

FINAL REPORT - TIER 2
AUTHORITY CASE STUDIES
SOMERSET

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Contents

1 INTRODUCTION TO SOMERSET'S INVOLVEMENT 3

1.1 Selection AND MANAGEMENT of corridors 3

1.2 approach to carbon data & analysis 4

1.3 CARBON BUDGETING 8

1.4 doughnut economics 8

1.5 innovation management, selection, & scoring 9

2 CARBON HOTSPOT STUDIES 10

3 CARBON BASELINES AND EXPERIMENTAL PROFILES 12

3.1 FULL-SERVICE CARBON BASELINE 12

3.2 CORRIDOR CARBON BASELINES 15

3.3 EXPERIMENTAL PROFILES 18

4 INNOVATION 26

APPLICATION OF THE HIGHWAYS DOUGHNUT 27

5 APPLICATION OF CARBON BUDEGTING METHODOLOGY 27

6 COMMISSIONING THE WORK 28

7 FUNDING & ADDED VALUE 28

8 TIMELINE OF DELIVERY 29

9 AUTHORITY-SPECIFIC RESULTS 29

LEGACY 30

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1 INTRODUCTION TO SOMERSET'S INVOLVEMENT

1.1 SELECTION AND MANAGEMENT OF CORRIDORS

Selection and Management of Corridors:

The methodological framework of the Wessex Live Lab is predicated on the isolation of nine 'Net Zero Corridors' across Somerset, Cornwall, and Hampshire to serve as high-fidelity operational proxies for the wider UK road network. Somerset Council identified three highly distinct corridors, each selected for its specific asset topology, traffic loading profile, and distinct maintenance requirements. The strategic management of these corridors treats each as a controlled test bed for specific materials and logistics before horizontal scaling across the authority's 6,600-kilometre network.

The A38 Corridor (Strategic Arterial): This corridor encompasses the Taunton-Devon route, specifically focused on the Chelston link road and the interchange at M5 Junction 26. It represents the highest-carbon segment of the municipal remit: high-volume arterial routes requiring deep structural maintenance. The management objective for the A38 was to evaluate heavy civil engineering interventions for legacy concrete assets, specifically a failing 50-year-old concrete carriageway that would traditionally require total excavation and reconstruction.

The B3139 Corridor (Rural Network): Selected to proxy the expansive, lower-category rural roads that dominate Somerset's physical geography, the primary focus is on the Mark Road (Causeway). Unlike the A38, where structural remediation was critical, the B3139 management strategy prioritised early lifecycle preservation and reactive maintenance efficiency. This corridor facilitates the evaluation of penetrative surface treatments designed to arrest degradation before the requirement for carbon-intensive resurfacing.

The Comeytrowe Corridor (Urban Fringe and Active Travel): Centred on the Queensway, this corridor represents the transition between residential environments and arterial networks. The management rationale shifted the focus toward pedestrian infrastructure and active travel. It was designated as the primary proving ground for circular logistics—eliminating waste haulage—and the deployment of tree-sensitive, permeable materials to protect localized biodiversity.

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1.2 APPROACH TO CARBON DATA & ANALYSIS

The carbon baselining and analysis process was carried out in accordance with the Carbon Calculation and Accounting Standard (CCAS) guidance for local highways authorities, developed by the Future Highways Research Group (FHRG). This was undertaken at two spatial scales using contrasting approaches: a top-down, inventory-based approach for the authority-wide 'full-service' carbon baseline, and a bottom-up, activity-based approach for the corridor-level carbon profiles (**Figure 1.**). All carbon calculations for the full-service baselines were conducted in the FHRG Carbon Analyser tool by the project Carbon Analyst; calculations for the corridor-level carbon profiles were initially conducted in Carbon Analyser, and later in the Excel-based Carbon Profiler Toolkit (CPT) which replaced Carbon Analyser. Both the full-service carbon baseline and corridor-level carbon profiles have been visualised in an interactive Power BI report, allowing for in-depth analysis of carbon 'hotspots' and potential carbon savings at full-service, corridor, activity, and scheme level.

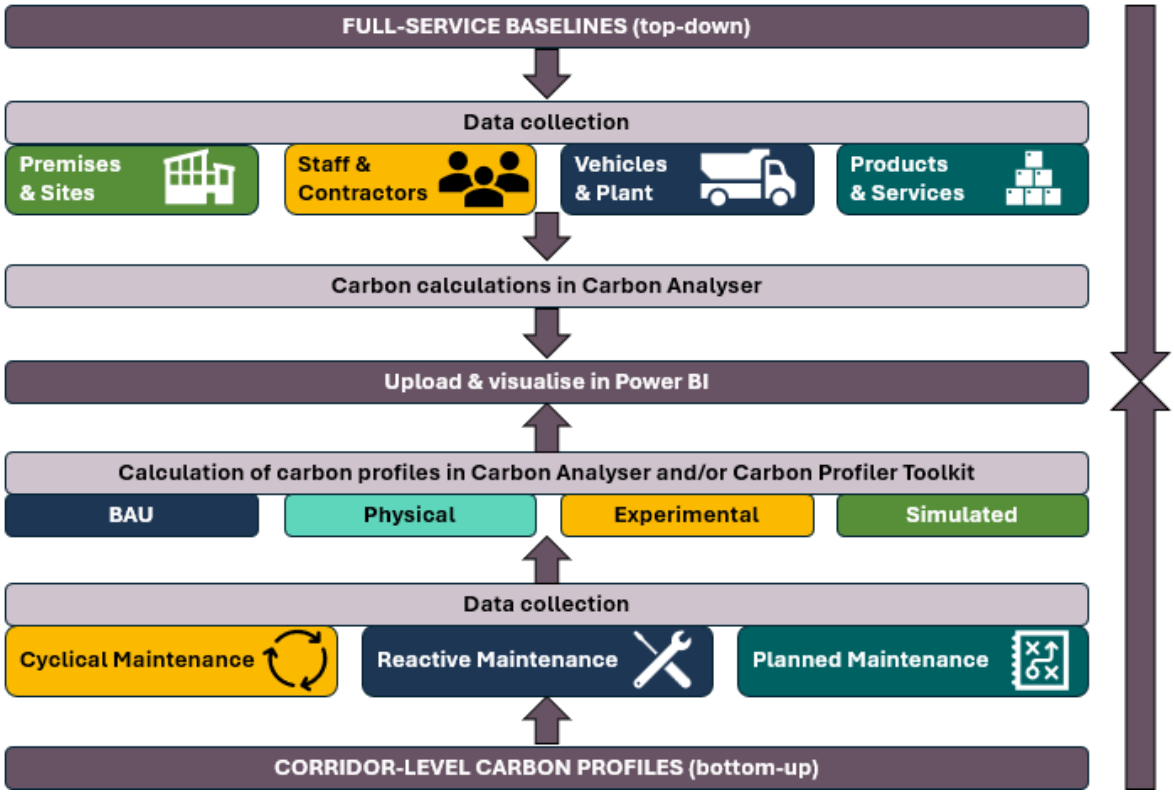


Figure 1: *Carbon analysis workflow.*

1.2.1. Full-service carbon baselining

A data collection proforma template was provided by the FHRG to collate data for each of the four carbon inventories from Somerset Council, their Tier 1 contractor at the time (Milestone Infrastructure, now known as M Group), and their Tier 2 subcontractor (Wainwright). The majority of the data for the full-service carbon baseline was either submitted via the proforma template itself, or provided in a format consistent with the requirements of the template. This covered the financial year 1st April 2022 – 31st March 2023, in accordance with the carbon baselines for the other two Local Authorities.

For the **Premises & Sites** inventory, electricity, gas, and water consumption figures were provided by M Group for each of their highways depots in Somerset; electricity and gas billing data was provided separately for County Hall (the Highways service HQ). Where meter readings were not available for

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the full 12 months of the baseline year, they were extrapolated from the available data. For County Hall, no water meter readings could be obtained, so water consumption was estimated based on the head count and average per-capita water consumption in the depots. The proportion of emissions from County Hall allocated to the Highways maintenance service was calculated based on the proportion of desks occupied by Somerset Council staff.

For the **Staff & Contractors** inventory, a survey was produced to gather data on the commuting and home working habits of Highways staff from Somerset Council. Key information provided in the survey included:

- Organisational unit
- Annual number of days working from home
- Annual number of days commuting to work
- Miles travelled per day to and from work
- Primary commuting mode
- Vehicle size class and fuel type, if applicable
- Vehicle ownership (personal, employer-owned, or lift share), plus vehicle registration number if employer-owned
- Primary mode of business travel
- Annual business mileage

A separate MS Forms survey was sent to M Group, adapted at their request to ascertain the average number of times each respondent visited each depot per week, and the average commute distance from their home to each of the depots. This data was then used to calculate the annual commuting distance for each contractor. As it was infeasible to obtain a 100% response rate on the surveys (40% of Somerset Council staff and 38% of M Group contractors responded), the automatic Extrapolation function in Carbon Analyser was used to approximate the emissions from commuting and home working for the remaining employees who did not respond, based on the average responses for each commuting mode and fuel type. Business mileages were obtained from Somerset Council's HR department and matched to each survey respondent; business miles for staff who did not respond to the survey were allocated to the Products & Services inventory, as advised by the FHRG.

For the **Vehicles & Plant** inventory, the primary function, fuel type, make, model, and annual mileage was provided for each vehicle in the Somerset Council and M Group highways fleets. M Group also provided the annual fuel consumption in litres (or kWh for electric cars), which was used in preference to the mileage, since the carbon factors for fuel consumption are deemed to be more accurate. The quantities of HVO and diesel consumed by all plant items were provided in bulk by M Group.

For the **Products & Services** inventory, data on purchased materials, purchased services, third-party plant and transport, and waste management were provided by M Group and Wainwright, as described in **Table 1** below. To prevent double counting, M Group cross-referenced their data against Wainwright's before submitting it for analysis.

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Table 1: Data provided for each category in the Products & Services inventory.

Category	Data provided	
Purchased materials	• Provider • Material type • Material description	• Quantity • Unit of measure
3rd-party plant & transport	• Provider • Vehicle/plant type • Fuel type	• Distance / fuel quantity • Unit of measure • Purpose
Waste management	• Provider • Disposal method • Waste type	• Quantity • Unit of measure

As the Eurobitume carbon factor for bitumen has since been updated to 530 $kgCO_2e$/tonne,[1] the carbon factors for all bituminous materials have now been retrospectively updated to ensure comparability between the full-service baseline and any carbon savings calculated at corridor level since this update. For M Group, no data was available on the fuel consumption or mileage of third-party plant and transport; instead, the transportation spend for each supplier was provided, and the average cost of diesel from April 2022-March 2023 (£1.8106 per litre) was used to estimate the quantity of diesel consumed.

1.2.2. Corridor-level carbon profiles

A carbon baseline was calculated for each of the three corridors using a bottom-up, activity-based approach, focusing on three categories of Highways maintenance: cyclical, reactive, and planned maintenance. These categories were broken down into activity types for cyclical and reactive maintenance, and individual schemes for planned maintenance (**Figure 2.**). To provide a representative baseline for the low-carbon innovations implemented on the corridors whilst also aligning with the full-service baseline, 2022-23 is considered to be the baseline year for cyclical and reactive works (as it is assumed that the scale and frequency of these works will have remained relatively constant over the past four years), whilst the baseline for planned works is a theoretical representation of the 'business-as-usual' (BAU) alternative to the low-carbon innovation trialled. The baseline carbon profile for each activity or scheme on a corridor is therefore termed the 'BAU' carbon profile. All carbon profiles have been uploaded to the Power BI dashboard for visual comparison between corridors, activities, and options for decarbonisation.

[1] See https://eurobitume.eu/wp-content/uploads/2025/03/EB-LCA-4.0-2025.pdf

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	Cyclical Maintenance	Reactive Maintenance	Planned Maintenance
When was the data provided for?	2022-2023	2022-2023	Live Labs scheme delivery phase (2024-2026)
What activities did the data include?	• Drainage cleansing (gullies) • Verge cutting • Highways Inspections	• Potholes & patching • Drainage works • Line markings • Winter maintenance (gritting) • Ironworks • Signage / bollard replacement • Jetting works • Kerbing • Footway defects • Debris / spillage / obstruction • Solar installation • Other minor works	• Concrete road refurbishment • Roundabout resurfacing • Footway reconstruction • Microsurfacing • Asphalt preservation
How was the data collected?	• Data on verge cutting provided by the Highway Service Manager. • Gully cleansing data from Confirm. • Inspections data obtained from staff survey and Highways Safety Inspection Manual.	• Defect data extracted from Confirm. • Winter maintenance was downscaled from full-service level.	• BoQ provided where available. • Carbon factors for specific products provided by the supplier if possible. • Transport information deduced from depot/supplier locations.

Figure 2: *Data collection methods for each of the three types of maintenance on the corridors.*

For activities or schemes on which a low-carbon innovation was trialled, a 'Physical' carbon profile was also created to illustrate the as-built carbon emissions compared to the baseline. Where a low-carbon innovation was proposed, but not physically trialled, a 'Simulated' carbon profile was created to illustrate the maximum carbon savings that could have been achieved on that activity/scheme. 'Experimental' carbon profiles were also created to illustrate intermediate scenarios that were lower-carbon than 'BAU' but higher-carbon than 'Simulated', or otherwise did not fall into the other three profile categories.

For **cyclical maintenance**, details on the frequency of verge cutting on A&B roads and C&U roads were provided by the Highway Service Manager, whilst the length of verge cut on each corridor was downscaled from the total length of verge cut on A&B and C&U roads and cross-referenced against Google Maps. The number and location of gullies cleansed on each corridor were extracted from Confirm, with the starting location of each gully tanker estimated from the depots to which the gully tankers were assigned in the Vehicles & Plant data provided by M Group. The frequency of inspections on each corridor was inferred from Somerset Council's Highways Safety Inspection Manual, with the type and starting location of each Inspections van being inferred from the Inspections team's responses to the staff survey.

For **reactive maintenance**, a Schedule of Rates for each activity on the corridors was extracted from Confirm and provided as an Excel spreadsheet. Where the dimensions or quantity of material required for a given defect were not specified, the average known dimensions or quantity for that defect type were assumed. The fuel consumption rates of plant items were estimated based on data from the CEDR and Liverpool Live Labs, as well as internet research. Transport distances were deduced from the location of the nearest M Group depot or supplier, depending on the type of material being transported. For winter maintenance, the distance travelled by the gritters and the quantity of salt required per corridor were deduced by downscaling the total gritter mileage and salt usage for Somerset to the proportion of the priority gritting network covered by each corridor.

