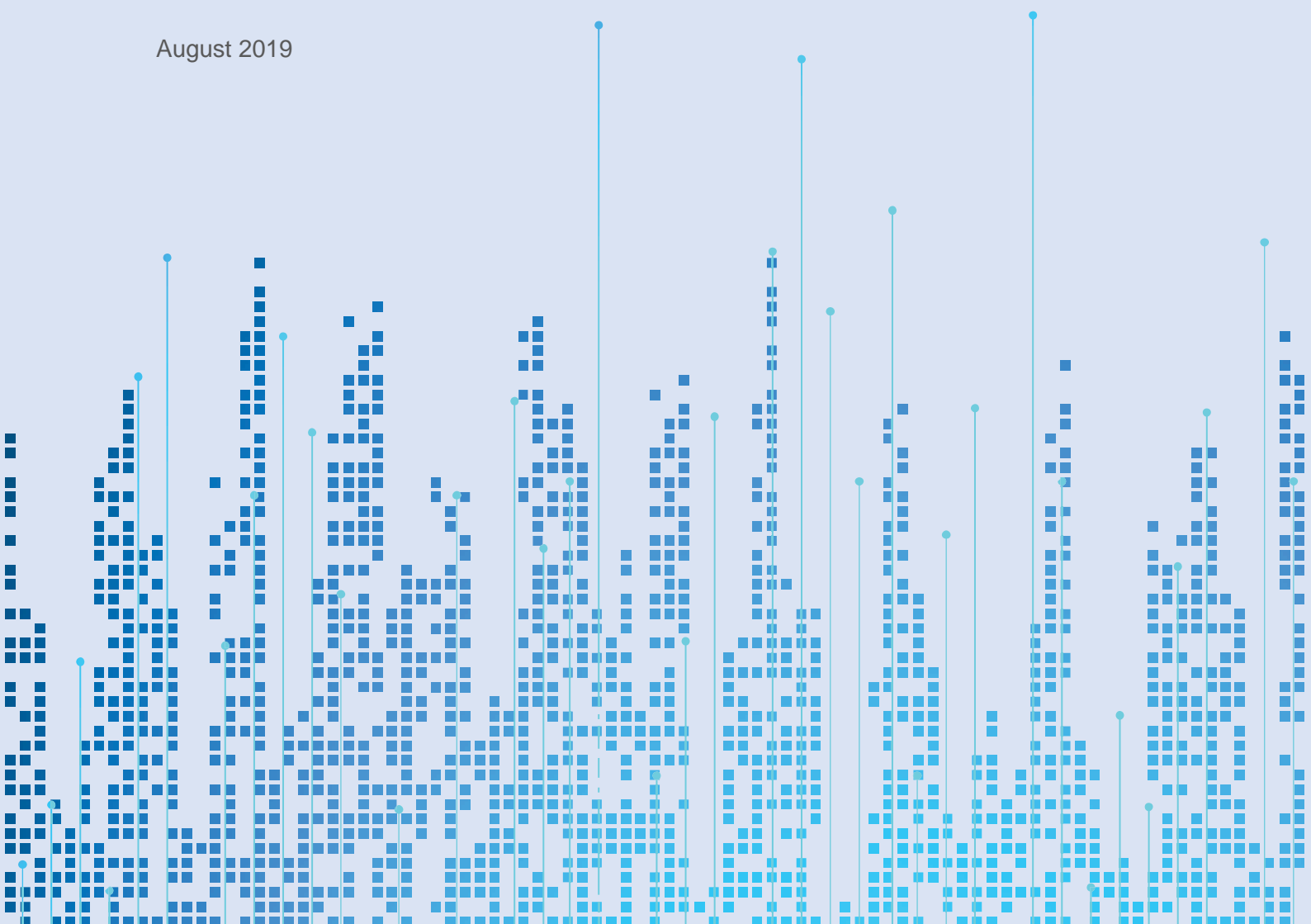


National Development Strategy Croatia 2030 Policy Note:

Croatia's Islands: Making the Most of Their Territorial Capital Through Smart Solutions

August 2019



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1 Smart Islands – challenges and opportunities on the European and global level

A smart island is an island that demonstrates the following elements - smart governance, smart people, smart mobility, smart living, smart economy, and smart environment.¹ Being a smart island is also becoming synonymous with being green, sustainable, energy efficient, and climate resilient. Smart Island Initiatives define a smart island as *an insular territory that embarks on a climate resilient pathway, combining climate change mitigation and adaptation efforts, in order to create sustainable local economic development and a high quality of life for the local populations by implementing smart and integrated solutions for the management of infrastructure, natural resources and the environment as a whole, supported by the use of ICT, all while promoting the use of innovative and socially inclusive governance and financing schemes.*²

Despite their uniqueness and differences, all islands face similar challenges with regards to their development. Those challenges consist of:

- overcoming the difficulties associated with geographical separation and distance from the mainland;
- solving the conundrum of public facilities that need to be able to meet peak demand during the tourist season but may be excessive and costly to operate for most of the year (such as information and communication technologies, energy, transport, waste collection and processing, sewage treatment, etc.); and related to this maintaining a balanced demographic make-up;
- organizing necessary education structures and providing vocational training and jobs for local people;
- guaranteeing the livelihoods of people working in the tourist industry, who have short seasons and often perform several different jobs;
- protecting the coastal and marine environment that is put under significant pressure at certain times of year;
- finding the necessary funding to provide public services for the permanent population, which is often small and aging; and,
- providing affordable housing for young people when holiday homes, the protection of natural areas and limitations on areas approved for development result in high housing costs.³

Despite their differences, islands are shaped by insularity, a structural, ever-present condition of geographic disconnection which has implications on energy supply, transportation costs, and economic diversification. However, they also tend to have unique ecosystems, enhanced levels of social capital, strong traditions of cooperation amongst the population, and a strong sense of identity and belonging. The Declaration states that this set of pluralistic characteristics is, in fact, conducive to the emergence of local development paradigms on islands that optimally combine environmental, social,

¹ Ghosal, A., Halder, S., 2018: Building Intelligent Systems for Smart Cities: Issues, Challenges and Approaches, in: Smart Cities: Development and Governance Frameworks (ed. Mahmood, Z.), Springer, Derby, UK

² Smart Islands Declaration: new pathways for European Islands, Smart Islands Initiative, 2016

³ TEN Section Report on the “Smart Islands” Project, European Economic and Social Committee, 2017.

economic and technological solutions underpinned by the premise of smart, integrated and inclusive natural resources and infrastructure management.⁴

The European Parliament resolution on the special situation of islands recognizes the various challenges as well as opportunities for future island development. It states that EU islands are also often peripheral regions, situated in some cases on the EU's external borders, and are particularly vulnerable to the challenges that are currently facing Europe, such as globalization, demographic decline and aging, climate change, energy dependency and, especially for the southern regions, exposure to increasing migration flows. Additionally, the resolution recognizes challenges related to the seasonality of tourism and the accessibility of islands.⁵

1.1 Challenges

Leaders around the world struggle to understand how best to invest in intelligent infrastructure and connectivity to deliver long-term value for their citizens.⁶ This can be the result of short-term mindsets or a lack of the visionary leadership necessary for creating successful, smart islands.⁷ In order to transform islands into smart and thriving economies, there is a need for well-designed and targeted community capacity building. Engaging and strengthening island stakeholders is crucial for understanding how to best invest in intelligent infrastructure and how to implement smart solutions that address real needs. Also, there is a need for a visionary leadership that will be able to see the opportunities to apply new cutting-edge technologies as they become available. Capacity building of different stakeholders, such as authorities, citizens, entrepreneurs and academia is necessary to be able to develop effective partnerships and holistic solutions and to ensure effective decision-making processes within the various levels of government.

There are specific technological challenges to be understood and overcome in any smart solution effort. These include machine-to-machine communications, security, spectrum utilization⁸, intelligent information networks, and the interconnection of a set of standards to achieve system interoperability.⁹ Data cannot be shared – and smart islands cannot fulfil their potential – if their systems cannot work with other related systems. Other challenges include implementation costs, high energy consumption, privacy and security, integration, and upgrading of technologies.¹⁰

Engaging citizens, as well as a broad spectrum of stakeholders, is crucial for the success of smart solutions to be implemented on islands. The potential solutions will be irrelevant to most inhabitants unless they can learn how to use new technology.¹¹ There is also the challenge of ensuring equity and fairness regarding access by various socio-economic or disadvantaged groups in the local community, such as people with low incomes or the elderly. Elderly inhabitants comprise a large share

⁴ Smart Islands Declaration: new pathways for European Islands, Smart Islands Initiative, 2016

⁵ European Parliament resolution of 4 February 2016 on the special situation of islands (2015/3014(RSP))

⁶ World Development Report 2016: Digital Dividends, World Bank Group, 2016

⁷ Smart cities: understanding the challenge and opportunities, Smart Cities World, 2017

⁸ Spectrum utilization refers to efficient use of radio frequencies in order to promote social benefit via the increase quality and speed of wireless communication – Cave, M. et al, 2007: Modern Spectrum Management, Cambridge University Press

⁹ Smart Sustainable Cities: Reconnaissance Study, United Nations University, International Development Research Center, 2016

¹⁰ Ghosal, A., Halder, S., 2018: Building Intelligent Systems for Smart Cities: Issues, Challenges and Approaches, in: Smart Cities: Development and Governance Frameworks (ed. Mahmood, Z.), Springer, Derby, UK

¹¹ Smart cities: understanding the challenge and opportunities, Smart Cities World, 2017

of the total population of the Croatian islands; therefore, including them in the process of implementation and use of smart solutions, and designing smart solutions based on their specific needs, is critical.

Enhancing institutional and administrative capacity is necessary to develop and adopt smart island solutions. It can, in general, be said that islands face challenges that are similar to, although more pronounced than, those that other levels of subnational government face, regarding institutional and administrative capacities. This is especially the case for small islands that are administrative units of their own, with limited local government staff and insufficient capacities, as well as lacking the finances needed to implement smart solutions. Additionally, due to negative demographic trends as well as unfavorable population structures and small local economies, it is challenging to find local stakeholders with the much-needed knowledge and capital to implement smart solutions. Aside from that, public-private partnerships, as a way to implement smart solutions, are limited at the local level and stakeholders willing to join the partnership, in most cases, must be found outside the local community.

The provision of digital services is the most immediate challenge associated with ensuring such technology and knowledge spillover. The digital divide in island societies and unequal access to information and digital services needs to be tackled to enable the uptake of smart and sustainable technologies on islands. Together with additional policies and support to the local economy, this could allow a more efficient and inclusive use of smart solutions, create new opportunities for citizens and business, boost the growth of innovative SMEs and start-ups, and facilitate the access to markets and sources of funding¹².

A potential way to begin identifying and developing solutions for some of these key challenges is the establishment of a multi-disciplinary smart island task force (with local representation) to be put in charge of creating smart solutions where the primary focus is to overcome the challenges and obstacles in the everyday lives of island citizens with the purpose of increasing the quality of life for all.

1.2 Opportunities

Islands have the potential to be a living lab for integrated solutions that showcase and boost smart approaches. As territories that have specific characteristics and constraints not faced on the mainland, islands can offer important lessons on multiple policy fronts, including efficient and innovative approaches to energy, transport, circular economy, climate adaptation, multi-level governance and ICT and for different geographies – cities and towns, rural and mountainous areas. The fact that islands are faced with different challenges as a result of variations in their size, distance from the mainland, population density, legal status and level of fiscal and political devolution, they also present the opportunity to demonstrate different solutions. Despite their differences though, and as mentioned earlier, islands are shaped by insularity, which presents challenges as well as strengths. The constraints and limitations are, in fact, conducive to the emergence of local development paradigms on islands that optimally and innovatively combine environmental, social, economic and technological solutions underpinned by the premise of smart, integrated and inclusive natural resources and infrastructures management.¹³

The population of islands traditionally coexist with nature and understand issues relating to natural resource limitations. Today they are increasingly aware of climate change consequences, making their potential to transition to clean energy and smart ecosystems all the more urgent and obvious. By their

¹² Smart Islands Declaration: New pathways for European Islands, Smart Island Initiative, 2018

¹³ Smart Islands Declaration: New pathways for European Islands, Smart Island Initiative, 2018

specific characteristics, island economies will increasingly need to close the loop locally to minimize their carbon footprint and manage increasingly scarce natural resources through renewable energy sources, smart water management, smart biodiversity preservation methods and other smart and integrated solutions. Islands will increasingly need to begin their clean energy and sustainability transition by improving the management of infrastructure, natural resources and the environment as a whole, supported by the use of ICT, all while promoting the use of innovative and socially inclusive governance and financing schemes. In this way, islands can become, not only self-reliant but also prosperous and open up to new opportunities for employment, as well as ensuring a high quality of life for their resident population.¹⁴

Various ICT solutions offer islands new opportunities to better manage their challenges. For instance, smart infrastructure can improve environmental sustainability, affordability, business climate, and general liveability. Solutions such as smart water meters and smart electricity grids can reduce usage and costs by raising awareness among individuals about how much they are using, as well as by automatically reducing consumption at times of limited demand. By collecting large amounts of data and then translating these data into insights, island communities could be able to greatly boost the efficiency and responsiveness of their infrastructure operations and manage the operating costs of infrastructure that will increasingly need to be designed for both peak and non-peak seasonal uses.¹⁵

Recognizing the importance of smart solutions for advancing island development various co-operation platforms have emerged across Europe with the goal of providing partnership and support in implementing those types of solutions. One of them is the *European Smart Islands Initiative*. It is a bottom-up effort of European island authorities and communities seeking to communicate the significant potential of islands to function as laboratories for technological, social, environmental, economic and political innovation.¹⁶ The initiative focuses on seven key areas of intervention: energy, transport, water, waste, governance, ICT and economy. Additionally, the EU recognizes the importance of implementing smart solutions for islands. For instance, the European Parliament resolution on the special situation of islands stresses that digital capacity is a vital means of counterbalancing the physical connectivity barriers faced by island regions. The resolution also underlines the importance of providing education at all levels, and where necessary by also making more use of distance education systems. Lastly, the resolution emphasizes that islands in the EU can contribute to strengthening sustainable development in the Union, in particular given their high potential for producing energy from renewable sources.¹⁷

It is critical to identify a clear financing strategy for investing in smart island solutions and the institutional capacity and resources available for implementing smart cities solutions. Funding sources could include national, municipal, and EU funding, as well as from leveraging financial or in-kind support from the private non-government sectors, including academia and local communities. It is also worth noting that the EU recognizes the need for an integrated approach in the 2021-2027 multiannual financial framework, where the main financing mechanisms, aside from the Cohesion policy, would be Horizon Europe, Digital Europe Programme, InvestEU, and LIFE. Within such financial support, islands can better manage the challenges they are facing and take advantage of their opportunities by empowering themselves to emerge as living labs for the energy transition, digital transformation, circular economy and innovative financing and so embark on sustainable and fair development pathways¹⁸.

¹⁴ Smart Islands Declaration: New pathways for European Islands, Smart Island Initiative, 2018

¹⁵ World Development Report 2016: Digital Dividends, World Bank Group, 2016

¹⁶ 2nd Smart Islands Forum: EU islands in the post-2020 era, 20-22 September 2018

¹⁷ European Parliament resolution of 4 February 2016 on the special situation of islands (2015/3014(RSP))

¹⁸ Florou, A., 2018: Proposal from the islands for the new MFF

Additionally, the European Parliament's Resolution on the island's special situation points out that although Croatia's islands are faced with constraints, they also have territorial potential that should be used as an opportunity for development, growth and job creation; the resolution highlights the importance of low taxes and the policy for reducing bureaucracy as key incentives for attracting investment. In this context, apart from seasonal tourism, the development of sustainable tourism, with the focus on the promotion of cultural heritage and special craftsmanship activities is also mentioned. The islands also have enormous potential in the production of alternative renewable energy sources - sun, wind, waves and sea currents. Thus, in the same document, point 11 emphasizes "the enormous potential of ocean, wind and sun energy, and the ability of the islands (EU islands) become important sources of alternative energy, as autonomous as possible, and above all, guarantee cheaper energy supply".

