The Role of Geosynthetics in Combatting the Effects of Global Warming

Tom Sangster
Downley Consultants Ltd
Switzerland

DOWNLEY CONSULTANTS

GEOANZ #1 ADVANCES IN GEOSYNTHETICS
7–9 JUNE 2022 | BRISBANE CONVENTION & EXHIBITION CENTRE

COP26

Already increases in:

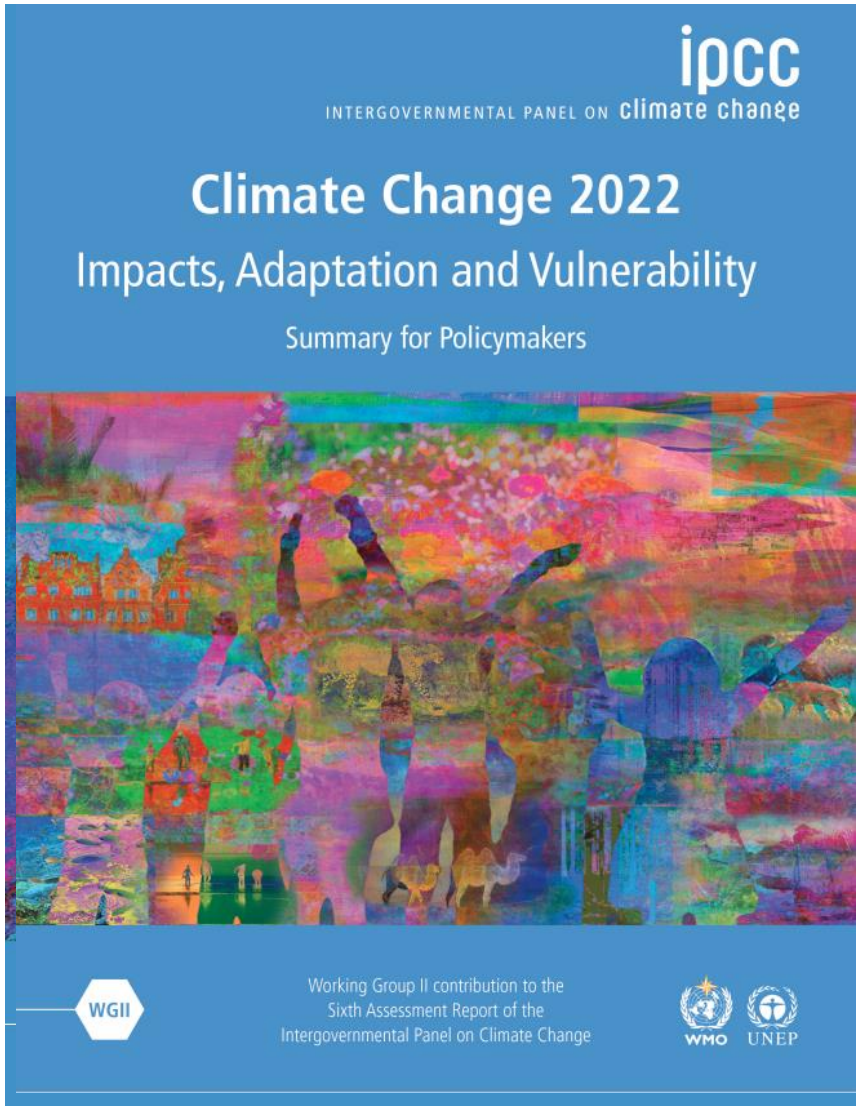
- Extreme high temperatures
- Torrential rain
- Droughts
- Weather conditions conducive to wildfires

Efforts to adapt to a changing climate are inadequate but…

…. in/by 2035

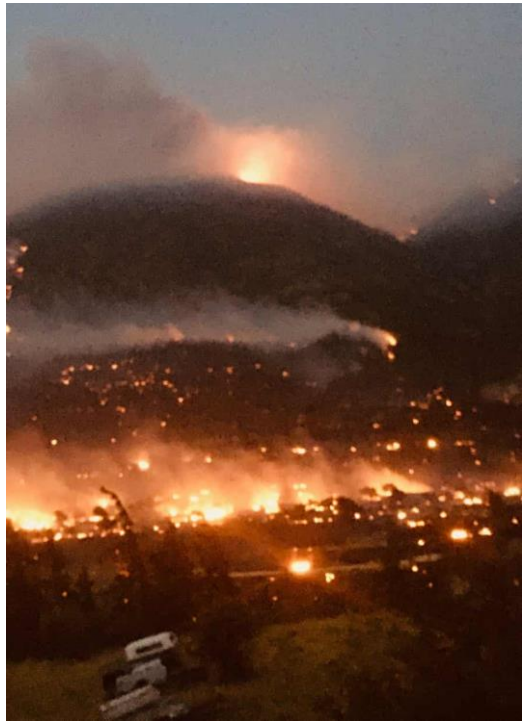
Beware of maladaptation –when efforts to deal with the impacts of climate change do more harm than good

… in/by 2050



Erftstadt, Germany
15 July 2021
196 dead (all Germany)

Zhengzhou, China
20 July 2021
12 dead



Lytton, Canada
30 June 2021
49°C previous day

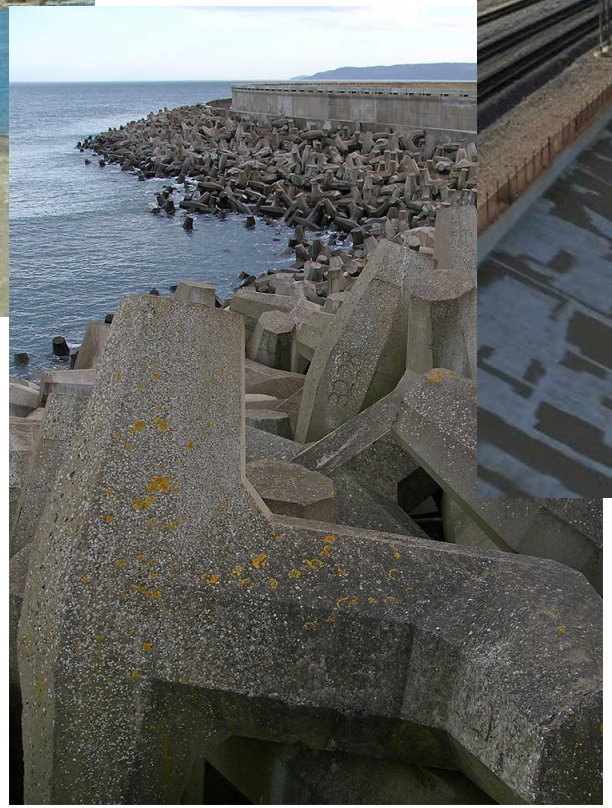
Lismore NSW 28 February 2022 (Source: The Guardian)

