The Liverpool 'Ecosystem of Things' driving a low-carbon economy for local highways

Part of the Live Labs 2 Corridor & Place-Based Programme Theme

OUTLINE BUSINESS CASE

Liverpool City Council

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Elevator pitch

Liverpool City Council and our project partners will target the challenge of decarbonising highways delivery and the road asset in complex city contexts, demonstrating that this benefits the local economy and people. The project will realise an 'Ecosystem of Things', a scalable and transferrable systems mapping and optioneering approach at city-level to introduce innovations offering the greatest impacts within individual schemes.

This spans design, public spaces, materials/process technology, recycling infrastructure and critically the legal, contractual and procurement processes that need to be implemented across local authorities nationwide so that decarbonisation initiatives can be successfully adopted as business as usual, leveraging collaboration across different scales enabled through the combined programme structure within the Corridor and Place-based theme.

Project overview

The Liverpool Live Lab, Wessex Partnership (Somerset, Hampshire and Cornwall) and Devon – alongside their partners – form the wider Corridor and Place Based Decarbonisation theme within the overall Live Labs 2 programme.

The road network is the biggest physical asset owned by Liverpool City Council (LCC), with a gross replacement cost of £4.9bn. Funding repairs on Liverpool's network is a long-term challenge and as such, the council launched a £30m Highways Investment Programme (HIP, see Strategic Case) to address the issues identified with the poor highways condition. The proposed investment will address key safety issues and improve highways condition, whilst providing a more accessible network, improving facilities in a compatible manner with the shift to active travel and sustainable transport. Accordingly, the Council and wider City faces numerous historic and emerging challenges across:

- Developing human resources and capacity, and preventing a 'brain drain' from the city
- A robust baseline carbon footprint from which to prioritise and manage emissions, against an ambitious net zero target of 2030
- Changing attitudes and practices
- Lack of an open access operational highways recycling facility to locally process waste arisings and reduce associated carbon, nor central directions of how contractors should recycle or act in a city-wide way
- Low level of collaboration in procurement and contractual alignment with the supply chain to support normalisation of decarbonisation

In response, our Live Labs programme will build a unique suite of solutions; an 'Ecosystem of Things', which is a scalable and transferrable system of holistic activities and interventions, inspired by the 'internet of things'. This will treat Liverpool's highways network as a holistic 'system of systems' enabling decarbonisation and addressing existing barriers to change. The project recognises that there is not just one solution to solve decarbonisation, and that to achieve carbon net zero all carbon emissions over the full asset lifecycle matter, and therefore need to be addressed.

The Ecosystem of Things therefore represents a system of interlinked elements that in isolation would be unlikely to achieve the requisite carbon reduction, but when combined in an intelligent way – to target the highest emitters within individual schemes – have potential to achieve the significant carbon savings driving Liverpool's trajectory to net zero by 2030.

Key 'Ecosystem elements

- Council-owned open access City Centre Recycling Hub for highways materials
- Decarbonised plant, equipment, tools and welfare, ready for introduction into standards
- Material innovations and flows for circularity and contribution to decarbonisation
- Wider suite of new technologies and more circular approaches within the edge-to-edge highways envelope

Directly supporting a circular economy, this diverse collection of integrated elements forms a complete decarbonised system, in which the longer-term maintenance and renewal horizons must be considered, not just carbon embedded during manufacture, transport and installation.

Similarly, our approach will be developed to address the vision that early decisions have the largest impact, in terms of realising the opportunity to build less to better address specific needs of local communities as well as reduce carbon. Full lifecycle considerations including preservation interventions and maintenance are key to these decisions, and built into these models.

However, in the face of this potentially overwhelmingly complexity and uncertainty – particularly within a mixed economy context – this approach is intended to provide the practical toolkits and workflow processes for practitioners to optimise the decarbonised outcomes without creating any negative unintended consequences. Critically, based on the assumption that a 'do everything' scenario is unfeasible in most scenarios, our approach targets the best possible outcomes for the

wider 'Triple Lock' commitments to People Planet and Equality, within a resource-constrained context faced by Authorities nationally.

Other Ecosystem enablers

At the centre of the proposed decarbonisation Ecosystem is the Carbon Lens hierarchy, based upon a proven matrix based optioneering methodology developed by our partner Pell Frischmann (an international, multi-disciplinary engineering consultancy with over 90 years' experience). This will be deployed to accurately evaluate and baseline projects and initiatives, driving re-design/co-design activities to effectively/acceptably minimise carbon footprint.

This will initially be applied to schemes and activities from Liverpool's capital and maintenance plans, but in the longer term we aim to integrate into the way plans are developed in the city 'at source' so that this thinking becomes not only policy but part of a new BAU not only for operations but more fundamentally how schemes are conceived, considered, planned and designed to address specific needs both at a local and City level.

- Processes and new ways of working supported by practical tools
- Legislative/Regulatory/Contract development to accelerate changes to LCC standards and policies to drive adoption of decarbonised approached into a new BAU
- Embedding Social Value through local jobs and skills development, as well as deep community engagement driving Equality, Diversity and Inclusivity into solutions

Demonstrators

The project is based on a minimum of three physical demonstrator neighbourhood sites in Liverpool chosen for their unique characteristics. A set of initiatives and toolkits will be rolled out at each location to support decarbonisation. Data monitoring will determine the effectiveness of each element of the project so that this can be shared across the rest of the Liverpool City Region, Aberdeen – where a further demonstrator is planned – as well as Kensington & Chelsea, Newcastle and other cities leveraging synergies within the Live Labs cohort where appropriate.

Coordinating closely with planning and operational teams within LCC to align with the most up-to-date pipeline and schedule of schemes planned within the HIP, potential demonstrator neighbourhoods are being identified within the new ward boundaries, still encompassing the North, South and Central city areas. As well as being equitable, this approach cuts across more contractors and communities, therefore accelerating roll out, education and wider engagement.

However, to enable the effective introduction of these processes into the Early Contractor Involvement phase of clustered HIP schemes, a further detailed review of specific clusters of schemes to achieve these objectives is ongoing. Continuing into the live project, this exercise seeks to balance operational requirements and opportunities with the even distribution of scheme locations.

Our programme can therefore address schemes of different scope and complexities planned across a range of highways classifications including footways, cycleways, residential, industrial, and strategic routes as part of Liverpool's HIP. Best practice identified in our neighbourhood demonstrators and Carbon Hierarchy Toolkit model will be integrated in BAU and adopted where appropriate and affordable by the authority.

Throughout the programme we will continue to engage closely with the rest of the Corridor And place-based Consortium to realise the synergies across standardised overarching functions, which also dovetail with the following core activities carried out by ADEPT's central M&E partner:

- Programme-level Monitoring & Evaluation
- Communications programme
- Learning and skills dissemination
- Behavioural and organizational analysis
- Aggregated carbon assessment and quantification

The Strategic Case

Alignment with Live Labs 2 Vision and Principles

Our proposal to implement and demonstrate the Ecosystem of Things was designed to inherently deliver ADEPT's Live Labs 2 vision. The core objective is to iteratively trial the de-carbonisation of all the activities undertaken in local highways repairs, improvements and ongoing maintenance using trial neighbourhoods. Our programme in Liverpool can therefore find sources of alignment at different scales from individual schemes, neighbourhoods to cities and wider sector. Being part of the wider 'Corridor and Place-based' thematic programme presents an opportunity to align and standardise terminology and perception of how different toolkits can be used to achieve the same objectives.

As introduced, applying Pell Frischmann's Carbon Hierarchy Lens approach to an Ecosystem of Things (Figure 1) and corresponding enablers is built on the premise that in the long-term all carbon matters, and therefore must be counted, budgeted and addressed. However, delivering this trajectory from highest impact to the more marginal gains required to achieve Net Zero has significant sensitivity locally at the level of individual schemes. There is no 'one size fits all' to optimally address each specific set of requirements based on diverse needs of different communities. Our programme seeks to address this challenge.

We do note however that there are certain fundamental elements which are inherent to minimising full lifecycle carbon (e.g. decarbonised materials and recycling), and the aim will therefore be to embed these into BAU as a priority. Likewise, the Ecosystem of Things is not a static concept, but a dynamic and evolving suite of approaches which is structured to capture the most impactful emerging technologies and process, and embedding these into business-as-usual (BAU) once proven.

Leveraging the built-in baselining within the Carbon Hierarchy Lens (CHL) as a virtual optioneering tool, as well as support of the Future Highways Research Group (FHRG), we will first shadow 5 representative schemes clustered within the East Speke ward to determine an initial carbon baseline for each demonstrator neighbourhood context.

Applying a laser focus on a scheme-by-scheme basis, using this analysis to baseline an intelligent virtual optioneering process through the Carbon Hierarchy Lens we will then preferentially target the specific combination of 'carbon components' with the highest emissions first within individual schemes.

Directly supporting circular economy ambitions, this diverse collection of integrated elements unquestionably form a complete decarbonised system, in which the longer-term maintenance, preservation and renewal commitments must be considered within the optineering model over carefully defined timescales. These horizons will evolve sector-level processes beyond simply the Scope 2/3 carbon embedded during manufacture, transport and installation, and is critically dependent on the wider change of thinking and behaviours starting to emerge across the entire value chain, and accelerated through Live Labs.

Accordingly, Pell Frishmann's Carbon Hierarchy Lens will be further developed to consider the whole system carbon specifically for the local roads environment and will investigate how the decision-making processes currently employed in determining annual maintenance programmes, effects carbon emissions and what changes in thinking, approach and behaviour are required to reduce emissions. This will be overlayed on top of the existing HIP prioritisation framework based on condition, function and safety against the available funding.

Also key to our approach is the iterative expansion to address the fact that early decisions have the largest impact on the full lifecycle carbon impacts, in terms of realising the opportunity to build less – whilst still meeting specific needs of local communities – as well as better mitigate risks of any negative unintended consequences.

We will provide a commentary on each element of the trials and bank what works through the Carbon Hierarchy Lens toolkit to provide Local Authorities with both the practical means and documented methods to realise changes to working processes and policies based on the trials. Where an element of the trials has proved inconclusive, or we have been unable to reduce a carbon component in the whole carbon maintenance lifecycle, we will report this for the sector to take forward and document what was considered, discounted and tested to extract the maximum value from the trials.

Likewise, the consideration of circularity in materials use through access to recycling at a local level is a particular example where clients, contractors and manufacturers can collaborate to realise the potential for much higher re-use and recycling supported by business model developments and drivers to change Local Authority standards and policies.

Ecosystem elements

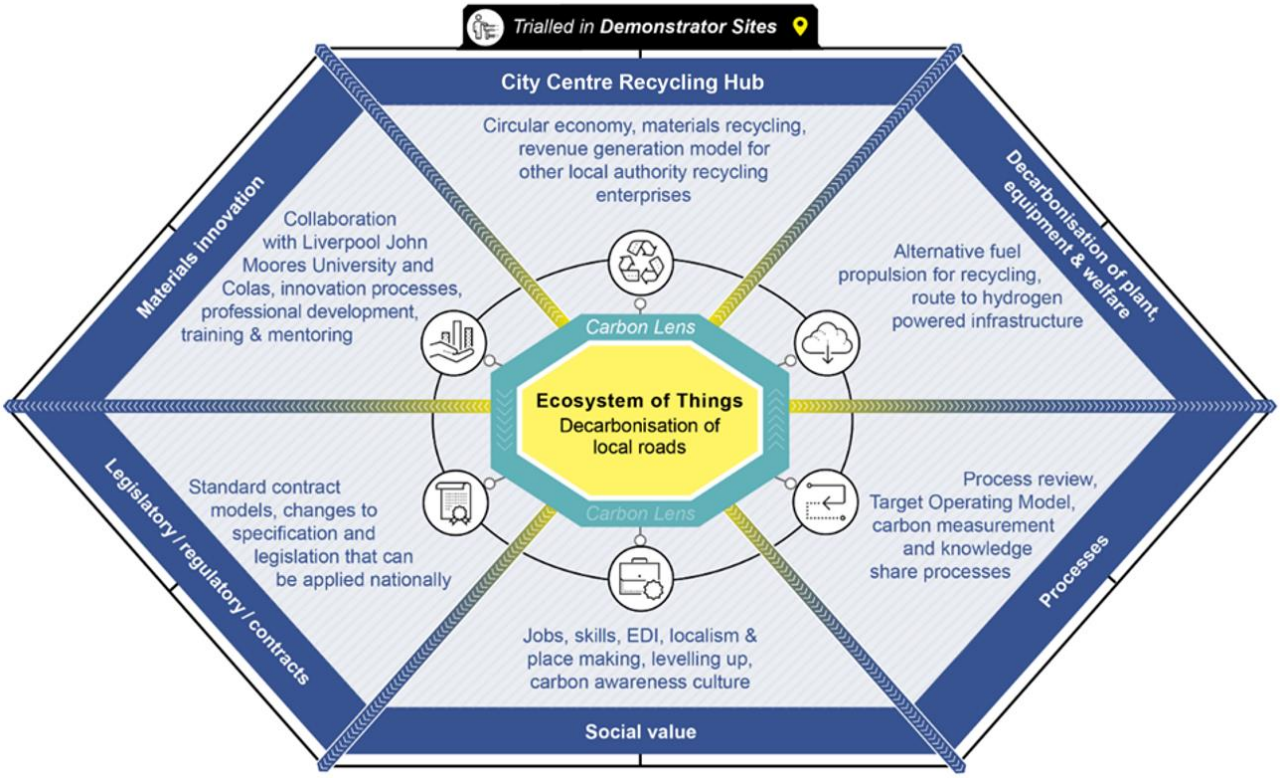


Figure 1: Visual representation of our proposed Ecosystem of Things

City Centre Recycling Hub. Our city centre site will be down-selected through an ongoing detailed evaluation exercise and developed for open-access use by all contractors across the region in highways and other building activity. This will be key to deep decarbonisation and help to establish an efficient circular economy with the city's highways becoming the main source of material locally. With this, the recycling hub becomes a commercial operation for the authority achieving a revenue stream for the processing and sale of recycled material. The carbon impact of the construction and operation of the hub will be baselined and monitored.

Moreover, the development will run in parallel with drawing up the 'blueprint' for local authorities to achieve decarbonisation and commercial benefits from recycling their raw feed locally. With the support and expertise of Bird & Bird and Colas, we will create templates outlining the contractual documents, licencing/permitting and planning consents necessary for local authorities to replicate the Liverpool model, once proven. Different models, including temporary pop-up facilities can be explored to address a national shortage of sites.

Decarbonised plant, equipment, tools and welfare. Reflecting our overall commitment to decarbonisation, we aim to accelerate adoption of alternative fuelled plant to reduce the impact of

all operations across schemes, logistics and recycling processing. We have a strong relationship and are working in close partnership with GAP, who are a leading industry supplier, to progressively decarbonise every element of site-based hardware. We will seek to 'bank' successful demos into BAU, driving a minimum green standard which can be imposed across the city.

Materials Innovation. Engaging other Live Labs – in particular the Materials CO2llaboration Centre of Excellence – and collaborating with our contractors and Liverpool John Moore's University (LJMU, highways materials experts), we will introduce new materials and explore local material flows and waste streams from other industries that could have value in the Highways context.

Leveraging the independent technical governance process, these materials will replace traditional approaches in planned works across the city on a scheme-by-scheme basis, with any residual risk shared between partners. An outline programme has been produced to schedule which products will be used when, making allowance for development of the local recycling and circular waste assets. Approaches include:

- Valorcol – Cold mix surfacing process using up to 100% RAP content (new to the UK)
- Vegecol – Asphalt mixed with proprietary plant-based binder (not yet used in the UK)
- Incinerator bottom ash (IBA) – incorporated in place of recycled aggregate in asphalt mixes to address local circular waste requirements
- Recycling processes – Addressing local challenges, recycling processes will be developed for tar bound waste and alternative materials, e.g. those with a very high percentage of RAP
- Calcined clay (CC) cementitious binder – an alternative eco binder to cement

New mobility technologies. Our programme will also seek to introduce disruptive technologies where they support community engagement within the decarbonised local roads context.

- Flowell – the world's first LED-based dynamic active road marking system, particularly suited to improving the safety of crossings for pedestrians and cyclists
- UBY Com'in **–** Smart networked sensors embedded with artificial intelligence algorithms allow us to detect, accurately locate, and report in real time a projects' environmental and health-related effects.

Ecosystem enablers

Processes. Developing robust processes that help promote innovation and manage the impact of carbon emissions as BAU will be a key feature of the Ecosystem of Things. Based on Pell Frishmann's Carbon Hierarchy Lens optioneering and scenario baselining toolkit, these processes will be reviewed and refined to improve collaboration, empower decision making and generally encourage challenge and a prioritisation of low carbon solutions using the carbon lens.

Pell Frischmann and Colas bring their experience of developing processes to manage carbon touch points and incorporate the carbon lens for project evaluation and optioneering. For Aberdeen, new processes will be introduced as part of the development of their Target Operating Model.

Legislatory/Regulatory/Contracts. Working with Bird & Bird (an experienced legal practise, working client and supplier side in local highways procurements) they will assist in identifying practices and options that will work in every local authority scenario. Bird & Bird's role in our project is to support and formalise better working together through the mixed economy model, working with all partners in the city to identify and create models and methods for coherent working, supported by legally compliant contractual documentation. This will feed through the Theory of Change and ultimately into BAU to be written into future contracts across the sector.

Social Value and the local skills base. This project will have both deliberate and consequential impacts on social value enabling to maximise benefits. For example, the commercial operation at the City Centre recycling Hub will process local waste/material, thereby contributing to the local economy. In collaboration with Liverpool in Work it will provide employment opportunities promoted

among typically hard to reach groups such as NEETs supporting the authority's EDI agenda. In partnership with Unicef and PlacED the project will target areas of regeneration within Liverpool to improve the environment and raise the profile of otherwise disadvantaged neighbourhoods, drawing an explicit link between decarbonisation and benefits for local communities.

A key project feature will be a public installation blending art and science to visually engage Liverpool communities in the decarbonisation challenge. This will be developed in collaboration with local schools and LJMU graphic designers specialising in the 'psychology of art'. We are exploring gamification elements or a totaliser that visually demonstrates our progression towards net zero.

The development of people will be key to the success of the Live Lab and taking decarbonisation forward, including perceptions of how we manage/make decisions. The Ecosystem of Things will provide a range of measures and initiatives equipping Liverpool's highways professionals with resources, tools and training to support the implementation of innovative low carbon solutions, with CIHT identified as a strategic partner for these activities.

