SUPPLY CHAIN SUSTAINABILITY SCHOOL

Introduction to Climate Change & Carbon Footprinting

James Cadman, Action Sustainability

House Rules

- Be present in the room! Cameras and mics on please.

- Get involved in our poll questions

- ‘Raise your hand’ or use the chatbox for questions

- Please participate in our small group discussions and activities: Yes, we will be breaking into groups to chat!

- Share your feedback at the end

- Slides will be shared

Mentimeter

- Go to www.menti.com in a new browser or tab on your phone or computer.
- When you see it on the slide or hear the trainer read it out, enter the menti code

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- Don’t disconnect from the Teams meeting; you will still need to hear the trainer and colleagues

What words come to mind when you think of climate change and carbon?

INTRODUCTIONS

Let's check your name badge

- ✓ Your name and role
- ✓ How much do you know about climate change from 0 - 10?

Workshop Overview

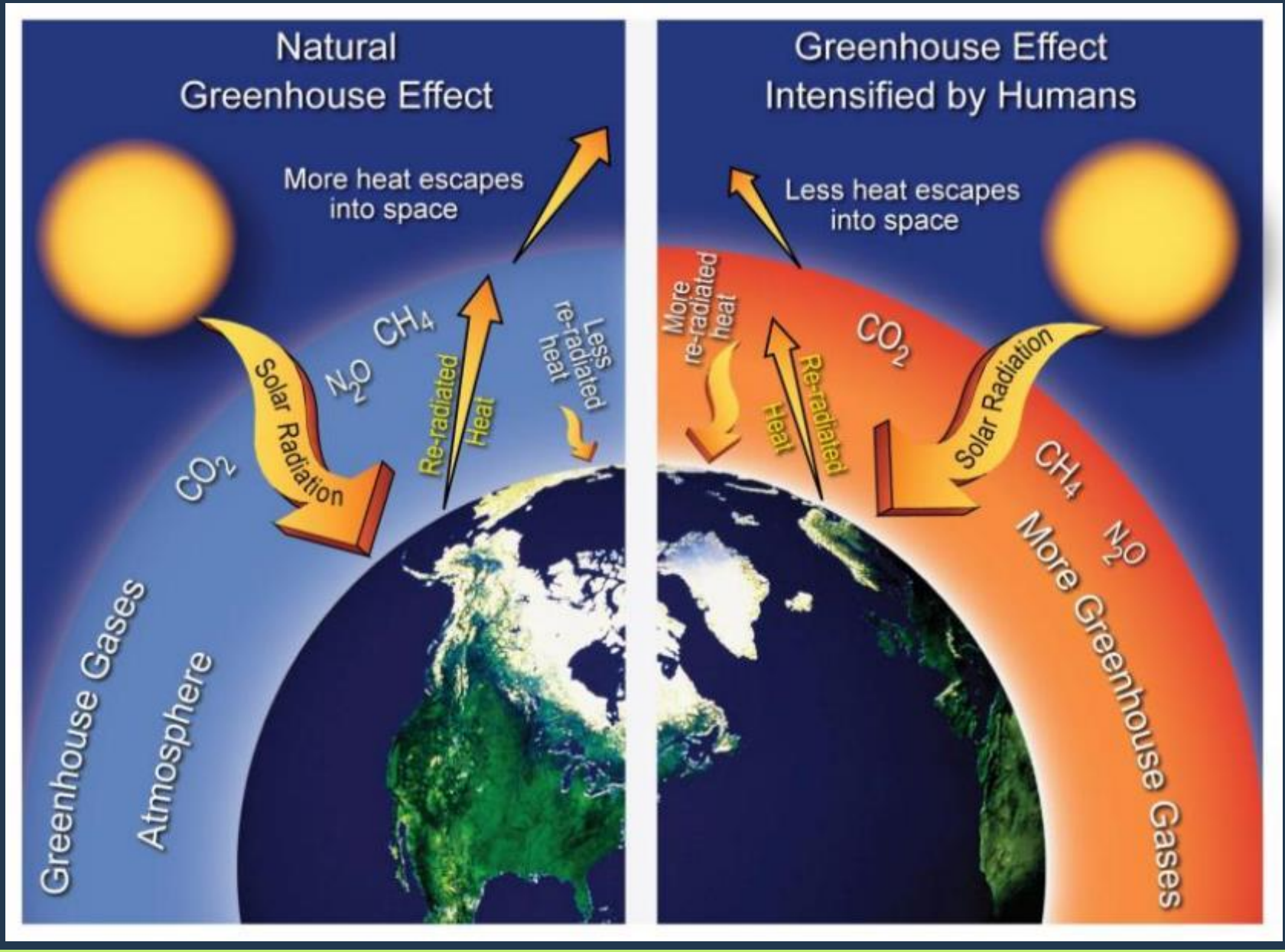
- ✓ Overview of climate change
- ✓ How to do carbon footprinting
- ✓ The importance of data
- ✓ Guidance on useful resources
- ✓ Look at a carbon reduction action planning

Workshop Outcomes

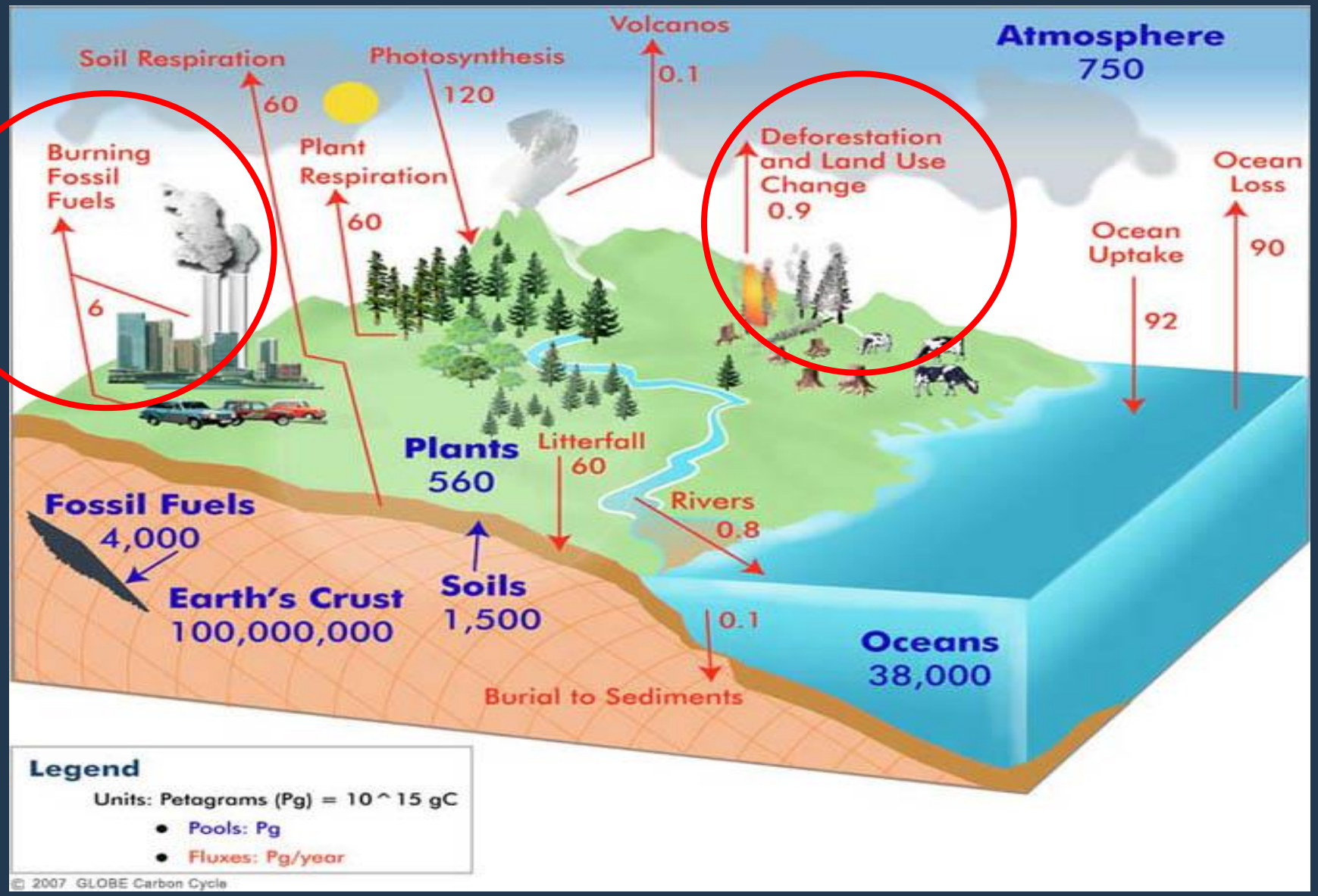
At the end of this workshop you will:

- ✓ Be more aware of the drivers reducing carbon
- ✓ Be able to explain what a carbon footprint is
- ✓ Be able to identify sources of data in your organisation and identify potential areas for carbon reduction

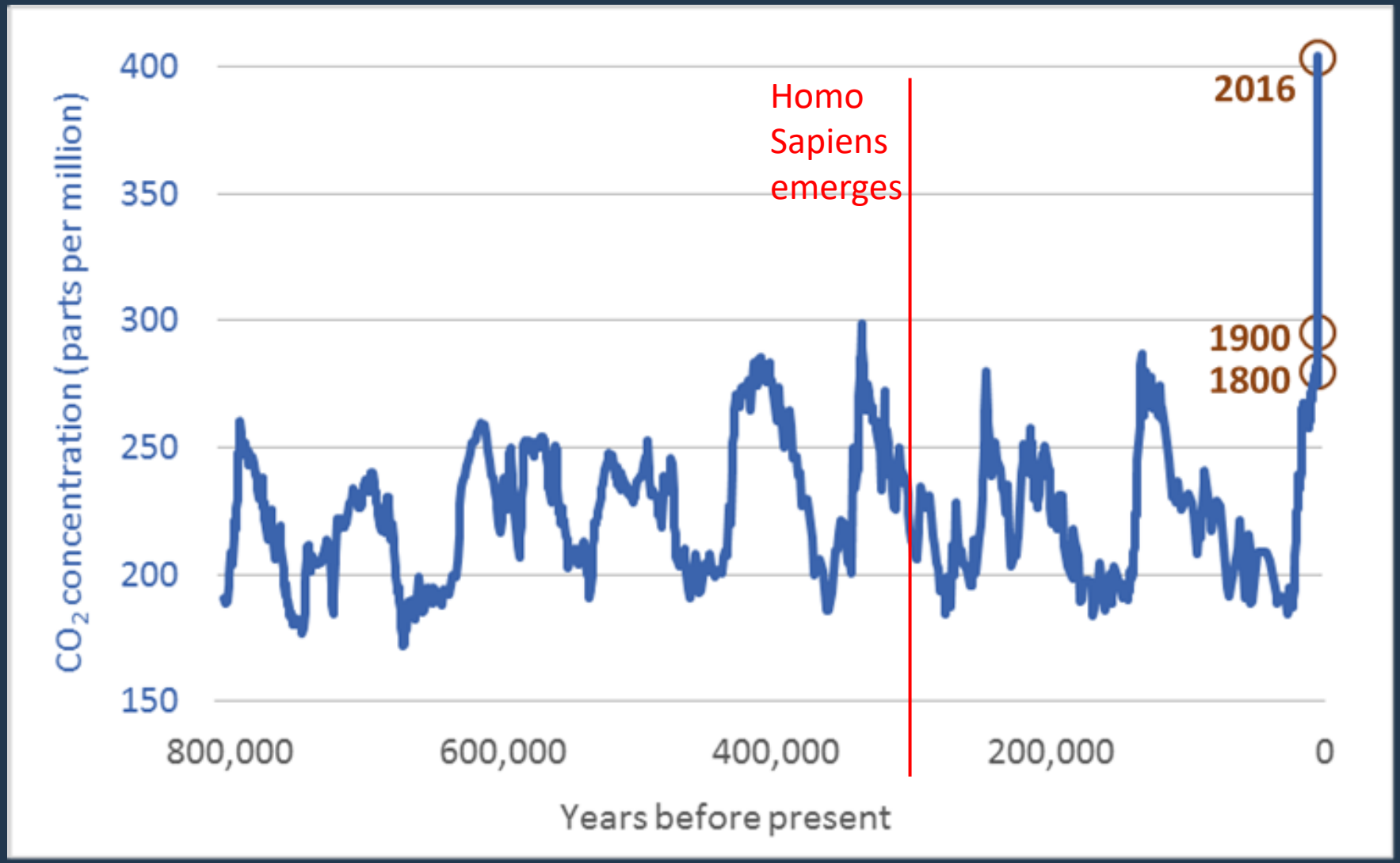
Greenhouse Gas Effect



The carbon cycle

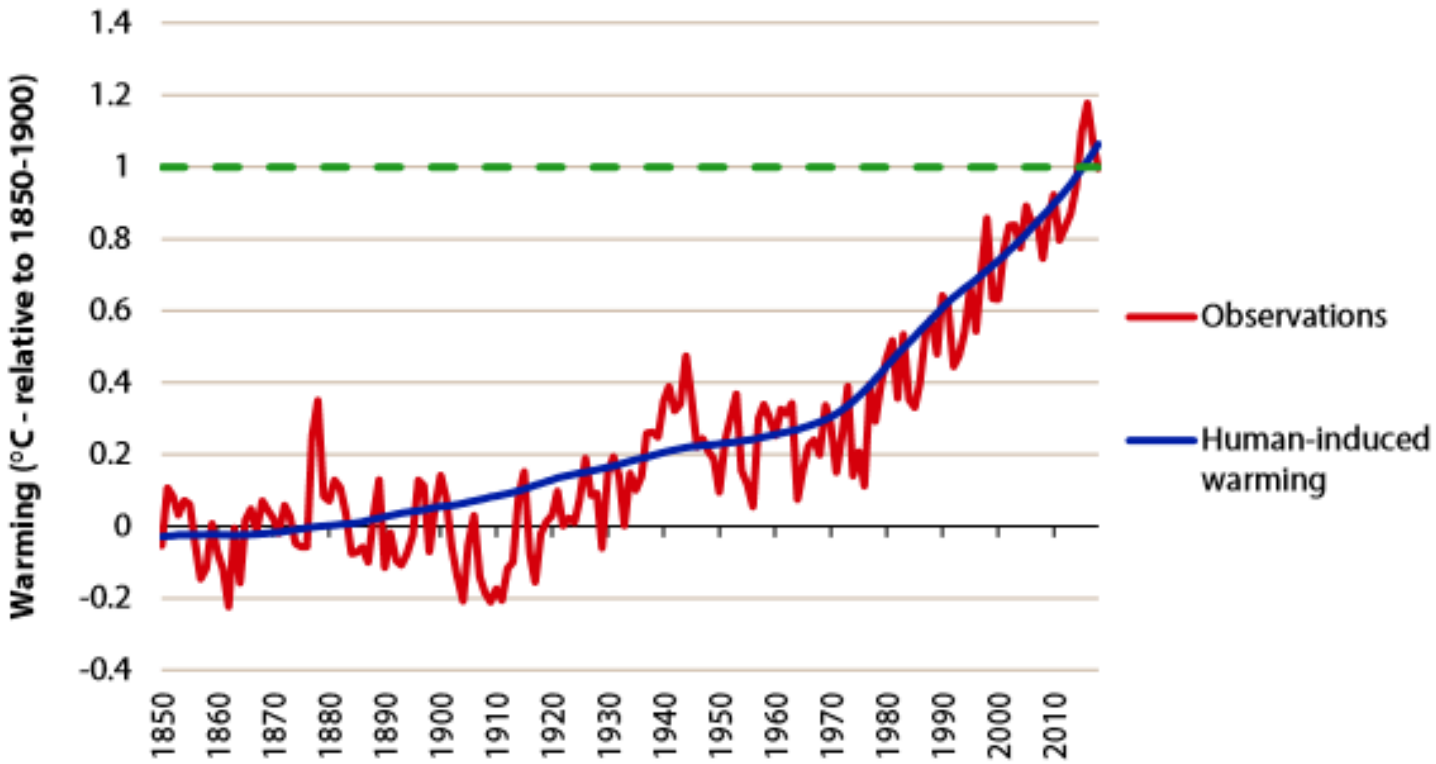


Scene Setting: Going back in time



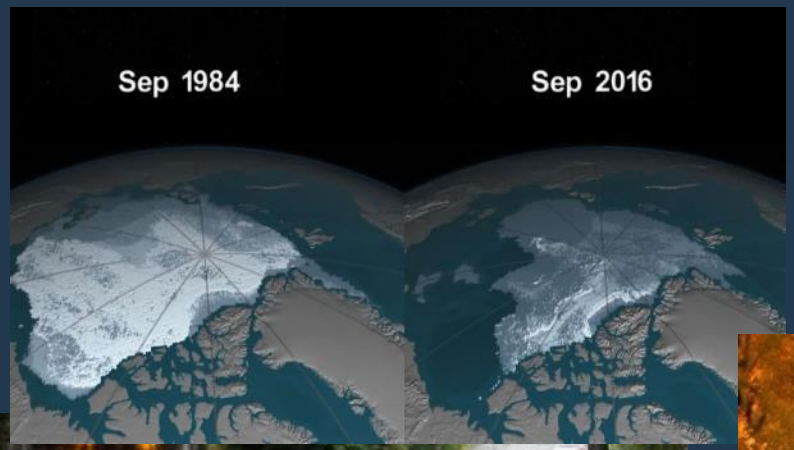
Scene Setting: The last 200 years

Figure 2.1. Observed and human-induced warming



Source: HadCRUT4, NOAA, NASA and Cowtan & Way datasets; IPCC (2018) *Chapter 1 - Framing and Context.*
Notes: 'Observations' are the average of the four datasets above as in IPCC-SR1.5 including for the full year of data for 2018.

