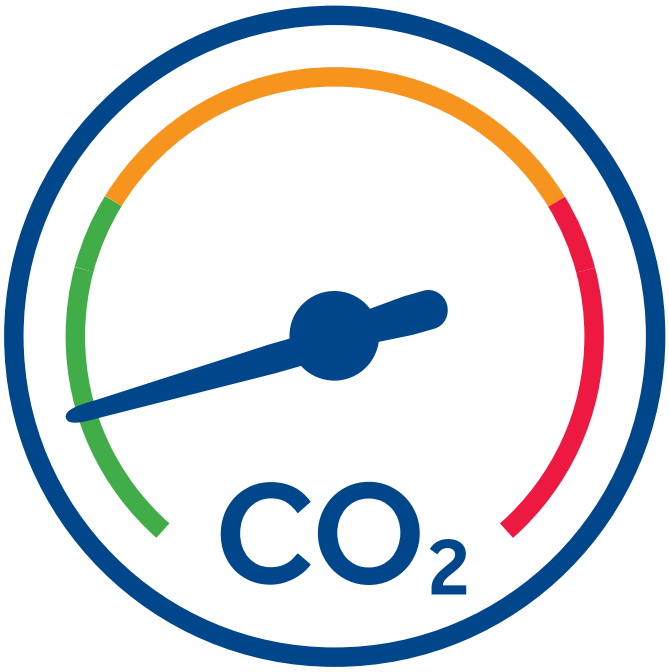
CIHT

Reducing emissions by 63% in a decade



Lessons from the highways, transportation and infrastructure sector

September 2023

Published by the:

Chartered Institution of Highways & Transportation

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Registered Charity in England No. 1136896
Registered Charity in Scotland No. SC040873
Registered Charity in Republic of Ireland No. 20103989

Published September 2023

Contents

Acknowledgements

The Chartered Institution of Highways & Transportation (CIHT) would like to thank the following people without whom the document would not have been possible.

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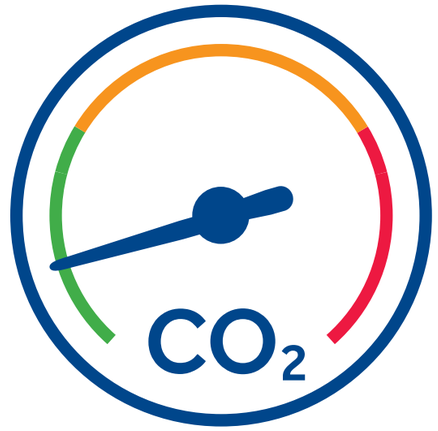
Supporters

CIHT would like to acknowledge and thank all our supporters and members of our Partnership Network who have contributed to this project.

Reducing emissions by 63% in a decade



Lessons from the highways, transportation and infrastructure sector

Foreword

Yara Al Hamdan, Chair, Reducing Emissions Project Team

Sharing the knowledge that transport professionals need to tackle the big challenges we face is at the heart of CIHT's mission as a learned society. This generation of professionals faces no bigger challenge than decarbonising our transport system.

There is growing global awareness of the urgent need to address climate change, and the role of sustainable transportation has emerged as a critical focal point for researchers, policymakers, and industries alike. Within the pages of this paper, readers will find strategies that have been successfully implemented within the transport sector to drive progress towards decarbonisation objectives, as well as examples of innovations that have been shown to contribute to the reduction of carbon embedded in highways infrastructure. This paper goes beyond theoretical discourse by delving into real-world case studies to showcase best practices and provide lessons learned from the sector.

I would like to extend my sincere gratitude to the CIHT team, especially Andrew Crudgington and Sara Zuin, for pushing this paper to the finish line, as well as members of the CIHT Partnerships and Technical Championship Networks who supported in reviewing the case studies and dedicated their expertise, time, and energy over the past six months. I would also like to thank all the organisations across the sector that have engaged with us so positively and shared details of their own parallel initiatives.

The report also provides recommendations for further work. It is our hope that this work will serve as a basis for dialogue, collaboration, and action over the coming years, where we can continue to grow our knowledge and come together in a shared commitment to decarbonise our transport systems.

Why have we produced this report?

In the highways sector, like every other part of the UK economy, we need to make deep and rapid cuts to greenhouse gas emissions (GHGs) created by our activities.

In 2019 the UK parliament approved legislation that requires the UK to achieve net zero emissions by 2050 (compared with 1990 levels). If we are to achieve this goal, action needs to begin now, because the total amount of emissions we spend on the route to net zero is as important as the target itself. To ensure that total levels of GHGs in the atmosphere do not exceed safe levels over the coming decades, the Climate Change Committee (CCC), the government's statutory advisory body, recommends Carbon Budgets. Each budget places a ceiling on emissions over successive five-year periods.

The latest, the Sixth Carbon Budget, requires a reduction in UK emissions of 78% by 2035 relative to 1990, which in practice means they must fall by 63% relative to their levels in 2019.

The Department for Transport (DfT) in England has published its Transport Decarbonisation Plan that sets out the targets and policies it is pursuing to reduce emissions from surface transport in line with the CCC budgets. The devolved governments in Wales, Scotland, and Northern Ireland all have their own, parallel plans for surface transport.

We also need to decarbonise the physical infrastructure that supports surface transport. The owners and operators of our highways assets are already responding to this challenge with the support of their partners in industry and academia. National Highways (NH) is committed to achieving net zero construction and maintenance on the English strategic road network by 2040, while local highways authorities are targeting this outcome at various dates, some as early as 2030 or 2035.

Change at this scale and speed means we do not have time to reinvent the wheel in every local highways authority or on every project or initiative. We must share information about what works and find ways to roll out these successful solutions rapidly and in as many places as possible. In this spirit, early in 2023 representatives from the organisations that make up the CIHT Partnerships Network formed a project team to gather the examples presented in this report.

Our case studies of course represent only a small fraction of the enormous amount of work going on across the highways sector – and the report signposts parallel initiatives that can be tapped into for further support. Nevertheless, we hope that transportation professionals are enthused by the evidence of what can be achieved and are inspired to think about how they can support the decarbonisation effort.

Who is this report for?

This report provides guidance that will be useful to anyone with a role in reducing and ultimately eliminating the GHG emissions associated with the planning, design, construction, maintenance, and operation of transportation systems and infrastructure.
The report will be particularly useful to individuals and organisations who are at the beginning of their journey to net zero. The case study format showcases examples of how organisations, projects, and programmes across the highways and infrastructure sectors have set themselves up for success and how they have delivered specific actions to reduce emissions through the asset life cycle. It also provides insight into new tools, materials, and ways of working that are being used in the drive to decarbonise the highways sector.

How has this report been created?

A project team, made up of members of the CIHT Partnerships and Technical Champions Networks, issued a call for evidence in 2023.

The team has also reviewed entries to the annual CIHT Awards and invited colleagues to make presentations about their work to a series of webinars organised by the group.

This has allowed us to collect real-world examples of work that has delivered significant reductions in emissions associated with:

- Transport infrastructure – the design, construction, operation, and maintenance of transport assets
- Mobility – the movement of people and goods.

We have found it significantly easier to identify data-rich case studies for work on the design, construction, maintenance, and operation of highway assets, and these make up the majority of the case studies in this report.

Some mobility solutions were also identified and, where quantifiable and credible reductions of GHGs were reported, the case studies have also been included in this report.

The difficulties we encountered in finding hard data on low-carbon mobility solutions highlight important challenges for the sector:

- Quantitative data about the reduction of emissions in mobility solutions is difficult to capture and measure. The evidence gathered suggests it is particularly hard to identify if a mobility intervention is responsible for changes in the pattern of demand or if other factors have had a greater impact on travel choices
- Long timescales are needed to observe significant reductions from mobility interventions. Solutions that are applied now might only show their full results over a decade or longer.

We are however aware that several of England's strategic transport bodies are collaborating with private-sector partners to produce a Low Carbon Transport Playbook that will use evidence gathered from across Europe and North America to create a toolkit to help authorities develop evidence-based and data-driven local transport plans. At the time of writing (August 2023), we understand this document will be available later in 2023.

Conclusions and recommendations for further work

The case studies are organised in two chapters.
Each chapter includes summaries of key lessons for practitioners and advice on other issues professionals should consider in supporting their work on decarbonisation.

We have also identified four areas where further work by CIHT and its partners will be valuable.

No-build and low-build solutions

As captured in the PAS 2080 standard for carbon management in buildings and infrastructure, reducing the need for carbon-intensive construction is the most effective way to reduce emissions from all types of infrastructure and should be a priority for future knowledge development and sharing, drawing on examples from across the world. There would also be value in providing guidance on how procurement and delivery models should evolve to support prioritisation of no-build and low-build solutions.

