



Wolfson Economics Prize

Secondary Submission



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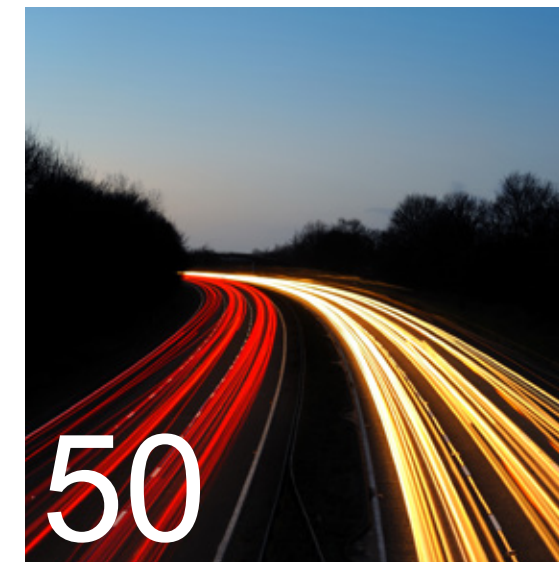
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The Clearways scheme architecture and smart mobility platform is patent pending
(Australian patent reference 2017901399).

Introduction

What if there was a product that:

- Improved the quality of life in the UK by significantly reducing the commute time of drivers enabling them to spend more time with their families.
- Reduced the costs of doing business by reducing freight costs.
- Improved the quality of the air that we breathed and helped us to meet our climate change commitments with no cost to the economy.
- Made our roads safer.
- Improved fairness.

- Put the UK at the leading edge of managing the coming technological revolution in autonomous vehicles (AVs).
- Brings in extra revenues for the Government.
- Was as desirable to the public as the latest iPhone.

Clearways is a product that delivers all of these things.

The UK Government faces a wide range of challenges in mobility:

- Terrible congestion that is expected to get significantly worse.

- An inefficient and poorly maintained road system that drags down productivity.
- An immediate air pollution challenge from motor vehicles.
- A plateauing of road safety casualty reductions.
- The regressive nature of existing fuel taxes.
- Managing the transition to autonomous vehicles.
- The future collapse of fuel excise revenues from the transition to Electric Vehicles (EVs).

All of these issues could be tackled, if we managed the demand on our roads more efficiently. Demand management works by reducing the demand for road space, especially during the peaks.

Traditionally, there has only ever been one way to comprehensively manage the demand on our roads — road pricing. This approach has consistently failed as it tries to get people to use the roads more effectively by Governments **forcing** them onto a new system and **sanctioning** them in order to get them

to change their behaviour. This has made it a political non-starter.

Clearways is totally different. Instead of forcing people onto a new system, it makes it voluntary. Instead of sanctioning people, it rewards people for changing their behaviour. Instead of being a Government run scheme, it is run by companies that know how to deliver desirable products and attract people to buy them.

Clearways provides incentives for people to use the roads more efficiently (and hence get rid of congestion) through either retiming

their journeys outside of the peak, getting them to remode on to public transport or use carpool options, reducing their travel altogether or rerouting their trips so that they have less impact on congestion.

Clearways can be rolled out steadily over the next couple of decades in a fiscally neutral way. If implemented in the next twelve months, significant reductions in congestion could be seen within this term of parliament.

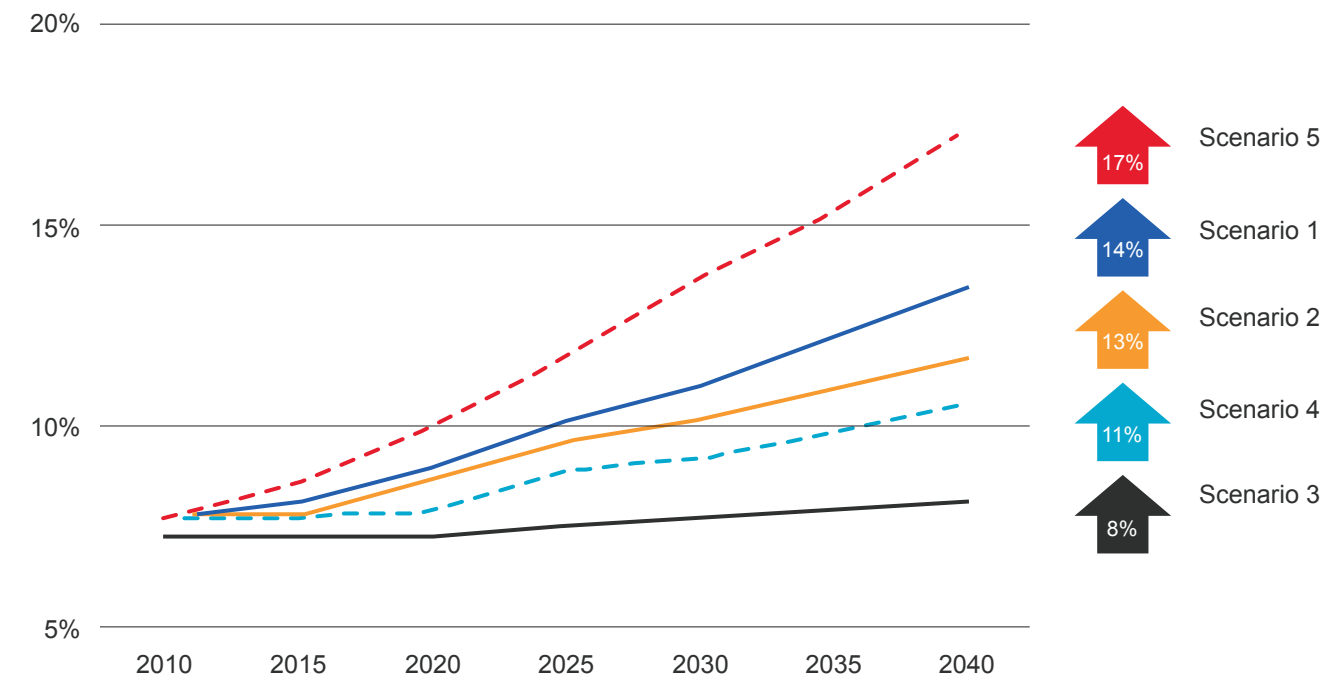
The Challenges

Increases in congestion

According to research by Inrix, an urban mobility company that gathers data on road performance, in 2016 the UK ranked as the 4th most congested developed country in the world. London is the 2nd most congested city in Europe after Moscow, costing London drivers £1,911 each and the capital as a whole £6.2 billion from direct and indirect costs.

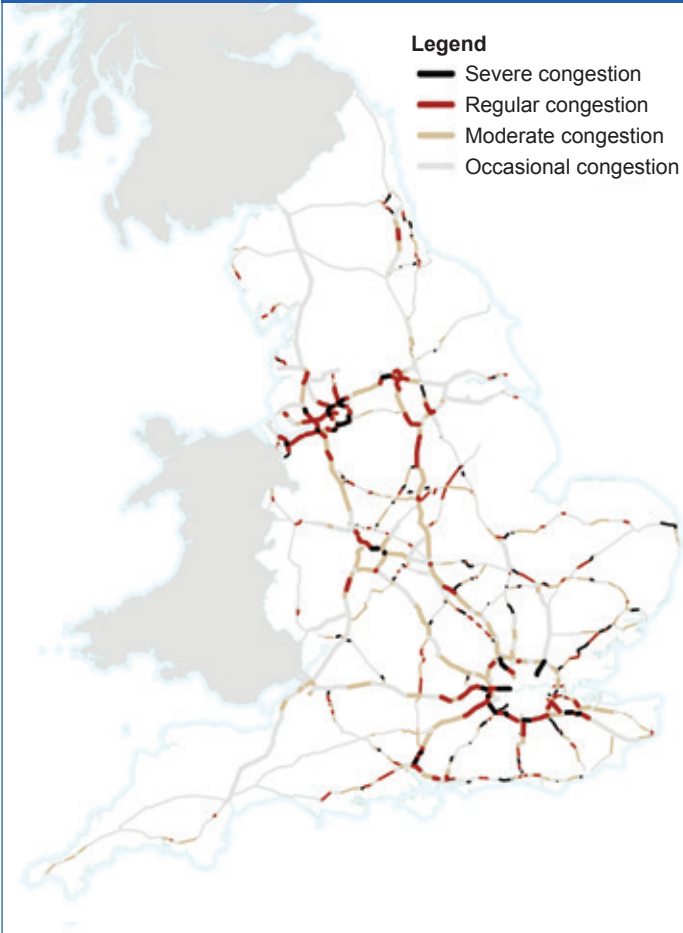
However, if we do nothing, congestion is expected to get worse. A study by Inrix and the Centre for Economics and Business Research predicts that the annual cost of congestion in the UK will rise to £21 billion by 2030 (a 63 percent increase compared to 2013) as a result of a range of factors including population and economic growth, internet deliveries and cheaper mobility.

Figure 1: Congestion (proportion of traffic in congested conditions)



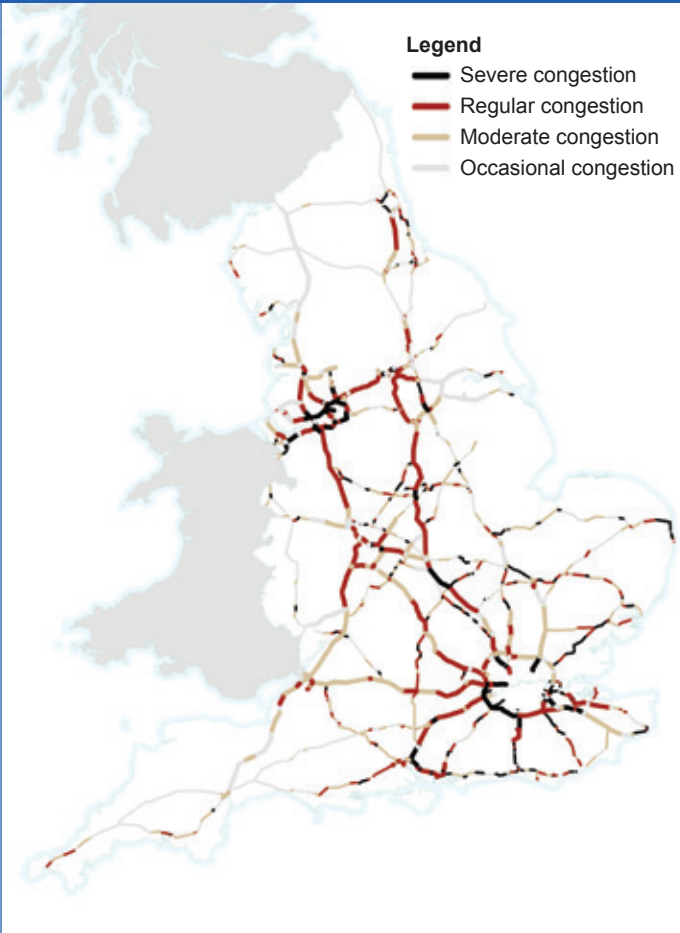
Source: UK Department for Transport, Road Traffic Forecasts 2015, March 2015.

Figure 2: Congestions on the strategic road network in 2010



Source: UK Department for Transport, "Action for Roads: A network for the 21st century", July 2013.

Figure 3: Predicted congestion on the strategic road network in 2040



Source: UK Department for Transport, "Action for Roads: A network for the 21st century", July 2013.

The impacts of congestion are pernicious and often underestimated. Impacts include:

- Longer commutes for road users, leaving them with less time to spend with their families, on social activities.
- Increased costs for business through extra freight delivery costs and reduced economic productivity through travel time delays.
- Increased vehicle emissions.
- Increased demand for new roads and road upgrades, destroying green space.
- Increased rates of road accidents.

Congestion is bad for people’s health and liveability, bad for the environment and bad for the economy.

Inefficiently used road system

The UK’s road system is inefficiently utilised with usage clustering in the peaks and occupancy rates of around 1.6 people per vehicle according to the 2015 national travel survey. By contrast, according to Carplus, car clubs have occupancy rates of 2.6 people per vehicle — more than 60 percent improvement in efficiency. This inefficiency helps to drag down the UK’s productivity with UK workers producing on average, around a third less per hour than those in France, Germany and the United States.

Transport is a significant contributor to the productivity gap. The traditional way of attempting to close the gap has been through building more transport infrastructure (increasing the supply side) whilst very little has been done on using our roads more efficiently (the demand side). There are significant opportunities to close the productivity gap in transport by re-balancing the focus onto demand management for our roads.

Poorly maintained roads

The condition of the UK’s roads is a major concern. The Centre for Economics and Business Research has said that the UK lags back in 27th place in the world for the state of its roads and the estimated cost of the maintenance backlog is in excess of £12 billion (see Figure 4 on page 9).

Providing additional funds to local authorities to improve road maintenance is attractive. However, there are a number of pitfalls that need to be considered:

- Providing unconditional additional funds to local governments for road maintenance could provide an opportunity for local authorities to reallocate some of their existing road maintenance funds to other priorities. This would slow down the clearing of the maintenance backlog.
- The deterioration of the UK’s roads is not uniform. Different areas of local government vary in the size of their backlog. This means that it makes sense to allocate additional resources to areas with greatest need. However, this rewards local authorities for failure rather than incentivising them to improve their performance such as streamlining their procurement processes or road maintenance procedures.
- The data on the condition of roads has traditionally been poor, relying on small sample sizes and anecdotal evidence. This prevents the optimum allocation of resources to improve the condition of the UK’s roads.
- Traditionally, Central Government regimes that have tried to mandate outcomes to local authorities have become overly bureaucratic and expensive for both parties. This would reduce the funds available for investing in roads.
- The National Audit Office has highlighted the problems that unpredictability of funding causes in terms of efficiency. Deciding on additional funds on an annual basis would suffer the same fate.

Air Pollution

Air pollution is a major problem in the UK. According to the Royal College of Physicians, air pollution cuts short 40,000 lives per year and according to the Institute for Public Policy Research, in many big UK cities safe limits on harmful particulates and oxides of nitrogen are regularly breached. This is of particular concern to the increasing numbers of people living in our major cities as their health

and their children’s health is impacted. The UK Government has recently been taken to court in order to force it to produce a credible plan for reducing air pollution.

Air pollution has many causes but congestion increases harmful emissions from diesel and petrol vehicles (see Figure 5).

In time, the transition to EVs (and the increased use of renewable energy sources) will significantly reduce pollution from motor vehicles. However, the Government is under significant pressure to do something sooner rather than later.

A plateauing of road safety fatality figures

Although the UK has some of the safest roads in the world with the road fatality rate dropping dramatically since the 1960s, the DfT believes that the UK is now in a period where the fatality numbers are fairly stable. The UK needs to find ways of further improving road safety (see Figure 6 on page 11).

The regressive nature of fuel taxes

The existing fuel tax is regressive. Not only is it a flat rate, regardless of income, it also disproportionately impacts people who drive older, less efficient vehicles — usually those from lower socio-economic groups.

The transition to EVs will make this worse as the people who transition more rapidly to EVs are those that replace their car more frequently, and typically purchase a new car. This is likely to be people in higher socio-economic groups.

The switch to autonomous vehicles

Technological change is already disrupting our transport systems. For example, Uber originally began by disrupting the taxi industry. However, we are now seeing Uber negate the benefits of the London congestion charge as people switch from public transport to Uber. In the next few years, technologies such as AVs will speed up the pace of change.

Although the speed of uptake is heavily debated, transport experts all

agree that AVs are coming, and will fundamentally disrupt our existing mobility behaviours. AVs have the potential to dramatically reduce the costs of road transport and supply trips that are not currently taken — such as trips for the elderly and people with disabilities, or for teenagers not old enough to have a driver’s license. The technological changes that are coming down the road will have different effects on congestion:

These trends are global and transport planners are only just beginning to get their heads around these changes. A 2016 report for the UK Department for Transport modelled significant benefits in terms of journey time savings, journey time variability and average delays when AVs made up 100 percent of the fleet, as long as there was no increase in demand.

However, there appears to be a trend towards transport planners believing that with current approaches to managing our roads, we will see an increase in congestion, potentially above what is currently forecast due to induced demand. For example, a recent RethinkX report estimated that there would be a 50 percent increase in passenger miles in the US between 2021 and 2030 as a result of cheaper transport. Given these concerns, managing the demand on our roads in order to reduce congestion will become even more important.

The collapse of fuel tax revenues

Whilst congestion is forecast to get worse, the way that we predominantly pay for roads through fuel taxes needs to change. Across the world, the major funding mechanism for roads is through fuel taxes. As a result of more fuel efficient vehicles, the switch to EVs and political resistance to increasing fuel taxes, governments will see a continuing fall in their revenues used to fund roads (see Figure 7 below).

The traditional approach

For decades, the traditional answer to implementing demand management and solving these challenges has been road pricing. If people have been recommending this policy for decades,

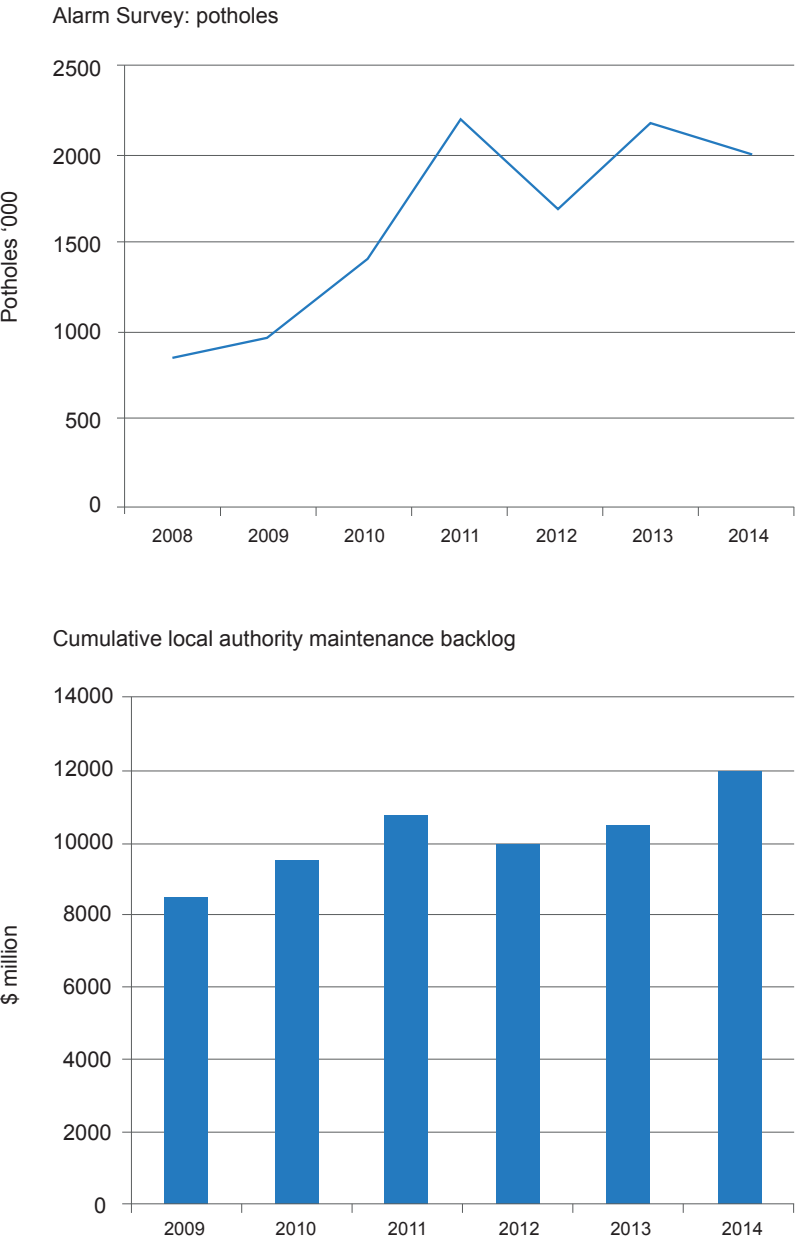
why has it not been implemented? There have been a number of barriers:

- The technology to implement the scheme has been expensive and visually intrusive requiring significant roadside infrastructure.
- Drivers and civil liberties groups have been concerned with the invasions of privacy involved in tracking vehicle location.
- Any mandated change of funding system that is broadly revenue neutral would have a significant number of losers. This makes

it difficult to gain widespread community acceptance.

