Adept Live Labs 2

East Riding of Yorkshire Council

Decarbonising Street Lighting

Test Area Carbon Baseline Report

May 2024

KARL ROURKE
LIVE LABS PROJECT MANAGER
EAST RIDING OF YORKSHIRE COUNCIL

EAST RIDING OF YORKSHIRE COUNCIL

Report to: Live Labs 2 Commissioning Board

Carbon Baselining

Report of the Live Labs 2 Project Manager for East Riding of Yorkshire Council

1. Executive Summary

As part of Live Labs 2 Decarbonising Street Lighting project, as for all Live Labs 2 projects there is a requirement to undertake a carbon baseline of existing assets being affected by our proposed changes. The baseline quantifies the amount of carbon in the highway and will provide an understanding the impacts of the projects changes on embedded carbon across the East Riding test beds.

Our carbon baseline figures are based on whole life carbon costs for visual assets on our defined test beds as highlighted in appendix 1 and identifies a total sum of 967.14 tons of embedded carbon in existing assets as detailed in our carbon baseline spreadsheet (*appendix 1*) if replaced with like for like new assets over a whole life (40 year) period.

This baseline will inform the development of our carbon assessment tool. The proposed tool is currently being scoped out and will assesses the carbon and cost effects of proposed changes based on known factors over a 40 year period.

2. Background

2.1 Adept Live labs 2 was launched by the Department for Transport in May 2023 with seven projects across the UK receiving a share of a £30 million funding pot in order to explore new and innovate ways to decarbonise our road network over a three-year project timeline

2.2 A partnership of nine highway authorities from across the United Kingdom, led by East Riding of Yorkshire Council proposed a project focussing on scrutinising the British Standards that govern the visual realm of our local roads, primarily street lighting through proposing new holistic visual realm designs that would replace street lighting with highly effective visual alternatives to locations that current British Standards strongly recommend street lighting as the ultimate safety mitigation.

2.3 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 must first understand the carbon impact of traditional street lighting designs for these areas.

2.4 To gain an understanding of “business as usual” we have undertaken 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.

2.5 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.

2.6 We made a minor deviation from our SOBC statement that the baselining work will be undertaken by academics. As we began planning the baseline and exploring the assets that would be included within the baselining, it became apparent that this process did not need the intervention of a university for example and as such the baseline has been developed and created as a combined approach between our primary consultancy support of Local Transport Projects and the East Riding of Yorkshire Council Street Lighting department. This approach has enabled detailed analysis to be undertaken at a precise local level.

2.7 The approach we set out within our SOBC, which was followed through in the baselining and continues to be followed through with the development of our carbon forecasting tool, is to build our carbon understanding and evaluation from the bottom up. This approach links with the nature of our overall project.

2.8 It is set out very clearly within our SOBC the nature of the roads we are trialling and advocating for our new approach, these being inter-urban A roads. We are not proposing a switch to our new interventions across an entire street lighting asset stock, mainly due to the social considerations that are now deeply interwoven with street lighting.

2.9 Whilst this may appear to be limiting, the lighting on the inter-urban roads we are trialling are the largest within the asset stock and as such have the largest carbon impact and are installed for reasons less socially driven. Many local authorities will have a number of locations similar to those being trialled through the project. In East Riding of Yorkshire we have identified approx. 15% of the lighting stock that could be replaced through live labs interventions, which equates to around 6000 lighting columns.

2.10 The fact that our project proposals do not apply to an entire service operation and asset base is the reason why we chose to build our carbon baselining on a site specific bases rather than evaluating the entire service and taking a proportional snapshot based on a percentage application of interventions. The fact that street lighting assets vary in size and carbon footprint also steered the baselining towards a detailed site specific analysis. This site specific approach is continuing through our carbon forecasting tool creation.

