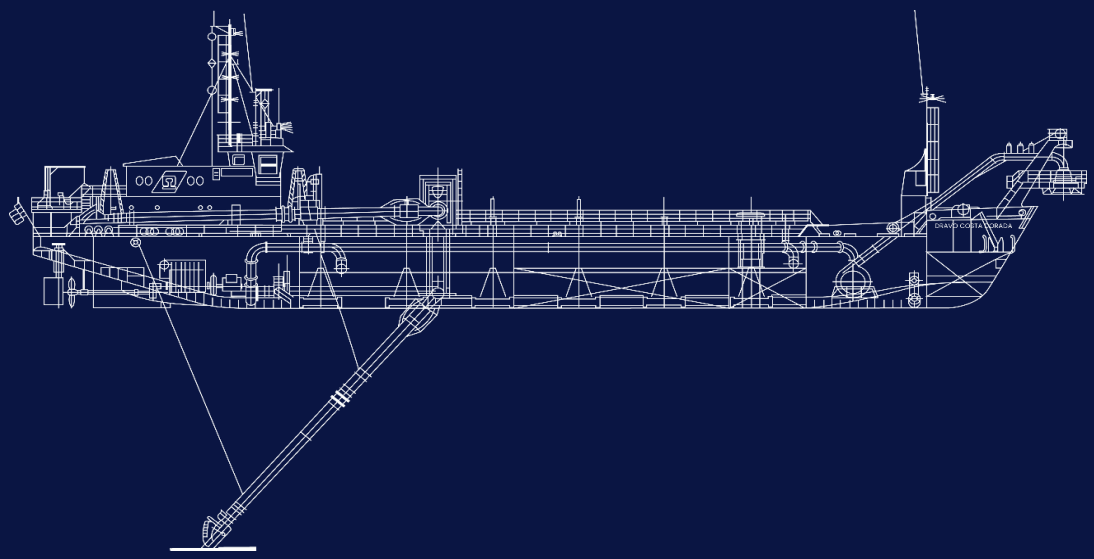


Decarbonizer Premium Report

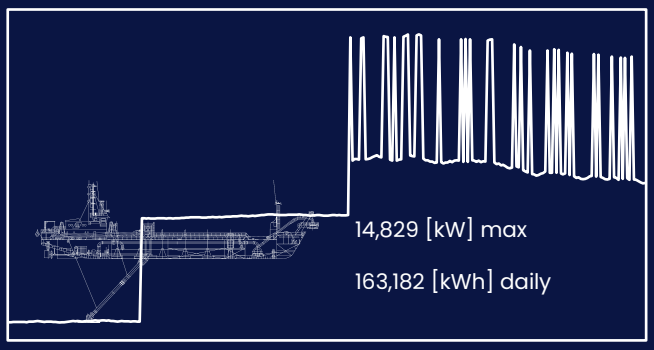
A techno-economic emission reduction guide for Happy Hopper

Client Name	**vincent**
Date	**2023-08-18**
Source	**Sustainable Ships**

EXECUTIVE SUMMARY

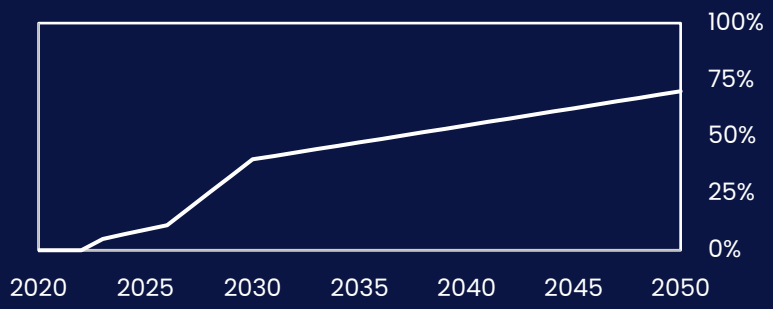
The purpose of this document is to provide vincent with guidance and insights on maritime sustainability of Happy Hopper. This report elaborates on your operational profile, applicable rules and regulations and on your preferred carbon reduction measures and costs.

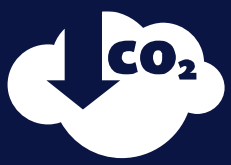
Operational Profile



Fuel	34,710	[l/day]
CO2	99,038	[kg/day]
ETS	€ 11,389	[€/day]
OPEX	€ 43,247	[€/day]
CII	Not Applicable	
EEXI	Not Applicable	

Rules and Regulations





#N/A
Year

100%
Reduction

Decarbonization Measures	CO_2 Red.	CAPEX	Dayrate*	Payback [yrs]
-				
-				
Methanol	93%	€ 6,595,608	- € 7,807	**2**

* The difference in daily costs after implementation of measure. A negative dayrate means your OPEX is reduced and you will save money.

	CO_2 Red.	CAPEX	OPEX [daily]	Payback [yrs]
Current situation	0%	€ 0	€ 43,247	-
Future Happy Hopper	**93%**	**€ 6,595,608**	**€ 35,440**	**2**

TABLE OF CONTENTS

About Report

Legislation is uncertain

Legislation, rules and regulations or politics in general are vague by nature. In contrast to the engineer's worldview, there is and will always remain uncertainty over upcoming rules and regulations due to 'the political process'. Additionally, the engineering performed for retrofitting is uncertain as well, as it is subject to significantly varying parameters and assumptions.

Our solution to this conundrum is twofold. First, we provide you with a free to use helpdesk, that can help you clarify and answer questions even after this report has been delivered. You can ask any question related to maritime sustainability by clicking on the 'contact helpdesk' button on the top of the page.

Secondly, we provide you with a model, not a solution. Our tools are fully customizable to your vessel and provide you with the option to easily change input parameters when new information is provided. In other words, you can use the Decarbonizer tool as a sensitivity analysis for your vessel, in which you can easily determine what works for you and what does not.

Class is exempt

Class rules and regulations from either DNV, Lloyds or other classification bureaus are excluded in the upcoming rules and regulations section because these are technical of nature. They are included in the cost breakdowns as lump-sum estimates that you can easily customize.

Liability Disclaimer

Sustainable Ships will not be held responsible for any damages that could arise from using the information provided in this report or on its platform. View all terms and conditions here.

