Interreg North-West Europe H2SHIPS

Port Oostende

H2 Refuelling Station

2023.06.29

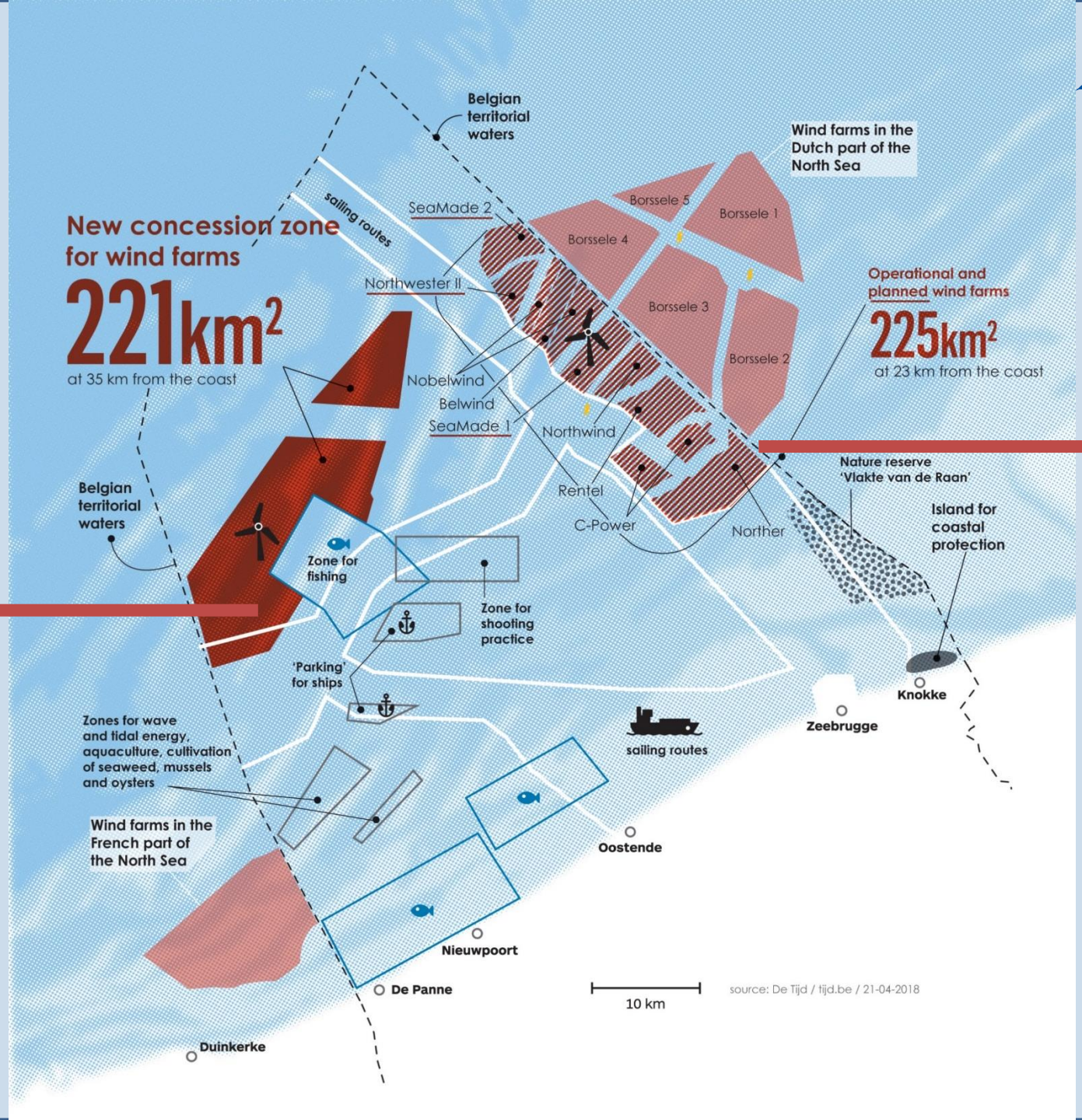
About Port Oostende

- In just over ten years, Port Oostende has become a major hub for the offshore wind business, with 2.2 GW installed of operational capacity in the Belgian North Sea.
- Active maintenance of those parks out of Port Oostende with crew transfer vessels and service operating vessels
- With more than 800 people directly employed in the O&M business for the offshore wind in Oostende.

