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In the period April – June 2016, much of the focus in the UK, and in fact worldwide, was on the EU referendum. With a slim majority voting to leave the EU, there has been much speculation about what the decision will mean for our transport system, legislation and policies. One area that appears unaffected by the decision is the UK’s commitment to tackling climate change.

Addressing the annual UK Business and Climate Summit in London on 28th June 2016, Christiana Figueres, Executive Secretary of the United Nations Framework Convention on Climate Change (UNFCCC), stated that regardless of the Brexit decision “climate change action is by now unstoppable” (Guardian, 28th June). At the same time, UK government announced its fifth Carbon Budget with aims to cut carbon emissions by 57% by 2032. However, in order to meet such ambitious targets, road transport needs to be almost completely decarbonised.

According to the Office for National Statistics, the transport sector is the only sector in the UK to increase CO2 emissions since 1970. Interestingly, the government’s own advisory Committee on Climate Change (CCC) warned that targets will be missed unless policies are improved, so we need to find ways to improve the sustainability of our transport network.

It’s not just the causes of climate change that need to be addressed; the effects of climate change on transport must also be considered. The impact of the recent torrential rain and heatwave on our rail and road networks has demonstrated that our infrastructure is not always able to cope with today’s extreme weather.

With the problem laid bare, it is clear that complacency is not an option. Climate change poses a significant risk to critical transport infrastructure and we must act now to limit any future economic, environmental and societal impacts.

To help drive improvements in sustainability, TRL is working on a number of different projects in the UK and globally. Key focus areas include: vehicle engineering, simulation and modelling; human factors and behavioural science; intelligent transport solutions; surface transport infrastructure and sustainability. Our research across these areas is helping not only to improve air quality and reduce emissions, but to create a low carbon transport ecosystem that improves the sustainability and resiliency of our transport network and promotes active transport modes.

Professor Nick Reed
Director, TRL Academy.
02 About the TRL Academy
02 About the TRL Academy

The Academy is TRL’s innovation and development centre that delivers research programmes and projects, underpinning our position as a leading transport research institute. The work of the Academy supports knowledge creation and transfer, aiming to increase our intellectual capital, skills and capabilities across science, engineering and research disciplines. We collaborate with academia, industry and the public sector to foster learning and discovery that benefits our customers and employees.

People
Our people are critical to the process of discovery and innovation. Through the Academy we facilitate career progression for TRL employees by proactively encouraging inventive thinking and supporting their academic studies. Academy investment in our people means that our clients benefit from pioneering, industry-leading and evidence-based research.

Research
The Academy’s work is supported by internal and external funding programmes. TRL’s parent body, the Transport Research Foundation (TRF) is a non-profit Scientific Research Association, which uses the income from its investment in TRL to fund an annual programme of research in areas of strategic importance.

As an Affiliated Research Centre to the Open University, we recruit, supervise and conduct examinations for internal and external candidates pursuing research degrees. The Academy is currently funding and supervising PhD and EngD programmes with the University of Southampton, University of Warwick, Royal Holloway and University of London.

The Academy has also recently formed an alliance with the Computer Science and Artificial Intelligence Laboratory (CSAIL) at MIT (Massachusetts Institute of Technology) to build our capabilities in this exciting and critical area of development for the transport sector.

Outcomes
The Academy’s work is vital for the development of evidence-based solutions and new insights into the ever-changing and demanding transport landscape. Our ability to generate and apply this knowledge not only helps to shape and define the future of transport, but also enables us to address and solve complex transport challenges for our clients.

Through the Academy’s research programmes, projects and relationships across industry, academia and the public sector, we build knowledge and awareness in the transport and mobility market. By understanding short, medium and long term developments across these sectors, the Academy ensures we have the skills and capabilities needed to maintain our market leading position.
03 Our Research
3.1 Encouraging sustainable travel through e-bikes

Air pollution is a global transport challenge. Vehicle emissions contribute to the development of respiratory disease which is causing more deaths per day than road collisions. Globally, transport policy makers and urban planners are looking for innovative ways to encourage:

- More sustainable forms of transport; to reduce congestion in towns and cities
- Reduce local air pollution and greenhouse gas emissions
- Increase physical activity in order to address obesity and a range of other health issues.

Electrically-assisted bikes are a cycling innovation that may help to achieve this goal.

