Office Partition Study
Embodied Carbon Assessment

01
27 March 2023

Workplace Futures Group

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ISSUE HISTORY

Issue	Date	Description
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Engineer (Initials)	Role
CP	Senior Sustainability Consultant
CF	Senior Acoustic Engineer
ZA	Graduate Sustainability Consultant

CONTENTS

1.0 EXECUTIVE SUMMARY

The following pages outline the Embodied Carbon performance of each Internal Wall Build-up assuming a site location in London and an average of all the possible factory-to-site delivery routes.

Build-ups are ordered from lowest to highest Upfront Carbon: A1-A5

1.1 Low Acoustic Performance

Name	Low-4	**Manufacturer**	ETEX
Acoustic Rating	43 dB	**Manufacturer Ref**	RTP 106

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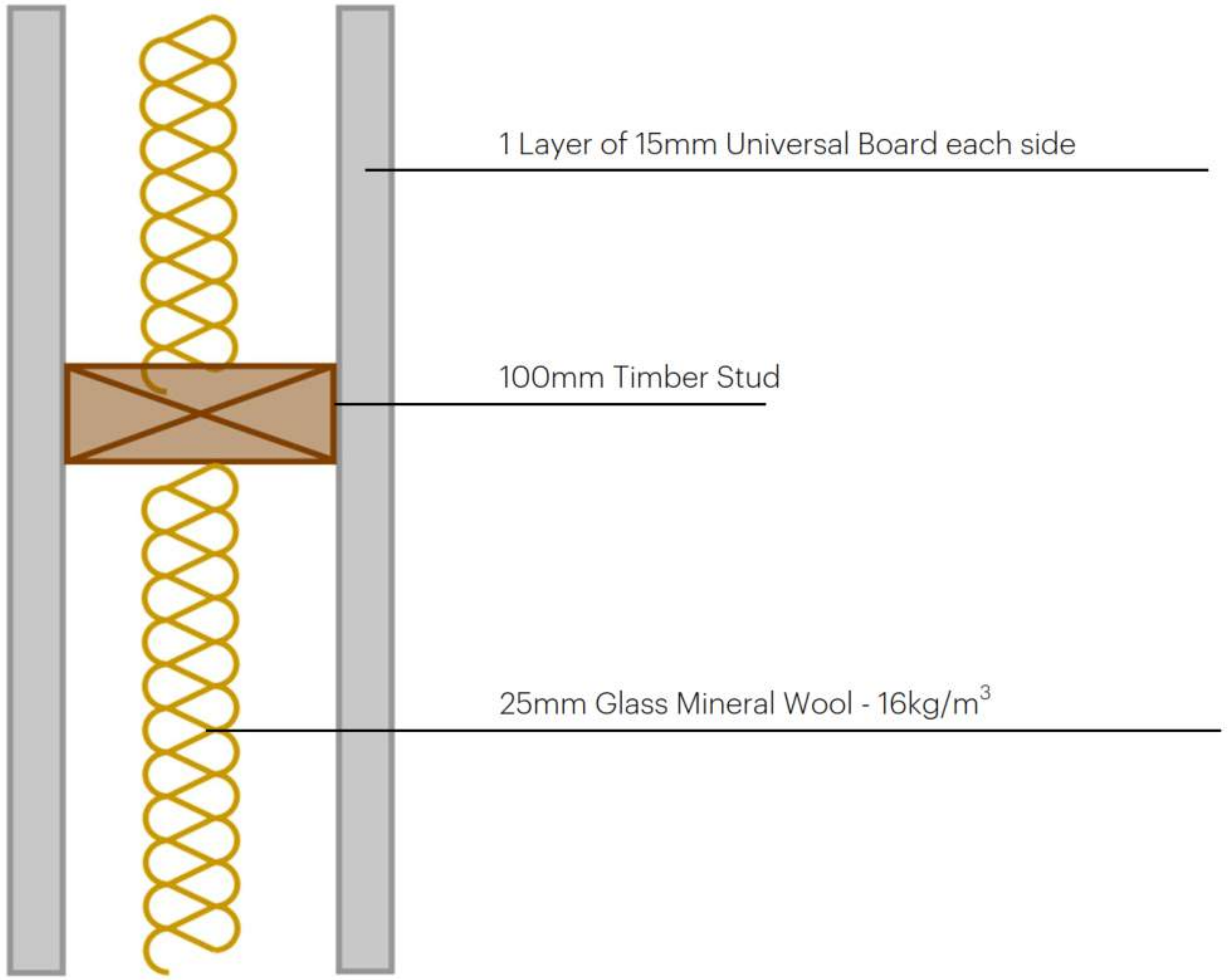

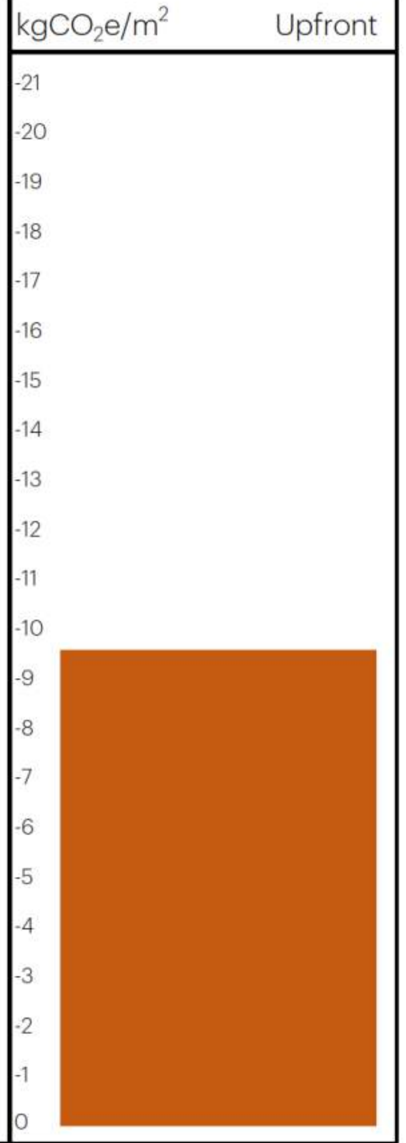

Upfront (A1-A5)	**Embodied** (A1-C4) - *excl B6 & B7*	**% Diff to Lowest**
9.6 kgCO2e/m2	17.9 kgCO2e/m2	+0.0%

Name	Low-3	**Manufacturer**	ETEX
Acoustic Rating	45 dB	**Manufacturer Ref**	RUP 055

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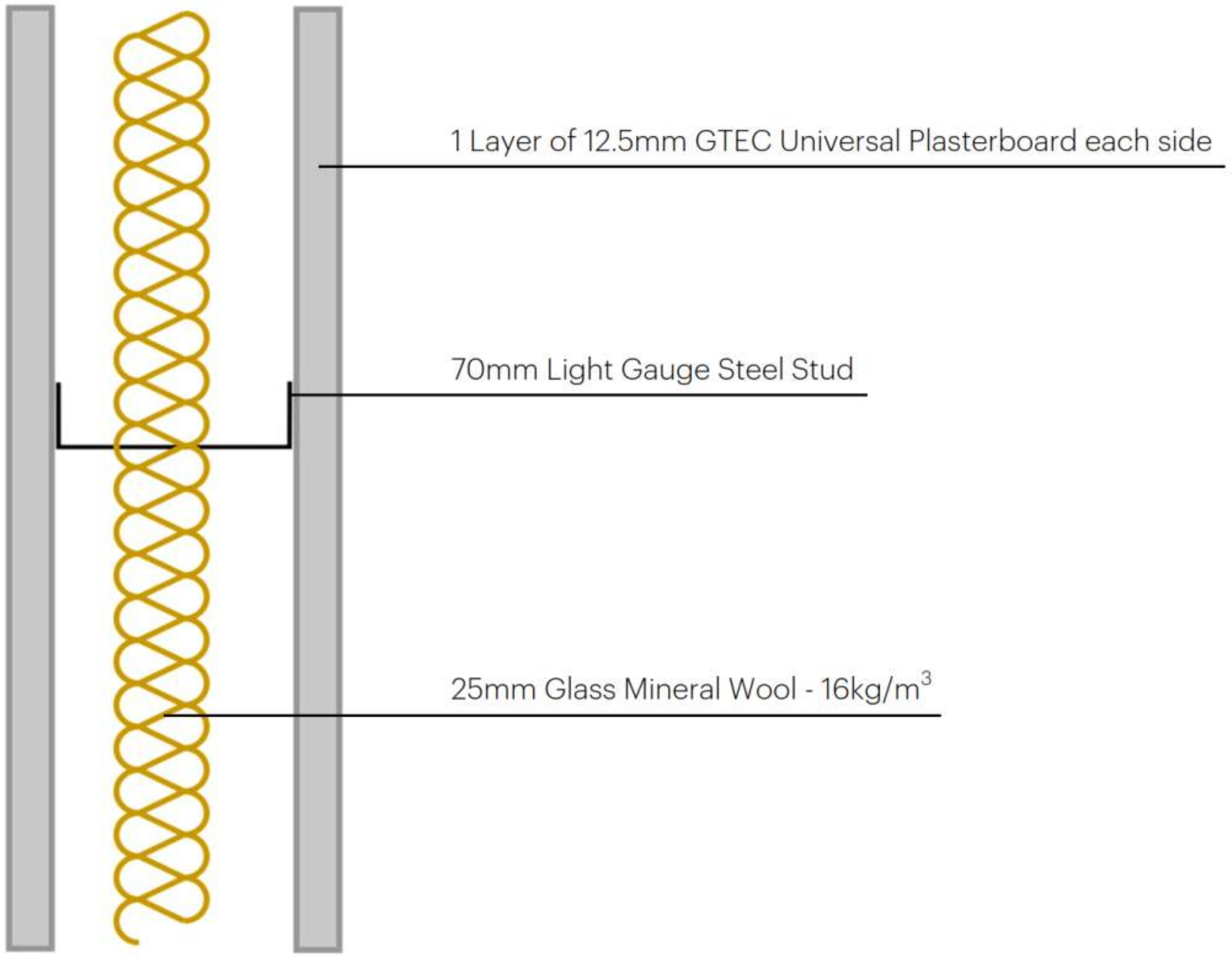

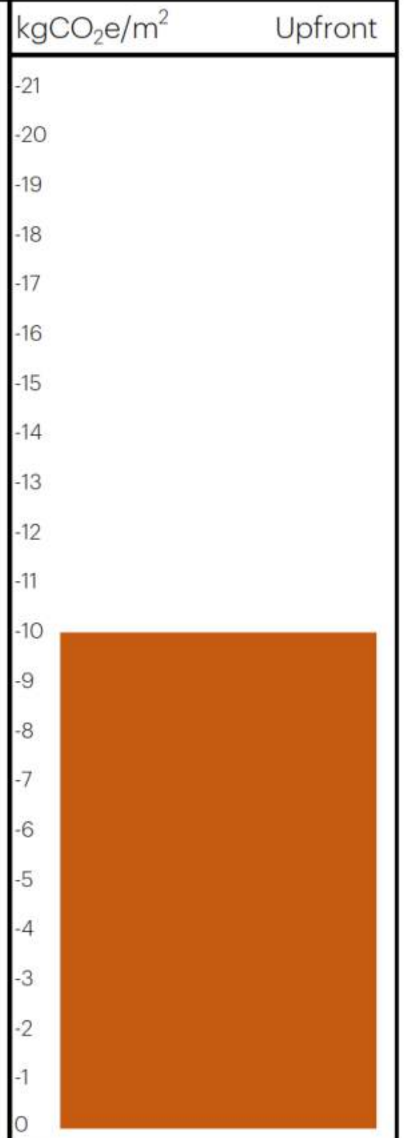

Upfront (A1-A5)	**Embodied** (A1-C4) - *excl B6 & B7*	**% Diff to Lowest**
10.0 kgCO2e/m2	18.9 kgCO2e/m2	+4.1%

Name	Low-1	**Manufacturer**	British Gypsum
Acoustic Rating	45 dB	**Manufacturer Ref**	A206196

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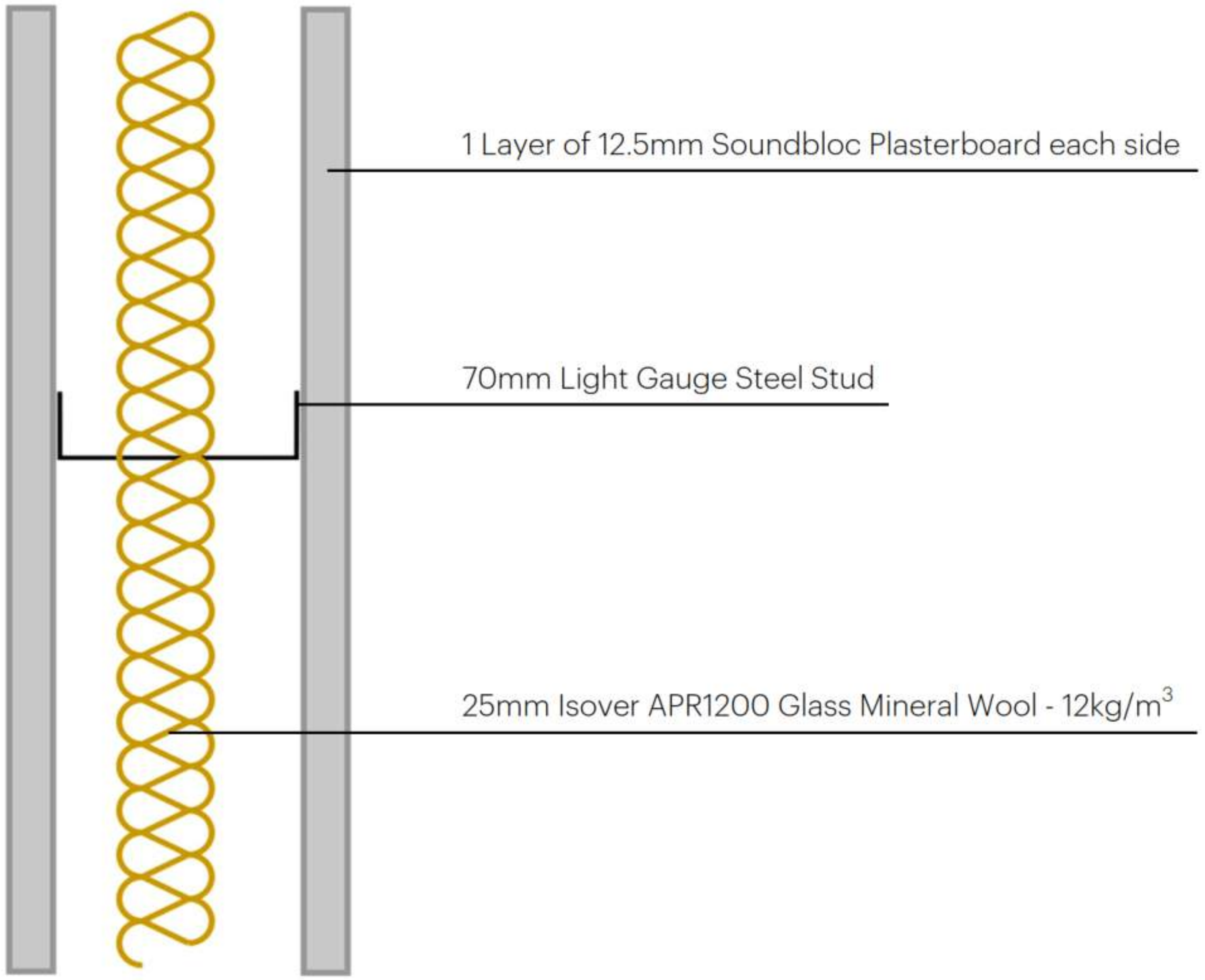
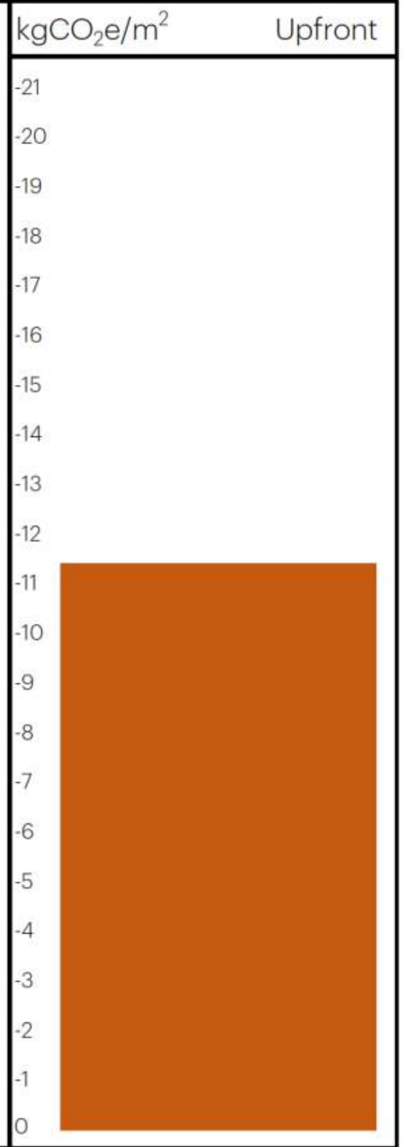


1 Layer of 12.5mm Soundbloc Plasterboard each side

70mm Light Gauge Steel Stud

25mm Isover APR1200 Glass Mineral Wool - 12kg/m^3



Upfront (A1-A5)	**Embodied** (A1-C4) *- excl B6 & B7*	**% Diff to Lowest**
11.4 kgCO2e/m2	22.9 kgCO2e/m2	+19.1%

Name	Low-7	**Manufacturer**	ClayTec
Acoustic Rating	45 dB	**Manufacturer Ref**	-

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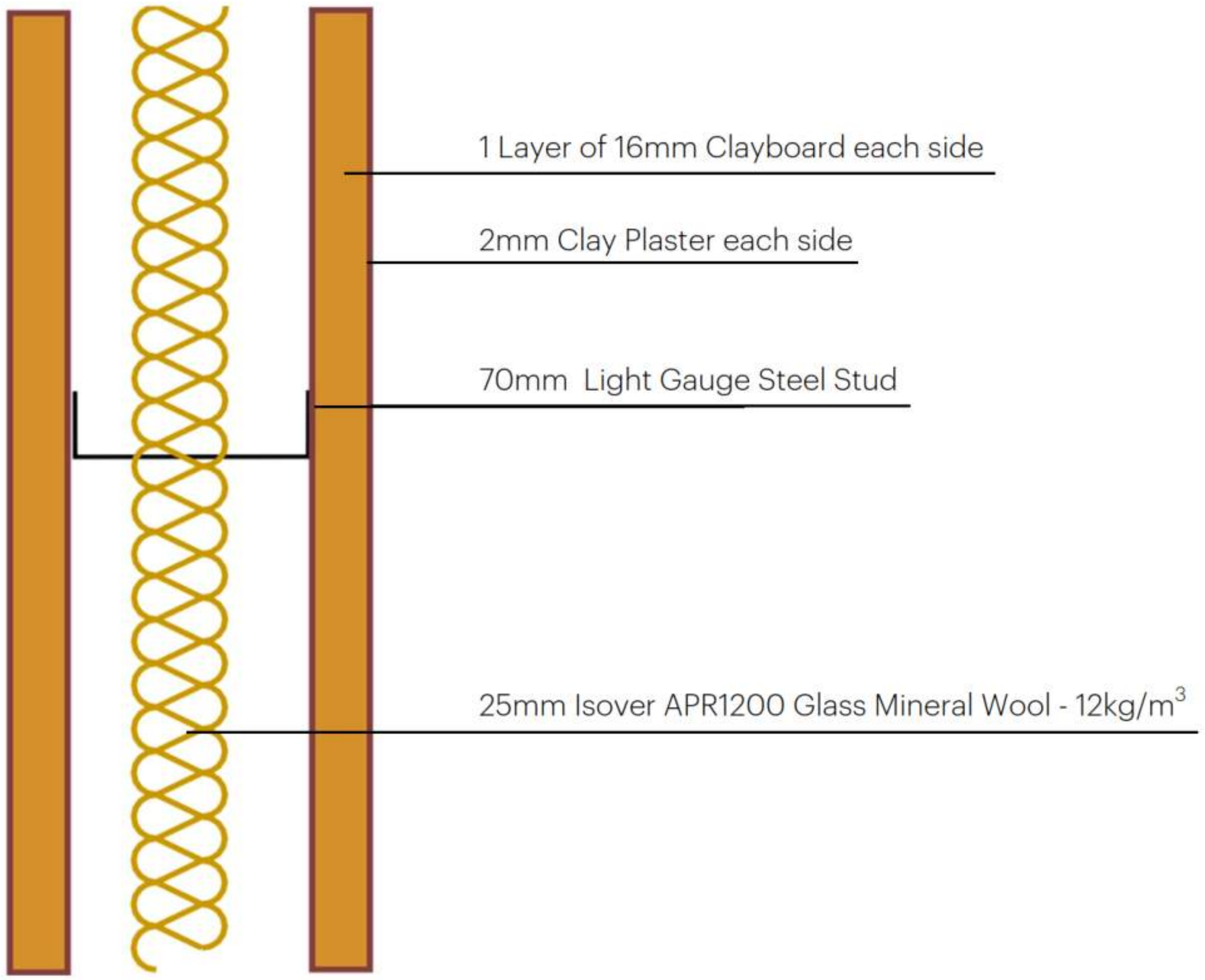

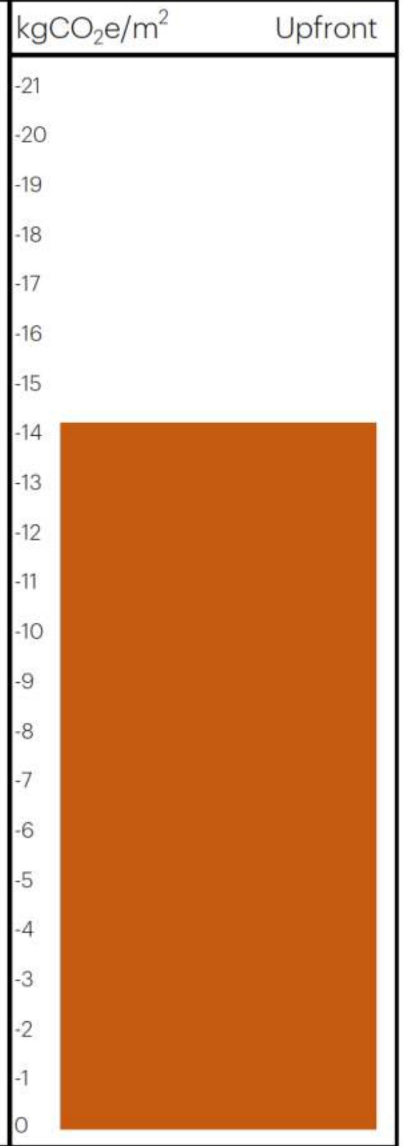

Upfront (A1-A5)	**Embodied** (A1-C4) - *excl B6 & B7*	**% Diff to Lowest**
14.2 kgCO2e/m2	27.7 kgCO2e/m2	+48.5%

Name	Low-2	**Manufacturer**	Fermacell
Acoustic Rating	44 dB	**Manufacturer Ref**	1 S 15/2

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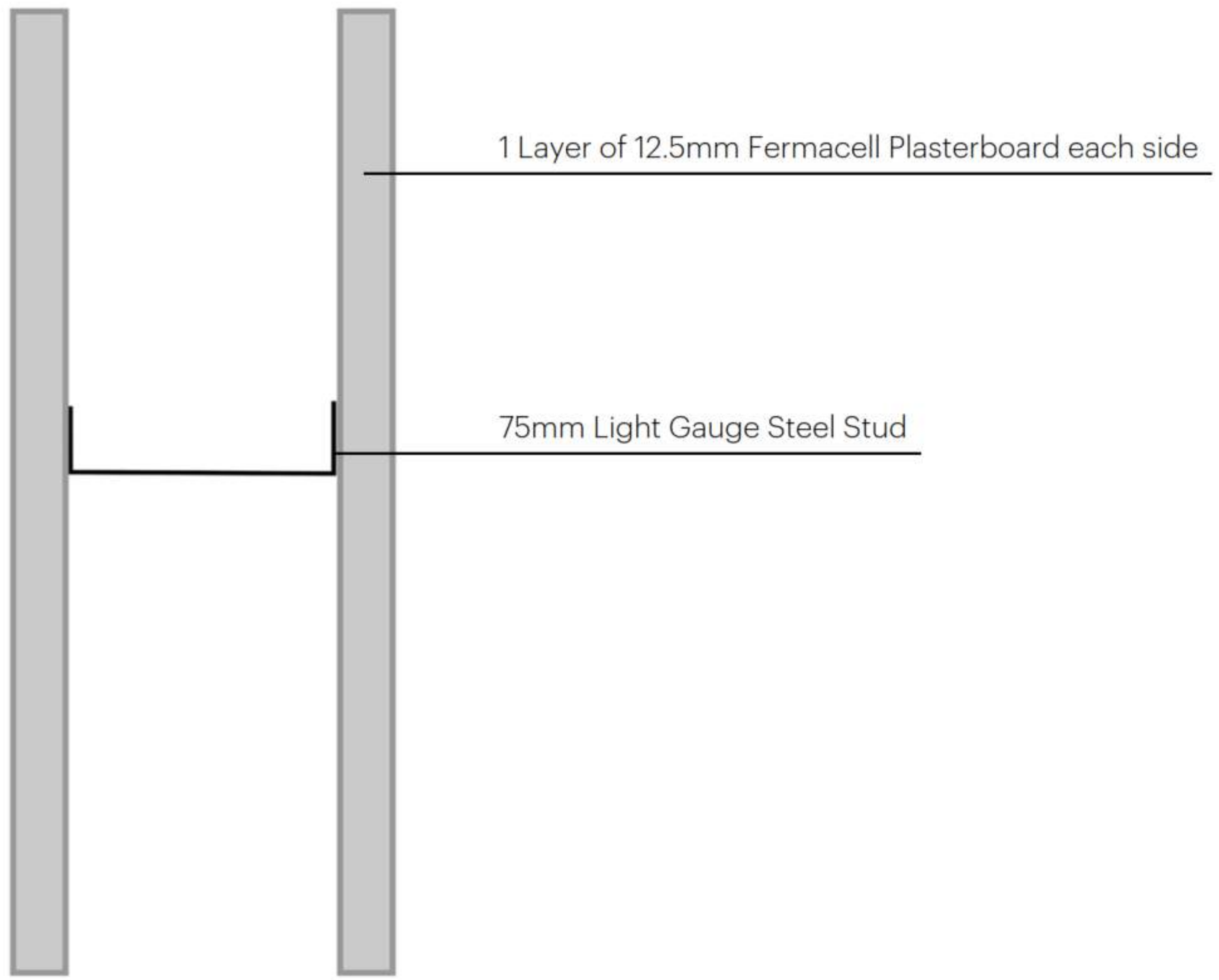

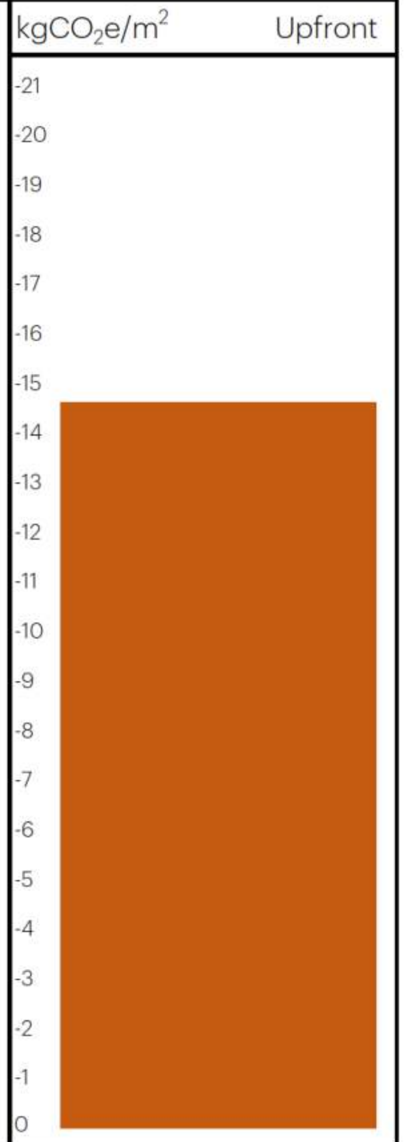

Upfront (A1-A5)	**Embodied** (A1-C4) *- excl B6 & B7*	**% Diff to Lowest**
14.6 kgCO2e/m2	27.9 kgCO2e/m2	+52.5%

