

Community Energy Transition in the Ionian Islands

An analysis and scenario roadmap with focus on Corfu and Zakynthos

Executive Summary

In order to limit the effects of climate change, transition to low carbon and clean energy activities is necessary and a key goal underlined in numerous international climate agreements. Energy transition and its incorporation to integrated socio-spatial planning are becoming strongly linked and can lead to more prosperous and empowered communities when favourable transition strategies are in place.

This short brief is a summary of an extensive analysis and scenario building study focusing on Corfu and Zakynthos. The executive summary highlights the findings and recommendations for action relevant for the energy transition of the Ionian Island communities in Greece. Our interest is in community-energy-driven transition, which is characterized by local ownership of the renewable energy projects, citizen's participation and benefit sharing.

The project took stock on the socioeconomic, environmental, regulatory and energy realities of the islands. Based on the above, different scenarios defined indicating the possible degree of Renewable Energy Systems (RES) penetration and the impacts of an energy communities' based transitional path for the given islands.

Investment and citizens' engagement potential for the islands were estimated based on feed deriving from an online survey exploring attitudes of the local population in relation to the energy transition and the energy communities. Scenario building and foresight are used to project on possible future community-based RES realities for the electricity sector in the local level while recommendations on how to achieve this are offered.

Key findings on the local and general context

The Ionian Islands as administrative and socio-spatial entity follows specific **socioeconomic patterns** that sometimes match and others divert from the rest of the country. An extensive analysis of those is offered in the full report. Here we summarise and discuss some main categories as they are linked to the energy needs and potential of developing prosumer behaviour. We also present briefly the **regulatory framework and the RES realities** in relation to **energy communities**, a **technical analysis** of the status quo **of the electric system** in place, and a brief **overview on the survey results** contacted on the two islands revealing citizens' engagement rates and views.

- Demographics

A relatively stable but ageing population is observed in both islands in line with trends across Europe. Given the evidence suggesting that ageing population is connected with higher energy demand, especially in warmer climates, along with evidence arguing that countries with a larger percentage of elderly

population are also recording lowest energy efficiency scores we can conclude that in the two islands, energy demand is expected to rise along with energy poverty among elderly population.

In both islands, the rates of higher education were low: in Corfu only the 12.08% of the population and in Zakynthos only the 10.23% of the population has a university degree. Considering that higher level of education is highly correlated with engagement in energy community projects, prosumer behavior is more difficult to be observed in these islands.

- Economic structure

During the 20th century, the islands followed an out-migration trend as a result of the shrinking primary sector industry (fishing and agriculture). The islands managed to achieve an economic stabilization during the last decades with tourism being their major industry. So, the main feature of the region's economy is the high concentration of activities in the tertiary sector (tourism - trade).

The impacts of the economic crisis were evident on the Ionian Islands. From 2008 to 2012, the GDP of the Ionian region had a decrease of almost 28%, while the Greek economy as a whole, faced a decrease of almost 21%.

Economic activities related to tourism as part of the tertiary sector also faced the negative effects of the economic crisis (2008-2012). The total decline, during the reported period, of the tourism sector in Zakynthos was almost 30%, while in Corfu the decline was at a level of 32%. Since 2012 the sector started growing again though evidence suggest that the effects of the crisis are still present in the real economy of the Ionian Islands and will continue given the impact of the COVID-19 pandemic.

The majority of the population in both islands are economically inactive (in Corfu is the 57% while in Zakynthos 55%). Unemployment in the region remains high after the crisis while wage compensation, from 2008 until 2017 have fallen by 22.5%.

The existing productive structure of the region has led to a large extent, to a dominant model of tourist activity characterized as "mass tourism". Tourism may stand out, but some indicators reflect trends of stagnation or even deterioration. Overall, this is a type of "standard" tourism; relatively low value added, strong pressures on the environment and unsatisfactory distribution of benefits.

Concerning the primary sector, although it has enriched the traditional activities and crops with a few local productions, it retains its structural weaknesses, which is reflected in its abandonment.

