ADEPT LIVELABS

ADEPT SMART Places Live Labs

White Paper #4

Decarbonisation

October 2021

www.adeptnet.org.uk/LiveLabs

@ADEPTLiveLabs #LiveLabs

DECARBONISATION

Introduction

This is the fourth in a series of white papers from the £23million ADEPT (Association of Directors of Environment, Economy, Places & Transport) SMART Places Live Labs programme funded by the Department for Transport (DfT). These papers are part of our commitment to transparency and are intended to share learnings and insights as they happen. This will allow industry colleagues to capitalise on work done through what is a wide-ranging innovation programme covering the smart materials, energy, communications, mobility, and environment spectrum.

The white paper has been developed through a series of 'Chatham House rules' one-to-one discussions with our local authority Live Lab leads, and we thank them for their openness in sharing their experiences to date. We hope that this and future white papers are useful and will help accelerate innovation for local authorities across the transport, planning and environment sectors. More details on our teams and their individual projects can be found on the Live Labs pages of the ADEPT website.

Following the UK Parliament's declaration of a climate emergency in 2019, the target of achieving net zero greenhouse gas emissions by 2050 has come to be viewed as not only feasible, but also necessary. The Department for Transport (DfT) and National Highways' respective Transport Decarbonisation and Net Zero Highways plans reiterate the importance of decarbonisation as a guide in transport policy decision-making.

The Transport Decarbonisation Plan details the Government's strategy to reach net zero transport in the UK, the wider benefits of doing so, and the strategy's underpinning principles. Broader in scope, the Net Zero Highways Plan rests upon three core commitments: to achieve net zero corporate emissions by 2030; net zero maintenance and construction emissions by 2040; and net zero road user emissions by 2050. Both plans hold great significance in light of the Climate Change Committee's 2021 Assessment of UK Climate Risk, which indicates that the UK is currently 'struggling to keep pace with climate change impacts'.

Reducing the quantity of pollutants released by the transport sector and improving air quality is vital in meeting national and global environmental targets. ADEPT members are committed to delivering clean, sustainable growth, as part of their work to tackle climate change at a local level. The Live Labs programme was established with the intention of driving innovation, utilising new materials and technologies, and creating new, sustainable techniques for highways that are fit for local roads of the future. Green growth is integral to this.

Our eight Live Labs each involve a variety of different projects that address decarbonisation in different ways, in an attempt to meet local needs. However, each individual innovation can be organised into one of the following overarching themes: materials, mobility, communications, energy, and environment, and the findings of each Live Lab are translatable to local authorities across the country. This paper explores the relationship between decarbonisation and the Live Labs programme, using these themes as a framework to demonstrate attainable decarbonisation benefits achieved through different thematic approaches.

Sustainable Materials

For some of our Live Labs, decarbonisation has come in the form of utilising more sustainable materials. The highways industry has often relied on oil-based products and quarry minerals, both conducive to environmental damage. Mitigating the environmental impact of materials used in road construction, through the inclusion of additives, is important in reducing our industry's carbon footprint, extending the lifecycle of our roads, and maximising our resource management efficiency. Longer-lasting roads and decreased waste disposal also presents the industry with significant cost savings.

The Cumbria Live Lab and its partner MacRebur are focussing their energies on developing a circular economy. An additive, developed and produced by MacRebur, is being used to replace bitumen removed from asphalt used in road laying. The additive is made of end-of-life unrecyclable plastic, that otherwise would have been incinerated or sent to a landfill site. In using this additive, waste and carbon emissions are reduced, and presents the opportunity of developing better and more cost-effective roads.

Cumbria has also established a new partnership with global energy company, Shell. Together with surfacing partner, Hanson, they are trialling the use of Shell Bitumen's LT R, an additive derived from modified recycled waste plastic that doesn't compromise on performance. A lower production temperature offers up to 40% CO_2 savings by comparison with a conventional hot mix. The recycling of end-of-life products and waste; the extension of road lifecycles; and reduced energy consumption are all recognised benefits of using plastic additives.

Similarly, the Kent Live Lab trialled Iterchimica's Gipave additive along a stretch of road in Dartford in June 2020. This additive, containing graphene and recycled plastic, is expected to extend the road's life by at least 50%, representing significant financial and carbon savings.

