UNIVERSITAT DE BARCELONA

Local Renewable Energy Projects on remote islands: Impacts, ethics, and transformative potential

Marouko Tsagkari

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Marula Tsagkari

UNIVERSITAT DE BARCELONA
Facultat de Biologia
Departament de Biologia Evolutiva, Ecologia i Ciències Ambientals

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Dissertation submitted by

Marouko Tsagkari

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PhD Candidate:	PhD supervisor:	PhD co-supervisor:	Tutor:
			
Marouko D. Tsagkari	Jordi Roca Jusmet	Giorgos Kallis	Teresa Elena Vegas Vilarrubia

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For the most inspiring women in my life; my mom and my grandmothers

Bend if you can to the dark sea forgetting
the flute's sound on naked feet
that trod your sleep in the other, the sunken life.

Write if you can on your last shell
the day the place the name
and fling it into the sea so that it sinks.

We found ourselves naked on the pumice stone
watching the rising islands
watching the red islands sink
into their sleep, into our sleep.
Here we found ourselves naked, holding
the scales that tipped toward injustice.

The instep of power, unshadowed will, considered love,
projects that ripen in the midday sun,
the course of fate with a young hand
slapping the shoulder;
in the land that was scattered, that can't resist,
in the land that was once our land
the islands, -rust and ash- are sinking.

Altars destroyed
and friends have forgotten
leaves of the palm tree in the mud.

[George Seferis, «Santorini»]

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Giorgos Kallis

Jordi Roca Jusmet

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ABSTRACT

In the discussions on climate change, the transition to renewable energy is seen as one of the biggest and most urgent steps the world can take to avoid ecological collapse. At the same time, the decentralized and abundant character of renewable energy is pushing for deeper changes in the energy system mostly around small scale, decentralized, and democratically owned projects. Despite the emergence of various community and local renewable energy projects, there is still limited discussion on the bigger impact these projects can have on the sustainability discourse and on their potential to scale up and push for a more radical change. Even less attention has been paid on the views of the local population. The evaluation of local projects is mostly done by experts and managers and fails to assess the impact of the projects on people's lives.

The present dissertation has identified and aims to tackle this literature gap. The focus is on two islands located in Southern Europe: Tilos in Greece, and El Hierro in Spain. Islands are ideal case studies due to their particularities like high energy cost, energy dependence from the mainland, remoteness and identified boundaries. For these reasons, the past years islands globally have been transformed into technological hubs for renewable energy projects. The two islands studied here have implemented innovative small scale, local renewable energy projects that go beyond mere electricity production and aim to support various sustainability actions.

The thesis is divided into three sections that answer different sub-questions all of which together shed light on the impact and potential of local renewable energy projects on islands. In Section A, I use two different approaches, namely the Strategic Niche Management and Degrowth to discuss to what extend these local energy projects can be scaled-up and can push for a more radical transformation like Degrowth. On the one hand, I conclude that the projects are in the inter-local phase and have a potential to influence the regime. Various actors are playing different roles in the scale up of the projects. On the other hand, when I examined a more radical vision, like Degrowth I found that the projects although embrace some of the degrowth ideas, are still operating under capitalistic terms. An important missing element is the strongest participation from the local population and the orientation towards non-profit initiatives.

In Section B, I explore to what extend the projects delivered their 'sustainability promises'. These promises were identified in the discussion with various actors and derived from the relevant documents. Surveys with the local population shed light on the impacts the projects had on people's lives. Overall, the communities assessed the projects quite high, and it was found that certain aspects like social and environmental parameters influence people's perceptions on the success of the project higher than others, like economic. Special attention was given on the gender aspects, which are often overlooked in the discussions around energy projects. The results support the initial suspicions that women perceive less benefits and feel less involved with the projects than men. In Section C the concept of Insular Degrowth is being introduced in an effort to conceptualize some of the aforementioned observations around islands, energy and development.

Overall, the present dissertation concludes that local renewable energy projects can enhance local sustainability and can be beneficial for the local community. I argue however that one should not romanticize local energy projects as very often the participation of local people is limited and symbolic while certain groups like women feel excluded. Additionally, certain aspects like environmental and social benefits that are overlooked on project evaluations are important factors for the success of the projects in the eyes of the local communities. Finally, the present dissertation challenges the idea of a "successful" project, as different actors have different ideas around what makes a 'successful project' based on their values and priorities. Thus, a novel framework that includes various aspects of sustainability and various views from multiple stakeholders is needed.

RESUMEN

En los debates sobre el cambio climático, la transición a las energías renovables se considera uno de los mayores cambios que el mundo puede implementar para evitar el colapso del cambio climático. Al mismo tiempo, el carácter abundante y descentralizado de la energía renovable está impulsando cambios más profundos en el sistema energético, principalmente en torno a proyectos a pequeña escala, descentralizados y de propiedad democrática. A pesar del surgimiento de varios proyectos comunitarios y locales de energía renovable en muchos países, todavía hay una discusión limitada sobre el mayor impacto que estos proyectos pueden tener en la sostenibilidad y sobre su potencial para escalar e impulsar un cambio socioeconómico más radical. Aún menos debates incluyen los puntos de vista de la población local, ya que la evaluación de los proyectos locales la realizan principalmente expertos y gerentes y no se evalúa el impacto que los proyectos tuvieron en la vida de las personas.

Esta disertación tiene como objetivo superar este vacío de la literatura. La atención se centra en dos islas ubicadas en el sur de Europa, Tilos en Grecia y El Hierro en España. Estas islas son casos ideales para iniciar esta discusión debido a sus particularidades como es el alto coste de la energía, la dependencia energética del continente, la lejanía y los límites bien definidos. Por estas razones, en los últimos años, muchas islas a nivel mundial se han transformado en centros tecnológicos para proyectos de energía renovable. Las dos islas estudiadas aquí han implementado proyectos innovadores de energía renovable local a pequeña escala que van más allá de la mera producción de electricidad y apuntan a apoyar diversas acciones de sostenibilidad.

La tesis se divide en dos secciones que tienen como objetivo responder a diferentes preguntas secundarias, todas las cuales arrojan luz sobre el impacto y el potencial de los proyectos locales de energía renovable. En la Sección A, utilizo dos enfoques diferentes, a saber, la gestión de nichos estratégicos y el decrecimiento para discutir en qué medida estos proyectos pueden ampliarse y pueden impulsar una transformación más radical como la que plantea la propuesta del decrecimiento. Por un lado, concluyo que los proyectos están en la fase 'inter-local' y tienen un potencial para influir en el 'régimen dominante'. Varios actores están desempeñando diferentes roles en la ampliación de los proyectos. Por otro lado, cuando examiné si representan una visión más radical, como la del decrecimiento, encontré que los proyectos, aunque adoptan algunas de las ideas del decrecimiento, siguen operando bajo términos capitalistas. Un elemento importante que falta es la mayor participación de la población local y la orientación hacia proyectos sin fines de lucro.

En la Sección B, investigo en qué medida los proyectos cumplieron sus "promesas de sostenibilidad". Estas promesas fueron identificadas en la discusión con varios actores y en los documentos relevantes. Las encuestas con la población local clarificaron los impactos que los proyectos tuvieron en sus vidas. En general, las comunidades evaluaron los proyectos como exitosos y se mostró que ciertos aspectos, como los parámetros sociales y ambientales, influyen en las percepciones de las personas sobre el éxito del proyecto más que otros, como el económico. Se prestó especial atención a los aspectos de género, que a menudo se pasan por alto en las discusiones sobre proyectos energéticos. Los resultados apoyan las sospechas iniciales de que las mujeres perciben menos beneficios y se sienten menos involucradas con los proyectos que los hombres.

En general, la presente tesis concluye que los proyectos locales de energía renovable pueden mejorar la sostenibilidad local y pueden ser beneficiosos para la comunidad local. Sin embargo, en base a los resultados, argumento que no se deben idealizar los proyectos energéticos locales ya que muy a menudo la participación de la población local es limitada y especialmente de ciertos grupos como las mujeres. Además, ciertos aspectos como los beneficios ambientales y sociales a menudo no se incluyen en las evaluaciones de proyectos, pero resultan importantes para las comunidades. Por último, pero no menos importante, la presente tesis desafía la idea de un proyecto "exitoso" ya que diferentes actores tienen diferentes ideas sobre el éxito del proyecto en función de sus valores y prioridades. Por lo tanto, se necesita un marco novedoso que incluya varios aspectos de la sostenibilidad y puntos de vista diferentes de múltiples partes interesadas.

LIST OF ABBREVIATIONS

CE

Community Energy

CFA

Confirmatory Factor Analysis

EU

European Union

FiT

Feed-in-Tariff

FiP

Feed-in-Premium

LE

Local Energy

PPA

Power Purchase Agreement

PV

Photovoltaic

RE(S)

Renewable Energy (Sources)

SDGs

Sustainable Development Goals

SIDS

Small Island Developing States

SUR

Seemingly Unrelated Regression

NGO

Non-Governmental Organizations

NII

Non-Interconnected Islands

SNM

Strategic Niche Management

T.I.L.O.S.

Technology Innovation for the Local Scale Optimum Integration of Battery Energy Storage

VIF

Variance Inflation Factors

W.W.F.

World Wildlife Fund

1. GENERAL INTRODUCTION

1.1 ENERGY TRANSITIONS

There is no doubt that climate change is the biggest challenge humanity is facing and is already happening to a potentially irreversible degree. The burning of polluting and exhaustible forms of energy like coal, oil products, and natural gas have released high levels of CO_2 into the atmosphere which, through infrared absorption, warms the Earth and causes a chain reaction of other changes. In 2018, it was reported that the average temperature of the Earth was already 1.2°C beyond the preindustrial levels. As a result, humanity witnesses the collapse of ecosystems, biodiversity loss, droughts, ice melts, wildfires, hunger, and the spread of diseases. According to World Bank (2018), about 143 million people will migrate from Latin America, sub-Saharan Africa, and Southeast Asia by 2050 due to climate events. In these turbulent times of crisis and in order to reverse or minimize the impacts of climate change, all eyes and expectations are turned to the potential of a quick energy transition to renewable sources like solar, wind, and hydropower.

The energy transition is not a new phenomenon for humanity. In fact, human development is marked by epochs defined by the exploitation of various forms of energy. Historically, a number of transitions have occurred from one energy source to another. However, the processes were slow, lasting a century or more (Fouquet, 2016; Smil, 2016; Sovacool & Geels, 2016). Historical evidence also suggests that previous energy transitions were driven by an increase in energy consumption and were additive, meaning that energy from new sources was used to cover the increased energy demand, rather than to substitute older forms of energy. But now humanity is running out of time. According to the latest Intergovernmental Panel on Climate Change Report (IPCC, 2021), we need to reach carbon neutrality in 30 years or less. This time, the transition must be different, with renewable energy replacing fossil fuels rather than driving an increase in energy production.

Energy transitions are also societal transformations and shape cultures, lifestyles, and politics. For instance, the beginning of the fossil fuel era in the 19th century also marked the begging of the 'petroculture' era defined by consumption-heavy lifestyles, expectations for perpetual growth, technological modernity, new forms of imperialism, and new patriarchal orders (Daggett, 2018). For this reason, to transform our energy systems and address climate change, we should also fundamentally change the established cultural, social, economic, and political norms shaped by the petro-hegemon era. 'Petrocultures' have created new networks of power and have shaped new "*privileged subjectivities [which] are oil-soaked and coal-dusted*" (Daggett, 2018 p27). Every energy transition has losers and winners and the transition from coal to oil allowed oil industries to become some of the most powerful entities globally, and oil states to become important players in global politics. At the same time, it was mostly the poorest communities that bearded the environmental, economic, and social costs.

