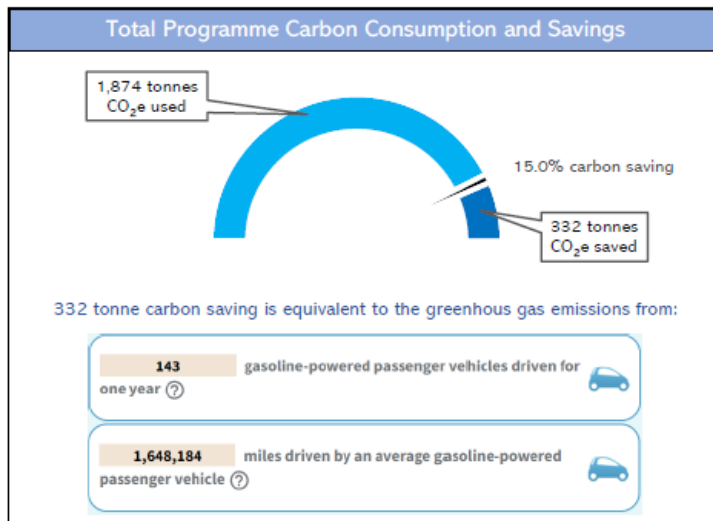


Decarbonising Highways Maintenance: Whole Life Carbon Modelling approach to highway maintenance

Paul Binks
(Lancashire CC)



DfT Self Assessment Q23: Carbon (January 2021)

23. Sustainability (additional questions)

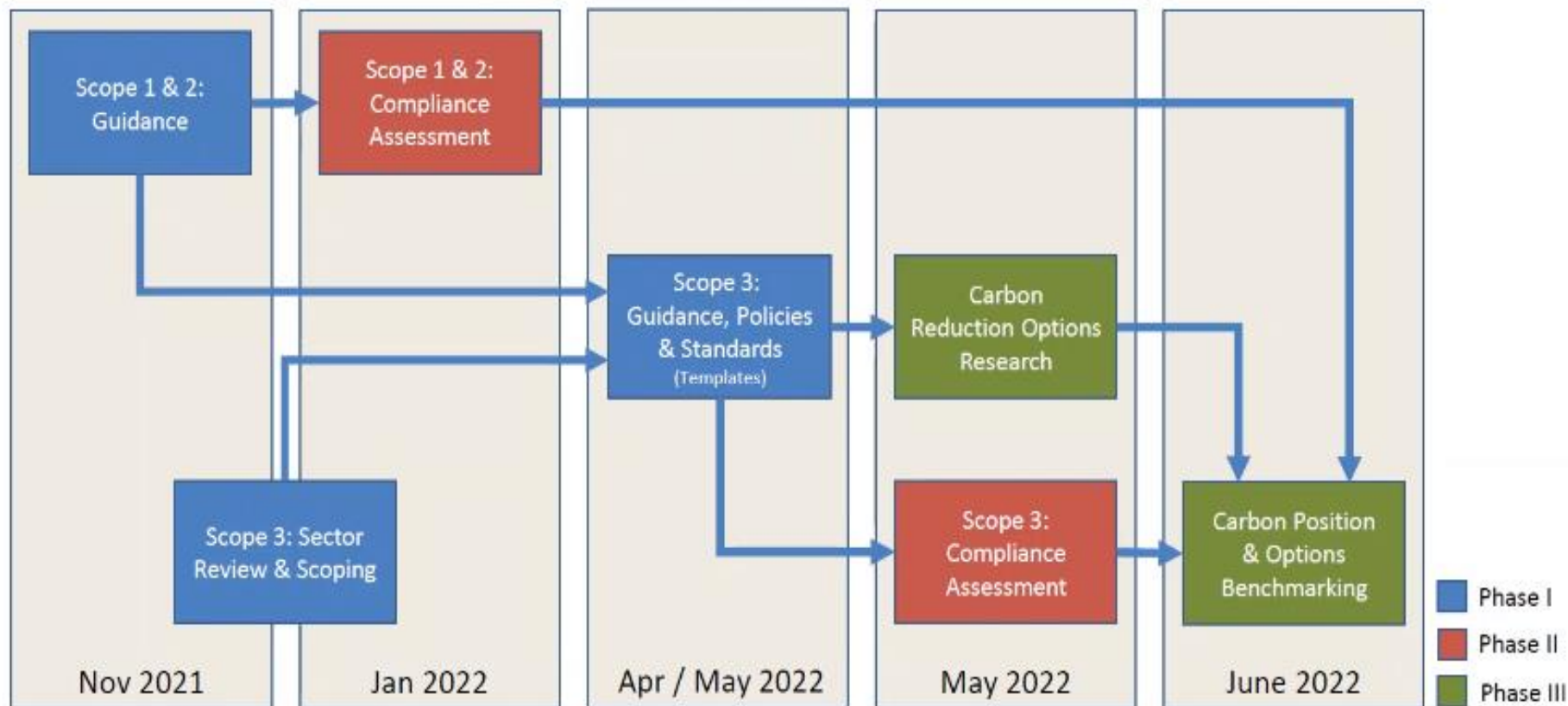
Q.4 If you were scoring your authority in relation to reducing carbon generation as a result of your maintenance operations, what score would you award on the basis of the below?