Electrically-assisted bikes, or ‘pedelecs’, are those where pedalling is required but the rider can choose to switch on battery-powered assistance to reduce the effort required. This type of bike varies in design but, in all cases, assistance cuts out when the rider stops pedalling or when the bike exceeds specified speed thresholds, as set out by legislation (25kmph across Europe). Although e-bikes are less environmentally friendly and require less physical activity than conventional bikes, the differences are small when compared with other forms of motorised transport, such as cars, and the activity required is still sufficient to count as at least ‘moderate intensity’ physical activity.

Across the sample as a whole, average usage was 15–20 miles per week and was accompanied by an average reduction in car mileage of 20%. At the end of the trial, 38% participants expected to cycle more in the future and at least 70% said that they would like to have an e-bike available for future use and would cycle more if this was the case. This is consistent with the results of the European literature review which showed that when made available, e-bikes get used. It also indicated that a proportion of e-bike trips typically substitutes for car use and that many people who take part in trials become interested in future e-bike use, or cycling more generally.

This research is based on a project funded by the UK Research Councils Digital Economy and Energy Programmes / EPSRC, grant EP/J004855/1, led by the University of Brighton, entitled ‘Smart e-bikes: understanding how commuters and communities engage with electrically-assisted cycling’, www.smart-ebikes.co.uk. Grateful thanks to the funding organisations, the trial participants, and to the other partner organisations involved in the study, namely Raleigh, Bupa International, Brighton & Hove City Council, Baker Street Bikes and M’s Cycles.

This project reported on results from a trial in the UK city of Brighton, where 80 employees were loaned an electrically-assisted bike for a 6–8 week period. This was accompanied by a review of the European literature available about other trials or surveys of those who have purchased e-bikes. In the Brighton trial, three-quarters of those loaned an e-bike used them at least once a week.
Development of more sustainable transport policies requires an understanding of private transport use. This research describes the development of new techniques for analysing several UK government datasets (used for other purposes), in order to provide insights into a range of different policy areas.

Specifically, it reports on using data collected during vehicle licensing and periodic vehicle inspection tests (the UK ‘MOT’ tests), in order to provide new insights into:

- Personal car ownership/use;
- The related issues of energy use;
- Air quality emissions;
- Vehicle-related climate change contributions;
- And the spread of new vehicle technologies.

Innovative features of the work include:

- The techniques developed to rework a national dataset which is relatively comprehensive, but collected for other reasons;
- Analysis of the core dataset in conjunction with other information sources;
- Undertaking exploratory analysis in a topic area which is usually restricted by data limitations;
- And the ability to look at issues at a range of spatial scales, including very detailed local analysis.

The work has been undertaken largely in a UK context, however the techniques and processes developed would potentially be of relevance to all states or countries which collect similar types of information via a centralised computerised system.

The work was commissioned as part of the MOT project (EP/K000438/1), [http://www.MOTproject.net](http://www.MOTproject.net), funded by the EPSRC under the Research Councils UK Energy Programme. It was led by the University of Leeds, and involves TRL, University of the West of England, University of Bristol, UCL, and initially, the University of Aberdeen, with formal support from the UK Department for Transport (DfT) and the UK Department of Energy and Climate Change (DECC).
3.3 CarConnect: setting the scene for home charging of EV

TRL is involved in the delivery of the CarConnect project for Western Power Distribution (WPD), the distribution network operator (DNO). CarConnect is a pioneering trial that will help the electricity industry to better understand how plug-in electric vehicles (PIVs) can be charged at home, without the need for large-scale network reinforcement works on the electricity grid. The project is being delivered by EA Technology, Drive Electric and Lucy Electric Gridkey.

TRL’s involvement is to oversee both technical and project management aspects of the project on behalf of WPD. CarConnect will run for three and a half years and will:

- Develop and deliver an electricity network modelling tool that will enable Western Power Distribution to identify which parts of their network are susceptible to plug-in-vehicle loads and to assess solutions to avoid network reinforcement works;

- Develop a method for monitoring the effect of plug-in vehicles on low voltage networks that will inform the network modelling tool development; and

- Recruit and manage a mass-market customer trial to prove the technical/economic viability of plug-in vehicle/V2G demand control to avoid or defer network reinforcement.

