



# **Updating The ICE Database: ICE V3.0**

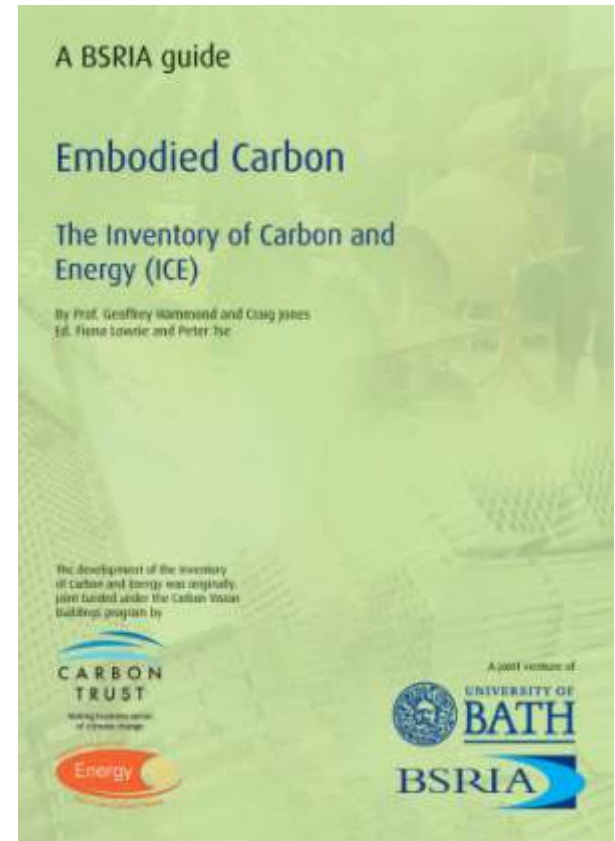
**ASBP, 1st Nov 2018**

**Dr Craig Jones**

**[Craig.Jones@CircularEcology.com](mailto:Craig.Jones@CircularEcology.com)**

# The Inventory of Carbon & Energy (ICE)

- An **embodied energy and carbon database** for building materials
- Primarily for Construction Materials
- Data for over 200 materials
- Over 20,000 worldwide users
- BSRIA hardcopy published in January 2011
- Free to download from [www.circularecology.com/ice-database.html](http://www.circularecology.com/ice-database.html)



# Updating The Inventory of Carbon & Energy (ICE)

- ICE database is a free resource – will remain free
- Still well used
- However last updated in 2011
- Very much due an update
- Update funded by:
  - Heathrow Airport
  - Rail Safety and Standards Board (RSSB)
  - Environment Agency

