

ECOSTRUCTURE – FUTURE DEMAND AND ENGAGEMENT WITH PARTNERS



Final Report

Flint Innovation, October 2022

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Executive Summary

This report seeks to show how the Ecostructure Project participants and partners can use their contacts, knowledge and research outputs to work with a variety of partners and other actors in the future to add value and to support various organisations in achieving their goals of net biodiversity gain in the coastal built environment.

The report details the work done with and information gathered from a variety of organisations to determine the drivers for engagement with Ecostructures and suggests routes to collaboration with these actors and potential partners.

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Introduction

Flint Innovation was engaged in July 2022 by Aberystwyth University to deliver a study and final report into Ecostructure future demand and engagement with project participants and wider partners.

This report seeks to identify the following aspects of Ecostructure engineering in the UK and Ireland:

- The current 'state of play' with regard to marine and coastal Eco-engineering activity, including current and future areas of growth
- A detailed vision for marine and coastal eco-engineering, that clearly identifies the areas where greatest demand is expected
- Detailed SWOT analysis
- Analysis of national and international trends and markets
- Analysis of relevant Welsh and UK policies
- Identification of potential industrial partners for future research in marine and coastal eco-engineering.

This report details the process through which actors and potential partners were engaged to give their input, and the findings of a series of workshops and structured interviews.

Caveat:

This report cannot be regarded as a primer or roadmap to commercialisation of Ecostructure research. Instead, it seeks to identify actors and potential partners in the sector, drivers of interest for these actors, known unknowns for future work with partners and possible models for collaboration.

Process

Flint Innovation carried out a brief review of the Ecostructure programme to inform conversations, and met with the Academic lead. We carried out a series of structured interviews with partners and held workshops to draw out and understand industrial and public sector actors' views and needs. We also performed a desktop review of the existing actors and overall size of the market.

Two separate workshops were held via Teams on 29th September 2022– one each for the Public Sector and Private Sector. Outputs from these workshops are at appendices F and G respectively.

Desk research into the market for Ecostructure engineering forms section 6 of this report.

Structured interviews were conducted with a variety of actors throughout the study and the detail of these conversations is summarised at Appendix C.

A brief presentation of the results of the study were briefly presented at Ecological Enhancement for Marine Infrastructure Workshop at Bournemouth on 12/10/22, and the slides are shown at Appendix A.

Actors

A brief analysis of actors is useful as this informs the diverse drivers that different potential partners have for engaging in the Ecostructure engineering space.

While a detailed analysis of the wide variety and range of scale of actors in this space and their drivers and constraints is beyond the scope of this report, the space can be simply broken down into two main categories – Public and Private Sector - with further subdivisions as set out below:

Public Sector

Public sector actors include:

- National Government agencies (UK and Ireland) and national level actors – e.g., Environment Agency, the Crown Estate
- Devolved government agencies (Welsh, Scottish and Northern Ireland) e.g., Natural Resource Wales
- Local Councils – there are 22 Local councils in Wales, of which 15 have some coastline
- Parish and Town Councils – there are 730 Parish and town councils in Wales

There is a complex range of statutory responsibilities shared between these actors and considerable overlap – rarely do they act in isolation especially when it comes to major coastal or offshore engineering projects. Navigating their complex interactions and relationships is an ongoing process of presence, networking and long term added value.

Bodies such as Network Rail or MOD may also be considered to be government actors in that they are funded by the taxpayer and are constrained by public sector procurement rules.

Interaction with public sector bodies should always consider budget, timescales (especially financial year boundaries), sign off levels and processes, public sector procurement rules and particularly evidence requirements and output metrics.

Private Sector

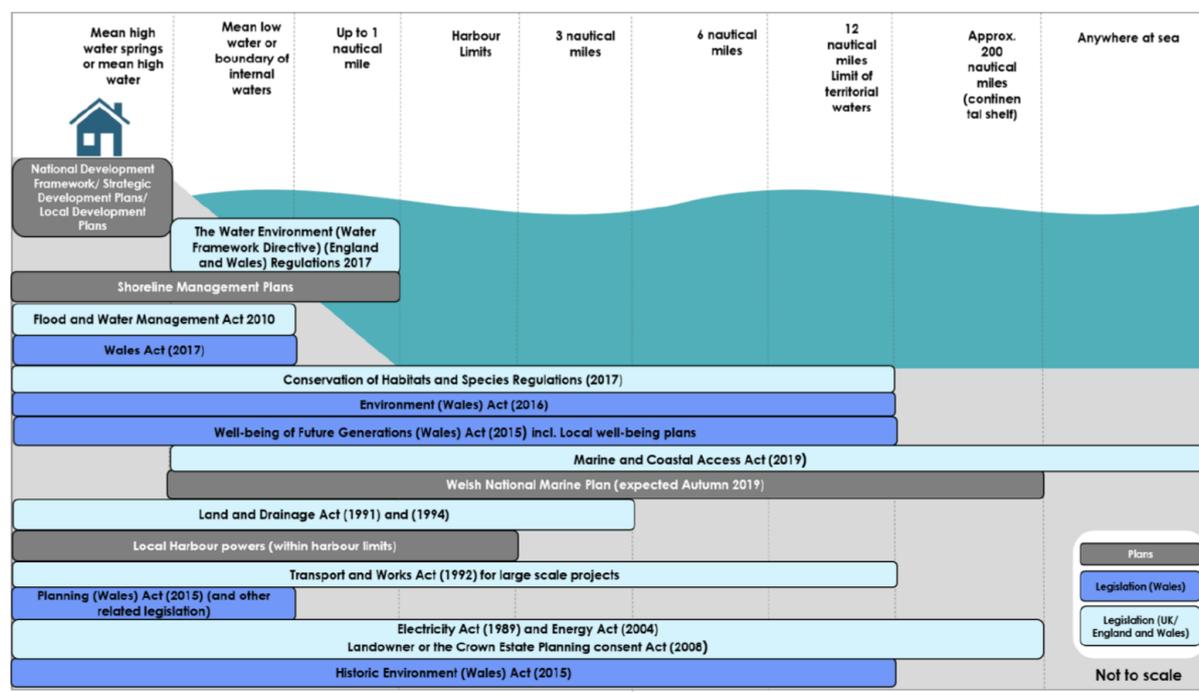
Private sector actors in this space include:

- Infrastructure owners – owners of ports (e.g. ABP) and wind farms and other structures.
- Construction firms and supply chain – the construction industry tends to be organised under a few large firms who tender for larger contracts with the public sector infrastructure owners and then manage a supply chain of smaller business.
- Manufacturers – Manufacturers supply distinct eco engineering products to the construction firms (e.g., Artecology and Exo Environmental).

Interaction with private sector bodies should necessarily pay close attention to how the collaboration can contribute to the profits of the business – without a clear logic model of how profit can be generated in a timescale that suits the business, interaction will be necessarily limited.

Policy, Planning and Legislation

Other work packages of the Ecostructure project have covered this complex area in more detail, and this report cannot provide more than a brief overview of the broad policy, planning and legislation that affects marine structures. A short summary of relevant legislation is set out below.



