



# Leveraging Technology for Streamlined Carbon Footprint Analysis from Design to Construction

6<sup>th</sup> Annual CONSTRUCTION EXCELLENCE  
PREFAB, PRECAST, MODULAR BUILDINGS & DIGITAL CONSTRUCTION

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Why am I here today?

I will tell you a story...



1. Current market
2. Digital Engineering role in current market
3. Digital Twin
4. Sustainability
5. AECOM digital solution for Sustainability

## A story about how the market and the clients' requirement are changing

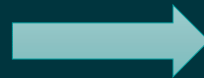
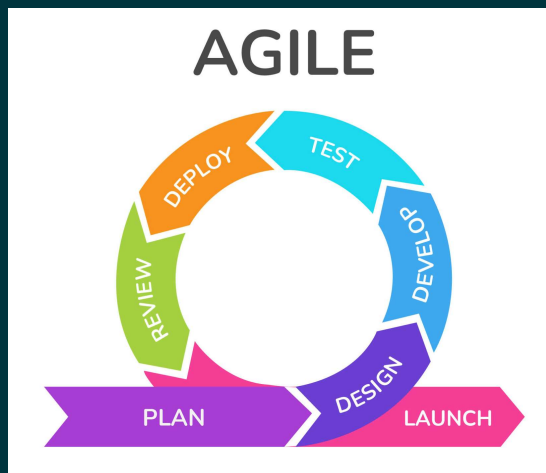


Our industry has changed, and everything is changing quickly and constantly as long as the technology comes out with a new tool

## How can we face these changes: being AGILE

- New tools coming out frequently
- New version of software implementing new features
- Client requirements getting higher and higher

WE NEED TO BE



- Be able to adapt to the changes
- Flexibility
- Multi-disciplinary teams
- Cross-functional teams



## How can we face these changes: being prepared to the change



**Lamborghini Trattori** is an Italian agricultural machinery manufacturer. The company designs and builds tractors. It was founded in 1948 in Cento, Italy by Ferruccio Lamborghini, who later went on to establish Automobili Lamborghini.



**Automobili Lamborghini S.p.A.** is an Italian manufacturer of luxury sports cars and SUVs based in Sant'Agata Bolognese. Ferruccio Lamborghini an Italian manufacturing magnate, founded Automobili Ferruccio Lamborghini S.p.A. in 1963 to compete with Ferrari.

## Digital Engineering role in every project

Project Managers

Design Managers

Discipline Leads



Digital  
Engineering  
people

### TfNSW requirements:

- Higher and higher LOI
- Higher and higher LOD

### Contractor:

- All TfNSW requirements
  - Additional specific requirements

## Main stakeholders and difficulties

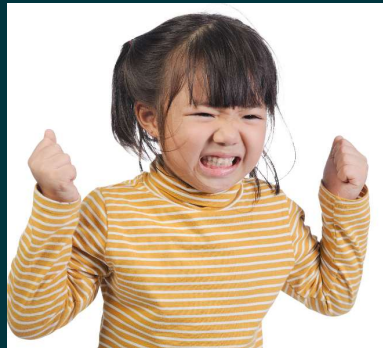
Project Managers

Design Managers

Discipline Leads



We will not do this, it is costing too much



We need to lock off the design, we can't look after digital now

The role of Digital Engineering is to make everyone happy, not only performing the best process/workflow but also to be able to **make it user friendly** and effectively **communicate** the benefits of new technologies to others within the organization

# DIGITAL TWIN: flow of information across the life project cycle

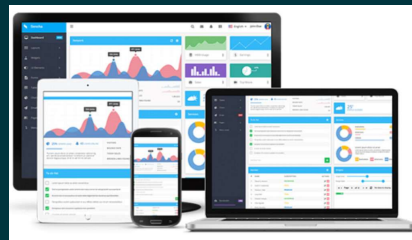
Virtual 3D geometry



Geometry connection with metadata



Connection with 3D



Connection with web platform





# It is not a commercial slogan for private companies anymore...



The screenshot shows the Financial Times website. At the top, there is a navigation bar with the FT logo and a search icon. Below this is a horizontal menu with links to HOME, WORLD, US, COMPANIES, TECH, MARKETS, CLIMATE, OPINION, WORK & CAREERS, LIFE & ARTS, and HTSI. A dark banner below the menu contains the text: "Expert, unbiased reporting from Gaza, Israel and the Middle East. Try the FT's comprehensive coverage for just £1". The main article headline is "US and China agree to boost green energy in climate action 'gesture'", with sub-headlines "Climate Capital" and "US-China relations". A red button labeled "Added" is next to the sub-headline. Below the headline is a summary: "Co-operation viewed as positive sign ahead of COP28 despite lack of commitment on phaseout of fossil fuels". The byline is "Aime Williams in Washington" and the date is "NOVEMBER 16 2023". There are 21 comments and a print icon. At the bottom, there is a promotional banner: "Get ahead with daily markets updates. Join the FT's WhatsApp channel". The article text begins: "The world's two biggest polluters have made a positive 'gesture' to co-operate on climate change, with the US and China agreeing to accelerate the rollout of renewable energy to displace their heavy reliance on fossil fuels."