- People perceive roads to be free. Large sections of the community are suspicious of any politician ‘selling’ the benefits of an alternative payment system.
- People are concerned that road pricing will disproportionately hit lower socioeconomic groups.
- The capabilities for successfully implementing a road pricing scheme have not existed either within governments or the private sector.

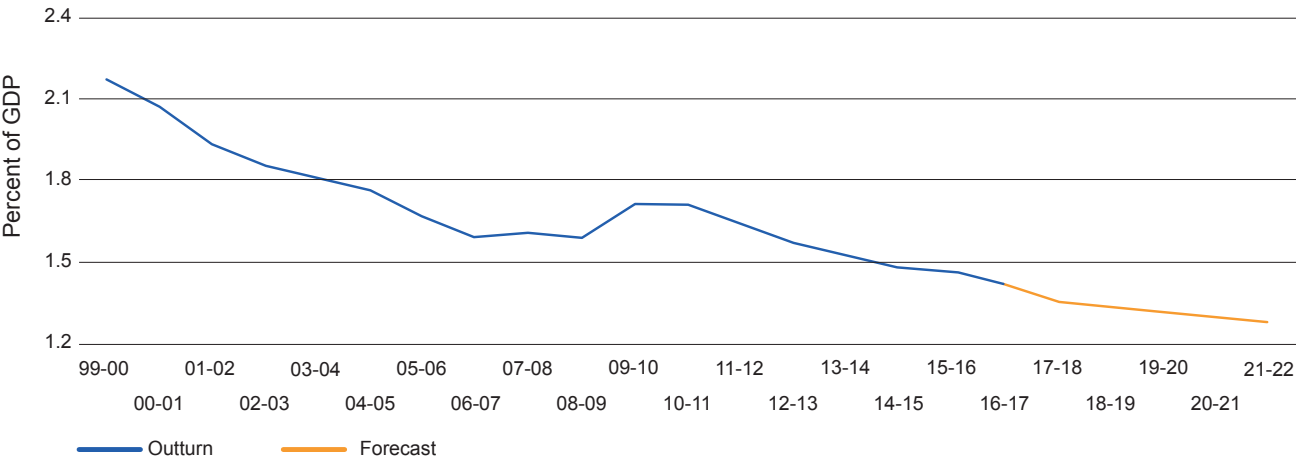
Figure 4: Trends in road maintenance



Source: Better roads for England, September 2014

Figure 7: Fuel excise

Fuel duties: latest forecast (percent of GDP)



Source: UK Office of Budget Responsibility forecasts, March 2017.

Over the years, a number of different approaches have been attempted to map a political pathway to road pricing:

- The average driver is better off: over the years, road pricing advocates have highlighted how they expect the average driver to be better off from moving to a road pricing scheme where revenues are broadly neutral. This has never been politically convincing as a significant proportion of drivers would be worse off.
- Urging politicians to show leadership: when advocates have a policy they want politicians to espouse that will be highly unpopular they often resort to urging politicians to make the

case for change. Unsurprisingly, politicians have either declined to ‘show leadership’ on road pricing or where they have, faced significant opposition that has killed the proposal.

- Incremental improvements to existing road charges: one of the common approaches to implementing policy is to take an incremental approach by starting small and expanding later. Unfortunately, in the case of road pricing, despite some initial road pricing schemes such as cordon charges (London, Stockholm), new toll roads (France, Australia), dynamic lane pricing (US) and freight road usage charging (New Zealand) there is nowhere in the world where this has made

it possible to transition to broad-based road usage charging. Even moving from a fixed price to a more dynamic priced system has proven politically unpalatable (Sydney).

- Conduct a study: a common suggestion from road pricing advocates is that politicians should lay the groundwork for road pricing by sponsoring a study to help stimulate debate and convince people of the benefits. Despite lots of studies around the world recommending moving to road pricing, not one jurisdiction has implemented the recommendations of a study.

Technology impacts that could help to reduce congestion

- More efficient driving by removing the human factor and linking to infrastructure
- Less human error leading to fewer accidents
- Different ownership structures encourage more ride-sharing and carpooling
- More freight is able to travel at night
- Mobility as a service takes off and is able to provide efficient multi-modal options
- Reduced need for vehicles to drive around looking for a parking space

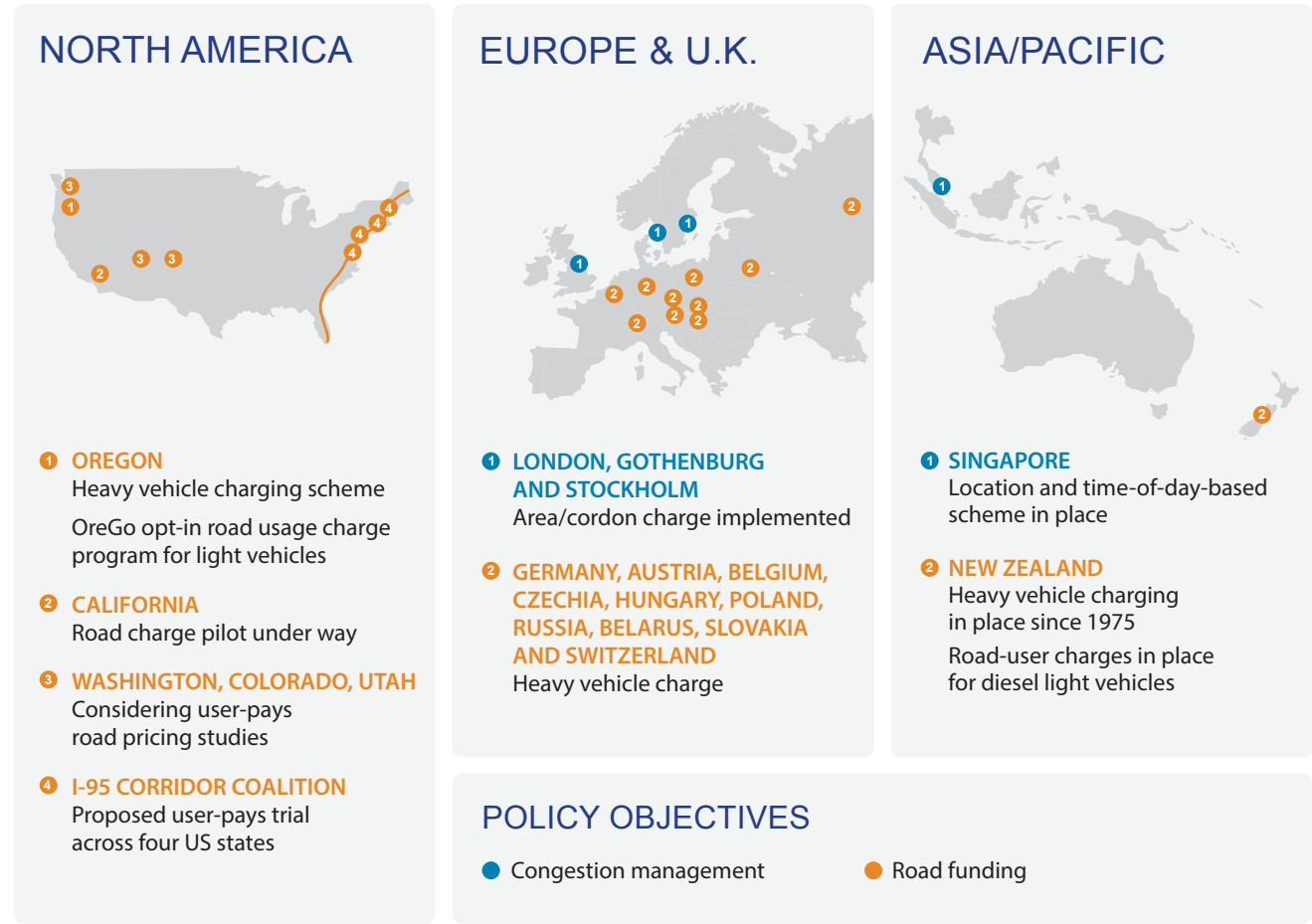
Technology impacts that could increase congestion

- Road vehicles become cheaper to use
- Traveling in congestion becomes more acceptable due to people being able to do other activities while travelling
- Groups that are currently prevented from travel will now be able to such as teenagers and people with disabilities
- Ride sharing becomes cheaper than public transport
- Passenger and driverless autonomous vehicles undertake new journeys
- Increased internet shopping and home deliveries

Global pricing approaches

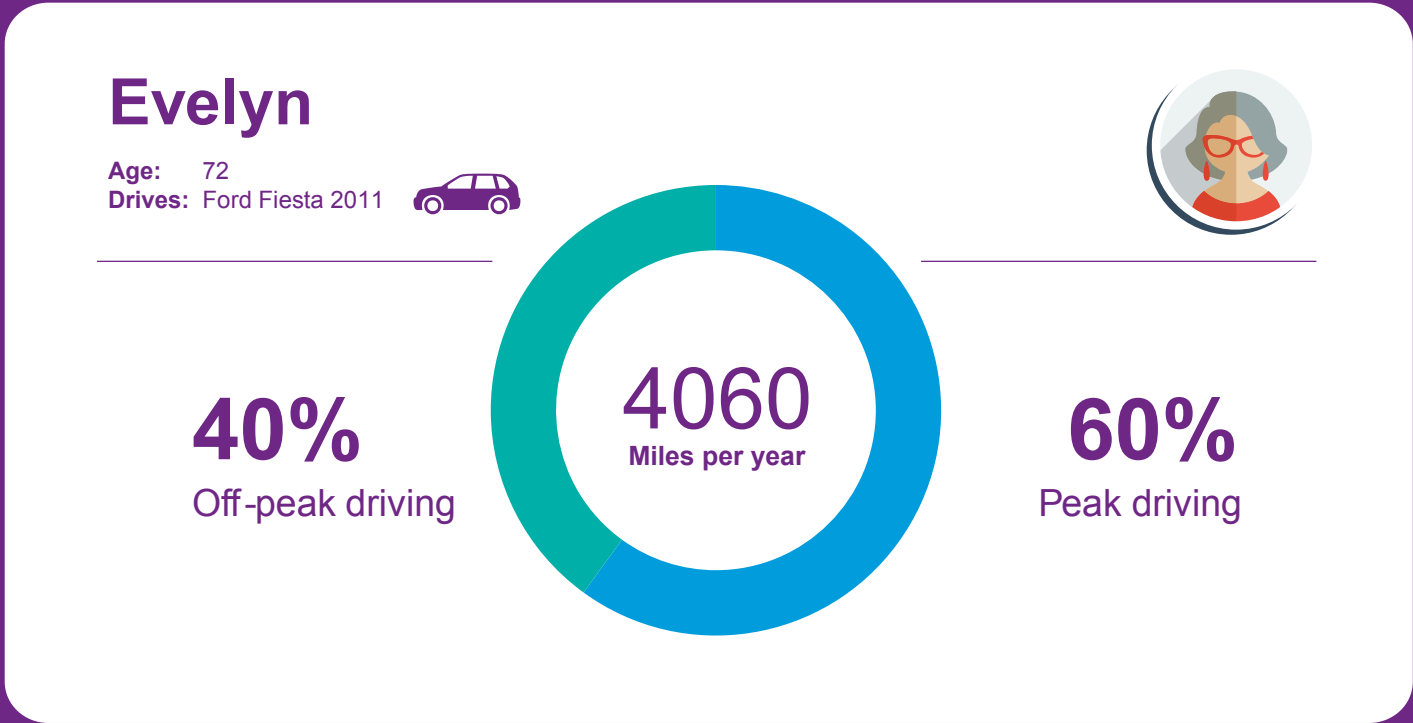
Various jurisdictions have introduced road pricing schemes, however none of these provide broad-based demand management. Some schemes focus on congestion management within a defined CBD cordon. Other schemes have been implemented or are being trialed as replacement or alternatives to fuel excise. Nevertheless none of these schemes provide network-wide demand management either via incentives or penalties.

Figure 8: Successes in other jurisdictions



Road Pricing infrastructure has traditionally been expensive and visually intrusive.

Retired Person



Although recently widowed, Evelyn has made an active retired life for herself in the seaside town of Eastbourne, a location she chose for its proximity to her daughter and grandchildren in nearby Brighton.

Evelyn finds her car handy for running errands around town, and occasional trips to see friends in Portsmouth. She happily volunteers to drive her friends on excursions around the East Sussex countryside. Her trips are mostly discretionary, except for a weekly commute to Brighton to babysit the grandchildren. Even though she could travel outside of peak hours, Evelyn often finds herself in rush hour traffic on the A27, which is tiring after a day spent caring for six-year-old twins.

“

“I love saving money by driving at hours that are less costly. My daughter’s an accountant, and she pointed out that Clearways is much fairer to drivers like me since it doesn’t charge less frequent travelers the same rate as motorists who drive at peak hours.”

“Even better than the financial savings, I can enjoy my trips better when I avoid all the bustle of peak hour traffic!”

”

My travel experience

“My car really gives me wings since I can scoot around town to see friends and help my daughter when she calls. I can’t imagine depending on public transport, since the bus service is quite limited here.”

“I’m fortunate that I could choose when I want to drive. My doctor’s office lets me make appointments at times that suit me and I set the schedule when my friends and I drive up the coast for the day.”

“I’m busier now than before I retired, so it’s annoying when I hit traffic jams that slow me down. I suppose I could plan my trips since I do find driving in traffic more stressful these days.”

Driving profile (Before Clearways):

Total miles / year	4,060
Peak driving	60%
Off-peak driving	40%
Fuel cost / year	£391
Fuel excise paid / year	£194



40% decrease in peak driving

Opting-in for Clearways:

Attracted to the idea of spending less of her pension on petrol - so she can spoil her grandchildren more - Evelyn opts-in to the Clearways Urban plan. After studying the pricing options at different times of day, Evelyn sees that she can save money by re-timing her travel. She begins arranging most medical appointments at mid-day to avoid morning rush hour.

Evelyn pledges to plan drives with her friends outside of the peak periods. She’ll also make use of her daughter’s comfortable guest room to avoid travelling to and from Brighton when most commuters are on the road.

Driving profile (After Clearways):

Re-timed: Evelyn halved her peak hour journeys by keeping an eye on her Clearways savings.

Peak driving:	20%
Off-peak driving:	80%
Reduction in vehicle miles travelled:	-
Miles reduced from peak:	812 (from re-timing)
Clearways fees:	£114
Clearways savings:	£79



Clearways savings

The Clearways Solution

The Clearways Solution takes a very different approach to the traditional road pricing scheme. Instead of punishing people for the way they travel, Clearways rewards people for changing their behaviour in a desirable way. Instead of forcing people to pay a new tax, Clearways is voluntary.

Instead of the Government being burdened with delivering a compelling customer proposition and selling it to consumers, Clearways uses organisations that have this as part of their DNA.

- Clearways has four parts:
- An opt-in approach.
 - Leverage trusted retail brands.
 - A compelling consumer proposition.
 - A phased market entry.

Figure 9: An overview of the Clearways solution



Component	Description
Opt-in	<p>Customers are provided with the ability to opt-out of fuel tax (in the case of petrol and diesel vehicles) and to opt-in to Clearways.</p> <p>For EVs, customers can choose to take the EV grant in exchange for opting into Clearways.</p>
Retail partners	<p>Clearways is distributed by selected retailers. Our retailers are known brands, giving customers confidence in the product, and are established businesses with the proven ability to market, sell and distribute products.</p>
Compelling customer proposition	<p>Price promise</p> <p>Customers who choose Clearways benefit from a price guarantee, meaning they will never pay more than the fuel excise they would have paid. In the case of EVs, customers get a guarantee that they will not pay more than the fuel excise for a low emission vehicle.</p> <p>Financial savings</p> <p>Customers choose a Clearways plan that suits their driving needs and habits. All Clearways plans charge a higher rate for peak period driving, with a lower rate for off-peak driving. Customers who minimise or eliminate peak hour driving are able to save a few hundred pounds per year.</p> <p>Bundled products</p> <p>Clearways customers can bundle parallel products alongside their plan. For instance, insurance companies will offer the convenience and cost savings of Pay As You Drive (PAYD) insurance.</p> <p>Rewards</p> <p>Clearways customers can also participate in a points-based reward scheme. This enables them to maximise the value of their Clearways membership by earning points for safer and more efficient driving. Points can be redeemed for a variety of rewards through Clearways' retail partners and other providers.</p>
Phased implementation	<p>Clearways is implemented in phases, designed to mitigate implementation risks and confirm public acceptance.</p> <p>Phase 1</p> <p>In the first phase, Clearways works with the Government on the detailed design of a trial. This is so that both parties are clear on how the trial will operate and the outcomes that need to be achieved.</p> <p>Phase 2</p> <p>In the second phase, the Government gives permission for Clearways to run a six month trial (for 50,000 vehicles), empowering people to voluntarily opt-out of fuel excise (for petrol and diesel vehicles) and opt-in to Clearways. A trial approach allows the Government and the operator to manage risks and validate assumptions so that an informed decision can be made about the full implementation of Clearways.</p> <p>A trial approach allows the Government and the operator to manage risks and validate assumptions so that an informed decision can be made about the full implementation of Clearways.</p> <p>Phase 3</p> <p>Following a successful trial, the Government makes Clearways available to all road users.</p> <p>As part of this phase, Government may also consider whether to move other vehicle taxes (such as VED) onto the scheme, thereby increasing the price signals that encourage desirable behaviour change, delivering efficient road use.</p>

An opt-in approach

A key part of the Clearways approach is to make the scheme voluntary. This works in two different ways — one for petrol and diesel vehicles and one for EVs.

