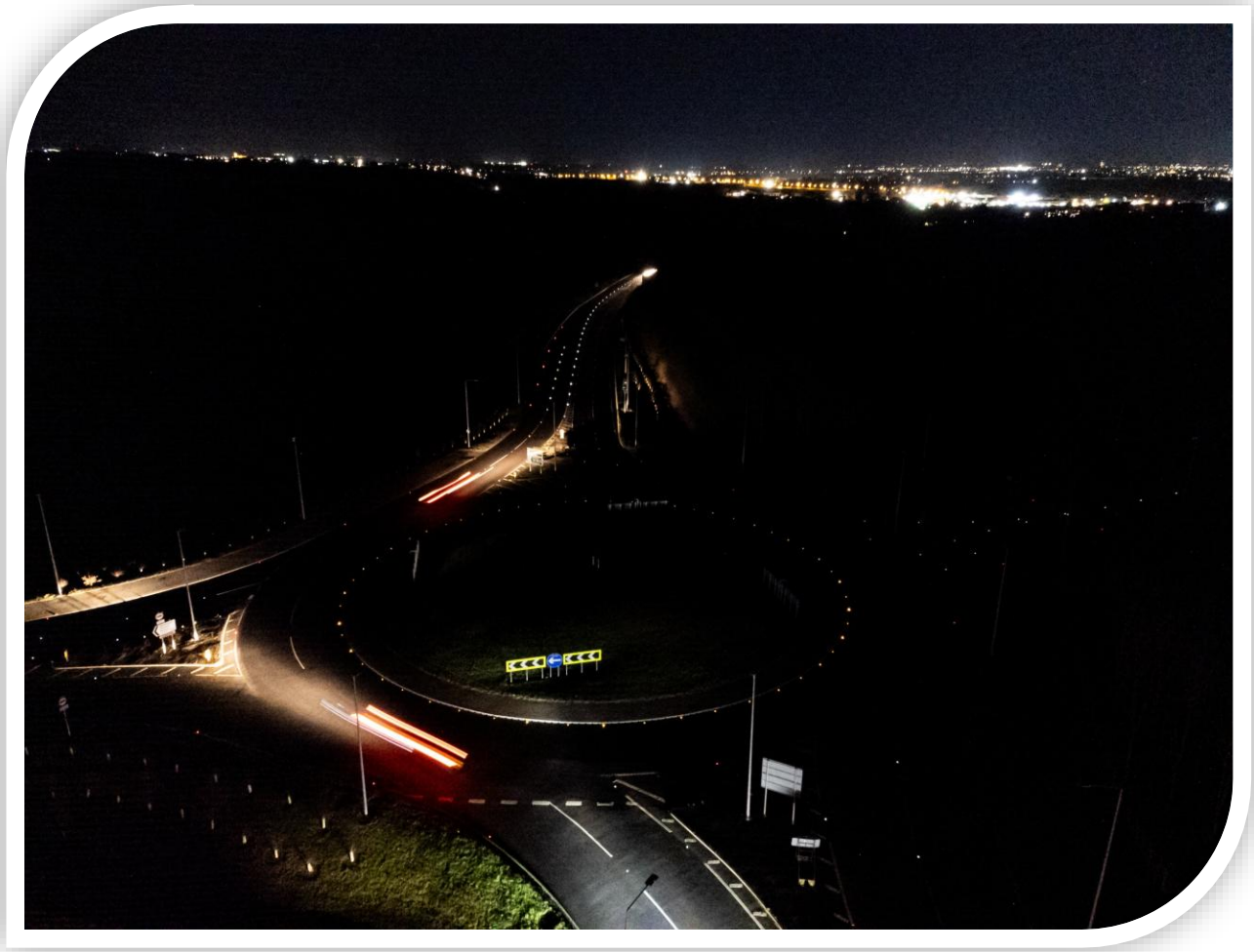
Department for Transport

EAST RIDING OF YORKSHIRE COUNCIL

ADEPT LIVELABS2 Decarbonising Local Roads

LIVE LABS 2 DECARBONISING STREETLIGHTING CARBON REPORT



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Live Labs 2 Decarbonising Streetlighting Carbon Report

1. Executive Summary

The main purpose of the ADEPT Live Labs 2 program is to understand and evaluate the embedded carbon of our highways and highway operations in a way never undertaken before and to undertake live testing and trialing of new and innovative ways to decarbonize our highways in a way that is scalable across the whole of the UK.

The East Riding of Yorkshire Council project to decarbonize street lighting, evidenced in this report, has evaluated the overall carbon impact of standard street lighting design for major A roads and conflict areas on these roads.

Simply understanding the carbon impacts of street lighting and other visual assets, however, is only part of the requirement of the program. Alongside the business-as-usual carbon baseline, the project has developed a tool to evaluate both the carbon and cost implications of standard street lighting compared to the innovative designs used to replace street lighting with low carbon visual alternatives, whilst still maintaining safety for road users.

The tool developed for the project and tested on sites not only in East Riding of Yorkshire, but across partners nationwide has shown that not only does this new visual approach provide a lower carbon environment but also challenges the myth that low carbon equals high cost.

2. Introduction

The *Decarbonising Street Lighting Live Labs 2* project, led by East Riding of Yorkshire Council with ten partner authorities across the UK, has been a £4.6 million, three-year project to transform how we think about lighting and the wider visual environment of our roads.