On the contrary with oil and gas, which are exhaustible sources, concentrated in certain places, and controlled by oligopolies, renewable energy (RE) is abundant and available everywhere (in

different forms). As McDermott Hughes (2021, p23) aptly points out: "*Petroleum, coal and gas are energy achieved elsewhere. Wind on the other hand, lives among is- so constant and available as to be free and forgettable*." Renewable energy's abundant, dispersed, and free nature has sparked debate about a more decentralized system of energy production, on a smaller scale and closer to consumption points. These decentralized systems can have important economic advantages, like lower transmission costs, lower maintenance costs, and reduced grid losses (McKenna, 2018). They can also pave the way for social transformation and can destabilize the dominant power systems(Stephens, 2019). As renewable energy technologies mature, calls for "energy democracy", "energy justice", and "just energy transition" dominate the discussions of scholars, activists, and policymakers.

Clean energy has been at the center of the sustainability discussion as it can provide opportunities not only for energy security but also for social and economic development and mitigate environmental and health impacts caused by fossil fuels (Asumadu-Sarkodie & Owusu, 2016). As Hui (1997, p.3) puts it "*Creating a sustainable structure in energy supply and use is a way to translate the sustainability concept into action*." In its most usual definition, sustainable development is the form of development that "*meets the needs of the present without compromising the ability of future generations to meet their own needs*." he term originated with the Brundtland Report in 1987 and gained currency in the modern debate with the Earth Summit in Rio in 1992 and the Rio+20 Conference on Sustainable Development in 2012.Sustainability is a complex concept with ecological, social, economic, and cultural dimensions. The idea of sustainability has evolved over the past decades to include wider social, economic, and political perspectives (Borowy, 2013; Olsson et al., 2014) and draws inspiration from the fields of ethics, justice, and political ecology. A simplistic linkage between energy and local socio-economic development, environmental impacts, institutional changes, and technical advances is shown in **Figure 1.**

Due to this over-complexity, sustainability often refers to a specific sector or industry (e.g., tourism or automotive industry) or to a specific locality (e.g., municipalities or islands). Many authors have highlighted the importance of local sustainability that is linked to actual practices rather than a set of principles or broad agendas (Waas et al., 2011). Thus, in the past decades, various "local", "community", and "territorial" sustainability initiatives have emerged (Nadaï, 2019). These initiatives vary from Smart Cities and Convention of Mayors (EU) (Bulkeley et al., 2012) to more local initiatives such as housing cooperatives (Tummers, 2016), the movement of transitional cities (Rakodi, 2003), and the recent local experiences to implant the "doughnut economics" (Raworth, 2017).

Apart from their input on capacity building and their influence in established policy frameworks, these initiatives also envision new ways of social organization around "energy commons"(Moss et al., 2015). In some countries, like in the UK, France, Germany, and recently also in Spain, the relevant legislation has been modified to facilitate local energy initiatives (del Rio, 2021; Inês et al., 2020) while in others like Greece, the policy barriers are still significant (see Appendix C). Local energy has been proposed as a new policy tool that can increase the acceptance of RE projects and push for new societal arrangements and democratic ownership of energy. Local energy projects can also be catalysts of social innovation (SI) and local sustainable development (del Río & Burguillo, 2008)

1.1.1 What are the Local Energy Initiatives?

Despite the increased interest in local and community energy, there is still not accepted definition for these concepts. Local energy projects can be limited by "a geographical location" or they can refer to the quality of relationships within a community of interest which is often referred to as "sense of community" (Walker & Devine-Wright, 2008). This latest is the most common and well-studied type as it includes cooperatives and community-owned projects. Other studies, however, use the term "community" to refer to neighborhoods or municipalities. Terms like "local energy", "local ownership", and "citizen initiatives" are often used to describe the same social phenomenon, creating vast ambiguity (Schreuer & Weismeier-Sammer, 2010). Some argue that this allows for further flexibility and experimentation in the modes of development with fewer restrictions (Walker & Devine-Wright, 2008) and therefore more divergent practices adopted in local contexts (Kunze & Becker, 2015). Others claim that the lack of a concrete definition complicates any effort of categorization, can lead to oversimplifications, and can obscure the roles and agendas of various actors (van Veelen, 2017). To avoid misconceptions, in the present dissertation, I follow the distinction of Devine-Wright (2019), who uses the term "local energy" (LE) to describe the new social arrangements of mixed business models in which various private and public actors participate. For the community energy (CE) initiatives, I follow the definition of Seyfang et al. (2014) adapted by Walker & Devine-Wright (2008), according to which community energy refers "*to those projects where communities (of place or interest) exhibit a high degree of ownership and control, as well as benefiting collectively from the outcomes*."

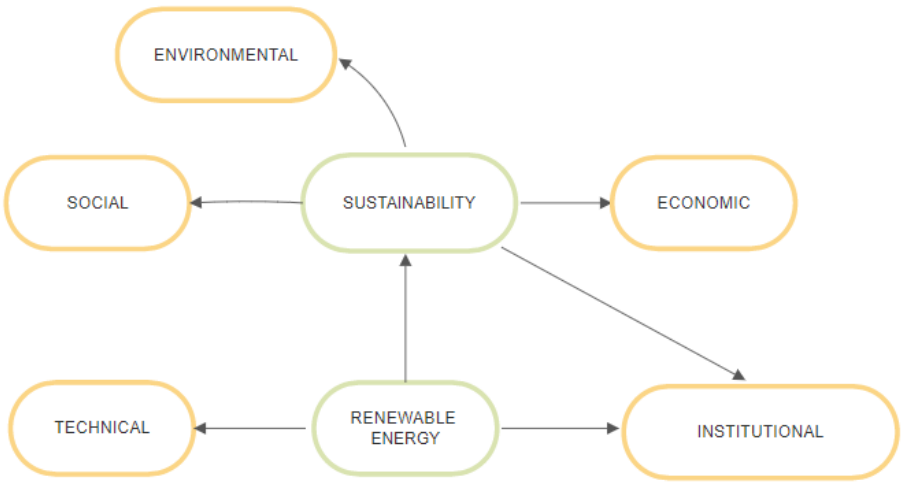
Academic interest in community and local energy has been sparked in the past decade with various discussions around the barriers and motivation for participation in RE projects, the potential of these initiatives to contribute to bigger system change, and their social dimension, especially through the concepts of justice and democracy. Local energy projects and place-based approaches have been associated with higher levels of acceptance and participation from the local population. In fact, research in Scotland found that community projects face less opposition than commercial ones (Haggett et al., 2014). Similarly, other research in the UK also concluded that community involvement in the project reduces the local opposition (Databuild Research & Solutions Ltd, 2013). Other benefits include increased income opportunities, environmental awareness, increased social cohesion, and feelings of autonomy and empowerment of the local communities. Local energy has also been seen as way to raise environmental awareness and promote sustainable behaviors and environmental citizenship (Walker et al., 2007). Participation in local energy projects can be a lesson for other collaborative activities and can improve and enhance common resource managements through the creation of emotional engagement with renewable energies (Rogers et al., 2012p. 243).

Many of these benefits are still discussed at a theoretical level as data is still scarce and many outcomes are difficult to measure. Most of the available literature focuses on one or two topics and includes the opinions of a small number of stakeholders, which are often external actors (managers, engineers, etc.). An overview of the available studies on the impacts of RE projects on communities and the use of the relevant methodology is presented in Appendix A. Nonetheless, there is a new critical stream of literature that argues that simply referring to decentralized, local, or community energy does not imply justice and fairness. For instance, it's often a small part of the community that initiates and benefits from the projects, and those people often belong to the most privileged groups. Other issues include "free-riding" behaviors and

"symbolic participation" in meetings that are not translated into actual decision-making power (Callaghan & Williams, 2014; Kalkbrenner & Roosen, 2016; Watts, 2019). Even when participation is meaningful, it is not always a positive experience for all; marginalized people, in many cases, remain excluded and unseen in the process (Sovacool et al., 2016).

At this point it is worth mentioning that very often when referring to the "community", there is an underlying assumption that communities are homogenous with one common moral and ethical orientation and one idea on "what is good for the community." However, communities are arenas of contestation with various actors with different values and competing interests. For instance, in her study of three community energy projects in Scotland, Pohlmann, (2018) observed that communities consist of different values, ideas, and knowledge that influence the projects. According to Watts (2019, p175): "*There is never a community out there with a common boundary and agreed vision. Communities are never whole and finished but require never-ending care to draw people together who have hifting interests and allegiances*." For this reason, in the present thesis, I use the term "community" with caution, and I aim to open-up a space for those who feel excluded and not heard.

Figure 1 shows the opportunities of renewable energy sources towards sustainable development (after Hui, 1997).



1.1.2 Co-production of Knowledge in Sustainability

Science and technology cannot be separated from the socio-political sphere in which they operate. The recognition of this interrelation is the central idea in the co-production of knowledge. One of the first appearances of the term is in the work of Elinor and Vincent Ostrom in 1970 who refer to citizens as co-producers of public services arguing that these public services are not just provided by governments to society, but also influenced and co-produced by society. Since then, the idea of knowledge co-production has gained a lot of attention in sustainability research (Norström et al., 2020).

The present thesis is driven by the idea of the co-production of knowledge in science. Thus, I aim to challenge the normative claim that technology and science are "value free" and to argue for further involvement of the social sciences that take into consideration the values and norms of various social groups in knowledge creation. Co-production of knowledge recognizes multiple ways of knowing and doing (Schneider et al., 2019). Thus, various scholars have argued that there is often not a "single truth". In this line, I challenge the idea of a "successful renewable energy project" and argue for a pluralistic co-produced assessment that includes different points of view from different stakeholders (researchers, government, business, civil society, local communities) and catalyzes the creation of new knowledge. The idea of success per se can take many different forms according to different actors and is often defined based on initial expectations. Especially when project success is measured with sustainability indicators the complexity increases. Even if sustainability is the desired goal, its' interpretation, and the means to achieve it can be called into question. According to Ratner, (2004) sustainability is a "dialogue of values", and this heterogeneity poses a challenge to the interpretation of different perspectives.

Following this line, I argue that post-implementation assessments of energy projects, like the ones presented in this thesis, should be approached through the lenses of post-normal science due to their complexity. Energy projects can have intended and non-intended consequences and affect differently actors with different values, expectations, levels of expertise, and knowledge. As also discussed in the previous section, involving stakeholders in knowledge production is quite challenging, and even within the academic community, there is no agreement on what this participation should entail (Rowe & Frewer, 2004; Silver & Campbell, 2005). Participation can be interpreted as simple communication with no real impact on the decision-making, or as voting with a more direct impact on the outcome. Although capturing all these different aspects is challenging, the present thesis attempts to capture and analyze some of these questions.

1.2 ISLANDS

Local jurisdictions like cities, regions, and local areas have become vectors of sustainability. These regions are not just small administrative units anymore; in the era of the new localized economies, they are seen as nodes of development(Laurent, 2018). This has also sparked an interest in local policies and approaches. A recent EU study (for the 2014-2020 period) [1] revealed that 15 Member States (Austria, Bulgaria, Croatia, Cyprus, Denmark, Finland, France, Greece, Italy, Malta, Portugal, Slovenia, Spain, Sweden, and the United Kingdom) face significant challenges as a result of their territories' insular, mountainous, and/or sparsely populated areas. These areas face some

unique challenges, including lower incomes, higher unemployment, an aging population, and/or out-migration of younger age groups, and lower education. Since the 90s, the "urbanization" trend attracted the population and the economic activity out of the remote rural areas into urban areas. Agriculture and farming, although still predominant in some rural areas, are less developed on islands, which due to their small size, often specialize in one or just a few fields – such as tourism. From the environmental point of view, the island ecosystems are fragile and highly vulnerable to climate change. Especially in the Mediterranean, islands are expected to face severe problems such as drought, rising sea levels, and land erosion (Tuel & Eltahir, 2020). Some islands also face severe environmental impacts from tourism (Gao & Zhang, 2021).

