Wier & Wind
D6.2 Business Model

Business model for a vertically integrated seaweed company

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Europees Fonds voor Regionale Ontwikkeling

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Wier & Wind Project

Project of INTERREG Vlaanderen-Nederland

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Murre Technologies
Total solutions for food processing

NORTH SEA FARMERS

UNIVERSITY OF APPLIED SCIENCES

GEOXYZ
GEOMATICS ENGINEERING SOLUTIONS

The Seaweed Company

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Introduction

This document is a high-level report on a vertically integrated business model for offshore-seaweed-farm-based companies. It describes what this business model is, what components should be considered for such a business model as well as their characteristics. It also gives an overview of main KPIs that could be monitored as part of such a business model.

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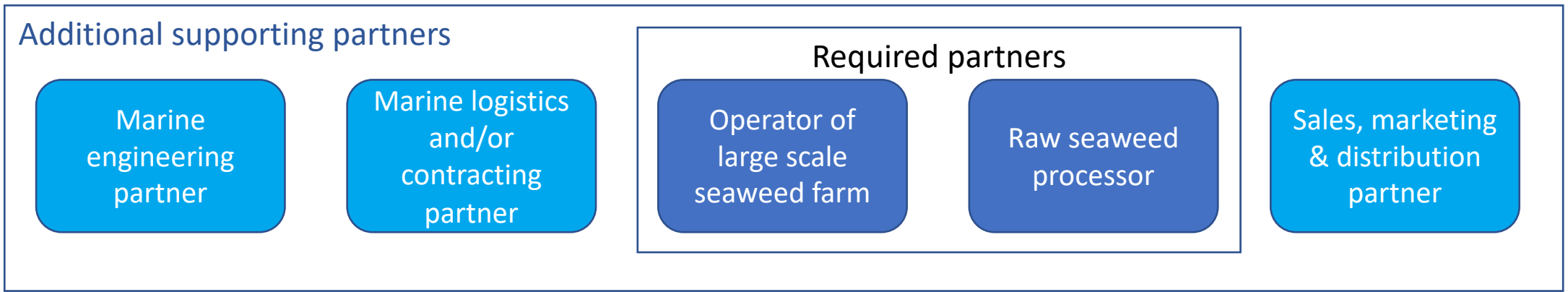
Vertically integrated business model for companies based on seaweed farms co-located with offshore wind farms

This business model is for seaweed farm owners that want to sell seaweed-based ingredients/products instead of raw, unprocessed seaweed to the highest bidder in the market.

It is assumed that this is necessary for a commercially viable operation of such a large scale farm setup. Producing seaweed in Europe is already difficult. Doing it offshore and even further offshore (e.g. in offshore wind farms) will only make it more expensive. By adding more value to the seaweed by processing it into an ingredient, intermediate or end-product the sales price and consequently the profit margin can be increased.

This setup requires collaborations between seaweed farmer and processor (and potentially a few other partners) for which a joint venture type of entity is suggested. This also allows to setup a fair sharing of risks and profit between the partners in this (part of the) value chain.



Business model phases

There are three main phases identified that are relevant for this business model:

EPCI is an abbreviation for engineering, procurement, construction (onshore) and installation (offshore). This is mainly a (marine) civil structural activity to get the seaweed farm up and running.

This is a phase that is unique to this business model setup in which 3 major components have been defined:

- Seasonal production of raw seaweed and keeping the farm infrastructure available for its intended design life
- Processing the raw seaweed into seaweed-based products suitable for selected markets
- Sales & marketing of the seaweed-based products

This EPCI phase is specific to renewal of seaweed farm components. The farm lifetime could extend up to 40 years whereas most components will have a design life of 5-10 years. Therefore, multiple major renewal activities will be necessary and this requires a specific approach and project team

EPCI (New build)

Seaweed production, , operation & maintenance

Seaweed-based products

Sales & marketing

EPCI (renewal)

