Introduction to the IGS Sustainability Benefits Calculator

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Special thanks to IGS Sustainability Committee members:
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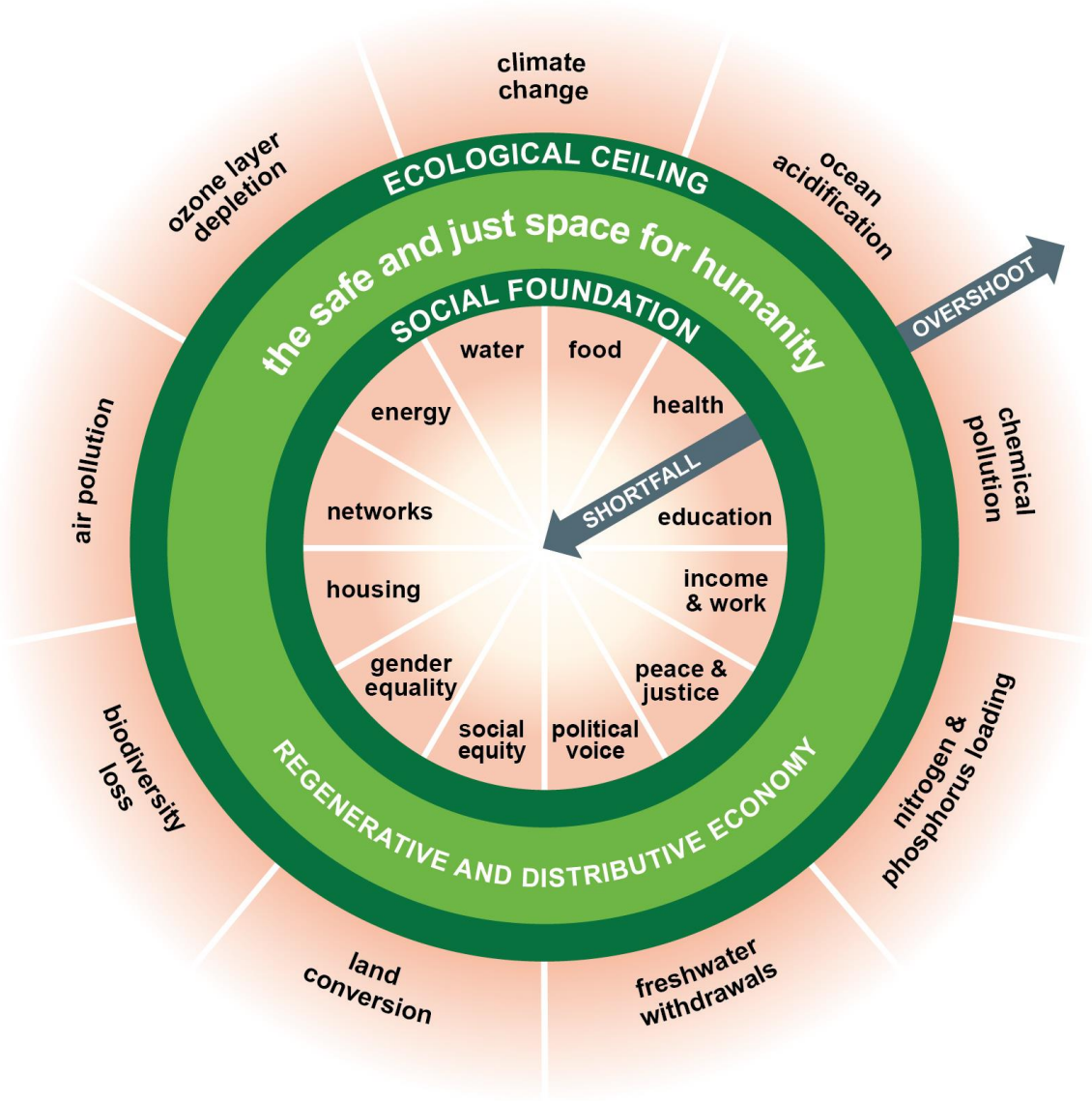
Goals

- What is sustainability?
- How is it measured?
- How does the IGS Sustainability Benefits Calculator help?

What is sustainability?



Doughnut Economics, Kate Raworth, 2017

What is sustainability?

- Geotechnical projects are directly related to several U.N. Sustainable Development Goals.