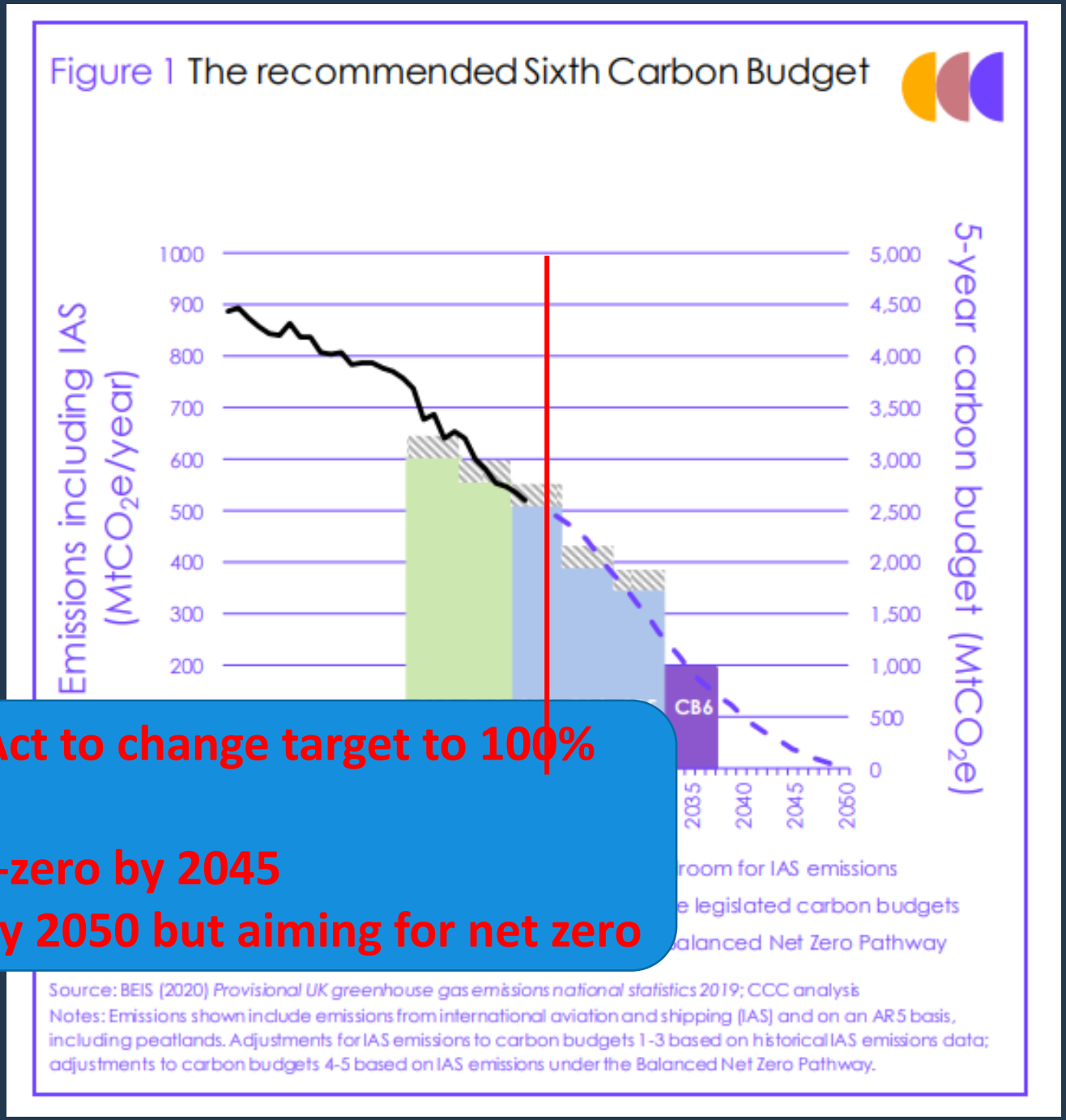
Setting the scene: the last few years



What causes climate change?

- CO_2 (carbon dioxide)
- CH_4 (methane)
- N_2O (nitrous oxide)
- SF_6 (sulphur hexafluoride)
- HFCs
- PFCs
- Kyoto Protocol ‘Basket’ of 6 GHGs
- Limit warming to 2°C above pre-industrial levels, if not 1.5°C

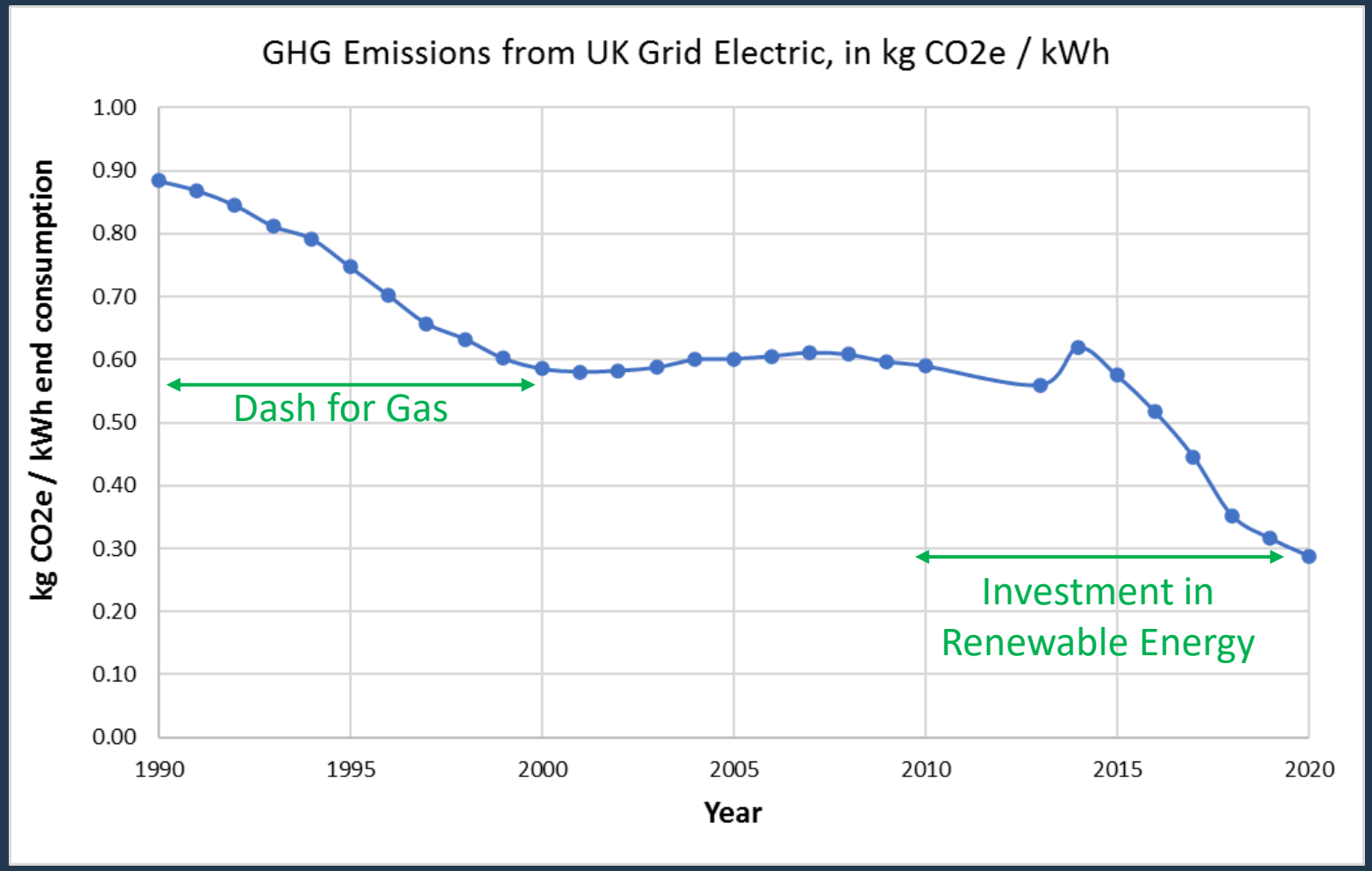
The scale of the challenge in the UK, and the Law!



- **Amendment to Climate Change Act to change target to 100% reduction by 2050 – 'net zero'**
- **Scotland has legislated to hit net-zero by 2045**
- **Wales' target to reduce by 95% by 2050 but aiming for net zero**

Progress decarbonising the UK's Grid

- Significant progress to reduce carbon intensity of the UK's grid electric
- Reduced by 67% since 1990. Why?
- Two big reasons
- 'Dash for gas' in 1990's (less coal)
- Five-fold increase in renewable energy production since 2010: on- & offshore wind, solar PV, and biomass
- 2020: Sunny weather + lower demand (covid-19) = no coal for over a month in our grid electric.
- Result? Renewables were 28% of production in that time with an average grid EF = 0.143kg CO2e/ kWh.



Paris Climate Change Agreement

- Significant progress on Kyoto
- Global engagement…

News

Half of UK businesses 'targeting carbon neutrality by 2030'

2 October 2019, source edie newsroom

A survey of 502 UK businesses has found that almost half are aiming to be carbon-neutral by 2030, with 8% claiming they had already reached this milestone.

Image: EcoAct

Conducted by YouGov this summer, the survey was used to track the climate attitudes of business representatives from major sectors including education, accounting, retail, wholesaling, transport, technology services, restaurant services, construction, real estate, personal care and natural resources such as mining, forestry and oil.

Of the respondents, 93% agreed that climate change is both real and being driven, either in full or in part, by human activity.

This agreement was evident in the respondents' answers to the question: "Is your business planning to be

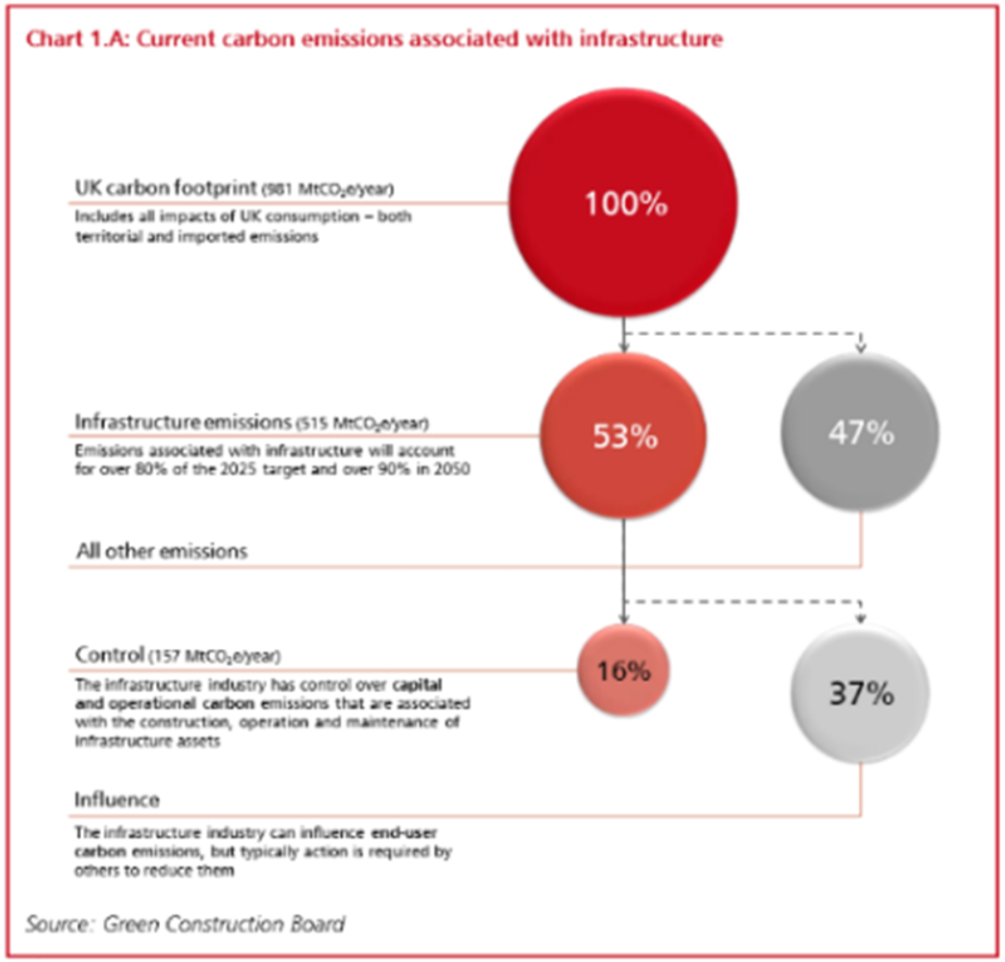
Sectoral Drivers on Carbon

"**50% reduction in greenhouse gas emissions** in the built environment by 2025 against a 1990 baseline

An industry that has become dramatically **more sustainable through its efficient approach to delivering low carbon assets more quickly and at a lower cost,** underpinned by strong, integrated supply chains and productive long term relationships."

https://www.gov.uk/government publications/construction-2025-strategy

Scale of the issue for Infrastructure



1.2 The impact of infrastructure is projected to increase from 53 per cent of UK emissions in 2010 to over 80 per cent of the carbon reduction target in 2025, and rising again to 90 per cent

