CASE STUDY — CARBON REDUCTION IN HIGHWAY MAINTENANCE MATERIALS

Carbon-Negative Aggregate in Asphalt: Evaluating ACLA for the Milton Keynes Network

Evidence submission — Local Highways Maintenance Transparency Report 2026/27 (Department for Transport)

Authority	Milton Keynes City Council (MKCC)
Programme	Decarbonisation of highway maintenance materials — evaluation of carbon-negative aggregate for asphalt
Technology	ACLA (Low Carbon Materials Ltd) — a manufactured pellet aggregate, 2–8mm, that locks biochar into a mineral matrix and partially substitutes quarried stone in asphalt
Status	Options appraisal and supplier engagement completed August 2026; demonstrator scheme under development
Baseline	All MKCC carriageways surfaced with SBS polymer modified bitumen mixes; no low carbon aggregate substitution in current specification; asset-level carbon baseline in development
Indicative cost	Circa £6–7 per tonne of asphalt for each 1% ACLA loading; circa £36/tonne uplift for a net zero surface course at 6% loading
Supply chain	Available through Tarmac and Holcim as a standard decarbonisation offer; MKCC asphalt supplied principally by Tarmac via Ringway Eurovia
Transparency link	Innovation and continuous improvement; carbon reduction and net zero progress; whole-life value and evidence-led decision making

1. Background and strategic context

Highway maintenance is a materials-intensive activity. For most local highway authorities the single largest source of construction carbon is not plant or transport but the asphalt itself — the quarrying, processing and heating of aggregate and the bitumen that binds it. An authority can improve its fleet, shorten its haulage distances and switch to warm mix, and still find that the great majority of the carbon in a resurfacing scheme is embodied in the material laid.

The Department for Transport's 2026/27 transparency reporting requirements ask authorities to evidence innovation, continuous improvement and progress towards carbon neutrality alongside conventional measures of network condition. Carbon neutrality progress is expected to be scored. That creates a practical difficulty for authorities: carbon baselining at asset level remains immature across the sector, and the interventions that make the largest difference to construction carbon are also the ones that carry a cost premium at a time when budgets are measured against road condition outcomes.

MKCC became aware of ACLA following a presentation to the East and Central Region Local Authority Carbon Reduction Group (ELCRG) in June 2026. A technical session was held with Low Carbon Materials Ltd in August 2026, bringing together MKCC's strategic asset management, infrastructure performance and highway service functions — including the officer responsible for routine, reactive and resurfacing delivery, formerly a materials laboratory manager. This case study records what was established, what remains to be resolved, and how MKCC intends to proceed.

2. The innovation

ACLA is a manufactured pellet aggregate, produced in a 2–8mm range and predominantly at 6–7mm, designed as a partial substitute for quarried stone in asphalt. Its carbon benefit comes from biochar: waste biomass is

pyrolysed so that the carbon the plant matter absorbed during growth is locked into a stable solid rather than returning to the atmosphere.

The engineering problem this solves is a real one. Biochar in its raw form is difficult to handle at scale and, above roughly 0.5% by mass, it begins to overload the rheology of the bitumen — the binder can no longer do its job. That ceiling is too low for the carbon benefit to be meaningful. By binding the biochar into a mineral matrix and presenting it to the plant as a conventional graded aggregate, ACLA allows loadings of 5–8% without the handling or binder penalties, which is the difference between a marginal saving and a net zero mix.

