

for

Field Progress | Docs | Integrator | Dashboards

Estimating | Cost Management | Change | Engineering Equipment & Materials | Procurement | Invoice | Contracts

# **Estimating and Reporting Carbon** Capital Projects





## Andrew Langridge Director of Business Development **ARES Software UK Limited** alangridge@aresprism.com

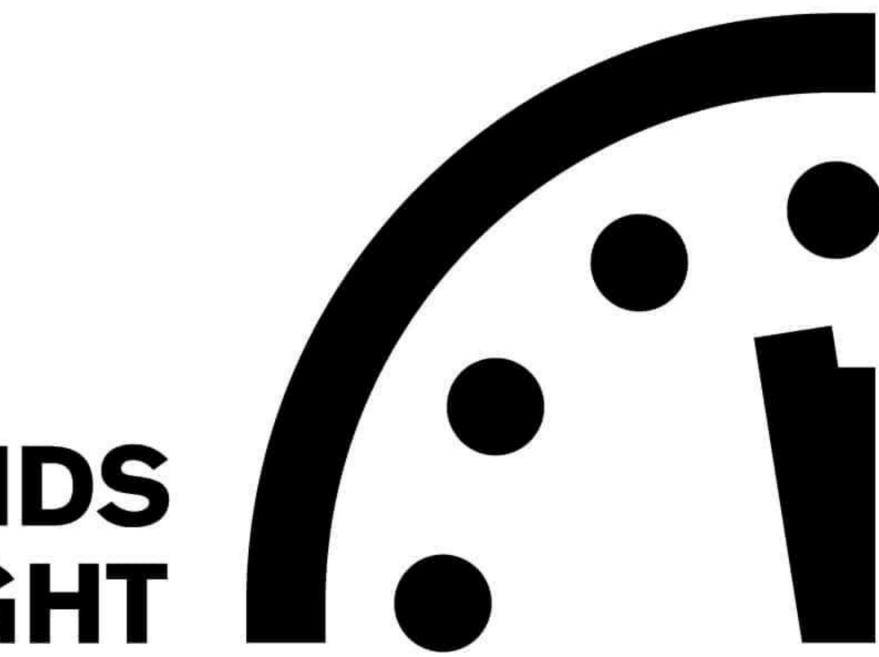
Visiting Professor University of Bath





## 100 Seconds To Midnight

# **IT IS 100 SECONDS**





## Why Is That Important To Us?

**Global construction accounts for** about 38% of total global emissions, with buildings equivalent to the size of Paris being built every week.

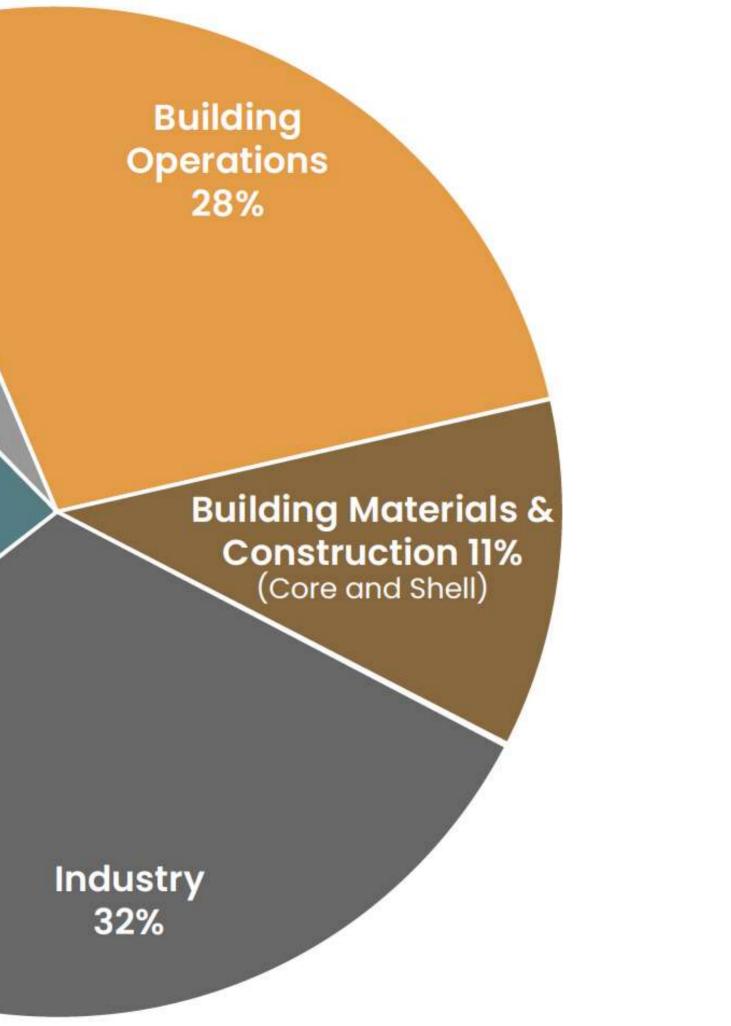


## CO2 By Sector

Transportation 23%

Other 6%

Source: Global Alliance for Buildings and Constructions. 2018 GLOBAL STATUS REPORT.





## Whole Life Carbon Vision

## Whole Life Carbon Vision

### 2050

New buildings, infrastructure and renovations will have **net zero embodied carbon**, and all buildings, including existing buildings, must be **net zero operational carbon**.

### Net Zero Operational Carbon

### Definition

A net zero carbon building is highly energy efficient with all remaining energy from onsite and/or offsite renewable sources

### **Guiding Principles**

### 1. Measure and disclose carbon

Carbon is the ultimate metric to track, and buildings must achieve an annual operational net zero carbon emissions balance based on metered data

- Reduce energy demand Prioritise energy efficiency to ensure that buildings are performing as efficiently as possible, and not wasting energy
- Generate balance from renewables Supply remaining demand from renewable energy sources, preferably on-site followed by off-site, or from offsets
- Improve verification and rigour Over time, progress to include embodied carbon and other impact areas such as zero water and zero waste

Net Zero Carbon Buildings Commitment All buildings within direct control to operate at net zero carbon by 2030

**x** + 7

Net Zero Opertational Carbor

### 2030

TIT

New buildings, infrastructure and renovations will have at least 40% less embodied carbon with significant upfront carbon reduction, and all new buildings must be net zero operational carbon.

> et Zero imbodied C

### Net Zero Embodied Carbon

### Definition

A net zero embodied carbon building (new or renovated) or infrastructure asset is highly resource efficient with upfront carbon minimised to the greatest extent possible and all remaining embodied carbon reduced or, as a last resort, offset in order to achieve net zero across the lifecycle.

