

英国建設業界におけるNet zero達成に向けた取組 IABSE Symposium Manchester 2024 を聴講して

JSCE 国際化実践小委員会 委員
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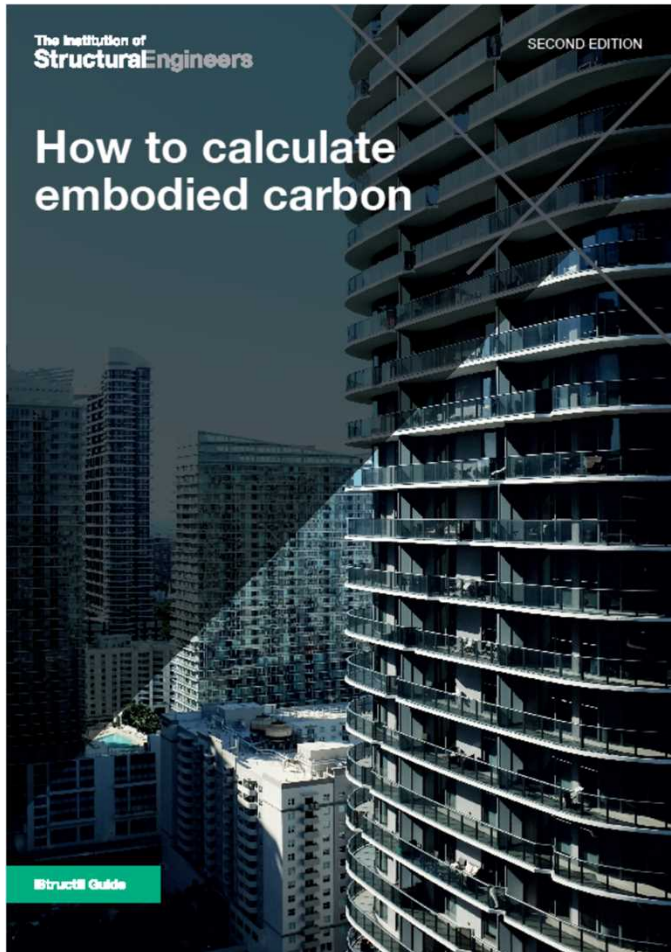
- ④ **EPD（環境製品宣言）** ← 自社製品の環境情報を透明性高く算定・開示する国際的枠組み
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3. おわりに

1. 英国のNet Zero達成に向けた取組例

① How to calculate embodied carbon

How to calculate embodied carbon (HCEC)



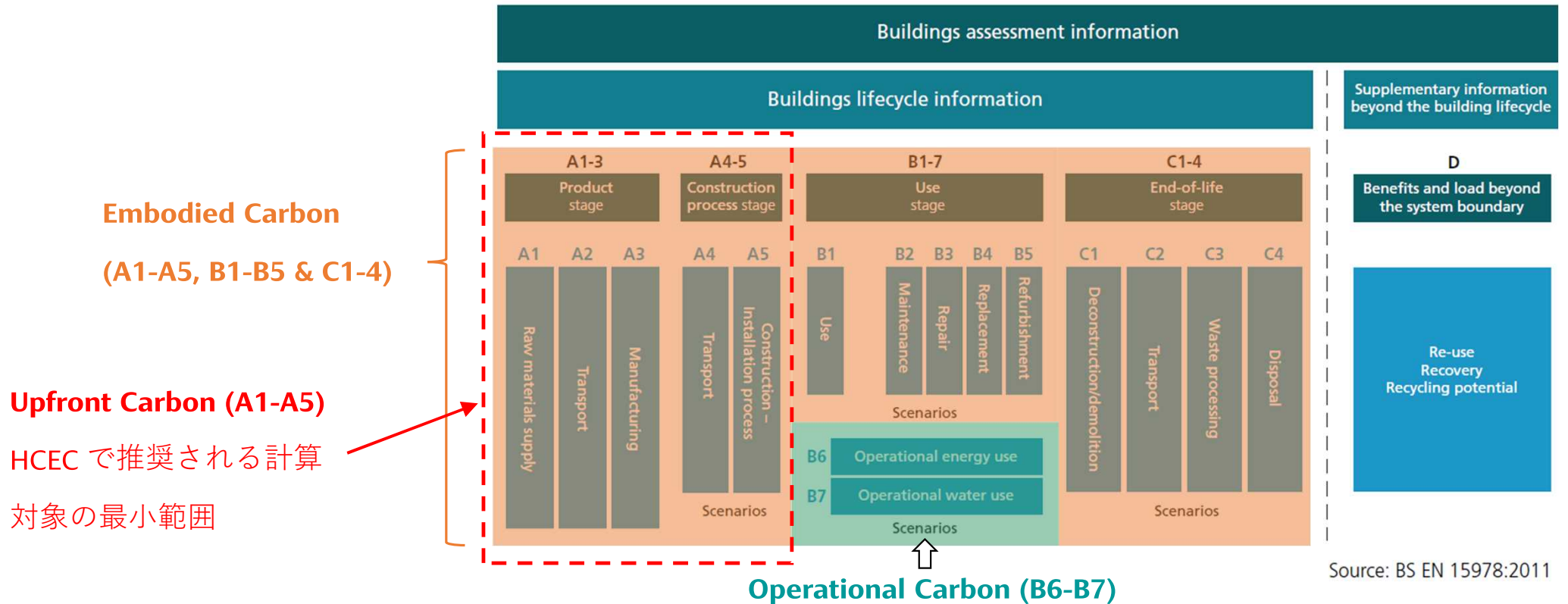
HCECとは？

- 英国の構造エンジニア協会（Institution of Structural Engineers）のClimate Emergency Task Groupが発行した、**建設工事における温室効果ガス（GHG）の排出量算出に関する方法論**を示したガイドライン。
- 1st Editionが2020年に、2nd Editionが2022年に発行。
- **インフラ及び建築工事の双方に適用可能。**
- 具体的な計算プロセスや計算事例を掲載しており、実務者向けのガイドラインとなっている。

出典：ISE “How to calculate embodied carbon” 2nd edition

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HCEC における Embodied Carbon の定義



Embodied Carbon : 建設対象のライフサイクル全体を通して、材料の製造や建設、供用、解体プロセスに伴う全温室効果ガスの排出量及び除去量 (B6, B7 に分類される供用時のエネルギー・水消費は除く)

Embodied Carbon + Operational Carbon + Module D = Whole Life Carbon

HCECの計算原則

➤ HCECにおけるEmbodied Carbonの基本計算原則：

建設材料の数量（重量や面積等） x 炭素係数（Carbon Factor） = Embodied Carbon

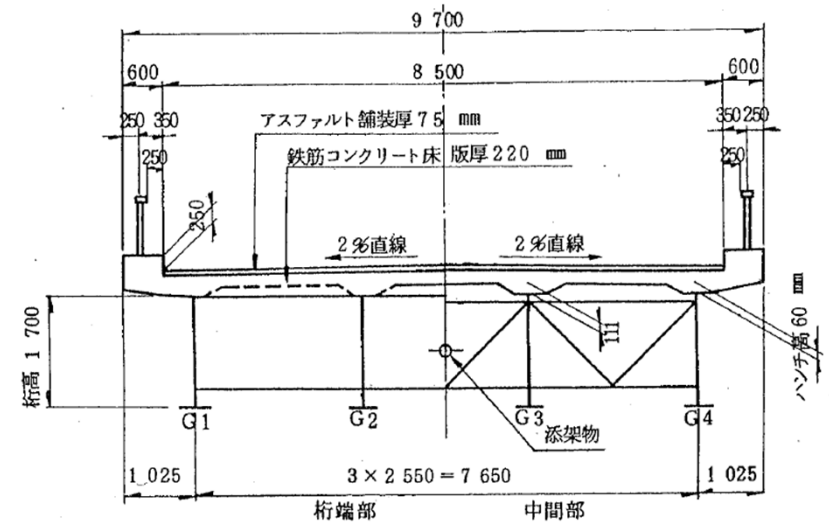
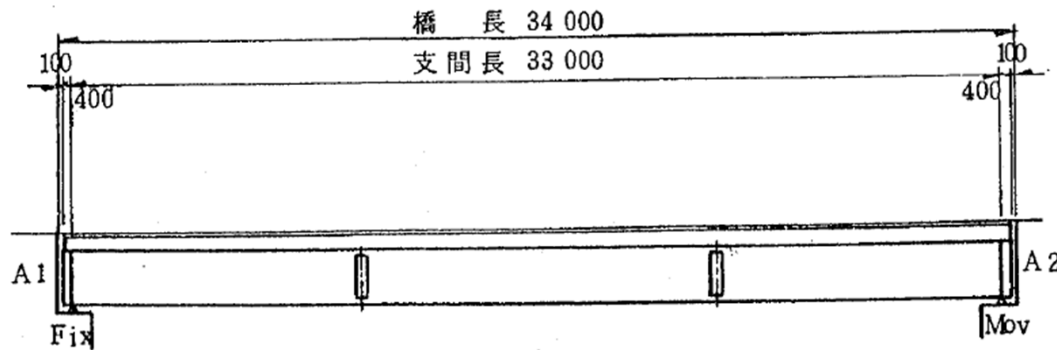
The fundamental principle of an embodied carbon calculation is to multiply the quantity of each material by a carbon factor for the life cycle modules being considered[†]:

$$\text{material quantity (kg)} \times \text{carbon factor (kgCO}_2\text{e/kg)} = \text{embodied carbon (kgCO}_2\text{e)}$$

