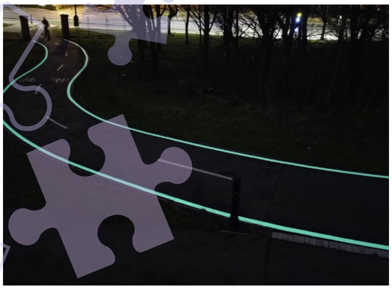
# LIVERPOOL LIVELABS

# 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

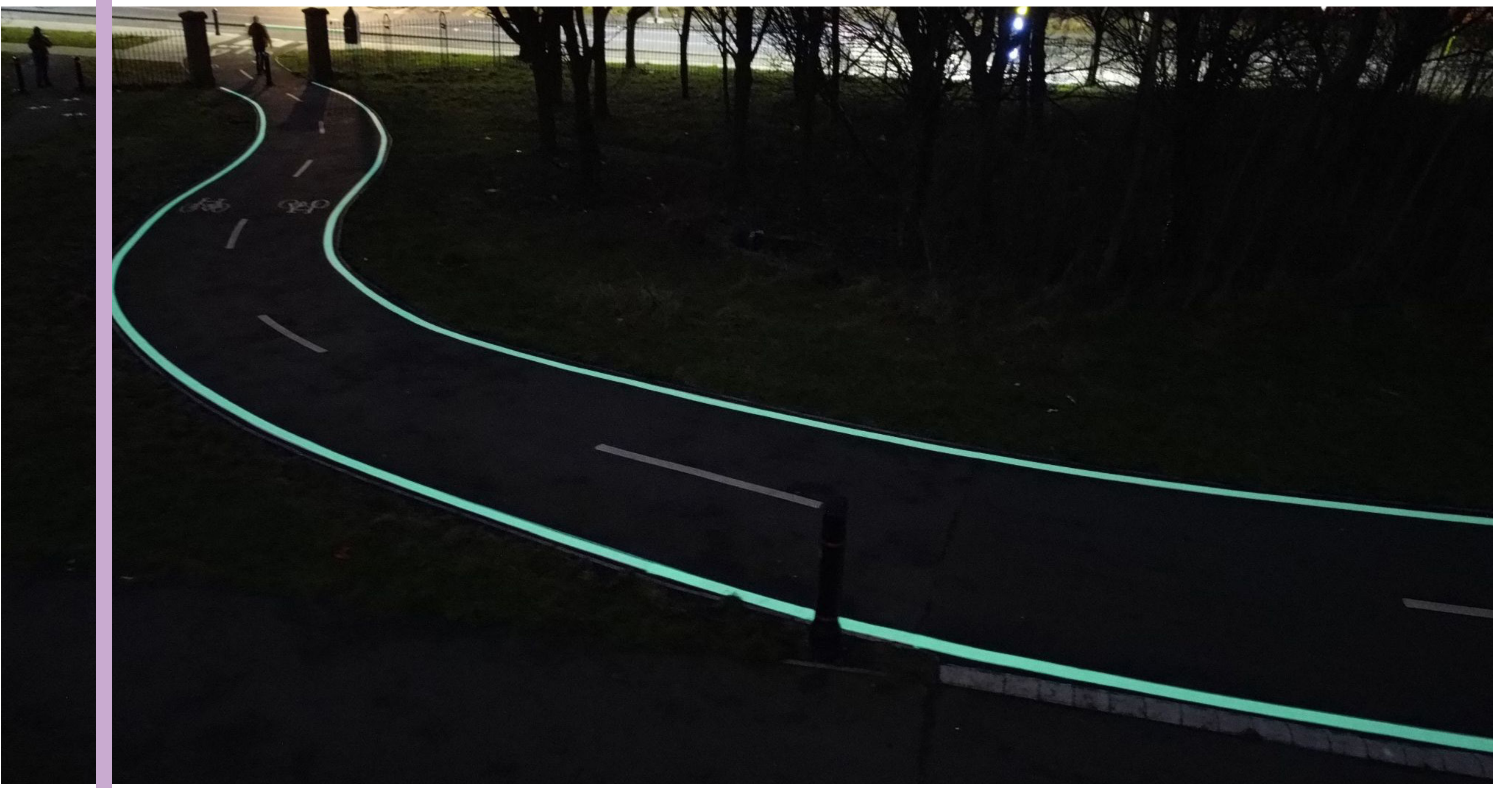
## CASE STUDIES

# ROAD MARKINGS & VISIBILITY

## Lower Carbon Alternatives to Business-As-Usual Road Marking

This Road Markings & Visibility 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.



*Authored by: Krishna Priya Sivaprasad, Kira Jefferies, Pamela McGuinness*

# 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.

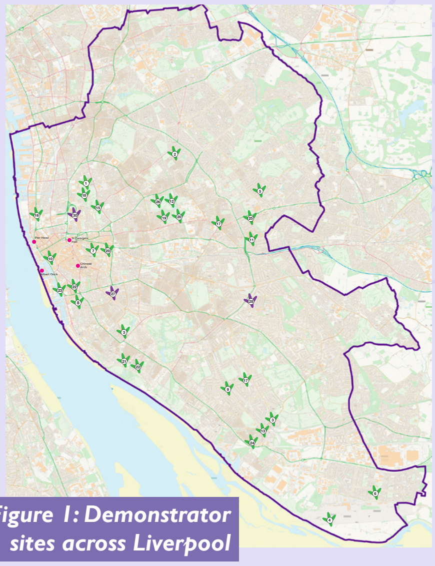


*Figure 1: Demonstrator sites across Liverpool*

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 Sustainability*
*Transport, Highways and Parking,*
**Liverpool County Council**

Department for Transport

ADEPT LIVE LABS 2 Decarbonising Local Roads

LIVERPOOL LIVE LABS DRIVING DECARBONISATION

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## ROAD MARKINGS & VISIBILITY

Lower Carbon Alternatives to Business-As-Usual Road Marking

# CASE STUDY ROAD MARKINGS & VISIBILITY

## Lower Carbon Alternatives to Business-As-Usual Road Marking

### 1. Executive Summary

Traditional road markings and visibility solutions carry significant embodied carbon and operational energy demand. Liverpool's strategic routes - particularly unlit active travel corridors also present safety challenges, reduced visibility, and community concerns after dark.