Name	Low-6	**Manufacturer**	EBB
Acoustic Rating	48 dB	**Manufacturer Ref**	-

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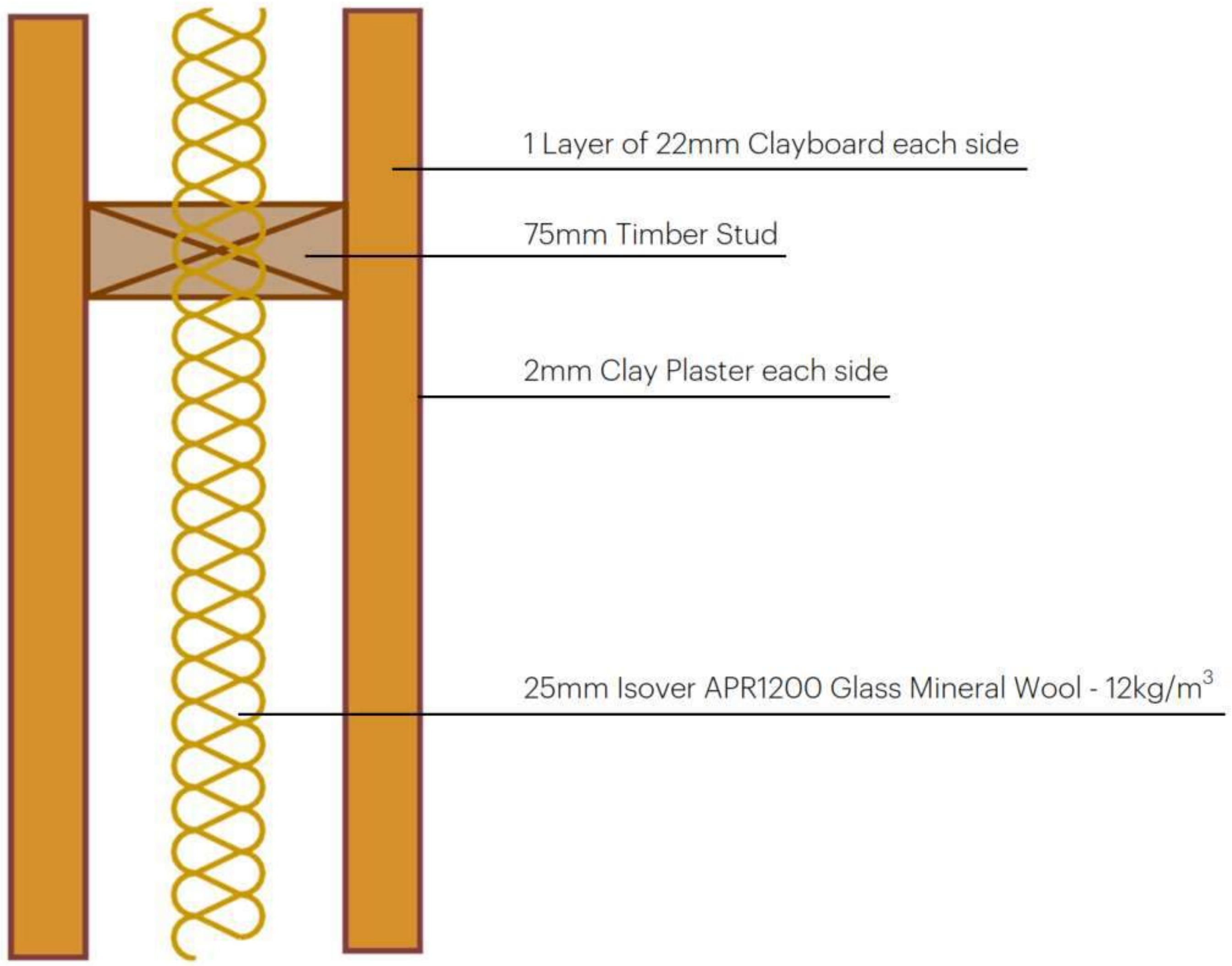
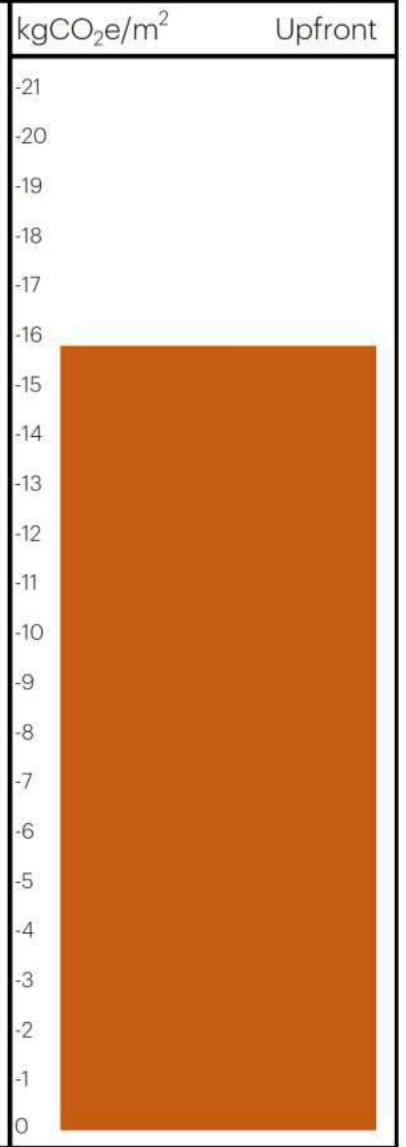
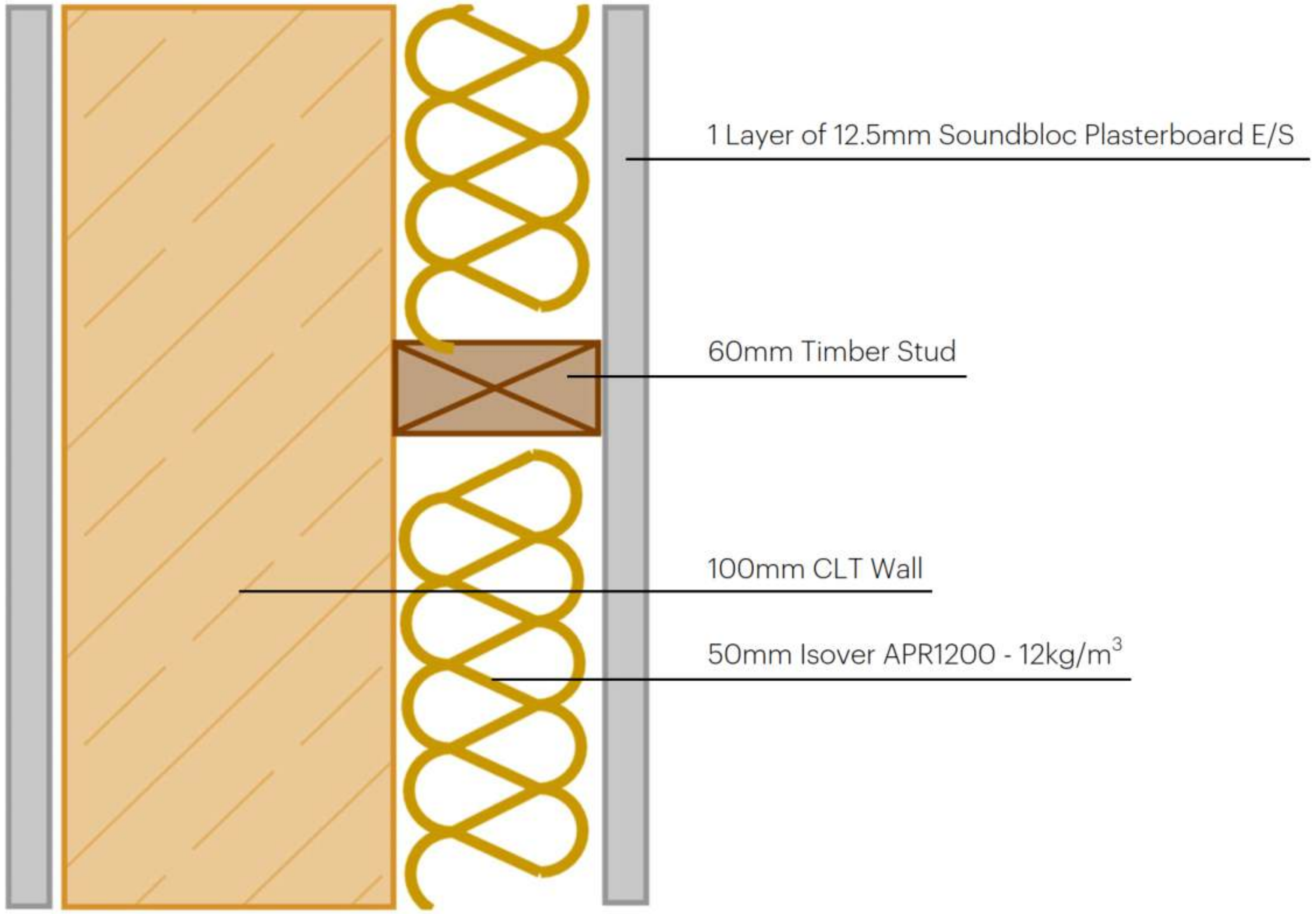




Upfront (A1-A5)	**Embodied** (A1-C4) - *excl B6 & B7*	**% Diff to Lowest**
15.8 kgCO2e/m2	30.6 kgCO2e/m2	+64.8%

Name	Low-5	**Manufacturer**	Binderholz	MAX FORDHAM
Acoustic Rating	45 dB	**Manufacturer Ref**	IW08b	



Upfront (A1-A5)	**Embodied** (A1-C4) *- excl B6 & B7*	
31.5 kgCO2e/m2	41.4 kgCO2e/m2	

1.2 Medium Acoustic Performance

Name	Medium-3	**Manufacturer**	ETEX
Acoustic Rating	53 dB	**Manufacturer Ref**	RSP 027

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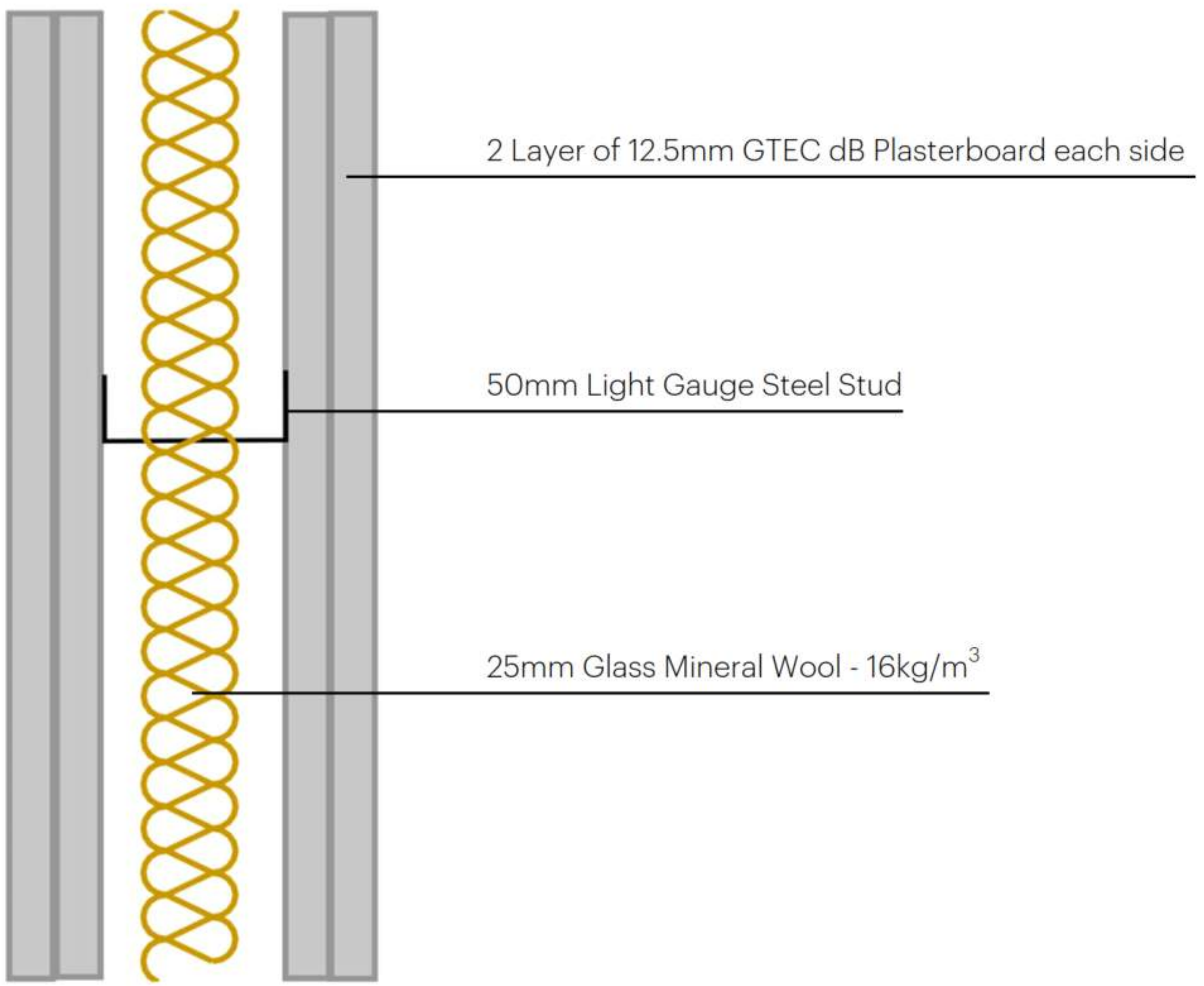

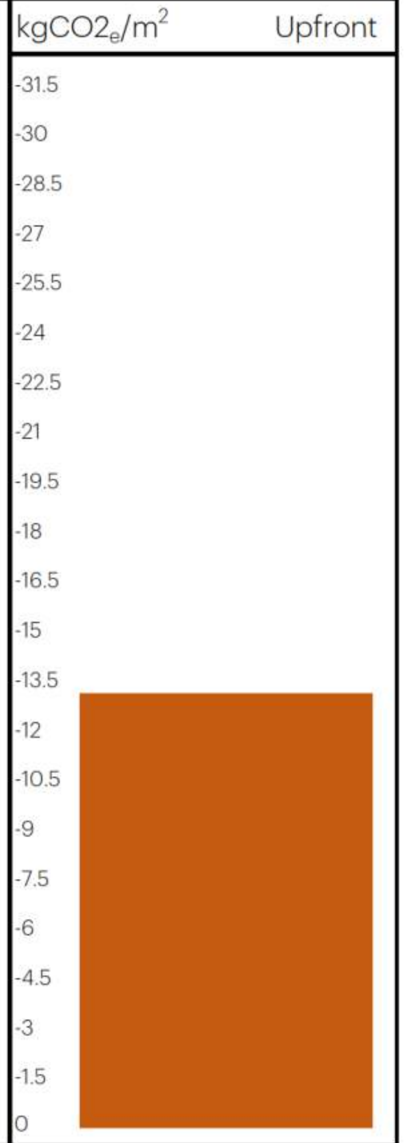

Upfront (A1-A5)	**Embodied** (A1-C4) *- excl B6 & B7*	**% Diff to Lowest**
13.1 kgCO2e/m2	24.5 kgCO2e/m2	+0.0%

Name	Medium-4	**Manufacturer**	British Gypsum
Acoustic Rating	52 dB	**Manufacturer Ref**	A206167S

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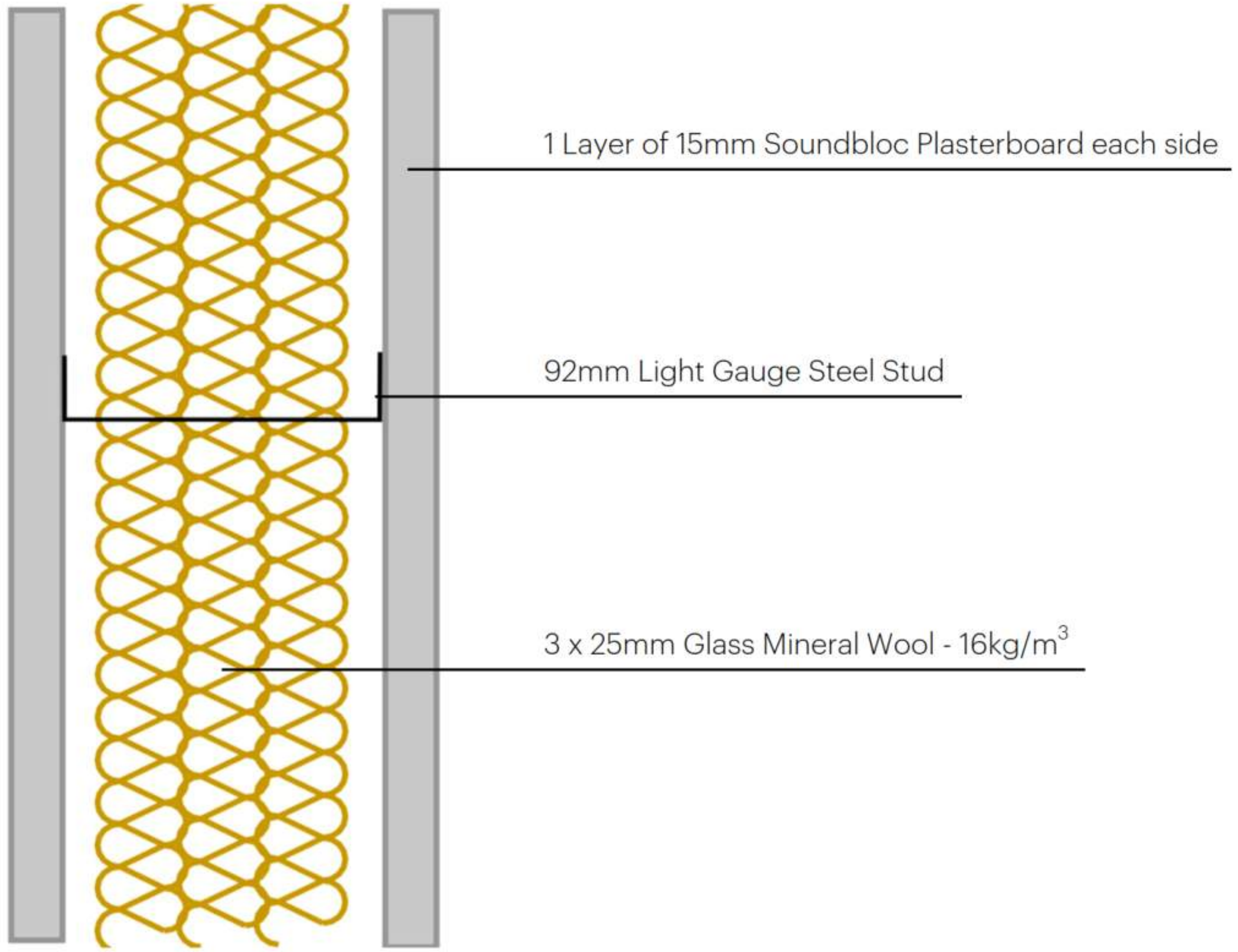

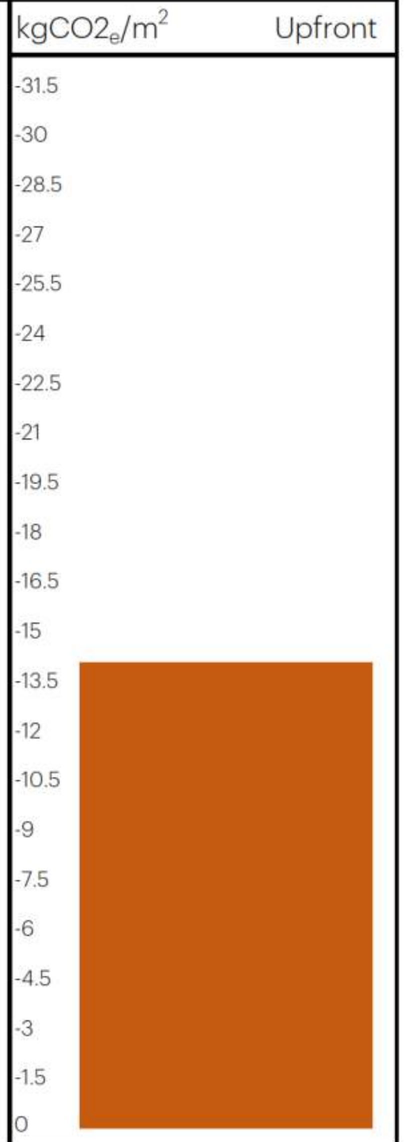

Upfront (A1-A5)	**Embodied** (A1-C4) - *excl B6 & B7*	**% Diff to Lowest**
14.0 kgCO2e/m2	28.2 kgCO2e/m2	+7.3%

Name	Medium-2	**Manufacturer**	Fermacell
Acoustic Rating	52 dB	**Manufacturer Ref**	1 S 11

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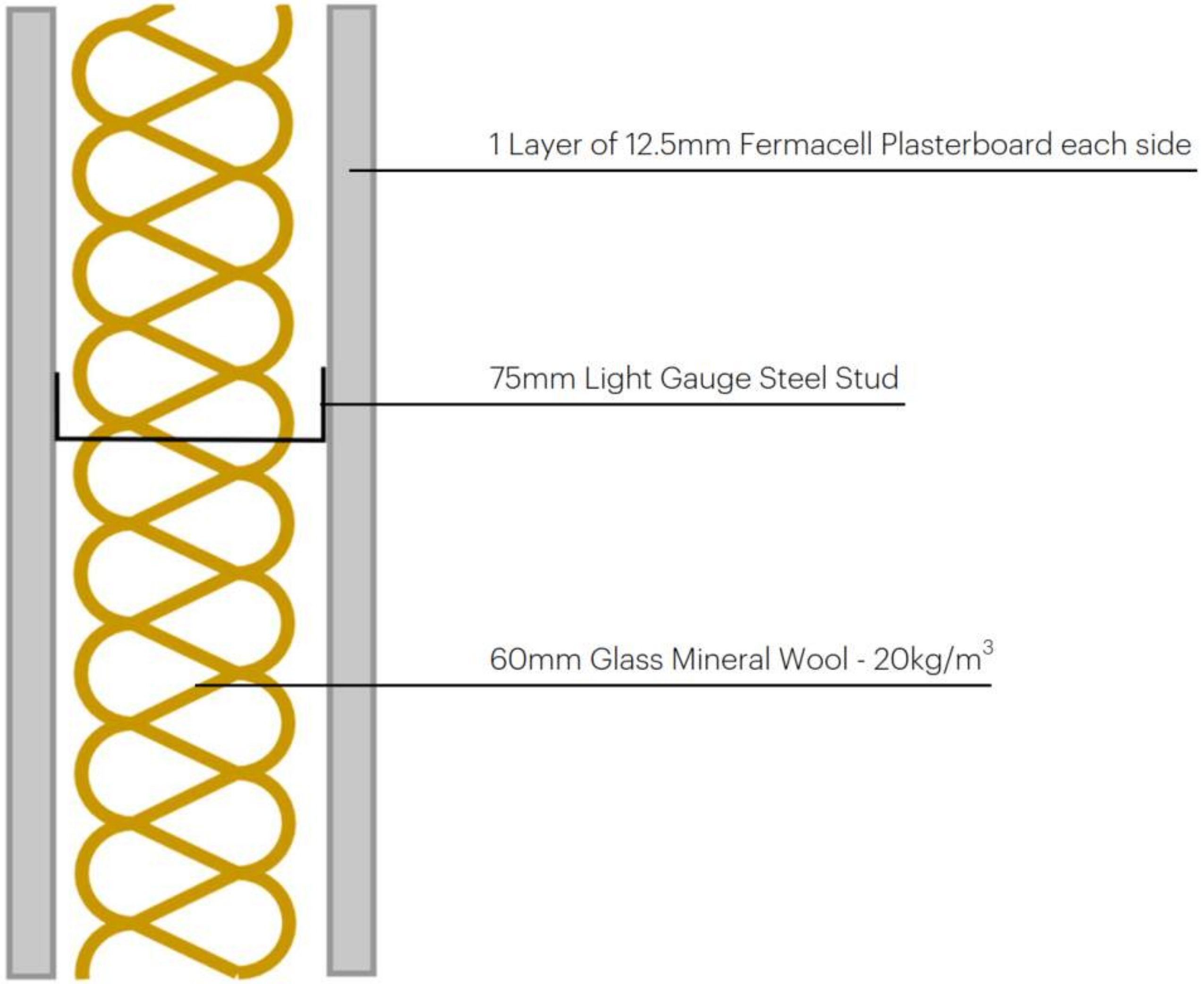

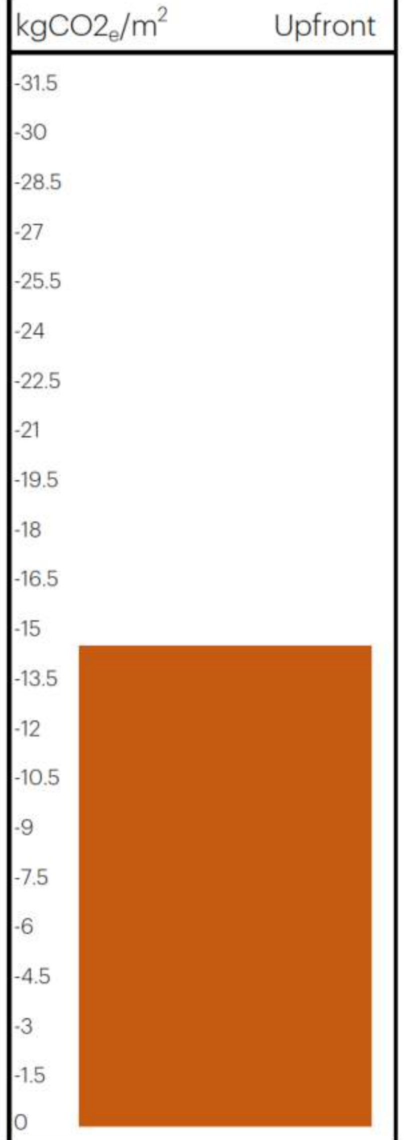

Upfront (A1-A5)	**Embodied** (A1-C4) - *excl B6 & B7*	**% Diff to Lowest**
14.5 kgCO2e/m2	27.8 kgCO2e/m2	+10.6%

Name	Workplace Future - 2	**Manufacturer**	British Gypsum
Acoustic Rating	51 dB	**Manufacturer Ref**	A206186 (EN)

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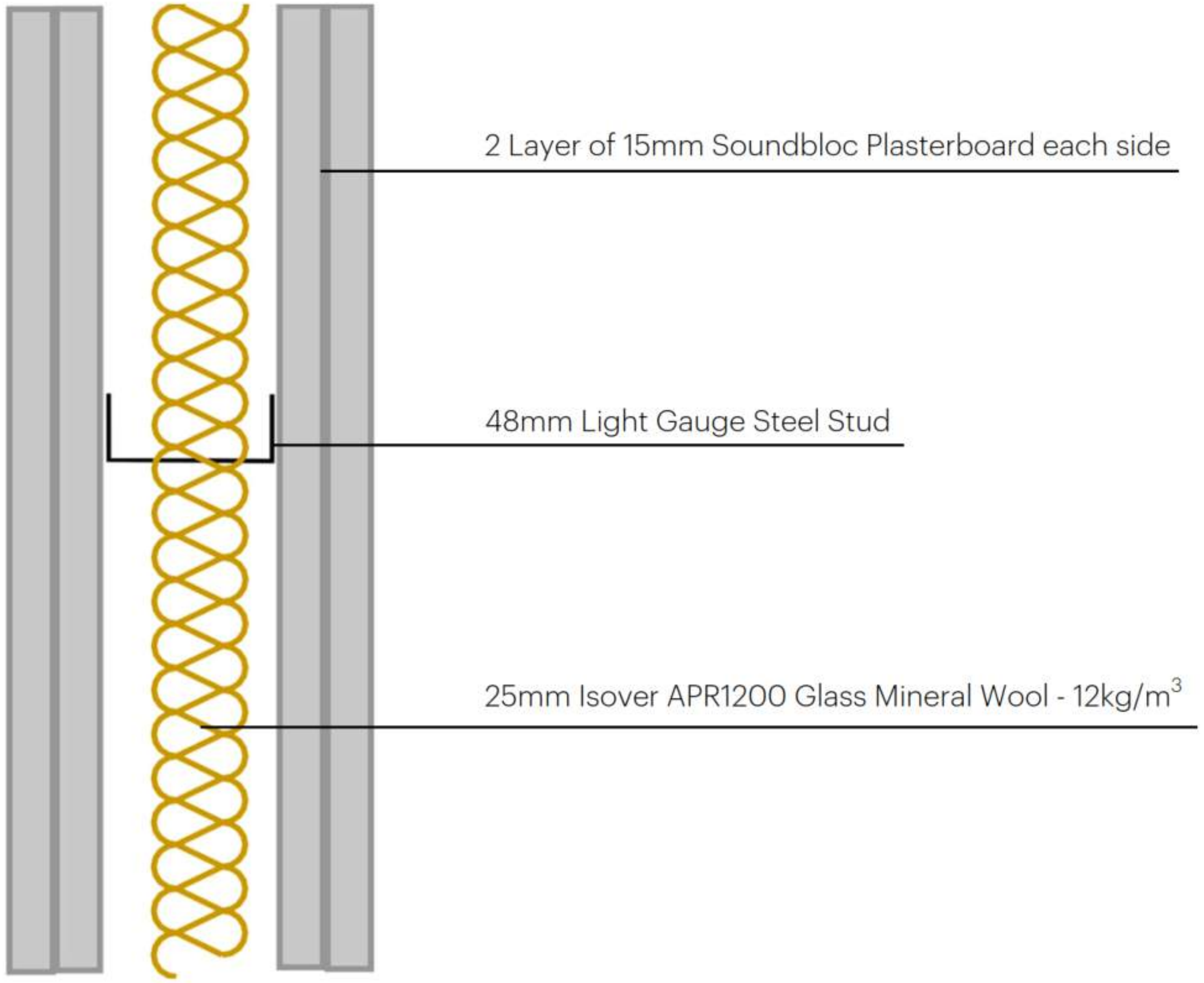
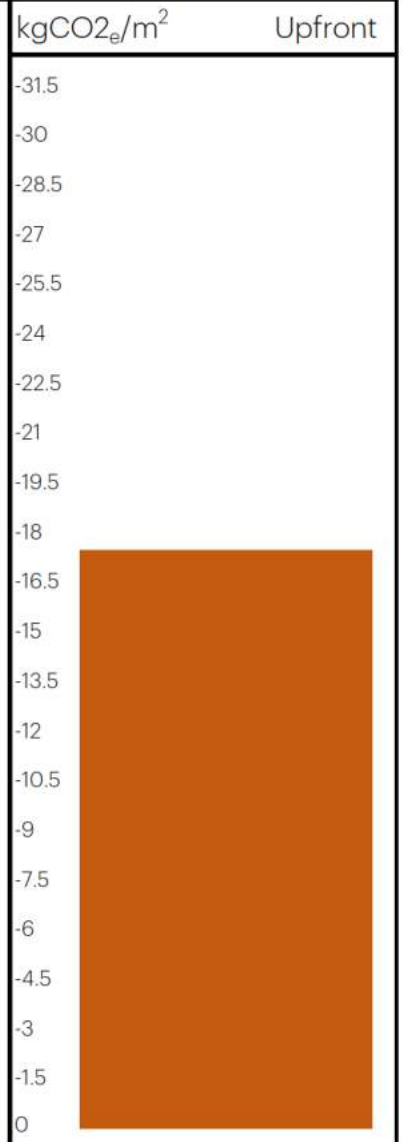
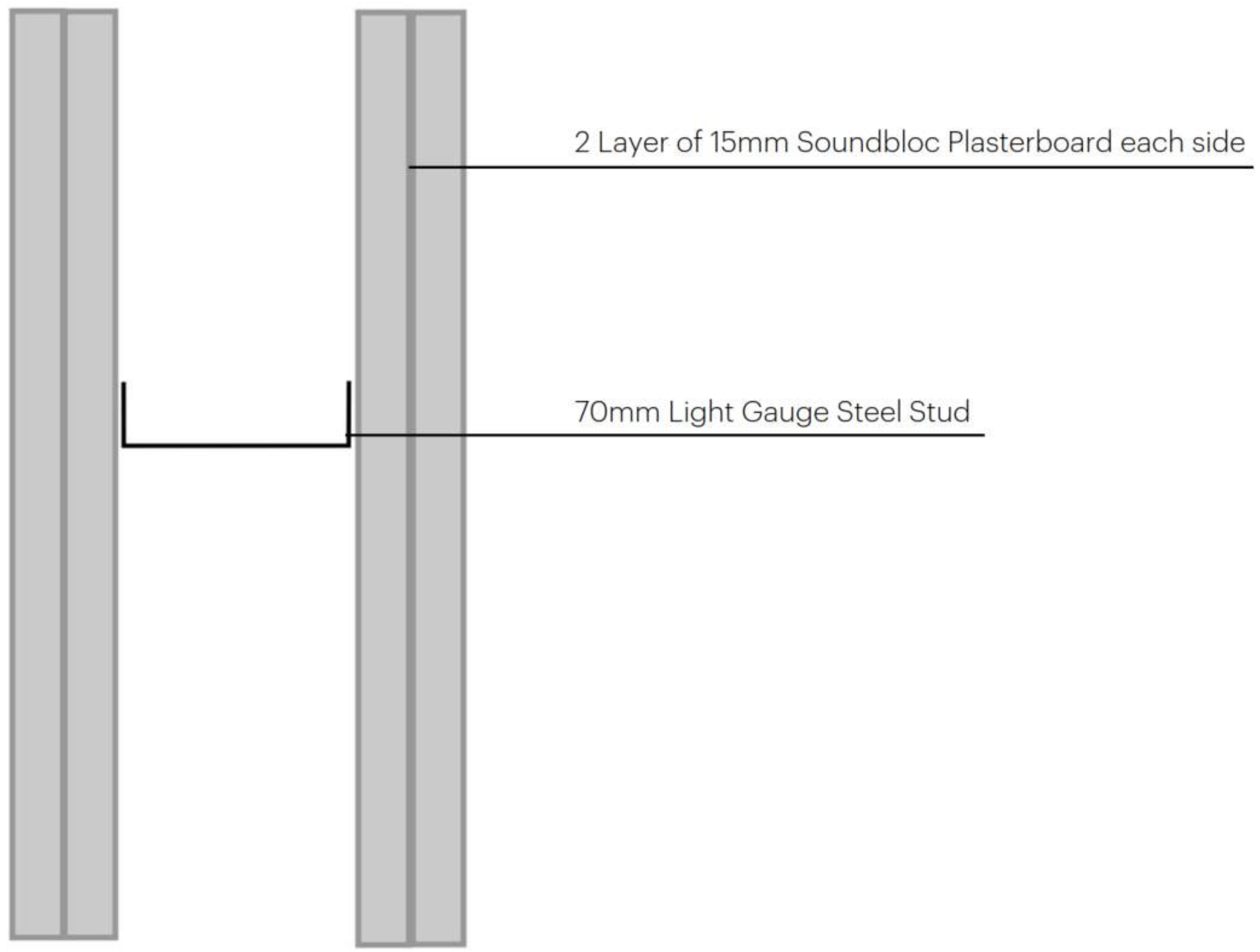
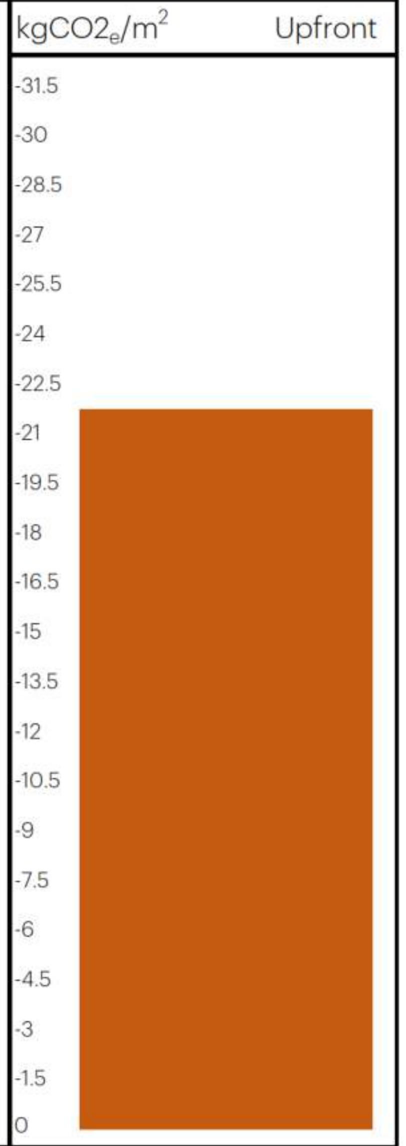