Brisbane 28 February 2022 (Source: ABC News)

Australia 2021 (Source: Univ. of Melbourne)

Australia 2020 (Source: REDUX Pictures)

Water Management

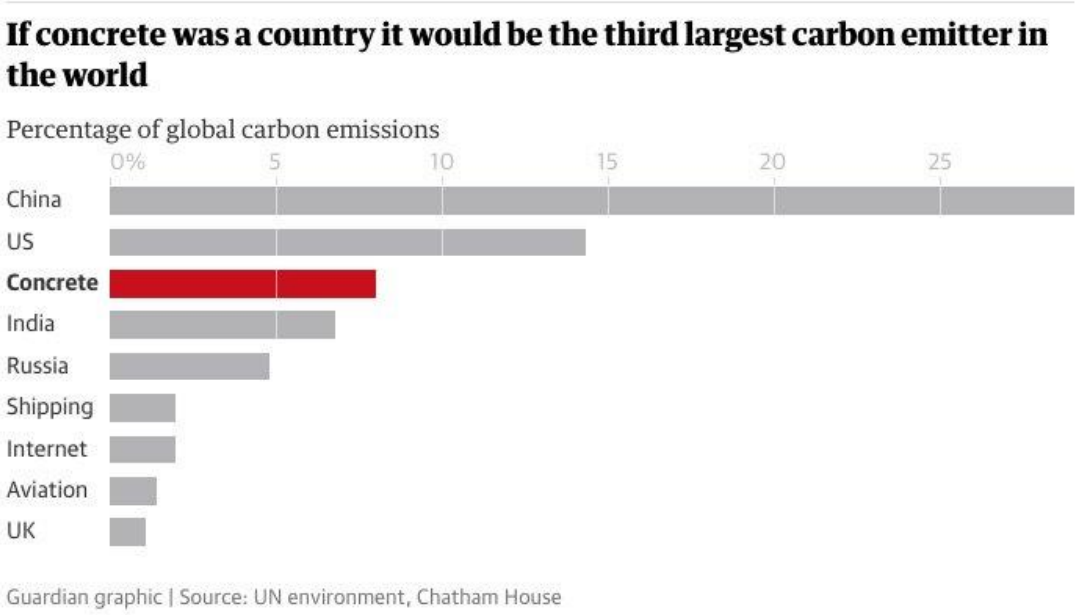


Keep it out

Or take it away

Water Management

LOTS OF CONCRETE



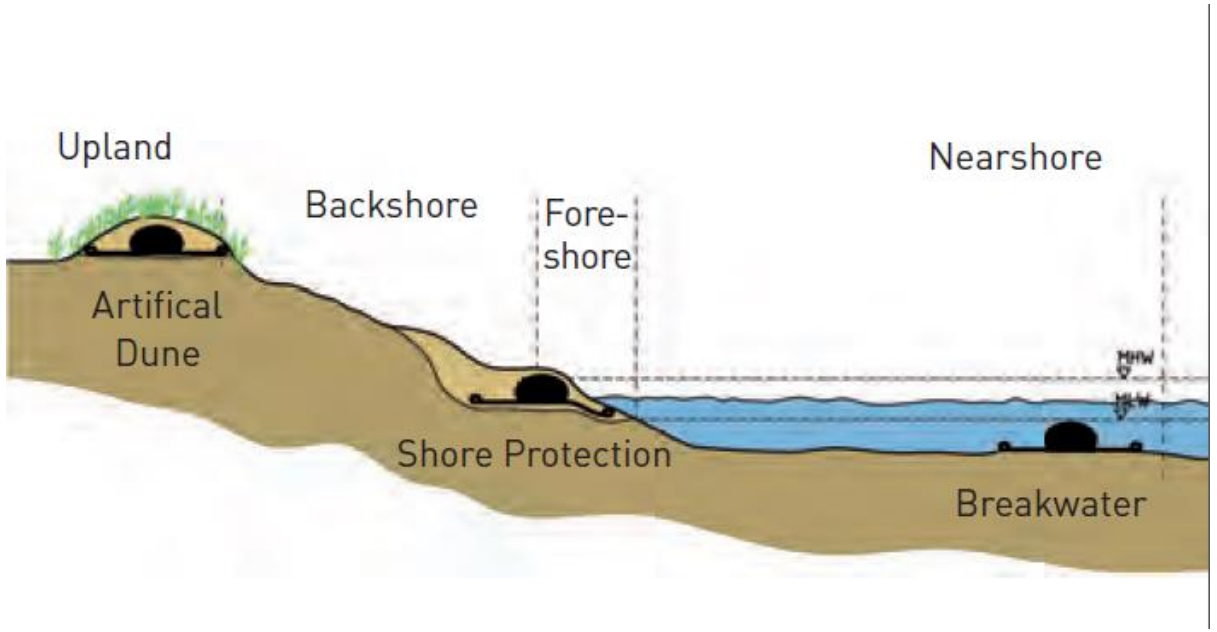
- **The construction industry is responsible for 11% of the world's man-made CO_2 emissions**
- **The industry's carbon footprint is not shrinking**
- **The solution makes the problem worse**
- **This is the opposite of sustainable**