Reducing the demand for travel

The most effective no-build solution is very often to reduce or eliminate the demand for travel, for example by better integration of land-use and transport planning. CIHT and the Partnership Network should engage with the strategic transport bodies and other interested parties to create more learning opportunities about interventions that have delivered reductions in travel demand.

Consistency and comparability of carbon accounting and reporting

The project team has often found it difficult to draw meaningful comparisons between similar projects due to wide variations in how carbon is accounted for and reported. Full standardisation may not be feasible or desirable, but CIHT should explore with partners action that can be taken to deliver greater consistency and comparability of carbon accounting. This should include CIHT identifying if it can use its convening role in the sector to bring together stakeholders to create new guidance or tools to support asset owners and their supply chain partners to make more robust decisions.

Develop a better understanding of wider benefits of carbon action and their contribution to a just transition to net zero

Many of the case studies identify co-benefits in areas such as local employment, improved air quality, or quality of life improvements for affected communities. CIHT and the Partnerships Network could usefully do further work to develop understanding of these benefits and the role they could play in addressing fears that the transition to a low-carbon economy will have negative impacts on communities least able to bear them.

Terminology

We have tried to avoid the use of technical terminology. However, this has not always been possible. Below are definitions of terms used regularly in this report.

Scope 1, 2 and 3 emissions:

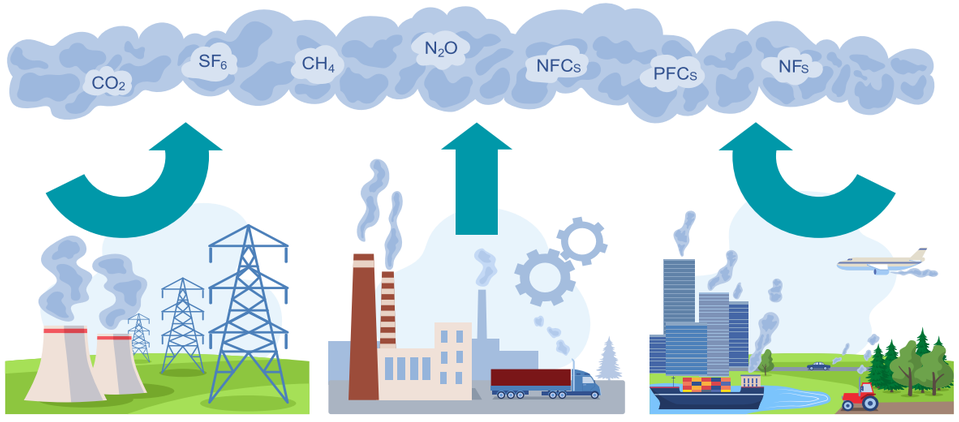
The three scopes are a way of categorising the source of emissions. The concept comes from the Greenhouse Gas Protocol, the world's most widely used GHG accounting standard.

Scopes 1 and 2 capture direct emissions, which means those owned or controlled by an organisation, such as its purchases of power to run its own buildings and vehicles.

Scope 3 captures an organisations' indirect emissions, those that are a consequence of its actions but which it does not own or directly control. For transportation projects and organisations, Scope 3 emissions are often a large proportion of the total, in particular the emissions related to the manufacture and transport of materials purchased from suppliers.

Tonnes of carbon dioxide equivalent (tCO2e):

Carbon dioxide equivalent is a standardised unit used to express the total impact of all GHG emissions, with their different impacts on global warming, in terms of the equivalent amount of carbon dioxide. In most cases this report refers to tonnes of CO2e (tCO2e).



Reporting of emissions reduction data in our case studies

CIHT has been keen wherever possible to include data on actual or projected emissions reductions in the case studies included in this report. This can be found in the 'Headline emissions reduction data' section at the start of each case study. We recognise that the measures used are not always directly comparable and that further work is needed to put the full significance of the data we have reported into context. However, we believe it is important to present this data to help readers judge the potential contribution of implementing similar measures in their own decarbonisation strategies and plans.

Navigating this report -

We have divided the case studies into two groups:

A - Setting up for success

Examples of how organisations, projects, and programmes have established strong strategies, governance, and decision-making processes to successfully drive progress towards decarbonisation objectives.

B - Delivering net zero construction and maintenance

Examples of innovations that have been used across the UK to contribute to the reduction of carbon embedded in highways infrastructure.

The following table also indicates which case studies provide insight into nine cross-cutting themes:

- Innovative Materials and Construction Processes
- Transport and Logistics
- Plant and Compounds
- Procurement and Contracts
- Design and Planning
- Data and Reporting
- Collaboration and Early Contractor Involvement
- Options Assessment
- Codes, Standards, and Specifications

Case Study	Innovative Materials and Construction Processes	Transport and Logistics	Plant and Construction Compounds	Procurement and Contracts	Design and Planning	Data and Reporting	Collaboration and ECI	Options Assessment	Codes, Standards, and Specs
A.1 Oxfordshire Highways Partnership carbon reduction strategy – embedding carbon reduction targets into a term maintenance contract									
A.2 Managing risk to a build nothing/build less agenda on the Isle of Wight									
A.3 West Yorkshire carbon impact assessment – making carbon a key criterion for decision making and funding									
A.4 Integrated Programme Alliance – decarbonisation of an interim work programme of carriage and footways improvements									
A.5 SEGRO Logistic Park East Midlands Gateaway									
B.1 Hampshire Highways low-carbon materials recycling									
B.2 Reuse of tar-bound materials in carriageway recycling									
B.3 LB Waltham Forest and Project Centre – embedding active monitoring of construction logistics plans into the construction process									
B.4 Pavement reconstruction: A590 carbon-neutral recycling scheme									
B.5 Pavement reconstruction: trial of 100% recycled binder course solution									
B.6 Use of recycled plastic stormwater crates in a road crossing for high-voltage power cables									
B.7 Decarbonising handheld plant									
B.8 Automated site energy management system									

A) Setting up for success

This set of case studies illustrates the importance of organisations, projects, and programmes establishing strong governance and decision-making processes to drive progress towards decarbonisation objectives.

Three important lessons learned

Collaborative governance
A successful carbon reduction strategy needs input, buy-in, and action from a wide range of stakeholders inside client organisations and across their value chain. The case studies show that forms of collaborative governance are helpful at both the strategic and operational levels.

Evidence-based prioritisation
Focusing on a limited number of priority areas and specific initiatives helps to maximise the return on effort and resources. The case studies show the value of putting in place processes to ensure prioritisation is transparent, consistent, and informed by robust data.

Ownership and accountability
Once agreed, priorities and initiatives need clear ownership and accountability. The case studies suggest that organisations benefit from an executive sponsor of the overall decarbonisation effort, while owners of initiatives benefit from direct reporting lines to the sponsor and other senior decision makers.

What opportunities are there to use contracts or contract renogtiations to drive carbon reduction?

What opportunities and tools can you use to embed carbon reduction considerations into decision making at all stages of the infrastructure asset lifecycle?

How will you get input and good ideas from all parts of the client organisation and all parts of the supply chain? How will you ensure that the organisational culture is one of all staff feeling a responsibility for delivering on decarbonisation objectives?

What else should you consider?

Will your strategy generate a need for approvals or departures from standards/ specifications from third parties? How will this be managed?

What are the potential impacts of a change in political direction at the national or local level on your strategy? How will this be managed?

How will you use targets? Do you want to include stretch targets? How will you ensure targets are credible?

A.1 Oxfordshire Highways Partnership carbon reduction strategy – embedding contractual carbon reduction targets into a term maintenance contract

Headline emissions reduction data
In its first year (2022/23) the partnership delivered a saving of 3,404tCO2e against a 2019 baseline of 12,982tCO2e, a 26.6% reduction.

Summary

The Oxfordshire Highways Partnership carbon reduction strategy embeds contractual carbon reduction targets into the county's £40 million (m) per year term maintenance contract (TMC).

The targets form part of a framework alliance contract (FAC) that was introduced as part of negotiations to extend Milestone Infrastructure's existing contract with Oxfordshire County Council to cover the three-year period 2022–2025. The two contracts work in synergy to promote carbon reduction, collaboration, and social value.

Targets were established under the FAC against a 2021/22 baseline of 12,792 tCO2e. The targets envisaged a carbon reduction of 25% (3,135tCO2e) by 2025, rising to as high as 92% (11,757tCO2e) if stretch targets were hit. The County Council is seeking to reach net zero by 2030.

Initial progress has been strong. In the first year (2022/23) the target was 973tCO2e, with a stretch of 2,829tCO2e. The partnership in fact delivered 3,404tCO2e savings, a 26.6% reduction against baseline, delivering the 2025 target in the first year and 20% above the stretch target.