Upfront (A1-A5)	**Embodied** (A1-C4) *- excl B6 & B7*	**% Diff to Lowest**
17.4 kgCO2e/m2	35.3 kgCO2e/m2	+33.3%

Name	Medium-1	**Manufacturer**	British Gypsum	MAX FORDHAM
Acoustic Rating	52 dB	**Manufacturer Ref**	A206167S	





Upfront (A1-A5)	**Embodied** (A1-C4) - *excl B6 & B7*	**% Diff to Lowest**
21.7 kgCO2e/m2	43.8 kgCO2e/m2	+65.7%

Name	Medium-6	**Manufacturer**	ClayTec
Acoustic Rating	52 dB	**Manufacturer Ref**	-

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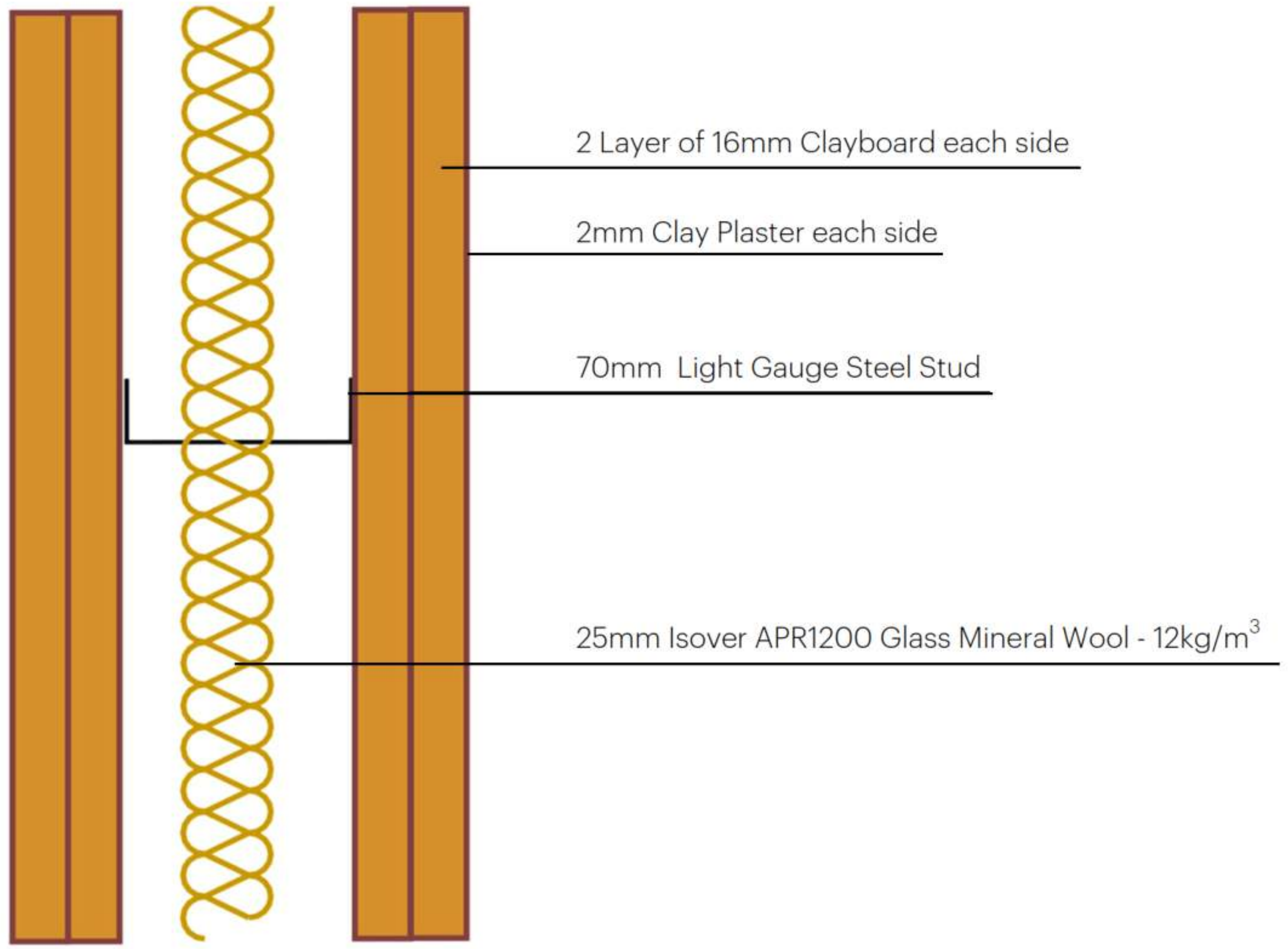
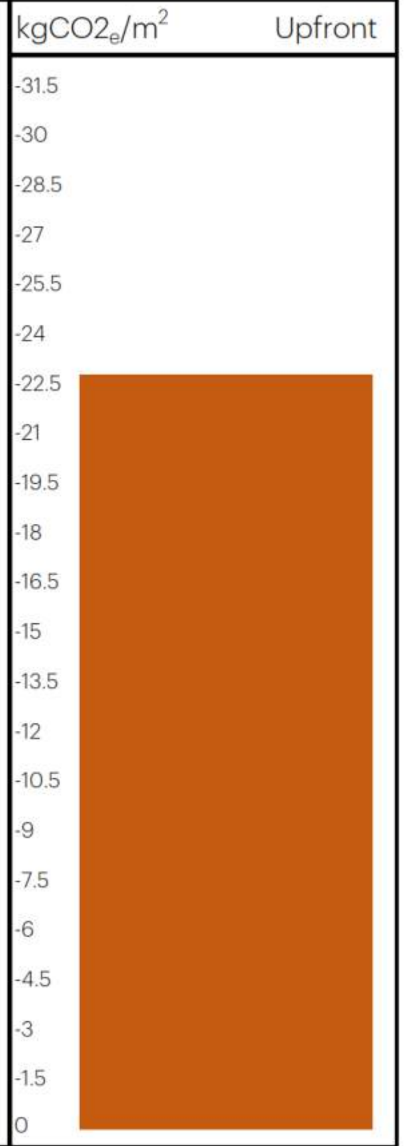
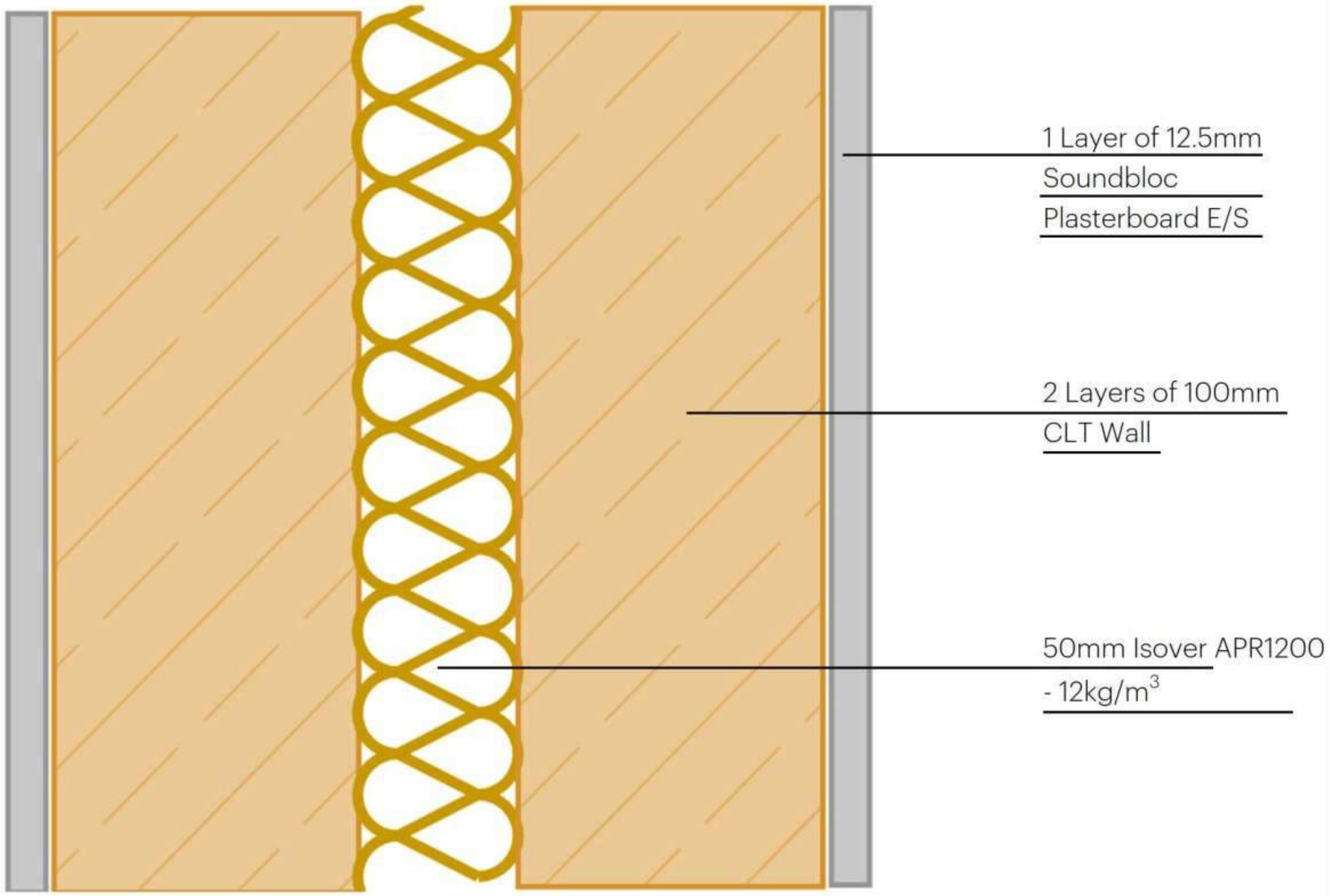




Upfront (A1-A5)	**Embodied** (A1-C4) *- excl B6 & B7*	**% Diff to Lowest**
22.7 kgCO2e/m2	44.2 kgCO2e/m2	+73.6%

Name	Med-5	**Manufacturer**	Binderholz	MAX FORDHAM
Acoustic Rating	52 dB	**Manufacturer Ref**	IW10b	



Upfront (A1-A5)	**Embodied** (A1-C4) - *excl B6 & B7*
53.1 kgCO2e/m2	62.9 kgCO2e/m2

1.3 High Acoustic Performance

Name High-5

Acoustic Rating 61 dB

Manufacturer Pliteq

Manufacturer Ref -

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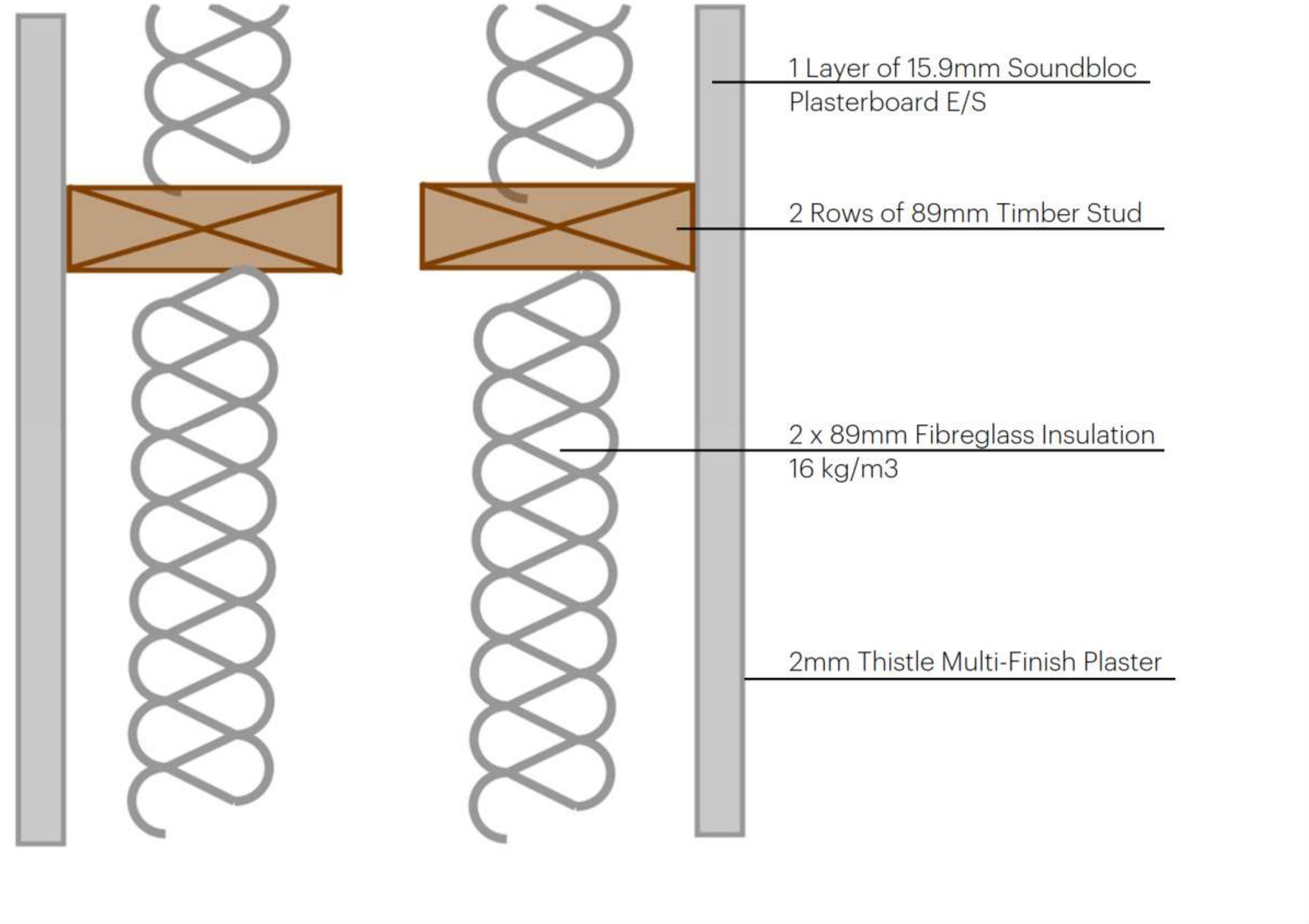
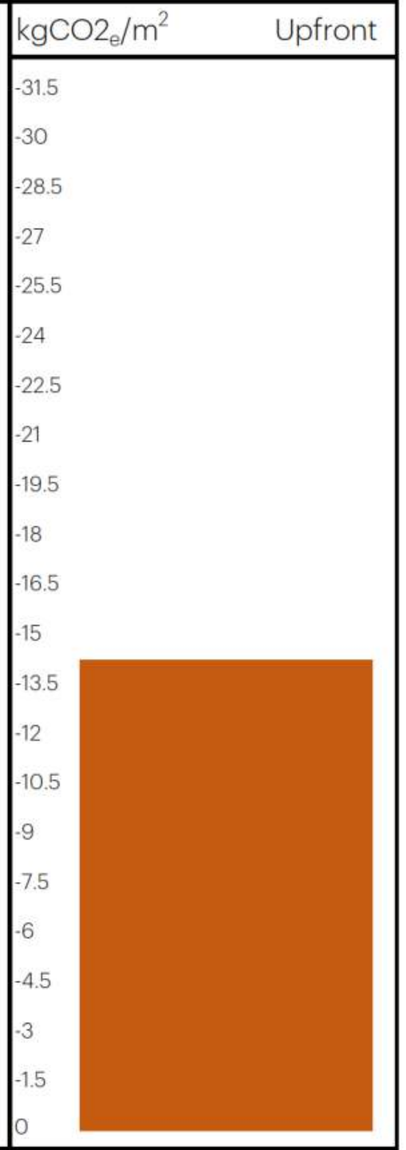
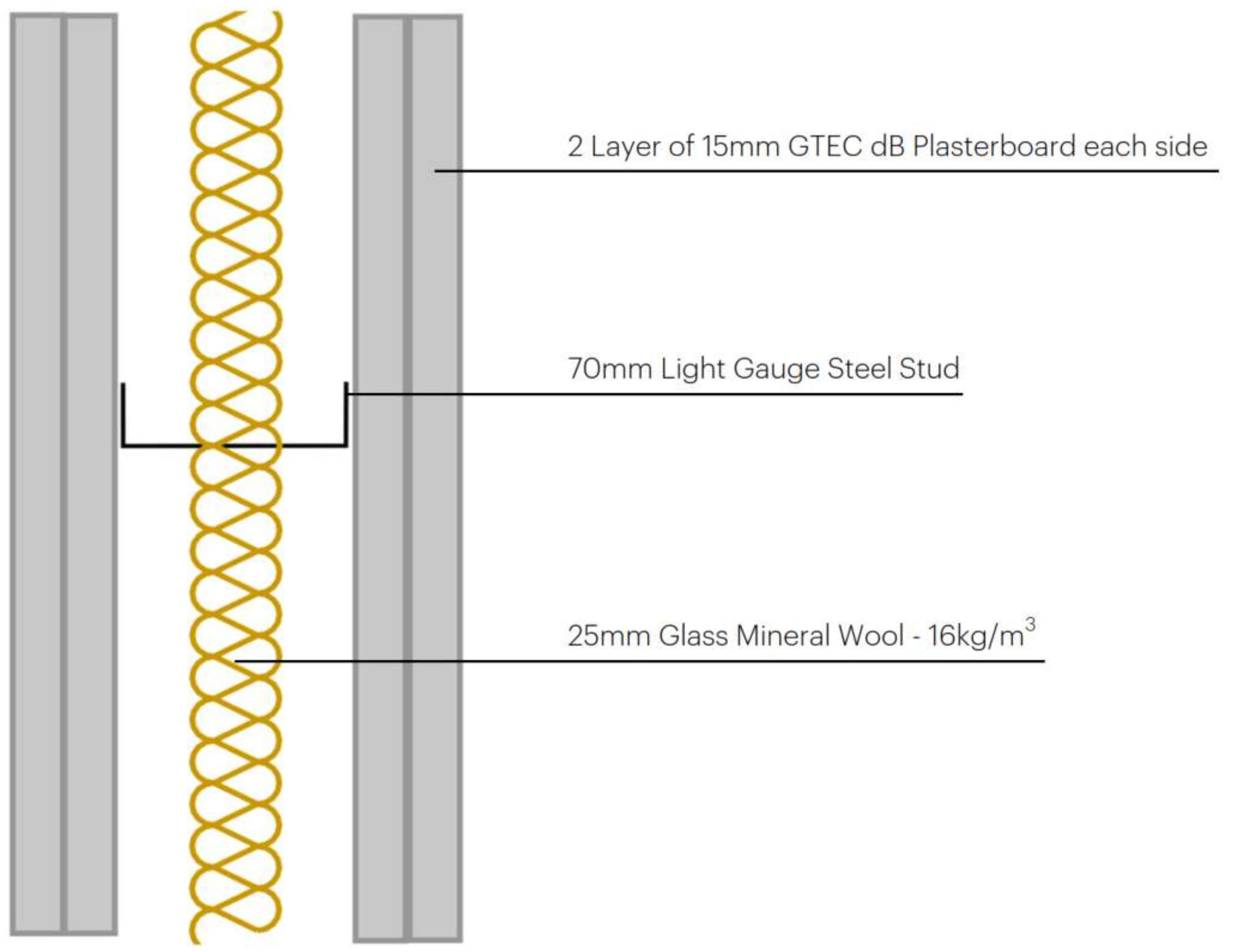
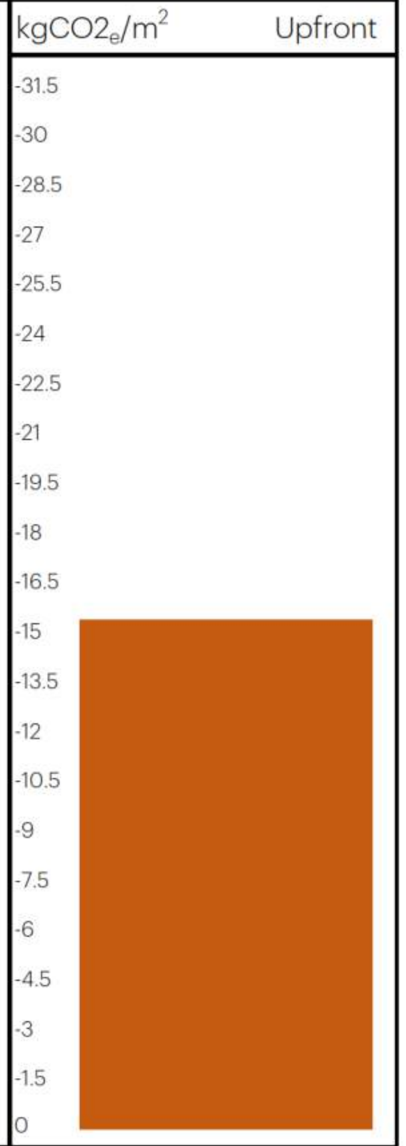




Upfront (A1-A5)	**Embodied** (A1-C4) - *excl B6 & B7*	**% Diff to Lowest**
14.2 kgCO2e/m2	28.2 kgCO2e/m2	+0.0%

Name	High-4	**Manufacturer**	ETEX	MAX FORDHAM
Acoustic Rating	55 dB	**Manufacturer Ref**	RSP 013	

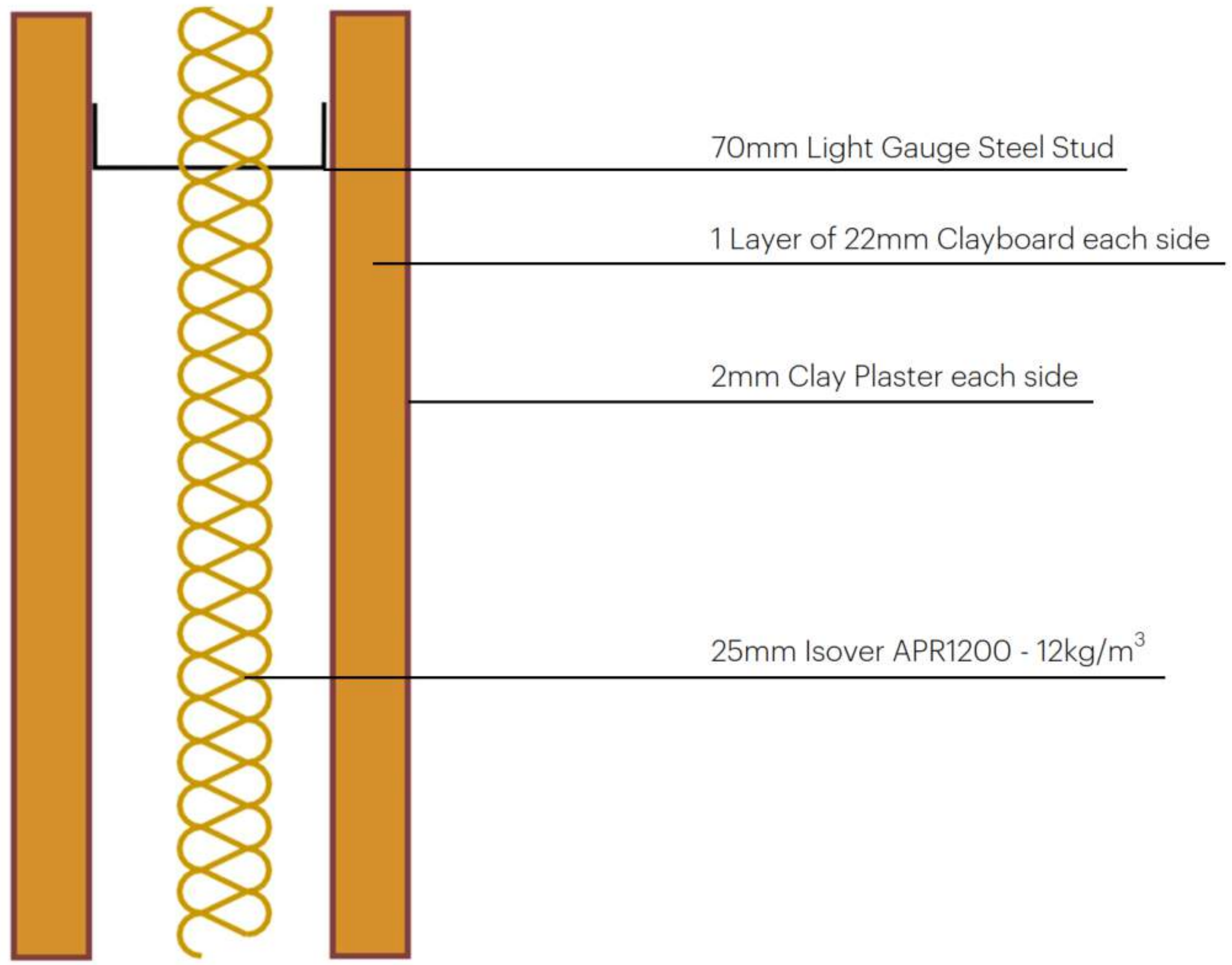


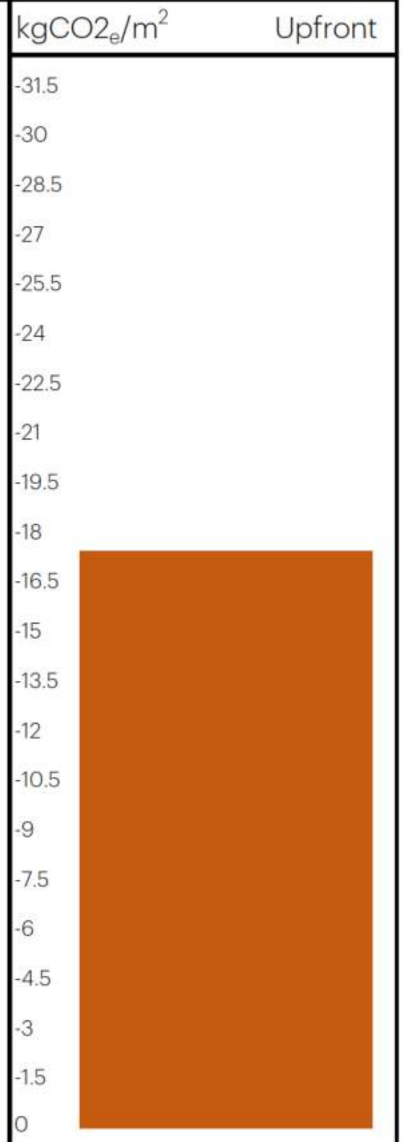


Upfront (A1-A5)	**Embodied** (A1-C4) - *excl B6 & B7*	**% Diff to Lowest**
15.3 kgCO2e/m2	29.5 kgCO2e/m2	+8.2%

Name	High-8	**Manufacturer**	EBB
Acoustic Rating	55 dB	**Manufacturer Ref**	-

MAX FORDHAM





Upfront (A1-A5)	**Embodied** (A1-C4) *- excl B6 & B7*	**% Diff to Lowest**
17.4 kgCO2e/m2	33.9 kgCO2e/m2	+22.7%

Name	High-3	**Manufacturer**	Fermacell
Acoustic Rating	56 dB	**Manufacturer Ref**	1 S 29

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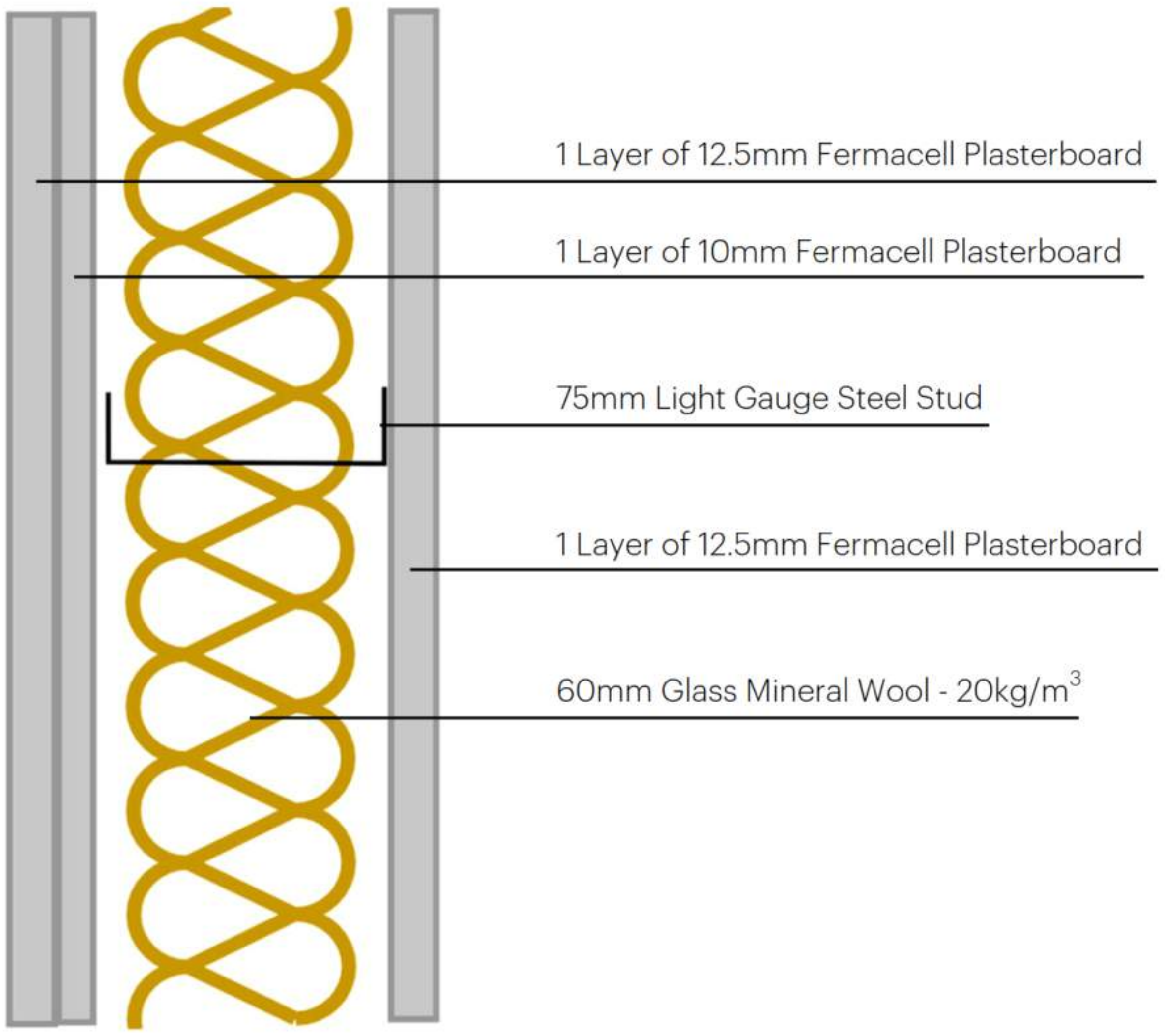