1.0 OPERATIONAL PROFILE HAPPY HOPPER

1.1 Vessel and operational properties

Property	Value	Unit
Ship name	Happy Hopper	
Ship type	Trailing Hopper Suction Dredger	
Fuel type main	MDO	
Main engine name	Main Engine	
Installed power kw	14410	[kW]
Main engine type	4-Stroke	184 [g/kWh]
Main engine speed	Medium	
Aux engine name	Aux Engine	
Aux power kw	2200	[kW]
Aux engine type	4-Stroke	
Aux engine speed	High	[kW]
Year built	2021	[years]
GT	11910	[-]
Deadweight	15600	[mT]
Cargo capacity	10700	[m3]
Propulsion type	Diesel-Electric	
Cruising speed	12.3	[knts]
Fuel tank capacity main	1600	[m3]
Length	137.5	[m]
Beam	27.6	[m]
Displacement	20000	[mT]
Fuel price MDO	€ 0.90	[€/liter]
Electricity price shore power	€ 0.35	[€/kWh]
Fuel price Methanol	€ 0.50	[€/kg]

Operational profile		
Idle / Moored	21%	76 days per year
Sailing	32%	118 days per year
Working	47%	171 days per year

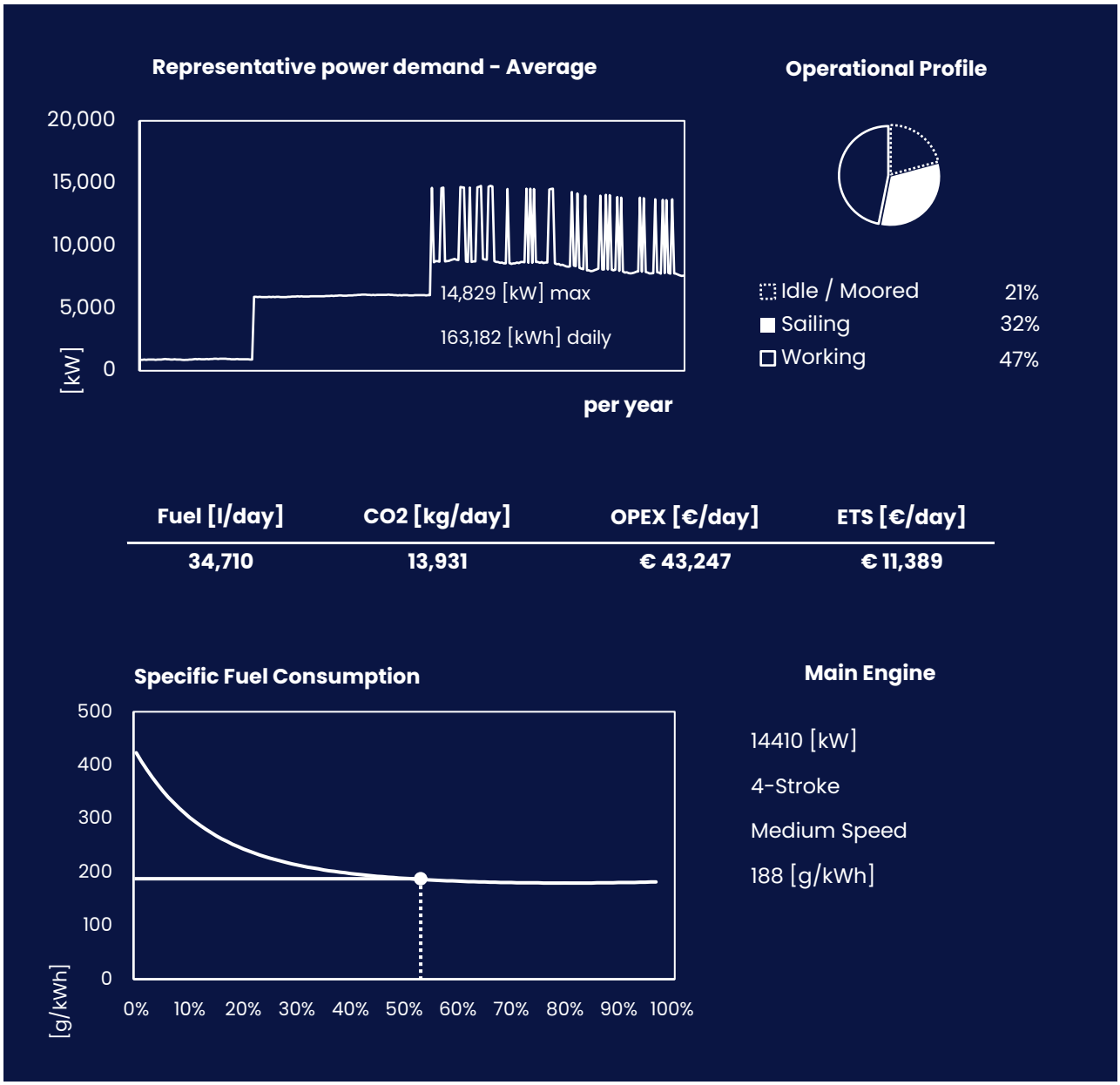
1.2 Current OPEX per operational profile

		Idle / Moored 76 [days/year]	Sailing 118 [days/year]	Working 171 [days/year]	Average per [day]
Max Power	[kW]	972	6,114	14,829	14,829
Average Power	[kW]	901	6,029	9,952	6,799
Energy Required	[kWh]	21,631	144,700	238,847	163,182
Fuel Consumption	[liter]	4,882	32,444	49,529	34,710
Engine Hours	[hrs]	24	24	24	24

CO2 Emissions	[kg]	13,931	92,574	141,324	99,038
NOx Emissions	[kg]	€ 238.47	€ 1,584.68	€ 2,419.17	€ 1,695.32
SOx Emissions	[kg]	€ 9.34	€ 62.08	€ 94.77	€ 66.42
PM Emissions	[kg]	€ 4.13	€ 27.43	€ 41.88	€ 29.35
CH4 Emissions	[kg]	€ 0.22	€ 1.44	€ 2.20	€ 1.54