Key features of this approach

Carbon Reduction Group: A Carbon Reduction Group (CRG) has been created drawing on expertise from project management, design, construction, and operational and energy strategy teams from across the partnership and its supply chain.

The CRG is tasked with identifying, implementing, and capturing data from carbon reduction activities across the partnership.

It has identified four focus areas: Design, materials, plant and fleet, and depots, each led by a senior member from the County Council and Milestone. These focus area leads report directly to the Highways Operations Board. In each area five initial objectives have been identified as the basis of a structured carbon reduction delivery plan.

Carbon Portal: The CRG has also created a Carbon Portal to support real-time comparisons between historic carbon emissions and current performance, allowing data on improved performance to be captured as it arises. Leaders in the four focus areas are responsible for managing their data input to the portal and analysing outputs to drive decision making.

Collaborative carbon workshops: Collaborative workshops involving specialists from the County Council, Milestone, and the wider supply chain were used to identify and secure buy-in to the four priority areas and create a shared delivery plan. A further workshop in March 2023 drew heavily on the supply chain to showcase the latest industry innovations along with guest experts from Oxford University. The outputs from this session are being used to steer the next phase of carbon reduction activity.

Action taken in 2022/23 to achieve the carbon savings reported above include:

- Switching from diesel to hydrotreated vegetable oil (HVO) fuel across the Milestone fleet (with no palm-oil additives) – delivering 330tCO2e annual savings
- Utilisation of the Milestone Dragon Patcher pothole repair system instead of the traditional two-person patching gang – delivering an 800tCO2e saving
- Introducing a collaborative carbon-focused value engineering process; as an example, a single design for the North Oxford Corridors scheme developed through this process delivered a 2,100tCO2e saving.

A.2 Managing risk to support a Build Nothing/Build Less agenda on the Isle of Wight

Headline emissions reduction data

No emissions reduction data is currently available. However:

72 of 118 parapets identified as potentially non-compliant with the Design Manual for Roads and Bridges (DMRB) were judged as presenting risks as low as reasonably practical (ALARP), justifying the granting of deemed to comply status requiring no engineering intervention.

82 of 98 retaining walls provisionally identified as substandard were assessed as not requiring engineering intervention

Summary

Ringway Island Roads (RIR), the service provider to the Isle of Wight's highways private finance initiative (PFI), has developed risk-based processes for assessing parapets and retaining walls across the island's highways network that have allowed it to significantly reduce construction activity.

This no/low-build approach is consistent with the PAS 2080 (see page 7) standard for carbon management in buildings and infrastructure and eliminates the carbon associated with civil engineering interventions and their ongoing maintenance. Co-benefits include avoiding unnecessary urbanisation of the Isle of Wight, which is a UNESCO Biosphere Reserve.

While assuring fitness for purpose of each asset remains the overriding priority, RIR's approach embeds sustainability considerations into the assessment process. As a result:

- 72 of 118 parapets identified as potentially non-compliant with the DMRB were judged as presenting risks ALARP, justifying the granting of deemed to comply status requiring no engineering intervention.
- 82 of 98 retaining walls provisionally identified as substandard were assessed as not requiring engineering intervention.

Key features of this approach

Risk review for managing non-compliant parapets: A document has been created that sets out a robust process for risk-reviewing sites where a parapet has been assessed as non-compliant where this is based solely on its remnant resistance as set out in CS 461 of the DMRB. The risk review enables a holistic assessment of a site to determine whether the residual risk is ALARP or requires control measures or other interventions. The document was endorsed by the technical approval authority via a technical note and agreed by the local authority.

Plausibility review for theoretically substandard retaining walls: Firstly, a retaining wall risk prioritisation model was created. The parameters for this model include retained height, consequence of failure, and factors of safety for failure modes. A second stage (the plausibility review) enables a holistic assessment of the structure to determine whether the residual risk is acceptable or requires intervention, again ensuring that strengthening work only occurs if absolutely required.

The development of these two processes was proposed by RIR and presented to the client for approval in the form of a technical note. The detailed assessment strategy was developed by RIR and the client, via collaborative dialogue. The strategy development initially focused on a select few structures to demonstrate the possibilities and to sell the benefits, with sustainability at the forefront of these discussions.

A.3 West Yorkshire carbon impact assessment – making carbon a key criterion for decision making and funding

Headline emissions reduction data

Not applicable at this stage, but as part of the decision-making process being established a low-carbon scenario has been developed to test how potential schemes perform against a set of assumptions aligned to a decarbonisation pathway consistent with the authority's ambition to reach net zero by 2038.

Summary

Mott MacDonald and the West Yorkshire Combined Authority (WYCA) have developed the West Yorkshire carbon impact assessment (CIA) to establish a standardised approach for assessing carbon across all funded projects in WYCA's portfolio. This supports the authority's ambition to make carbon a key criterion for funding and wider decision making as part of its aspiration to achieve a net zero region by 2038.

The partners' ambition is to reduce the overall embodied and operational carbon across projects in West Yorkshire by promoting carbon consideration early in the scheme life cycle and tracking carbon as schemes progress through funding gateways.

Key features of this approach

Early screening of proposals for carbon impact: Options will be screened for their potential carbon (and other environmental) impacts to determine progression through WYCA's assurance framework from the earliest decision points.

Flexible consistency: The authority recognises that different issues exist for different projects in different sectors (including transport) and that different tools can be used. There is, however, a consistent set of assumptions and rules, for example with respect to the scope of the emissions that are included in the assessment and the metrics that are used for assessment and reporting.

All projects must be assessed: Impacts should be considered for all project types and not just for "good" emission-reduction projects.

All emissions must be assessed: All GHG emissions associated with the proposed investment will be assessed, including embedded and operational emissions from infrastructure.

Use of a broad range of forecasts: Transport schemes will be assessed using the DfT's assumptions around traffic growth and fleet mix. In addition, a special low-carbon scenario has been developed to test how schemes perform against an alternative set of assumptions consistent with the authority's ambition to reach net zero by 2038.

Induced traffic must be included: Assessment of carbon emissions from proposed transport investments must include the impacts of induced traffic.

A.4 Integrated programme alliance – decarbonisation of an interim works programme of carriage and footway improvements

Headline emissions reduction data

4,700tCO2e was saved over a £130m interim works programme (IWP) of carriageway and footway improvements on the Birmingham highway network.

Summary

An integrated programme alliance (IPA) made up of Birmingham City Council (BCC), Birmingham Highways Limited (BHL), and supply chain partners Kier, Arcadis, Tarmac, HTM, and WJ Group has saved over 4,700tCO2e on a £130m IWP of carriageway and footway improvements on the Birmingham highway network.

On 11 June 2019 BCC declared a climate emergency and a target for "the council and city to become net zero carbon by 2030, or as soon as possible thereafter as a just transition allows".

The IPA was established in spring 2020 to deliver works required to maintain the network to an acceptable level while a new PFI service provider could be procured following the exit of the previous PFI provider. The Council looked to its contractors and suppliers, including the IPA, to support it in achieving its net zero objectives.

Key features of this approach

Collaborative governance: The IPA has a Board made up of directors from each of the partner organisations. The Board is tasked with overseeing the delivery of the programme, encouraging collaborative working, and driving innovation and sustainability.

Innovation and Sustainability Group (ISG): An ISG was set up to investigate how innovative construction techniques and materials could be used to enable decarbonisation in design, construction, operation, and maintenance across the programme.

Prioritisation: The ISG carried out a review of existing activity and future decarbonisation opportunities, which identified the following areas for improvement:

- **Materials:** primarily asphalt due to the scope of works and including recycling and circular economy techniques
- **Practices and procedures:** focusing on transportation and site-related activities
- **Asset management:** introducing longer-lasting designs, specifications, and materials.

Process for assessing viability of carbon reduction initiatives: A process was established to provided clarity on viability of introducing materials or processes into the contract over the short to long term. Where precedents existed, for example for specifying warm mix asphalt, these were implemented rapidly.

Client sustainability reports were created for other potential innovations: Reports provided technical data, including case studies and risk assessments, and made recommendations based on whole-life cost and carbon benefits. Reports were reviewed by all parties to the IPA and approved or rejected by the client.

Specification across the programme: Once approved, initiatives were taken forward by the design team, discussed in detail in value engineering meetings, and specified in areas appropriate to their use.