(Ref: Page 103 of pdf Aligning Flood & Coastal Erosion ... - UEA Digital Repository https://ueaeprints.uea.ac.uk/eprint/Evaluation_FC)

Listing of Relevant legislation

Coastal and Marine Development

Marine and Coastal Access Act 2009
 Energy Act 2013
 Planning Wales Act 2015
 Crown Estate Act 1961
 Wales Act 2017
 Harbours Act 1964
 Transport Act
 Town and Country Planning Act 1990
 Welsh National Marine Plan

Environmental Improvement

Environment Wales Act 2016
 Historic Environment Wales Act 2016
 Well-being of Future Generations Wales Act 2015

Wildlife and Countryside Act 1981
Environmental Permitting (England and Wales) Regulations 2010
Conservation of Habitats and Species Regulations 2010
Offshore Marine Conservation Regulations 2007
Water Environment Regulations 2003
Environmental Damage (Prevention and Remediation) (Wales) 2009

Flood and Coastal Erosion Risk Management

Shoreline Management Plans
Flood and Water Management Act 2010
Coast Protection Act 1949
Climate Change Act 2008
Land Drainage Act 1991

Planning Policy Wales relevant to eco-engineering through biodiversity restoration

1. The first priority for planning authorities is to avoid damage to biodiversity and ecosystem functioning. Where there may be harmful environmental effects, planning authorities will need to be satisfied that any reasonable alternative sites that would result in less harm, no harm or gain have been fully considered
2. Planning authorities should ensure that features and elements of biodiversity or green infrastructure value are retained on site, and enhanced or created wherever possible, by adopting best practice site design and green infrastructure principles. Where necessary, planning authorities should seek to modify the development proposal through discussion with the applicant at the earliest possible stage. Biodiversity and green infrastructure modifications should draw on the issues and opportunities identified through the Green Infrastructure Assessment.
3. In some circumstances, it will be appropriate to attach planning conditions, obligations, or advisory notes to a permission, to secure biodiversity outcomes. Planning authorities should take care to ensure that any conditions necessary to implement this policy are, relevant to planning, relevant to the development to be permitted, enforceable, precise, and reasonable in all other respects.
4. When all other options have been exhausted, and where modifications, alternative sites, conditions, or obligations are not sufficient to secure biodiversity outcomes, offsite compensation for unavoidable damage must be sought:
 - a. This should normally take the form of habitat creation, or the provision of long-term management arrangements to enhance existing habitats and deliver a net benefit for biodiversity. It should also be informed by a full ecological assessment before habitat creation or restoration starts.
 - b. The Green Infrastructure Assessment should be used to identify suitable locations for securing offsite compensation. Where possible, a landscape-scale approach, focusing on promoting wider ecosystem resilience, should help guide locations for compensation. This exercise will determine whether locations for habitat compensation should be placed close to the development site, or whether new habitat or additional management located further away from the site would best support biodiversity and ecosystem resilience at a wider scale.
 - c. Where compensation for specific species is being sought, the focus should be on maintaining or enhancing the population of the species within its natural range. This approach might also identify locations for providing species-specific compensation further away from the site. Where they exist, Spatial Species Action Plans should be used to help identify suitable locations.

d. Any proposed compensation should take account of the Section 6 Duty (Biodiversity and Resilience of Ecosystems Duty), and the five key ecosystem resilience attributes that it outlines. It should also be accompanied by a long-term management plan of agreed and appropriate mitigation and compensation measures.

5. Finally, where the adverse effect on the environment clearly outweighs other material considerations, the development should be refused.

Section 6.5.20 In considering new coastal defence works, account should be taken of all potential environmental effects, both on and offshore, including the impacts on habitat fragmentation and consequential 'coastal squeeze', as well as information contained in SMPs and other relevant documents such as Area Statements.

Section 6.6.23 clarifies that 'government resources for flood and coastal defences are directed at protecting existing developments and are not available to provide defences in anticipation of future developments. This signals that the only type of suitable eco-engineering interventions of coastal structures will be in the form of retrofitting. Section 6.6.28 recommends that NbS should be the first type of intervention to be considered when improving flood defences in coastal and or/riverside locations.

Drivers of Ecostructure engineering and Biodiversity Gain Requirements

The diagram below attempts to order the different drivers for engagement with different projects and owners:

| | Ownership | |
|-----------------|----------------------------------|---|
| Type | Public | Private |
| New | Policy & Planning | Bid Differentiation, CSR, Planning |
| Existing | Policy & Maintenance | Environmental Reporting |
| | Biodiversity Unit Trading | |

These drivers are expanded in the table below:

| Element | Detail | Opportunity for ecostructure research and impact |
|---------------------|--|--|
| Ownership Type | Structures and projects fall into public or private sector ownership | |
| Public | Examples include Coastal Defences and council owned harbours | |
| Private | Privately owned ports and harbours, wind farms | |
| New | Projects and structures yet to be built, requiring planning permission | |
| Policy | Policy made by local and national government sets the framework for the requirement for biodiversity gain in new structures and projects. Policy is generally evidence based. | Evidence for informing policy |
| Planning | Planning rules set at national and local level implement higher level policies. While there is a degree of commonality between councils planning policies, there are local differences, particularly in environmental requirements. Planning permission is applied for and granted (or otherwise) at local council levels. | Advising local authorities Helping actors to understand and comply with biodiversity planning rules. |
| Bid Differentiation | Private sector bidders for coastal engineering or turbines increasingly see ecoengineering as a differentiator in their bids, over and above environmental standards, electrification, use of low carbon concrete and the like. The issue here is the cost of ecoengineering set against the biodiversity gain: without quantification of benefits, there is a | Advising bidders on options for achieving maximum bid differentiation at minimum cost Ensuring that measures selected are appropriate and will deliver the promised gains |

| | | |
|-------------------------|---|--|
| | pressure to minimise costs and so limited measures are proposed which may have little practical impact on biodiversity. | |
| CSR | Corporate social responsibility (CSR) is a form of international private business self-regulation which aims to contribute to societal goals of a philanthropic, activist, or charitable nature by engaging in or supporting volunteering or ethically oriented practices | Advising companies on options for achieving maximum CSR benefits at minimum cost |
| Existing | Existing Structures | |
| Maintenance | The opportunity exists for improvement in biodiversity through implementation of ecostructure engineering through the routine maintenance of structures and larger repairs. | Advising companies on options for achieving maximum biodiversity benefits through maintenance and repairs at minimum cost |
| Environmental Reporting | Quoted (PLCs) and large unquoted companies already have to report on their environmental performance (Environmental Reporting Guidelines: Including streamlined energy and carbon reporting guidance). | Ecostructure engineering offers the opportunity to achieve and enhance biodiversity KPIs, but the issue of cost effectiveness needs to be addressed. |

Biodiversity Unit Trading

A new UK market in biodiversity units is at an early stage but is developing to support the requirement in the Environment Act 2021 for new developments to achieve biodiversity net gain.

