ECOSYSTEMIC TRANSITION UNIT ETU

Interreg Mediterranean RENEWABLE ENERGY

Project co-financed by the European Regional Development Fund

Policy Recommendations

Ecosystemic energy transition based on territorial dimension

November 2022

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POLICY PAPER
ECOSYSTEMIC ENERGY TRANSITION BASED ON TERRITORIAL DIMENSION

Activity 5.3.3 Regional and Local Policy ETU Mainstreaming
WP5 Capitalisation
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Coordination:
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Introduction

1.1 Energy transition in the Mediterranean

The Mediterranean is one of the most vulnerable regions to climate change given the severity of the impact of rising temperatures, water scarcity and the risk of fires, among others. Climate change mitigation and adaptation measures need to be effective in their implementation, in order to succeed in their transformative action. The recent IPCC report on Climate Change 2022 Impacts, Adaptation and Vulnerability (February 2022) recognises the relevance of acquiring a holistic approach for climate change adaptation, considering the ecosystems as a whole, including natural, ecological, social and economic trade-offs. Episodes of heat waves, forest fires, and floods corroborate year after year, showing that all territories are vulnerable and that there is an urgent need to accelerate the implementation of targeted measures to increase their resilience to these impacts.

Islands and remote rural areas of the Mediterranean are not exempt, and their vulnerability lies not only in the impacts of climate change on productivity and access to resources, but also in the high risk of social exclusion and poverty. Depopulation trends in recent decades have in turn led to great inequality between urban and rural areas. All ecosystems and territories will be altered by rising temperatures. Productive sectors such as agriculture, livestock, fisheries, and aquaculture will be affected, with a strong territorial impact on both biodiversity and economic activity. Rural areas will therefore be doubly affected given their link to these economic sectors.

These deeply problematic developments in island, rural and urban areas of the Mediterranean require coordinated and meaningful action at several levels and with multiple objectives. Specifically, action is needed to accelerate the energy transition process and increase climate change adaptation measures, while maintaining and improving policies and funding to support territorial cohesion.

The aim of this paper is to examine the territorial dimension of the ecosystemic energy transition and to outline the main recommendations for energy transition policies at the local level. The recommendations are based on the capitalisation work developed in the last six years in the framework of the Interreg MED Renewable Energy Community project and the experience of transfer and replicability of knowledge through the ecosystemic transition unit (ETU) initiative[1].

The policy paper is structured in six sections. Section 1 sets the context of the policy paper and section 2 gives a brief overview of the territorial dimension of the energy transition in islands, rural and urban areas. These reflections are part of the contributions compiled through the consultations and workshops held with the regional groups created in Croatia, Italy, Slovenia, Greece, and Spain, and which have shaped the focus of the transfer actions promoted by the project. Sections 3, 4 and 5 explain the three main policy recommendations addressed to the following regulatory frameworks:

1. Transposition of the European directives: Renewable Energy Directive (RED II) and Internal Electricity Market Directive (IEMD) in the regulatory framework at national level
2. National plans for climate and energy
3. Urban Agenda and the implementation of Agenda 2030, Energy and Climate Plans and Urban Agenda at local level
4. The European Structural Funds and Transnational Cooperation Programmes

1. C.Echave et al. ETU White Paper. Interreg MED Renewable Energy. (https://etuinitiative.eu/the-etu/#manifesto)

1.2 Renewables evolving in Europe

Europe has increased the share of renewable energy in its gross consumption of electricity by 7% from 2012 to 2020. According to data published by Eurostat (see Figure 1), the energy mix in the European Union in 2020 consisted of 17.4% of renewables, 12.7% of nuclear energy, 23.7% of natural gas, and 46.2% of other sources including fossil fuels. Oil and petroleum products are the most important energy source for the European economy and natural gas is the second largest energy source, although their shares decreased in 2020 compared to 1990 by 12.6 and 2.4%, respectively. There has been a gradual increase in the share of renewable energy in the European Union, which has exceeded that of solid fossil fuels since 2018. Solid fossil fuel consumption decreased by 18.4 % in 2020, reaching the lowest value since 1990.

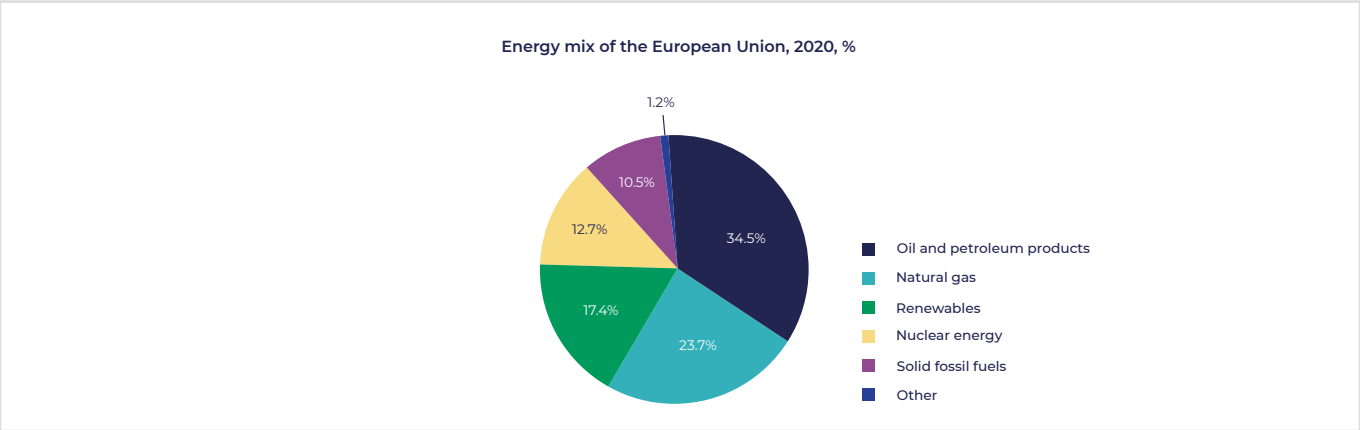


Figure 1. Energy mix of the European Union in 2020. Source: Eurostat

Despite this, there is still a heavy reliance on energy imports from outside the continent. In 2020, the European Union (EU) registered an overall energy dependency of more than 55% distributed by the state members. This dependency is not equal among the Member States. From Figure 2, we can see that the countries with more than 80% dependency are mainly island territories (e.g., Malta, Cyprus, Greece). Mediterranean countries such as Italy, Spain, and Portugal are above the European average rate (55%), while Croatia, Slovenia, and France are below the European average. Moreover, only Romania and Estonia are the countries with a dependency rate lower than 30%. At this moment, Russia is the world's third largest oil producer and among the main exporters. In 2020, the dependency on Russia was equivalent to 24.4% of all EU energy needs, reaching around 25.7% of Russia's crude oil imports (440.3 Mt).