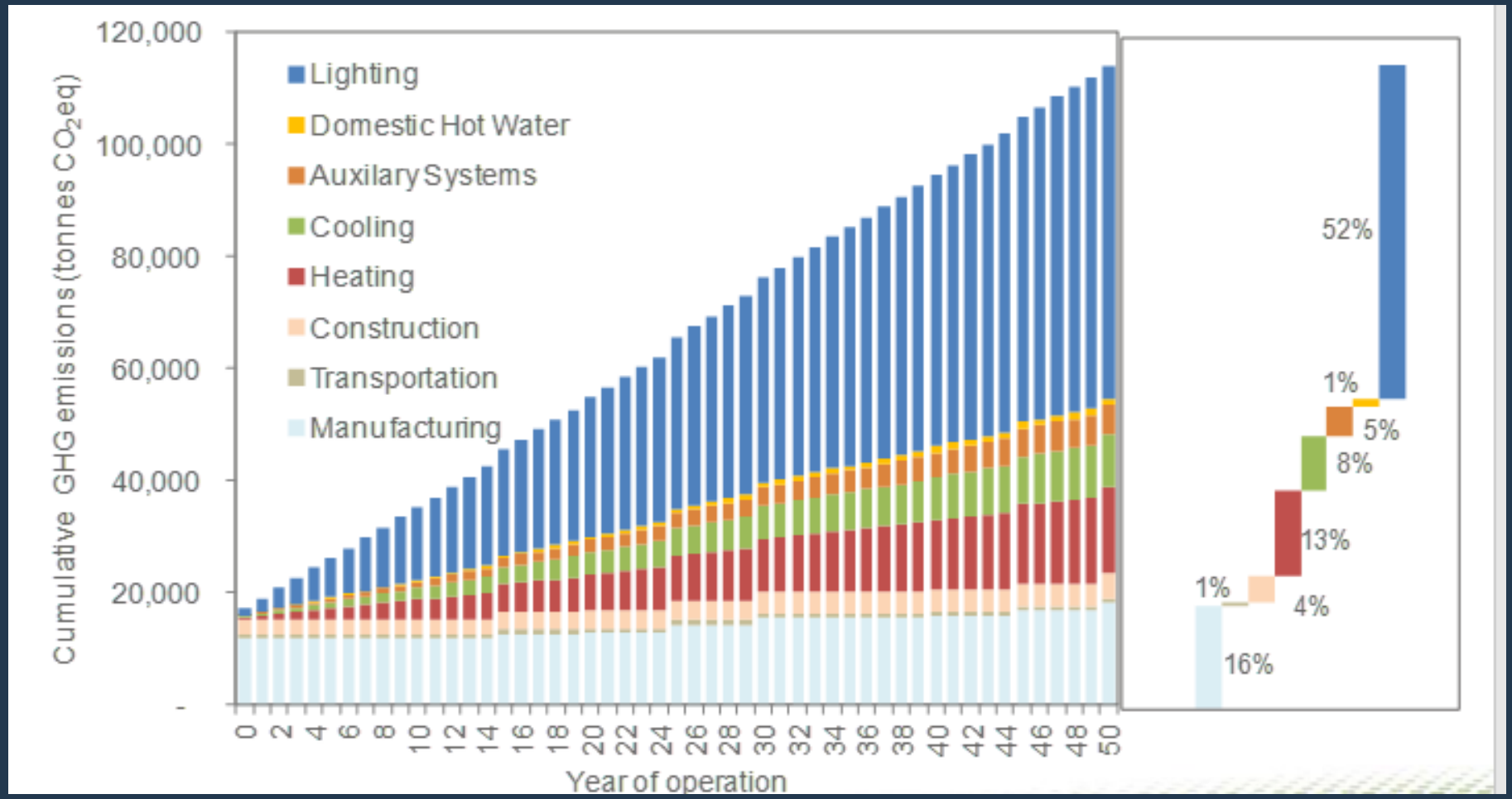
HM Treasury

Infrastructure Carbon Review

- ✓ This report makes clear **that reducing carbon reduces costs.** It is part and parcel of saving materials, reducing energy demand and delivering operational efficiencies
- ✓ 53% of UK emissions from infrastructure
- ✓ 1/3 of which we can control
- ✓ 2/3 we can influence
- ✓ CapCarb rising in relation to OpCarb

November 2013

In Commercial Buildings…



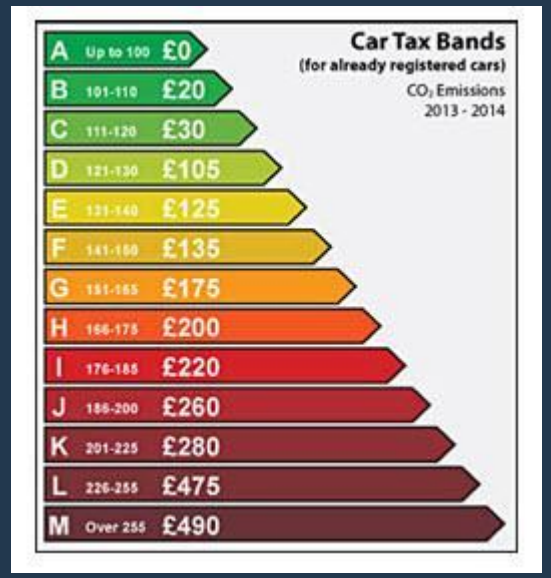
Case Study – Cooperative Bank

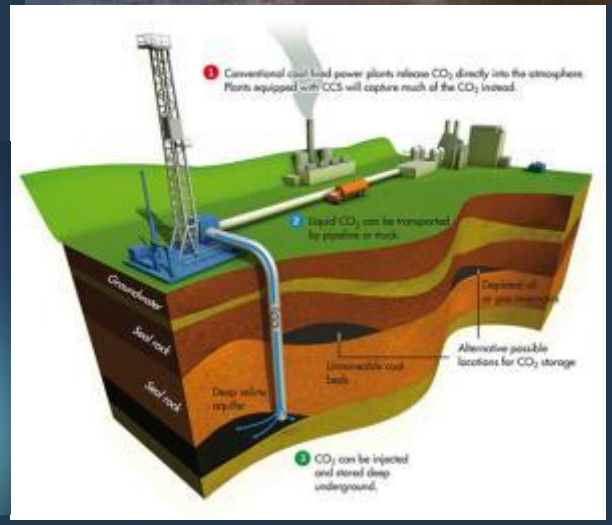
- The design allows for natural heating, cooling and lighting:
  - Fully-glazed double skin façade curves around the whole building and full-height atrium in its middle
  - Louvres at the top of the façade: open in summer to allow warm air trapped between its inner and outer skins to rise up and out of the building; close in winter so the facade can insulate the building
- Efficient and renewable use of energy and water
  - CHP plant powered by renewable fuel (rapeseed oil) grown on the Co-operative's own farm land
  - Heat recovery from IT systems used to heat the building
  - Energy-efficient LED lighting, IT equipment and lifts
  - Greywater and rainwater recycling for toilet flushing and irrigation
- Predicted 80% less carbon and 50% less energy use than the old head office. Awarded BREEAM "Outstanding rating.

But, still, why should we…?

- Reporting for compliance
- Reduced risk of energy security
- Stay ahead of regulation
- Identify hotspots to make carbon reductions and cost savings
- Improve reputation
- Meet stakeholder/client demands
- Win new work
- Become a market leader
- Which all means data accuracy…

What can we do about it?





Carbon Reduction Actions

More efficient energy use in equipment and transport

- **Invest in energy-efficient equipment**, e.g. lighting, welfare cabins, plant & equipment, HVAC, IT
- **Upgrade your fleet** to Euro 6 and plant to NRMM Stage V. Go further to electric / hybrid. Knock on air quality benefits
- **Consider infrastructure needs**: provision of charging points for EV and land for ground-source heat pumps or solar PV
- Think about **alternative transport modes**, e.g. river barges
- **Green travel plans**: public transport, more tele- / video-conferencing than travel for face-to-face meetings: Covid-19

Carbon Reduction Actions

Consider the materials you are using

- **Take an eco-design approach** to enable easier maintenance, repair and upgrade later in the asset's lifetime - 'future proof'
- **Use less material in absolute terms** – work with design and procurement teams
- Switch to alternative **materials with lower carbon impacts** – encourage innovation
- **Increase reuse and the recycled content** of materials – engage suppliers
- **Reduce waste and promote circular economy** – leaner processes
- **Install insulating materials** to reduce in-use energy consumption
- **Pursue offsite production** where possible: lower env'l impacts as well as output efficiency, reduced safety risks

Carbon Reduction Actions

Improve behaviours

- Energy Management Systems and automatic switches & sensors
- Train colleagues and suppliers in how to use equipment efficiently:
  - Choose the right equipment for the job – don't overspec
  - Turn off equipment that's not being used
  - Avoid machine idling
  - Use correct power modes including in low / eco power modes

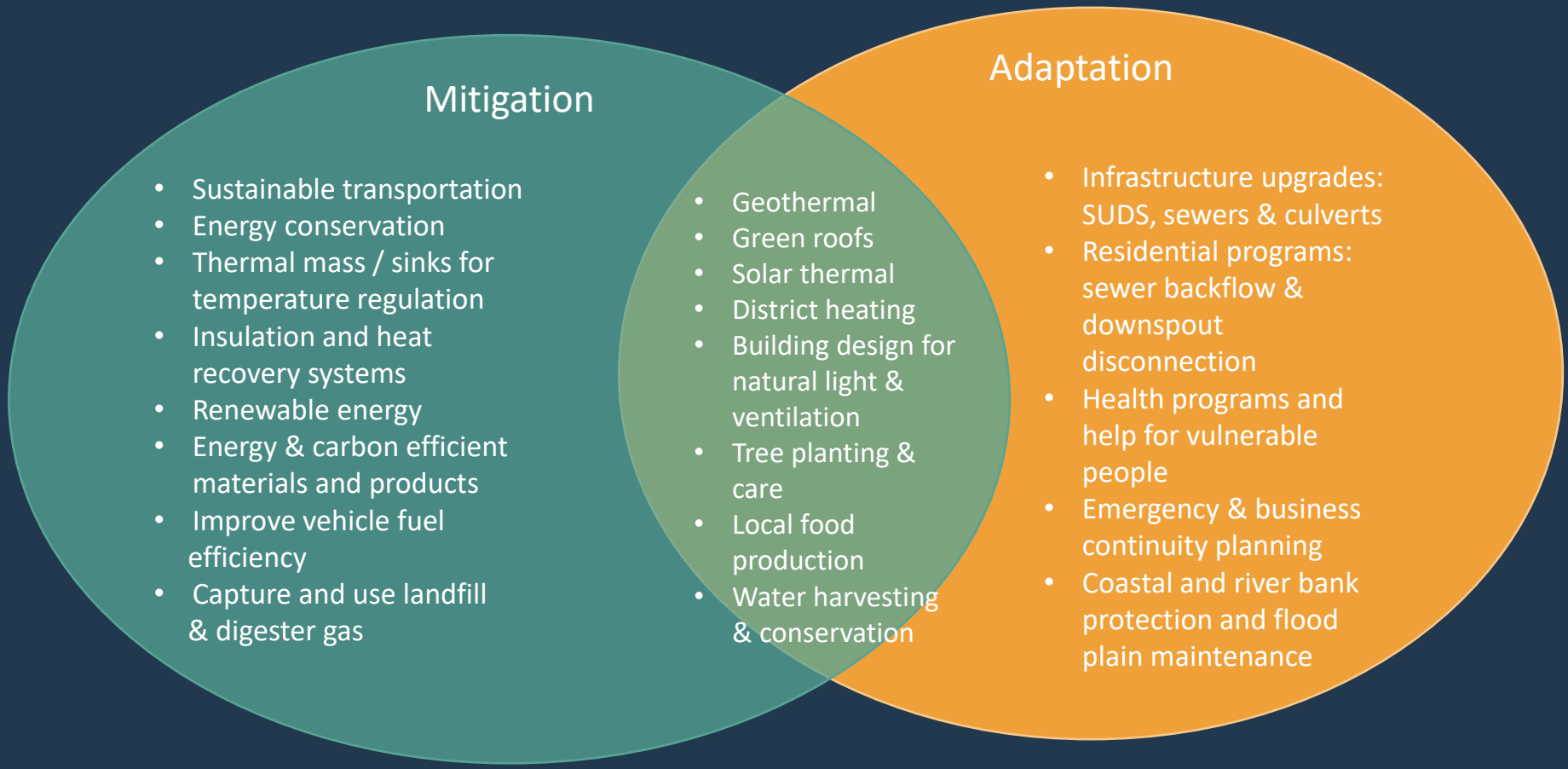
Energy and power sources

- Increase onsite renewable energy provision in offices and sites, e.g. solar PV, micro CHP
- Battery operated instead of diesel or petrol
- Alternatives to diesel: GTL, HVO

Different, lower-carbon business models

- Service / rental rather than ownership
- Remote rather than face-to-face

What can we do about it?



Mitigation: the globally responsible thing to do

Actions that reduce the emissions that contribute to climate change.

Adaptation: the locally responsible thing to do

Actions that minimize or prevent the negative impacts of climate change.

Use the Carbon & Energy Hierarchy

AVOID: don't use energy if you can avoid the need

REDUCE: use less by smart design, more efficient equipment, less materials, and better behaviours

SWITCH to low carbon and renewable sources of energy and materials

OFFSET the residual remaining emissions when all other actions have been taken

Mentimeter

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Where will you take action to reduce your carbon emissions?

How do you compare?...

Activity: Better or Worse Bingo!

Which is better for carbon: train or plane? (for the same distance)

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In % how much better for carbon is travelling by train vs plane (for the same distance)?

Train vs Plane

Train lower impact per passenger.km

Comparison	Rail: Oxford to Glasgow 497km	Air: Brum to Glasgow, 418km
Cost for return ticket	£153	£215
Time	5h 30	4h estimated: 1h15 train Oxford to Brum Intl, 1h check in & wait time in airport, 1h15 flight, 0h30 to leave airport
Carbon emitted (per passenger)	**22 kgCO2e**	**125 kgCO2e**
Saving for Rail	103 kgCO2e, or 82% less impact than flying; £60 or 29% cheaper	Approx. 1h30. But, you can work more effectively on a long distance train than in airport and on plane

Which is better for carbon: plastic or cotton?

Vs.

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How often do you need to use the cotton bag for a lower footprint than a plastic bag?

Plastic vs Paper vs Cotton

Type of bag	HDPE bag (No secondary reuse)	HDPE bag (40.3% reused as bin liners)	HDPE bag (100% reused as bin liners	HDPE bag (Used 3 times)
Paper	3	4	7	9
LDPE 'bag for life'	4	5	9	12
Non-woven PP	11	14	26	33
Cotton	131	173	327	393

How do you know where to act?

What is Carbon Footprinting?

"Commonly used to describe the total amount of CO_2 and other greenhouse gas (GHG) emissions attributable to an organisation, project or product."

