

Strategic asset and carbon forecasting report

Introduction

The NHT CQC Efficiency Network has developed a strategic asset and carbon forecasting tool as part of its work to enable member authorities to develop asset plans to support net zero. The tool forecasts life added, defect growth, carbon expended and savings to assets resulting from a highway authority undertaking maintenance activities. This report summarises the work applied to measure2improve, based on the following assumptions:

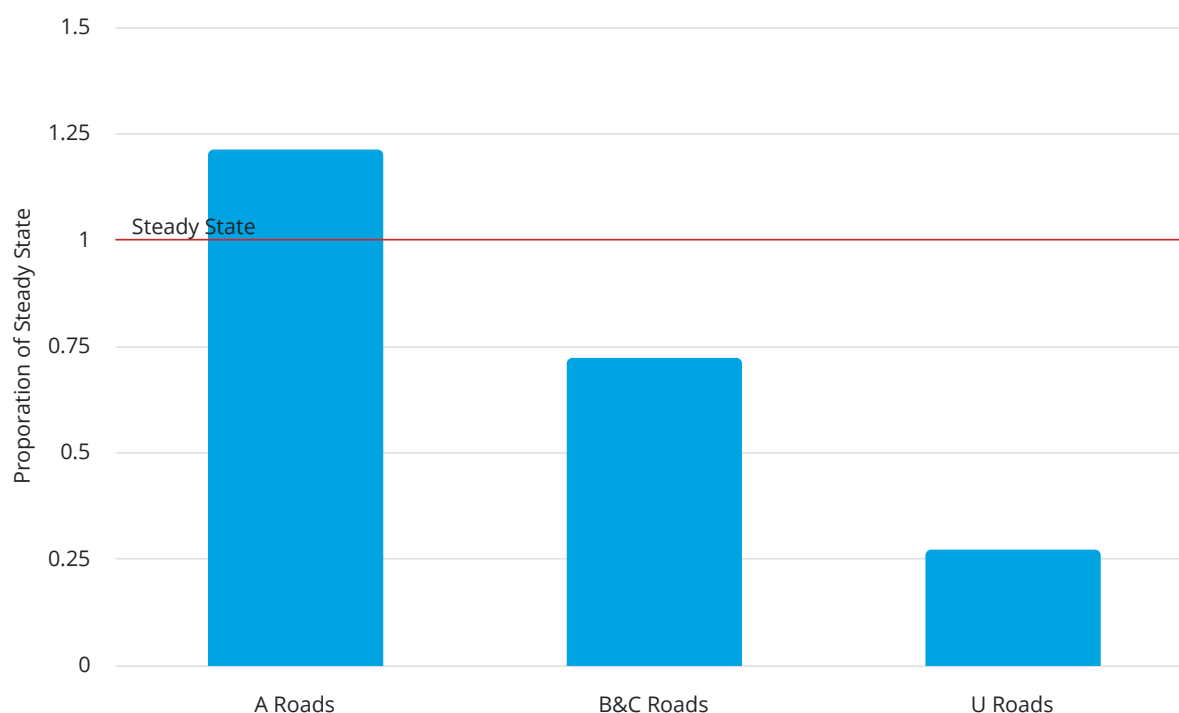
- (i) The average volume of maintenance over the last three years (from 2021/22 to 2023/24) is maintained for the next 10 years;
- (ii) Carbon factor, life added of treatments are as Appendix 1 and unchanged in the next 10 years.

