Centre of Excellence
for Decarbonising Roads

CATAPULT
Connected Places

ADEPT
Live Labs 2:
A Local Authority Playbook for Low-Carbon Material.

March 2025

Department for Transport

ADEPT LIVELABS2 Decarbonising Local Roads

Transport for West Midlands

North Lanarkshire Council

Amey

COLAS
WE OPEN THE WAY

ADEPT Live Labs 2

This report is the result of a collaboration between Connected Places Catapult and a consortium led by Transport for West Midlands, North Lanarkshire Council, Amey, and Colas. The partnership focuses on producing outputs that enhance decision-making and encourage the adoption of innovative materials and deployment processes in the construction of road and highway assets and the establishment of the Centre of Excellence for Decarbonising Roads (CEDR).

CEDR is one of four themes across seven Live Labs 2 projects included in Live Labs 2, a three-year, £30 million, UK-wide programme funded by the Department for Transport that will run until March 2026, with a five-year subsequent, extended monitoring and evaluation period.

Part of the ADEPT Live Labs 2 : decarbonising local roads programme, a three year £30million UK-wide initiative funded by the Department for Transport that aims to decarbonise the local highway network.

Connected Places Catapult

Our work underpins Connected Places Catapult work to connect people, places and businesses to a future of inclusive sustainable growth and prosperity. This project was led by the Human Connected Design and Design Futures Teams for their expertise in Foresight and Speculative Design.

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Introduction

Challenge space

The UK's road network spans over 396,000 kilometres, making it one of the largest infrastructure systems in the country. This means that the roads could encircle the Earth around 10 times. Out of this, 97% of the roads are maintained and looked after by the local authorities. Each kilometre requires vast quantities of materials, the production and use of which have major environmental consequences. Bitumen, a by-product of crude oil refining, is used as a binder in road surfaces. The UK consumes approximately 1.3 million tonnes of bitumen annually, nearly 90% of which is allocated to road construction and maintenance. This material is energy-intensive to produce, with emissions tied not only to its refining process but also to its transportation and application.

Aggregates, used as the structural backbone of roads, represent an even greater scale of resource use. The UK construction industry consumes over 400 million tonnes of aggregates annually, with a significant proportion allocated to road layers such as the sub-base and base course. These materials are typically extracted from quarries, a process that involves habitat disruption, high energy consumption, and emissions from heavy machinery. Transporting these materials to construction sites further amplifies their carbon footprint. Cement, often used in concrete pavements and structural elements, is another critical material.

By starting with fundamental questions: what materials are essential, what properties they must have, and how they are produced: these basic questions allow us to identify the true drivers of emissions and design pathways to minimise them. Decarbonising the UK's roads requires not just innovation but a willingness to dismantle entrenched assumptions and rebuild our approach from the ground up.

First principles

The first principles concept breaks down complex problems to the basic foundations to get to the root of the problem. We can strip away assumptions and conventional thinking to uncover the root causes and design better solutions.

When applied to UK road construction and maintenance, this means examining the main materials that form the backbone of our infrastructure: concrete, asphalt, bitumen, steel. Each material has its own environmental impact, production cost, and lifecycle considerations. By starting with these fundamental components, we can rethink how roads are designed, built, and maintained in a way that aligns with sustainability goals. To visualise the scale of this challenge, consider the materials used annually for road construction and maintenance in the UK.

The diagram demonstrates these materials stacked on a 50m by 100m base. The resulting heights are compared to The Shard, the tallest building in the UK at 309.6 meters. The visualisation highlights the sheer volume of resources consumed and the potential impact of reducing, rethinking, or replacing these materials.

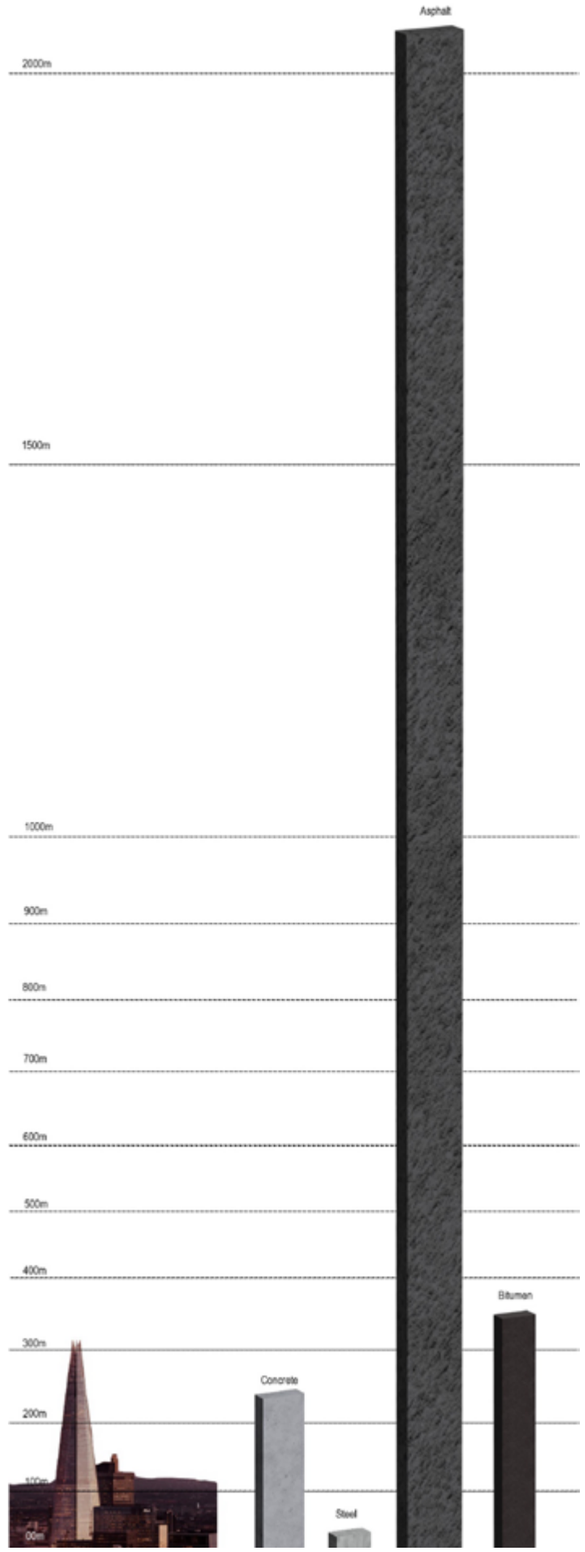


Table of materials

Concrete: 2,468,182 tonnes [1]

Steel: 35,360 tonnes [1]

Asphalt: 20 million tonnes [2]

Bitumen: 1.54 million tonnes [3]

1.Calculated from the emissions reported in Net zero highways: Roadmap for concrete our zero carbon roadmap for concrete, steel and asphalt

2. Source: Asphalt Industry Website

3. Source: Argus Media

Embodied carbon emission and the need to decarbonise road infrastructure

Road infrastructure is at the heart of modern societies, connecting people, places, and economies. However, the environmental cost of its development, particularly through the production of asphalt, a key material in road construction and maintenance, poses a significant challenge. Asphalt contributes 15% of CO_2 emissions in the UK for road construction and maintenance. For every tonne of asphalt produced, approximately 0.9 tonnes of CO_2 are emitted due to the energy-intensive chemical processes and high temperatures required. With millions of tonnes of asphalt used annually in UK infrastructure projects, the cumulative impact on carbon emissions is immense.

Addressing this challenge begins with rethinking our approach to local road construction and maintenance. Local roads consists of 294,513 kilometres of road and represents 97% of the total road network in the UK, presenting a unique opportunity to the local authorities to decarbonise UK roads (NAO, 2024). Fundamental questions like what materials are truly essential, what properties they must have, and how they are produced, allow us to pinpoint the drivers of emissions and identify opportunities to minimise embodied carbon. This is not merely about improving existing processes; it is about challenging entrenched assumptions and reimagining the way we build and maintain.

Decarbonising the UK's road infrastructure requires a shift in mindset as much as it demands technical innovation. It calls for local authorities to embrace a forward-looking approach, exploring innovative low-carbon materials and methods while fostering collaboration across sectors. Validation and assessment processes must evolve, leveraging real-time human-machine evaluations to ensure precision in carbon and lifecycle assessments. By embedding decarbonisation into every stage-from material selection to adoption, local authorities can lead the transition to a more sustainable future, setting a standard for resilience and environmental stewardship.

The journey to a decarbonised road network is as ambitious as it is necessary. By dismantling traditional practices and embracing innovation, the UK has the opportunity to create roads that meet the demands of the present while safeguarding the planet for future generations. This transformation is within reach, but it will require decisive action, visionary leadership, and a commitment to sustainable infrastructure.

Role of local authorities

Local Authorities (LAs) hold a pivotal role in decarbonising road infrastructure, uniquely positioned to address one of the most pressing challenges of our time: transforming transport networks to meet national and local environmental targets. Balancing economic, social, and operational considerations, Local Authorities have a distinct responsibility to lead this shift while serving the immediate needs of their communities. This responsibility is matched by their power to drive meaningful change, as the decisions they make today will shape the sustainable infrastructure of tomorrow.

Through a structured approach, this playbook empowers Local Authorities to navigate the journey from identifying low-carbon materials to their full adoption. Each stage:Identify, Assess, Trial, Evaluate, and Adopt, is designed to support strategic, evidence-based decision-making.

By leveraging the ability to convene stakeholders, implement innovative practices, and set new standards, Local Authorities can act as catalysts for sector-wide transformation.

Local authorities are uniquely positioned to lead the transformation toward road decarbonisation. With the right tools, knowledge and decisive action, they can catalyse the decarbonisation process by setting an example through the local transport networks. They play an active and pivotal role in setting the foundation for a sustainable future that can inspire broader progress on a national scale.

Role of CEDR

The Centre of Excellence for Decarbonising Roads (CEDR) plays a critical role in advancing sustainable innovation within the UK's local road infrastructure. As a cornerstone of ADEPT's Live Labs 2 programme, CEDR focuses on enabling local authorities to reduce the carbon impact of road construction and maintenance by trialling innovative materials and methods. Its approach ensures that the adoption of low-carbon solutions is both evidence-based and achievable, addressing the challenges of scalability, performance, and stakeholder confidence.

CEDR places trialling at the heart of its mission, supporting local authorities through a structured process encompassing identification, assessment, trialling, evaluation, and adoption. By facilitating live trials on local roads, CEDR generates robust performance data, offering local authorities the clarity and confidence needed to make informed decisions. Central to this effort is CEDR's knowledge bank, a comprehensive database of hundreds of low-carbon alternatives to traditional materials and methods. These options undergo rigorous evaluation and are curated for trials, offering local authorities a dependable resource to investigate, assess, and adopt cutting-edge solutions to road infrastructure.

By fostering collaboration and sharing insights through its knowledge bank and a growing community of local authorities across the UK, CEDR is empowering leaders to make transformative change. This initiative is shaping a sustainable future for road infrastructure, equipping local authorities with strategic resources, such as this playbook, to confidently embrace innovation and achieve decarbonisation goals.

Visit the Centre of Excellence for Decarbonsing Roads at:

decarbonisingroads.co.uk

Centre of Excellence
for Decarbonising Roads

Critical Path

Introduction

The fastest way to decarbonise road infrastructure is to build no new roads or construct roads with significantly longer lifespans. However, recognising that these options may not always align with current needs, adopting proven low-carbon materials becomes a critical step. This playbook acknowledges the complexities of adoption, with diverse materials offering variable performance. The critical path diagram provides guidance for local authorities on when to move directly to adoption and when further assessment, trialling, or evaluation is necessary. Each stage mitigates risks, ensuring low-carbon choices are effective, sustainable, and tailored to local conditions. With diverse materials available and variable performance outcomes, the journey involves strategic planning.