For decades, highway design has relied on traditional streetlighting standards, resulting in significant carbon costs from both energy use and the manufacture, installation and replacement of millions of lighting columns. With over 7.2 million streetlights across the UK costing more than £1 billion in energy each year and contributing over one million tonnes of carbon emissions, the sector urgently needed new thinking.

This Live Lab set out to show that highways can remain safe, inclusive and cost-effective while substantially reducing reliance on conventional streetlighting. By testing innovations such as high-performance reflective road markings, advanced sign materials, solar road studs and low-carbon lighting for footways where essential, the project has demonstrated alternative approaches that support net zero, cut costs and enhance visual outcomes for all road users.

Evidence has been gathered through test sites in East Riding, most notably along the A1079 Hull–York corridor and the A164, and at partner locations nationwide. These have been monitored using cutting-edge technologies including a world first application of AI and infrared cameras to monitor user behaviour 24/7. Supported by Sheffield University, The Institute of Transport Studies and a host of technical specialists and supply chain partners, the project has investigated and undertaken a complex study and evaluation of the technical, safety, carbon and cost requirements to develop new standards for future streetlighting. The project has also explored public perceptions, equality, biodiversity and the wider social role of lighting.

As the programme concludes, it has delivered a set of practical outputs:

- A **Strategic Carbon and Cost Decision Tool** to help authorities forecast carbon and cost savings.
- The evidence to inform the evolution of British Standards and highway design practice.
- Demonstrated test sites showing how energy use can be reduced while maintaining safety.
- Practical frameworks and guidance to support adoption by local authorities across the UK.
- A cutting edge AI driven 24/7 driver behaviour and road safety monitoring system.

Together, these outcomes provide a foundation for permanent change. Making the case for a design-led, carbon-aware approach to the highway visual environment.

As the project has progressed, our work has been structured around a series of focused workstreams, each exploring a different dimension of the challenge. These reports represent the key outputs and outcomes from those workstreams—covering the technical, nature, legal, safety, community, carbon and cost cases. Together, these reports from the core outputs of the Live Lab 2 project. They provide the evidence base needed to inform new guidance, influence policy, and support local authorities in making better-informed, lower-carbon and more cost-effective decisions about their street lighting and wider visual environments. Each report stands alone in addressing its specialist theme. Collectively they form the comprehensive picture of how to decarbonise the UKs streetlighting and help to shape the future of sustainable highways.

3. The Carbon Case

Building on the strategic aims and evidence base set out in the overarching project introduction, this report provides greater operational detail on how the approach has been applied in practice and the considerations required to support adoption by local highway authorities.

This project responds to the scale of the national street lighting challenge identified through sector data, including the UKRLG State of the Nation survey, which estimated that the UK's 7.2 million streetlights carried an annual energy cost of £302 million and an associated carbon footprint of 478,000 tonnes of CO_2e in 2020. Since that time, rising energy prices have increased national expenditure on street lighting to over £1 billion per year, reinforcing the need for alternatives that reduce both carbon and long-term cost.

While the project recognises the important social role of street lighting in urban centres—supporting night-time economies and perceptions of personal safety—this work focuses specifically on the strategic road network outside major population centres. These locations are typically characterised by high-energy lighting installations on A roads with limited pedestrian interaction, where lighting has historically been introduced as a road safety mitigation, particularly at conflict points such as roundabouts, junctions and crossroads. It is within this context that the greatest opportunity exists to rethink how safety, visibility and carbon performance are balanced.

Alongside testing alternative visual interventions, this project has directly addressed two longstanding assumptions within highway design and asset management: that conventional street lighting is always required to manage road safety risk, and that reducing carbon emissions necessarily leads to increased costs.

A critical early requirement of the project was to establish a robust understanding of the existing carbon impact of street lighting and associated visual assets. A comprehensive baseline was completed in spring 2024 across the East Riding of Yorkshire test routes and the national partner sites. This process highlighted persistent challenges within the sector, including the limited maturity of carbon accounting for lighting assets and gaps in available carbon factors across parts of the supply chain.

Rather than developing a simple comparative model, the project has focused on creating a practical, decision-led approach that reflects the operational realities faced by local authorities. This recognises the ongoing pressures on budgets, the need to maintain safe and reliable networks, and the importance of producing evidence that can be translated into business cases and funding submissions.

The baselining methodology developed through this project has informed the creation of the Strategic Carbon and Cost Decision Tool described elsewhere in this report suite. The approach provides a repeatable framework that other authorities can apply to understand their own visual asset stock and evaluate alternatives in a consistent and transparent way.

By integrating financial appraisal alongside carbon assessment, the tool enables whole-life cost and carbon impacts to be considered together. This supports site-specific decision-making, ensuring that locations are assessed on their individual characteristics rather than through a blanket approach. In doing so, the project demonstrates that a design-led, evidence-based approach can reduce carbon emissions while also delivering cost-effective and operationally viable outcomes for the highway network.

4. Project Objectives / Baseline overview

Our project has identified a new design approach using a combination of lower carbon alternatives to street lighting, however to be confident in our hypothesis and to understand the overall carbon benefit of our new approach to historically lit conflict areas such as roundabouts, crossroads and priority junctions, we first had to understand the carbon impact of traditional street lighting designs for these areas.