出典：ISE “How to calculate embodied carbon” 2nd edition

Embodied carbon の計算例

➤ 合成桁橋の製作に伴う Embodied Carbon (Module A1-3 : 製造段階)



出典：日本橋梁建設協会「合成桁の設計例と解説(H17)」

桁長：33.8m，有効幅員：8.5mの単純活荷重合成桁橋

| 材料 | 数量 ① [ton] | Carbon factor A1-A3 ② | Embodied carbon ① x ② [ton-CO ₂ e] |
|---|---------------|--------------------------|--|
| 鋼鉄 | 51 | 2.450 | 125 |
| コンクリート ($\sigma_{ck}=30\text{N/mm}^2$) | 214 | 0.175 | 37 |
| 鉄筋 | 18 | 1.960 | 35 |

1 橋の製作で
約200tonのCO₂を排出

Embodied carbon of Module A1-3 (製造段階)

material quantity (kg) × carbon factor (kgCO₂e/kg) = embodied carbon (kgCO₂e)

Table 2.3: Suggested embodied carbon factors ($ECF_{A1-A3,i}$) for common construction materials

| Material | Type | Specification/details | Recommended default value | Typical lower bound | Typical upper bound | References | | |
|-------------------------------|--|--|---|---|---|---------------------------|-------------|-------------|
| | | | | | | Default | Lower bound | Upper bound |
| Concrete | In situ concrete (unreinforced) ^a | UK C16/20 | 0.087 25% GGBS ^b | 0.050 (70% GGBS) | 0.113 (0% SCM ^b) | Ref. 19 | Ref. 19 | Ref. 19 |
| | | UK C20/25 | 0.093 25% GGBS ^b | 0.053 (70% GGBS) | 0.112 (0% SCM ^b) | Ref. 19 | Ref. 19 | Ref. 19 |
| | | UK C25/30 | 0.100 25% GGBS ^b | 0.056 (70% GGBS) | 0.119 (0% SCM ^b) | Ref. 19 | Ref. 19 | Ref. 19 |
| | | UK C32/40 | 0.120 25% GGBS ^b | 0.063 (70% GGBS) | 0.149 (0% SCM ^b) | Ref. 19 | Ref. 19 | Ref. 19 |
| | | UK C40/50 | 0.138 25% GGBS ^b | 0.072 (70% GGBS) | 0.159 (0% SCM ^b) | Ref. 19 | Ref. 19 | Ref. 19 |
| | | Global Average (excludes China) C32/40 ^c | 0.175 ^d (mean) | 0.139 ^d (20th percentile) | 0.210 ^d (80th percentile) | Ref. 20 | Ref. 20 | Ref. 20 |
| | Mortar/screed | 1:4 cement:sand mix ^e with average UK cement mix ^f | 0.149 | - | - | Ref. 19 | - | - |
| Precast concrete ^g | UK C40/50, unreinforced ^g | (Average UK cement mix) | 0.178 | 0.090 (70% GGBS) | 0.191 (0% SCM) | Ref. 19 | Ref. 19 | Ref. 19 |
| | | UK 150mm reinforced hollow core slabs: British Precast Flooring Federation average | 50.2 kgCO ₂ e/m ² | - | - | Ref. 21 | - | - |
| Steel | Reinforcement bars | UK CARES sector average (EAF production) | 0.760 | - | - | Ref. 22 | - | - |
| | | Global | 1.960 | 0.395 (EAF production) | 3.970 (BOF production) | Ref. 23 | Ref. 24 | Ref. 25 |
| | PT strand | Assume the same as reinforcement bars | - | - | - | - | - | - |
| | Structural sections and plate | UK Rolled open sections | (consumption average) | 1.740 | 0.567 (EAF production) | 2.450 (BOF production) | Ref. 26 | Ref. 27 |
| Global Rolled open sections | | | 1.580 | - | - | Ref. 23 | - | - |

➤ モジュールA1-A3のCarbon factor 推奨値をデータベースとして提供。

➤ 工事地域は英国を想定。全世界における建設工事の標準値も記載。

出典：ISE “How to calculate embodied carbon” 2nd edition

Embodied carbon of Module A1-3 (製造段階)

↓ Carbon factorの推奨値

| Material | Type | Specification/details | Recommended default value | Typical lower bound | Typical upper bound |
|----------|-------------------------------|--|-----------------------------|------------------------|------------------------|
| Steel | Reinforcement bars | UK CARES sector average (EAF production) | 0.760 | – | – |
| | | Global | 1.960 | 0.395 (EAF production) | 3.970 (BOF production) |
| | PT strand | Assume the same as reinforcement bars | – | – | |
| | Structural sections and plate | UK Rolled open sections | 1.740 (consumption average) | 0.567 (EAF production) | 2.450 (BOF production) |
| | | Global Rolled open sections | 1.580 | | |

出典：ISE “How to calculate embodied carbon” 2nd edition

↑ 電炉材

↑ 転炉材

➤ 各材料の製造方法に応じて、Carbon factorにばらつきがあるが、HCECとしては**所定の推奨値を示す**。

Embodied carbon of Module A1-3 (製造段階)

Table A1: Life cycle assessment material/product carbon factor databases

| Region | Database | Notes | Link |
|-------------|--|--|---|
| Europe | | | |
| UK | Built Environment Carbon Database (product-level database) | Free online database developed by a consortium of built environment institutions to collect UK EPD data. Beta version launching 2022 | www.becd.co.uk |
| UK | ICE database | Wide-ranging material database covering Modules A1-A3 | https://carbon.tips/ice3 |
| UK | BRE Verified BSEN 15804 EPD | EPDs for specific products, with a range of modules | https://carbon.tips/breEPD |
| UK | BRE IMPACT | 350 BS EN 15804-compliant datasets modelled in SimaPro | https://carbon.tips/umx |
| Europe | European Aluminium EPD Programme | EPDs for specific aluminium products, with a range of modules | https://carbon.tips/lca8 |
| France | Environmental and health reference data for building construction products | EPDs for a range of building construction products, in French | https://carbon.tips/lca33 |
| Germany | Oekobaudat | EPDs for a range of building products | https://carbon.tips/lca15 |
| Germany | IBU | EPDs for specific products, in German. Requires registration | https://carbon.tips/lca17 |
| Ireland | Irish Green Building Council | Generic data for 15 building materials on the Irish market | https://carbon.tips/igbc |
| Italy | EPD Italy | EPDs for specific products | https://carbon.tips/lca19 |
| Norway | EPD Norge | EPDs for specific products | https://carbon.tips/lca18 |
| Spain | DAP construcción | EPDs for specific products | https://carbon.tips/lca21 |
| Sweden | International EPD | EPDs for specific products | https://carbon.tips/lca22 |
| Switzerland | Ecoinvent | Paid database | https://carbon.tips/lca23 |

← HCEC Reference A

Carbon factorのReferenceとして

各国のEPD(環境製品宣言)データベース等を活用

出典：ISE “How to calculate embodied carbon” 2nd edition

Embodied carbon of Module A4 (輸送段階)

$$ECF_{A4,i} = \sum_{mode} (TD_{mode} \times TEF_{mode})$$



Carbon Factor for A4 = 輸送距離 x 輸送手段 (輸送モード)

$ECF_{A4,i}$ = embodied carbon factor for transport to site for i^{th} material
 TD_{mode} = transport distance for each transport mode considered
 TEF_{mode} = transport emission factor for each transport mode considered

Table 2.4: Example transport emissions factors for the UK

| Mode | TEF_{mode} (gCO ₂ e/kg/km) | Source |
|---|---|----------------------|
| Road transport emissions, average laden | 0.10749 | Ref. 64 ^a |
| Road transport emissions, fully laden | 0.07375 | Ref. 64 ^b |
| Sea transport emissions | 0.01614 | Ref. 64 ^c |
| Freight flight emissions | 0.53867 | Ref. 64 ^d |
| Rail transport emission | 0.02782 | Ref. 64 ^e |

:トラック輸送 (平均的な積載量)
 :トラック輸送 (最大積載量)
 :海上輸送
 :航空輸送
 :鉄道輸送

Notes:

- ^a For HGVs (all diesel), average laden.
- ^b For HGVs (all diesel), fully laden.
- ^c For cargo ship/container ship, average.
- ^d International, to/from non-UK (direct effects from CO₂, CH₄ and N₂O emissions only).
- ^e Freight train.