For **planned maintenance**, a Bill of Quantities was provided for each scheme where available; otherwise, the quantities of material and plant usage required were deduced from a diagram or

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description of the scheme. EPDs (Environmental Product Declarations) were provided for specific products where available; otherwise, an approximate carbon factor was deduced from the available carbon factors in the database built into the CPT. The fuel consumption rates of plant items were estimated based on data from the CEDR and Liverpool Live Labs, as well as internet research, whilst the transport distances were deduced from the location of the nearest M Group depot or supplier, depending on the type of material being transported. The carbon factors for all bituminous materials have now been retrospectively updated to reflect the recent increase in the Eurobitume carbon factor for bitumen.

1.3 CARBON BUDGETING

A central innovation of the Wessex Live Lab is the transition from retrospective carbon reporting to proactive Carbon Budgeting. This represents a fundamental shift in municipal asset management, ensuring that greenhouse gas quantification is integrated directly into the inception phase of capital design and decision-making.

In collaboration with the Centre for Energy and the Environment at the University of Exeter, Somerset Council developed and piloted a bespoke Carbon Budgeting Toolkit. The methodology establishes a service-wide 'macro' carbon budget—a finite allowance derived from the authority's commitment to achieving a carbon-neutral estate and operations by 2030. This macro budget is subsequently fractionated into micro-corridor and project-level allocations.

Under this constraint, project engineers must evaluate the long-term carbon implications of material selection and maintenance frequencies at the design stage. If a proposed Business-As-Usual (BAU) intervention exceeds its localised carbon budget, the engineering parameters must be revised to integrate lower-carbon alternatives—such as bio-based binders or in-situ recycling—before procurement is finalised. The toolkit facilitates complex scenario modelling, allowing the council to mathematically align its routine highway operations with its climate emergency declarations.

1.4 DOUGHNUT ECONOMICS

The project's strategic appraisal is underpinned by the Doughnut Economics Model, a macroeconomic framework developed by Oxford economist Kate Raworth. The model visualises a "safe and just space" for human activity, bounded internally by a social foundation (human essentials) and externally by an ecological ceiling (planetary boundaries).

To operationalise this theory for the highways sector, the Wessex Partnership collaborated with Circle Economy to develop the 'Highways Doughnut Toolkit'. The toolkit translates the global model into 18 specific, measurable themes tailored to highway maintenance. The ecological ceiling comprises nine themes: climate change, biodiversity loss, air quality, chemical pollution, waste, and material footprint. The social foundation comprises nine corresponding themes, including accessibility, health, safety, employment, and equality.

By applying the Highways Doughnut Scorecard, Somerset Council ensures that decarbonisation strategies do not inadvertently compromise network resilience or user safety. This holistic evaluation framework allows the authority to understand the wider impacts of its activities, including regional 'levelling up,' by balancing environmental goals with social wellbeing.

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1.5 INNOVATION MANAGEMENT, SELECTION, & SCORING

Innovations were selected for each activity on the corridors through a process of iterative evaluation as illustrated in the 'Innovation Funnel' shown in **Figure 3**. A longlist of innovations was firstly collated from various project partners into an Innovations Opportunity Register, from which a shortlist of potential innovations was selected for each corridor by Somerset Council. Shortlisted innovations were then assigned a normalised weighted score in terms of their attractiveness, achievability, and sustainability using the Strategic Change Portfolio Management module of Carbon Analyser; the scoring process is explained in more detail in the Tier 1 Overarching Wessex Live Lab Final Report. Finally, the innovation scorecards were exported from Carbon Analyser and uploaded to a Power BI dashboard (**Figure 4**), whereupon the top-scoring innovations were identified and trialled on the corridors if feasible; if not, the theoretical carbon savings that would have been achieved were simulated in Carbon Analyser / Carbon Profiler Toolkit.

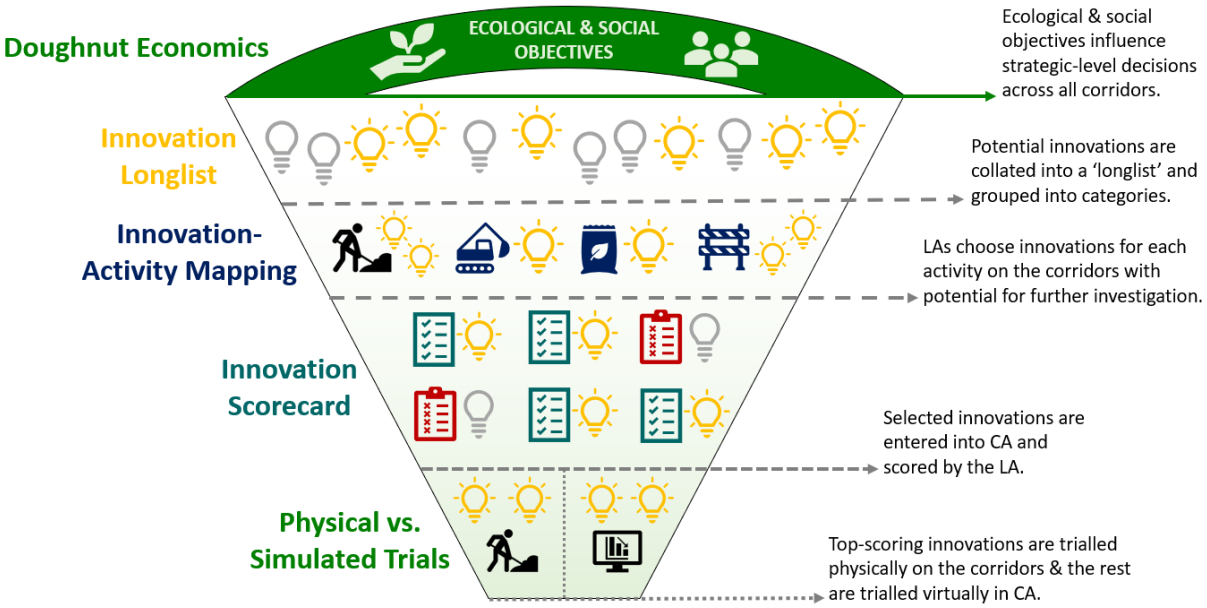


Figure 3: *Innovation Funnel illustrating the process of innovation selection and scoring.*

As shown in **Figure 4**, the five top-scoring innovations were as follows:

- **Hardstone aggregates from back-hauled RAP – 72.2** (the joint most sustainable innovation)
- **Ex-situ asphalt recycling (mobile plant) – 61.8**
- **KielyLock** – 57.9
- **Drone for inspections** – 53.7 (the most attractive innovation)
- **EV fleet for verge maintenance** – 51.7 (the joint most sustainable innovation)

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Note that these scores are based upon the assessment of the Live Labs team, and are only intended to be a comparative indicator of the expected environmental performance and desirability of each innovation within the context of the Live Labs 2 trials in Somerset.

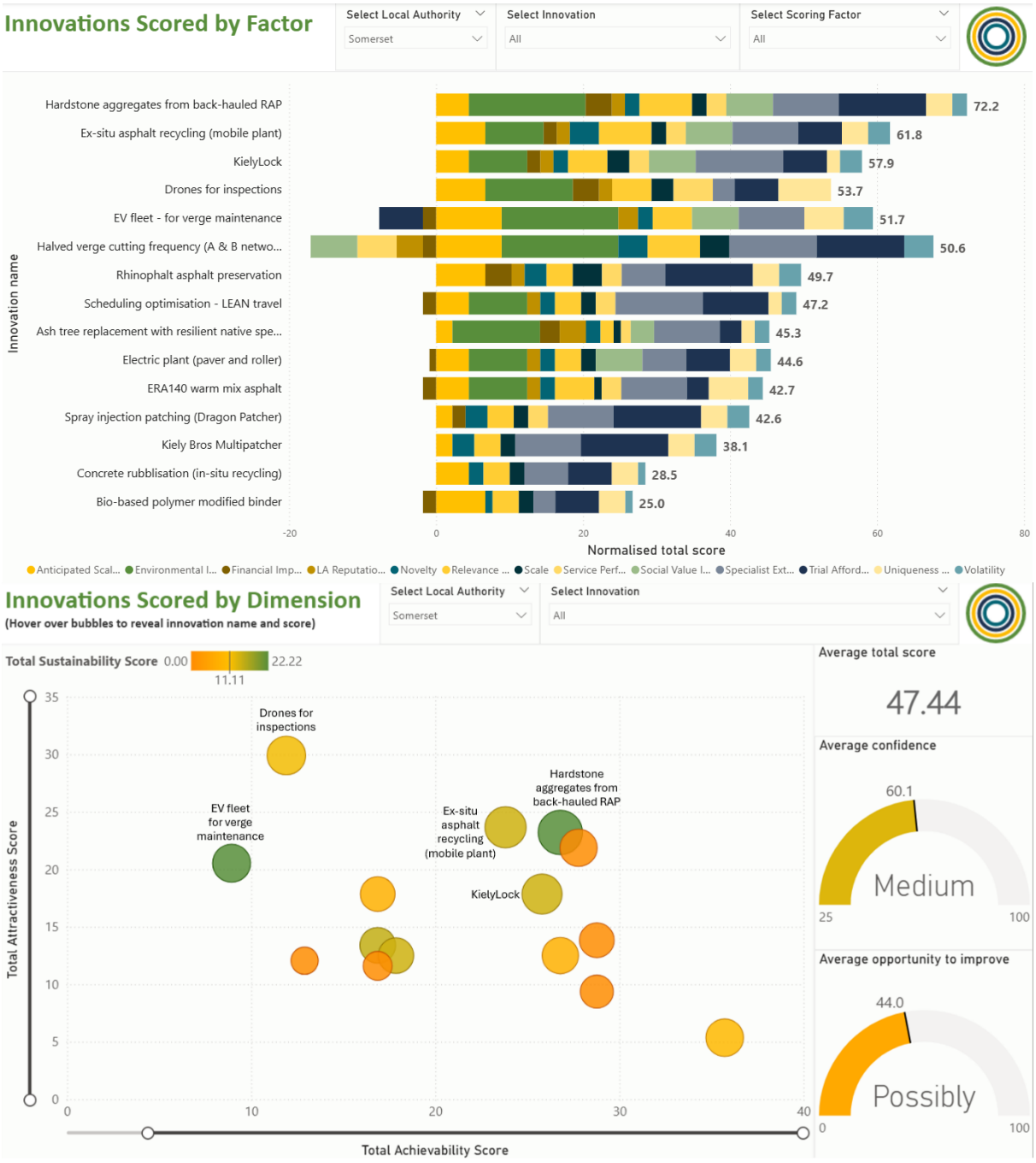


Figure 4: *Innovations scored by each of the 13 scoring factors (top) and 3 dimensions (bottom).*

2 CARBON HOTSPOT STUDIES

Identifying the highest-carbon items and activities - or 'carbon hotspots' - within Somerset Council's carbon baseline is vital for determining which aspects of the Highways maintenance service should be prioritised for decarbonisation, allowing for more cost-effective allocation of budgetary and operational resources. At full-service level, purchased Products & Services were the highest-carbon inventory, comprising 89% of the total carbon baseline. Within this, materials were the greatest

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carbon hotspot at 79% of the Products & Services inventory, with the highest-carbon materials being asphalt at 33% of the inventory, steel at 19%, plastic at 13%, and concrete at 10%. Combusted fuels also made a notable contribution to the carbon baseline at 17% of the Products & Services inventory, with the highest-carbon fuel being fuel oil at 10%, as shown in **Figure 5.**

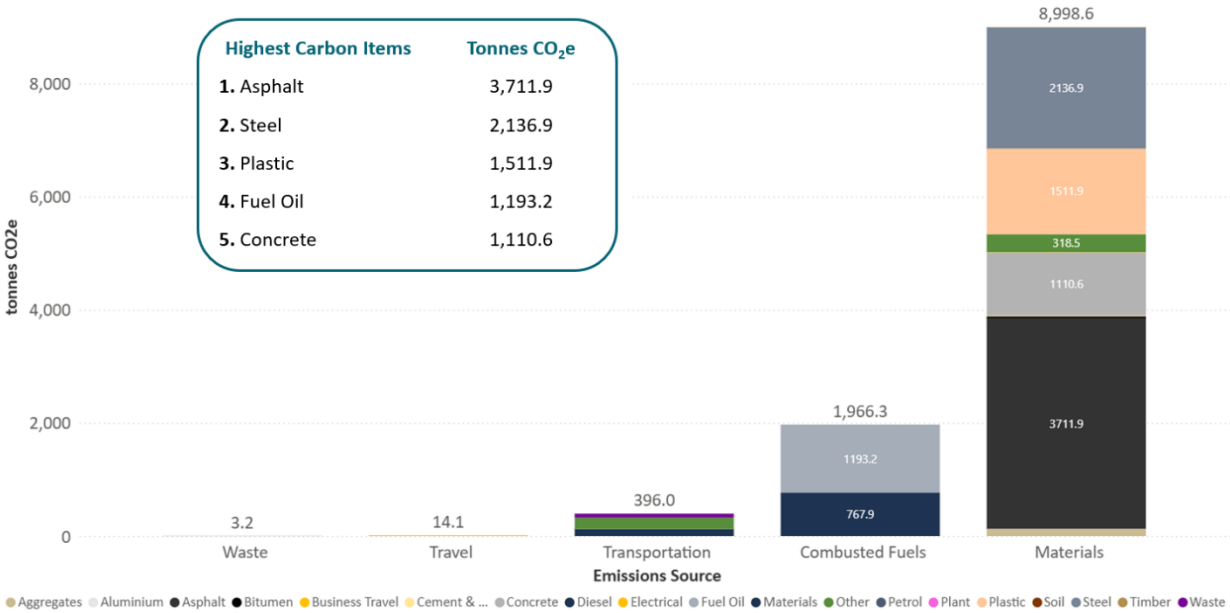


Figure 5: *Breakdown of carbon emissions within the Products & Services inventory.*

At corridor level under the BAU scenario, planned maintenance was the highest-carbon maintenance type for all three corridors, at 99% of the baseline for the A38; 66% for the B3139; and 99.6% for the Comeytrowe corridor. Carriageway resurfacing was the highest-carbon activity on the A38, at 41% of the baseline; asphalt preservation on the B3139 at 66% of the baseline; and footway reconstruction on the Comeytrowe corridor at 53% of the baseline. The majority of emissions associated with each activity came from material usage, with asphalt accounting for 47% of the A38 baseline and 52% of the Comeytrowe baseline, whilst bitumen accounted for 42% of the B3139 baseline. **Figure 6.** summarises the breakdown of carbon sources for all three corridors combined, with 40% of emissions coming from carriageway resurfacing; 69% from materials; and 47% from asphalt.

