



**Innovation
Norway**

French maritime and inland waterways

Report

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Executive summary

The market for low and zero carbon solutions in the maritime and inland waterway sectors in France is still emerging. However, it will experience sustained growth over the next 20 years. Short-term positioning will allow pioneer companies to gain visibility in the early stages of this market and maximize their ability to capture future market opportunities.

France is one of the most important maritime and river transport markets in Europe with 564 ports, 360 million tonnes of goods processed, 30 million passengers per year, 560 registered merchant and service vessels and more than 1000 ferries for river transport. There is a strong political ambition for decarbonization of the French transport sector. Greenhouse gas emissions are to be reduced by 28% in 2030 compared with 2015 level, and complete decarbonization is targeted by 2050. Availability of public funding for the development of low and zero carbon solutions in the maritime and in-land waterway sectors includes €650 million for the maritime sector and €175 million for modernization of inland waterways as part of the Covid Recovery Plan (France Relance) + tax deduction for the installation of equipment on passenger or freight ships to reduce greenhouse gas emissions or air pollution.

Numerous initiatives aim at deploying electric and hybrid solutions, hydrogen and e-fuels in the maritime and inland waterway sectors, with different stages of maturity. Many of them are still open to new partnerships with technology developers and/or equipment suppliers. There are currently (October 2022) 12 open public calls for projects, 70 projects identified in the river mobility sector, including 21 at a high maturity stage, according to the Communauté Portuaire de Paris. There are also 21 projects identified by Sia Partners for the development of hydrogen uses in the maritime and in-land waterway sectors, including 8 projects targeting the development of hydrogen ecosystems and 12 initiatives for the development of new boats for specific uses. The interest of major industries and energy players to develop large-scale e-fuels production is strong, among others EDF, Engie, Vicat and ArcelorMittal.

Norwegian companies possess recognized expertise and competencies that are needed to implement low and zero carbon solutions. There has been a development of an almost complete value chain for electric boat propulsion with technologies verified and scaled up over the last 5-6 years. Thanks to supportive public policies for the development of low or zero carbon solutions, there are opportunities to be seized in all segments, from ship manufacturing to operation and infrastructure. The most significant opportunities in the equipment, services, design and engineering segments.

Various strategies can be considered for Norwegian players to penetrate the French market:

- Participation in public calls for projects, along with French partners (12 currently open).
- Participation in public or private calls for tenders, preferably along with French partners regarding public calls for tenders.
- Partnerships with project holders for the development of green ecosystems.
- Cooperation in the R&D and training fields, especially with one of the numerous emerging programs related to hydrogen technologies and e-fuels production.

Innovation Norway and Team France can provide support to export innovative solutions to the French market through:

- Significant, professional network of French stakeholders, including public institutions, clusters and companies.
- Support from Innovation Norway of French-Norwegian trade and collaboration, and Norwegian export efforts through capital, networks and advisory services for Norwegian companies, including market surveys, delegations at national events and support to groups or individual companies.
- Close collaboration with other Innovation Norway offices abroad.

Content

Executive summary	2
Table of figures.....	8
Compliance matrix.....	9
1. Green maritime France	11
Introduction.....	11
1 Environmental and energy challenges	11
1.1 Environmental rules.....	11
1.1.1 IMO.....	11
1.1.2 European Union.....	12
1.1.3 France	12
1.2 Market tending	13
1.2.1 Oil price and energy saving.....	13
1.2.2 Shipper’s demand.....	13
1.2.3 Public intentions.....	14
1.2.4 Market access.....	14
1.3 Public support policies for innovation	14
1.3.1 Initiatives for maritime transport.....	14
1.3.2 Initiatives for river transport	15
1.3.3 Supporting by regions.....	15
2 The French market.....	17
2.1 Context France.....	17
2.2 France’s green transition laws	17
2.3 National incentive schemes for low/zero emission maritime solutions.....	17
2.3.1 France’s green programmes.....	17
2.3.2 Establishment of the French hydrogen strategy	18
2.3.3 The French national hydrogen strategy	19
2.4 Overview of existing fleet	19
2.4.1 The importance of the maritime fleet.....	19
2.4.2 Age of existing fleet	20
2.5 Examples of zero emission projects.....	21
2.5.1 The FLAGSHIPS project	21
2.5.2 The virtual-FCS project	21
2.5.3 The HySHIP project.....	22
3 Infrastructure and energy supply	22
3.1 Infrastructure	22

3.1.1	Port infrastructure	22
3.1.2	Port infrastructure ambitions	23
3.1.3	Main infrastructure technologies	23
3.2	Energy Mix & Supply	24
3.2.1	Total Energy supply by source	25
3.2.2	Carbon emission indicator	26
4	French maritime, river and ports innovation	26
4.1	Maritime sector	26
4.1.1	Overview	26
4.1.2	Innovation	28
4.2	Sailing	Feil! Bokmerke er ikke definert.
4.2.1	Sailing project	29
4.2.2	Sail technology	29
4.3	Local Passengers activities	30
4.3.1	Overview	30
4.3.2	Innovation	31
4.4	Port services	31
4.4.1	Overview	31
4.4.2	Innovation	31
4.5	Offshore Wind services	32
4.5.1	Overview of CTV and SOV	32
4.5.2	Demand for CTV and SOV	32
4.5.3	Supply of CTV and SOV	33
4.5.4	Installation vessels	33
4.5.5	Innovation	33
4.6	Others maritime activities	34
4.6.1	Sea rescue	34
4.6.2	Laisure	34
4.6.3	Administrations	34
4.7	River transport cargo and pax	34
4.7.1	Overview	34
4.7.2	Innovation	35
4.8	Ports innovations	35
4.8.1	LNG bunkering for ship	36
4.8.2	Shore power for ship (maritime)	36
4.8.3	Shorepower for ship	37
4.8.4	Floating H2 electricity from ship	37

4.8.5	Industrial production of hydrogen	38
4.8.6	Biogas.....	38
4.8.7	Offshore hydrogen production.....	38
4.9	The French Maritime Cluster & Innovation	39
5	Key stakeholders.....	39
5.1	Public actors	39
5.2	Maritime clusters	40
5.3	Shipowners.....	41
5.4	Yards.....	42
5.5	Design and engineering	42
5.6	Equipment and service.....	43
5.7	Energy companies	44
5.8	Ports	44
6	French Shipbuilding industry	45
6.1	General overview	45
6.1.1	French shipyards specialties	45
6.1.2	Sectorial organisations	46
6.1.3	Regional clusters.....	47
6.1.4	Exhibitions	47
6.2	French shipbuilding enterprises.....	47
6.2.1	Chantiers de l’Atlantique	47
6.2.2	Piriou.....	47
6.2.3	Ocea.....	48
6.2.4	Construction Navale de Normandie (CMN).....	48
6.2.5	BMA	48
6.2.6	Socarenam	48
6.2.7	Architech and engineering	49
6.2.8	Subcontractor sector	49
6.2.9	Manufacturer suppliers	50
6.2.10	Ship repairs	51
7	Relevant Projects & Current Green Vessel Solutions	52
7.1	Relevant future or ongoing projects and green vessel solutions already in the market.....	52
7.1.1	Projects integrating maritime and river uses potentially open to partnerships	52
7.1.2	Regional projects	52
7.1.3	Calls for projects	53
7.1.4	Hydrogen hubs & regional value chains	53
7.1.5	R&D and deployment of new technologies.....	55

7.2	Low and zero-emission solutions in the French market	56
	Bibliography.....	58
2.	French Inland waterways	65
	Introduction.....	65
1	Overview of the French inland navigation sector.....	66
1.1	Inland Navigation sector	66
1.1.1	Inland navigation specificities: administration and public stakeholders	66
1.1.2	Inland navigation fleet.....	69
1.1.3	Inland waterways networks and navigation requirements.....	71
1.2	French river sector market.....	74
1.2.1	Passenger transport overview.....	74
1.2.2	Inland navigation shipping activity	77
1.3	Purchasing system	80
1.3.1	Public purchasing system	80
1.3.2	Public purchase's useful links	82
1.3.3	Private purchase	83
1.4	Technical requirements for inland navigation vessels.....	84
1.4.1	Applicable technical prescriptions for French Inland Waterways Vessels	84
1.4.2	Class certification societies.....	88
1.4.3	Non-Road Mobile Machineries emissions thresholds for thermal engines	89
2	French inland waterways environmental transition	89
2.1	Environmental pressure towards carbon neutrality.....	89
2.1.1	Inland navigation's global emissions reduction objectives	90
2.1.2	Low Emissions Zones: an indirect game changer for inland navigation?.....	91
2.2	Environmental concerns from public and private stakeholders.....	93
2.2.1	Environmental requirements from operators and transporters.....	93
2.2.2	Environmental requirements in tenders	94
2.3	National incentives for low or non-polluting solutions	95
2.3.1	A centralised desk for low and non-polluting solutions: the pami.....	95
2.3.2	Energy Economy Certificates (CEE), an extra funding tool compatible with public fundings	97
2.3.3	Other public subsidies	97
2.4	Maturity of the ecological transition ecosystem	98
2.4.1	Existing ecological transition ecosystem	98
2.4.2	Example of existing projects: new build green vessels	101
2.4.3	Retrofits projects examples.....	103
3	Competitive situation and potential cooperative partners.....	106

3.1	Solution providers on the market	106
3.1.1	Green vessels	106
3.1.2	Autonomous systems	109
3.2	Potential partners for Norwegian companies.....	111
3.2.1	Associations and public entities	111
3.2.2	Integration companies.....	113
3.2.3	Shipyards	114
3.2.4	Relevant clusters	115
4	Annex	117
4.1	Annex 1: type and characteristics of cargo boats.....	117

Table of figures

Figure 1 - Hydrogen development in Pays de la Loire.....	16
Figure 2 - Hydrogen development in Brittany.....	16
Figure 3 - Establishment of the French hydrogen strategy.....	18
Figure 4 - The French national hydrogen strategy.....	19
Figure 5 - Fleet under French flag - Service fleet.....	20
Figure 6 - Fleet under French flag - Transport fleet.....	20
Figure 7 - Age of existing fleet.....	21
Figure 8 - Total energy supply by source (Iea, n.d.).....	24
Figure 9 - Total energy supply (TES) by source, 1990-2020 (Iea, n.d.).....	25
Figure 10 - Germany - Total energy supply (TES) by source, 1990-2020 (Iea, n.d.).....	25
Figure 11 - Carbon intensity of industry energy consumption, France and Germany (Iea, n.d.).....	26
Figure 12 - Sailing Technologies and enterprises.....	30
Figure 13 - National ecosystem, Source : Wind Ship.....	30
Figure 14 - Shorepower for ship (maritime).....	36
Figure 15 - Shorepower for ship (maritime).....	36
Figure 16 - Cluster Maritime Français.....	41
Figure 17 - French shipbuilders.....	51
Figure 18 - Location of projects.....	52
Figure 19 - Timeline of projects based on announced commissioning dates.....	52
Figure 20 - Regional projects with strong ambitions regarding maritime and/or waterway mobility.....	53
Figure 21 - Calls for projects with strong ambitions regarding maritime and/or waterway mobility	Feil!
Bokmerke er ikke definert.	
Figure 22 - Hydrogen hubs & regional value chains with strong ambitions regarding maritime and/or waterway mobility.....	54
Figure 23 – R&D and deployment of new technologies with strong ambitions regarding maritime and/or waterway mobility.....	55
Figure 24 - Seine's docks in Paris, source: APUR.....	69
Figure 25 - Map of the different gauge networks, source VNF.....	72
Figure 26 - Source: CESNI.....	84
Figure 27 - The opening ceremony, artist views. Source: Paris 2024.....	100
Figure 28 - Source: AFBE's electric boats catalogue.....	101
Figure 29 - Source: Ducasse sur Seine.....	102
Figure 30 - Source: lantenne.....	102
Figure 31 - Source: Naviwatt.....	103
Figure 32 - Source: ParisNautes.....	103
Figure 33 - Source: Yachts de Paris.....	104

Figure 34 - Source: Vedettes du Pont Neuf.....	104
Figure 35 - Source: Compagnie des Bateaux d'Aix-les-Bains	105
Figure 36 - Source: Paris Marais.....	105
Figure 37 - Source: Neptech	106
Figure 38 - Source: Neptech	107
Figure 39 - Source: Seabubbles	107
Figure 40 - Source: Mobyfly	108
Figure 41 - Source: VNF quoted in ADEME's 2019 energy efficiency study.....	117

Compliance matrix

	1 Green maritime: Page 11 - 68	2 Inland waterways: Page 69 - 125
1. Market maturity		
Are there local/regional emission targets in city, harbour or areas – year for the introduction of these targets, if there are any. For example, non-emission zones in city/harbour.	Section 1.1.3; 4.8.	Section 2.1.2.
Are there any present environmental requirements in tenders from public or private buyers (operator, shipowner)?		Section 2.2.
Are there expressed any special environmental requirements from the purchaser?	Section 1.2.	Section 2.2.
Are there any national incentive programs for low/non-polluting solutions?	Section 1.3.	Section 2.3.
Condition of the existing fleet (age, size) and if there are any special requirements for vessels.	Section 2.4. ; 4.1.1.	Sections 1.1.2. ; 1.1.3. ; 1.4.1. ; 1.4.3.
Examples of projects that have been carried out.	Section 2.5. ; 4.1.1. ; 4.2.1. ; 4.3.2. ; 4.4.2 ; 4.5.5. ; 4.7.2.	Sections 2.4.2. ; 2.4.3.
2. Infrastructure/access to energy		
Energy mix on the electrical grid	Section 3.2. ; 4.8.3.	

Energy supply – condition of the electrical grid	Section 3.2.	
3. Mapping of customer segments – purchasing system		
Central policy makers and decision makers/customers for the different types of vessels (referring to the relevant types of vessels).	Section 1.3.	Sections 1.1.1. ; 1.4.1. ; 1.2. ;
Shipping companies that operate current vessels	Section 5.3.	Section 1.2.2.
How are public tenders carried out?	Section 1.2.4	Section 1.3.1.
Are there any larger tenders that are expected to be published in the time ahead? Estimated size of these?		Section 1.3.1. ; 1.3.2.
Any special public conditions that must be taken into account		Sections 1.1.1. ; 1.1.3. ; 1.4. ; 2.1. ; 2.2. ; 2.3.1 ; 2.3.3 ; 3.2.1.
4. The competitive situation and potential cooperative partners		
Have there been launched any other green vessel solutions in the market?		Section 3.1.
National maritime clusters or clusters within related areas (for example green energy)	Section 4.9. ; 5.2.	Section 3.2.4.
Central cooperative partners in the market (for example shipyards)	Section 6	Section 3.2.
Any other relevant market conditions that one should know of in relation to the kind of investment that is specified here		Sections 1.4.1., 2.4.1. ; 3.2.1.

1. Green maritime France

Introduction

France is a nation with a strong maritime heritage, enjoying direct access to the Atlantic and Mediterranean seas, as well as overseas territories. The economy is intrinsically linked to the sector, which accounts for 78 % of the country's imports. Meanwhile, France is undergoing a green transition and has set ambitious goals for its reduction of greenhouse gas emissions. Consequently, the country has banned all new oil and gas exploration and made legally binding commitments to reduce its energy consumption from fossil fuels by 30 % by 2030, and to reach carbon neutrality by 2050.

France has one of the most modern maritime fleets in the world with an average age of only 10 years but will need to develop innovative new solutions in order to keep up with the demands of the green transition. Currently, a considerable amount of projects is being carried out across France impacting the whole maritime value chain, and there are large government investment programs dedicated to creating the sustainable industries of the future.

This report gives an overview of environmental and energy challenges in the French maritime sector, describes the major sustainable developments in the sector, the funding programs and mechanisms that are put in place to generate these developments, and gives an overview of important stakeholders, infrastructural developments as well as relevant innovations, projects, and green solutions in the maritime market.

1 Environmental and energy challenges

International maritime transport represents 2-3 % of global greenhouse gas (GHG) emissions, according to a study conducted by the International Maritime Organisation (IMO) (Erbach, 2020). According to the calculations of the IMO, this share could increase to 17 % by 2050 if no measures are taken to reduce emissions (Nougè, 2019).

1.1 Environmental rules

1.1.1 IMO

New IMO measures will come into force in 2023 with the introduction of an existing ship energy efficiency index (EEXI) calculated against a baseline. The Carbon Intensity Indicator (CII) will impose from 2023 to 2030 annual reduction factors necessary to ensure a continuous improvement in the operational carbon intensity of the ship, in order to achieve the -40 % emission target.

The IMO has a general objective to decarbonize maritime transport as soon as possible by the end of the century and in line with the objectives of the 2015 Paris Agreement, broken down into intermediate "ambition levels":

to reduce the carbon intensity of ships by 40 % by 2030, then by 70 % by 2050 (emissions per mile travelled) on a 2008 basis, and to reduce the total volume of GHG emissions in 2050 by at least 50 % compared to 2008.

The IMO has set a limit of 400 GT for the application of its environmental rules. The French fleet of cargo and passenger ships as well as maritime services and on-sea works therefore comply with its rules. Smaller ships intended for port services, passenger transport and wind offshore fleet are not concerned. The choice to adapt vessels to the rules will depend on the owners or the concessions for contracted public transport.

The ship pollution control rules included in the MARPOL code now also address the reduction of air emissions from combustion engines. The lowering of SO_x emission levels has been implemented with Global Sulphur 2020 and more restrictive regional standards (SECA) also exist. France will be concerned by the SECA Med on 1 January 2025. NO_x also has its specific timetable.

1.1.2 European Union

The European Union is setting up its own environmental regulations, to which France is committed. A new phase of European policy has been in place since 2019. The EU Commission published an extensive legislative proposal package called 'Fit For 55' as part of its larger European Green Deal, which aims to make the EU carbon-neutral by 2050.

By the European Trading System (ETS) Directive, in 2023 maritime shipping will be subject to the EU CO₂ emissions trading scheme. It will include all emissions within the EU, but only 50 % for voyages to and from the EU. Phase-in period: 20 % coverage in 2023 and 100 % by 2026.

The Fuel EU Maritime Regulation for 2025 is a new regulation that will come into force that sets greenhouse gas footprint standards for ships. GHG intensity from energy used on board must improve by 2 % by 2025, 6 % by 2030, 13 % by 2035, 26 % by 2040, 59 % by 2045 and 75 % by 2050. From 2030, the regulation will also require container and passenger ships to connect to shore power for calls lasting more than 2 hours.

The Alternative Fuel Infrastructure regulation is a revision of the existing directive will. It states that EU Member States must increase the availability of LNG by 2025 and shore power by 2030 in EU core ports (TEN-T).

By the Energy Taxation Directive, conventional fuels will be taxed between EU ports commencing 1 January 2023. The new rate will be around 37 € per tonne for heavy fuel oil. Initially, LNG will be taxed at a rate of 0.6 € per GJ. Alternative fuels will be tax-exempt for a period of 10 years.

The European directives and regulations apply to ships over 5 000 GT. All the fleet of European small ships isn't concerned by this environmental packet of rules.

1.1.3 France

France does not have any unique constraints on maritime transport; they are based on global and European rules. River transport has no specific constraints. Associations are only contested in Mediterranean ports because of the high number of cruise ships. The contestation concerns, in particular, the strong frequentation of cruise ships (Marseille¹, Nice, Ajaccio) and this accelerates the public measures of environmental solutions, in particular the shore power (Cueto, 2022) (AFP, 2022).

The French government's policy is mainly aimed at decarbonizing road transport. For freight and passenger transport, the government set up a task force in 2021 dedicated to the energy transition of road freight and

¹ Port of Marseille is the French leader for cruise calls, but the City authority launched a petition to prohibit the most polluting ships from stopping over. To date, more than 52,000 people have signed the petition to stop the Mediterranean from 'suffocating'.

passenger vehicles. To date, this task force has noted a very variable maturity of technological and industrial solutions depending on the use (weight, autonomy, distance). Significant delays in the deployment of decarbonized solutions on an industrial scale, particularly for heavy vehicles. The French decarbonizing ambitious is not a directive for maritime and river transport (France mobilités, n.d.).

There are constraints linked to the new Low Emission Zones (LEZ) which limit the use of combustion engine vehicles in the urban regions which apply them (45 to 50 conurbations in 2025). This does not concern maritime and river transport, but the decarbonization of goods transport will allow the emergence of urban logistics on water (harbours, rivers), particularly for last-km links, complementing urban warehouses and soft mobility. The LEZ will also encourage public transport using water to adapt to alternative energies (Gouvernement, 2021a).

1.2 Market tending

1.2.1 Oil price and energy saving

It is difficult to say what the price of oil will be in the next few years, but the energy crisis linked to the Russian-Ukrainian war shows that the price of fuel can become very high. The economic players are therefore attentive to energy saving solutions, more efficient engines and alternative solutions.

Energy savings are a good incentive to initiate efficiency processes in maritime and inland waterway transport in the design of ships and their means of propulsion.

1.2.2 Shipper's demand

The first step is the shipowner's initiative to develop "green ships". The next step is the demand from shippers and may be from customers for a strong environmental progress for "green shipping". The same case will be for cruise industries from passengers.

Part of the "greening of ships" comes from requirements linked to IMO emission reduction schedules. A second part will come from EU carbon quota requirements which may be of interest to freight shippers. The general idea is that higher transport costs and societal demands from consumers will lead to environmental solutions for ships. The shippers will be central in supporting the maritime industry mutation.

Several large shippers intend to put pressure on shipowners to green their fleets. They have come together in the Cargo Owners for Zero Emissions Vessels (coZEV) platform. In a joint statement, 19 companies (among them Amazon, IKEA, Michelin, Patagonia, and Unilever), brought together by the American NGO Aspen Institute, set themselves the goal of transferring their freight to ships powered by "zero carbon fuels" by 2040.

There are examples of companies making a commitment today. For instance, the Electrolux group, which has signed a partnership for its products to travel on LNG ships in the CMA CGM fleet. With the sailing ship projects there is a stronger commitment from shippers. The Neoline project received the partnerships of the shippers involved to initiate the bottom of the roro sailing vessel. In another case, a coalition of shippers for low carbon maritime transport (eleven companies) was set up under the aegis of AUTF (National Shippers Association) and France Supply Chain (group) to accelerate the deployment of low-carbon maritime transport solutions with a call for tenders for a fleet of 2024 container ships powered mainly by wind power on a transatlantic link. The company Zéphyr & Borée has been selected for this program.

The demand for the greening of ships in the passenger segment stems from two dynamics. The first is due to environmental regulations, the second to relative societal pressure on air pollution in port cities and respect for fragile environments in the case of expedition cruises.

The demand for environmentally friendly ships on the part of ferry or cruise passengers does not really exist but will become an important criterion in the coming years. In the case of small touring ships, the use of electric and hydrogen power should also develop as ships are renewed to offer cleaner and no noise ships.

(Arias & Dahl, 2022) (CMA GCM, 2022c) (Sporrer, 2022) (Roussard, 2022)

1.2.3 Public intentions

Another form of demand for greening may come from local authorities in the context of public transport (bay shuttle, river bus, river ferry). The choice of modernisation of floating units can therefore involve innovative solutions: solar panels, batteries, hydrogen. Relatively small vessel sizes may be suitable for innovations while having relatively easy financing support.

The environmental policies of cities for their public transport can lead to innovations for floating means of transport on seas or rivers. The EPZs should encourage this also for private and public passenger transport.

In France, there are no regulations for the use of low-emission ships in sensitive natural areas. In the Parc Régional des Calanques (Marseille Area), touristic passenger transport is regulated in order to protect this fragile area. Only authorised vessels may navigate there, provided they comply with a set of rules (reduction of noise and polluting emissions, waste management, etc.) and give preference to eco-responsible vessels with hybrid propulsion.

(Naviliy, 2022)

1.2.4 Market access

The shipbuilding market is a free market without nationality constraints in the framework of free European competition. Naturally, France applies the European rules on thresholds and access to public contracts.

The French shipbuilding industry operates relatively with mainly national service providers. The presence of foreign companies is often through their entity in France. Only the large shipyard in Saint-Nazaire has a high level of foreign participation.

For ships under the competence of public administrations (national, local), the "Public Procurement Code" applies with calls for tender (studies, supplies, works).

Since January 2021, the threshold of non-competition concerns contracts of less than €40,000 excluding tax, there is also a threshold of €100,000 excluding tax for contracts for innovative works, supplies or services (Economie, n.d.).

The public contracts correspond in one case to ships owned and entrusted to private companies under concession contracts, in another case under public tenders. It is quite possible that in the future passenger and freight fleets linked to public contracts will contain environmental obligations for the energy used. Brittany region will probably be the first to do so. The only recent call for tenders concerned a global performance contract for the design, construction and maintenance of a transshipment vessel using hydrogen as fuel April 2022 Lorient Agglomeration (Centrale des Marches, 2022).

1.3 Public support policies for innovation

1.3.1 Initiatives for maritime transport

For maritime transport, there has in 22 been a process of "green additional depreciation" voted by the Parliament applying to French companies for ships under the national, EU and EEA registers. This tax deduction is valid for all contracts for the acquisition or construction of ships that respect environmental criteria (January 2020-December 2024). This mainly concerns the additional costs of equipment acquired when new allowing the use

of fuel reducing greenhouse gas emissions for main propulsion, as well as equipment intended for main or auxiliary propulsion using wind energy.

This is a sum equal to 125 % of the additional capitalised costs (excluding financial costs) directly linked to the installation of equipment, acquired when new, allowing the use of hydrogen or any other decarbonized propulsion as the main propulsive energy or to produce electrical energy for the main propulsion of goods or passenger ships. The sum is 105 % for the use of liquefied petroleum gas, compressed natural gas, ammonia, methanol, ethanol or dimethyl ether. A sum equal to 85 % of the additional capitalised costs, excluding financial costs, directly linked to the installation of goods intended for the treatment of sulphur oxides, nitrogen oxides and fine particles contained in the exhaust gases. A sum of 20% for the installation of shore power.

(Secrétariat d'État chargé de la Mer, 2021)

1.3.2 Initiatives for river transport

Voies Navigables de France (NVF) is the public agency of the river infrastructures in France. Part of its work is aimed at supporting the energy transition in the sector. River transport consumes three to four times less energy and therefore emits three to five times less CO₂ than the same transport by truck. However, the environmental performance can be further reduced because today's inland waterway vessels and their engines are sometimes quite old. Inland waterway transport must therefore adapt to new environmental standards, or even anticipate them, in order to maintain its natural competitive advantage.

VNF has already set itself the task of informing the sector about innovative solutions, based for example on "marinized" road or industrial engines, the pollution control, the development of hydrogen, liquefied natural gas (LNG) or compressed natural gas (CNG), or even electric or hybrid engines. The objective is to identify financial support tools and help inland waterway transport operators to mobilise them.

VNF have this Modernisation and Innovation Assistance Plan (PAMI) for river fleet with a component for innovation budgeted at €2M over five years. It is open to freight carriers and river tourism, but also to technical service providers. VNF can support demonstration projects in innovative technologies. The objective is to reduce consumption, emissions and pollutant discharges, encourage the use of renewable energy and optimise energy management on board.

In addition, the Energy Savings Certificates (CEE) scheme allows for partial financing of energy saving investments, partly through the installation of equipment that optimises the energy consumption of a river unit. This aid is granted by energy suppliers and distributors. Any carrier located in France that invests in new equipment (river ship, pusher tug & barge) can claim CEE. Other actions that promote fuel savings on a river transport unit are now eligible for CEE: fuel consumption measurement equipment, careening operations on a river transport unit, electrical connection at the quay, electrical repowering of a river vessel.

(République Française, n.d.a) (République Française, n.d.b) (République Française, n.d.c)

1.3.3 Supporting by regions

The regions in France have competences both in terms of transport and economic development. The energy transition is at the heart of the economic strategies of all regions. For the maritime regions, the development of innovative solutions for maritime transport and ports are among the objectives.

The regions are notably undertaking "hydrogen plans" which represent a means of supporting energy innovation. The Pays de la Loire region has announced €100 million over 10 years for hydrogen-powered ships.

Brittany wants to deploy renewable hydrogen by 2030 and its applications, including maritime applications, with calls for projects. The regional ambition is for a first fleet of 10 pilot vessels (passenger service, freight cabotage, handling, fishing), with electro-hydrogen propulsion, with a power range from 500 kW to 6 MW. The investment will be around 150 M€ public/private. The three maritime port ecosystems will also have to be involved in the supply of hydrogen. Future offshore wind farms will also be able to produce hydrogen at sea.

The Normandy region has launched an accelerator (Plan Normandie Hydrogen) for €4M to carry out an application project in the field of liquid hydrogen for heavy maritime and/or river mobility. The hydrogen strategy of the Haut de France Region aims to produce green hydrogen by electrolyser in the Port of Dunkirk in 2022 from renewable electricity. The Occitanie region supports hydrogen innovation solutions in the port of Sète (dredge ship).

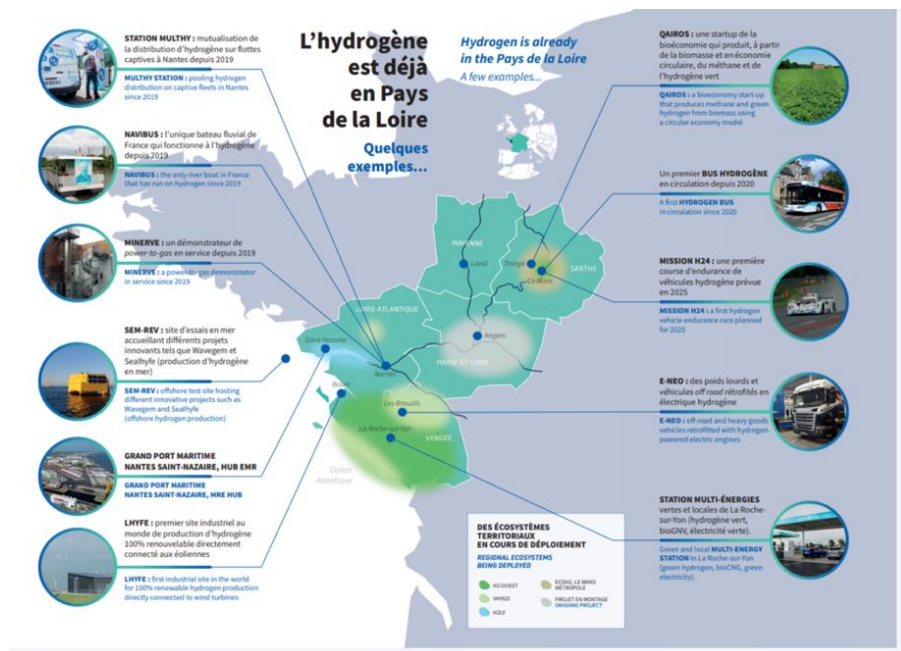


Figure 1 - Hydrogen development in Pays de la Loire

Carte des projets hydrogène renouvelable en Bretagne



Figure 2 - Hydrogen development in Brittany

(Rio, n.d.) (Robert & Dobaire, 2021) (RÉGION HAUTS-DE-FRANCE, 2021) (La region Occitanie, n.d.)

Sailing innovation is the other subject of future support from the regions. In 2021, the region of Brittany launched a roadmap for the emergence of the emerging sector. According to a study carried out by Bretagne development innovation, 156 Breton companies are involved in marine transport with a velic propulsion system (61 are active, 95 are interested). 61 are linked to architecture, engineering and modelling. The region has not yet established specific aid.

The Pays de la Loire also benefits from an ecosystem around velic with two cargo projects (Neoline, Zephyr & Borée) and innovation in sails (Chantiers de l'Atlantique). The Pays de la Loire region mentioned its contribution in financial guarantees for the Neoline project. The unique events about sailing for commercial maritime transport is in St Nazaire: Wind for good (next edition 2023).

It also supports the "PERFO" project, which aims to estimate the propulsion performance of sails, wings, kites or rotors, in order to reduce the consumption of commercial vessels and their impact on the environment. This project is based on software developed by the LHEEA laboratory at Centrale Nantes.

(Tincelin, Sergent, & Duduyer, 2021) (Wind for Goods, 2022) (Bretagne Development Innovation, n.d.)

2 The French market

2.1 Context France

France, like the rest of Europe, has taken steps in the direction of more sustainability in the last decade. and has already passed several laws in commitment towards a green transition. France does not have an overarching plan or roadmap of how to manage the green transition of the hydrogen sector, but rather a number of laws and programmes on EU, national and regional scale creating incentives to develop the maritime sector as well as demanding the companies of the sector to conform to the needs of the green transition.

2.2 France's green transition laws

The **Energy Transition Law**, published in 2015, sets ambitious targets of achieving within 2030 a rate of 30 % renewable energies in final energy consumption and 40% renewable energies in electricity production, reducing the consumption of fossil fuels by 30% in 2030 and decarbonizing 10 % of gas (Elysee, 2021). Hydrogen energy applications are considered as interesting levers for achieving these objectives.

The **Energy and Climate law of November 2019** (Climate Laws, 2019) is France's framework document on climate and energy matters. The law notably enshrines into law the objective of carbon neutrality for 2050 and sets several quantified objectives for the energy sector. It is an extensive document amending the Energy Code, the Environment Code, the General code of local and regional authorities and other codes and laws. The law notably makes the High Council for the climate a permanent body (art. 11 and 12), enacts the closure of the last four French coal power plants (art. 12), streamlines the administrative framework of electricity supply companies with the aim of boosting renewables (art 14), takes measures to improve energy efficiency in building, discusses measures to regulate air and maritime international transport. It amends several pieces of legislation to increase the emphasis on adaptation to climate change and resilience, alongside mitigation efforts. Article 1 further aims to promote a research and innovation policy that favours the adaptation of business sectors to the energy transition.

2.3 National incentive schemes for low/zero emission maritime solutions

2.3.1 France's green programmes

So far, France lacks a clear, over-arching strategy or roadmap for green transition in the maritime sector. However, other government strategies, also cover sustainable maritime developments.

Unlike Norway, France does not have a detailed roadmap or specific funding scheme for the green transition of the sector, but several funding schemes coupled with more ambitious policies and plans at the regional and city level also cover the transition towards sustainable maritime solutions.

France Relance: Their €100 Billion Covid recovery package *France Relance* presented in September 2020 included €650 million for the decarbonization of the maritime sector, €175 million for the upgrading of waterway infrastructure and €200 million for the upgrading and greening of ports. In addition to this they have set aside €9.1 billion for the development of industry and technology in their hydrogen strategy, which has a strong focus on utilising green hydrogen for ships and ferries. These French projects need relevant partners, and French authorities organise several public tenders at any one time. These tenders identify as important gateways to the French market, where Norway stands a great chance as it is among the countries in the world that have come the longest in the development of hydrogen-electric ferries and ships.

France 2030: In October 2021 President Macron unveiled the France 2030 plan. The plan assigned money towards 10 different goals, most notably the following objectives:

- *Becoming the leader in the green hydrogen sector.* The French government has devoted large funds, and their ambition is to have at least two gigafactories of electrolyzers on its soil by 2030 and to achieve a large production of hydrogen and all the technologies relevant for its use.
- *Decarbonizing the industry* with an ambition of reducing greenhouse gas emissions by 35% compared to 2015 levels by 2030.
- Development of the hydrogen sector will receive €9.1 billion of investments by 2030, a higher budget than that of Germany. Most of these funds will be invested in the first few years of the decade (Girardin, 2020).