To gain an understanding of “business as usual” we undertook a carbon baseline assessment, evaluating and quantifying the carbon impact of street lighting over a whole life period, forty years in East Riding of Yorkshire, which is the average design life of a lighting column and the point at which investment decisions are applied.

The carbon baseline we produced very closely follows the principles and assessment areas as set out in our SOBC, these being manufacture, installation, operation, maintenance and end of life and as stated within our SOBC, was overseen by our Carbon and Habitat working group.

We encountered several challenges in producing this carbon baseline. The street lighting sector is lagging much of the wider highways sector in terms of its understanding of its own carbon footprint and has only recently started to fully understand its role in carbon and environmental impact evaluation. This has led to a carbon baselining exercise that relies on a mix of detailed location specific data and proxy data. The lack of data highlights the primary challenge in developing this carbon baseline and provides useful feedback to the sector on their existing data gaps. This information should help inform the sector's understanding for further action.

From an ongoing project perspective, however, the need to compare proposed interventions to the carbon baseline we generated was obvious. There was an overwhelming desire within the project group to take the opportunity to produce more than a carbon difference engine and to create something specifically to address the difficult decisions that local authorities face on a daily basis of carbon reduction vs cost, to burst the myth that the two factors are exclusive to each other.

To assist us with this work we approached Leeds University and set them the challenge of turning our baseline and the information we had gathered for that into an interactive tool that can assess the overall carbon and financial implications of a proposed material or design. The decision support tool we were intent on creating and detailed in the brief given to Leeds University is designed for use at point of decision, be that new design, redesign or street lighting end of life and to compare both carbon and financial implications of a business as usual decision process against a Live Labs 2 design, replacing the street lighting for our proposed interventions.

But local authorities are multi-layered organisations. Budget holders and decision makers are not usually the same people that make technical design decisions. For us to make our decision support tool as useful to local authorities as possible we also required dual functionality. One that can be utilized for site and material specific applications and one for more strategic decision making. These two approaches allow for detailed assessment along with promoting a shift towards a new business as normal.

5. Strategic Carbon and Cost Decision Support Tool

5.1 Purpose and scope of the tool

A central output of this project has been the development of a Strategic Carbon and Cost Decision Support Tool for street lighting and the wider highway visual environment. The tool has been designed to support local highway authorities in making informed, evidence-based decisions about alternative approaches to illuminating the highway, considering carbon, cost and operational implications together across the whole life of assets.

The scope of the tool is deliberately strategic rather than transactional. It enables users to compare different design approaches and intervention options over a defined appraisal period, assessing the whole-life in-service carbon impacts of visual assets and innovations alongside financial considerations where data is available. This allows authorities to understand the relative implications of continuing with established 'business-as-usual' lighting solutions compared with alternative low-carbon approaches being trialed through this project.

Importantly, the tool has been developed to reflect real-world decision-making contexts within local authorities, where carbon reduction objectives must be balanced with affordability, risk, safety, procurement constraints and service delivery requirements.

5.2 Building on Sector Leadership and Academic Expertise

The development of the Strategic Carbon and Cost Decision Support Tool builds directly on the National Highways and Transport (NHT) Network's established leadership in carbon governance and decision support across the highways sector, alongside the specialist academic expertise of the Institute for Transport Studies (ITS) at the University of Leeds.

The NHT Network has played a leading role in advancing consistent and credible approaches to whole-life carbon assessment for local highway authorities. This includes the development of shared tools, benchmarking frameworks and peer learning mechanisms that support authorities in embedding carbon considerations within everyday decision-making. A key element of this work is the Carbon Quality Code (CQC), which sets clear principles for transparency, comparability and robustness in carbon data, helping to build confidence in carbon-based assessments across the sector.

The Strategic Carbon and Cost Decision Support Tool reflects these principles by prioritising transparency of assumptions and data sources, comparability between options rather than false precision, and practical usability within existing local authority decision frameworks. Rather than functioning as a standalone calculator, the tool sits within a wider ecosystem of NHT-supported guidance and tools designed to raise the quality and consistency of carbon-informed decision-making across the highways sector.

Leeds University was engaged through the NHT Network to lead the technical development of the tool, with the work undertaken by the University's Institute for Transport Studies. ITS was selected due to its established expertise in transport systems analysis, whole-life appraisal and the development of decision-support tools for the highways sector at both UK and European levels. The ITS team brought specific experience in designing tools that move beyond static carbon accounting, instead enabling optioneering, scenario testing and strategic comparison to support informed investment decisions.

This approach aligns with established tools already familiar to local authorities, including the Department for Transport's Road Transport Infrastructure Carbon Benchmark Tool and

lifecycle planning tools developed through the UK Roads Liaison Group. As a result, the Strategic Carbon and Cost Decision Support Tool has been designed in a format and structure that is accessible to local authority officers, consistent with established practice, and capable of supporting decisions at multiple levels within an organisation.

5.3 Development approach and tool structure

The development of the tool followed a structured, two-stage process.

Task A focused on defining user requirements, data availability and functional scope. This included workshops with project partners to understand how the tool would be used in practice, what decisions it needed to support, and the constraints created by inconsistent or incomplete data across the street lighting sector. This stage established the tool's architecture, inputs, outputs and limitations, and ensured alignment with wider decision-making frameworks used by highway authorities.