The above conditions create obstacles due to financing difficulties but also present an opportunity for energy communities business models to emerge. Those can act as poverty reduction and income generation schemes and be part of sustainable tourism strategies.

- Spatial morphology and RES

The natural properties of the islands make them suitable candidates for renewable energy projects mainly solar and wind. Given the data of the island areas, the main geomorphological characteristics of the Ionian Islands are the mountainous areas with a significant altitude, while there are also hills, lagoons, as well as mainly coastal, lowland areas.

Ionian Islands possess a good solar energy potential according to existing long-term measurements (daily solar radiation ~4.35 kWh/m²/day). There is also plenty of land availability as well adequate build environment to support PV deployment.

The wind potential of the two islands is generally low at the biggest part of them, except for a few specific areas, mainly the more mountainous ones.

In Corfu, the wind potential reaches almost 7m/s (average annual) at the mountainous regions of the northern and central part of the island.

For Zakynthos, sufficient wind potential is found at some parts of the mountain range crossing the island from north to south but most importantly at the two southern regions at the sides of Laganas bay protected area.

- Cultural, social, built and natural environment

A key problem that island communities face is remoteness; thus, mobility and supporting infrastructure, local culture, the social and natural milieu are key parameter that influences community wellbeing, and define attitudes and behavioural patterns. As the Ionian Islands lag behind in the formation of energy cooperatives for local projects to emerge a full set of local resources needs to be mobilised and utilised.

For example, the utilisation of public building stock as they are marked as priority for intervention according to the EU's energy strategy. In Corfu and Zakynthos the 216 school buildings that operate along with numerous other, municipal and other state owned facilities (e.g. museums, ports, health units) are an asset for energy investments.

Furthermore, the large number of Small and Medium size Enterprises (SMEs) (>700) operating in the touristic sector of the islands offering accommodation services can easily provide space for PV installations. They can experience direct economic benefits by reducing energy bills and developing a sustainable profile for their business.

Civic society via socially innovative activities can tackle sufficient issues of energy poverty so local organisations and individuals at the Ionian Islands should further explore this opportunity. The already active environmental non-for-profit organisations can take lead on this role.

- Regulatory framework, RES and community energy realities

Greece has early introduced an energy community law providing a concrete definition that addresses a major part of the EU framework providing novel interpretations on specific issues such as insularity and energy poverty.

An energy community is organized as a cooperative that can produce, distribute, and supply renewable energy from installations of up to 3MW. Additional activities may include natural gas heating/cooling, demand side management, aggregation of producers/consumers, and network development.

Community energy currently forms a tiny part of the overall energy mix of the country. Nevertheless, since the introduction of the Greek law on energy communities in 2018, several energy communities are emerging (>400) though limited number of those emerge in the Ionian Islands.

The existing regulation framework allows the collective self-consumption concept to be realized from ECs. An important provision of the framework is that it allows the participation of vulnerable households into the virtual net metering scheme providing a powerful mechanism to reduce barriers for these groups.

The legal framework on renewable energy is exceptionally fragmented, making the access to information very complex.

After the latest legislation changes the licensing steps for RES project has simplified. However, the new framework raises concerns regarding the introduction of the new mechanism for assessing the potential impact on the environment from the implementation of the RES projects.

- Citizen's engagement and views

As local societies views and aspirations define the success and speed of transition we organised an online survey to record the views of the habitants of the island regarding renewable energy sources and Energy Communities.

The survey took place from October of 2020 until February of 2021. We gathered 173 complete answers: 42 from Zakynthos and 131 from Corfu. Sample characteristics: Men (45%), women (52%), 40.4% is between ages 35-44 while the majority (50.8%) has a university degree and is employed full time (39.8%). The 68.6% of the respondents has an income lower than 20,000€ - the 27.8% has income lower than 10,000€ and the 40.8% has income between 10-20,000€ while the vast majority 81.5% represent domestic consumers of energy.

