

Decarbonisation of construction activities to achieve Net Zero Targets

Muhammad Shaban
(PhD, CEng, MIET)

September 2025

CIGRE UK Monthly Technical Webinar

nationalgrid



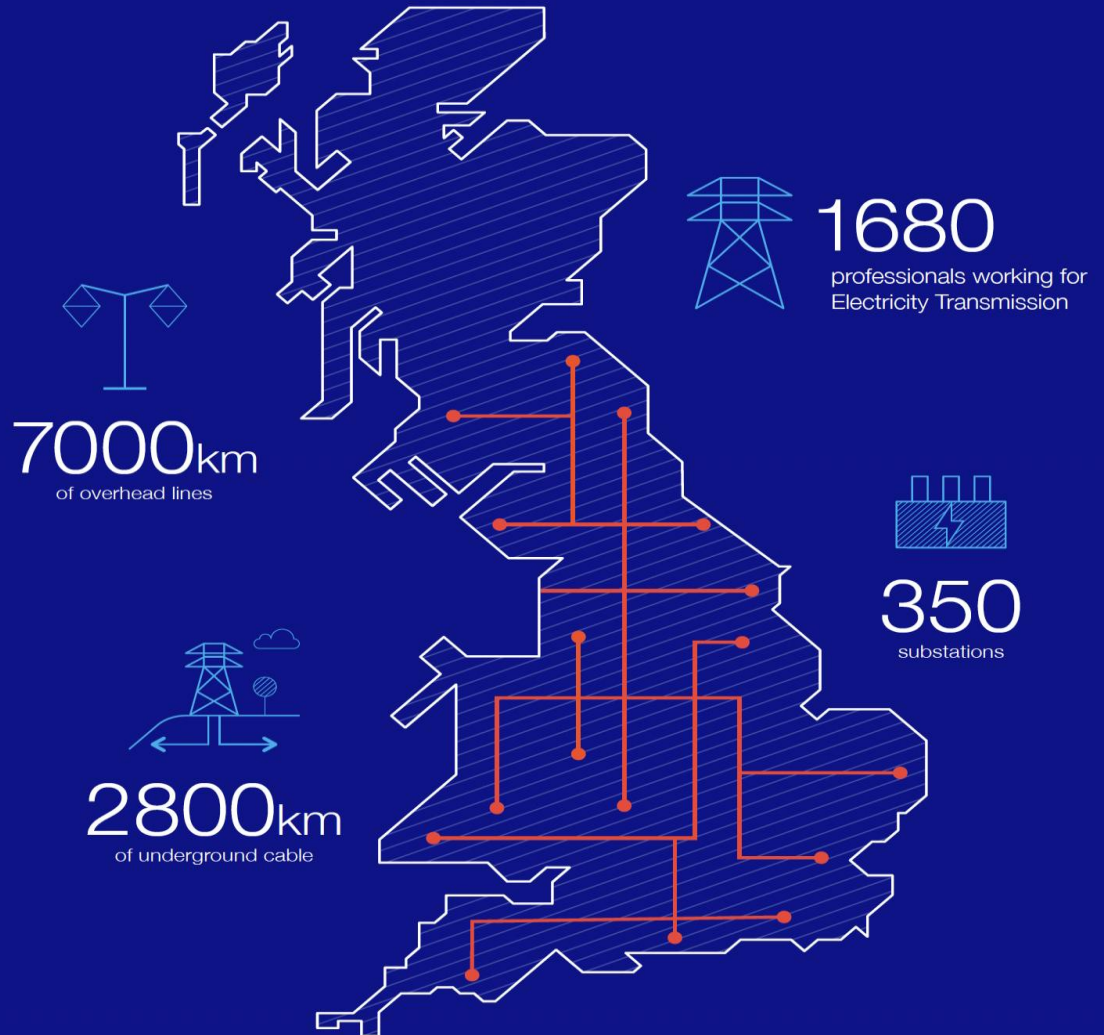
- 
- A photograph of an offshore wind farm with several white wind turbines in the sea. In the foreground, a coastal town with red-roofed houses is visible. A dark blue rectangular box is overlaid on the image, containing a white bulleted list.
- **Introduction to NGET**
 - **Introduction to Innovation**
 - **National Grid Initiatives**
 - **Questions**

Who we are and what we do

National Grid Electricity Transmission (NGET) owns and maintains the high-voltage electricity transmission network in England and Wales. Every time a phone is plugged in, or a switch is turned on, we've played a part, connecting you to the electricity you need.