The Environment Act 2021 introduces new provisions into the Town and Country Planning Act 1990. These set out that, in future, every planning permission granted for the development of land in England will only be granted if a biodiversity gain plan (showing a net gain of 10%) has been submitted and approved.

The Department for Environment Food and Rural Affairs has recently carried out a [consultation](#) to start the process of adding detail to this concept.

The basic approach to demonstrating biodiversity gain is already set out. Developers are required to try first and foremost to generate gain on the development site itself. Where they cannot, they can utilise offsite gains achieved on third party sites – preferably as close to the development site as possible. Finally, and as a last resort, developers can purchase “biodiversity credits” from the Government, though these may be priced to disincentivise this option.

The use of gains made on third party sites will be key to the concept of compulsory biodiversity net gain in the planning system, as it will not always be possible to achieve the necessary habitat enhancements within a scheme design. The consultation suggests that the supply of offsite gains at third party sites should be achieved through creation of a market. Third party landowners who create or enhance habitat will be able to sell the resulting biodiversity “units” to developers, with intermediaries helping to create a market.

Regulations and guidance on the operation of the market are yet to be drafted, though it is expected that the private sector will be in the lead. The size and scope of this market is not fully defined.

Alongside the consultation, Defra has published market analysis which models the expected size and dynamics of the market for biodiversity units and their price in England. The analysis comes with a number of recommendations to inform policy development.

“Habitat banking” (creation of biodiversity net gain before development and “banking” until allocated to a suitable project) will be allowed to smooth out supply and demand.

The calculation methodology for biodiversity units (including intertidal zones and specifically referencing artificial habitats) is known as Biodiversity Metric 3.1 (at the time of writing) and can be found at: <http://publications.naturalengland.org.uk/publication/6049804846366720>

The opportunity here is to advise owners of coastal structures on the possibility of creation of biodiversity credits in the intertidal zone, and on the cost effectiveness of this credit creation. This applies to new projects and existing structures:

| Type of structure | Opportunity for biobanking |
|---------------------|---|
| New Structures | <p>Creating maximum biodiversity credits offsetting the cost of third party credits.</p> <p>Potentially creating excess credits for sale.</p> |
| Existing Structures | Retrofitting ecostructure engineering to existing coastal structures to create biobanking credits for sale. |

Market research

A desk-based study of the market for UK, Ireland and worldwide coastal engineering and potential application of eco structure engineering within this market was carried out.

Size and Scale

The market for new sea marine structures is largely driven by flood defence in response to rising sea levels driven by climate change. It is a large global market measured in billions, with a UK local authority spend of over £90m/yr, and there are a variety of drivers for the take up of Ecostructures. The question is not whether there is a market, but how best to access it and drive engagement with funders.

There are a number of actors in UK and Ireland (with the UK market being larger and more developed) – different actors have different reasons to become engaged and will require different approaches. The number of unrelated actors involved (e.g., coastal local authorities) means that the marketing effort has many targets, which determines the nature of any engagement effort.

Most marine structures are public sector commissioned, but even in private sector there is significant public sector involvement and of course planning & permitting.

Legislative drivers for new structures are largely place in UK, less so in Ireland

Specifiers of new structures exist in both public and private sectors but will need different emphases in marketing and engagement.

Existing public structures can be tackled through both policy and maintenance angles.

Existing private structures can be tackled through legislation regarding corporate reporting on biodiversity and through their maintenance regimes.

Biodiversity Unit trading

An opportunity exists for biodiversity gain to be monetised via the trading of Biodiversity Units. The owner of an existing marine structure could improve its biodiversity, create a number of biodiversity units (based on area and quality of biodiversity gain) and then sell these units to developers unable to create sufficient net biodiversity gain on their own sites.

The opportunity there would be for Aber to advise existing structure owners as to the most cost-effective way of creating the biodiversity units.

<https://www.fpcr.co.uk/services/ecology/biodiversity-unit-banking/>

<https://environmentbank.com/>

Commissioners of sea defences

This is generally a government and local authority function. The opportunity is to advise on strategy and implementation – specifically on the most cost effective way of achieving biodiversity targets, and also in the specification and assessment of tenders.

England <https://www.gov.uk/government/collections/flood-and-coastal-erosion-risk-management-authorities>

Natural Resources Wales - <https://naturalresources.wales/flooding/managing-flood-risk/nature-based-solutions-for-coastal-management/?lang=en>

Scottish Environmental Protection Agency <https://www2.sepa.org.uk/frmplans/>

Northern Ireland - <https://www.daera-ni.gov.uk/topics/marine/marine-and-coast>

Southern Ireland - <https://www.floodinfo.ie/scheme-info/>

Ports and Harbours

Ports and harbours exist at a variety of scales and ownerships, but the larger ports tend to be privately owned, whereas smaller ones tend to be under local authority control. Different approaches will be required for each ownership group as they have different drivers – CSR and compliance for the private sector, with a variety of drivers for the public sector.

Trade Associations

<https://www.britishports.org.uk/about-us/our-staff/>

rhona.macdonald@britishports.org.uk

<https://ukmajorports.org.uk/policies/sustainability/>

Five companies own the majority of UK ports:

[Associated British Ports \(ABP\) https://www.abports.co.uk/about-abp/sustainability-and-decarbonisation/](https://www.abports.co.uk/about-abp/sustainability-and-decarbonisation/)

<https://www.linkedin.com/in/alan-tinline-30383513/?originalSubdomain=uk>

[Forth Ports - https://www.forthports.co.uk/forth-ports-group/environment/](https://www.forthports.co.uk/forth-ports-group/environment/)

[Hutchison Port Holdings - https://www.linkedin.com/in/kavya-jayaram-0a3b08193/](https://www.linkedin.com/in/kavya-jayaram-0a3b08193/)

[Peel Group - https://www.peelports.com/sustainability/environment](https://www.peelports.com/sustainability/environment)

<https://www.linkedin.com/in/archie-mccluskey-1163a3b6/>

[PD Ports - https://www.pdports.co.uk/corporatesocialresponsibility/environment/](https://www.pdports.co.uk/corporatesocialresponsibility/environment/)

<https://www.linkedin.com/in/emma-north-48009423b/>

Size of Market – Sea Defences

A number of sources were reviewed that confirm that there is a large and growing market for coastal defences, driven largely by sea level rise and climate change.