Petrol and Diesel Vehicles

For Petrol and Diesel vehicles, Clearways empower consumers by allowing them to voluntarily opt-out of paying for fuel excise and opt-in to Clearways.

By making the change voluntary, we do not face many of the barriers that stand in the way of road pricing. Drivers who are concerned with privacy or paying more to drive, simply do not move from the existing system.

Opt-in approaches can potentially be criticised because they might only attract people who would save money because they do not use the roads very much. This would provide costs with none of the congestion reduction benefits.

The Clearways opt-in approach is different. The people that save the most money in the Clearways scheme are those who change their driving behaviour in a way that reduces congestion — for example by re-timing to reduce travel during the peaks.

Electric Vehicles

Of course, EVs do not pay fuel excise.

However, we still need to get them onto Clearways so that we can help them to use the roads more efficiently as well. We do this by amending the existing EV subsidy scheme. Currently, the EV scheme provides a grant of £4500 for the purchase of a new EV. We recommend amending this so that the grant is only available if drivers opt into Clearways. In order to prevent gaming, once an EV car has been opted into Clearways, it cannot be removed, even when the car is sold. The vast majority of drivers will want to opt into Clearways because:

- It is financially attractive with an average payback period of five years.

- They can bundle in additional connected car products at the same time.
- They can make further savings, if they are able to change their behaviour.

This change to the grant rules, provides extra Government revenues that can then be used to:

- Subsidise petrol and diesel vehicles onto Clearways.
- Support additional investment in road maintenance.
- Extend the life of the subsidy and encourage greater EV uptake.

Leverage trusted retail brands

The second part of our solution is to harness the capabilities of trusted consumer brands to educate customers and sign them up to Clearways. Rather than governments and politicians attempting to sell the scheme (the road pricing approach), we will use trusted brands who have established the credibility and capability to market to millions of customers.

We will use consumer brands that have parallel products or services that could be naturally bundled alongside our scheme, such as Pay As You Drive (PAYD) insurance, PAYD roadside assistance and in-car infotainment.

Brands could include motorist organisations such as the AA or RAC, major retailers such as Tesco or Sainsburys and telecommunications companies such as Vodafone or BT.

A compelling customer proposition

In order for people to opt-in to Clearways, it is essential to create a compelling customer proposition. Our product has six features:

- Price promise.
- Financial savings.
- Pricing plans designed for customers.
- Companion products.
- Seamless customer experience.
- Rewards for smart travel choices.

Price Promise

We start our customer proposition with a price promise. We will guarantee that no-one who opts-in to Clearways pays more than they would if they had remained paying fuel excise (on a like-for-like driving basis).

For EV drivers, we guarantee that they will not pay more than a low emissions vehicle on a like-for-like driving basis.

Financial savings

Road users will be able to make significant savings if they are able to change their driving behaviours in a desirable way and retime, remode, reroute or reduce their travel.

For EV drivers, they benefit from both the driving behaviour savings as well as the discount.

Pricing plans designed for customers

Customers will be able to choose from a range of pricing plans that enables them to pick one that suits them. For example, someone who mainly drives at weekends will be able to pick a different plan from someone who mainly drives at peak times during the week. Similar to mobile phone plans, customers will have minimum tie in periods.

Companion products

Customers will be able to take advantage of other products that leverage the connected car technology. For example, customers could purchase PAYD car insurance, PAYD roadside assistance and in-car infotainment services such as Sky.

Seamless customer experience

The entire customer experience from signing up to the scheme through their choice of channel, to receiving timely information on their road usage and incentives for making smart travel choices will be seamless, enabled by technology. For example, customers will automatically get their fuel tax rebated when they pay at the petrol station. This will give them a feel good factor when they fill up and save 57.95p per litre, dramatically reducing their fuel bill.

Rewards for smart travel choices

The final part of our customer proposition is a points based rewards scheme that provides additional incentives to make smart travel choices such as changing modes onto public transport.

Taken together, these six elements produce a compelling customer proposition.

A phased rollout

In order to reduce risks, we propose implementing the Clearways solution via a phased approach. We have three phases:

Phase 1 — Trial co-design

Phase 2 — Trial

Phase 3 — Full rollout

Phase 1 — Trial co-design

In the first phase, Clearways works with Government on the detailed design of the trial. This is so that both parties are clear on how the trial will operate and the outcomes that need to be achieved.

Phase 2 — A Trial

In the second phase, the Government gives permission for Clearways to run a trial (involving around 50,000 cars) for six months empowering people to voluntarily opt-out of fuel excise and opt-in to Clearways.

A trial approach allows the Government and Clearways to manage risks and validate assumptions so that an informed decision can be made about the full implementation of Clearways.

Phase 3 — Full rollout

Following a successful trial, the Government will roll out the scheme across the entire fleet.

As part of this phase, governments may also consider whether to move other vehicle taxes (e.g. VED) onto the scheme, thereby increasing the price signals that encourage desirable behaviour change.

During Phase 3, an increasing proportion of road vehicles will be on Clearways with the scheme delivering ongoing benefits including reductions to congestion.

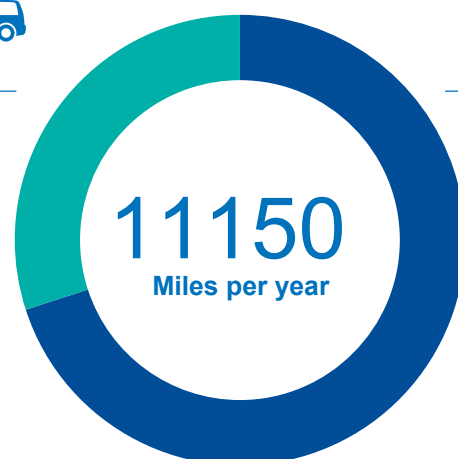
Solution Summary

The four aspects of our customer-led approach: opt-in, retail brands, compelling consumer proposition and a phased rollout combine to create a viable alternative to fuel excise and road pricing as demonstrated in the table below.

	Fuel Excise	Road Pricing	Clearways
Provided by	Public Sector	Public Sector	Private Sector
EVs integrated into paying for the roads	No	Yes	Yes
Supports the introduction of AVs	Neutral	Yes	Yes
Supports shared mobility	No	Yes	Yes
Political lens	Unpopular	Strong opposition	Opt-in so consumer choice
Financial Winners	EV drivers	Those who do not drive very much	People who change their behaviour
Financial Losers	People on low incomes who drive inefficient vehicles	Those who drive a lot	No financial losers
Fairness	People on low incomes pay more	People on low incomes pay more	People on low incomes pay the same or less and are not disadvantaged by take up of EVs
Government Revenues	In decline	Maintains existing revenue levels	Maintains existing revenue levels
Impacts on congestion	Makes it worse	Makes it better	Makes it better
Impact on the environment	As today	Improves environment by reducing emissions	Improves environment by reducing emissions
Impact on road safety	Same as today	Improves road safety	Significantly improves road safety due to incentives to encourage better driving
Other connected car products enabled	No	Maybe	Yes
Privacy Concerns	No	Yes	No as purely voluntary



Inter-city commuter



While Niles enjoys spending time in his well-maintained car, listening to his favourite playlists, the regular commute adds up to two hours a day due to morning and evening congestion on his usual inter-city route. Increasingly, he begrudges the early hour he must leave for work. Although there is a direct train link between Bristol and Bath, he doesn't live or work near either of the stations so it is much easier to drive.

“

"Now I'm 'in the driver's seat,' since I can make the best decisions so my trips are quicker. I feel like a pilot setting a flight plan, based on all the latest data from air traffic control." ■ ■

”



25% decrease in peak driving



Clearways savings

My travel experience

"I used to enjoy my daily commutes, but the traffic seems to get worse each year, making the trip longer and slower."

"It's become impossible to predict how long each trip will take since the travel time varies depending on congestion, accidents or roadworks. I have to leave for work earlier than ever just to be sure I get to the clinic on time."

"I tell my wife 'I'll see you when I see you,' because I really never know what time I'll get home for dinner."

Driving profile (Before Clearways):

Total miles / year	11,150
Peak driving	70%
Off-peak driving	30%
Fuel cost / year	£1,280
Fuel excise paid / year	£636

Opting-in for Clearways:

Niles opts-in to the Clearways Urban plan because of the bundled benefits offered through his insurer. He also hopes to save a bit of money each month. An analytical thinker by nature, he's very aware of the amount of his petrol bill that goes to the fuel tax. Although he doubts he can travel at off-peak times, he likes how the price promise guarantee means he won't pay any more than before.

Within a few months, after studying his monthly Clearways statements, Niles is inspired to change his commute. Although his traditional work hours required him to travel at peak times, he negotiates with his manager to change his work schedule, so he can start and leave work earlier, and take advantage of Clearway's off-peak pricing.

Niles also studies his vehicle usage data and assorted traffic and navigation apps to analyse which routes between Bristol and Bath provide the fastest commute. With the aid of the technology, he becomes a whiz at choosing the optimal route depending on the hour and day.

Driving profile (After Clearways):

Re-timed: Niles retimed some of his commuting by adjusting his work schedule to make time and cost savings.

Peak driving:	45%
Off-peak driving:	55%
Reduction in vehicle miles travelled:	-
Miles reduced from peak:	2,787 (from re-timing)
Clearways fees:	£447
Clearways savings:	£189

Solving the key challenges

Congestion that is only going to get worse

A key expected benefit of Clearways is its ability to significantly reduce congestion. In order to achieve this, it is not enough to simply sign people up to Clearways, they also need to change their behaviour in a way that causes less congestion. Clearways produces behaviour change in a number of ways:

- Through pricing plans that incentivise driving outside of the peak.
- Using a points based gamification system which provides additional incentives for driving outside of the peak, driving safely or shifting to more efficient modes.
- Using the rich data insights stemming from people's driving patterns to work with transport providers to provide alternative congestion friendly options such as on demand transport, new bus routes or pooling options.
- Informing customers with proactive messages that may improve their journey, such as better routes, better times or alternative modes.
- Reducing barriers to alternative, congestion friendly options. For example, some jurisdictions have begun offering a fixed number of free taxi/ride share trips a year for parents who are worried about the

need to be able to quickly pick up their children from school if they are sick.

These approaches will be refined during the trial phase in order to maximise behaviour change in the most cost effective way.

We have used the latest research on the elasticity of demand management techniques combined with Google traffic data and SCOOT data for key cities within the UK as well as the UK National Travel Survey Data in order to estimate a range for the level of congestion reduction we would see from our Clearways (see Appendix C).

Discretionary journeys in the am peak, account for over 20 percent of all trips. These are the journeys that can most easily be re-timed. If Clearways is able to initiate behaviour change in just a quarter of these trips (ie. 5 percent of all trips) then we would be able to achieve a 14.5 percent improvement in travel times. A 7 percent reduction in trips would yield a 20 percent improvement in travel times whilst a 10 percent reduction in traffic yields a 27.5 percent improvement in travel times.

Within the next five years, Clearways has the potential to sign up at least a quarter of the people making discretionary journeys and so deliver a

14.5 percent reduction in travel times. These numbers are conservative and do not include any potential for people to remode their journeys onto public transport, use car pooling or reduce their travel needs altogether by, for example, working more from home.

A key issue to consider is induced demand. This occurs when there is demand for people to use a congested route but they avoid it due to the congestion. Therefore, if congestion is reduced they are more likely to use the road, re-creating the congestion. This effect is normally associated with increasing road supply through new roads, additional lanes or other infrastructure upgrades. This is why the time savings claimed in business cases for road construction and smarter motorways are often not realised.

Induced demand is only minimised through a demand management solution. With Clearways having demand management at its core, it is well placed to minimise induced demand.

Figure 10: Clearways logic map

Context

Major policy challenges associated with roads:

- Congestion
- Inefficiently used and poorly maintained
- Air pollution
- Road safety
- Fairness
- Financial sustainability of road funding

Technological changes:

- Shared mobility
- On demand transport (eg. Uber)
- EVs, AVs and Mobility as a service (MaaS)

Input

Clearways introduced, enabled by a small government investment and partnership with leading retailers.

System operator selected and contract awarded.

Government decision on governance framework.

Output

A proportion of the UK road users opt-in to Clearways through well-known, trusted retailers that they trust.

Clearways incentives and rewards deliver behaviour change as follows:

- Drivers re-time some or all journeys
- People switch modes, increasing public transport use and reducing vehicle miles travelled
- Some car journeys are re-routed to avoid and reduce congestion
- Some people share car journeys, reducing the road space used

Outcomes

Congestion is reduced leading to the following immediate user benefits:

- Reduced travel times
- Improved journey time reliability
- Reduced air pollution
- More efficient road usage and better road maintenance
- Increased road safety

In addition, the scheme allows the Government to keep tax revenue constant (as a share of GDP), making the system financially sustainable as EVs increase their market share.

Impact

The scheme leads to long-term benefits for the UK:

- More efficient use of roads
- Sustainable reduction in journey times and improved journey time reliability
- Better maintained roads leading to reliability and safety benefits
- Productivity benefits from increased connectivity
- Better public transport provision enabled by more public transport demand and revenues
- Less polluted and more "liveable" cities
- Different attitude to travelling and transport — "roads are not free"
- As car sharing is increasingly used, the cost of paying for the roads is blended with on-demand driving costs, so people feel less the difference in how they pay for the roads
- Sustainable road funding

Inefficient use of road system

Clearways is ideally placed to improve the efficient use of our road system. It does this by taking a whole-of-network approach to incentivising behaviour change (demand management) so that people:

- Retime their journeys outside of the peaks.
- Remode onto public transport or car-pool with higher vehicle occupancy.
- Reroute their trips in a way that uses the network more efficiently.
- Reduce travel whilst still remaining productive.

Poorly maintained roads

Clearways provides an option for the Government to put additional revenues generated into road maintenance. If this option is taken up, the UK Government should work with local Government representatives such as the LGA in order to agree an approach that maximises the clearance of the maintenance backlog and puts the maintenance of the UK's roads on a sustainable footing.

Air pollution

Transport has a major impact on the environment, whether it is through pollutants such as carbon dioxide emissions from vehicles or the replacement of green space for the construction of roads.

Clearways will be priced for each individual based on their existing driving habits (how much they drive, when they drive (peak versus off-peak)), the pollution rating of their car (higher charges for the most polluting) and providing incentives for people to reroute, remode, retime or rethink their journeys.

This will lead to reduced emissions and air pollution through reduced congestion, reducing distances travelled and more efficient driving.

Reduced congestion will also reduce demand for new roads and upgrades therefore reducing road construction at the expense of green space.

Road safety

Our proposal will improve road safety in a number of ways:

- By reducing vehicle miles travelled (VMT). All other things being equal, this will reduce the number of accidents.
- Research evidence shows that congestion increases the rate of road accidents. By reducing congestion, we will reduce the rate of road accidents and improve safety.
- Our connected car platform can provide feedback about people's driving style, informing them about hard braking, rapid acceleration and other events that indicate inefficient, unsafe or erratic driving habits.
- Our points based reward system will have the option of rewarding people for good driving behaviours such as keeping within the speed limit where customers want to participate. These rewards can be aligned with government safety messages and campaigns.
- We will be able to analyse routes and provide smarter, safer alternatives to avoid road safety risks such as passing schools and avoiding routes with poor safety performance.

The regressive nature of fuel excise

We directly improve the equity of our roads system in a number of ways:

- Our voluntary opt-in approach with a price guarantee that no-one will pay more means that no-one on lower incomes will be worse off than they are today.
- The savings on offer for behaviour changes will be more significant to people on lower incomes as a proportion of income, improving

their cashflow and making these drivers comparatively better off.

- By EVs being on Clearways, we remove the unfairness where those last to take up EVs are the only ones paying for the roads through fuel excise.

Once we have most road users on Clearways, new opportunities to improve equity and fairness will arise. At this time, with the data we have on driving patterns, politicians would have an increased number of options for helping people from lower socioeconomic groups with mobility.

Managing the switch to autonomous vehicles

With the widespread adoption of AVs expected to be just around the corner, it is critical that any future solution works in both a world where AV adoption is just beginning but also in the longer term when AV adoption has matured.

A key related trend is the adoption of shared mobility solutions. Shared mobility has already begun to be created with the advent of ridesharing services such as Uber and car clubs such as ZipCar. In addition, regions such

as the West Midlands are already beginning to roll out shared mobility services that enable people to pay for their mobility through one account to access a much wider range of mobility providers than has traditionally been the case with a service like the Oyster card.

The combination of shared mobility and AVs is expected to be even more transformative than either trend on its own. In the US, RethinkX have estimated that shared mobility AVs will save the average American family more than \$5,600 per year in transportation costs, equivalent to a wage raise of 10%.

Clearways enables our road system to adapt and perform in a shared mobility AV world by:

- Creating the incentives to significantly reduce congestion despite induced demand through increasing the efficient use of road space such as through higher occupancy rates.

- Treating personal and shared vehicles equally, allowing consumer preference to decide.
- Treating AV and non-AVs equally, again allowing consumer preference to decide.
- Facilitating shared mobility services by providing information on costs, travel times, route options and integrated payments.
- Enabling more sophisticated demand management approaches. In a world of shared mobility AVs, the car acts on behalf of the passenger to optimise their journey based on passenger preferences. With the car acting as an agent, it provides the ability to develop much more sophisticated pricing models to manage the demand on the roads such as those that can be provided by Clearways. The economics of autonomous car sharing means that this scenario is unlikely to predominate for long.

The collapse of fuel tax revenues

Our scheme fixes the fiscal black hole that is created by the switch to EVs and hybrids through the revenues generated by moving them onto the Clearways product.