### **Guiding Principles**

### 1. Prevent

Avoid embodied carbon from the outset by considering alternative strategies to deliver the desired function

### 2. Reduce and optimise

Evaluate each design choice in terms of the upfront carbon reductions and as part of a whole lifecycle approach

### 3. Plan for the future

Take steps to avoid future embodied carbon during and at end of life

### 4. Offset

As a last resort, offset residual embodied carbon emissions within the project or organisational boundary where possible or if necessary through verified offset schemes

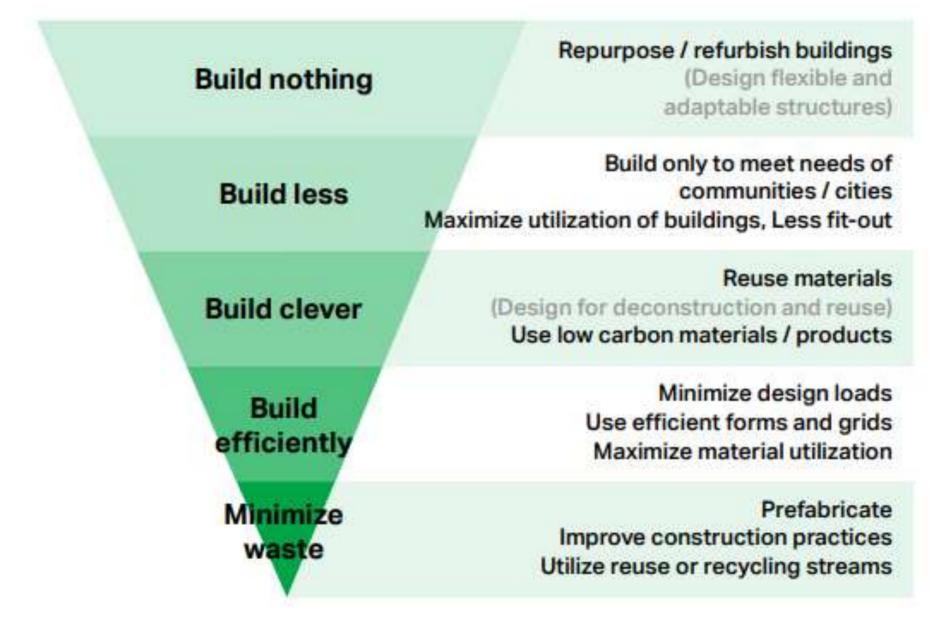
Source: World Green Building Council

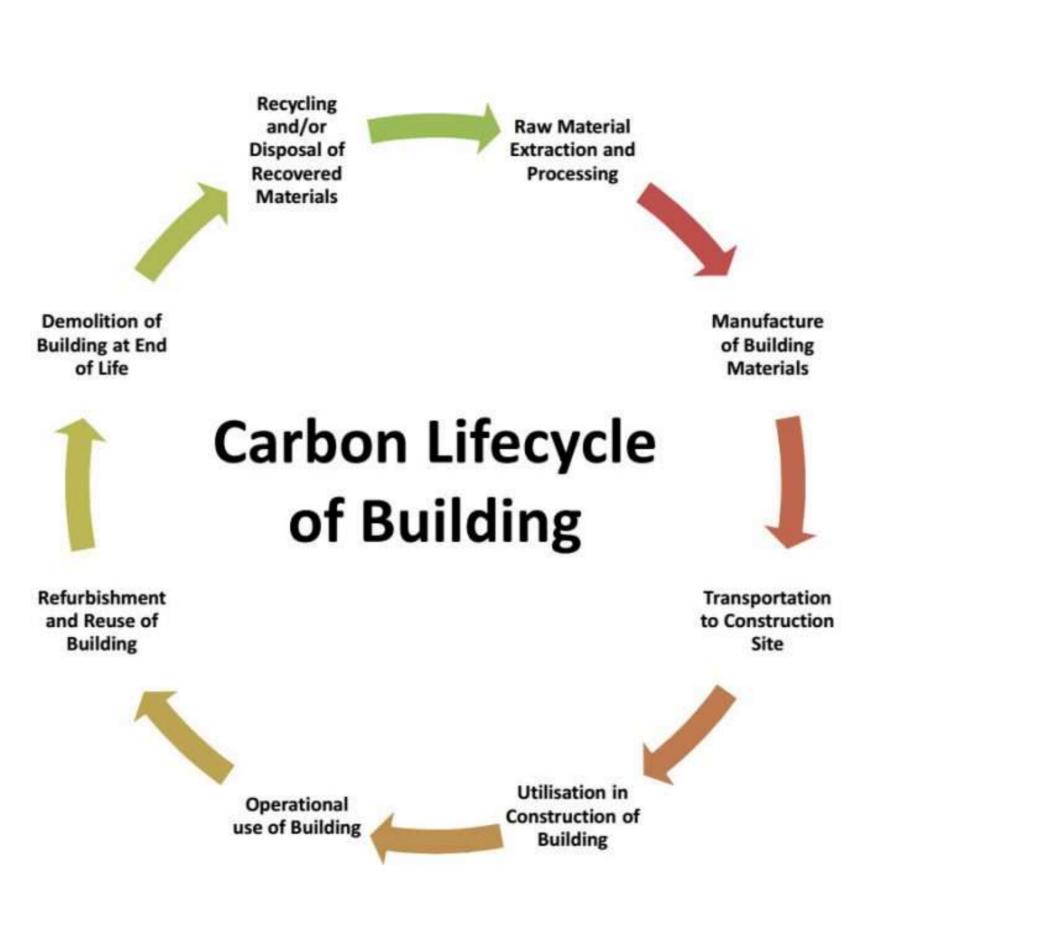


## Multiple Climate Change Initiatives

More Countries Passing Net Zero Legislation

### **Embodied carbon Reduction Strategy**





Source: World Business Council for Sustainable Development



## Standards – PAS 2080

Following the Infrastructure Carbon Review in 2013 it was identified that infrastructure is responsible for over 50% of the UK's carbon emissions therefore PAS 2080 was designed to specifically address the management of carbon in infrastructure.

# PAS 2080 Carbon Management in Infrastructure Verification

It looks at the whole life cycle of the carbon used on projects and promotes reduced carbon, reduced cost infrastructure delivery and a culture of challenge in the infrastructure value chain where innovation can be fostered.







- Cost and Carbon are not directly related
  - (its not a ratio)
- Whole life carbon is a function of
  - Asset delivery (Capex)
  - Asset operation (Opex)
  - Asset lifecycle (disposal, repurposing, recycling, residual)
- Carbon Net Zero is not the same as Zero Carbon
- We need to keep global warming under 2 degrees





## The Role of Estimation



## Challenge – Generate Whole Life Cost & Carbon Estimates

### CAPEX (PAS 2080 A1 – A5)

• At element level allow Cost and Carbon visibility at element/component level an support

- Material substitution to see effect on cost and carbon
- Impact of transport for:
  - Material
  - Labour
  - Equipment
- Site fuel costs
- Support full estimate life cycle
  - Early day / budget setting
  - Optioneering and design
  - Target cost and negotiation