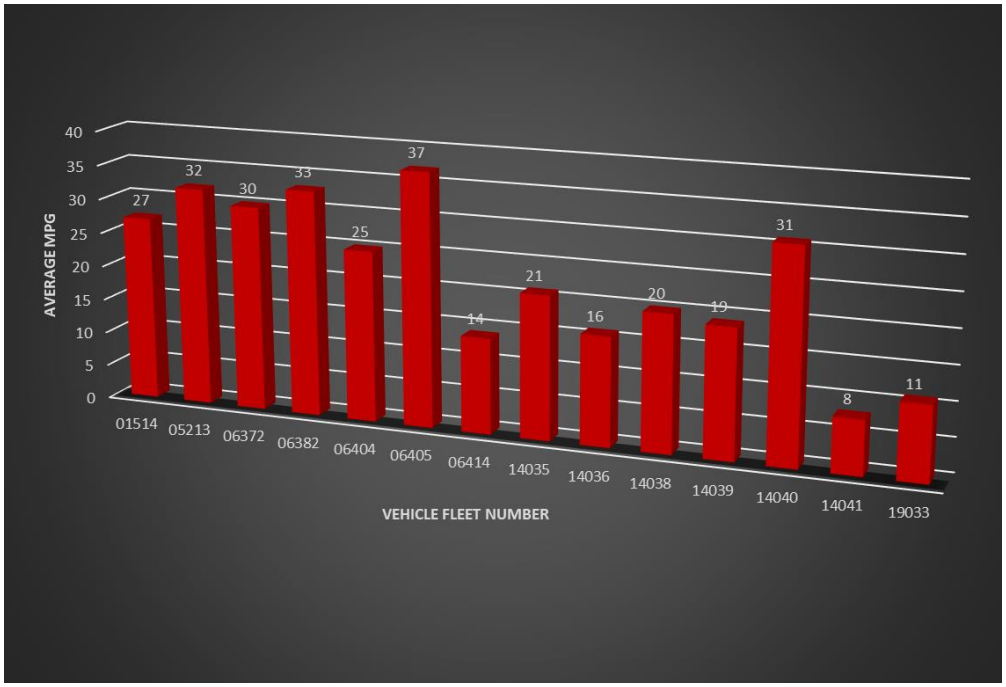
2.11 This carbon baseline, along with the carbon estimates for installation, whole life operation and maintenance, embodied carbon in materials involved and carbon emissions associated with the disposal at end of life will all be required to produce a carbon forecasting tool. The tool will enable designers and budget holders to accurately assess alternatives to street lighting within their own locality from a combined financial and carbon perspective at the point of end of life, when decisions on capital investment are being made.

2.12 Baseline Process, Key Challenges and Lessons Learned

2.13 We have encountered several challenges in producing this carbon baseline. The street lighting sector is lagging behind 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 tool 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 sectors understanding for further action.

2.14 The variety of materials and processes concerned with street lighting installation, operation and ultimately end of life disposal has made the data collection challenging due to the range of sources required. In order to create this carbon baseline we have collected specific carbon data where available, namely in the form of Environmental Product Declarations (EPD's) for the lanterns used by East Riding of Yorkshire Council (*appendix 3*) in the test bed locations and specific data based on East Riding of Yorkshire Council fleet (*appendix 4*), models of vehicles and specific distances to site. We have also utilised ad-hoc repair visit data generated using East Riding of Yorkshire Council's asset management system (*appendix 5*) to determine the average amount of ad hoc and statutory visits over an assets life and average distance between faults.

Average MPG per vehicle



2.15 All carbon baselines will require assumptions to be made relating to certain inputs and to account for missing data, our tool will be no different. Our assumptions are based around real life operational management of a street lighting installation, along with acknowledging the various forms of carbon reporting that are undertaken within a local authority setting. Best practice is for local authorities to report the carbon impact of its operations within its premises including the emissions of buildings. On this basis, and to avoid the potential for double counting carbon emissions our baseline is based on operational activities only and over a forty-year timeline, the average life of a street lighting column. The baseline is based on gate-to-gate operations and energy consumption of the street lights on the designated test beds, everything within the depot gate has been disregarded as is included in wider local authority reporting.

2.16 The baseline is generated on the specific test beds within the East Riding of Yorkshire Council as stated within our SOBC and are highlighted in appendix 1. It is a site-specific baseline based on the assumption of the installation of a brand new like for like lighting installation. It hasn't been 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. The calculation spreadsheet has been created based on the installation of like for like brand-new products and assuming end of life of the existing installation. It has been created to be flexible and adaptable to assess additional test beds within our partner areas and requires site specific data that is easily obtainable by any local authority, parameters and assumptions will also be adjustable to account for changes, for example in emissions factors.

2.17 Some proxy data was required to develop our carbon baseline figure due to lack of information from the sector and the manufacturers within the sector. Proxy data has been used for the following information: Street lighting column manufacture, cable manufacture, base material products and end of life recycling. Data has been gathered from existing work across our partner authorities and National Highways. We have drawn on proxy data from the National Highways Carbon Calculator v2.6, the ICE database v3.0, Carbon tool for design v2, and work undertaken for capital works appraisal undertaken by our partner authority Lancashire County Council (*appendix 2*). All reference sources have been verified through the course of our baselining process.