Sources of Carbon Emissions from your Organisation

Your Suppliers

- *Materials, goods and services,*

"Embodied" Carbon
"Capital" Carbon - CapCarb

Your Business

- *Fuel and energy in company facilities*

"Operational" Carbon - OpCarb

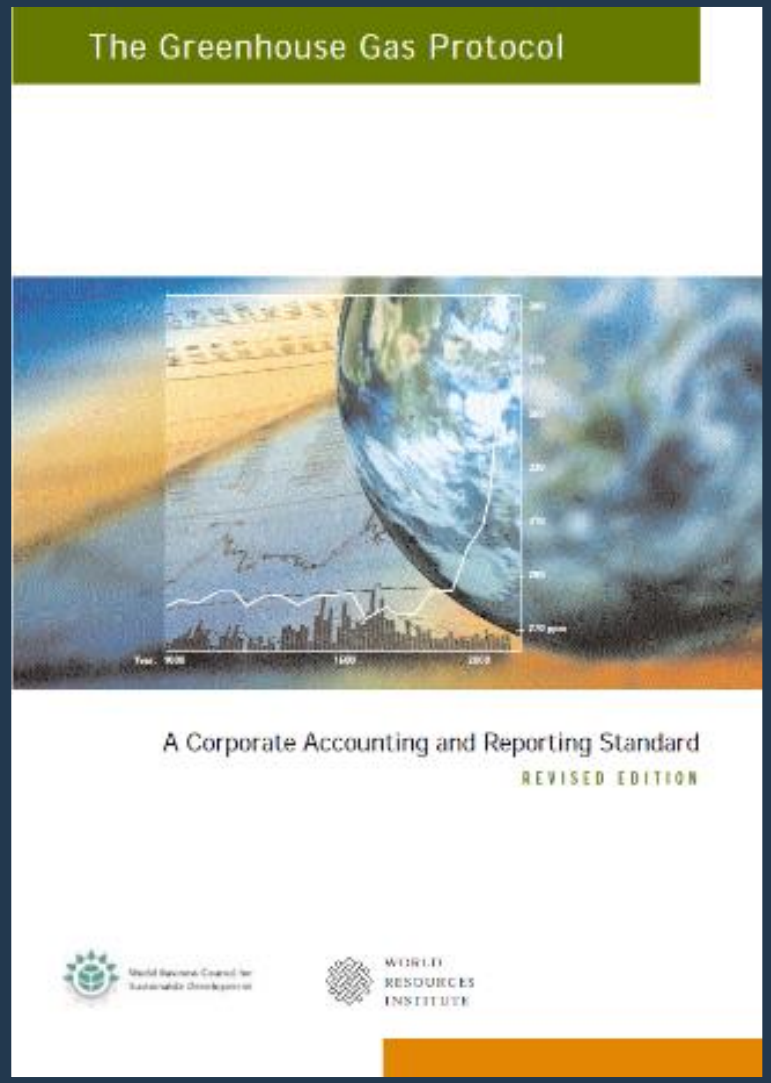
Your Client

- *In-use emissions from running the*

"End User" Carbon
UseCarb

Upstream | Company | Downstream

The GHG Protocol



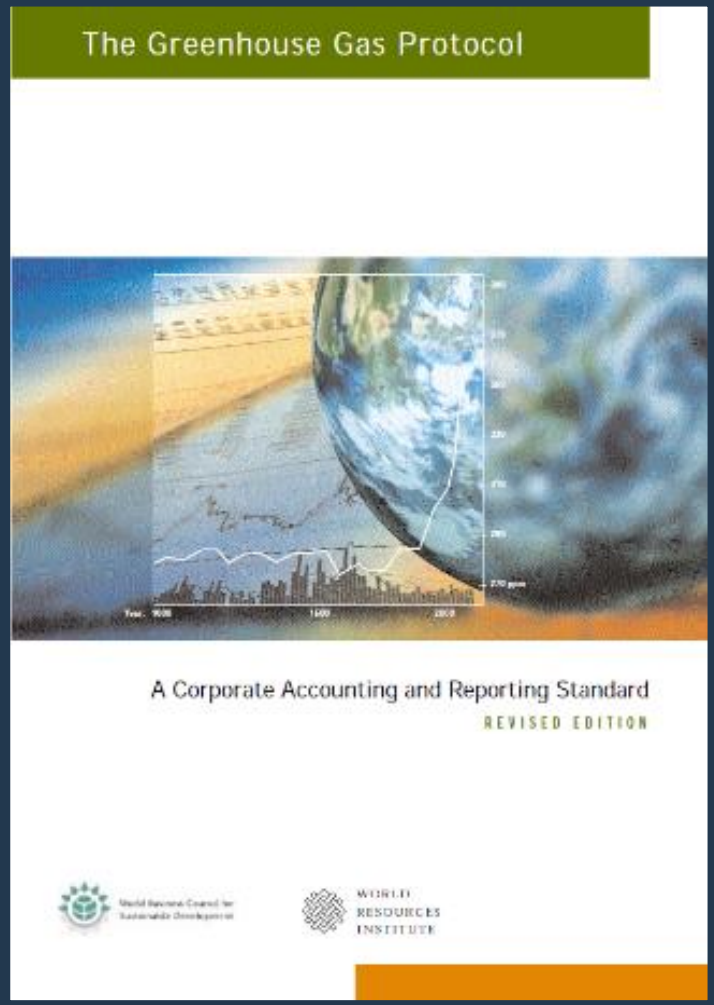
- Accounting and Reporting of 6 greenhouse gases (Kyoto Protocol)
- GHG inventory using standardised approaches and principles
- Develop an effective strategy to manage and reduce GHG emissions
- Consistency and transparency in GHG Accounting and Reporting
- Describes how to identify levels of ownership and control

GHG Protocol

Organizational Boundaries: Consolidation approaches

- Equity share approach

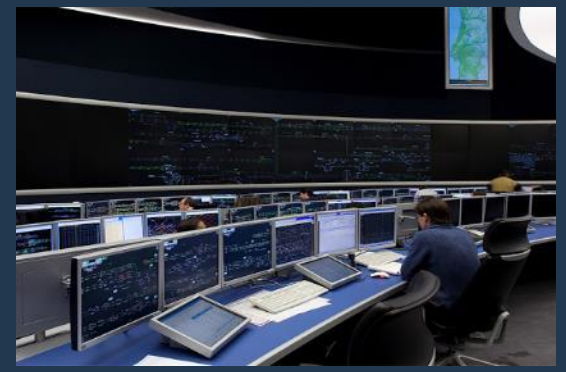
- Control approach
  - Financial control
  - Operational control



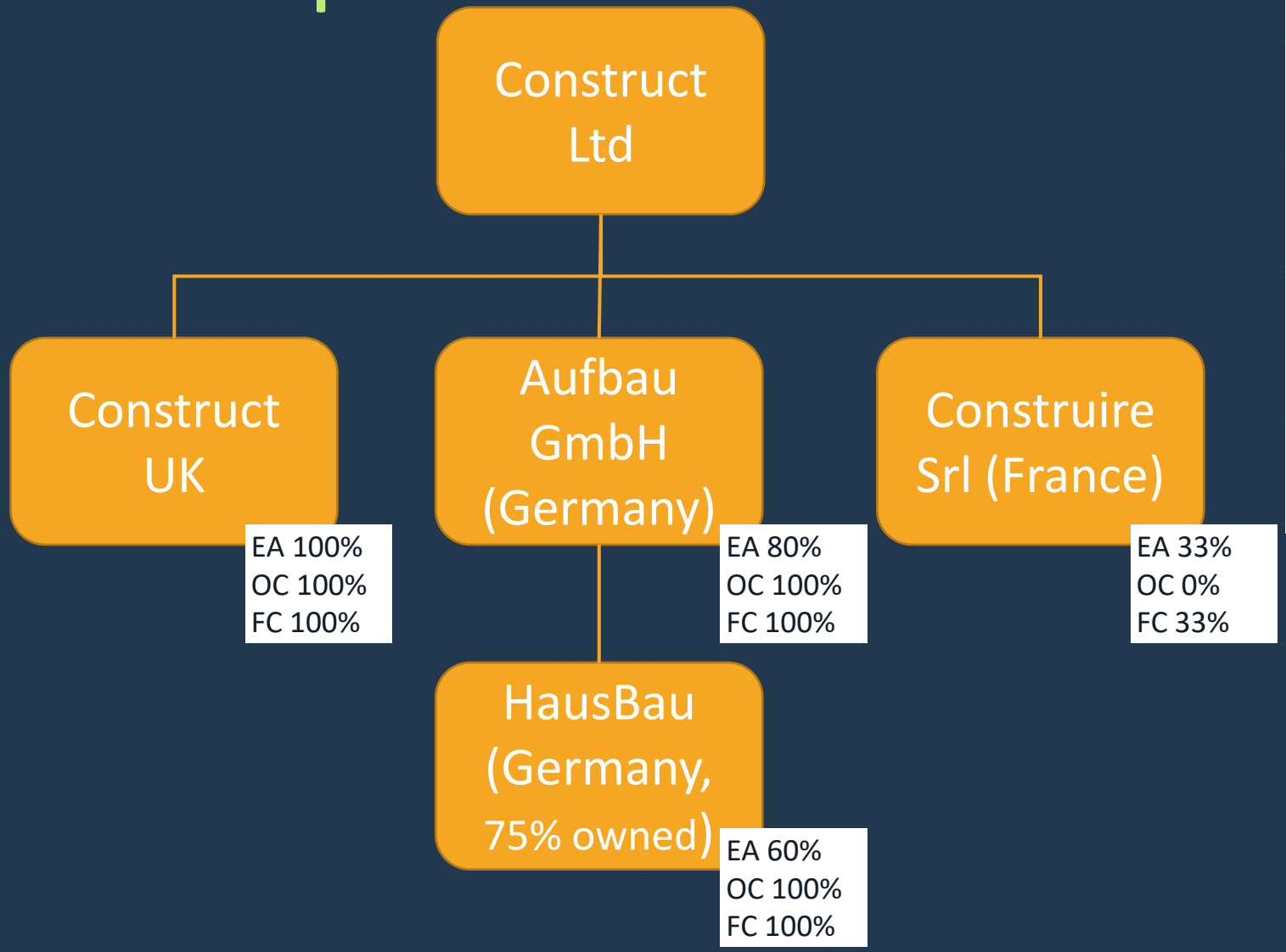
- **Equity share**
  - Under the equity share approach, ***a company accounts for GHG emissions from operations according to its share of equity in the operation***. The equity share reflects economic interest, which is the extent of rights a company has to the risks and rewards flowing from an operation.

- **Financial control**
  - Under the financial control approach, ***a company accounts for 100% of the GHG emissions over which it has financial control.*** It does not account for GHG emissions from operations in which it owns an interest but does not have financial control.

- **Operational control**
  - Under the operational control approach, ***a company accounts for 100% of the GHG emissions over which it has operational control***. It does not account for GHG emissions from operations in which it owns an interest but does not have operational control.



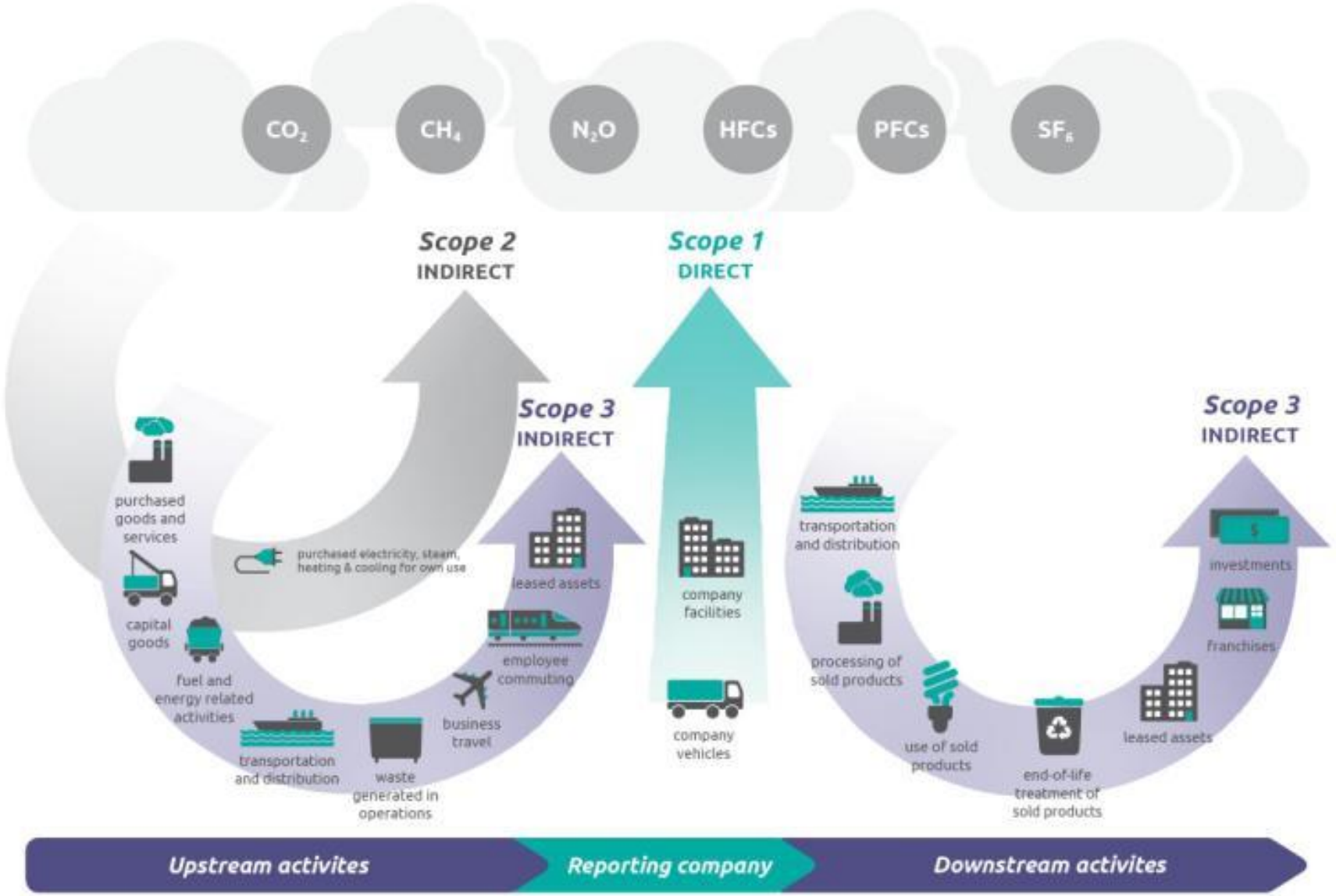
Example



Biz Units	Structure	Equity	Control
Construct UK	Incorporated Company	100%	OC 100% FC 100%
Aufbau GmbH	Incorporated Company	80%	OC 100% FC 100%
HausBau	Subsidiary of Aufbau GmbH 75% owned	60%	OC 100% FC 100%
Construire SrL	Non-incorporated Joint Venture	33%	OC 0% FC 33%

Operational Boundaries – Scopes

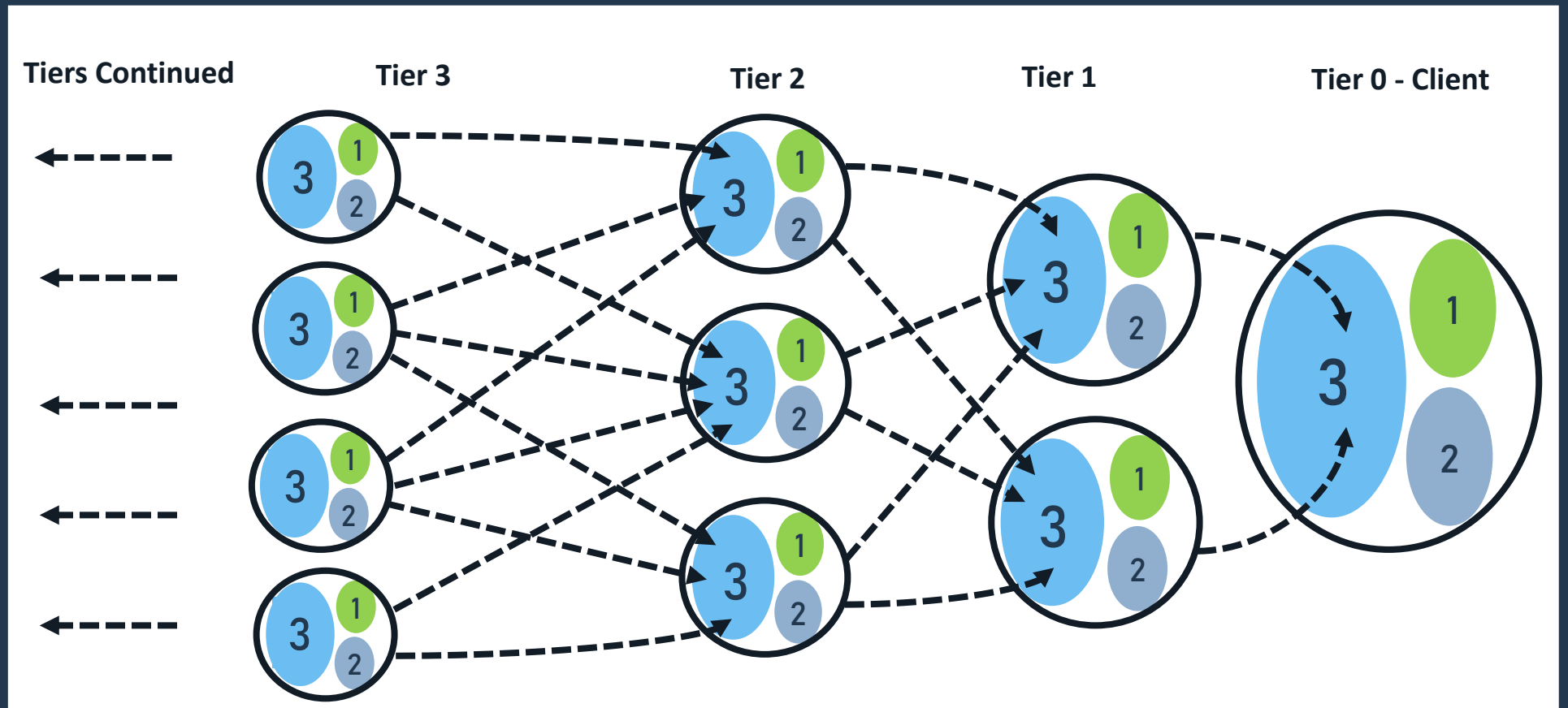
Figure [1.1] Overview of GHG Protocol scopes and emissions across the value chain