The present thesis approaches islands through three different but interconnected angles, inherent to most island studies: natural environment, imaginaries, and differences and commonalities between different island cultures. The word 'island´ comes from the Latin "terra en sala", which in English became "isolated land" and later "island". Islands can be small or big, close to the mainland or remote, inhabited or virgin, in clusters or alone, permanent or temporal (e.g., tidal islands), real or mythical. Islands have always fascinated humanity and have been at the center of the imagination as utopias and paradises or as dystopias and purgatories. Folklore tales refer to magical islands that you can never escape, like Antilles or islands that you can never find, like Atlantis. In some cultures, islands are birthplaces of gods, like the Island of Flame in the Egyptian culture or Aeaea, the home of Circe. They can also be places where the dead rest, like the imaginary island of Baralku for the indigenous Australians Yolngu or the crossovers to another world, like Avalon Island. In literature, islands are also seen as microcosms where various political and social experimentations can take place, with more characteristic examples being 'The Island' (1962) by Aldous Huxley and Stanisław Lem's 'Solaris' (1961).

More recently, islands have been depicted as technology hubs where new technologies are tested. In "Island 73:1by J. Robinson, human experimentation takes place on a remote Pacific Island during World War II. In his book "Island", Huxley envisions a solar paradise where people live in balance with nature using the latest technological advantages. The underlining idea of islands as technological testbeds due to their controllable environment and well-defined barriers that resemble laboratory conditions does not belong only to the sphere of fantasy (Skjølsvold et al., 2020). According to (Baldacchino, (2013 p. 57) , islands are "*premier sites, and models, for carefully designed and manicured spaces*." Nowadays, many islands around the world lead technological innovation, especially around renewable energy.

1.3 RENEWABLE ENERGY ON SMALL ISLANDS

Island territories that are not connected to the mainland grid have some peculiarities derived from their high level of isolation, like the higher cost of energy, grid instability, and high energy dependence (Erdinc et al., 2015). Most insular power systems rely mostly on imported fossil fuels with a cost 3-4 times more compared to the mainland. This makes the already vulnerable island economies susceptible to oil price fluctuations, leading to energy insecurity (Atteridge & Savvidou, 2019; Kougias et al., 2019). For instance, 20% of the annual import costs of Small Island Developing States (SIDS) is due to fuel imports (Khoodaruth et al., 2017). In Greece, the period 2014-2017 the electricity price on the non-interconnected islands was on average 3.6 times higher than the

average price in the mainland (Katsoulakos, 2019). Furthermore, insular grids also face structural instabilities, leading to voltage and frequency drops that affect the whole system. Notton (2015) reports that in Corsica (before the partial interconnection with Sardinia), the system failed more than 200 times per year. Reliable and affordable energy is an element of social and economic development and can improve living conditions on islands by reducing poverty and improving health and education conditions.

While challenges derive from insular environments, so do the solutions. And IT is this character of islands that creates what Kallis et al. (2021, p1) call "a potential sensitivity of islands to energy projects." Small-scale decentralized hybrid energy systems, which take advantage of renewable energy sources locally available in remote areas, are promising alternatives to costly and polluting fuels. A decentralized energy system is based on distributed generation closer to the point of consumption. A hybrid system normally consists of a micro-grid system that operates independently from the main grid and provides energy produced from diverse local sources, often renewable(Ackermann et al., 2001). The systems are complemented with energy storage solutions like batteries, hydrogen storage, and pumping and coupled with technologies like demand-side control and management. Wind and solar are the most widely adopted RE technologies on islands, while only a few islands invest in biomass, geothermal, and ocean energy for electricity generation (Kuang et al., 2016).

RE projects have been associated with a series of benefits for islands that go beyond mere electricity production and include socio-economic benefits like new opportunities for tourism and jobs (Jaramillo-Nieves & del Río, 2010). Thus, despite the great benefits that islands can perceive from local RE projects, these can also have negative impacts on the environment and on the communities by affecting local businesses and cultures and alternating the character of the islands (Kallis et al., 2021). This depends on various parameters like the technology type, the size of the project, the location, the organization and ownership, and the alignment of the project with the values and expectations of the local insular population. These impacts have been neglected in the relevant literature, as they are complex and difficult to measure. Different stakeholders - local people, governments, and technicians- often represent different values and opinions around renewable energy.

Another key element in the discussion around pilot and demonstration energy projects on islands is the potential to scale-up or duplicate these projects in other areas. Some argue that islands are mostly used as "truth spots," meaning that they can be used to give credibility to new technological solutions and substantiate claims around sustainable futures and green technologies (Hoffman, 2020).

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2. OBJECTIVES OF THE THESIS

The objectives of the thesis are summarized below:

- To identify barriers in the clean energy transition path for Islands.
- To suggest a new innovative framework for the evaluation of renewable energy projects post-implementation.
- To shed light on the progress of the projects towards their sustainability targets focusing on their strengths and problems.
- To highlight that various stakeholders can have different perceptions around the "success" of a renewable energy project.
- To discuss different perspectives among various actors and to bridge the differences in perspectives.
- To envision the future of these initiatives and analyze their potential for scaling-up.
- To discuss their potential as vehicles for a radical socio-economic transformation.
- To propose co-production of knowledge between different actors in the assessment of renewable energy projects.

3. METHODOLOGICAL APPROACH

For the present thesis, I collected data from multiple levels of information, namely individual, organizational, and institutional. Data on individual perceptions were collected through questionnaires, while semi-structured interviews with local operators, politicians, managers, and technicians were conducted to collect data at the organizational level (Appendix B).

The study used three combined approaches, aiming to provide rigorous results (Sovacool et al., 2018):

Case-study approach: This approach uses in-depth analysis of one or more subjects of study and can be both qualitative and quantitative. According to Yin (2014, p23), a case study is "*an investigation of a contemporary phenomenon within its real-life context when the boundaries between phenomenon and context are not clearly evident*". As del Río & Burguillo, (2008, p1317) put it: "*Case studies allow the identification of economic and social relationships which are hidden in quantitative studies*." In this dissertation, the use of case studies allowed me to capture the detailed social, environmental, and economic effects that would be otherwise difficult to capture. In Table 1, I present the criteria used to choose the case studies for this thesis.

Islands
Located in Southern European countries with similar regulation
Aim to become 100% electricity self-sufficient
Are not connected to the mainland grid
Have innovative RE installations
Include the local population
Eco-villages and religious, ideological, and spiritual communities were excluded
Energy cooperatives were excluded
Projects that are pre-mature or have vague ambitions were excluded

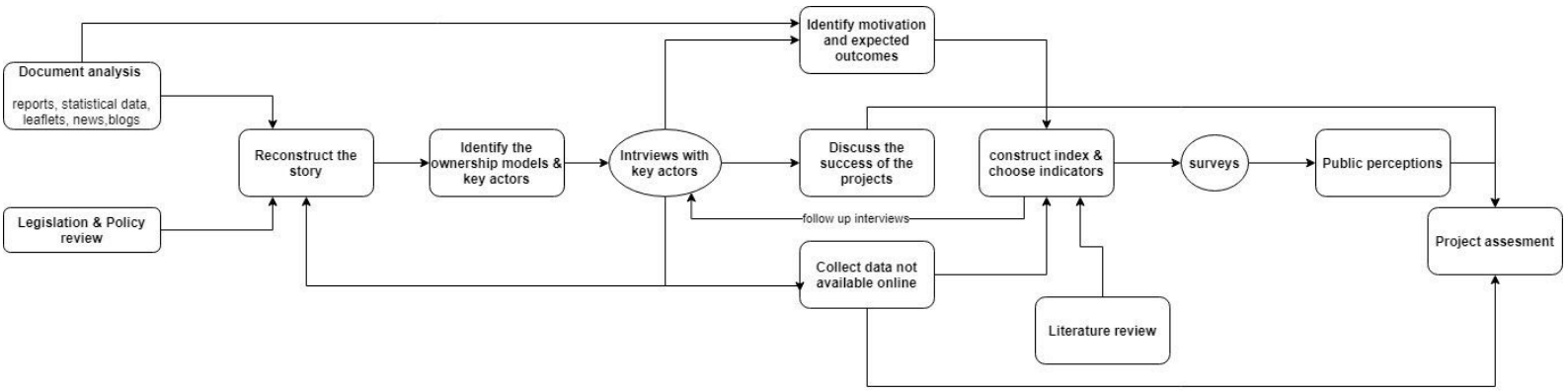
Table 1. Criteria for choosing the case studies

Surveys: are a key tool of empirical research in the field of social science-based energy research. However, too often they are carried out with insufficient design and unclear planning. Although the the survey design is decided in the initial stages of the project, it can also be modified in later stages. The design of the survey is based on the methodology proposed by Oppenheim, (1992, p. 7) and analyzed in Section 3.2.

Qualitative research: is based on data about the opinions, attitudes, perceptions, and understandings of people and groups in different contexts. The focus is on understanding a perspective in depth. For this reason, I conducted interviews with various stakeholders as an explorative tool. Thus, the present thesis follows a mixed-methods approach (Graph 1) to answer multiple research questions from different points of view as this is defined by Johnson & Onwuegbuzie (2007, p.123):

"Mixed methods research is the type of research in which a researcher or team of researchers combines elements of qualitative and quantitative research approaches (e. g., use of qualitative and quantitative viewpoints, data collection, analysis, inference techniques) for the broad purposes of breadth and depth of understanding and corroboration."

Graph 1. Overview of the mixed methods approach of the thesis



3.1 Survey Design

To design the survey questionnaire, I followed the process proposed by Oppenheim (1992 p7). The main steps and their relevance in the design of the questionnaire are the following:

1) Define the aim of the questionnaire: The aim is to evaluate the sustainability outcomes of the project based on people's perceptions.
2) Start with a literature review and document review (Appendix A)
3) Conduct a preliminary conceptualization of the study, followed by interviews with involved partners (discussed in Chapters 1 and 2)
4) Draw the representative sample (discussed in Chapters 3 and 4)
5) Design of the questionnaire

- The general structure of the questionnaire will be identical in both cases.
- I developed the applied questionnaire in an iterative approach to assure its appropriateness and applicability (Preston, 2009).
- The questionnaire is based on a list of every variable to be measured and the dimension it is related to (Appendix B).
- The questions were grouped under the sustainability dimensions using funneling (from more general to more concrete).
- The questionnaires were in the native language of the respondents (Spanish and Greek). No jargon, abbreviations, or technical terms were used.