1.3 Best practices

On a global and European scale, there are good examples of smart island approaches worth learning from; some particularly relevant cases are presented below. There are cases of islands implementing various smart solutions, which differ from smart city solutions in their scale and complexity, but which have the same aim of making a more efficient use of resources and achieving higher levels of environmental and social sustainability. **Samsøe island in Denmark**, for example, has a project known as *Fossil Free Island* where they are introducing a number of technologies such as biogas, smart energy systems, upgraded wind power feeding heat pumps, storage heat and electricity, energy savings, smart energy systems, and e-mobility (e-vehicles, ferry). Around 70-80 % of financing is obtained through public-private partnership and only 20% comes from funding or direct subsidy.¹⁹

The **Island of Salina, often labelled as 'the greenest of the Aeolian islands'**, has started its clean energy transition. The island has taken initiatives to promote eco-tourism and initiatives to reduce pollution and environmental degradation and is planning to implement energy efficiency and energy saving measures particularly in public lighting systems and the heating and cooling of its public buildings. Further, the municipalities aim to produce energy locally, capitalizing on the island's abundant renewable energy resources of electricity and heat, and to switch their public transport to electric minibuses powered by solar PV. Charging stations would be available for electric vehicles on the island as well. These initial plans and activities have been well received by residents, local tour operators and visitors.

Involving all actors of the local community - including citizens, companies, trade associations, and tour operators - is a challenge Salina is working to overcome as it advances its energy transition. The municipalities driving the transition are aware of the shift needed in people's mindsets in order to choose clean energy options (such as opting for an electric vehicle for a new car rather than one that runs on fossil fuel) and plans target education and communications activities to bring the local community on board.

The municipality of **Palma de Mallorca is currently the second largest "Wi-Fi" city, after Miami (USA)**. WiFi Palma is a project run by the Universitat de les Illes Balears on big data and tourism. The project is being developed in cooperation with the Supercomputing Centre in Barcelona, the most powerful supercomputer in Spain. To increase its attractiveness as a tourism center, starting in 2014, Majorcan authorities began to provide free Wi-Fi access across the entire island starting in 2014 thus aiming to become an intelligent tourism destination. In some areas, work is still underway, but in Palma

¹⁹ Smart Islands Projects and Strategies, Issued from the 1st European Smart Islands Forum, Athens, Greece, 2016

de Mallorca, especially in the city center, and on Playa de Palma, people have free Wi-Fi access. The hotspots were technically improved so that everyone could move around the city without losing connection. The provision of Wi-Fi on the beach promenade of Playa de Palma aims to identify new trends (shopping, cultural and sports activities), which will help Palma propose tailored activities for tourists. The project also has considerable potential for user groups who need special attention (i.e. people with mobility impairments). Potentially, it may be possible to see whether fully accessible venues (i.e. for people with disabilities, elderly people using mobility devices, families with baby strollers) are more likely to be visited than venues which are not accessible to these target groups.

Further good practice examples can be found in **Annex | Smart Islands: Best practices – a detailed overview**.

2 Development challenges and opportunities of Croatian islands based on their territorial capital

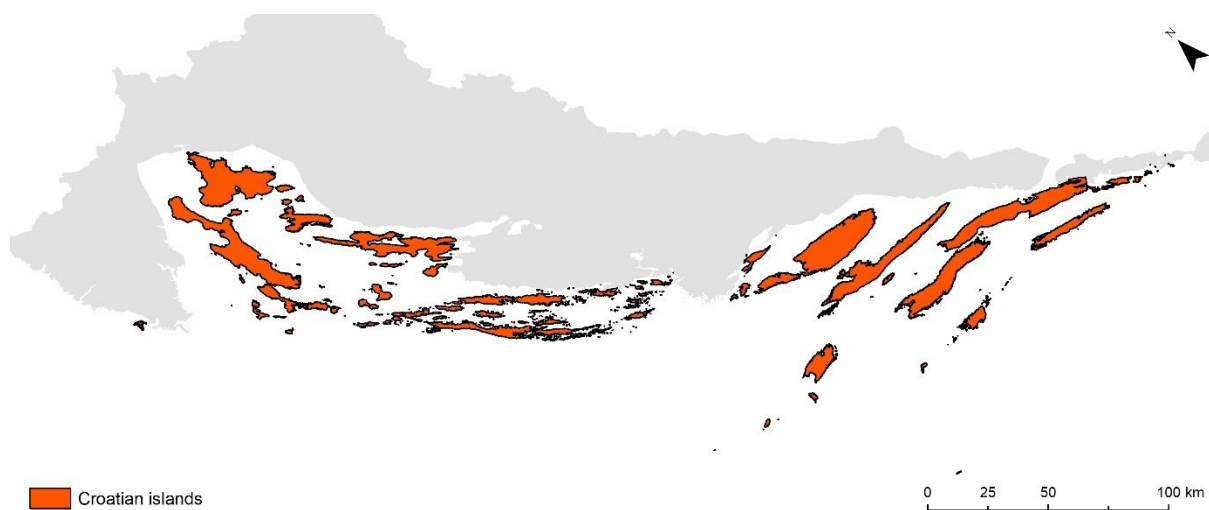
This section looks in detail at the development challenges and opportunities of Croatian islands based on their economic, cultural, social, and environmental assets otherwise known as their ‘territorial capital’.

In total there are 1244 islands, islets, rocks and ridges in Croatia. Of these, 78 are islands and 524 are islets. They are spread over an area of 31,479 square kilometres, which cover the surface of the whole interior and territorial sea of Croatia (35.7 % of the total surface area, including land and sea area). The significance of the Croatian islands can also be seen in the fact that over 70% of the total Croatian coastal line length (6.278 km) relates to its islands.

In an administrative sense, the Croatian islands are divided into cities and municipalities. That said, it is worth mentioning that 60% of all islands are administratively parts of cities and municipalities with center on the mainland on some other island. Such is the case for the cities of Šibenik, Zadar, Pula, Split, etc., where numerous islands (and settlements on them) are considered integral parts of these administrative cities on the mainland. A certain number of islands are within the city or municipality having their administrative center on some other island (e.g. Osljak, Sestrunj and Rivanj within the Preko Municipality). Thus, the analysis of territorial capital cannot include islands that are in an administrative sense part of mainland cities, as most of the data is available at the level of local administrative units (LAU). If data for the mainland cities would be considered in the analytical process, the results would not be representative given the size and development characteristics of those cities. Therefore, this analysis is limited to looking at the territorial capital of the 50 LAUs that are entirely located on the islands.²⁰

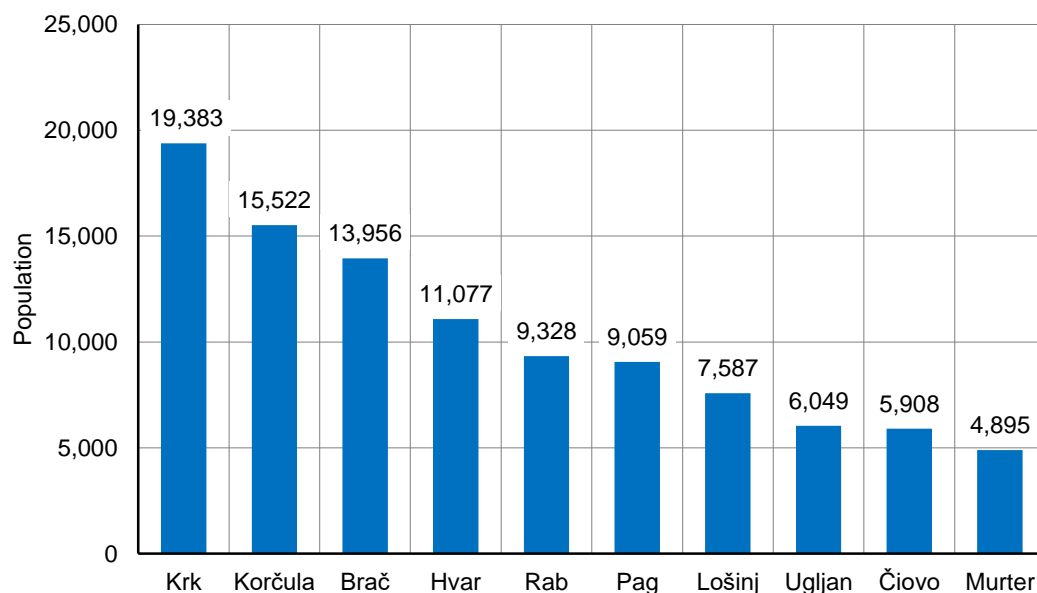
²⁰ LAUs included in the analysis are: Baška, Blato, Bol, Cres, Dobrinj, Hvar, Janjina, Jelsa, Kali, Kolan, Komiža, Korčula, Krk, Kukljica, Lastovo, Lopar, Lumbarda, Mali Lošinj, Malinska-Dubašnica, Milna, Mljet, Murter-Kornati, Nerežišća, Novljica, Okrug, Omišalj, Orebić, Pag, Pašman, Postira, Poveljana, Preko, Pučišća, Punat, Rab, Sali, Selca, Smokvica, Stari Grad, Ston, Sućuraj, Supetar, Sutivan, Šolta, Tkon, Trpanj, Vela Luka, Vir, Vis, Vrbnik.

Figure 1. Geographical distribution of Croatian islands



In 2011, there were 132.756 inhabitants on Croatia's islands, which is 3% of the total population of Croatia.²¹ Out of 78 islands, 47 are permanently settled. There are exceptionally large differences in the number of inhabitants across the islands, with the largest being Krk, with 19,383 inhabitants, while the smallest island of Male Srakane has only 2 inhabitants. Aside from Krk, the most populated islands are Korčula, Brač, Hvar, Rab, and Pag. Looking at the surface area of islands, the largest are Krk and Cres, both with an area of 406 square kilometers. Following that are the islands of Brač (395), Hvar (300) and Pag (285). Croatian islands also have differing altitudes, with Brač being the islands with the highest peak, St. Vid which stands at 780 m.

Figure 2. Largest Croatian islands by population in 2011



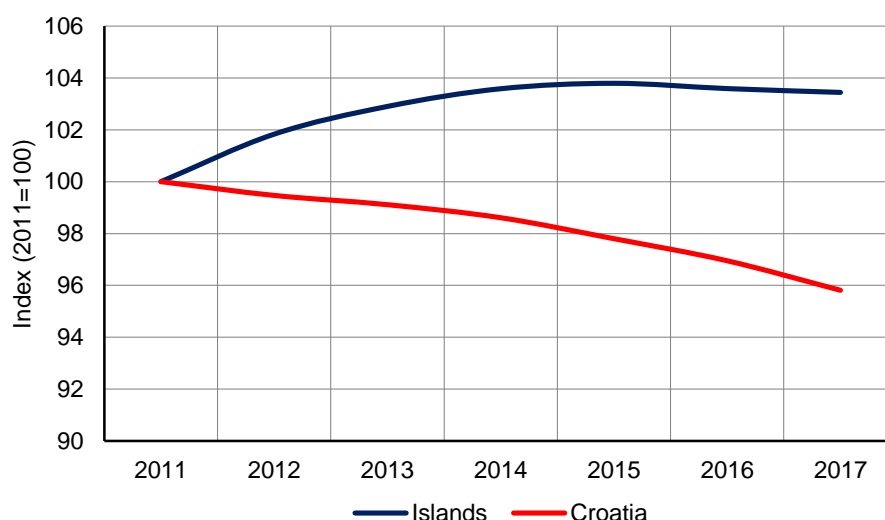
Source: Croatian Bureau of Statistics, 2018

²¹ Statistical Yearbook of the Republic of Croatia 2018, Croatian Bureau of Statistics, Zagreb, 2018

In contrast to the national population, which has seen negative growth since the 1990s, the population of the Croatian islands increased by circa 3.4% between 2011 and 2017 according to the estimation of Croatian Bureau for Statistics (2019). ²²In the same period the population of Croatia declined by 4.2 %.

The age coefficient demonstrates the share of the aged population versus the total population. The age coefficient on the islands in 2011 was around 31%, while the national average was 24%. At the same time, the aging index, which shows the number of elderly people per hundred young people, amounted to 171.2 in the islands in 2011. This indicator was considerably higher than the national average of 115. **Therefore, it is noticeable that despite having greater population growth, the islands do have a more aged population compared to the country as a whole.**

Figure 3. Population change of Croatian islands and Croatia 2011-2017



Source: Croatian Bureau of Statistics, 2019

Immigration is the key factor in the overall population growth of the islands rather than natural population increase (childbirth). However, as immigration did not contribute to the increase of childbirths, some researchers assume that the increase in the number of immigrants can be attributed to the so called “fictitious population” – inhabitants only registered on islands, but actually living on mainland.²³ Additional studies, focused primarily on individual islands, show that larger Croatian islands, despite population aging, are potentially attractive destinations for a number of domestic and foreign immigrants. Although it is difficult to expect a more significant demographic revitalization of the islands from this immigration, tourism certainly brings new actors to it. Large islands are in a more favorable position due to the greater number of inhabitants and the greater density of social relations, social and public services and infrastructure facilities.²⁴

Natural population change on the Croatian islands is negative, with an increasingly negative trend in recent years similar to the country as a whole. Both Croatia as a whole and islands have

²² Data used for Croatian islands refers to all local administrative units (LAU) located on the islands, including the Peljesac Peninsula which is considered an island according to the Islands Act (NN 116/18)

²³ Lajić, I., Mišetić, R., 2013: Basic demographic processes on the Kvarner islands 1991-2011, *Geoadria* 18/1, 71-92

²⁴ Marinović Golubić, M., 2017: Immigration to the island - modern migration on the island of Korčula, *Migracijske i etničke teme* 33 (2), 115-141

experienced a significant increase in the number of deaths. However, the number of live births on Croatian islands is pretty much consistent, with only a slight decrease, while the number of births in Croatia as a whole is rapidly decreasing. Simultaneously, the net migration rate of Croatian islands is positive, unlike the one of Croatia. However, the net migration rate of Croatian islands has been continuously decreasing in the last several years.

One of the biggest challenges for the development of the Croatian islands is therefore the issue of depopulation and aging. Along with the already mentioned problem of the small number of people living on the islands, the most significant challenge is the availability of workplaces on the islands due to their geographic distance from the mainland. The lack of young people and the growing number of emigrants leaving Croatia pose a major challenge for all Croatian islands since smart development is based on having an educated and working-age population. The decreasing number of local residents leads to a functional change from a work-residence area to holiday-recreation-retirement area and contributes to the disappearance of many elements of the traditional island economy. The promotion of the islands as quality living and working areas must be incorporated into all management policies as one way to overcome this challenge and could be considered a precondition for the islands' economic prosperity. At the same time, new and smart strategies are needed to service a declining, dispersed and increasingly aged population.

