

NETWORK RAIL

S&C Circular Economy and Low Carbon Track

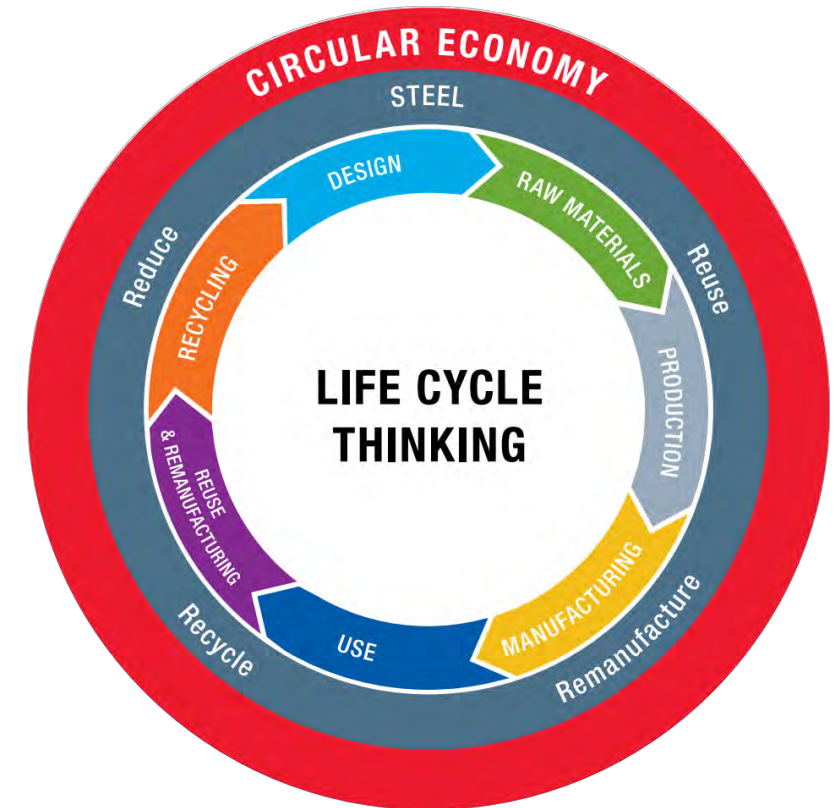
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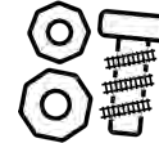
Darren Sharp
Principal Engineer
Track and S&C Team

Recycling/Reuse/Refurbishment of S&C Components and the Reduction in Carbon Footprint