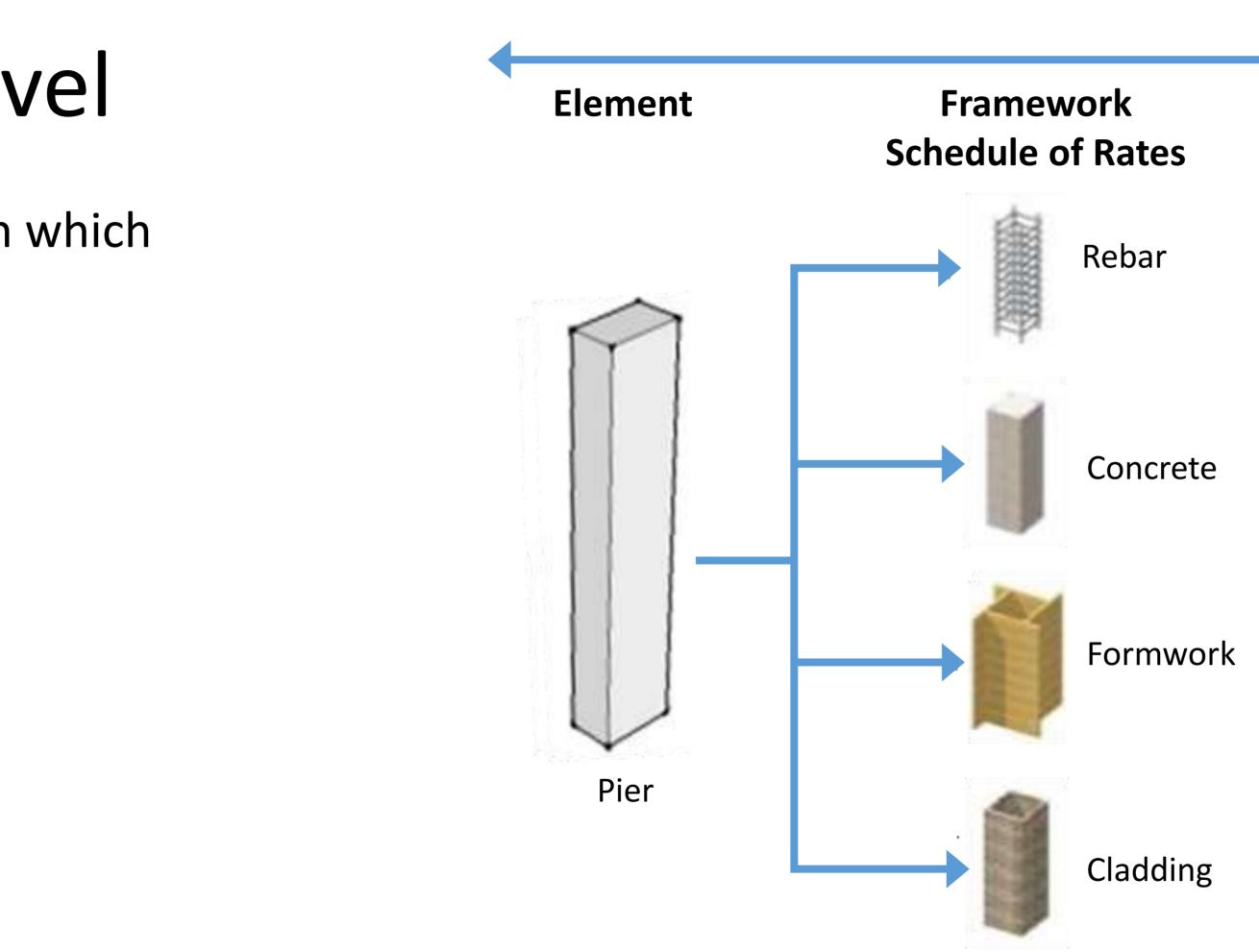
### Opex and end of life (PAS 2080 B, C and D)

- At asset level forecast cost and carbon for:
  - Operation
  - Repair and replace
  - Demolition
  - Residue carbon
- Also look at:
  - Circular economy
  - Repurposing
  - Links to asset management
  - Condition based monitoring and maintenance

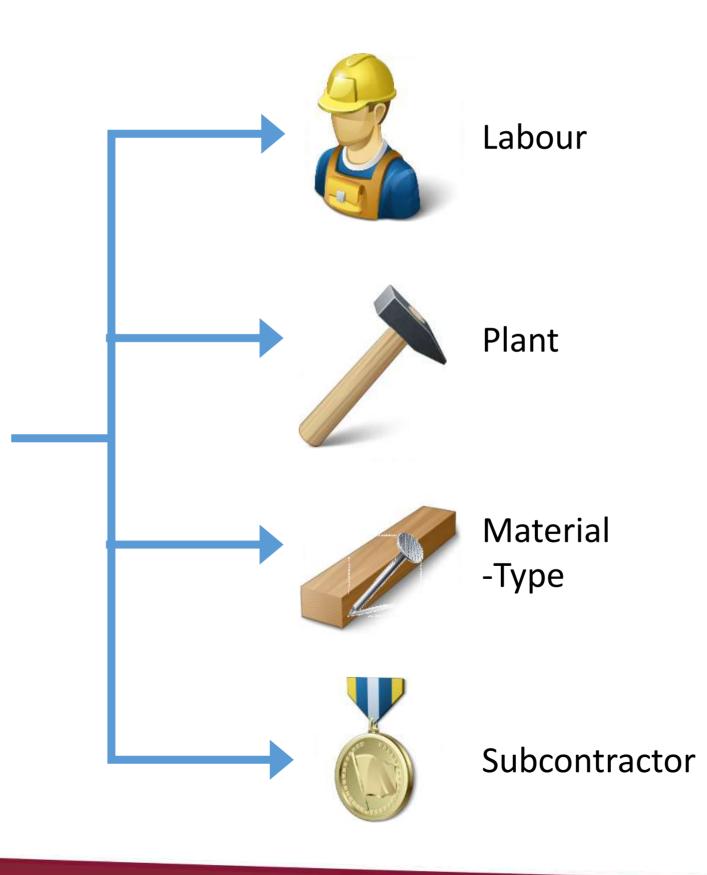


## Carbon At Resource Level

Planning Activity Structure – Asset Screen which contains:



## Framework Schedule of resource rates



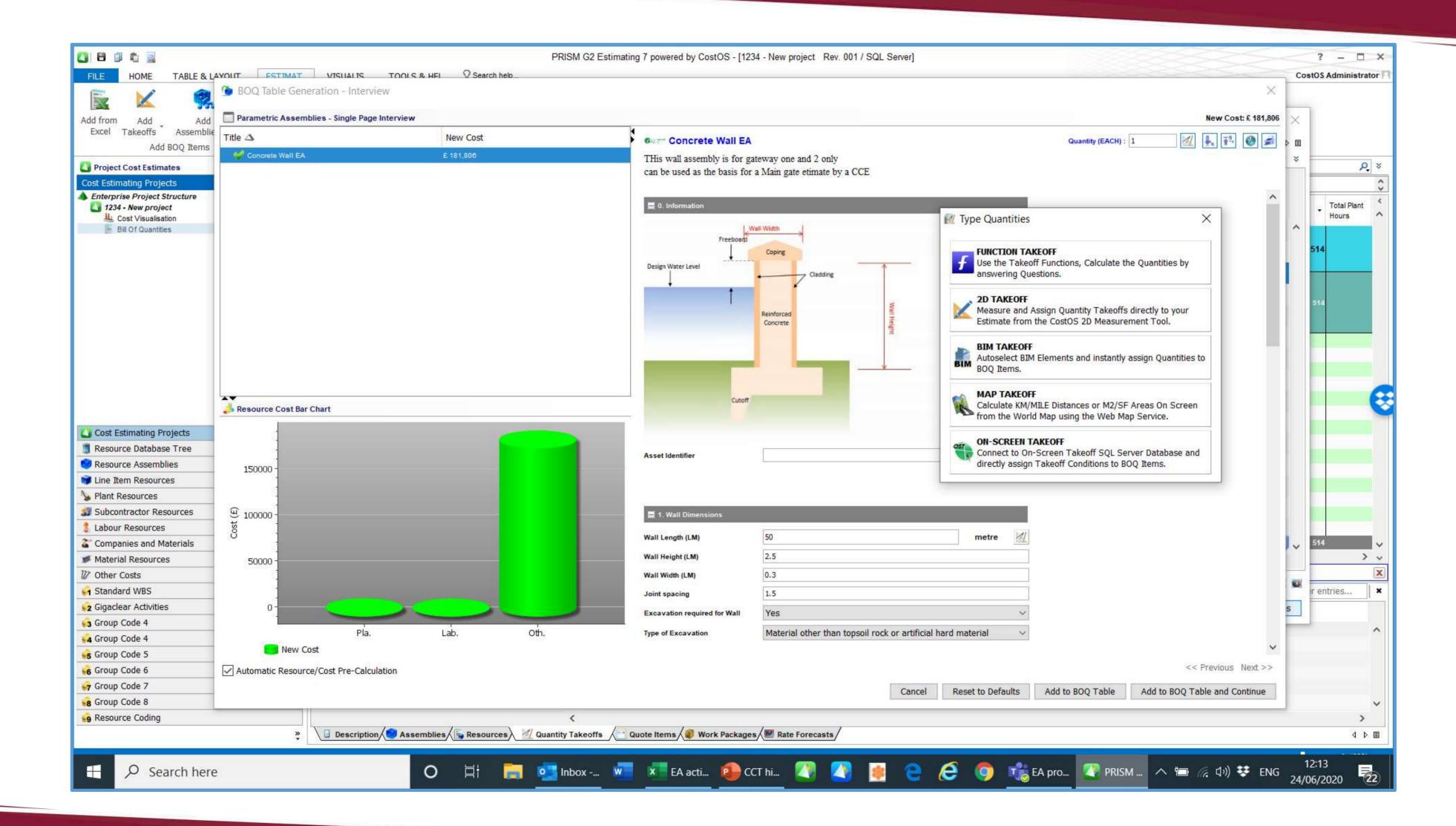


## Example Bill of Quantities with Carbon

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Concrete Wall - Simpe no takeoff	[DESCRIPTION] CLASS G: CONCRETE ANCILLARIES / JOINTS / Formed surface	1	. £ 181,806	236	0	33	134	48 9	. 0.12	
ne 0.5m; 25mm Flexcell joint filler	CLASS G: CONCRETE ANCILLARIES / JOINTS / Formed surface with filler; average width / ne 0.5m; 25mm Flexcell joint filler	2	2. £ 193	0	0	0	0	0 (	0 0	
🚡 150 - 300 mm	CLASS F: IN SITU CONCRETE / PLACING OF CONCRETE; REINFORCED / Walls; thickness / 150 - 300 mm	38	8 £ 1,928	0	0	o	o	0 (	0 0	
🚡 on horizontal or vertical surfaces	CLASS W: WATERPROOFING / SPRAYED OR BRUSHED WATERPROOFING / Two coats RIW liquid asphaltic composition on horizontal or vertical surfaces	/ 12	5 £ 11,114	o	o	o	o	0	o o	
- 🚡 20 mm aggregate	CLASS F: IN SITU CONCRETE / PROVISION OF CONCRETE / Designated Concrete / Grade C30 / 20 mm aggregate	34	8 £ 4,736	125	0	12	80	33 (	0 0	
	CLASS E: EARTHWORKS / FILLING / Excavated topsoil; DfT specified type 5A / Filling	44	4 £ 0	16	0	16	o	0 (	0.0757	
🚡 16 mm nominal size	CLASS G: CONCRETE ANCILLARIES / REINFORCEMENT / Deformed high yield steel bars to BS 4449 / Bars; supplied in ben and cut lengths / 16 mm nominal size	t 10	0 £ 17,933	o	0	o	o	0 0	0 0	
🛐 E.04.01.01	CLASS E: EARTHWORKS / FILLING ANCILLARIES / Trimming of filled surfaces / Topsoil	61	8 £ 0	66	0	0	54	12 (	0.0443	
🚡 exceeding 1.22 m	CLASS G: CONCRETE ANCILLARIES / FORMWORK; EXTRA SMOOTH FINISH / Plane vertical, width / exceeding 1.22 m	250	0 £ 25,348	14	0	5.	0	0 9	. 0	
Elinding; 100 mm thick	CLASS S: RAIL TRACK / TRACK FOUNDATIONS / Imported sand Blinding; 100 mm thick	4	1 £ 1,570	3.	o	o	o	3. (	0 0	
🚽 👼 25 x 20 mm	CLASS G: CONCRETE ANCILLARIES / JOINTS / Polysulphide sealant; gun grade / Sealed rebates or grooves / 25 x 20 mm	8:	3 £ 407	0	o	0	0	0	o	
76 mm diameter tubular handrail, 48 mm diameter standards at 750 mm centres, 48 mm diameter middle rail, 1070 mm high overall	CLASS N: MISCELLANEOUS METALWORK / MILD STEEL / Mild steel; galvanised / Handrails / 76 mm diameter tubular handrail, 4 mm diameter standards at 750 mm centres, 48 mm diameter middle rail, 1070 mm high overall		0 £ 7,172	0	o	o	o	0	o o	
📗 Soil Nailing - 3m deep	Soil Nailing - 3m deep	(	0 £ 0	0	0	0	0	0 (	0	
🚡 10 mm nominal size	CLASS G: CONCRETE ANCILLARIES / REINFORCEMENT / Deformed high yield steel bars to BS 4449 / Bars; supplied in ben and cut lengths / 10 mm nominal size	t 10	0 £ 18,967	0	o	o	0	0	0 0	
🚡 25 mm nominal size	CLASS G: CONCRETE ANCILLARIES / REINFORCEMENT / Deformed high yield steel bars to BS 4449 / Bars; supplied in ben and cut lengths / 25 mm nominal size	t 10	0 £ 14,935	12	0	o	o	0 0	0 0	
🚡 32 mm nominal size	CLASS G: CONCRETE ANCILLARIES / REINFORCEMENT / Deformed high yield steel bars to BS 4449 / Bars; supplied in ben and cut lengths / 32 mm nominal size	t 10	0 £ 14,935	0	0	0	0	0	0 0	
🛐 Topsoil	CLASS E: EARTHWORKS / FILLING ANCILLARIES / Preparation filled surfaces / Topsoil	of 68	8 £ 284	0	o	0	0	0	0 0	
🚡 12 mm nominal size	CLASS G: CONCRETE ANCILLARIES / REINFORCEMENT / Deformed high yield steel bars to BS 4449 / Bars; supplied in ben and cut lengths / 12 mm nominal size	t 10	0 £ 18,967	0	o	o	o	0 0	0 0	
Totals			£ 181,806 ∢	263 ▷ 🗉 🕴 <	0	33	134	48 9	. 27	
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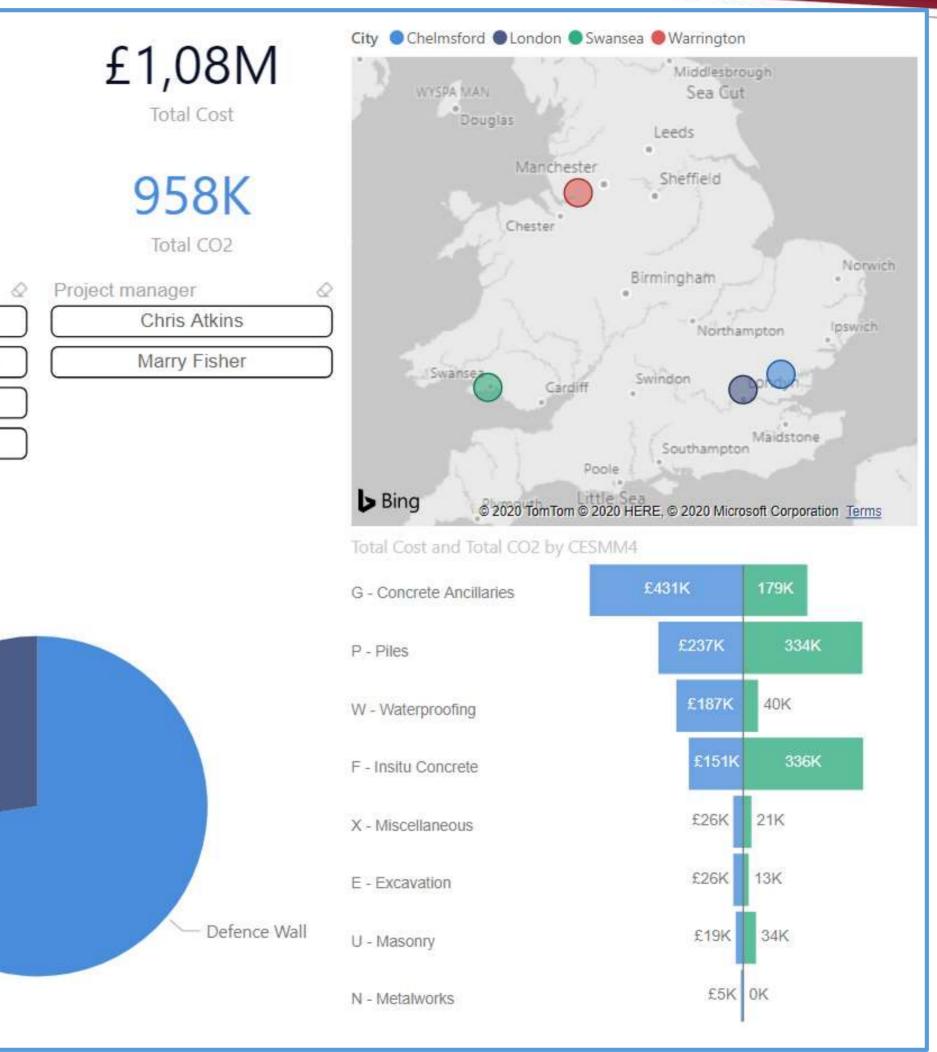
## Takeoff Linked to Assemblies