出典 : ISE "How to calculate embodied carbon" 2nd edition

Embodied carbon of Module A5 (建設段階)

Carbon Factor for A5

- Carbon factorを**A5w** (Material **w**astage on site : 現場の材料廃棄)と**A5a** (Site **a**ctivities : 現場作業)の2領域に分類して整理。
- 仮設備の製造に関わるEmbodied CarbonもA1-3の算出法に則り、A5に含む必要あり。

Carbon Factor for A5a

- 施工に関わるEmbodied Carbonの排出量は、**架設現地における電力・燃料消費実績**より算出可能。
- そして施工方法が定まっていない計画・設計段階では、英国の既往実績を踏まえ、以下の簡易的な算出法を提案。
 - ✓ **1,400** kgCO₂e per £100,000 (建設費) ← **建設工事全範囲**
 - ✓ **700** kgCO₂e per £100,000 (建設費) ← **上部工・下部工のみ**
 - ← **建設対象の種別や施工方法を問わないラフな推定。**

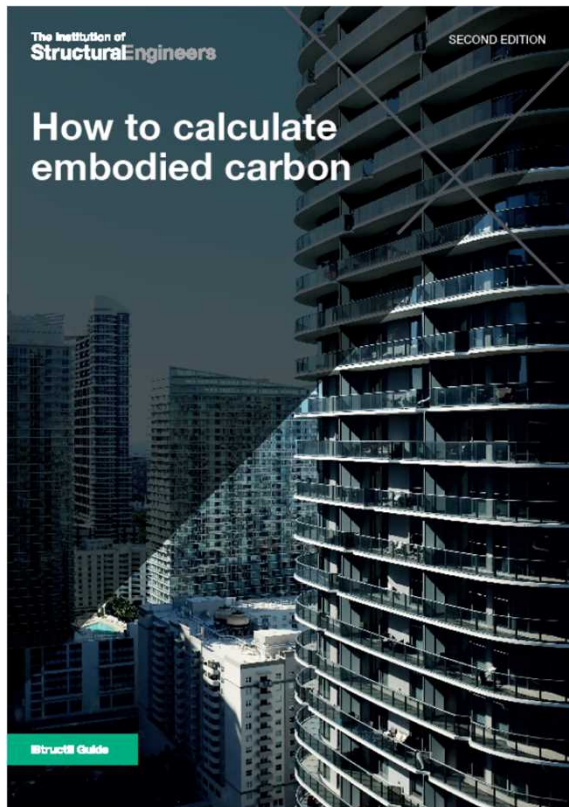


出典 : <https://www.liebherr.com>

HCECの入手法

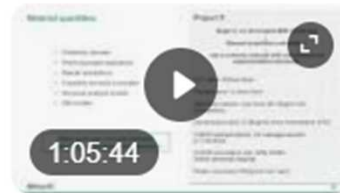
英国構造エンジニア協会のHP上でPDF版を無料でダウンロード可能。ページ数：58

<https://www.istructe.org/resources/guidance/how-to-calculate-embodied-carbon/>



www.youtube.com > watch

How to calculate embodied carbon



Speakers: Dr John Orr - University of Cambridge Orlando Gibbons - Arup.

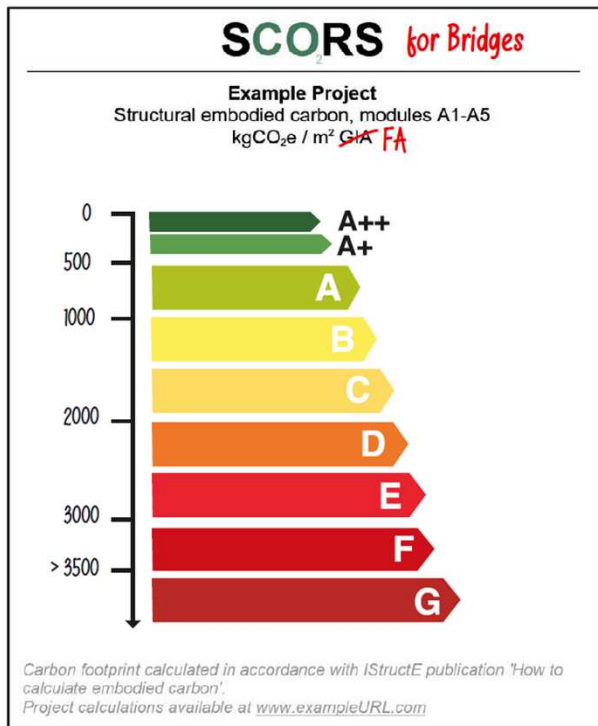
YouTube · The Institution of Structural Engineers · 2020/11/18

1. 英国のNet Zero達成に向けた取組例

② SCORS

SCORSとは？

- 建設工事の環境性能を横並びで評価するための**レーティングシステム**。
- Module A1-A5（製品の製造・輸送・建設）に伴う温室効果ガスの排出量に着目。
- プロジェクトに関わるあらゆる利害関係者のための**コミュニケーションツール**として活用。



IABSE Symposium Manchester 2024
Construction's Role for a World in Emergency

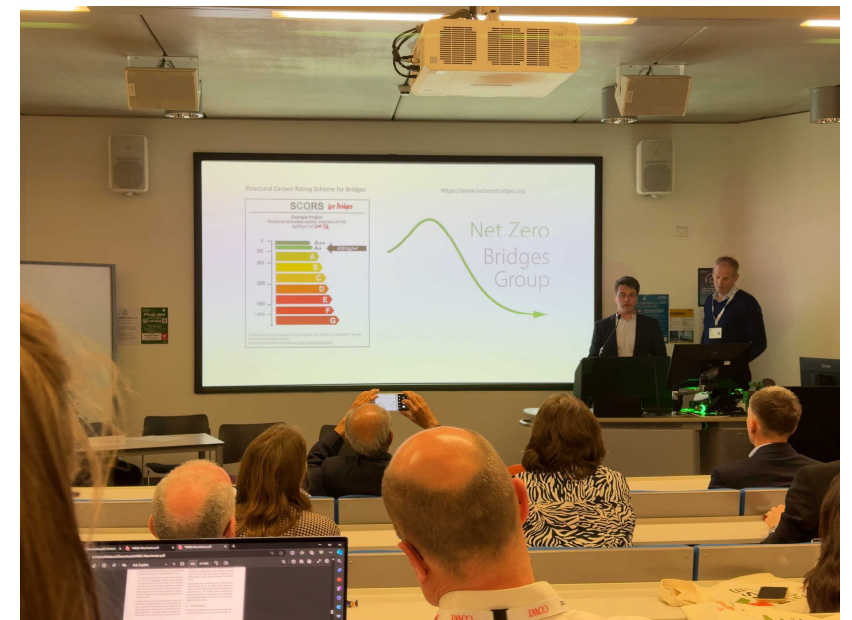
2.2 Main Span Foundations
The main span piers sit atop 1.2m thick pilecaps and groups of six 900 diameter bored concrete piles.
The use of bored concrete piles is ubiquitous in bridge construction, but in comparison to the spread footings of the approach ramps the main span foundations were a very sizeable proportion of its overall embodied carbon. This outcome raised the question of whether a different foundation system might have been more efficient in carbon terms.
The approach ramps were supported on single steel columns on concrete plinths attached to shallow spread footings, a system which constituted a much lower proportion of the overall embodied carbon. This suggests that shallow foundations should be the default foundation type for low-carbon bridge designs unless geotechnical constraints force the use of a piled foundation.
Smaller-diameter piles used in conjunction with a thinner pilecap could offer the benefits of a piled foundation with less material usage compared to larger-diameter piles. Driven piles such as steel tubes might also be suitable in certain situations.
In conclusion, designers should be creative and try to look beyond the usual assumption that bored concrete piles are most appropriate.

