Driving Change:
Applying Behavioural Insights to Improve Air Quality on the UK’s Strategic Road Network

A report by The Behavioural Insights Team for Highways England

Report 2 of 2, April 2018
Toby Park & Carolin Reiner

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Report 1 (separate publication):

• Project Introduction
• Part I – Drivers of Behaviour and Routes to Change: 6 Lessons in Behavioural Science
• Part II – A Review of the Literature on Behaviour–Change in Transport

Report 2 (this document):

• Identification of road-user behaviours contributing to air pollution, and prioritisation of which to target
• Exploration of drivers & barriers for these behaviours, and population segmentation
• Creation of a longlist of intervention ideas, and prioritised shortlist
• Development of outline implementation and evaluation strategies for each shortlisted intervention idea
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EXECUTIVE SUMMARY
Executive Summary

Introduction & purpose
This report is the second part of a project focused on road-user behaviours, and their impact on air quality on the Strategic Road Network (SRN). The purpose of the project is to explore road-user behaviour, understand the motivations of those behaviours and barriers to change among different population segments, and draw on behavioural insights to propose a range of potential interventions to encourage less polluting behaviours.

To this end, the report focuses on the contexts in which these behaviours occur, what drives and what limits their uptake, and how different segments of the population might be affected by different drivers and barriers. Subsequently, the report draws on behavioural science and the wider relevant literature base to propose a longlist of potential behavioural interventions. Four priority interventions are looked at in more detail, with logic maps outlining their expected impact and required inputs. Finally, guidance is given on how to implement and rigorously evaluate the four proposed interventions, which aim to:

- Encourage the uptake of electric vehicles
- Encourage eco-driving styles
- Encourage compliance with the 70mph speed limit
- Increase public engagement and support of on-road and off-road policy measures to tackle air pollution

Supplementary to this report, there is an earlier report which consists of two main parts. First, a detailed introduction to behavioural-change principles, identifying 6 key lessons from the wider psychological and behavioural economic literature, and in particular drawing examples from pro-health and pro-environmental behaviours. Second, an extensive literature review of the transport behaviour research, summarising the evidence on modal shift, driving styles, purchasing decisions, and responses to traffic management measures.

The structure of this report follows a four-stage project methodology, TEST: Target, Explore, Solution and Trial.

TARGET
The first stage is to identify the specific road-user behaviours and actions Highways England should prioritise in their efforts to improve air quality on the SRN. To this end, and building on the research summarised in Report 1, a comprehensive list of target behaviours is developed, each having an impact on air quality. These range from improved driving styles, to better vehicle maintenance, and car purchasing decisions. In total eight high-level categories of behaviour are identified, with multiple ‘micro behaviours’ under each. Four target behaviours were then prioritised, listed to the left. These were selected on their potential for change, their impact on air quality, and the extent to which they are a strategic priority for Highways England. These four behavioural objectives serve as the basis of the remainder of this report.

EXPLORE
This section includes two major sections. First, an exploration of the barriers and drivers to each of the four target behaviours. Second, a synthesis of existing population segmentation literature to identify characteristics specific to different population subgroups which may inform the design and delivery of effective interventions.

Uptake of electric vehicles:

**Barriers** – Higher initial costs of electric vehicles and our tendency to focus on up-front costs and rewards relative to those in the future (‘future discounting’) are a major barrier to uptake. Risk and uncertainty aversion of new and unknown technologies exacerbate our tendency to stick with existing options, particularly while perceived risks (e.g. associated with limited range) are high given current technological limitations.

**Drivers** – The way EVs are presented in a showroom or on a price comparison website can influence our decision-making (choice architecture). Financial incentives paid out in cash are likely more effective than subsidies automatically deducted from the purchasing price (framing). Purchasing an EV signals ‘green’ values and bears a ‘warm glow’ bias. The lower running costs are also a motivation for uptake. Each of these are largely under-exploited at present but provide potential to shift behaviour.
Executive Summary

Encouraging eco-driving:

**Barriers** – Driving is a very automatic and habitual process, which is hard to change, particularly among more experienced drivers. Lack of know-how, or information and cognitive overload from driving feedback can overwhelm drivers and keep them from adapting their driving styles.

**Drivers** – Most drivers have an intuitive understanding of what fuel-efficient driving means. Cost framings of the benefits could be effective, both among individuals and fleet operators. Technological solutions also have great potential, from simple in-vehicle telematics, through to elements of gamification and social comparisons to promote fuel-saving in fleets, for example.

Increase speed limit compliance:

**Barriers** – The majority of people tends to believe they are better than average and thereby justify their speeding behaviour. The thrill of driving can be hard to resist for some, while many of us speed slightly because it is perceived as totally normal and acceptable. The need to multi-task when driving can limit cognitive control and make concerted compliance difficult, particularly if other vehicles are speeding. Drivers in a high emotional state have been found to be more prone to speeding.

**Drivers** – We overestimate the extent to which others engage in undesirable behaviours. Pointing out the actual norm behaviour, can be a powerful driver of compliance. We reciprocate generous and kind gestures, this can be harnessed when the design of speeding offence penalties. The right framing of the consequences of speeding is important, as well as considering the design of the built environment.

Increase public acceptance of on-road and off-road policy measures:

**Barriers** – Awareness of the issue is relatively low, exacerbated by it’s intangible nature. There is also currently a lack of good understanding as to the predominant ‘narrative’ around air pollution – i.e. how do people perceive pollution, and what is their role in improving it? Collective action problems often mean individuals are hesitant to change their own behaviour voluntarily, and thus building support for stronger national policy is key.

**Drivers** – Increasing the awareness of air quality issues, the salience of the policy measures’ benefits and harnessing people’s self-interest can be powerful drivers of acceptance. Structured community engagement in the planning process can also help avoid the impression that communities are being engaged as an afterthought.

Segmentation exercise:

In addition to looking at behaviour-specific drivers and barriers, a ‘segmentation’ exercise is conducted. The purpose of segmentation is to identify groups of the population who are relatively distinct from one another with respect to their main motivations and barriers determining their behaviour. Identifying these sections of the population offers insights from which we can think about tailoring or targeting the intervention, either designing it to suit a particular segment’s characteristics, or targeting it at the segment most receptive to (or most in need of) behaviour change.

Unlike a classic market segmentation, this analysis does not reflect a complete range of mutually exclusive segments but rather highlights groups that are distinct in so far as the underlying barriers and motivations require different interventions and target mechanisms. The segmentation exercise therefore helps to identify which population groups are most likely to change their behaviour in response to the proposed interventions, and why that is.

**SOLUTION**

A long-list of intervention ideas is generated to encourage and increase engagement with each of the target behaviours. Each of these ideas is based on a suite of evidence from the wider behavioural literature and informed by BIT’s own experience in testing applying behavioural insights for numerous other policy challenges. This background literature is summarised in Report 1. The intervention ideas were rated on their potential impact, feasibility for implementation and their originality in terms of how novel and rooted in behavioural science the idea is. All 67 ideas are included in Appendix C, and the body of this report describes in detail four prioritised ideas to be taken forward to the field for evaluation, as well as 9 further ideas which are less feasible for implementation by Highways England alone, but otherwise emerged as frontrunners in the prioritisation exercise.
Executive Summary

The four prioritised ideas are:

- Design an app that tracks driving data and uses behaviourally-informed features to encourage eco-driving.
- Display of 70mph speed limit sign and behavioural messages on smart motorway signs to increase speed compliance.
- Develop a scheme for owners of clean vehicles (EURO 6 and VI, hybrid and electric) by making these vehicles identifiable and more normative through bumper stickers and (potentially) providing benefits such as free parking in city centres or at work.
- Running a social marketing campaign harnessing the feeling of disgust, and using credible messengers such as the NHS, to increase acceptance of on-and off-road policy measures to improve air quality.

These four ideas form the basis of the final stages of the report, in which implementation and evaluation strategies are proposed.

The additional nine high-impact ideas are:

- Re-frame existing government EV subsidies to make them more appealing.
- ‘Green Deal’ for EVs / ‘Green mortgages’ for EVs to front-load their benefits, overcome the barriers of upfront-cost, and make the long-term savings associated with low running costs much more salient.
- Mandate new price labelling for all new vehicles (EVs and ICE) to include purchase price and their lifetime running cost.
- Overcome frictions, hassle, and range anxiety through smart (bookable and searchable) charging stations, or free coupons for sandwiches/ coffee during charging periods at motorway service stations.
- Promote EV test-drives through prompts at timely moments, including on the DVLA website after vehicle tax renewal.
- A modified license points system to increase speed compliance.
- Behaviourally-informed league tables within firms and fleets to promote eco-driving.
- Deliberative Forums to engage the public in policy development.
- Public votes on details of proposals to engender sense of agency, and promote constructive engagement.

TRIAL

This section first provides an overview of recommended impact evaluation methodologies, their statistical underpinnings, and their advantages and disadvantages. Secondly, it outlines a recommended implementation and evaluation strategy for each of the four prioritised ideas.

The eco-driving app can be tested through a suite of randomised controlled trials, both testing the app as a whole (against a control group with the app), and testing specific features of the app. This also provides the potential to analyse the impact by population segment, and consequently create targeted and personalised content.

The speed compliance prompts on smart motorways can be tested through a randomised controlled trial by randomising the week of the year that signs are displayed on a given stretch of smart motorway. The number of variants tested will be limited by the number of sections of smart motorway available with minimal contamination (minimal instances of drivers using more than one motorway section). Eight behaviourally-informed sign variants are proposed.

The bumper stickers and (possible) incentive scheme intervention can be evaluated through a mixed method approach consisting of focus groups and interviews to explore initial reactions to the stickers, and a large longitudinal survey, capturing public awareness of and perceived commonality of EVs and low-emission ICEs over time. A control region can be created either by comparing England to, say, Scotland, or by only introducing the stickers in some Local Authorities, albeit some contamination will occur as drivers move around the country.

The social marketing campaigns can be evaluated initially through online experimentation, testing a variety of elements (for example, using different messengers, and testing different framings of the information). Subsequently, the final campaign can be tested in the real-world using a quasi-experimental approach comparing matched local authorities with and without the campaign. Surveyed awareness and self-reported support for policy measures would be measured.
INTRODUCTION
Introduction

Poor air quality in the UK is estimated to cause 40,000 early deaths per year, with vehicle exhaust emissions and particulates from brakes and tyres being a major contributor to these adverse health effects.

Clearly there is a need to rethink the way we travel, but as the UK transport network is largely designed around private car ownership there are no easy or quick solutions to these problems. UK policy is becoming more ambitious, for example with a recent announcement to ban the sale of new petrol and diesel cars by 2040. Technological developments are also rapidly emerging with advances in battery design, and new models of mobility as a sustainable service, rather than as a practice of private ownership. However these developments are long-term, remain speculative and are likely to hit stumbling blocks in years to come. In the short term, Highways England face the challenge of beginning to address the air quality issue on the UK’s Strategic Road Network (SRN). A wide range of infrastructure and policy solutions are available, and this project, undertaken by the Behavioural Insights Team (BIT) focuses on the use of behavioural insights – findings from psychology, behavioural economics and the wider social sciences – to help inform those solutions. This includes the following:

- Ensuring that conventional policy tools, such as road pricing, speed compliance, and infrastructure changes, are ‘behaviourally informed’. By drawing upon behavioural insights, and designing policy to go with the grain of human nature, we can increase our chance of such policies having the desired impact on road-users’ behaviour;
- Exploring the use of more novel behavioural interventions, including nudges, to help support and encourage drivers, fleet operators and other stakeholders to pursue less polluting transport choices and behaviours; and
- Thinking about how public consent emerges and how communities can be best engaged to ensure interventions are publically and politically acceptable.

This report is the second of two deliverables from this project. It summarises BIT’s recommended solutions, as well as the thinking which underpins them, and provides outline strategies for implementing and evaluating them. It sits alongside Report 1, which presents a background to behavioural science in the context of transport.

Objectives of the first report

- To provide a detailed overview of behavioural science in the context of pro-environmental and pro-health behaviour, such that we can begin to understand what might be effective in promoting less polluting transport choices.
- To provide a detailed literature review of the behaviour-change literature in the context of transport behaviour. This is split into four key themes: transport mode choice; vehicle purchasing decisions; driving style; and traffic management.

Methodology of the first report

- An extensive review of academic literature across the fields of psychology, behavioural economics, public health and sustainability to identify major approaches to behaviour-change, with a focus on pro-environmental and pro-health behaviours, drawing transferrable lessons from these contexts.
- An extensive review of academic, policy and commercial literature on transport behaviour interventions.
- 12 in-depth expert interviews with professionals working in transport policy, transport research and behaviour change. This includes representatives from UK and overseas departments for transport, independent transport research organisations, leading, and other policy practitioners and behaviour-change specialists. The purpose of the interviews is to invite experts to share their knowledge about the extent to which different behaviours impact air quality and to get their views on what the most pertinent barriers to behaviour change are, and what inherent motivations could be harnessed to encourage behaviour change.

Objectives of this report

- To provide a systematic longlist/matrix of potential behaviour-change objectives that may be pursued to improve air quality on the SRN, alongside potential interventions, and metrics of impact, feasibility, and time-scale.
- To identify four priority behaviour-change objectives, and to undertake further in-depth exploration of each, identifying key barriers, opportunities, touchpoints for intervention, and relevant consumer segments.
- To provide detailed intervention recommendations for each, and an outline strategy for the implementation and rigorous evaluation of the proposed interventions.

Methodology of this report

- Systematic identification of behaviours which contribute to pollution on the SRN.
- Prioritisation of those behaviours, identifying four key objectives to focus on.
- Workshops and expert engagement to develop potential intervention ideas, drawing upon the wider behavioural science and transport literature summarised in Report 1.
- Segmentation exercise to identify most viable target populations and tailor the intervention ideas accordingly.
- Prioritisation in collaboration with Highways England to identify four interventions (solutions to the four prioritised objectives) to pilot.
- Development of a robust Trial Protocol for each intervention, outlining the intervention design, implementation and evaluation strategy, and Theory-of-Change.
Project methodology

**T.E.S.T – Behavioural insights as a methodology**

Behavioural insights is not just a collection of research findings and insights into human behaviour, but is also a methodology. Armed with this behavioural understanding, the objective is to understand the context, the motivations and barriers for people’s behaviour, and to develop solutions which are sensitive to these contextual factors. In this spirit a four-stage project methodology, T.E.S.T., is adopted.

**Target:** Setting clear behavioural objectives.

The starting objective for this project is to improve air quality on the SRN through behaviour change. However, there are many specific behaviours which might contribute to this objective and many population segments whose behaviour is relevant. This high-level objective must, therefore, be broken-down into specific, discrete behaviours. The first stage in this work is therefore to identify a longlist of potential target behaviours which have a bearing on air quality on the SRN.

With this longlist of potential behaviours identified, four were prioritised: 1. Encouraging eco-driving styles, 2. Increasing compliance with the motorway speed limit, 3. Increasing uptake of electric vehicles, in general and in particular vans, and 4. Increasing public engagement with, and acceptance of, air quality interventions including roadside barriers.

**Explore:** Understanding the context, barriers, drivers and motivations.

In order to develop effective interventions, it is necessary to understand the problem and the context: why are people doing what they do? What are the barriers, drivers and motivations (practical and psychological) for each of the Target behaviours?

A literature review of the behaviour change literature (in transport and more broadly), as well as 12 expert interviews, answers some of these questions. This is presented in Report 1, and summarised in Appendices A and B of this report. Building on this work, a segmentation exercise has been undertaken to identify the most relevant barriers and drivers for different population subgroups, as they relate to the four target behaviours. Potential touch-points for intervention are also identified.

**Solution:** Developing behaviourally-informed interventions to achieve the TARGET objectives.

Drawing upon the insights learnt during the EXPLORE phase, as well as the wider literature and theory on behaviour-change, intervention ideas are developed. In this report a longlist of potential intervention ideas for each of the four priority behaviours is presented (the longlist is included in Appendix C). These are then scored on potential impact, feasibility, and originality (scorings are included in Appendix D). From this, two short-lists are generated: First, a short-list of four ideas to be taken into the field. These were prioritised heavily on feasibility, whilst also considering their likely impact and original use of behavioural insights. Second, a short-list of nine other ‘ambitious recommendations’, prioritised with greater weight on likely impact.

**Trial:** Implementing and robustly evaluating our interventions.

Ultimately the aim is to know, with a good degree of certainty, whether an intervention is effective. The final stage is therefore to design robust implementation and evaluation strategies for each of the four selected intervention ideas. These draw on a range of research methods to address the challenges facing each intervention, including Randomised Controlled Trials (RCTs), quasi-experimental and laboratory techniques.
Project Methodology
(The remainder of this report follows this structure)

REPORT 1

- **Understanding behaviour-change, and reviewing the transport literature.** Report 1 provides two key elements:
  - 1. An in-depth review of core behaviour-change principles relevant to air quality on the SRN. This draws upon the fundamentals of psychology and behavioural economics, and provides examples from a wide range of contexts including pro-health and pro-environmental behaviour.
  - 2. A literature review of transport behaviour research, focusing on four themes found in the literature: mode shift, purchasing decisions, driving style, and traffic management. Both of these sections were informed by the published literature as well as 12 expert interviews. **A short summary of Report 1 is included in Appendices A and B of this report.**

TARGET

- **Identifying potential target behaviours.** A longlist of 30 potential behavioural objectives were identified. ‘Behavioural objectives’ are defined as discrete actions or decisions we wish to encourage among road-users. These range from encouraging eco-driving styles, to purchasing electric vehicles, and complying with the speed limit.
- **Prioritisation and narrowing of scope.** The list of behavioural objectives was prioritised during a workshops and subsequent meetings. Four priority objectives were agreed: 1. Encouraging Eco-driving. 2. Increasing compliance with speed limits on the SRN. 3. Increasing uptake of electric vehicles, in general and with a particular focus on electric vans. 4. Increasing public engagement with, and acceptance of, air quality interventions including roadside barriers.

EXPLORE

- **Barriers and Drivers.** Key barriers and motivations for each priority behaviour were identified, drawing on the literature summarised within Report 1.
- **Population segmentation.** Existing segmentation literature was reviewed and synthesised. Implications for intervention design are highlighted.

SOLUTION

- **Intervention design.** Drawing upon the behavioural science literature, knowledge of the barriers and motivations, and segmentation literature, a longlist of intervention ideas is generated for each of the four priority behavioural objectives. **This longlist is in Appendix C.**
- **Solution refinement and prioritisation.** Through discussion with Highways England, and scoring the long-list of intervention ideas on metrics of originality, feasibility and impact, four interventions were chosen to take into the field, alongside nine other ‘ambitious recommendations’ for further consideration. **A record of the scores is included in Appendix D.**

TRIAL

- **Trial design.** Implementation and evaluation strategies have been developed for each of the four selected interventions. These strategies identify the key research questions, recommend a trial/research design, identify appropriate outcome measures, and provide guidance on sampling, statistical power, and implementation challenges.
1. **TARGET:** A longlist of potential behavioural objectives is identified, and four priority topics are selected.
**TARGET:** Identifying a longlist of potential target behaviours

The first step is to identify all possible road-user behaviours which might lead to improved air quality on the SRN. These are expressed as ‘target behaviours’ and are the desirable actions and decisions which road-users could make (and which Highways England might promote). As such, though they might be considered solutions (or partial solutions) to the problem of air pollution, they are in fact the starting point, i.e. the objectives, of a behaviour-change intervention or campaign. These objectives are subsequently prioritised to narrow the scope of the project, and behavioural interventions developed to achieve them.

The below diagram presents all the target behaviours considered. Blue boxes represent the categories of behaviours. Grey boxes below are the discrete micro-behaviours within each category. Note that there is inevitably some overlap. For example, maintenance of recommended distance (under increase road-user compliance with highway code) overlaps with anticipating traffic early (under encourage eco-driving styles).
Prioritisation of objectives

Each of the target objectives listed above represents a possible ‘problem statement’ and a starting point for a major piece of research. In some cases several of these objectives may be addressed with a single intervention (for example, eco-driving training may achieve all of the micro-behaviours listed under ‘encourage eco-driving styles’). In many other cases however, each specific behaviour deserves its own intervention to reflect the particular barriers, motivations and contextual factors at play. For example, encouraging drivers to maintain the correct tyre pressure is an objective which faces a particular set of contextual factors and barriers, quite different to the objective of removing excess weight and unused roof-racks (even though both reside under the same category of ‘encourage vehicle maintenance and optimisation’).

As such, it is not possible to address all of the above objectives at once. It is therefore necessary to narrow the scope by prioritising a few discrete behavioural objectives. Wanting to maximise impact, this exercise was based on the review of existing behavioural literature (detailed in Report 1 and summarised in Appendices A and B). This enabled a judgement on the level of potential impact, considered alongside a desire to test something original and go beyond the existing evidence (i.e. to avoid very well-researched territory), as well as remaining sensitive to Highways England’s existing programmes of work and preferences.

The following four behavioural objectives were chosen on this basis, and are the focus of the remainder of this project. The rationale behind each objective is given below, rooted in the behavioural literature reviewed in Report 1.

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<tr>
<th>Target objective 1: Increase compliance with the 70mph speed limit on motorways and trunk roads</th>
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<td><strong>Rationale:</strong> There is evidence to suggest that emissions increase significantly at higher vehicle speeds, with potentially significant benefits therefore arising from greater compliance with existing speed limits. Greater speeding compliance may also lead to less lane changing and aggressive driving styles among the fastest drivers, and therefore smoother traffic flow and less congestion as a result. This all brings further reductions in gaseous and particulate emissions.</td>
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This objective also aligns well with Highways England’s existing priorities. Speed limit enforcement is a potentially sensitive issue, but nonetheless an important one. It is therefore well-suited to the application of ‘soft’ behavioural interventions, nudging road-users towards compliance without relying upon conventional enforcement measures.

From a behavioural perspective, there is much that can be done. Previous work by the Behavioural Insights Team has successfully reduced speeding re-offenses through the use of behaviourally-informed warning letters highlighting to drivers the consequences of speeding, and reasons behind the limits. There has also been a lot of successful work on compliance in other domains (such as tax and fine payments, attendance rates at hospital appointments, for instance). This has often drawn upon the use of social norms, and other aspects of ‘social influence’ such as harnessing the power of reciprocity, and increasing the perceived observability of the behaviour (see Report 1, lesson 5 on social influence, and the sections on reciprocity and conditional cooperation in lesson 2).

It is also clear that driving styles are very automatic (see ‘driving style’ in section 2 of Report 1). The braking of automatic habit can be achieved through the use of timely prompts and reminders, for example, using salient on-road signage (see lesson 3 within Report 1). Finally, there is much evidence that the precise framing of information is important (see lesson 2 in Report 1 on harnessing the right motive, and lesson 3 on harnessing cognitive biases and heuristics to frame information most powerfully). This suggests there is potential to re-frame speed-compliance messaging in a way which more strongly motivates behaviour change. Many of these ideas have not previously been tested in this context, and thus there is great potential to innovate and go beyond the existing evidence base.

In summary this objective was chosen due to it’s alignment with existing priorities, its potential for cost-effective and short-term impact, and the relative lack of novel interventions evidenced in existing research.
# Target: Prioritising Four Behavioural Objectives

## Target Objective 2: Increase the Uptake of Electric Vehicles and Low-Emission Combustion Vehicles.

**Rationale:** A transition to Electric Vehicles (EVs), and/or to the most efficient internal combustion vehicles (ICEs) would represent a major improvement in air quality on the SRN. However, the immediate impact is limited by the extent to which such a transition is feasible in the short and medium-term, and the potentially high cost of the kinds of interventions necessary to have a major impact (e.g. charging infrastructure, or subsidy schemes). That said, while impacts may not be immediate or overwhelmingly large, there is still scope to promote the purchase of more efficient vehicles through the application of behavioural insights.

Evidence summarised in Report 1 (Section 2, ‘purchasing decisions’) shows upfront cost to be a major barrier against EV adoption, yet relatively little has been tested to change the framing of this cost. Interventions from other contexts (e.g. energy efficiency) provide valuable lessons in re-framing investments which have high upfront costs and long-term benefits. For example, restructuring existing incentives to make them more salient and perceived as a better deal, or front-loading savings relative to costs, may be effective (these ideas are expanded on in the later Solution section). Moreover, most new cars are bought on credit, providing an obvious mechanisms through which high upfront costs can be spread, if people better understood that savings would be made in the long term.

We also identify in Report 1 a range of other behavioural factors which remain relatively unexplored (see Lesson 3 on nudging with biases and heuristics, and the purchasing decisions section with section 2 of Report 1). For example, the perceived prevalence of EVs may be low, with this perceived social norm exacerbating numerous biases which cause us to avoid unfamiliar purchases: status-quo bias, uncertainty aversion, risk aversion and loss aversion. Overcoming these preconceptions and increasing people’s perceived normalcy of EVs and low-emission vehicles may therefore have a modest but meaningful impact on purchasing decisions. Linking them to high-status is also a relatively unexplored avenue of research. In summary, there is enormous scope to generate marginal but meaningful shifts in purchasing choices through the use of behavioural insights.

## Target Objective 3: Increase Public Engagement with, and Consent of, Roadside Pollution Barriers and On-Road Air Quality Policy Developments

**Rationale:** Behavioural insights are most commonly adopted to encourage or discourage certain actions or decisions. However, they also have an important role to play in understanding public attitudes, building trust, awareness and consent for policy changes. This objective is important because many high-impact solutions to air pollution will unavoidable require legislative changes or stronger economic leavers. It is important that the public are engaged with these inevitable changes and that any potential objections are understood and addressed.

Report 1 (Lesson 6) summarises several key considerations for building public consent and engagement. Evidence shows that we are often averse to change and policy intervention before it happens, but more accepting of new policies after-the-fact (for example, support for the London congestion charge was very low before implementation, but much higher immediately after). Nonetheless, much can be done to build support ahead of policy developments. Key factors include a sense of transparency and procedural justice, for example by hypothecating funds raised through new levies or taxes to be spent on the related social problem.

Report 1 (Lesson 2) also discusses the importance of developing a convincing narrative to successfully deliver public awareness campaigns. Such campaigns must understand the perspective and mindsets of the public, and frame information in a way which emotionally connects, rather than using dry, technical content. For example, one possible framing is to harness the emotion of disgust to help people understand the true impact of poor air quality (akin to anti-smoking adverts which also harness disgust). This may be particularly pertinent to the challenge of making air pollution ‘visible’ and intuitively understandable to the public.

Ultimately, building public support and engagement is a critical step towards many potential policy solutions, and as such this is an important objective with the potential to be widely impactful.
**TARGET:** Prioritising four behavioural objectives

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<th><strong>Target objective 4:</strong> Increase uptake of eco-driving styles (including more constant speeds, lower revs, greater distance between vehicles, and greater anticipation of traffic flow ahead)</th>
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| **Rationale:** Though a transition to less polluting vehicles may ultimately bring the biggest impact, it is also long-term. Highways England are keen to deliver interventions which have a short-term impact, addressing the level of pollution created by the UK’s current fleet of vehicles. Research (summarised in Report 1, section 2 ‘eco-driving styles’) shows that significant reductions in fuel use and in emissions are possible by changing driving styles. This includes driving slower, at more consistent speeds, with less harshbraking and acceleration, and not idling at junctions and in traffic.  

There is a modest body of literature on interventions to promote eco-driving styles (reviewed in Report 1, Section 2). However these tend to fall within a two categories: training, and feedback (e.g. in-vehicle feedback delivered real time through the use of telematics). Our driving habits are very much automatic and ingrained, and as such training tends to be most effective for new drivers who do not need to undo years of habit. The evidence on training schemes delivered to more experienced drivers suggests the effects are very modest and short lasting, with old habits soon returning. In-car feedback has been shown to be more effective, but if very much depends on the design of this feedback. Relatively little research exists which convincingly disaggregates the different features of feedback and identifies the most effective mechanisms and designs. It is also notable that existing feedback designs are, to date, relatively unimaginative in their use of behavioural principles. Report 1 (lessons 2, 3, 4 and 5) summarise the many ways in which information can be framed to promote behaviour change, and novel financial and social incentives can be harnessed. For example, there is evidence to show that league-tables and peer comparisons are effective interventions to promote energy efficiency, and to reduce fuel use among airline pilots. These and many other similar interventions have been used to good effect in other contexts, but have not been well tested in the context of driving feedback despite their obvious relevance to individual and fleet drivers.  

This objective was therefore chosen both for the immediacy of potential impact, and because there is great potential to apply behavioural principles which are well established in other contexts, and therefore likely to be effective, but relatively unexplored in the driving literature. |
2. **EXPLORE:** Investigation of the drivers and barriers for each target behaviour, and a review of relevant population segmentation literature.
EXPLORE: Identifying behavioural barriers and drivers, and segmenting the target populations

Methodology

This Explore phase aims to understand the barriers and drivers, motivations, context and influencers of behaviour. Many of these questions have been addressed during the first phase of the project through detailed research into the existing behavioural literature and transport literature, and through conducting expert interviews. The output is detailed within supplementary Report 1, and signposted where relevant in this publication.

In this report we build on this work by expanding further on the specific drivers and barriers relating to each of the four high-level objectives, namely the uptake of EVs, eco-driving, compliance with the 70 mph speed limit and public acceptance of on- and off-road measures. This is to ensure a good understanding of the behavioural underpinnings of each objective so as to develop the most impactful intervention ideas. Also presented is a synthesis of existing population segmentation literature relating to these four objectives, with the intention of tailoring and targeting any interventions to reflect particular populations’ characteristics.

Segmentation exercise

The purpose of segmentation is to identify groups of the population who are relatively distinct from one another, differing in their attitudes and values, potentially demonstrating different motivations, and characterised by different demographics. Identifying these sections of the population offers insights from which we can think about tailoring or targeting the intervention, either designing it to suit a particular segment’s characteristics, or targeting it at the segment most receptive to (or most in need of) behaviour change. When segmentation is done well, it brings major benefits, avoiding a ‘one-size fits all’ approach to intervention design. However, there are also some common pitfalls.

Common pitfalls of segmentation

One major challenge with segmentation is finding the right variables on which to segment. On the one hand, these need to be meaningful in terms of capturing ‘real’ differences across the population which usefully inform the design or targeting of an intervention. On the other hand, in order to target interventions at individual segments, these also need to be identifiable through readily available, observable variables such as demographic variables, car ownership, local area, etc.

Often, this is not straight-forward: the ‘meaningful differences’ across a population which we would ideally reflect in the way we tailor or target interventions are often invisible. For example, people may differ in their environmental attitudes, their tendency to take risks when driving, or in what they look for when buying a car. Many studies do an excellent job of creating different categories based on such characteristics through surveys. This, in theory, might encourage us to target those who care about the environment with pro-environmental messages, and those who do not with cost-saving messages, for example.

However, short of surveying the entire population these variables are often not observable, and thus not ‘targetable’. Therefore, segmentation studies aim to correlate these meaningful differences with observable characteristics such as age, gender and income group. This allows us to identify the populations we want to target, but the correlation between these variables and the one we really care about (motivations, attitudes, barriers) is often weak, and thus the targeting of interventions is crude. This significantly undermines the ability use segmentation studies to target interventions, even if at face value they are valid in their segmentation of the population.

With these limitations in mind, this section aims to achieve the modest objective of synthesising only the most useful elements of existing segmentation research, to inform the design of, or targeting the application of, the interventions ideas proposed in this report.
**Segmentation approach**

**Implications for intervention**
Existing segmentation literature was reviewed to identify population segments which show different attributes and identifiable characteristics. Given that this exercise is drawing from multiple studies, it does not necessarily identify groups that are mutually exclusive. Rather the approach focuses on identifying segments that have distinct and to a certain extent unique implications for the design of interventions. For example, one identified segment might be ‘new drivers’ whilst another might be ‘existing electric vehicle owners’ – the two will overlap, though still provide useful insight into the way interventions might be tailored or targeted. All the segments that have been identified or created (some are amalgamations from multiple sources) are worth singling out because of a few distinct characteristics that are relevant to our objectives.

**Touchpoints**
In addition to outlining these implications for intervention design, potential touchpoints are also identified for each: even if an intervention cannot meaningfully be tailored to a particular segment, it can be delivered through different customer touchpoints which emerge for different populations. Here the aim is to consider the most effective ways to get interventions across or identify a platform where much of the target audience can be reached. Some of these touchpoints will be specific to certain segments, while others will be broadly applicable to many segments. For instance, the DVLA website where all existing car owners submit their annual vehicle tax might be a good touchpoint to reach a large population of existing drivers, while other, more specific touchpoints can be imagined for new drivers, or new parents.

**Segment characteristics**
Each segment is described by its particular characteristics with a focus on the behavioural drivers and barriers specific to each. As the groups are not mutually exclusive many of these naturally overlap.

**Observable variables**
Where possible, an attempt is made to identify observable variables for each segment. Some of these are taken from the existing segmentation literature, while others are added based on the wider behavioural literature summarised in Report 1. It is important to note that this is not the output of original, formal segmentation research (which would require extensive survey work), but is a synthesis and interpretation of existing literature. They are not intended to be exhaustive, and ‘usefulness’ is prioritised over precision or completeness.

**Ranking each segment**
As a final step to the segmentation exercise each segment was ranked on a two-by-two matrix. One metric indicates the extent to which drivers, customers or citizens are motivated to engage with the desired behaviour. The psychological drivers and barriers identified for each segment are determinant of each segments’ positioning on this metric. The other metric indicates the extent to which drivers, customers or citizens have the opportunity to adopt the desired behaviour, based largely on practical barriers. The particular positioning of each segment on this two-by-two matrix could therefore be interpreted as that segment’s receptiveness to behaviour change, which is a function of the level of motivation and opportunity to change.

![Fig. 1 The potential for behaviour change per segment is mapped on a 2x2 matrix of motivation for, and opportunity (lease) for change.](image-url)
2a. 

EXPLORE: Encouraging the uptake of electric vehicles
## EXPLORE: Behavioural drivers & barriers to the uptake of EVs

### Barriers

**Upright cost & future discounting:** Most electric and hybrid vehicles on the market today tend to be more expensive than their conventional ICE (internal combustion engines) counterparts. That large upfront payment in itself is a barrier to a lot of people, especially given that about 80% of new vehicles in the UK are purchased on credit and the second hand market, which most vehicle buyers rely on, has very few electric vehicles.

In addition, we have a tendency to focus on up-front costs and rewards relative to those in the future, meaning the immediate present is particularly salient. When purchasing products this leads us to focus too strongly on the price tags and ignore the long-term running cost of our purchase. As such we may discount the fact that EVs can lead to long-term savings due to very low running costs.

**Mental accounting:** We also focus on the price tag of a new purchase rather than its running costs because we tend to compartmentalise funds into separate categories, thereby violating the standard economic assumption that all money is interchangeable fungibility. With vehicle purchases, we might ascribe different ‘envelopes’ to the upfront cost of a vehicle, the vehicle tax, and the fuel costs, meaning that our purchasing decision will focus on one envelope, namely the upfront cost and disregard the others like tax and fuel costs and thereby underestimate the total cost of a conventional vehicle (given that both tax and fuel are cheaper for EVs).

**Status quo bias:** We tend to stick with existing options, and not make changes. This is often fuelled by uncertainty and risk aversion. We have a tendency to steer away what’s new and unknown without a strong motivation to change from the default. These aversions are exacerbated by:

- **Range anxiety,** with uncertainty around range, battery life and the scattered charging infrastructure deterring people from buying (friction cost, risk-aversion, & inconvenience)
- **Concerns over unknown safety and reliability** may also be a barrier that stems from an aversion towards new technologies.

**Environmental scepticism:** Those who are not motivated to protect the environment through their own actions and consumption habits have less motivation to consider an EV. Moreover, there are relatively few ‘high status’ EVs for those who do not gain status from a pro-environmental identity.

**Availability heuristic & perceived norms:** We tend to judge the frequency and prevalence of a situation, good or service by how easy it is to recall examples. Given that most EVs are not necessarily identifiable as such, many people might underestimate their actual prevalence. This influences the perceived norm of how common it is to buy an EV.

### Drivers

**Framing to counter future discounting:** Changing the way upfront prices are presented can help to overcome future discounting, for example by displaying the life-time cost of the vehicle (upfront +running cost) instead of just the upfront price.

**Choice architecture:** The way choices are framed and presented influences the choices we make. For instance, in a car showroom, the way vehicles are positioned, or the way a price comparison website for cars is designed will influence which vehicles we notice more and it will influence the type of information we are drawn to. Testing and knowing what the most effective choice architecture is to promote the sales of EVs can be a powerful driver.

**Framing of incentives:** The way financial incentives to encourage the uptake of EVs are framed will impact our decisions. Subsidies or a tax exemption, for instance are likely to be more effective if paid out in cash (or otherwise) rather than automatically deducting it from the purchasing price.

**Identity, signalling norms and the ‘green halo’:** Purchases and behaviours we engage in signal something about our identity and attitudes to the people around us. The ‘green halo’ effect describes the ‘glow’ derived from displaying green behaviours as it has become a symbol of status in that eco-products and a sustainable one are on average more expensive than conventional products and lifestyles.