We take electricity generated across England and Wales, including from windfarms and nuclear power stations, and transport it through our network, consisting of more than 7000 kilometres of overhead line, 2800 kilometres of underground cable and 350 substations, on to the distribution system, so it reaches homes and businesses.

We're investing in the network, connecting more and more low-carbon electricity – it's a crucial role and pivotal in turning the UK's net zero ambitions into reality.



Regulated funding mechanisms

Network Innovation Allowance

What is it?

- NIA provides an allowance to network Licensees to fund research, development and demonstration trials between TRLs 2-8 – subject to eligibility requirements.
- There is no max/min spend criteria for a project.
- We need to demonstrate why we cannot fund it as BAU activity e.g., due to risk profile.

What has changed since T1?

- NIA existed in T1, although there are some changes.
- T2 eligibility criteria: facilitate energy system transition and/or benefit consumers in vulnerable situations.
- New benefits framework and reporting, with more focus on tracking implementation and associated benefits.

What funding is available?

- We have £49.3m in T2, c. 35% increase on T1. This covers 90% costs (NGET/other sources must fill the rest) therefore total NIA spend for T2 is £54.7m.

Strategic Innovation Fund

What is it?

- SIF is a funding mechanism for projects that have the potential to accelerate the net zero transition. Ofgem set 'Innovation Challenges' that projects must respond to.

What has changed since T1?

- SIF is a new funding approach, replacing the Network Innovation Competition from RIIO-T1.

What funding is available?

- £450m is available over T2 for the network companies. SIF projects have to go through three phases:
 - Discovery (feasibility): up to 2 months & £150k
 - Alpha (experimental development): up to 6 months and £500k
 - Beta (build, operate and/or demonstrate): from £500k.
- NGET must contribute 10% to Alpha and Beta.

Deeside Centre for Innovation



19 acres, including a substation and overhead line test areas, workshops, storage space and offices.

Each of the test areas can operate independently or can be combined with other areas to suit any testing requirements:

- **Overhead lines**
- **Civil infrastructure**
- **Protection and control**
- **Switchgear**
- **Transformers**
- **Gas insulated switchgear & lines**
- **Offices and workshops**

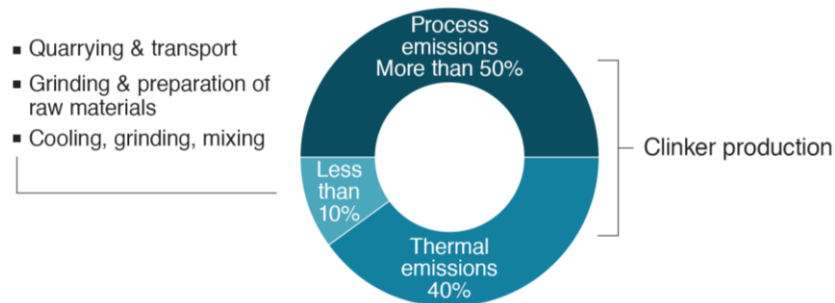
Our Construction Research

national**grid**



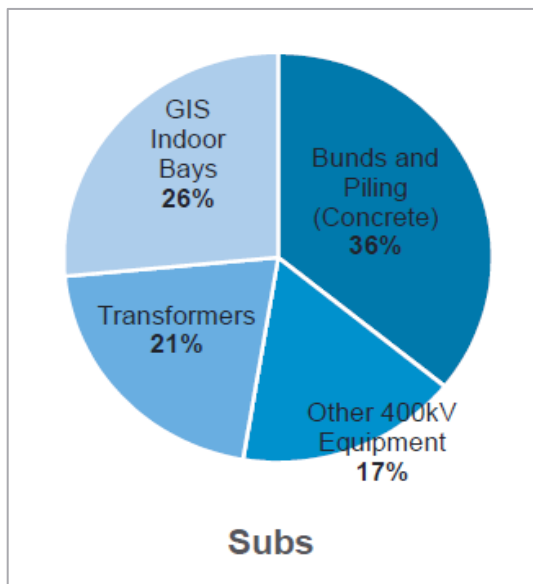
The problem – Concrete CO2 emissions

Cement manufacture is ~ 90% of total emissions



- Concrete is made up of primarily cement, aggregates, water and air
- Concrete accounts for up to 8% of the worlds global CO2 emissions
- Although cement only accounts for 10% of content in the concrete mix, it is responsible for approximately 80-90% of the emissions
- For National Grid, the concrete we use is a direct contributor to Scope 3 emissions

