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The social perspective on small islands' energy transitions: The case of Unije island (Croatia)

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ABSTRACT

This paper reflects upon the concept of social innovation and its role in islands' energy transition. As isolated energy systems, islands typically depend on energy imports from the mainland and mostly use fossil fuels for electricity, heating, and transport, which are significant sources of carbon emissions. At the same time, islands have an abundance of locally available renewable energy sources (RES) at their disposal, which makes them ideal test-beds for energy transition, or the technology-based switch of the energy system, from fossil-based to renewable energy.
However, new RES technologies must be incorporated into society and, thus, to enable successful decarbonisation, technological innovations must be coupled with social innovations. Different authors stress that energy transitions are not strictly technical but socio-technical since they are also comprised of policies, politics and other artefacts, not just technological. Nevertheless, the role of social innovation in local energy transitions is still under-studied, and this paper aimed to contribute to this lack of literature, focusing on the local energy transitions of islands.
By combining theoretical and empirical research, this paper aims to explore the role of social innovation in energy transition and analyse whether social innovation can be considered a success factor in the energy transition process of the case-study island, the small Croatian island of Unije.

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1 Introduction

The Paris Agreement, an international treaty on climate change (UNFCC, 2015) adopted in 2016, presented a global consensus to limit global warming to below 2 °C. Numerous greenhouse gases contribute to global warming, but CO_2 is the most prevalent, and bringing net carbon emissions to zero is necessary. Decarbonization in the energy sector implies a transition from fossil-based to renewable energy sources on all levels, from global to local.

This paper aims to present the importance of social innovation (SI) in the local energy transition processes, focusing on the decarbonization of islands. Typically, *"islands have high energy prices, rely on imported fuels, lack space and resources, and are vulnerable to natural disasters"* (Serpell O., 2020). Still, they *"could be powerful leaders in the energy transition and become hubs of innovation and experimentation – if a policy or system can balance the load on an island, it can certainly help balance load in far more integrated and robust mainland energy systems"* (Serpell, 2020, p. 2). On the other hand, islands are specific because they have an abundance of locally available energy resources (wind, sun, waves) which, after a successful energy transition and a switch from carbon-dense fuel to renewables, could contribute to islands' resilience and significantly reduce their carbon emissions.

However, research and empirical evidence from different EU islands (Heaslip & Fahy, 2018; Selvakkumaran & Ahlgren, 2021; Sperling, 2017) suggest that renewable technology installations are not the central aspect of successful local energy transitions. What seems to be of utmost importance are the social issues or the social innovations that contribute significantly to citizen engagement and new technology acceptance.

In its empirical part, this paper will focus on the small Croatian island of Unije by analysing how the energy tran-

sition of Unije could be accelerated by relying more firmly on the social aspects (i.e. social innovations) rather than focusing solely on the new renewable energy technology introduction, or the technological innovations.

2 Theoretical framework

From the general point of view, research and innovations are supposed to contribute to finding solutions to complex and interconnected socio-economic challenges. In contrast to technological innovations that offer practical and almost immediately applicable solutions, although not always sustainable, social innovations do not always offer quick results and are meant to have a long-term impact.

The first scientific mentions of the term "social innovation" date back to the beginning of the 20th century when the political economist Alois Schumpeter (1883-1950) claimed that in response to the complex modern societal challenges, it would be necessary that the public sector takes on an active role, as a front-runner and creator of prerequisites for the development of social innovations and entrepreneurship (Schumpeter, cited by McNeill, 2012).

At the end of the 20th century, Peter Drucker, in his book "The Frontiers of Management: Where Tomorrow's Decisions Are Being Shaped Today" (1987), devoted its last chapter to social innovations, calling them the new dimension of management. In 2007, Geoff Mulgan with his definition of social innovation as *"innovative activities and services that are motivated by the goal of meeting a social need and that are predominantly developed and diffused through organizations whose primary purposes are social"* (Mulgan et al., 2007: 8) shifted the focus from business to social sphere. In line with Mulgan's reasoning, Murray et al. (2010) state that the prefix "social" marks the potential of specific innovations to be applied to whatever aspect of everyday life that requires improvement and better needs satisfaction.

If we further analyse available definitions, we see that the social innovation concept can (and has been) approached from many different perspectives (Table 1).

Regardless of the approach taken, these definitions put a value on the final benefits for society.

Social innovation appears as a research concept not only in social sciences and humanities but also in technical sciences, i.e. in the research of power sector decarbonization. According to Hoppe & De Vries (2019, p. 1&2), decarbonization cannot be seen solely as a technological issue; it also requires social innovations "as the uptake and use of the latter calls for new ways of organizing and governing energy supply and energy systems (and thus, regulatory response)." Furthermore, authors (Hoppe & De Vries) stress the importance of behavioural barriers, such as the social acceptance of local RES, that are of immense importance in successful energy transitions.

