



Centre of Excellence
for Decarbonising Roads




MILES MACADAM MILEPAVE PMB LIVE TRIAL EVALUATION REPORT

Live Labs 2 North Campus

This report presents the findings of a live trial evaluating MilePave PMB, an asphalt grouted, macadam surface course, as a sustainable alternative to Hot-Rolled Asphalt (HRA). MilePave demonstrated overall higher carbon emissions (A1-A5) than HRA. However, MilePave has the potential to offset these emissions over-time due to its high resistance claims. Recommendations drawn from this trial include Miles Macadam gaining an Environmental Product Declaration for MilePave to further verify the materials low carbon claims.

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Executive Summary

This report evaluates a live trial conducted as part of the Live Labs 2 project, which aims to test innovative highway solutions to reduce carbon emissions, improve road performance, reduce maintenance needs, and enhance safety. This trial concerns MilePave, described by the manufacturer as a hot-applied, open-graded PMB asphalt surface course sealed with an asphaltic grout sealant containing polymer-modified bitumen binder. It is designed to reduce fretting, water ingress, oxidation, and stone loss while delivering high skid resistance and temperature resilience. For this trial, MilePave was supplied and manufactured by Miles Macadam with Holcim handling mixing and site delivery at their nearby Duntilland quarry and then laid by Miles Macadam.

The supplier and manufacturer, Miles Macadam, claim that MilePave achieves carbon savings due to its grout sealing and PMB binder that extends useful life and reduces the need for frequent maintenance and stone replacement, reducing cumulative emissions over an extended service life.

MilePave was trialled as part of the Supersite trial (a single stretch of highway trialling several materials and techniques) along Hirst Road in North Lanarkshire. MilePave was trialled as a surface course along Junction 2 of the supersite at a depth of 50mm. A control section of Hot Rolled Asphalt (HRA) surface course was also applied to the Supersite at 50mm to allow for direct comparisons to the business as usual (BAU) approach to surfacing for North Lanarkshire Council. The findings, limitations, and recommendations presented here aim to inform the potential wider rollout of MilePave across UK local councils.

This report assesses carbon emissions across material extraction to construction lifecycle stages in accordance with EN 15804, covering product stages A1-A3 of this standard (raw material extraction, transportation to processing facilities and manufacturing) and construction stages A4 to A5 (transportation of the finished material to site and installation). EN 15804 classifies carbon and establishes a modular, transparent approach to lifecycle assessment that assigns emissions to defined stages. Using EN 15804 ensures that this live trial is in line with the recognised European standard, follows accepted boundaries and allocation rules, and enables results that are comparable, auditable and consistent across products and projects.

The findings from the trials have shown MilePave has higher recorded A1-A5 emissions when benchmarked against HRA, producing an 55% higher embodied carbon figure per square meter in this trial. However, this does not consider the substantial durability benefits from the asphaltic grout sealant which holds potential to offset this initial higher carbon emissions over the whole lifecycle of the surface. It is important to highlight that carbon emission factors for this trial are supplier-sourced and an independent third-Party verified Environmental Product Declaration (EPD) for MilePave was not available at the time of this trial. This limits independent verification, direct comparability and reduces the overall confidence of this carbon analysis.

Introduction

This Evaluation Report provides a high-level assessment of MilePave, an emerging sustainable material in highways, construction and maintenance, focusing on its environmental impact, product viability, and alignment with future infrastructure needs.

This product is being trialled as part of Live Labs 2 a three-year UK-wide programme funded by the Department of Transport (DfT), with a five-year monitoring and evaluation period, focusing on how to decarbonise local highways infrastructure and assets. As part of this initiative, North Lanarkshire Council (NLC) are working alongside Transport for the West Midlands (TfWM), to establish the UK Centre of Excellence for Materials Decarbonisation in Local Roads.

The Centre of Excellence will act as a central hub within Live Labs 2, supporting research, innovation, and best practices to accelerate low-carbon solutions in road construction and maintenance. By integrating findings from Live Labs 2 trials, the Centre will drive sustainable advancements, enabling Local Authority Highway sectors across the UK to adopt more efficient and environmentally responsible materials and methodologies.

The purpose of these reports is to present key findings from a comprehensive evaluation of sustainable materials, including their carbon intensity, potential application, and overall benefits by examining carbon appraisals, lifecycle benchmarks, and various factors such as scalability, compliance, durability and supply chain viability. The report aims to provide decision-makers with valuable insights into the material's capacity to meet sustainability goals while maintaining construction quality and durability. The evaluation will inform ongoing efforts to balance environmental considerations with operational efficiency in infrastructure development.

The carbon profiles of materials have been calculated using the Future Highways Research Group (FHRG) Carbon Leadership Profiler Toolkit (previously known as Carbon Analyser), a excel-based tool developed in collaboration with local highway authorities to provide a simple, standardised method for quantifying carbon emissions associated with transport and highways activities, and the OneClickLCA database where embodied carbon data is otherwise unavailable. All carbon profiles have incorporated a local and sector-wide baseline material to benchmark carbon savings. The MilePave PMB trial has been evaluated against conventional HRA. For this trial, Miles Macadam supplied and laid the MilePave while Holcim mixed and delivered the material from its nearby Duntilland quarry.

The carbon evaluations for MilePave PMB incorporate whole lifecycle assessments which consider:

- Embodied Carbon;
- Transportation emissions of materials and people;
- Operation of plant and equipment during construction period;
- Operational electricity, fuel and water emissions;
- End of life emissions including deconstruction and waste processing.

Feature	Description	Carbon Intensity	Product Prospects
Material Summary	Description of material	Specific emissions data (CO₂e per unit of material)	Brief product potential overview
MilePave PMB– Miles Macadam	<p>MilePave is an asphalt grouted, open-graded macadam surface course. The material is hot applied, laid via a conventional paver and sealed with an asphaltic grout.</p> <p>The asphalt grout sealing prevents fretting and water ingress, reduces the speed of oxidisation and reinforces surface strength.</p> <p>The addition of PMB (polymer-modified bitumen) binder to the grout sealing enhances cohesion, strength and temperature resistance compared to standard binders.</p> <p>MilePave’s high durability makes it suitable for highly trafficked areas such as the junction within this trial.</p>	<p>This product produced 14.27 kgCO₂e/m². When applied on the same stretch of road the control, conventional HRA produced 9.19 kgCO₂e/m². Both surface course materials were applied at a depth of 50mm.</p> <p>Comparative carbon analysis in this trial showed a 55% increase in A1-A5 lifecycle stage carbon emissions per square metre.</p> <p>However, a key benefit of the added asphalt grout is improved durability. Modelling indicates that if MilePave extends service life by 5 years compared with conventional HRA, lifecycle carbon emissions fall by 27% and if service life is extended by 20 years, the modelled reduction increases to 63%.</p>	<p>It is considered that this product has a potential in the road construction and maintenance industry, particularly in projects prioritising high durability.</p> <p>MilePave has not shown material stage carbon savings when compared to HRA within this trial. However, when modelled to demonstrate its high durability aspects it shows a potential 27% reduction in carbon emissions proving it can potentially deliver reduced-carbon surfacing in live environments.</p> <p>These values, supported by high durability claims, promote the inclusion of MilePave in surfacing programmes and show applicability and potential for widescale carbon savings across local authority networks. However, the implementation of a 5 years+ monitoring programme is required to verify durability claims.</p>

Methodology

Trial Design

The MilePave trail was undertaken to evaluate the performance, durability, and environmental impact of the material. The trial was conducted as part of the larger Supersite trial (a single stretch of highway trialling several materials and techniques) which focussed on testing innovative low-carbon surfacing materials and in-situ recycling techniques to evaluate their carbon savings and long-term performance under real-life road conditions.

