A Whole Life Carbon Model for Railway Track System Interventions

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Outline

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Research Motivation

CP6 (2018-2024) cost estimates suggest a projected expenditure of c. £7.5bil. (£4.2bil. on maintenance and renewal on plain track alone).

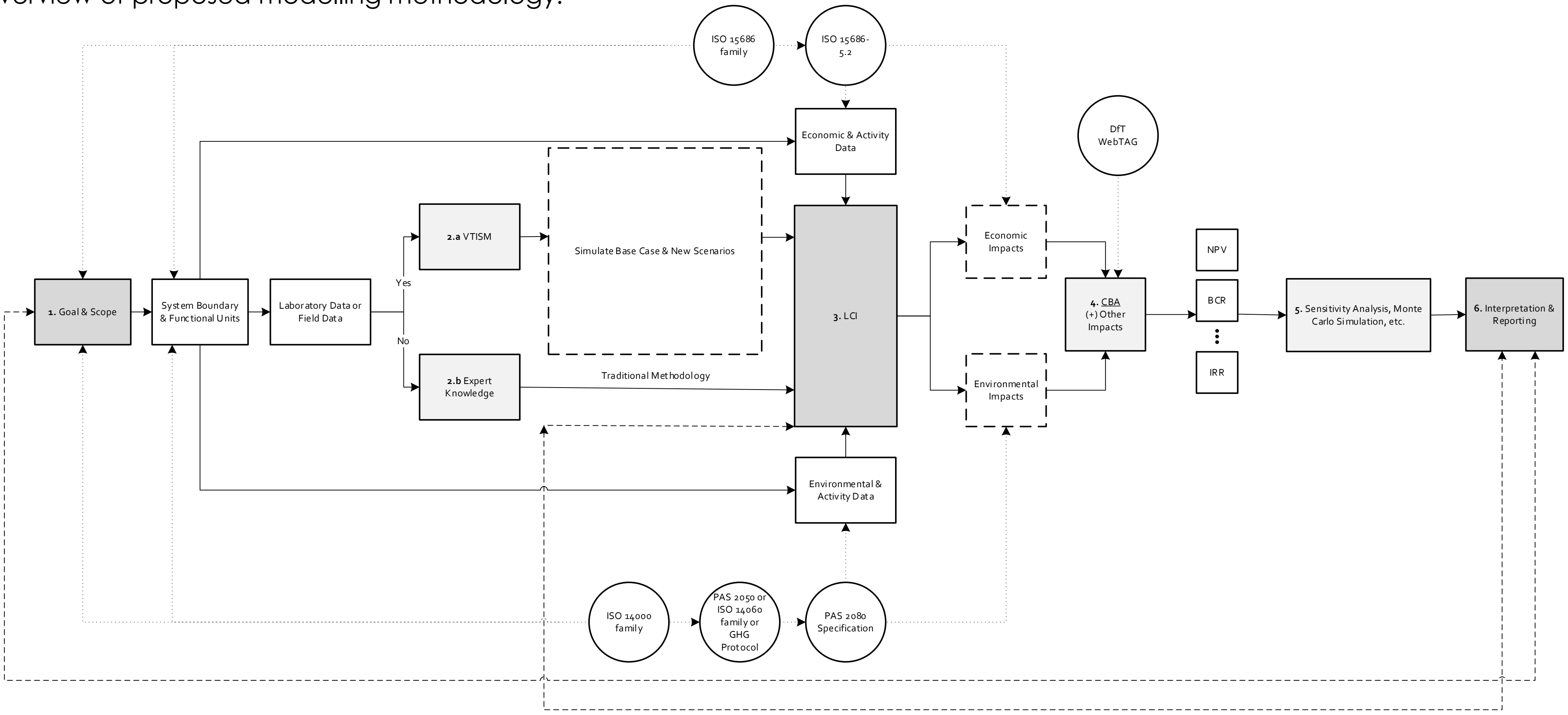
Annual emissions for maintaining and renewing the infrastructure are equivalent to the annual CO_2 footprint of c. 75,000 to 163,000 residents of the United Kingdom (own estimates based on 2017 data).

Aim

The overall aim of this project is to develop an integrated methodology for investigating the potential for a range of novel interventions to reduce the whole life carbon footprint and LCC of ballasted track.

Methodology

Figure 1: Overview of proposed modelling methodology.