- **1** - We have an awareness of the carbon reduction challenge.
- **2** - We are developing plans and processes that will enable us to compare whole life carbon generation when selecting suitable materials/processes.
- **3** – Our plans and processes are fully embedded to ensure least whole life carbon generation when selecting suitable materials/processes.

Future Highways Research Group

Zero Carbon Highways: Route Map Measurement, Options Development & Reduction

Future Highways
Research Group



Carbon: Project Objectives (?)

- Focus on Scope 3 emissions (80% of all emissions)
- Quantify the CO₂e usage of the carriageway surfacing & other programmes
- Identify opportunities to reduce CO₂e usage
- Implement CO₂e reduction measures
- Measure CO₂e savings
- Develop and implement a CO₂e lifecycle planning model: ability to inform decisions.
- Propensity to change opportunity
- Developing a Decarbonisation Strategy

Surface Treatments



In-situ recycling



Opportunities for CO₂ reduction

Warm Mix Asphalt



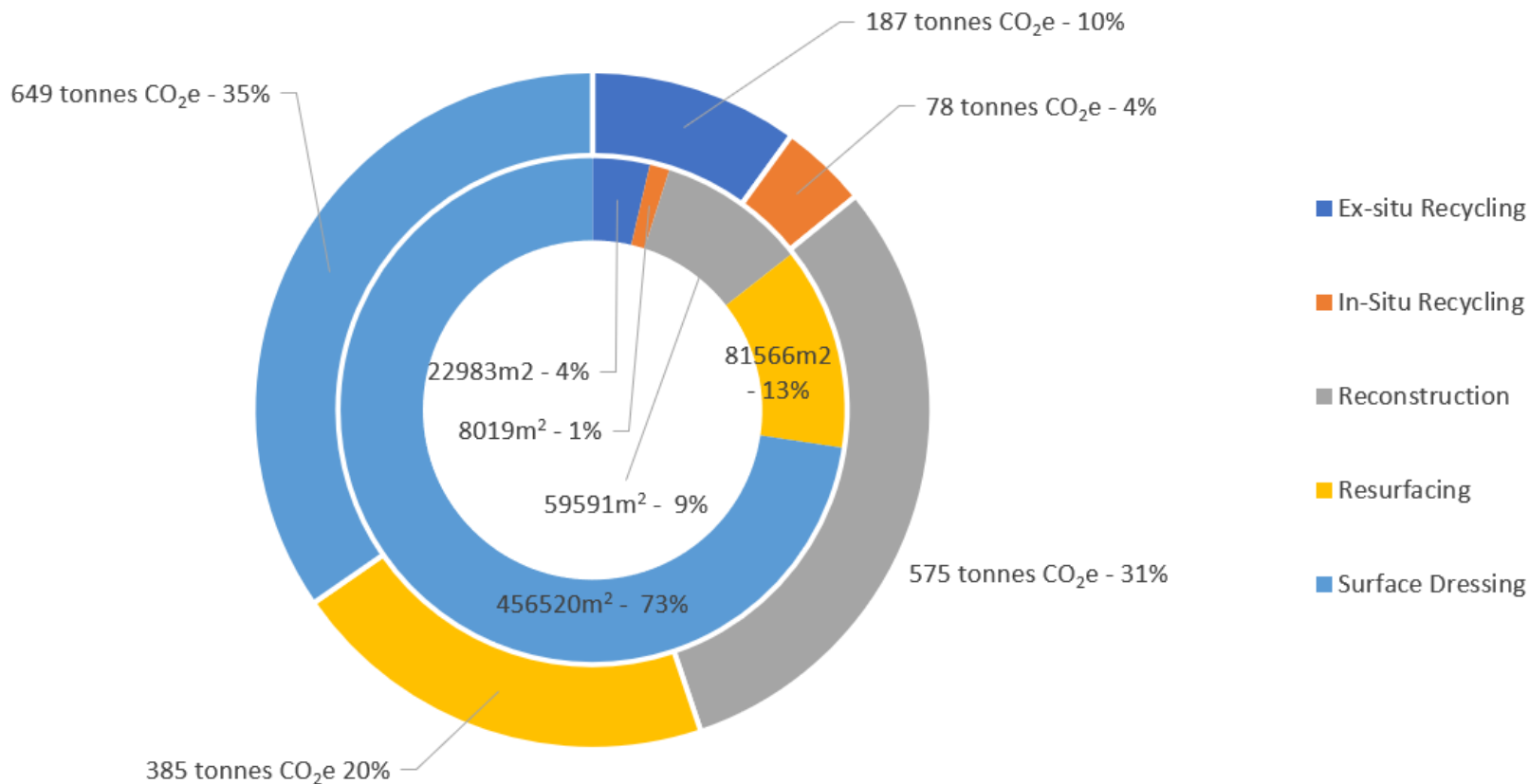
Ex-situ recycling



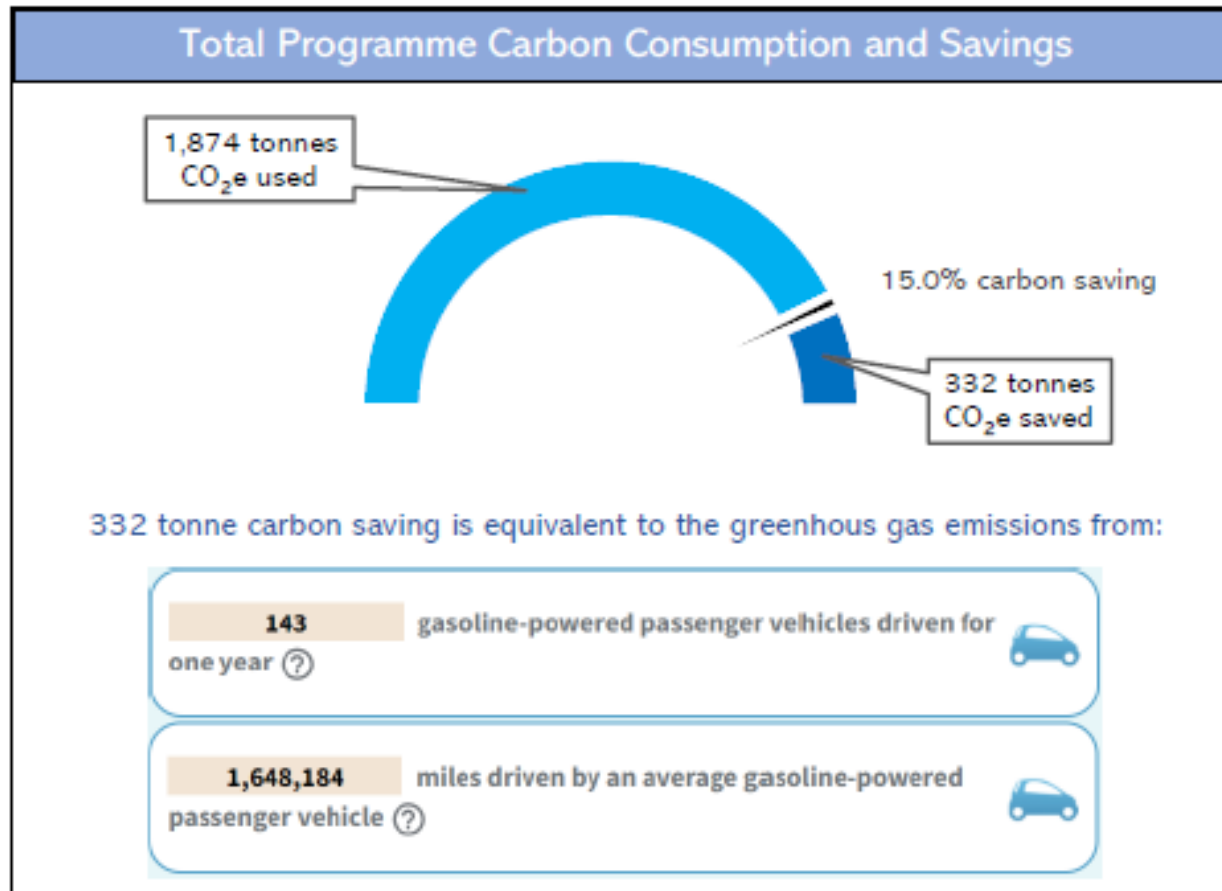
Determining carbon footprint – where to start?

