

Elemental Accelerator Tech Overview

The world's road to green recovery from COVID 19, achieving net zero emissions by 2050 and UN Sustainable development goal 14 "life below the water" are driving forces behind ARC's technology.

Seafloor habitats around the world have been drastically impacted by humans. Large areas of habitats like oyster reefs, rocky reefs and seagrass beds have been destroyed, resulting in a biodiversity decline. Offshore developments will play a key role in addressing the above targets and legislation is pushing for 10% net biodiversity gains (UK Environment Bill). In the Netherlands, Offshore Wind must budget for biodiversity enhancement. The challenge is *how* to integrate biodiversity enhancement with offshore renewable energy. Currently, enhancement structures are deployed only by additional crane-lifting operations, incurring extra costs and carbon emissions.

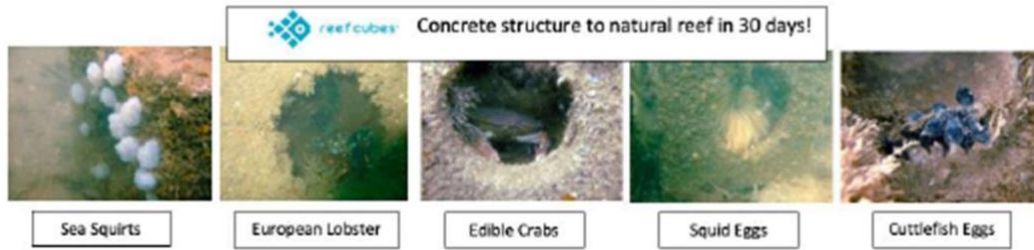
Solution

Our solution is to integrate Reef Cubes with fallpipe vessels. Reef Cubes are pre-cast concrete units with a complex hollow shape to enhance biodiversity. Incorporating Reef Cubes with these vessels allows for higher production, integration with standard rock placement operations (avoiding extra vessel use) and the potential to replace rock scour protection. In this application they are at **TRL 5/6**, having been tested in laboratory settings and deployed subsea with crane-lifts. **TRL** will be increased to **7/8** by demonstrating at an operational wind farm.

Concrete products have a global CO2 footprint. To overcome this, we developed an alkali-activated material (AAM) binder. Our binder follows cutting-edge research, ensuring the utmost sustainability. Our materials are 98% recycled and our research indicates net carbon neutrality with incorporation of carbon capture materials. Emissions footprinting requires 3rd-party verification and concrete manufacture generally uses cement so we need to complete extra tests to verify the materials to offshore standards.

To gain a competitive advantage over simply rock dumping and to ensure every offshore construction project can budget for habitat restoration. ARC need to load Reef Cubes into a large vessel at the same time as the granite scour protection using excavators and conveyors which have large impact forces on the structures. This is an innovative application of biodiversity enhancement units; none have ever been deployed in this manner.





We completed desk-based calculations of the sum carbon footprint of our individual concrete materials (cradle-to-gate plus transportation), with the inclusion of negative emissions materials to bring the footprint down to neutral/ negative. The results can be seen in the below graph and table. We produced a sample of the carbon neutral concretes for strength testing and found a mixture with satisfactory results (>40MPa). We now need a 3rd party to calculate the footprint for us, including our up to date manufacturing processes and including validation of the negative emissions materials footprint given by our supplier.

The sum of cradle-to-gate carbon footprints of constituent concrete materials

Net carbon footprint including cradle to gate and transport kg CO₂e/tonne of concrete
28

ARC AAM-based concrete as of 12.4 -4.9 January 2021.

References

Glarou, M., Zrust, M. and Svendsen, J.C., 2020. Journal of Marine Science and Engineering, 8(5), p.332