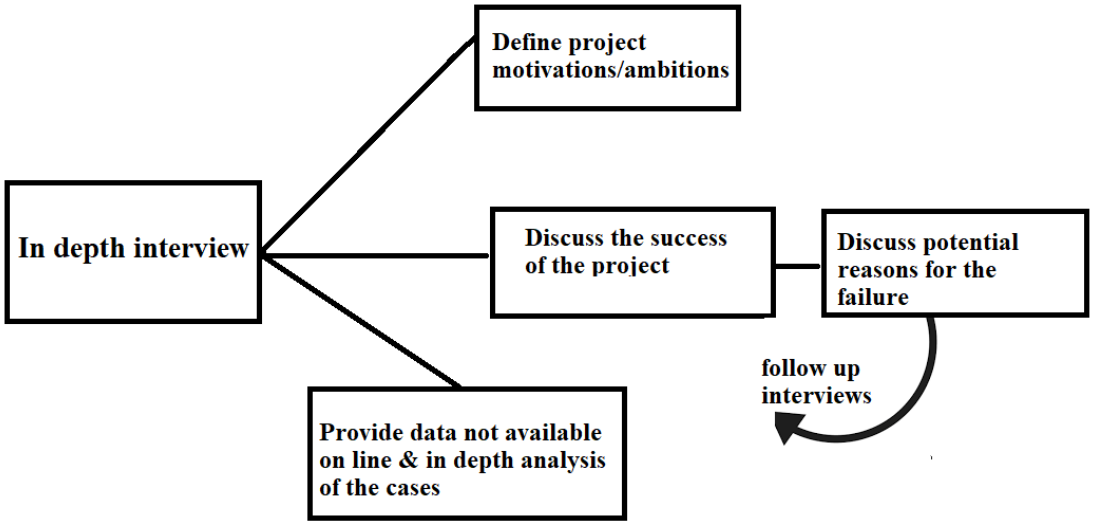
- The type of questions included mostly closed questions measured on a Likert Scale of 1-5 with the higher score meaning positive effect on sustainability, and the lowest negative. These questions are easier to answer, easier to quantify and quicker case of a big sample.
- Confidentiality & anonymity were ensured.
- The appearance of the questionnaire was carefully designed, and the time to respond was measured to be around 10 minutes.
- The present survey is falling under the category of attitude statements, as it examines people's perceptions regarding the success of the project compared to the initial expectations. Each question deals with no more than one issue.

6) Pilot work. The pilot work can suggest significant changes (from wording to the paper use). The pilot study was conducted in Tilos island in June 2019.
7) The questionnaire was reviewed and updated based on the pilot work.
8) The actual data collection using the questionnaires was conducted between Nov 2020-March 2021 for both cases. As a result of the COVID-19 restrictions, the questionnaires were disseminated mostly online, using the platform Survey Anyplace.
9) The processing of the data included coding the responses, cleaning the data for analysis, and enter them into excel.
10) Data Analysis was done using Python

The questionnaires were designed and disseminated in line with the ethical guidelines of the University of Barcelona. The participants were ensured anonymity and were allowed to stop the process at any time (Consent form presented in the Supplementing Material)

3.2 Interview Methodology

The interview methodology is based on exploratory interviews. I chose this approach because the role of these interviews is heuristic: to help the researcher develop the tools and hypotheses rather than to get facts (Kothari, 2004). In many cases, respondents were used also as a data source, for data not available online. The interviews were recorded on tape and analyzed later. These interviews add a new dimension to the analysis by providing an additional point of view in the results. **Graph 2** below depicts how the depth interviews are used in the present thesis:



Graph 2. Overview of the interview process applied on this thesis

I followed the ethical regulations for research, as these are defined by the University of Barcelona, by explaining the aims of the project to the interviewees and asking them for their consent to participate. The interviewees were given the option to end the interview at any time and had the option not to answer a question if they felt so. It was ensured that participants would remain anonymous and only participant scientists would have access to the transcripts of the interviews. (A consent form is included in the supplemental material.)

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4. PRESENTATION OF THE CASE STUDIES

4.1 Canary Islands-El Hierro

The non-peninsular systems in Spain include Mallorca–Menorca, Ibiza–Formentera, and the Canary Islands. El Hierro is located in the Atlantic Ocean and is the smallest (278 km2) and most south-westerly of the Canary Islands, with a registered population of approximately 10.000 people. Prior to the implementation of a renewable energy system, the island was dependent on nine diesel units located in the Llanos Blancos power station that produced 45 GWh/year via nine diesel units (13.36 MW total) to cover the local demand. In 2014, the hydro plant started its operation. The project, situated in Gorona del Viento, combines a wind farm and a pumped-storage hydroelectric power station. It consists of an upper deposit and a lower deposit of a maximum capacity. The wind farm consists of five aero generators each with 2.3 MW of power (total 11.5 MW) and a pumping plant of two 1500 kW pump sets and six 500 kW pump sets with a total power of 6 MW. During windy days, the extra energy excess is used to store water from the lower deposit in the upper deposit as a storage solution (Frydrychowicz-Jastrzębska, 2018). However, the project is still underperforming, due to various technical difficulties, like the small capacity of the upper reservoir and the lack of grid stability. A recent study concluded that Gorona del Viento has increased the annual cost by 16.8 M€ in 2016 and by 12 M € in 2017 compared to conventional production until 2014 (Garcia Latorrea & de la Nuez 2019).

4.2 Dodekanese islands- Tilos

The Greek islands host 15% of the Greek population and are responsible for 14% of the total national annual electricity consumption. The Greek electricity network can be divided into two parts: the national power grid found on the mainland and a number of smaller local grids on the islands (Hatziargyriou et al., 2017; Katsoulakos, 2019). The island of Tilos is located in the South-East Aegean, has a total area of 61.49 km2, and a population of 780 people. The island belongs to the Dodekanese area, and it is one of the islands of the "Barren Line", meaning that it has limited connection with the mainland. Until now, the electricity demand on the island of Tilos was covered by the oil station of the nearby island of Kos. However, the connection was rather unstable, with many regular and long-term power blackouts. In order to deal with this issue, in 2015 it was decided to develop and operate an innovative renewable energy project. The system is a hybrid photovoltaic/wind/storage energy system that consists of NaNiCl2 batteries with a capacity of 2MWh, an 800kW wind turbine, 592 PV panels with a total capacity of 160 kW, distributed heat storage that controls the domestic electrical water heaters, and smart meters that monitor energy loads (Notton et al. 2017).

4.3 Policy support and barriers for renewable energy development on the selected case-studies[1]

4.3.1 International

The strategic role of the European islands in the energy transition has been acknowledged in 1992 in the Maastricht Treaty and later, in 1997, in the Amsterdam Treaty. Following the Amsterdam treaty, the European Commission composed the "Resolution on the Problems of Island Regions in the European Union" (Resolution on the Special Situation of Islands 2015/3014 (RSP), 2016). As a result, the EU allowed member states to adopt specific measures in these "small, isolated network territories", acknowledging the importance of these areas in order to tackle climate change. EU policies have tried to reduce the main obstacles regarding renewable energy, especially the high initial investment and the high risk involved, to promote renewable energy communities and autonomous renewable energy systems on islands. The Smart Islands project (Partnership 2019), inspired by the European Commission's Smart Cities and Communities, started in 2015, aiming to identify best practices among island communities and to propose similar or adapted solutions for other island communities in the EU. The most important step in the EU legislation regarding renewable energy on islands is the Clean Energy for European Islands Initiative, which prioritized the clean energy transition on the EU's 2700 islands and highlighted the need for new, modern, and innovative energy systems (EU Commission 2017). Following the declaration, the Clean Energy for EU Islands Secretariat was established, as well as the design of a platform and a European Island Facility under the Horizon 2020 project (for more information, see **Chapter 5**). Additionally, the Azores, the Canary Islands, and the Greek Non-interconnected islands (NIIs) have all been derogated from certain provisions of Directive 2009/72/EC (EU Commission 2014). According to this derogation, these territories are not obligated to separate production, network management, and transport activities from the supply.

4.3.2 National Policies

Greece has acknowledged that islands are a key element in the energy transition and national economic growth. For this reason, the 10-year Development Plan of Greece includes special sections dealing with the problems on the islands (Ministry of the Environment, 2010). The proposed solutions are the interconnection of the islands and, when this is not feasible due to financial and technical restrictions, the development of self-sufficient renewable energy systems. According to the Greek Regulatory Authority for Energy (RAE) the islands that are not powered by the mainland power grid, termed as the Non-Interconnected Islands (NIIs), have an electricity market that consists of thirty-two autonomous systems and of island complexes (Electrical System Operation Code for Non-Interconnected Islands (NII Code), 2014). In Spain, Article 10 of Law 24/2013 (Gobierno de España, 2013) also defines special regulations for the "Insular and Extra-peninsular

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Electricity Systems", while the remuneration scheme was updated with the though Royal Decree 413/2014 (Gobierno de España, 2014).

4.3.3 Unified Price Electricity Systems

The aforementioned insular systems, due to the high levels of isolation, also have higher investment and operating costs, which normally should have been reflected in the electricity prices the consumers pay monthly. In Spain, Law 54/1997 (Ley 54/1997, de 27 de Noviembre, Del Sector Eléctrico, 1997) introduced a system of unified prices in the whole Spanish territory, aiming to reduce differences in prices between the islands and the mainland that can lead to discrimination. More recently, Article 10 of Law 24/2013 (Electricity Sector Regulation (Electricity Law 24/2013), 2013) provides the basis for the regulation of the electricity market on non-interconnected islands, which is different from the mainland. The electricity price depends on the moving average of the peninsular prices of the 12 months prior to delivery of the supply, corrected by a coefficient. This new reference index considers the variation of the generation costs of each hour in each independent insular system. Similarly, in Greece, due to the system of unified prices, the population on the mainland pays a special tariff in order to cover the elevated price of electricity on the islands. This amount is an annual estimation that is being paid to the Hellenic Electricity Market Operator (LAGIE). At the end of every year, the special accounts of LAGIE and the Hellenic Electricity Distribution Network Operator (HEDNO) are balanced. The unified price system poses limited direct incentives for the improvement of electricity production and the decrease of energy demand. Thus, the main incentives are in the form of subsidies and are not reflected directly on the bills of the consumers. The unified price systems, although aiming to ensure fair prices and to avoid discrimination between the inhabitants of the mainland and the islands, do not allow for a pricing structure that reflects the cost of energy production and thus, promotes renewable energy (Owens, 2009).

4.3.4 Remuneration scheme

In Greece, the Feed-in-Tariff (FiT) scheme that was in place with small alterations since 1994 was replaced with a Feed-in-Premium (FiP) scheme in 2014, which adds a premium to the price received by renewable generators in the wholesale electricity market. The FiP contracts of renewable energy projects participate in the wholesale electricity market (either directly or through aggregators) and enter with zero-price energy offers on an hourly basis. According to the Code for NII, projects operating after 2016 will continue to benefit from a fixed price through Power Purchase Agreements (PPAs), under the condition that the islands are not interconnected to the mainland grid or do not have a daily electricity market (Electrical System Operation Code for Non-Interconnected Islands (NII Code), 2014). The remuneration is calculated as the difference between the reference price and the reference market price. The reference price per category of Renewable Energy Source (RES) is published or auctioned and reflects the overall average remuneration which is required by RES generators. The difference between the electricity price in the wholesale market and the RES tariff is mainly through the Special Fee for the Reduction of

Greenhouse Gas Emissions – ETMEAR, charged to all final electrical energy consumers (Republic 2016). Regarding renewable energy from hybrid stations, like the one in Tilos, there is still not a clear remuneration mechanism, as a special tariff only of hybrid stations is currently under consideration (for more info on the Greek regulation, see also Appendix C)

In Spain, the National Decree RD 738/2015 introduced a new remuneration scheme for the NII (Ministerio de Industria Energia y Tourismo 2015). This remuneration is an addition to the remuneration received from the sale of the energy valued at the price of the market and aims to cover the difference between the extra costs and the income. For the calculation of this compensation, the initial investment costs, the income from the sale of energy at the market price, and the operating costs for a company well managed and efficient are considered. Exceptionally, the specific remuneration scheme may include an additional incentive for investment if the installation contributes to a significant reduction in costs in non-peninsular territory systems. This incentive will be established based on the reduction of the costs generated and not so much on the characteristics of the type of installation (Royal Decree 413/2014 on Electricity Generation by Means of Renewable, Cogeneration and Waste Facilities, 2014). This extra cost resulting from the incentives is covered 50% through a specific item in the General State Budget; while the remaining 50% is paid by all consumers through the fees charged for access to the electrical system. In January 2016, the Spanish Electricity sector launched the model of auctions for energy renewable projects to comply with the objectives of renewable energy at the minimum possible cost (del Rio, 2021).