Task B involved building, testing and refining the working tool using data from the East Riding of Yorkshire test sites. This stage validated internal calculations, refined the user interface, and produced the accompanying user guide and development report. Throughout this process, particular emphasis was placed on data transparency, auditability and avoiding 'black box' outputs that could undermine confidence in the results.

The tool has been developed with two user routes:

- **Strategic users**, who rely on default datasets and assumptions to produce early-stage comparisons with minimal input.
- **Expert users**, who can input bespoke asset data, service lives, carbon factors and costs where more detailed information is available.

This dual route approach reflects the differing levels of data maturity and expertise across authorities and across stages of scheme development.

Carbon Accounting vs Carbon Forecasting

Carbon accounting and carbon forecasting serve different but complementary purposes within this project. Understanding the distinction is critical to understanding the role of the Strategic Carbon and Cost Decision Support Tool.

Carbon accounting: *What has happened*

Carbon accounting measures and evidences the carbon impacts of a defined scheme once its scope and design are known. It compares:

- The carbon associated with a conventional or 'business-as-usual' approach
- The carbon associated with an alternative intervention (such as Live Labs 2)

with the difference representing the carbon saving for that specific site.

Within this project, carbon accounting:

- provides a robust, real-world evidence base,
- validates use cases and assumptions, and
- informs the data and calculation logic required by the decision support tool.

Carbon accounting is inherently retrospective and site-specific. It is essential for validation and reporting, but it does not, on its own, support strategic decision-making across networks or over time.

Carbon forecasting: *What could happen*

Carbon forecasting supports forward-looking decision-making. It answers the *"what if?"* questions that local authorities face when planning investment, considering:

- **What** assets are being changed and what they are being changed to,
- **Where** those assets are located and the characteristics of the scheme,
- **When** interventions take place and how timing affects outcomes.

Carbon forecasting uses accounting data as its foundation, but extends it to compare options, explore scenarios and support strategic choices across asset portfolios.

The Strategic Carbon and Cost Decision Support Tool is designed to support carbon forecasting, not simply carbon accounting.

Decision support, not carbon accounting

As set out in the explainer above, the Strategic Carbon and Cost Decision Support Tool has been designed to support **carbon forecasting rather than carbon accounting alone**.

Carbon accounting undertaken at project test sites has provided essential validation and an evidence base. However, the tool itself is intended to support forward-looking decisions by enabling users to explore scenarios, compare options and understand trade-offs over time.

The tool presents outputs that support this role, including:

- Whole-life carbon forecasts over a defined appraisal period,
- Breakdown of carbon by activity (installation, operation, energy, maintenance and removal),
- Year-by-year and cumulative impacts,
- Comparative outputs between alternative design solutions.

This enables users to understand not just *how much* carbon is associated with an option, but *where*, *when* and *why* that carbon arises, and how different choices influence long-term outcomes.

Incorporating finance alongside carbon

Recognising that carbon considerations alone are insufficient to drive adoption, the tool has been designed to incorporate financial appraisal alongside carbon wherever feasible. This reflects the reality that local authority decisions must be supported by robust business cases, affordability assessments and funding bids.

The tool accommodates varying levels of cost data maturity, allowing costs to be included at activity, asset or scheme level. Where cost data is available, outputs enable users to consider whole-life cost and carbon together, supporting more informed discussions around value for money, invest-to-save opportunities and long-term cost avoidance.

This integrated approach helps challenge the perception that carbon reduction doesn't necessarily lead to increased cost and supports practical, evidence-based decision-making.

Procurement, risk and operational considerations

The design of the Strategic Carbon and Cost Decision Support Tool explicitly recognises procurement, risk and operational constraints faced by highway authorities. Assumptions around asset service lives, maintenance cycles and replacement strategies have been developed to reflect typical industry practice, with safeguards to avoid over-reliance on unverified manufacturer claims where in-service evidence is limited.

The tool supports site-specific decision-making rather than blanket application of low-carbon approaches. This enables risk-based assessment, ensuring that alternative solutions are only taken forward where they are appropriate in terms of safety, operational performance and whole-life impact.

Long-term legacy and sector benefit

Looking ahead, there is clear potential for the tool to provide lasting value beyond the life of this project. If hosted within a cloud-based environment through the NHT Network, anonymised examples of tool use could be aggregated over time, enabling the sector to demonstrate the cumulative carbon benefits of alternative approaches to street lighting at a national level.

In doing so, the tool becomes not only a decision-support mechanism for individual authorities, but a means of evidencing the long-term contribution of design-led, low-carbon lighting approaches to national net zero objectives.

6. Methodology

The first step in the development of the Strategic Carbon and Cost Decision Support Tool was the identification of an itemised list of carbon and cost data that was required from partners and the supply chain to allow a carbon baseline to be identified for each of the test sites.

An inventory of the existing highway and lighting assets at each of the test sites was compiled, to include both lit assets such as lighting columns and non-lit assets such as road markings, reflective road studs and signposts.

It was important that this inventory included all components that make up an asset, which in the example of a lighting column included the column, bracket, lantern, cabling and the concrete base. This would allow carbon factors to be identified for each component and ensure that future users of the Strategic Carbon and Cost Decision Support Tool would be able to construct an asset to reflect those in place on their network, and that the assets did not just reflect those used within the East Riding.

In addition to the assets themselves, the operational requirements of the assets needed to be considered, including the vehicle types, travel distances and frequency of movements to support the installation, maintenance and removal requirements of each asset. The carbon associated with the energy to operate the lit assets was also considered and derived from UK Government standard carbon factors.