**Self-interest – localised and personal impacts on air quality:** With many environmental issues, the challenge to mobilise people often arises from a feeling of incapacity and not being able to change anything about the situation through individual action. Luckily, with air pollution this is less so the case as it is with climate change. Air pollution is local and so is its impact. The adverse health effects of NOx and particulate emissions are closest to the source. Greenhouse gas emissions are local but the impact of climate change on the other hand is global. Communicating this ideas more clearly to people might somewhat lift their feeling of individual incapacity to bring about change.

**Loss aversion** – We are more willing to pay more and put more effort in to avoid losing something than we are to obtain or gain the same thing. This aversion to losses can be harnessed by framing the gain from lower running costs, and foregone tax payments for EVs when compared to conventional vehicles.

**Costs** – the running costs for EVs are low, meaning they can be better long-term purchases, if people can be encouraged to recognise this.
# Explore: Population segments relevant to the uptake of EVs

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<td>1 Environmental cynics</td>
<td>A comparative survey found that 15% of the UK population are not at all concerned about climate change. This population is likely to overlap with this segment of environmental cynics. Households in this group are the most likely to be multi-car households. This would also suggest middle or higher income groups.</td>
<td>This segment is the most likely of all to be driving a petrol or diesel vehicle. This group has inclinations to display negative attitudes towards EVs. In particular, they are concerned about reliability and safety issues with regards to EVs. In addition to highlighting the concerns about EV technology, this group does not consider the typical benefits of EVs to be relevant as they do not consider environmental concerns of car use to be their responsibility nor do they consider the instrumental capabilities of EVs to be particularly valuable. Cars owned by this group hold instrumental value, and this segment would therefore only really consider purchasing an EV if they are perceived to being functionally equivalent to conventional cars.</td>
<td>This group is one of the hardest to reach due to their lack of environmental concern and fairly high level of instrumental symbolism associated with cars. Regulatory and monetary incentives, as well as technological advancement is likely necessary to encourage uptake of EVs among this segment. This said, given that this segment is the most likely to consist of households with multiple cars, interventions focused on promoting the uptake of EVs for a household's secondary car might be more impactful to this segment than to segments with single-car ownership. Similarly, this segment might be interested in scrappage type schemes as one of their multiple cars is likely to be older and replaceable. Overall, cost-based arguments are much more likely to resonate with this group than environmental messages. Potential touchpoints: EVs are most likely to be purchased as a secondary vehicle, meaning that these people already own at least one car. This makes the process of paying vehicle tax, or renewing MOT tests particularly effective touchpoints for this group.</td>
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<td>2 Weekend drivers</td>
<td>Compared to other segments, it’s a lower income segment and more people are retired. Hence, the average age is higher than for most other segments. On average, households in this segment log the lowest mileage compared to other segments, which is likely to be a function of their age, their employment status and lack of commuting requirement. Households tend to have only one car, and are more likely than other segments to be single-occupancy households.</td>
<td>This segment is likely to have a petrol car, and least likely to purchase a pure battery electric vehicle. They have little knowledge of functional aspects of car operations, and are inclined to display negative attitudes towards EVs, such as considering EVs to be lacking reliability and safety. This segment does not take responsibility for environmental consequences of their own car use. Given their relatively low technological savviness and low innovativeness, they are unlikely to consider the instrumental capabilities of EVs to be particularly valuable. As this segment tends to be older, brand loyalty and inertia may be more likely to play a role in vehicle purchasing decisions. They have relatively low annual mileage and consequently also a relatively low outlay, which might make these households more sensitive to the upfront costs and less concerned with EV’s lower operating costs.</td>
<td>Similar to environmental cynics, this group is also hard to reach due to their lacking of a sense of responsibility for their own behaviour and societal environmental consequences. This group is likely less far along the ‘stages of change’, in that they are not yet at the point of actively considering EVs. Technological improvements to EVs and funding will likely be indispensable to promote uptake among this group, and even then are likely to be later adopters. Given these households’ employment and income status, and low mileage (meaning low running costs do not offer as attractive a return on upfront investment) funding to overcome the upfront cost barrier will be key for this group. In comparison to most other segments, messages highlighting the savings on operational costs with EVs is not likely to be very effective given low existing outlays. As most of these households own only one car and voiced concerns about safety and reliability, technological improvements to increase range and battery lifetime are essential to promote uptake. Potential touchpoints: Entry into retirement could be a timely moment to promote the uptake of EVs.</td>
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## EXPLORE: Population segments relevant to the uptake of EVs

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<td>3 Keen greens</td>
<td>This segment spreads across a fairly wide age bracket, with one study suggesting that among car owners about 45% are between 40 and 60 years old, and another 45% being older than 60. Similarly, most people work full-time, but there is a significant fraction that is retired. Due to this, average income is lower than in some other segments. We also know that younger people tend to have stronger pro-environmental attitudes, though are less likely to own a car, and also relatively lower in income.</td>
<td>These people have low involvement with cars in general but express high concerns about the environment. Therefore, these households care to reduce their own pollution contribution at the expense of variables like cost, range, comfort, speed, etc. As a result, this segment is most likely of all to demonstrate a preference for plug-in hybrids, or a pure battery EV, demonstrating their concern for the environment. To consider buying an EV, these households care about sufficient range, adequate vehicle performance and whether they could recharge the vehicle at home. While preference and motivation to purchase EVs or hybrids is high among these households, feasibility ranks lower due to the older leaning age range and lower income average due to retirement.</td>
<td>This segment’s high concern for the environment make them receptive to messages highlighting environmental consequences in general and also to messages framing these alongside individual responsibility and contribution. Policies focusing on the environmental benefits of EVS whilst stressing the negative externalities associated with conventional cars could potentially harness this segment’s motivation. Financial incentives would likely be effective to attract this segment’s interest, and could address the feasibility aspect by easing the strain of relatively high upfront costs to EVs. <strong>Potential touchpoints:</strong> Many of these households will likely be aware and engaged in other sustainable behaviours like recycling, installing insulation, energy-efficient appliances, etc. Environment focused magazines could therefore be a suitable touchpoint. Where other government communication around sustainable behaviours exist, particularly if in relation to cost-savings (e.g. green deal and insulation) a message highlighting the savings in running costs associated with EVs could be included.</td>
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| 4 Early adopters | Early adopters demonstrate a higher than average education level and correlated to this also higher than average income levels, only behind ‘car enthusiasts’. They are the segment most likely to have children in the household, and thus also most likely to reside in a multi-occupancy household. This segment has a fairly high annual mileage, likely to be a result of their high employment rate and commuting to work from suburbia. In short, these are young and middle-aged, middle-class families living in suburban areas. | This segment is the most likely to be interested in hybrids. This is indication that environmental concerns are existent but not as predominant in their decision-making as for the ‘keen greens’. Consisting of families, this segment is likely to also be interested in cost-saving arguments alongside environmental and health concerns, and that’s where hybrids present a good substitute for conventional vehicles. Cars, in general, don’t bear instrumental value to households in this segment, which means they care less about attributes like speed and power. Given their busy lifestyles as working parents, these households are likely to care about comfort and safety. Sufficient range, battery life and charging infrastructure at home and at work are key variables that are likely to determine if they will purchase an EV or a hybrid. This segment ranks quite high in motivation though lower than ‘keen greens’ but given their higher incomes purchasing an EV might be more feasible to ‘early adopters’ than to ‘keen greens’, especially as a second vehicle in the household. | Given this group’s high mileage, they will be the most sensitive of all groups to messages on saving through lower running costs. Tools like apps or web-based calculators that can make this information very salient might be effective for this group. This segment is also likely to be receptive to more general environmental messages, and as parents, also attentive to health-based arguments. Framing pollution in terms of the equivalent cigarette smoke your children inhale each day could be salient to this group. Upfront costs, compared to other segments, will likely be a major barrier but not the main barrier here. The other main barriers to address are range, battery life and also charging infrastructure at home and at work. Financial incentives promoting charging stations for new homes and in the workplace should be considered. **Potential touchpoints:** Many in this segment are working parents. Schools and employers are therefore good touchpoints with a large potential reach in this segment. Many young families may also be upgrading to larger vehicles during the birth of a second child. |
## EXPLORE: Population segments relevant to the uptake of EVs

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<td><strong>5 Car enthusiasts</strong></td>
<td>This segment is predominantly male, well educated and younger than average. Most are full-time working with above average income levels (&gt; £50,000). About half of this segment lives in bigger cities.</td>
<td>This segment considers cars to be symbolic representations of their identity. As performance is a key variable in their decision-making, these people are buyers of powerful cars, and attached to the benefits of conventional vehicles such as speed and sound, for example. They enjoy driving and associate positive emotions with their cars.</td>
<td>This segment would perhaps benefit from medium-term policy initiatives intended to shift the symbolic meaning associated with EVs away from environmental considerations and more towards their embodiment of advanced and innovative technologies. Given these households’ fairly high incomes, they could be receptive to interventions aiming to increase the uptake of EVs as second vehicles in the household. As car enthusiasts, some of these households will have multiple vehicles, some of which might be older and well-suited to be replaced through traditional scrappage schemes. In similar fashion, this segment is likely to be impacted by regulatory changes to emission standards of older vehicles, signage systems, emission charges, etc. <strong>Potential touchpoints:</strong> Vehicle fairs are likely to reach car enthusiast, and car-loving celebrities (such as Jeremy Clarkson, Chris Evans and Matt LeBlanc) might also be good messengers to shift the perception of EVs away from purely because of environmental benefits, towards innovation and performance. Digital and technology-focused platforms could also be considered as good touchpoints for the same reasons.</td>
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<td><strong>6 Young urbanites</strong></td>
<td>These are 18-35 year olds, who are well educated, employed and predominantly live in urban areas. Most of them will be living in flats rather than a house.</td>
<td>While this segment does on average exhibit high concerns for the environment, it is less likely to host early adopters of EVs. This is mostly due to the high upfront cost, which many of these young urbanites who have just started their careers cannot yet afford. In addition, the fact that most of them live in urban areas makes car ownership less of a necessity due to public transport. The fact they live in flats rather than houses adds to the trouble with finding parking places common to urban areas, which makes car ownership not just unnecessary but sometimes even more of a hassle. EV charging would also be a problem for apartment-dwellers. This segment considers itself to be hip and, as many in their generation, want to show concern for the environment and social impact more generally. The ‘green halo’ effect of EV uptake could be quite powerful if the upfront cost is less of a barrier as these people age. Motivation ranks fairly high in terms of environmental benefits for EVs but that is mitigated by their low propensity of car ownership on the whole. Opportunity is also quite low due to lower income. This might change over time.</td>
<td>As most people in this segment live in urban spaces, parking spots in close proximity to their homes would be highly valuable. On the flipside, living in urban areas also means that range and battery life is likely to be less of a barrier than in comparison to other segments. Harnessing the ‘green halo’ effect of EVs might work reasonably well for this segment as a signal of status and a pro-environmentalist image. As the upfront cost will be a main barrier, green mortgages and similar financial incentives easing the initial investment effort are likely to be well received in this segment. <strong>Potential touchpoints:</strong> Young urbanites who can afford mortgages might also be able to afford an EV over the next few years, offering a way to target the wealthier portion of this segment.</td>
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### EXPLORE: Population segments relevant to the uptake of EVs

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<td>7 Public and private fleet operators</td>
<td>All private or public fleet operators. In the private sector, this can include everything from logistic companies, taxi services, Uber, car sharing services, to moving services. In the public sector it mostly refers to bus fleets, government vehicles and the procurement of private vehicles and services.</td>
<td>Fleet operators have an inherent incentive to minimise their vehicle’s running cost. In turn, the initial investment required is likely to be a significant barrier to fleet operators who have cash-flow concerns, but surmountable with borrowing/purchasing on credit if long-term benefits are achievable. To those fleets that travel long distances, range and battery life will also be key barriers and also present a significant investment risk. Depending on the type of company or operator and their remit, being first-movers in the market to adopt EVs might be advantageous with regards to their image of operating a responsible fleet. Both motivation and opportunity are present but potentially moderate and different from operator to operator.</td>
<td>Financial solutions to overcome the upfront investment barriers may be important. Lower running costs of EVs should be communicated saliently, as this speaks to the core of fleet operators’ business. This pertains to fuel cost, insurance cost, and maintenance costs. Investments along the SRN to provide a reliable charging infrastructure will be necessary. Potential touchpoints: Trade and industry organisations offer ideal touch-points for this segment. Direct interactions with government through, for instance companies house, HMRC and BEIS, are also a possibility.</td>
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<td>8 Users</td>
<td>Existing owners of an EV. Tend to have pro-environmental attitudes, above average income and education. Some (predominantly male) car-lovers with an interest in the technology have also been early adopters.</td>
<td>This segment regularly drives or owns an electric vehicle. They have therefore overcome the first barrier related to cost and safety. For households where the EV serves as a second vehicle, range and battery life might still be of concern. Encouraging these households to overcome those and use their EVs for most of their trips, should be the focus for this segment. Opportunity is clearly very high among this segment as they either already own an EV or already have seized good opportunities to rent one. Motivation ranks high, but still slightly lower than opportunity.</td>
<td>This group should be encouraged to use the secondary EV they own, particularly where they may be averse to using it for longer journeys on the SRN due to concerns about range. Cost-saving messages focused on lower running cost, or harnessing people’s sunk cost bias could be effective, as could interventions which aim to remove uncertainty about charging infrastructure and availability on the SRN. Potential touchpoints: Holiday bookings, and bank-holidays are timely moments when long journeys on the SRN are likely. Highways England could display messages along the SRN prompting people to use their EVs, e.g. “Take a breath. Use your EV on your break”. There is also potential to provide information at the point of purchase.</td>
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EXPLORE: Opportunity and motivation of segments for EV uptake

- High opportunity
  - Early adopters
  - Fleet operators

- Low opportunity
  - Environmental cynics
  - Weekend drivers

- High motivation
  - Keen greens
  - Young urbanites

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2b. EXPLORE: Encouraging eco-driving
## EXPLORE: Behavioural drivers & barriers to the uptake of eco-driving styles

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<th>Drivers</th>
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<td><strong>Habit &amp; emotions</strong>: For most drivers over time, the act of driving develops into a series of very automatic and habitual behaviours. We drive, using our ‘cognitive auto pilot’ mode, meaning we don’t think about our manoeuvres much but do them rather intuitively. This is highly efficient as it leaves room for out attention to focus on the traffic. At the same time it also means these ingrained and automatic driving processes are hard to change and require a great deal of attention and effort to do so. Emotions tend to captivate our attention and cognition as well, particularly in a heightened state, making us even more susceptible to being acting and driving on ‘auto-pilot’.</td>
<td><strong>Mental models</strong>: Most drivers have mental models of eco-driving, i.e. when prompted to drive fuel-efficiently without further explanation, drivers can put these mental models into practice immediately without the need to train. It means there is an intuitive understanding of what more fuel-efficient driving is, but it does not mean that drivers can execute the full range of eco-driving behaviours at once, and consistently.</td>
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<td><strong>Information &amp; cognitive overload</strong>: This describes a situation where the information presented to you leaves you overwhelmed and is too much to be taken in all at once. Eco-driving feedback, visual or haptic, needs to be designed in a way that feedback is intuitively understood and does not require a lot of cognitive effort from the driver. This is also important to keep the driver’s main focus on the road and traffic so as to ensure safety.</td>
<td><strong>Personalised framing (cost and health)</strong>: Highlighting more immediate and personal benefits of eco-driving like cost savings and local health impacts of pollution may be more effective than framing eco-driving as a pro-environmental behaviour with positive implications to many.</td>
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<td><strong>Lack of know-how</strong>: With regards to eco-driving, drivers tend to have an idea of what driving behaviours are more fuel-efficient but many are not entirely clear about what really works. Partly this is a reflection of mixed results from the academic literature, and partly also a lack of training and communication to new and existing drivers.</td>
<td><strong>Salience of benefits</strong>: Our attention is drawn to that which is novel and seems personally relevant to us. Giving drivers personal feedback and a salient presentation on how much they saved can be effective to keep them engaged.</td>
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<td><strong>Intention-behaviour gap</strong>: Even if sincere motivations and intentions to drive more fuel-efficiently exist, behaviour may not follow. This gap is often observed in the environmental space and elsewhere due to a number of practical barriers (the hassle of eco-driving, the lack of proper feedback, and the lack of know-how) and psychological barriers (habit, emotions, forgetfulness, and cognitive overload).</td>
<td><strong>Social comparison &amp; gamification</strong>: We are social creatures, meaning that we tend to mimic those we identify with, and tend to compare ourselves to and conform with what those around us are doing. Moreover, we derive our motivation to engage with effortful tasks such as eco-driving from seeing progress and improvement in comparison to our own past behaviours but also to those around us. Providing feedback on personal progress and setting up competitions and league tables to allow for social comparisons have been found to be effective to promote engagement.</td>
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<td><strong>Hyperbolic future discounting</strong>: Related to making benefits salient, this concept describes our tendency to overweight benefits and costs incurred today at the expense of future cost and benefits. We are not good at associating current behaviours with their long-term consequences. To promote consistent and long-term eco-driving, it is therefore crucial to keep reminding drivers of cumulative and long-term benefits of consistent eco-driving.</td>
<td><strong>Sunk cost fallacy</strong>: It describes situations when our decisions today or in the future are influenced by costs we have incurred in the past. For instance, having already invested in a car should not have any bearing on decisions today how much you use the car. Often however, it may lead us to overuse the car because we have already ‘invested’ in it. So we might even use it for journeys where a train ticket would be cheaper than fuel-costs. This tendency can be harnessed to promote eco-driving, in the sense that if people are already overusing their cars, they should want to at least drive more fuel-efficiently.</td>
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### EXPLORE: Population segments to encourage the uptake of eco-driving styles

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<td>1 Cost-focused</td>
<td>This group tends to be lower income</td>
<td>Given their lower incomes, this group tends to be cost-focused and is more risk averse than other groups. Their risk aversion makes them followers rather than trend-setters, and that also translates into their driving styles. The way to motivate this group to apply eco-driving behaviours would be through encouraging eco-driving in salient other groups to shift the norm. This is similar with regards to pro-environmentalbehaviours. The willingness of this segment to be particularly pro-environmental would depend on others around them to be doing the same. Motivation of this segment is moderate in that they might lack intrinsic motivation to apply eco-driving but might respond to cost-based arguments depending on their personal situation with regards to income and fuel costs.</td>
<td>This lower income group will likely be drawn to cost-based arguments and framings of messages. Social norms are likely to be powerful tools to motivate this segment. League tables, social comparisons and competitions could be effective as well, as they not only make the cost-savings a gamified element but it also includes a social element, which is an important driver of this groups’ behaviour. Potential touchpoints: Employers could implement internal fuel-savings competitions. Insurance companies could also provide voluntary competition platforms and link these to monetary prizes.</td>
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<td>2 Experienced &amp; confident</td>
<td>This segment tends to be slightly older where most are above 40. Due to their age, they have held their license for along period and are experienced drivers. Many are employed full-time and therefore tend to drive during peak-hours as regular commuters.</td>
<td>This segment drives repetitive and familiar journeys, accumulate high annual mileages and frequently use the SRN Drivers are confident in their driving ability and tend to drive quite fast, especially on familiar routes. These drivers hate dense traffic, and care about the driving experience and arriving at their destination quickly much more than they care about the environmental impact of their behaviour. The motivation to apply eco-driving behaviours is fairly low for this group given their affinity for speed. Their high mileage and related cost-based arguments could positively impact their motivation. These drivers rank moderately high for opportunity to change because they are good drivers with lots of experience and the fact they drive commute and drive familiar routes frequently makes it easier to apply eco-driving techniques consistently. In turn, the fact they are experienced drivers also means they have ingrained habits determining their driving style, which are hard to change.</td>
<td>Eco-driving framed as a way to avoid congestion and delays might be well-received by this segment. Getting them to drive at a steady speed might be best communicated by linking it back to congestion. As these drivers log a high mileage, cost-based arguments could be attractive, too. Potential touchpoints: Insurance companies could potentially communicate cost-based arguments, and also provide voluntary competition platforms and link these to monetary prizes.</td>
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<td>3 Environmental advocates</td>
<td>This segment spans across many demographic variables but what makes them different to other segments is their high concern for the environment and their willingness to take responsibility and contribute to reducing pollution.</td>
<td>This segment is most likely of all to be interested in eco-driving training, and other tools that help them apply eco-driving. It would fit within their current lifestyles to adopt eco-driving behaviours to enhance the ‘feel good factor’ emerging from their perceived contribution to the environment. This group is also community-driven and enjoys being part of something ‘green’. They do not need to be convinced why eco-driving is important but they need to learn what it means in practice and to make it a habit that is applied consistently. Motivation is very high among this group, while opportunity could also be fairly high but would likely depend on individual characteristics such as access to training or technological devices such as telematics and eco-driving dashboards.</td>
<td>This group is likely to be receptive of most interventions given their inherent motivation to encourage eco-driving. For this group environmental benefits are important so environmental framings will likely work. Visual feedback communicating how much they save in emissions might be a salient framing. Potential touchpoints: Many of these households will likely be aware and engaged in other sustainable behaviours like recycling, installing insulation, energy-efficient appliances, etc. Environment focused magazines could therefore be a suitable touchpoint. Where other government communication around sustainable behaviours exist, a message about the potential of eco-driving could be included highlighting its effect on the environment and the potential to save on running costs.</td>
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## EXPLORE: Population segments to encourage the uptake of eco-driving styles

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<td>4 Fast &amp; furious</td>
<td>This segment is predominantly male. Drivers tend to be younger and mostly working full-time. The so-called &quot;affluent empty nesters&quot; as described in DIT’s segmentation would likely also fall within this category. These drivers typically log high mileages as they like to drive.</td>
<td>What stands out about this group is their tendency to speed, their affinity for cars and their lack of personal responsibility with regards to driving and pollution. This group cares about their image transmitted through when driving and their vehicle. While younger drivers in this segment might focus on what image their driving styles represent, while older and more affluent drivers will likely own larger and powerful vehicles. In both groups, drivers are unlikely to compromise on their image to save on fuel, and certainly not to reduce pollution. Motivation to apply eco-driving techniques is very low for this segment, while opportunity ranks quite a bit higher. These tend to be skilled drivers who could drive more fuel-efficiently if they wanted to.</td>
<td>This is probably the hardest segment to reach, and not likely to be encouraged by nudges and information campaigns. Real financial incentives through insurance premiums are likely necessary. This group might be receptive to messages about telematics and feedback technology that highlight the innovative aspect of these new technologies. League tables, gamification and lotteries could also be effective with this segment as these drivers are quite risk-prone and drawn to performance comparisons and are determined to maintain their image. <strong>Potential touchpoints:</strong> Car clubs and fairs offer platforms typically visited by car enthusiasts. This group is also the most likely to be speeding and putting themselves at risk. Eco-driving messages, while focused on cost-savings, could be communicated with a health and safety framing. Like for other segments, insurance companies could implement competitions and league tables.</td>
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<td>5 Diligent drivers</td>
<td>This segment is made up of more mature drivers, elderly couples, and more widely of mid–age employees. On average, this segment has a lower mileage and have held their licenses for a while.</td>
<td>These drivers are drawn to the idea of being environmentally friendly, but are reluctant to make major changes to their lifestyles. Given this segments’ average age, selling techniques that highlight the ease and convenience of eco-driving, would be arguments these drivers could possibly get behind. The direct benefits of eco-driving would need to be clear and tangible. On the other hand, this group is also conscious of the need and benefits for others that would come from eco-driving, and take these into account when making decisions. Typically, they are careful drivers, drive for necessity rather than for fun and would appreciate if others also followed the rules. Motivation to adopt eco-driving is moderately high as they understand the benefits and the responsibility individuals hold towards the greater good. Opportunity ranks lower as their ability to change habits and respond to training and feedback is likely more limited.</td>
<td>Haptic feedback devices, as well as easy-to-use dashboards might be useful forms of feedback that make eco-driving easier. Given these drivers age and long driving experience, training is less likely to be effective as habits will already be ingrained and with increasing age, habitual behaviours tend to be more difficult to change. Cost-based and environmental messages should be applied but are not likely to be sufficient on their own. <strong>Potential touchpoints:</strong> These drivers tend to be attached to their communities, and care to get others around to follow the rules. A community-driven approach could be an effective platform for this segment.</td>
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<td>6 Inexperienced and new drivers</td>
<td>This group is characterised by drivers less confident in their driving abilities and who typically do not enjoy to drive. These can be either new drivers, those in training and also include older drivers and are skewed towards females.</td>
<td>These drivers tend to be ‘nervous’ drivers who are less experienced, tend to drive less an also use the SRN less than other segments. Given their lack of confidence, these drivers’ cognitive load might be taken up by focusing too much on individual driving elements to get them right. As a result, these drivers might be less able to put eco-driving behaviours into practice as they are still too ‘clumsy’ on the road. Their focus is on safety rather than fuel-efficiency. On the other hand, their low experience levels might present an opportunity in that they might not have fully-formed driving habits yet and can more easily respond to alternative instructions. Motivation of these drivers to adopt eco-driving might be neutral. They are neither keen nor against it. In terms of opportunity, it depends quite a lot whether it’s just a new driver who is inexperienced, in which case opportunity will grow over time as the driver becomes more confident, and can adopt eco-driving as the status quo driving style from the beginning. Drivers who are a bit more experienced but just do not like driving and are not the greatest performers, might demonstrate less opportunity to change over the long-run.</td>
<td>Training is the most promising intervention to teach new drivers the ‘right’ habits. Visual and haptic feedback would also be useful for inexperienced drivers, as it provides constant reminders of what to do, or to change. These should be tested with caution to make sure it doesn’t distract too much from traffic. Potential touchpoints: Driving lessons and schools are great points of intervention to communicate eco-driving skills from the outset.</td>
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<td>7 Fleet drivers and operators</td>
<td>Fleet drivers or operators</td>
<td>This group is not necessarily distinct in its driving style, though fleet drivers are professional drivers, likely to be experienced and steady drivers. Rather this group stands out due to the inherent incentive to minimise running costs. Spreading eco-driving behaviours among this group could have quite substantial impact on a company’s running costs. Fleets also present a nice opportunity to adopt eco-driving more formally, which might help bridge some drivers’ intention action gap, in that monitoring would be enforced stronger. Motivation for this group is likely very high, and so is opportunity as fleets present a good opportunity to mandate the installation of telematics and other behavioural interventions.</td>
<td>The use of telematics could be easily deployed in fleets and therefore enable gamified competitions, league tables and lotteries or other incentive structures to be put in place. Cost-based messages are likely to hit hard and should be made very salient. Potential touchpoints: Fleet operators themselves are a natural touchpoint. Insurance schemes could offer salient incentives to encourage operators to install the required technology and put competitions in place, for instance.</td>
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EXPLORE: Opportunity & motivation of segments to eco-drive

- High opportunity
- Low opportunity
- High motivation
- Low motivation

- Fast & furious
- Experienced & confident
- Diligent drivers
- Inexperienced & new drivers
- Fleet drivers & operators
- Cost-focused
- Environmental advocates
2c.

**EXPLORE:** Encouraging compliance with the national speed limit of 70mph
### Exploring: Behavioural drivers & barriers to increase compliance with 70mph limit

**Barriers**

**Illusory superiority:** This describes our tendency to believe we are better than average, for example at driving and that’s how many justify their speeding behaviour. Of course, mathematically this is impossible. This is a major risk with safe driving campaigns as many drivers will discount the risk. This suggests, campaigns around driving ability should focus on highlighting the risk others’ pose to safety rather than targeting the driver’s ability with the message.

While most people are conscientious drivers who may be susceptible to illusory superiority and may occasionally speed but don’t willingly put their own and others’ safety at risk, there is a segment that is driving for the thrill of it. These drivers are typically very overconfident in their driving abilities and almost consider it their right to drive faster than others because they are ‘better drivers’.

**The thrill of driving fast:** We often struggle to resist the temptation immediate gratification at the expense of longer term consequences. Speeding is an excellent example of this, where the thrill of driving fast even if just for half a mile is too strong to resist, despite the well-known associated risks.

**Multi-tasking & limited cognitive control:** Much like with eco-driving, sometimes it can be overwhelming to pay attention to too many things and information inflows and also process all these at once. If speed limits change often, the traffic is dense, or we are inexperienced drivers, we might not be able to handle driving smoothly and process the inflow of information fast enough to react adequately. In these instances, if speed limits change abruptly we may be slower to react, or if traffic is challenging we can find ourselves driving faster momentarily to accommodate others around us who might be speeding. This may be particularly common among inexperienced drivers.

**Emotions:** Similar as with eco-driving, emotions like anger, sadness or happiness influence our driving behaviour quite significantly if in a heightened state. Often we find ourselves absorbed with thoughts and generally less attentive if we are emotionally consumed by a recent event. These capture our attention, make us more susceptible to biases and to drive on ‘auto-pilot’ and leave less room to be attentive to things like eco-driving or speeding. Studies found positive correlations between drivers’ state of emotions and speed.

**Social norms.** It is perceived as normal (and thus acceptable) among many drivers to go slightly above the speed limit. Our behaviour is very much influenced by perceived descriptive norms (what most people appear to be doing) and injunctive norms (expectations of acceptable behaviour). There may therefore be a need to shift perceived norms in order to change the habits of every-day, normalised speeders who may not consider themselves as actively ‘speeding’ despite regularly going slightly over the limit.

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| **Social norms:** We like to be confirm with behaviours and attitudes of those around us, and we tend to mimic behaviours of those we relate to. Social norms have been used to good effect to increase compliance with actions we know we should be doing, but might not be doing because we believe, often falsely, that most people are not doing it either. We tend to overestimate the extent to which others around us engage in adverse behaviours such as drinking, speeding, using public transport without a ticket, etc. Correcting people’s perceived social norm to match the actual norm will likely encourage them to gravitate towards that new norm.

Motorways are susceptible to a more immediate from of social and physical influence, where the speed of those immediately driving around us will directly influence our speed, where we evaluate our speed relative to that of those around us on the motorway.

**Reciprocity:** It describes our tendency to reciprocate generous and kind gestures addressed towards us. For instance, by reducing the fine for drivers’ first-ever speeding offence and framing it as an act of generosity, drivers might take this into account when consciously speeding thereafter. Alternatively, fleet operators could offer to donate to charity in return for drivers’ demonstrating speed limit compliance.

**Framing:** Much like with eco-driving, the right framing of the consequences, reasons behind the policy and personal benefits of compliance is indispensable to promote engagement. As indicated among the barriers, most drivers think they are better drivers than the average, it might therefore be more effective to run a safety campaign highlighting the risk of speeding given others’ lack of experience, than suggesting the driver him/her self may be at risk to cause accidents.

**Built environment:** Attitudes and behaviours are not triggered in isolation from the world around us. Our environment has huge influences on our behaviour and our choices, this is meant in terms of how choices are framed but even more literally it means the built environment in which we act. In the US, for instance, car usage is heavily encouraged by the lack of sidewalks in certain areas where it would simply be dangerous to walk or cycle. Similarly, studies found the way roads are designed and lanes are painted can influence our speeding behaviour. Narrower lanes makes us slow down. The same is true for horizontal lines painted across lanes with decreasing distance between the lines.
## EXPLORE: Population segments to increase compliance with 70mph limit

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<td>1 Deliberate speeders</td>
<td>This group is predominantly male, more than 30% are under 24 years old and 28% are between 25 and 39 years old. These drivers log a higher mileage than the average driver.</td>
<td>This segment is characterised by its fast and reckless driving style. These drivers are likely to speed where possible, are confident in their driving abilities and don’t think they are a risk to others on the road. In general, they don’t consider speeding to be dangerous. These drivers are continuous risk-takers, and engage in dangerous overtaking, speeding, using other lanes to get ahead, etc. They are deliberate speeders, i.e. consequence ignorers so to speak that are unlikely to reduce their speed even once they’ve realised they are over the limit. Motivation to comply is very low for these drivers, as they love speed and drive for the thrill of it. Opportunity is potentially higher as these tend to be good drivers that could easily comply if they wanted to.</td>
<td>This segment is not likely to respond to messages just stating that speeding is risky. Rather, these drivers might be more inclined to be attracted to safety messages that state the correlation between speeding, crashing, and the severity of the damage. This way their abilities would not be questioned but the focus would be on the objective mechanisms behind speeding. These drivers will likely be opposed to stricter enforcement and on-road measures like lowering the speed limit to bring the average speeds driven down. As a young, male segment, these drivers might be favourable to technological interventions like telematics and haptic feedback devices making their actual speed more salient to them. Potential touchpoints: Online platforms and social media could be used to communicate these messages as they capture younger cohorts. Car clubs, and car magazines might also be good platforms to reach this group.</td>
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<td>2 New drivers</td>
<td>This group consists of new drivers, i.e. those that have recently (over the past year) received their license and are inexperienced. A large proportion of these drivers is likely to be quite young.</td>
<td>These drivers are characterised by their little experience driving, which might make them less confident and more hesitant drivers. Typically drivers with low confidence don’t tend to speed intentionally, they might however as a result of being intimidated by cars approach fast from behind, for instance. They are also inexperienced with regards to hazard detection and prediction of others’ driving behaviour. Motivation to comply is high as beginners typically want to ‘get it right’ as they start driving independently. Opportunity however, will not be that high as new drivers might struggle to be fully in control of their driving.</td>
<td>Interventions that aim at getting new drivers to commit and pledge to be responsible drivers that do not speed could potentially be effective. One idea could be to get them to sign such a commitment the day they obtain their license. Potential touchpoints: Driving trainers and schools are good messengers and platforms as practically every new drivers is in touch with them.</td>
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<td>3 Chauffeurs</td>
<td>Drivers fall into this segment if they are driving with other people in the car.</td>
<td>Drivers in this segment are expected to adjust their driving style in response to having passengers in the car. Studies suggest that often passengers have a slowing effect on speed, in particular if these are children or parents. Having peers as passengers has been shown to have the opposite effect and encourage speeding, especially among young male drivers – these should be the focus of a ‘chauffeur’ intervention. Motivation of speeding chauffeurs to stick with the speed limit is probably fairly high as they bear the responsibility for their passengers. Opportunity is moderate though reasonably high given that these drivers don’t tend to be notorious speeders when driving alone, and therefore have demonstrated to be able to comply.</td>
<td>Interventions could perhaps focus on evoking a sense of responsibility for passengers’ safety, e.g. “Speeding risks your passengers’ lives”. These signs could be put up in combination with 70mph signs indicating the speed limit along the SRN. Potential touchpoints: Dashboards in cars could light up with a message focused on passenger safety as soon as someone uses seat belts other than that of the driver seat.</td>
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### EXPLORE: Population segments to increase compliance with 70mph limit

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<td>4 Reactive drivers</td>
<td>The only key observable variables here is that there seems to be a slight tendency for these drivers to be female.</td>
<td>Reactive drivers are often in a hurry and tend to take increased risks when running late, like speeding or using other lanes to get ahead. Typically, reactive drivers are those that tend to speed as a result of a heightened emotional state such as anger, annoyance or irritation. In other words, reactive drivers adopt their driving when they are under pressure, emotional or time-wise. In a heightened emotional state, these drivers may also become inattentive drivers. Motivation of these drivers to comply is likely to be high as they don’t speed deliberately rather their cognition process behaves like on ‘auto-pilot’. Opportunity to be high as this is not a question of changing attitudes but rather finding the right intervention to interrupt the cognitive ‘auto-pilot’.</td>
<td>Intervention should aim to be as salient as possible to interrupt drivers’ ‘auto-pilot’ cognitive state and make them aware that they are in fact speeding. Prompts should reach these reactive drivers while they are driving so they can immediately adjust their behaviour. A letter or fine arriving after they’ve completed the trip might be too late and feel detached as these drivers don’t typically speed, and in fact, might not notice when they are speeding. Dashboard or mobile app prompts when your speed goes above 70mph could be effective. Potential touchpoints: It’s important to nudge and alert these drivers while they are speeding. Touchpoints therefore would be things like vehicle technology, apps, or radio alerts.</td>
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<td>5 Normalised speeders &amp; lapsers.</td>
<td>Most drivers occasionally or regularly speed, either unintentionally (lapses in attention) or following perceived norms.</td>
<td>The majority of drivers often go slightly above the speed limit, due to a combination of unintentional lapses of attention, and reflecting the perceived normality and acceptability of speeding a little. Perceiving a 70mph limit to be more of a guideline, with margins of acceptability either side, many people reflect this perceived norm in their driving and will happily drive at 75mph without considering it to be ‘speeding’. This is not accidental speeding, in the strictest sense, but is unlikely to be considered deliberate speeding on their own terms. Relatedly, many speeders will occasionally go over the limit due to inattentiveness. Driving is largely an automatic behaviour, and absent-mindedness causes us to ‘go with the flow’ of the road and the traffic, easily slipping above the limit without acknowledging our speed.</td>
<td>Continuous reminders and prompts, or changes to the choice architecture in order to overcome inattentiveness may be effective for inattentive lapsers. These may take the form of salient speed limit signs, or dashboard prompts. Road markings can also increase attentiveness, or impact a greater feeling of speed (e.g. chevrons, or narrower lane markings). Given the important of perceived norms (i.e. we tend to perceive the act of going slightly over the limit as normal and acceptable), norm-based messaging may be effective. These may be descriptive norms to update our perceptions of what normal behaviour is (along the lines of ‘the majority of people don’t go over the limit), or injunctive norms inferring what ought to be done (e.g. ‘70mph is a limit, not a target’). Potential touchpoints: Since the majority of drivers fall into this category, and the relatively unthinking nature of their behaviour, prompts and messages must be timely and ‘in the moment’. On-road signage is therefore most appropriate.</td>
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<td>6 Well-calibrated speeders</td>
<td>This segment tends to be more male and mid-aged.</td>
<td>These drivers are “calculated risk takers” who take risks when it is ‘safe’ to do so. For example, these drivers tend to be of the opinion that 30mph should be 40mph, and they switch lanes quite commonly under normal conditions, and also when they are in a hurry. This group is also likely to engage in situational speeding, for instance at night when roads are empty and perceived risk is low. Motivation to comply with speed limits is therefore fairly low as this groups’ speeding is deliberate and drivers are confident in their ability to speed and be safe. Opportunity for change might be moderately stronger as these typically drivers in control of their cars and the situation and could comply if they wanted to.</td>
<td>One study found that these drivers dislike speed bumps as it limits their freedom in deciding for themselves if they consider a situation safe to speed. In turn, they are more favourable towards technological solutions like cruise control or telematics. Insurers could provide discounts for those who are willing to adopt and use these technologies. They are confident drivers and also would like to display the image of being a good driver. Linking speeding to insurance premiums by framing speeding in terms of bad and risky driving habits might be effective with these drivers. Potential touchpoints: Insurance premiums could be a potential lever. As this group is mid-aged, most are likely to work full-time, hence employers could be another potential touchpoint.</td>
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EXPLORE: Opportunity and motivation of segments for compliance with 70mph limit

