

An underwater photograph of a coral reef. The water is a deep, clear blue. In the foreground, there are various types of coral, including some with bright orange and yellow colors. Several fish are visible, including a large, dark-colored fish on the left and a smaller, lighter-colored fish in the center. The background shows a rocky reef structure extending into the distance.

# Princess Elisabeth Island

Nature Inclusive Design



Princess Elisabeth Island

# Princess Elisabeth Island

## Nature Inclusive Design

### Introduction from Elia

The rapid and large-scale development of offshore power generation is universally recognised as a necessary condition for achieving society's decarbonisation, security of supply and energy independence goals. Offshore technology is becoming ever more efficient, and sustainability and respect for marine environments are being increasingly taken into account in offshore project design and construction methods.

This is why Elia has chosen to adopt a Nature Inclusive Design (NID) approach for the construction of its artificial energy island: the Princess Elisabeth Island. Elia wants to minimise the disruptive effects the island will have on the surrounding marine environment at the same time as embedding real ecological and environmental value into its project.

The innovative and unique NID co-creation process that Elia led on with a number of experts from research institutions, universities, consultancies and non-governmental organisations has produced very valuable lessons for the project. The models that resulted from our interactions form the basis for the detailed design of the Princess Elisabeth Island. This design is presented in this publication.

This project has already made an important contribution to scientific developments in the field. Moreover, monitoring and experimentation linked to our approach are opening up new possibilities.

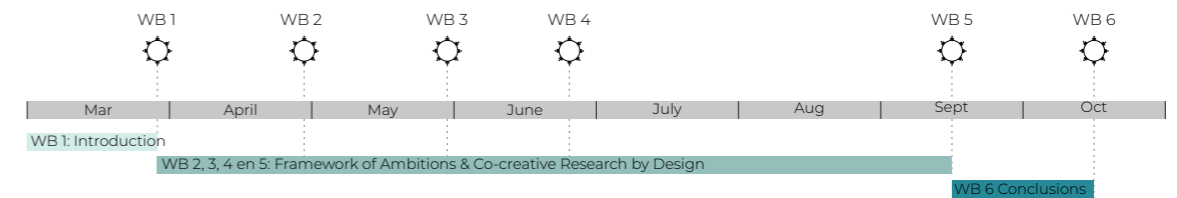
Elia is hopeful that the transparent and constructive attitude of all participants who have contributed to this process so far will pave the way for even closer cooperation related to the sustainable realisation of the energy transition.



“

Achieving sufficient scale in combination with a diversity of habitats and long-term stability are guiding principles in NID.”

Source: NID co-creation process



## Background

During six workshops which were held between March and October 2022, Elia invited experts to contribute to the development of its NID strategy for the construction of the Princess Elisabeth Island.

The Framework of Ambitions and Preconditions were jointly developed at the start of this co-creation process. NID concept models were then co-creatively examined, refined and further enhanced by taking these documents into account.

The experts involved mainly focused on expressing their views about topics related to nature. They took the initial design of the island that Elia proposed as their starting point.

The co-creation process resulted in ten recommendations and different NID models with a wide range of options being produced.

During the subsequent Detailed Design Phase in 2023, Elia and the construction consortium DEME and Jan De Nul explored the technical and economic feasibility of these models. The final NID approach was established based on the studies and took into account the experts' recommendations.



Standalone NID elements by themselves are not sufficient; we are therefore pursuing an ecosystem approach with integrated ecosystems as the goal."

Source: NID co-creation process

## Nature Inclusive Design (NID)

To ascertain the NID potential of the Princess Elisabeth Island, we identified four zones: the supratidal zone; the intertidal zone and shallow subtidal zone; the deep subtidal zone, which hosts pelagic species; and the seabed, which hosts demersal species. During the co-creation process, we examined several potential NID elements for each of these zones in relation to their contribution to species reproduction, foraging and shelter. Following a technical analysis and an economic feasibility study, the following NID elements were then selected to enhance the Princess Elisabeth Island from an ecological standpoint.