How it performs in the mix

- **Dosing and carbon outcome —** approximately 6% ACLA takes a typical warm mix to net zero; up to 8% takes it carbon negative. At the low end, a 1% loading delivers around a 16% carbon reduction for a modest cost uplift.
- **Permanence of sequestration —** the carbon is locked irreversibly. It survives grinding, planing and recycling under normal conditions; releasing it would require temperatures in the order of 1,400–1,500°C, well beyond anything the material encounters in service or at end of life.
- **Specification performance —** on the A64 scheme, supplied by Tarmac, indirect tensile strength ratio and saturation ageing tensile stiffness tests were run on a net zero mix against a control. Both met all specifications. The control returned an ITSR of 86% and the ACLA net zero mix 95%, against a pass threshold of 80%. SATS results improved as ACLA loading increased across 0%, 3% and 5%.
- **Service record —** 45–50 commercial resurfacing schemes have been completed. The oldest, in County Durham in March 2024, laid a net zero binder course on one carriageway against a conventional control on the other; after two and a half years and two winters, no issues have been reported on either. ACLA has also been used in surface course on 8–10 County Durham schemes.
- **Strategic road network acceptance —** three trials have been completed on motorway and dual carriageway, all as permanent works rather than experimental sections, the first on the M11 just over two years ago. ACLA is listed on the National Highways low carbon opportunities register, approved for use in lower layers on the strategic road network.
- **End of life —** no ACLA road has yet been planed, so recycling performance is not yet demonstrated in practice. No issues are anticipated and, critically, the sequestered carbon is not lost when the material is recycled.

3. What changes on the network

The table below sets out the position for a typical MKCC resurfacing scheme.

Aspect	Current position (baseline)	With ACLA substitution
Embodied carbon	Conventional asphalt using quarried aggregate; carbon reduction limited to plant efficiency and warm mix temperatures	Circa 16% reduction at 1% ACLA loading; net zero achievable at circa 6%; carbon negative at up to 8%
Carbon permanence	No sequestration in the material itself	Biochar carbon locked irreversibly in a mineral matrix — survives grinding, planing and recycling; release would require circa 1,400–1,500°C
Specification compliance	Standard mixes tested to specification	A64 trial: control ITSR 86%, ACLA net zero mix 95% against an 80% pass threshold; SATS improved as loading increased across 0%, 3% and 5%
Service history	Well understood, decades of performance data	Oldest scheme March 2024 in County Durham — 2.5 years and two winters with no reported issues; 45–50 commercial schemes delivered

Aspect	Current position (baseline)	With ACLA substitution
Network approval	n/a	Three permanent trials on the strategic road network, the first on the M11; listed on the National Highways low carbon opportunities register for lower layers
Cost	Circa £130/tonne supplied for surface course; circa £80/tonne for binder course	Circa £6–7/tonne per 1% loading — a £36/tonne uplift at net zero on surface course, proportionally more palatable on binder course
End of life	Planings reused as recycled asphalt	No ACLA road has yet been planed; carbon is not lost on recycling and no handling issues are anticipated

4. Cost, supply chain and deliverability

Pricing currently runs at approximately £6–7 per tonne of asphalt for each 1% of ACLA loading. On a surface course supplied at around £130 per tonne, taking the mix to net zero at 6% loading adds roughly £36 per tonne — a material uplift. On a binder course at around £80 per tonne the same intervention is proportionally more significant in percentage terms but is applied to a layer where the specification demands are different and the case is easier to build. MKCC's working view is that an uplift in the order of £10–12 per tonne would be broadly market-acceptable as business as usual; £36 per tonne is not yet at that point.

The trajectory is favourable. Current output is 1,500–2,000 tonnes per year from a pilot plant. A new facility expected in the second half of 2027 is projected to take capacity to 30,000 tonnes per year with a cost reduction of 30–50%, which would bring net zero mixes close to the threshold MKCC considers sustainable at scale. Biochar is currently imported from mainland Europe, with onshoring planned within approximately two years — a change that improves both cost and the supply chain carbon position.

Supply chain readiness is not a barrier. All four major asphalt manufacturers — Tarmac, Holcim, Heidelberg and Breedon — have supplied net zero asphalt, and Tarmac and Holcim now offer ACLA as a standard decarbonisation solution. MKCC's asphalt is supplied principally by Tarmac through Ringway Eurovia, with Heidelberg, Holcim and Cemex also accessible. Lead time for a small scheme is a matter of weeks, and stock can support schemes of up to around 500 tonnes. A comparable case study with Surrey County Council, delivered through Ringway Eurovia, is due to report shortly.