- Well-calibrated speeders
- Chauffeurs
- Normalised speeders & lapsers
- New drivers
- Reactive drivers

Low motivation

High motivation

Low opportunity

High opportunity
EXPLORE: Increasing public awareness of and engagement with on- & off-road measures
**EXPLORE:** Behavioural drivers & barriers to public acceptance of on-road and off-road measures

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<td><strong>Tragedy of the commons and collective action:</strong> It describes a situation where self-interest prevails over the common good, resulting in the depletion of a resource and destroys the benefits of it for the whole community of of users. This is commonly ascribed to environmental goods such as a common stock of land, or even clean air. The tragedy arises because individual incentives and societal incentives are misaligned. Vehicle emissions as well as speeding and using busy roads are individual behaviours with societal impact, and if individual use is exaggerated it will harm everybody. The key to overcome the tragedy of the commons is to encourage collaboration. This can however be challenging in the face of self-interest, particularly if the benefits of behaving in an egoistic manner can easily be exploited and societal consequences are not immediate and intangible (invisible). This is the case for speeding which impacts not only road safety but also causes congestion if done in large numbers, and of course, also for air quality more generally. People often will object policy change in first instance because they don’t understand the new policy fully and also because they don’t understand its benefits and the need for change. Making their individual-level incentive to support the new measure really clear using different framings to reach the target group is indispensable for public consent.</td>
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<td><strong>Status quo bias:</strong> We tend to go with the flow of defaults, stick with existing options, and not make changes. This is often fuelled by uncertainty and risk aversion. We have a tendency to fear what’s new and where consequences are unknown. Policy changes and changes to our built environments will require people to make changes and possibly adapt their habits (for example if the new speed limit were to be set at 60mph). Public surveys and polls give people an opportunity to intervene and prevent a policy change they don’t like, or which they anticipate to require effortful adjustments. By virtue, therefore opinion polls give people an opportunity to preserve the status quo.</td>
<td><strong>Awareness of the air quality issues:</strong> While a lack of awareness and understanding will be a barrier, deep awareness and understanding for air quality issues and the need for intervention will be drivers of public acceptance and engagement.</td>
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<td><strong>Salience of benefits:</strong> We are drawn to information that is personal and novel. Related to the above, making the benefits of planned policy measures relevant to people on a personal level, and especially targeted at those most impacted, or most likely to object is key to engage the community and win their consent. In other words, harnessing self-interest to benefit from potential consequences of the new policy can be a good way to increase consent.</td>
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<td><strong>Reciprocity:</strong> We tend to reciprocate generous and kind gestures addressed towards us, meaning we are more likely to contribute to a public good if everyone else is, too. It harnesses the feeling of indebtedness, where we feel obliged to pay back favours. Local authorities could harness this by investing in something for the community while planning a more restrictive and unpopular change. For instance, free masks could be distributed, or new public parks built and trees planted while a public campaign for roadside barriers or lower speed limits is set up. This would not only create a sense of reciprocity but also increase salience of the severity of the issue.</td>
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<td><strong>Community engagement:</strong> To avoid the impression that communities are being engaged as an afterthought or because they must be, early engagement of communities in policy planning can be a powerful tool to prevent NIMBYism (not-in-my-backyard). Genuine engagement should is important to give individuals a sense of agency and influence over both process and outcomes.</td>
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<td><strong>Retrospective approval:</strong> Behaviour change models suggest that often changes in attitudes only occur after changes in behaviour. This may be for a number of reasons, including the fact that our own behaviours and experiences inform our beliefs and attitudes. Trends of public support of the London congestion charge are a good example for this.</td>
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<td><strong>Conditional &amp; collective incentives:</strong> Providing conditional and/ or collective incentives can be effective to encourage collective action and prevent a tragedy of the commons situation. For instance, encouraging neighbourhoods to car-pool through financial incentives or fuel vouchers could be effective to reduce car use. Non-monetary incentives can also be effective. For instance, a drawing competition could be set up in a neighbourhood where the construction of a roadside barrier is planned, where the winning team can assist picking the art work to be painted onto the barrier.</td>
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### EXPLORATION: Population segments to increasing public acceptance of on-road & off-road measures

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<td><strong>1</strong> Preoccupied</td>
<td>Mid-age range, employed, have children</td>
<td>This segment is characterised by their busy lifestyles, which prevents them from being more engaged with political issues and activist forums. This group is not likely to object and support hard-line activists. They believe in climate change and its anthropogenic origins, for instance and not inclined to object measures addressing that issue, or environmental issues more generally. This group feels unable to contribute and act because at this point in their lives they have other priorities, mostly work and children. This group will be conscious they should contribute to reducing pollution but are very susceptible to barriers like cognitive overload, forgetfulness and friction costs. In terms of motivation, this group is likely to be supportive of policy measures to improve air quality but it would depend to what extent the new measure would require effortful adjustments, which would be a barrier for this group due to their busy lifestyles. Given that these people will agree and understand the need for intervention, opportunity to change their attitudes is reasonably high.</td>
<td>In terms of interventions, this group is quite disengaged, meaning that messages need to be made very salient, personalised and impactful so as to attract the attention of this busy segment. Many of these people have families and as parents, are likely to be receptive to framings focusing on the adverse health effects of emissions on their own or their children’s health, such as framing the damage to our lungs due to air pollution in number of cigarettes causing equivalent harm. Interventions that aim at smoothing traffic for instance, could be promoted by highlighting their time saving component, or the increase in travel comfort due to less congestion. Potential touchpoints: This group is hard to reach as they are likely to be somewhat disengaged. Their children or their work might be good touchpoints to capture their attention.</td>
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<td><strong>2</strong> Supporters</td>
<td>Young and mid-age range, more female, average and above average education level</td>
<td>This segment is prepared to take action as they believe that small actions by many will make an impact. Their sense of fairness and equality is big, and so they believe everyone should contribute and do ‘their bit’. This group is forward-looking, and also concerned about the future of their children. In general, this group is open to a wider range of behaviour change initiatives, including more effortful changes like walking or cycling more. This group is highly motivated, and captures many opportunities for change.</td>
<td>This group is easier to reach. Unlike many other segments, for these people classic outreach and awareness campaigns might be sufficient. Highlighting the benefits of collective action, or in turn, the adverse consequences of self-interested behaviour will strongly resonate with this segment. Reciprocity framings or interventions, like community days where local authorities invest in free goodies or amenities will likely also win over this segment. Potential touchpoints: As this segment is likely to already be engaged and active in some form, local community centres might be good touchpoints. Local activist groups, NGOs or non-for-profits might also capture some of these people.</td>
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# EXPLORE: Population segments to increasing public acceptance of on-road & off-road measures

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<td>3 Environmental sceptics &amp; car devotees</td>
<td>Older, conservative, higher income, from suburban or rural areas</td>
<td>These people are sceptics in every sense of the word. They are likely to be sceptical of the anthropogenic origins of climate change, as well as the sudden need to reduce vehicle emissions. They are also likely to be reluctant to heavy interventionist policy measures like lower speed limits and roadside barriers. Others in this group might be less sceptic about environmental issues but are fundamentalist when it comes to driving. They love their cars, their freedom whilst driving and would strongly oppose most on-road measures. Motivations to public acceptance are low for this group as they don’t believe in the cause, so are the opportunities to change their attitudes as they are suspicious of government and activist groups as messengers.</td>
<td>In terms of interventions, this group is hard to reach and should probably not be the target group for a classic social marketing campaign. The goal for this group, is not to get them on board but to keep them from vehemently objecting. As they are suspicious of government, environmental scientists and activist groups, the messenger for this group could for instance be Public Health England or the NHS. The focus should then be on their own individual health attempting to harness self-interest, which is likely to be strong among this segment. Deliberative forums would be a clever, non-invasive way to encourage engagement among this group, and provide participants with agency and a voice to shape the debate. Being in discussion with many other participants who hold different views might influence even these sceptics. Potential touchpoints: If Public Health England or the Chief Medical Officer are used as the messenger, GP surgeries or other NHS outlets could be used as touchpoints.</td>
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<td>4 Disengaged</td>
<td>Urban, no car ownership, don’t live in immediate surroundings of motorways</td>
<td>This is a group of people that is disengaged from the local discussion around on-road and off-road policy measures. Most people in this group are disengaged because they are likely not at all, or only marginally impacted by the planned changes. In the case of roadside barriers, these people might live far away from the motorway, only occasionally use the motorway and don’t feel like roadside barrier would have much impact on their lives. In the case of on-road measures, these are people that don’t drive regularly and/or don’t have a car, but rather use alternative modes of transport. Consequently, they would only marginally be impacted by on-road measures and are therefore unlikely to get engaged in the discussion. Motivations to accept such policy measures is quite high given these people don’t have much at stake in the debate. Opportunities to change their attitude are rather low as this group has little stake in the game and is thus disengaged from the discussion.</td>
<td>To reach this group is not easy because they are disengaged and uninterested. This is not a major issue however, given that these people are unlikely to object even to major on- or off-road policy measures. To drive engagement among this segment, conditional incentive and reward schemes could be set up. Those who adequately fill in a survey, or who can demonstrate participation in communal discussions and events will be entered into a lottery or receive a small cash subsidy. Potential touchpoints: As this segment consists of people who use alternative modes of transport to private vehicles, public transport providers might be effective touchpoints.</td>
</tr>
</tbody>
</table>
## EXPLORE: Population segments to increasing public acceptance of on-road & off-road measures

<table>
<thead>
<tr>
<th>Segments</th>
<th>Observable variables</th>
<th>Segment characteristics</th>
<th>Implications for interventions</th>
</tr>
</thead>
</table>
| 5        | Aspirational                          | Young, urban, average or above average level of education                                                                                                                                                                                      | This segment consists of young drivers, young professionals and students who tend to know a fair bit about air quality as well as their own contribution and agree with the overall agenda to implement certain measures.  
However, due to their young age and inexperienced driving style, these people are not likely to have formed strong opinions regarding on-or off-road measures yet, but holds strong potential to become engaged and to form supportive opinions. These will be a few among them who act like car addicts and may oppose restrictive measures, but that is more likely to be a minority.  
On average, motivations to accept are moderately high because they understand the motives behind such policy measures. But it’s not as high as among supporters, for example. Simply due to their lack of experience and less ingrained opinions on measures that impact their driving experience.  
Opportunity for change in attitude is exceptionally high among this young cohort mostly due to their age, less ingrained attitudes and the fact that they are the ones to bear the consequences of today's generation inaction. | Given the young age of this cohort, messages around the long-term benefits of the policies in questions should be highlighted. Alternatively, the flipside, i.e. the long-term consequences of inaction could be framed as a strong call to action.  
Deliberative forums would be a good platform to capture the voice of this young population group. These could be set-up more regularly to foster political engagement on the whole among this, often described as, apolitical cohort.  
**Touchpoints:** Universities and vocational schools will be effective touchpoints. Campaigns should focus their distribution on social media.                                                                                                                                                                           |
EXPLORE: Opportunity and motivation of segments to increase public acceptance & engagement
3. SOLUTION: Intervention ideas

(See Report 1 for further detail on all behavioural insights referenced in this section)
**SOLUTION:** Creating a longlist of intervention ideas and prioritising

Generating and scoring solution ideas

A range of resources were used to develop behaviourally-informed intervention ideas. For this project ideas draw heavily on the behavioural science literature detailed at length in Report 1 (summarised in Appendices A and B of this report). Inspiration is taken from interventions which have been shown to work in the transport literature, as well as those from other contexts, in particular where the underlying behavioural characteristics of the problem are similar (for example, from public health and from pro-environmental interventions). A deep understanding of core psychological and behavioural-economic principles (also summarised in Report 1) aid the formation of novel and untested intervention ideas. 12 expert interviews, undertaken during the preparation of report 1, also contributed to the longlist of ideas. The full longlist of intervention ideas is included in Appendix C.

Each idea has been scored on the following metrics:

**Impact on behaviour:** the likely impact of the intervention on the behaviour of interest. This judgment is based on the existing literature (reviewed in Report 1) and BIT’s expertise in designing and evaluating behavioural interventions. Each intervention idea is scored from 1 (very low impact) to 5 (very high impact).

**Impact on air quality:** the impact of the behaviour in question on air quality, accounting for both the extent to which a given behaviour causes air pollution, and the size of the target population to whom the behaviour and intervention are relevant. Each intervention is scored from 1 (very low impact on air quality) to 5 (very high impact).

**Feasibility of delivery of the intervention:** the ease with which the intervention could be implemented. This score takes into account the complexity of the intervention, the likelihood of political or public resistance, and the extent to which third parties (e.g. retailers, central government, manufacturers) might need to be involved for delivery to be successful. Each intervention is scored from 1 (very challenging for Highways England to implement) to 5 (a quick-win for Highways England to implement).

**Cost of delivery of the intervention:** a crude measure from very low to very high based on our best estimate, accounting for material costs (e.g. physical infrastructure, funding for incentives) and running costs (e.g. for ongoing enforcement or management). Each intervention is scored from 1 (very expensive) to 5 (very economical).

**Timescale of impact:** the rapidity with which impact might be expected, accounting both for the timescale of intervention development and delivery and the timescale over which behaviour change might emerge after the intervention is delivered. Each intervention idea is scored from 1 (very slow impact) to 5 (very quick impact).

**Originality:** Highways England are keen to trial interventions which have not been trialled before, or which mark a departure from ‘standard thinking’ about air quality interventions. This score is an approximate measure of how ‘novel’ the intervention is, based on the extent to which similar interventions (don’t) arise in the existing literature, and the extent to which they draw upon behavioural insights in innovative ways. Each intervention idea is scored from 1 (not at all original) to 5 (highly original and/or drawing heavily upon behavioural insights novel to the context of air quality).

Based on the scoring system outlined above, and with particular focus on interventions which Highways England are able to deliver in the short-to-medium term, Highways England have selected four ideas to take forward to potential implementation:

- An eco-driving app, akin to a ‘FitBit for your car’, providing feedback, gamification and other behavioural nudges to promote eco-driving styles.
- Speed compliance prompts on smart motorway signs, with several variants to be tested including simple ‘70’ signs, social norms, and warnings of consequence.
- Bumper stickers on EVs and low-emission ICEs to increase awareness and perceived normality/familiarity. Optionally, these could be combined with incentives such as parking privileges.
- A campaign based around the emotion of disgust, and framing air quality in terms of health impacts and equivalent cigarettes smoked, to increase public engagement and consent towards air-quality interventions.

A long-list of all 67 intervention ideas is included in Appendix C, and their scores in Appendix D.
3a. SOLUTION 1: Eco-driving app
**SOLUTION:** Proposed intervention 1: Eco-driving app

Intervention design 1 – eco-driving app.

The first intervention proposed to be tested is a smartphones app designed to promote eco-driving styles. The app is broadly based on the idea of a ‘FitBit for your car’, motivating eco-driving styles in order to save users money, and employing data analytics in conjunction with nudges such as elements of gamification, targets and goal-setting, competitions, social comparisons and incentives. Target behaviours include less car use, lower speeds, reduced idling, lower revs, and more consistent speeds.

The app would be strengthened through partnerships with insurance providers who are in a position to incentivise good behaviour (on the basis that eco-driving styles overlap greatly with safe driving styles, and taking fewer unnecessary short trips also reduces accident risk). This is akin to incentives provided by health insurers and employers on the basis of FitBit users’ physical activity. We also propose partnerships with fuel retailers including large supermarkets, who are in a position to incentivise the purchase of fuel through the app, as a way of getting fuel consumption data into the app, and providing more salient incentives for the money-saving features of the app.

At a minimum the app would draw on GPS and accelerometer data from the smartphone (from which speed, acceleration and distance can be inferred, albeit imperfectly), in addition to user-provided information on the make and model of vehicle. The capabilities of the app would be greatly expanded if it could also draw on fuel consumption data, and odometer readings via one of three possible sources. This data may be obtained from the users, prompted to provide fuel purchase data and odometer readings semi-regularly (e.g. by submitting a photo). However this would be prone to error, and so other sources of data would be preferable. Having users purchase fuel through the app itself would help ensure reliable data (either incentivised by a small discount, or self-motivated by the fact that the app is designed for the purpose of tracking expenditure). A better source of data would be from the On-Board Diagnostics (OBD) port found in all vehicles sold in the UK since 2003. This is able to provide various useful metrics such as real-time speeds (giving more accurate acceleration data than the GPS), fuel level, and engine status. This approach would be preferable due to the richness and reliability of data and so the recommendation is that the product is an app combined with a hardware device to connect the OBD wirelessly to the phone. Economical hardware solutions already exist, albeit unforeseen technical challenges may arise.

**Key behavioural features of the eco-driving app**

The app is to include a number of behavioural games and features in order to promote eco-driving styles and promote less driving. These include the following:

**Incentives**

- Partnerships with insurance providers who are willing to base their premiums on driving style, and small discounts on fuel bought through the app as a way to capture fuel consumption data.
- In addition to discounts on premiums, a range of smaller incentives are feasible in response to specific behaviours. For example, some health insurers provide free cinema tickets in return for meeting certain weekly exercise and health targets. This could be replicated in return for not driving for a journey less than 3 km in a week, or not going over the speed limit for a period of time.
- Lotteries have been shown in many contexts to be more effective than fixed payments of equivalent face value (particularly where those fixed payments are small), and as such entry into a prize draw (funded by insurers) in return for meeting weekly targets may be more effective than receiving guaranteed micro-payments.
- More ambitiously, it is possible that those demonstrating good driving styles receive discounts when entering low-emissions zones, or discounts on vehicle tax. This may be justified on the basis that these payments are linked to emissions standards, and true emissions levels depend on driving style (and miles driven) as much as they do on vehicle specification.
- Savings targets may be turned into pro-social incentives, which may be more motivating for some users. For example, with a weekly fuel budget of £40, any money left in this pot is automatically given to a charity of choice. The ‘signalling-value’ of this act may be strengthened by (automatically) posting on social media the amount donated. This also harnesses ‘mental accounting’ since the budgeted money (£40) is ‘spent’ regardless, and thus users are able to do something good and donate to charity without incurring any additional costs.
SOLUTION: Proposed intervention 1: Eco-driving app

Incentives could be augmented with visual cues or progress towards goals, for example some hybrid cars show a tree which grows when you save on petrol.

**Behavioural insight – lotteries**
We tend to over-estimate small probabilities, and focus on the size of the prize. This means a chance of winning a large sum can be more motivating that a guaranteed small sum of ‘equivalent’ value.

Lotteries have been used in many contexts to incentivise behaviour. For example, in China the rate of tax avoidance was reduced by using lotteries: retailers were prone to avoid tax by not registering sales. It was mandated that state lottery tickets were included on the back of sales receipts (delivered through tamper-proof receipt machines). Consumers now asked for a receipt, making it very difficult for retailer to not register the sale. The key insight is that the face value of the lottery ticket was extremely low (due to the very low odds of winning), however we tend to focus more on the size of the prize and over-estimate our chance of winning. We also get utility directly from the ‘hope’ – in other words the ticket is worth more to us than the true value.

**Framing**
The manner in which the app presents information and targets can draw upon a range of behavioural insights.

- For example, ‘loss aversion’ may be harnessed by framing fuel in the tank as a pot of money which is drawing down. This could also be shown in terms of the amount left on the weekly fuel target, rather than just the amount left in the tank. As the remaining money draws down, we would expect increasing efforts to conserve fuel in order to hit the target.
- We suggest testing a range of incentive framings to identify which are most impactful – for example it is plausible that small weekly ‘cash-back’ payments in return for meeting weekly targets may be more impactful than a discount on the annual insurance premium.
- ‘Endowed progress’ might be harnessed by showing targets as being partially met to incentivise effort to complete them.

**Behavioural insight – loss aversion**
We are more sensitive to losses than to equivalent gains, such that the prospect of losing £100 is generally more motivating than the prospect of gaining £100.

For example, teachers incentivised for performance (based on student outcomes) were more likely to improve performance when given the reward upfront, which they would then lose if not meeting their targets (as opposed to the conventional approach of paying the reward if targets are met). Energy consumption feedback through in-home displays has also been shown to be more effective when framed as a loss, showing credit ‘running down as though cash was flowing out of the consumer’s pocket’.

**Behavioural insight – endowed progress**
We are more likely to make effort to complete a task if we have already made some progress towards it. For example, loyalty ‘stamp cards’ (e.g. from coffee shops) which have 10 spaces, and 2 pre-filled, lead to greater sales than those with 8 empty spaces: in both cases 8 more coffees must be bought, but in the former, we feel like we have been given 20% progress.

**Targets, goal-setting, and gamification**
Targets can be self-motivating and somewhat addictive. Mirroring the ubiquitous 10k steps target with FitBit, a range of driving behaviour targets can be set:

- Targets may be based around miles driven, or short-journeys not taken, for example aiming to maximise the number of days over which a journey less than 2km has not been driven (“I’ve been clean for 22 days”). There is a risk that this encourages longer journeys (and hence, evaluation is critical).
- A more sophisticated approach to goal-setting is to set ‘implementation intentions’ (‘if, then’ plans) to help them develop strategies and plans for achieving certain monthly or annual savings. This would be augmented with simple tools for estimating savings made from certain behaviours and changes to driving style.
- Money-saving targets would be one of the major selling-points of the app. For example, having weekly or monthly fuel expenditure targets, which are personalised (input from the user, or generated automatically based on analysis of prior fuel usage).
SOLUTION: Proposed intervention 1: Eco-driving app

- Money-saving targets can be made more motivating by associating them with savings goals, for example setting a weekly target of £40, any amount below that can be hypothecated into a ‘savings pot’ which gradually increases with the goal of, say, paying for a holiday. The saved money could be automatically hypothecated into a nominated account, since fuel would be purchased through the app.

**Behavioural insight – gamification**
Adding fun, competitive, addictive or chance/skill elements such as competitions, targets which stretch users’ goals, and small rewards in recognition of achievements, can increase engagement. For example, in Singapore, a 7.5% reduction in peak-time travel on the metro was achieved through the use of novel incentives and gamification: points were awarded for non-peak travel, and these points could either be cashed-in for a small discount on tickets, or ‘played’ on an online gaming platform to win much larger prizes. The vast majority opted to play the games.

**Behavioural insights – goal-setting**
We are more likely to achieve something if we have a specific goal. Where targets are ambiguous, we tend to fudge our success and cut corners. We also gain more satisfaction from completing discrete objectives, e.g. completing 10,000 steps on the fit-bit feels qualitatively different to completing 9,999 steps.

**Behavioural insight – implementation intentions**
We are more likely to achieve our goals when we have pre-set ‘if, then’ plans to overcome potential obstacles. For example, women who were prompted (during a health survey) to decide exactly where and when they would conduct a breast self-examination were 4.5 times more likely to have done it one a month later.

**Social nudges**
- One of the motivating features of technologies like FitBit and Strava is users’ ability to share their achievements on social media. This should be incorporated into this app.
- Other nudges harnessing social influence include simple norm messages, such as “9 out of 10 people saved £x this week. Don’t miss out on saving money,” or targeting those who have made least improvement with messages such as “90% of users have saved more than you. Here’s a few tips to increase your savings”.

- Competitions between users, or league tables, also harness norms and gamification to good effect.

**Behavioural insight – social influence**
Our beliefs and actions are hugely influenced by those of our peers. Simply telling people what most people do is an effective way to encourage certain behaviours, and we are particularly influenced by people ‘like us’.

**Behavioural insight – Social norms**
We conform to norms, both because we feel the need to ‘fit in’ (peer pressure, social expectation), and because we infer the correct/appropriate/best thing to do from the actions and beliefs of others. Smoking, risk-taking, laughter, court judgements, wine preferences, music preferences, obesity, crime and many other aspects of our lives are social to conformity and social influence through norms. Simply telling people what most people do is an effective way to encourage certain behaviours, and we are particularly influenced by people ‘like us’. For example, millions in UK tax revenue was brought forward by including the sentence “9 out of 10 people pay their tax on time” on tax reminder letters. Similar effects have also been achieved to increase the re-use of hotel towels (the message “most guests in this hotel re-use their towels” was significantly more effective than a pro-environmental message imploring guests to reuse their towel).

**Behavioural insight – Social comparisons**
Our tendency to conform to norms means we are influenced by comparison to our peers. Social comparisons have been used to reduce energy consumption: A US company called OPower uses social norms and comparisons on utility bills. People see how much they have consumed in comparison to the average and more efficient neighbours (a descriptive norm). In addition, a smiling or frowning face will indicate whether their consumption is socially desirable or not (injunctive norm). 2-3% energy reductions are achieved over the long-term. The BIT used a similar technique to reduce the over-prescription of antibiotics: targeting the top 20% of antibiotic prescribers with the message “80% of GPs in your area prescribe fewer antibiotics per head than yours”, and providing some simple advice on what a GP can do instead of prescribing antibiotics, resulted in a 3.3% reduction in antibiotic prescriptions, orders of magnitude more effective than a conventional awareness campaign.

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SOLUTION: Proposed intervention 1: Eco-driving app

Timely prompts, feedback, and tip

• Users who are motivated to meet targets may opt to have alerts and prompts to help them meet those targets. Real-time prompts would act as basic telematics feedback, for example the app may notify them if they creep above the speed limit, or upon hard acceleration.
• Other timely prompts may occur when, for example, buying petrol (giving a new tip on how to save fuel and reduce emissions), and through MOT tests and tax-renewals.

Behavioural insight – timely moments and prompts
We are more likely to take actions at certain points in time – when prompts are more relevant and salient, when our habits are naturally disrupted anyway, or when change is more convenient. Prompts or reminders are therefore particularly effective at these moments. For example, those who had just moved home were more likely to join a cycle scheme in response to an information campaign, and the number of people undertaking diabetes tests was significantly increased in Qatar, by setting up clinics outside mosques during Ramadan – a period of fasting, addressing the inconvenience of needing to fast for several hours before taking the (most available and cost effective) diabetes test.

Population segmentation: targeting and tailoring the app

The app is well suited to, and can be readily tailored towards, many of the driver segments identified in section 5b of this report. The nature of the app means features can be designed as bespoke to certain demographic segments, provided sufficient information is collected form users through which to target these features. Features may also be self-selectable to help users adopt the most appealing version of the app.

For example, a specific features of the app may be tailored to fleet drivers. These might include peer comparisons with colleagues or competitor companies, rather than with friends or strangers (as would be the case for mainstream users). There may also be an employer feature through which fleet operators or employers have access to their employees’ or drivers’ data such that they can manage their fleet more efficiently. Indeed this may represent an attractive business case and justify the development of a higher cost (or subscription) professional version of the app.

Other population segments also imply bespoke features. For example, ‘environmental advocates’ may respond best to messages framed in environmental terms, while ‘cost focussed’ drivers are more likely to be motivated by the potential for cost savings. Targeting this later group with insurance savings or petrol savings is therefore likely to be most effective. Given that the potential for cost savings is one of the key features of the app, there may be merit in marketing the app heavily towards this group.

‘New drivers’ may also deserve close attention in order to maximise impact. Here there may be merit in encouraging the kinds of behaviours and actions which lead to ingrained habits such that their future driving style is cemented as eco-friendly. For example, through GPS data the app is able to identify new drivers’ first trip on the motorway, and provide tips (and set challenges) accordingly. A version of the app could also feasibly be developed for learner drivers, giving feedback on driving style and coaching the user towards good habits (marketed in the name of improving their odds of passing, but also cementing the habit of an eco-driving style). Naturally, care should be taken to not present new drivers with challenges which detract at all from safe driving.

All of this being said, it is not necessary to conjecture which features may best serve different population segments. It is recommended that when piloting the app and evaluating its impact (as outlined in section within the ‘Trial’ section of this report), demographic and attitudinal data is collected from trial participants. This will form the basis of segment (subgroup) analysis, identifying which features are most effective for which population segments. Moreover, this can be an ongoing process of testing and learning, with features constantly evolving, enabling the app to be continually enhanced and tailored to different groups of users.
**SOLUTION**: Proposed intervention 1: Eco-driving app

**Behavioural outcomes**
- Positive feedback loop - self-reinforcing nature of feedback and goal-achievement, increases motivation. Targets on app can also be updated to create ‘stretch goals’
- Motivated to meet targets & achieve goals
- Motivated to comply with norms (social proof)
- Motivated to save money (incentives)
- Eco-driving behaviours adopted (less revving, less fuel use, less idling etc.)
- Driving mileage reduced (regoing car for shorter trips)
- Engaged by game elements
- Motivation boosted by framing (e.g. less aversion and endorsed progress)
- Intentions more likely to be acted on (commitments and implementation intentions)
- Timely reminders and prompts encourage action

**Inputs**
- Hardware development / procurement
- App development (staff time & financial resources)
- Data protection protocols
- Marketing & sales capability (potentially through partnerships)
- Ongoing server support

**Activities**
- Partnerships with insurance providers (incentives on premiums)
- App & hardware marketed and sold
- Partnerships with petrol retailers (incentives for buying petrol through the app)
- Dedicated product for fleet operators also possible

**Outputs**
- Drivers adopt product
- Eco-driving styles become more common
- Improved air quality on DRN
- Money saved

**Impacts**

**Moderating factors by population segment**

- **Cost-focused.** This group is most cost-sensitive, and thus potentially highly receptive to the app, as well as likely to adopt it in the first place if the proposition is made sufficiently attractive through effective partnerships (e.g., with insurance premium discounts available and cheaper petrol if bought through the app). Information, goals, games and norms should all be framed around cost. This framing is likely to be particularly effective given the common tendency to under-estimate the costs of running a car (partly due to the dispersion of different costs such as fuel, maintenance, depreciation, tax etc.)

- **Experienced and confident.** Though potentially less motivated by cost and by environmental benefits, this group has certain advantages, namely higher than average driving skill meaning they may be able to adapt their driving style with relative cognitive ease (although this group may, conversely, have habits which are well ingrained). One potential framing worth testing is the vehicle-maintenance benefits of eco-driving.

- **Environmental advocates.** Most likely to be receptive to environmental framings and targets. May be particularly receptive to goals around reducing car use on short journeys, for instance. That said, cost-based targets are also worth testing as evidence shows environmental values, even among those who self-identify as ‘green’, are not always as strong as financial motivations. However, green feedback (e.g., ‘well done, you saved X kg of CO2 this week compared to last week, and saved £X’ will likely resonate with their pro-environmental identity and offer a ‘feel good factor’ to encourage continued use.

- **Fast and Furious.** Potentially least likely to change their driving behaviour for environmental reasons. Cost benefits may have some bearing, particularly on the less affluent of this group (e.g., younger drivers). Framing the app’s goals, challenges and targets around skill, for example with escalating ‘levels’ (akin to a game) and with competitive elements may be particularly effective for this group (e.g., targets around how high they can push their average mpg compared to their peers). Social norm elements would benefit from being linked to groups of known peers (e.g., through social medial, because comparisons to the general public are likely to be discounted as irrelevant and lack the same peer pressure.

Despite challenges associated with this group, adoption of the technology might be high since interest in vehicle tech may be high, especially if framed around performance monitoring and diagnostics.

**Diligent drivers.** Being on average older, and with lower mileage, the main challenge with this group might be uptake. Among the various potential motivations for uptake, insurance premium discounts (or being given it for free upon insurance renewal) may work well. These drivers may be quite ‘well behaved’ and thus receptive to injunctive (‘ought to’) norms and social comparisons.

**Inexperienced and new drivers.** A strong motivator exists with this group if tailored towards learning and increasing the odds of passing their test (with major benefits in driving safety also possible as a result). This is an important group to target as driving styles are easiest to change before ingrained habits are formed. Targeting the product at parents of new drivers as well as new drivers themselves may be effective, particularly if safety features are included (e.g., parents’ ability to monitor speed of their children’s driving – which in itself provides a major motivator for young drivers not to speed).

**Fleet operators and drivers.** A bespoke version of the product could be targeted at fleets. This could be a powerful way for operators to monitor their fleet performance and manage costs. Cost-framing are likely to be most attractive to operators, whilst peer comparisons (between employees) may be effective for the drivers. Having features which enable fleet operators to incentivise their drivers may also be powerful (e.g., drivers with the best mpg each week get prizes or commision).
3b. 

SOLUTION 2: Speed compliance prompts
**SOLUTION:** Proposed intervention 2: Smart motorway speed compliance prompts

**Intervention design 2 – speed compliance prompts.**

The second proposed intervention is a series of prompts delivered through electronic smart motorway signs designed to reduce the extent to which (and prevalence with which) drivers drive above 70mph. It is acknowledged that there can be a tendency for some people to drive slightly above the speed limit, but below the threshold for speeding fines on the SRN. However driving at these speeds can have a detrimental impact on air quality.

Most motorways do not have numeric speed limit signs. Wide roads and a lack of opposing traffic passing at close range are likely to lead to a faster comfortable driving speed, and most motorways do not have speed limit signs to prompt compliance. The hypothesis is therefore that drivers may be nudged to reduce their speed by simply making the speed limit more salient. This prompt can be combined with a number of behavioural insights through short messages on electronic signs.

A number of signs are proposed. The number of variations which can be tested depends on the statistical power and the number of smart motorway stretches available to use during the trial (discussed later). The following variations are recommended for consideration:

- **Control:** no sign
- **Observability/threat 1:** ‘70. Average speed cameras in operation’.
- **Observability/threat 2:** ‘70. We send fines to 4 drivers per minute’.
- **Simple prompt / salience & novelty:** ‘70’.
- **Social norm message:** ‘70. Most people don’t speed’, or ‘70. 95% are doing less’.
- **Injunctive norm /no tolerance:** ‘70. It’s a limit, not a suggestion.’ or, in-keeping with the phrasing on prior campaigns: ‘70. It’s a limit, not a target’.
- **Consequence:** ‘70. Speeding kills’ or ‘70. Speeders killed X people on this road last year’.
- **Cost:** ‘70. Speeding wastes fuel and money’.

**Key behavioural features of the speed compliance prompts**

The simplest proposed intervention is a ‘70’ sign to be used whenever the smart motorway signs are not displaying a lower speed limit. This acts as a reminder, and makes the speed limit more salient.

**Behavioural insight – salience, novelty, prompts and reminders**

Our attention is drawn to that which is made salient. Simple prompts and reminders are often effective at encouraging behaviours, particularly where we have no aversion to the behaviour but are distracted by habit or automatic behaviour. For example, some drivers may creep above 70mph because they don’t fully consider their speed but drive as the traffic flow permits, and speed is less perceptible on a wide, multi-lane road when it is relatively clear.

A ‘70’ sign is also quite a novelty on the motorway. Even though the speed limit is the national limit, the fact that a ‘70’ is being shown may imply some special reason that the limit is being enforced, or simply act as a reminder.

One of the key causes of modest speeding (fractionally over the limit) is that many drivers perceive it to be normal and thus acceptable. As such there may be value in updating this perceived norm through messages which explicitly divulge what the normal behaviour is (a descriptive norm) or should be (an injunctive norm).

