Priorities for the Sustainability of Maritime and Coastal Passenger Transport in Europe
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Analysis of New Sustainable Mobility Solutions for Maritime Passengers Transport

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Abstract This chapter aims to describe new sustainable people's mobility solutions, in the field of maritime cross-border transport. The review proposed here extends beyond the typical review of technological solutions. Starting from the need to profile the cross-border traveller and the overall context, four possible strategies for reducing the environmental impact of a transport system are identified. Technology is an important catalyst of sustainable transport strategy but the changes in behaviours, the adoption of data-based planning process and the definition of targeted policy measures (e.g., soft measures adoption) are important as well.

Keywords Sustainable mobility. Cross-border transport. Maritime passengers transport. Transport environmental strategy. Environmental impact of transport.

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1 Introduction

This chapter aims to describe new sustainable people's mobility solutions in the field of maritime cross-border transport.

Instead of usual technology-based analysis, in our view the premises are in the identikit of the cross-border travellers and in the description of the current situation, as reference points for the identification of the main strengths and weaknesses of passenger mobility solutions in use. Innovations are considered by virtues of their feasibility and environmental impacts.

The process at the basis of the analysis proposed in this chapter is outlined below in figure **1**.

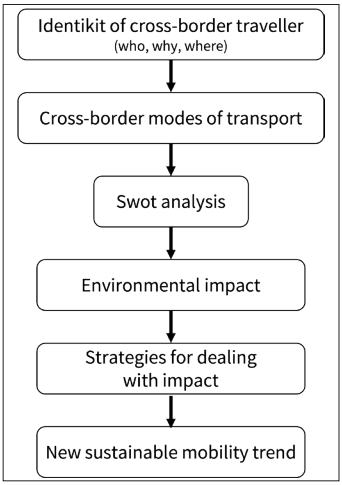

Figure 1 The framework of analysis

We start by proposing four relevant strategies for dealing with environmental impacts of cross-border passengers flows (§ 2).

Then an analysis of the main innovations follows. They concern new technological solutions that the producers of transport means and in turn the operators of the passenger transport adopt. New fuels and infrastructure related solutions are no less relevant. Their adoption is based on economic, social and environmental criteria (§ 3).

New technologies for transport flows data collection and analysis are the object of the fourth paragraph. They can orient travellers' behaviours towards more environmental sensitive habits, for example in the choice of new transport means and new routes.

New trends are emerging in travellers' mobility also in territorial tourist systems: sharing mobility and non-profit groups promoting alternative mobility solutions. They are increasingly active in local

territorial governance alongside public bodies, promoting alternative transport modes to the private car (§ 5).

Then an empirical description of previous issues is proposed presenting cross-border, maritime and coastal people's flows between Italy and Croatia. The case-study sums up some of the main results of analyses conducted within the European Project "MarItime and MultimOdal Sustainable pAssenger transport solutions and services" with acronym MIMOSA (Interreg Programme Italy-Croatia) (§ 6).

2 Strategies for Dealing with Environmental Impacts of Cross-Border Passengers Flows

Generally speaking, in cross-border transport there are at least four strategic directions that are considered crucial for the reduction of the environmental impacts:

1. changes in the habits and behaviour of cross-border travellers;
2. intervention by public bodies (State, Regions, Counties) for the definition and implementation of targeted public policies and reliable public transport solutions;
3. adoption of innovations (both technological and organisational) by cross-border passenger transport operators;
4. planning tools based on data collection analysis, traffic models and visualisation by advanced ICT tools (e.g., Web-Gis tools related to both transport solutions and passengers' habits and behaviours).

Public policies and transport solutions, adoptable to reduce the flow of cars and the consequent environmental damages, must take into account various aspects related to people's behaviours and habits; in particular: their travel reasons and length of stay in the host country (hikers, tourists) (Pafi et al. 2020).

In order to influence behaviour and habits of passengers (to orient them towards environmental protection), it is necessary to know them. In recent times, technology has been making new tools available to collect information on the habits and behaviour of passengers. Private companies and public bodies can adopt these new technologies for collection and analysis of data on the modes of transport used (whether car, bus, ferry, airplanes, train), on routes taken, on frequencies and more other.