MilePave was chosen to be applied to the junction of Hirst Road and School Road to assess the materials high durability claims.

Carbon emissions have been assessed based on the whole lifecycle stages A1-A5 (material extraction to construction) in accordance with EN 15804. EN 15804 is the European standard that defines the standards and reporting format for Environmental Product Declarations (EPD) for construction products, providing a consistent, audible framework for quantifying carbon impacts across a products lifecycle. These stages cover raw material extraction, transport to and manufacture at the factory, delivery to site and on-site installation, see Figure 1. This clear separation of stages enables precise attribution of emissions to each segment of the supply chain, helping to identify areas for potential reduction measures and ensuring comparability across all trials.

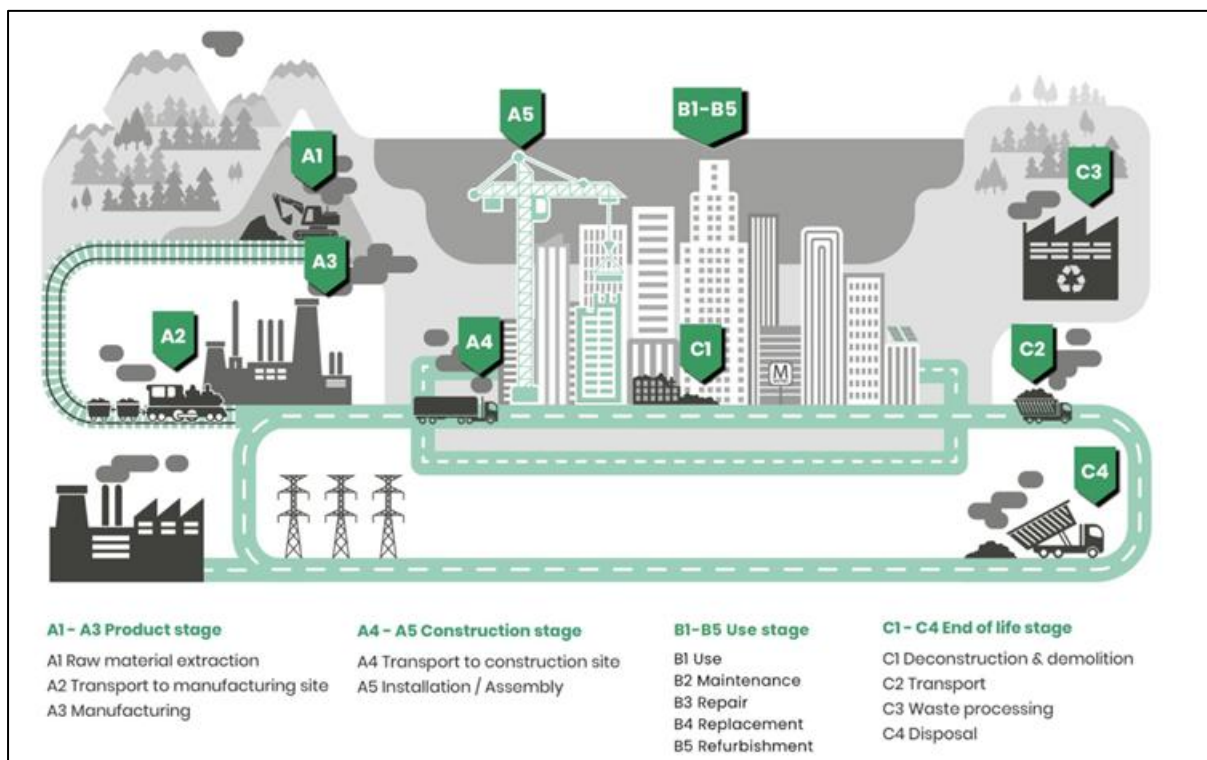


Figure 1: Carbon Lifecycle Stages¹

¹ [Life Cycle Stages | One Click LCA](#)

Site Selection

The trial sites were chosen based on the following criteria:

- **Traffic Volume:** The site was chosen as it experiences high volumes of both light and heavy vehicles allowing for assessment of the material's performance under differing stress conditions.
- **Environmental Conditions:** The Supersite site was selected due to its varying weather conditions (e.g., temperature, humidity) to evaluate the surfacing material's resilience.
- **Surface Type:** Sites were all originally with hot-rolled asphalt (HRA) and had severely deteriorated with time and use, requiring urgent maintenance.

Data Collection Plan

The following data items were collected to ensure a thorough evaluation of MilePave during site trials:

DATA ITEM	UNIT(S)	RESPONSIBLE	LOCATION OF DATA	PURPOSE
Trial Location	Road name, Road Type (A, B, C), Coordinates of location of MilePave	Operational Staff	Site Diary	Technical comparisons
Conditions at the time of lay	Temperature (°C) Conditions (rain, dry, etc)	Operational Staff	Site Diary	Operational considerations and technical comparisons
Coring	Pen Softening Point DSR	University of Nottingham	Site Diary	Technical Evaluation
Road Surface Temperature	Temperature (°C)	Inspector	Site Diary	Technical Evaluation
Quantity	m ² of MilePave used	Operational staff & Carbon Lead	Site Diary	Cost and Carbon Evaluations
Cost	£ for MilePave £ for conventional resurfacing	Amey Procurement and Suppliers	SAP	Purchase cost and whole lifecycle cost evaluation
Line Characteristics	Length and Width (cm)	Carbon and/or Technical Lead	Site Diary	Technical and Carbon Evaluation
Operational Experience – ease of installation	Subjective – any concerns or benefits experienced by Operations Team	Project Manager to collect on-site data with Operations Team	Case Study in knowledge bank	Scalability Evaluation
Health & Safety	Ease of installation on-site Temperature required for installation	Operational staff and supplier information	Site Diary	Health and Safety Assessment
Operational Data	Time to complete (hh:mm)	Operational Staff	Site Diary	Operational considerations and carbon evaluation
Fuel Usage	Litres of petrol used Type of plant/fleet used (electric, diesel, model)	Operational Staff	Site Diary	Carbon evaluation

Table 1: Data collection plan

Trial Location Plan

The primary aim of the Supersite trials is to undertake a comparison analysis of surface courses with the current benchmark used by North Lanarkshire Council, traditional HRA. There were a total of eight trial sections along one site (Hirst Road), with six surface courses and two binder courses on the main straight stretch of carriageway and a further two surface course sections at junctions – MilePave was tested on one of these junction sections. All trial sites were completed on one B classification of road (Hirst Road).