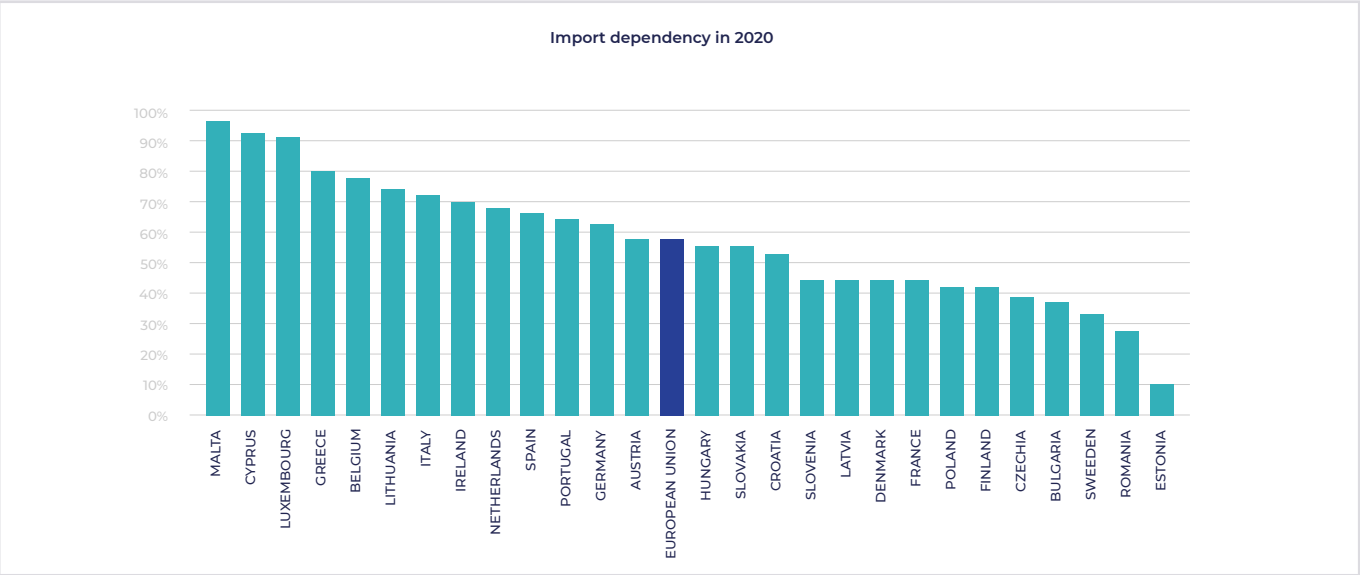


Figure 2. Import dependency in 2020. Source: Eurostat, calculation based on energy balances

The EU Green Deal targets

The European Commission through the EU Green Deal has set the goal of carbon neutrality by 2050, which will require an enormous effort from all the actors involved in the system, including the generation, distribution, and end use of energy. The transition towards a new model based mainly on renewable energies is also an opportunity to diversify energy sources and to improve the management model. For example, by identifying the potential available in each territory and establishing energy efficiency measures, decentralised and participatory distribution. Each territory needs to identify its roadmap and be able to conduct its transition in a more adequate and effective way. Given that rural areas cover almost 80% of the territory in the world, climate policies should integrate their role in terms of resources provision and biodiversity preservation[2]. Rural areas generally lack sufficient resources to implement their plans and therefore may take a longer time to complete their transition. Therefore, it is necessary to ensure the knowledge and tools necessary for modelling, planning, and implementing their plans are readily available in all territories to enable them to build a fairer, more inclusive and environmentally responsible energy model.

1.3 About the Interreg Med capitalisation action

The Interreg MED Programme launched an innovative architecture based on the transferring and capitalisation[3] of the results of co-funded projects for the programme period 2014-2021. The objective of this structure was to test an alternative way of extending the impact of the project's results, beyond the classical dissemination action. For this purpose, the architecture was structured by eight thematic communities of projects grouped into three main axes: *Innovation, Low carbon economies,* and *Natural heritage*. The thematic communities gathered projects by their impact on blue growth, green growth, social and creative sectors, biodiversity protection, sustainable tourism, efficient buildings, urban transport, and renewable energies.

The Interreg MED Renewable Energy Community was composed of six modular projects and one horizontal project. These modular projects developed different types of methodologies, tools and pilots, all focusing on promoting the use of renewable energies in the Mediterranean region, with a particular focus on islands and rural areas. Since 2016, the Interreg MED Renewable Energy Community worked on a capitalisation strategy built upon a conceptual framework, the ecosystemic approach on energy transition. The strategy allows for the integration of a common understanding of the community of projects and to identify their complementarity in order to avoid competition between them. This has been an exceptional community building action driven by the horizontal project, which subsequently allowed the launch of the transferring and capitalisation action together as a community. The capitalisation strategy of the project is set through the ETU initiative[4], a governance model for energy transition in rural and island areas in the Mediterranean region. The conceptual and methodological framework of ETU initiative builds the principles in which the community of projects worked as an association organising their results to be transferred in a more coherent way.

1.4 About the ETU Initiative

The energy transition requires the active participation of society, local authorities and associations, businesses and innovation centres. This ecosystem of actors in the territory needs tools to identify, coordinate and establish strategic alliances to accelerate the transition in an inclusive and green way. The ETU Initiative has been created and promoted by the Interreg MED Renewable Energy Community as a platform to foster the ecosystemic approach to energy transition, capitalising on knowledge transfer and transnational cooperation within the Mediterranean region. The ETU Initiative from 2020 to 2022 has involved around 161 organisations between target groups and key stakeholders, mainly local authorities and local entities involved in energy transition projects. The process of capitalisation begins with the creation of five Regional Groups distributed in Croatia, Greece, Italy, Slovenia, and Spain as a starting point for the transferring action. A training programme was launched to present the application of the tools of the modular projects, bringing together nearly 300 participants from these countries.

2. https://www.oecd.org/regional/rural-development/Rural-Agenda-for-Climate-Action.pdf
3. https://www.interact-eu.net/events/concept-%E2%80%9Ccapitalisation%E2%80%9D-interreg-2020
4. C.Echave et al. ETU White Paper. Interreg MED Renewable Energy. (https://etuinitiative.eu/the-etu/#manifesto)

Participants were then invited to submit their proposals to the ETU Flagship Call to test the tools and received technical support from the Interreg MED Renewable Energy Community to implement them. From April 2021 to March 2022, the initiative worked with nine flagship cases, integrating the ETU toolbox into their energy plans, renewable energy communities and energy efficiency projects. This experience provides evidence of several constraints of local authorities and local entities when implementing energy transition policies into specific plans and projects. The ETU Initiative now calls on local public and private entities and civil society organisations to join the initiative and build a common contribution towards a holistic approach to energy transition based on territorial equity, social innovation, green economy, and multi-level cooperation.

2. Implementation of clean energy by typology of territories

2.1 Population density and energy consumption

A number of factors influence energy consumption in the context of energy use in urban, suburban, and rural settings (e.g., population, transport, building stock, labour mobility). However, an important question concerns the impact of population density on the management of energy consumption and use. Densely populated areas present high demand for energy generation, but also have great potential for integrated savings schemes in concentrated spaces due to scale. To properly implement energy transition strategies in other types of territories in terms of local renewable energy production, it is necessary to have a more accurate understanding of the relationship between population density and sustainable energy consumption. Moreover, this data will be useful for identifying the needed actions for densely populated areas and for the more dispersed ones.

Following a desktop survey, we have identified the work of Masayuki Morikawa from the Research Institute of Economy, Trade and Industry (RIETI) in Japan as the one with the most interesting and relevant findings. In his work 'Population density and efficiency in energy consumption: An empirical analysis of service establishments'[1], Mr Morikawa finds that energy efficiency increases by approximately 12% when the density in a municipality's population doubles. In terms of how this finding interacts with energy and urban-rural planning, the author's recommendations focus on the need to deregulate the excessive restrictions that hinder urban agglomeration and on investment in the infrastructure of city centres. Moreover, the author puts more emphasis on the service economy for environmentally sustainable growth. These recommendations certainly represent a good set of actions for energy planning at the urban level. However, the question remains for rural areas, especially in the context of territorial cohesion and accessibility to clean energy for all citizens, while preserving the role of rural areas as 'clean air sinks'.

Indeed, less densely populated areas require **more complex and tailored solutions to compensate for lack of scale and population density**. Thus, it is necessary to design and identify specific solutions to address local challenges. The appropriate solutions should be defined by a holistic approach, considering the territorial, technological, social, and organisational components of the energy transition. This requires considering the geographical and socio-demographic characteristics of the location in question, together with the technological solutions available. In sum, a 'one size fits all' solution should be avoided, while proper design and identification of specific actions at local level, taking the ETU principles into account, should be prioritised

1] Energy Economics Volume 34, *Issue 5, September 2012, Pages 1617-1622*

2.2 Key findings from Interreg MED Renewable Energy Community

The project carried out workshops and consultations with the regional groups created in Croatia, Italy, Slovenia, Greece, and Spain in the framework of the ETU Initiative, to identify the main needs of island, rural, and urban territories. The territorial dimension of the energy transition is identified as a determining factor when developing energy projects and urban planning in different typologies of living areas.