Table 1. Natural population change of Croatian islands and Croatia

Area	Element	2011	2012	2013	2014	2015	2016	2017
Islands	Live births	1.076	1.091	1.034	1.041	1.078	1.015	1.007
	Deaths	1.519	1.595	1.557	1.596	1.725	1.699	1.800
	Natural population change	-443	-504	-523	-555	-647	-684	-793
Croatia	Live births	41.197	41.771	39.939	39.566	37.503	37.537	36.556
	Deaths	51.019	51.710	50.386	50.839	54.205	51.542	53.477
	Natural population change	-9.822	-9.939	-10.447	-11.273	-16.702	-14.005	-16.921

Source: Croatian Bureau of Statistics, 2019

Table 2. Population Migration

Area	Element	2011	2012	2013	2014	2015	2016	2017
Islands	Immigrants	3.694	4.052	4.628	4.637	4.172	3.787	3.874
	Emigrants	2.310	2.302	2.788	3.241	3.268	3.354	3.263
	Net migration rate	1.384	1.750	1.840	1.396	904	433	611
Croatia	Immigrants	79.937	77.798	87.218	91.374	87.633	88.737	87.133
	Emigrants	84.102	81.716	92.102	101.594	105.578	111.188	118.932
	Net migration rate	-4.165	-3.918	-4.884	-10.220	-17.945	-22.451	-31.799

Source: Croatian Bureau of Statistics, 2019

Only 14% of the population living in the Croatian Islands has attained higher education (amounting to 15,621 inhabitants), yet this number is only slightly less than at the national level. In comparison to the national level, where the percentage of the population that has attained higher education is 16.39 %, the islands have only a slightly lower percentage. In the analyzed islands, local

units have 2.6% of all the country's population with higher education. The proportion of the highly educated population varies between islands, which demonstrates the uniqueness of each island. **The largest ratio of highly educated people that make up their total population percentage is in the municipalities of Omišalj and Trpanj, which have more than 22% of the total highly educated population.** The largest number of islands have a 16% or 17% share of the highly educated population. The lowest share of the highly educated population is in Pučišća (8.4%) and Nerežišća (7.3%), which are both located on the third most populated Croatian island, Brač, where the main economic activities are tourism, agriculture and fishing.

Table 3. Population with higher education

	Population (15+ years)	Higher education	% of higher education
Islands	107 137	15 621	14,58
Croatia	3 632 461	595 233	16,39
% of islands	2,95	2,62	1,8

Source: Croatian Bureau of Statistics, 2012

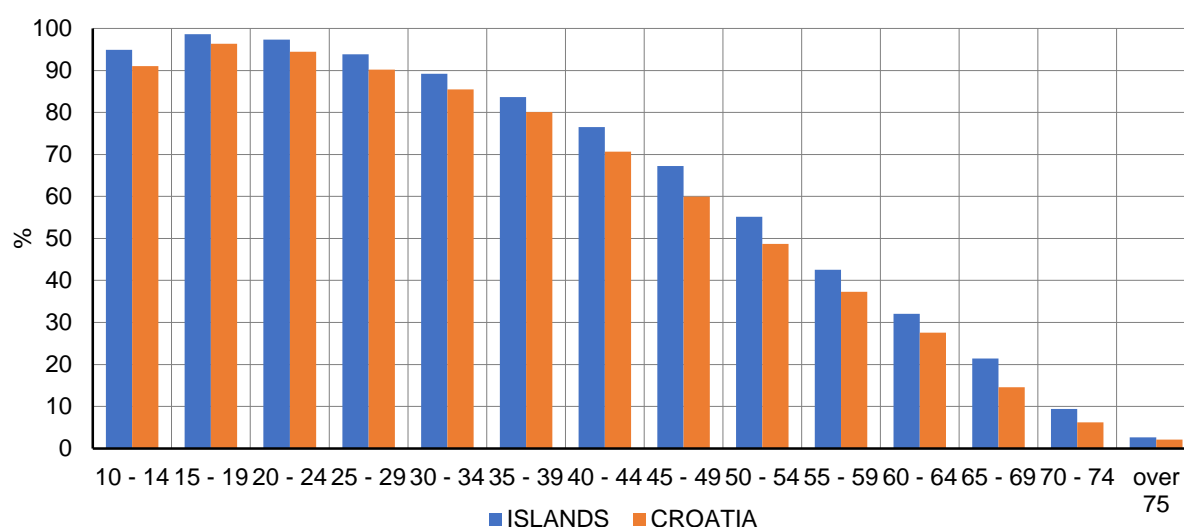
The population in the Croatian islands has on average in all age groups a higher informatic literacy than the national level. ²⁵At the national level, average informatic literacy is 57.5%, and on the islands that rate is 61.7%. However, because of the small number of people that live on the Croatian islands only 2.85% of all people in Croatia who are informatically literate live on the islands.

In terms of age group, the highest levels of informatic literacy is amongst the 15-24-year old age group, where it is above 95%. The informatic literacy of the population in the age groups 10-14 and 25-30 years is slightly lower but is still over 90%. In the same age groups, informatic literacy on the national level is a bit lower and as can be seen in figure 7, the percentage in the age group between 10 and 14 years is 91% and between 25 and 30 years is 90%. Informatic literacy in the population of Croatian islands is gradually and continuously decreasing in older age groups as well as at the informatic literacy of elderly at the level of Croatia. The working-age population between 15 and 65 years old has an average information literacy of 68.8 % and is drastically lower in the three oldest groups of the population. In the last two age groups, the population's informatic literacy it is lower than 10%.

However, a slightly lower percent of island households (at 50.3 %) has a personal computer compared to the national average of 55.3%. Out of the total number of households in Croatia who own a computer, 2.8 % are in cities. In comparison, 51.6% of households in Croatia that own personal computers are in the 17 largest cities.

²⁵ Informatic literacy (defined as the ability to use computers and computer programs), is a key component of the labor market and today's economy, and especially required for certain branches of the tourist industry.

Figure 4. Population by age using the internet on islands and in Croatia in 2011



Source: Croatian Bureau of Statistics, 2012

There is only a small number of university students living on the islands. There are fewer than 4,000 university students in the analyzed islands, accounting for 3.1% of the island population. More than 147,000 students were enrolled in professional and university studies in Croatia in 2017, with only 2.6% of these being in the analyzed islands. In the period between 2011 and 2017, the number of students on the analyzed islands that enrolled in universities decreased by 6% compared to 2011. Observing the ratio of enrolled students and the number of inhabitants, 31.26 students per 1,000 inhabitants are enrolled on the islands, while the average at the Croatian level is 34.43 students per 1,000 inhabitants.

Government quality and transparency on the islands, as measured by the publishing of public documents and documents of major importance, is below the national average. In the context of local governance quality and transparency, the Institute of Public Finance conducts research on the transparency of the work of local and county authorities across Croatia. The research is based on the number of publicly-published documents relating to the budget and the work of local bodies. Measured by the number of published documents, the average transparency of the budgets of local self-government units in Croatia is improving from year to year, so in the last four cycles, it almost doubled from an average of 1.8 to 3.52 published documents (values are from 0-5). With an average level of transparency of 3.28, LAUs on islands are below the national average, suggesting that public documents and documents of major importance for the development of local communities are not as easily available to island citizens. Out of a total of 50 LAUs on islands, 8% scored 0 in 2018, while an additional 38% of them were below the national average. This data indicates that local governments on islands must put significant efforts in increasing the transparency of their work.

In recent years, island LAUs have achieved a positive budget execution. In terms of budget realization, in 2016 the average budget surplus in island LAUs was 204,993 kunas per capita. However, there are significant differences amongst the LAUs, with Smokvica having a surplus of 4,092,78 knpc, while on the other hand, Pag had a budget deficit of -3,130,27 knpc.

Table 4. Budget transparency of island LAUs in 2018

Score	Number of LAU	% of LAU
0	4	8,00
1	3	6,00

2	5	10,00
3	11	22,00
4	17	34,00
5	10	20,00
Average	<i>Islands</i>	3,28
	<i>Croatia</i>	3,52

Source: Institute of Public Finance, 2019

Two key challenges of introducing smart solutions on Croatia's islands are a lack of local regulations and guidelines for these; and a lack of coordination in implementing planned ICT projects. Furthermore, local authorities often lack the agile, open and inclusive forms of governance that would allow innovation to happen. Also, they lack the tools and approaches to involve local communities, non-government entities, and the private sector; these are all issues that need to be addressed and solved in order to fully implement smart solutions.²⁶

The lack of digitally available services affects the quality of life on the islands. Local islands authorities are characterized by a low level of provision and use of public e-services and their poor adaptation to the needs of individual users, as well as by the insufficient efficiency, efficacy, transparency, and accountability of authorities in the implementation of public policies related to the provision of public services.²⁷ In island communities, there is a relatively small number of existing digital services related to communication between citizens and local authorities on social services such as health, education, culture, etc. It is also important to emphasize the lack of monitoring and prevention system related to natural disasters that many islands are exposed to, especially due to climatological changes and seismological conditions. Wildfires in recent years exemplify how such impacts have posed a specific threat to communities and tourism.

In order to retain the population and improve the quality of life on the islands, improvements in basic services such as education, health care, and others are critical and necessary for the further development of the island economy. One of the indicators of the education system is the number of kindergartens and the number of enrolled children in these kindergartens. On the Croatian islands in 2018 there were 72 kindergartens, which is an increase of 3 preschool institutions compared to 2013. These 72 kindergartens account for about 4.2 % of all kindergartens in Croatia. While only 2.92% of the Croatian population lives on the islands, there are 4.2% of kindergartens and other legal entities implementing preschool education programs on them. This is due to the geographical characteristics of islands and their separation from the mainland as well as the separation between them – a large number of islands and settlements on them requires an increased number of kindergartens per capita due to the inaccessibility of those institutions to nearby mainland towns or nearby islands. During 2014, in the 69 kindergartens there were 3,392 children enrolled, and just as the number of kindergartens has increased, so has the number of enrolled children, growing by 15.5 % in the observed five-year period.

The number of pupils enrolled in elementary school in the islands grew by 5.42% since 2011, which is a positive trend, especially in comparison to the national level where during the same period the number of pupils enrolled fell by 7.11%. On Croatian islands, there are 93 elementary schools with 8,212 pupils enrolled as of 2017. The share of pupils that are enrolled in elementary schools on islands represents 2.6% of all elementary school pupils in Croatia. In 2017 there were 2,094 pupils

²⁶ The smart city sector in Croatia, Flanders investment & trade market survey, 2017

²⁷ e-Croatia strategy 2020, Ministry of Public Administration of the Republic of Croatia, 2017

enrolled in upper secondary schools, which is a decline of -18,68 % in comparison with 2011. In 2017 only 1,4 % of all upper secondary school pupils were enrolled in secondary schools on islands, which indicates a need to strengthen the system of secondary schooling on islands, as some families decide to move to mainland in order to have more accessible secondary schools for their children. The development of secondary education, especially vocational education, would contribute to the island's population, but also to the diversification of the island's economy, and potentially to the strengthening of entrepreneurship.

Table 5. Kindergartens and schools on Croatian islands in 2011 and 2017

	2011	2017	Change (%)	2011	2017	Change (%)
Kindergartens	Institutions			Children		
Islands	69	72	4,35	3.392	3.918	13,43
Croatia	1.513	1.715	13,35	127.028	139.228	9,60
% islands	4,56	4,20	-0,36	2,67	2,81	0,14
Elementary schools	Schools			Pupils		
Islands	94	93	1,08	7.790	8.212	5,42
Croatia	2.073	2.030	-2,07	340.116	315.942	-7,11
% islands	4,53	4,58	0,03	2,29	2,60	0,31
Upper secondary schools	Schools			Pupils		
Islands	36	37	2,78	2.575	2.094	-18,68
Croatia	715	744	4,06	183.807	155.642	-15,32
% islands	5,03	4,97	-0,60	1,40	1,35	-0,05

Source: Croatian Bureau of Statistics, 2012

Recent research on the availability and geographic distribution of social and public services in Croatian islands shows that spatial-development processes of Croatian islands are manifested through the polarization of population and littoralization. When it comes to the island area of Croatia in the context of the national network of central settlements, it is evident that on islands there are no settlements of higher-ranking centrality other than the weaker subregional centers. By analyzing the distribution of the functions and services of island settlements, it can be concluded that some settlements, parts of the island or entire islands are sub-capacitated in terms of the basic functions/services such as education, health care, etc. and gravitate to a greater or lesser extent to the neighboring island or mainland center. This issue needs to be considered from the aspect of the quality of life of the local population on the islands and as one of the most influential factors of emigration from islands where basic services and functions are lacking.²⁸

Modern technology is a tool that can be used to overcome the challenges of unequal access to economic and social services in Croatia's islands. Various services are nowadays easily available through the use of the broadband Internet and modern technologies. The right for education and health care are fundamental rights guaranteed by the Constitution and can be upgraded and rationalized through

²⁸ Marinković, V., 2018: Identifikacija prostorno-razvojnih trendova hrvatskih otoka analizom opremljenosti naselja centralnim funkcijama, Sociologija I prostor, 56, 210 (1), 3-34.

the development of educational and health digital platforms. Modern tools thus contribute to social cohesion and eliminate spatial barriers, which is of great importance for the island population.

Social welfare, taking into account the poverty risk rate, is lower on the analyzed islands. In the analyzed islands, the poverty risk rate in 2011 was 25.43%, which was significantly higher than the national average of 21.10%. Poverty risk rates differ significantly between the islands; in the best position is Municipality Blato at a rate of 5.97%, while the Municipality Pašman is in the most unfavorable position with a poverty risk rate of 29.01%.

The number of doctors who permanently reside in the general hospitals in the Croatian islands is very small. In the Mali Losinj and Supetar municipalities, there are only ten hospital beds and one doctor practicing general medicine. In Mali Losinj, a special hospital for physical medicine and rehabilitation has 200 beds and five specialist doctors (Croatian National Institute of Public Health, Annual publication 2017). The health insurance on the islands under compulsory health insurance is carried out by the Croatian Compulsory Health Insurance Agency through 107 contracted teams of General Family Medicine, 5 contracted health care teams for preschool children, 9 teams for health care for women, 64 multidisciplinary dental healthcare teams, 10 emergency medical emergency teams, 17 emergency medical teams, 21 health care teams, 12 emergency medical teams, 3 emergency medical teams, 8 emergency medical emergency teams, 3 healthcare team. Patronage's health care is implemented by 41.5 teams, and the health care of the patients in the house is carried out by 28 teams. There are also 28 pharmacies on the islands. Specialist-conciliar health care is implemented by 4.5 teams of internal medicine; 4.7 Physical Medicine and Rehabilitation Teams; one team of general surgery; 2.6 teams of ophthalmology; 0.5 teams of urology; one team of orthopaedics; a team of orthodontics; 4.3 teams of radiology; one team of clinical cytology; 0.6 teams of medical biochemistry and 4 physiotherapists of physical therapy at home (Plan and program of health protection on islands, 2007).

The main economic activities on the Croatian islands originate from their natural resources and human adaptation to these natural resources. Along with tourism, which is the main economic activity of the islands, trade, small shipbuilding, fishery, and agriculture are the dominant economic activities. While agricultural land accounts for only 6 percent of the total island area, island products are characterized and known for their high quality.

The Adriatic Sea, as an integral part of the Croatian islands, is considered to be the most valuable territorial capital for islanders. It has been an important source of natural resources for centuries as well as a medium for communication and the exchange of goods, technology, and knowledge. It contributes to high tourist attractiveness and the islands' economic orientation. At the same time, it is a medium that separates and connects. Although the Croatian islands represent about 6 percent of the land territory of the Republic of Croatia, the islands determine the territorial sea, which accounts for almost 37 percent of the total area of Croatia.

Croatian islands have a work-age population of 107,000 inhabitants, of which 41.3% are employed, which is almost the same percentage of people that are employed at the national level (41.4 %). Given the small number of people living on the islands, the share of the employed population of the island on the national level does not deviate from that figure; only 2.95% of the employed population in Croatia works on the islands. A positive characteristic of the labor market of the Croatian islands is the smaller rate of the unemployed working population in the period between 2014 – 2016 which was 10.5 % then that of the national level, where the rate of unemployment is 17.83 %.