**Behavioural insight – social norms**

See page 49. Also note that social norm messages can be particularly effective for issues of compliance, as we tend to rationalise that we are not alone, i.e. ‘everyone else ignores the speed limit too’. It is therefore useful to correct these belief through social proof.

There are some important considerations to the way that a social norm message is designed. For instance, it is important that prior beliefs are corrected in the appropriate direction. If the common assumption is that, say, 50% of drivers speed, and the true figure is actually 5%, then the message ‘95% of drivers don’t speed’ may be effective. However if the common assumption is that 20% of people speed and the true figure is 30%, the message ‘70% of people don’t speed’ may backfire as it leads people to conclude that speeding is more normal than they previously thought.
**SOLUTION:** Proposed intervention 2: Smart motorway speed compliance prompts

It is also important to consider whether the message is interpreted as the proportion of people not speeding right now (real-time information), the average proportion of drivers who are not speeding at any one moment, or the proportion of people who never speed. Different interpretations will lead to different behavioural responses. For example, interpreted as 90% of drivers currently not currently speeding may seem quite low (a full 10% are currently speeding, yet presumably 10% won’t end up with a penalty, implying it’s easy to not get caught). However, 90% of people never speeding is very high. We therefore suggest using surveys and/or focus groups to understand drivers’ intuitive understanding of a norm message to refine the wording.

**Behavioural insight – observability**

We are more likely to comply with norms, rules and expectations when we are being observed. In part this is rational: if the chances of getting caught are higher, we are less likely to defy the law. However, it is also socially motivated: an innate sense of peer pressure and social stigma leads us to comply with the expectations of society under observation. Hence, research has shown observation to increase compliance with norms even when there is no threat of punishment. We should therefore highlight the fact that drivers are not anonymous, alongside reminding them of the limit.

**Population segmentation: targeting and tailoring the motorway signs**

A number of population segments were identified as they relate to a propensity to speed, and their reasons for speeding. There are a number of ways messages on signs could be tailored to cater to these particular populations. However, there is a major challenge in delivering this: there is no effective way of a.) identifying the ‘type’ of driver in a particular vehicle, or b.) of delivering a particular message to them, isolated from other drivers on the road. The only way to target this intervention is to target the time, day and road (and lane, if signs as per-lane, though drivers would likely notice signs across all lanes). This does not allow sophisticated targeting of the intervention by segment, though may allow some crude targeting. Moreover, consideration of different segments response to different messages may be useful for prioritising and evaluating the intervention messages.

For example, mid-week rush hour is likely to be dominated by regular commuters. These drivers drive frequently, regularly along the same route, and cover a lot of miles per year. Those speeding under such circumstances are likely to be a mixture of well-calibrated speeders (intentionally speeding, but believing the risks to be low, for example because they are running late), deliberate speeders (those who knowingly drive fast, regularly), and perhaps reactive drivers (speeding in response to some emotional trigger or aggressiveness, for example because of heavier traffic under time commitments, or a bad day at work). We would expect there to be fewer than average new drivers and chauffeurs (drivers with passengers) at these times of day.

Rush-hour therefore presents an opportunity to target certain drivers, albeit we do not have a captive audience of just one type. Reactive drivers, if in a heightened emotional state, may be more receptive to emotional stimuli. The message “70. 4 people were killed on this road last year” might therefore have greater impact. Conversely, those who are relaxed and driving on auto-pilot may be more likely to speed by accident or unawareness, and as such a simple prompt or reminder may be effective. Deliberate speeders who regularly speed may be under the illusion that everybody speeds, and thus well-suited to the message ‘70. Most people don’t speed’, to update their normative beliefs.

Well-calibrated speeders are, by their definition, well attuned to the risk and aware that it is not a normal or acceptable behaviour, and thus may not be receptive to the social norm message, or the simple reminder. However they may be receptive to a message which updates their risk-awareness (such as ‘70. We send fines to 4 people per minute’).

Other times and locations may lend themselves to different messages. For example, where stretches of road are commonly used as part of a school run, we might expect more drivers with passengers (children), and more new drivers (teenagers). For parents driving children, a risk-based message may be most effective (‘70. X people were killed on this road last year’). The same may be true during busy bank-holiday traffic where many families are travelling together, and emotions are often running high due to the long journeys and congestion. Young drivers however, particularly male, tend to be less risk-sensitive and more thrill-seeking, but potentially more sensitive to financial costs. The message highlighting risk of death is may therefore be less effective than one highlighting the risk of penalty (either ‘70. We send fines to 4 drivers per minute’, or ‘70. Average speed cameras in operation’.)
**SOLUTION:** Proposed intervention 2: Smart motorway speed compliance prompts

**Inputs**
- Motorway infrastructure (smart signs and speed cameras)
- Staff time
- Financial resources

**Activities**
- Display signs on smart motorways
  - Multiple variants
  - ‘70’
  - ‘70. Average speed cameras in operation’
  - ‘70. We send fines to 4 drivers per minute’
  - ‘70. Most people don’t speed’
  - ‘70. It’s a limit, not suggestion’
  - ‘70. 20 people killed on this road this year’
  - ‘70. Speeding wastes fuel & money’

**Behavioural outcomes**
- Salient prompt / reminder of speed limit
- Increased perception of risk of penalty
- Updated beliefs on normality (and acceptability) of driving (descriptive norm)
- Reminder of legal (injunctive) norm
- Emotional (risk or guilt-based) response to message
- Increased understanding of cost of speeding

**Impacts**
- Fewer accidents
- Fewer speeding offences, fewer fines collected
- Increased speed compliance on SRN
- Improved air quality on SRN

**Estimated impact**
- Low/modest: driving styles are relatively ingrained, and prompts are a cost effective but soft intervention.

**Time-scale of impact**
- Short-term: intervention can be delivered quickly, and any behaviour change will be immediate.

**Estimated cost**
- Low. Implementation requires minimal resource and will use existing infrastructure and data sources. Expansion of the programme is subject to cost-benefit analysis, which will be informed by trial results.

**Impact on air quality**
- Moderate, depending on traffic density.

**Political & public acceptability**
- Medium – though speed limits and speed compliance are contentious issues, the main benefit of this approach is that it is liberty-preserving and does not bring new enforcement or restricted speeds.

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**Moderating factors by population segment**

**Deliberate speeding**
- Least likely to be speeding accidentally, and so least receptive to simple reminders of the limit, or reminders of the law. Predominantly young males, who have a strong socially normative element to their behaviour. The social norm message may therefore be effective. The threat of penalty may also be effective.

**Reactive drivers**
- Tending to speed in a ‘hot state’ (i.e. in a rush when running late) they are not pre-mediated speeders, but are happy to speed when the need arises. The social norm message may therefore be ineffective since it is easily discounted (‘I don’t normally speed either, but I’m running late’). Instead, harnessing emotion and highlighting the risk of speeding may be most effective.

**Well-Calibrated Speeders**
- Taking risks when they believe it is safe to do so, they may discount risk-based messages, believing themselves to be better drivers than average, and having already considered the safety risk. Reminding them of the legal limit may be effective since they are unlikely to acknowledge what they are doing as wrong. With little need to speed, cost messages may also be effective, as might highlighting the risk of getting caught.

**New Drivers**
- Inexperienced and often young. Speeding may partly be accidental (e.g. nervous drivers, going with the flow of traffic, and not keeping a close eye on the speedometer or having an intuitive sense of speed, e.g. when traffic is light or going downhill). Younger drivers may also be more sensitive to cost, implying the threat of penalty may be effective.

**Chauffeurs**
- Social norms are more effective when we are being observed, so this message may be effective given the loss of anonymity when a passenger is with us. Similarly, being responsible for another person may elevate the impact of the safety message which has emotional appeal, particularly among parents driving with their children in the car.

**Normalised Speeders and Lappers**
- Most likely to be speeding accidentally due to lack of attention, and/or through perceptions that it is totally normal. Reminders that the limit is a limit, not a suggestion may be effective, as may social norm messages which update their beliefs of normality.

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3c. SOLUTION 3: Clean vehicle bumper stickers
**SOLUTION:** Proposed intervention 3: Bumper-stickers for clean vehicles

**Intervention design 3: Bumper-stickers for clean vehicles.**

The third intervention idea aims to increase the uptake of clean vehicles. Though the prioritized objective was to increase uptake of electric vehicles, this solution has been designed to potentially promote cleaner petrol and diesel vehicles (e.g. those meeting the EURO 6 & VI standards), as well as hybrids and electric vehicles. **The intention is to increase the salience, perceived norm and familiarity with these vehicles through the use of bumper-stickers.** Subsequently, as people see clean vehicles more frequently their perception of the purchasing norm will adjust accordingly and ultimately might lead to increased uptake of clean vehicles in the long run.

To further encourage uptake of clean vehicles (and encourage owners to use the stickers such that the intervention may be most effective) incentives could be attached. For example, cars with stickers could be coupled with free parking in city centres (dependent upon partnerships with Local Authorities) or at workplaces (for example Highways England could trial this themselves in the context of a small pilot scheme). To facilitate this, the bumper stickers should have a bar code or a QR code printed on them, which links back to the vehicle license plate for instance, and acts as verification of the stickers’ authenticity.

**Key behavioural features of the bumper stickers**

The underlying hypotheses are that many people underestimate the actual prevalence of electric and ‘clean’ combustion vehicles, or are at least relatively unfamiliar with them and thus less likely to consider buying one when purchasing a new vehicle. Behavioural science suggests that we base our estimates of probabilities, frequencies and prevalence on how easily we can recall examples, i.e. in this case how easy is it to recall a memory of having seen an electric or clean vehicle on the roads. Currently, most clean vehicles are not recognised as such because they look like all other cars – in particular, electric vehicles are perhaps under-acknowledged by virtue of being indistinguishable to the casual observer.

**Behavioural insight – availability heuristic**

We are poor at estimating probabilities, and in doing so, tend to rely on the availability heuristic – our perception of probability/frequency/likelihood/prevalence is based on how easily we can recall examples. For example, we overestimate the risks of shark attacks and plane crashes because they are high-profile and culturally salient events. We underestimate the risk of falling out of bed or being hit by falling coconuts (which are both far greater killers) because they are not salient, and examples are not high profile. The fact that EVs are not distinguishable on the SRN may be undermining our perception of their prevalence. Conversely, making them identifiable may harness the availability heuristic, as even with 1 in 1000 vehicles being electric, they would stick in our mind, and thus greatly increase our perception of their prevalence.

**Behavioural insight – the mere exposure effect / familiarity effect**

We tend to be more fond of things which are familiar to us. This is the basis for the effective marketing technique of merely increasing consumers’ familiarity with brands and products to drive sales.

Making clean vehicles recognizable therefore influences their perceived normality and prevalence. We are greatly influenced by what we perceive to be the perceived norm.

**Behavioural insight – social norms**

See page 49.

Also note that even if the observed behaviour is not yet normative (i.e. not yet the majority behaviour) we are also sensitive to dynamic norms – that is, if a behaviour seems to be increasing in prevalence, we are inclined to join the bandwagon. As such, bumper stickers would not need to be present on the majority of vehicles for a norm effect to work – it may be sufficient that there is an observable increase in the number of stickers.
**SOLUTION: Proposed intervention 3:**

**Bumper-stickers for clean vehicles**

**Behavioural Insight – Reciprocity.** Reciprocity describes our tendency to return in kind favours done to us. It is relevant to pro-environmental and pro-social behaviours because we often feel disinclined to act for the benefit of others if other people are not doing the same (a collective-action problem, often leading to a tragedy of the commons). By making people aware that others are in fact acting in their benefit (i.e. by updating their perception of the social norm), it is possible to encourage others to do the same. For example, becoming aware that many other people are buying clean vehicles (to our benefit) we may be more inclined to do the same.

While the vast majority of clean vehicles are not identifiable as such, there are examples like the Toyota Prius for instance, where cleanliness is a core marketing property. The ‘green’ image it hosts is a big driver of sales. This relates to what the literature terms as the ‘green halo’ effect, i.e. where the display of ‘green’ attitudes and behaviours has become a symbol of status. Harnessing the power of the ‘green halo’ symbolism through bumper stickers may be effective, albeit only among population segments who derive value from signaling their green credentials.

**Behavioural Insight – virtue signaling.** We often conspicuously choose our products, fashions and other expressions of our identity to ‘signal’ our virtue to others. Among those who care about the environment, it is common to signal this aspect of themselves through explicitly ‘green’ product choices. By making electric and other clean vehicles more identifiable, this strengthens their ability to signal their virtues.

**Population segmentation: targeting and tailoring the bumper stickers**

Based on existing literature, consumer segments were identified to distinguish their propensity of buying an electric vehicle. The drivers and barriers behind this propensity are similar for the wider ‘clean vehicle’ market. While the bumper stickers in and of themselves cannot be tailored, the attached incentive scheme offers an effective tailoring opportunities.

Moreover, the roll-out of the bumper stickers can be prioritized for certain segments. It is to note however, that by virtue, the impact of this intervention is best harnessed through wide adoption of bumper stickers to increase visibility as much as possible. A phased roll-out could therefore be a good approach, where the incentives attached to the bumper stickers are first tailored to those who can afford clean vehicles, like “Early adopters” or “car enthusiasts”. Over time, increased visibility of clean vehicles is likely to impact perceptions and attitudes of other segments too, that might still be deterred by range anxiety related to EVs and status quo bias – like weekend drivers.

If guaranteed parking is scarce in a certain area, even “environmental cynics” could be convinced to purchase an EV or a cleaner vehicle, if the attached incentive focuses guaranteed and free parking for EVs in citycentres, or in areas where parking is in high demand.

This intervention could be extended to also benefit fleets. Free parking could be attractive to those that drive into city centres. For logistics companies, lower tolls other road charges could be considered as incentives.

Given that EVs in particular, but also replacing an old vehicle, can be an expensive undertaking, only households with a certain income will be able to harness the benefits. To avoid a scenario where parking becomes a privilege for the wealthy, loans and other financing opportunities should be created to encourage the uptake of clean vehicles among lower-income population groups.

If they can afford it, “Keen greens” would purchase clean vehicles for the sake of their environmental convictions. Attaching a lucrative incentive to this behaviour therefore risks ‘crowding out’ their intrinsic motivation. To avoid this, a social marketing campaign could be developed around the bumper stickers to highlight the ‘green’ and health value of driving a clean vehicle.
**SOLUTION:** Proposed intervention 3: Bumper-stickers for clean vehicles

### Inputs
- Staff time
- Financial resources

### Activities
- Designing, producing, and delivering the stickers
- DfT/ELA coordinates delivery of bumper stickers upon tax renewal
- Car dealerships / manufacturers put stickers on new and second-hand sales

### Outputs
- Some owners attach the stickers
- Some owners remove the stickers
- EVs become more noticeable on roads

### Behavioural outcomes
- Awareness of EVs increases
- ‘Mere familiarity effect’ - fondness of vehicles increases with familiarity
- ‘Availability Heuristic’ - salience of EVs increases perceived commonality
- ‘Social proof’ - perceived norm of owning EV increases
- ‘Virtue-signalling’ - green credentials more obvious, adds appeal to ownership

### Impacts
- EVs more likely to be considered when buying a new vehicle
- Greater proportion of EVs on the road
- Boost to EV market, accelerates development of technology
- Improved air quality on SRN

### Moderating factors by population segment

<table>
<thead>
<tr>
<th>Environmental Cynics</th>
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<tbody>
<tr>
<td>Most likely to be multi-car households, thus higher opportunity to have an EV as a second car. Higher income, thus less restricted by upfront cost of EVs. However, severe lack of motivation and disinterest in the cause of the policy. May respond if incentives are strong, and/or when EVs are viable (or better) in performance to ICEs. Social norm element likely to be weak, as norms are strongest when displayed by people we identify with. Similarly, ‘virtue-signalling’ benefits do not apply.</td>
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<table>
<thead>
<tr>
<th>Weekend Drivers</th>
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<tbody>
<tr>
<td>Least knowledgeable, with common misconceptions (e.g. about reliability or driving experience), most in need of being addressed. Social proof and familiarity could therefore be effective mechanisms. However, also mostly older drivers, potentially with stronger brand/loyalty and inertia, less likely to deviate from familiarity. Lower income also presents barriers to purchase. Often single-car owners, and therefore less likely to purchase an EV in the near-term.</td>
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<thead>
<tr>
<th>Car Enthusiasts</th>
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<tbody>
<tr>
<td>Potentially sensitive to social proof (wanting to be ahead of the curve). Awareness likely to raise quickly because they pay attention to what they see on the road, and so salience of the stickers may be an effective mechanism. May be more sensitive than most to the sticker design (not spoiling the aesthetic of the car). Highest income of all segments, and likely to purchase new cars more frequently. Among some car enthusiasts, preference for ICEs may be stubborn.</td>
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<table>
<thead>
<tr>
<th>Keen Greens</th>
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<tbody>
<tr>
<td>Most likely to be drawn to the virtue-signalling element. Pre-existing interest means this group is easiest to nudge. However, quite a lot of young, and retired people, both having lower incomes, therefore presented with upfront(cost issues of EVs and new ICEs. Slower car replacement is likely, and overall least likely to be drivers / car owners.</td>
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<thead>
<tr>
<th>Public &amp; Private Fleets</th>
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<tbody>
<tr>
<td>Strong interest in long-term cost, and therefore relatively likely to be interested in efficient vehicles. Also may have a strong public image to maintain, and so increased public awareness / virtue-signalling may be strong as the value of conspicuously having a clean fleet increases (and the cost of not, also increases).</td>
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<thead>
<tr>
<th>Young Urbanites</th>
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<tbody>
<tr>
<td>Young and educated, familiar with technological developments, and sensitive to emerging trends. However, mostly living in flats and apartments, making charging difficult for EVs. Modest incomes may also be a barrier.</td>
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<table>
<thead>
<tr>
<th>Users</th>
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<tbody>
<tr>
<td>Already convinced of the benefits of EVs. By virtue of being early adopters (often with strong green attitudes), they are quite likely to be happy to have the stickers on their vehicles. They are therefore integral to the success of the intervention since they are ‘patient zero’ from which the social norm will spread.</td>
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<table>
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<tr>
<th>Early adopters</th>
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</thead>
<tbody>
<tr>
<td>Higher than average income, and high annual mileage means they have a high exposure to the stickers, and may replace their cars more frequently than average. Known to have a high interest in hybrids, and high mileage means low running costs &amp; high reliability are appealing.</td>
</tr>
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</table>
SOLUTION 4: Disgust-based social marketing campaign
SOLUTION: Proposed intervention 4: ‘Disgust’ based social marketing campaign

Intervention design 4 – social marketing campaign.

In addition to the three behavioural interventions outlined previously, the fourth intervention does not target drivers’ behaviour per se, but rather the attitudes of, and level of engagement among, road-users and nearby communities affected by air pollution. Engagement is low, and many peoples’ understanding of air pollution is poor. This hampers policy development and thus there is a need to boost understanding and concern such that on-road policies (such as low emission zones) and infrastructure (such as roadside barriers) are more acceptable to the public.

The proposed intervention contains two parts: first, a campaign targeted at the general population aiming to increase awareness of the air quality issue and increase the acceptability of on-road policies such as temporary speed restrictions, road pricing, or clean air zones. Second, a supplementary campaign specifically targeting communities who would benefit from roadside air quality barriers, with a view to increasing the acceptability of this infrastructure. Both aspects of this campaign aim to harness three key behavioural insights and test their effectiveness. First, they are designed to evoke the emotion of disgust at air pollution and the constituency of what road users and nearby residents are inhaling. Second, the framing of the impacts of air pollution is critical, with a variety of approaches to be tested (including quantifying air pollution in terms of equivalent cigarettes smoked per day or months of life lost). Third, the campaign is to test the impact of different messengers (e.g. Highways England vs NHS).

Key behavioural features of the marketing campaign

Emotions, both positive and negative, are powerful drivers of our behaviour. The feeling of disgust has been harnessed in other public health contexts, with the most well-known example in the UK being the use of graphic images in anti-smoking campaigns and on cigarette packs. However, the approach has not been used in the context of an air quality campaign, despite its obvious potential: one of our expert interviewees suggested that though the vast majority of people don’t know what they are breathing in, when the constituency of the particulates is explained to them, most react with a feeling of disgust.

However negative emotions are not always effective behaviour-change tools. If we do not feel we can actually do anything about the heath hazard, we may react with despair, anger and frustration rather than act, or deliberately avoid the information which is evoking the negative response (anxiety-avoidance). However, in this instance we are not trying to change behaviour, but rather to change attitudes such that the public may be more willing to engage with, and be accepting of, other policy interventions to improve air quality. With this objective in mind, emotional appeals can be effective social marketing tools to raise awareness and support for action – though a note of caution is appropriate: it may be unreasonable to build public awareness (and concern), if government action is not forthcoming to help solve the problem.

Here we focus on increasing awareness and support for two particular policies – roadside barriers (targeted at specific communities) and temporary or permanent reduced speed limits (targeted at the population at large). The feasibility of reducing the motorway speed limit is questionable, however we use this as an example of an on-road policy which may generate public objection, but which may benefit from greater public understanding and engagement. The trial methodology described herein can be used in the context of building understanding and support for other policy-interventions too, but may benefit from being tailored to one specific measure at a time.

The metrics of air pollution particulates mean little to most people. The manner in which the information is framed is therefore crucial to succeed in evoking the feeling of disgust. For instance, the act of smoking a cigarette is very emotive, salient, and easy to understand, and so framing the issue in terms of equivalent cigarettes you (or your child) are smoking per day is one suggested approach. This may be more effective for non-smokers than for smokers, and so segment analysis should be undertaken to evaluate this. An alternative framing is to highlight the number of years of life lost due to the health effects of air pollution.

Behavioural insight – emotions

Both positive and negative emotions are powerful drivers of our behaviour, with disgust being a deeply ingrained survival response to avoid infection and illness. A number of campaigns have used disgust with success, the most well-known being anti-smoking campaigns which have used graphic images to deter smokers. Some research suggests the novelty of these may wear off, though in the case of air pollution, this may not matter if the intended impact is not to drive changes in habit, but to build community engagement and consent for the implementation of new infrastructure or policies.
**SOLUTION:** Proposed intervention 4: ‘Disgust’ based social marketing campaign

**Behavioural insight – salience**
Our modern age is characterised by an overflow of information and signals capturing out attention. It is therefore important to draw people’s attention to the most relevant information by making it salient or novel. For example BIT’s research has shown that the use of coloured, hand-written envelopes has increased the rate of payments across a number of contexts.

**Behavioural insight – framing**
We respond differently to logically equivalent scenarios depending how the information is framed. For example, food described as ‘95% fat-free’ is viewed more positively than food described as ‘5% fat’. One of BIT’s studies has similarly shown that non-vegetarians are twice as like to order sustainable, vegetarian food when termed ‘field-grown’ rather than ‘meat-free’.

In addition to the message itself, often the identity of the person or organisation delivering the message is just as important as the message itself. This is termed the **messenger effect**. We tend to perceive people ‘like us’ as more trustworthy, whilst credibility and political independence can also be important. Highways England may have high credibility, but may not be viewed as impartial, nor particularly identifiable or familiar to people. Initial research could be useful in determining how familiar HE is to the public, and what their impressions of the organisation are. Engaging community leaders, or using high-profile figures who are respected and liked, may help improve the impact of information campaigns. A campaign based around cigarettes or health impacts may be best coming from the NHS or Public Health England, for example. Also note that the Chief Medical Officer has chosen to focus efforts on air pollution this year.

**Behavioural insight – messenger effects**
We are far more likely to respond to some messengers than others. For example, we significantly increased the rate of charitable donations with messages from a company CEO compared to the same message form the company HR department. In health, interventions delivered by research assistants and health educators were more effective than those delivered by trained facilitators or teachers.

**Population segmentation: targeting and tailoring the campaign**
A social marketing campaign lends itself well to a targeted intervention approach. Depending on the medium used for the campaigns, different messages, messengers and framings could be applied and targeted at different segments. In fact, through the online experiments in phase 1 of this trial design (see methodology in part 4d of this report), demographic and attitudinal data could be collected from participants to form the basis of a primary segmentation analysis specific to this given policy scenario. Based on this bespoke population segmentation, the campaign could be tailored and targeted even more effectively. Having not done this exercise yet, some inferences can be made based on the existing literature used to create the population segments described in section 2 of this report.

“Preoccupied” drivers, for instance, are in the middle age-range, lead busy lives and many of them are families with children. This may make them receptive to messages comparing air pollution levels to the number of cigarettes their child would need to smoke to suffer similar health damage. “Disengaged” individuals are likely to have little at stake in the air quality debate, and express least interest in the campaign. However, if the policy measures being proposed affect them (e.g. a fuel duty rise), they may become increasingly engaged. In contrast, “supporters” are likely to respond well to messages highlighting the need and providing the opportunities for collective action, and may be relied on the spread the messages through word-of-mouth. Evidence shows campaigns are most effective among those who already sympathies with the message (an example of confirmation bias), so although this is not a cohort that needs convincing, they may help support the shift in wider public sentiment.

“Environmental sceptics & car devotees” who are distrustful of government, are hard to reach through a social marketing campaign, in particular if it’s a governmental campaign promoting citizen engagement and support. General suspicion of paternalistic government activity may be common, and the default response may be to critique the efforts. Less polarising and more likeable messengers (e.g. such as the NHS rather than an ostensibly politicised body) could be most effective with this group. For “aspirational”, given their young age, social media is likely to be an effective medium to spread the campaign with, and appropriate messengers (e.g. influencers in that cohort) could be used, too.
**SOLUTION:** Proposed intervention 3: ‘Disgust’ based social marketing campaign

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**Inputs**
- Staff time
- Financial resources
- Undertake pilot studies (online experimental) to ascertain most effective framing messages & ‘disgust’ elements
- Develop marketing campaign materials
- Delivery campaign materials through chosen media (online, leaflets, radio, bus-stops)

**Activities**
- If possible, develop multiple versions tailored to different segments
- Campaigns shared and discussed among friends & communities
- Increased understanding of air pollution health effects
- Public awareness raised

**Outputs**
- Improved air quality on SHN
- Public attitudes towards air pollution shifted
- More intuitive, emotive and repetitive association with air pollution
- Risk of victimisation and sense of blame for the problem

**Impacts**
- Victims of air pollution (e.g. roadside residents) - greater adhesive for avoidance
- Contributors to air pollution (e.g. drivers) - more accepting of the need to contribute to a solution
- Accelerated policy developments to improve air quality (e.g. on-road policy) and protect communities from exposure (e.g. roadside barriers)

**Moderating factors by population segment**

- **Preoccupied**
  - Likely to be relatively disengaged from the campaign, but also not obstructive to it, responding quite passively. Generally understand the issue, but have ‘more important’ things to think about. Commonly families with children, and therefore may be sensitive to ‘equivalent cigarettes your child is smoking’ framings.

- **Aspirational**
  - Among the most knowledgeable about the problem (only behind supporters), though generally with less experience and less strong opinions on the issue. Likely to support policy intervention if the campaign makes a convincing argument.

- **Disengaged**
  - This group has the least at stake in the air quality debate, because they are least affected (for example living in the countryside). If policy measures do not affect them, they are likely to play little part in the public debate, however if policy measures are national (e.g. fuel tax increase) this group may become more vocal as they will feel the cost of the policy but gain little benefit, and have no pre-low awareness of the importance of the issue.

- **Supporters**
  - Highest propensity to be in favour of action on air pollution. Generally younger and biased towards females and higher education levels (i.e. broadly politically progressive). Likely to be allies to the campaign and spread the message through word of mouth.

- **Environmental Sceptics & Car Devotees**
  - This group may be least likely to accept measures which impose costs of restrictions on car use. However, it is unclear what their perception may be of their own health-effects, and whether environmental scepticism extends to disinterest in pollution if it is framed around a health issue. The messenger should be chosen carefully (e.g. credible and likeable, such as the NHS, rather than a political figurehead).

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**Estimated impact**
- Medium: depending on the design of the campaign, public values and attitudes can shift dramatically, though this is not always easy to predict (hence evaluation necessary).

**Time-scale of impact**
- Medium-term: attitudes shift as awareness spreads. The campaign will be live for some time before seeping into the public consciousness across the population.

**Estimated cost**
- Low-Medium. Public campaigns are relatively cost-effective interventions, delivered through established mass-media channels. Stickers are cost effective.

**Impact on air quality**
- Depends entirely upon the policies which may follow greater public awareness and engagement. Potentially very high impact as the purpose of this intervention is to increase acceptability of stronger regulatory and infrastructural interventions, beyond nudes and voluntary behaviour change.

**Political & public acceptability**
- Medium – raising public awareness may put pressure on government to do more.
3e.

SOLUTION: Additional intervention ideas
SOLUTION: Other recommendations for further consideration

The four solutions described in detail across previous pages have been prioritised to take forward to pilot studies for potential evaluation. However, a range of other intervention ideas from the longlist (included in Appendix C) also emerged during the prioritisation exercise as potentially high impact ideas. They have not been selected at this stage primarily because they are less suited to implementation by Highways England (and thus require other parts of government to lead or partner on). Nonetheless, they are worth highlighting and so are summarised over the following pages alongside the behavioural insights underpinning them. Only those behavioural insights not previously described are given definitions here – otherwise readers are directed to the previous descriptions.

<table>
<thead>
<tr>
<th>Overcome frictions, hassle, and anxiety of taking an EV on a long journey (Intervention ideas EV6, 11, 12 &amp; 13 from the longlist)</th>
</tr>
</thead>
<tbody>
<tr>
<td>People who currently own an EV tend to own it as a second car, and may be inclined to take their other, ICE vehicle on longer trips on the SRN. This is partly down to range anxiety, and concern that a charging station may not be available. A number of modest interventions could overcome this, encouraging more existing EVs to be used on the SRN. A suite of interventions may include:</td>
</tr>
<tr>
<td><strong>Smart charging stations which can be booked / alert users to their status in advance</strong> – These charging stations connect to an app, which indicates availability ahead of time, allow booking / queuing so you know when it will be free and allow you to reserve one when an hour away.</td>
</tr>
<tr>
<td><strong>Charging stations to provide a free code / coupon for a coffee or sandwich at motorway stations</strong> – Overcoming the concern that a half-hour wait (or longer) while a car recharges is tedious.</td>
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<td><strong>Map of charging stations</strong> – Produce an easy-to-use, live map of charging stations informing drivers where the next station is and whether it is in working order. It could also have a functionality that allows you to select your car model and the programme maps out your ‘charging journey’ along the SRN.</td>
</tr>
<tr>
<td><strong>Behavioural insights used, rationale, and selected examples from other contexts</strong></td>
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<tr>
<td><strong>Friction costs and hassle factors</strong> – Removing and introducing friction-costs is a powerful way to promote and discourage behaviours. These seemingly trivial points of effort can have a disproportionate impact. For example, subscription services tend to make it as easy as possible to sign up to their service, whilst introducing slight frictions to cancelling (for example requiring written notice, or have an auto-renewing subscription unless we remember to cancel). We significantly increased the UK’s tax revenue by removing a single ‘mouse click’ from the process, directing recipients of reminder letters directly to the form, rather than to a webpage hosting the form. Other studies have shown that removing the tray at a canteen significantly reduced food waste, since it introduces a small friction to taking too much (even where repeat visits to the canteen are allowed). Similarly, suicides by paracetamol have been significantly reduced by having the pills in blister packs rather than pots, and requiring shoppers to visit multiple stores if they wish to buy multiple packets.</td>
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<tr>
<td><strong>Uncertainty and risk-aversion</strong> – We are highly risk averse under normal circumstances. For example, we would generally take a guaranteed £20 over a 50% chance of winning £50 (or indeed much more – precise risk preferences vary between individuals). We also have a very strong preference for zero risk – people are on average willing to pay considerably more to reduce risk from 5% to zero than from 25% to 20%. This means we are disproportionately sensitive to small risks. This is an important consideration when choosing a car or van to purchase (or choosing a car or van to use for a particular trip), as concern over lack of range and lack of available and functioning charging points is high, even if the actual risk is relatively low.</td>
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Relatedly, we also like to plan on a ‘just-in-case’ basis. For example, we tend to choose mobile phone tariffs which have sufficient data, texts and minutes for a highest-consumption periods, which we rarely use. We might be better off, financially, to choose a lower tariff and occasionally pay the excess. The same is likely to be true when choosing which vehicle to buy or take on a particular trip – an EV may suit 99% of our needs and be cheaper in the long run. We could rent a vehicle for the other 1% of trips, or accept the inconvenience of extended charging. However, research which shows the prevalence of range anxiety suggests we are overly influenced by the ‘just in case’ scenario.
**SOLUTION:** Other recommendations for further consideration

The existing EV subsidy is relatively hidden, automatically applied to the sales price but not made salient to the public. More novel framings of this incentive could include the following:

- **Scrapage scheme.** We judge cost proportionally, not in absolute terms. For example, £2,500 off a £20,000 car may be less motivating than being paid £2,500 above market rate for your part-exchange vehicle (which may be worth very little). Framing the subsidy as a £2,500 payment ‘for your old banger’ may therefore be more effective.

- **Free fuel.** E.g. “drive the first 65,000 miles for free – we’ll cover your electricity costs for the first 65,000 miles”.

- **Cash-back.** A cash-back offer may be particularly appealing for those buying a vehicle on credit (around 86% of vehicle purchases in 2016), since it represents a windfall (e.g. buy a £30k EV on credit, get £2,500 cash now). Such a cash injection may be a strong motivator to buy an EV over a similar ICE. A cashback offer may also be highly appealing to the buyers of vans (subsidies up to £8k available), since small and large businesses are often very sensitive to cash-flow considerations.

- **There may also be benefits to simply making the discount more salient, and advertising it more explicitly as a discount/subsidy, rather than having it applied automatically by the dealer and ‘hidden’.”**

- **It would also be possible to apply artificial deadlines / scarcity principals to these subsidies.** For example the subsidy may be ‘only applied to the first 100,000 EVs registered each year’ to increase the sense of it being a good deal, or it could be personalised and targeted, for example, making the subsidy larger, but restricting eligibility (e.g. “up to £5k subsidy if you are selling a diesel car over 7 years old”)

**Behavioural insights used, rationale, and selected examples from other contexts**

**Hyperbolic future discounting / present bias.** Costs and rewards in the near-term loom large, while those in the long-term are less salient to us and less motivating, i.e. we discount them. Moreover, this ‘discount rate’ is hyperbolic, meaning we put disproportionate weight on the immediate present. This is largely why we partake in risky behaviours such as smoking, overeating, heavy drinking and unsafe sex – the immediate gratification outweighs the long-term (and often uncertain) costs. This also has major consequences for purchasing decisions, as we tend to gravitate towards products which have lower upfront cost regardless of long-term running cost. For example, we may buy or rent homes which are cheaper but more expensive to run and maintain, we buy appliances which are cheaper but have lower energy ratings, and we inadequately account for the running cost of cars.

It is therefore preferable to bring the benefits upfront and the push the costs to the future, in order to promote a particular purchase or behaviour. The Green Deal, though poorly implemented with a huge amount of friction and complexity in the process, had this idea at its core – the home retrofit was provided immediately, and payment was made over the long-term only through the savings which arose from reduced energy bills. This makes salient the fact that savings will be achieve in the long run, and removes the risk of being worse-off in the short-term, whilst also getting the immediate benefits of a warmer home.

**Framing.** We respond differently to an economically equivalent scenarios depending how the information is framed. Examples of framing include framing as a loss (to harness loss aversion – see paragraph 9), or using proportional price evaluation – we perceive costs (and all magnitudes) proportionally, not in absolute terms. For example, we are more willing to walk 10 minutes to save £7 off a £15 product than we are to walk 10 minutes to save £7 off a £1200 item. This may be partly why the 5p plastic bag charge introduced in the UK is effective – it is noticeably more than 0p, the previous cost, and thus paying comes with a degree of annoyance, salience, and acts as a strong prompt. Adding 5p to the cost of a fizzy drink to discourage purchase would be highly unlikely to have the same effect. Through similar logic, receiving an additional £2,500 for a vehicle valued at £500 may be perceived as much better value than receiving £2,500 off a £25,000 vehicle, and receiving something worth £2,500 for free may be more motivating than receiving a 10% discount on a £25,000 purchase. A related concept is that of transactional utility – we get value not just from the item we are purchasing, but from the transaction itself, i.e. we find inherent value in the ‘deal’. This is partly why we often succumb to buying products we do not need or particularly want when they are heavily discounted.

**Scarcity.** We are attracted to that which is scarce. Partly this may be an evolved tendency to hoard scarce resources, and partly this may be a form of ‘social proof’ – their scarcity signals popularity, or that the deal must be good. This can be harnessed through marketing techniques such as “only 2 seats left at this price”, or “maximum of 6 bottle per customer”.