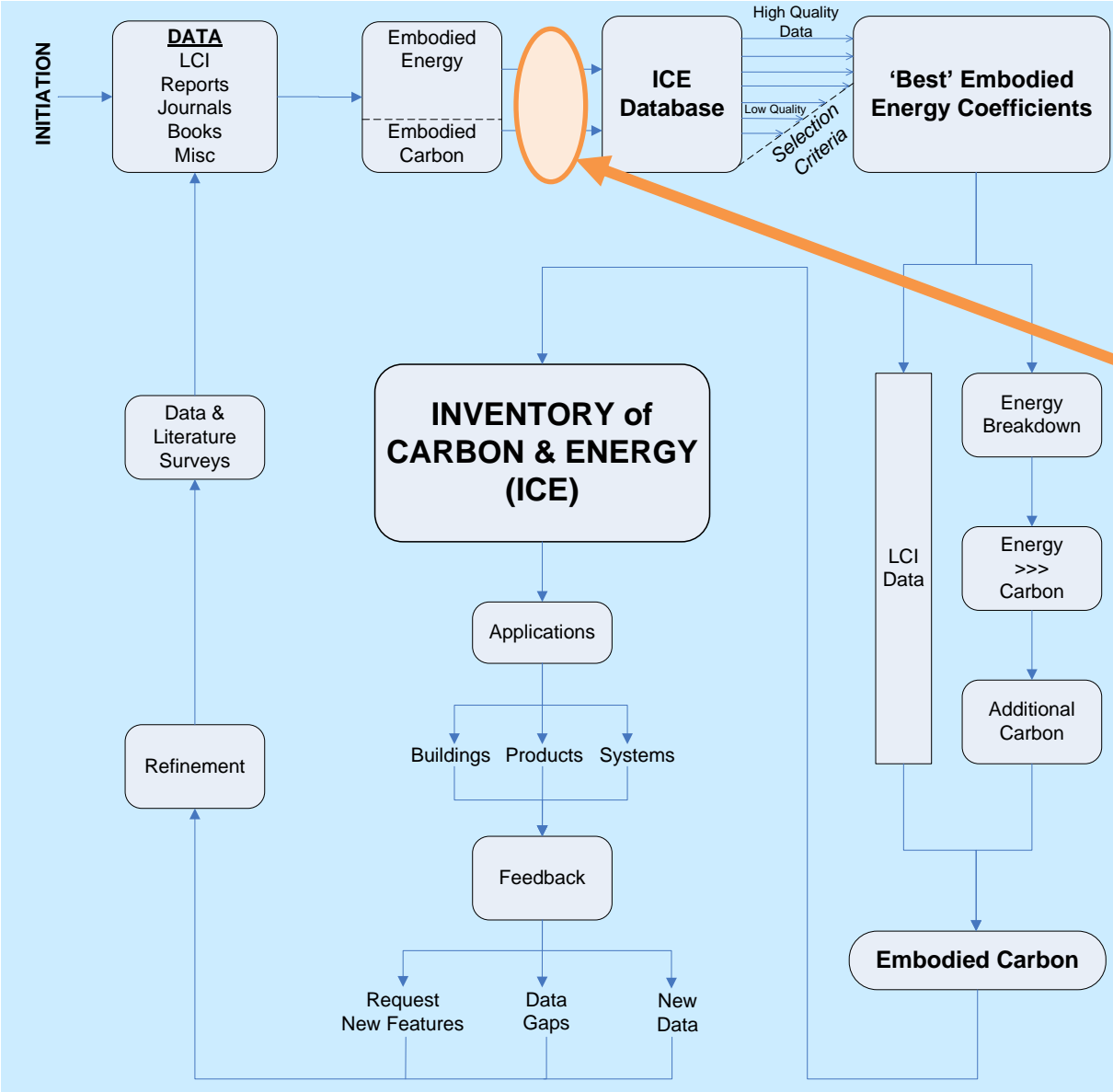
# The Inventory of Carbon & Energy (ICE)

ICE V2.0 - Jan 2011 [Compatibility Mode] - Excel

INVENTORY OF CARBON & ENERGY (ICE) SUMMARY				
Materials	Embodied Energy & Carbon Coefficients			Comments
	EE - MJ/kg	EC - kgCO2/kg	EC - kgCO2e/kg	
EE = Embodied Energy, EC = Embodied Carbon				
<u>Aggregate</u>				
General (Gravel or Crushed Rock)	0.083	0.0048	0.0052	Estimated from measured UK industrial fuel consumption data
<u>Aluminium</u>				
Main data source: International Aluminium Institute (IAI) LCA studies (www.world-aluminium.org)				
General	155	8.24	9.16	Assumed (UK) ratio of 25.6% extrusions, 55.7% Rolled & 18.7% castings. Worldwide average recycled content of 33%.
Virgin	218	11.46	12.79	
Recycled	29.0	1.69	1.81	
Cast Products	159	8.28	9.22	Worldwide average recycled content of 33%.
Virgin	226	11.70	13.10	
Recycled	25.0	1.35	1.45	
Extruded	154	8.16	9.08	Worldwide average recycled content of 33%.
Virgin	214	11.20	12.50	
Recycled	34.0	1.98	2.12	
Rolled	155	8.26	9.18	Worldwide average recycled content of 33%.
Virgin	217	11.50	12.80	
Recycled	28	1.67	1.79	
<u>Asphalt</u>				
Asphalt, 4% (bitumen) binder content (by mass)	2.86	0.059	0.066	1.68 MJ/kg Feedstock Energy (Included). Modelled from the bitumen binder content. The fuel consumption of asphalt mixing operations was taken from the Mineral Products Association (MPA). It represents typical UK

FRONT PAGE | Changes from V1.6a | **SUMMARY TABLE** | Annex A - Boundaries | Annex B - Methods for Recycling | Material Profiles Guide | Aggregate | Aluminium | Asphalt | Biti ...