4.3.5. Energy storage

Renewable energy is characterized by inherent volatility and randomness, while the island power grids should maintain the balance of supply and demand in a real-time mode. Energy storage techniques are effective approaches to cope with the stochastic and volatile behavior of renewable energy generation. With these techniques, redundant renewable energy can be transformed into mechanical, electromagnetic, and chemical energy in various energy storage systems (ESSs). The stored energy can then be released when real-time renewable energy generation is insufficient. An ESS can be stand-alone or part of a hybrid system. The analysis of Neves & Silva (2015) concluded that storage is a challenging but essential part of a hybrid system (Bayod-Rújula et al., 2017) also recognized the high potential of storage in off-grid islands. However, until the various barriers in storage technology are overcome, it will be difficult to achieve 100% self-sufficiency.

In Greece, the regulations regarding energy storage in non-interconnected islands are rather unclear. Before the implementation of the T.I.L.O.S project, there was no policy framework for battery storage, especially for cases in which the storage system would operate in both stand-alone and grid-connected systems. The laws 3851/2010 (Ministry of the Environment, 2010) and 4414/2016 (Hellenic Republic, 2016) have detailed provisions dealing with the operation of hybrid stations in the NIIs and within the interconnected system. Greece was the first European country to adopt specific regulations regarding the installation of hybrid systems (Krajačić et al., 2011). According to this framework, there are two different tariffs, one for the electricity that is fed to the

grid and one for the electricity that comes from storage units. Additionally, there is a limited amount of energy from the grid that can be used for storing and can only be used when RES are not available.

Experiences from other technologies (e.g., wind and photovoltaic), and from other areas (e.g., incentives for storage in Hawaii) have shown that subsidies can decrease the investment risk and encourage the deployment of storage technologies. According to one study (Hoppmann et al., 2014), incentives for the promotion of storage systems, although not necessary, can be valid for a short term. In another case study on the island of Corvo, the authors concluded that for a battery capacity up to 40 kWh the proposed remuneration scheme is a fixed tariff of €53.8/kWh, multiplied by the battery capacity (Krajačić et al., 2011).

4.3.6 Interconnections

Diesel plants (like El Hierro) or an underwater cable connection (like Tilos) provide the backup system for the 100% RES electricity system. These backup systems can be found in other islands around the world that also aim to be self-sufficient, like Reunion Island, Samoa, Cook Islands, and Hawaii. Although many have suggested alternative solutions, like island hydrogen production (Vivas et al., 2018), natural gas (Raghoo et al., 2017), and biomass (Sakaguchi & Tabata, 2015) there seems to be an agreement that a reliable and non-intermittent back-up system needs to be in place at least in the medium term. This is because even if these islands can achieve 100% production from local RES, their total installed capacity should be approximately three times the maximum annual demand, given the current capacity reserve margin. In this line, it is acknowledged that interconnected systems hold some advantages against a standalone system, even in the case of renewable energies. For example, Alves et al. (2019) concluded that for the islands of Pico and Faial in the Azores, the interconnection with an underwater cable can increase RES penetration and decrease intermittency. Similarly, another research Lobato et al., (2017), highlighted that interconnection among the Canary Islands can lead to more efficient use of the thermal units. The better exploitation of the power generated by RES with the use of underwater cable interconnections has also been observed for the case of Malta-Sicily-Italy (Ippolito et al., 2018) and among the Greek islands (Georgiou et al., 2011). The underwater cable interconnection with other islands can be very helpful in cases of overcapacity as in the case of Tilos, which can avoid this overload by sending the excess energy to Kos. Without this interconnection and given the priority dispatch, the problem of overcapacity can be a burden for El Hierro. Thus, a potential interconnection with neighboring islands can allow for better utilization of local RES to be used up and at a lower cost. The introduction of a better selling price of energy from RES in the NII compared to the continental system can provide additional incentives for interconnections among the islands.

4.3.7 Electricity markets

Electricity suppliers of the island territories examined are monopolies and controlled by national companies. This is often the case for small-scale electricity markets around the world. There are

many options to include competition on insular electricity markets like bilateral contracts which establish a price and quantity negotiated between the generation and demand-side without the intervention of the operator, or wholesale markets (pools) which allow for trading between generators and suppliers in the electricity wholesale market (López-Lezama et al., 2011). According to an EU deliverable (Project 2012), the single buyer, and the bilateral contracts models are the most suitable. In the Canary Islands, Endesa is the local vertically integrated company responsible for the transmission, distribution, and supply of the electricity, manager of the system and generator of most of the electricity. Red Eléctrica Española (REE), as the system operator is responsible to ensure access to electricity to all the stakeholders. REE acts as a single buyer that buys the energy based on the minimum variable costs and then delivers it to the distribution network. In Greece, PPC is the grid operator of all the NIIs and the sole generator, distributor, and supplier on islands. Despite the market opening, there are still no liberalized electricity markets in small islands like Tilos. Apart from RE installations, PPC holds all the generation licenses at the Greek islands. In order to break these monopolies, the EU and as a result, the national governments call for a competitive free market. This allows little space for adaptation to the specific island characteristics, where market structure cannot follow the continental trends. Even in cases in which the markets are open to competition, they are not still operational due to various administrative barriers, like the delay of payments from the regulated price system in the cases of Greece and Spain.

A potential interconnection with neighboring islands can help overcome the limitations in small electricity markets. In Greece, HEDNO is responsible to operate a platform suitable for energy trading between the members of a community, facilitating a 'micro-market' for energy transactions. In Spain, the new law 738/2015 (Ministerio de Industria, Energíia y Tourismo, 2015) paves the way for the creation of a new virtual market and is expected to increase the security of the investors, as each year 50% of the electricity price in the NIIs will be known and based on the prices of the past year (Uche-Soria and Rodríguez-Monroy, 2018). According to Sumper (2019), a micro-market can develop stronger social relationships among the actors and thus, lower levels of competitiveness and self-interest. In the case of islands, not interconnected to the mainland but with interconnections among them, the prices will reflect the local demand and labor.

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5. THESIS OUTLINE

The present thesis is centered around islands and sustainable energy projects and is divided into three main sections and one concluding section. All sections are centered around the impacts of local insular RE projects, whether these are political, socio-economic, transformative, or ethical. These impacts are analyzed from various points of view, from managers and politicians to local communities or through the eyes of the researcher. What binds these sections together is the idea that local energy projects are not always just and beneficial for the local community (see also: van der Waal et al., 2018) and that, despite their untapped potential, there are still numerous challenges to overcome. Each section of the thesis employs a different methodology; Section A uses a qualitative approach based on interviews; Section B is based on quantitative data obtained from online questionnaires, while the concluding section combines a mixed-methods approach. Overall, the dissertation offers insights into these local RE projects and analyzes their impact on local sustainability as well as their potential impact on the energy transition and a more radical socio-economic transformation.

SECTION A: ISLANDS AS SOCIO-TECHNICAL IMAGINARIES

In the first part of the thesis, I discuss how and if RE projects can scale up and lead a broader socio-ecological transformation. In this section, the research is mostly organized around several interviews conducted with various actors involved in the projects. In the first paper, titled "Local Energy Projects on Islands: Assessing the Creation and Upscaling of Social Niches" (Sustainability, 2020), I discuss the transition potential of these projects, using the Strategic Niche Management Theory. In this paper, the focus is on the socio-technical potential of these "niches of innovation" to scale up. In the second paper of this section, "From local island energy to degrowth? Exploring democracy, self-sufficiency, and renewable energy production in Greece and Spain" (Energy Research and Social Science, 2021) I investigate the promise of the Tilos and El Hierro initiatives to push for a radical social transformation and an alternative way of living. I do so by examining to what extent these projects might align with the degrowth idea and principles.

SECTION B: ASSESSING THE IMPACT OF LOCAL RE PROJECTS ON THE LOCAL POPULATION

In this second part of the dissertation, I discuss the impact of local RE projects on the local island communities. In the relevant publication "*Sustainability assessment of local renewable energy projects: A comprehensive framework and an empirical analysis on two islands Renewable Energy*" (Sustainable Development, 2022) people in El Hierro and Tilos had the opportunity to evaluate the renewable energy projects focusing on the social, economic, and environmental impact they had in their lives. The results were analyzed using an innovative framework that compares the outcomes of the project with the initial goals around the five pillars of sustainability: economic, social, environmental, institutional, and technical (Ilskog, 2008).

In the second article, "The need for gender-based approach in the assessment of local energy projects" (Energy for Sustainable Development, 2022), I focused more on gendered aspects and analyzed the different expectations women and men have around RE projects and to what extent they felt these were achieved. In this way, I dived into the societal power dynamics and hierarchies of the societies that can be formed or perpetuated through a new technological project. These two papers focus on concrete case studies, namely the island of El Hierro in Spain and Tilos in Greece. Both islands are pioneers in the energy transition in their respective countries and aim to become 100% electricity self-sufficient. The aim of this chapter is to shed light on the real benefits of local energy projects and to discuss why it is important to include communities in the post-implementation assessment.

SECTION C: CLEAN ENERGY FOR EU ISLANDS AND INSULAR DEGROWTH: RETHINKING DEVELOPMENT AND SUSTAINABILITY ON ISLANDS

This last part zooms out of the two case studies and looks at the bigger picture of insular development and energy transitions. Drawing from the previous results that underlined the potential and barriers of the islands in the energy transition, in this section I discuss the idea of an "Insular Degrowth" for small EU islands like Tilos and El Hierro, and compare this idea with the relevant EU policies, paving the way for a dialogue between the two ideologies. The concept of insular degrowth is novel in the literature, and it arose from three years of research that revealed the unique characteristics of islands, their central role in the energy transition, and the potential negative consequences of their transformation into energy hubs. The idea of Insular Degrowth is a central policy recommendation of the present dissertation, and as it's discussed in this last section, it can be aligned with the relevant EU policies, like the Clean Energy for EU Islands Package.

6. Published Chapters

6.1 Section A- **Chapter 1**

sustainability

MDPI

Article

Local Energy Projects on Islands: Assessing the Creation and Upscaling of Social Niches

Marula Tsagkari

Department of Economics, University of Barcelona, Diagonal 696, 08034 Barcelona, Spain; marula.tsagkari@ub.edu

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Abstract: Islands have great potential for renewable energy, and several pilot and experimental projects have been set up on islands globally, aiming to promote clean energy and self-sufficiency. Many of these decentralized energy initiatives oppose the established regimes of centralized electricity generation and introduce new forms of organization and management. Thus, they can be considered social niches. The aim of the present study is to explore the transition potential of renewable energy projects on three islands located in southern Europe. The analysis mobilizes literature on the strategic niche management theory (SNM) with a focus on the role of the various actors and the different management models. Through a systematic analysis of policy documents and the literature, enriched by interviews, the paper identifies different types of renewable energy projects and discusses the potential for scale up. The paper concludes that these projects are currently in the inter-local phase, and decentralization is not only an important innovation for energy production, but also a new form of energy management often dominated by different actors than the established electricity system.