Overview of anticipated benefits and outcomes

A successful Live Lab for Liverpool promises to deliver a range of tangible benefits in the highways sector's journey to net zero. Benefits and outcomes of our project will include:

- Significant contribution to Liverpool's target of net zero in 2030 and transferable solutions to support national decarbonisation targets, with an increased lifecycle analysis of future carbon and cost savings
- Smart, clean, accessible and integrated infrastructure that meets the needs of a modern and productive city and its residents
- Robust data from demonstrator sites inform future works and maintenance strategies
- Enhanced measurement/monitoring of carbon for accounting and budgeting purposes
- A future-proofed diverse team of skilled, experienced and passionate people capable of measuring and mitigating carbon
- Wider cultural awareness around carbon reduction both within the authority and for the public giving people a voice, empowering them to influence effective decisions
- Systems and processes to unlock new green technologies and enable continuous improvement embedded as BAU
- Effective model of public/private/academia/charity sector collaboration with contractual toolkits for nationwide replication
- Modified LCC specifications exercising greater influence and control over material selection
- Established recycling platform which processes waste efficiently and generates revenue for the authority and is replicable and scalable nationwide to benefit multiple local authorities
- Demonstration of the alignment between decarbonisation projects and social value impacts
- An opportunity to showcase Liverpool and partners as leaders in roads decarbonisation
- Low-carbon infrastructure, together with active travel and improved local planning to improve; health and quality of life, the local economy and services, the natural environment.
- Sharing best practise and application across multiple locations (Liverpool City Region, Aberdeen, Newcastle, Kensington and Chelsea) demonstrating national reach

Through these carefully configured activities our programme therefore responds directly to the core principles of Live Labs 2 replication as detailed in the prospectus. We therefore address the overarching Live Labs vision by decarbonising the construction of new local road assets; local roads operations and maintenance; plant and machinery; the local roads lifecycle; community environments; and baking in decarbonised resilience.

Alignment with national, sub national and local policies and strategies

Level	Body	Policy/Strategy	Specific Policy alignment
National	BEIS	UK Net Zero Strategy – Build Back Greener	Industrial carbon footprint and transport elements

National	Dept. for Transport	Decarbonising Transport Plan	Informs future local roads infrastructure requirements
Sub-National	Transport for the North	Transport Decarbonisation Strategy	Specifically targets embodies carbon and full lifecycle aspects
Sub-National	Transport for the North	Socially inclusive transport strategy	Aligning with wider aim to improve network for communities
Sub-National	Liverpool City Region Combined Authority	Transport plan	Facilitating an inclusive economy, connected communities
Local	Liverpool City Council	Triple Lock commitment – people, planet & equality	Mandatory for all for public sector procurement
Local	Liverpool City Council	Highways Improvement Programme	Critical point of alignment – see below for detail
Local	Liverpool City Council	City Plan	Targets a thriving, sustainable, fair city for all
Local	Liverpool City Council	Neighbourhood Plan	Engaging communities to give more power over what will provide the most positive impact
Local	Liverpool City Council	Transport Plan	Brings together actions across other delivery plans
Local	Liverpool City Council	Action on Climate Change	Targeting city-scale solutions within fragmented context
Local	Liverpool City Council	Customer Engagement Strategy (ECF)	Have developed a contractor's toolkit as a starting point to improve existing BAU
Local	Aberdeen City Council	Transport Paper – Local development plan	Includes monitoring of development delivery, underpinning translation

Liverpool Highways Investment Programme

In 2019 the Council launched the Highways Investment Programme – the HIP – to address the issues identified with the poor condition of the highway assets. The proposed investment was intended to primarily address key safety issues and improve the condition of the network, whilst providing a safer and more accessible network, improving facilities in support of a shift to active travel and sustainable transport.

In the past, the HIP focused only on the current condition of the asset (capturing structural, functional and safety factors). Following the shift in national policy to promote active travel and in line with the council's street charter, inclusive design requirements, the Triple Lock, the City Plan and in support of the climate emergency declaration, it was therefore proposed that the scope of HIP be updated to include all highway assets and active travel and inclusive design enhancements. Whilst the HIP therefore encourages contractors to propose/adopt techniques with lower carbon footprint – which aligns perfectly with our Live Lab – our objective is to also transform the processes and behaviours to accelerate the trajectory to net zero beyond that of the existing BAU.

How our programme addresses additional future challenges

Our scheme-level optioneering approach capturing pavement/scheme re-design considerations will be able to address future requirements for:

- Mixed economic models for local roads procurement and local circular economies
- Increased requirements for climate resilience and extreme weather events (Aberdeen)
- Requirements for hydrogen buses (heavier, increasing wear on the carriageway)
- Changes patterns of how people use the road network due to increased active travel
- The wider evolution towards becoming a Smart City, including how to effectively leverage Sensors and air quality monitoring on key routes

Confirmation of core partners, roles and associated funding leverage

Liverpool have assembled a diverse but highly specific and targeted consortium partners, as the core of an extended group capturing stakeholders within the city, adjacent authorities and nationally. Roles have been reviewed, updated to reflect the reduced budget allocations, and refined to efficiently address the proposed objectives despite the overall resources being reduced.

Organisation	Role	Leverage
Liverpool City Region Combined Authority	Scale out support into adjacent authorities and key stakeholder as HIP funder	• Cycle Hub funding • Interactive Smart bus stop displays dovetails with public assets piece • ESF Ways to Work Programme, part-funded by the European Social Fund and the Youth Employment Initiative.
Aberdeen City Council	Peer city demonstrator exploring Interface with organisational level decision-making	• Exploration of relationship with organisation-level option development and impact measurement • Parallel investments into recycling assets
Pell Frischmann	Carbon optioneering tool development and scheme baselining	• Baseline tool development carried out through internal investment • Exposure to parallel schemes and SRN • BAU investment through their Target Operating Model and planned works
proving	Support and verification of carbon baselining and analysis	• Established links with trusted data sources • Development of toolkits exceeding £1million
Bird & Bird	Mixed economy contract novation and standards changes to design manuals; recycling business models	• Additional governance support of local deliverability and social value • Reduced Local Authority cost rate
Liverpool John Moores University	Targeted materials innovation support and independent technical governance; Ensuring a strong relationship with LJMU to leverage sector expertise and deliver local student placements.	• Local supply chain decarbonisation support through parallel funding, e.g. Eco-I NW • The programme seeks to leverage industrially relevant outcomes from PhD programmes • Potential KTP opportunity to develop the Liverpool-specific decarbonised materials strategy & asset mapping.
COLAS	Project management, Ecosystem development/road mapping, supply chain innovation management, carbon analysis, communications support, supply chain management. New technologies, scheme delivery.	• Access to technical advice and laboratory testing at Colas' facility in Runcorn, Cheshire. • Social Value leverage through existing HIP contract. • Potential access to digital tools
Huyton Asphalt	Ecosystem formation, scheme delivery (extra over)	• Existing BAU low carbon roadmap activities • Social value investments
Dowhigh	Ecosystem formation, scheme delivery (extra over)	• Existing BAU low carbon roadmap activities • Social value investments

GAP GROUP HIRE SOLUTIONS	Zero emissions plant and welfare 'extra over' provision, supporting creation of new minimum standards to extend best practice on public sector contracts	• Interlinks with partners' existing net zero programmes, including #GAPEcoFamily programme • Scalability across other partners including utility providers.
e.c.f.	Community engagement; supporting introduction of LCC contractor toolkit	• Builds on existing engagement work and local process development
PLACED	Community engagement (workforce of the future)	• Builds on existing local activities via contractor partnerships.
COCREATION partnership	Community engagement (pre-construction process)	• Broad voice-of-customer experience in local roads context to feed in

Additional LCC leverage

The Liverpool programme inherently leverages funding allocated from existing capital/revenue budgets – Live Labs funding represents 'extra-over' input on top of HIP schemes with funding already committed from LCC, LCR Combined Authority and the DfT. We will therefore act on the back of this existing budget to deliver schemes within the demonstrator neighbourhoods that target better outcomes for communities, with Live Labs funding used to provide the difference between the standard and decarbonised approaches – if a HIP scheme would normally cost £500,000 and a low carbon approach cost £600,000, we would only fund the £100,000 'extra-over' costs.

We have targeted the demonstrator wards based on network characteristics, diversity of communities and the fact that these have been identified as growth areas for regeneration and levelling-up. These wards are beneficiaries of existing funding packages or earmarked for future potential funding which will have good alignment with the Live Labs project. The National Infrastructure Commission has an "Inter-Urban Transport Connectivity" measure which is used to support the award of funding, with several locations in Liverpool well-placed to attract funding.

Community safety. The Live Lab will be designed to support existing funding secured for relevant neighbourhoods through the Home Office's Safer Streets Fund. The purpose of this funding is to improve community safety, tackle anti-social behaviour and improve community relationships.

Future Government capital grants. We will explore applications for highways funding from future government capital grants over the three-year project duration. We will explore funding of allied sectors such as the government's national Social Housing Decarbonisation Fund to tackle fuel poverty and reducing carbon emissions.

Just Transition Fund. Using the developments in Liverpool as a testing ground, we will then replicate successful elements in Aberdeen, helping to contribute to the Councils transition to net zero and supporting their funding bid to the Scottish Government 'Just Transition Fund' (£500m fund).

S106 contributions. We will leverage local developer contributions to support the delivery of improvements on demonstrator sites.

Benefit in Kind. The project has already benefitted from significant pro-bono time from LCC and key project partners and this is expected to continue once the project is established. It is expected that in total benefit in kind will generate equivalent value of around £500k across the programme.

Drivers for change

LCC have declared a climate emergency and identified Highways Maintenance as major source of each Council's own emissions. As the majority of emissions from the activities in this sector are attributed to Scope 2 and 3, this scenario has naturally stimulated activities to involve and engage our contracted supply chain and local and regional materials suppliers who were all pursuing this agenda from their perspective as part of the corporate social responsibility and governance. It is this collaboration at a City level which is identified to underpin the formation of the Ecosystem to

accelerate adoption of targeted decarbonisation on a scheme-by-scheme basis to meet local requirements across all vectors.

A principal driver for change recognises that although new highway construction is expected to cease in line with wider societal and economic changes, the requirement for highway maintenance/interventions to preserve and improve existing assets will increase as a statutory legal duty of Local Authorities. Accordingly, these activities will have to be de-carbonised to meet the Government's commitment to achieve net zero by 2050. Liverpool Highways and Transportation have gone further by setting a target of 2030. We also consider that as efficiency will be key in reducing carbon emissions alongside increased asset lifetime, vital cost savings can be achieved.

We also identified that there needs to be substantial engagement with Local Communities to create understanding and subsequently behavioural and attitudinal changes necessary to deliver reductions in carbon emissions. Our ambition is to stimulate specific scheme involvement where the local community are mobilised to support trials and interventions base on decarbonisation vectors.

The broader spectrum of drivers for change is captured through the sector-level and local contextual background to challenges in our Theory of Change logic map.

Process to realise the practice of change

Carbon Hierarchy Lens – Assessment and Vision

Our approach is based on the principle that the impact on £/tCO2e increases with earliest involvement in a project lifecycle, capturing the opportunity to do something different or less, as the starting point to then determine the options to deliver these schemes in the most decarbonised way.

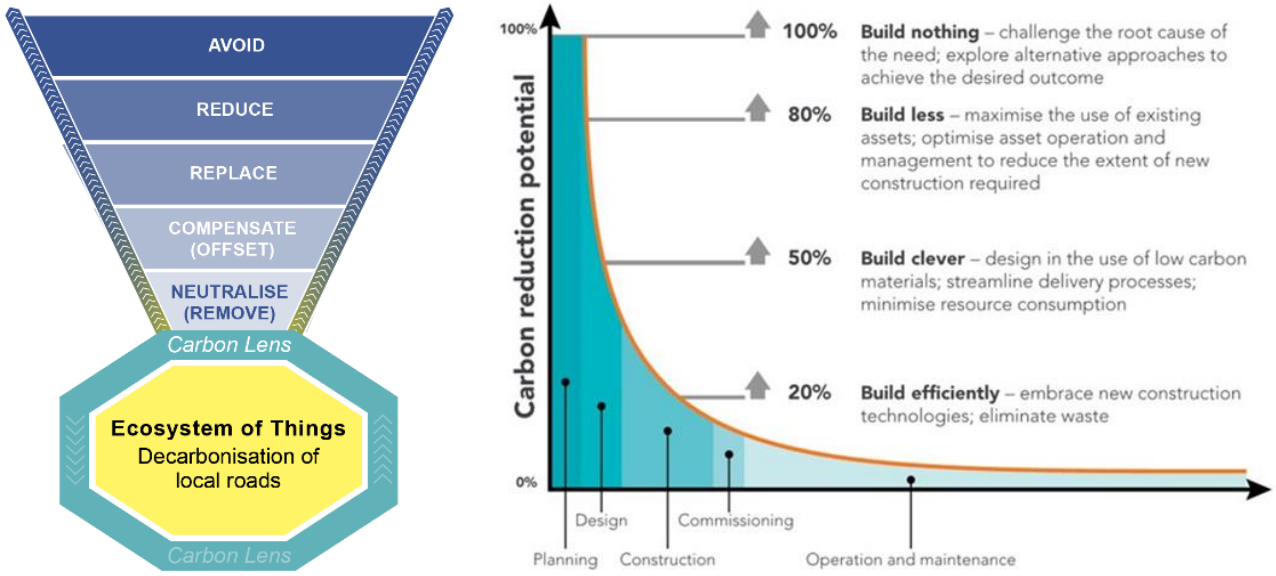


Figure 2: The Carbon Hierarchy

Full lifecycle nature of the Carbon Hierarchy

Building on the industry approach to carbon lifecycle assessment, seen in Embodied Carbon Stages A1 to D, the Carbon Hierarchy Lens includes provision of an early 2 Stage Concept Assessment. Our premise of including this earlier stage is to ensure an optimised scheme is considered at the earliest opportunity. In a full lifecycle context this includes alternative preservation techniques to prolong assets to maintain optimum life, and is a major cultural change for Local Authorities.

Dependent on the Stage 1 assessment i.e. need or function and stage of development (Red = Fixed, Amber = Potential to Innovate, Green = Optioneering), questions such as "is this the right scheme to deliver" can be considered and options of a similar or different nature but ultimately delivering the

necessary outcomes can be considered. The decision to delivery can then consider carbon as well as cost, programme and stakeholder benefits and drivers.

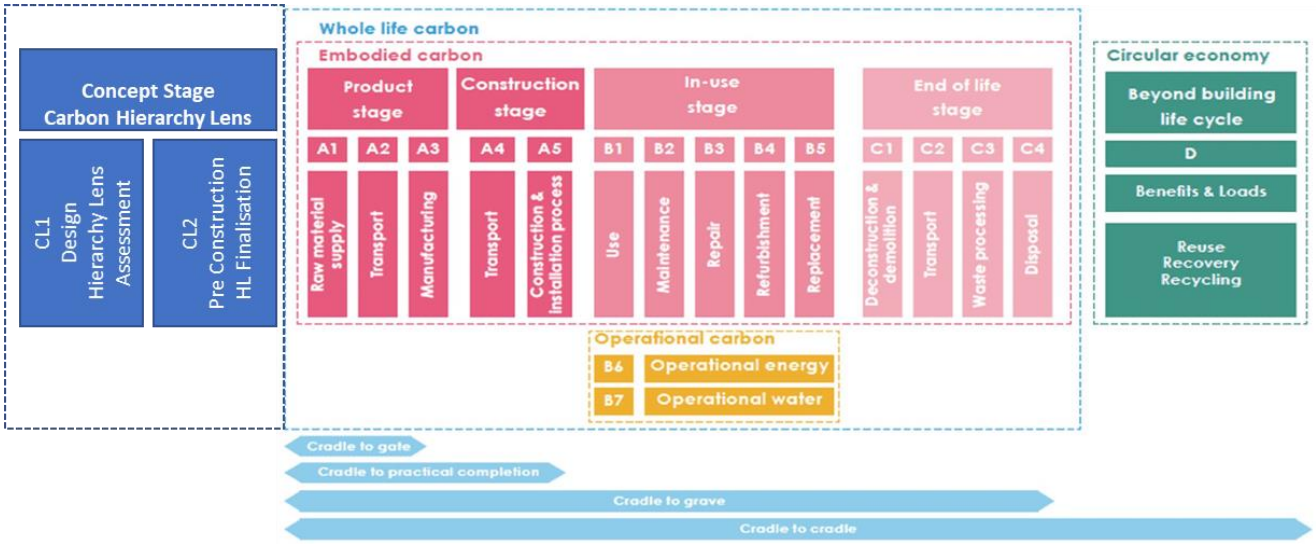


Figure 3: Embodied carbon stages of the Carbon Hierarchy Lens approach

The Carbon Hierarchy Lens approach underpins the pathway to a new BAU during the Live Labs programme. Accordingly, a new layer of functionality will be developed in Pell Frischmann's tool to reflect not just the full lifecycle carbon optioneering and scenario planning (including carbon cost), but also how this interfaces with other processes and tools within local authority/planning workflows.

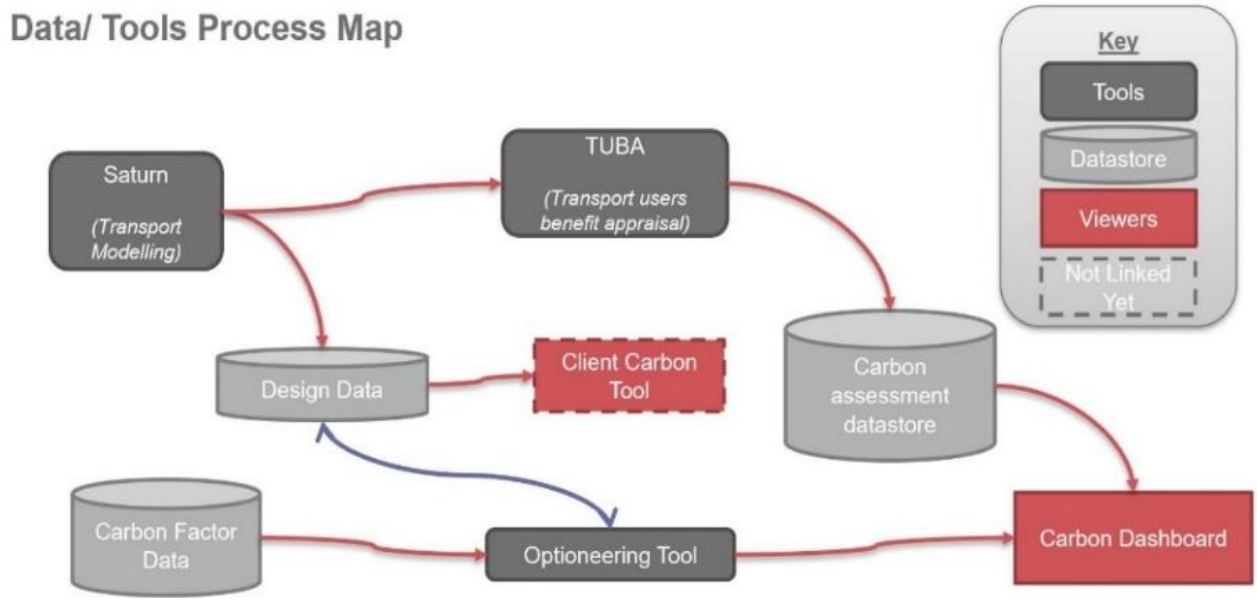


Figure 4: Data and tools process map for the Carbon Hierarchy Lens approach

Within the incumbent iteration of the Carbon Hierarchy Lens a simple interface is provided to support intuitive optioneering to run different virtual baselines for a scheme, with knowledge of key parameters such as the surface area of the works and the initial design for scheme where this exists.