2.18 The source materials for this baseline have been checked and conversion factors updated if required based on current government figures. We have specifically been required to use proxy data for lighting columns, cable, base materials and waste disposal across all elements of the baselining as we were unable to obtain these figures from the sector. Where proxy figures have been utilised we have applied these to either the weight, volume or length of the materials relative to the specific sites being baselined.

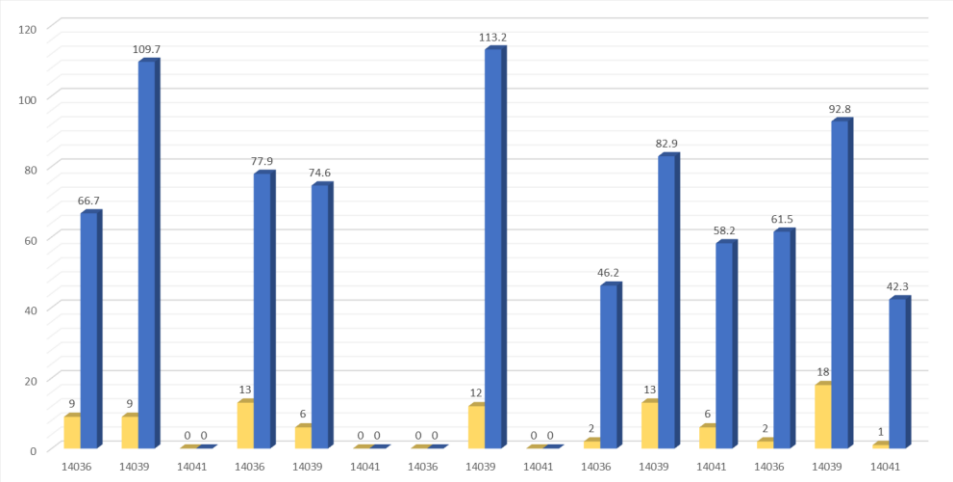
2.19 This process has identified some areas of the street lighting sector are moving forward in the realms of carbon mapping. Lantern manufacturers are significantly further ahead than other materials manufacturers in being able to provide detailed Environmental Product Declarations (EPD's) for their products and it is these EPD's that we have used in our carbon baselining for the standard lanterns used by East Riding of Yorkshire Council. We will be gathering EPD's from across the project partners as part of our larger carbon assessment tool creation to provide a library of lantern EPD's and the ability for users to pick from a list for their standard product. It will also give insight to identify outliers

2.20 East Riding of Yorkshire Council does not procure exclusively renewable energy and purchases its energy on the open market, identifying ERYC as a brown energy consumer. This is not the case for all local authorities and if the evaluation spreadsheet is used across our partners, any change in conversion factor for energy can be accommodated using a drop-down conversion list.

2.21 Given that we are generating this baseline over a forty-year lifecycle, we also must address the current stated target of net zero and the reduction in carbon within the national grid down to zero over time. Current stated targets for carbon reduction by 2050 are within the lifespan of the baseline figure, however the reduction in energy to carbon conversion factors to zero cannot be plotted for the future in a straight-line graph reduction, as this reduction is dependent on political decisions and technological advancement. We have taken the decision within this first round of baselining to take a snapshot of energy related carbon based on the current government conversion factor (appendix 1) and extend that out across the forty-year lifecycle. This gives us a worst-case scenario of carbon impact whilst giving us the flexibility to update the conversion factors as they change over time. Our upcoming final carbon assessment tool will make an accommodation for the reduction in energy to carbon conversion factors over time.

2.22 Our figures relating to vehicle based activities such as installation and maintenance are detailed and specific to the existing East Riding of Yorkshire Council fleet, manufacturers stated carbon factors for these vehicles and specific distances between base depot and site. The frequency of planned and reactive maintenance visits are based on a data set relating to East Riding of Yorkshire Council street lighting assets and generating average number of reactive and planned maintenance visits for a single asset over the course of its life using historic data stemming back 25 years. The average distance per ad-hoc visit has been taken from fleet vehicle data and ad-hac visits made across East Riding of Yorkshire Council operational area from the week of 11th December to 15th December 2023 and is summarised in the below graph