- **Direct emissions** are emissions from sources that are owned or controlled by the reporting company

- **Indirect emissions** are emissions that are a consequence of the activities of the company but occur at sources owned or controlled by another company

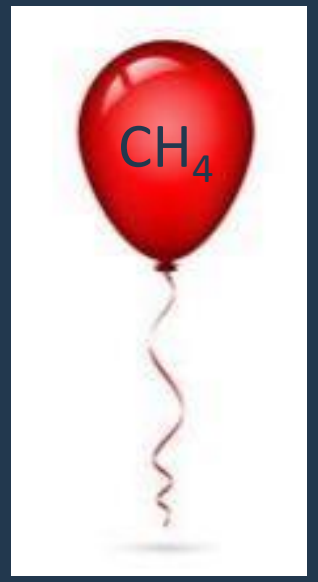
The links between Scope 1, 2 and 3 carbon emissions in the Supply Chain



Scope 1 – Direct Emissions from owned or controlled sources
Scope 2 – Indirect emissions from generation of purchased energy
Scope 3 – All other indirect emissions that occur in a company's value chain

Some fundamentals – Global Warming Potentials: GWP

- It's all relative...
  - CO_2: 1
  - CH_4: 25
  - N_2O: 298
  - SF_6: 22,800
  - HFCs: 12 – 14,800
  - PFCs: 7,390 – 12,200



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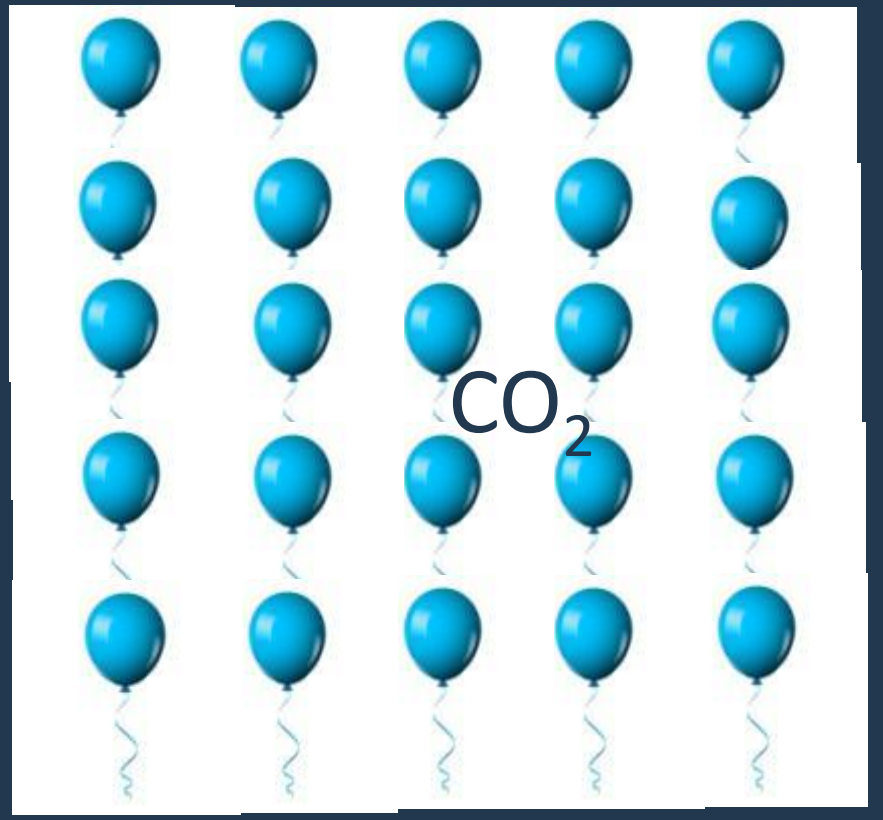


- Expressed as "tonnes of CO_2 equivalent"; tCO_2e

Some Fundamentals- Emissions Factors

Comparing Power Sources and Modes of Travel

1 kWh grid electricity =

0.288 kg CO_2e

1 kWh red diesel =

0.316 kg CO_2e

500 p.km by train =

18 kg CO2e

500 km by car =

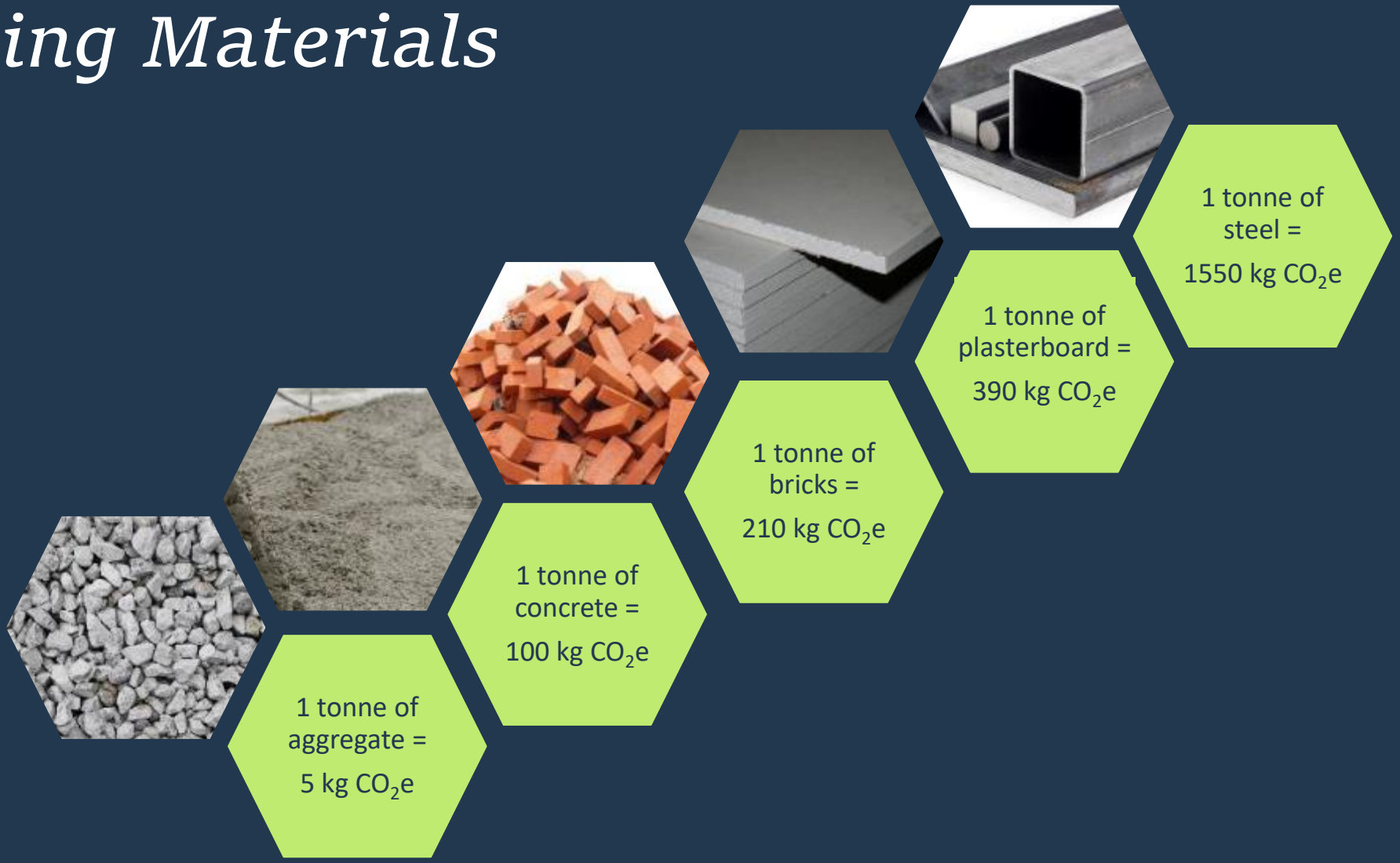
84 kg CO2e

500 p.km by airplane =

122 kg CO2e

Some Fundamentals- Emissions Factors

Comparing Materials



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Check your understanding of scopes! 5 questions! Operational Control

How to get a carbon footprint

- **A carbon footprint = activity data** *(e.g. litres of fuel used) x* **an emissions conversion factor** *(e.g. GHGs emitted per litre burnt)*
- **KgCO_2e ("equivalent")** takes into account all the main GHGs emitted: CO_2, CH_4 and N_2O
- Think about **units of measurement** and converting between them: factors of a thousand
- Don't forget you can calculate carbon from **proxy data** such as spend

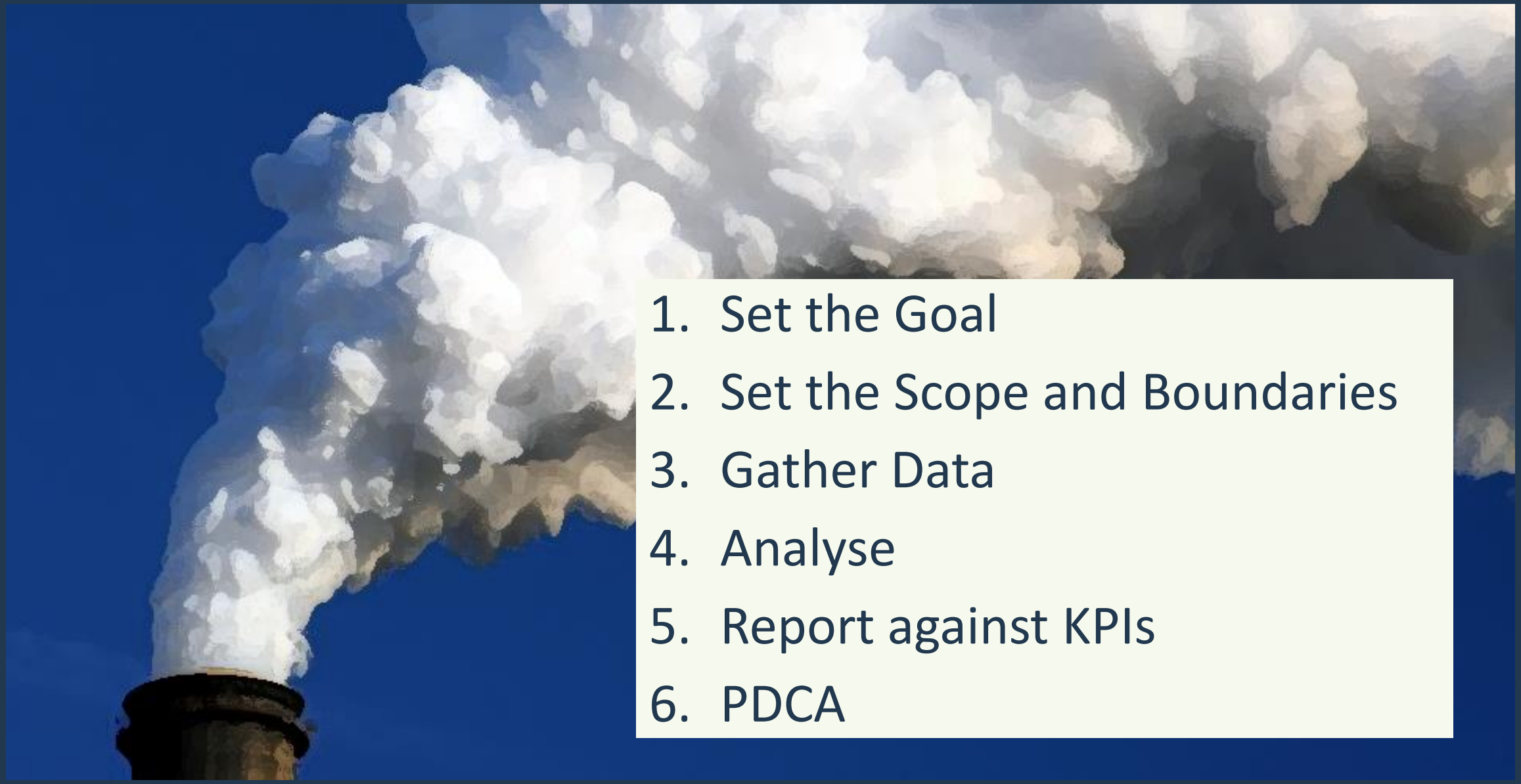
Exercise: Calculate the carbon footprint for your organisation or site

- Use the data provided to calculate the carbon footprint of your site's activities:
  - Fork lift trucks
  - Electricity for your offices
  - Diesel for outsourced logistics
  - List it as scopes 1, 2 and 3 and the overall total
  - Time: 15 mins

And the answers are…

- Scope 1 389 kg CO2e
- Scope 2 1,282 kg CO2e
- Scope 3 2,546 kg CO2e
- Total 4,217 kg CO2e