Initiatives that made it through the process and were implemented across the programme include:

- Standard specification of warm mix asphalt
- Quick visco-elastic Foamix – circular economy recycling of existing tar-bound arisings
- Slow visco-elastic Foamix – circular economy recycling used in all footway crossings
- Biogenic bitumen in asphalt – use of binder with bio components that sequester and capture carbon in the asphalt
- Biogenic binder in road markings – use of a biogenic additive to provide significant carbon savings
- Recovery of high polished stone value (PSV) aggregates from Birmingham's current network for reuse in new surface courses (virgin high PSV aggregates are typically sourced from great distances from Birmingham)
- Consistent use of recycled asphalt (RAP) in base and binder course materials (25–30%)
- Solar and hydrogen-powered welfare units.

Supply and logistics planning: The IPA worked collaboratively to ensure any supply and logistical issues with delivery were well thought out and planned through close liaison with the supply chain.

Social value co-benefits: Engaging with the supply chains meant 66% of footway supply chains were West Midlands based and 100% within the Midlands region; 5% of roles were new local jobs including apprentices and graduates.

The IPA was the winner of the 2023 CIHT Decarbonisation Award. The judges stated:

"The breadth of the collaborative team assembled is very impressive. Intelligent analysis and prioritisation have allowed strong prioritisation and quantifiable carbon reductions. Early wins have been combined with a process for establishing the viability of introducing further innovations into the contract. We particularly applaud the commitment to the circular economy, supporting local supply chains, and sharing knowledge with the profession."

A.5 Strategic logistic site, East Midlands Gateway

Headline emissions reduction data

11,500tCO2e of Scope 3 emissions savings against 2019 baseline.

Summary

SEGRO Logistics Park East Midlands Gateway (EMG) is a regionally significant employment centre adjacent to East Midlands Airport and within the East Midlands Freeport, comprising a 700-acre commercial development, incorporating a 50-acre rail freight terminal. Integrated Transport Planning (ITP) and SEGRO have collaboratively developed a sustainable transport strategy to reduce single-occupancy car commuting journeys to work through long-term investment in sustainable transport infrastructure and services.

Achieving sustainable commuting patterns was recognised as a real challenge for EMG, given that the site is 13 miles from the closest city, located in between Nottingham, Derby, and Leicester, with a plethora of shift patterns 24/7.

2022 marked the fourth year of travel plan delivery and, as a site average, only 42% of employees drive to work on their own (against a target of 68% single occupancy car use).

The wider impacts have been monitored through a bespoke commuter calculator, which is underpinned by robust emissions data from DEFRA and DfT. The annual emissions calculation for the site is based on actual employee travel patterns. Employees complete a travel survey, which provides information on how they travel to work (by which mode), where they are travelling from (postcode), and how frequently they travel to the site.

The survey asks employees to complete the survey based on their typical travel patterns for commuting. It also allows employees to select different forms of travel for different days of the week to allow for those people who may drive some days and catch the bus other days, or work from home.

The data is inputted into the ITP carbon calculator to establish the emissions being generated by commuting to the site. From this it is estimated that since opening in 2019, over 11,500 tonnes of Scope 3 emissions have been saved and 21 million fewer employee km travelled by car. £7m has also been saved in employee commuting costs.

Located 13 miles away from the nearest urban core, single-occupancy journeys had the potential to be the dominant travel choice to EMG. However, this has successfully been controlled by ensuring sustainable travel infrastructure and policies were in place from the outset. Additionally, rather than being prescriptive over specific measures within the travel plan and public transport strategy, a broad package was proposed, supported by two secured sustainable travel funds that allowed investment in the right measures. Furthermore, a Sustainable Transport Working Group and Transport User Group allow for cohesive collaboration to create suitable alternatives to the car.

Key features of this approach

Working together, ITP and SEGRO have:

- Developed a travel plan and public transport strategy to gain planning consent
- Introduced innovative transport schemes including and on-site bus interchange with comfortable waiting facilities and real-time information, electric shuttle bus to link development plots to the new bus interchange, on-site bike hire scheme, and electric vehicle (EV) charging points
- Developed travel packs, information and maps to promote sustainable transport, supported tenants of the site to include information on commuting options in their recruitment processes, and developed a site-wide Move More campaign to support active travel
- Measured the impact to determine progress towards sustainable commuting patterns.

This work was commended in the 2023 CIHT Decarbonisation Awards, the judges' citation stating:

"The sustainable transport programme at the SEGRO logistics park has delivered a significant reduction in emissions from a major regional employer. The plan is focused, grounded in data, and backed by sustained investment. The judges were particularly impressed by the quality of stakeholder engagement and co-ordination in developing the plan and its day-to-day delivery."

Box 1: PAS 2080 and managing carbon across the asset life cycle

The importance of the British Standard Institute's PAS 2080 standard for carbon management in buildings and infrastructure has been a recurring theme of many of the case studies and the wider work of the Task and Finish Group.

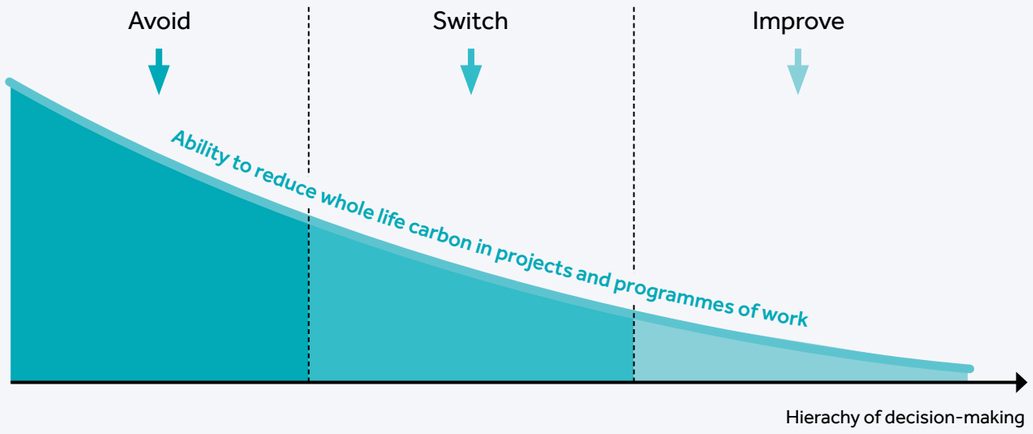
The standard sets out a common, collaborative process for managing the whole-life carbon impact of projects and programmes of work. This includes definitions of the respective responsibilities of asset owners, designers, constructors, and product/material suppliers under eight headings:

- Effective leadership
- Maximising opportunities for whole-life carbon reductions at all stages of the delivery process
- Selecting appropriate carbon emissions assessment methodologies
- Setting appropriate carbon reduction targets
- Determining baselines against which to assess carbon reductions
- Establishing metrics (e.g. key performance indicators – KPIs) for credible carbon emissions monitoring and reporting
- Integrating carbon management into procurement
- Continual improvement of carbon management and performance.

A wide range of organisations in the sector from National Highways through to materials suppliers such as Aggregate Industries have achieved PAS 2080 accreditation, an independent verification that their systems and processes are compliant with the standard.

One of the most influential aspects of PAS 2080 is its carbon reduction hierarchy (see Figure 1).

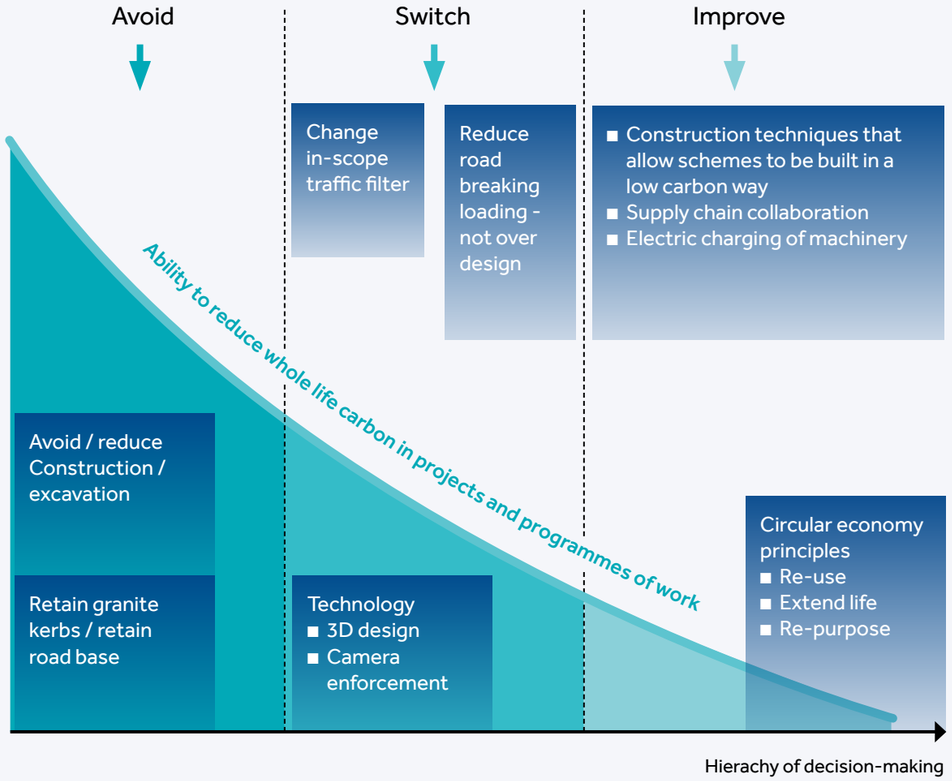
Figure 1. Carbon reduction hierarchy



The hierarchy highlights that the greatest opportunity to influence whole-life carbon emissions is at the earliest stage of scheme design, where the need for carbon-intensive activity can be eliminated at source.