**Deadlines and decision points.** We are much more likely to act when we are faced with a firm deadline. This is partly related to scarcity (time is scarce), partly about fear of regret (we don’t want to miss out), and partly because we have a great tendency to procrastinate in the absence of clear deadlines (with consequences) or natural ‘decision points’ (moments in which we are forced to make a decision, and as such ‘carry on as normal’ isn’t, momentarily, as strong a default course of action). For example, people on average eat more popcorn from a large box than from 2 half-size boxes (since reaching the end of one box is a natural ‘decision point’ to pause and consider). Likewise, social media sites such as Facebook are designed with ‘infinite scrolling’ features so there is never a need to click onto a second page, and thus never a natural time to stop browsing. Time spent on the app is significantly increased as a result. More relevant to this context, UK voting applications increased by around 100% the day before the deadline (relative to a just a few weeks before).
**SOLUTION:** Other recommendations for further consideration

<table>
<thead>
<tr>
<th>‘Green Deal’ for EVs / ‘Green mortgages’ for EVs (Intervention Idea EV3 from the longlist)</th>
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<tr>
<td>The UK’s ‘Green Deal’ allowed homeowners to have insulation installed for free at the point of delivery, with the cost paid back only through the energy savings they were making, overcoming issues of upfront cost, harnessing our tendency to bias towards the present and discount the future, and helping to make salient the fact that you will never be worse off by buying insulation as it eventually pays for itself.</td>
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<tr>
<td>Green mortgages are financial products whereby lenders increase the amount they are willing to lend on a more energy efficient home, on the basis that maintenance and running costs of the property are lower, and thus the borrower is more able to maintain a higher monthly repayment.</td>
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<tr>
<td>Electric vehicles tend to be more expensive than ICE equivalents upfront, but significantly cheaper to run. They are therefore well suited to a policy which combined aspects of the Green Deal and of Green mortgages.</td>
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<tr>
<td>Where EVs are bought outright, a ‘Green Deal’ system could allow buyers to pay the cheaper price of an equivalent ICE, and then pay off the difference based on their mileage (and an estimate of how much more than would have cost on fuel). With the government subsidy on top, this would make EVs cheaper at the point of purchase.</td>
</tr>
<tr>
<td>Where EVs are bought on credit (86% of new cars were bought on credit in 2016), a ‘green mortgage’ arrangement would be particularly apt. EV buyers would receive favourable credit options compare to ICES of the same upfront cost. This permits buyers to get a more expensive (and potentially more desirable) vehicle, whilst the higher monthly payments would be negated by the cheaper running costs. This fact should be made as salient as possible by highlighting the total monthly cost (repayment and running costs) at the point of purchase. For example, a £20,000 ICE may be has the potential to negate the premium cost of an EV. For example, a £20,000 ICE may be sold at £650 per month for 36 months, plus an estimated running cost of £200 per month (insurance, petrol, tax), totalling £850 per month. A £25,000 EV may be offered at £800 per month plus a running cost of £50 per month. By making the equivalence of the long-term costs salient, buyers may be tempted by the more expensive car with lower running costs which seems a better deal when framed in this manner, and when made possible with appropriate credit offerings.</td>
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**Behavioural insights used, rationale, and selected examples from other contexts**

- **Hyperbolic future discounting / present bias** – see previous description
- **Framing** – see previous description

**Incentives** – incentives can take many forms, and though there are often ways to make them more ‘behaviourally informed’, conventional economic incentives are often highly effective. One relevant comparison is the idea of Green Mortgages, currently offered by a minority of lenders and a topic of discussion in central government. Mortgage lenders should be willing to offer a higher loan-to-value ratio on properties which are energy efficient, on the basis that the customer has lower costs and is thus able to afford higher repayments. A similar policy could equally apply to EVs, and the argument may be even stronger since the difference in running costs for an EPC B and EPC E home is modest, whereas the difference in running cost between comparable petrol and EV cars can be significant, and represent a large portion of the car’s lifetime cost. Many cars are bought on credit, allowing retailers to offer significantly more attractive credit deals on EVs.

Incentives may be targeted at consumers or producers. A recent example of an incentives designed to influence consumer health, but designed in such a way as to impact manufacturers’ behaviour, is the UK’s sugar tax. The tax is set at thresholds of sugar content, such that manufacturers can avoid the tax or fall into the lower band through reformulation of their drinks. This was designed with the recognition that consumers themselves may be unlikely to change their behaviour in response to sugary drinks being fractionally more expensive.
**SOLUTION:** Other recommendations for further consideration

**Mandate new price labelling for all new vehicles (EVs and ICEs), to be advertised both in terms of their purchase price and their lifetime running cost. Trial a variety of framings. (Intervention idea EV4 from the longlist)**

Many consumer products have mandated label designs to help consumers make informed decisions. EVs have substantially higher price tags than ICEs (even after the government subsidy is applied), however the latest models are now cheaper over their lifetime than equivalent ICEs, thanks to very low running costs. However, we tend to discount these future benefits relative to the present, and so it is important to help consumers recognise and consider the long-term costs when purchasing a vehicle. As such, a standardised label advertising the price of the car’s running costs may help consumers make choices in their long-term interests. This may be particularly relevant where cars are sold on credit or lease and advertised by their monthly instalment – in this instance, a price label showing the ‘total cost’ (instalment plus running cost) would favour EVs and more efficient ICEs.

**Behavioural insights used, rationale, and selected examples from other contexts**

*Hyperbolic future discounting / present bias* – see previous description

*Framing* – see previous description

**Promote EV test-drives through prompts at timely moments (e.g., on DVLA website after renewing tax). (Intervention idea EV16 from the longlist)**

Prompt people completing their DVLA tax renewal to book a free test drive in an EV. This is particularly relevant and salient given that tax has just been paid on a vehicle, and EVs are tax free. Moreover, it exclusively targets drivers, and a very large population of them.

Messages could harness loss aversion (highlighting the loss of tax just paid, relative to tax-free EVs), scarcity (a limited number of free test drives available), social norms (highlighting the increasing number of people buying EVs, or the number of people choosing to book a free test drive), novelty (framed as an ‘experience’ (à la a track day) rather than as a ‘test drive’ (as when buying a vehicle), and personalisation/exclusivity (‘you have been chosen’).

A similar approach could be taken at MOT time (especially if repairs are necessary, as it will capture people considering an upgrade).

**Behavioural insights used, rationale, and selected examples from other contexts**

*Loss aversion* – see previous description

*Social norms* – see previous description

*Personalisation* – see previous description

*Timely moments and prompts* – see previous description
**SOLUTION:** Other recommendations for further consideration

**New driver pledge before driving on the motorway to increase speed compliance (Intervention idea C6 from the longlist)**

Require those passing their test to sign a formal pledge to drive safely and to meet certain expectations of driving style (including not breaking the speed limit, and following a series of simple rules relating to driving style). There is evidence to show that making a public commitment increases our likelihood of doing something, and this process, if appropriately designed, may effectively relay the gravity of the undertaking of driving a car. There is also evidence to show that simply signing a formal document/pledge increases compliance.

A timely moment to include this could be in the context of the forthcoming changes allowing learner drivers to drive on the motorway – such a pledge/signature could be required of learners before being allowed to take a lesson on the motorway. The impact of this intervention is likely to be greater if a degree of officialdom/ceremony/gravitas is instilled.

**Behavioural insights used, rationale, and selected examples from other contexts**

**Public commitments, pledges and honesty prompts** – Simply prompting people to commit to being honest can be enough to shift behaviour, as we tend to be consistent with our own perceptions of selves when those perceptions are made salient, and consistent with our past behaviour (‘consistency effects’). For example, it is common for people to deliberately under-estimate their annual mileage in insurance forms to reduce their premium, after which they happily sign the form declaring honesty. However if the declaration of honesty is at the beginning of the form, people are less inclined to underestimate their mileage.

Making a public commitment can help people stick to their targets. We are more likely to let ourselves down, than we are to ‘lose face’ publically, or backtrack on a promise. For example, when people make a public commitment to weight loss (by having their name and target displayed on a bulletin board), on average they lost 20% more weight than those who made a private commitment.

Simply writing something down can strengthen our sense of commitment and intent to follow-through with action. For example, in a context where many people were not bothering to get vaccinations, encouraging people to write down the time and date of their appointment increased vaccination rates.

**Intervention idea E5,6,7,8. Behaviourally-informed league tables within firms and fleets to promote eco-driving.**

Partner with large fleet operators (taxi operators, delivery and freight firms) to set up league tables within these companies, comparing individual drivers on fuel consumption. Such schemes have been tested (though rarely robustly), and found to be effective in a range of contexts (i.e. outside eco-driving). However relatively little has been done to explore the wealth of behavioural insights which could be embedded in such a scheme. This could include:

- Simple social comparisons (comparing drivers against their more efficient peers)
- Lotteries and prize draws
- Regret lotteries (in which you find out if you would have won, if you’d met the eco-driving requirement that week, instilling regret and thus more effort to comply next week)
- Charitable donations through which the organisation donates money saved on petrol to charity (to overcome cynicism that the firm is just maximising profits).

**Behavioural insights used, rationale, and selected examples from other contexts**

**League tables and peer comparisons. See social comparisons (paragraph 8), and gamification (paragraph 1).**

UK government departments successfully reduced their energy consumption by an average 25% over just several weeks in response to published performance in the context of a competition (league table) for the maximum reduction in consumption month-on-month. Similarly a trial conducted with Virgin Atlantic tested different measures to get pilots to fly more fuel-efficiently. Successful interventions included league tables of performance comparing pilots against each other, in addition to the provision of feedback and goal setting. In this Virgin study the simple fact of being observed (with no other intervention) also led to a significant decrease in fuel consumption, highlighting the fact we are more likely to adhere to implicit norms/expectation when being observed (see surveillance/observation, paragraph 14).

**Regret lotteries.** Regret lotteries have been shown to be more effective than standard lotteries in some contexts. For example, In the Netherlands there are two state lotteries: a conventional lottery in which you buy a ticket with a number on a, and a postcode lottery in which your postcode is the number. With the latter, you know if you would have won (though you don’t receive the winnings unless you’d paid to play). This has been shown to encourage participation more than with the conventional lottery.
**SOLUTION:** Other recommendations for further consideration

<table>
<thead>
<tr>
<th>Deliberative Forums (Intervention idea PE8 from the longlist)</th>
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<tr>
<td>Deliberative forums bring together a representative panel of the public to discuss a policy issue and develop solutions to it, in a similar format to a jury service. They have been used around the world often to good effect. Additional mechanisms can also bring in wider views, for example with media coverage during the debates and technological solutions (e.g. through social media) to enable other members of the public to pose questions and views. Deliberative forums have the potential to create an unusually strong mandate for policy, particularly where difficult trade-offs are required and often officials may feel they are ‘damned if they do, damned if they don’t’ – where a decision is made by the public, there is far less scope for anger or objective from aspects of the media or other groups. It is also possible that such forums generate more innovative solutions. By presenting all the evidence to the forum, common misconceptions can be overcome, a plurality of perspectives can be sincerely debated, whilst policy-makers can capture a wide range of views and varying expertise. They also bring with them a unique opportunity to influence wider behaviour, since public consensus and the policy-making process itself is likely (if done in this manner) to influence wider social norms and attitudes, as well as signalling the public’s views to corporations.</td>
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<tr>
<th>Behavioural insights used, rationale, and selected examples from other contexts</th>
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<tr>
<td><strong>Procedural justice</strong> – procedural justice has been found to be as important or more important than justice of outcomes across a range of contexts. This includes, for example, staff remuneration where transparency and thoroughness of process is important in determining staff perceptions of fairness of salary reviews and promotions.</td>
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<td><strong>Agency, sense of worth</strong> – we often like to make our opinions known and value a sense of control, agency, and impact over outcomes. Often the only way to do this within a planning system or proposed infrastructure development is to object. This sets up a one-sided system in which only negative views are captured, and which people who might otherwise have something positive and constructive to share, provide objections as their only available route to expressing their agency and influencing the development.</td>
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However this need not be the case – residents and road users could be invited to help decide on aspects of a proposal, for example design elements which have no material impact on cost or performance. More consequential decisions could also be put to the public, albeit we suggest a deliberative forum would be better suited rather than a simple vote. Such votes are likely to detract some people away from mere objections, since they now have another way to express their agency; the community is more valued, and they have an opportunity to achieve the best of several possible outcomes.

The votes could also relate to something quite trivial (but no less engaging). For example, this might offer residents the opportunity to vote on the name of a new tunnel. Similar schemes have garnered positive media attention previously (for example, with the case of the expedition ship voted to be named ‘Boaty McBoat Face’. This puts a good-natured and humorous spin on media coverage, revealing those in charge of the development to be human and good –willing, not faceless and disinterested in the community).

<table>
<thead>
<tr>
<th>Public votes on details of proposals to engender sense of agency, and promote constructive engagement (Intervention idea PE10 from the longlist)</th>
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<tbody>
<tr>
<td>Allow residents or road-users to have meaningful input into decisions, for example by voting on details of a development or policy. Proactive and constructive engagement in this way is likely to reduce the amount of outright objection.</td>
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4. TRIAL: Recommended approach to rigorous evaluation, and implementation and evaluation strategies for the four prioritised interventions.
**TRIAL: Recommended approach to rigorous evaluation**

The following sections outline the recommended approach to rigorous evaluation. Subsequent sections 4a – 4d outline implementation and evaluations strategies for each of the four interventions.

### Identifying the right research questions

Evidence-based policy demands robust empirical evidence. The quality and relevance of this evidence depends on the quality and appropriateness of the research undertaken. However there are many ways to approach research design, many potential research questions to answer, and many research tools available to us. To avoid possible confusion from the outset, it is useful to put some structure to the different kinds of research question we might seek to answer. We break these down into four categories:

**Impact evaluation** – research intended to quantify the impact of an intervention or policy change on the outcomes of interest. Note that the outcomes on which we are quantifying impact may be ‘primary outcomes’, ‘secondary outcomes’, ‘intermediary outcomes’ or ‘proxy outcomes’. It is therefore vital to identify the appropriate outcome measure to answer the research question of interest.

**Primary outcome measures** – the metric of most importance to the research. In this case, pollution level, or the prevalence of a particular behaviour.

**Secondary outcome measures** – those which are either of subordinate or peripheral importance to the main research question (e.g. reductions in accidents, where the research is primary focussed on air quality), or those which make little sense in their own right but which add second-order detail to primary outcomes (e.g. if the primary outcome is the prevalence of eco-driving, a secondary outcome might be the extent to which eco-driving styles sustain after the intervention).

**Intermediary outcome measures** – metrics which are ‘en-route’ to the primary outcome measure. For example if testing the impact of an app on a particular behaviour, intermediate outcome measures may be the number of people downloading the app, and the frequency of its use.

**Proxy outcome measures** – imperfect/indirect metrics of something else we would ideally measure. For example, fuel consumption may be a proxy for eco-driving styles, or self-reported behaviour may be a (often weak) proxy for actual behaviour.

**Subgroup (segment) analysis** – research intended to illuminate variation in impact. For example different segments of the population may respond differently to an intervention. Segment analysis may be undertaken on primary, secondary, intermediate or proxy outcome measures.

**Process evaluation** – usually supplementary to an impact evaluation, process evaluations aim to understand the ‘how’ and ‘why’ of the intervention’s impact. It seeks to evaluate the mechanisms through which the intervention ‘works’, and understand the delivery of the intervention to identify any problems. A pure impact evaluation may only look at the final outcome of an intervention, whereas a process evaluation allows us to ‘open the black box’ and thus understand the impact evaluation in more nuanced terms.

This can help us infer when, where and with whom an intervention might work beyond the specific context of the particular trial, as well as how the intervention might be improved in its design or its delivery.

A process evaluation may also have its own segment analysis associated with it – i.e. does the mechanism differ for different segments of the population? Process evaluations are also integral to the development of a Theory-of-Change which aim to illustrate the mechanisms and logic of an intervention’s impact.

**Exploratory research** – research with no a-priori hypothesis being tested, but rather an open-ended exploration for interesting findings. Typically this involves data analysis looking for trends and non-causal relationships which exist in the data.

Note that here we are referring to exploratory research undertaken on data collected during a trial or experiment, distinct from the ‘explore phase’ described earlier (which may include focus groups, surveys, and data analysis ahead of a trial to understand the context of a problem or develop ideas for intervention).

Exploratory analysis is inherently less rigorous due to the very high risk of drawing false-positive conclusions (patterns within data will always exist by chance, and if we look for them with no prior hypothesis, we will find them).
TRIAL: Recommended approach to rigorous evaluation

Identifying the right research design (for impact evaluations)

With research questions identified, we need to choose the best research design. Here we focus primarily on research designs for impact evaluations, since this is usually the primary purpose of a trial or experiment. A wide range of options are available to us. Below we describe some of the most common and most robust methods, all of which are used frequently at BIT.

Randomised controlled trials

Randomised Controlled Trials (RCTs) are the ‘gold standard’ of field trial impact evaluation research designs. They aim to identify the causal impact of an intervention or some other change, on outcome(s) of interest. They do this robustly by incorporating two key components: 1. the presence of a counterfactual sample who do not receive the intervention (creating a ‘treatment’ and ‘control’ group), and 2. random assignment of the trial population into these groups. RCTs are not limited to just 2 groups: multi-arm RCTs may have multiple treatment conditions (e.g. different variations of a policy intervention, or different medical treatments) being compared against a single or multiple control groups.

The purpose of the control group is to identify what would have happened without the intervention. Without this counterfactual, it would be impossible to attribute any differences we see in our outcomes to the intervention, as opposed to other extraneous factors which may have been happening anyway (such as cultural, political and economic changes). The purpose of allocating the sample randomly is to ensure that receipt of treatment is not correlated with any other confounding variables: our groups must be balanced (like-for-like) on important observable and unobservable characteristics such that the only important difference is receipt of the treatment. Randomisation achieves this if the sample size is large enough (through the law of large numbers). However small samples risk ‘randomisation failure’ (imbalance between the groups on confounding factors). This is one of the two major reasons for having large samples in field trials, the other reason being to maximise statistical power (our chance of detecting an impact of the intervention, if one really exists) – see comments on ‘sample size’ later.

Note that random allocation is not the same thing as ‘random sampling’, by which we generate our whole trial population from a random sample of the wider population of interest, to ensure the results are representative of that sample.

We outline the basic structure of an RCT below.

![RCT Design Image]

Figure 2: RCT design

Note that by randomly allocating our treatment across a large sample, we can rely on the randomisation to ensure our two groups are balanced at baseline (before intervention). We therefore do not need to collect data before intervention. However, it is nonetheless common to run ‘balance checks’ to ensure randomisation has successfully created equivalent groups – statistical comparisons between the two groups on the outcome measure at baseline (if the outcome measure can be measured at this point) and other observable characteristics such as key demographic variables.
**TRIAL: Recommended approach to rigorous evaluation**

The main benefit of an RCT is that bias is avoided in the design of the trial, and therefore there is no need to statistically control for bias during analysis, which is invariably imperfect, as it can only ever be done on variables we have managed to measure.

**Quasi-experimental studies**

A quasi-experimental design is one which contains elements of a true experiment but elements which are missing. Most commonly this means the intervention has not been randomly allocated. Treatment may have been self-selected, for example if we were trying to evaluate the impact of an app on driving style where the app have been voluntarily downloaded by a fraction of the population. Alternatively, it may be that treatment has been randomly allocated, but we cannot rely on randomisation to create groups which are similar – for example, if testing the impact of new motorway prompts and randomly allocating this intervention to 3 out of 6 areas across the UK, we could not assume each trio of areas were comparable to each other.

Here the general aim is to try to recreate the conditions of a ‘true’ experiment as closely as possible, with the two main features of an RCT being our goal: 1. the presence of a counterfactual (control group), and 2. comparability between our control and treatment groups before the intervention is delivered (achieved through random allocation in an RCT, and achieved through other means with quasi-experimental designs). Two quasi-experimental research designs are most common and most reliable: Matching (of which many variants are possible), and difference-in-differences analysis (Diff-in-Diff). The two are also often combined.

These are essentially two strategies for overcoming the problem that our two groups are not comparable at baseline: matching selects portions of the original sample which are comparable, while a diff-in-diff accepts their difference, but aims to quantify and account for it in its estimation of the intervention’s impact.

**Matching (Exact matching, and Propensity Score Matching).**

If the intervention has not been randomly allocated, but allocation has been on the basis of some logistical or bureaucratic process, or selection has been voluntary, a control group formed from a random sample of the population is unlikely to be equivalent to the treatment group. This renders any comparison between them biased: for example, if testing the impact of an eco-driving app on emissions, we won’t know if the app has caused a difference in emissions, or whether people with less polluting driving styles were more likely to download the app.

Matching techniques therefore aim to create a control group which is matched to the treatment group on all important observable characteristics. This will always be imperfect because we can only match on observable characteristics, and some bias is still likely to exist on unobservables (albeit we benefit from the fact that the observables we match on will often be correlated with other unobservables).

Many matching methods exist. The first choice should generally be exact or coarsened exact matching, where each treatment participant is matched on every known characteristic to a control participant.

Often there are too many variables on which to match (‘the curse of dimensionality’). A suitable method in this case is Propensity-Score-Matching (PSM). PSM aims to identify the observable characteristics which predict someone’s propensity to have the treatment. For example, we might be able to predict who chooses to download an eco-driving app from age, income, education, ethnicity and geographic variables. We then build a control sample which, based on their characteristics, have the same propensity to adopt the app. The control group is therefore defined by similar characteristics which means they are just as likely to have adopted the app, albeit we know they did not. Note that this will not necessarily lead to individuals in each group having the exact same combinations of characteristics, as different permutations of variables might lead to similar ‘propensity scores’ (likelihood of receiving treatment). Balance checks, including (if possible) on the primary outcome measure before intervention, are used to check the strength of the match.

Without matching or random allocation, a simple comparison between group A (with the treatment) and group B (without the treatment) would be a basic cross-sectional study subject to severe bias. This simplistic approach should be avoided.
TRIAL: Recommended approach to rigorous evaluation


An alternative solution for a non-randomly allocated treatment, is to accept that the two groups are different at baseline (before intervention), but to measure and account for this difference. This is possible if we can measure our outcome variables before intervention. Sometimes this is straightforward because we can retrospectively access data (as with energy billing data, for example). Other times this must be considered in advance of the intervention being delivered, to include an extended period of baseline data collection.

The principle of a difference-in-difference is therefore to measure the difference between the two groups before the intervention is delivered, and again after the intervention is delivered. It is the difference between the differences which can be attributed to the impact of the intervention itself. We illustrate this simple logic of a diff-in-diff design below.

Note that if we did not account for the pre-existing difference between our treatment group and control group, in the above illustrated example we would grossly over-estimate the impact of the intervention. Such cross-sectional studies should therefore always utilise random allocation or matching to negate any pre-existing difference, or measure the pre-existing difference between groups in a diff-in-diff design. If we did not have a control group at all, and simply took a before-after measurement in the treatment group, we would suffer the problem of a missing counterfactual. This would be a simple longitudinal study, though again in the above example we would severely over-estimate the impact of the intervention as the outcome measure was trending upwards anyway. Simplistic longitudinal studies without a control group should therefore be avoided.

Laboratory experiments

The laboratory (online or not) offers a controlled environment in which to test hypotheses. Their main advantage is that the researcher has great control over all factors, and usually has the opportunity to measure things with great precision and specificity. This means, for example, we could measure such things as eye-movement when testing the design of in-car feedback, or specifically test retention of information if testing newly designed correspondence. By having such control over extraneous factors, we can be highly confident that measured effects are attributable to the intervention being studied, i.e. they have very high internal (causal) validity.

However their main drawback is weak external validity (our ability to generalise the result to real-world contexts). There are often many reasons why a result identified in a lab would not be observed in the real world. This can sometimes be partially addressed, for example introducing real financial incentives to mimic real-world decisions. As with all research designs, we should use the appropriate tool for the job, and these pros and cons should be borne in mind when considering a particular research question.

We often use laboratory studies as a precursor to a field trial, for example to test multiple variants of an intervention, or small elements of that intervention, in detail and in a manner which is often quicker and cheaper than a field trial. We then take the most promising intervention design into a field trial (typically an RCT).
TRIAL: Recommended approach to rigorous evaluation

Surveys, focus groups and interviews

Surveys, focus groups and interviews are not research designs. They are research tools for the collection of data. All of the above research designs (RCTs, quasi-experimental, lab experiments) could use surveys to collect outcome measures, such as self-reported miles driven. Alternatively we might use surveys to collect other demographic data to run balance checks, to assist with our matching, or to feed into our statistical analysis as control variables.

As with any research tool, when using surveys to collect data we should consider whether it is the best tool for the job. Surveys are clearly appropriate for subjective outcomes (such as journey comfort). However as a proxy measure for actual behaviour (e.g. asking someone how often they drove to work, rather than measuring it directly) they are flawed due to our tendency to misremember, and bias our response to that which we think is expected of us. This is particularly true where the survey question asks respondents to forecast their behaviour (e.g. asking people what they will do in response to an intervention), as our self-reported intentions often do not translate to action. It is generally best to avoid self-reported proxies for behavioural outcomes wherever possible, except where self-report bias is likely to be minimal and it is the only feasible way of capturing data.

Focus groups, interviews, ethnography and other qualitative research are generally less suited for quantifying outcomes, due to lack of precision and researcher bias: these tools are unavoidably subjective and interpretive to the observing experimenter. However they bring value by capturing great depth of insight. For example, they are valuable for process evaluations to understand the mechanisms, customer journey and experiences of an intervention. They are also useful in early exploratory research to create hypotheses, or to aid the design of an intervention through a better understanding of the problem and the people we are delivering the intervention to.

Ultimately we must aim to use the most appropriate tool for a particular purpose, and employ this tool within a robust research design. It is relatively common to see surveys used poorly (e.g. with poorly worded questions), or where they shouldn’t be used at all (e.g. where a physical outcome measure is available and would be more reliable), or used within a poor research design (e.g. with no control group, nor baseline data, but simply asking people of their experiences of an intervention). Here, however, the problem is not with surveys per se, but with their poor application, or their use within a research design which is fundamentally weak regardless of the research tools being used to collect data (surveys or otherwise). For example, asking someone who has just received eco-driving training whether they intend to use any of the taught methods, would not constitute strong evidence of the impact of the training course: a survey is a sub-optimal tool because self-report bias is likely with participants answering as is expected of them, or being unrealistic about their intentions. Moreover, the research design is weak due to a lack of counterfactual and lack of baseline measures.

Non-compliance

Non-compliance may occur with treatment. For example, if our intervention is the provision of an eco-driving app, we cannot force people to download and use the app, and so only a self-selected fraction of our treatment group will be truly treated.

To address non-compliance and self-selection bias we can draw upon the quasi-experimental designs described above, for example running a difference-in-difference analysis or creating a matched control group from the original control group (or a combination of both).

Alternatively it may be more appropriate to run an ‘intention to treat’ analysis (ITT). An ITT compares all those offered the app to all those in the control group. In other words we use the groups originally intended for the RCT, measuring the impact not of the treatment itself, but of the intended treatment. This will be a diluted estimate of the true treatment effect because it includes those who didn’t use the app. This is a robust approach, free of bias, albeit answering a different research question: not “what is the impact of the app on those who use it?” but “what is the average impact of providing the app, across a population including those who don’t use it?” Not only is an ITT robust, but it is also often the more relevant policy question, since we rarely mandate adoption of a policy intervention, but must recognise some self-selection and non-compliance in the population. If the researcher wants to know the impact of the intervention on those who actually adopt it, an average treatment effect on the treated (ATT) can be estimated from the ITT.

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**TRIAL: Recommended approach to rigorous evaluation**

**Statistical power and sample size**

Statistical power is our ability to detect a difference between two populations (i.e. to detect an impact of an intervention) if a difference is truly present. The larger the sample, the more able we are to detect a small difference and deem it statistically significant (that is, highly likely to be real and not merely due to chance). The intuition of this can be explained as follows: If we believe a coin to be unfairly weighted, we might toss it multiple times to test this hypothesis. If we toss it 4 times and receive 3 heads (75%) we cannot draw confident conclusions: there is a fairly high probability that this outcome could be observed purely by chance. If, however, we toss it 4000 times and receive 3000 heads (75%), we can be highly confident the coin is weighted (the probability of this happening by chance is extraordinarily small).

We therefore run power calculations to determine the sample size required for a trial. This is a function of the ‘power’ (the chance we have of detecting an effect if there is one present, conventionally set at 80%), the threshold of statistical significance (the certainty we require to conclude that an observed difference is real, conventionally set at 95%), the level of natural variation in the data (more variation masks the effect, so larger samples are required), and the effect size we expect or need to be able to detect (smaller differences between groups require larger samples to detect, e.g. in the above example, if we received 60% heads instead of 75%, we would need to toss the coin more times before being sure it was weighted).

**Randomisation strategy and clustering**

When we randomly allocate our intervention to a sample population, we must be wary of spillover and contamination. Spillover occurs where those in the treatment group interact with the control participants, who therefore indirectly benefit from treatment. For example, if testing an educational intervention and delivering it to one class, using another class as a control group would risk spillover if the two classes talk to each other about it. Contamination occurs where control participants directly receive treatment, e.g. because treatment is delivered in one region, and control participants from another region travel into the treatment region.

Both spillover and contamination undermine our ability to robustly estimate the true impact of the intervention. The most common solution is to ‘cluster’ treatment delivery, randomising by, say, classroom or perhaps by school, even though the unit of our outcome might be from individual pupil (e.g. test scores). This keeps treatment and control groups isolated.

However, this comes with trade-offs. Our statistical power is usually reduced because we have fewer truly independent observation: each observation within a single cluster will be correlated. We also risk randomisation failure, since randomising 10 schools into two groups of 5 will less reliably give us comparable treatment and control groups than randomising the 2000 pupils at those 10 schools into two groups of 1000.

Therefore it is best to randomise at the ‘lowest’ level possible without risking spillover or contamination (where randomising the sample into groups ‘by pupil’ is lower than ‘by classroom’, which is lower than ‘by school’).

**Representativeness**

A finding is considered representative if it can be generalised to the wider population to which the intervention might apply. For example, if we only run a pilot experiment in one region, we may be unable to generalise results to other regions, if other regions differ on important characteristics. Similarly if severe self-selection bias occurs such that only a particular ‘type’ of person receives the intervention during a trial, we may use matching or another quasi-experimental technique to generate a comparable control group and thus robustly estimate the impact of the intervention on that group of people, although the result might not be representative of the wider population.

It can be helpful to run representativeness checks on the treated sample population, comparing their key demographics against datasets from the wider population (for example national datasets such as the indices of multiple deprivation).
4a. **TRIAL 1:** Implementation and evaluation strategy 1. Eco-driving app.
Trial Design, implementation and evaluation

The following sections outline an implementation plan and research design for robust evaluation of the impact of the eco-driving app. These recommendations are intended to be preliminary, and all technical details of the evaluation design will require further consideration once the precise nature of the app is determined.

Research questions to be addressed

The development and deployment of an app with multiple features raises many possible research questions. The most important are those relating to the overall impact of the app on driving style, the impact of its specific features on driving style, as well as those aiming to understand differential impact and use among different population subgroups. Three priority high-level research questions are therefore identified:

Impact evaluation:
**RQ1:** What is the impact of the app on users’ driving style (to be defined) / emissions?

**RQ2:** What is the impact of <specific app feature> on users’ driving style (to be defined) / emissions?

Subgroup analysis:
**RQ3:** What differences emerge in the way that different app user segments alter their driving style (to be defined) / emissions in response to the app?

Each of the above three research questions may also have secondary questions assessing the impact on a secondary outcome measure of customer usage (i.e. frequency and duration of use of the app and number of downloads).

Research design – overview

A 2-part research programme can address the above research questions as follows:

**Addresses RQ1 and RQ3.** A pilot randomised controlled trial to determine the overall impact of the app, recruited through a screening survey to identify willing participants. This RCT may include subgroup (segment) analysis.

**Addresses RQ2 and RQ3.** An ongoing succession of randomised controlled trials among those who have adopted the app, testing the impact of specific feature variations. This would be undertaken in much the same way that major websites such as Amazon and Facebook might regularly run A/B tests to trial different versions of their websites in a process of continuous innovation and controlled testing. These RCTs will also include subgroup (segment) analysis.

Each part is described in turn below

Research design – part 1 (pilot RCT)

**Trial design and implementation**

One of the major challenges in evaluating the impact of the app is that the natural data source is the app itself. This makes an RCT challenging as it is not possible to collect data from a control group who do not have the app. The most appropriate strategy is therefore to recruit participants who are willing to use the app and randomly assign the app to half of those volunteers, with a comparable data-collection device (e.g. the app with all features disabled) allocated to the control group.

This design provides the highest rigour and causal inference, however, potential challenges include the inability to have a large enough sample size due to the need to provide (monetary) incentives to attract participants, as well as any hardware costs associated with data collection in both groups.
The intervention logic map adjacent outlines the implementation of the pilot RCT. Participants are recruited through a screening survey distributed to a large representative UK sample, for example through one of the many available marketing panels which enable the researcher to pre-select on certain characteristics (for example, being over 18, living permanently in the UK, and owning a car). The survey will include questions on driving habits and attitudes, and any relevant demographic variables not already available through the survey platform.

The final survey question will invite respondents to partake in a 7 month trial in return for compensation, and will explain in high-level terms the nature of the trial, what is required of the participants (installing an app, installing a small device in their car, and answering further surveys in 7 months’ time). At this point participants should not be given details about the nature of the study (relating to eco-driving, emissions or fuel consumption), or any such clues which may bias sample selection to people with an inherent interest in these matters.

Representativeness checks should then be run on the willing volunteers, by comparing them to all respondents to the initial survey. If they are not representative of the wider sample, then a representative subgroup of the willing volunteers should be selected. This final sample is then randomly allocated to treatment and control. At this point a ‘basic’ app which captures the necessary data but has all behavioural and user-facing elements disabled, is installed in both groups, alongside an OBD device to capture richer data (we suggest doing this for the purpose of the trial even if the app will not ultimately have a hardware component).

For one month, baseline data on driving behaviour is collected from both groups. Because random allocation into treatment and control groups has been employed, and assuming the sample is relatively large, the two groups should be comparable at baseline. Nonetheless it is wise to capture data to corroborate this assumption.

After one month the treatment group will receive the full app and instruction on its purpose and functionality (not to the extent that they are being unduly encouraged to use it and change their behaviour, but to the extent that anyone ‘in the real world’ who chose to download the app would understand its purpose and functionality). Data collection then continues for 6 months. The control group would receive no instruction, and from their perspective they are merely being monitored for a 7 month period.

At the end of the trial period a follow-up survey should be undertaken, serving a number of purposes. First, the same driving habit and attitudinal questions asked during the screening question should be re-asked in both groups. This captures any changes in self-reported driving style and attitudes caused by the app. Second, the treatment group should be asked a series of questions designed to understand their experience of and use of the app. This helps form a more thorough process evaluation to reveal the mechanisms through which the app was or was not effective.

Figure 4: Eco-driving app implementation plan
Third, both groups should be asked a set of final screening questions, removing participants from the analysis if they fail to meet certain criteria. For example, those who have bought a new car over the trial period should be excluded. Other major life changes, such as moving home or moving job, may or may not warrant exclusion, but certainly balance checks should be run between the two groups on these factors. Throughout the trial, app usage data should also be collected to measure compliance levels, with a pre-defined threshold for being a ‘user’. This will enable an Intention-to-treat (ITT) analysis, estimating the effect of having (but not necessarily using) the app, and an Average-treatment-effect-on-the-treated (ATT) analysis, estimating the effect of actually using the app (see previous comments under ‘compliance’ in Section 4 for explanations of these approaches).

Finally, within the treatment group detailed interviews should be undertaken with a small sub-sample to further shed light on the experiences of using the app.

**Sample size considerations**

Power calculations should be run to identify the necessary sample size. These power calculations depend on the expected impact of the app (currently unknown, but likely to be modest, <10% of fuel consumption), the required statistical power (conventionally 80%), the required significance threshold (conventionally 95% confidence), the variation in the outcome measures at baseline (currently unknown, but likely high as driving distances and styles vary greatly), and the available data on the participants (the more covariates, i.e. other variables which partly determine driving style and fuel use, the more of the ‘variance’ is explained and thus increase statistical power). Power calculations have not been undertaken but based on the likely modest impact, and likely high variance in baseline data, the required sample is likely to be in the order of thousands of drivers.

**Outcome measures and data collection**

The precise outcome measures which are feasible will depend on the sophistication of the app once developed, and on the ability to augment the app (for the purpose of the trial, and/or as part of the product itself) with additional hardware. The use of hardware in addition to the phone itself is strongly recommend to collect richer data, for example a Bluetooth device connected to the vehicles OBD port which can provide data on speeds, fuel consumption, odometer readings and more.

A range of metrics will have to be developed for the purpose of the app itself (in order to set targets, give real-time feedback, and moderate competitions and social comparisons, for example). Most of these metrics would form the basis of the outcome measures during the trial, even though the user-facing aspects of these would not be accessible to the control group. These will likely include:

**Outcome measures for impact evaluation:**
- Total distance travelled in car.
- Number of trips taken, and average trip length.
- Total fuel consumed, and average fuel consumed per km.
- Average speed relative to speed limit of road being driven on (i.e. compliance).
- Metric of harshness of acceleration and braking (metrics would need to be developed).
- Consistency of speed.
- Frequency of driving at high revs.
- Money saved through changes to driving style.