United Nations, 2026

How is it measured?

- **Measurable**
- ISO 21931-1:2022 - Sustainability in buildings and civil engineering works
- Framework for methods of assessment of the environmental, social, and economic performance of construction works as a basis for a sustainability assessment.
- Equal emphasis on environmental, social, and economic performance.

How is it measured?

- Sustainability value as a standalone score has no meaning. We must include some comparison.
- There is no unique way to measure sustainability.
- Examples using a sustainability tool in environmental geotechnical engineering
  - Reddy et al., 2024
  - Basu and Lee, 2021

How is it measured?

How to quantify each requirement?

- Environmental
- Economic

Life Cycle Assessment (LCA) / Costing (LCC)

- Functional unit
- Life Cycle Inventory
- (Environmental) Indicators

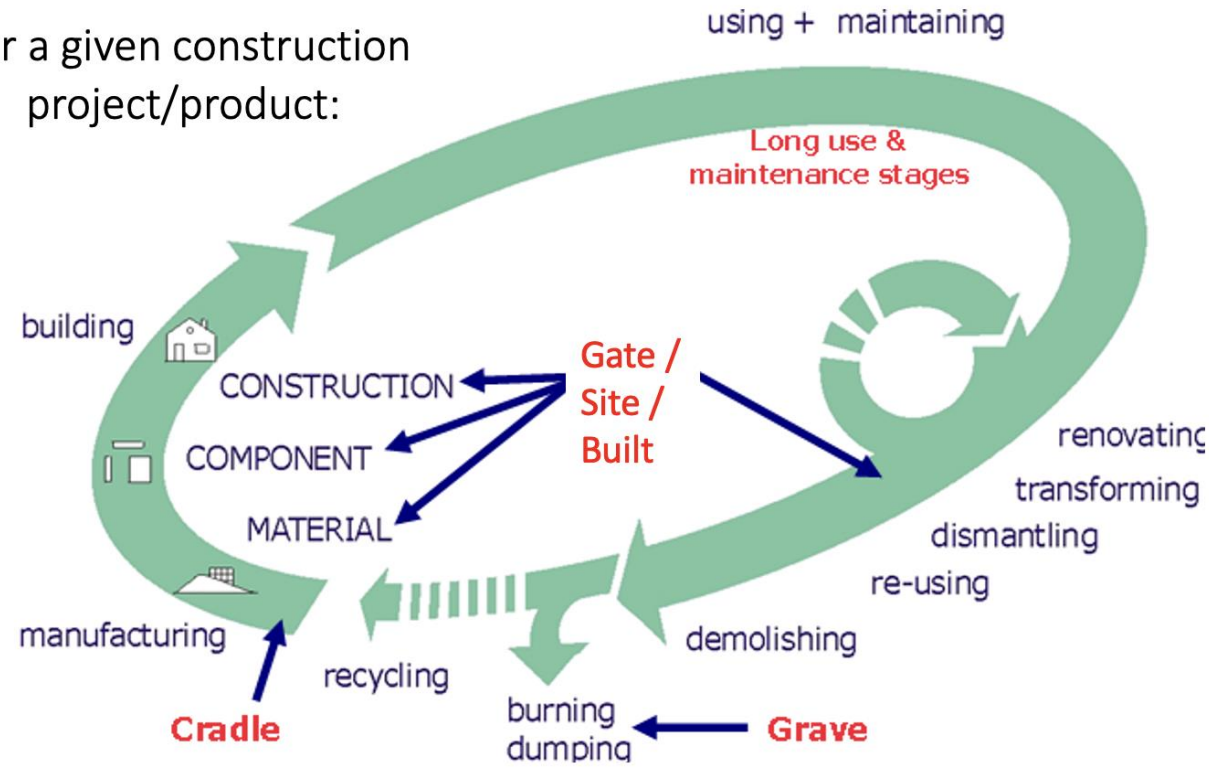
- Social
  - Surveys
  - Public opinion
  - Past experiences
  - …

- Functional
  - How future proof is the solution
  - Repairability
  - Climate effects?
  - (Resilience)
  - …