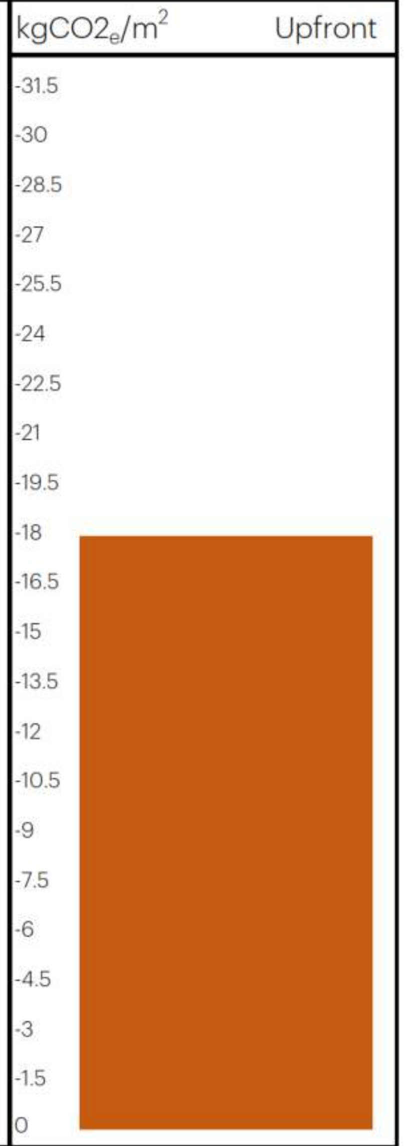

Upfront (A1-A5)	**Embodied** (A1-C4) *- excl B6 & B7*	**% Diff to Lowest**
17.9 kgCO2e/m2	34.2 kgCO2e/m2	+26.1%

Name	High-1	**Manufacturer**	British Gypsum
Acoustic Rating	55 dB	**Manufacturer Ref**	A206210

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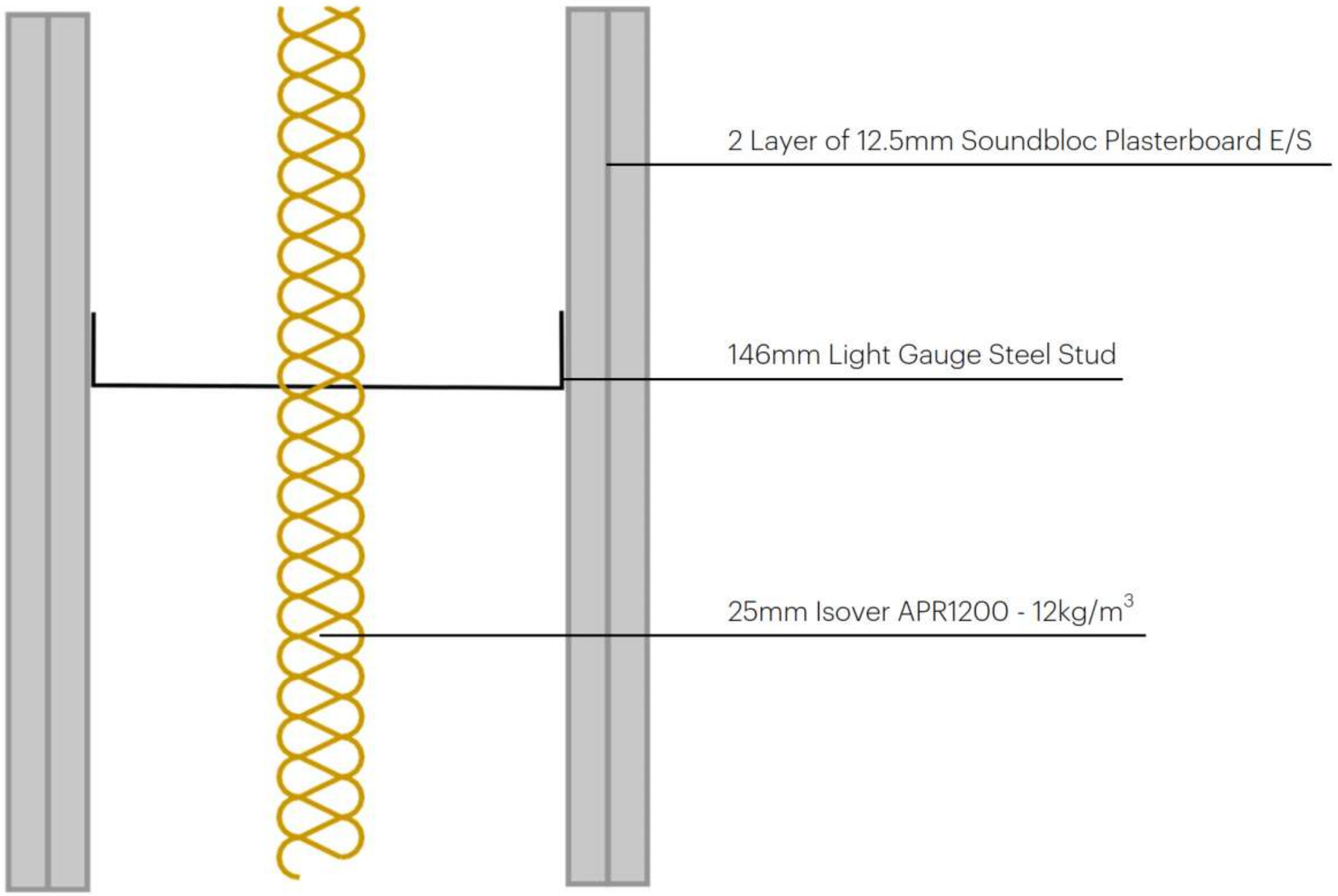

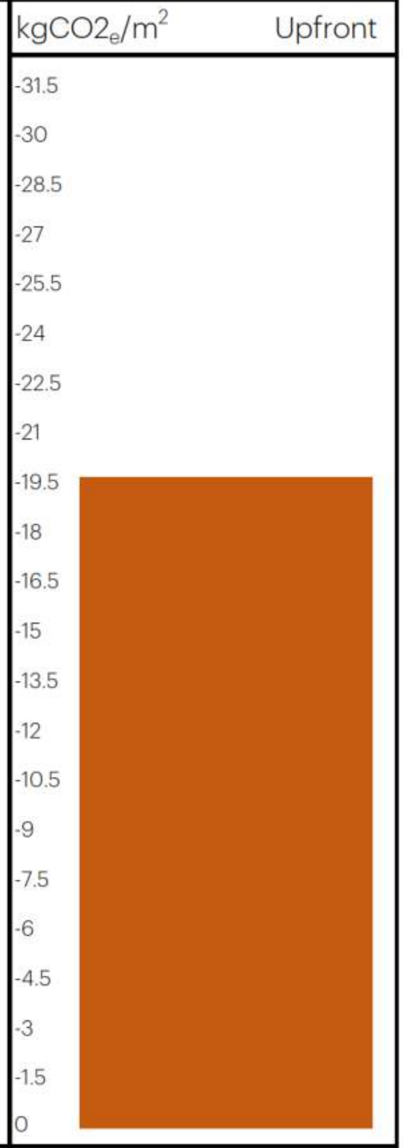

Upfront (A1-A5)	**Embodied** (A1-C4) *- excl B6 & B7*	**% Diff to Lowest**
19.6 kgCO2e/m2	39.6 kgCO2e/m2	+38.6%

Name	High-2	**Manufacturer**	British Gypsum
Acoustic Rating	55 dB	**Manufacturer Ref**	A206A167S (EN)

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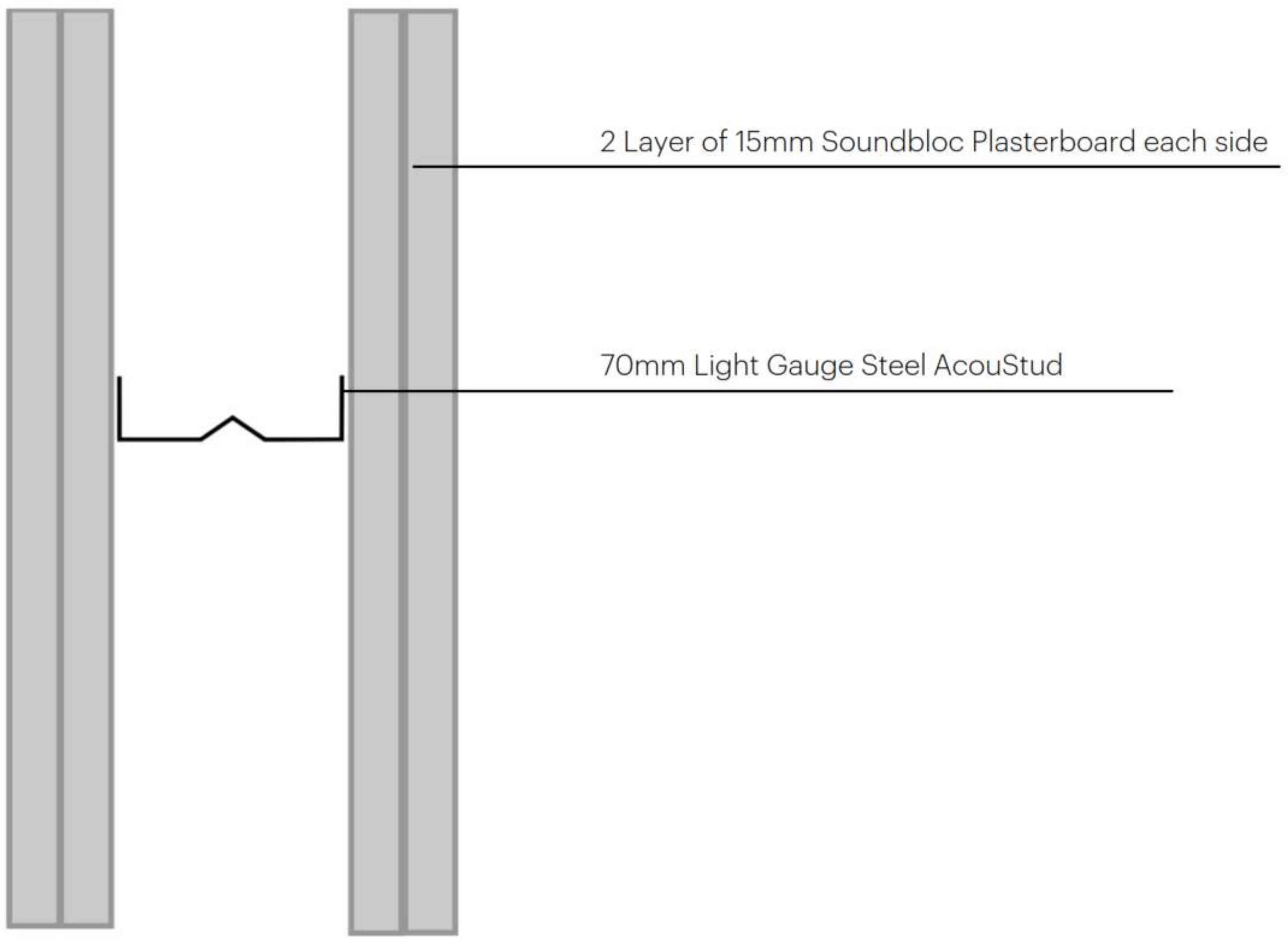

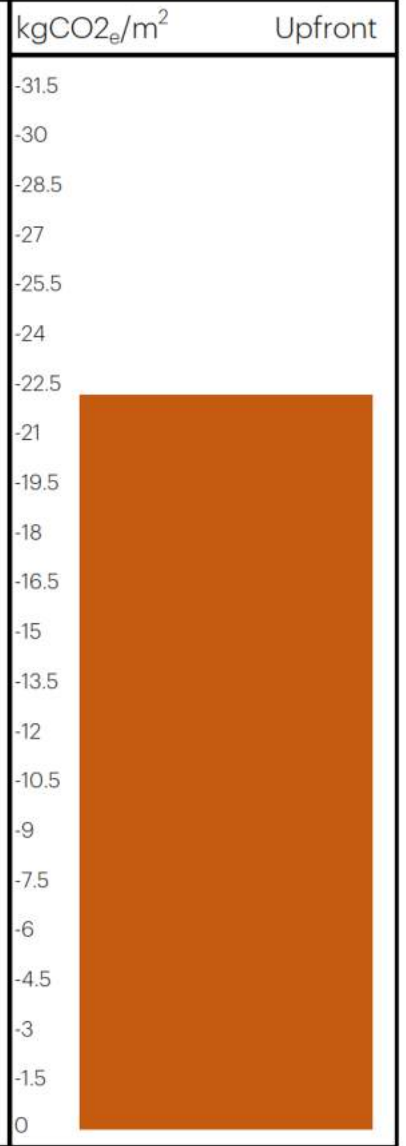

Upfront (A1-A5)	**Embodied** (A1-C4) - *excl B6 & B7*	**% Diff to Lowest**
22.1 kgCO2e/m2	44.6 kgCO2e/m2	+56.0%

Name	High-7	**Manufacturer**	EBB
Acoustic Rating	55 dB	**Manufacturer Ref**	-

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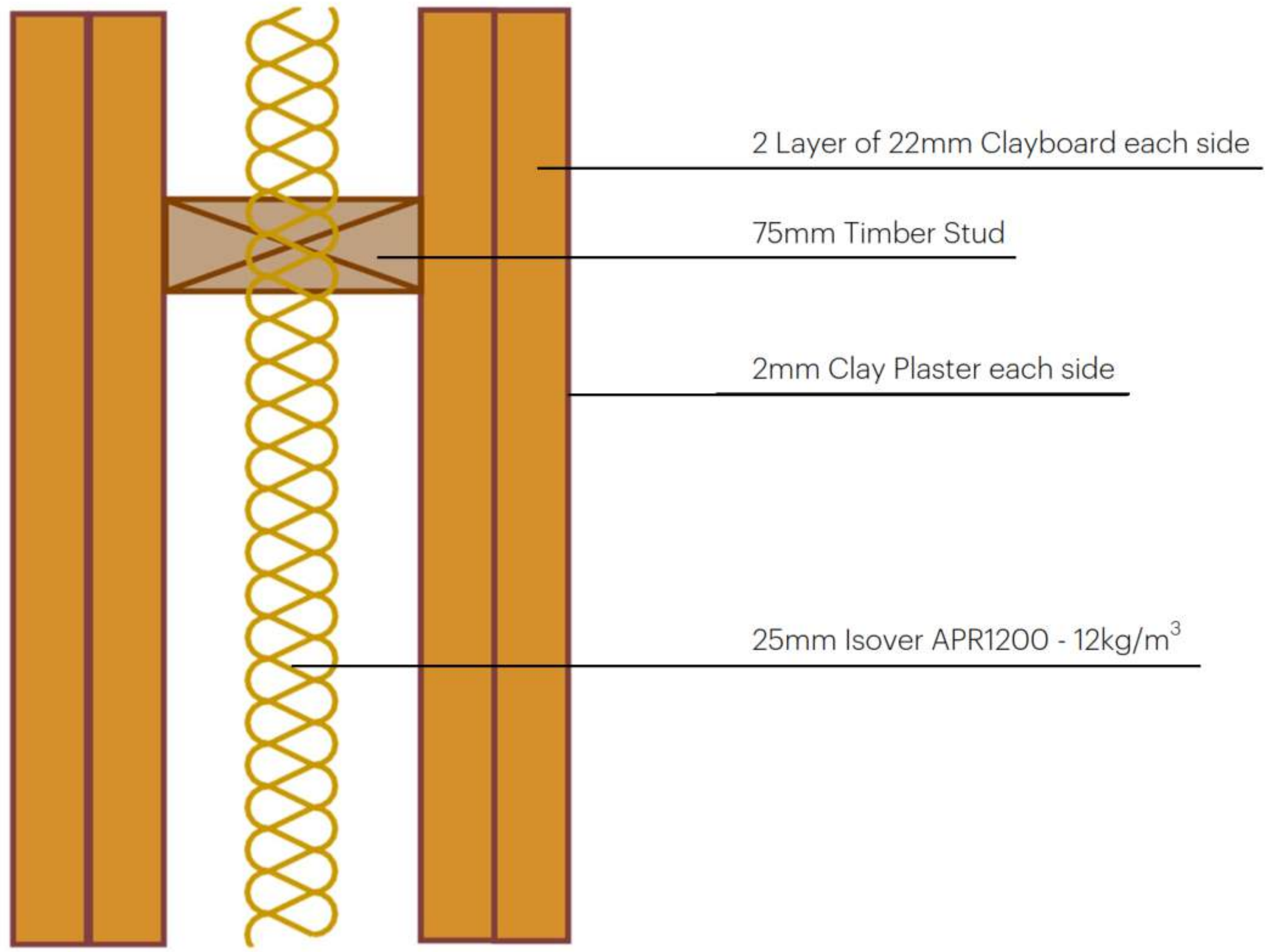

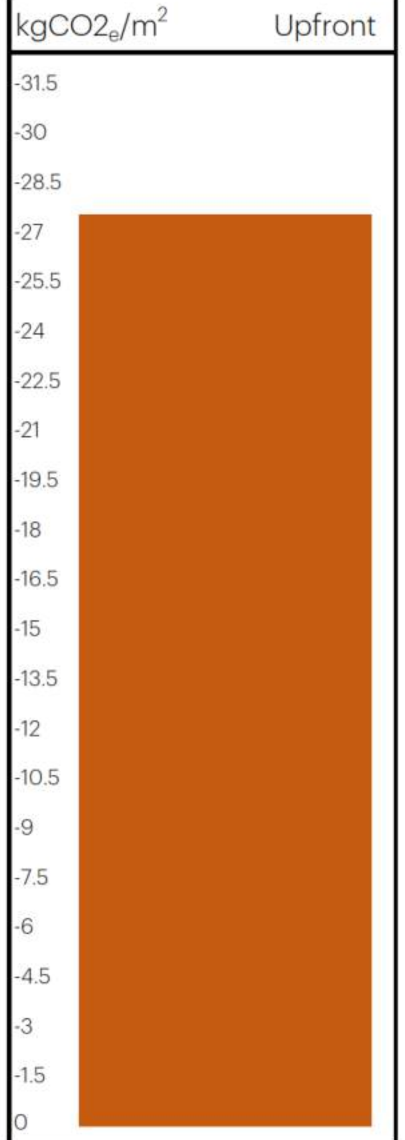

Upfront (A1-A5)	**Embodied** (A1-C4) *- excl B6 & B7*	**% Diff to Lowest**
27.5 kgCO2e/m2	33.9 kgCO2e/m2	+93.9%

Name	High-6	**Manufacturer**	Binderholz
Acoustic Rating	55 dB	**Manufacturer Ref**	IW11

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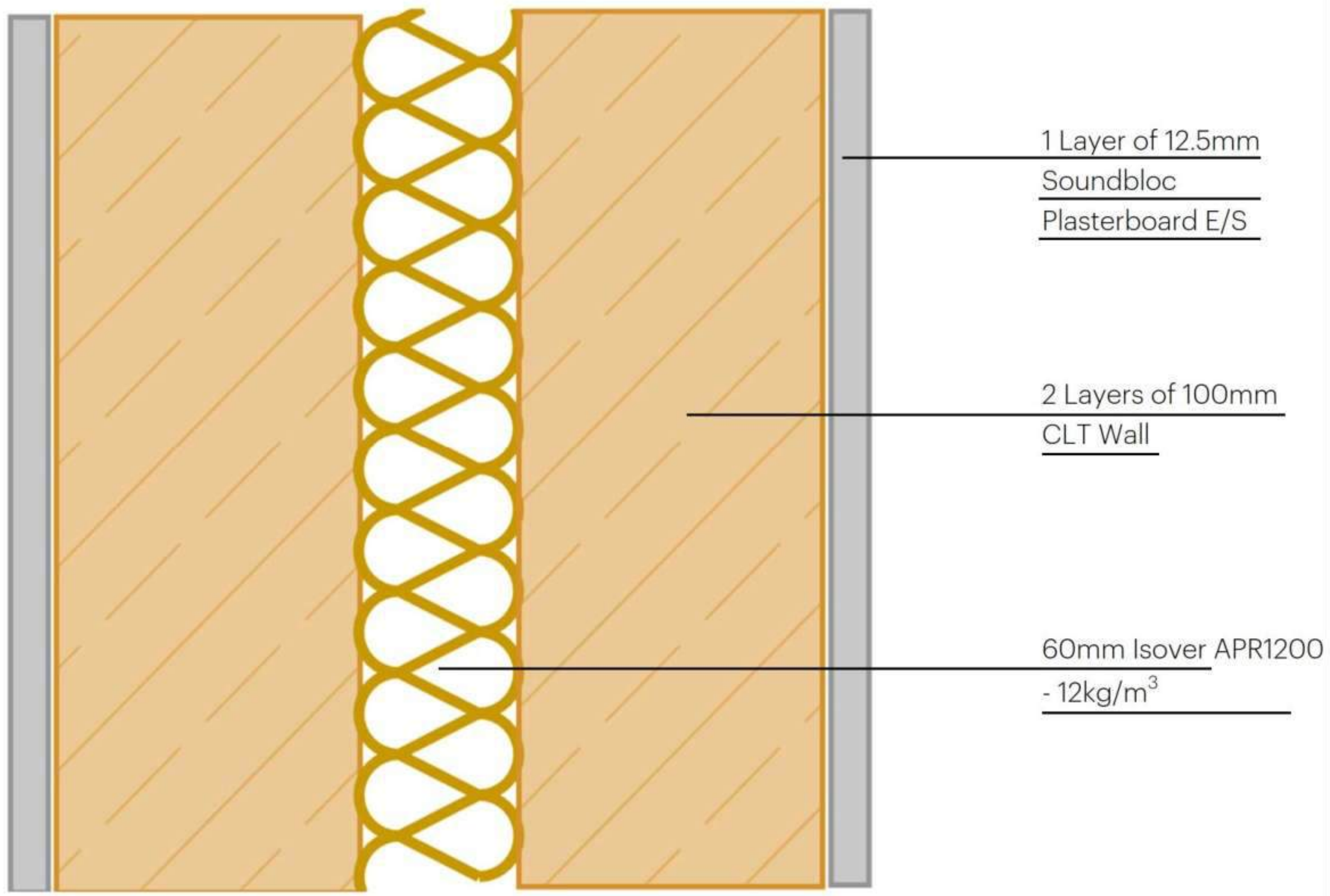


Upfront (A1-A5)	**Embodied** (A1-C4) *- excl B6 & B7*
52.9 kgCO2e/m2	62.6 kgCO2e/m2

2.0 INTRODUCTION

2.1 Project

The Office Partition Study has been commissioned by Workplace Futures in order to ascertain the performance of various Internal Wall build-ups with respect to Acoustics, Fire, Cost and Embodied Carbon. The scope of this report covers the **Acoustic** and **Embodied Carbon** aspects of this study.

The chosen build-ups for analysis were chosen based on Acoustic profiles and either Manufacturer approved data or acoustic analysis by MF on non-standard partitions.

3.0 ACOUSTICS

Wall constructions have been developed for three categories of sound insulation:

Category	Laboratory sound insulation performance / dB R_w	Use case
Low	45	Wall containing a door*
Medium	52	Walls between open plan office and cellular office OR between cellular offices
High	55	Between demises
having a door in the partition will limit the sound insulation performance. Unless a door with a sound insulation performance >R_w35dB is proposed, R_w 45dB is considered appropriate.		

For each of these categories a series of possible partition constructions has been developed comprising:

- British gypsum with metal stud
- Fermacell construction with metal stud
- Siniat construction with metal stud
- British gypsum (or similar) with timber stud
- CLT

Other possible boarding options such as clayboard and ClayTEC have also been discussed as possible lower carbon alternatives. These are outlined in Table 1, with full drawings provided on the following pages.

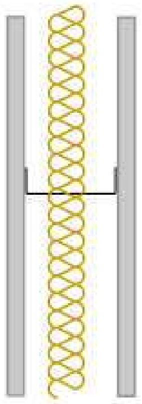
Table 1: Classification of partition for purposes of the study

Sound Insulation Performance	British Gypsum	Fermacell	Siniat	Timber stud	CLT	Clayboard	ClayTEC drylining
Low	Low-1	Low-2	Low-3	Low-4	Low5	Low-6	Low-7
Med	Med-1	Med-2	Med-3	-	Med-4	Med-5	Med-6
High	High-1 High-2 (acoustic stud)	High-3	High-4	High-5	High-6	High-7	High-8

Modular constructions which can be installed and then deconstructed for use elsewhere are a further alternative. However, no acoustic data / testing was found on products of this nature. Based on their density, these types of products would not meet the requirements of ‘low’ and have therefore been excluded.

3.1 Build-ups

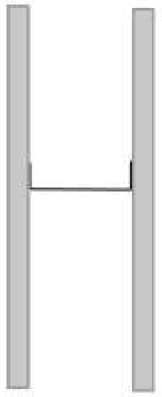
Low-1



1 layer 12.5mm soundbloc (BG)
70mm stud
25mm mineral wool in the cavity
1 layer 12.5mm soundbloc (BG)

Rw 45dB

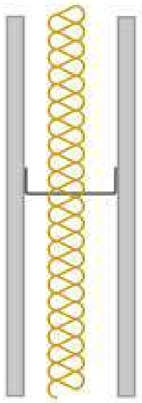
Low-2



1 layer 15mm Fermacell board
75mm stud
no mineral wool in the cavity
1 layer 15mm Fermacell board

Rw 44dB

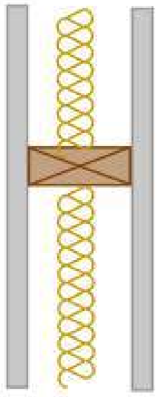
Low-3



1 layer 12.5mm GTEC universal board
70mm stud
25mm mineral wool in the cavity
1 layer 12.5mm GTEC universal board

Rw 45dB

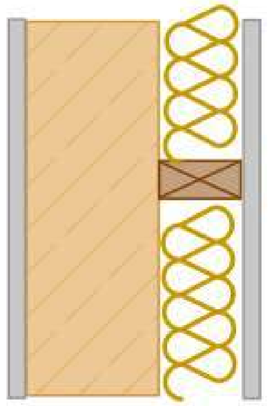
Low-4



1 layer 15mm Universal Board
100mm timber stud
25mm mineral wool in the cavity
1 layer 15mm Universal Board

Rw 43dB

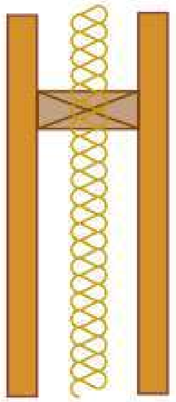
Low-5



1 layer 12.5mm plasterboard
1 layer 100mm CLT
60mm timber battens
50mm mineral wool in the cavity
1 layer 12.5mm plasterboard

Rw 45dB

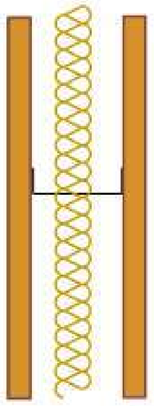
Low-6



1 layer 22m clayboard (29.5kg/m2)
75mm timber stud
25mm Isover in cavity
1 layer 22mm clayboard (29.5kg/m2)

Rw 48dB estimated

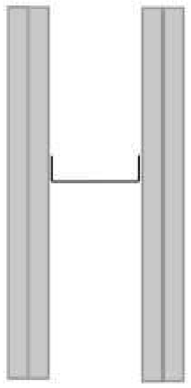
Low-7



1 layer 16mm ClayTEC drylining board
70mm stud
25mm mineral wool in cavity
1 layer 16mm ClayTEC drylining board

Rw 45dB estimated

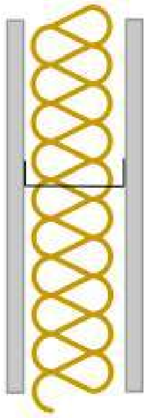
Med-1



2 layers 15mm soundbloc (BG)
70mm stud
2 layers 15mm soundbloc (BG)

Rw 52dB

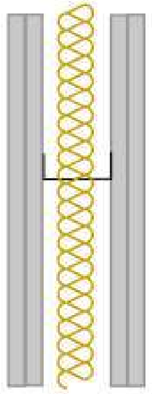
Med-2



1 layer 12.5mm Fermacell board
75mm stud
60mm mineral wool in the cavity (20kg/m2)
1 layer 12.5mm Fermacell board

Rw 52dB

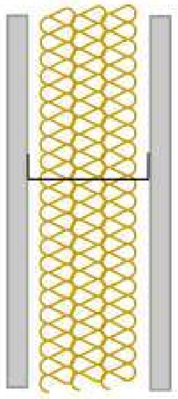
Med-3



2 layers 12.5mm GTEC dB board
50mm stud
25mm mineral wool in the cavity
2 layers of 12.5mm GTEC dB board

Rw 53dB

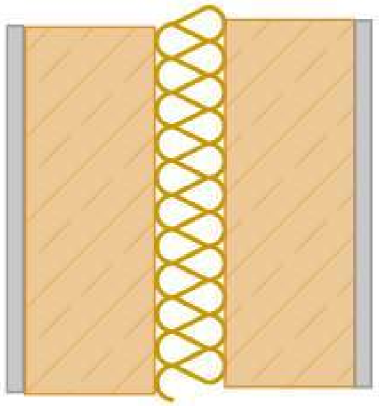
Med-4



1 layer 15mm soundbloc (BG)
92mm stud
75mm mineral wool in the cavity
1 layer 15mm soundbloc (BG)

Rw 52dB

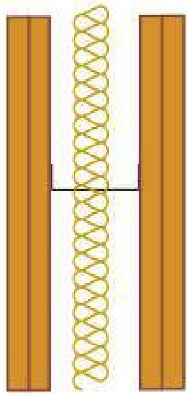
Med-5



1 layer 12.5mm plasterboard
1 layer 100mm CLT
50mm mineral wool in the cavity
1 layer 100mm CLT
1 layer 12.5mm plasterboard

Rw 52dB

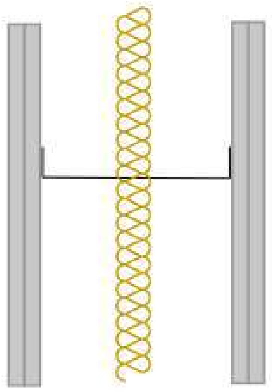
Med-6



2 layers 16mm ClayTEC drylining board
70mm stud
25mm mineral wool in cavity
2 layers 16mm ClayTEC drylining board

Rw 52-54dB estimated

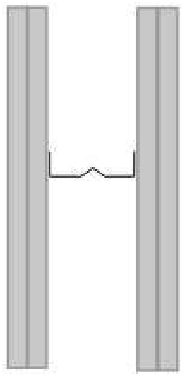
High-1



2 layers 12.5 soundbloc (BG)
146mm stud
25mm mineral wool
2 layers 12.5mm soundbloc (BG)

Rw 55dB

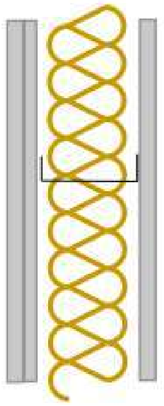
High-2



2 layers 15mm soundbloc (BG)
70mm acoustud
2 layers 15mm soundbloc (BG)
2mm plaster either side

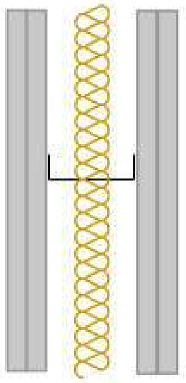
Rw 55dB

High-3



1 layer 12.5mm Fermacell board
1 layer 10mm Fermacell board
75mm stud
60mm mineral wool in the cavity
1 layer 12.5mm Fermacell board
Rw 56dB

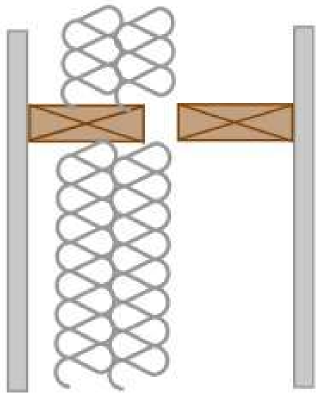
High-4



2 layers 15mm GTEC dB board
70mm stud
25mm mineral wool
2 layers 15mm GTEC dB board

Rw 55dB

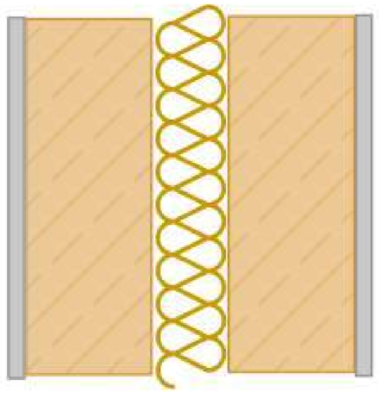
High-5



15.9mm plasterboard (Pliteq)
203mm cavity (2 no. 89mm twin frame studs)
89mm fibreglass
15.9mm plasterboard (Pliteq)

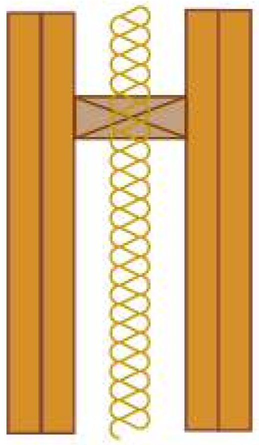
Rw 61dB

High-6



1 layer 12.5mm plasterboard
1 layer 100mm CLT
50mm Isover Domo-Twin in 60mm cavity
1 layer 100mm CLT
1 layer 12.5mm plasterboard
Rw 55dB

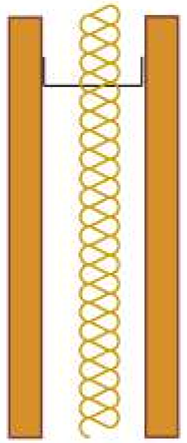
High-7



2 layers 22mm clayboard
75mm timber stud
25mm isover in cavity
2 layers 22mm clayboard

Rw 55dB estimated

High-8



1 layer 22mm clayboard
70mm steel stud
25mm isover in cavity
1 layer 22mm clayboard

Rw 55dB estimated

3.2 Assessment

Standard Partitions
The possible constructions are shown on pages 5 and 6. It should be noted that in the case of the ‘low’ category timber stud, a small degradation in performance is proposed. This is proposed as an acceptable compromise between acoustics and sustainability. There is no ‘medium’ category option with a timber stud as this would introduce a resilient bar which would negate the desire to remove steel from the construction and are often compromised acoustically when installed.