This plan sets ten targets for the future of France to be achieved by 2030, and notably devotes an additional €1.9 billion towards hydrogen solutions. In addition to this the maritime sector can benefit from programmes on *regional and city level*

2.3.2 Establishment of the French hydrogen strategy

Before 2018, hydrogen projects and demonstrators were initiated locally by the regions and departments, together with industrials, through public call for projects financed by ADEME, the national agency responsible for the implementation of public policy in the areas of the environment, energy and sustainable development.

The "Hulot Plan" presented in June 2018, by the (at the time) Energy Minister N. Hulot, is the first national hydrogen strategy and aims to support innovation and industrial deployment of carbon-free hydrogen, to make it one of the pillars of the energy transition. The strategy is focused on decarbonizing the industry and developing hydrogen mobility, through an investment of 100m€ through public calls for tenders.

The 2019 Climate-Energy Law sets targets for carbon-free hydrogen consumption within 2030 and the establishment of a Guarantee of Origin system for hydrogen.

In September 2020, as part of the National Recovery Plan following the COVID-19 crisis, the French government unveiled its Hydrogen Strategy and sets very ambitious goals accompanied with €7.2 billion of investments for the next decade (given an additional €1.9 billion in funding from the plan France 2030 in October 2021). France's hydrogen commitment now totals €9.1 billion, which is an equivalent commitment to that of Germany.

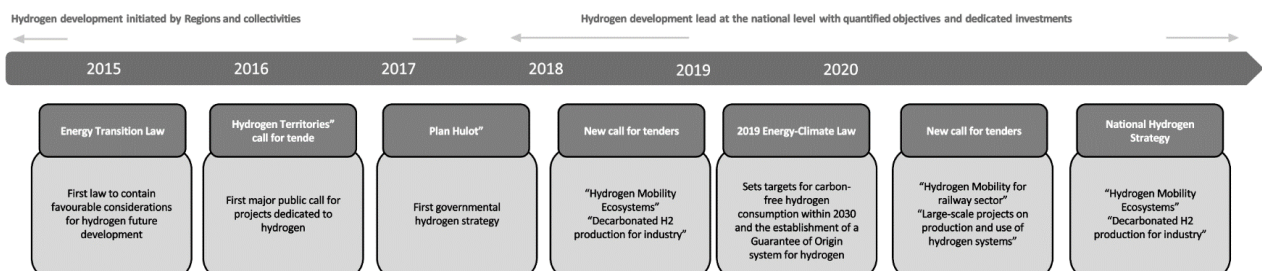


Figure 3 - Establishment of the French hydrogen strategy

2.3.3 The French national hydrogen strategy

In the context of 100bn€ French Recovery Plan, the Ministry of Economy, Finance and Recovery in September 2020 presented the National Hydrogen Strategy for the next decade. Allocated with 7.2bn€, this strategy strengthens the previous 2018 Hulut Plan, and aims to make France a leading nation in green hydrogen production by 2030. The hydrogen strategy is built upon 3 priorities (Pompili & Maire, 2022):

1. Decarbonate industry by creating a French electrolysis sector
2. Develop heavy mobility with carbon-free hydrogen
3. Support research, innovation and education to promote tomorrow's users

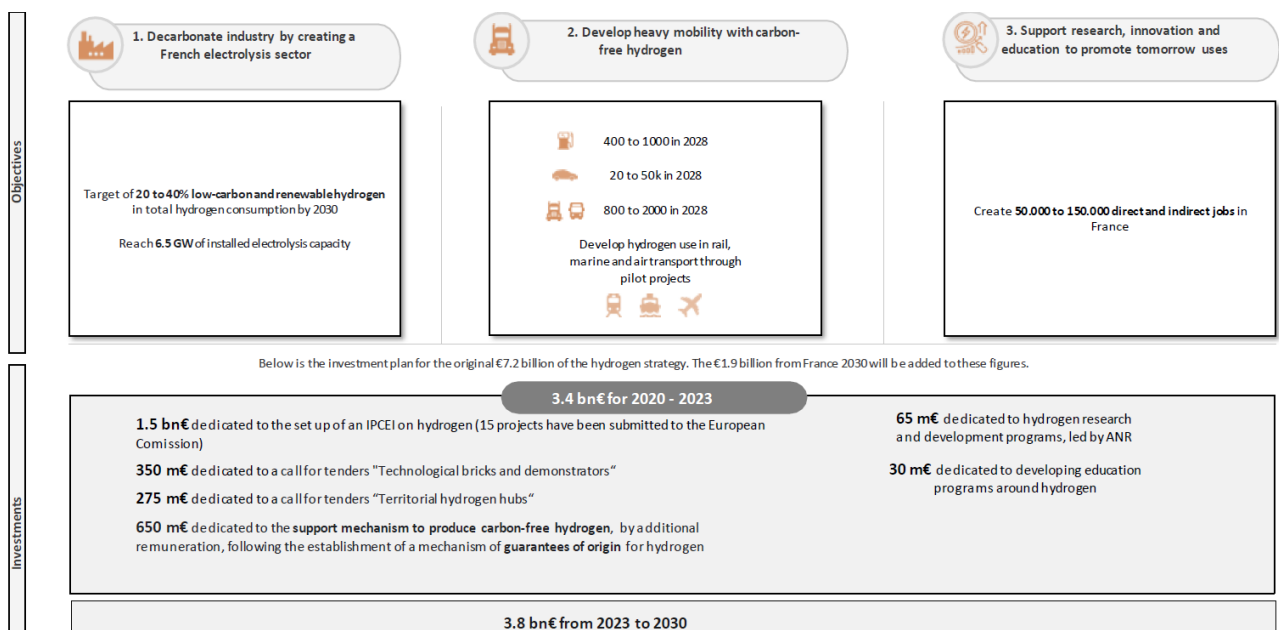


Figure 4 - The French national hydrogen strategy

2.4 Overview of existing fleet

The fleet under the French flag consists of ships registered in the six French registers: the metropolitan register (1^{er} Registre), the French International Register (RIF) created in 2005, the Register of the French Southern and Antarctic Territories (TAAF); the register of New Caledonia; the Wallis and Futuna register and the French Polynesia register. The French flag has about 428 vessels in all registers. However, several hundred other ships are controlled by French interests, due to the global principle of open registration.

2.4.1 The importance of the maritime fleet

Maritime transport accounts for nearly 90 % of world trade and 78 % of French imports. French maritime employment represents:

- 22,000 direct jobs (16,000 seafarers and 6,000 sedentary),
- 80,000 indirect jobs (shipping agents, insurers, classification societies, etc.)
- The French companies themselves directly.

ECSA ambitions

The European Community Shipowner's Association (ECSA) represents the European shipping industry and has stated its commitment to achieve the global IMO CO2 reduction targets (Armateurs de France, 2021). They expect a peak in emissions from international shipping shortly and an at least 50 % reduction in emissions by 2050 (ECSA, 2018) (IMO, 2019) In its position paper *A Green Deal for the European Shipping Industry*, ECSA (2020) further states that this strategy will be revised in 2023 to incorporate concrete targets for full decarbonization of the European shipping industry.

Armateurs de France are aligned with, and complying with the targets stated by the IMO, but state that they wish for more direct state funding and incentive programmes to help companies comply with the needs of the green maritime transition.

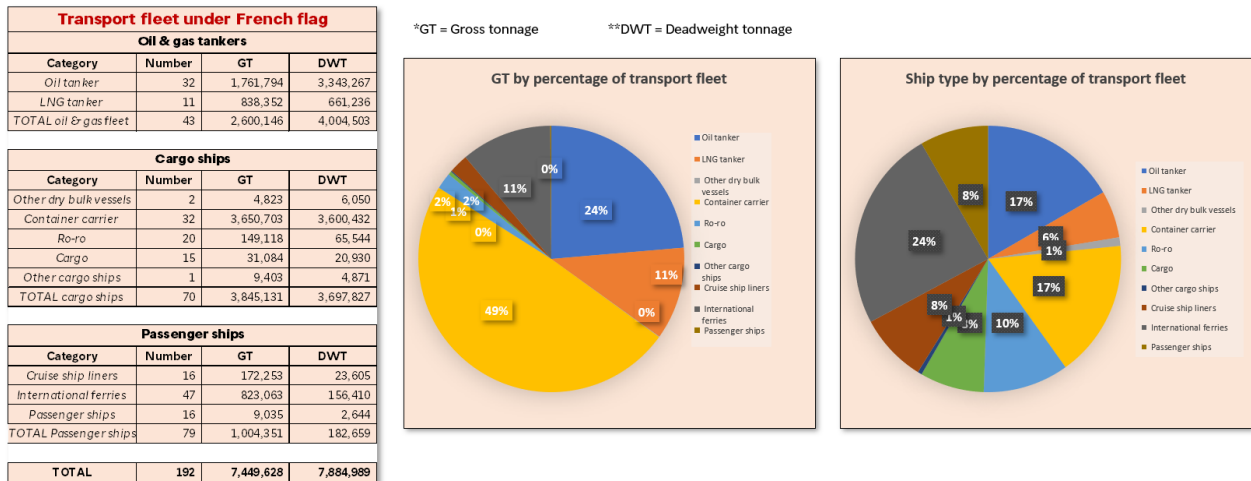


Figure 5 - Fleet under French flag - Transport fleet

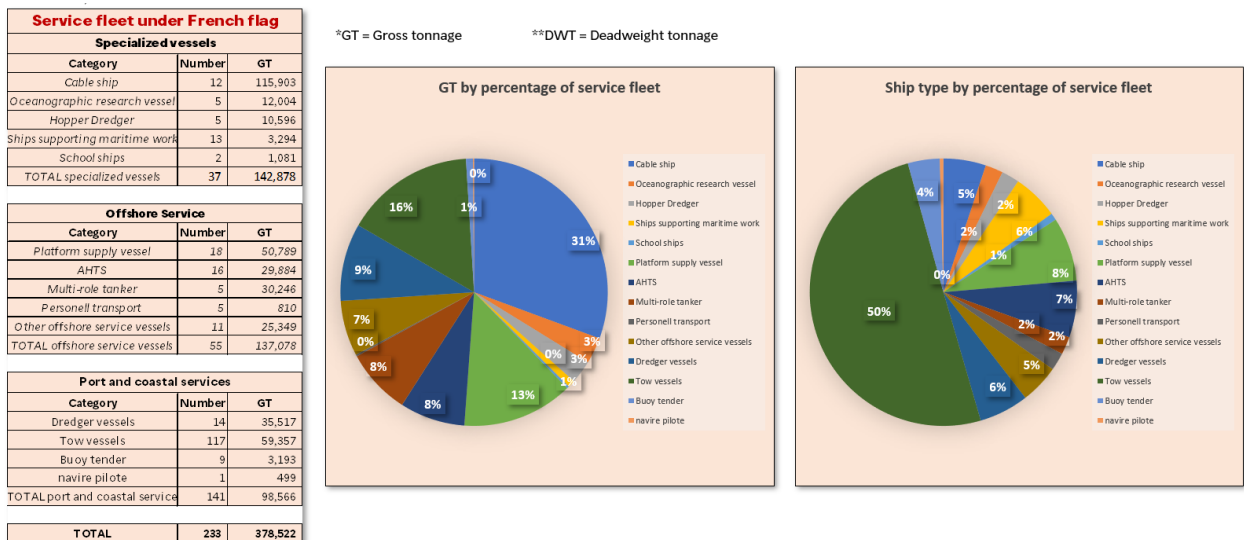


Figure 6 - Fleet under French flag - Service fleet

2.4.2 Age of existing fleet

The French fleet has a young average age of barely 10 years of average age against 15 for the European fleet and 17 for the world fleet. This is due to the transport fleet being very young. However, French service fleet is growing old and is in need of renewal. Observing the average age of the service fleet we see this is on the global average, which is behind the ambitions of France. They will need to focus on modernising their service fleet if they are to be able to compete on the international market and abide with the requirements of the green transition.

Service fleet under French flag				
Specialized vessels				
Category	Number	GT	Average age 1	Average age 2
Cable ship	12	115,903	19.7	21
Oceanographic research vessel	5	12,004	21.7	20.2
Hopper Dredger	5	10,596	13.2	13.6
Ships supporting maritime work	13	3,294	13	13.3
School ships	2	1,081	13.2	62.9
TOTAL specialized vessels	37	142,878	22.2	21.6
Offshore Service				
Category	Number	GT	Average age 1	Average age 2
Platform supply vessel	18	50,769	11.2	11.4
AHTS	16	29,884	16	16.3
Multi-role tanker	5	30,246	10.5	10.2
Personell transport	5	810	13.7	13.9
Other offshore service vessels	11	25,349	10.7	10.4
TOTAL offshore service vessels	55	137,078	12.4	13
Port and coastal services				
Category	Number	GT	Average age 1	Average age 2
Dredger vessels	14	35,517	16.3	17.5
Tow vessels	117	59,357	14.6	14.3
Buoy tender	9	3,193	24.4	25.1
navire pilote	1	499	12.5	14
TOTAL port and coastal service	141	98,566	18	18.3
TOTAL	233	378,522	17.5	17.6

Transport fleet under French flag				
Oil & gas tankers				
Category	Number	GT	Average age 1	Average age 2
Oil tanker	32	1,761,794	10.1	10.1
LNG tanker	11	838,352	5.1	4.3
TOTAL oil & gas fleet	43	2,600,146	8.5	8.3
Cargo ships				
Category	Number	GT	Average age 1	Average age 2
Other dry bulk vessels	2	4,823	22.5	25.0
Container carrier	32	3,650,703	5.9	5.0
Ro-ro	20	149,118	14.6	15.8
Cargo	15	31,084	18.3	25.6
Other cargo ships	1	9,403	27.5	27.0
TOTAL cargo ships	70	3,845,131	6.4	5.6
Passenger ships				
Category	Number	GT	Average age 1	Average age 2
Cruise ship liners	16	172,253	9.2	9.8
International ferries	47	823,063	18.7	19.8
Passenger ships	16	9,035	18.2	19.7
TOTAL Passenger ships	79	1,004,351	17.1	18.1
TOTAL	192	7,449,628	6.4	5.6

Figure 5 - Age of existing fleet

*Average age 1: average of the median ages of the classes weighted by gross tonnage

**Average age 2: average of real ages weighted by gross tonnage

2.5 Examples of zero emission projects

2.5.1 The FLAGSHIPS project

The FLAGSHIPS project is carried out by a European consortium to build and deploy two commercially operated zero-emission hydrogen fuel cell vessels, one in Lyon, France and one in Stavanger, Norway. Both vessels will run on green hydrogen and the project will contribute to providing more hydrogen-powered ferries in the future. In France, a hydrogen ferry will be operated on the Rhône river by the Compagnie Fluviale de Transport (CFT), and in Norway, the hydrogen-powered ferry will be operated by Norled and act as a passenger and car ferry. The project is EU-funded and has been awarded 5 million euros through the EU's Research and Innovation program Horizon 2020 under the Fuel Cells and Hydrogen Joint Undertaking. The consortium includes nine European partners, with two ship owners Norled (NO) and CFT (FR), maritime OEM and design companies ABB (FI) and LMG Marin (NO & FR), fuel cell technology provider Ballard Europe (DK), vessel energy monitoring and management company PersEE (FR), management and safety experts VTT (FI), and industry cluster NCE Maritime CleanTech (NO). Westcon Power & Automation (NO) has later joined the project. The first of these vessels has just been finished and left the shipyard in February 2022 (Flagships, n.d.).

2.5.2 The virtual-FCS project

The Virtual-FCS project is carried out by a European consortium coordinated by SINTEF (NO) and including partners Université Bourgogne Franche-Comté/FC Lab (FR), Ballard Power Systems Europe AS (DK), Westcon Power and Automation AS (NO), Vivarail Ltd. (UK) and Solaris Bus & Coach Spolka Akcyjna (PO). The objective of the project is to make the design process of hybrid fuel cell and battery systems easier, cheaper and quicker

(SINTEF 2020). Fuel cells is a promising technology in a wide range of transport applications including ships. The project is funded by the EU Horizon 2020 programme and has been awarded 1.9 million euros. The third release of its open-source platform was announced in February 2022.

2.5.3 The HySHIP project

The HySHIP project includes 14 European partners in the design and construction of a new ro-ro demonstration vessel running on liquid green hydrogen (LH2), as well as the establishment of a viable LH2 supply chain and bunkering platform (Hyship, n.d.). The project is coordinated by Wilhelmsen (NO) and the ship will operate Norway's west coast, but aims to lower development and operational costs of a Europe-wide move to LH2 for ship propulsion. The project has been awarded 8 million euros from the EU Horizon 2020 program. French and Norwegian partners include Kongsberg Maritime (NO), LMG Marin (NO & FR), Equinor (NO), Norled (NO), PerSEE (FR), Air Liquide (FR), NCE Maritime Cleantech (NO) and DNV GL (NO).

3 Infrastructure and energy supply

3.1 Infrastructure

France is a leading maritime and port nation with access to almost all the oceans and the largest exclusive economic zone in the world. It stands at the crossroads of the world's busiest shipping routes and enjoys a strategic position thanks to its overseas territories. Despite its strategic geographical position and large maritime industry, France has lagged behind other European countries in the modernisation of its ports and other maritime infrastructure. To address this challenge, major efforts are now undertaken to assert France's status as a globally competitive maritime destination.

3.1.1 Port infrastructure

France is the 5th biggest port nation in Europe, with approximately 360 million tonnes of goods processed and 30 million passengers per year. The French maritime economy accounts for €75 billion worth of production each year and 300 000 jobs.

The ports

The ports provide essential infrastructure for electrification and hydrogen supply. France has 564 ports encompassing inland ports, marinas, military ports, fishing ports and commercial ports (T2EM, n.d.). Despite its strategic geographic location and major maritime industry, France has suffered from European competition and 19 French ports have been late to start their digital and environmental transformation. However, major efforts are now being made to assert France's status as a globally competitive maritime destination. Green infrastructures and digitalisation are now major priorities for French ports. Several major French seaports have defined their own smart port strategies and are currently in the testing phase of various projects. Energy and green technologies are viewed as an integral part of the ports' smart strategy and developing a hydrogen value chain is a major priority. France also has several projects to electrify the infrastructure in small and big harbours, e.g., in Marseille Fos, Le Havre, Toulon (close to Montpellier) and Sète (by Marseille).

Major public investments

Major public investments are currently being made in the modernisation of ports and green port infrastructure. The French government's €100 billion economic recovery plan France Relance will devote €200 million to the modernisation and upgrading of the country's seaport infrastructure. An updated national port strategy was also presented at the beginning of 2021, outlining the ambition to regain market share for its ports, focusing on inter-port collaboration, more sustainable solutions and autonomous solutions. Simultaneously, France is moving from a national source model to a stronger focus on international sourcing.

Seven major seaports

Among the 66 French commercial seaports, seven ports in mainland France have been given the status of “major seaport”. The two biggest ones, Marseille and Le Havre, are ranked among Europe’s top ten busiest ports and are the country’s most active and advanced ports in terms of smart technology.

The lack of a long-term national strategy and insufficient investment in port infrastructure have long been a handicap for French ports that are faced with growing global competition. To address this challenge, major efforts are now undertaken to assert France’s status as a globally competitive maritime destination.

3.1.2 Port infrastructure ambitions

The national port strategy centres on the following four ambitions:

1. Making ports essential links in the performance of supply chains.
2. Making ports essential tools for the economic development of the entire country.
3. Making ports accelerators of the ecological transition.
4. Making ports motors of innovation and the digital transition.

These ambitions are operationalised as follows:

- Accelerating the ecological transition of ports by optimising the integration of innovative economic activities.
- Accelerating the digital transition of ports by digitalizing information flows, procedures, and the flow of goods.
- Developing the zone of influence and attractiveness of the French ports by developing means of mass transportation – rail and river – to streamline the flow of goods.
- Strengthening the competitiveness of the French metropolitan and overseas port system on the international arena.

3.1.3 Main infrastructure technologies

Following the global movement toward smarter seaports, all French ports are actively testing new technologies and developing use cases, particularly in the fields of mobility, security, energy and green technologies. French ports’ development strategies focus on the following main areas.

Management of goods and procedures: Soget and MGI are French leaders in port community systems to manage the flow of goods, people and customs procedures.

Energy: Floating offshore wind, hydrogen and LNG are at the core of the biggest French ports’ efforts to reduce their carbon footprint. The port of Marseille Fos is also investing in geothermal energy and is currently working to connect the shopping centre “Les Terrasses du Port” to a power station that heats and cools using seawater.

Digitalisation: Artificial intelligence, big data and IoT are viewed as crucial tools to optimise logistics and to analyse wind speed, wave height, tides, etc. Predictive maintenance is high on the French ports’ agenda, with a strong focus on digital twins, blockchain, virtual reality and autonomous systems (such as submarine drones). Similarly, 5G is a rising topic along with cybersecurity issues.

Security of workers and citizens: For instance, in Le Havre, the Computerized Processing of Hazardous Materials (CPHM) tool improves port security for industrial and logistical actors, using a simplified, dematerialized, optimized declaration process and real-time pre/post-dispatch monitoring of hazardous goods. Cybersecurity is also a key topic, with major French actors involved such as Naval Group.

The environment: For instance, the port of Marseille-Fos has created an Environmental Performance Index, a platform to discuss and initiate environmental actions, in cooperation with Air PACA and A Lab in the Air.

Marseille and Le Havre have come furthest in terms of testing and implementing smart technologies. The former has an especially dynamic ecosystem which benefits from the presence of leading worldwide shipping group CMA CGM and its own start-up incubator called Ze Box. On a smaller and more local scale, the ports of Dunkerque, Nantes Saint-Nazaire and Bordeaux are also developing their smart ecosystems and are experiencing a growing need for cooperation.

3.2 Energy Mix & Supply

France is a country with an energy tradition different to other European countries. From early on it has been a producer of nuclear power, which today constitutes 42% of its energy supply, as seen in the figure below.

France - Total energy supply by source 2020
(%)

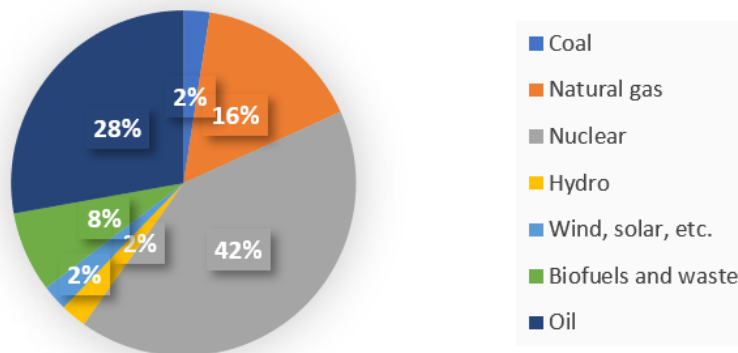


Figure 6 - Total energy supply by source (Iea, n.d.)

3.2.1 Total Energy supply by source

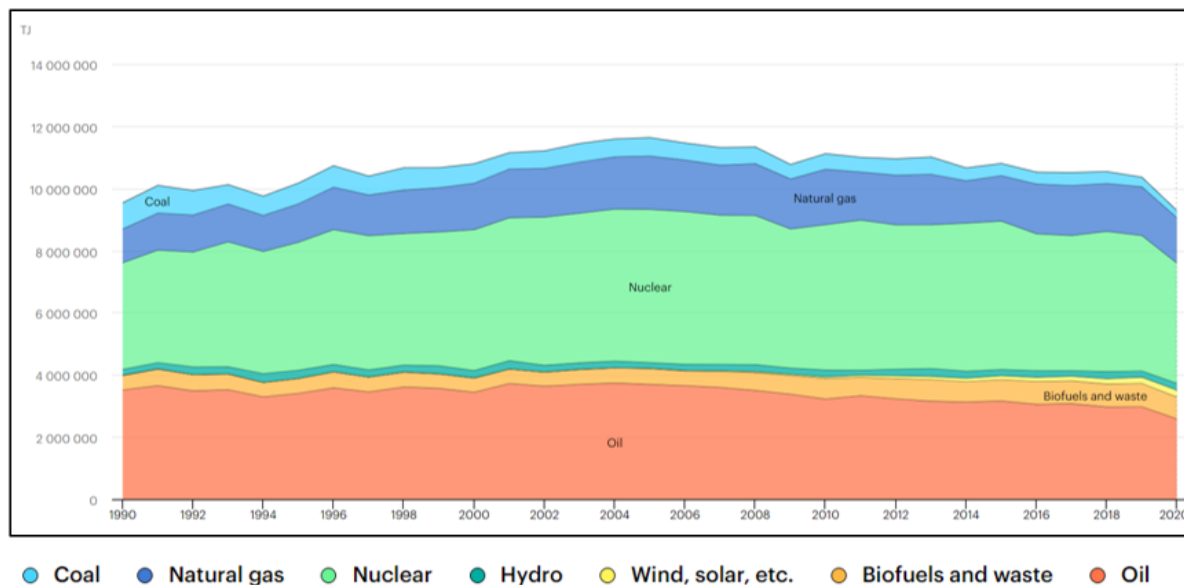


Figure 7 - Total energy supply (TES) by source, 1990-2020 (IEA, n.d.)

France has a very low-carbon electricity mix owing to its large nuclear power, the second largest after the United States. As an early leader in setting out an ambitious energy transition, France legislated a net zero emissions target for 2050 in its 2019 Energy and Climate Act. France believes nuclear energy has an important part to play in reducing its carbon emissions, vowing to increase its number of small-scale nuclear power plants with better waste management in its France 2030 goals.

France and Germany are two countries that are often compared due to their similar size and geographic positioning. Germany initiated their Energiewende in late 2010 and have gone in the opposite direction of France with regards to nuclear energy. They have aimed at phasing out nuclear power by 2022 and to replace it with renewable energies. However, the war in Ukraine has caused an energy crisis in Europe putting a halt to these changes.

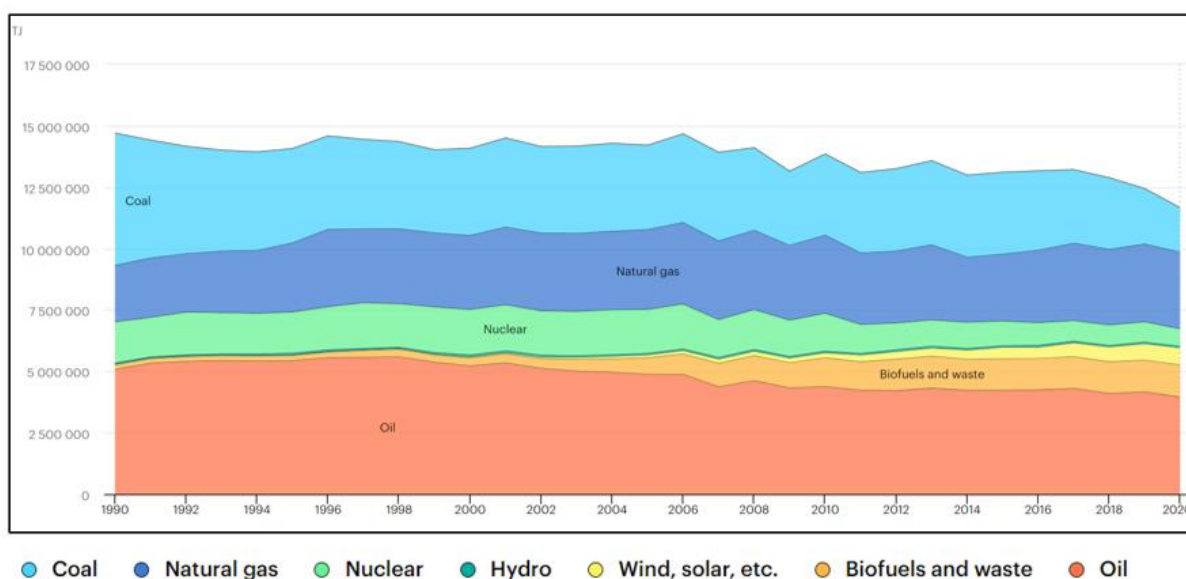


Figure 8 - Germany - Total energy supply (TES) by source, 1990-2020 (IEA, n.d.)

3.2.2 Carbon emission indicator

Carbon intensity measures the amount of greenhouse gases emitted per unit of electricity produced, in this case megajoule. The two figures below give the respective developments in the carbon intensity of industry energy consumption in France and Germany between 1990 and 2019/2020. Comparing the two countries' carbon intensity of industry energy consumption we see that France has had a lower carbon intensity of its industry since the data starts in 1990. However, Germany was working towards the green transition earlier than France by for example adopting their Energiewende as early as 2010, while the French energy transition law was adopted five years later, in 2015. By observing the German graph, we can see that the carbon intensity of their energy consumption has been dropping quicker than that of France. On the other hand, France has been catching up with Germany and the rest of Western Europe, and is now devoting a large amount of funding towards the green transition.

Noteworthy goals for greening the energy mix include:

- The government's commitment towards 40 GW of offshore wind by 2050
- €9.1 billion towards development of the hydrogen sector to be invested by 2030

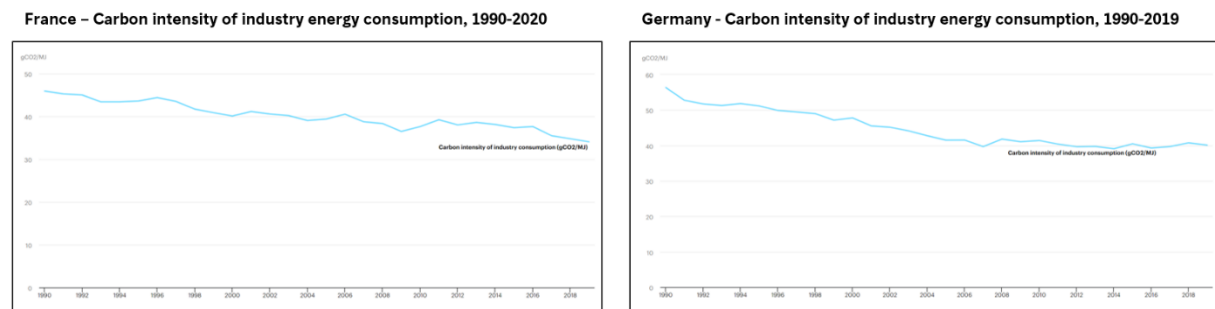


Figure 9 - Carbon intensity of industry energy consumption, France and Germany (Iea, n.d.)

4 French maritime, river and ports innovation

4.1 Maritime sector

4.1.1 Overview

The French maritime sector is relatively large with a presence in several key subsectors. In the summer of 2002, there were 560 merchant and service vessels under the various French registers and about the same number under foreign registers. The French fleet of over 100 UMS counts 425 units (Secrétariat d'État chargé de la Mer, 2022),

The main French company CMA CGM is the number 3 in the world container market. Marfret is its partner on some lines, especially overseas French territories. Four companies are active in the ferry sector (Channel, Corsica/Maghreb), several in the oil and gas sector. Liquid bulk is by few operators and LNG by foreign specialists (NYK in France LGN with Geogas, Knutsen).

Bourbon is the world leader for offshore supply. Jiff is a national player. Ponant is a leading player in the luxury expedition cruise segment.

The merchant fleet (transport and maritime services) of more than 100 UMS under French flag counts 425 ships. It is divided into a transport fleet of 192 vessels and a maritime services fleet of 233 vessels. Divided between

the different registers, the French transport fleet of more than 100 UMS comprises 93 vessels registered in the French International Register (RIF), 59 vessels in the metropolitan register and 40 vessels in the overseas registers, including 22 in French Polynesia. The maritime services fleet comprises 89 vessels registered in the French International Register (RIF), 128 vessels in the metropolitan register and 16 vessels in the overseas registers. The average age of the French shipping fleet is 8.6 years as of 1 January 2022. The age of the world transport fleet is 15.

Main French maritime enterprises

Sectors	Society	ships
Container	CMA CGM	237
	Marfret	7
Ropax	Brittany Ferries	10
	Corsica Linea	8
	Corsica Ferries,	18
	La Meridionale,	4
	Transmanche Ferries	2
	DFDS France.	3
Roro	Sogestran (CMN)	5
	CMA CGM	2
	LDA	3
	Marfret	2
Liquid bulk (oil products, GPL, bunkering)	Socatra	11
	Rubis	5
	Geogas	8
	Sogestran	15
	France LNG	6
	Knutsen France	2
Luxury Cruise	Ponant	13
Offshore oil & gas supply	Bourbon	174
Offshore wind energy supply	LDA	3
	Thomas	3
Maritime Works	LDA	3
	Foselev Marine	7
	Jiffmar Offshore	18
Cables	Orange Marine	6

	LDA	2
	Alcatel Marine	7
Research	Ifremer	9
	Saas Offshore	2
Tugs	Boluda,	71
	Chambon	9
	Thomas	18
CTV & SOV (wind farm)	LDA	3
	TSM Windcat	4

Source: Le Marin

4.1.2 Innovation

Shipping companies are following IMO and EU regulations in terms of emission reduction. As part of fleet renewal, shipowners are implementing LNG solutions. CMA CGM is developing a fleet of LNG container ships (31 today, 77 in 2026). According to the International Energy Agency (IEA), the potential of biogas and biomethane is "largely untapped" even though they could already meet around 20 % of global gas demand if the "sustainable" resources currently available (the IEA excludes those competing with food for agricultural land) were fully devoted to their production.

The CMA CGM Group (2022a) announced that it is creating a Special Fund for Energies, backed by a five-year, USD 1.5 billion budget, to accelerate its energy transition and achieve net-zero carbon by 2050. The Fund will invest to support the industrial production of new fuels, as well as low-emission mobility solutions across the Group's business base (maritime, overland and air freight shipping; port and logistics services; offices). The Fund has been tasked with driving forward the emergence of industrial-scale production facilities for biofuels, biomethane, e-methane, carbon-free methanol, and other alternative fuels, and increasing and securing volumes in line with Group needs, in partnership with other major industrial groups with expertise in these technologies, or with investment funds or promising start-ups. The group will invest with Engie (national gas provider) in a bio-methane production in Le Havre (Salamandre Project) and with GRT Gas in e-methane in Fos (Jupiter 1000). CMA CGM will help to support a global innovation platform developed alongside large corporations, SMEs, start-ups, and the academic and scientific community

(Engie, 2022d) (CMA CGM, 2022b)

Brittany Ferries via charters with Stena Roro and Corsica Lina will receive its first LNG ship. This company has set up shore power in the port of Marseille as has La Méridionale which has also set up the world's first particle filter for ships. In the cruise segment, Ponant has announced that its fourteenth ship in the fleet will sail "without any impact on the environment (La Méridionale, 2021).

French shipowners have not implemented innovations with methanol or ammonia. Hydrogen is not considered by the owners of large ships in the world. As the classification society DNV GL points out, due to the logistical problems of liquid hydrogen (storage at -253°, very large storage tanks), it is not possible to use it in the same way as methanol. Hydrogen derivatives such as ammonia and methanol are potentially better candidates to fuel long-distance cargo ships. Pure hydrogen could still be useful as a fuel for short sea shipping (France Gaz Maritime, 2022) (DNV, 2022).

All the French cargos and passenger ships over 100 m are ordered from foreign yards: container ships in China or Korea, the latest ferry in Italy, and small cargo ships often in Turkish yards.

