LIVERPOOL LIVELABS

CASE STUDIES

These case studies highlight the extensive scope of collaboration with a goal to create a framework for decarbonising local roads in the UK in order to achieve net zero by 2030.

LIVERPOOL LIVELABS

CASE STUDIES

ENABLING LOW-CARBON, PEOPLE-FOCUSED STREETS BEYOND THE CARRIAGEWAY

Reducing Embodied Carbon in Streetscape, Public Realm & Supporting Infrastructure

This Beyond the carriageway case study forms part of a wider suite of case studies capturing the findings from the Liverpool Live Labs programme and reflects the city's commitment to decarbonising highway infrastructure.

Live Labs 2 is a three-year, £30 million UK wide programme funded by the Department for Transport, running until March 2026 and followed by a five-year extended monitoring and evaluation period.

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FOREWORD

The ADEPT Live Labs 2: Liverpool programme has been an enriching learning experience for Liverpool City Council, our highways teams, our communities, and the many SMEs that form the backbone of our local innovation ecosystem. Decarbonisation sits at the core of long-term resilience, and with Liverpool's ambitious goal of becoming a net zero city by 2030, this programme has played a critical role in accelerating our progress, alongside our wider evolution as a Council.

Through Live Labs 2, Liverpool is now equipped with a cohort of professionals who are familiar with a nationally accepted carbon assessment and capture methodology – giving us the tools, understanding and confidence to make informed, accountable decisions about carbon reduction across the lifecycle of our highways assets. This capability will long outlast the programme itself, embedding a legacy of informed, data-driven decarbonisation in the city's operations where these have been proved by the programme.

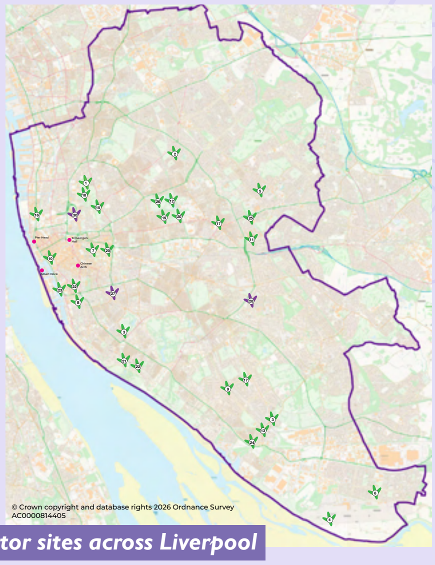
Within the programme ecosystem, we tested 26 innovations, spanning far more than materials alone. These included new processes, toolkits, decision-making approaches, and practical interventions that collectively support our commitment to building a functioning highways decarbonisation ecosystem. Supported by an expert panel, each option was rigorously assessed for its innovation potential and its ability to meaningfully reduce carbon before being adopted. Our ambition from the outset was clear: embrace innovation, remain open to challenge, and work collaboratively to understand what truly moves the needle on carbon reduction.

Despite needing to align with wider changes within the Council, and the challenges faced by nearly all Authority's across the UK, the programme succeeded because of the strength, expertise, and dedication of our partners across the ecosystem. We would like to extend our sincere thanks to the core members of the innovation ecosystem developed through the programme:

- **Colas** – Programme Delivery & Innovation Management Partner, also realising new ways of including carbon impacts into road condition-based Asset Management approaches.
- **Bird & Bird** – Co-developer of a pioneering procurement toolkit.
- **Pell Frischmann** – Developers of the Options Configurator Tool.
- **Proving Services** – Independent testers of our assumptions and carbon assessment approaches.
- **Liverpool John Moores University** – Innovators in materials development.
- **Dowhigh and Huyton Asphalt Civils** – Our committed local contractors installing innovation products and embracing new ways of working.
- **Newcastle City Council** and **Aberdeen City Council** - Partner cities for demonstrators and vital knowledge sharing.

Another defining strength of the programme was its verge-to-verge scope. This was not limited to resurfacing or traditional asset management innovations. We trialled solutions in road marking, drainage, reuse and recycling, operational processes, and more – reflecting the full complexity and opportunity of the road environment.

From the 26 innovations we trialled, 17 innovations spanning categories such as Decision-Making & Network Management, Road Markings, Intelligent Lighting, Asset Maintenance, Drainage, and People-Focused Street Enhancements have already been adopted or are moving toward becoming business-as-usual, provided the site conditions are suitable. Others are undergoing extended monitoring and evaluation over the next five years to better understand performance, durability, and long-term carbon reduction potential. And while not every innovation delivered the outcomes we hoped for, each trial provided valuable learning - an essential part of any genuine innovation journey.



Demonstrator sites across Liverpool

As we present this suite of case studies, we do so with pride in what can be achieved with a laser-sharp focus, unwavering dedication and a culture of collaboration. These pages represent countless hours of collaboration, problem-solving, curiosity, and shared ambition across partners, teams, and communities.

On behalf of Liverpool City Council, I would like to extend our sincere thanks to the Department for Transport (DfT) and ADEPT as the funding and commissioning bodies, whose support and leadership have been essential in enabling this work. I would also like to thank every partner, every member of our LCC teams, every contractor, SME, academic, and every community voice – big or small – who contributed to the success of this project. Your effort and commitment have not only delivered a highly successful programme but have also helped build the foundations for a cleaner, more resilient, and more sustainable Liverpool.

Director of Sustainable Transport, Highways and Parking,
Liverpool City Council

Department for Transport

ADEPT LIVELABS2 Decarbonising Local Roads

LIVERPOOL LIVE LABS DRIVING DECARBONISATION

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ENABLING LOW-CARBON, PEOPLE-FOCUSED STREETS BEYOND THE CARRIAGEWAY

Reducing Embodied Carbon in Streetscape, Public Realm & Supporting Infrastructure

1. Executive Summary

This case study explores a category of decarbonisation interventions that sit beyond the conventional focus areas of resurfacing, road marking, and lighting. While these mainstream techniques dominate most carbon reduction programmes, Liverpool Live Labs has consistently taken a broader, ecosystem-led approach - one that evaluates the environmental benefits of the entire streetscape rather than the sum of its individual components.

In urban environments, smaller elements such as tactile paving, kerbs, street furniture, green columns, and public seating often go overlooked in carbon accounting despite being installed frequently and at scale across a highway authority's programme. Traditionally, these items rely on high carbon materials including cement-heavy paving, concrete kerbs, virgin plastics, metals, and diesel-powered construction equipment. Collectively, these 'minor works' contribute substantial embodied and operational carbon, even though each asset is smaller in isolation.

Liverpool Live Labs challenged this norm by trialling a suite of innovative, lower carbon alternatives that prioritise recycled or reclaimed materials, reduced cement content, and fossil free operation. The interventions assessed were:

- Tac Grid
- Urban Kerb
- Circular 11
- Mube
- Instagrid Electric Generator

These innovations were designed not only to reduce embodied carbon but also to enhance accessibility, improve asset longevity, and support the integration of green infrastructure in densely built environments. Each intervention was independently benchmarked against its Business As Usual (BAU) equivalent to quantify carbon savings, operational efficiencies, and wider social value.

