

MAKING BETTER PLACES:

Autonomous vehicles and future opportunities

WSP | Parsons Brinckerhoff in association with Farrells

WSP | PARSONS BRINCKERHOFF

FARRELLS



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We would like to offer our sincere thanks to everyone who took the time to talk with us and share their thoughts, including experts from:

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FOREWORD

Autonomous vehicles will be transformational. They have the potential to support a better quality of life, economic growth, health, safety and social connections. They offer convenient and affordable mobility to all of us, regardless of where we live, our age or ability to drive. They could also help to improve the way that our existing places and routes work, while offering new potential for more valuable land, and additional homes and jobs.

Working together, WSP | Parsons Brinckerhoff and Farrells have built on leading-edge research into connected and autonomous vehicles to explore new thinking and ideas. From this, we have created future visions of what we think five places in the UK might look like in an autonomous vehicle world.

The transition has already begun. So these visions put aside, quite intentionally, futuristic townscape designs that bear no resemblance to today's reality.

These are visions for existing and familiar places: the city centre, the suburban road, motorways, and the local county town. We have also looked at the new places to come and taken our best guess at how autonomous vehicles can influence the design of emerging opportunity areas, garden cities and housing zones.

In short, we see enormous potential for a new generation of living streets and communities, designed for vehicles, but putting people first.

INTRODUCTION

DRIVERLESS AND AUTONOMOUS VEHICLES (AVs) ARE COMING, AND THEY WILL BE TRANSFORMATIONAL.

WITH THE RIGHT PLANNING, THEY OFFER THE POTENTIAL FOR A BETTER QUALITY OF LIFE, ECONOMIC GROWTH, IMPROVED HEALTH AND BROADER SOCIAL CONNECTIONS, BY OFFERING CONVENIENT AND AFFORDABLE MOBILITY TO ALL OF US, REGARDLESS OF WHERE WE LIVE, OUR AGE OR ABILITY TO DRIVE.

A connected network of vehicles will be safer, more sustainable and efficient than the cars of today. In time, AVs will be able to move around without direct driver input to transport people and goods, on demand, from door to door using the most efficient routes.

What's more, tomorrow's road transport system will interact seamlessly with other transport systems, offering end-to-end journey connectivity and resilience.

The transition to AVs also offers enormous potential for "land value uplift" alongside additional homes and jobs, if key steps are taken to lock in the anticipated place making and land-use benefits.

We are not seeking to justify or rationalise the business case for driverless cars or AVs in themselves.

Instead, we explore their potential benefits and impacts on real UK places:

- City centres
- Suburban spaces
- Motorways
- Rural areas

For each, we have drawn images of a **feasible future case**, to show the spaces as they could look and feel if we reach a point where autonomous vehicles are the norm.

New technologies will only win widespread acceptance when they are shown to work seamlessly, safely, efficiently and affordably in existing places, using current transport infrastructure and – where appropriate – when mixed with other vehicles.

In parallel, we can accelerate progress, trust and take-up through investment in AV systems in new places, allowing trials and roll-out of innovative concepts with fewer constraints. Therefore we also explore how a fully-autonomous future opportunity area, garden city or housing zone could look and feel.



Removing the clutter
Autonomous vehicles will transform Britain's busy streets

THE TECHNOLOGY WORKS.

In 2015, Google's on-road driverless cars in California clocked up their millionth mile.

UK trials of driverless car technology were funded in 2014 by InnovateUK. These are ongoing in Milton Keynes, Coventry, Greenwich and Bristol.

Live trials of Dutch driverless shuttles have started. These will build to a 6km on-street stretch between Wageningen and Ede, without guideways or safety drivers on board. This is the first European trial to mix with live traffic, rather than having a dedicated route or running in a pedestrianised area.

In China, self-driving bus prototypes have completed a 32km intercity circuit in normal traffic, reaching 68km/hr, changing lanes and overtaking without driver intervention.

In April 2016, the first driverless semi-trucks trial will commence at Rotterdam port. The goal is to be able to send autonomous road trains across the continent by 2019.

A NEW VISION FOR BETTER PLACES

WHAT IS AN "AUTONOMOUS VEHICLE"?

Building on the UK Department for Transport definitions, **a fully autonomous vehicle is capable of completing journeys safely and efficiently, without a driver, in all normally encountered traffic, road and weather conditions.** Occupants are able to engage in tasks other than driving for the duration of their journey. There is no driver's seat and the vehicle can move without a driver on board.

With each vehicle acting as one part of a wider system, decisions about route choice, travel speed and movement are made and adjusted in real time.

AVs will vary in size and will not all be cars, as the autonomous technologies can also be applied to light vans and heavy freight.

As AVs **can move while empty**, they can therefore offer door-to-door journeys to match individual needs exactly **without needing a parking space** at either end of that trip. This is critical to the potential for better placemaking.

ARE AVS THE SAME AS "DRIVERLESS VEHICLES"? AND WHAT ABOUT "CONNECTED VEHICLES"?

'Connected' simply means a vehicle that can connect with devices in the car (for example, a smartphone), to external networks (via the internet) and with other vehicles around them. It is worth noting that many of the newer cars on the UK's roads are already connected in some way.

A 'highly automated' driverless vehicle is not the same as a 'fully automated' AV. The key distinction is that while the vehicle can operate in driverless mode, **there must be a qualified person in the driving seat who is able to take manual control as required.**

IS AN AV A NEW MODE OR ARE THEY JUST THE "NEXT GENERATION" OF CARS?

Road-based transport is already moving towards fully autonomous operation: all major vehicle manufacturers are heavily invested. Today, the newer cars on the UK's roads already have a great deal of automation on board. From cruise control, automatic braking and parking assistance to the latest lane-following and lane-changing technology, we already trust it to keep us safe.