Material innovation is not restricted to the roads themselves; as part of the Buckinghamshire Live Lab, fibre-reinforced polymer composite lamppost columns are being put up around Aylesbury Garden Town. These columns are more lightweight and transportable, are recyclable, and provide greater versatility than traditional metal lampposts. In addition to these new columns, the existing lighting infrastructure in Aylesbury is being modified through the use of 3D-printed components, which by their very nature allows for easier use of their digital centres.

Environmental Monitoring

Environmental monitoring is required in order to manage and reduce the impact that our activities have on the environment, and to lessen the risk of harmful effects on personal health. Effective environmental monitoring, both of immediate conditions and long-term trends, is a useful tool that can help to guide future policymaking decisions and policy implementation, providing much needed context to local, national, and international decisionmakers, as well as informing the public at large.

In the highways sector, one of the primary focuses of environmental monitoring is on air pollution. Air pollution has a detrimental effect on human health and wider ecosystems. Pollutants can also erode technical infrastructure. Improving the data around air quality (AQ), including the calculation of nitrogen dioxide and particulate matter levels, is necessary to make better network management and planning decisions.

The Thames Valley Live Lab has been working in collaboration with Siemens to implement Earthsense AQ sensors across three local authority areas in Reading, Wokingham and West Berkshire. Combined with O2's prediction tools and public health data, an evaluation is being conducted by Stantec and the University of Reading. The trial aims to determine the optimal number of sensors required to provide accurate AQ data, whilst also remaining cost-effective and balancing high quality data with worthwhile investment. Data from these sensors can then be integrated into the Siemens STRATOS traffic management system to optimise the traffic network and eliminate local hotspots of poor AQ. Siemens' ROADCAST tool can also predict short-term future traffic congestion and its consequent AQ impact, thus informing future urban transport planning. One benefit of Covid-19 has been the stark demonstration of AQ improvement through reduced traffic, observable in the data collected.

In a similar vein, the Suffolk Live Lab is using its existing street lighting infrastructure to install a variety of sensors, including AQ sensors, alongside the roll-out of a low-power wide-area network (LoRaWAN). These sensors can also be used to responsively turn the street lighting on and off. The data is primarily being analysed by the University of Suffolk and will inform future environmental initiatives. Likewise, the Buckinghamshire Live Lab's composite lamppost columns can accommodate sensors for the measurement and collection of noise, surface temperature, and AQ data.

Energy

Renewable energy - alternative energy produced by natural processes that can be constantly replenished - is preferable to unsustainable fossil fuel sources. Sunlight, wind, rain, tidal and wave energy, and geothermal heat are all valuable forms of clean energy and are in increasing demand as we seek to protect the planet from climate change. Alternative energy generation on our transport network is an important element in our effort to meet decarbonisation targets and can help local authorities to mitigate an overreliance on drawing electricity from the National Grid.

The Central Bedfordshire Live Lab team has been entirely focussed on a variety of different, innovative renewable energy solutions, fitting in with the council's carbon reduction ambitions. One such solution is the fitting of geo-thermal probes underneath the Thorn Turn Depot car park, which are able to de-ice the carpark during the colder winter months. The heat is contained in an on-site storage unit and can also be used to heat the depot - this represents cost savings both in terms of gritting salt, but also indoor energy bill costs. As a heavy traffic area, Thorn Turn acts as a reliable indicator of the project's effectiveness and wider applicability.

The team has also installed 216 solar panels directly onto the road surface, generating up to 17,400 kilowatts per hour - enough to provide five houses with their annual electricity usage. The road surface can still be safely driven on by vehicles and is contributing to the target of running the depot solely using renewable energy.

Another solution trialled in Central Bedfordshire is the installation of a Pavegen kinetic walkway around Leighton Buzzard train station, a UK first for this innovation. Launched in April 2021, the walkway creates energy from commuters' footsteps, which then powers digital data screens and USB charging benches situated around the station. The screens remind commuters of their energy saving contribution, keeping them engaged in pursuing a decarbonised future. This innovation has great potential and could be applicable to all types of indoor and outdoor facilities, particularly in areas with a heavy footfall, and could be used more widely to power road signs and streetlights.