By examining these smaller yet significant components of the public realm, this case study demonstrates that meaningful carbon reduction is achievable beyond traditional highways interventions. When aggregated across an authority's annual programme, these innovations offer a scalable, replicable pathway to lower carbon, more sustainable, and more inclusive urban infrastructure.

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2. Business-As-Usual (BAU) Baseline

The typical BAU solutions used as baseline scenarios include:

- Traditional concrete tactile paving slabs (multiple locations across Old Swan)
- Precast concrete kerbs (Otterspool Drive)
- Steel benches, tables, and planters (Everton Park & Liverpool Irish Centre)
- Diesel generators for site power (Multiple sites across Liverpool)

The most significant carbon impacts are attributable to:

- Transportation of waste and materials
- Carbon-intensive materials such as hot asphalt and precast concrete
- Diesel usage for plant items

The category investigates how these standard elements can be replaced with lower-carbon alternatives without compromising functionality or compliance.

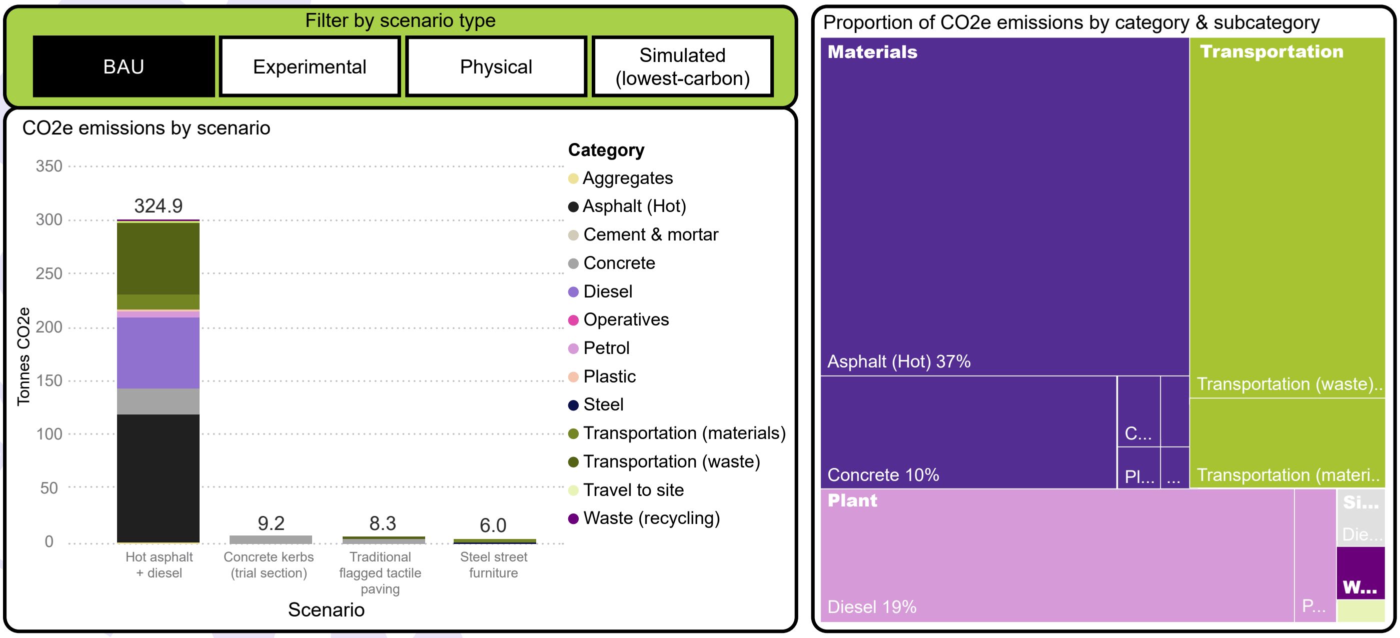

Figure 1: Breakdown of carbon impacts for the BAU baselines for Alderfield Drive (hot asphalt + diesel), Otterspool Drive (concrete kerbs), Old Swan (tactile paving), and Everton Park & Liverpool Irish Centre (steel street furniture)

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3. Innovation Funnel and Advisory Panel

To support consistent, transparent and evidence-based decision-making across the programme, an Expert Advisory Panel was established to guide the evaluation and selection of all innovations considered for Live Labs trials. The panel brings together specialists from local authorities, academia, engineering, behavioural insights, lighting, and innovation management, providing a balanced and multidisciplinary review of each proposed solution. Working alongside the scoring workshop, the panel independently assesses technical feasibility, safety benefits, carbon impact, operational risks, installation constraints and long-term sustainability. Through structured scoring, expert discussion and refinement, the panel ensures that only the most suitable, high-value technologies progress to the planning and implementation stages. This process has been instrumental in ensuring that all chosen innovations are robust, appropriate for local conditions, and aligned with the overarching objectives of safety, decarbonisation and improved user outcomes.