Our forecasts

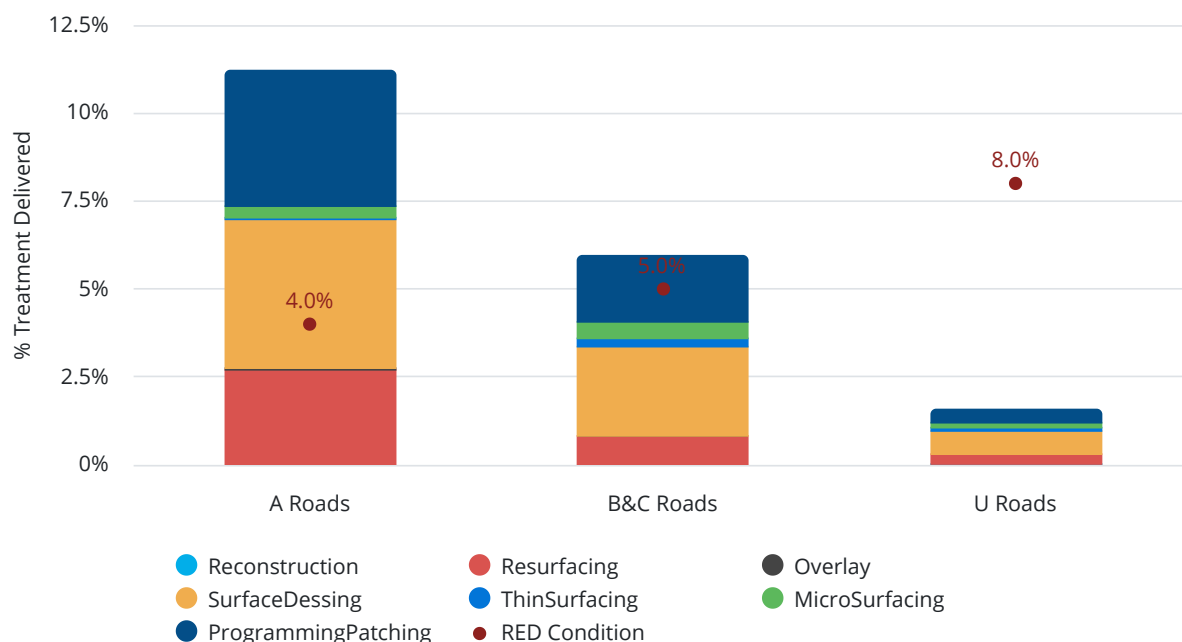
Maintenance volumes and life added

- The volume of maintenance is only 46% of that required to prevent assets from deteriorating, implying that the asset loses life every year (-0.54 years).
- For the strategic A roads, the volume is nearly 121% of the steady state maintenance level.
- For B and C roads, it is 72% of the steady state maintenance level.
- On the unclassified network i.e. where most people live, 27% of the necessary volume to prevent assets deteriorating is delivered.
- Therefore, overall there is a deficit in the volume of maintenance delivered compared to that required to prevent assets from deteriorating.

Proportion of Steady State Maintenance Delivered



Treatment delivered as % of road length and road condition



Defects

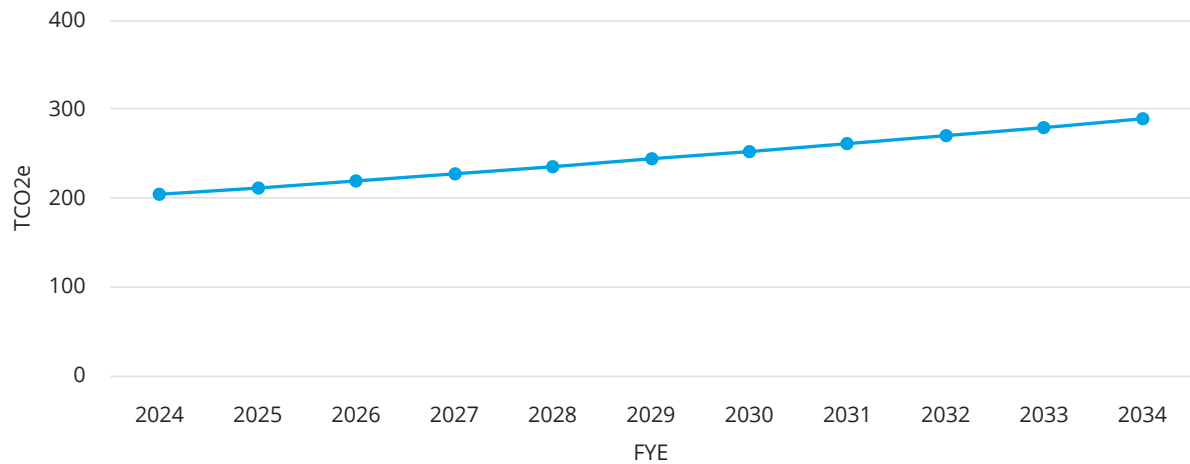
- As a result of the maintenance under the steady state level, defects are predicted to increase by 40% across all roads, with around 6,054 more defects in 2033/34, compared to defects in 2023/24.
- Defects are predicted to decrease on A roads, increase on B&C roads, and increase on U roads.
- The majority of the additional defects are in U Roads roads. It is predicted that the defects on U Roads roads increase by 62% in the next decade from an already high current base.
- The carbon and cost impact of this deterioration is substantial. Over the next ten-year period from 2024/25 to 2033/34, measure2improve is forecast to emit an avoidable around 2,488 tonnes CO₂e (TCO₂e) and face a budget pressure of £18.70 Million* will be expended to fill defects. We term this carbon avoidable carbon as it is simply carbon required to make the asset safe rather than carbon which adds life to the asset.