The purpose of this programme was to:

- Identify and test lower carbon alternatives to BAU road markings and lighting.
- Evaluate their real world performance under Liverpool's climatic and usage conditions.
- Quantify whole life carbon impacts using a consistent CCAS-aligned process.
- Understand user perception, safety implications, and operational practicality.
- Provide evidence to support future BAU integration and/or wider adoption.

These trials directly address Liverpool's commitments to decarbonisation, active travel enhancement, and sustainable public realm improvements.

The innovations trialed in this category include LuminoKrom, UltiGlow, and cold-applied MMA. These were selected for their potential to deliver measurable carbon reductions compared with their conventional business-as-usual equivalents.

Each innovation underwent independent evaluation to assess its embodied carbon performance, lifecycle impacts, and overall suitability for wider implementation across Liverpool's network.

# CASE STUDY ROAD MARKINGS & VISIBILITY

## Lower Carbon Alternatives to Business-As-Usual Road Marking

### 2. Business-As-Usual (BAU) Baseline

The typical BAU solutions for road markings and nighttime visibility used as baseline scenarios include:

- Thermoplastic road markings with periodic reapplication (Pinehurst Avenue).
- Wired street lighting installations for unlit routes (Everton Park and Newsham Park).
- High-energy lighting infrastructure (Everton Park and Newsham Park).
- Standard hot asphalt surfacing with no visibility enhancements (Newsham Park).

The BAU baseline includes embodied carbon from material manufacture, transportation, installation processes, and ongoing maintenance or energy use.

The most significant carbon impacts are attributable to:

- Thermoplastic road markings.
- Hot asphalt surfacing.
- LED lanterns.
- Steel street lighting columns.
- Concrete for bedding street lighting columns.

### Carbon Analysis

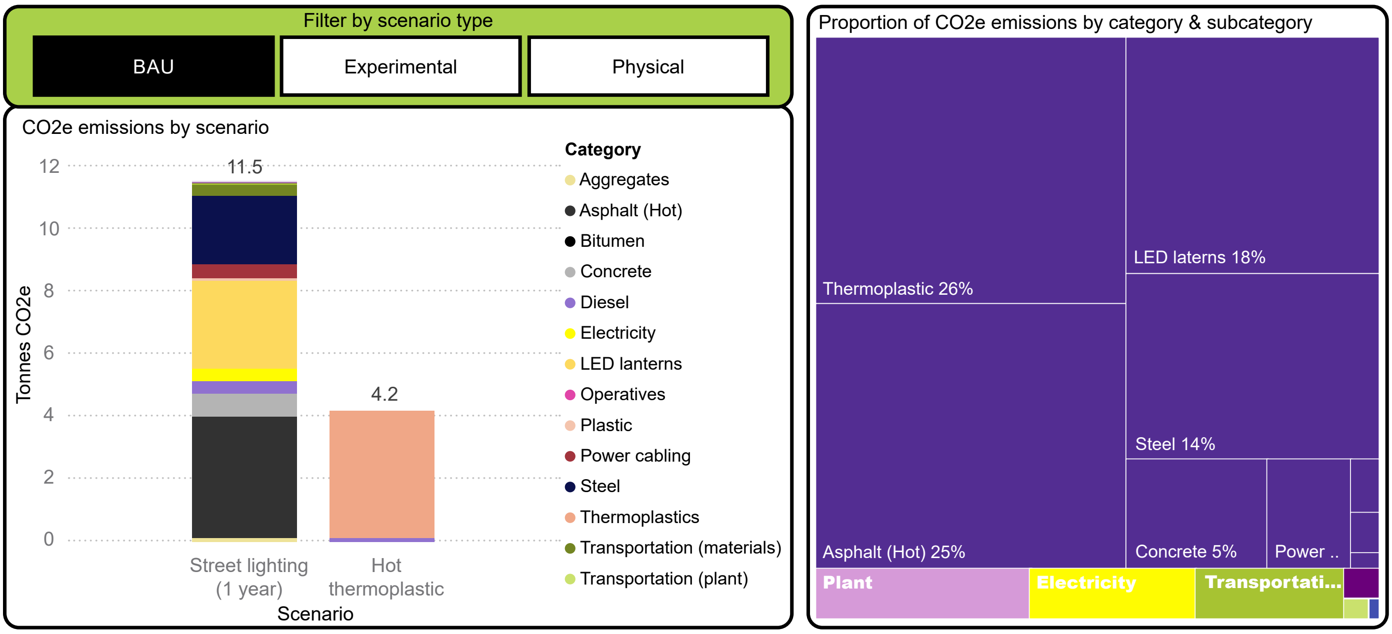


*Figure 1: Breakdown of carbon impacts for the BAU baselines for Everton Park & Newsham Park (street lighting) and Pinehurst Avenue (hot thermoplastic)*

# CASE STUDY ROAD MARKINGS & VISIBILITY

## Lower Carbon Alternatives to Business-As-Usual Road Marking

### 3. Innovation Funnel & 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 a scoring workshop, the panel independently assessed the technical feasibility, safety benefits, carbon impact, operational risks, installation constraints, and long-term sustainability.

Through structured scoring, expert discussion, and refinement, the panel ensured that only the most suitable, high-value technologies progressed 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.