There is no single interpretation of what social innovation in energy transition can entail (Matschoss K. et al., 2020). However, Matschoss K. et al. point out some of its

Table 1 Different definitions of social innovation, observed from different perspectives

Type of perspective	Definition
Managerial	Social innovation "can concern conceptual, process or product change organizational change and changes in financing, and can deal with new relationships with stakeholders and territories." [OECD LEED Forum on Social Innovations, URL: https://www.oecd.org/fr/cfe/leed/forum-social-innovations.htm]
Behavioural	Social innovations are supposed to "bring about the behavioural changes which are needed to tackle the major societal challenges, such as climate change." [European Commission (2010, p. 23) Europe 2020 Flagship Initiative Innovation Union]
Social	Social innovations are defined as "new solutions (products, services, models, markets, processes, etc.) that simultaneously meet a social need (more effectively than existing solutions) and lead to new or improved capabilities and relationships and better use of assets and resources. In other words, social innovations are both good for society and enhance society's capacity to act." [The Young Foundation (2012, p. 18) Defining Social Innovation].
Non-profit	"Even though the vast majority of social innovations are business innovations as well, it would be a blunder for governments (particularly, those of rich countries) not to encourage innovation without a profit motive (…) These social innovations address needs that are not satisfied through the market mechanism (because they do not exhibit potential profits) may be called pure social innovations." [Pol, Ville (2009, p. 883) Social innovation: Buzz word or enduring term? The Journal of Socio-Economics]
Sectoral: Energy	"In the context of the energy transition, social innovation can be defined as innovation that is social in its means and which contributes to the low carbon energy transition, civic empowerment and social goals pertaining to the general wellbeing of communities." [Hoppe, DeVries (2018, p. 1) Social Innovation and the Energy Transition. Sustainability 2019, 11, 141]

Source: Various sources, adapted by the author

characteristics, saying that it is an innovation that is social in its means or methods. It often emerges bottom-up rather than top-down, contributes to civic empowerment, improves relationships or collaborations, advances the low carbon energy transition, usually at a local or regional scale, takes into account the native cultural particularities, social needs or goals and strives for the general wellbeing of the society during its implementation or execution.

Regarding their role in energy systems, social innovations could include "new and alternative business models, novel policy instruments, financing schemes, participatory governance approaches to energy questions, or new discourses" (Wittmayer, J.M., 2020, p. 1).

This paper contributes to broadening the understanding of social innovation in energy transition processes by analyzing the location of Unije island in Croatia. Apart from defining social innovation concepts, the terms "energy transition" and, more precisely, "energy transition in the islands" need to be elaborated.

The International Renewable Energy Agency states that the energy transition is *"a pathway toward the transformation of the global energy sector from fossil-based to zero-carbon by the second half of this century"* (IRENA, 2021).

Also referred to as the "decarbonization of the energy sector" (Papadis, Tsatsaronis, 2020) and the "decarbonization of the electricity generation sector" (Gupta et al., 2021), or described as the "sustainable energy description" (Nogueira Soares, Gava, & de Oliviera, 2021), "clean energy transition" (Liao, Erbaugh, Kelly, & Agrawal, 2021), or "just energy transition" (Mang-Benza, 2021), energy transition, in any case, requires prompt actions on a global level, together with additional actions that will mitigate the negative effects of climate change and reduce all kinds of harmful emissions.

Sustainable energy transition focuses on the need of stakeholders to first build the governance that would allow changes in the practices of current energy regimes. They observe the socio-technical perspective of the energy transition, allowing them to understand sustainable transition processes' political complexity (Nogueira Soares, Gava, & de Oliviera, 2021).

In other words, the energy transition can also be examined from other non-technological perspectives since the energy transition demands a shift not only in technology but also in political regulations, power sector regulations, and the behaviour of users and adopters (Sovacool B.K., 2016).

3 Review of previous research

Although the new renewable technology may be the core of energy transition, the local energy transitions are to be foreseen primarily as "socio-technical" and "actor-centered" transitions rather than as "pure technological" transitions (Selvakkumaran & Ahlgren, 2021, p. 2).

Low-carbon innovations, defined by Geels & et al. (2018, p. 23) as "new technologies, organizational arrangements and modes of behavior (or social practices) that are expected to improve energy efficiency and/or reduce energy demand" can also be classified "by their degree of technical or social novelty" (Geels & et al., 2018, p. 23). So far, most policy efforts have focused on technically and socially incremental innovations, but the expected more radical demand reduction will also require more radical innovations and substantial changes in social and user practices (Geels & et al., 2018). Figure 1 shows some relevant examples of energy field segments in which more substantial innovations are expected.

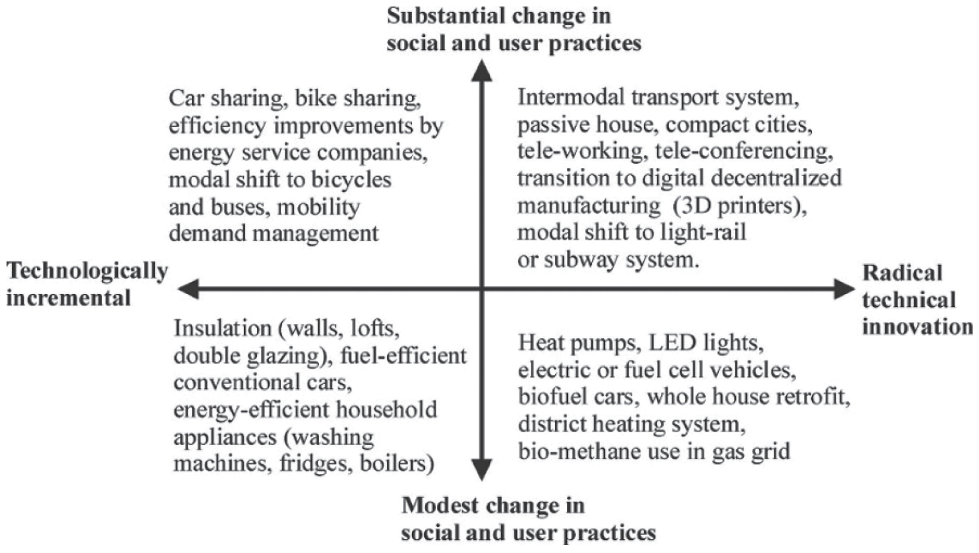

Figure 1 Variety of low-carbon innovations with different degrees of social and technical novelty