The two countries backed the key goal of **tripling renewable energy** capacity globally by 2030 to **“accelerate the substitution for coal, oil and gas generation”**.

EXAMPLES OF PRIVATE COMPANIES:



PATAGONIA



APPLE

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## How to achieve net-zero goals...

1. The key to achieving net-zero goals lies in the process of **measuring**
2. But the big question is, how can we **improve carbon emission** unless we measure them?
3. How can we measure carbon emission and keep them **under control**?

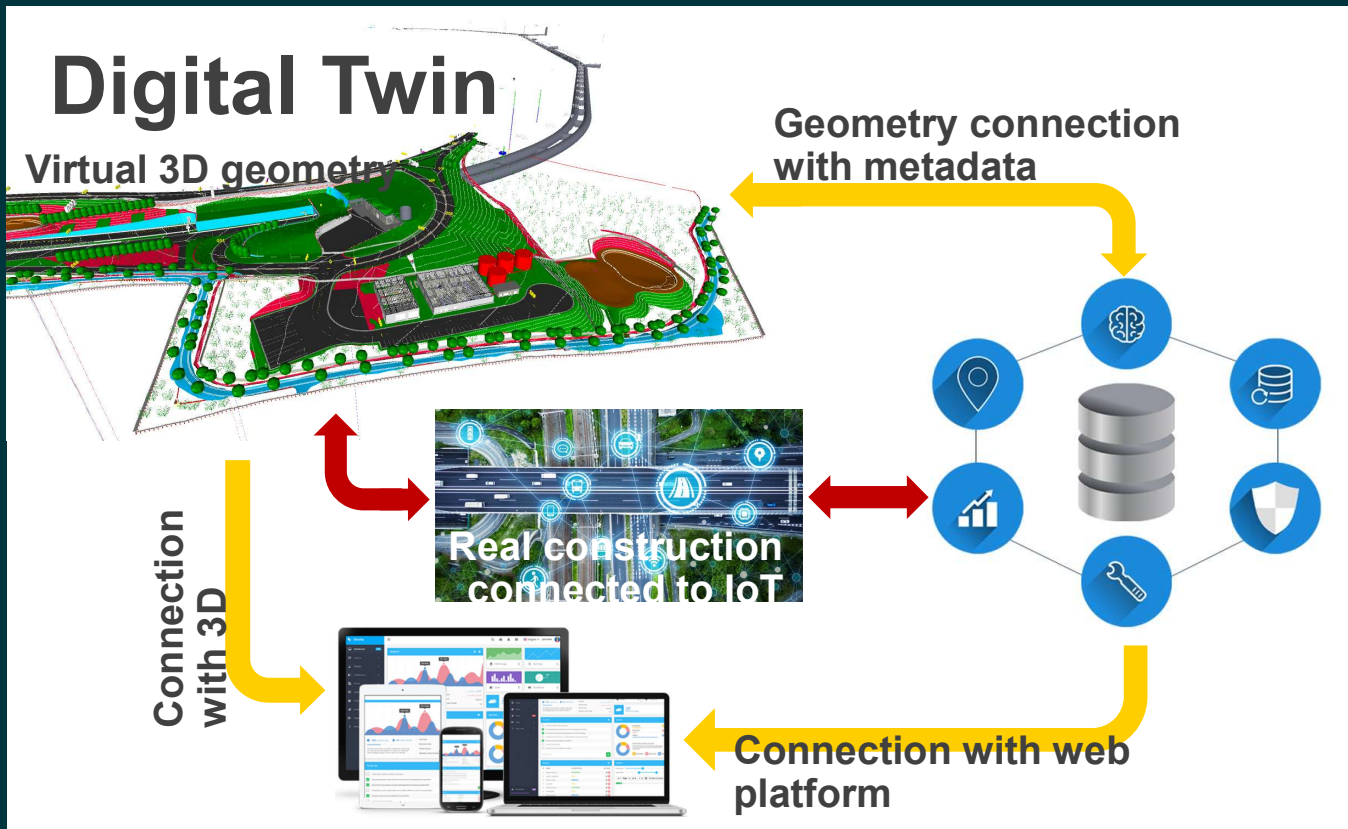
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**Use a technology driven approach to solve the problem**