An example of how the hierarchy can drive decision making was presented at one of our project webinars by the London Borough of Southwark. The Liverpool Grove scheme forms part of the Walworth Low Traffic Neighbourhood and set out to deliver a broad range of outcomes that included improved air quality, safety, and quality of life for residents and businesses.

Figure 2 shows how the PAS 2080 shaped key decisions on the scheme



As Figure 2 shows, a key design criterion for the scheme was to avoid unnecessary construction activity through minimising excavation by using the existing asphalt carriageway within the paving construction. Reduced excavation of the existing carriageway lowered the demand for high embedded carbon reinstatement materials. It also reduced demand for heavy construction plant and for transport of spoil and materials to the site.

B) Delivering net zero construction and maintenance

These case studies describe specific practices and innovations that have been used across the UK to contribute to the reduction of carbon embedded in highways infrastructure.

We have identified case studies that relate to the top three priority areas in NH's plan to achieve net zero construction and maintenance on the strategic road network by 2040:

- Zero carbon materials (41% of emissions savings in the plan)
- Zero carbon transport of materials (20% of emissions savings in the plan)
- Construction plant and compounds (17% of emissions savings in the plan).

Signposts to other initiatives

National Highways

In England, working with its supply chain partners, NH has published a net zero roadmap for concrete, steel, and asphalt. This document sets out a decarbonisation trajectory for each material up to 2040, alongside action for reducing emissions in the period up to 2030 and the emerging technologies that may drive further reductions in 2030–2040.

NH is working intensively with major aggregate manufacturers to develop detailed plans for each material, including exploring how industry can provide standardised test results to ensure low-carbon materials meet all performance requirements for use of products on the strategic network. The operator is also committing to communicate clearly to the industry the potential innovations that it is not interested in taking forward, to ensure time and resources are not wasted.

NH's Accelerating Low Carbon Innovation Programme is also currently funding seven SMEs to develop ideas for use on the network, including several innovative materials.

Organisations in NH's supply can access the Low Carbon Opportunities Register. The register contains a wide range of carbon reduction opportunities relating to the design, construction and maintenance of assets and includes interventions at various stages of innovation maturity (from research level to market ready), along with information on applicability of these interventions within National Highways' current standards. The register currently (August 2023) contains 175 published entries, spread across low carbon material/technologies, design approaches, construction approaches, maintenance approaches and other.

Local highways authorities

In the local highways sector, ADEPT's Live Labs programme has supported trials by local highways authorities and their supply chain partners of a range of sustainable materials. Results from Live Labs 1 are captured in an October 2021 White Paper on Decarbonisation. Live Labs 2, focusing on decarbonising local roads, will run until March 2026 and includes plans to create a UK Centre of Excellence for Materials, creating both a central knowledge bank and real-life test bed for innovative materials.

ADEPT and the Future Highways Research Group (FHRG) have produced step-by-step guidance for local authorities on measuring and reporting their direct, Scope 1, and Scope 2 emissions. Work to extend the guidance to Scope 3 and codify it into a carbon calculation accounting standard for local highways authorities is ongoing and is expected to be published later in 2023.

Supply chain

In the supply chain, Aggregate Industries and Tarmac, two of the biggest materials manufacturers, have switched to warm mix asphalt (WMA) as standard in their plants across the UK. WMA has the potential to reduce embodied carbon in asphalt by around 15% compared with conventional hot mixes while maintaining acceptable levels of performance.

The three most important lessons from this group of case studies

Early contractor involvement (ECI) and client leadership

Across the case studies, early engagement between client organisations and their supply chain has been key to unlocking opportunities to deploy innovative low-carbon materials and practices. Projects also benefited from strong client leadership, for example via establishing embedded carbon as a key design constraint at the earliest possible stage.

Co-benefits and business cases

Several of the case studies describe significant financial savings, creation of local employment, reduced disruption for local populations, and other co-benefits from the use of innovative materials and construction practices. If co-benefits can be identified early, they can be used to create a more robust business case for the deployment of an innovative material or practice. In addition, as noted in our recommendations for further work, capturing co-benefits may have a part to play in delivering a just transition to net zero that distributes benefits and costs fairly across communities.

Standards and specifications

In several of the case studies, effort was required to demonstrate that materials or processes met all performance requirements. Elsewhere the client's standard specifications needed to be revised to facilitate their use. Projects need to commit time to understanding the constraints and opportunities they face in this context, for example identifying who will be responsible for securing a departure from any given standard.

How will you get input and good ideas from all parts of the client organisation and all parts of the supply chain? How will you ensure that the organisational culture is one of all staff feeling a responsibility for delivering on decarbonisation objectives?

Who needs to buy into an innovative solution? How will you get them onside, and what data do you need to convince them?

What else should you consider?

How will you make sure suppliers have the capacity to meet your requirements for a given material at the quality required? Can you be confident of their quality assurance process and your security of supply?

How will you make sure the workforce has the capabilities to work with a given material, process, or piece of equipment? What upskilling or changes to practice are required to deploy this material?

B.1 Hampshire Highways delivers a step change in the use of recycled materials – the Micheldever Road Materials Recycling Facility (MRMRF)

Headline emissions reduction data

In 2021–2022 the facility processed 35,500t of recycled material, saved 700tCO2e, reduced waste disposal costs by £4m, and earned £150,000 of direct income for Hampshire County Council (HCC).

Hampshire Highways (HH) has investment plans that have the potential to scale up recycling to 500,000t, carbon savings to 7,000tCO2e, waste disposal savings to £50m, and income to £1.5m (in the period 2021–29).

Summary

HH is a collaborative partnership between HCC, Milestone Infrastructure, and over 85 supplier organisations. OCL Regeneration joined the partnership in 2018 to bring materials recycling expertise.

The MRMRF is a key element of HH's carbon strategy and is aligned with the Council's wider objective of carbon neutrality by 2050.

HCC had previously obtained planning permission for an asphalt plant, but through collaboration with Milestone and OCL, the MRMRF was identified as a better solution on both cost and environmental grounds. The facility has been developed to allow HH to recycle raw materials already embedded in its roads, supporting maintenance of the existing assets while significantly reducing carbon emissions from the manufacture and transportation of key materials.

Acceptance of the materials produced at Micheldever and wider hearts and minds buy-in to the new approach have been crucial for the project's success. A multi-disciplinary Carbon Champions Group was formed, drawing on specialists in asset management, design, planning, and delivery. Trials of MRMRF outputs were also needed to give the design and asset management teams confidence in their suitability for use as permanent materials in highways construction.

These were a success, leading to a rewrite of HCC's specifications to facilitate their use as standard and as default choices across the network.

This work was commended in the 2023 CIHT Decarbonisation Awards, with the judges noting:

"This project shows what can be achieved if an organisation is willing to be bold and make significant investments. The judges recognise that to adopt recycling/circular economy measures on this scale demands the applicant has had to make a compelling case to a range of stakeholders including elected members, designers, contractors, and business down the supply chain. The project has already delivered a sound carbon and financial return which will grow significantly over the coming years."

Co-benefits included:

Financial: The underlying partnership agreement allows OCL to sell products to third parties, with HCC receiving royalty payments, generating £150,000 for the County Council in 2021–22.

Reliability of supply: The facility helps mitigate the risk created by the increasing cost and scarcity of key materials. Improvements to the reliability of supply also offer productivity benefits by reducing the risk of interruption to projects.

Supporting further innovation: HH is using the facility as a hub to support trials and adoption of innovative lower-temperature materials, including a new carbon-negative recycled asphalt mix and a low-carbon concrete using recycled aggregate. This represents a further saving of 500tCO2e a year.