Induced demand

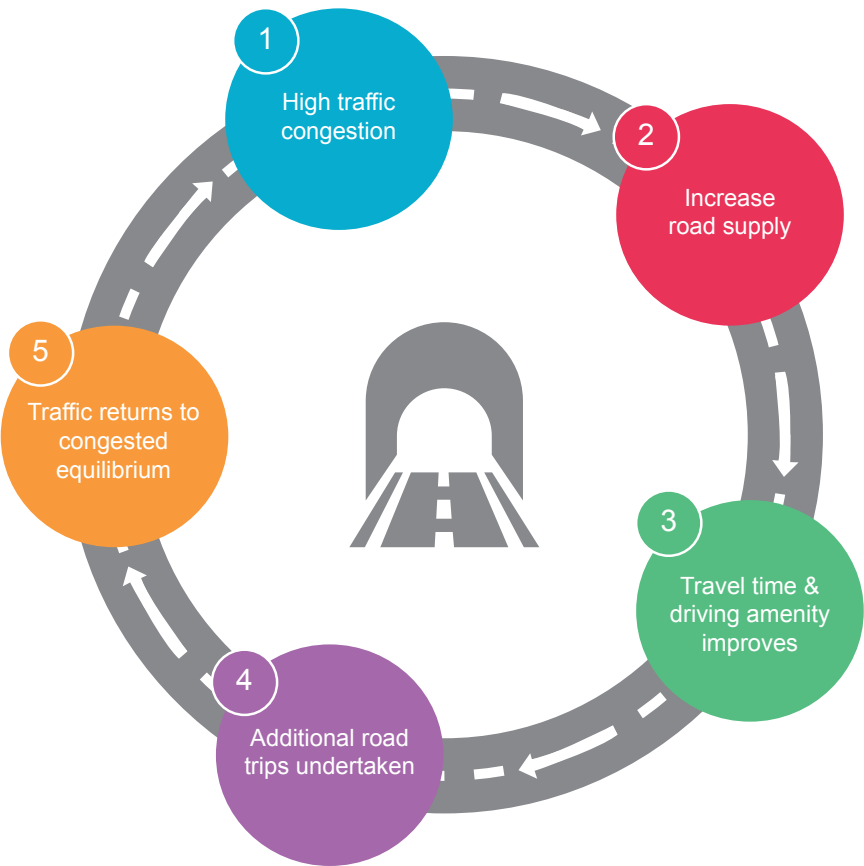
Induced demand occurs as a result of increased road supply improving the amenity of driving. Improvements to travel times delivered by new or expanded road space generate additional demand, meaning additional trips are undertaken by drivers availing themselves of the (temporarily) improved road conditions.

Induced demand reflects our current approach to demand management, whereby congested traffic conditions, increased travel times and poor travel time reliability serve to limit road traffic. When these factors improved — through the supply of additional road space — the demand for road usage increases, returning the route to its previous (congested) equilibrium.

Demand management delivered by financial incentives or penalties, limits road usage through price signaling: with road users making an active choice about their road usage by trading off amenity, need and cost.

Clearways delivers demand management by providing financial incentives for driving outside of peak periods. Clearways Rewards amplifies these incentives through gamification — enabling people to earn rewards in the form of bonuses and discounts, and social recognition, through smart travel choices.

Figure 11: Induced demand



Source: Adapted from Committee for Sydney, "A Fork in the Road", April 2016.

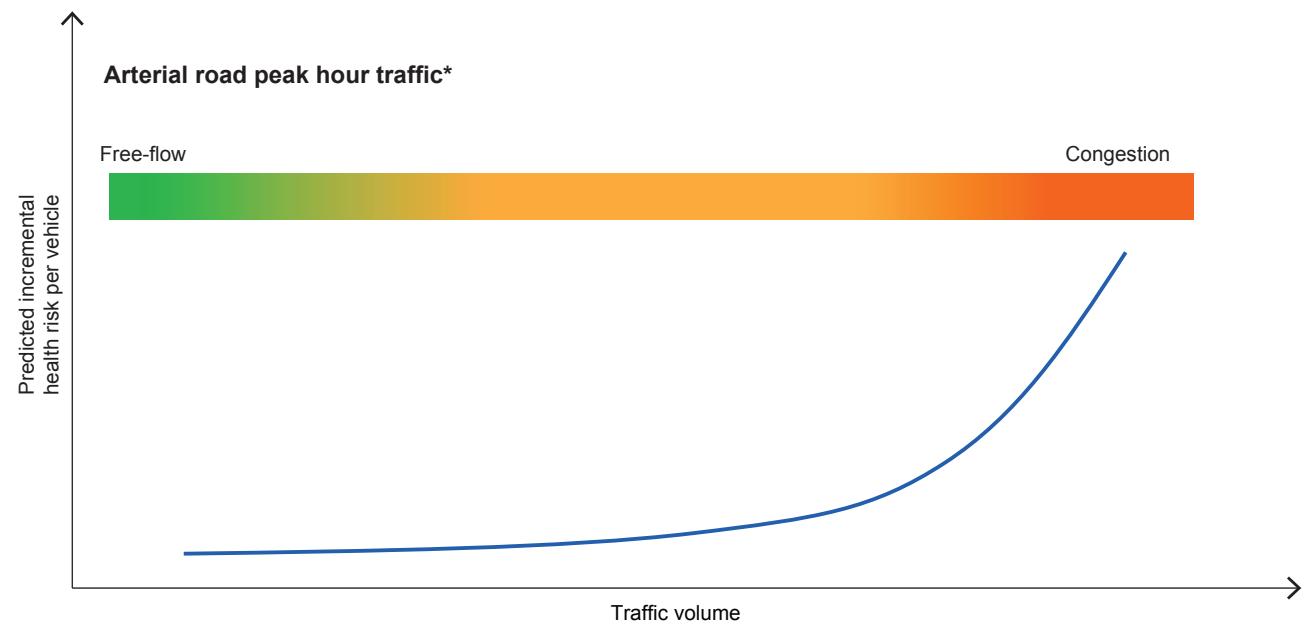
Congestion and air quality

The relationship between traffic congestion and air quality, and associated health risks, has recently been studied. Early research on vehicle emissions and associated health risks have not typically considered the impact of congestion versus free-flow traffic volumes.

Traffic performance, in terms of free-flow and congested traffic, is known to effect vehicle emissions — and therefore air quality. Congested traffic degrades air quality over and above free-flowing or constantly flowing heavy traffic in two ways:

- 1. Vehicle emissions increase substantially during periods of frequent acceleration and deceleration
- 2. Low traffic speeds reduce dispersion of vehicle emissions (due to lower vehicle-induced turbulence)

Figure 5: Congestion and air quality



Source: Zhang and Batterman, *Air pollution and health risks due to vehicle traffic*. The Science of the Total Environment, 2013.
*Illustrative only

On arterial roads, relatively modest reductions in traffic volume yield significant reductions in emissions (as shown in the diagram).

Demand reduction delivered by Clearways targets congested traffic, resulting in meaningful improvements to air quality and associated health outcomes.

Congestion and road safety

Road safety outcomes vary based on the relative skill of a driver, road quality, weather conditions, vehicle speed and traffic conditions.

The primary attributable causes of severe road accidents are driver fatigue, speed and driving under the influence of drugs and alcohol.

Congestion does impact road safety outcomes, with minor accidents increasing in frequency at higher traffic volumes. The diagram shows the relationship between traffic volumes and the probability of accidents, for different accident severities.

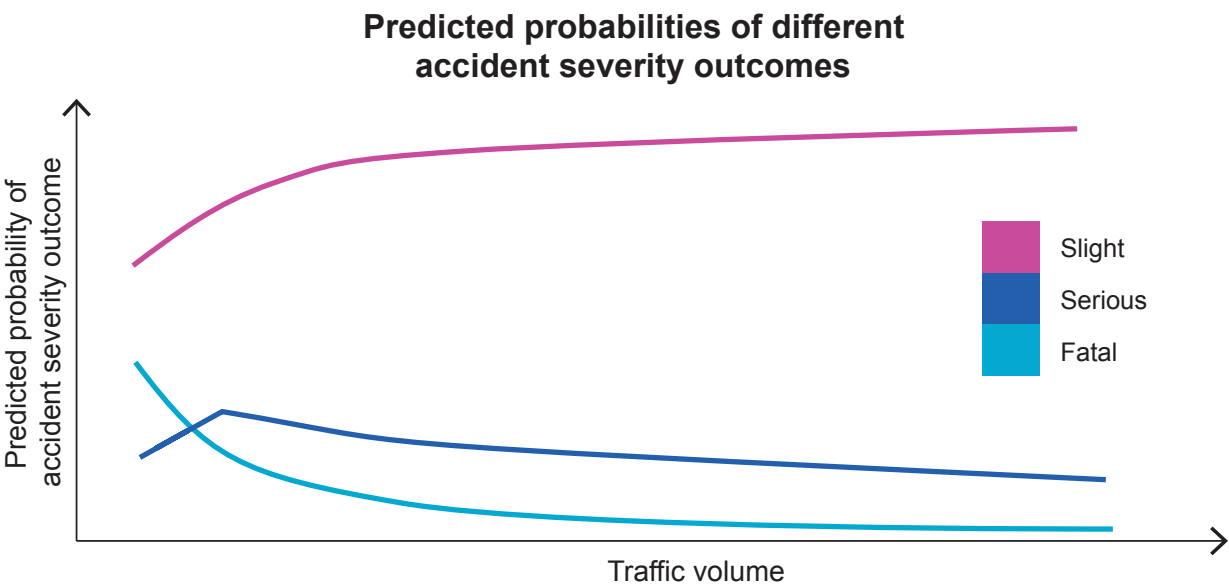
Lower probability of severe and fatal accidents at higher (congested) traffic volumes is largely explained by the

lower traffic speed of heavy traffic. Whereas minor accidents increase in frequency due to factors such as the erratic nature of congested traffic and driver frustration.

As the increasing uptake of Clearways reduces congestion, road safety outcomes — in terms of minor accidents — would improve, along with the related costs from vehicle and health insurance claims.

Clearways will also improve average driving behaviours, by providing regular feedback to customers on their driving habits. Our solution also promotes road safety improvements through points-based rewards and incentives for safe and efficient driving.

Figure 6: Congestion and road safety



Source: Chao Wang, Doctoral thesis, Loughborough University, 2010.
Based on analysis of UK road safety data.
*Illustrative only

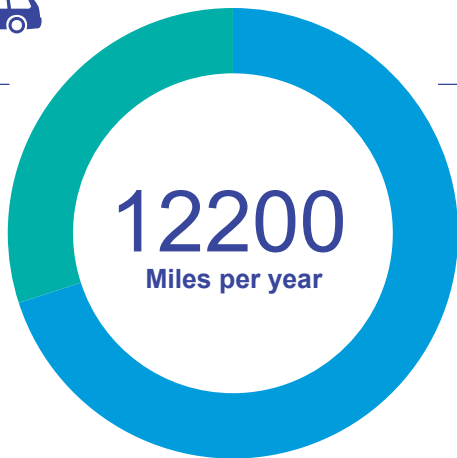
Family — two kids

Roger and Anne

Ages: 38 and 36
Drives: Vauxhall Zafira 2014 (Roger's car)



40%
Off-peak driving



60%
Peak driving

With two school-age children, Roger and Anne were drawn to Erith, in the London Borough of Bexley, near Dartford for its reasonable home prices and proximity to central London, where Roger is a project manager at an engineering firm. As an interior designer who works freelance assignments, Anne can work from home most days. This allows her to manage household errands and attend occasional client meetings.

Although this family seems to have things all worked out, they often feel squeezed financially since they require two cars, with the corresponding fuel, maintenance, insurance and parking costs. Since Roger must often visit construction sites, he is tied to a 44-minute drive to and from work. In contrast, Anne's car sits idle most of the day, after she's driven the kids to school, and her car is seldom used on weekends when the family piles into Roger's sedan for outings.

“

“I didn't see how we could dig ourselves out of the vicious circle we were in, depending on two cars and feeling powerless to control those expenses. I'm really happy with the changes we've made and the extra cash in our wallet at month end.”

“This was a case of ‘We can't see the forest for the trees.’ We were caught up in our routines without realising there are now better ways to go everywhere we need, for a lower price.””

My travel experience

“The cost of maintaining two cars is killing us, especially when we've got so many expenses for the kids on the horizon. It's frustrating that our second car is collecting dust. I understand that Anne needs to juggle the kids' schedules and her clients, but there has to be a cheaper way.”

“This routine is no picnic for me either. Roger thinks my car is a luxury, but I could never get from one far-flung spot to the next by public transport. It's hard enough as it is fighting all the traffic. I'm always looking at my watch, afraid I'll miss a meeting or leave the kids waiting on the curb.”

Driving profile (Before Clearways):

Total miles / year	12,200 (Roger's car)
Peak driving	60%
Off-peak driving	40%
Fuel cost / year	£1,656
Fuel excise paid / year	£823

Opting-in for Clearways:

This busy couple decides to sign up for the Clearways Urban plan because Roger believes he can adjust his work schedule so more of his driving to and from London will be during lower-cost, off-peak times. He also pledges to help Anne with errands on weekends, to benefit from off-peak vehicle pricing.

Clearways also inspires the couple to think about ‘re-moding’ their travel. Roger realises that he could take the train into the City at least two days a week, and car-pool with a co-worker when project site visits pop up. This reduces both his fuel costs and the steep parking fees downtown.

The real breakthrough occurs when Anne does some calculations regarding her travels. She sees that it would cost less to use ride-sharing or car-sharing services for her errands and meetings rather than maintain the second vehicle. Not only do her monthly transportation costs drop, but they make a tidy profit selling her car with its low accumulated mileage. Roger and Anne deposit this windfall cash in their kids' education fund, giving them assurance that they are building up savings for looming priorities.

Driving profile (After Clearways):

Re-timed and reduced: Roger significantly reduced his peak road use by re-thinking his travel options, remodeling to public transport for regular commutes, and car-pooling with a colleague for most of his client site visits.

Peak driving:	30%
Off-peak driving:	70%
Reduction in vehicle miles travelled:	3,000
Miles reduced from peak:	4,560 (from re-timing journeys, and reducing road use overall)
Clearways fees:	£394
Clearways savings:	£429



30% decrease in peak driving



Clearways savings

Messaging of the Clearways Scheme

The Clearways scheme has many facets. However, it needs to be communicated in a way that explains the benefits simply and gives politicians the freedom to support it whilst expending the minimum amount of political capital. At the same time, government should rightly take credit for the benefits that are obtained.

A trial creates the perfect platform to make the argument for using technology and innovation to tackle some of the biggest challenges in transport including congestion, air pollution, road funding and road safety.

The biggest risk is that the scheme gets confused with road pricing leading people to object to it on a misinformed premise.

Appendix A contains a press release demonstrating what the messaging could look like.

Financial Modelling

We have created a model that demonstrates the financial benefits of our scheme (see Appendix B). The financial model has a number of key variables:

- The financial incentives to consumers.
- EV uptake and associated revenues.
- The rate of rollout of the scheme.
- The costs of running the scheme.
- Future fuel excise revenues.

The financial incentives to consumers

A key cost of our scheme is the level of financial incentives that need to be paid to consumers in order to sign up to the scheme and achieve the levels of behaviour change that we need to significantly reduce congestion. The greater the level of behaviour change, the greater the savings to the consumer, the greater the reduction in congestion but the higher the direct costs to the Government.

A couple of complications in this modelling are that different segments of consumers could vary greatly for the

financial incentives that they require and those who are most easily able to change their behaviour are both the most likely to sign-up to the scheme and to make significant savings. We have taken these issues into account in the modelling.

EV uptake and associated revenues

Our scheme is made fiscally neutral by moving EVs onto Clearways. Revenues are sensitive to the number of people who choose the Clearways product, the amount that EVs are charged and the rate of EV uptake. There is a wide variation in the projections for EV uptake. Our scheme is able to accommodate a wide range of the EV uptake scenarios — be they ambitious, or conservative.

The rate of the rollout of the scheme

In order to keep the scheme fiscally neutral using first order effects (direct revenues and expenses as opposed to second order effects of faster economic growth, health benefits from improved air quality or less need for road upgrades), we vary the rate of the rollout of the scheme.

The costs of running the scheme.

These costs include those paid to retailers, telecommunications companies and Clearways. These costs will vary depending on agreements that can be made with the Government and the retailers chosen. Some costs will come down over time as more and more vehicles come already connected to the cloud and economies of scale kick in.

Future fuel excise revenues.

These revenues are subject to a number of factors — the adoption of fuel efficient vehicles such as hybrids as well as EVs, any indexation of fuel excise, and total vehicle miles travelled. We have made a number of assumptions to estimate these revenues.

Fortunately, our scheme is designed to be broadly revenue neutral and replace lost fuel excise revenues as they occur.

The Government has the option to reduce the level of subsidy for the scheme (and therefore reduce rollout) in order to put money into alternatives that would also benefit mobility including increased road maintenance.

How our scheme works

This section provides more detail on how key aspects of our proposal work:

- The trial
- The opt-in approach
- Privacy
- Scheme architecture
- Behavioural science
- Measuring behaviour change
- Pricing
- Technology
- Data.

The trial

The trial is designed to achieve a number of objectives.

Objective 1 — Establish the financial costs and benefits to the Government, consumers and the scheme operator

A key reason that governments need to look at moving away from paying for roads through fuel excise is due to falling revenues from ever more fuel efficient vehicles and the switch to EVs. Therefore, the trial needs to provide governments with visibility around the financial costs of transitioning to Clearways.

There are a number of costs and benefits that need to be accurately assessed through the trial. These include:

- *The amount of fuel excise revenue being given up.* This is the current cost to a consumer of their fuel excise bill, which is the same as the level of revenue that goes to the Government.
- *The operating costs of Clearways.* This includes the costs of the technology, maintaining the systems, handling queries and compensating retailers.
- *The revenues obtained from Clearways.* This is how much customers will pay. The lower this figure the greater financial incentive the customer has to opt-in resulting in less revenue for the Government. The trial will establish what this figure is so that enough people will opt-in to the product and change their peak driving behaviour.

Objective 2 — Establish what impact the product will have on congestion

A key reason for moving to Clearways is the potential for it to be used to manage demand on our roads, especially at peak times, and reduce levels of congestion. Therefore, we need to look at whether Clearways changes the behaviour of drivers at peak times and if so, by how much and what these implications are for road congestion.

Objective 3 — Establish the support of the public for Clearways

Government revenues are always a politically controversial subject. Although our proposed approach is designed to remove political barriers there are likely to be some people who will still object. Therefore, managing the messaging around the trial, monitoring public perceptions and establishing widespread community support will be important.

Objective 4 — Establish that the voluntary approach can be scaled up

A key aim of the trial is to prove that this approach can be rolled out successfully across the country. In order to do this, we need to validate adoption rates of customers at specific price-points — along with the level of behaviour change that we can expect to see, and the resultant congestion improvements.

Objective 5 — Conduct a number of micro trials in order to test assumptions and optimise the approaches taken

As part of the trial, a number of micro trials will take place in order to test a range of approaches, including different:

- Ways of engaging and messaging consumers.
- Pricing models.
- Baseline approaches.
- Non-financial ways of achieving behaviour change.