Within the next decade, an entirely new mode of transport is likely to emerge. These will be electric vehicles that are designed and built as AVs from the outset. While these may share many characteristics with cars to begin with, and may - as an interim step - have optional manual controls, in time the separation will become more clear.

WHO WILL OWN THE AVS?

There are two primary options for AV investment: **private ownership** and **shared use.**

Under a shared use scenario, within a specific place, fleets of AVs would be owned and operated by city or local authorities, or by site owners and developers holding a long term interest. In practice, fleet AV operations are likely to be subcontracted to specialist private companies who supply and maintain the vehicles.

If we can reach a **shared use solution**, people would not purchase or own the AVs they use. Instead, **people would buy into a mobility service offered by the AVs.** This is similar to cycle hire schemes and car clubs that already operate in many of our cities. Recent US-based studies have shown that travel cost savings of up to 75% could be available for shared vehicles travelling 24,000 kilometres per year, compared with typical car running costs today.

The two models are not mutually exclusive. That said, their availability for a particular city, place or route will play a major role in determining the benefits that are generated.

CAN WE TRUST THE TECHNOLOGY? HOW SAFE IS 'SAFE ENOUGH'?

The widespread introduction of AVs could reduce both the number and severity of road accidents substantially.

Today, we accept that every time we get into our cars, there is a risk of accident. With 1775 reported road fatalities in the UK in 2014, and 195,000 casualties of all severities, road accidents cost the UK upwards of £10 billion each year. While the number of fatalities has fallen by nearly half since 2005, upwards of 90% of all accidents continue to be caused in some way by driver error.

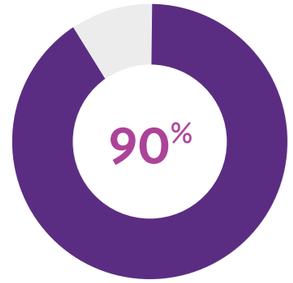
There is an expectation that driverless and autonomous systems will deliver a near-zero harm solution for everyone, including pedestrians and cyclists as well as those inside the vehicles. However, "near zero" will never mean "absolutely zero". There will always be times when an AV is forced to choose between options where there is no outcome that avoids all harm.

DO WE NEED WHOLESALE INFRASTRUCTURE INVESTMENT OR CHANGE BEFORE DRIVERLESS CARS AND AVS CAN WORK ON OUR ROADS?

No, neither driverless cars nor AVs will require significant on-street infrastructure investment before they can be used.

Inbuilt technology will allow AVs to navigate on all types of roadway while taking account of other users including pedestrians and cyclists.

That said, we have the opportunity to adapt our places and roads to maximise the benefits offered by AVs over time. Most of these changes will be long-term and evolutionary, accruing more benefit as a larger proportion of vehicles become equipped to operate in a driverless and then autonomous environment.



Upwards of 90% of all accidents continue to be caused in some way by driver error

IMAGINING FUTURE PLACES: AN AV ZONE



High quality, safe, flexible spaces for people, not cars

Roadside clutter eliminated: no road signs, speed limits or traffic lights needed

Cycle and pedestrian safety transformed as all routes are shared

Last mile freight deliveries made by AV

No permanent parking on-street, but flexible spaces available for deliveries and servicing

Fluid vehicle ‘lanes’ can adapt to match demand

IMAGINING FUTURE PLACES: AN AV ZONE

A FORWARD-THINKING AUTHORITY OR DEVELOPMENT CORPORATION COULD PLAN FOR AN AV ZONE TODAY WHEREVER THERE ARE PLANS FOR A GROWTH AREA, HOUSING ZONE, OPPORTUNITY AREA, GARDEN CITY OR SIMILAR. IN THE FIRST INSTANCE, AN AV ZONE WOULD OPERATE AS A SELF-CONTAINED SYSTEM WITHIN A DEFINED AREA.

This aligns well with the development areas already identified in planning documents across the country, where growth plans are of a relatively large scale and are expected to build out over the next ten to twenty years.

AV ZONES OFFER 15-20% ADDITIONAL DEVELOPABLE AREA

A new development designated as a dedicated zone for shared AV use could offer between 15% and 20% additional developable area compared with a typical central urban layout. This is primarily due to the removal of almost all parking spaces, but also because of roadspace simplification that will save space.

AVs would move seamlessly between 'booked' journeys or would return to a designated hub for storage, charging and maintenance until they are next needed.

Available data confirms that central London has a parking coverage of around 16% and a total of around 6.8 million parking spaces, on and off street. Assuming a typical average parking bay size, this means that around 8,000 hectares of central London is used for parking. General figures of 15-30% parking coverage are typical of New York, Paris, Vienna, Boston and Hong Kong.

Designing out the majority of parking spaces from a new AV zone would create at least 15% additional land area (at ground level) for more valuable uses, compared with our existing urban centres. Depending on scale, this could create the potential for **thousands of additional homes and jobs, as well as extra land for quality green and open spaces.**

It could also **reduce costs** as the same developable area could be achieved with a more efficient use of ground level space (and perhaps above or below as well, depending on the situation).

With reference to the latest DCLG figures (below), a **100 hectare AV zone development in the heart of London could gain more than £1.25 billion in additional land value uplift as a direct result, or £300 million in outer London or £15-£75 million across much of the rest of the country.** The introduction of AV zones could therefore become a significant factor in future development viability appraisals.

RESIDENTIAL LAND VALUE UPLIFTS

AV zones that increase the amount of residential land by removing parking spaces could make future developments considerably more viable.

DCLG's data (2015) identifies that post-development residential land value uplifts of £1-4 million per hectare are typical of much of the country.

