



Green, Autonomous Ecosystems: A paradigm shift for maritime business models

Kristoffer Kloch

Navigating the Future of European Waters with Autonomous Innovation

7 November 2023, Rotterdam



These projects have received funding from the European Union's Horizon 2020 research and innovation programme under grant agreements N° 815012, 859992, 861678.

AEGIS Inland Waterways Case



The cargo is there...



Table 9 – Goods in the direction of Rotterdam – Ghent. Including conversion scenarios. Own calculations.

load_region	unload_region	type_of_good	tonnes	tkm	vkm	movements
NL330	BE230	04	198.774	43.534	4.308.484	11.337
NL330	BE230	18	163.036	34.022	3.654.625	11.380
NL330	BE230	08	93.398	14.765	1.119.017	5.368
NL330	BE230	01	92.810	22.295	2.043.238	5.564
NL330	BE230	03	59.746	8.422	317.164	2.499
NL330	BE230	09	58.536	10.810	932.969	3.409
NL330	BE230	06	39.116	6.743	848.168	2.893
NL330	BE230	10	36.021	6.061	873.892	2.499
NL330	BE230	16	34.360	4.543	754.190	6.469
NL330	BE230	14	25.992	7.695	505.480	1.444
NL330	BE230	13	7.322	1.799	621.020	1.004
NL330	BE230	07	5.729	860	81.346	403
NL330	BE230	05	3.899	654	143.489	369
			818.739	162.203	16.203.083	54.638
			tonnes	tkm (1000)	vkm	movements
Per day			2.243	444	44.392	150
Scenario - day		20%	449	89	8.878	30
Scenario - year		20%	163.748	32.441	3.240.617	10.928
Scenario - day		30%	673	133	13.318	45
Scenario - year		30%	245.622	48.661	4.860.925	16.391
Scenario - day		40%	897	178	17.757	60
Scenario - year		40%	327.496	64.881	6.481.233	21.855

Table 21 - Goods in the direction of Ghent - Paris. Including conversion scenarios. Own calculations.

load region	unload region	Type of good	tonnes	tkm	vkm	movements
BE230	FR100	04	94.674	28.764	1.892.966	5.525
BE230	FR100	18	85.558	42.005	2.340.877	4.862
BE230	FR100	01	84.664	37.079	1.941.944	4.504
BE230	FR100	08	83.507	28.055	1.446.270	4.107
BE230	FR100	10	66.102	30.205	1.345.300	2.769
BE230	FR100	03	43.658	7.431	525.970	2.315
BE230	FR100	06	37.347	9.965	606.291	2.796
BE230	FR100	13	35.559	35.815	2.171.729	2.644
BE230	FR100	09	23.626	7.320	551.415	1.610
BE230	FR100	07	21.241	1.789	167.785	1.014
BE230	FR100	14	2.785	676	50.247	234
BE230	FR100	05	1.484	356	34.927	182
BE230	FR100	02	317	69	2.792	13
			580.522	229.528	13.078.512	32.576
			tonnes	tkm (1000)	vkm	movements
Per day			1.590	629	35.832	89
Scenario - day		20%	318	126	7.166	18
Scenario - year		20%	116.104	45.906	2.615.702	6.515
Scenario - day		30%	477	189	10.749	27
Scenario - year		30%	174.157	68.858	3.923.554	9.773
Scenario - day		40%	636	252	14.333	36
Scenario - year		40%	232.209	91.811	5.231.405	13.030



The business case holds...

Table 31 – Sensitivity analysis of the Rotterdam/Vlaardingen - Ghent scenario. 50 units.

	Units <u>Linehaul sensitivity on € km cost of trucking</u>					
	50 12 HR CYCLE					
	1,60	1,40	1,50	1,70	1,80	
Linehaul only	16.000,0	14.000,0	15.000,0	17.000,0	18.000,0	15.470,0
	320,0	280,0	300,0	340,0	360,0	309,4
		1,40	1,50	1,70	1,80	1,547
Last m. Rotterdam	1.520,0	1.442,5	1.481,3	1.558,8	1.597,5	1.499,5
THC Rotterdam (opening hrs)	2.900,0	2.900,0	2.900,0	2.900,0	2.900,0	2.900,0
Rotterdam -Ghent Barge	2.000,0	2.000,0	2.000,0	2.000,0	2.000,0	2.000,0
THC Ghent	1.590,0	1.590,0	1.590,0	1.590,0	1.590,0	1.590,0
Last mile Ghent	7.600,0	7.212,5	7.406,3	7.793,8	7.987,5	7.497,3
	15.610,0	15.145,0	15.377,5	15.842,5	16.075,0	15.486,8
Barge + Linehaul last mile	312,2	302,9	307,6	316,9	321,5	309,7

Table 35 - Sensitivity analysis of the Rotterdam/Vlaardingen - Ghent scenario. 50 units. No manning, increased CAPEX by 25%.