***Green energy entrepreneurs at heart.**

Interreg North-West Europe H2SHIPS

EXTENSION BELGIAN MARINE SPATIAL PLAN



+3,6 GW
Installed 2030

2,2 GW
Installed 2020

Interreg North-West Europe H2SHIPS

Crew Transfer Vessels

Infra - O & M

Interreg North-West Europe H2SHIPS

Infra - O & M

SOV (Service Operating Vessels) - hotelvessels

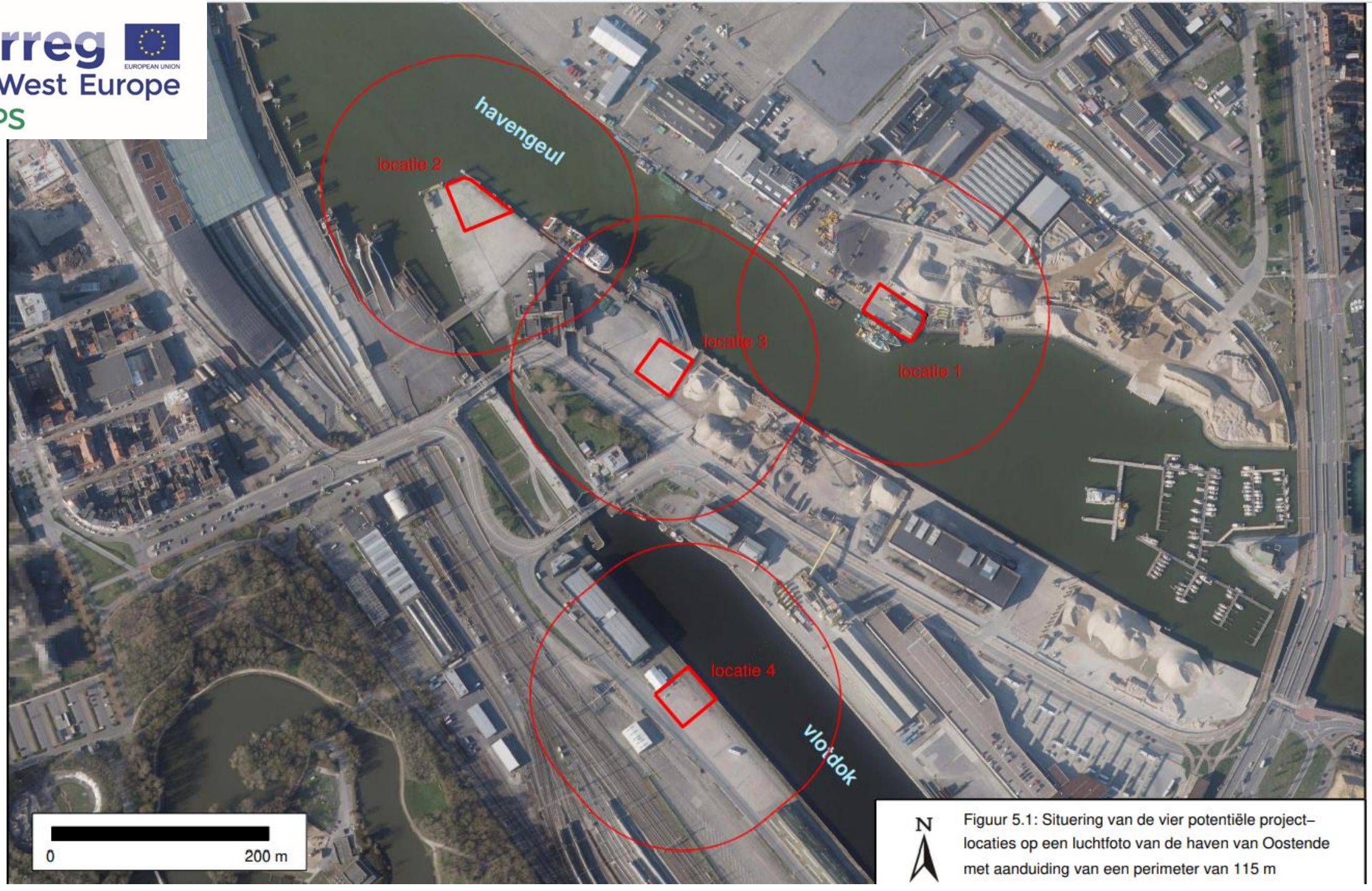
Interreg North-West Europe H2SHIPS

Reducing the carbon footprint of an offshore windfarm

- The O&M activities in the offshore wind industry have today a **considerable carbon footprint**
  - The vast majority of specialized vessels for offshore wind installation, operation and maintenance are driven by internal combustion engines, mainly using fossil fuel, for propulsion.