On the side of travellers, these instruments can be useful to choose the transport mode, to help change their travel behaviour. In addition, on the side of public bodies, they can provide data useful in planning the mobility of people at local, regional and national level and could contribute to contain pollutant emissions.

The change – voluntary or induced by public policies – in the travel habits of cross-border travellers from the use of the car to the use of the

bus could be a solution, because it is much more environmentally-friendly than the car: the bus has a much lower rate of pollution per passenger than car. In fact, double-deck coaches can transport up to 80 passengers, thus substituting on average from 15 to 35 cars, while smaller coaches can provide up to 45/50 seats, virtually taking away from the road up to 25 cars. But the tendency to travel by bus is decreasing, with a decrement of about -13% over the time period between 2015 and 2019.

In seaborne passenger transportation, a distinction should be made between passenger liner services and tourist shipping services.

Public bodies in collaboration with private companies are making significant efforts to integrate passenger terminals into a single transport network and coordinate them with air, rail and road transport to ensure the fastest possible passenger traffic.

In addition, passenger terminals should have possibility to extend port limits and general activities in function of prosperity and future development. But there are low possibility to expand their terminal infrastructure areas.

Analysing services provided usually into passenger terminals, lack of adequate service activities/infrastructure is observed inside the port area or in vicinity, in particular: passenger long-stay accommodation facilities, food facilities, rent a car/bike, etc. But also lack of communication services through ICT integration that support interoperability (free Wi-Fi availability, ICT tools for providing adequate real-time information for the passenger, on-line ticket purchasing, etc.). Furthermore, to promote sustainability in function of environmental protection, port area vicinity should have possibility for rent and infrastructure to charge electric vehicles and bicycles.

The next two sections are dedicated to innovations in transport means and new technologies for data collection analysis.

3 The Role of Innovation in Cross-Border Transport Modes

As it is known, cross-border passengers flows cause significant environmental damages, generating negative externalities whose control and regulation by neighbouring countries can be difficult. There are some viable ways to reduce transport pollutant emissions. In the previous paragraph four strategies are proposed.

Public policies and transport adoptable solutions are among the most relevant. Both are based on knowledge of the main characteristics that distinguish travellers, in particular habits and behaviours, reasons of travel, destinations, length of stay (one day for hikers; more than one day for tourists).

In recent times, technology has been making new tools available to collect information about passengers' habits. They are soft solutions that are combined with hard solutions: the innovations that are

taking place or will be effectively implemented in the various modes of transport. When adopted by passenger transport operators, they will prove useful in fighting polluting emissions.

The most important innovations in environmental terms concern maritime transport and road transport. Those of air transport will be of lesser impact.

In fact, in air transport, relevant innovations expected in particular in transport means (airplanes) by 2030 will lead to a -13% reduction in CO2 emissions (ICAO 2019). But usually, for their short distances, the volumes of cross-border passengers traffic by airplanes are too low to contribute to significant reductions in total quantities of emissions.

In maritime transport, important innovations are expected. They will lead to a -40% reductions in CO2 emissions caused by vessels and ships (IMO 2021; 2018).[1]

Key innovations will concern new technological solutions in ships, new fuels (liquefied natural gas, hybrid propulsion, full electric, cold ironing) and related infrastructural solutions.

Technological innovations in ships have to be based on economic, social and environmental criteria. The economic criteria concern the decoupling of financial growth from social and environmental externalities.

In fact, the improved efficiency of the new ships leads to lower fuel consumption. These savings, in turn, lead to lower operating and maintenance costs, which consequently lead to more affordable ticket prices. As a consequence, more people can travel by the new ships improving social inclusion, obtaining positive social impacts and externalities.

On the other hand, financial growth from economic efficiency of innovative ships leads also to consumption of lower carbon content fuels and consequently to ecological preservation.

The contribution of international passenger ships to the production of these positive externalities is guaranteed by ships that must comply with all relevant International Maritime Organization (IMO) standards, including the Safety of Life at Sea (SoLaS) Convention and requirements for the prevention of pollution from ships together with Load Lines Convention regulations.