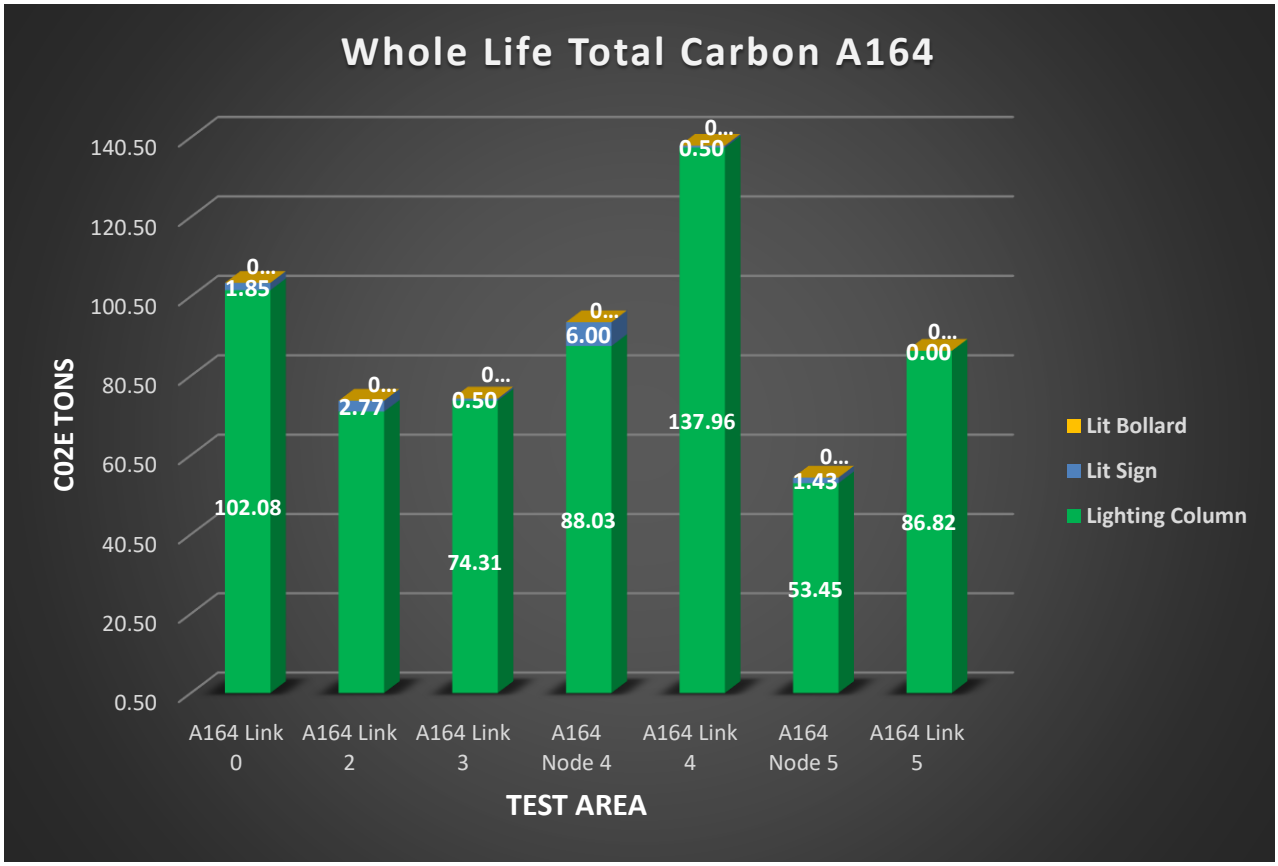
Vehicle distance for daily fault repairs