Demonstrator location selection process

Whilst we will continue to refine the demonstrator plan during the mobilisation and delivery phases, this transformation project will principally be delivered across three Liverpool neighbourhood wards (north, south, central). Adopting a phased approach to align operations with existing schedules and facilitate transfer of learning, these have been selected based on the urgency and complexity of planned highways schemes within HIP (and wider Planned Works Framework), index of Multiple

Deprivation, the state of network characteristics, demand, opportunities for growth/levelling up and diversity. This approach captures schemes of different scope and complexities across the local road hierarchy. All have features and systems that are replicated across cities nationwide and worldwide, supporting future scaling-up and global carbon reduction becoming BAU.

A key aspect of the project that is designed to benefit authorities nationwide is the development of an open access city centre recycling platform, which aims to demonstrate best practice and opportunities for transformational 'pop-up' recycling models to access sites in the short-term. Likewise, this can be expanded to explore recycling opportunities for assets beyond aggregates, for example barriers which are no longer required but still have significant value.

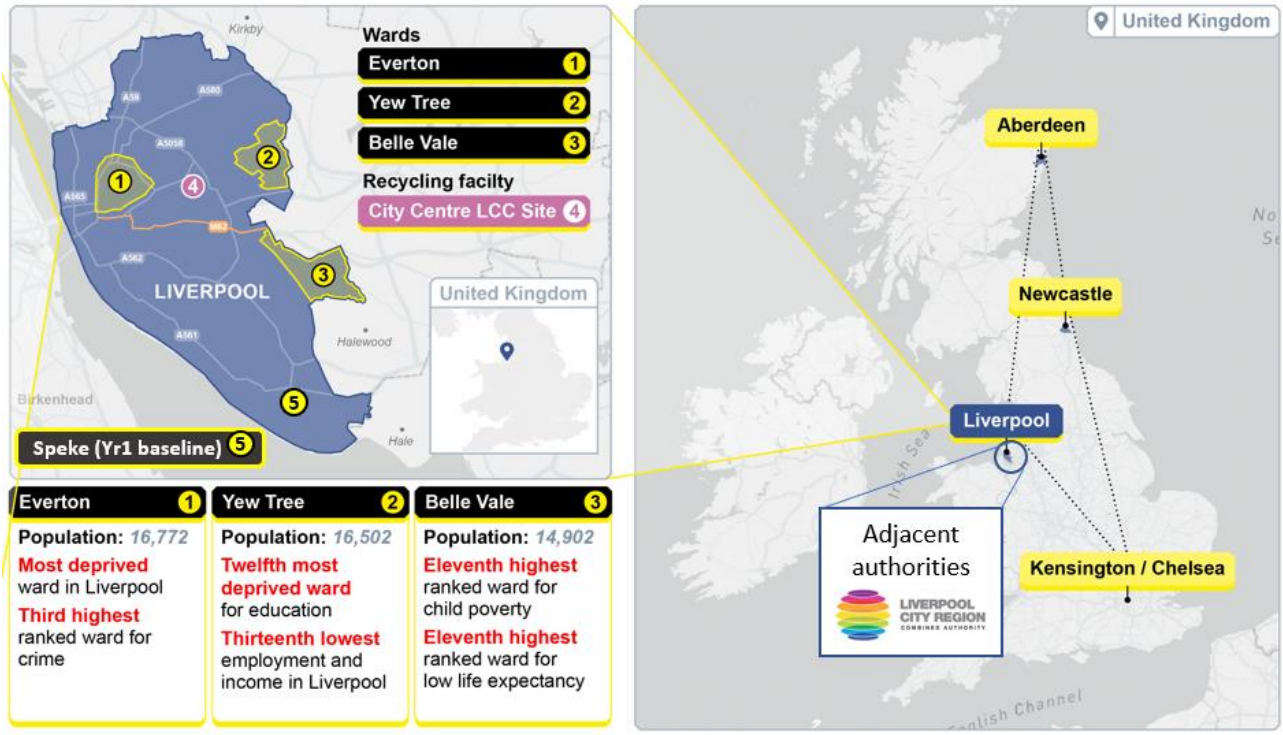


Figure 5: Proposed demonstrator scope for the Ecosystem of Things.

Vital to the scalability of the outcomes, the Liverpool programme will be delivered in collaboration with our 'Peer City'; Aberdeen City Council, which shares much in common with Liverpool. It too is a thriving major northern coastal city balancing growth and levelling up challenges along the route to achieving net zero. By working together on this project, by comparison and contrast through a systematic approach, the councils of Liverpool and Aberdeen will benefit from collective learning, best practice share and policy sharing.

To maximise overall benefits, the project has been designed, around the current and future operations of local councils and therefore as it evolves, the aim is to then include/bring on-line additional partners within a Leader-Follower model, including Newcastle City Council, Royal Borough of Kensington & Chelsea and adjacent authorities within the Liverpool City Region. This targets both immediate neighbours (e.g. Sefton) and those lying further afield, e.g. Cheshire West and Chester and Leeds City Council). Both CIHT and LCRIG act as amplification mechanisms.

Detailed theory of change / logic map for your proposal

We have extended our Theory of Change logic analysis to expand the number of key threads aligning with the principle themes explored within the Liverpool programme, included at the end of this section (Page 15). A summary of these is provided as follows:

Challenge	Solution targeted through Live Labs
Immaturity of carbon calculation and optioneering tools for option development	Suite of practical tools shared with Local Authorities as the basis for new BAU processes and behaviours
Disconnected geographic supply chains	Collaborative decarbonisation ecosystem realised
Disengaged public with specific demographic issues e.g. 'skills drain'	Multi-channel community engagement piece joining up the end-to-end decarbonisation process
Complex decision-making & diverse needs at neighbourhood level	Alignment of local scheme context and embodied carbon stages through the CHL
Inflexible contractual structures and workflows	Dedicated workstream for legal support of new contractual processes and standards into policy
Significant gaps in local highways recycling assets	City Centre Recycling Hub accessible by all local contractors, also targeting adjacent authorities

As per the logic map, these characterise and identify the critical routes to address key challenges through the development and demonstration workstreams within our Live Labs programme.

We note that nearly all of these are interrelated within the wider 'systems of systems' landscape, either through dependencies or synergies within our Ecosystem approach – however, for clarity not all are shown, and this situation itself provides a very clear illustration of the overwhelming complexity for Local Authorities that our programme aims to address.

Measurement of impacts and link with M&E

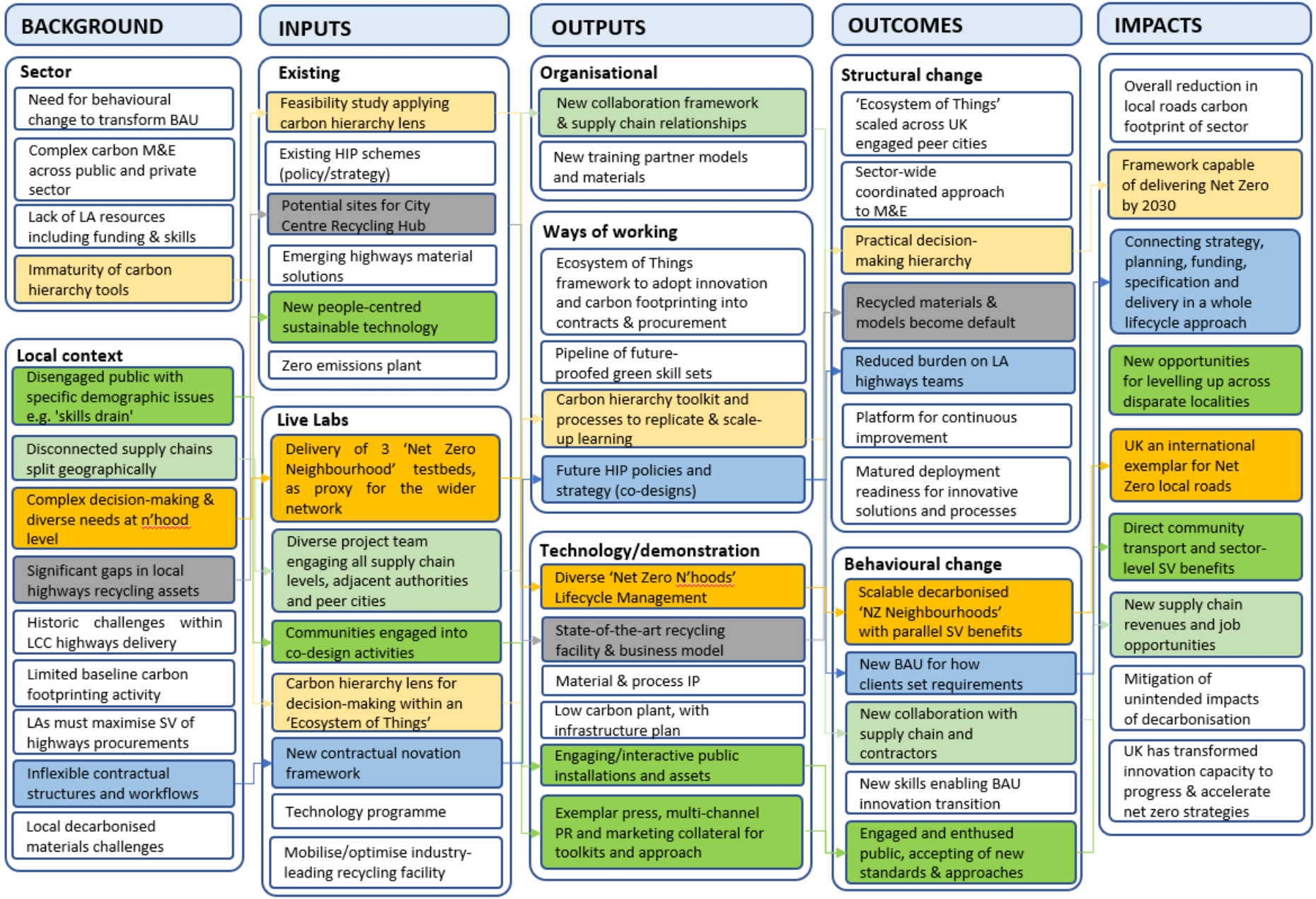
Underpinning our local M&E strategy is a deep understanding of what constitutes success in Liverpool, and corresponding impacts at sector-level for which we are aligned with the central M&E exercise (M&E Case). Elaborated in subsequent Cases, data that we will collect targets: Carbon footprint; Asset data; Public engagement/satisfaction; Cost; Operational data; Culture change; Jobs created; and Social Value related to 'triple lock' commitments.

We will continuously collect data to monitor how these outcomes change over the project, both in the 3-year programme and prescribed tail (3-5 years), over which we will continue to leverage contractor contributions into BAU (see Financial Case). Effective management of local data collection (including through the planned community engagement activities) will be facilitated through the relevant functional teams via the Programme Managers.

Full lifecycle carbon accounting is inherent to the fully developed Carbon Hierarchy Lens project optioneering and scenario modelling approach. We will therefore use Pell Frischmann's CHL toolkit as the foundation for our carbon footprinting activity, with robust data gathering and analysis supported by a dedicated Carbon Analyst role shared with our partners in Wessex. This KPI view (See Measurement and Evaluation Case, Figure 13) will be aligned with our existing Highways KPI dashboards, which will be supplemented with a specific view dedicated to the enhanced Live Labs.

Leveraging synergy across the thematic programme, we have engaged FHRG to support our Liverpool-specific carbon baselining activity, within a 'check and challenge' approach. As well as independent validation, FHRG have established a robust data framework to feed the CHL model carbon coefficients and consider residual emissions. In line with our phased approach, in Project Year 1 (2023-24) we will shadow a minimum of 5 representative schemes clustered within the demonstrator wards, to determine an initial Year 0/1 baseline representative of BAU across the city and feed a virtual optioneering demonstration of the new toolkit developments.

This workstream also supports ADEPT's wider objective to inform how different toolkits can be used to achieve the same objectives, in the context of different local challenges and requirements.


BACKGROUND
Sector
Need for behavioural change to transform BAU
Complex carbon M&E across public and private sector
Lack of LA resources including funding & skills
Immaturity of carbon hierarchy tools
Local context
Disengaged public with specific demographic issues e.g. 'skills drain'
Disconnected supply chains split geographically
Complex decision-making & diverse needs at n'hood level
Significant gaps in local highways recycling assets
Historic challenges within LCC highways delivery
Limited baseline carbon footprinting activity
LAs must maximise SV of highways procurements
Inflexible contractual structures and workflows
Local decarbonised materials challenges
INPUTS
Existing
Feasibility study applying carbon hierarchy lens
Existing HIP schemes (policy/strategy)
Potential sites for City Centre Recycling Hub
Emerging highways material solutions
New people-centred sustainable technology
Zero emissions plant
Live Labs
Delivery of 3 'Net Zero Neighbourhood' testbeds, as proxy for the wider network
Diverse project team engaging all supply chain levels, adjacent authorities and peer cities
Communities engaged into co-design activities
Carbon hierarchy lens for decision-making within an 'Ecosystem of Things'
New contractual novation framework
Technology programme
Mobilise/optimise industry-leading recycling facility
OUTPUTS
Organisational
New collaboration framework & supply chain relationships
New training partner models and materials
Ways of working
Ecosystem of Things framework to adopt innovation and carbon footprinting into contracts & procurement
Pipeline of future-proofed green skill sets
Carbon hierarchy toolkit and processes to replicate & scale-up learning
Future HIP policies and strategy (co-designs)
Technology/demonstration
Diverse 'Net Zero N'hoods' Lifecycle Management
State-of-the-art recycling facility & business model
Material & process IP
Low carbon plant, with infrastructure plan
Engaging/interactive public installations and assets
Exemplar press, multi-channel PR and marketing collateral for toolkits and approach
OUTCOMES
Structural change
'Ecosystem of Things' scaled across UK engaged peer cities
Sector-wide coordinated approach to M&E
Practical decision-making hierarchy
Recycled materials & models become default
Reduced burden on LA highways teams
Platform for continuous improvement
Matured deployment readiness for innovative solutions and processes
Behavioural change
Scalable decarbonised 'NZ Neighbourhoods' with parallel SV benefits
New BAU for how clients set requirements
New collaboration with supply chain and contractors
New skills enabling BAU innovation transition
Engaged and enthused public, accepting of new standards & approaches
IMPACTS
Overall reduction in local roads carbon footprint of sector
Framework capable of delivering Net Zero by 2030
Connecting strategy, planning, funding, specification and delivery in a whole lifecycle approach
New opportunities for levelling up across disparate localities
UK an international exemplar for Net Zero local roads
Direct community transport and sector-level SV benefits
New supply chain revenues and job opportunities
Mitigation of unintended impacts of decarbonisation
UK has transformed innovation capacity to progress & accelerate net zero strategies

The Economic Case

Background

Given the nature of the programme and funding sources, and in line with the Live Labs guidance, the Economic Case will be undertaken under the umbrella of the Department for Transport (DfT) Value for Money (VfM) Framework. However, it is recognised that the Programme is not a traditional transport scheme, and the Economic Case will acknowledge the wider objectives of the innovative pilot programme including the learning and evidence gained that can be used elsewhere nationally and internationally.

As introduced, the process of aligning HIP schemes for each of the demonstrator neighbourhoods is ongoing, with strong dependency on existing operational scheduling/timelines as well as the nature and objectives of the scheme.

As described in the Strategic Case, refining the scheme down-selection process is a key objective of the programme, representing the challenge of overwhelming complexity currently faced by local authority decision-makers seeking to maximise the impact of limited resources.

Therefore, whilst it is not realistic to undertake a detailed and credible economic appraisal and provide a Benefit Cost Ratio for VfM Assessment, following discussions with ADEPT it has been agreed that a higher-level approach can be taken that is reflective of the more conceptual nature and development stage of our programme. However, at the end of this section we present relevant case study data to support our assertion that core elements of our programme will deliver against different VfM levers.

We will also elaborate our rationale below in terms of the Department for Transport VfM Framework, which states that a VfM assessment should be formed of three elements:

- Option development
- Consideration of costs and benefits
- Consideration of risks and uncertainties

We have therefore structured our Economic Case around these three factors and demonstrate how VfM will be driven by each element. The proposed approach to each of these elements is detailed further below, providing critical linkages with the other Business Cases where appropriate.

Proposed value for money categories for the investment proposal

Option Development

The 2022 update to the HM Treasury Green Book reinforced that a scheme cannot demonstrate value for money if it does not deliver against objectives at a local, regional or national level. The programme objectives and their alignment to the Live Labs vision and principles and local, regional and national policies is shown in the Strategic Case. The implementation of our approach for every scheme will therefore be aligned with the Strategic Case in terms of the overarching objectives.

Fundamentally, our Ecosystem of Things concept exists to address the scenario in which all carbon matters, but also that for individual schemes there is a suite of established and emerging solutions which can be prioritised to yield the maximum carbon impact if introduced at the appropriate design and development stage; the Carbon Hierarchy.

The Carbon Hierarchy Lens approach for carbon optioneering approach – enabled by access to a fully-developed decarbonisation ecosystem – is the process by which this option development is realised in practice. Similarly, our Live Lab addresses the scenario that there are insufficient resources to simultaneously deploy all of these interventions.

The requirement for option development within the programme is therefore strongly met.

The different demonstrator neighbourhoods within Liverpool, in addition to those selected within the partners and other adjacent authorities, are being selected to provide a thorough representation of these complex urban contexts.

The option development will explore the different interventions appropriate to these varied contexts. The use of the Carbon Hierarchy Lens model/toolkit as part of the option development and assessment ensures understanding and management of the positive and negative impacts from a range of perspectives and demonstrates potential trade-offs. This aligns with the Green Book process of considering all the societal impacts across a multi-criteria spectrum.

Therefore, whilst seeking to identify the KPIs against which we can quantitatively measure the impacts of a particular decarbonisation approach at scheme or contract/service-level, the case for VfM delivered by our Live Lab programme is underpinned by the inherent relationship between decarbonisation and wider operational efficiency. This synergy lies at the heart of calculations within Pell Frishmann's CHL toolkit, which through developments for the strategic road network is already configured to provide:

- Whole life cost analysis matrix
- Whole life carbon analysis matrix

Whilst the corresponding end-user emissions arising from the baselined in-use phase of the asset is not an objective for Live Labs, the CHL toolkit is also able to estimate the impact of a particular design on how it is used, which remains relevant to our approach.

Within the wider thematic programme, it is recognised that selecting the appropriate horizon for this analysis is vital to produce meaningful outputs with long-term utility. The relevant horizon for analysis is proposed to be 2050, aligned with that for carbon lifecycle analysis and budgeting and the overall UK horizon for Net Zero compliance.

Consideration of costs and benefits

The Theory of Change, presented as part of the Strategic Case, provides the framework to understand the main impacts of the programme and how these align to the objectives. In line with the steer from ADEPT, the DfT VfM Framework will be used as an 'umbrella' under which the potential costs and benefits are considered, without being fully tied to it.