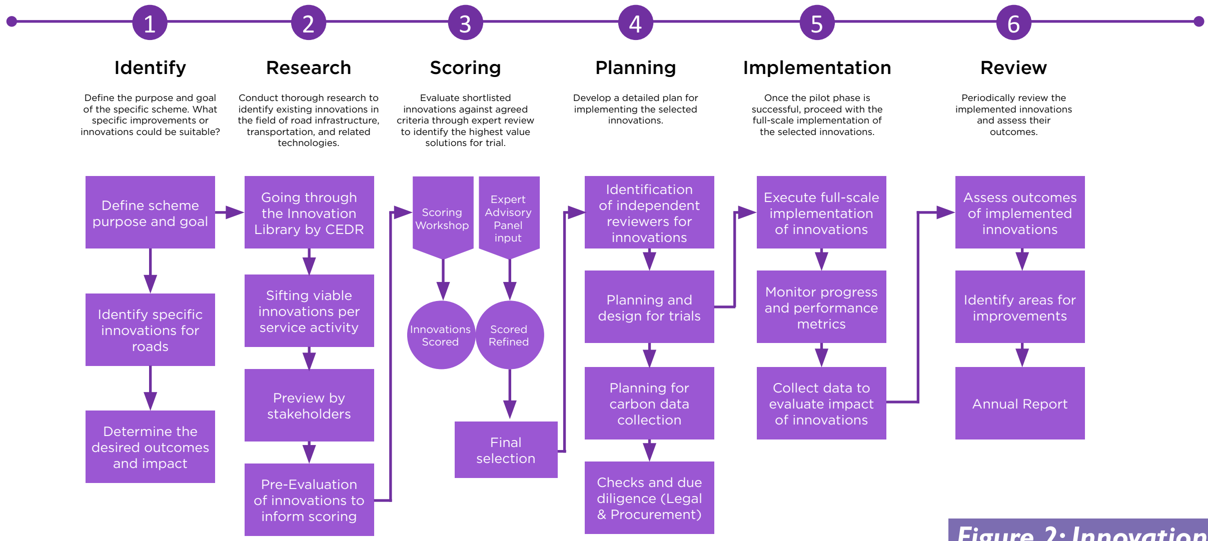

Figure 2: Innovation Funnel

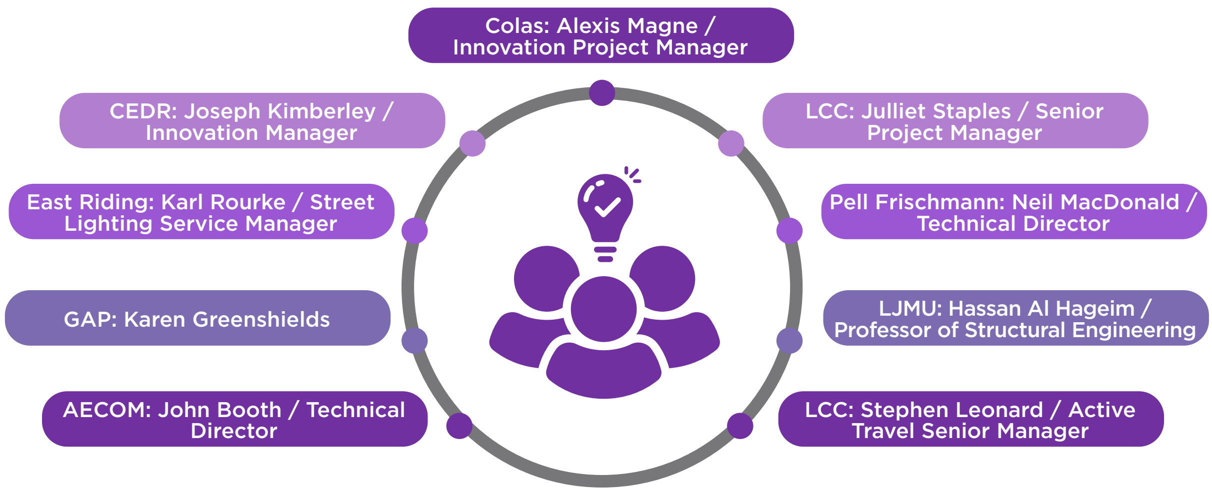

Figure 3: Expert Panel

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4. Carbon Assessment Methodology

Each innovation was assessed against its BAU comparator using whole-life carbon principles, in accordance with the Carbon Calculation and Accounting Standard (CCAS) process (as outlined in Figure 4 and the PAS2080 carbon lifecycle stages.

Carbon calculations considered:

- The embodied carbon of the materials used
- Transportation and travel to site
- Installation processes and plant use
- Operational energy requirements (where applicable)
- The processing of waste removed from site
- Maintenance frequency
- Expected lifespan

Data collection template sent to & completed by each contractor

SCHEME DETAILS
- Location
- Asset Type
- Activity type
- Area / volume

PREMISES & SITES
- On-site fuel & electricity consumption

STAFF & CONTRACTORS
- Communting days
- Commuting mode
- Vehicle fuel & size
- Daily commuting miles

VEHICLES & PLANT
- Vehicle / plant type
- Function
- Weight / Engine size
- Fuel type
- Miles travelled OR litres of fuel consumed

PRODUCTS & SERVICES
- Materials
- Transport as a service
- Waste management
- Other purchased / subcontracted services

Carbon factors obtained from the supplier for bespoke materials, where possible

Data entered into Carbon Profiler Toolkit (CPT) to calculate CO_2e emissions for each scheme

Calculation of long-term CO_2e emissions and normalisation to scale of scheme

Options comparison and calculation of carbon savings

Figure 4: The carbon assessment process

Percentage reductions stated in the Carbon Impact section of each case study reflect the difference in carbon emissions between the innovation and its conventional equivalent.

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Reducing Embodied Carbon in Streetscape, Public Realm & Supporting Infrastructure

5. TAC-GRID: TACTILE PAVING SYSTEM

Location: Broad Green, Old Swan

Type: Tactile paving system

Primary Driver: Cement reduction and joint elimination

Carbon Saving: 5.7 tCO2e (70%)

Installed on site by: Huyton Asphalt Civils

5.1 Innovation Description

Tac-Grid is a joint-free tactile paving system designed to improve accessibility for visually impaired users while significantly reducing embodied carbon compared to traditional concrete tactile paving.

Tac-Grid is highly resilient in challenging environments and can withstand loading from heavy vehicles without cracking, subsidence, or generating trip or slip hazards. Its material composition includes recycled plastics combined with a cold applied bespoke MMA resin, supporting durability while reducing reliance on virgin materials. Installation requires minimal traffic management and no heavy plant, with a standard crossing typically returned to service within one hour.

The system can be installed by a maximum of two operatives, offering benefits in relation to health and safety, manual handling, and reduced site footprint.

5.2 Site selection

Broad Green, Old Swan was chosen for the Tac-Grid trial due to its concentration of uncontrolled pedestrian crossings with consistently high footfall, especially near schools, shops, and bus corridors. The area has a diverse mix of users, including children, and older residents. These conditions made Old Swan an ideal live environment to test Tac-Grid as a quick install safety enhancement to improve visibility, user confidence, and accessibility without major infrastructure works.

5.3 BAU Comparator

- Precast concrete tactile paving slabs
- Mortar bedding
- Cement-intensive installation

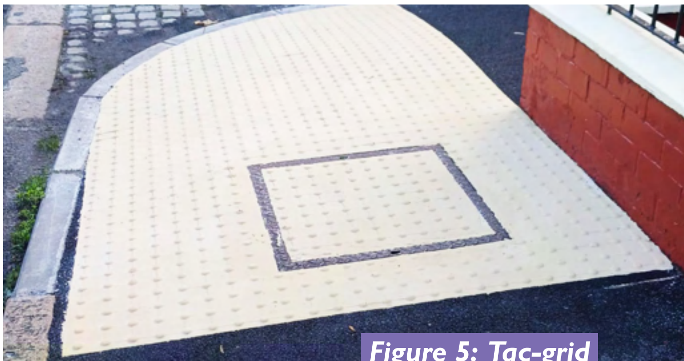

Figure 5: Tac-grid at Old Swan

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5.4 Carbon Impact

- 5.7 tCO_2e saving (0.5-1.6 tCO2e per location).
- 70% reduction vs BAU

Carbon reductions arise from:

- Elimination of cement content
- Reduced material mass
- Simplified installation process
- Extended durability through joint elimination