**Outcome measures to aid process evaluation:**
- App usage (number of visits per day, duration of visits) (also critical to track compliance with treatment).
- Surveyed experience of the app, and user satisfaction.
- Self-reported changes in behaviour (including speed, harshness of acceleration, revs, consistency of speed).
- Attitudes towards driving style.
- Awareness of cost savings.

**Demographic and attitudinal characteristics to aid sampling, balance checks:**
- Attitudes towards driving.
- Metric of technological know-how.
- Basic demographics (age, income, gender, location, family status).
- Type of vehicle.
**TRIAL: Implementation & Evaluation**

**Strategy 1: Eco-driving app**

**Implementation challenges and further considerations**

It is likely that the sample size may be limited by the expense of compensating participants and costs associated with any hardware for data collection. More data, and better quality data, from running the trial for longer and using richer sources of data, will enable a smaller sample size due to the greater statistical power that more observations provides.

One consequence of a limited sample size is a restriction on the extent to which segment analysis is possible, particularly where populations segments are small. This presents a strong case for having a large sample, to understand the differential impact of the app on different groups of users.

**Research design – part 2 (ongoing, feature-specific RCTs)**

**Trial design and implementation**

The above pilot RCT aims to quantify the overall impact of the app. Also of interest is the impact of specific features. In many ways this is an easier research exercise because the treatment and control groups would both have the app, with the treatment group having access to a particular feature which the control group does not. This allows the researcher to draw upon a large sample of people who have opted-in to downloading and using the app, and to capture equivalent data from both groups through the app itself (and any hardware that is integral to the product).

The suggestions is to undertake this research in an iterative fashion of constant testing and improvement similar to that undertaken by many major websites such as Facebook and Amazon: these organisations constantly make alterations to their service, randomise which IP addresses receive the new version and which see the existing version, and then ascertain which is ‘best’ on various metrics (customer retention, time spent on site etc.). The best version then becomes the new ‘standard’ and is the starting point against which another variation is tested. In this manner it is possible to test the impact of new and existing features by gradually enabling them within a large population. The adjacent implementation plan illustrates this approach. Each comparison would be a conventional RCT with random allocation into treatment and control.

**Figure 5: Intervention plan**
**TRIAL: Implementation & Evaluation**

**Strategy 1: Eco-driving app**

**Sample size considerations**

The sample size requirements will be similar to ‘part 1’ above, albeit obtaining a larger sample should be more feasible since this trial draws on the existing customer base with no significant marginal cost to adding customers to the trial. It is therefore recommended to have as large a sample as possible to enable precise estimates of impact, even where the impact is very small. This population will not be representative of the wider UK population, but will be representative of the population who have the app.

**Outcome measures and data collection**

All outcome measures listed under the ‘impact outcome measures’ for the pilot RCT would also be captured here, as well as customer use of the app (time spent on it, number of visits etc.). The duration of each RCT would depend on the number of observations required to achieve adequate statistical power (which depends on a number of other unknowns, including the sample size). It is likely that each RCT would last for a few months.

It is also recommended that when users first download the app, they are required to fill in a short survey to capture basic demographic information, as well as information on their self-reported driving style and the vehicle they own. This information can be used to run balance checks each time an RCT is run, as well as to run segmentation analysis identifying differential impacts of certain features on certain demographics. In this way, powerful segmentation analysis would allow the app to be tailored based on features which are proven to be more effective for certain groups.
4b.

**TRIAL 2:** Implementation and evaluation strategy 2. Speed compliance prompts.
**TRIAL: Implementation & Evaluation**

**Strategy 2: Speed compliance prompts**

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**Trial Design, implementation and evaluation**

The following sections outline an implementation plan and research design for robust evaluation of the impact of the speed compliance prompts. These recommendations are intended to be preliminary, and all technical details of the evaluation design will require further consideration once the precise nature of the interventions, and the availability of data and of stretches of smart motorway, is determined.

**Research questions to be addressed**

The proposed evaluation is foremost an impact evaluation with little need for additional process evaluations or exploratory research. As such, there is a single key research question to address:

**RQ1:** What is the impact of the speed compliance prompts on driving speeds?

**Research design and implementation**

As is often the case when designing an impact evaluation, a good starting point is a Randomised Controlled Trial, from which the limitations and restrictions are identified, and adjustments to the research design made from there. In this instance, the aim is to randomise which drivers see each of the signs being tested. There are two potential ways to do this: 1. randomise by road (identifying several stretches of smart motorway, with different signs on each); 2. randomise by day or week (displaying signs on some days, and no signs (control condition) on other days, on a given road).

The main challenge with randomising by road is that the counterfactual will be weak. For example if the ‘simple prompt’ 70mph sign is on a stretch of the M25, and the control condition (no sign) on the M6, with average speeds compared between the two, there will be many confounding variables which are likely to obscure any true impact of the signs. A matched-sample approach does not address this problem as there are not enough stretches of smart motorway to create well-matched pairs.

Moreover, a differences-in-differences approach is likely to fall foul of the underlying assumption of parallel trends; in other words, natural changes in speed on one road (e.g. due to congestion) are unlikely to be synchronised to similar changes in speed on other roads (a busy day on the M6 will not necessarily coincide with a busy day on the M25).

The alternative approach, randomising by day or week, should therefore be considered. The main challenge with this approach is contamination. Many drivers drive the same journey repeatedly, which means they would be exposed to both the treatment and control condition. This is only a problem if the effect of the signs lasts for more than a few days. The hypothesis is that many of the prompts would not have a lasting impact, but would only be effective in the moment. However some of the treatment messages (in particular those which inform the driver of the number of people who are caught speeding, and the number of people who are killed) may have a lasting impact on drivers’ attitudes and beliefs. Therefore, the impact from treatment during week 1 would contaminate the control condition in week 2, etc.

Neither approach is perfect, but on balance the recommendation is to randomise by week. With 7 messages to test, 7 or 14 stretches of smart motorway should be identified to randomly allocate one or two per treatment condition. The assumption is that at least 7 should be achievable, for example it might be possible to identify as many as four stretches on the M25 alone, plus some sections of the M1, M6, M60, and M4. Each road then has its sign displayed (treatment week) or not (control week) on random basis. Whether or not a week is treatment or control should be consistent across all roads so that if there are any particularly unusual weeks (e.g. very heavy traffic at bank holidays) all treatment arms are affected simultaneously, ensuring the comparison between treatments arms is still valid. Speeding data is then compared between those weeks when the sign is showing and when the sign is not, for each road individually, to get an estimate of the impact of each sign.

One additional recommendation is to have ‘separation weeks’ between each week of data collection. On these weeks, nothing will be shown, and data not included in analysis. This reduces the risk that treatment weeks will contaminate subsequent control weeks, due to short-term lasting impacts of the signs.
The implementation of this design is illustrated below. Note this is a ‘within-road’ comparison, i.e. comparing speeds on a particular road to itself, with and without the intervention. The randomisation over time helps remove any extraneous time-trends which would otherwise confound a more simple within-road comparison (e.g. in a simple longitudinal or before-after study).

### Outcome measures and data collection
The precise outcome measures which are feasible will depend on the kind of data currently collected, and the availability of technological solutions to collect new data. Ideally, individual-vehicle data would be collected:

- Vehicle speed (per vehicle)
- Time (i.e. a time-stamp associated with the vehicle speed data)

From the above, the following can be inferred:

- The proportion of vehicles going above 70mph (per road), or some other pre-set threshold, e.g. 75mph.
- Among vehicles going above 70mph, the extent to which they do so (average speed among all vehicles, or average speed among speeding vehicles)
- Congestion (e.g. number of vehicles per hour)

Congestion may be used as a control variable in regression analysis. Other variables may be collected for the same purpose, including weather (e.g. level of precipitation).

If speed data is not captured for every vehicle through existing smart motorway infrastructure, temporary on-road sensors are also possible.

### Sample size considerations
Power calculations should be run to identify the necessary sample size. These power calculations depend on the expected impact of the app (currently unknown, but likely to be modest), the required statistical power (conventionally 80%), the required significance threshold (conventionally 95% confidence), and the variation in the outcome measures at baseline (currently unknown, but likely high). Also note that we assume it is possible to collect data at the level of the individual vehicle (i.e. speed). However our intervention is delivered at the level of the road. As such this is a ‘clustered’ trial, and we expect the intra-cluster correlation to be high (that is, the speeds of vehicles on a given road at a given moment will be correlated, since they are heavily influenced by factors at the cluster level, e.g. weather and congestion). This increases the necessary sample or duration of the trial.
The researcher has no control over the number of vehicles using the roads, nor over the number of smart motorway stretches available – only the number of treatment arms, and the duration of the study, can be controlled to achieve statistical power. Running the trial for longer both increases power, and (by corollary) reduces noise in the data as any week-to-week fluctuations in speed will average out. It is therefore recommended that the trial be run for a year, bringing the additional advantage of being able to test the impact of the signs over a longer time period. This is particularly important for this intervention which in part depends upon the salience and novelty of the signs.

Implementation challenges and other considerations

Provided data collection is feasible, the trial should not present any major challenges to implement. Until baseline data is collected, and power calculations run, it is difficult to ascertain whether statistical power is a concern or not. In the researchers’ favour, there is a very high number of observations (assuming individual vehicle data is available).

Also important is the fact that smart motorway signs will not always be available to deliver the intervention, as at times they will be displaying a speed limit lower than 70mph as part of ongoing traffic management. It is suggested that the intervention is simply delivered to plan whenever the signs are available to do so, with a record kept of when the signs were not available, with these periods excluded from analysis, and balance-checks run between treatment and control weeks on sign availability.
**TRIAL: Implementation & Evaluation Strategy 3: bumper stickers for clean vehicles**

**Trial Design, implementation and evaluation**

The following sections outline an implementation plan and qualitative research design for evaluation of the impact of the eco-driving app. These recommendations are intended to be preliminary, and all technical details of the evaluation design will require further consideration once the precise nature of the app is determined.

**Research questions to be addressed**

Ultimately, the long-term research question of interest is to assess the impact of the bumper stickers on future vehicle sales. However, this outcome is very long term, and a controlled experiment likely to be impossible due to severe spillover effects (an inability to maintain isolated treatment and control groups over a long period). A two-step, mixed-methods approach is therefore proposed instead, with the objective of understanding the perception of the bumper stickers among road-users in an effort to explore the hypothesised underlying behavioural mechanisms. Four research questions have therefore been identified:

**RQ1:** How do people perceive bumper stickers as an idea to make clean cars identifiable?

**RQ2:** How do people like the idea of attaching incentives (such as free parking) to the bumper stickers?

**RQ3:** How will the increased visibility of clean cars affect people’s attitude towards those and also their purchasing intentions and behaviour?

**RQ4:** What are the perceptions around the prevalence of electric vehicles (before and after bumper stickers)

**Research approach**

An exploratory mixed method approach is proposed to answer the above research questions. First, a qualitative research phase explores questions 1, 2 and 3 in-depth with participants. Thematic analysis of the findings can be used to further understanding of people’s reaction to the bumper stickers.

In a second phase, with the intervention rolled-out, a large-scale survey should be undertaken to track people’s perceived prevalence of, and attitudes towards, electric vehicles (EVs). This is to respond to question 4. The idea behind this survey is to shed light on the underlying hypothesis that people are likely to underestimate the prevalence of EVs and clean combustion vehicles, and be broadly unfamiliar with them. As awareness and familiarity increase, so should positive attitudes towards them.

**Phase 1: 10 Focus groups + 20 in-depths interviews**

In this first phase, focus groups and interviews will address questions 1-3. These are about people’s perceptions of the intervention idea itself and how, or if, they will expect it to influence their awareness and fondness of clean vehicles. For example, underlying hypotheses relate to the ‘virtue signaling’ power of the stickers which depend upon users actually wanting to have them on their car – this can be tested through self-reported attitudes. Other hypotheses relate to the under-estimated prevalence of clean vehicles, which can also be discussed during focus groups. These sessions will also provide opportunity to explore different designs of the stickers to maximize their appeal (since the intervention depends on them being used), as well as their salience, and intuitive interpretation.

In creating the focus groups, a spread of demographics should be captured, including on the following characteristics:

- Income level
- Urban and rural residence
- Current car ownership
- Driving habits (commuting behaviour, frequency of car usage, etc.)
- Awareness of air quality issues
- Environmental attitudes
In each of the groups, discussion will include the following topics:

- Factors that influence their decision to buy a new car, or to replace the old one
- Understanding of what ‘clean vehicles’ are
- Perception and attitudes towards bumpers stickers on their own cars
- Expectations around how likely they are to notice the bumper stickers on other people’s cars
- Attitudes towards the attached incentives, such as free parking
- Perceived benefits of clean vehicles

From each focus group, 2 participants should be identified for in-depths interviews, in order to explore some of these themes in more detail. Thematic analysis would provide an understanding of key trends and themes from the focus groups and the interviews, and should be undertaken explicitly to shed light on the underlying behavioural mechanisms of the intervention.

Phase 2: National surveys
In this second phase, assuming the intervention is taken forward and rolled out fully, the objective is to track shifts in perceived prevalence of and attitudes towards clean vehicles as a result of the bumper stickers. This is to be done through repeated surveys to create a longitudinal dataset, specifically several months before the intervention has been rolled out (to collect baseline data), at the point of roll-out, several months after roll-out, and potentially every several months or year thereafter. By tracking perceived prevalence and attitudes towards EV, we test the hypothesis that the bumper stickers will both increase awareness (and thus perceived prevalence) and favourable attitudes towards EVs (on the basis that we are more favourable towards that which is perceived as normal and familiar), and thereby address research question 4.

If a control region can be created (for example, rolling-out the bumper stickers in England but undertaking the survey in Scotland, Wales and Northern Ireland as control regions) it will be possible to approximately track the effect of the stickers on awareness, as distinct from background increase in awareness that might naturally be expected over time. Additionally, measuring perceived prevalence and comparing it to actual prevalence in the areas where respondents live gives a good indication whether there is a gap, and whether that gap is closing as a result of the bumper stickers.

Engaging with local authorities, it may be possible to create multiple smaller treatment and control regions across the UK, rolling-out the stickers in a ‘step-wedge’ design (with all regions receiving the policy, but not all at once, so that at any given period it is possible to compare regions with the stickers to those without).

It would theoretically be possible to track vehicle purchasing data in England subsequent to roll-out of the stickers, and compare to other regions of the UK. However, as a controlled experiment this is a flawed approach as the counterfactual would be weak: other policy measures specific to the different parts of the UK would be major confounders, as would different attitudes among these populations.

Moreover, spillover would be a problem with vehicles driving and being sold across borders, and media attention spreading. Given the long-term and likely modest impacts the stickers would have on vehicle sales, it is unlikely that this approach would yield robust findings.

Sample considerations
As indicated above, the participants for the focus groups and the interviews will be purposefully sampled (purposive sampling) by achieving a good representativeness between the groups on the basis of some the variables listed above. For the national surveys, the sample should be larger and nationally representative.

Implementation challenges and other considerations
The most significant challenge to the success of this intervention is to get car owners to put the bumper stickers onto their vehicles. One way to do this would be to mandate manufacturers to attach them to all eligible new vehicles sold, and mandate dealerships to do the same for second-hand vehicles. Though owners would be free to remove them, the default would be to leave them on (with defaults tending to have a powerful influence on our behaviour). In any case, the intervention does not require 100% of eligible vehicles to display the stickers. For those vehicles already in ownership which are eligible, an effective mechanism may be to distribute them upon renewal of vehicle tax through the DVLA, since vehicle and address information is available.
Another effective way to promote the uptake of stickers among eligible vehicle owners is to attach incentives to their use. This not only increases the likelihood of eligible vehicle owners using them, but also adds an incentive to purchase a clean vehicle in order to be eligible for the stickers. These incentives may include free parking (through local authority collaborations), free/discounted entry to clean air zones, or more ambitiously, dedicated lanes on motorways of use of bus lanes in cities.

It is also worth considering in further detail whether bumper stickers should apply to all ‘clean’ vehicles, or only to EVs (or to both but with separate designs). The behavioural mechanisms underpinning the benefits of the intervention to each class of vehicle may differ – for example, harnessing the availability heuristic (increasing the perceived commonality of the vehicles) may be particularly appropriate for EVs, since they are a distinct category of vehicle likely to be under-recognised (since they do not look distinct, whereas a recognisable bumper sticker would distinguish them). This argument is less strong for clean combustion vehicles, since they are not a distinct category to which we might attribute awareness and recognition, but rather are one end of a spectrum of vehicle efficiencies. It is therefore recommended that as part of the qualitative research the pros and cons of using separate sticker designs for EVs and clean combustion vehicles is explored.
TRIAL 4: Implementation and evaluation strategy 4. Disgust-based social marketing campaign
Trial Design, implementation and evaluation

The following sections outline an implementation plan and qualitative research design for evaluation of the impact of a disgust-based social marketing campaign, aiming to raise public awareness and engagement with air pollution, ultimately to help drive forward necessary policy developments to protect the public from the effects of air pollution. In this case we frame the evaluation strategy around two hypothetical scenarios of building consent for 1. a speed limit reduction to 60mph, and 2. the building of roadside air pollution barriers. However this is intended to exemplify the approach, which is not specific to the policies being pursued.

These recommendations are intended to be preliminary, and all technical details of the evaluation design will require further consideration once the precise nature of the app is determined.

Research questions to be addressed

The key impact evaluation questions center around the effectiveness of the proposed campaign, as follows:

RQ1: What is the impact of a social marketing campaign (harnessing the feeling of disgust) on the average level of consent towards proposed policy interventions?

Moreover, the main hypotheses underpinning the intervention are that 1. disgust drives attitude change and thus consent for intervention, and 2. different messengers with different levels of credibility and recognisability are key to driving consent. As such, two process evaluation questions emerge to understand whether these underlying mechanisms are valid:

RQ2: What is the correlation between subjective levels of disgust (in response to campaign materials) and the level of consent for a speed limit of 60 mph/ roadside barriers?

RQ3: What is the correlation between credibility / recognisability / trustworthiness of branded organisation and consent for a speed limit of 60mph/ roadside barriers?

Research approach

A two-stage research design is proposed. First, a series of online experiments to prototype a variety of messages, to identify which messages evoke the strongest reaction, and to test the hypotheses associated with research questions 2 and 3. The findings from this phase would inform the design of the final campaign. Second, a field trial evaluates the impact of the campaign on consent for on-road and off-road policies, addressing research question 1.

Part 1: Online experimentation design

It is proposed that the campaign is built around a particular messenger (e.g. Highways England, or the NHS), a particular ‘disgust’ element (e.g. graphic images) and a particular framing of the consequences of air pollution (e.g. framing it in terms of the number of cigarettes smoked, or in terms of months of life lost). With this three-part campaign in mind, Part 1 uses an online testing platform to test and compare the various options for each element of this campaign. This is done in order to simultaneously identify the most effective elements (from which a ‘greatest hits’ campaign can be built) whilst also addressing research questions 2 and 3 by ascertaining to what extent disgust, and trust (in the messenger) is associated with consent for government intervention on air pollution.

Participants would be shown campaigns built from random permutations of messengers, disgust elements and framings, drawing upon the elements below.

<table>
<thead>
<tr>
<th>Messengers</th>
<th>Disgust elements</th>
<th>Framing of consequences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highways England</td>
<td>Graphic images (a la cigarette packs)</td>
<td>Equivalent cigarettes smoked</td>
</tr>
<tr>
<td>NHS</td>
<td>Description of particulates</td>
<td>Equivalent cigarettes your child is smoking</td>
</tr>
<tr>
<td>Public Health England</td>
<td>Combination of images and description</td>
<td>Years of life lost</td>
</tr>
<tr>
<td>Chief Medical Officer</td>
<td></td>
<td>Lives lost to air pollution in the UK each year</td>
</tr>
</tbody>
</table>
Participants’ self-reported level of disgust (in response to the campaign they are shown), level of trust (in the messenger) and level of consent for government intervention would be measured. Retention questions may also be asked to ascertain how memorable the framing is (e.g. asking how many cigarettes smoked is equivalent to living in London, if that was the framing presented).

Correlations between disgust and consent, and between trust and consent, address research questions 2 and 3. The permutation with the highest consent determines the campaign to be rolled-out in the field in part 2. Basic question relating to environmental attitudes, attitudes to driving and other individual characteristics would also be asked for the purpose of controlling for any differences between groups.

**Part 2: Field trial**
The most impactful elements from Part 1 are to be combined into a coherent campaign. To test this campaign in the field, three conditions are to be compared: a control region receiving no campaign, a treatment region receiving the campaign, and a second treatment region receiving the campaign in addition to a similar targeted campaign promoting road-side barriers (on the basis that these communities are very geographically specific, and thus would likely be exposed to the wider campaign, and targeted with materials specifically related to the erection of barriers.

Circa 15-20 local authorities spread across England should be recruited, with their residents then surveyed on their attitudes towards, and knowledge about, air pollution and vehicle emissions, driving, and the environment, as well as their current level of consent/acceptance of lowering speed limits and having roadside barriers installed in their area. This provides baseline data which, in combination with basic demographics (age, income, ethnicity) should be used to create three matched groups (with several regions in each). The three groups are randomly allocated to 1. control, 2. general campaign, and 3. general campaign plus specific roadside barrier campaign. After the campaign is rolled-out, residents in all local authorities will again be surveyed about their attitudes to driving, to the environment, and to air pollution, and to their level of consent (for on-road policies such as speed limit reductions, and to the erection of roadside barriers).

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**Sample screening** Develop a process through which sample of local authorities can be pre-selected to roll-out the baseline survey in

**Data collection pt1.** Randomly select sample within each LA based on electoral register and roll-out the baseline survey and recruit

**Representativeness checks.** Check if survey respondents are representative of the demographic make-up of the local authority

**Matching.** Compare local authorities on matching variables, and pair local authorities most similar to one another on those.

**Treatment allocation.** One LA in each pair is randomly assigned to treatment 1 while the other LA will be allocated to the control group.

**Treatment 1. Roll-out social marketing campaign about on-road policy measure**

**Treatment 2. Roll-out social marketing campaign about off-road policy measure**

**Control group 1. No action.**

**Data collection pt2.** Randomly select sample within each LA based on electoral register and roll-out surveys. Run balance checks between groups survey responses.

**Data collection pt2.** Randomly select sample within each LA based on electoral register and roll-out surveys. Run balance checks between groups survey responses.

**Figure 7: Implementation plan**
**Sampling strategy**
Indicatively, the recommendation is to recruit through 15-20 local authorities. The sample size will depend more on the number of people able to be recruited (to answer surveys) within these local authorities, than the number of authorities. However, it is necessary to cluster the intervention at local authority level (since it is impossible to deliver a public-facing social marketing campaign to some people but not others within a confined geographic region). As such, a sufficient number of local authorities is necessary such that three groups of regions can be created which are reasonably well-matched on baseline attitudinal and demographic data.

The necessary number of survey responses will be informed by power calculations (not yet undertaken) and will likely be thousands of responses. Public surveys tend to have a modest response rate of 1-5% without incentive, or around 10% if incentives are provided for responding, and as such it will be necessary to send surveys to as many as 100,000 individuals to achieve robust findings. Postal surveys of this magnitude are costly, and so it may be preferable to utilize email, SMS (if a sufficiently simply survey can be developed), or drawing upon existing marketing panels which can be filtered by region and, depending upon the information held by the panel, may negate the need to ask for basic demographic information.

**Implementation challenges and other considerations**

Contamination and spillover effects (those exposed to the campaign in one region interacting with those not exposed to the campaign in the control regions) are a risk even if local authorities are far apart from one another. Some elements of the campaign may end up on social media, for instance, and thereby influence attitudes of some residents in control areas. It may therefore be worth asking people in the control regions whether they are aware of the campaign, and excluding those who are (albeit insuring this does not unduly bias the sample, for example excluding a majority of younger respondents by virtue of being more likely to be on social media and thus be aware of the campaign).

It may be that a strong match is not possible, depending upon the number of local authorities recruited into the trial. A difference-in-differences approach is therefore a viable alternative, particularly since baseline data will be collected anyway.

The primary outcome variable for analysis would be the stated level of consent. The same primary outcome measure should be used for both the online testing (part 1) and also in the field (part 2). Using the same outcome variable throughout both research components provides consistency, and allows the validation of the online results through comparison to field results (where the external validity of the results is higher). By validating the online study, this may demonstrate the online tool to be appropriate for testing other similar future campaigns in a highly cost effective manner.
CLOSING REMARKS

Since the mass production of cars changed personal travel, relatively little has changed with regards to the role automobiles and combustion engines play in modern mobility. Private cars remain the dominant mode of transport, and less polluting choices, though made by many, face a range of behavioural barriers: the engrained habit of driving styles; high costs of new technologies; risk aversion and biased perception of costs; the convenience of your own car; or the thrill of driving and so on. These facts are revealed in the existing empirical literature which demonstrates that transport behaviours can be extremely difficult to influence, in large part because these motivators and barriers are deep-seated and powerful, and in part because they are often exacerbated by structural issues such as lack of infrastructure and high costs.

In spite of this, there is also a lot of potential for the application of behavioural insights to transport behaviour, including many novel interventions which remain relatively untested. Sustainable behaviour change interventions (and the design of policy more broadly) must reflect and take into account the nuance and quirks of human nature. Drawing on key lessons from core psychological principles and examples from other contexts such as broader pro-environmental and pro-health behaviours, there is enormous scope for a wide variety of behavioural interventions to be harnessed. Report 1 highlighted some of the literature in transport behaviour and wider pro-environmental and pro-health behaviours, which hints at the potential for developing and testing new interventions on the Strategic Road Network.

This piece of work adds to the existing transport literature in that it provides an overview of the way behavioural science can be applied to this topic. It takes a bird’s eye’s view and maps out a comprehensive list of discrete driver behaviours that impact air quality. This map of behaviours serves as a tool to translate the overall policy challenge (improving air quality) into a more navigable format focussing on specific, discrete behaviours, the barriers and motivations of those, the population segments of relevance, and ultimately their potential solutions. These solutions should be subject to rigorous impact evaluation, and thus four implementation and evaluation strategies have been proposed. These four proposed trials span four quite distinct behaviours: eco-driving; speed compliance; purchase of clean vehicles; and public acceptance of policy developments to tackle air quality.

The impact that each proposed intervention has on air quality will be a function of the impact of the underlying behaviour on air quality, the likelihood of the intervention bringing about behaviour change, as well as the timescales involved, i.e. how soon and for how long behaviour change occurs. For instance, 70mph speed limit signs can be immediately implemented on existing smart motorways with minimal cost, and represents a good starting point for rapidly ‘getting into the field’. Other proposals, such as initiating a ‘clean vehicle bumper sticker’ programme is rooted in much slower mechanisms – the gradual building-up of perceived norms and familiarity with subtle but potentially profound impacts on awareness, perceptions and vehicle choices.

Key next steps will be to develop the proposed implementation and evaluation strategies, to develop comprehensive research proposals; build partnerships for their effective delivery; and ultimately to test some of these ideas to find out what works.
APPENDIX A: Short summary of Report 1, Section 1: A review of the core behaviour-change principles relevant to air quality on the SRN.
**APPENDIX A: Evidence from behavioural science reveals 6 key lessons**

**Introduction**

This section aims to provide a general understanding of behavioural insights and approaches to behaviour change. We draw upon fundamental theory and evidence from psychology and behavioural economics, as well as findings from public health and environmental behaviour-change research. These topics were chosen because the air quality agenda is something of a hybrid between the two, and thus provide a lot of transferrable lessons.

**What are behavioural insights, and how can they help?**

Behavioural Insights are research findings from psychology, behavioural economics, social anthropology and the wider behavioural sciences. They are insights into the way we behave, make decisions and choices, and are influenced by the world around us. The application of behavioural insights to a policy challenge is the application of a more sophisticated and realistic understanding of human behaviour to the issue. Whether the focus is on educational attainment, crime rates, pension savings rates, recycling, transport use or public health, most policy goals are ultimately about behaviour, and most public services are intended to be used by real people. Policy outcomes can therefore be improved by designing policies and services which go with the grain of human nature.

A common confusion is that ‘behavioural insights’ are ‘nudges’. The two are related but not the same: a nudge is a particular policy tool which aims to maintain freedom of choice whilst gently encouraging citizens to opt for the ‘good’ choice, for example by making pension enrolment the default, but keeping it easy to opt-out. Behavioural insights themselves however, are far broader, and can be applied to all manner of policy tools: *regulation*, *incentives* (such as taxation, subsidies, fines and grants), and *information* are all ‘behavioural’ tools, and can all be made more effective by embracing a better understanding of human behaviour.

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**About the Behavioural Insights Team**

BIT is a social purpose company. We are jointly owned by the UK Government; Nesta (the innovation charity); and our employees.

BIT started life inside 10 Downing Street as the world’s first government institution dedicated to the application of behavioural sciences. Our objectives remain the same as they have always been: making public services more cost-effective and easier for citizens to use; improving outcomes by introducing a more realistic model of human behaviour to policy; and wherever possible, enabling people to make ‘better choices for themselves’.

We do this by redesigning public services and drawing on ideas from the behavioural science literature. We are also highly empirical; we test and trial these ideas before they are scaled up. This enables us to understand what works and (importantly) what does not work.
APPENDIX A: Evidence from behavioural science reveals 6 key lessons

The following sections provide a short summary of a more detailed account provided in a supplementary report (Report 1). Report 1 provides a detailed overview of behaviour-change principles in general drawing from the core findings of psychology and behavioural economics and providing examples from a variety of contexts. It also provides an in-depth literature review of transport behaviour research.

This in-depth review was undertaken to inform the intervention ideas, by drawing upon ideas from other contexts, as well as aiding the development of original intervention ideas borne from an understanding of the core behavioural science. This evidence base also informed the prioritisation exercise, helping to indicate the likely impact of intervention ideas.

We encourage readers to review Report 1 for more detail.

A flawed starting point: Rational choice, values, attitudes and beliefs.

A common and intuitive understanding of behaviour is that we act on our intentions, which are rationally based on our values and attitudes. This is broadly the ‘rational choice model’ of behaviour and it implies our actions are the product of our own cognisant and deliberate choices, which aim to maximise our utility, as defined by our values and beliefs. For example, if we care about the environment or our health, we would choose an environmentally-friendly or healthy mode of transport. If people do not, then the implied strategy for behaviour-change is to make them more aware of, or care more about, the environmental or health impacts of their transport. The common solution is therefore to run information, awareness, and attitudinal campaigns to shift the public’s beliefs and attitudes, with the expectation that behaviour will follow.

This approach certainly has merit – our choices do (sometimes) reflect our values, we do have the capacity to make deliberative choices, and we are often driven by the desire to maximise our utility (i.e. we act in ways which we believe will best deliver what we want, be that convenience, cost-savings, enjoyment, or more virtuous values). However this account of behaviour is also flawed, failing to capture much of what really drives our behaviour, and exaggerating the extent to which we are ‘rational, deliberate agents’.

In fact, our behaviour are driven by many other factors: by emotion, by social influence and conformity to an identity, by instinct, and by ingrained habit. Our decisions are rarely based on careful deliberation, but more commonly drawing upon fast and frugal heuristics (cognitive short-cuts, rules of thumb). This leaves us susceptible to a wide range of cognitive biases – systematic deviations from the logically optimum outcome, even on our own terms. It also leaves us highly susceptible to external influence since these heuristics often draw from simple cues in our social and physical environment. This means we are very sensitive to the choice architecture, with subtly different framings or presentations of options having an often profound impact on our so-called ‘choice’.

Where values and attitudes do play a role, their relationship to behaviour is complex. We tend to greatly exaggerate our more virtual values (such as concern for the environment), meaning they are an important part of our identity and of the narratives of our lives, but they rarely dominate our decision-making. More self-interested factors such as cost and convenience usually prevail, and in particular we are great effort-minimisers, tending to ‘go with the flow’ of the path of least resistance and default options. Moreover, we often find that our attitudes and values emerge after our behaviour, rather than act as drivers of it. For example, we may cycle to work because it is cheap, or convenient, or we have little choice, and then subsequently adopt a pro-environmental stance compatible with our actions.

In other words, promoting pro-social values such as concern for the environment or for societal health is rarely the most efficient route to behaviour change.
APPENDIX A: Evidence from behavioural science reveals 6 key lessons

Constructing a better model

We require a model of behaviour which captures the valuable elements of the rational choice theories, but which also reflects the many problems with it, and the many other drivers of behaviour which it overlooks.

We provide such a model below, which shows a generic form of the rational choice model in blue. To the left is a conventional awareness campaign which aims to change behaviour by updating beliefs and attitudes. In orange are three ‘leaks’ to this model (three reasons why the chain of logic implied by the rational choice model often fails, and thus three gaps which must be plugged if an intervention relies on this chain of logic). Also shown in orange are three oversights (three important drivers of behaviour and decision-making which are overlooked by the conventional rational choice model). We explore the implications of this model of behaviour through six key lessons.

Lesson 1: Changing attitudes and beliefs is difficult, particularly around environmental and public health issues, but behaviourally-informed messaging can help.

Changing peoples beliefs and attitudes is very difficult. We are armed with numerous psychological defences to deflect incoming information which threatens, or is incompatible with, our existing beliefs or world-view. We are also not receptive to information which implies guilt or blame for our current behaviours.

There are various biases and traits responsible, including confirmation bias (our tendency to seek out information which confirms prior beliefs, and ignore or downplay that which discredits them), and motivated reasoning (our tendency to employ convenient logic which justifies what we want to be true). Often we arrive at a conclusion intuitively, emotionally, or self-interestedly, and then retrospectively rationalise in a way which is self-enhancing (i.e. puts us in a good light, and frames us as consistent with our values – often for our own benefit as much as others’).

These psychological barriers are particularly strong when it comes to environmental and health issues for a number of reasons. Both have the potential to cause anxiety, which we are motivated to avoid. This is evidenced through experiments in which people were found willing to pay to not know about an illness, and willing to pay more for more serious illnesses.

Environmental and health issues also frequently face conflicting motives – behaviours which are fun, convenient or cheap are often damaging for our health or the environment. Guilt and cognitive dissonance emerge when we act in ways which contradict our values, but we are rarely willing to compromise our convenience, our wallets or our enjoyment, and so we instead resolve the issue with these tools of denial, motivated reasoning, justification and confirmation bias. Moreover this is extremely easy to do in matters of health and the environment, because there is so much complex and seemingly contradictory information available to selectively pay attention to.
APPENDIX A: Evidence from behavioural science reveals 6 key lessons

This all implies that information and awareness campaigns may not be the best approach to behaviour change. The empirical evidence confirms this to be the case: such efforts often change self-reported attitudes, and perhaps intentions, but often fail to change actual behaviour.

However it also raises the question of how we might best design information and messaging where these are the only, or most economical or feasible, intervention. Behavioural science provides a number of principles we should follow:

- Generally avoid technical, complex and dry information laden with facts and figures.
- Generally avoid messages with harness guilt, since we tend to close-up and avoid the source of guilt. This is particularly true if there is little that people can do to change their behaviour, or changing behaviour requires effort, cost, or a compromise to enjoyment. For example, many people are attached to their cars and derive a lot of meaning from them, whilst many others may have little choice but to drive. Confronting these people with negativity about their choices is unlikely to be effective.
- Positive emotions, including encouraging people to envisage their sense of pride after doing something good for their health or the planet, have been shown to be more effective than those harnessing guilt.
- We are social creatures, and messaging can harness norms and social identity to good effect (we focus on this in more detail in Lesson 5).
- Understand the mental model or mindset through which people think about air quality. We should aim to draw on existing concepts, ideas, narratives and categories which are deeply ingrained within a culture. The public’s understanding of air pollution is not well understood.
- A message will not be judged on its factual accuracy, but rather on its narrative fidelity – to what extent does it ‘make sense’ in the context of people’s existing beliefs, desires, identity and emotional stance on a subject?
- Emotional messages, for example evoking the emotion of disgust (a la cigarette packs with graphic images, for example), may be powerful motivators.
- It is always critical to maintain self-efficacy, and ensure the behaviours and choices we are promoting are viable and do not require significant comprise.

Lesson 2: Changing attitudes isn’t enough to change behaviour, though it is sometimes possible to bridge the gap

Lesson 1 explained why it is often very difficult to promote new attitudes, values and beliefs. However, if this is achieved, this is not necessarily sufficient to encourage new behaviours. There is a value-action gap caused by several factors, illustrated in the above model by Leak 2 (values and attitudes don’t always lead to sincere intentions), and Leak 3 (sincere intentions don’t always lead to action). There are several reasons for these leaks, which we discuss below alongside strategies for overcoming them.

Other motivations may still prevail – so harness the right ones.