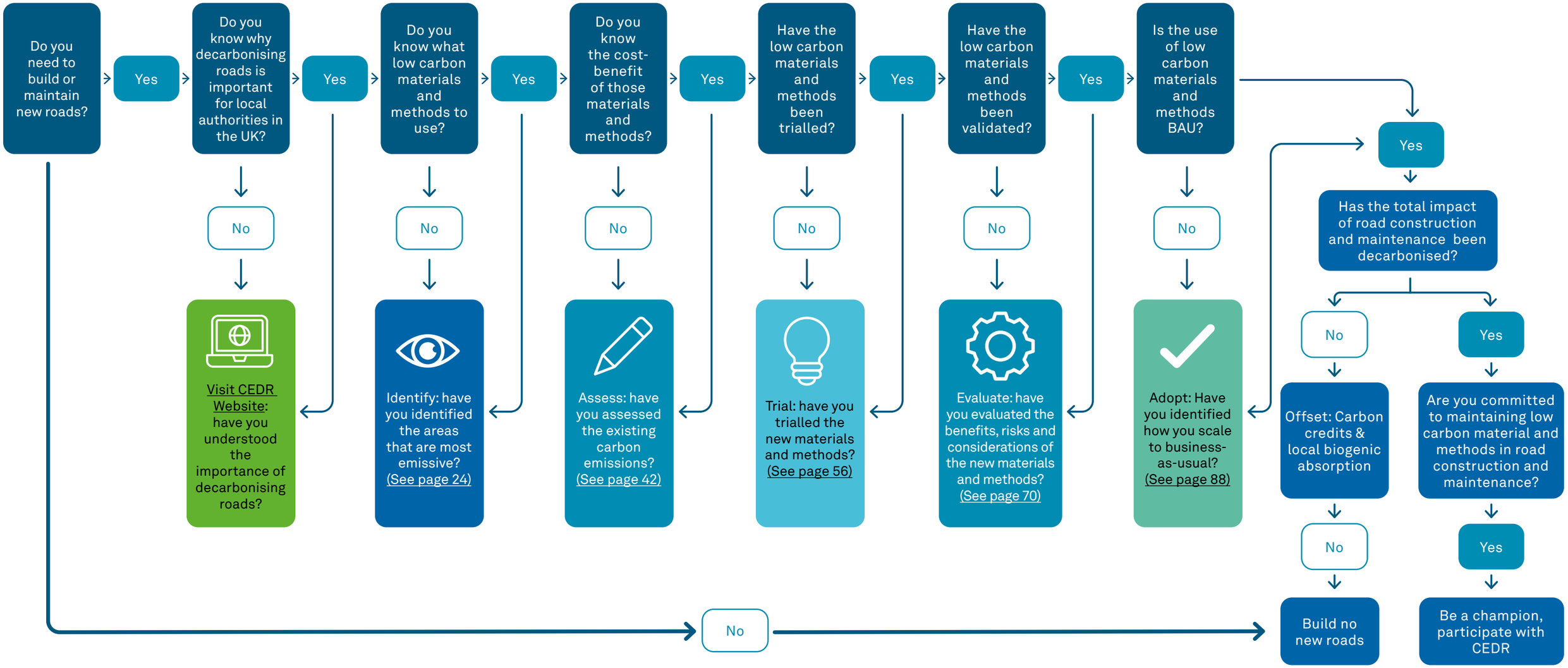
Pathways to sustainable road infrastructure

Decarbonising roads requires more than simply adopting low-carbon materials. While adoption is the ultimate goal, the journey involves critical stages to ensure effective, lasting outcomes. The critical path in this playbook outlines the necessary steps and highlights points where it may be possible to streamline the process based on available insights, previous trials, or proven supply chains.

The playbook's stages: identification, assessment, trialling, evaluation, and adoption, have been carefully designed to navigate the complexities and risks associated with low-carbon materials. Identification helps pinpoint potential solutions, while assessment evaluates their specific suitability. Trialling provides local insights into material performance, while evaluation confirms that these materials meet expected standards over time.

Each stage has built-in decision points where it may be possible to advance directly to adoption or adjust the approach. Risks such as selecting materials that underperform, paying too much, or adopting without adequate supply and maintenance plans can be mitigated by following the critical path. Furthermore, risks of supply chain disruptions or technical uncertainties are reduced by comprehensive preparation through each stage. This pathway thus provides the rigour needed for successful adoption, balanced with the flexibility to adapt and accelerate when appropriate.

Critical path - Diagram



Legend

This legend explains the components of the critical path diagram, guiding you through each question, branch, and decision point.

Questions

Key prompts that help determine where your local authority currently stands in the decarbonisation process and what next steps might be appropriate.

Branches

Connections that lead from one question to the next, indicating possible pathways based on specific answers.

Decision Nodes

Critical junctures where a decision must be made based on current information and resources, directing your authority toward the next step in the decarbonisation path.

This structure will help local authorities clearly understand and follow their unique path through the playbook.

Future state of road decarbonisation ecosystem

This section envisions a transformative future for road infrastructure, where decarbonisation is no longer an ambition but a reality. Through a critical path of thought-provoking questions, it explores how future leaders—armed with innovation, data, and collaboration—can confidently affirm their commitment to sustainable practices.

Do you need to build or maintain new roads? → Yes

Multi-modal Transit Hub designer

"Yes, but rarely, as roads now last longer. Maintenance is an opportunity to prioritise sustainable mobility and integrate power-generating pathways between transit hubs."

Are you committed to low carbon materials and methods? → Yes

Local Decarbonisation Designer

"Absolutely! Every project is a step towards zero carbon, where recycled materials and regenerative methods define our construction ethos."

Do you know what low carbon materials and methods to use? → Yes

Sustainable Infrastructure Analyst

"Always. Our national digital twin integrates decades of trials and simulates road use, weather, and material performance, tailoring low-carbon solutions for maximum resilience across UK roads."

Do you know the cost-benefit of those materials and methods? → Yes

Lifecycle Valuation Specialist

"Certainly. Full cost analysis uncovers hidden trade-offs, steering us towards materials that balance lifecycle costs, safety, sustainability, and resilience for a holistic picture of true value."

Have the low carbon materials and methods been trialled? → Yes

Chief Innovation Officer for Road Infrastructure

"Extensively. Over 500 trials this year validated carbon performance, and safety standards, tailored to climates, traffic patterns, and road types—building on decades of rigorous trial research."

Have the low carbon materials and methods been validated? → Yes

Low-Carbon Material & Methods Evaluator

"Undeniably. Human-machine teams evaluate material performance in real-time during and after trials, providing unmatched precision and transparency in lifecycle assessments."

Is the use of low carbon materials and methods BAU? → Yes

Sustainable Infrastructure Policy Advocate

"Of course. Low-carbon materials are the standard. They're not just business as usual—they're a prerequisite for future-ready, resilient, and sustainable road networks."

The Playbook

The Playbook

What it is

A playbook is a practical, step-by-step guide designed to help organisations or teams navigate complex processes. For local authorities, this decarbonisation playbook is tailored to support the shift towards low-carbon materials in road construction and maintenance, providing a structured pathway from initial concept to successful implementation. Each stage: from identifying and assessing materials to trialling, evaluating, and ultimately adopting, builds on the last, helping authorities make informed decisions that align with decarbonisation goals.

Beyond the technical process, this playbook emphasises collaboration, knowledge-sharing, and foresight, which are essential in an evolving field where innovations are continually emerging. It highlights who local authorities should connect with, such as industry experts, researchers, and peer networks, ensuring that each step is backed by insights and expertise from the field.

Practical resources, probing questions, and expert insights embedded in each chapter make this playbook adaptable to local contexts and scalable for future needs. This playbook is more than a procedural manual; it's a foundation for sustainable innovation, providing local authorities with the tools to lead confidently in creating resilient, low-carbon infrastructure that meets both current and future demands.

What it is not

A playbook is not a rigid checklist or a one-size-fits-all solution. It doesn't replace local expertise, mandate specific actions, or provide ready-made answers. Instead, it offers adaptable guidance, encouraging local authorities to tailor approaches based on context and collaborate to achieve shared decarbonisation goals in road infrastructure.

Who is it for

This playbook is designed for local authorities seeking structured, practical guidance on decarbonising road infrastructure with low-carbon materials, tailored to support informed decision-making and collaborative progress.

Navigating the playbook

Navigate this playbook by following each stage sequentially. Use sub-steps, resources, and key questions to guide decision-making. Where applicable, bypass steps if leveraging work done by other authorities, professional bodies, academic institutions.

Quick start guide

Navigate this playbook by following each stage sequentially. Use sub-steps, resources, and key questions to guide decision-making. Where applicable, bypass steps if leveraging work done by other authorities, professional bodies, academic institutions.

1. Identification

Navigate this playbook by following each stage sequentially. Use sub-steps, resources, and key questions to guide decision-making. Where applicable, bypass steps if leveraging work done by other authorities, professional bodies, academic institutions.

2. Assessment

Evaluate the identified materials for their feasibility, sustainability, and compatibility with local conditions. This assessment informs trialling decisions to test the materials in real settings.

3. Trialling

Implement small-scale trials to observe material performance in real-world conditions. Insights from trials feed into long-term evaluation for broader applicability.

4. Evaluation

Conduct rigorous, long-term assessments of material durability, effectiveness, and environmental impact. These evaluations guide adoption readiness for scalable use.

5. Adoption

Adopt materials that meet performance, sustainability, and regulatory standards, integrating them into road-building practices. This adoption drives forward decarbonisation efforts across infrastructure projects.

Route to

Decarbonising local roads

1 Identify

1. Get inspired
2. Define Scope
3. Market Scan
4. Understand impact
5. Consider local context
6. Prioritise materials for assessment
7. Share your findings

2 Assess

1. Define assessment scope
2. Gather data on materials
3. Benchmark assessment criteria
4. Explore compatibility and risks
5. Select trial-ready options

3 Trial

1. Set trial objectives
2. Design the trial process
3. Prepare for trial execution
4. Implement trial on-site
5. Analyse and share trial outcomes
6. Allow for long-term monitoring

4 Evaluate

1. Understand the trial
2. Define evaluation standards
3. Analyse material performance
4. Gather stakeholder feedback
5. Conduct cost-benefit analysis
6. Validate findings externally

5 Adopt

1. Assess scalability and suppliers
2. Develop procurement guidelines
3. Evaluate and award contracts
4. Plan workforce training
5. Update road design standards
6. Monitor long-term performance

Stage 1: Identify

Stage 1

Identify

Overview of the stage

The Identify stage establishes the foundation for decarbonising roads by systematically exploring low-carbon materials and innovative methods while considering the specific needs of local road networks. By expanding knowledge through case studies, academic research, and market analysis, stakeholders gain insights into materials and methods that can reduce emissions, enhance durability, and support long-term sustainability goals. This stage fosters creative thinking and informed approaches to road construction and maintenance through a structured process of defining scope, scanning the market, and assessing impact. It addresses knowledge gaps and builds a clear framework for further exploration, ensuring collaboration between local authorities, highway engineers, and industry innovators. By the end of this stage, stakeholders will have a prioritised list of promising solutions and a shared understanding of their potential, setting the stage for rigorous assessment and trials.

Who is this stage for?

- Transport planners
- Suppliers
- User
- Highway engineers
- Consultant
- Procurement manager
- Head of services
- Local authorities transport organisations (ADEPT, LCRIG)
- Sustainability consultant
- Funders
- Asset managers

Sub-steps and resources

1. Get inspired

What real-world examples are available which might showcase successful low-carbon road materials?

- Organic Highway Speculative Design in China
- Case studies from Low Carbon Materials
- Behaviour Change to Fight Climate Change: Mapping the behavioural journey of material decarbonisation

2. Define Scope

Which road elements offer the biggest opportunity for decarbonisation?

- See Appendix A: Scope of road infrastructure materials
- Design Manual for Roads and Bridges (DMRB)
- Local Network Hierarchy List

3. Market Scan

What are the established and emerging low-carbon materials advancing road decarbonisation

- International Market Scan
- Local Council Roads Innovation Group (LCRIG)

A few of the suggested sources from many are:

- Centre of Excellence for Decarbonising Roads: https://decarbonisingroads.co.uk/
- Future Highways research Group: https://www.adeptnet.org.uk/fhrg
- Local Council Roads Innovation Group (LCRIG) https://lcrig.org.uk/

4. Understand impact

What is the potential of each material to reduce carbon emissions?

- Resource Library: RSTA Document Library for any Road Surfacing Guidance
- Measuring Road Infrastructure Carbon: A 'critical' journey to net-zero, Decarbon8, 2022
- Asphalt Pavement Embodied Carbon Tool

5. Consider local context

How does the materials align with local road conditions, budgets and environmental factors?

- Supply Chain Sustainability School Resources
- Project Amber Framework by LCRIG

6. Prioritise materials for assessment

Which materials provide the best balance of cost, scalability, and performance?

- Net zero highways: our zero carbon roadmap for concrete, steel and asphalt
- Supply Chain Collaboration: White Paper from Saint-Gobain
- See Appendix B: Prioritisation criteria

7. Share your findings

What are the key findings to share for road decarbonisation?

- The Centre Trial Proforma

Identify

Explore examples of innovative low-carbon materials being implemented globally and locally in road infrastructure. Draw from case studies, academic insights, and industry achievements to broaden perspectives and fuel creativity. Inspiration is crucial to build confidence in this evolving field and to envision transformative opportunities in road decarbonisation.

Step 1: Get inspired

Expert comments

> ...we're so good at talking about operational carbon when it comes to transport, (however) we don't always think about the embodied impacts of our infrastructure.

Academic

Questions to ask

What excites us most about the potential for decarbonised roads, and how might this align with our long-term goals?

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What excites us most about the potential for decarbonised roads, and how might this align with our long-term goals?

Clarify the objectives of identifying materials, setting criteria such as carbon reduction targets, road compatibility, and budget constraints. Additionally, determine which aspects of local road infrastructure—such as pavements, base layers, or surface treatments—are most suitable for decarbonisation, ensuring efforts are both targeted and impactful.