Most London boroughs typically reach an uplift of £10-30 million per hectare, while Westminster and the City of London uplifts are upwards of £90 million.



Some newer city centre developments are already planned and delivered without car parking, usually where they are near to a station offering fast, frequent public transport services. AV zones would allow this strategy to be delivered equitably across far larger development areas, giving everyone a high quality transport solution at their front door.

MUCH SAFER LOCAL ROADS

In an AV zone, cycle safety would be transformed as AVs would be far more aware of bicycles than drivers are today. The bicycles themselves could be linked into the wider system in time, offering even greater safety improvements.

Similarly, pedestrians will be better protected and vehicle speeds will adjust to allow AVs to take proper account of people crossing roads.

In return, as pedestrians and users of public spaces, we will all have to get used to a new etiquette for AVs to match the logic and behaviour of the vehicles.

One of the key changes that will make an AV zone significantly safer than today's urban areas is that **AVs will put people at the top of the user hierarchy**, rather than vehicles. This offers many of the **benefits of a pedestrianised area without the need to compromise on accessibility.**

LESS CLUTTERED STREETS

This shift in urban design creates the opportunity to bring forward high quality, high density communities enhanced by open and green spaces. At the same time, the streets themselves become more functional and efficient thoroughfares.

Street clutter can be virtually eliminated, as AVs will not need to gather information from the roadside. In a zone designed and built for AVs from the outset, direction signs, speed limit signs and traffic lights will no longer be required. Visibility splays can be reduced and intersections can be simplified.

AV STORAGE AND THE CAR-TO-AV INTERCHANGE

AVs have to be stored somewhere when not in use. Vehicles can be supplied from a series of 'mini-hubs' throughout the AV zone, which ensure a local supply of a vehicle on demand to any home or business. When not 'on call', AVs would return to these mini-hubs for charging. Larger AV hubs or depots would be needed for servicing and storage purposes, but these do not need to occupy prime locations so could be underground or out-of-centre.

For those who wish to drive outside the AV zone in the short to medium term, car clubs and car parks (similar to today's park and ride facilities) could be created at the zone edge.

TRANSFORMING CITY CENTRES







More space for urban retail, commercial and leisure activity

Safe interaction between cyclists, pedestrians and AVs

Edge of centre car parks become larger AV servicing and storage hubs

AVs able to access hard-to-reach places, especially for mobility impaired passengers

Much reduced congestion and smoother traffic flow

Better quality of townscape with more space for pedestrian activity



TRANSFORMING CITY CENTRES

THE WIDESPREAD UPTAKE OF CONNECTED AND AUTONOMOUS VEHICLES CREATES AN OPPORTUNITY TO REINVIGORATE CITY AND TOWN CENTRES ACROSS THE COUNTRY. THESE PLACES WOULD REMAIN FAMILIAR BUT WILL BECOME GREENER, CLEANER AND MORE LIVEABLE SPACES AS DRIVERLESS VEHICLES AND THEN AVs ARE INTRODUCED.

MORE EFFICIENT MOVEMENT

With driverless cars and/or under a private AV ownership model, safety, efficiency and air quality benefits could be substantial. Around 30% - or 45% in some places - of city centre traffic is made up of drivers searching for parking spaces.

As vehicles become better connected to network-wide information, this inefficiency would be eliminated, flows would be smoothed and journey time reliability improved.

SAFER STREETS FOR EVERYONE

Accidents on built-up roads (with 20, 30 and 40 mph speed limits) accounted for nearly 800 deaths and 72% of all accidents in 2014. Accidents on built-up roads cost us, nationally, more than £6 billion each year, excluding damage-only incidents.

Not surprisingly, urban accidents tend to involve more pedestrians and cyclists than other road types. “Failure to look properly” caused almost 50% of urban accidents in 2014 (higher than any other road type), with “poor judgement” and “careless driving” causing an additional 40%.

The introduction of driverless vehicles and AVs to urban centres could therefore generate large reductions in accident numbers.

Using urban population as a broad proxy for casualty distribution across the UK:

- In Greater London, a 50% reduction in road-related casualties could generate savings of £360 million each year, rising to £650 million if a 90% reduction can be achieved
- For Greater Manchester, these savings could be £125-£225 million per year and for Birmingham, £50-£90 million a year
- For cities of a size similar to Glasgow, Sheffield or Edinburgh, these savings could reach £25-£45 million a year

EXTRA BENEFITS THROUGH SHARED USE

Adding shared AV use to this future scenario offers additional placemaking benefits and congestion relief.

First, similar to the AV zone, **unnecessary parking can be removed from city centre streets, and car parks can be redeveloped for more valuable uses**. As discussed earlier, parking takes up around 15-30% of a typical urban area, so the land value uplift could be similar – on a per hectare basis - to that identified for an AV zone.

Of the estimated 8,000 hectares of central London land occupied by parked cars today, **it is reasonable to assume that 50-70% – potentially more than 5,000 hectares – could be released once AVs are commonly in use.** Some of this land (largely on-street parking spaces) will be well suited to pedestrian and cycle enhancements, small-scale retail and commercial improvements or better open spaces. Off-street car parks and similar could offer larger-scale redevelopment opportunities.

At typical densities between 25 and 50 dwellings per hectare, the introduction of AVs therefore **opens up the potential for hundreds of thousands of new homes in our existing city centres.**

Second, under a shared use model, **we would need far fewer AVs than cars in circulation to maintain today’s car-based travel patterns.** Recent research, repeated with similar results around the world, suggests that in the UK our cars are parked for 96% of the time (80% at home and 16% elsewhere). With shared use, each AV would be in use for a far greater proportion of time than a typical car today. On this basis, even allowing for peaks in demand and growth, the efficiency benefits on offer would be transformational.