**We have to unlock Sustainability through Digital Solutions**

## Connecting the dots...



1. Connect **sensors** in a Digital Twin model
2. **Measure** sustainability parameters
3. Leverage **Machine Learning** technology to predict future measurements and act accordingly
4. **Visualize** all information on a user-friendly platform accessible from everyone to emphasize the problem and how we are contributing to solve it

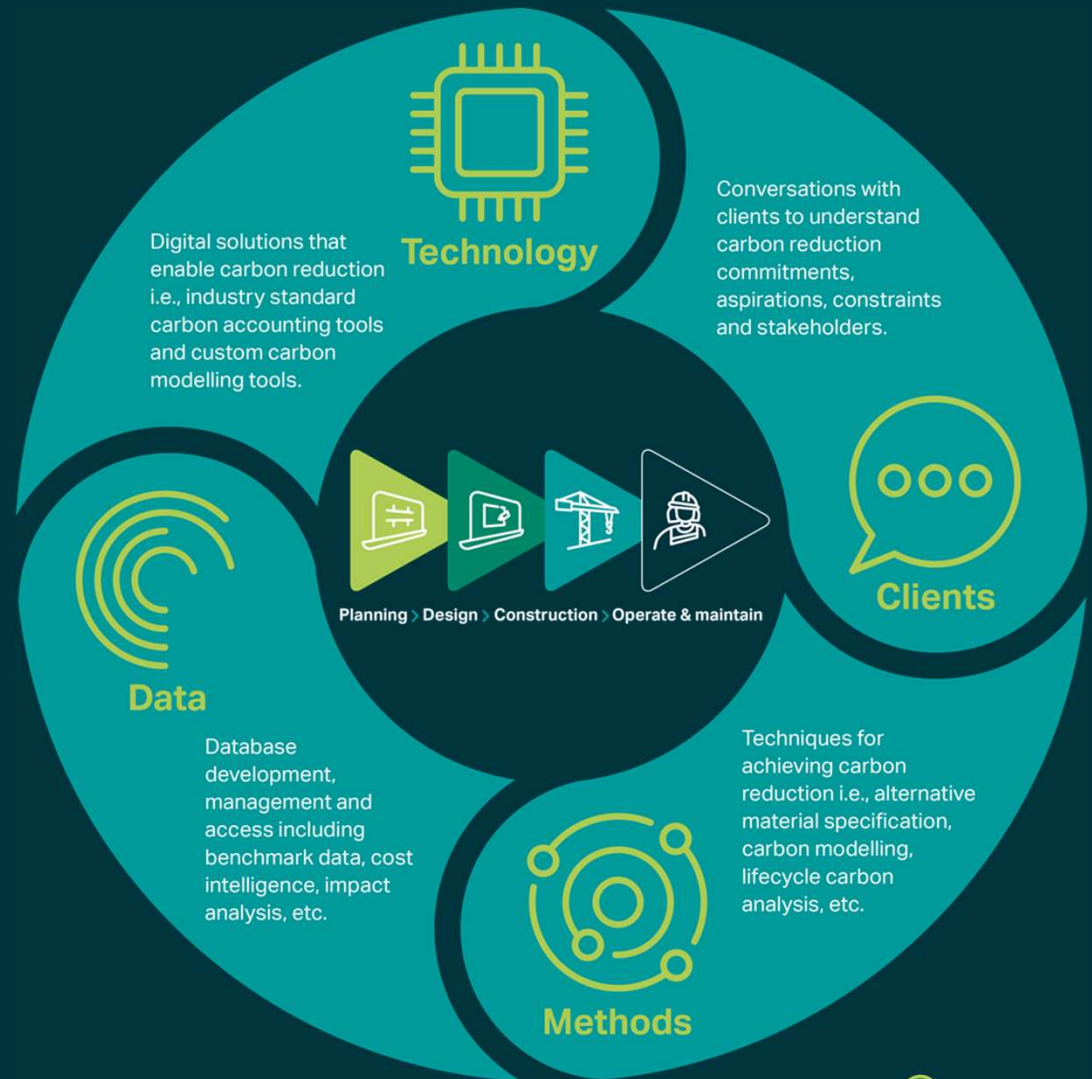
# AECOM ScopeX approach

AECOM's ScopeX™ approach is an innovative framework designed to embed sustainable development and resilience by incorporating an ESG action plan and leveraging data, technology, and expertise.

ScopeX aims to revolutionize the way major planning, design, construction, and operation projects address carbon reduction.

ScopeX™ is AECOM's approach to decarbonizing our clients' projects. It is a process comprising of four elements (Clients, Methods, Data, and Technology) that can be applied at any time through planning, design and construction phases.