Carbon reduction workshop: undertaking a footprint



1. Set the Goal
2. Set the Scope and Boundaries
3. Gather Data
4. Analyse
5. Report against KPIs
6. PDCA

Set your Boundaries for your Organisation

Your Suppliers

- *Materials, goods and services,*

“Embodied” Carbon
“Capital” Carbon - CapCarb

Your Business

- *Fuel and energy in company facilities*

“Operational” Carbon - OpCarb

Your Client

- *In-use emissions from running the*

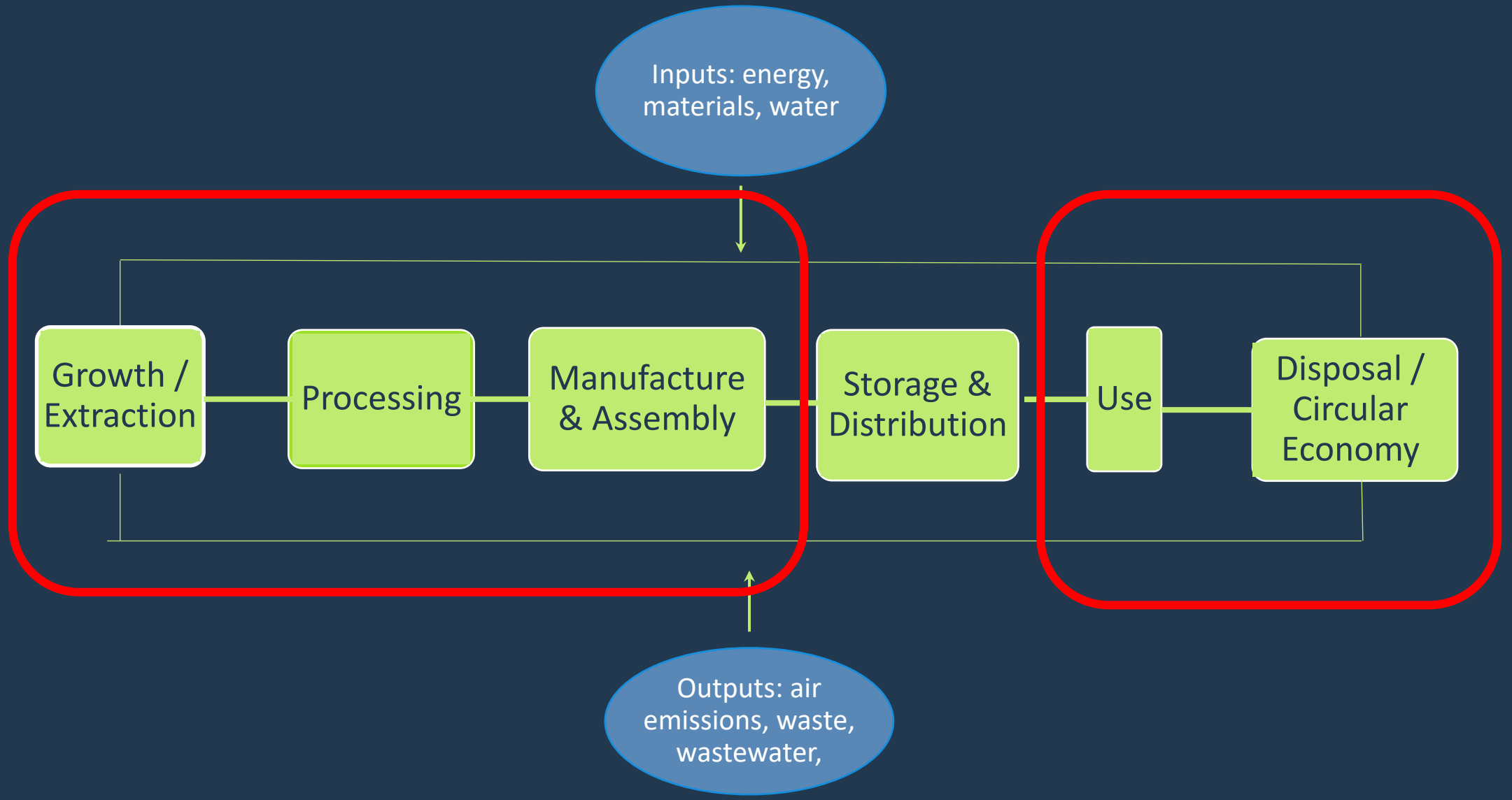
“End User” Carbon UseCarb

Upstream Scopes 2 & 3 *(Indirect)*

Company’s Scope 1 *(Direct)*

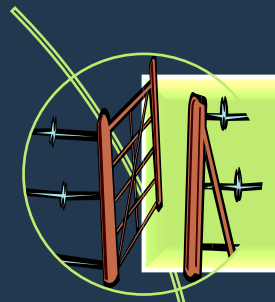
Downstream Scope 3 *(Indirect)*

Product Boundaries



Boundaries

Setting the Boundaries – Lifecycle stages

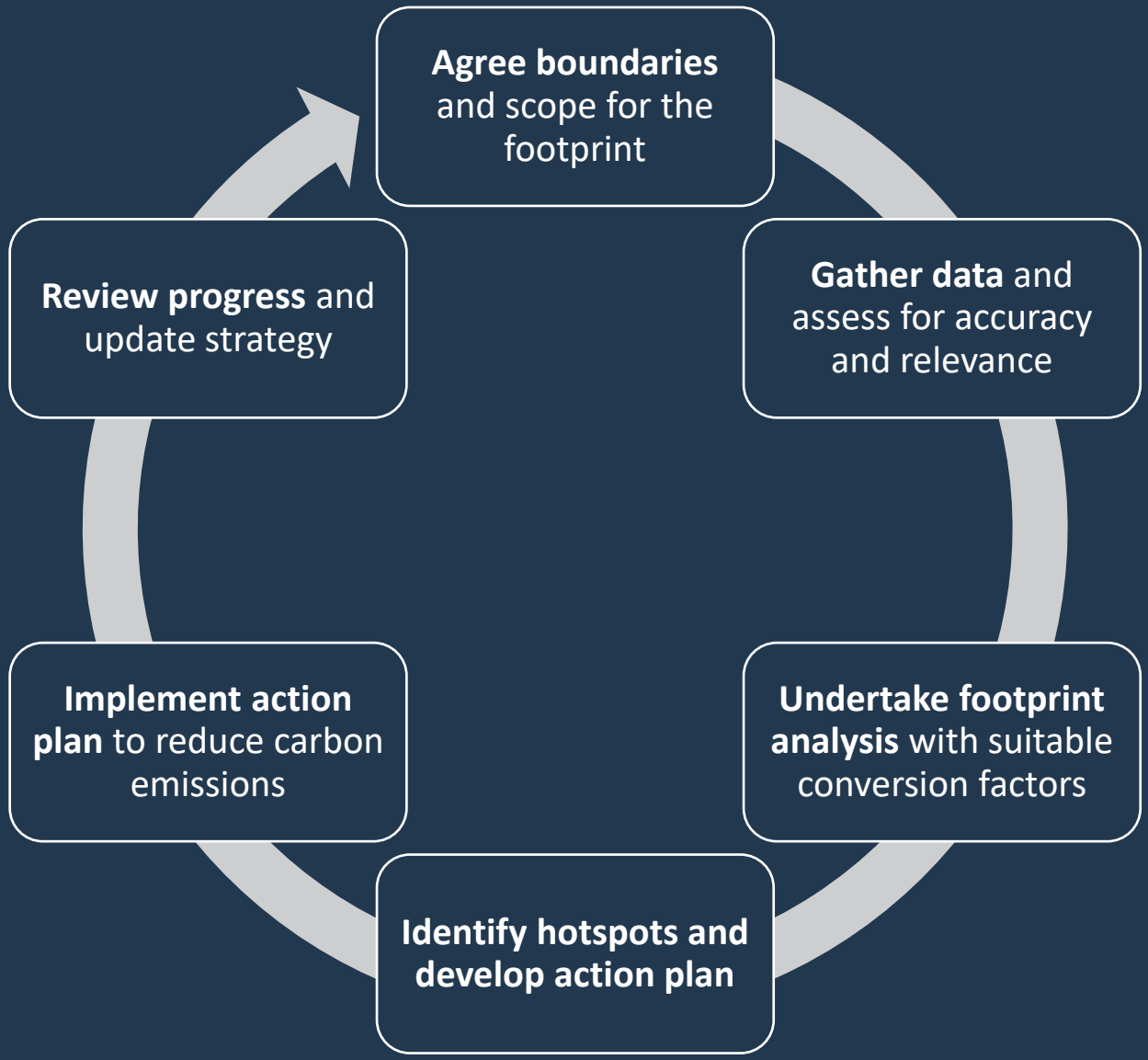


"Cradle-to-Gate" – Supply Chain from raw material extraction to factory gate

"Cradle-to-Site" – Supply Chain from raw material extraction to construction site

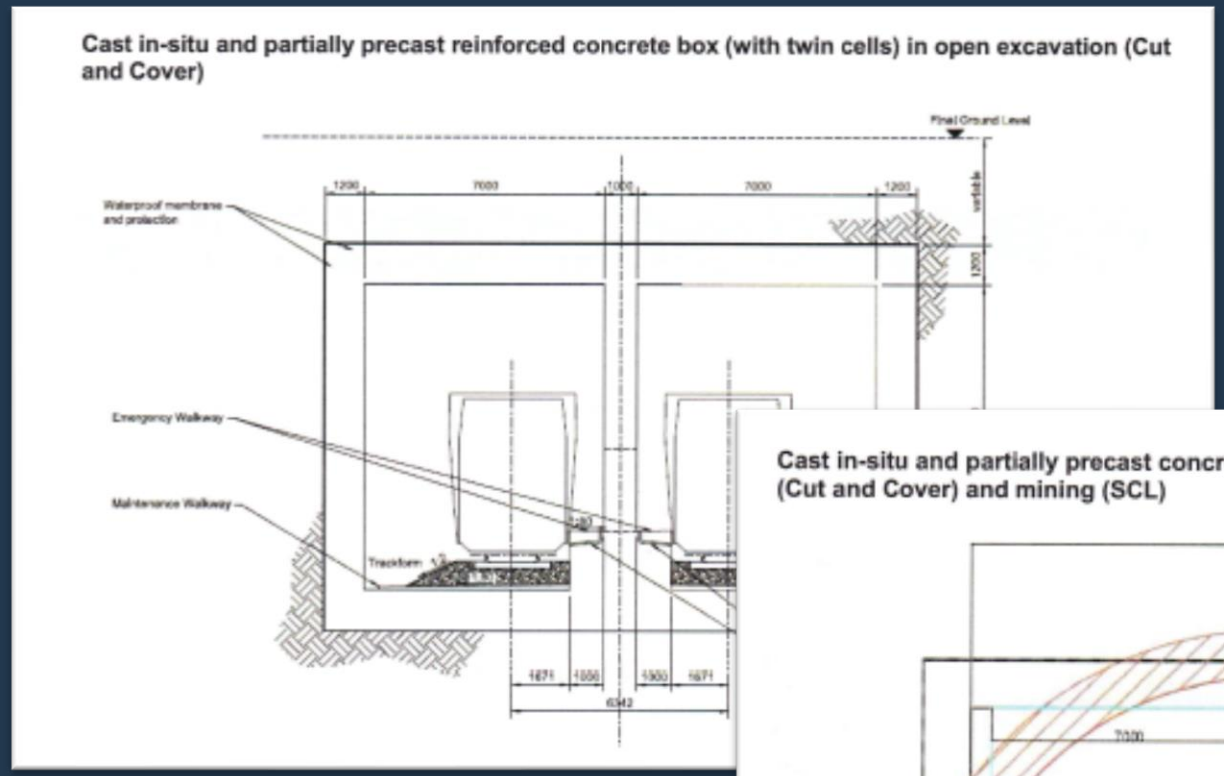
"Cradle-to-Grave" – Full supply chain from raw material extraction to end-user and final disposal. Or "*cradle-to-cradle*"

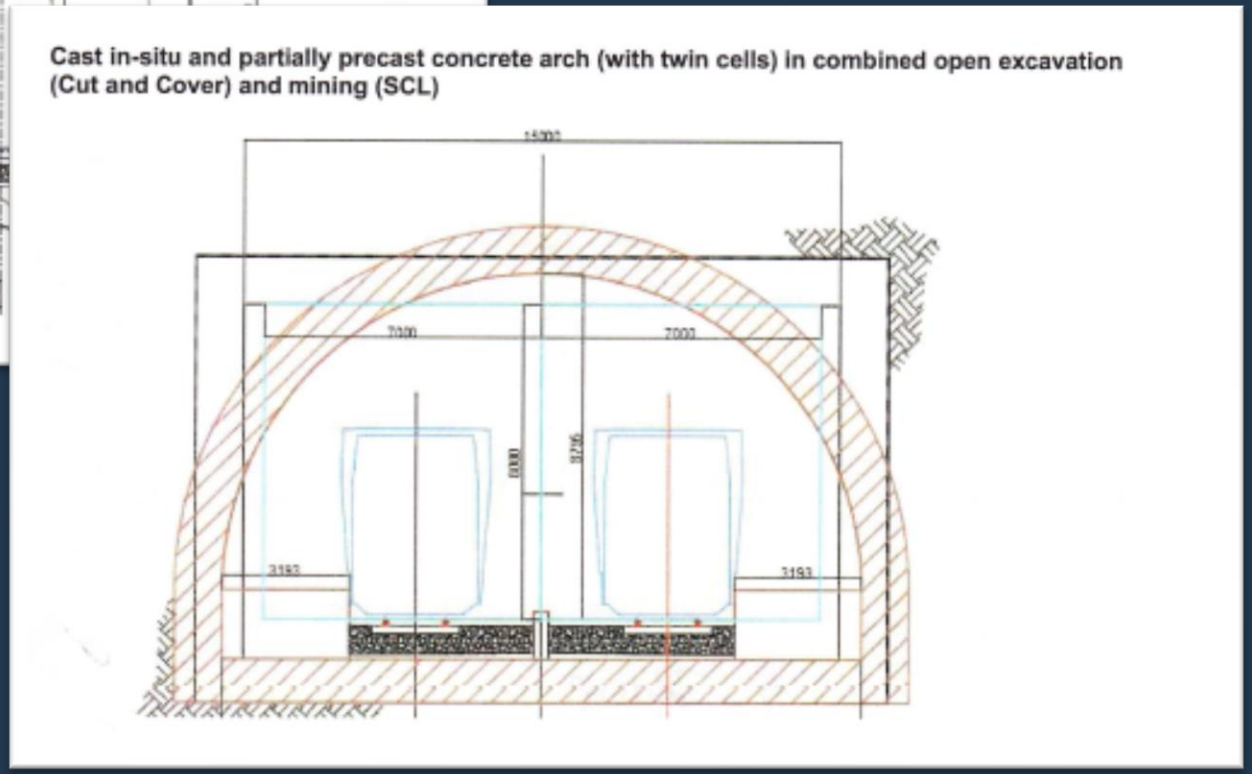
The Footprinting Process: Data Collection & Analysis



Example: building a train tunnel

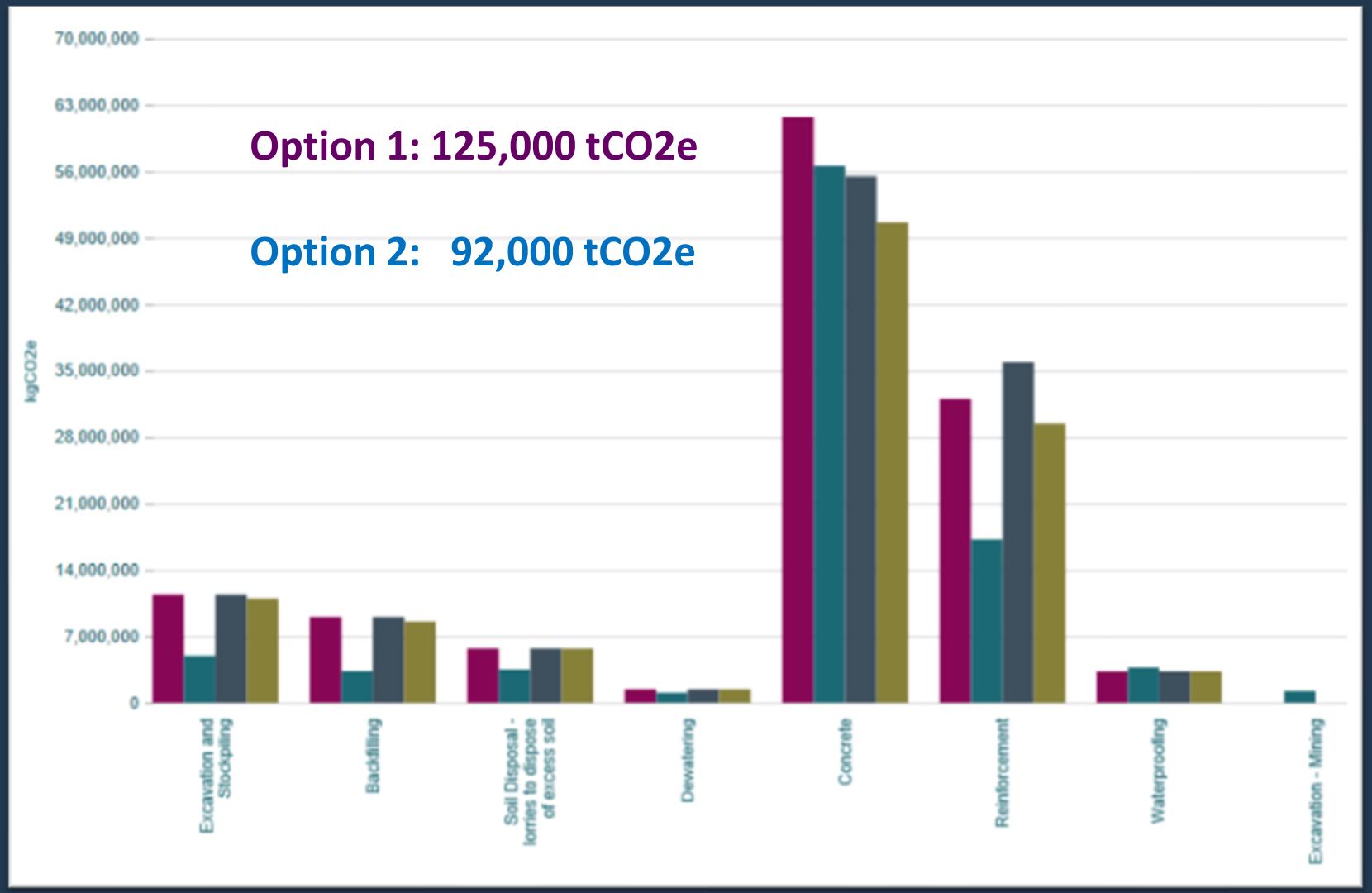
Different Engineering Options





- Variations on
  - Cut & cover and/or mining
  - Concrete and/or steel
  - Boxes and/or arches