NO NEED FOR MAJOR INFRASTRUCTURE INVESTMENT

Driverless vehicles and AVs could start to use our urban streets without major change to the existing streetscape or city-wide infrastructure. The new technology is vehicle-mounted rather than at the roadside.

While non-driverless cars remain a part of the traffic flow, the fundamentals of the urban streetscape, both junctions and links, will need to remain in place. This does not mean “no change” in the interim. As roadspace is freed up, local authorities and developers will have a key role in managing and improving the public realm for different users.

Once driverless technologies are well-established and trusted, there will come a key point when sufficient vehicles meet the defined standards for driverless vehicles. A city or urban authority could then decide to designate some routes or areas as ‘driverless zones’ or, beyond that, ‘AV zones’. These could be used by vehicles that meet the DfT-defined standard of driverless connectivity, regardless of ownership (private or shared), and the streetscape could be changed and de-cluttered to suit.

SEAMLESS INTERCHANGE WITH INTER-URBAN MASS TRANSIT

Demand for mass movement along core routes between urban centres will remain, catering for peak commuter routes and inter-city trips. It is unlikely that sufficient efficiency or cost gains would be made by hundreds of individual AVs converging on particular routes.

Instead, AVs will offer a door-to-door first or last mile travel option to and from mass transit interchanges. They will also be able to fulfil journeys where there is no public transport equivalent, or where levels of demand do not support an economically viable service.

The combination of a data-rich connected network for road transport together with similarly developed systems for other transport modes will help to make stations highly efficient integrated interchange points between AVs and rail or bus services. This will cut waiting times for the travelling public: it is worth noting that if this integration saves **just ten minutes of waiting time for commuters each day, this is equivalent to reclaiming five working days per year for everyone.**

ENHANCING OUR SUBURBS



Residential roads become quieter social spaces, safe play spaces and better cycle routes

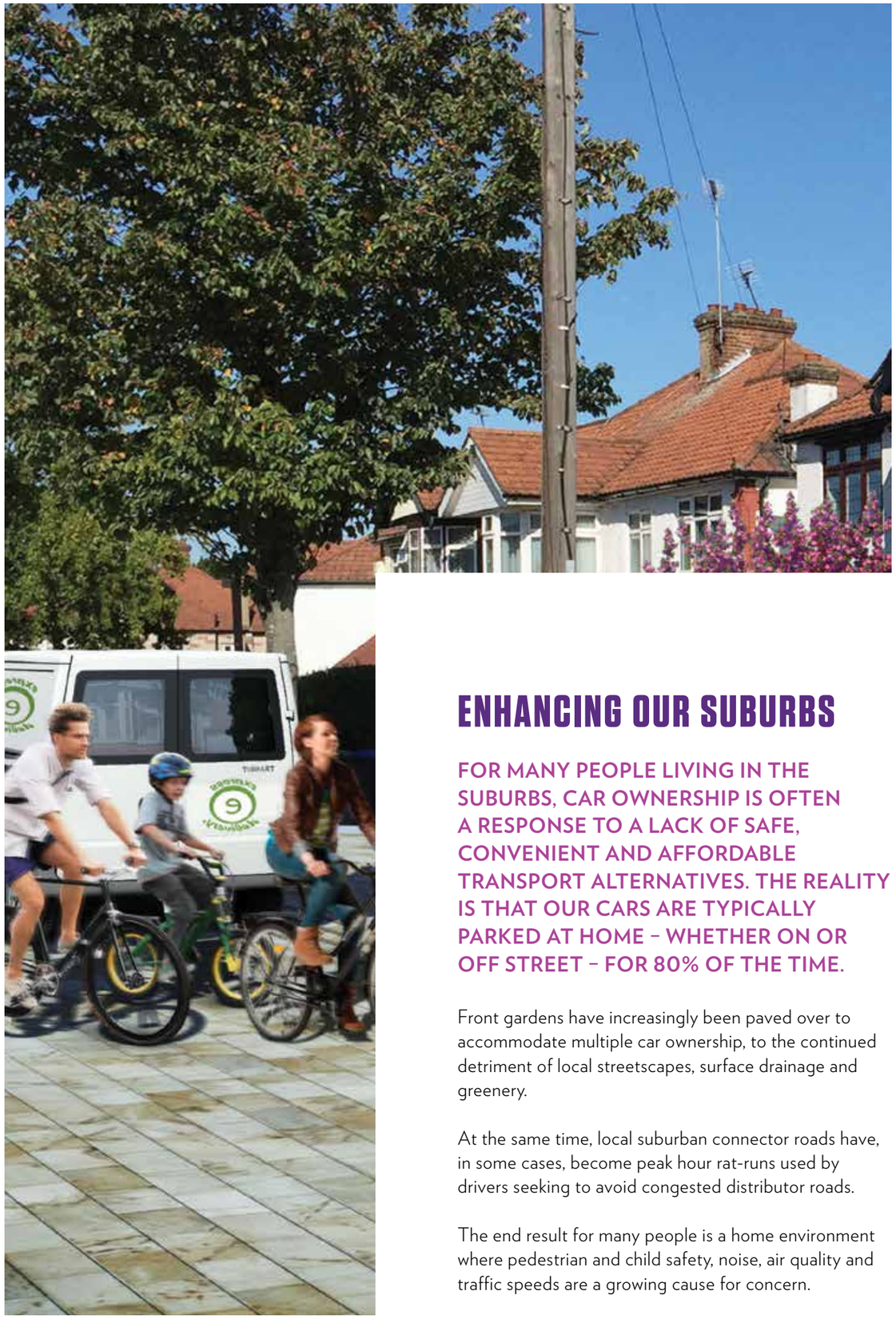
On-street parking is eliminated

AVs only use suburban residential roads for local pick-up and drop-off

Restored front gardens have better biodiversity and drainage, reducing flood risk