The economic structure in today's island lacks diversification, with tourism being the dominant economic sector. Activities closely related to the tourism sector employ the largest share of the inhabitants of the Croatian islands; within this, activities tied to accommodation and food services account for about 18%, which is a lot higher than the national level wherein the same activities employ

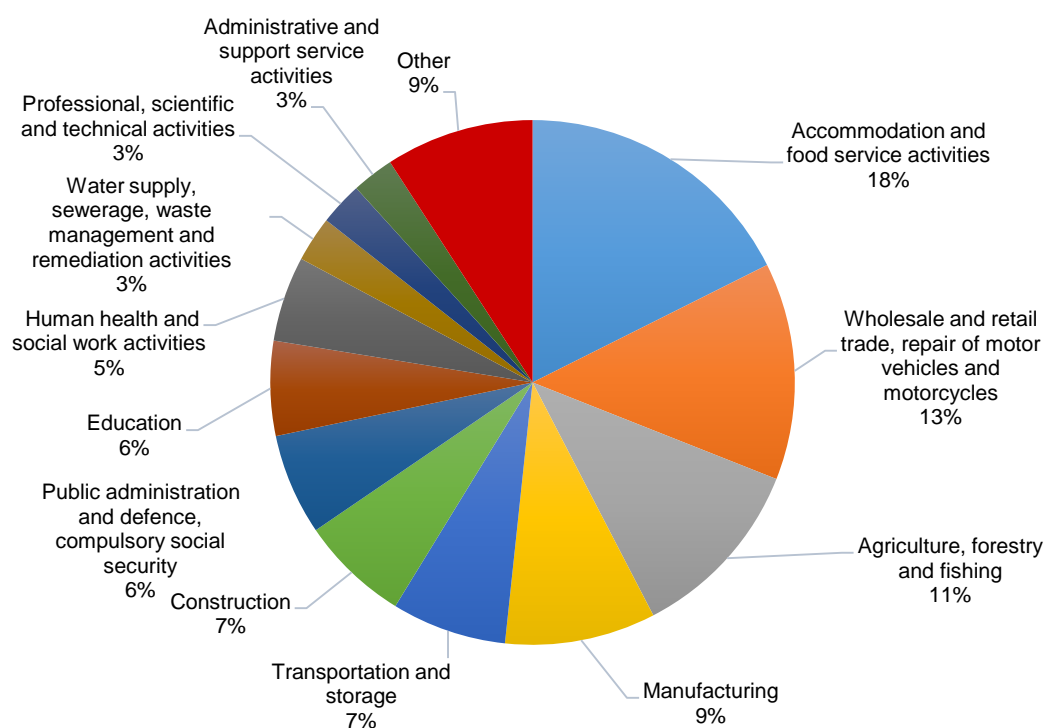
only 6% of people. Retail and wholesale trade represent the second most important activity on the islands and employs 13% of workers. Tourism has the biggest and most important role in the economy of the islands in terms of employment. After tourism, activities in the primary sector, which on the islands include agriculture and fishing, employ the biggest percentage of working people at around 11%. This is higher than the nation level where 6% work in the primary sector. Manufacturing employs the largest number of people nationally (16%) but considering the significantly different structure of the islands' economy, the share of workers employed in these activities on the islands is significantly lower (6%). Almost the same share of employees work in transport and storage activities, as well as construction activities in the islands (7%) and at the national level (6%). As for rest of the activities, the biggest percentage of the population is employed in public administration (6%), education (6%) and human health and social work activities (5 %) (Table 6).

Table 6. Structure of the labor market on islands and on the national level in 2011

Activity	Croatia	Islands	% islands in totally employed
A Agriculture, forestry and fishing	5,31	11,38	6,32
B Mining and quarrying	0,52	0,86	4,93
C Manufacturing	16,90	9,30	1,62
D Electricity, gas, steam and air conditioning supply	1,10	0,93	2,50
E Water supply, sewage disposal, waste management, and environmental remediation activities	1,51	2,79	5,46
F Construction	7,64	6,72	2,59
G Wholesale and retail trade	15,71	13,39	2,51
H Transportation and storage	6,01	7,08	3,47
I Accommodation and food service activities	6,10	17,61	8,51
J Information and communication	2,80	0,82	0,87
K Financial and insurance activities	3,03	1,43	1,39
L Real estate activities	0,35	0,51	4,37
M Professional, scientific and technical activities	4,26	2,67	1,85
N Administrative and support service activities	2,61	2,59	2,92
O Public administration and defence	8,18	6,24	2,25
P Education	7,04	5,83	2,44
Q Human health and social work activities	6,75	5,25	2,29
R Art, entertainment and recreation	1,79	2,01	3,32
S Other service activities	1,97	2,12	3,16
T Activities of households as employers, household activities that produce different goods and perform various services for their own needs	0,11	0,08	2,14
U Activities of extra territorial organizations and bodies	0,04	0,01	0,48
Unknown	0,27	0,36	3,85

Source: Croatian Bureau of Statistics, 2012

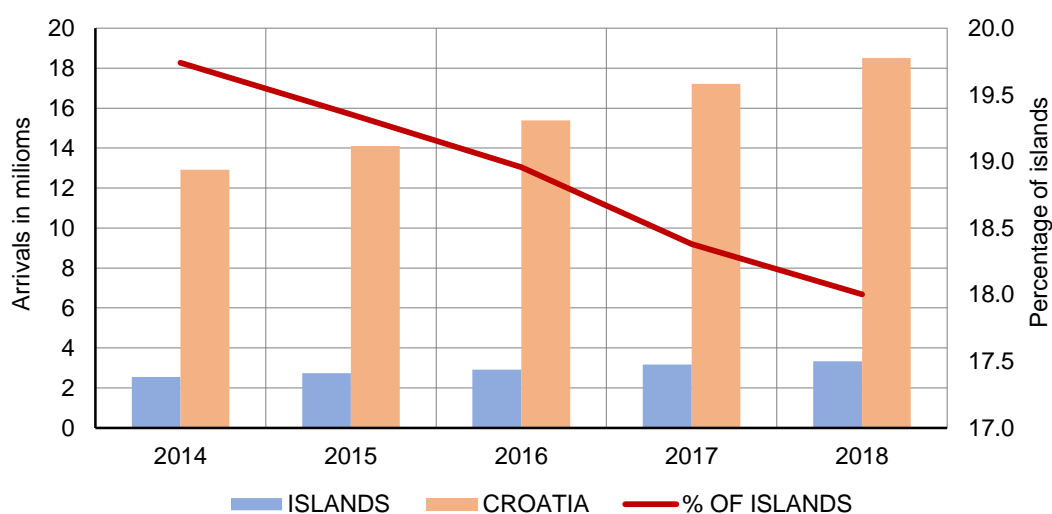
Figure 5. Labor market characteristics of Croatian islands in 2011



Source: Croatian Bureau of Statistics, 2012

Considering that tourism makes up a significant portion of the islands' economies it also has greater economic, socio-cultural and ecological impacts on the islands. The size and importance of tourism for the islands are best reflected in the number of tourist arrivals and overnight stays, which has steadily increased over the past five years. During 2018, more than 3.3 million tourists visited the Croatian islands which, is a 5.4% increase compared to 2017. The number of tourist arrivals has been continuously increasing in the observed five-year period; the number of tourists increased by a total of 30% in 2018 compared to the number of arrivals in 2014. In the same period, the number of tourist arrivals at the Croatian level increased by 43.3%. The share of tourist arrivals on islands, out of the total number of arrivals in Croatia, is continuously decreasing in the observed five-year period; in the year 2018, 18.44% of the total number of tourists in Croatia were visiting and staying on islands. Foreign tourists in Croatia account for a significantly higher number of arrivals (89.3%) than domestic tourists (10.7%), but the share of foreign tourists is even more pronounced on the islands, accounting for 91.4% of the total number of arrivals while domestic tourists make up only 8.6% of arrivals.

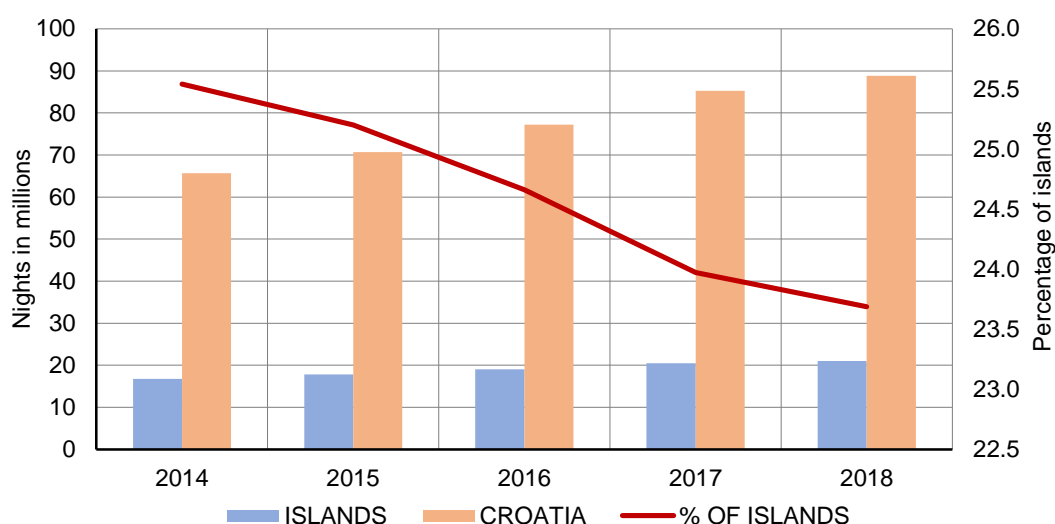
Figure 6. Number of tourist's arrivals on islands



Source: Croatian Bureau of Statistics, 2019

Between 2014-2018, the number of overnight stays on Croatian islands increased by 25.5% (Figure 13). In the area of the Croatian islands, over 21 million overnight stays were recorded in 2018, representing an increase of 2.94% compared to 2017. In comparison, in 2014, when the tourism sector in Croatia was recovering from the economic crisis, some 17 million overnight stays were recorded. In total, on the national level, the number of overnights in the observed period increased by 35.4% which is, as can be seen, 10% more than on the islands. During 2014, about 25.5 % of all tourists' nights in Croatia were recorded on Croatia islands, but in 2018 this percentage fell down to 23.7%.

Figure 7. Number of tourist's nights on islands

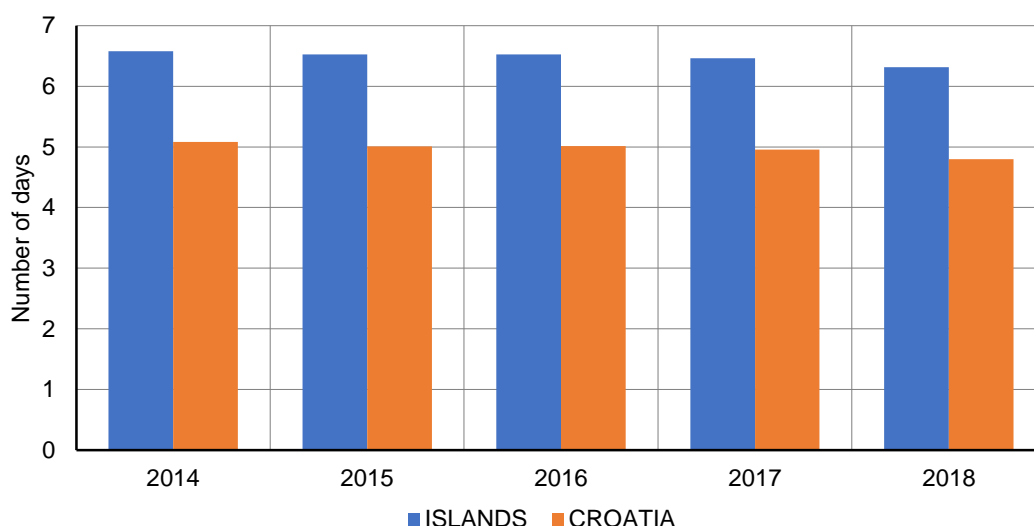


Source: Croatian Bureau of Statistics, 2019

If comparing the number of nights spent in a location per individual arrival that were recorded in the islands versus at the national level, visitors to the islands stay an average 1.5 days longer. During the summer of 2018 tourists spent 6.3 days on average vacationing on the islands, while at the national level they stayed 4.8 days. In the last five years, the length of the tourist visiting period has decreased by 0.3% at both the national level and on the islands.

Further progress of islands' economies will undoubtedly depend on the development of tourism and related activities, so the sustainability of tourism is one of the most important components of island development. The sustainability of tourism can be measured by its bearing capacity or space load. Space capacity can be monitored by looking at the number of tourists in relation to the number of local residents. The fact that there are 27,040 tourists per one thousand island inhabitants, while only 4,320 per thousand inhabitants at the national level, indicates that during the summer months the existing islands' infrastructure and services are highly overloaded.

Figure 8. Number of days that tourists spend in Croatia and islands



Source: Croatian Bureau of Statistics, 2019

One key challenge for Croatia's islands is to harmonize tourism development with sustainable development. Dependence on tourism is causing imbalances in, and fragility of, the island economy, which is why the diversification and development of knowledge-based and island-based industries are necessary. Also, there is a need to ensure that higher value-added is gained from the tourism industry itself and opportunities are identified to extend and diversify the tourism season along the coast, inland, and in cities. Along with strengthening the role and ensuring the sound management of tourism, there are a large number of challenges, such as the seasonal nature of these social and economic activities on the islands.²⁹ The high seasonal pressure on communal infrastructure, particularly on the water supply and waste management, will require specific management approaches. Also, the concentration of activities in the coastal area results in large environmental pressures on the coastline, including the uncontrolled construction of holiday apartments and tourism infrastructure.

With smart management, tourism can generate sustainable economic development on the islands. The use of smart technologies can ensure optimal resources and infrastructure management and thus help to develop sustainable tourism on the islands. Geographical isolation and environmental conservation also represent potential for the development of ecological agriculture on the Croatian islands.

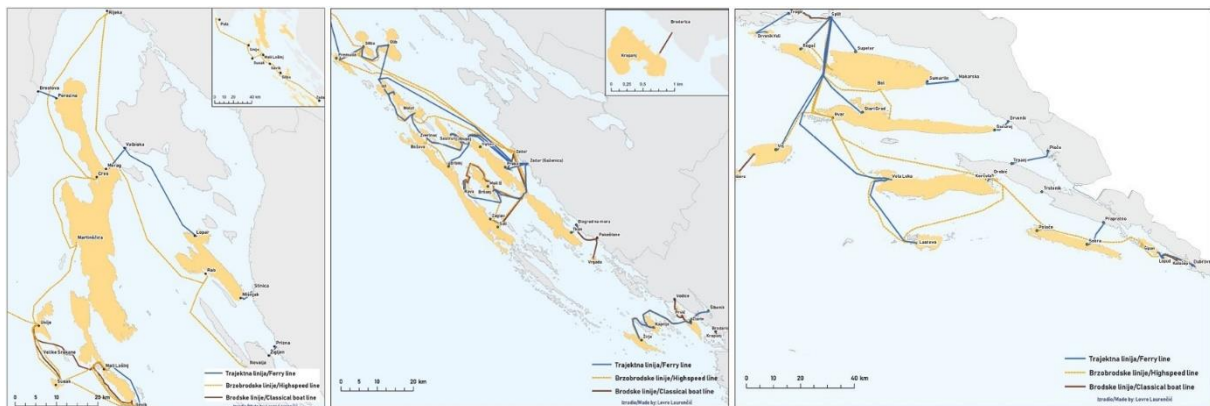
In shaping the overall development of the islands, transportation is another critical factor. In the context of islands' accessibility, research shows that generally, perhaps unsurprisingly, islands with a greater number of inhabitants and a greater number of central functions have more frequent daily connections to the mainland than smaller ones. For islands with less inhabitants and less represented

²⁹ Faričić, J., 2012.: Geography of North Dalmatian islands, Školska knjiga, Zagreb

features of central functions, better transport services are also a prerequisite for meeting the island's key needs. The islands with the best accessibility are those connected with the mainland by bridge - these are Krk, Pag, Murter, Vir, and Čiovo. Conclusions of the research related to the transport connectivity and accessibility of the Croatian islands confirms that this deepens the structural inequalities between the smaller and larger islands, between the more populated and less populated islands, and between the islands closer to the land and those farther away.