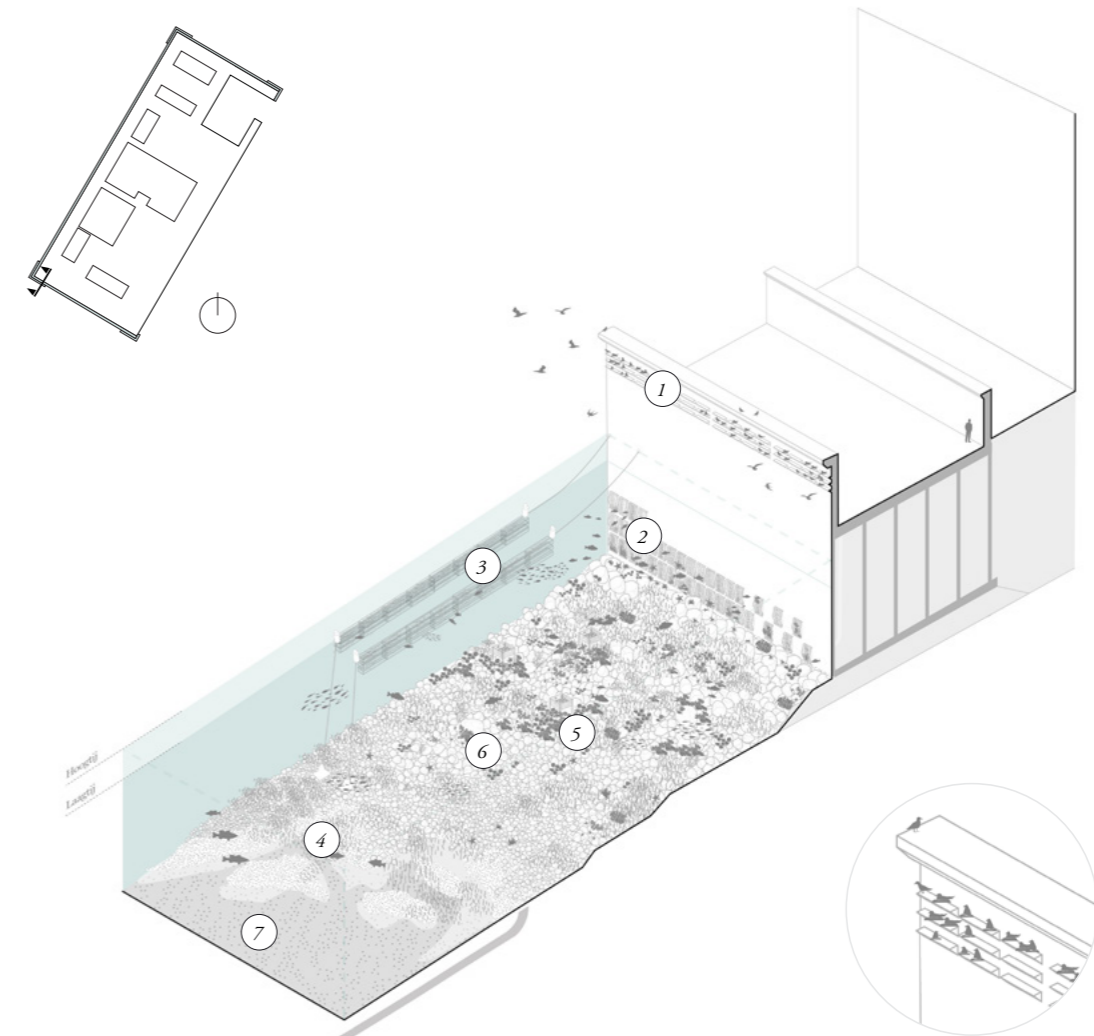
In the supratidal zone, we will attach ledges to the storm wall along the south, west and north sides of the energy island, allowing cliff-nesting birds such as the black-legged kittiwake to breed and rest there.