The outcome of the standard RCIS assessment suggests that Siniat (GTEC) plasterboard is generally favourable across the range of acoustic performances, with Fermacell comparing well in the medium and high categories. Whilst clay based boards as a material have a low embodied carbon, their location of manufacturer means they have a significantly higher embodied carbon when used in the UK. For full, details see Max Fordham’s ‘Office Partition Study – Embodied Carbon Report’.

Glazed Partitions
For glazed partitions, the acoustic performance of the constructions is largely similar between manufacturers. Thus, the location of the manufacturing process and travel distance to site is critical.

For example:

- 12.8mm laminated glass typically achieves R_w 38-40dB
- Double glazed units comprising 10mm toughened glass each side typically achieves R_w 42dB or up to 47dB if overall depth if cavity is 80mm.

Manufacturers of glazed partitions include Optima, Fusion, Komfort, Pilkington, Lindner. As mentioned the distance from manufacture location to site is critical.

3.3 General Guidance on Detailing

The following section gives outline guidance on detailing but will need to be reviewed depending on the specific arrangement / geometry of the proposed construction.

Head and Base Junction Detailing

The head and base details should have a flanking performance at least 5dB greater than the wall performance in order not to reduce the overall sound insulation performance.

Ideally, partitions should be installed from slab to slab and detailed as shown in Figures 1 and 2. Any raised access for would be located either side of the partition as the screed is shown.

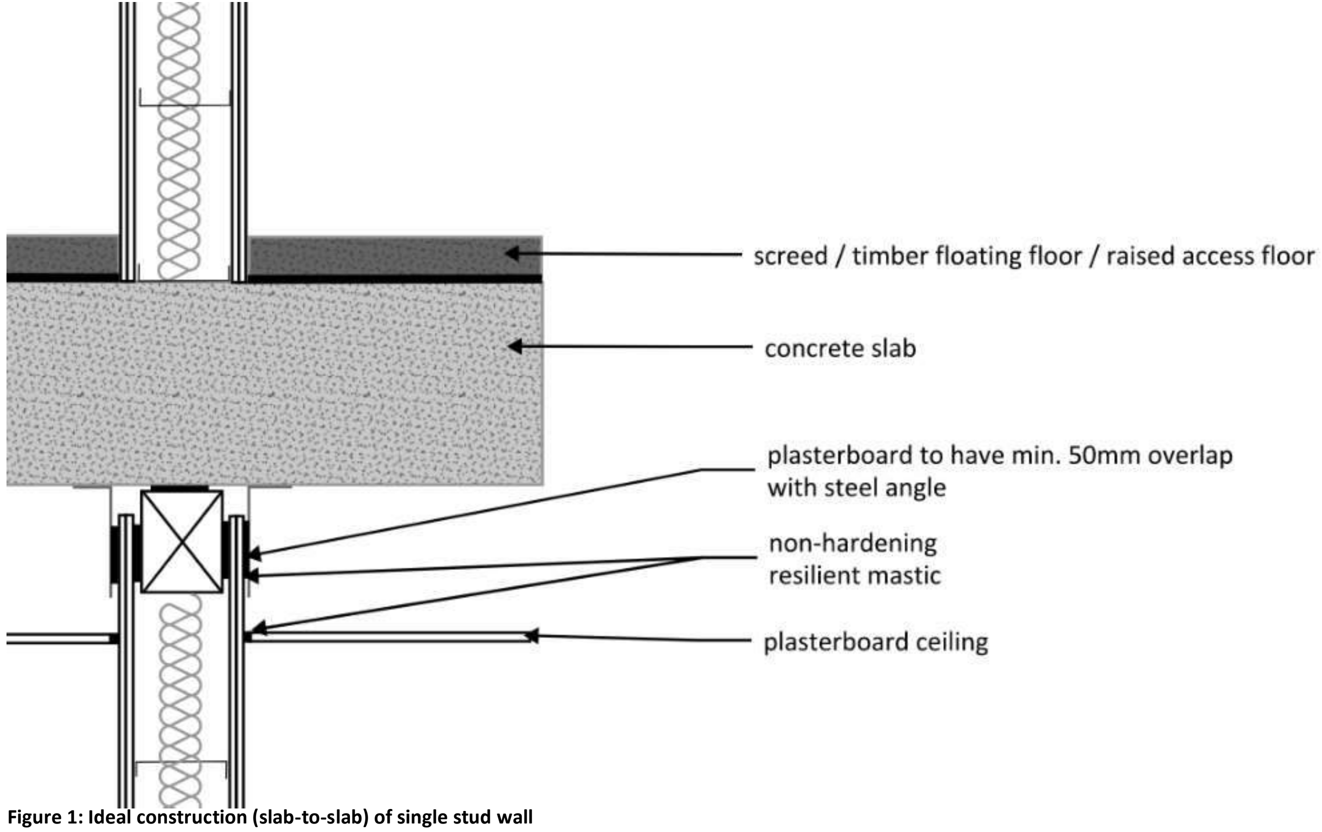


Figure 1: Ideal construction (slab-to-slab) of single stud wall

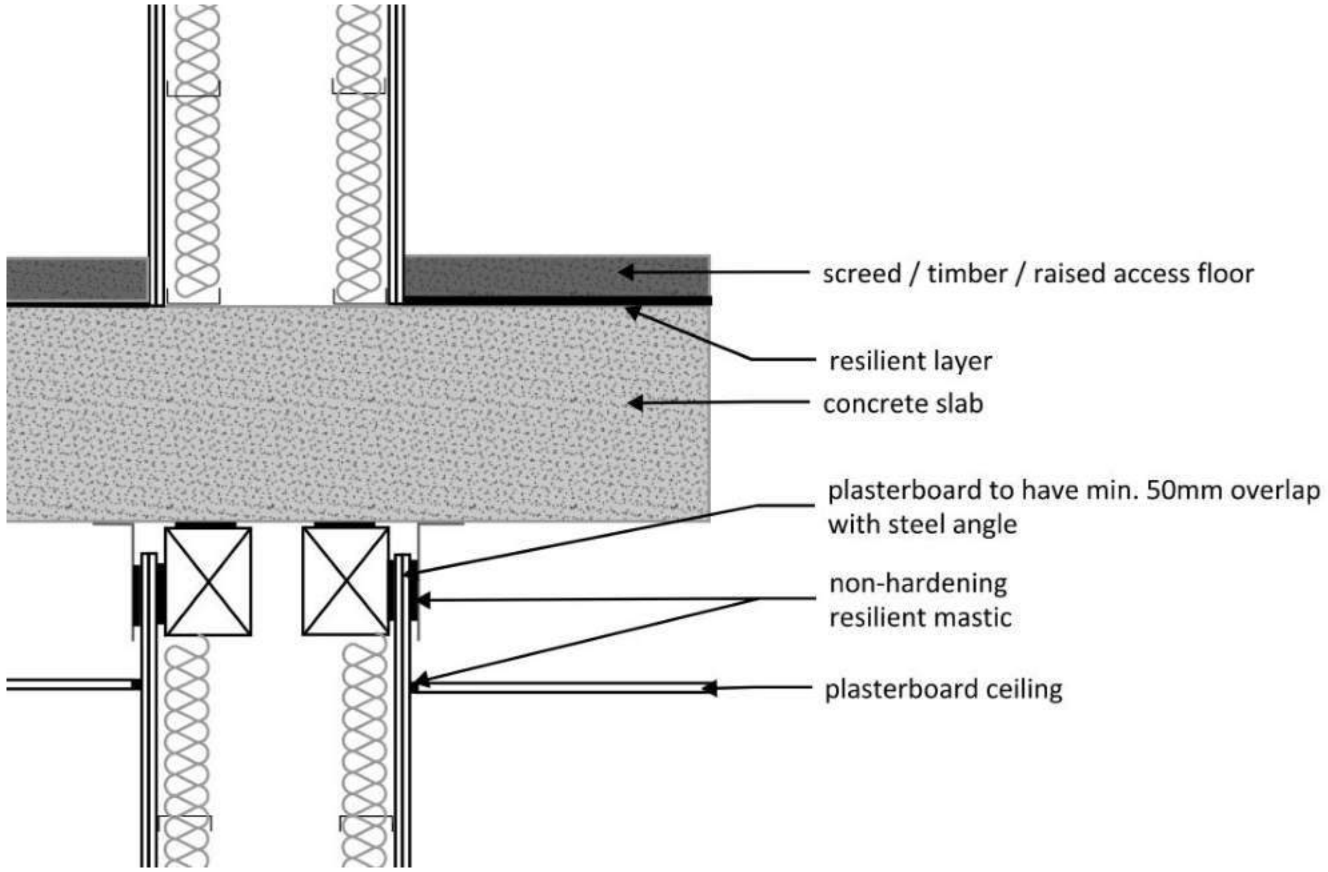


Figure 2: Ideal construction (slab-to-slab) of twin stud wall

If a partition must be installed above a raised access floor and/or not continue above a suspended ceiling, void barriers must be used as shown in Figure 3. The performance of the void barriers required is given in Table 2.

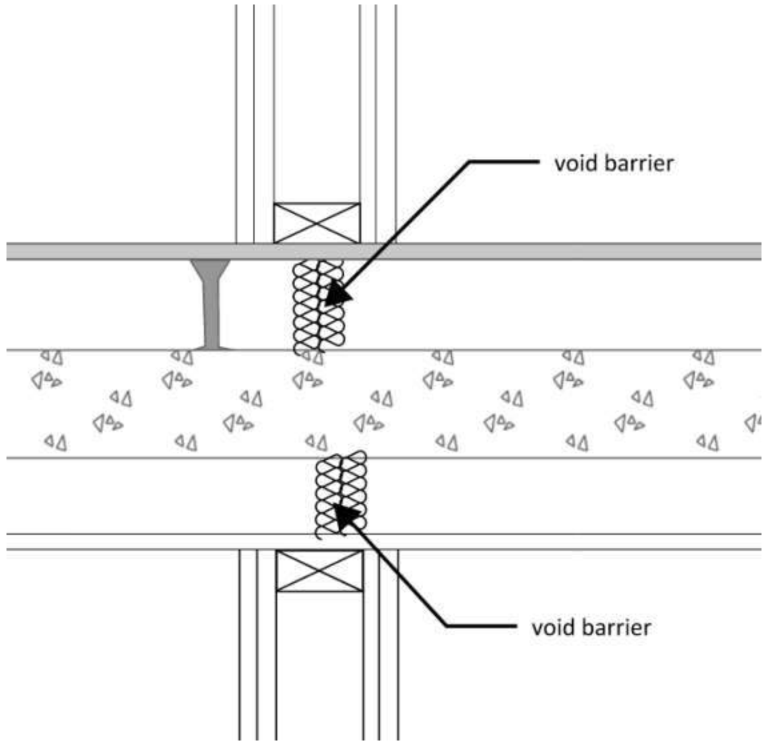


Figure 3: Sketch showing the position of the void barrier

Table 2: Void barrier performance

Location	Sound Insulation performance of partition / R_w dB	Required flanking performance (overall) / $D_{nf,w}$ dB	Void barrier performance (e.g. Siderise)
Raised access floor	45	50	R_w 23dB
	52	57	R_w 28dB
	55	60	Twin Barriers*
Suspended ceiling (solid plasterboard or greater)	45	50	R_w 25dB
	52	57	R_w 30dB$^+$
	55	60	Twin Barriers$^+$

**The performance in this situation may be limited. Additionally, heavier floor tiles with a surface mass of at least 44kg/m^2 could be used to improve the flanking performance*

$^+$ For ceiling, it is recommended to break-through the line of the ceiling where possible (i.e. ceiling non-continuous) to minimise risk of transfer via the ceiling panels

If a separation between demises is required, twin barriers must be used to give a sound insulation performance of R_w 49dB from the void barriers alone. With the inclusion of a plasterboard ceiling, the attenuation should be sufficient to meet the overall criteria.

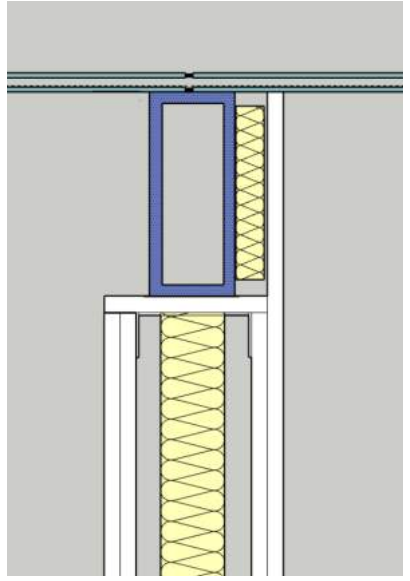
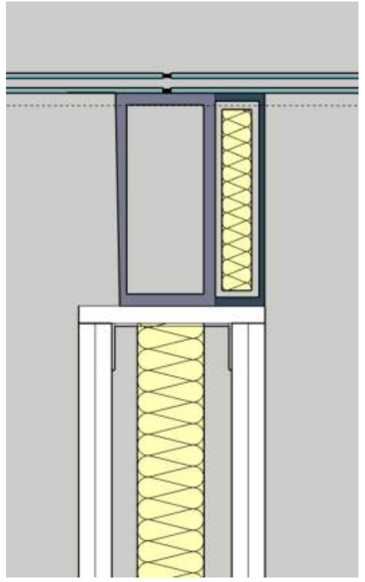
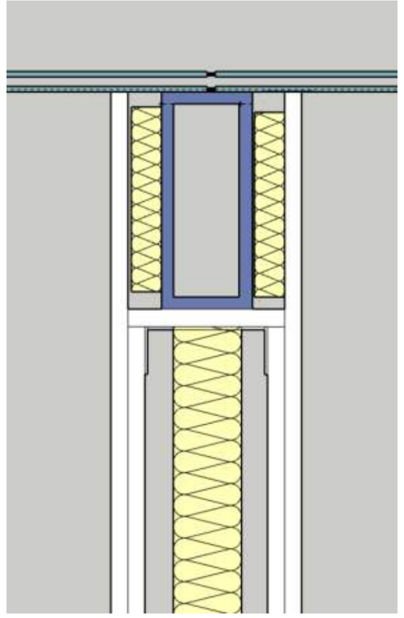
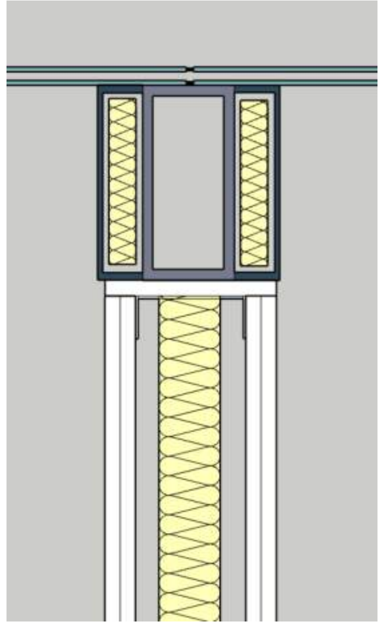
Façade Detailing
As with the head and base details, the façade flanking details will require a $D_{nf,w}$, 5dB greater than the R_w performance as a minimum. In all cases, split mullions are acceptable.

However, where split mullions are not present:

- For R_w 45dB partitions, mullions will require overcladding with 1 layer of board and 15mm mineral wool to **one side** or 2mm steel with 4kg/m2 damping material. Alternatively, mullion inserts can be used.
- For R_w 52dB partitions, mullions will require overcladding with 1 layer of board and 15mm mineral wool to **each side** or steel with 4kg/m2 damping material. Alternatively, mullion inserts can be used.

The constructions are shown in Table 3. It should be noted that Rw 55dB cannot be achieved with a single mullion and a special detail will need to be developed in this instance. Similarly, specific details should be developed if there is only a single transom between floors.

Table 3: Detailing for mullions

Rw 45dB partitions meeting a mullion		
Rw 52dB partitions meeting a mullion		

4.0 EMBODIED CARBON

4.1 Embodied Carbon Scope

The Embodied Carbon study was carried out as per the RICS Whole Life Carbon Assessment for the Built Environment and included life-cycle modules:

- A1-A5
- B4
- C1-C4

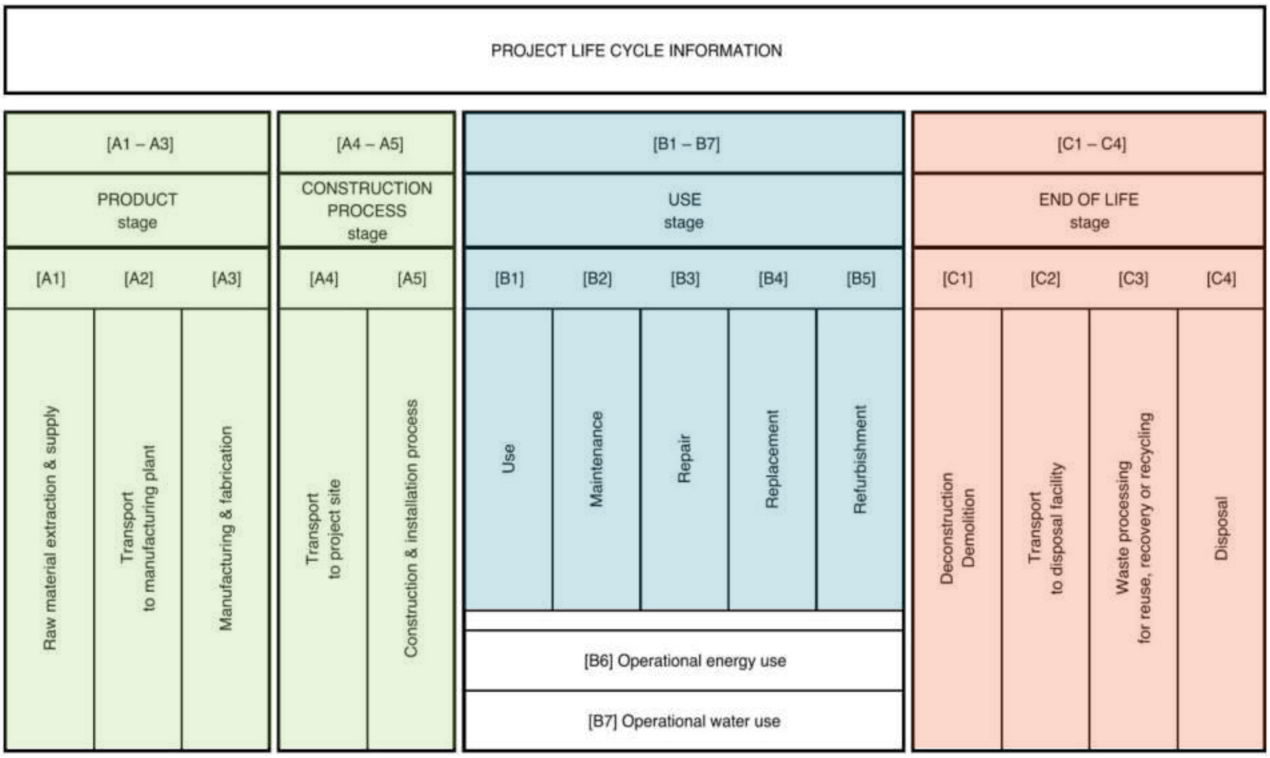
B1, B5, B6 and B7 are zero carbon stages for a partition and do not really apply. B2 and B3 are poorly understood in the industry and the general benchmarks used for these would be consistent among all partition types.

Upfront Carbon is given a higher weighting within the study as it is the carbon price that would be paid today. Looking 30years into the future, when the internal wall might theoretically be replaced has limited value as carbon factors for the constituent materials will undoubtedly be vastly different.

Embodied Carbon is only particularly relevant for build-ups containing bio-genic materials, especially in the context of the Carbon Capture and Storage scenario.

4.2 Terms

Life-cycle stages



Upfront Carbon

Upfront carbon refers to Life-cycle modules **A1-A5** and essentially covers the manufacture of a product, transporting it to the site and installing it – with any associated wastage. Essentially this captures all the carbon emitted by using this product by the time the building is constructed.

Upfront Carbon is also important when operating within the UKGBCs Net Zero Carbon Construction framework. This carbon is the quantity required to be offset and thus is proportionally linked to the final offset payments.

For a partition with an assumed RICS design life of 30yrs, Upfront Carbon form about half of the total carbon associated with a partition over the standard 60yr building life.

Embodied Carbon
Embodied Carbon refers to Life-cycle modules **A1-C4 (excl. B6 and B7)** and essentially covers the all the carbon emissions associated with making, transporting, constructing, replacing and the end-of-life (EOL) of a product.

Biogenic Carbon
Sometime referred to as Sequestered Carbon, Biogenic carbon is a 'negative' carbon emission associated with materials that absorb carbon during their life before manufacture (i.e. Timber) or during their design life and after (i.e. Concrete carbonation).

GWP
GWP stands for Global Warming Potential as is measured in comparison to Carbon Dioxides warming impact over 100 years. The unit of measurement is kgCO2e – kilograms of Carbon Dioxide equivalent.

5.0 LIMITATIONS

The construction industry is still in its formative years with regards to understanding and reporting embodied carbon emissions. Due to the rapid changes occurring to standards, methodologies and fundamental data, embodied carbon estimates are subject to intrinsic uncertainty. Below are listed a few of the limitations of this study.

5.1 Environmental Product Declarations (EPD)

A2 Update

EPDs are the foundation of comparative studies between different manufacturers or the same general product. We generally only use Type III EPDs carried out to the BS EN 15804 2012+A1:2013 or A2:2019 standard. The A2 update provided a number of key changes to carbon reporting however, in the context of this partition study, the key update was in separating out Biogenic GWP from Fossil GWP and Luluc (land use and land use change) GWP. The two points below are key to understanding this subtly:

1. Biogenic Carbon reporting could wildly sway the outcome of an Embodied Carbon study. For mainstream biogenic materials like timber, and other plant-based products, the carbon absorbed during its growth phase is re-emitted back into the atmosphere at its End-of-Life phase, where we typically incinerate wood waste. This means there is no net carbon absorption. **All absorbed carbon is re-emitted** by current reporting methodologies.

2. Upfront Carbon emissions should also **exclude Biogenic carbon**, which should be reported separately.

Below is an example of how these two principles are important in the context of the A1 and A2 EPDs:

Product A has a Fossil GWP of 5 and a Biogenic GWP of 7

- **A1** EPD:
  - Reported within the EPD as A1-A3 **=** 5 - 7 **=** -3 kgCO2e/unit
  - Upfront Carbon reporting, A1-A5, would show this a ‘negative’ carbon
- **A2** EPD:
  - Reported as A1-A3 =
    - Fossil GWP = 5 kgCO2e/unit
    - Biogenic GEP = -7 kgCO2e/unit
  - Upfront Carbon reporting, A1-A5, would be a ‘positive’ carbon emission as Biogenic Carbon is reported separately as this stage

The relevance of this to the Partition Study lies in the fact that some Manufacturers have issued updated A2 EPDs and others still only have A1 EPDs. Due to the proprietary nature of EPDs, we are unable to ascertain whether and Biogenic values have been included with the A1-A3 figure and, more importantly, is they are clearly re-emitted at end-of-life.

Variability

EPDs are not currently completely standardised. There are standards they must meet, like BS EN15804, but the underlying carbon factors for various raw materials may vary between EPD producers depending on the database they use. Other factors will also influence the final ‘accuracy’ of a given EPD.

Below is a graph of EPD results for A1-A3 amongst different manufacturers, normalised for a plasterboard of the same weight. This demonstrates the quite large range in data.

EPDs like ETEX which appear to be significantly lower than competitors without an obvious manufacturing reason make us slightly nervous about the validity of the carbon numbers.

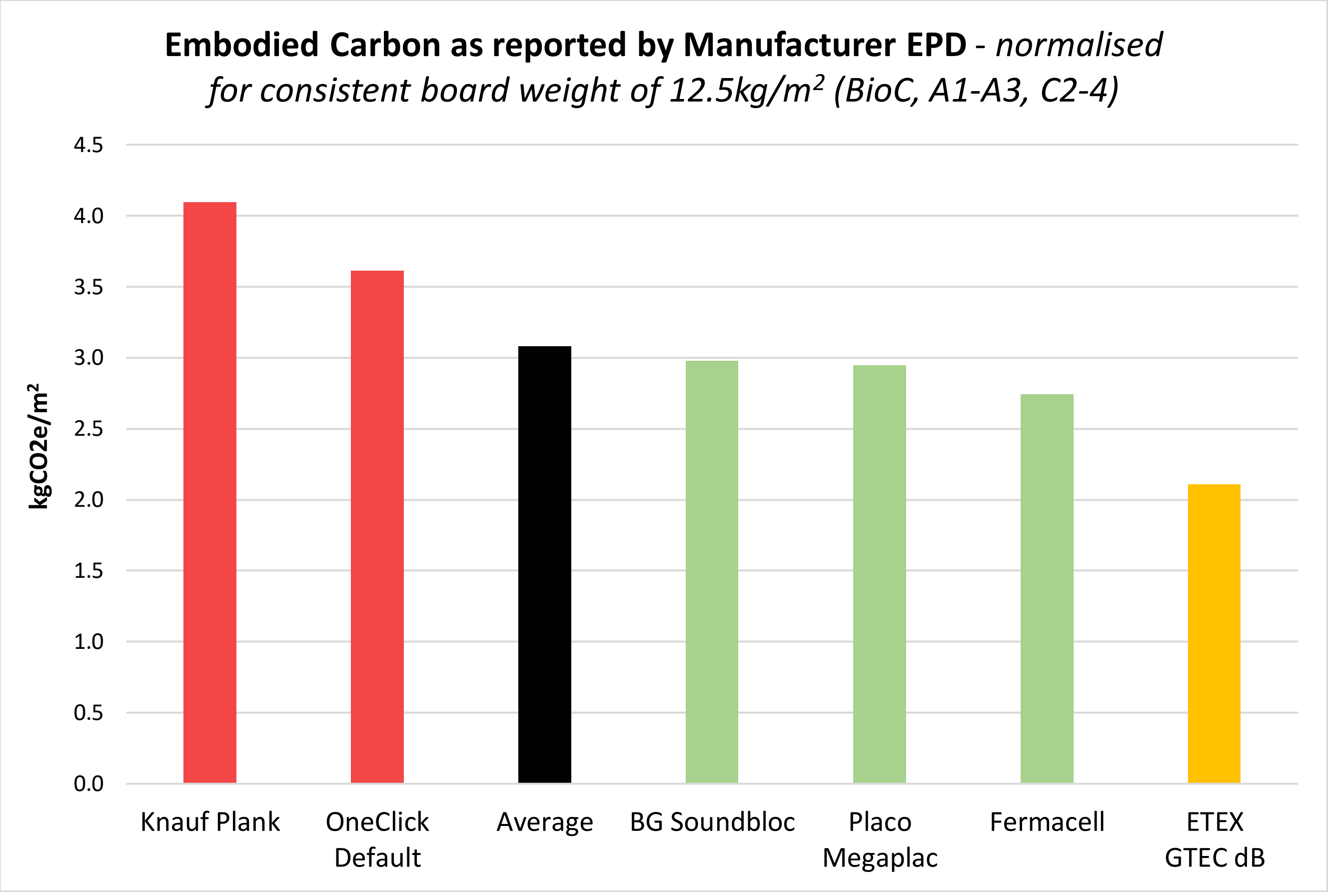


Figure 4 - Comparison of normalised Plasterboard EPDs

5.2 Transportation

The distances from factory to site, coupled with the exact method of transport, are fundamentally important aspects of the embodied carbon study. This is due to the nature of plasterboard as a relatively heavy product with a relatively low A1-A3 (Manufacture/Production) carbon. This means that long distance HGV drives will quickly add up to a significant proportion, or indeed exceed, the original carbon required to produce the product.

This can be seen most clearly in Section 6.,5 where the 1000+km of HGV driving for the Clay option is comparable the original A1-A3. While on others, 1000+km of sea travel is a fraction as intensive.

During the course of this study, we reached out to all the manufacturers listed in order to ascertain the factory locations that supply the UK market, as well as the method by which they transport their product. Some manufactures provided very clear data, while others either were either vague or have still not provided any data in this area.

Transport Assumptions Table
The table below outlines the various factories and routes used during the course of this study – depending on site location. Cells highlighted in **blue** are assumptions.