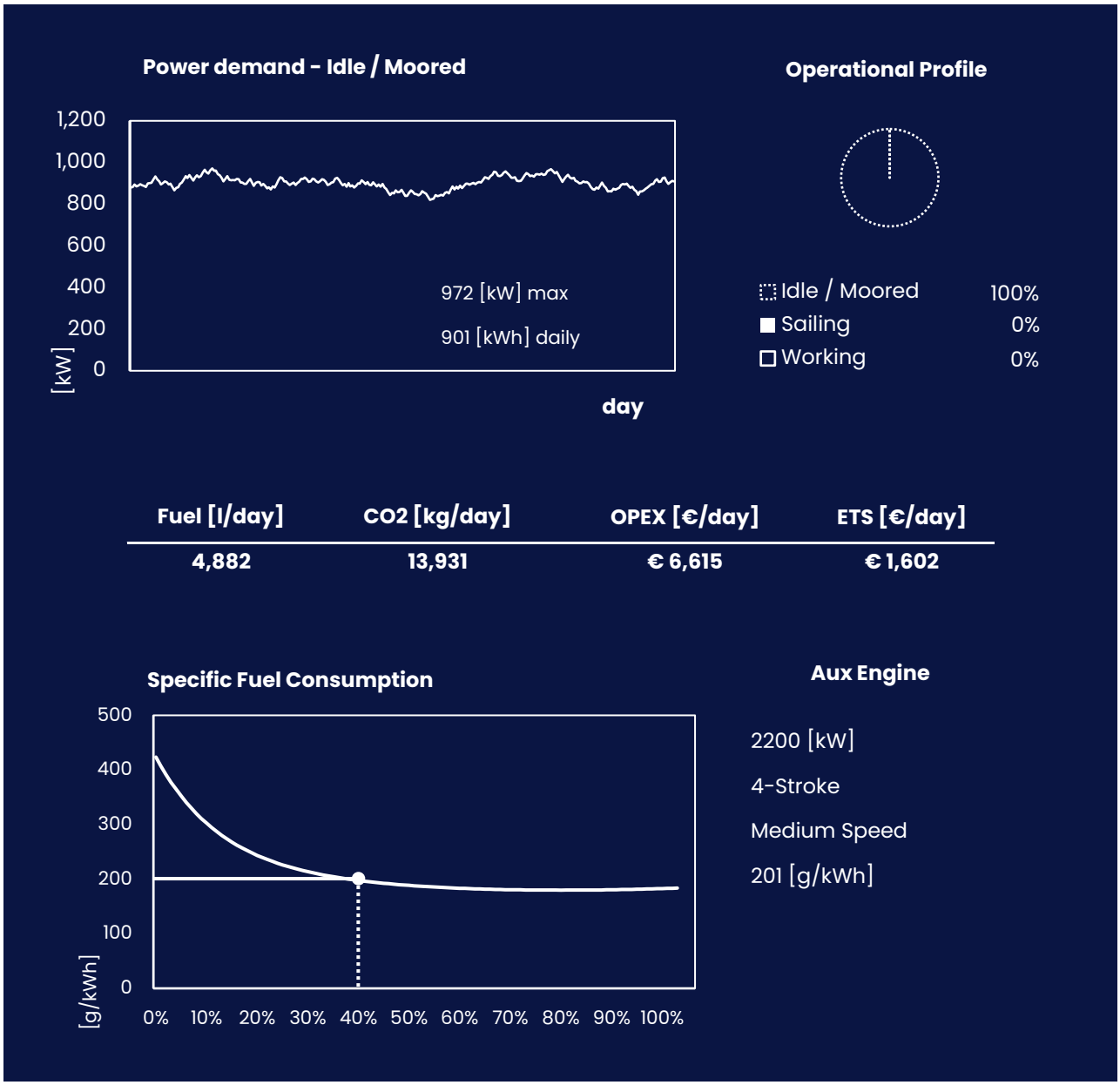
Fuel	[€]	€ 4,394	€ 29,200	€ 44,576	€ 31,239
Lease / Rental	[€]	€ 0	€ 0	€ 0	€ 0
Engine Maintenance	[€]	€ 480	€ 480	€ 480	€ 480
Spares / Consumables	[€]	€ 48	€ 48	€ 48	€ 48
ETS Costs	[€]	€ 1,602	€ 10,646	€ 16,252	€ 11,389
Coating	[€]	€ 91	€ 91	€ 91	€ 91
OPEX	**daily**	**€ 6,615**	**€ 40,465**	**€ 61,448**	**€ 43,247**
	yearly	**€ 2,414,605**	**€ 14,769,709**	**€ 22,428,375**	**€ 15,785,172**