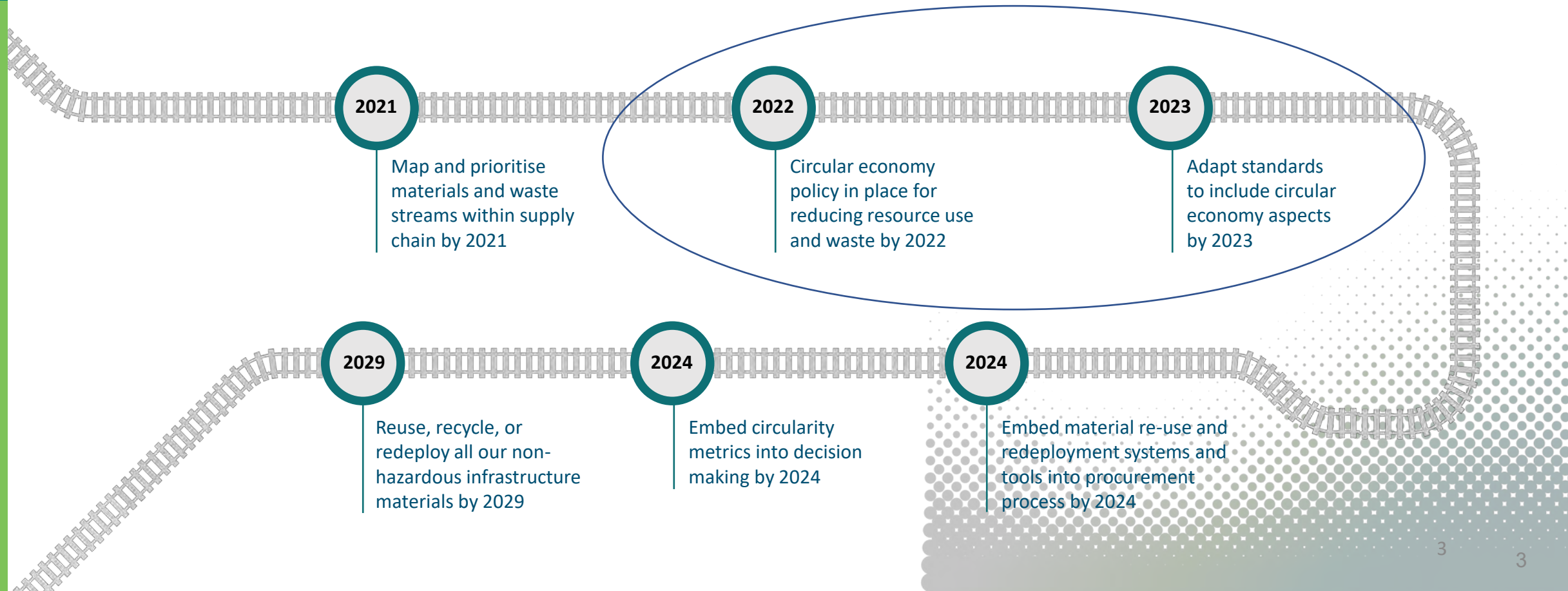
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3. Rail Production and CO₂ emissions
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