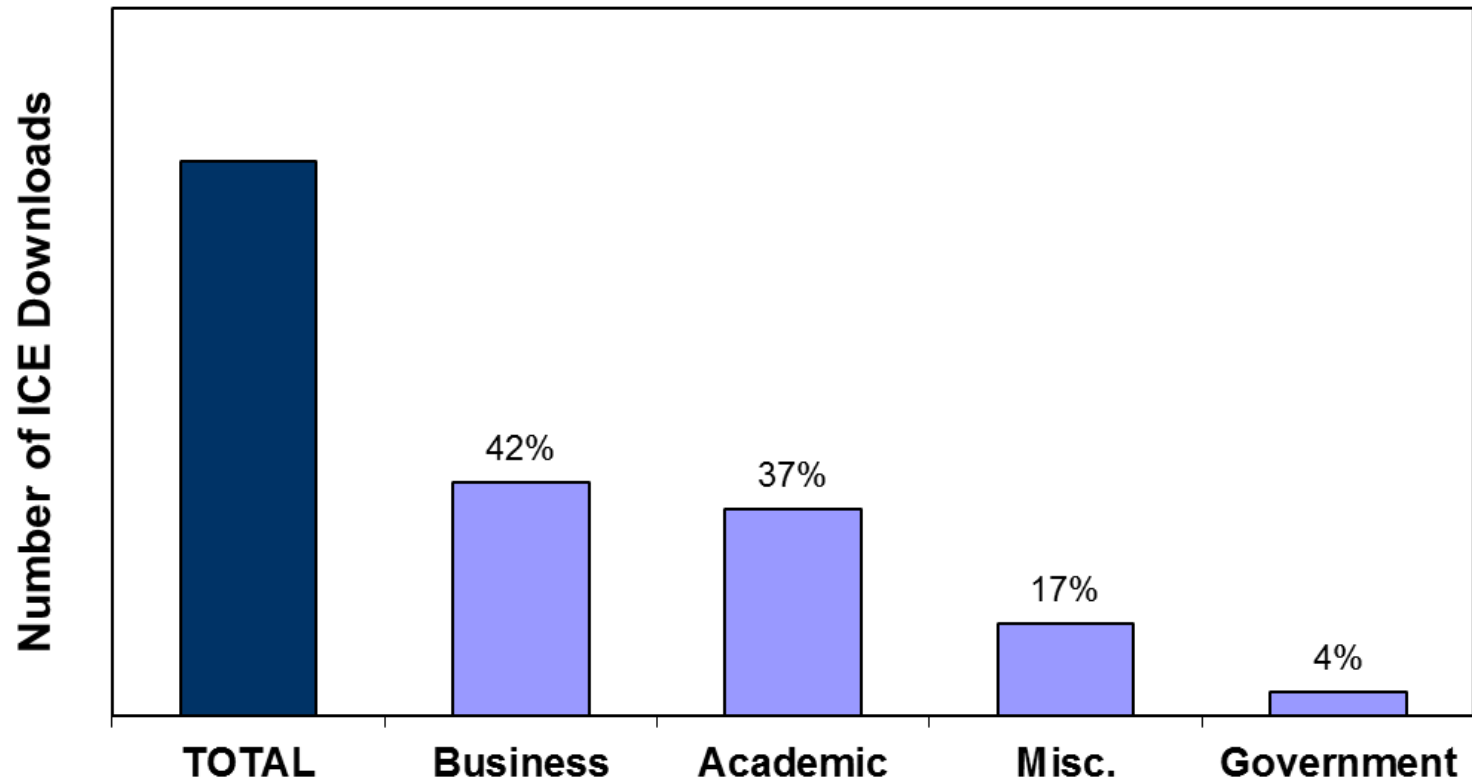
# Creation of the ICE database



2018 Update:  
Quality screen  
introduced here  
for efficiency

# Profile of ICE database Users

## ICE Professional Interest



# What's Changed Since Last ICE Update

- **EN 15978:2011:** Sustainability of construction works — Assessment of environmental performance of buildings — Calculation method
- **EN 15804:2012:** Sustainability of construction works — Environmental product declarations — Core rules for the product category of construction products
- **PAS 2050:2011 Version** - Product carbon footprint standard from BSI. Linked to Carbon Trust Carbon Reduction Label
- **World Resources Institute:** GHG Protocol for Products
- **HM Treasury Infrastructure Carbon Review, 2013**
- **PAS 2080 – Carbon Management in Infrastructure – May 2016**

# What's Changed Since Last ICE Update

- These new standards generally bring more certainty to embodied carbon calculations
- Have stimulated more studies to be published
- Far more data is available on embodied carbon of products
- Including thousands of new Environmental Product Declarations (EPDs)
- The data available today is far better than was previously available



# EPDs

- EN 15804 EPDs are now an important data source
- In fact, the perhaps the main data source
- They are standardised and offer more than just embodied carbon