4.2 Wind propulsion

4.2.1 Wind propulsion project

France is one of the most active countries for wind propulsion maritime transport passengers and goods. The focus of this emergence is Brittany and Nantes Saint-Nazaire area. Wind Ship is the French association for the promotion of sailing in France and published in 2022 a white paper on the development of the industry (Association Wind Ship, 2022).

France has several projects at various stages of development:

- **Grain de Sail:** The goods are coffee and cocoa transport from Latin America with a 24 m sailing ship for 50 t. The second vessel will be 52 m and 1,170 m² of sail for 350 t of cargo. It will be built by Piriou in Vietnam by the end of 2023 (Piriou, n.d. a).
- **TransOceanic Wind Transport (TOWT):** The market is also transatlantic with chartered sailing vessels. The new vessel will be in 2023 of 69 m and 2,500 m² of sail for 1,100 t of cargo (Piriou, n.d. b).
- **Neoline:** the start-up shipping company is developing a 136m ro-ro cargo ship (two masts) for 5,000 tonnes of freight. The shipping company CMA CGM has acquired a 15 % stake in the company. Leading French shippers have announced their future commitment. The construction site has not been designated. The delivery is planned for 2024. The first Neoliner, designed by Mauric, will be a 136 m vessel for 5,000 t of cargo. The sails will be the concept developed by Chantiers de l'Atlantique "SolidSail" with 3 000 m² of sails.
- **Zephy & Borée:** Alisée is partnership between Zephy & Borée and Jifmar Offshore Services for a single vessel dedicated to transporting Ariane rocket components (Europe – French Guyana). The ship will be 121 m long with four masts for composite wings (Ayro company) 1 452 m². The cargo capacity is 10 700 t. In December 2020, the Dutch shipyard Neptune Marine start the building of ship called Canopée. Zephyr & Borée is developing a concept ship for containers, the 185m ship Meltem (€35m) is designed for 1,832 TEU. It was designed in a partnership between three French companies - VPLP Design (architect), Alwena Shipping and Ayro - and the Shanghai Merchant Ship Design & Research Institute. The vessel would form the basis of the fleet to be built after winning the tender by the coalition of shippers in 2022. The ships are to operate two weekly transatlantic routes between Europe and North America from 2024. Another project is a small container ship of 85 m and 2,300 m². With a capacity of 100 TEU, it would be dedicated from 2025 to a service between Marseille, Madagascar and Mayotte. The developing company is Windcoop, a spin-off of Zephyr and Borée (Zephyr & Borée , n.d.).

(FRANCE SUPPLY CHAIN, 2022)

4.2.2 Sail technology

- **Solidsail:** Chantiers de l'Atlantique has been developing a metal sail solution with different test levels since 2018 (Chantiers de l'Atlantique, n.d. a)
- **Econowind:** Developed by a Dutch company, Econowind offers an innovative system of foldable and autonomous rigid wings on the front of a ship (Marfret, 2022). The French shipowner Marfret is going to test this system.
- **Wisamo:** the Michelin group is developing an inflatable sail, a 100 m² prototype will be tested on the Compagnie Maritime Nantaise's roro ship (Michelin, 2022).
- **Turbowind:** Crain Technologies, a design office based in La Rochelle, is developing a wind propeller based on a thick wing with a system that allows air to be sucked in and accelerated around the profile (Habibic, 2022). A prototype has been tested in the port of La Rochelle.
- **Oceanwings:** A spin-off of the naval architecture firm VPLP, Ayro designed the rigid wing system (Ayro, n.d.). The small version was tested on the *Energy Observer* laboratory ship and the normal version will be used on the Canopée, currently under construction. The Oceanwings will be supported by four m37 high masts, giving the ship a maximum air draught of 50 metres. The double flap wings will each have a surface area of 363 m². The rig is self-supporting, riggable and fully automated.

- Public transportation: several cities have urban river or trans bay services (Nantes, Toulon, Bordeaux, Rouen, Marseille).
- River ferry: crossing the river estuaries, operated by the territorial authorities (French department).
- Local ferry: connection of a dozen islands in the Atlantic area for passengers and freight. The companies are in public or private sector with a public service delegation.
- Touristic boat: private operators are active in areas with high touristic (Brittany, La Rochelle area, Provence, Corsica, major river estuaries).

France has 80 private passenger touristic transport companies with vessels of all sizes. The professional organization is ARMAM (private owners association). The fleet of passenger tourism vessels is very large. The number of vessels of at least 25 m has 115 units in 2022. The total of ship is around 300 unities for 7 million people transported. The ships are almost all ordered in France.

The current order book includes a micro ferry (391 pax, 150 t of freight) built by Priou Shipyard. This boat ordered by Pays de la Loire (region) for the Ile d'Yeu connection. In the south of France, Transmétal is building two boats for local Mediterranean businesses. Priou Shipyard produces two ships (26 m) for a small company in Brittany. None of its ships are undergoing environmental modernisation around their engines.

4.3.2 Innovation

The Navibus *Jules Vernes 2* in Nantes agglomeration is a small passenger boat include in public transport network with a hydrogen fuel cell boat (25 pax) since 2019 (SCHWOERER, 2020).

In the Gulf of Morbihan, the Brittany region and industrial enterprises (Europe Technologies CIAM, Morbihan Énergie, L20 Naval) are working on the “Hylia” project, which aims to build the first hydrogen-powered ship (24 m) capable of carrying between 150 and 200 pax by 2024 (Vannes – Atz Island) (Europe Technologies, n.d.). For Brittany is the first path for the environmental renewal of the regional fleet of passenger vessels.

The Lorient agglomeration community in South Brittany is working on the conversion of its fleet of urban harbour buses at a cost of 5 M€ (Lorient Agglomération, 2021). First with the transformation of a boat with an electric motor and then a boat with hydrogen or compressed natural gas. No manufacturer has been mentioned to date.

Naviwatt is developing an electro-solar catamaran capable of carrying 24 passengers, built in Brittany, the first of which will be operated in the south of France (Navi Watt, n.d.). The WePro900 is 10 m long and has sixteen solar panels.

4.4 Port services

4.4.1 Overview

France has 30 pilot stations (22 mainland, 8 overseas), with only one pilot ship (Nantes Saint-Nazaire). The rest of the fleet is around one hundred pilot speedboats (max 12 m). Piloting is a regulated public service provided by private local association of pilots with monopoly situation.

Mooring is carried out by the port authority or by private companies (often in cooperative). The equipment is composed of very small vessels.

The French tug business (around 40 ports) is shared by three companies, Boluda (Spain), Chambon and Thomas (France). In the port sector, there are fleets of small pilot service vessels (local organizations) and mooring vessels. In addition, there is few local dredging boats.

4.4.2 Innovation

Port service vessels are suitable testing grounds for hydrogen or electricity solutions.

The small dredger ship *Ostrea* (dual LNG diesel) was delivered to the GPM of Bordeaux in 2020 by Socarenam (DRAGAGES-PORTS, n.d.). Another project was an intermediate dredged ship refitted for LGN order by GPM of Nantes Saint-Nazaire in 2020.

The Piriou shipyard is in charge of the construction of the future dredger ordered by the Occitanie region for several ports of the maritime coast. It has chosen Helion Hydrogen Power to supply the fuel cell that will equip the vessel, named Hydromer, which will be operational at the end of 2023.

In the port of Sète, a thirty-year-old pilot boat was equipped with electric propulsion in 2021 as part of a project called "Green Pilot" led by the company MGH and supported by the Occitanie Region and the Port of Sète-Frontignan, with the participation of the pilotage stations of Sète and Marseille-Fos (Republique Française, 2021) (Republique Française, 2018) (MAN Energy Solutions, 2022)

4.5 Offshore Wind services

4.5.1 Overview of CTV and SOV

A new sector is emerging with ships for the program of offshore wind farms. Louis Dreyfus Armateurs (LDA) own two Service Operation Vessels (SOV) under French flag operate for Orstad's Danish farms. For the French farm field of de Saint-Brieuc, one SOV chartered for five years by Siemens Gamesa to the Norwegian operator Edda wind.

For Crew Transfer Vessels (CTV) France and the Netherlands are providing welcome opportunities in the market, along with German projects. With more construction work starting in these three countries, the upward trend is expected to continue for the next 12-18 months. While construction work is under way in the UK on Seagreen and Dogger Bank, it will be Service Operational Vessel (SOV) demand that will see the long-term benefit as projects have a sea-based O&M strategy in place. New building is ramping up rapidly with 35 CTVs, 26 SOVs / CSOVs scheduled to enter the market by 2025. The appetite to invest in the service market remains strong.

The French fleet of CTVs for the transfer of personnel and materials is in development. TSM Windcat is a joint venture of Thomas Services Maritimes (France) and Windcat Workboat (Netherland) with 3 ships. LD Tide is a partnership between LDA (France) and Tidal Transit (UK) with three new CTV build by French yards OCEA, the first delivery for 2022. The rest of the fleet is owned by Alka Marine (one), Foselev Marine (two), Atlantique Maritime Services (three).

Europe has developed market for offshore wind which is further growing due to strong policies and political will. Established European markets include Belgium, Denmark, France, Germany, the Netherlands and the United Kingdom. Among these, France is targeting net-zero by 2050, and has set high ambitions for offshore wind development. To date, France has awarded 3.6 GW of offshore wind due to be operational by 2022-2025 and commits to 40 GW of offshore wind by 2050 (50 projects).

4.5.2 Demand for CTV and SOV

Trends for CTVs in 2022 shows a decreased demand compared to 2021. The annual cycle of demand for CTV support has slowly risen from the depths seen in February 2022 but remains below 2021 levels. Across Europe, demand was down 2 %. Despite the slow recovery for CTVs, the French market is creating significant demand, with four sites under construction: Saint-Brieuc, Saint-Nazaire, Fécamp and Calvados. Furthermore, construction demand for CTVs in France, Germany, UK and the Netherlands has slowed the slide in construction days for CTVs. There was a modest increase of 6 % overall, a total of 168 days. O&M days were down by 3 % (514 days) YoY. While this is a fall in demand, the rate is slowing compared to Q1 2022 when the reduction was 6 %. Once the projects currently under construction enter full operations, the demand for O&M days is expected to increase again.

European SOV demand increased with 29 % YoY in Q2 2022. While the increase is partly due to an increase in the number of vessels from 17 to 23 operating in Q2 2022 compared to last year, there was also an increase in countries where SOV support is in use. SOV were operating in France providing 82 days, whereas *Acta Auriga* has scored work on the Saint-Nazaire site until the autumn.

4.5.3 Supply of CTV and SOV

Regarding CTV supply of vessel days to offshore wind projects, the market share and fleet utilisation for the top six key operators fell in Q2 compared YoY, and they all delivered fewer days in offshore wind. The main winners were the smaller operators in the market, which increased their market share from 27.9 % last quarter to 37.3 % this quarter. Key operators include *Windcat*, *Northern Offshore Services (NOS)*, *Njord Offshore*, *Mareel* and *Seacat Services*. The UK remains unchallenged as the key market for the majority of the top ten CTV operators, while France, as an emerging market, is attracting new builds. So far in 2022 there are 311 active vessels in Europe, however, by the end of 2022, a further 15 vessels could join the fleet. In the bid to optimise offshore operations and meeting the changing needs of clients and project locations, the design and size of CTVs is constantly evolving. One clear trend is the increase in vessel sizes. While vessel optimisation minimises fuel consumption, the end goal is to decarbonize marine operations completely. While currently only one vessel can operate 100 % on green fuel, there are an increasing number of vessels with hybrid options.

For SOV supply, *Esvagt* maintains place as market leader with a market share of 40 %, followed by *BS Offshore* and *Acta Marine*, and vessels under 90m supply 80 % of the market share. There have been no new SOVs starting work in Q2. When it comes to new builds, much of the focus is on the supply of CSOVs (Commissioning Service Operation Vessels). Currently there are 18 CSOVs scheduled for delivery by 2024, while there are five SOVs under construction for the European market. There remain other market opportunities for SOVs. 4C Offshore models that up to 16 projects which are expected to start construction by 2030, are likely to use an SOV strategy to support operations and maintenance work.

4.5.4 Installation vessels

Looking at two major components of an offshore wind farm, the turbines and the foundation, there is a clear trend towards increased water depths, further distance from shore and increased project sizes. At the supply side of installation vessels monopiles continue to be the preferred solution of the future, however the market for jacket installations is less restricted. Concerning new builds, several vessels are expected to receive upgrades in the near to mid-term. Increasing turbine dimensions mean that to secure asset longevity, operators are proceeding with upgrades to existing vessels, which provide a lower cost option than newbuilds. Several existing operators and new market entrants intend to build new jack ups to meet the rising demand. Europe is the largest demand centre for installation vessels. Overall trends show increasing demand, but visibility on future foundation types is limited. However, due to their lower CAPEX, it is expected that developers will select monopiles over other foundation types wherever feasible. Delays to turbine installation are expected due to knock-on schedule impacts from foundation installation vessel shortages.

4.5.5 Innovation

No vessel purchased or built for French operators has innovative technology, but projects are underway. The Pôle Mer Bretagne Atlantique cluster and the energy company WDP have launched a call for innovative solutions for MRE. In this context, the Piriou Shipyard has been selected for a hydrogen-powered CTV (Piriou, n.d. c).

The ZEST (Zero Emission & Safe Transfer) project is led by a French consortium comprising the shipping company LDA, the marine architect firm Mauric, the electrician company Barillec, as well as the foil specialist SEAir and the start-up specialising in propulsion ADV Propulse (Cogné, 2021). It aims to develop a new-generation CTV that "tends towards zero emissions". Zest is intended to serve as a showcase for the technological building blocks that will be developed during the project and that can be used on other vessels. These include the design of a hydrofoil CTV architecture, a wave monitoring and floating object detection system and the development of innovative energy management.

In the Netherlands, the Dutch company Windcat Workboats, Thomas' partner in France, is developing a hydrogen-powered CTV with MAN and CMB Tech.

4.6 Others maritime activities

4.6.1 Sea rescue

Sea rescue is managed in France by a state-supported association, the Société Nationale de Sauvetage en Mer (SNSM) with 40 medium speedboats and 150 small speedboats. The Couach shipyard has the actual contract for new boat.

4.6.2 Laisure

The world number one builder of sailing yacht and leisure motorboat is Bénéteau Group. On the other hand, the positioning in mega yachts is weak. This activity is mainly Italian and Turkish.

The Ocea company built only seven 50m vessels for 2003-2016. It can build ships of up to 90m.

The under 20m segment is occupied by three companies: Couach (Cujan-Mestras), CNB (Bordeaux), Guanboat (La Grande-Motte).

In the small motorboat segment, the company Hynova is developing a 13 m (12 pax) boat with an electric motor powered by hydrogen and a Toyota Mirai (Range Extender Hydrogen) fuel cell, which is being tested in France on the experimental vessel *Energy Observer*. The vessel launched in Saint-Malo in 2017 was developed to test an autonomous energy boat, using wind, sun and water resources to make hydrogen.

4.6.3 Administrations

There are many French State entities using small and medium-sized vessels:

- Gendarmerie maritime
- Customs (Douanes)
- Maritime Affairs Administration (DGAM)
- Lighthouses and Beacons Service (Services des Phares et Balises)
- French Southern and Antarctic Lands Administration (TAAF)

The coastal salvage and assistance service is provided by few private companies like Les Abeilles (Econocom group) for the French administration (Brest, Cherbourg, Toulon, Boulogne).

France does not have a coastguard service. This function is through several civil and military corps of the State.

The French administration vessels are always ordered from small private French shipbuilders. These yards are also positioned for export, particularly in the patrol ship and speedboat sector.

Lighthouses & Beacons Service will have a new ocean-going buoy vessel (54 m) ordered from SOCARENAM - LMG Marin in 2024, equipped with a battery-electric propulsion system whose autonomy is extended by a fuel cell powered by green hydrogen (Groizeleau P. V., 2022).

4.7 River transport cargo and pax

4.7.1 Overview

In 2019, the inland freight fleet consisted of 1,042 cargo vessels (96 % dry bulk and containers, 4 % liquid bulk). These are self-propelled vessels and pusher tug & barges. They transport around 50 Mt per year. The fleet is getting smaller over the years, but the ships are bigger. The number of cruise ships is 32 in France with two main operators also present in the world (CroisiEurope, Rivages du Monde). The annual volume is around 120,000 passengers per year. The fleet of small tourist ships is around 600 units.

River vessels must engage in the process of pollution control solutions in the same way as maritime vessels or trucks (Euro VI standard). For VNF, because of the specific characteristics of "navigation in a confined environment", new engines or new exhaust systems must be designed and put on the market, which requires a

major research and development effort, but the small inland waterway transport market opens up limited prospects for amortising this effort.

VNF believes that it is necessary to offer river transporters operational and inexpensive solutions to enable them to upgrade their vessels to cleaner engines. The best solution is to "marinize" road engines that comply with the Euro VI standard, implement solutions based on hydrogen or natural gas (compressed or liquefied). Electric or hybrid engines can also be developed. VNF regularly organises information sessions for river transporters, inviting various service providers (engine manufacturers, energy suppliers, etc.).

(Republique Française, n.d. a) (CCNR, n.d. a) (CCNR, Cargo Fleet, n.d. b)

4.7.2 Innovation

For freight, the innovation is carried by the Compagnie Fluviale de Transport, a subsidiary of the Sogestran group, with the support of the European Flagship program. Initially announced as a pusher on the Rhone, the project was transformed into the hydrogen motorisation of a vessel on the Seine. The group is developing a series of shuttle barges (50 m) for urban river transport of pallets. The vessels, named Zulu, are operated by Blue Line Logistics. The vessel will run on compressed hydrogen produced by electrolysis of the two 200 kW Ballard fuel cells and the 300 kg storage container. Initially expected to enter service by the end of 2022, the Zulu 6 is not expected to enter service until the end of the first quarter of 2023 from the Romanian Piriou Shipyard.

The giant cement group Cemex, which is present on the Seine, is working on the construction of a 13 m hydrogen-powered pusher for its activities between ports in the Paris region. The EDF group will be in charge of the fuelling, but first a technical feasibility study will be carried out by the engineering group Europe Technologies (Durand, 2022) (Cemex, 2019).

In the passenger segment, two of the five boats of the company Vedettes de Paris will be converted to electric propulsion with the equipment in two 550 kWh batteries, supplied by the French company E4V and installed by Barillec. A 100 % electric re-powered boat is also planned for the Vedettes du Pont Neuf in partnership with TotalEnergies. The Batobus fleet has switched entirely to Gas to Liquid (GTL) (Stassi, 2022) (Courtin, 2022).

As part of the Paris 2024 Games, a call for innovation in mobility was launched. Six river projects were selected as winners in May 2021. They cover the entire river logistics chain, in line with the needs and strategic axes of Paris 2024: carbon footprint management, circular economy, social inclusion and inclusion of people with reduced mobility. "These projects will be supported to represent the showcase of French innovation in mobility during the 2024 Olympic Games" (Republique Française, n.d. b).

- Hy-Generation: Innovative electric propulsion for boats.
- NepTech et EODev: Hydrogen mobility for passenger transport on the Seine.
- Fludis: A service barge serving as a floating warehouse and sorting centre to enable low-carbon "last mile" deliveries using Cyclofret-type cargo bikes.
- Blue Line Logistics
- FinX: Innovative, 100 % electric, propeller-less engines for small boats and sailboats.
- XYT: a clean containerised urban logistics solution.

The implementation of a free trade zone in Strasbourg allows for the development of innovative delivery solutions in urban centres. The company Urban Logistic Solution won the call for projects from the Metropolis and VNF in 2019 for small urban delivery barges (15 m, 112 tonnes) powered by GTL (gas to liquid). A similar solution will be developed in Lyon with a pusher tug & barge (30 m, 122 tonnes of goods) (Roussard, 2021).

Two river crossing ferries exist on the Loire in the Nantes area. The departmental council of the Loire Atlantique will order for 2026 a new ferry (16 M€) with hydrogen technology (Vallée, 2022).

4.8 Ports innovations

In French ports, the dynamics of energy and environmental innovation are of several dimensions:

- Ports' initiative (energy saving, solution for ships and port tools).
- Business strategy (major groups, start-ups).

- Territorial authorities' policy (environment, economy).
- State support (policy, financing).
- European aids.

The strategy of the French port authorities is now all based on energy transition policies, parts of which include the development of new energies, collaboration between energy producers and consumers (circular economy) and solutions for ships and land-based equipment.

One of the calls for projects aims to promote the development of "Low Carbon Industrial Zones" (ZIBaC). The ports of Dunkerque, Nantes and Marseille will respond to the call for tender. The port of Marseille already has an industrial innovation approach in Fos with 130 ha dedicated within the framework of the PICTTO platform. Dunkerque has experience in the industrial ecology approach (collaborations partnerships between industrial stakeholders).

(Gouvernement, La France, géant de l'hydrogène vert en 2030 ?, 2022) (ADEME, 2022) (Piicto, n.d.)

4.8.1 LNG bunkering for ship

LNG solutions are not binding on port authorities but on shipping companies, energy companies and bunkering vessel operators. The only vessel operating in France is the Gaz Vitality chartered by TotalEnergies and owned by Mitsui O.S.K. Lines, Ltd (MOL) (TotalEnergies, 2022).

4.8.2 Shore power for ship (maritime)

Shore power requires substantial investments with typically 3M€ per shore station. A large part of this requires a connection to the national public network of Enedis (Enedis, 2019), as the ships need the high tension network. Smart grid type solutions are being promoted for the optimised management of energy flows. For large ports, the problem will be the size of the infrastructure, especially for remote terminals. It will take a decade to bring French ports up to speed.

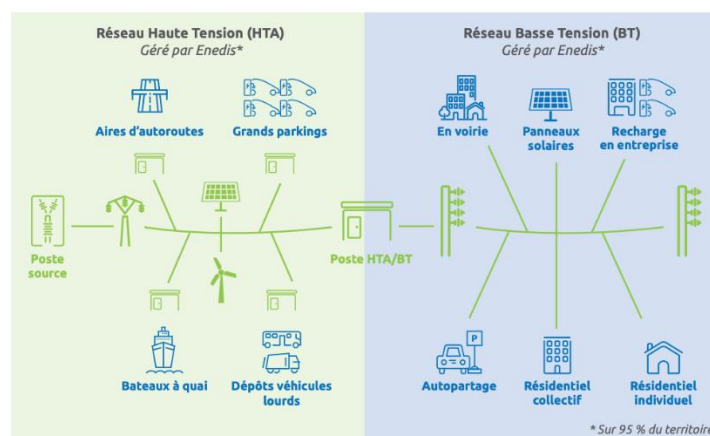


Figure 12 - Shorepower for ship (maritime)

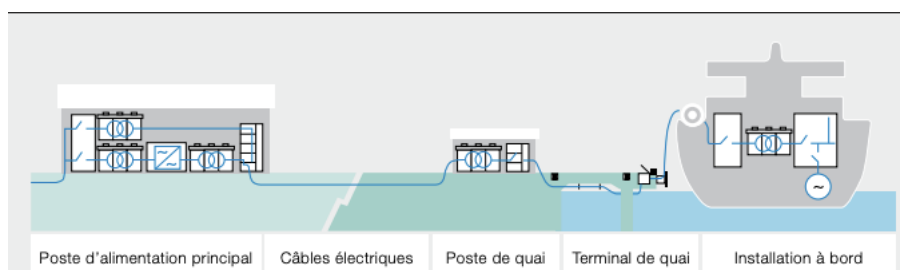


Figure 13 - Shorepower for ship (maritime)

At the CMA CGM terminal in Dunkerque, Actemium has built an 8 MW conversion station. Integrated into a set of six containers, this power station will transform the 20 kV 50 Hz high voltage current into 6.6 kV 60 Hz current sent on board. The operation was co-financed by the Dunkerque Urban Community, the Hauts-de-France Region (via the European Regional Development Fund) and the Grand Port Maritime de Dunkerque.

HAROPA Port is carrying out the electrification of the three cruise docks between 2023 and 2025. The project is being carried out by Enedis (national network). The port of Le Havre will benefit from a €11.1 million aid within the framework of the recovery plan as well as a contribution of €0.9 million, included in the Territorial Pact for the ecological and industrial transition.

The extended electrification of the quays of Port 2000 (container terminals) should be deployed by 2028, in application of the protocol of agreement signed in 2022 between the five ports of the Northern Range: Antwerp, Hamburg, Rotterdam, Bremerhaven and HAROPA Port.

The small ferry port of Fromantine (Pays de la Loire) is to be equipped for the new ferry linking with the Ile d'Yeu. Bordeaux Metropole is developing a solution for small vessels.

The port of Marseille already has two terminals equipped with shore power, Corsica Linea and La Méridionale. The GMPM wants to create three new facilities for another ferry terminal by 2023. This investment, estimated at 14 M€ and whose financing is not completely closed. It must also associate the Algerian and Tunisian ferry companies that must equip their ships (€1.2 million). The most virtuous shipowners will benefit from a 20 % reduction in port dues.

(Britz, 2020) (HAROPA PORT, 2021b) (HAROPA PORT, 2021c) (Groizeleau, 2021) (Marseille Fos, n.d. a) (Gouty, 2022) (Britz, 2019)

4.8.3 Shorepower for ship

In France, only 7.5 % of the electricity produced comes from fossil fuels, thanks in particular to hydroelectric production (13 %) but also to nuclear energy (67 %); the electricity grid is therefore already highly decarbonized. The increase in offshore wind farms will further reduce the share of fossil fuels.

Along the Seine, VNF has created a network of water-electricity terminals for river transport at a total cost of €9.2 million, and in 2020 obtained €1.8 million in funding from the European Commission.

At the Rouen and Paris terminals, HAROPA Port and VNF are installing 78 river bollards to supply water and electricity to freight and river cruise ships, following on from the 14 bollards already installed since 2018;

In Paris, the quays of the port of Grenelle are hosting a specific system for passenger ships; to date, one bollard has been installed, and 6 others will be added by 2024.

(RTE, 2021) (VNF, n.d.) (HAROPA PORT, 2021a)

4.8.4 Floating H2 electricity from ship

In Rouen, a power barge called "Elementa H2" will be developed in the port of Rouen on the Seine to supply high-powered electricity and hydrogen to ships at the quayside. The project involves six French players: Améthyste, ArianeGroup, Cetim, HDF Energy, Rubis Terminal and Sofresid Engineering. The aim is to develop a mobile solution for shore power supply using green or low-carbon hydrogen for container ships, cruise ships and tankers. The barge will also allow hydrogen bunkering of future hydrogen powered ships.

In Sète, the "Greenharbour project" aims to develop a hydrogen barge to supply electricity to ships calling at the Port of Sète by 2024. The partners are Port of Sète, Nexeya, Europe Technologies CIAM, Jifmar, Pôle Mer Méditerranée (industrial Cluster for innovation).

(Cetim, n.d.) (Futur, 2019)

4.8.5 Industrial production of hydrogen

Hydrogen production is possible on a port-based basis at LNG terminals or refineries. But the objective is to have decarbonized hydrogen. With the ambitious strategy announced by the Government, France wants to give the means, by relying on its research laboratories and its industrialists at the forefront of innovation, to create a competitive renewable and low-carbon hydrogen industry, and to become one of the world leaders in decarbonized hydrogen by electrolysis. After the announcement of the strategy, two calls for projects were opened: "Territorial hydrogen ecosystems" and "H2 technology bricks and systems". Players are starting to develop industrial solutions in French ports.

The Normand'Hy electrolyser project wants to produce a capacity of 200 MW of "green" hydrogen from the electrolysis of water and renewable electricity (Air Liquide Normand'Hy, 2022). It will be installed in Port-Jérôme (HAROPA Port) for commissioning in 2025. It will use Siemens Energy's proton exchange membrane (PEM) technology and will be built in partnership with Air Liquide. The company is also expected to develop production sites in Dunkirk and Fos.

The company H2V will set up a 600 MW green hydrogen production unit in Fos (Marseille GPM), to be developed in six 100 MW tranches between 2026 and 2031, on a 36-ha site in the industrial port area (Marseille Fos, n.d. b). Coupled with the Ascométal electric steel mill, H2V Fos is to produce 84,000 tonnes per year of renewable hydrogen by electrolysis of water with an investment of €750m. The GPM of Marseille has taken a share in the capital of H2V.

With the Jupiter 1000 project, GRTgaz and its partners aim to implement on an industrial scale an innovative 1 MWe hydrogen production facility, consisting of two electrolysers of two different technologies: PEM (membrane) and Alkaline. CMA CGM is one of the destination partners for the production of low-carbon e-methane for its ships.

The GPM of Nantes Saint-Nazaire is launching a call for interest for the development of a solution for the production of hydrogen in Montoir from renewable energy (Daehron, 2021). A company wants to convert wood waste into biogas with a non-combustion process and eventually into hydrogen.

In 2020, the Grand Port Maritime de Bordeaux (GPMB), Storengy and Nexeya signed a memorandum of understanding to develop the hydrogen sector in the Bordeaux region (H2Bordeaux, 2022). This project, called H2 Bordeaux, won a European call for projects to co-finance the first studies of this project which aims to make Bordeaux and its port a hydrogen territory for industry and mobility.

4.8.6 Biogas

CMA CGM has joined forces with Engie to build a biomethane production site to supply its fleet of LNG container ships. Called Salamandre, the project will be based on pyrogasification in the Le Havre region using dry biomass from local wood waste and solid recovered fuels. Up to 200,000 tonnes of biomethane per year. The site should start up in 2026 with an initial capacity of 11,000 tonnes of bio-methane per year.

(Grtgaz, 2021)

4.8.7 Offshore hydrogen production

The objective of Centrale Nantes' Lhyfe project is ambitious, producing renewable hydrogen with an offshore electrolyser (Lhyfe, n.d.). It will be based on a partnership with Chantiers de l'Atlantique. It will be tested on the SEM-REV test site (La Turballe area, Saint-Nazaire area). The electrolyser will be installed on GEPS Techno's floating platform and connected to the various sources of Renewable Marine Energy available on the test site at sea, including the Floatgen floating wind turbine.

4.9 The French Maritime Cluster & Innovation

In 2020, the French Maritime Cluster launched the Coalition for the Maritime Eco-Energy Transition (T2EM) (Cluster Maritime Français, 2022). In partnership with the Ministry of the Sea, ADEME as well as federations and companies, clusters and research centres, the CMF has worked with the entire maritime ecosystem on three elements:

- A state of the art of the objectives, the players, their needs or the solutions they propose, the projects undertaken to develop them, and the financing mechanisms.
- Reference documents on the energy models of tomorrow with the energy mix and associated new technologies, the energy efficiency of systems and operations, and respect for biodiversity.
- The integration of these elements into a digital information and decision support system with a view to proposing, at a later stage, more effective complementary collaboration and modelling tools.

After this initial work, the founding partners of the T2EM and new partners, have acted the phase 2 of the Coalition, namely the creation of the Meet20250 institute. The challenge is, following the example of other countries that have launched mutualised research and R&D centres, to pilot a "national structuring programme for zero emission ships and ports", to coordinate the various roadmaps, synchronise the efforts of the sector and integrate the entire value chain, around concrete objectives spread over time. The maritime sector must pool its human, financial and technological resources to accelerate the development of transition levers and their deployment in scaled prototypes. Meet20250 aims to define and steer the "Ships & Ports 0 Emission" program for French maritime industry.

5 Key stakeholders

5.1 Public actors

Public actors are essential in supporting the greening of the maritime sector. They cover a wide array of roles and services, including the distribution of funding to companies and projects and the support to growing and innovative businesses.

Add'Occ is the Occitanie region's agency for economic development. An advocate in public processes on behalf of industrial actors, the agency works to influence the region to make battery or hydrogen solutions required in calls for tenders. www.agence-adocc.com

ADEME (Agence de Environnement et de la Maîtrise de l'Énergie) is a public environmental agency under the authority of the Ministry of the Ecological Transition and the Ministry of Education. ADEME is active in the implementation of public policy in the areas of the environment, energy and sustainable development. They provide expertise and advisory services to businesses, local authorities and communities, government bodies and the public at large, to enable them to establish and consolidate their environmental action. As part of this work the agency helps finance projects, from research to implementation, in its areas of action. www.ademe.fr
Calls for tenders: <https://agirpoulatransition.ademe.fr/entreprises/>

BPI France is a central actor in the French business support system. They have close partnerships with banks, investors, regions and public institutions to fund entrepreneurial efforts. Website: www.bpifrance.fr

The strategic committee for the maritime industries (Comité stratégique de filière des industriels de la mer) defines the issues at stake and the concrete solutions for the sector's future development. The committee has developed a roadmap for research and development (R&D) structured around four pillars: Green Ship, Smart Ship, Smart Yard and Smart Offshore Industries. The committee's R&D support body CORIMER funds projects to reduce the emissions from the maritime sector. www.conseil-national-industrie.gouv.fr/comites-strategiques-de-filiere/industriels-de-la-mer

The Ministry of Ecological Transition prepares and implements the French government's policies in the areas of sustainable development, the environment, protection of nature and biodiversity, green technologies, the energetic and ecological transition – especially in the areas of taxation, climate, the prevention of natural and technological risks, industrial security, transport and its infrastructure, and maritime industries. www.ecologie.gouv.fr

The regions are important actors in matters of innovation, financing and industrial development. The regions Pays de la Loire, Brittany, Occitanie, Île-de-France, Provence-Alpes-Côte d'Azur and Hauts-de-France are especially active in the greening of maritime transport.

5.2 Maritime clusters

The Maritime Cluster is a functional entity in which the various industries, such as shipping, marine industries and port operations, are in close interaction with one another not only directly but also through their company networks. Their development can be traced to the focus of economic competitiveness policies by both firms and policymakers, both on a regional and national level.

The French association for electric boats' (Association française pour le bateau électrique, AFBE) main ambition is to develop the image and the market for electric boats both in France and abroad. The association has about 30 members including both companies and institutional actors. The association engages in lobbying efforts to influence government policy, conducts and publishes market research, and participates at marine policy events. Website: www.bateau-electrique.com

The French Maritime Cluster (Cluster Maritime Français, CMF) brings together all the actors in the maritime ecosystem and service industry. The CMF consists of 430 members, including companies of all sizes, clusters, associations, laboratories and research centres, education institutions, local economic actors and the French navy. The cluster takes initiative in the formulation of ambitions and roadmaps to green transition for its many member companies. Talks with the CMF have uncovered an interest in contacts with Norwegian companies or clusters, and IN France would be happy to facilitate such contact. Website: www.cluster-maritime.fr

GICAN, the French Marine Industry Group, affiliates more than 200 industrialists in the maritime industry. It brings together shipyards, system and equipment manufacturers, subcontractors, engineering and architect businesses that are involved in the design, construction, maintenance and implementation of military and civilian vessels, and those who work in the domain of maritime security and Marine Renewable Energies. Talks with GICAN have uncovered an interest in contacts with Norwegian companies or clusters, and IN France would be happy to facilitate such contact. Website: www.gican.asso.fr

Pôles Mer consists of two clusters, Pôle Mer Bretagne Atlantique and Pôle Mer Méditerranée, that work to encourage the growth of maritime companies in the Brittany/Loire regions and the Mediterranean area, respectively. The two clusters work to increase the competitiveness and dynamism of the coastal and maritime 39 industries. To this end, they encourage collaborative projects within research and development and guide their member companies through their growth and development. Website: www.pole-mer.com



Figure 14 - Cluster Maritime Français

5.3 Shipowners

The French shipowners' association Armateurs de France counts 57 members operating about 1000 ships. Establishing a partnership with a French shipowner is a good way to enter the market. Some world leading French shipowners are Bourbon, CMA CGM and Louis Dreyfus Armateurs. French shipowners have so far mostly explored LNG as their 'green' fuel alternative. More innovative actors include Zéphyr & Borée that are designing and operating sail cargo ships, and major actors such as CMA CGM and Brittany Ferries, that are exploring the possibility of using hydrogen propulsion. CMA CGM is also looking into fuel cells. The ferry owner CFT is also a driver in the green transition and especially engaged in hydrogen, for which it takes part in several projects such as Flagships where it also collaborates with Norwegian actors. Nicols, Canalous, Locaboat and Le Boat dominate the recreational boating market and have some fully electric models.