- Set to be the largest PIV project in the world, CarConnect will be working with up to 700 EV drivers in its trials to ensure that such systems are acceptable.
3.4 Tomorrow’s railway and climate change adaptation (TRaCCA)

TRL is a key partner in the second phase of Tomorrow’s Railway and Climate Change Adaptation, a recently completed project funded by RSSB and supported-in-kind by Network Rail. The two and a half year project was carried out by a consortium led by Arup, including TRL, the University of Birmingham, Met Office, BGS, University College London, CIRIA, JPA Consulting and Beckford Consulting. It builds on a previous project (Phase 1) which carried out a review of existing knowledge and identified knowledge gaps.

Ageing transport infrastructure is vulnerable to the effects of climate change. Understanding the potential impact of climate change is important to not only maintain access to transport services, but also to ensure that transport safety is not compromised.

The project produced guidance and recommendations to support the GB rail industry in responding to the impacts of climate change. This includes:

- Methods of including climate change in economic appraisal;
- Use of overseas analogues to identify transferable approaches from other countries;
- Metrics to measure the impact of climate change on performance;
- Systems tools to provide insight into critical interfaces and dependencies;
- Geographical based decision-support tools to evaluate vulnerability;
- Benefits realisation to implement existing research;
- Identification of future research priorities, and a review of potential funding sources for adaptation research.

The final project report is available on the RSSB rail research website SPARK. Link: [http://www.sparkrail.org/](http://www.sparkrail.org/)
3.5 Practical verification of the theory behind long life pavements

The potential effects of climate change are causing a rethink of transport infrastructure assets. With road operators under pressure to create a more resilient network and improve the lifecycle of assets, long life pavement design has been positioned as the way forward.

Long life pavement design focuses on ensuring that the pavement has the strength required to resist structural issues (such as fatigue, deformation and rutting), and designing a pavement surface that is able to tolerate increasing traffic levels and environmental effects, without significant damage due to wear and tear or weather conditions.

The existence of these ‘long-life’ pavements challenges the current design and maintenance methodologies and suggests a need for a radical approach to pavement design. Although findings from global research have verified that a threshold effect for pavements does exist, there is limited real life data to support this theory.

To put the theory to the test, TRL embarked on a research project, sponsored by Highways England, aimed to demonstrate the threshold effect as well as develop a radical approach to flexible pavement design and maintenance, using the threshold concept.

Three instrumented road sections of varying thicknesses were designed, built, and trafficked under varying wheel loads and speed. The results demonstrated classical pavement deterioration through both rutting and fatigue cracking. However, one of the sections showed no deterioration and the associated strains illustrate the threshold effect.

In addition, a methodology was presented which involved the development of a robust model that predicts tensile asphalt strains directly from falling weight deflectometer (FWD) measurements which could be used as a tool to identify long life pavements on the English Strategic Road Network (SRN).
3.6 Landslides and environmental risks

Led by the University of Dundee, TRL has secured a Natural Environment Research Council (NERC) project, on assessing the risk to the coastal and rural road network in Scotland due to the effects of storms and extreme rainfall events.

Using the A78 coastal trunk road between Skelmorlie and Largs on the Ayrshire coast as a case study, the project will develop hazard, risk and economic impact assessment techniques for coastal flooding of roads. This builds on the work that TRL has already undertaken on landslide assessment and the work of the University of Dundee on flood assessment. The project is supported by Transport Scotland.

The hazard assessment is primarily based upon static and dynamic wave gauge data and the historic frequency of storms in the Clyde Estuary. Direct economics are derived from event data and direct consequential economic impacts are modelled to obtain user delay, carbon and accident costs. Climate change will be accounted for using UKCP09 data to estimate the increasing frequency of events that cause coastal flooding in the Clyde Estuary. The economic impacts can be factored to obtain a profile of annual costs of flooding at a given site over time, accounting for traffic growth also. The current work is essentially a case study to develop the techniques, but there is the potential to expand this work to cover Scotland as a whole, as well as other parts of the UK.

TRL has also secured a NERC Urgency Grant, led by Newcastle University and with Northumbria University, on landslides triggered by Storm Desmond at the A83, Rest and Be Thankful viewpoint area, Scotland. The project is intended to help exploit and review the monitoring data available from the Storm Desmond and Storm Frank landslide events and to refine and expand future monitoring strategies for the A83. This builds on work currently being carried out by Northumbria, Newcastle and TRL in a PhD project that seeks to use terrestrial LiDAR, UAV imagery and sophisticated debris flow runout modelling, to better understand the risks posed by debris flows at this site. The project is funded by Transport Scotland through TRL.