Step 2: Define scope

Expert comments

> Within the design of a project, you could lean the design. Reduce the number of junctions or reduce the material hungriness of the design and avoid materials going to a more strategic level. Or it could be durability and quality. If you can squeeze everything to last a few years longer, that reduces your material needs. And then (once you establish the need for building roads) we do need the materials.

Director of Environmental Sustainability

Questions to ask

Which areas of our road infrastructure most urgently require maintenance, and how could low-carbon solutions address these needs?

Which parts of our road network are most discussed by the public, and how could innovation respond to their concerns?

Where might there be the greatest tolerance or enthusiasm for piloting innovative low-carbon materials or methods?

Identify

Investigate the materials landscape, exploring established and emerging low-carbon solutions. Research suppliers, innovators, and academic developments to identify pioneering materials. Focus on those aligning with decarbonisation goals, while ensuring a comprehensive view of market opportunities and potential challenges.

Step 3: Market scan

Expert comments

"I think one of the things for me is there's not a huge amount of direction coming out of central government on material and things. So we are naturally risk averse as local authorities because we have the duty to maintain the network."

Head of Service, Highways & Transport

Questions to ask

Which innovative suppliers, research organisations, or global projects are leading advancements in low-carbon road materials?

What tools or platforms can help systematically track and evaluate emerging low-carbon material options?

Are there overlooked opportunities within our existing network or supply chain that align with decarbonisation objectives?

Develop a high-level understanding of each material's proposed contribution to decarbonising roads. Assess its potential to reduce whole-life carbon emissions, advance sustainability objectives, and align with overarching decarbonisation strategies. Focus on key benefits and promises to gauge its strategic value in transforming road infrastructure.

Step 4: Understand the impact

Expert comments

"...if you know a neighbouring authority had shared a case study where they're using innovative material and done, you know, 50,000 square metres of their primary network and it was a great success then that should be good enough for us because it's already been tried."

Head of Service, Highways & Transport

Questions to ask

What potential environmental, economic, and social benefits might these materials bring to your road network?

In what way could these materials help achieve whole-life carbon reduction compared to traditional methods, based on the claims provided?

What risks or trade-offs are associated with their adoption, and how can they be mitigated?

Identify

Analyse how discovered materials align with the specific conditions of roads under the local authority's jurisdiction. This includes assessing climate impacts, traffic volumes, supply chain logistics, and resource availability to ensure practicality and maximise integration potential within the local road network.

Step 5: Consider the local context

Expert comments

> The primary driver for selecting works is the condition data. We know that we've got the wettest 20 months, I think in history, which has had a detrimental effect to the network. We have the condition data; we have the digital data, and we have comments from inspectors.

Head of Service, Highways & Transport

Questions to ask

How do regional climate conditions, traffic patterns, and road maintenance needs shape the feasibility of identified materials?

What specific constraints or opportunities arise from local supply chains and resource availability?

How do these materials align with jurisdiction-specific requirements and community priorities?

Get inspired | Define scope | Market scan | Understand the impact | Consider the local context | Prioritise materials for assessment | Share your findings

Shortlist materials based on criteria like carbon reduction potential, cost, scalability, and technical performance. Focusing on a shortlist ensures efficient use of resources while narrowing down the most viable options for further assessment, trialling, and eventual adoption.

Step 6: Prioritise materials for assessment

Expert comments

> It's important to emphasise that it's not all about the emissions factors associated with it, but actually that key attribute of what life are you adding to the asset as a result of doing this.

Academic

Questions to ask

Which materials combine high potential for carbon reduction, cost-effectiveness, and technical feasibility within our specific local context?

What materials or methods are most likely to inspire enthusiasm and support from stakeholders and constituents?

Which options am I most excited to explore, and how do they align with broader decarbonisation objectives?

Get inspired | Define scope | Market scan | Understand the impact | Consider the local context | Prioritise materials for assessment | Share your findings

Identify

Create clear, accessible reports to share discoveries with stakeholders, including colleagues within your local authority, industry bodies, and academia. By fostering collaborative knowledge-sharing, this step ensures that innovative insights contribute to collective progress in decarbonising road infrastructure.

Step 7: Share your findings

Expert comments

"So you need a programme that allows the evidence to be gathered for the performance of materials and where those are within the kind of requirements that we are making adjustments to the standards and making it available to the industry to straightforwardly adopt."

Director of Environmental Sustainability

Questions to ask

Who are the key stakeholders within and beyond the local authority that need access to these findings?

What opportunities exist to integrate findings into conferences, webinars, or cross-authority forums to maximise knowledge sharing?

How will we document insights to contribute to broader decarbonisation efforts and support knowledge-sharing platforms?

Stage summary

Identify

Acceleration

Foster collaborations with academic institutions and industry leaders to access cutting-edge materials research. Use digital innovation trackers and host collaborative sessions with stakeholders to identify and focus on promising solutions. Early engagement with suppliers and experts can fast-track the discovery process.

Amplification

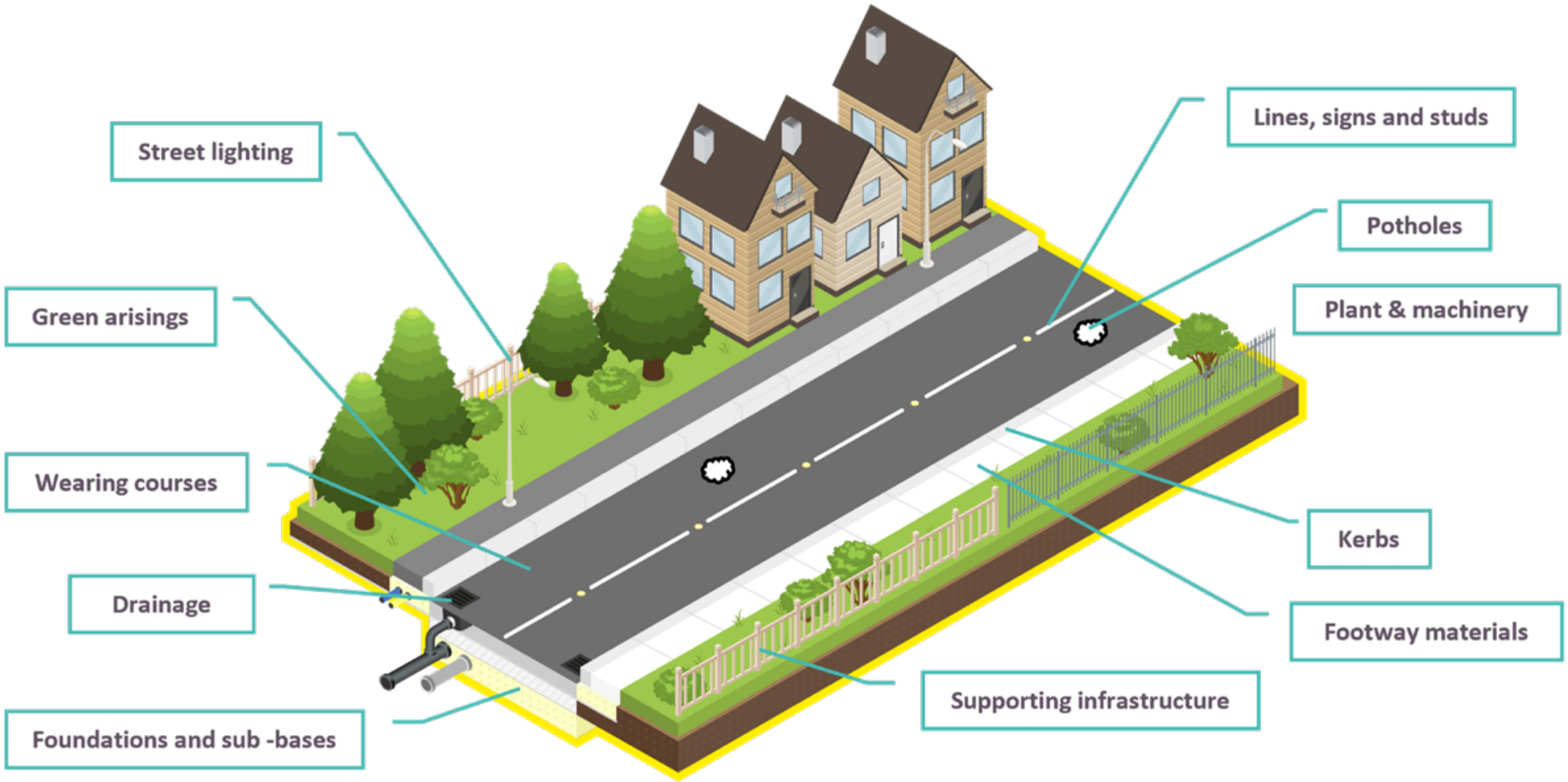
Organise knowledge-sharing events, such as public workshops or webinars, showcasing innovative materials and their potential impact. Publish case studies on local authority websites and industry platforms. Engage with media outlets to highlight the exploration phase, building public and sector-wide momentum for road decarbonisation initiatives.

Action

Explore innovative low-carbon materials through case studies, research, and global insights.

Appendix A

Scope of road infrastructure materials



Appendix B

Prioritisation criteria (Pre-Trial)

Cost (£/Functional Unit/Year)
Evaluates the financial implications of adopting a material across its lifecycle.

- Purchase Cost: Initial cost of acquiring the material.
- Maintenance Cost: Ongoing costs for upkeep and repair.
- Asset Lifecycle Cost: Total cost of ownership over the material's lifespan, factoring in durability and performance.

1 2 3 4 5
1 2 3 4 5
1 2 3 4 5

Carbon (kgCO2e/Functional Unit/Year)
Focuses on the material's ability to reduce carbon emissions.

- Scale of Whole-Life Carbon Reductions: Quantified carbon savings compared to standard materials.
- Operational Longevity: The material's ability to maintain performance while minimising emissions over time.

1 2 3 4 5
1 2 3 4 5

Service Life (Years)
Assesses how the material improves operational efficiency and longevity.

- Process Effectiveness Improvements: Enhancements to operational lifespan and reduced maintenance needs.
- Process Efficiency Improvements: Gains in installation speed, design simplicity, or reduced downtime.
- Scale of Change Required to Implement: Ease of adoption in existing workflows.
- Flexibility of Innovation: Versatility in application across varying contexts.

1 2 3 4 5
1 2 3 4 5
1 2 3 4 5
1 2 3 4 5

NegativeExternalities
Accounts for environmental and systemic risks.

- Pollution and Other Environmental Externalities: Impacts on air, water, and soil quality.
- Circular Economy and Supply Chain Considerations: Recyclability, use of waste materials, and supply chain sustainability.

1 2 3 4 5
1 2 3 4 5

Future Compatibility
Evaluates the material's preparedness for evolving demands.

- Scale of Future Climate Change Resiliency: Ability to withstand changing environmental conditions.
- Scale of Future-Proofing for Trends: Alignment with future mobility trends (e.g., EVs, autonomous vehicles).
- Current Regulatory and Standards Compliance: Alignment with existing laws and standards.

1 2 3 4 5
1 2 3 4 5
1 2 3 4 5

Broader Implications
Considers wider sectoral and societal impacts.

- Value of Trial to the Sector: Contribution to shared knowledge and best practices.
- Value of Trial to the Local Authority: Likelihood of scaling to business-as-usual.
- Supply-Side Capacity for Scaling: Supplier readiness and scalability of production.
- Contribution to Social Value: Benefits to local communities, such as safety, job creation, or reduced disruption.
- Impact on Road User Safety: Improvements or risks for road users.
- Impact on Operational Safety: Enhancements to worker safety during material handling and installation.

1 2 3 4 5
1 2 3 4 5
1 2 3 4 5
1 2 3 4 5
1 2 3 4 5
1 2 3 4 5

How to Use This Guide

Evaluate Each Material
Assign a score (1-5) for each subcategory based on data provided by suppliers, research, and stakeholder input. Use clear benchmarks to ensure consistent scoring across materials.

Weight Categories
Adjust category weightings based on local priorities (e.g., emphasising carbon reductions or cost-effectiveness).

Rank Materials
Sum the weighted scores to rank materials and identify those with the highest potential for assessment and trials. Set clear go and no-go conditions to determine feasibility

Consider Context
Use contextual factors, such as road type or traffic conditions, to further refine priorities and align selections with local needs.

Note:
Access the online Prioritisation Tool by clicking here.

Stage 2: Assess

Stage 2

Assess

Overview of the stage

The Assess stage provides a rigorous evaluation framework to determine the feasibility, sustainability, and performance of shortlisted low-carbon materials. This stage ensures that decisions are informed by robust data, aligning materials with decarbonisation targets and operational requirements. By establishing clear criteria—such as carbon reduction potential, cost, durability, and lifecycle impact—this stage builds confidence in the materials selected for trials and adoption.

By gathering comprehensive data and benchmarking options against local needs and standards, the Assess stage addresses uncertainties surrounding the practical application of materials. Stakeholders, including highway engineers, sustainability consultants, and asset managers, work together with local authorities to conduct in-depth analysis and validate findings. The outcomes of this stage provide decision-makers with actionable insights and ensure that the materials chosen are ready for real-world testing and integration.

Who is this stage for?