1.3 Average – Yearly



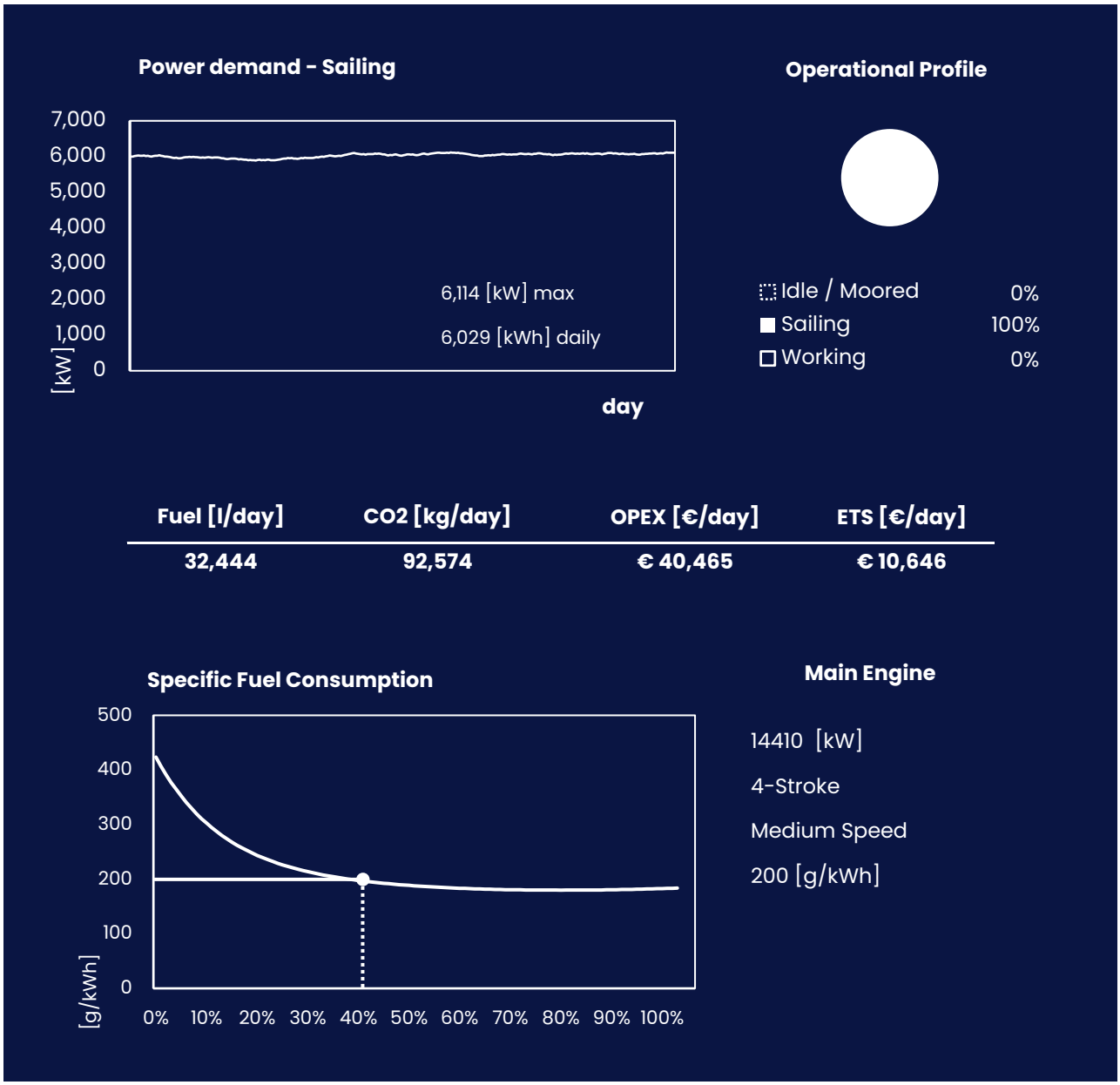
The estimated operational profile of Happy Hopperwhen operational modes are combined (i.e. idle/moored, sailing and working). For example, a vessel can be moored for 25% of the year and sailing for 75% of the year, which results in a combined power demand representing vessel operations. This can be viewed as 'yearly combined profile". OPEX includes ETS, the ETS component is shown for additional reference.

1.4 Idle/Moored – Daily



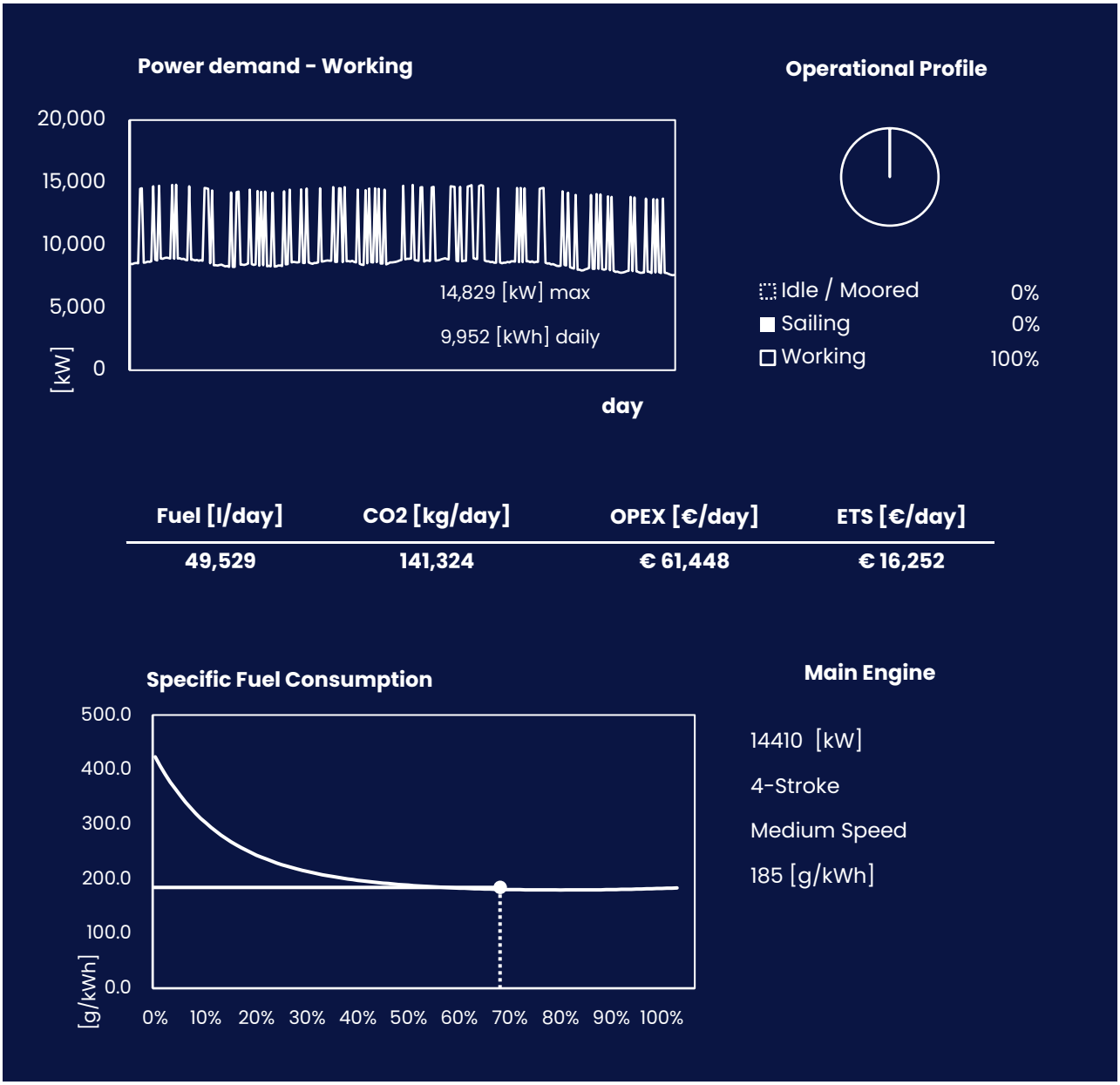
The estimated idle / moored power profile, main fuel and cost parameters for Happy Hopper. OPEX includes ETS, the ETS component is shown for additional reference.

1.5 Sailing – Daily



The estimated sailing power profile, main fuel and cost parameters for Happy Hopper. OPEX includes ETS, the ETS component is shown for additional reference.