## Project by Region – Cost and Carbon

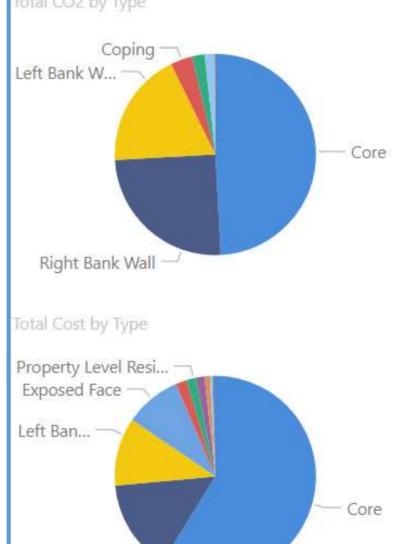
Brynmill Park Wall	Marry Fisher	Construction	£1,16M
Project name	Project manager	Stage	
Swansea	4 Brynmill Terrace	SA2 0BA	Budget
City	Street	Post code	
£295 000,00	£261 701,00	£33 299,00	10V
Budget	Total Cost	Profit	
Mornga Sindall	Mott MacDonald	168 945	£78,19K
Contractor	Designer	Total CO2	Profit
Hornsey Refurbish	Chris Atkins	Handover	Project name
Project name	Project manager	Stage	Brynmill Park Wall
London	22 Chadwell Ln	N8 7RB	Hornsey Refurbishmen
City	Street	Post code	
£120 000,00	£148 355,00	- <mark>£28 355,00</mark>	River Can Upgrade
Budget	Total Cost	Profit	Sankey Brook
Skanska	Arup	209 344	Cunicoy Brook
Contractor	Designer	Total CO2	
River Can Upgrade	Chris Atkins	Pre-construction	Total Cost by Asset Type
Project name	Project manager	Stage	
Chelmsford	44-55 Andrews Pl	CM1 2QY	
City	Street	Post code	
£300 000,00	£261 701,00	£38 299,00	Debris Screen
Budget	Total Cost	Profit	
Costain	AECOM	173 408	
Contractor	Designer	Total CO2	
Sankey Brook	Marry Fisher	Construction	
Project name	Project manager	Stage	
Warrington	11 Lilford Ave	WA5 0BE	
City	Street	Post code	
£445 000,00	£410 056,00	£34 944,00	
Budget	Total Cost	Profit	
Skanska	Arcadis	406 163	
Contractor	Designer	Total CO2	