  - This is still the case for most of the recently build Crew Transfer Vessels (during the last 5 years), which will be in use for at least another 10 to 15 years
  - For CTVs the priorities are speed, reliability and safety of transfer, while incentives on CO2 emission reduction are low, and so far little or no requirements were imposed as permit requirement or as award criteria

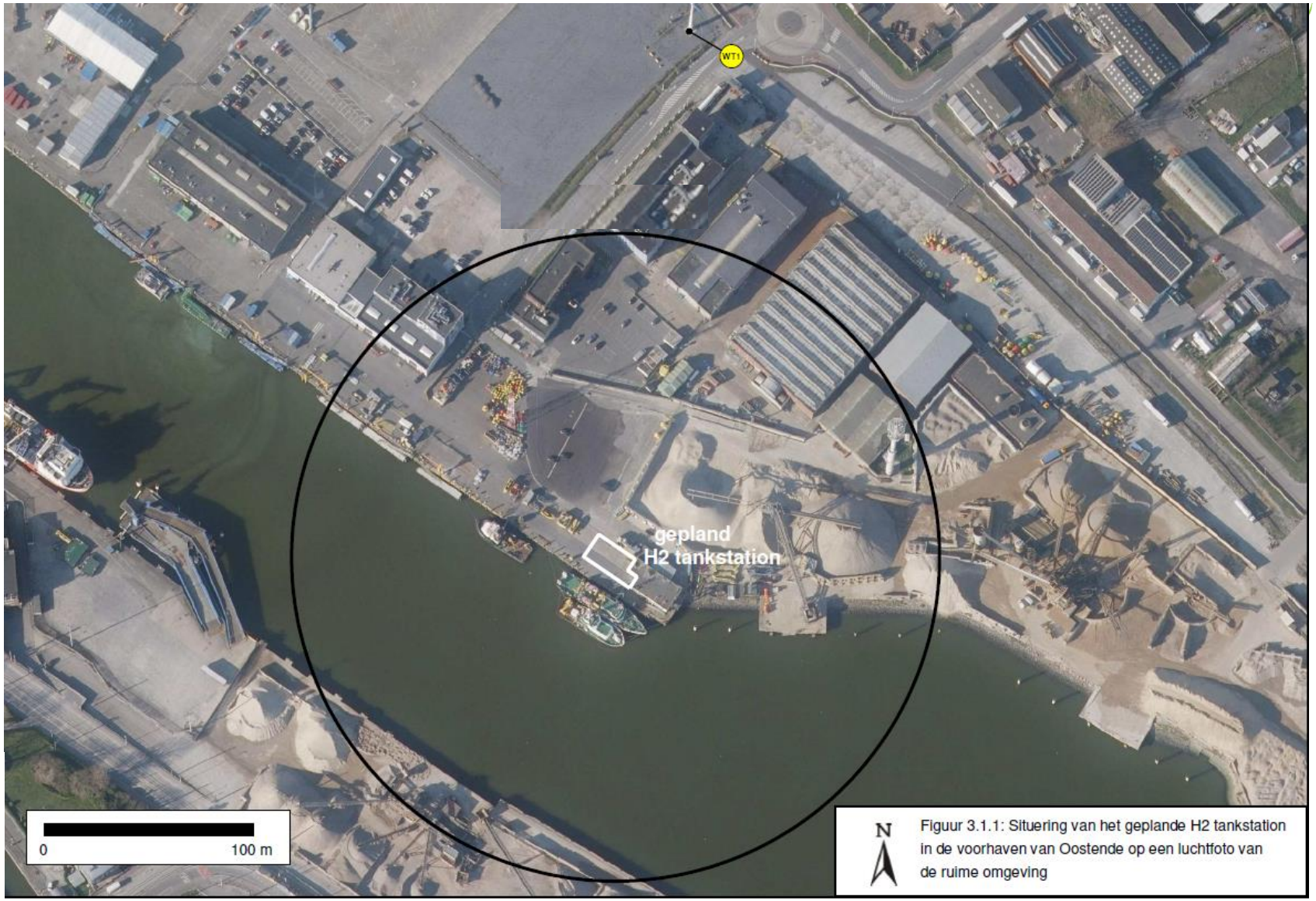
- Our existing BE wind farms
  - We estimate that the O&M operations and maintenance logistics for the existing BE windfarms consume **7.5 - 9 million litre of diesel fuel per year,** generating **20000 – 24000 tons of CO2** (approx. the equivalent of 3000 cars)
  - => average of 3500 to 4000 litre / year / MW of installed capacity