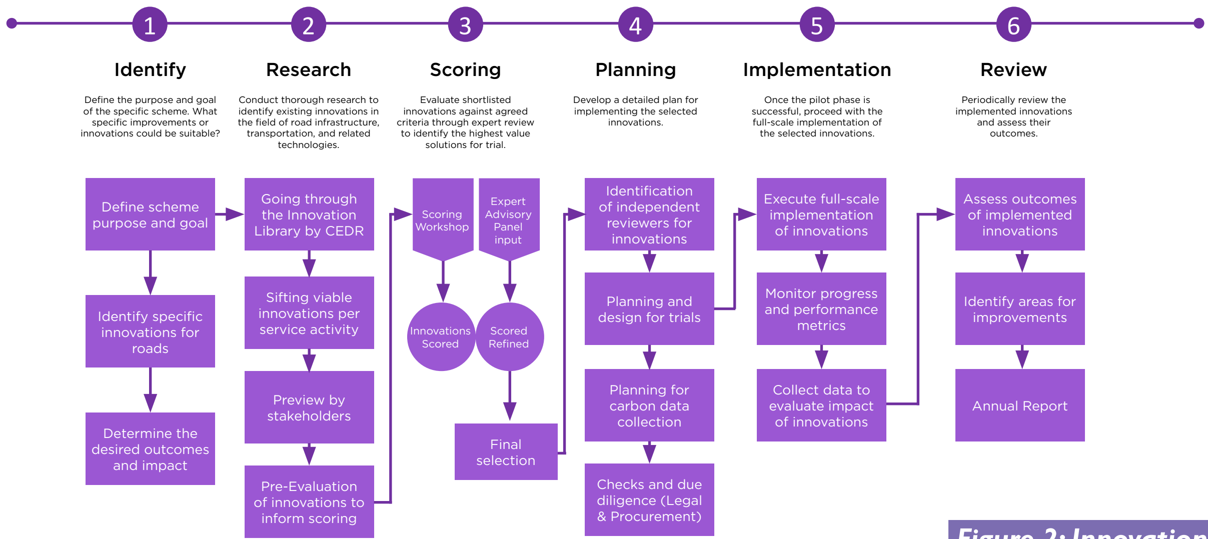


***Figure 2: Innovation Funnel***

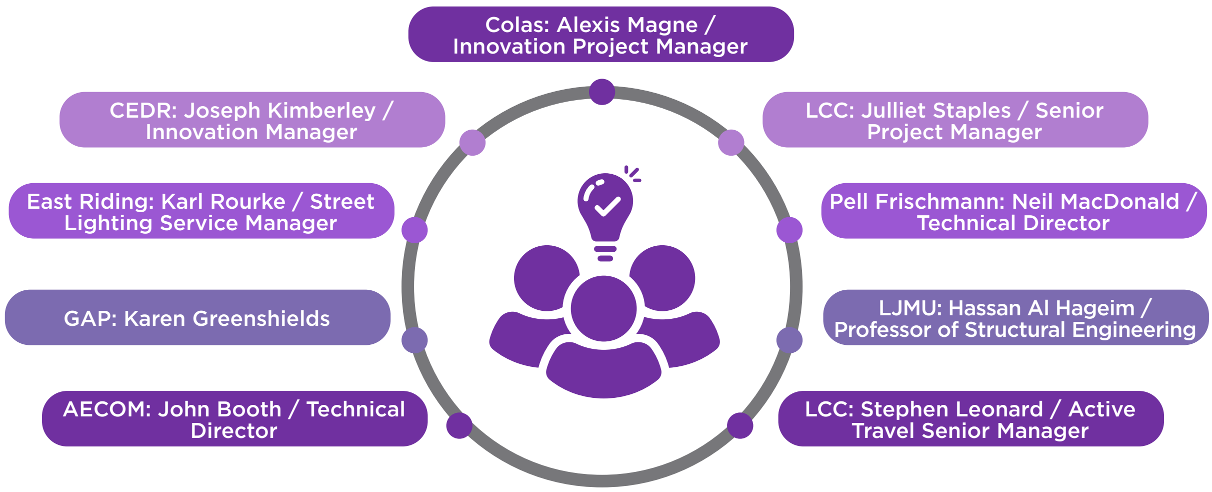


***Figure 3: Expert Panel***

# CASE STUDY ROAD MARKINGS & VISIBILITY

## Lower Carbon Alternatives to Business-As-Usual Road Marking

### 4. Carbon Assessment Methodology

Each innovation was assessed against its Business as Usual (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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# CASE STUDY ROAD MARKINGS & VISIBILITY

Lower Carbon Alternatives to Business-As-Usual Road Marking

## 5. LUMINOKROM (PHOTOLUMINESCENT ROAD MARKINGS)

### 5.1 Innovation Description

LuminoKrom® is a high-performance photoluminescent road marking paint that absorbs natural or artificial light and emits a green glow for up to 10 hours in darkness. It is certified to ISO 17398 - Class G/E depending on product type and provides high slip resistance (SRT > 0.50).

For this installation, the material was applied over a white undercoat and sprayed using airless equipment to maximize luminosity, consistency, and long-term durability.

### 5.2 Context & Site Selection

Everton Park is a large, high-use public green space on the outskirts of Liverpool City Centre. It functions as an important movement corridor, with a mixed-use pedestrian and cycle route linking residential areas to schools, university facilities, and major football stadia.

The park also attracts a wide spectrum of recreational users, including skateboarders, BMX riders, scooter users, families, and those accessing its sports hub, heritage trail, and nature garden.

Despite its strategic value for active travel, Everton Park has no existing street lighting infrastructure, resulting in significantly reduced visibility after dark. Community feedback consistently raised concerns about perceived safety during evening travel, particularly for students, commuters, and match-day crowds. These issues were magnified by local socio-economic factors - including higher-than-average crime rates and health vulnerabilities - that make safe and accessible active-travel routes even more essential for residents.

Traditional wired lighting was considered but found to be impractical due to significant installation costs, heavy embodied carbon, and the environmental impacts associated with trenching and disturbing mature green infrastructure.

Given these constraints, Everton Park offered an ideal setting to test low-carbon illumination methods. A 1 km unlit shared-use path - identified by stakeholders as a priority route connecting schools and university buildings - was selected for the trial.

The path had a documented history of user conflict in low-light conditions. This made it an ideal environment to trial LuminoKrom® photoluminescent markings, which illuminate for up to 10 hours without the need for electricity and provide certified anti-slip performance suitable for high-use mixed-mode environments.

### 5.3 BAU Comparator

The Business-As-Usual comparator for this scheme was the installation of traditional wired street-lighting columns along the park's route. This approach would have required civil engineering works, trench excavation, cabling, ongoing energy consumption, and periodic maintenance - resulting in significantly higher cost and embodied carbon.

### 5.4 Hypothesis

The project hypothesised that photoluminescent markings could provide sufficient night-time visibility to support safe pedestrian and cyclist navigation, without the carbon, energy, and environmental impacts associated with conventional street lighting infrastructure.