In addition, the social criteria are related to security design and ship infrastructure safety in terms of mobility elements of (vulnerable) passenger groups.

The ecological criteria encompass eco-efficient ship design in terms of hull shape, engine type, fuel type, propulsion and information-communication technologies use as well. Passenger liner ships have to be technologically designed in a way that will alleviate the negative con-

1 https://www.imo.org/en/MediaCentre/HotTopics/Pages/Reducing-greenhouse-gas-emissions-from-ships.aspx.

sequences of passenger self-organisation in terms of excessive car use, which means that ship design has to be passenger-centric and focus on creating multimodality with other environmentally friendlier modes of transport such as bicycles for achieving social inclusivity.

In addition to new technological solutions described above, another key innovation are the new fuels and related infrastructural solutions.

Focusing on fuel types (Directive 2014/94/EU) and their role in environmental protection, hydrogen propulsion systems have the best environmental balance but the conditions for their large-scale deployment will not be in place for at least 10-15 years. In the short term, liquefied natural gas (LNG) and hybrid systems are the most promising solutions. LNG system as a shipping fuel will have most probably wider application on the passenger vessel. LNG is already widely used, especially on freighter. In addition, passenger liner ships will mostly use LNG as a fuel in the future. Presently, one of the limiting factors for ships using LNG as a shipping fuel is the insufficient number of ports with fuel supply capabilities. On the other hand, hybrid propulsion systems achieve lower fuel consumption and consequently lower emissions. The application of existing hybrid solutions is possible on almost all passenger ships of coastal liner shipping and does not impose any additional restrictions. The technology is fully developed and applicable to all ships with diesel-electric propulsion and even the largest ones. The biggest barrier to this solution given by significant initial investment.

A possible alternative for ships sailing on a short distance and in protected area is the full-electric propulsion mode. Of course, the emissions of an electric ship are not zero but this technology provides a significantly reduced range compared to a liquid fuel propulsion.

Provision of cold ironing, i.e., supplying vessels, boats and crafts with shore-side electrical power, represents the must-have port's ability, in order to provide a comprehensive service, while at the same time maintaining control on energy consumption. Cold ironing acts as a segment of efficient vessels handling in a whole, thus controlling emissions from vessels in terms of emissions inventories and emissions monitoring.

In road transport, over the last five years, trends have been underway that are leading to an ever increasing adoption by vehicle manufacturers of engines based on new forms of power supply: the main ones are hybrid and electric powertrains.

If, by way of example, we consider the Italian situation, given its current renewal rate, it is possible to make some predictions on the composition of the Italian car fleet in 2030. In the most optimistic scenario, in case of enduring incentives, by 2030 the share of hybrid cars will be 20%, 10% for electric cars and at least 40% for Euro 6 standard. The remaining 30% will be made up of cars of the Euro 5 standard or one below this.

Consequently, the major reduction in emissions of car fleet would not come from the growth in the share of electrified powertrain, rather from the progressive elimination of older cars up to Euro 5, which currently make up more than 60% of the Italian car fleet. An average value of CO_2 emissions per car has been calculated as weighted average of standard emissions **[fig. 2]**.

From these estimates, it emerges that at the current modal split the efficiency gain of the internal combustion (IC) car provides the greatest benefit. In fact, for every percentage point of CO2 reduction of IC vehicles, total emissions decrease by more than 1,739 tons in the low growth scenario and by 2,261 tons in the high growth scenario **[fig. 2]**.

Of course, the overall benefit depends on the intensity of use of each mode. Planes, which have much higher emissions per passenger than the car, are however much less used and therefore their improvement has a relative lower impact on the overall reduction of emissions (see the figure below). Maritime transport deserves a separate discussion, as different types of ships have very different emissions per passenger depending on their age and type. In addition, a key role will be played by the switch to liquefied natural gas, which significantly reduces emissions and for whose large-scale use both shipping companies and ports are gearing up **[fig. 2]**.