Armateurs de France is the French shipowners' association. They represent 57 companies, 26 000 jobs and about 1000 ships. www.armateursdefrance.org

Bourbon is a world leader in marine services for offshore oil and gas organised into three distinct affiliates: Bourbon Marine & Logistics that offers a wide range of support services in continental and deep offshore; Bourbon Mobility that is dedicated to high-speed passenger and light cargo transport services for offshore oil & gas clients; and Bourbon Subsea Services that handles complex Subsea operations. www.bourbonoffshore.com/en

Louis Dreyfus Armateurs (LDA) Group offers maritime transportation and services in dry bulk transportation, logistics and transportation, and offshore and onshore industrial solutions. The LDA Group has collaborated with Norwegian shipowner Leif Høegh through their joint-venture Fret-CETAM that in 2001 signed a contract to deliver parts to Airbus' A380 to different production sites in Europe with their Ro-Ro vessel Ville de Bordeaux. www.lda.fr/en/

Zéphyr & Borée is a sail shipping company that designs and operates innovative vessels to offer low-carbon transport services. They have designed the Canopée vessel, the first modern sail cargo ship. www.zephyretboree.com

CMA CGM: is a shipping company with global expertise in maritime transport and logistics with a presence in 160 countries serving 420 of the world's 521 commercial ports and operating 285 shipping lines. In France they have agencies in Dunkerque, Le Havre, Paris, Marseille and Montoir. CMA CGM now operates seven LNG-powered containerships and will have a fleet of 26 containerships by 2022. The ports of Rotterdam and Marseille Fos are expected to become the gas bunkering hubs for the group's LNG-vessels. The shipowner has stated their goal to be carbon neutral by 2050 amongst others by the help of biofuels and they are also looking into how they can use hydrogen and fuel cells for this transition (Crozel 2020). www.cmacgm-group.com/en/ How to become a supplier? www.cmacgm-group.com/en/procurement/how-to-become-a-supplier

5.4 Yards

The French shipyards constitute a strong industry with technical skills supported by high-level maritime research, operational excellence, and a commercial dynamism that allows them to export over 60 % of their production. French naval construction employs between 42 000 and 90 000 people and are ranked 6th in the world. Their emblematic products and services are cruise ships, military ships, maintenance operations and recreational boats/yachts. Some of the major French yards are Chantiers de l'Atlantique and Naval Group. French domination is most firmly established in the yachting segment, with the shipyard Bénéteau as one of the world leaders. La Ciotat Shipyards completed the world's first hydrogen yacht in September 2020, which will serve as a demonstrator until commercialisation in the spring of 2021.

Chantier Bretagne Sud is specialised in aluminium shipbuilding and offers repair and maintenance services. The shipyard is in the process of building its two first electrically propelled catamarans which will be equipped with a hydrogen engine. www.chantier-bretagne-sud.fr

Chantiers de l'Atlantique is one of the world's largest shipyards located in Saint-Nazaire, constructing a wide range of commercial, naval and passenger ships. <https://chantiers-atlantique.com/en/>

Naval Group is a European leader in naval defence with a presence in 18 countries and serves the strategic operations of more than 50 navies. Blue Ship is one of six axes of their R&D strategy, the purpose of which is to bring together all the environmental topics of interest to the group in order to combine innovation, new operational capacities and sustainable growth. www.naval-group.com

Navalu is a shipyard specialized in designing and building custom-made aluminium ships up to 35 meters. The company is recognized for the quality of construction and the long-lasting welding quality. Navalu has constructed the first hydrogen vessel to be approved for European navigation with the shuttle boat NAVIBUS operating on the Erdre river in Nantes since 2019. www.navalu.fr

La Ciotat Shipyards is a Local Public Company (SPL) whose shareholders are the Department of Bouches-duRhône (50 %), the Provence-Alpes-Côte d'Azur Region (25.8 %), the Metropole Aix-Marseille-Provence (19.9 %) and the city of La Ciotat (4.3 %). The shipyard has witnessed the success of a voluntarist and partnership-based policy of the reindustrialisation of the site formerly geared towards the construction of large industrial units through a repositioning in the sector of repair, servicing and maintenance of large yachts. La Ciotat Shipyards completed the world's first hydrogen yacht in September 2020, which will serve as a demonstrator until commercialisation in the spring of 2021. www.laciotat-shipyards.com

5.5 Design and engineering

Engineering skills are essential in translating energy solutions into propulsion systems for ships. According to LMG Marin that is present both on the French and Norwegian markets, engineering expertise is in especially high demand within hydrogen solutions as it is an industry in the starting blocks. These actors especially need to be involved in the process now, as technological requirements will soon go down to a lower level once the market is past the initial introductory phase. Some actors in this segment that are directing their activities towards low-carbon technologies are LMG Marin, Air Liquide and ABB.

Air Liquide is a world leader in gases, technologies and services for industry and health with a presence in 80 countries. Oxygen, nitrogen and hydrogen are at the core of the company's activities. Their portfolio includes hydrogen and LNG for maritime transport solutions, and Air Liquide is taking a lead role in the development of

such technologies e.g., through its participation in the HySHIP project led by Norwegian maritime industry group Wilhelmsen. www.airliquide.com

Airseas is a spin-off of the aeronautical company Airbus that has created Seawing, an innovating wing that can tow commercial ships. www.airseas.com

Europe Technologies offers its expertise for the industrialization, manufacturing and maintenance of composite, metallic and plastic parts and sub-assemblies. Their brand CIAM (Collaborative Integration for Alternative Motorization) offers manufacturing and integration of the complete electrical propelling system of ships based on a hydrogen or LNG. Europe Technologies coordinates the Hylias project for a hydrogen-driven passenger ship in the Golfe du Morbihan, to be operative from 2023. www.europetechnologies.com

L2O Naval is a naval architecture firm that can take on an expert role in third party projects (hydrodynamic calculation, structure, etc.) as well as undertake complete ship studies from start to finish. The common denominator for all their projects is a decisiveness to reduce the environmental impact of river and maritime activities, and they work with both electric, hybrid and wind propulsion. They are the ship designer in the Hylias project for a hydrogen-driven passenger ship in the Golfe du Morbihan. www.l2onaval.com

LMG Marin is one of Europe's leading naval architect and ship design houses, with a highly dedicated organization of skilled engineers and naval architects. Originally a Norwegian company, they also have offices in Toulouse, France. They are at the forefront of exploring alternative propulsion technologies such as 100 % electric, hydrogen, LNG and hybrid, and are also exploring velic propulsion in collaboration with Airbus. LMG Marin is a partner in both the Flagships and HySHIP projects. www.lmgmarin.no

5.6 Equipment and service

According to actors such as the maritime industrial group GICAN, equipment and services companies are parts of the value chain that holds most potential for international actors as the supply chain for equipment manufacturers is global. In this segment a large group of SMEs are active in pushing the sector forward and coming up with new technologies, and often they have activities abroad where they develop their technologies. Examples of such companies are GTT, Saft Batteries, PerSEE (that is also involved in the Flagships and HySHIP projects), Barillec Marine and the R&D department at EDF.

ABB is an industrial equipment supplier at the forefront of the evolution of sustainable shipping with a presence both in France and Norway. Electrical propulsion, data-driven decision support and integrated solutions for ship and shore from ABB are paving the way to a zero-emission marine industry. <https://new.abb.com>

GTT is a leading engineering company in containment systems for the shipping and storage in cryogenic conditions of LNG (liquefied natural gas). GTT offers engineering, consultancy, training, maintenance support and technical design services. www.gtt.fr

Barillec Marine is an electricity subcontractor that is a branch of Vinci Energies specialised in electric and hybrid propulsion systems for maritime and river transport. Barillec Marine will carry out the operation of converting the Batobus fleet of river shuttle services on the Seine into hybrid ferries. www.barillec-marine.com

Mission Hydrogène is a non-profit association finance by ADEME, the DIRECCTE and the Pays de la Loire Region. It gathers economic actors around the hydrogen and fuel cell technology. The Mission Hydrogène has developed a unique competence on hydrogen uses for marine and ferry applications. It contributes to the French hydrogen platform AFHYPAC (Association Française pour l'Hydrogène et les Piles A Combustible). At the European level, Mission Hydrogène is the French referent for the MHFCA (Marine Hydrogen and Fuel Cell Association). Mission Hydrogène has initiated many demonstrator projects and ensures a proper level of communication (technical workshops, technology watch). www.mh2.fr/en/

PerSEE supports the digitalisation of the hydrogen economy through a Hy-suite of digital products ranging from diagnosis tools to real-time optimisation software. These products uniquely blend industry 4.0 techniques with an in-depth understanding of hydrogen. PerSEE provides vessel energy monitoring and management in both the Flagships and HySHIP projects. www.pers-ee.com

Siemens operates in the domains of electrification, automation and digitalisation. They have a strong presence in the naval and maritime world, and with its unique digitalisation skills offer a large portfolio of solutions

including automation of shipping, transport and distribution of energy, equipment and infrastructure services. www.siemens.com

5.7 Energy companies

French energy giants such as EDF, Engie and Total are all strengthening their engagements across the spectrum of renewable energy. France already has a low-carbon electricity mix because of its nuclear power, but many reactors are reaching the end of their lifetime. France has a stated ambition to reduce the share of nuclear in its electricity mix from 75 % today to 50 % by 2035. Scaling up renewable energy production is therefore imperative, and France already has quite a large hydro-electricity production and is rapidly scaling up its offshore wind industry. Major actors such as Engie and EDF as well as a growing number of energy start-ups are also exploring hydrogen technologies, including for use in the maritime sector. There are several energy start-ups active within both hydroelectric and hydrogen technologies including companies like LHYFE, Hydroquest, Eolink and Sabella. La Compagnie Nationale du Rhône (CNR) is an electricity generation company that is supplying renewable power from hydroelectric facilities on the Rhône river and is also in the process of developing a green hydrogen production in the Rhône basin using hydroelectricity.

EDF is a French electric utility company largely owned by the French state. EDF is working to strengthen its engagement for the climate and invests heavily in renewable energy. To diversify its low-emission transport, EDF is strengthening its presence in the river transport sector, and in 2019 entered into a partnership with VNF to this end. www.edf.fr

Engie is a French industrial energy group and the second largest provider of electricity in France after EDF. Engie invests in renewable energy projects all over France and is France's largest provider of green electricity. They also have their own "green mobility" program, Mobility Today, that aims to develop new and smart solutions for climate-friendly mobility. <https://www.engie.com/en>

Helion Hydrogen Power is a key player in the hydrogen and fuel cell industries. In their facilities in Aix-en-Provence they design, manufacture and commercialise PEM fuel cell stacks and fully integrated hydrogen systems with a power range from kW to MW. www.helion-hydrogen-power.com

LHYFE is an energy start-up with ambitions to become Europe's leading actor on green hydrogen. They conceive, develop and operate industrial sites for green hydrogen production. www.lhyfe.com

Naval Energies is a leader in the field of marine renewable energy. They contribute to the development of alternative, renewable and environmentally friendly energy, originating from the sea. www.naval-energies.com/en/

TotalEnergies is a leading international oil & gas company and a major player in renewables and electricity. Present in more than 130 countries, it is the fourth largest oil and gas company in the world and one of the most important energy players. As part of its transition towards renewable energies it is focusing on the development of hydrogen and solar power. www.total.com

5.8 Ports

The large seaports of Le Havre, Marseille and Dunkerque are important both in a maritime context in addition to managing the river network situated inside their respective port domains. The ports located by the entry point of a river also play an important role in the development of waterways as they tend to facilitate ferry transport by linking the arrival of great ships to inland transportation. Marseille is the most important port for ferry transport by sea.

HAROPA ports, the 5th largest port complex in Northern Europe, is a joint venture between the ports of Le Havre, Rouen and Paris. It is connected to every continent owing to a first-rate international shipping offer (linking around 700 ports worldwide). It serves a vast hinterland the centre of which is in the Seine valley and the Paris region forming the biggest French consumer market area. With around 10 Normandy and Paris area partner ports, HAROPA now forms in France a global transport and logistics system, capable of providing a comprehensive end-to-end service. HAROPA handles over 120 million tons of cargo by sea and waterway each year. HAROPA business represents 160,000 jobs. www.haropaports.com

Marseille Port (Marseille Fos) is France's leading port, a major player in international trade, the port of Marseille Fos accommodates nearly 10,000 ships, handles 79 million tonnes of goods, serves 800 customers and is developing 10,400 hectares for green industries. <https://www.marseille-port.fr/en>

France's third-ranking port, **Dunkerque**, is well known as a port handling heavy bulk cargoes for its numerous industrial installations. It has also built its reputation in other sectors such as cross-Channel Ro-Ro traffic to Great Britain, containers, fruit, etc. Classified as the 7th port of the North Europe Range which extends from Le Havre to Hamburg, it is also France's leading port for ore and coal imports; France's leading port for containerised fruit imports; France's leading port for copper imports; and France's second-ranking port for trade with Great Britain. <http://www.dunkerque-port.fr/en/>

Nantes Saint-Nazaire is a leading port on France's Atlantic Seaboard and the fourth biggest national port authority. It has a port area extending over a 65-kilometre stretch along the Loire Estuary. Energy accounts for the largest share of the total traffic volume (70 %). <https://www.nantes.port.fr/fr>

6 French Shipbuilding industry

6.1 General overview

6.1.1 French shipyards specialties

The activity area of French yards is specific with three pillars: military construction of all sizes (not covered here), very large cruise ships and small or very small ships for various purposes.

The main civil shipbuilders are the Chantiers de l'Atlantique (state control), whose production is sold only to international cruise companies. The other shipyards build for the national or international market in segments of less than 100 m: CMN, Piriou, Socarenam, Ocea, BMA. The small builders are responsible for vessels of less than 20 m, including the fishing fleet.

Passengers' ships

Type of vessels	Type of shipbuilder
Cruise boat	Chantiers de l'Atlantique
Expedition cruise boat	Chantiers de l'Atlantique
Large ferry	Chantiers de l'Atlantique
Small ferry	Intermediate shipbuilders
Touristic boat	Small and intermediate shipbuilders

Services ships

Type of vessels	Type of shipbuilder
Tugboat	Small and intermediate shipbuilders
Maritime Works and dredging	intermediate shipbuilders
Research vessel	Small and intermediate shipbuilders
Crew boat (offshore, wind)	Small shipbuilders

Speedboat (eg. Pilot)	Small shipbuilders
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Public sector administrations

Coastal patrol vessel, Speedboat	Small shipbuilders
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Ship orders are placed within the framework of contractual relations between private actors. The same applies to builders, suppliers and subcontractors.

The only known contracts are orders from the State and local authorities that own naval resources or subsidise them. Calls for tender go through the official website of the Bulletin des Marchés Publics. It's a European tender. (Bdmp, 2022)

The public market is

- Defence fleet, services vessels
- State Administrations fleet
- Ports vessels owned by GPM or territorial authorities
- Passengers and/or cargo public transportation

6.1.2 Sectorial organisations

The GICAN (Groupement des Industries de Construction et Activités Navales) is the national professional association that brings together 200 companies and 48,100 employees from the various civil and military sub-sectors: shipyards, systems manufacturers, equipment manufacturers, sub-contractors, engineering companies and naval architects. GICAN is also open to the offshore wind energy industry.

The CORIMER (Conseil d'Orientation pour la Recherche et l'Innovation de la MER) created in 2018 includes the shipbuilding, offshore oil & gas and marine energy sectors. The aim is to target both public aid and structuring projects to be supported, for both public authorities and industry. The procedure for guiding and examining projects carried out by the sector has been optimised to better direct projects towards the most suitable funding mechanisms and to better integrate the sector into the examination process of the best projects. A single body for approving maritime research and innovation projects, bringing together public authorities and the maritime industry.

CORIMER has selected four areas for R&D (Corimer, 2022):

- Smart ships and autonomous systems (Smart Ship)
- Energy and propulsion (Green Ship)
- New materials and intelligent yards (Smart Yard)
- Marine resources (Smart offshore industries).

GICAN is involved in a start-up innovation programme, SEAstart, with 12 first small companies (GICAN, 2022).

CORIMER is responsible for publishing an annual call for innovative projects. The 2019 call for innovative projects resulted in 21 projects being labelled, for a total amount of funding of approximately €60M. CORIMER's second call for innovative projects, published in September 2020, resulted in 51 maritime research and innovation projects, for a total funding request of around €360M.

6.1.3 Regional clusters

In Brittany, Bretagne Pôle Naval federates 200 companies in three sectors: shipbuilding, marine energies and offshore oil & gas. The shipbuilding and ship repair sectors concern small and medium-sized ships. <https://www.bpn.bzh/>

Located in Nantes Saint-Nazaire, Neopolia brings together 240 companies representing 30,000 jobs. Neopolia is a multi-sector industrial cluster (Aerospace, Marine, Land Mobility, Renewable Marine Energies, Oil&Gas, Nuclear). The network aims to bring together companies to work on business issues in France and abroad. <https://www.marine.neopolia.fr/>

6.1.4 Exhibitions

SOGENA (Naval Events Organization and Management Company) is a subsidiary of the GICAN – French Marine Industry Group. The purpose of SOGENA is to ensure international promotion of the naval and maritime industry by organizing international events and exhibitions for two domains naval defence with Euronaval and civil maritime sector with Euromaritime. This exhibition is the biennial event for those actors involved in blue growth in Marseilles, next time in 2024. <https://www.euomaritime.fr>

Exist two events at Lorient, Navexpo a small business exhibition about naval industry (organization by Fishing Port of Lorient Keroman). Itechmer is the first trade fair for fishing industry in France, Itechmer is a meeting of professionals working in sectors from ship design to final processing of seafood products with a presence of shipyards for fishing sector. <https://www.navexpo.com/fr/>

In Saint-Nazaire, the new event, Wind for goods is the chance to discover solutions and innovations with sailing and kite solutions. Next edition is programmed for 2023. <https://www.windforgoods.fr/>

6.2 French shipbuilding enterprises

6.2.1 Chantiers de l'Atlantique

Chantiers de l'Atlantique (CdA) is one of the largest European shipbuilders, competing with Italian, German and Finnish yards (Chantiers de l'Atlantique, 2021a). Since 2000, some 30 cruise ships have been built for several shipowners: MSC, RCCL, NLC and Hapag Lloyd Cruises, Ritz Yacht Carlton Collection.

CdA produces 25 % of a ship in-house (3,500 employees) and obtains 75 % of its supplies from 500 partner companies (3,500 employees), 50 % of which are in the west of France, 10 % in the rest of France and 35 % in Europe outside France.

The industrial movement already includes the role of small and intermediate in the Saint-Nazaire ecosystem: Mecasoud, Sofreba, ADF, Kaefer Warner, Mariniso, Marper. It is estimated that there are 1,500 companies linked to the CdA, 800 of which are in west France.

The innovation for Chantiers de l'Atlantique is his first cruise ship with LNG and fuel cells. The other project is development of sail (SolidSail) and the first application for Neoline. <https://chantiers-atlantique.com/>

6.2.2 Piriou

Piriou was created in 1965 and is present in France and several other countries. The company has 1,000 employees, including 450 in France, and a turnover of €180 million in 2019. The French site is located in Concarneau in Brittany on 25,000 m², with a capacity to build under cover of 100m and a dry dock of 130m.

It specialises in medium-sized vessels (100-120 m): small ferries, offshore supply, hydrographic boats, fishing, tugs. The yard has an orderbook with sailing cargo vessels and hydrogen ships. For the sailing ship, two contract with TOWT and one with Grain de Sail. For hydrogen solution is the river ship Zulu (in Romanian Yard) and the small dredger boat Hydromer for the port of Sète and potential project for CTV.

<https://www.piriou.com/>

6.2.3 Ocea

Ocea has production units at Sables-d'Olonne, Saint-Nazaire and La Rochelle with 400 employees and a turnover of €150 M in 2019. The group builds 15 to 20 ships per year, mainly in Sables-d'Olonne yard because Saint-Nazaire unit is dedicated to subcontracting for the CdA.

The OCEA group generates 95 % of its turnover from exports with four types of aluminium vessels: coastal patrol, small ferry, technical boat and crew boat. The export orderbook include crew boat, oceanic research vessels, navy speedboat and patrol vessel.

<https://www.groupe-ocea.fr/>

6.2.4 Construction Navale de Normandie (CMN)

The Cherbourg-based shipbuilder (350 employees) is a manufacturer of military ships for the French state or foreign countries. The specialities are offshore patrol vessel, coastal patrol, torpedo patrol. Currently, CMN is building 39 interceptor ships for Saudi Arabia, 21 of which were built in Cherbourg. CMN has acquired Hydroquest from Naval Group, a company specialising in water flows energy (tidal power, river power) (CMN, n.d.).

6.2.5 BMA group

Merré is a shipbuilder based on a river in the Nantes region, building vessels from 12 to 80 m in steel or aluminium. The company is owned by the BMA group. It has taken over two other shipbuilders: Mecasoud of Saint-Nazaire and CIB of Brest.

- Merré & Mecasoud (70 employees and €20 million in turnover): Tugboat, pilot boat, patrol ship, river ferry, barge.
- CIB (25 employees and €5 million in turnover): Speedboat, small tugboat.

<http://www.merre.fr/>

6.2.6 Socarenam

This employee-owned company (holding company Socalliance) is one of the main small French manufacturers. The various construction and maintenance sites represent 250 employees and €54 million in turnover in 2019. Two shipyards are dedicated to the construction of ships:

- Boulogne (max 110 m): Fishing boat, fireboat, patrol boat
- St Malo (max 110 m): Patrol boat, landing craft

In 2020, the DGA ordered three coastal patrol boats (€20m) from Socarenam for the national gendarmerie. The company has built the first dredger (52 m) with LNG engines. In international, three patrol ships for Belgium and one offshore patrol ship for Poland.

<https://socarenam.com/fr/>

6.2.7 Architect and engineering

Shipbuilding relies on the skills of architectural firms:

- Mer et Design: <http://www.meretdesign.fr/>
- Agence Neuman: <https://ingenieur-architecte-naval.com/>
- Bureau Mauric : <https://www.mauric.ecagroup.com/>
- Mer Forte : <https://www.merforte.com/>
- H&N
- VPLP: <https://www.vplp.fr/>
- Ship ST: <https://ship-st.com/>
- Stirling Design: <https://www.stirlingdesign.fr/>

The use of architectural firms depends on the nature of the contractual links between shipowners and shipyards. There are two possibilities:

- The shipowner is the project manager. He orders the design services and then the construction of the ship and the supply (fittings, specific equipment, engines). This is generally the process for fishing vessels.
- The shipyard is the prime contractor who, based on the shipowner's order, integrate all parties. Almost all shipyards use the skills of external design offices.

France has only two hull test basins, a civilian one at the Ecole Centrale (engineer major school) in Nantes and a military one at the Direction Générale de l'Armements in Val de Reuil (Normandy).

The shipbuilding sector uses engineering solutions companies at various levels of ship design and construction. They are important in the innovative energy solutions that are coming to the shipbuilding sector.

The main companies are:

- CT Engineering: https://www.ctingenierie.com/index.php/home/?idioma_id=2®ion_id=2
- Sofresid: <https://sofresid-engineering.com/>
- Segula: <https://www.segulatechnologies.com/fr/>
- Alca Torda: <https://www.centrealcatorda.com/>
- D-Ice Engineering: <https://dice-engineering.com/>
- MGH Energy: <http://www.mgh-energy.com/>
- LGM Marin: <https://www.lgmgroup.fr/fr-fr/naval.aspx>

6.2.8 Subcontractor sector

The installation of the motorization and the piping often remain the competences of the construction site. Subcontracting therefore operates in a network of direct relationships between companies (price, competence, experience).

In the case of Chantiers de l'Atlantique, the company retained the functions of the design office and the construction of the sections. The rest is subcontracted under the authority of the Chantiers de l'Atlantique. The modernisation of French subcontracting is moving from "part" supply to "system" supply. Shipyards are thus becoming less of an "assembler" than an "integrator" of several industrial processes. The risk for the sector is to lose competitiveness in the context of strong European and Asian competition.

Shipbuilding is a highly subcontracted sector. The yards often keep a hull construction activity even if there are purchases of this part as a whole or in kit form.

Shipyards are assemblers on two purchasing bases:

- Suppliers: equipment, electronics, engines
- Subcontractors: fittings, electricity, painting, services

The installation of the motorization and the piping often remain the competences of the construction site. Subcontracting therefore operates in a network of direct relationships between companies (price, competence, experience). The modernisation of French subcontracting is moving from "piece supply" to "system supply". Shipyards are thus becoming less of an "assembler" than an "integrator" of several industrial processes. The risk for the sector is to lose competitiveness in the context of strong European and Asian competition.

In the case of CdA, the company retains the functions of the design office and the construction of the sections. The rest is subcontracted under the authority of the CdA. It's a free market of providing.

6.2.9 Manufacturer suppliers

France has two major shipbuilders, CdA for large cruise boats and Naval Groupe for war vessels. A network of intermediate companies and small shipyards completes the French shipbuilding network. A number of suppliers are therefore linked to this market of the French shipbuilding industry.

Nevertheless, the French panorama shows a limited number of companies for the main sectors of naval supplies. Thus, the equipment suppliers are foreign, European and Asian, particularly for the construction of liners, with choices also linked to the shipowner.

There is no data to know who the suppliers of French shipbuilders in their different sectors are. International suppliers are undoubtedly numerous, particularly in motorization, mechanicals elements and electronic systems.

Main French companies manufacturing components for the naval industries

Motors & propulsion

Moteurs Baudouin	Intermediate Moteur thermique	https://baudouin.com/?lang=fr
EN Moteur	Small Moteur électrique	https://www.enmoteurs.com/fr

Equipment

France Helices	Propulsion, propeller, shaft lines	https://www.francehelices.fr/
Maucourt	Propulsion, propeller, shaft lines	https://www.maucour.fr/
FOB (Sofibel)	Anchor, marine safety equipment	https://www.fob.fr/
Bopp	Deck machinery, hydraulic power	https://www.bopp.fr/
Hutchinson	Vibration & isolation products	https://www.hutchinson.com
GTT	Membran for LNG tank	https://gtt.fr/fr

Systems

SNEF	Electricity	https://www.snef.fr/
Barillec Marine	Electricity	https://www.barillec-marine.com
Schneider Electric	Electricity	https://www.se.com/fr
Saft (Total)	Batteries	https://www.saftbatteries.com/fr/
Carwatt	Batteries	https://carwatt.net/fr/accueil/
Olenergies	Batteries	https://www.olenergies.com/
Axima (Engie)	Marine and Offshore HVAC	
Sofreba	Piping	http://www.sofreba.com/
FCE	Flow control	https://fcefrance.com/

IXblue	Navigation	https://www.ixblue.com/
Marinelec Tech.	Technical alarm	https://www.marinelec.com

Innovative propulsion

FinX	Propulsion	https://finxmotors.com/
ADV Propulse	Propulsion	https://adv-propulse.fr/
Bluenav	Hybrid engine	https://bluenav.com/fr/
Alternatives Energie	Hybrid system	https://www.alternativesenergies.com/

6.2.10 Ship repairs

In 2012, the Dutch shipbuilding company Damen Shipyards took over the sites in Dunkerque (ARNO) and Brest (Sabena). The Dunkerque yard mainly works on ferries and dredgers with two dry docks (100 m, 285 m) and a floating dock. The Brest shipyard can accommodate the largest ships in the world (liners, container ships) and is specialised in LNG carriers with two dry docks.

The Marseille shipyard is controlled by the Italian company San Giorgio del Porto. It is located in the Eastern Docks and operates the Forme 10 which is the largest in the Mediterranean and the third largest in the world. The activity is concentrated on ferries and liners. For smaller vessels, there are local repairers in most French ports.

Due to the strong presence of mega yachts on the French and Italian Riviera, a major repair activity (refit, maintenance) has developed in South-East France with about 15 % of the annual market. The number of mega yachts is around 40 units per year and vessels over 80 m now represent 85 % of the market. Repair sites for this type of vessel are few and far between.

The La Ciotat site was once one of the main shipbuilding yards and has now been converted to ship repair for yachts and mega yachts. The site is owned by the local authorities and managed by La Ciotat Shipyards. The site accommodates ships of over 80 m, but needs to be developed

The equipment is made available to the companies present on the site; MB92 (Spain): Monaco Marine (Monaco), Nautech (France) In Marseille, the MOC has dry docks dedicated to yachts and mega yachts, which are concessioned to Palumbo SY (Italy), Sud Marine (France) and Monaco Marine. In Toulon / Saint-Mandrier / La Seyne, two sites are dedicated to repairs Monaco Marine and IMS.

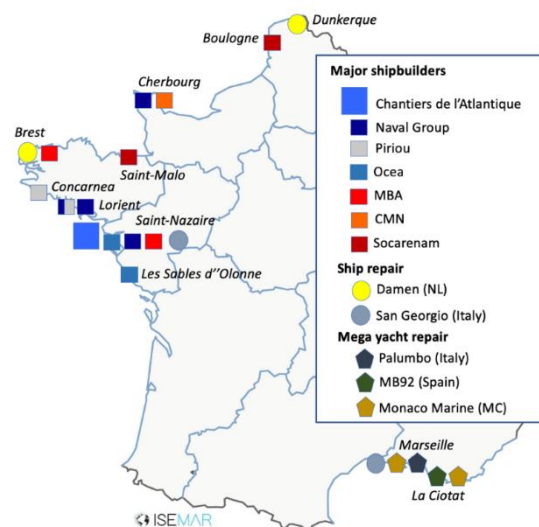


Figure 15 - French shipbuilders

7 Relevant projects & current green vessel solutions

7.1 Relevant future or ongoing projects and green vessel solutions already in the market

7.1.1 Projects integrating maritime and river uses potentially open to partnerships

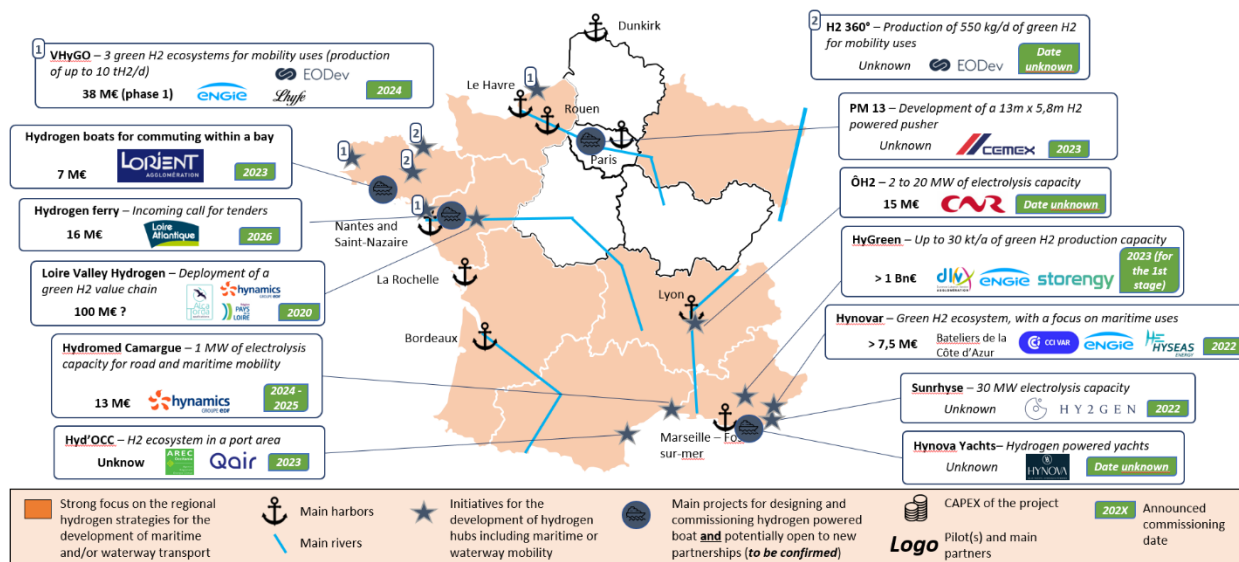


Figure 16 - Location of projects

7.1.2 Regional projects

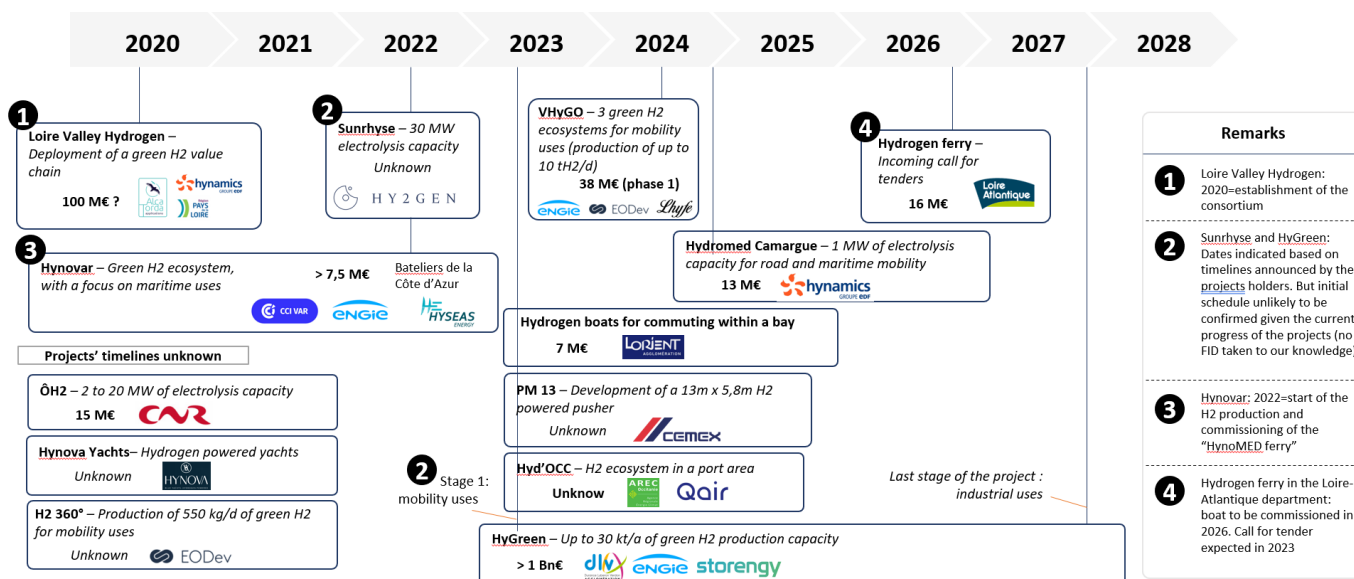


Figure 17 - Timeline of projects based on announced commissioning dates

7.1.3 Calls for projects

























Initiative	Pilot(s)	Main themes	Deadline to submit projects	Support granted	Open opportunities for new partnerships	Size / Potential impacts	Market potential of the solutions to develop
Call for projects ADEME "Briques technologiques et démonstrateurs hydrogène" - Technological blocks and demonstration projects	ADEME 		Closing of the call for projects on December 31 2022	Total budget of 350 M€	++	++	++
Call for projects "Hydrogène renouvelable : maillage des territoires bretons" - Renewable hydrogen deployment in Brittany	Brittany region 		Closing of the call for projects on May 31 2022	Support for the preliminary study phase: up to 50% / €50,000. Support for the investment phase: up to 65% / 1 M€	++	+	++
Call for projects "Hub de mobilité Hydrogène - routier et maritime" - Hydrogen hubs for road and maritime mobility in the Nouvelle-Aquitaine region	Nouvelle-Aquitaine region 		Closing of the call for projects on December 31 2022	Support to the preliminary studies (up to 50%) and to the extra CAPEX due to the environmental value of the project (up to 65%)	++	?	++
4 calls for projects ADEME "France 2030" to support the decarbonization of the French industry sector	ADEME 		Closing of the call for projects on April 2022 (IBaC PME), September 2022 (ZiBaC), September 2023 (SollNBaC) and October 2023 (DEMIBaC)	Total budget of 610 M€	++	++	++

Figure 18 - Regional projects with strong ambitions regarding maritime and/or waterway mobility.