*Figure 5: LuminoKrom at Everton Park in daylight*

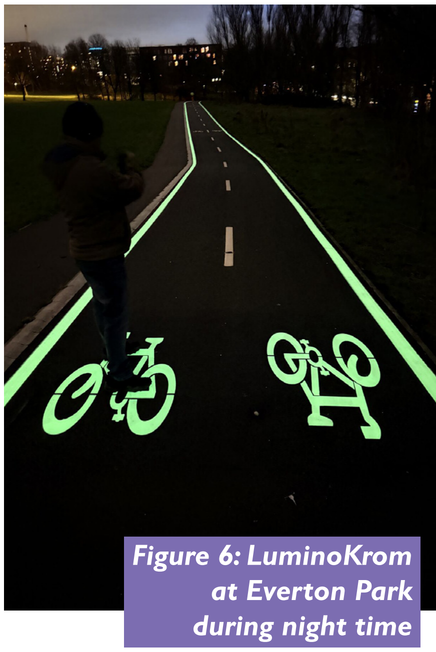

*Figure 6: LuminoKrom at Everton Park during night time*

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# CASE STUDY ROAD MARKINGS & VISIBILITY

## Lower Carbon Alternatives to Business-As-Usual Road Marking

### 5.5 Carbon Impact

The scheme delivered an estimated carbon saving of 4.5 tCO2e, representing a 97% reduction compared to the BAU lighting solution.

This saving is primarily attributed to the elimination of operational energy use and reduced infrastructure requirements.

Over a 40-year period, this saving is expected to increase to 12.1 tCO2e (96%) due to the elimination of operational energy use.

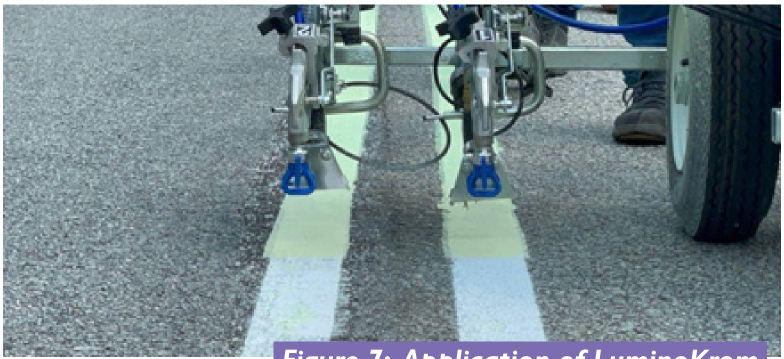


*Figure 7: Application of LuminoKrom*

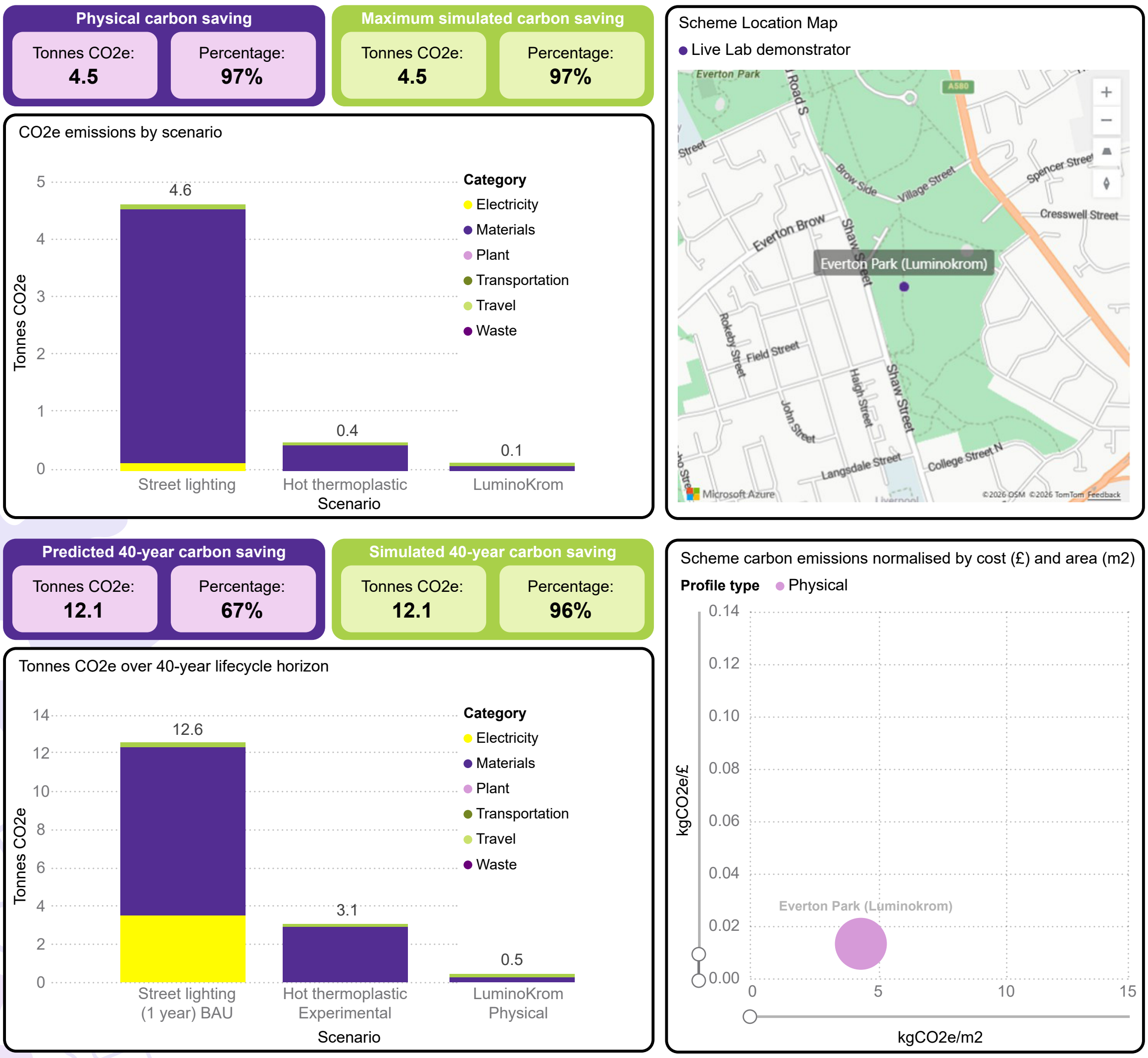



*Figure 8: Carbon profiles for LuminoKrom scheme in Everton Park, including upfront emissions (top) and long-term emissions over 40 years (bottom)*

# CASE STUDY ROAD MARKINGS & VISIBILITY

## Lower Carbon Alternatives to Business-As-Usual Road Marking

### 5.6 Monitoring & Evaluation

The installation was monitored over a 12-month period, including seasonal variations. Evaluation activities included:

- Observation of luminosity duration through all seasons.
- User perception testing to understand impacts on confidence, visibility, and feelings of safety.
- Visual comparisons with traditional white lining under low-light conditions.
- Durability assessments of the coating's performance under UK weather.