	Units <u>Linehaul sensitivity on € km cost of trucking</u>					
	50 12 HR CYCLE					
	1,60	1,40	1,50	1,70	1,80	
Linehaul only	16.000,0	14.000,0	15.000,0	17.000,0	18.000,0	15.000,0
	320,0	280,0	300,0	340,0	360,0	300,0
		1,40	1,50	1,70	1,80	1,500
Last m. Rotterdam	1.520,0	1.442,5	1.481,3	1.558,8	1.597,5	1.481,3
THC Rotterdam (opening hrs)	2.900,0	2.900,0	2.900,0	2.900,0	2.900,0	2.900,0
Rotterdam-Ghent Barge	1.630,0	1.630,0	1.630,0	1.630,0	1.630,0	1.630,0
THC Ghent	1.590,0	1.590,0	1.590,0	1.590,0	1.590,0	1.590,0
Last mile Ghent	7.600,0	7.212,5	7.406,3	7.793,8	7.987,5	7.406,3
	15.240,0	14.775,0	15.007,5	15.472,5	15.705,0	15.007,5
Barge + Linehaul last mile	304,8	295,5	300,2	309,5	314,1	300,2

Table 33 - Sensitivity analysis of the Paris - Ghent scenario. 50 units.

	Units <u>Linehaul sensitivity on € km cost of trucking</u>					
	50 48 HR Transport					
	1,60	1,40	1,50	1,70	1,80	
Linehaul only	27.040,0	23.660,0	25.350,0	28.730,0	30.420,0	20.702,5
	540,8	473,2	507,0	574,6	608,4	414,1
		1,40	1,50	1,70	1,80	1,225
Last m. Ghent	1.520,0	1.442,5	1.481,3	1.558,8	1.597,5	1.374,7
THC Ghent (opening hrs)	2.900,0	2.900,0	2.900,0	2.900,0	2.900,0	2.900,0
Ghent-Paris Barge	8.000,0	8.000,0	8.000,0	8.000,0	8.000,0	8.000,0
THC Paris	1.590,0	1.590,0	1.590,0	1.590,0	1.590,0	1.590,0
Last mile Paris	7.600,0	7.212,5	7.406,3	7.793,8	7.987,5	6.873,4
	21.610,0	21.145,0	21.377,5	21.842,5	22.075,0	20.738,1
Barge + Linehaul last mile	432,2	422,9	427,6	436,9	441,5	414,8

Table 37 - Sensitivity analysis of the Paris - Ghent scenario. 50 units. No manning, increased CAPEX by 25%.

	Units <u>Linehaul sensitivity on € km cost of trucking</u>					
	50 48 HR Transport					
	1,60	1,40	1,50	1,70	1,80	
Linehaul only	27.040,0	23.660,0	25.350,0	28.730,0	30.420,0	19.012,5
	540,8	473,2	507,0	574,6	608,4	380,3
		1,40	1,50	1,70	1,80	1,125
Last m. Ghent	1.520,0	1.442,5	1.481,3	1.558,8	1.597,5	1.335,9
THC Ghent (opening hrs)	2.900,0	2.900,0	2.900,0	2.900,0	2.900,0	2.900,0
Ghent-Paris Barge	6.520,0	6.520,0	6.520,0	6.520,0	6.520,0	6.520,0
THC Paris	1.590,0	1.590,0	1.590,0	1.590,0	1.590,0	1.590,0
Last mile Paris	7.600,0	7.212,5	7.406,3	7.793,8	7.987,5	6.679,7
	20.130,0	19.665,0	19.897,5	20.362,5	20.595,0	19.025,6
Barge + Linehaul last mile	402,6	393,3	398,0	407,3	411,9	380,5



... so why is it not done more?

Barriers to transportation on inland waterways today

- Geographical scope
- Accessibility
- Capital-intensiveness
- Trucks are easier to sell off
- Large road network
- Bridges, Fairways, Locks
- Long dry spells
- Noise restrictions on canals
- Berthing requirements
- Port handling requirements
- Port security requirements
- Port size constraints
- Last mile transportation
- Transshipment & transloading
- Risk profile / rerouting
- Responsiveness to economic cycles
- Ineffective barge handling
- Communication between actors
- Speed
- Short vs long distances
- Consolidating cargo
- Large waiting times in seaports
- Inadequate optimum terminal planning
- Contractual relationships
- Lack of operational standards
- Part loads are handled by logistic firms
- Schedules and routes
- Direct runs vs milk runs
- Inertia of past experience
- Lack of knowledge
- Freight forwarders vs. customers
- Additional transshipments
- Independent vessel owners
- One customer at a time
- Rest hour requirements
- (and more...)



Green, Autonomous Ecosystems



Nesheim et al. (2022)

The underdevelopment of suitable business models in autonomous shipping and how conventional business models hinder the necessary infrastructural investments that are the physical basis for autonomous ship operations.

The study suggests a list of collaborative business options centered around

1. long-term contracts;
2. co-ownership of equipment (“as-a-service” models);
3. common responsibility for equipment balances; and,
4. revenue sharing from final customer.



... Future projects building on AEGIS



**DFDS Industrial PhD project
by *Kristoffer Kloch***

Sustainable Transport Ecosystems:
Autonomous ships as an enabler for
green and innovative business models.



**DFDS Industrial PhD project
by *Nanna Thit***

Winning slowly: How the way we think is
influencing innovation - and change processes
in connection with the green transition in
shipping





Thank you

Rotterdam Ahoy
7 November 2023



These projects have received funding from the European Union's Horizon 2020 research and innovation programme under grant agreements N° 815012, 859992, 861678.