

Forth Green Freeport Seed Capital Carbon Opportunities Review

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FORTH
GREEN FREEPORT

Introduction

The Forth Green Freeport (FGF) is delivering a transformative programme of enabling infrastructure projects supported by c. £25m in Scottish Government Seed Funding capital.

These small to medium-scale interventions are designed to unlock key sites, prepare land for future third-party investment, and accelerate the wider development potential across the Green Freeport.

As part of these upcoming projects, FGF is committed to embedding opportunities for reducing carbon and implementing best practice carbon management strategies across all seed-funded works. As part of this ambition, a **Seed Capital Carbon Assessment** has been undertaken to understand anticipated early carbon impacts, evaluate construction materials, and ensure alignment with national net zero objectives and best-practice sustainable procurement (including [PAS 2080](#)).

The assessment was designed to look at typical construction materials and processes that may be used as part of the projects and to highlight to developers that there may be alternative solutions compared to business-as-usual material and construction choices.

This assessment is supported by additional strategic guidance around procurement and supply chain guidance, thus aiming to encourage aligned partners and developers to explore alternative measures to construction projects, and to ultimately support FGF in securing an enhanced approach to decarbonisation across both the seed funded projects, as well as wider developments.

FGF hope that the recommendations of the assessment encourage development partners to approach material and construction selection in a more considered approach compared to business as usual (BAU), thus setting a low carbon precedent for the Green Freeport and the region. The findings of the study can be used to leverage and explore ways to improve the carbon credentials of various material choices, and approaches to construction.

Whole life carbon in context of FGF Development

FGF and Whole Life Carbon

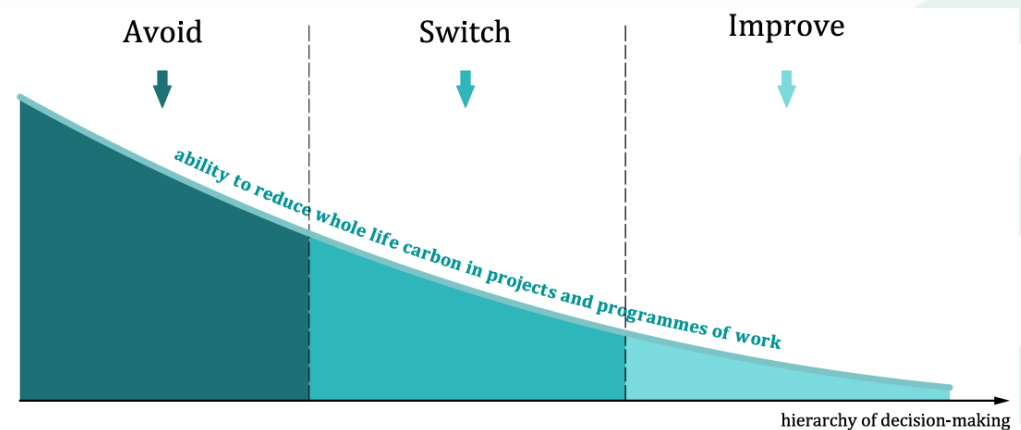
FGF aims to set the precedent and work with its development partners to deliver low carbon solutions to the Green Freeport's projects. Understanding embodied and operational carbon (whole life carbon) for projects is key and needs to be tackled inline with government policy and the FGF Net Zero Charter.

Assessing whole life carbon of materials or projects will enable FGF and its development partners to:

- Understand carbon impacts early in the proposal, inception, design and technical development stages.
- Identify and adopt alternative solutions to reduce carbon from construction and operation.
- Highlight material-related impacts early to inform design and specifications.

Assessing carbon impacts alongside key material costs helps reveal carbon and cost hotspots, supporting high-value opportunities for reductions across infrastructure projects.

While seed-funded works are still at an early stage, the [PAS 2080](#) hierarchy shows the greatest potential to reduce carbon occurs when decisions are made early in project planning.



Source: PAS2080:2023 Carbon management in buildings and infrastructure

Seed Funding Carbon Assessment and Guidance

Carbon Assessment Decisions

To aid the FGF and its partners, an analysis of key infrastructure materials has been developed to help in decision making around the seed funding projects. This assessment sought to estimate the baseline embodied carbon associated with typical infrastructure construction materials.

By establishing an initial view of the material impact of such options, the assessment seeks to support FGF in understanding the scale of carbon impacts at an early stage of development and to offer alternative recommendations.

The assessment tested alternative material scenarios by allowing comparisons between conventional material choices and lower-carbon substitutes that are available in the UK construction market. Through this assessment, various recommendations and hot spots have been identified to help inform decision-making for the material choices. These findings are not only applicable to the seed funding projects but could be adopted on wider development works for Forth Green Freeport.

Key Material Sectors Assessed

Key material sectors that have been assessed as part of the seed funding carbon assessment:

- **Asphalt & Bituminous Materials** – emissions linked to surfacing and roadworks.
- **Concrete & Cementitious Materials** – a major contributor to embodied carbon across multiple projects.
- **Steel (Structural & Reinforcement)** – significant emissions from structural elements and reinforcement.
- **Plant & Construction Equipment** – carbon associated with diesel-powered machinery and on-site operations.
- **Transport (HGVs & Site Logistics)** – emissions from freight, deliveries, and site logistics movements.