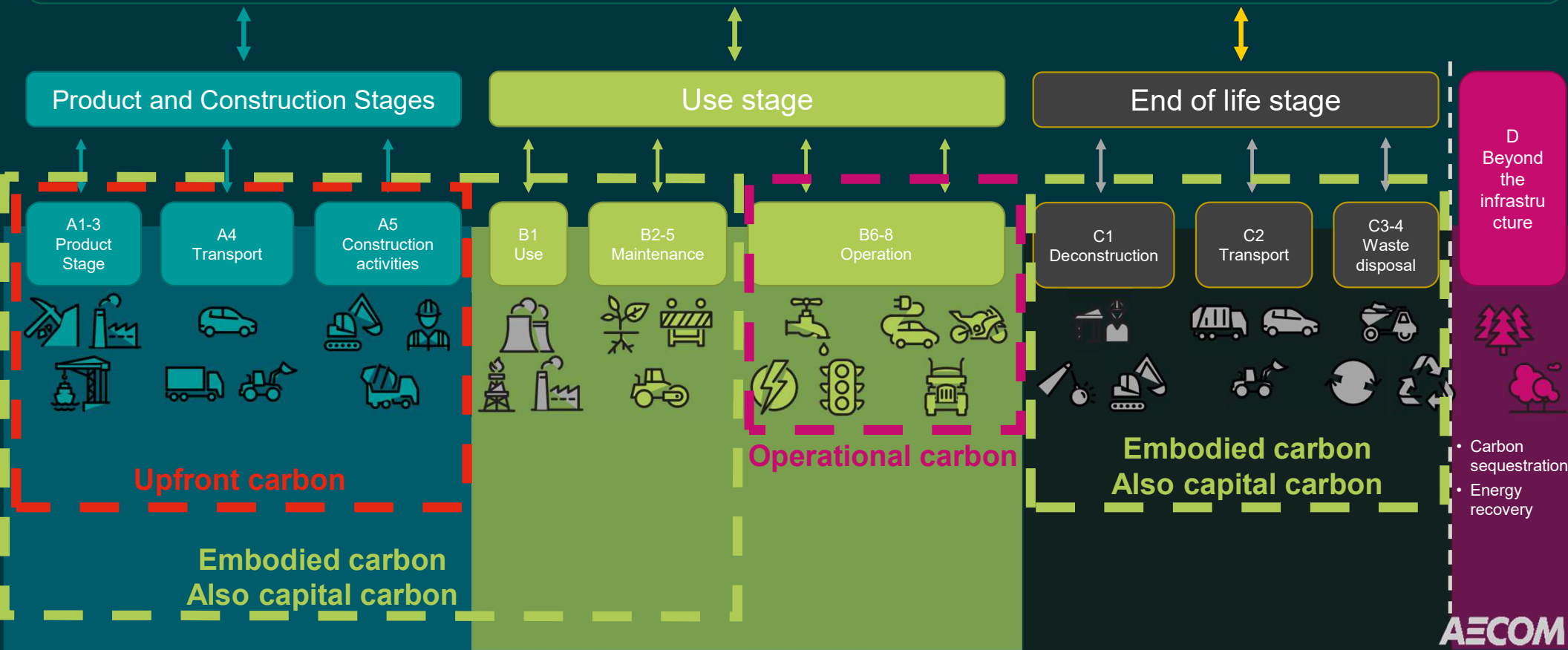
Today we will focus more in the **Data** and **Technology** part of the process.