- Transport planners
- Suppliers
- Users
- Highway inspectors
- Finance officer
- Carbon auditors
- Contractors
- Asset managers
- Procurement manager
- Local authorities transport organisations (ADEPT, LCRIG)
- Academia
- Maintenance team
- Carbon experts

Resources and substeps

1. Define assessment scope

What real-world examples are available which might showcase successful low-carbon road materials?

- Local environmental policy & targets
- Local Design Standards and Specifications
- See Appendix B: Prioritisation Criteria

2. Gather data on materials

Which road elements offer the biggest opportunity for decarbonisation?

- Material Specifications from the Supplier
- CEDR Knowledge Bank

3. Benchmark assessment criteria

What are the established and emerging low-carbon materials advancing road decarbonisation

- SCOTS 2022 Cost Planning For Sustainability (only for Road Surfaces)
- Net zero highways: Roadmap for concrete our zero carbon roadmap for concrete, steel and asphalt
- National Highways Carbon Tool

4. Explore compatibility and risks

What is the potential of each material to reduce carbon emissions?

- Integrating embodied carbon into transport infrastructure scenarios from Decarbon8
- Road condition statistics - a basic guide and quality assessment

5. Select trial-ready options

How does the materials align with local road conditions, budgets and environmental factors?

- Material information from the supplier
- Gold Standard Trial Protocols Contact CEDR

Assess

Focus on key criteria to determine the specific objectives and boundaries of the assessment. Define factors like carbon reduction, technical feasibility, cost, and lifespan to ensure evaluations align with your decarbonisation goals and address critical performance requirements for the local road infrastructure.

Step 1: Define assessment scope

Expert comments

"...we normally use the PCF process which is product control framework and essentially it's like a design process. You basically have different gateways: outline design, detail design, etc (for road design)."

Head of Service, Highways & Traffic Management

Questions to ask

What are the key objectives this assessment aims to achieve in terms of decarbonisation and infrastructure performance?

Which criteria (e.g., carbon reduction, cost, durability) are most critical for evaluating materials within this context?

How do our goals align with broader decarbonisation policies or local road infrastructure priorities?

Define assessment scope | Gather data on materials | Benchmark assessment criteria | Explore compatibility and risks | Select trial-ready options

Collect comprehensive insights and compile data on identified materials based on the defined scope. Leverage supplier specifications, case studies, technical reports, and expert consultations to build a robust understanding of material properties, performance metrics, and potential limitations.

Step 2: Gather data on materials

Expert comments

"...you need the tools that can convert design into carbon numbers.. What we need is a tool that turns it(design) into a carbon number as well as a cost number. You need a bunch of carbon factors that convert materials and activities into estimates of the carbon associated with the project. That decision needs to be made by the designer where they're pushing down the carbon associated with the design."

Academic and Carbon Expert

Questions to ask

What data sources, such as supplier specifications or technical reports, are most reliable for assessing material properties?

Which performance metrics are critical to understanding material suitability for trials?

How can expert consultations and case studies validate supplier claims or address gaps in available data?

Define assessment scope | Gather data on materials | Benchmark assessment criteria | Explore compatibility and risks | Select trial-ready options

Assess

Set comparative standards by developing benchmarks for evaluation, such as carbon savings, lifecycle costs, durability, and maintenance needs. Use these criteria to ensure a consistent and rigorous comparison across all candidate materials, supporting informed decision-making.

Step 3: Benchmark assessment criteria

Questions to ask

What baseline benchmarks will enable a fair comparison across candidate materials?

How will lifecycle costs and maintenance needs be weighed against upfront investment and ease of adoption?

Are the benchmarks aligned with my local authority priorities?

Expert comments

"....it is a really difficult thing to position because, first it has to be useful, so it has to have a certain amount of detail in it. But secondly, it has to be applicable to a broad set of scenarios. So, one of the motivations we had was listening to our members who were quite clear that there was a general frustration that there is an awful lot of these tools, but the investment required to populate them is very consuming."

Academic

Define assessment scope | Gather data on materials | Benchmark assessment criteria | Explore compatibility and risks | Select trial-ready options

Collect comprehensive insights and compile data on identified materials based on the defined scope. Leverage supplier specifications, case studies, technical reports, and expert consultations to build a robust understanding of material properties, performance metrics, and potential limitations.

Step 4: Explore compatibility and risks

Questions to ask

What data sources, such as supplier specifications or technical reports, are most reliable for assessing material properties?

Which performance metrics are critical to understanding material suitability for trials?

How can expert consultations and case studies validate supplier claims or address gaps in available data?

Expert comments

"...you need the tools that can convert design into carbon numbers.. What we need is a tool that turns it(design) into a carbon number as well as a cost number. You need a bunch of carbon factors that convert materials and activities into estimates of the carbon associated with the project. That decision needs to be made by the designer where they're pushing down the carbon associated with the design."

Head of Service, Highways & Traffic Management

Define assessment scope | Gather data on materials | Benchmark assessment criteria | Explore compatibility and risks | Select trial-ready options

Assess

Choose promising materials based on gathered data and benchmarks, identify the most viable materials or methods for trialling and potential adoption. This step ensures a focused approach, prioritising innovations with the greatest potential for successful implementation and impact.

Step 5: Select trial-ready options

Expert comments

> ...the existing surface is malleable. It is treated, used and you can recycle and reuse it. You end up with a jointless repair. So, you get rid of one of the failure points and any repair is a joint.....now, you think that if you compare 5 square metres of that to 5 square metres of excavation, removal and import new material.

Head of Service, Highways & Traffic Management

Questions to ask

Which materials offer the best balance of feasibility, cost, and impact for trials while ensuring high certainty for learning and success?

Which materials can be sourced reliably and economically at the necessary volumes for a trial?

For which materials is there the strongest interest and enthusiasm among stakeholders to support successful trials?

Define assessment scope | Gather data on materials | Benchmark assessment criteria | Explore compatibility and risks | Select trial-ready options

Stage summary

Assess

Acceleration

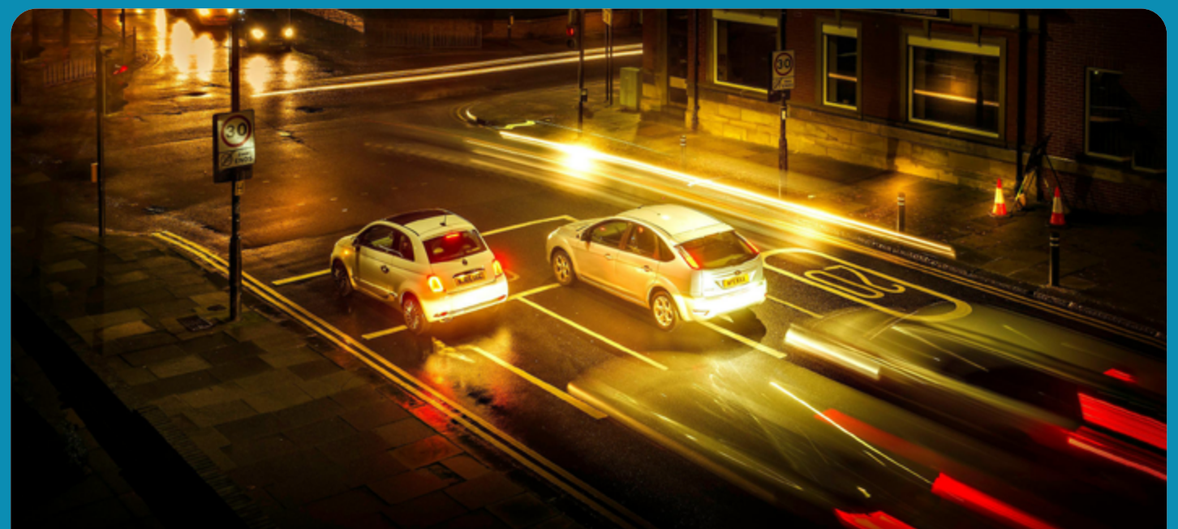
Create a structured evaluation framework with predefined benchmarks to speed up comparative assessments. Collaborate on an open-access database that enables transparent comparison of solutions using standard benchmarks. Encourage supplier partnerships to secure rapid access to technical specifications and trial data, ensuring swift early-stage decision-making on material suitability.

Amplification

Share assessment methodologies and findings with other local authorities through dedicated forums. Create user-friendly summaries for public consumption, explaining the criteria and potential benefits of the assessed materials. Actively participate in national and regional conferences to highlight innovative approaches in material evaluation.

Action

Evaluate shortlisted materials against key criteria like cost, durability, and carbon reduction.



Appendix B

Prioritisation criteria (Pre-Trial)

Cost (£/Functional Unit/Year)
Evaluates the financial implications of adopting a material across its lifecycle.

- Purchase Cost: Initial cost of acquiring the material.
- Maintenance Cost: Ongoing costs for upkeep and repair.
- Asset Lifecycle Cost: Total cost of ownership over the material's lifespan, factoring in durability and performance.

1 2 3 4 5
1 2 3 4 5
1 2 3 4 5

Carbon (kgCO2e/Functional Unit/Year)
Focuses on the material's ability to reduce carbon emissions.

- Scale of Whole-Life Carbon Reductions: Quantified carbon savings compared to standard materials.
- Operational Longevity: The material's ability to maintain performance while minimising emissions over time.

1 2 3 4 5
1 2 3 4 5

Service Life (Years)
Assesses how the material improves operational efficiency and longevity.

- Process Effectiveness Improvements: Enhancements to operational lifespan and reduced maintenance needs.
- Process Efficiency Improvements: Gains in installation speed, design simplicity, or reduced downtime.
- Scale of Change Required to Implement: Ease of adoption in existing workflows.
- Flexibility of Innovation: Versatility in application across varying contexts.

1 2 3 4 5
1 2 3 4 5
1 2 3 4 5
1 2 3 4 5

NegativeExternalities
Accounts for environmental and systemic risks.

- Pollution and Other Environmental Externalities: Impacts on air, water, and soil quality.
- Circular Economy and Supply Chain Considerations: Recyclability, use of waste materials, and supply chain sustainability.

1 2 3 4 5
1 2 3 4 5

Future Compatibility
Evaluates the material's preparedness for evolving demands.

- Scale of Future Climate Change Resiliency: Ability to withstand changing environmental conditions.
- Scale of Future-Proofing for Trends: Alignment with future mobility trends (e.g., EVs, autonomous vehicles).
- Current Regulatory and Standards Compliance: Alignment with existing laws and standards.

1 2 3 4 5
1 2 3 4 5
1 2 3 4 5

Broader Implications
Considers wider sectoral and societal impacts.

- Value of Trial to the Sector: Contribution to shared knowledge and best practices.
- Value of Trial to the Local Authority: Likelihood of scaling to business-as-usual.
- Supply-Side Capacity for Scaling: Supplier readiness and scalability of production.
- Contribution to Social Value: Benefits to local communities, such as safety, job creation, or reduced disruption.
- Impact on Road User Safety: Improvements or risks for road users.
- Impact on Operational Safety: Enhancements to worker safety during material handling and installation.

1 2 3 4 5
1 2 3 4 5
1 2 3 4 5
1 2 3 4 5
1 2 3 4 5
1 2 3 4 5

How to Use This Guide

Evaluate Each Material
Assign a score (1-5) for each subcategory based on data provided by suppliers, research, and stakeholder input. Use clear benchmarks to ensure consistent scoring across materials.

Weight Categories
Adjust category weightings based on local priorities (e.g., emphasising carbon reductions or cost-effectiveness).

Rank Materials
Sum the weighted scores to rank materials and identify those with the highest potential for assessment and trials. Set clear go and no-go conditions to determine feasibility

Consider Context
Use contextual factors, such as road type or traffic conditions, to further refine priorities and align selections with local needs.

Note:
Access the online Prioritisation Tool by clicking here.

Stage 3: Trial

Stage 3

Trial

Overview of the stage

The Trial stage transforms theory into practice by testing low-carbon materials in labs, or on real-world road networks. This stage is critical for evaluating materials under actual conditions, providing invaluable data on their technical performance, carbon impact, and operational feasibility. It bridges the gap between research and implementation, ensuring that innovative solutions are rigorously validated before widespread adoption.

Through carefully designed trials, stakeholders collect robust data while monitoring and documenting every aspect of material performance. Collaboration between contractors, suppliers, and local authorities ensures the trials reflect real-world challenges and the true opportunities for adoption. The outcomes of this stage inform best practices, highlight areas for improvement, and demonstrate the practical viability of low-carbon materials, paving the way for successful adoption.

Note: If there is sufficient data available on the trials, please consider moving to the Adoption phase.

Who is this stage for?

- Head of service
- Suppliers
- Asset managers
- Sustainability consultant
- Procurement manager
- Finance officer
- Road safety officer
- Local authorities transport organisations (ADEPT, LCRIG)
- Highway engineers
- Consultant
- Highway inspectors
- Academia
- Communication team
- Maintenance team

Resources and substeps

1. Set trial objectives

What real-world examples are available which might showcase successful low-carbon road materials?