7.1.4 Hydrogen hubs & regional value chains

Initiative	Location	Pilot(s)	Main themes	Progress	Budget	Open opportunities for new partnerships	Size / Potential impacts	Market potential of the solutions to develop
Hydrogen roadmap of the Pays-de-la-Loire region	 Pays-de-la-Loire	Pays-de-Loire Region		Roadmap adopted in 2020	100 M€ announced for the hydrogen economy for the period 2020-2030	++	++	++
Hydrogen roadmap of the Provence-Alpes-Côte d'Azur region	 Provence-Alpes-Côte d'Azur	Provence-Alpes-Côte d'Azur region		Roadmap adopted in 2020	Support of up to 50 M€ for all regional targets 35 M€ of investments projected to develop hydrogen uses in maritime ecosystems. Planned support from the region at 5 M€	++	++	++
Hydrogen roadmap of the Grand Est region	 Grand Est	Grand Est region		Roadmap adopted in 2020	Not announced	++	++	++
Breton Hydrogen roadmap	 Brittany	Brittany region		Roadmap adopted in 2020	Public and private investments by 2030: - 8 H2 hubs: 50 M€ - 3 maritime H2 ecosystems: 45 M€ - 10 H2 ships: 150 M€ Calls for projects for H2 hubs: 10 M€ in 2020, 2021, 2022 and 2023	++	++	++

Initiative	Location	Pilot(s)	Main themes	Progress	Expected commissioning date	Budget	Open opportunities for new partnerships	Size / Potential impacts	Market potential of the solutions to develop
Hyd'Occ – H2 ecosystem in a port area	 Port-la-Nouvelle	Premier Element (Gair group) and AREC Occitanie		Final Investment decisions (FID) made?	2023	? (Support from the French state: 11,4 M€)	++	++	++
Sunrhysse – Green H2 production with a 30 MW electrolysis capacity	 Toulon	HY2GEN France		No FID seems to have been made	Start of production 2022 to gradually reach its maximum in 2024	?	++	++	++
Hynovar – Green H2 ecosystem	 Var	CCI du Var, Engie, Hyseas, Bateliers de la Côte d'Azur, Circuit Paul Ricard, GrennGT		Ongoing construction of a hydrogen-powered ferry	Hydrogen production expected in 2022 HynoMED' ferry expected in 2022	HynoMED: 7,5 M€, including 2,2 M€ for the construction of a hydrogen-powered ferry	++	?	++
HyGreen Provence – Production of up to 30 kt/a of green H2 in 2030, for various uses	 Manosque	Engie, Air Liquide, DLVA, Storengy		Ongoing construction of a PV plant. But no FID seems to have been made regarding the hydrogen production equipment.	2023 for the first stage of the project	1 bn€	+	++	++



















Initiative	Location	Pilot(s)	Main themes	Progress	Expected commissioning date	Budget	Open opportunities for new partnerships	Size / Potential impacts	Market potential of the solutions to develop
H2 360 – Production of 550 kg/d of green H2 for mobility uses	 Rennes, Saint-Malo	Energy Observer Developments		Under construction?	?	?	-	+	++
VHyGO – Deployment of 3 green H2 ecosystems for mobility uses (production of up to 10 tH2/d)	 Brest, Dieppe, Saint-Nazaire	Lhyfe		?	2024 for the third phase of the project (but the first one was originally supposed to be implemented in 2020)	38 M€ for phase 1 of the project	?	Heavy road mobility: ++ Maritime mobility: ?	++
OH2 – Green H2 production (2 to 20 MW of electrolysis capacity) with hydroelectric power	 Chemical Valley	CNR		No FID seems to have been made	?	15 M€	?	-	++
Loire Valley Hydrogen (H2LV) – Deployment of a green H2 value chain	 Pays-de-Loire	Alca Torda, Hynamics (EDF group), Pays-de-la-Loire		?	2020	100 M€ (source: Usine Nouvelle, to be confirmed)	?	?	++
Hydromed Camargue – 1 MW electrolyser for road and maritime mobility	 Grau-du-Roi	Hynamics (EDF group)		?	2024 or 2025 (source: Les Echos, to be confirmed)	3 M€ for the hydrogen ferry 10 M€ for other aspects of the project	?	-	++

Figure 19 - Hydrogen hubs & regional value chains with strong ambitions regarding maritime and/or waterway mobility

7.1.5 R&D and deployment of new technologies

Initiative	Location	Pilot(s)	Progress	Expected commissioning date	Budget	Open opportunities for new partnerships	Size / Potential impacts	Market potential of the solutions to develop
Hydrogen ferry in the Loire-Atlantique department – Incoming call for tender. Capacity to load 40 cars expected.	 Loire-Atlantique	Département de Loire-Atlantique	Call for tender expected in 2023	2026	16 M€	++	-	+
Hydrogen boats for commuting within a bay – one newly built boat and one retrofitted electric boat	 Lorient	Lorient Agglomération	No FID seems to have been made	2023	5 M€ for the new boat 2 M€ for the retrofitted boat	++	-	++
Hynova Yachts – Design and construction of 12 passengers leisure boats	 La Ciotat	Hynova	?	?	-	?	+	+
PM 13 – Development of a H2 powered pusher (800 t of capacity)	 Paris	Cemex	Feasibility study launched in 2019	2023	?	?	-	++
Development of a 120 meters cargo ship – Load capacity of 5 kt	To be built in France	Energy Observer	?	2025	40-80 M€ (source: France Bleu)	-	++	++

Initiative	Location	Pilot(s)	Progress	Expected commissioning date	Budget	Open opportunities for new partnerships	Size / Potential impacts	Market potential of the solutions to develop
Promovan H2 – Modeling of a set of 7 H2 boats for an overview of constraints and potential economic and environmental solutions	 Rhône-Saône basin	Voies navigables de France, LMG Marin, Compagnie Fluviale de Transport (CFT), Entreprises Fluviales de France	?	?	?	?	+	+
HyBarge – Demonstration of the possibility to use a fuel cell for waterway transport	 Canal des Deux mers	L'Equipage	Ongoing ground experimentation of a fuel cell	?	?	-	?	++
BARGE – Artistic venue in a hydrogen powered boat and valorization of the heat generated by the fuel cell and the low pressure hydrogen tanks for cogeneration	 Seine river	Dans le Sens de Barge, Mincatec	Ongoing technical studies	2024 (for Paris Olympic Games)	?	?	-	++
2 Catamarans with electric propulsion, suitable for future hydrogen powered motorizations	 Belz	Chantier Bretagne sud	Catamarans delivered to its sponsor	2020	?	-	-	+





Initiative	Location	Pilot(s)	Progress	Expected commissioning date	Budget	Open opportunities for new partnerships	Size / Potential impacts	Market potential of the solutions to develop
Caravelle - Development of a 25-meter long H2 powered sightseeing boat	 Operation: Strasbourg Construction: Saint-Mandrier-sur-mer	Batorama	Ongoing construction of the first ship	2022	3 M€ for the first ship 30 M€ for the whole investment program	-	++	++
Flagship Program (Zulu vessel) – Development of a 50 meter long H2 powered cargo vessel	 Paris	ABB Marine & Ports, Ballard, LMG Marin	Ongoing construction	Demo in Paris: 2022 Deployment of two commercial vessels: 2023	5 M€ awarded by the FCH JU to deploy 2 H2 vessels in France and Norway	-	+	++
Hyllas - Development of a 24 meter long H2 powered ferry with a capacity of 150-200 passengers	 Vannes Arz island	Europe Technologies CIAM	Ongoing construction	2024	15 M€ (source: Les Echos)	-	-	++
Telo Martius - Repowering of leisure/tourism boats from diesel to fuel cells	 Provence-Alpes-Côte d'Azur	Hyseas, Bateliers de la Côte d'Azur	?	2022	1 M€	-	-	++

Figure 20 – R&D and deployment of new technologies with strong ambitions regarding maritime and/or waterway mobility

7.2 Low and zero-emission solutions in the French market

Electrification

France has no centralised policy or large-scale industry incentive scheme for the development of fully electric ferries, and the technology may not have as many applications as in Norway where there are more short, fixed ferry routes. However, a number of pilot projects are ongoing for electrification. Electrification seems most relevant in the recreational boating (i.e., rental boats, yachts, etc.) and sightseeing cruise/city boat segments. There are also ambitions for the development of fully electric passenger transport on the Seine river. The Île-de-France region with the city of Paris appears to be the most active and promising geographical area. The cities of Paris and Le Havre are engaged in electrification projects such as the installation of charging stations along the Seine. Examples exist of fully electric boats in France, such as the recreational boats and river cruise boats operated by Nicols or Canalous.

Hydrogen

The French hydrogen sector is expected to grow significantly in coming years, with massive public investments. France launched its first national hydrogen strategy in 2018 already, a strategy now accompanied by €9.1 billion in funds over the next few years. Some funds for using hydrogen as an energy carrier in transport are channelled through ADEME which currently has several calls for projects out related to R&D projects on hydrogen technologies. Several pilot projects, some publicly funded through e.g. ADEME and VNF's PAMI program, are currently under development. French actors are also paying close attention to the Norled project for a hydrogen powered ferry, which has contributed to raising awareness for the Norwegian competency and potential contribution.

Hybrid

Hybrid in a French context usually refers to diesel-electric solutions, but electric-hydrogen solutions are also gaining traction. Hybrid propulsion systems are deemed to have a higher commercial potential on the French market than fully electric applications by many of the French industrial actors interviewed for this report. The ships can operate on either battery or hydrogen but with a reserve of fossil fuels, allowing for greater autonomy and capacity. Hybrid applications will also be most relevant for large ships that cannot be completely decarbonized, e.g., Corsica and canal ferries.

Liquified natural gas (LNG):

French actors also see LNG as an important interim solution for large ships, as it pollutes less than other fossil fuels and offers more autonomy than hydrogen. The major French shipowners such as CMA CGM, Ponant or Corsica Ferries all rely on LNG to green their fleets. Onboard functions on these ships can still be driven by hydrogen or battery, and according to the French Maritime Cluster there are opportunities in the market for these auxiliary functions as they will be based on technologies developed in fully electric ferry projects. This gives Norwegian companies a comparative advantage on the technology side.

Ammonia

Ammonia is also being mentioned as an alternative fuel for large ships that require more autonomy with potential applications for both service ships to offshore sites and various types of transport ships. There seems to be no concrete projects in this area, but the Norwegian case of an ammonia driven fuel cell to be tested on Eidesvik Offshore's supply vessel Viking Energy has risen interest among French actors. This experience could be leveraged by Norwegian actors to establish a dialogue with French actors.

Velic propulsion

Velic propulsion is mentioned by several as a possible emerging market that could entail opportunities for new actors. According to LMG Marin, this combined with other solutions such as hydrogen or batteries is very promising and a real possibility that could interest shipowners. The French shipowner Zéphyr & Borée is already operating the first modern sail cargo ship, Canopée.

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2. French Inland waterways

Introduction

Over the last few years, there has been a large-scale electrification and hybridisation of ferries, service and offshore vessels in Norway. The development of a strong domestic market for battery electric and hybrid electric propulsion has led to the development of an almost complete Norwegian value chain for this type of vessels. The technology has been verified and scaled in Norway and has a large international market potential as a result of global and regional climate goals, especially in the European Union.

French inland navigation sector has historically been a niche, artisanal activity, with boat designs dating from decades before, and not perceived as the most innovative mode of transport. Environmental objectives from state entities as well as from the general public have generated a growing interest in inland waterborne transport. The 2024 Olympic and Paralympic Games of Paris, and the showcase they will offer the sector have helped the latter to become mature enough to transition.

The present report aims to synthesise information on inland navigation specificities and offer a compilation of the relevant data for Norwegian companies interested in exporting their expertise towards the French market.

First, a general overview of the French Inland Navigation sector will be given, with a focus on the sector's specificities regarding its administration, fleet, and waterways. Then, the sector's market will be detailed for passenger as well as goods transport followed by a presentation of the purchasing system for public and private buyers. This general overview will end with a presentation of the technical requirements for inland navigation vessels and components.

Second, the sector's environmental transition will be presented, with an analysis of the environmental pressure towards carbon neutrality via its global emission reduction objectives and the possible impact of low emission zones on inland navigation. Then, the environmental requirements and concerns expressed by public and private stakeholders will be synthesised before a presentation of the national incentives granted for low or non-polluting solutions. The maturity of the sector's ecological transition will then be addressed with a presentation of the ecological ecosystem and examples of retrofits and boat build projects.

Finally, the competitive situation and potential cooperative partners for Norwegian companies will be presented with an overview of green vessels as well as autonomous system solution providers, followed by a presentation of the different type of potential partners for Norwegian companies.

1 Overview of the French inland navigation sector

This section aims at providing a general overview and useful insights on the French inland waterways structure, organization, and operations.

First, the sector's administrative organization will be detailed, followed by inland navigation fleet and its waterways. Then, passenger and transport sectors will be studied before a focus on the purchasing system and a final analysis on technical prescriptions regarding the vessels and their components.

French inland waterway sector's, contrarily to maritime or other modes of transport disposes of scarce statistical and analytical data. The sources and useful links where more detailed information can be found will be indicated, but some data are derived from unpublished documents.

1.1 Inland Navigation sector

Some of the information disclosed in this first section are issued from non-public documents and work groups with the French administration.

The objective of this section is to present inland navigation decision makers and public stakeholders, its fleet and the specificities and requirements of the different French inland waterways network.

1.1.1 Inland navigation specificities: administration and public stakeholders

1.1.1.1 Mapping of public decisionmakers

The main national decision-maker regarding inland navigation's legislation is the Directorate General for Infrastructure, Transport and Mobility (DGITM). The DGITM prepares and implements national land and waterway transport policy². Attached to the Ministry of Ecological Transition and Territorial Cohesion, the DGITM

² For more information: DGITM's presentation on the government website's:

<https://www.ecologie.gouv.fr/direction-generale-des-infrastructures-des-transport-et-des-mobilites-dgitm>.

takes part in sustainable development and energy transition process, promoting environmentally friendly modes of transport and uses in their areas of relevance.

DGITM constitutes the Central Administration for the sector and is responsible for both drafting inland navigation's regulations and interpreting these regulations. It ensures the harmonised implementation of these regulations throughout the country, and navigation basins.

The central administration is also competent for certain administrative procedures:

- Accreditation of companies installing navigation equipment
- Approval of organisations in charge of training and examining special passenger attestations³

DGITM is organized in specialized offices⁴:

- Inland Waterway Transport Office (PTF3)
- Social Law Office for Ports and Inland Navigation (TS3)
- Mission for the transport of dangerous goods (MTMD)
- Pleasure Craft Mission (MNP)

The DGITM represents France in the European Committee for drawing up Standards in the field of Inland Navigation (CESNI), which elaborates the European norms regarding technical prescriptions, professional qualifications and information technologies⁵. DGITM currently presides over CESNI's committee on technical prescriptions in 2022. CESNI is composed of experts of the Member States of the European Union (EU), with the addition of Switzerland, and was created by the CCNR (Central Commission for the Navigation of the Rhine) in 2015.

The CCNR⁶ is an international organization responsible for Rhine navigation, counting 5 member states (Germany, Belgium, France, Netherlands, Switzerland), and Observer states (Austria, Bulgaria, Great Britain, Hungary, Luxembourg, Poland, Romania, the Republic of Poland, Romania, the Republic of Serbia, the Slovak Republic, the Czech Republic, and Ukraine) as well as accredited organisations which are involved in its activities.

CCNR's main mission is the adoption of common regulations necessary for the safety of Rhine navigation.

Thus, DGITM, CCNR and CESNI are responsible for inland navigation's norms and regulations. They prepare and issue standards regarding inland navigation's vessels, professional qualifications of crewmembers and general rules.

The river safety instructor services (Instructor Services, IS) are the administrative authority responsible for the implementation of these norms, they are the decentralised services of the State, as such they are under the supervision of department's prefects. They are organised geographically, in 7 Directorates⁷.

IS oversee several administrative procedures related to commercial and recreational vessels, floating devices, and floating establishments in inland waters⁸.

³ This special passenger attestation will be detailed below, in the section 1.1.3.

⁴ The different entities entitled of inland navigation prerogatives are detailed on DGITM's website: <https://www.fluvial.developpement-durable.gouv.fr/l-administration-centrale-r45.html>

⁵ These prerogatives are detailed on CESNI's website: <https://www.cesni.eu/en>

⁶ CCNR's website: <https://ccr-zkr.org/10000000-en.html>.

⁷ These directorates are listed, with specific contact information at the following link: <https://www.fluvial.developpement-durable.gouv.fr/liste-et-coordonnees-des-services-instructeurs-a29.html>

⁸ As defined in article L. 4000-3 of the Transport Code: https://www.legifrance.gouv.fr/codes/article_lc/LEGIARTI000032748283/.

They issue navigation titles attesting the applicable technical compliances regarding technical prescriptions (gauges, navigation permits, vessels registration, etc.), or personnel (Rhine Navigation personnel regulations, service and training books for crew members, special passenger certificates, etc.). They also have prerogatives regarding pleasure navigation.

Some specific institutions or superposition of jurisdictions may rarely be found as, for example, in the Leman Lake, which constitutes the border between the French and Swiss states.

1.1.1.2 *Inland waterways infrastructure managers*

One of the sector's specificities is its administrative organization. If the main entity managing inland waterways' infrastructure in France is VNF (*Voies Navigables de France*), there are a plurality of infrastructure managing entities throughout the country.

Based in Béthune, VNF is a Public Administrative Institution employing 4300 persons in 500 territorial implantations. VNF manages most of the French inland waterways' infrastructures, and is organized in seven regional directorates:

- Nord Pas de Calais
- Seine Basin
- North-East
- Strasbourg (French Rhine ports)
- Central Burgundy
- Rhône-Saône
- South-West

Among other managing entities, the *Compagnie Nationale du Rhône* (CNR) can be noted. CNR is the concessionaire of the Rhône for hydroelectricity production, river transport, agricultural uses, and as such, is responsible for inland waterways' infrastructures management on the Rhône.

In some cases, the waterways managers may also be:

- a seaport (e.g., HAROPA PORT's Rouen agency on the Seine, from Rouen to the estuary);
- the State (e.g., Lake Annecy, French part of Lake Geneva, etc.);
- a local authority (e.g., city of Paris on the Paris Canals, Somme departmental council, Brittany regional council);
- a local public establishment (e.g., local public establishment of the Dordogne River basin).

1.1.1.3 *A unique public decision-maker on the Seine: HAROPA PORT*

HAROPA PORT⁹ is the public port resulting from the merger of Le Havre, Rouen and Paris' harbours.

It constitutes the leading French port complex in France, the 5th largest in northern Europe with more than 110 million tonnes of maritime and river traffic.

HAROPA PORT's prerogatives concern the implantation of actors on the river Seine, as it is the main owner of the Seine's docks, and real estate sites and industrial amenities.

These administrative complexities, the multiplicity of decision-makers, and plurality of exceptions can result in some conflict of competences. For instance, this map highlights the administrative managing entities of the Paris' docks.

⁹ <https://www.haropaport.com/en/discover-haropa-port>.

Barges	344	Not motorized	
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To these numbers, it is necessary to add the figures of inland navigation boats navigating on other networks (such as lakes, or certain canals, for which there is no compiled data available), as well as electric rental boats.

Based on counting processes under development, it is estimated that the electric propelled, or hybrid commercial fleet currently in operations is the following:

	Number of units
Small passenger boats	9
Other passenger boats	14
River cargos	1

Please note that DGITM's data estimates 47 new registration of passenger boats of less than 12 meters annually (pleasure boats included).

1.1.2.2 *An ageing fleet*

In 2019, the estimated average age of the river fleet was 66 years (date of construction). Due to less corrosion than sea water, and relatively calm waters, inland navigation's boats are very well preserved and resilient over the years. Mainly made of steel, boats' hulls and structures stand through time, and are assimilated as real estate assets in some cases (and taxed as such).

French inland navigation's sector's particularity resides in the resilience of its boats. Motorisations, layouts, and sometimes hulls (extensions, shortens, etc.), are adapted on existing boats for new purposes. Old river cargos are refitted to become river houses, sightseeing boats or private boats. This specificity of the French market also explains why the ecological transition of the sector (in terms of number of actions, projects, and subsidies rates) are focused on retrofitting existing boats.

Engines are frequently changed on river boats, but they tend to be ageing as well. Approximately a third of operating boats have engines of the CCNR II generation (built after 2008), a third of the CCNR I generation (built between 2003 and 2008), and a third of older generations (built before 2003)¹⁰.

1.1.2.3 *Shipping fleet*

In 2019, the French operating inland navigation fleet amounted to 1042 cargo boats for a global freight capacity of 1.1 million tonnes.

- Boats typology¹¹

The self-propelled unit (River Cargo)

The self-propelled river cargo (River cargo) is a motorised unit with a transport capacity between 250 and 4,000 tonnes. The self-propelled unit can be combined with a barge depending on its driving capacity.

¹⁰ Estimations based on a work document issued by VNF.

¹¹ Data from ADEME's study on energy efficiency of the French inland waterway transport : <https://bibliothèque.ademe.fr/air-et-bruit/775-efficacite-energetique-et-environnementale-du-transport-fluvial-de-marchandises-et-de-personnes.html>, pp.19 and following.

Barges

Barges are non-motorised units with a hold for transporting goods; the advantage of barges is that they can be immobilised at a lower cost than self-propelled vehicles. The barges are pushed by self-propelled cargos or pushers.

Pushers

Pushers are boats with powerful engines that can propel up to 6 barges in convoys (up to 180 m in total length). The separation of the barge from the pusher during the load breaking or handling phases enables the pusher not to be immobilised.

- River cargos fleet

According to VNF's 2019 data, the inland navigation self-propelled cargo fleet was the following¹²:

Type of River Cargos	Number of Units
1500 tonnes and more	234
From 1000 tonnes to 1499 tonnes	144
From 400 tonnes to 999 tonnes	364
Inferior to 400 tonnes	300
TOTAL	1042

Annex 1 describes the different technicalities of the different river boats (size, drafts, accessible gauges class, etc.).

1.1.3 Inland waterways networks and navigation requirements

In this section, the data is sourced from a 2019 study on the energetic efficiency of inland waterborne transport by the French Environment and Energy Management Agency (ADEME), where additional information about inland waterways networks can be found¹³.

France has an 8 500 km navigable network (rivers, canals). In 2017, this network was used for the transport of goods and passengers (river tourism) at 57% of its capacity. In 2000, 68% of this network was in use.

1.1.3.1 Transport of goods

The different waterways are differentiated by gauge, depending on their dimensions and the permissible deadweight for inland waterway transport units.

Gauge	Class	Deadweight (tonnes)	Network share
Small Gauge	0	50t to 250t	1 %

¹²<https://www.vnf.fr/vnf/accueil/logistique-fluviale/economie-du-secteur-logistique/la-flotte-fluviale-caracteristiques-et-chiffres-cles/>

¹³<https://librairie.ademe.fr/air-et-bruit/775-efficacite-energetique-et-environnementale-du-transport-fluvial-de-marchandises-et-de-personnes.html>, pp. 7-14.

	1	250t to 400t	59 %
Medium Gauge	2	400t to 650t	4 %
	3	650t to 1000t	4 %
Large Gauge	4	1000t to 1500t	1 %
	5	1500t to 3000t	4 %
	6	> To 3000t	27 %

Table 1: Distribution of the waterway network by gauge, VNF, quoted in the ADEME study

The large-gauge waterways (1000 tonnes and over of permissible deadweight DWT) correspond to the Seine, the Rhine, the Rhone and the Moselle. The large-gauge waterways represent more than 30 % of the navigable network. The small-gauge waterways, used mainly for "inter-basin" navigation, represent 60 % of this national network. This network of secondary routes is exclusively accessible to small-gauge units (known as "Freycinet") of less than 400t DWT. Annex 1 describes the type of boats that can access the different gauges by class.

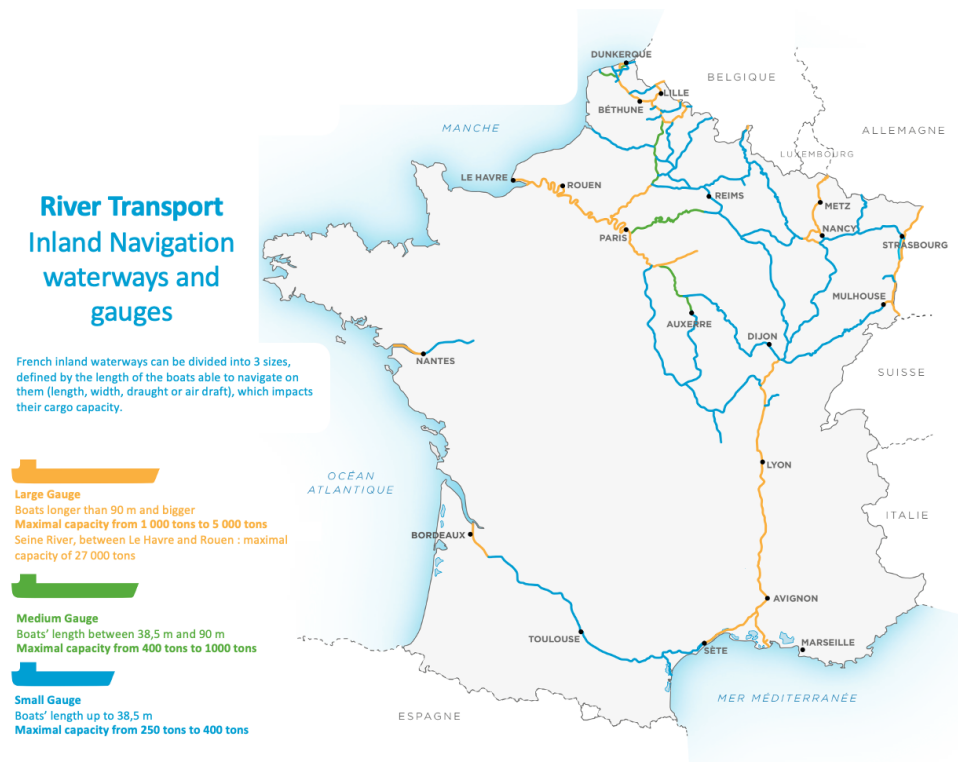


Figure 22 - Map of the different gauge networks, source VNF

Approximately 20 % of the 8,500 km of French waterways (1,800 km) are suitable for convoys of 3,000 tonnes and more. It is considered that 6,000 km of the navigable network are regularly used for the transport of goods or passengers, while the remaining 2,500 km are used to a lesser extent: 1,500 km are mainly used for pleasure boating, while the remainder (about 1,000 km) are no longer used for navigation.

The major French navigable basins are organised around large-gauge navigable waterways (Seine, Rhine, Rhône, etc.) allowing the navigation of vessels of up to 135 m or even 180 m. These basins are linked by intermediate gauge waterways (>38.5 m and <90 m) or small gauge waterways.

The detail of the waterways network is shown in 6 geographically focused high-resolution maps that can be downloaded at the following links:

- [Nord Pas de Calais](#)
- [Seine Basin](#)
- [North-East and Rhine](#)
- [Centre region and Burgundy](#)
- [Rhône Saône](#)
- [South-West](#)

1.1.3.2 Boats specifications and police regulations

The rules and specifications concerning boat requirements and inland navigation operations in general are compiled in the French Code of Transport¹⁴. These regulations determine the general rules concerning boats requirements (boats registration, gauges, navigation titles, crew requirements, as well as other specific dispositions).

Inland Navigation's general police regulations (RGP)¹⁵ compile navigation rules at a national scale which may be completed by special police regulations (RPP).

These regulations make adaptations to the general rules which are necessary due to local circumstances, in particular because of the characteristics of the watercourses concerned.

RPPs may define specific provisions concerning:

- Structures' dimensions
- Size of admissible vessels
- Maximum speed allowed
- Rules for certain modes of navigation
- Rules restricting certain modes of navigation
- Special safety rules (e.g., life jackets)
- Blind zones' characteristics
- Radio communication devices (VHF), automatic identification systems (AIS) or electronic chart display systems (ECDIS)
- Navigation rules (passing, overtaking between vessels)
- Mooring rules (mooring, anchoring, lock garages)
- Pleasure boating and water sports

There are 7 RPPs referenced by VNF, and available at the following links:

- [Nord Pas de Calais](#)
- [Seine Basin](#)
- [North-East](#)
- [Strasbourg and Rhine](#)
- [Centre region and Burgundy](#)

¹⁴ DGITM's compilation of inland navigation's specificities https://www.fluvial.developpement-durable.gouv.fr/IMG/pdf/2020_06_recueil_cdt_partie_4_i-ii.pdf

¹⁵ https://www.fluvial.developpement-durable.gouv.fr/IMG/pdf/recueil_rgpni_2019_09.pdf

- [Rhône-Saône](#)

- [South-West](#)

Other navigation rules are available on DGITM's website, regarding harbour navigation rules, geographical information, navigation rules on the Rhine and in international waters in Moselle, Lemman Lake's specificities, etc¹⁶. Please note that there are navigational zones from 1 to 5 determined by the navigation conditions, defined in the 2nd of October 2018 ministerial decree¹⁷. Boats certificates and Union certificates (as defined in section 1.4.2) mention the restricted zones where a boat is allowed to navigate in case of restrictions.

1.2 French river sector market

In this section, the inland waterway sector will be studied, with an emphasis on passenger transport and shipping companies. Unfortunately, statistical data are rare in this sector, and only a few studies have addressed the statistics of the river sector activity. Notably this concerns some specific passenger transport services (for instance public transport, or power boats with a length shorter than 20 metres).

On a European scale, the CCNR (Central Commission for the Navigation on the Rhine) publishes public global market overviews, gathering information with an emphasis on river cargo transport and river cruises¹⁸.

1.2.1 Passenger transport overview

1.2.1.1 Tourism passenger transport activities

In this section, sightseeing cruises, as well as river cruise-liners, and houseboat hotels are addressed with data sourced by VNF, in a 2020 study¹⁹. The total fleet of these types of boats amounts to 603 boats with 326 sightseeing boats, 188 cruise liners, and 89 houseboat hotels, totalizing 11 million passengers transported. Please note that Paris represents more than 70 % of the French market and accounts for the vast majority of transported passengers.

One of the specificities of French inland waterborne transport consists in the small size of operating companies. Tourism passenger boats are no exception with 88.1 % of tourism transport companies counting less than 10 employees.

Sightseeing cruise boats

Sightseeing cruise boats are passenger transport boats with a minimal capacity of 13 passengers and no accommodation but the possibility to offer catering services. The boats can differ in size or passenger capacity, with an important difference between Paris and the rest of the country. Paris represents approximately a third of the French sightseeing boats' fleet, and the average capacity of a Paris sightseeing boat is 278 passengers versus 92 passengers in the rest of the country.

Sightseeing cruises amount to 11 million passengers nationwide, with total revenues in the French market of approximately 190 M€ (taxes excluded), with 130 M€ only in Paris. For information, the *Compagnie des Bateaux Mouches* company first introduced tourism sightseeing cruises in the 1950's and amounted to 2.5 million passengers transported before the 2020 pandemic in Paris.

¹⁶<https://www.fluvial.developpement-durable.gouv.fr/connaitre-les-regles-applicables-selon-les-zones-r103.html>

¹⁷ https://www.legifrance.gouv.fr/download/pdf?id=03QWdU4u_hbCiVa4fAPOJf00OY2r1ad3LaVVmnStGvQ=

¹⁸ <https://ccr-zkr.org/13020800-fr.html>

¹⁹ VNF's 2020 study on French river tourism transport <https://www.vnf.fr/vnf/brochure-et-lettress/portraits-de-filieres/>

The sizes of the different sightseeing structures differ a lot. Some corporate groups like Sodexo (owning the premium company *Yachts de Paris* or the leading Paris sightseeing company *Bateaux Parisiens*) have invested the market, but most of the companies are SMEs.

Outside Paris, sightseeing cruises is a dynamic market, with some structured companies such as Batorama, a sightseeing company located in Strasbourg. They constitute the first tourism activity of the Great-Est region with approximately 800 000 passengers, their revenues amount to 10 M€ and have launched a 30 M€ ecological transition program, all while diversifying their activity with smaller electric vessels cruises.

1.2.1.2 *Cruise liners*

Cruise liners are passengers transport vessels offering an average cruise of 6.7 days with accommodation. Over the last 5 years, there has been a 50 % increase of cruise liners amounting to 52 vessels for 17 companies, 188 vessels including international cruises on the Rhine.

Cruise liners have an average capacity of 150 passengers and measure between 80 and 135 metres long. The average duration of a cruise is 6.7 days, for 5.9 stops. Due to their relatively important dimensions and capacity, most of cruise liners can only navigate on the large gauge waterways network, which has been detailed in the previous section (1.1.3)

This activity's total revenues represent 438 M€ (taxes excluded) and more than 200 000 passengers per year. The leading European river cruising company is French, Croisieurope, with 55 boats and 200 000 passengers yearly throughout Europe²⁰.

1.2.1.3 *Houseboat hotels*

Houseboat hotels are passenger transport vessels offering an average cruise of 6.7 days with accommodation. Their activity is similar to cruise liners at a smaller scale. Houseboat hotels navigate mainly in the smaller waterways network, and count between 6 to 20 passengers.

France is the world leader in the houseboat hotels business, with the development of offers such as bicycle and cruises trips combinations, or premium cruises promoting French "art de vivre".

This activity counted 68 operators and 89 boats in 2020, with approximately 15 000 passengers transported and total financial revenues of 54,4 M€ (taxes excluded).