AVs are supplied on demand and charged locally, returning to larger hubs for servicing

Non-perishable and non-critical AV deliveries are made outside peak travel times



ENHANCING OUR SUBURBS

FOR MANY PEOPLE LIVING IN THE SUBURBS, CAR OWNERSHIP IS OFTEN A RESPONSE TO A LACK OF SAFE, CONVENIENT AND AFFORDABLE TRANSPORT ALTERNATIVES. THE REALITY IS THAT OUR CARS ARE TYPICALLY PARKED AT HOME – WHETHER ON OR OFF STREET – FOR 80% OF THE TIME.

Front gardens have increasingly been paved over to accommodate multiple car ownership, to the continued detriment of local streetscapes, surface drainage and greenery.

At the same time, local suburban connector roads have, in some cases, become peak hour rat-runs used by drivers seeking to avoid congested distributor roads.

The end result for many people is a home environment where pedestrian and child safety, noise, air quality and traffic speeds are a growing cause for concern.

The widespread introduction of driverless cars and AVs to suburban areas would help to address these issues, while adding specific value to the suburban streets. In particular, with system-wide control over route choice to maximise efficiency and network capacity, vehicles would use the most appropriate routes. Residential streets could largely be avoided, except where they form an essential element of the trip.

If a shared use solution for AVs was available to a suburban community, offering appropriately sized vehicles within minutes, supplied from local hubs, and with significantly lower costs than running a car year-round, then interest and demand would grow fast.

This does not necessarily mean that today's cars would be formally excluded from suburban areas over the short or medium term in favour of driverless vehicles or AVs.

Instead, suburban households could transition to shared AVs in place of second car ownership to begin with. Over time, as trust and familiarity builds, we might then see a shift towards greater use of shared AVs for everyday trips to and from home.

For household deliveries, it is feasible that autonomous light vans could come into use. In this case, customised AVs might operate as secure mobile 'lockers' that can be opened and unloaded by an operator or the recipient.

SAFER STREETS FOR EVERYONE, WITH BETTER CHILD SAFETY

If AVs become largely privately owned, one of the primary benefits for the suburbs will be road safety. On 30mph roads, almost half of drivers tend to travel above the speed limit and around 15% travel at more than 35mph. In future, driving speeds will be controlled by the system. Long-term evidence suggests that the risk of a fatal injury to a pedestrian hit by a car travelling at 30-40mph is around 350-500% greater than vehicles travelling below 30mph. It follows that suburban accident rates could be reduced dramatically through this change alone.

Sensors mounted within driverless vehicles and AVs will be much faster and more reliable at detecting and avoiding vulnerable road users than most drivers today. This could provide further benefits for children, the elderly and cyclists in suburban spaces.

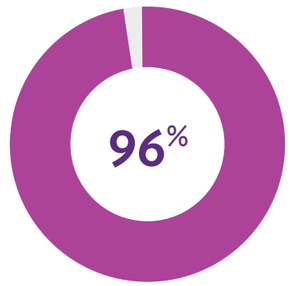
SHARED AV USE: THE KEY TO RECLAIMING SUBURBAN SPACE AND ADDING VALUE

Around 80% of the UK's suburban housing stock has some form of front garden space, of which around a third have been paved to become a parking space. This is an area equivalent to 100 Hyde Parks or approximately 1400 hectares. In London, the proportion of front gardens that have become parking spaces is even higher, at around 50%. These figures are rising: in 2015 five times as many London homes had front gardens with no plants compared with 2005.

In addition, on-street parking is permitted along many suburban roads, with or without some form of Controlled Parking Zone in operation.

The uptake of shared use AVs, able to move without a driver on board, opens up options to reclaim on-street parking and to convert many residential off-street parking spaces back into gardens. This would improve the look and feel of the streetscape, leaving more safe space for leisure and social uses. It would also benefit biodiversity and rainwater runoff, while reducing pressure on water storage systems. **Taking the figures above, if half of the UK's paved suburban front gardens were reclaimed, this would stop or significantly slow up to 2,400 litres/second of rainfall entering the system and causing flooding.**

Another direct benefit for suburban residents is that reduced levels of car ownership might allow more households to convert existing garage spaces into new living space, bedrooms and bathrooms. **Today, this form of conversion tends to add 5-20% to the value of a typical suburban property** and allows for more flexible use in future.



In the UK our cars are parked 96% of the time, including 80% at home.

NEXT GENERATION MOTORWAYS & MAJOR ROUTES







Crash barriers, sign gantries and lane markings are no longer required

Flexible, fluid lanes cater for tidal flows, freight and live work on carriageways

AVs move in connected platoons for maximum safety and route efficiency

Priority lanes can be created for high occupancy AVs and/or premium users

Safety is enhanced by on-board sensors to monitor road obstructions

Improved water runoff, flood management and ecology benefits for the motorway corridor

New uses alongside the motorway could include long distance cycle routes, light industry and energy capture

Motorway lighting – and associated light pollution – dramatically reduced



NEXT GENERATION MOTORWAYS & MAJOR ROUTES

TAKING A ROUTE-BASED APPROACH, DRIVERLESS AND AUTONOMOUS VEHICLES COULD SUBSTANTIALLY CHANGE ROAD SAFETY AND EFFICIENCY ON MOTORWAYS AND MAJOR ROUTES.

The Department for Transport is already considering changes needed to the Highway Code for driverless vehicles, and Highways England's first motorway trials for driverless cars will take place in 2017.