In order to get sufficient data and make it statistically significant for the number of micro trials that we want to run, the trial would run for six months with at least 50,000 vehicles.

The opt-in approach

The Clearways product is based on the premise that many road users would respond to our consumer proposition. In order to make a voluntary scheme work in large numbers, a number of principles would need to be set:

- The scheme needs to reward congestion-reducing behaviour rather than punish existing driving habits.
- The scheme needs to save people money, especially if they make changes to their behaviour that reduces congestion.

For petrol and diesel vehicles, our voluntary scheme would work in the following way:

1. The Government enables the Clearways alliance to switch road users voluntarily from paying fuel excise to the Clearways product.
2. A small number of Clearways alliance retail partners — with trusted consumer brands — undertake marketing and customer acquisition activities to sign-up road users to Clearways.
3. Clearways plans are offered to customers which are designed to

influence road usage through price signals and behavioural science.

4. Customers save money by not being charged fuel excise and instead making informed choices about road usage and paying appropriately for use of the roads.
5. Financial incentives are amplified through gamification, enabling customers to earn reward points for smart driving choices, safer driving habits and environmentally-friendly driving behaviour.

For EVs, the scheme would work in the following way:

1. The Government enables the Clearways alliance to switch EV purchasers voluntarily to the Clearways product.
2. Clearways alliance retail partners undertake customer acquisition activities to sign-up EV purchasers to Clearways.
3. Clearways plans are offered to customers which are designed to influence road usage through price signals and behavioural science.
4. Customers save money by getting the grant for a new EV and making informed choices about road usage.
5. Financial incentives are amplified through gamification, enabling customers to earn reward points for smart driving choices, safer driving habits and better driving behaviour.

In order to ensure that both Clearways and the retailers are aligned with the Government objectives of reducing congestion, a suitable remuneration scheme needs to be developed. Considerations that need to be taken into account include:

- *Paying by distance travelled.* An incentive scheme that paid by distances travelled would incentivise the scheme to encourage more driving not less.
- *Ignoring the costs to the Government.* Pricing the scheme too cheaply would result in larger take up and behaviour changes. However, this would be at the expense of government revenues.

Other incentives designed using behavioural science should be used to create the desirable outcomes.

- *Retention on the scheme.* It is important for consumers to stay on the scheme (unless they give up their car altogether) in order for the congestion benefits to be realised.

- *Not all customers are as valuable in reducing congestion.* Customers who do not drive in the peak will have a much smaller impact on congestion than those who regularly drive in the peak. Remuneration needs to encourage high congestion impact consumers to be signed up.

- Behaviour change that produces congestion reducing behaviours needs to be rewarded.

- Congestion reducing behaviour change needs to be ongoing not temporary.

- *Some users will come off the scheme because they have given up their car and switched to alternative forms of transport.* Unfortunately, this is very hard to track and therefore very hard to reward appropriately without rewarding people coming off the scheme for unrelated reasons such as emigrating or passing away.

- *In an ideal world it would be desirable to reward the scheme based on reducing congestion.* This comes with significant challenges in separating out the myriad other factors that affect congestion (growing population, economic growth, road maintenance, etc) from those that reduce congestion through Clearways. As a consequence, a proxy is required.

Taking all of these issues into account, we have designed an approach that rewards the scheme operator in the following way:

- *A perpetual monthly fee for signing up and retaining a vehicle on Clearways (for EVs this will be for sign-up only as once signed up, vehicles will not be able to leave the EV scheme).* This fee will vary

depending on the baseline (see below) driving of the vehicle, i.e. higher for peak driving baselines and lower for off-peak driving baselines. This will both encourage the signing up of users who can make the most impact on reducing congestion and keeping them on the scheme.

- *A perpetual monthly fee for achieving desirable behaviour change.* This fee will vary depending on the amount of behaviour change. The greater the reduction in peak driving, the higher the payment. This will incentivise achieving as much behaviour change as possible and maintaining it.

- *The monthly fees for both sign-up and behaviour change will be based on the average pricing that has been signed up to.* The higher the price charged to consumers, the higher the fees. This will create an incentive to maximise the revenues from consumers.

- *The government will set a floor below which road pricing charges cannot fall.* This will prevent

governments from paying too much to get a consumer onto the scheme.

Clearways will be responsible for getting a financial agreement with the retailers that aligns with the objectives of the scheme.

With this approach, Clearways profits are dependent on:

- Maximising revenues from the Government through getting the right people to sign up for the scheme and stay on it.
- Maximising revenues from the Government through getting the maximum level of behaviour change possible and maintaining that change.
- Minimising the cost of marketing and customer acquisition activities.
- The efficiency of operating the scheme.
- Ongoing innovation efforts to increase sign-up and driving behaviour change.
- The ability to sell additional products to consumers.

Governance

The Government needs to think carefully about how to structure the governance of the scheme to deliver the best community outcomes. Things that need to be considered include:

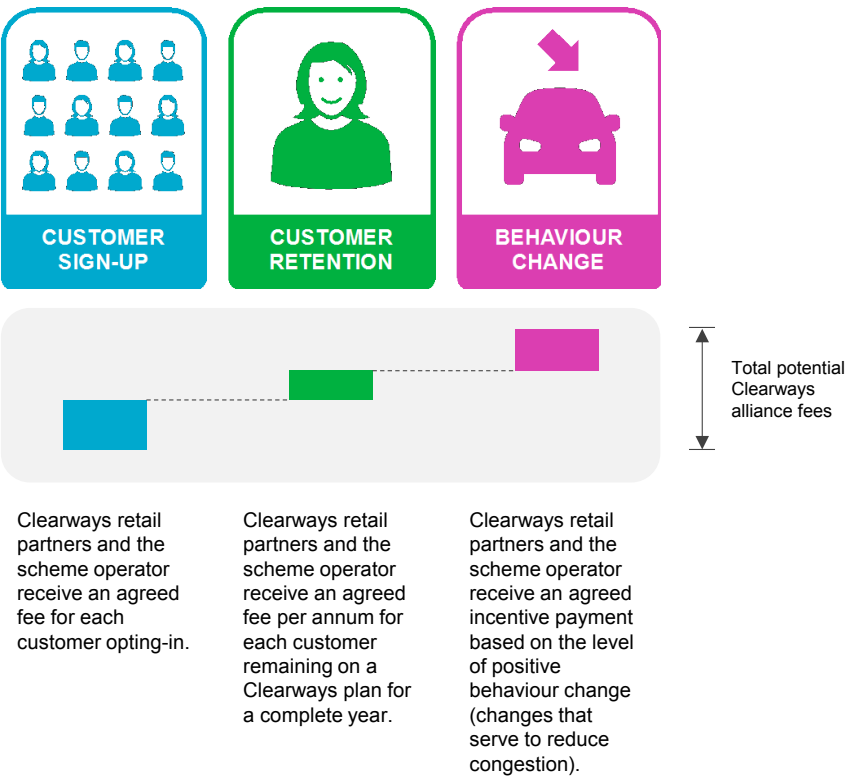
Selection of an operator. In order to get the best outcomes, the Government needs to ensure that the operator remains efficient. This is best done through competition. In the medium term (five years plus) there are likely to be a number of operators globally who could operate a scheme of this kind. Therefore, the Government will have the option of either competitively tendering the operator role(s) or licensing a number of operators to run the scheme who can compete with each other.

Customer Switching. Customers need to be able to switch easily both between retailers and (where applicable) operators. The Government needs to set rules around this in the same way it does for things like bank accounts.

Price Regulation. In a road pricing scheme, price regulation is a significant consideration in order to stop abuse of consumers. However, in the Clearways scheme, there are natural built-in protections — the voluntary nature of the scheme and the price guarantee. These protections mean that pricing is limited through the rate set for fuel excise which becomes a benchmark for the price guarantee.

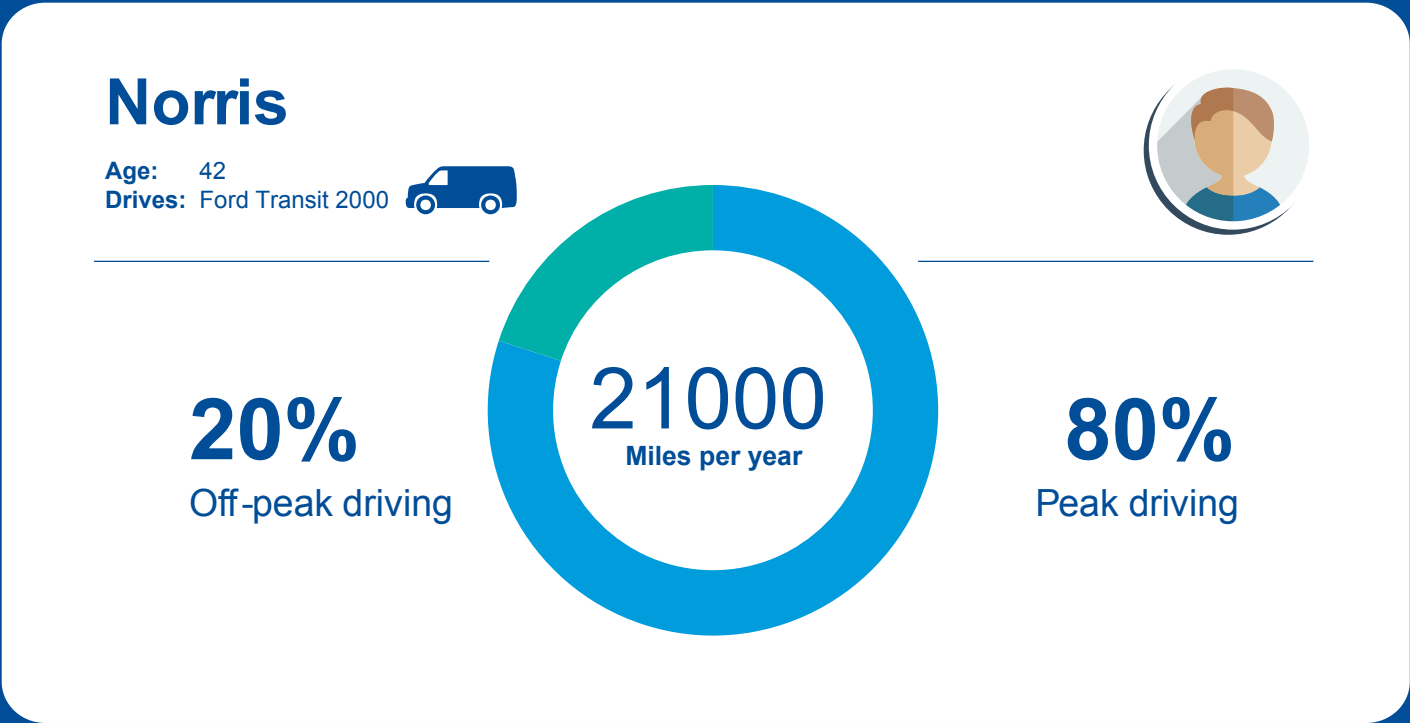
In the longer term, when more dynamic pricing via AVs could be used to manage congestion, more thought will need to be given to pricing and potential regulation. Currently, transport economists have put forward a myriad of ways for pricing the road system. However, there is no consensus on which approach is the best. As a result of our scheme, there will be significant research and evidence as to the effectiveness of our pricing plans and behavioural science that can help to inform future government decision making.

Figure 13: Clearways logic map



Source: Clearways, 2017

White Van Man



Norris has always lived in Moston, a North Manchester neighbourhood, where he and his wife Penny are raising their three young sons. Norris followed his father’s footsteps into the plumbing trade and now he is sought-after for both emergency calls and home renovations. While Penny cares for the kids, Morris drives his panel van between multiple jobs each day.

Norris depends on his own vehicle, to transport his tools and dash around town to pick up parts as needed. While his customers can’t do without him when a pipe breaks, Norris knows that, in today’s economy, they are very price sensitive. He can’t easily raise his prices to cover his own rising petrol and parking costs. This puts a pressure valve on the income he brings home each week.

“

“My friends call me a ‘pipe monkey’ but they’re not laughing when I tell them how much I’m saving with Clearways. The only problem is they expect me to buy the pints now!”

“Believe it or not, my trade is about making the customer happy too. They’re not happy if I’m sitting in traffic while their kitchen is flooding, so Clearways helps me get there faster and without wasting so much time.”

”

My travel experience

“I practically live in my van since my clients are all over town. They ring me up and I’m stuck on Oldham Road during the morning rush or sweating it out on the M60 at six o’clock picking up supplies for a renovation’.”

“A lot of my customers are mates I’ve known all my life. Try telling them that I have to raise my prices because of nonsense over rising fuel excise rates. They’re as short on cash as I am!”

Driving profile (Before Clearways):

Total miles / year	21,000
Peak driving	80%
Off-peak driving	20%
Fuel cost / year	£3,364
Fuel excise paid / year	£1,672

Opting-in for Clearways:

Ever worried about paying his household bills, Norris decides to take a chance and opts-in to the Clearways Urban plan.

Although Norris will always race to last-minute jobs during peak travel times, he is making a conscious effort to ‘re-time’ his other jobs to come and go at off-peak hours. For example, he can book a shower installation at a building site in the early morning, before rush hour or perform customer in-home quotations mid-afternoon when traffic is lighter. Even for urgent jobs, Norris now uses an in-car navigation app so he can ‘re-route’ his travel away from busy roadways, and avoid the higher fees of using those routes.

All of this effort is paying off, since Norris is now saving at least 57.95p per litre, dramatically reducing his fuel bill. He’s also getting home earlier in the evening, so he can play football with his boys or stroll to the park with Penny.

Driving profile (After Clearways):

Re-timed: Norris retimes some of his journeys outside the peak by paying more attention to how he schedules customer jobs.

Peak driving:	70%
Off-peak driving:	30%
Reduction in vehicle miles travelled:	-
Miles reduced from peak:	2,100 (by re-timing some customer jobs)
Clearways fees:	£1325
Clearways savings:	£346



10% decrease in peak driving



Clearways savings

Privacy

Historically, the idea of the Government tracking someone's location would have brought significant concerns about a 'Big Brother' state. However, today people's location data is routinely shared with many private companies through their mobile phone location data and use of common digital platforms such as social media and mobile navigation services. People have been willing to exchange access to personal information with private companies for services that they value. The Direct Marketing Association's research has shown that:

- Consumers are more accepting of sharing their personal data.
- Overall privacy concerns are reducing as awareness over how and why data is collected grows.

Despite this more accepting attitude to privacy by consumers, it is still vitally important to protect people's personal information and respect key privacy obligations.

Given that the scheme is entirely voluntary, people who still have concerns about privacy, can opt out simply by not taking up the scheme.

Scheme Architecture

In order to implement our solution, a number of capabilities are needed, along with robust commercial arrangements and associated technology integration.

A partnership between the Government, Clearways and retailers allows each party to bring its strengths to the table for a successful scheme. The premise here is that Government has the regulatory powers and fiscal imperative required for Clearways. However, we suggest that the Government is not best-placed to deliver the broad range of customer outcomes and commercial and technology innovation that will be key to implementing Clearways.

In our model, the Government commissions a Clearways operator with the objectives of running the scheme, driving customer uptake and applying demand management techniques to achieve desirable behaviour change and reduce congestion. The scheme operator partners with trusted brands to retail Clearways, market the product and provide customer support. An approach that exploits the respective strengths and capabilities of both the public sector and the private sector can deliver a solution that enables the transition to the Clearways product.

Behavioural Science

As well as getting consumers to change their behaviours through the pricing mechanism, a key aspect of our solution is to seek to change driving patterns through behavioural science.

Companies already exist that are seeking to gamify the driving experience in order to improve driving behaviour (people get rewarded for safe driving). Our concept will allow this sort of gamification and other forms of 'nudge' techniques. Examples of what this might look like include:

Remode — We will seek to change behaviours by bundling other mobility products into our scheme to provide incentives for people to remode; such as introductory offers with transport providers.

Retime — we will communicate opportunities for people to make changes to the time of their regular journeys that will deliver significant journey time savings.

Reroute — we will communicate opportunities for people to reroute their journeys to alternatives that deliver significant time savings and benefit the transport network.

Reduce — using our data, we will work with major employers to identify their

The power of feedback and rewards

Feedback loops have the power to change and moderate people's behaviour in powerful ways. They have been used in different ways for centuries to change behaviour, through sanction or reward. Feedback loops tap into innate human tendencies to moderate behaviour – or change habits – when given timely, relevant feedback along with clear choices to act.

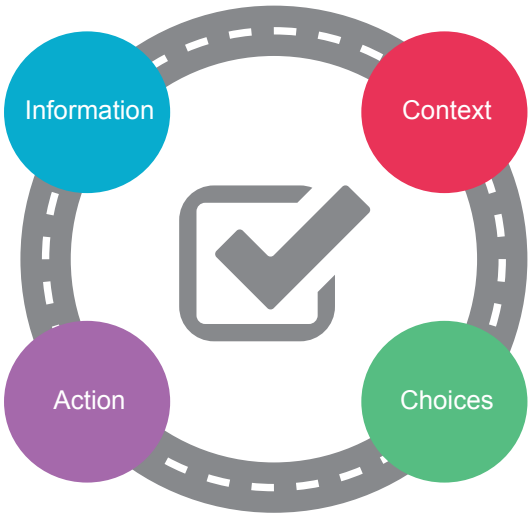
New technology and consumer electronics has made this approach more prevalent. It is what drives the 10,000 steps-a-day fitness movement, and the range of pedometers and fitness trackers that connect our daily activity to our smartphones.

- Feedback loops work by:
- capturing relevant information.
 - providing that information in a meaningful context.
 - presenting choices or options.
 - encouraging you to take positive action toward a goal.

Clearways uses this approach to encourage efficient and safe driving. Customers receive regular information and feedback about their travel choices and driving habits. Information about peak hour driving, hard braking and hasty acceleration all help customers make smart choices about the times they drive and their driving habits.

