

   - Rebel Group – Amsterdam alternatives to the car
   - West Yorkshire Combined Authority – Stourton Park and Ride, Leeds

5. **More public transport for everyone**
Mass transport systems do not just reduce carbon emissions in the transport sector, but also congestion, air pollution and embodied carbon. Public transport needs to change its energy sources as quickly as possible. While public transport levels are currently lower than needed, the rail sector was headed in the right direction before the pandemic, with patronage and miles travelled increasing every year (1.8 billion journeys were made in 2018-19)[43].

   Public transport growth is possible. But there are significant challenges in making public transport affordable versus car travel, providing the capacity needed, and the frequency and reliability. The bus network needs the most attention as services are being cut and patronage is declining in a vicious cycle. But the bus is the most public of transports, serving the greatest range of people and accounting for a huge number of journeys (still many more than rail at 4.07 billion in 2019-20, after five years of decline[44]). A greater focus on public transport is needed, with better interchange, reliability, affordability, and network coverage. This may require innovative approaches to financing and a mode-agnostic approach to finding the best solutions to take people where they need to go.

   Examples of successful support and investment in public transport networks include:

   - Transport for the West Midlands Electric Buses in Coventry
   - Transport for the West Midlands (TfWM) – Commonwealth Games Travel Demand Management Programme

6. **More active travel for everyone**
58% of all private car journeys in 2019 in the UK were under five miles – many of these journeys could be walked or cycled instead. Workshop attendees particularly focussed on the first/last mile: those connecting starts and ends of journeys that connect to longer train, tram or bus journeys. Focusing active travel schemes and investment in a radius around stops and stations will benefit public transport as well. Active travel schemes need to focus on accessibility, safety and public realm. People are more likely to walk if there is a bench to take a break if they have mobility issues, decent lighting to feel safe after dark, and a well-designed green route to invite them.

Examples of where the first/last mile component of journeys has focused on alternatives to the private car include:

- West Yorkshire Combined Authority – Stourton Park and Ride, Leeds
- Safe, sustainable travel for young Londoners (STARS programme)

7. **Mobility as a Service (MaaS)**
There is a danger the autonomous and electric vehicle revolution leads to more cars, more roads, more congestion, more exclusion and more isolation. This is not the sustainable future our attendees wanted to live in. As part of a suite of solutions, MaaS could change how we travel and how our transport system works.

A successful MaaS system would require cars to not be owned but hired for parts of journeys (whether they are driven or autonomous), public transport to increase, and on-demand vehicles to serve places that buses do not connect to. The A-to-B journey would be connected and accessed by user-friendly interfaces, unified ticketing, and well-timed interchanges, and work would need to be done to enable people to access MaaS if technology phases them. There is still a long way to go with MaaS – it needs fully integrated operators, payment systems, multimodal solutions and ubiquitous smartphone use. But it could provide access to democratic travel options, and could be particularly impactful for marginalised, remote, disadvantaged and disabled people.

Well-planned MaaS could be beneficial for the travelling public, those who currently find public transport difficult to access, and reduce the presence of single-occupancy vehicles in the areas we work, live and play. That could revolutionise not just travel, but also place-making and town planning. As an alternative solution, if MaaS cannot be provided, greater use of on-demand services – especially using advanced technology and with public planning to prioritise equitable access – could provide some of the benefits.

8. **Home working where it works**
Connectivity does not have to be provided by a mode of transport, but can be digital. Working from home reduces journeys and the pressure on the transport system. But not everyone can work from home, and the types of jobs that lend themselves to home working are often those that could have been made by public transport. While home working affects city-centre economies, it can have benefits for local communities and economies, increasing patronage in local shops and cafes, increasing walking, and benefitting those with caring responsibilities. We recommend home working is supported where it fits with work requirements and can be applied flexibly.

9. **Bring transport and energy together**We cannot decarbonise transport without seeing transport and energy together as a system of systems. Bringing specialists and investment together is key. Our network of petrol stations with tankers full of fuel and quick-stop refuelling may one day seem as antiquated as stables did when cars took over from horses. To create a transport network fuelled either by renewable energy or the power of our own legs (walking and cycling!), an electricity and re-charging network is needed with advances in storing energy, infrastructure that can accommodate new types of vehicles (including freight, planes, shipping and public transport). Transport practitioners need to understand more about the energy sector. Energy specialists need to work with transport specialists.

