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Using technology to improve sustainable mass transit uptake

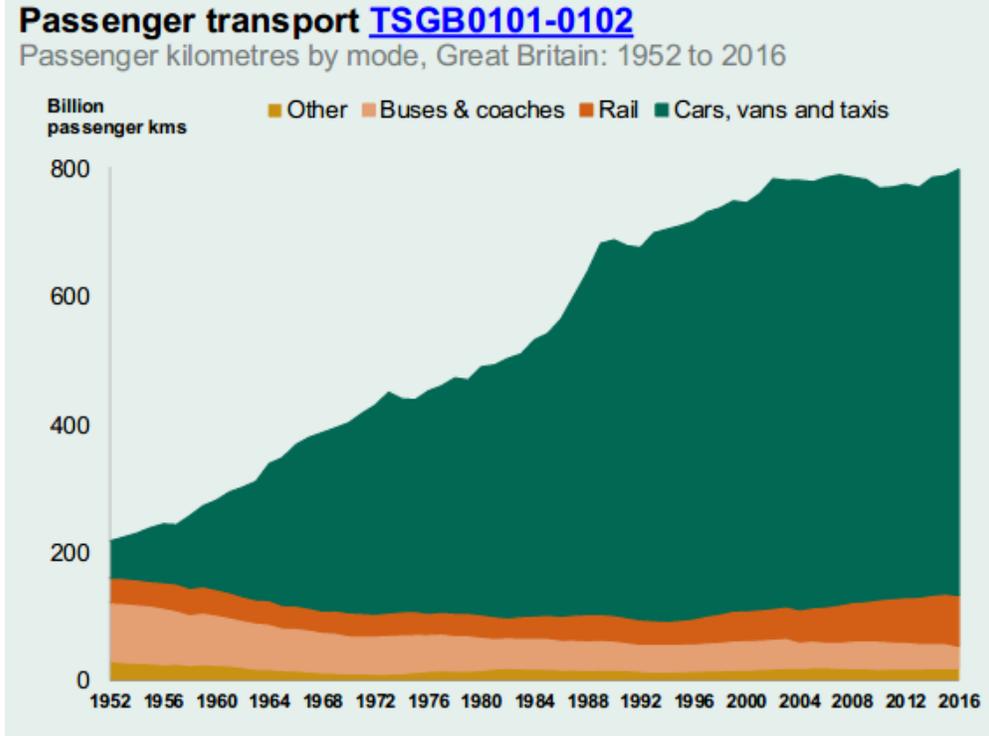
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THE PROBLEM

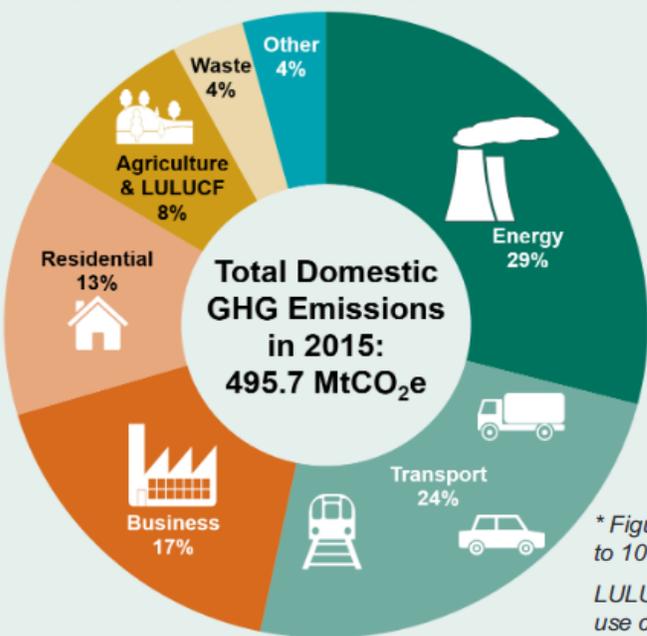
High dependency on private vehicles is increasing the amount of CO₂ in the atmosphere which is contributing to climate change and a global temperature increase of nearly 1°C

- Two thirds of UK domestic transport CO₂ emissions come from trips of less than 25 miles ([Imperial College](#))
- 58.3% of UK domestic transport GHG emissions come from passenger cars (2007, [Imperial College](#))
- There are over 31 million cars registered in the UK ([RAC](#))
- The average length of the UK commute by car is 10 miles ([RAC](#))



UK greenhouse gas emissions [TSGB0306](#)

Domestic emissions from all sectors: 2015*



495.7 million tonnes of CO₂ equivalent (MtCO₂e)



is the total net domestic emissions from all sources.