Other islands are connected by ferries or boats. There are 24 state ferry lines that connect the mainland with the islands, 12 boat lines, and 15 fast state boat lines³⁰. Poor connections on an island, especially between the islands and the mainland, impacts the mobility of island inhabitants. The connection to the mainland determines the integration of the islands into the Croatian and Mediterranean economic areas. The islands are characterized by a high cost of living and investments on them are conditioned by higher transport costs. Compared to the mainland, the costs of economic investments are about 10 percent higher for the larger and more accessible Croatian islands, while for small and distant ones those costs can be 30 percent higher or more.³¹

Figure 9. Traffic connections of the Croatian islands



Source: Marinković, 2018

A highly important aspect of quality of life is the availability of various infrastructures and services such as water supply, sewerage, electricity, and gas. On average, in 2011 on the Croatian islands 99.66% of households were connected to water supply infrastructure³², 99.64% were connected to the sewerage system and 99.94% had electricity. It is worth noting that these numbers are higher than the Croatian average (98.19% for water supply, 97.98% for sewerage and 99.83% for electricity), which indicates that islands households are actually better equipped with basic infrastructure than the national average. However, as the gas supply infrastructure is not present on islands, only 1.76% of households have gas installations (in Croatia the average is 36.55%).

A total of 112,606.72 tons of municipal waste was collected on the islands in 2017, which is 8.06 % of the total waste collected in Croatia. Given that only 2.92 % of the Croatian population lives on islands, the significance of the islands, and specifically island-based tourism, in creating waste is

³⁰ Marinković, V., 2018: Croatian islands – insight into the traffic-geographical features of accessibility, *Geoadria* 23/2, 177-205 (number of ferry and boat lines refers to all populated islands in Croatia, including the ones that are administratively part of LAU with administrative center on mainland).

³¹ Starc, N., 2015: Towards the sustainable development of Croatian islands

³² According to the MRDEUF (2019), approximately 5.000 households on Croatian islands does not have access to drinking water.

notable. Of the total waste produced in cities, only 3.18% was collected from separate waste collection tanks in public areas. Although very low, this share is slightly above the national average of 2.71%. An analysis of the amount of collected waste compared to the number of residents shows that 0.91 tons of waste per capita are collected annually on islands, which is above the national average of 0.33 tons per capita, as well as above the average in cities (0.34 tons per capita). It is evident that tourism plays an important role in producing large quantities of waste on islands, which indicates the need for the further development and more intense implementation of waste separation and waste awareness amongst tourists on the islands.

Average seawater quality on the islands is rated with a grade of 2.98, similar to the average rating of seawater on all analyzed beaches in Croatia (2.94).³³ Additionally, data about the rating of the quality of seawater in coastal cities on the mainland records an average rating of 2.84. Clear water of high quality is a valuable resource for islands communities that has to be maintained by all means necessary.

Significant resources on Croatian islands are being irrationally spent as a result of obsolete infrastructure and the lack of mechanisms for use monitoring and real-time management. In some island communities, there is a shortage of water during the tourist season due to the considerable increases in its demand from tourism facilities. The issues of smart water distribution and management, as well as of waste management, drainage, and energy efficiency, are challenges that all the Croatian islands are increasingly facing.

Small islands economies have the potential to achieve energy independence by using renewable energy sources. The high level of annual insolation (i.e. amount of solar radiation received on a given surface) is the most important resource of the islands in the context of electric energy production. For instance, through the installation of solar panels and smart public lighting, and through the use of biogas, the island of Unije became the first energy-independent island in Croatia whose example is now being followed by other islands. The integrated energy management system is a step towards savings in the energy system and efficient energy management.

Island ecosystems are strongly affected by climate change. Soil drainage associated with global warming, plant cover degradation and a further increase of fire risks from abandoned lands are some of the greatest challenges that the Croatian islands face. Low coastal zones and island settlements are endangered by rising sea-levels and intrusion of saline seawater which further reduces the already limited freshwater resources. All of this gives rise to an urgent need for both the mitigation of locally produced CO₂ emissions and the introduction of resilience and adaptation planning for the islands, including through the development of the green economy and sustainable tourism approaches and infrastructure.

As local island communities (and islands themselves) greatly vary in their characteristics, challenges, and opportunities, the sustainable and smart development of islands in Croatia requires innovative and differentiated approaches based on local specificities. For small island communities' new innovative models are needed that balance between the preservation of the natural and historic heritage and sustainable socioeconomic development. Additionally, there is a need to better use the limited public resources and find alternate models for financing smart infrastructure and solutions. Other than private entrepreneurship projects and national and local subsidies, there are European Structural and Cohesion Funds that can be accessed through which the EU is encouraging Member States to

³³ According to the Institute of Oceanography and Fisheries (2019). Qualitative assessments by Institute of Oceanography and Fisheries have been assigned with quantitative ratings for the purpose of calculating the average quality of the sea: unsatisfactory - 0, satisfactory - 1, good - 2, excellent - 3. The minimum possible rating is 0 and maximum is 3.

implement smart and locally appropriate solutions. Also, the EU has introduced new financial instruments to support environment and climate action projects, for which cities can apply including: The Financial Instrument for the Environment and Climate Action (LIFE) Programme, Horizon 2020 and Intelligent Energy Europe (IEE).³⁴

³⁴ The smart city sector in Croatia, Flanders investment & trade market survey, 2017

3 Key areas of intervention and performance indicators

3.1 Key areas of intervention (KAI)

Based on the conducted analysis, the key areas of intervention for “smart islands” are identified below:

1. Smart governance and smart resource management
 - a) e-public administration
 - b) ICT infrastructure
 - c) communication platforms for dialogue with citizens, and the civil and private sectors
 - d) smart planning of island development
 - e) encouraging social innovations
 - f) transparency of public data and information
 - g) integrated management systems for islands’ infrastructure and natural resources
2. Smart economy
 - a) ecosystem for entrepreneurs
 - b) diversification of island economies
 - c) sustainable tourism development
 - d) territorial branding
 - e) development of creative and cultural industries and IT sector
 - f) expansion of opportunities for locally produced food
 - g) e-commerce
 - h) e-business and businesses networking
 - i) lifelong learning in line with the needs of the labour market and informatic literacy
 - j) development of skills related to smart specialization and entrepreneurship
3. Smart mobility
 - a) infrastructure for clean island transport
 - b) alternative fuel infrastructure
 - c) walking, cycling and non-motorized transport infrastructure and services
 - d) digitalization of island transport systems
 - e) clean island transport vehicles
 - f) improving the mobility of the island population (not only tourists)
 - g) intermodal transport and better connectivity of islands and mainland
4. Smart environment

- a) renewable energy sources and promoting self-sustainable islands
 - b) smart energy and water distribution systems and smart drainage
 - c) smart public infrastructure
 - d) smart buildings, homes and districts
 - e) smart waste management
 - f) control and monitoring of air, soil and water quality, noise reduction
 - g) smart and environmental management of industrial sites
 - h) smart measures for adapting to climate change
 - i) increasing the awareness of the local population and visitors about the need to preserve the environment and providing means for more rational use of resources
5. Smart living and safe islands
- a) high capacity broadband network
 - b) support to the development of e-citizens
 - c) digitalization in the field of health care (smart healthcare infrastructure)
 - d) and e-health services
 - e) smart educational infrastructure and development of educational platforms
 - f) social and inclusive infrastructure provision (including universal access for elderly and disabled)
 - g) protection, valorization and promotion of cultural heritage and cultural services
 - h) improvement in quality and security of public spaces
 - i) more effective development of a program to combat indigenous wildlife

3.2 Key performance indicators (KPI)

In order to monitor the intensity of the use of smart solutions on islands and the impact of their application on the socio-economic development of islands' populations, there is a need to identify suitable indicators for monitoring the degree of "smart island" development. These indicators can also be used to define a unique composite indicator for monitoring the development of smart islands. It is important to note that in Croatia numerous statistical data are not collected at the local level, but exclusively at the regional and/or national level; therefore, the number and quality of the available individual indicators at the island-level (that is, at the level of the local administrative units located on islands) are affected by the above-mentioned limitations, which may require further consideration.

Potential indicators that can be used to track progress in the development of smart islands are presented below:

Indicator	Indicator description	Data source
Smart Governance and Smart Resource management		

Budget transparency	Budget transparency in 2017 measured by the number of key budget documents published on the official websites of LAUs located on islands.	Institute of Public Finance
Share of children in nurseries and kindergartens out of the total number of children aged 0 to 6 on the island	The share of children in nurseries and kindergartens in the total number of children aged 0 to 6 on the island.	Croatian Bureau of Statistics
The proportion of women council members to the total number of island LAUs council members	The proportion of women council members to the total number of island LAUs council members	State Election Commission
Smart Economy		
Share of employees in cultural industries	The share of employees in cultural industries located on the island in relation to the total population of the island.	Financial Agency (FINA)
Self-employment rate	The share of self-employed in the total number of employees on the island.	Croatian Pension Insurance Institute
Newly established enterprises	The share of newly registered enterprises in the total number of companies on the island.	Ministry of Justice Court Register
Export intensity	The share of revenue from exports in the total revenues of all companies with headquarters on the islands.	Financial Agency (FINA)
Employment in Knowledge-intensive industries	The share of employees in knowledge-intensive industries in the total number of employees in all companies with headquarters on the islands.	Financial Agency (FINA)
Unemployment rate	The share of unemployed persons on the island in relation to the total population	Croatian Employment Service
Smart Mobility		
Share of daily commuters on the island	The share of daily commuters commuting between different settlements on the island in relation to the total island population	Croatian Bureau of Statistics
Share of daily commuters to the mainland	The share of daily commuters commuting between island and mainland in relation to the total island population	Croatian Bureau of Statistics
Electric vehicles charging stations	Number of electric vehicles charging stations on the islands	Google Maps, HEP
Public transport lines per area	Number of public transport lines (bus, tram, train) per km ² of total island area	LAU
Public transport lines per inhabitant	Number of public transport lines (bus, tram, train) per 1.000 inhabitants	LAU
Smart Environment		
Mixed municipal waste	Produced mixed municipal waste per inhabitant. Quantity of waste (tons) in relation to the population of the island.	Croatian Environment Agency
Amount of municipal waste collected separately	Amount (tons) of total municipal waste collected separately	Croatian Environment Agency
Quality of seawater on island beaches	Average annual grade of water quality of seawater on the beaches located on islands	Institute of Oceanography and Fisheries

Use of electricity	Electricity delivered to households (MWh per capita)	HEP Distribution System Operator
Smart Living and Safe Islands		
Share of highly educated citizens	The share of population with tertiary education (university and more) on the island in relation to the total population.	Croatian Bureau of Statistics
Share of citizens using internet	The share of population using internet on the islands in relation to the total population of the islands.	Croatian Bureau of Statistics
Students enrolled in university studies	The number of students enrolled in university studies with residence on islands.	Croatian Bureau of Statistics
Doctors of medicine per 1,000 inhabitants	The number of medical doctors on the islands in comparison to the number of inhabitants.	Croatian Health Statistics Yearbook
Hospital beds per 1,000 inhabitants	The number of hospital beds on the islands in comparison to the number of inhabitants.	Croatian Health Statistics Yearbook
Theatre attendance per inhabitant	The number of theatre visitors on the islands in comparison to the number of inhabitants.	Croatian Bureau of Statistics
Museum visitors per inhabitant	The number of museum visitors on the islands in comparison to the number of inhabitants.	Croatian Bureau of Statistics
Residential area per capita in m ²	The size of residential area per capita in m ² on the island.	Croatian Bureau of Statistics
At-risk-of-poverty rate in 2011	The estimated risk-of-poverty rate.	Croatian Bureau of Statistics
Crime rate	Number of crimes on 1.000 island inhabitants	Regional police departments

4 Policy mix recommendations

The thematic coverage of smart islands encompasses a wide range of development sectors, which is evident from the thematic areas outlined in the previous chapter:

- smart governance and smart resource management
- smart economy
- smart mobility
- smart environment
- smart living and safe islands

Given that almost all of these sectors are the subject of a number of sector-oriented policies, within the policy mix for the development of smart islands recommendations have been defined with the aim of creating general incentive conditions for the development and implementation of smart solutions from different sectors to facilitate their application on islands.

Several general recommendations were identified:

- Defining the financial viability of implementing smart solutions before implementing the project through a simple cost-benefit analysis that will determine the future cost of maintaining the implemented solutions and the financing options for maintaining them. This is necessary to ensure the long-term functionality and sustainability of the project and to determine the realistic financial capacity of the provider (responsible body) in terms of ensuring the long-term benefits of the project for the local community.
- When defining the criteria for the selection of projects submitted through the call for proposals, it is necessary to diminish the importance or completely remove the criterion of the development index of units of local self-government on the islands. Given the specific characteristics of islands' socio-economic development (the over-emphasized importance of, and income from, tourism, the small number of inhabitants etc.), the development index cannot be considered as a suitable criterion in terms of determining the needs of individual islands (e.g. 15 island LAUs are in the eighth development group according to the development index – most developed LAUs). For example, Vis (LAU – only one on the island of Vis) belongs to the seventh development group (the second most developed group of LAUs) although it is very poorly connected with the mainland and is characterized by its inaccessibility/geographical isolation.
- There is a need to improve and adapt the system, procedures and time intervals for collecting statistics for island settlements so that island development can be monitored and planned better (eg setting up a Population and Housing Register and adjusting existing forms and procedures so that the islands can be statistically accurately monitored, regardless of their administrative status).

4.1 Short-term policy recommendations (1-3 years)

Recommendation

Strengthening the competencies of local authorities

Problem:

Most local authorities in the Croatian islands, as well as in LAUs on mainland whose territory includes islands, considering the size and population of island settlements, do not have adequate competencies to implement smart solutions. This presents a challenge for preparing smart projects and implementing smart solutions and smart projects on islands. As such, smart solutions are only just beginning to be implemented on the Croatian islands, and there is still limited competency for designing and applying solutions and limited ability to coordinate the types of actors and partnerships needed to build smart solutions.

Approach:

The scope and quality of the implementation of smart solutions on the islands largely depends on the competencies, knowledge, and skills of local authorities. Given that there are indications that the local authorities in Croatia are not sufficiently familiar with smart solutions, their potential, and their importance for the overall development of the local community, it is necessary to strengthen the competencies and capacities of the local authorities on islands. This will contribute to more focused actions of island authorities and will facilitate the process of preparing and implementing smart projects.

Required actions:

1. Strengthen the capacities and competencies of local authorities
 - a) It is necessary to carry out an assessment of the knowledge and capacities of local authorities on the concept, thematic coverage, and possibilities of implementing and financing smart solutions.
 - b) Based on the results obtained, conduct an assessment of the training needs of the local authorities on specific segments of the development, implementation, and financing of smart solutions.
 - c) Provide education to local authorities (unified for all local authority representatives).
2. Define a clear direction for the development of smart islands based on the identified needs and potentials
 - a) Develop strategies for the development of smart islands and consider differentiated strategies for different islands.
 - b) Develop a Smart Investment Directory (catalogue) containing a list of identified needs with the potential to apply smart solutions in order to attract investors.