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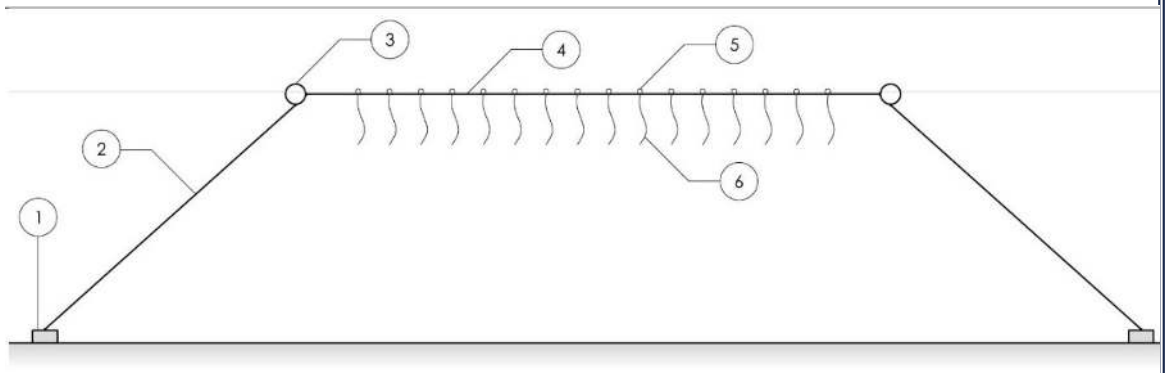
Seaweed growing system Terminology

- Anchoring system
  1. Anchor
  2. Anchor line
  3. Anchor buoy
- Substrate connection system
  4. Main structural line
  5. Buoyancy parts
- Seaweed production components
  6. Seaweed growing substrate

Seaweed Production System

Seaweed growing system



Growing system installation tools	Seaweed seeding tool/machine	Seaweed harvesting tool/machine
Growing sytem installation vessel	Seeding/harvesting vessel	Inspection/ maintenance vessel

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EPCI New Build

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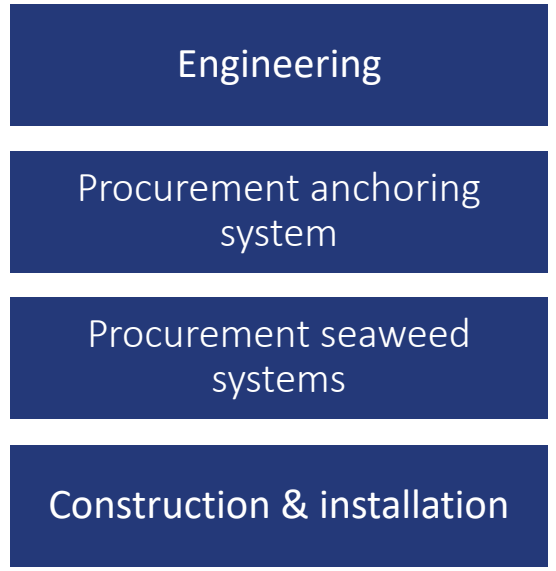
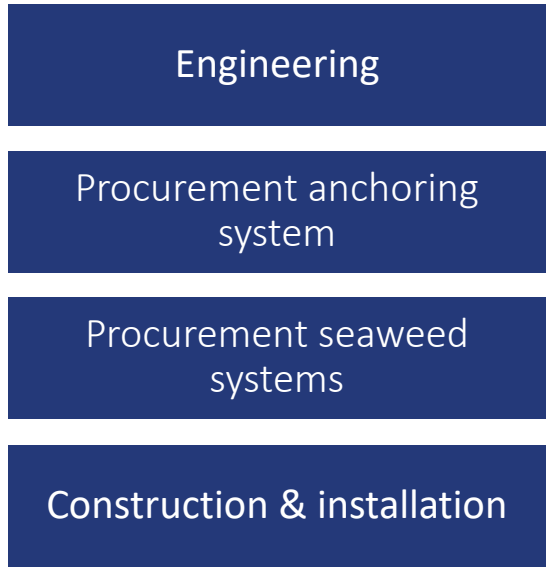
EPCI New Build General