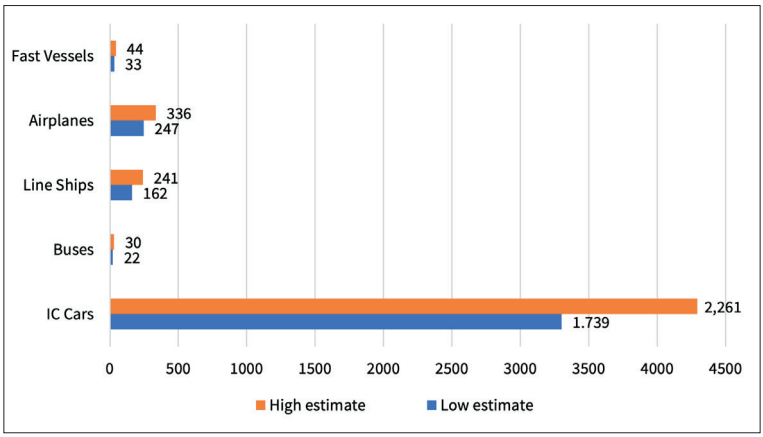

Figure 2 Yearly reduction in CO_2 emissions (tons) of travels between Italy and Croatia (projected to 2030) for each percentage point reduction in emissions from the various transport means. Source: MIMOSA Project, Passenger Transport Demand Analysis (0.3.1)

Innovations in transport means can modify people behaviours and habits. But, as said above, in next years, cars are expected to remain the most used mean of transport.

Differently, a shift from cars to buses can be observed in the future years above all among the youths and visitors without accompanying children, given a series of conditions, among the following seem particularly relevant:

- there will be a further diffusion of long-distance bus or minibus lines/rental services (following the business model of, for example: Flixbus, Go-Opti, etc.), and related services (e.g., luggage transfer, high-comfort equipment, etc.);
- there will be an improvement of first/last mile connectivity and nodes accessibility;
- new services of (fast) vessels from and to main coastal attractors, especially within a logic of increasing the attractiveness of sea travels by offering improved services, such as bicycle transportation or all-inclusive packages.

In addition, for segments of young and highly educated people, other alternative forms of passengers mobility can be identified, oriented towards multimodality that does not use cars, but a combination of at least two transport modes, the most frequent of which are: bike + bus, bike + ship, bike + train, etc.

New technologies for transport data collection and analysis can also help to change people's behaviour, as explained in the next section.

4 New Technologies for Transport Flows Data Collection and Analysis

Gained experiences, best practices of the countries of the European Union[2] and lessons learnt in the Anglo-Saxon world[3] allow us to affirm that the current situation in passenger transport, habits and behaviours of cross-border and resident travellers will be changed by new technologies, innovative solutions, smart and interactive tools, because they will make regional connections more accessible through multimodal solutions and sustainable passenger mobility.

New technologies for transport flows data collection and analysis are acquiring a special role, gradually more and more important.

These innovative technologies collect and analyse data from mobile telecommunication operators. Mobile phone operators, who provide large anonymised datasets, have significant market shares. This

2 Please see UNECE 2020.

3 See "The Major of London transport strategy" adopted in 2018, available at: `https://bit.ly/3bQffdt`.

guarantees that their information refers to significant portions of the resident population and tourists.

Their datasets contain information for better understanding of the needs, habits and behaviours of cross-border visitors and residents and for taking strategic decisions on planning and development of sustainable transport solutions.

So, these big datasets collect data on travel habits, intensity and structure of traffic flows by transport mode, and distribution of traffic flows for target geographic areas. Then, each one of these target areas is further analysed regarding its spatial content, mobility status, including infrastructure and mobility services and the identification of traffic samples within target areas for target population groups. In addition, key points of interest (i.e., ports, transport passengers' terminals, public transport stops, border crossing points, etc.) and the associated corridors are identified. Demographic and economic data related to these geographic areas are also inserted in the big datasets.

These points of interests are geographical locations and elements of transport infrastructure that can be used to detect modes of transport. Other points of interest (such as: hospitals, restaurants, and the like) can be used to identify the purpose of travel (such as: commuting, school, shopping and personal care, leisure, work, transport of goods, etc.).

The next step in the analysis involves the identification of the trip. It is defined by time, spatial and speed thresholds, which are essential to determine each trip (or travel).