Materials	Density (tonnes/m ³)	KgCO ₂ e per ton	KgCO ₂ /m ²	@thickness
10mm SMA PMB	2.392	76.0	7.3	40mm
10mm SMA 50p	2.392	63.9	6.1	40mm
6mm DSC 50p H/S	2.252	63.9	2.9	20mm
10mm CGSC 50p H/S	2.252	63.2	5.7	40mm
20mm H/Duty L/S	2.252	54.5	7.4	60mm
32mm H/Duty L/S	2.252	54.3	12.2	100mm
30/14 HRA 50p	2.427	62.5	6.8	45mm
35/14 HRA 50p	2.427	62.2	6.8	45mm
35/14 HRA PMB CI.943	2.427	76.4	8.3	45mm
55/10 HRA 50p	2.427	61.9	6.0	40mm
55/14 HRA 50p	2.427	61.9	6.8	45mm
10mm SMA PMB WMA	2.392	69.6	6.7	40mm
10mm SMA 50p WMA	2.392	57.5	5.5	40mm
6mm DSC 50p H/S WMA	2.252	57.5	2.6	20mm
10mm CGSC 50p H/S WMA	2.252	56.8	5.1	40mm
20mm H/Duty L/S WMA	2.252	48.1	6.5	60mm
32mm H/Duty L/S WMA	2.252	47.9	10.8	100mm
AC14 Open Grade	2.079	51.4	4.3	40mm
CBGM	2.2	25.0	3.3	60mm
CI 948 B4	2.2	21.0	2.8	60mm
CI 948 B4	2.2	21.0	4.6	100mm
Type 1 GSB (Virgin aggregate)	2	0.0	N/A	N/A
Type 1 GSB (50:50 Recycled:Virgin)	2	0.01	N/A	N/A
Site won capping	2	0.0	N/A	N/A
Readymix Concrete (CEM1 only)	2.385	132.0	N/A	N/A