TRIAL SECTION	BINDER COURSE			SURFACE COURSE			
	MATERIAL / METHOD	DEPTH (MM)	SUPPLIER	PRIMARY MATERIAL	INNOVATION	DEPTH (MM)	SUPPLIER
1	In-situ Recycling	50	Colas	HRA	GiPave	50	Iterchemica/ Holcim
2	In-situ Recycling	50	Colas	HRA	Styrelf bio-PMB	50	Total /Holcim
3	In-situ Recycling	50	Colas	HRA (warm mix)	HRA 35/14 Warm Mix	50	Holcim
4	In-situ Recycling	50	Colas	HRA	Traditional Surface HRA 35/14	50	Holcim
5	In-situ Recycling	4% CEM II and 4% calcined clay binder (150mm HBM recycled layer)	SPL	HRA	UltiPave Bio	50	Tarmac/ Holcim
6	In-situ Recycling	4% CEM II and 4% calcined clay binder (150mm HBM recycled layer)	SPL	HRA (warm mix)	HRA 35/14 Warm Mix	50	Holcim
Junction 1	Traditional Binder	60	Hochtief	14mm HardiPave	HardiPave	40	Miles Macadam
Junction 2	Traditional Binder	60	Hochtief	14mm MilePave PMB	MilePave	50	Miles Macadam

Table 2: Supersite Trial Information

Procedure

Site Preparation: The selected sites were cleaned, prepared and planed for the application of MilePave. Loose debris and water were removed to ensure proper adhesion.

Material Application: Roads were prepped as per manufacturer's instructions prior to the products application. All materials are applied in accordance with manufacturer's instructions and specifications. MilePave was applied via a paver following conventional HRA processes. It was applied by Miles Macadam employees who were trained to install the material.

Monitoring and Data Collection: The trial sites were monitored over a period of 12 months. Data on surface condition, material performance, and environmental impact were collected at regular intervals.

Performance analysis: The performance of MilePave was evaluated based on criteria such as durability, resistance to traffic stress, and environmental impact. Comparisons were made versus traditional resurfacing to benchmark performance.

Data Analysis

The collected data were analysed to determine the effectiveness of MilePave as an alternative surfacing material to conventional HRA. Statistical methods were used to evaluate the performance of MilePave versus a control section (HRA) along the same road. The analysis focused on:

- **Durability:** Assessing the longevity of the treated site and resistance to traffic and environmental stress;
- **Environmental Impact:** Evaluating the reduction in carbon emissions and use of recycled materials; and
- **Cost- Effectiveness:** Comparing the costs associated with MilePave, including material, application, and maintenance costs.

For this trial, MilePave was supplied by the manufacturers Miles Macadam, with Holcim handling mixing and site delivery at their nearby Duntilland quarry. Holcim were responsible for material mixing prior to installation by Miles Macadam. The embodied carbon factor for trialled materials have been built based on Holcim product data, supplier product data and supported from carbon factors sourced from OneClick LCA where required. An Environmental Product Declaration (EPD) had not been produced for MilePave PMB at the time of this carbon evaluation.

Holcim have provided A1-A3 carbon values for the mixing of MilePave at Duntilland Quarry. Holcim's internal carbon tool was used to calculate these values. This tool follows the principles of EN 15804 and has been third party verified by Circular Ecology Ltd. The tool uses primary activity data from Holcim operations, secondary data coming primarily from the UK Government GHG emission factors and Inventory of Carbon and Energy v4.0 by Circular Ecology and University of Bath, with additional data supplied by Carbon Trust.

The reliance on supplier provided carbon emission factors raises possible confidence issues due to limited transparency within the supplier's methodology however, the best available data has been used to ensure consistency across trial materials.

Carbon Appraisal

Carbon appraisal

Drawing on data collected through trials; a carbon assessment has been undertaken. This establishes the parameters of the model, defines assumptions and outlines product specifications. Table 3 presents assumptions for all the materials used in the trial on site, including those employed by Holcim during the mixing process as well as the MilePave supplied by Miles Macadam.

ASSUMPTIONS	JUSTIFICATION
All transportation is undertaken via diesel HGV.	Based on standard modelling assumptions from similar schemes.
Design life of pavement surface is 40 years.	Based on PAS 2080 guidance ² . At 40 years the binder course of HRA requires replacing.
Unit of measurement used is 'kgCO ₂ e/ m ² '.	Based on the best available data used to conduct carbon appraisals.
Assuming fuel usage is based on an 8-hour shift.	Based on the best available data used to conduct this assessment.
Traffic management activities were not included within this carbon assessment.	Traffic management differs between sites and local authorities so requires separate capturing.
Government database GHG emission factor transport, HGV, diesel 2025 was used to calculate A5 for plant when a specific emission factor is unknown.	Based on the best available data at the time of this carbon appraisal.
This carbon analysis does not incorporate planing out activities within this assessment.	This is a BAU activity therefore is not influenced by this innovative process.
Where specific emission factors are unavailable OneClick LCA machine hours.	Based on the best available data at the time of this carbon appraisal.
Bondcoat application rate 1.2 kg/m ²	Based on application records from the Hirst Road Supersite trial.
Machinery hours have been pulled from site diary records	Based on the best available data at the time of this carbon appraisal.
The comparative carbon modelling for MilePave and HRA assumes a standard 20-year service life for HRA and models scenarios in which MilePave extends the surface material's service life by an additional five years and an additional 20 years. Modelling assumes every 20 years HRA requires planing and re-installing.	Based on PAS 2080 guidance.
The service-life scenario modelling does not include emissions or impacts from lifecycle stages B1–B9.	This information was not available at the time of this carbon analysis. Therefore, these stages have been excluded to ensure service-life scenario modelling to maintain a clear, auditable scope focused on construction-phase and embodied impacts where robust, project-specific data are available.
To calculate the CO ₂ e emissions per tonne of aggregate from each quarry, Holcim utilised the total energy consumption for each quarry (Duntilland and Leven seat) over the previous 12 months. Each quarry's energy use was converted to an equivalent CO ₂ emission value then divided by the total tonnage of aggregate sold in that same period.	Based on the most up to date information the contractor, Holcim, had available at the time of this carbon analysis.
Holcim utilised Eurobitume's 2025 carbon emission factor for bitumen, 530kgCO ₂ e/ tonne.	This figure is the most recent bitumen emission factor and is considered the industry standard.
Fuel consumption of dryers has been calculated by the amount of fuel used divided by the tonnage of asphalt supplied. Giving the CO ₂ e	Based on the best available data at the time of this carbon appraisal.

² [2023-03-29-pas_2080_guidance_document_april_2023.pdf](#)

value per tonne of asphalt mixed can vary plant to plant based on tonnage supplied, fuel type, efficiency etc.	
The emission factor used for fibre pellets was sourced from ASPECT.	Based on the most recent emission factors available to the contractor, Holcim, for emission factor calculation. Holcim's internal carbon calculation tool has been externally verified by Circular Ecology and follow the principles EN 15804.
The default emission factor used for RAP (reclaimed asphalt pavement) was sourced from ASPECT.	Based on the most recent emission factors available to the contractor, Holcim, for emission factor calculation. Holcim's internal carbon calculation tool has been externally verified by Circular Ecology and follow EN 15804 principles.
The emission factor used for limestone filler was sourced from ICE v.3 2020.	Based on the most recent emission factors available to the contractor, Holcim, for emission factor calculation. Holcim's internal carbon calculation tool has been externally verified by Circular Ecology and follow the principles EN 15804.