The key findings of the Interreg MED Renewable Energy Community can be summarised as follows:

- The feasibility of municipalities with less than 50,000 inhabitants to accelerate the implementation of their energy plans can be hampered by the lack of trained human resources and/or sufficient technical support.
- The transposition of European directives is not always accurate according to the particularities of different territories.
- The 2030 Agenda presents itself as a good opportunity to align multiple sectors for the formulation of transformative measures at the local level. However, there is still a lack of alignment of actions and decisions in key areas in synergy with the energy transition, such as urban mobility, social housing policies, and urban vulnerability.
- Remote areas can take as a reference the energy plans of islands to achieve maximum energy efficiency and self-consumption systems.
- Industrial areas have a strong potential as local renewable energy communities to involve the private sector and diversify local renewable energy sources according to the final use of energy.

2.3 Energy transition by type of territory

As for the holistic approach and territorial dimension, we suggest a set of recommendations for urban, rural, and island areas. For each one of these areas, we identified the ETU components (territorial, technological, social and organisational) that must be taken into account during territorial planning and in the development and deployment of energy plans. The main arguments gathered through the surveys and workshops conducted between 2020 and 2022 are described below.

Table 1. Typology of territories

RURAL AREAS	RURAL AREAS	ISLANDS
Remote villages - Isolation Villages and towns < 5000 inhabitants Association of municipalities	Small cities < 5000 and < 50,000 Urban neighbourhoods Urban Districts	Seasonal islands Non seasonal islands

Rural areas

Technological component

The major technological issue in all types of rural areas is the lack of infrastructure. These areas should integrate other sectors, such as agriculture and industry, together with environmental issues in the implementation of energy transition projects, to find the adequate technology. In the case of associations of rural villages, territorial planning and metropolitan plans must include the provision of sufficient shared infrastructures. Moreover, villages and towns with less than 5,000 inhabitants are under pressure from urbanisation and second residences. They need infrastructure planning that takes into account the intensity and fluctuation of migration flows. Energy and climate plans should foresee the provision of sufficient means to compensate for the needs in the event of a seasonal increase in energy demand in rural areas due to tourism or second residence.

Social component

The major social issue in rural areas is the lack of citizen awareness and mobilisation. Rural areas should increase the involvement of citizens through a better participatory process and the engagement of civil society settled in the territories. This will ensure the needs of the most vulnerable population are understood by national and local regulatory frameworks in terms of risk of energy poverty and lack of capacity for accessing clean energy.

Organisational component

The issues related to the organisational component include the lack of technical skills and resources in local administrations, planning, data, and the risk of potential contradictions between agricultural development policies and the deployment of energy transition policies. Several solutions have been identified to address these challenges. These include: offering training to technical staff from local authorities and external experts supporting local authorities, encouraging the involvement of agri-food and industrial sectors in energy transition plans, creating an association of municipalities that can in turn allow the creation of a dedicated technical committee for all and an open data consultation platform, as well as the installation of renewable energy sources (RES) generation shared between rural villages and municipalities.

Urban areas

Technological component

The technological issues for urban areas rely on several factors, including instability of energy market prices, high technological costs and long payback period without sufficient EU or national subsidies. There is a need to ensure that more funds are available to all public and private investors to gain environmentally friendly heating and cooling. Moreover, it is important to explore the possibility of using industrial areas within or nearby urban areas, as potential renewable energy communities that can produce and share energy with other neighbourhoods. On the other hand, metropolitan areas mainly lack land-use dedicated to the production of renewable energy for their own energy demand. They should encourage investment for common and sustainable RES infrastructure that could trade and share energy among municipalities.

Social component

Urban areas face several social challenges such as the lack of information on how to receive EU funds and the difficulty of adapting the financial mechanism allowing vulnerable groups to obtain RES. It will be essential for these areas that local public authorities establish energy advisory offices to engage and mediate with the private sector and citizens through public consultations, give more information to the citizens, encourage community collaboration between urban and rural areas, and develop a set of criteria to identify households without access to energy. On the other hand, there is a significant gap between the socio-economic characteristics of the populations among the municipalities and the main cities of the metropolitan areas. They should monitor energy poverty by encouraging open data and common tools among the municipalities within the metropolitan area and promoting synergies between social departments of municipalities through workshops, surveys, and campaigns.

Organisational component

There are several organisational issues that affect urban areas, these include: the risk of lacking sufficient funds due to high public debt, insufficient cooperation between regional, national, and local levels, and low awareness of citizens and the private sector of existing opportunities for building renovation. It is necessary to enhance training for technical staff from local public authorities and the external experts supporting them. Urban areas should encourage agreements and initiatives between regional, national, and local levels to accelerate the energy transition beyond their political vision. In the case of metropolitan areas, there is often a lack of agreements between municipalities due to political differences. These areas should create figures that can enable dialogue between municipalities and help the technical support for intermunicipal plans, and encourage fiscal incentives between the metropolitan municipalities to enable public-private investment on RES.

Island areas

Technological component

Islands interconnected to the mainland are fully dependent on the power connection with the mainland and the seasonality of demand. The digitalization of grids and demand response applications are necessary to address these issues. Islands interconnected to bigger islands have weak interconnections that lead to load shedding and voltage variations and polluting transports between islands. They should implement the automation of electricity distribution grids and the electrification of transport coupled with RES. Non-interconnected islands have limited RES penetration and high reliance on fossil fuels. It is necessary to install storage and RES coupled with infrastructure and local needs in these areas.

Social component

Islands interconnected to the mainland have low social acceptance of RES due to the impact on landscape and land use conflicts to address these issues. They should develop participatory processes for local energy planning. The lack of knowledge and awareness, and costly and infrequent itineraries of transportation among the islands and mainland are the major issues in islands connected to bigger islands. They should engage with citizens through the promotion of energy communities and apply participatory business models to maximise local benefits. Non-interconnected islands have high energy costs and poverty, and they lack waste infrastructure and water. They should install small-scale RES connected to the demand and develop a master plan integrating energy planning with other sectoral plans, making use of the synergies that emerge towards decarbonization.

Organisational component

Islands interconnected to the mainland have not defined a role in legislation for their local authorities in the planning decision-making process. They should devolve authority to maximise the interest of local stakeholders. Islands interconnected to bigger islands have complex and lengthy permitting procedures for RES projects, bureaucracy issues, a lack of data, and human resources. They need external support through agencies and educational activities to simplify the permitting procedure for RES projects, with particular emphasis on small autonomous island systems. Non-interconnected islands have limited space and lack an on-island energy market. They should promote islands as innovative lighthouse pilot solutions and create energy communities with the participation of all local stakeholders to manage local infrastructure.