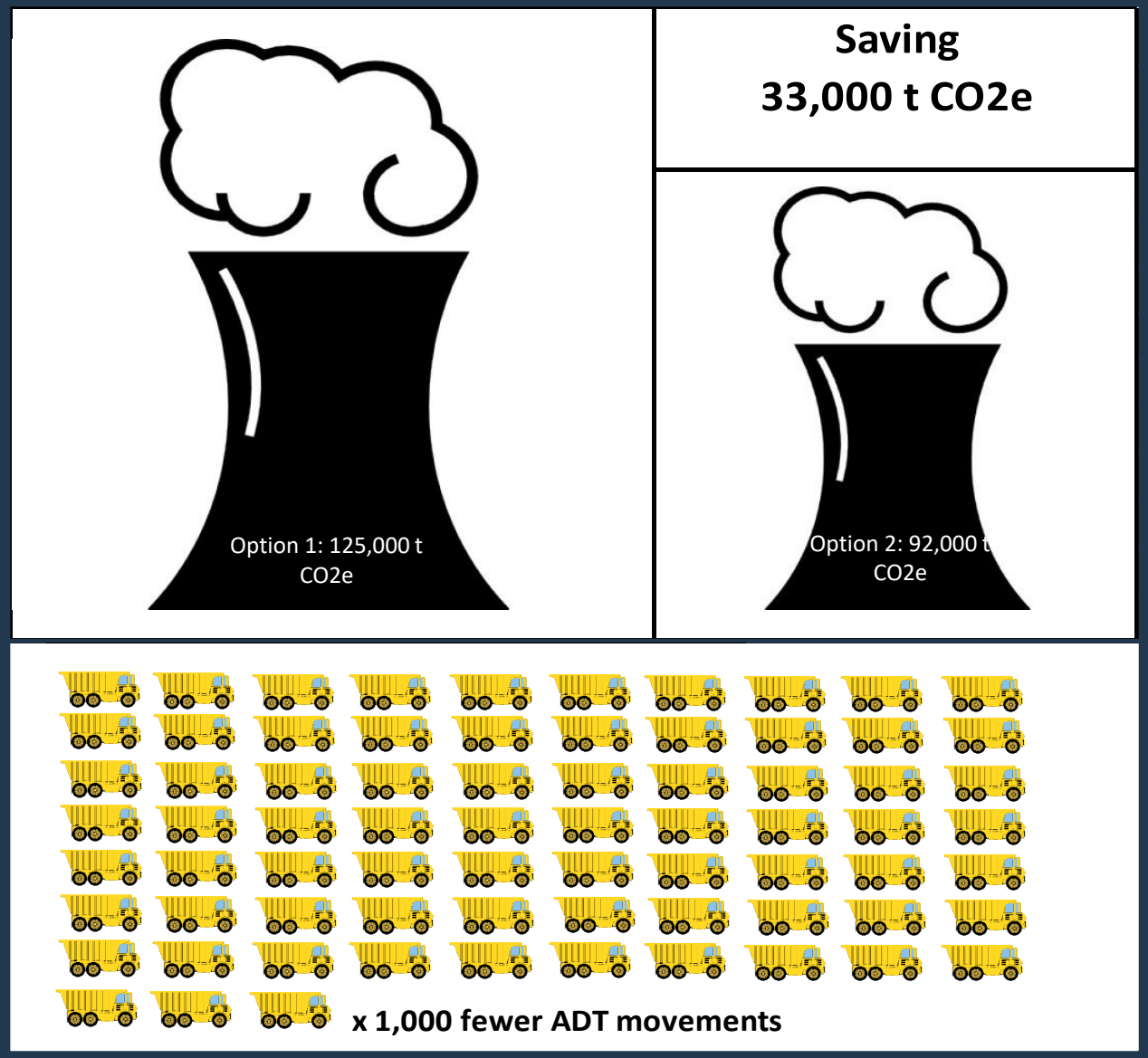
Carbon impacts for the options

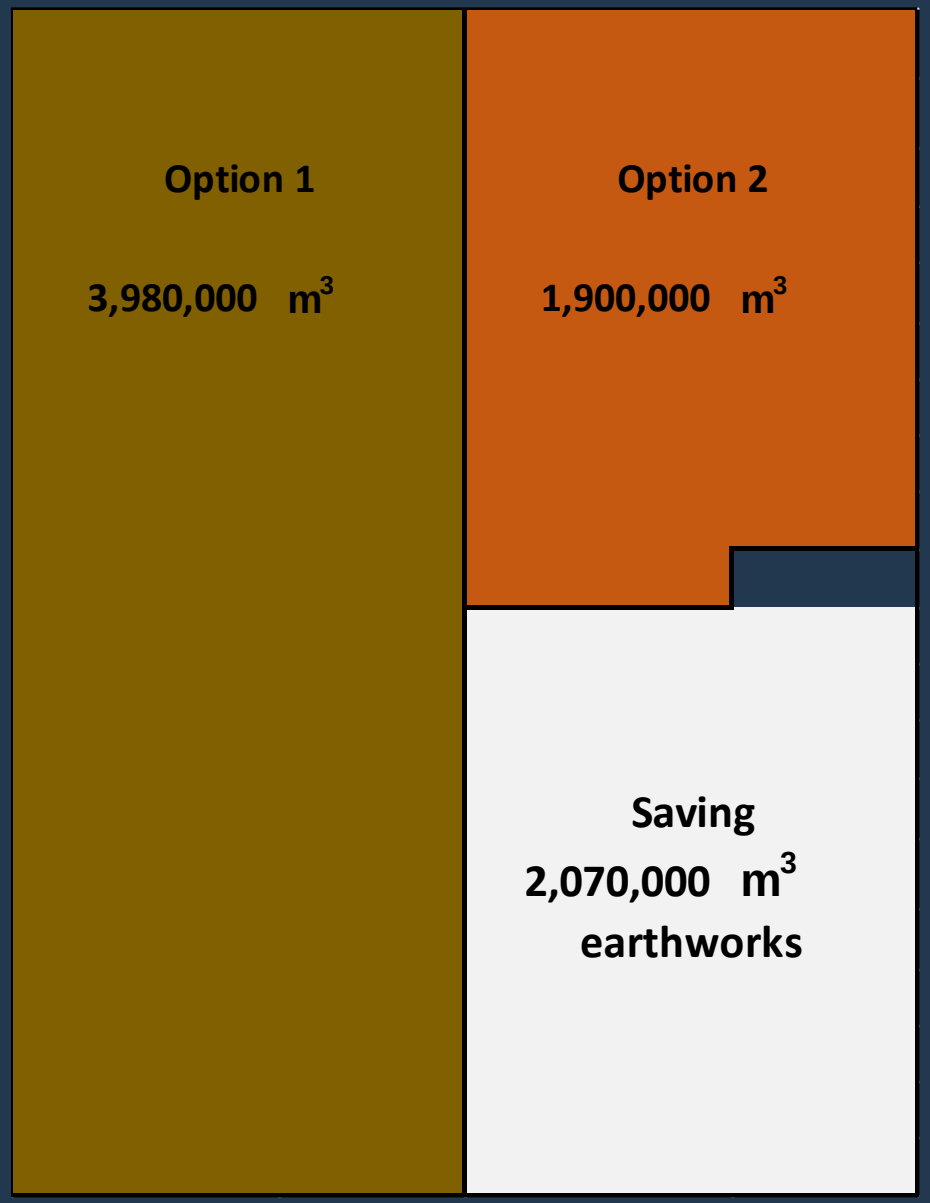


1. Excavation
2. Backfilling
3. Soil disposal
4. Dewatering
5. Concrete
6. Reinforcement
7. Waterproofing
8. Mining

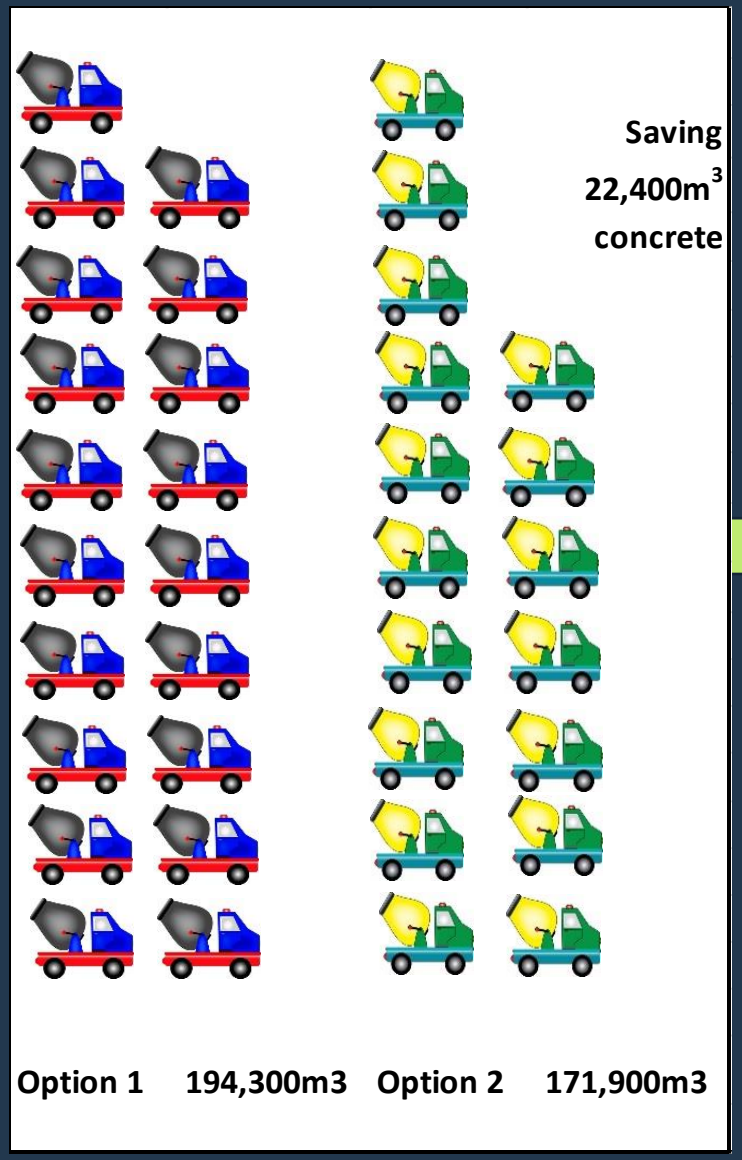
Savings: Option 1 vs Option 2

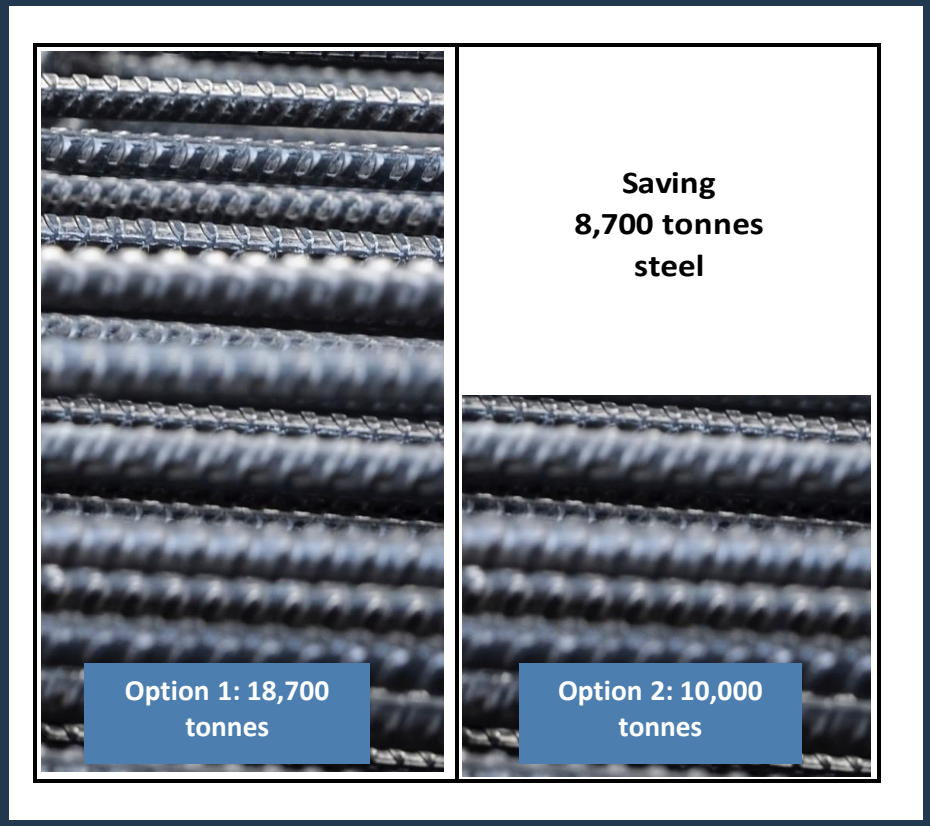
Carbon and Earthworks savings





Concrete and steel savings





Carbon Equivalency

- 33,000 tCO_2e saved is equivalent to avoiding:
  - 1000 HGVs, each driving 24,000 miles; or
  - 40 full A380 flights from LHR to NYC; or
  - Emissions from grid electric used in 32,000 UK homes for a year - equivalent to a town the size of Lichfield, or Darwen, or Motherwell

Exercise: Calculate the carbon footprint of concrete

- Use the data in the hand-out
- Look at the conversion factors:
  - Aggregates
  - Cement
- Calculate answers