Source: Geels F.W. et al. (2018)

This list is non-exhaustive since many examples are missing. In their editorial to the 11th edition of Sustainability Journal, Hoppe T. and de Vries G. (2019), based on the article contributions to this special issue dealing with social innovation in energy transition, list the following areas as fertile ground for social innovation:

- "social incentives (including 'green nudges') to stimulate behavioural change (e.g. to lower energy consumption),
- new social configurations (e.g. using social entrepreneurs or intermediaries to build social networks supportive to renewable energy),
- new organizational forms to stimulate low carbon energy services (e.g. renewable energy cooperatives),
- new forms of governance to stimulate transitions to low carbon economy (either at the local or regional scale; e.g. citizen self-governance or co-creation to co-design low carbon policy),
- novel policies and regulations to empower social groups to engage in low carbon energy activities." (Hoppe T. and de Vries G., 2019, p. 3).

In the words of Hoppe T. and de Vries G. "social innovation seeks to attain particular social goals, like community empowerment, alleviating (energy) poverty, (energy) justice, social equality, and increasing the wellbeing of local communities" (2019, p. 9) and it is expected to have the capability to address the above mentioned social challenges (Selvakkumaran & Ahlgren, 2020).

4 Analysis of the social aspects of the Unije island energy transition

The island of Unije is on a path to becoming the first small carbon-neutral island in Croatia.[1] With the support of the Primorje Gorski Kotar County (regional government) and Regional Energy Agency Kvarner (as local transition coordinator), the energy transition of the island of Unije is being implemented as part of the broader "Unije: Self-Sufficient Island" policy framework that, apart from energy independence, also promotes measures in the area of water supply and drainage, agriculture and mariculture, transport infrastructure and tourism.

Energy developments on Unije were, however, given a significant boost in 2018 when the H2020 project "INSULAE – Maximizing the impact of innovative energy approaches in the EU islands" (Grant agreement ID: 824433), with the island of Unije as one of the pilot islands, was selected for funding (H2020 INSULAE, 2021). This 4-year project (2019-2023) is at the heart of Unije's energy transition. INSULAE seeks to develop new innovative solutions for the decarbonization of European islands, which is key to achieving climate and energy goals and increasing the quality of life on the islands (H2020 INSULAE project).

Project activities are focused on the islands of Unije (Croatia), Bornholm (Denmark), and Madeira (Portugal) as pilot islands, and the results of pilot activities conducted on these islands will be used to transfer knowledge and develop energy action plans for Menorca (Spain), Norderney (Germany), Psara (Greece) and Bonaire islands (Netherlands Antilles). INSULAE pilot activities on Unije are based on the previous activities of the Primorje-Gorski Kotar County and Regional Energy Agency Kvarner in the field of Unije's decarbonization. Regardless of the project, as mentioned before, a solar power plant with a capacity of up to 1 MW will be built, followed by installing an INSULAE battery storage. Apart from the battery storage, under the INSULAE project, several other innovations and solutions are to be implemented (H2020 INSULAE project):

- Smart integration and control of water and energy systems: setting up the system of smart agriculture/vineyards (monitoring soil and environmental parameters), smart water use and energy use (optimizing agricultural production), management of the existing desalination system;
- Empowerment of the island's energy communities through 5G and IoT: Smart Energy Boxes connected through 5G will be installed in private households, allowing the inhabitants to monitor and manage their energy consumption.

Once all the activities are conducted, Unije will most likely become the first 100% RES island, but the project leaders hope that this will be one of the triggers for reaching broader good, and that is to stop the depopulation process in the island and give a boost to its economy.

The SWOT analysis prepared by the Regional Energy Agency Kvarner within the INSULAE project (RINA-C, 2019) defined some threats to the successful island's decarbonization that could be mitigated with the project's implementation, namely:

- Inappropriate and inefficient system of state incentives for the realization of EE/RES projects;
- Long and complicated administrative procedures for the realization of infrastructural projects;
- NIMBY (Not In My Back Yard) syndrome, resulting in inhabitants' resistance to taking part in some of the activities;
- "Fear of technology" – elderly citizens' resistance towards the installation of Smart Boxes;
- 5G, IoT, and other complex terminology not properly communicated towards the inhabitants with no technical background and no prior knowledge of the matter.

To address these threats and to examine the local community's perception of the energy transition happenings on the island of Unije, the author conducted a survey intended for both permanent residents of Unije island living there full-time, as the primary target group, as well as the occa-

[1] Yet another island in the Kvarner Bay is famous for its zero-energy agenda, and that is the island of Krk, but these two islands are not really comparable since Krk is connected to the mainland with a bridge and only 25 km away from the City of Rijeka as the regional centre.