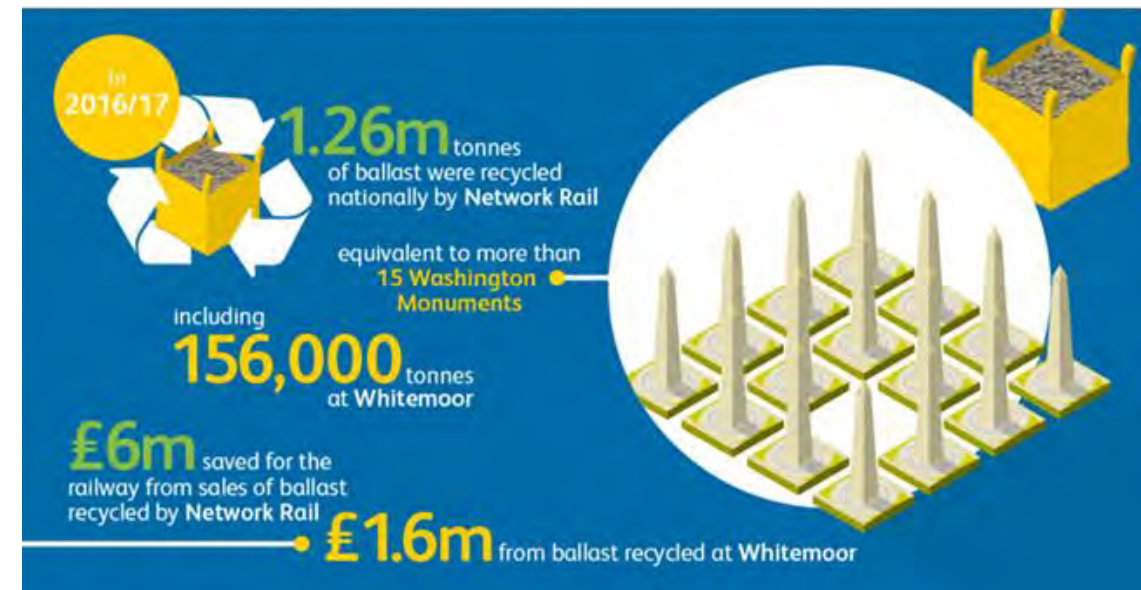
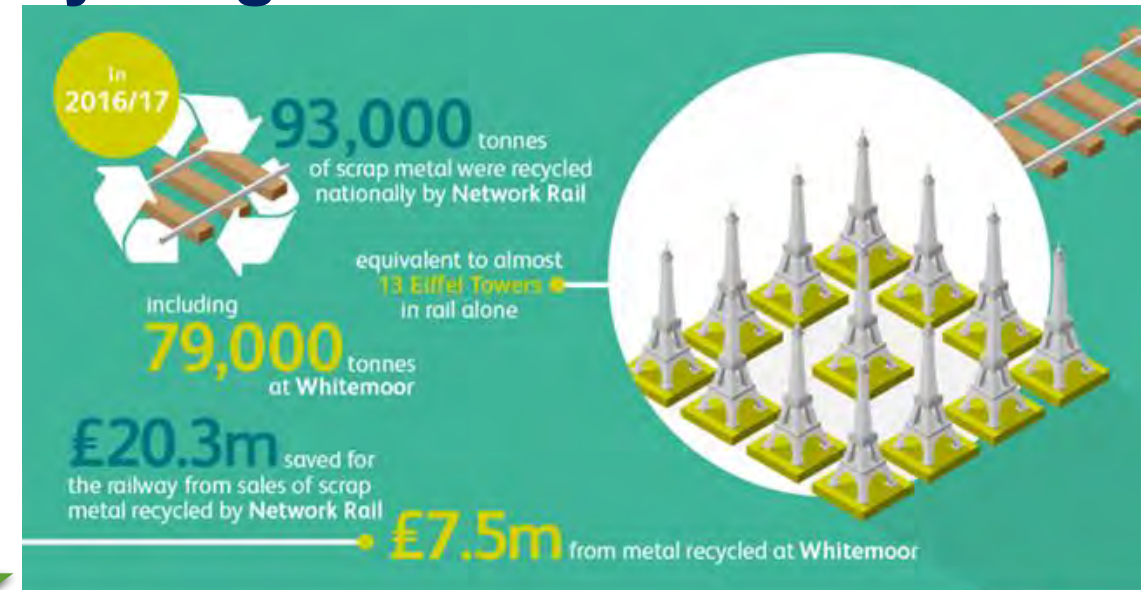
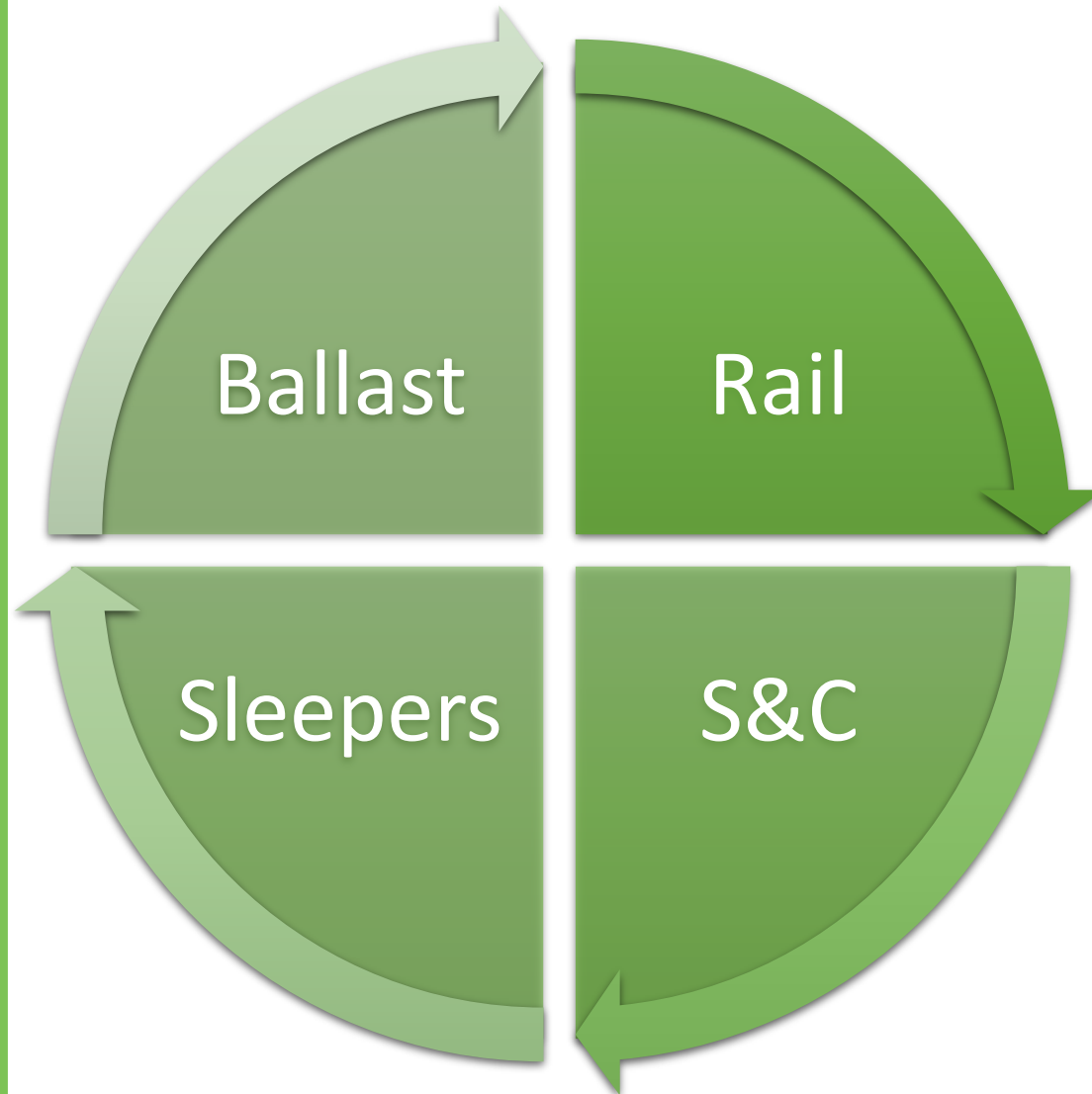
Minimal waste and the use of materials