Risk management:

Potential risks	Mitigation measures
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A lack of interest of islands' (LAUs on islands) authorities on the topic due to insufficient familiarity	Information/media campaigns showing the necessity and benefits of smart solutions
Insufficient human and/or financial capacity of local authorities to develop smart strategies	Provide financial support from state bodies

Recommendation

Intensify the use of the islands' specific developmental potential while simultaneously addressing specific local development challenges

Problem:

As physically isolated territories, islands are areas with specific challenges, as well as specific development potential that require identifying solutions that meet local needs. Islands are shaped by insularity, with a series of related implications including energy dependency – particularly on fossil fuels – high transportation costs, limited economic diversification, as well as having unique ecosystems, enhanced levels of social capital, and a strong sense of identity and belonging. This set of constraints and limitations is, in fact, conducive to the emergence of local development paradigms on islands that optimally and innovatively combine environmental, social, economic and technological solutions underpinned by the premise of smart, integrated and inclusive natural resources and infrastructures management. The solutions designed for the islands will be irrelevant to most island inhabitants unless solutions solve the real local specific needs and contribute to the integration of the islands into the overall development processes of the entire country.

Approach:

Islands should identify their most important development needs themselves and be encouraged to realize project ideas that will adequately address their specific development challenges. It is necessary to set up a targeted program through which funds will be provided, together with technical support, to implement pilot projects that will solve the development needs of the islands in an innovative and smart manner. It is necessary to enable the islands to realize pilot projects from a broad spectrum of thematic areas, i.e. from all thematic areas of smart islands mentioned above: smart governance and smart resource management, smart mobility, smart economy, smart environment, smart living and safe islands.

Required actions:

Establish and implement a pilot projects programme for the islands.

Short description

Co-financing the piloting of smart projects, which represent innovative and smart solutions at the local level, which significantly and directly contribute to the local community and which are, by their character, unique and currently unavailable on the Croatian islands.

Pilot project proposals/some possible pilot for transport solution – as an example only

Development of the boat&park&ride system - Island integration in the public transport of the city of Zadar: the project coordinates the activities of various operators operating in the transport sector in the

Zadar area (city port operator (berths), public bus operator, etc.). The purpose of the project is to provide the residents of Zadar islands with a parking space in the port in case of arrival to the city by their own boat. Users pay a subsidized fee for using berths in the port and the purchased card can also be used for public buses.

Bodies responsible for implementation

Local and/or regional administrative units implementing pilot projects.

Implementation model

Grant scheme.

Risk management:

Potential risks	Mitigation measures
Long-term implementation of pilot projects due to poor development of "innovative" project ideas and maturity projects for implementation	Information and education campaigns prior to the calls for proposals and implementation of the programme

Recommendation

Strengthening capacity to implement smart solutions through the establishment of a specialized, interdisciplinary, coordination body.

Problem:

In the administrative sense, the Croatian islands are divided into cities and municipalities, while some islands are administratively parts of cities and municipalities located on the mainland. Despite the administrative separation, island authorities need to work together in order to accomplish common goals and to strengthen capacities for a holistic approach. Due to that, there is an expressed need for a coordination body that will assist island authorities and actors in establishing strategic partnerships with entrepreneurs, universities and civil society to develop smart solutions for islands that are sustainable, integrated, transferable and scalable. This holistic approach derives from insularity, the condition that forces island authorities to focus on how to ensure the optimal use and management of their resources and infrastructure, very often within island boundaries, in order to support sustainable and equitable economic development that fully taps into islands' local potential (geography, natural and human resources, products).

Approach:

Croatian islands are faced with many challenges, one of which is the lack of local authorities' interest in long-term thinking about development based on smart solutions, as well as the inadequate human and organizational capacities of the often small local self-government units on the islands. There is a need to develop a coordination and advisory body at the national level, which will be the driver for intensifying the application of smart solutions on the islands and will coordinate and link local self-government units operating in the same island area. The body could be set up by the ministry responsible for regional

development and be composed of experts relevant to the territorial development policy and to the islands, and specifically aim for the development and application of smart solutions and their financing mechanisms.

Required actions:

1. Defining the scope of work of the “Smart Islands Task Force/Coordination Body”.
2. Determining the composition of the “Smart Islands Task Force” (multi-disciplinary experts and island representatives).
3. Establishing the “Smart Islands Task Force”.
4. Monitoring and evaluation of the “Smart Islands Task Force” and its contribution to the implementation of smart solutions on islands.

Risk management:

Potential risks	Mitigation measures
Insufficient knowledge of local authorities regarding the Smart Islands Task Force and the possibilities of using their assistance	Educational and information campaigns directed to local authorities on islands
Distrust of local government representatives towards the Smart Islands Task Force	Including the experts and representatives from the islands into the Smart Islands Task Force

4.2 Medium-term policy recommendations (4-7 years)

Recommendation

Intensify the process of developing digitally available services for islands’ residents

Problem:

The scope and quality of digital services on the Croatian islands are mostly poor, thus resulting in inhabitants having to travel to the mainland for certain services that could potentially be done online. According to the Digital Economy and Society Index (DESI) survey of the European Union, in 2018, Croatia was 22nd out of 28 EU members, only one place ahead of its 2017 position. Accordingly, Croatia belongs to a group of less successful countries in digitalization. It is important to point out that the overall rating of the Croatian digital index is distorted, with poor technical connectivity and a very bad result in e-government, where Croatia is ranked 25th. And while the results compared to the number of users are favorable, it is precisely the offer of services that would respond to the implicit interest of the user that is missing. Considering the importance of islands as potential labs for overall smart development, and as the area with expressed need for improving quality of life and smart management of limited resources, islands are suitable areas for smart service development. Croatian islands are characterized by insufficient levels of digitalization of services, lack of user experience in digital services and poor awareness of the importance of data in management. The development of e-services at the local level needs to be coordinated to the most possible extent with the development of e-services envisaged within the e-Croatia 2020 Strategy.

Approach:

Digital services are one of the key steps in improving the quality of life of the local population on islands, enabling considerable time and money savings in carrying out administrative and other obligations and procedures (education, health, culture, etc.). Currently, carrying out many administrative procedures requires physical presence in the public services offices, which are often located on the mainland or on another island. A clear strategy for digital island transformation is the basic prerequisite for a clearly focused development plan aligned with existing needs (as well as potentials). When defining the steps that need to be taken, it is essential to initiate an analysis of user experience to determine the needs of local inhabitants, as well as to undertake a thorough analysis and optimization of the islands' LAUs business processes. As a result, the need to define concrete action plans for the development of digital services on islands is emphasized, and it is necessary to define the institutional framework for implementation, but also to provide funding for the action plan to be fully implemented. It is worth noting that the digitalization of public services will have benefits not only for the local population, but also for visitors (tourists) which are especially numerous during the summer months.

Required actions:

1. Develop an Action plan for the development of digital services on islands.
2. Define the institutional framework for the implementation of the Action plan and secure the cooperation of various LAUs on the island (if applicable).
3. Secure funding for the implementation of the Action plan.
4. Implement Action plan for the development of digital services on islands.
5. Monitoring and evaluation of the implementation of the Action plan.

Risk management:

Potential risks	Mitigation measures
Insufficient human capacity for implementation at the local level	Provide education to the employees of the local administration
Insufficient financial resources for the development of digital services	Provide financial support mechanism for island LAUs in the development of digital services

Recommendation

Increase cohesion between the islands by improving functional and territorial linkages

Problem:

Croatian islands are spread over an area of 31,479 square kilometres, which is the surface of the whole interior and territorial sea of Croatia. Each island represents a separate functional unit that is in most cases poorly functionally connected to other islands. Based on the common acknowledgment of the particular problems that islands face but also on their opportunities for development, specific actions need to be undertaken concerning the links between the islands, especially in terms of the common services offered to the local population. Functional and territorial connectivity can contribute to reducing

regional disparities and the stronger transmission of good practices and knowledge, which is why it is the postulate for a more intensive development and implementation of smart solutions.

Approach:

A large number of Croatian islands are in close proximity to each other, while some share the same or similar development needs. Geographic proximity and similar development needs in some ways create favorable conditions for the simultaneous development of two or more islands through the implementation of a single project. This needs to be seen as a potential to be used through the development of financial and implementation cooperation mechanisms. There is a need to develop a program aimed at integrated territorial investments or projects at the level of the Croatian islands, with emphasis on the development and implementation of smart projects that simultaneously contribute to the development of two or more islands. This can primarily be achieved through projects to improve transport connectivity, but also through the development of infrastructure and/or services and soft measures/support that contribute to the functional linking of the island and to improving the quality of life of the residents of all the island involved in the project. At the same time, given the physical separation of many islands from the mainland, it is necessary to encourage the implementation of integrated projects which can simultaneously address the needs (or contribute to the development) of two or more different thematic areas of "smart islands".

Required actions:

Developing the programme “Island Integrated Territorial Investments (ITI) – Integrated Projects”

Short description

Local self-government units on islands are offered project implementation funds in the form of a grant scheme. Projects must meet one of two aspects of the integrated approach: a) Contributing to the territorial integration of two or more islands – thereby solving common development challenges, and/or b) Contributing to the development of two or more sub-areas of smart islands (smart management and resource management, smart economy, smart mobility, smart environment, smart living and safe islands).

Proposals/examples of integrated projects

- a) Contributing to territorial integration
 - Adapting/creating space for the work of a local action group or partnership that includes several islands, whose work is aimed at improving the socioeconomic aspects of all islands in the spatial scope of a local action group.
- b) Contributing to the development of two or more sub-areas of smart islands
 - Revitalization of protected cultural heritage and its transformation into a cultural center (within the framework of the project a neglected object that is a protected cultural heritage is renewed and put into operation). The result of such project will be a cultural center with an area for exhibitions, manifestations and film projections. During the implementation of the project, smart solutions will be applied in the form of a rainwater collecting system that will be used in the facility, while solar energy photovoltaic panels will be used for the

purpose of producing electricity. The project contributes to the sub-areas of smart living and safe islands, a smart environment and a smart economy).

Bodies responsible for implementation

Local and/or regional administrative units

Implementation model

Annual calls for proposals.

Risk management:

Potential risks	Mitigation measures
Slow preparation and implementation of projects due to the need for mutual coordination between different LAUs	Establishment of body at the national level with the purpose of supporting the co-ordination and co-operation of different LAUs on the islands
Unclear criteria regarding the integrated projects	It is necessary to clearly define the concept of a project that contributes to the territorial/functional integration of the islands and an integrated project that contributes to the development of two or more different thematic areas

4.3 Long-term policy recommendations (8-10 years)

Recommendation:

Improve existing and develop new infrastructure and services on the islands

Problem:

Insularity, as the main characteristic of the islands, generates many problems in terms of accessibility of the basic infrastructure and services available on the islands, which affects the quality of life on islands. This includes, in particular, issues regarding the availability of drinking water, the management of risks resulting from the islands' current climate characteristics, and the unavailability of broadband infrastructure, which is one of the basic preconditions for the application of a large number of smart island solutions and sustainable development. That is why it is extremely important to boost investment in large (big-scale) projects that improve existing and develop new infrastructure and services on the islands that stimulate and facilitate the application of smart solutions for Croatian islands as a whole.

Approach:

It is necessary to implement comprehensive projects that will develop certain areas/elements of society, the environment and the economy on all Croatian islands in order to simultaneously improve the living conditions on all of them. Projects should be selected according to their importance for the improvement of the entire Croatian islands area and should be accordingly prioritized and implemented. Projects should focus on key development challenges, primarily infrastructure, and should be tailored to the real

needs and potentials of each island individually (for instance, not all islands have the same level of needs and potentials for the development of water supply infrastructure – distant islands should focus on desalination, collecting rainwater etc, while the ones closer to the land can get water from the water sources located on the mainland).

Required actions:

Implementing big-scale strategic projects on the islands

Short description

Several major strategic projects should be defined that in the spatial aspect include (are implemented on) the entire island area of Croatia. Thematic, major strategic projects address the basic development needs of the islands by applying smart solutions.

Project proposals/examples

- Depending on the needs of each island: desalination infrastructure, rainwater collection through wells systems, tanks and similar solutions, rainwater collection systems on individual facilities (private houses, buildings), improvement of water supply pipeline infrastructure ...), and shared solid waste facilities.
- Unified/single fire protection system for all islands (analysis of the optimal model of the system of fire protection on islands, application of smart technological and organizational solutions taking into account real needs and capabilities - thermal surveillance of island areas most vulnerable to fire, strategic deployment of drones for monitoring, coordination and improving the capacity of fire brigade services stationed on the islands, developing a single joint center on one of the islands ...).
- Development of broadband infrastructure on the islands (one of the basic prerequisites for the application of a large number of smart island solutions and sustainable development).

Bodies responsible for implementation

Competent bodies at the national level (ministries responsible for the strategic project theme).

Implementation model

In the process of implementation, a decommitment system is implemented, whereby the main project stakeholder is defined before the start of the realization of the project, and depending on the capabilities and competencies of other possible stakeholders several secondary stakeholders are defined. At the same time, the deadlines for the implementation of certain activities within the project (phases) are defined, and if the primary stakeholder does not reach the set goals within certain deadlines, the financial resources and the project implementation authority are transferred to another (secondary) stakeholder.

Risk management:

Potential risks	Mitigation measures
Complex implementation due to different development needs for different islands	Timely preparation of the document (study) under which a detailed analysis of similarities, differences and the scope of the development needs of the islands was carried out with the purpose of facilitating the identification of a direction of action - identification and definition of strategic projects
Slow implementation due to the need to engage and negotiate with a large number of LAUs	Establishment of body at the national level with the purpose of supporting the co-ordination and co-operation of different LAUs on the islands

4.4 Cross-cutting issues and their implications for policy

Smart islands cover different thematic areas, such as transport, economy, public administration, social services and the environment (including water and energy supply, environmental protection, waste management, etc.). From the aforementioned thematic coverage (i.e. a broad spectrum of sectors within which smart solutions can be implemented on the islands) it is clear that the application of smart solutions on islands almost always overlaps with some of the individual sectors (water supply, protection of seawater and sealife, waste management, improving public transport, etc.). Within the National Development Strategy (NDS) of the Republic of Croatia, some of the key areas of intervention (KAI) overlapping with "smart islands" are: KPI digital technology integration into the economy, KAO application of green and smart technologies in agriculture, industry, households, transport and other sectors, KAI digitalization of culture, KAI development and construction of electronic communications networks and infrastructure of very large capacity, KAI effective public administration, and a number of other KAIs which by their very nature are smart solutions.

For this reason, it is extremely important to understand that, thematically, „smart islands“ are relevant across the NDS and that significant contribution to the development of smart islands will be given not only through the recommendations proposed in this note, but also through the implementation of recommendations and projects defined within a large number of other KAIs. It is important to point out that at present, very few islands in Croatia have developed smart development strategies. At the same time, development documents at the regional and national level (sectoral development documents) have so far not put particular emphasis on the application of smart solutions specifically on islands. In the future, it is necessary to ensure a more intensive integration of sectoral development planning at the national level with documents that guide smart islands' development at the local level to ensure sectoral coherence between the required and anticipated development measures that have the character of smart solutions.

5 Overview of possible funding sources

Local budget funds represent the initial resources needed to implement a project that fosters the development, innovation, sustainable management, and growth of islands. A local budget is being developed in advance for the next two fiscal years, with a projection of revenue and expenditures, so it is the main framework for financing all future public projects in the local units. Regional unit budgets in Croatia have the same framework as the budget of local units. When considering the various financial instruments available at the EU level, it should be kept in mind that on Croatian islands there are a number of administrative cities, while at the same time some islands are administratively part of larger cities located on the mainland (Šibenik, Split etc), and others are included in urban agglomerations/urban areas (i.e. Zadar). Therefore many LAUs located on islands have the opportunity of financing smart solutions through financing instruments intended for cities.