- Gold Standard Trial Protocols Contact CEDR

2. Design the trial process

Which road elements offer the biggest opportunity for decarbonisation?

- Requirements for safety risk assessment- DMRB
- Refer to Appendix C: Trial Design

3. Prepare for trial execution

What are the established and emerging low-carbon materials advancing road decarbonisation

- Refer Gold Standard Trial Protocols: Section 3.5 Operational Contact CEDR
- Building carbon reduction into procurement processes

4. Implement trial on-Site

What is the potential of each material to reduce carbon emissions?

- National Road Safety Audit
- Instructional Manual from the supplier
- Gold Standard Trial Protocols Contact CEDR

5. Analyse and share trial outcomes

How does the materials align with local road conditions, budgets and environmental factors?

- Share the trial outcomes with other Local Authorities through networks such as LCRIG, ADEPT, MHA, etc
- Gold Standard Trial Protocols: 3.4 Monitoring & Evaluations Contact CEDR

6. Allow for long-term monitoring

How does the materials align with local road conditions, budgets and environmental factors?

- Gold Standard Trial Protocols: 3.4 Monitoring & Evaluations Contact CEDR

Trial

Focus on key criteria to determine the specific objectives and boundaries of the assessment. Define factors like carbon reduction, technical feasibility, cost, and lifespan to ensure evaluations align with your decarbonisation goals and address critical performance requirements for the local road infrastructure.

Step 1: Set trial objectives

Expert comments

"We're looking at doing a trial of in situ recycling starting next month to see, you know, what are the benefits or issues with doing it on site, the actual recycling. Any trials we do, the labs are heavily involved in testing to see if it works and then at the end, we'll have a review to say did this work right now? Is it the right time to implement or do we need to wait till it moves on a bit?"

Sustainability Manager at Construction company

Questions to ask

What specific outcomes and results do we aim to achieve from this trial, and how do we define success?

Why is this material or method being tested, and how do its properties address our decarbonisation goals?

How do the trial objectives align with long-term infrastructure needs, and have prior lab tests informed this trial?

Set trial objectives | Design the trial process | Prepare for trial execution | Implement trial on-Site | Analyse and share trial outcomes | Allow for long-term monitoring

Develop a rigorous, comprehensive trial design considering risk assessments, data collection protocols, and evaluation criteria. Include plans for monitoring, reporting, and stakeholder engagement to ensure the trial is methodical, transparent, and capable of generating robust evidence for decision-making.

Step 2: Design the trial process

Expert comments

"The initial consideration of a treatment is based on the asset. What treatment do you want to do? How much life do you want to put back into it? Are you doing it? Are you doing a small, medium or large scheme in terms of scale and lifespan?"

Head of Service, Highways & Traffic Management

Questions to ask

What data sources, such as supplier specifications or technical reports, are most reliable for assessing material properties?

Which performance metrics are critical to understanding material suitability for trials?

How can expert consultations and case studies validate supplier claims or address gaps in available data?

Set trial objectives | Design the trial process | Prepare for trial execution | Implement trial on-Site | Analyse and share trial outcomes | Allow for long-term monitoring

Trial

Select appropriate sites and gather necessary materials, equipment, and permissions. Ensure readiness through meticulous planning and by engaging relevant stakeholders, including contractors and suppliers, to guarantee smooth trial execution and minimise disruptions.

Step 3: Prepare for trial execution

Expert comments

"EA permits are a slow process. Our permits went in December, came back in May, and we were given a 10-day deadline for additional information or risk rejection. On average, it takes two years to get these permits, so planning for this timeline is critical to trial execution."

Sustainability Manager at Construction company

Questions to ask

Which sites offer the best conditions for trialling the material or method, considering factors like traffic and maintenance needs?

Are all necessary resources, including materials, equipment, and personnel, in place to commence the trial on schedule?

How will coordination with suppliers and contractors ensure readiness for trial implementation?

Set trial objectives | Design the trial process | Prepare for trial execution | Implement trial on-Site | Analyse and share trial outcomes | Allow for long-term monitoring

Conduct the trial by installing the selected material or applying the chosen construction and maintenance method on-site. Follow the designed process while ensuring safety and adherence to quality standards. Document all conditions, techniques, and methodologies to support robust future analysis and replicability across contexts.

Step 4: Implement trial on-Site

Expert comments

"It's just me going off and researching things. And then talking to my colleagues and Surrey Labs, to say, what do you think of this? Is it worth putting it forward to see if we can do a trial or, implement it?"

Sustainability Manager at Construction company

Questions to ask

Are installation conditions properly documented to ensure accurate interpretation of trial results later?

How can safety and quality be maintained throughout the installation process?

How will the installation be monitored to capture real-time data that reflects its actual performance?

Set trial objectives | Design the trial process | Prepare for trial execution | Implement trial on-Site | Analyse and share trial outcomes | Allow for long-term monitoring

Trial

Review the trial execution to assess construction and maintenance method efficacy, including adherence to design, ease of application, and safety. Gather data on short-term performance indicators where applicable. Share findings through reports and discussions, promoting sector-wide collaboration and iterative improvements in decarbonisation practices.

Step 5: Analyse and share trial outcomes

Expert comments

"How do we share the learnings of trials? Yeah, so we do workshops, write a report, have meetings about it, have a review. So, trying to do face to face meetings, workshops have more interactive discussions. So people don't dismiss it or miss it. And again, to get people enthused, so when they're working on their schemes, they can go, they've trialled this and it worked. I could use that on my scheme."

Sustainability Manager

Questions to ask

What does the trial data suggest, and does it correspond to the trial objectives?

What processes will ensure complete and accurate analysis of trial data, including environmental and economic impacts?

How can trial results be standardised and shared across the sector to maximise their impact on decarbonisation efforts?

Set trial objectives | Design the trial process | Prepare for trial execution | Implement trial on-Site | Analyse and share trial outcomes | Allow for long-term monitoring

Account for time scales recognising that material performance evaluations may require months or years to reveal meaningful results. Establish mechanisms for periodic monitoring and interim reporting to maintain focus on long-term goals while addressing immediate learning opportunities.

Step 6: Allow for long-term monitoring

Expert comments

"We have condition data, and I have a team of inspectors doing safety inspections. The cyclic inspections, the walks and driven routes are 3 monthly, 6 monthly, annuals, biennials depending on where and which bit of the network it is. So, I've got the digital view once a year and then I've got my inspectors going around over and over again."

Head of Service, Highways & Traffic Management

Questions to ask

What is the expected timeline for performance evaluation, and how will milestones be monitored during this period?

How can interim observations be captured to refine the long-term assessment process?

What contingency plans are in place if the timeline for meaningful results extends beyond initial expectations?

Set trial objectives | Design the trial process | Prepare for trial execution | Implement trial on-Site | Analyse and share trial outcomes | Allow for long-term monitoring

Stage summary

Trial

Acceleration

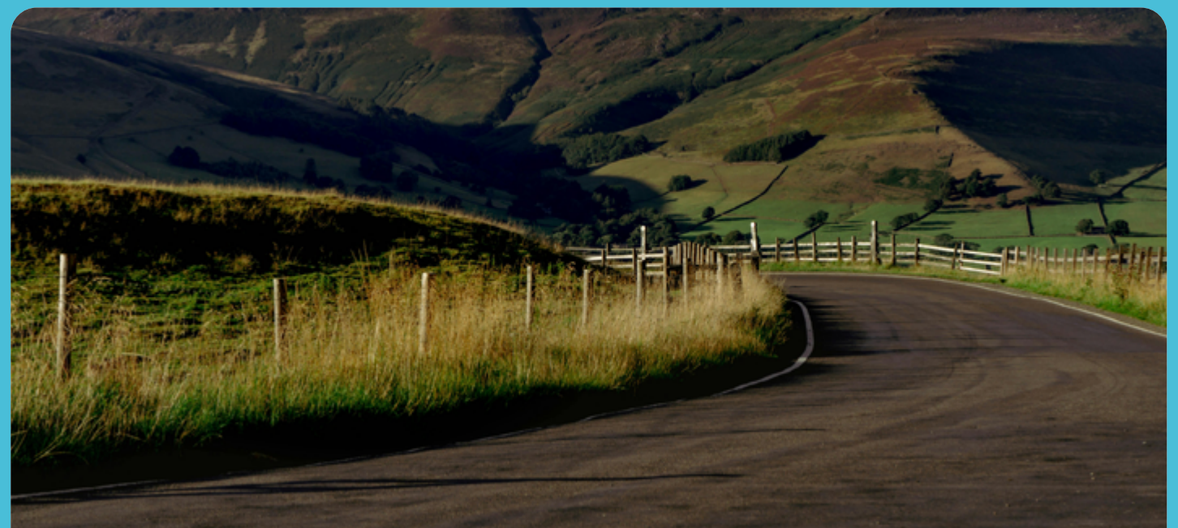
Streamline trial approval processes by predefining objectives and success metrics. Use human resources and digital monitoring tools for real-time performance tracking. Collaborate with material innovators and contractors to ensure seamless implementation and adapt trial designs based on immediate feedback to gather insights more efficiently.

Amplification

Link up with other local authorities, local organisations and share the trial results. Develop visual content, like videos or infographics, to document the trial process for public awareness. Partner with stakeholders to host on-site trial visits or virtual walkthroughs. Disseminate updates through newsletters and social media platforms to build enthusiasm for low-carbon road initiatives. Share the results with CEDR.

Action

Pilot innovative materials under controlled conditions to validate performance and feasibility.



Appendix C

Trial design

Innovation Name:

Trial Owner:

(Who will be tracking, monitoring and reporting on the trial?)

Trial Evaluator:

(Who is evaluating the trial or needs to be consulted for input?)

Brief Innovation:

(Provide a brief description of the material and/or solution)

Supplier(s):

Trial Location:

(What is the testing environment required for the trial?)

What class of road(s) should be tested?

(E.g. A, B, C)

Are there any specific considerations required?

(E.g. near a roundabout, etc.)

Trial Methodology:

(What is the overall trial methodology?)

Quantity of material required:

Timelines, including optimal trial duration:

Expected start date:

Plant/fleet required:

Baseline Product:

(What are we comparing the innovation against?)

Carbon Baseline:

(What are the carbon emissions of the current standard?)

Technical Baseline:

(What is the technical performance of the current standard?)

Anticipated Benefits and Trial Outcomes:

(What are we expecting to learn from the trial?)

Potential Risks:

(Provide a high-level risk register for the trial)

For further guidance, contact adept@cp.catapult.org.uk or explore the full trial protocols by CEDR.

Stage 4: Evaluate

Stage 4

Evaluate

Overview of the stage

The Evaluate stage focuses on analysing data from trials to assess the long-term viability and scalability of tested materials. This stage ensures that insights are translated into actionable knowledge, empowering stakeholders to make evidence-based decisions. By reviewing trial outcomes through a structured evaluation process, stakeholders can compare materials against predefined criteria and identify solutions that meet both environmental and operational goals.

Collaboration with academics, industry experts, and local authorities ensures the evaluation is robust and unbiased. This stage also integrates stakeholder feedback and cost-benefit analysis to provide a holistic understanding of each material's performance. The findings from this stage guide the adoption process and contribute to the development of a shared knowledge base for sustainable road construction and maintenance.

Who is this stage for?

- Consultant
- Suppliers
- Heads of service
- Asset managers
- Highway inspectors
- Academia
- Sustainability consultant
- Finance officer
- Legal advisor
- Local authorities transport organisations (ADEPT, LCRIG)
- Contractors
- Maintenance team
- Communication team

Resources and substeps

1. Understand the trial

What real-world examples are available which might showcase successful low-carbon road materials?

- Gold Standard Trial Protocols: Section 2 Trial Planning Process Contact CEDR

2. Define evaluation standards

Which road elements offer the biggest opportunity for decarbonisation?

- PAS 2080

3. Analyse material performance

What are the established and emerging low-carbon materials advancing road decarbonisation

- Gold Standard Trial Protocols: 3.4 Monitoring & Evaluations Contact CEDR
- See Appendix D: Checklist: evaluating trial performance

4. Gather stakeholder feedback

What is the potential of each material to reduce carbon emissions?

- See appendix E: Checklist: Gathering Stakeholder Feedback

5. Conduct cost-benefit analysis

How does the materials align with local road conditions, budgets and environmental factors?

- HM Green Book

6. Validate findings externally

How does the materials align with local road conditions, budgets and environmental factors?

- CEDR Knowledge Bank
- Gold Standard Trial Protocols: 3.4 Monitoring & Evaluations Contact CEDR

Evaluate

Review trial design and process by examining the objectives, execution, and evaluation plans, especially if conducted by another authority. This ensures a clear understanding of how the trial was structured and prepares for consistent evaluation aligned with its original goals.

Step 1: Understand the trial

Expert comments

"We know where we are now with the materials we've got. But with the landscapes changing and climate change, the heat, the wetter weather, (fluctuating) cold. So again, it's around stress testing materials just to exist, it's not just around the traffic. It's how will it fare at increased temperatures or increased levels of saturation through the winter."