We will reuse, repurpose or redeploy all surplus resources, minimise use of resources, design out waste and embed waste life-cycle/ circular economy thinking into the rail industry by 2035.



Network Rail Whitemoor Recycling Centre



Recycling/Reuse/Refurbishment of S&C Components

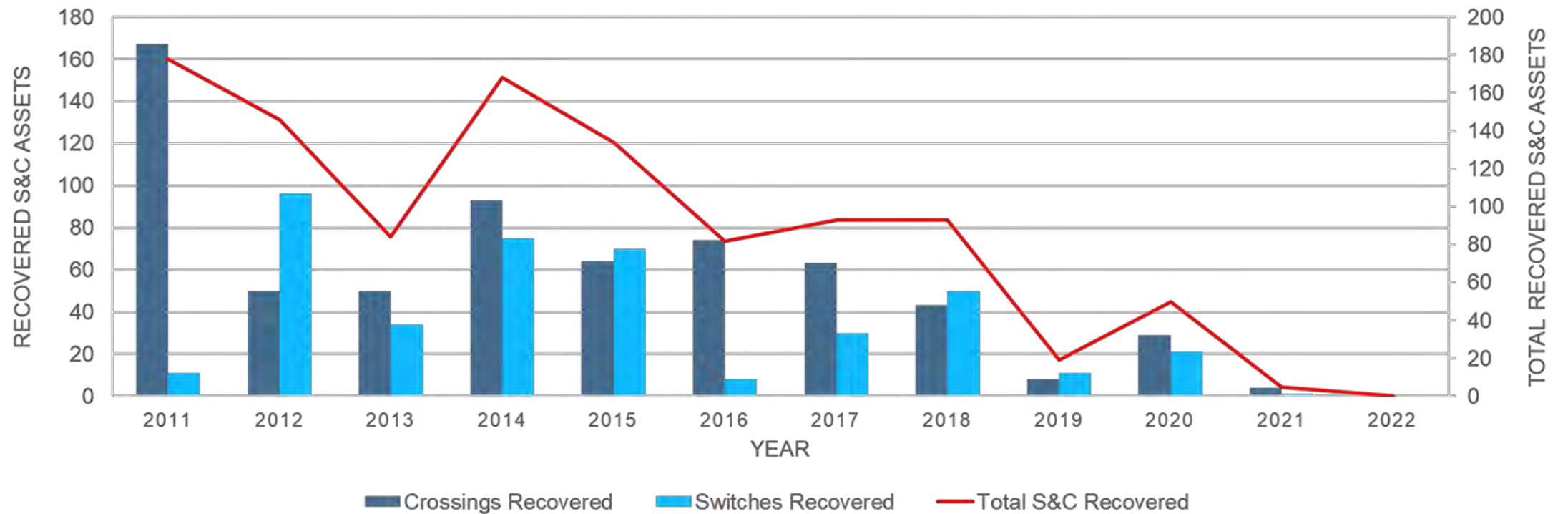
Recovery of S&C Components

- Network Rail renews 200 – 300 S&C units per year.
- Opportunity to re-use, re-furbish or recycle switches and crossings utilising the NR Whitemoor recycling centre
- 2020 NR ordered 958 new/replacement cast manganese crossings (1053 units in 2022)