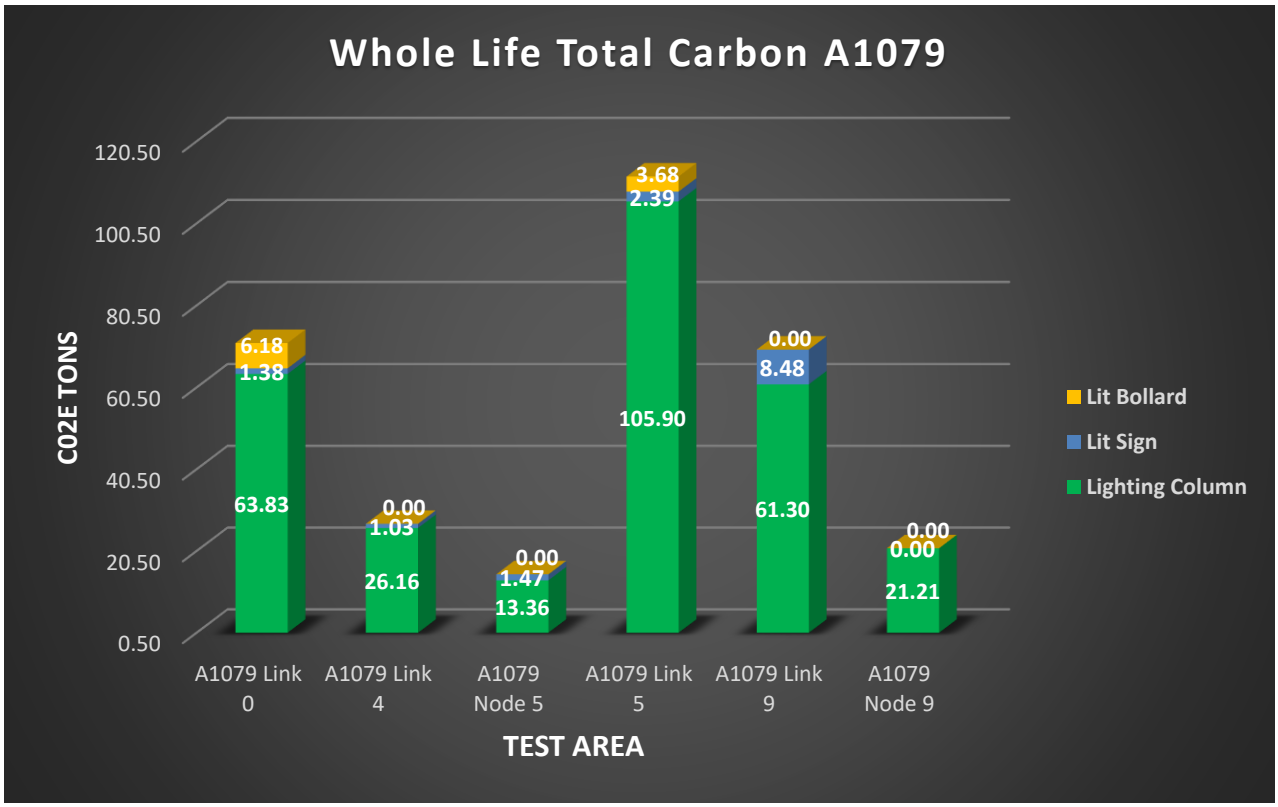


2.23 This carbon baseline tool is broken down into each individual test bed and is an accumulation of embedded carbon of materials, energy consumption and activities and shows that a single street light is responsible in East Riding of Yorkshire Council for the generation of **2.55** tons of carbon per year over its lifecycle of forty years based on our assumptions as detailed and the limitations of specific data with an overall carbon impact of new like for like street lighting installations across the entire test beds of **943.552** tons of embedded carbon over the forty year life of the installations and is shown below in both volume and percentage detail