<https://openknowledge.worldbank.org/handle/10986/31308>

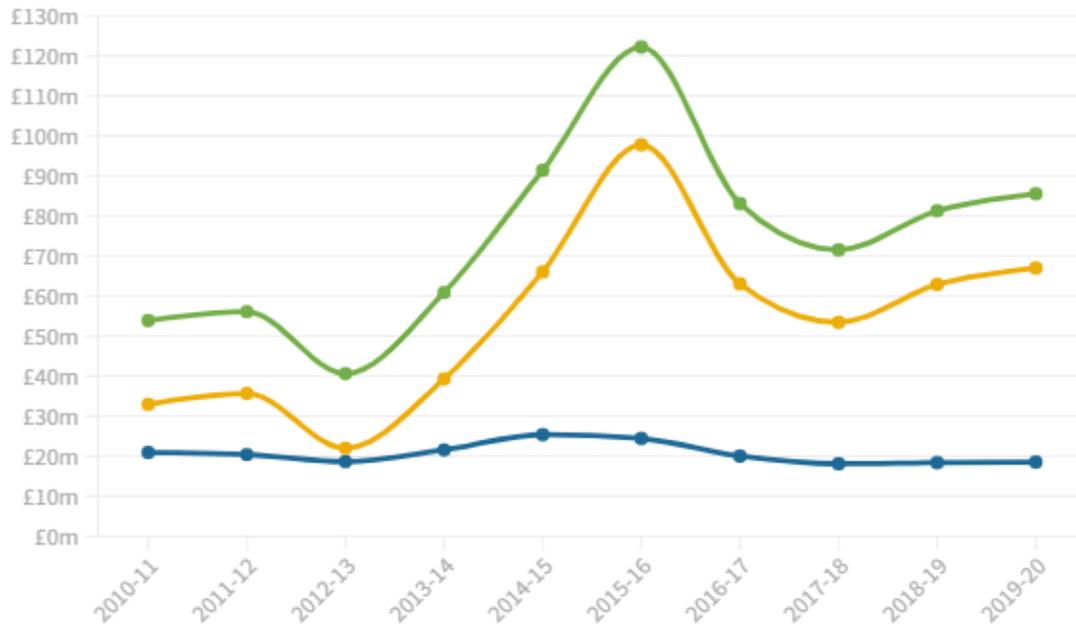
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1070943/Funding_for_FCERM_March_2021_Final_v1_accessible.pdf

Local authority spending on coast protection in England, 2010-11 to 2019-20

Figures in 2019-20 prices

Click items in the legend to filter the graph

Revenue Capital Total

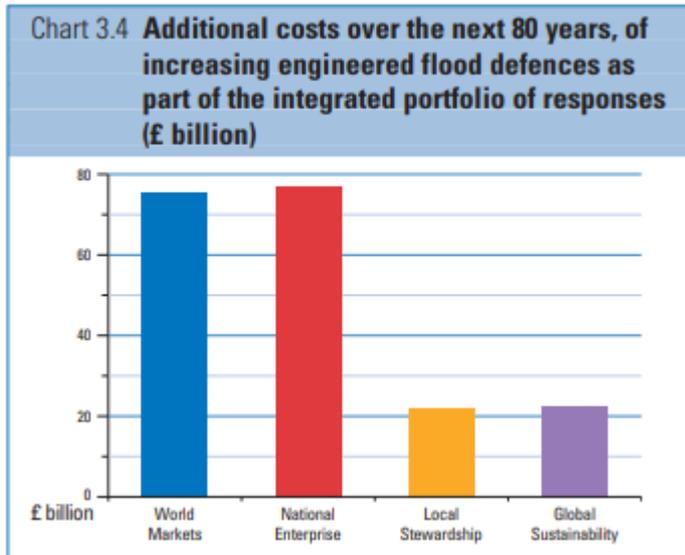


Source: Ministry of Housing, Communities and Local Government • Prices adjusted using GDP deflator, HM Treasury October 2020

NationalWorld

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/300332/04-947-flooding-summary.pdf

Which suggest between £22 billion and £75 billion of new engineering by the 2080s in the UK.



Ireland

Ireland has a less well developed public sector structure in this area.

Coastal defence is largely devolved to counties.

The Office of Public Works is the overarching national structure.

Flood defences referred to in Irelands National Development plan 2021-230

<https://www.gov.ie/en/publication/774e2-national-development-plan-2021-2030/>

Investment of €440 million since 1995 has already delivered forty-eight major flood relief schemes around the country, which provide protection to over 10,000 properties and an economic benefit to the State in damage and losses avoided estimated to be in the region of €1.8 billion. Investment of €186m since the start of 2018 underpinning the commitment of the NDP to 2027 of €1bn, has allowed the investment in work on flood relief schemes to almost treble from 33 to 92 in that time. This is part of a programme of investment in some 150 schemes to be progressed over the lifetime of the NDP, identified by the Flood Risk Management

Size of Market: Ports

<https://www.britishports.org.uk/uk-port-investment-roars-past-pre-pandemic-levels-as-many-cargo-sectors-return-to-growth/>

Trading in BNG units

<https://www.macfarlanes.com/what-we-think/in-depth/2022/trading-in-biodiversity-units-the-creation-of-a-new-environmental-market/>

<https://www.gov.uk/guidance/biodiversity-metric-calculate-the-biodiversity-net-gain-of-a-project-or-development>

<https://environmentbank.com/>

Biodiversity reporting for PLCs

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/850130/Env-reporting-guidance_inc_SECR_31March.pdf

Network Rail

<https://www.networkrail.co.uk/wp-content/uploads/2020/07/Understanding-the-impact-of-the-Shoreline-Management-Plans-on-the-railway-across-Wales-Borders-Interim-Findings.pdf>

Known Research Questions and opportunities

The opportunities for future Ecostructure opportunities that have been elicited from partners, interviewees and workshop participants through this project are summarised below:

| Opportunity | Known Unknown | Actors/Funders |
|------------------------------|--|--|
| Biodiversity Banking Credits | Value of intertidal credits Cost of achieving credits | Biodiversity banking intermediaries Coastal structure owners |
| Policy Advice | Evidence for informing policy | National and local authorities |
| Planning Advice | Advice for local authorities Advice to actors to understand and comply with planning rules. | Local Authorities Businesses seeking planning permission |
| CSR advice | Advice for companies on options for achieving maximum CSR benefits at minimum cost | Large Companies |
| Bid Differentiation | Advice for bidders on options for achieving maximum bid differentiation at minimum cost | Businesses (typically larger) bidding for contracts and licences |
| Maintenance | Advice on maintenance and repair actions to maximise biodiversity | Owners of coastal infrastructure – public and private |
| Environmental Reporting | Advice on environmental reporting, setting and achieving KPIs | Large businesses |

Options for future Ecostructure collaboration

There are clearly a number of academic, public sector and private sector organisations that wish to work together to address their individual and institutional goals in this field. However, as is often the case in low TRL level areas with a nascent supply chain and a need for more research in academia to answer known research questions, progress is often limited by the availability of public funding. However, other options for working together exist, rather than being wholly reliant on intermittent funding from the EU or UKRI or other public sector bodies.

Options for future funding include:

| | Public Sector | Private Sector |
|-------------|------------------------|--|
| High Value | EU, Research Councils | Collaborative R&D, InnovateUK, Contract Research |
| Lower Value | Local Council projects | KPI, Project Consultancy, Planning Advice, Biodiversity Banking advice |

These funding mechanisms are relatively “business as usual” from a university perspective and will require action and resource to win and implement including:

- Maintaining the Ecostructure community through events and newsletters
- Horizon scanning for funding opportunities
- Resource for bid writing
- Resource for industry outreach and fielding industrial enquiries

However, this resource is often difficult to corral and maintain within academic departments, and there is only a limited amount of central support available in universities for “speculative” future activity, regardless of the REF, KEF or TEF value that such activities may generate (though the monetary value of such case studies to the institution should not be underestimated).