1.2.1.4 *Passenger transport companies – ferries*

Passenger transport from a point A to a point B — similar to, or a part of public transports — has not been studied by any professional organization, although the few existing services in the country amount to a high level of activity. With the current environmental requirements from public and private deciders, and customer expectations in terms of mobility, this market appears promising and could be an opportunity for Norwegian companies. In the past, this type of service was marginal in the French market but has seen a growing interest from the different stakeholders. Public entities like municipalities, metropolises, departments, or regions have recently been interested in diversification with more environmentally friendly public transport. Thus, river transport has been investigated as a modal shift opportunity, transporting passengers with their bikes for instance. The number of public consultations, or developments of such passenger transport services has been growing²¹.

This section aims at describing a few operating ferry services, and to describe the French specificities of this activity.

Some river transport services have been in operations for decades, for instance, Batobus, a transport service located in Paris (part of the Sodexo group), created in 1989, operating six catamarans with nine stops located at

²⁰ <https://www.croisieurope.com/information/societe#-croisieurope-une-entreprise-familiale-alsacienne-libre-et-independante>

²¹ Some European services are described in CCNR's study, https://ccr-zkr.org/files/documents/om/om21_IV_en.pdf, pp. 37-43.

the heart of Paris, and transporting 1.8 M passengers every year. This boat service is not fully integrated in the public transport offer, and a special ticket or pass must be bought. The possibility to buy day passes has placed Batobus among the favourite means of transport for tourists in Paris, making the company an indirect competitor for sightseeing cruises operators.

Another highly used service consists of Icade's free electric ferry service²², which has been running since 2007 in Paris, on the Saint-Denis Canal, linking Paris' metro with the "Millénaire", an entity regrouping a mall and several headquarters (Chanel, Ministry of Justice, BNP Paribas, Véolia, etc.). This service transports up to 1.5 million passengers a year on four catamarans. The service is free of charge, and is funded by ICADE, the "Millénaire"'s park developer part of the Caisse des Dépôts et des Consignations public group.

In Bordeaux, the BAT3 service²³ has been diversifying the city's public transport offer since 2013 with three catamarans ferries transporting up to 45 passengers and six bikes per ride and up to 415 000 passengers annually in 2019. In Nantes, Navibus offers a similar six boats service²⁴, integrated, like in Bordeaux into the public transport offer and accessible to passengers with a regular public transport ticket or subscription.

Some other specific services linking riverbanks as a public service are also being operated on rivers (e.g., Rouen²⁵, Nogent-sur-Marne²⁶). These services, similarly to Icade's electric ferries, are free for the final user, and the services are operated by boatowners remunerated by public entities to develop these mobility offers. The business models of river passenger transport in the French market are thus mainly offer-oriented with a participation of public or para-public entities.

One example highlights the difficulties of the development of a passenger ferry service: Voguéo. In the Paris Region, Ile-de-France Mobilités tested a river ferry between 2007 and 2011 called Voguéo and operated by Batobus, linking Maison-Alforts to the Austerlitz train station in 35 and later 28 minutes. The service was not fully integrated in the public transport offer and a special subscription was to be bought. The service was supposed to become operational in 2013 but was never implemented due to a lack of a viable business model.

Inland navigation car carrying ferry services are operated, especially in the Seine-Maritime department. The Seine maritime service is using eight ferries, (six considered inland navigation boats), transporting up to 10 vehicles and 50 passengers²⁷. The service, operated by the Seine-Maritime department is free for the final user and amounts to 3 million passengers per year. Some smaller units are used in Angers to transport cyclists and hitchhikers²⁸.

To resume this overview of French passenger transport's specificities:

- Inland navigation public passenger transport is marginal in the French mobility market
- Public sector develops a growing interest on waterborne transport
- Business models of existing services tend to rely on public entities' participation

²² <https://www.pariscanal.com/navettes-electriques-paris/>

²³ <https://www.infotbm.com/fr/bat3.html>

²⁴ <https://metropole.nantes.fr/navibus>

²⁵ A solar-electric boat is used to connect a car parking lot with a hockey stadium during hockey games in Rouen: <https://www.metropole-rouen-normandie.fr/actualite/2021/hockey-la-navette-solaire-pour-aller-au-match-15806>

²⁶ <https://www.valdemarne.fr/vivre-en-val-de-marne/actualites/les-passeurs-de-rives-reprennent-du-service>

²⁷ <https://www.seinemaritime.fr/mon-cadre-de-vie/routes-bacs/bacs-de-seine.html>

²⁸ <https://www.tourisme.destination-angers.com/sejours-angers-nos-inspirations/prendre-le-bac-a-angers>

1.2.1.5 Smaller passenger transport vessels

A recent activity that has been booming is the commercial exploitation of “Small boats”, an administrative European category of boats measuring less than 20 metres, able to transport up to 12 passengers. Almost non-existent ten years ago, they approximately represent 15 % of the Paris area commercial river fleet.

This niche activity has benefited from the health crisis, allowing small groups of people to enjoy private cruises. Unfortunately, statistical data is rare concerning this type of boats. VNF counts 40 operating passenger boats smaller than 20 metres, which seems underestimated, and excludes the waterways under another administrative management (such as lakes), or rental boat fleets. In Paris only, approximately 25 boats of small passenger transport vessels are commercially operated²⁹.

This type of boats is mainly used for private sightseeing cruises, but on-demand water transportation has seen a growing development. Such a service has been developed on lakes near Annecy³⁰. Another similar service has been developed in Strasbourg by the sightseeing company Batorama³¹ with electric powerboats provided by the Danish company Rand. This diversification of activity by a sightseeing company is also being developed in Paris.

Small boat activities are booming. In Paris, tenders for fixed activities along the river promote the development of small boats activities which benefit from a positive image compared to sightseeing companies assimilated to mass tourism.

Please note that another business case with small river vessels exists on small waterway network, especially on the Midi Canal (linking Toulouse to the Mediterranean Sea): rental boats with accommodation. These boats, inferior to 15 metres, and up to 12 passengers can be driven without a river license (thanks to a small engine power), and annually amount to 130 000 passengers and 45,9 M€ (taxes excluded) of total revenues for 1 603 boats.

1.2.2 Inland navigation shipping activity

In this section, inland navigation shipping activity will be described. First general information, trends, and key figures will be presented before an overview of the type of goods transported on the river. Then, the articulation of the shipping logistics and structures will be presented before an overview of the river shipping companies operating in the French market.

1.2.2.1 General overview of the French Market

French inland waterways are constituted of 6800 km of rivers and canals, with 1800 km accessible to the biggest river cargo (1350T – 3000T). As previously mentioned, in 2019, the French inland navigation fleet was 1042 cargo boats strong for a global freight capacity of 1.1 million tonnes³².

French river cargo transport amounts to 5.2 % of the total transport performance in Europe (in tonnes-km)³³, and the modal split of waterway transport in France represents 2.2 % of inland transport in 2020³⁴.

²⁹ As previously mentioned, DGITM counts 47 new small boats and pleasure boats registration annually

³⁰ <https://www.water-taxi.fr/en/with-friends-or-family/entre-amis-transfert/>

³¹ <https://www.batorama.com/en/nao-electric-boat>

³² VNF's 2019 study on French river cargo transport https://entreprises-fluviales.fr/wp-content/uploads/2020/11/LesChiffresDuTransportFluvial_2019.pdf

³³ CCNR's 2021 annual report: https://ccr-zkr.org/files/documents/om/om21_II_en.pdf, pp. 22

³⁴ Source: Eurostat Data browser https://ec.europa.eu/eurostat/databrowser/view/sdg_09_60/default/table?lang=en

It is commonly stated that river transport could be doubled on the existing inland navigation waterways with no need to create new infrastructures³⁵. Compared with road saturation, greenhouse gas emissions caused by road transport and environmental preoccupations from final consumers and public entities, inland waterway transport represents strong growth potential and new market opportunities.

With 7.4 billion of tonne-kilometres transported in 2019 (pre-COVID), the sector registered a 10 % growth compared to the previous year's traffic. In terms of volume, the sector represented in 2019 a global volume of 56.3 million tonnes of transported goods (+9 % in 2019 compared to 2018 levels), with a relative stability³⁶. Despite the COVID-19 pandemic, in 2020, French inland waterway transport amounted to seven billion tonne-kilometres of transported goods³⁷.

These figures do not count the volumes of goods transported on the French segment of the Rhine. For information, in 2021, the total volume of goods transported on the Rhine is 55 billion tonne-kilometres³⁸.

Let us note that the number of operating cargo boats has been decreasing (1 042 in 2019 vs 1 792 in 2000). This reflects the transformation of the average cargo, with an increase of the average capacity from 650 tonnes in 2000 to 920 tonnes in 2019³⁹. This transformation of the average French inland navigation cargo explains the decrease of small sized cargos, able to navigate in the small gauge waterways network (from 800 units in 2000 to less than 300 in 2016).

Inland waterway transport is often considered more ecological than road transport. Indeed, with a single river cargo convoy, the amount of transported goods can be equivalent to a maximum of 250 truckloads. The massification of goods stored on a river cargo makes this type of transport also more energy efficient.

With 1 kg of oil-equivalent, 1 tonne of merchandise can be transported for 275 km by river shipping, vs 130km by rail and 50 km by road (highway)⁴⁰.

This environmental performance is one of the reasons why VNF promotes inland waterway transport. This promotion can take the form of a subsidy, through the PARM program (Plan d'Aide au report Modal), subsidizing up to 50 % of feasibility studies to transport goods through the river (capped at 25k€ per project). This program can also fund part of shipping transport experimentations or handling machines⁴¹.

Please note that this program ends in 2022, and a new PARM will be presented in 2023. The details of this new PARM have not been published or shared for the moment.

1.2.2.2 Shipping intermediaries

Waterway transport may imply intermediaries intervening between shippers and transporters.

³⁵ As previously mentioned, inland navigation waterways' network is used at 57 % of its capacity. In the biggest cities, the current flow of transport could be multiplied up to 4 times.

³⁶ Figures issued by the professional federation of the sector: Entreprises Fluviales de France, <https://entreprises-fluviales.fr/chiffres-cles>

³⁷ https://ccr-zkr.org/files/documents/om/om21_II_en.pdf, pp. 27.

³⁸ https://ccr-zkr.org/files/documents/om/om21_II_en.pdf, pp. 26.

³⁹ ADEME's 2019 study details this transformation of the fleet: <https://bibliothec.ademe.fr/air-et-bruit/775-efficacite-energetique-et-environnementale-du-transport-fluvial-de-marchandises-et-de-personnes.html>, pp.19 and following.

⁴⁰ <https://www.vnf.fr/vnf/brochure-et-lettress/guide-pratique-des-achats-publics-durables-et-climato-esponsables/>, pp. 6.

⁴¹ <https://www.vnf.fr/vnf/brochure-et-lettress/guide-pratique-des-achats-publics-durables-et-climato-esponsables/>, pp. 15.

Inland waterway transport brokers link shippers and transporters, whereas commissionaires (shipowners, cooperatives, or independent consultants) organize the transport and have the transportation operated under their legal responsibility⁴².

Model contracts may be drawn based on trips (single trip or multi-trips), on tonnage for a specific duration, or on a time basis (provision of a cargo vessel and the crew for a determined period of time)⁴³. The contracts between transporters and boatowners or artisans are generally short-term. The ecological transition represents the opportunity to develop long-term commitments from transporters, and to give boatowners a greater employment security, while increasing their companies' value.

Intermediaries are not mandatory in the contracting process: transporters and boatowners or artisans may deal directly, and some companies may acquire cargos and employ crews to answer their own internal needs — this solution is chosen among the largest French shipping companies.

Please note that VNF publishes a directory of brokers, commissionaires, and transporters' contacts on their website⁴⁴.

1.2.2.3 Companies

98 % of Most of inland waterways transport companies are artisanal: 650 companies, each counting less than 10 employees operating more than 700 boats together. Only approximately 10 companies (2 %) are industrial and operate the remaining 300 boats.

Among the industrial inland waterway transport companies, the following companies are the largest:

Company	Fleet	Activity
CFT (Compagnie Fluviale de Transport)	80 pushers, 120 cargos and barges	Materials, containers, oil products, gas, chemicals
CEMEX	12 pushers, 100 barges e	Materials
Lafarge	9 pushers, 65 barges	Materials
LMPS	11 pushers, 15 barges	Bulk transport
FluvioFeder	8 cargos	Containers and bulk transport
Vinci	12 pushers, 45 barges, 5 workboats, 15 pontoons	Materials, riverbanks and floating waste clean-ups

1.2.2.4 Type of transport

In 2019, 45 % of transported goods through inland waterways were construction materials and salt, followed by agricultural products (25 %), energy-related products (9 %), heavy packages, containers, and automobiles (7 %), metallurgy (7 %) and chemicals and fertilizers (7 %).

⁴² The definition and legal references related to these intermediaries are detailed by the DGITM: https://www.fluvial.developpement-durable.gouv.fr/intermediaires-de-transport-a210.html#sommaire_1

⁴³ These model contracts can be found as annexes to the fourth book of the transport code: <https://www.legifrance.gouv.fr/codes/id/LEGISCTA000027245034/>

⁴⁴ <https://www.vnf.fr/vnf/app/uploads/2022/03/Transporteurs-fluviaux-en-France-mars2022.pdf>

A detailed analysis of French inland waterway transport activity in 2020 can be found in VNF's 2019 study on French river cargo transport⁴⁵. ADEME's 2019 study on energy efficiency also details river transport's sectors of activity⁴⁶.

Urban logistics is a promising sector, for the same multi-factors as passenger transport activity. With the current environmental requirements from public and private deciders, road congestion, and final customers' expectations in terms of carbon footprint, waterborne urban logistics appears as a strong market potential. European opportunities and examples of pilot projects are addressed in a study by CCNR assessing the general market opportunities of inland waterway transport⁴⁷.

For example, in Paris, a project launched in 2016 called FLUDIS⁴⁸ has been proposing an electric urban logistics solution⁴⁹:

- A semi-trailer truck transport manufactured goods directly to the boat in Austerlitz (Paris)
- Outbound journey: transport of office supplies for the French company Lyreco
- Navigation time is valued onboard: the packages are prepared (break down of pallets and reconstitution of the loads)
- Cargo bikes deliver the goods to the final consumer in different Paris stops
- The return journey consists of a transportation of waste from Paprec

In Strasbourg, the Urban Logistics Solutions (ULS)⁵⁰ launched a package delivery service in 2020. Packages are transported from one side of Strasbourg's harbour to the other side and stored in containers before being delivered to the final consumer by cargo bikes.

ULS has implemented such as service in June 2022, in Lyon, with a thermal propelled pusher boat⁵¹, and similar tests are being run in Paris by Warning+ and Box2Home⁵².

1.3 Purchasing system

1.3.1 Public purchasing system

Public purchase represents all the contracts concluded between a public buyer or an authority within a public service mission to meet their needs in terms of projects, supplies or services with private actors.

The legislative frame of public purchase is the Public Purchase Code⁵³ which ensures the market's freedom of access and candidates' equity in the attribution and the procedure's transparency.

⁴⁵ https://entreprises-fluviales.fr/wp-content/uploads/2020/11/LesChiffresDuTransportFluvial_2019.pdf

⁴⁶ <https://librairie.ademe.fr/air-et-bruit/775-efficacite-energetique-et-environnementale-du-transport-fluvial-de-marchandises-et-de-personnes.html>, pp. 14 and following.

⁴⁷ https://ccr-zkr.org/files/documents/om/om21_IV_en.pdf, pp. 44.

⁴⁸ <https://fludis.eu/?lang=en>

⁴⁹ Idem, pp.49

⁵⁰ <https://www.ortl-grandest.fr/nouveau-service-logistique-urbaine-fluviale-strasbourg/>

⁵¹ <https://www.vnf.fr/vnf/avec-le-soutien-de-vnf-lyon-accueille-son-premier-service-de-logistique-urbaine/>

⁵² <https://www.voxlog.fr/actualite/6666/box2home-et-warning-veulent-democratiser-le-fluvial-a-paris>

⁵³ https://www.legifrance.gouv.fr/codes/texte_lc/LEGITEXT000037701019/

Different rules are set based on thresholds regarding the market size⁵⁴, making the public purchase more or less flexible. The main threshold rules are the following:

- Below 40 000€: the public purchase's publicity is not mandatory
- Between 40 000€ and 89 999,99€: flexible and "adapted" publicity conditions
- Supply and Services: Between 90 000€ and 213 999€: stricter publicity conditions: publicity in a Legal add Journal (JAL) or an Official Public Markets Add Bulletin (BOAMP)
 - The threshold is of 5 349 999€ for a public works contract
- Above 214 000€ (5 350 000€ for a public work contract): publicity in an Official Public Markets Add Bulletin as well as in the Official Journal of the European Union⁵⁵ (OJEU)

These general rules are detailed below with different types of public purchase and consultations.

1.3.1.1 Negotiated procedure with no publicity nor competition

Public purchases of a value inferior to 40 000€, may be concluded directly between public and private actors without publicity or competition.

Please note that public actors may choose to go through public consultations, to use electronic catalogues (described below) even though they are not legally obliged to.

1.3.1.2 Tenders

Adapted procedure market

For markets between 40 000€ and 90 000€, the publicity must be "adapted" according to the public buyer's appreciation in order for the competition to be granted the public market to be sufficient.

The criteria for which the publicity is considered "adapted" depend on the object, nature, complexity, the level of competition between the concerned companies, the emergency of the need, and the potential audience.

The period between the emission of the market's call and the deadline is not legally defined but must be reasonable, according to the complexity of the expected application.

Above the 90 000€ threshold, only the market's publicity conditions differ, as previously mentioned.

Some other procedures may be chosen by public buyers: competitive discussions, procedures with negotiations, electronic auctions, electronic catalogues.

1.3.1.3 Electronic catalogue

UGAP (standing for the Union of Public Purchasing Groups, *Union des Groupements d'Achats Publics*) is an industrial and commercial public establishment. UGAP is the only French general central purchasing office. UGAP emits tenders for specific products or services and references the laureates for public buyers for a determined period⁵⁶. As the products are already qualified through a tender, public buyers do not need to go through a specific procedure.

UGAP commissions 7 % of the purchase, and different rates are generally charged the public buyers depending on their size and specific contracts with UGAP.

Suppliers must indicate the price they charge, and UGAP is the commercial intermediary negotiating directly with public buyers, including commercial prospection.

⁵⁴ The thresholds can be calculated with a simulator: <https://entreprendre.service-public.fr/vosdroits/F23371>

⁵⁵ <https://eur-lex.europa.eu/oj/direct-access.html>

⁵⁶ Example of the electric-propelled semi-rigid inflatable boat, constructed by Naviwatt: https://www.ugap.fr/catalogue-marche-public/embarcation-electrique_111482.html

Please note that UGAP's tenders

- Are not restricted to French companies
- Expect a high level of technical details and consider the applicant's internal environmental policies, or the company's social responsibility (waste management, etc.)

This type of procedure presents a few advantages for public buyers:

- Time: public buyers can directly place an order, and do not have to organize any public consultation
- Resources: public buyers generally hold a tender to select a project management assistant responsible for the technical specificities of the tender or market's publicity. UGAP's process, charging 7 % of the purchase may amount to less resources

1.3.1.4 Call for proposals

Although quite frequently used by public buyers⁵⁷, call for proposals do not have a strict legal definition. They are generally following a call for expressions of interest (AMI, *Appel à Manifestation d'Intérêt*), aiming at pre-selecting candidates for undertaking a project. Call for proposals represent a quite innovative public purchase publicity, but do not constitute a public market as such.

The president of the Association for Public Purchase in Public Services (APASP) defines call for proposals as a competitive bidding procedure of private actors by public buyers based on a document fixing the objectives to achieve and leaving the private actors the initiative of the proposal's content and its implementation⁵⁸.

Thus, call for proposals define a thematic frame with an objective. Private operators conceive and define the operations to realise and finance the project.

1.3.2 Public purchase's useful links

1.3.2.1 Useful links

Unfortunately, there is no centralised platform gathering all the public consultations, publicities, and tenders. The BOAMP (*Bulletin Officiel des Annonces des Marchés Publics*, official bulletin of public purchases calls) represents the main digital centralising entity, indicating calls, results of consultations and closed tenders.

Nonetheless, it is necessary to follow different centralising and general platforms, using keywords alerts to be sure not to miss a pertinent tender or consultation. Please note that most of the platforms and calls are only published in French language.

Some of the following platforms are important to monitor:

Name	Link	Detail
BOAMP (official bulletin of public purchases calls)	https://www.boamp.fr/pages/entreprise-accueil/	Official public markets platform

⁵⁷ Paris 2024's call for proposals: <https://www.paris2024.org/fr/modeles-livraison-evenements-sportifs-paris-2024/> ; laureates form the Reinventing the Seine call for proposal: <https://www.lehavre.fr/espace-presse/reinventer-la-seine-decouvrez-les-projets-laureats>

⁵⁸ <https://www.lemoniteur.fr/article/comment-distinguer-les-appels-a-projets-des-marches-publics.1953214>

Public Purchase platform of the State	https://www.marches-publics.gouv.fr/?page=Entreprise.AccueilEntreprise	Official platform for public purchases
AW Solutions	https://awsolutions.fr/blog/	General public tenders and calls catalog
Marchés Online	https://www.marchesonline.com/	
La salle des marchés	https://www.achatpublic.com/sdm/ent/gen/index.do	
Marchés Sécurisés	https://www.marches-securises.fr/entreprise/?	
France Marchés	https://www.francemarches.com/	
#entreprises2024	https://entreprises2024.fr/category/appels-doffres/	Paris 2024's tenders and calls platform
HAROPA PORT	https://www.haropaport.com/en/marches-publics	Calls from HAROPA PORT
Maximilien	https://marches.maximilien.fr/entreprise	General platform specialized in the Ile-de-France Region
CNR's publicity	https://www.cnr.tm.fr/appels-a-manifestation-dinteret-ports/	Calls from the CNR

1.3.2.2 Upcoming tenders

There is no major tender that has been announced in the near future. Please note that [UGAP's 2022-2023 consultation program](#) has been published.

VNF has issued an autonomous boats [call for proposals](#) aiming at developing autonomous vessels demonstrators before 2024's Olympics.

Please note that a public consultation will be published by VNF by the end of the year regarding expertise in retrofitting boats. The call will be issued within Energy Economy Certificates' Remove program⁵⁹ and will consist in creating project management assistance teams with fixed fees depending on the type of boat involved (AMO). The objective will be to bring technical and operational support to boatowners' retrofitting projects (preliminary studies, retrofitting studies, electrical architecture design, supplier consultation and integration supervision). (See section 3.2.2.)

This call should not exclude international competition but will be focused on developing a local ecological transition ecosystem.

1.3.3 Private purchase

There are no codes or specific legal frame for private purchase. There are nonetheless specificities regarding the ecological transition of inland navigation fleets.

Some companies called integration companies have the technical expertise and are missioned by boatowners to design retrofits architectures or new constructions and to run supplier consultations. The main integration

⁵⁹ Energy Economy Certificates' (CEE) standardized operations will be detailed in the 2.3.2 section ; for more information on the Remove program: <https://www.ecologie.gouv.fr/cee-programmes-daccompagnement>.

companies are listed in the section 3.2.2, as potential partners for Norwegian companies. They are the target of VNF's tender to come and are the actors responsible for private purchase.

Please note that boatowners and operators have the decision-making power, and may choose not to go through suppliers' consultations, but to work directly with solutions providers.

The tendency seems to indicate that larger companies tend to adopt a consultation process similar to a public tender, to avoid any conflicts and to promote transparency.

1.4 Technical requirements for inland navigation vessels

If general boat specifications and requirements are compiled in the French Code of Transports⁶⁰ (as mentioned in section 1.1.3.), some specific technical requirements and norms set out technical requirements for inland navigation vessels, their navigation permits and its obtainment.

1.4.1 Applicable technical prescriptions for French Inland Waterways Vessels

1.4.1.1 European norms

The European Union 2016/1629 directive⁶¹, completed by the Commission Delegated Directive (EU) 2018/970⁶² lay down technical requirements for inland waterway vessels. This directive is linked with the Directive 2009/100/EC⁶³ on reciprocal recognition of navigability licences for inland waterway vessels.

Annex II of Directive (EU) 2016/1629 refers to the ES-TRIN standard (European Standard for Technical Requirements for Inland Navigation Vessels), which sets out the technical requirements for vessels and floating devices to which a Union certificate is issued. These requirements are also applicable to vessels and floating devices to which a Rhine Vessel Inspection Certificate is issued in accordance with Article 1.03 of the Rhine Vessel Inspection Regulation⁶⁴.

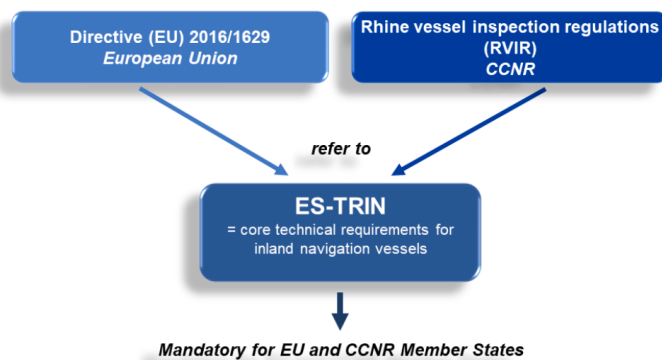


Figure 23 - Source: CESNI

ES-TRIN contains:

⁶⁰ DGITM's compilation of inland navigation's specificities https://www.fluvial.developpement-durable.gouv.fr/IMG/pdf/2020_06_recueil_cdt_partie_4_i-ii.pdf

⁶¹ <https://eur-lex.europa.eu/legal-content/FR/TXT/?uri=CELEX:32016L1629>

⁶² <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32018L0970&from=FR>

⁶³ <https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32009L0100&from=FR>

⁶⁴ <https://www.ccr-zkr.org/13020500-en.html>

- general provisions (part II - provisions on construction, equipment and rigging, chapters 3 to 18) which apply, unless otherwise stated, to all vessels to which a Union certificate is issued
- special provisions (Part III, Chapters 19 to 31) which lay down specific rules for certain categories of vessels or floating devices
- transitional provisions (Part IV, Chapters 32 and 33) which allow older vessels to derogate from certain requirements for a limited period

The current version of ES-TRIN is the 2021 version⁶⁵. Periodic revisions are issued (ES-TRIN 2022 will be applicable in 2023).

1.4.1.2 French norms

The technical requirements applicable to vessels, floating devices and floating establishments are defined according to the nature of the floating craft, its use and navigation zone (as mentioned in section 1.1.3.).

In application of the French Transport Code, the following decrees define technical prescriptions applicable:

- Decree of the 5th of November 2018⁶⁶: technical safety prescriptions applicable to inland navigation boats and floating establishments
- Decree of the 2nd of October 2018⁶⁷: definition of the navigation zones for commercial vessels, recreational craft and floating machines as well as additions to or reductions in the technical requirements applicable in some of these navigation zones
- Decree of the 17th of October 2013⁶⁸: specific prescriptions for inland navigation in French Guyana
- Decree of the 20th of August 2019⁶⁹: issuing navigation titles for a restricted area (AZR, *Arrêté de Zone Restreinte*)

Please note that specificities and additions in the applicable technical requirements are applicable for the transport of dangerous goods, see the international ADN agreement⁷⁰.

1.4.1.3 Navigation titles

Crafts in French and EU waterways must carry a navigation title, which can be either a Union Certificate (or rhine vessel inspection certificate) or a boat certificate.

For boats longer than 20 metres, of 100 m³ or more; carrying more than 12 passengers; floating establishments or pushers and tugboats (with exceptions) navigation titles are either:

- a Union certificate for inland navigation vessels
- a Rhine Vessel inspection certificate

For other boats (and pleasure crafts):

- A boat certificate

⁶⁵ https://www.cesni.eu/wp-content/uploads/2020/10/ES_TRIN_2021_en.pdf

⁶⁶ <https://www.legifrance.gouv.fr/loda/id/JORFTEXT000037738393/>

⁶⁷ <https://www.legifrance.gouv.fr/loda/id/JORFTEXT000037469594/>

⁶⁸ <https://www.legifrance.gouv.fr/loda/id/JORFTEXT000028114860/>

⁶⁹ <https://www.legifrance.gouv.fr/loda/id/JORFTEXT000039050476/>

⁷⁰ <https://unece.org/fr/node/4524>

The procedures for obtaining navigation titles are described in the decree of the 21st of December 2007⁷¹. This decree sets out the terms and conditions and deadlines for the examination of applications.

Navigation titles are issued by the national competent authorities (Local Inspector Services, IS) and confirms the full compliance of the vessel with ES-TRIN's or the applicable technical requirements, and must be renewed every five years for passengers' transport and every seven years for cargo transport with the obligation to comply with the latest technical prescriptions issued. Some derogations called NRTs may be granted temporarily.

The DGITM issued compilations and documents regarding applicable norms, title navigations and specificities per type of craft, available on their website⁷².

The objective of these requirements is to guarantee a high level of safety in inland navigation, protect the environment and the people onboard. For boats with boat certificates (length inferior to 20 metres, carrying less than 12 passengers or of a lesser capacity than 100 m³), pleasure boats standards are applicable, more particularly the French 245 division⁷³. Note that a website lays out lists of approved authorities, firms, installations, and equipment in the field of technical requirements for inland navigation vessels in Europe⁷⁴.

As a conclusion: different type of navigation titles may be granted to boats, depending on their specificities. For each type of navigation title, technical standards are applicable. Most of the boats are concerned by ES-TRIN's prescriptions, whereas smaller units assimilated as pleasure crafts with less demanding technical prescriptions.

1.4.1.4 Innovative technologies

The tenth chapter of the ES-TRIN 2021 version is dedicated to technical specifications for electrical equipment and installations.

Currently, some innovative technologies — such as hydrogen fuel cells, hydrogen storage, ammonia, Compressed Natural Gas, autonomous unmanned navigation, etc. — are not addressed in ES-TRIN.

A technical prescriptive document on fuel cells integration is being finalized and should be applicable by 2024, which paves the way for technical integration schemes. Nonetheless, there is yet no norm mature enough to be edited concerning hydrogen storage onboard.

As for gases, Liquefied Natural Gas is allowed for inland navigation⁷⁵, but other gas-based solutions are not considered in the different versions of the ES-TRIN.

This lack of applicable prescriptive documents and prescriptions for an operator willing to use an innovative technology (other than battery-electric, or hybrid-battery-electric) doesn't rule out the possibility to experiment them⁷⁶.

⁷¹ <https://www.legifrance.gouv.fr/loda/id/LEGISCTA000017838102>

⁷² For general rules on applicable norms used for this section: <https://www.fluvial.developpement-durable.gouv.fr/titres-de-navigation-r72.html> ; guide relating to the application of the transposition texts of the UE 2016/1629 directive: https://www.fluvial.developpement-durable.gouv.fr/IMG/pdf/2019-08-12_tret_1906584n_note_technique_application_textes_transpo_directive_2016-1629_avec_mention_signe.pdf ; with its useful annex describing the applicable norms, navigation titles and specific rules for each type of boats: https://www.fluvial.developpement-durable.gouv.fr/IMG/pdf/annexe_1_tret1906584n_note_technique_application_textes_transpo_directive_2016-1629.pdf.

⁷³ https://www.ecologie.gouv.fr/sites/default/files/Division%20245%20-%20version%2005%20juin%202015%20-%20avec_signets.pdf

⁷⁴ <https://listes.cesni.eu/1000-en.html>

⁷⁵ ES-TRIN 2021, Chapter 30 "Special provisions applicable to craft equipped with propulsion or auxiliary systems operating on fuels with a flashpoint equal to or lower than 55 °C."

⁷⁶ CESNI's guide to European derogations: https://www.cesni.eu/wp-content/uploads/2019/04/Guide_Sp_craft_en.pdf

Central Commission for Navigation on the Rhine's and EU's legal frameworks allow derogations to the technical requirements of the ES-TRIN in justified cases⁷⁷:

- to encourage innovation and the use of new technologies in inland navigation:
- when the technical requirements are technically difficult to apply or where their application might entail disproportionate costs (hardship clause).

Boatowners must initiate a derogation request before the national competent authority (General Directorate on Infrastructures Transport and Mobilities, DGITM — PTF2 for France).

The derogation process is the following⁷⁸:

Steps	Type of certificate
	Union certificate for inland navigation vessels (request for derogation according to Directive (EU) 2016/1629)
I File preparation	Project initiators and national authority (3-12 months)
II Submission of the application	via the CCNR Secretariat in the case of the CESNI/PT Working Group (max. 3 months, i.e. in good time prior to a meeting)
III Technical examination	Working Group CESNI/PT (6-9 months)
IV Approval process	Communication from the MS to the EC - adoption of the implementing act (approximately 12 months)

A national derogation process can also be implemented if the vessel is restricted to an area (navigation basin, country, department, etc.). As previously mentioned, the DGITM delivers a derogation called "*Arrêté de Zone Restreinte*" for the experimentation of new technologies⁷⁹.

The process is quite similar to CCNR's, and generally longer. It follows different phases⁸⁰:

- 1) Derogation request
- 2) Constitution of a consultative technical committee responsible for safety studies
- 3) Establishment of a reference document
- 4) Visit and audit of the craft
- 5) Derogation attribution

⁷⁷ See Article 2.20 RVIR, see Articles 25 and 26 of Directive (EU) 2016/1629, quoted in op. cit.
https://www.cesni.eu/wp-content/uploads/2019/04/Guide_Sp_craft_en.pdf

⁷⁸ Extracted from CESNI's guide to European derogations previously quoted.

⁷⁹ <https://www.legifrance.gouv.fr/jorf/id/JORFTEXT000039050476/>

⁸⁰ https://www.nweurope.eu/media/14081/210610_h2ships_t222_rapport_r%C3%A9glementaire_national.pdf
p. 32 and following.

As for autonomous navigation: CCNR oversees and coordinates the harmonious development and implementation of autonomous navigation projects⁸¹. CCNR entrusted the Restricted Navigation Committee (RN, composed of members of Member State delegations and members of the Secretariat) with the coordination of work relating to automated navigation. The RN Committee deals with all questions relating to automation by involving experts in different fields (depending on the type of subject dealt with technical, nautical, personnel, legal, etc.). The Small Navigation Committee examines applications for the authorisation of pilot projects⁸².

Please note that European Commission's NAIADES III Action plan⁸³ which was released in June 2021, with the core objective to shift more cargo over Europe's rivers and canals and to facilitate the transition to zero-emission vessels by 2050 stressed the importance of speeding up of the certification processes for innovative and low emissions vessels.

1.4.2 Class certification societies

The French Transport Code defines which categories of inland navigation vessels that are compelled to be followed by a class society⁸⁴, such as:

- Inland navigation cargo vessels which are longer than 110 metres, or transport dangerous materials
- Passenger vessels transporting more than 150 passengers (75 passengers in zone 2 or all inland navigation passenger boats in zone 1)
- Floating establishments with a passenger capacity above 300

A class society, a company mentioned in the 1° of the article D. 4221-17 of the same code⁸⁵ can be considered as a control organism⁸⁶. Bureau Veritas is practically the only approval society for navigating boats and floating establishments of the river sector in France for the moment (RINA also follows a few vessels in the country). This monopoly generates difficulties for boatowners to find competitive certification approvals, and important delays. Inland navigation operators and boatowners would welcome newcomers in class society's business, especially regarding the ecological transition of the fleets (retrofits, new builds, plan approvals, classification, etc.).

Please note that some boatowners choose to comply with class societies' requirements even though they are not compelled to, which are generally more demanding than the legal frame previously defined.