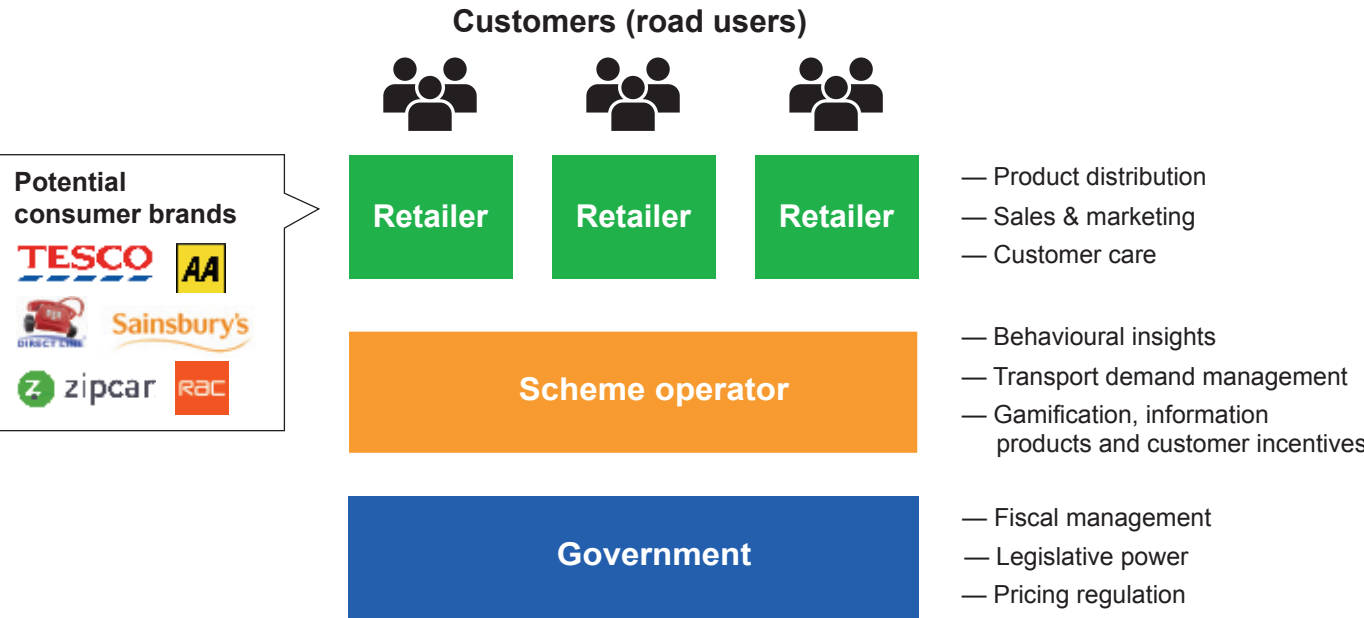
Customers quickly learn that they save money by driving outside peak periods. This incentive is reinforced with reward points, which recognise good habits and can be exchanged for discounts and other benefits much like frequent flyer points.

Figure 9: Feedback loop



Source: Adapted from Thomas Goetz, Wired, 2011.

Figure 14: Clearways scheme architecture



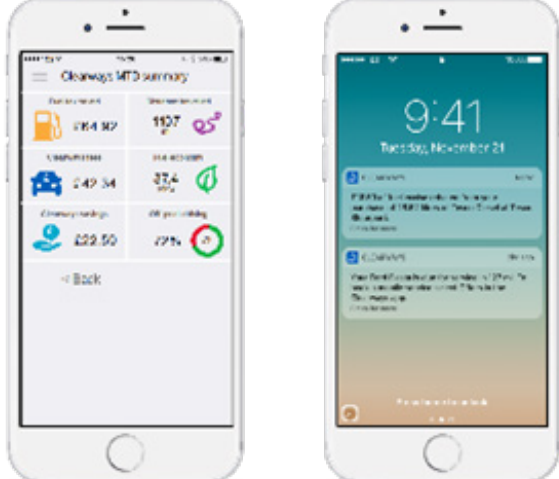
Regular feedback



Habits clarified



Savings detailed



employees travelling behaviour and work with them to support initiatives that reduce car journeys such as working from home policies.

Measuring behaviour change

A key objective of our proposal is to change behaviours in order to reduce congestion. In order to understand whether we are succeeding in this objective, we need to be able to baseline existing driving behaviour, produce an appropriate pricing scheme that encourages behaviour change at the lowest possible cost and compare the baseline with behaviours after someone has taken up the scheme. There are a number of issues that need to be tackled in order to successfully collect a baseline:

Issue 1 — Self-reporting is onerous. Asking people to report their existing driving behaviours would require a series of questions. This puts barriers in the way of people adopting the product.

Issue 2 — Self-reporting is subject to error. Asking people to report their existing driving behaviours may result in responses that are not accurate simply because people are unaware of their existing driving behaviours.

Issue 3 — Self-reporting is open to gaming. Some people will 'game' the system in order to try and obtain bigger financial incentives for behaviour changes than should be applied to them.

Issue 4 — Collecting data after sign-up is open to gaming. Attempting to carry out a baseline once someone has signed up to the scheme faces the issue of them changing their behaviours to get bigger financial incentives for behaviour changes than should be applied to them.

Issue 5 — Collecting data after sign-up delays implementation of behaviour changes. Baseline data needs to be obtained before any incentive for behaviour change is implemented or incentivised. This means that the pricing system with different rates for off peak and peak driving cannot be implemented until after the baseline is taken.

Issue 6 — Baseline data needs to take into account periodic events such

as school holidays. The collection of baseline data needs to take into account whether the car was driven in a typical or atypical way. For a family with school age children, their car may well be driven differently between term time and the school holidays. Other factors will include holidays, serious illnesses, moving home, car accidents, etc.

In order to collect the baseline data, there are a number of different solutions that either avoid or minimise the issues above.

1. *Use existing location history data.* Apps and online platforms already collect location history for billions of users worldwide. With permission from people who sign up, we can access this data and use it as our baseline. This avoids the self-reporting and after sign-up collection issues.
2. *Use existing car data.* A small number of cars are already connected to the cloud and gather location history as part of their data collection. With permission from people who sign up, we can access this data and use it as our baseline. Again, this avoids the self-reporting and after sign-up collection issues.

In cases where people do not have good quality existing location data, then we can baseline after sign-up. The trial will test different ways of doing this in order to assess the pros and cons of different approaches, such as the time taken for collecting the minimum amount of data required to get a valid baseline.

Pricing

A key part of our proposal is providing consumers with a choice of different pricing plans. These plans need to:

- Encourage changes in behaviour that reduce congestion.
- Be at least as cost effective to the consumer as the existing fuel excise regime in order to encourage take up and meet our price guarantee.
- Be seen to be fair by the community.
- Minimise the financial losses to the Government.

- Provide the same or equivalent incentives for driving environmentally friendly vehicles as currently available in order to maintain community support.
- Encourage people to stay in the scheme.

In order to achieve these aims, our proposed pricing plans contain a number of principles:

- All pricing plans will account for customer segments and individual circumstances in order to achieve the best possible balance in terms of take-up, revenue generation and incentives for behaviour change.
- All pricing plans will provide incentives to avoid driving during the peak congestion periods.
- For people who sign up to Clearways, they will never pay more than they would under the fuel excise regime based on their current 'baseline' driving behaviour.
- All pricing plans will seek to replace as much of the lost fuel excise revenue as possible if there are no behaviour changes (for EVs this is against the hypothetical low emission vehicle).
- All pricing plans take into account the fuel efficiency/pollution footprint of the vehicle.
- A tie-in period (similar to a mobile phone plan) of at least twelve months to offset the setup costs of a new customer will be in place (this does not apply to EVs as once opted in, they cannot opt out).

Road users — and transport customers overall — have a variety of needs, wants, lifestyles, constraints and preferences. People also have different access to alternative transport options, along with different incomes, social commitments and discretion regarding their travel time.

Clearways needs to accommodate the variety of customer preferences, constraints and socio-economic circumstances.

As well as providing core pricing, the trial will provide an opportunity for bundling other products to encourage take up and behaviour change. This

An OBD dongle being installed.

might include introductory offers for public transport, support for a switch to cycling or incentives for using a pooled vehicle provider.

Pricing plans also have the potential to be varied based on location and individual roads. These other Clearways 'products' can be experimented with during the trial in order to assess their benefits and disadvantages.

The technology

Our technology infrastructure for the scheme comprises:

- OBD dongles (small consumer-grade devices that connect to the industry standard vehicle maintenance port).
- Payment platform for financial transaction management and reconciliation.
- Security modules for encryption and data rights management.
- Central (cloud-based) data capture, processing and storage.
- Analytics and compute engines for interpreting and processing vehicle logs, billing metrics and road usage behaviour insights.

- Application integration and messaging platforms.
- Web, mobile and digital channels.

The advantage of consumer digital revolution

From a technology perspective, prevailing tolling, smart motorway and congestion zone schemes overwhelmingly rely on physical infrastructure. The design and architecture of this infrastructure largely pre-dates the advent of consumer grade mobile technology and consumer GPS adoption. The physical infrastructure and related technologies for traditional tolling schemes and Intelligent Transport Systems (ITS) implementations are expensive to install and maintain, when compared with current and emerging consumer technology and digital architectures.

Physical technology deployment also provides less flexibility in terms of changing pricing schemes, road network configuration or cordon zones due to the time and cost associated with system changes.

Our proposal provides a flexible, cohesive pathway to adopt consumer grade technology for today's car fleet

— enabling rapid rollout of Clearways in the short term — and an open architecture for connecting large fleets, existing "connected cars" and emerging vehicle technology over time.

This approach provides a method for the Government to rapidly adopt Clearways in the short term, at a lower cost than legacy road tolling technologies and ITS deployments that use fixed infrastructure. As a jurisdiction's vehicle fleet mix changes with the increasing adoption of EVs and connected car platforms, our proposed platform can readily integrate newer vehicles.

Connecting the vehicle fleet

For Clearways to be effective, it relies on connecting large numbers of vehicles and providing the ability to apply charges across a large geographic area. The prevalence of GPS technology and related consumer digital innovations make this feasible and more affordable than ever before.

Clearways requires a minimum dataset from each vehicle in order to apply the range of pricing mechanisms and information services needed for behaviour change and demand

management. The core vehicle dataset requires:

- Time-stamped geolocation.
- Unique vehicle identifier (either VIN or an equivalent unique identifier).
- Fuel consumption.

Of course, many vehicle manufacturers are already selling cars with connectivity — often bundling in roadside assistance functionality, navigation and infotainment services. This portion of the vehicle fleet offers the ability to connect via manufacturer or OEM connected car platforms.

The ‘legacy car fleet’ — comprising the largest number of vehicles in any jurisdiction right now — can be readily connected using inexpensive consumer-grade technology. In 2017 the best fit technology choice is connected OBD dongles. These devices have been used in the United States for recent road pricing trials (for example the Oregon MyOReGO trial). These devices are small, relatively inexpensive and user-installable, plugging into a vehicle’s On Board Diagnostics (OBD) port. OBD ports have been mandated in vehicle standards in most jurisdictions for ten or more years — originally required to standardise access to vehicle maintenance functions and allow for competition in the car maintenance sector.

Both of these connectivity options (manufacturers’ connected car platforms and OBD dongles) offer the ability to readily connect the vast majority of any country’s vehicle fleet (and in instances where manufacturers or OEMs are reluctant to provide platform access for our core dataset, OBD dongles are a cheap and readily available fallback option).

Using these connectivity options and our core dataset, we are able to implement Clearways in a way that includes a simple but effective method of validating eligibility for a full fuel excise rebate under the scheme.

Conceptual architecture

Clearways depends on a technology architecture that enables discrete components of functionality to evolve independently from the overall system. This approach means that Clearways

can embrace the latest methods in areas such as intelligent pricing or driving risk algorithms without incurring the cost and risk associated with a complete system upgrade.

The approach is also key to enabling Clearways to progressively ‘bolt-on’ new features as the rollout proceeds. For example, it is likely that initial adoption of our product would keep things simple at the outset, focusing on the core pricing and behaviour change functionality needed to drive adoption. After initial rollout, once the scheme is ‘at scale’, additional features such as gamification and more sophisticated price bundling would be introduced — enriching the customer experience and strengthening the range of mechanisms available to effect behaviour change, and hence tackle congestion.

Information Security

Information Security is crucial to both the consumer proposition in this scheme and the interests of the Government.

Our proposed scheme will generate and rely upon a number of information assets, each of which will need to be protected against threats to confidentiality, integrity and availability.

Overall, Clearways presents information security challenges that are no different from digital platforms that are now commonplace in the market. This enables us to adopt readily accepted technical and customer solutions to address service levels for confidentiality, data integrity and system reliability.

This is not to say that Clearways can simply leave all Information Security issues to be addressed by “industry standards” — only that our product design harnesses current digital technologies and industry solutions.

However it is worth highlighting a key aspect of our scheme design that is critical to the customer promise and overall scheme integrity. By adopting consumer-grade technology, such as OBD dongles, Clearways can be rapidly implemented and readily adopted by mass market customers. This means that the integrity of vehicle odometer and location data needs to

be managed carefully to assure the validity of usage charges, government revenue and overall scheme credibility.

For instance, a customer enrolled in the scheme could either siphon tax-free fuel for other individuals, or tamper with their OBD dongle to circumvent odometer and location logs.

This exemplifies the approach we have taken across the scheme design to address critical security considerations.

In this scenario, our solution for seamless fuel tax rebate at point-of-sale will automatically validate the integrity of a customer’s critical membership data. This real-time validation step will check the integrity of:

- Clearways account status.
- Current (or recent) vehicle connectivity.
- Actual fuel consumption vs imputed consumption based on driving history.
- Continuity of vehicle odometer and location data.

Any minor discrepancies will be flagged for later validation with the customer via their online account, or another customer channel such as a call centre, as required.

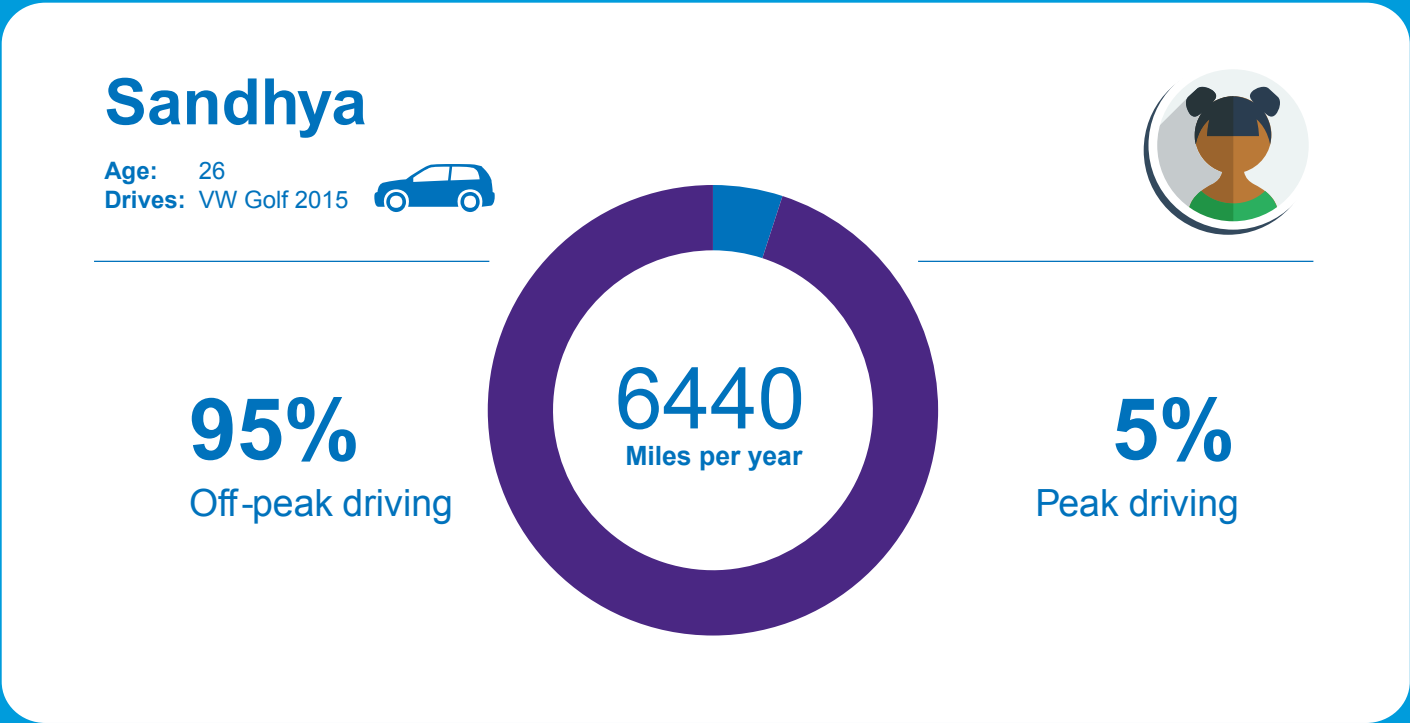
In the event of a major discrepancy or suspected fraud then the customer’s fuel payment can be declined at point-of-sale. The customer can then pay for their fuel — including fuel tax — using an alternate payment method. Their account is then flagged for manual review and validation.

Risks

We have carried out a risk assessment on our scheme:

Risk	Likelihood	Impact	Mitigation Measures
The scheme is not financially viable	Low	High	Detailed financial modelling has taken place.
			The speed of rollout can be adjusted to align with EV take up and keep the scheme revenue neutral.
			Beginning with a trial allows the financials of the scheme to be established.
The scheme does not deliver the behaviour changes required to reduce congestion	Low	High	The trial allows experimentation with different pricing and behavioural science techniques to change behaviour.
			The scheme operator works with leading academics in demand management and behavioural science to develop appropriate techniques based on the best research.
The scheme cannot find retailers to participate	Low	High	Appropriate financial incentives factored into modelling.
			Discussion with retailers has demonstrated significant enthusiasm.
The technology does not work	Low	High	The technology is already deployed in the marketplace, none of it is new or bleeding edge.
			Technology integration mitigated through use of minimum viable product for trial and early rollout.
Political opposition	Low	High	Prototyping and design validation of the technology is already taking place.
			Customer-led proposition.
Induced demand prevents significant congestion reduction early in scheme	Medium	Medium	Opt-in to prevent losers.
			Use of trusted retail brands to market the product.
Customers do not sign up for the scheme	Low	High	With significant adoption, demand can be reduced to the point where induced demand does not get triggered.
			Use of trusted retail brands to market the product.
Data security is compromised	Low	High	Financial incentives.
			Compelling consumer proposition.
			Leverage industry standard platform solutions, coupled with procedural controls.
			Ongoing ISO27001 compliance.

London commuter



Recent graduate Sandhya was thrilled to find her first job as a recreational therapist at a hospital in Ilford. To save money, she shares a flat in Epping, her hometown, and takes public transport to work rather than use her car. Catching the Central Line and changing to TFL Rail at Stratford, the 46-minute journey gives Sandhya time to read and text friends.

Despite her car-less routine during the week, she and her boyfriend Raman drive frequently on weekends to cheer their favourite football team, Tottenham, from Southampton to Sunderland. As well, when she's not making road trips to visit former school friends in Birmingham or Liverpool, she finds herself en-route to the Bicester Village outlets, to buy wedding and baby gifts for them.