B.2 Reuse of tar-bound materials in carriageway recycling

A46 Warwick bypass (Kier, National Highways and Aggregate Industries)

A76 Muirside culvert to Croftmaggot Road (Amey, Transport Scotland)

Headline emissions reduction data

A46: Around 23% reduction in scheme carbon (against a "typical" comparator project), 56% overall scheme recycled content, 26,782 road miles saved, 13,107t saved in virgin aggregate, 11,000t of hazardous material reused and saved from landfill.

A76: Overall carbon saving of 200tCO2e, including 67.6tCO2e saved via reduced lorry journeys and waste treatment and 131.7tCO2e from ex situ recycling process (compared with using the equivalent volume of new virgin aggregate). 2356.5t of hazardous material saved from landfill, with a cost saving of £706,950.

Summary

Road tar was used extensively in all pavement layers until the mid 1980s. It is a complex mix of hydrocarbons, some of which can be carcinogenic or toxic to aquatic life. Consequently, the normal approach to tar-bound material is to remove it from the road site and transport it to a licensed hazardous/special waste tip.

These two projects have both identified ways to recycle this material, reducing carbon associated with the extraction and transportation of virgin aggregates.

A46 Warwick bypass

The A46 Warwick bypass is a rural two-lane dual carriageway all-purpose trunk road with grade-separated junctions. Originally constructed in 1967, it has required regular temporary repairs to deal with surface deterioration. The importance of the bypass to NH's strategic network has limited most repairs to the top two layers of the pavement (surface and binder courses) as these can generally be repaired overnight.

Consequently, the deeper layer (base course) continued to contain tar-bound material dating from its original construction.

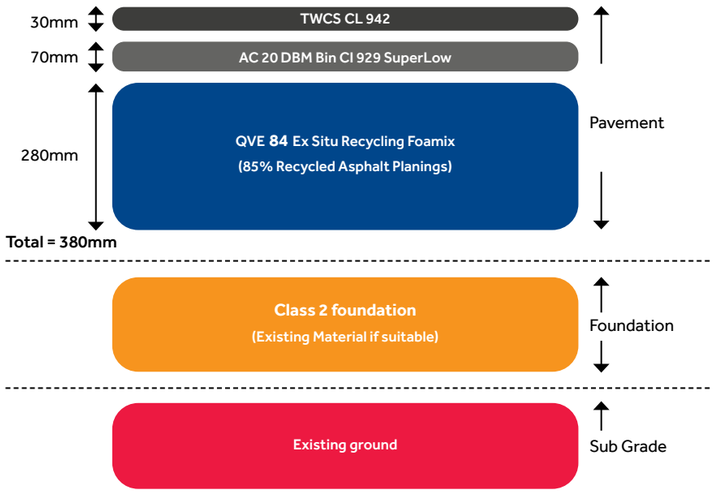
Early contractor engagement and a strong commitment from NH led to the development of a low-carbon pavement solution. This involved the full recycling of the existing carriageway, including the problematic base layer. All the existing tar-bound material was recycled back into the new carriageway, using Aggregate Industries' ex situ cold recycled Foamix solution. This was batched on site next to the works to minimise vehicle movements and increase daily volumes, all of which helped to reduce the scheme's carbon footprint.

The pavement design (see Figure 3) followed industry standards and was agreed by NH through a departure process. The design removed all the existing pavement layers, but after testing reused the existing foundation. The planing process was planned to harvest any clean aggregate or planings that could be used off site or back within the asphalt layers.

The solution is compliant with relevant standards and will deliver a surface that is able to withstand heavy traffic loadings. It also meets quality control requirements for its manufacture.

(Continued from prevous page) B.2 Reuse of tar-bound materials in carriageway recycling

Figure 3. Pavement design for Warwick bypass



FACTS AND FIGURES

- 32kt removed
- 11kt identified as Tar Bound
- 21kt clean aggregate
- 15kt recycled back into Foamix
- 4kt recycled back into asphalt
- 13kt used on the local SRN

A76 Muirside culvert to Croftmaggot Road

A76 Muirside culvert to Croftmaggot Road is the largest scheme to involve the recycling of tar-bound material carried out to date in Scotland. In this case elevated levels of coal tar were present in both the base and binder layers of the pavement.

Engagement between Amey and its supply chain identified an opportunity to recycle the material in accordance with clause 98 of the Specification of Highways Works in Transport Scotland's Manual of Contract Documents for Highways Works (MCHW). The process followed involved recycling tar-bound material from the site and other nearby locations.

The recycling process involved the ex situ recycling of planings for reuse on site. The planings were removed off site to a nearby quarry and reprocessed before being brought back to site and relayed as the base layer of the road pavement.

Within the quarry a mobile unit was set up and the tar-bound planings were crushed and regraded with the addition of 7% PFA (pulverised fuel ash, a by-product of the coal industry). This was then loaded into the Recofoam plant where cement (1%) and bitumen (3%) were added. The encapsulated material was loaded into a lorry and taken back to site to lay.

Co-benefits included:

Financial: The A76 project reports a saving on hazardous waste disposal of £706,950. Both projects report opportunities for saving from reduction in raw materials and haulage costs.

Safety in construction: The process used on the A46 project involved a colder mixed material that can be handled and compacted at a much safer ambient temperature. This also helps reduce the site workforce's exposure to asphalt fumes.

Programme: The A46 project reports benefits for the programme from on-site recycling, including minimising the logistical risks of bringing base course mix from external batching plants.

B.3 Embedding active monitoring of construction logistics plans into the planning process to ensure compliance (London Borough of Waltham Forest and Project Centre)

Headline emissions reduction data

Schemes in the Borough report 80% less waste on site and 40–45% reductions in embedded carbon on schemes via promotion and adoption of modern methods of construction (MMC) including modular approaches to construction, supported by construction logistics plans (CLPs).

Summary

CLPs are a tool that can be used by planners, developers, and construction contractors to help plan, manage, and reduce the carbon impact of construction schemes. This can include the promotion of offsite and modular methods of construction and the reuse of materials on site; both of which can contribute to lowering the total carbon generated by a project. Further reductions can be achieved by identifying options for moving materials and waste by alternative modes, for example by river or rail.

The potential of CLPs to play a greater role in highways decarbonisation can unfortunately be undermined by inconsistent approaches to their development and implementation by local planning authorities. London Borough of Waltham Forest, working with Project Centre, has taken an active approach to embedding CLPs within the planning process.

The Borough is a CLOCS (Construction Logistics and Community Safety) champion and requires all construction schemes to meet defined safety and environmental standards for deliveries and site operations. In 2019, to help embed CLPs in Waltham Forest, in-house training was delivered to staff responsible for highways, planning, transport planning, planning policy, and planning enforcement. These teams formed a working group, which established a process for CLPs for schemes in the Borough, from policy through to document submission, approval, and resourcing. Adherence to the CLOCS construction logistics plan template is a minimum requirement for a CLP to be considered as part of a planning application.

Project Centre was commissioned to establish guidance and processes for active monitoring of CLPs to help ensure they are implemented. This involved researching good practices across the UK and carrying out site visits across the Borough to check CLP compliance.

The Borough has now established a programme of CLP monitoring and compliance for construction and maintenance schemes, which includes visits from a dedicated CLP monitoring officer to sites. The costs of these monitoring resources are covered via Section 106 developer contributions to schemes. Documentation to support compliance is requested by the dedicated officer, and the authority works collaboratively with the scheme to address any areas of non-compliance. If there are continued breaches, as a last resort the authority has powers to instigate a temporary stop notice (TSN). This process is being implemented for both small individual schemes as well as large-scale construction developments in Waltham Forest.

Based on its experience at Waltham Forest, Project Centre is confident that this approach is repeatable across schemes and local highways authorities of all sizes.

Co-benefits included:

Impact on local communities: CLPs can help to reduce the impact of construction schemes on residents, by reducing vehicle movements and their associated impacts on safety, noise, and air quality.

Project management: CLPs can help scheme owners and their contractors manage project costs, programme, and quality.

B.4 Pavement reconstruction – A590 carbon neutral recycling scheme (Amey, National Highways, Aggregate Industries, AE Yates, and HW Martin)

Headline emissions reduction data

300tCO2e in total saved (over 90% derived from materials and transport).

Summary

This £8m scheme involved the reconstruction of 5.6km of dual carriageway of the A590 in Cumbria. Design work began in 2017 and the project was delivered in 2021.

The project benefited from NI's establishing of carbon reduction as a key design consideration from the very beginning of the project. The designer (Amey Consulting) and contractors were engaged early and tasked with collaborating with NH to identify how the project's carbon footprint could be reduced.