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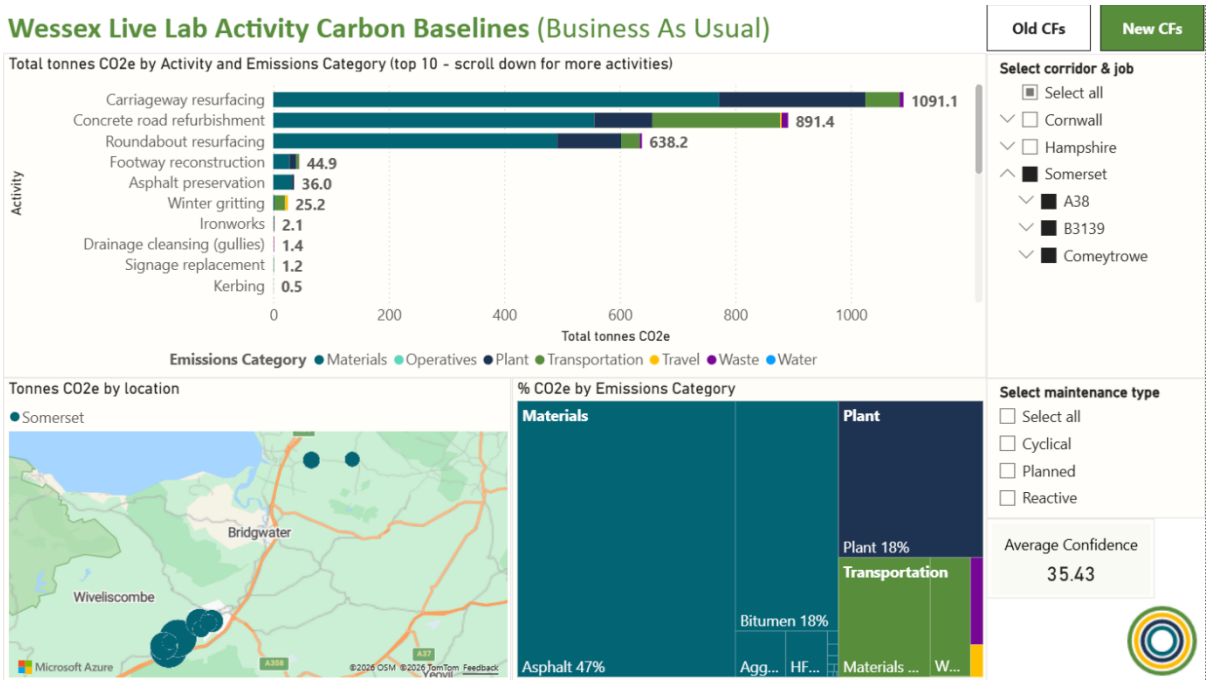


Figure 6: *Breakdown of carbon emissions sources for each activity on the three corridors.*

3 CARBON BASELINES AND EXPERIMENTAL PROFILES

3.1 FULL-SERVICE CARBON BASELINE

Following the update of the carbon factors for bituminous materials, the full-service carbon baseline for Somerset's highways maintenance service in 2022-23 was 12,840.1 tCO_2e, which is roughly equivalent to 12,400 passengers taking a one-way flight from London to New York.[2] Normalised by network length, this equates to approximately 1.95 tCO_2e per km of Somerset's local Highways network. Products & Services was the highest-carbon inventory at 89% of the total baseline, followed by Vehicles & Plant at 9%; Premises & Sites at 2%; and Staff & Contractors at 1% (**Figure 7.**). The majority (92%) of emissions were attributable to the Tier 1 contractors M Group, with 5% being directly attributable to Somerset Council and 3% to the Tier 2 subcontractors Wainwright.

[2] Assuming distance from Gatwick to JFK airport is approximately 5583.74 miles, using 2025 DESNZ/DEFRA carbon factor for a long-haul flight for an average passenger.

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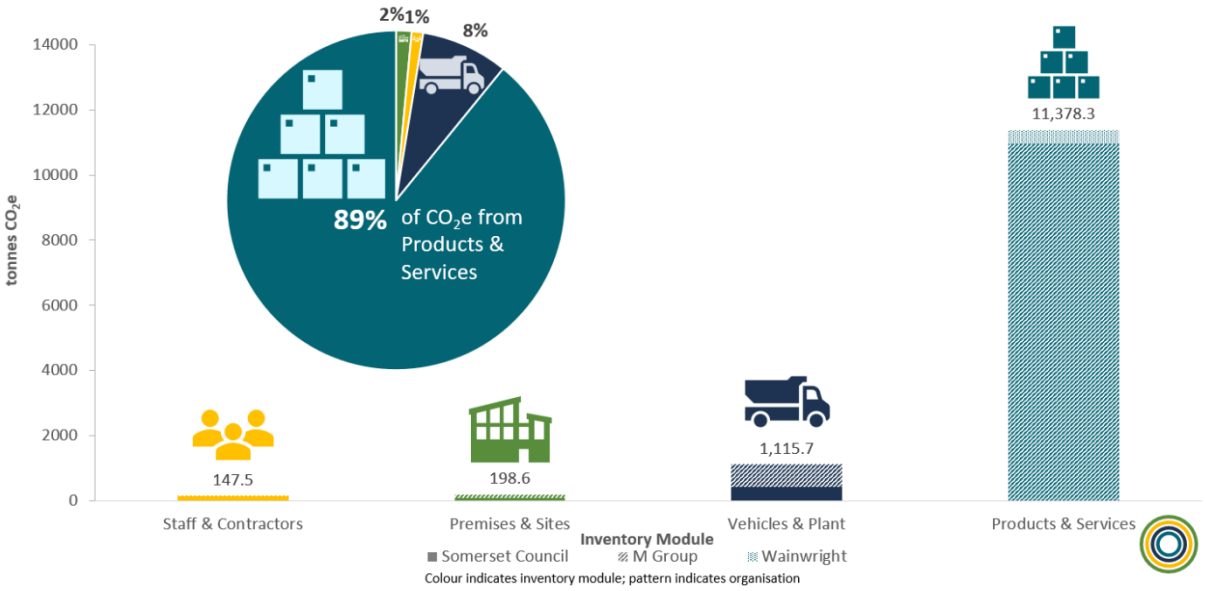


Figure 7: *Full-service carbon baseline for Somerset Council's Highways maintenance service, 2022-23.*

Staff & Contractors accounted for 147.5 tCO_2e of emissions, of which 46% were from commuting, 49% from home working, and 5% from business travel. Note, however, that additional business mileage claims which could not be attributed to a single survey respondent were allocated to Products & Services, as recommended by the FHRG. As the majority (47%) of the 76 survey respondents commuted to work using a private car, these were the largest source of commuting emissions at 58.9 tCO_2e, of which 38.4 tCO_2e came from diesel cars (**Figure 8.**).

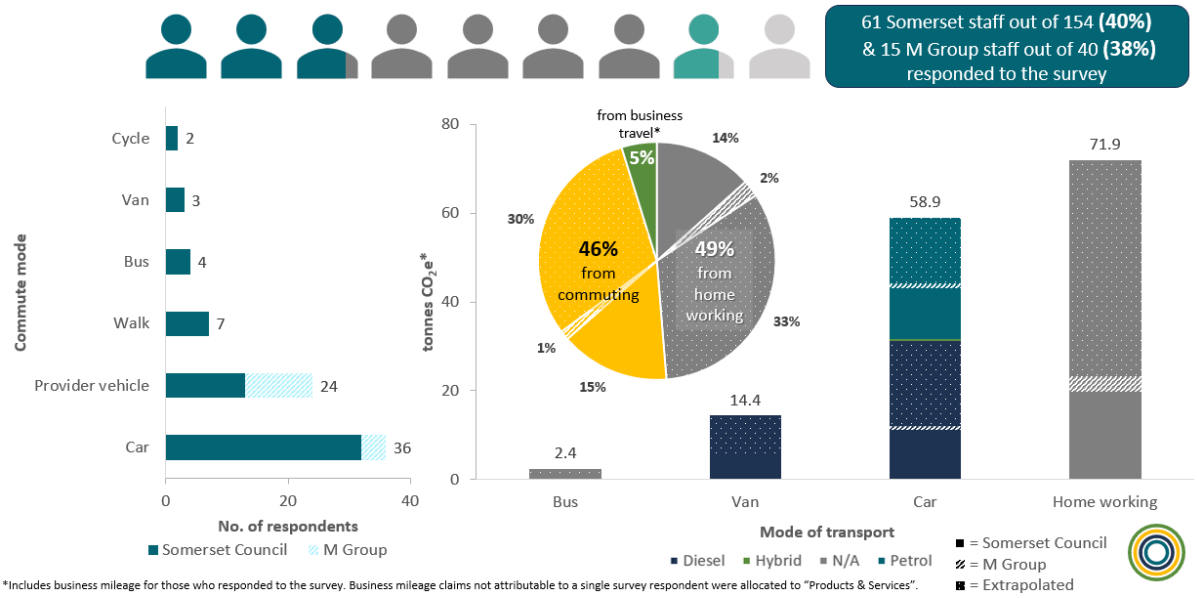
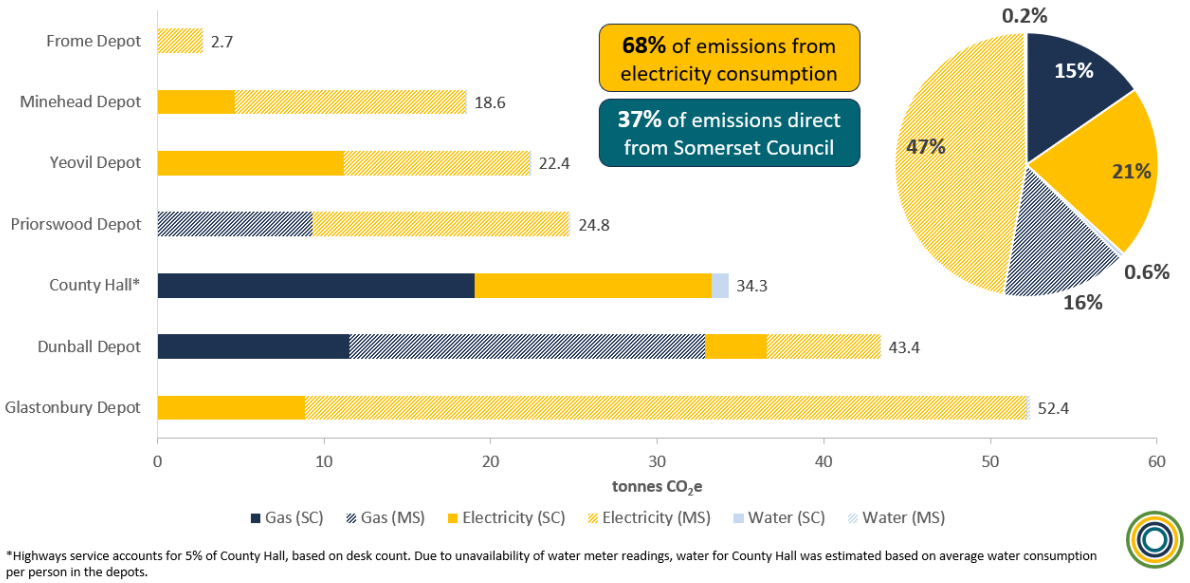


Figure 8: *Breakdown of carbon emissions from the Staff & Contractors inventory.*

Premises & Sites accounted for 198.6 tCO_2e of emissions, of which 68% were from electricity consumption, 31% from natural gas, and 1% from water. The majority of emissions (52.4 tCO_2e) came from Glastonbury Depot, due to this depot having the highest electricity consumption rate. 63% of emissions from Premises & Sites were attributable to M Group, whilst 37% were directly attributable to Somerset Council (**Figure 9.**).

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*Highways service accounts for 5% of County Hall, based on desk count. Due to unavailability of water meter readings, water for County Hall was estimated based on average water consumption per person in the depots.

Figure 9: *Breakdown of carbon emissions from the Premises & Sites inventory.*

Vehicles & Plant accounted for 1,115.7 tCO_2e of emissions, of which 93% came from diesel, 4% from HVO, 2% from petrol, and 1% from hybrids. Pool vans were the main source of emissions at 339.8 tCO_2e. Approximately 38% of emissions were directly attributable to Somerset Council vehicles, with the remaining 61% coming from M Group vehicles and plant (**Figure 10.**).