Interreg
EUROPEAN UNION
North-West Europe
H2SHIPS
Port Oostende
Google Earth



Figuur 5.1: Situering van de vier potentiële project–locaties op een luchtfoto van de haven van Oostende met aanduiding van een perimeter van 115 m

Location



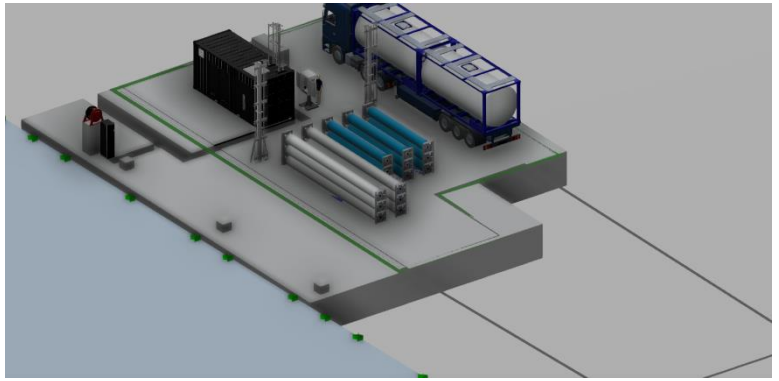
Figuur 3.1.1: Situering van het geplande H2 tankstation in de voorhaven van Oostende op een luchtfoto van de ruime omgeving

Interreg North-West Europe H2SHIPS

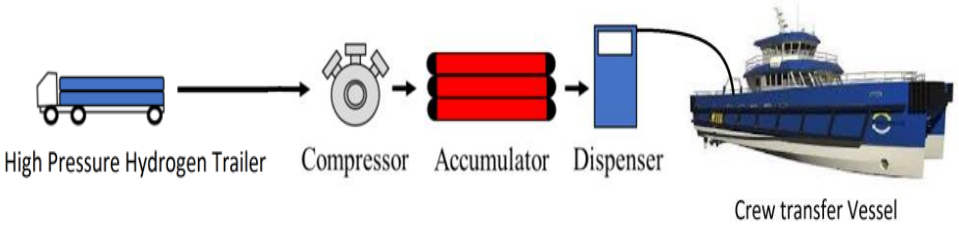
ISHY – Hydrogen Refuelling Station (HRS)

Status of the project

- Feasibility study:
  - ✓ Explore the potential future demand and related business model for hydrogen in the harbor of Oostende
  - ✓ Technical concept, safety screening for suitable locations, preferred location identified