A potential model suggests itself based upon the success of the [High Value Manufacturing Catapult’s membership model](#), though in no way is it suggested that a catapult is an appropriate vehicle for future Ecostructure work, and the term “catapult” should preferably be avoided.

The membership model is built around two different types of organisation and seeks to address their different needs by cofunding a Core Research Programme (CRP) that benefits all members.

The two types of organisation are:

- Technology end users (e.g., Local Authorities, Contractors)

These are organisations with challenges to solve. They usually cover the cost of membership with cash. Members use cash fees to commission their own fully funded research projects (the outputs of which are generally owned by the funder, though they may be shared with other members), and to engage with the CRP.

- Technology providers (e.g., SME Ecostructure product manufacturers, consultancies)

These are organisations with products or services that are relevant to the challenges that end users are seeking to address. They usually cover the cost of membership via Contribution in Kind (CIK), the provision of goods, services, equipment, training etc. in lieu of cash. CIK is used either to help deliver research and CRP projects or to provide access to a particular capability to the wider business.

The CRP is determined by the members through a board and voting structure. All members have access to the output of the CRP. The membership organisation, if properly constituted, can also bid for public funding in collaboration with its members, so that membership resources can be leveraged.

The membership model also gives rise to a number of membership services – eg conferences, newsletters etc, helps to build a community, and readily forms partnerships for collaborative working.

It is suggested that Ecostructure partners are approached with a view to determining the appetite for an analogous CRD programme.

Conclusions & Recommendations

While it is fair to say that the argument for marine biodiversity gain through Ecostructure engineering is largely won, and that legislative requirements are in place and developing (e.g., Biodiversity Credit trading), the process by which this gain can be achieved is less well developed.

Both public sector and private sector actors are keen to move towards quantification of both costs and impacts – the “how much for how much” question.

While an evidence base for the efficacy of interventions is developing (e.g., <https://www.conservationevidence.com/>) this has yet to develop to quantification.

Without this quantification, and even while understanding that biodiversity in the coastal environment can be difficult to quantify and changes over time, specifiers and builders of marine structures cannot answer simple questions of scale or investment.

For instance, to create a 10% net biodiversity gain along a given length of sea defence, do we need to install one vertipool, ten vertipools or one hundred vertipools? Or do we need a combination of interventions (pools, tiles, reef blocks, integral features etc)? Essentially, what is the most cost-effective way of creating the biodiversity gain we are attempting to achieve.

This question is important for public sector organisations specifying structures (e.g., local authorities) and for private sector contractors bidding for these Invitations to tender – both parties are seeking to deliver the required biodiversity gain at the least cost.

With this cost effectiveness question answered, the possibility of biodiversity banking in the intertidal zone can be considered. If it can be demonstrated that biodiversity credits can be created cost effectively (i.e., the cost of creating the credit is less than its market value), then it is likely that market forces will draw in investment for Ecostructure engineering (including research and advice services).

It is also suggested that interest in a membership organisation that maintains partner relationships and cofunds a future research programme is examined.

Appendices

Appendix A

Presentation given at Eco Engineering Workshop at Bournemouth 12/10/22



- Intro
- What we did
- What we found
- What that means
- What's next?



Research and tools for ecologically-sensitive coastal and marine infrastructure

Results and resources developed by Ecostructure, a European research project that ran from 2017 to 2022.

Aberystwyth
asked for

Report exploring demand for coastal and marine eco-engineering and identifying industrial partners for future research in these areas

Colm Watling & Liz Flint

- Elizabeth Flint
 - A career at the Interface of Academia, Business and Government
- Colm Watling
 - Experience in IP Commercialisation, innovation and engineering



What We Did



What We Found

Why are people interested?

- Differentiation in bids

Legislation affects different owners in different ways

- Planning
- Reporting

CSR

Biobanking

How to implement?

- Owners
- Manufacturers
- Contractors

What that means?

Drivers largely
in place

Legislation
developing

Supply chain
developing

Awareness
growing

What's Next?



METRICS



ECONOMICS



A STRUCTURE TO WORK
TOGETHER

Appendix B

Ecostructures Structured interview Questionnaire

This set of questions was the basis for each of the structured interviews conducted. Details of interviews can be found at appendix C.

1. What was your involvement in ecostructures – involved, peripheral, never heard of it?
2. What is your organisations interest in ecostructure engineering in the marine environment?
3. How would more or better ecostructure engineering help your organisation achieve its goals?
4. What are the barriers you perceive inside your organisation to more/better ecostructure engineering?
5. What are the barriers you perceive outside your organisation to more/better ecostructure engineering?
6. What opportunities in ecostructure engineering are you currently pursuing?
7. Do you feel that there is a community of practice developing in this area or are you on your own?
8. Are there any great examples of ecostructure engineering you can point to?
9. Are there any really bad examples of ecostructure engineering you can point to?
10. If there was a community formed in this area, would you/your organisation be interested in joining in some way?

Ecostructures demand interview notes

Academic 04/08/2022

- Coastal Infrastructure ownership in Wales ~ 1/3 NRW, 1/3 Local Councils, 1/3 private sector
- Network rail own a lot of the privately owned stretches
- Shoreline management plans will drive future investment - 'hold the line' stretches
- Barriers are law, planning, licensing etc, not lack of research
- Councils lack resource and understanding - want to do it but don't know how.
- Concerns beyond biodiversity e.g. public safety if vertipools accessible
- Conservation Evidence work provides access to evidence but stakeholders don't all know it's there
- NRW staff don't understand how, where, how, when to deploy tools and need practical guidance and training
- Challenge for greater uptake is to make eco-engineering integral not stuck on to structures
- NRW legislation is good but doesn't have 'enough teeth', it needs be part of the license agreement. This is coming

Academic 26/08/2022

- 'Lobster hotel' project can be used together with modified hatchery releases to reduce predation and cannibalism
- Opportunity to look at lobster population support around windfarms - lobsters colonise scour defense
- Barriers to more use of eco-engineering include a perceived lack of evidence base - some research is behind paywalls
- Need to unlock access to evidence base - Conservation Evidence site is way to do this but still waiting for them to review most of the material`
- Need to get costs down alongside evidencebase and legislative drivers to unlock uptake
- Opportunity to create floating habitat vegetation units to replace squeezed saltmarsh - acts as a carbon sink so net zero angle
- NRW are looking at having eco-engineering as the rule not the exception in future
- No clear answers yet on 'how much is enough' eg scale of interventions needed
- A variety of habitats is key - better colonisation when there are multiple scales e.g. replicate natural rocky foreshore

Academic 15/07/2022

- Trials have been at pilot scale, scale up of e.g. moulded panels is in its infancy
- Offshore windfarms can be modified to provide habitat. Would this count as habitat compensation?
- Lot of species on underside of floating pontoons - problem if non-native species. Environmental DNA tool can detect
- Offshore renewables structures can provide habitat for commercial species inc brown crab, lobsters, bass.
- Possibly commercial seaweed species too
- E-concrete artificial rockpools don't work but Artecology's Vertipools do
- Need some Government champions for eco-engineering.