3. Collective self-consumption and energy communities in remote areas

3.1 Policy framework: Transposition of The Renewable Energy Directive (REDII) and the Internal Electricity Market Directive (IEMD) into national regulatory framework

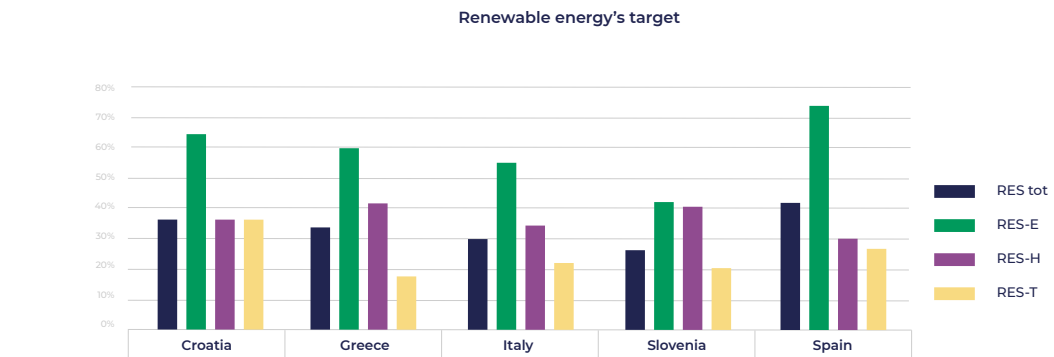
EU targets for climate and national plans for climate and energy

On 14 July 2021, the European Commission passed a crucial milestone by adopting the EU "**Fit for 55**" package with the target of **reducing net greenhouse gas emissions by at least 55% by 2030**, compared to 1990 levels and becoming the first climate-neutral continent by 2050. The new ambitious targets of EU regarding climate are:

- a reduction in **greenhouse gas emissions** by at least **55%** compared to 1990
- a share of **renewable energy** of at least **40%**
- a reduction of the **final energy consumption** by at least **36%**

Each Member State has written and published a **10-year integrated National Energy and Climate Plan (NECP)** for the period from 2021 to 2030, which contains the **objectives that each country should meet** in order to reach the targets established by the EU previously.

In the coming years, the member states will have to update their NECPs according to the new ambitious targets set with the "Fit for 55" package. Based on the NECPs currently in force, the main targets concerning renewable energy for Croatia, Greece, Italy, Slovenia, and Spain, are summarised in Figure 3:



	Croatia	Greece	Italy	Slovenia	Spain
RES tot	36.40%	35%	30%	27%	42%
RES-E	63.80%	61%	55%	43%	74%
RES-H	36.60%	43%	33,9%	41%	31%
RES-T	13.20%	19%	22%	21%	28%

Figure 3. Renewable energy's target for 2030 of Croatia, Greece, Italy, Slovenia and Spain. Source: NECPs of the analysed countries

Europe is suffering from a severe energy crisis, with a significant rise in energy prices, in part due to the Russia-Ukraine war, This situation can become unsustainable for citizens and companies, causing a significant increase in energy poverty and creating severe issues for high energy demanding industries. It may lead to a lack of competitiveness and dynamism in the EU industrial system and have undesirable social consequences. This increase in prices shows that it is even more necessary to save energy and to produce and consume it in a smarter way. Energy communities may be very helpful in this regard and will play a crucial role in the future. The increase in the production of renewable energy and shared self-consumption will contribute to the expansion of energy communities and will be a driving factor in reaching the 2030 targets sooner. Indeed, sharing renewable energy within a community will lead to an increase in the production of renewable energy by RES and improve energy efficiency, thus reducing carbon dioxide emissions. Moreover, energy communities will allow the creation of a more distributed energy system, with citizens and companies participating directly in the energy market and therefore being less dependent on the global energy crisis.

EU directives REDII and IEMD

In 2019, the European Union adopted a series of directives to decarbonise the energy sector. **The Clean Energy Package** contains eight directives on different energy topics and is in line with the objectives defined in the **European Green Deal**. These new rules will benefit the consumers, the environment, the economy and help the EU tackle global warming and achieve **carbon neutrality by 2050**.

The Clean Energy package introduced the energy communities (ECs) and collective self-consumption (CSC), thanks to two specific directives:

1. The first is the **Renewable Energy Directive 2018/2021**, also known as RED II, which sets the rules to reach the 40% renewables target by 2030. It also focuses on the role of citizens in the development of renewables, introducing renewable energy communities (RECs) and CSC.

2. The second is **Directive 2019/944 on common rules for the Internal Electricity Market Directive, or IEMD**, that wants to put the consumer at the centre of the clean energy transition. It also aims to allow more flexibility on the grid, so that it becomes easier to increase the share of renewable energy. This directive concerns the citizen energy communities (CECs) as it aims to enable the active participation of consumers.

ECs will play an important role in the future by contributing to the acceleration of the **energy transition**. With an increasing number of renewable plants foreseen in the following years, it is very important to keep the grid in balance to **use the self-produced electricity in a smarter way** and to avoid overloads. In addition, the **decentralisation of energy systems will give citizens a more active role in the energy transition**.

With the RED II and IEMD directives, the EU has given a common framework and definition to the two concepts of RECs and CECs. The level of transposition of these two directives is currently not the same in all the EU countries. More specifically, by examining the specific regulatory framework of Croatia, Greece, Italy, Slovenia, and Spain, it is possible to delineate three different macro levels of transposition (see Table 2).

	RED II DIRECTIVE	IEMD DIRECTIVE
Croatia	Fully transposed, with some details still under definition	
Greece	ECs concept already introduced in the national legal framework before the EU directives, and thus applied with different definitions	
Italy	Fully transposed, with some details still under definition	
Slovenia	Fully transposed, with some details still under definition	
Spain	In an early stage of transposition	Not yet transposed

Table 2. Summary of the EU Directive REDII and IEMD transposition level in Croatia, Greece, Italy, Slovenia and Spain

According to the document “Energy community in the MED Area: state of the art of the regulatory framework - Focus on Croatia, Greece, Italy, Slovenia, and Spain”, Croatia, Italy, and Slovenia have transposed both RED II and IEMD. Spain has only partially transposed the RED II giving a basic frame for CECs definition, although it has not yet regulated the RECs. The situation is different for Greece. The Greek Law defined energy communities in 2018, one year before the publication of EU Directives. For this reason, there is no distinction between RECs and CECs, but only between the non-profit or for-profit energy communities.

Although the regulatory frameworks are not always complete, ECs are currently a concept of high interest for territories and local communities as a response to the climate and energy crisis given the environment, social and economic benefits they can bring to the community. Moreover, ECs can be vital for stimulating renewable energy growth. In a very relevant study, Caramizaru and Uihlein (2020) analyse ECs in Europe with a particular focus on energy and social innovation. The estimates of these two authors suggest that by 2030, Ecs could own around 17% of installed wind capacity and 21% of solar. By 2050, nearly half of the European population could be producing energy, with a share of 37% coming from ECs. These communities will mainly remain connected to the energy system, although stand-alone systems may be applied, especially in islands or remote areas (Caramizaru and Uihlein, 2020).

3.2 Policy recommendations

The key policy recommendations addressed to ECs and CSC can be summarised as follows:

As for regulatory framework:

- Establishment of a **clear and complete regulatory framework** for CSCs and ECs as soon as possible
- Establishment of **simple administrative procedures** for the creation and management of ECs and CSC schemes and setting of flexible criteria according to the typology of the territories.
- Establishment of **dedicated financial incentives** for investments and fiscal support schemes for operation of ECs and CSCs

As for the technical support:

- Provide **clear and detailed information** to local authorities and citizens related to their opportunities to join a local EC
- Create **digital and simulation tools** to understand where and how it could be possible to create ECs
- Provide **technical and administrative support** for the creation of ECs for local authorities and citizens

3.3 Contributions of the ETU Initiative

In the fragmented regulatory framework of the different MED countries, the ETU Initiative contributed to the implementation of REC projects through the exchange of best practices related to realisation of ECs within the Mediterranean area, the promotion of a multilevel coordination, and the application of the tools developed by the modular projects (see examples below).

- PRISMI RES assessment toolkit: The toolkit needs a comprehensive frame of energy data of the territory studied and allows to obtain a simulation of local RES (to be implemented). This then makes it possible to reach different levels of targets with regard to renewable energy share. This toolkit is particularly useful for the energy planning of a territory, giving the RES capacity of a territory, and crossing it with its current and future energy needs.
- Microgrid simulation tool from PEGASUS project: This tool can simulate a small size EC, from a technical and economical point of view, enabling to understand the good size of a given EC (number and type of prosumers/consumers) and related energy production plants capacity.
- PV + battery systems simulation tool from STORES project: This tool can support the simulation of a PV + battery system for residential use.