Water Management

OR LOTS OF STONE

- **Depletion of natural resource**
- **Large number of truck journeys**
- **May travel long distance from source**
- **Very large carbon footprint**
- **Again not sustainable**

Water Management with Geosynthetics



Keep it out

Geocontainers

Water Management with Geosynthetics

Take it away

Geomats, GCCM & turf reinforcement mats

Water Management with Geosynthetics

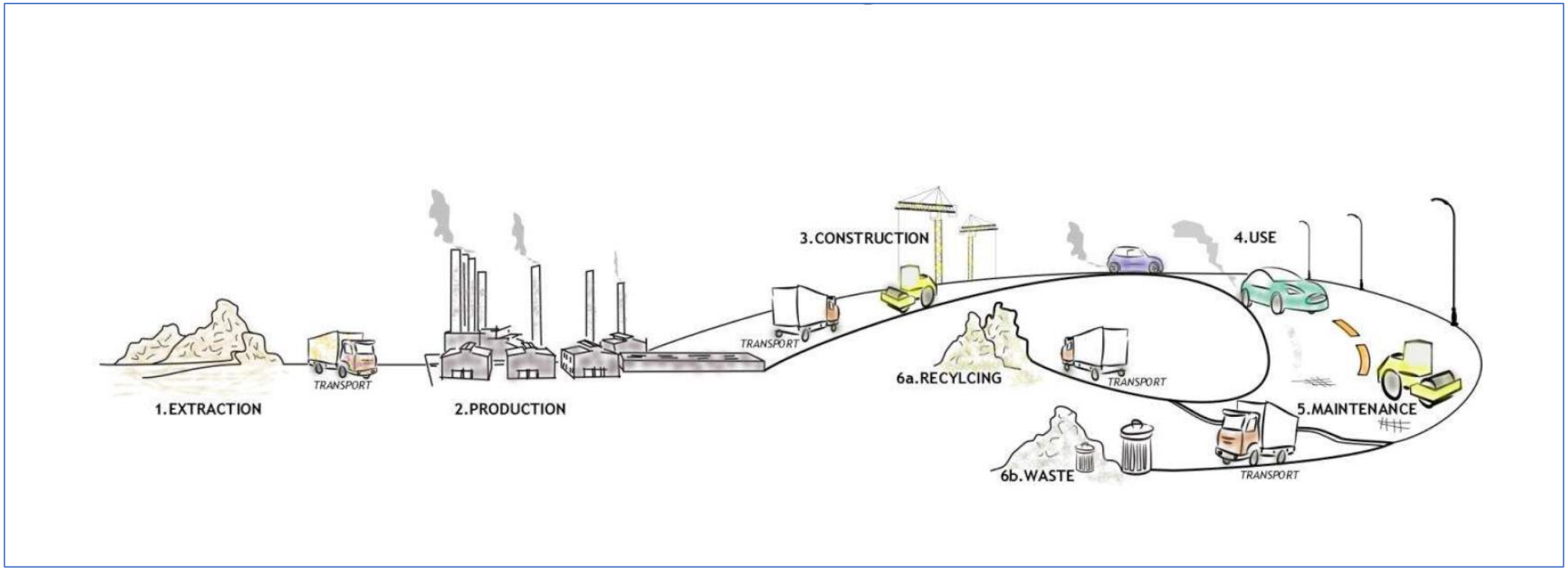
Geomats & geotextiles

Soft solutions & stormwater storage

Measuring the Environmental Benefits

LIFE CYCLE ANALYSIS (LCA)

- **Cradle to grave**
- **Compares different methods of construction**



Measuring the Environmental Benefits

LCA considers several aspects.:

- **Greenhouse gas emissions**
- **Particulate matter formation**
- **Summer smog**
- **Eutrophication**
- **Abiotic resource depletion**
- **Acidification**
- **Land use related impacts**
- **Cumulative energy demand**
  - non-renewable
  - & renewable

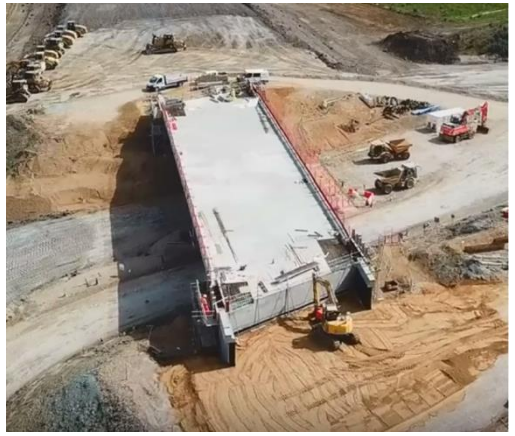
It is a central part of a larger sustainability analysis

Measuring the Environmental Benefits

4 Case Studies

- £1.5 billion (A$2.7 billion) road project – UK
- Offshore wind farm project – Germany
- Reinforced concrete v. reinforced soil retaining wall
- Landfill capping drainage project