Table 3: Carbon appraisal matrix

Carbon Modelling

The carbon modelling for the trials was conducted using the Future Highways Research Group (FHRG) Carbon Leadership Profiler Toolkit to collect and analyse primary carbon data from the trials, detailing emissions from materials, transport, construction activities and equipment use. Using this information the tool generated carbon profiles that identified emission hotspots and using the toolkit's emission database providing verified emissions factors to improve data accuracy.

One Click LCA was also utilised in modelling to support the FHRG Carbon Leadership Profiler Toolkit due to its large database of emission factors supported by Environmental Product Declaration (EPD). The carbon emission factor for MilePave is supplier sourced and lacks third-party verification or EPD at the time of this carbon analysis.

Indicative results from carbon modelling for the MilePave works at School Junction (junction 2) are presented graphically in Figure 2:

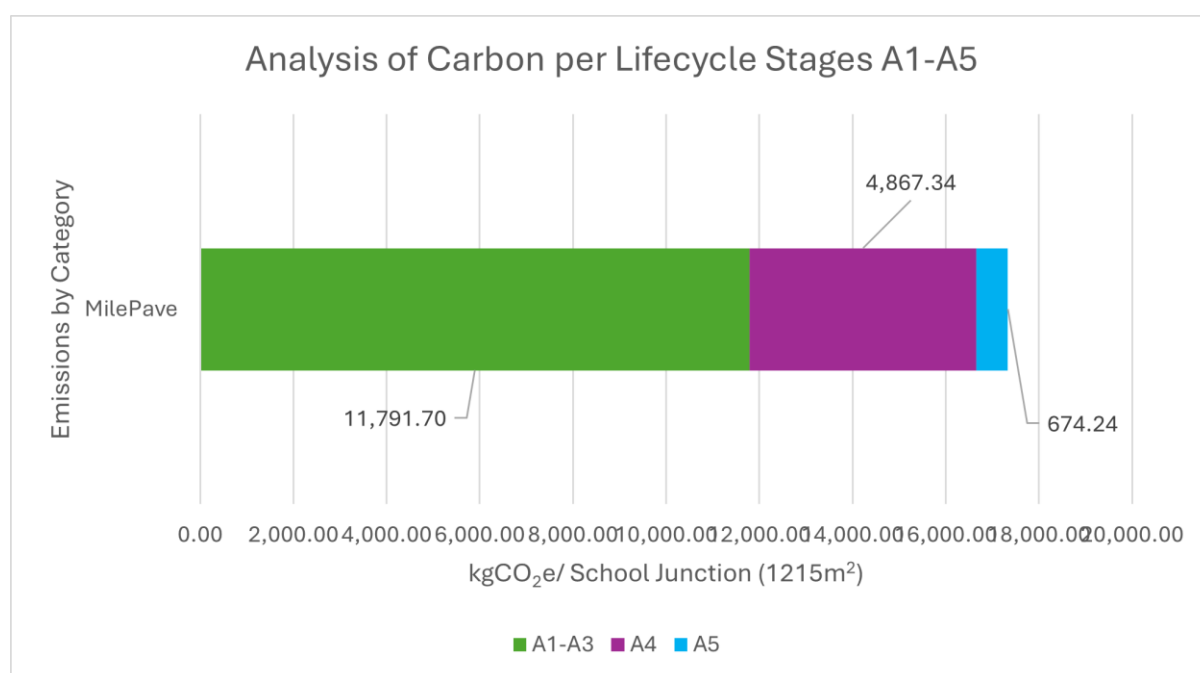


Figure 2: MilePave Analysis of Carbon A1-A5

The following graphs illustrate the live trial results, expressed in kgCO₂e/m². This presentation of emissions enables direct comparison across different surfacing materials, to highlight carbon-efficient options and support data-driven decision making for reduction strategies. See Figure 3 and Figure 4:

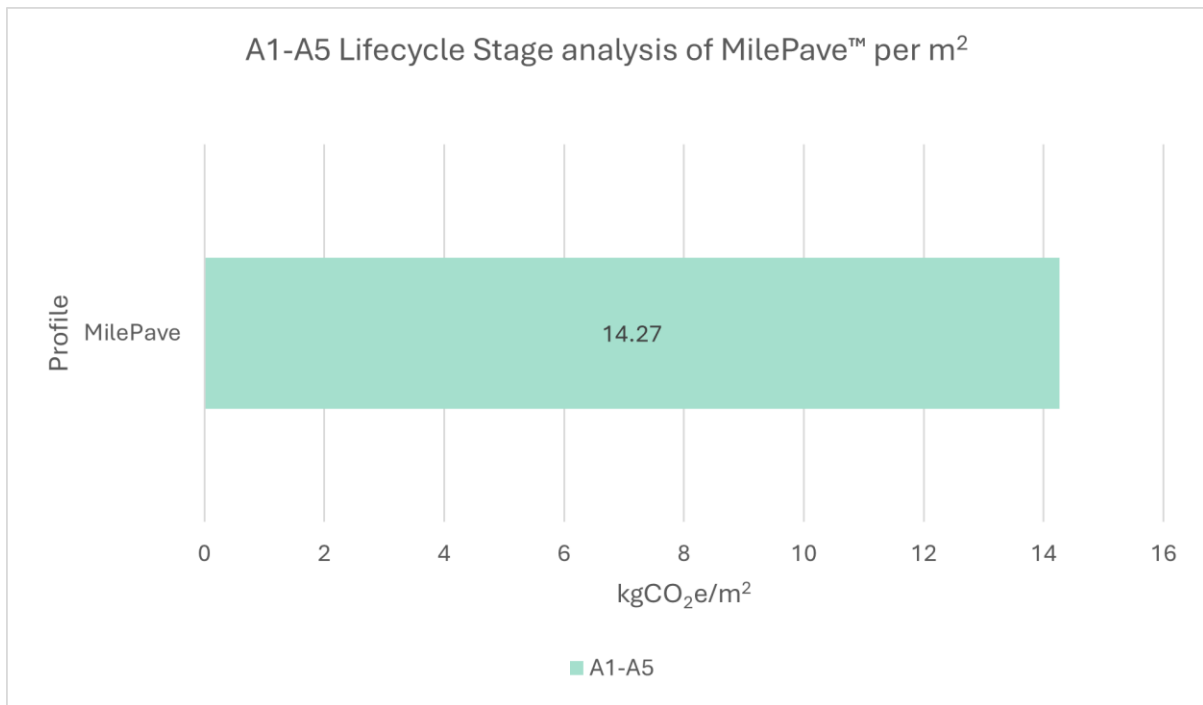


Figure 3: MilePave Analysis of carbon per m²

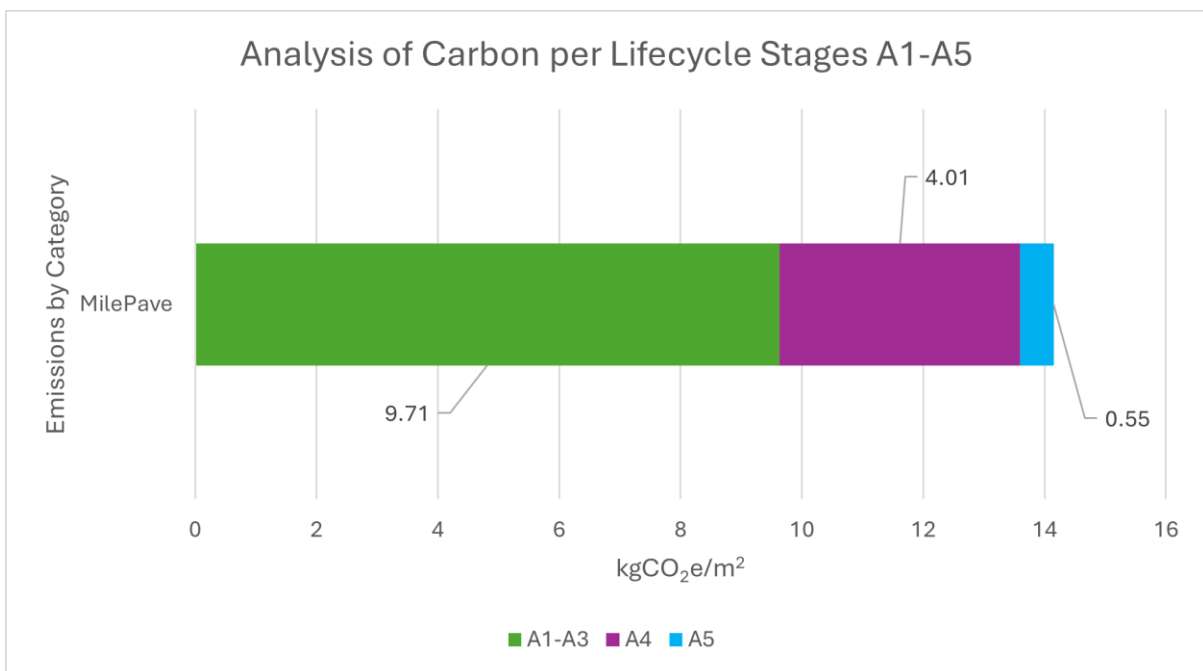


Figure 4: MilePave Analysis of carbon lifecycle stages A1-A5 m²

Benchmarking

MilePave is yet to be used as business as usual (BAU) on North Lanarkshire Highways. These trials allow for an analysis of the performance of MilePave in comparison to conventional HRA on the same road of the same traffic loads. This would be the traditional option for re-surfacing if MilePave PMB were not used and allows for comparative carbon analysis between MilePave PMB and BAU HRA surfacing.

Comparative analysis results is presented graphically in Figure 5 and Figure 6:

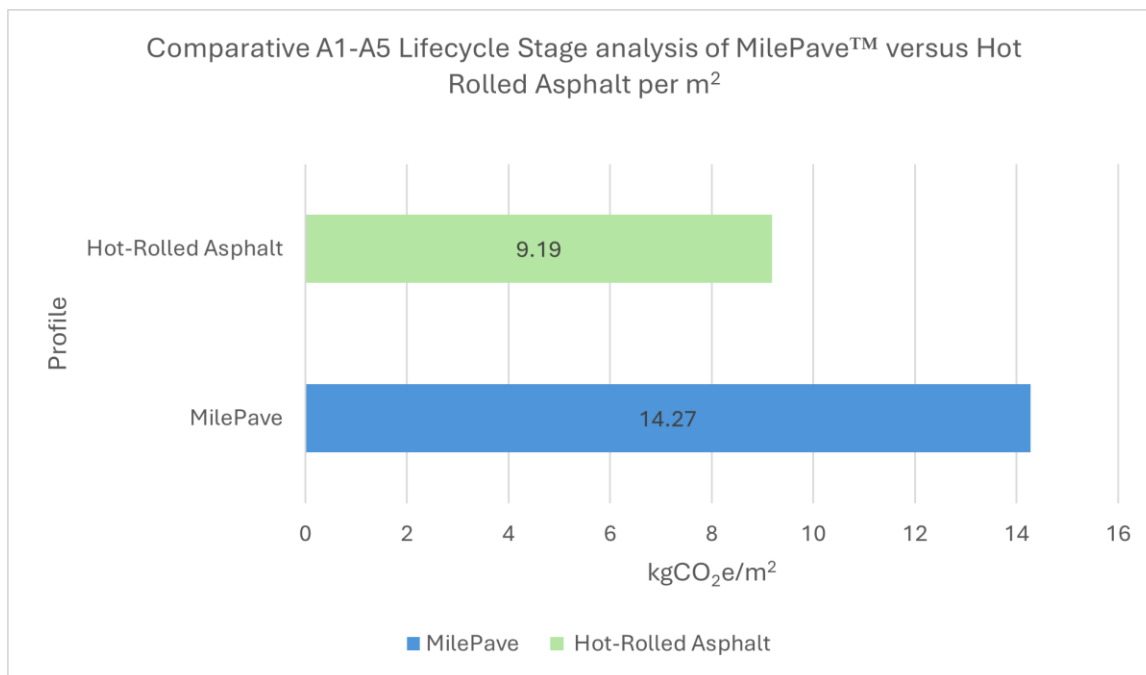


Figure 5: Comparative carbon analysis MilePave versus HRA per m² (50mm depth)

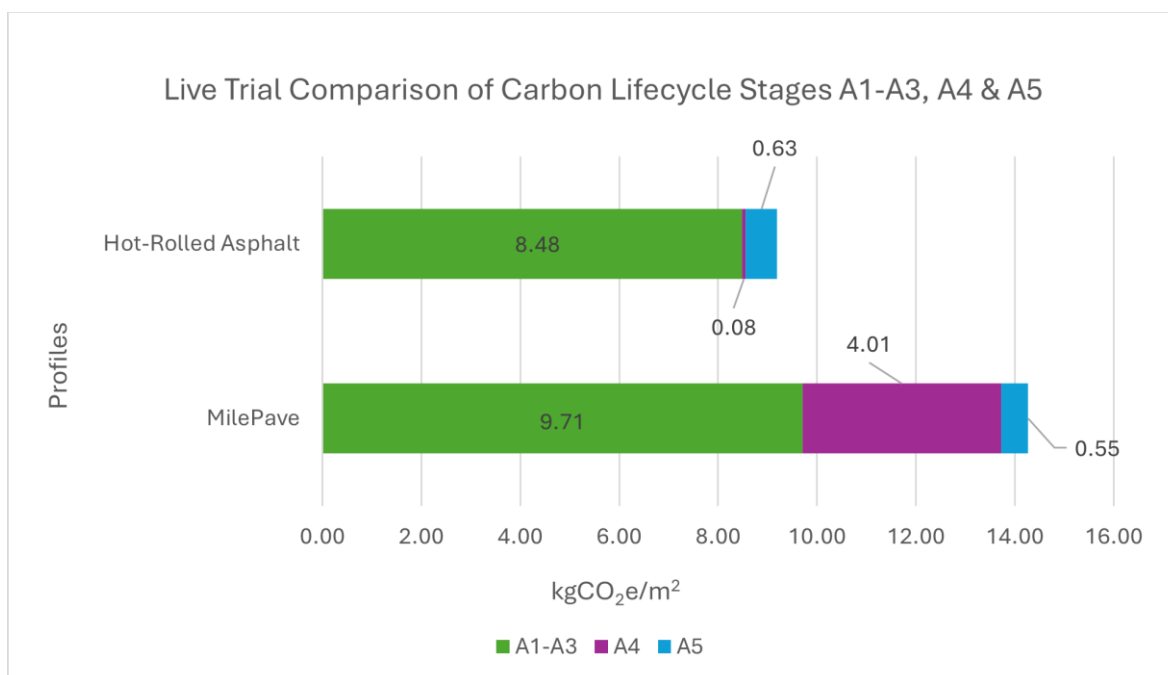


Figure 6: Comparative carbon analysis of MilePave versus HRA, lifecycle stages A1-A5.