The list of all trips (travels) can be used for different types of analysis and visualisations. The analysis may include the determination of origin/destination (OD) travel matrix for all types of means of transport, the identification of OD travel matrix for specific types of transport, the calculation of travel-related statistics (e.g., average speed between zone pairs for a predefined time period, etc.).

The analysis of information contained in big datasets provided by mobile phone companies is completed with the display of the main results using a Web-Gis visualisation tool. It is used to visualise, display, and generate reports based on information obtained by analysing the anonymised datasets. It has a function to display the geographical map as background, the locations of transport terminals and other defined points of interest (e.g., ports, stations, airports, border crossings, etc.) and their associated geographic interest zones (described above).

5 New Trends in Soft Measures for Sustainable Mobility

New tendencies are emerging in passengers' mobility. Here we specifically highlight the two major trends we consider relevant for the goal of this analysis: sharing mobility and private/non-profit groups promoting alternative mobility.

While private transport is still dominant and widely used, in many European regions, there is a new growing wave of mobility modes that belong to the wide sphere known as 'sharing mobility'. Sharing mobility is a new socio-economic phenomenon affecting transport sector both on demand and supply side. On the demand side, sharing mobility demonstrates a transformation of individuals' behaviour, as they tend to prefer temporary access to mobility services rather than using their own means of transport. On the supply side, this phenomenon consists in the affirmation and diffusion of mobility services that use digital technologies to facilitate the sharing of vehicles and/or journeys, creating scalable, interactive and more efficient services.

Sharing mobility, in its various forms, provides viable solutions to different contexts. Typically, it is implemented in the urban transport, where the emphasis is placed on the problem of traffic jams on the roads in the centres of major cities and tourist destinations and on parking. But it is also an important tool of potential development of cross-border mobility. Still today, the majority of European cross-border areas are territory characterised by low short-haul passengers' demand, where regular bus or train services are not considered financially viable, such as the rural or peri-urban areas. These areas can today be reached by the so-called demand-responsive transport (DRT), a form of transport where vehicles alter their routes based on particular transport demand rather than using a fixed route or timetable. Private operators working on this business models are already present also in cross-border routes. Moreover, DRT and sharing mobility in general can integrate existing transport, thus contributing to the creation of a resilient, accessible multimodal transport infrastructure, which is a precondition for sustainable and smart transport and mobility [EC COM(2020)789 final]. Studies conducted in the framework of the MIMOSA Project has shown that in maritime transport nodes connectivity has a crucial impact both on environmental aspects and on the reduction of car dependency.

Another trend refers to the increasing role in public transport of non-profit groups that promote the use of alternatives to the private car. There are in fact groups that promote daily bike use, other groups that watch out for passenger rights, for the maintenance of pedestrian areas or even for traffic surveillance. These groups (neighbourhood associations or common interest groups, non-governmental organisations, etc.) can help the local administrations and transport authorities in their duties and help to promote the use of the public

transport. The participation of such associations, local groups and non-governmental organisations in the transport planning decisions should be promoted and considered.

6 An Empirical Investigation on Italy-Croatia Mobility Trends and Opportunity

The issues presented in the previous paragraphs will be now investigated in the cross-border flows of passengers between Italy and Croatia.

These passengers are made up of 'excursionists' (cross-border travellers returning to their own country in the day) and tourists (cross-border travellers spending at least one night in the other country). The National Institutes of Statistics (Istat in Italy, DSZ Državni Zavod Za Statistiku in Croatia) periodically collect data of tourists using the information provided, by law, by hotels and structures that host them. Instead, information on hikers is not collected by the Statistical Institutes, but is estimated through sample surveys conducted mostly through interviews with travellers at border crossings, thanks to specially designed research activities carried out by public bodies.

In 2019, the last year before the COVID-19 pandemic, it is estimated that cross-border and coastal passengers[4] reached the total number of 4.8 million: 4.2 million Italians (87%) and about 600,000 Croats (13%).

The main travel reasons for Italian tourists are vacation and holiday in coastal Croatian places. Instead, for Croatian tourists they are cultural interests, cities of art and naturalistic sites.

The main reasons why 'excursionists' travel cross-border are business/work-related, visiting parental and shopping (reason stated exclusively by Croatian hikers ones).