Case Study 1 – UK A14 Huntingdon to Cambridge



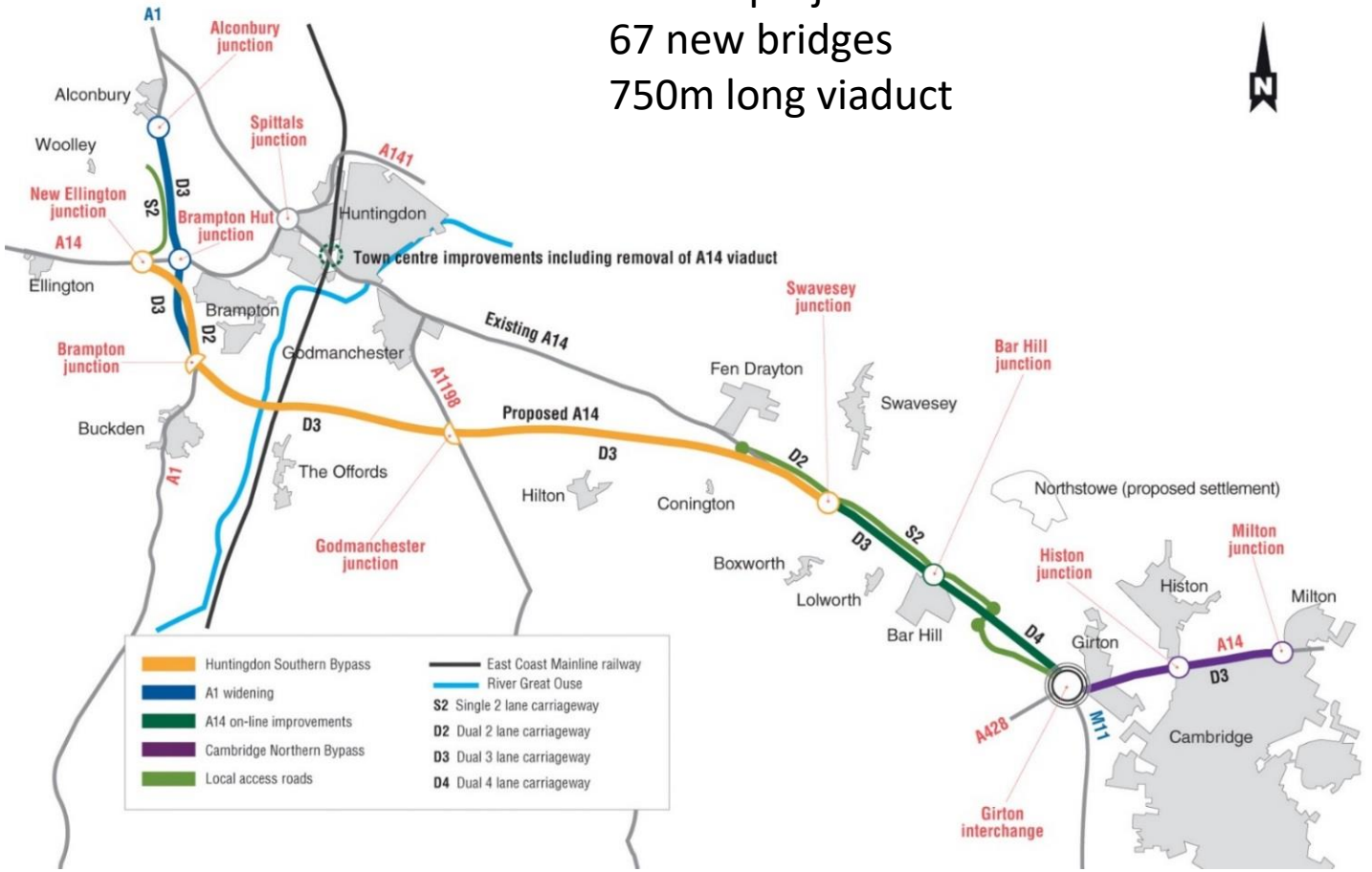
Carbon reduction target for site from specification – 20%

3 main contractor JV all represented on each section

£1.5bn project

67 new bridges

750m long viaduct



Structural Drainage to Buried Structures

Comparison between three alternatives based on 55sqm of wall coverage (typical size of roll)

1. Geocomposite
2. Hollow concrete blocks filled with gravel
3. No-fines concrete

Output

Construction Stage	ABG Deckdrain	Hollow concrete blocks and gravel	No-fines concrete
Part A - Removal of waste material	-	-	-
Part B - ECO_2e of imported materials	148 kg	1,220 kg	2,475 kg
Part C - CO_2e from transporting imported materials to site	2 kg	49 kg	524 kg
Part D - CO_2e emissions during Construction	-	520 kg	1,311 kg
Total CO_2e	**150 kg**	**1,789 kg**	**4,310 kg**
Replacing the Hollow concrete blocks and gravel with an ABG Deckdrain results in CO2e emissions being reduced by:		**92%** ✓	**97%** ✓

92% CO_2e reduction
Geocomposite v hollow concrete blocks
And it was lower cost $$$!

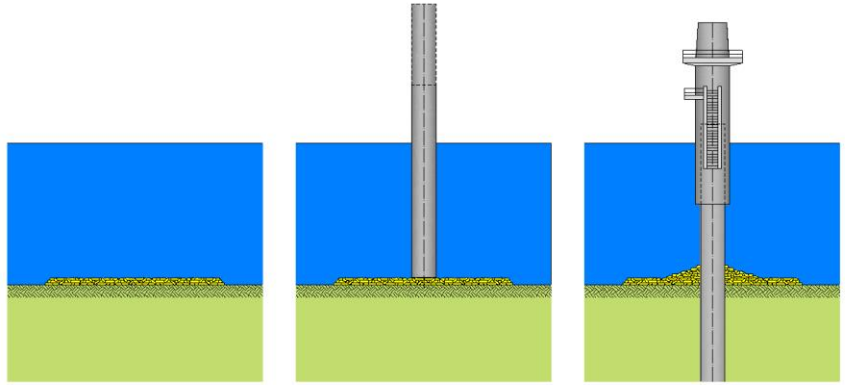
Offshore Wind Farm Scour Protection - Germany