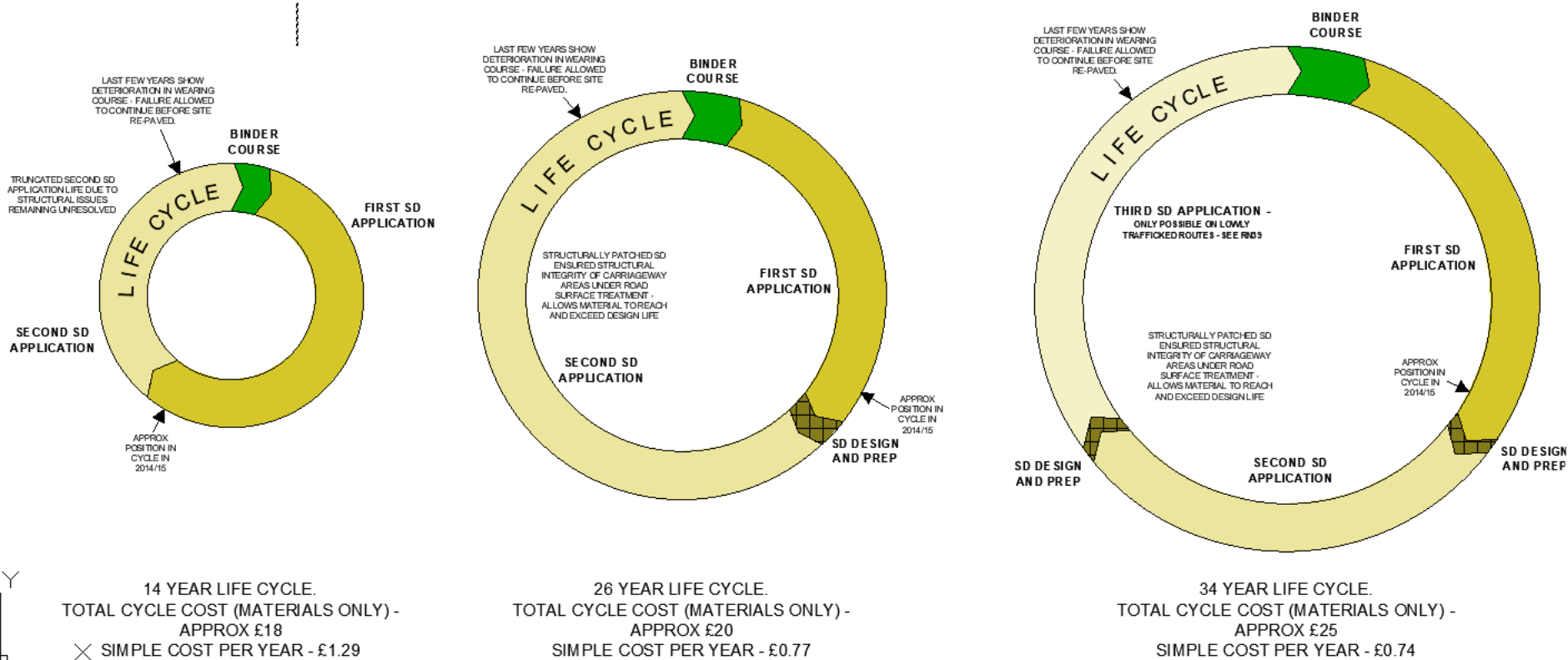
Carbon Dashboard Area Treated and Carbon consumption by Treatment Type