Existing monitoring has been invaluable in defining post-event conditions and sediment dynamics with instruments often installed after events, but we do not have complete (pre- and post-) data on a single large event. This is essential in refining and validating physical and numerical modelling approaches which can be used for enhanced management of the problem and the design/refinement of appropriate monitoring and mitigation strategies.

The work will collect transient post-event data to document the transience of key evidence and inform how ‘urgently’ we need to respond to future large events to adequately quantify them. The Rest and be Thankful viewpoint is in one of the several regions in which low, medium and high emission climate change scenarios all predict an increase in ‘intense’ rainfall days, mainly in winter months.

While the link between rainfall and failure events leading to debris flows is complex, current intensity-duration thresholds for potential failure will be exceeded more frequently under predicted future conditions. The work has significant potential to steer our future approach to monitoring and evaluating both the dynamic movement on slopes, such as the Rest and be Thankful viewpoint, but also in assessing the risk associated with such movements.
3.7 Road maintenance budgeting tool

With limited budgets and a focus on improving customer satisfaction, road authorities are under pressure to be smarter with asset management and maintenance. This means evaluating the condition of infrastructure assets, in order to commit spend where it is needed most.

To help facilitate decision making, TRL has launched a free software tool to enable highway authorities to achieve greater road maintenance and repair cost efficiencies. The tool, which is available free of charge to members of the Road Surface Treatments Association (RSTA) and UK local authorities, allows users to compare the lifecycle cost of road maintenance treatments across the areas of reconstruction, resurfacing and full range of road surface treatments. Users are able to compare costs over a 50-year period in order to identify the most cost effective solution for their needs.

The software, which is part of TRL’s iROADS asset management software suite, was launched at the Spring conference of the RSTA in response to growing local authority demand for asset management software with enhanced planning and budgeting capability. The software was developed over a six-month period by TRL under the auspices of an industry working party comprising representatives from the RSTA, Highway Term Maintenance Association (HTMA), Local Government Technical Advisors Group (TAG) and members of ADEPT, which represents local authority chief officers, and the MSiG Highway Maintenance and Asset Management Group.

The introduction of the treatment selection tool follows the launch of the DfT’s Highways Maintenance Appraisal Tool (HMAT) software, a spreadsheet based model designed to estimate the wider benefits that arise from road maintenance, developed by TRL. It also reflects TRL’s ongoing dedication to streamlining innovation and efficiency across the UK’s local and strategic road networks. RSTA will be working closely with TRL to provide training courses aimed at local authorities who wish to use the tool.
Below is a summary of other activities that our people were involved in within this quarter.

### 4.1 TRL Science in the media

- A simulator trial by Simon Tong was featured in the Metro newspaper and website.
  

- Nick Reed was interviewed by BBC Radio Berkshire regarding GATEway and automated vehicles.

- Shaun Helman was involved in filming in the TRL DigiCar simulator for Good Morning Britain on the dangers of using live streaming apps while driving.

- BBC Radio 4’s All in the Mind programme visited TRL to discuss behaviour in relation to automated vehicles and recorded an interview in the DigiCar Simulator with Alan Stevens.

### 4.2 Lectures, presentations, conferences

TRL staff are regularly invited to participate in conferences and symposia, recent events in this quarter include:

<table>
<thead>
<tr>
<th>Event</th>
<th>Topic(s)</th>
<th>Participant(s)</th>
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<tbody>
<tr>
<td>EU-US-JP Trilateral meeting on Automated Transport, Warsaw, Poland.</td>
<td>UK CAV activities</td>
<td>Nick Reed</td>
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<tr>
<td>DGAC (French Civil Aviation Authority) Symposium, Paris</td>
<td>Assessment and reporting of runway surface conditions</td>
<td>Martin Greene</td>
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<td>TRA 2016 (Transport Research Arena), Warsaw.</td>
<td>USE-iT (H2020), REETS, Hi-Speq, CEDR European Safety Review Tool</td>
<td>Sarah Reeves, Matt Wayman, Emma Benbow, Jill Weekley</td>
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<tr>
<td>Smart Research Live! Milton Keynes.</td>
<td>Impacts of the sustainable travel towns programme</td>
<td>Sally Cairns</td>
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<tr>
<td>Young Drivers 2016.</td>
<td>Characteristics of collisions involving young drivers in UK</td>
<td>Richard Cuerden</td>
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<tr>
<td>Cycle City conference, Leicester.</td>
<td>E-bike sharing in Europe/ The power of electric assist bikes and their role in public bike hire</td>
<td>Sally Cairns</td>
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<tr>
<td>PACTS Safer Vehicles</td>
<td>Understanding the strengths and weaknesses of Britain’s road safety performance</td>
<td>Brian Lawton</td>
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<tr>
<td>Brain Injury Group, London.</td>
<td>Child seats, seatbelts and brain injury’ and ‘Road traffic accident investigations and reconstruction</td>
<td>David Hynd, Richard Lambourn</td>
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<tr>
<td>Advanced Brain and Spinal Cord Injury Conference</td>
<td>The potential for cycle helmets to prevent injury</td>
<td>Stephen Jowitt</td>
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<tr>
<td>PACTS Safer Vehicles</td>
<td>Opportunities to influence vehicle safety</td>
<td>Richard Cuerden</td>
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<tr>
<td>PACTS Safer Vehicles</td>
<td>How does Britain’s car fleet compare with the world’s safest</td>
<td>Caroline Wallbank</td>
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4.3 Growing future research