2.3 Parapets
The Hams Way parapets are fabricated from 10mm thick steel flat sections at 110mm centres, with tubular stainless steel handrail and flat section top rail.
This is a fairly typical footbridge parapet, but the design team was surprised to discover that across the whole bridge the parapets alone weigh more than the entire main span superstructure (the parapets are in the category "road/track furniture" in Figure 2 above).
Although a small proportion of the overall embodied carbon, the parapets aren't part of the primary structure and were identified as a candidate for streamlining in future projects.

Figure 4 - Hams Way Parapets
The overall design of Hams Way Footbridge was a success, winning several awards including the Structural Steel Design Awards 2021 [2]. Despite being an architectural "statement bridge", the lightweight main span superstructure and efficient approach ramps on shallow spread footings achieved a low overall carbon intensity of 815kg per square metre of deck area. This value achieves an A-rating on the SCORBS scale.
With lighter systems for the parapets and main span substructure, and marginal efficiency improvements on the steelwork design, a SCORBS A+ rating seemed within reach.

2.4 Summary

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出典：IABSE Manchester 2024 Proceedings

SCORSの来歴

➤ SCORS: Structural Carbon Rating Scheme for buildings (建築分野)

Ref.1: 'Setting carbon targets: an introduction to the proposed SCORS rating scheme' (2020) Published by IStructE

2.Low carbon
Setting carbon targets:
an introduction to the proposed
SCORS rating scheme

Will Arnold, Mike Cook, Duncan Cox, Orlando Gibbons and John Or present SCORS - a proposed carbon rating scheme for structures - and encourage engineers to adopt carbon targets for their projects.

The Institution has recently published a guide on how to calculate embodied carbon. The guide has in effect become a structural engineer's go-to resource to estimate how much embodied carbon is present in their design, at any stage in the design process. For many, the publication of this method has raised the question of what a 'good' figure for their carbon footprint might be.

In this article, the authors propose the use of a Structural Carbon Rating Scheme (SCORS) that has been informed by project carbon data, and that can be used to compare high-carbon and low-carbon design decisions and options. We compare SCORS to targets set by the Royal Institute of British Architects (RIBA), the London Energy Transformation Initiative (LETI), and the Intergovernmental Panel on Climate Change (IPCC), and also how the reader might set their own targets.

The article highlights the search for a net-zero and low-carbon targets that are periodically updated and that trend towards zero, starting immediately.

SCORS
Figure 1 shows the SCORS rating 'sticker' suggested for use by structural engineers in communicating the implications of design decisions to those who work with and for the project.

The SCORS rating of an option, asset, or company is estimated on a scale based on the estimated A1-A6 emissions of the primary structure (superstructure plus substructure), calculated in accordance with how to calculate embodied carbon, which outlines calculation rules and assumptions, such as including the benefits of decarbonisation in electricity. (See Figure 1.1 in the guide for an explanation of the rules.)

For each stage calculation, embodied carbon factors should be based on typical values for the country in which the project will be built (including assumptions around

GET THE GUIDE
How to calculate embodied carbon is free to download at www.istructe.org/resources/guidance/how-to-calculate-embodied-carbon/. A hard copy version is also available to buy.

How to calculate embodied carbon

SCAN QR CODE

Using the scheme
It is proposed that structural engineers use SCORS to communicate the implications of design decisions. The benefit of using SCORS is that people assign a meaning to a green A+ rating, or a red F rating, facilitating conversations around embodied carbon with those who hold the most influence. It reinforces the carbon impact of a design, helping engineers, architects, clients and planners understand whether their design is high or low in embodied carbon compared with the typical range of industry practice.

In SCORS, no differentiation is made between structural type, number of stories, client brief, presence of a basement, or whether the project is a residential or non-residential. General building structures, anywhere on the planet and in any configuration, an A rating means that the estimated A1-A6 carbon footprint of the primary superstructure plus substructure is in the range of 100-150kgCO₂eq/m² GVA.

As well as allowing comparisons between different options of the same scheme or to a benchmark, it will allow structural engineers and our collaborators to understand the relative embodied carbon impacts of different types of building (e.g. comparing a 30-storey tower with three 10-storey buildings) with the intent of challenging the brief

SCORS
Estimated embodied carbon (kgCO₂eq/m² GVA)

| | |
|----|-----------|
| A+ | 0 - 100 |
| A | 100 - 150 |
| B | 150 - 200 |
| C | 200 - 250 |
| D | 250 - 300 |
| E | 300 - 350 |
| F | 350 - 400 |
| G | 400 - 500 |

October 2020 | www.istructe.org



➤ SCORBS: Structural Carbon Rating Scheme for Bridges (橋梁分野)

Ref.2: 'Carbon targets for bridges: a proposed SCORS-style rating scheme' (2021) Published by IStructE

2.Low carbon
Carbon targets for bridges:
a proposed SCORS-style
rating scheme

Cameron Archer-Jones and Daniel Green propose a version of the IStructE's 'SCORS' rating scheme for bridges and encourage engineers to adopt carbon targets for their projects.

Introduction
In October 2020, the Institution of Structural Engineers Climate Emergency Task Group published a detailed proposal for a Structural Carbon Rating Scheme (SCORS) for buildings.

In this article, the authors adapt the same methodology for application to bridge projects - a Structural Carbon Rating Scheme for Bridges (SCORBS). The rating scheme has been informed by analysis of GVA project carbon data and can be used to communicate the carbon performance of a bridge project or a set of design options.

As per the original SCORS proposal, the authors also reinforce the need to adopt and hold ourselves to low targets that are periodically updated and that trend towards zero, starting immediately.

SCORS for bridges
Using SCORBS
Figure 1 shows the SCORBS rating 'sticker' suggested for use by bridge engineers in communicating the carbon performance of the design we produce to those we work with and for.

The SCORBS rating of a design, an asset, or a company's portfolio of work is based on the estimated A1-A6 emissions of the primary structure (superstructure plus substructure), including foundations and the superimposed dead load, calculated in accordance with how to calculate embodied carbon (H2C2). The carbon footprint is normalised in line with PAS 20300-1: 7.1.2 using the structural area (SA) of the bridge deck (Figure 2).

Bridge assets are assigned a letter and a colour between A+ (green) and G (red) depending on the normalised carbon footprint. This rating can be conducted at any stage in design or construction, with the underlying calculation updated to an appropriate level or detail at each stage, as described by Arnold et al.

GLOSSARY

Carbon = Carbon dioxide equivalent emissions - a unit of global warming potential corresponding to kg of carbon dioxide (kgCO₂e).

CapEx = Capital carbon associated with construction of the asset, the equivalent to upfront carbon for buildings (Formworking to Recycle modules A1-A6).

UseCarb = In-use carbon associated with use of the asset by the public (responding to Recycle modules B1).

OpCarb = Operational carbon associated with ongoing energy use, maintenance, replacement or replacement assets (Formworking to Recycle modules B1-B7).

Infrastructure vs buildings
H2C2 outlines extensive guidance for the calculator which is not repeated here. However, it is primarily building oriented and some aspects of the guidance should be adapted for application to transport infrastructure projects. For example, superimposed loads, such as surfacing and parapets, should be included for a bridge.

In addition, for A6 emissions, i.e. those due to site activities, explicit calculations should be made rather than relying on a capital cost multiplier. For instance, activities that require significant temporary works to consume large quantities of scaffolding material should receive close attention, as should double-handling of bulk materials over a large site.

It can be difficult to obtain emissions data related to construction site activities, even at a late stage in the project. In the absence of primary data from an activity, a first principles approach should be adopted, focusing on the most energy-intensive processes.