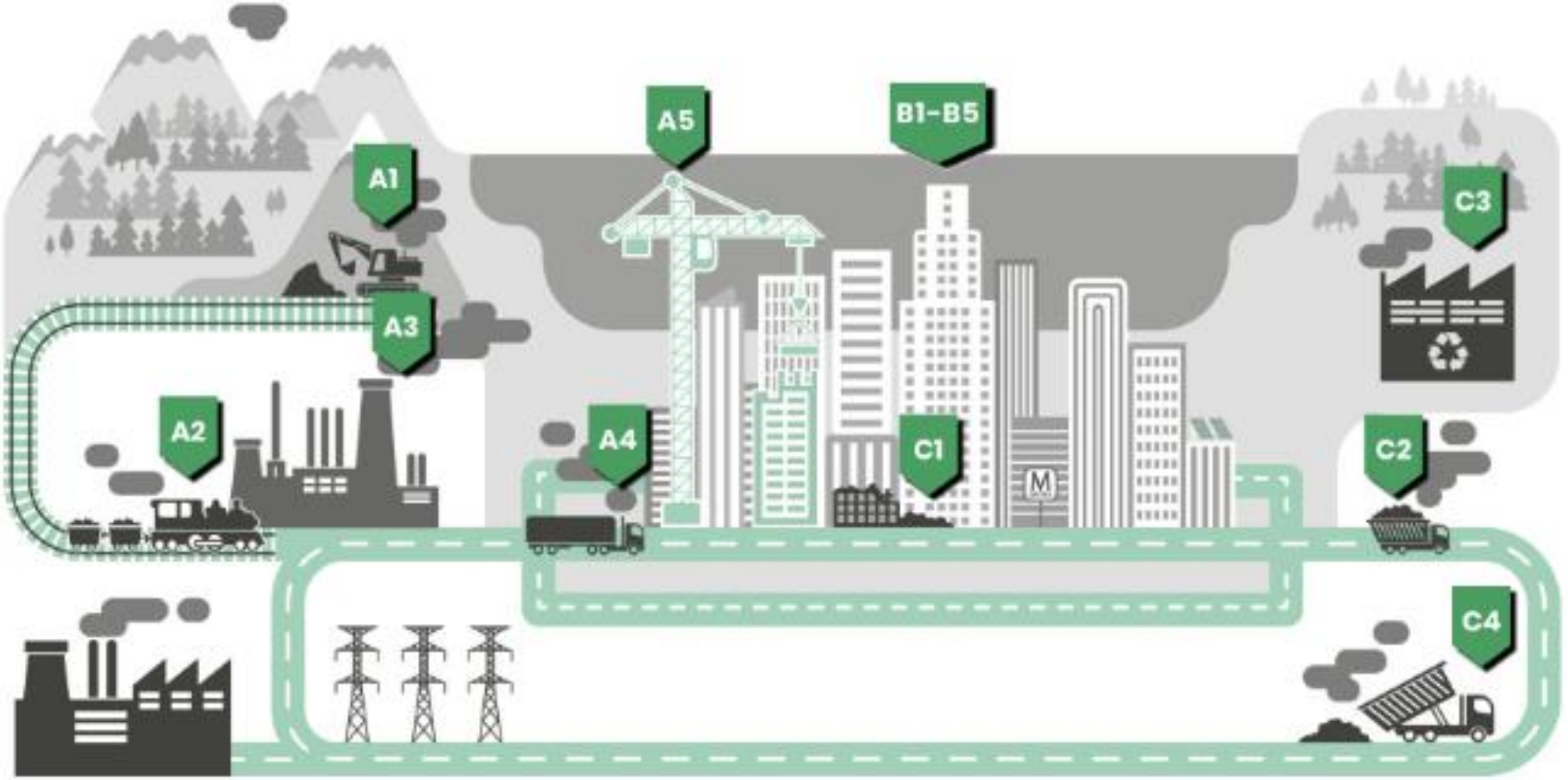
How is it measured?

Life cycle analysis - Stages

For a given construction project/product:



How is it measured?



OneClickLCA

How is it measured?

- Step 1 – Define the problem to be solved and the boundaries (needs, service life, environment, etc.)
- Step 2 – Define the functional unit, the quantified performance of a product system for use as a reference unit
- Step 3 – Define alternatives
- Step 4 – Quantify the life cycle inventory
- Step 5 – Calculate and assess.