Head of Service, Highways & Transport

Questions to ask

What were the key objectives of the trial, and to what extent were they achieved?

Was the trial experiment conducted effectively, adhering to the initial objectives and design?

What key lessons emerged from the trial regarding its design, execution, and outcomes?

Understand the trial | Define evaluation standards | Analyse material performance | Gather stakeholder feedback | Conduct cost-benefit analysis | Validate findings externally

Review trial design and process by examining the objectives, execution, and evaluation plans, especially if conducted by another authority. This ensures a clear understanding of how the trial was structured and prepares for consistent evaluation aligned with its original goals.

Step 2: Define evaluation standards

Expert comments

"The initial consideration of a treatment is based on the asset. What treatment do you want to do? How much life do you want to put back into it? Are you doing it? Are you doing a small, medium or large scheme in terms of scale and lifespan?"

Head of Service, Highways & Transport

Questions to ask

Was an evaluation plan pre-defined, and how well did it align with the trial's objectives?

What monitoring intervals are necessary to assess material performance comprehensively?

Which evaluation criteria or standard are most applicable given local road and community contexts?

Understand the trial | Define evaluation standards | Analyse material performance | Gather stakeholder feedback | Conduct cost-benefit analysis | Validate findings externally

Evaluate

Quantify key indicators to assess data from the trial, such as durability, carbon savings, and cost metrics. These insights provide an objective understanding of the material's performance against predefined standards.

Step 3: Analyse material performance

Expert comments

"The Surrey Labs play a big role in decision-making and implementation. They conduct the necessary testing and provide reports, ensuring the materials meet our standards. Contractors and stakeholders rely on these findings for trials, which makes coordination with labs a key part of trial preparation."

Sustainability Manager at Construction company

Questions to ask

How does the material's performance in durability, carbon reduction, and cost compared to traditional options?

Are there unexpected strengths or weaknesses revealed during the trial?

What factors influenced performance outcomes, such as installation techniques or environmental conditions?

Understand the trial | Define evaluation standards | **Analyse material performance** | Gather stakeholder feedback | Conduct cost-benefit analysis | Validate findings externally

Include qualitative insights by developing a structured approach for collecting stakeholder input, including road users, maintenance teams, and local communities. Their perspectives help contextualise performance metrics with real-world experiences and usability considerations.

Step 4: Gather stakeholder feedback

Expert comments

"I would say it's about analysing the whole value chain and making sure you've got representation of as many people there as possible."

ICE Policy Fellow

Questions to ask

How do road users, maintenance teams, and local communities perceive the material's performance and impact?

What challenges or benefits did stakeholders identify in using and maintaining the material?

Was the trial process perceived as safer, more efficient, or more complex compared to traditional methods?

Understand the trial | Define evaluation standards | Analyse material performance | **Gather stakeholder feedback** | Conduct cost-benefit analysis | Validate findings externally

Evaluate

Assess lifecycle impacts by performing in-depth assessments, including cost-benefit analysis and lifecycle assessments, to measure economic and environmental trade-offs. These evaluations provide a holistic view of the material or method's long-term value.

Step 5: Conduct cost-benefit analysis

Expert comments

"What happens is you end up with a pothole next to that pothole and then we'll go and do another pothole repair because it's £75, it's cost effective, it's quick. it just accelerates the deterioration, I've got 55 pothole repairs in a line. If you did a patch, it will be more expensive. But, the whole life cost of that is much better than multiple visits over a long period of time doing pothole repairs."

Head of Service, Highways & Traffic Management

Questions to ask

What are the economic trade-offs when comparing this material to traditional alternatives over its lifecycle?

How do the material's environmental benefits balance against its cost and implementation complexity?

What long-term advantages could this material offer for scaling decarbonisation efforts?

Understand the trial | Define evaluation standards | Analyse material performance | Gather stakeholder feedback | **Conduct cost-benefit analysis** | Validate findings externally

Engage academic institutions, industry experts, and third-party reviewers to validate collected data and evaluation methods. Independent scrutiny enhances credibility and ensures conclusions are robust and widely accepted.

Step 6: Validate findings externally

Expert comments

"....(Local councils) are trying to bring local authorities together to communicate and share best practices. But it's still difficult to overcome the competitive mindset where people see innovation as a secret and don't want to share it. To hit targets, we need to collaborate more and validate findings across organisations."

Sustainability Manager at Construction company

Questions to ask

How do the trial results compare with existing benchmarks, databases, or similar projects?

Have the material's carbon savings been independently validated to ensure accuracy?

What additional insights can industry experts or academic reviewers provide to contextualise the findings?

Understand the trial | Define evaluation standards | Analyse material performance | Gather stakeholder feedback | Conduct cost-benefit analysis | **Validate findings externally**

Stage summary

Evaluate

Acceleration

Use pre-established evaluation criteria to guide rapid analysis of trial outcomes. Engage external experts for independent validation to enhance credibility and reduce review time. Employ a centralised geolocated repository to communicate findings internally and externally more efficiently.

Amplification

Publish evaluation findings in accessible formats, such as executive summaries or user-friendly data exploration tools. Host stakeholder briefings to discuss lessons learned and next steps. Share insights widely within the sector, encouraging collaboration and fostering a shared commitment to decarbonisation.

Action

Review trial outcomes rigorously, focusing on performance data, stakeholder feedback, and cost-benefit analysis.

Appendix D

Checklist: Evaluating trial performance

This checklist provides a structured approach for Local Authorities to evaluate trialed materials across various aspects of road infrastructure. It ensures a comprehensive assessment of durability, safety, environmental impact, and long-term performance, supporting informed decisions on adoption.

Defining Evaluation Scope & Data Collection

[ ] Establish clear objectives based on material type, location, expected performance, and broader decarbonisation goals.
[ ] Identify which road elements are being evaluated (e.g., surface layer, foundations, markings, drainage).
[ ] Ensure trial evaluation criteria align with maintenance and safety priorities.
[ ] Maintain structured logs, including photographic evidence and quantitative performance data, to track changes over time.
[ ] Compare findings against supplier-reported claims, industry benchmarks, and traditional materials.

Visual, Structural & Safety Assessment

[ ] Inspect surfaces for cracking, chipping, separation, sinking, bulging, discolouration, and vandalism.
[ ] Assess reflectivity, visibility, and durability of road markings, signs, and studs under different lighting and weather conditions.
[ ] Monitor for material displacement, water pooling, ice formation, or other environmental interactions.
[ ] Conduct traction, skid resistance, and load-bearing tests to determine stability and response to stress.
[ ] Evaluate safety impacts, including road user experience, accident reports, and maintenance ease.

Laboratory & Field Testing

[ ] Collect core samples to assess internal integrity, bonding, and potential micro-fractures.
[ ] Perform chemical analysis to detect material degradation, emissions, or leaching risks.
[ ] Use thermal imaging, laser scanning, or LiDAR to detect structural shifts, temperature sensitivity, or degradation.
[ ] Conduct accelerated wear simulations to estimate long-term performance under real-world conditions.

Comparative Performance & Cost Analysis

[ ] Benchmark trialed materials against traditional alternatives in durability, lifecycle costs, and maintenance needs.
[ ] Assess financial implications, including initial investment, upkeep costs, and potential long-term savings.
[ ] Compare carbon footprint and embodied emissions, identifying any unintended environmental trade-offs.
[ ] Evaluate integration with existing maintenance processes and compatibility with road-use demands.

Long-Term Monitoring & Reporting

[ ] Establish a timeline for periodic reassessments (e.g., seasonal reviews, annual reports).
[ ] Implement monitoring through digital asset management systems or IoT sensors where applicable.
[ ] Share insights with industry networks, suppliers, and other local authorities to support broader knowledge-sharing.

Note: This checklist is a guide for ensuring comprehensive stakeholder feedback collection during material trials. Adjustments can be made based on trial specifics, stakeholder availability, and the feedback goals of the local authority. Refer to DMRB, BSEN Standards, MCHW, SHW, or HAPAS for further evaluation guidance.

For further guidance, contact adept@cp.catapult.org.uk or explore the full trial protocols by CEDR.

Appendix E

Checklist: Gather stakeholder feedback

This checklist provides a structured approach to collect qualitative insights from stakeholders, ensuring that feedback enhances understanding of material performance and usability.

Integration of Feedback into Decision-Making

[ ] Define and document how feedback will influence the next steps in the trial or adoption process.
[ ] Highlight and prioritise stakeholder feedback points that align with strategic or operational goals.

Stakeholder Identification and Engagement

[ ] Identify key stakeholder groups, including road users (drivers, cyclists, and pedestrians), maintenance teams, and local communities.
[ ] Ensure representation from diverse demographics and abilities for balanced feedback.
[ ] Communicate the purpose of feedback collection and how it will be used.

Feedback Collection Design

[ ] Develop a structured feedback framework, including surveys, interviews, or focus groups.
[ ] Tailor questions to align with trial objectives and stakeholder expertise.
[ ] Plan for accessible feedback methods to accommodate all stakeholders.
[ ] Pilot feedback tools (e.g., surveys or interviews) with a small stakeholder group before full implementation.
[ ] Ensure online feedback tools are mobile-friendly for greater accessibility.

Performance and Impact Insights

[ ] Gather perceptions of material performance in real-world conditions.
[ ] Assess stakeholder-identified challenges or benefits of using the material.
[ ] Document feedback on environmental, operational, and safety impacts.

Comparison and Usability

[ ] Collect insights on how the trial compares to traditional methods.
[ ] Evaluate ease of use, safety, and efficiency from stakeholder perspectives.
[ ] Identify any areas for improvement in material or process usability.

Analysis and Integration

[ ] Analyse qualitative insights for common themes and actionable recommendations.
[ ] Contextualise qualitative feedback with quantitative trial data to identify trends or discrepancies.
[ ] Use visual tools (e.g., heatmaps or graphs) to map stakeholder feedback by frequency or intensity of concern.
[ ] Share summarised feedback with relevant teams to inform next steps.

Note: This checklist is a guide for ensuring comprehensive stakeholder feedback collection during material trials. Adjustments can be made based on trial specifics, stakeholder availability, and the feedback goals of the local authority.

For further guidance, contact adept@cp.catapult.org.uk or explore the full trial protocols by CEDR.

Appendix F

Prioritisation criteria (Post-trial)

Cost (£/Functional Unit/Year)
Evaluates the financial implications of adopting a material across its lifecycle.

- **Purchase Cost:** Initial cost of acquiring the material.
- **Maintenance Cost:** Ongoing costs for upkeep and repair.
- **Asset Lifecycle Cost**: Total cost of ownership over the material's lifespan, factoring in durability and performance.

1 2 3 4 5
1 2 3 4 5
1 2 3 4 5

Carbon (kgCO2e/Functional Unit/Year)
Focuses on the material's ability to reduce carbon emissions.

- **Scale of Whole-Life Carbon Reductions:** Quantified carbon savings compared to standard materials.
- **Operational Longevity:** The material's ability to maintain performance while minimising emissions over time.

1 2 3 4 5
1 2 3 4 5

Service Life (Years)
Assesses how the material improves operational efficiency and longevity.

- **Process Effectiveness Improvements:** Enhancements to operational lifespan and reduced maintenance needs.
- **Process Efficiency Improvements:** Gains in installation speed, design simplicity, or reduced downtime.
- **Scale of Change Required to Implement:** Ease of adoption in existing workflows.
- **Flexibility of Innovation:** Versatility in application across varying contexts.

1 2 3 4 5
1 2 3 4 5
1 2 3 4 5
1 2 3 4 5

NegativeExternalities
Accounts for environmental and systemic risks.

- **Pollution and Other Environmental Externalities:** Impacts on air, water, and soil quality.
- **Circular Economy and Supply Chain Considerations**: Recyclability, use of waste materials, and supply chain sustainability.

1 2 3 4 5
1 2 3 4 5

Future Compatibility
Evaluates the material's preparedness for evolving demands.

- **Scale of Future Climate Change Resiliency:** Ability to withstand changing environmental conditions.
- **Scale of Future-Proofing for Trends:** Alignment with future mobility trends (e.g., EVs, autonomous vehicles).
- **Current Regulatory and Standards Compliance:** Alignment with existing laws and standards.

1 2 3 4 5
1 2 3 4 5
1 2 3 4 5

Broader Implications
Considers wider sectoral and societal impacts.

- **Value of Trial to the Sector:** Contribution to shared knowledge and best practices.
- **Value of Trial to the Local Authority:** Likelihood of scaling to business-as-usual.
- **Supply-Side Capacity for Scaling:** Supplier readiness and scalability of production.
- **Contribution to Social Value:** Benefits to local communities, such as safety, job creation, or reduced disruption.
- **Impact on Road User Safety:** Improvements or risks for road users.
- **Impact on Operational Safety:** Enhancements to worker safety during material handling and installation.

1 2 3 4 5
1 2 3 4 5
1 2 3 4 5
1 2 3 4 5
1 2 3 4 5
1 2 3 4 5

How to Use This Guide

Evaluate Each Material
Assign a score (1-5) for each subcategory based on data provided by suppliers, research, and stakeholder input. Use clear benchmarks to ensure consistent scoring across materials.