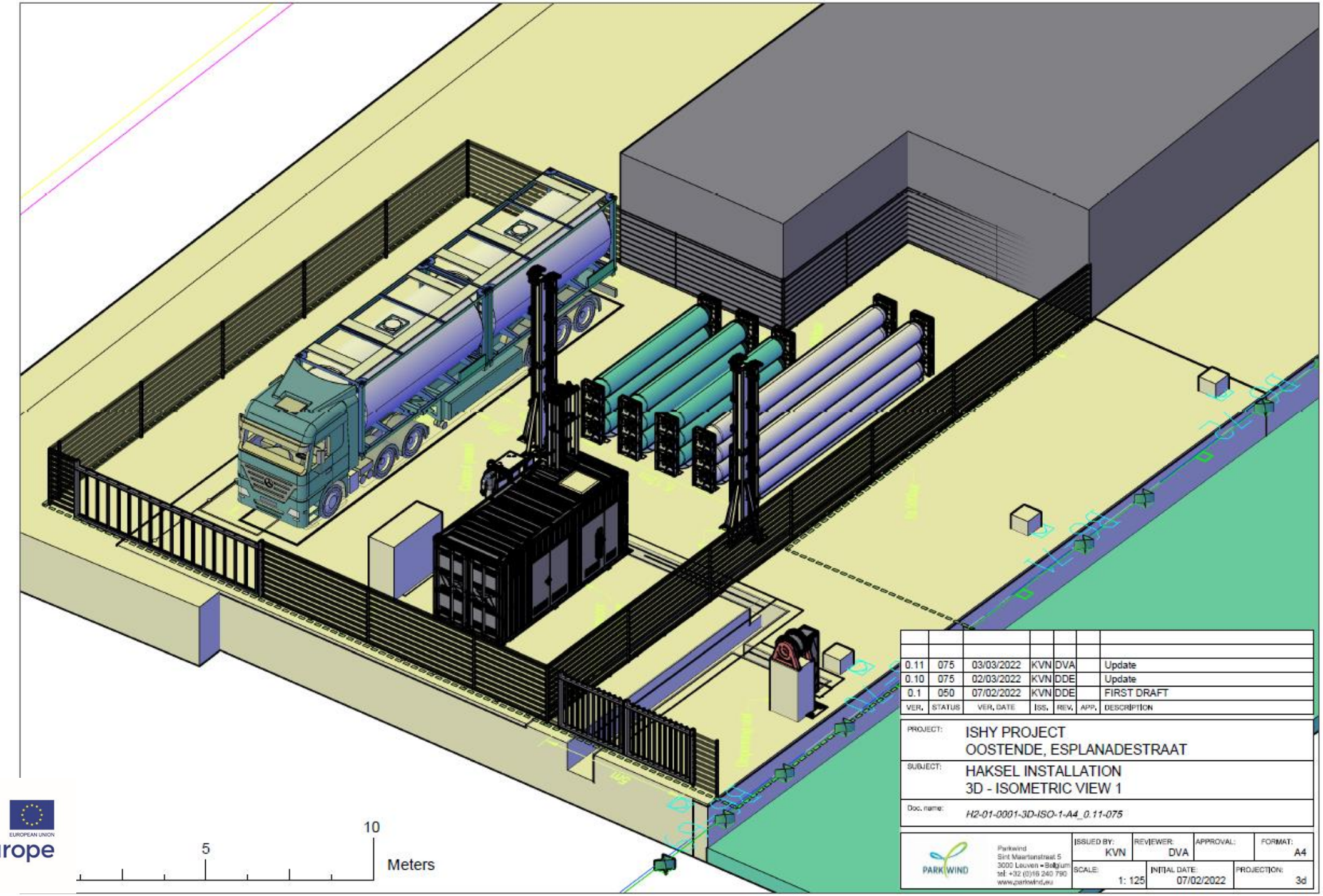


- Realization of the facility:
  - ✓ Detailed engineering completed
  - ✓ Safety and implementation study completed
  - ✓ Permit (“Omgevingsvergunning”) awarded on 25.08.2022
  - ✓ Procurement, realization and testing – all contracts signed
  - • Assembly of main components, civil works and construction of the HRS ongoing