1.6 Working – Daily



Fuel [l/day]	CO2 [kg/day]	OPEX [€/day]	ETS [€/day]
49,529	141,324	€ 61,448	€ 16,252

Main Engine

14410 [kW]

4-Stroke

Medium Speed

185 [g/kWh]

'Working' is defined as an operational mode in which the vessel operates on its main engines and experiences peaks in power demand. This can be the case for offshore working vessels when on DP or operating cranes.. OPEX includes ETS, the ETS component is shown for additional reference.

2.0 KEY UPCOMING RULES AND REGULATIONS FOR HAPPY HOPPER

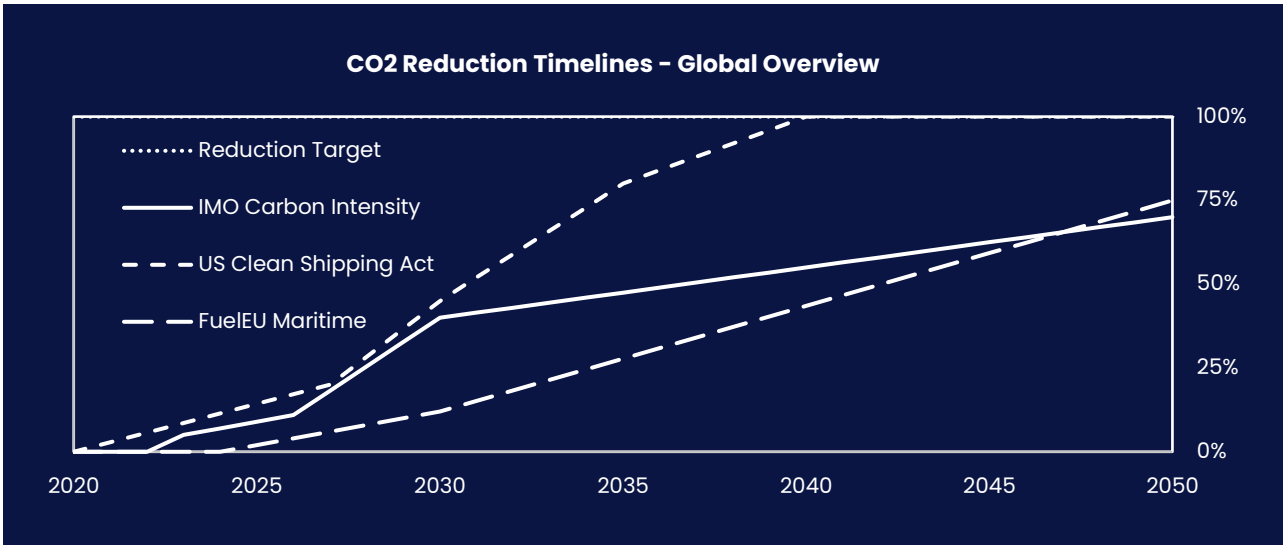


Figure 5. CO2 reduction timelines for key organizations around the world.

Key takeaways	
#N/A	Key regulatory frameworks for maritime sustainability include IMO and EU, of which IMO is more stringent at the moment and EU probably after 2030. In addition, the US Clean Shipping Act requires all vessels to be fully zero emission by 2040. Client requirements have not yet been incorporated.
Electrification is excluded	Electric vessels 'pass' all rules and regulations that have been identified. It is therefore highly recommended to pursue a course of electrification of your vessel where possible to ensure smooth sailing in the future.
Shore power is mandatory	Shore power will become fully mandatory in EU and US by 2030, as per FuelEU and US clean shipping act and this trend in expected to be tightened while at berth. Shore power in the Netherlands is more attractive for operators due to HBE.
Carbon tax & fossil is expensive	Shipping industry will be incorporated into EU ETS from 2025 onwards. With the current price of €115 per mT CO2, that would equate to a surtax of roughly €345 per mT of fuel.

Key rules and regulations for Happy Hopper		
Regulation	**Organization**	**Impact / Restraint**
PAS	Netherlands	-80% NOx
HBE	Netherlands	Get € 0.04-0.20 kWh
UK ETS	UK	£ 2241232 per year
EU ETS	EU	€ 4157125 per year
FuelEU Maritime	EU	Unknown
US Clean Shipping Act	US	Zero emission required (!)
ECA Norway	IMO	0.1% SOx max
Global Sulphur Limit	IMO	0.5% SOx max
ECA North Sea	IMO	0.1% SOx max
ECA US East/West	IMO	0.1% SOx max
ECA Caribbean	IMO	0.1% SOx max
ECA Japan	IMO	0.1% SOx max
China Coastal LF Fuel	China	ECA fuel standards
ECA Mediterranean	IMO	0.1% SOx max
IMO Carbon Price	IMO	Unknown

CII / EEXI / EU ETS		
CII	**EEXI**	**EU ETS [year]**
Not Applicable	Not Applicable	€ 4,157,125

Purchase the **premium Rules and Regulations report** for an overview on all rules and regulations on sustainability. This includes regulations imposed by energy majors, shipping companies and ports around the world that might affect your operations. It is accompanied by a one-hour consult to clarify all your questions. Click below fore more information.

Learn more

3.0 CARBON REDUCTION MEASURES & COSTS

3.1 All carbon reduction measures

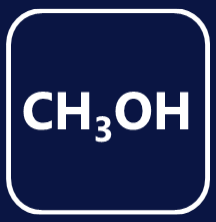
Below is an overview of several key carbon reduction measures. Δ-OPEX represent the difference between current OPEX and OPEX when measures is implement. OPEX of carbon reduction measures include fuel, ETS and maintenance costs. All costs are indicative. No rights or claims can be made based on this analysis.

Measure	CO_2 Reduction	CAPEX	Dayrate	Payback [yrs]
Shore Power	3%	€ 231,400	- € 05	123
Shore Battery	3%	€ 8,844,891	- € 05	4,706
Solar PV	1%	€ 501,143	- € 417	3
Wind Power	0%	€ 814,800	- € 157	14
Hull Coating	3%	€ 328,490	- € 1,244	1
Battery Hybrid	3%	€ 19,373,231	- € 1,060	50
Biofuels	51%	€ 26,000	+ € 8,193	-
Ammonia	100%	€ 10,640,781	+ € 8,240	-
Methanol	**93%**	**€ 6,595,608**	**- € 7,807**	**2**
Hydrogen	100%	€ 105,401,713	+ € 81,466	-
Full Electric	100%	€ 121,267,514	- € 21,518	-

Current situation	**0%**	**€ 0**	**€ 43,247**	**-**
After measures	**93%**	**€ 6,595,608**	**€ 35,440**	**2**
Target reduction	**100%**			

3.2 Selected measures for Happy Hopper

The below carbon reduction measures have been applied to Happy Hopper. Click on the links below the figures to learn more, or contact the helpdesk to clarify any questions.