- EPCI is an abbreviation for engineering, procurement, construction (onshore) and installation (offshore). Generally, this is a one-off phase only relevant when starting-up or expanding the seaweed farm.
- This is mainly a (marine) civil structural activity to get the seaweed farm up and running. Therefore, it could be useful to assign this activity to the marine contractor in your consortium or subcontract it in case you do not have such a partner.
- It assumes you have obtained a permit although the engineering step will initially be closely linked to this permit application process.
- For more information on howto obtain a permit, please refer to the multi-use procedure that is included in the Seaweed Industry Roadmap under the section regulatory affairs



EPCI New Build Engineering

- Main cost components in Engineering phase
  - Internal engineering hours
  - Engineering design consultant
  - Cost for obtaining metocean, geophysical & geotechnical data
  - Design certification cost
  - Cost for required studies to obtain nature permit



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EPCI New Build
Procurement main farm infrastructure

- General this activity can start if all required permit have been obtained as then you will know what you are allowed to build and install and typically this is scope that's best suited for your marine contracting partner.
- Procurement seaweed farm infrastructure – by marine contracting partner
  - Anchors
  - Anchor chains/lines
  - Anchor buoys
  - Main structural line
  - Buoyancy parts
  - Sensors
  - Installation and support vessel contracting
  - Installation equipment

Engineering

Procurement anchoring system

Procurement seaweed systems

Construction & installation

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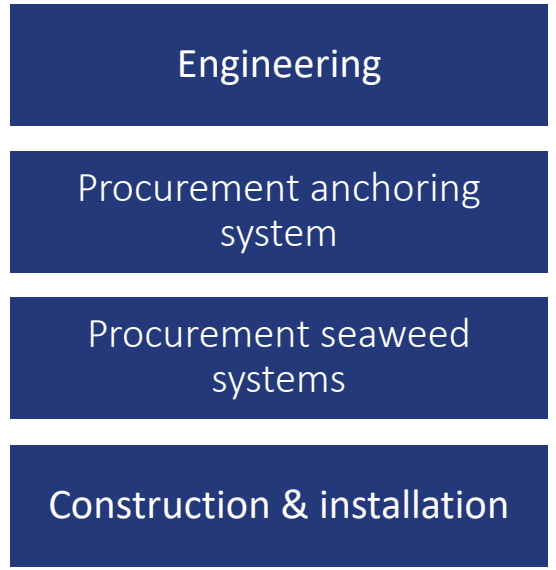
EPCI New Build
Procurement seaweed production components

- This are the parts of the seaweed farm that have a direct impact on the yield and quality of the seaweed. Therefore this scope is more suited to the seaweed farming partner.
- Procurement seaweed production components
  - Seaweed substrates
  - Seaweed starting material (including attachment solution: glue or twine-based)
  - Seeding machine contracting
  - Harvesting machine contracting
  - Sensors
  - Remote monitoring contracting (incl. vessel contracting)
  - Seeding, harvesting and maintenance vessel contracting



EPCI New Build
Construction & installation

- All the procured items need to be manufactured and assembled at a convenient onshore location. From a designated marshalling port the farm can be installed offshore. Main cost components to be considered are:
  - Onshore construction yard
  - Load-out location in marshalling port
  - Mobilisation cost installation/support vessels
  - Duration of operations onshore and offshore
  - Weather delay contingencies
  - Installation delay contingencies

Engineering

Procurement anchoring system

Procurement seaweed systems

Construction & installation

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Seaweed Production & Processing Phase

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Seaweed Production & Processing Phase General

- In many onshore and offshore main (infrastructural) development projects this phase is designated as the Operations & Maintenance phase. However, seaweed farm projects will have a major biological component that should require specific attention. Hence we propose to define this a the POM phase, i.e. Production, Operations and Maintenance
- In addition, this phase should manufacture seaweed-based products on an periodic basis (as the biomass becomes available).
- In the end, the consortium should sell these seaweed-based products to get the required revenues as part of the business case.