- Planned capacity and phasing:
  - • Phase 1: 600 kgH2/day **(R&D project)**, 4 vessels @150kg H2/day
  - • Phase 2: 1600 kgH2/day, expected within 5 years, investment not part of R&D project
  - • Phase 3: 3000 KgH2/day, expected within 10 years, investment not part of R&D project

Interreg North-West Europe H2SHIPS



VER.	STATUS	VER. DATE	ISS.	REV.	APP.	DESCRIPTION
0.11	075	03/03/2022	KVN	DVA		Update
0.10	075	02/03/2022	KVN	DDE		Update
0.1	050	07/02/2022	KVN	DDE		FIRST DRAFT

PROJECT: ISHY PROJECT
OOSTENDE, ESPLANADESTRAAT

SUBJECT: HAKSEL INSTALLATION
3D - ISOMETRIC VIEW 1

Doc. name: *H2-01-0001-3D-ISO-1-A4_0.11-075*

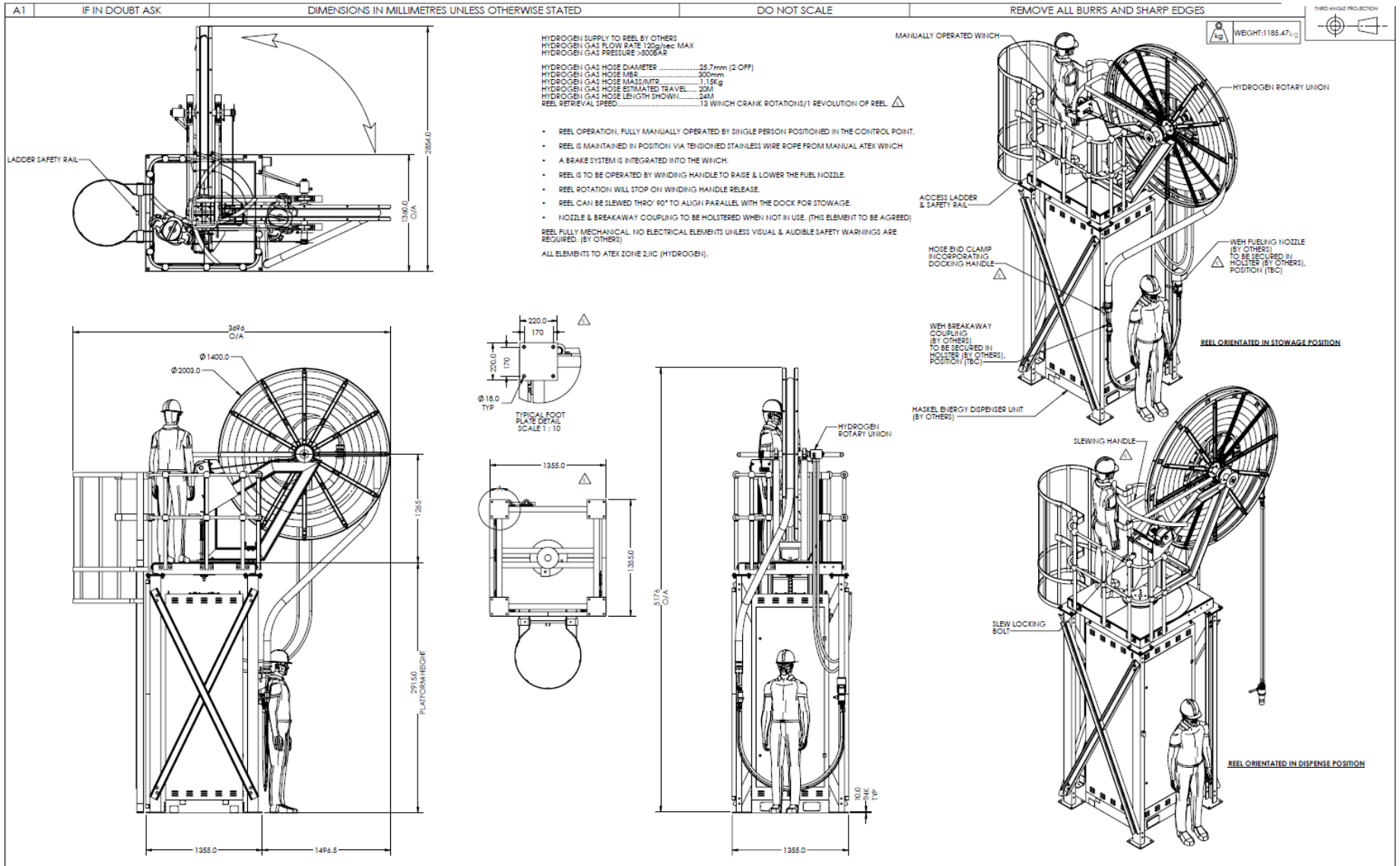
Parkwind
Sint Maartenstraat 5
3000 Leuven • Belgium
tel: +32 (0)16 240 790
www.parkwind.eu