IGS Sustainability Benefits Calculator

- **Utilizes OneClickLCA software**
  - Access to many LCA assessment tools
  - Facilities the creation of Environmental Product Declarations (EPDs)
  - IGS demos starter demos for geosynthetic-based scenarios.

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- **Landfill drainage project**
- Assumptions for this project
  - Energy consumption:
    - Earth movements: 4.4 MJ/m3 (Berg et al. 2000)
    - Placement of geosynthetic layers: 1 MJ/m2 (Berg et al. 2000)
- Transportation:
  - Gravel, bitumen, cement: 50 km via lorry
  - Geosynthetics: 400 km by rail, 200 km by lorry
  - Metals and plastics: 100 km by lorry, 200 km by rail

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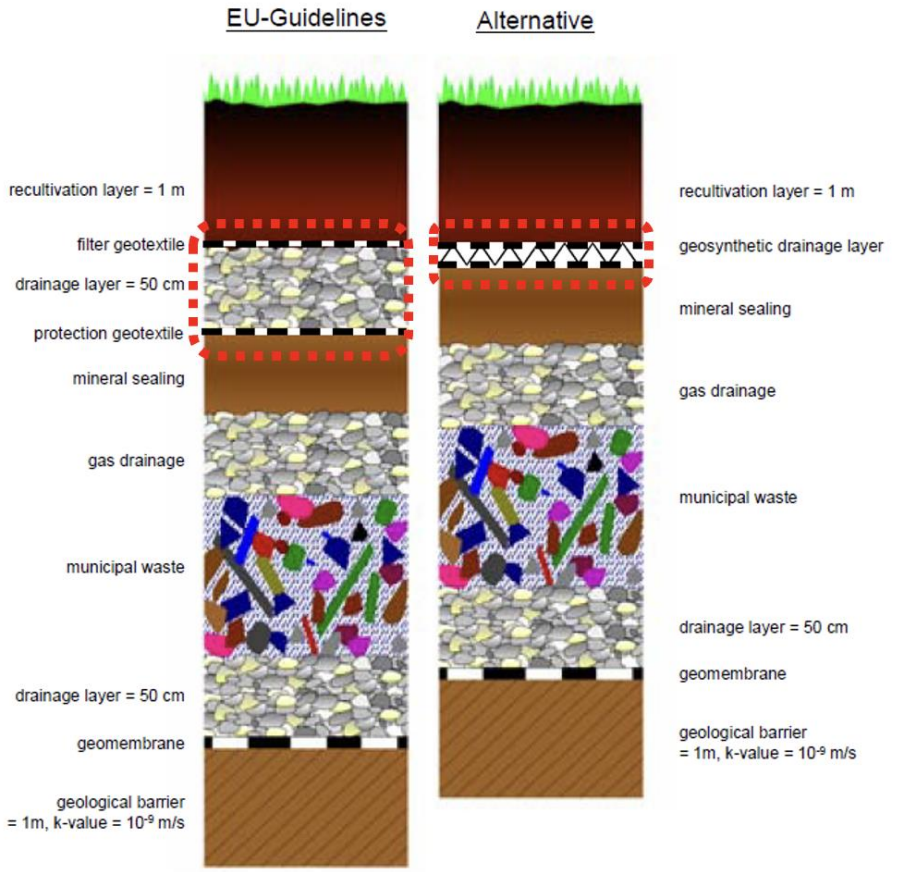
Case 1 - Landfill drainage layer

- Comparison of drainage systems over a waste landfill site.
- **Function**: Provide a proper drainage layer in a landfill cap of a waste landfill site by discharging infiltrating rainwater from the surface.
- **Functional unit**: Construction and disposal of 1 m^2 surface area drainage layer with a hydraulic conductivity of 1 mm/s or more and 100 years of life time.
- Based on the work of Werth et al. (2012)