Table 4 - Transportation Data

	Site Location	Factory	Leg 1		Leg 2		Leg 3	
			Distance (km)	Vehicle Type	Distance (km)	Vehicle Type	Distance (km)	Vehicle Type
SoundBloc (BG)	London	East Leake	199.6	>33t HGV				
		Kirkby Thore	454.0	>33t HGV				
		Robertsbridge	102.2	>33t HGV				
		Sherburn-in-Elmet	309.1	>33t HGV				
	Birmingham	East Leake	76.0	>33t HGV				
		Kirkby Thore	331.7	>33t HGV				
		Robertsbridge	301.1	>33t HGV				
		Sherburn-in-Elmet	186.8	>33t HGV				
	Bristol	East Leake	219.0	>33t HGV				
		Kirkby Thore	475.0	>33t HGV				
		Robertsbridge	283.4	>33t HGV				
		Sherburn-in-Elmet	330.1	>33t HGV				
	Manchester	East Leake	150.9	>33t HGV				
		Kirkby Thore	178.7	>33t HGV				
		Robertsbridge	434.7	>33t HGV				
		Sherburn-in-Elmet	112.4	>33t HGV				
			0.0					
Gypframe (BG)	London	Smethwick, West Midlands	212.5	>33t HGV				
	Birmingham		6.3	>33t HGV				
	Bristol		142.8	>33t HGV				
	Manchester		133.6	>33t HGV				
Isover APR1200	London	Runcorn	331.7	>33t HGV				
	Birmingham		130.9	>33t HGV				
	Bristol		262.4	>33t HGV				
	Manchester		42.3	>33t HGV				
			0.0					
GTEC Universal Board	London	**Bristol**	201.3	>33t HGV				
		Ferrybridge	296.2	>33t HGV				
	Birmingham	**Bristol**	144.6	>33t HGV				

		Ferrybridge	173.9	>33t HGV				
	Bristol	**Bristol**	14.2	>33t HGV				
		Ferrybridge	317.2	>33t HGV				
	Manchester	**Bristol**	272.1	>33t HGV				
		Ferrybridge	92.1	>33t HGV				
			0.0					
Fermacell Boards	London	Spain	16.7	>33t HGV (Factory to Port of Santander)	1154.3	Cargo ship (From Port of Santander to Port of Southampton)	134.757	>33t HGV (From Port of Southampton to London)
		Holland	109.0	>33t HGV (From Factory to Port of Rotterdam)	542.9	Cargo ship (From Port of Rotterdam to Port of Southampton)	134.757	>33t HGV (From Port of Southampton to London)
	Birmingham	Spain	16.7	>33t HGV (Factory to Port of Santander)	1154.3	Cargo ship (From Port of Santander to Port of Southampton)	235.06	>33t HGV (From Port of Southampton to Birmingham)
		Holland	109.0	>33t HGV (From Factory to Port of Rotterdam)	542.9	Cargo ship (From Port of Rotterdam to Port of Southampton)	235.06	>33t HGV (From Port of Southampton to Birmingham)
	Bristol	Spain	16.7	>33t HGV (Factory to Port of Santander)	1154.3	Cargo ship (From Port of Santander to Port of Southampton)	173.88	>33t HGV (From Port of Southampton to Bristol)
		Holland	109.0	>33t HGV (From Factory to Port of Rotterdam)	542.9	Cargo ship (From Port of Rotterdam to Port of Southampton)	173.88	>33t HGV (From Port of Southampton to Bristol)
	Manchester	Spain	16.7	>33t HGV (Factory to Port of Santander)	1154.3	Cargo ship (From Port of Santander to Port of Southampton)	368.69	>33t HGV (From Port of Southampton to Manchester)
		Holland	109.0	>33t HGV (From Factory to Port of Rotterdam)	542.9	Cargo ship (From Port of Rotterdam to Port of Southampton)	368.69	>33t HGV (From Port of Southampton to Manchester)
			0.0					
Fermacell Metal	London	Heathrow	26.4	>33t HGV				
	Birmingham	Heathrow	183.5	>33t HGV				
	Bristol	Heathrow	165.8	>33t HGV				
	Manchester	Heathrow	315.6	>33t HGV				

BG Thistle MutliFinish	London	Barrow	185.2	>33t HGV				
	Birmingham	Barrow	93.4	>33t HGV				
	Bristol	Barrow	225.4	>33t HGV				
	Manchester	Barrow	169.1	>33t HGV				

Knauf Insulation	London	St Helens	344.5	>33t HGV				
		Torfaen	228.6	>33t HGV				
	Birmingham	St Helens	153.0	>33t HGV				
		Torfaen	164.2	>33t HGV				
	Bristol	St Helens	289.8	>33t HGV				
		Torfaen	56.4	>33t HGV				
	Manchester	St Helens	45.1	>33t HGV				
		Torfaen	281.8	>33t HGV				

CLT	London	**Southern Germany**	893.0	**>33t HGV (factory to Port of Hamburg)**	1057.9	**Cargo ship (port of Hamburg to port of Southampton)**	134.757	>33t HGV
	Birmingham	**Southern Germany**	893.0	**>33t HGV (factory to Port of Hamburg)**	1057.9	**Cargo ship (port of Hamburg to port of Southampton)**	235.06	>33t HGV
	Bristol	**Southern Germany**	893.0	**>33t HGV (factory to Port of Hamburg)**	1057.9	**Cargo ship (port of Hamburg to port of Southampton)**	173.88	>33t HGV
	Manchester	**Southern Germany**	893.0	**>33t HGV (factory to Port of Hamburg)**	1057.9	**Cargo ship (port of Hamburg to port of Southampton)**	368.69	>33t HGV

Clayboard	London	Waldsassen, Germany	900.0	**>33t HGV (factory to port of Hamburg)**	60.0	**Cargo ship (port of Dunkirk to Southampton)**	134.757	>33t HGV
	Birmingham	Waldsassen, Germany	900.0	**>33t HGV (factory to port of Dunkirk)**	60.0	**Cargo ship (port of Dunkirk to Southampton)**	235.06	>33t HGV
	Bristol	Waldsassen, Germany	900.0	**>33t HGV (factory to port of Dunkirk)**	60.0	**Cargo ship (port of Dunkirk to Southampton)**	173.88	>33t HGV
	Manchester	Waldsassen, Germany	900.0	**>33t HGV (factory to port of Dunkirk)**	60.0	**Cargo ship (port of Dunkirk to Southampton)**	368.69	>33t HGV

6.0 OPTIONS SUMMARY

The following options have been considered in this study in order to try capture the impact of some of the variations that may impact the final order of carbon performance:

- **Option 1 – Standard RICS Model – Average London**
    - Modelled in the same manner we would for a normal Embodied Carbon assessment of a whole building. We've used accurate EPDs where possible, and proxy products or industry default data where no EPD information exists. Transport is a simple average of the potential routes with the centre of London as the assumed site location. These results reflect what would appear in a standard design stage RICS embodied carbon assessment.

- **Option 2 – Transport Sensitivity**
    - As Option 1 but comparing the best-case transportation route option for each element of the build-up and broken down by site location. This represents which build-ups have the potential to be best if the right factory site is requested and whether the site location matters much in the UK context.

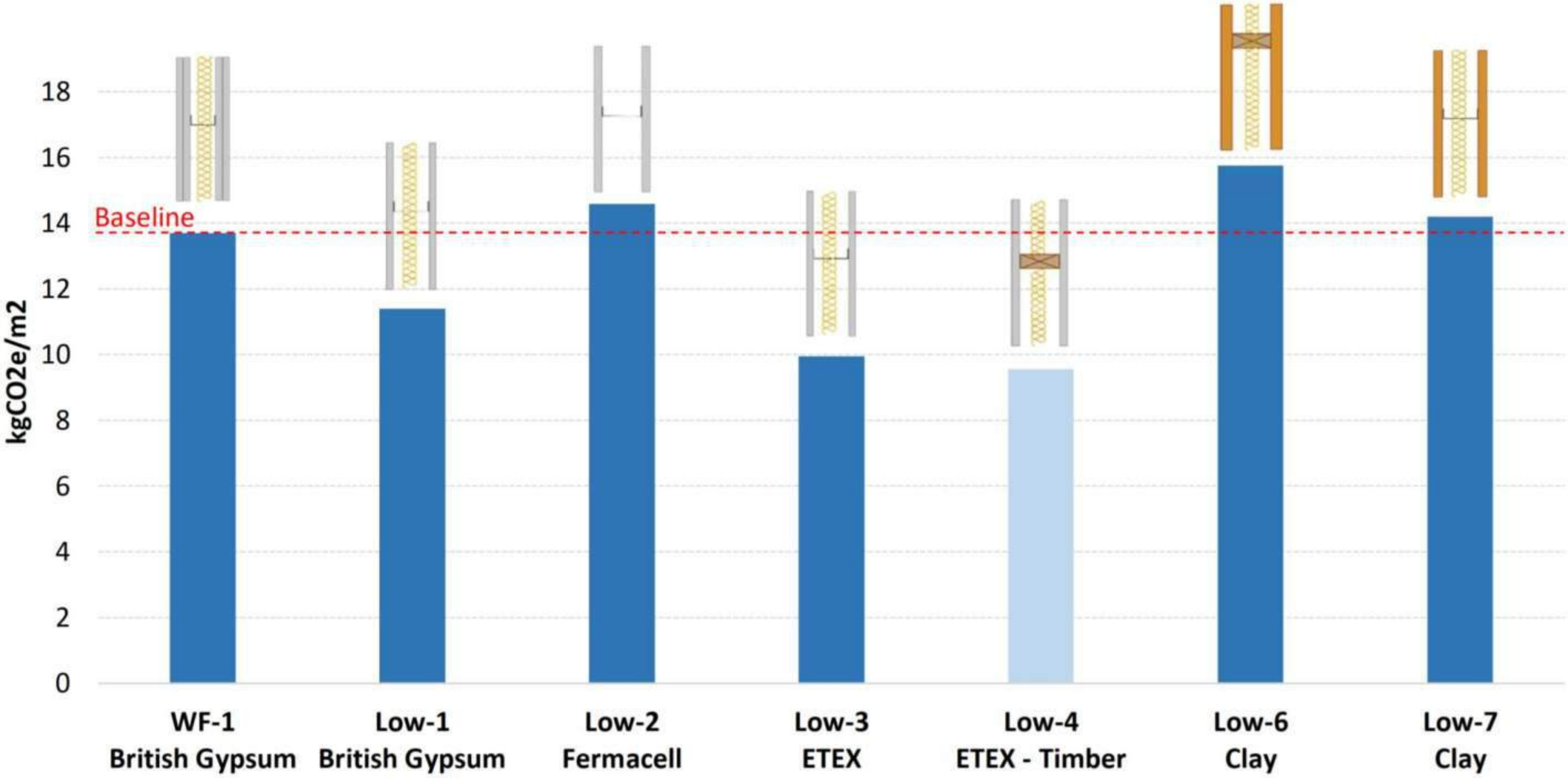
- **Option 3 – Galvanised Steel Carbon Factor**
    - The carbon impact of steel is generally 2nd in importance behind the plasterboard. Of all manufacturers contacted, only British Gypsum could provide and EPD for their galvanised steel metal studs. This value is 2.09 kgCO2e/kg and when compared to the Inventory of Carbon and Energy (ICE database 3.0) default value for Hot-dipped Galvanised Steel of 2.76 kgCO2e/kg, represents a 24% reduction compared to industry default. We don't have an issue with the BG EPD, but in order to not sway the data too much, we've assumed the BG Gypframe EPD value for all metal studwork but the different manufacturers. This is not an unreasonable assumption, but we felt it was worth seeing what the impact of the results would be if we instead assumed ICE default value foe all steelwork not manufactured by British Gypsum.

- **Option 4 – All Build-ups include 2mm Skim**
    - Some of the build-ups necessitate a plaster skim in order to meet the specification that has been acoustically tested. Given that a 2mm skim is not an uncommon action to be taken for purely aesthetic reasons, we wanted to see what the results would look like if all build-ups included a 2mm skin on each side.

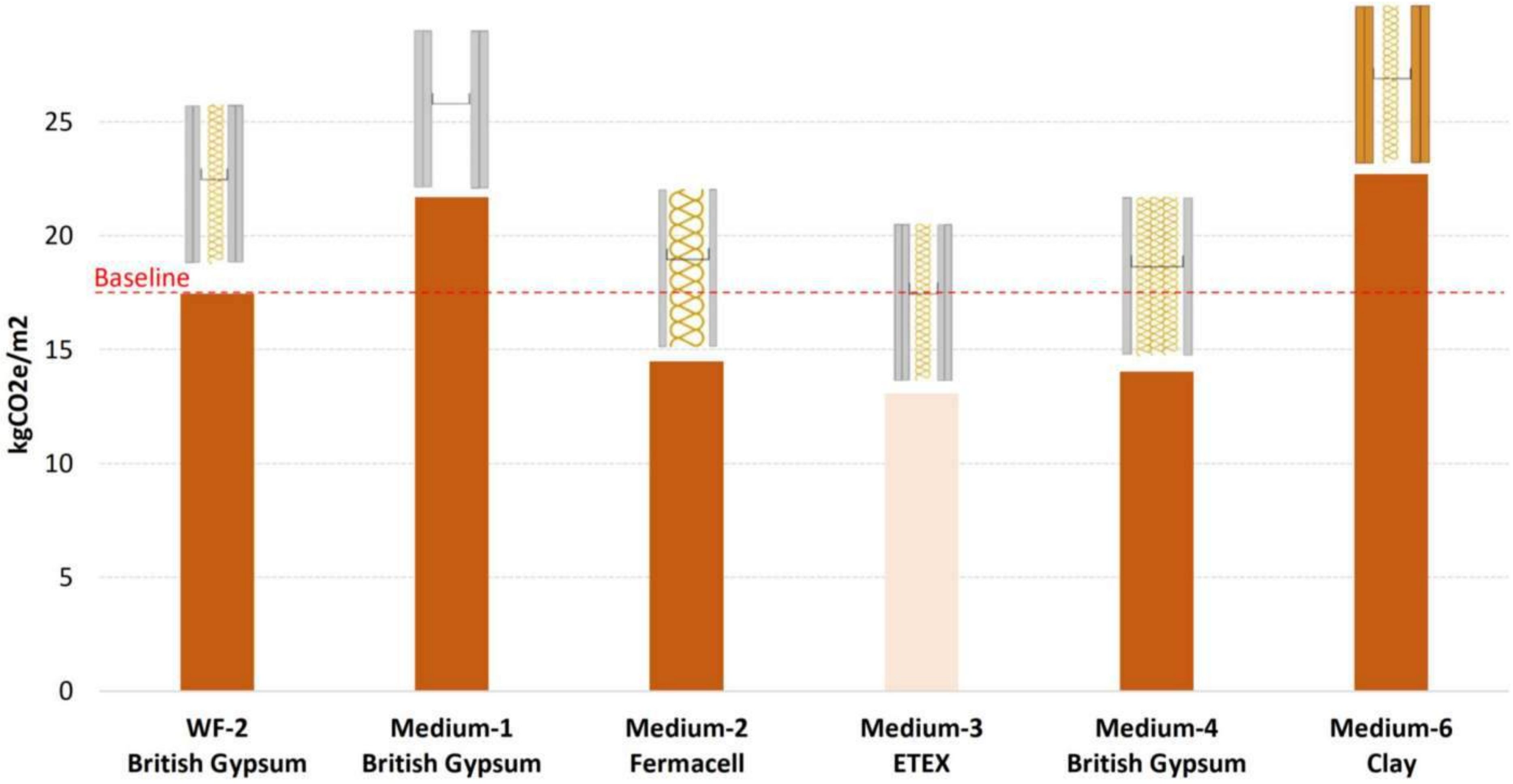
- **Option 5 – 50% Carbon Capture and Storage**
    - This option represents, in our opinion, a more realistic treatment of biogenic carbon stored within timber/cellulose elements within this study. By current carbon accounting rules, all CO2 absorbed is re-emitted at end-of-life incineration i.e. not net benefit from the original carbon sequestration. Given the emerging industries of Carbon Capture and Storage (CCS) and Bioenergy with Carbon Capture and Storage (BECCS) is currently viewed as a vital part of the global efforts to reduce carbon emissions, we feel it's likely that by the end-of-life of these materials (30+yrs) CCS will present in some capacity. This implies that at end of life, we believe it is likely that 'on-average', only a portion of a given elements biogenic carbon would actually be released back into the atmosphere. In this option, we have assumed that 50% of all biogenic carbon is recaptured at end-of-life. This demonstrates a future scenario where biogenic materials are actually rewarded for capturing carbon within the carbon accounting process.

7.0 OPTION 1 – STANDARD RICS MODEL - LONDON

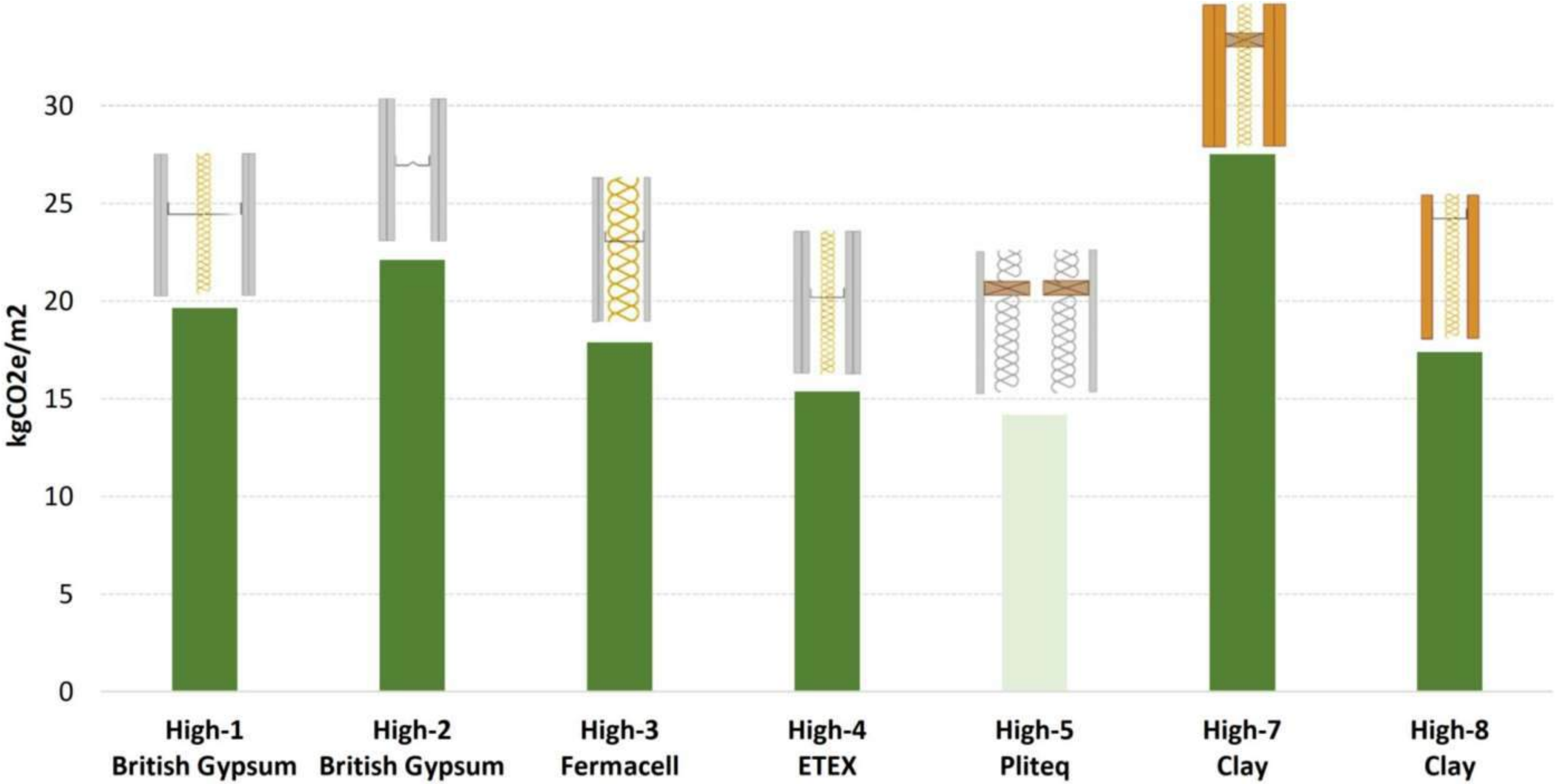
7.1 Upfront Carbon (A1-A5) – Low Acoustic Range



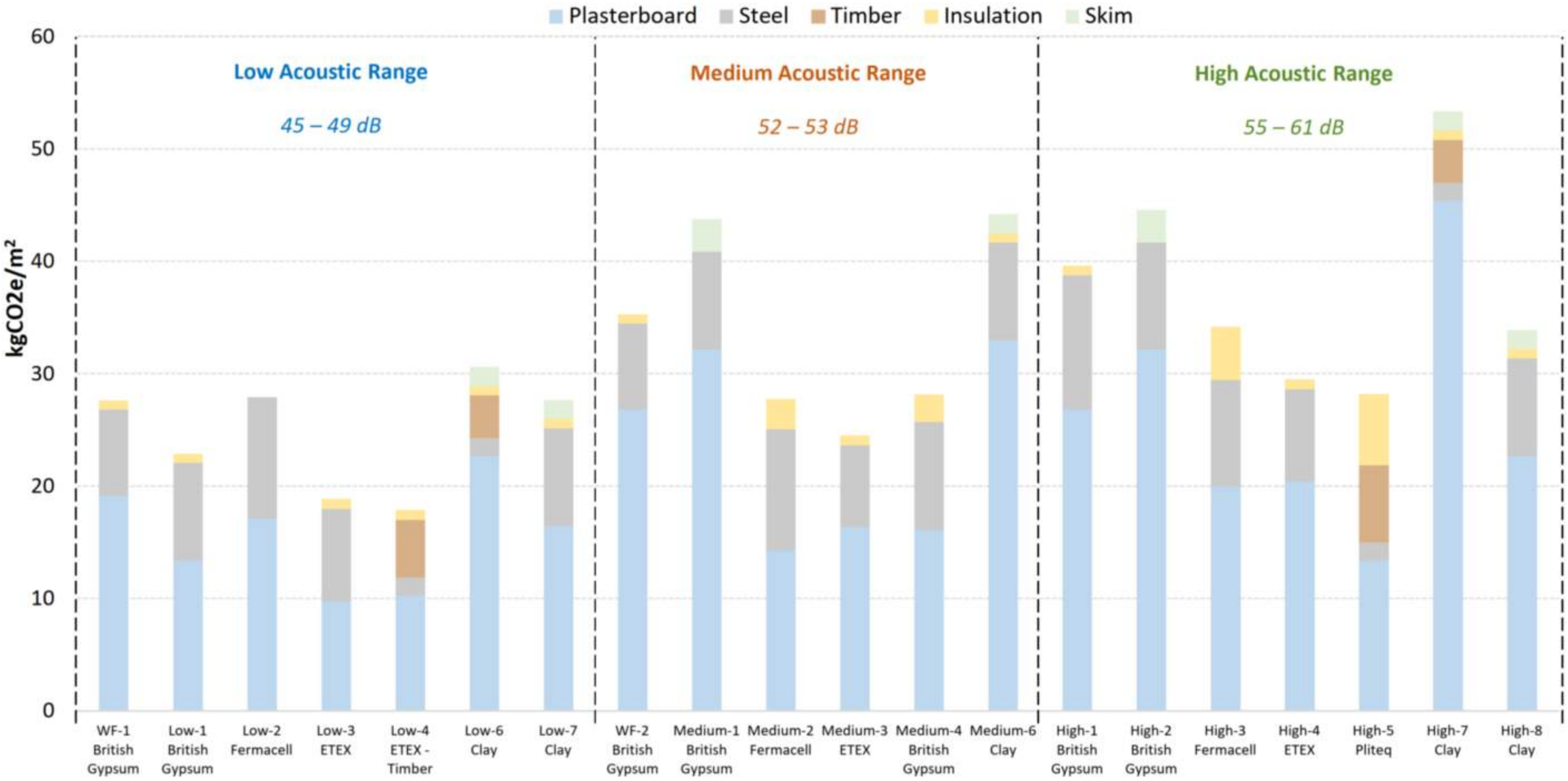
7.2 Upfront Carbon (A1-A5) – Medium Acoustic Range



7.3 Upfront Carbon (A1-A5) – High Acoustic Range



7.4 Embodied Carbon (A1-C4) – Material Contribution



7.5 Embodied Carbon (A1-A5) – Lifecycle Contributions

8.0 OPTION 2 – TRANSPORT SENSITIVITY ANALYSIS

8.1 Context

This study explores the sensitivity of the results to Site location within the UK. It uses the 'best' possible transport routes. i.e. picking the nearest factory to the site, for a given manufacturers.

This option also explores if the best-case transportation routes for various elements impact the results when compared to averaging all possible routes.

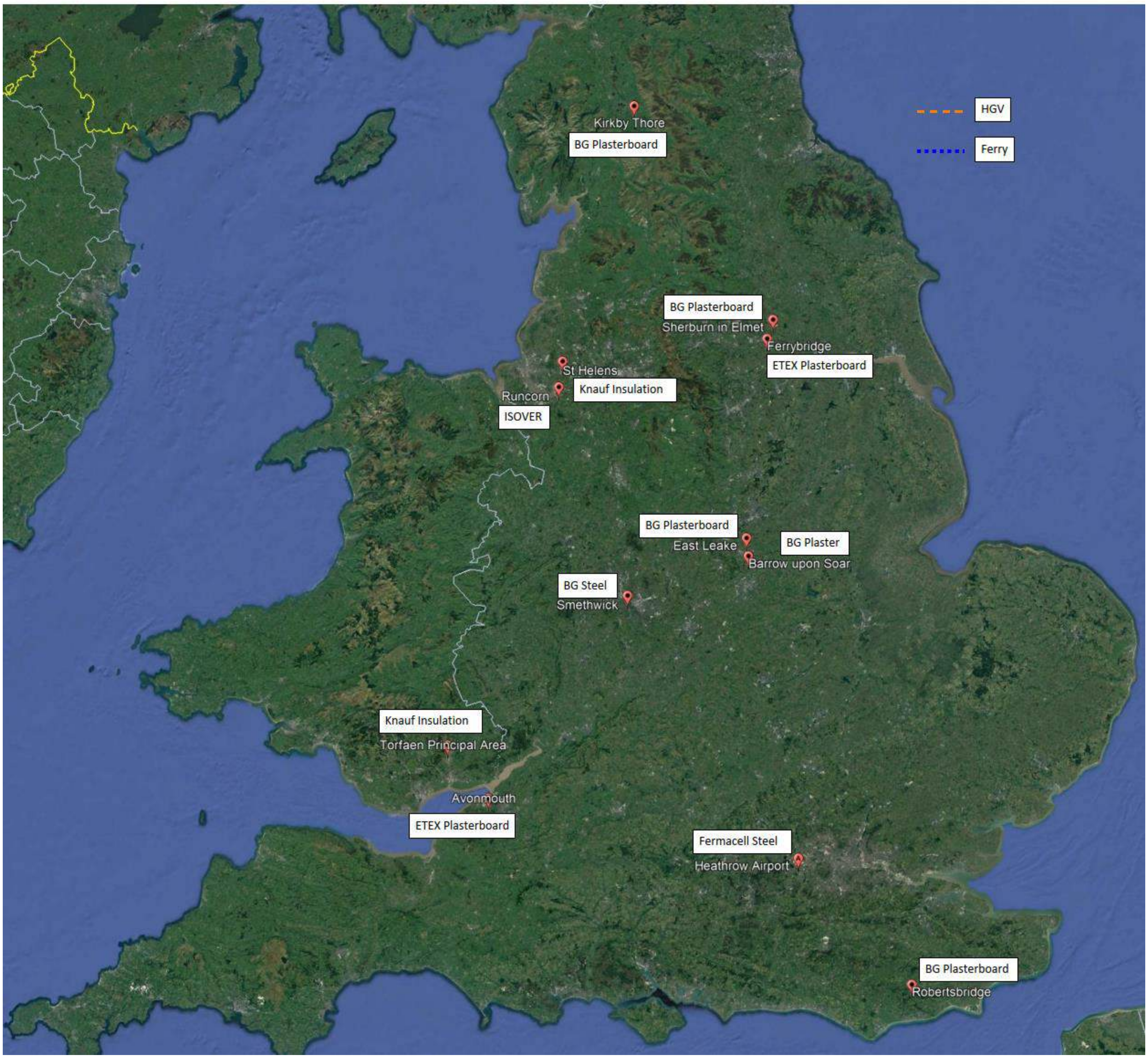
8.2 Summary

Site Location did not have a significant affect on Embodied Carbon. Intra-England transport differences weren't significant enough in their carbon differences to affect the overall results. Products manufactured outside the UK had their A4 emissions dominated by the routes and transportation methods between their origin and the UK.

The only notable exception to this was the ranking of Build-up Medium 4 (British Gypsum), which moved from 2nd to 3rd place depending on the site location.

The 'best-case' transportation routes also didn't have much of an impact when compared against the average carbon of 'all possible routes' used within Option 1's base case.

8.3 UK Factory Locations



8.4 Fermacell

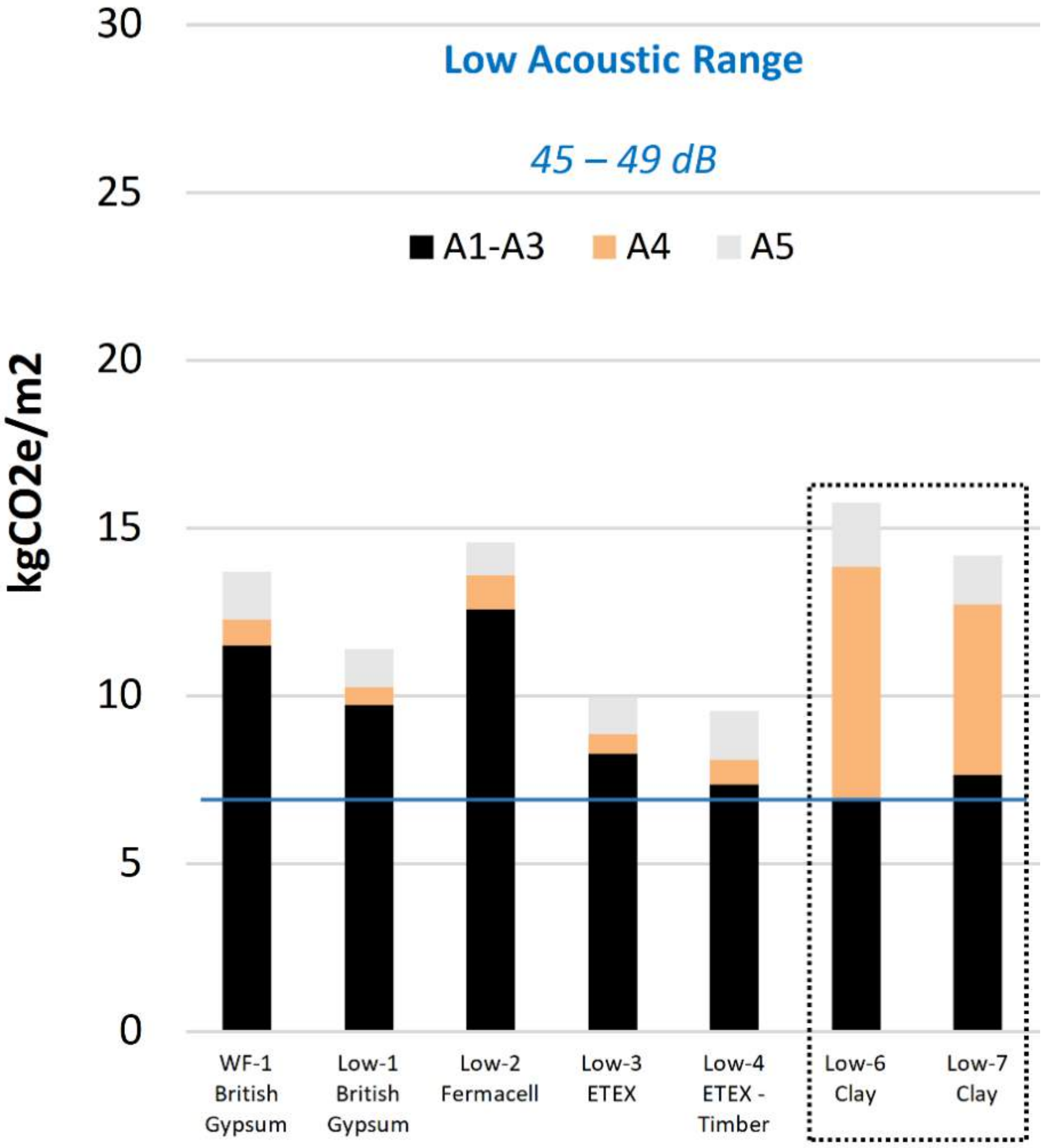
8.5 Clayboard

Transport Impact

Clayboard has a frustratingly high Upfront carbon, mostly driven by A4 Transportation associated carbon. Both ClayTec and EBB Boards both manufacture their Clayboards in South Germany. The long HGV route to the ports of northern France dominate the Upfront Carbon Emissions associated with this product, whilst the actual production carbon associated with making Clayboard is typically the lowest of all build-ups.

The graph below is an extract of the 'Low Acoustic' range: A1-A5 Impacts. The orange bars below represent the Carbon emissions associated with Transport (A4), and the black bars represent the Carbon emissions associated with production/manufacture (A1-A3).

As can be seen, Clay is normally the lowest carbon to produce, but has extraordinary transportation emissions.