⁸¹ More information on CCNR's role and vision on autonomous navigation: <https://ccr-zkr.org/12050000-en.html>

⁸² Mandate of the Small Navigation Committee to steer and coordinate work on automated navigation (unfortunately not available in English): https://ccr-zkr.org/files/documents/AutomatisationNav/Resolution2020-II-21_fr.pdf

⁸³ https://transport.ec.europa.eu/transport-modes/inland-waterways/promotion-inland-waterway-transport/naiades-iii-action-plan_en

⁸⁴ https://www.legifrance.gouv.fr/codes/article_lc/LEGIARTI000036263576

⁸⁵

<https://www.legifrance.gouv.fr/affichCodeArticle.do?cidTexte=LEGITEXT000023086525&idArticle=LEGIARTI000027232625&dateTexte=&categorieLien=cid>

⁸⁶ According to the article D. 4221-18

<https://www.legifrance.gouv.fr/affichCodeArticle.do?cidTexte=LEGITEXT000023086525&idArticle=LEGIARTI000027232627&dateTexte=&categorieLien=cid>

The decree⁸⁷ of the 21st of December 2007 defines navigation titles procedures, including the rules concerning surveys and approval processes.

Some class certification societies can intervene in the French market as certification entities to approve specific components (electric engines, batteries, etc.) for maritime and inland navigation use cases. DNVGL is one of the main class societies of the segment.

1.4.3 Non-Road Mobile Machineries emissions thresholds for thermal engines

Pollutant emissions thresholds for inland navigation thermal engines have been introduced by European norms for Non-Road Mobile Machineries (EMNR, *Engins Mobiles Non-Routiers*)⁸⁸. They forbid the acquisition of thermal engines of a former generation than the stage 5 generation (also known as CCNR III, equivalent to road generation Euro VI).

To find more information on inland navigation thermal engines EMNR norms, DGITM provides useful information and legal references on its website⁸⁹.

These engines are difficult to get on the market⁹⁰ because inland waterway represents a niche market. Thus, inland navigation thermal engines come from marinized heavy road transport or construction machines after their conception was profitable. The small business volumes inland navigation engines represent do not encourage constructors to prioritize research and innovation or marinization of the latest generations engines. The small number of existing engines on the market also reduces power ranges available for inland navigation operators. If a thermal engine is damaged on an existing boat, the same power will not necessarily be immediately available on the market. This could be an opportunity for hybrid solutions, or diesel-electric propulsive architectures, as this marinization of engines are not necessary for electric solutions.

Please note that PAMI, VNF's incentive funds the acquisition of the latest generation thermal engines to encourage a renewal of older engines.

2 French inland waterways environmental transition

After a general overview of French Inland waterways sector, its environmental transition will be studied in detail. First, the environmental pressure towards carbon neutrality will be addressed, next the environmental requirements expressed from public and private purchasers, then a presentation of the existing financial subsidies available to encourage the ecological transition of the fleets, and finally an overview of the existing ecological transition ecosystem.

2.1 Environmental pressure towards carbon neutrality

This section aims at describing the environmental pressure that is influencing and will continue to influence mobility and inland navigation sector in the future. First, the objectives regarding the environmental transition towards carbon neutrality will be laid out, followed by a focus on Low Emission Zones and their indirect consequences on the sector.

⁸⁷ <https://www.legifrance.gouv.fr/loda/id/LEGISCTA000017838102>

⁸⁸ https://www.cesni.eu/wp-content/uploads/2018/11/FAQ_Engines_en.pdf ;
<https://www.ecologie.gouv.fr/sites/default/files/fiche%204-web.pdf>

⁸⁹ <https://www.fluvial.developpement-durable.gouv.fr/motorisations-fluviales-r83.html>

⁹⁰ List of available engines on the market in Europe: <https://listes.cesni.eu/2060-en.html>

2.1.1 Inland navigation's global emissions reduction objectives

Inland navigation is considered on average five times less polluting (CO₂ emissions) than road transport per tonne of goods transported according to the French waterways' infrastructures managing authority *Voies Navigables de France* (VNF)⁹¹.

Nonetheless, tackling the environmental issue of climate change through a reduction of GHG emitted by the sector has become a political priority both internationally, and locally in France. The 2016 Paris Agreement — aiming to limit the global average temperature increase below 2°C compared to pre-industrial levels by reducing GHG emissions — is one of the milestones of this global roadmap. Other crucial agreements, legislative packages, or decisions lay out the general objectives regarding inland navigation, and the reduction of pollutant emissions the sector must achieve by 2035 and 2050.

On the 17th of October 2018, the inland navigation ministers of the Member States of the Central Commission for the Navigation of the Rhine (CCNR): Germany, Belgium, France, Netherlands and Switzerland signed a declaration in Mannheim, reasserting the objective of largely eliminating GHG and other pollutants by 2050.

This Declaration tasked the CCNR to elaborate a roadmap to reduce GHG and other pollutants by 35 % by 2035 compared with 2015 levels, and to largely eliminate GHG and other pollutants by 2050⁹².

The European Commission's Green deal for Europe⁹³, of December 2019 and its "Smart and Sustainable Mobility Strategy" of December 2020, laid out priority policy areas, among them: sustainable mobility, and actions to be realised to achieve climate neutrality by 2050.

One of the measures promoted is the prompt introduction of more ambitious policies aiming to reduce transport dependency on fossil fuels, in synergy with efforts to achieve the "zero pollution" target. It sets:

- a global GHG reduction target of at least 50 % and close to 55 % by 2030 compared with 1990.
- a GHG reduction target of 90 % in the transport sector by 2050 (and objective to achieve climate neutrality).

These objectives are accompanied by the goal of increasing inland waterways' modal split (currently at 6 % of global European transportation) by 25 % in 2030 and by 50 % by 2050⁹⁴.

On the 14th of July 2021, the European Commission published its "Fit for 55" legislative package⁹⁵, consisting of a proposal package to make the EU climate, energy, land use, transport and taxation policies fit for reducing net greenhouse gas emissions by at least 55 % by 2030, compared to 1990 levels.

Finally, the European Commission's NAIADES III Action plan⁹⁶ was released in June 2021, with the core objective to shift more cargo over Europe's rivers and canals and to facilitate the transition to zero-emission vessels by 2050. Some flagship measures relate for instance to speeding up the certification process for innovative and low emissions vessels, the development of multimodal alternative fuel supplying infrastructure hubs and the need to support the sector and Member States in the transition towards zero-emission, particularly regarding funding and financing.

⁹¹ <https://www.vnf.fr/vnf/bilan-2021-du-fret-fluvial-des-trafics-en-hausse-sur-le-bassin-de-la-seine/>

⁹² https://ccr-zkr.org/files/documents/Roadmap/Roadmap_en.pdf

⁹³ <https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1576150542719&uri=COM%3A2019%3A640%3AFIN>

⁹⁴ European Barge Union, 2021-2022 annual report, "Inland waterway transport. A huge potential sector", pp. 4, <https://www.ebu-uenf.org/wp-content/uploads/EBU-Annual-Report-2021-2022.pdf>.

⁹⁵ https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal/delivering-european-green-deal_en

⁹⁶ https://transport.ec.europa.eu/transport-modes/inland-waterways/promotion-inland-waterway-transport/naiades-iii-action-plan_en

Thus, it appears that European and international context aim at reducing the GHG emissions of inland navigation while increasing the traffic of goods and passengers transported on the water. This perspective is also shared by French inland navigation's stakeholders and operators who voluntarily committed to ambitious environmental and growth objectives laid out in July 2021 in the *Engagements pour la Croissance Verte du secteur fluvial*⁹⁷ (ECV).

This commitment gathered public authorities of French waterways as well as the sector's economic actors. Among the signatories were the Minister of transports, VNF, the harbour of Le Havre-Rouen-Paris (HAROPA PORT), and the economic actors of the sector such as the sector's federation of economic actors (Entreprises Fluviales de France), the harbour community of Paris (CPP) or industrial and inland waterways shipping companies.

The ECV aims for a 20 % reduction of inland navigation's GHG by 2030 through the deployment of charging and electric infrastructures for onboard consumption on docks and harbours, and through the experimentation of innovative propulsion systems for passengers and goods transport.

Although these environmental policies and measures are ambitious and bold, some political decisions may have hindered, or slowed down the transition's process. In July 2020, the domestic consumption tax on energy products (TICPE), a taxation on diesel for inland navigation passenger transport was suppressed. This suppression was part of a taxation systems simplification, which provoked a reduction of non-road diesel prices by 33 % overnight. Until then, passenger transport had a special taxation rate, (not applicable for inland navigation goods transport), which has been suppressed. Some new tax will probably be created in the medium term.

On the other hand, a reduction of the domestic tax on final electricity consumption (TICFE) has been implemented to encourage the electrification of docks and harbour facilities for onboard energy consumption, but not for the electricity used to charge batteries to propel a boat.

Thus, it appears that despite political pressure — the European Energy taxation Directive aims to encourage the use of renewable alternative and sustainable fuels through taxes incentives by 2023⁹⁸ — some new policies or taxation regimes may have sent a counterproductive message for the ecological transition of the river fleets.

As a conclusion, it appears that European and National political ambitions towards environmental exemplarity have been expressed, even though some political and fiscal decisions have had an indirect negative impact on the transition. It also appears that the sector private stakeholders have committed to achieve GHG emissions reductions in the short to medium term.

Another indirect incentive that may play an important role in boatowners' and economic operators' mobilisation are Low Emission Zones.

2.1.2 Low Emissions Zones: an indirect game changer for inland navigation?

If the European Union as well as the sector's stakeholders have committed to reduce inland navigation's GHG global emissions, the local perspective needs to be addressed.

There currently are 8 Low Emission Zones⁹⁹ (LEZ) banning pollutant road vehicles (up to 3.5 tonnes) in the following cities and some municipalities of their surrounding area:

- Paris (79 municipalities)
- Grenoble
- Lyon
- Rouen

⁹⁷ https://www.fluvial.developpement-durable.gouv.fr/IMG/pdf/engagements_pour_la_croissance_verte.pdf

⁹⁸ European Barge Union, 2021-2022 annual report, "Inland waterway transport. A huge potential sector", pp. 6, <https://www.ebu-uenf.org/wp-content/uploads/EBU-Annual-Report-2021-2022.pdf>.

⁹⁹ <https://www.gouvernement.fr/les-actions-du-gouvernement/transition-ecologique/zones-a-faibles-emissions-pour-mieux-respirer-en>

- Reims
- Nice
- Toulouse
- Saint-Etienne

The LEZ have different schedules and ambitions. Since August 2021¹⁰⁰, they are administered by municipalities or cooperative entities gathering different municipalities (i.e., metropolis), and are obligatory in the most polluted areas. Thus, more LEZ are to be created in the following cities:

- Aix-Marseille region
- Toulon
- Montpellier
- Strasbourg

These Low Emission Zones are not applicable for waterborne transport and are focused on road transport for the moment, but they have an indirect impact on the former by forcing road transport to transition. Thus, LEZ create a competitive environment for river transport to transition in order to keep its environmental competitiveness (as previously mentioned, river transport is up to five times less polluting than road transport).

If waterborne transport is not yet concerned by LEZ, some local restrictions could be implemented in the years to come¹⁰¹.

Let us note that a study is being led by the French Environment and Energy Management Agency (ADEME), the city of Paris and the Greater Paris Metropolis to measure inland navigation's pollutant emissions in different locations in Paris. A sample of boats have been instrumented as well as some key locations to measure the concentration of air polluting gases generated by inland navigation activity.

This study has not yet been concluded but could lead to some local policy decision concerning the emissions of the sector.

Please note that the 21st of September 2022; VNF signed an agreement with Airparif, the association observing air quality in Paris' Region aiming to improve their knowledge on inland navigation's pollutant emissions¹⁰². This signature increases the institutional pressure on inland navigation stakeholder's environmental impact and follows the logic behind a hypothetical future legislation concerning inland navigation and LEZ.

Low Emission Zones, although not applicable on inland navigation transport for the moment have a considerable impact on the sector's GHG emissions reductions ambitions and the Paris authorities are measuring the impact of inland navigation on local air quality in that perspective. LEZs appear as an increasing factor of the political pressure towards environmental exemplarity.

¹⁰⁰ <https://www.legifrance.gouv.fr/jorf/id/JORFTEXT000043956924>

¹⁰¹ Please note that Paris LEZ's FAQ explicitly quotes boats as targets to be controlled by such zones.

¹⁰² <https://www.vnf.fr/vnf/airparif-et-vnf-un-partenariat-pour-ameliorer-la-connaissance-des-enjeux-environnementaux-du-transport-fluvial/>

2.2 Environmental concerns from public and private stakeholders

2.2.1 Environmental requirements from operators and transporters

2.2.1.1 *The use of inland navigation transport: an environmental choice?*

Since October 2013, In France, transport service providers (goods and passenger alike) are obliged to inform beneficiaries of the quantity of GHGs emitted during the performance of a transport service¹⁰³. As previously mentioned, inland navigation is considered on average 5 times less polluting (CO₂ emissions) than road transport per tonne of goods transported according to VNF¹⁰⁴. The massification of goods stored on a river cargo makes this type of transport also more energy efficient — with 1 kg of oil-equivalent, 1 tonne of merchandise can be transported for 275 km by river, vs 130km by rail and 50 km by road (on a highway)¹⁰⁵.

This energy efficiency, and low environmental impact compared to road transport makes inland waterway transport to be often considered as an ecological mode of transportation.

Thus, the use of inland navigation itself is perceived as an environmentally friendly prospect both from the consumer and the provider ends.

Emblematic construction sites and major works such as the Olympic Village construction site in Saint-Denis, the Champs Elysees renovation work or the Greater Paris Metropolitan's works have entrusted inland waterways with the supply of construction materials and the removal of rubble. Internationally renowned companies such as IKEA¹⁰⁶ or Ferrero¹⁰⁷ have also decided to incorporate river logistics in their low emission transport strategy, all while advertising to their consumers its low environmental impact.

Some synergies have also been developed to increase boats' filling rates to improve their environmental performance with the development of additional services on existing navigation programs — for example, directly delivering construction materials on the riverbanks near a worksite or developing new services to optimise return journeys.

Even though inland navigation is seen as a greener transport solution than road transport, inland navigation transport services providers are looking to increase that environmental advantage, to meet consumers' environmental preoccupations, political ambitions, and the general transition towards carbon neutrality.

Transporters and operators are interested in new solutions such as new hydrogen constructions, battery hybridization and retrofits or low GHG emitting technologies (biodiesel, biogas, etc.), and are ready to transform the nature of their cooperation with boatowners. As previously mentioned, transport contracts are generally short term, and are renegotiated every few years. With the new kind of investment low emissions technologies represent, transportation contracts and commitments are extended. Transporters and suppliers are ready to commit to a boatowner or artisan and guarantee volumes transported for a 10 to 15 years duration. This shift tends to increase the value of boatowner's companies, financially securing their ecological transition program and instituting work security for artisans.

2.2.1.2 *Passenger Transport: the environment as a commercial argument*

If energy efficiency and fossil fuel consumption assertions about river transport are also applicable to passenger transport, the same arguments are not easily assimilated by their customers. Indeed, passengers transported

¹⁰³ [Article L 1431-3, of the Code of Transport.](#)

¹⁰⁴ <https://www.vnf.fr/vnf/bilan-2021-du-fret-fluvial-des-trafics-en-hausse-sur-le-bassin-de-la-seine/>

¹⁰⁵ <https://www.vnf.fr/vnf/brochure-et-lettress/guide-pratique-des-achats-publics-durables-et-climato-esponsables/>, pp. 6.

¹⁰⁶ <https://www.lloydloadinglist.com/freight-directory/news/IKEA-plans-giant-river-connected-warehouse-in-Paris/79049.htm>

¹⁰⁷ <https://www.sogestran-logistics.com/en/news.php?id=60>

directly experience the navigation conditions and particularities of each boat contrarily to the end user of goods transported by river. These customers are particularly sensitive to electric-mobility, and environmental exemplarity. This incites cruise companies to transition their fleet towards electric and hybrid propulsions. Electric and hybrid boats can be seen as a strategic positioning for these companies as electric propulsion generates a service upgrade. The cruises on electric boats are silent, vibrationless, with no exhaust smoke nor disturbance of the environment, which constitutes added value for high end cruises.

Passenger transport from point A to point B is generally partly managed by public entities. As such, they represent showcases of public transport technologies and of the city or region they are implemented in. Public actors frequently express their aim to transition existing fleets or to develop electric or hybrid propelled transport services as previously mentioned.

Thus, it appears that purchasers of services: industrial transport, river cruises and public transport are sensitive to environmental exemplarity. Inland navigation itself is perceived as an environmental mode of transportation and its actors are exploring ways to increase their environmental exemplarity to develop new services, attract new customers on the river, all while competing with road transport.

2.2.2 Environmental requirements in tenders

2.2.2.1 *Different levels of environmental requirements*

As previously mentioned, inland navigation itself is perceived as an environmentally friendly mode of transport. As such, VNF promotes and supports the integration of inland navigation as an environmental requirement public authorities may express in their tenders and public consultations regarding logistic missions¹⁰⁸. VNF offers legal toolkits and support to help public authorities integrating an inland navigation requirement in an environmental perspective and motivation. As an example, VNF has supported Lyon's Metropolis to include a mandatory inland navigation clause in the tenders' requirements specification for construction works on Lyon's lower harbour¹⁰⁹.

Beyond that perspective, environmental exemplarity has become a determinant aspect when it comes to attributing grant or electing a tender's laureate, at least, indirectly, as it has become a growing political concern as highlighted by European and national emission reduction objectives previously overviewed in section 2.1.

Generally, tenders try to value environmental exemplarity, or projects with a concern on their environmental impact. HAROPA PORT explicitly mentions its determination to value initiatives aiming at reducing activity's impact on the environment in its most recent tenders for "regular" non navigating business activities developments¹¹⁰. As such, there are no requirements, or expressed requirements, but in fact, projects which would not take into account the environment, or their externalities would probably be graded lower in the attribution process.

Certain public tenders for specific commercial operations can nonetheless explicitly express environmental requirements. For instance, VNF launched a tender on zero emission autonomous navigation demonstrators for summer 2024¹¹¹ explicitly promoting zero emission autonomous passenger boat transport. Local entities, such as Seine axis' Metropolises in partnership with VNF and HAROPA PORT, or Bordeaux's metropolis have launched

¹⁰⁸ <https://www.vnf.fr/vnf/accueil/logistique-fluviale/adopter-le-transport-fluvial/aides-et-financements-adopter/logistique-des-chantiers-publics/> ; <https://www.vnf.fr/vnf/brochure-et-lettress/guide-pratique-des-achats-publics-durables-et-climato-esponsables/>

¹⁰⁹ <https://www.vnf.fr/vnf/au-coeur-de-lyon-la-voie-fluviale-au-service-des-chantiers-de-la-metropole/>

¹¹⁰ January 2021 : <https://www.haropaport.com/fr/paris/appel-projets-pour-le-developpement-dactivites-sur-plusieurs-ports-parisiens>

¹¹¹ <https://www.vnf.fr/vnf/dossiers-actualites/appel-a-projets-mise-en-oeuvre-de-demonstrateurs-de-bateaux-autonomes-et-decarbones-pendant-lete-2024/>

tenders to fund decarbonized urban logistics on the Seine¹¹², or hydrogen-ready hybrid river public transport in Bordeaux.

Please note that port vessels, or speedboats operated by public institutions (firefighters, river police, etc.) have not stressed environmental exemplarity in their purchase's requirements. Some public operators have tested electric propelled boats but are not planning to purchase any unit for the moment.

2.2.2.2 In Paris, Public Domain Occupation Convention's extension for operators with retrofit projects

In Paris, HAROPA PORT, a state entity managing the harbour is the owner of the docks. Any commercial activity has the right to be operated for a limited period of time according to a Temporary Public Domain Occupation Convention (TPDOC). At the end of the period, a tender is formulated for the next period (generally, 10 to 15 years).

Environmental exemplarity has become an important aspect in the attribution of these conventions, without being stated as a compulsory component for laureates.

Regarding existing conventions, for economic operators already in activity, HAROPA PORT has issued a measure extending TPDOC's duration up to four years for boatowners who would commit to retrofit their river fleet before the convention's (extended) term if a first boat is retrofitted before June 2024¹¹³.

This type of measure embodies public concern for low impact transformation of existing boats (through electrification of hybridization). This measure aims at securing retrofitting processes for boatowners because such investments were not initially planned when the conventions were first issued. It is a highly effective incentive, adding 4 years of business activity for passenger transport boatowners, who would have retrofitted their first vessel by 2024.

2.3 National incentives for low or non-polluting solutions

This section describes the existing financial incentives to encourage the ecological transition of river boats.

These incentives can finance ecological transition projects such as retrofits or, for the PAMI, the acquisition of low emissions to zero emission boats. These national incentives are granted to boat owners or operators, at the condition that the boats are mainly operated on French territory. Thus, Norwegian companies operating or selling an electric or hybrid boat, whether the boat is produced in series, constructed on demand, or pre-owned, would be eligible to PAMI funding (section 2.3.1). In the case of a retrofit, the boat could be bought beyond French territory before the retrofit to benefit from CEEs (section 2.3.2). Retrofitting works could be realised by a non-French company on non-French territory to benefit from the different subsidies if the owner operates it on the French waterways. Please note that public entities financing these projects would value cooperation with French-based companies, or French shipyards to operate retrofits.

2.3.1 A centralised desk for low and non-polluting solutions: the pami¹¹⁴

The PAMI (*Plan d'Aide à la Modernisation et à l'Innovation*), stands for Modernization and Innovation Subsidy Plan. It constitutes a subsidy central desk gathering different public organisations' funds like the ADEME's, some partner regions', or other public organisations such as HAROPA PORT (with a symbolic economic contribution).

This subsidy aims at modernising the river sector. The eligible projects are retrofits, non-polluting or low polluting propulsive and energy systems for new boat builds, the associated charging infrastructure as well as innovation projects in general. The eligible costs are the clean propulsive/energetical system's additional costs compared with a thermal traditional solution. VNF uses a fixed reference scale to calculate the thermal reference for

¹¹² <https://www.metropolegrandparis.fr/fr/appel-manifestation-interet-logistique-urbaine-fluviale-axe-seine>

¹¹³ The measure, and its technical specificities is available here: <https://www.cpp.paris/documents-liens-reglementaires-17mars2021>

¹¹⁴ <https://www.ecosia.org/search?q=pami%20vnf>

retrofits estimated at a maximum price of 54€ per kW of electric propulsion installed, which enables a high subsidy rate.

Feasibility studies for retrofits, new builds or the development and implementation of innovative technologies may also be funded with the PAMI, the eligible costs being the cost of the studies, or the implementation of an innovative technology.

This subsidy is capped by EU's General Block Exemption Regulation (GBER)¹¹⁵, depending on the size of the applicant company. It means that public subsidies cannot exceed 40 %, 50 % or 60 % of the eligible costs for large, medium, or small sized companies.

Let us note that the most innovative projects can exceed GBER's, up to 80 % of the eligible costs¹¹⁶, and that a new GBER will introduce the zero emission notion, fundable at 100 % of the eligible costs.

The PAMI's funding rates are currently not publicly available especially for the French Environment and Energy Management Agency (ADEME) potential funding rates. ADEME can grant additional fundings to a laureate. The maximum funding rates are set as follows:

- **Case scenario 1: Small and Medium sized Enterprises (SME)**
 - Studies can be funded with a rate of 50 % up to 100 000 € for VNF, and an additional ADEME contribution up to 20% capped at 100 000 € can be added for certain projects determined by a special jury.
 - Retrofits or new construction eligible costs can be funded with a rate 40% up to 150 000 € for VNF, and an additional ADEME contribution up to 10% capped at 150 000 € of ADEME fundings can be added for certain projects determined by a special jury.
 - For the most innovative retrofits or new constructions, the subsidy rate can be up to 40 %, up to 300 000€ for VNF, with a possible additional ADEME contribution up to 20 %, capped at 300 000 €.

- **Case scenario 2: Large companies**
 - Studies can be funded with a rate of 30 % up to 100 000 € for VNF, and an additional ADEME contribution up to 20 % capped at 100 000 € can be added for certain projects determined by a special jury.
 - Retrofits or new constructions' eligible costs can be funded with a rate 30 %, up to 150 000 € for VNF, and an additional ADEME contribution up to 10 %, capped at 150 000 € of ADEME fundings can be added for certain projects determined by a special jury.
 - For the most innovative retrofits or new constructions, the subsidy rate can be up to 20 %, up to 300 000€ for VNF with a possible additional ADEME contribution up to 20 %, capped at 300 000 €.

PAMI is a pluriannual plan, with 3 to 4 annual juries granting projects fundings. The current plan (2018-2022) is going to an end. The upcoming program's detailed finances have not been shared yet, but it is estimated as a 60 million euros plan (for 5 years), representing twice the budget of the 2018-2022 plan. For the next PAMI, the following principles have been introduced:

¹¹⁵ <https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32014R0651&from=FR#d1e38-73-1>

¹¹⁶ https://www.europe-en-france.gouv.fr/sites/default/files/sa.58995_rdi_-_prolongation_0.pdf

- Funding rates will be increased, with the possibility for VNF to further support certain selected projects which would need more fundings
- EU's GBER is to be modified, allowing 100 % of the eligible costs of zero emission projects to be funded without caps. It should be the applicable rate for the most innovative technologies and/or the most powerfully motorised river boats. PAMI's contribution will nonetheless be capped in a similar logic used in the current program.

PAMI is the main national subsidy program allowing zero emission (battery-electric or hydrogen), and hybrid-battery propulsive systems to be financed by French public fundings. One private funding system has been launched and can be added to these rates.

2.3.2 Energy Economy Certificates (CEE117), an extra funding tool compatible with public fundings

CEE are a multi-sector dispositive which promote energy efficiency. Specific projects may be funded through a heavy and long process operations, but standardised operations are fundable through a dispositive which then is comparable to a public subsidy.

2.3.2.1 Concept

Energy suppliers are given an obligation to finance a certain quantity of energy savings (quantified in GWh-cumac) during a given period of time. If at the end of the period, they have not fulfilled their obligation, they are proportionally taxed on the difference between the energy savings they have financed and the obligation they were given.

GWh-cumac of energy savings are exchanged at a market price, logically capped by the tax rate.

Through specific or standardised operations, the energy suppliers, called "Obligés" can fund energy savings.

The CPP is at the initiative of the standardised operation TRA-EQ-126 published in spring 2022¹¹⁸, quantifying the energy (GWh-cumac) saved through a retrofit.

It applies to different types of inland navigation vessels, with a standardised formula taking only into account the replaced engine power, and the number of hours the retrofitted boat is used after being hybridised or electrified.

CEE market prices fluctuate, but some first conventions have been signed between boatowners and energy suppliers, for which the CEE subsidy represents up to 30 % of the investment costs.

Please note that there is a time gap that can be up to 18 months from the moment the convention between an energy supplier and a boatowner is signed (before retrofitting the boat) and the moment the fundings are perceived by the latter.

The funding obtained through the Energy Economy Certificate is considered as the result of a business operation between private actors (stock sale), thus, they can be cumulated with public subsidies.

Please note that another standardised operation is currently being elaborated to fund the acquisition of newly constructed electric or hybrid vessels.

2.3.3 Other public subsidies

Other public subsidies may be added to the PAMI fundings as long as the amount of public subsidies perceived for a single project remains in accordance with GBER's or Innovation's cap rules. These subsidies can be issued

¹¹⁷ <https://www.ecologie.gouv.fr/dispositif-des-certificats-deconomies-denergie>

¹¹⁸ <https://www.ecologie.gouv.fr/sites/default/files/TRA-EQ-126.pdf>

by the regions (although they tend to no longer fund projects outside PAMI's canvas), or municipalities¹¹⁹. They vary depending on the city, region, or department where the projects are being elaborated.

Some generic subsidies, banking guarantees or technical support may be provided by other public entities. Please note that a specific dispositive grants 0 % interest bank loans to project owners upon certain conditions, up to 40 000€¹²⁰.

2.4 Maturity of the ecological transition ecosystem

French inland navigation market has not historically been the most innovative market. Key projects like SeaBubbles paved the way for the market potential and inspiring new opportunities. Thanks to political ambitions towards carbon neutrality, raised awareness amongst boat owners, operating companies, and final consumers, and the impact of the 2024 Olympic and Paralympic Games; the sector is initiating a major environmental transition. Public authorities support and promote this transition through incentives that appear like game changers. PAMI's fundings enable project launches, the addition of CEEs can constitute a turning point, and HAROPA PORT's incentive regarding Temporary Public Domain Occupation Convention (TPDOC)'s extensions are an extra motivation for Parisian project owners to launch their demonstrators by 2024 (these incentives are described in section 2.3).

Currently there are 70 identified ongoing projects being studied or launched on national territory¹²¹. Among these 70 projects, it is probable that some will not be launched for technical or financial reasons, but 21 projects are currently at a high maturity stage, undergoing retrofit processes, waiting for supplies to be delivered, financed or in advanced technical phases. These figures do not include boats that will be launched with the different already mentioned tenders and public calls (Bordeaux's Metropolis ferries, VNF's autonomous boats, Paris Metropolis' urban logistics solutions, etc.). Thus, there is a general dynamic and public support towards the greening of inland navigation fleets (PAMI's budget has doubled from 2018-2022 to 2023-2027).

This section aims at describing the market maturity of zero or low emissions boats with a presentation of the existing ecological transition ecosystem, and some examples of ongoing and completed projects.

2.4.1 Existing ecological transition ecosystem

If some boatowners or operators have launched ecological transition programs — with retrofits or innovative boat builds — others in the inland navigation sector, especially in Paris, developed a specific approach to the transition.

As previously explained, inland navigation operating companies are small structures for which the ecological transition is a complex and costly perspective. Thus, some entities, such as the Harbour Community of Paris (CPP), have initiated collective initiatives, gathering industrial and tourism actors of various sizes (from multinational industrial corporations to passenger transport companies operating a single less than 20 metres boat).

2.4.1.1 A collective initiative: the Paris Ecosystem

This spontaneous collective initiative is organised by the CPP which is composed of boatowners and operators of the Seine River, which amounts to the majority of the French inland navigation sector's activity.

This ecological transition of the river is initiated with the retrofit of existing boats (replacement of polluting thermal engines with clean electric solutions) in a circular economy perspective and in line with the objective to make the river sector more sustainable in Paris before 2024, the deadline of the Olympic and Paralympic Games. Giving a second life to existing river assets is even more relevant as the boats have particularly long lifespans

¹¹⁹ City of Paris' measures: <https://les-aides.fr/aide/Uiif3w/ville-de-paris/aide-a-la-depollution-des-moteurs-de-bateaux.html>

¹²⁰ https://les-aides.fr/mes_obligations/aide/OFgv3w/entreprendre-pour-le-fluvial/pret-d-honneur-fluvial-initiative.html

¹²¹ Source: unpublished workdocuments.

(average age of 60 years on the Paris reach). For the future of inland navigation, CPP develops a project called “Boat of the future” in order to rethink boat conceptions, construction processes, materials, and distinctions between uses (transport of goods vs of persons).

The collective initiative began in 2019 with a study of the Paris fleet under the authority of the Inter-ministerial Delegate for the Seine Valley. This study was then followed by technical feasibility studies for retrofitting a representative sample of the waterway’s various uses: the Pilot Group. This sample was made of 12 freight and passenger boats, with specific studied criteria such as: autonomy, operational specificities, regulatory obligations, available volume, and charging infrastructures to be deployed, among others. The technologies studied were electric battery, electric battery with diesel/biogas (Natural Compressed Gas) range extenders, or hydrogen fuel cells in some cases.

This collective initiative is the first in France, and as such, has been followed by other stakeholders at a national scale. Boatowners from different navigation areas, or public entities of different geographical domains have been interested and associated with this project.

Ever since, the CPP has been working to build the ecological transition ecosystem, with the objective to aim for economic neutrality on each project, i.e., to make the TCO (Total Cost of Operation), over approximately 10 years lower after retrofitting the boat than the costs of keeping, using, and maintaining the thermal engines. In order to achieve this economic neutrality, and to help a maximum number of boatowners and operators to launch retrofits or new constructions projects, this local initiative has grown.

2.4.1.2 *The ecological transition ecosystem*

As the CPP’s initiative is the first of its kind, some aspects initiated by its project have been implemented at a national scale, beyond the Seine River.

The CPP has negotiated fixed fees with three integration companies (Naviwatt¹²², Ship-ST¹²³ and Alternatives Énergies¹²⁴) for retrofits studies, supplier consultations and technical assistance with shipyards and during the retrofitting process. The fixed fees depend on the type of river boat considered. This potential partner for Norwegian companies will be detailed in section 3.2.2. This technical support and general oversight have proven their efficiency, and necessity for projects to be conducted as efficiently as possible. Thus, VNF is going to issue a public consultation to provide this kind of technical support nation-wide.

Regarding funding these ecological transition projects, the CPP has created, with the public institution Caisse des Dépôts et des Consignations (CDC), and NEoT Green Mobility, a Special Purpose Vehicle (SPV), dedicated in the financial carrying of inland navigation green vessel projects. This SPV, called Fluvial Zero Emission is ready to operate in the country, but has not yet financed its first project. It offers a functional guarantee for the batteries and systems installed (generally for a ten-year duration) which can help boatowners in their decision-making process towards green vessels¹²⁵.

Another SPV has been created with an impact investment fund: Famae Impact, to offer more flexible financial setups such as sale and leasebacks, or the possibility to exit the funding contract after 3 full years, through a bank refinancing for example.

These financial structures have national ambitions and are currently engaged in discussions with operators of Rhone, Gironde, or Rhine regions. This financial partnership has also been a possibility to answer European calls with the support of the CDC, such as the *Alternative Fuels Infrastructures Facilities*, of the *Connecting European Facilities*.

¹²² <https://www.naviwatt.com/>

¹²³ <https://ship-st.com/>

¹²⁴ <https://www.alternativesenergies.com/>

¹²⁵ <https://www.caissedesdepots.fr/actualites/des-solutions-pour-verdir-la-flotte-fluviale-de-laxe-seine>

2.4.1.3 Paris 2024 ecological transition ecosystem

Paris will host the 2024 Olympic and Paralympic Games (OPG). Inland navigation and the Seine River will be at the centre of the OPG, with certain competitions disputed on the docks or in the river Seine, the use of inland navigation transport for the construction of Olympic sites and a unique opening ceremony called “The Olympic Seine”¹²⁶. This opening ceremony will consist of a parade on the Seine River of boats embarking national delegations as well as artistic performances. For the first time in the history of modern Olympic Games, the opening ceremony will be outside of a stadium. This event, watched by more than a billion viewers, will offer an incredible showcase to the sector. As the Olympic Games aim for carbon neutrality, with very strong environmental commitments¹²⁷, this ceremony, and the Olympic Games in general will represent a formidable opportunity for waterborne electric transport, and electric mobility in general, as proves VNF’s tender on autonomous navigation¹²⁸.