We have considered the economic, environmental and social sub-impacts in the DfT VfM Framework and set out which are likely to be key impacts of the programme, noting this will depend on:

- Actual measure that has been implemented
- Context of the pilot demonstration neighbourhood

The potential measures delivered as part of the pilot will be considered and the key outputs mapped to the sub-impacts within the VfM Framework to demonstrate both the range and scale of potential impacts on the indicators. However, it is recognised that some of the impacts of the pilot will not align directly with these sub-impacts, for example where the key value delivered by the pilot is the lessons learned and the application of these elsewhere, and industry behavioural change.

Consideration of the VfM will compare the costs of the programme to the benefits that are delivered by the measures implemented. It is anticipated that through this work we can accurately ascribe costs to each of these, to determine a relevant Benefit Cost Ratio for the programme as an aggregation of scheme-level demonstration activity and corresponding translatability across the whole of Liverpool, local authority partners and also at sector-level.

The Financial Case provides details of the anticipated upfront capital expenditure of undertaking the demonstration activity targeted within the Liverpool programme, as well as the funding sources which will be leveraged from both the public and private sector. There is also potential for the interventions

to reduce the ongoing operation, maintenance and renewal costs of the highway network for the councils.

We therefore anticipate that the further development of our approach for local roads will align with the following VfM categories, with examples given:

- Future carbon reductions – estimate for monetised carbon value included below
- Cashable financial benefits (operational)
- Revenue generating benefits (as commercialisation benefits)
- Non-cashable benefits (operational efficiency gains, effectiveness gains, through increased resilience, capacity and capability)
- Assets performance benefits (increased longevity, reduced maintenance requirements or increased climate resilience)
- Social benefits (increased wellbeing, increased equality)
- National and local economy benefits
- Other ecology, air quality, biodiversity, and other environmental benefits
- Knowledge and learning benefits
- Sovereign Capability
- Reputational benefits

Through the exercise at programme-level to work closely with the ADEPT's down-selected M&E supplier (see Measurement and Evaluation Case), these will be aligned with an expanded consideration of the measurable (tangible) benefits of our Live Lab:

- Significant contribution to Liverpool's target of net zero in 2030 and transferable solutions to support national decarbonisation targets
- Smart, clean, accessible and integrated infrastructure that meets the needs of a modern and productive city and its residents
- Robust data from identified demonstrator sites to inform future maintenance and project strategies
- Changes in the requirement for maintenance teams to travel to / from sites could impact on the fuel and vehicle maintenance costs
- Potential for reduced future maintenance, repair and replacement requirements through removal of assets which are no longer required (e.g. barriers protecting a sign which has been upgraded to have collapsible legs).
- Reduced time taken to plan and deliver schemes, also leveraging asset-sharing to yield process improvements
- Changes in the requirement for maintenance teams to travel to / from sites could impact on the fuel and vehicle maintenance costs.
- Commercial operation of the City Centre Recycling Hub with revenue generation, underpinned by business model for open access within city and adjacent authorities
- Enhanced measurement/monitoring capability for carbon baselining and accounting
- A future-proofed diverse team of skilled, experienced and passionate people capable of measuring and mitigating carbon
- Wider cultural awareness around carbon reduction both within the authority and for the public giving people a voice and empowering them to influence decisions and make the transition more effective

- Systems and processes to unlock new green technologies and enable continuous improvement embedded as BAU
- Effective model of public/private/academia/charity sector collaboration with contractual toolkits for nationwide replication
- Modified specifications with the authority exercising greater influence and control over material selection
- Demonstration of the alignment between decarbonisation projects and social value impacts improving sense of place and belonging
- An opportunity to showcase Liverpool and partner local authorities as exciting industry leaders in roads decarbonisation, with sector-level scalability supported through FHRG engagement
- Low-carbon infrastructure, together with active travel and improved local planning to improve health and quality of life, the local economy and services, the natural environment.
- Sharing best practise and application across multiple locations (Liverpool City Region, Aberdeen, Newcastle, Kensington and Chelsea) from Scotland and the north east and north west of England to the south east.

Consideration of the risks and uncertainties

Driven by its nature as a demonstrator programme, the greatest risk to value for money is the uncertainty of impacts due to the novel interventions being considered. The examples taken from case studies demonstrate that these types of interventions have delivered benefits and cost savings elsewhere, however many of these interventions are not mature in their development and so there is limited testing and evidence to give full confidence in their outputs.

Our Carbon Hierarchy Lens approach will allow understanding of both the positive and negative impacts from different perspectives. Key to this the consideration of unintended consequences as a result of the implementation of innovative interventions that are at an early stage of development. Likewise, by considering the full operational value chain and lifecycle we can expand this to include factors such as additional travel associated with diversions whilst works are carried out, which can be baselined and benchmarked against the incumbent approaches.

The wider Carbon Hierarchy Lens approach will also be leveraged to indicate the sensitivity to extending the approach to consider the potential impacts of entirely mitigating or reducing construction work through data-driven selection of schemes, as well as more fundamental re-design opportunities. Likewise, our approach linked with the wider 'Triple Lock' impacts captured through existing KPI dashboards can consider and monitor these on a scheme-by-scheme basis.

The Management Case sets out the general risks beyond value for money of the programme, and the mitigation measures which will be put in place to manage and overcome these. This process will ensure the risk and uncertainty do not impact on the value delivered by the scheme. Likewise, overall economic efficiency will improve as it is implicit in de-carbonisation that to maximise the economic output from any carbon omitted efficiency will improve, this might be achieved through closer management of all inputs involved in HM which previously have left to societal custom and practice. This is entirely aligned with the approach to enhance the long-term performance of assets leveraging circular preservation techniques where appropriate.

Evidence for estimated level of monetised carbon impacts

Whilst we recognise the lack of a detailed baseline for the schemes targeted in Liverpool, we provide the following high-level analysis to 1) provide evidence of a quantified approach and 2) illustrate the challenge of making reasonable assumptions within this context.

We therefore provide the following calculations for reference only, in lieu of the rigorous VfM assessment which will accompany our programme through the internal and external M&E workstream.

Carriageway reconstruction activity

Pell Frischmann have carried out a concept study using their Carbon Hierarchy Lens toolkit to baseline a representative complex HIP scheme – Mersey Road – with a nominal value of [redacted]. This was done as a virtual exercise from the engineering drawings and specification documents released with the original tender.

Based on standard BAU local authority reconstruction materials and approaches this scheme was calculated to have a baseline carbon footprint of 280-tonnes CO2-equivalent.

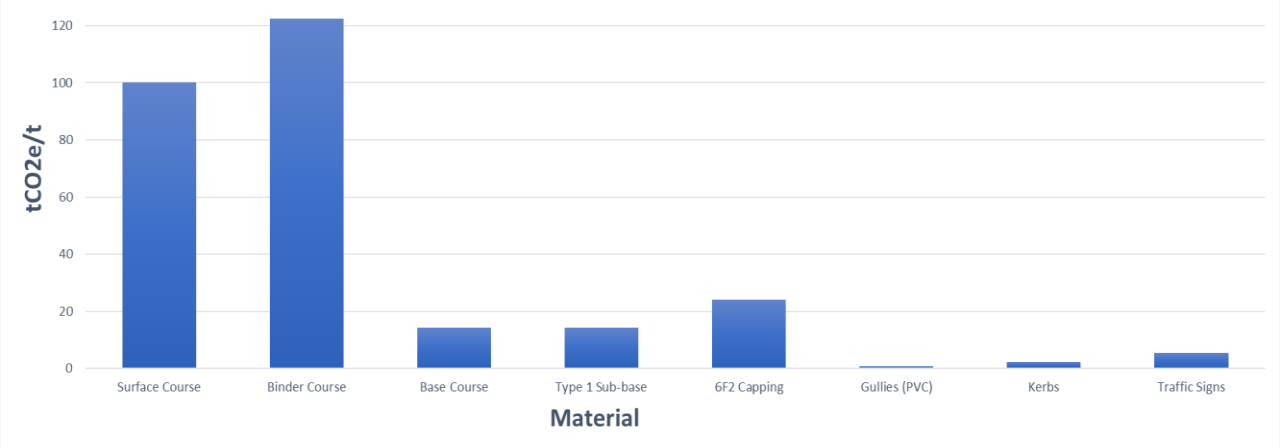


Figure 6: Baseline calculated using concept CHL design optioneering for a reconstruction HIP scheme (Mersey Road)

Extrapolating this to the reconstruction and resurfacing aspects of scheme delivery in the demonstrators in terms of the expected Live Labs capital spend (£1,200,000 over the 3-year programme) indicates a direct carbon impact of 509 tonnes, in a 'do nothing' scenario.

As described in the Carbon Case, a reduction of 42% on the input (i.e. Year-0) baseline is required to deliver the linear trajectory to net zero by 2030, corresponding to a direct 214 tonnes saving, which we estimate to exceed any BAU reductions by a factor of 4:1 over these timescales (170 tonnes).

However, over the whole scope of the HIP or equivalent assuming successful integration into BAU, this scales to 2312 tonnes based on committed spend within the Planned Works Framework, which is doubled when considering these impacts over the full 5-year tail over which M&E will continue. We therefore expect to start realising this benefit from 2026 and will monitor this until 2030.

Using the Green Book Supplementary guidance for carbon values we can deduce values for 2023 until 2030 (£/tCO2e). All calculations have made use of the Green Book Standard Discount Factors.

2023	2024	2025	2026	2027	2028	2029	2030
£252	£256	£260	£264	£268	£272	£276	£280

For Liverpool alone, we therefore conservatively estimate a value of this benefit of £1,840,000 by extrapolating in terms of the anticipated HIP value. However, further levers can be applied to this to account for optimised pavement design and other cashable impacts of increased asset performance and resilience.

Scaling across the other local authority partners in the programme, as well as adjacent authorities within the City Region identify the clear opportunity to directly generate a 6.5:1 Benefit Cost Ratio based on our total programme budget of £3.995million, against indicative analogous spending exceeding £232million on Highways Maintenance and Non-Maintenance packages through the City Region Sustainable Transport Settlement (a14.2-fold scale factor with respect to Liverpool alone).

Similarly, scaling nationally requires only a conservative estimate of the number of Local Authorities covering comparable complex urban contexts to generate further transformational impacts.

The Commercial Case

Projected procurement / intellectual activities, options and intended procurement routes

The Liverpool Live Labs programme will be delivered by Liverpool City Council as the de facto Local Authority lead, but with collaboration throughout the programme with Aberdeen City Council as a 'peer city' to effectively scale the outputs. With the authority under intervention, Liverpool is currently re-evaluating its approach across multiple activities to improve efficiency and service levels. This presents a prime opportunity to review procurement, commissioning and design/delivery processes. The project activities are broadly split into procurement categories, as follows, with corresponding outputs and outcomes aligned with our Theory of Change logic map indicated.

Programme Management – Programme and project-level management, Governance, Carbon Support, Communications and Knowledge Sharing

This area of activity ensures effective delivery on the ground, coordination, progress reporting and information dissemination as follows.

Internal Local Authority Resources: Liverpool City Council

LCC will recruit a Programme Manager to work alongside a Project Manager recruited by Colas as the lead delivery partner. Shared legal and communications budgets will be utilised through existing legal and comms advisors where possible.

External Innovation Partner: Colas Ltd

Colas Ltd were central to developing the overall concept for the Liverpool programme, coordinated the bid preparation and detailed proposals, and leveraged their relationships with the key (unique) knowledge partners to create the proposition that has now been agreed in principle. They also have access to a substantial R&D knowledge base within their organisation. Colas have not charged for the work undertaken prior to this business case. Colas are therefore a key innovation partner and central to the success of this programme and ensuring it offers best value for money through utilising embedded knowledge for efficient and effective roll-out.

Accordingly, Colas are in the process of recruiting an Innovation Project Manager and shared Carbon Analyst support to work as part of the Liverpool programme team.

Colas will also undertake programme management and governance support for the wider Corridor and Place Based Consortium. Resource is included in both the Liverpool and Wessex programmes.

Outputs and outcomes: Delivery of the Live Lab programme on time and budget, enabling a significant contribution to Liverpool's target of net zero in 2030 and transferable solutions to support national decarbonisation targets, with an increased lifecycle analysis of future carbon and cost savings.

Outcomes are underpinned by delivery of the Ecosystem of Things framework to adopt innovation and carbon footprinting into contracts/procurement as BAU, supported by new policies within our Council.

This includes facilitating the new collaboration framework and supply chain relationships, and the dissemination piece to share best practise and application across multiple locations (Liverpool City Region, Aberdeen, Newcastle, Royal Borough of Kensington and Chelsea), demonstrating national reach. These activities will be supported by provision of exemplar press, PR and marketing materials for toolkits and approach.

Preferred procurement route: We have explored various sourcing options for these services including:

- **Bespoke open or restricted tender process.** This was discounted due to the need to secure the embedded knowledge and the unique relationships provided by Colas as a key innovation partner in the development of the programme.

- **Crown Commercial Services Construction Works and Associated Services (RM6088).** Lot 1.2.1: Civil Engineering Works & Minor Associated Building Works & Services – North England (Value band £0-3m). Appropriate for both the Project Management/Professional Services and Works/Scheme delivery aspects.
- **Pagabo Civils and Infrastructure Framework.** Lot 1 North of England – Road Transport (Value band £0.5-5m). Must include construction/scheme delivery, with PM/Professional Services included as part of Pre-Construction Services Agreement.
- **NEPRO** – Suitable for Professional Services only.

For external costs, our preferred option is to put in place a single call-off agreement with Colas through the 'Crown Commercial Services Construction Works and Associated Services' framework, which is able to accommodate all aspects of Colas' work scope across programme-level activities (considered more as 'Professional Services') and scheme delivery. The CCS route was deemed to be preferable to Pagabo by virtue of having fewer restrictions around the balance of these activities, as well as the significantly lower framework management fees by the provider.

Design – Decision-making and ecosystem enablers

This aspect focuses on knowledge-based activity which will drive the works programme and designs.

Carbon Hierarchy Toolkit and optioneering: Pell Frischmann.

As described in the Strategic Case Pell Frischmann are uniquely placed to undertake this activity as the developers of a proprietary Carbon Hierarchy Lens tool, which has already been demonstrated in the context of a major scheme on the strategic road network and also undergone pre-feasibility validation for local roads during the Live Labs bid development phase.

Pell Frischmann can therefore be considered to represent a unique supplier of the relevant services in relation to providing this optioneering capability in the local roads context, having developed and retained ownership of the intellectual property related to the model.

Outputs and outcomes: The key deliverable from this workstream is a Carbon Hierarchy toolkit (for optioneering and baselining), as well as processes to replicate and scale-up learning across Local Authority stakeholders.

Legal framework and business model development: Bird & Bird.

Engaged to support delivery of a mixed economy contract and novation framework, changes to standards and design manuals and Local Authority-led recycling business models. Delivery of Liverpool-specific and sector-wide processes and guidance to support introduction of new approaches and models into policies and standards.

Outputs and outcomes: The deliverables from these activities correspond directly to tangible outputs. This workstream combined with the physical demonstrator activity will also deliver critical data supporting provision of modified LCC specifications exercising greater influence and control over material selection.

More generally, we intend to deliver an effective model of public/private/academia/charity sector collaboration with contractual toolkits for nationwide replication.

Technical Governance and Materials Support: Liverpool John Moores University.

Ensuring a strong relationship with LJMU to leverage sector expertise, local student placements & leverage parallel SME supply chain support.

Outputs and outcomes: This collaboration between academia and industry will deliver independent technical governance of new materials in the context of the Ecosystem of Things. This workstream will also cover the demonstration of a Liverpool-specific circular model for deployment of a LJMU cold-lay base or surface course material with high proportions of waste material (binder and aggregate).

Community engagement

Local Authority Resources: Direct resource can be allocated from the Community and Neighbourhood Teams, also supporting outreach and education activities through the Marketing and Communications team.

ECF: Engaged under subcontract to ensure Live Labs programme aligns with existing LCC community engagement activities and triple lock objectives.

PlacED: Engaged under subcontract to employ an interactive place-making and community consultation to specifically target engagement of young people in the city and EDI.

Co-Creation Partnership: Engaged under subcontract to adopt a highways focus on community engagements to reach the ultimate objective of decarbonisation through community co-design.

Outputs and outcomes: Tangible outputs from these activities will be the data gathered from these engagements and wider cultural awareness around carbon reduction both within the authority and for the public giving people a voice, empowering them to influence effective decisions.

The outcome of this will be improved provision of Smart, clean, accessible and integrated infrastructure that meets the needs of a modern and productive city and its residents.

Planned procurement route: For external costs, our preferred option is for partners to draw down these costs under subcontract through Colas' single call-off agreement within the 'Crown Commercial Services Construction Works and Associated Services' framework. We have received assurance that as an 'Innovation Partner', no additional management fees will be added to facilitate this arrangement.

Scheme delivery – Delivery of works within the demonstrator neighbourhoods

Works will be aligned with our Highways Improvement Programme (HIP), for which schemes are contracted individually through the Planned Maintenance Framework. The Live Labs programme will therefore take 'business as usual' delivery routes already in the Council's pipeline plans and establish how carbon emissions can be reduced through changes to specifications and working methods. The Live Labs grant will be combined with our Local Authority BAU funding for these schemes, applied as an 'extra over' layer to fund the additional costs of undertaking the works in this way. This approach will be applied to materials, plant and equipment and designs, as well as programme specific activities such as community engagement, re-design and enhanced M&E.

The Planned Works Framework or equivalent is expected to run continuously for the duration of the 3-year funded Live Lab and all of the main contractors delivering the HIP – Dowhigh, Huyton Asphalt and Colas – have been engaged to collaborate in this programme. There Corresponding neighbourhood demonstration activity will be distributed equitably across North, Central and South areas of the city, and adjacent authorities can also be reached through these contractors. This can also be extended to include other contractors on the Planned Works Framework, such as Graham Construction to access relevant schemes outside HIP in line with the programme governance.

Outputs and outcomes: The primary outputs from this workstream are embodied through the designated and diverse set of demonstrator neighbourhoods, underpinned by robust lifecycle management. Robust data from demonstrator sites will be delivered to inform future works and maintenance strategies. A key output of the demonstrators driving the public engagement which is vital for acceptance and co-design inputs is a set of interactive public installations and assets, targeted through collaboration with Liverpool John Moores University.

These activities will contribute directly to provision of low-carbon infrastructure, together with active travel and improved local planning to improve health and quality of life, the local economy and services, and the natural environment. They also directly enable a pipeline of future-proofed green skill sets for Liverpool.

Accordingly, M&E will aim to demonstration the direct alignment between decarbonisation projects and social value impacts.

Planned procurement route: The key purpose of the Liverpool programme is to explore delivery of low-carbon solutions through existing delivery mechanisms. For the demonstrator activities carried out in Liverpool, we therefore initially considered using the HIP via the existing Planned Works Framework, so as to preclude the need for any alternative sourcing options for the delivery of the Live Labs extra-over scheme delivery within demonstrator neighbourhoods.

