ADEPT LiveLabs 2 | Liverpool City Council: Decarbonising local roads

Embedding Whole Life Carbon -Decision Making through the Pell Frischmann- Options Configurator

Location

Liverpool, UK

Client

Liverpool City Council

Services

- Whole Life Carbon Optioneering
- Application Development & Deployment
- Carbon Technical Reporting
- Stakeholder Engagement & Training
- Procurement Support

Project Scope

Liverpool City Council (LCC) is committed to becoming a net zero carbon city by 2030. Transport is one of the city's highest-emitting sectors. The city's highway network, valued at approximately £4.9 billion, is its largest physical asset and a significant contributor to operational carbon emissions. LCC wanted to explore how they could optimise operational maintenance and ensure that the most cost and carbon effective design options were considered from the outset.

The ADEPT LiveLabs 2 programme, funded by the Department for Transport, helped local authorities to trial, test and embed low-carbon solutions in real-world highway environments. As part of the Liverpool LiveLabs 2 workstream, Pell Frischmann were commissioned to develop a practical approach that would allow carbon and cost to be considered at the earliest possible stage, consistently and transparently across highway schemes.

Key Deliverables

Carbon Hierarchy Lens (CHL) Toolkit

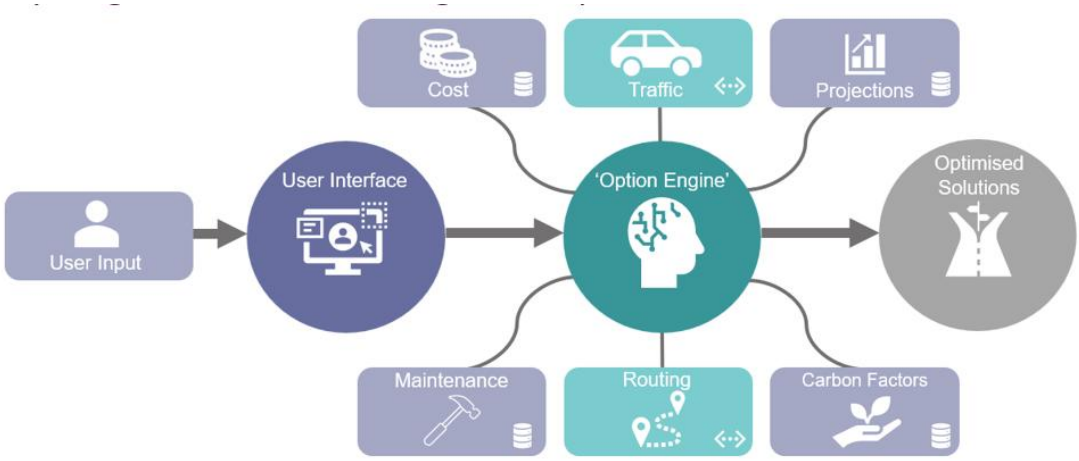
The CHL toolkit was developed as a structured framework that supports decision-making, and embeds the principles of "build less, build differently, and build better" at the earliest stages of highways schemes. The CHL prompts project teams to ask whether an intervention is required, whether outcomes can be achieved differently, and where lower carbon materials or methods can be adopted before design decisions are fixed.

PF Options Configurator

The PF Options Configurator application was developed to help incorporate the CHL toolkit into the design process. The configurator app evaluates the whole-life carbon and cost of different design options and then recommends the cost and carbon optimal design option. A digital optioneering tool that operationalises the CHL by enabling users to compare whole life carbon and whole life cost for alternative materials and maintenance strategies. The tool assesses impacts across PAS 2080 lifecycle stages A–D and presents results in a format that supports clear, auditable decisions.
Together, the framework and tool were designed to bridge the gap between high level carbon targets and day to day delivery decisions.

Headline results

Early, whole-life optioneering embedded into LCC highways practice, enabling carbon and cost to be considered before designs are fixed.
10+ live maintenance schemes assessed using the approach, providing a transparent audit trail and informing material choices.
Scheme-level outcomes include 8–25% whole-life carbon reduction from pavement material choices; further material-specific savings evidenced through trials (e.g., cold-applied MMA markings, photoluminescent surfacing).
Approach now being explored within Aberdeen and Newcastle, demonstrating transferability.