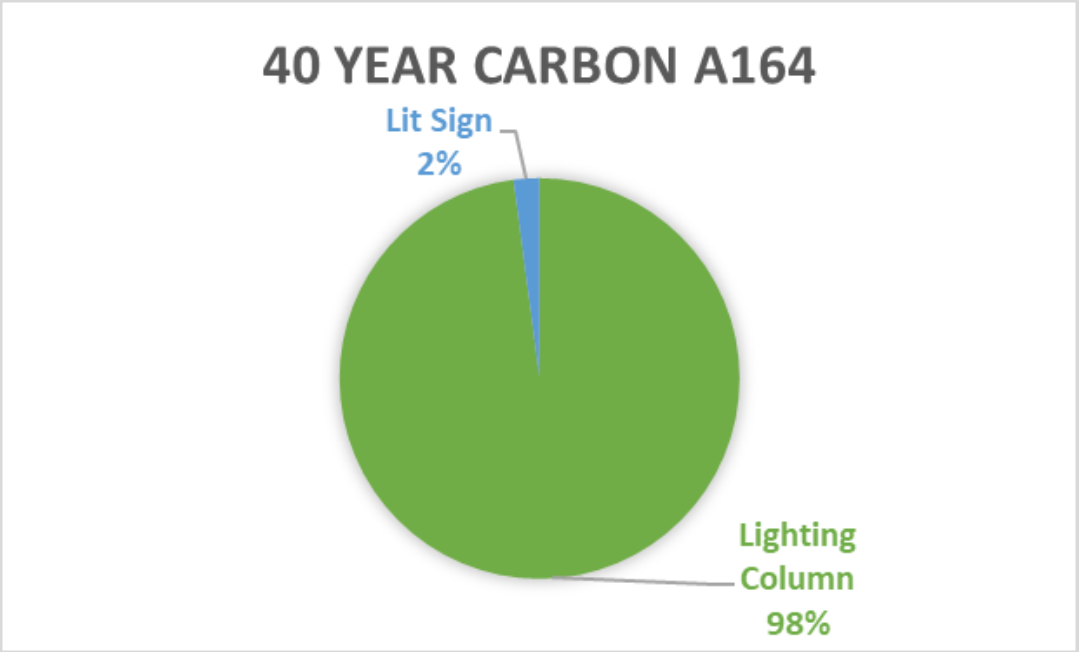
Carbon Breakdown per test area in tons

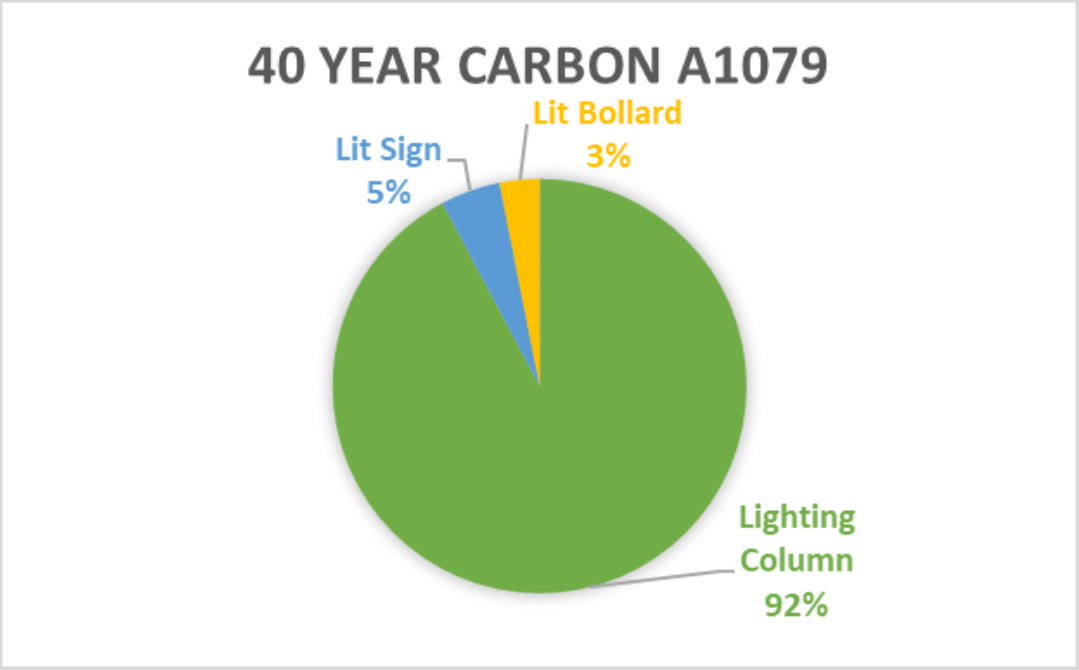
Total Carbon - 40 Year Lifespan				
Link/Node	**Lighting Column**	**Lit Sign**	**Lit Bollard**	**Total Carbon**
A164 Link 0	102.08	1.85	0.00	**103.931**
A164 Link 2	71.51	2.77	0.00	**74.277**
A164 Link 3	74.31	0.50	0.00	**74.805**
A164 Node 4	88.03	6.00	0.00	**94.027**
A164 Link 4	137.96	0.50	0.00	**138.457**
A164 Node 5	53.45	1.43	0.00	**54.876**
A164 Link 5	86.82	0.00	0.00	**86.820**
A164 TOTAL	**614.15**	**13.04**	**0.00**	**627.19**
Link/Node	**Lighting Column**	**Lit Sign**	**Lit Bollard**	**Total Carbon**
A1079 Link 0	63.83	1.38	6.18	**71.39**
A1079 Link 4	26.16	1.03	0.00	**27.19**
A1079 Node 5	13.36	1.47	0.00	**14.83**
A1079 Link 5	105.90	2.39	3.68	**111.96**
A1079 Link 9	61.30	8.48	0.00	**69.78**
A1079 Node 9	21.21	0.00	0.00	**21.21**
A1079 TOTAL	**291.76**	**14.75**	**9.85**	**316.36**


Whole Life Total Carbon A164
C02E TONS
140.50
120.50
100.50
80.50
60.50
40.50
20.50
0.50
0...
1.85
102.08
0...
2.77
0...
0.50
74.31
0...
6.00
88.03
0...
0.50
137.96
0...
1.43
53.45
0...
0.00
86.82
A164 Link 0
A164 Link 2
A164 Link 3
A164 Node 4
A164 Link 4
A164 Node 5
A164 Link 5
TEST AREA
Lit Bollard
Lit Sign
Lighting Column