86.12% of responders have a positive (49.13%) or very positive (36.99%) opinion about RES. However, only the 21.39% is sure that RES contribute to the reduction of climate change effects. Despite this, the majority (70.52%) believes that the RES potential of their islands should be exploited.

Regarding the organizational mixture of the energy production respondents seem that prefer the public sector (35.85%) to have the central role in production or local communities through partnerships (39.88%). It is really interesting that only the 4.05% believes that the central role in energy production should be undertaken by the private sector.

52.61% think that local communities are not involved in decisions while the 26.59% feels that is not able to express an opinion on RES initiatives. 49.71% believes that there is no fair and transparent decision-making processes in RES installations. On municipalities' initiatives about RES; the 52.6% has absolutely no information on whether or not there are such initiatives, while only the 2.31% is fully aware.

The respondents are not very informed about Energy Communities, only the 8.09% knows exactly about the term while the 43.93% is not familiar at all with the term and have not even heard or read about it before.

After providing to our respondents a short explanation of Energy Communities projects, we see that they appear willing to participate in the future in such a project; the 41.86% respond that they would participate for sure, while the 45.35% respond 'maybe' indicating that they have some doubts.

The preferred organizational and managerial mix of potential Energy Communities projects is that of smaller energy communities build with people from their wider social circle of friends and relatives, with

active management by the members (34.46%). The business as usual model with private sector dominating the project is the option with the less acceptance.

We tried to capture the amount willing to be invested by citizens in an Energy community project, as it is resulting from the survey's responses. The analysis indicates that the willingness to invest is 1,043.15€ per household. Based on this the estimation on the total possible socially invested capital for energy communities' projects can range between 23,929,907€ to 26,875,768€ for Corfu, and for Zakynthos between 8,562,192€ to 9,615,775€;

- Technical status of electrical energy

Corfu and Zakynthos are both interconnected islands. Currently, the largest part of the electricity needs of the two islands is covered by the main grid and only a very small part, namely 4.40% for Corfu and 5.48% for Zakynthos in 2019, is covered by local generation.

Local generation comes almost exclusively from PV plants, 16.6 MWp of installed power in Corfu and 8.9MWp in Zakynthos, which were installed during the period 2012-2013. Since then, no other plant has been activated, except only for a 320-kW biogas unit in Corfu, which was activated in 2018. During the period after 2013 up to now there was a complete stagnation with regards to new RES investments.

The commercial sector is by far the largest contributor in the total electrical consumption with a share of around 55% in Corfu and 60% in Zakynthos for 2019 while the residential sector, the second largest, has a share of 37% and 32% respectively. The rest of the sectors, industrial, agricultural, public and other have a share of less than 10% in total.

The occurrence of the peak electricity demand in summer can be largely attributed to the impact of tourism and weather. We found that there is a positive correlation between the airport arrivals (for the case of Corfu) and the energy demand for the years 2017 until 2020, during the touristic season (April until October). For the same period, a positive correlation occurs between electricity demand and air temperature while for the rest of the year, the cold months, this correlation is negative.

Towards a sustainable community energy future

Above we presented findings of our study helping to define the socioeconomic milieu, the policy framework, behavioural attitudes and technical context of our study areas. Here we briefly present the roadmap and scenario building exercises developed for the report.

A vision of how RES investments can occur in the two islands using community energy schemes rather than the current business as usual model of segregated private investments has been created.

We made a forecast over the status of the electric system up to 2030 for the two islands and then we developed two scenarios of local RES projects deployment to meet a 64% renewable energy coverage of the expected demand by 2030 along with their projected costs and benefits. This is followed by a reasoning towards the problematiques and a foresight exercise over the possibility of a 100% local RES coverage of electricity demand by 2040.

Using insights from our survey and the international bibliography we analysed, the barriers and opportunities providing the way forward for an operationalisation of the energy communities model in

the Ionian Islands. As part of this, a stakeholders' mapping and a SWOT analysis was also performed (see main report).