Seed Funding Carbon Assessment and Guidance

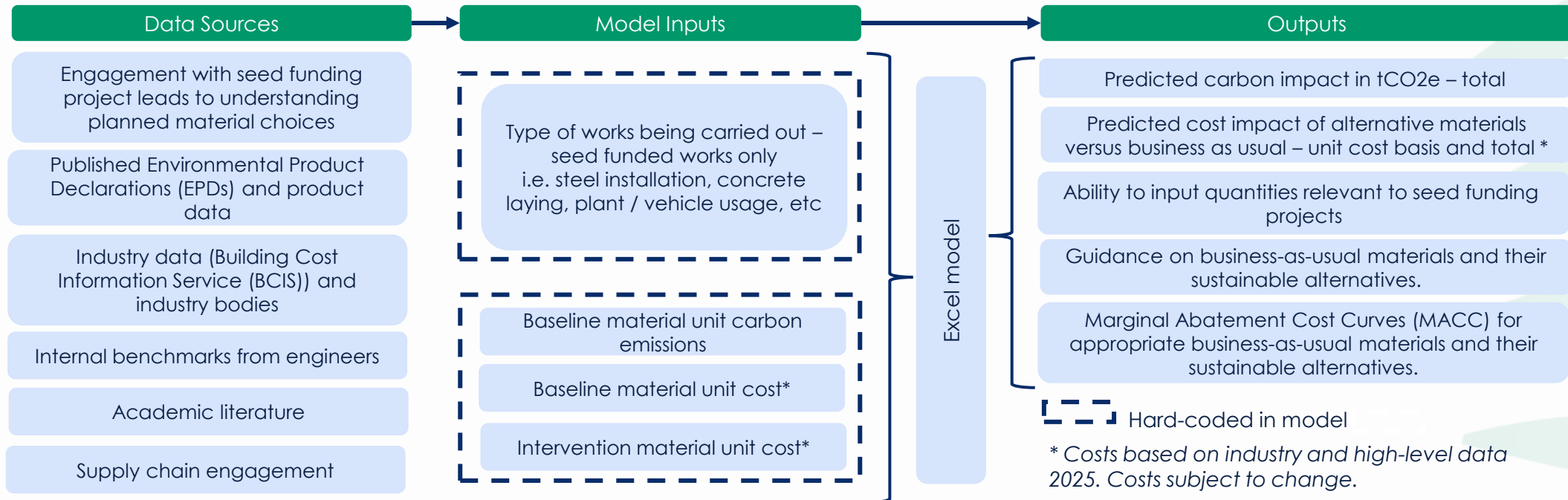
Material Assessment Model

The assessment model was designed to aid and enable FGF and its partners to make more informed and transparent decisions regarding material selection, by quantifying both the carbon impacts and associated cost implications (£/tCO₂e) of different

material options.

The model also helps to optimise procurement pathways by providing evidence-based insights aligned with [PAS 2080](#) and wider sustainable construction standards.

The model structure is established as follows:



Seed Funding Carbon Assessment and Guidance

Material findings

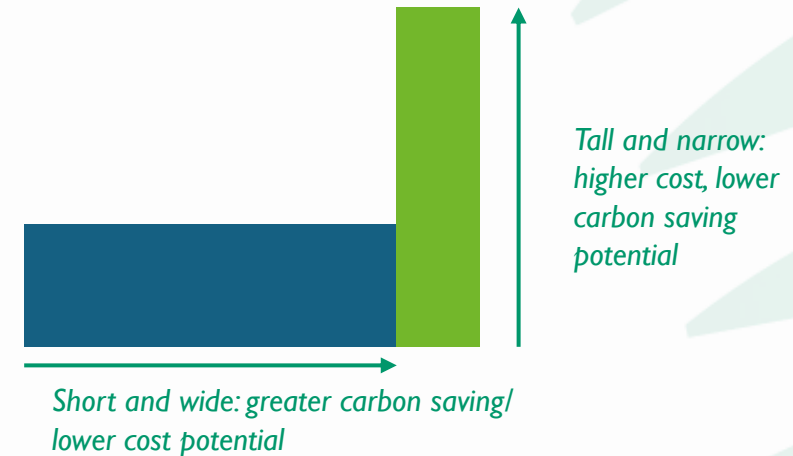
To support early design and procurement decisions, the assessment prepared outputs across a range of key material options and highlighted hotspots, such as carbon impact vs cost (tCO₂e/£).

A series of **Marginal Abatement Cost Curves (MACCs)** for key material categories were developed to illustrate relative carbon/cost-effectiveness of lower-carbon alternative materials compared to business-as-usual (BAU) specifications.

The MACCs show each material category as a box where:

- **Width** represents the carbon abatement potential (tCO₂e saved per unit). The wider the box the greater the carbon saving potential.
- **Height** represents the marginal cost per tonne of CO₂e saved. Boxes above the x-axis (positive) show a cost premium. Boxes below the x-axis (negative) indicate a cost saving.