Table 2 Demographic information on the respondents – permanent and occasional residents

	Permanent residents		Occasional residents	
	N	%	N	%
Gender:				
Female	12	32.4	21	48.8
Male	25	67.6	22	51.2
Total	37	100.0	43	100.0
Age:				
18-24	1	2.7	3	7.0
25-44	7	18.9	20	46.5
45 -64	10	27.0	18	41.9
65 or over	18	48.6	1	2.3
Missing data	1	2.7	1	2.3
Highest achieved level of education:				
Attended or finished primary school	4	10.8	1	2.3
Secondary school	16	43.2	6	14.0
Bachelor's degree (In Croatia: VŠS and BA degree)	9	24.3	14	32.6
Master's degree (In Croatia: VSS and univ. spec. degree)	5	13.5	17	39.5
PhD	3	8.1	5	11.6

Source: Author

sional residents with property on the island, i.e. staying with family or their own weekend houses[2]. The reason for having two groups of survey participants was to compare the viewpoints of both permanent and occasional residents.

The survey was conducted during June 2021, door-to-door in paper format and online via a digital questionnaire. The participants in the online survey were initially approached by phone, e-mail, or social networks. The chain-referral sampling technique was used since the participants were asked to propose future participants from among their acquaintances. The same questionnaire was used for both groups of participants. It was structured as a combination of closed-type and open-type questions, focusing on the following:

- Public attitudes towards the current "Unije Self-Sufficient Island" action plan
- Willingness for a more active personal engagement
- Actions that could increase the overall public support towards the island energy transition
- Level of familiarity with the "social innovation" concept.

The collected data were analysed using standard descriptive analysis and statistical analysis. The analysis showed that the permanent and occasional residents share similar opinions and experiences across almost all questions, which is not unexpected, given that most of the occasional residents of Unije originate from the island and thus know Unije's history and challenges. In addition, secondary data from the H2020 INSULAE survey was used.

According to the last national Census of Population, Households, and Dwellings (2021), the total population of Unije in 2021 amounted to 64. Based on the data received from the Unije District Council, the actual number (of people living on the island throughout the year) amounts to 50, out of which one person is under 18 years of age, which leads to the overall sample size of 49 islanders that live permanently on the island (others may have registered living on the island due to various reasons, but are not present on the island throughout the year). All of them have been approached, but 12 refused to participate in the survey. The number of permanent residents that participated in the survey was thus 37, with a ± 8% error margin at the 95% confidence level.

Apart from the permanent residents, the occasional residents, i.e. people who own a house on Unije but do not spend the whole year on the island, were also invited to participate in the survey. There is no information on the total number of such individuals (the size of this target population) since there is no data on how many houses on Unije are abandoned and how many are occasionally in use, nor with how many household members. Nevertheless, the collected sample of 43 occasional residents was administered to see whether there were any significant differences in the perspectives of permanent and occasional residents.

The demographic overview of the respondents is presented in Table 2 and includes gender, age, education, and type of residence (permanent/occasional).

The current "Unije Self-Sufficient Island" action plan, prepared in 2015 by the project team appointed by the re-

[2] The questionnaire template used can be found in Annex 1.

Table 3 Ranking of the Unije self-sufficient island action plan measures done by permanent residents

Thematic group	Measure	Minimum	Maximum	Mean	Std. Dev.
WSD2	Municipal drinking water storage tanks	3	5	4,62	0,721
WSD3	Water supply network	2	5	4,57	0,801
WSD1	Self-powered desalination plant	1	5	4,49	0,932
WSD4	Public sewage system	1	5	4,35	0,919
WSD5	Wastewater treatment plant with discharge	3	5	4,35	0,824
ENI1	Energy-efficient public lighting	1	5	3,95	0,97
AAM2	Olive oil production – revitalization and mill construction	2	5	3,84	1,093
TSM3	Tourist trails and promenades – cycling, ecology, ornithology, archaeology	1	5	3,62	1,21
ENI3	Solar thermal collectors in buildings	1	5	3,59	1,235
TIN1	Local airport – putting into action	1	5	3,57	1,444
TIN2	Breakwater extension	1	5	3,57	1,119
AAM3	Growing vegetables in greenhouses	1	5	3,51	1,367
TIN3	Maintenance of field roads	1	5	3,51	1,07
ENI5	Electric bikes and vehicles	1	5	3,49	1,17
AAM1	Land consolidation	1	5	3,43	1,144
ENI2	1MW PV with battery energy storage system	1	5	3,32	1,107
TSM1	Marina in Maračol bay	1	5	3,19	1,469
AAM5	Sheep and goat farming – increase in herds and cheese production	1	5	3,14	1,251
ENI4	Biogas plant – zero waste system demonstration	1	5	3,03	1,258
AAM4	Permanent preservation of the Istrian cattle („boškarin“)	1	5	2,73	1,239
TSM2	Green hotel in Maracol bay	1	5	2,41	1,554
AAM6	Fish farming	1	5	2,22	1,336

Thematic groups' legend: ENI – Energy independence, WSD – Water supply and drainage, AAM – Agriculture and mariculture, TIN – Transport infrastructure, TSM – Tourism

Source: Author

gional government (Primorje Gorski Kotar County), contains different measures divided into five thematic groups: (1) Energy independence, (2) Water supply and drainage, (3) Agriculture and mariculture, (4) Transport infrastructure and (5) Tourism. The participants were asked to grade on a scale ranging from 1 (Not at all important) to 5 (Extremely important) **the importance of every individual measure proposed for the island's overall sustainability (Q1)**. Average grades given by permanent residents are ranked from the most important to the least important and are shown in Table 3.