6.1 Transport Modes Currently in Use

In cross-border connections between Italy and Croatia all the main modes of transport are used: car, bus, ship, train, plane. A particular role is played by intermodal transport solutions.

The means of transportation usually adopted by excursionists differ significantly from those used by tourists. Excursionists (as daily visitors) travel usually by car or coach, respectively 99.3% and 0.7% of them. It is estimated that they generate an annual flow of between 1.3 and 1.5 million cars.

4 They are passengers travelling by car, coaches, planes, vessels (high speed vessels), liners.

On the other hand, for 'tourists' of both nationalities, between Italy and Croatia, the preferred transport mode is the car, which in the case of Italian tourists is estimated to be used by 90% of travellers, while for Croatian tourists this percentage drops to 76%.

Italians also use ships more than Croats. 7% of people from Italy to Croatia travel by vessels or liner ships. This percentage decreases to 2% for Croats from Croatia to Italy.

The main reason is due to the fact that most Italian travellers go to Croatia for tourism on the Adriatic coast or in the Croatian islands, and the best way to make at least the last few kilometres of the trip is by boat.

Instead, unlike what happens for ships, Croats use plane more than Italians: 6% of travellers from Croatia to Italy use airplane, and just 2% of Italians from Italy to Croatia. It is due to the fact that among the preferred destinations of Croatian tourism there are also cities of art and natural and cultural sites located far from ports.

It is estimated that 1% of Italian tourists travel by bus from Italy to Croatia, and this percentage becomes 16% for Croatian tourists.

The train is a residual modal transport for cross-border tourists (rarely even for excursionists).

But, at least one in two travellers on their cross-border journey between Italy and Croatia uses more than one transport means. In fact, it is estimated that a percentage between 55 and 60% of tourists and excursionists both Italian and Croats have a multimodal trip, meaning that they use at least two transport modes during their travels. The public transport as additional mode is higher than expected, about 67.9%, including bus, local public transport and long range bus transport that are the three most used. Then car rental/taxi, ferry/cruise, train and bicycle follow in this order.

6.2 Cross-Border Passenger Liner Ships

As the natural border between Italy and Croatia is entirely on the sea, maritime transport should have a special role in the cross-border transport mode in use. Even if, as said just above, less than 10% of all cross-border Italian and Croat tourists travel by sea, respectively 7% Italians and 2% Croats.

Currently, 21 passenger liner vessels operate between Italy and Croatia, offering connections with the mainland and between the islands.

They are of different types: 4 are coastal liner passenger ships, 9 are Ro-Ro passenger ships (ferry) and 8 are high-speed passenger crafts (Jugović, Mezak, Lončar 2006).

Although the use of ferries for cross-border passenger transport is minimal and the connections offered are few, they represent an important element in helping to make cross-border transport inter-

modal. Strengths are certainly represented by the shortness of connections and the availability of Ro-Ro passenger vessels and high-speed passenger craft.

Relevant weaknesses are represented by the fact that the fleet operating in the cross-border area is very old: 39 years for long distance Ro-Ro passenger vessels and 27 for high-speed passenger crafts. It inevitably leads to strong pollutant according to the propulsion system, fuel in use and ship construction.

6.3 Means of Transport and Infrastructure for Croatian Nautical Tourism

In Italy and Croatia there are 24 seaports that provide access to cross-border travellers. The Italian coast is home to 14 of the 24 ports, with the 10 remaining on the Croatian side of the Adriatic area. Passenger terminals are located near widely known sights and they are visited by millions of tourists each year. General terminals infrastructure is adequate for existing traffic demand.

A particular segment of maritime transport is the nautical tourism (Onofri, Nunes 2013). It is mainly a type of tourism of Italians in Croatia. Once they arrive in Croatia, as transport means they use boats that can stay in port or move along the Adriatic coast. Usually average stay of boaters is twice as long as the average stay of other kinds of tourists. In addition, two thirds of nautical tourists use charter boats for navigation and the sailing season correspond to the period between April and October, with a peak in July and August.