TRL staff are actively involved in supervising, researching, or completing higher degrees in transportation research. TRL is proud to support this work to grow and encourage the next generation of transport researchers. Highlights this quarter include:

- **Alan Stevens** acted as an external examiner for an MPhil viva at Newcastle University.
- **George Beard** and **Shaun Helman** are in discussions with Coventry University about supervision of a PhD on driving simulator sickness.
- **Helen Viner** and **Stephen Jarvis** (University of Warwick) interviewed PhD candidates of the TRL-supported “data” PhD.

Two projects are currently active using Science Innovation time (where scientific research and efforts are allowed in conjunction with profit generating projects):

- **137** – Travel and mental health (Rebecca Posner).
- **138** – The data analysis, data visualisation and statistical modelling package R (Caroline Wallbank).

Two PhD students were hosted in the TRL Technology Development group as part of their studies:

- **Sergio Ibarra** (Universidade de São Paulo, Brasil) is researching vehicle emission inventories and modelling. In his 2 weeks with INT he worked on scaling factors applicable to NOx emissions (road transport) which allowed us to update the factors used in TRL’s transport emissions modelling tool (TEEM). Sergio will be presenting his work at a technical conference in Lyon.
- **Federico Perrotta** (University of Nottingham) is undertaking a PhD on truck fuel consumption as part of an EU funded programme and spent a week with us gaining a better understanding of what road condition data are available to support his studies. He gave a presentation at the end of the week to a group of data analysts about a data segmentation algorithm developed at the university.

The TRL Academy also supports an internal lunchtime seminar programme which is open to all TRL staff and supports various research interests around the organisation. This quarter we were very pleased to welcome:

- Dr Charles Musselwhite (Swansea University) who spoke on Auto-mobility, driver safety and life beyond the car in later life.
- Dr Neil Walton, (University of Manchester) Potential Directions in Decentralized Traffic Control.
- Svitl Pabari (TRL), Neil Ebenezer (DfT), and Phil Blythe (DfT) gave a seminar on How to work with the DfT, and build on our strong research supply to this organisation.
- We also heard from Nathan Koren (Podaris) who spoke on A survey of the rugged history of transport innovation, from ancient Greece through to driverless pods at Heathrow.
- Mike Lenne and Michael Fitzharris (both Monash University) visited TRL from Australia and spoke on Driver Monitoring Technology: The Future of the Driving Experience, and The critical role of in-depth crash investigation data in building the case for the establishment of UN Global Technical Regulation 14 (pole side impact test) respectively.
Exploring distributions of car usage: new insights into travel patterns using annual mileage estimates for every private car registered in Great Britain.

Link: http://trl.co.uk/reports-publications/papers-articles/report/?reportid=7040

Bateman D (2016)

Link: http://www.trl.co.uk/reports-publications/road-notes/report/?reportid=7034

Cairns S, Beaumont C and Millard K (2016)
Car rental customer survey 2015 Published Project Report PPR783. Crowthorne: TRL.

Link: http://trl.co.uk/reports-publications/trl-reports/report/?reportid=7041


Link: http://trl.co.uk/reports-publications/papers-articles/report/?reportid=7017


Review of the XVI European Conference on Soil Mechanics and Geotechnical Engineering. Proceedings, Institution of Civil Engineers (Geotechnical Engineering), 1–20. DOI: 10.1680/jgeen.16.00020.

Wright A, Benbow E et al (2016)