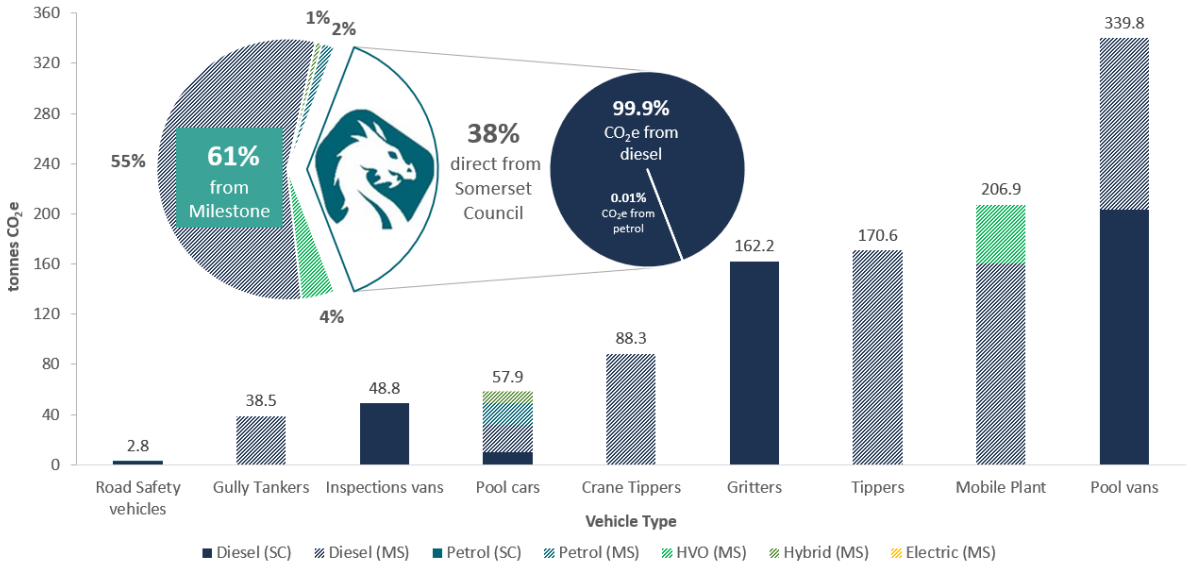


Figure 10: *Breakdown of carbon emissions from the Vehicles & Plant inventory.*

Products & Services accounted for 11,378.3 tCO_2e of emissions, of which 79% came from materials, 17% from combusted fuels, 3% from transportation, 0.1% from business travel, and 0.03% from waste. Asphalt was the top carbon hotspot at 3,711.9 tCO_2e, followed by steel at 2,136.9 tCO_2e, plastic at 1,511.9 tCO_2e, fuel oil at 1,193.2 tCO_2e, and concrete at 1,110.6 tCO_2e (**Figure 11.**).

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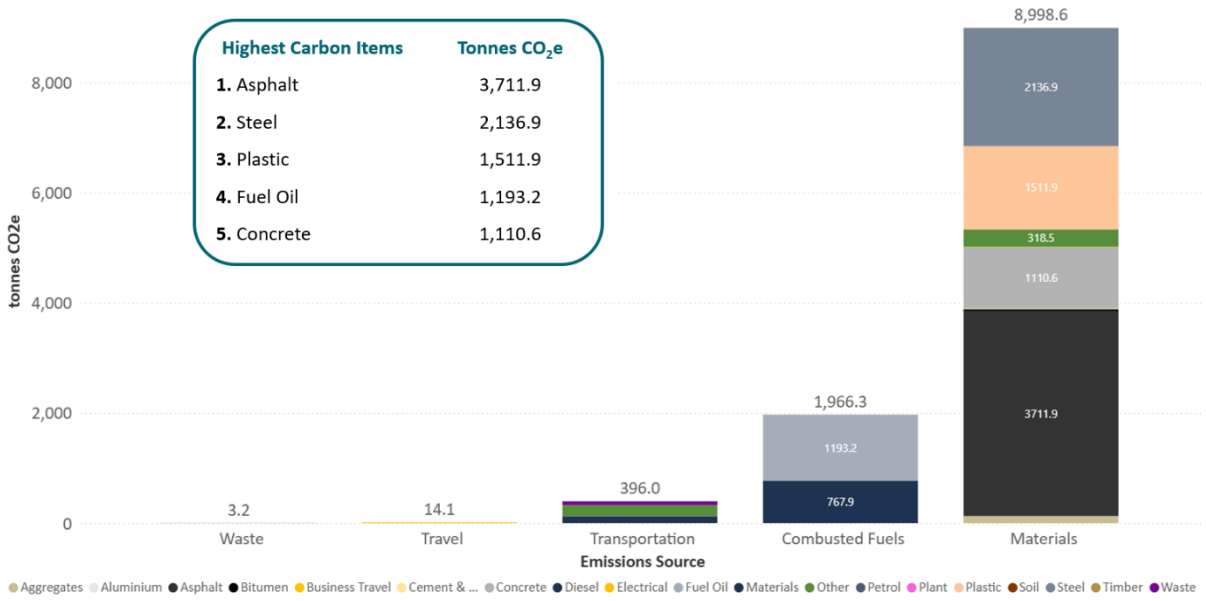


Figure 11: *Breakdown of carbon emissions from the Products & Services inventory.*

3.2 CORRIDOR CARBON BASELINES

In the BAU scenario, the A38 was the highest-carbon corridor at 2,637.7 tCO_2e, followed by the Comeytrowe corridor at 84.1 tCO_2e and the B3139 at 54.3 tCO_2e. When normalised by corridor length, this equates to approximately 149.0 tCO_2e/km for the A38, 26.3 tCO_2e/km for the Comeytrowe corridor, and 2.2 tCO_2e/km for the B3139 (**Figure 12.**).

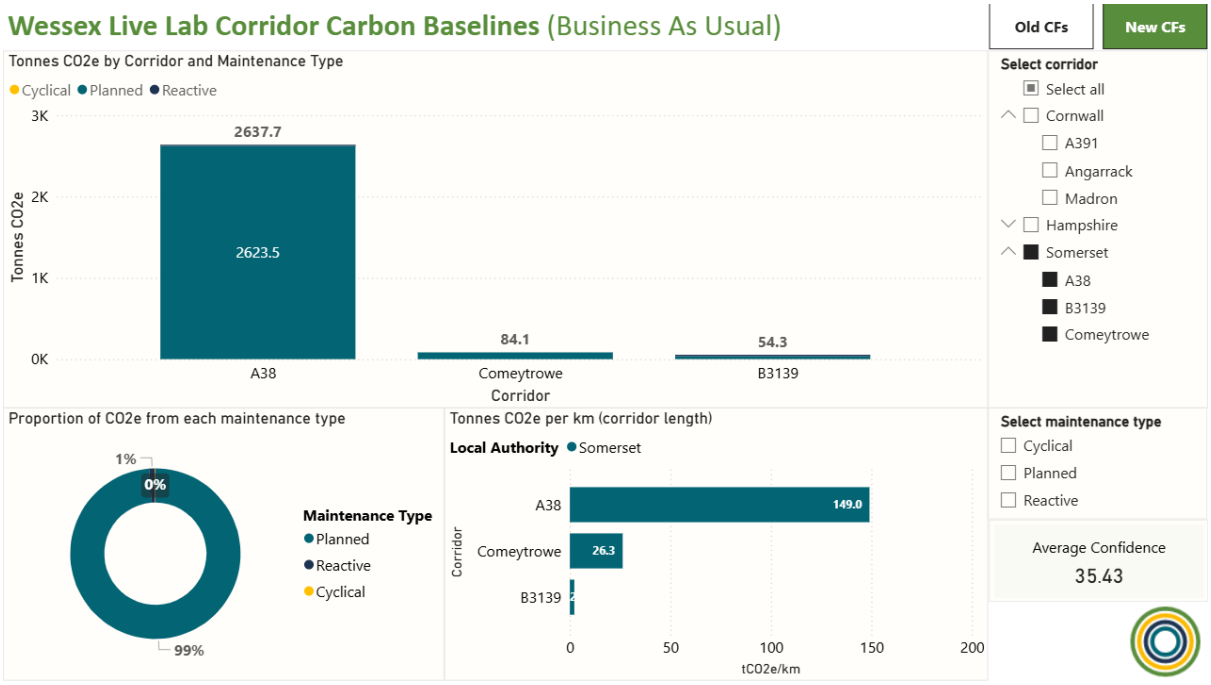


Figure 12: *Corridor-level carbon baselines for the A38, B3139, and Comeytrowe corridors.*

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On the **A38** corridor, 99% of emissions came from planned maintenance, with 0.5% from reactive maintenance and 0.02% from cyclical maintenance. 1,732.1 tCO_2e (66%) of emissions came from resurfacing works - including 1,085.5 tCO_2e (41%) from carriageway resurfacing from Cann Street to Park Street and Rumwell to Chelston, and 646.6 tCO_2e (25%) from roundabout resurfacing on the Wellington New Road roundabout and the Chelston and West Park roundabouts. A further 891.4 tCO2e (34%) of emissions came from concrete road refurbishment on the Chelston Link Road and Junction 26 of the M5. At emissions category level, 70% of emissions came from materials, 17% from plant, 12% from transportation, 1% from waste, and 0.2% from travel. The majority of the emissions from materials came from asphalt, which accounted for 48% of the baseline (**Figure 13.**).

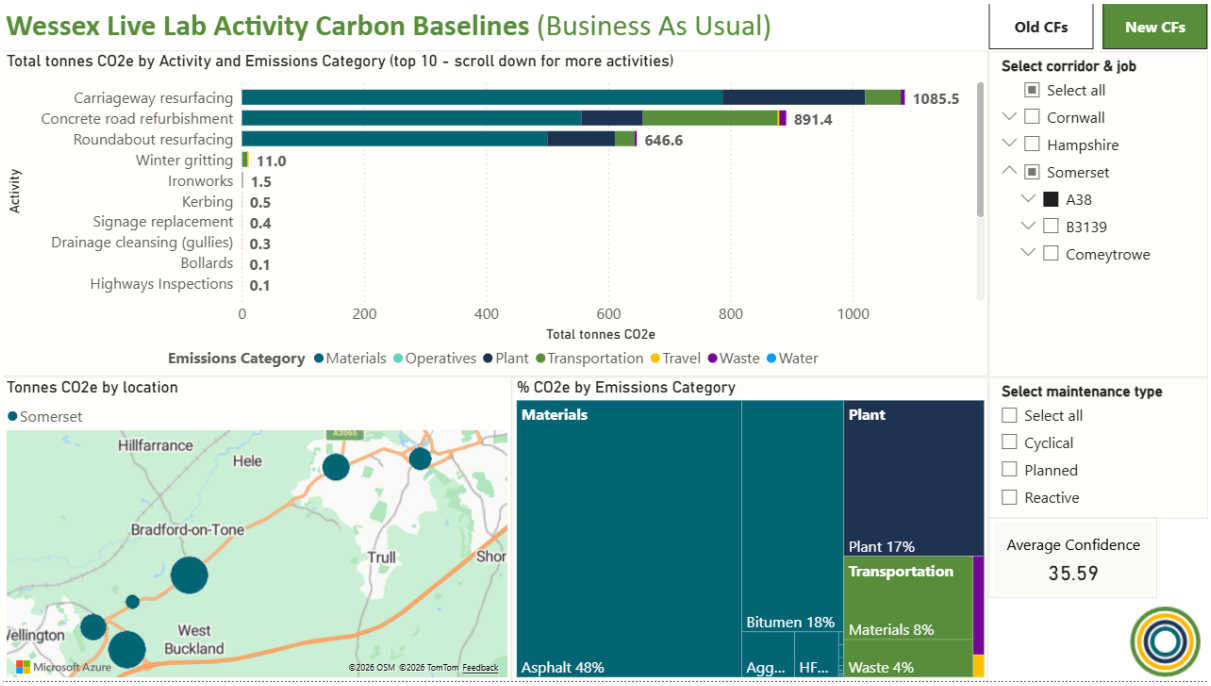


Figure 13: *Breakdown of carbon emissions at activity and category level for the A38 corridor.*

On the **B3191** corridor, 66% of emissions came from planned maintenance, with 32% from reactive maintenance and 2% from cyclical maintenance. 36.0 tCO_2e (66%) of emissions came from asphalt preservation on the Mark Causeway, whilst 14.2 tCO_2e (26%) of emissions came from winter gritting. At emissions category level, 65% of emissions came from materials, 19% from transportation, 8% from plant, 6% from travel, 1% from waste, and 0.03% from operatives. The majority of the emissions from materials came from bitumen, which accounted for 42% of the baseline (**Figure 14.**).

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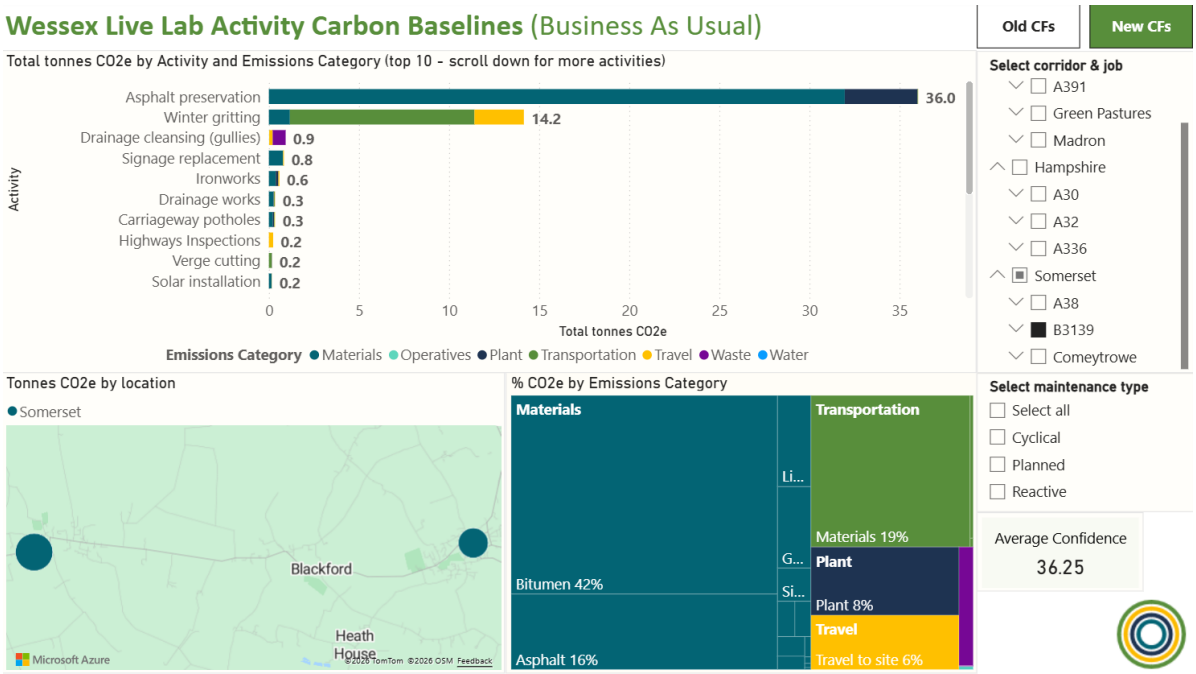


Figure 14: Breakdown of carbon emissions at activity and category level for the B3139 corridor.