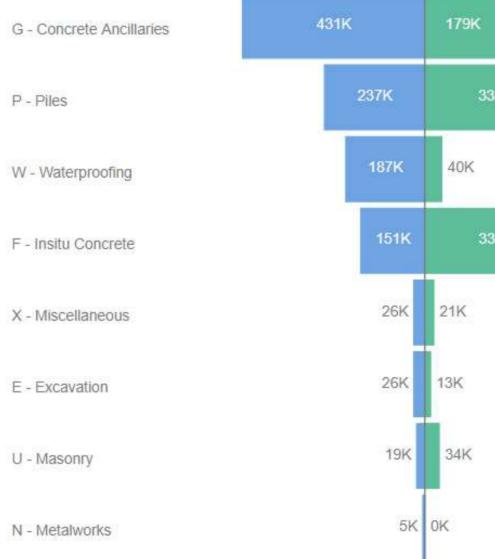




## Cost and Carbon by Type

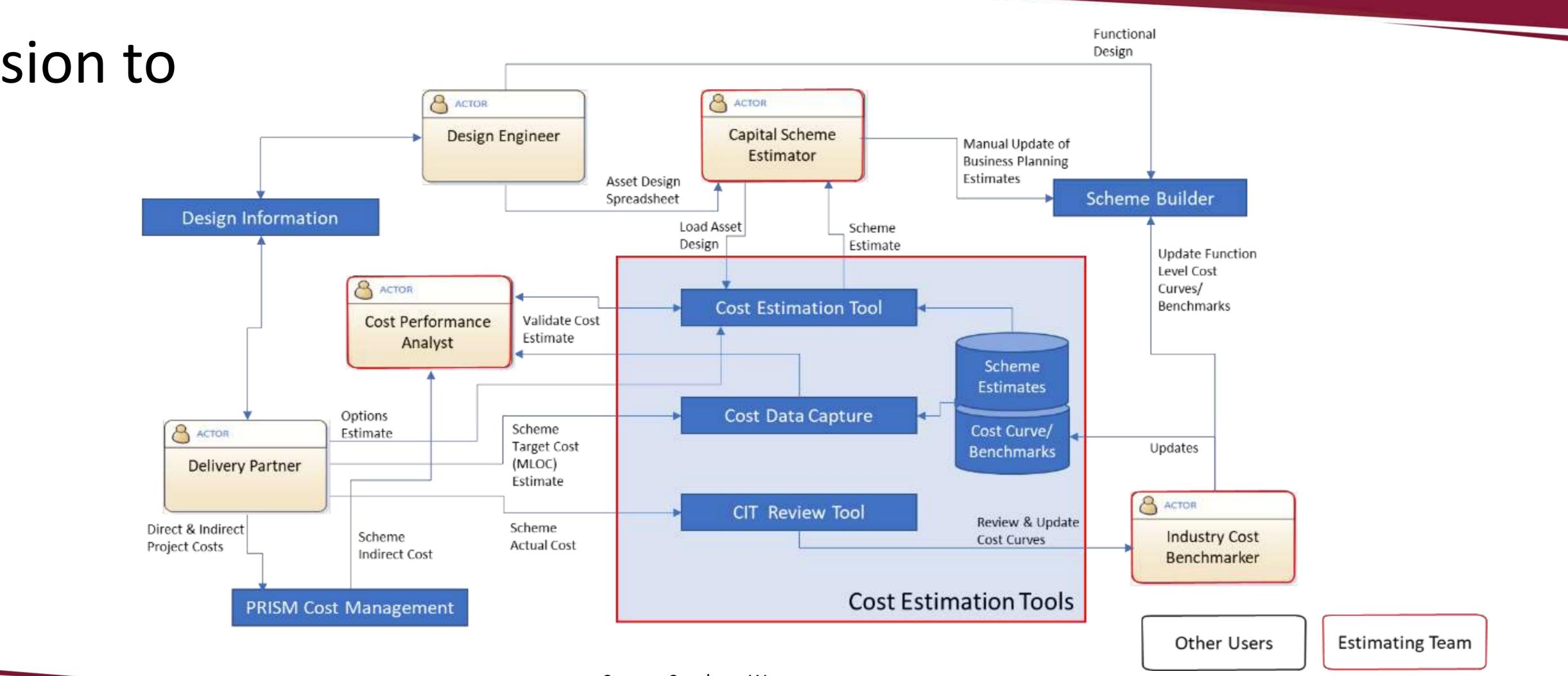
Asset Location	Asset Type	EA DRL Group	Title		Quantity	Unit	Rate	Total Cost	A1-A3	Transport (km)	A4	Wastage %	A5	Total kgCO2e
Chelmsford	Defence Wall	Core	Disposal of Excavated Material		126,58	M3	17,21	2 178,92	0,00	150	3 323,20	0,05	0,00	3 323,20
Chelmsford	Defence Wall	Core	Excavate material other than topsoil, rock or a	artificial hard material	126,58	M3	3,40	430,82	0,00	0	0,00	0,00	0,00	0,00
Chelmsford	Defence Wall	Core	Excavate topsoil		105,44	M3	0,62	65,49	0,00	0	0,00	0,00	0,00	0,00
Chelmsford	Defence Wall	Core	Formwork: plane vertical: 0.4-1.22		1 265,24	M2	38,04	48 125,65	6 199,66	300	602,32	0,05	309,98	7 111,96
Chelmsford	Defence Wall	Property Level Resilience	Gabion Wall: Placed on river bank above wate mesh 80mm; random filled by hand with brok character; average mass 2 - 10kg; Size: 2 x 1 x	ken rock of cubic	33,00	EACH	169,84	5 604,65	221,43	300	7 925,39	0,05	11,07	8 157,89
Chelmsford	Defence Wall	Coping	Parapet copings		210,87	LM	30 <mark>,</mark> 23	6 375,10	9 137,11	175	2 0 <mark>45,</mark> 26	0,01	91 <mark>,</mark> 37	11 273,74
Chelmsford	Defence Wall	Core	Placing concrete: reinforced: bases : 300 mm		126,52	M3	27,93	3 534,06	0,00	0	0,00	0,00	0,00	0,00
Chelmsford	Defence Wall	Core	Placing concrete: reinforced: walls : 250 mm		158,15	M3	33,52	5 301,09	0,00	0	0,00	0,00	0,00	0,00
Total					24 028,91		15 042,26	1 081 812,32	711 639,45	12995	189 542,23	1	56 678,50	957 860,18
otal CO2 by Ty	ype		Total Cost and Total CO2 by CESMM4											
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Right Bank otal Cost by Ty Property Level Exposed Face Left Ban	ype Resi —	Core	W - Waterproofing F - Insitu Concrete X - Miscellaneous E - Excavation	187K 151K 26K 1	40К 336К 21К 3К			A1 - A5 T 71 A1 - A3 Emi 189 A4 Trans	otal (kgCO2 1,64k bodied (kgC0 9,54k	e) D2e) As	Bing 2020 TomTo sset Location Cheln	Cardiff om © 2020 HERE,	rmingham Nor windon © 2020 Micro Sw	thampton