   Examples of where this connected thinking between energy, fuel and the transport network include:

   - Midlands Connect Alternative Fuels for Rail

10. **Focus on the world we want to live in**
    Net zero and decarbonisation are crucial in the climate crisis. But we want to focus on the outcomes needed to create the world we want to live in. Collectively, we need to understand and agree if that is a world full of autonomous, electric vehicles, or one where EVs are included in a flexible blend with much more public and on-demand transport? Is a decarbonised world one that excludes people who cannot afford new shiny vehicles or trains, a world where people are cut off from services because they have mobility issues, live in disconnected neighbourhoods, or work in jobs that require transport options outside of core journeys or hours? Does a focus on decarbonisation forget a focus on biodiversity, nature-based solutions, and the green environment we want to live in? Social, economic and environmental sustainability are needed in the round. The transport decarbonisation revolution needs to benefit everyone, and the world we live in.

Let's get to work

The London Transport Museum 'Transport Decarbonisation' initiative brought together disparate people and places, leaders across their fields, and enabled a conversation on how we can collectively lead towards a different type of transport, a different way of travelling.

Most of all, it set a challenge and an impetus for everyone who attended and, we hope, everyone who reads this report. We can all be part of the change we need in the transport sector if we work together, prioritise outcomes, put equality front and centre, and consider all aspects of sustainability.

We need to put our collective actions and collective voices to use.

It's time to get to work.

Appendix A – Our partners on the Interchange ‘Decarbonisation in Transport’ Series

Introducing Gowling WLG
Gowling WLG is a sector focused international law firm, with more than 1,500 legal professionals in London, Birmingham, Leeds and 16 other cities worldwide. We have signed up to the UN Global Compact and certification to management systems for quality (ISO9001), environment (ISO14001) and energy (ISO50001), and have developed our PLANET+ commitments, which include a 2030 Net Zero target, to steer our behaviours and hold ourselves to account.

We give our clients access to in-depth expertise and experience in key global sectors including transport and infrastructure, energy, tech, advanced manufacturing, government and real estate. We pair this specific sector and industry knowledge with renowned service area expertise to meet each client’s unique needs.

We see the world through our clients’ eyes, and collaborate across countries, offices, service areas and sectors to help them succeed, no matter how challenging the circumstances. Our culture is, above all, about people and teams, based on our belief in the power of relationships in delivering tangible business results.

We are longstanding corporate members of the London Transport Museum, and are proud to be sponsoring the Decarbonising Transport series and this report, as part of our established and ongoing support for the Museum’s Interchange thought leadership programme. Learn more at www.gowlingwlg.com

Introducing Thales
Thales is pleased to be working with London Transport Museum and its partners on the Interchange programme thought leadership initiative, facilitated by the museum.

Thales Ground Transportation Systems (GTS) is an established global player in the urban and light rail market, providing leading edge, green and safe signalling and telecommunications which mobilise the world’s major cities. Currently we are the largest UK provider of urban train control and signalling systems, with a focus on London and Manchester where we supply signalling solutions which optimise network capacity and operational cost.

Thales GTS has a team of around 900 staff dedicated to working in London where we are currently focused on delivering London Underground’s Four Lines Modernisation programme to upgrade the Circle, District, Hammersmith and City and Metropolitan lines. Since the 1990s we have also been extensively involved in the Docklands Light Railway, helping to progressively upgrade the network. We future-proof transport communications to leverage the benefits of new technology. This includes using Artificial Intelligence to create insights which can benefit passengers, operators and maintainers, and make travel leaner, more connected and smarter. We provide and support the core UK rail data system (Darwin), enabling operator and passenger planning, and are responsible for powering the National Rail Enquiry app and website.

At a UK level, we invest over £575 million each year into our UK supply chain, working with over 2000 companies and investing over £130m in research and development annually.

We are committed to developing skills for the future, with over 400 apprentices and graduates across the UK, while also continuously developing our people and creating highly skilled experts. Taken together, our rail operations knowledge makes us central to the rail industry’s vision for green, smarter travel which provides an enhanced customer experience**.**

To contact the report authors with queries or to understand how to decarbonise your business or organisation, contact **Katie Chesworth katie.chesworth@mottmac.com**

Appendix B – Attendees and contributors to the Interchange ‘Decarbonisation in Transport’ Series workshops

Three workshops were held in autumn 2022, in London, Leeds and Birmingham. Leaders, partners and stakeholders from the following organisations attended at least one of the workshops. We would like to thank everyone who participated, shared their ideas and issues, and shared best practice and case study examples.