Figure 24 - The opening ceremony, artist views. Source: Paris 2024

129

¹²⁶ See Paris 2024’s dedicated video: <https://youtu.be/ay4ghAR1DD0> ; from <https://www.paris2024.org/en/ceremony/>

¹²⁷ <https://www.paris2024.org/en/a-pioneering-ambition-for-the-environment/>

¹²⁸ <https://www.vnf.fr/vnf/dossiers-actualites/appel-a-projets-mise-en-oeuvre-de-demonstrateurs-de-bateaux-autonomes-et-decarbones-pendant-lete-2024/>

¹²⁹ <https://www.paris2024.org/en/ceremony/>

2.4.2 Example of existing projects: new build green vessels

This section will describe a small number of existing green vessels launched in the past years. The French Association for Electric Boats (AFBE) holds a catalogue on their website presenting some electric boats builds and retrofits from their members in both inland navigation and maritime sectors (builders, shipyards, integrators, etc.).¹³⁰ This section will not address scaled production of passenger boat builds of less than 20 metres and up to 12 passengers which are similar to pleasure boats.

2.4.2.1 *Bernard Palissy III: a sightseeing battery-electric cruise boat*

The Bernard Palissy III is a 25 metres sightseeing battery-electric cruise boat, embarking 2 x 80 kWh battery packs, for two 36 kW propellers. The boat's energetical architecture was designed by Alternatives Énergies in 2018 using Valence batteries. The Bernard Palissy navigates in Saintes, on the Charente River.



Figure 25 - Source: AFBE's electric boats catalogue

131

2.4.2.2 *Ducasse Sur Seine: a battery-electric restaurant boat*

The Ducasse Sur Seine is a 40 metres battery-electric restaurant boat navigating in Paris, designed by Seine Design, and built in the Chantier de la Haute-Seine (CHS) shipyard in 2019. The energetical architecture was designed by the French company SFMNI, the French leader in commercial marine motorisation and industrial energy, in collaboration with three partners: KEB for the motorisation, the on-board network and the automation, ZF for the azimuthal steerable thrusters, and a battery supplier.

The aimed autonomy was 2 hours of cruise and onboard energy. Additional batteries will be added to the boat in the coming year.

¹³⁰ <https://www.bateau-electrique.com/catalogue/>

¹³¹ <https://www.bateau-electrique.com/catalogue/bernard-palissy-3/>



Figure 26 - Source: Ducasse sur Seine

2.4.2.3 FLUDIS: a hybrid battery-electric river cargo

Fludis is 37 metres hybrid electric river cargo, built in 2016, and operating in Paris. The boat operates electrically along with diesel generators onboard as range extenders. Its operations have been described in section 1.2.2.



Figure 27 - Source: lantenne

Other projects are being conducted, such as Caravelle by Strasbourg's company Batorama's designed by Ship-ST and Alternatives Énergies for the propulsion and energetical architecture¹³². Furthermore, new industrial pushers are being developed (undergoing advanced feasibility studies). AFBE's catalogue is an exhaustive guide to explore electric or hybrid maritime and river boats constructed and operated by AFBE members¹³³.

2.4.2.4 Naviwatt's 580 Zen Pro: a semi-rigid electric port vessel

Naviwatt offers a small semi-inflatable electric port vessel / service boat with an aluminium hull: the Zen Pro.

5.8 metres long in the existing version, the Zen pro is propelled by a 55 kW Torqeedo engine, powered by 42 kWh of BMW I3, lithium-ion batteries.

¹³² <https://www.batorama.com/en/node/627>

¹³³ <https://www.bateau-electrique.com/catalogue/>

The multipurpose boat has maritime as well as inland navigation certifications.

Please note that the Zen Pro is also declined in 4.6 and 6.9 metres versions. Naviwatt also offers a range of workboats, port vessels and passenger transport ferries, in various sizes and capacities¹³⁴.



Figure 28 - Source: Naviwatt

2.4.3 Retrofits projects examples

After detailing examples of new boat constructions in operation, some retrofits are now going to be studied. Some of the projects presented are upcoming projects, currently undergoing the retrofitting process.

2.4.3.1 Small passenger boat: hybridisation of Hortense

Hortense is a luxurious Hackercraft, operated by ParisNautes that offers private cruises on the Seine River. This small boat carrying less than 12 passengers and of a length shorter than 20 metres is administratively considered as a pleasure boat, which allows for more flexible technical requirements (the ES-TRIN does not apply for this type of boat, see section 1.4.2). This boat has been hybridised with a small electric engine and battery pack, in addition to the original thermal engines. The electric propeller is officially considered as a backup engine even if it allows for full electric navigation for short periods of time. Such an architecture can be seen on this type of boat, as a first step towards electric mobility with a limited initial investment and boat transformation¹³⁵.



Figure 29 - Source: ParisNautes

¹³⁴ <https://www.naviwatt.com/nos-metiers/electric-workboats/> ; first ZenRiver launch: <https://www.linkedin.com/feed/update/urn:li:activity:6981894361089220608/>

¹³⁵ Another example would be Seine Avenue's Lugano: <https://www.seineavenue.com/en/lugano-the-newcomer-at-seine-avenue/>

2.4.3.2 *Cachemire: a full battery electric high end private boat*

Yachts de Paris' Cachemire is currently (September 2022) at the end of its retrofit process. It should be tested in operations in mid-October 2022.

The Cachemire is a 24 metres, 18 passenger private boat. The Cachemire's retrofitted systems are Torqeedo's: 2 x 100 kW propellers, with 3 x 40 kWh battery packs allowing a full electric navigation for 3 daily cruises of 2 hours.



Figure 30 - Source: Yachts de Paris¹³⁶

2.4.3.3 *Rocca II: a full electric small sightseeing vessel*

The Rocca II is a sightseeing vessel operated by Vedettes du Pont Neuf, in Paris. It is a 1963, 21 metres passenger boat allowed to embark up to 105 passengers. The Roccas are a typical Seine passenger boat design from the late 20th century.

The boat has been equipped with a Torqeedo system by Naviwatt: 110 kW propellers and two 30,5 kWh battery pack allowing up to 7 hours of full electric autonomy at the boat's cruising speed: 11 km/h. This retrofit had been initiated before the 2020 pandemic and has resumed in 2021 thanks to the financial support of TotalÉnergies, through an innovation private subsidy called CITEPH.

In September 2022, the electric system was installed and tested, and the boat's layouts are being remodeled, with the goal of launching commercial operations by the end of 2022.



Figure 31 - Source: Vedettes du Pont Neuf¹³⁷

¹³⁶ <https://www.yachtsdeparis.fr/cachemire>

¹³⁷ <https://www.vedettesdupontneuf.com/croisiere-luxe-seine-paris/>

2.4.3.4 *Hydraaix: a full electric lake sightseeing and restaurant cruise boat*

Hydraaix is a 25 metres boat operated by Compagnie des Bateaux d’Aix les Bains on the Bourget lake for up to 150 passengers.

The boat has been retrofitted and has been doing navigational tests in September 2022. Once again, the retrofit system is Torqeedo’s with 316 kWh battery packs and 2x 160 kW propellers. AMO Facili has been entrusted to assist and oversee the project.

Please note that the Compagnie des Bateaux d’Aix les Bains is going to retrofit their whole fleet (10 boats) by 2024 with different technology suppliers.



Figure 32 - Source: Compagnie des Bateaux d’Aix-les-Bains¹³⁸

2.4.3.5 *Vedettes de Paris – announces of retrofitting projects*

The sightseeing company Vedettes de Paris based in the French capital have announced their ambition to reduce by 50 % their GHG emissions by 2024 through the full electric retrofit of their five boats river fleet among other policies.

The first two boats will be the Paris-Trocadéro and the Paris-léna, sightseeing boats embarking between 200 and 250 passengers daily. Barillec Marine has been charged with these projects, and a first retrofitted boat should be delivered by spring 2023.

The boats will embark 2x550 kWh battery packs from E4V, a French supplier. This retrofit will imply the installation of fast charging facilities, in order for the 10 to 12 daily cruises (1 hour each) to be fully electrically operated.



Figure 33 - Source: Paris Marais

¹³⁸ <https://www.bateaux-aixlesbains.com/>

3 Competitive situation and potential cooperative partners

3.1 Solution providers on the market

This section aims at completing the information on existing projects and operating low or zero emission river boats. The main green vessel solution providers (new boats, integration systems, retrofitting kits, etc.) as well as companies developing autonomous systems are detailed below.

3.1.1 Green vessels

3.1.1.1 *Electric or hybrid boats providers*

Several companies are currently making progress and launching new designs for public transport offers, with low or zero emission propulsive systems. So far, some of the following companies have not launched any projects in France, but are conducting studies, or are planning to operate a demonstrator in Paris during the Olympic and Paralympic Games.

Neptech

Neptech is a French startup Aix-en-Provence incubated in the #CleanTech incubator at the Technopôle de l'Arbois based in in Aix-en-Provence.

Founded in 2020 and supported by different entities (Cluster Maritime Français, GICAN, La French Tech, etc.), Neptech's mission is to transform urban mobility towards more waterborne transport. As such, they offer a range of different boat builds, including the NepRiver and Nep Cargo.

NepRiver is a zero-emission river passenger catamaran, measuring 24 metres per 8.50 catamaran, and with a 200 passengers (accompanied with 20 bikes) capacity¹³⁹. During summer 2022, Neptech revealed the model at 1/7th scale.



Figure 34 - Source: Neptech

NepCargo is a cargo catamaran aiming to provide urban logistics. The NepCargo has smaller dimensions than the NepRiver: 21 metres per 7.50 metres enabling the transport of a maximum of 20 tonnes of goods¹⁴⁰.

¹³⁹ <https://neptech.co/produits/nepriver/>

¹⁴⁰ <https://neptech.co/produits/nepcargo-fr/>



Figure 35 - Source: NepTech

Within this framework, NepTech is working towards autonomous navigation systems, and hydrogen propulsive systems. Their designs include hydrofoils to reduce the boat's drag, and improve its hydrodynamics

Seabubbles

Seabubbles is a French company created in 2015, developing hydrogen powered hydrofoils small passenger vessels¹⁴¹. In September 2022, they revealed their first newbuild's design with hydrofoils reducing its wetted surface area (at low speeds) for 8 passengers with an 8 metres length and 3.5 metres beam¹⁴².

Initially announced as a taxi service provider in Paris for 2021, the company has been restructured and is aiming to launch a vessel for the Olympic and Paralympic Games, in 2024.



Figure 36 - Source: Seabubbles

MobyFly

Mobyfly is a Swiss company developing a hydrofoil speed passenger transport ferry¹⁴³, aiming to deliver demonstrators for the Olympic and Paralympic Games. Mobyfly has 3 designs: a 30 metres boat with a maximum capacity of 300 passengers; an 18 metres boat with a maximum capacity of 59 passengers; and a 10 metres boat with a maximum capacity of 12 passengers.

¹⁴¹ <https://www.seabubbles.com/the-seabubble/details/>

¹⁴² <https://www.linkedin.com/feed/update/urn:li:activity:6973222170210484224/>

¹⁴³ <https://mobyfly.com/>



Figure 37 - Source: Mobyfly

Small passenger boats (assimilated to pleasure crafts)

Certain pleasure boats companies provide green vessels that can be operated commercially for passenger transport (less than 12 passengers transport).

Sun Wave¹⁴⁴, Rand¹⁴⁵, Hynova¹⁴⁶, Candela¹⁴⁷, Ruban Bleu's Marin d'eau douce's boats¹⁴⁸, Pure watercraft¹⁴⁹, Nicols¹⁵⁰, or Bateaux pour la planète¹⁵¹ are examples of boats providers that are operated or identified as possible solutions by inland navigation's boat operators.

Zulu associates

Zulu associates¹⁵² are providers, developers, and operators of logistic zero emission boats. The Belgian company operates through their subsidiary Blue Line Logistics (BLL), part of the Sogestran group in France¹⁵³.

BLL already operates a range of four Zulus and is building their new models: Zulus 5 and 6. Zulu 5 is a series hybrid (electric drive, battery park and range extenders via generators). Zulu 6 will operate in 100 % zero emission mode using a fuel cell with at least 50 % green hydrogen. The boat is currently (September 2022) being finalised with the installation of the hydrogen system in France.

Zulu associates are also developing autonomous systems for their logistic services.

3.1.1.2 Integration system providers

Naviwatt

As developed in section 2.4.2., Naviwatt have developed a range of electric river boats. The French company created in 2008 are experts of electric waterborne mobility. Naviwatt is an integration company, able to operate

¹⁴⁴ <https://www.sunwaveline.com/>

¹⁴⁵ <https://www.randboats.com/>

¹⁴⁶ <https://www.hynova-yachts.fr/en/>

¹⁴⁷ <https://candela.com/>

¹⁴⁸ <https://www.boating-paris-marindeadouce.com/>

¹⁴⁹ <https://www.purewatercraft.com/product/electric-pontoon-boat/>

¹⁵⁰ <https://www.nicols.com/bateau-fluvial/nouveautes#>

¹⁵¹ <https://en.bateauxpouurlaplanete.com/>

¹⁵² <https://www.zulu-associates.com/>

¹⁵³ <https://www.bluelinelogistics.eu/>

energetical audits of existing boats and design new energetical architectures. They would be a key partner to cooperate with for Norwegian component suppliers (see section 3.2.2.).

Other integrating companies

Other integrating companies such as Ship ST¹⁵⁴, Alternatives Énergies¹⁵⁵, Barillec Marine¹⁵⁶, AMO FACIL¹⁵⁷, or Green Vision¹⁵⁸ have similar profiles and experience. They are described in section 3.2.2. and provide boat owners support and design solutions to transition existing boats, or to build new boats. These companies have an expertise in both inland navigation and maritime vessels.

Systems manufacturers

In the same perspective, certain system manufacturers (electric engines, batteries, and general energetical systems), can act as solution providers for green vessels. Companies such as Transfluid¹⁵⁹, GCK¹⁶⁰, Torqeedo¹⁶¹ or Bluenav¹⁶², offer boatowners energetical expertise on energetical designs for existing boats or new builds.

3.1.2 Autonomous systems

This section will list the existing companies working towards autonomous vessel solutions. This report is being written during *Voies Navigables de France* (VNF)'s tender for autonomous vessels, which makes the gathering of information quite complex on the matter. Nonetheless, the following companies have developed or are developing autonomous or remote-control operating systems in inland navigation.

Sirehna

Sirehna¹⁶³ is a subsidiary of the French naval system integrator Naval Group¹⁶⁴ which mainly operates on military boats, submarines, vessels, or systems.

Sirehna operates in various fields of expertise such as hydrodynamics and control of mobile maritime units. Those skills are directly applied to maritime embedded systems such as Dynamic Positioning Systems, Unmanned Surface Vessels or remote-control kits applicable to existing boats.

NEAC-Industry

NEAC-Industry¹⁶⁵ is an engineering and applied research company dedicated to developing the concept of the Autonomous and Connected Electric Shuttle: NEAC (*Navette Électrique Autonome et Connectée*) designed for coastal areas and smart city waterways.

¹⁵⁴ <https://ship-st.com/>

¹⁵⁵ <https://www.alternativesenergies.com/>

¹⁵⁶ <https://www.barillec-marine.com/en/home-page/>

¹⁵⁷ <http://amo-facili.fr/>

¹⁵⁸ <https://www.green-vision.fr/>

¹⁵⁹ <https://www.transfluid.eu/en/>

¹⁶⁰ <https://gck.co/en/>

¹⁶¹ <https://www.torqeedo.com/en/home>

¹⁶² <https://bluenav.com/vision-2/>

¹⁶³ <https://www.sirehna.com/>

¹⁶⁴ <https://www.naval-group.com/en>

¹⁶⁵ <https://neac-industry.com/>

NEAC's core business is to design and develop an autonomous navigation system to empower passenger and freight transport. This intelligent navigation assistance is based on an onboard digital solution: ASPEDSA (Autonomous Ship Positioning and Environmental Detection for Steering Action).

Based in Caen, NEAC-Industry use on a prototype-platform to test their systems.

Neptech

Neptech is a French startup incubated in the #CleanTech incubator at the Technopôle de l'Arbois based in Aix-en-Provence, as developed in section 3.1.1.

Neptech is working on the development and integration of a piloting aid system allowing automatic navigation, the detection of floating objects and autonomous docking. This development is in progress with industrial partners of the North West area of the country.

ECA Group - IX BLUE

IX BLUE¹⁶⁶ is a French company specialised in the design of maritime navigation systems. They have been working for several years on the development of autonomous systems in military

environments. The company is not operating in the river sector for the moment.

ECA Robotics is a French company specialised in the design of autonomous systems. They design systems for complex intervention at sea to detect intrusions in given areas and carry out demining actions. They are a subsidiary of ECA GROUP¹⁶⁷ (along with Mauric).

Please note that IX Blue has been bought and are now also part of the ECA Group.

HP Robotics

HP Robotics is a French company specialised in the design of autonomous system design. They work particularly in Belgium and the Netherlands to develop autonomous or semi-autonomous machines, from harbour cranes, trucks and ships.

Roboat

Roboat is a Dutch company which works with partners to deliver a turnkey solution on an inland navigation shuttle integrating both urban transport issues via autonomous navigation based on environment recognition systems and electric motorisation.

Argonics

Argonics is a German company specialised in the design and installation of autonomous navigation systems.

They collaborate with French and German companies to equip ships, considering the interfaces with the systems of the boats. To date, their system does not include full autonomous docking.

Bluenav

Bluenav is a French electric engines and systems provider. Bluenav is working on the development of an autonomous system in partnership with an industrial company from unmanned vehicles business.

SEAFAR

SEAFAR is a Belgian company based in Antwerp which has developed a semi-autonomous shipping system¹⁶⁸. SEAFAR's remote-control systems allow ship owners and shipping companies to operate unmanned and crew-reduced vessels.

SEAFAR is commercially operating several river cargos in Belgium and has announced its launch in Germany and the Netherlands. A French Control Centre is expected to be tested in the Nord-Pas-de-Calais region. The Belgian

¹⁶⁶ <https://www.ixblue.com/>

¹⁶⁷ <https://www.ecagroup.com/>

¹⁶⁸ <https://seafar.eu/>

company have announced the launch of 10 river cargos builds in partnership with RensenDriessen shipbuilding¹⁶⁹.

Zulu associates

Zulu associates¹⁷⁰ are providers, developers, and operators of logistic zero emission boats. In France, they operate through their subsidiary Blue Line Logistics¹⁷¹, as developed in section 3.1.1.

Blue Line Logistics are working on autonomous navigation's developments, for which they are participating in European Union projects, with the AUTOSHIP, (Autonomous Shipping Initiative for European Waters, part of the Horizon 2020 program), or the ST4W Interreg North-West program¹⁷².

Geoflex¹⁷³

Geoflex is a French company specialised in hypergeolocation, providing global services to a large range of industries (maritime included). They are developing an autonomous navigation system based on their geolocation technology.

DICE-Engineering¹⁷⁴

D-ICE is a French innovative research & engineering deeptech company bringing digital solutions for the industry. Specialised in software engineering, hydrodynamics, applied maths and advanced control, DICE is developing an autonomous navigation system.

3.2 Potential partners for Norwegian companies

This section aims at presenting potential cooperative partners for Norwegian companies interested in exporting towards the French inland navigation market.

First, professional associations and federations, as well as public entities will be presented. Then, integrators, and AMO will be detailed, followed by an overview of shipyards and possible cooperation opportunities for foreign companies. Finally, relevant clusters will be presented.

3.2.1 Associations and public entities

As described in section 1.1., inland navigation is managed by an important number of public entities. These entities are potential cooperative partners for Norwegian companies. However, the main bodies Norwegian companies should connect with are the associations representing inland navigation companies at local and national scales. They can introduce relevant business relations and more specifically project owners in European cooperation perspectives and European tender answers (some of which are accessible for Norwegian companies).

3.2.1.1 Associations representing the sector's companies

E2F - *Entreprises Fluviales de France* (French River Companies)¹⁷⁵, is the professional association of river companies nation-wide. The objective of E2F is to bring together all the players in the waterway transport sector in order to respond to the challenges of transport and mobility, while giving visibility to the sector.

¹⁶⁹ <https://seafar.eu/10-semi-autonomous-seafar-vessels-announced/>

¹⁷⁰ <https://www.zulu-associates.com/>

¹⁷¹ <https://www.bluelinelogistics.eu/>

¹⁷² <https://www.bluelinelogistics.eu/innovation>

¹⁷³ <https://www.geoflex.xyz/>

¹⁷⁴ <https://dice-engineering.com/>

¹⁷⁵ <https://entreprises-fluviales.fr/>

E2F has a national perspective on the sector and is composed of various industrial and passenger companies. Please note that E2F's membership fee may be an obstacle for the small artisanal companies, making E2F's members mainly structured companies.

E2F represents its members' interests among political and public stakeholders on matters such as taxation, legislation regarding crewmembers and inland navigation's employment attractiveness. E2F also gathers information on the sector's different industries (cruises, tourism, shipping, etc.).

The Electric Boat French Association (AFBE)¹⁷⁶ was created in 1994 in Bordeaux by partners from different professional backgrounds - academics, researchers, engineers, and industrialists - concerned with developing the image and market of electric boats in France and abroad. The AFBE promotes electric waterborne mobility in France with French and foreign members from the electric mobility sector (maritime and river companies). Please note that the AFBE is presided by Yannick Wileveau, founder, and president of the integration company Naviwatt.

The Harbour Community of Paris (*Communauté Portuaire de Paris*, CPP)¹⁷⁷ is the association gathering the Seine and canals professionals in the Paris region. It brings together members with different profiles (restaurants, booksellers, cement manufacturers and carriers, industrial companies, canal boats, etc.) and has taken up the subject of the ecological transition of river fleets from 2019, through a study under the aegis of the Interministerial Delegate for the Development of the Seine Valley.

Its implantation is local, with a territory restricted upstream by the limits of Paris Region, and downstream at the Saint-Denis Island by CPSA's (Harbour Community of Downstream Seine, *Communauté Portuaire de Seine Aval*)¹⁷⁸. Beyond CPSA's territory, two other Harbour Communities represent their members: Rouen Harbour Union (UPR: *Union Portuaire Rouennaise*)¹⁷⁹, and Maritime and Harbour Union (UMEP *Union Maritime Et Portuaire*) in Le Havre. All these harbour communities are gathered in a federation of the Seine axis, Seine Port Union (SPU)¹⁸⁰.

Please note that the CPP, although limited in its territorial implantation is being entrusted national prerogatives regarding the ecological transition of the sector. As such, within SPU, the CPP is the key partner for ecological transition projects.

The CPP is also working on the "Boat of the future" project aiming to rethink boat conceptions, construction processes, materials, and distinctions between uses (transport of goods vs of persons), as well as navigation (autonomy, zero emission mobility, fleet monitoring, etc.). The project is still at an early stage, but international cooperation could be an interesting lead.

Please note that E2F and the CPP will be associated with VNF's CEE program "Remove", which will fund ecological transition studies (retrofits for instance), as well as education and awareness campaigns for the sector's professionals. The program will be officialised in Autumn 2022.

This specific organisation of economic actors on the Seine has no similar equivalent on other French navigation basins, where public or para-public entities might have a similar role.

3.2.1.2 Public entities

Public entities managing inland navigation's waterways (see section 1.1.1.) are potential cooperative partners for Norwegian companies interested in the French Market. For instance: HAROPA PORT on the Seine axis, CNR on the Rhone, CCNR on the Rhine, VNF on most of the waterways.

¹⁷⁶ <https://www.bateau-electrique.com/>

¹⁷⁷ <https://www.cpp.paris/>

¹⁷⁸ <https://cp-sa.fr/>

¹⁷⁹ <https://www.uprouen.org/>

¹⁸⁰ <https://www.seineport-union.fr/>

These entities catalogue the existing available locations to develop business activities, and the associated port facilities. They may also participate in answering the European Union's call for proposals along with private project owners.

Once again, the administrative complexity makes the previously mentioned professional associations a better initial contact able to introduce an interested company with the relevant contact.

3.2.2 Integration companies

Integration companies (integrators) are companies offering solutions for the integration of low or zero emissions systems. They intervene on retrofit projects as well as new boat builds and provide boat owners support and assistance in the realisation of their projects. They establish design solutions, boat studies, and energetical architecture conceptions. As such certain integrators have been mentioned as actors of project descriptions, in section 2.4.2 and 2.4.3.

Integrators are generally small structures, with technical experience and know-how regarding inland navigation regulations and operational specificities. They generally are active on both maritime and inland navigation sectors and are associated with the most innovative projects. They are ideal partners for Norwegian companies of the electric mobility ecosystem: solution providers, components suppliers (i.e., engine or electronic components), or technological developers (autonomous transport, etc.).

The CPP has negotiated fixed fees with three integrators (Naviwatt¹⁸¹, Ship-ST¹⁸² and Alternatives Énergies¹⁸³) for retrofits studies, supplier consultations, technical assistance with shipyards and throughout the retrofitting process. The fixed fees depend on the type of river boat considered. This service called AMO (*Assistance à Maîtrise d'Ouvrage*) has proven its necessity, which motivated VNF to issue an upcoming public consultation to provide this AMO service nation-wide. In order for the integrators able to instrument boats and operate retrofits themselves (Alternative Énergies and Naviwatt), they have been associated with larger engineering companies (respectively Akka Technologies¹⁸⁴ and SCE¹⁸⁵).

Other integrating companies such as Barillec Marine¹⁸⁶, AMO FACIL¹⁸⁷, or Green Vision¹⁸⁸ have a similar profile and experience and are considered as the main experts for boat owners and operators.

3.2.2.1 Alternatives Énergies

Created by Philippe Pallu de la Barrière in 1997, Alternatives Énergies designed its first 100 % electric boat in La Rochelle in 1998. Since then, Alternatives Énergies has designed solutions for solar-electric propelled boats and sightseeing buses, multi-mission barges with hybrid technology, hydrogen range extenders, etc. Alternatives Énergies proposes global and connected solutions, from design to maintenance, and is often associated with other integration companies or naval architects (such as Ship-ST or Barillec Marine). Alternatives Énergies has implemented public transport boats, among which boats equipped with hydrogen fuel cells.

Please note that Alternatives Énergies developed its own battery cells production, which are optimised for their specific purpose.

¹⁸¹ <https://www.naviwatt.com/>

¹⁸² <https://ship-st.com/>

¹⁸³ <https://www.alternativesenergies.com/>

¹⁸⁴ <https://www.akka-technologies.com/>

¹⁸⁵ <https://sce.fr/en>

¹⁸⁶ <https://www.barillec-marine.com/en/home-page/>

¹⁸⁷ <http://amo-facili.fr/>

¹⁸⁸ <https://www.green-vision.fr/>

3.2.2.2 *Ship-ST*

Ship-ST was created in 2000 by Laurent Mermier and Philippe Videau, is based in Lorient and Nantes and intervene on maritime and inland navigation projects.

Ship-ST is tasked with feasibility studies, basic and detailed designs, construction studies, technical monitoring and assistance, refit studies, stability and lightweight checks, life cycle analysis, and R&D. Ship-ST has been associated with Alternatives Énergies or Barillec Marine on several projects. They have been tasked with advanced feasibility studies and designs for the transition of Vedettes de Paris' vessels, for instance.

3.2.2.3 *Naviwatt*

The French company created in 2008 by Yannick Wileveau (president of the AFBE) is an expert in electric waterborne mobility, able to operate energetical audits of existing boats and to design boats' new energetical architecture. Naviwatt has developed a fleet monitoring solution to optimise boats energy consumption.

They have a specific expertise in smaller units (less than 20 metres) and have launched a range of service boats and river transport boats.

3.2.2.4 *Barillec Marine*

The company was founded in 1957 and has grown thanks to its link to the harbour of Concarneau and to the successive modernisations of the renowned fishing fleets, since then, it has joined the Vinci Énergies group.

Barillec Marine has a global know-how in electricity, electronics and marine automation and experience in the development of creative, innovative applications in propulsion, production, and energy conversion.

Barillec Marine has been the historical partner of Sodexo's inland navigation companies. They have been tasked with the retrofit of Vedettes de Paris' first two vessels (see section 2.4.3.).

3.2.2.5 *AMO Facili*

AMO Facili is an engineering company specialised in inland navigation boats. AMO Facili provides AMO services, in the construction of vessels, industrial processes and inland navigation construction, as well as design, studies, plans, diagrams of all electrical and automatic installations.

Amo Facili has been entrusted with the advanced feasibility studies for retrofits and new constructions of industrial vessels (undisclosed projects), as well as Compagnie des Bateaux d'Aix les Bains' retrofit (see section 2.4.3.).

3.2.2.6 *Green Vision*

Green Vision is an integrator with experience with road vehicles as well as boats. Their expertise is with small boats (less than 12 passengers and 20 metres maximum), which are not concerned by the same technical prescriptions (see section 1.4.). They have equipped boats with Renault second life car batteries in Paris.

3.2.3 *Shipyards*

French inland navigation shipyards are mainly small artisanal structures used for maintenance work or adaptations to existing boats and hulls. As seen in section 1.4.2., every five to seven years, river boats must renew their navigation titles, which implies the applicability of the latest technical prescriptions, which causes adaptations and modifications of existing boats. These upgrades to the latest standards, as well as repurposes or refits represent most of inland navigation's shipyards activity.

In case of innovative processes on existing boats (i.e., retrofits), existing shipyards execute metal and welding works, hull adaptations, and regular works, whereas specialised integration companies, or electrical engineers intervene in the shipyards.

In fact, it is common that inland navigation shipyard facilities are used as dry docks where specialised teams, or independent workers teams intervene. These shipyards are generally not as structured as maritime shipyards,

although certain river shipyards are as up to date as maritime oriented shipyards, for instance: the CHS, *Chantiers de la Haute-Seine*.

Even though certain shipyards have shown a growing interest in building or retrofitting low emissions ships (for instance: OCEA, Ritzdorf / Mobilité+ in Germany), it appeared that innovative boat transformations, or boat builds are not considered a priority for regular inland navigation shipyards which only have a few available slots due to their regular activity for the renewal of navigations titles. Thus, in order to reduce the deadlines such as the Olympic and Paralympic Games of Paris 2024, transportation costs and downtime of the existing vessels in case of a retrofit, the intervention of extra operators (shipbuilders, integrators, etc.) would be critical. Foreign boatbuilders have already informed inland navigation's stakeholders their abilities to intervene locally in regular inland navigation shipyards to build low emission vessels or retrofit existing boats. In order to contact regular shipyards that could host Norwegian companies, professional associations indicated (AFBE, CPP, E2F, GICAN) will be the most efficient communication canal.

In case of innovative new builds, it is common for inland navigation boatowners and solution providers to partner up with maritime shipyards. For example, Batorama's Caravelle, designed by Ship-ST and integrated by Alternatives Énergies is being built by the maritime shipbuilding company Transmetal Industrie¹⁸⁹.

The GICAN, presented in the following section is the cluster regrouping an important number of maritime as well as inland navigation shipyards. The GICAN is the relevant entity to first contact in order to be linked with relevant maritime shipyards.

3.2.4 Relevant clusters

To conclude the overview of Norwegian companies' potential partners regarding the ecological transition of inland navigation fleets, some relevant clusters need to be mentioned.

3.2.4.1 GICAN

The GICAN, French Maritime Industry Group (*Groupement des Industries de Construction et Activités Navales*), is the entity affiliating more than 250 manufacturers of the maritime and river industries. It mainly gathers shipyards, system and equipment manufacturers, subcontractors, engineering and architect businesses that are involved in the design, construction and maintenance and implementation of military and civilian vessels, as well as maritime security and marine renewable energies actors.

The GICAN is mainly maritime-oriented but is also active and constituted of inland navigation companies.

3.2.4.2 NEOPOLIA Marine

Neopolia Marine¹⁹⁰ is a business cluster which brings together industrial companies from the Pays de la Loire region. Based on the Loire estuary, an area with a strong shipbuilding tradition, Neopolia Marine represents more than 40 companies which pool their expertise and collaborate in order to respond to the needs of the shipbuilding industry.

Certain companies previously mentioned are part of the cluster (Ship-ST, Barillec Marine, Sirehna, DICE-Engineering, etc.)

¹⁸⁹ <https://www.transmetal-industrie.com/actualites/10248/construction-chantier-naval-aluminium-saint-mandrier-transmetal-industrie-batorama-caravelle-fluviale-alternatives-energies-verriere.htm>

¹⁹⁰ <https://www.marine.neopolia.com/>

3.2.4.3 Other inland navigation transport clusters or gatherings

COALIS¹⁹¹ is an inland navigation transport cooperative, gathering boat owners and operators of small sizes (artisans). They offer transport services on the Seine River and are leading ecological transition projects (retrofit and new boat build).

Finally, various gatherings or associations may be mentioned, such as:

- The River Boatowners Committee (CAF¹⁹² *Comité des Armateurs Fluviaux*) which regroups inland navigation shipping companies.
- The National Artisanal River Boat Chamber (CNBA *Chambre Nationale de la Batellerie Artisanale*¹⁹³) regrouping artisan boat owners.
- The association of Freight Transport Users (AUTF *Association des Utilisateurs de Transport de Fret*¹⁹⁴) regrouping inland navigation chargers.
- The River Transport Brokers and Transport Auxiliaries Union Chamber (*Chambre syndicale des courtiers de fret fluviaux et auxiliaires de transport*), represents the intermediaries of inland waterway transport

¹⁹¹ <https://coalis.eu/>

¹⁹² <http://caf.asso.fr/>

¹⁹³ <http://www.cnba-transportfluvial.fr/la-cnba/presentation-de-la-cnba>

¹⁹⁴ <https://autf.fr/>

4 Annex

4.1 Annex 1: type and characteristics of cargo boats









Types de bateaux fluviaux		Linéaire de voies d'eau en France
Freycinet 38,5 m x 5,05 m – 250 CV 250 T à 360 T (TE 1,80 – 2,50 m)		Classe I (4015 km) TE : 1,80 à 2,20 m TA : 4 m
Campinois 55 à 65 m x 6,05 à 7 m – 550 CV 650 T – 750 T (TE 2,50 – 2,60 m)		Classe II (266 km) TE 2,50 m TA 4-5 m
Bateau et convoi « Canal du Nord » 60 m + 30 m x 5,70 m – 550 CV 750 T (TE 2,50 – 2,60 m)		Canal du Nord TE : 2,50 m TA : 4-5 m
DEK (« Dortmund-Ems Kanaal ») 67-80 m x 8,20 m – 800 CV 950 – 1100 T (TE 2,50 – 2,90 m)		Classe III (568 km) TE : 2,50 m TA : 4-5 m
RHK (« Rhein-Herne Kanaal ») 80-85 m x 9,50 m – 700 à 1000 CV 1350 – 1500 T (TE 2,50 – 2,80 m)		Classe IV (137 km) TE : 2,50 – 4,50 m TA : 5,20 – 7 m
Rhénan 95-110 m x 11,40 m – 1200 CV 2000 – 3000 T (TE 2,50 – 3,40 m)		Classe Va-Vb (247 km) TE : 2,50 – 4,50 m TA : 5,20 (Va) – 7 m (Vb)
Grand Rhénan 135 m x 11,40 m – 1900 CV 2500 – 3500 T (TE 2,50 – 3,40 m)		Classe Vb et VI (1621 km) TE : 2,50 – 4,50 m TA : 5,20 m (2 couches) 7,00 m (3 couches) 9,10 m (4 couches)
Convoi poussé 1 à 4 barges EUROPA II 100-185 m x 11,40 m 1 à 4 barges de 2000 à 2750 T chacune 2000 CV (4400T-2B) à 5700 CV (11000T-4B)		

Figure 38 - Source: VNF quoted in ADEME's 2019 energy efficiency study