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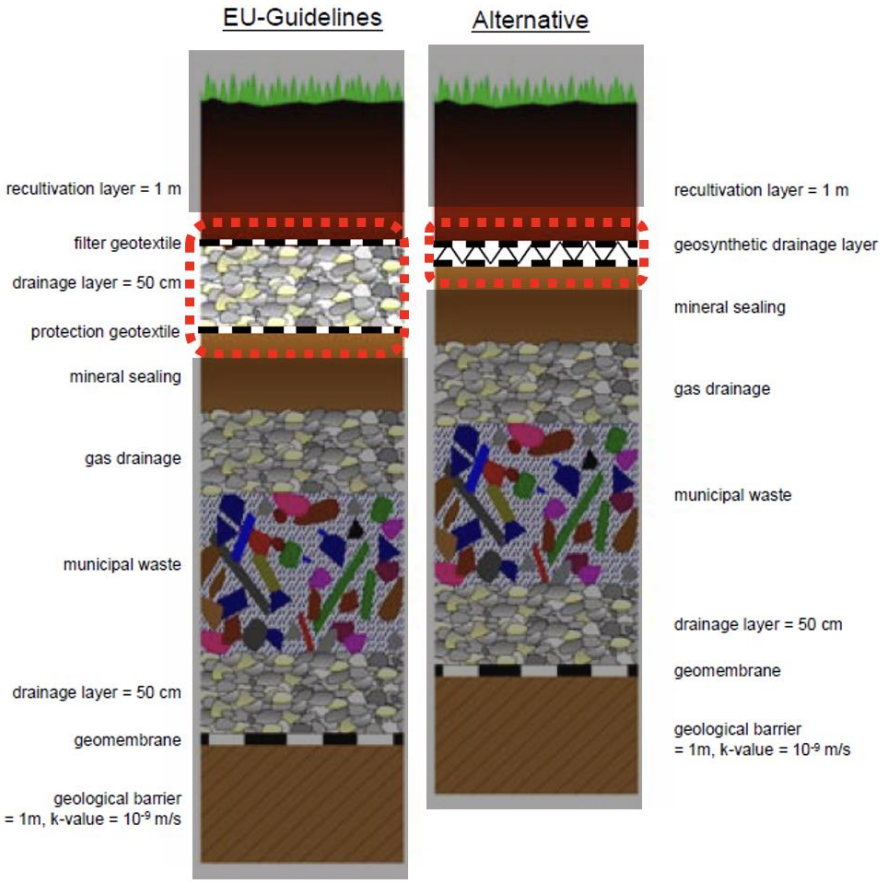
Case 1 - Inventory

Item	Unit	Case 1A	Case 1B
Gravel	t/m^2	0.90	-
Geosynthetic filter layer	m^2/m^2	1	-
Geosynthetic protection layer	m^2/m^2	1	-
Geosynthetic drainage core	m^2/m^2	-	1
Diesel used in building machines	MJ/m^2	4.5	3.8
Transport, lorry	tkm/m^2	45.1	0.2
Transport, freight, rail	tkm/m^2	0.1	0.3



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1. Foundations and substructure

Materials in the foundations will never be replaced, no matter assessment period length (except for RE2020 and FEC tools). For BREEAM UK Mat 1 IMPACT equivalent provide the data for site excavation fuel use here, choose resource Excavation works.

Foundation, sub-surface, basement and retaining walls ⇄ Compare answers

Start typing or click the arrow

Resource	Quantity		CO_2e	Comment	Classification	Transport, kilometers		Transport, leg 2, kilometers	
Aggregate (crushed gravel), generic	0.5	m3	4.8kg - 61%		Gravel	50	Dumper truck, 19 ton	0	Train, average
Geotextile, generic, 312 g/m2 (1.02	0.32	m2	0.25kg - 3%	Protection layer, recycle	Geotextile	200	Trailer combination, 40	400	Train, average
Geotextile, generic, 312 g/m2 (1.02	1.04	m2	0.8kg - 10%	Protection layer, landfill	Geotextile	200	Trailer combination, 40	400	Train, average
Geotextile, generic, 312 g/m2 (1.02	0.64	m2	0.92kg - 12%	Protection layer, incineration	Geotextile	200	Trailer combination, 40	400	Train, average
Geotextile, generic, 312 g/m2 (1.02	0.0384	kg	0.1kg - 1%	Filtration layer, recycle	Geotextile	200	Trailer combination, 40	400	Train, average
Geotextile, generic, 312 g/m2 (1.02	0.1248	kg	0.31kg - 4%	Filtration layer, landfill	Geotextile	200	Trailer combination, 40	400	Train, average
Geotextile, generic, 312 g/m2 (1.02	0.0768	kg	0.36kg - 4%	Filtration layer, incineration	Geotextile	200	Trailer combination, 40	400	Train, average