Once the existing assets and operational requirements were identified, an exercise to identify carbon factors for each component asset and activity was undertaken. This drew on existing industry standard carbon data, including from databases compiled by National Highways, Inventory of Carbon and Energy (ICE) and ConnectPlus. As detailed above, several challenges were encountered in producing this baseline given the street lighting sector is lagging behind in its understanding of its carbon footprint.

It was not possible to provide original carbon figures for assets that are now forty years old and any attempts to factor in the age of these items could be significantly inaccurate given the lack of carbon emissions knowledge at the time of production and the changes in production methods over time. A calculation spreadsheet was therefore created based on the installation of like-for-like brand-new products and assuming the existing installation was end of life.

There were several data gaps, and whilst attempts were made to fill these gaps using proxy data, the carbon impact of some assets is not well understood. A specific example of this was the difficulty in obtaining a carbon factor for a standard reflective road stud.

Following the construction of a baseline, the same exercise was required for the Live Labs 2 alternative approach to consider the carbon impact of assets such as solar road studs, higher reflectivity road markings and pedestrian only lighting. Given the infancy of most of these technologies, the carbon factors were largely available via manufacturers or through product EPDs.

The baseline and 'future' carbon data was collated within Excel spreadsheets, and asset information was populated for each Live Labs 2 site to produce an initial before/after analysis of the Live Labs interventions over a 40-year appraisal period. This baseline analysis was concluded in May 2024.

The key challenge was that whilst containing rich data, the Excel spreadsheets were not particularly user friendly and could not be easily adapted to allow for completion by other users. It was also important that the reduction in carbon within the national grid over the appraisal period was captured, something which the Excel spreadsheets were not formulated to do.

Leeds University was therefore approached to utilise the data collated to develop an interactive Strategic Carbon and Cost Decision Support Tool which would address these challenges and develop a tool that could be rolled out to both project partners and the wider street lighting sector.

An initial workshop was held with Leeds University in September 2024 to understand user requirements, which was soon followed by a second workshop to understand critical data requirements to inform the tool build. It was agreed that an important component of the tool was that it was available to two user groups: Strategic and Expert users. Strategic users would use the default values and assumptions inherent within the tool, whereas Expert users would be able to input their own carbon and asset life values.

The tool build then commenced, with close liaison between the project team and Leeds University to ensure that the data being fed into the tool was validated and clearly understood. Progress meetings were held every two weeks, and any queries around the data were promptly resolved. The tool architecture was presented to and agreed by the project team in December 2024.

However, a number of data gaps were identified, and it was highlighted that these gaps would preclude the tool from working correctly. This linked back to the previous concerns highlighted around the availability of carbon data for some assets. In order to provide focus to the additional data collection, a ranking system of the importance of data gaps was identified, and it was agreed that any additional data collection was to be completed by mid-February 2025.

To ensure that there were no data gaps. relevant assumptions on some carbon factors needed to be made where required, as it was not acceptable to leave any asset unaccounted for. Any decisions and assumptions made during the development of the tool

were clearly identified and recorded to ensure full transparency. When data was supplied to Leeds University, a review process was undertaken to ensure the data was fully validated.

A draft version of the Strategic Carbon and Cost Decision Support Tool was presented to the project team in March 2025, along with a user guide for both Strategic and Expert users and a training session on its use for the wider project team. The tool and user guide were then thoroughly tested by the project team, and amongst a focus group of partner authorities in order to obtain feedback, which was collated and fed back to the team at Leeds University. A number of updates to the tool were agreed and completed in July 2025, at which point the finalised version of the tool was accepted by the project team.

The 'Expert' function of the tool was then utilised by the project team in August 2025 to calculate the existing and proposed carbon and cost impact of the Live Labs 2 interventions, for all test sites within the East Riding of Yorkshire and across partner authorities. Whilst this exercise was previously undertaken using the carbon baseline and future carbon Excel spreadsheets, this represented a key step in obtaining a full understanding of the carbon impact of the Live Labs interventions.

The project team led a webinar in September 2025, during which a user demonstration of the Strategic Carbon and Cost Decision Support Tool was presented to all partner authorities, who were then invited to test the tool and provide feedback. This webinar was well-received, and no detailed feedback was provided, which gave confidence that the tool achieved its desired outcomes.

A number of key challenges emerged during the carbon baselining exercise and during the development of the tool, many of which are documented above, but can be summarised as follows:

- The sector lags behind in its understanding of its carbon footprint, which led to significant challenges in the collection of carbon data. This means that proxy values were identified for some assets, and whilst efforts were made to validate this data, there remains uncertainty around the understanding of carbon for some assets.
- The carbon values for many fixed assets are a snapshot at that given moment in time, which does not account for the decarbonisation of manufacturing processes and materials over the 40-year appraisal period. This matters because some assets (such as road markings) will need to be replaced within this appraisal period, but the future carbon impact is difficult to estimate.
- The capture of carbon data for other assets requires further consideration. The Expert version of the tool allows users to input their own carbon data, but the tool is intended to be used offline, which will make it difficult for new carbon values to be captured centrally, particularly once the project is completed.