OWF Amrumbank: Solution and Experiences with Geotextile Sand Containers

Sellhorn INGENIEURGESELLSCHAFT

OWF Amrumbank West

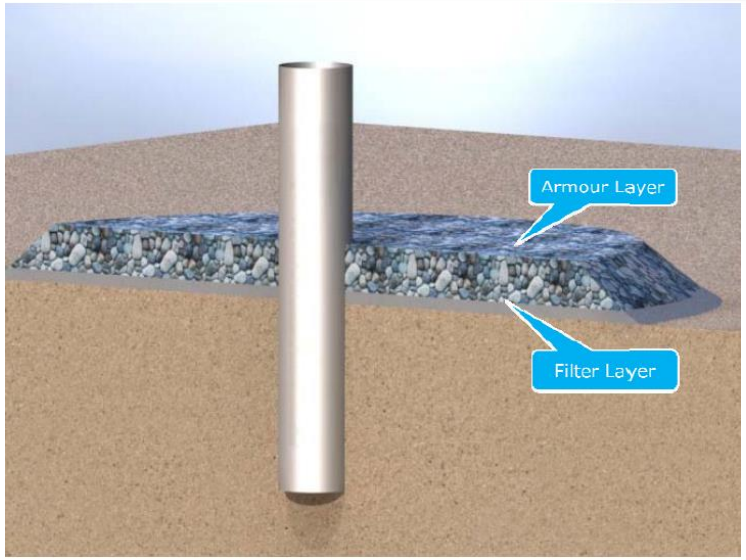
- Client: e.on Kraftwerke
- Location: North Sea
- Project Area: 32 km²
- Number of Turbines: 80
- Installed Capacity: 288 MW
- Distance to Shore: 33 km
- Start Offshore Activities: April 2012
- Completion: 2015

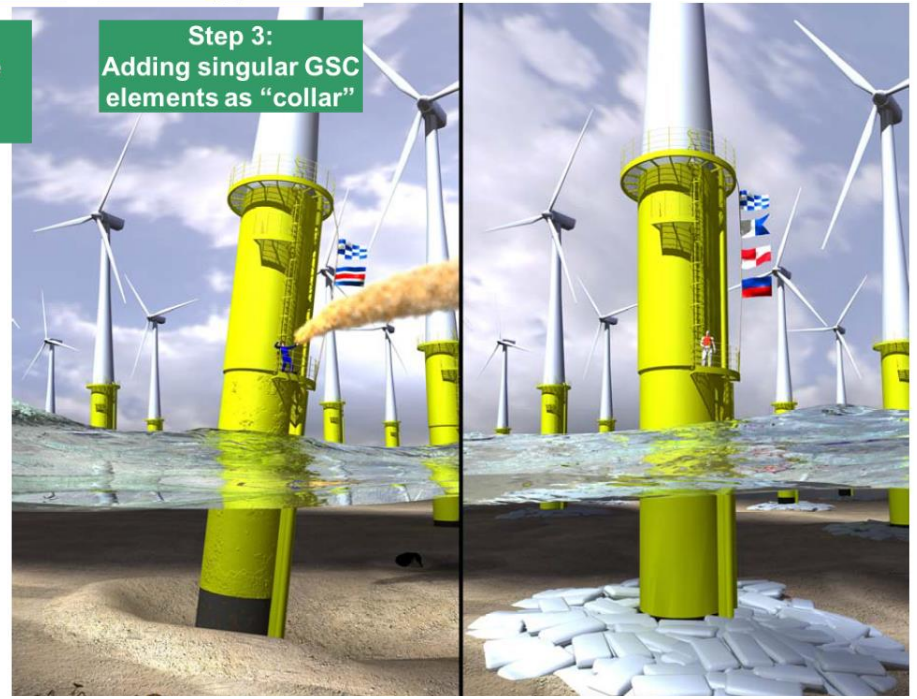


Step 1: 2 layers GSC as effective scour protection

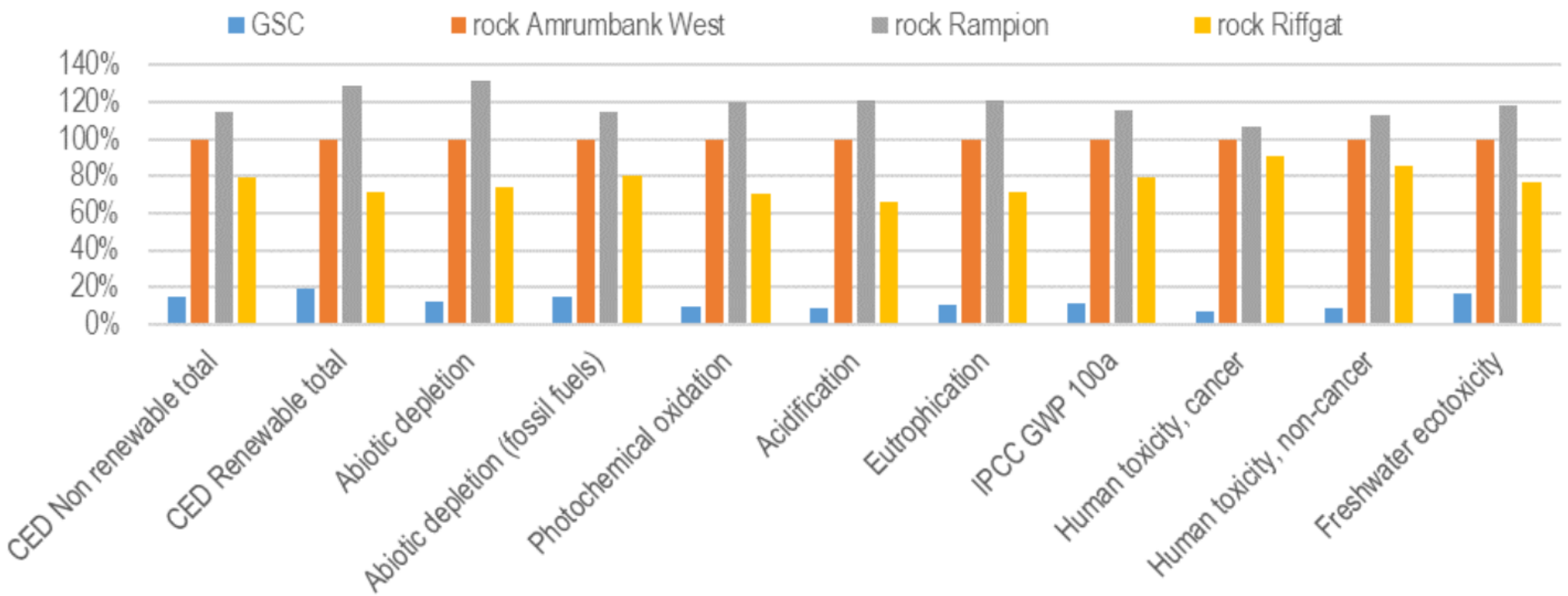
Step 2: Mono-Pile driving

Step 3: Adding singular GSC elements as "collar"