Whole Life Total Carbon A1079
C02E TONS
120.50
100.50
80.50
60.50
40.50
20.50
0.50
6.18
1.38
63.83
0.00
1.03
26.16
0.00
1.47
13.36
3.68
2.39
105.90
0.00
8.48
61.30
0.00
0.00
21.21
A1079 Link 0
A1079 Link 4
A1079 Node 5
A1079 Link 5
A1079 Link 9
A1079 Node 9
TEST AREA
Lit Bollard
Lit Sign
Lighting Column

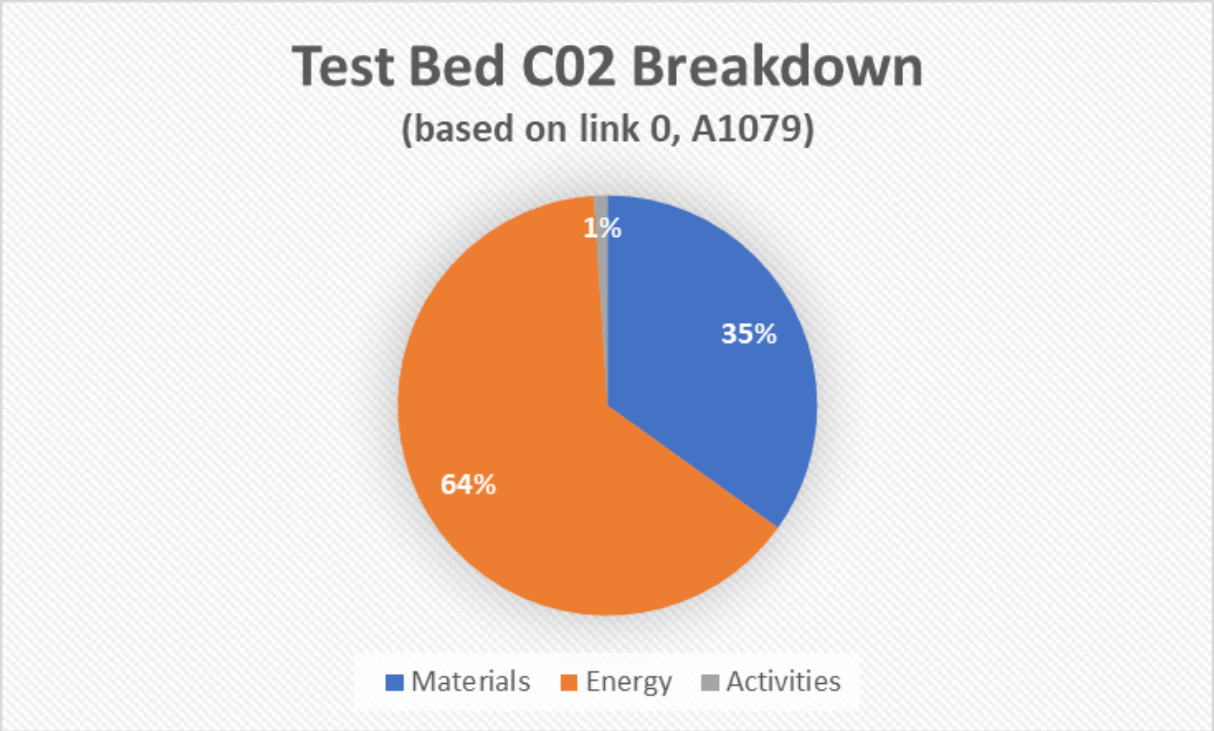
Carbon breakdown per test route in %





2.24 What is evident through our baselining is that 35 percent of carbon generation is from the actual materials of the installation, 1 percent is from the installation, maintenance and removal of the streetlight, whereas only 64 percent is from the actual energy consumption of the street light over its lifetime, even taking the assumption that there will be no further decarbonisation of the grid.

Carbon breakdown per test bed



3.0 Conclusion

3.1 Producing this carbon baseline for our primary test beds has been extremely challenging at times. By producing a detailed analysis of the carbon impact of our assets, we have exposed worrying gaps in a sector, that whilst being extremely efficient in understanding impacts of energy consumption, is still in its infancy in terms of understanding its carbon impacts as a sector, specifically relating to the overall lighting installation.