Buckinghamshire's composite lamppost columns also offer additional functionality to support the installation of solar panels and wind turbines, complimenting their ability to collect and measure AQ, noise, and surface temperatures.

Communications / Digital

In an increasingly digitalised world, data-driven solutions, that seamlessly integrate multiple data sources, platforms, and communicative tools are fundamental in developing decarbonisation strategies. They allow for the continuous identification of problematic environmental incidents and trends, predictive systems that can optimise traffic control and the street lighting network, and collaborative open data approaches that ensure information reliability and inform decarbonisation policy. Overall, better asset management through digital solutions can result in incremental benefits, with decarbonisation occurring across every facet of operations.

Kent's Local Highways Asset Management Technology Incubator initiative brings together information from various sources, including IoT sensors, external data sources such as traffic and weather reports, and asset management systems to produce integrated and visualisable data sets that can be used to address different enquiries and support work on the road network. Sensors include drone and road vehicle-mounted sensors for detecting potholes and assessing road condition, as well as road temperature sensors that can help to inform the council's winter road gritting approach. Through targeted interventions, the team expects to see "marginal gain" decarbonisation improvements across the network.

The Smarter Suffolk Live Lab also hopes to achieve improved community decision making through the trialling of sensors. Five air quality and 20 traffic speed and volume sensors, as well as the accompanying software, have been provided by Canadian technology company LED Roadway Lighting. The sensors operate 24/7, 365 days a year, and report to the software using the existing mobile communication network. Collectively, the data and insights offered allows for evidence-based targeting of problem locations for traffic build-up and AQ, and consequently smarter urban mobility and town planning in the future.

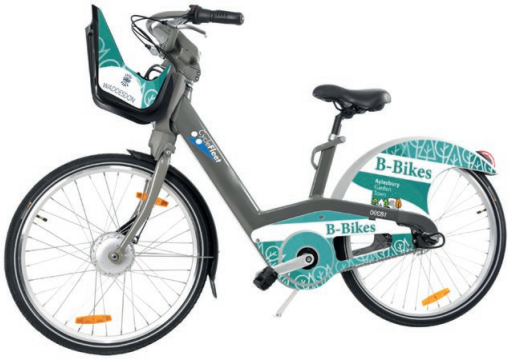
The West Midlands Network Resilience (NR) Live Lab has been trialling the use of video analytics on the Key Route Network, including in Birmingham and Solihull, to combat road congestion. The intention is to increase the capacity and efficiency of the local road network, understand travel behaviour, and improve the ability to manage incidents.

A key objective of this Live Lab project is to identify personas most accepting of travel change. Motivations for residents to change their behaviour to use more sustainable modes including public transport, walking and cycling can be better understood, alongside how to influence the travel behaviour of those that do drive, and how to minimise delays caused by disruption to the network.

Ultimately, through the integration of new digital technology and existing assets, the project is aiming to enhance the capabilities of the Regional Transport Coordination Centre (RTCC) and take steps towards a better-connected transport network in the region. In addition, West Midlands' involvement in both the Live Labs and Future Transport Zone programmes has resulted in the development of new segmentation and 14 'traveller personas' - snapshots of individuals and households created using quantitative data from participants, from home location and travel behaviours, to income and responsiveness to technology. This data helps to better understand travel behaviour and could inform localised travel policy that responds to local residents' needs, thus helping mitigate carbon and environmental impacts.

Mobility

Congestion on the national road network has rapidly intensified, with an overreliance on private petrol or diesel-powered vehicles to move around the country. To meet net zero targets and reduce emissions figures, a shift towards 'active travel' alternative transport options within congested communities is required, with particular emphasis on short journeys. A cultural shift away from cars and towards sustainable transport presents an opportunity to lower emissions and improve air quality, promote active and efficient shared transport modes, reduce vehicle running and maintenance costs, and more effectively connect isolated communities to adjacent developed areas.