The Strategy Europa 2020 recognizes the problem of the structural weaknesses of the European economy, but also highlights ways to improve its productivity through smart and sustainable economic growth. In the Republic of Croatia, EU structural and investments funds (ESIF) that are used to finance the projects of environmental protection, research and innovation, education, strengthening of public administration capacities, and small and middle business development, represent the primary source of funding for the implementation of smart projects. Within the Operational Program Competitiveness and Cohesion 2014-2020 (OPKK) the Republic of Croatia has 6,8 billion euros available, out of which 4,3 billion euros are from the European Regional Development Fund (ERDF) and 2,5 billion euros are from the Cohesion Fund (CF).

- *The European Maritime and Fisheries Fund (EMFF)* is one of the five European structural funds which provides funds to the fisheries industry and coastal communities with a goal of adapting them to the changing conditions in the sector and achieving economic and environmental sustainability. The Republic of Croatia within the Operational Program for Maritime and Fisheries 2014-2020, has 252 million euros available.
- *The European Agricultural Fund for Rural Development (EAFRD)*, through the Common agriculture policy, has the goals of fostering competitiveness in agriculture, ensuring the sustainable management of natural resources and climate change, and achieving the balanced territorial development of rural areas. Through the grants, EAFRD targets all types of projects pursuant to one of the six priorities, including activities supporting the transition to a low-carbon economy and adaptation to climate change and risk prevention.
- *HORIZON 2020* is the main EU programme for research and innovation. In the HORIZON 2020 structure there is the special initiative "Smart Cities and Communities" which financially supports the demonstration of advanced information and communication solutions. After the end of the 2014-2020 EU financial period, EU plans to continue the work of HORIZON 2020 through Horizon Europe. Horizon Europe will incorporate policy missions to ensure the effectiveness of research and innovation funding by pursuing clearly defined targets.
- *The European Local Energy Development Assistance (ELENA)* is an instrument created to facilitate the mobilization of funds for investments in the development of sustainable energy at the local level. The European Commission (EC) and the European Investment Bank (EIB) have established the ELENA technical assistance facility, financed through the IEE Programme. ELENA support covers a share of the cost of technical support that is necessary to prepare,

implement and finance investment programmes, such as in-depth feasibility and market studies, the structuring of programs, business plans, energy audits, the preparation for tendering (etc.). ELENA support can be provided for the development of investment programs or projects within the following areas: (i) Public and private buildings, including social housing and street and traffic lighting, to support increased energy efficiency, (ii) The integration of renewable energy sources (RES) into the built environment – e.g. solar photovoltaic (PV), solar thermal collectors and biomass, investments in renovating, extending or building new district heating/cooling networks, including networks based on combined heat and power (CHP); decentralized CHP systems, transport to support increased energy efficiency and integration of renewable energy sources, e.g. high energy efficiency buses (including hybrid buses) etc.

- *CIVITAS Activity Fund* is a programme that supports the take-up of sustainable urban mobility measures in Europe by providing financial assistance for specific activities of the CIVNETS.
- *European Cross Border, Transnational and Interregional Cooperation Programs (INTERREG)* - one of the key instruments of the EU, which supports cross-border cooperation through project funding. Its aim is to jointly tackle common challenges and find shared solutions in fields such as health, environment, research, education, transport, sustainable energy and more. The fifth period of Interreg (2014-2020) is based on 11 investment priorities laid down in the ERDF Regulation which contribute to the delivery of the Europe 2020 strategy for smart, sustainable and inclusive growth.
- *COSME* – the programme targets actions meant to improve and strengthen the competitiveness and sustainability of EU enterprises in general, and in particular those of SMEs. This programme can be used to support the development of skills and innovative companies offering the services required in a smart city.
- *LIFE+* - the new 'climate change' component of the LIFE programme can be used to promote both mitigation and adaptation activities in urban areas. These can be related to seed capital, testing and pilot projects, exchanging good practices and improving governance.
- *URBACT III* is an interregional cooperation program funded by the European Regional Development Fund (ERDF) under the European Territorial Cooperation objective. The aim of the program is to exchange knowledge and build the capacities of European cities (and municipalities) that develop or implement integrated strategies and action plans for sustainable urban development.
- *Urban Innovative Actions (UIA)* are European Commission initiatives that provide resources to cities across Europe to test new solutions for sustainable urban development that are very relevant at the EU level.
- *The Urban Development Network* is a programme, financed by ERDF, that is responsible for implementing integrated actions based on Sustainable Urban Development strategies. It is a network of more than 500 cities with the mission of reviewing how European funds are implemented on the ground in Europe's cities, support information exchange between cities involved in integrated Sustainable Urban Development and in Urban Innovative Actions and promote direct dialogue between the Commission and cities on Sustainable Urban Development.
- *The European Urban Initiative* is a new instrument providing coherent support for cities that builds on all thematic priorities of the Urban Agenda for the EU (UAEU) and covers all urban areas in the next programming period (2021.-2027.). This initiative aims to strengthen integrated and participatory approaches to sustainable urban development and provide a stronger link to relevant EU policies. It will do so by facilitating and supporting cooperation between -

and the capacity building of- urban actors, innovative actions, knowledge, policy development and communication in the area of sustainable urban development. The Instrument is planning on providing the information and results of experiences and expertise from the initiatives and programs from this programming period (URBACT, UDN, UIA, etc.).

In order to increase the role of ESI funds in the period up to 2020, additional financial instruments are needed in order to encourage and support the use of public and private sources for project financing.

- *European investment bank (EIB)* is the main EU financial institution which provides technical and financial advice as well as financing support for smart city projects. Transforming cities and making them smarter and more sustainable are important goals of the investment approach, informed by both the EU's 2020 Strategy and the EU Urban Agenda. EIB supports big and important infrastructural projects and, in cooperation with Croatian Bank for Reconstruction and Development, gives credits for smaller development projects.
- *Croatian Bank for Reconstruction and Development (CBRD)* is a specialized bank whose main goal is stimulating the development of Croatian economy. CBRD offers and supports a broad range of guarantees and credits for projects of primary importance like the development of small and medium entrepreneurship, infrastructural projects and energy efficiency projects.
- *European Bank for Reconstruction and Development* is the main international bank for financing countries undergoing an economic transition whose focus is to re-stimulate markets by lending to businesses and local financial institutions or by offering long-term credit to governments and utility companies.
- *The World Bank*, through - The International Bank for Reconstruction and Development (IBRD) and the International Financial Corporation (IFC)- provides public and private sector financing with and without sovereign guarantees for a range of sectoral investments and assistance related to smart solutions.
- *European Fund for Strategic Investments (EFSI)* - is an initiative launched jointly by the EIB Group, the European Investment Fund, and the European Commission to help overcome the current investment gap in the EU. EFSI is one of the three pillars of the Investment Plan for Europe that aims to revive investment in strategic projects to ensure that money reaches the real economy. EFSI is providing funding for economically viable projects, especially for projects with a higher risk profile
- *InnovFin* is a joint initiative launched by the European Investment Bank Group (EIB and EIF) in cooperation with the European Commission under Horizon 2020. One of the key factors constraining the implementation of R&I activities is the lack of financing available at acceptable terms to innovative businesses since these types of companies or projects deal with complex products and technologies, unproven markets and intangible asset. This is where InnovFin aims to facilitate and accelerate access to finance and capital for innovative businesses and other innovative entities.
- *Europe's Connecting Instrument (CEF)* - provides guarantees and financing through bonds for investment in the construction of new high performing, sustainable and efficient projects.
- *European Energy Efficiency Fund (EEEF)* - provides market-based financing for commercially viable public energy efficiency and renewable energy projects, and free technical assistance to investors within the EU. The projects that are financed through EEEF can be divided into three groups: Energy Saving and Energy Efficiency, Renewable Energy sources and Clean Urban Transport. The EEEF provides financing for projects on a municipal, local and regional level.

- *Private Energy Efficiency Facility* (PF4EE) is a joint agreement between the EIB and the European Commission which aims to address the limited access to adequate and affordable commercial financing for energy efficiency investments. It provides credit for investments in energy efficiency projects in line with the priorities included in the national energy efficiency action plans.

Various other financing and funding models and instruments are available:

- *Crowd funding* raises funding from individuals to support projects. The difficulty of such an approach is the need for the project to be of interest to a large constituency. Crowdfunding can take many forms such as donations, equity or loans.
- *Smart bond* - these bonds are paid off following the completion of projects (i.e. the achievement of a stated goal) and their return is based on the financial returns of the initiatives covered by the bond. The bond offers a fixed interest rate.
- *The spread shareholding mechanism* is a way of investing where investors buy shares in the ownership of the infrastructures and services they are financing. This involves a higher level of risk, but the potential for higher profit and a more active involvement as 'owners' of the project. Investors may finance projects for which they are partially beneficiaries. This can be particularly useful for projects such as district heating.
- *Challenge Fund* is a competitive financing facility used to disburse donor funding for international development projects, typically utilizing public sector or private foundation funds for market-based or incentive driven solutions. In practice, the objective of a Challenge Fund is to provide the smallest possible financial contribution to a socially worthwhile project consistent with making it less risky and more financially sustainable to the private promoter.
- *Matching grants* are an effective means of funding small projects, especially those with active community support. The concept of a matching grant is simple: state or local governments designate funds to go to particular types of projects. Various groups within the community can then develop project proposals and apply for the grant.
- *A public-private partnership* (PPP, 3P or P3) is a cooperative arrangement between two or more stakeholders from the public and private sectors, typically of a long-term nature. PPPs are best seen as a special kind of contract involved in the provision of infrastructure, such as the building and equipping of schools, hospitals, transport systems, water and sewerage systems.

From the aspect of quality project preparation, it is worth mentioning the technical support instrument *Joint Aid for Project Support in European Regions (JASPERS)*. It is the main technical support instrument of the European Commission, the European Investment Bank and the European Bank for Reconstruction and Development. JASPERS provides independent advice to beneficiary countries to help prepare high-quality major projects to be co-financed by two EU Structural and Investment Funds (European Regional Development Fund and Cohesion Fund). JASPERS' assistance may cover:

- I) Project preparation support, from the identification to the submission of the request for EU grant financing,
- II) Independent Quality Review of projects,
- III) Post-submission appraisal function for all major projects submitted directly to the EU Commission,
- IV) Horizontal assignments and strategic support,

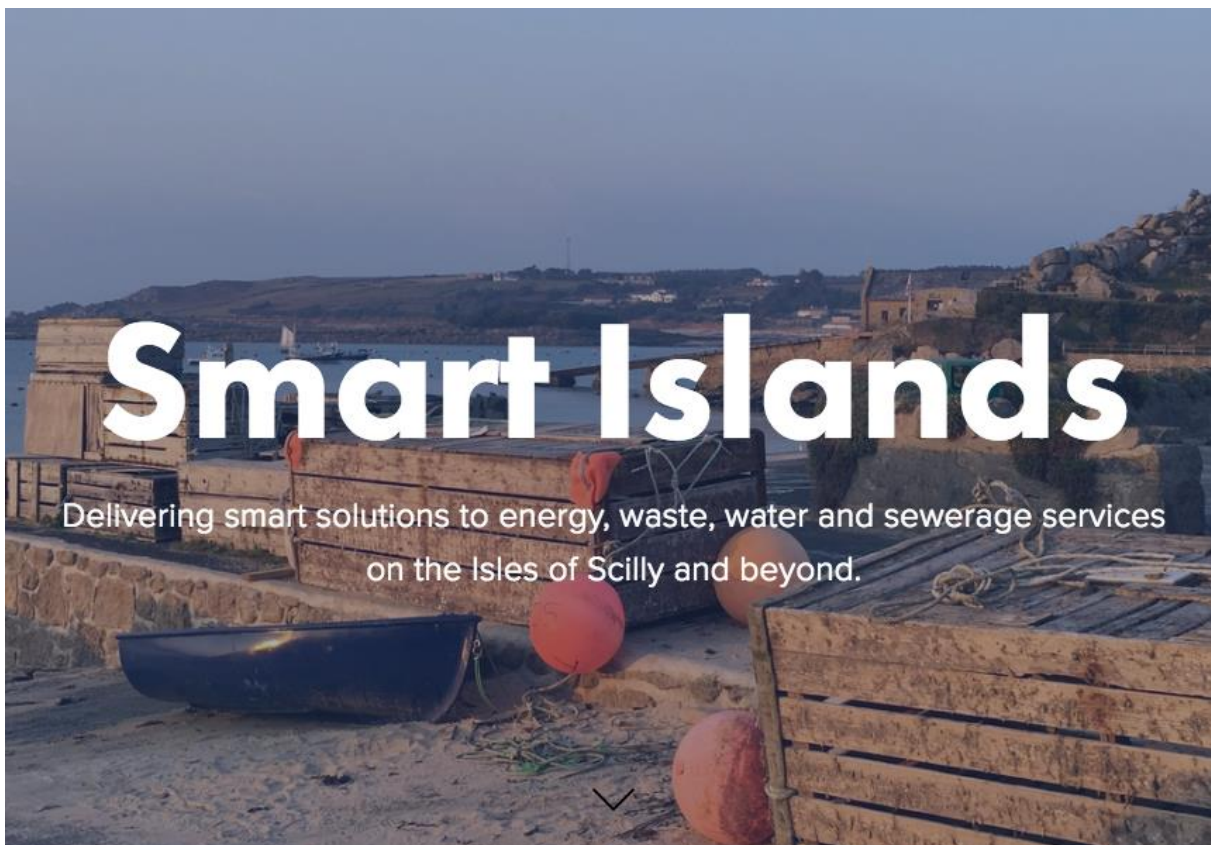
- V) Capacity building, including a Competence Centre, Implementation support, Connecting Europe Facility projects, mainly in the rail and road sectors, European Investment Advisory Hub (EIAH) through the screening and handling of requests.

6 Annex | Smart Islands: Best practices – a detailed overview

In this annex, the success stories are re-presented and, above all, the opportunities for replication that can assist islands on the way to becoming smarter are discussed. Some of the best practices of projects in islands across Europe are showcased and their innovative technologies in energy, mobility and transport, and ICT are presented.

6.1 The Smart Islands programme, the Isles of Scilly, United Kingdom

The Smart Islands programme in Scilly intends to deal with Scilly's main infrastructure and utility issues through a sustainable and affordable approach, whilst providing a model for the community that can profit from a rapid transition from being carbon intensive to having a low carbon footprint. The main goals of the project are a 20% reduction in electricity bills by 2020 and 40% by 2025, to cover the isles' energy demand with the renewable generation up to 40% by 2025, having 40% of vehicles be low carbon or electric by 2025 as well as increased offerings for internships, cultural exchange and STEM skill delivery for young people.



Source: SmartIslands.org, 2019

Providing affordable and reliable electricity, drinking water, sewage treatment and waste disposal for Scilly's remote island population is expensive and presents considerable practical challenges. That

is why the solutions must be achieved within the sensitive environmental and heritage context of the islands. The programme deals with those issues by introducing a Smart Grid, generating energy from waste, sewerage and a mix of renewable energy sources, thereby unlocking value and savings for Scilly's residents and businesses through a locally owned Community Energy Services Company. It represents an innovative programme in its scale and range of technologies, linking rooftop solar panels, solar gardens, batteries, domestic heat pumps, and electric vehicles through an Internet of Things (IoT). The IoT platform will be also established to manage electricity throughout the islands, balancing its supply, storage, and demand. Rooftop solar photovoltaic systems will be installed on 100 homes and 190 businesses buildings including smart batteries that will allow homes with solar panels to save money by using more of the power they generate. That way, the Smart Islands Programme is creating an ambitious smart energy system that will provide a model to support the transition to low carbon sustainable communities and reduce the islands' carbon footprint.

6.2 Emergency Quick Response Code, The Balearic Islands, Spain

The Balearic Islands have a long tradition of tourism, which is reflected in their wide range of tourist facilities and services. In August alone at the peak of the tourist season, Mallorca usually has over 13 million tourists. The emergency and police authorities are involved daily in 150 to 200 interventions, of which 50 to 80 can be resolved swiftly. The main problems are lost children, people who have lost their bearings and injured cyclists.