For the projection of the electrical demand in the two Ionian islands in 2030 we used the national trend of the electrical demand of Greece, estimated by the Greek transmission system operator in the 10-year planning of 2019. We have considered only the "ESEK" scenario, therefore we assumed an increase of the total electrical demand in the two islands equal to 14.15%. translated to a total demand of 633.6 GWh for Corfu and 279.9 GWh for Zakynthos.

As regards the local generation from RES, in this analysis we adopt the goals set by the updated National Energy and Climate Plan (NECP) that was announced in 2019. According to it, by 2030 a 61% - 64% share of RES in the total final electricity consumption of the country is to be met. Assuming equal responsibility of all regions in Greece to achieve this goal and that all necessary technical requirements to support this level of RES penetration in the grid, both at national and at regional level, will be met by 2030 we estimate for Corfu 405.5GWh and for Zakynthos 179.1GWh of RES generation by 2030.

To achieve the set goal of RES participation in the demand in the two islands, we have examined only the case of wind and solar generation projects due to their maturity both in terms of technological advancements and economics.

The wind and solar RES projects that need to be realized in the near future are examined considering the total required installed power per technology, the initial investment costs and the area required (only for PV technology) for the installations.

Based on typical values of such projects in Greece and Europe we have concluded to the following two scenarios:

Scenario 1		
	Corfu	Zakynthos
Demand Forecast	633.600 MWh	279.900 MWh
RES coverage 64% (2030)	405.504 MWh	179.136 MWh
RES mix	PV: 100% - Wind 0%	PV: 100% - Wind 0%
Total Installed Power	275 MW	122 MW
Total Installation Costs	226.875.000 €	100.650.000 €
Total required area <i>(Refers to solar projects only)</i>	3.14 km ²	1.39 km ²

Scenario 2		
	Corfu	Zakynthos
Demand Forecast	633600 MWh	279900 MWh
RES coverage 64% (2030)	405504 MWh	179136 MWh
RES mix	PV: 65% - Wind 35%	PV: 57% - Wind 43%
Total Installed Power	220 MW	91 MW

Total Installation Costs	208.260.000 €	89.793.000 €
Total required area <i>(Refers to solar projects only)</i>	2.05 km ²	0.79 km ²

- Economic gains for the local system

The above-mentioned upfront investment volume needed to reach the renewable energy target for the two islands surpasses the 300 mill euros mark and might feel demotivational. However, if the 64% locally sourced and owned RES target is met by 2030, tens of millions of euros will be recirculated yearly in the local economy rather than being extracted from the local system.

The yearly electric energy costs for the two islands in total reaches approximately 90 mil euros. As the islands have limited (around 5%) and privately owned RES installed capacity, this amount represents local economic value extracted from the two islands systems every year to cover energy needs.

Local investments in RES will give the opportunity to those systems to not only source locally their energy needs but capture large share of this economic value and maintain it within their local economic system. With energy communities in place a large amount of this value will be captured and remain in the local economic system diffused to the local societies.

- Business as usual vs community energy

In Greece and subsequently the Ionian Islands private investments and corporate interests, dominate the electric energy production through two main types of private investors: small-scale PV investments by individual producers, and medium to large scale PV and wind parks operated by corporations.

In a business-as-usual scenario for the RES development the next decade, same typologies of investments are expected. The advantage, of this model of RES deployment, is that with the technical and legal framework in place the deployment of RES will be accelerated, as market dynamics operate.

However, with this model the RES potential of the islands will be harvested and privatized with limited gains for the locality.

Energy community projects are gaining great attention, as an alternative of the business-as-usual models of energy production and distribution, because of their high social involvement character, their decentralized approach and the democratization of energy system.

The crucial differentiation of the energy communities' projects, compared to a business-as-usual model, is that energy communities include two different conceptualizations of localism; the physical geography and the geography of ownership.

Every decision about the establishment, the activation of energy plants, their maintenance, the local accumulation and consumption, is taken by local citizens and not a distant detached, from the local community, managers.