7. Expected Outcomes

The replacement of street lighting on A roads with our new Live Labs 2 alternatives has always anticipated significant carbon savings, however until the creation of the decision support tool, the extent of the potential carbon reduction was an unknown element and to some extent still is. Set against the backdrop of grid decarbonization, we appreciate the energy used will gradually reduce – and eventually become Net Zero. There will however always be a significant cost of paying for energy – even if it is net zero.

By using a whole life evaluation period of forty years we have incorporated a number of necessary variables into our tool, variables such as non-comparable replacement rates and the impact of the national political landscape on grid decarbonization are just an example of these variables alongside improvements in carbon factors for the replacement materials through future product development.

The introduction of these variables has a significant impact on long term confidence in the future projections of the support tool. Whilst these long-term projections are accurate based on all available information (as at 2026) confidence in accuracy reduces and reduces further at every refresh point after that. For our live lab we assume a refresh point is every ten years, the indicative life of surfaced dressed roads and certain key products as an alternative to street light columns (40-year life span) or lanterns (20-year life span). Accordingly, up to our first refresh point of the replacement materials (10 years) we have confidence, but beyond that there are assumptions in our decision-making tool which can be adjusted as we better understand life in 2036, 2046 etc.

Streetlights inherently require energy, and although long-term electricity-grid carbon factors are published in HM Treasury's Green Book, uncertainties remain due to the grid's decarbonisation rate and how political decisions may influence it. This Live Labs 2 project deals with comparing dynamic assets to fixed assets. In essence replacement street lighting can be seen as a dynamic asset as it consumes electricity every day of its lifetime and hence the carbon footprint of this asset is dependent on the carbon factor of that energy year on year. The replacement asset can be seen as a fixed carbon asset; they are installed and remain there until replacement is required. Their carbon factor is fixed for that whole life period at the point of manufacture and installation.

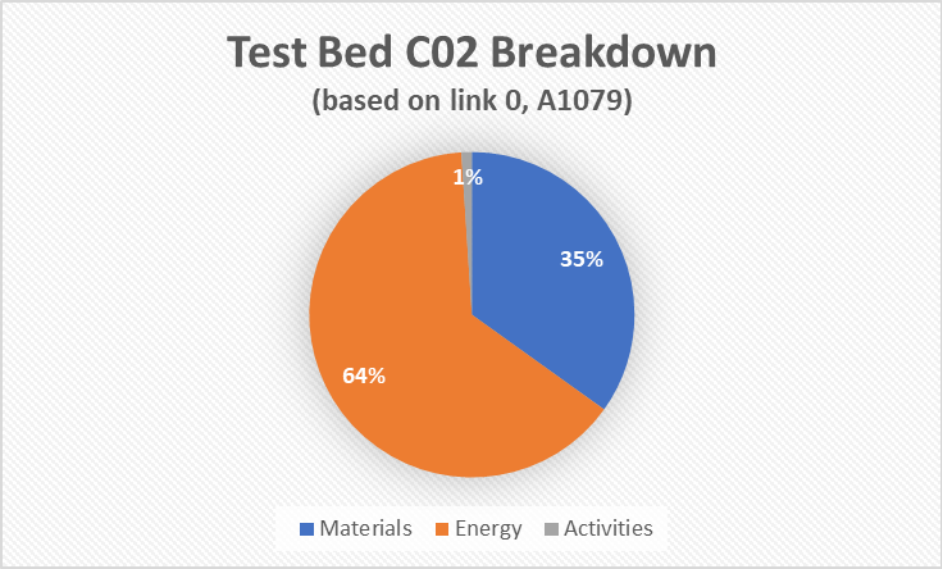
What can be said with a large degree of certainty is that the carbon footprint demonstrated by the tool at the point of decision to switch to Live Labs 2 methodology are highly unlikely to increase.

8. Findings

What is clear from undertaking this Live Labs 2 project focusing on streetlighting is how complex and underdeveloped the carbon landscape is within this sector, the issues developing the test site baseline are testament to this. However, as we progressed through the program, we were able to develop our understanding, fill in the gaps to the best of our ability and generate measurable results.

The overall baseline results indicate the scale of the carbon impact of owning and operating streetlighting, particularly large A-road lighting columns. These results can be seen in appendix 11.1but to summarise the carbon footprint of a like for like streetlighting replacement across the East Riding of Yorkshire test beds amounts to 967 tonnes of carbon over a fourty year life period. This baseline also accounts for other lit assets including bollards and signs; however, these assets only make up an average of 6% of the total carbon cost.

What is evident from the carbon baselining process is that the general assumptions of the streetlighting sector have been misplaced for a number of years. The assumption that energy reduction is the only solution for the sector to reduce carbon emissions is wrong. As can be seen from our baselining breakdown, energy consumption as of 2024 accounted for 64% of the overall whole life carbon emissions and with the decarbonisation of electricity production, this figure will fall over time. The infrastructure however will remain in place and as of 2024 this infrastructure and materials accounts for 34% of carbon emissions, a percentage figure that will only rise as energy generation decarbonises.



The question of whether the streetlighting needs to be there is the fundamental question to ask when considering decarbonisation for lit assets, a question this Live Labs 2 project has answered.

In terms of evaluating the embedded carbon for the replacement installations, utilising our Carbon and Cost Decision Support Tool, the results can be seen in appendix 11.2 and show positive returns when put into context.

Given that energy decarbonisation rates depend on several external factors such as funding and political environment, whilst we have stated grid decarbonisation figures released by Central Government, we can hold a significant amount of certainty over those figures. This uncertainty puts significant doubt in any projections beyond the first refresh point for the replacement materials. We can only project over a fourty-year period with the information available to us in 2025, however this information carries great long-term risk.