Case Studies

Table 1: Proposed railway track interventions. [C]: conducted, [C*]: conducted (on-going), [P]: planned, [N] excluded.

		Sleeper interventions (with and without USP)									
		Mono-block			Twin-block			Timber	Steel	Composite	
		None	USP 1	USP 2	None	USP 1	USP 2	None	None	None	
Ballast (or Subgrade) interventions	NR ballast-Granite	[C*]	[C*]	[C*]	[N]	[C*]	[C*]	[C]	[C]	[C*]	Plain Track
	Variant 3	[C*]									
	RPS	[C*]									
	TLB	[N]									
	Fibre Reinforced Ballast	[C*]									
	Asphalt Underlay	[N]									
	Geogrid wrap around	[N]									
	None	[P]						[P]			S&Cs
											Track Layout

- ECML (122 mi.) & Portsmouth (Direct) Line (74 mi.).
- Tonnage: 16 & 22 EMGTPA.
- Time horizon: 60 years.

Track interventions

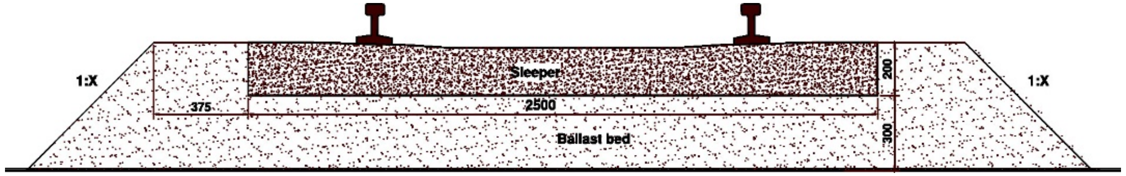
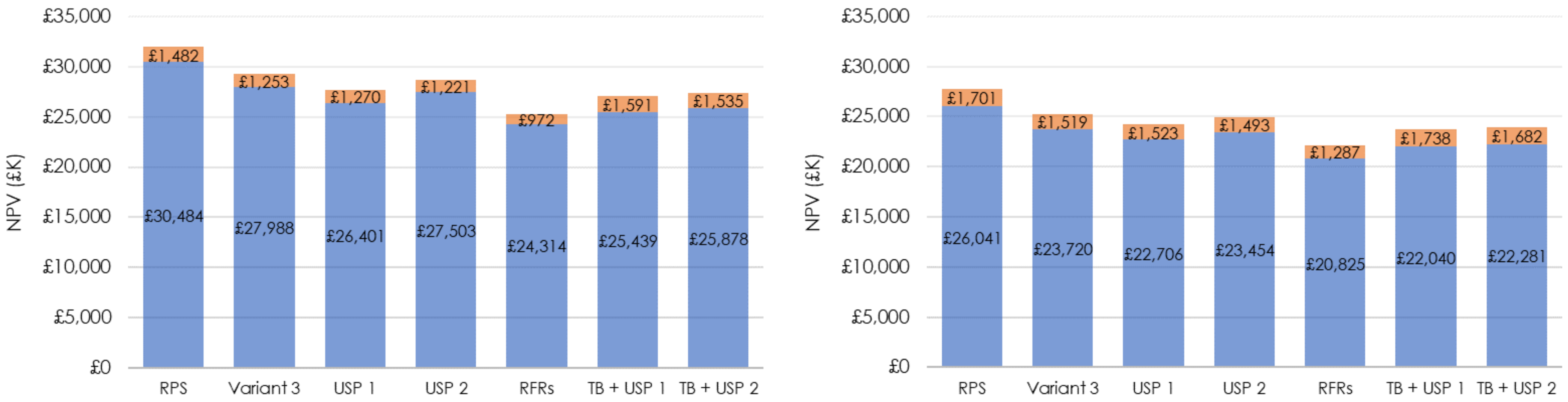


Figure 2: Schematic of conventional ballasted Track.

Figure 3: Novel track interventions.