However, having explored this option further it was found to lack the flexibility required for the Live Labs approach due to each HIP scheme being contracted individually through our Planned Works Framework. The final value for each overall contract would also need be set as part of the ECI approach, requiring all surveys and designs are completed before starting with the works. Whilst later in the programme we seek to demonstrate that we can merge interventions into existing contractual arrangements, in the first instance this would present significant timing issues aligning Live Labs interventions with HIP schemes. The corresponding operational risks to the BAU aspect of HIP scheme planning and delivery are not acceptable to the Council.

We also identified a risk that the maximum value of the Planned Works framework would be exceeded. This is despite the fact that the central programme management costs and those associated with development of enabling technologies and assets not linked to any single demonstrator scheme would also not align with the Planned Works Framework.

We therefore considered a range of public sector procurement frameworks with provision for delivery of highways works.

- **Crown Commercial Services Construction Works and Associated Services (RM6088).** Lot 1.2.1: Civil Engineering Works & Minor Associated Building Works & Services – North England (Value band £0-3m). Appropriate for both the Project Management/Professional Services and Works/Scheme delivery aspects.
- **Pagabo Civils and Infrastructure Framework.** Lot 1 North of England – Road Transport (Value band £0.5-5m).

Preferred option: For simplicity, our preferred option is to put in place a single call-off agreement with Colas as the primary Innovation Partner through the 'Crown Commercial Services Construction Works and Associated Services' framework', which collaborating contractors can then draw down extra-over funds against additional costs on a scheme-by-scheme basis.

The CCS route was deemed to be preferable to Pagabo by virtue of having fewer restrictions around the balance of these activities, as well as the lower framework management fees by the provider.

However, the option also exists to put in place a separate call-off agreement with each contractor, with drawn down managed through the central programme governance process.

Project Services – Additional Carbon Baselining, Assessment, Review and Certification

This will be undertaken by the programme team with tools and support provided by Proving Services who facilitate the Future Highways Research Group (FHRG), a partnership between ADEPT and Proving Services. Proving Services is a small research organisation based at Cranfield University which has worked extensively to develop sector-leading, research-based tools and processes which are used extensively across the highways sector. They have developed what is becoming the industry standard carbon analyser tool and associated highways industry carbon profiles, so are uniquely placed to contribute to this activity and work to embed emerging practice into the sector.

Proving Services have agreed a support package which is part of the process of designing the works programme and comprises carbon baseline analysis, carbon analyser licensing and training, carbon profiling, review and certification, assessing benefits risks and costs, years 1 and 2 waypoint assessments and write-up and dissemination of learning.

Outputs and outcomes: This workstream will deliver a robust carbon baseline for existing BAU scheme delivery across the City (supported by independently-validated, and corresponding data for the demonstrator schemes.

Dovetailing with the Carbon Hierarchy Lens development and deployment, this collaboration therefore aims to deliver enhanced measurement/monitoring of carbon for accounting and budgeting purposes. The outcome of this process contributes to a future-proofed diverse team of skilled, experienced and passionate people capable of measuring and mitigating carbon.

Planned procurement route: The option to undertake a negotiated procedure without prior publication is considered the most appropriate mechanism to secure these services. Our intended/preferred procurement route is therefore for Proving Services to draw down these costs under subcontract through Colas' single call-off agreement.

Partner	Key activities	Workstream	Budget	LCC internal costs	External Programme costs	Scheme delivery
LCC Project Team						
Contribution to wider 'Greener Roads' shared functions						
LCC 'Other'						
Colas						
Colas						
Colas						
Huyton						
Dowhigh						
Pell Frischmann						
Bird + Bird						
Liverpool John Moores University-led activity						
GAP						
ECF						
PlacED	Community engagement (workforce of the future)					
Co-Creation	Community engagement (pre-construction process)					
Aberdeen City Council	Aberdeen - peer city demonstrator exploring Interface with organisational level decarbonisation					
Key + Ch						
Newcastle						

Figure 7: Provisional budget plan with costs split by stakeholder and whether incurred internally or externally.

How the proposed approach will comply with procurement and subsidy control

The Crown Commercial Services Construction Works and Associated Services (RM6088) is a national framework which has been competitively procured. It has terms which allow direct award to contractors and their sub-contractors who are available through the framework for values up to £3m, which is sufficient for any individual external party. We are therefore confident that there are no compliance issues regarding the drawdown of Live Labs funding through this mechanism.

Outline output / outcome-based specifications

Demonstrator Works: These will be ordered through task orders within these extra-over call off agreements and will be specified on a case-by-case basis as a result of the technical and strategic programme governance to ensure the joined-up approach and maximum value for money. Payment will be under the individual contract terms.

Programme management and design activities: The outputs under these contracts – indicated above and in our Theory of Change logic map – will be delivered for fixed sums in line with the proposals submitted by the suppliers which informed the costed bid proposal.

Proposed procurement plan and timescale considerations

The procurement team have been engaged during the OBC preparation phase to elucidate the optimum procurement route for us to contractually engage our project partners and suppliers. However, as detailed further in the Financial Case – regarding the spend profile – given Liverpool City Council's status as being under additional oversight, the actual delivery of our Live Labs procurement strategy to begin discharging the funds can only proceed with the approval of Cabinet to accept the grant funding, expected August-September 2023 (draw down commencing October).

In spite of this, all contractual arrangements will be put in place during this more conventional mobilisation period, such that the programme delivery can commence at the earliest opportunity.

Early consultation with the supply chain

LCC can leverage mature supplier relationships in the context of Live Labs development as well as the existing HIP framework, in which all of the contractors are partners in the Live Labs. Furthermore, the core Ecosystem partners have been closely involved in discussion regarding delivery of the programme since the summer of 2022 and have met regularly throughout the development of the bid and the business case.

In terms of collaborative working across the wider Corridor and Place-based Decarbonisation thematic programme, a partnering agreement and MOU was put in place during the bid process. Activities to engage the extended delivery team and wider ecosystem partners will be ongoing during the OBC and mobilisation phase.

ECI is written into the HIP framework for all of the HIP delivery partners. Individual contracts for schemes include an early contractor involvement (ECI) phase. This means contractors are already expected to be part of the design process and engage in initial stages of each scheme to firm up the baseline price and provide greater assurance that schemes will meet all council requirements. Some schemes will be delivered as design & build schemes. These already provide an enhanced level of flexibility in the context of Live Labs.

Design and build schemes will tend to be simple schemes where the intervention will focus on improving the condition of assets without having to address significant issues, such as the introduction of segregated cycle facilities or changes of the traffic regulation order. For more complex schemes, we can retain further control of the design. Therefore, provision is already made within the existing Framework to commission professional services partners. This approach is therefore precisely aligned with how we intend to deliver our live Lab.

Section 151 officer sign-off

The Council's Section 151 Officer has been briefed by the Senior Responsible Officer and has approved the following declaration.

This is in anticipation of receiving a formal grant confirmation letter (detailing the grant conditions and confirmation of eligible costs), for signing following the OBC review and stage gate recommendation to proceed.

Section 151 Officer Declaration	
As Section 151 Officer for the Council, I declare that the financial information in this business case is accurate to the best of my knowledge and that the Council has allocated sufficient budget to enable delivery of the programme on the basis of its proposed funding contribution/leverage.	
Liverpool City Council Name: Barry Scar	Approved on: 20/04/2023

The Financial Case

Funding profile

The representative workstream costs presented in the Commercial case have been assigned at a high level to corresponding Work Packages (Gannt, see Management Case) better reflecting how the project tasks and activities will be delivered during the programme. These cost centres align with the internal LCC resource and external costs arising from programme-level activities to develop the ecosystem and framework of enablers, as well as scheme delivery.

Work Packages			Y1		Y2	Y3
			Q1	Q2		
1	Programme management		£0	£0		
2	Collaborative decarbonisation ecosystem framework and programming		Mobilisation			
3	Ecosystem of Things	3.1 Supply chain innovation				
		3.2 Recycling hub				
4	Enabling tools and processes	4.1 Carbon hierarchy Lens				
		4.2 Contract, regulatory standards & policy				
		4.3 Education and skills development				
5	Live Lab Demonstrators	5.1 HIP scheme baselining - South				
		5.2 Community engagement				
		5.3 Demonstrator A - South				
		5.4 Demonstrator B - North				
		5.5 Demonstrator C - Aberdeen				
		5.6 Demonstrator D - Central				
		5.7 Demonstrator E - South				
6	Evaluation and impacts					
7	Benefits realisation and management					
			£0	£0		
		TOTAL (Annual)	£725,000		£1,846,000	£1,424,000

Figure 8:Indicative project spend profile summary, by project year and workstream activity.

As introduced in the Commercial Case, as part of the increased oversight we face Cabinet approval to formally accept the Live Labs grant funding from ADEPT/DfT is required – this applies for all grants up to £250,000 in value. Whilst this Cabinet Reporting process has commenced based on the information contained in this OBC document, the expectation is that we will not receive Cabinet sign-off until August-September 2023.

As indicated by the Gantt (Management Case, attached) we are therefore working on the basis of a more conventional 5-month programme/project mobilisation period from the point of this OBC submission, not dissimilar to that anticipated at the point of the initial bidding.

Whilst this mandatory internal governance process represents an unavoidable period of time before which we can begin to draw down and discharge the anticipated Live Labs funding – expected October 2023 – this mobilisation period will enable our procurement and HR teams to:

1. Facilitate the extended team preparations including recruitment

2. Reach full readiness to enact the contractual aspects of procurement which could not proceed until we get formal grant confirmation from ADEPT

However, we will actively explore other mechanisms to enable us to commence the funded project phase as early as possible in Project Year 1 – for example, an interim payment of <£250,000 – to minimise impacts on ADEPT's intended 40/30/30 spend profile. In the current scenario, we have accounted for £0 project spend during this 5-month period.

We note that even without this requirement which prevents any front-loading of the project spend, we were expecting a deviation away from the 40/30/30 profile. This is due to the timing challenges of aligning physical demonstrator interventions with HIP schemes, which has informed our strongly phased approach for extra-over scheme delivery.

The corresponding 3-year balance of costs therefore reflects an 18.1% spend in Project Year 1, 46.2% in Year 2 and 35.7% in Year 3. However, following discussions initiated during the interim OBC review we are hopeful that the justification provided is considered appropriate.

Financial risk management

Our intention is for the whole-life cost impact is captured within the Carbon Hierarchy Lens through the relationship with full lifecycle analysis of emissions (including maintenance interventions), which will underpin the decision-making process on whether to pursue a particular approach within the Ecosystem. As presented in the Economic Case, this is designed to mitigate the risk of a particular intervention generating an increased maintenance or operational requirement over the selected lifecycle horizon.

The sequential and agile nature of scheme delivery will also enable a level of contingency to be built into the programme during the physical demonstration phase. We also intend to inherently mitigate risks through a focus on mature technically proven solutions at a high level of maturity and adoption readiness, in line with overall acceleration approach. In all cases, rapid translation of learnings across different stakeholders in the Liverpool programme as well as the wider thematic programme will be used to minimise risks of any negative long-term impacts with financial implications.

However, given the nature of the programme it is not possible to entirely negate the risks and we are prepared to manage this effectively (see Management Case). Most notably, for LCC we consider the establishment of a City Centre Recycling Hub to represent one of the key ongoing financial responsibilities, within the proposed operating model. However, can leverage external partnership to mitigate some of these operational financial risks, further offset by the considerable revenue-generating potential for the Council, underpinned by the initial proposal for the operating model.

Description of any contribution or match funding being provided

The Live Labs financial profile is delivered without any direct financial contribution of match-funding. However, as described in previous sections the approach is to leverage Live Labs investment against existing business-as-usual budgets and sources of parallel funding.

Financial governance of additional LCC leverage

The Liverpool programme inherently leverages funding allocated from existing capital/revenue budgets – Live Labs funding represents 'extra-over' input on top of individual strategically aligned HIP schemes. This funding has already been committed from LCC, LCR Combined Authority and the DfT and would be spent within the existing Planned Works Framework as business-as-usual, and we therefore do not consider this to represent match-funding.

However, we will leverage against this existing budget to deliver schemes within the demonstrator neighbourhoods that target better outcomes for communities, with Live Labs funding used to provide the difference between the standard approach and the decarbonised approach. For example, if a

HIP scheme would normally cost £500,000 and a low carbon approach cost £600,000, we would only fund the £100,000 'extra-over' cost through Live Labs.

We have targeted the demonstrator wards based on network characteristics, diversity of communities and the fact that these have been identified as growth areas for regeneration and levelling-up. These wards are beneficiaries of existing funding packages or earmarked for future potential funding which will have good alignment with the Live Labs project. The National Infrastructure Commission has an "Inter-Urban Transport Connectivity" measure which is used to support the award of funding, with several locations in Liverpool well-placed to attract funding.

Community safety

The Live Lab will be designed to support existing funding secured for relevant neighbourhoods through the Home Office's Safer Streets Fund. The purpose of this funding is to improve community safety, tackle anti-social behaviour and improve community relationships. No additional governance is required and our Live Lab represents targeted synergies not fresh funding/investment.

Future Government capital grants

We will explore applications for highways funding from future government capital grants over the three-year project duration. We will explore funding of allied sectors such as the government's national Social Housing Decarbonisation Fund to tackle fuel poverty and reducing carbon emissions. These will be administered in the way described, with the governance/oversight dictated by the grant value targeted (over or under £250,000).

S106 contributions

We will also seek to leverage local developer contributions to support the delivery of improvements on demonstrator sites. Expected to not exceed the [redacted] threshold, thus easing governance.

Benefit in Kind

The project has already benefitted from significant pro-bono time from LCC and key project partners and this is expected to continue. It is expected that in total benefit in kind will generate equivalent value of around £500k across the programme, but with minimal governance requirements.

Details on accepting financial responsibility for the project going forward

Whilst there is significant external leverage as described above, the programme is not dependent on additional sources of funding (e.g. HIP) which have not already been committed to expenditure. However, as per the Declaration included in the Commercial Case, our Section 151 Officer has been briefed by the Senior Responsible Officer and has provided the requisite approval in anticipation of receiving a formal grant confirmation letter to sign following the OBC review/stage gate.

Long-term financial viability through sustained benefits beyond the programme

Specific programme developments and activities are included to drive acceptance of Carbon Hierarchy Lens tools and processes into BAU transport planning, procurement and operations (scheme delivery and maintenance). This will be driven at Local Authority level by the complementary updates to policies and standards.

Embedding the Carbon Hierarchy Lens into BAU – Finalisation and application

Following two years of programme delivery, generating lessons learned and data driven decision making, the focus for Year 3 – and beyond into the 3-5-year tail – is to establish embedded processes in a lean, outcome focused model which can be tested through the final demonstration phase. Engaging with all parties within the Net Zero Carbon Roadmap the principles of CHL delivery will be shared more widely on an open platform to be integrated in new BAU workflows within the Council and our partners.

It is considered that the various parties will have different inhouse functions, software and processes however embedding the CHL toolkit principles, benefits and ways of working, towards 2025 and 2030 targets collaboratively, will establish the LCC framework for the future of carbon-considered decisions. This workstream driven in partnership with our key partner Pell Frischmann will include activities to:

- Integrate and Verify programme wide CHL Process
- Formalise the CHL Assessment for BAU;
- Working Group Completion – Task and Finish
- Embed CHL principles collaboratively working with all parties on an "open" platform basis
- Summary 3 Year Outcomes Assessment Report, including an explicit pathway to our 2030 vision and targets
- Dovetail with wider Liverpool KPI dashboard to move out of Live Labs programme phase

Wider outcomes supporting transition to a new BAU

The Ecosystem of Things takes account of the need to rapidly transition any successful new ways of working into BAU so that resulting carbon savings can be maximised. All stakeholders will be engaged with the transition to net zero supporting ownership and visibility of a common approach. This is in turn supported by a robust measurement reporting and communication process aligned with the Theory of Change. The Ecosystem of Things model specifically supports the transition to BAU in the following ways:

- Continuous refinement with Pell Frischmann of the innovative Carbon Lens methodology, considered at every stage of design and delivery throughout the project period with approved alternative approaches communicated and embedded into BAU processes to be deployed on future projects. This will be initially applied to identified projects but then integrated into how the projects are identified and designed in the first place (at source)
- Effective planning and programming of alternative materials installation in the three demonstrator wards to deliver quick wins with rapid communication of project outcomes
- Flexibility and empowerment to change specifications including the local authority being capable of specifying recycled materials supplied from the City Centre Recycling Hub across all contractors and utility providers working on behalf of the authority or in the region which will mean recycled material becomes the 'standard'
- Technical support from Bird & Bird to design contractual documents, commercial templates and toolkits so that successful initiatives can be formalised and replicated across Liverpool and partner local authorities and organisations outside the project team
- Providing carbon literacy training, mentoring and career support to shift mindsets across staff and contractors to actively embed a culture and ambition to collaborate, change and decarbonise roads
- Ensuring that new ways of working in a decarbonised approach are continuously maintained to encourage challenge of conventional wisdom. By engaging and stimulating the public, we are increasing awareness, engaging the community and building momentum establishing a new BAU and progress towards net zero. This extends to full lifecycle considerations of maintenance interventions and updated asset life estimations etc.

Targeting a leadership position aligned with our ambitious stance, we are actively exploring mechanisms to potentially claw back Live Labs funding from stakeholders not demonstrating that they have embedded these new learnings and approaches into BAU.

This will be developed alongside the strategic and operational teams and would be monitored as part of the 3- and 5-year tail, to serve as additional incentive to maintain progress and scale-out of the programme outcomes.

The Management Case

Governance structure and key roles and responsibilities

Since the inception of the thematic programme, we have united around a common vision that the power of this approach lies in the opportunity to:

1. Leverage synergies and standardisation across the three individual Live Labs
2. Also accommodate the inevitable differences in Local Authority processes, as well as those emerging during the programme to address specific local requirements.

However, development of an effective governance structure to enable these ambitions was underpinned by a strong commitment to a set of 'rules of engagement' from Local Authority senior management, contained within the signed MOU from all Consortium authorities as part of the revised combined budgets prior to mobilisation. Accordingly, both the overarching thematic programme management and Liverpool-specific programme/project management has been approached in this way as detailed in the following sections.

Overarching combined Place-based governance

The overall governance structure for the thematic programme is set out below, illustrating how the wider programme enables the effective sharing of roles and activities in key programme functions.