Selected carbon reduction measures		
Shore Power	Prevent Measure	Change Measure
None Chosen	**None Chosen**	
-	-	**Methanol**

3.3 CII / EEXI / EU ETS

Below is an overview of current and future CII, EEXI and EU ETS. Future means after implementation of carbon reduction measures. More details and calculations are provided in Appendix I.

CII / EEXI / EU ETS			
	CII	**EEXI**	**EU ETS**
Current	Not Applicable	Not Applicable	€ 4,157,125
Future	Not Applicable	Not Applicable	€ 305,310

3.4 Technical Details -

None chosen

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3.5 Technical Details Prevent Measure n.a.

None chosen

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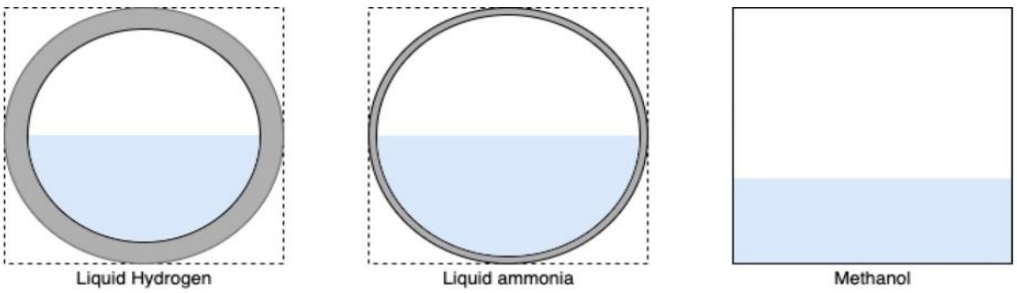
3.6 Technical Details Change Measure Methanol

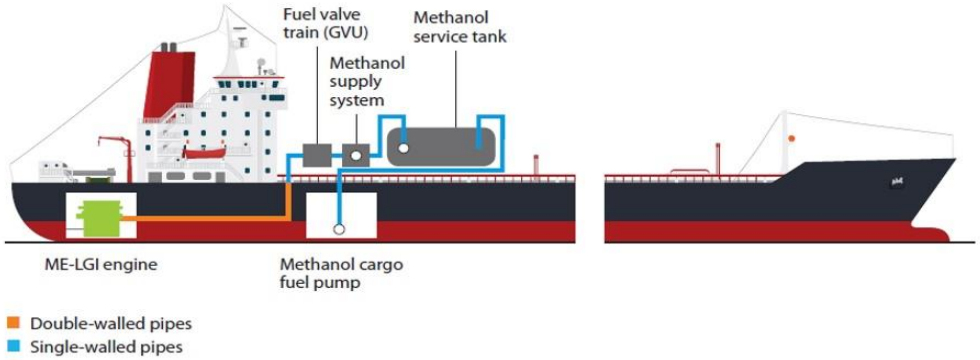
This measure is the use of methanol in a dual fuel combustion scenario together with a fossil fuel. It is assumed an engine refit is required, as well as a battery pack is required to accommodate for ramp-up speed of methanol engine. All piping is to be double-walled, and both piping and valves are to be replaced to accommodate gas inerting. Fuel tanks are to be retrofitted or additional tanks are to be placed on deck.

Parameter	Value	Unit
Combustion efficiency	43%	
Methanol costs	€ 0.50	[€/kg]
Refueling time (trip)	18	[days]
Total fuel per trip	1,223	[mT/trip]
Total fuel per trip	1,545	[m3/trip]
Fuel tank increase	- 3%	
Density	792	[kg/m3]
Idle/Moored fuel consumption	11,376	[kg/day]
Sailing fuel consumption	76,099	[kg/day]
Working fuel consumption	125,613	[kg/day]
Combined fuel consumption	67,969	[kg/day]
Combined energy required	163,182	[kWh/day]
Rated power	14,410	[kW]
MeOH Engine refit costs	€ 350	[€/kW]
MeOH fuel handling system costs	€ 57	[€/kW]
MeOH storage tank costs	€ 0.14	[€/kWh]
Battery system required?	No	
Battery running time	-	[mins]

Learn more about Methanol



Methanol is a promising fuel from a shipowner perspective, as it has the highest volumetric energy density compared to other 'alternative fuels' such as hydrogen and ammonia



Working with methanol on-board is comparable to working with LNG - IMO code for low-flashpoint fuels applies. This implies the use of double-walled piping, engine refits etc.

State of marine methanol 2023

Methanol as clean fuel

3.7 CAPEX Breakdown -

None chosen

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3.8 CAPEX Breakdown Prevent Measure n.a.

None chosen

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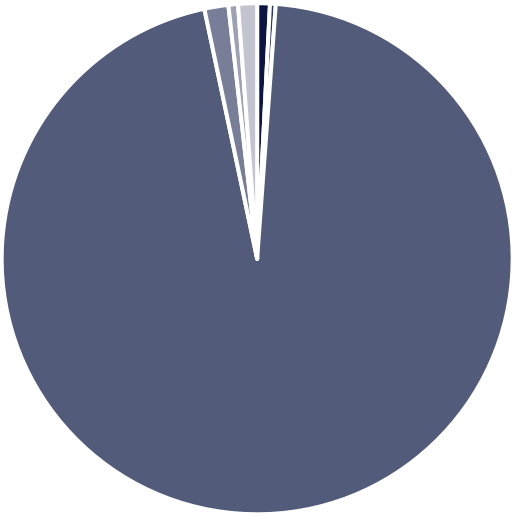
3.9 CAPEX Breakdown Change Fuel Methanol

	Time [hours]	Costs
Design/engineering supplier	440	€ 52,800
Design/engineering shipowner	240	€ 24,000
Equipment procurement	0	€ 6,300,088
Execution/retrofitting	1,000	€ 100,000
Commissioning	400	€ 40,000
Class/Certification	200	€ 78,720
Total	**57 fte weeks**	**€ 6,595,608**