- Green local fiscal policies as defined by the LOCAL4GREEN project: The LOCAL4GREEN project provides guidelines for creating local fiscal policies to encourage the type of project that a municipality would like to promote on its territory, according to its possibilities. In fact, municipalities do not have the same room for manoeuvre in fiscality in the different countries of the Mediterranean area and must adapt according to their capabilities.

- Crowdfunding campaign: Crowdfunding is a valuable tool for EC projects as it allows facilities to be at least partially funded and raise awareness of a green project among citizens and other related stakeholders, attracting more private investments for the community.

Mainly thanks to this support, the ETU Initiative contributed to the EC projects of:

- Vall d'En Bas (Spain): Deployment of RECs in both neighbouring villages Olletes and St Privat, including 10 public buildings and 145 houses.

- Rio Monachil (Spain): Deployment of REC planning through the simulation of foresight scenarios, extending the REC approach in four municipalities: Monachil, Cajar, La Zubia and Huetor la Vega, all with a total number of 42.307 inhabitants.

- Ragusa (Italy): Creation of a REC in the rural hamlet of San Giacomo, including 1 prosumer (public school) and 10 consumers (families).

4. Integration and alignment of plans

4.1 Policy framework: Urban Agenda, SECAP and SUMP

The Urban Agenda through its policy paper on Urban Ecology and Resilience (2016) reveals the need for planning solutions that integrate the linkage of urban and rural areas. The agenda states that policies and programmes for the sustainable development of rural areas that integrate rural regions into the national economy, require strong local and national institutions for the planning of rural contexts that can improve the management of natural resources such as water, energy, and food. Moreover, it reveals that strong local and national institutions are important for the management of human settlements that emphasises rural-urban linkages and treats villages and cities as two ends of a human settlements continuum.

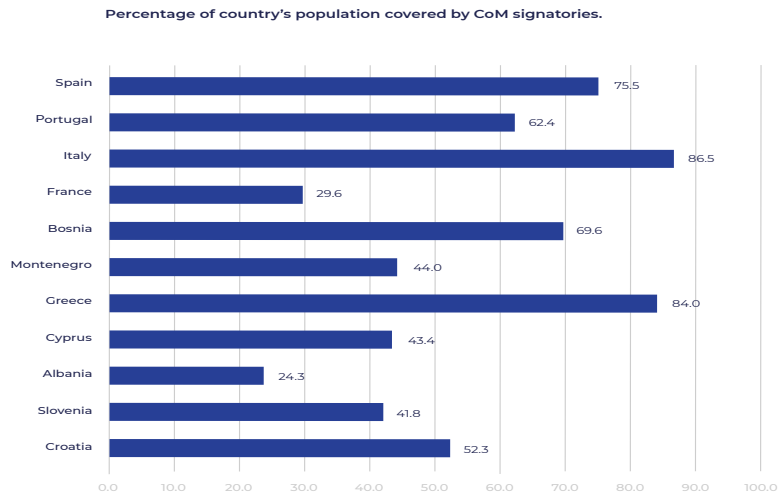


Figure 4. Percentage of country's population covered by CoM signatories. Source: Covenant of Mayors.

The Covenant of Mayors (CoM) is the world's largest movement for local climate and energy actions and brings together thousands of local governments voluntarily committed to implementing EU climate and energy objectives. The project has analysed the CoM signatories of the following Mediterranean countries: Croatia, Slovenia, Albania, Cyprus, Greece, Montenegro, Bosnia and Herzegovina, France, Italy, Portugal, and Spain. The total number of signatories is 8,118 that represents more than 120 million inhabitants. Based on the data gathered through the Covenant of Mayors, the project estimated the population covered by SEAP or SECAP in the Euro-Mediterranean countries. Sustainable energy plans in Greece and Bosnia-Herzegovina cover around 84 and 70% of their total population respectively, while sustainable energy plans in France and Albania only cover 29.6 and 24.3% of their population. The key finding of this analysis reveals that there is a clear gap between the size of municipalities already addressed to CoM signatories in the set of countries in the Mediterranean area analysed. Small villages and municipalities **with less than 500 inhabitants represent 89%** of the type of municipalities but **less than 1% are among the CoM signatories**. That means that it is necessary to have a special focus on the energy transition of small villages and rural areas. **This is a key finding to strengthen the ETU initiative transferring action plan in these types of territories**, where it is necessary to adapt a strategy based on community building, the revitalisation of the green economy and social innovation.

4.2 Policy recommendations

The EU has set ambitious sustainability targets for 2050, with significant reductions in greenhouse gas emissions from all sectors, a significant increase in energy efficiency and the use of renewable energy sources, as well as adaptation to climate change in urban and rural areas. The level of action needed will require significant mobilization of financial and human resources. Regions and cities have an important role to play in the development of a sustainable and low-carbon economy through their strategic plans for energy, transport, and mobility. Energy and transport are generally managed by different administrative departments of the local authority and are not part of the same process. The departments often lack a common strategic vision and implement separate and individual sectoral policies, which can result in an inability to provide effective and long-term solutions. Therefore, these strategies must be harmonized and integrated to ensure that they all aim to achieve a common target and make optimal use of available resources. Sustainable Urban Mobility Plans (SUMPs) and Sustainable Energy and Climate Action Plans (SECAPs) are based on a formal commitment resulting from the political decision of the local authority to achieve sustainability targets. The integration between SUMPs and SECAPs can represent an important step forward to significantly improve the effectiveness of actions by achieving synergies and harmonizing energy, transport, and mobility planning in the frame of a wider urban development and land-use planning. This can involve the setting-up of a long-term regional cross-sectoral vision and strategy that integrates multiple areas and sectors of the economy, the development of common tools and methodologies, a harmonized data collection process and single databases for the region, the establishment of coordinated targets and common monitoring systems, as well as the engagement with citizens and key stakeholders (Interreg Europe, 2021).

Urban growth needs to be accompanied by green infrastructure and targeted financing mechanisms to guide the development of cities that are adapted to climate change and cause the least negative effect on the environment. The transport sector accounts for 33% of EU energy consumption and is one of the main sources of greenhouse gas emissions. From this perspective, infrastructure deployment and urban planning must be based on sustainability to reduce greenhouse gas emissions and facilitate the energy transition. Sustainable and efficient transport infrastructure provides economic, environmental, and social benefits to regions and cities. These include improving market accessibility and productivity, ensuring balanced regional economic development, creating jobs, promoting labour mobility and connecting communities, improving air quality and associated health benefits, as well as improving resource efficiency and protecting biodiversity. The growth in transport demand and the need to reduce greenhouse gas emissions in the sector will require several actions from local authorities. First, it will be essential to increase investment in new and renovated transport infrastructure, clean installations, and green mobility. Then, a shift in investment from carbon-intensive road transport to sustainable transport modes is needed for a transition to a new development path at the urban level. The SUMP-SECAP integration will ensure coordination between technical departments within local authorities to align common targets, strategies and actions, with the aim of adopting an integrated approach to combine transport, environmental, energy and land-use planning.

4.3 Contributions of the ETU Initiative

The ETU Initiative contributes to the integration of energy plans and sustainable mobility plans through two of the flagship cases: Onda in Valencia, Spain and Brdovec in Croatia. Both municipalities participated in the ETU Initiative transferring action, working mainly with experts from the Interreg MED Renewable Energy modular projects: PRISMI and LOCAL4GREEN. In both cases, there were defined scenarios for achieving the maximum generation of renewable energy to cover the demand for energy electricity from public buildings, including electric vehicles and public transportation fleets.