8.6 London – Best-case Transportation routes

		London					
		Embodied Carbon			Upfront Carbon		
		kgCO2e/m^2	Rank	% Difference to Lowest	kgCO2e/m^2	Rank	% Difference to Lowest
Low Acoustic Range 43 – 45 dB	**WF-1 British Gypsum**	27.22	5	+54%	13.28	5	+43%
	Low-1 British Gypsum	22.61	**3**	+28%	11.10	**3**	+19%
	Low-2 Fermacell	27.89	6	+58%	14.55	7	+57%
	Low-3 ETEX	18.67	**2**	+6%	9.75	**2**	+5%
	Low-4 ETEX - Timber	17.62	**1**	-	9.29	**1**	-
	Low-6 Clay	29.30	7	+66%	14.42	6	+55%
	Low-7 Clay	26.68	4	+51%	13.17	4	+42%
Medium Acoustic Range 52 – 53 dB	**WF-2 British Gypsum**	34.71	4	+42%	16.85	4	+30%
	Medium-1 British Gypsum	43.06	6	+76%	20.98	6	+62%
	Medium-2 Fermacell	27.75	**2**	+14%	14.44	**3**	+11%
	Medium-3 ETEX	24.43	**1**	-	12.96	**1**	-
	Medium-4 British Gypsum	27.83	**3**	+14%	13.67	**2**	+5%
	Medium-6 Clay	42.39	5	+74%	20.87	5	+61%
High Acoustic Range 55 – 61 dB	**High-1 British Gypsum**	38.83	5	+39%	18.85	5	+35%
	High-2 British Gypsum	43.89	6	+57%	21.40	6	+54%
	High-3 Fermacell	34.15	4	+22%	17.82	4	+28%
	High-4 ETEX	29.36	**2**	+5%	15.17	**2**	+9%
	High-5 Pliteq	27.96	**1**	-	13.93	**1**	-
	High-7 Clay	50.91	7	+82%	25.01	7	+80%
	High-8 Clay	32.58	**3**	+17%	16.06	**3**	+15%

8.7 Birmingham – Best-case Transportation routes

		Birmingham					
		Embodied Carbon			Upfront Carbon		
		kgCO2e/m^2	Rank	% Difference to Lowest	kgCO2e/m^2	Rank	% Difference to Lowest
Low Acoustic Range 43 – 45 dB	WF-1 British Gypsum	27.12	5	+55%	13.17	4	+43%
	Low-1 British Gypsum	22.52	3	+29%	11.01	3	+20%
	Low-2 Fermacell	28.13	6	+61%	14.79	6	+61%
	Low-3 ETEX	18.54	2	+6%	9.62	2	+5%
	Low-4 ETEX - Timber	17.52	1	-	9.18	1	-
	Low-6 Clay	29.80	7	+70%	14.92	7	+62%
	Low-7 Clay	27.01	4	+54%	13.50	5	+47%
Medium Acoustic Range 52 – 53 dB	WF-2 British Gypsum	34.57	4	+43%	16.72	4	+31%
	Medium-1 British Gypsum	42.85	5	+77%	20.78	5	+63%
	Medium-2 Fermacell	27.94	3	+15%	14.63	3	+15%
	Medium-3 ETEX	24.21	1	-	12.75	1	-
	Medium-4 British Gypsum	27.72	2	+14%	13.56	2	+6%
	Medium-6 Clay	43.09	6	+78%	21.58	6	+69%
High Acoustic Range 55 – 61 dB	High-1 British Gypsum	38.73	5	+39%	18.75	5	+35%
	High-2 British Gypsum	43.78	6	+57%	21.29	6	+54%
	High-3 Fermacell	34.42	4	+23%	18.09	4	+31%
	High-4 ETEX	29.09	2	+4%	14.90	2	+8%
	High-5 Pliteq	27.89	1	-	13.85	1	-
	High-7 Clay	51.92	7	+86%	26.02	7	+88%
	High-8 Clay	33.05	3	+19%	16.53	3	+19%

8.8 Bristol – Best-case Transportation routes

		Bristol					
		Embodied Carbon			Upfront Carbon		
		kgCO2e/m^2	Rank	% Difference to Lowest	kgCO2e/m^2	Rank	% Difference to Lowest
Low Acoustic Range 43 – 45 dB	**WF-1 British Gypsum**	27.53	5	+54%	13.58	5	+44%
	Low-1 British Gypsum	22.82	**3**	+27%	11.31	**3**	+20%
	Low-2 Fermacell	27.98	6	+56%	14.64	7	+55%
	Low-3 ETEX	18.34	**2**	+2%	9.42	**1**	-
	Low-4 ETEX - Timber	17.90	**1**	-	9.57	**2**	+2%
	Low-6 Clay	29.49	7	+65%	14.61	6	+55%
	Low-7 Clay	26.81	4	+50%	13.30	4	+41%
Medium Acoustic Range 52 – 53 dB	**WF-2 British Gypsum**	35.14	4	+48%	17.28	4	+40%
	Medium-1 British Gypsum	43.59	6	+83%	21.52	6	+75%
	Medium-2 Fermacell	27.81	**2**	+17%	14.50	**3**	+18%
	Medium-3 ETEX	23.78	**1**	-	12.32	**1**	-
	Medium-4 British Gypsum	28.08	**3**	+18%	13.92	**2**	+13%
	Medium-6 Clay	42.66	5	+79%	21.15	5	+72%
High Acoustic Range 55 – 61 dB	**High-1 British Gypsum**	39.04	5	+38%	19.06	5	+34%
	High-2 British Gypsum	44.42	6	+57%	21.94	6	+55%
	High-3 Fermacell	34.23	4	+21%	17.91	4	+26%
	High-4 ETEX	28.57	**2**	+1%	14.38	**2**	+1%
	High-5 Pliteq	28.23	**1**	-	14.20	**1**	-
	High-7 Clay	51.30	7	+82%	25.41	7	+79%
	High-8 Clay	32.77	**3**	+16%	16.24	**3**	+14%

8.9 Manchester – Best-case Transportation routes

		Manchester					
		Embodied Carbon			Upfront Carbon		
		kgCO2e/m^2	Rank	% Difference to Lowest	kgCO2e/m^2	Rank	% Difference to Lowest
Low Acoustic Range 43 – 45 dB	**WF-1 British Gypsum**	27.23	4	+54%	13.29	4	+43%
	Low-1 British Gypsum	22.61	**3**	+28%	11.10	**3**	+19%
	Low-2 Fermacell	28.52	6	+62%	15.18	7	+63%
	Low-3 ETEX	18.47	**2**	+5%	9.55	**2**	+3%
	Low-4 ETEX - Timber	17.63	**1**	-	9.30	**1**	-
	Low-6 Clay	29.49	7	+67%	14.61	6	+57%
	Low-7 Clay	27.52	5	+56%	14.01	5	+51%
Medium Acoustic Range 52 – 53 dB	**WF-2 British Gypsum**	34.73	4	+44%	16.87	4	+34%
	Medium-1 British Gypsum	43.08	5	+79%	21.01	5	+67%
	Medium-2 Fermacell	28.26	**3**	+18%	14.95	**3**	+19%
	Medium-3 ETEX	24.04	**1**	-	12.58	**1**	-
	Medium-4 British Gypsum	27.82	**2**	+16%	13.66	**2**	+9%
	Medium-6 Clay	44.10	6	+83%	22.59	6	+80%
High Acoustic Range 55 – 61 dB	**High-1 British Gypsum**	38.83	5	+39%	18.85	5	+35%
	High-2 British Gypsum	43.91	6	+57%	21.43	6	+54%
	High-3 Fermacell	34.86	4	+25%	18.53	4	+33%
	High-4 ETEX	28.89	**2**	+3%	14.70	**2**	+5%
	High-5 Pliteq	27.98	**1**	-	13.94	**1**	-
	High-7 Clay	51.29	7	+83%	25.40	7	+82%
	High-8 Clay	32.76	**3**	+17%	16.24	**3**	+16%

9.0 OPTION 3 – GALVANISED STEEL CARBON FACTOR

9.1 Context

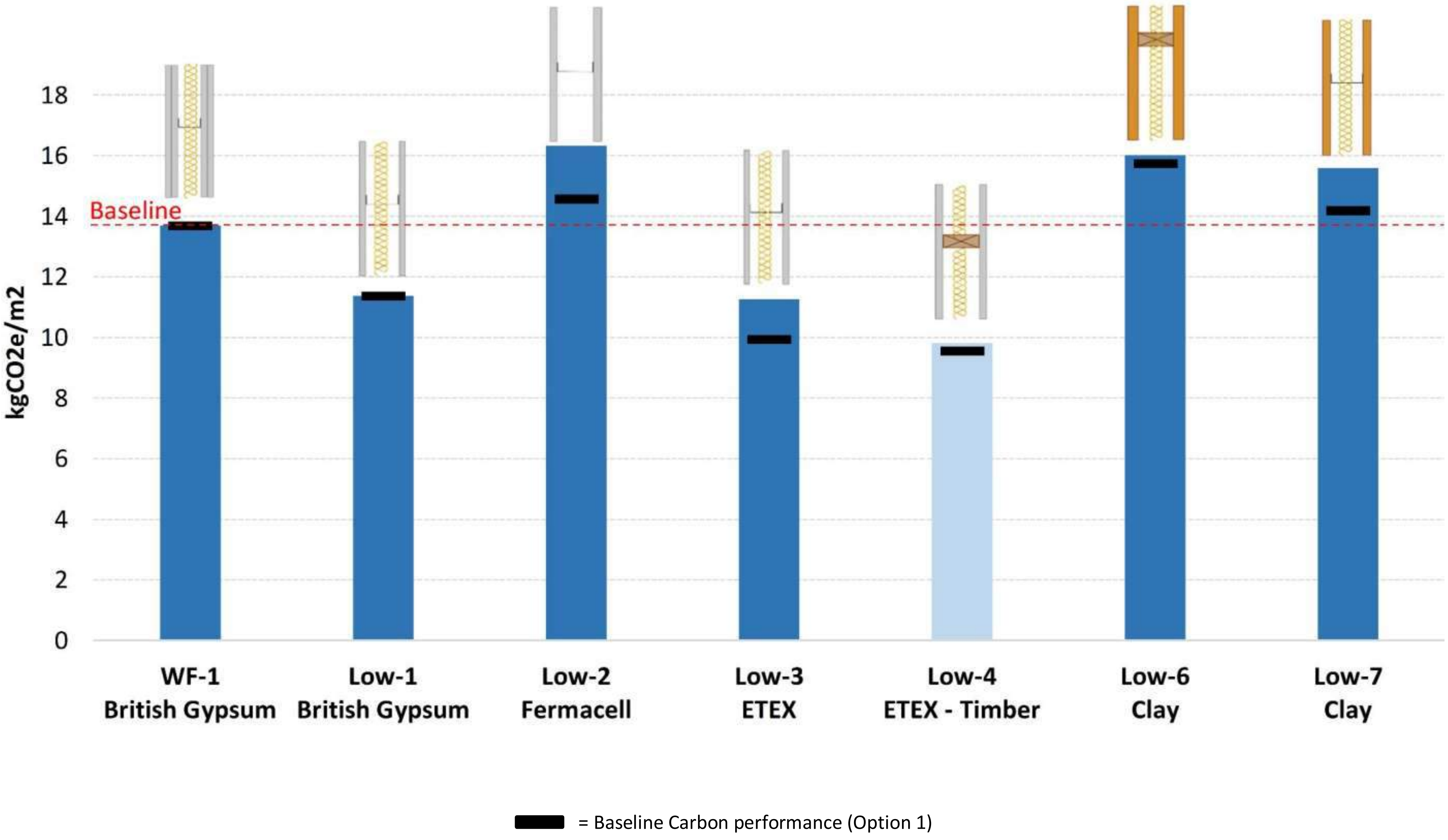
The carbon impact of steel is generally 2nd in importance behind the plasterboard. Of all manufacturers contacted, only British Gypsum could provide and EPD for their galvanised steel metal studs. This value is 2.09 kgCO2e/kg and when compared to the Inventory of Carbon and Energy (ICE database 3.0) default value for Hot-dipped Galvanised Steel of 2.76 kgCO2e/kg, represents a 24% reduction compared to industry default. We don't have an issue with the BG EPD, but to give other Galvanised Steel manufacturers the benefit-of-the-doubt, we've uesd the BG Gypframe EPD value as a 'proxy-product' for all metal studwork but the different manufacturers. This is not an unreasonable assumption, but we felt it was worth seeing what the impact of the results would be if we instead assumed ICE default value for all steelwork not manufactured by British Gypsum, and thus the sensistivity of the analysis to this Carbon Factor.

9.2 Summary

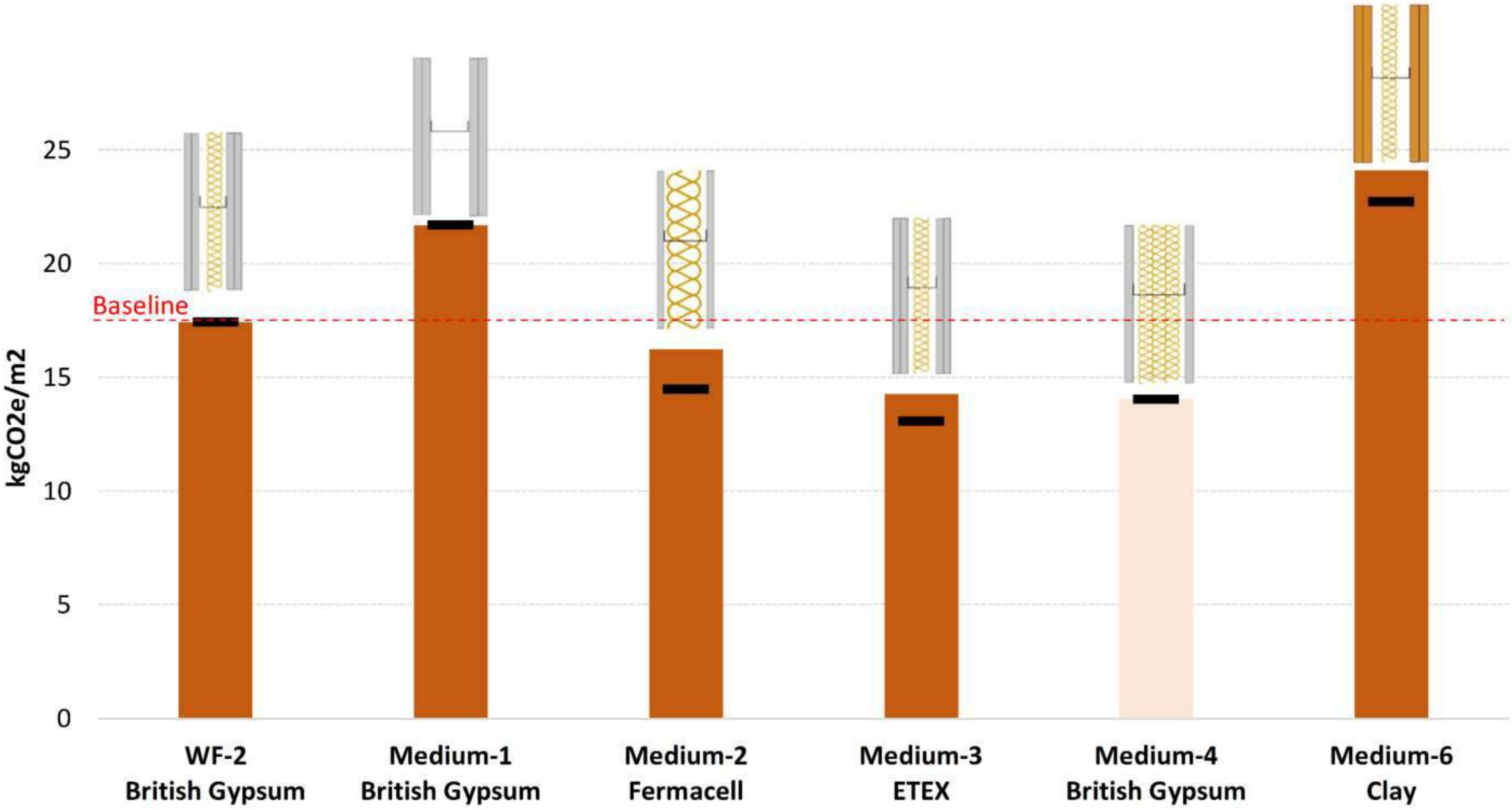
Given that steel is typically 25-40% of the Upfront Carbon, the variation in Galvanised Steel carbon factor (around 24%) does result in a noticeable effect:

- Fermacell build-ups have marginally more steel quantities than other manufacturers and are therefore affected more by this choice. Especially in the 'Low' category.
- British Gypsum Build-ups get more competitive
- Siniat (ETEX) Build-ups are penalised, but still remain below the rest due to the markedly lower carbon Plasterboard EPD

9.3 Upfront Carbon (A1-A5) – Low Acoustic Range

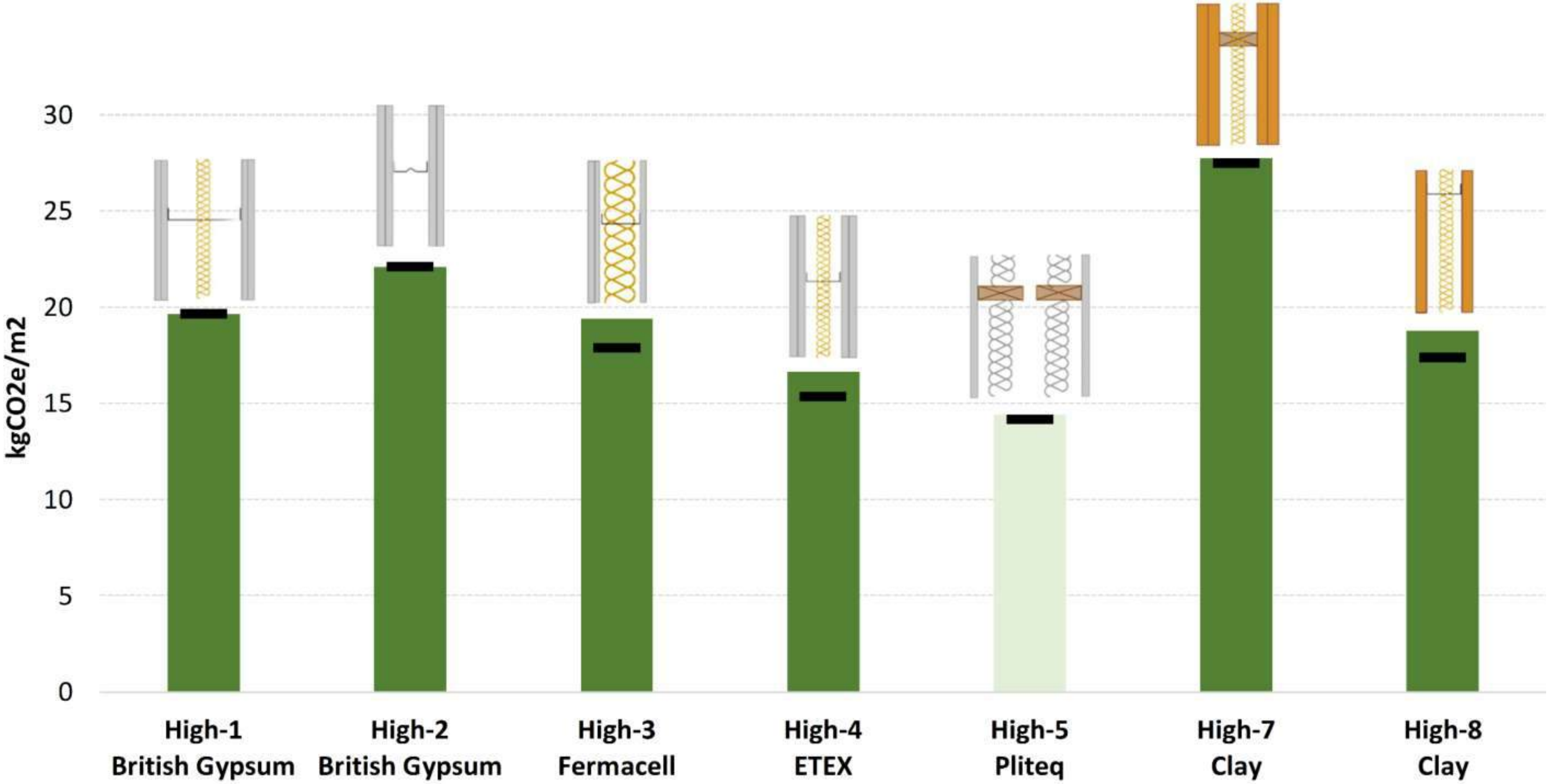


9.4 Upfront Carbon (A1-A5) – Medium Acoustic Range



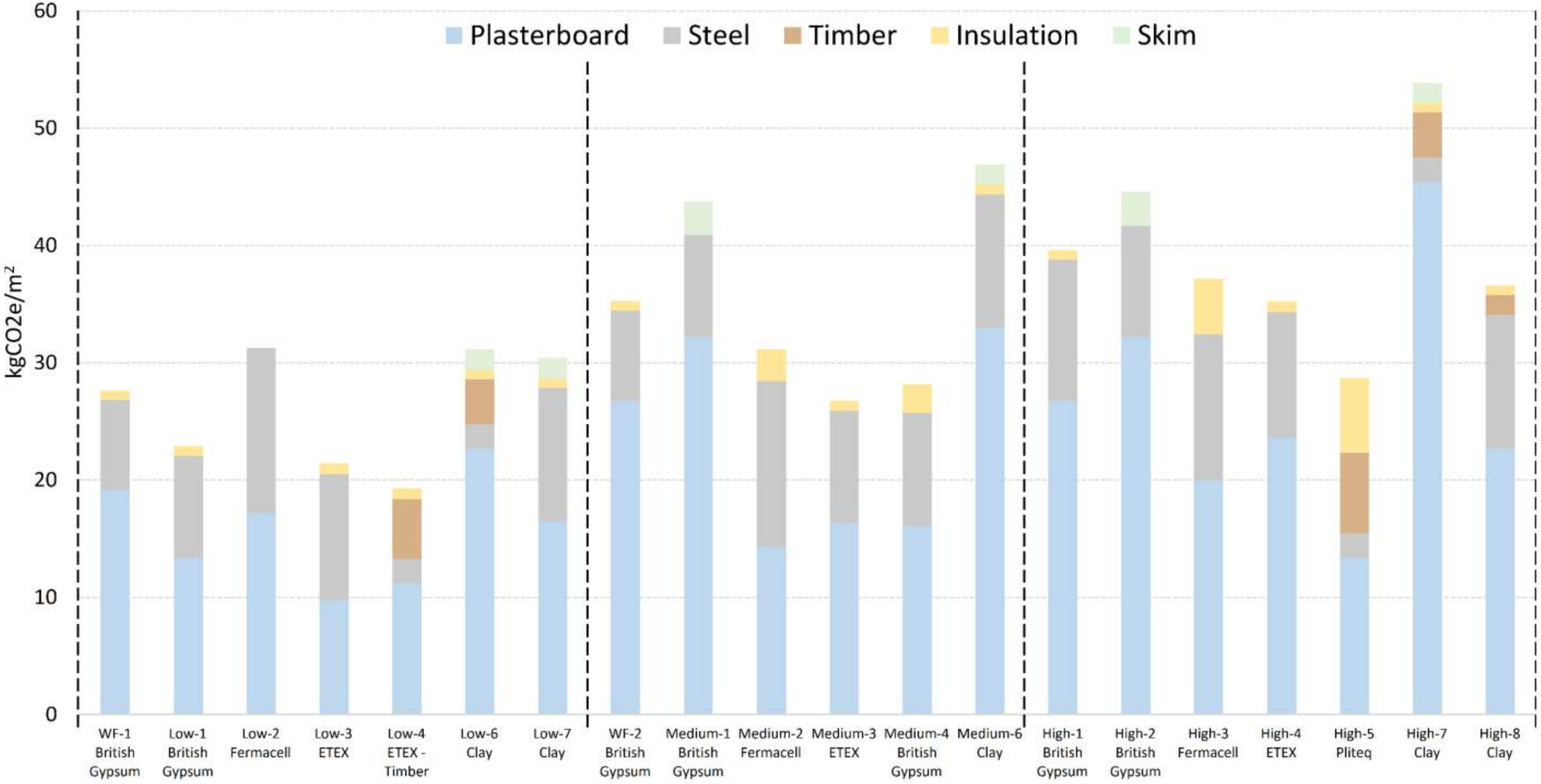
▬ = Baseline Carbon performance (Option 1)

9.5 Upfront Carbon (A1-A5) – High Acoustic Range



▬ = Baseline Carbon performance (Option 1)

9.6 Embodied Carbon (A1-C4) – Material Contribution



10.0 OPTION 4 – ALL BUILD-UPS INCLUDE SKIM

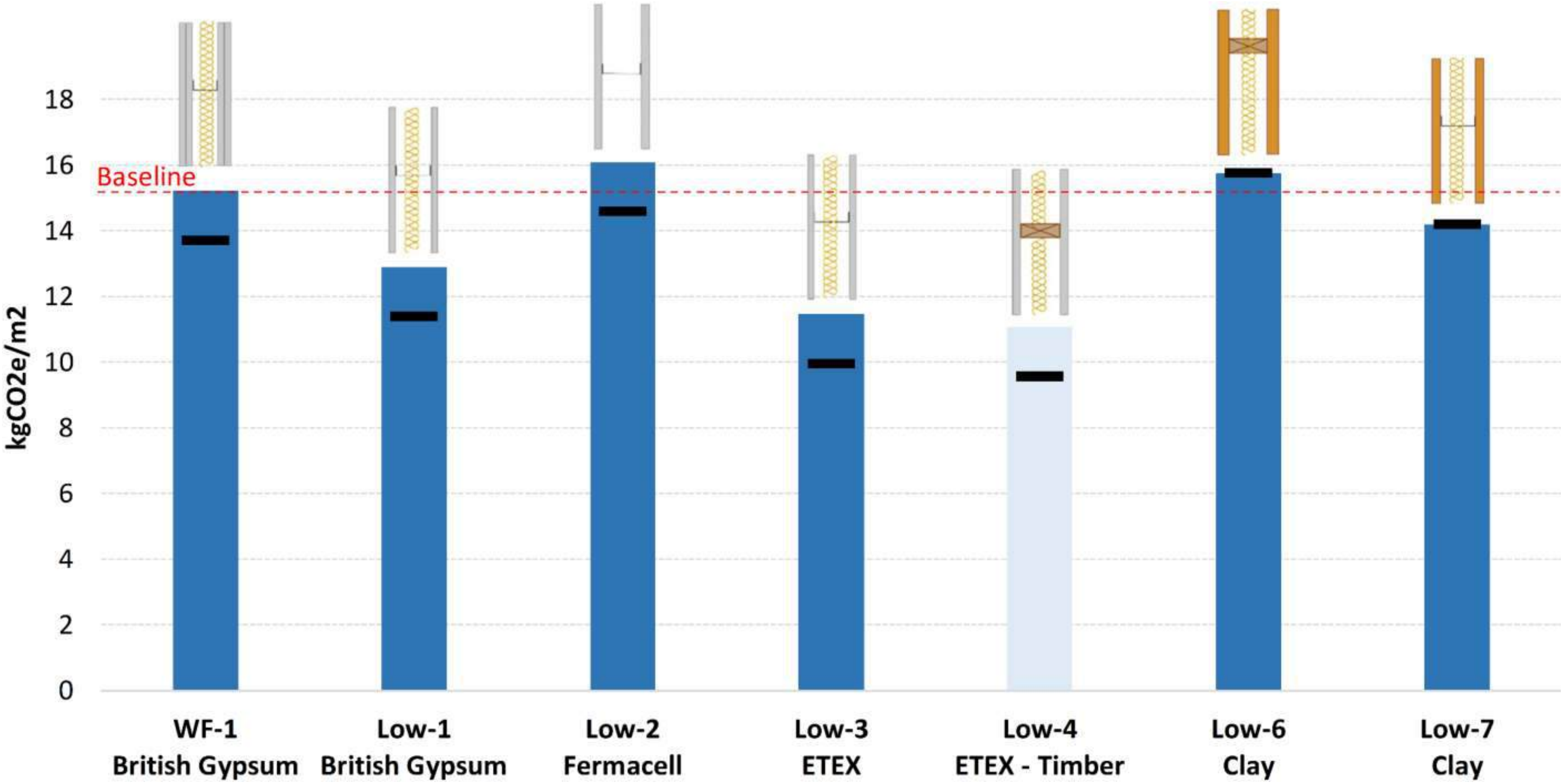
10.1 Context

Some of the build-ups necessitate a plaster skim in order to meet the specification that has been acoustically tested. Given that a 2mm skim is not an uncommon action to be taken for purely aesthetic reasons, we wanted to see what the results would look like if all build-ups included a 2mm skin on each side.