- Can contain over 20 environmental impact categories
- However, a lack of a detailed life cycle assessment (LCA) report means understanding the results is challenging
- Example EPD...

# EPDs

bre

## Statement of Verification

BREG EN EPD No.: 000087  
ECO EPD Ref. No. 0000269

Issue 03

This is to verify that the  
**Environmental Product Declaration**  
provided by:  
**MEDITE EUROPE DAC**



is in accordance with the requirements of:  
**EN 15804:2012+A1:2013**  
and  
**BRE Global Scheme Document SD207**

This declaration is for:  
**MEDITE EXTERIOR**

### Company Address

Redmondstown  
Clanmell  
County Tipperary  
Ireland



**MEDITE®**  
DEFINING THE STANDARD OF MDF

*Emma Baker*  
signed for BRE Global Ltd

Emma Baker  
Operator

02 October 2017  
Date of this issue

17 December 2015  
Date of first issue

16 December 2020  
Expiry Date



This Statement of Verification is issued subject to terms and conditions for  
Alerts V14 [www.breglobal.com/alerts](http://www.breglobal.com/alerts)  
To check the validity of this statement of verification please visit  
[www.breglobal.com/epd](http://www.breglobal.com/epd) or contact us.  
BRE Global Ltd, Garsdon, Watford WD25 8DQ,  
T: +44 (0)333 321 8811 F: +44 (0)1932 694623 E: [enquiries@breglobal.com](mailto:enquiries@breglobal.com)



## LCA Results

(MND = module not declared; MNR = module not relevant; INA = indicator not assessed; AGG = aggregated)