Time: 15 mins

And the answers are…

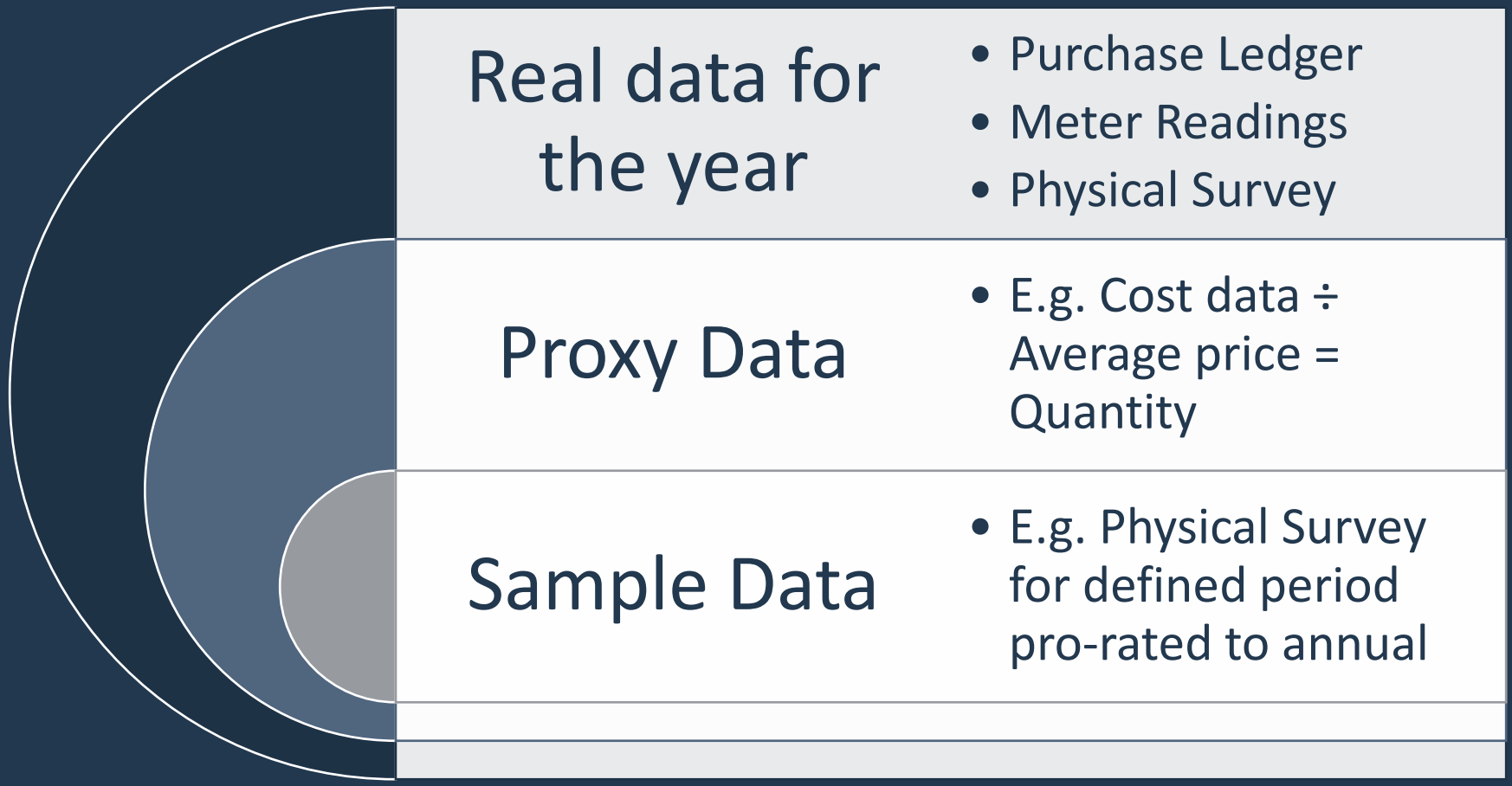
- 67.7 kg CO_2 per tonne

  or

- 148.8 kg CO_2 / m^3

Primary Data Sources

Sources of Data – Quantities (tonnes, m^3, etc.)



Challenges in Carbon Footprinting

Data

- Relevant data to your situation
- Reliable, unbiased data
- Up-to-date data

Time

- Control and influence
- Time constraints - what do you have time to collect?
- Pareto 80/20

Competence & Collaboration

Conversion Factors

Publicly Available

- Individual Company Research
- “Trade Body” / Sector Research
- Academic Research

Key Points Before Use

- Are all conversion factors comparable?
- What does it include/exclude?
- Up to date?

Resources Guidance – Data and Tools

A Selection of Free-to-use Tools and Databases to Calculate

- **Defra 2020 Greenhouse gas reporting conversion factors :** the UK Government's database of carbon factors for fuel, energy, transport, and materials, updated annually. https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2020
- **Bath Inventory of Carbon and Energy (ICE)** database: a well-established database of embodied carbon factors for a variety of materials, updated periodically. http://www.circularecology.com/embodied-energy-and-carbon-footprint-database.html
- **Environment Agency Carbon Calculator:** a free-to-download tool to calculate the carbon impact of different material and transport options in your project www.ice.org.uk/knowledge-and-resources/best-practice/environment-agency-carbon-calculator-tool
- **Highways England Carbon Tool:** a free-to-download Excel tool to calculate carbon emissions for operational, construction and maintenance activities undertaken on behalf of Highways England that draws on Defra and Bath ICE dataset www.gov.uk/government/publications/carbon-tool
- **The RSSB Rail Carbon Tool** is a web-based tool that allows you to calculate, assess, analyse, report and reduce your rail project carbon footprint by evaluating low-carbon options using verified, centrally-available carbon factor data that draws on Defra and Bath ICE datasets https://www.railindustrycarbon.com/
- **Carbon Trust Carbon Calculator** for SMEs: The Carbon Footprint Calculator has been designed to help UK based SMEs measure their corporate emission footprint following GHG Protocol Guidance, including direct emissions from fuel and processes (Scope 1 emissions) and those emissions from purchased electricity (or Scope 2 emissions) for the assets they operate https://www.carbontrust.com/resources/tools/carbon-footprint-calculator

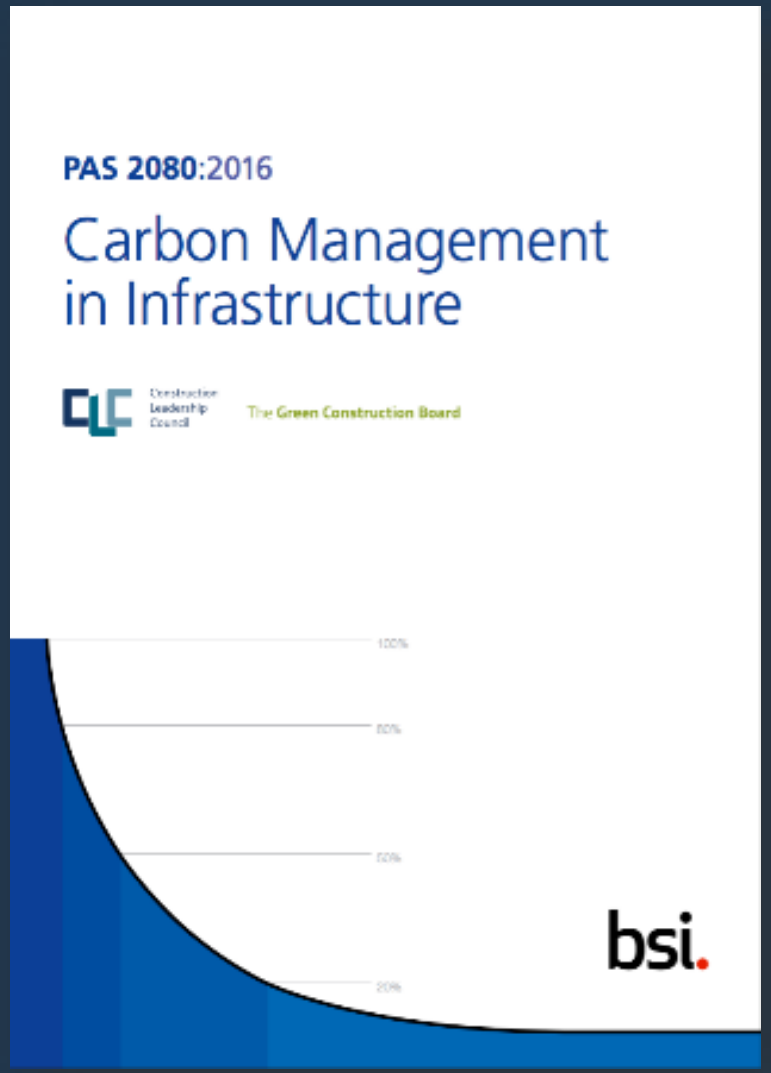
Introduction to relevant standards

- Accounting and Reporting of 6 greenhouse gases (Kyoto Protocol)
- GHG inventory using standardised approaches and principles
- Develop an effective strategy to manage and reduce GHG emissions
- Consistency and transparency in GHG Accounting and Reporting
- Construction-specific GHG Protocol - Encord

GHG Protocol

Introduction to relevant standards

PAS 2080: 2016



- Management of carbon reduction across infrastructure value chain
- Determining baselines, establishing metrics and setting targets
- Selecting carbon emissions quantification methodologies
- Reporting at appropriate stages & visibility of performance
- Continual improvement of management and performance

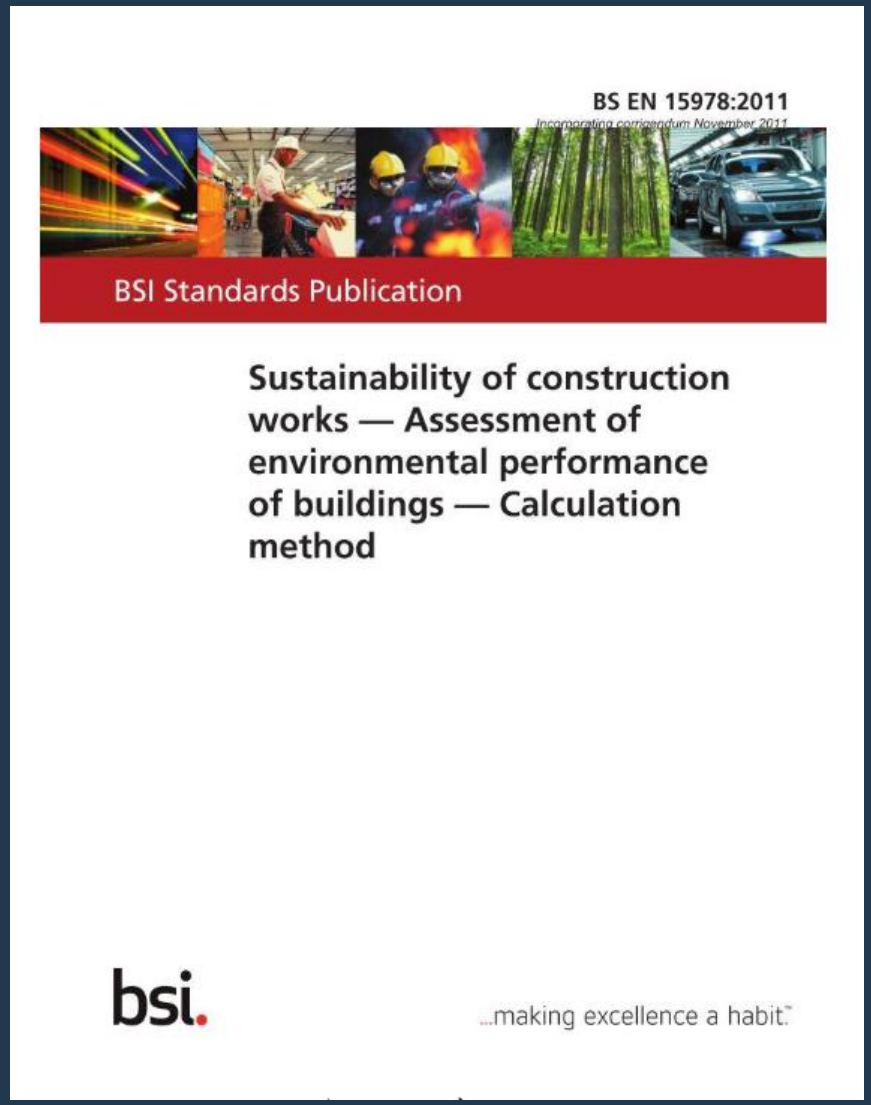
PAS2080: 2016

Introduction to relevant standards

BS EN 15978

BS EN 15978

- Applicable to construction projects, services and processes
- Provides a structure to capture all aspects of carbon emissions
- Encompasses life cycle: manufacture, construction, operation, maintenance and demolition
- Allows for fair comparison and a robust route to reducing carbon impacts
- Covers all environmental impacts of a construction project



Introduction to relevant standards

BS EN 15804

BS EN 15804

- Applicable to construction products, services and processes
- Provides a structure to ensure that all EPDs are derived, verified and presented in a harmonized way
- EPDs communicate verifiable, accurate, non-misleading environmental information for products
- Allows for fair comparison and a robust route to reducing environmental impacts
- EPDs = Environmental Product Declarations

Introduction to relevant standards

PAS 2050:2011

PAS 2050:2011

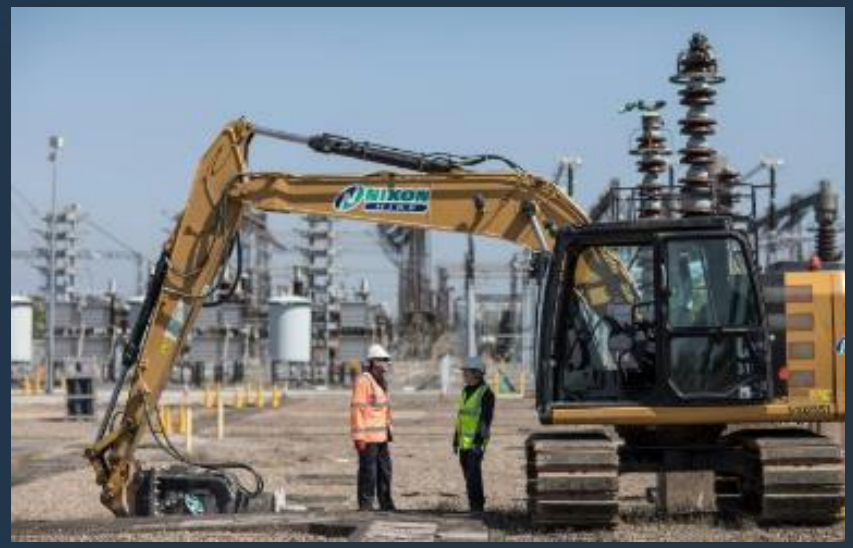
- Publicly Available Specification (PAS)
- Standardised approach to product Carbon Footprinting
- Applicable to products life cycle and/or cradle-to-gate
- Design for all organisation regardless of size and sector
- Additional economic, social and environmental impacts are **not** assessed

Business Reality

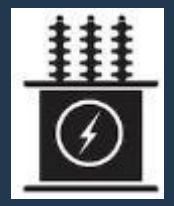
National Grid

"One idea that's really worked is the start of a 5% carbon weighting on our new construction projects.

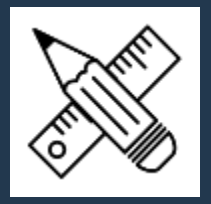
We're saying to our suppliers that if you can design a lower-carbon solution you stand a better chance of winning our business."



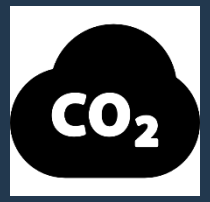
National Grid Example



- New electricity substation at Wimbledon



- Smarter thinking on design and use of materials



- Calculated carbon savings of 20% across the asset's life, equivalent to about 39,000 tCO_2

- Saved £3 million in costs compared with the original design

"By having clear data on carbon emissions, we can use energy and resources more efficiently. We've been able to prove the business case that lower carbon can equal lower cost"

Get a Carbon Reduction Strategy

Scope

Agree boundaries, base year and targets

Measure

Measure your footprint, identify hotspots and agree strategy

Reduce

Implement reduction actions, on hotspots first and then other aspects, using carbon hierarchy, and measure the reductions

Offset

Offset residual GHG emissions, but only after other actions have been taken

Report

Disclose your emissions and reduction actions. Follow up with revising and continual improvement

The end of the training… for now…

…but the beginning of your carbon reduction plans!....

Questions, Answers and Feedback

https://www.surveymonkey.co.uk/r/Introtocarbonworkshop

Thank you!

James Cadman

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