Current construction industry impact



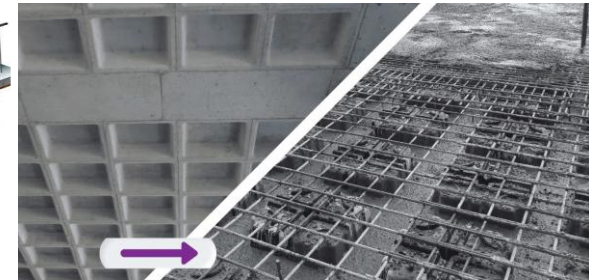
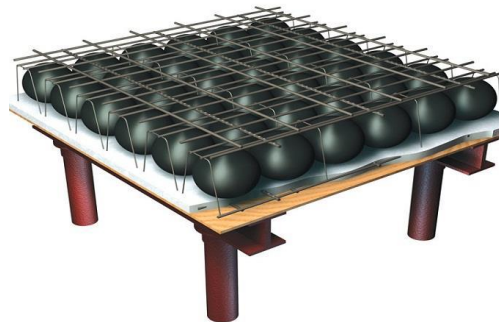
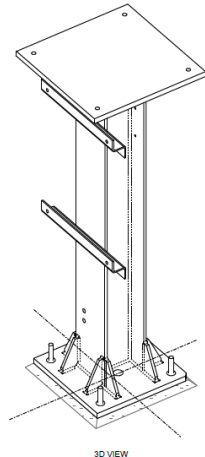
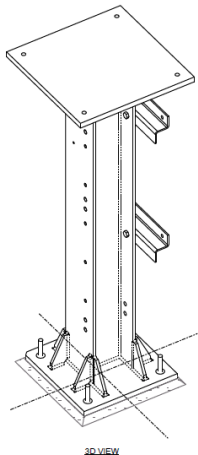
National Grid

- For National Grid, the majority of construction emissions form part of the Scope 3 emissions in 'Purchased goods and services'
- NGET have a commitment to Ofgem to have carbon neutral construction by 2025/6 with the potential of leveraging carbon offsetting to reach this.

Innovative Materials

Structures: **Weathering Steel**, Generative Design and 3D printing of Structures, Polymer structures (GRP & FRP)

Civils: Bubble Slab foundations, Waffle Slab foundations, Ashcrete, Ferrocure, **GEC**, Light-weight foam foundations



Glass Fibre Reinforced Polymer (GFRP)

Emissions, mining, energy intensive process, scattered process, corrosion, material shortage, price fluctuation.

In 2023, UK imported approx. **4.6 million metric tons** of steel (60% of the total demand)

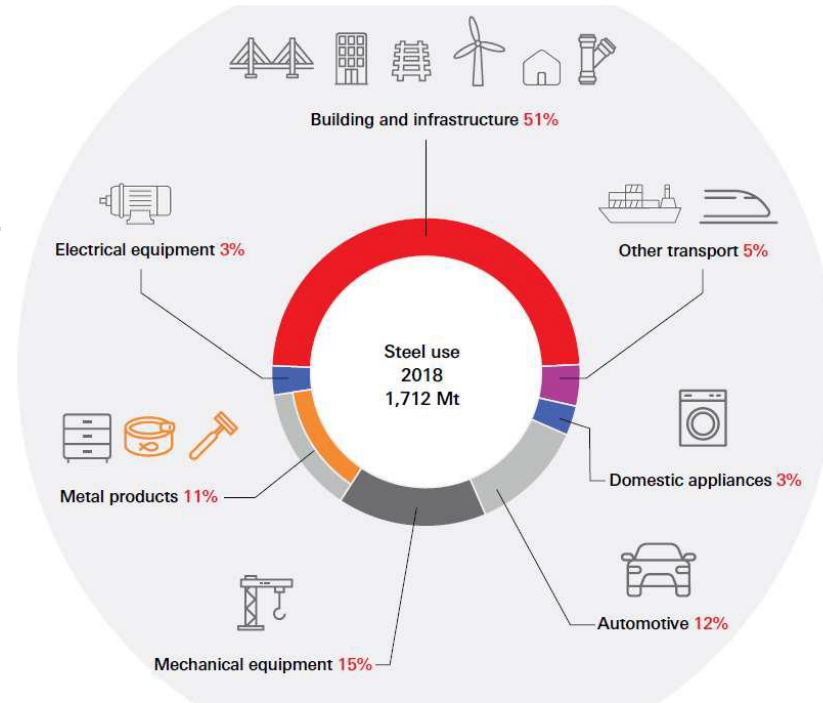
Stronger & lighter than Steel (**4x**), **30%** cheaper

Doesn't rust or conduct (**Non-corrosive**)

130 kg of GFRP can replace 1 ton of reinforced steel.