The following shows comparative carbon modelling of MilePave under the scenario that the asphaltic grout sealant extends the pavement's service life by 5 years. This analysis accounts for the planing off, single re-application and disposal of the HRA surface course that would be required over the same assessment period. This analysis assumes the standard service life for conventional HRA is 20 years and does not include emissions associated with the surfaces use (B1-B9). Results from this modelling is represented graphically below in Figure 7:

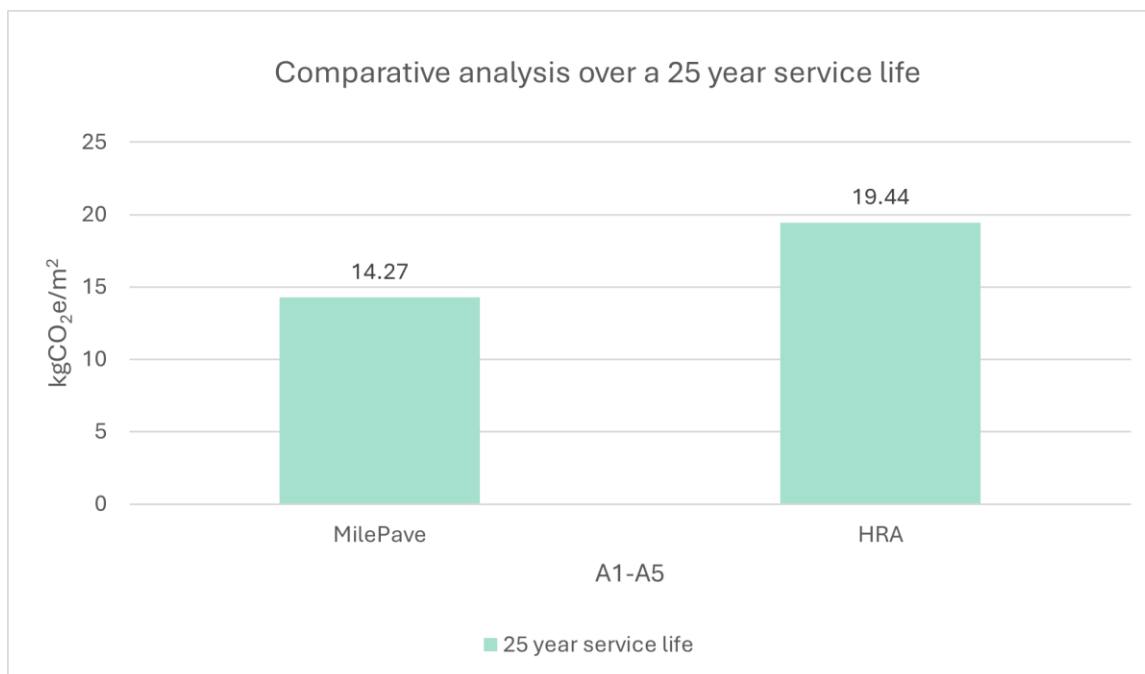


Figure 7: Comparative carbon analysis MilePave versus HRA per m² (50mm depth) over a service life of 25 years

The following shows comparative carbon modelling of MilePave under the scenario that the asphaltic grout sealant extends the pavement’s service life by 20 years. This analysis accounts for the planing off, single re-application and disposal of the HRA surface course that would be required over the same assessment period. This analysis assumes the standard service life for conventional HRA is 20 years and does not include emissions associated with the surfaces use (B1-B9). Results from this modelling is represented graphically below in Figure 8.

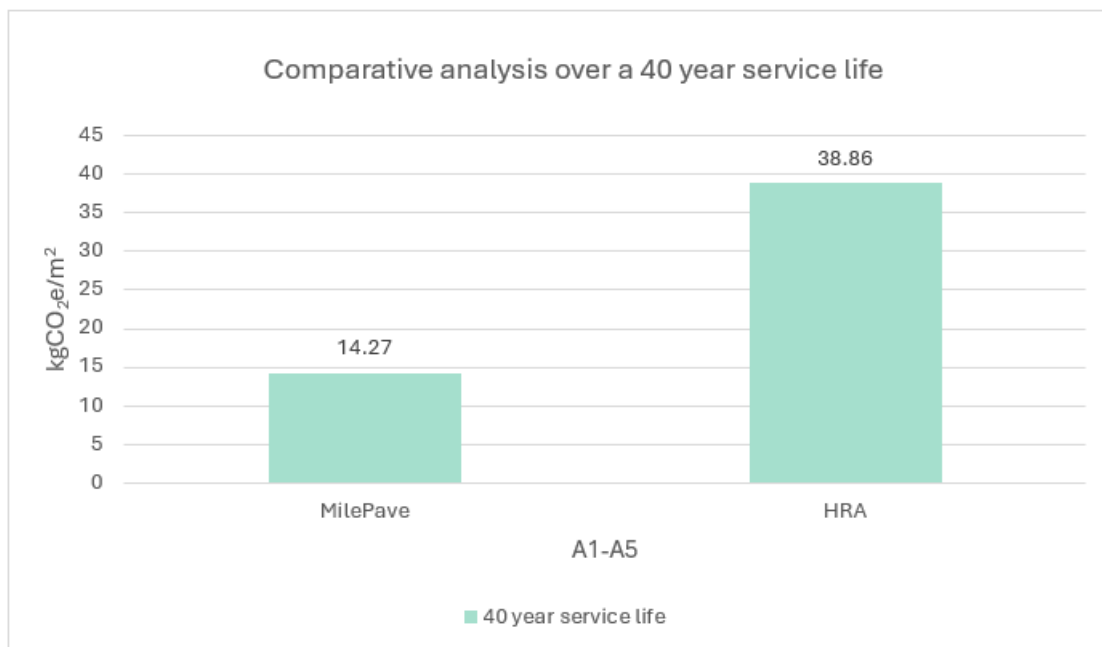


Figure 8: Comparative carbon analysis MilePave versus HRA per m² (50mm depth) over a service life of 40 years

Further benchmarking has been undertaken as the HRA control section on the supersite contained 15% RAP, which is higher than that conventionally used. RAP content varies by HRA mix and by Local Authority due to specification and design. To provide an alternative like-for-like comparison, MilePave has been modelled against an HRA baseline with no RAP. Previous scenario modelling used the figure for HRA 15% RAP, as used on the supersite. Results from this modelling are represented graphically below in Figure 9:

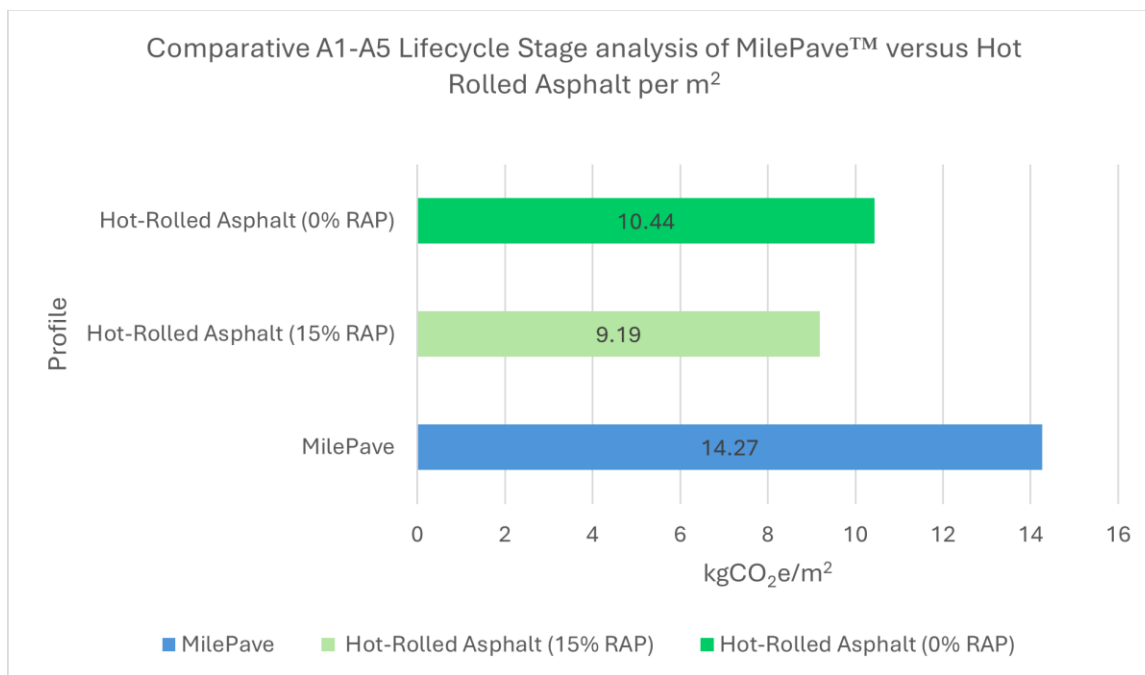


Figure 9: Comparative carbon analysis MilePave versus HRA with no RAP content per m²

MATERIAL	COMPOSITION	APPLICATIONS	PERFORMANCE	INSTALLATION	SUSTAINABILITY
HRA	<p>HRA is a gap-graded bituminous mix comprising of a mortar of fine aggregate.</p> <p>It is hot applied via a paver.</p> <p>Immediately after paving, the pre-coated high-PSV chippings are rolled into the hot mix to lock in a positive texture for skid resistance.</p>	<p>HRA is predominately intended for use on high-speed and heavily trafficked roads such as motorways, A-roads, bus lanes, roundabouts etc.</p>	<p>The densely mortared matrix makes HRA impermeable and resistant to rutting and deformation under heavy loads.</p> <p>Its sharp chippings protrude from the surface maximising adhesion and increasing skid resistance even at speed.</p>	<p>HRA is supplied and laid on site at approximately 160-180 degrees.</p> <p>After initial compaction, pre-coated chippings are spread at a controlled rate and rolled in immediately to embed them into the mortar.</p>	<p>Traditional HRA can incorporate reclaimed asphalt pavement (RAP) percentages, though high fines and virgin bitumen grades often limit RAP rates to maintain mortar cohesion.</p>
MilePave PMB	<p>MilePave is a hot, paver-laid, open-graded asphalt grouted surface course that uses asphalt grout sealing to prevent fretting and water ingress, reduce the speed of oxidation and reinforce surface strength.</p> <p>PMB binder is also added to the sealing to enhance cohesion and temperature resistance.</p>	<p>MilePave can be laid on flexible and concrete carriageways across rural and urban highway networks, including A-roads, bus lanes, roundabouts and junctions.</p> <p>Its asphaltic grout sealing makes it an ideal for concrete overlay.</p>	<p>The asphaltic grout sealing creates a layer that resists fretting, oxidation and stone loss.</p> <p>The PMB binder increases temperature resistance.</p> <p>The material has high skid resistance even in highly trafficked areas.</p>	<p>The material is laid using traditional paving machinery at a layer thickness of 30-50mm (same as traditional HRA).</p> <p>MilePave requires lower temperatures during installation.</p> <p>Immediately after compaction, the liquid asphalt grout with PMB binder is delivered by tanker and applied to the laid material to fill the voids and embed chippings.</p> <p>The material fully cures in approximately one hour, allowing quick reopening to traffic.</p>	<p>MilePave PMB requires lower mixing temperatures than conventional HRA reducing energy consumption.</p>

Table 4 MilePave Appraisal

Life Cycle Stage	Baseline Carbon Emissions (HRA) (kgCO _{2e})	MilePave Carbon Emissions (kgCO _{2e})	Difference (%) (Increase/ Reduction)
A1 – A3	17,799.73	11,791.70	33.75%
A4	163.98	4,867.34	2868.25%
A5	1,326.71	674.24	49.18%

Table 5: Comparison of lifecycle stages per instance.

Carbon Benefits and Considerations (Matrix)

Table 6 presents the findings of the carbon benefits and considerations matrix for MilePave PMB application on a HRA and SMA laid road. **All scoring is bold and underlined.**

Technical data used during benchmarking and the carbon benefits and considerations matrix were supplied by the manufacturer and are not derived from the Supersite live trial in North Lanarkshire. While reliance on supplier-provided information may introduce uncertainty in confidence levels, the information and data represent the best available evidence at the time of the appraisal. Data quality has been considered when selecting supplier information and, where possible, supplier values were chosen from manufacturers' standard test reports, specifications and product datasheets that reference recognised test methods and certification.

BENEFIT/LOAD UNDER REVIEW	CONSIDERATIONS	SCORING SYSTEM	JUSTIFICATION
Costs	Transport, operational, material procurement	1 - Significant additional costs 2 - Costs approximate baseline 3 - Costs significantly lower than baseline	MilePave PMB is typically more expensive than traditional HRA due to its dual stage grouting process and polymer modifier. However, HardiPave's increase durability has potential to reduce maintenance associated costs.
Maintenance	Design life, maintenance burden, on-time for plant	1 - Significantly more maintenance/lower longevity 2 - Approximately same maintenance/similar longevity 3 - Significantly less maintenance/higher longevity	MilePave offers high durability and minimal stone loss due to asphaltic grout sealing. The addition of PMB (polymer-modified bitumen) binder to the grout sealing enhances cohesion, strength and temperature resistance compared to standard binders, increasing longevity and reducing maintenance requirements.
Scalability	Manufacturing facilities	1 - Lab testing only 2 - In process of commercialisation w. small scale manufacture 3 - Already has market presence with developed supply chain	Miles Macadam already has market presence within the UK and has a variety of case studies highlighting the durability and suitability of MilePave for high trafficked areas.
Compliance with specifications	Requirements for standards departures	1 - Requires significant departure(s) from standard and has not been used before by end client 2 - Requires some departure from standard, but has been used before by end client 3 - Does not require any departure from standard.	MilePave PMB meets relevant National Highways and local authority HAPAS criteria.
Environmental	Nature-based solution	1 - Would have significant net disbenefit for environmental factors (noise, AQ, biodiversity, landscape etc) 2 - Would have negligible net benefit/disbenefit or no	MilePave reduces the frequency of maintenance, minimising traffic disruptions and traffic management requirements. This minimises air and noise pollution due to the absence of heavy machinery and personnel.