These main activities have been split as they will require very specific expertise to be successful

Seaweed production, , operation & maintenance

Seaweed-based products

Sales & marketing

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Seaweed Production & Processing Phase POM - general

- Production, Operation & Maintenance (POM) is the activity in this phase that is responsible to produce seaweed biomass an a periodic basis.
  - Production: producing the seaweed and safeguarding the yield and quality
  - Operation: keeping the seaweed farm production system available and functional to enable seaweed production
  - Maintenance: planned and unplanned maintenance to the seaweed farm infrastructure

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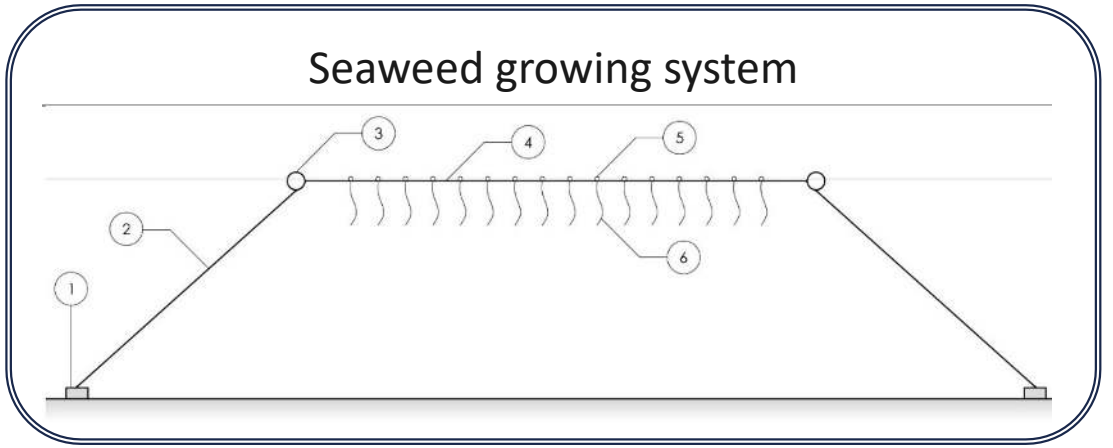
Seaweed Production & Processing Phase
POM – General production parameters

- Apart from the specific component based cost, there are general farm cost items that could/should be specified:
  - # seaweed growing systems
  - production capacity per seaweed growing system
  - # individual substrate units (e.g. nets)
  - Yield per m^2-substrate
  - Distance from logistics harbour
  - Max. H_s workability
  - Seaweed production staff & office cost
  - Staff working shifts (e.g 8hr vs. 24/7)



Seaweed Production & Processing Phase
POM – Seeding, deployment, monitoring & maintain

- Main cost components associated with seeding:
  - Total seed cost
  - Seeding speed [m^2-substrate/hr]
  - Rental/depreciation seeding machine
  - Onshore seeding location rental (in case of onshore seeding)
- Main cost compnents assocated with deployment (in case of offshore seeding these cost items should be combined)
  - Vessels cost (including mob/demob)
  - Substrate deployment speed [e.g. m^2-substrate/hr]
- Monitoring & maintain
  - Sensor cost and remote monitoring subscription fees
  - Inspection & maintenance vessel cost (including mob/demob)

Project management

Seeding

Deployment

Monitoring & maintain

Harvest

Delivery

Clean & store

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Seaweed Production & Processing Phase
POM – Harvest, delivery, clean&store

- Main cost components associated with harvest:
  - Vessels cost (including mob/demob)
  - Harvest speed [m^2-substrate/hr]
  - Rental/depreciation harvest machine
- Main cost components assocated with delivery to processing location (onshore)
  - Total seaweed yield [t-wet] and volume [m^3/t-wet]
  - Seaweed storage units (e.g. IBCs)
  - Temporary conservation cost (e.g. additives or cooling)
  - Onshore load-out cost (e.g. harbour, cranes, etc.)
  - Onshore transportation cost to processing facilities
- Clean & store
  - Cleaning substrates [€/m^2-substrate]
  - Storage [€/m^2-substrate]

Project management

Seeding

Deployment

Monitoring & maintain

Harvest

Delivery

Clean & store

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Seaweed Production & Processing Phase
Processing, sales & markting

- Main cost components associated with processing and manufacturing of seaweed-based products:
  - Load-out cost at factory
  - Processing cost [€/t-wet or €/t-end product]
  - Product warehouse cost
- Main cost components assocated with sales & marketing of seaweed-based products
  - Staff cost
  - Marketing cost
  - Distribution cost
  - After-care cost
  - Legal fees