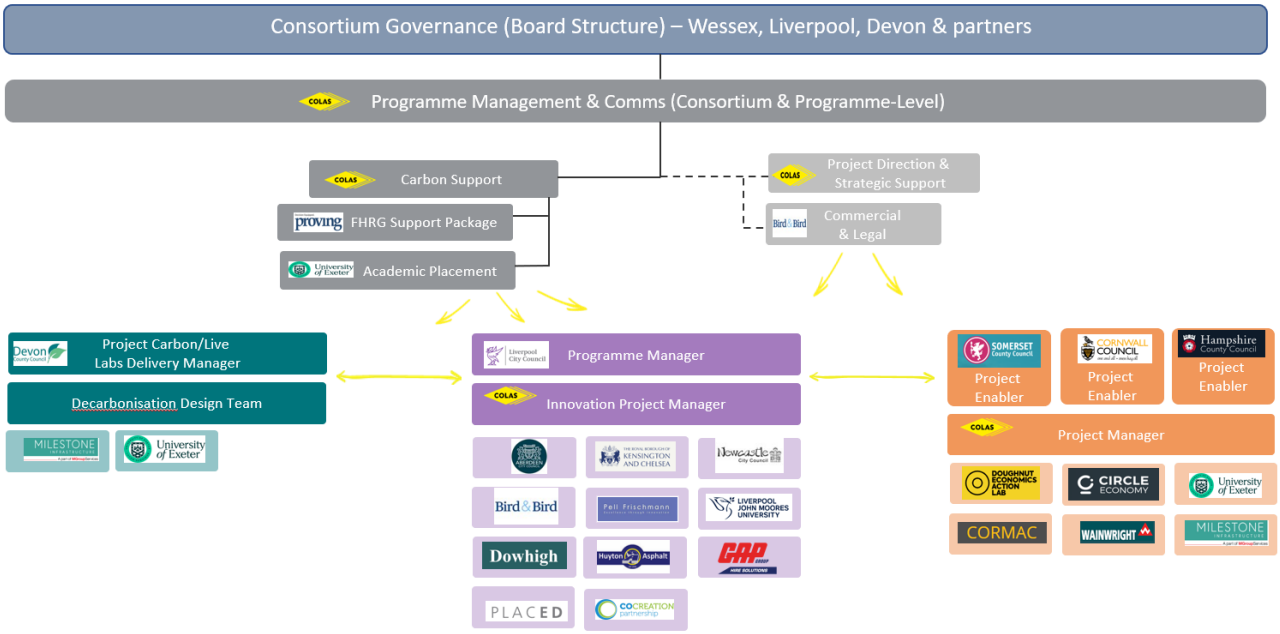


Figure 9: Overall governance structure of the Corridor and Place-based Decarbonisation thematic programme.

The structure and terminology is based on the principles of Managing Successful Programmes and PRINCE2 project management, taking a tailored approach to implementing these methodologies and safeguard the project outcomes. It is this tailored approach that enables both the flexibility to interface effectively with existing LA assurance processes, as well as practical alignment with the overall structure and governance of the Live Labs programme and cohort by ADEPT. We recognise that rapidly establishing these communications channels is vital for the cross-pollination that will drive the sector-level impacts.

This tailoring also extends to the terminology, which diverges from pure MSP and PRINCE2 where necessary to remain logical in the wider Live Labs context, and also recognises the different level of training across project teams.

Liverpool Live Lab governance

The Liverpool programme management structure reflects the objective of the Live Lab to provide 'extra-over' stimulus as an additional layer on top of planned business-as-usual activity to maximise leverage and tangible impacts.

Accordingly, a dedicated programme team will be established to ensure that all Live Labs activity being delivered to align with the planned works pipeline can be fully-resourced in parallel to the existing LCC and contractor operational teams.

As well mitigating any additional risk of disruption to these critical highways service delivery activities, this centralised Live Labs programme team allows all of the enabling ecosystem activities falling outside any particular demonstrator scheme to be accommodated without any restriction or conflict of interests.

As described in the following section, all of these are new roles funded through the resource allocated to programme management, for which recruitment has started following receipt of a 'Letter of Comfort' from the Department for Transport. The blended team structure strategically aligns the key roles with different stakeholders to ensure both broad representation and a level of independence, but also that specific organisational needs are effectively met.

Overlapping with the economic procurement case, this arrangement also enables the project financial administration to be separated from day-to-day BAU operations, as well as a level of independence from any single stakeholder or operational team. This feature of the governance structure is particularly important for the Liverpool programme given the participation of the three contractors currently delivering schemes within the HIP (Colas, Huyton and Dowhigh), with others potentially engaged through the underlying Planned Works Framework (for example, Graham Construction).

Individual teams manage the day-to-day delivery of the respective areas of the service, supported by the following Board structure:

Operations Board – part of the governance structure, which oversees operational performance across the contract, manage health & safety and drive innovation. Operational issues that cannot be resolved at a local team level are referred to the Operations Board

Strategic Board – Any issues that cannot be resolved at Operations Board are referred to Strategic Board, the most senior level of governance structure, responsible for the strategic leadership of the highways service and contract.

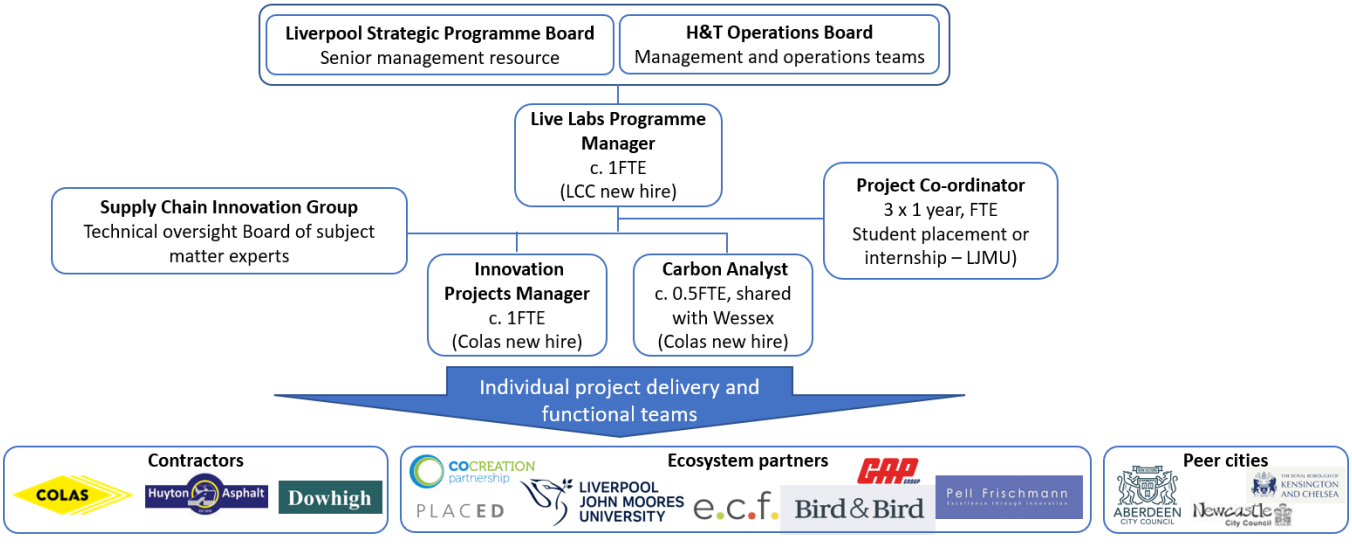


Figure 10: Liverpool project management and governance structure, with core recruitment targets.

A description of the key roles, lines of accountability and Senior Responsible Owner

Roles and terminology at local level also align with the tailored PRINCE2 approach used across the programme and within individual innovation projects catalysed through the project activity.

Cabinet support

Councillor Dan Barrington – Cabinet Member, Climate Change and Environment. As introduced, we need to obtain Cabinet sign-off, but we have benefited through the unequivocal and continuing support of Councillor Barrington throughout the process.

'We need to take drastic action to prevent a climate catastrophe and I am personally 100% committed to supporting this brilliant innovation project to decarbonise Liverpool's highways'.

Senior Responsible Owner

Jamie Blake – interim Director of Highways, Liverpool City Council. Jamie has recently taken over leadership of the Council's Highways function from Karen Agbabiaka, coming from his previous position of Corporate Director of Environment and Sustainable Transport at London Borough of Newham. He is therefore ideally positioned to continue driving the Liverpool programme forwards, in line with his broad expertise across core areas relevant to successful delivery of the programme and integration into BAU.

This includes: Strategic Leadership; People Management; Commissioning services; Local Government; Local Democracy; Commercial Negotiations; Contract Management; Service Redesign; Change Management; Key Performance Indicators (KPIs); Efficiency; Value for Money; Stakeholder Management; Community Relations; Regeneration; Planning; Environmental Services.

Having been briefed on the Liverpool Live Lab proposal during the OBC preparation phase, Jamie brings a clear strategic and procedural direction to the programme as the SRO, having the delegated responsibility to submit this OBC by the Monitoring Officer.

Karen Agbabiaka – interim Chief Highways Officer until 6th April 2023. From the point of inception of the Liverpool Live Lab proposal, Karen Agbabiaka has been the catalyst within Liverpool City Council as the interim Chief Highways Officer, a role she has held since May 2021. However, as the Commissioning Board have recently been made aware, Karen has moved on from this role to take up a Non-Executive Director position at Active Travel England.

We therefore acknowledge the central role Karen has played in developing this proposal to the point of mobilisation in terms of technical service delivery impacts, but also from the perspective of the embedded Triple Lock objectives regarding the workforce of the future, local socio-economic and social value impacts and a wider motivation to make the city the best place possible for communities.

Programme Manager

A dedicated Programme Manager position has been created to deliver the Liverpool Live Lab, taking the senior role in the management partnership with the Innovation Project Manager. This dynamic is considered to be important to participate at the level required to operate effectively and engage key internal stakeholders within the Council. A summary of the job specification is provided below.

Responsible for working with Highways Commissioning, Design and Operations teams at all levels in the deployment of the Live Labs project on behalf of LCC to ensure delivery of project outputs and outcomes throughout the life of the 3-year programme. To provide a conduit between the rest of the Live Labs Project Management, functional teams and LCC staff who have the legal and statutory responsibility for the delivery of the Highway Maintenance Programme where it interfaces with the Live Labs projects.

ECI in capital, routine and reactive maintenance operations with Highways Commissioning, Design, Operations teams and with Innovation Project Manager and Carbon Analyst roles to identify and implement decarbonised alternative approaches in targeted neighbourhoods as part of the HIP.

Engaging and collaborating with other Live Lab demonstrator activities undertaken by our partners will be inherent to share learning and experience. Suitable candidates with relevant experience and expertise have already been identified within LCC.

Innovation Project Manager

Forming a key axis within the Liverpool Live Lab Innovation PMO, this new role enables a focus on the more technical and conceptual activity underpinning the realisation of the decarbonisation Ecosystem. Resourcing this function centrally also enables a level of independence from any individual contractor or activity.

Project Co-ordinator

We are working closely with LJMU to resource this role through an internship or student placement in a relevant project management subject. This arrangement is anticipated to be mutually beneficial to create skills and a sense of ownership which can stay within the city, which will be developed and tested within a challenging real-life operational Local Authority environment.

Carbon Analyst (shared 50/50 with Wessex)

A dedicated position has been established to resource this activity, which will be split (and co-funded) appropriately between Liverpool and Wessex to reflect the relative scope of the geographical scope and density of trial schemes making up the local carbon M&E activity.

Technical governance

Prof. Hassan el Nageim (Liverpool John Moores University). Prof. Al Nageim has knowledge, practical experience and skills which gained over 25 years in the fields of highways and bio-based materials technology. This includes 3 patents and more than 170 journal and conference publications. His expertise in the design, evaluations and testing of pavement engineering for walkways, roads, highways and infrastructures materials underpins a strong local angle to the independent technical governance of solution targeted through the decarbonisation Ecosystem.

Delivery and functional support

The Liverpool Live Lab will also be supported by the following delivery resources:

- **Existing local authority highways departments** (including major projects, network and asset management teams), who will carry out their normal roles across both the demonstrator neighbourhoods and the wider network. With support through the Local Authority coordination responsibilities held within key project roles (as above), this input will feed into the enhanced decision-making ecosystem realised through the programme
- **Existing local authority communications teams** (potentially supported by commissioned PR support, shared across the Consortium)**:** This role will oversee the communications and marketing aspects of the Live Labs project in collaboration with the local authorities' existing teams, including our knowledge sharing proposal detailed in the relevant section below
- **Existing Local Authority Community teams:** supporting community engagement and trial planning activities through their existing work.
- **Contractors** on the LCC Planned Works Framework (covering the HIP and other maintenance/improvement schemes) and their supply chain to deliver work in the demonstrator neighbourhoods (but with consistent monitoring across schemes and overall demonstrators to enable comparability). Specialist suppliers will be added as appropriate to deliver low carbon solutions.

Reporting arrangements to provide key updates on progress and cadence

The process for reporting progress at the Programme, Consortium and Live Lab levels will be undertaken in the spirit of Prince2 Project Management and Managing Successful Programmes methodologies. Maintaining the tailored approach will enable us to reflect the wider requirements of the ADEPT programme cadence and different stakeholder groups.

Local reporting at both Consortium and individual Live Lab levels will mesh with ADEPT's overarching Live Labs programme cadence, and the combined cadences are set out in the table

below. For example, the Project Team Meeting will meet every two-weeks, interleaved with ADEPT's Technical Meetings, and provide the conduit for reporting progress via Highlight Reports. Templates for the reporting tools (progress reports, highlight reports and exception reports) will be used to ensure consistency in reporting.

Meeting	Frequency	Mechanism for progress reporting
ADEPT Commissioning Boards	Quarterly	Summary Report from the Consortium & Liverpool Live Lab
Consortium Steering Group	Quarterly	Progress Reports to the Consortium Board from the Live Lab Programme & PM
Consortium Comms Leads Meeting	Quarterly	Comms Plan Progress Report
Liverpool Live Lab Strategic Meeting	Quarterly	Progress & Exception Reports to the Project Board from the Project Manager
ADEPT Programme Technical Meeting	Two-weekly	Highlight Report from the Project Manager
ADEPT Programme Comms Leads Meeting	Two-weekly	Highlight Report from the Local Authorities' comms leads
Liverpool Project Team Meeting	Two-weekly	Progress Reports from the Innovation Project Manager

Project plan

We have adopted a Gantt-based approach to project planning, in terms of the duration and timing of key tasks and activities. The corresponding timing of deliverables and milestones align with the requirements of the SMART objectives fixed for the Liverpool and wider thematic programme.

The high-level rolled up Gantt provided (attached separately) presents a quarterly timing profile, which is sufficient to determine the programme cost profile (as per the Financial case) and aligns with the wider programme cadence of the governance and external reporting. However, the project delivery team will enact the detailed 2nd-level planning activity during the mobilisation phase within a Microsoft Project environment. This will provide the required granularity to effectively deliver the project task and resource management.

The work packages (WPs) capture dependencies across the different functional activities, reconciling the high-level workstreams based on provisional scopes of work agreed with all of the key partners and stakeholders. However, we note that the project governance structure and approach to innovation management and evidential decision-making supports an inherent flexibility. This more experimental approach is therefore agile to enable new developments and learnings across the cohort and wider sector to be rapidly but rigorously integrated into the programme plan if appropriate. In this way, impacts will be maximised.

Initial risk register

Our approach supported by the core consortium partners – as well as those in the wider programme theme – is informed by an ISO9001:2015 quality management framework and complementary time/resource-efficient 'Fail Well' strategies. The overall risk register for Liverpool (attached) will reflect programme-level risks reflecting mitigations associated with thematic programme synergies and new knowledge developed during the OBC collaboration phase.

The risk register will be an active document owned by the Programme Manager. Management of individual risks will be cascaded and delegated to owners at project and task-level, based on specialist knowledge and individual responsibilities. The process will capture assessments on work package commencement, updated during the monthly reviews. Mitigations and contingencies will be incorporated into task-level plans and communications by WP leads, tackling programme-blockers early.

Our approach follows the follows the Red-Amber-Green (RAG) assessment methodology matrix, with selected risks (gross and post-mitigation scored from 1-25) combining likelihood and impact (1-5) to indicate the relative controllability.

The Carbon Case

We will use a framework for carbon measurement, incorporating the proof of method and benefits statement. This framework will examine the following elements:

- The total carbon reduction (kgCO2e) estimated and actual and the cost £/kgCO2e over the whole lifecycle, both estimated and actual
- The scale of changes and the anticipated impact on carbon
- Carbon targets and the basis of the calculations, benefits realisation timescales and the timespan of the anticipated benefits
- Carbon measurement methods, the accuracy and completeness of measures, and assessment waypoints. This includes error mitigation and double-counting management protocols.

The framework will also:

- Include the Impact on service VfM (linked to the Economic Case) and the impact on service performance (economy, efficiency, effectiveness, strategic value, stakeholder value)
- Consider the impact on asset performance, including the cost of ownership, longevity, performance and user experiences
- Evaluate collateral benefits and dis-benefits, including other cashable and non-cashable benefits plus environmental, ecological, societal, local economy, and reputational benefits.
- Consider the sector-wide benefits

Description of a carbon baseline estimation and reduction target

LCC's target to achieve Net zero by 2030 within Highways and Transportation is highly ambitious, both within the UK and wider global context. Alongside the more nuanced set of criteria against which 'success' in Liverpool can be evaluated, this context provides a stark measure of whether the means of delivering the required decarbonisation trajectory is being achieved.

This trajectory can be considered either as:

- A linear relationship setting out the minimum carbon footprint reduction required annually so as not to fall behind the required rate of change – the corresponding target would be 42% over the duration of the Live Lab.
- An exponential relationship, with rapid initial decarbonisation stimulated by easy wins and more transformative interventions, preceding more marginal gains aligned with the law of diminishing returns as net zero is approached (or the effective limit against which any residual emissions can be practically offset at organisational level) – the corresponding target would be >60% over the duration of the Live Lab.

It is clear that neither of these trajectories is addressed by current BAU activities, and in both cases the 3-5-year tail beyond the programme envelopes the point at which our Net Zero target falls.

Accordingly, these activities need to be systematically considered and integrated at organisational level. The service-level functionality falls within the scope of the full lifecycle considerations embedded into our two main carbon footprinting toolsets accessed through Pell Frishmann and Proving Services (FHRG). The partnership with Aberdeen City Council – who are currently exploring organisational-level decision-making and M&E through the Climate OS platform – also enables this to be probed. These activities are inherently linked with the M&E Case.

Baselining

A significant challenge – aligned with those identified by ADEPT as the premise for Live Labs – is the largely incomplete baseline across LCC's existing Highways activities. Full lifecycle carbon accounting is inherent to the fully developed Carbon Hierarchy Lens project optioneering and scenario modelling approach (see following section). We will therefore use Pell Frischmann's CHL toolkit as the foundation for our carbon footprinting activity.

Leveraging synergy across the thematic programme, we have also engaged FHRG to support our Liverpool-specific carbon baselining activity, within a 'check and challenge' approach. As well as independent validation, FHRG have established a robust data framework to feed the CHL model carbon coefficients and consider residual emissions. In line with our phased approach, in project Year 1 (2023-24) we will shadow a minimum of 5 representative schemes clustered within the demonstrator wards, to determine an initial Year 0/1 baseline representative of BAU across the city and feed a virtual optioneering demonstration of the new toolkit developments. Engaged through the wider Corridor and Place-based thematic programme, the FHRG are a partner within our consortium, offering full access to the Carbon Analyser tool for the life of our programme.