Communicating with SCORBS
The SCORBS sticker is presented as a communication tool to help stakeholders in a project can have a conversation, regardless of their level of carbon literacy. An A+ rating in green or an F rating in red gives context through readily understandable cues. The normalisation of the results and transparency of the rating

SCORS for Bridges
Estimated embodied carbon (kgCO₂eq/m² GVA)

| | |
|----|-----------|
| A+ | 0 - 100 |
| A | 100 - 150 |
| B | 150 - 200 |
| C | 200 - 250 |
| D | 250 - 300 |
| E | 300 - 350 |
| F | 350 - 400 |
| G | 400 - 500 |

October 2021 | www.istructe.org

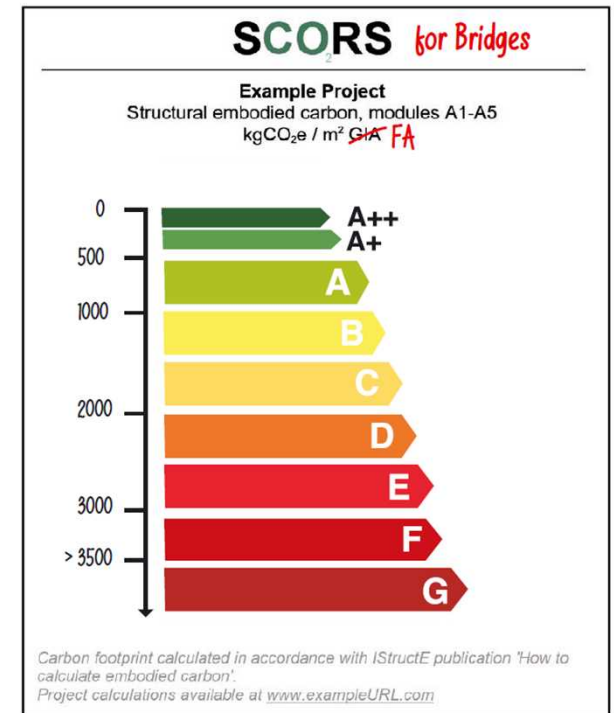
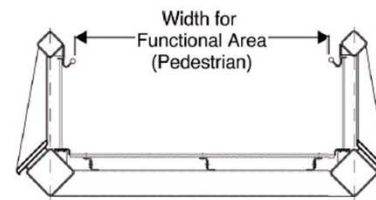
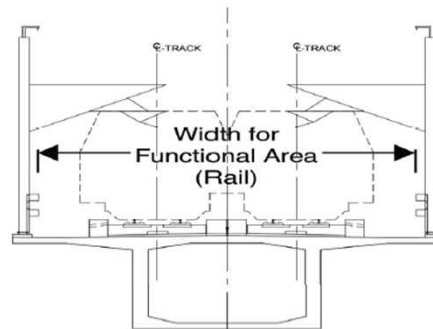
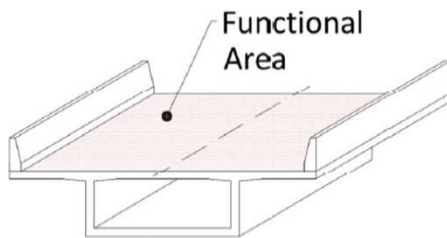
SCORBSの評価指標

➤ SCORBS の評価指標：Structural embodied carbon, module A1-A5 [kgCO₂e] / Functional Area [m²]

- ✓ 対象：一次構成要素（上下部工・基礎）及び搭載部材（舗装・高欄等）
- ✓ モジュール A1-A5：製品の製造・輸送・建設段階に着目
- ✓ 分母となる機能面積（Functional Area）の定義は右図の通り。
- ✓ Embodied Carbon の算出は HCEC に準拠。

← 橋梁の「構造設計」の環境性能を評価

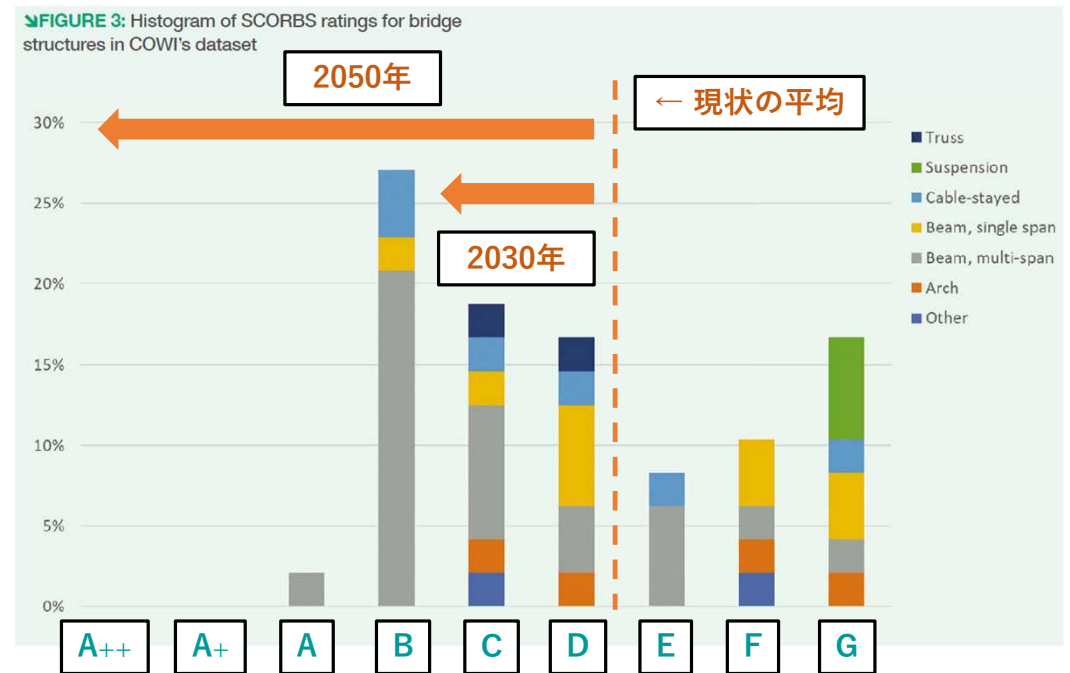
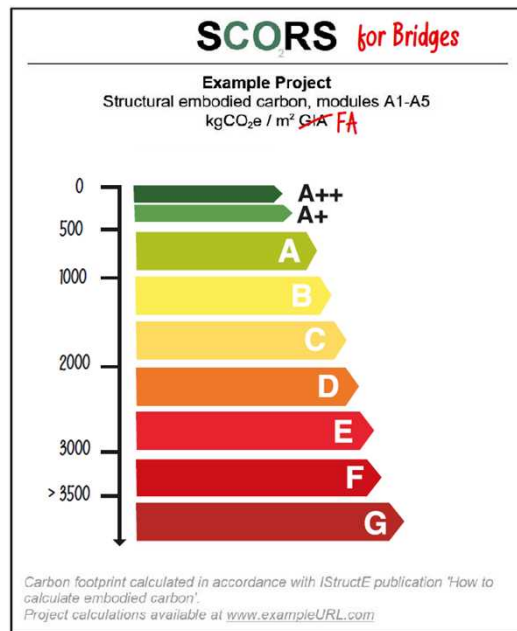
FIGURE 2: Functional area depicted for various bridge types



出典：ISE "Carbon targets for bridges a proposed SCORS style rating scheme"

英国における SCORBS の達成目標

- 現在の英国橋梁建設工事におけるSCORBSの平均ランクは、**D~E (2000~3000 kgCO₂e)**のレンジにある。
- **2030年**までに、SCORBSの平均ランクを少なくとも**B (~1500 kgCO₂e)**とする。← 現在入手可能な材料や計画時の慎重な配慮によって達成可能な、意欲的であるが妥当な目標。
- **2050年**までに、SCORBSの平均ランクを**A++ (~250 kgCO₂e)**とする。← 排出量の削減達成には、材料面の技術革新が不可欠。

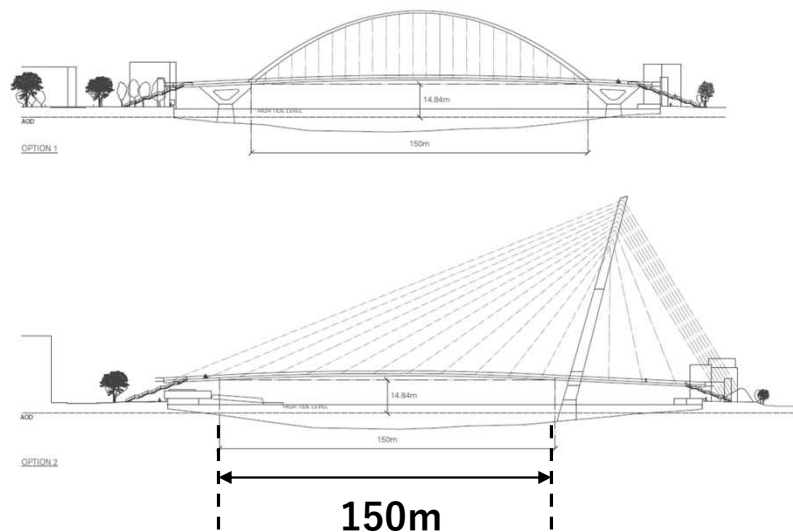
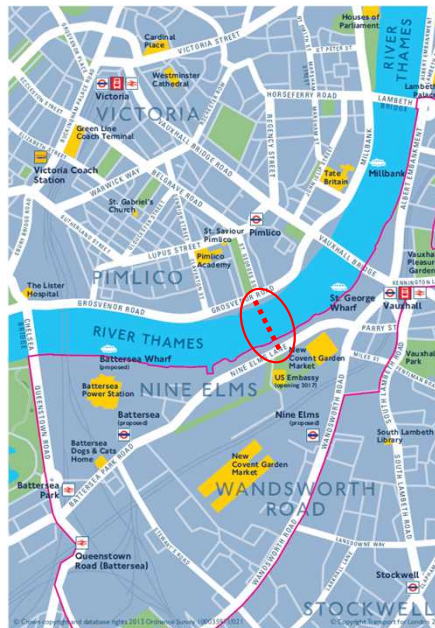