Results obtained by Flagship Cases

The City Council of Onda is committed to the fight against climate change, which is why it created an office as an instrument for the management and development of all projects related to energy efficiency in several areas, mainly the rehabilitation of buildings, sustainable transport and mobility, and greenhouse gas emissions. The flagship case in Onda is represented by the application of the ETU model and toolbox into their ongoing SECAP. The aim is to extend and complement the Energy Saving and Sustainability Plan approved by Onda Town Council. The results obtained by PRISMI simulations for the three scenarios (current situation as a baseline; targets by 2030 and long-term targets by 2050) show the potential of renewable energy generation to cover the electricity consumption of the facilities and offices of the City Council of Onda. Regarding private buildings, Onda's current fiscal policies were analysed to understand which modifications and new fiscal measures could be adopted to promote RES. An important measure recommended is to reduce the tax for companies with relevant investment in RES and those providing sustainable mobility plans for workers.

Scenario 2:
Public buildings
50% totoal emission reduction electrification of municipal fleet

PV Solar 36%
PV+Wind 77.4%

Scenario 3:
Public building and transportation
% total emission reduction, electrification of both municipal fleet and public transport fleet.

PV Solar 54%
PV + Wind 100%

Figure 5. Scenarios Onda Flagship Case. Source: Interreg MED Renewable Energy Community

The municipality of Brdovec, as a signatory of the Covenant of Mayors, prepared a SECAP, specifying 23 measures to reduce carbon dioxide emissions from buildings, transport, and public lighting by at least 21%, compared to the 2009 level. To achieve this goal, Brdovec developed a project named ‘EP4GREENFUTURE’, to strengthen the capacity of local governments to carry out renewable energy and energy efficiency activities. If Brdovec has good results as an ETU flagship case, its model will be replicated in other municipalities in Croatia, with the aim of ensuring access to clean energy for the entire population.

5. Capitalisation approach of EU projects

5.1 Policy framework: EU Structural Investment Funds[12]

It is crucial to make maximum efforts to make an efficient use of the EU Funds applied into EU Projects through all the existing programmes. Within the framework of EU Projects, the capitalisation of results becomes a strategy to ensure effective knowledge transfer and replicability among all Member States. The ERDF represents approximately 43.3% of the total amount of the planned budget for the period 2014-2020. It has an important dedication to Research and Innovation (> 61 billion €), Competitiveness of SMEs (> 50 billion€) and Low carbon economy (> 46 billion€). The relevance of transnational cooperation through capitalisation initiatives also becomes a strategic aspect to increase innovation and its incidence as an incubator of new business models. The Interreg MED Programme is part of the ERDF and the scope of the programme is focused on encouraging the cooperation between MED Regions in order to achieve the maximum mainstreaming of the outcomes produced within the projects funded into the policy framework. Transferring and mainstreaming actions held through capitalisation initiatives contribute to spread acquired knowledge and to increase access to innovation and its benefits in all territories. Access to innovation should in turn help address the main economic and wellbeing concerns in the Mediterranean Region, especially in countries in vulnerable circumstances and low competitiveness.

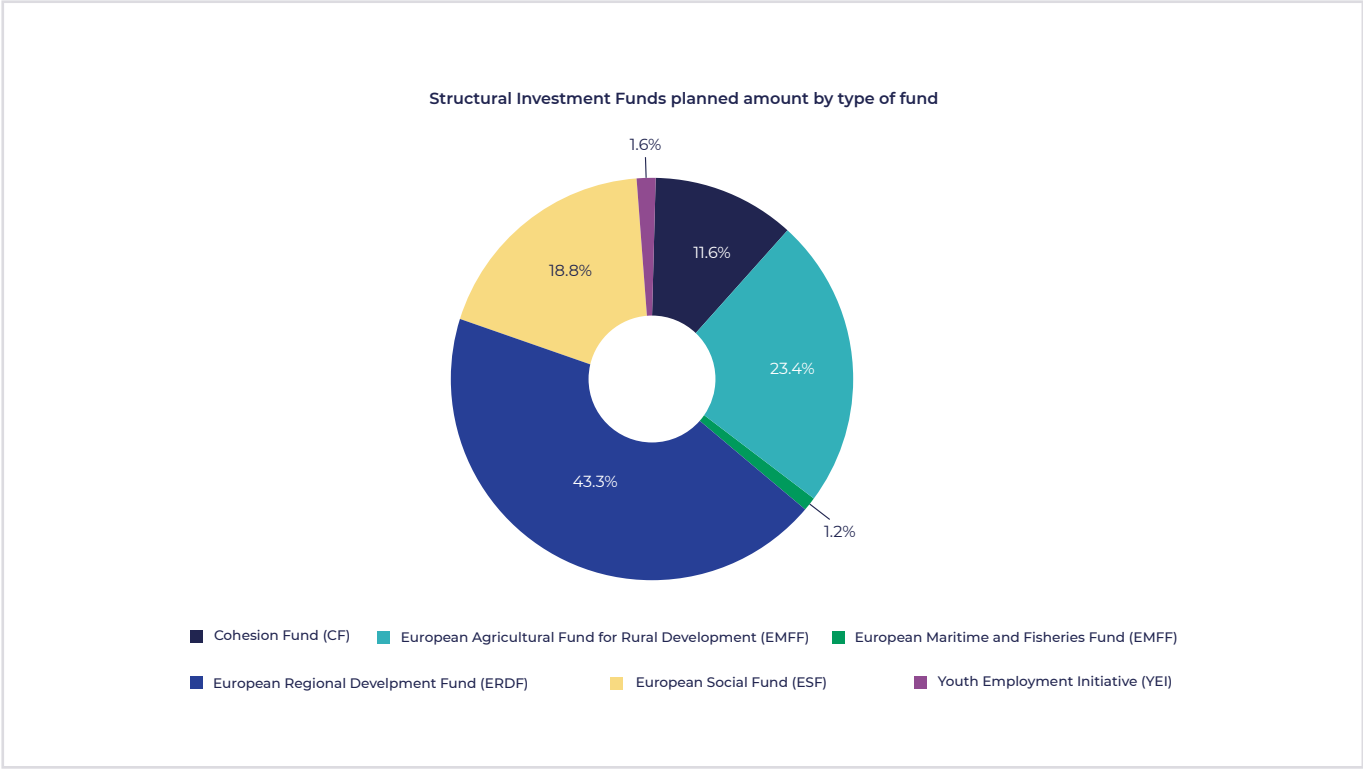


Figure 6. Percentage of total EU Structural Investment Funds planned amount by type of fund. Source: EU SIF

5. https://cohesiondata.ec.europa.eu/2014-2020/2014-2020-Planned-investment-by-MS-by-territory-ty/f4rm-caxr

Capitalisation framework of the Interreg MED Programme.

One of the targets established by the Interreg MED Programme (2014-2021) is to boost as much as possible the transferring of all the results produced by the projects co-funded by the programme. The main purpose of horizontal projects is to ensure the reuse and replicability of scientific, technical, and learning experiences, and their integration into policies. The horizontal projects were oriented to achieve this objective, by setting up a transferring and mainstreaming strategy to obtain the maximum replicability of the tools and results of the projects.

The Interreg MED Renewable Energy Community launched a capitalisation strategy framed under the ETU Initiative addressing the six modular projects carried out during the period 2016-2019 across the Mediterranean. The six modular projects are: COMPOSE, FORBIOENERGY, LOCAL4GREEN, PEGASUS, PRISMI and STORES. They supported rural and island municipalities to implement renewable energy projects, while identifying and finding solutions to common challenges. The tailored mainstreaming methodology focused on the alignment of the community results as a unit, with the intention to provide an effective toolbox to local authorities and any local entity involved in the development of energy plans at local level. The ETU Initiative flagship cases are composed of nine rural, island and urban municipalities that have been chosen by the Interreg MED Renewable Energy Community to receive technical support from the project's experts to apply the ETU Toolbox to support ongoing renewable energy projects, policies, and energy communities. There were also five ETU cases, with unique territorial characteristics, which required the adaptation of the ETU Toolbox to their contexts. The replication of tools and methodologies among the ETU flagship and territorial cases were supported by one or more modular projects. The number of replications is used as a proxy to measure the replicability of the project.