24%



of UK domestic greenhouse gas emissions were from transport, up from 15% in 1990.

93%



of total domestic transport greenhouse gas emissions were from road transport.

* Figures may not add up to 100% due to rounding.
 LULUCF - Land use, land use change and forestry.

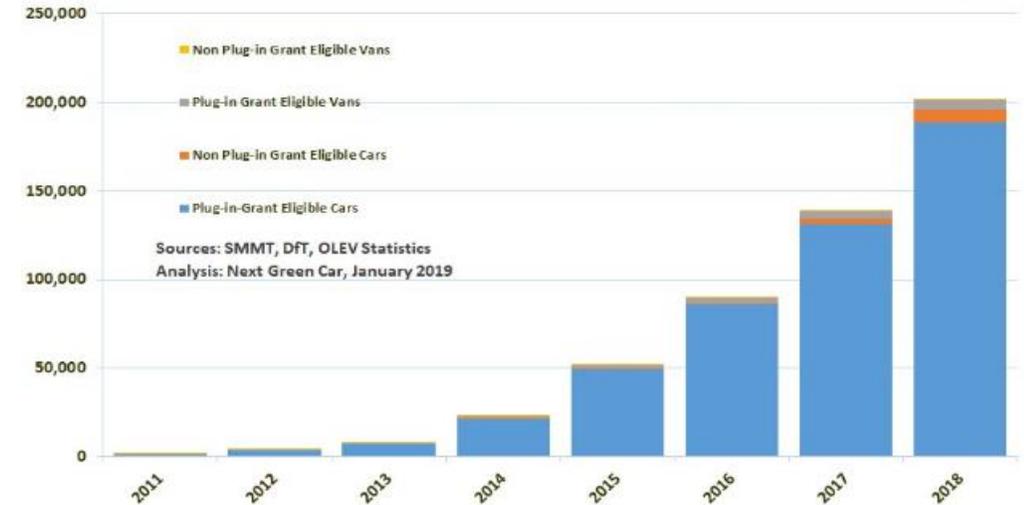
WHAT NEEDS TO BE DONE?

Electric cars cannot be the only solution to reduce the impact of transport on air quality.

Particle emissions from braking and tire wear have an impact too as is currently being researched into.

The UK roads are more congested than ever, increased capacity is needed to sustain the current level of private car use. More roads are not good for the environment.

Cumulative electric vehicle registrations (UK) 2011-2018 next greencar™



Electric cars 'will not solve transport problem,' report warns

The aim of the transport sector should be to reduce the need for cars, not just to make journeys quicker.