3.2 This baseline has identified gaps in the understanding of whole life energy related carbon and possible initiative based carbon savings across our sector. The perception within the sector is that the switch to LED over recent years is a solution to permanent cost and carbon saving, however this is a misleading approach. Whilst this approach has reduced energy consumption on a national level and relative cost, the sector needs to be made aware that saving energy is a medium term approach to saving carbon due to the ongoing decarbonisation of the countries energy supply and that there will still be a considerable embedded carbon value in the materials of a street lighting installation.

3.3 Whilst we have published a worst case scenario of carbon impact through energy consumption and that switching to lower consuming LED sources does bring around a carbon saving, these savings will continuously reduce over time. As the project develops with the creation of our carbon forecasting tool, we hope to show the need for a broader focus on carbon reduction, not limited to simply saving energy, but to a holistic understanding of carbon savings potential, particularly from new innovations in design and material use. Further changes could be seen by moving away from existing standard practise, exploring if street lighting is still required and utilisation of sustainable or recycled products such as aluminium or wood.

3.4 The reluctance to challenge British Standards and accepted industry practice has led to a belief that the only way to save carbon is by saving energy and doesn't take into account the impact of the whole asset on its carbon footprint. Particularly from the

manufacturing element of the sector, and we are dealing with a sector that is manufacturer led, not consumer led.

3.5 The lack of pressure from local authorities on manufacturers to understand their carbon impact has led to complacency within some areas of manufacturing and a “we will get round to it” attitude across many suppliers. This is compounded by the primary focus of local authorities over recent years being cost, compounded by the current local authority funding crisis and the perception that low carbon means expensive.

3.6 Our baselining investigations have revealed pockets of best practise amongst the sector supply chain but this best practise is driven by context. Where we are seeing the creation of EPD’s and a strong carbon focus are on materials that are more costly than standard day to day materials or where the market place is crowded with similar price points. In both cases the carbon information is being for these items as a unique selling point to enable procurement decisions to be made not wholly based on cost.

3.7 Conversely to this where we are seeing real lag in carbon understanding and profiling are on materials that are used in large quantities, day to day items such as cable and lighting columns. It is in these areas where there is a stagnation in innovation, limited providers in the market place and procurement decisions are based predominantly on cost because of the volumes being used. In these areas there is a worryingly large lack of understanding on carbon profiling and the purpose of EPD’s.

3.8 By creating this carbon baseline for illuminated assets in a structured way we can identify the specific areas of assets that are the most significant carbon generating areas or are lacking detailed carbon information. It is our expectation that this detailed breakdown is a catalyst for both client and manufacturers alike to both understand and address the significant knowledge gaps and to find alternatives to business as usual.

3.9 In relation to our findings through our baselining process of the carbon embedded in street lighting installations, we can evidence that 35% of equivalent emissions are scope three, with the energy usage of 64% being scope 2 and scope 1 emissions of maintenance, installation and removal making up 1%.

3.10 Whilst it is difficult to extrapolate this site-specific carbon baselining across the whole street lighting stock of East Riding of Yorkshire Council numbering approx. 42,000 lights, if we did make a straight comparison this would indicate a total carbon footprint of 107,000 tons of carbon emissions per year.

3.11 In summary this baselining process has been difficult but informative. We have generated a baseline using a set of reasonable assumptions to calculate the carbon baseline effectively. This baseline will inform our future carbon assessment tool and has provided detailed figures in which we can evaluate future design and materials changes against. It has been a worthwhile process but has exposed serious gaps and misconceptions within the sectors carbon understanding.

Contact Officer: Karl Rourke
Live Labs 2 Project Manager
Email: livelabs2er@eastriding.gov.uk

Appendices

Appendix 1

LTP 5264 PI A164 00 - A164 Proposed Inter

LTP 5264 PI A1079 00 Proposed Interven

Carbon Baseline Spreadsheet Final.xlsx

Appendix 2

- **Greenhouse gas reporting: conversion factors 2023 here**

Activity	Country	Unit	Year	kg CO_2e	kg CO_2e of CO_2 per unit	kg CO_2e of CH_4 per unit	kg CO_2e of N_2O per unit
Electricity generated	Electricity: UK	kWh	2023	0.207074	0.20496	0.000896	0.001218

Copy of Carbon-Tool-for-Desi

230323 Street Lighting CO2e Calcs R

- **National Highways Carbon emissions calculation tool here**

national-highways_carbon-tool_version2-6(

- **Circular Economy here**

Appendix 3

Thorn Isaro Pro EPD.zip

Appendix 4

Street Lighting Fleet Data V3.xlsx

Appendix 5

Faults Complete 2023-24 V1.xlsx