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Resource	Quantity		CO_2e	Comment	Classification	Transport, kilometers		Transport, leg 2, kilometers	
Geocomposite from polypropylene, W	0.1152	kg	0.29kg - 11%	0.72 kg/m2, recycle	Geocomposite	400	Trailer combination, 40	400	Train, average
Geocomposite from polypropylene, W	0.3744	kg	0.93kg - 35%	0.72 kg/m2, landfill	Geocomposite	400	Trailer combination, 40	400	Train, average
Geocomposite from polypropylene, W	0.2304	kg	1.1kg - 40%	0.72 kg/m2, incineration	Geocomposite	400	Trailer combination, 40	400	Train, average

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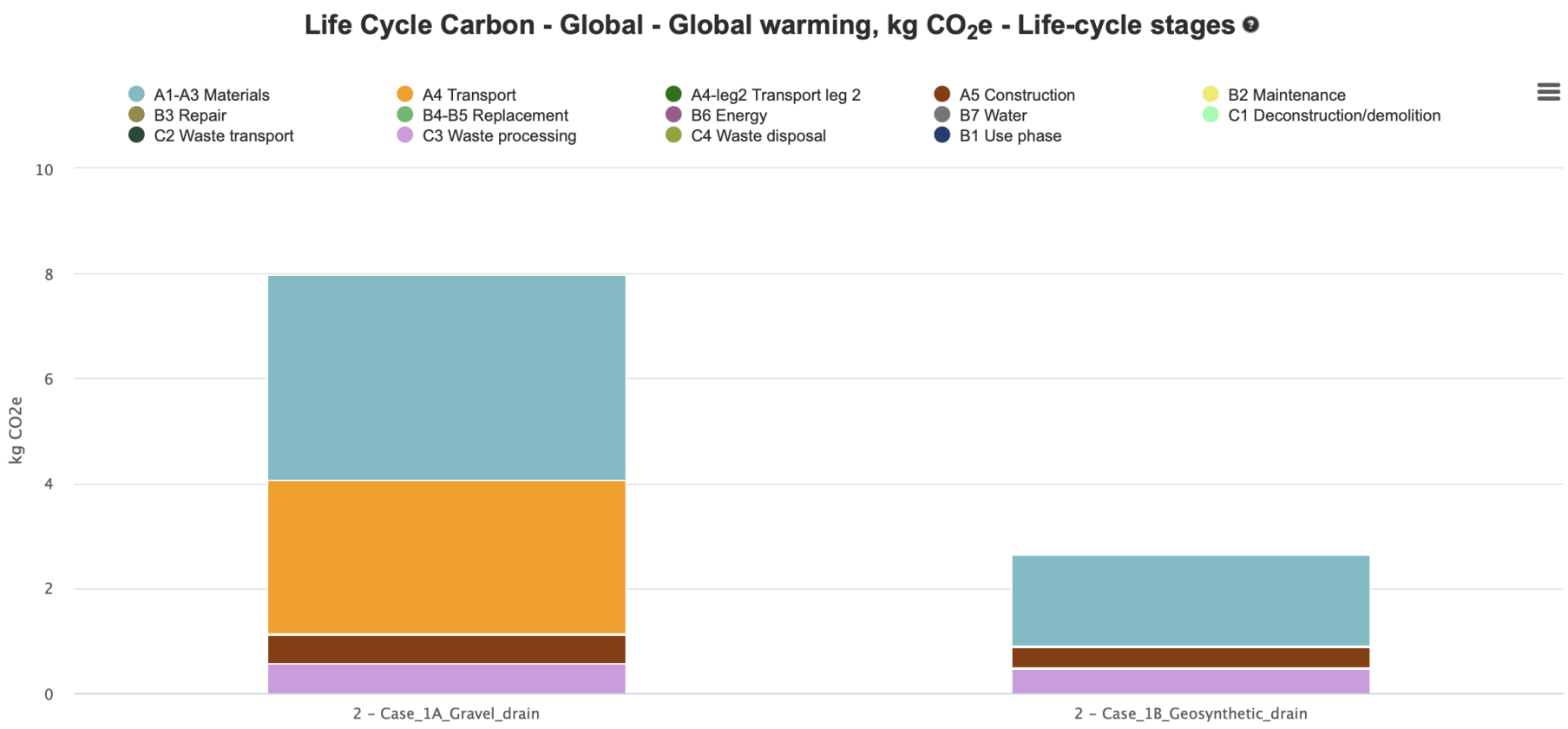