出典：ISE "Carbon targets for bridges a proposed SCORS style rating scheme"

1. 英国のNet Zero達成に向けた取組例

③ テムズ川にかかる歩道橋の低炭素化検討ケーススタディ

参考：Low carbon bridge に関するケーススタディ



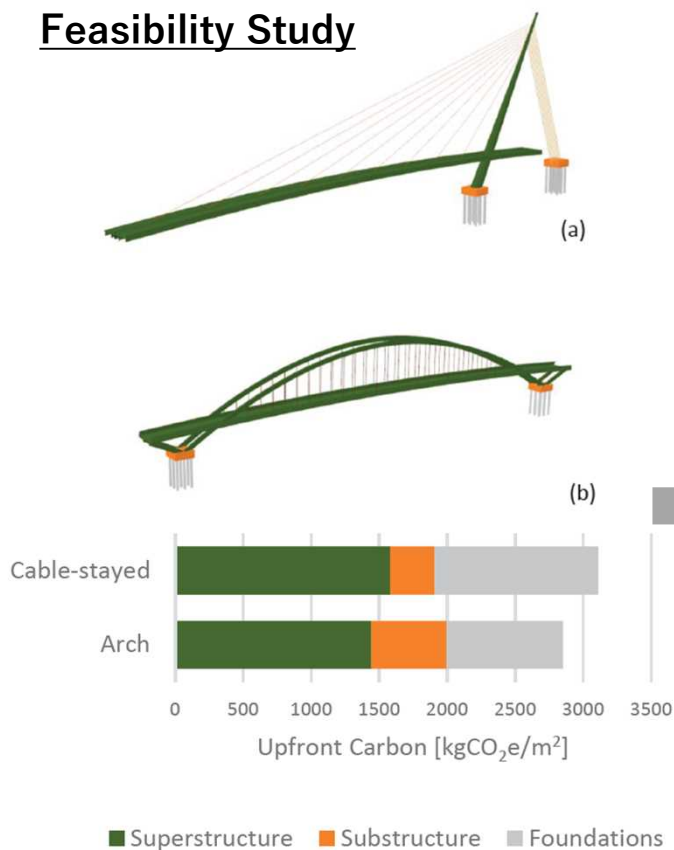
出典：Transport for London. Nine Elms - Pimlico bridge - Feasibility study summary report, Final version

ロンドン テムズ川にかかる自転車歩道橋計画の低炭素化検討

- 2013年、Buro Happold社が本橋の建設計画のFeasibility Study (FS) を実施。支間長約150mの自転車歩道橋。
- この橋梁計画を題材として、**SCORBSの”A++”(250kg CO₂e/m²)**の達成を試みるケーススタディ。
- FSの最終案は下路アーチ橋および斜張橋。FSにおける設計成果を低炭素化検討のベースラインとする。

参考：Low carbon bridge に関するケーススタディ

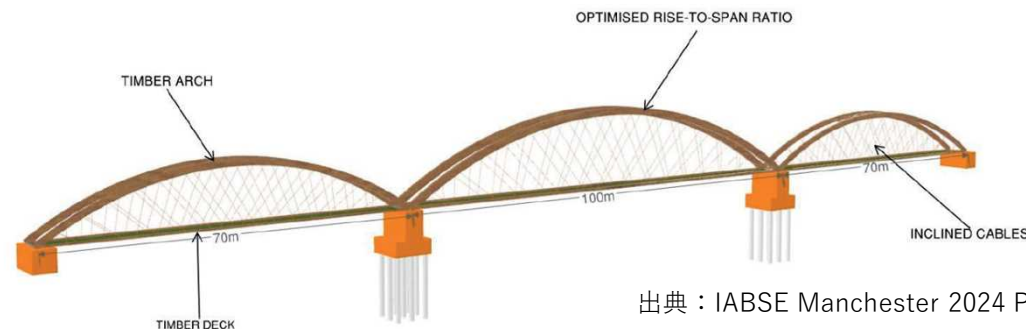
Feasibility Study



Module A1-5 : **2850** kgCO₂e/m²
(SCORBS : E)

Module A1-5 : **1360** kgCO₂e/m²
(SCORBS : B)

鋼材リサイクル及び木材へCO₂貯留考慮
Module A1-5+D : **640** kgCO₂e/m²
(SCORBS : A)



出典：IABSE Manchester 2024 Proceedings

“A low carbon bridge over the River Thames, London, UK”

低炭素化を達成するための取組

- ▶ 構造用集成木材（Glulam材）をアーチリブに採用。
Glulam材 Carbon Factor : **0.280 t-CO₂e/t** ← 鋼材の約1/10
- ▶ 木材アーチリブの強度上、航路限界を侵さない範囲で支間を3分割。
- ▶ 床版：アルミ、FRP、木材で比較し、自重・炭素排出量のバランスを考慮して木材を採用。

2. 事後調査した関連項目

④ EPD(環境製品宣言)

EPD (Environmental Product Declaration : 環境製品宣言)

EPDとは？

- EPDとは、**自社製品のライフサイクル全体にわたる環境影響を定量的に評価し、それを公開するための情報提供ツール**。発行主体は製品の製造企業。

EPDの歴史

- 1990年代に、製品のライフサイクル全体にわたる環境負荷を評価し公開する方法として、EPDがスウェーデンで初めて導入される。
- 2006年には、EPDの制定に関する国際規格「**ISO 14025 : 環境ラベルおよび宣言 – タイプIII環境宣言 – 原則および手順**」が発行され、その普及が加速。
- EPDは、世界各国でISO 14025に準拠するEPDプログラム運営者によって管理されている。



出典 : <https://www.iso.org/standard/38131.html>

EPD (Environmental Product Declaration : 環境製品宣言)

EPDで取り扱うデータ

- EPDでは、原材料の取得や製造プロセスで発生する**温室効果ガスの排出量**や、**その他の環境指標**（例：エネルギー消費、水利用量、廃棄物の量など）を報告。

| 影響領域 | 製造+間接影響※1 | 製造のみ※2 | 単位 |
|-------------------------|-----------|--------|-------------|
| 気候変動 IPCC 2013 GWP 100a | 1200 | 2300 | kg (CO2換算) |
| 酸性化 | 0.18 | 2.0 | kg (SO2換算) |
| 光化学オキシダント | -0.13 | 0.12 | kg (エチレン換算) |

※1：A1~A3およびDの合計 ※2：A1~A3の合計

| ②ライフサイクルインベントリ分析関連情報 | | |
|----------------------|----------|----|
| 項目 | | 単位 |
| 非再生可能資源 | 7.3E+02 | kg |
| 非再生可能エネルギー | 2.6E+04 | MJ |
| 再生可能資源 | 9.5E+02 | kg |
| 再生可能エネルギー | -1.1E+02 | MJ |
| 淡水の消費 | 5.6E-02 | m3 |

【 ↑ H形鋼 1 t の製造に伴う環境影響例 】

製品群別共通ルール (PCR)

- EPDは、**製品群ごとの環境影響評価算定共通ルールであるPCR (Product Category Rules)**に基づき算定・検証・情報開示が行われる。⇒ 同業他社間で公平な比較が可能。



エコリーフ
タイプⅢ環境宣言 (EPD)
登録番号：JR-AJ-19002E-C

SuMPO環境ラベルプログラム
一般社団法人サステナブル経営推進機構
東京都千代田区内神田1-14-8
<https://ecoleaf-label.jp>



日本製鉄株式会社

H形鋼
(Wide flange shapes)



算定単位

1t

算定対象段階

最終財 中財

製造段階 (原材料調達、原材料の輸送、製品の製造) および間接影響

製品の型式、主要仕様・諸元

製造サイト：君津製鉄所、鹿島製鉄所、和歌山製鉄所
主な規格：SMA400A, SMA400B, SMA490B, SMA490Y, SMA490YA, SMA490YB, SMA490Y, SMA490A, SMA490B, SMA490YA, SMA490YB, SMA490B, SMA490AW, SMA400BW, SMA490AW, SMA490BW