- Design/engineering supplier
- Design/engineering shipowner
- Equipment procurement
- Execution/retrofitting
- Commissioning
- Class/Certification

Total Time [hrs]*	Total Estimated for Project	Total Cost
2280		€ 6,595,608

Estimated Costs for Methanol Combustion System

	Time [hrs]	Units	Parameter	Price per hour/unit	Total Cost
Design/engineering supplier	**440**				**€ 52,800**
Mechanical engineering for engine refit	160		EUR/hr	€ 120	€ 19,200
Mechanical engineering for fuel tank storage	40		EUR/hr	€ 120	€ 4,800
Electrical engineering for switchboard and breaker modifications	40		EUR/hr	€ 120	€ 4,800
Electrical engineering for battery system	40		EUR/hr	€ 120	€ 4,800
Electrical engineering for PMS modifications	80		EUR/hr	€ 120	€ 9,600
Short circuit and selectivity study	80		EUR/hr	€ 120	€ 9,600
Design/engineering shipowner	**240**				**€ 24,000**
Misscalenous engineering	40		EUR/hr	€ 100	€ 4,000
Engineering for piping routing	40		EUR/hr	€ 100	€ 4,000
Mechanical engineering for changes needed to accommodate tanks & batteries in ves	160		EUR/hr	€ 100	€ 16,000
Equipment procurement	**0**				**€ 6,300,088**
Engine refit		1	EUR	€ 5,043,500	€ 5,043,500
Mathanol storage tank(s) including foundation		1	EUR	€ 411,218	€ 411,218
Fuel Handling System MeOH including nitrogen purge equipment		1	EUR	€ 821,370	€ 821,370
Battery pack (cells only)		0	kWh	€ 500	€ 0
Inverter		0	kW	€ 150	€ 0
Foundation/containment for battery system		0	kWh	€ 4	€ 0
Fire suppresion system		0	kW	€ 10	€ 0
Switchboard, breakers, cabling		0	kWh	€ 150	€ 0
FAT testing of equipment (Factory Acceptance Test)		1	lot	€ 6,000	€ 6,000
Power management system modifications		1	lot	€ 6,000	€ 6,000
Spare parts		1	lot	€ 4,000	€ 4,000
Consumables used on-board, general supplies, paint, electrodes etc.		1	lot	€ 4,000	€ 4,000
Rental tools		1	lot	€ 4,000	€ 4,000
Execution/retrofitting	**1000**				**€ 100,000**
Creating means of access for safe working location	80		EUR	€ 100	€ 8,000
Cleaning/removing obstructions from working locations	40		EUR	€ 100	€ 4,000
Installation/removal of scaffolding on working locations	80		EUR	€ 100	€ 8,000
Installation of foundations for fuel tanks and battery system	80		EUR	€ 100	€ 8,000
Installation/Implementation of fuel tanks	80		EUR	€ 100	€ 8,000
Installation/Implementation of battery system	80		EUR	€ 100	€ 8,000
Installation/Implementation of switchboard and breaker modifications	80		EUR	€ 100	€ 8,000
Implementation of power management modifications	80		EUR	€ 100	€ 8,000
Creating bulkhead penetrations for piping	80		EUR	€ 100	€ 8,000
Installation/Implementation of piping	80		EUR	€ 100	€ 8,000
Installation of bulkhead penetrations for cable and hoses routing	40		EUR	€ 100	€ 4,000
Installation of cable trays to complete routing	40		EUR	€ 100	€ 4,000
Pulling, fastening and terminating of cables and hoses	80		EUR	€ 100	€ 8,000
Painting/coating of equipment	40		EUR	€ 100	€ 4,000
Non-destructive testing of structures (if installed)	40		EUR	€ 100	€ 4,000
Commissioning	**400**				**€ 40,000**
Testing of engine	40		EUR	€ 100	€ 4,000
Testing integrity of storage tanks	40		EUR	€ 100	€ 4,000
Testing of battery system	40		EUR	€ 100	€ 4,000
Testing of cabling	40		EUR	€ 100	€ 4,000
Testing integrity of piping	40		EUR	€ 100	€ 4,000
Testing of power management system modifications	40		EUR	€ 100	€ 4,000
Training and familiarising of crew	160		EUR	€ 100	€ 16,000
Class/Certification	**200**				**€ 78,720**
Approval costs of drawings/calculations	456		EUR/hr	€ 120	€ 54,720
Surveyor attendence during fabrication/installation incl. travelling expenses	40		EUR/hr	€ 120	€ 4,800
(Writing) Operational manuals and procedures	160		EUR/hr	€ 120	€ 19,200

All numbers are indicative. Ask your supplier for fixed numbers.

It is assumed transportation costs for all equipment is included in the pricing.

3.10 Future OPEX Breakdown Happy Hopper

The below table shows the current and future OPEX breakdown for Happy Hopper, based on the representative daily operational profile. Depreciation of equipment has not been taken into account (neither for existing or newly purchased equipment).

		Current	Future
Max Power	[kW]	14,829	14,829
Average Power	[kW]	6,799	6,799
Energy Required	[kWh]	163,182	163,182
Fuel Consumption	[liter]	34,710	85,819
Engine Hours	[hrs]	24	24

Fuel	[€]	€ 31,239	€ 33,984
Lease / Rental	[€]	€ 0	€ 0
Engine Maintenance	[€]	€ 480	€ 480
Spares / Consumables	[€]	€ 48	€ 48
ETS Costs	[€]	€ 11,389	€ 836
Coating	[€]	€ 91	€ 91

OPEX	**daily**	**€ 43,247**	**€ 35,440**
	yearly	**€ 15,785,172**	**€ 12,935,588**

3.11 Potential suppliers

The below partners can assist in implementing the proposed measures on-board your vessel. You can contact them directly, or contact the helpdesk for further guidance. In case you prefer to work with (local) partners on your own, feel free to use this report as a guideline for their input.