On the **Comeytrowe** corridor, 99.6% of emissions came from planned maintenance, with 0.2% from reactive maintenance and 0.2% from cyclical maintenance. 44.8 tCO_2e of emissions came from footway reconstruction on the Queensway, whilst 38.7 tCO_2e of emissions came from carriageway resurfacing (as a theoretical baseline alternative to microsurfacing) on Parkfield Road. At emissions category level, 55% of emissions came from materials, 38% from plant, 7% from transportation, 0.6% from waste, 0.2% from travel, and 0.03% from operatives. The majority of the emissions from materials came from asphalt, which accounted for 52% of the baseline (**Figure 15.**).

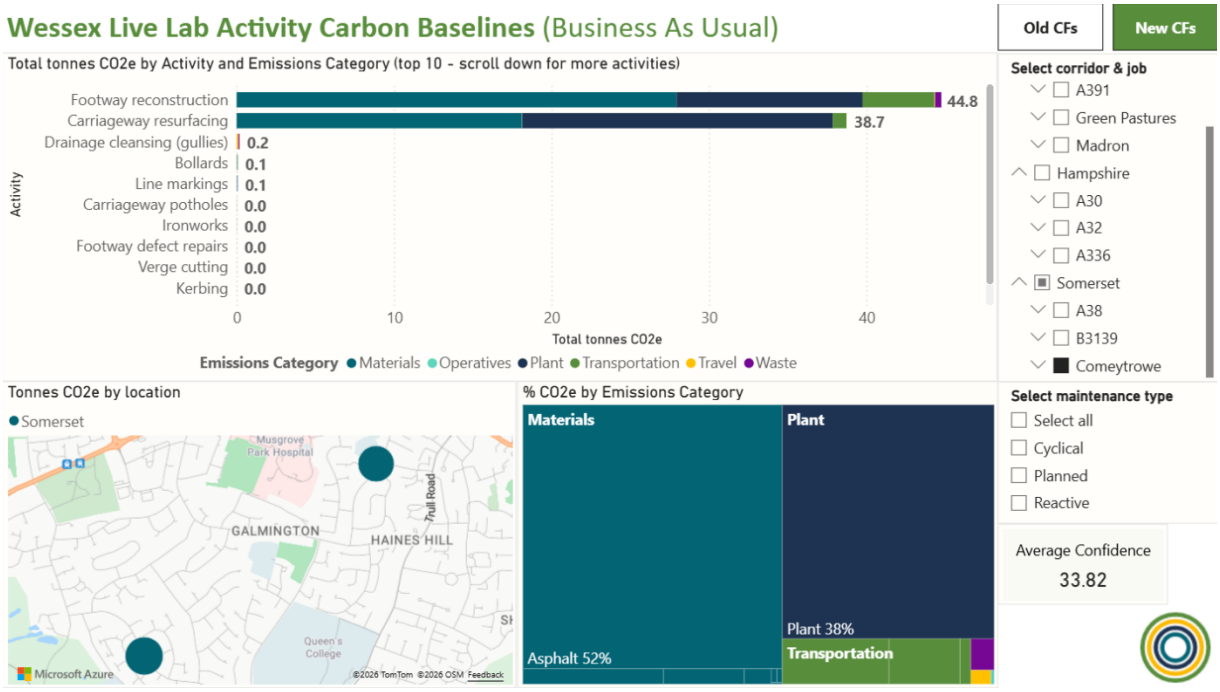


Figure 15: *Breakdown of carbon emissions at activity and category level for the Comeytrowe corridor.*

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3.3 EXPERIMENTAL PROFILES

Overall, the experimental carbon profiles for Somerset's three corridors indicate that a total of 398.8 tCO_2e (14%) were saved across all three corridors. Whilst this falls short of the hypothetical 30% saving estimated in the Strategic Outline Business Case, two corridors did exceed this benchmark: the B3139 at 32% and the Comeytrowe corridor at 68%. Furthermore, had all of the potential innovations identified been implemented on the corridors, a saving of up to 850.5 (31%) could have been achieved across all three corridors, as shown in **Table 2** and **Figure 16**. At full-service level, an additional saving of approximately 49.0 tCO_2e per year is expected to come from the transition from a domain-based system to a route-based system for winter maintenance. To avoid double counting, this has not been included in the total saving, as a proportion of this saving has been assigned to the A38 and B3139 corridors based on the proportion of the P1 gritting network they cover.

Table 2: *Summary of the physical carbon savings achieved and simulated carbon savings achievable on each of the three corridors and maintenance types.*

Corridor	Physical carbon saving		Simulated carbon saving	
	tCO_2e	% of BAU	tCO_2e	% of BAU
A38	337.7	13%	760.3	29%
B3139	17.2	32%	23.3	43%
Comeytrowe	57.0	68%	66.9	80%
Maintenance type	tCO_2e	% of BAU	tCO_2e	% of BAU
Planned	408.4	15%	841.7	31%
Reactive	3.5	11%	8.2	26%
Cyclical	0.0	0%	0.7	43%
Total	**411.9**	**15%**	**850.5**	**31%**

Due to the predominance of carbon emissions from planned maintenance activities, this was the source of 99% of both physical and simulated carbon savings across all three corridors, with only 1% of physical carbon savings being attributable to changes in reactive maintenance activities and 0% to changes in cyclical maintenance activities (**Figure 16.**).

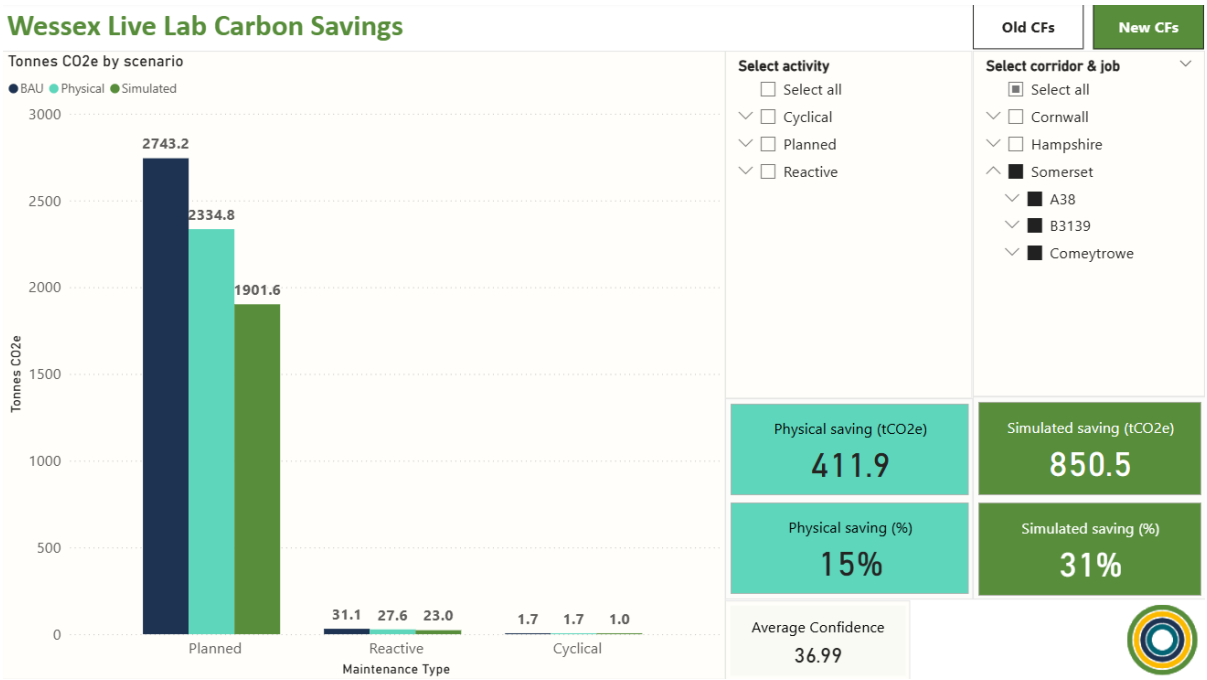


Figure 16: *Total physical and simulated carbon savings from planned, cyclical, and reactive maintenance activities across the three corridors.*

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On the **A38 corridor**, the majority (238.3 tCO_2e) of physical carbon savings came from concrete rubblisation on the Chelston link road and Junction 26 of the M5. Compared to the baseline approach of removing the existing concrete and replacing it with a virgin aggregate subbase, this delivered a 27% carbon saving. Had HVO (hydrotreated vegetable oil) been used instead of diesel for the vehicles & plant - and had warm mix asphalt (WMA) with a biogenic binder been used for resurfacing instead of hot mix asphalt - this carbon saving could have increased to 578.6 tCO_2e (65%), as shown in **Figure 17**. As the surface of the carriageway will no longer be concrete, the rubblisation process will not need to be carried out again, so the long-term carbon savings over a 40-year lifespan will only be influenced by the longevity of the asphalt used for resurfacing. Assuming that this will need to be resurfaced every 15-25 years (estimated approx. 15-22 years for WMA with biobinder), the 40-year carbon savings would be approx. 476.5 tCO_2e (27%), or 844.4 tCO_2e (47%) with HVO and WMA with biobinder.

These higher-saving scenarios are useful in showing the further decarbonisation potential of the approaches trialled, but they also reflect practical delivery constraints at the time of the schemes. The use of HVO, warm mix asphalt and bio-based binders was influenced by a combination of product availability, supplier readiness, specification acceptance, cost certainty, programme constraints, plant compatibility, and confidence in long-term performance under live network conditions. A key learning from the Somerset trials is therefore that maximising carbon savings depends not only on identifying lower-carbon products, but also on addressing the commercial, technical and programme barriers that determine whether those products can be adopted at scale.

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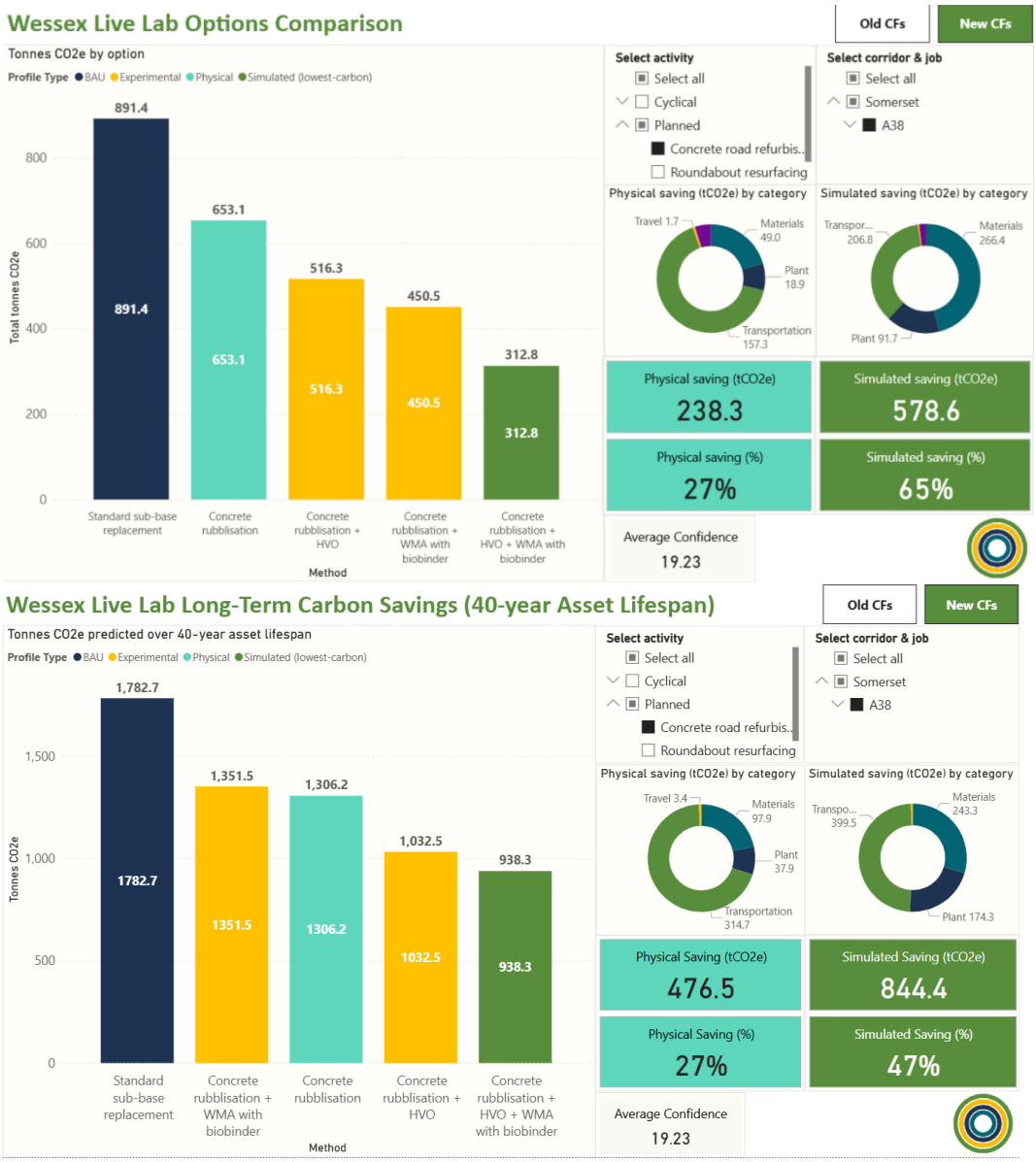


Figure 17: *Comparison between BAU, physical, experimental, and simulated carbon profiles for the concrete road refurbishment scheme on the Chelston link road and J26 of the M5, including upfront carbon emissions (top) and over a 40-year asset lifespan (bottom).*

A smaller saving of 97.9 tCO_2e (6%) was also achieved across four resurfacing schemes, including:

- 5.5 tCO2e (2%) from West Park Roundabout to Chelston Roundabout (RS006013) through the use of ERA140 Tufflex) with back-hauled RAP and bio-binder (**Figure 18.**).
- 18.8 tCO_2e (6%) on Wellington New Road Roundabout (PR001001) through the use of ERA140 Tufflex) with back-hauled RAP and bio-binder, along with a small electric paver and roller (**Figure 19.**).
- 7.2 tCO_2e (4%) from Cann Street to Park Street (DFT001001) through the use of ERA140 Tufflex with hardstone RAP and bio-binder, along with an electric paver and roller (**Figure 20.**).
- 53.3 tCO_2e (6%) from Rumwell to Chelston (DFTCR001001) through the use of a warm mix polymer-modified asphalt (ERA140 Tufflex) with back-hauled hardstone RAP and bio-binder (**Figure 21.**).