In the deep subtidal zone, we will install relief panels on each of the four corners of the Princess Elisabeth Island. The three-dimensional design of these panels will provide a structure onto which smaller marine organisms can attach themselves. Smaller fish will also be able to shelter and forage here. Higher up on each of these same corners, we will install longlines with oyster baskets for European flat oysters.

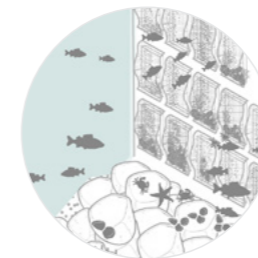
Their larvae can then attach themselves to the optimally designed rock revetment around the island (see below), meaning that the growth of oyster reefs will be promoted.

We will install a chaotic scour protection system with complex edges around the entire island. As well as forming a smooth connection to the original gravel beds, this will create a range of diverse habitats where different animal species can forage, shelter and/or rest. Placing larger boulders throughout this will add an additional layer of complexity that will make the environment around the island all the more attractive to marine organisms. Near the corners and longlines, we will incorporate oyster tables into the chaotic scour protection system, providing an extra boost for the creation of oyster reefs for European flat oysters.

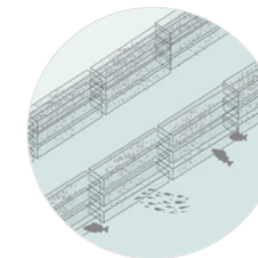
In addition to these NID elements, other features are being explored in terms of their feasibility. For example, tidal pools in the island's harbour and the targeted covering of horizontal surfaces on the island with shells and sand for birds are also being considered.



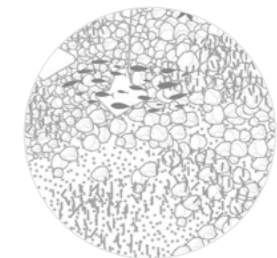
1. Storm wall with ledges for cliff-nesting birds



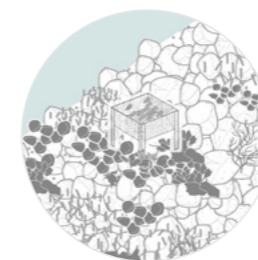
2. Relief panels



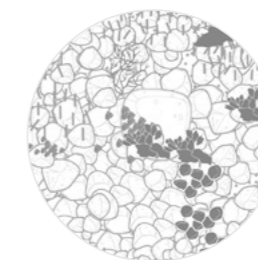
3. Longlines for European oysters



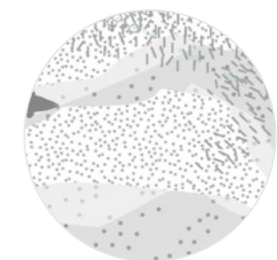
4. Chaotic scour protection with complex edges



5. Tables for European flat oysters



6. Boulders



7. Gravel beds

\* Pelagic species are species that live and forage in the water column.

\*\* Demersal species are species that live and forage on or just above the sea floor.



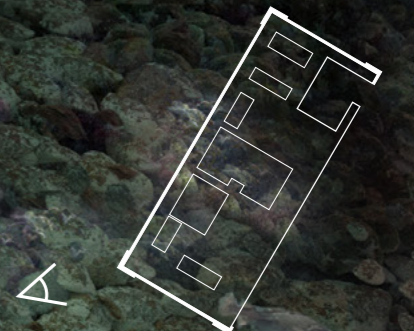
8

9

“

Scientific research with continuous monitoring will allow continuous knowledge building. This will also enable Belgium to claim intellectual and economic market leadership with regard to the NID of (energy) islands.”

Source: NID co-creation process





NID elements are selected based on their compatibility and interactions with each other, so that the overall ecological added value is strengthened."