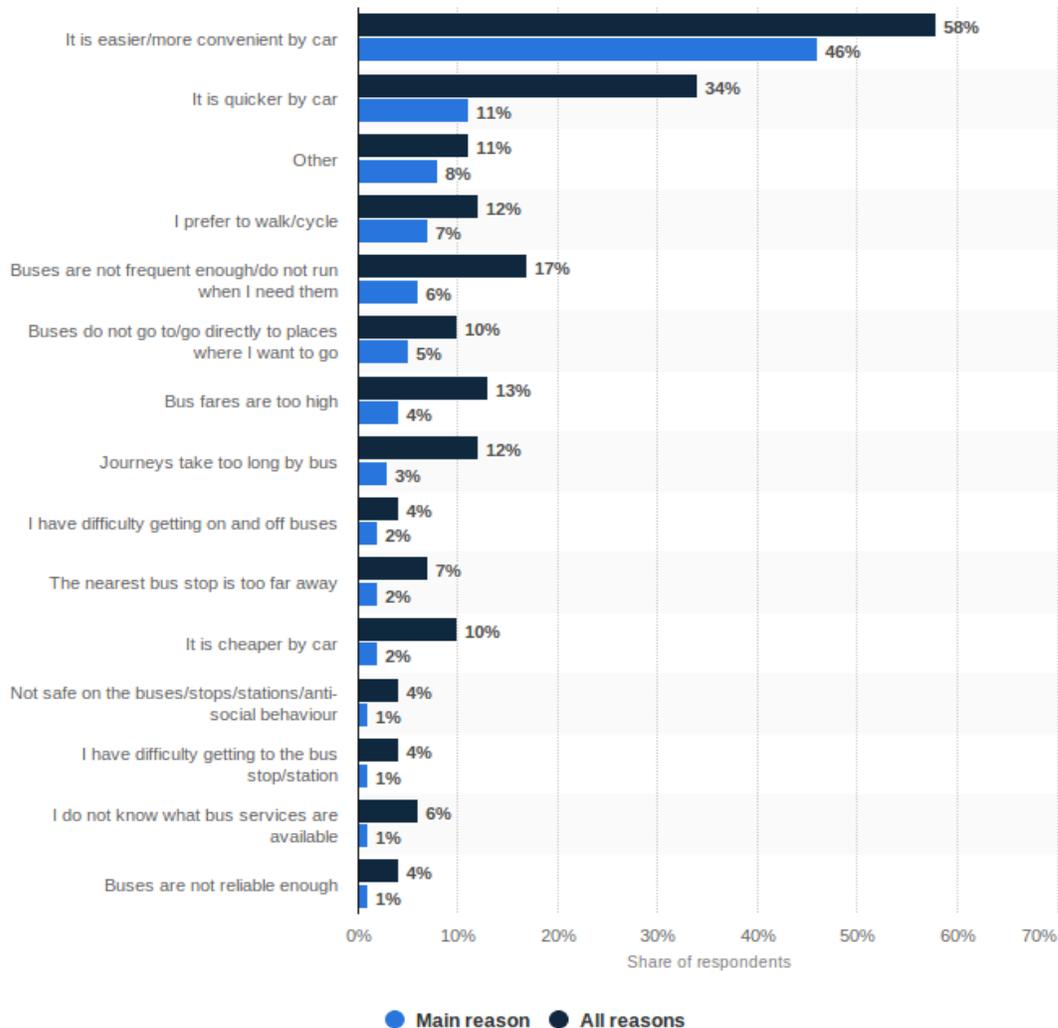
Advances in technology such as electric and autonomous vehicles should be used to improve mass transit modes of transport such as buses to reduce the overall number of vehicles on our roads.



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EXISTING PUBLIC TRANSPORT

Why don't you use/what is the main reason you don't use local bus services (more often)?

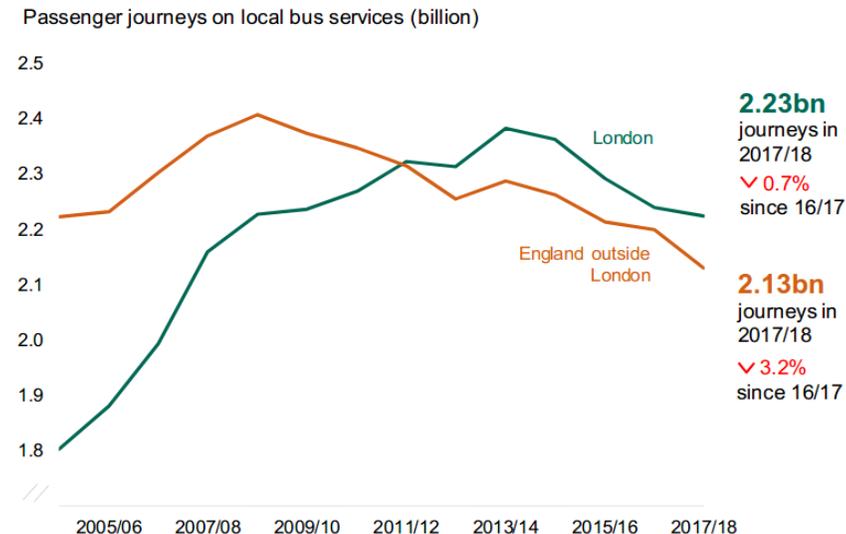


Buses are often overlooked as a viable alternative to using the car to make a journey due to the stigma attached to them as being unreliable, inconvenient and sometimes a generally unpleasant experience.