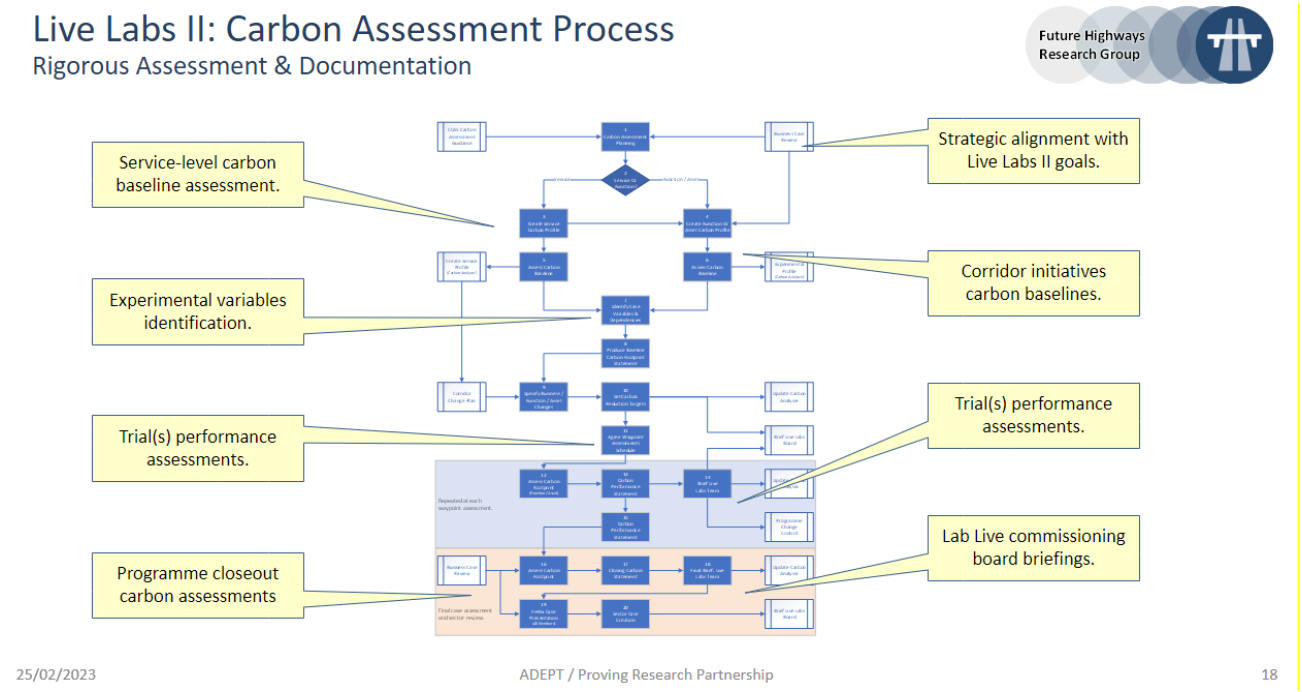


Figure 11: FHRG carbon assessment process for Live Labs 2 based on their mature academic framework.

Description of your expected carbon benefits / reductions broken down by intervention type

As introduced in the Economic Case, the VfM delivered by our Live Lab programme is underpinned by the inherent relationship between decarbonisation and wider operational efficiency. Accordingly, this synergy lies at the heart of calculations within Pell Frishmann's CHL toolkit, which through developments for the strategic road network is already configured to provide:

- Whole life cost analysis matrix
- Whole life carbon analysis matrix

Whilst the corresponding end-user emissions arising from the baselined in-use phase of the asset is not an objective for Live Labs, the CHL toolkit is also able to estimate the impact of a particular design on how it is used, which is relevant to our approach.

This feature complements the new functionality targeted through the Live Lab development phase, which targets the earliest decision points regarding whether the objectives and scope/specification of a scheme meets the current requirements, or whether an opportunity exists to design and build less. This therefore goes beyond simply leveraging design efficiencies, supporting more fundamental transformation.

Both contribute to a meaningful 'full lifecycle' view and within the group it is recognised that selecting the appropriate horizon for the scenario modelling and analysis is vital to produce meaningful outputs which can be actioned into decision-making and operations.

Full lifecycle nature of the Carbon Hierarchy

Building on the industry approach to carbon lifecycle assessment, seen in Embodied Carbon Stages A1 to D (Figure 3), the Carbon Hierarchy Lens includes provision of an early 2 Stage Concept Assessment. Our premise of including this earlier stage is to ensure an optimised scheme is considered at the earliest opportunity. Dependent on the Stage 1 assessment i.e. need or function and stage of development (Red = Fixed, Amber = Potential to Innovate, Green = Optioneering), questions such as "is this the right scheme to deliver" can be considered and options of a similar or different nature but ultimately delivering the necessary outcomes can be considered. The decision to deliver can then consider carbon as well as cost, programme and stakeholder benefits and drivers.

Within the incumbent iteration of the Carbon Hierarchy Lens a simple interface is provided to support intuitive optioneering to run different virtual baselines for a scheme, with knowledge of key parameters such as the surface area of the works and the initial design for scheme where this exists. Accordingly, if applying this lens suggests we can avoid building something, we can claim both the immediate carbon and ongoing full lifecycle carbon of that asset, associated with preservation and ongoing intervention requirements.

Carbon Hierarchy Lens feasibility study

During the initial bidding process a pre-feasibility study using Pell Frishmann's Carbon Hierarchy Lens tool was performed on a representative 'Complex' HIP scheme – Mersey Road. This produced the baseline presented in Figure 6 as part of the feasibility case study supporting the Economic Case, based on implementing their design optioneering toolkit at the current stage of development.

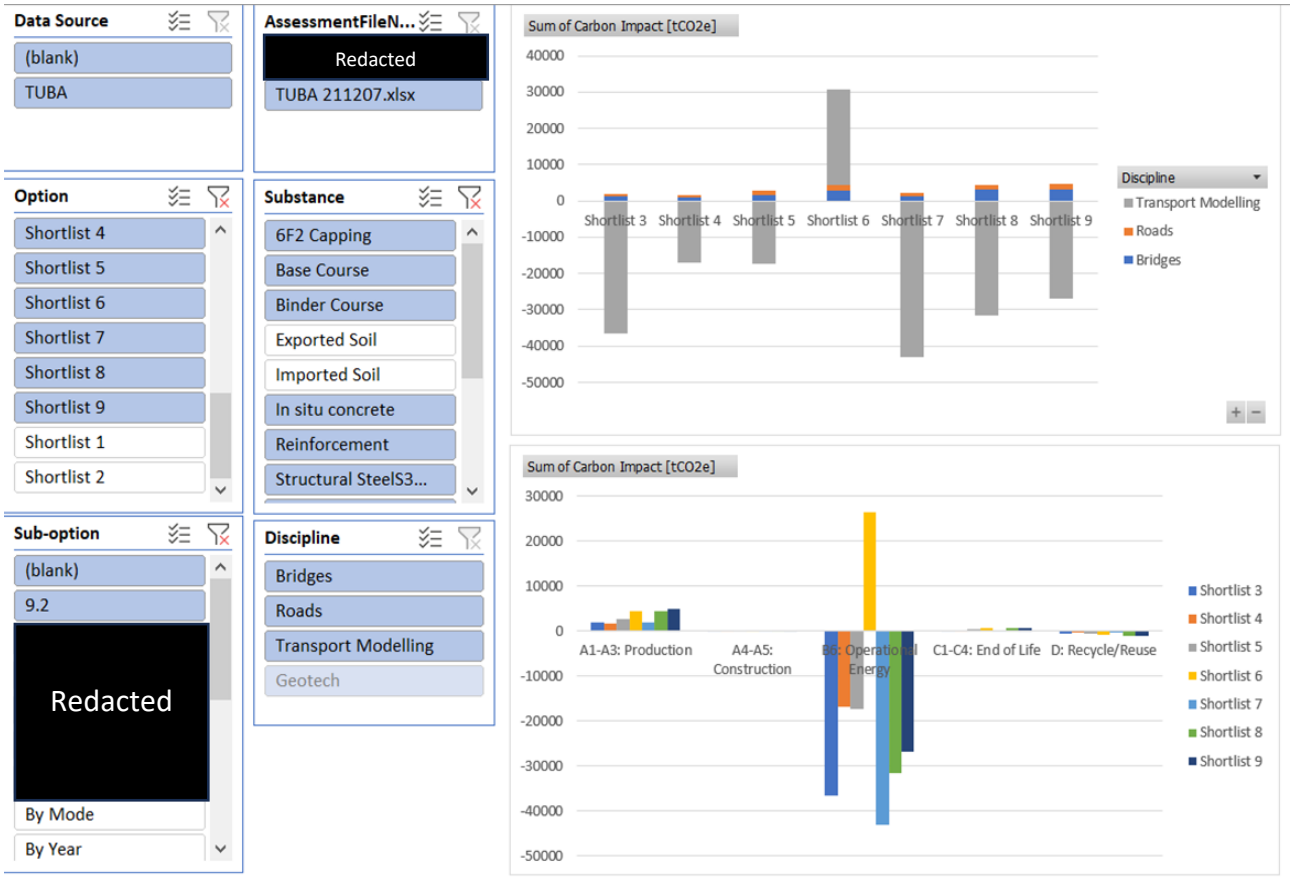


Figure 12: Example interface of Pell Frishmann's design optioneering toolkit (Carbon Hierarchy Lens).

This considers the carbon footprint of different layers of the pavement based on materials and volumes (design), construction processes (including vehicles, fuel, plant/welfare), as well as other highways infrastructure (lines, signs, kerbs etc., including refurbishment processes rather than replacement). Even prior to fully developing the downstream maintenance and preservation impacts

of these approaches this exercise indicated the validity of the approach to identify the priorities for decarbonisation interventions on local roads schemes. The option development process is presented in terms of shortlists representing the relative carbon impact of a particular methodology within a scheme-specific scenario – this underpins our overall approach. In this way, limited resources can be targeted in the most effective way, e.g. using the available zero emission plant on spatially distributed schemes with significant materials movements, and any decarbonised materials with cost premiums in the pavement layer offering greatest carbon reductions.

This was extended during the OBC development and mobilisation phase to lay the foundations to extract further information relevant to estimating the cost of carbon reductions (£/tCO2e), addressing the need to fully consider full lifecycle intervention impacts. This exercise focussed on the levers and corresponding carbon coefficients available within the local roads realm. Each of these can be probed in more detail through the optioneering interface, as per Figure *12*: Example interface of Pell Frishmann's design optioneering toolkit (Carbon Hierarchy Lens).Figure 12 above.

Approach to carbon measurement across the lifecycle

Given the requirement for a laser sharp focus on carbon, we have allowed for a dedicated role in our team structure to measure and monitor Carbon emissions throughout the project duration, recruited by Colas. This will ensure that carbon is measured at every stage of the project to enable the success of our approach to be monitored and evaluated in both qualitative and quantitative forms. However, because this team structure is overseen by the Council, we can ensure that we maintain ownership and objectivity of the carbon footprinting activity.

In line with the baselining approach, we will use a blended approach to compare the effectiveness of carbon calculation platforms including those shown in the table below. To allow comparison between demonstrator sites and the reality of implementing the outcomes of the Carbon Hiererarchy Lens optioneering process, we will primarily use the Pell Frishmann Carbon Hierarchy Lens toolkit across all sites to provide a consistent measurement approach. This tool will be used both for benchmarking and the ongoing measurement of carbon emissions, so that before and after can be compared through a single tool. As introduced, their tool currently monitors Scope 1 and 2 emissions, and is being further developed through Live Labs to fully handle Scope 3 emissions and impacts of early re-design interventions.

Also aligned with the baselining approach, we will leverage the wider partnership with FHRG to support the carbon footprinting activity. Their Carbon Analyser is a research-led, web-based carbon profile builder and carbon analysis toolkit, tailored to provide carbon case assurance specifically at service level for the highways sector. Guidance will be provided by FHRG through direct involvement with the team and the Carbon Calculation and Accounting Standard (CCAS), across GHG Scopes 1, 2 and 3 and based on the relevant GHG, BSEN ISO 14001, PAS 2050 and PAS 2080 standards.

Carbon measurement on the ground within this common approach will be supported by the contractors – Colas, Dowhigh and Huyton. This will include:

- Using these common carbon calculator tools across all demonstrator sites
- Using shared data sets for carbon information as appropriate
- Having a clearly defined scope – what elements of the service are included within the calculations, and which are excluded. This will be aligned to international standards, as well as the FHRG guidance for measurement of Scopes 1 & 2 (plus the guidance for Scope 3 which is currently in development).

Alongside this, we will trial all other tools in parallel with the Pell Frishmann CHL and FHRG CCAS tool for independent verification. These will be used on a small scale (e.g. at a single site, or a specific activity) to:

1. Identify the strengths and weaknesses of different tools, supporting the work carried out by the FHRG to compare established carbon calculators
2. Verify the effectiveness of the our toolkit across different asset types and circumstances
3. Enable contractors to compare decarbonisation outcomes like-for-like with their other projects outside Live Labs, which currently use these alternative tools for carbon calculation.

Carbon calculator	Description
SEVE	Carbon comparison calculator from 'cradle to gate' across all value chain elements. managed by *Routes de France*. The tool uses a range of data including how materials were transported and plant/equipment on site.
National Highways Carbon Calculator	A tool used to capture emissions for construction and maintenance works delivered on the strategic road network
BRE Smartwaste	A web-based tool used to prepare and implement Site Waste Management Plans and capture carbon within the construction industry.

At the City Centre Recycling Hub, carbon footprinting will leverage the BRE Smartwaste carbon measurement tool, which will be used to capture carbon associated with every aspect of both the commissioning of the site and subsequent operations.

Colas are well-qualified to take a significant role in the carbon measurement activity given their team's involvement in the testing and roll-out of the FHRG Scope 3 tool (one of just three contractors undertaking this work). As well as the baselining support, we will also work with FHRG to use their carbon tool to support and independently validate the carbon footprinting activities embedded within our Carbon Hierarchy Lens approach.

In addition, Colas brings expertise through the application of SEVE, developed and used globally as a carbon comparison for surfacing and earthworks. SEVE is a comparison tool, so we can measure reductions in carbon emissions relative to alternate solutions. We can also use this tool to perform scenario analysis.

We have also engaged Liverpool John Moores University to support where additional laboratory testing is required to enable/validate more experimental outputs. We will also benefit from Aberdeen City Council's experience recognised with a recent Best Practice Award for its Climate Change Plan.

Description of your approach to the quantification of residual emissions

We are targeting the FHRG workstream to support analysis of residual emissions as part of the baselining and validation exercise. These are included within Carbon Analyser as emissions without any achieved reduction or without stated carbon reduction actions (based on the current portfolio of reduction initiatives within the Analyser). To ensure comprehensive analysis and reduction strategies are adopted, residual emissions are red-flagged if they exceed 15% of the total emissions in any context. All red-flagged emissions will be subject to further scrutiny and reported through exception reporting to the project meetings and Board. Red-flag Challenge sessions will be held with the wider team to focus the search for further innovation on areas contributing to the residual emissions.

Details of any academic or industrial partners assisting in this process

Further to the key carbon footprinting and baselining roles of Pell Frischmann, FHRG and Colas, our programme can leverage access to umbrella programme carbon analysis and the Wessex consortium's engagement of the University of Exeter.

Their role is to further support Wessex with carbon measurement/budgeting, analysis and the implementation of Doughnut Economics, which can be considered to be analogous with the Carbon Hierarchy Lens and Triple Lock for optimised decision-making at a local level. Their scope also extends to scenario planning for potential decarbonisation methods, feeding into knowledge sharing through their Green Futures Network.

Equality Impact Assessment

Approach to EDI

We recognise that diversity is a key driver of innovation and critical to the success of our Live Labs programme in Liverpool.

This underlying principle is embedded within our project and a feature of our Ecosystem of Things, recognising the need to increase access and improve the diversity of people and skills within the highways sector to achieve net zero carbon ambitions. Furthermore this project comes at a time where recent activities in the council have led to a significant turnover of staff. We have the opportunity to use this project to create Liverpool, both the City and the Council as a desirable, inspiring place to work.

We have assembled a diverse team that brings a wide range of insights, perspectives and experiences to maximise the likelihood of success. Our project management structure will reflect the inclusive corporate EDI policies and six equality objectives of Liverpool City Council. To deliver this transformation project, our delivery team blends a strong team of people brought together from the public and private sector with academia and charities.

To deliver this project, we will recruit additional staff to support existing local authority teams (as outlined in the section above). Recruitment will be compliant with our partners' EDI policies to remove barriers to employment and therefore ensure we have a diverse project team.

We will be inclusive of the views of local communities, to ensure any changes we make are positive for everyone. Within the complex urban environment of Liverpool – expanded to reflect partners in adjacent authorities within the LCR and other cities – communities vary in terms of deprivation and demographic profile (including age, race and gender). Supported by our community teams and partner organisations we intend to monitor EDI within all of the demonstrator environments to ensure that outcomes can be scaled up successfully in the future.

With the inclusion of Aberdeen City Council, Newcastle City Council and Kensington and Chelsea Borough Council, our project therefore enables collaboration across geographic boundaries and authorities with many comparable, but some contrasting issues. Bringing a global perspective are our partners Colas, Pell Frischmann and Liverpool John Moores University with their links to international specialist communities and research and development hubs.

Our project also recognises the value and creativity brought by industry forums such as CIHT and will maximise opportunities to collaborate with the industry's flagship organisations on developing future-proof training programmes and upskilling our in-house people and partners.

Community engagement

A key feature of our project involves engaging communities via our demonstrator locations aligned with growth and local regeneration. This project presents an opportunity to engage with local people, raising awareness of climate change and helping people understand how this project helps deliver clean reduced carbon communities and places.

With support from our specialist partners Co-Creation Partnership, PlacED and Unicef and drawing on expertise from Liverpool Race Equality Taskforce we will identify key local stakeholder groups and proactively engage with local communities to include them in co-design and decision-making, capitalising on their perspectives and ideas to help maximise decarbonisation impacts whilst better meeting local needs.

Since initially submitting our proposal, we have accommodated an additional role in the programme for ECF, who LCC have already engaged with extensively to develop plans and policies for community engagement aspects within Highways and Transportation. Accordingly, our Live Labs can be a channel to accelerate the adoption of the corresponding contractor toolkit.

Similarly, during the Live Labs assessment phase there have been changes to the ward boundaries in Liverpool, with the number of wards increasing. However, these specific activities are designed to ensure that we maintain fairness in targeting this funding and maximise triple lock impacts alongside decarbonisation objectives.

Equality Impact Assessment

Implications for people with protected characteristics have been considered through the Equality Impact Assessment undertaken for the project, in terms of positive, negative, neutral or unknown impacts across:

- Age
- Disability
- Transgender
- Sex
- Race
- Religion
- Sexual orientation
- Pregnancy and maternity
- Marriage and civil partnerships

To the best of our current knowledge, no adverse impacts have been identified. The assessment has highlighted that a well-maintained highway network includes roads, footways, lighting and other assets which provide a safe environment for potentially vulnerable people who are typically older or younger people and may include women or girls.