Findings [i]

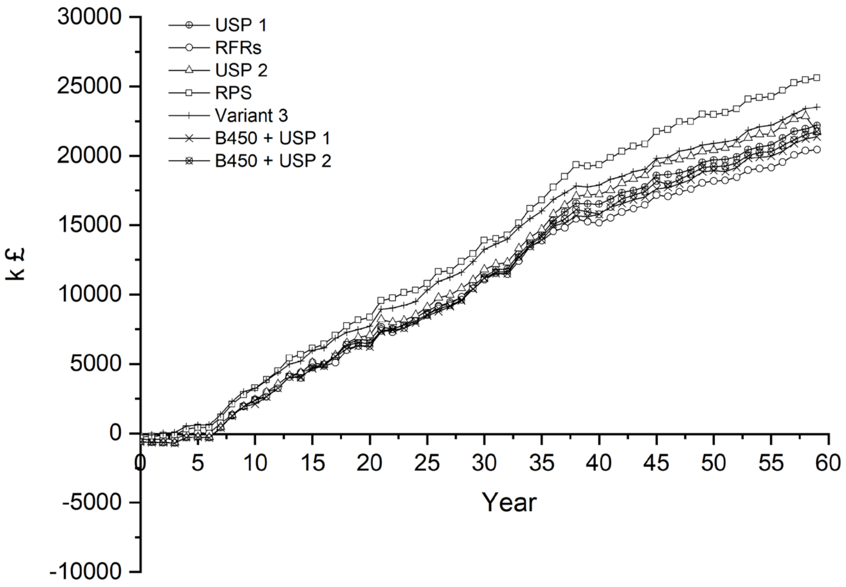
Figure 4: NPV (in 2019 prices). ECML (left), Portsmouth (Direct) Line (right).

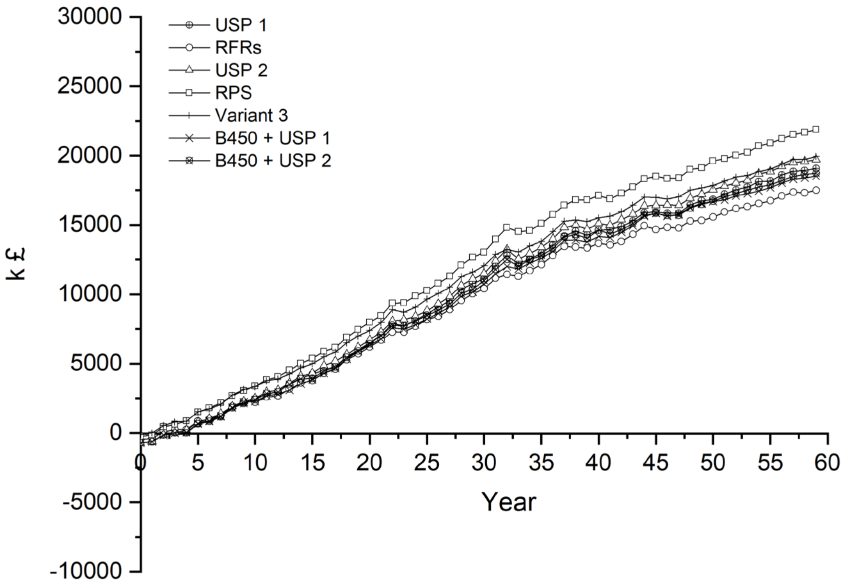


- **Total Savings**: 9.4-11.8% & 8.8-10.9%.
- **Carbon Savings**: small compared to the total footprint (range from 3-5% & 7-9%).
- **Carbon cost savings**: 4.8% to 9.4% of the financial benefits from reduced M&R activities.
- £107.6-110.3 million disbenefit from the use of FFU sleepers (+ c. £671k/mile & 20% higher settlement).

Findings [ii]

Figure 5: Maintenance and Renewal Accumulated Benefits. ECML (left), Portsmouth (Direct) Line (right).





- Payback period – USPs, Twin-block: **3-7** years, RFRs: **2-5** years, RPS: **2-4** years, Variant 3: **1-2** years.

Conclusions

- The relative improvement in overall settlement in the laboratory testing was implemented into an economic and carbon model to assess the LCC and carbon implications.
- Inclusion of novel interventions at renewals brings important benefits in terms of reduced M&R needs – less material & energy used in the track.
- Track quality is also improved – better ride quality may be expected.
- Soft modifications (RPS, Variant 3) to ballasted track provide higher LCC savings compared to more radical alterations (RFRs, B450 sleepers, USPs).
- It was also shown that the inclusion of novel interventions can bring sizeable carbon footprint savings.
- The welfare benefits from these modifications are small in relation to the expected financial benefits for both routes.

Thank you for your attention!

Questions ?

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