- Abellio
- ABM
- Addleshaw Goddard
- Arriva London
- Arup
- Atos
- Birmingham City Council
- Capita
- CGI
- CPCS Transcom UK Limited (Formerly First Class Partnerships)
- Create Consulting Engineers
- Dott
- Drax
- Element Energy
- Gowling WLG
- Hitachi Rail Europe
- HS2 Ltd.
- Jacobs
- Leeds City Council
- London Transport Museum
- Magway
- Microsoft
- Midlands Connect
- Mott MacDonald
- Network Rail
- Price Waterhouse Cooper
- QBE Insurance
- Rebel Group
- Ricardo Plc
- Sopra Steria
- Sustrans
- Thales UK
- TIER
- Transport for London
- Transport for West Midlands
- Virgin Media Business O2
- West Yorkshire Combined Authority
- Worldline
- Zenobe Energy Ltd

References

1 Decarbonising Transport – A Better, Greener Britain (publishing.service.gov.uk)

2 Department for Transport, Transport and environment statistics 2022, 20 October 2022

3 Mitigation and Adaptation | Solutions – Climate Change: Vital Signs of the Planet (nasa.gov)

4 Mitigation and Adaptation | Solutions – Climate Change: Vital Signs of the Planet (nasa.gov)

5 Mitigation and Adaptation | Solutions – Climate Change: Vital Signs of the Planet (nasa.gov)

6 Decarbonising Transport – A Better, Greener Britain (publishing.service.gov.uk)

7 The Ten Point Plan for a Green Industrial Revolution (publishing.service.gov.uk)

8 Decarbonising Transport – A Better, Greener Britain (publishing.service.gov.uk)

9 Bus Back Better (publishing.service.gov.uk)

10 Transport decarbonisation plan - GOV.UK (www.gov.uk)

11 Taking charge: the electric vehicle infrastructure strategy (publishing.service.gov.uk)

12 Cycling and walking plan for England - GOV.UK (www.gov.uk)

13 Gear change: a bold vision for cycling and walking (publishing.service.gov.uk)

14 Page 4, Decarbonising Transport – A Better, Greener Britain (publishing.service.gov.uk)

15 The tool 'Physical Climate Risk Assessment Methodology' R M and the application of approaches such as PAS 2080 can help scheme developers with this.

16 Climate Change Committee, The Sixth Carbon Budget: Surface Transport, 2020

17 Climate Change Committee, The Sixth Carbon Budget: Surface Transport, 2020

18 '15-Minute Neighbourhoods' (also sometimes called '20-Minute Neighbourhoods') is a spatial planning concept emerging in the past decade, whereby people in cities or neighbourhoods can access the services they need within a 15/20 minute radius of where they live, and ideally by walking or cycling. It is a return to localism.

19 Climate Change Committee, The Sixth Carbon Budget: Surface Transport, 2020

20 The Guardian, Bring back the speed limits of the 1970s, Nov 2019

21 Department for Transport, National Travel Survey: 2019, Table 0409

22 Department for Transport, National Travel Survey: 2021, Working from Home, Chart 28

23 National Travel Survey 2021

24 Centre for Research into Energy Demand Solutions (2019), Shared mobility – where now, where next?

25 Decarbonising Transport – A Better, Greener Britain (publishing.service.gov.uk)

26 Gear change: a bold vision for cycling and walking (publishing.service.gov.uk)

27 Gear change: a bold vision for cycling and walking (publishing.service.gov.uk)

28 Decarbonising Transport – A Better, Greener Britain (publishing.service.gov.uk)

29 Cycling and walking investment strategy (CWIS) (publishing.service.gov.uk)

30 Decarbonising Transport – A Better, Greener Britain (publishing.service.gov.uk)

31 Pedestrian-pound-2018.pdf (livingstreets.org.uk)

32 https://www.gov.uk/government/news/quick-off-the-spark-electric-vehicle-sales-continue- to-soar-in-green-revolution, May 2022

33 Walking as a service – Does it have legs? - ScienceDirect

34 4471.pdf (sustrans.org.uk)

35 Decarbonising Transport – A Better, Greener Britain (publishing.service.gov.uk)

36 Decarbonising Transport – A Better, Greener Britain (publishing.service.gov.uk)

37 Llwybr Newydd: the Wales transport strategy 2021 | GOV.WALES

38 Stourton Park & Ride - Evo Energy - Leeds City Council

39 MOL Drybulk and Drax launch green shipping initiative - Drax Global

40 Transport, Local Government and the Regions – Ninth Report Annex 8

41 Introducing default 20mph speed limits | GOV.WALES.

42 Charging-Electric-Vehicles-Best-Practice-Guide.pdf (energysavingtrust.org.uk)

43 Rail factsheet 2021 (publishing.service.gov.uk)

44 London sewer system | Institution of Civil Engineers (ICE)

45 Annual bus statistics: England 2019/20 (publishing.service.gov.uk)

Opening opportunities with connected thinking.

mottmac.com