- So far WG Env Minister has engaged somewhat
- Already deliver some short courses, opportunity to do more. A barrier is staff moving on after funded project ends

Harbourmaster 21/09/2022

- CSR is a priority
- No quantification of benefits of ecostructures
- We're doing it, but we're not quite sure why?
- Planning permission extends to intertidal and is clear on gain requirement
- Trust ports all have an environmental policy and good governance guidance
- Key environmental issues are turbidity, dredging, native oysters and invasive species

Manufacturer 30/09/2022

- Need to argue quality improvement in metric 3
- Monitoring is expensive no one understands quantification of biodiversity/area
- Scour protection blocks are in demand
- Not sure which features on blocks work best
- Developers and specifiers need help with Metric 3

Manufacturer 13/10/2022

- Issues with scaling concrete production low carbon concrete is a differentiator
- Market for ecostructures slowly developing
- Sell/deliver/grow cycle
- Still mostly sales into small scale trials and academia rather than larger deployments
- Interested in future models of working together

Manufacturer 04/08/2022

- Freedom from the tyranny of maintenance
- How many structures are required
- Islands withing reach of each other seem to work well
- Variability in installations difficult to quantify
- Health and safety is a post hoc objection rationalisation

Consultancy 11/10/2022

- How well do blocks work as flood defences?
- How well do blocks work in a high wave energy environment?
- How does colonisation affect structure/performance?
- How do you compare marine biodiversity when replacing sandy shore with rock?
- Specifiers/public sector are not sure how to specify biodiversity gain
- No engagement in ecostructures without legislative push yet

- Local authorities only have money for defence from central government - not for nice to haves

Harbourmaster 28/10/2022

- Recently installed Rock armour has disrupted local ecosystem and local species don't seem to grow on it
- Private harbour owners would welcome ecostructures for CSR reasons and commercial species gain
- local fishermen unlikely to work together to create net gain - tragedy of the commons
- Unaware of regulatory drivers other than health and safety

Local Authority 03/10/2022

- Resource limited and likely to be passed over to other officers
- Little resource to do anything more than simply comply with regulations and planning
- Desire to do more linked to mission zero and UNESCO biosphere, but budget and resource limited
- Preference to use local suppliers but concern over scale
- Coastal defences largely budgeted and controlled by DEFRA through FCERM

Consultancy 03/10/2022

- Differentiation in bids
- Differentiation in planning applications
- Developers unsure of scale required
- Cofunding research with universities
- Use of reef blocks as anchors for fish farms
- Use of reef blocks as mooring systems for other structures
- Scour protection for wind turbines is proven

Consultancy 12/09/2022

- People know what they need to do but not how

RTO 12/9/22

- Private sector don't know how to deliver net biodiversity gain
- Public sector don't know how to specify net biodiversity gain well
- Smaller local authorities lack staff to engage
- Can ecostructures help deal with invasive species
- Engagement with fishermans union may be useful

Appendix D

Map of Ecostructures engineering sites

Wales:

<https://www.google.com/maps/d/edit?mid=1D2bMzjQ3UiHFfXa4Cqe3scmimMVNPc0&ll=52.387911856891655%2C-3.9956109999999988&z=8>

Wales Ecostructures

| | |
|-------------------------|---|
| Wales Access Steps.xlsx |  All items |
| Wales Boat Slips.xlsx |  All items |
| Wales Breakwaters.xlsx |  All items |
| Wales Groyne.xlsx |  All items |
| Wales Other.xlsx |  All items |
| Wales Pontoon.xlsx |  All items |
| Wales Revetment.xlsx |  All items |
| Wales Rip-Rap.xlsx |  All items |
| Wales Seawall.xlsx |  All items |



Ireland:

<https://www.google.com/maps/d/edit?mid=1DbzLJHFT2Jl4W8dEnxdlxZ8pGS7ul9g&ll=52.7576102922372%2C-9.917212502000016&z=8>

Ecostructures Ireland





Beyond Ecostructure - unlocking Eco-Engineering at scale

A series of workshops for the public sector, private sector, and academia

As the Ecostructure programme reaches the end of its funded period, we want to ensure the work we've done is accessible and can be used to drive uptake of eco-engineering. We're putting together ways to provide easy, straightforward guidance on the tools we've delivered, but we know that there are some barriers to eco-engineering at scale. We'd like to invite you to attend one of our workshops to share your perspectives and help us unlock the potential of these tools.

Academia workshop: Tues 27th September, 11:00—13:00, via Zoom
Public Sector workshop: Thurs 29th September, 09:00—11:00, via Zoom
Private Sector workshop: Thurs 29th September, 12:00—14:00, via Zoom

To book your place, please email liz@flintinnovation.co.uk

Outline agenda for each workshop:

- ◇ **Develop SWOT analysis of Wales and Ireland's position in coastal and marine eco-engineering**
- ◇ **Develop the vision and mission for coastal and marine eco-engineering**
- ◇ **Identify market drivers, growth potential for eco-engineering and how it could be unlocked**
- ◇ **Determine value propositions (Value Proposition Canvas)**
- ◇ **Determine interest in further research, collaboration or commercialisation**
- ◇ **Consider models for further investment**

About Ecostructure:

The Ecostructure programme has brought together five leading universities in Wales and Ireland to research and raise awareness of eco-engineering solutions to the challenge of coastal adaptation to climate change. Ecostructure aims to promote the incorporation of secondary ecological and societal benefits into coastal defence and renewable energy structures, with benefits to the environment, to coastal communities, and to the blue and green sectors of the Irish and Welsh economies.

ECOSTRUCTURE is part-funded by the European Regional Development Fund (ERDF) through the Ireland Wales Cooperation Programme 2014-2020.





| | |
|--------|---------------------------------------|
| Agenda | Background |
| | SWOT |
| | Vision and Mission |
| | Drivers of uptake |
| | Barriers to uptake |
| | Growth potential |
| | Value Proposition for eco-Engineering |
| | Model for next steps |

Background

Mentimeter



INTERREG funding



Multiple projects



Growing evidence base for effectiveness of eco-engineering inc Conservation Evidence upload



As funding ends, what comes next?

Mentimeter

SWOT – where are we now?

Internally focused

- Strengths

What have we achieved in Ecostructure that's really useful

- Weakness

What did we miss?

Externally focused

- Opportunities

What do we not have enough evidence on yet, but would be really useful

- Threats

What external factors are working against more uptake of ecoengineering?

SWOT

Directions

SWOT
Strengths, Weaknesses,
Opportunities, Threats

Strengths = What have we achieved in Ecostructure that's really useful?
Weaknesses = What did we miss?
Opportunities = What do we not have enough evidence on yet, but would be really useful?
Threats = What external factors are working against more uptake of Ecoengineering?