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Had all of these innovations been applied to all four schemes, the total carbon saving would have increased to 177.8 tCO_2e (10%). In the long term, assuming that polymer-modified asphalt has a 40% longer lifespan than standard SMA, the 40-year carbon saving would be approximately 195.8 tCO_2e (6%), or 355.5 tCO_2e (10%) with all innovations applied to all four schemes.

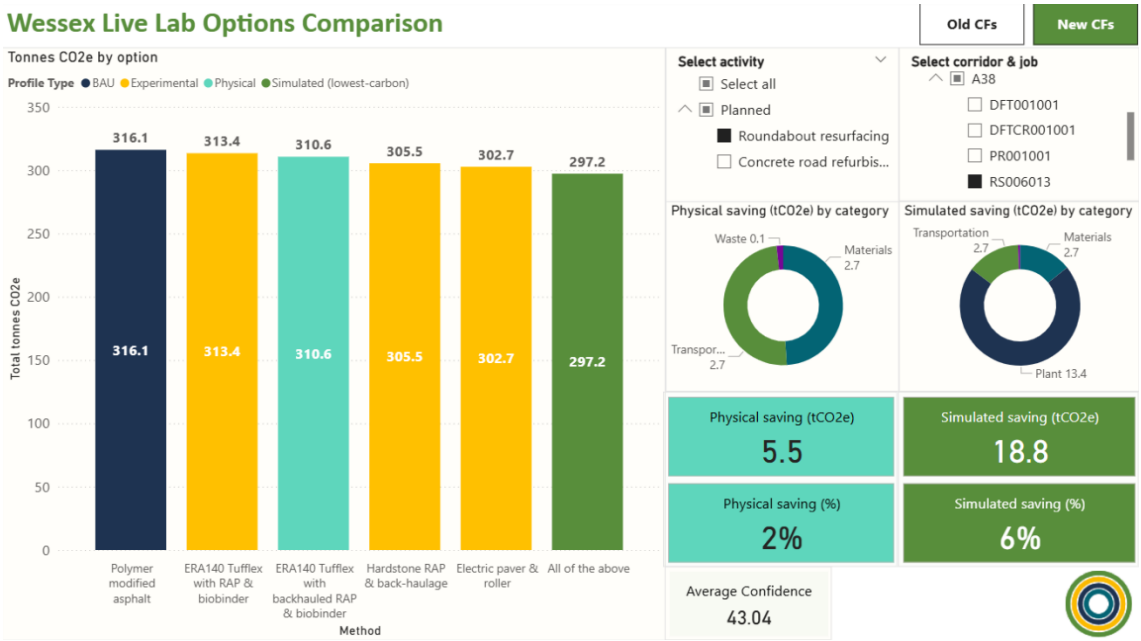


Figure 18: *Comparison between BAU, physical, experimental, and simulated carbon profiles for the roundabout resurfacing scheme from West Park to Chelston Roundabout (RS006013).*

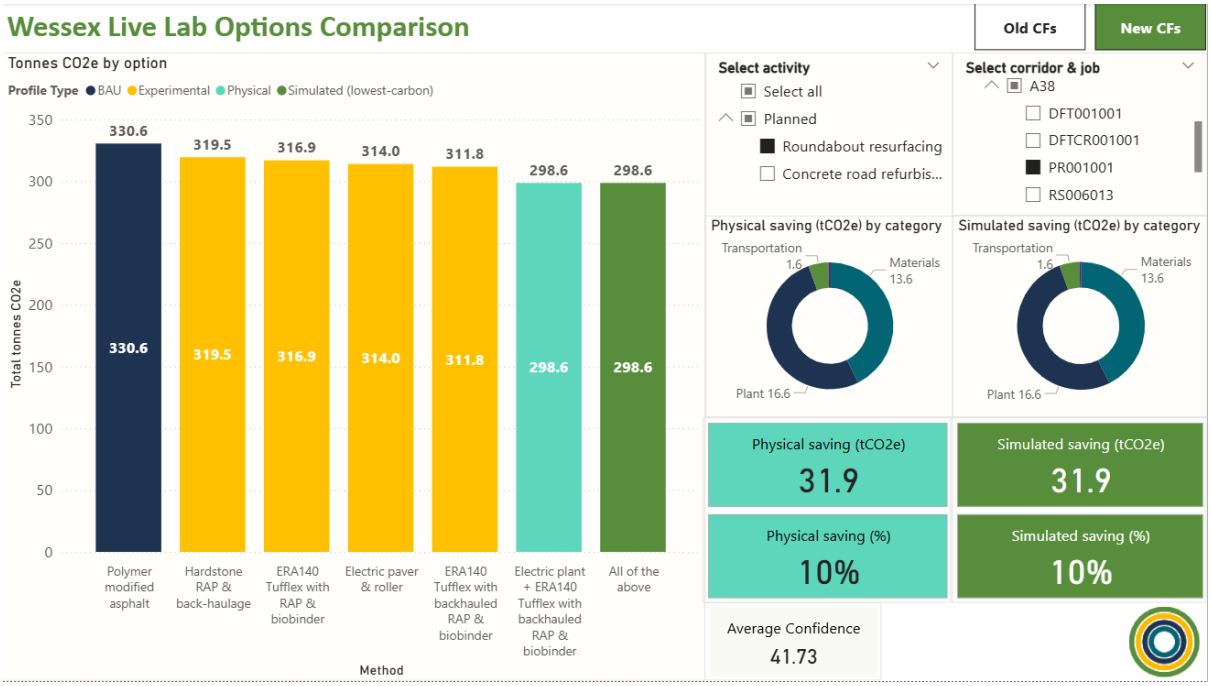


Figure 19: *Comparison between BAU, physical, experimental, and simulated carbon profiles for the roundabout resurfacing scheme on Wellington New Road Roundabout.*

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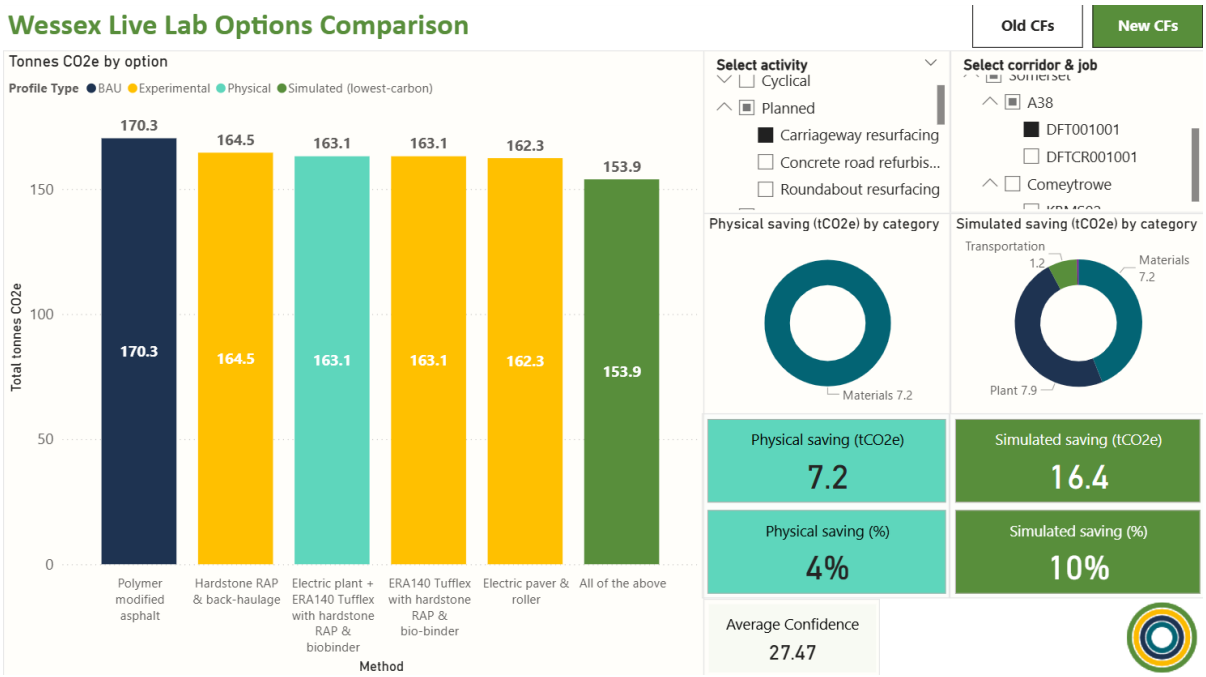


Figure 20: *Comparison between BAU, physical, experimental, and simulated carbon profiles for the carriageway resurfacing scheme on Cann Street & Park Street.*

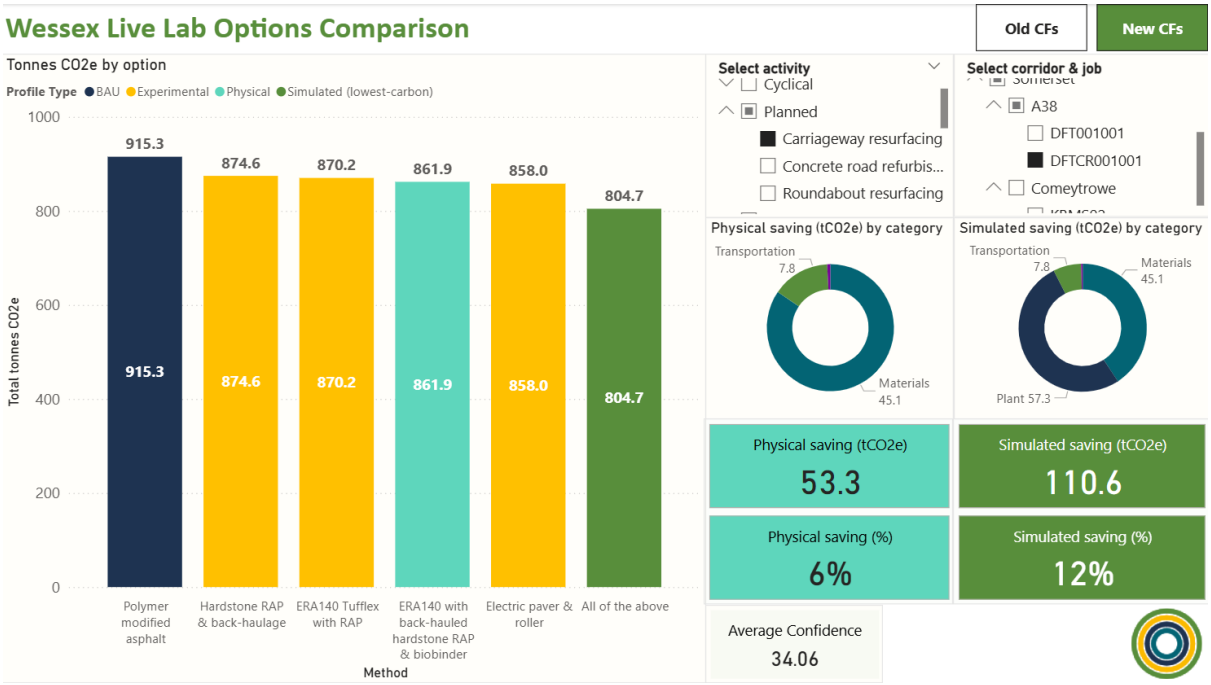


Figure 21: *Comparison between BAU, physical, experimental, and simulated carbon profiles for the carriageway resurfacing scheme from Rumwell to Chelston.*

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On the **B3139 corridor**, the majority (15.2 tCO_2e) of physical carbon savings came from the use of the asphalt preservation system Rhinophalt on the Mark Causeway, delivering a 42% carbon saving compared to the double-layer surface dressing R10 Maintrain finished with the chip encapsulation system Kielylock. Had HVO been used instead of diesel for the vehicles and plant, with cold-applied MMA instead of hot-applied thermoplastic line markings, this saving could have increased to 18.5 tCO_2e (51%). Assuming a 10-year lifespan for Maintrain with KielyLock (stated by the RSTA to be a typical lifespan for a double-layer locked surface dressing), and 5-7 years for Rhinophalt[3], the 40-year carbon savings would range from -1.5 tCO_2e (-1%) with hot thermoplastic line markings and diesel vehicles & plant, to 21.7 tCO_2e (15%) with MMA line markings and HVO (**Figure 22.**). However, this only accounts for future applications of Rhinophalt – not for any subsequent resurfacing works, although Rhinophalt may also increase the lifespan of the carriageway surface itself by up to 100%[4].