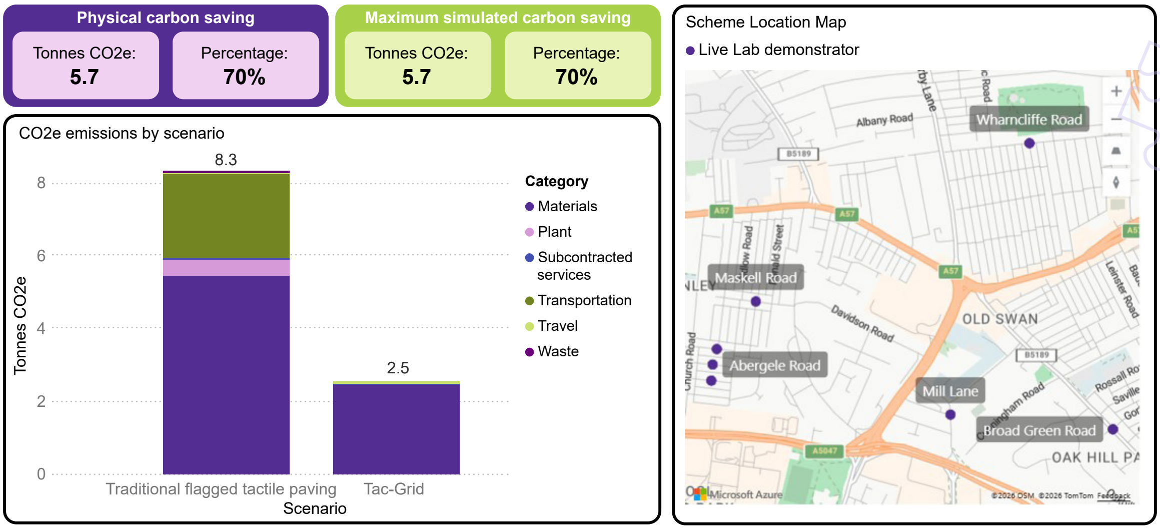

Figure 6: Carbon profiles for Tac-Grid

5.5 Wider Benefits

The Tac-Grid system demonstrated a range of wider benefits that extend beyond its primary role as a tactile paving solution. By adopting a continuous wet lay method, the installation process removes the need for jointing, cutting, or excavation. This results in a seamless finish with no weak points, preventing the joint failures and subsequent maintenance interventions typically associated with modular tactiles. The absence of joints, combined with the system's ability to follow natural surface undulations, produces a stable and consistent surface profile that reduces the risk of trips, slips, and premature deterioration.

One of the most significant operational advantages observed during the trial was the speed of installation. A typical crossing could be installed and returned to service within around an hour, minimising disruption for pedestrians, bus users, local businesses, and road traffic.

This rapid turnover is made possible by the system's cold applied resin and recycled plastic composition, which requires no curing time typical of cementitious installations. The approach also eliminates the need for heavy plant or machinery and can be undertaken by only two operatives, reducing site footprint and improving safety through lower manual handling demand.

Tac-Grid's material performance also offers long term benefits. Its ability to withstand heavy vehicle overrun without cracking, subsidence, or surface delamination reduces the likelihood of recurrent maintenance cycles. This aligns with the objectives of asset managers seeking durable solutions that minimise whole life costs while improving accessibility outcomes.

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5.6 Learnings and Outcomes

The trial highlighted several important learning points relevant to wider adoption of low carbon tactile paving alternatives. Substituting cement based tactiles with a resin based system containing recycled plastics offers significant carbon reduction potential, particularly when considering the cumulative impact of tactile installations across a network. By avoiding excavation, heavy plant, and cementitious materials, Tac-Grid demonstrates how targeted interventions in smaller streetscape components can still contribute meaningful carbon leverage within a highways decarbonisation programme.

The project also showed that accessibility improvements can sit alongside carbon reduction objectives rather than competing with them. The rapid installation, reduced surface irregularities, and reliable long term performance all supported safer outcomes for visually impaired users while simultaneously reducing material intensity and operational emissions. This reinforces the value of evaluating typically overlooked assets within the highway ecosystem as opportunities for aligned accessibility, safety, and environmental gains.

A key insight from the trial was the influence of existing standards and specifications on innovation uptake. Current tactile paving specifications are largely built around precast concrete units, excavation, and modular installation. These assumptions create barriers to alternative systems that do not fit the conventional model despite delivering equivalent or improved performance. For resin based, continuous tactiles to be more widely adopted, specifications and approval pathways may need updating to reflect modern materials, installation techniques, and carbon reduction priorities. This may include revisions to permissible materials, detailing tolerances, and testing criteria to ensure consistency while enabling innovation.

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6. URBAN KERB: MODULAR RECYCLED PLASTIC KERB

Location: Otterspool Drive

Type: Modular recycled plastic kerb

Primary Driver: Virgin material substitution

Carbon Saving: 7.5 tCO_2e (81%)

Installed on site by: Huyton Asphalt Civils

6.1 Innovation Description

Urban Kerb is a modular recycled-plastic kerbing system designed to replace traditional concrete kerbs. The system incorporates integrated conduits for power, data, and fibre, enabling future-proofed "smart street" applications such as EV charging, sensors, and communications infrastructure.

The product is currently going through HAPAS testing with BBA, with early-stage live testing carried out on-site on Otterspool Drive in Liverpool. One of the key reasons for the trial was to understand how the recycled-plastic kerb would perform under real-world conditions, particularly in terms of material degradation. If successful, this could change the way kerbing systems are specified, offering a lower-carbon, modular alternative to traditional concrete while enabling integrated smart-infrastructure delivery.

Figure 7: Urban Kerb on Otterspool Drive

6.2 Site Selection Rationale

Otterspool Drive was deliberately chosen as the pilot location due to the high-stress environment it presents for any kerb product. The area experiences heavy vehicle movements, and drivers frequently park over or mount the kerbs, causing significant load and impact on traditional concrete kerbs. Additionally, the location includes a skatepark and an entertainment centre, attracting constant footfall and vehicular turnover throughout the day.

This made Otterspool an ideal real-world stress test to determine whether the modular recycled-plastic Urban Kerb could withstand the same demanding conditions typically handled by concrete kerbs.

6.3 BAU Comparator

- Precast concrete kerbs
- Cement-based installation (haunching and bedding)
- Traditional trenching for power/data utility installation
- Repeated excavation to access buried services (common for EV charger rollout)

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6.4 Carbon Impact

- 7.5 tCO_2e saving
- 81% reduction vs BAU

Carbon savings are achieved through:

- Recycled HDPE replacing virgin concrete, with recycled HDPE showing up to 88% lower carbon footprint than virgin HDPE.
- Elimination of high-cement materials, including beds and haunching.
- Reduced excavation, because the kerb itself carries services, removing the need for deep trenching.
- Zero material waste due to durable product and modular replacements.