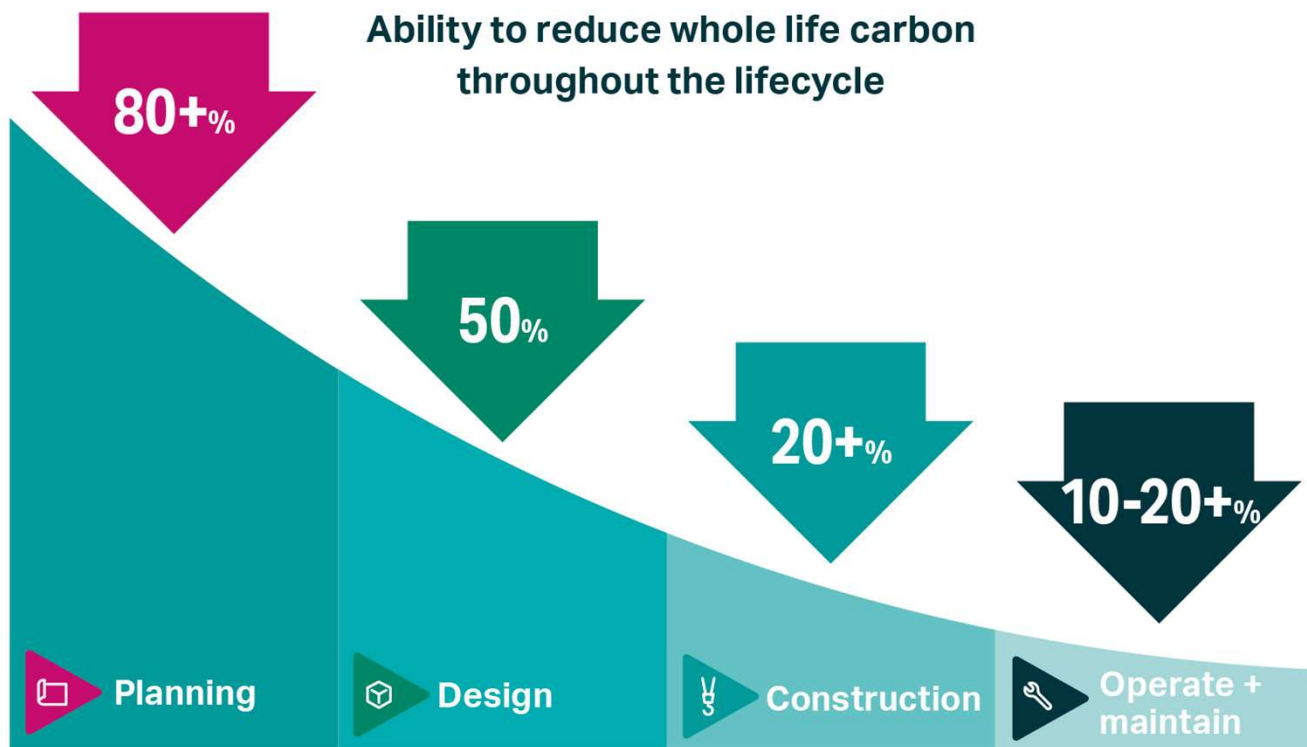


# Carbon footprint: Asset Assessment Scope and Boundaries

## Lifecycle Carbon Assessment (LCA) Emissions EN17472 (Infra), EN15978 (Buildings)



## Life carbon reduction at different life cycle phases



Source: Adapted from PAS 2080:23

Avoid “greenwash”  
*misleading  
or deceptive publicity disseminated by an organisation so as to present an environmentally responsible public image*

## Carbon estimation: the concept of calculation

### Quantity (FU)

FU = Functional Unit

- Materials – Kg, tonnes
- Energy – kWh, MJ, kL diesel

$$\text{Carbon footprint (KgCO}_2\text{e)} = \text{Quantity (FU)} \times \text{Emissions Factor (kgCO}_2\text{e/FU)}$$

### Carbon footprint (KgCO<sub>2</sub>e)

- Multiple mechanism/tools to calculate emissions
- All rely on input data
- A very manual process that does not scale

### Emissions Factor (KgCO<sub>2</sub>e/FU)

- Many data sources/format
- Specific to substance, manufacturer, manufacturing process, geography, local energy inputs

## Carbon estimation and quantity mapping

Carbon footprint (KgCO<sub>2</sub>e) = Quantity (FU) x Emissions Factor (kgCO<sub>2</sub>e/FU)

CAD FILES



### Quantity Mapping

- [t, m3] Concrete, 40 MPa, 100 kg/m3 steel reinforcing, 40% fly ash
- [t] Steel, structural, hot rolled, [imported, local]
- [t] Steel, sheet, cold rolled, [imported, local]
- [t] Aluminium glass framing
- [m2] Double glazing

## Carbon estimation and quantity mapping

Carbon footprint (KgCO<sub>2</sub>e) = Quantity (FU) × Emissions Factor (kgCO<sub>2</sub>e/FU)