The Buckinghamshire and Staffordshire Live Labs have been trialling both e-bikes and e-scooters. In Buckinghamshire, e-bikes have been installed along the traffic-free route between Aylesbury Vale Parkway Station and Waddeston Manor, whilst e-scooters have been installed around Aylesbury Value town centre in collaboration with the company, Zip. Between August 2020 and February 2021, the bikes were used more than 215 times for a distance of over 2,000km. They do not require a driver's licence, thus removing any barriers for use, giving locals the opportunity to reduce the number of car journeys. The e-bike trial has run concurrently with an in-depth last mile mobility feasibility study, conducted by Connected Places Catapult. The scope of this study has been to make recommendations for future last mile mobility solutions that can reduce the environmental, social, and economic impact of road congestion, be it within urban, sub-urban, or rural communities.

Staffordshire deployed over 200 e-scooters across Stafford and Newcastle-under-Lyme, recording in excess of 40,000km of travel, with a focus on driving a modal shift in urban and rural areas, where private vehicles are still the primary form of transport. Staffordshire's e-scooters are but one element of the team's investigation into the feasibility of integrated mobility hubs, a radical new approach to integrated multi-modal mobility that also involves pop-up electric vehicle chargers and living walls - natural plant and moss-made filters to reduce air pollution. The e-scooter trial is to be followed by an e-bike scheme, working in collaboration with two operators later this autumn.

Collectively, these transport hubs and smaller transport nodes create a sustainable, multi-modal network of county transport options, that is demand responsive. A sustainable future requires a behaviour change that favours electric vehicles, collaboration between transport providers to build a model of integrated transport planning, and the elimination of geographically influenced accessibility issues - all of which the mobility hubs seek to address.

Conclusion

The ADEPT SMART Places Live Labs programme has demonstrated across all projects a variety of different approaches to decarbonisation. Achieving net zero in our sector can be achieved through interventions in every aspect of what we do, whether through the introduction of sustainable materials, the phasing out of traditional petrol and diesel powered vehicles in favour of sustainable transport alternatives, stricter environmental monitoring and data collection to make better informed policy decisions, or the integration of renewable energy generation into public spaces and the road network.

Although each Live Lab project has been tailored to meet local demands with each approach to decarbonisation reflecting this, it is anticipated that the innovations demonstrated in each project are, to a great degree, transferable to other local authorities, and that the findings and conclusions made can help to set and achieve environmental objectives up and down the country. The projects have encapsulated both top-down and bottom-up approaches to innovation implementation - the former in the case of macro-level project planning and deployment, and the latter in the fulfilment of marginal decarbonising changes.

As the first set of Live Labs projects draw to a close, a new challenge is on the horizon. ADEPT has proposed a Live Labs 2, focusing on zero carbon highways. This aims to develop a programme of projects that, as the mission statement details, shall *'through deployments at demonstratable scale ... will achieve a step change in the normalisation and uptake of zero-carbon techniques, solutions and materials in the local roads realm to meet the needs of today and prepare us for an uncertain tomorrow'*.

If it proceeds, the three 'scopes' of Live Labs 2 will cover direct emissions from owned or controlled sources (Scope 1); indirect emissions from the generation of purchased electricity, steam, heating and cooling consumed (Scope 2); and all other indirect emissions that occur in a company's value chain (Scope 3). The ambition is to implement zero carbon and climate change-focused local highway road plans through ambitious public and private sector collaboration in local areas, covering the operation and maintenance of existing road assets; support of fixed and moving assets to enable successful operations; the construction of new local assets; and the enhancement, adaptation and / or decommissioning of existing assets.

Previous White Paper topics include Mobilisation, Digitalisation, and Monitoring & Evaluation, and are published on a quarterly basis. The full findings of the ADEPT SMART Places Live Labs will be published at the end of 2021. For more information on decarbonisation across the programme, or for wider information on the Live Labs projects, please visit www.adeptnet.org.uk/livelabs.

ADEPT LIVELABS

ADEPT SMART Places Live Labs

ADEPT
Association of Directors of Environment, Economy, Planning & Transport

Department for Transport

SNC·LAVALIN

ATKINS
Member of the SNC-Lavalin Group

EY

KIER

O2

RINGWAY

WSP

White Paper #4

October 2021

@ADEPTLiveLabs

www.adeptnet.org.uk/LiveLabs

#LiveLabs