Offshore Wind Farm Scour Protection - Germany

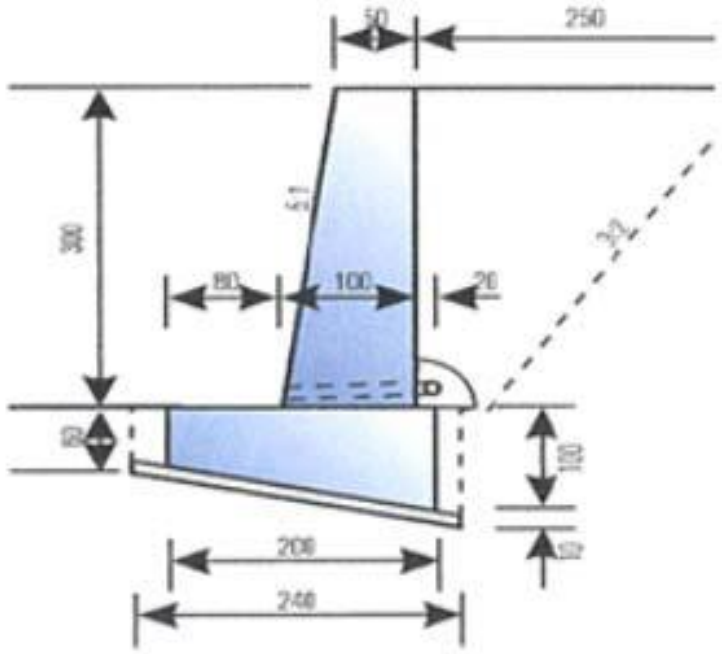


GSC = Geosynthetic Sand Containers

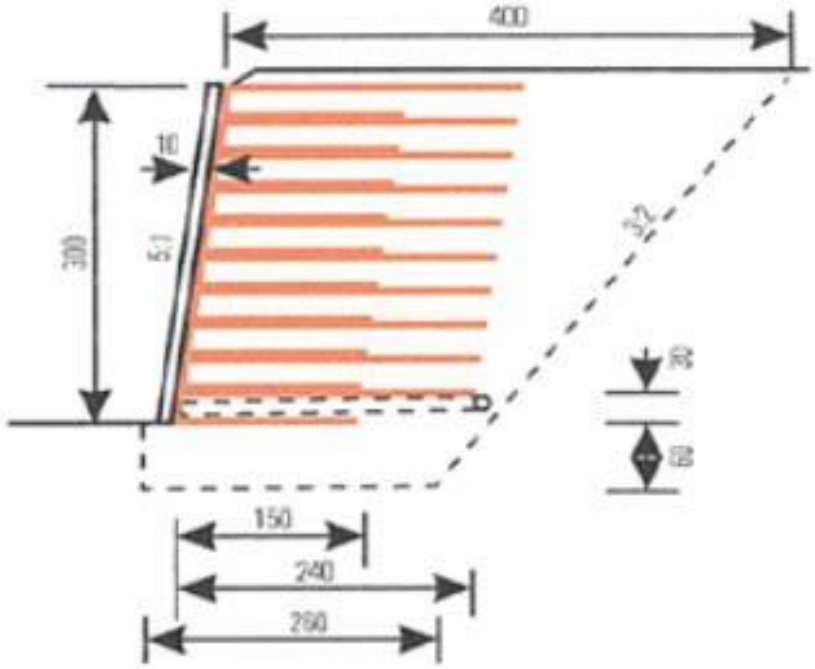
Reduction in every environmental impact category is >80%

In addition using geosynthetics resulted in significant construction cost savings compared with the conventional approach of rock armour

Reinforced Soil Retaining Wall



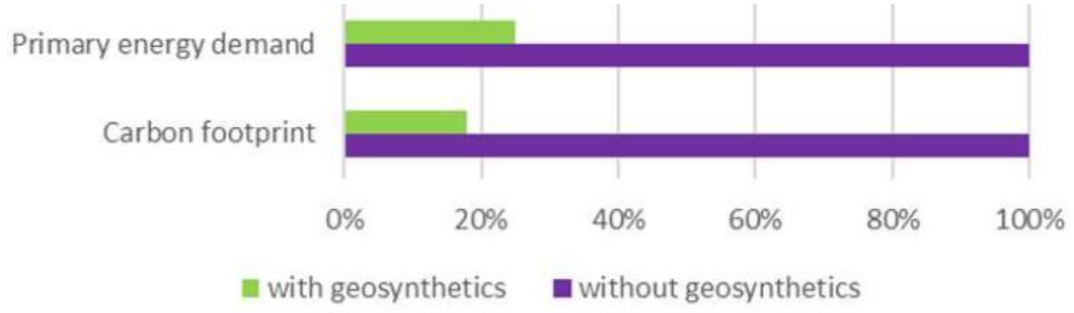
Reinforced concrete retaining wall (strength class B300)