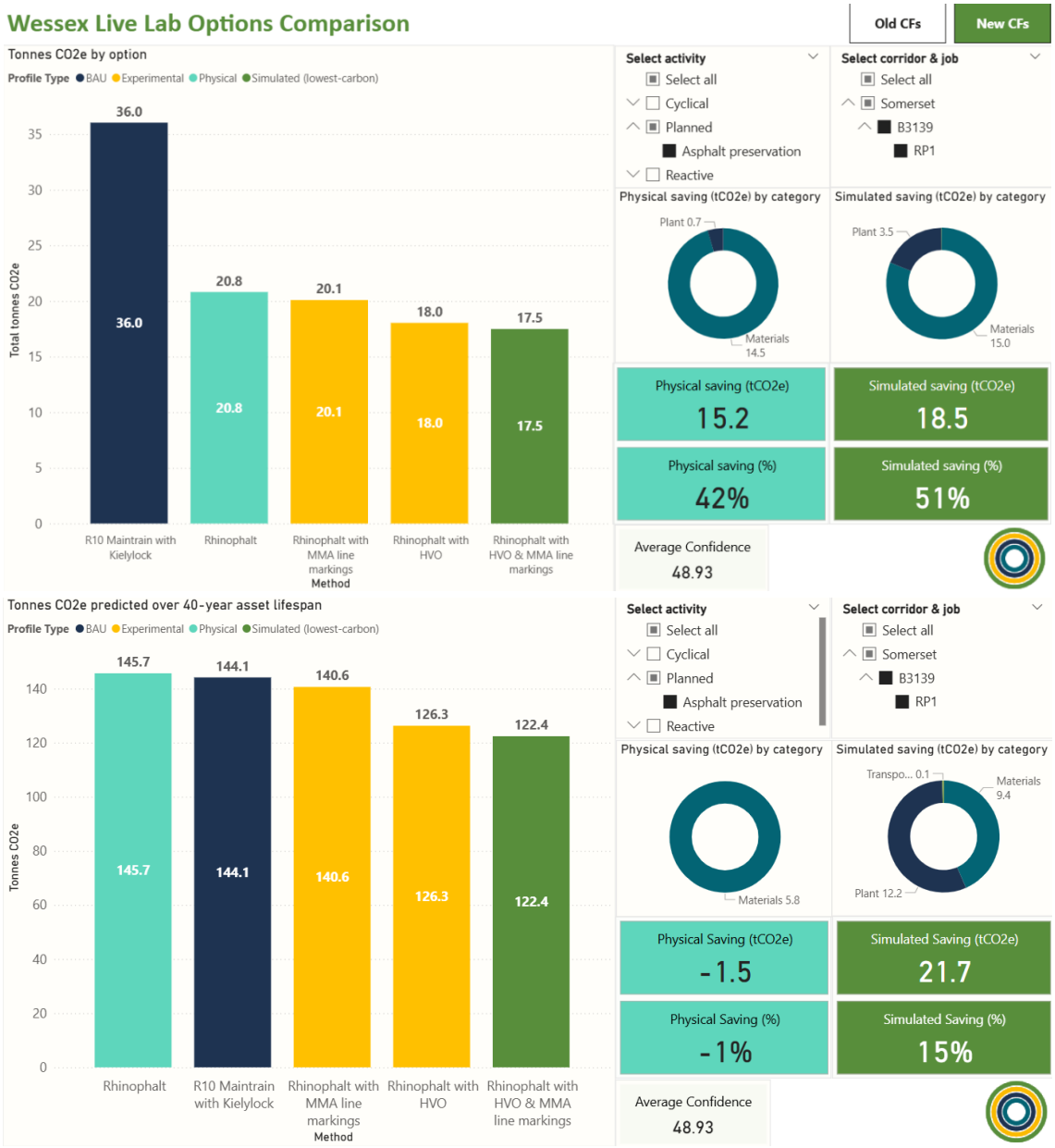


Figure 22: *Comparison between BAU, physical, and simulated carbon profiles for the asphalt preservation scheme on the Mark Causeway, including upfront carbon emissions (top) and over a 40-year asset lifespan (bottom).*

[3] https://asisolutions.co.uk/how-often-should-i-re-apply-rhinophalt-asphalt-preservative/
[4] https://asisolutions.co.uk/rhinophalt-asphalt-preservation/

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On the **Comeytrowe corridor**, the majority (30.6 tCO_2e) of physical carbon savings came from the use of microsurfacing on Parkfield Road, delivering a 79% carbon saving compared to standard carriageway resurfacing. Had HVO been used instead of diesel for the vehicles and plant, this saving could have increased to an estimated 31.6 tCO_2e (81%). Assuming a lifespan of 20-25 years for standard carriageway resurfacing and 8-10 years for microsurfacing, the 40-year carbon savings would be approximately 153.1 tCO2e (79%), or 157.8 tCO2e (81%) with HVO (**Figure 23.**).

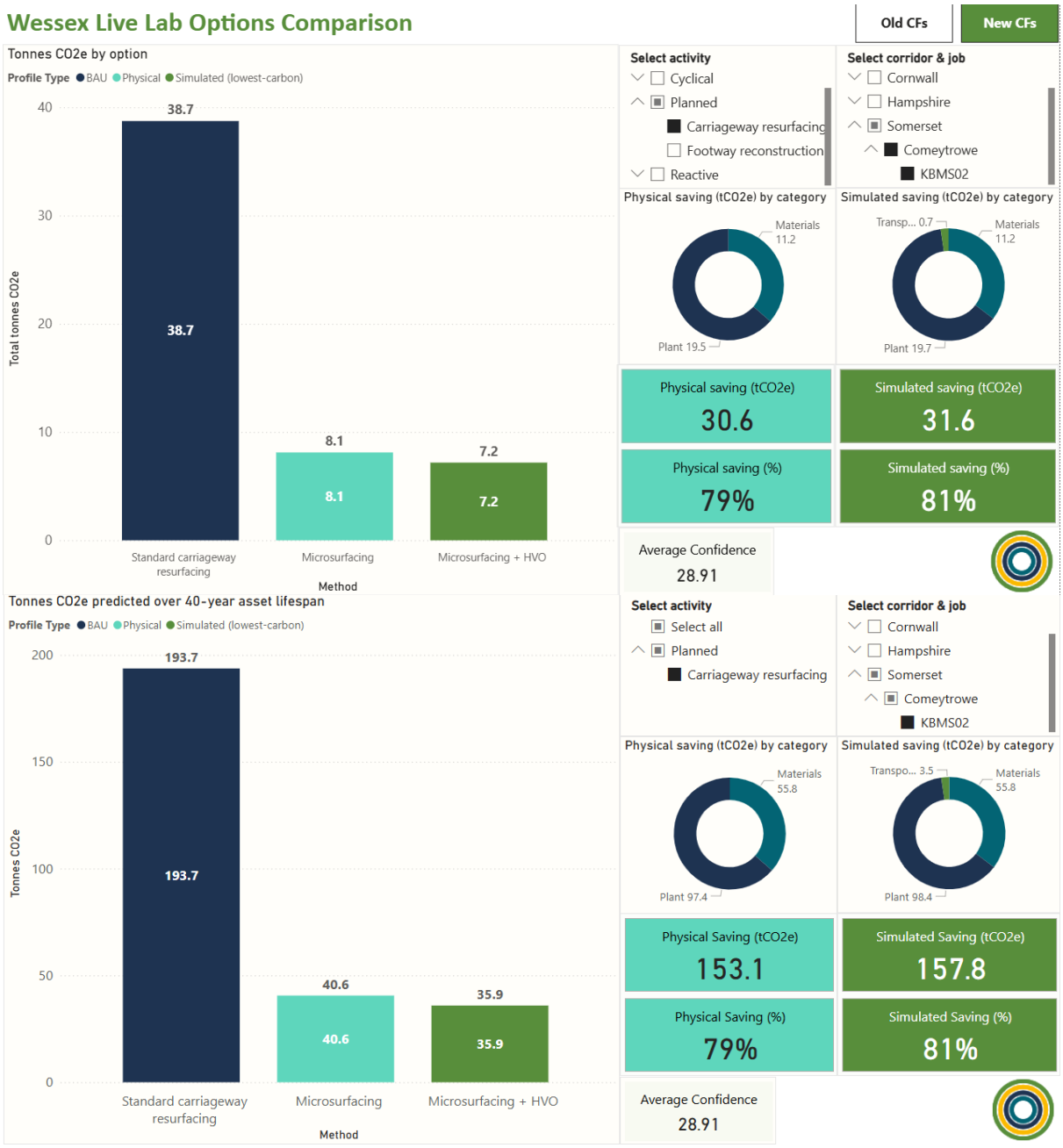


Figure 23: *Comparison between BAU, physical, and simulated carbon profiles for the microsurfacing scheme on Parkfield Road, including upfront carbon emissions (top) and over a 40-year asset lifespan (bottom).*

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A smaller carbon saving of 26.4 tCO_2e (59%) was also achieved on the Comeytrowe Queensway footway reconstruction scheme through the use of the single-layer surfacing solutions Bio Ultifastpath and Ultifastpath PMB, instead of a standard asphaltic concrete surface course and binder course. Stick-down tactile paving was also used instead of concrete tactiles, and HVO was used instead of diesel for the vehicles and plant. Had Warm Bio Ultifastpath been used instead, the carbon saving would have increased slightly to 26.9 tCO_2e (60%), or to 35.2 tCO_2e (79%) with the addition of ACLA at 5% of the asphalt mix content (**Figure 24.**). The comparative lifespan of each solution is not known with sufficient confidence to provide a 40-year carbon saving, but it is anticipated that the innovative materials selected will have a similar or greater lifespan compared to the BAU case.

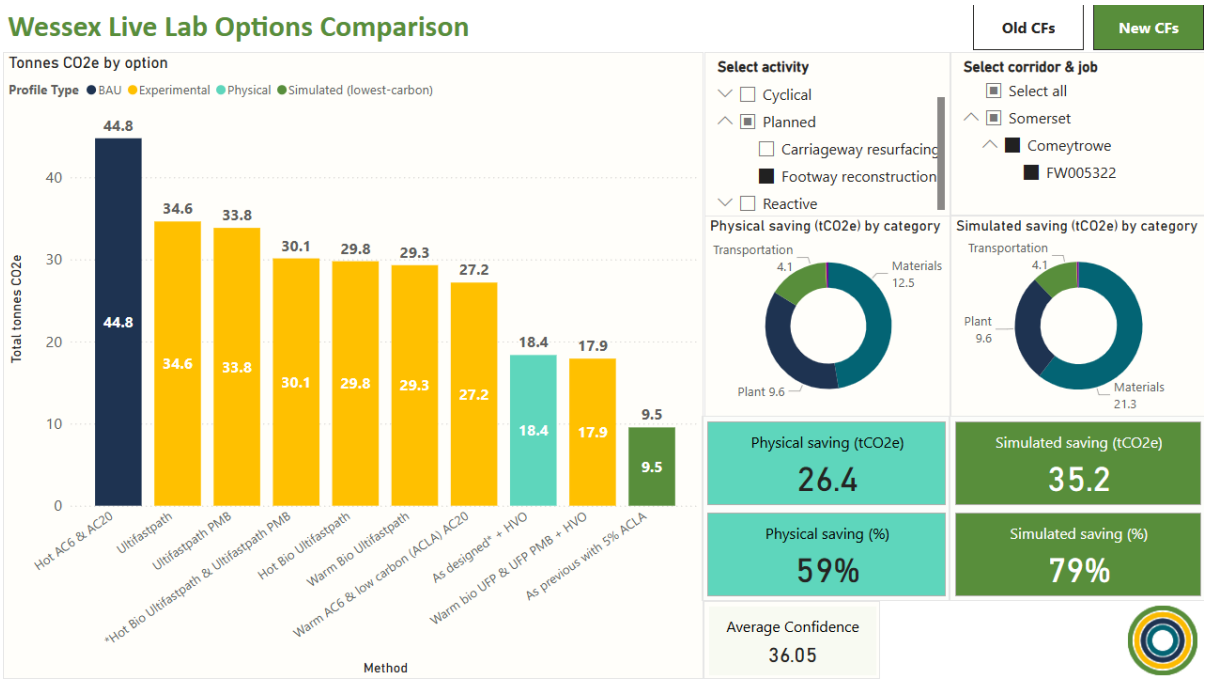


Figure 24: *Comparison between BAU, physical, experimental, and simulated carbon profiles for the footway reconstruction scheme on the Queensway at Comeytrowe.*

Across all three corridors, minor carbon savings were also achieved on reactive and/or cyclical maintenance activities. For example, the shift from a domain-based system to a route-based system for winter gritting is expected to result in a saving of approximately 12%-26% per year across Somerset Council's P1 gritting network, equating to a saving of 1.5 tCO_2e (14%) on the A38 and 2.0 tCO_2e (14%) on the B3139 (**Figure 25.**). In theory, this 3.5 tCO_2e saving could be increased to 6.6 tCO_2e (26%) with the use of electric gritters, as has been trialled in Hampshire. The Comeytrowe corridor is not included as part of the P1 gritting network.

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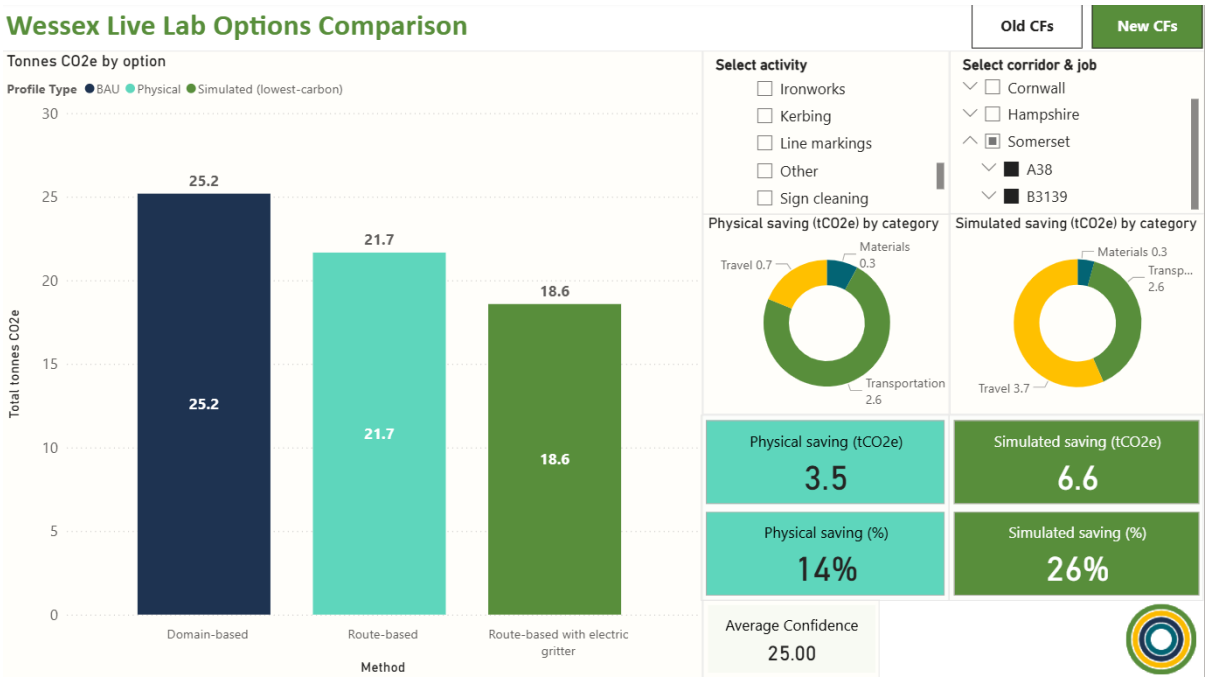


Figure 25: *Comparison between BAU, physical, and simulated carbon profiles for winter gritting on the A38 and B3139 corridors.*

4 INNOVATION

The Somerset trials deployed a suite of technological and operational interventions addressing the chemistry of materials, the physics of asset remediation, and the logic of municipal logistics.