5.2 Policy recommendations

The ETU Initiative capitalisation impact is used as a measure of the efforts in monetary terms of a modular project to reuse and replicate its various results and tools in the selected municipalities. The figures below show the replicability of the six modular projects and their ETU Initiative capitalisation impacts. PRISMI and PEGASUS capitalised 0.80 and 1.34 million euros, respectively. These figures indicate a significant replication capacity of the two modular projects as their main outcomes can be easily replicated in the municipalities. This in turn can enable effective knowledge transfer and replicability between municipalities. PRISMI is the project with the highest capitalisation impact, although it received less funding from the ERDF than the other projects. FORBIOENERGY and STORES capitalised 0.59 and 0.57 million euros, respectively. Finally, the capitalisation of LOCAL4GREEN is low compared to the funds allocated to the project by the ERDF. However, it should be mentioned that LOCAL4GREEN has a high potential for replicability and the low capitalization impact is due to the lack of time to replicate the results of the modular project.

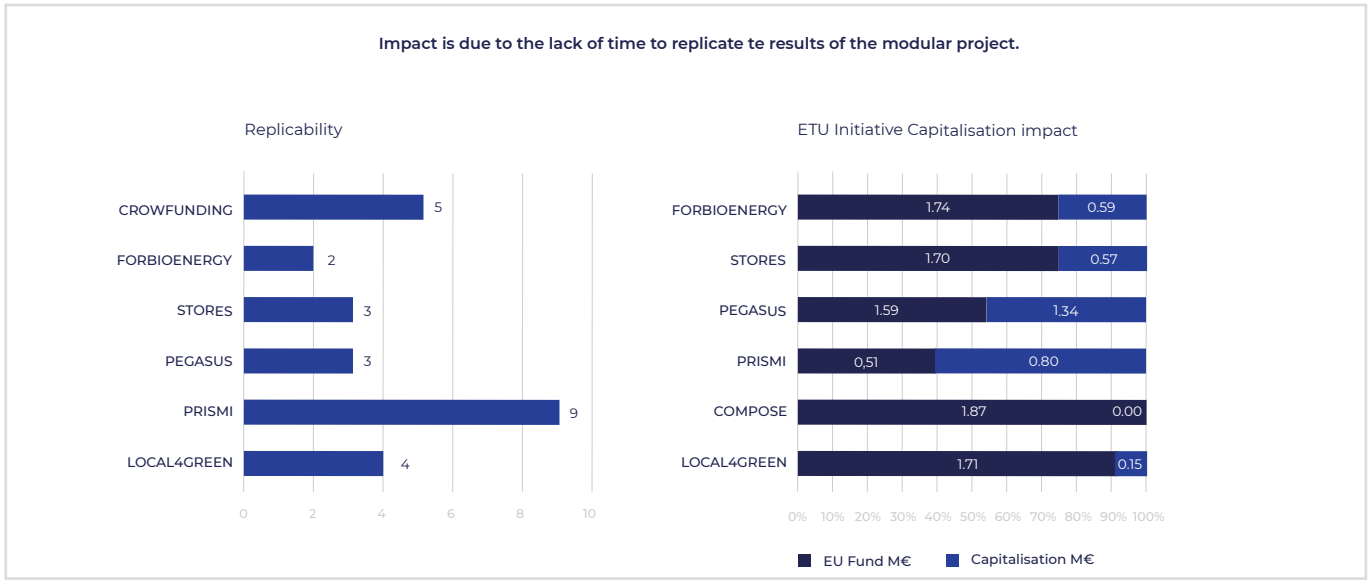


Figure 7. Capitalisation impact in EUR equivalent. Source: Interreg MED Renewable Energy Community

The transferring experience of the project revealed the importance of integrating a capitalisation impact assessment to measure its efforts (in monetary terms) to replicate its scientific, technical, and learning experience. Assessing the capitalisation of the project's results is essential to encourage more effective transferring actions and use of funds invested in EU projects across all existing programmes, provide evidence on the real impact and quality of the process launched, and to improve the transformative impact in the medium and long term. The Interreg MED Renewable Energy Community project recommends considering an assessment method to be integrated in the upcoming Interreg Euro-MED Programme period and in other EU projects.

5.3 Contributions of the ETU Initiative

The ETU initiative allows testing a capitalisation process by aligning the complementarity between the scope of modular projects and the tools developed in an integrated way. The experience allowed us to identify potential synergies among the tools as a unit toolbox, which can be applied jointly in a case of study. In addition, the effort was complemented by exercising an advisory role with local authorities. We encourage a co-creation exercise in which the horizontal and modular projects work together as a community to estimate different scenarios according to the needs of the municipalities. This exercise added value to the transferring process, thus encouraging knowledge transfer, networking and cooperation in areas related to climate change, energy transition, sustainability, and green economy.

6. Conclusions

This paper examined the territorial dimension of the ecosystemic energy transition and outlined the main recommendations for energy transition policies at the local level. Climate change adaptation and the energy transition process require accelerating the implementation of collective and targeted actions, especially when human and economic resources are not abundant. Cooperation among research organisations, local authorities and civil society can ensure a more active response to current challenges and help reduce carbon dioxide emissions by supporting the transition to clean energy. The recommendations of this paper are based on the capitalisation work developed in the framework of the Interreg Med Renewable Energy Community project and the experience of knowledge transfer and replicability through the ETU Initiative.

Section 2 provided an overview of the territorial dimension of the energy transition in islands, rural and urban areas. The evidence in the recent literature on the relationship between population density and energy consumption reveals that there is a need for appropriate identification and design of specific actions at local level, taking into account the ETU principles, in order to address local concerns and challenges. In particular, less densely populated areas require more complex and tailored solutions to compensate for the lack of trained human resources and sufficient technical support. The section also presents the main arguments gathered during the workshops and consultations carried out with the regional groups created in Croatia, Italy, Slovenia, Greece, and Spain on the main needs of island, rural and urban territories, in the framework of the Interreg Med Renewable Energy Community project. The territorial dimension of the energy transition is identified as a determining factor when developing energy projects and urban planning in different typologies of living areas.

Section 3 presented the main policy recommendations addressed to the transposition of the European directives RED II and IEMD at national level. The EU Clean Energy Package introduced the energy community and collective self-consumption through these two specific directives. The ETU Initiative contributes to the implementation of REC projects through the exchange of best practices, the promotion of a multilevel coordination and the application of the tools developed by the modular projects. ECs are attracting high interest from territories and local authorities as a response to climate change and the energy crisis. In the coming decades, they will play a key role in stimulating the use of renewable energies, improving energy efficiency, and accelerating the energy transition. The establishment of a clear and complete regulatory framework, simple administrative procedures, financial incentives dedicated for investments and fiscal support schemes for operations are necessary for the creation and management of ECs and CSC. Moreover, local authorities and citizens need clear and detailed information, digital and stimulation tools, as well as technical and administrative support to help them create energy communities.

Section 4 proposed policy recommendations related to the integration and alignment of local plans for climate, energy, and mobility. The integration between SUMPs and SECAPs can represent an important step forward to significantly improve the effectiveness of actions by achieving synergies and harmonizing energy, transport, and mobility planning in the frame of a wider urban development and land-use planning. This can involve the setting-up of a long-term regional cross-sectoral vision and targets that integrate multiple areas and sectors of the economy, the development of common tools and methodologies, a harmonised data collection process and single databases for the region, as well as the coordinated engagement with citizens and key stakeholders. Local authorities will also have to implement actions for the development of sustainable and efficient mobility. First, it will be essential to increase investment in new and renovated transport infrastructure, clean installations and low carbon mobility. Then, a shift in investment from carbon-intensive road transport to sustainable transport modes is needed for a transition to a new development path at the urban level. The SUMP-SECAP integration will ensure coordination between technical departments within local authorities to align common targets, strategies and actions, with the aim of adopting an integrated approach to combine transport, environmental, energy and land-use planning.