Capital Programme – Carbon Dashboard



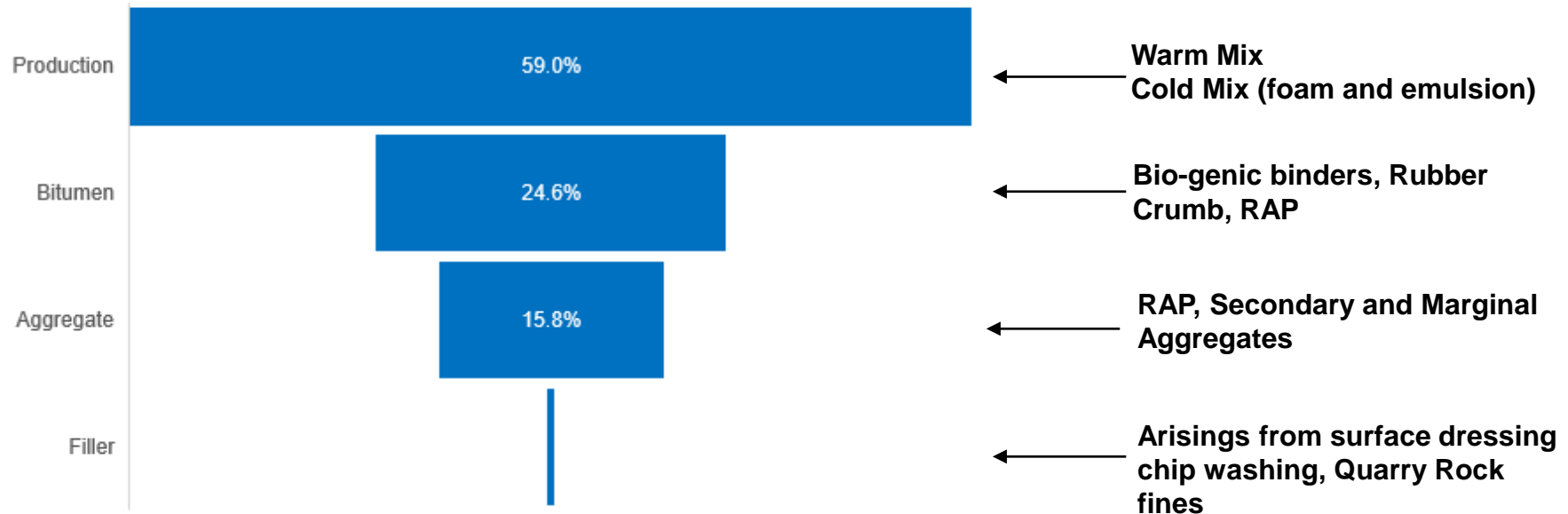
Carbon in the lifecycle



Manage our network in this way and we reduce CO₂e over the 'life' of the asset

Propensity to further reduce CO₂e in asphalt

Typical contributions to the carbon footprint of asphalt



Sustainability through durability

Layer	Sample ID (from register)	Chainage	Lane/Location of manufacture	Volume of specimen	Height of specimen	Site Bulk Density	Average Density	Age at test	Laboratory Bulk Density	7 day strength
Binder	LH/17-02-2021/RNA2134/1	15	WB	0.99	56	2225	2225	7	2099	3818
Binder	LH/17-02-2021/RNA2134/2	15	EB	0.97	55	2265	2245	7	2109	3918
Binder	LH/17-02-2021/RNA2134/3	25	EB	0.97	55	2260	2250	28		
Binder	LH/17-02-2021/RNA2134/4	35	EB	0.97	55	2264	2246.8	28		
Binder	LH/17-02-2021/RNA2134/5	35	WB	0.97	55	2220	2242.5	28		
Binder	LH/17-02-2021/RNA2134/6	25	WB	0.97	55	2200	2239	28		
Binder	NO/22-02-2021/RNA2134/1	NA	Site Batcher	1.01	57	2206	2206	7	2107	4284
Binder	NO/22-02-2021/RNA2134/2	NA	Site Batcher	1.06	60	2148	2177	28		
Binder	NO/22-02-2021/RNA2134/3	NA	Site Batcher	0.95	54	2308	2220.7	28		
Binder	NO/22-02-2021/RNA2134/4	NA	Site Batcher	1.01	57	2209	2217.8	28		
Binder	NO/23-02-2021/RNA2134/1	400	NB	1.03	58	2185	2185	28		
Binder	NO/23-02-2021/RNA2134/2	420	SB	1.01	57	2204	2194.5	28		
Binder	NO/23-02-2021/RNA2134/3	460	NB	0.99	56	2260	2216.3	28		