Network Rail Whitemoor Recycling Centre

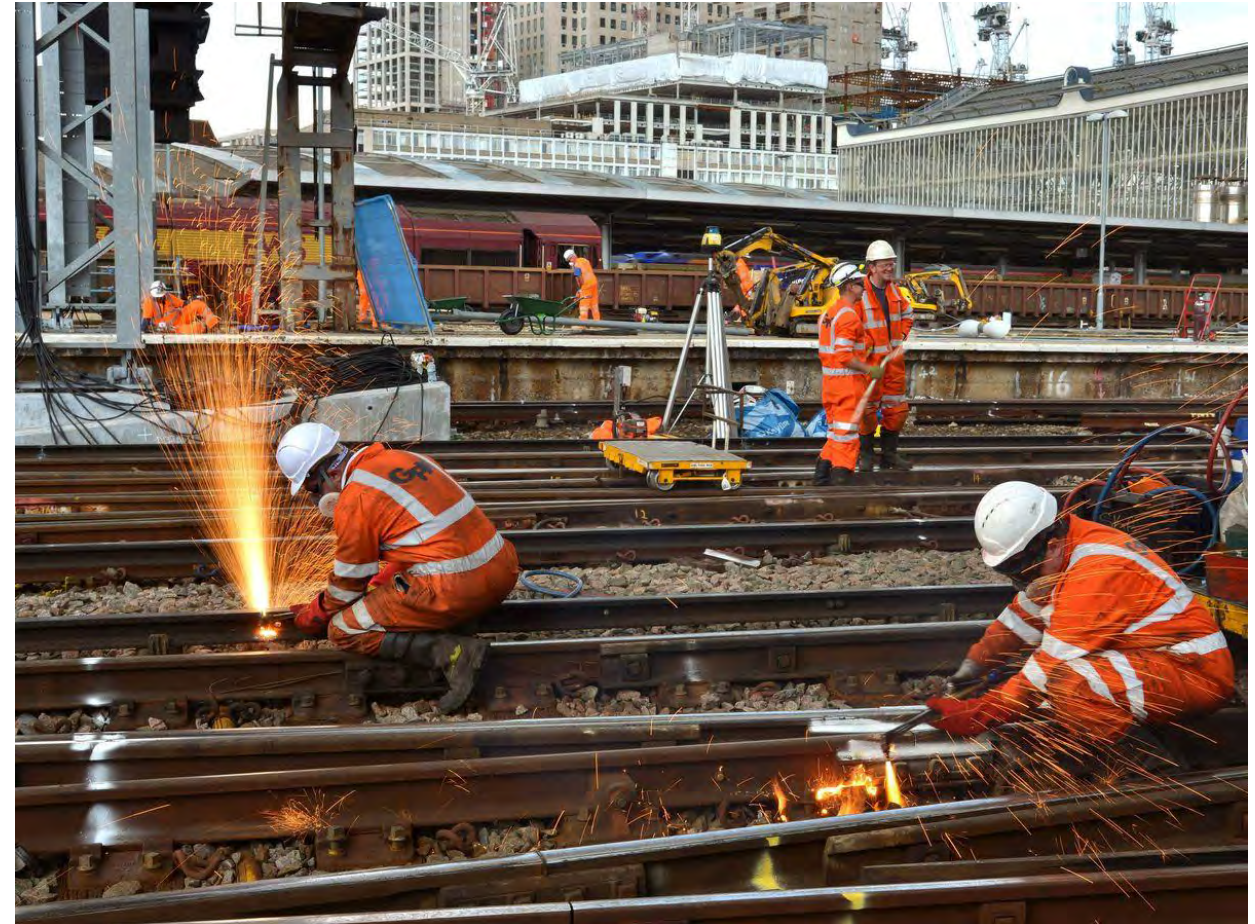
S&C RECOVERED TO WHITEMOOR



Network Rail Whitemoor Recycling Centre

Current capabilities

- Assessment/refurbishment of Full Depth, Shallow Depth & Bullhead Switches
- Assessment/refurbishment of Crossings
 - Fabricated
 - Part-Welded
 - Cast Manganese (CMX)
- Stocking
 - Recovered Check Rails
 - Recovered Expansion Switches
- Re-use of components into refurbished S&C
 - Pressing of switches or crossings to required design geometry
 - Milling and weld repair
- Timber layouts with baseplates



All items supplied with a Certificate of Conformity



Network Rail Whitemoor S&C Recycling Facility



Component recovery figures for 2022 (as of 7th November)

Crossings x 1 (Used item)

Switches x 6 (Unused items)

Components supplied figures for 2022

Crossings x 2

Switches x 8 half sets

Check rails x 8

Adjustment switch panels x 4 full sets

Some items are non-used lineside, incorrect orders, partially used and fully serviceable



Network Rail S&C Recycling Standards

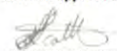
Ref:	NRL3/TRK/063
Issue:	2
Date:	05 December 2020
Compliance date:	05 December 2020

Level 2
Manual
Recycling and Reuse of Switches & Crossings

Approvals

Content approved by:

James McNamee,
Technical Lead

Content approved by:

Tara Scott,
Standard and Control Document Owner

Approved for publication by:

John Winniffrith,
Standards and Controls Management Team

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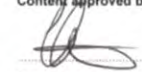
Ref:	NRL3/TRK/3415
Issue:	2
Date:	06 March 2021
Compliance date:	06 March 2021

Level 3
Work Instruction
Refurbishment of Switches and Crossings

Approvals

Content approved by:

Bethany Quayle,
Technical Lead

Content approved by:

Gareth Evans,
Standard and Control Document Owner

Approved for publication by:

John Winniffrith,
Standards and Controls Management Team

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Standards 063 and 3415 provide guidance on how and what can be refurbished/recycled



Why has S&C recovery decreased ?

- Possession time constraints and fear of over run penalties.
- Recovery of S&C is seen as difficult to do.
- Recovery not considered in the planning process.
- Poor perception of the cost (time and money) of sympathetic removal.
- Perceived machinery and equipment requirements to remove and handle S&C.
- No sustainability targets or incentives included in contracts

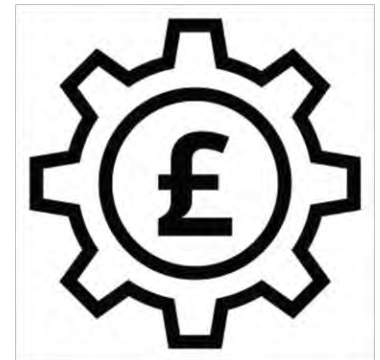


Almost new shallow depth switches – returned but cut too short when removed @£15k wasted.

Network Rail Whitemoor Recycling Centre

What could be achieved if S&C was recovered as part of every renewal delivery?

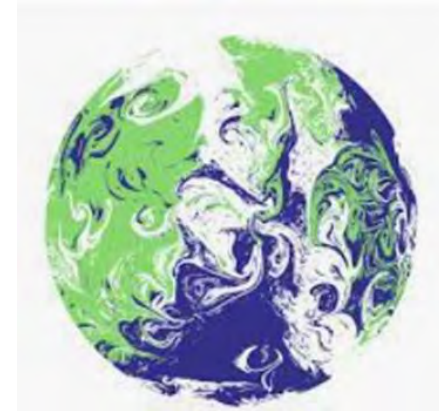
- Reduction in Carbon Footprint
- Cost reduction
- Reduce the depletion of natural resources
- Better availability in emergencies for spare components
- Reduced lead times compared to replacing with new
 - Lead time for new replacement CMX can be up to 52 weeks
- Availability of assets to be cascaded/used in renewals
- Strategic spares inventory
 - Bespoke component replacements storage
- Improved performance
 - Reduced train delay minutes and schedule 8 costs



S&C Recycling – The Circular Economy

Is S&C removed during renewals being assessed for recycling as serviceable components for re-use?

- What are the blockers to this ?
- How do we remove these ?
- **Carbon footprint** - as a business we need to start embracing this challenge and *doing our bit for the environment. It is our **Corporate responsibility***
- Recycling/re-using S&C can make a big impact.





Rail Production CO₂ Emissions

- **Network Rail Steel Suppliers – Rail is 40% of the CapEx CO₂e**
- 3 Contracted rail suppliers working towards a hybrid electric arc furnace production method from current blast furnace technology.
- 1 current supplier has electric arc furnace production method but not currently contracted to NR.
- ‘Green steel’ - next tenders will include an environmental weighting requirement.