## Carbon is Natural Extension to Cost Intelligence



Source: Southern Water

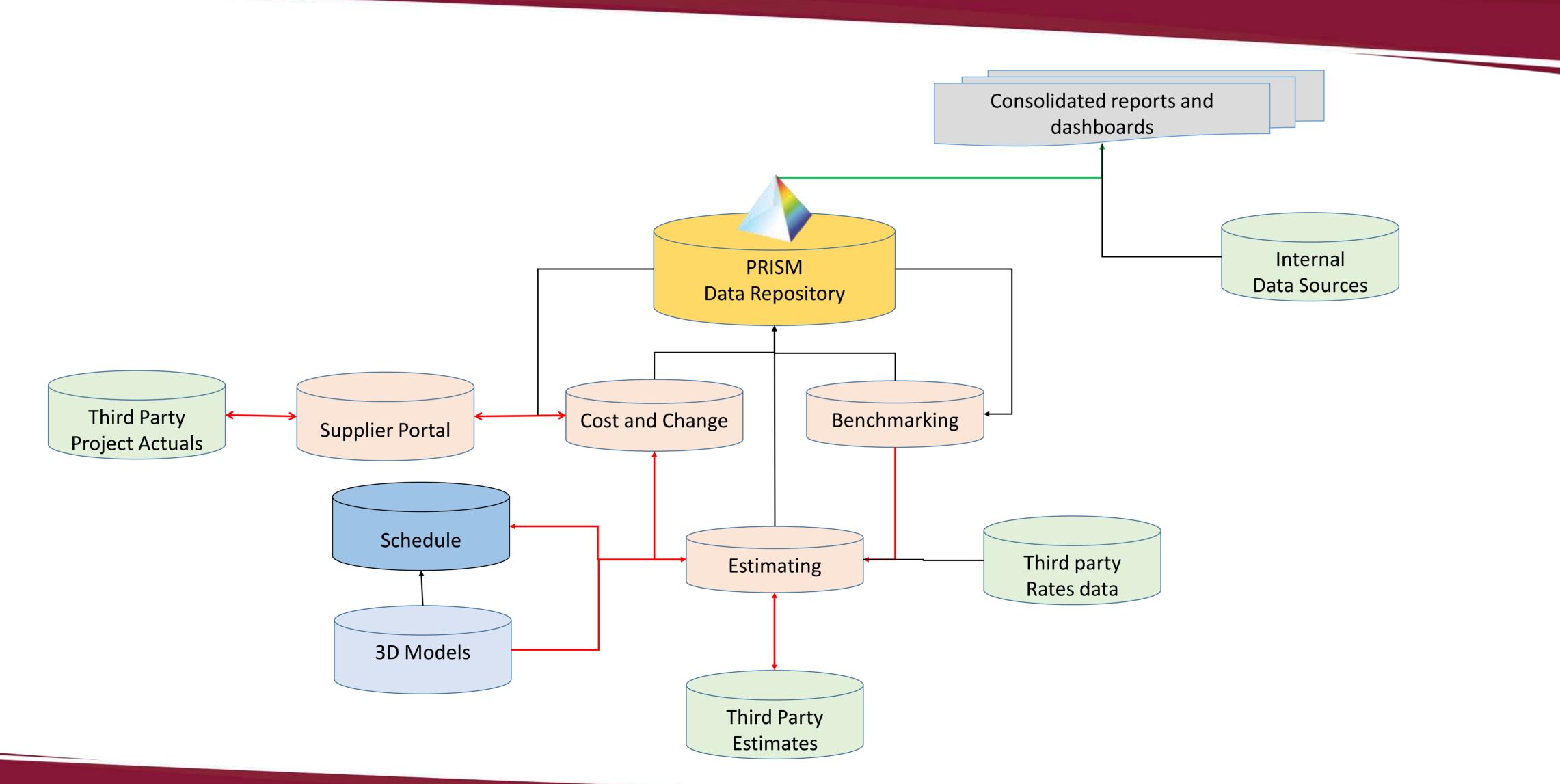




## The Role of Project Controls



## Common Data Environment





## Capture Actual Carbon and Cost

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	A4 MAT	Carbon	Transport Mat		Q			
	A4 LAB	Carbon	Transport Lab		Q			
	A4 EQU	Carbon	Transport Equ		Q			
	A5 SIT	Carbon	Site Usage		Q			

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rs	Cost	TP Quantity	TP Hours	TP Cost	Period Actuals	Actuals History	ETC Detail	Commitments	Chan

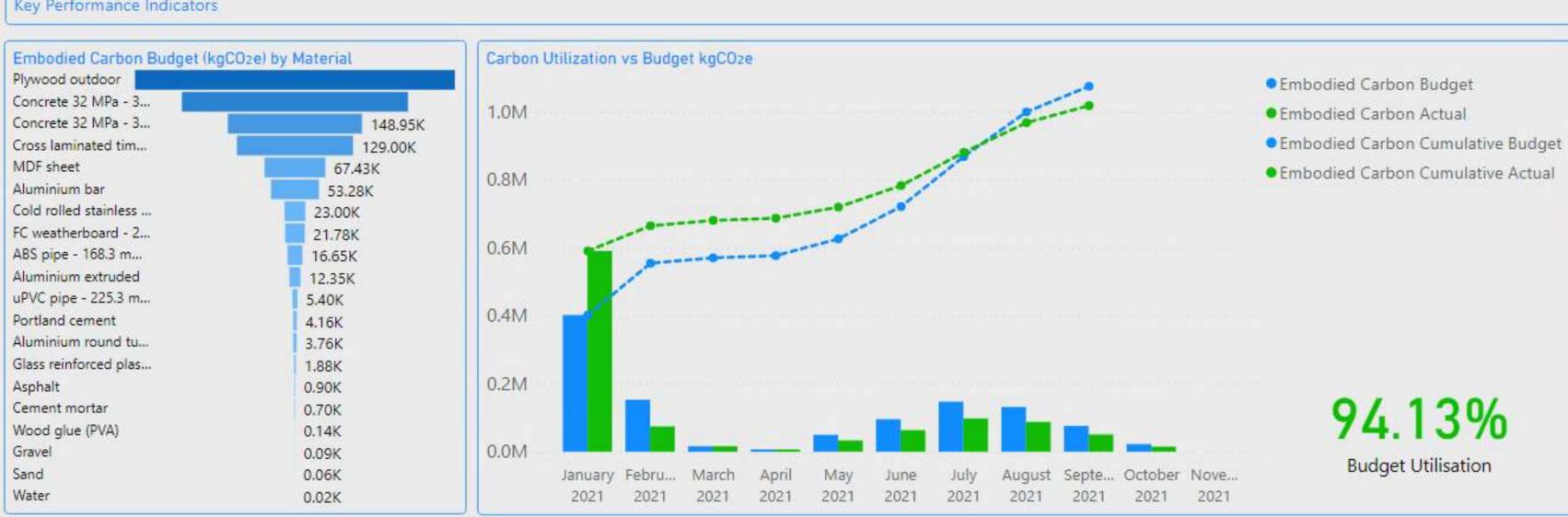


## Carbon Tracking From Cradle to Grave



### What is driving performance?

### Key Performance Indicators



Reporting Period	Lead Organisation	Category	Material	BUDGET Functional	unit Embodied Carbon Budget Utilisation	Embodied Carbon Actual Utilisation	Variance
March 2021	Narnia Inspections	Plastics	ABS pipe - 168.3 mm outer dia., 7.7 mm thick	178 m	11859.462 kgCO₂e	11859.462 kgCO2e	0.00
April 2021	Narnia Inspections	Plastics	ABS pipe - 168.3 mm outer dia., 7.7 mm thick	72 m	4790.538 kgCO2e	4790.538 kgCO2e	0.00
May 2021	Parent Company	Metals	Aluminium bar	171 kg	5053.904 kgCO2e	4913.6 kgCO₂e	-140.30
June 2021	Parent Company	Metals	Aluminium bar	329 kg	9734.848 kgCO2e	9464.304 kgCO2e	-270.54
July 2021	Parent Company	Metals	Aluminium bar	508 kg	15037.984 kgCO2e	14620.328 kgCO2e	-417.66
August 2021	Parent Company	Metals	Aluminium bar	454 kg	13444.32 kgCO2e	13071.064 kgCO2e	-373.26
September 2021	Parent Company	Metals	Aluminium bar	262 kg	7743.064 kgCO₂e	7527.872 kgCO2e	-215.19
October 2021	Parent Company	Metals	Aluminium bar	77 kg	2265.88 kgCO2e	2202.832 kgCO2e	-63.05
May 2021	Parent Company	Metals	Aluminium extruded	40 kg	1171.296 kgCO2e	390.432 kgCO2e	-780.86
June 2021	Parent Company	Metals	Aluminium extruded	77 kg	2255.862 kgCO2e	751.758 kgCO₂e	-1,504.10
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### Last Refresh 19/10/2021 14:49:32





## The Role of Benchmarking



## Key Strengths of Benchmarking

- Integrated with Estimating and Cost Management
  - Estimate to estimate
  - Estimate + scope change to actuals
- Import external data to benchmark against
  - Multiple benchmarking portfolios
  - Multiple coding capability
- Normalise using indices, location factors, currency conversion
- Generate cost analyses, benchmarks and plot charts
- Feed new benchmarks back into the cost and carbon intelligence environment to improve



## Where Can We Benchmark?



Asset- "Screen"

Element – *"Left Wall, Right Wall, Pier etc."* 

Sub Element – "Foundations, Wall, Capping tec."