BIM MODELS



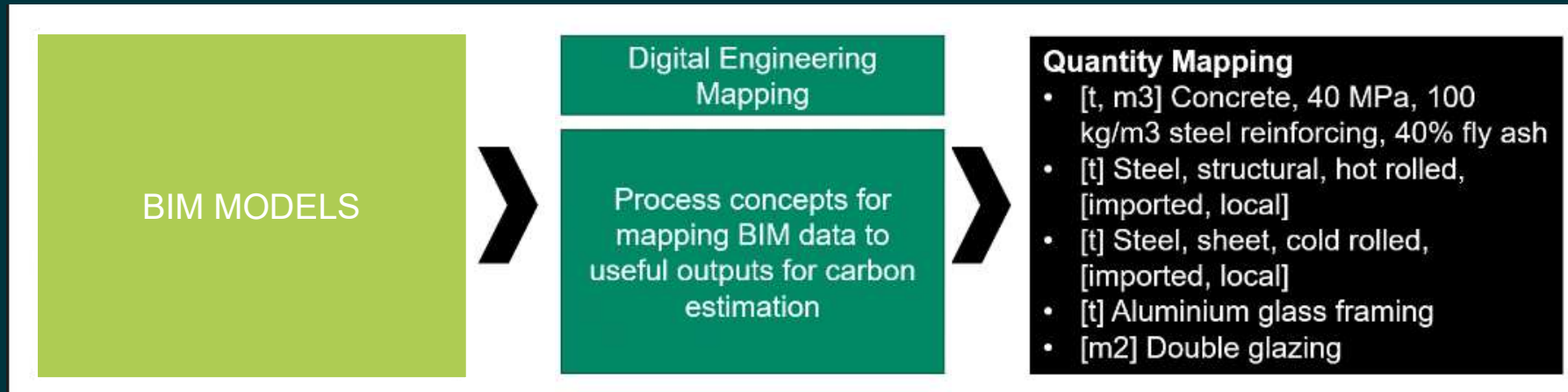
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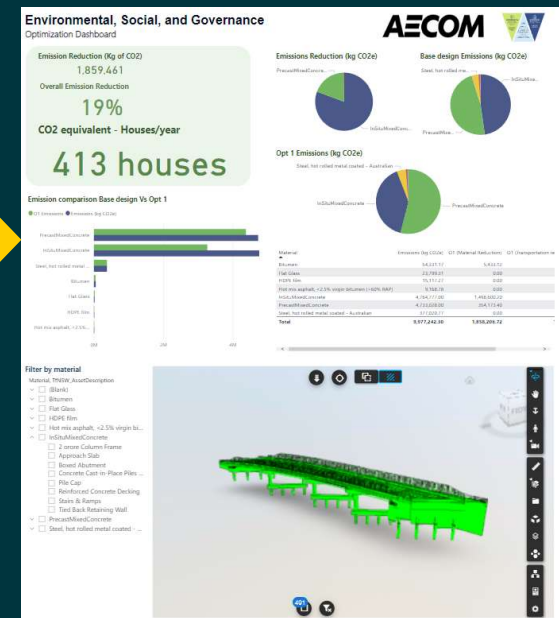
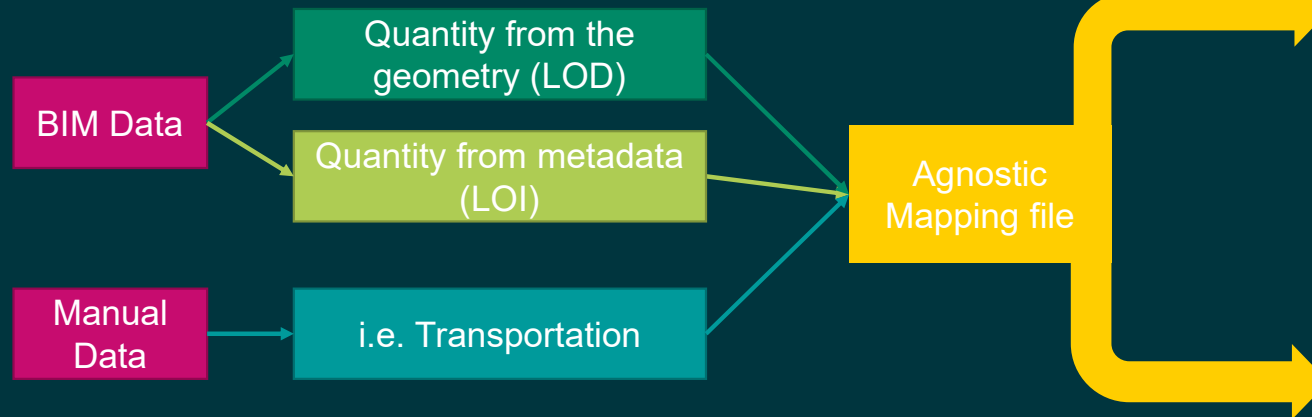