Rail Production CO₂ Emissions

Rail CO₂e/track km

Single rail weighs
Tonnes of rail per track km (x2 rails)
Blast furnace or electric arc scrap
Approximate CO₂e content of steel
Kg of CO₂e per track km of rails

CEN60	
0.060	tonnes/m
120	tonnes/km
Blast furnace	
2780	kgCO ₂ e/tonne
333,600	

Steel produced
using a blast
furnace (BOF)

Rail CO₂e/track km

Single rail weighs
Tonnes of rail per track km (x2 rails)
Blast furnace or electric arc scrap
Approximate CO₂e content of steel
Kg of CO₂e per track km of rails

CEN60	
0.060	tonnes/m
120	tonnes/km
Electric arc scrap	
450	kgCO ₂ e/tonne
54,000	

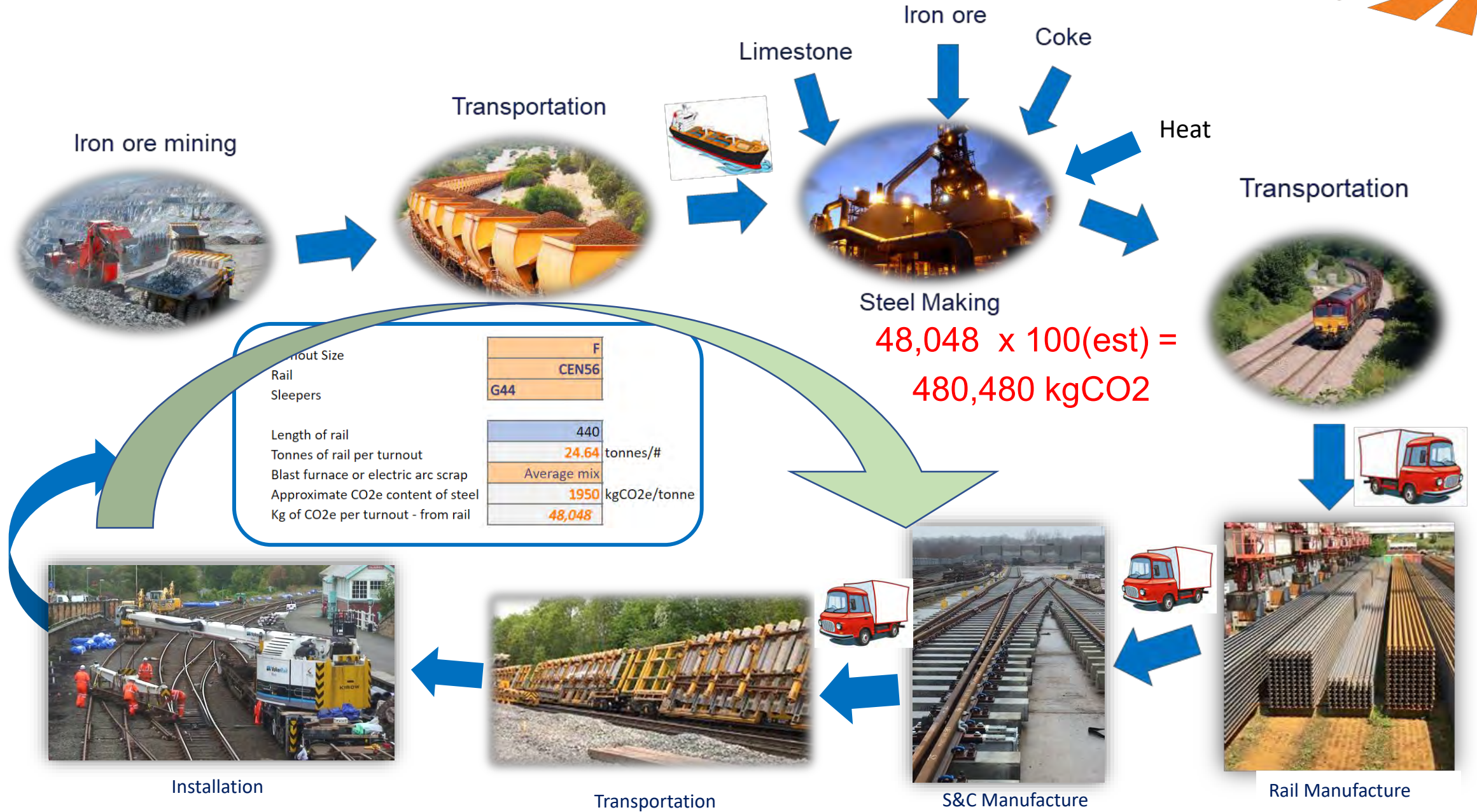
Steel produced
using an electric
arc furnace (EAF)

EAF has 1/6th of the
carbon content of BOF

Material savings only! – CO₂e
calculated from cradle to gate



Rail Production CO₂ Emissions



Recovery of S&C from Renewal Sites

NR Carbon Tool example (under development)