As seen in Table 3, the highest importance was attributed to water supply and drainage measures and the lowest to fish farming and building of the green hotel in Maračol bay. It is interesting to see that the five measures that received the highest grades (Mean > 4) all belong to the Water supply and drainage (WSD) group of measures and that the best-rated energy-related measure is the Energy-efficient public lighting, which is also the only energy measure from the list that has already been implemented (Regional Energy Agency Kvarner, 2021).

Looking at the same answers from occasional residents, we see no significant difference, with water-related measures again being assessed as the most important, and green hotel and fish farming as some of the least important, together with the permanent preservation of the Istrian cattle. All the energy measures are assessed quite similarly, with Solar thermal collectors in buildings being considered slightly more important than the Energy-efficient public lighting.

The results from this question also showed that some of the measures from the action plan that were first implemented by the regional authority, such as the preservation of the Istrian cattle "boškarin" (Primorje Gorski Kotar County, 2017), are actually at the bottom of the islanders' list, measured by assessed importance. In another survey question that was an open-ended type, the participants expressed concern that farming cannot be developed along with tourism, and one of the two needs to be put aside. However, the Aran Islands' experience shows differently since their main economic branches are tourism and farming (Pleijel, 2015).

Given that the "Unije Self-Sufficient Island" action plan was created ten years ago and can already be considered outdated, it would be advisable to re-examine the measures and its future implementation timeline, considering the islanders' opinions. By doing this, the islanders would feel that they are being consulted, which could (according to best practice examples from EU islands) increase their support towards the plan realization.

Individual items from thematic categories (ENI – Energy independence, WSD – Water supply and drainage, AAM – Agriculture and mariculture, TIN – Transport infrastructure, TSM – Tourism) were further grouped to investigate the effects of five thematic categories and two groups of participants (permanent and occasional residents) on the assessed importance of measures proposed. For each category, the average grade was calculated. The reliabilities (Cronbach's alphas) of the five subscales (categories) are within the range from moderate to high (the acceptable values are over 0.6 or 0.7, depending on the literature source, states Taber, 2018), which means that formed subscales are reliable and that it is appropriate to use such subscales (grouped data) in further analysis (Table 4).

Table 4 Reliability test of thematic categories

Thematic categories	N of items	Cronbach's Alpha (α)
ENI – Energy independence	5	,727
WSD – Water supply and drainage	5	,802
AAM – Agriculture and mariculture	6	,813
TIN – Transport infrastructure	3	,603
TSM – Tourism	3	,703

Source: Author

Next, to examine if the effects of thematic categories and groups of residents (and their interaction) on the assessed importance are statistically significant, a two-way ANOVA with thematic categories (ENI, WSD, AAM, TIN, TSN) as a within-participants factor and with groups of residents (permanent and occasional residents) as a between-participants factor was performed.

The analysis revealed a significant main effect of thematic categories, $F(4, 312) = 44{,}81$, $p < ,001$. Duncan's post hoc test revealed that participants rated category WSD ($M = 4{,}44$, $SE = ,08$) as more important than other categories ($M_{ENI} = 3{,}40$, $SE_{ENI} = ,09$; $M_{AAM} = 3{,}14$, $SE_{AAM} = ,10$; $M_{TIN} = 3{,}58$, $SE_{TIN} = ,10$; $M_{TSM} = 3{,}23$, $SE_{TSM} = ,12$; ps < .001). Furthermore, participants rated categories ENI and TIN as more important than category AAM (ps < .001). Finally, participants rated category TIN as more important than category TSM (p < .001). Other differences were not significant.

The analysis also revealed no significant main effect of the group of residents, $F(1, 78) = 0.04$, $p = .849$, and no thematic category × group of residents interaction, $F(4, 312) = 1.34$, $p = .254$.

Descriptive data for the ratings given by two residents' groups to five thematic categories are presented in Table 5, and means are presented in Figure 2.

Table 5 Descriptive data for the ratings given by two residents groups to five thematic categories

Thematic categories	Permanent residents		Occasional residents	
	Mean	Std. Error	Mean	Std. Error
ENI – Energy independence	3,476	,135	3,316	,125
WSD – Water supply and drainage	4,476	,117	4,405	,109
AAM – Agriculture and mariculture	3,144	,142	3,132	,132
TIN – Transport infrastructure	3,55	,152	3,612	,141
TSM – Tourism	3,072	,176	3,388	,163