形状：H形鋼
主な断面・板厚(単位mm, t=板厚) (例：中継系列の場合)
H150(t6)×B100(t9)~H900(t19)×B400(t37)
※その他の規格・断面等は@備考に記載

問い合わせ先

日本製鉄株式会社 厚板・建材事業部
<https://www.nipponsteel.com/product/contact/structuralsteel.html>

登録番号 JR-AJ-19002E-C

通用PCR番号 PA-180000-AJ-06

PCR名 建設用鉄鋼製品 (中財)

公開日 2019年12月6日

検証合格日 2024年1月12日

検証方式 個別検証方式

検証番号 JV-AJ-24001

検証有効期間 2024年11月28日

PCRレビューの実施

認定日等 2023年5月10日

委員長 松野 泰也
(千葉大学)

第三者検証者*

外部検証員 小関 康雄

ISO14025およびISO21930に従った本宣言及びデータの独立した検証

内部 外部

*システム認証を受けた事業者内の検証の場合は、システム認証を行った審査員の名称を記載。

登録番号：JR-AJ-19002E-C

出典：https://ecoleaf-label.jp/epd/search

EPD (Environmental Product Declaration : 環境製品宣言)

欧州でのEPDの活用

- 建築分野を中心に広く採用され、EU加盟国の多くで建築物の環境ラベリング基準として利用される。
- 一部の国では、**公共工事の入札条件にEPDの提出を求め、評価項目としている**など、土木分野におけるEPDの利用が進んでいる。(Ex. ノルウェー, スウェーデン, フランス) ⇒ **請負業者に対し、自社製品の環境性能改善を促す。**

日本でのEPDの活用

- 現在、日本では**SuMPO** (一般社団法人サステナブル経営推進機構) が**SuMPO EPD**を運営。
- 2024年4月に ISO 14025準拠のタイプIII環境ラベルの名称変更。「エコリーフ」⇒「SuMPO EPD」
- 2002年にエコリーフ環境ラベルとして始動して以来、20年以上の運営実績を持つ。EPDプログラムとしては、世界で2番目に長い歴史を有する。

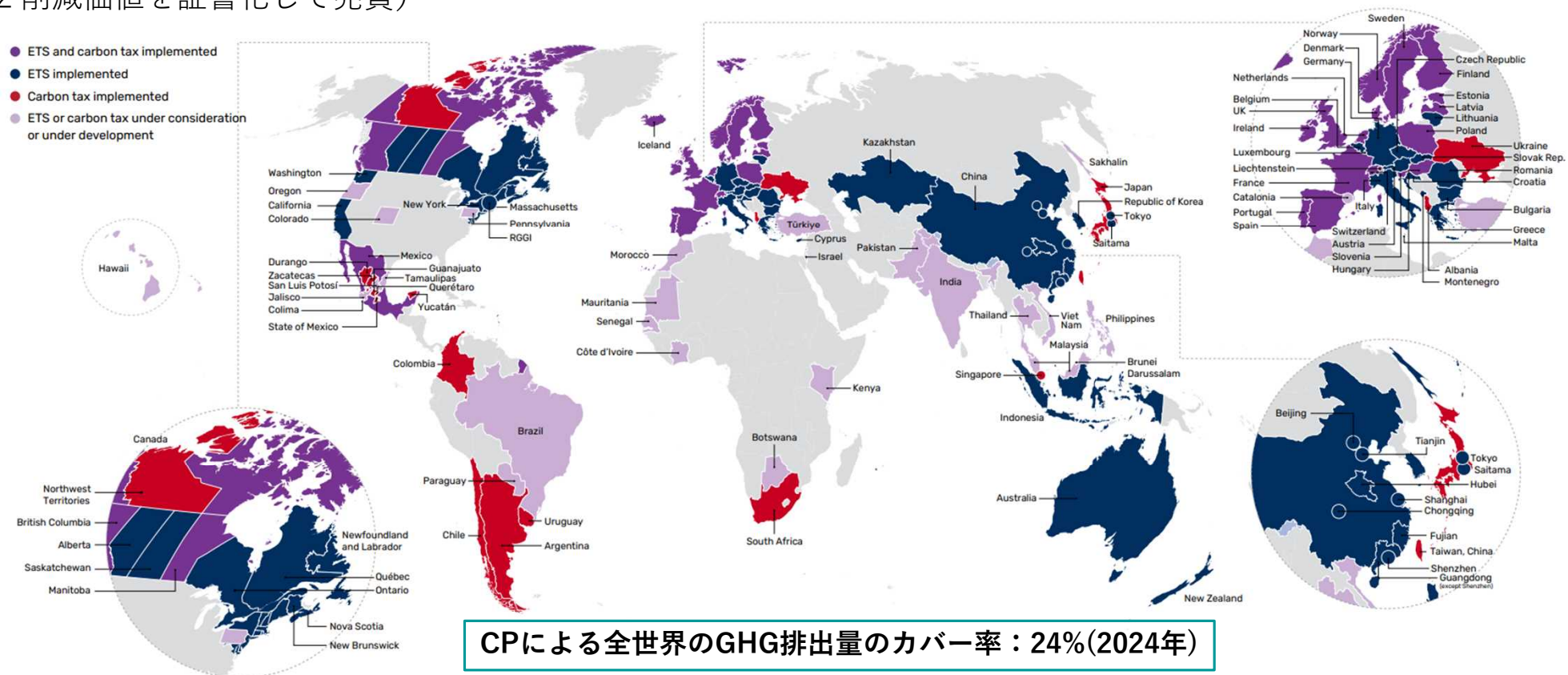


2. 事後調査した関連項目

⑤ カーボンプライシング

カーボンプライシング (CP)

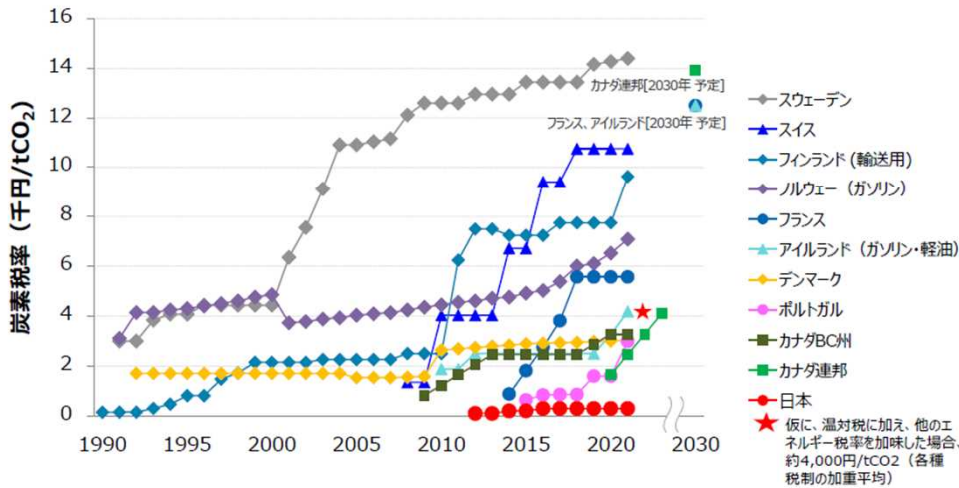
カーボンプライシング：個人・企業等の排出するCO2に価格を付け、それにより排出者の行動を変化させることを目的として導入する政策手法。例：炭素税，排出量取引制度（企業間での排出量の取引），クレジット制度（CO2削減価値を証書化して売買）