Weight Categories
Adjust category weightings based on local priorities (e.g., emphasising carbon reductions or cost-effectiveness).

Rank Materials
Sum the weighted scores to rank materials and identify those with the highest potential for assessment and trials. Set clear go and no-go conditions to determine feasibility

Consider Context
Use contextual factors, such as road type or traffic conditions, to further refine priorities and align selections with local needs.

Note:
Access the online Prioritisation Tool by clicking here.

Stage 5: Adopt

Stage 5

Adopt

Overview of the stage

The Adopt stage focuses on scaling successful low-carbon materials and methods from trials to widespread application. This stage ensures that lessons from trials are systematically applied, enabling local authorities and industry partners to integrate innovations into standard practice. By addressing supply chain scalability, procurement, and workforce training, this stage ensures readiness for large-scale implementation.

Through clear guidelines, training programmes, and collaborative partnerships, the Adopt stage facilitates the seamless transition to low-carbon road construction and maintenance. Stakeholders work together to update standards, monitor performance, and share lessons learned, ensuring the sector evolves toward sustainability. The outcomes of this stage solidify long-term decarbonisation impacts and establish a framework for continuous improvement.

Resources and substeps

1. Assess scalability and suppliers

What real-world examples are available which might showcase successful low-carbon road materials?

- See Appendix G: Checklist: Assess Scalability and Suppliers

2. Develop procurement guidelines

Which road elements offer the biggest opportunity for decarbonisation?

- Local Procurement Framework and Policy
- Project Amber Framework by LCRIG

3. Evaluate and award contracts

What are the established and emerging low-carbon materials advancing road decarbonisation

- LCRIG Innovation Procurement System (IPS)

4. Plan workforce training

What is the potential of each material to reduce carbon emissions?

- National Highways: Project Control Framework

Who is this stage for?

- Asset managers
- Suppliers
- Academia
- Consultant
- Cerification body
- Contractors
- Transport planners
- Procurement manager
- Highway engineers
- Local authorities transport organisations (ADEPT, LCRIG)
- Sustainability consultant
- Finance officer
- Legal advisor
- Heads of service & Director
- Councillors and Cabinet members

5. Update road design standards

How does the materials align with local road conditions, budgets and environmental factors?

- See Appendix H: Checklist: Plan Workforce Training

6. Monitor long-term performance

How does the materials align with local road conditions, budgets and environmental factors?

- Case Study: Highway Design Guide from Leicestershire
- Refer to your Local Design Guide
- See Appendix I: Checklist: Updating Local Road Standards

5. Monitor long-term performance

How does the materials align with local road conditions, budgets and environmental factors?

Gold Standard Trial Protocols: 3.4 Monitoring & Evaluations Contact CEDR

Adopt

Evaluate supply chain capacity to confirm suppliers' ability to meet demand consistently, ensuring materials are available without cost fluctuations or supply disruptions. Evaluate the scalability of production and supply chain resilience to support widespread adoption.

Step 1: Assess scalability and suppliers

Expert comments

"We've got a technology development cycle and there is around 20 to 25 years typically, to go from first concept through to bringing it to market and being well established in the market. So, we've got one technology cycle left.....we've got to accelerate that and make it at least two cycles if not three. Otherwise, we're not going to meet our (net-zero) targets..."

ICE Policy Fellow

Questions to ask

How reliable and resilient is the supply chain for this material under varying demand levels?

Can suppliers meet volume requirements consistently without significant cost fluctuations or delays?

What adjustments are needed to scale the material from trials to widespread adoption within the local context?

Assess scalability and suppliers | Develop procurement guidelines | Evaluate and award contracts | Implement low-carbon alternatives | Plan workforce training | Update road design standards | Monitor long-term performance

Draft procurement documentation or internal work orders to establish clear scope of construction or maintenance of road infrastructure. Specify technical requirements, sustainability standards, and performance expectations to guide supplier selection or in-house construction and maintenance.

Step 2: Develop procurement guidelines

Expert comments

"The framework holds 14 suppliers who can deliver different treatments. They've all got different treatments. So, you can do a combination of direct award or ask the suppliers to come (and have a look) at the surface (and ask) if there's a treatment you want. Because in the framework, the supplier wouldn't have got on there if they weren't a competent and viable company."

Head of Service, Highways & Traffic Management

Questions to ask

What aspects of adoption—such as material sourcing, construction, or maintenance—require external providers, and which can be managed in-house to optimise cost and efficiency?

What technical requirements and sustainability standards should be included in procurement documentation to ensure alignment with decarbonisation goals?

How can procurement guidelines be tailored to balance cost, quality, and long-term impact?

Assess scalability and suppliers | Develop procurement guidelines | Evaluate and award contracts | Implement low-carbon alternatives | Plan workforce training | Update road design standards | Monitor long-term performance

Adopt

Assess proposals for suitability and select supplier based on cost, sustainability impact, and technical compatibility. Use rigorous evaluation processes to ensure chosen partners align with local authority objectives and can deliver reliable, high-quality materials.

Step 3: Evaluate and award contracts

Expert comments

"We look at alternative mixes, thin surfacing. And we've had good success with everything we've tried. We've got the sound basis of if you engage actively with a supplier of a material, the one that makes it or the people that lay it, all they want is success. They want it to be as successful as you do."

Head of Service, Highways & Traffic Management

Questions to ask

Which proposal offers the most reliable and high-quality materials while meeting our sustainability and technical compatibility objectives?

How well do the proposed timelines, cost structures, and resource commitments align with our project requirements and budgetary constraints?

What evidence is provided to demonstrate the supplier's capacity to deliver consistently and adapt to potential challenges during implementation?

Assess scalability and suppliers | Develop procurement guidelines | **Evaluate and award contracts** | Implement low-carbon alternatives | Plan workforce training | Update road design standards | Monitor long-term performance

Initiate construction and maintenance of road infrastructure projects using low-carbon materials and methods. Monitor implementation closely to ensure compliance with agreed-upon processes and standards.

Step 4: Implement low-carbon alternatives

Expert comments

"You've got to work on those principle because you might be sharing risk, and they too don't want to carry out a job that fails. You've always got the support of your supplier."

Head of Service, Highways & Traffic Management

Questions to ask

What steps are necessary to ensure compliance with agreed processes and standards during the implementation phase?

How can challenges encountered during the trial phase be addressed to optimise material performance in real-world conditions?

What mechanisms will be put in place to monitor progress and capture data during the initial adoption phase?

Assess scalability and suppliers | Develop procurement guidelines | Evaluate and award contracts | **Implement low-carbon alternatives** | Plan workforce training | Update road design standards | Monitor long-term performance

Adopt

Develop training programmes for staff and contractors, focusing on the unique requirements of new materials or methods in the local context. Implement monitoring protocols to track workforce capacity and capability to ensure long-term performance of new road infrastructure.

Step 5: Plan workforce training

Expert comments

"The training would be provided most of the time by the suppliers. You have to instigate it yourself, but you will need the supply chain's involvement because they've got that technical understanding of the new product."

ICE Policy Fellow

Questions to ask

What skills and knowledge do staff and contractors need to successfully implement and maintain the new materials?

How can training programmes be designed to address potential challenges and ensure smooth adoption across teams?

What frequency and format of training will best support ongoing workforce capability as adoption scales?

Assess scalability and suppliers | Develop procurement guidelines | Evaluate and award contracts | Implement low-carbon alternatives | **Plan workforce training** | Update road design standards | Monitor long-term performance

Integrate adopted methods and materials into local road design manuals and standards. Use change management practices where necessary to ensure adoption across teams and projects.

Step 6: Update road design standards

Expert comments

"People are too overwhelmed that they've got hundreds or thousands of these standard designs or specifications. How long is it going to take to rewrite all of those? Who's going to do it? How many people have got to read it and sign off for it?"

Sustainability manager at Construction company

Questions to ask

What updates are required to local road design manuals to integrate the new material or method?

Are change management practices required to ensure smooth adoption of new standards across teams and projects?

Who will champion these updates, and how will their influence ensure successful integration and adherence?

Assess scalability and suppliers | Develop procurement guidelines | Evaluate and award contracts | Implement low-carbon alternatives | Plan workforce training | **Update road design standards** | Monitor long-term performance

Adopt

Conduct ongoing monitoring to assess long-term material performance, safety, and emissions. Use data to refine future projects and support compliance with reporting and sustainability objectives.

Step 7: Monitor long-term performance

Expert comments

> So you need a programme that allows the evidence to be gathered for the performance of materials and where those are within the kind of requirements that we are making adjustments to the standards and making it available to the industry to straightforwardly adopt.

Director of Environmental Sustainability

Questions to ask

What data collection and monitoring protocols will ensure comprehensive evaluation of long-term material performance?

How frequently should performance reviews be conducted, and what metrics will be prioritised?

How can lessons from ongoing monitoring be shared across the sector to inform future innovations and adoption efforts?

Assess scalability and suppliers | Develop procurement guidelines | Evaluate and award contracts | Implement low-carbon alternatives | Plan workforce training | Update road design standards | Monitor long-term performance

Stage summary

Adopt

Acceleration

Collaborate with suppliers to secure scalable solutions and streamline procurement. Conduct workforce training sessions early to build implementation capacity. Develop a phased rollout plan with clear milestones, ensuring smooth integration into existing infrastructure processes.

Amplification

Celebrate adoption milestones through public announcements and case studies. Share implementation success stories across national and regional platforms. Actively engage with policymakers to promote scaling opportunities and position your local authority as a leader in sustainable infrastructure innovation.

Action

Scale up successful materials by integrating them into procurement, road design standards, and operations.

Appendix G

Checklist: Assess Scalability and Suppliers

This checklist provides a structured approach for Local Authorities to evaluate trialed materials across various aspects of road infrastructure. It ensures a comprehensive assessment of durability, safety, environmental impact, and long-term performance, supporting informed decisions on adoption.

Contextual Data

[ ] Site location(s) and selection criteria documented.
[ ] Key contextual factors influencing scalability identified (e.g., local road classifications, traffic levels).
[ ] Supplier capabilities mapped, including logistics, production scalability, and geographic reach.

Supply Chain Evaluation

[ ] Evidence of supplier reliability under varying demand levels (e.g., historical performance).
[ ] Assessment of supply chain resilience, including capacity to adapt to material demand shifts.
[ ] Identification of risks related to cost fluctuations, delivery delays, or material shortages.

Material Scalability

[ ] Feasibility analysis of scaling production from trial volumes to widespread use.
[ ] Availability of raw materials and dependencies evaluated for long-term adoption.
[ ] Supplier scalability plans reviewed, including production timelines and infrastructure readiness.

Operational Integration

[ ] Clear understanding of supplier support for installation, training, or maintenance requirements.
[ ] Confirmation of compliance with technical specifications and local authority standards.
[ ] Documentation of supplier ability to adapt to project-specific needs (e.g., material customisation).

Carbon and Sustainability

[ ] Evaluation of carbon footprint associated with supply chain logistics.
[ ] Supplier environmental certifications (e.g., EPDs) verified for accuracy and alignment with goals.
[ ] Analysis of material lifecycle impacts, focusing on end-of-life recyclability and embodied carbon.

Cost and Risk Management

[ ] Detailed cost analysis, including material unit costs, transport expenses, and lifecycle projections.
[ ] Risks related to market conditions, material price volatility, and supplier dependencies addressed.
[ ] Contingency plans developed for supply disruptions or performance issues.

Collaboration and Validation

[ ] Supplier partnerships formalised with clear roles and responsibilities.
[ ] Independent validation of supplier claims through certifications, trials, or external audits.
[ ] Engagement with industry networks (e.g., CEDR, LCRIG) to benchmark practices and share insights.

Note: This checklist aligns with the broader goals of enabling evidence-based decision-making and fostering innovation in low-carbon road materials. By systematically assessing scalability and supplier reliability, local authorities can ensure sustainable and efficient adoption of novel materials

For further guidance, contact adept@cp.catapult.org.uk or explore the full trial protocols by CEDR.

Appendix H

Checklist: Plan Workforce Training

This checklist provides a structured approach for Local Authorities to evaluate trialed materials across various aspects of road infrastructure. It ensures a comprehensive assessment of durability, safety, environmental impact, and long-term performance, supporting informed decisions on adoption.

Training Needs Assessment
[ ] Identify required skills and knowledge for implementing and maintaining new materials.
[ ] Assess workforce readiness, including contractors and local authority staff.
[ ] Evaluate specific challenges linked to local contexts, such as material properties or road types.
[ ] Check with the suppliers for training provided on material upkeep and maintenance.

Training Programme Development
[ ] Design training programmes tailored to unique requirements of new materials or methods.
[ ] Incorporate best practices and lessons learned from pilot trials or other authorities.
[ ] Develop scenario-based modules to address potential challenges during adoption.