Source: Author

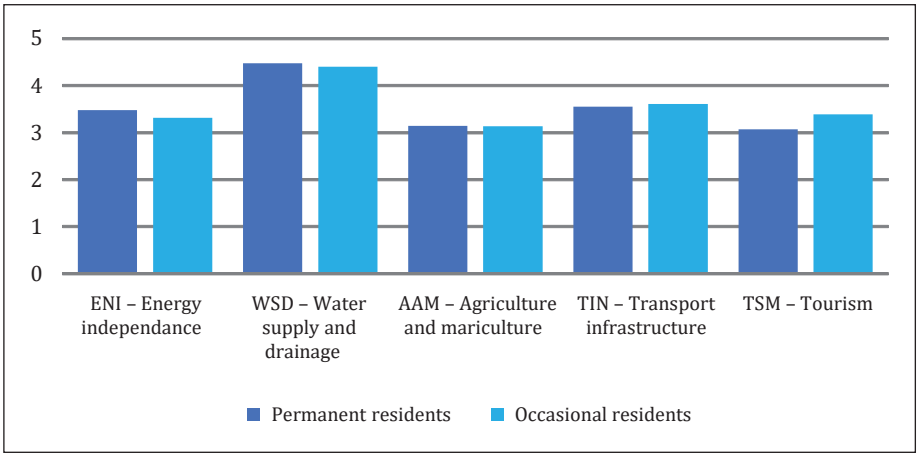

Figure 2 Assessment of importance per thematic categories

Source: Author

This data confirms that, in general, permanent and occasional residents assess quite similarly the importance of specific thematic categories of the Unije Self-Sufficient action plan, giving water-related issues a priority over other sustainability issues. This fact was interesting to see since one may assume that occasional residents would have different priorities (e.g. wish to develop tourism more strongly or lower sensitivity for the preservation of natural habitat) than the permanent residents, but on Unije that is not the case.

The next question was **which of the listed benefits to be triggered by the investments in the island's sustainability the respondents consider most relevant for the island**. Participants were asked to rank the options offered from 1-6 (with 6 having the highest importance). Descriptive data are summarized in Table 6 (for permanent) and Table 7 (for occasional residents).

The results generally showed that "Providing drinking water from the desalination plant" is considered the most relevant benefit by both groups, and "Supporting the further development of tourism as a major source of income" is the least relevant.

Experience from Aran Islands (Heaslip, 2017) shows that the development of renewable energy projects had a positive effect on tourism, supporting green tourism rather than mass tourism, and the locals, therefore, welcomed it. Also, on Tilos, tourism development led to desired population growth (South Aegean Region , 2014). In the case of Unije, which is evident from the answers received to open-ended questions, locals are primarily afraid of the tourism development and overcrowdedness that would endanger the island's peacefulness and untouched nature.

Table 6 List of benefits – median and semi-interquartile range (permanent residents)

List of benefits	Permanent residents				
	Minimum	Maximum	Mode	Median	Semi-Interquartile Range
Availability of green energy produced from renewable energy sources	1	6	2[a]	4,00	1,5
Improved energy security, not depending on undersea power cable from the mainland	2	6	3	4,00	0,5
Providing drinking water from the desalination plant	1	6	6	5,00	1,00
Introduction of a public sewage system replacing the traditional septic systems	2	6	5	4,00	1,00
Enhancing the resilience of agriculture and food security	1	6	2	2,00	1,25
Supporting the further development of tourism as a major source of income	1	6	1	1,00	/

a. Multiple modes exist. The smallest value is shown

Source: Author

Table 7 List of benefits – median and semi-interquartile range (occasional residents)

List of benefits	Occasional residents				
	Minimum	Maximum	Mode	Median	Semi-Interquartile Range
Availability of green energy produced from renewable energy sources	1	6	1[a]	3,00	1,5
Improved energy security, not depending on undersea power cable from the mainland	1	6	3	3,00	1,00
Providing drinking water from the desalination plant	1	6	5	5,00	0,5
Introduction of a public sewage system replacing the traditional septic systems	1	6	4	4,00	1,5
Enhancing the resilience of agriculture and food security	1	6	2[a]	4,00	1,5
Supporting the further development of tourism as a major source of income	1	6	1	2,00	2,00