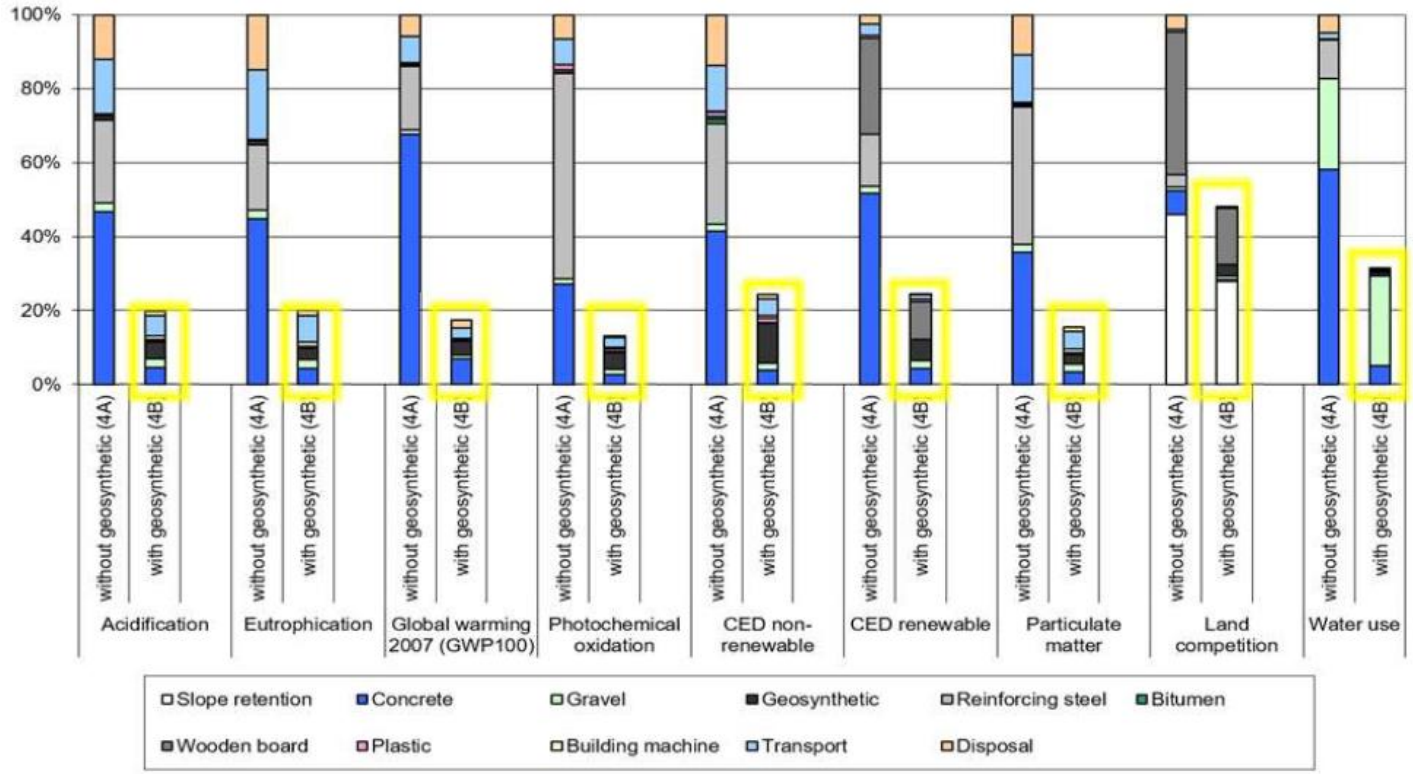


Soil wall reinforced with geosynthetics (LTDS 14 kN/m)

- "Average" of 3 different geogrids is modelled
  - extruded stretched geogrids
  - laid (welded) geogrids
  - woven/knitted geogrids