This resulted in recycled and reduced carbon materials being identified as key design considerations, which in turn led to:

- Reuse of site materials to produce ex situ Foamix base to encapsulate tar-bound materials (collaborative working with Aggregate Industries to address historical durability concerns)
- Use of recycled asphalt pavement (RAP) materials (25% for binder and 10% for surface course)
- Use of WMA (super-low-asphalt binder and surface course).

Co-benefits included:

Cost: £3m saved as project delivered ahead of schedule.

B.5 Pavement reconstruction – trial of 100% recycled binder course solution (Colas, Coventry City Council, University of Nottingham)

Headline emissions reduction data

The SEVE eco-comparator tool was used to compare the performance of the demonstrator against a traditional treatment (AC20 binder, hot mix asphalt solution). This showed a 71% carbon saving over the traditional treatment.

Summary

Colas has been funded by the former Department for Business, Energy and Business Strategy (BEIS) and the Carbon Trust to establish a demonstrator project in UK conditions for a process that the business has deployed successfully in its French operations.

Recycol is an emulsion-based, cold-applied, in situ recycling process that recycles 100% of the binder course back into the new road. The process is delivered using a "Recycol train", a series of (notionally) linked resurfacing vehicles that move along a road, mixing the planed asphalt with new emulsion and laying it back down onto the road to be paved and compacted, using the following steps:

- Planed asphalt is carried up into a mixing drum and mixed with water and a Colas proprietary emulsion
- 100% of the recycled material is dropped back onto the road, in a windrow mound behind the planer/mixer
- The recycled material is then picked up by a scooper machine
- Bondcoat is applied to the planed surface below the scooper
- The recycled material is dropped into a typical paver vehicle
- The recycled material is then laid back down as a paved surface
- Another layer of Bondcoat is applied and a roller compacts the surface
- The road is opened to vehicular traffic an hour after compaction.

The emulsion-based process delivers a high visco-elasticity in the new carriageway surface allowing the asphalt to better withstand traffic loads and environmental factors including temperature changes and moisture.

The cold technique removes the high carbon cost of heating asphalt, and the reuse of 100% RAP in situ reduces the need for the extraction, processing, and transport of virgin materials, and the transport and processing of waste asphalt.

A demonstrator event was held at three sites in Coventry in October 2022. Three long, straight residential roads with moderate traffic levels were selected for the demonstrator.

All three sites were designed at a depth of 80mm (range of 50–120mm). Various surface courses were overlaid on the recycled binder layer, including 10mm Superflex from Aggregate Industries and 10mm stone mastic asphalt (SMA) using graphene and recycled rubber crumb from Tarmac.

Colas reports a small number of localised issues with the finished binder layer, due to the slow-curing surface and sheer forces created by high volumes of turning traffic at a busy junction and at a bus stop. These were swiftly remediated before laying the surface course.

Colas proposes to open this solution up to the sector and encourages other organisations to adopt similar approaches.

B.6 Use of recycled plastic stormwater crates in a road crossing for high-voltage power cables (Wills Brothers, Renfrewshire Council)

Headline emissions reduction data

The use of recycled plastic stormwater crates as the main design element of a crossing for high-voltage power cables delivered an 87% reduction in emissions against the specimen design solution, an estimated saving of about 1,350tCO2e. This represents around 11% of the projected footprint for the whole scheme.

Summary

In 2019, Wills Brothers was appointed as design and build contractor for a transport infrastructure project within the Glasgow Airport Investment Area. RPS was in turn engaged as design consultant. The project, led by Renfrewshire Council and jointly funded by the UK and Scottish governments, involved a road realignment, two new bridges, junction upgrades, and new and improved routes for pedestrians and cyclists.

An important design challenge was to identify a solution for a new road crossing for a series of underground, high-voltage power cables. Wills Brothers set out to identify an alternative to a specimen design solution that included 22 piles up to 30m long with prestressed precast concrete beams.

The innovative solution adopted used plastic stormwater storage crates manufactured by Wavin as the core of a lightweight embankment. Key benefits included the fact that the crates are formulated from 100% recycled plastic materials and are manufactured in the UK, reducing emissions and costs from transport.

As part of the design development process, Wills Brothers needed to demonstrate that the plastic crates, which are normally used in stormwater drainage applications with a maximum required lifespan of 50 years, would be suitable for a road structure with a required lifespan of 100 years.

Wavin was able to supply laboratory testing data which confirmed that a lifespan exceeding 100 years could be achieved.

On site the crates were combined with a specialist lightweight fill and a very small quantity of lightweight concrete for a slab directly beneath the road. Geotextiles were also used to distribute the dead and live loads. The solution also allowed Wills Brothers to eliminate the need for carbon-intensive steel in the structure.

Co-benefits included:

Construction-phase benefits: The extensive upfront design effort had benefits in the construction phase. The lightweight crates were largely placed by hand, removing the need for heavy machinery during most of the installation.

B.7 Decarbonising handheld plant (Kier Highways)

Headline emissions reduction data

450 items of fossil fuel-powered handheld plant have been transitioned to battery-powered alternatives. To date the initiative has delivered a saving of 373tCO2e.

Summary

The project has made a significant contribution to a 30% reduction in Scope 1 and Scope 2 emissions achieved between 2020 and 2023.

Kier Highways is committed to achieving net zero for its direct Scope 1 and 2 emissions by 2030. Transition to electric-powered fleet and plant has been identified as a top priority. After trials of various technologies, electrification of handheld plant was selected as an early measure to kick-start this decarbonisation programme.

A project working group was established with equipment supply chain partners GAP Group, and Kier's in-house leaders with responsibility for fleet and plant, sustainability, finance, innovation, and health and safety. Sponsorship from the Kier Highways senior leadership team was secured, and a project manager was assigned to drive the work on a day-to-day basis. The group met every two weeks to review progress and manage the environmental, financial, and health and safety aspects of the scheme.

The first step was to create a list of all the equipment to be transitioned. This was carried out in consultation with teams from individual contracts, drawing on fleet and plant managers and a full list of the items Kier had on hire from GAP. This exercise identified the 500 most used items of plant including brush cutters, chainsaws, pole saws, cut-off saws, blowers, hedge trimmers, plate compactors, rammers, and traffic lights. The team estimated that switching these plant items to battery power would save up to 473tCO2e emissions each year, compared with the fossil fuel versions. They also identified that on a whole-life basis all costs were within around 5% of their conventional alternatives.

The second step was to work with energy providers to assess grid capacity at each contract depot. It was important to identify how much electricity each site was using so that charging points could be installed in the right locations. Suitable charging infrastructure was then identified, consisting of either a standalone cabin full of charging portals or several charging locker units (each consisting of 10 lockers).

Staff buy-in was extremely important. Consultation took place with employees to gauge concerns and a series of two-week mini trials were held for each Kier contract to dispel any worries. Items excluded from the transition following the trials included a larger chainsaw and a plate compactor, which were found to have less power, extending the time needed to finish tasks and exposing the user to greater hand-arm vibration (HAV).

The trials also highlighted that each item of plant needed two batteries to last a whole eight-hour shift, which in turn created a need for twice as many charging points. Kier chose to rationalise mess room layouts and utilise "dead space" to locate the new chargers.

The transition was rolled out one contract at a time to support a proof of concept and allow the business to learn from early mistakes. Transition plans for each contract included engaging and educating operational employees through electric plant inductions and toolbox talks. Each contract also had a charging plan detailing the infrastructure required and its location.

Kier's Birmingham contract was the first to be successfully transitioned with 65 items of plant changed. This created a contract annual saving of 45,775kgCO2e. Feedback from operational employees involved in the transition was overwhelmingly positive. The new plant is quieter, lighter, easier to use, and reduces HAV. The business has subsequently switched plant from fossil fuel to battery power in another five contracts.

On a whole-life basis, the plant has a higher cost of £12,000 per year, which the business is happy to absorb due to the importance of reducing carbon emissions. To sell the benefits to the wider Kier Group, its Highways division calculated a carbon reduction return on investment (CRRoI) figure of 31.1kgCO2e per extra £1 spent, a good return on investment compared with other CO2 reduction initiatives.

Kier is now shifting its attention to a second phase of work to decarbonise larger items of plant.

B.8 Automated site energy management system – A63 Castle Street, Hull (Balfour Beaty and Sunbelt Rental)

Headline emissions reduction data

Balfour Beatty has completed a baseline comparison of sites, one with EcoNet and one without EcoNet. On an annual basis this delivers an annualised energy saving of 37%. Carbon savings are a relatively small 7.86tCO2e but need to be seen as a contribution to broader site decarbonisation plans.