a. Multiple modes exist. The smallest value is shown

Source: Author

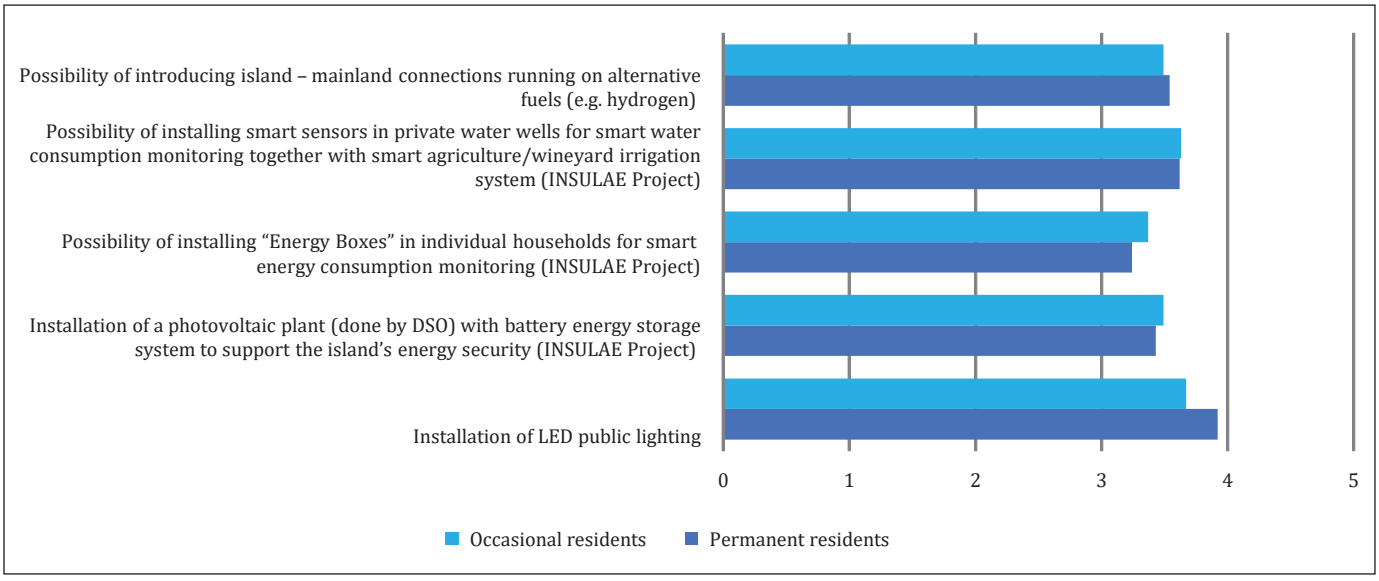

Figure 3 Assessment of personal support towards the listed RES actions

Source: Author

Next, participants were asked to assess on a scale ranging from 1 (Do not support at all) to 5 (Strongly support) their **support towards the listed renewable energy developments on the island of Unije**.

The comparison of the two groups is presented graphically (Figure 3).

Again, the results for the two groups are similar. Both groups, in principle, support the RES developments since the mean for all actions listed is between 3 and 4. Also, the average personal support toward RES actions was calculated (reliability of the scale: α =,78), and the T-test for independent groups showed that there was no difference in average support expressed by two groups of residents ($t_{(78)}$ = 0,11, p = ,913).

It was interesting to check that the installation of a photovoltaic plant that will contribute to the island's energy security did not receive the highest support. The reason could be that participants still do not experience many electricity cut-offs, influencing their opinion, especially the occasional residents, since the electricity cuts occur primarily in winter.

Also, further comments were received, not referring to any of the proposed RES developments but stressing the overall desire to keep the island simple and authentic and avoid mass construction. Finally, it was stated that all these developments could be beneficial, but the priority is to decrease the island's depopulation. Ten years ago, around 100 people were living on the island, now, there are only 50, so the question is who would benefit from all this if people continue leaving the island.

The next set of questions questioned the participants' willingness to engage personally, e.g. by investing in domestic RES installations or just by changing their energy consumption habits. The comparison of answers among the two groups is shown in graphs.

Q: Would you be more willing to support the installation of renewable energy systems on the island if it would bring you direct financial benefits, e.g. savings on utility bills?

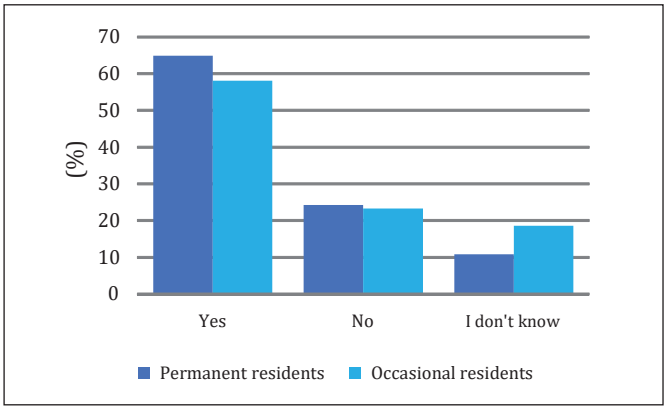

Figure 4 Willingness to support the installation of renewable energy systems on the island if that would bring direct financial benefits

Source: Author

This data showed that most participants would be willing to support the installation of renewable energy systems on the island in return for some direct financial benefits. More importantly, the distribution of the answers does not differ between the two groups of residents, $\chi 2$ = 0,962, df = 2, p >,05.

Q: To what extent would you be willing to change your habits to lower your utility bills or earn an extra profit (e.g. by turning on the domestic electrical appliances when the electricity rate is lower and not when it suits you best)?

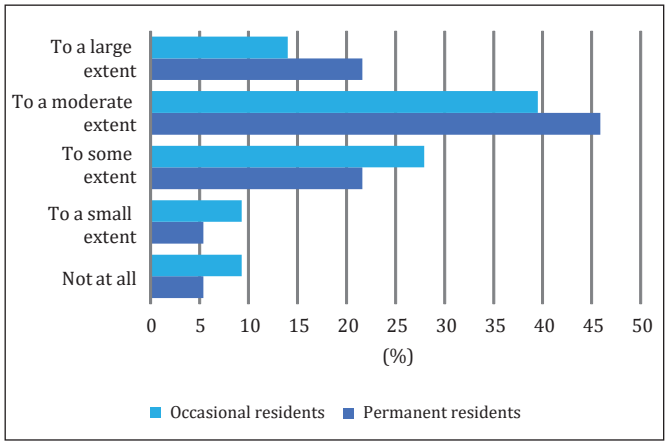

Figure 5 Willingness to change personal habits to lower the utility bills

Source: Author

This data showed that most participants would be "to some extent" or "to a moderate extent" willing to change their habits to lower their utility bills or earn extra profit. Also, the distribution of answers does not differ between the two groups of residents, $\chi 2 = 1{,}980$, df = 4, p >,05.