Concrete S&C Single Turnout CO2e/track km

Turnout Size	F
Rail	CEN56
Sleepers	G44
Length of rail	440
Tonnes of rail per turnout	24.64 tonnes/#
Blast furnace or electric arc scrap	Average mix
Approximate CO2e content of steel	1950 kgCO2e/tonne
Kg of CO2e per turnout - from rail	48,048
G44 sleeper weighs (concrete)	0.295
Approximate CO2e content of concrete/kg	129
Approximate CO2e content of sleeper concrete	38.055
Baseplate (pair) and/or fixings weighs (approx)	3
Approximate mass of rebar	22.66
Blast furnace or electric arc scrap	Blast furnace
Approximate CO2e content of steel/kg	2780
Approximate CO2e content of pair of sleeper baseplates and fixings	8.34
Approximate CO2e content of sleeper rebars	62.99
1# G44 sleeper contains	109.38
Equivalent sleepers per turnout	330
Kg of CO2e per layout bearers	36,097
1 turnout requires approximately	960 tonnes/km
Approximate CO2e content of ballast	4.38 kgCO2e/tonne
Kg of CO2e per track km of ballast	4,205 kg CO2e/km
Kg of CO2e per turnout	88,349

- Re-using S&C would considerably reduce the carbon footprint against supplying new.
- Recover S&C to Whitemoor for assessing to re-use/refurbish/recycle.
- Create a component resource for emergencies and other renewals – reducing lead times
- Cost savings not only components but schedule 8 delay costs.
- Including recovery in renewal plans should not add significant time to possession requirements if planned effectively.

Re-using S&C could save all of this carbon!
Transport and machinery CO₂ footprint would remain but would be the same as a renewal.



Recovery of S&C from Renewal Sites

Carbon Content in S&C



If 50 x Evs stock and switches and 1 in 15 cast crossings are repurposed each year this can save 900 tonnes CO2

Stock and Switches

- Full Set Evs = 10,000kgCO₂e
- Rail steel = 1950kgCO₂e/tonne

Cast Crossings

- 1 in 15 = 8000KgCO₂e
- 1 in 21= 9900kgCO₂e
- (CO₂kg data to be verified)

Concrete Bearers

- Average EV21 layout = 340 lin m of bearers = 17,950kgCO₂e
- D type bearer = 142kg/m = 53kgCO₂e/m