Keywords: local energy; strategic niche management; islands; energy transitions; niches

1. Introduction

New forms of sustainable energy production are paving the way for a new energy regime away from the traditional centralized fossil fuel system. This new generation of decentralized hybrid power systems can be connected to the main grid or operate in isolation and consist of micro-grids, energy produced from local renewable sources, and storage solutions. These systems are considered a viable alternative for rural areas and small islands, as they can reduce the cost of imported fuel and increase stability and autonomy, while at the same time they offer various economic and social benefits.

Due to their competitive advantage and the clearly defined boundaries, islands are ideal isolated laboratories for sustainability, circular economy, and renewable energy. The high cost of imported oil makes renewable energy sources economically viable in small insular power systems. Additionally, the isolation and need for self-reliance can trigger stronger community involvement, which can create a favorable environment for socio-technical innovations. The European Commission's White Paper on Renewable Energy Sources, the United Nations Conference on Islands and Small Island States, and the European Island Agenda recognize the central role islands can play in the energy transition.

This idea of islands as laboratories for renewable energy technologies has been tested in a number of case study islands in Europe, such as Samsø in Denmark [1], Greek islands [2,3], the Canary islands [4,5], and Faroe islands [6]. Beyond Europe, energy transition and self-sufficiency are now a priority for many islands worldwide, such as Cape Verde [7,8], Reunion island [9], Yong Shu Island in the South China Sea [10], and in the Pacific island countries [11]. Thus, islands with their unique environments are hubs, not only for new technologies, but also for new forms of social organization and governance.

Due to the lack of available funds, the high levels of isolation, and the limited skills and knowledge at a local level, in many of these areas a new business model that includes various actors such as municipalities, universities, private companies, and Non-Governmental Organizations (NGOs) has emerged. This new business model is a response to the challenges energy communities face globally and to a new regulatory environment that undermines their entity (e.g., [12,13]).

In this context, the present article discusses the emergence and development of decentralized renewable energy systems with a hybrid ownership model, as social niches which can push not only for a simple shift in energy generation technology, from fossil to renewable energy sources, but for a social shift in the energy management and consumption system. In the established regulatory and market frameworks in Greece, Spain, and Portugal, and under the interesting opportunities presented by the EU Clean Energy Package and the relevant provisions on citizen participation and energy communities of the Renewable Energy Directive (EU) 2018/2001, various local and regional initiatives are being developed, implementing new structures and challenging the old regimes [14]. In this line, I assume that these decentralized energy initiatives (local or regional) oppose the established regimes of centralized electricity generation, as it is also discussed by other scholars [15]. I take the hypothesis one step further and argue that these niches are currently in the inter-local phase in which projects exchange knowledge and experiences. Applying the Strategic Niche Management (SNM) theory [16], this comparative case study analysis attempts to answer the following research question: *how might some heterogeneous local projects with hybrid ownership contribute to niche development and a deeper change in the overall system of electricity generation, and what is the role of the various actors in the process?*

The rest of the paper proceeds as follows: in the next section Ibriefly analyze the theoretical context, addressing the Strategic Niche Management Theory (SNM) and the role of various actors in the different business models. Section 3 presents the methodology. In Section 4 the three cases are introduced in more detail followed by an analysis. In Section 5 I apply the framework to analyze the case studies and discuss the most important findings. Section 6 concludes.

2. Theoretical Context

2.1. Strategic Niche Management

The Strategic Niche Management (SNM) framework is an evolutionary analytical tool focused on understanding the gap between Research and Development (R&D) and market success regarding new technologies. This phenomenon is related to the "locked-in" socio-technical regimes which define the set of rules according to which, actors such as firms, users, and policymakers act [17,18]. The established regimes are less open to radical technologies that require a change in important system parameters. Thus, for a radical change to happen, innovations must come from outside the regime, and the transformation needs to develop in niches. Niches are protected spaces in which experimentation can take place and new technologies can incubate and mature (e.g., [19,20]). In this line, the SNM aims to analyze the success and failures of niche creations, and to provide a tool for the management of innovations for sustainability. According to the SNM theorists, the development of niches depends on three key elements: (i) expectations; (ii) social networks; and (iii) learning processes [21]. If the formation and the interaction of these internal processes are well-managed, the niche has the potential to influence and transform the regime [22,23].

Concrete and well-defined expectations, which are shared by many actors and are successfully substantiated by the project, are a crucial element in the niche formation process. Expectations that are robust, realistic and credible can provide the groundwork for an effective learning mechanism [19,21,23]. Learning processes focus on generating knowledge and changing the cognitive framework to overcome barriers and constraints of innovation. During this learning process, various niche actors reflect on the niche development and adapt their views and expectations. Some scholars (e.g., [19,24]) distinguish between first- and the second-order learning. First-order learning refers to the design of a cognitive framework based on the gathered information regarding technology, policy, infrastructure,

etc., while second-order learning is applied when the initial cognitive frame is reshaped and adapted, for example, during changes in the technological design and modification of the network [24]. Networking refers to knowledge transfer and coordination among the actors. A variety of actors can better support the social niches and can create a deeper network. Generally, a broader network that includes various actors from incumbents to challengers and intermediary actors can be more effective [25].

Another important aspect discussed broadly in the relevant literature is the scaling up of niches and the factors that can motivate it. Scaling up is the process of moving from "from experimentation to mainstream" [26]. In order for a global niche to emerge, local projects need to pass from the local phase of independent projects to the inter-local phase, in which knowledge, actors, and visions are shared among various local projects, and then to the trans-local phase in which knowledge is fed into the regime, to end up in the global phase in which the knowledge becomes established and institutionalized [19]. The scaling up of the local niches can happen either through fit and comfort, meaning that the niches coexist and integrate with the present regime without bringing too much change, or through stretch and transform, meaning that the niches push for a change and a reform of the regime [26]. Social innovations can change the established regime in three ways: through replication of local projects at the niche level, though scaling up of existing projects, and through a stimulation process in which ideas of the niche are being transferred to the mainstream regime [27].

The SNM theory has often been criticized for seeing the niches as "unrealistically homogenous" [27] and for failing to acknowledge the important role of different actors and the quality and type of their interactions [18]. As a response to these criticisms, the present work focuses on the role of various actors and their interactions. While indeed a lot of the previous work focused on a single project [28], in the past years there is an increased interest in the interaction among projects and how multiple projects interact and influence each other while forming a "global niche". In this line, our study uses a cross case research approach.

2.2. Actors

Actors working in a project can vary from civil participants, to local and national governments, and private sector organizations, such as energy companies and external consultants. During the niche formation process, these actors have different roles which can foster or deter the transition. For instance, certain actors such as civil societies can initiate the transition and advocate for the benefit of the local society, leading to conflicts with incumbent actors which have an established position within the regime and advocate for private interests [29]. Other important actors are the intermediary actors, who facilitate learning and the exchange of knowledge among projects, as well as the cooperation between incumbent actors and challengers [23,30,31]. They are often charged with the role to create networks and to enable relationships and learning between similar niches. Their contribution to energy transitions and more concretely the niche empowering process has been the topic of various research [30,32].

2.3. Organizational Types

The idea of a "business model" has gained increasing attention the past years in the literature of SNM [32–35]. Business model innovation is considered an important element for the formation and upscaling of niches. Additionally, "appropriately designed business models are an important opportunity to overcome some of the key barriers to the market diffusion of sustainable energy technologies" [36].

The most common organizational models are public, private, and community based. Recently a new hybrid model has emerged, in which "societal roots of shared responsibility and environmental concerns are combined with market tasks such as energy profitability, security and access and governmental responsibilities" [37]. In the energy sector it can have the format of private–public agreements or of local government projects with citizen participation. In these new model, key actors

such as the state, private sector, and community work in cooperation through the various stages of the niche formation. Despite the criticisms [12], these new arrangements offer more flexibility and a more democratic and pluralistic approach. Especially for small rural areas and islands, with limited access to funds, and lack of knowledge and capacity, this hybrid ownership model can be proven ideal for the energy transition through the availability of public land and the release of funds from private investors [38,39].

In technological innovation, technological arrangements are the main focus of the niche analysis, while in social innovation, the social arrangements are the focal point [27]. In the cases analyzed here, the renewable energy technology itself is mature and established on the market; however, this new social arrangement that includes a broad network, secures public acceptance, pushes for policy changes, and promotes the dissemination of knowledge among various actors is part of the social innovation. These new social arrangements are a "continuum" between grassroots initiatives, driven by ideological motives and market-based initiatives driven mostly by profit [23].

Thus, I argue that this model can favor the local renewable energy niches on islands to pass from the local to the trans-local phase through the incorporation of various actors with strong common visions that create a robust network. I also examine the role of these actors through the niche formation and scaling up process. This approach allows us to analyze sustainability transitions, not only through technological aspects, but also through social organizations and the actors behind them.

3. Methods

The research used a multiple case study approach based on data from an in depth-literature review, enriched with interviews. The comparative case study approach was chosen to bring into view the differences and similarities between these initiatives, to illustrate their heterogeneity regarding their locations, size, technologies, organization, and motivations, to examine the niche formation in real life context, and to discuss replication [40].

The three case studies selected are pioneer projects and are characterized by a hybrid ownership model that includes corporate and governmental and public involvement. Due to their innovative character in terms of management and technology, they can be considered representative cases of a sociotechnical niche emergence with new social institutions, values, and aims that do not form part of the mainstream regime. A full list of the criteria used to choose the case studies is presented in Table A1. I was especially interested in studying established projects with innovative technologies and a hybrid ownership model in countries that have not yet been studied well. The three cases are in southern Europe, namely, in Spain, Portugal and Greece that have a huge renewable energy potential which remains unexplored to a certain degree, especially in insular areas.

The analysis is based on key concepts of the SNM framework (presented in Section 2), with a special focus on the role of various actors in the niche formation process. Data were obtained through a review of the available scholarly literature and internet sources (public reports, policy papers, official websites) and from online interviews conducted with key actors between November 2019 and January 2020. These actors were identified from the preliminary document analysis. The participants were given the right to remain anonymous, but information regarding their role is provided in Table A2.

The open-ended questions were guided by the key processes of the SNM and covered among others, the motivation for participating in a joint project, the expected outcomes, the relationship with the other partners, the organization, and the knowledge they acquired (Table A3). The program Atlas.ti (Scientific Software Development GmbH, Berlin, Germany) was used to code the sections and to structure the verbal material from the interviews under the themes of the SNM (motivation/expectations, learning, and networking). [19]. The same categories were used for the primary documents.

By analyzing the aforementioned themes, I examined how the decentralized energy projects on isolated islands emerged, to what extent they might be contributing to niche development, and the role of the various actors in this new organizational model. The present research focuses on the heterogeneity of the actors and the design, assuming that a combination of specific structural and

organizational forms and adequate policies can help new projects and can contribute to a change in the overall system of electricity generation on isolated islands.

4. Results

The three case studies chosen are the islands of Hierro (Spain), Tilos (Greece), and Graciosa (Portugal). The three projects have different forms of ownership and incorporate various forms of renewable energy.

4.1. El Hierro

El Hierro island is located in the Canary archipelago and has a population of 11,154 people. Currently, five wind turbines (total 11.5 MW) and a hydro plant (11.32 MW) supply about 80% of the island's energy demand. This flagship project is managed by Gorona del Viento El Hierro S. A. that consists of the El Hierro Island Council (65.82%), Endesa (23.21%), the Technological Institute of the Canary Islands (ITC) (7.74%), and the Autonomous Community of the Canary Islands (3.23%). The pilot program was inaugurated in 2015 to substitute the polluting diesel oil used in the Llanos Blancos thermal station. The project gained widespread recognition and in 2019, members of the International Energy Association visited the island to overview the progress and discuss the challenges. Gorona del Viento has inspired similar initiatives on other Canary Islands and worldwide and is currently expanding to include the use of electric vehicles and water desalination.