DEDICATED DRIVERLESS ROUTES VERSUS MOTORWAYS WITH MIXED OPERATION

There is a key decision to make about whether to dedicate routes for driverless vehicles or to aim for 'mixed operation' where today's cars and freight use the same roadspace as well.

Mixed operation on higher speed routes introduces some very pragmatic challenges: driverless vehicles and AVs will behave differently to cars, and every non-connected, non-driverless vehicle will affect all others around it. There are useful parallels with rail, where higher speed services, local services and freight are separated wherever possible onto separate lines.

THE SAFETY CASE

Despite being one of the safest route types, 5500 accidents occurred on British motorways in 2014, including 85 fatalities and almost 600 serious injuries. Driverless motorways could transform road safety.

If half of the current accidents on our motorway network could be prevented, this would generate savings of £240 million each year and if 90% were eliminated (the percentage of accidents that involve driver error today) it would be almost £400 million per year. These benefits include wider costs but exclude the costs of delays that occur as a result of the motorway incidents.

THE EFFICIENCY AND CAPACITY CASE

The typical stopping distance for vehicles travelling at 70mph, the current speed limit for most British motorways, is 96 metres. This is made up of 21 metres of thinking time (or 0.7 seconds) plus 75m of stopping time (2.4 seconds).

This means that today's cars make use of just 5% of a typical lane at any given time, under good conditions. A fully driverless motorway would allow much better utilisation of roadspace, reducing reaction times and smoothing flows across segments. This will also reduce energy consumption.

Recent estimates suggest capacity improvements of around 1.4 times current capacity once all vehicles are fully connected. With driverless capability in place, **a dedicated motorway or strategic route could deliver as much as 3.7 times its current capacity.**

CHANGING THE INVESTMENT CASE FOR MOTORWAYS

With efficiency and safety expectations transformed, driverless motorways have the potential to change the investment strategy for DfT and Highways England. Some routes may have sufficient headroom for many more years due to the move to driverless motorways. This will shift the emphasis of both capital and operational spend, and at the same time the potential for new revenue streams could be explored.

In other cases, there is potential to convert existing motorway land to other uses. This could take many forms, from long-distance commuter cycle routes to light industrial uses, to energy capture or leisure uses.

DRIVERLESS MOTORWAYS: OPERATION, LOOK AND FEEL

The best long term option would be fully driverless motorways, available for use by any vehicle that meets new Highway Code standards. **With every vehicle operating in driverless mode, the system could maximise efficiency through speed, vehicle position and lane changing.**

On a fully driverless route, the operation, look and feel of the route will change substantially:

- **Fixed, formal, marked lanes will not be needed.** Changing over the course of the day, fluid lanes would allow demand and capacity to be matched by direction. This opens up large efficiency gains on routes with heavily tidal flows at different times of the day. The lanes could also be narrowed as vehicles travelling closer together would not affect each other.
- **Roadside clutter could be almost entirely removed.** Direction signs, distances to key points of interest, incident information and so on could be delivered directly to passengers.
- **Speed limits will no longer be required.** All vehicles in the same lane will travel at the same speed, as appropriate to the road layout and surface, traffic volume and conditions on the route ahead.
- **High priority lanes or convoys could be formed**, effectively creating a **pay-as-you-go** motorway with a live revenue stream, irrespective of vehicle ownership. Higher revenue business trips could then travel faster or use the shortest available routes.
- **High occupancy lanes could benefit those who choose to share a vehicle**, offering faster travel times or shorter travel distances to those travelling more sustainably.
- **Freight lanes or convoys could be formed to match demand outside peak times,** with options to consolidate driverless loads at motorway access points. Freight vehicles would avoid the nearside lanes, given the long distances they tend to travel, to minimise interaction with other vehicles joining or leaving the route.
- **Journey times will be more reliable** as real-time connected systems use live data to forecast arrival times. Should any incidents occur, all vehicles using the route will react to adjust speeds and their optimum routes.
- **Passenger comfort would also be much enhanced**, as shockwave braking and poor driver reactions would be eliminated.
- **Roadway surface monitoring** could be revolutionised with vehicles scanning the surface and reporting any issues, for example obstructions in the carriageway, live.
- **Live carriageway and roadside works would become much safer,** as driverless vehicles would avoid carriageway space where works (whether manual or automated) are underway.
- **Green links and landscaping would be enhanced** alongside the strategic route network.

OUR RURAL COMMUNITIES







On-demand AV service gives everyone access to local rural centres

Reduced isolation, including better access to jobs (urban and rural) for rural residents

Strengthened rural communities and centres, commercially and socially

AVs are supplied on demand from small community hubs

Improved identity for rural towns, with public realm and community spaces at their centre

Rural businesses use AVs for local deliveries or to lock into national distribution hubs



OUR RURAL COMMUNITIES

AV TAKE-UP IN RURAL AREAS IS LIKELY TO BE DRIVEN BY BETTER ACCESS AND MOBILITY, RATHER THAN CONGESTION REDUCTION OR LAND VALUE INCREASE.

IN RURAL COMMUNITIES, CARS ARE AN ESSENTIAL INGREDIENT OF EVERYDAY LIFE AND MOBILITY. JUST 7% OF HOUSEHOLDS IN THE MOST RURAL AREAS (RURAL VILLAGES, HAMLETS AND ISOLATED DWELLINGS) HAVE NO CAR, IN CONTRAST WITH LONDON, WHERE 44% OF INNER LONDON HOUSEHOLDS DO NOT HAVE A CAR.