Innovation within Somerset's programme combined material substitution, circular construction, programme redesign and operational change. The most significant engineering example was the refurbishment of the M5 Junction 26 and Chelston Link Road, where a deteriorated **51-year-old** concrete pavement was renewed using **rubblisation** rather than conventional excavation and full reconstruction. This retained approximately **7,300 tonnes of concrete** on site for reuse as sub-base, substantially reduced waste export and virgin aggregate demand, and avoided **more than 1,100 lorry movements** when compared with traditional methods. Where clearance constraints beneath the motorway bridges prevented standard rubblisation, materials were crushed and reused locally so that circularity could still be maintained across the scheme. The scheme delivered a verified physical saving of 238.3 tCO2e.

The same scheme also incorporated **ERA 140 warm-mix asphalt** technology for the base and binder course, enabling asphalt production at up to **40°C lower** than conventional hot mix and reducing manufacturing emissions by up to **15%**. Additional lower-carbon measures included the use of **Tufflex D surface course with 6 mm high-PSV aggregate**, the incorporation of **over 6,000 tonnes of recycled asphalt planings** into new asphalt mixes, and sourcing **more than 90% of asphalt volumes from within Somerset** to reduce haulage impacts. Together, these measures demonstrate how major highway reconstruction can combine asset reuse, lower-temperature asphalt production, recycled content and local sourcing within a live delivery environment.

Advanced Bio-Based Materials and Warm Mix Asphalt (WMA): On the Comeytrowe Queensway scheme, the project trialled 'Bio Ultifastpath' and 'Ultifastpath PMB'—single-layer surfacing solutions using biogenic binders derived from renewable biological feedstocks to replace hot-rolled bitumen. Coupled with circular haulage strategies to reuse site arisings, this delivered an aggressive 59% (26.4 tCO2e) absolute reduction in embodied carbon compared to traditional asphaltic concrete. On the

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A38, the use of warm mix polymer-modified asphalts (ERA140 Tufflex) incorporating back-hauled Reclaimed Asphalt Pavement (RAP) further reduced manufacturing energy requirements and secured an additional 53.3 tCO2e saving.

Early Lifecycle Preservation (B3139): The application of Rhinophalt—a highly penetrative, Gilsonite-based preservative resin—on the Mark Road Causeway demonstrated the carbon efficiency of preventative maintenance. By sealing micro-fissures and re-nourishing the binder matrix of the aging asphalt, the treatment arrests surface degradation. This proactively extends the operational lifespan of the asset, deferring the requirement for deep excavation and resurfacing, which fundamentally improves the 40-year lifecycle carbon profile of the B3139.

Winter Service Optimisation: A systemic operational shift from domain-based forecasting to intelligence-led, route-based forecasting for winter gritting yielded an estimated annual saving of 44.1 tCO2e. By integrating localized thermal mapping and route-specific meteorological data, the authority treats only specific topological routes with a confirmed icing risk. This reduces superfluous gritting runs, leading to massive proportional reductions in salt procurement, fuel consumption, and vehicle washdown water waste.

APPLICATION OF THE HIGHWAYS DOUGHNUT

The Highways Doughnut was used to broaden scheme appraisal beyond carbon alone, helping Somerset consider the wider environmental and social impacts of highways maintenance decisions. The framework supported assessment of how interventions could contribute to ecological objectives, such as reducing emissions, waste and material consumption, while also considering social outcomes including safety, accessibility, health, employment and community benefit.

In practice, the toolkit helped structure conversations about trade-offs. For example, a lower-carbon material or treatment still needed to be considered alongside durability, disruption, affordability, deliverability and implications for highway users. This helped avoid a narrow focus on embodied carbon and encouraged a more rounded view of value across the whole life of the asset.

Somerset's use of the Doughnut approach should therefore be presented as an emerging decision-support method rather than a fully embedded governance requirement. Its value has been in helping officers and partners test how a broader set of sustainability factors could be brought into highways asset management and scheme planning, with further work needed to mainstream the approach across future programmes.

5 APPLICATION OF CARBON BUDEGTING METHODOLOGY

The application of the Carbon Budgeting methodology transforms Somerset's approach to capital schemes from retrospective accounting to mathematically constrained forecasting.

Following the establishment of the CCAS baseline, the project utilised the Carbon Budgeting Toolkit to integrate greenhouse gas quantification into the earliest design phases. The second Carbon Budget Workshop refined the methodology for establishing a macro, service-wide envelope aligned with the authority's science-derived 2030 net-zero targets.

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This methodology dictates that project engineers are granted a finite 'carbon allowance' alongside their financial budget. If a proposed resurfacing scheme on the A38 or B3139 exceeds its localised carbon allowance, the design must be revised to incorporate low-carbon materials or methodologies. This systemic constraint ensures that high-level climate commitments are executed at the project level, forcing the integration of circular materials and low-temperature bio-asphalts before procurement commences.

6 COMMISSIONING THE WORK

Somerset delivered its work through mainstream highways commissioning arrangements rather than through a wholly separate delivery model. The wider programme operated alongside existing maintenance activity, while Somerset's highways delivery model changed during the programme period through the introduction of a new disaggregated contract approach from April 2024. This gave the authority more direct relationships with specialist contractors and improved control over delivery, cost and performance.

In April 2024, Somerset Council implemented a fundamental restructuring of its highways maintenance procurement, transitioning from a monolithic single-source Tier 1 to an agile 'multiple contractor model'.

Under the new paradigm, the authority let separate, specialist contracts for core maintenance, carriageway surfacing, surface treatments, and earthworks/footway schemes. Kier Transportation Ltd was awarded the core maintenance contract, including gritting and drainage. This shift to dealing directly with specialist discipline contractors is a primary driver for the authority's decarbonisation agenda, as it structurally removes the 'fee-on-fee' cost inflation associated with traditional TMC supply chain hierarchies.

The multiple contractor model facilitates greater transparency and granularity regarding costs and carbon impacts. Somerset Council can now embed specific carbon reduction Key Performance Indicators (KPIs) and Doughnut Economics compliance metrics directly into individual discipline Service Level Agreements (SLAs). This fosters a more competitive, innovation-driven supply chain, empowering specialist Tier 2 and Tier 3 providers—such as those developing biogenic binders or unique RAP back-hauling logistics—to propose low-carbon solutions directly to the authority without navigating a dominant Tier 1 hierarchy.

7 FUNDING & ADDED VALUE

The Somerset demonstrator projects are funded via the Department for Transport's £30 million Live Labs 2 allocation, of which the Wessex Partnership secured £5.1 million. Beyond the direct capital used for material trials, the project generated substantial strategic and economic added value.

The creation and dissemination of scalable, open-source operational frameworks—the Carbon Budgeting and Highways Doughnut Toolkits—provides a turnkey solution for other Local Highway Authorities to instigate systemic change without the initial R&D costs. Furthermore, the 'Lean Travel Carbon Review' successfully optimised internal processes using value stream mapping and root cause

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analysis (FMEA) to establish a blueprint for municipal fleet and traffic management inspection efficiency.

The project further stimulated the regional circular economy by de-risking the use of advanced materials. Validating the efficacy of in-situ rubblisation and warm-mix bio-asphalts provided the local supply chain with the technical confidence to invest in recycling infrastructure and low-carbon batching plants. The collaborative delivery model has fostered a carbon-literate regional workforce, while the inclusion of stringent 'social value' commitments in the new multiple contractor agreements ensures direct community benefits alongside targeted carbon reductions.

8 TIMELINE OF DELIVERY

The Wessex Live Lab followed a tightly controlled three-year timeline, driving toward a funding conclusion in March 2026.

- **2022–2023 (Pre-Programme Baselining):** Establishment of the full-service CCAS carbon baseline using the 2022-2023 financial year dataset to ensure a stable, post-pandemic benchmark.
- **2023 to Early 2024 (Mobilisation and Development):** Formal project launch and cross-authority governance establishment. The Carbon Budgeting and Highways Doughnut frameworks transitioned from academic conceptualisation to beta-testing.
- **April 2024 (Commissioning Shift):** Official transition to the multiple contractor model, integrating new specialist partners for core maintenance and surfacing delivery.
- **Late 2024 to 2025 (Physical Execution):** Intensive delivery of physical demonstrator projects, including the successful completion of the A38 concrete rubblisation, the Comeytrowe footway trials, and the formal rollout of route-based winter gritting.
- **Early 2026 (Secondary Trials):** Finalisation of complex carriageway resurfacing on the A38 using lower temperature asphalts and high recycled content.
- **March 2026 (Programme Conclusion):** Formal cessation of DfT funding and submission of the Final Report. This marks the transition into a mandated five-year extended monitoring and evaluation phase to assess the long-term performance of the trials.

9 AUTHORITY-SPECIFIC RESULTS

The empirical results from Somerset unequivocally validate the efficacy of the physical interventions.

Structural Engineering: In-situ concrete rubblisation on the A38 recycled 7,300 tonnes of legacy material and circumvented 1,130 HGV movements, delivering a verified saving of approximately 200 tonnes of CO2e (a 27% baseline reduction for the activity).

Urban Infrastructure: The use of bio-based surfacing and circular haulage on the Comeytrowe Queensway scheme delivered an aggressive 59% (26.4 tCO2e) absolute reduction in embodied carbon compared to traditional designs.

Operational Efficiency: The transition to route-based winter forecasting generated a permanent annualized saving of 44.1 tCO2e, coupled with substantial proportional reductions in salt usage, fleet fuel expenditure, and vehicle washdown water.

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Collectively, the Somerset physical trials yielded a verified saving of 411.9 tCO2e. Simulation data indicate that scaling these methodologies service-wide—without the logistical constraints of a trial environment—could yield 850.5 tCO2e (a 31% reduction across the corridors).

Somerset's work produced measurable carbon savings across its demonstrator corridors. The corridor analysis identified physical carbon savings of **337.7 tCO_2e** on the A38, **17.2 tCO_2e** on the B3139 and **57.0 tCO_2e** on Comeytrowe, giving a total physical saving of **411.9 tCO_2e**, equivalent to **15%** of the business-as-usual baseline across the three corridors. Simulated analysis suggested that, if all identified innovations had been implemented, the total saving could have increased to **850.5 tCO_2e**, or **31%**.

The M5 Junction 26 and Chelston Link Road scheme provides one of the clearest examples of these outcomes. The wider reconstruction approach combined rubblisation, recycled material reuse and warm-mix asphalt to retain approximately **7,300 tonnes of concrete** on site, avoid **more than 1,100 lorry movements**, and deliver a wider scheme carbon saving of **339 tonnes** against traditional reconstruction. Within the corridor carbon profiling work, the rubblisation intervention itself was identified as delivering **238.3 tCO_2e** of physical carbon saving. Read together, these figures show both the overall decarbonisation benefit of the full construction strategy and the specific saving attributed to the core rubblisation activity within the corridor analysis.

The scheme also delivered strong engineering and operational outcomes. These included a long-life pavement solution with **Level 3 wheel-rut resistance**, improved skid resistance, improved ride quality, reduced running noise compared with the former concrete carriageway, and drainage works that resolved historic flooding issues. This means the intervention can be presented not only as a carbon-saving measure, but also as a durable and resilient asset renewal scheme.

Other authority-specific results also remain important. On the B3139, asphalt preservation achieved a **42%** carbon saving compared with the profiled business-as-usual alternative. At Comeytrowe, the Queensway footway reconstruction achieved a **59%** carbon saving and microsurfacing on Parkfield Road achieved a **79%** saving against their respective business-as-usual comparators. Winter service optimisation also produced measurable savings through fewer gritting actions and reduced salt usage, although the exact quantified carbon saving varies between the available estimates depending on scope and modelling basis.

LEGACY

The ultimate legacy of Somerset's involvement is the movement of lower-carbon thinking from individual trials into wider highways service practice. Internally, the Highways Doughnut and Carbon Budgeting frameworks are now becoming more integrated into Somerset Council's asset management and capital planning procedures. Carbon analysis is increasingly being used to inform scheme appraisal, option development and reporting, although the wider use of carbon budgeting and the Doughnut toolkit remains an area of continued development rather than a fully embedded business-as-usual process.

Somerset's annual reporting states that Doughnut Economics has been used in asset management and scheme planning, with plans for wider adoption, and that carbon analysis and budgeting have

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been integrated into decision-making, with the relevant toolkit being scaled for wider use. This provides a realistic legacy position: the programme has created practical tools, evidence and confidence, but further work is needed to fully mainstream them across future highways investment decisions.

Externally, the project has catalysed the formation of the 'Highways Doughnut Alliance'—a cross-sectoral consortium designed to identify and dismantle systemic barriers to decarbonisation across the UK infrastructure landscape. Furthermore, the launch of the Live Labs 2 'Industry Decarbonisation Pledge' ensures these principles will be actively championed by delivery partners and academic institutions nationally.

To ensure rigor, the physical innovations will undergo a mandated five-year monitoring period. This long-term lifecycle analysis will definitively validate the chemical durability of biogenic binders and the structural longevity of rubblised concrete base layers under traffic loading, providing the definitive engineering confidence required for nationwide adoption of net-zero road maintenance.

The strongest legacy of Somerset's programme is the movement of lower-carbon thinking from individual trials into wider highways service practice. This work is part of a broader move towards whole-life asset management, evidence-based prioritisation and making lower-carbon approaches part of routine highways delivery.

The Chelston / Junction 26 scheme strengthens that legacy by providing a practical model for future highway renewal. Its combination of asset reuse, recycled content, warm-mix asphalt, local sourcing and compressed delivery demonstrates how major maintenance schemes can reduce embodied carbon while also improving durability, resilience and user outcomes. In that sense, the scheme contributes not only direct carbon savings, but also evidence and confidence for the wider application of similar approaches in future programmes.

Legacy also has a wider partnership dimension. Correspondence on the next phase of work shows that Wessex partners were already discussing how some post-programme requirements might best be taken forward collectively, particularly where shared carbon-related expertise could add value. The most robust legacy position, therefore, is that Somerset has used the programme both to embed new approaches internally and to contribute to a wider Wessex evidence base that may continue to support shared learning beyond the funded period.

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