*Assuming it costs £105 to fill a defect.

Total number of projected defects over the next 10 years, by road type

Road Type	2024	2025	2025	2027	2028	2029	2030	2031	2032	2033	2034
A Roads	1,696	1,666	1,637	1,617	1,597	1,577	1,558	1,539	1,539	1,539	1,539
B&C Roads	5,697	5,847	6,006	6,168	6,335	6,507	6,683	6,864	7,050	7,240	7,432
U Roads	7,198	7,601	8,026	8,461	8,901	9,345	9,811	10,276	10,739	11,197	11,674
Total	14,591	15,114	15,669	16,246	16,833	17,429	18,052	18,679	19,328	19,976	20,645

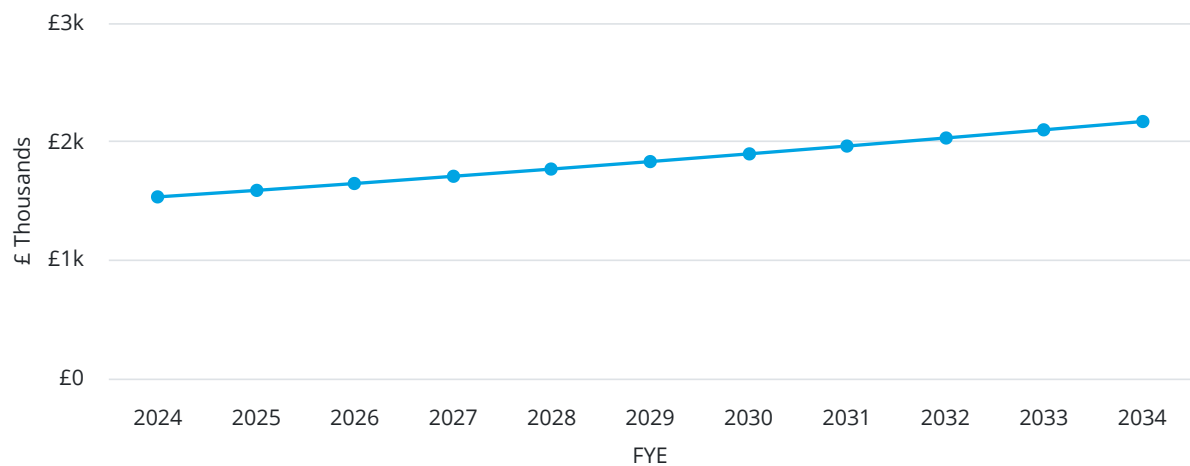
Defect Filling Avoidable Carbon - All Roads



Projected Avoidable Carbon (to fill defects) (TCO2e) over next 10 years

Road Type	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
A Roads	24	23	23	23	22	22	22	22	22	22	22
B&C Roads	80	82	84	86	89	91	93	96	99	101	104
U Roads	101	106	112	118	124	131	137	144	150	157	163
Total	205	211	219	227	235	244	252	262	271	280	289