Source: NID co-creation process



Interaction effects will lead to a multiplication of the ecological added value of NID."

Source: NID co-creation process

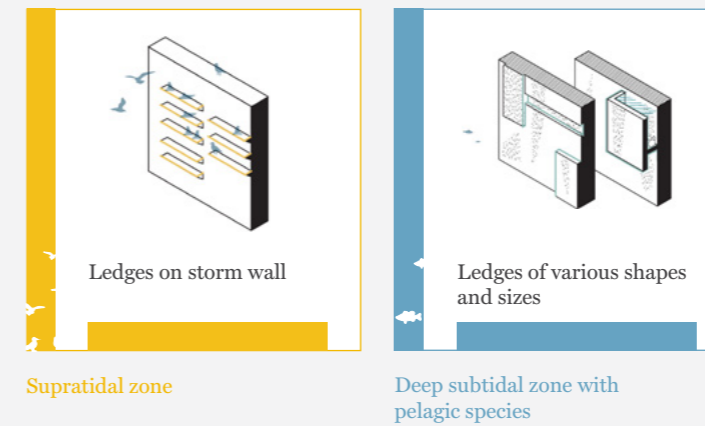
## Conclusions relating to added value scores

Along with the experts we worked with, we tried to measure the ecological added value of each of the different NID elements. The results are depicted on the opposite page.

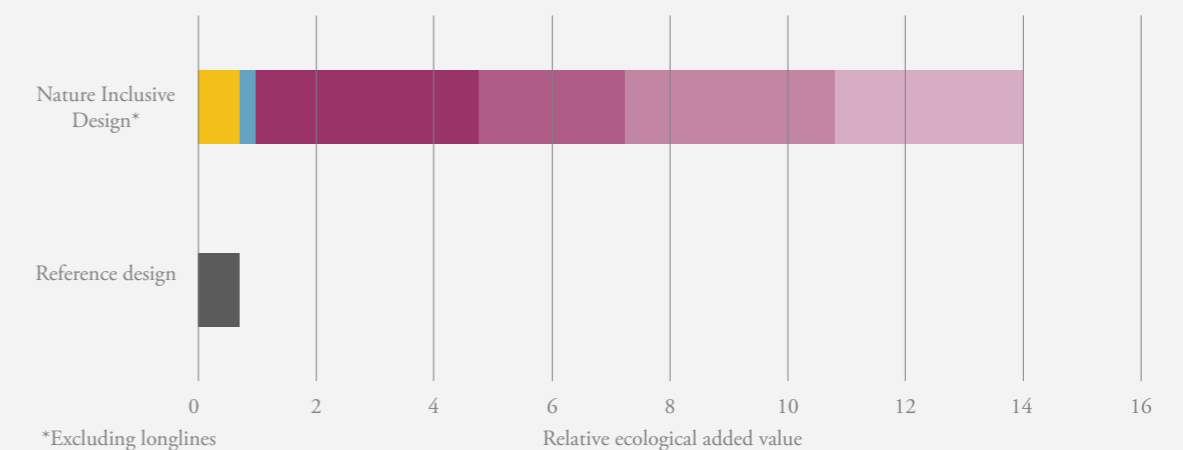
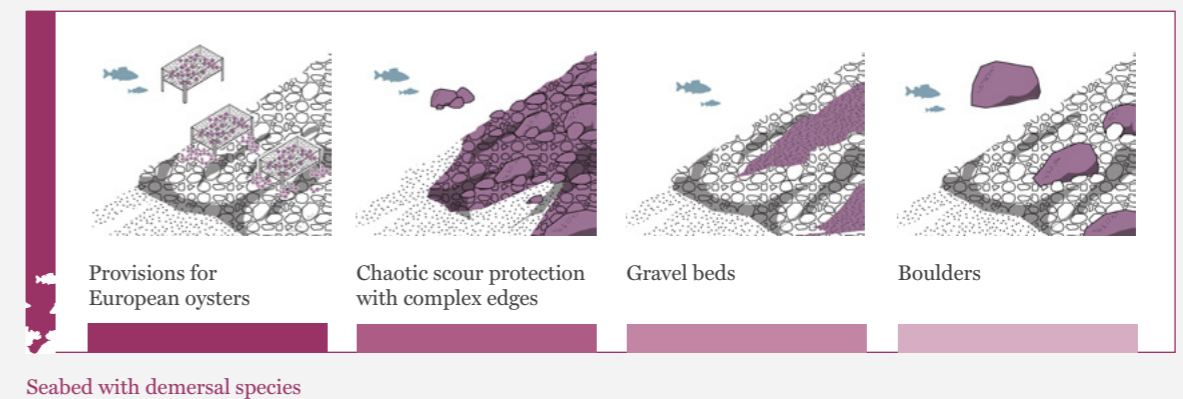
The figure which includes different purple shades demonstrates the strong measures we are taking to enhance the seabed's biodiversity through the NID approach for the Princess Elisabeth Island. We will apply NID elements that increase complexity by focusing on creating habitats inspired by gravel beds and by aiming to support oyster reefs (European flat oysters).