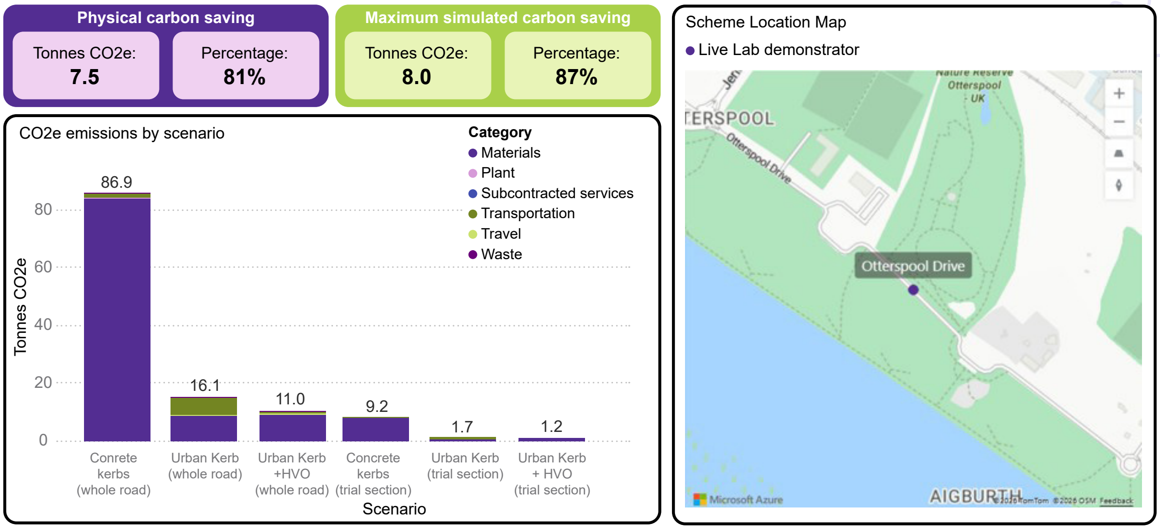

Figure 9: Carbon profiles for Urban Kerb scheme on Otterspool Drive

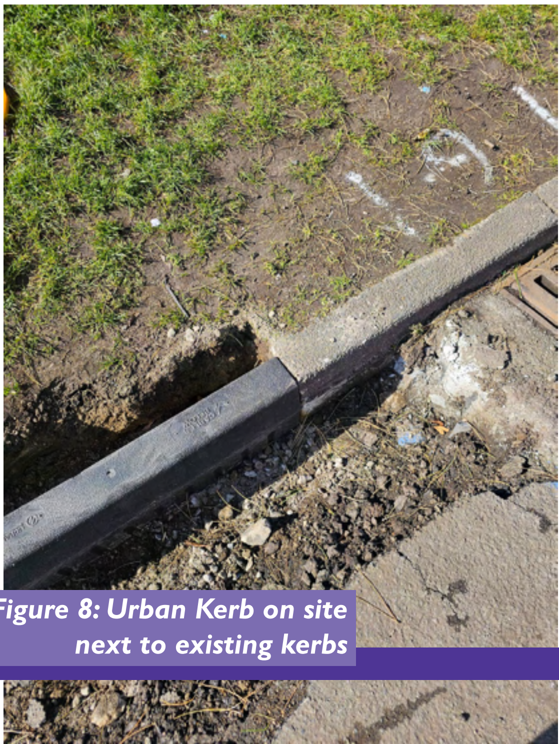

Figure 8: Urban Kerb on site next to existing kerbs

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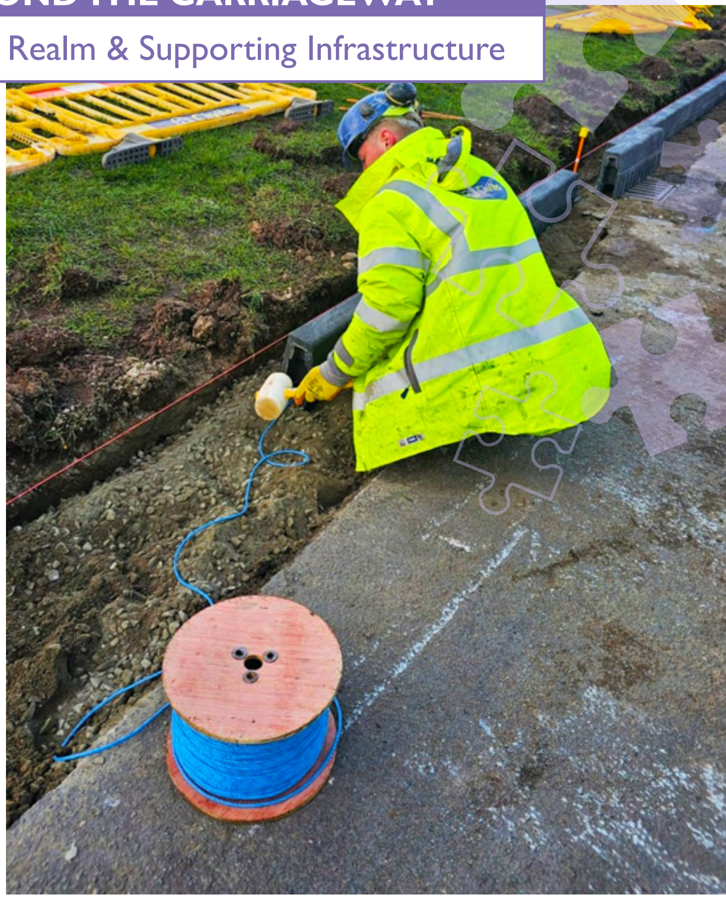
6.5 Wider Benefits

One of the key advantages of this solution is its potential for integrated service capability, including power, data, fibre, and EV charger feeds. Although this feature was not implemented during the Liverpool trial - given that it was the first deployment of the product - it represents a significant opportunity for future phases. Should the trial perform well, the system can be expanded to incorporate these utilities, offering a long term benefit by installing the underlying infrastructure once and revisiting it later as technology and service demands evolve.

The system also provides a notable reduction in installation time, supported by lightweight components and simplified cable routing channels. This design directly contributes to a lower manual handling risk, as the plastic kerbs weigh substantially less than their traditional concrete counterparts, reducing strain on operatives and improving overall safety. Feedback from the installation team reinforced these advantages: operatives reported that they were able to install more kerbs in a single shift than ever before, attributing this directly to the ease of handling and reduced weight of the system.

Because the installation avoids repeated excavation of the footpath, the method minimises disruption to both pedestrians and local residents. Its modular adaptability also means the same product can be configured for access kerbs, drop kerbs, and any future upgrades to service provision without major rework.

Additional public facing benefits include improved accessibility features and reduced risk of vehicle wheel damage due to more consistent kerb profiles.



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6.6 Learnings

Performance Under High Stress Conditions

The Otterspool Drive location proved effective as a stress test environment. Early observations indicate that the recycled plastic system can withstand frequent vehicle overruns, mounting, and sustained footfall. Continued monitoring will be essential to confirm long term durability and material behaviour, particularly regarding potential plastic deformation under repeated impact loads. As this was the first deployment, further observation is necessary to assess UV exposure, structural creep, and overall performance over multiple seasons. This data will be critical for informing specification guidance and ensuring confidence for broader rollout.

Figure 10: installation

Suitability for Rapid Installation

The lightweight modular design significantly improved installation efficiency. Operatives reported achieving installation rates higher than any previous kerbing works, attributing this to the reduced weight, simplified handling, and integrated cable routing channels. This demonstrates strong potential for productivity gains on future schemes, especially on programmes where speed and reduced disruption are critical.

Health & Safety Benefits

The reduced manual handling burden was a clear operational advantage. Lower kerb weights decreased strain and minimised lifting related risks compared with concrete units. This benefit alone could support wider adoption, particularly on labour intensive urban maintenance programmes.

Value of Integrated Service Infrastructure

Although integrated services were not included in the first trial, the kerb system's built in conduits represent a major long term opportunity. Installing the physical ducting once - and re accessing it as technology evolves - could avoid repeated excavation, reduce lifecycle costs, and support the roll out of EV charging, sensors, and digital infrastructure. Future pilots would benefit from activating at least one of these service applications to fully test compatibility and access requirements.