Material categories are sorted along the x-axis, left to right, by increasing cost per tCO₂e.



The analysis highlights where the largest and most cost-effective carbon savings can be achieved across key material categories. Outputs enable decision-makers to see which options deliver the greatest carbon savings at the lowest relative cost (based on 2025 industry cost data). While some alternative materials offer higher abatement potential than BAU at a cost premium, others provide meaningful carbon reductions at relatively low cost.

Results are indicative only, based on per-unit analysis, 2025 cost assumptions.

Seed Funding Carbon Assessment and Guidance

Material findings

Key areas examined:

Asphalt: Used in over 90% of paved roads globally, its cumulative impact on climate change is substantial. Asphalt is a significant contributor to greenhouse gas (GHG) emissions, primarily due to the energy-intensive process of heating aggregates and petroleum-based bitumen. Alternative binders, and lower temperature interventions are key for reducing carbon emissions associated with Asphalt.

Concrete is the most widely used construction material globally, contributing 7–8% of global CO₂ emissions, primarily from cement manufacturing. Cement is the binding component of concrete. Decarbonising concrete is an environmental imperative and a strategic necessity for sustainable construction. Alternative cementitious materials are key to reducing the carbon emissions of concrete.

Steel: Steel production is one of the most carbon-intensive industrial processes, accounting for approximately 8% of global CO₂ emissions. Using steel with high recycled content or producing steel through electric arc furnace (EAF) methods are key to decarbonising steel production.

Transport: Heavy Goods Vehicles (HGVs) are among the most carbon-intensive components of the transportation sector, accounting for nearly 39% of life-cycle road vehicle greenhouse gas emissions. Strategies for emissions reduction include transitioning to zero-emission technologies such as battery-electric and hydrogen fuel cell trucks.

Plant: Diesel-powered construction equipment is a major source of GHG emissions and air pollutants. Reducing emissions from these machines is essential for achieving net zero targets and improving air quality. Strategies include transitioning to electric or hydrogen-powered construction equipment.

Analysis Findings: Marginal Abatement Cost Curve (MACC) for Asphalt: BAU vs Alternatives

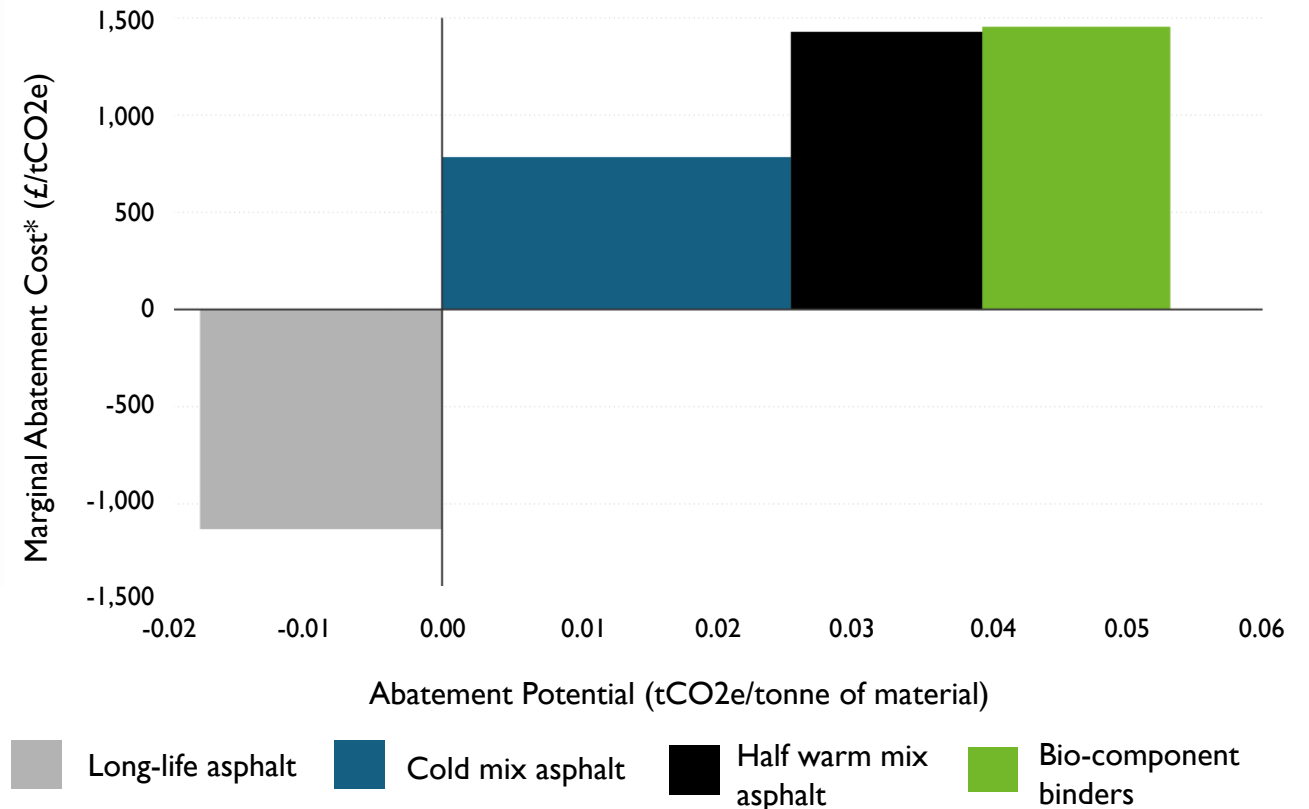
COMMENTARY

This marginal abatement cost curve (MACC) illustrates the business-as-usual (BAU) material, general asphalt, compared to its potential alternatives indicated in the graph's legend.