“

“I realise now that we were just hopping in the car without thinking first. With a bit of planning while I'm on the tube, I can pick the best travel times, buy train tickets or decide if driving makes sense.”

“Since I'm just starting my career, and I've got student debts to pay back, the less I spend on driving the better. The less I use the car, the longer I can put off buying a new one.”

”

My travel experience

“I'm a bit surprised by my odometer reading, since my car sits in the garage all week. I guess our weekend trips add up and I'm afraid I'll need to replace my old car sooner than I thought.”

“I'm quite happy taking transit during the week. A neighbour of mine drives the same way each day and it takes him twice as long!”

“Raman complains that we are always in a rush on weekends, but that's because we are stuck in weekend traffic on the way to matches or trips up north.”

Driving profile (Before Clearways):

Total miles / year	6,440
Peak driving	5%
Off-peak driving	95%
Fuel cost / year	£727
Fuel excise paid / year	£361

Opting-in for Clearways:

Sandhya selects Clearways Weekender plan, since it fits perfectly with her weekly driving habits. She's happy to see her petrol costs drop — freeing up some disposable income she'd gladly spend on other things.

This planning exercise also convinces Sandhya to adjust her travel behaviour further. She and Raman decide to 're-mode' some of their weekend travel. For example, they could take public transport to White Hart Lane in less time than driving, and avoid the parking costs. For away games across the UK, they will take the train rather than sit in traffic on the M1 or M40. Sandhya also decides to 'reduce' her weekend driving by doing more online shopping, to eliminate traffic jams at the shops and have more time to relax with Raman.

Driving profile (After Clearways):

Reduced: Sandhya makes a conscious decision to reduce her road use in order to save some money and save hassles on weekends.

Peak driving:	5%
Off-peak driving:	95%
Reduction in vehicle miles travelled:	3,200
Miles reduced from peak:	160 (from reducing overall road use)
Clearways fees:	£79



3,200 decrease in miles travelled



Clearways savings

Other considerations

Localisation

If the UK Government did not want to pursue a national Clearways scheme, there is the potential for a more localised scheme to be introduced for example in a city or mayoral region in order to create changes in behaviour and tackle the challenges locally. However, this would still require the agreement of the UK Government to allow people to opt out of fuel excise and amend the EV grant scheme within the region.

A global perspective

Clearways has the potential to work in almost all countries across the world. All countries in the OECD, with the exception of Mexico, have a fuel tax (see Figure 17 on page 44).

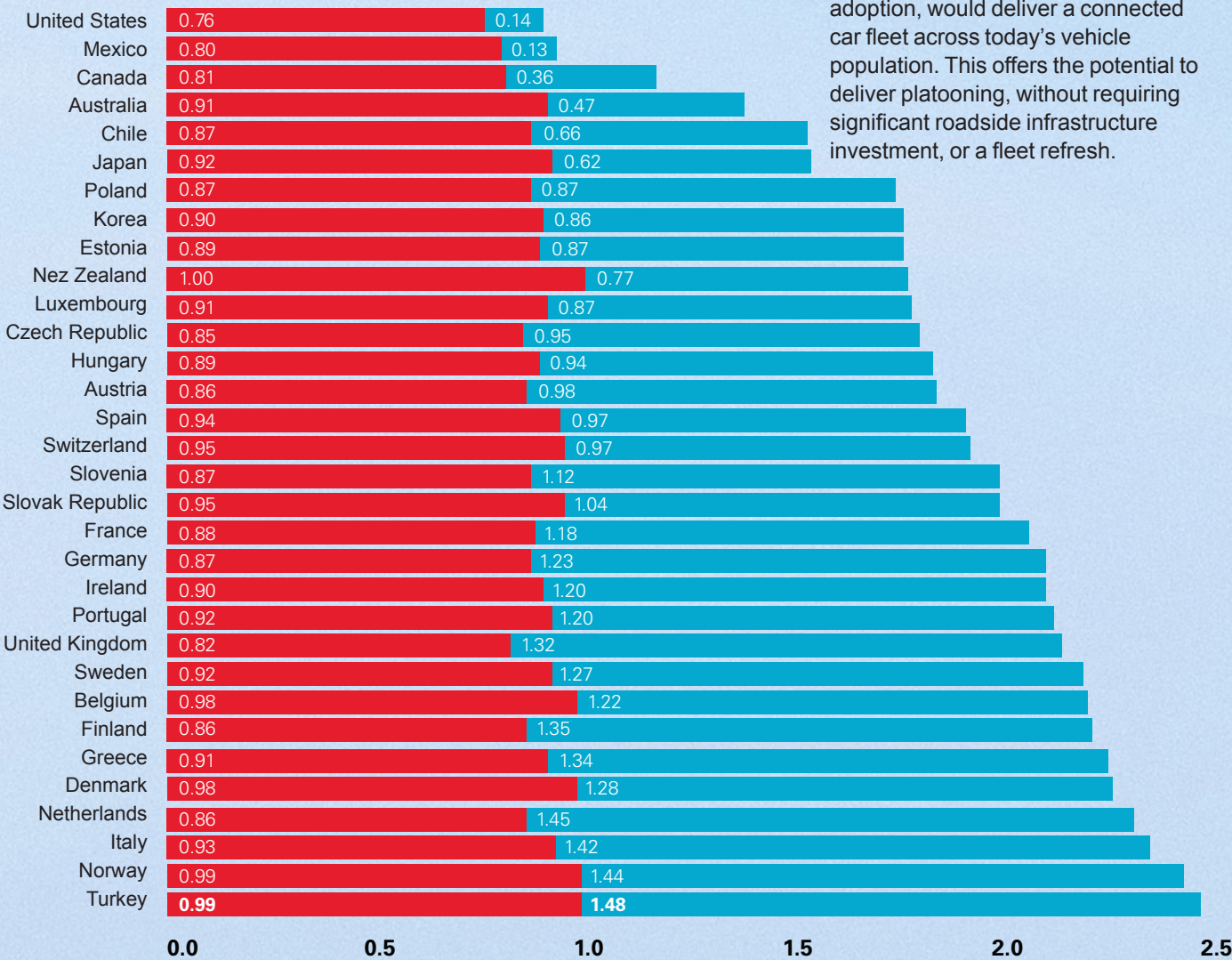
Both India and China with large populations, increasing motor vehicle penetration and increasing congestion have fuel taxes, providing the potential to adopt a scheme like ours.

Platooning

Transport operations centres in some cities are beginning to consider the possibility of coordinating traffic signals and smart motorway controls to facilitate 'platoons' of vehicles. This is one of the mooted benefits of vehicle-to-infrastructure (V2I) solutions, and some uses of vehicle-to-vehicle (V2V) solutions. These solutions typically rely on large-scale upgrades to existing traffic control infrastructure and/or a major refresh of the vehicle fleet.

Clearways, once at large-scale adoption, would deliver a connected car fleet across today's vehicle population. This offers the potential to deliver platooning, without requiring significant roadside infrastructure investment, or a fleet refresh.

Figure 16: Global fuel tax comparison



Most countries have substantial fuel taxes and so could adapt the Clearways scheme to their local circumstances.

Source: International Energy Agency, *Energy Prices & Taxes – Quarterly Report*, Second Quarter, 2014.

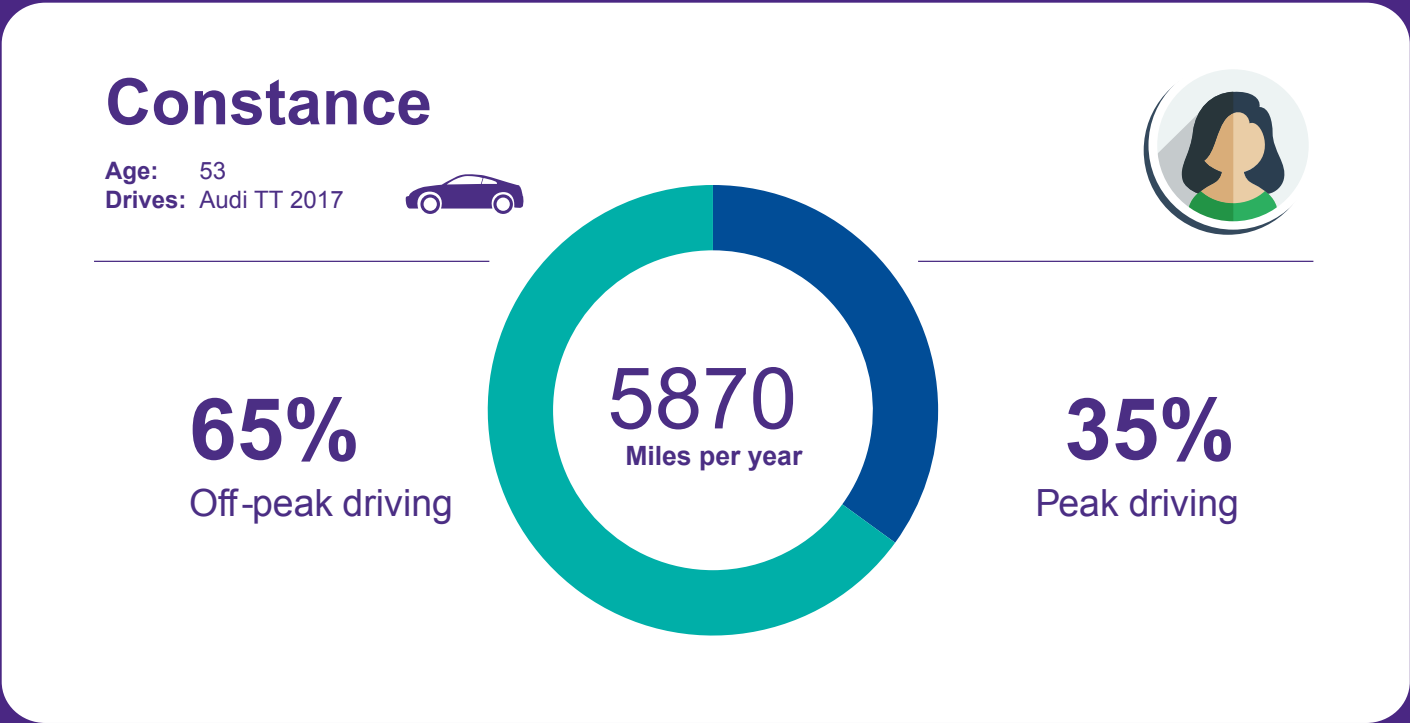


The future of road upgrade funding

By using our roads more efficiently, we will be able to defer the need to upgrade or build new roads to cope with the demand for travel, in some cases indefinitely. However, there will still be a need to fund some road upgrades.

Once Clearways has been extensively rolled out, the revenues (or partial revenues) from a particular stretch of road could easily be hypothecated to form a revenue stream that can be used as the basis for obtaining funding for road upgrades from the private sector. If a suitable operator is used that is either wholly separate from the Government or at arm's length (like Highways England), then this funding would not be classified as Government debt.

Inner city landowner



Described as a disciplined, Type-A personality, Constance has built a successful career in the capital markets, overseeing the fixed income desk at a global bank. To reward herself for an intensive work life, this divorced executive has acquired a comfortable townhouse in Chelsea and a country home in Buckinghamshire where she relaxes on weekends with her teenage daughter and friends.

Throughout her career, Constance has been a faithful tube traveller into the City, and she resorts to taxis or ride-sharing to return home after her 12-hour workdays. Although her Audi TT sits mostly in her west end garage she enjoys her country drives on the weekend.

Although Constance is shrewd with her daily spending, her transportation costs are not a huge concern in light of her high income. She harbours a strong environmental consciousness, as a mother who worries about the planet her daughter will inherit.

“

I guess you could call me an ‘early adopter’, since I like to try find better ways of doing things and new technology - so I like the idea of helping to pioneer the Clearways program.”

“I want to teach my daughter to be smart with her money, so I make a point of driving to the country house during non-peak times, which costs less.”

“Some of the benefits of the bundled Clearways package are rather nice too — I get points for improving my driving and I was able to redeem a discount for my daughter’s mobile phone plan.”

”

My travel experience

“I take the tube into the office to avoid the gridlock in Mayfair, but sometimes the car is the only option. Traffic is consistently terrible and I’ve got enough stress in my day without that to contend with.”

“The Friday night drive to the country house is agonising. I make use of my time — calling offshore clients in other time zones — but it’s not easy with my daughter on her phone too.”

“Someone really needs to take a stand on this, show some vision and introduce a new approach to resolve our transport problems. It’s only going to get worse, in terms of the burden on taxpayers and the health of our environment.”

Driving profile (Before Clearways):

Total miles / year	5,870
Peak driving	35%
Off-peak driving	65%
Fuel cost / year	£730
Fuel excise paid / year	£363



Opting-in for Clearways:

Constance chooses to enlist in the Clearways Weekender plan since she objects to the fuel tax on principle and believes that she is in a position to help address the transport congestion and public funding issues confronting society.

As a busy professional, she appreciates the seamless customer experience of signing up online, and the companion products and reward offers are a nice touch.

Driving profile (After Clearways):

Reduced: Constance pays more attention to her driving choices and is now more consistent about leaving earlier or later for her country house on Fridays.

Peak driving:	15%
Off-peak driving:	85%
Reduction in vehicle miles travelled:	-
Miles reduced from peak:	1,260 (by retiming her Friday evening trips)
Clearways fees:	£183
Clearways savings:	£179



The future of road upgrade funding

Economic productivity and transport connectivity

The UK faces a mounting productivity challenge. Average productivity in the UK is 19% lower than the average for its G7 peers and this gap has widened over the last 20 years. The UK’s productivity gap is now the largest since modern records began in the mid-1990s and the starkest when compared with the UK’s major trading partners: Germany and the US (a gap of 36% and 29% respectively).

Transport connectivity has an important role in fostering productivity and economic performance as well as bringing benefits to users and society. Improvements in connectivity bring businesses effectively closer to their markets; be that to other businesses they trade with, the customers they serve, or the skilled labour they require. This improved connectivity provides economies of scale and enables businesses to become more productive in what they do. In turn, this increased productivity allows businesses to pay their workers higher wages.

There is well-established evidence on the relationship between connectivity and productivity.

Specifically for connectivity by road, it is estimated that a 10% improvement in connectivity is associated with a 0.7% increase in productivity. There is also an established consensus that places with higher levels of transport connectivity are typically more attractive business destinations;

shaping the location and investment decisions of firms and the demand for employees. This can lead a redistribution of economic activity towards well-connected locations, and in turn additional jobs, housing and commercial development at the local level.

The poor quality of the UK’s transport network relative to its global peers, including levels of congestion, are highlighted as a drag on productivity and growth in the Modern Industrial Strategy, citing that 96% of UK businesses feel that the country’s roads are too congested.

Economic impact of Clearways

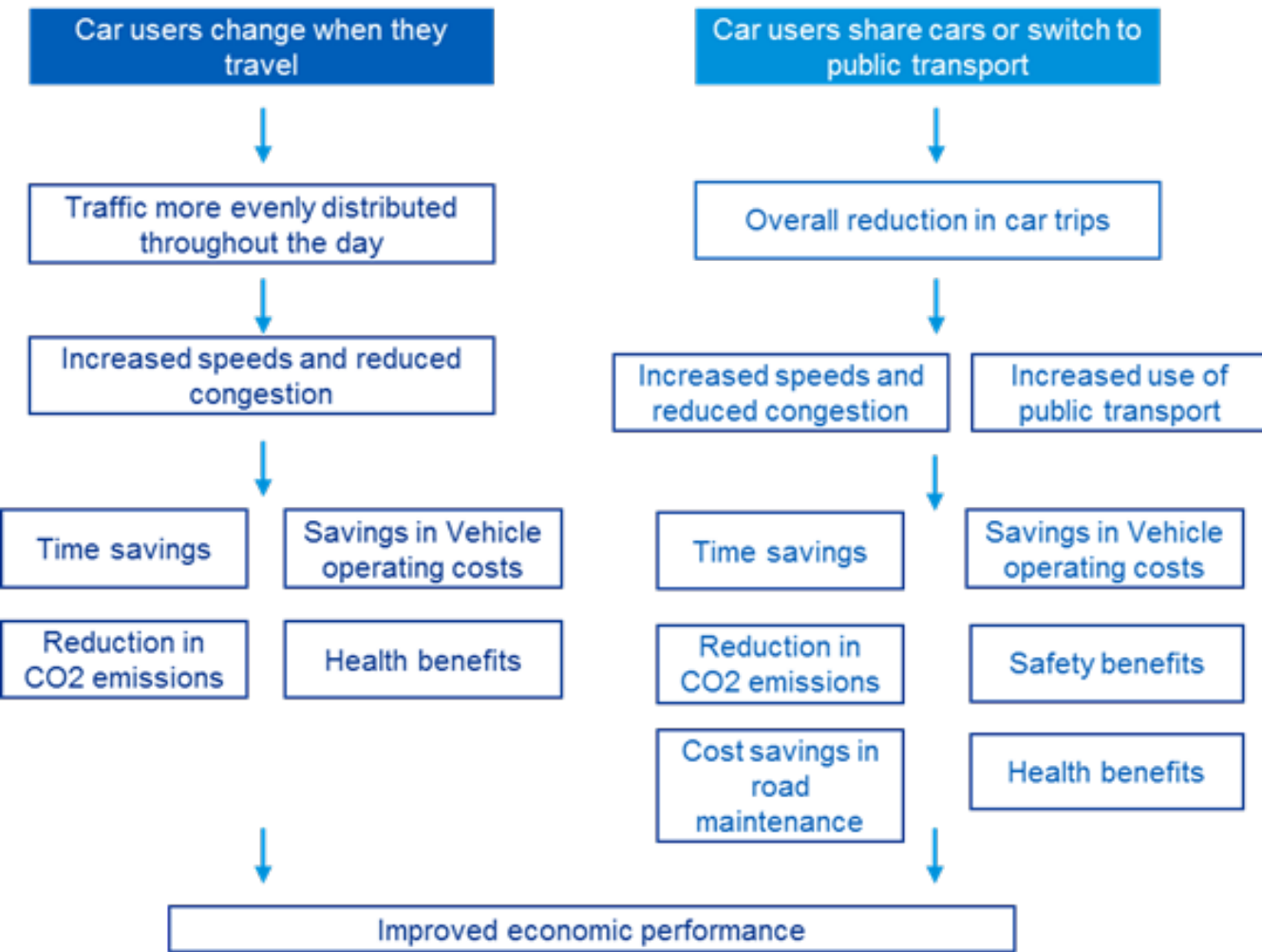
Clearways will allow people to make faster, cheaper and more reliable journeys leading to significant benefits to users of the road network and to society. This improved road connectivity will also have a positive impact on the wider economy and generate net national economic growth by increasing labour productivity and wages, and in turn net national tax receipts. Through behaviour changes by car users which incentivises a more efficient use of the transport network, road congestion will be reduced leading to faster and more reliable journeys as well as cost efficiencies.