Reduced Disruption and Improved Public Realm Outcomes

Minimising excavation helped reduce disruption to pedestrians, residents, and nearby businesses. The trial also indicated potential improvements to accessibility and reduced vehicle wheel damage due to consistent kerb profiles. These public realm benefits should be assessed through future user experience or community impact feedback.

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7. CIRCULAR11: RECYCLED PLASTIC STREET FURNITURE

Location: Everton Park & Irish centre

Type: Recycled plastic street furniture

Primary Driver: Avoided virgin plastic and landfill diversion

Carbon Saving: 0.9 tCO_2e (39%)

Installed on site by: Dowhigh Ltd

7.1 Innovation Description

Circular11 benches and planters transform hard-to-recycle plastic waste into long-lasting, weather-resistant outdoor seating that delivers a minimum 25-year lifespan, remains rot-proof and low-maintenance, and can be recycled multiple times to keep the material in circulation for up to a century. Produced through a lower carbon manufacturing process that prevents more emissions than it creates, these benches provide a robust, sustainable alternative to timber and other conventional materials, offering durable, circular, and climate-positive infrastructure for public and commercial spaces.

Figure 11: Circular11 Benches next to BAU benches at Everton Park

7.2 Site Selection

The Circular11 benches were installed at the Liverpool Irish Centre and Everton Park as both locations offer high community value and strong visibility for showcasing recycled content street furniture.

The Irish Centre provides a well-used social hub with regular footfall from cultural events, making it an ideal setting to test how sustainable seating supports community spaces.

Everton Park, one of the city's key green open areas, presents contrasting environmental conditions and a diverse user base, enabling assessment of durability, comfort, and weathering in an outdoor recreational setting.

These locations were also chosen with asset protection in mind. Some public benches in Liverpool have historically experienced vandalism and fire damage, so sites with natural supervision, regular activity, and closure or limited access after nightfall were prioritised to minimise risk during the trial.

7.3 BAU Comparator

- Steel benches
- Wooden benches

7.4 Carbon Impact

- 0.9 tCO_2e saving
- 39% reduction vs BAU
- 0.3 tCO_2e (28%) saving in Everton Park
- 0.7 tCO_2e (47%) saving at Liverpool Irish Centre

Savings derived from:

- Recycled feedstock use
- Reduced virgin polymer demand
- Lower embodied material intensity

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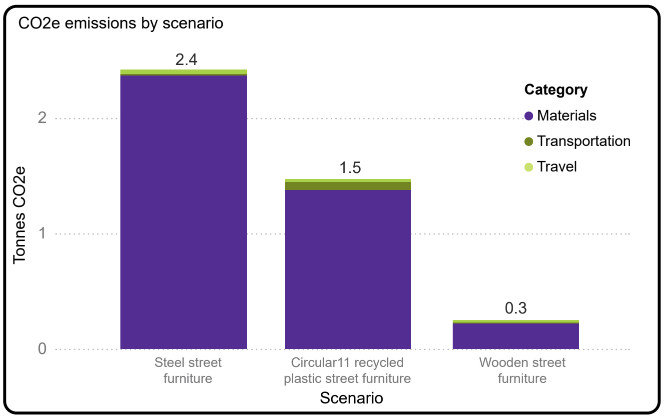
Physical carbon saving		Maximum simulated carbon saving	
Tonnes CO2e: 0.9	Percentage: 39%	Tonnes CO2e: 2.2	Percentage: 89%



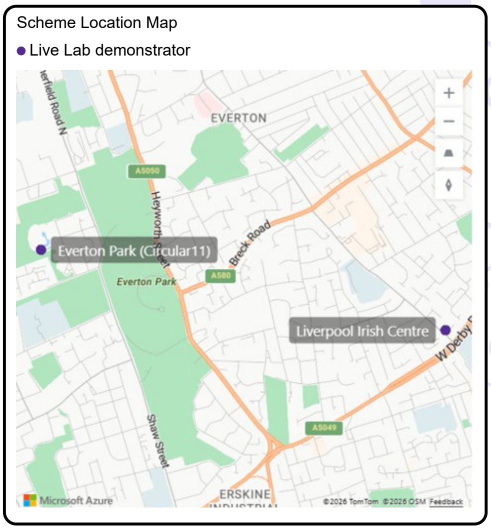


Figure 12: Carbon profiles for Circular11 street furniture at Everton Park and Liverpool Irish Centre

7.5 Wider Benefits

Durability and longevity

The recycled plastic construction provides significantly enhanced resistance to rot, moisture, weathering, and general wear, resulting in a long service life and reduced need for replacements. This delivers reliability across varied outdoor contexts.

Low maintenance requirements

Unlike timber, which requires periodic staining or treatment, the benches retain structural integrity and appearance with minimal upkeep. This reduces operational costs and avoids chemicals often used for wood preservation.

Circular economy alignment

The benches directly support circular economy objectives by transforming hard to recycle plastic waste streams into high value, long life infrastructure. Their ability to be recycled multiple times further prevents material loss and supports long term resource looping.

Improved safety and reduced flammability

Compared to timber street furniture, the material offers reduced susceptibility to fire damage, improving resilience in locations where assets have historically experienced vandalism or burning.

Figure 13: Circular11 benches & planters at Irish Centre

7.6 Learnings

Smaller assets still provide meaningful cumulative carbon savings

While individually low in material volume, benches installed across a portfolio of sites can deliver significant carbon benefits when scaled, demonstrating that sustainable procurement at all asset levels contributes to wider net zero goals.

Public realm procurement is a key driver for circularity

Benches, bins, planters, and other small assets represent frequent purchasing categories for councils. Embedding recycled content into these items provides an accessible, low risk entry point for circular procurement and supply chain transformation.

Context matters for asset placement

Although durable, the trial highlighted that recycled plastic benches are best suited for locations with some level of passive supervision or controlled access. Sites with limited surveillance or high vandalism risk may require additional mitigation measures.

Performance varies by environment

Different settings (e.g., green open spaces versus high footfall cultural venues) provided valuable insight into comfort, weathering, and public acceptance, helping refine guidance for future siting and asset selection.

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8. MUBE: AUTONOMOUS GREEN INSFRASTRUCTURE COLUMN

Location: Campbell Square

Type: Autonomous green infrastructure column

Primary Driver: Biodiversity enhancement and carbon absorption

Carbon Impact: 4.1 tCO_2e (38%) over 40 years in combination with Omniflow (2.0 tCO_2e absorbed)

Installed on site by: McCann and United Utilities

8.1 Innovation Description

Mube is an autonomous green infrastructure column designed to enhance biodiversity, absorb CO_2, and discreetly host smart-city technologies. The system integrates hundreds of plants, supported by a patented smart irrigation system that reduces water consumption by up to 70% and accelerates plant growth through intelligent watering management. The column also acts as a structural support for connected city infrastructure, enabling the integration of telecom antennas, Wi-Fi relays, smart cameras, environmental sensors, LED lighting, fibre and electrical networks, all routed through a protected internal passage.