Energy decarbonisation has an influence on all carbon factors used in this project. It impacts not only on the energy consumption of a proposed streetlighting replacement, it also effects materials production such as metals and electronic components.

So, for the purpose of this report, while there are reductions on a number of test beds over the fourty year period we will focus on the ten-year projections as this is where we have great certainty. There is an anticipation over the fourty-year period that carbon factors will reduce for the replacement materials due to manufacturing improvements and increased market competition, this is impossible to factor in at this point.

The certainty over the ten year period is due to two key factors, firstly that this is the expected life of the replacement products, giving a refresh date of year 11 after initial installation and secondly that none of the replacement materials have ongoing carbon considerations, their carbon factors are fixed at the point of production and installation.

Also, as part of the year three evaluation, we have also revisited the test site designs to explore value engineering, and this is reflected in the results giving an option for a value engineered design proposal.

There are key points to extract from the test bed carbon results over the initial ten-year period:

- Overall saving across all test sites of 134 tonnes of CO_2e (29% reduction)
- Links without pedestrian lighting requirements show the highest return (46% reduction)
- Slight increase in CO_2e at junctions (24% increase)

With respect to the increase at junctions, this is due to the ratio of existing streetlighting compared to the volume of replacement materials, particularly illuminated road studs. There is a disproportionate volume of road studs required in a relatively short section of highway, compared to a relatively low volume of streetlighting. This can be offset by looking at any potential lighting replacement on a wider scale, for example de-illumination of adjacent links to offset the CO_2e increase at the junction to give a wider project reduction.

We must also acknowledge the balance between cost and carbon reduction. There are significant cost savings available across all locations, between 15% and 80% compared to streetlighting replacement depending on the location. This level of saving cannot be ignored by local authorities, so the decision whether to undertake this methodology should be looked at in a wider network context.

9. Future Development

There is significant scope for further development of the work undertaken by this Live Lab 2 project in a number of key areas.

Beginning with the Carbon and Cost Decision Support Tool. This tool was created specifically to address the pressures faced by local authorities. It was designed for local authorities by local authorities and has fulfilled its requirements for the Live Labs 2 project; however, it can go further. In coming years there is scope to make this a web-based tool available to all local authorities. It requires more data input in terms of carbon factors for a range of materials, particularly specific brands of white lines and streetlighting lanterns. Opening up the tool to a wider audience will help to facilitate the expansion of data as users are able to add products used specifically by them.

What this project has highlighted throughout its three-year program is the lack of carbon understanding within the wider streetlighting sector and its reliance on information and guidance from manufacturers who have a vested interest in selling products. There are several areas of misinformation across the sector and sheer reluctance to engage with carbon mapping from a range of manufacturers. It is important as this project comes to an end that the drive towards increased carbon literacy is not lost in the noise of daily operations.

Manufactures and sector bodies have a responsibility to ensure that the products they sell are fully carbon mapped, however this is not going to occur without increased carbon literacy from the customers buying those products. The various sector bodies, supported by the Live Labs 2 program, the first of its kind for the streetlighting sector, must incorporate carbon training into future development for their members, which is

something as a project team we are supporting beyond the end date of the original program.

10. Conclusion

This project has faced significant challenges from the very start. Challenging decades of engrained design process, creating new innovating systems for data collection and convincing an entire sector that this methodology is both safe and cost effective have been some of the key hurdles to overcome.

But as a group of forward-thinking local authorities spanning all four nations of the UK, we have tackled those head on and burst the bubble that streetlighting equals road safety and carbon reduction means increased cost.

There are few sectors more risk averse than local authority, and rightly so, the safety of the travelling public is of paramount importance. To ensure that we showed positive outcomes for this project, we needed to view this idea through the lens of local authority decision makers and what questions they would ask when challenged. The issue of carbon and cost is high on that list of questions.

The work undertaken by the project team, its national and academic partners through the carbon baselining process and then onto the creation and use of the Carbon and Cost Decision Support Tool has answered those questions.

Through our work we have developed the tools and the evidence to support local authorities to re-evaluate their approach to streetlighting, ask the question “Do we really need it”, provide an alternative all supported by well collected evidence. We have given the sector the tools and template to scale this methodology nationwide using a risk and value-based approach. The carbon and cost reduction data collected through this project is the basis for any local authority to create their own business to show that this is a methodology that can be beneficial to them.

As with any pilot project, there is scope for further refinement and development, such as value engineered designs that improve carbon and cost reductions while not impacting on road safety improvements or improving the data set and usability of the decision support tool. The results however are undeniable and to quote member of the cabinet at East Riding of Yorkshire Council “it’s a no brainer”.