National Grid

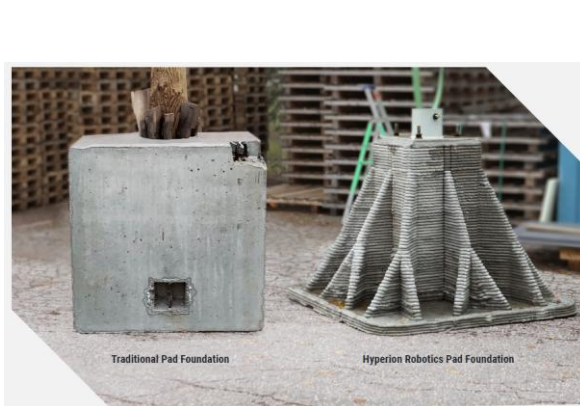


3D Concrete Printing (3DCP)

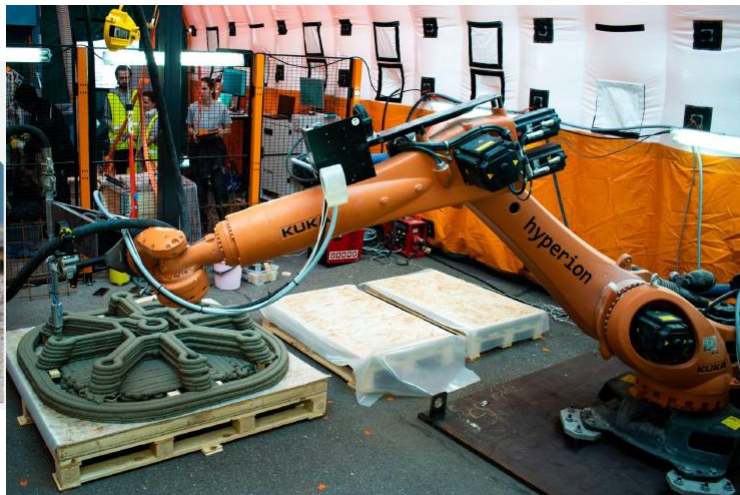
Optimize infrastructure build using a sustainable and efficient method that utilizes 3D printing and earth friendly concrete

Utilises **75% less** typical material amount

Saves up to **80%** of excavated material



National Grid



3DCP

Sustainability



**Up to
90%
improvement**

- Zero Waste
- Material placed when needed

Cost



**Up to
30%
reduction**

- Fast production & installation
- Labour & material

Time



**Up to
50%
reduction**

- Streamlined design
- Parallel process

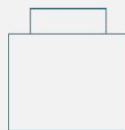
H & S



**Up to
50%
improvement**

- Min labour
- Min time on site from labour

Traditional Concrete
Foundation



W: 4 tons
CO2: 400kg

3D-printed in Hype-Cement
mix



W: 1 tons
CO2: 130 kg

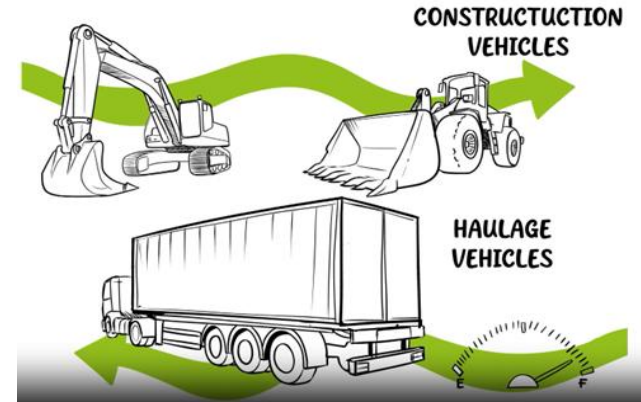
3D-printed in
Hype-Geopolymer mix



W: 1 tons
CO2: 15 kg

Diesel Free Construction Sites

- 100% zero emission power with heat & water as output.
- Fully sustainable site trial to collect energy data.
- AC 22kW dual socket EV chargers.
- 50 L water/hr to be used for toilet and vehicles.
- Drop in Syntech Biofuel (recycled cooking oil) for plants & generator.
- Performance and service comparison (Efficiency, fuel, response time, noise).
- Publish construction site energy policy to phase out diesel.