For the Liverpool demonstrator, the Mube column was installed at Campbell Square at the same time as the Omniflow smart mast, with both systems being mounted together on a single shared structure. This was a deliberate and sustainable design choice - avoiding the need to construct a separate post and therefore minimising additional embodied carbon.

8.2 Site Selection

Campbell Square was identified as the optimal site for this pilot due to its centrality, existing infrastructure, environmental potential, and strong opportunities for public engagement. Located within Liverpool's Ropewalks district, Campbell Square benefits from high footfall and strong links to surrounding residential, commercial, and cultural areas.

The square already hosts an Omniflow smart mast - another Live Labs demonstrator being trialled and installed at the same location. This created a unique opportunity for co-location of innovations, enabling the Mube system to be integrated directly onto the existing mast without additional structural works. This reduced installation requirements, minimised disruption, and enhances the synergy between Live Labs technologies deployed on-site.

The square's predominantly hard-surfaced, urban character offers significant potential for environmental uplift. Introducing greenery, cooling benefits, and biodiversity-supporting features would bring immediate value to local residents and visitors, helping improve comfort and wellbeing in the public realm.

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8.3 BAU Comparator

Under a business as usual scenario, only standard non green infrastructure - such as conventional steel street lighting columns - would have been installed. No greening, biodiversity features, or multifunctional enhancements would have been introduced, as these are not part of routine highways works.

This intervention would not have taken place without the additional Live Labs funding and its specific focus on trialling greening solutions within highways infrastructure.

8.4 Carbon Impact

- 50 kgCO_2e absorbed per year (2.0 tCO_2e over 40 years)
- 4.1 tCO_2e saving (38% compared to BAU) over 40 years

Carbon performance reflects:

- Carbon sequestration delivered through 128 plants across 15 perennial species, providing approx. 10 m² of vertical plant area per column.
- Offset of embodied materials, due to avoiding a separate metal column and integrating with Omniflow infrastructure.
- Low operational emissions, supported by the autonomous irrigation system requiring only 6 m³ of water per year - significantly less than comparable green infrastructure.

Figure 14: Installation of Omniflow and Mube together at Campbell Square

8.5 Wider Benefits

Biodiversity Gain

Planting uses perennial, melliferous (pollinator-supporting) and non-allergenic species, contributing to increased urban biodiversity.

Urban Cooling

Vegetation and soil improve local micro-climate conditions, helping to reduce surface temperatures and mitigate heat-island effects.

Air Quality Contribution

The planting provides natural air-filtration benefits, complemented by on-mast air-quality monitoring.

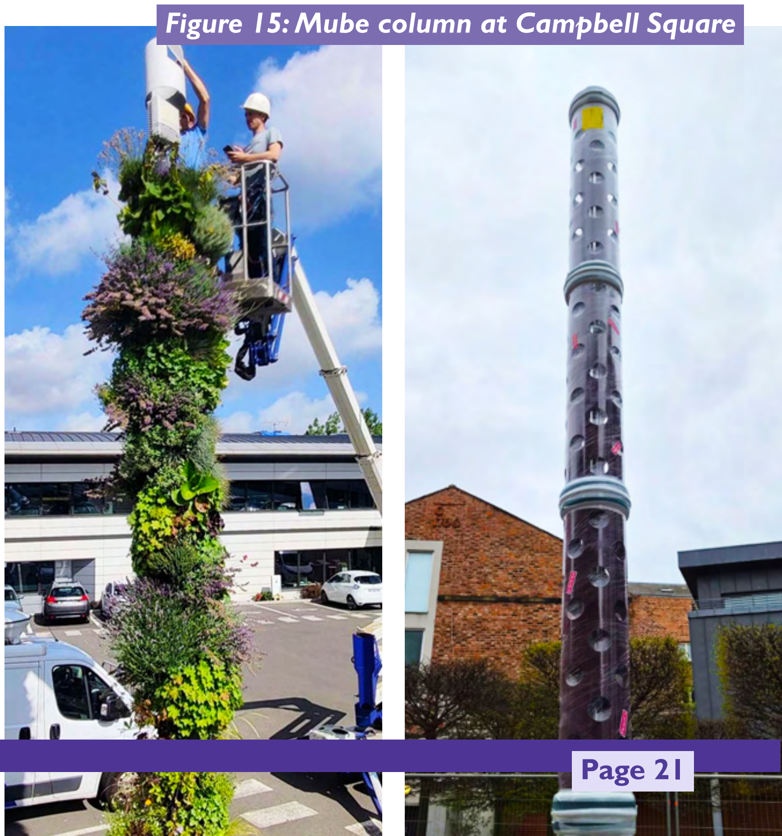
Smart-City Integration

Supports IoT devices, environmental sensors, telecoms and lighting on a single mast, avoiding additional street clutter.

Aesthetic and Public-Realm Uplift

Converts standard utility poles into greened urban assets, improving visual quality and encouraging decarbonisation in a dense urban context.

Figure 15: Mube column at Campbell Square



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8.6 Learnings

CO_2 Absorption Is Achievable at Small Scales:

Even compact green-infrastructure units (<1 m²) can deliver measurable levels of CO_2 uptake, demonstrating viability in dense urban settings.

Co-Benefits Extend Well Beyond Carbon

Biodiversity support, public-realm value, micro-climate cooling, and enhanced smart-city functionality provide a wider benefits package that significantly exceeds carbon alone.

Integration with Existing Smart Assets Is Efficient and Scalable

Co-locating green infrastructure with existing systems such as the Omniflow mast avoids additional embodied-carbon impacts and enables scalable deployment. The main requirement is ensuring the host structure can accommodate the added weight.

Intelligent Irrigation Improves Lifecycle Performance

Automated, moisture-responsive irrigation systems cut water use, reduce maintenance needs, and increase plant survival rates.

Seasonal Timing Influences Success:

Installation is best undertaken in spring or early summer to ensure saplings establish before exposure to harsh weather conditions.

Site Selection Must Consider Water Access

Although water demand is low, units require a reliable and sustainable water source to support planting and irrigation functions.

Continued Monitoring Required

Further time is needed to fully assess long term maintenance requirements and the ongoing health and upkeep of the planting.

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9. INSTAGRID ELECTRIC GENERATOR

Location: Utilised on multiple schemes across Liverpool by Huyton Asphalt

Type: Portable battery plant replacement

Primary Driver: Diesel displacement

Carbon Impact: 82% reduction vs diesel

9.1 Innovation Description

The Instagrid portable power unit delivers clean, silent, and generator-free energy on demand, providing full mains-level performance (3.6 kW with peaks up to 18 kW) in a compact, 20 kg, zero-emission package that can be carried by hand and used safely indoors or outdoors in any weather. Designed to replace traditional combustion generators, it offers grid-quality power, eliminates fumes and noise, reduces trip hazards, and cuts lifetime operating costs by up to 80% thanks to the absence of fuel or maintenance requirements.