Bus usage has decreased annually since 2009

The majority of people (58%) say the reason they don't use the bus is because it is easier/more convenient to make a journey by car.

Chart 2: Local bus passenger journeys in England outside London and London, 2004/05 to 2017/18 ([table BUS0103](#))



STEPS TO PROMOTE CHANGE

Improve existing local bus services

A light blue downward-pointing arrow with a white outline, indicating the flow from the first step to the second.

Embrace autonomous technology to provide a new mass transit system

A dark blue downward-pointing arrow with a white outline, indicating the flow from the second step to the third.

Utilise current public engagement to encourage sustainable transport uptake

IMPROVE EXISTING LOCAL BUS SERVICES

98% of UK buses are fitted with Automatic Vehicle Location (AVL) devices which can provide real-time data on their location

Use AVL data to provide live data feeds at bus stops to give passengers clear messages about the progress of their bus

- *Potential barrier: requires infrastructure being in place to have live screens/messages showing arrival times, something which may not always be possible in rural environments or urban areas which cannot afford to implement such*
- *Potential barrier: existing real-time data collection is reliant on manual processes, these would need automating in order to ensure consistent, reliable collection to provide a good enough service to entice higher usage.*

Create a single mobile application which provides consistent information

- *Currently each bus provider has their own app which means information can be difficult to find when you don't know which bus provider you need.*
- *Create a single, unitary authority which can provide this information much like the National Rail app for railways.*
- *Potential barrier: this is dependent on internet connectivity and ability to use such a mobile device*

IMPROVE EXISTING LOCAL BUS SERVICES

Provide on-board audio visual announcements of upcoming stops

- *It can be difficult to know where your stop is when in a new location, let alone if you have disabilities which made this even harder*
- *Use location data to provide audio and visual announcements of the next stop as they do on trains*
- *In July 2018 the Department for Transport set out a plan to introduce regulations that require bus operators to provide audible and visual information on local buses. This is planned to be a phased implementation between 2021 and 2025*
- *Potential barrier: this would involve investment from bus providers to upgrade their buses to provide such a service*



STEP 2: AUTONOMOUS RAPID TRANSIT

Bus Rapid Transit (BRT) is a bus-like public transport system which gives dedicated lanes/roadways to buses and gives them priority at junctions. It often also includes measures to reduce the time taken to board/leave the vehicles as well as purchasing tickets.

Autonomous Rapid Transit (ART) uses these concepts combined with autonomous technology to create a mode of transit between trams and BRT, which can also be known as trackless-trams. Automated buses are guided between high demand zones via road markings and segregated lanes. There would be designated roadside stops similar to those required for trams, it is likely that these would be slightly raised to ensure easy access for all.

Payment for travel would be made at the stop prior to boarding and safety on-board would be ensured by CCTV cameras and potentially conductors.



ART: BENEFITS

- *BRT and tram solutions provide higher efficiencies than cars and traditional buses, ART would likely have the same capacity as BRT but could reach that of trams with sufficient infrastructure.*
- *ART can provide a cheaper solution than trams with trams costing between £60-100m/km and ART likely coming between £7-15m/km*
 - *Cost savings come from utilising battery technology instead of overhead wiring, using simple road surfaces instead of rails & sleepers, using rubber tyres instead of steel and narrowing the vehicle size so that supporting infrastructure can be minimised*
- *ART would use 100% electric vehicles which would know when to charge themselves, taking themselves out of operation to charge and ensuring they had sufficient charge to be utilised during busy periods*
- *Giving priority to ART over cars would significantly improve journey times and would make them a more attractive option than a car*
- *ART can be implemented between new and existing housing and employment zones for not much more cost than introducing a new bus route*

TRANSPORT MODE	TYPICAL MAXIMUM CAPACITY PER LANE INBOUND PASSENGERS PER HOUR
Car (1.2 people – current commuter average)	720
Bus	1,800
Bus Rapid Transit	2,100
Tram	2,880

Maximum system capacity for different modes of transport.
Source: NIC (2018)

Characteristics of transit systems

The table summarises the key characteristics of Bus Rapid Transit (BRT), Light Rail Transit (LRT) and Autonomous Rail Transit (ART, or trackless tram) systems.