After one year, the markings continued to deliver 8-10 hours of luminosity during hours of darkness, even through periods with limited daylight exposure.

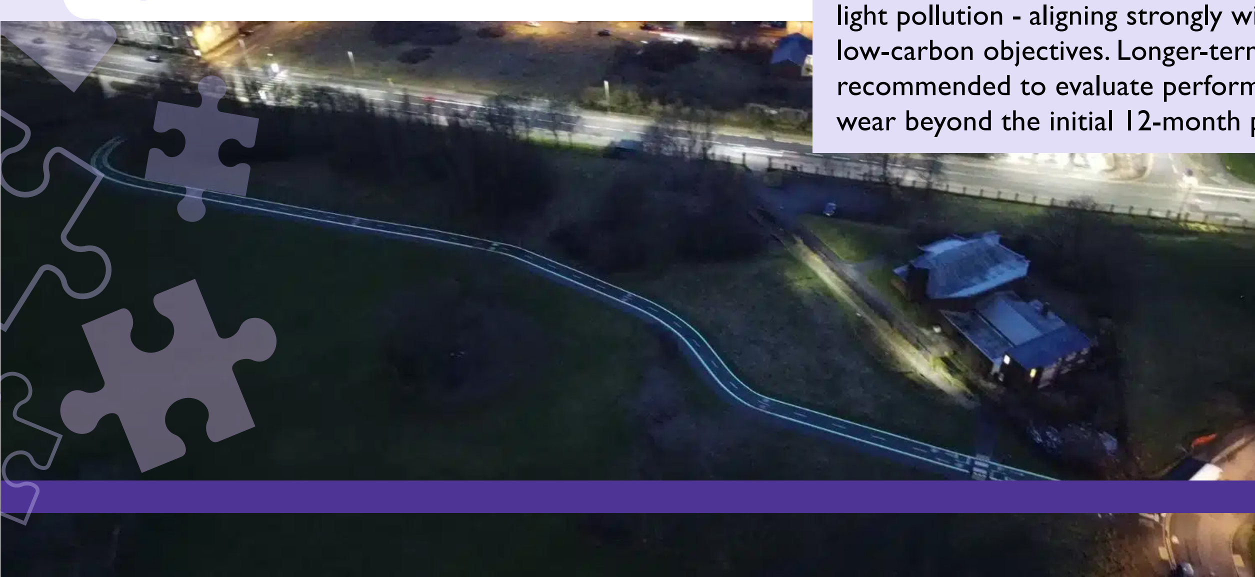
### 5.7 Outcomes & Learning

The installation successfully improved low-light visibility, providing clear delineation of path boundaries and enhancing user confidence during night-time travel. It demonstrated strong suitability for parks, green corridors, and other locations where street lighting is not viable due to financial, ecological, or carbon constraints.

Our experience has confirmed that the markings are best applied when temperatures outside are warmer, with lower levels of humidity. When installed in colder temperatures, extra care must be taken as the material may perform differently, with drying times longer.

A key lesson learned during the trial was that photoluminescent markings perform best in areas without competing artificial light sources. Where nearby streetlighting is present, the LuminoKrom® paint continues to absorb light, but the emitted glow becomes visually indistinguishable from standard road markings. In these conditions, the benefit of photoluminescence is diminished, as the surrounding light effectively masks the glow that would otherwise be visible in darkness. This learning is important when selecting future trial locations, ensuring photoluminescent solutions are targeted to genuinely low-light or unlit environments.

The product delivered evident environmental advantages, including eliminating energy use, avoiding disruption to green infrastructure, and reducing light pollution - aligning strongly with dark-sky and low-carbon objectives. Longer-term monitoring is recommended to evaluate performance and surface wear beyond the initial 12-month period.



# CASE STUDY ROAD MARKINGS & VISIBILITY

Lower Carbon Alternatives to Business-As-Usual Road Marking

## 6. ULTIGLOW: GLOW-IN-THE-DARK ASPHALT SYSTEM

### 6.1 Innovation Description

ULTIGLOW is an innovative glow-in-the-dark asphalt system that incorporates photoluminescent chippings into a specially prepared asphalt receiving layer. The chippings absorb daylight and emit a visible glow in darkness, designed to improve night-time visibility for pedestrians and cyclists. The system offers:

- A distinctive glowing appearance, available in aqua, yellow, or combined effects.
- Suitability for footpaths, cycle paths, promenades, and landscaped areas.
- Potential to support safety and night-time demarcation, helping users navigate in unlit settings.
- Simple installation using conventional equipment - the asphalt is laid by machine or hand, and the photoluminescent chippings are applied in a process similar to a standard HRA finish.

The visual uniqueness of the material made it especially suitable for public-facing demonstration trials aimed at stimulating interest and understanding of sustainable surface innovations.

*Figure 9: Ultiglow at Newsham Park*

*Figure 10: Ultiglow and standard footway*

### 6.2 Context & Site Selection

The selected site was an unlit active-travel corridor where users had previously raised concerns about visibility and safety at night. The location also served as the trial area for another Live Labs footway material experiment, providing an opportunity to observe real-world route-choice behaviour: specifically, whether pedestrians and cyclists would choose a longer but visually interesting glow-in-the-dark route, or prefer the shorter standard footway surfacing.

Beyond safety and behavioural insights, the site also offered a unique opportunity to engage the public in conversations about decarbonisation, sustainable materials, and low-carbon alternatives to traditional lighting. By placing a visually distinctive innovation directly into the community, the project team aimed to increase awareness, spark curiosity, and generate discussions about practical, low-energy approaches to improving the night-time public realm.