Configurator App Development and Assurance

Development of the PF Options Configurator followed a user-led and iterative process. Initial stages focused on understanding LCC's operational needs, available data sources and preferred ways of working. Early interface designs were developed and subsequently presented to LCC.

The application was then built and tested through a closed-loop process to ensure robustness and usability. The PF Sustainability team undertook an independent review of all carbon calculations to provide additional assurance. Whole-life costing functionality was added to ensure carbon and cost outputs were directly comparable.

Once validated, the configurator app was issued to a test group within Liverpool City Council. Structured feedback informed final refinements before wider deployment. Development was supported throughout by close collaboration with trusted project partners, which include, Colas, Liverpool John Moores University and Bird & Bird.

How it works

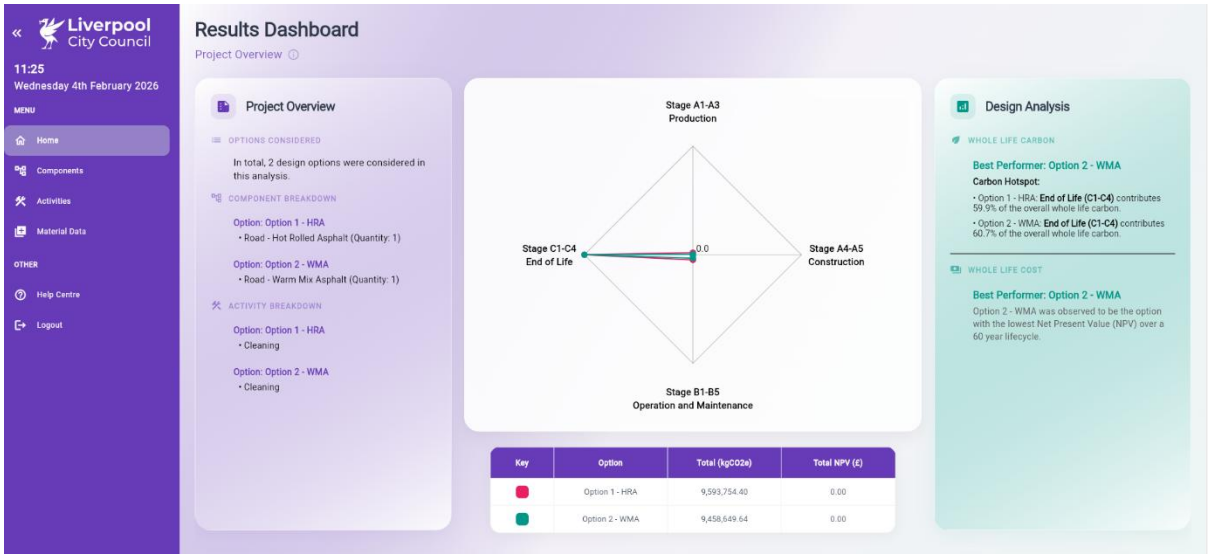
Users set up a project by selecting relevant highway components (such as pavements, kerbs, drainage, road markings and signage) and associated activities (including maintenance and operational interventions). The tool then compares alternative options side-by-side.

Behind the interface, an option engine considers:

- Whole-Life Embodied Carbon
- Whole-Life Cost And Net Present Value
- Asset Life And Maintenance Cycles
- Wider impacts such as traffic management and future changes in vehicle technology (e.g. shift to hybrid and electric vehicles and plant)

Carbon factors are drawn from Environmental Product Declarations (EPDs) and aligned with PAS 2080. Cost data is matched to LCC asset records and maintenance practices. Databases are hosted on secure cloud infrastructure and updated regularly. Results are thereafter presented through the "At-a-glance" dashboard which summarises lifecycle carbon and cost. The "Detailed" view shows a more thorough, stage-by-stage comparison across PAS 2080 modules A1–D.

What's different: Unlike traditional tools used late in design, the Configurator provides early-stage, whole-life insight linked to scheme need, material selection and asset management practice, making carbon a driver of decisions rather than a retrospective metric.