炭素税・実効炭素価格

(参考) 主な炭素税導入国の炭素税率

- 多くの炭素税導入国において、税率の引上げが行われている。
- フランス、アイルランド及びカナダでは、中長期的に大幅な炭素税率の引上げが予定されている。

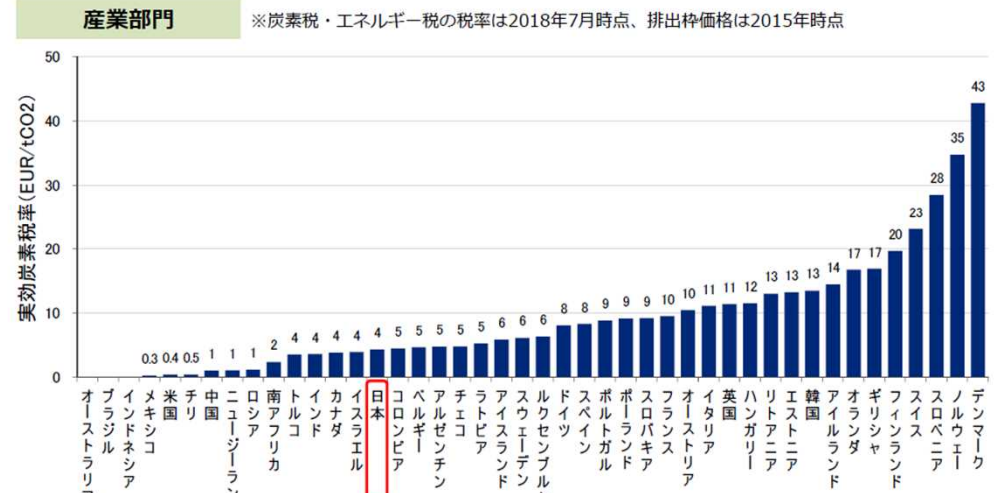


(出典) みずほ情報総研
 (注1) スウェーデン (1991年～2017年) 及びデンマーク (1992年～2010年) は産業用軽減税率を設定していたが、ここでは標準税率を採用 (括弧内は産業用税率を設定していた期間)。
 (注2) 為替レート: 1CAD=約82円、1EUR=約125円、1CHF=約112円、1DKK=約17円、1SEK=約12円、1NOK=約12円。(2018～2020年の為替レート (TTM) の平均値、みずほ銀行)

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(参考) 産業部門の実効炭素価格の比較 (OECD)

- OECDによれば、日本及び諸外国の実効炭素価格 (排出枠価格、炭素税、エネルギー税の合計) (産業部門) は以下のとおり。



(注) 部門別の実効炭素価格は、各国の減免措置を考慮した部門別の炭素税・エネルギー税の実効炭素価格及び排出量取引制度の実効炭素価格を合計した値。炭素税・エネルギー税の実効炭素価格はOECD「Taxing Energy Use 2019」の値 (税率は2018年7月1日時点)、排出量取引制度の実効炭素価格はOECD「Effective Carbon Rates 2018」の部門別カーボンを考慮した各国の2015年の排出枠価格をOECD「Taxing Energy Use 2019」の部門別のエネルギー起源CO₂排出量で加重平均をとって算出した値。排出量と課税額にそれぞれバイオマス起源排出への課税が含まれる。
 (出所) OECD (2019) 「Taxing Energy Use 2019」、OECD (2018) 「Effective Carbon Rates 2018」より環境省作成。

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出典：環境省 炭素税について

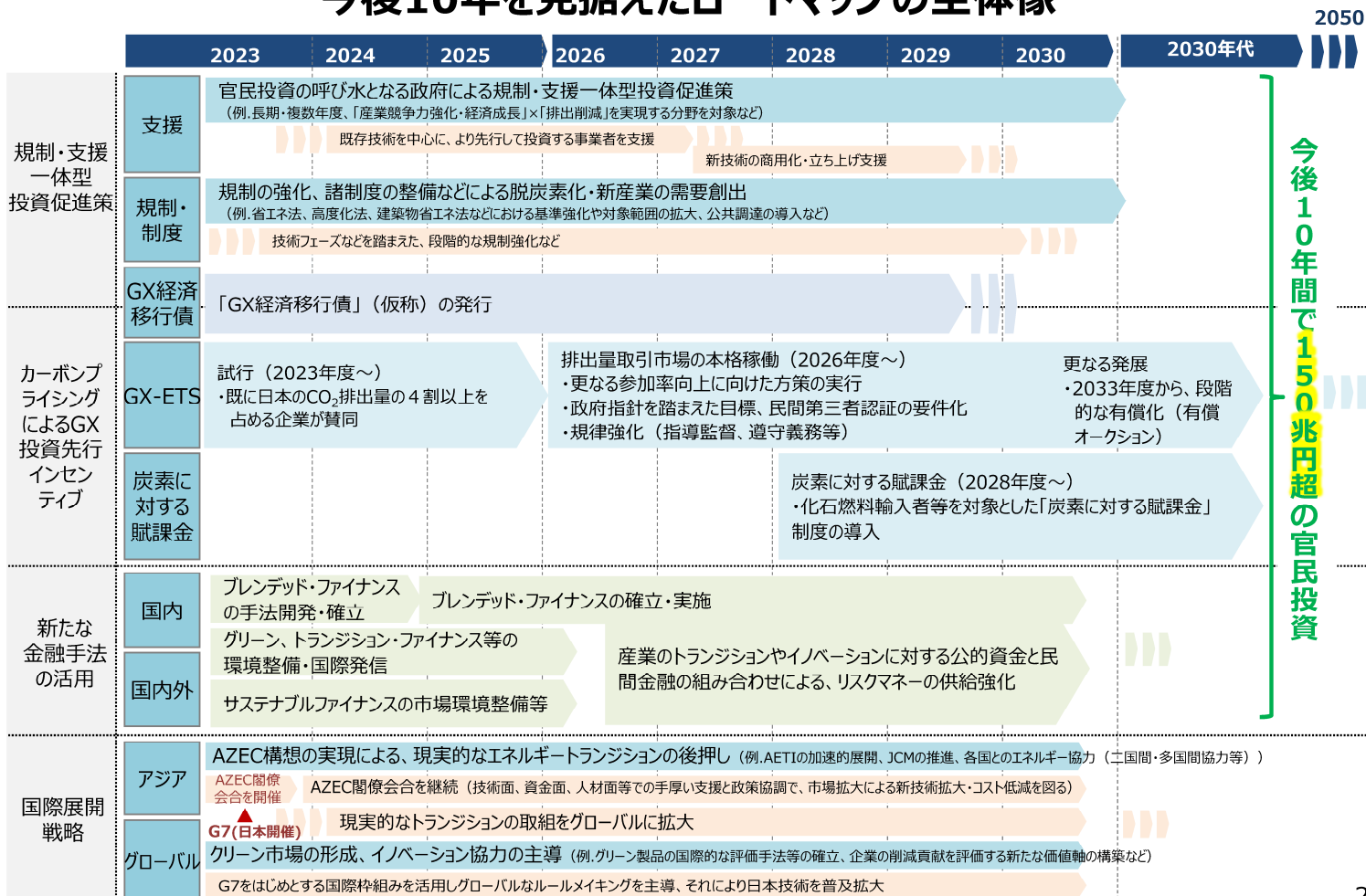
実効炭素価格：カーボンプライシングの水準を国際比較するため、経済協力開発機構 (OECD) が開発した指標

実効炭素価格 = 「炭素税」 + 「排出量取引制度炭素価格」 + 「エネルギー課税 (燃料消費税)」 - 「燃料補助金」

日本：諸外国と比べ、温室効果ガスの排出者に課す経済的負担が低い水準にある。

カーボンプライシングに関する日本の動向

今後10年を見据えたロードマップの全体像



今後10年間で150兆円超の官民投資

「成長志向型カーボンプライシング構想」のもと、

- ① 2026年度より「排出量取引市場」の本格稼働
- ② 2028年度より「炭素に対する賦課金」制度の導入

2 出典：第5回GX実行会議資料

3. おわりに

IABSE Symposium Manchester 2024 に参加して

おわりに：IABSE Symposium Manchester 2024 に参加して

- ▶ 欧州の土木工事において、環境性能（温室効果ガスの排出量）が**計画時の最大の関心事かつ判断指標・制約**となりつつある。
- ▶ 欧州のエンジニアは「2050年までのNet zero達成」を**この時代に生きるエンジニアの主要課題**として、自分事として捉えている印象。個人レベルでの環境意識の高さが日本とは異なる。
- ▶ 一方、ものづくりにおける時代に即した新たな制約として、また技術革新の機会として、温室効果ガスの削減活動をエンジニアがEnjoyしているとの印象も受けた。



Figure 0.1: Contextualising potential impact of structural engineers[†]



出典: How to calculate embodied carbon (IStructE Guide) 2nd Edition

おわりに： IABSE Symposium Manchester 2024 に参加して

- ▶ 欧州においても、Net Zero関連の取組は**建築分野が先行**。その後、考え方や仕組みが土木分野に展開。
- ▶ 欧州において、土木分野におけるNet Zero関連の取り組みは**黎明期**にあると言える。日本としてキャッチアップする良いタイミング。
 - ✓ EN 17472 (2022) : Sustainability assessment of civil engineering works.
 - ✓ Carbon targets for bridges: a proposed SCORS-style rating scheme (2021)
- ▶ 環境施策が進んでいる背景には、欧州における**カーボンプライシング制度**の普及・充実がある？
- ▶ 「リーダーシップをとる」⇔「主導権を握る」。各国・各企業が環境分野における課題解決を国際競争における**競争力の源泉**とみなしている。