10.2 Summary

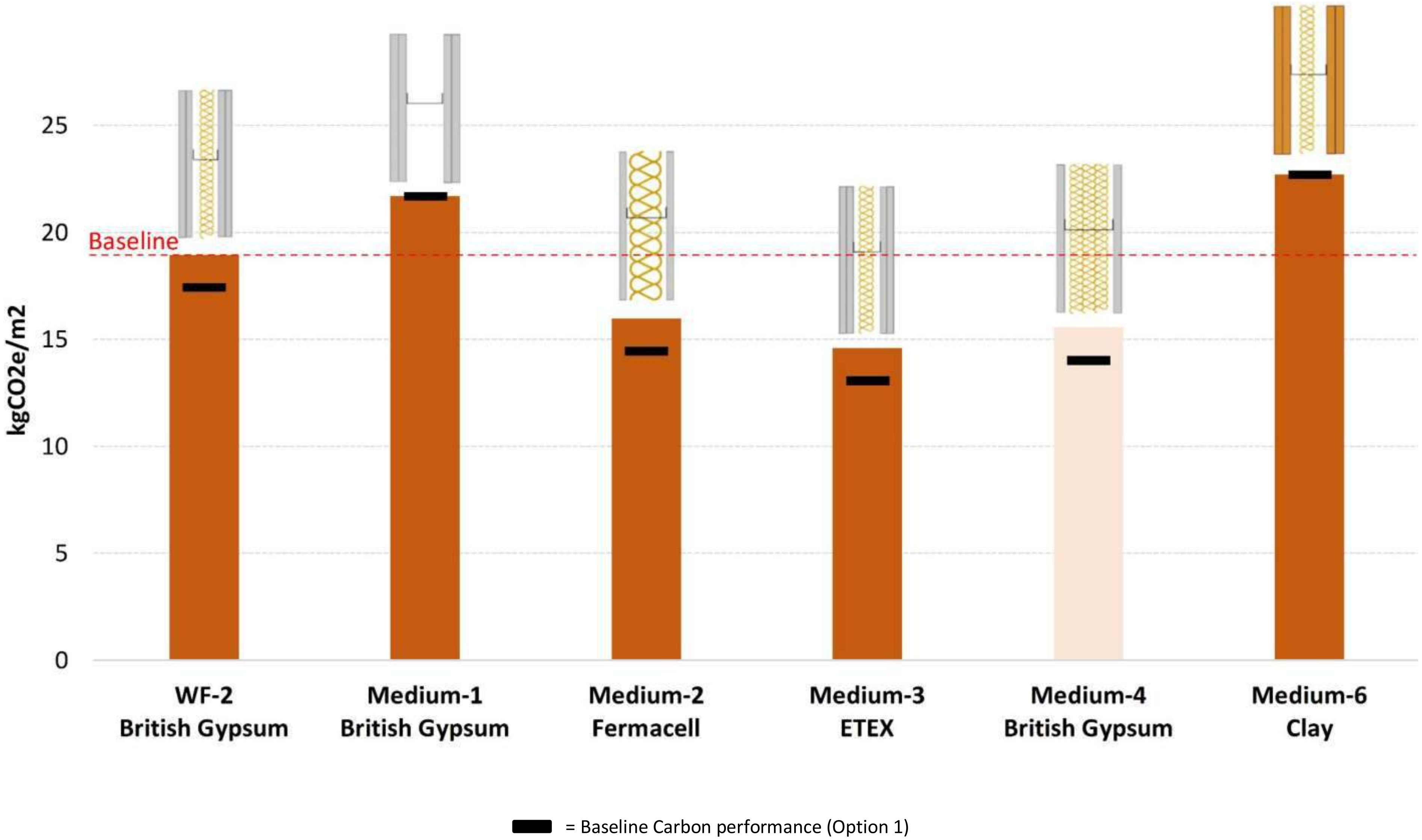
The impact of a 2mm Skim was relatively minor and did not significantly alter the results. Some Clayboard build-ups became slightly more competitive, but generally still sat above the baseline

10.3 Upfront Carbon (A1-A5) – Low Acoustic Range

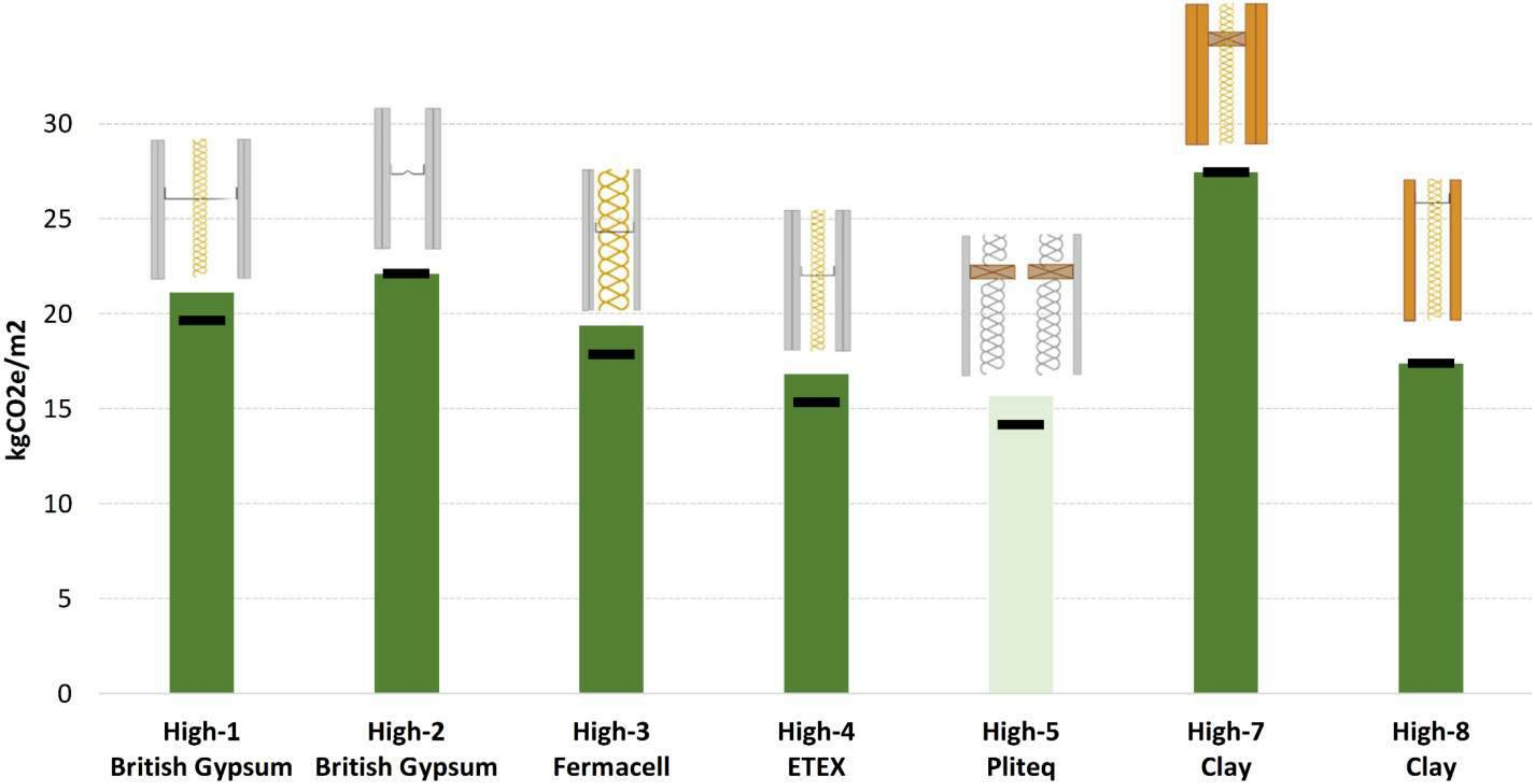


▬ = Baseline Carbon performance (Option 1)

10.4 Upfront Carbon (A1-A5) – Medium Acoustic Range

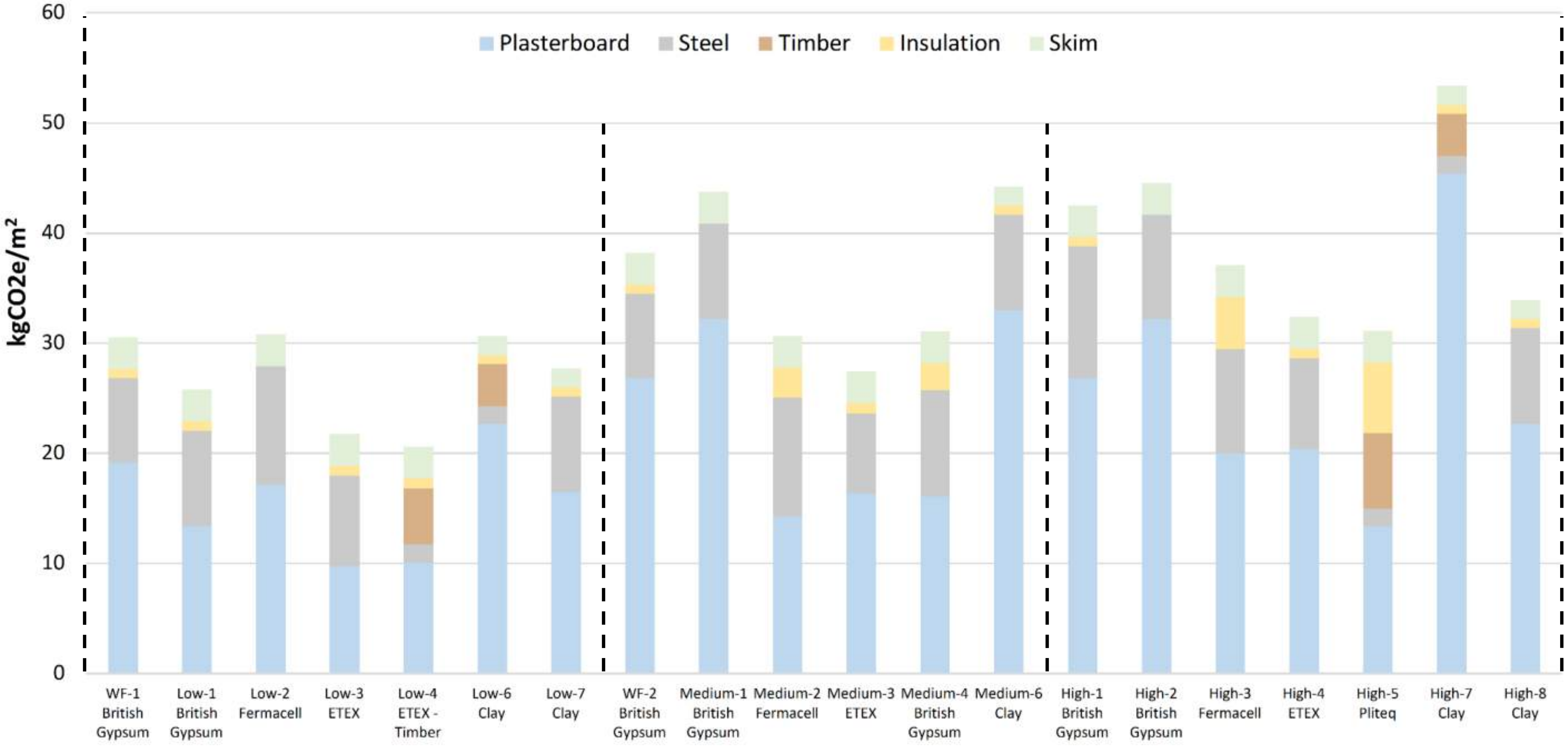


10.5 Upfront Carbon (A1-A5) – High Acoustic Range



▬ = Baseline Carbon performance (Option 1)

10.6 Embodied Carbon (A1-C4) – Material Contribution



11.0 OPTION 5 – 50% CARBON CAPTURE & STORAGE

11.1 Context

This option represents, in our opinion, a more realistic treatment of biogenic carbon stored within timber/cellulose elements within this study. By current carbon accounting rules, all CO2 absorbed is re-emitted at end-of-life incineration i.e. not net benefit from the original carbon sequestration. Given the emerging industries of Carbon Capture and Storage (CCS) and Bioenergy with Carbon Capture and Storage (BECCS) is currently viewed as a vital part of the global efforts to reduce carbon emissions, we feel it's likely that by the end-of-life of these materials (30+yrs) CCS will present in some capacity. This implies that at end of life, we believe it is likely that 'on average', only a portion of a given elements biogenic carbon would actually be released back into the atmosphere. In this option, we have assumed that 50% of all biogenic carbon is recaptured at end-of-life. This demonstrates a future scenario where biogenic materials are actually rewarded for capturing carbon within the carbon accounting process.

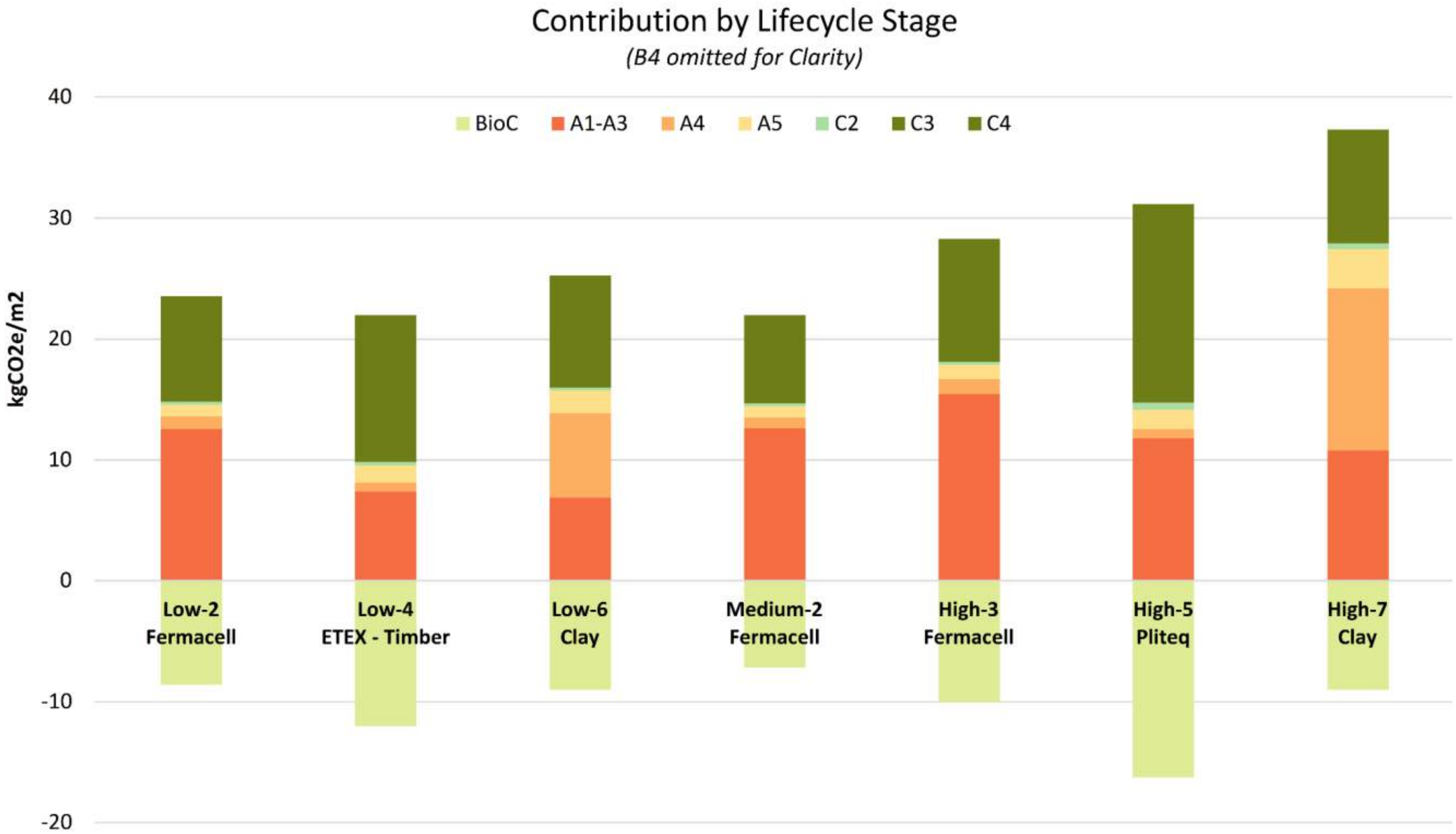
11.2 Summary

50% CCS naturally benefits only the build-ups containing Biogenic material. In this study, this pertains to either:

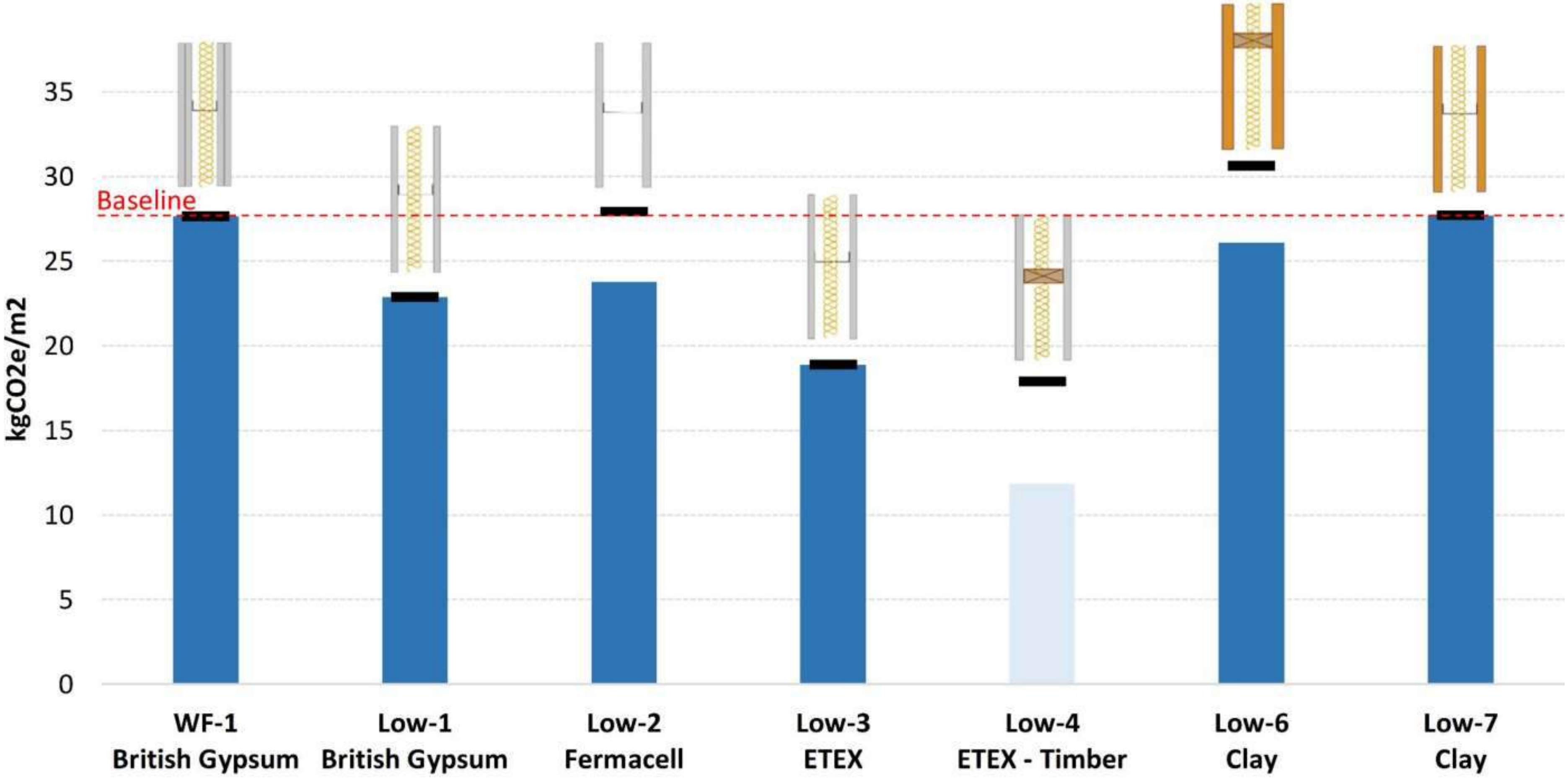
- Build-ups with Timber Studs
- Build-ups containing Fermacell (20% cellulose Fibres)

This option has a large affect on these build-ups with these options coming out lowest carbon by a large margin – or in the case of Fermacell – becoming significantly more competitive and generally the best 'non-timber' options.

11.3 Build-ups Including Biogenic Material

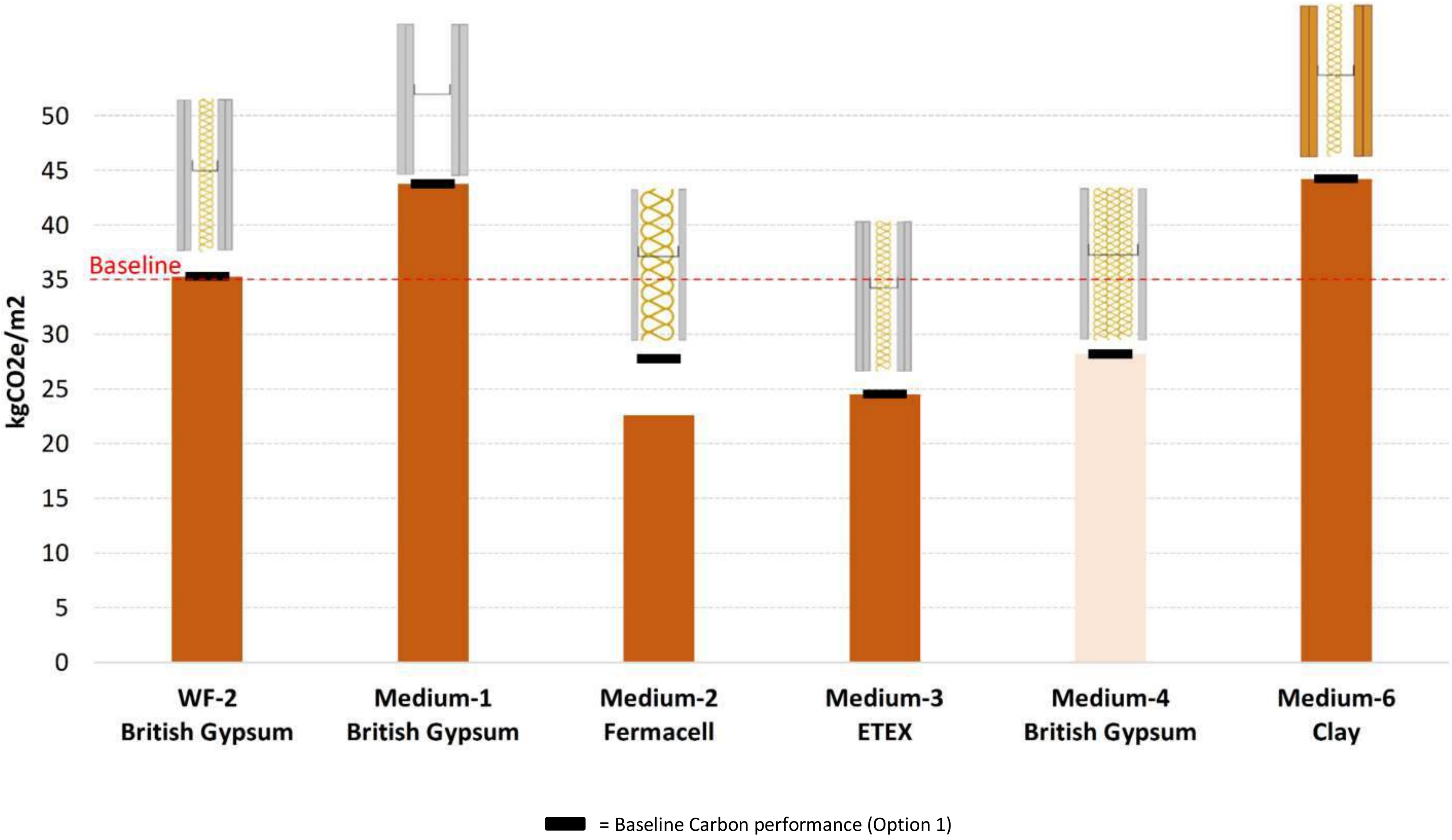


11.4 Embodied Carbon (A1- C4) – Low Acoustic Range

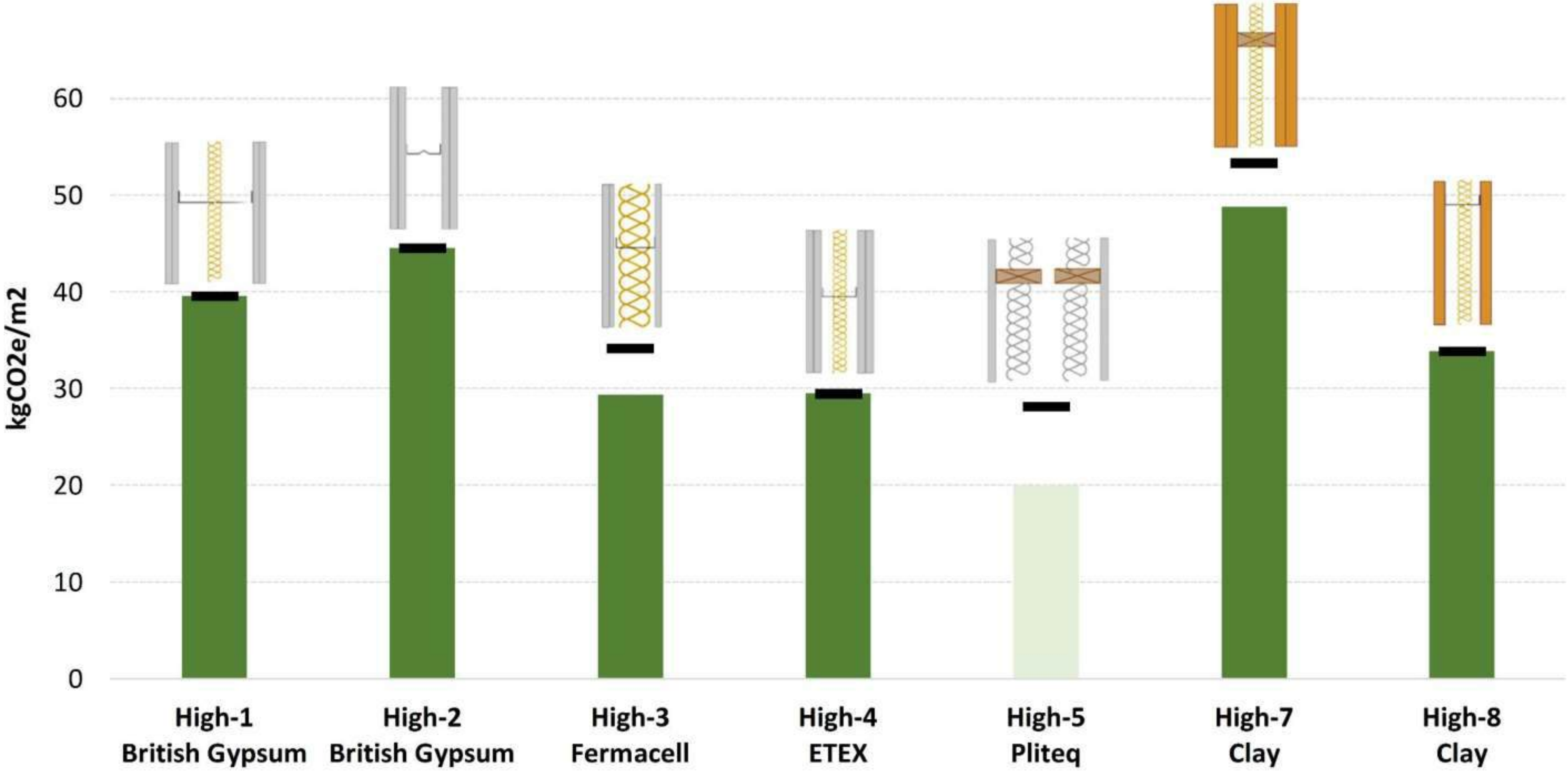


▬ = Baseline Carbon performance (Option 1)

11.5 Embodied Carbon (A1- C4) – Medium Acoustic Range

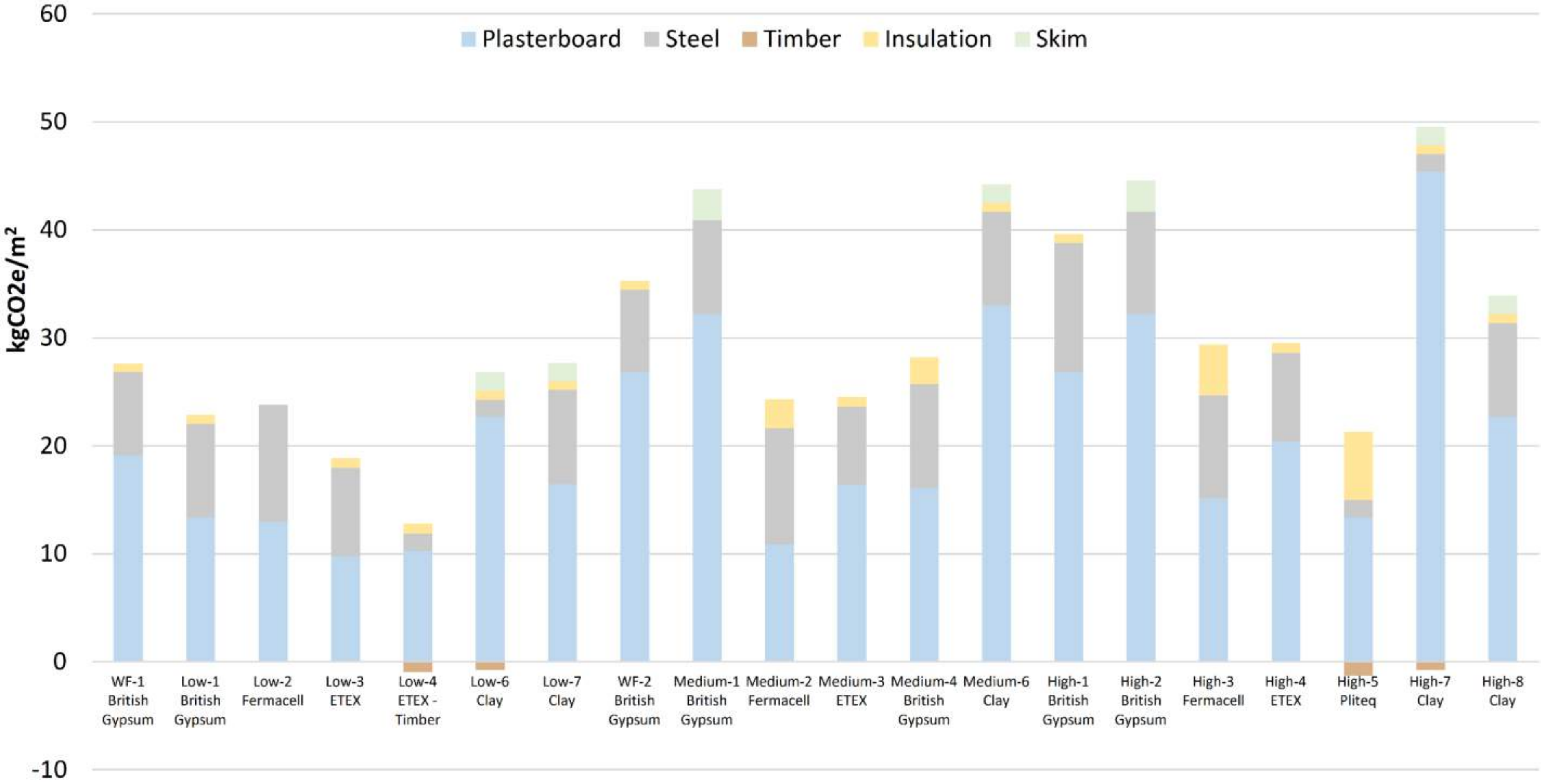


11.6 Embodied Carbon (A1- C4) – High Acoustic Range



▬ = Baseline Carbon performance (Option 1)

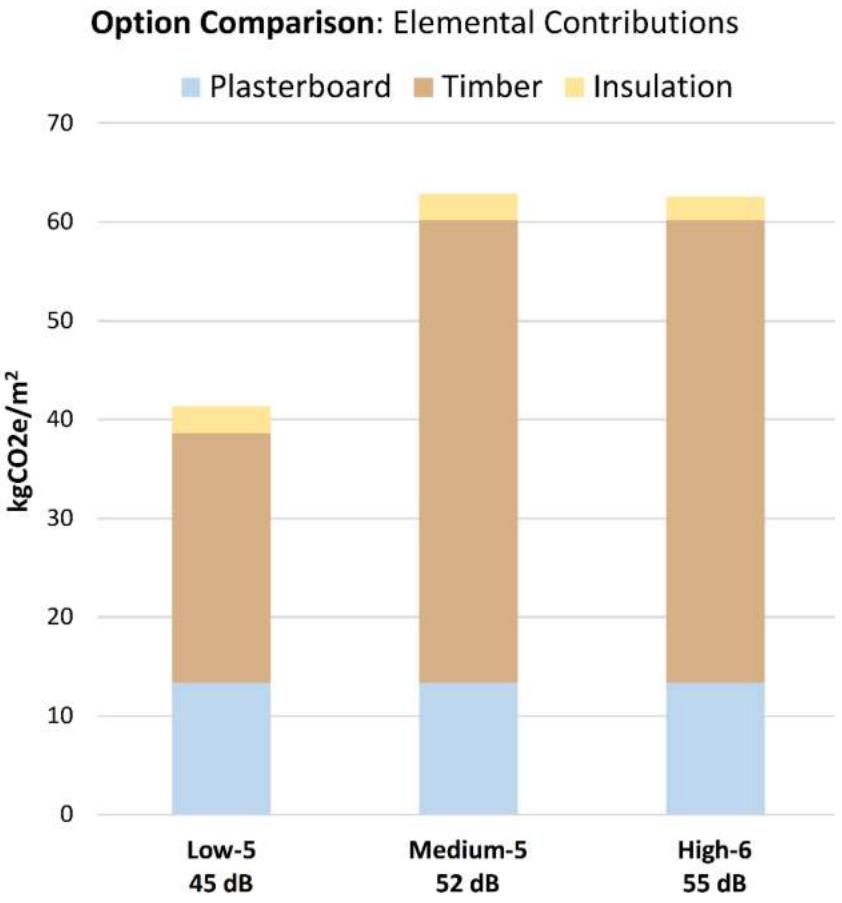
11.7 Embodied Carbon (A1-C4) – Material Contribution



12.0 CROSS LAMINATED TIMBER (CLT)

Cross Laminated Timber partitions are only likely to be present on a scheme that utilises CLT Slab and Walls as the load bearing system. Due to their significant mass, comparing to other internal wall types, we have not compared them against Steel / Timber stud options.

This study also assumes a single layer of British Gypsum Soundbloc on each side for fire-protection



Acoustics drive the No. Panels and the size of the insulation. The Medium / High acoustic categories are virtually identical due to the need for 2 layers of 100m thick CLT Panels – only the insulation type varies across these options.

13.0 ADDITIONAL NOTES

13.1 Patressing

Patressing has been excluded from this study as it is not always present and when it is, is not always a ‘standard’ quantity. As such, Plasterboards with higher load-hanging capabilities are not shown as having a carbon benefit from a reduction in patressing materials.

Fermacell is noted as being a plasterboard with unusually high load-hanging capacity which might remove the need for the patressing other build-ups may require.

13.2 The future of Gypsum

The majority of the plasterboards analysed in this study have high proportions of DSG:

- **ETEX**: 60%
- **British Gypsum**: Not Disclosed
- **Fermacell**: 80-85%

DSG stands for Desulphurised Gypsum (sometimes called FDG = Flue gas Desulphurisation Gypsum) which is a by-product of the treated gas produced by Coal Fired Power stations. As Europe will be closing down its Coal Fired power stations in the coming decades, a question arises as to where the gypsum industry will source their gypsum. Mining more natural gypsum will almost certainly be required, along with a drastic increase in recycling of waste gypsum products. Whether these measures will be enough to satisfy demand and keeps costs competitive is to be seen. But there is a viewpoint where getting to grips with using Clayboard may have value, despite the current state of this fledging market (i.e. produced in Central Germany at the time of writing).

14.0 FURTHER STUDIES

14.1 Glazed Partitions

Glazed Partitions are part of the scope of this report. This section will be updated once our manufacturer engagement is complete.

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