## Carbon estimation and quantity mapping

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# Workflow overview

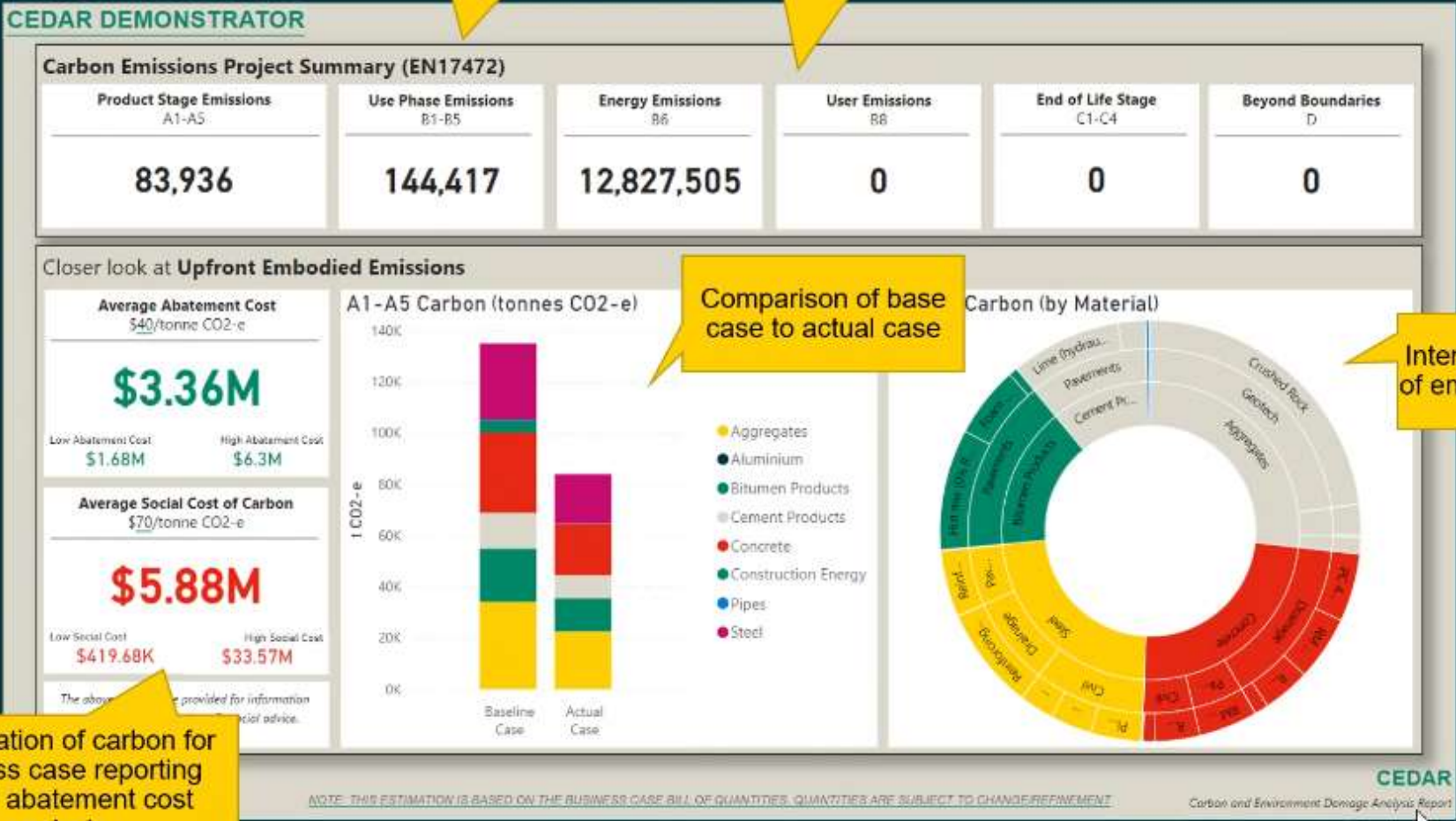


# Final Output

Technical dashboard

Declaration of standard

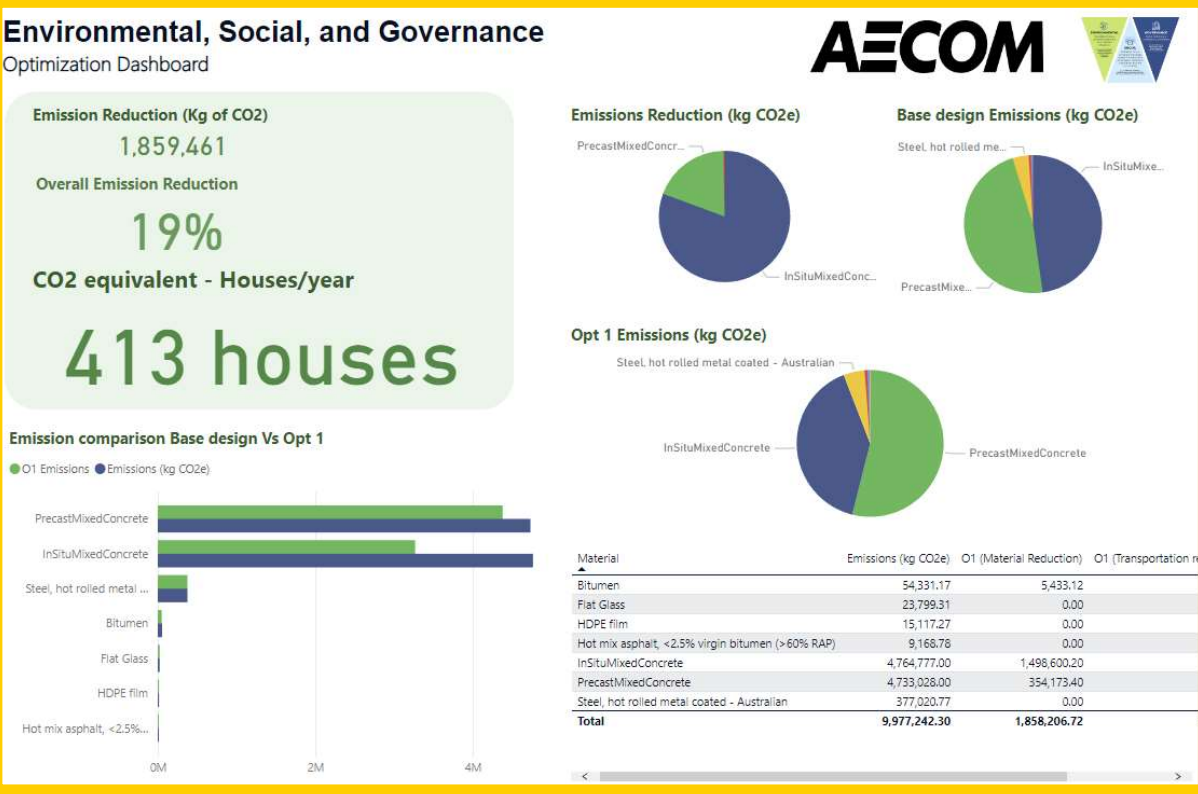
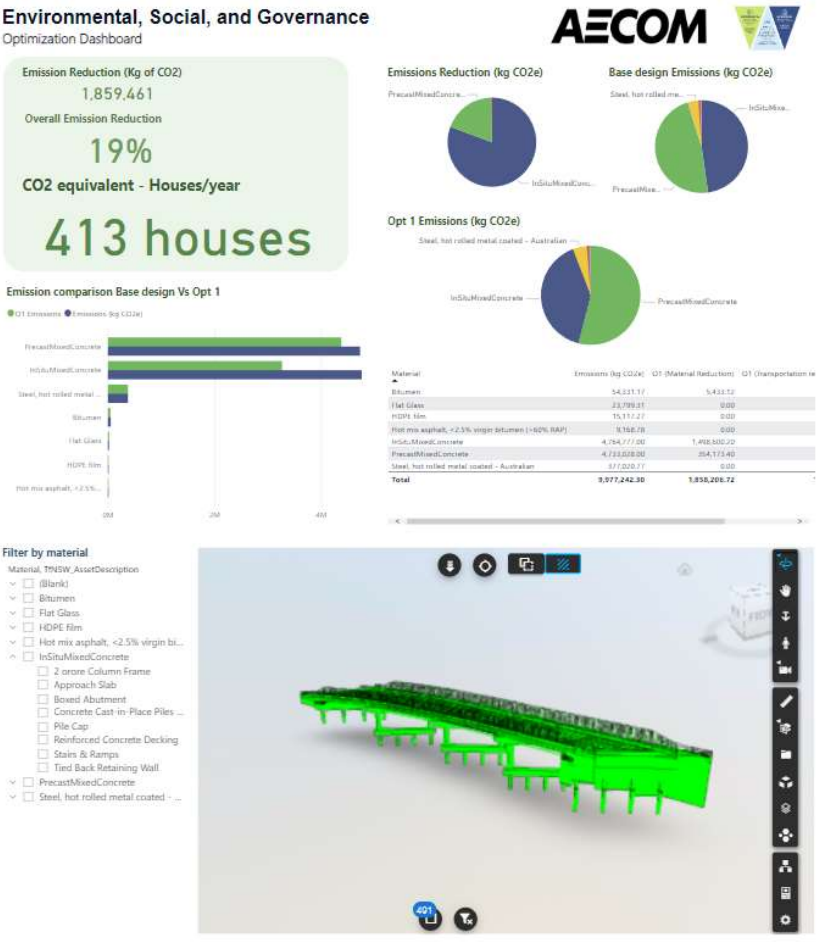
Declaration of emissions for each module



NOTE: THIS ESTIMATION IS BASED ON THE BUSINESS CASE BILL OF QUANTITIES. QUANTITIES ARE SUBJECT TO CHANGE/REFINEMENT

# Final output

## User friendly dashboard



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## Conclusion

...if we want to **build projects that will help the environment**, local communities need to be fully on board.

To do that, we need to build **trust**.

The only way to build trust is by **being transparent**.

And to be transparent, we need the **power of real data**.



# Leveraging Technology for Streamlined Carbon Footprint Analysis from Design to Construction

Thank you



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Delivering a better world