Long-life asphalt (LLA) offers potential cost savings, but its abatement potential is negative, indicating higher carbon emissions than BAU on installation. However, fewer replacements are needed over LLA's economic life span, as such carbon savings are made long term, reducing whole life carbon.

Long-life asphalt presents a significant whole life decarbonisation and cost saving opportunity associated with fewer maintenance activities over economic lifetime, despite initially being slightly more carbon intensive than current products.

* Based on 2025 industry cost data



Analysis Findings: MACC for Concrete - Ready Mix - General : BAU vs Alternatives

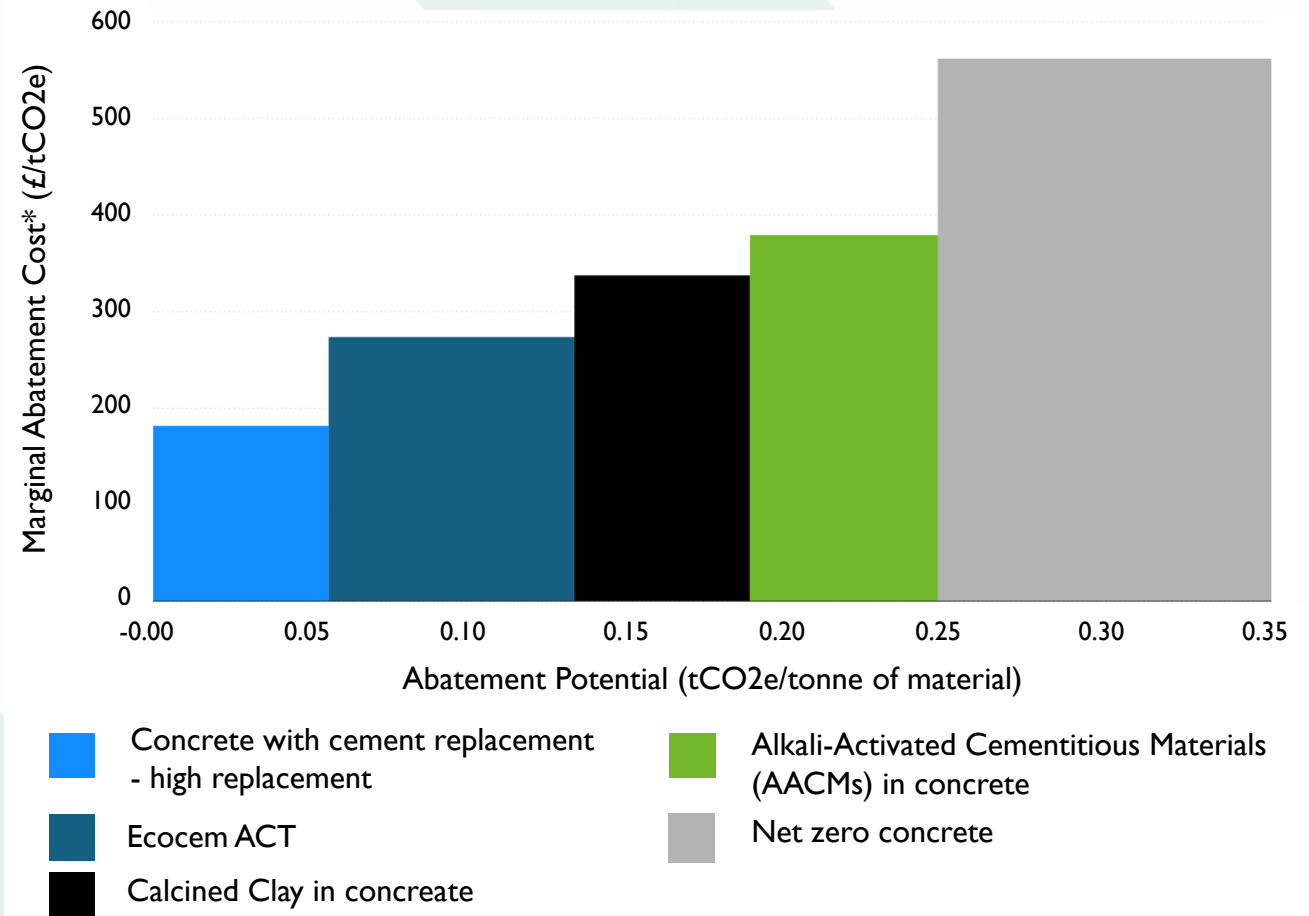
COMMENTARY

This marginal abatement cost curve (MACC) illustrates the business-as-usual (BAU) material, Ready Mix – General (Concrete), compared to its potential alternatives, as indicated in the graph's legend.