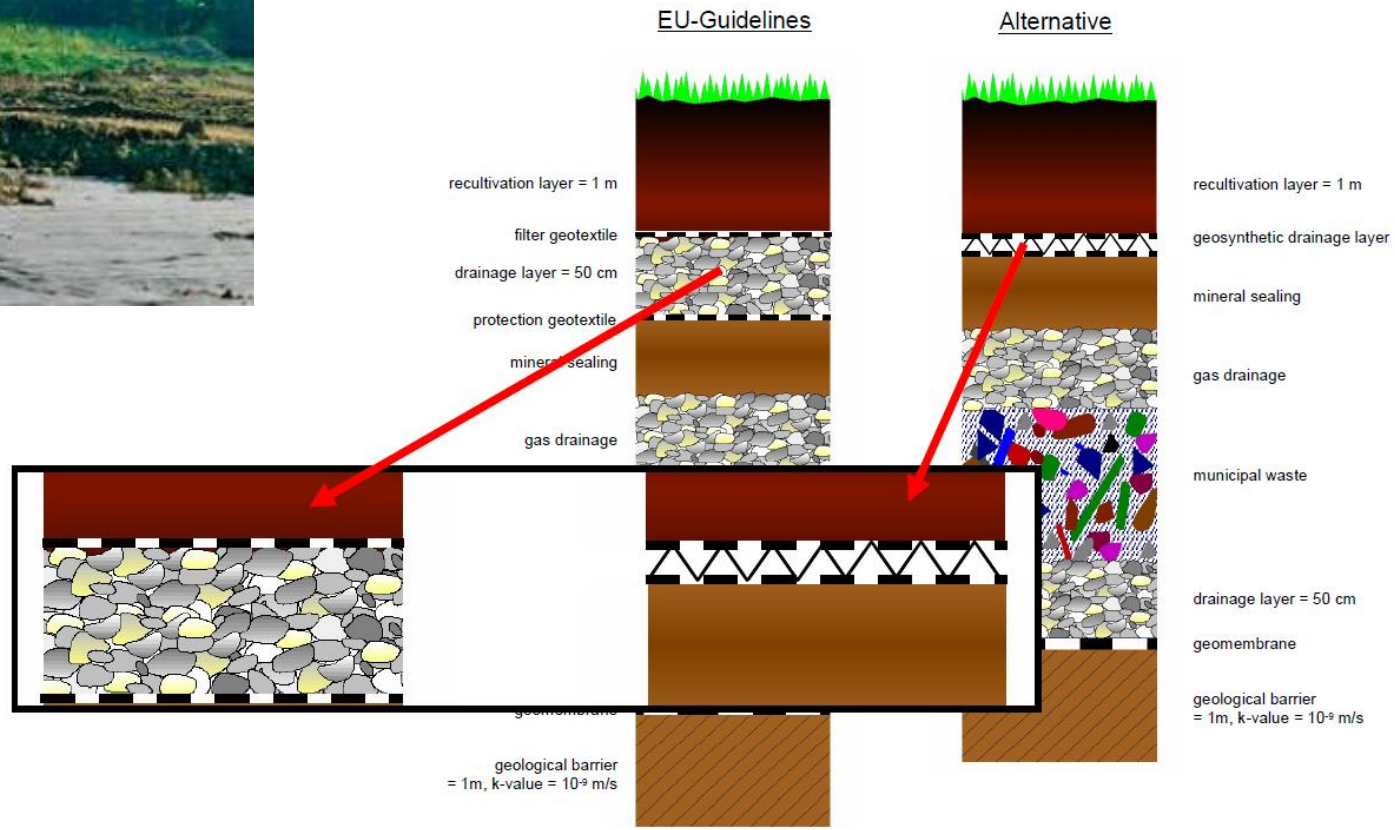
Reinforced Soil Retaining Wall



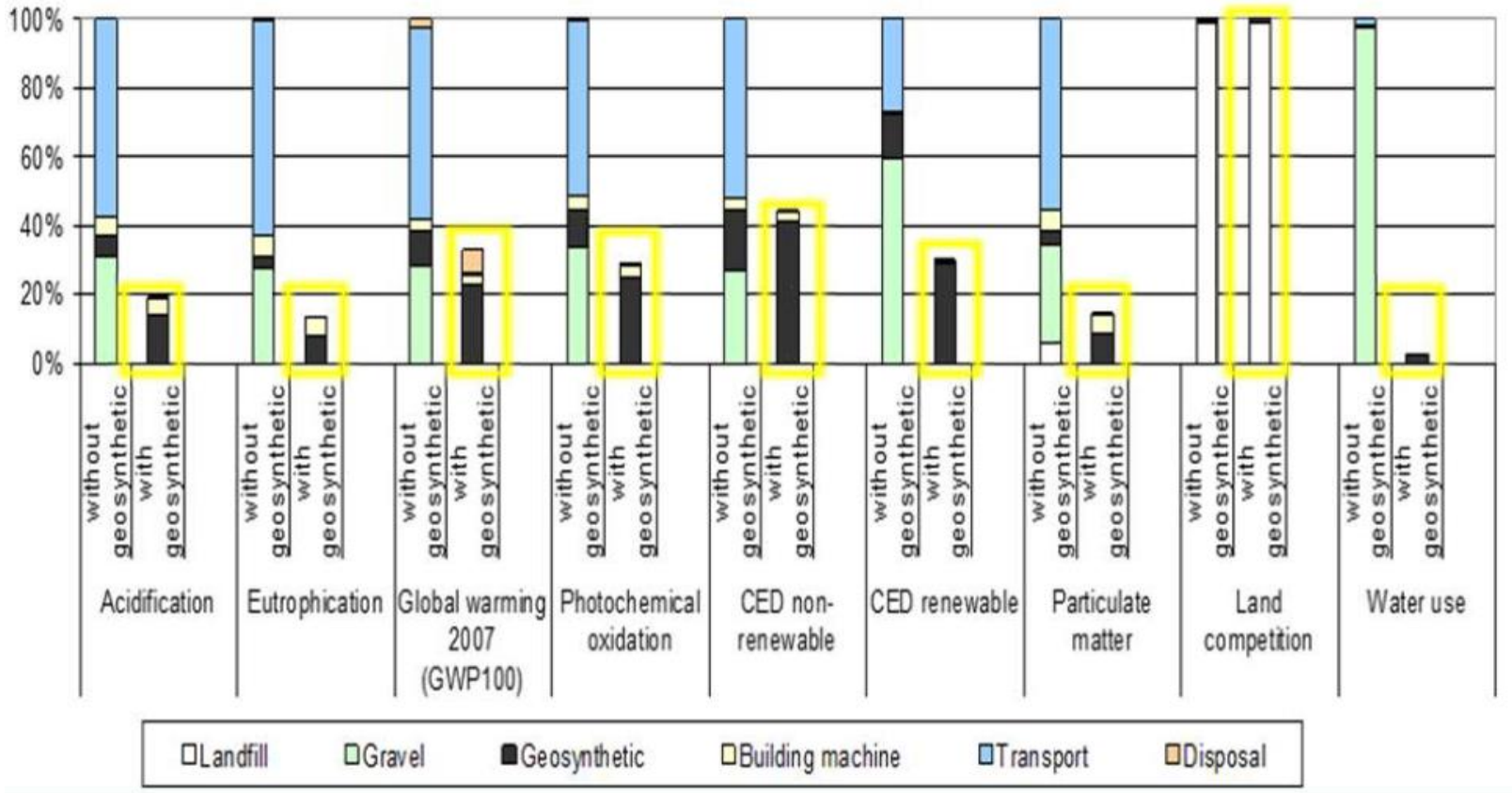


- Signficantly lower impact in all categories
- 85% reduction in cumulative greenhouse gas emissions
- 75% reduction in non-renewable cumulative energy demand (CED)

Landfill Capping Drainage



Landfill Capping Drainage



- Signficantly lower impact in all categories except land competition
- 95% reduction in water use
- 220 tonnes CO_2e reduction on area of 30,000 m^2

Conclusions

Examples have shown how construction with geosynthetics are able to:

- **reduce CO_2 and other emissions**
- **reduce natural resource depletion**
- **reduce energy demand (CED)**
- **reduce construction costs**
- **reduce the impacts for residents near construction**

while protecting people's lives from the effects of climate change

Geosynthetics contribute significantly to reducing the climate change impact of civil engineering works

The reductions in emissions and other environment impacts are huge – mainly greater than 80% and up to 95%

Geosynthetics are a key part of the solution – they enable the infrastructure needed to adapt to climate change to be created sustainably

We acknowledge the resources and images provided by courtesy of:

EAMG European Association of Geosynthetic product Manufacturers

NAUE GmbH & Co KG

ABG Geosynthetics Ltd

Concrete Canvas Ltd

HUESKER Synthetic GmbH

Tensar International

Thank you for your attention!

DOWNLEY CONSULTANTS

UK SWITZERLAND UAE