Energy communities serve the interests of their members, and their community, in an inherent way; those initiatives include a commitment to place and interest both in processes and outcomes.

Energy communities can bring several benefits compared to business-as-usual models where private investments dominate the RES transition such as:

- Generate economic benefits for their members and increase the local economic value
- Tackle energy poverty from the bottom-up
- Generate multilevel environmental benefits preserving local natural and cultural landscape
- Increase social capital and cohesion
- Strengthen cooperative thinking, energy democracy and environmental planning

There the role of external and internal stakeholders becomes critical in creating or sustaining the frameworks within which energy communities emerge and operate. Stakeholders have different levels of interest, motivations, level of accountability and influence. Stakeholders affecting community energy projects can be:

- Local governments and municipalities
- Citizens
- Local Companies and SMEs
- Universities/ research institutes
- Vulnerable Households
- Media
- Environmental organizations
- Policy makers at national and EU level
- Distribution System Operators (DSO) and Transmission System Operators (TSO)
- Energy Suppliers
- Financial institutions and funding organisations

Recommendations

In line with our study and analysis there are several general and case-specific considerations emerging in the report. These derive from our knowledge generated via this research and can be used as policy or project guidance by a large spectrum of actors within the two islands and the broader region, or as initiator of follow up steps.

- A change has to take place aiming on increased responsibility and activation of local communities and local authorities on the general energy planning shifting from a state dominated centralised planning perspective
- Government policy impact on the relative success of community energy initiatives. A clear and predictable regulatory framework are key components for the development of energy communities
- A turn to a regional energy planning integrating regional socioeconomic and technical characteristics can lead among others to a less intensive but more sustainable touristic activity with diffused benefits for the local socioeconomic and environmental system.
- Local RES spatial planning that respects ecological boundaries and cultural heritage is necessary to avoid conflicts.

- Increased energy self-sufficiency is possible in the areas of study without violating environmental and cultural boundaries and without leading to major land-use issues given the characteristics of the build and natural environment.
- Local authorities need to get strongly involved and support or initiate energy communities' initiatives as the benefits to the local societies are evident.
- Direct endorsement and support from local authorities can provide crucial financial backing and credibility to community energy projects that is needed to succeed and proliferate.
- The inclusion of the commercial sector and SMEs in energy community initiatives is key for the success of the transition. Information campaigns should also explicitly target that audience.
- Institutional partnership building at the local level needs to be initiated. Municipalities, public institutions, local associations, educational and research institutes, need to collaborate, investigate and initiate community energy projects lifting local barriers and using appropriate technologies and processes for the region. Collaboration with external institutions for a coordinated research on the subject will also provide faster results.
- Citizens report that they are uninformed and disconnected from local authorities on issues related to RES capabilities and investments; but they really interested over the RES potential of their region, wishing for it to be exploited locally and willing to invest on it.
- Initiation of a public discourse over the energy transition creating a collective vision with energy communities in the center is needed. Promoting the idea of local control on energy production and needs using environmental and social conscious decision-making is key.
- A communication campaign for RES and energy communities has to take into account behavioral aspects. It needs to include positive messages to encourage the engaged local stakeholders focusing on the mid-long term economic, social and cultural returns of investment rather than the upfront costs and the problematiques.
- Several EU initiatives and funding opportunities are expected the following years and local actors along with energy communities need to take advantage of those.
- There is a lack of financing tools and relevant information for energy communities. Providing a set of incentive mechanisms not only as financial support but as lending credibility or tax reduction it matters.
- A nurturing programme targeting the first initiatives that will provide real life examples and help energy communities to proliferate has also to be established. This can be a citizens ' or institutional driven platform of cooperation and knowledge exchange.
- Energy communities should be inclusive and promote the equality among all aspects of their activities. Caution should be taken to avoid the formation of energy communities that involve only middle and upper economic classes as this will not assist on the just transition and might accelerate social disparities.
- Beyond community mobilization, the electrical infrastructure needs to be reinforced to support the transition and allow the growth of energy communities and promote the electrification of other energy sectors.