Strengths

- Explored different types of methods and structures - was needed for advisors at NRW
- Testing tools for engagement e.g. Liz Morris virtual marina work
- Raised profile of ecoengineering
- Bringing evidence together saves time for NRW
- Nature based solutions at coastline
- Reducing risk and uncertainty for NRW when suggesting use of these features
- Strengthened evidence base for effectiveness
- One central place to look for evidence is valued
- Educating people who aren't aware of ecoengineering

Opportunities

- More UK evidence - not confident extrapolating from other countries e.g. Australia trials
- BioPredict and EPredict getting more data - increasing confidence in predictions
- Larger scale uptake and larger scale deployment - monitored over time
- Is anything better than nothing, or are we striving for certain quantity or quality of biodiversity?

Weaknesses

- Engage with people working in terrestrial zone - in some aspects land management is ahead
- Prediction tools require training to use - people don't find them intuitive
- Still a sense that not enough evidence yet - projects haven't been there long enough yet - 3 yrs to stabilise (2 yrs in now)
- Struggle with question of how much is enough to make significant biodiversity difference
- Is there a linear relationship between extent of ecoengineering infrastructure deployed and species conservation and diversity? Milford project - looking at bigger array
- To what extent do structures act as compensation for reef and shore habitat loss?
- Is the benefit enough to go ahead with the carbon cost of the structures? (ongoing project at Milford)

Threats

- No agreement, yet on whether ecoengineering can fit into compensation hierarchy - leaning towards no due to lack of similarity between communities?
- Populations in artificial structures not likely to be same as those displaced - no consensus, yet on measure of value of biodiversity
- Private sector will want to do whatever is cheapest - risk of poor choices from ecological perspective
- Risk of disproportion of where compensation ends up vs where habitat is lost - don't want to create loopholes
- Metric 3 is a bit too crude and also requires v large net gain - not really an issue in Wales as net gain less of a focus

Over to the whiteboard...



Mission = What we do

We deliver...what....to who...in
order to...

Vision = What we're going to deliver

We will have...done what....to/with
who...by when

Introducing Menti...

Mission: We deliver...[what]...[to who]...[in order to]

we deliver infrastructure with biodiversity in mind to improve the condition of MPAs

An evidenced based project, with multiple benefits.

We have confidence in the advice we provide so developments focus on environmental improvements

Appropriate projects that delivers multiple legislative drivers, Env Wales Act, wellbeing goals, mpas, Welsh marine plan



Vision: We will have...[done what]...[to/with who]... [by when]

Mentimeter

We will have a wealth of Wales based case studies for eco-engineering which has been applied with monitoring programmes that measure its success

Engaged with local communities about coastal structures

Collected strong ecological evidence base with partners and citizen scientists

Raised the profile of eco engineering to all stakeholders

Make eco-engineering a consideration in the routine planning process



Mentimeter

Drivers of uptake

What's encouraging the public sector to deploy eco-engineering?

What's encouraging large private companies?

What's encouraging SMEs?

Barriers to uptake

Mentimeter

What's preventing or delaying the public sector to deploy eco-engineering?

What's preventing or delaying large private companies?

What's preventing or delaying SMEs?

What's encouraging the public sector to deploy eco-engineering?

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planning approval

lack of evidence

biodiversity goals

area statements

exemplars

develop evidence base

legislation



What's preventing or delaying the public sector from deploying eco-engineering?

Mentimeter

percieved makes unsafe
licencing required percieved cost
lack of leg driver lack of evidence
lack of advice
lack of guidance
confidence in advice
behaviour change required



What's encouraging large private companies to deploy eco-engineering?

Mentimeter

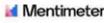
planning permission
coorporate responsibility
being green for public su
develop them in market



What's preventing or delaying large companies from deploying eco-engineering? 

cost
cant see strong leg drive
longer production time
increased workload
not mainstream
technical difficulties
changing their production



What's encouraging SMEs to deploy eco-engineering? 

gain skills
cost
diversification opps
to be the leaders
bigger market potential
potential to expand
uncertainty of success



What's preventing or delaying SMEs from deploying eco-engineering?

Mentimeter

production facilities
uncertainty of success
cost
uncertain of market
not enough expertise



How much growth potential is there?
Where is it?

If the barriers were removed, what do you think uptake would look like 5 years from now?



If the barriers were removed, what might uptake look like 5 years from now?

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Possible models for next stage

Developing CPD/training?

Ad-hoc consultancy?

Create joint consultancy spin-out?

Trials before development is tendered?

Membership structure for R&D Centre?

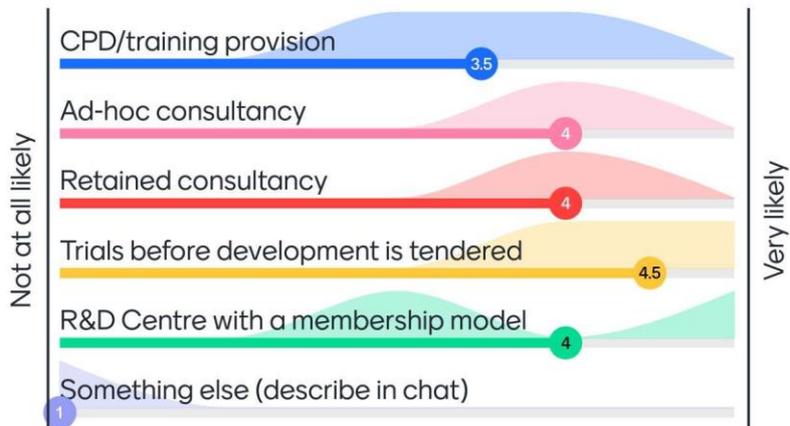
How effective do you think each of these would be in supporting uptake?

Mentimeter



How likely would you be to use:

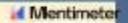
Mentimeter



Wrap up



Appendix G - Private Sector Workshop Outputs



Beyond Ecostructure... Unlocking Eco-Engineering at scale



Agenda

Background

SWOT

Vision and Mission

Drivers of uptake

Barriers to uptake

Growth potential

Model for next steps

Background

Mentimeter



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Mentimeter

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SWOT

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SWOT
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Strengths = What have we achieved in Ecostructure that's really useful?

Weaknesses = What did we miss?

Opportunities = What do we not have enough evidence on yet, but would be really useful?

Threats = What external factors are working against more uptake of Ecoengineering?