Seaweed-based products

Sales & marketing

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Potential KPIs for monitoring progress in the Seaweed Industry

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Potential KPIs

KPI	unit	target value	Description
Seaweed yield	kg-wet/m^2	10kg/m^2	Industry target could be 10kg/m^2 on average over the entire individual growing system and/or farm. For line based systems the target could be 5kg-wet/m
Total yield per seaweed growing system	t-wet/seaweed growing system	to be determined	Depends on the growing system – more interesting for individual farmers than industry as a whole
Cost per seaweed growing system	€/seaweed growing system	to be determined	on the growing system – more interesting for individual farmers than industry as a whole
Seaweed growing system cost per unit seaweed yield	€/t-wet	to be determined	This is a more generalistic parameter, suitable for industry as a whole to compare farmers' processes and farming technologies/systems
Seeding speed	m/hr or m^2/hr	50m^2/hr	50m of net-substrate seems possible at this time. For line-based systems higher values may be possible
Harvesting speed	m/hr or m^2/hr	50m^2/hr	50m of net-substrate seems possible at this time. For line-based systems higher values may be possible
Seaweed growing system design life	[years]	7 years	Number derived from mussel aquaculture. It should be tested if this design life is feasible and economically smart for offshore farming
Anchoring system design life	[years]	25 years	Number is based on operation in wind farms where anchor operations should be limited. Includes anchor and anchor chain.

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Future of offshore seaweed production
What can we learn from offshore wind?

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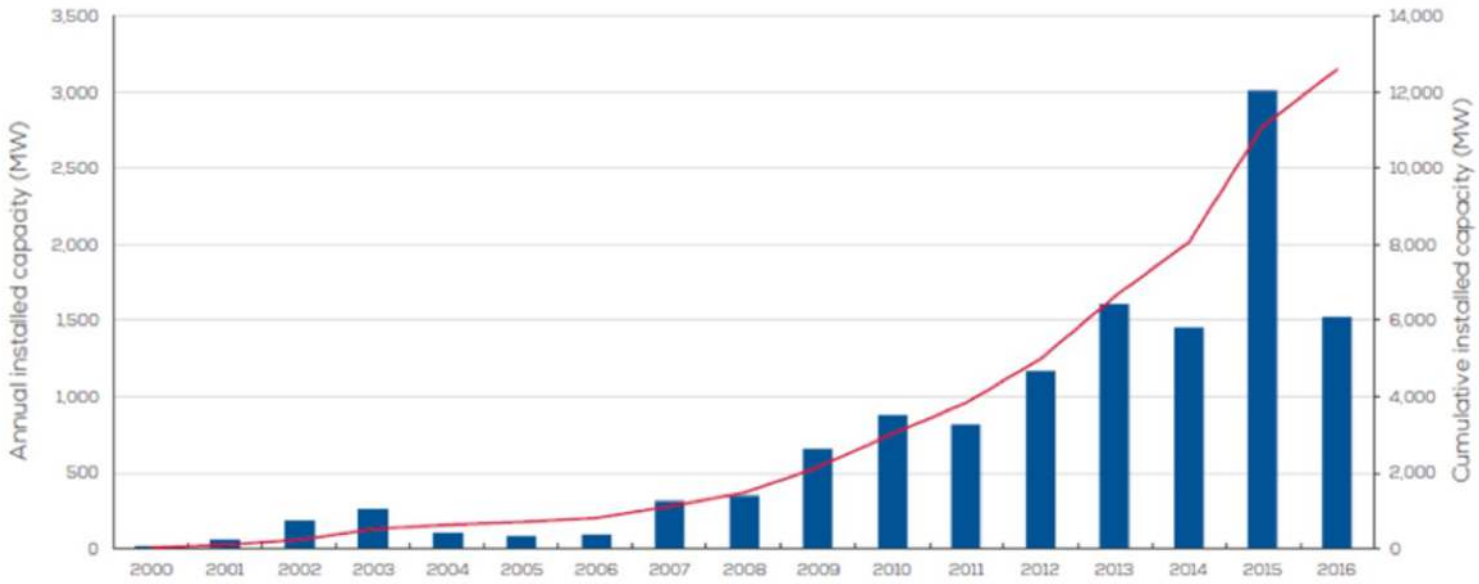
Wind farm capacity has increased in the last 2 decades