### Parameters describing environmental impacts

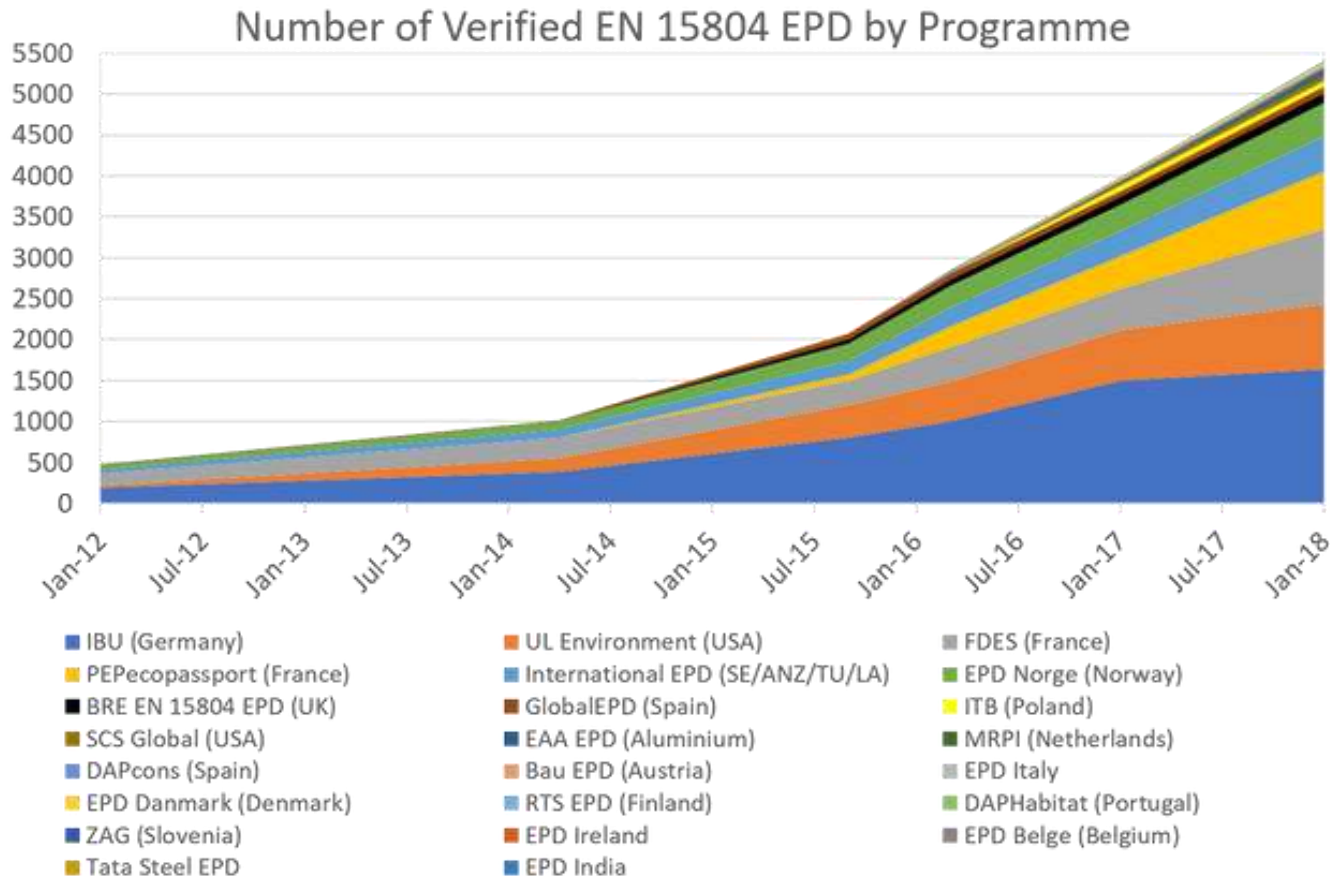
			GWP	ODP	AP	EP	POCP	ADPE	ADPF
			kg CO <sub>2</sub> equiv.	kg CFC 11 equiv.	kg SO <sub>2</sub> equiv.	kg (PO <sub>4</sub> ) <sup>3-</sup> equiv.	kg C <sub>2</sub> H <sub>4</sub> equiv.	kg Sb equiv.	MJ, net calorific value.
Product stage	Raw material supply	A1	AGG	AGG	AGG	AGG	AGG	AGG	AGG
	Transport	A2	AGG	AGG	AGG	AGG	AGG	AGG	AGG
	Manufacturing	A3	AGG	AGG	AGG	AGG	AGG	AGG	AGG
	<b>Total (of product stage)</b>	<b>A1-3</b>	<b>-1430</b>	<b>0.0000375</b>	<b>5.05</b>	<b>0.746</b>	<b>1.16</b>	<b>0.000688</b>	<b>12900</b>
Construction process stage	Transport	A4	MND	MND	MND	MND	MND	MND	MND
	Construction	A5	MND	MND	MND	MND	MND	MND	MND

GWP = Global Warming Potential;  
ODP = Ozone Depletion Potential;  
AP = Acidification Potential for Soil and Water;  
EP = Eutrophication Potential;

POCP = Formation potential of tropospheric Ozone;  
ADPE = Abiotic Depletion Potential – Elements;  
ADPF = Abiotic Depletion Potential – Fossil Fuels.