Therefore they need adequately equipped port infrastructures. The inclusion of ICT system in technology of production of nautical tourism ports services is necessary to improve quality and streamline operations. In fact, modern ICT technology allows most of the classic port functions such as berth reservation, vessels monitoring or online service payment.

Location of all nautical tourism ports, with minor exceptions envisaged mainly within hotel complexes, are planned within guidelines of the Spatial Development Strategy, defined at County level. Main obstacles are related to outstanding communal sewage infrastructure, especially on islands. Therefore, the most important thing is to resolve land sewage infrastructure utility as base of installations of sewage system collection plant from yachts. It is also necessary to solve the collection and disposal of waste on the islands in accordance with EU legislation and MarPol 73/78 Convention.[5]

5 The International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978.

Part of the planned nautical tourism ports (up to 2,200 berths) is paired with the construction of hotel resorts. Together they activate such a synergy that, in those particular locations, represent the only way to build ports for nautical tourism at low cost. The construction of a hotel and nautical tourism complex are classified into:

a. dominant hotel complex and nautical tourism port is a supplement with added value for the hotel;
b. dominant nautical tourism ports and the hotel facility is in function of nautical tourism ports with added value for ports.

In the first group, indisputably, nautical tourism port creates added value to the quality of the hotel resort. In these cases, when nautical tourism ports is planned in isolated locations, the construction of nautical tourism ports without the construction of a hotel resorts is not realistically expected.

Another case is the construction of hotels to complement the content of nautical tourism ports, due to lack of or insufficient capacity in existing hotels in the vicinity. Such an example is the planned nautical tourism port in Ploče. In this case, the construction of the hotel enables more profitable business to the nautical port and better service to the yachtsmen. It is not uncommon in the world that hotel and nautical tourism ports complement each another and, in that case, hotels are mostly B&B (4 stars) services with open facilities, such as restaurants and bars, becoming cult gathering places for sea lovers. Usually in such cases, hotel chain and marina chain enter into strategic alliances. And each one for its part contributes to the overall result.

Spatial plan of some Municipalities and Counties foresee additional capacity building in public ports. This form of competition at public ports built with public money, adversely affects the investment entrepreneurial climate, especially on islands where revenue is based mainly on transit seasonal nautical tourism.

Positive impacts of the construction of nautical berths in public ports is the management of the use of the coast and anchorages in an environmentally acceptable manner and provision of modern ICT technologies and services in ports for environmental protection.

But nautical tourists also need multimodal transport solutions, which can be subdivided in two categories. On one hand, there is part of the trip from and to the region of origin, with the predominant use of cars and airplanes, the biggest traffic polluters.

On the other hand, there is the second part of multimodal transport, that takes place in the ports of nautical tourism where yachtsmen berth and use car rental, bicycles or wind or kite surfing for sightseeing or active holidays. In particular, they use light modes of transport that connect the docking port areas to the hotels for any overnight stays and to the urban centres for any visits and excursions during their stay in port.

This opportunity is provided at all mainland ports of the nautical tourism, where yachtsmen can cycle around the natural and cultural heritage – of which the local landscape is rich – and get acquainted with ways of life of rural areas. On some islands, recreational cycling has been developed with the possibility of renting a bicycle, while on others there is a lot of room for improvement. By implementing cycling into the nautical ports, it will add new value to port.

7 Policy Implications and Conclusions

Previous paragraphs describe strategies and innovations being defined in individual transport areas for the containment of polluting emissions and aimed at defining new sustainable solutions for cross-border passengers' transport.

Over the last decade, development strategies related to cross-border and coastal passengers' mobility by the European Union[6] have been based on a vision focused on improving quality and sustainability. In our case-studies about flows between Italy and Croatia, we can find this same vision in the strategies contained in the pillars[7] of the EU Strategy for the Adriatic and Ionian Region (EUSAIR).

Therefore, the general EU policy framework and the current situation of the area under consideration with its strengths and weaknesses are the basis for identifying operational priorities for sustainability in cross-border passenger transport. As discussed in this document, they consist essentially in: a) reducing car use; b) reducing maritime transport-related emissions; c) improving connections to the hinterland, islands and coastal areas; d) supporting multimodal transport.