Strengths

methodology which can be applied elsewhere

Conservation evidence is a great tool

created flexible tools and apps and published research findings

created research community focused on eco engineering

increased awareness in general on importance of eco engineering

relations between research and social communities

demonstrated techniques and methods which can be applied in practice to enhance biodiversity and counteract

Opportunities

different climatic environments

segmentation of methods and solution in relation to given needs

define indicators and baseline

Continued monitoring and reporting of interventions to support evidence

Eco engineering will be important due to Env Act 2021 re Biodiversity Net Gain in 2023

larger scale prototypes

policy/legislation element. Leg needs to change and this project obviously provides an excellent evidence base to

plan next update of the Conservation Evidence

Weaknesses

monitoring methodology?

long term monitoring (up to 10 years)

roadmap with the roles of different players in the eco-system

interventions in subtidal environments

Threats

lack of incentives for eco-engineering

legislation to push

Uncertainty in quantifying benefits (£) of eco engineering

our clients need strong evidence base so they are "guaranteed" biodiversity gains, which may need to be demonstrated to governing bodies such as the EA. At the moment, we can not guarantee or do not feel comfortable guaranteeing, any one (or few) designs ... I do think, however, that Ecostructure is a great first port of call for starting to find this evidence

risk that clients will shy away from implementing these designs because not a "sure thing"

Chicken and egg situation with manufacturers and suppliers. They would like to know what is the demand to adjust

Awareness of eco engineering varies between decision makers e.g. local authorities

Large cost of individual / small scale panels and tiles

Over to the whiteboard...



Mentimeter

Mission = What we do
We deliver...what....to who...in
order to...

A graphic representing a whiteboard. It features a central white diamond shape with a white border, set against a background of overlapping blue and yellow geometric shapes. The text "Mission = What we do" is written in a large, bold, black font. Below it, the phrase "We deliver...what....to who...in order to..." is written in a smaller, black font. A small "Mentimeter" logo is visible in the top right corner of the graphic.

**Vision = What we're
going to deliver**

We will have...done what....to/with
who...by when

Introducing Menti...

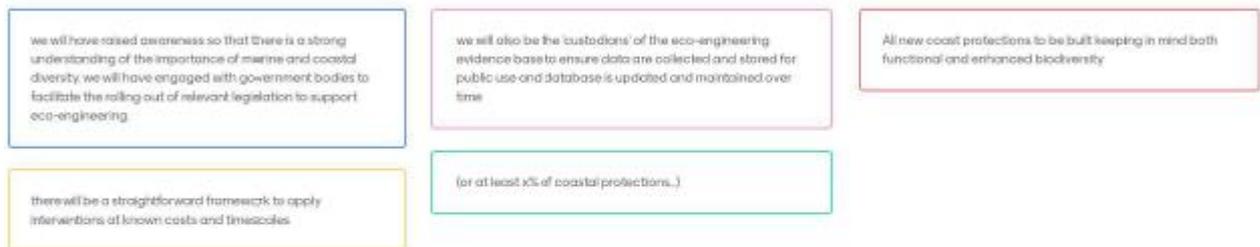
Mission: We deliver...[what]...[to who]...[in order to]

Mentimeter



Vision: We will have...[done what]...[to/with who]... [by when]

Mentimeter





Drivers of uptake

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What's encouraging the public sector to deploy eco-engineering?

What's encouraging large private companies?

What's encouraging SMEs?



Barriers to uptake

Mentimeter

What's preventing or delaying the public sector to deploy eco-engineering?

What's preventing or delaying large private companies?

What's preventing or delaying SMEs?

What's encouraging the public sector to deploy eco-engineering?

Mentimeter

climate change pledges
gradually reducing cost
stronger evidence base
set an example
community well being
legislation and policy
climate change mitigation



What's preventing or delaying the public sector from deploying eco-engineering?

Mentimeter

lack of dedicated ppl
lack of funding
too long for visible
lack of indicators
lack of awareness not in their remit
still relative high cost
lack of resources
perception of benefits
net gain type legislation
results costs
maintenance costs
lack of time
differentiation



What's encouraging large private companies to deploy eco-engineering?

Mentimeter

interesting topic to work
net gain type legislation
increasing awareness
competitive advantage
not in tor from client reputation
positive perception
look like doing something
secondary in flood defenc
adapting service offering



What's preventing or delaying large companies from deploying eco-engineering?

Mentimeter

lack of incentives for
little profit to be made business as usual is safe
secondary in flood defenc
not in tor from client
not statutory
niche market
not yet scalable
internal investments



What's encouraging SMEs to work in eco-engineering?

Mentimeter

interest in sustainable
competitive advantage
room for innovation reputation
looks good
gradual economies scale
more arbitrage with price



What's preventing or delaying SMEs from working in eco-engineering?

Mentimeter

certification of products
high costs of small units
lack of expertise
visibility of demand
intermittent pipeline
complicated licences



How much growth potential is there?
Where is it?

If the barriers were removed, what do you think uptake would look like 5 years from now?



If the barriers were removed, what might uptake look like 5 years from now?

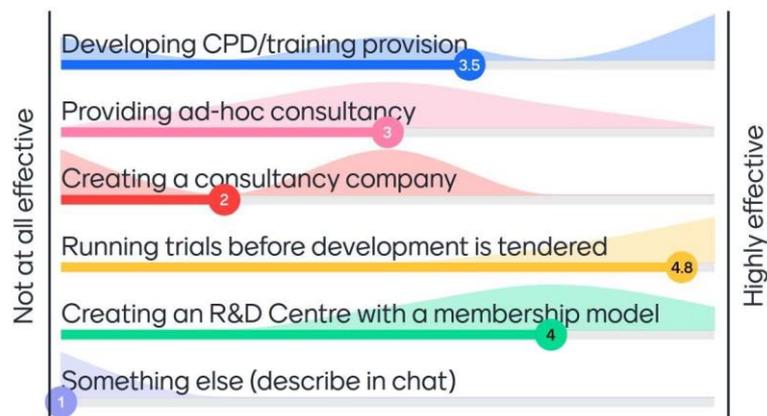
Mentimeter



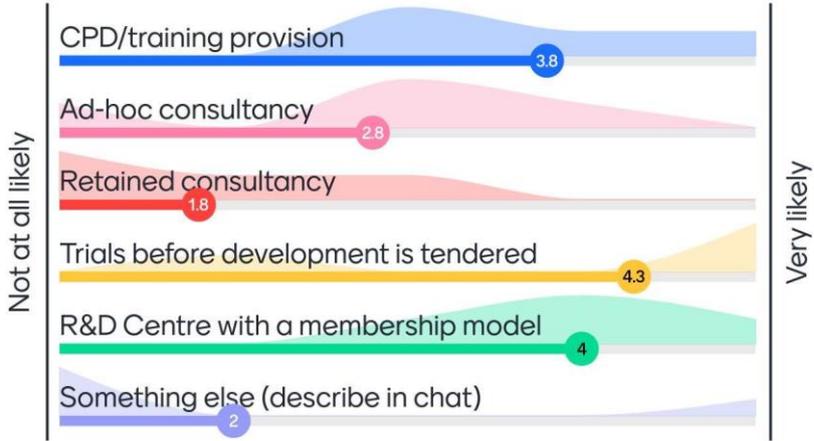
Possible models for next stage

- Developing CPD/training?
- Ad-hoc consultancy?
- Create joint consultancy spin-out?
- Trials before development is tendered?
- Membership structure for R&D Centre?

How effective do you think each of these would be in supporting uptake?



How likely would you be to use:



Wrap up