One practical point matters for procurement: the ACLA loading required to reach net zero is plant-specific, because the baseline carbon intensity of the mix varies with the plant producing it. One London authority found that two equidistant plants operated by the same manufacturer required 6% and 8% respectively for the same outcome. Precise figures for MKCC therefore depend on engaging Tarmac's technical function directly for the local plant.

5. Issues to resolve before commitment

- **Compatibility with polymer modified binders —** MKCC specifies SBS polymer modified bitumen across the network to manage deformation risk at surface temperatures above 50°C. ACLA's interaction with PMB mixes specifically has not yet been established to MKCC's satisfaction and is the primary technical question outstanding.
- **Whole life carbon, not construction carbon —** the authority's position is that a carbon saving at the point of laying is only real if the material lasts. Polymer modified binders cost more upfront precisely because they extend life; a low carbon mix that doubles resurfacing frequency would wipe out its own saving and more. Any adoption decision must be made on a whole-life basis.
- **Level of ambition against budget —** at a £36 per tonne uplift, funding net zero from within a fixed programme means delivering fewer schemes, which risks a deterioration in road condition scores that DfT also measures. The real internal question is whether to target a circa 16% reduction at 1% loading for £6–7

per tonne across a wide programme, or full net zero on a narrow one. The authority's sustainability and carbon function needs to define what MKCC actually requires before that is answered.

- **Routine and reactive works —** MKCC lays 5–10 tonnes per day of standard 10mm asphalt on routine and reactive repairs. This is unglamorous, continuous, and cumulatively significant; even a small percentage reduction applied here would aggregate meaningfully over a year and at low absolute cost.
- **Carbon baselining —** the authority is developing an asset-level carbon baseline. Without it, the reduction achieved by any intervention can be claimed but not evidenced to the standard transparency reporting will require.

6. How this evidences the transparency report requirements

- Innovation and continuous improvement — active evaluation of a carbon-negative aggregate technology with demonstrated performance on the strategic road network, engaged at the point where it can influence forward programming rather than retrospectively.
- Carbon neutrality progress — a defined, costed pathway to net zero asphalt with quantified dosing, quantified cost and a credible supply chain, rather than an aspiration without a delivery route.
- Evidence-led decision making — the assessment is built on comparative ITSR and SATS data against controls, on service history through multiple winters, and on plant-specific carbon figures, not on supplier claims.
- Whole-life value — the authority has explicitly declined to treat construction carbon in isolation, and is testing compatibility with its polymer modified specification before committing, to avoid a carbon saving that is reversed by shortened asset life.
- Collaboration and sector learning — MKCC is facilitating a presentation to the ELCRG South East and Central group so that other local authorities can access the same technical assessment, and is drawing on the experience of County Durham, Surrey and National Highways.

7. Next steps

- **Obtain full test and carbon data.** Case studies, ITSR and SATS results against controls, and mix-specific carbon figures — with binder course scenarios prioritised — to support the internal case to budget holders.
- **Establish plant-level carbon figures.** Engage Tarmac's technical function to determine the ACLA loading required for net zero at the plant serving Milton Keynes, given the demonstrated variation between plants.
- **Set the level of carbon ambition.** An internal decision, with the sustainability and carbon team, on whether MKCC targets a broad low-cost reduction or full net zero on selected schemes.
- **Develop a demonstrator scheme.** Most likely a binder course application, with Stratford Road identified as a near-term candidate; kept small in scale until the price point improves with the 2027 capacity expansion.
- **Share the assessment with the sector.** A short session at the ELCRG South East and Central group, giving multiple local authorities access to the same evaluation and avoiding duplicated effort.

Prepared by MKCC Highways Service — August 2026. Technical source: Low Carbon Materials Ltd, ACLA product and performance data, supplier technical session, 3 August 2026. Comparative test data (ITSR and SATS against control mixes), scheme case studies and plant-specific carbon figures to be held by the Highways Service and available to DfT on request. Figures quoted are indicative and subject to confirmation with the supplying manufacturer.