Net zero concrete provides the highest abatement potential but has the highest cost premium, when assessed on a per-unit basis.

Concrete with cement replacement – high replacement offers the lowest cost premium, but one of the lowest abatement potentials. Currently concrete with cement replacement – high replacement is widely abundant in the short term, but may become scarcer as the steel industry moves towards electric arc furnace (EAF) produced steel.

* Based on 2025 industry cost data



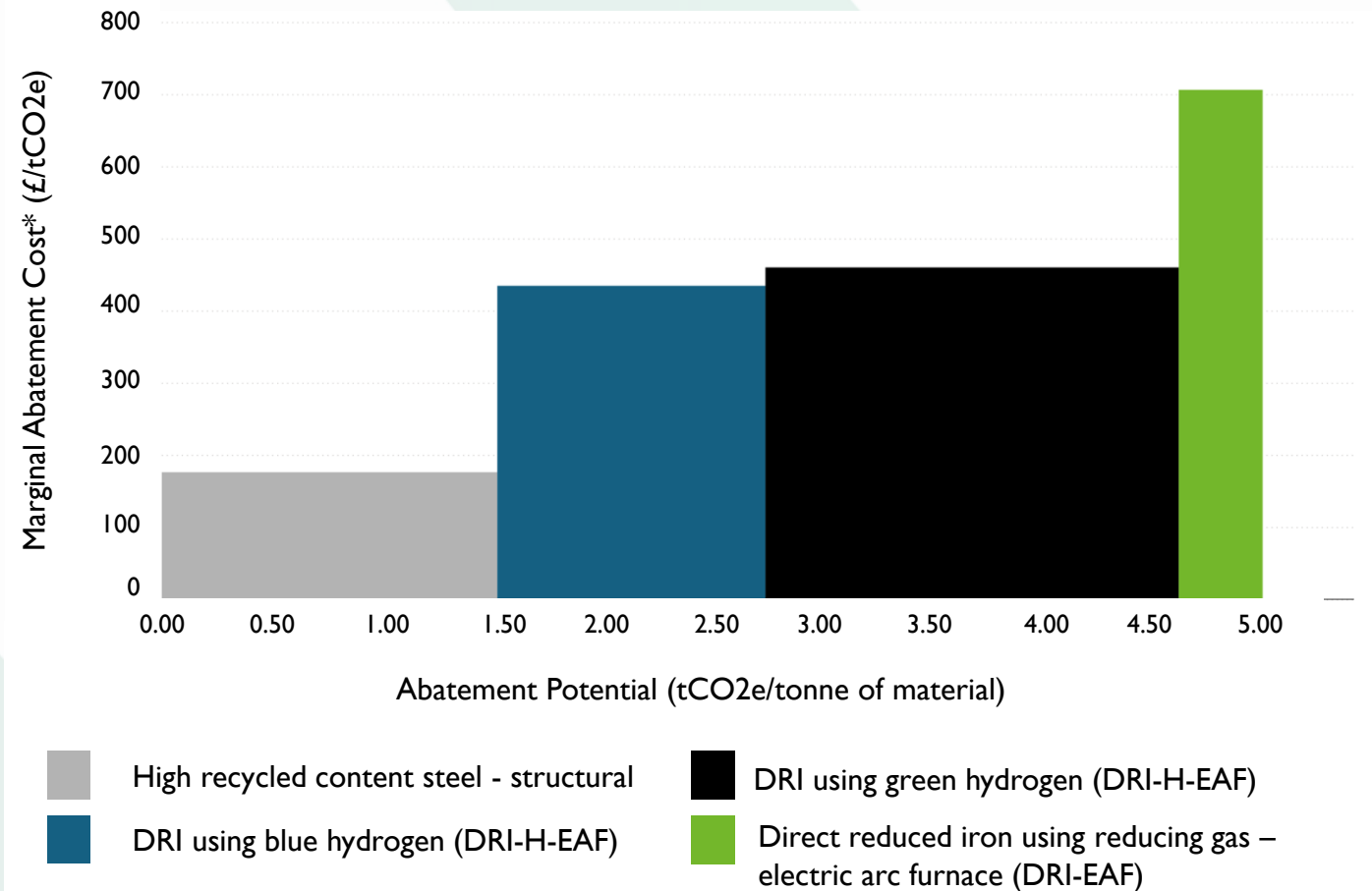
Analysis Findings: MACC for Steel : BAU vs Alternatives

COMMENTARY

This marginal abatement cost curve (MACC) illustrates the business-as-usual (BAU) material, general steel, compared to its potential alternatives, as indicated in the graph's legend.

High recycled content steel – structural (Electric Arc Furnace) offers the highest abatement potential with the lowest cost premium relative to general steel, when assessed on a per unit basis.