In order to promote the Balearic Islands as a destination, the Balearic authorities, including the port authorities, are giving due consideration to the issue of security, combining public, medical and environmental safety. To improve the security and safety of tourists, the port authorities and the authorities of the Balearic Islands asked the University of Palma to develop an emergency system. A QR code (abbreviation for Quick Response Code) system is being developed for this purpose. The QR code is machine with optical label that contains information about the item to which it is attached. It consists of black modules (square dots) arranged in a square grid on a white background, which can be read by an imaging device (such as a camera or scanner).



Source: EESC Europe, 2019

In practice, the system has been used, starting in summer 2016, for cruise tourists disembarking for a short period in Palma. The MSC Company will include the QR code in the medical questionnaire

shared with the Spanish emergency system (112, hospitals, doctors). The QR emergency system is particularly suitable for groups with special needs (people with disabilities, minors and senior citizens, sportsmen, etc.). The system is totally safe since the information (identity, medical information, contacts, and GPS location) is not stored online but encrypted and printed in the square. The information is only readable using the requisite application and can always be updated by the person providing data about him/herself. Using the QR code is also better than calling an ambulance or the police in all cases, as that will cause a serious disturbance in a tourist area. One challenge is to convince visitors to start using the QR codes on themselves, as this cannot be made compulsory. The project has great potential for island destinations which receive many seasonal visitors, often arriving in cruise ships, who stay for a short time and would not become sufficiently familiar with the destination to be able to help themselves easily in case of an emergency.

6.3 The WiFi Palma project, Palma de Mallorca, Spain

The municipality of Palma de Mallorca is currently the second largest “wifi” city, after Miami (USA). WiFi Palma is a project run by Universitat de les Illes Balears on big data and tourism. The project is being developed in cooperation with the Supercomputing Centre in Barcelona, the most powerful supercomputer in Spain. In order to increase its attractiveness as a tourism center, starting in 2014, Majorcan authorities began to provide free wifi access across the entire island, aiming to become an intelligent tourism destination. In some areas, work is still underway, but in Palma de Mallorca, especially in the city center, and on Playa de Palma, people have free wifi access. The hotspots were technically improved so that everyone could move around the city without losing connection. The provision of wifi on the beach promenade of Playa de Palma aims to identify new trends (shopping, cultural and sports activities), which will help Palma propose tailored activities for tourists. The project also has considerable potential for user groups who need special attention (i.e. people with mobility impairments), as users’ behavior can be monitored. Potentially, it may be possible to see whether fully accessible venues (i.e. for people with disabilities, elderly people using mobility devices, families with baby strollers) are more likely to be visited than venues which are not accessible to these target groups. The project processes data confidentially. Data protection is a key topic in such projects and needs to be addressed considering that, if handled carelessly, online storage of data can have serious and undesired implications.



Source: NewsRoom, 2019

6.4 The VIRTU/ELVI project, Saaremaa, Estonia

On Saaremaa, the VIRTU/ELVI project aims to connect elderly people via the internet. The project started a few years ago as an EU Interreg project and is currently financed and sponsored by one of the nation-wide telecom enterprises (TELIA). The remote care service aims to improve the activity of elderly people and to save public money. The project also helps to maintain links and relations between elderly people and their relatives by increasing internet communication. On the island, 20 people are connected to the initiative. The system helps people to socialize throughout the year, while the most frequent use is during the winter when moving around is a bigger challenge for elderly people who often also have impaired mobility. People use VIRTU to avoid being isolated. The system requires a computer, a screen, and internet. It can be used for bilateral meetings, group activities (e.g. singing) and to organize 24-hour surveillance. The service keeps people active when they live in very remote areas or are unable to attend gatherings frequently. Online events are organized for the target group and the feedback has been positive. Users can communicate with each other as well as meet people or get back in touch. The initiative has great potential for sparsely populated areas with limited accessibility, which often include island communities.

6.5 The smart Salina island, Italy

The island of Salina, often labelled as ‘the greenest of the Aeolian islands’, has started its clean energy transition. The island has taken initiatives to promote eco-tourism and initiatives to reduce pollution and environmental degradation and is planning to implement energy efficiency and energy saving measures particularly in public lighting systems and the heating and cooling of its public buildings. The municipalities, additionally, aim to produce energy locally, capitalizing on the island’s abundant renewable

energy resources of electricity and heat, and to switch their public transport to electric minibuses powered by solar PV. Charging stations would be available for electric vehicles on the island as well. These initial plans and activities have been well received by residents, local tour operators and visitors.

Involving all actors of the local community - including citizens, companies, trade associations, and tour operators - is a challenge Salina is working to overcome as it advances its energy transition. The municipalities driving the transition are aware of the shift needed in people's mindsets in order to choose clean energy options (such as opting for an electric vehicle for a new car rather than one that runs on fossil fuel) and plans targeted education and communications activities to bring the local community on board.

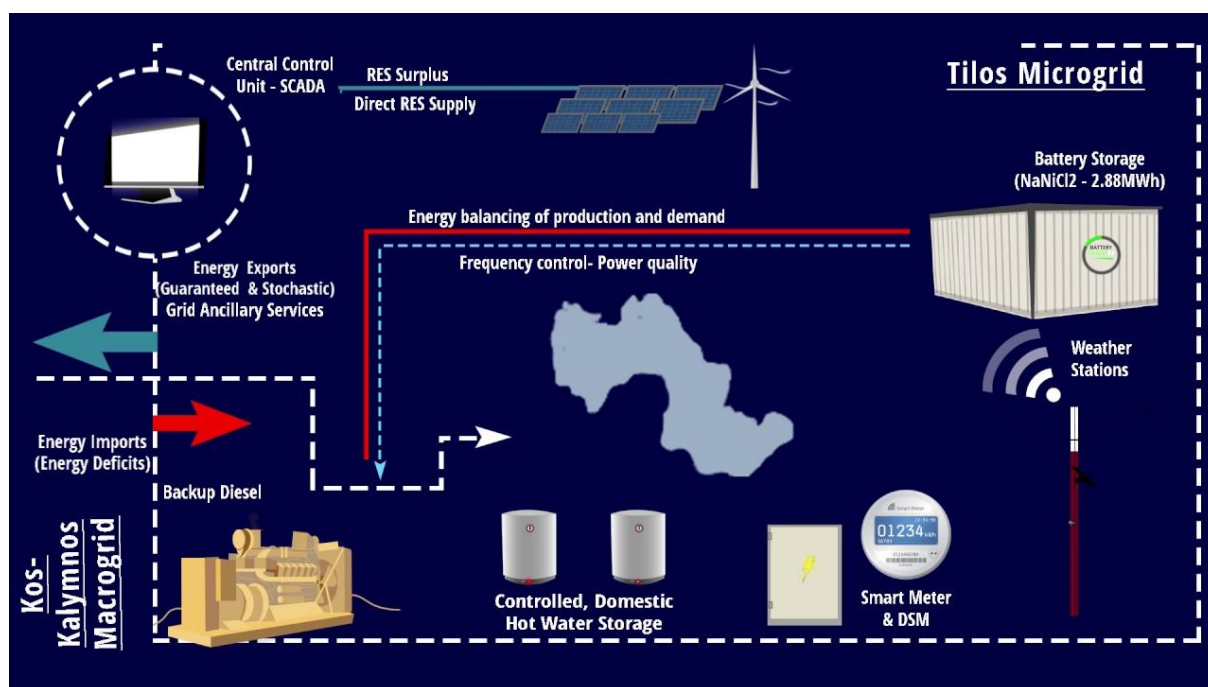
6.6 The TILOS project, Greece

'Technology Innovation for The Local Scale Optimum Integration Of Battery Energy Storages' or the TILOS project is a European research project engaging 13 participating enterprises and institutes from 7 European countries to share investments and introduce models to improve storage in a long-term bid for energy self-sufficiency. The project's main goal is to demonstrate the potential of local/small-scale battery storage to serve a multipurpose role within an island microgrid that also interacts with the main electricity network. Among others, the project aims to achieve large-scale renewable energy system penetration and asset value maximization through the optimum integration of a hybrid renewable energy system (wind and PV) power station together with advanced battery storage, distributed, domestic heat storage, smart metering, and DSM. The final goal is to cover 70% of the Tilos island's electrical power needs with renewable energy.

Key elements of the project are:

- microgrid energy management
- maximization of Renewable Energy System (RES) penetration
- grid stability
- export of guaranteed energy
- ancillary services to the main grid of Kos

Tilos belongs to the island complex of Dodecanese, on the south-eastern part of the Aegean Sea, and is interconnected to the host grid of Kos and Kalymnos islands via an undersea cable. However, this interconnector might soon be exporting energy from Tilos as it shifts away from traditional fossil fuel reliance by harnessing the power of the wind and sun. The project's objectives will be accomplished through the development and operation of an integrated, smart microgrid on the island of Tilos.



Source: Tilos Horizon, 2019

6.7 Island of Sifnos, Greece

Located in the western Aegean Sea, Sifnos is one of the islands comprising the circle of Cyclades. It features the traditional Cycladic architecture and is an area of outstanding natural beauty. Even though Sifnos is a popular island, both amongst Greeks and foreigners, it has kept its originality avoiding the commercialization many other islands have suffered. The island's main economic sectors are tourism, pottery, construction, agriculture, livestock farming, fishing, and beekeeping. Prioritizing low-impact tourism, the island of Sifnos also offers a network of 100 km of marked hiking trails, which are based on a pre-existing old network connecting small villages and cultural attractions around the island. With a population of about 2,600 inhabitants, which more than quadruples in the summer, the island is pushed towards creativity and innovation in order to accommodate the needs and wishes of both its residents and visitors.

Sifnos is not connected to the mainland or other neighboring islands. Like for most islands, its electricity demand is characterized by large seasonal variation. The peak occurs during the main tourist season, in July and August.

The annual electricity demand of Sifnos is about 17,5 GWh. Currently, the power on the island is mainly generated by a diesel power plant owned by the national Public Power Corporation (PPC). In 2018, the total fuel demand for power generation on the island was more than 4 million liters of fuel, which does not include the fuel necessary for heating nor that used for vehicles and recreational boats. As the fuel needs to be shipped to the island, electricity costs are higher than on the mainland. In order to keep electricity prices affordable for its islanders, the Greek government put in place a mechanism that effectively subsidizes the island electricity through taxes paid by consumers on the mainland. Whilst beneficial to the islanders, this support comes at a high overall cost. In 2015, with oil prices around \$30/barrel (approx. 27 Euros), the production cost of the power station on Sifnos was circa 300 Euros per MWh; thanks to the tax-funded subsidies, only 180 Euros per MWh were charged to electricity

consumers on the island. Renewable energy is seen as a means to save money on the mainland and the island. That is when a group of Sifnians thought: what if we could find a solution that would not only reduce the overall cost of our energy supply and its burden on the country overall, but also contemporarily make the island clean and self-sufficient? Since then, the Sifnos Island Cooperative (SIC) has been the main driver of the energy transition on the island. The cooperative has been working closely with the municipality on the island, to the point that the municipality is currently examining how to become a member of the cooperative.

In early 2019, the national PPC installed two wind-turbines with a total capacity of 1,26MW on the island. This was done with the support of the local community, thanks to the local community energy initiative's efforts to address the concerns of the residents regarding wind turbines. In addition, Sifnos counts about 335 kW of photovoltaics generators distributed over 25 residential and two small commercial installations.

In an effort to make Sifnos self-sufficient and powered by 100% renewable energy, the cooperative decided to propose a plan for an 8 MW wind and hydro hybrid power plant. The plan was submitted to the Greek Regulatory Authority of Energy for a production license in 2016, with the support of the local municipality.

In order to support the island in developing a comprehensive decarbonization strategy, the Clean Energy for EU Islands Secretariat is working with Sifnos on elaborating an island-wide Clean Energy Transition Agenda.

6.8 The PORT-PEV project, Malta

The PORT-PEV project in Malta aimed to reduce the port of Valletta's carbon and noise emissions. It consisted of three main elements: the installation of 1,460 square meters of solar panels on the port administration buildings; the installation of three solar car charging stations; and the operation of 13 electric vehicles. The PORT-PVEV project was designed to combat misconceptions by targeting both the public at large and, more specifically, private companies who own and operate large vehicle fleets. The project resulted in the reduction of carbon emission and in cost savings for the port authorities.



Source: ElectromobilityCMS, 2019

6.9 The Energy Self-Sufficient Island, the Island of Unije, Croatia

In order to achieve energy independence, the Island of Unije in Croatia has started a SMART project prepared by the Regional Energy Agency of Kvarner (REA Kvarner) in cooperation with the Department of Energy, Power Engineering and Environment at the Faculty of Mechanical Engineering and Naval Architecture, University of Zagreb. The study examines different scenarios leading up to 2020 or 2030 and discusses concrete RES and EE measures with the view to transforming Unije into an energy independent smart island with zero carbon emissions.

The project foresees the construction of a desalination plant powered by renewable energy, the installation of a ground photovoltaic power plant (up to 1 MW) combined with battery storage and energy-efficient LED technology in street lighting, the construction of a small biomass plant using the island vegetation and oil trees as fuel, the construction of educational walking paths leading to RES demonstration plants and special routes for bicycles, electric bicycles and electric vehicles used in short-distance transportation and agricultural activity. Through such measures, the project aims to ensure the security of energy supply and reduce the ecological footprint of all segments of life in the Island of Unije.

6.10 Marine Protected Area, Italy

Italy intends to develop a network of 54 Protected Marine Areas (MPAs), which will ultimately include all the Italian islands. Currently, the Italian network of MPAs is made up of 27 protected areas. Established by the Ministry of the Environment in December 1991, the Egadi Islands' MPA is the largest marine reserve in the Mediterranean (around 54.000 ha), covering approximately 25% of the sea's vulnerable or protected areas. The size of the area is explained by the interaction of three marine currents, the nutrients and the transparency of the water whose hydro-dynamic conditions facilitate the treatment

of wastewater. The area includes the islands of Favignana, Levanzo and Marettimo and the islets of Maraone and Formica. The MPA is managed jointly by the government and the local community.

The Egadi islands MPA involves various internationally protected habitats and species included in the Natura 2000 network. One of the most important and best-preserved networks is the *Posidonia oceanica* seabed (almost 8.000 ha), which contributes to rich biodiversity (fish nursery), mitigates coastal erosion and produces oxygen. The species protected include bottlenose and striped dolphins, sperm whales, storm petrels, sea turtles (especially *C. caretta*), and, above all, monk seals (*Monachus monachus*), repeatedly sighted in the archipelago after being absent from Italy for 60 years. Extensive formations of vermetid reefs (*Dendropoma petrolineum*) are also common along the coasts.

In Favignana, the network's partnership with local fishermen has been very important in establishing the MPA. Being key partners in the MPA since its establishment in 1991, fishermen are involved in the integrated coastal management system and the promotion of sustainable development objectives and plans. 'Guardians of the Sea', a bottom-up initiative, was developed and based on an approach where fishermen are considered 'one of the protected species'.

6.11 Movitz electric ferry, Sweden

Urbanization is a global phenomenon, and increased commuting is one of its consequences if people want to get into city centers. Using the inland waterways is a partial solution to traffic congestion. That is why Stockholm is dedicated to connecting its islands with electric ferries that represent an effective and green way of commuting.

Stockholm smart mobility project includes the retrofit of the existing ferry in Stockholm with the battery energy storage system and electric drive. Smart batteries that are used deliver high power instantly and can be charged very quickly, making them very efficient.

Today, the Movitz ferry transports commuters to work and home again across the Stockholm waterways safely and sustainably. The previous 250 kW diesel engine – which had an annual footprint of 130 tons of CO₂, 1.5 tons of NO_x, and 80 kg of diesel particles – now has no-emission electrical engines.



Source: NewAtlas, 2019