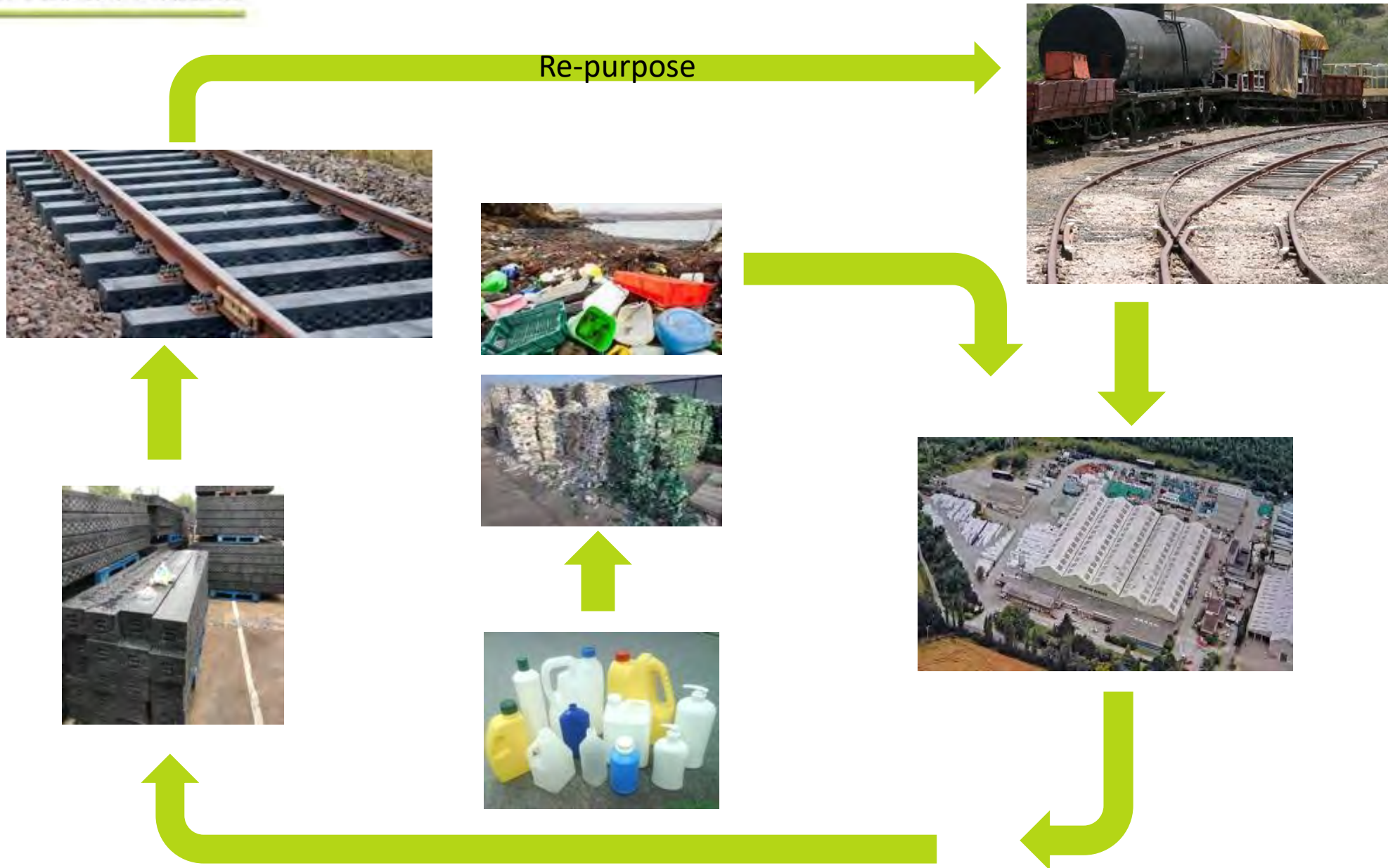
Plain Line Track Renewal CO₂

Composite Sleepers

- First installation on NR in March 2021. Approved to replace softwood sleeper.
- Contains a third of the CO₂ compared to a G44 concrete sleeper
- Full PA April 2022 for 135mm and May 2022 for 155mm. Guard rail, check rail and fastclip baseplates can be used
- Over 2000 installed so far.



Delivering Circular Economy PLUS



Plain Line Track Materials CO₂

Embodied kgCO₂/km values for plain line track with concrete sleepers

KVL	Complete renewal with trax No form	
Length of renewal	1	km
Total kgCO ₂ e	2,019,177	kgCO ₂ e
<i>Select Sleepers</i>		
Sleeper type	G44	
Steel from	Blast Furnace	
kgCO ₂ e/km	143,177	
<i>Select Rail</i>		
Sleeper type	CEN60	
Steel from	Blast Furnace	
kgCO ₂ e/km	336,000	Value for 2 x rails
<i>Ballast</i>		
Dig width	3.5	m
Dig depth	0.35	m
kgCO ₂ e/km	1,460,000	
<i>Plant Overhead</i>		
kgCO ₂ e/km	80,000	

Embodied kgCO₂/km values for plain line track with composite sleepers

KVL	Complete renewal with trax No form	
Length of renewal	1	km
Total kgCO ₂ e	1,942,615	kgCO ₂ e
<i>Select Sleepers</i>		
Sleeper type	Composite	
Steel from	Blast Furnace	
kgCO ₂ e/km	66,615	
<i>Select Rail</i>		
Sleeper type	CEN60	
Steel from	Blast Furnace	
kgCO ₂ e/km	336,000	Value for 2 x rails
<i>Ballast</i>		
Dig width	3.5	m
Dig depth	0.35	m
kgCO ₂ e/km	1,460,000	
<i>Plant Overhead</i>		
kgCO ₂ e/km	80,000	

Saving of 77 tonnes of CO₂/km

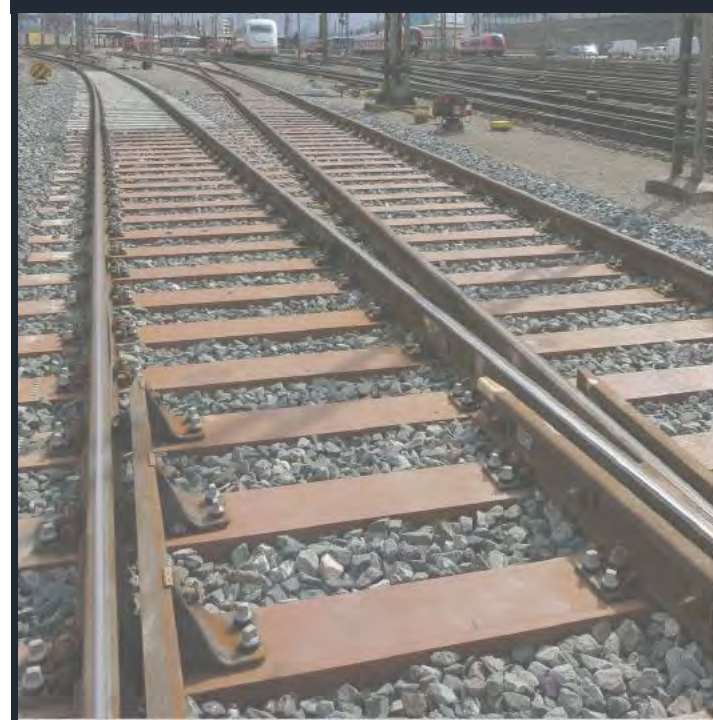


New Sleeper Technology and Low Carbon Alternatives

NR TA are exploring and researching sleeper designs with;

- Reduced CO₂
- Circular by design
- High lateral restraint

ThioTrack Sulphur Sleeper now being considered for potential trials.





Visit to Thiocrete (DeBonte), Belgium

Sulphur replaces cement and water to create a sleeper with 40% reduced CO₂e
Sleeper can be heated up to 120 deg C and re-moulded making the mix fully re-usable.
Fully EN tested including full operating and physical temperature range tests completed satisfactorily
Installed on SNCF and Infrabel classic sites up to 200kph. DB have started a 5 year trial.



The Bigger Picture – Save the Planet

- Recovering and re-using track and S&C components will help to reduce our carbon footprint.
- Use of low carbon alternatives
- Its our corporate and personal responsibility to act.
- It may seem a small contribution to a huge problem but every CO₂ reduction helps.
- Lets stop the reluctance to change. Step up to the challenge and play our part !



Thank you for listening

Any Questions?



**Technical
Authority**



Providing technical leadership