Section 5 described the capitalisation framework of the Interreg Med Renewable Energy Community project. The project aims to drive an effective capitalisation through the ETU initiative to ensure the transferring of Renewable Energy Community's tools to local authorities, boost strategic liaising between key stakeholders to achieve the implementation of multilevel coordination experiences, and integrate the ETU initiative in energy transition policies and territorial planning. The transferring experience of the project **revealed the importance of integrating a capitalisation impact assessment** to measure its efforts (in monetary terms) to replicate its scientific, technical and learning experience. Assessing the capitalisation of the project's results is essential to **encourage more effective transferring actions and use of funds invested** in the upcoming Interreg Euro-MED Programme period and in other EU projects across all existing programmes, provide evidence on the **real impact and quality of the process launched and to improve the transformative impact in the medium and long term.** This will in turn enhance knowledge transfer and synergies on climate change, energy transition, sustainability and green economy.

The application of systemic thinking is paramount to achieving the goal of carbon neutrality by 2050. In the coming years, the ETU Initiative aims to continue the commitment to broaden the ecosystemic approach to energy transition for a greener future of our settlements, capitalising on knowledge transfer and transnational cooperation within the Mediterranean region. The initiative calls on local public and private entities and civil society organisations to join it and build a common contribution to a holistic approach to energy transition, based on territorial equity, social innovation, green economy and multilevel cooperation.

7. Annex: Energy transition recommendations by type of territory

RURAL AREAS				
Territorial component	**Technological component**		**Social component**	
	ISSUE/ LIMIT FACTOR	**RECOMMENDATIONS/ SOLUTIONS**	**ISSUE/ LIMIT FACTOR**	
Remote villages – isolation	Lack of infrastructures Energy access	Take into consideration also other sectors and biodiversity/ environmental concerns and issues in the implementation of energy transition projects and find the best technology considering the integration of all the relevant sectors	Raise awareness and encourage their representation	
Villages and towns < 5000 inhabitants	Lack of infrastructures Pressure of urbanization and second residences	Infrastructure planning considering the migration flows intensity, and provision of funds to compensate the needs in the case of seasonal increase of energy demands in rural areas due to tourism or second residences.	Raise awareness and mobilise citizens	
Association of rural villages	Lack of infrastructures	Territorial planning and Metropolitan plans must include the provision of sufficient infrastructures shared through association of rural municipalities.	Raise awareness and mobilise civil society	

		Organisational component	
	RECOMMENDATIONS/ SOLUTIONS	**ISSUE/ LIMIT FACTOR**	**RECOMMENDATIONS/ SOLUTIONS**
	Increase rural population participation in territorial planning. Adapt solutions according to their needs	Lack of technical competences and resources in the local authority admin-istrations Lack of planning Lack of data Risk of potential contradictions between agriculture development policies and deployment of energy transition policies	• Training directed to technical staff of local authorities and to external experts supporting local authorities • Take into consideration also other sectors and biodiversity/environmental concerns and issues in the implementation of energy transition projects • Encourage the involvement of agrifood and industrial sectors in the energy transition plans • Creating an association/ group of municipalities can allow the creation of a common dedicated technical committee • Creation of an open data consultation platform • Installation of RES generation shared among rural villages and municipalities
	Increase the citizens participation through a better participatory process (for collecting tech data, or other) using also tool as a dedicated platform, favouring also the local sharing economy		
	Increase the engagement of civil society in the territories associated and build specific communication campaigns for their mobilization		

URBAN AREAS

Territorial component	Technological component		Social component
	ISSUE/ LIMIT FACTOR	RECOMMENDATIONS/ SOLUTIONS	ISSUE/ LIMIT FACTOR
Urban areas (> 5000 inhabitants, industrial areas, and neighbourhoods)	Instability of energy market prices Too high technology costs Long payback period without sufficient EU or national funds	To insure more available funds for all investors to gain environmentally friendly heating and cooling Apply complementary criteria to prices in local energy production projects that also includes social impacts Regular monitoring of implemented measures (energy efficiency and RES projects) Explore the possibility of using industrial areas within or nearby urban areas, as potential renewable energy communities that can produce and share energy with other neighborhoods.	Lack of information about and how to receive EU funds There is too much general information about energy and citizens get lost How to adapt the financial mechanism for vulnerable groups to get RES
Metropolitan areas	Lack of land-use dedicated to Renewable Energy Production for their own energy demand	Encourage investment for common and sustainable RES infrastructure that could trade and share energy among municipalities.	Gap between socio-economic characteristics of populations among municipalities and the main cities

Organisational component

RECOMMENDATIONS/ SOLUTIONS	ISSUE/ LIMIT FACTOR	RECOMMENDATIONS/ SOLUTIONS
Establish advisory offices in the local public authorities Engagement of the private sector and citizens through public consultation (before launching the public calls) Give more information to the citizens through advisory offices. Encourage the community's collaboration between URBAN and RURAL Develop a set of criteria to identify energy poor households	national funding due to public debt Lack of cooperation among regional, national, and local level Lack of awareness of citizens and the private sector on existing opportunities for building renovation	technical staff of local public authorities and to external experts supporting them Prepare the Guide about self consumption for local public authorities (expected goals: energy savings) Encourage agreements and initiatives between regional, national and local level Raising awareness of citizens and the private sector on existing opportunities for building renovation
Monitoring energy poverty and encouraging open data, common tools and indicators among the municipalities within the metropolitan area. Encourage synergies between social departments among municipalities through workshops, surveys, and campaigns.	Lack of agreements between municipalities due to political differences Lack of public-private partnerships	Creation of figures that enable and facilitate dialogue among municipalities and help the technical support for intermunicipal plans. Encourage fiscal incentives among the metropolitan municipalities to enable private-public investment on RES.

ISLANDS

Territorial component	Technological component		Social component
	ISSUE/ LIMIT FACTOR	**RECOMMENDATIONS/ SOLUTIONS**	**ISSUE/ LIMIT FACTOR**
Islands interconnected to mainland	Fully dependent on the power connection with the mainland.	Digitalisation of grids	Low social acceptance of RES due to impact on landscape and land use conflicts.
	Seasonality of demand	Demand response applications	
Islands interconnected to bigger islands	Weak interconnections lead to load shedding and voltage variations	Automation of electricity distribution grids	Lack of knowledge and unawareness
	Polluting transports among islands	Electrification of transport coupled with RES	Costly and infrequent itineraries of transportation among the islands and mainland.
Non interconnected islands	Limited RES penetration - high curtailments	Installation of storage	High energy costs – energy poverty
	High dependency on fossil fuels	Installation of RES coupled with infrastructure and local needs (e.g., desalination/waste water management plants)	Lack of water / waste infrastructure and difficulty to maintain in due to high seasonality

	Organisational component	
RECOMMENDATIONS/ SOLUTIONS	**ISSUE/ LIMIT FACTOR**	**RECOMMENDATIONS/ SOLUTIONS**
Participatory processes for local energy planning	Undefined legislated role of local authorities in the decision-making process planning.	Legislating higher authorities to local municipalities maximizes the interest of local stakeholders.
Citizen engagement through the promotion of energy communities	Complex and long permitting procedures for RES projects. Bureaucracy issues.	Simplify permitting procedure for RES projects ensuring a special focus on small autonomous island systems
Apply participatory business models to maximize local benefit	Lack of data and human resources	Need for external support through agencies and education activities
Installation of small-scale RES connected to the demand	Limited space, all vital infrastructure on the island	Promote islands as innovative lighthouses pilot solutions.
Develop a master plan integrating energy planning with other sectoral plans making use of the synergies that emerge towards decarbonization	Lack of energy market on the islands, monopoly thermal generation	Create energy communities with the participation of all local stakeholders to manage the local infrastructure

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