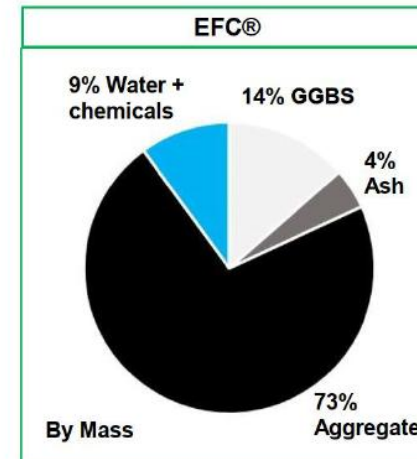
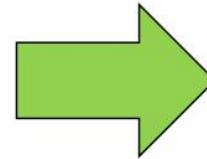
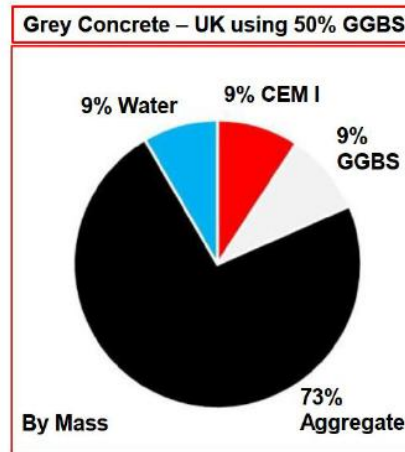
Earth Friendly Concrete (EFC)

About **60-80%** of the carbon footprint of tunnel construction is embodied in the concrete linings.

EFC is an ultra-low carbon (30-70%) alternative to traditional concretes containing Portland Cement

EFC binder:

- Ground Granulated Blast Furnace Slag (GGBS), Pulverised Fly Ash (PFA), Unique chemical activators



EFC

- A total of **7,641 tCO₂e saved** on LPT2 if EFC was used instead of OPC
- EFC saves **131.5 kgCO₂e/m³**
- Reduces CO₂ emissions by up to 53% per tonne.

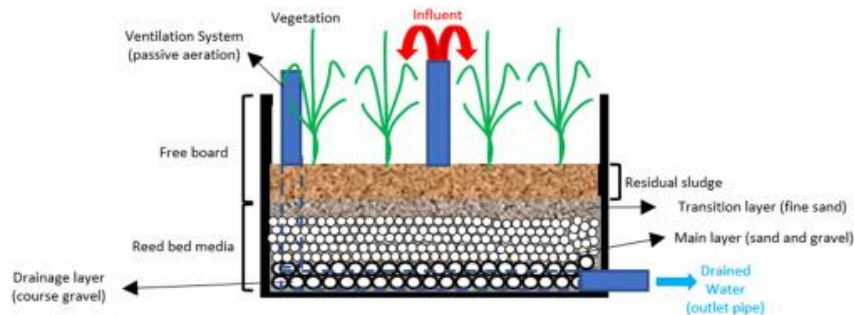


Sustainable Drainage Systems (SUDS)

Engineered system for treating contained oil from transformer leaks.

**Low energy and
maintenance solution**

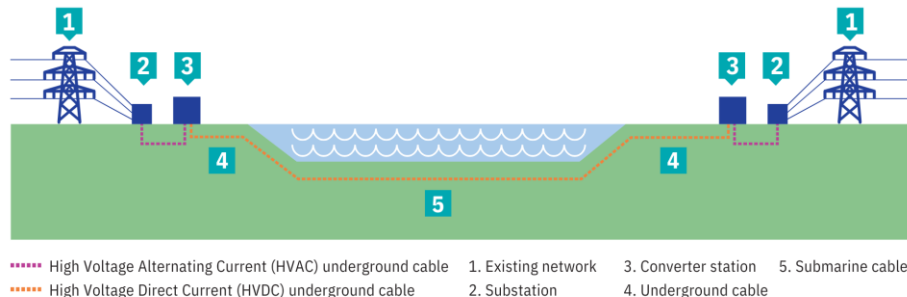
**Enhancement to landscape
and biodiversity**