BENEFIT/LOAD UNDER REVIEW	CONSIDERATIONS	SCORING SYSTEM	JUSTIFICATION
		<p>overall change regarding environmental factors</p> <p>3 - Would have significant net benefit/disbenefit for environmental factors.</p>	
	Road noise	<p>1 - Would have significant net disbenefit</p> <p>2 - Would have negligible net benefit/disbenefit or no overall change regarding</p> <p>3 - Would have a significant net benefit</p>	The material does not provide any overall change in terms of acoustics when compared to traditional HRA.
	Climate resilience/future proofing	<p>1 - Would have significant net disbenefit</p> <p>2 - Would have negligible net benefit/disbenefit or no overall change regarding</p> <p>3 - Would have a significant net benefit</p>	The PMB's enhanced elasticity and the impermeable grout layer resist thermal cycling, moisture ingress, and freeze-thaw, supporting adaptation to extreme weather.
Risk and safety	H&S impacts, safety testing data	<p>1 - Would present increased risk or safety versus BAU option</p> <p>2 - Would present no overall risk increase or safety impact versus BAU option</p> <p>3 - Would present lower risk or safety impact versus BAU option.</p>	<p>Health and safety concerns were raised on site during the trial.</p> <p>This was concerning a relaxed attitude to health and safety on site, with operatives riding on moving plant with no safety chains used while working at height.</p>
Technology Readiness Level	Is it commercially available, is there enough R&D?	<p>1 - Not yet commercially available</p> <p>2 - Commercially available from worldwide suppliers</p> <p>3 - Commercially available from European suppliers</p> <p>4 - Commercially available from UK suppliers</p> <p>5 - Commercially available from local suppliers</p>	<p>MilePave is commercially available from the UK, with the head office of Miles Macadam located within Cheshire, UK.</p> <p>Has the readiness for widespread adoption for maintaining road infrastructure within the UK.</p>
Constructability	How easy is it to handle on site, install, recover, curing time, specialist equipment/training, storage?	<p>1 - Specialist contractors, time on site and/or equipment required</p> <p>2 - No considerations required above and beyond baseline solution</p> <p>3 - Significant benefits to on-site activity / ease of installation</p>	<p>The two-stage application (lay and grout) adds complexity compared to single-pass asphalt. It relies on the co-ordination of plant, materials and curing windows.</p> <p>On site there was some concern raised over constructability with some voids experienced from foreign bodies.</p>

BENEFIT/LOAD UNDER REVIEW	CONSIDERATIONS	SCORING SYSTEM	JUSTIFICATION
Supply Chain	Material availability	<p>1 - Novel materials used with limited supply</p> <p>2 - Materials are available with some supply restrictions</p> <p>3 - Materials are readily available</p>	<p>Miles Macadam has a high presence within the UK market. However, they do not have local depots within Scotland, Miles Macadam employees had to travel from Malpas, Cheshire to install MilePave in North Lanarkshire.</p>
Circular Economy	Recycled content	<p>1 - Virgin materials are used with little or no recycled content</p> <p>2 - Materials contain a level of recycled content</p> <p>3 - Materials are predominantly recycled and/or use novel sources of recycled content that would otherwise be discarded as waste</p>	<p>Miles Macadam make no claims to include recycled content within MilePave's composition.</p> <p>MilePave does not include any bio-derived aggregates or binders – instead uses polymer and bitumen.</p>
	Ease of recycling	<p>1 - Minimal recycling of material possible upon removal</p> <p>2 - Limited recycling is possible and/or significant reprocessing required</p> <p>3 - Reuse/recycling is easy and convenient</p>	<p>Miles Macadam make no claims over the recyclability of MilePave.</p>

Table 6: Carbon benefits and considerations matrix

Long-Term Performance Analysis

The carbon analysis within this report does not contain analysis of longevity. This will be finalised dependent upon the publishing of longer term test results in partnership with the University of Nottingham.

These tests will focus on the following:

- Durability and Aging Resistance,
- Skid Resistance and Surface Integrity,
- Lifecycle Carbon Savings,
- Traffic and Environmental Stress Testing,
- Optimal Reapplication Intervals.

Conclusion & Recommendations

Conclusions

Carbon analysis of MilePave has shown higher A1-A5 carbon emissions relative to the HRA benchmark. MilePave's measured carbon emissions of 14.27kgCO₂e/m² versus 9.91 kgCO₂e/m² for conventional Hot Rolled Asphalt (HRA). However, when comparing the MilePave and HRA sections, analysis displayed a 33.75% reduction in emissions per instance, indicating that materially MilePave can demonstrate potential for carbon reduction.

Transport and construction emissions (A4-A5 lifecycle stages) for this live trial were higher than the HRA baseline due to the installers distance from and travel to North Lanarkshire, and site logistics, eroding some lifecycle benefits. The trial demonstrates that reducing haulage distances, developing regional supply or installer capacity, or training local operatives will materially improve net lifecycle performance.

MilePave exhibits strong operational performance potential, characteristics highly relevant to Local Authority use. These include high skid resistance, reduced stone loss, rapid curing time, and lower mixing temperatures, supporting faster reopening to traffic and reduced disruption. These factors help make MilePave a promising low-carbon surfacing solution that can deliver meaningful carbon savings over the useful life of the material.

In scenario-based carbon modelling MilePave showed potential to reduce carbon emissions by 27% when service life was increased by 5 years and a 63% reduction over a 40-year increased, when compared to conventional HRA.

It must be considered that A1-A3 lifecycle stage modelling inputs have been produced based on supplier and contractor (Holcim) delivered data, this and the absence of a third-party EPD reduces independent confidence in reported embodied carbon values and limits direct comparability across authorities.

To convert trial findings into dependable, scalable benefits, Miles Macadam should obtain third-party verification of material production stage emissions, secure an EPD and pursue regional manufacturing or local installer capacity to reduce A4 emissions. These steps will strengthen confidence in MilePave's embodied-carbon claims and enable local authorities to realise its demonstrated carbon advantages in routine surfacing programmes.

Recommendations

North Lanarkshire council could potentially work with Miles Macadam to establish or expand manufacturing and distribution facilities within Scotland. This would minimise transport emissions and potentially highlight further carbon savings.

MilePave has potential to be utilised by Local Authorities within closer proximity to the supplier, or who can work with Miles Macadam to develop regional supply and who can leverage location for reduced transport to site. By adopting MilePave as a business-as-usual material with local held inventory, councils can streamline distribution, minimise haulage distances and associated emissions, and unlock economies of scale for a more cost-effective, low-carbon surface course solution.

It is advised that robust long-term monitoring (over 5+ years) be undertaken at the trial sites to comprehensively evaluate performance and verify lifecycle carbon savings. This further long-term monitoring will allow for more expansive carbon modelling to assess end-of-life scenarios to provide a more comprehensive understanding of whole life carbon emissions.

It is recommended that Miles Macadam prioritise obtaining a third-party Environmental Product Declaration (EPD) for the surfacing material. This should be a priority to verify their carbon saving claims. If an EPD is obtained MilePave will be in the position for integration into preventative maintenance strategies within North Lanarkshire and the wider UK. This would involve the investment in training programmes for contractors to enable broader deployment of MilePave without reliance on Miles Macadam personnel.