Preferred Suppliers		
Technology	**Supplier**	**Contact**
-	-	
-	-	
Methanol	Available soon	

Other Suppliers		
Technology	**Supplier**	**Contact**
Methanol	Freudenberg	

4.0 APPENDIX I – ASSUMPTIONS AND CALCULATIONS

4.1 Input values and assumptions

Parameter	Value	Unit
Fuel Price	€ 0.90	[€/liter]
ETS	€ 115	[€/mT]
Engine Maintenance Costs	€ 20	[€/hr]
Spares / Consumables Costs	€ 2	[€/hr]
Parasitic Load Engine	15%	[-]
(Engineering) Hour External	€ 120	[€]
(Engineering) Hour Internal	€ 100	[€]
Depreciation Time	10	[years]
Annual (Fuel) Price Increase	1.03	[-]

MDO density	0.89	[kg/l]
CO2 Emission Factor MDO	3.206	[kg/kg]
NOx Emission Factor MDO	0.05488	[kg/kg]
SOx Emission Factor MDO	0.00215	[kg/kg]
PM Emission Factor MDO	0.00095	[kg/kg]
CH4 Emission Factor MDO	0.00005	[kg/kg]

Fuel after change	Methanol	[-]
Fuel density after change measures	0.792	[kg/liter]
Fuel price after change measure	€ 0.50	[€/kg]
Shore-side kWh price	€ 0.35	[€/kWh]
CO2 Emission Factor	0.107013889	[kg/kg]
Nox Emission Factor	0.00062037	[kg/kg]
Sox Emission Factor	0	[kg/kg]
PM Emission Factor	0	[kg/kg]
CH4 Emission Factor	0	[kg/kg]

4.2 CII Calculation

Happy Hopper CII Scores	2023	2024	2025	2026
Baseline	n.a.	n.a.	n.a.	n.a.
After reduction measures	n.a.	n.a.	n.a.	n.a.

CII Input Values		
Operational Mode	Yearly average	
CO2 Emissions	36,148,910,095	[g/year]
Capacity	n.a.	[mT]
Distance Sailed	34,834	[nm/year]
a		for Reference line
c		for Reference line
CII ref	n.a.	Reference line
Required CII 2023	n.a.	5% reduction
Required CII 2024	n.a.	7% reduction
Required CII 2025	n.a.	9% reduction
Required CII 2026	n.a.	11% reduction
Attained Current CII	n.a.	Baseline
Attained CII	n.a.	After modifications

Learn more about CII

CII Scores per Technology	2023	2024	2025	2026
Shore Power	n.a.	n.a.	n.a.	n.a.
Shore Battery	n.a.	n.a.	n.a.	n.a.
Solar PV	n.a.	n.a.	n.a.	n.a.
Wind Power	n.a.	n.a.	n.a.	n.a.
Hull Coating	n.a.	n.a.	n.a.	n.a.
Battery Hybrid	n.a.	n.a.	n.a.	n.a.
Biofuels	n.a.	n.a.	n.a.	n.a.
Ammonia	n.a.	n.a.	n.a.	n.a.
Methanol	**n.a.**	**n.a.**	**n.a.**	**n.a.**
Hydrogen	n.a.	n.a.	n.a.	n.a.
Full Electric	n.a.	n.a.	n.a.	n.a.

4.3 EEXI Calculation

$$EEXI = \frac{CO2\ emissions}{Transportation\ work}$$

$$EEXI = \frac{Main\ engine\ emissions + Auxiliary\ engine\ emissions + (PTI - Innovative\ electrical\ energy\ technologies) - Innovative\ propulsion\ energy\ technologies}{Capacity * Reference\ speed * Reduction\ factors}$$

$$EEXI = \frac{\left(\prod_{j=1}^{n} f_j\right)\left(\sum_{i=1}^{nME} P_{ME(i)} C_{ME(i)} SFC_{ME(i)}\right) + (P_{AE} C_{AE} SFC_{AE}) + \left(\left(\prod_{j=1}^{n} f_j \sum_{i=1}^{nPTI} P_{PTI(i)} - \sum_{i=1}^{neff} f_{eff(i)} P_{AEeff(i)}\right) C_{FAE} SFC_{AE}\right) - \left(\sum_{i=1}^{neff} f_{eff(i)} P_{eff(i)} C_{FME} SFC_{ME}\right)}{Capacity\ V_{ref} f_i f_c f_l f_w f_m}$$

EEXI Input values		
Ship Type	ing_Hopper_Suction_Dredger	
Operational Mode	Sailing	
CO2 Emissions	3,857,268	[gram/hour]
Capacity	15,600	[mT]
Reference Speed	12.3	[knts]
fi	n.a.	
fc	n.a.	
fl	n.a.	
fw	n.a.	
fm	n.a.	
Reduction factor	n.a.	

EEXI	**Not Applicable**	**[gram/mT mile]**
EEXI After	**Not Applicable**	**[gram/mT mile]**
EEXI Required	**Not Applicable**	**[gram/mT mile]**

Learn more about EEXI

4.4 EU ETS Calculation

Yearly ETS Costs	2024	2025	2026	2027
Current	€ 0	€ 1,662,850	€ 2,909,987	€ 4,157,125
Shore Power	€ 0	€ 1,614,146	€ 2,824,756	€ 4,035,366
Shore Battery	€ 0	€ 1,614,146	€ 2,824,756	€ 4,035,366
Solar PV	€ 0	€ 1,645,501	€ 2,879,626	€ 4,113,751
Wind Power	€ 0	€ 1,655,404	€ 2,896,956	€ 4,138,509
Hull Coating	€ 0	€ 1,605,959	€ 2,810,428	€ 4,014,898
Battery Hybrid	€ 0	€ 1,620,536	€ 2,835,937	€ 4,051,339
Biofuels	€ 0	€ 821,103	€ 1,436,929	€ 2,052,756
Ammonia	€ 0	€ 0	€ 0	€ 0
Methanol	**€ 0**	**€ 122,124**	**€ 213,717**	**€ 305,310**
Hydrogen	€ 0	€ 0	€ 0	€ 0
Full Electric	€ 0	€ 0	€ 0	€ 0
Yearly Gains	**€ 0**	**-€ 1,540,726**	**-€ 2,696,270**	**-€ 3,851,815**

Year	% Phase-in
2024	0%
2025	40%
2026	70%
2027	100%

Learn more about EU ETS

5.0 APPENDIX II - CASE STUDIES SIMILAR TO HAPPY HOPPER

Here are several case studies similar to your vessel type, as well as more references on potentially interesting technologies and regulations from the Sustainable Ships site. Click on the stories' title to learn more.

Hydrogen power propulsion crane vessel

Methanol hybrid working vessels

Methanol as marine fuel

Regulations for maritime sustainability