The chosen location was intentionally low-light to test the performance of photoluminescent surfacing in the absence of nearby artificial lighting, consistent with ULTIGLOW's intended use of "enhancing or even replacing external lighting and/or conventional markings in certain environments.

# CASE STUDY ROAD MARKINGS & VISIBILITY

## Lower Carbon Alternatives to Business-As-Usual Road Marking

### 6.3 BAU Comparator

The Business-As-Usual comparator for this scheme was the installation of traditional wired streetlighting infrastructure to illuminate the route during hours of darkness. This would ordinarily involve trench excavation, cabling, post installation, and ongoing energy consumption - activities associated with higher embodied carbon, greater environmental disturbance, and higher long-term operational costs.

### 6.4 Hypothesis

It was hypothesised that photoluminescent chippings embedded within asphalt could provide sufficient low-light visibility to support safe pedestrian and cyclist movement, while avoiding the carbon, energy use, light pollution, and ecological disruption associated with installing and operating conventional streetlighting.

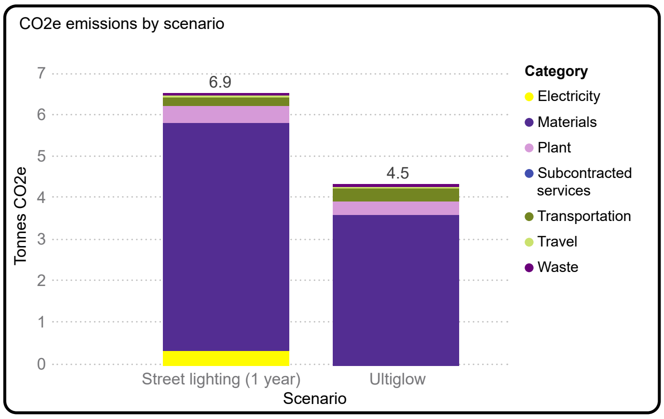
### 6.5 Carbon Impact

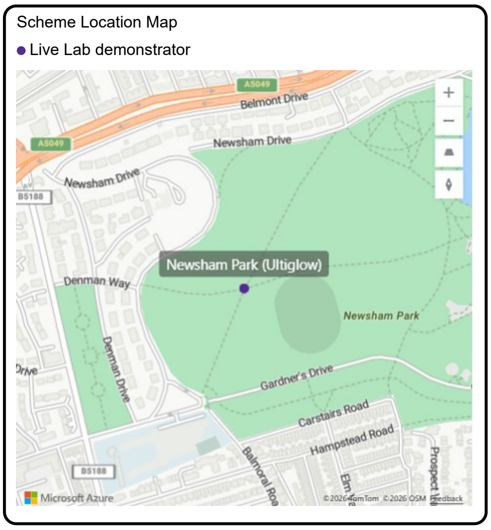
The scheme delivered an estimated carbon saving of 2.4 $tCO_2e$, representing a 34% reduction compared to the BAU lighting solution.

This saving is primarily attributed to the elimination of operational energy use and reduced infrastructure requirements.

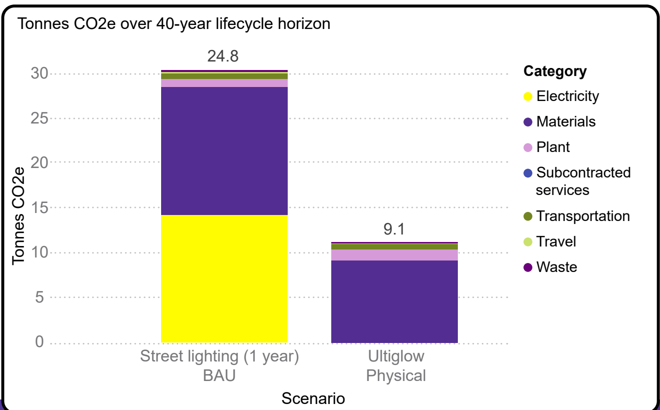
Over a 40-year period, this saving is expected to increase to 15.8 $tCO_2e$ (63%) due to the elimination of operational energy use.

| Physical carbon saving | | Maximum simulated carbon saving | |
|---|---|---|---|
| Tonnes CO2e: 2.4 | Percentage: 34% | Tonnes CO2e: 2.4 | Percentage: 34% |




| Predicted 40-year carbon saving | | Simulated 40-year carbon saving | |
|---|---|---|---|
| Tonnes CO2e: 15.8 | Percentage: 63% | Tonnes CO2e: 15.8 | Percentage: 63% |



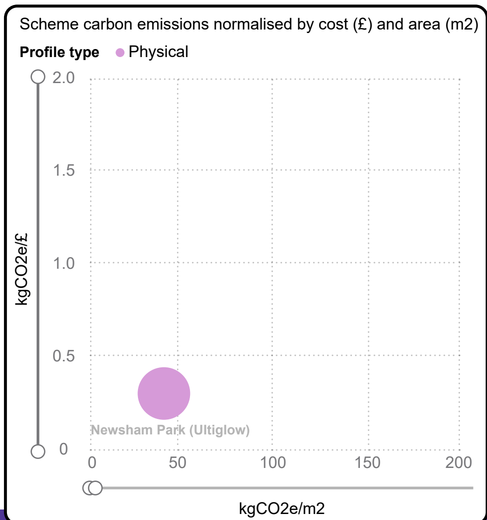




*Figure 11: Carbon profiles for Ultiglow scheme in Newsham Park, including upfront emissions (top) and long-term emissions over 40 years (bottom)*

# CASE STUDY ROAD MARKINGS & VISIBILITY

## Lower Carbon Alternatives to Business-As-Usual Road Marking

### 6.6 Monitoring & Evaluation

The installation was monitored over a 6-month period, with evaluation activities including:

- User perception testing to assess visibility, confidence, and feelings of safety along the route.
- Visual comparison with traditional asphalt under low-light conditions.
- Durability assessments, observing the performance of embedded chippings through typical UK weather exposure.

Unlike photoluminescent paint solution discussed earlier, the ULTIGLOW chippings did not display strong luminosity, and their glow was significantly less visible during extended periods of low daylight. This limitation was compounded by the small aggregate size, which reduced the overall illuminated surface area.