Defect Filling Avoidable Costs - All Roads



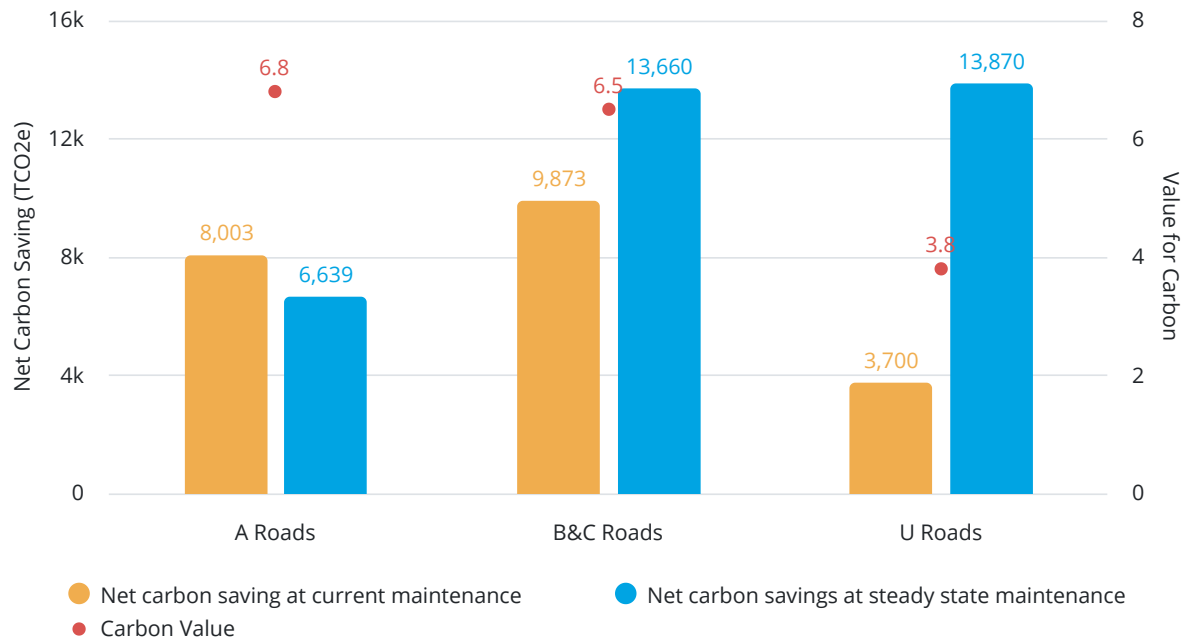
Projected Avoidable Cost (to fill defects) (£000's) over next 10 years

Road Type	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
A Roads	178	175	172	170	168	166	164	162	162	162	162
B&C Roads	599	614	631	648	666	684	702	721	741	761	781
U Roads	756	798	843	889	935	982	1,031	1,080	1,128	1,176	1,226
Total	1,533	1,587	1,646	1,707	1,769	1,832	1,897	1,963	2,031	2,099	2,169

Carbon

- Carbon expended of the current treatments (without defect filling) is estimated 4,495 tCO₂e per year.
- However, because road treatments add life to the asset and so defer the need to reconstruct assets, we estimate that the saving from the delay of the reconstruction (thanks to the treatments) to be 26,072 tCO₂e.
- Put another way, the future carbon saved is 6 times that of carbon being invested in maintenance.
- If the roads are maintained at a steady state (i.e. there is enough maintenance applied to keep them from deteriorating from their current state) by proportionately changing the maintenance volume, the net savings from the delay of the reconstruction (i.e. the difference between saving from the delay of the reconstruction and carbon expended of maintenance) increases from 21,577 tCO₂e to 34,169 tCO₂e per year. This shows that good asset management maximises the contribution of highways to achieving net zero.