THIS IS A VERY DIFFERENT STARTING POINT FOR THE TRANSITION TO DRIVERLESS AND THEN AUTONOMOUS VEHICLES, WITH DIFFERENT DRIVERS OF CHANGE.

IMPROVING RURAL QUALITY OF LIFE

For rural centres and market towns, a shared AV future will reduce the need for parking, opening up opportunities to re-use valuable shared spaces in town squares and village centres for flexible commercial and leisure uses.

The widespread introduction of AVs to a rural environment also brings a wealth of potential opportunities for better mobility and access, therefore reducing isolation. This will be delivered at lower cost than current public transport provision (for local authorities) or car running costs (for residents).

Among the varied potential benefits on offer:

- Young people who do not drive or cannot afford a car will be able to access a far greater range of jobs, both rural and urban
- People of all ages will be able to maintain a level of mobility, irrespective of their ability to drive
- Access to healthcare, schools, community centres and social activities would be much enhanced. This would be two-way: rural residents could access a wider range of services and specially adapted AVs could bring a range of new health, library and other social services to rural communities
- Deliveries and logistics can be made at lower cost, opening up opportunities for rural businesses to serve a larger catchment - and for rural residents to access services from more businesses

SHARED AVs FOR BETTER RURAL 'BUS' PROVISION

While some rural centres and roads have access to a bus service, frequencies and route choices are often limited and very few routes are commercially viable without subsidy. Many rural centres have no service at all, and have no prospect of any form of provision in future. Shared AVs, scaled to match levels of demand and available on-demand, could significantly enhance the services now offered by rural buses. Offering a 'from-the-door' service to rural residents, AVs would eliminate service gaps as well as walk and wait times. The key shift is from a fixed route service to one that is infinitely flexible. By serving known demand, there are large efficiency benefits and cost savings on offer through route optimisation and adaptation.

This system could operate alongside current car-based travel, while building familiarity and public trust in the technology.

RURAL-URBAN CONNECTIONS

The potential for much-enhanced mobility across the UK's rural areas leads naturally into debates around future urban intensification versus rural drift.

There is no denying that connectivity between rural areas and urban centres would be transformed by AVs. The journey itself could include a high proportion of productive time for those using AVs for business travel or commuting.

MAKING THE TRANSITION WHILE MAXIMISING THE POTENTIAL

ACROSS THE FIVE TYPES OF PLACES AND ROUTES WE HAVE CONSIDERED, THERE ARE MAJOR BENEFITS ON OFFER FROM THE INTRODUCTION OF CONNECTED VEHICLES, BOTH DRIVERLESS (HIGHLY AUTOMATED) AND AUTONOMOUS (FULLY AUTOMATED). THESE RELATE TO PLACEMAKING, SAFETY AND ROAD NETWORK CAPACITY AT VARIOUS SCALES. INDIVIDUALS USING THE NEW SYSTEM WOULD BENEFIT FROM SIGNIFICANT COST SAVINGS COMPARED WITH TODAY'S CAR RUNNING AND INSURANCE COSTS, WITHOUT COMPROMISING ON CONVENIENCE.

These benefits will accrue fastest through decisive and bold transitions at the local scale, rather than tentative steps.

There are three major factors that will determine the speed of our transition to AVs:

1. **Growing public trust and familiarity, with appropriate incentives for change**
2. **Strong public and private sector leadership**
3. **The right legal framework**

This leads to big questions that need to be answered before the places and benefits described can become a reality.



Within the next five years, driverless technologies will be far more commonplace and better understood.



Driverless and autonomous technologies will offer everyone a whole new mode of transport within the next 25 years.

CAPTURING THE BENEFITS: WHO WINS? WHO LEADS?

The maximum benefits of AVs will not accrue without the right leadership.

Within the next five years, driverless technologies will be far more commonplace and better understood. Within 15-25 years, driverless and autonomous technologies will offer everyone a new mainstream mode of transport for everyday journeys.

What is not yet fixed is the scale of benefits on offer, and how these could accrue to vehicle manufacturers, technology firms, others in the private sector or the public purse.

It is in our collective interest to maximise the overall placemaking, efficiency and safety benefits, but this can only happen through joint working between public and private sector, with investment and leadership from local government and developers. Ahead of this, DfT will need to continue its lead role in defining standards and baselines for connected and increasingly autonomous vehicles.

THE CASE FOR PUBLIC SECTOR LEADERSHIP

Transport policymakers and asset owners hold the key to a successful transition at national, city and local scale, as they are in a position to influence change and also stand to gain from land value uplifts, road safety improvements and efficiency benefits across the network.

For example, if a city was to define one or more areas where moving vehicles (whether privately owned or shared) had to meet a baseline level of driverless technology from a defined point in time, the transition could be rapid and the benefits secured directly in that area. The area could then be enlarged or joined with others over time. As we have seen, in the longer run, the largest benefits could be created through the widespread introduction of shared use AV systems that provide a relevant, tailored solution to meet the needs of the local community.

THE CASE FOR PRIVATE SECTOR PARTNERSHIP

Developers and land-owners can also expect to make significant gains through the shift to AVs. Sites that are not viable due to poor transport access today could become far more accessible and acceptable with the introduction of a tailored AV solution.

The creation of 15-20% additional land area for development could generate millions – or even billions – of pounds of new value and/or construction cost savings. This can be secured without needing to compromise on development quality, while securing freedom from current planning constraints around parking.

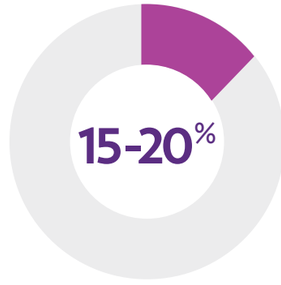
For developers who wish to retain a long-run interest in their sites, for example through a Private Rented Sector (PRS) model, as it also seems feasible that access to a maintained AV fleet could become part of the package available to future residents.