Component/Composite – detailed design (BIM Object)

Items – CESMM4 Hybrid

Resources/Complex resources

Enterprise Project Structure - Project

Assembly within A Project

Element within Assembly

Sub Element dependant on Element within Assembly

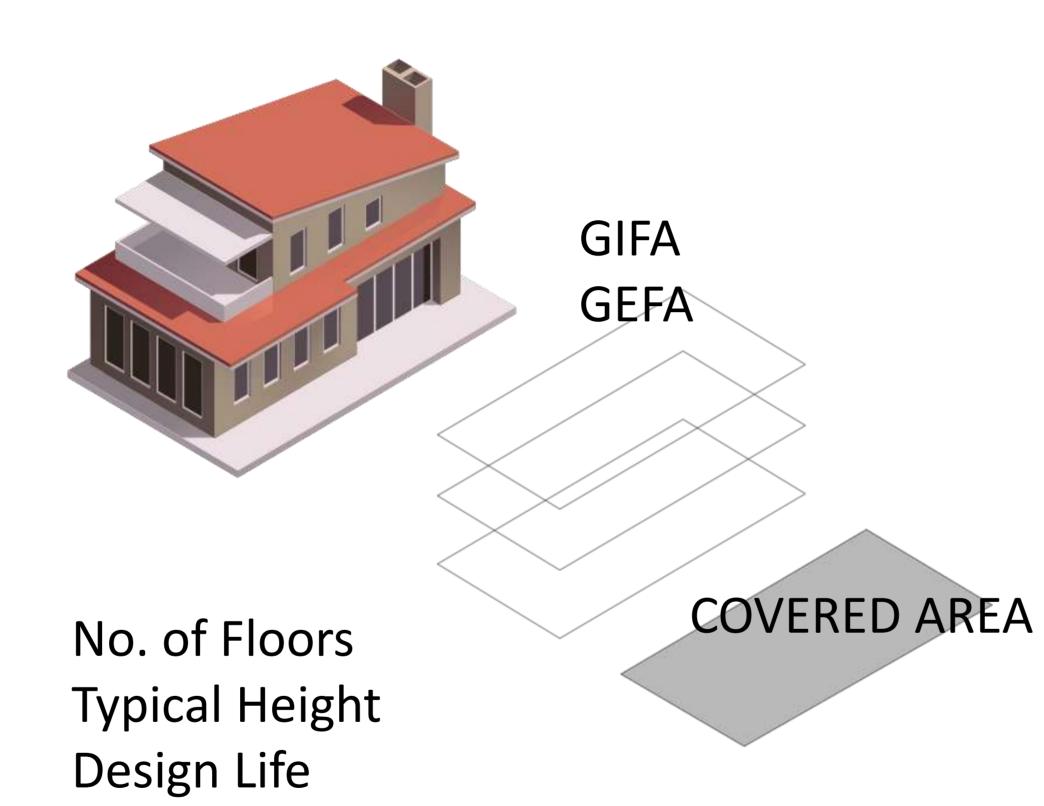
3D Takeoff (2D and GIS Takeoff optional)

Line Item Resources

**Resource Libraries** 



## Project Level Attributes



Site Area

Functional type : Residential Nature: New Build Grade: Medium Quality Environmental Grade: B, Status: Targeted

### **Principal Design Features**

Structural (predominant): concrete External walls (predominant): brick/block Environmental control: air conditioning Degree of prefabrication: less than 25%

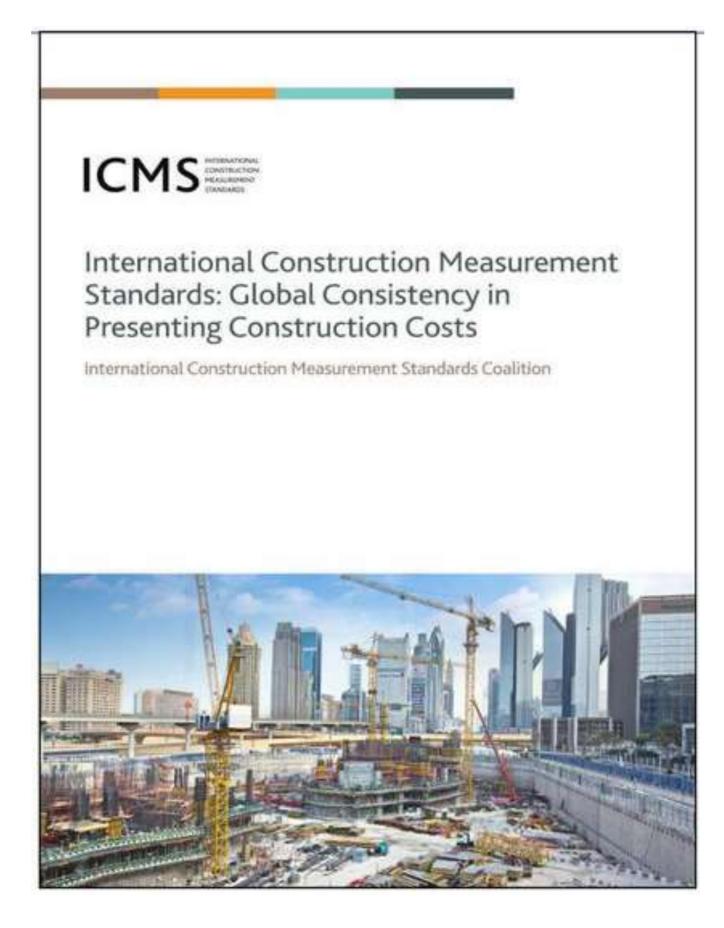
### **Project Complexity**

Shape (on plan): rectangular Design: simple Method of working



## ICMS at COP 26

ICMS is an international standard created to provide organizations with a consistent means of grouping, classifying, and reporting construction and infrastructure project costs. The standards provide categorizations for all the costs associated with a project and is meant to provide consistency across countries and locations.





## Already Receiving Recognition



BCIA Awards 2021 – Finalists for Innovation Projects



## Summary

- We all recognise we have a problem
- We, the Project Controls profession, are in a position to facilitate a change within our industries
- We don't know all the answers but that should not distract us from starting
- We MUST combine Cost and Carbon in all conversations





## Any Questions?



# Stand 10

Meet the ARES PRISM team at