ISSUED BY:	REVIEWER:	APPROVAL:	FORMAT:
KVN	DVA		A4

SCALE:	INITIAL DATE:	PROJECTION:
1: 125	07/02/2022	3d

Interreg
North-West Europe
H2SHIPS

Dispenser – Refuelling a moving vessel



Interreg North-West Europe H2SHIPS

H2 refuelling station – Power installed

H2 Mass Flow	1544.648649	kg/day

H-Drive Parameters	Inlet Pressure (Bar)	Interstage (Bar)	Outlet Pressure (Bar)	Flowrate (Nm3/hr)	Flowrate (kg/hr)	Running Time (Hours)	Hyd Pressure (Bar)	Hyd Power (kW)	No. of Boosters	Hyd Power (kW)	Hyd Flow (l/min)	Process Cooling Required Per Booster (kW)	Total Process Cooling Required Per System (kW)
	99	308	500	357.2	32.18018018	24	248	73	2	146	140	37.8	60.48
	99	308	500	357.2	32.18018018	24	248	73	2	146	140	37.8	60.48
Average				357.2	32.18018018	24	248	73	2	146	140	37.8	60.48

	Maximum	Average Running
Total Hydraulic Power (kW) / Running (kW)	146	97.3236
Total Process HPU Cooling Required (Per HPU / Total)	20	40
Total Process Cooling (kW)	100.48	
Total Process Electrical Power Installed (kW) / Running (kW)	49.53004953	25.4
Total Dispense Cooling Electrical Power (kW) / Running (kW)	0	0

HPU Installed Power 150 kW

HPU T0 Cooling:- 8 kW for 30 kW for 55 kW motor. 12/55 For 75 kW 16/75

Chiller Installed

ICE 116 42 kW

CO2 Chiller Running 65

0 kW

	Maximum Installed	Average Running	Maximum Running	
Total Electrical Power Required (Installed / Running)	193.285	122.7236	195.5300495	kW
Safety Factor (10%)	212.6135	134.99596	215.0830545	kW
Total + Safety Factor (Installed / Running)	**212.6135**	**134.99596**	**215.0830545**	**kW**

150 kW Installed

Hydraulic Power	1.512166797	
Process Power	0.394652856	
Dispense Power	0	
Ancillaries	0.019965705	
Total kWh/kg	**1.926785358**	**kWh/kg Total (Running)**

Ancillaries	kW
Extractor Fan (x2)	0.75
Fire System	0.25
Lights (x2)	0.03
PLC	0.025
HMI (x2)	0.05
Solenoids (x10)	0.06
TT (x10)	0.06
PT (x10)	0.06
Total	**1.285**