* Based on 2025 industry cost data



Analysis Findings: MACC for Plant & Equipment: BAU VS Alternatives

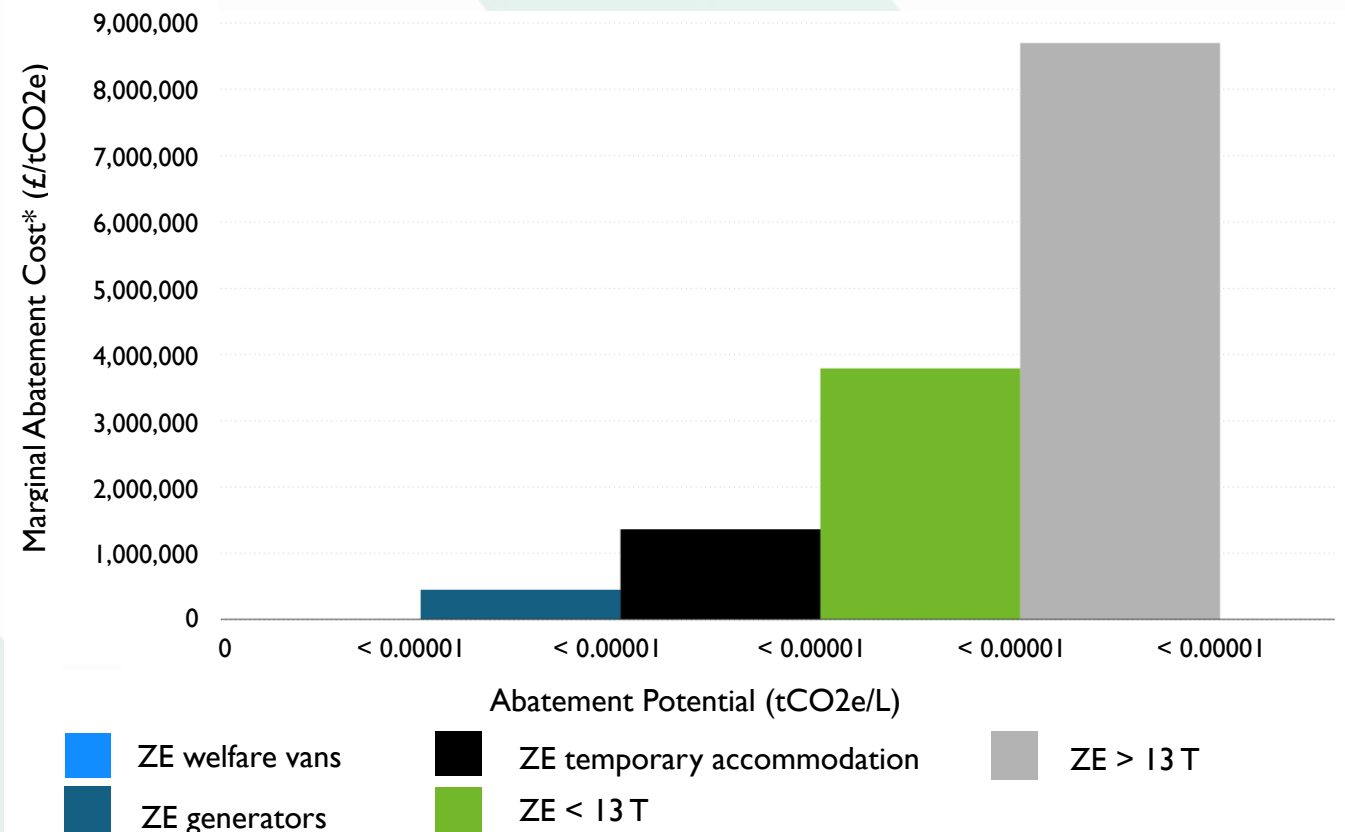
COMMENTARY

This marginal abatement cost curve (MACC) illustrates the business-as-usual (BAU) diesel-fuelled plant and equipment assessed, compared to their respective zero emission (ZE) alternatives.

As expected, transitioning to a zero-emission alternative will involve additional costs but will deliver carbon abatement potential, as shown in the MACC. The graph shows that the abatement potential in each case is negligible.

Typically, heavier plant is more challenging to source. Initial research indicates that ZE generators are becoming more widely considered by contractors.