Training Delivery and Format
[ ] Determine optimal training formats (e.g., workshops, e-learning, on-site demonstrations).
[ ] Schedule regular training sessions to accommodate scaling and new team members.
[ ] Ensure training materials are accessible, clear, and practical for all participants.

Monitoring and Evaluation
[ ] Implement protocols to track workforce capacity and training progress over time.
[ ] Monitor staff and contractor competency through assessments and feedback loops.
[ ] Adjust training content based on participant feedback and observed challenges.

Collaboration and Validation
[ ] Engage external consultants or training providers for specialised expertise.
[ ] Align programmes with existing frameworks (e.g., Local Authority Skills Framework, IfATE standards).
[ ] Validate training programmes with industry networks or academic institutions.

Health and Safety
[ ] Address safety protocols for using and maintaining new materials.
Integrate risk mitigation strategies into training, ensuring compliance with local regulations.

Budget and Resources
[ ] Confirm available budget for training development, delivery, and monitoring.
[ ] Secure necessary resources, including trainers, facilities, and learning platforms.
[ ] Evaluate cost-effectiveness of training solutions and explore potential funding sources.

Note: This checklist supports the sustainable implementation of low-carbon materials by equipping staff and contractors with the knowledge and skills needed for success. Ongoing monitoring ensures long-term workforce capability and readiness.

For further guidance, contact adept@cp.catapult.org.uk or explore the full trial protocols by CEDR.

Appendix I

Checklist: Updating local design standards

This checklist provides a structured approach for Local Authorities to evaluate trialed materials across various aspects of road infrastructure. It ensures a comprehensive assessment of durability, safety, environmental impact, and long-term performance, supporting informed decisions on adoption.

Planning and Preparation
[ ] Review local design manuals to identify required updates for integrating new materials or methods.
[ ] Ensure alignment with national and regional standards, where applicable.
[ ] Engage stakeholders, including asset managers, design teams, and regulatory bodies, to build consensus.

Development and Drafting
[ ] Draft clear technical guidelines for new materials, covering application procedures and safety protocols.
[ ] Share draft updates with stakeholders for review and gather feedback on feasibility and clarity.
[ ] Verify compliance with regulatory requirements and incorporate references to external standards.

Change Management
[ ] Identify change champions to lead adoption efforts and address potential resistance.
[ ] Develop a timeline for phasing in updates and train teams on technical changes.
[ ] Monitor adherence through audits and provide support during the transition.

Documentation and Communication
[ ] Publish revised design standards and ensure accessibility for internal and external stakeholders.
[ ] Communicate changes using internal platforms, briefings, or newsletters.
[ ] Highlight benefits and success stories to build confidence in the new standards.

Sustained Integration
[ ] Establish feedback loops to address issues and refine standards post-implementation.
[ ] Document lessons learned for future updates or similar initiatives.
[ ] Celebrate milestones and recognise contributions to encourage continued engagement.

Note: This checklist serves as a practical guide for updating local road design standards, ensuring the integration of new materials and methods aligns with organisational goals, stakeholder needs, and regulatory requirements. Adjustments may be necessary based on the unique requirements of the local authority, the scale of updates, and the specific challenges of the adoption process.

For further guidance, contact adept@cp.catapult.org.uk or explore the full trial protocols by CEDR.

Conclusion

Conclusion

Driving the future of sustainable roads

This playbook marks a critical step in empowering local authorities to lead the decarbonisation of the uk's road infrastructure. With the five-stage framework—identify, assess, trial, evaluate, and adopt—authorities are equipped with practical guidance to navigate the complexities of innovation adoption. These stages ensure a comprehensive approach, balancing the need for robust performance with environmental and social imperatives.

Ambition into action

To turn ambition into action, local authorities should prioritise the following next steps:

1. **Set clear and achievable goals**
   Establish specific, measurable objectives for decarbonising road infrastructure. Align these goals with local and national targets, ensuring they reflect the unique needs and challenges of your authority. By breaking down broader ambitions into actionable milestones, teams can create a roadmap for progress and maintain focus throughout the journey.

2. **Embed innovation into decision-making**
   Incorporate the evaluation and adoption of low-carbon materials and methods as a standard practice. Use tools like the knowledge bank and stakeholder insights to ensure informed choices. Prioritise solutions that balance sustainability with cost-effectiveness, operational efficiency, and long-term resilience.

3. **Invest in capacity building**
   Equip teams with the expertise and resources needed to trial and adopt innovative materials effectively. Provide training, access to technical guidance, and opportunities for collaboration with experts. By fostering a culture of continuous learning, local authorities can ensure the workforce is prepared for the transition.

4. **Create a feedback loop for continuous improvement**
   Use insights from trials and stakeholder feedback to refine processes, evaluate performance, and inform future decisions. Regularly revisit goals, methods, and materials based on real-world outcomes to ensure efforts remain relevant and impactful.

5. **Champion collaboration and knowledge sharing**
   Engage with networks like CEDR to share lessons learned and gain access to collective expertise. Collaboration across authorities and stakeholders fosters a unified approach, driving innovation and accelerating the transition to low-carbon road infrastructure.

Leading the way

As custodians of local roads, authorities are uniquely positioned to enact meaningful change. By trialling, evaluating, and adopting new materials and methods, local authorities can create resilient infrastructure that serves communities today and safeguards the environment for tomorrow.

The road to decarbonisation is one of innovation, collaboration, and perseverance. With this playbook as a guide, local authorities have the power to lead by example, turning challenges into opportunities and paving the way for a sustainable future.

FAQs & Glossary

FAQs: Decarbonising local roads playbook

About the Playbook

What is the purpose of the Road Decarbonisation Playbook?
The playbook provides a structured framework for local authorities to decarbonise road infrastructure using novel materials and methods. It offers step-by-step guidance, tools, and best practices to ensure informed, collaborative, and effective implementation.

Who is the playbook designed for?
The playbook is intended for local authorities, including transport planners, highway engineers, sustainability consultants, and decision-makers involved in road infrastructure projects.

How is the playbook structured?
The playbook is divided into five key stages: Identify, Assess, Trial, Evaluate, and Adopt. Each stage includes sub-steps, actions, acceleration strategies, and amplification methods, supported by guiding questions and stakeholder roles.

What kinds of materials and methods are considered in the playbook?
The playbook focuses on low-carbon materials and innovative construction and maintenance methods that reduce whole-life carbon emissions, enhance sustainability, and align with local road infrastructure requirements.

About Decarbonising Roads

Why is decarbonising road infrastructure important?
Road infrastructure significantly contributes to carbon emissions, particularly during construction and maintenance. Transitioning to low-carbon materials and methods supports climate goals, reduces environmental impact, and fosters sustainable development.

What are examples of low-carbon materials?
Examples include recycled aggregates, bio-based binders, carbon-absorbing concretes, and alternative surface treatments designed to reduce lifecycle emissions.

What are the key benefits of using novel materials in road decarbonisation?
Benefits include reduced greenhouse gas emissions, extended material lifespans, improved resource efficiency, and alignment with national and local sustainability targets.

What challenges might local authorities face in implementing these materials?
Challenges include material availability, cost, technical feasibility, and compatibility with existing infrastructure. The playbook addresses these through structured assessment, trials, and collaboration.

About the Stages

How does the "Identify" stage support local authorities?The Identify stage inspires innovation by exploring global and local examples of low-carbon materials. It helps authorities envision transformative opportunities and prioritise potential solutions.

What happens during the "Assess" stage?
This stage focuses on evaluating shortlisted materials against criteria like cost, durability, and carbon reduction. It ensures that selected options are viable for trials and aligned with decarbonisation goals.

Why are trials essential in the decarbonisation process?
Trials validate the performance, feasibility, and safety of innovative materials under real-world conditions. They provide actionable insights to inform broader adoption.

What does the "Evaluate" stage achieve?
This stage reviews trial outcomes, analysing performance data and stakeholder feedback to determine the material's long-term value and suitability for scaling.

How does the "Adopt" stage support implementation?
The Adopt stage scales up successful materials by integrating them into procurement guidelines, design standards, and workforce training. It ensures materials are implemented effectively across road projects.

Practical Considerations

How can local authorities collaborate with suppliers and experts?
Authorities can establish partnerships with suppliers, engage in knowledge-sharing forums, and use open-access databases to align efforts and leverage expertise in material innovation.

What tools or resources does the playbook recommend?
The playbook suggests using geolocated repositories for data sharing, advanced analytics tools for assessments, and dynamic dashboards for tracking progress and communicating results.

How can local authorities amplify the impact of their efforts?
By sharing successes through public announcements, conferences, and accessible reports, authorities can inspire broader adoption and position themselves as leaders in sustainable infrastructure.

About Sustainability and Compliance

How does the playbook ensure alignment with national decarbonisation targets?
The playbook is designed to integrate with national and regional climate strategies, ensuring materials and methods align with established carbon reduction goals and policy frameworks.

What role do lifecycle assessments play in this process?
Lifecycle assessments are critical for evaluating the environmental and economic trade-offs of materials over their entire lifespan, providing a holistic view of their sustainability impact.

About Stakeholder Engagement

How can local authorities engage communities in road decarbonisation projects?
Engaging communities through consultations, public forums, and educational campaigns helps build trust, gather insights, and foster local support for sustainable road initiatives.

What role do contractors and workforce training play in the adoption process?
Contractors and trained staff are essential for successfully implementing novel materials. Training ensures teams understand the unique requirements of low-carbon solutions and maintain quality standards.

Future Outlook and Scaling

How does the playbook address scalability challenges?
By focusing on supplier collaboration, procurement guidelines, and phased rollouts, the playbook ensures materials and methods can transition smoothly from trials to widespread adoption.

What is the long-term vision for decarbonising road infrastructure?
The vision includes a shift to fully sustainable, circular road systems where materials are reused, carbon emissions are minimised, and infrastructure adapts to future needs.

Can this framework be applied to other types of infrastructure?
While focused on roads, the framework could be adapted for other infrastructure projects, such as bridges, railways, or urban developments, promoting decarbonisation across sectors.

How does the playbook handle risks associated with novel materials?
The playbook incorporates risk assessments at every stage, addressing challenges like compatibility, safety, and long-term performance to mitigate potential issues.

Glossary

Adopt

The stage where low-carbon materials and methods are integrated into standard road-building practices following successful trials and evaluations. It includes scaling solutions, updating procurement guidelines, and workforce training.

Assessment

A stage involving the evaluation of identified materials for feasibility, sustainability, cost, and compatibility with local conditions. This step informs trialling decisions and ensures materials align with decarbonisation goals.

Case Study

A detailed analysis of a specific project or example that showcases the application and results of low-carbon materials in road construction and maintenance, often used for learning and inspiration.

CEDR (Centre of Excellence for Decarbonising Roads)

An initiative supporting local authorities in reducing the carbon impact of road construction and maintenance by facilitating the trial, evaluation, and adoption of innovative low-carbon materials.

Collaboration

The process of working with stakeholders, including industry experts, researchers, and peers, to share knowledge, pool resources, and achieve common goals in decarbonising roads.

Critical Path

A structured, step-by-step approach outlined in the playbook that guides local authorities through the stages of identifying, assessing, trialling, evaluating, and adopting low-carbon materials.

Decarbonisation

The reduction of carbon emissions in road construction and maintenance to align with environmental targets and sustainability goals.

Embodied Carbon Emissions

The CO_2 emissions generated during a material's lifecycle, including extraction, production, and transportation. In road construction and maintenance, materials like cement and asphalt contribute significantly. Reducing embodied carbon is essential for achieving decarbonisation goals in infrastructure.

Evaluation

A stage focused on analysing data from trials to assess the long-term viability, performance, and environmental impact of tested low-carbon materials.

Foresight

The practice of anticipating future developments and trends to make informed decisions about adopting low-carbon materials in road infrastructure.

Identify

The initial stage where innovative low-carbon materials and methods are explored through case studies, market analysis, and stakeholder collaboration.

Knowledge Bank

A comprehensive database containing information on low-carbon materials and methods, used to support decision-making and trial planning.

Low-Carbon Materials

Innovative materials designed to minimise carbon emissions in road construction and maintenance while maintaining or enhancing performance.

Market Scan

The process of researching the landscape of low-carbon materials, including emerging innovations, suppliers, and academic developments, to identify promising options.

Monitoring

The continuous tracking of material performance, safety, and environmental impact to ensure long-term viability and compliance with sustainability objectives.

Playbook

A practical, step-by-step guide tailored for local authorities to navigate the complex process of decarbonising road infrastructure using low-carbon materials.

Procurement

The process of sourcing and contracting suppliers for low-carbon materials, guided by sustainability standards and performance expectations.

Stakeholder Engagement

Involving individuals and groups such as suppliers, contractors, local communities, and road users in the decision-making process to ensure diverse perspectives and support.

Sustainability

The practice of balancing environmental, economic, and social considerations in road construction and maintenance to meet current needs without compromising future generations.

Trialling

A stage where small-scale tests of low-carbon materials are conducted under real-world conditions to validate performance and feasibility before broader adoption.

Whole-Life Carbon

The total carbon emissions associated with a material or method throughout its lifecycle, from production to disposal.

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