Process Chillers

Model ICE		003	005	007	010	015	022	029	039	046	057	076	090	116	150	183	230	310	360
aircooled	Cooling capacity	kW	2,5	5,1	7,0	9,5	14,3	21,8	28,1	38,2	45,2	56,4	76,0	90,2	115,5	149,2	182,3	227,9	309,1	359,7
	Compr. abs. power	kW	0,70	1,40	2,0	2,27	3,43	5,19	5,66	7,69	10,1	12,3	15,4	20,3	24,9	30,8	40,1	51,4	46,4	81,5
	Cooling capacity	kW	1,8	3,8	5,2	7,0	10,6	16,2	20,8	28,4	33,8	42,1	56,5	67,1	86,4	110,9	135,4	165,3	223,7	259,1
	Compr. abs. power	kW	0,62	1,31	1,67	2,16	3,24	4,46	5,93	8,26	10,6	13,1	16,4	21,2	25,8	33,5	42,1	54,3	66,4	83,7
watercooled	Cooling capacity	kW	N.A.				on request		29,6	39,5	47,6	59,0	79,8	97,5	120,1	156,7	195,0	on request	N.A.	
	Compr. abs. power	kW							5,16	7,13	9,04	11,0	13,8	17,3	22,6	27,6	34,8			
	Cooling capacity	kW							21,9	29,3	35,3	43,9	59,1	72,3	89,4	116,1	144,6			
	Compr. abs. power	kW							5,17	7,17	8,93	11,1	13,9	17,0	22,8	27,8	34,4			
Compressors																				
Compr./circuits			1/1										2/2			4/2				
Max abs. power - 1 compr.	kW	0,7	1,5	2,0	3,0	4,3	6,9	7,8	11,1	13,7	16,8	11,1	13,7	16,8	11,1	13,7	16,8	23,3	28,7
Axial fans																			
Quantity	n°	1						2				3			2		3	4	
Max abs. power - 1 fan	kW	0,12	0,12	0,14	0,14	0,61	0,61	0,78	0,61	0,61	0,61	0,78	0,78	0,78	2,0	2,0	2,0	2,0	2,0
Air flow	m³/h	2300	2300	4400	4100	7100	6800	9200	12400	12000	17400	25500	25000	26400	47000	46000	66000	88000	86000
Centrifugal fans																			
Quantity	n°	N.A.				on request		2	2	2	3	3	3	3	3	3	on request	N.A.	
Max abs. power - 1 fan	kW							1,1	1,1	1,1	1,1	1,5	1,5	1,5	3	3			
Air flow	m³/h							9200	12400	12000	17400	25500	25000	26400	47000	46000			
Head pressure	kPa							200	180	160	200	100	100	100	180	180			
Water-cooled version																			
Condenser water flow	m³/h	N.A.				on request		2,57	3,94	5,36	7,79	10,84	10,96	16,16	18,88	29,17	on request	N.A.	
Connections (in/out)	"							1 ¼"	1 ¼"	1 ¼"	1 ¼"	1 ¼"	1 ¼"	1 ¼"	1 ¼"	1 ¼"			

75 Kw Per booster – Total 150 Kw

50 Kw for the process chiller

10 Kw for ancillaries. – Air Compressor and PLC / Lights etc.

Total Installed 210 kW

HRS challenges

- Market
  - Very immature market and technology (hybrid marine propulsion), impossible to forecast
  - Many recently built CTVs, still using fossil fuel technology
  - Zero-emission difficult to achieve in offshore wind (speed and distance)
  - Lack of incentives on existing wind farms, requirements mostly on new projects

- Engineering first of a kind, no HRS experience in marine, higher quantity of H2
  - No H2 industry-standards in marine environments, difficult certification
  - Refueling a moving vessel laying at the quayside at 500bar pressure
  - Much higher quantity of H2 compared with road transport

- Permit first of a kind
  - Permit for the HRS was first of a kind for the local authorities
  - Safety / risk difficult to assess

- Withdrawal of GEOaqua
  - GEO withdrew from the project after all contracts for the HRS were signed, and after we had agreed a long-term use contract for GEO's hybrid vessel in our wind farms
  - Currently only 1 other hybrid vessel active in the port of Oostende

Port Oostende

Interreg
EUROPEAN UNION
North-West Europe
H2SHIPS