The project has a small but deep network. Incumbents such as the private company Endesa and the public company Red Electrica de España (REE) form part of the network, which proved to be very stable. All the interviewees highlighted the trust and good cooperation among the members of the network. The municipality played a key role, not only in envisioning the project, but also throughout the implementation. Several interviewees acknowledged that without the aspiration and guidance of the local government the project would not have been realized. The expectations and motivations were clearly articulated from the beginning and shared among all the actors. These include environmental benefits—mostly carbon dioxide (CO_2) emissions reduction, financial, such as a lower cost of electricity, and social, such as new income and job opportunities. An important vision shared by several interviewees was the energy self-sufficiency of the island and the avoidance of electricity blackouts, which prior to the project, were common on stormy days.

However, despite the initial expectations, the underperformance and the high costs led many to question the idea, as expectations are still not confirmed by tangible results. Many claim that self-sufficiency cannot be achieved under the present design and call for a reconsideration of the expectations and the outcomes. This, combined with the elevated costs of the project, has raised doubts among the experts regarding the economic feasibility. The expectations have been re-evaluated and the new target is lower than the initial 100%. Gorona del Viento is expected to cover about 55% of the annual demand at the moment.

Learning was essential for the project as there are no other similar experiences worldwide. The experiment showed that some of the technologies do not function properly and the design had several flaws. For instance, the size of the upper reservoir was not sufficient and there were gird stability issues. This failure produced important technical knowledge, leading to reflexive learning. This knowledge resulted in various publications and presentations in conferences and world forums. Recently, the project opened internship to students from universities, aiming to disseminate the acquired knowledge. Information was also disseminated through the website of Gorona del Viento. Social knowledge was a quite important element and was achieved through discussions with the local community, brochures, workshops, seminars and exhibitions, and training organized by the Red Cross [41]. Overall, the learning process was broad and reflexive.

4.2. Tilos

The small Greek island of Tilos is located in the Southeast Aegean Sea and has a population of 780 people. The island belongs to the electric system of Kos-Kalymnos that is powered with fuels from a thermal station located in Kos. The unstable connection, with frequent blackouts, led to the conception of the idea of the TILOS Project (Technology Innovation for the Local Scale Optimum Integration of Battery Energy Storage). The idea, which involves a wind turbine (800 kW), a photovoltaic park (160 kW), battery storage (2.4 MWh/800 kW $NaNiCl_2$ FIAMM), and smart meters, is coordinated mainly by the University of West Attica (former Technological Education Institute of Piraeus), the private Greek Energy Company EUNICE, the Hellenic Electricity Distribution Network Operator (HEDNO), the World Wide Fund for Nature (WWF), the municipality, and a number of other supporting partners worldwide. The project was named the best energy island project in 2018 and received two EU Sustainable Energy Awards.

The initiative pushed for institutional transformations, including policy changes regarding the hybrid systems on islands that are not connected to the mainland grid and the use of batteries as storage solutions. The energy supplier and the grid operator, despite their established role in the incumbent regime, played a crucial role in the project development. The wide range of different partners from local to national created a broad network and knowledge was disseminated among the actors through meetings and forums. The process of learning was essential and multi-dimensional. The project design and the outcomes resulted in various publications, and details are available on the website of the project. Additionally, an annual summer school was organized. The universities brought knowledge about innovative technological solutions, while the energy firms brought their experience from other projects. During the design and implementation, special focus was placed on the social dimension of learning, with organizations such as the WWF being responsible for the dissemination of knowledge among local people. Learning also occurred through exchange with other projects. Most interviewees when they were asked to mention other similar projects, named El Hierro, Samsø or other Greek cases, indicting an exchange of knowledge and experience. This strengthens the hypothesis that these niches do not operate in isolation but form a trans-local network.

The articulation of motivations and expectations was clear from the beginning. Self-sufficiency, environmental, and economic motives were the most important aspirations shared among the actors. However, some legislative barriers led to a change in the initial expectations. The original design included elements to push for the island's autonomy from the existing power grid, but this has not worked in practice, as there are conflicting provisions in the Greek legislation.

Nonetheless, self-sufficiency and energy autonomy are still the most dominant visions among the interviewees. All the participants associate the project with a more reliable power supply system and fewer power cuts. For some of them, the TILOS project falls into their broader view of a more decentralized power system that allows further autonomy and flexibility. Three interviewees referred to economic motives and assume that the project will bring economic benefits on the island such as new jobs and increased tourism.

The project shed light on the legal limitations regarding decentralized energy, including the pricing system, the licensing process, as well as numerous technical difficulties such as the grid stability [14]. Currently Greece has opened a public consultation regarding the regulation of hybrid power plants. The knowledge acquired from the TILOS project has proven viable in the public discussion, pushing for regulatory changes to allow replication on other islands (e.g., Gaudos, Fournoi, Othonoi).

Regarding the actors involved, the municipality played a key role, not only during the design of the project, but also as a manager of the process, especially in licensing and legislative issues. The figure of a green mayor has been acknowledged as an important asset for the niche formation and the case of Tilos confirms this. Several interviewees referred to the past and present mayors as leading figures in the energy transition of the island. Another interesting aspect is the role of intermediaries and more concretely of WWF and of the University of West Attica, which appeared to play an important role in fostering the communication among actors and the transfer of knowledge.

4.3. Graciosa

Graciosa, a small island in northern Azores with a population of 4777 people, has also initiated a journey towards a 100% renewable energy future. The Graciolica project combines solar (1 MW) and wind generation (4.5 MW) with lithium-ion batteries for storage. The project is led by Graciolica Ltd., a subsidiary of the private company Younicos (Berln, Germany), and the main stakeholder is the Dutch company Recharge A/S owning 50.1% stake in the €24 million investment. The project was delayed due to disagreements among the stakeholders, but it 2019 the Azores Regional Directorate of Energy allowed the injection of the renewable energy produced by Graciolica into the grid. Before the implementation of the project the island was heavily dependent on fuel imports of about 3.3 million liters of diesel per year.

The network consists mainly of partners from industry such as Younicos, Leclanché SA (Yverdon-les-Bains, Switzerland), and Wärtsilä (Helsinki, Finland). There was limited involvement from public organizations (Eletricidade dos Açores-EDA) and research institutes (Instituto de Engenharia de Sistemas e Computadores, Tecnologia e Ciência–INESCTEC) and no involvement from non-governmental organizations. Thus, the Graciolica project is strongly business oriented and the network is not overly broad or deep. Mostly, partners from the private sector worked together to mobilize resources and provide technical assistance. However, a "deadlock" in the renewable energy project occurred due to a disagreement between the shareholders of Graciólica, leading to a change in the composition and the incorporation of a new partner, the company Green Smith. The network in this case was not stable and there was lack of continuation, leading to significant delays and a loss of money for EDA.

The role of the local government in the project was less important than in the previous cases and as one of the interviewees stated: "*I don't think the government played a major role apart of "showing" its support towards a successful completion. Hard to say if the government involvement could have been different*". This statement highlights the limited role and influence local governments have in business-oriented projects. Similarly, in this project, the local community had a rather invisible role, but there were no complaints or local opposition. Intermediary organizations were not clearly defined, and the municipality was identified as the only connecting actor between the local people and the project partners.

The only available research regarding the project is a comprehensive Life Cycle Analysis by [42], who concluded that the new hybrid system will reduce the environmental impacts by 43%. The partners signed a disclosure agreement, and as a result, limited knowledge was available to the public, apart from some technical reports from involved partners, available online. There was also limited exchange of knowledge with other projects during the design and implementation. This is partly due to the unique character of the project, but also because the main partners such as Younicos and Leclanché had significant experience in the field of renewable energy production.

Throughout the process, the experiment produced knowledge on various domains. It revealed technical weaknesses regarding grid stability and the use of batteries. Social learning focused on the energy users and more concretely on the demand side of management. In the policy domain, the experiment highlighted various legal gaps and the inadequate subsidy mechanism. All these lessons are very important for the replication and scaling up of the project, which at the moment is expanding to include the use of electric vehicles.

The expectations were articulated well among partners and included economic benefits, the ambition to make their project a reference in the industry, and to prove to investors that storage solutions can work. Secondary motivation included social and environmental benefits. However, during the implementation phase, technical differences, and more concretely the software and the equipment, led to significant delays. There was no initial vision about how to scale up the project or which partners are prepared to invest resources in a next phase. Many of the partners are currently implementing the acquired knowledge in other similar projects around the world.

5. Discussion

5.1. Articulation of Visions and Expectations

The main collective drivers and goals for each project were extracted from the official documents reviewed and from the interviews and are presented in Table 1. All three cases had clear visions and well-defined goals and objectives, which were well substantiated by the projects' design and the outcomes. Common drivers and motivations include self-sufficiency, reduced energy cost, increased grid stability, and reduction of CO_2 emissions.

Table 1. The main priorities of the decentralized renewable energy projects examined (authors own elaboration).

Priorities/Motivation	El Hierro	Tilos	Graciosa
Maximizations of RES penetration	✓	✓	✓
Grid stability	✓	✓	
Tourism	✓	✓	
Indirect economic benefits	✓	✓	
Reduced electricity cost	✓	✓	✓
Reduced CO_2 emissions	✓	✓	✓
Self sufficiency	✓	✓	✓

Note: ✓ indicates that a certain priority/motivation is applied to the respective project.

The importance of self-sufficiency for isolated communities which depend on local diesel generators or fossil fuel imports is being highlighted in various studies, for example, in the work of [43] in Canada and of [44] in the Netherlands. In a broader context, the ability to be independent of energy providers and to achieve energy autarky is an important driving factor [45–47] for energy transition and can fulfill psychological parameters such as the need for self-determination and a sense of control [48,49]. The emphasis on self-sufficiency shown in the present three case studies provides further evidence for the importance of autarky and how it can influence the development of decentralized energy supply systems, especially in these isolated areas which have a high sense of belonging. Overall, the vision of a decentralized renewable energy system was shared among several interviewees as a response to the current problematic and unreliable centralized system.

The environmental benefits were clearly mentioned in all three cases and were often measured by CO_2 emissions reduction. Despite the emphasis on climate change mitigation, there was no mention of other environmental impacts such as water use, land use, and biodiversity. The secondary environmental benefits were not addressed in any of the cases. This is in contrast with the findings of [50], who questioned and interviewed the participants in a sustainable energy community in the UK and found that the most frequently mentioned reason for becoming involved with the project was environmental awareness.

The economic motive is another important driver. Funding from a local budget or from external corporations increases the pressure for economic viability. Overall, profit orientation is a main motive both for the communities and the corporations that deal with the energy supply. In the case of Tilos, the community considers the idea to export excess energy to the island of Kos in order to increase the profits, while on El Hierro, the community is already experiencing economic benefits from selling the energy and investing the gains in other social projects. On Graciosa, the electricity generated is also sold by Graciolica to the local utility.

Despite the extensive focus on the direct economic benefits due to the reduction in the cost of energy, in all cases there was a specific mention of the indirect economic benefits, such as job creation and new income sources. Tourism, as a sector that can be beneficiated, was explicitly mentioned only in the cases of Tilos and El Hierro. The interconnection by local renewable energy sources and

sustainable tourism has been the subject of various studies [51], and renewable energy projects can serve as promotional tools to advertise the islands and increase tourist arrivals.