Chainage	Lane	Test Location	Layer	Target Density	Average Target Density	Bulk Density Offset	Moisture Content Offset	Gauge Bulk Density	Gauge Dry Density	Gauge Moisture Content	Percentage Compaction	Overall Average mean compaction	Average
15	WB	Centre	Binder	2239	2239	0	0	2221	2095	6	99.2	99.2	
35	WB	Centre	Binder	2239	2239	0	0	2255	2117	6.5	100.7	100	
25	WB	Centre	Binder	2239	2239	0	0	2127	2046	4	95	98.3	
35	EB	Centre	Binder	2239	2239	0	0	2144	2051	4.5	95.8	97.7	
15	EB	Centre	Binder	2239	2239	0	0	2183	2075	5.2	97.5	97.6	
25	EB	Centre	Binder	2239	2239	0	0	2178	2070	5.2	97.3	97.6	98.4

Next steps and expanding influence

Pavement Scheme Carbon Calculator							
Road Number:		District:					
Road Name:	Example Scheme	Division:					
Extents:							
Planing Operation							
Planing Area Identifier	Thickness (mm)	Area (m ²)	Tonnage	Planing operation CO ₂ e	Transport CO ₂ e	Processing and Disposal CO ₂ e	
Area 1	100	4000	880	3.995	3.828	3.586	
			0	0.000	0.000	0.000	
			0	0.000	0.000	0.000	
				3.995	3.828	3.586	
Surfacing Materials and Installation							
Layer Identifier	Material	Thickness (mm)	Area (m ²)	Tonnage	Material tonnes CO ₂ e	Transport CO ₂ e	Installation CO ₂ e
Surface Treatment		Not applicabl	0	Not applicable		Not applicable - For surface treatments material CO ₂ e is 'cradle-to-laid'	
Surface Course	10mm SMA 50p WMA	40	4000	383	17.950	2.629	2.312
Binder Course	CI 948 B4	60	4000	528	11.088	3.189	2.397
Base Course	CI 948 B4	100	0	0	0.000	0.000	0.000
Sub-base	CBGM	250	0	0	0.000	0.000	0.000
Capping	Site won capping	400	0	0	0.000	0.000	0.000
					29.038	5.818	4.709
Total CO ₂ e Materials		29.038	tonnes				
Total CO ₂ e Transport		9.646	tonnes				
Total CO ₂ e Operational		8.704	tonnes				
Total CO ₂ e Processing and Disposal		3.586	tonnes				
Scheme Total CO ₂ e		50.974	tonnes				