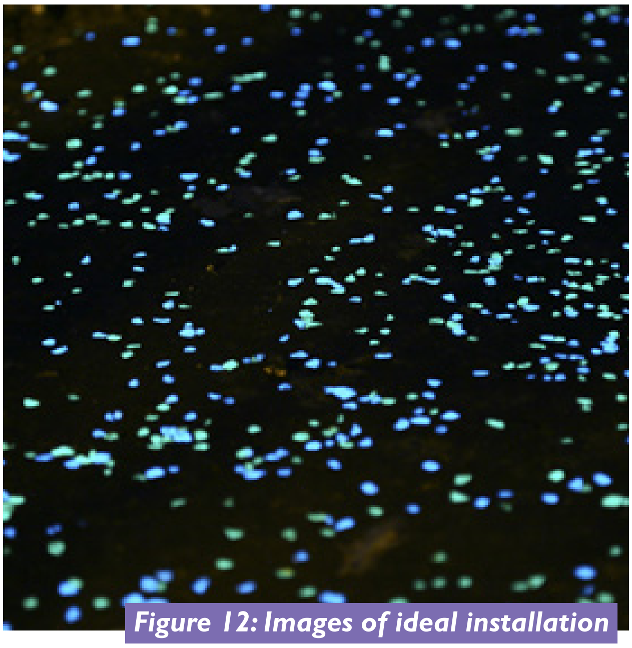


*Figure 12: Images of ideal installation*

# CASE STUDY ROAD MARKINGS & VISIBILITY

## Lower Carbon Alternatives to Business-As-Usual Road Marking

### 6.7 Outcomes & Learning

The trial achieved partial success. Some improvement in night-time visibility was observed, and users initially expressed curiosity and optimism about the glowing route. During the first days after installation, many travellers deliberately chose the longer glowing path over the shorter conventional one, demonstrating early positive engagement and strong public interest in the innovation. Over time, however, regular users gradually reverted to their usual preferred routes, indicating that novelty influenced early behaviour more than long-term functional benefit.

Several important learning outcomes emerged:

**1. Limited luminosity due to chip size**

The small chipping size reduced light-emitting surface area, resulting in weaker visibility than anticipated. If used again in future, larger chips or increasing chip volumes in the mixture may have added benefit.

**2. Wildlife interaction**

An unexpected issue was observed where birds pecked at the surface in an apparent attempt to remove the chippings. In some cases, they were successful, revealing a potential ecological or behavioural incompatibility that should be considered in future designs. The location of the pathway near a lake, and within a park with many trees may have added to the issue.

**3. Competition with nearby lighting**

As with other photoluminescent products, ULTIGLOW performed best in areas free from artificial light. Where any nearby streetlighting or ambient lighting was present, the glow became washed out, making the chippings appear similar to standard aggregate rather than a luminous surface. ULTIGLOW requires near-complete darkness to glow at full effectiveness. For future applications, pathways deeper within a park area, or where no exisiting streetlighting is present, would result in a more successful trial/ demonstration.

**4. Positive community engagement**

The trial generated significant local interest due to its novelty. It successfully opened conversations around low-carbon alternatives, innovative surfacing, and the wider aims of the Live Labs project.

It was popular with younger children, who also had been seen looking to extract the 'glowing gems' from the footpath surface.

**5. Environmental advantages**

The system consumes no operational energy, introduces no additional light pollution, and avoids the ecological disruption associated with lighting installation - making it compatible with dark-sky and biodiversity objectives.

Further monitoring over a longer period is recommended to assess durability, performance degradation, and user interactions beyond the initial 6-month window.

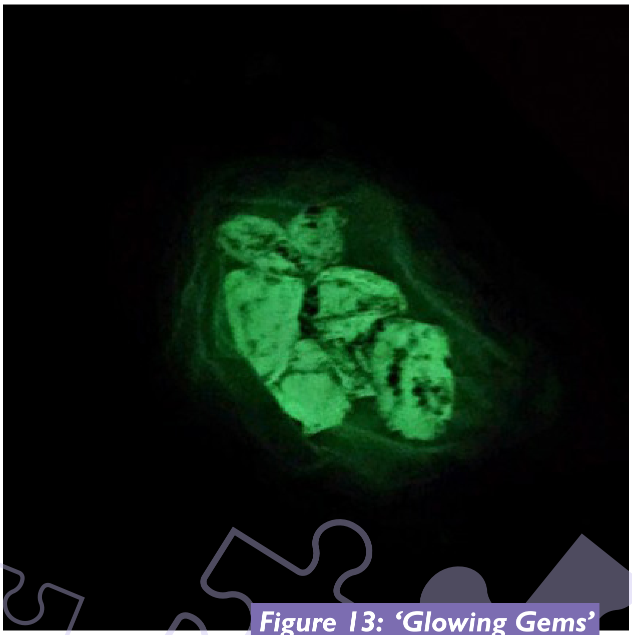


*Figure 13: 'Glowing Gems' as termed by children*

# CASE STUDY ROAD MARKINGS & VISIBILITY

Lower Carbon Alternatives to Business-As-Usual Road Marking

## 7. COLD APPLIED MMA

### 7.1 Innovation Description

MMA (Methyl Methacrylate) is a two-part, cold-applied road marking material used as a durable alternative to thermoplastic. Unlike heat-applied products, MMA cures chemically rather than thermally, enabling:

- Lower-carbon installation due to no burner or heating requirements.
- Strong adhesion to a wide range of substrates.
- Excellent UV and wear resistance.
- Longer life expectancy than conventional paint marking.

In this scheme, MMA (KSP120) was selected specifically for its sustainability benefits, ease of application using van-based logistics, and consistent performance in refurbishment scenarios.

### 7.2 Context & Site Selection

This trial was completed as part of ongoing work to understand the performance, carbon impact, and practical considerations of MMA cold-applied road marking systems. The Pinehurst Avenue scheme used MMA (KSP120) in place of screed thermoplastic across multiple site visits, allowing the project to observe installation conditions, durability, and real-world constraints while also quantifying embodied carbon impacts. The site was selected because it offered:

- A live traffic environment with realistic operational constraints.
- A mix of new and existing markings suitable for refurbishment comparison.
- The opportunity to evaluate carbon savings achieved by using cold-applied MMA instead of traditional thermoplastic.