Offshore wind development in Europe

https://northsearegion.eu/northsee/e-energy/offshore-renewable-energy-developments-offshore-wind/



GLOBAL WARMING

ipcc
INTERGOVERNMENTAL PANEL ON climate change

WMO UNEP

Klimaat-akkoord

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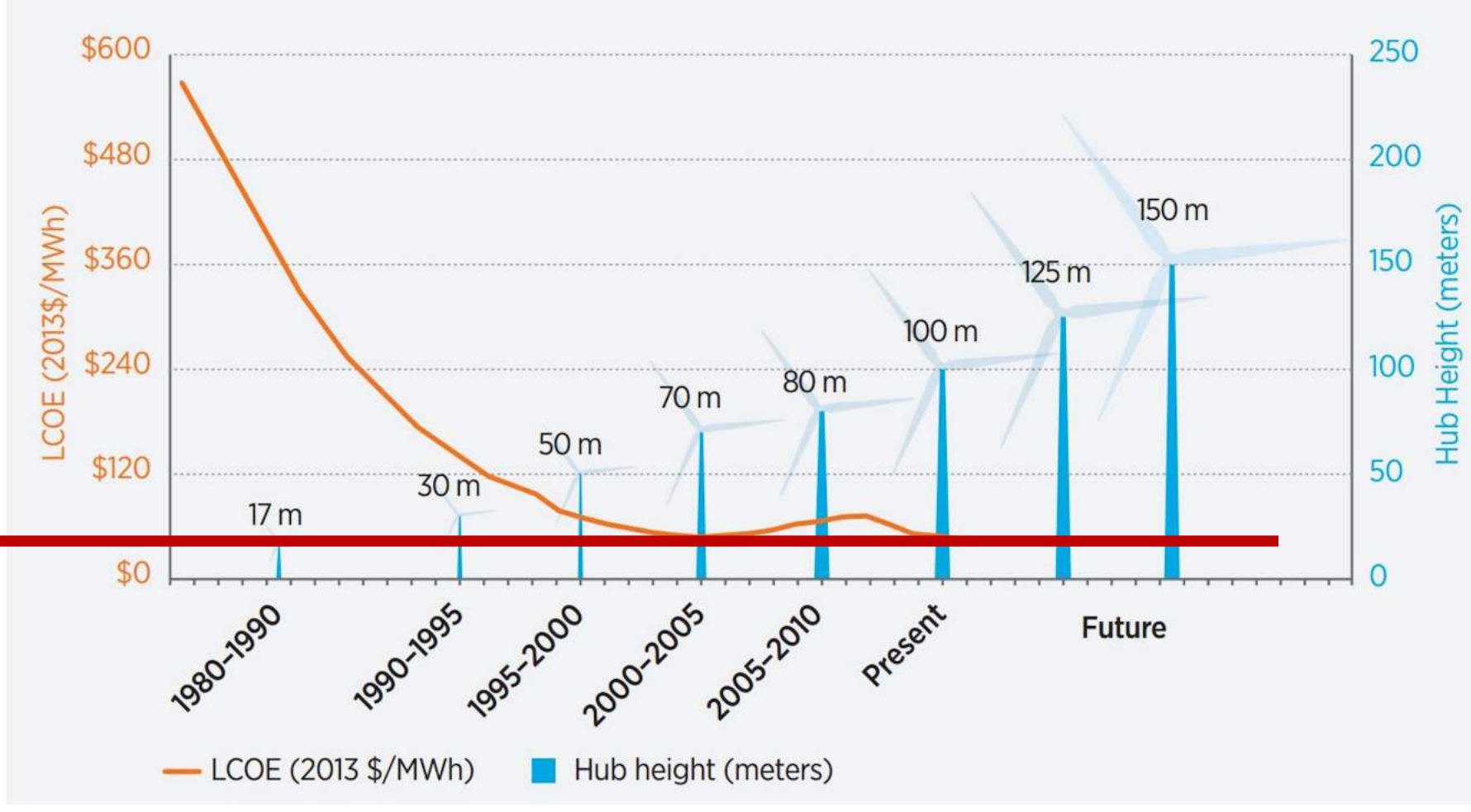
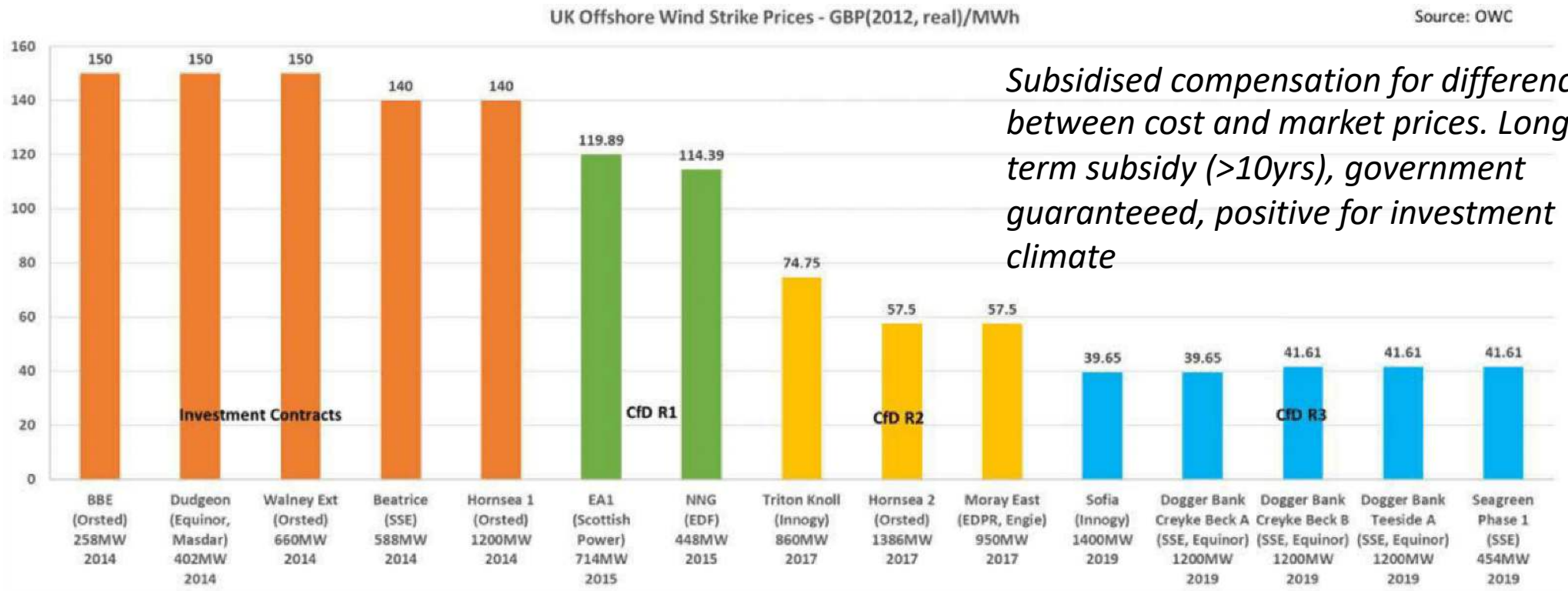
Although it was too expensive compared to the grey electricity market

Indicative market price

The red line is a simplified representation of the “grey” electricity price



The right support scheme has helped offshore wind to develop into a valuable industry in Europe



Subsidised compensation for difference between cost and market prices. Long-term subsidy (>10yrs), government guaranteeed, positive for investment climate

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Can the seaweed industry learn from this offshore wind development?

Suggested routes for the path forward for the seaweed industry are:

- Focus on cost reductions and sell raw, unprocessed seaweed.
- Business model integration: sell seaweed intermediates/end-products.
- Focus on government support schemes.
- Show the perspective.

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