All of this suggests that private sector investment, working in partnership with the public sector, would maximise the total benefit on offer to both.

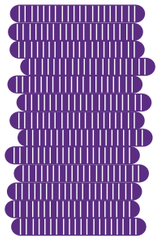
ARE WE HEADED TOWARDS A PAY-AS-YOU-GO TRANSPORT SYSTEM?

Once the majority of vehicles have the ability to operate in driverless mode, we have the opportunity to move to a pay-as-you-go system for road transport.

With a shared use scenario, the process of confirming an AV journey from A to B at a specific time and in a particular vehicle is, in essence, a network 'booking'. It is reasonable to assume that the cost of that journey will be set, for example, according to time of day (and anticipated congestion), distance travelled and the priority to be assigned to the vehicle. Those who are willing to use a shared AV, book further in advance or are flexible over choice of route would presumably be able to make a trip at lower cost than those who request their own AV for immediate use. People who are not prepared to compromise on departure or arrival times can expect to pay more, especially where their journey is at peak times. Much of this has direct parallels with existing taxi, minicab, rail and airline booking systems.

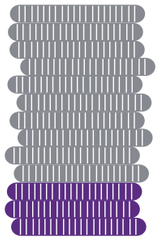


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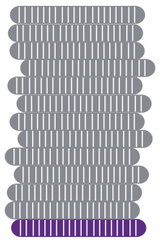
£1.25bn

A 100 hectare AV zone development in the heart of London could gain more than £1.25 billion in additional land value uplift as a direct result



£300m

£300 million in outer London



£15-75m

£15-£75 million across much of the rest of the country. The introduction of AV zones could therefore become a significant factor in future development viability appraisals

Even with a shared use system available, some will want their own AVs. There is nothing to prevent this, although private AV-owners would have to take responsibility for maintaining them to defined standards and for finding a suitable parking space at both ends of every trip. It also seems likely that private AV-owners would have to pay some form of network access charge according to trips made, as they will be reliant on the wider system to carry them from A to B.

Revenues – and returns - would flow directly to the operators and maintainers of the system in a pre-defined way. Unlike today's shadow tolling models, the rich trip-making data generated by day-to-day AV use will allow revenues to be allocated precisely to fund operations and maintenance, capital investment in vehicles and infrastructure, security and similar.

WILL AVS INTEGRATE WITH - AND WORK ALONGSIDE - MASS TRANSIT?

Under an autonomous system, journey times will become entirely predictable and adjusted in real time, meaning that AVs offer enormous potential for cross-modal trip integration. At the same time, future enhancements in mass transit technology can be expected to advance the current state-of the-art, for example for journey time information and live adjustments.

This brings forward a new potential, for example, for 'free-flow' smart rail stations where AVs operate on a just-in-time basis to deliver and collect people at their chosen interchange.

As such, mass transit systems would integrate with the future AV system to operate as a powerful combination. In time, pricing and ticketing will be seamlessly integrated with the end-to-end journey in mind. For example, AVs could carry people from home to a rail station (if walking or cycling is not an option) and could fulfil a similar role in getting people to their ultimate destination. To be competitive, this combined AV/rail/AV trip would be cheaper than the same trip made by AV alone.

DO AVs SPELL THE END OF ACTIVE TRANSPORT?

No. It is quite the opposite:

- Pedestrians and cyclists will be far safer. Always-on sensors will offer better protection from moving vehicles in the streetscape than today.
- Urban and suburban streetspace could be managed much more actively, opening up options for pedestrianised zones during daytime or peak hours.

NEXT STEPS: BUILDING PUBLIC TRUST IN THE SHORT TERM

From our thinking about specific places, routes and needs, the roll-out of driverless cars and AVs is unlikely to be homogeneous or synchronised across the country. Initial steps will be taken to suit local circumstances, opportunities and challenges, supported by enabling legislation at a national scale.

In parallel, the first steps towards this roll-out can be used to build widespread public awareness and trust. A wide range of ideas could be rolled out within the next five years, including:

- **CONNECT OUR EXISTING SYSTEMS AND VEHICLES:** appropriate communication between existing systems and modern cars is a critical next step to generate benefits to our road transport system. This could relate to traffic control systems or parking systems, for example, to provide better information about route choices and the availability of on or off-street parking spaces in real time.
- **DEDICATED DRIVERLESS PARKING AREAS:** mainstream vehicles with self-park capability are already on our roads. Another quick win to raise awareness could be to allocate 'self-parking' spaces, perhaps in premium locations on-street or within existing car parks.
- **AUTONOMOUS BUSES:** the introduction of live on-street running of autonomous buses and minibuses would offer real benefit to urban centres, core suburban routes and rural areas. It would again build familiarity and public trust in new technologies, starting with fixed routes and moving towards demand responsive flexible routes, where passengers 'call' the AV to their closest stop.
- **FIRST FORMAL AV ZONE CREATION:** there is very little to prevent us planning for the creation of a dedicated driverless or AV zone for an emerging major development area. Opportunity and Growth Areas around our major cities offer great potential for this solution. In the longer run, as more zones are established - and as public trust grows - interlinkages between adjacent zones would be a natural next step.
- **LAST MILE TRIP-MAKING:** within five years, short distance trips around urban, suburban and more rural centres could be made by AVs, for people and deliveries.
- **DRIVERLESS MOTORWAYS:** further to the planned roll-out of driverless car trials on motorways in 2017, an onward programme of pilot trials would ensure readiness for driverless motorways as and when the uptake of new vehicles permits.



8000

Hectares of central London land is occupied by parked cars

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