# Rise of EPDs

- A significant number of Environmental Product Declarations (EPDs) are now available
- Figure taken from [www.constructionlca.co.uk](http://www.constructionlca.co.uk) (Jane Anderson, ex. BRE)



# Scope of Update

- Core update scope = Update the key construction materials, e.g.:
  - Aggregates
  - Aluminium
  - Bricks
  - Cement
  - Concrete
  - Glass
  - Sand
  - Steel
  - Timber
  - Plastics (including trying to add data for recycled plastics)
- Further scope, beyond core update, currently includes:
  - Asphalt and bitumen (e.g. for road surfaces)
  - Other materials only as data and resource allows

# Beyond Data: Adding Value to the Data

- The ICE database contains data and also comments on each material
- 2018: Trying to extract more value from the data
- To allow users to understand important areas for each material
- For example,
  - Recycled aggregates
  - Concrete cement content, curing time
- Note: EPDs do not generally offer as much value for this task

# Adding Value to the Data

- Existing statistics example, aggregates:

Material Profile: Aggregate						
Embodied Energy (EE) ICE-Database Statistics - MJ/Kg						
Main Material	No. Records	Average EE		Standard Deviation	Minimum EE	Maximum EE
Aggregate	37	0.11		0.12	0.01	0.50
<i>Aggregate, General</i>	37	0.11		0.12	0.01	0.50
<i>Predominantly Recycled</i>	3	0.25	0.21	0.10	0.40	
<i>Unspecified</i>	17	0.11	0.07	0.02	0.28	
<i>Virgin</i>	17	0.10	0.15	0.01	0.50	

- New stats (just ideas of stats that could be included) – now on carbon:

## Embodied Carbon Stats - kg CO2e per kg

Count GWP	136
-----------	-----

Percentiles										
0	5	10	15	25	50	75	85	90	95	100
0.93	1.65	2.00	2.12	2.26	3.45	5.16	6.14	7.62	37.86	260.80

Average	St Dev
9.7	32.5

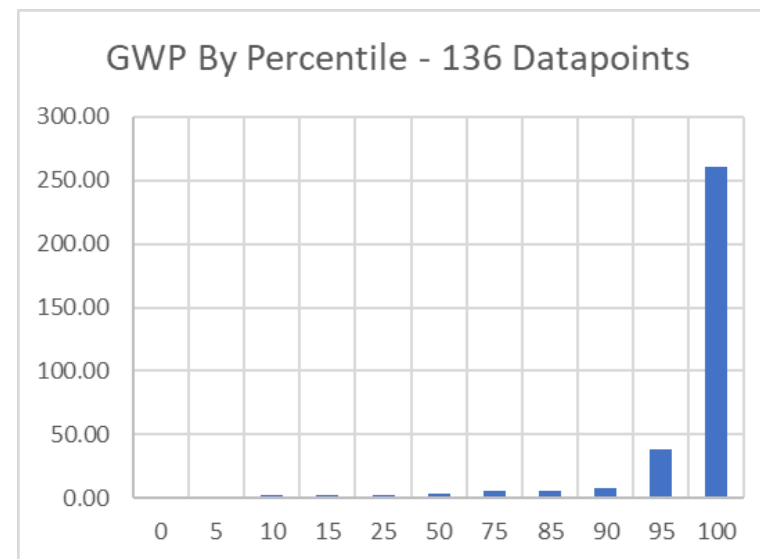
Mean (5 to 95 percentile)	Mean (10 to 90 percentile)	Mean (15 to 85 percentile)	Mean (20 to 80 percentile)
4.3	3.7	3.6	3.6

Average of percentile 10 and 90
4.8

# Adding Value to the Data

- Stats have always been in the ICE DB, but were not encouraged to be used due to the averages being influenced too much by poor studies and anomalies (e.g. unusually high or low values)
- However, with poor quality data being identified before data extraction and with more standard measurement methods (e.g. EN 15804), stats could now play an important role
- Possible: Trim the top and bottom values, to provide a more representative average embodied carbon. Values settle around mean 10-90 percentiles (e.g. trim top and bottom 10%)

Mean (5 to 95 percentile)	Mean (10 to 90 percentile)	Mean (15 to 85 percentile)	Mean (20 to 80 percentile)
4.3	3.7	3.6	3.6