A well-maintained highway network also provides a safe environment for people with disabilities, particularly wheelchair users or those with impaired vision. Any proposed changes to working practice or specification arising from this programme will need to carefully consider impacts on these groups, for instance if changes to lighting, design, materials or signing etc. are proposed.

The project management team working with LCC's 'Neighbourhood Team' will ensure that an equality impact assessment is undertaken in association with any significant proposed change to working practice or specification arising from the programme. Relevant stakeholder groups including people with protected characteristics will be consulted as part of this process. Any identified impacts on people with protected characteristics, together with any necessary mitigation, will be considered by the programme board prior to adopting new practices:

Whilst it is council policy to assess socio-economic impact and not a statutory duty, we recognise that protected groups and socio-economic status commonly can cross relate, for example disabled people are disproportionately represented in lower socio-economic groups. For every scheme we will consider the actions that will be taken to reduce or eliminate any negative impact identified above, including any consultation with stakeholders.

The corresponding Equality Impact Assessment will be published with the decision being taken and published separately on the EIA part of the website. In terms of approvals, an Assistant Director or Director will approve an assessment verifying their agreement and confirming that all relevant factors, including relevant feedback from an Equality and Cohesion Officer, have been taken into account.

Monitoring and Evaluation

Details of any local, tactical M&E activities related to your proposals

To demonstrate that DfT funding is spent well and delivers value for money, tangible benefits and achieves the stated aims of the Live Lab, evaluation will take place throughout the life of the project and beyond into the legacy tail. (Further details are set out in the Strategic and Economic Cases.) All partners will participate in the development, data gathering, and evaluations involved, echoing the collaborative approach taken across all Live Lab activities. There will be three interwoven strands of activity:

- **Local - Live Lab:** undertaken by the Live Lab project team across all three authorities
- **Local – Consortium:** pulling together M&E information at a theme level for the Corridor and Place-Based Decarbonisation Consortium
- **National programme:** commissioned by the DfT through ADEPT, and the appointment of a supplier (hereon referred to as the 'DfT Supplier).

The approach adopted for this Live Lab will mesh the national and local M&E activities in a framework to achieve the seamless delivery of robust, consistent and transparent performance data. It is anticipated approximately two-thirds of M&E activity will be undertaken by the DfT Supplier and one-third at a local level. At the local Live Lab and Consortium levels the themes and aims of the M&E activity are:

Monitoring and reporting on performance. Undertaken at quarterly intervals, aligned with the local governance structure, the annual local Waypoint assessment undertaken by FHRG plus the national reporting and funding stage gate mechanisms for ADEPT.

Demonstrating Value for money (VfM): utilising both the DfT Supplier and the Proving Services VfM assessment frameworks

Sharing, learning & disseminating: Providing a robust way of gathering learning from the Live Lab and supporting a consistent approach to disseminating it locally and nationally, linking the M&E activities with the Comms Plan (detailed in the Sharing and Dissemination section). Focusing on transferability.

Delivery of innovations and scalable results: providing reassurance the Live Lab is developing innovations and producing scalable results (as set out in the Strategic Case).

Highlighting synergies: supporting the identification of opportunities for collaboration by highlighting synergies locally and nationally

Addressing issues & risks: Flagging areas where performance against targets may not be meeting expectations, identifying remedial actions and prioritising where improvements can be made (assessed alongside the local risk register, as detailed in the Management Case)

These local themes and aims will map across to the national level M&E evaluations set out in the M&E Scope tendered by the DfT/ADEPT. These evaluations are summarised below:

- **Impact evaluation** to measure the outcomes of each of the seven Live Labs and the programme as a whole. This will determine whether Live Labs have delivered their objectives and the extent to which their approach can be successfully scaled up. It will also measure the success of the Live Labs 2 programme in achieving a move towards decarbonisation across the roads infrastructure sector.
- **Process evaluation** to examine how the Live Labs operated, what helped and hindered them in achieving their aims and how effective the Live Labs 2 programme model was in supporting the adoption of innovation in the roads sector.
- **Value for money evaluation** to assess the costs and benefits of each Live Lab and whether they present an effective use of resources.

We will work with the supplier to develop their understanding of the project, the outputs and intended outcomes and how these will be measured. We will support them in scoping out an impact evaluation approach in the first three months of the supplier being commissioned and support their evaluation throughout the delivery phase. In addition, we will explore with the supplier the consideration of common approaches to monitoring and evaluation across the Consortium.

Local data gathering

M&E is inherent to the Carbon Hierarchy Lens and project optioneering approach, aligned with LCC's KPI dashboards combining standard existing LCC Highways KPIs and new considerations specific to new Live Labs processes and delivery.

Our approach will capture both quantitative and qualitative metrics in line with assumptions underpinning carbon case and economic case, which will be refined as the project evolves and delivers. The activity seeks to dovetail the programme-level M&E in line with the tender documents with the effective management of local data collection before, during and after schemes, including through the planned community engagement activities.

This is required to underpin an overarching evidential approach to Live Labs. In particular, our M&E approach will seek to probe deeper into aspects related to behavioural change and corresponding barriers to a new BAU across multiple stakeholders, including:

- Policy changes and new standards
- Community oppositions

We will therefore use Pell Frischmann's Carbon Hierarchy Lens toolkit supported by the supplementary carbon calculators (including FHRG) to set a Year 0 baseline for each demonstration neighbourhood in the trials and sequentially address from the largest to smallest each element of carbon emissions in the reported baseline. The impacts of change will be measured directly in most cases during the live trials and reported annually as an overall summary in a Year 0 outcome which will then become the Year 1 baseline.

Data collection will be conducted throughout both the three-year project duration and the five-year tail. The types of data that we will collect for this project include:

- **Carbon footprint:** to demonstrate that the project successfully reduces carbon emissions, we will implement a comprehensive carbon measurement process as described
- **Asset data:** we will measure the impact decarbonisation has on the highway assets performance, particularly where we have used an innovative material or new maintenance approach. This will include reliability and resilience and can also be extended to consider the wider network performance as defined with the appointed M&E supplier. As a minimum, we will collect data including Scanner, Coarse Visual Inspection (CVI), routine safety inspections, defect history, photographs and SCRIM. Where extra information is required, we will also conduct deflectograph surveys
- **Network impact of decisions:** for example, the impacts of road closures and diversion routes etc. from a network management perspective
- **Public engagement:** Capturing statistics on the number and broad demographics of those engaged with throughout the project, through the different channels targeted
- **Public satisfaction:** the perception at demonstrator sites will be assessed through the monitoring of complaints/compliments and surveys. Public satisfaction data will highlight any social issues caused by decarbonisation in the demonstrators.
- **Cost:** to enable our project to be replicated and scaled up, we will collect data on the financial impact of decarbonisation (1st-year and lifecycle over long-term horizons)
- **Operational data:** we will collect details of the required change to operational delivery, including time on site, type of traffic management required, whether works can be delivered at day or night, and the level of resources required

- **Culture change:** supported by the appointed M&E supplier we will conduct annual surveys of our project teams (both local authority and main contractors) to assess changes in behaviour, particularly whether carbon is more prominent in decision making
- **Jobs created:** we will monitor the number of jobs created through the project including the number of student placements
- **Social Value:** we will use the TOMS framework to evaluate the social impact of alternative approaches ranging from biodiversity scores to employment and volunteering that has been generated through the new approach to working

The data we collect will be vital to our knowledge sharing approach with the wider highways sector, including other local authorities. These organisations will require evidence that the new methodology piloted in demonstrator sites was successful and does not pose a risk to their service. Therefore the collection of this data will enable a smooth roll-out to business as usual.

More generally, simply targeting de-carbonisation could have unintended future consequences. Fundamental to our programme is that delivered projects will be better for people, the planet and equality. Our approach and activities will therefore provide evidence of which other sustainability factors should be measured, monitored and reported to ensure that the 'triple lock' objectives for all projects and procurement are met.

KPI dashboards

The opportunity exists to extend existing KPI dashboards leveraged from our partners, as well as develop a dedicated Council dashboard for the Live Lab programme, which we are currently exploring with relevant operational teams within our major projects function.

An example KPI dashboard taken from the Pell Frishmann CHL toolkit is provided below:

Option Title	Brief Description	ML Cost £M	BCR	Adj BCR	CSF 1 Safety	CSF 2 Journey and reliability	CSF 3 Air quality	KPI Making network safer	KPI Network in good condition	KPI Better environmental outcomes	KPI User satisfaction	KPI Economic growth	KPI Helping cyclists, walkers other vulnerable	KPI Customer	Carbon Impact
Redacted		£46	1.27	3.33	Est savings - 25			Improved KSI							
		£306.7	0.27 (0.34)	0.64 (0.71)	37			Improved KSI							
		£110.7	0.4	1.33	28			Improved KSI							
		£160.7		1.18	28			Improved KSI							
		£164.7		0.88	33			Improved KSI							
		£191.83		0.86	34			Improved KSI							
		£124.1		1.25	28			Improved KSI							
		£177.31		1	29			Improved KSI							
		£205.62		0.86	32			Improved KSI							

Figure 13: Illustrative KPI dashboard based on the Carbon Hierarchy Lens applied to the Strategic Road Network.

Outputs and benefits

As presented in our Theory of Change logic map (Strategic Case), the following outputs are tangible and measurable. All of the corresponding outcomes and benefits align with the SMART objectives for the Liverpool Live Lab and our role in the wider thematic programme.

Organisational

- New collaboration framework and supply chain relationships
- New training partner models

- New materials accepted into standard specifications for Local Authority deployment

Ways of working

- Ecosystem of Things framework to adopt innovation and carbon footprinting into contracts/procurement as BAU, supported by new policies within our Council
- Pipeline of future-proofed green skill sets
- Carbon hierarchy toolkit and processes to replicate and scale-up learning
- Future HIP policies and strategy (co-designs)

Technology/demonstration

- Diverse 'Net Zero Demonstrator Neighbourhoods' and Lifecycle Management
- State-of-the-art recycling facility & business model
- Material & process IP
- Low carbon plant, with infrastructure plan
- Engaging and interactive public installations and assets
- Exemplar press, PR and marketing materials for toolkits and approach

Details of methodologies and tools to be employed

Impact evaluation

ADEPT's M&E scope for the Impact evaluation involves an objective test of what changes have occurred, the extent of those changes, an assessment of whether they can be attributed to the intervention and a comparison of benefits to costs. It supports understanding of the intended and unintended effects of outputs, as well as how well SMART objectives were achieved.

We will work with the supplier to develop their understanding of the project, the outputs and intended outcomes and how these will be measured. We will support them in scoping out an impact evaluation approach in the first three months of the supplier being commissioned and support their evaluation throughout the delivery phase. In addition we will explore with the supplier the consideration of common approaches to monitoring and evaluation across the Consortium.

The supplier will propose impact measurements that are Specific, Measurable, Attainable, Relevant, and Time-Bound (SMART), where possible. The Theory of Change developed for the project, which aligns with the overall programme logic model, will underpin these metrics.

A scoping report produced by the supplier will set out data collection activities going forward. This will specify what metrics will be collected, and timeframes for data collection and reporting.

We anticipate the impact evaluation will address the following research questions:

- To what extent has the project led to reductions in a) Scope 2 and b) Scope 3 carbon emissions from local roads compared to existing standard practice? (Project level impacts)
- What contribution has this made to the reduction of a) Scope 2 and b) Scope 3 carbon emissions from local roads, and to overall carbon emissions (including Scope 1) of local roads? (Project and programme level impacts)
- Did the project deliver the individual intended outputs, outcomes and objectives?
- How favourably did the project compare with the other Live Labs in delivering reductions in Scope 2 and Scope 3 carbon reduction?
- What other impacts – both intended and unintended – have occurred due to interventions?

As the programme has a priority and novel objective in driving down indirect carbon attributable to infrastructure, a robust and clear approach on how this will be measured must be outlined, alongside the expected risks and how they will be mitigated.

Scope 1, 2 and 3 emissions should be defined consistently to ensure emissions from each Live Lab are being measured in the same way, particularly within each of the four Live Lab themes outlined in para 6.3.

If more than one method of measuring these emissions is identified, they should be trialled in order to assess their accuracy and degree of uncertainty, to increase the robustness and reliability of the quantification. The supplier should develop a robust approach to carbon measurement that works but can be changed and improved as required during the delivery phase.

Findings relating to carbon emission reductions should be set in the context of the broader findings from the value for money evaluation, in order that the evaluation avoids advocating further roll out of Live Labs that deliver carbon benefits but are not economically viable.

Process evaluation

In conjunction with the impact evaluation, the process evaluation will seek to identify and share findings iteratively as the programme develops by monitoring the successful delivery of outputs, sharing lessons learnt between projects and being an active part of the communications critical to wider adoption and legacy. We will engage with the supplier as they work with ADEPT, DfT and other stakeholders to address the following research questions:

1. How have we engaged with stakeholders and influenced partners to become early adopters of new technology and what role have different partners played?
2. What are the barriers and enablers to scaling up and were any other lessons learnt?
3. What lessons have been learnt around delivering and capturing Scope 2 and scope 3 carbon reductions?
4. Is it possible to develop a standardised approach to measuring Scope 2 and Scope 3 carbon reductions across programmes?
5. To what extent have Live Labs 2 approaches been adopted as business as usual across the LHAs they operate in?
6. Has Live Labs 2 led to the adoption of Scope 2 and scope 3 carbon reduction approaches beyond the local roads sector?
7. Given all of the above, how effective was Live Labs 2 in its mission of achieving a step change in the normalisation and uptake of zero carbon techniques, solutions and materials in the local roads' realm?

Value for Money evaluation

The value for money evaluation will demonstrate and quantify the outcomes of the Live Lab, comparing the costs and benefits achieved through the programme against the original expectations. The supplier will undertake a cost-benefit analysis of each of the Live Labs which aligns with the outputs and impacts identified in the impact evaluation, and where possible taking account of counterfactual analysis.

The evaluation will address the following research questions:

1. How should Scope 2 and Scope 3 emissions reduction be accounted for and treated in cost benefit analysis? How feasible is it to monetise these benefits, and what is the optimum approach?
2. For our individual Live Lab project, to what extent do the benefits outweigh the costs?
3. To what extent do the benefits of the programme as a whole outweigh the costs?
4. What efficiencies can be gained when delivering at scale?
5. Across the programme, what types of innovations deliver best value for money?
6. What is the estimated potential impact of adopting our Live Lab approach into business- as-usual across the UK?

Summary of draft communications plan

The Greener Roads programme provides Liverpool City Council and its Greener Roads partners with an opportunity to improve their reputation, locally, nationally and within the highways and environment sectors; evidencing to residents, staff, the media, and key stakeholders that local government can lead, collaborate, innovate and deliver solutions to improve the cost effectiveness of roads maintenance and tackle the climate change crisis at the same time. This communication and engagement plan will also support Liverpool's specific deliverables for the demonstrator projects, alongside its three contractors, and as part of our transformation journey, including:

- Industry, academia & community engagement in the process
- Promotion of outputs and Net-Zero ambition
- Development of skills / jobs
- Engagement with potential investors

The role of Liverpool City Council's Communications Team, along with and as part of the Live Labs 2 Consortium, is to:

- Raise awareness of the Greener Roads programme for residents
- Outline the challenge and demystify the science involved
- Explain the ambition and what difference it will make locally, nationally and globally
- Enhance the reputation of Liverpool City Council / all partners
- Provide key spokespeople for interview including Council Leader, Lead Cabinet Member, Contractors and Liverpool John Moores University

The Communications Team is working closely with the Live Labs 2 consortium to amplify their messaging and work with trade press in the run-up to, during and post demonstrator events. The reach, tone and sentiment of all coverage will be evaluated continuously (by a media monitoring company – TBC), to measure the impact of key messages.

Key objectives

In the run-up to the demonstrator projects:

- **To build awareness and understanding** of what's planned in/around each project
- **Make clear these are pilot projects** and part of a UK wide consortium
- **To produce distinct content** showcasing Liverpool's/UK's innovative pedigree
- **To promote the skills involved in the process**
- **To provide advance warning of event impact** travel disruption, road closures etc
- **To maximise opportunities to secure positive PR** for Liverpool and the consortium by offering LCC representatives to local, regional, national and international media; sourcing/facilitating opportunities for diverse 'voices' to be heard; and sharing LCC bespoke content on our channels/with partners.
- **To manage stakeholders' communications expectations/needs**

During the demonstrator projects:

- **To continue to maximise opportunities** to secure ongoing positive PR (media/socials) as 'milestone moments' are delivered
- **To provide ongoing, clear public information about the journey** – from the research process to the delivery of the projects
- **To continue to manage stakeholders' communications effectively**
- **To respond to emerging issues** through the consortium, social listening, feedback from customer channels, media enquiries and coverage, stakeholder issues etc.

Post-delivery:

- **To celebrate delivery** internally/externally and **promote achievements** to key audiences. We will reshare milestone moments, positive data and feedback driving credit back to LCC/partners/ the consortium.

- **To communicate the evaluation report** into the impact of the demonstrator projects.

Crisis communications will be dealt with by each lead local authority at project-level. Any potential negative issue/ media inquiry (financial, contractual, operational) to be shared with identified comms leads within the consortium, as part of best practice. Inquiries from a national media outlet relating Live Labs 2 programme will be escalated to ADEPT/DfT with any statements to be agreed by Coast.

Key themes

The Communications Team will deliver proactive campaigns around key themes to be agreed with the consortium. These could include:

- **Greener Roads** – a campaign to explain the process/journey; and to introduce the partners involved.
- **Innovation UK** – a campaign to highlight the partnership work of the partners involved and that showcase UK manufacturing/academia as world-leading.
- **Education** – a programme to involve schools in understanding the environment and economic challenges cities/local authorities face in highways construction.

External communications

Audience	Channels
Liverpool residents (in three demonstrator project communities and city-wide)	Video will be a key tool in explaining the challenge, the goals and the process
Liverpool JMU – staff and students	LCC's social media channels (Facebook, Instagram, Twitter, LinkedIn, TikTok)
Schools/students/young people	Dedicated microsite – potential to be hosted by DfT for the consortium will be explored
City's transport sector – bus operators, taxi drivers, haulage companies	Press releases/media briefings, interviews
LCR Council leaders and Chief Executives	Mersey Views residents' newsletter
Metro Mayor, Liverpool City Region MPs	Community Facebook groups
Live Labs 2 Consortium partners and Department of Transport	Tailored content and images supplied to local, regional, national and international media
Local, regional, national, international and specialist media	
Key stakeholders (universities, travel partners, business community representatives - Liverpool BID, Chamber of Commerce – full list to be mapped and circulated)	

Internal communications

Audience	Channels
Councillors	Intranet and Staff Extranet news articles
LCC customer-facing staff (contact centre staff, civic enforcement officers)	Staff Facebook posts
All other LCC staff (internal ambassadors, potential volunteers)	Lunchtime learning sessions
LCC managers	All staff conference
	All staff emails
	Video messages from Cabinet lead and project lead
	Councillors' newsletters / briefings