Raising someone’s concern for air quality, their health or the environment will not change their choices or intentions if other conflicting motivations still dominate. Surveys show that concern for societal issues among the public is often ‘high’, but very low relative to factors such as cost, convenience and enjoyment. As such, it is highly likely that where pro-environmental or other pro-social attitudes are elevated, they will still not be a significant enough factor to dominate a decision. This is particularly so given our tendency to exaggerate these pro-social values (to ourselves, and others), despite our tendency to relegate them when it comes to making a choice.

It is therefore often better to harness existing motivations rather than to try to elevate very weak ones. For example, harnessing our concern for cost, to promote eco-driving or electric vehicles, will be more effective for most people than promoting them on environmental grounds (regardless of the fact that we may rationalise that we are in fact making these choices for environmental reasons).

Self-efficacy and empowerment are critical.

Elevating someone’s concern for the environment or their health will have little impact on their actions if they do not feel empowered to do something about it. Learning about air pollution as a terrifying force, with little we can do to avoid it or...
APPENDIX A: Evidence from behavioural science reveals 6 key lessons

The intention-behaviour gap needs to be closed. If intentions are formed, they will often fail to lead to action because of a range of psychological and practical barriers. These include: procrastination; a lack of will-power; short-termism; forgetfulness; lack of know-how; hassle and ‘friction costs’. Each of these barriers can be quite profound – for example the average household in the UK could save around £300 by switching energy supplier, but the hassle of doing so, and our tendency to procrastinate, are major reasons why we do not.

Individual action may depend on conditional cooperation and reciprocity. Pro-environmental behaviour often requires personal compromise (to our convenience, for example) for a dispersed and small benefit across society. If we accept that people are largely driven by self-interest, the trade-off of personal cost or inconvenience for the benefit of society rarely makes sense. As such it is a lot to ask of people to pay a premium for an electric car or take public transport where driving is easier.

Conventional solutions to this tragedy of the commons would be to heavily tax externalities associated with the negative behaviours, or regulate. However, our psychology may also provide a solution: We have evolved largely to reciprocate rather than to freeload, meaning we are more likely to contribute to the public good if we believe others are also doing so, or someone does something for us. For example we successfully increased the number of people on the organ donor register by pointing out that they would benefit from others having done so if they needed an organ. We also doubled the number of bankers donating a day’s salary to charity by giving them a small packet of sweets (unconditionally) before asking. Reciprocity may be particularly relevant where the objective is to increase compliance with an expectation or norm, and where those who deviate from the norm rationalise that most people do the same. Updating their beliefs, making it clear that most people are doing the right thing for the benefit of all, may increase compliance. This may apply to compliance with the speed limit, for example.

It is also possible that the tragedy of the commons can be avoided simply by appealing to self-interest rather than to pro-social motives. For example, the health impacts of driving on polluted roads may prove to be a more powerful motivator because one’s actions are directly linked to one’s own benefits, not to those of others.

Harnessing timely moments of change is also key, particularly where the behaviour is automatic and habitual, or where there is relatively little motivation to change from an existing behaviour. For example, people who move home close to a cycle share depot are much more likely to start cycling to work than those who have a cycle share depot built near them.

Where intentions do exist, but we are thwarted by forgetfulness, lack of willpower or procrastination, it can be useful to provide feedback, help people make plans, and encourage them to use commitment devices and social commitments. We are less likely to go back on a public promise than on a private intention, and this can be strengthened if there is some consequence to our failure to act (such as losing a deposit). Using deadlines (even if set arbitrarily) can also help spur us into action. A particular form of plan-making, called implementation intentions, provides a method to develop ‘if, then’ plans to pre-empt and overcome unexpected obstacles.
APPENDIX A: Evidence from behavioural science reveals 6 key lessons

Lesson 3: Our behaviour is often automatic, we think with heuristics, and we’re susceptible to bias and influence.

Contrary to the rational choice model of behaviour commonly used in classical economics, our decisions are not perfectly rational deliberative, nor independent of context. As expressed by Nobel Laureate Daniel Kahneman in his ‘dual process of cognition’, our behaviour is largely dominated by more automatic processes, including habit and emotion. Moreover our decision-making is largely based on heuristics (rules of thumb), drawing upon simple assumptions and cues from the environment.

This has two major consequences:
1. Though these cognitive processes are highly efficient, there is some trade-off on accuracy. As such we are susceptible to many cognitive biases: deviations from the optimal outcome, for example over-weighting losses relative to gain, biasing towards immediate outcomes, and misjudging probabilities.
2. We are highly susceptible to influence, both from the behaviour of others (see Lesson 5 for more detail on social influence), and from the environment in which we are making a choice. This means the choice architecture with which options are presenting (their framing, ordering and relative positioning, for example).

Habit
Habits are automatic responses to familiar cues and stimuli, and can be difficult to change (particularly with conventional tools which target beliefs and values), because they operate through less deliberative drivers of behaviour. Where there is an intention to change a habit, the main barriers are forgetfulness and lack of willpower. Here, the use of carefully structured ‘if, then’ plans can be helpful, encouraging people to devise strategies for avoiding temptation, identifying useful prompts and reminders, or turning familiar triggers into different behaviours. However, where there is little motivation for people to change their habits (as may be the case with driving style, for example), habits can be much harder to change. Here it may be necessary to introduce a stronger incentive. One approach found to be useful is to substitute the behaviour with another which has a similar (but less damaging) reward – for example, substituting cigarettes for e-cigarettes is much more viable for smokers than quitting.

Nudging with choice architecture.
The use of choice architecture gives us a way to harness, or overcome, cognitive traits and biases. For example, the way a form is designed, the order of items on a menu, or the framing of investment options in a pension fund will all influence our decisions, but can be done in such a way that the ‘good’ choice becomes more likely that the ‘bad’ choice without precluding the freedom of choose.

The list of cognitive biases and heuristics which choice architects can harness is long, and we cover many in the supplementary Report 1. Here we summarise a few key techniques:

- Hyperbolic future discounting (present bias): immediate costs and rewards loom large, and we steeply discount those in the future. For example, we may focus on the upfront cost of a car, even if the long-term running cost is the primary contributor to the overall cost. We might nudge people by pricing options in terms of long-term costs as well as upfront costs, or by reducing the upfront costs through a pay-as-you-save scheme.
- Availability Heuristic: we judge probability on how easily we can recall an example. We example, we over-estimate the frequency of high-profile events like airline accidents. We might harness the availability heuristics by making electric vehicles more recognisable (e.g. with a bumper sticker) so that they become more noticeable and thus judged higher in prevalence.
- Loss aversion: we are more sensitive to losses than equivalent gains. Framing incentives as money lost is therefore often more motivating than money gained.
- Choice overload / attribute overload: limited cognitive bandwidth leads us to make suboptimal choices where options are too plentiful or where we need to make comparisons on multiple factors. We tend to ‘satisfice’ by focusing on a single attribute to choose or rule options out. We can improve decisions by simplifying choices or providing comparison tools to aid comparisons.
APPENDIX A: Evidence from behavioural science reveals 6 key lessons

Lesson 4: Incentives often work, but should be ‘behaviourally informed’.

Cost is a major consideration for most choices we make, and so incentives are often effective. However there are various ways they can backfire, and various ways they can be improved by harnessing certain cognitive biases or other psychological traits.

A key insight is that incentives do not solely function through their economic forces, but also send strong signals. For example, paying someone to do something may imply the act is undesirable and ‘deserves’ payment, and so may reduce willingness act. This emerges in medical trials, for example, where high payments imply high risk. This is an example of extrinsic rewards ‘crowding out’ any intrinsic motivation which may have existed, and so common advice is to ‘pay enough or don’t pay at all’.

Similarly, a fine may be construed as a license to misbehave, as found when parents started turning up later to collect their children from kindergarten after a fine was introduced. Here, payment from the parent displaced the stronger motive of social stigma, and so it became more acceptable to turn up late and pay for it.

Conversely, however, an incentive may ‘crowd in’ and strengthen intrinsic motivations. For example, the UK’s 5p plastic bag charge acts as a salient reminder that we should be using less plastic, and strengthens that intrinsic motivation. It is not always easy to predict how an incentive will effect a behaviour, but it is important to understand the intrinsic motivators before considering a monetary or non-monetary incentive or penalty.

A range of more novel incentive designs can help overcome these risks, and may also harness cognitive biases to be made more powerful. For example, pro-social incentives, through which the recipient passes on the reward to a charity or a nominee, can be effective. Behaviours which have a high ‘virtue-signalling value’ may be undermined by extrinsic rewards, since doing something for money undermines it’s signalling value. Pro-social incentives overcome this, and in fact strengthen the behaviour’s virtuousness.

Our tendency to overweight small probabilities, and to focus on the size of a prize more than on our odds of winning, mean that lotteries and prize draws are often more effective, per pound spent, than flat rewards. Gamification can take this a step further by introducing competitive, fun and social elements into rewards to ‘hook’ people into the behaviour.

Our tendency to discount the future relative to the present is important when considering incentive designs. It is generally best to bring rewards forward to the present, and push costs back to the future. For example, the UK’s Green Deal aimed to do this by providing retrofits which were free at the point of installation, and only paid over the long term through energy bill savings. A similar scheme could be envisaged to overcome the barrier of higher up-front costs with electric vehicles.

Lesson 5: We’re social creatures.

Our beliefs, attitudes and actions are profoundly influenced by our social environment, our peers, our culture and our social identity. We are far from independent choosers, but draw on cues from our social environment to infer what is right or appropriate (‘social proof’), and we are also innately predisposed towards conformity to fit in and succumb to peer pressure.

The power of social norms can be harnessed by simply highlighting to people that most people follow the norm (particularly where perceptions may be very different). For example, telling late payers of tax than 9 out of 10 people pay on time has been shown to reduce late payments. Direct peer comparisons are a variation of this approach, for example comparing energy customers’ consumption to their more efficient neighbours has been shown to reduce energy consumption. We have also reduced antibiotic prescriptions among GPs by highlighting to the top 20% of prescribers that they prescribe more antibiotics per head than the majority (80%) of other GPs.
APPENDIX A: Evidence from behavioural science reveals 6 key lessons

Where the main motivation of conformity is to avoid social ‘punishment’, i.e. when we conform to an expectation, point of etiquette or social rule, the effects are much stronger when we are being observed. Simply making drivers aware of surveillance may therefore have a strong impact on their tendency to comply with expected behaviours. For example, we have decreased the number of unlicensed vehicles on the road by including a photograph of the car and driver in the reminder letter (relative to the letter without the photo).

The effects of social influence also tend to be most powerful when influenced by people ‘like us’, i.e. those who we identify with. We may even actively diverge from the beliefs or behaviours of those who we don’t identify with, as a way of differentiating ourselves from the ‘out group’.

This means the identity of the messenger for any campaign is important – we are more likely to pay attention if the message comes from a person or organisation who we respect, identify with, and who seems credible. Highways England may be perceived as credible and legitimate, but may have less influence than a peer or cultural icon when promoting safety driving among young men, for example.

Lesson 6: It’s not all about behaviour change. Sometimes we want to build public engagement and consent.

Previous lessons highlight the challenges in changing behaviour through targeting values and attitudes and beliefs. However, behaviour change is not always the end objective. Sometimes we may want to promote certain beliefs, attitudes or values for their own sake, for example to raise public awareness, engage people in a topic, or increase the public acceptability of other policy interventions (such as clean air zones) or infrastructure (such as roadside air quality barriers).

With this in mind many of the insights from lesson 1 are valid – targeting emotions, building a coherent narrative which resonates with existing beliefs and mindsets, and avoiding anything that puts blame or guilt onto the public (which will tend to be rejected and thus the message disregarded).

On the subject of public engagement and building consent for infrastructure and policy changes, lessons can be learnt from the context of planning. Here we find that genuine community engagement is key, giving people a sense of ownership and agency over what is happening. In many planning systems the only way to meaningfully express a view or influence a proposal is to object, leading to a very one-sided and negative public engagement. This does not need to be the case, for example a wider variety of input may be incentivised so that people with varied opinion have reason to engage, not just those with negative options. Similarly there is scope to offer communities a vote over aesthetic or peripheral parts of a proposal such that they can express their view constructively, and gain a stronger sense of ownership.

Deliberative forums provide a means through which Highways England could engage the public with depth and sincerity, and they have been used successfully around the world to inform policy developments. They provide a very strong mandate for policy, as well as attract a wide variety of expertise and fresh thinking.

Perceived procedural justice is also critical: regarded of the outcome of a process or decision, we are generally more accepting of it if we perceive it to be a fair process. Transparency is therefore often beneficial. Also beneficial to the perceived legitimacy of a policy is to hypothesise any funds raised, such that they benefit those who are affected by the issue the policy is aiming to address. For example, a carbon tax spent on environmental programmes or research in renewable energy is likely to be more acceptable than a carbon tax spent on overseas aid or police recruitment, even though those two expenditures tend to receive positive support from the public. Likewise, increased fuel duty is never popular, but may be more acceptable if the money is used to directly to cover the NHS costs incurred through air pollution.
APPENDIX B: Short summary of report 1, Section 2: An in-depth literature review and expert interviews on transport behaviour research
APPENDIX B: Evidence from the transport literature

Introduction

The six key lessons summarised above provide a ‘first principles’ understanding of behaviour change. We now turn our attention to the literature specifically on transport behaviour, and summarise what works and what doesn’t work from four fields of research: mode shift, vehicle purchasing decisions, driving style, and traffic management. Our hope is that armed with a more fundamental understanding of behaviour change, the findings from the transport literature can be better understood in context. This is particularly important given the relatively weak methodology common across these fields of research, making it difficult to draw robust conclusions from any one finding.

As with the six key lessons, we encourage readers to read the full supplementary Report 1 for a more exhaustive review of the literature.

Mode shift

The UK is largely dominated by private car use, and this presents a number of challenges to mode shift: our infrastructure is broadly geared toward drivers, and though good alternatives exist in some parts of the country, often they cannot compete on the metrics which consumers care most about. This includes cost, ease and convenience, flexibility, and comfort. Though behavioural interventions such as personalised-travel-plans (PTPs) sometimes report modest impact, much of the research shows that there is rarely an easy or cheap approach to encouraging the uptake of alternative modes, unless the infrastructure is present and delivered to a high standard. Even road pricing, which can provide a strong disincentive to drive, tends not to be successful unless good, viable alternatives are present.

A number of psychological factors exacerbate these structural barriers to mode shift. For example we tend to be biased in our perception of costs, being quite poor at judging the total cost of driving (including depreciation, maintenance, fuel use, tax and insurance) compared to public transport where the full cost is simple and salient in the ticket price. This is especially true if we have a car already, where the sunk cost motivates us to use it even where it may make little sense (to justify the sunk cost of buying it), and it rapidly becomes the default choice with little consideration given to other modes without a strong reason to reconsider.

Research shows that where viable alternatives to the car do exist, simple informational interventions may bring modest benefits if delivered at a timely moment, for example when people move home or start a new job. However, the evidence is mixed, with ample examples of where such interventions have had no impact, and generally quite weak methodological rigour across the discipline.

More substantive impact is often found with more structural interventions. For example, employers are in a relatively unique position of influence employees’ behaviour through the parking and other benefits they provide. In the UK it is common to have (and expect) a free parking space at work. However research shows that removing this benefit has a major impact on the rates of car use. Where employers not only stop providing free parking, but swap it for subsidised public transport, the impact can be profound. However this is context dependent: if other free parking exists nearby, or if alternative means of transport are infeasible, this may not have the intended effect.

We therefore recommend that behavioural interventions are likely to be most effective to increase awareness and boost uptake of alternative means where the infrastructure is sufficient and genuinely competes with car use on convenience comfort and cost, and where the intervention prompts behaviour–change at a timely moment. Otherwise, structural intervention to provide such infrastructure, or fiscal policies to introduce a very strong incentive, appear to be the only reliable effective solution.

That said, there is a lot which has not been tested, including the application of more novel behavioural interventions. For example, smart technologies bring a lot of potential to deliver complex incentives through gamified systems. Moreover, the inconsistency with which we judge costs associated with cars and with public transport has received relatively little attention. This leaves us cautiously aware that mode choice can be very difficult to influence, but also cautiously optimistic that there is much that is worth trialling.
**APPENDIX B: Evidence from the transport literature**

**Purchasing decisions**

In this section we focus on the uptake of vehicles: electric, and combustion, with a view to promoting less polluting choices at the point of purchase.

For electric vehicles there is strong evidence that structural barriers, including upfront cost, lack of infrastructure, and the limited capabilities of current technology (including range), continue to be the dominant barriers to widespread uptake. A range of behavioural factors also impinge on these structural factors. For example, we are poor at considering the long-term running cost of vehicles, tending to steeply discount the future over the immediate. As such the upfront cost is likely to be dominant in purchasing decisions compared to running and maintenance costs which make electric vehicles more competitive in the long-term. Some research has tested the impact of presenting long-term costs to vehicle buyers, but the results are inconclusive – in this particular context failing to find a significant impact, though similar interventions seem to work for some other consumer goods (such as white goods).

Moreover, concern over range limitations, charging infrastructure, long-term battery performance and resale value may be well founded, but are also likely to be exaggerated by our tendency for risk aversion and uncertainty aversion which bias us towards the familiar. We also tend to make plans and purchasing decisions on a ‘just in case’ basis, catering for the 1% of journeys we need to drive more than 200 miles even though we could in theory take alternative transport or hire a car for those rare occasions.

Many of the same behavioural issues emerge with internal combustion vehicles as with electric vehicles, particularly around cost, as new, more efficient vehicles upfront cost may not always be offset by significant savings in running costs. We are also quite poor at estimating these savings, with evidence showing that the non-linear nature of miles-per-gallons (as opposed to gallons per mile) further exacerbates this. It is also important to recognise that the majority of car purchases are through the second-hand market, and thus it takes several years for more efficient technologies to trickle-down into mainstream ownership.

The prevalence of structural barriers, and the need for new technologies to trickle-down into the cheaper second-hand market, leads us to conclude that conventional policy levers will be responsible for the bulk of improvements in vehicle purchases (including gradually advancing fuel standards, and the recently announced band on combustion vehicle sales in 2040). It is also clear that the market will shift quite slowly. However there are areas which behavioural insights can contribute to in the more immediate term, including efforts to re-frame the cost benefits of more efficient vehicles, designing novel incentives (for example re-designing the existing subsidies to harness some of the biases discussed previously), and addressing some of the uncertainty around range and longevity. Ultimately these efforts will need to be supported by improvements to the supporting infrastructure.

**Driving style**

Differences in driving style have a significant impact on fuel use and emissions. This includes speed, harshness of acceleration and braking, lane-changing, and anticipation of traffic flow ahead. Changing our driving style is not easy, however, because it tends to be deeply ingrained as habit. Existing interventions have tended to use one of four approaches: informational and awareness interventions, training courses, in-vehicle feedback, and post-trip feedback.

Each of these approaches has certain advantages and disadvantages. To achieve habit change, information alone tends to be insufficient, though there are unexplored possibilities, for example harnessing particularly timely moments such as new births (when parents might be motivated to drive more safely, for instance). Training programmes appear to be somewhat effective when targeted at new drivers, since habits have not yet ingrained. Administratively, this also brings benefits of scale, whereas signup rates to post-test courses tend to be very low. If targeting existing drivers, we suggesting targeting fleets, since there appears to be greater scope to leverage stronger incentives (such as fleet operators’ higher fuel costs, or using social comparisons and league tables, shown to be effective nudges in other contexts, and drawing upon social norms and comparisons, discussed previously in Lesson 5).
APPENDIX B: Evidence from the transport literature

The use of in-vehicle feedback (telematics) holds a lot of potential, since habitual behaviours tend to require constant prompts to break. It is also easier to learn new behaviour and improve performance if we have feedback against which to benchmark our improvements. Feedback in itself does not necessarily provide a motivation to change, and so telematics should not necessarily be seen as an intervention in their own right, but rather as the tool with which other motivators can be delivered (for example, using league tables, incentives or social comparisons among fleet drivers). Research in the design of this feedback is still relatively rudimentary given how rapidly technologies are evolving, and the clear potential that modern smartphones and sensors have. We believe this is likely to be a major area of research in the near future, and there is much potential for smart, engaging, and behaviourally-informed telematics to impact our driving style.

Traffic Management

Traffic management refers to a range of activities, including demand management, congestion reduction, and compliance with speed limits and other rules of the road. The link between congestion and air pollution is complex (for example, slow-moving traffic might produce less emissions than fact-moving traffic), though certainly the smoothness of traffic flow is beneficial. Sophisticated smart motorway systems are becoming increasingly common, using variable speed limits to smoothen traffic flow. Evidence suggests they tend to be effective, in some contexts, but only if road users comply. Increasing compliance is therefore a key objective, and the same is true of static speed limits with pollution tending to rise significantly at speeds much over 70 mph. This is also a topic which behavioural insights has good potential to contribute to. Social norms have been used to good effect to increase compliance with actions we are aware we should be doing anyway, but believe (often erroneously) that most people are not. We have also successfully reduce repeat speeding offenses using behaviourally-informed letters explaining the purpose of speed limits.

Other aspects of traffic management have received relatively little attention from an air quality perspective. Reducing overall demand (for example by promoting remote working), or smoothing the peak demand (for example by incentivising non-standard work hours) have great potential, with a small number of successful interventions showing that behaviourally-informed incentives can also be very effective.

For interested readers, the supplementary Report 1 provides a more detailed review of relevant behavioural science research and transport behaviour literature.
APPENDIX C: Longlist of intervention ideas and behavioural principals
## APPENDIX C: Longlist of intervention ideas: promoting eco-driving

The following tables summarise the longlist of intervention ideas. We reference the behavioural concepts drawn upon, and direct readers for the definitions and examples given earlier within the tables in ‘step 6: Solution’. We include short descriptions here only of the behavioural concepts not previously defined.