The Princess Elisabeth Island could become very attractive to birds. Bird ledges (see yellow shading in the figure) will provide breeding and resting opportunities for species such as the black-legged kittiwake. Relief panels in the subtidal zone (see green shading in the figure) also have an ecological added value, despite their smaller surface area.

There is scientific consensus among experts that interactions between individual elements are important for the ecological added value of NID. These interaction effects could double or triple the ecological added value of NID as a whole.



Selection of NID elements for three of the four zones as a basis for the NID design of the Princess Elisabeth Island. Longlines were added to the island's design after the co-creation process. That is why no score has been provided here for longlines in relation to reproduction, foraging and shelter.



NID added value without interactions = average indicative ecological score for an element's contribution to reproduction, foraging and shelter (provided by experts) x relative surface area of the NID element compared to the total surface area provided for in the concept model that was developed during the co-creation process.



“

The area around the Princess Elisabeth Island will be teeming with marine life in 15 to 20 years.”

Source: NID co-creation process

“

The more complex the habitats we create, the richer the biotic community that will develop there.”

Source: NID co-creation process



## Experts involved

Dr. Annelies Boerema  
Prof. Dr. Steven Degraer

Dr. Yana Deschutter

Dr. Hans Pirlet  
Dr. Eric Stienen

Sarah Tilkin  
Dr. Sarah Vanden Eede  
Dr. Katrien Van der Biest  
Dr. Gert Van Hoey

Prof. Dr. Ann Vanreusel  
Ir. Kristien Veys

IMDC  
Royal Belgian Institute of Natural Sciences  
(RBINS)

Department for the Marine Environment,  
Federal Public Service Health, Food Chain  
Safety and Environment

Flanders Marine Institute (VLIZ)  
Research Institute for Nature and Forest  
(INBO)

Natuurpunt / 4Sea  
WWF Belgium / 4Sea  
University of Antwerp  
Flanders Research Institute for  
Agriculture, Fisheries and Food (ILVO)  
Ghent University  
Blue Cluster

14

## Research commissioned by

ELIA

Nicolas Beck - Mathieu Donche - Riet Durinck -  
Pierre-Yves Guillermin - Mélanie Laroche - Carolien Pouleyn - Tim Schyvens

## Commission holders

ORG

Alexander D'Hooghe - Timothy Vanagt -  
Heinrich Altenmueller - Nikita Shah - Léa Colombain -  
Caterina Dubini - Rupert Vanstapel - Jules Van Rijsselberge

MANTIS CONSULTING

Emile Lemey - Bernd Herremans

MARIJN RABAUT

Right: construction of the model in progress



15





Prepared by ORG  
Translated from the original version in Dutch