Characteristic	BRT	LRT	ART
Speed and capacity	✓	✓✓	✓✓✓
Ride quality	✗	✓✓	✓✓✓
Land development potential	✗	✓✓	✓✓✓
Cost	✓	✗	✓
Disruption to services and local economy in construction period	✓	✗	✓✓
Implementation time	✓	✗	✓
Overall	✓	✓✓	✓✓✓

Source: Author provided

ART: POTENTIAL BARRIERS

- *ART would require more infrastructure provisions than traditional bus systems.*
- *ART services would need to be so frequent and reliable that no timetable is necessary for them to entice a significant number of people away from private car usage.*
- *Provisions would need to be made to ensure that they are as accessible, if not more so, to individuals with reduced mobility - how would it ensure wheelchairs could easily board the vehicle and ensure sufficient time at stops for those with low mobility to board?*
- *ART infrastructure would require constant maintenance to ensure all signs and road markings are a sufficient standard that the vehicles can correctly read and interpret them.*
- *Potential mixing of ART and pedestrians/cycling could cause concerns by the general public that the vehicles are safe to interact with humans.*



ART: FEASIBILITY

- *Technology*
 - *Lower than wholly autonomous vehicles as using dedicated spaces which are separated from general traffic for the majority of the route*
- *Affordability*
 - *ART infrastructure investment would be much lower than introducing an equivalent tram scheme*
 - *With sufficient frequency and a city wide implementation it is possible for future ART schemes to cover costs without need for public subsidy - something which would be welcomed by the public and governments alike*
- *Future Proofing*
 - *ART systems can be easily designed so that they are flexible to route demand*
 - *Using tarmac for routes means that systems could accommodate a range of vehicles such as individual autonomous pods/vehicles which may be needed to allow access for disabled passengers*
- *Public Acceptability*
 - *ART produces less risks than fully automated, free roaming CAVs and so would incur less concerns from the public*
 - *Sufficient actions should be taken to ensure priority to active travel modes over ART such that there are sufficient pedestrian crossings and cycle lanes*
 - *Utilise improvement strategies outlined in Stage 1 to provide high quality service*



STEP 3: ENCOURAGE CHANGE

USE THE CURRENT CLIMATE AWARENESS AND PUBLIC APPRECIATION FOR THE ENVIRONMENT TO SPARK CHANGE

Create Awareness

Create awareness of the amount of emissions journeys would take via different modes.

Provide emission statistics when planning routes so that people know the impact of their choices.

Wide scale scheme implementation

Implement city wide schemes to improve likelihood of uptake rather than one small trial on the outskirts.

The larger the change the more likely people are to trust and try it.

Create a stigma against private car usage

Social and political change to create a similar stigma around car usage than that around single use plastics.

Provide alternative, low emission choices

Provide alternative routes as different modes rather than solely different driving routes.

CONCLUSION

- *Transportation is a major contributor to CO2 emissions which are causing climate change*
- *Private car usage is on the rise at the detriment of public transport, particularly buses*
- *Using technology to enhance existing bus services has to be an immediate priority to encourage change within the public to choose buses, this include:*
 - *Real-time updates at bus stops*
 - *On-board announcements to make services more accessible*
 - *Universal App to provide consistent information*
- *Autonomous Rapid Transit provides numerous opportunities to reduce the dependency on private car usage. Benefits include:*
 - *High passenger capacity*
 - *Use of battery power means less required infrastructure and more flexible routing*
- *Encouraging investment in ART and other rapid transit options is a must for the future to help reduce emissions and improve congestion in cities.*

There is current culture of change and the transport sector needs to embrace this to get as many people as possible away from their cars and onto sustainable and active transport modes.





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THANK YOU