Both retiming trips and switching modes plus car sharing will lead to significant economic benefits. On the one hand, the retiming of

trips will lead to benefits in the peak such as time savings, reduced vehicle operating costs and reduced emissions. On the other hand, trips changing mode or car sharing could lead to an overall reduction in traffic, leading to further time savings, savings in vehicle operating costs (both in terms of fuel consumption as well as the new road pricing strategy which will ensure the user doesn’t pay more) and emissions, in addition to safety benefits and financial savings in road maintenance. An improvement in speed will also lead to significant health benefits, as it has been shown that reduced traffic speeds drastically worsen air quality.

In addition, increased public transport use could lead to improvements in public transport provision as increased demand incentivises operators to increase frequency. Our solution will also have a positive impact on the wider economy and net national economic growth. Improving road connectivity will bring businesses effectively closer to their markets, reducing the cost of doing business and enabling firms to take advantage of economies of scale, leading to increased labour productivity and higher wages. This productivity-led growth not only generates additional GVA at the UK level, but provides an additional source of tax revenue for the Exchequer (given that HM Treasury earns c35-40p in every £1 of GVA at the UK level).

Summary of the economic benefits of Clearways



Sources:

Department for Business, Energy and Industrial Strategy, Building our Industrial Strategy Green Paper, January 2017

Greener Journeys, Tackling pollution and congestion, 2017

UK Department for Transport, Transport investment and economic performance: implications for project appraisal, 2014

Conclusion

Managing the demand for our roads and improving the efficiency of how they are used has the potential to:

- Improve people's quality of life by reducing commute times.
- Reduce the costs of doing business by reducing freight costs.
- Improved the quality of the air that we breath and helped us to meet our climate change commitments.
- Make our roads safer.
- Improve fairness.
- Set-up the UK to manage the coming technological revolution in autonomous vehicles.
- Brings in extra revenues for the Government.

For the past few decades, transport planners and economists have suggested doing this by implementing road pricing. For a wide range of reasons, this has proven to be politically impossible.

Clearways delivers demand management for our roads and so improves their efficiency. However, because of the voluntary nature of the product, its consumer proposition and the way that it is marketed, it does it without political barriers.

Clearways can transform how transport works in the UK by rewarding those people who use our roads efficiently and safely. Within five years, we could achieve significant reductions in congestion and establish a sustainable and fair funding mechanism for our roads - ready for 2030 and beyond.

Appendix A

Example Media Release

Government support to reduce congestion, air pollution and improve road safety

The Government today announced support for a pilot scheme that will significantly alter the way we use our roads.

The new scheme, to be delivered by Clearways, will result in less congestion, better environmental outcomes, safer roads and savings for motorists.

A 50,000 vehicle pilot, commencing in 2018, will allow drivers to use an innovative technology platform that delivers savings through more efficient individual road use.

The Clearways scheme, which recently won the Wolfson Economics Prize, allows people to opt out of paying for roads through fuel excise, and instead pay only for the time they are on the road. For a driver filling up a 50L vehicle, they would save nearly 28 pounds off their fuel bill with their associated expenses dependent on when they use the roads.

Research shows that 20% of current journeys across peak times can be modified. Even a modest change in driver behaviour will dramatically reduce congestion.

The Clearways scheme enables drivers to save money by changing their driving habits - the times they travel, the modes they use, or the routes they take.

“The Government is working to reduce congestion across our road network, and this scheme will deliver benefits to participating drivers, the environment and other road users”, the Prime Minister said.

“By guaranteeing that no driver will pay more than they currently do in fuel excise, the scheme will transform our road network to reduce congestion, improve safety and air quality and deliver savings to drivers.”

Jamye Harrison, co-founder of Clearways said ‘we are delighted that the Government has embraced technology and innovation by becoming the first jurisdiction in the world to trial the Clearways scheme. Our aim is to abolish congestion globally and it now looks like we will do that in the UK first.’

The trial will run for 6 months. Drivers can sign up to participate in the Clearways scheme through either the AA, Vodafone or the Nectar loyalty scheme.

Clearways Media Release Q&As

1. How does your scheme differ from road pricing?

Road pricing is a compulsory tax that punishes drivers who have to travel during peak times. Clearways is a voluntary scheme that rewards drivers who are able to change their behaviour to avoid driving in the peak. The table at the bottom of the Q&As provides more detail.

2. What impact will Clearways have on congestion and by when?

Approximately 20% of people who drive during the AM peak report that they are able to re-time their journeys. By getting just a quarter of these people to avoid driving during the peak, we can deliver a ‘school holiday effect’ reduction in congestion every day. Clearways can achieve this by the end of 2022.

3. How will the changes to the EV subsidy impact air quality?

In order to improve air quality, we need to both encourage the uptake of EVs and reduce congestion. Clearways does both. Our changes to the EV subsidy means that it is affordable in the longer term and so can continue for many years to come. This will increase uptake of EVs. By getting people to change their behaviours, Clearways also dramatically reduces congestion and so improved air quality.

4. How much does the scheme cost the Government?

Clearways is revenue neutral for the Government.

5. How much can road users save?

Road users who are able to change their behaviours are able to save hundreds of pounds.

6. How much more will road users have to pay?

Clearways has a price guarantee. No road user will have to pay more than they do today, compared to what they would pay through the existing fuel excise system.

7. Is Clearways available to freight vehicles and van drivers?

Yes.

8. How does Clearways impact on road safety?

Clearways improves road safety in a number of ways:

- By reducing vehicle miles travelled (VMT).
- Our connected car platform can provide feedback about people's driving style, informing them about hard braking, rapid acceleration and other events that indicate inefficient, unsafe or erratic driving habits
- Our points based reward system will have the option of rewarding people for good driving behaviours such as keeping within the speed limit where customers want to participate.
- We will be able to analyse routes and provide smarter, safer alternatives to avoid road safety risks such as passing schools and avoiding routes with poor safety performance.

9. How does your scheme affect fairness?

We directly improve the equity of our roads system in a couple of ways:

- Our voluntary opt-in approach with a price guarantee that no-one will pay more means that no-one on lower incomes will be worse off than they are today.
- The savings on offer for behaviour changes will be more significant to people on lower incomes as a proportion of income, improving their cashflow and making these drivers comparatively better off.

10. Is Clearways the beginning of privatisation of the roads?

Clearways makes no changes to the existing ownership or governance of the roads.

11. How will Clearways impact carbon emissions?

Clearways reduces carbon emissions by:

- Encouraging a faster uptake of EVs.
- Reducing congestion and so reducing carbon emissions from conventionally fuelled vehicles.

Appendix B

High-Level UK Modelling of Clearways' Proposition

KPMG UK has undertaken high-level financial modelling of Clearways' UK proposition. This has utilised a range of operating cost and other assumptions which, while in Clearways' view plausible, are subject to validation in a trial of the scheme. The analysis seeks to establish that, with a plausible set of placeholder assumptions, the scheme is financially sustainable.

The high-level modelling covers twenty years from Financial Year 2020 (i.e. April 2019 – March 2020). It assumes that EVs/ hybrids account for 10% of new car sales by FY2021 (compared to 3.4% in the year to Dec 2016), 50% by FY2028 and 92% by FY2039. It is assumed that 90% of new EV/hybrid sales join the Clearways' scheme, thereby receiving a Govt. subsidy to reduce the purchase price.

Million vehicles	Y/E Dec 2016	FY2022	FY2030	FY39
EVs/hybrids in circulation	0.4m	1.5m	8.7m	16.9m
EVs/hybrids joining Clearways scheme	-	0.4m	1.4m	2.2m
EVs/hybrids on Clearways scheme	-	0.8m	7.8m	15.1m

An average EV/hybrid joining the Clearways scheme is assumed to have road charges set such that, if they don't change their previous baseline driving behaviour, gross receipts would be 90% of average UK fuel duty per vehicle (assumed to be circa £910 p.a. in FY2017). It is then assumed that 20% of this potential revenue from new EV/hybrid owners is lost due to changes in driving behaviour in response to road price incentives (e.g. travelling at a different time; using public transport instead).

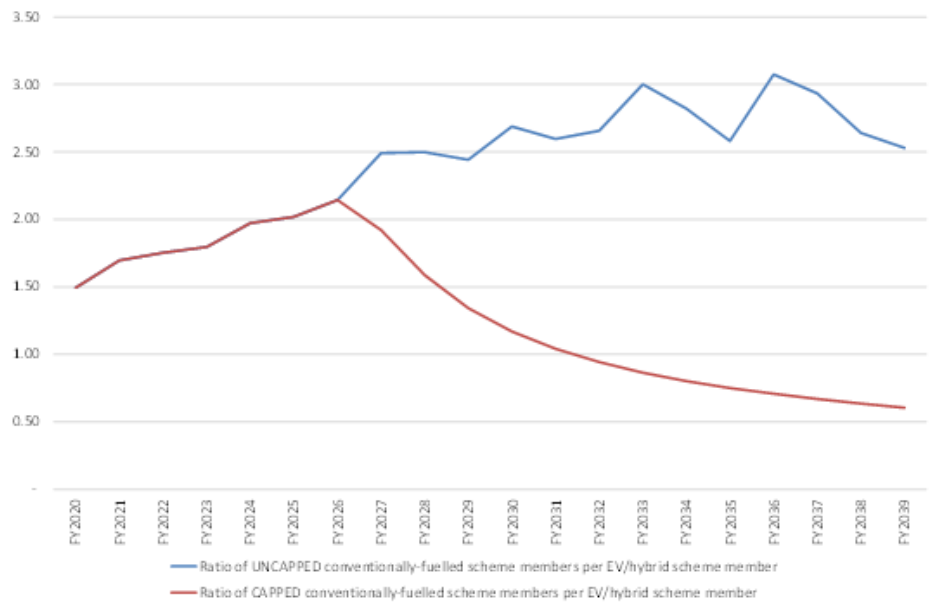
The net revenues from EVs and hybrids, after deducting scheme costs and an assumed regulated scheme operator returns, are then assumed to be available to subsidise conventionally-fuelled vehicles voluntarily joining the scheme. Road charges are set such that each conventionally-fuelled vehicle that joins the scheme voluntarily would pay 5% less than the average UK fuel duty per vehicle if they did not change their baseline driving behaviour. It is then assumed that a proportion do change their behaviour in response to road pricing incentives and yield a further 20% saving. The proportion of conventionally-fuelled vehicles that change behaviour is assumed to decline from 80% to 33% over the 20 year period of the high-level model.

The high-level model calculates the annual and one-off costs associated with conventionally-fuelled cars. It then calculates how many slots for conventionally-fuelled vehicles to join the Clearways scheme could be afforded each year from the net EV/ hybrid revenues. The number of conventionally-fuelled vehicles on the Clearways scheme is then capped at 9.1m (equivalent to 30% of the current conventionally-fuelled fleet). This cap reflects an assumption about the number of people willing to voluntarily join.

Million vehicles	Y/E Dec 2016	FY2022	FY2030	FY39
Conventionally-fuelled vehicles in circulation	30.5m	32.8m	25.8m	17.7m
Conventionally-fuelled vehicles voluntarily joining Clearways scheme (capped)	-	0.7m	0.7m	1.0m
Conventionally-fuelled vehicles on Clearways scheme (capped)	-	1.4m	9.1m	9.1m

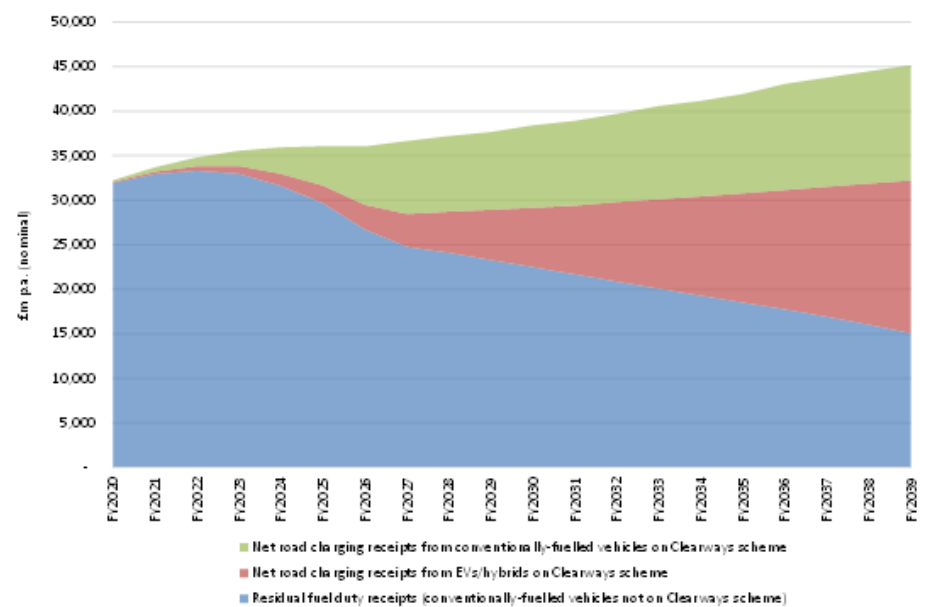
The high-level UK model demonstrates that, with the reasonable placeholder assumptions described above, the scheme operator's finances are sustainable.

The ratio of conventionally-fuelled vehicles that can be subsidised to join the scheme is as follows:



Receipts to Government are assumed to comprise:

- Net road charging receipts from EVs/hybrids on the Clearways scheme.
- Net road charging receipts from conventionally-fuelled vehicles who voluntarily join the Clearways scheme.
- Residual fuel duty receipts from conventionally-fuelled vehicles who do not volunteer for the Clearways scheme.



Appendix C

Projections for travel time savings

Volume and travel time are related by the widely used BPR formula:

$$t_{new} = t_0 \cdot (1 + a \cdot sat^b)$$

where

$$sat = \frac{q}{q_{max} \cdot c}$$

t_{new} = the volume dependent time;

t_0 = the free flow time;

q = the vehicle flow;

q_{max} = the link capacity; and

a , b and c are user defined parameters.

The parameters a,b and c are obtained from the following table.

Table 6.1– Volume-Delay Parameters

Link Type	Parameters			
	<i>a</i>	<i>b</i>	<i>b'</i>	<i>c</i>
Motorway D4 and D3	0.341	3.1	2.8	1
Motorway D2	0.358	3.1	2.8	1
Motorway Slips 2 Lane	0.19	4.2		1
Motorway Slips 1 Lane	0.35	5		1
CR Rural Primary A Road S2	0.355	2.98		1
CR Rural Primary A Road D2	0.346	3		1
CR Rural Primary A Road D3	0.334	2.8		1
A Road S2	0.832	2		1
A Road S4	0.653	2		1
A Road 3 and 4 Lanes-At Junction	0.334	2.8		1
B Road S2	0.832	2		1
CR B Road D2	0.933	2		1
City Centre S2	0.551	3		1
Residential S2	1.358	2		1

Therefore Delay (d) is written as

$$d = t_0 \cdot a \cdot sat^b$$

The percentagae reduction in delay is: $(d_{reduced\ volume} - d_{peak}) * 100 / d_{peak}$

It can be seen that travel time is dependent on the ratio of the volume and capacity (level of service). Any change in travel time is dependent on the intial level of service of a link. The results are provided in the excel sheets.

Calculation of Delay for Percentage Reduction for only City/Motorway

- 1) From Peak travel times infer saturation rate given by $sat = \sqrt[b]{\frac{d}{t_0 a}}$
- 2) An x% reduction in volume implies an x% reduction in sat. Therefore reduced volumes are equal to $sat_{red\ x\%} = \left(1 - \frac{x}{100}\right)^b \sqrt[b]{\frac{d}{t_0 a}}$
- 3) Delay observed from x% reduction in volume is $d \left(1 - \frac{x}{100}\right)^b$
- 4) % reduction in delay is given by: $\left(\left(1 - \frac{x}{100}\right)^b - 1\right) * 100$

Impact on Delay for Urban Streets

% Reduction in Volume	% Reduction in Delay
5	14.26
7	19.56
10	27.10

Assumption-Speeds on Motorway During Peak

Assuming equilibrium the speeds on the motorways should be approximately equal to those on the city streets, otherwise vehicles would re-route to take the city streets to have approximately similar travel times.

Impact on Delay for Motorways

% Reduction in Volume	% Reduction in Delay
5	14.70
7	20.15
10	27.86

Assumption-Percentage Motorway Usage

66.5 billion vehicle miles of traffic on Motorway
89.7 billion vehicle miles of traffic on strategic road network
Implies 74.1% travel on motorway.
This value is needed to determine the combined impact

Combined Impact

Average Delay= $P_{motorway}Delay_{motorway} + (1 - P_{motorway})Delay_{urban}$

Delay observed from x% reduction

% reduction in delays

$$\frac{P_{motorway}d_{motorway}\left(1 - \frac{x}{100}\right)^{b_{motorway}} + (1 - P_{urban})d_{urban}\left(1 - \frac{x}{100}\right)^{b_{urban}}}{(P_{motorway}d_{motorway} + (1 - P_{urban})d_{urban})} - 1$$

Which is shown below

% Reduction in Volume	% Reduction in Delay
5	14.63
7	20.05
10	27.74

Acknowledgements

Thank you

Clearways would like to recognise the support of KPMG during the development of our Secondary Submission for the 2017 Wolfson Economics Prize, with particular thanks to: Ian Clarke, Chelsea Dosad, Leah Fegan, Hanboon Khor, Adriana Moreno, Helen Oxenbridge and Richard Threlfall. We also thank the University of NSW, Faculty of Engineering team for working with us on traffic modelling and travel time projections, with particular thanks to: Professor Travis Waller, Associate Professor Vinayak Dixit and Dr Taha Rashidi.

Clearways also appreciates the support and encouragement of our numerous friends and collaborators. Their review and critique of our work has helped to hone our instincts and refine our story along the way. A huge thanks to: Gareth Dando, Susette Dixon, Claire Grego, Professor Ian Harper, Douglas Howe, Bruce Jeffries, Steve Porter, Michael Pratt AM, Geoff Roberts, Michael Rose AM, Dr Tim Williams and Andrew Wilson.

Jamye is where he is due to the unwavering love, support and inspiration of his awesome family - Catharine Pruscino, Francesca Harrison, Octavia Harrison, Evelyn Evans and Michael Pruscino.

Russell could not have been inspired to develop Clearways without the loving support of his darling wife Kate or the boundless joy from his son Albert.

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