HVDC-LCA

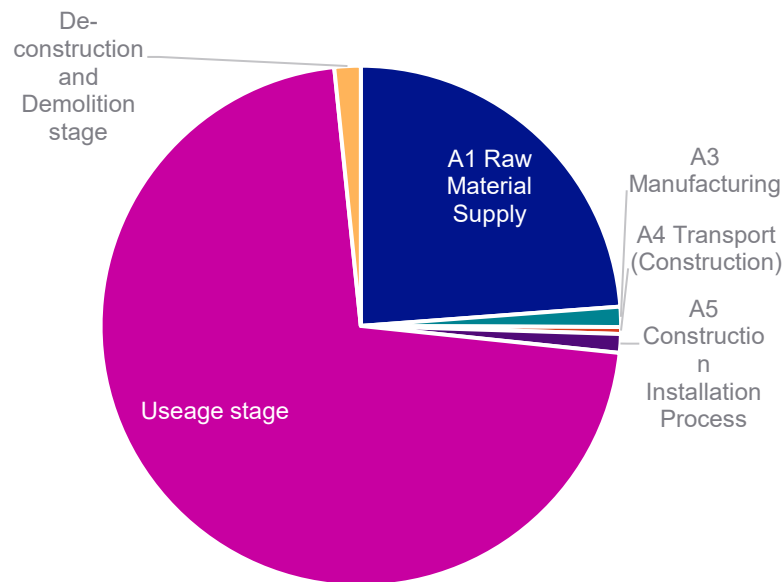
We did not have a good understanding of the carbon footprint of HVDC projects

A good understanding of each project's carbon footprint will help focus decarbonisation efforts

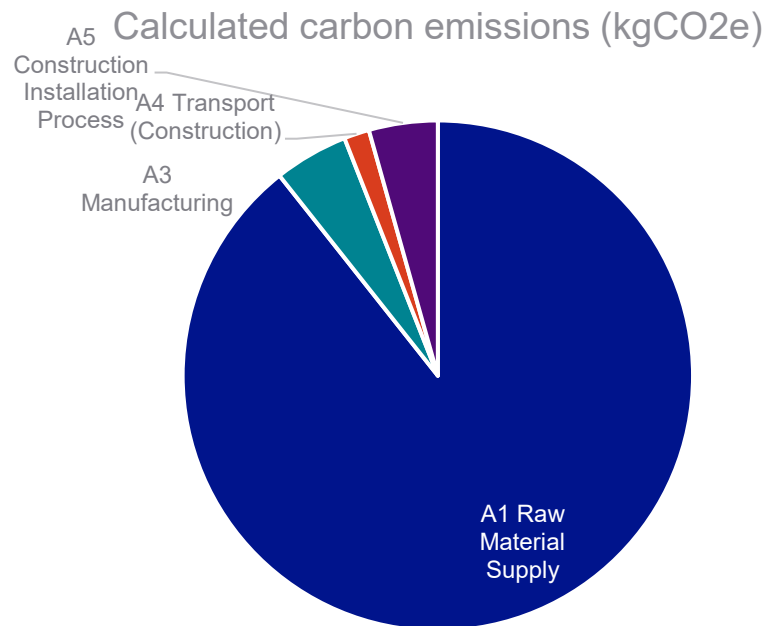


Whole project

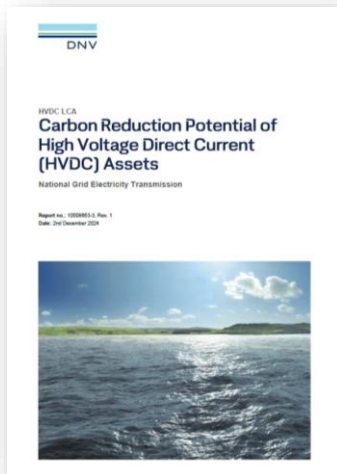
Calculated carbon emissions (kgCO₂e)



Construction stage only



HVDC-LCA



Carbon Reduction Option	Carbon Emissions Avoided (kgCO ₂ e)	Construction (A1-A5) Emissions Avoided (%)	Total Emissions Avoided (%)
MMC VSC	61,786,453	-	8.2
SF6-free GIS (air insulated)	2,601,597	-0.03	0.35
Replacing diesel with HVO during construction	5,192,190	1.41	0.69
Eco- rock armour	25,794,358	6.99	3.44
Local rock armour	1,033,183	0.28	0.14
30% PFA cement	8,114,400	2.2	1.08
Replacing marine fuel oil with HVO	1,927,978	0.52	0.26
Low carbon copper (cables only)	6,532,753	1.77	0.87
Solar PV	-(195,000)	-	-0.01
Aggregate (reused)	87,774	0.02	0.01

Key Messages

Don't focus only on the numbers

Drive decarbonisation early

Supply chain collaboration is key

Option	Carbon	Cost	Compliance	Readiness
EFC	High	High	TBC	High

national**grid**