Net Carbon Savings and Carbon Value



Appendix

Appendix 1: Default carbon factor and life added of treatments

Treatment	Asset	Unit	% Patching if applicable	Carbon emission factor (TCO2/unit)	Life added (years)
Reconstruction	A	km	100%	436	28
Reconstruction	BC	km	100%	248	37
Reconstruction	U	km	100%	174	48
Resurfacing	A	km	100%	72	20
Resurfacing	BC	km	100%	50	27
Resurfacing	U	km	100%	50	34
Programmed patching	A	m2	10%	0.00975	5
Programmed patching	BC	m2	10%	0.00975	6
Programmed patching	U	m2	10%	0.00975	7
Surface Dressing	A	km	100%	8.62	10
Surface Dressing	BC	km	100%	6	12
Surface Dressing	U	km	100%	6	15
Micro Surfacing	A	km	100%	9	10
Micro Surfacing	BC	km	100%	6	12
Micro Surfacing	U	km	100%	6	15
Overlay	A	km	100%	132	20
Overlay	BC	km	100%	95	27
Overlay	U	km	100%	66	34
Thin surface	A	km	100%	25	10
Thin surface	BC	km	100%	17	12
Thin surface	U	km	100%	17	15
Defect filling	A	m2	100%	0.01398	0
Defect filling	BC	m2	100%	0.01398	0
Defect filling	U	m2	100%	0.01398	0

Definition of Terms

Life Added (or Net Life Added)

Life Added represents the average number of years added to the network as a result of implementing the chosen treatment portfolio. It can be interpreted as the proportion of steady state maintenance being delivered;

- Life Added = 1: Maintenance is at a steady state level: enough to fully offset deterioration.
- Life Added > 1: Maintenance exceeds the deterioration rate, adding net life to the asset.
- Life Added < 1: Maintenance is insufficient to prevent deterioration.

Thus, Life Added = 1 corresponds to 100% of steady state maintenance, and other values scale proportionally.

Net Life Added (years) adjusts for deterioration. It is life added minus 1. This metric represents the additional service life gained after accounting for deterioration. Its values are evaluated relative to 0, rather than 1, making interpretation more intuitive.

Net Carbon Saving

Carbon expended (TCO2e) is the total emissions associated with delivering the selected treatment portfolio.

Future carbon savings (TCO2e) represent the emissions that would have been generated if the same amount of life added to the network were instead achieved through reconstruction at the end of asset life. In other words, these savings reflect the carbon avoided because today's treatments delay reconstruction.

Net Carbon Savings (TCO2e) is the difference between Future carbon savings (TCO2e) and Carbon expended (TCO2e). It represents the net amount of TCO2e saved after subtracting today's carbon expenditure.

Steady State

Steady State maintenance is maintenance that adds just enough life to an asset to offset its deterioration, resulting in no net change in overall asset life.

Carbon Value

Carbon Value provides a measure of the extent to which your chosen maintenance treatment mix yield carbon savings relative to the carbon they incur. It is calculated as a ratio of the carbon saved (from all treatments) resulting in the future to carbon expended (from all treatments) in a given year.

The measure is distinct from net carbon saving which reflects the scale of contribution to net zero of a maintenance regime. This is in turn a function of the volume of maintenance and the Carbon Value from the average treatment deployed.

A larger Carbon Value generally indicates that a more preventative maintenance regime is being implemented as such treatments result in substantial life added to assets (as opposed to more reactive maintenance). Holding volume of activity constant, a higher Carbon Value indicates there is more carbon saving bang for the buck from adopting one maintenance regime than another.

Strategically, Carbon Value is useful when an authority is considering different treatment mixes to be deployed and want to understand the carbon impact of a change in mix.

A note on the steady state scenario presented in this report

In the pilots for this report, we noted that many authorities are not undertaking enough maintenance for unclassified roads to maintain the condition of those roads. In addition the set of treatments deployed on these roads tend to have low carbon value (the mix tends to be more towards reactive maintenance). These two observations combine to imply that when the steady state solution is computed by our systems, that implies a large increase in unclassified road treatment volume which in turn reduces the carbon value when averaged across all road types. This is because we hold the treatment mix for each road type the same when we do the scaling to form the steady state scenario. We are keen to discuss how the steady state comparison scenario could be more helpfully be formulated with members