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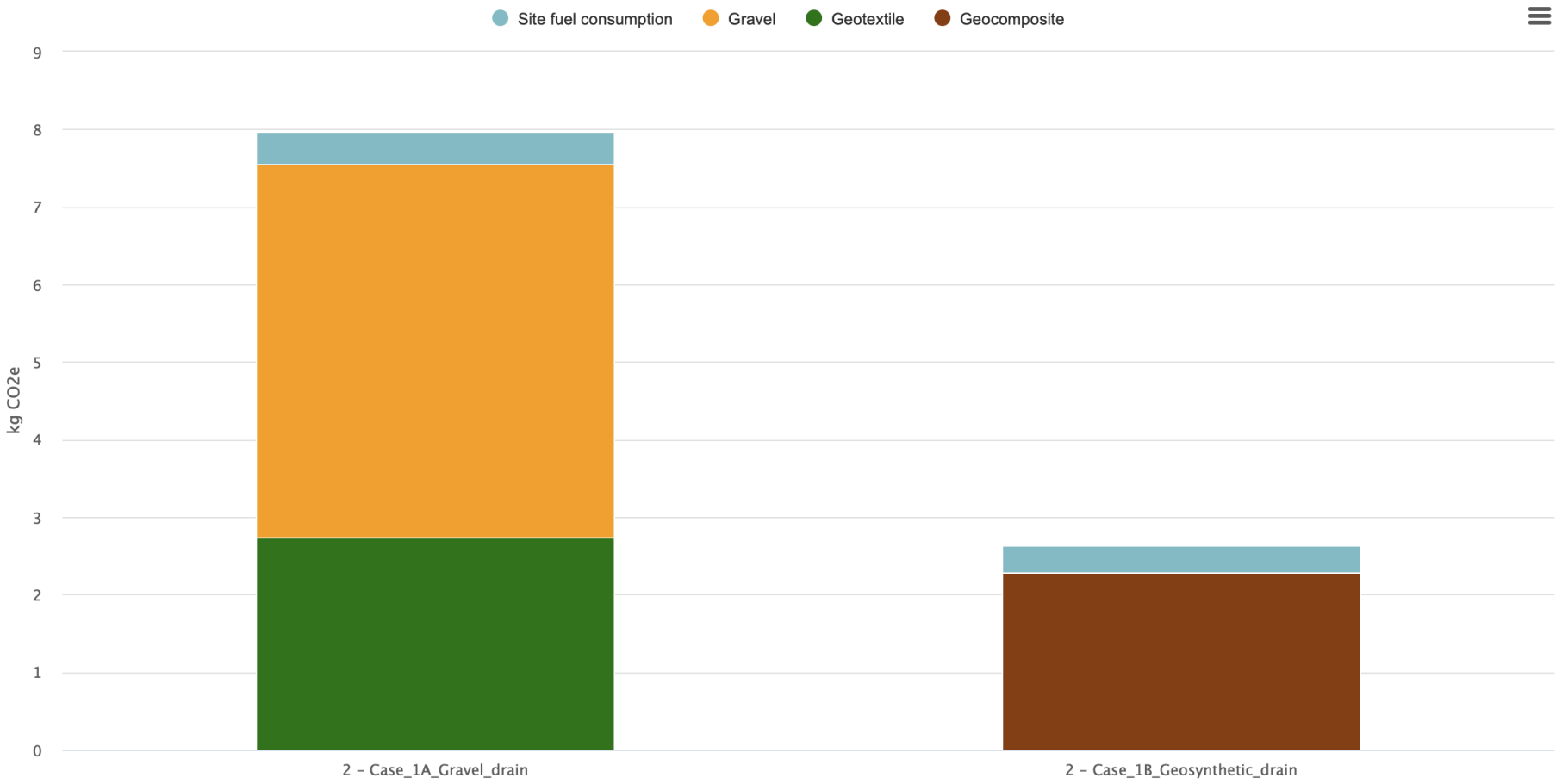

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Interested? Join IGS to gain access

https://www.geosyntheticssociety.org/sustainability/calculator/

Questions?

Thank You For Attending!

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