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   Regulation to mandate manufacturers to include a certain standard / functionality of telematics in new vehicles. This might apply to cars, but equally be tailored to fleet vehicles / HGVs. Make their use the default.  
E2. FitBit for your car / Money-saver petrol app in collaboration with supermarket or insurance providers  
   The OBD port, mandated in all European-sold cars since 2003, usually provides real-time fuel use data, odometer, speed etc. Connected to a smartphone app this can be merged with GPS, trip length data etc. to provide sophisticated metrics including predictions of fuel consumption costs and monitoring of driving style. This makes for an economical retrofit telematics solution, lending itself to myriad nudges:  
   - Promote the purchase of fuel through the app (to capture fuel purchase data, and promote uptake of the app) by partnering with supermarkets who give a small discount on fuel for doing so, which must be spent in store.  
   - Partner with insurance providers who may base their premiums on driving style, but also offer novel incentives similar to exiting health insurers through FitBit (e.g. free cinema tickets in return for particular behaviours, such as foregoing driving for 2 weeks).  
   - Set targets, mirroring the ubiquitous 10k steps target with FitBit. E.g. not driving for journeys <2km, or make it through the week with X amount of fuel (smart targets, personalised based on prior usage, and encouraging saving for something the user wants to buy (e.g. a holiday, or child’s birthday gift).  
   - Harness loss aversion by framing fuel in the tank as a pot of money being drawn down, and prompting users with an estimate of the amount that could be saved per week/month by adopting a more efficient driving style.  
   - Use timely and real-time prompts and feedback in response to driving style (e.g. hard acceleration).  
   - Incorporate social nudges, e.g. competitions, social norm messages (9 out of 10 people saved £X this week, peer-comparisons to others using the app with a similar car, or ‘network nudges’ (peer sharing elements, e.g. social media sharing for partaking in local ‘no car week’ among users).  
   - Implementation intentions could help users develop goals to save a certain amount of money per year.  
   - Appeal to mental accounting, e.g. by framing costs saved as ‘travel costs’ to motivate users to save money they can legitimately spend on ‘travel’ (e.g. a trip abroad). Alternative, users set a budget, e.g. £30 per week automatically added to account (which is used to buy petrol through the app) and anything left over goes into hypothesised account for something exciting.  
   - Use gamification elements of competition, league tables, gambles and prizes for certain performance.  
   - Incentives, e.g. insurance premium reductions based on driving style, or prizes and lottery for certain activities. Pro-social incentives may also be effective, e.g. every £ you save on petrol is and mileage, or novel lottery/prize draw aspects for certain behaviours (e.g. for partaking in your region’s ‘car free week’). Could also adopt pro-social incentives, e.g. money saved by driving carefully automatically taken from the user and given to charity of choice (and posted on social media to show how much money you’re raising, attributing eco-driving with virtue-signalling).  
E3. Frame petrol consumption and dashboard mpg as a loss of money.  
   As an alternative to using a standalone app or hardware solution, there are ways in which the simple information provided on most existing vehicle dashboards could be updated to harness behavioural insights. For example, frame petrol use as £, drawing down from a sum (estimated by the fullness of the tank and the known average litre price in the region). This both makes the cost of petrol salient, and harnesses loss aversion, particularly when, for example, accelerating hard at which point the display may show a very high £/km.  
E4. Link insurance premiums to driving style  
   Some insurance providers already use telematics to tailor their insurance products. There may be a role for government/HE or other stakeholders in promoting this further, for example, mandating that insurance providers allow customers the option of this if they have a vehicle with a minimum standard of telematics functionality. This could be thematically linked to smart metering campaigns, not paying for something which is estimated. This also links strongly to illusory superiority – research shows the vast majority of drivers think they are better drivers than average, and as such most drivers might be willing to adopt this scheme on the illusion they’d be saving money relative to the average (thus target at confident drivers, and low-mileage drivers – see segmentation section of this report).
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| Set fuel usage goals within or between companies, and nudge driving behaviour using ranking / social comparisons / charitable giving / lotteries | • League tables and peer comparisons.  
• Regret lotteries.  
• Social comparisons | **E5. Public ranking/league tables within companies and fleets**  
Set up league tables within company comparing individual drivers on fuel consumption. Alternatively, in multi-depot or multi-team companies, these league tables can be between teams and offices. |
| **E6. Charitable giving** | Employers can commit to match drivers’ effort with a donation (fuel saved times X) to a charity of the winner’s choice. This overcomes any cynical response that the purpose of the initiative is to maximise profits, and maintains the intrinsic motivation which may otherwise be crowded out. |
| **E7. Lottery/ reward** | Alongside a league table, the best performing employees/drivers could be rewarded with a financial or non-financial reward to increase engagement. Alternatively, all drivers that reach a certain % of fuel reduction or achieve their goal could be entered into a lottery. **Regret lotteries** are also effective - all drivers are entered into the lottery, but only those who meet a prescribed target are eligible to receive the prize. Many winners ‘would have’ got the prize, and this sense of missing out motivates better performance next time. |
| **E8. Social comparisons** | target the least efficient 20% of drivers and inform them that “80% of staff driving the same model of vehicle use less fuel per km than you do. Here’s some tips for how you can drive more efficiently” |
| **E9. Set up ‘efficient fleet’ awards** | Set up a government or industry award through which fleet operators compete against each other to be the most fuel-efficient fleet. The award should carry high-profile industry and consumer recognition. |
| Increase uptake of eco-driving training courses through the use of behavioural nudges and incentives (and maximise retention of content by using tailored content targeted at most receptive population segments) | • Personalisation.  
• Friction costs.  
• Implementation intentions & goal setting.  
• Social norms  
• Loss aversion  
• Timely moments and prompts  
• Simplification of information/cognitive load. | **E10. Target fleet drivers / operators to make the benefits of eco-driving, and of eco-driving training, salient and relevant.**  
Fleet drivers may be receptive to eco-driving courses and behaviours if there is ongoing motivation to adopt the trained driving styles. We suggest promoting training courses among fleet drivers/operators in conjunction with ongoing motivational nudges as outlined above (e.g. league tables, prize draws, or insurance premium reductions).  
Uptake could be encouraged through incentives (e.g. business rate reductions, or recognition in a formal ‘efficient fleet’ programme). Alternatively, the fuel-saving incentive is already present, and so there may be merit in simply making this fact more salient & relevant to fleet operators. This may include:  
• Providing simple, frictionless information and booking support on training programmes (removing frictions, increasing awareness)  
• Social norms messages (“many other fleet operators are doing this, have you thought about it? Maintain your competitive edge, don’t waste money...”)  
• Using loss aversion in personalised messages (“how much would 5% of fuel costs be worth to your business? Why are you throwing that hard-earned profit away?”)  
• Using novel framings to make the issue salient (e.g. “it’s a win-win situation - you save money and help the environment”)  
• Personalisation (providing personalised estimates of the monetary savings which could be achieved, based on data of fleet size and mileage) |
| **E11. Target new parents to promote safe driving tips, harnessing new concerns for safety** | Becoming a new parent is a timely moment at which point the importance of safety becomes particularly profound. New parents may therefore be more receptive to campaigns on driver safety than the average driver, and motivated to make the effort to change driving habits. They are also a large cohort, and often well engaged with the community and thus provide a number of existing touch-points for targeting information campaigns (e.g. NCT classes, nursery, post-birth health visits), all of which could be used to deliver behaviourally-informed prompts and tips relating to safe driving. This could be conventional driving training (e.g. presentations at NCT class or nursery), or could be a more economical and scalable solution (albeit probably a less effective solution), providing simple written information via health visitors. |
| **E12. Target eco-driving training at new drivers before habits are formed** | New drivers without long-ingrained habits are likely to be more receptive to training, particularly if linked to incentives such as reduced insurance premiums (with insurance often representing a major cost to young drivers). Parents of new drivers are also likely to be keen to encourage anything which can increase the safety of their child’s driving style. As such, eco-driving courses should be promoted on the basis of safety to parents, and cost-savings to teenagers.  
There are a number of ways this could be implemented. For example, introduce a secondary parallel scoring system into the existing driving test, not leading into the pass/fail of the test, but giving a score (based on safe and calm driving style, aggressiveness etc.). This may be taken into account by insurance providers. Alternatively, introduce a new ‘pass-plus’ test to formalise the existing pass-plus course, with eco-driving made a significant component of this.  
Uptake may not be high, though could be boosted by mandating it for drivers who don’t do well on their driving test (e.g. those with < 20 points pass unconditionally, and those with > 20 points pass but must take the ‘pass plus’ test 3 months later.)  
There is also scope to integrate behavioural insights into the structure of the training itself. For example, developing implementation intentions (if, then plans) can be effective at breaking old, and creating new, habits, and good behaviour may be encouraged by having drivers sign a pledge / public commitment. |
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| Timely and behaviourally-informed prompts and information to promote eco-driving styles | • Timely prompts • Messenger effects • Loss aversion • Goal-setting • Heuristics - We tend to think in terms of simple rules of thumb and associations. We can appeal to this mode of thinking by developing simple heuristics for people to follow: ‘5-a-day’ and ‘clunk click every trip’ are both examples which for which the direct impact on behaviour is not well evaluated, but they have effectively stuck in the public’s memories, greatly raising awareness (of nutrition, and of seatbelt safety respectively). | **E13. Eco-driving prompts on petrol pumps**
Each time we fill up the tank is a timely moment at which point the cost of driving becomes salient. A low-cost intervention would be to put behaviourally-informed prompts on petrol pumps providing tips on how to save money. These might draw upon a wide range of ideas and behavioural insights. For example, loss aversion (“The average driver loses £340 per year on fuel by driving inefficiently. Wouldn’t you rather have a free holiday? Keep your distance, accelerate gently, and keep the revs low!”); goal-setting (“Fed up of paying for petrol? See how many miles you can do before your next tank. Keep your revs low and acceleration gentle to save petrol”), social status and humour (“Think you’re a good driver? 95% of people think drivers who speed and accelerate hard are idiots”), local pride and wellbeing (“Keep our high-street healthy – air pollution kills our children, so please drive considerately in our town. Keeps the revs low, don’t idle, and accelerate gently”). |
|  |  | **E14. Eco-driving prompts on smart motorways and other signage**
A range of prompts and messages could be trialled on smart motorway signs to promote eco-driving styles. For example, a short message based around loss aversion may be: “80mph costs you 20% more per mile than 70mph”, or “save 5% on fuel – slow down and keep the revs low” Research also shows that a paid of watching eyes is often enough to increase compliance. For example, this has been used with some success at level-crossings to reduce idling. |
|  |  | **E15. Eco-driving & maintenance tips delivered through MOT test**
The MOT test represents another timely moment at which point the cost of running a car is salient. It also provides the opportunity to harness the messenger effect, since our local mechanic may be a trusted messenger (at least in relation to tips on how to maintain the car). Advice on driving style could be delivered in the context of being kind to the car and reducing the need to expensive maintenance costs (or the risk of failing the next MOT). Face-to-face advice may be most effective, though costly and subject to non-compliance among mechanics. A more scalable approach would be to provide information on / with the MOT certificate. This could cover a range of basic maintenance topics with an impact on air quality (e.g., correct tyre pressure, checking the oil) as well as driving tips for extending the healthy life of the car and saving fuel. |
|  |  | **E16. Eco-driving prompts through radio alerts and other media outlets, based on a memorable heuristic, or emotional resonance.**
Simple reminders and prompts could be effectively delivered through radio ‘ditties’, for example delivered through traffic alerts, or regular advertisements on high-traffic periods (e.g., bank holidays, rush hour). The messages could harness any of the behavioural insights outlined in ideas A1-A15, however one particularly relevant approach may be to develop a simple and memorable ‘heuristic’. For example ‘5 a day’ (fruit and veg) ‘clunk click every trip’, and ‘see it, say it, sorted’ are all sufficiently memorable that they stick in the public’s mind. A similar heuristic could impart the most pertinent aspect of eco-driving (relating to changing up early, for example). Another way to simplify the information delivered through a campaign is a simple checklist – eco driving is quite complex, and many people may not know what it entails. Summarising the key behaviours in a short list, pneumonic or phrase will help the information stick when delivered through conventional campaigns. |
| Introduce a new term for driving styles | Norming through language | **E17. Bumper stickers reminding people to keep their distance**
Bumper stickers with messages like: “Don’t let my tailpipe emissions get to you, keep your distance.” “If you can read this you’re too close”. “What would happen if I hit my brakes – keep back” This message can be framed in a number of ways. It can play with the idea of safety, or play with the feeling of disgust of directly breathing in the tailpipe emissions from the vehicle in front of you. The messages need to serve two behavioural objectives – getting people to stick them on their car, and being effective in keeping following cars at a distance. The former objective may be optimised by tailoring the messages to specific car-owning segments or making many variants available to choose from, including humorous messages. These might then be given out for free, e.g. with driving licence renewals. |
| Incentives for eco-driving through points system | Incentives | **E18. Campaign to create a common (pejorative) term for people who drive in a polluting fashion**
New norms can be created through language – the easier it is to describe, identify or call out something, the more prevalent the conversation becomes, and thus norms of behaviour and expectations can evolve. Insurance companies, NGOs, or civil society may be best suited to run an ad campaign (perhaps on social media) to introduce a term which captures negative driving styles, or indeed one which captures positive driving styles and removes any negative preconceptions of that driving style (being boring by driving slowly, not in-keeping with peer pressure among young male friends, etc.) For example, When the term ‘designated driver’ was introduced, the rates of drink-driving dropped. The term cleverly takes an action which could previously only be described in quite negative terms (in the context of going out with friends) – not drinking, boring, missing out, going against the group norm) and ‘re-branded’ the activity as a positive, and with a simple, recognisable, and socially-acceptable term. |
|  |  | **E19. Reverse ‘points system’ for eco-driving**
Allow drivers to reclaim any points on their license by demonstrating exceptional driving over a period of 6 months. Where an offence results in points on a license, either offer, or mandate, the use of a telematics device in the car for a period of 6 months. Exceptional driving will remove these points. Exceptional driving includes not braking/accelerating too harshly, not going over the speed limit, not revving to higher, etc. Time period should be long enough to instil new habits, and such that it does not become too ‘easy’ to get points removed (thus undermining the purpose of the points system) – might be deemed suitable only for minor offenses. System could be augmented with feedback highlighting cost savings and maintenance savings of the driving style, such that habits initially start in response to the mandate, but become self-interested and driven by cost in the long run (to avoid rebound effects once the time period is over). |
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<tr>
<th>Intervention category</th>
<th>Behavioural concepts used</th>
<th>Intervention idea (promoting speed compliance)</th>
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<tr>
<td>Behaviourally-informed messaging targeted at speeders</td>
<td>* Awareness-raising, * Explaining the consequences * Social * Surveillance/observability * Illusory superiority * Habit formation</td>
<td>C1. Develop new messages targeting those who speed but not enough to receive a penalty</td>
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<td>Letters or emails highlighting the fact that their actions have been noticed:</td>
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<td>A number of behavioural elements should be integrated and evaluated, including:</td>
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<td>- Personalisation, identifying the make/model of the car (&quot;you have been caught going above the limit in your Ford Escort&quot;)</td>
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<td>- A picture of the car (captured by the speed camera)</td>
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<td>- A message along the lines of &quot;we assume in this instance your actions were an oversight or mistake. If you are caught speeding again you we will treat it as a deliberate choice and you risk penalty&quot;</td>
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<td>- A message based on reciprocity of concession: &quot;we will not be penalising you on this occasion. Do not do it again&quot;</td>
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<td>- A social norm message highlighting that most people don't speed</td>
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<td>- A social status message, for example &quot;95% of people think drivers who speed are idiots. Don't be an idiot&quot;.</td>
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<td>- A sincere explanation of the purpose of the speed limits.</td>
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<td>- A message which appeals to their illusory superiority: &quot;you may be a safe driver, but if you go just 5 mph above the speed limit you are 10% more likely to have a serious accident if the car in front of you loses control&quot;</td>
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<td>- Personalise messages to the recipient’s area, e.g. &quot;Last year someone was killed or injured in [county/city/town] every [# days]. Your friends and family walk these streets. Please don’t hurt those closest to you.”</td>
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<td>New scheme of speeding warnings on a 'strike' basis.</td>
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<td>C2. Behaviourally-informed messaging in existing speeding penalty notices</td>
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<td>Existing speeding notices have great scope to be 'behaviourally updated', using any of the ideas presented in idea B1 above, to reduce reoffending rates.</td>
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<td>C3. System of warning points for speeding</td>
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<td>Introduce a new threshold of speeding offence which leads to a warning on a 'strike' basis. For example, on a 70mph limit, going above 80mph = penalty, going above 76 mph = warning, 5 warnings = penalty.</td>
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<td>Given the high number of strikes which will be issued, this may be best administered through email rather than written letter.</td>
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<td>This in itself is a straightforward incentive, but can be structured to harness a range of behavioural insights. For example, each of the messages outlined in idea C1 above could be sent with a warning 'strike'.</td>
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<td>C4. Mandated speed checking device for offenders</td>
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<td>Speeding offenders currently lose points on their licence, and/or attend obligatory courses. Modern technology provides an alternative course of action – mandated devices in the car to monitor speed for 6 months on a 'zero tolerance' basis (based on GPS, or plugged into the vehicle's OBD port). This may operate as a 'parole for your car' with stricter requirements to force a new habit of driving more slowly.</td>
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<td>C5. Parents' safety pledge</td>
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<td>Public commitments, pledges * Honesty prompts</td>
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<td>Parents are generally more motivated about safe roads in the community. There are various ways to appeal to this emotional connection, and to encourage parents to pledge to safe driving. Pledges / public commitments have been shown to be effective at encouraging behaviours which we might otherwise lapse on. Approaches to this might include targeting schools and leveraging the influence that children have over their parents, or targeting new parents and encouraging them to sign a pledge at an NCT class or other community event. This may be combined with eco-driving training (as per idea E18). A social network effect may also be particularly powerful, for example getting all parents at a school or parent group to pledge to safe driving to make their local roads safer.</td>
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<td>C6. New driver pledge</td>
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| | | Require those passing their test to sign a formal pledge to drive safely and to not break the speed limit. There is evidence to show that making a public commitment increases out likelihood of doing something, and this process, if appropriately designed, may effectively relay the gravitas of the undertaking of driving a car.
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| On-road reminders, prompts and nudges to reduce speed | - Prompts & reminders  
- Salience  
- Surveillance/observability | **C7. Bumper stickers**  
See intervention idea E17 – tailored to speeding  
**C8. Radio prompts and alerts**  
see intervention idea E16 – tailored to speeding  
**C9. Smart motorway prompts / signage**  
See intervention idea E14 – tailored to speeding  
In particular, the use of social norms may be effective e.g. including the message ‘9 out of 10 people aren’t speeding’ or ‘most people stay below 70mph’ on smart motorway signs. Research also shows that a visual pair of eyes can be enough to give the impression that we are being watched, increasing our likelihood of complying with expectations.  
**C10. Decoy speed cameras / speed checks, or use ‘eyes’ to increase compliance.**  
Drivers tend to slow down when approaching a speed camera, and speed up again after passing it. Decoy speed cameras could be spread along the SRN in more frequent distances (every 500 metres) to discourage braking/accelerating dynamic around occasional cameras. This cannot be applied to the entire SRN, but could be an effective measure on motorway strips close to or in urban areas where air pollution is most severe.  
While the cameras are likely to increase speed limit compliance, we need to make sure that the higher frequency of cameras does not increase braking/accelerating as this would adversely impact air quality]- average speed camera could therefore be more effective.  
**C11. Place 70 mph signs along motorways to make the national speed limit more salient**  
The UK’s SRN often rely on national speed limit signs rather than 60mph / 70mph signs. Including these signs may help make the speed limit more salient. It is also quite novel to see a 70mph speed limit on a motorway. Though further research may be needed on this. It is plausible that people are more inclined to speed on a motorway without speed limit signs, than they are to speed on another 70mph road with signs, as it alters the implied context.  
**C12. Timely prompts targeting cinema goers after particular high-energy films which may encourage speeding.**  
For example, research has shown that the ‘Fast and Furious’ films led to an increase in speeding offenses within the localities of the cinemas after the showings. Providing safety messages after similar films, harnessing effective messengers, and behavioural messages (e.g. social norms) may be a timely moment to intervene.  
**C13. Children as messengers**  
Work with schools to engage kids in this topic. Teach them to keep an eye on their parents’ speeds. Children have a lot of influence over their parents, and if delivered through a safety message may effectively leverage guilt and parental duty to good effect. Would need to be delivered very sensitively.  
**C14. Name and shame’ system**  
Develop a ‘name and shame’ system, for example through twitter or more a formal online platform through which road-users submit (or tweet) the number plates of aggressive / speeding drivers. If done formally, multiple submissions of the same vehicle could lead to a warning letter.  
**C15. ‘I’m not impressed by your speeding’**  
Develop a norm and promote a heuristic to make it more acceptable to ‘call out’ friends who are driving over the limit. Passengers may fail to call out a speeding driver through fear of losing face (especially among young male friends), or not wanting to criticise. Campaigns may struggle to address speeding directly, but may have more success in making it more acceptable to call out a friend, to re-frame it as a confident, desirable defiant act, directly tackling the issue of social status in speeding among certain population segments. For example, this might play into the humorous meme of aggressive young male drivers needing to compensate for inadequacy elsewhere, to undermined the status of speeding.  
The impact of this message could be strengthened by drawing upon the right messenger. For example, someone who attracts respect and credibility in this context among the target demographic might include the late Paul Walker’s family, or racing driver Lewis Hamilton.  
**C16. Endowed progress license points**  
With 12 points available, adjust the system such that 6 points are received for the first offence, 5 for the second offence, 2 for the third offence etc. This sense of ‘endowed progress’ (being further along the process, proportionally) may reduce reoffending rates after the first offence.  
**C17. Ratcheting license points**  
If speeders are caught speeding again within a certain timeframe (say, 6 months), the penalty is more severe (e.g. 3 points for speeding the first time, 6 points the second time if caught again within 6 months).  
| Peer-to-peer ‘policing’ | - Messenger effects  
- Social status, social norms (see social norms) but also note that social status is an innate need. Furthermore, being ‘called out’ works for similar reasons discussed under ‘surveillance’ – it removes the possibility of transgressing the expected / normative behaviour in anonymity, and thus greatly increases our propensity to conform to those norms. Relatedly, people who act antisocially online, sheltered by their anonymity, rarely have such confidence to break etiquette in person. This is related to the idea of ego (wanting to maintain a positive image of oneself), impression management (wanting to maintain others’ positive image of us), and consistency effects (it becomes harder to ignore our own hypocrisy or violations of the values we think we hold, when those transgressions are public and known – i.e. we fool ourselves quite easily, but fooling ourselves is harder when we know that other people are wise to our actions). |  
| Modifications to license points system | - Endowed Progress (dis)incentives |  
| | **C16. Endowed progress license points**  
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<tr>
<td>Financial products to promote uptake of EVs</td>
<td>• Hyperbolic future discounting / present bias • Incentives • Framing • Scarcity • Deadlines and decision points.</td>
<td><strong>EV1. GreenDeal for EVs</strong>&lt;br&gt;Allow EVs to be bought such that the difference in price above an equivalent ICE (subsidy accounted for) is paid for by interest-free government credit, with the amount only paid back in instalments the magnitude of which reflect the savings being made on petrol (e.g. recipients of the deal must submit odometer readings every 6 months, with payments based on mileage and the difference between average fuel costs and electricity costs for that vehicle).&lt;br&gt;This could be applied to all EVs, but may be particular relevant for fleet operators and businesses for whom cash-flow is a significant consideration, but also for whom the prospect of long-term savings are likely to be highly incentivising.</td>
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<td><strong>EV2. Green mortgages for EVs.</strong>&lt;br&gt;Provide favourable credit options to individuals and businesses buying EVs on credit (relative to the credit deals which would be offered for similar-priced ICE vehicles). Justifiable by virtue of the fact that running an EV is significantly cheaper than running an ICE, and thus ability to pay increases. This may apply to all EVs, but may be particularly relevant for fleet operators who may be more likely to seek the best credit deals or seek to maximise their credit to benefit their business’ cash flow.</td>
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<td><strong>EV3. Differential VAT rates on vehicles, targeted at consumers (EVs) and manufacturers (ICEs)</strong>&lt;br&gt;(This idea is targeted at all vehicle types to promote efficiency, but would consequently have advantages for EVs too).&lt;br&gt;Have differential rates of VAT on vehicle sales based on emissions. If designed as a consumer-facing policy, this has the potential to boost sales of EV of less polluting ICES. However it could equally be targeted at manufacturers, for example by setting multiple tax thresholds in such a way that common vehicle classes could avoid the tax (or fall into the cheaper band) through modest, achievable improvements to the vehicle’s performance. Alternatively, the rate of VAT paid by producers could be linked to the average emissions level of the vehicles they sell, encouraging them to promote more efficient vehicles over more polluting ones.</td>
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<td><strong>EV4. Re-frame existing government subsidies to make them more appealing.</strong>&lt;br&gt;£2,500 off a £20,000 car may be less impactful than being paid £2,500 above market rate for your part-exchange vehicle, for example. Therefore, reframe and campaign around a scrappage scheme “we’ll pay £2,500 above market rate for your old banger”. Alternatives include re-framings like ‘free fuel (electricity) for 3 years’ (based on estimated mileage and kWh cost.)&lt;br&gt;There may also be benefits to simply making the discount more salient, and advertising it more explicitly as a discount/subsidy, rather than having it applied automatically by the dealer and ‘hidden’ to the end-consumer.&lt;br&gt;Alternatively, this may be a cash-back offer, for example “But the £30k EV on credit, get the £2,500 cash-back = equates to cheap credit”. This may be particularly appealing for fleet operators who may buy multiple vehicles, and who may have strong cash-flow incentives. This is particularly attractive where vans are being bought, considering the larger subsidies available (up to £8k).&lt;br&gt;It would also be possible to apply artificial deadlines or the scarcity principle to these subsidies. For example, ‘only applied to the first 100,000 EVs registered each year’ (with limit set fairly high such that no restriction would actually be imposed).</td>
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<td><strong>EV5. Create a ‘refer a friend’ subsidy scheme.</strong>&lt;br&gt;Harness powerful messenger effects, and the power of personal, trusted recommendations to drive EV sales. Existing subsidies could be restructured such that EV owners receive cash-back in return for someone referencing their name when buying an EV. This harnessed a natural form of targeting and segmentation, since EV attitudes and purchasing habits are correlated with certain demographics and values – in other, the people most likely to buy an EV are likely to be people who, on average, have friends that are also most likely to buy an EV. Alternatives to a simple cash-back sum include entry into a lottery (for example, to win back the cost of your EV, or a high-profile free upgrade (for example, for a Tesla).</td>
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<td>Incentives to promote uptake of EVs</td>
<td>• Incentives • Frictions costs / hassle • Status</td>
<td><strong>EV6. Priority/ free parking for EVs on all HE facilities (or other organisations)</strong>&lt;br&gt;<strong>EV7. Create priority lanes for EVs</strong>&lt;br&gt;Implement priority lanes for EVs on SRN or, more feasibly in towns and cities allowing EVs to use the bus/taxi lanes.</td>
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<td><strong>EV8. Government to make a commitment to infrastructure development based on EV purchasing.</strong>&lt;br&gt;For every X EVs that are purchased in your area, government could commit to installing a charging point in the same area. Alternatively, allow EV buyers to vote or choose where the next charging points are to be installed. To add a personal sense of ownership, charging stations could be personalised, attributed to EV owners with name plaques.</td>
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<td><strong>EV9. Charging stations to provide a free code / coupon for a coffee or sandwich at motorway stations.</strong>&lt;br&gt;This may not lead to an increase in uptake of EVs. However, for a significant period EVs are likely to be second-cars in a 2-car family. This incentive, which directly addresses the concern of waiting for 30mins+ while the car charges, may encourage owners to use their EV on the SRN during longer journeys.</td>
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| | | **EV10. Expand free parking for EVs, such that is covers all publically owned car parks**
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<td>Removing frictions, hassle, uncertainty and anxiety</td>
<td>• Uncertainty and risk-aversion&lt;br&gt;• Loss aversion&lt;br&gt;• Social norms&lt;br&gt;• Personalisation&lt;br&gt;• Timely moments and prompts&lt;br&gt;• Friction costs and hassle factors</td>
<td>EV11. Smart charging stations&lt;br&gt;These charging stations connect to an app, which indicates availability ahead of time (through an app), allow booking / queuing so you know when it will be free and allow you to reserve one when an hour away, it could work kind of like a car pooling app&lt;br&gt;EV12. Map of charging station&lt;br&gt;Easy-to-use map/ guideline to inform drivers about charging infrastructure along the SRN. Could be an online platform where you indicate your planned travel route and it tells you exactly where you find charging points along the SRN, how far they are from one another, etc. It could also have a functionality that allows you to select your car model/ or one similar in size and the programme maps out your ‘charging journey’ along the SRN&lt;br&gt;EV13. Salient information about charging infrastructure in your proximity&lt;br&gt;Sticker (or other type of label) on petrol pumps indicating how far the next charging point is, and the necessary range an EV would need to get from where you are to there (next electricity charging point on the SRN) – the idea here is to address range anxiety occurring from being uninformed. By anchoring drivers to figures around range that are relevant in practice might influence how customer think about range. The goal would be to get them to think about EVs and necessary range in different terms (range you need to get from charging point A to charging point B) rather than directly comparing the driving experience to that with combustion engines&lt;br&gt;EV14. Allow reserved parking spaces for those with access only to on-street parking.&lt;br&gt;Many people with on-street parking cannot be sure of parking directly outside their house. Allow buyers of new EVs to have a charging point installed on the curb-side, along with a private parking space adjacent to the charging point. This not only addresses a major concern that they wouldn’t be able to reliably charge their EV if they bought one, but the prospect of getting a private space outside their home may also be a major incentive in itself for those living on busy streets&lt;br&gt;EV15. Mandate all new homes to have an EV charging point installed.&lt;br&gt;This removes certain frictions, but also introduces a norm. Moreover, if people move into such a home, the existence of the charging points acts as a degree of ‘sunk cost’ (they’ve paid for the charging point when buying the house, which may modestly increase their desire to ‘make use of that expenditure’ by considering an EV). The presence of a charging point is also a novelty which may simply increase salience and awareness of EVs being an option to consider when purchasing their next car&lt;br&gt;EV16. Promote EV test-drives through prompts at timely moments (e.g. on DVLA website after renewing tax)&lt;br&gt;Prompt people completing their DVLA tax renewal to book a free test drive in an EV. This is particularly relevant and salient (given that tax has just been paid on a vehicle, and EVs are tax free). Moreover, it exclusively targets drivers, and a very large population of them.&lt;br&gt;Messages could harness loss aversion (highlighting the loss of tax just paid, relative to tax-free EVs), scarcity (a limited number of free test drives available), social norms (highlighting the increasing number of people buying EVs, or the number of people choosing to book a free test drive), novelty (framed as an ‘experience’ (a la a track day) rather than as a ‘test drive’ (as when buying a vehicle), and personalisation/exclusivity (you have been chosen).&lt;br&gt;A similar approach could be taken at MOT time (especially if repairs are necessary, as it will capture people considering an upgrade)&lt;br&gt;EV17. Increase awareness and harness social norms by providing bumper stickers (by default) on all new EVs, and providing stickers to existing EV owners&lt;br&gt;EVs are hard to distinguish on the road and are therefore not salient for most road-users. This means their perceived prevalence may be even lower than reality.&lt;br&gt;Though the stickers could be removed, our susceptibility to defaults and inertia suggests many would be left on.&lt;br&gt;Though only a minority of cars would have them, our availability heuristic would lead to the perception that they are more common than they are, e.g. an average drive on the motorway might lead to several sightings – we would remember this, but would be unlikely to account for the fact this is a tiny fraction of the thousands of cars we have seen (base rate fallacy). The stickers should therefore be made memorable and eye-catching, e.g. using humour and recognisable design.&lt;br&gt;As familiarity increases, fondness will also increase, and perceived norms will start to shift.&lt;br&gt;EV18. National EV rally / track day.&lt;br&gt;For example, an additional day could be added to the Goodwood Festival of Speed celebrating “all things EV”, allowing owners to drive the track, and celebrating the technology, historic and future. This should aim to radically increase the status associated with EVs among a festival audience who might otherwise be attracted to petrol vehicles. Influential messengers such as Chris Evans could widely promote the event&lt;br&gt;EV19. Mandate all vehicles (EVs and ICEs) to be advertised both in terms of their purchase price and their lifetime running cost (including price).&lt;br&gt;EVs have substantially higher price tags (often even with the subsidy applied), however they are now cheaper over their lifetime than equivalent ICES&lt;br&gt;EV20. Directly target fleet owners and business owners highlighting the loss they are incurring&lt;br&gt;Business owners and fleet operators, including ‘one-man-band’ van owners, may be particularly receptive to messaging focussing on cost savings. Harnessing loss aversion, and personalising the information, such messages should highlight the lost costs of running a petrol or diesel vehicles. This could tie-in to intervention idea EV16 – upon completing the DVLA form, and identifying the number of vehicles registered to the owner/company from the DVLA database, personalised messages could highlight the loss of profits from running costs of ICES compared to EVs.&lt;br&gt;A variety of other behavioural insights could also be incorporated into these messages, including social norms (highlighting the increase in the number of people choosing to buy EVs, since absolute numbers are still low and thus may not be persuasive) and trusted messengers from people with a similar vehicle use in mind (aiming to overcome any scepticism that EVs may suit other people, but ‘aren’t for me’. We also know that social norm messages are more effective when the norm is tailored to ‘people like me’.</td>
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| **Social marketing campaigns harnessing emotion, and other behavioural insights** | * Emotions / Affect * Salience * Personalisation | **PE1. Messages to evoke a feeling of disgust around tailpipe emissions**  
Disgust is a powerful emotion, and one which is hard-wired to drive our behaviour. We have evolved to react, unthinkingly, to that which disgusts us. When people understand the constituency of the pollution they are breathing in (i.e. what is contained), they find it disgusting. However a lack of awareness, and the fact that it is largely invisible, means we often don’t notice it. A campaign based explicitly on the emotion of disgust may effectively change this. |
| **Behaviourally-informed framing of policies and interventions** | * Procedural justice * Future discounting * Framing * Messenger effects | **PE2. Your child is smoking 30 cigarettes per day**  
We often neglect our own health. However the health of our children is a powerful motivator. Research has quantified the impact of air quality in different regions as the equivalent number of cigarettes smoked per day, and the numbers are often alarmingly high – for example, New Delhi air is equivalent to smoking 45 cigarettes per day. Average London air is equivalent to 15 cigarettes per day, with some hotspots such as Marylebone as high as 30.  
A campaign based on the question “How many cigarettes are your children smoking?” may therefore prove to be particularly effective at building support for local intervention, such as roadside barriers, or indeed for wider regional or national policy to tackle the issue. |
| **Make air quality barriers more attractive** | * Simplification * Framing * Procedural justice | **PE3. Upfront benefits, longer-term demands**  
Provide residents or road-users with upfront benefits in return for committing to longer-term policy or infrastructure changes. For example, in return for the inconvenience of building work nearby their home, some form of compensation could be provided immediately, highlighting that works will not commence for 18 months. |
| **Increase awareness of the benefits** | * Simplification * Framing * Procedural justice | **PE4. Justice and fairness: Frame policy proposals positively, hypothecate funds for public and community benefits, and target manufacturers’ and producers, not individual lifestyle choices.**  
Policies and interventions can be framed positively to signal their benefits. For example ‘limiting fuel duty increases to no more than 2% per year’ is a subtly more positive framing to ‘2% increase in fuel duty year-on-year’. Similarly, framing the intervention as an amount of money being spent on the local area for the health benefit of residents, while a sense of exclusivity or preferential treatment can be inferred if a limited resource is prioritised in certain areas.  
Fairness and procedural justice are extremely important in garnering public support for policies. One way to boost fairness and legitimacy of an intervention is to hypothecate any funds raised, such that they benefit those who are affected by the issue the policy is aiming to address. For example, a carbon tax spent on environmental programmes or R&D in renewable energy is likely to be more acceptable than a carbon tax spent on overseas aid or police recruitment, even though those two expenditures tend to receive positive support from the public. Likewise, increased fuel duty is never popular, but may be more acceptable if the money is used directly to cover the additional costs on the NHS of respiratory illnesses (and this fact is made well known), or to fund roadside trees and vegetation, for example. |
<p>| <strong>PE5. Harness trusted and credible messengers</strong> |  | The identity of the messenger is often as important as the message. We tend to perceive people ‘like us’ are more trustworthy, whilst credibility and independence are also important. Highways England may have high credibility, but may not be viewed as impartial, not particularly identifiable. Engaging community leaders, or using high-profile figures who are respected and liked, may help improve the impact of information campaigns. |
| <strong>PE6. Community art projects</strong> |  | Allow barriers to be designed, augmented or decorated through community art projects, or commission respected local artists to help design them. |</p>
<table>
<thead>
<tr>
<th>Intervention category</th>
<th>Behavioural concepts used</th>
<th>Intervention idea (increasing public engagement and consent for interventions)</th>
</tr>
</thead>
</table>
| Public engagement in decision-making | * Procedural justice  
* Lotteries  
* Agency, sense of worth | **PE8. Deliberative Forums**  
Deliberative forums bring together a representative panel of the public to discuss a policy issue and develop solutions to it, in a similar format to a jury service. They have been used around the world often to good effect. Their precise nature can vary, for example the decision of the forum is not necessarily binding but a formal recommendation, and some are short events while others last several weeks and bring in large groups of the public. Additional mechanisms can also bring in wider views, for example media coverage during the debate, and alternative technological solutions (e.g. through social media) to enable other members of the public to pose questions and views.  
Deliberative forums have the potential to create an unusually strong mandate for policy, particularly where difficult trade-offs are required and often officials may feel they are ‘damned if they do, damned if they don’t’ – where a decision is made by the public, there is far less scope for anger or objection from aspects of the media or other groups.  
It is also possible that such forums generate more innovative solutions. By presenting all the evidence to the forum, common misconceptions can be overcome, a plurality of perspectives can be sincerely debated, whilst policy-makers can capture a wide range of views and varying expertise. They also bring with them a unique opportunity to influence wider behaviour, since public consensus and the policy-making process itself is likely (if done in this manner) to influence wider social norms and attitudes, as well as signalling the public’s views to corporations. |
| | | **PE9. Incentive to engage residents in the planning and decision process**  
Set up a lottery to incentivise engagement with planning and decisions processes where anyone who does engage (this could be defined broadly as opposing, supporting or expressing indifference) is automatically entered into the lottery. The prize of the lottery could be to support the purchase of a cleaner vehicle, EV, or a public transport pass, etc. While this could backfire if it simply increases the number of objections, the logic behind this approach however, is to attract a much broader range of views. Normally, public engagement activities in the context of planning decisions are overwhelmingly dominated by negative views, because the objectors are the only people motivated enough to engage and share their opinion. However this is not a representative view of the public – the ‘silent majority’ are often in mild support or indifferent. This bias is reflected in mainstream media accounts of proposals (e.g. “proposal X has received 5000 objections” – with no indication of whether this is a tiny or large proportion of the overall population who have an opinion.  
By re-framing the planning process in this way, and garnering much broader and more representative input, the number of ‘objections, becomes less important than the balance of support. |
| | | **PE10. Public votes**  
Allow residents or road-users to have meaningful input into decisions, for example by voting on details of a development or policy. Proactive and constructive engagement in this way is likely to reduce the amount of outright objection. |
APPENDIX D: Scoring of longlisted intervention ideas
**APPENDIX D: Scoring the intervention ideas on originality, impact and feasibility**

**Scoring each intervention idea**

Each of the longlisted solution ideas was scored on the following metrics:

**Impact on behaviour:** the likely impact of the intervention on the behaviour of interest. This judgment is based on the existing literature (reviewed in Report 1) and BIT’s expertise in designing and evaluating behavioural interventions. Each intervention idea is scored from 1 (very low impact likely) to 5 (very high impact likely).

**Impact on air quality:** the impact of the behaviour in question on air quality, accounting for both the extent to which a given behaviour causes air pollution, and the size of the target population to whom the behaviour and intervention are relevant. Each intervention is scored from 1 (very low impact on air quality) to 5 (very high impact).

**Feasibility of delivery of the intervention:** the ease with which the intervention could be implemented. This score takes into account the complexity of the intervention, the likelihood of political or public resistance, the extent to which third parties (e.g. retailers, central government, manufacturers) might need to be involved, and their likelihood of doing so (depending how well aligned their motives are perceived to be). Each intervention is scored from 1 (very challenging for Highways England to implement) to 5 (a quick-win for Highways England to implement).

**Cost of delivery of the intervention:** a crude measure from very low to very high based on our best estimate, accounting for material costs (e.g. physical infrastructure, funding for incentives) and running costs (e.g. for ongoing enforcement or management). Each intervention is scored from 1 (very expensive) to 5 (very economical).

**Timescale of impact:** the rapidity with which impact might be expected, accounting both for the timescale of intervention development and delivery and the timescale over which impact might emerge after the intervention is delivered. Each intervention idea is scored from 1 (very slow impact) to 5 (very quick impact).

**Originality:** Highways England are keen to trial interventions which have not been trialled before, or which mark a departure from ‘standard thinking’ about air quality interventions. This score is an approximate measure of how ‘novel’ we perceive the intervention to be, based on the extent to which similar interventions (don’t) arise in the existing literature, and the extent to which they draw upon behavioural insights in innovative ways. Each intervention idea is scored from 1 (not at all original) to 5 (highly original and/or drawing heavily upon behavioural insights novel to the context of air quality).
# APPENDIX D: Scoring the intervention ideas on originality, impact and feasibility

<table>
<thead>
<tr>
<th>Intervention #</th>
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<th>Impact on behaviour</th>
<th>Impact on AQ</th>
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<th>Feasibility of delivery</th>
<th>Cost of delivery</th>
<th>Timescale of impact</th>
<th>Total score</th>
</tr>
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<tbody>
<tr>
<td>E1</td>
<td>Mandate minimum telematics standards</td>
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<tr>
<td>E2</td>
<td>FitBit for your car (eco-driving / money-saving app in collaboration with</td>
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<tr>
<td></td>
<td>supermarkets and insurance providers)</td>
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<td>E3</td>
<td>Frame petrol consumption and dashboard mpg as a loss of money</td>
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<td>Link insurance premiums to driving style</td>
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<tr>
<td>E5</td>
<td>Employee/fleet employee league tables</td>
<td>4</td>
<td>2</td>
<td>3</td>
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<td>4</td>
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<tr>
<td>E6</td>
<td>Charitable giving (employers and fleet operators give in return for eco-</td>
<td>4</td>
<td>2</td>
<td>4</td>
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<td>driving among staff)</td>
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<tr>
<td>E7</td>
<td>Lotteries or rewards based on driver league tables</td>
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<tr>
<td>E8</td>
<td>Social comparisons and norm messages targeted at least efficient fleet</td>
<td>4</td>
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<td>E9</td>
<td>Set up ‘efficient fleet’ awards</td>
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<tr>
<td>E10</td>
<td>Target fleet drivers / operators to make the benefits of eco driving, and of</td>
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<td>1</td>
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<tr>
<td></td>
<td>eco-driving training, salient and relevant.</td>
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<tr>
<td>E11</td>
<td>Target new parents to promote safe driving tips, harnessing new concerns for</td>
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<td>E12</td>
<td>Target eco-driving training at new drivers before habits are formed</td>
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<tr>
<td>E14</td>
<td>Eco-driving prompts on smart motorways and other signage</td>
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<td>Eco-driving &amp; maintenance tips delivered through MOT test</td>
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<tr>
<td>E16</td>
<td>Eco-driving prompts through radio alerts and other media outlets, based on a</td>
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<td>5</td>
<td>4</td>
<td>5</td>
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<tr>
<td></td>
<td>memorable heuristic, or emotional resonance.</td>
<td></td>
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<td>E17</td>
<td>Bumper stickers reminding people to keep their distance</td>
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<td>E18</td>
<td>Introduce a pejorative term for people who drive in a polluting fashion</td>
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<td>1</td>
<td>5</td>
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<tr>
<td>E19</td>
<td>Reverse ‘points system’ for eco-driving</td>
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<tr>
<th>Intervention #</th>
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<th>Total score</th>
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<td>C1</td>
<td>Develop new behaviourally-informed messages targeting those who speed but not enough to receive a penalty</td>
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<td>Behaviourally-informed messaging in existing speeding penalty notices</td>
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<td>C3</td>
<td>System of warning points for speeding – multiple warnings lead to a penalty</td>
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<td>5</td>
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<tr>
<td>C4</td>
<td>Mandated speed checking device for offenders</td>
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<td>1</td>
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<tr>
<td>C5</td>
<td>New parents’ safety pledge</td>
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<td>C6</td>
<td>New driver pledge</td>
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<td>C7</td>
<td>Bumper stickers to prompt speed compliance</td>
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<td>3</td>
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<td>C9</td>
<td>Smart motorway speed compliance prompts incorporating behavioural nudges</td>
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<tr>
<td>C10</td>
<td>Simple 70mph signs on smart motorways</td>
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<td>2</td>
<td>3</td>
<td>5</td>
<td>5</td>
<td>5</td>
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<tr>
<td>C11</td>
<td>Decoy speed cameras/ speed checks, or use ‘eyes’ to increase compliance.</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
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<td>C12</td>
<td>Timely prompts targeting cinema goers after particular high-energy films which may encourage speeding.</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>4</td>
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<td>C13</td>
<td>Children as messengers</td>
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<tr>
<td>C14</td>
<td>Name and shame’ system</td>
<td>3</td>
<td>2</td>
<td>4</td>
<td>3</td>
<td>4</td>
<td>4</td>
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<tr>
<td>C15</td>
<td>‘I’m not impressed by your speeding’</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>5</td>
<td>4</td>
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<tr>
<td>C16</td>
<td>Endowed progress license points</td>
<td>1</td>
<td>1</td>
<td>5</td>
<td>3</td>
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<tr>
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<td>Ratcheting license points</td>
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<th>Timescale of impact</th>
<th>Total score</th>
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<tbody>
<tr>
<td>EV1</td>
<td>Green Deal for EVs</td>
<td>5</td>
<td>5</td>
<td>4</td>
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<tr>
<td>EV2</td>
<td>Green mortgages for EVs.</td>
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<td>4</td>
<td>3</td>
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<td>24</td>
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<tr>
<td>EV3</td>
<td>Differential VAT rates on vehicles, targeted at consumers (EVs) and manufacturers (ICEs)</td>
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<td>5</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>17</td>
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<tr>
<td>EV4</td>
<td>Re-frame existing government subsidies to make them more appealing.</td>
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<td>5</td>
<td>5</td>
<td>4</td>
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<tr>
<td>EV5</td>
<td>Create a ‘refer a friend’ subsidy scheme.</td>
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<td>3</td>
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<td>1</td>
<td>2</td>
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<tr>
<td>EV6</td>
<td>Priority/ free parking for EVs on all HE facilities (or other organisations)</td>
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<td>2</td>
<td>1</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>18</td>
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<tr>
<td>EV7</td>
<td>Create priority lanes for EVs</td>
<td>4</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>1</td>
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<tr>
<td>EV8</td>
<td>Government to make a commitment to infrastructure development based on EV purchasing.</td>
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<td>5</td>
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<td>2</td>
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<tr>
<td>EV9</td>
<td>Charging stations to provide a free code / coupon for a coffee or sandwich at motorway stations.</td>
<td>1</td>
<td>5</td>
<td>2</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>19</td>
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<tr>
<td>EV10</td>
<td>Expand free parking for EVs, such that it covers all publically owned car parks</td>
<td>4</td>
<td>4</td>
<td>2</td>
<td>3</td>
<td>2</td>
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<tr>
<td>EV11</td>
<td>Smart charging stations (bookable and with availability/status visible on an app)</td>
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<td>5</td>
<td>3</td>
<td>2</td>
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<tr>
<td>EV12</td>
<td>Smart map of charging station</td>
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<td>EV13</td>
<td>Provide salient information about charging infrastructure in your proximity</td>
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<td>5</td>
<td>3</td>
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<td>EV14</td>
<td>Allow reserved parking spaces for those with access only to on-street parking</td>
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<td>3</td>
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<td>2</td>
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<tr>
<td>EV15</td>
<td>Mandate all new homes to have an EV charging point installed.</td>
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<td>EV16</td>
<td>Promote EV test-drives through prompts at timely moments (e.g. on DVLA website after renewing tax)</td>
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<td>25</td>
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<tr>
<td>EV17</td>
<td>Increase awareness and harness social norms by providing bumper stickers on all new &amp; 2nd hand EVs and least polluting ICEs</td>
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<td>5</td>
<td>4</td>
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<td>23</td>
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<tr>
<td>EV18</td>
<td>National EV rally / track day.</td>
<td>1</td>
<td>2</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>18</td>
</tr>
<tr>
<td>EV19</td>
<td>Mandate all vehicles (EVs and ICE) to be advertised both in terms of their purchase price and their lifetime running cost (including price).</td>
<td>3</td>
<td>5</td>
<td>5</td>
<td>3</td>
<td>5</td>
<td>4</td>
<td>25</td>
</tr>
<tr>
<td>EV20</td>
<td>Directly target fleet owners and business owners highlighting the loss they are incurring</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>22</td>
</tr>
</tbody>
</table>
### APPENDIX D: Scoring the intervention ideas on originality, impact and feasibility

<table>
<thead>
<tr>
<th>Intervention #</th>
<th>Intervention idea</th>
<th>Impact on attitudes</th>
<th>Impact on AQ</th>
<th>Originality</th>
<th>Feasibility of delivery</th>
<th>Cost of delivery</th>
<th>Timescale of impact</th>
<th>Total score (1/25)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PE1</td>
<td>Campaign to evoke a feeling of disgust around tailpipe emissions</td>
<td>3</td>
<td>-</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>18</td>
</tr>
<tr>
<td>PE2</td>
<td>Your child is smoking 30 cigarettes per day</td>
<td>4</td>
<td>-</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>20</td>
</tr>
<tr>
<td>PE3</td>
<td>Structure policies to bring upfront benefits (delaying costs to the long-term)</td>
<td>3</td>
<td>-</td>
<td>4</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>14</td>
</tr>
<tr>
<td>PE4</td>
<td>Justice and fairness: Frame policy proposals positively, hypothecate funds for public and community benefits, and target manufacturers' and producers, not individual lifestyle choices.</td>
<td>3</td>
<td>-</td>
<td>4</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>18</td>
</tr>
<tr>
<td>PE5</td>
<td>Harness trusted and credible messengers</td>
<td>3</td>
<td>-</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>5</td>
<td>20</td>
</tr>
<tr>
<td>PE6</td>
<td>Community art projects on roadside barriers</td>
<td>3</td>
<td>-</td>
<td>3</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>16</td>
</tr>
<tr>
<td>PE7</td>
<td>Increase awareness of the benefits of AQ policies infrastructure and policies, both generally, and on a case-by-case basis with plain-English guides and a Q&amp;A service</td>
<td>4</td>
<td>-</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>18</td>
</tr>
<tr>
<td>PE8</td>
<td>Deliberative Forums</td>
<td>5</td>
<td>-</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>19</td>
</tr>
<tr>
<td>PE9</td>
<td>Incentive to engage residents in the planning and decision process</td>
<td>4</td>
<td>-</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>17</td>
</tr>
<tr>
<td>PE10</td>
<td>Public votes</td>
<td>3</td>
<td>-</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>18</td>
</tr>
</tbody>
</table>
Encouraging the uptake of electric vehicles
6. https://www.smmt.co.uk/2017/02/more-than-8-million-used-cars-sold-in-2016-a-new-uk-record/

Encouraging the uptake of eco-driving styles
BIBLIOGRAPHY: Drivers & Barriers

Increasing compliance with 70mph speed limit

Encouraging public acceptance of on-road & off-road measures
BIBLIOGRAPHY: Segmentation

Encouraging the uptake of electric vehicles

**Main source:**

**Specific reference points:**
2. [from main source]

Encouraging eco-driving

**Main source:**


**Specific reference points:**
- Highways England segmentation of drivers [need to get ref from Deirdre]
Increasing speed limit compliance

7. Musselfwhite, 2006
10. Musselfwhite, 2006

Increasing public acceptance of on-road and off-road policy measures

**Main sources:**