# Adding Value to the Data – Concrete

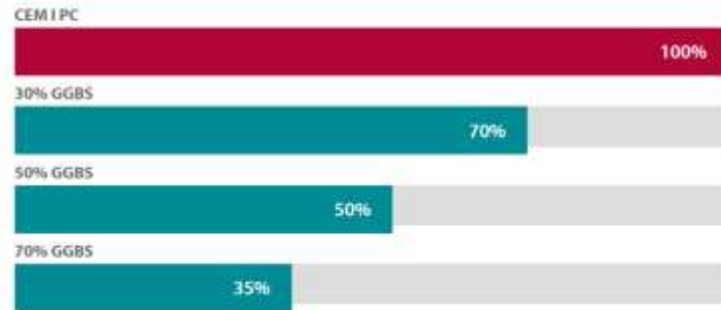
- Currently focussing on curing times, which I think would add good value to the data
- The embodied carbon of concrete is dominated by cement.
  - Cement is on average only 12% of the concrete mixture
  - But it is typically 80% or more of the embodied carbon
- Low carbon cement replacements, e.g. GGBS, PFA (fly ash), require longer to cure than concrete
- As a consequence more cementitious material is added when using GGBS or PFA
  - e.g. A concrete is using 300 kg pure cement per m<sup>3</sup>.
  - A 50% ggbs content concrete would not be 150kg cement and 150kg GGBS.
  - Total cementitious content would be increased above 300kg total.
  - Cementitious content could go up 10-30%



# Adding Value to the Data – Concrete Curing

Relative strength development of concrete with different cement types

At 7 Days



At 28 Days



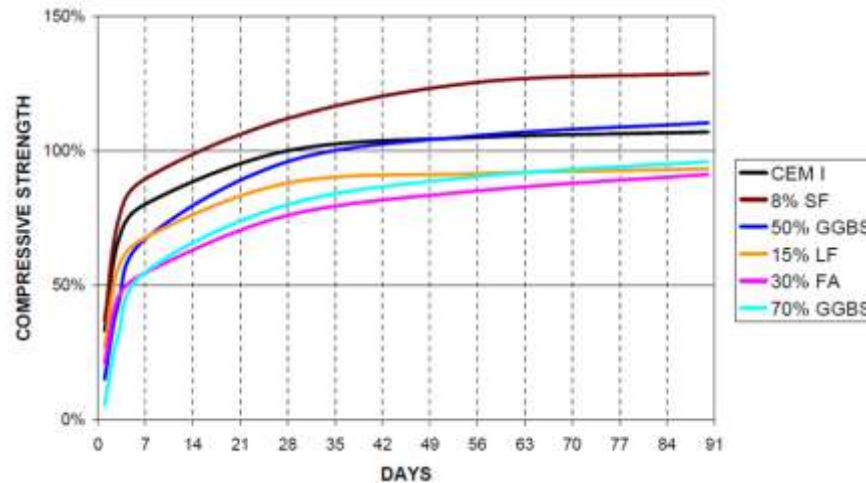
At 56 Days



• Above chart from <https://ukcsma.co.uk/ggbs-concrete/>

# Adding Value to the Data – Concrete Curing

• Below chart from Richard Barnes, Concrete Association



- Found a paper (“Fly ash in Concrete - Enhanced Durability For Sustainable Construction”) that suggests specifying 56 day concrete strength instead of 28 days reduces embodied carbon of 30% PFA concrete by a further 6-7% (total saving 26-29%) versus a CEM I concrete
- Moving to 56 day specifications unlikely to be easy (e.g. different schedule of works), but likely a larger saving of not specifying short times, e.g. 3 day or 7 day concrete strength
- Depends upon the project on what is feasible

# Next Steps

- Current focus on producing draft results for key infrastructure construction materials:
  - Concrete (and constituents)
  - Steel
  - Asphalt and bitumen (e.g. for road surfaces)
- Remaining materials target for drafts in Dec
- Beta version sent to interested stakeholders for comments
  - Contact me to be sent a beta version
- Launch final database early 2019 (Q1 2019)