This environment provided a representative testbed for examining installation techniques, surface interactions, weather impacts, and long-term performance.

### 7.3 BAU Comparator

The Business-As-Usual approach would have used traditional screed thermoplastic line marking, requiring:

- Heated boilers or burners for molten application.
- HGV-based logistics for transporting thermoplastic equipment and material.
- Higher material usage per square metre.

The comparison study for this scheme found that thermoplastic would have produced 1.09 $tCO_2e$, while MMA produced 0.89 $tCO_2e$, representing an approximate 0.21 $tCO_2e$ reduction across nine visits.

### 7.4 Hypothesis

It was hypothesised that MMA could be successfully applied to both new and existing markings, offering improved durability and lower environmental impact compared with thermoplastic. Additional hypotheses included:

- MMA would perform reliably if installed within appropriate temperature and humidity ranges.
- Cold-applied systems would reduce carbon emissions due to reduced energy and logistics demands.
- MMA would deliver a high-quality finish and robust performance where substrate conditions were suitable.

*Figure 14: Pinehurst Avenue with cold applied MMA*

# CASE STUDY ROAD MARKINGS & VISIBILITY

## Lower Carbon Alternatives to Business-As-Usual Road Marking

### 7.5 Carbon Impact

The scheme delivered an estimated carbon saving of 3.8 $tCO_2e$, representing an 89% reduction compared to the BAU thermoplastic solution.

This saving is primarily attributed to the use of a material with a lower embodied carbon content and the reduction of energy consumption during the application process.

Over a 40-year period, this saving is expected to increase to 27.2 $tCO_2e$ (92%) due to the elimination of operational energy use.


*Figure 15: Carbon profiles for cold-applied MMA scheme on Pinehurst Avenue, including upfront emissions (top) and long-term emissions over 40 years (bottom).*

# CASE STUDY ROAD MARKINGS & VISIBILITY

## Lower Carbon Alternatives to Business-As-Usual Road Marking

### 7.6 Monitoring & Evaluation

Monitoring took place throughout the installation period, focusing on application method, weather conditions, surface compatibility, and finish quality. Evaluation included:

**Application Over Existing vs New Markings**

MMA can be applied over new markings, but best practice requires a minimum 24-hour curing period before overlay.

- Refurbishment conditions often provide better performance, as older markings are well-bed in, with voids filled and the surface texture stabilised.

**Weather & Site Condition Assessment**

Works were evaluated under varying site conditions, revealing that the most suitable environment for MMA installation included:

- Dry weather
- Ambient temperatures above 5°C
- Road surface dry and stable
- Relative humidity below 80%

Installation cannot occur in active rainfall, and if rainfall stops, drying may be assisted using a Zirroco device, depending on surface conditions.

**Observed Constraints**

- High humidity above 80% negatively affected curing.
- Dampness within the substrate delayed application and sometimes prevented early-morning starts.
- Road closure efficiency and competent crews significantly improved installation performance.

**Performance Findings**

- MMA material demonstrated strong adhesion and high-quality finish when placed under the correct conditions.
- MMA avoided the heating energy required by thermoplastic, supporting carbon reduction outcomes aligned with the Pinehurst carbon report.

### 7.7 Outcomes & Learning

**What Worked Well**

- Full road closures allowed safe, efficient working.
- Dry, mild conditions supported rapid curing and high-quality finish.
- Using van-based logistics and cold-applied product reduced carbon emissions compared to thermoplastic.
- Using a competent, experienced crew and suitable equipment ensured consistent finish quality.
- Application over worn existing markings performed particularly well due to stable substrate conditions.

**What Didn't Work Well**

- Elevated humidity (>80%) and damp surfaces delayed works and negatively affected curing.
- Rainfall or residual moisture created unsafe or unsuitable conditions for MMA.
- Newly laid surfacing required extended curing periods before MMA could be applied.

**Key Lessons for Future Schemes**

- MMA should not be applied to newly laid surfacing until a minimum of 28 days has passed, allowing oxidisation and substrate stabilisation.
- A temporary lining may be required (e.g., K710 or K835) while waiting for the substrate to stabilise.
- Relative humidity must be below 80% to ensure successful curing.
- MMA is most effective when used for first-stage remarking or refurbishment, where a single, well-bonded thermoplastic layer remains.
- Minimising weather-related risk by selecting optimal installation windows greatly improves outcomes.

# CASE STUDY ROAD MARKINGS & VISIBILITY

## Lower Carbon Alternatives to Business-As-Usual Road Marking

### 8. Trial Findings

The trials demonstrate that low-carbon alternatives to traditional road markings and lighting can deliver significant carbon savings when evaluated against their Business-As-Usual equivalents. Each innovation - LuminoKrom, Ultiglow, and MMA - showed measurable reductions in embodied or operational carbon by replacing high-energy lighting, heated thermoplastic, or heavy logistics.

Performance across all three trials highlighted that outcomes depend strongly on site conditions and correct product-to-context matching. Photoluminescent materials require dark environments to be effective, while MMA requires dry, stable, low-humidity conditions to cure properly. Overall, the programme confirms that decarbonisation of road marking and visibility solutions is both viable and practical when deployment is context-led.

### 9. Recommendations for Business-As-Usual Integration

- Deploy innovations where carbon savings are high and operational performance is maintained.
- Screen locations carefully to ensure photoluminescent products are used only in dark areas, and that MMA is scheduled for dry, low-humidity weather windows.
- Use temporary markings when MMA cannot be applied immediately on new surfacing.
- Continue to prioritise low-carbon logistics, such as van-based operations, and avoid heated processes where possible.
- Conduct further trials in high-wear conditions to validate long-term durability before full BAU adoption.

### 10. Testimonials

Suppliers appreciated the opportunity to test innovative materials in real conditions and valued Liverpool's evidence-based carbon assessment process.


*Figure 16: Comments about the scheme from the public*

LCC officers and operational crews praised the reduced need for heavy plant, simpler logistics, and the public engagement benefits - especially glowing materials that visibly demonstrated decarbonisation efforts.

Neighbourhood Teams have highlighted strong community interest, noting that the innovations sparked public conversations about sustainability, safety, and the future of public spaces. They expressed support for wider deployment where site conditions are appropriate.