11. Appendices

11.1 Carbon Baseline Results

Total Carbon - 40 Year Lifespan					
Link/Node	**Lighting Column**	**Lit Sign**	**Lit Bollard**	**Total Carbon**	
A164 Link 0	102.080	1.851	0.000	**103.931**	tCO2e
A164 Link 2	71.509	2.768	0.000	**74.277**	tCO2e
A164 Link 3	74.305	0.500	0.000	**74.805**	tCO2e
A164 Node 4	88.030	5.997	0.000	**94.027**	tCO2e
A164 Link 4	137.958	0.499	0.000	**138.457**	tCO2e
A164 Node 5	53.447	1.429	0.000	**54.876**	tCO2e
A164 Link 5	86.820	0.000	0.000	**86.820**	tCO2e
A164 TOTAL	**614.149**	**13.044**	**0.000**	**627.193**	**tCO2e**

Link/Node	**Lighting Column**	**Lit Sign**	**Lit Bollard**	**Total Carbon**	
A1079 Link 0	63.833	1.378	6.176	**71.387**	tCO2e
A1079 Link 4	26.165	1.026	0.000	**27.191**	tCO2e
A1079 Node 5	13.360	1.473	0.000	**14.833**	tCO2e
A1079 Link 5	105.898	2.389	3.676	**111.963**	tCO2e
A1079 Link 9	61.296	8.482	0.000	**69.778**	tCO2e
A1079 Node 9	21.207	0.000	0.000	**21.207**	tCO2e
A1079 TOTAL	**291.759**	**14.748**	**9.852**	**316.359**	**tCO2e**

Total Carbon - Annual					
Link/Node	**Lighting Column**	**Lit Sign**	**Lit Bollard**	**Total Carbon**	
A164 Link 0	2.552	0.046	0.000	**2.598**	tCO2e
A164 Link 2	1.788	0.069	0.000	**1.857**	tCO2e
A164 Link 3	1.858	0.012	0.000	**1.870**	tCO2e
A164 Node 4	2.201	0.150	0.000	**2.351**	tCO2e
A164 Link 4	3.449	0.012	0.000	**3.461**	tCO2e
A164 Node 5	1.336	0.036	0.000	**1.372**	tCO2e
A164 Link 5	2.170	0.000	0.000	**2.170**	tCO2e
A164 TOTAL	**15.354**	**0.326**	**0.000**	**15.680**	**tCO2e**

Link/Node	**Lighting Column**	**Lit Sign**	**Lit Bollard**	**Total Carbon**	
A1079 Link 0	1.596	0.034	0.154	**1.785**	tCO2e
A1079 Link 4	0.654	0.026	0.000	**0.680**	tCO2e
A1079 Node 5	0.334	0.037	0.000	**0.371**	tCO2e
A1079 Link 5	2.647	0.060	0.092	**2.799**	tCO2e
A1079 Link 9	1.532	0.212	0.000	**1.744**	tCO2e
A1079 Node 9	0.530	0.000	0.000	**0.530**	tCO2e
A1079 TOTAL	**7.294**	**0.369**	**0.246**	**7.909**	**tCO2e**

11.2 Test Bed Results

		Total Carbon over the appraisal period (TCO2e)	% Carbon Change to Existing	
Total Carbon	Existing	598.73		
	Test Bed	643.78	8%	
	Scenario - Manufacturing decarbonisation of all studs/E-road markings from Yr11 (Design Solution: -12 Studs)	551.27	-8%	
Total Carbon - Links Only (Exc. Ped Lighting Links)	Existing	298		50%
	Test Bed	243.64	-18%	
	Scenario - Manufacturing decarbonisation of all studs/E-road markings from Yr11 (Design Solution: -12 Studs)	184.69	-38%	34%
Total Carbon - Links Only (Inc. Ped Lighting Links)	Existing	383		64%
	Test Bed	386.86	1%	
	Scenario - Manufacturing decarbonisation of all studs/E-road markings from Yr11 (Design Solution: -12 Studs)	309.63	-19%	56%
Total Carbon - Roundabouts Only	Existing	184.3		31%
	Test Bed	202.45	10%	
	Scenario - Manufacturing decarbonisation of all studs/E-road markings from Yr11 (Design Solution: -12 Studs)	188.35	2%	34%
Total Carbon - Junctions Only	Existing	31.43		5%
	Test Bed	54.47	73%	
	Scenario - Manufacturing decarbonisation of all studs/E-road markings from Yr11 (Design Solution: -12 Studs)	53.29	70%	10%

		Total Carbon over 10 years (TCO2e)	% Carbon Change to Existing	
Total Carbon Year 10	Existing	467.3		
	Test Bed	333.39	-29%	
	Scenario - Manufacturing decarbonisation of all studs/E-road markings from Yr11 (Design Solution: -12 Studs)	299.01	-36%	
Total Carbon Year 10 - Links Only (Exc. Ped Lighting Links)	Existing	239.18		51%
	Test Bed	129.91	-46%	
	Scenario - Manufacturing decarbonisation of all studs/E-road markings from Yr11 (Design Solution: -12 Studs)	111.52	-53%	37%
Total Carbon - Links Only (Inc. Ped Lighting Links)	Existing	304.28		65%
	Test Bed	203.53	-33%	
	Scenario - Manufacturing decarbonisation of all studs/E-road markings from Yr11 (Design Solution: -12 Studs)	176.84	-42%	59%
Total Carbon Year 10 - Roundabouts Only	Existing	141.59		30%
	Test Bed	103.2	-27%	
	Scenario - Manufacturing decarbonisation of all studs/E-road markings from Yr11 (Design Solution: -12 Studs)	96.1	-32%	32%
Total Carbon Year 10 - Junctions Only	Existing	21.43		5%
	Test Bed	26.66	24%	
	Scenario - Manufacturing decarbonisation of all studs/E-road markings from Yr11 (Design Solution: -12 Studs)	26.07	22%	9%

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