9.2 Site Selection

Instagrid was deployed across multiple Live Labs sites to provide a clean, quiet alternative to diesel generators during routine highway and footway works. Its portability and high-output battery made it suitable for varied locations where reducing noise, emissions, and fuel use was a priority. Using Instagrid in different operational settings allowed the team to assess its reliability, tool compatibility, and carbon-saving potential while supporting Liverpool City Council's shift toward low-carbon construction practices.

9.3 BAU Comparator

- Diesel generator usage on site

9.4 Carbon Impact

- 82% reduction vs diesel generator
- 72.4 tCO_2e saving overall
- 22% saving on whole scheme vs. BAU

Savings derived from:

- Elimination of fossil fuel combustion
- Reduced transport and fuel supply impacts
- Lower operational emissions

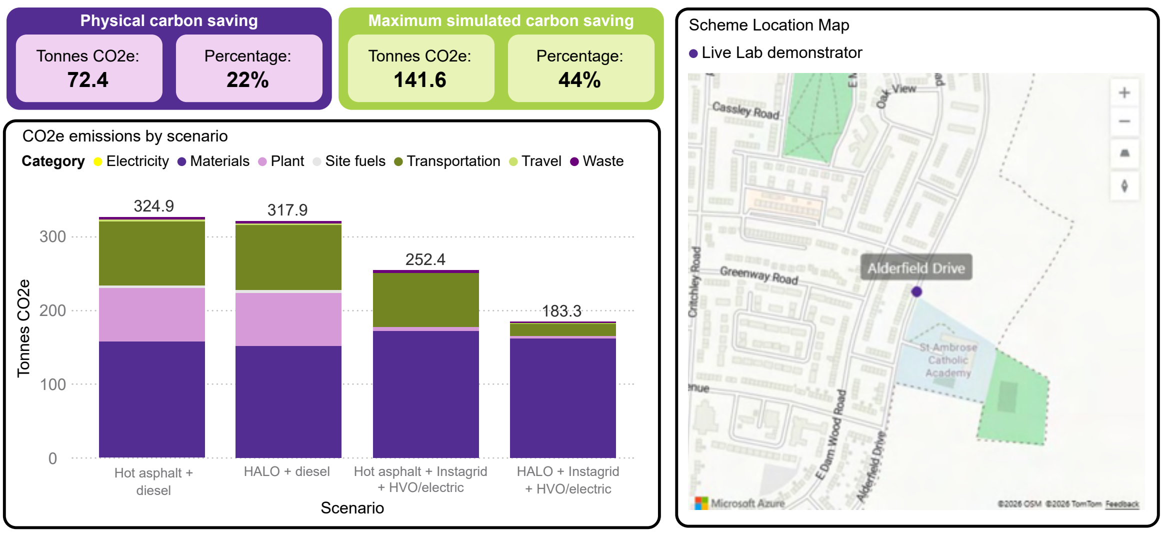

Figure 16: Carbon profiles for Instagrid scheme on Alderfield Drive

CASE STUDY ENABLING LOW-CARBON, PEOPLE-FOCUSED STREETS BEYOND THE CARRIAGEWAY

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9.5 Wider Benefits

- The Instagrid unit operates silently, significantly lowering noise impacts on residents and site workers compared with diesel generators.
- As a zero-emission system with no combustion fumes, it removes localised exhaust emissions and contributes to cleaner working environments.
- The absence of fuel storage, fumes, hot exhaust surfaces, and trailing cables reduces common on-site risks and improves overall safety conditions.
- Its portability and ability to operate indoors, in confined spaces, and in low-ventilation environments expands where and when power tools can be safely used.
- Displacing diesel plant aligns with sector-wide ambitions to cut carbon, reduce dependency on fossil fuels, and accelerate the electrification of construction activities.

9.6 Learnings

- While carbon savings are significant, some contractors were hesitant due to charging requirements and shorter run-times compared with diesel generators. Effective planning around shift patterns, charging cycles, and tool load is essential.
- The trial highlighted that temporary power use is often overlooked in carbon calculations for highway schemes, despite being a large and readily addressable source of emissions.
- Wider deployment requires reliable access to charging points at depots and active work sites, especially for teams with high output demands.
- Transitioning to electric generators requires caution: Instagrid units run almost silently, unlike diesel generators. This means workers must be more vigilant around active equipment and rely on visual cues rather than noise, reinforcing the need for updated toolbox talks and safety procedures.
- Trials demonstrated strong compatibility with a wide range of tools and consistent performance in varied operational environments, supporting potential for mainstream adoption.

Figure 17: Instagrid on site in Liverpool

Department for Transport

ADEPT LIVELABS2 Decarbonising Local Roads

LIVERPOOL LIVE LABS DRIVING DECARBONISATION

CASE STUDY

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10. Trial Findings

Across all five innovations trialled - Tac-Grid, Urban Kerb, Circular 11, Mube, and Instagrid - several consistent category level insights emerged. These findings highlight opportunities to decarbonise smaller scale streetscape assets while improving operational efficiency, safety, accessibility, and public realm experience.

Smaller assets provide significant cumulative carbon savings.

Across all innovations, replacing carbon intensive materials - cement, concrete, virgin plastics, steel, and diesel - with recycled polymers, resin systems, or electric plant produced the highest carbon savings.

All innovations reduced installation effort through lightweight components, modular systems, wet lay methods, or electric power.

Benefits included:

- Faster programme delivery
- Reduced traffic management
- Lower manual handling risk
- Fewer return visits for maintenance
- Durable designs reduce maintenance demand and whole life costs

Current highways standards and procurement frameworks are predominantly written around concrete tactiles, heavy kerbing, timber/steel street furniture, and diesel plant. As a result, non traditional alternatives face friction despite equal or better compliance and performance.

Co benefits strengthen the case for adoption. These amplifying benefits support multiple council priorities simultaneously:

- Accessibility improvements (Tac-Grid)
- EV ready / smart city infrastructure (Urban Kerb)
- Circularity and waste diversion (Circular11)
- Biodiversity and air quality uplift (Mube)
- Noise, safety and air quality improvements (Instagrid)

11. Recommendations for Business-As-Usual Integration

- Update Standards & Specifications to allow low carbon alternatives - such as resin tactiles, recycled plastic kerbs, recycled content street furniture, and electric generators - to be formally recognised within highways specifications.
- Replace diesel generators with electric units wherever feasible, supported by reliable depot/site charging and updated safety procedures.
- Adopt kerb systems and urban assets that integrate power, data, and green infrastructure to reduce future excavation and duplicated assets.
- Track durability, maintenance, carbon, and user experience over 5 years to refine BAU specifications and support scaling.

12. Testimonials

Working with colleagues and the ward member, and using part funding from the s106 Edge Lane Accessibility Improvements, we used TacGrid to overcome issues with water and service boxes when installing tactile crossings.

TacGrid delivered a 93.6% CO_2 reduction compared with traditional concrete tactiles and is made from recycled plastics.

It installs quickly in a single wet lay with no cutting or excavation, reducing programme time and future maintenance.

Tac-Grid is the only MMA resin tactile system authorised under Highway Safety Regulations.

Chris Parkes, Team Leader - Major Works - Commissioning & Project Delivery , LCC