* Based on 2025 industry cost data



Analysis Findings: MACC for HGVS & Other Vehicles: BAU VS Alternatives

COMMENTARY

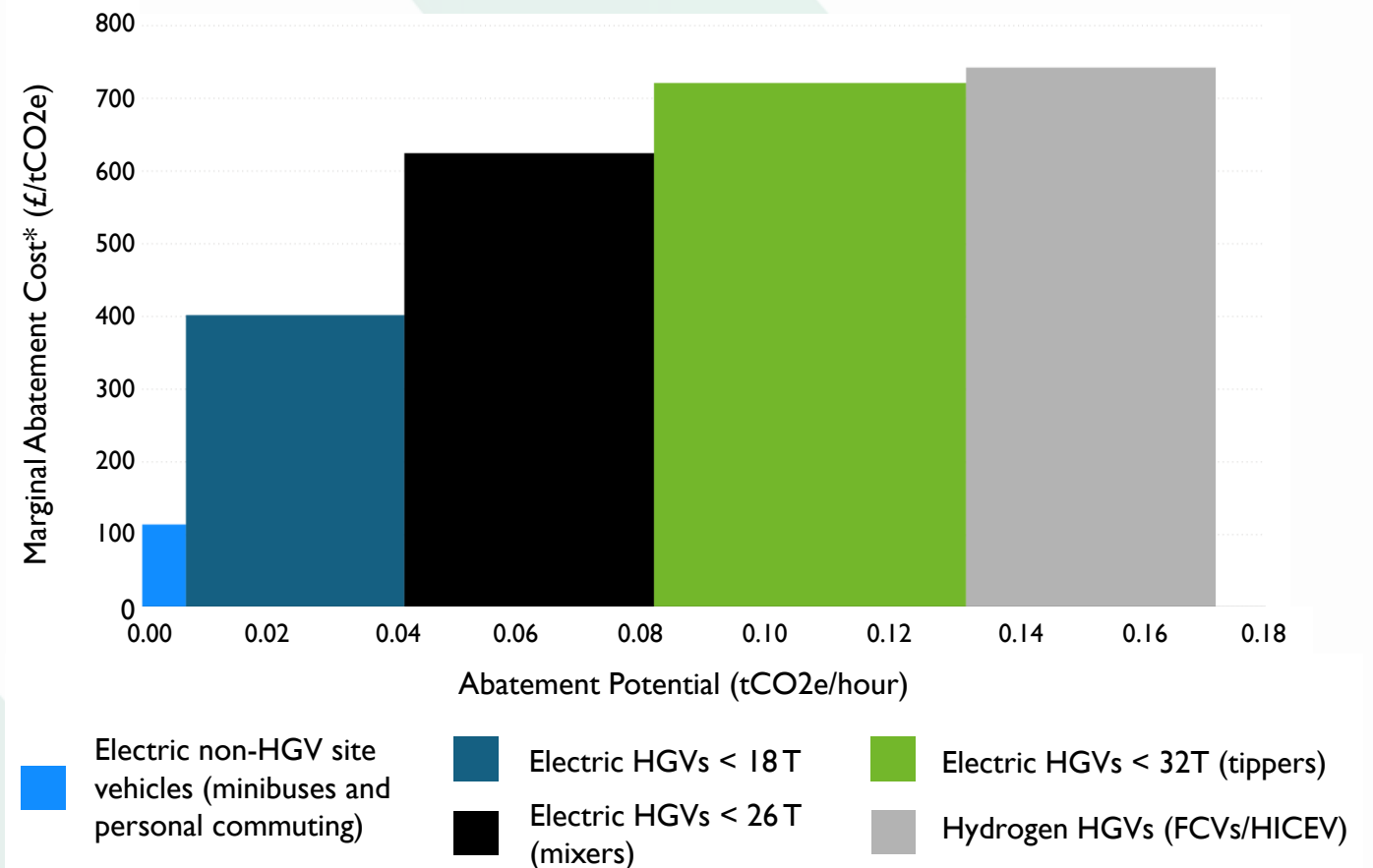
This marginal abatement cost curve (MACC) illustrates the business-as-usual (BAU) diesel-fuelled HGVs and non-HGV site vehicles assessed, compared to their respective electric alternatives.

Transitioning to a zero-emission alternative will involve additional costs but will deliver meaningful carbon abatement potential.

This MACC disproportionately favours transitioning heavier vehicles to electricity as an intervention. Heavier vehicles have a larger abatement potential, due to being more polluting and fuel demanding.

The transition of non-HGVs to electric is far more easily achieved by comparison, despite the lower abatement potential, and are more widely available in the market.

* Based on 2025 industry cost data



Key recommendations for targeting carbon hotspots and Green Freeport supply chains

As part of the workstreams and analysis, a range of carbon recommendations, material procurement and governance processes were identified. Recommendations aim to target carbon reduction across both seed funding projects and wider end users on FGF tax sites.

The summary overleaf provides an overview of key recommendations that could be deployed across the following four areas of development:



Policy



Supply chain engagement



Governance and monitoring KPIs and targets



Procurement for contracting and design

Recommendations

Policy

- **Continue to promote the Net Zero Charter:** Share the Net Zero Charter with all prospective end users and project partners, offering tailored support, where appropriate. Ensure that all landowners, seed projects and end users understand and adhere to the Charter's requirements.

Supply Chain Engagement

- **Support for suppliers:** Promote collaboration between landowners, seed funded projects, end users, and supply chain partners to enhance net zero and sustainability performance across all operations. Emphasise reducing supply chain impacts and encourage innovation in procurement, including opportunities for shared energy, logistics, and waste management services.

- **Increased awareness:** Inform suppliers and partners into FGF of the net zero ambitions of the tax sites that they work on. Provide access to information and explainers, as needed, to ensure that evolving procurement expectations and carbon reduction requirements are understood.
- **Encourage innovation and celebrate progress:** Create platforms to showcase success and recognise excellence to motivate continuous improvement across construction, logistics and operations.