In the next set of questions, participants were asked to detect actions that would increase their overall support towards the island energy transition of Unije. Actions that appeared at the top of both groups' lists (in a very similar order) were the following:

- Better risk communication (communicating the potential downsides of energy projects)
- Being informed in person about the projects' progress (during local meetings with project owners)
- Being informed about the projects' progress by the local media (incl. social media)
- Stronger and more visible endorsement of energy projects from the municipal government.

5 Recommendations

The current Unije Self-Sufficient Action Plan was created ten years ago and should be re-examined in collaboration with the locals. Survey results have shown that some of the actions contained in this action plan have shallow support from the residents (both permanent and occasional), such as building the green hotel in Maracol bay, preservation of the Istrian cattle ("boškarin") or the fish farming, and if there are no people interested in those activities (especially farming), there is no use of developing them. Regarding technology investments, the population of Unije (both groups of residents), in principle, supports the RES developments on the island (the mean for all actions listed in the survey is between 3 and 4). However, they give water-related issues a priority over other sustainability issues. In other words, they would be more eager to support water and drainage-related activities rather than energy independence projects.

The Islanders must understand what they can gain from it and how concretely they can benefit from transition activities. Most survey participants would be willing to support the installation of renewable energy systems on the island in return for some direct financial benefits. Also, they would be willing to invest personally in domestic renewable energy systems on their property on Unije if they could gain concrete benefits from it.

Technical and social experts' successful engagement and collaboration are highly appreciated in communicating those benefits and bridging the gap between the new technology and society (which was very well illustrated in the presented story of Samso's energy transition). The technicians, of course, know how RES technology works, what its outputs are, and also what the environmental risks are (which often concerns the local community), but social experts should also be hired as communicators to reach the final users and, in a sense *storify* the transition. As the project owner, the local/regional government has complete authority over this matter.

Islanders should be well informed about RES infrastructure's positive aspects and possible downsides. Both groups of survey participants emphasized the need for better risk communication. In parallel, supportive national legislation and policies would be appreciated but cannot be influenced. Property and land rights issues often complicate the realization of projects on the islands, so additional effort must be put into resolving those barriers.

There is also a question of setting up the vision and mission for the island. Sometimes some activities pose a threat to the realization of others. In Unije, for example, there is a parallel aspiration to preserve cattle breeding and to develop green tourism (Jardas et al., 2011), which may not go hand in hand. In terms of energy, solar power plant construction is foreseen, and solar panels on private houses are also a possibility, but the islanders are concerned that it would destroy the natural landscape and authenticity of the island.

There is, of course, no progress without some investments. The truth is also that some of the worst-rated projects resulting from the survey conducted for residents and occasional visitors to the island are activities that can potentially provide jobs on the island and bring young families to the island. Thus, the local/regional government is challenged to find the right balance between progress and preservation. When speaking about solar panels, for example, technology solutions to satisfy both exist, such as solar roofs designed with tiles that look similar to a tradi-

tional roof but are much more expensive. This brings us back to population issues and the cost-efficiently of capital-intensive investments in societies with decreasing populations. However, energy independence and water supply and drainage projects alone will not bring young families to move to the island – it is just the necessary infrastructure. There are many more different measures that have to be implemented. Nevertheless, this should be the role of local/regional governments to enable the realization of projects that are not always cost-efficient in market terms but could bring some significant benefits.

The challenge to improve the project communication on all levels remains an open task, together with the need to make greater use of local knowledge, to re-examine the current sustainability action plan, and to fine-tune it along with the islanders' needs – having in mind the repopulation of Unije as a long-term goal. These areas of concern can offer fertile ground for developing and implementing social innovations (e.g. new energy market models, better institutional support, new governance models, increasing citizens' participation and cooperation in energy services, community energy initiatives, and similar).

Most survey participants believe that social innovations can contribute to Unije's energy transition to a moderate or large extent, and it is up to the project leaders to exploit this potential.

6 Conclusion

There are different social aspects of local energy transitions, ranging from social incentives influencing behavioural changes, new social configurations, and organizational forms stimulating low-carbon energy services to new forms of governance. Social innovations in all these areas can potentially support local energy transitions in the islands.

The survey conducted on the island of Unije in June 2021 showed that the islanders, in principle, support renewable energy developments on the island, so the technology itself (or the often-seen fear of new technology) is not an issue. However, some social aspects of energy transition appear to be more problematic. The survey participants recognized a need for: more efficient and frequent project communication, better risk management, more substantial personal involvement, stronger endorsement of RES projects from the local government, need for participatory planning that would not be carried out in a perfunctory manner, better exploitation of local knowledge and experiences, and similar.

The fact that the population on Unije is, in general, supportive towards RES technology implementation (although to some extent concerned that it might irreversibly affect the island's natural landscape and cultural authenticity) but recognizes the need for improvement in different social areas leads to the conclusion that social innovation can have a positive role and be considered as a success factor in the island of Unije energy transition process.

It remains a challenge and idea for some future research to analyse how to measure this impact. Also, some future research might put less focus on community actions (citizen engagement, energy cooperatives, etc.) and more on multilevel governance, energy poverty (putting more focus on people with the lowest energy consumption), and motivation of individuals, trying to answer the question what motivates people to change their lifestyle and voluntarily decrease their energy consumption since it is evident that the large-scale behaviour change will be needed if we wish to meet the EU's climate targets.

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