Application on Live Schemes

The CHL toolkit and the PF Options Configurator were applied across multiple live maintenance schemes in Liverpool. Both the toolkit and the configurator app supported optioneering, material selection and maintenance planning before designs were finalised which enabled significant real-world carbon savings to be achieved:

- *Pavement materials - side-by-side comparison of lower-carbon alternatives indicated 8–25% whole-life carbon reduction relative to conventional hot-rolled asphalt while meeting performance requirements.*
- *Road markings - cold-applied MMA markings demonstrated substantial embodied carbon reductions compared with traditional methods (scheme-specific).*
- *Innovative surfacing - photoluminescent surfacing demonstrated context-dependent carbon savings compared with conventional solutions (e.g., relative to lighting or thermoplastic), as evidenced in trials.*

For each scheme, Carbon Technical Notes documented assumptions, data sources and decisions, creating a transparent audit trail for governance and learning.

Outcomes and Impact

Embedded practice: Carbon-led optioneering is now integrated into LCC's standard highways processes, supported by training and guidance so council teams can use the tool independently.

Quantified benefits: Across live schemes, the approach delivered 8–25% whole-life carbon reduction from material choices, with additional material-specific savings evidenced through trials (e.g., cold-applied MMA, photoluminescent surfacing).

Whole-life visibility: Decisions now consider whole-life impacts rather than upfront cost alone, producing consistent, auditable justification for material and maintenance choices.

Policy alignment: The approach supports alignment with PAS 2080 and Liverpool's Highway Asset Management Plan.

Key Learnings

The Liverpool LiveLabs programme has shown that effective decarbonisation of local roads is shaped less by individual products and more by when, how and on what basis decisions are made. The introduction of the CHL Toolkit and PF Options Configurator demonstrated that shifting carbon intervention to the *earliest* point in the process delivers significantly greater impact than interventions applied during detailed design or construction.

A central learning is the importance of establishing a robust evidence base. High-quality operational and maintenance data, accurate carbon factors and consistent assumptions were essential to producing credible whole-life forecasts. Issues often faced by local authorities - such as variable supplier data, incomplete baselines and dated maintenance schedules can be managed effectively through transparent assumptions, supplier engagement and iterative testing. Importantly, the tools showed that authorities do not need perfect data to begin; confidence and accuracy grow over time.

The work also highlighted the value of practitioner-led design. Embedding highways engineers, asset managers, procurement staff and sustainability specialists in the development process ensured that the tool was intuitive, operationally relevant and aligned with real-world constraints. This usability was critical to adoption: non-carbon specialists could understand trade-offs quickly and make informed decisions without requiring extensive training.

On-site trials demonstrated the need for a closed-loop process, where digital forecasting is continually tested against real performance. Trials validated carbon factors, adjusted maintenance cycles, and ensured that material innovations were grounded in practical delivery considerations rather than theoretical modelling.

Above all, Liverpool's experience showed that creating a repeatable, auditable decision-making process is more transformative than producing a one-off tool. By embedding whole-life carbon governance within standard practice, LCC has established a model that delivers sustained decarbonisation benefits across multiple investment cycles.

Wider Impact and Transferability

The combined CHL + Configurator approach is intentionally scalable, transferable and authority-agnostic. Other councils can adopt the method by inserting their own asset inventories, cost libraries, maintenance regimes and policy objectives, while the framework, calculation approach and assurance process remain consistent. This directly addresses common barriers: fragmented datasets, limited specialist resource, procurement complexity and variable supplier information.

The model also strengthens carbon governance, creating a transparent record of how and why decisions were made: supporting investment cases, procurement specifications and progress against Net Zero targets. The approach is already being explored with Aberdeen City Council and Newcastle City Council, demonstrating cross-regional adaptability. Sector learning has been shared via ADEPT, CIHT, Highways UK and PIARC global, supporting DfT's objective for LiveLabs innovations to become mainstream practice. As more authorities adopt the toolkit, the collective dataset will grow, improving forecasting accuracy and accelerating a sector-wide shift to low-carbon, whole-life highways management.