Recommendations

Governance and monitoring

- **Carbon management plans:** Promote end users on tax sites to prepare Carbon Management Plans aligned to PAS 2080 where appropriate, including annual reporting and carbon reduction roadmaps.
- **Emissions reporting:** Require seed funded projects to monitor and report on progress against the carbon emissions estimated within the Full Business Case. Ensure that all end users on tax sites monitor and report on embodied and operational carbon emissions in year. Enabling FGF carbon management progress to be monitored against targets, drawing from the principles of PAS 2080.
- **Adoption of principles:** Encourage end users in the tax site to require suppliers to adopt PAS 2080 principles, supported by third-party verification where viable. Provide access to guidance to help meet requirements.
- **KPIs:** Encourage carbon KPIs to be embedded in supplier contracts to track progress. Targets could include percentage reductions in embodied carbon and requirements for contractor training on KPI delivery.

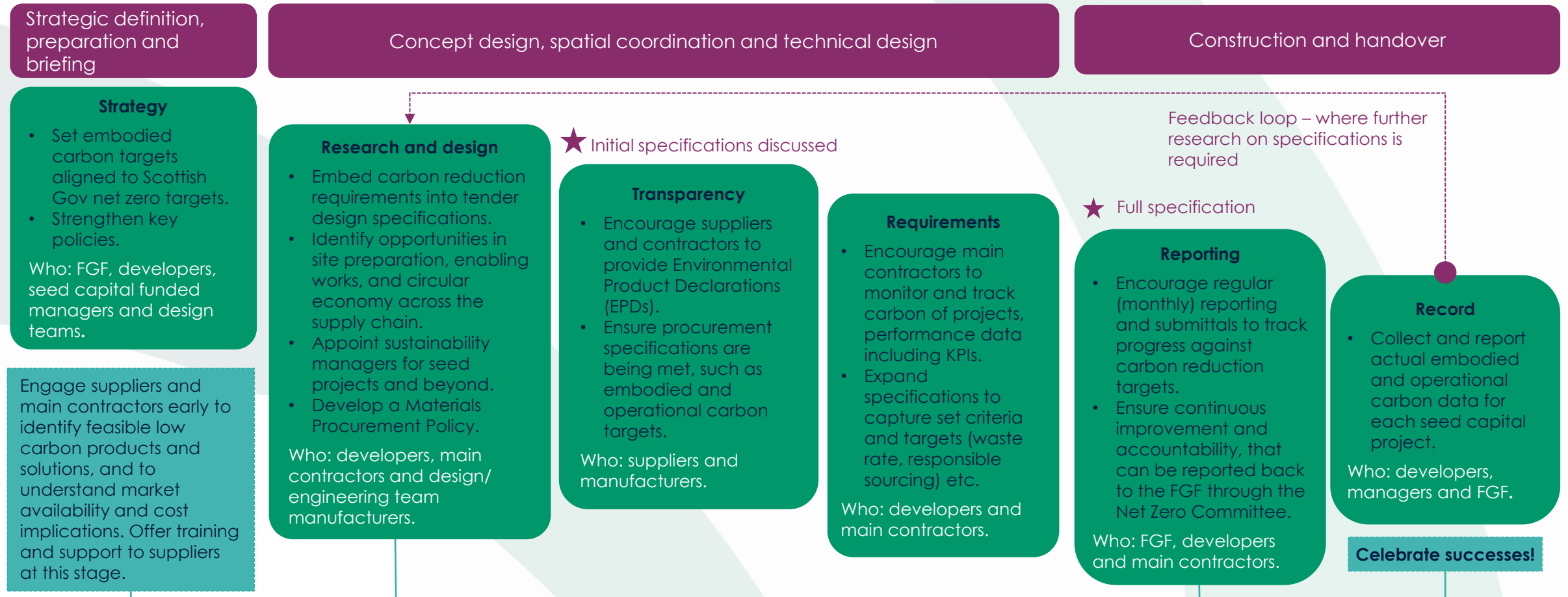
Recommendations

Procurement, contracting and design

- **Design tender specifications:** Encourage end users on tax sites to include clear, measurable carbon reduction requirements in tender design specifications, covering material sourcing, recycled content, and certified low-carbon products.
- **Materials procurement policy:** Encourage end users on tax sites to prioritise procuring materials with recognised environmental standards, verified sustainability data, and embodied-carbon limits for key materials like aluminium and steel.
- **Circular economy principles:** Promote end users on tax sites to align with BS 8001:2017, embedding circular economy principles across project delivery and resource management.
- **Responsible sourcing:** Help end users on tax sites to identify suppliers of responsibly sourced, certified, or accredited materials to minimise environmental impact and ensure transparent supply chains.
- **Waste Management:** Support end users on tax sites to develop robust waste management strategies aligned with national best practice, including clear processes for segregation and hazardous waste handling.

Recommended Roadmap for Project Procurement

A further recommendation is for end users on tax sites to follow a carbon reduction roadmap across all stages of project design and procurement. Below is a high-level roadmap example, structured in alignment with typical planning, design and construction stages.





Thank you

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