Input
Calculation
Output

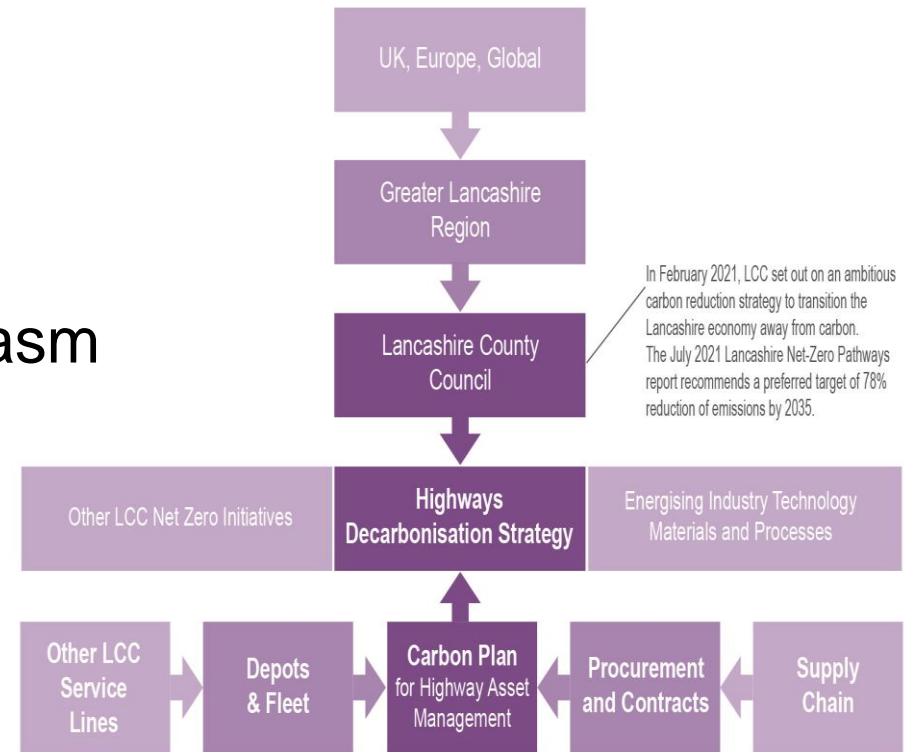


Sustainability through design

- More fundamental considerations:
 - Reduce asset size – lane widths, traffic lanes
 - Lower material and resource use from maintenance
 - Reduced traffic speeds through principles of 'sustainable safety'
 - Reduce texture and low voids = more durable
 - Potential to use recycled, secondary or marginal aggregates (recycle and preserve high PSV)

Developing a Decarbonisation Strategy

- ‘Neutrally’ facilitated
- Engage with all internal stakeholders
- Buy In to principles - enthusiasm
- Clear Road Map
- Manageable SMART Actions
- Clear Governance – existing
- Political Buy In



- Highways decarbonisation strategy - Lancashire County Council



Promoting low carbon approach in procurement of goods and services; Stimulate innovation from our supply chain, by communicating our ambition and leveraging commercial incentives to take action.



Measure the carbon impact of all highway maintenance activities and publish carbon baseline and impact assessments; so we can prioritise initiatives and continuously improve.



Aim for lowest carbon impact across the lifecycle of the asset; by considering the impact of carbon in lifecycle modelling as part of the decision-making process.



Ensure the carbon impact of ongoing revenue maintenance activities are considered as well as replacement carbon costs; achieving sustainability through durability.



Purchase of green energy [OM1]; buy 100% of our electricity via a certified renewables tariff.



Replace energy intensive services with low energy products and processes; futureproof for evolving highways infrastructure and technology associated with a low carbon society.



Consider carbon off-setting as option of last resort; Minimise dependency on offsetting and remain transparent on scope 3 emissions throughout the value chain.



Work towards Net Zero across all depots and fleet operations; working collaboratively with other service lines.



Work with other stakeholders to consider innovation and develop low carbon initiatives across highway maintenance activities; embed a decarbonisation culture with the necessary behaviours, roles and skill sets.



Consider the planting of trees within the highway boundary and measures to increase net biodiversity; wherever appropriate.



Decarbonisation Strategy

22/23 priorities:

- Carbon Statement for Carriageway Programme
- Carbon Dashboard
- Study on propensity\opportunity to save Carbon in Carriageway Capital Programme and Lifecycle Planning
- Carbon Calculator for scheme development
- Procurement & Supply Chain engagement
- Carbon Literacy and Engagement

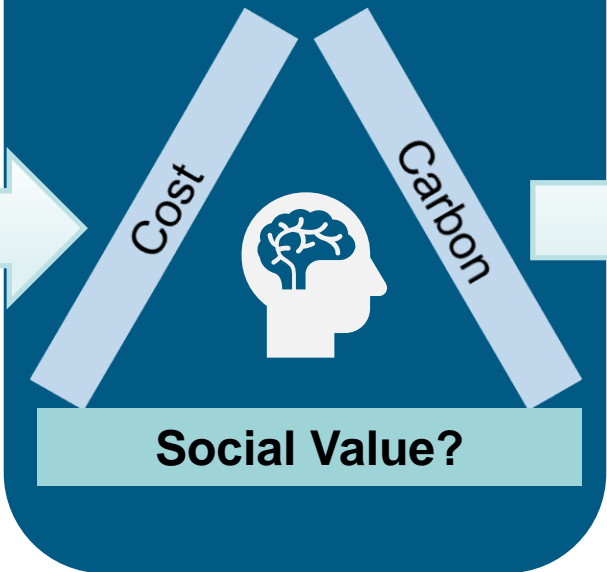


Challenges:

- Maintenance backlog
- Constrained budget
- Hyper-inflation
- GHG emissions
- Public expectations
- Member Expectations



Decisions



Opportunities:

- Innovation
- Propensity to change
- Challenge Assumptions
- More informed decisions