Therefore a first important contribution to the sustainability of the connections is given by public policies that support alternative means of transport to cars, given the very high number of cross-border passengers using the car.

It is a topic that concerns travellers' behaviours, technologies currently available, adoption of innovations in the sector of vehicle man-

6 In particular: a) White Paper from the European Commission "Roadmap to a Single European Transport Area" (2011); b) EC COM(2009)8 final; c) The "European Green Deal" (Brussels, 2019); d) "Maritime Transport Strategic Approach of the European Union" (Brussels, 2020); e) "Integrated Maritime Policy of the European Union" (IMP) (Brussels, 2020).

7 The key strategies of EUSAIR pillars 1 and 2, respectively: Blue Growth and Connecting the Regions. More specifically: a) to improve sea basin governance, by enhancing administrative and institutional capacities in the area of maritime governance and services (pillar 1, specific objective 3); b) to strengthen maritime safety and security and develop a competitive regional intermodal port system (pillar 2, specific objective 2); c) to develop reliable transport networks and intermodal connections with the hinterland, both for freight and passengers (pillar 2, specific objective 3).

ufacturers, the speed of renewal of the fleet in use. So, it is a theme that concerns wide-ranging public policies, defined at European and national level.

A second contribution of cross-border connections to sustainability is related to maritime transport, because the natural border between Italy and all Mediterranean Countries (including Croatia) is entirely on the sea.

From an infrastructural point of view, in order to guarantee efficient maritime line services, it is crucial that local spatial planning tools provide for an adequate number of berths and a sufficient operational shore length. In addition, as for passenger services, the organisational aspects of port surface area within the cross-border passenger terminals need to be restructured to achieve a harmonisation of multimodal transport options, oriented towards sustainability principles. But, in some cases, there are system boundaries that hamper this progress. For instance, passenger terminals should encourage the use of electric bicycles and vehicles, thus promoting intermodality and raising awareness of environmental safety, but one of the boundaries is that many ports do not have proper infrastructure (e.g., chargers for electric bicycles or vehicles).

On the other hand, in order to facilitate passengers in the process of buying tickets, all ports should have appropriate conditions for tickets sales and availability of buying tickets online. Other examples of ICT integration regarding the passenger demands are: free Wi-Fi, real-time information systems for passengers, schedule information/itinerary of maritime transportation lines.

Regarding the organisational aspect, line schedule could be implemented in function of harmonisation of multimodal transport options. As third contribution to sustainability of cross-border maritime interconnections.

Furthermore, consider that usually a hub terminal and its operational coast essentially consists of several Ro-Ro ramps for the acceptance of Ro-Ro passenger ferries. A greater number of Ro-Ro ramps increases the number of ferries that can moor at the same time. This makes the organisational aspects related to ferries more complex, but allows the activation of more passenger transport lines, according to the requests of passengers. Also, larger operational coast gives the possibility to enlarge the number of high-speed-passenger crafts, which give the possibility for increase passenger traffic flow.

Together with multi- and intermodality, the development of environmental impact procedures of a passenger terminal acts as a key indicator of port's sustainable development in terms of reduction of pollution and raising environmental awareness.

In this field, consider supply of alternative energy sources other than fossil fuels. The main advantages of such energy are their inexhaustibility and renewability, as well as usage of techniques that, in

significantly less extent, affects the environment. The development of alternative energies (wind, solar energy, hydrogen gas, tidal energy, biomass energy, and biofuels) contributes to port competitiveness on the market, as well as its environmental sustainability. For all these reasons, regional and local public authorities should support alternative energy sources also in maritime transport, even more than what is already happening.

A fourth contribution should be focused on improving connections to the hinterland, islands and coastal areas, because the sustainable development of cross-border transport is determined by technologies, infrastructures but also by links between coast and its hinterland. Also in this case, regional and local authorities are called to improve the infrastructural equipment and the connections (as stated in the pillar 2 of the EUSAIR strategy).

The four recalled contributions (reduction of the car use; ways to reduce maritime transport emissions; multimodal transport options; improvement of hinterland links) allow the definition of concrete and operational interventions by public entities and private operators to support new solutions for sustainable mobility and protection of the environment.

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