Summary

Balfour Beatty, with the assistance of its supply chain partner Sunbelt Rental, has introduced EcoNet, a new energy management system to its A63 Castle Street scheme in Hull. EcoNnet manages the power supply to the site compound, turning off appliances and equipment automatically when not in use, including over weekends and other periods in which the site is unoccupied. This helps to regulate consumption when demand is at its highest, reducing reliance on grid connections or diesel generators used to power sites.

A key learning has been that the EcoNet system needs to be configured based on project employee working patterns, which can provide a challenge if shift patterns are regularly changing, for example switching from 24/7 to day shift only.

Box 2: Examples of action by materials suppliers to help highways authorities and contractors manage their Scope 3 emissions

WJ Group – cradle to gate life cycle assessment model for road marking products

WJ Group, one of the UK's largest road markings contractors, has created a cradle to gate life cycle assessment model, which offers reliable carbon footprinting for hot-applied thermoplastic products.

The business can now provide detailed carbon reports for each of its road marking operations across the UK, helping clients to understand the contribution to their Scope 3 emissions (see page x) of the products that they procure from WJ.

The model was developed via a comprehensive in-house research project that has created a detailed database of all the materials used throughout WJ's product supply chain and their carbon footprint.

Using this data, WJ discovered that by replacing hydrocarbon resin binders with rosin ester, a biogenic alternative with similar costs, it could reduce the embedded carbon in its materials by an average of 81%. Across the business, this amounts to a 22,000tCO2e reduction, double its current annual operational footprint of approximately 10,000tCO2e.

WJ's model has been independently verified by Lucideon, meeting PAS 2050:2011 and ISO14067 (2018) specifications and standards requirements.

Fosroc – creating environmental product declarations for chemicals used in highways construction

Fosroc manufactures and supplies high-performance chemicals for the construction industry and has a particular focus on cement and concrete, widely used in the highways sector. Like WJ Group, it wants to provide robust information to clients on the embedded carbon in its products and to use this data to identify how it can improve its own environmental performance.

To achieve this objective the business is creating environmental product declarations (EPDs) for products across its range.

The International Organization for Standardization (ISO) defines an EPD as a declaration that "quantifies environmental information on the life cycle of a product to enable comparisons between products fulfilling the same function". This comparability is achieved by conducting a life cycle assessment in accordance with a relevant standard. In construction these include ISO 14040/14044, ISO 14025, EN 15804, and ISO 21930. Assessments are independently verified and EPDs normally have a life of five years before requiring renewal. A completed EPD provides information on a range of environmental impacts including the CO2e of the fossil fuel emissions embedded in any given quantity of a product.

To create its EPDs, Fosroc has gathered and analysed data covering carbon from the manufacture and transport of raw materials by its supply chain, the energy used in its own manufacturing processes, packaging, waste, and the delivery of the end product to customers. This information is now being used by the business to identify opportunities for carbon reduction at each stage of its production process.

In March 2023, the business completed EPDs for its range of concrete repair products and intends to expand to other aspects of its range during 2023.

Box 3: Examples of action by materials suppliers to help highways authorities and contractors manage their Scope 3 emissions

Many new materials are at the trial stage across the UK. Three examples submitted to the Task and Finish Group follow.

A) Creating a carbon sink within the pavement binder

Kier Highways and Shell

Kier Highways is trialling the use of polymer modified bitumen (PMB). PMB has the potential to increase the lifespan of asphalt roads, contributing to a reduction in carbon emissions from repair and renewals. Unfortunately, polymers currently in use in the UK significantly increase the embodied carbon in the pavement's binder layer. Manufacturers, including Shell, have developed PMBs containing biogenic material from plant-based sources including by-products of the wood-pulping process. In theory this will create a sink for the CO2 absorbed by the material as it grows, locking it into the binder before it can be released back into the atmosphere. However, the use of this material as a commodity needs to be scrutinised to ensure that it comes from local renewable sources and has not led to undesirable land-use changes. Biogenic binders are also currently more expensive than conventional products.

Colas

Following a similar logic, Colas is looking for UK sites to trial its Vegecol asphalt mix, which it has successfully used on a 2.2km section of cycleway in northern France. Here the binder is mainly composed of a resin obtained from pine trees. Colas reports that taking the carbon sink quality into account, this binder reduces emissions by 60% compared with conventional solutions. Its light colour also has the potential to mitigate the urban heat island effect associated with traditional black asphalt mixes. Vegecol is intended for use on active travel pathways.

B) Low-carbon, high-durability permeable concrete

Imperial College

Researchers at Imperial College London are leading the development of Kiacrete, a durable and free-draining permeable concrete pavement. Kiacrete's engineered pore structure seeks to reduce the amount of cementitious material used in concrete pavements by up to 12%, which along with its use of recycled material results in an equivalent saving of around 3.4kgCO2e/m2, compared with a traditional concrete pavement. These initial emissions savings are further enhanced through the product's potential to deliver long service life and minimise maintenance requirements. Kiacrete's high permeability is also intended to help eliminate flooding and stormwater runoff and improve driver safety by reducing weather-related accidents.

Kiacrete's development has received significant interest and technical support from industry, including local government (City of London), infrastructure operators (National Highways; TfL; Gatwick Airport), engineering consultancies (Mott MacDonald; Arup; AECOM; Jacobs) and contractors (Costain; Balfour Beatty). This strong stakeholder support has helped secure £3.5m in funding to develop Kiacrete and verify its real-world performance via trial deployments.

Box 4: Examples of tools to support carbon reduction through the infrastructure life cycle

Brightly CarbonZero – tracking and managing emissions from highways operations and maintenance

Brightly Confirm is an enterprise asset management system that is used widely in the UK highways market by both local highways authorities and National Highways. Brightly has developed CarbonZero, a new tool to allow clients to track, manage, and ultimately reduce the GHG emissions associated with the operation and maintenance of their assets base. Activities covered include reactive maintenance, planned works, cyclical maintenance, and safety inspections.

The tool supports authorities to accurately measure their carbon, in line with the FHRG's methodology for recording Scope 1 and 2 emissions and is based on the UK government's GHG conversion factors. The design of the tool means that users do not need specialist knowledge and allows carbon data to be captured on site at point of use, ensuring that the information collected is accurate and timely.

This data can be used by authorities to calculate a baseline and carry out year-on-year tracking, reducing the reliance on assumption-based calculations. Brightly has worked with FHRG to validate its approach and ensure it meets the needs of the highways sector.

The tool was shortlisted for the 2023 CIHT Decarbonisation Awards, with judges noting:

"Decarbonisation of ongoing routine maintenance throws up different challenges to a single, short duration project. This tool addresses that problem and has the potential to be a valuable part of client organisations' armoury. The judges were impressed by the approach to stakeholder engagement and the effort to ensure the tool can be easily embedded into day-to-day activities."

Moata Carbon Portal – understanding the embodied carbon impact of design choices

The Moata Carbon Portal (MCP) is designed to enable all project participants to make low-carbon choices, empowering non-specialists and democratising decarbonisation.

It allows users to understand the embodied carbon impact of design choices across all stages of a project life cycle, including emissions associated with materials, energy, and construction. Mott MacDonald, the tool's creators, report that it can generate carbon assessments up to nine times faster than traditional spreadsheet-based methods. It also allows users to view and change assumptions.

MCP can be linked to CAD design software, and bespoke plug-ins are available for widely used packages including Revit and Civil 3D. Results can then be fed back to project teams to support design decision making. The NH A303 Sparkford to Ilchester scheme provides an example of the potential impact of using the portal. By identifying and targeting carbon hotspots using MCP, designers were able to cut carbon emissions by 46%. One of the main ways this was achieved was by widening the existing single carriageway stretch to dual status, instead of building an entirely new section of dual carriageway through surrounding countryside.

MCP was commended in the 2023 CIHT Decarbonisation Awards, the judges' citation reading:

"The Moata Carbon Portal has the potential to make an important contribution to the "democratisation of decarbonisation", empowering all project contributors to build low-carbon choices into their decision making – something that judges agreed will be vital in the coming years. The results of the tool's application to a series of real-world projects have been impressive."

About CIHT

CIHT provides strategic leadership and support to help our members develop, deliver, and maintain sustainable solutions for highways, transport infrastructure, and services that:

- **Address the challenges of climate change**
- **Support the economy**
- **Help address societal inequalities**
- **Reduce environmental degradation**
- **Respond to a changing world**

We bring members together to share, learn, and feel confident about addressing these challenges through the application of good practice, by embracing innovation and by acting with integrity. It is through this and the values that CIHT can demonstrate and deliver on thought leadership and shaping the highways and transportation sector for the public benefit.

Whether you are a student, apprentice, work in the private or public sectors or are a company director, CIHT has a place for you and a commitment to fulfilling your professional development needs throughout your career.

Become part of a community of professionals just like you at:

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