5.1.1. Initiating

When it comes to energy transitions, communities are often mobilized by endogenous actors such as local governments as seen in El Hierro and Tilos. In both cases, "green mayors" envisioned and initiated the projects. On the contrary, in the case of Graciosa, an exogenous actor (Younicos) played the role of the driving force.

In all three cases the initial face of the project included incentives from exogenous organizations. The incentives are typically in the form of loans or grants to support the preparation and implementation of the project. Although the incentives came from national or international entities, the response to the opportunity was taken up at the local level mostly by local organizations and the local government in Tilos and El Hierro. These results highlight the importance of exogenous organizations as providers of the funding source and the technical capacity especially in small, isolated areas with limited municipal funds. The initiative of the local community and the local authorities is supported by those external organizations that have a catalytic role in helping the community overcome the initial budget and knowledge limitations. Thus, cooperation among the various endogenous and exogenous actors is important at this stage.

5.1.2. Learning & Networking

Intermediate actors, such as NGOs and universities often provide the required technological knowledge but are also responsible for networking and sharing experiences. Intermediaries can design channels and events that can bring together initiatives from local, regional, and national levels. Growing niches depend on the expansion of these networks and on the network-building activities of the participating actors.

Although learning and networking are important common elements among the three cases, there are some significant differences. In the case of Tilos, the role of educating the public and reducing conflicts was carried out by the non-governmental organization WWF. The University of West Attica was responsible for sharing the learning with other energy intermediaries, for networking, as well as for the project coordination. Similarly, in the case of El Hierro, the knowledge aggregation was also carried out by the Technological Institute of Canarias (ITC) and training of the local population was implemented by the Red Cross. Interestingly, in the case of Graciosa, an external corporation, Tractebel, was the project manager, but not with a clearly defined role of networking and learning. This role was partially taken up by the municipality. The role of universities as intermediaries was strong in two out of the three cases examined. The importance of these institutions in promoting social innovation niches, also highlighted in previous research [52,53], is strengthened further by our observations.

The local energy providers are key actors that serve various interests, have a balancing role, and work closely with other partners such as municipalities (e.g., El Hierro, Tilos) and international corporations (e.g., Graciosa). In all three cases the projects have contracts for selling energy to the energy providers. In this context, the energy providers participate actively in the management of the demand and supply.

There is an informal network among the three case studies available to exchange knowledge and expertise (Figure 1). This network is quite diverse and includes the participation of various actors. The company Younicos that financed the project on Graciosa is a consortium member in the Tilos project. Similarly, ITC participates in both the El Hierro and Tilos projects. Those are the "bridging organizations" of the network that create an inter-local phase in the scaling up process [54].

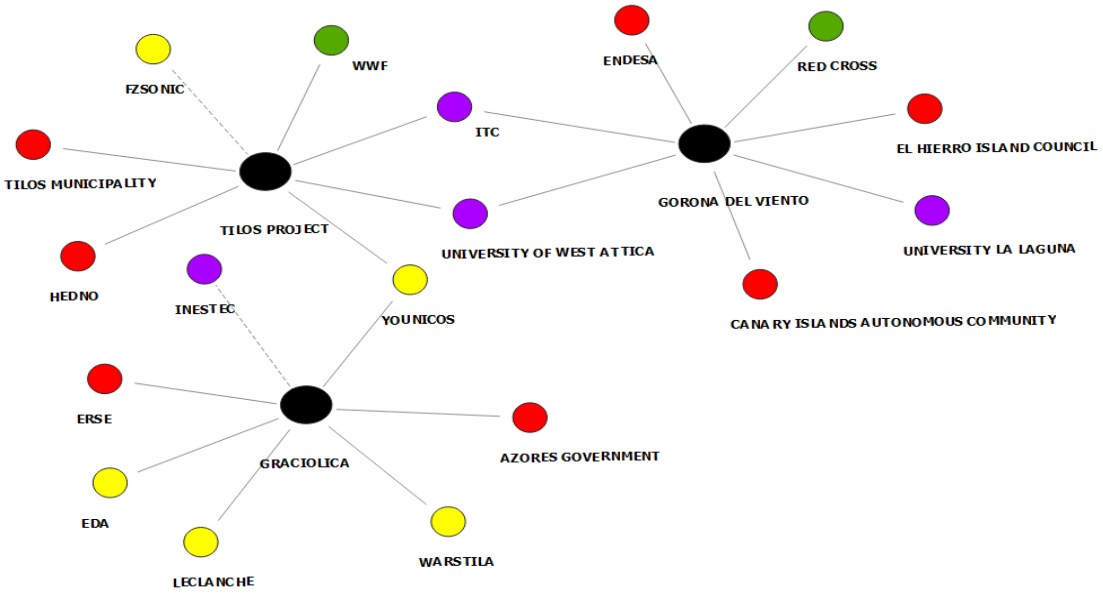

Figure 1. Illustration of the networks for the three projects including public actors (**red color**), private actors (**yellow color**), NGOs (**green color**), and universities (**purple color**).

5.1.3. Management

Moving from the envisioning of the project to management, the three projects can be divided according to their central institutions and their guiding principles into community oriented, state oriented, and market oriented [38,55]. Based on that, the most community-oriented project is El Hierro where the municipality holds the majority of the shares and has the leading role in the management. Graciosa is a more market-oriented system as the owners and managers are private entities. Tilos is a mix of the state and market project due to the strong presence of public organizations, such as the University of West Attica and HEDNO combined with the presence of Eunice. This can be related to the various political systems in the three countries. While in Spain the governmental system is more decentralized and the autonomous communities and municipalities have more financial means and independence for policy design, the Greek system is highly centralized [56].

5.1.4. Funding

When it comes to resources, these seem to come from all the levels of government (local, regional, national, and European) and vary from grant funding to price-support schemes. Overall, external funding is a crucial factor for the vitality of the project especially during the initial stages. Similar to what was observed in the study of [57], the funding worked as an "interssesment device" to further boost the cooperation among the various partners and to strengthen the ties among the participating actors.

5.1.5. Actors

In all three cases, the electricity distribution is a monopoly that has been well established the past years despite that the energy providers participated to different extents in the local initiative. The low levels of resistance can be explained due to the fact that energy providers, through contracts, buy the renewable energy and thus, are not being excluded from the new regime. Our results are in line with the findings of [58], who pointed out that the increased competition increases pressure to invest and thus often the incumbent actors get involved in new technologies. This is often through collaboration in order to limit the risks and costs [59], as is also observed in our cases. These "cooperation strategies" are often mutually favorable for the challengers and the incumbents [60]. Additionally, the energy providers are in a position of power as in all of the cases examined the local communities do not aim to

disconnect completely from the grid. On the contrary, they need to have an energy backup in place to deal with the problem of intermittency of the renewable energy sources and the lack of affordable energy storage technologies. This makes the distribution operators crucial actors in the process.

5.1.6. Emergence of a Global Niche

There are indications that the three projects are moving beyond the niche phase into the inter-local and the trans-local phases. Our results suggest that the projects are growing and expanding, including new partners and approaches (e.g., electric vehicles, waste management, and water desalination). I also observed a significant exchange of information among the projects, the presence of weak tiers, and project-to-project links. The initiatives have influenced the regime mainly by pushing for regulatory changes; however, this influence is still marginal. For instance, in the Canary Islands, the El Hierro project highlighted the need for the "Decreto Eólico 6" that simplifies the process of wind farm authorization on the islands. Similarly, in Greece, the Tilos project paved the way for other similar projects and pushed for regulatory changes with the introduction of law no. 4495/2017. The Younicos Company is in charge in both the Tilos and Graciosa projects, allowing the exchange of information while at the same time designing similar projects on other islands (e.g., Lanai and Maui), indicating replication. Similarly, the University of West Attica is also involved in similar projects on other Greek islands, using the knowledge gained from Tilos. Similar new projects inspired by the cases presented here are also emerging all around the world under the prospects of the EU Clean Energy Package. These elements of replication, scaling up, and stimulation further enhance our hypothesis that the cases discussed here are pushing for a reform of the established regime and for a deeper change in the overall system of electricity generation

6. Conclusions

In this paper I used the Strategic Niche Management (SNM) theory and examined the role of various actors in order to analyze three decentralized renewable energy projects on isolated islands with a hybrid ownership model. The projects demonstrated high levels of heterogeneity, but all had some common denominators including clear motives, strong intermediary actors, and support from the local energy providers and the community. Additionally, the results indicate that three key factors from the SNM theory (building networks, managing motivations, and facilitation of learning), as well as the participation of concrete actors in these processes, are of great importance for all three cases. As one can observe from Table 2, in the three projects, the various actors played different roles during the niche formation process, highlighting the variation and complexity of the hybrid ownership model as well as the importance of cooperation among the various partners.

Decentralization is not only an important innovation for energy production, but also a new form of energy management often dominated by different actors other than the dominant ones in the established electricity system. In this line, a heterogeneous group of actors that are less visible in the established regime play an important role in the various niche-nursing stages, such as mayors, universities, and NGOs. On the contrary, incumbent actors can hold new roles in the new decentralized management (e.g., energy providers) and cooperate with the new actors. This can be beneficial for the incumbent and reduces the lines of conflict among challengers and incumbents. In this line, the hybrid management model can be highly efficient if it includes a deep and stable network with clear articulation of expectations and motivations.

Table 2. The main actors participating in the stages of the niche-formation process.

Actors	Initiating			Learning			Networking			Funding			Managing		
	El Hierro	**Tilos**	**Graciosa**	**El Hierro**	**Tilos**	**Graciosa**	**El Hierro**	**Tilos**	**Graciosa**	**El Hierro**	**Tilos**	**Graciosa**	**El Hierro**	**Tilos**	**Graciosa**
National Government					+			+			+	+			
Municipality	+	+		+	+	+	+	+				+	+	+	
National corporations										+			+		
International corporations			+		+	+		+	+		+	+		+	+
Electricity distribution operators													+	+	+
European Union							+	+	+	+	+	+			
Universities		+		+	+		+	+						+	
Non-governmental organizations					+			+							
Citizens	+	+		+	+	+									
Utilities				+						+			+		+

Note: + indicates participation of the partner in the respective stage.

Our paper started with the assumption that the decentralized renewable energy initiatives studied here are pioneers in the efforts to change the electricity supply system in their respective countries. Indeed, one can conclude they can be considered important niches for innovation that have created a new policy and structural regime, enforced new institutions, and designed new ambitions. At the same time, they have introduced an alternative management model for local energy projects.

Given the diversity of actors involved, strategies developed, and organizational forms established, one can talk about a heterogeneous emerging field that is not yet stabilized, but with great potential for upscaling. The EU Clean Energy Package paved the way for renewable energy communities, local energy projects, and other forms of citizen's initiatives. So far, these initiatives have shown their potential as active players in the electricity system and have raised hopes regarding the achievement of the binding 32% EU target for RES.

Nonetheless, a future expansion of the niches requires more support for the experiments, especially from intermediary organizations that can promote networking and learning. By creating and maintaining an environment in which expectations are well articulated and reflexive learning processes take place, the niches can expand and be scaled. Another important implication is the need for further collaboration and lobbying to achieve further change in the institutional environment. Significant reforms to national legislation and regulation are still needed in order to provide space for social innovation.

The heterogeneity and the local character of the cases do not allow generalizability. Nonetheless, the present study has theoretical implications that go beyond the particular places. It can offer useful insights for similar projects that are still in the initial stage (e.g., Menorca [61]) and serve as an example for islands with similar characteristics and potential (e.g., Lampedusa [62], Fournoi [63]). In this way it can enhance the creation of new networks and the exchange of knowledge. The business model and governance concept behind these projects can be replicated and applied in multiple arenas.

Building on the present analysis, it would be appropriate to collect further data and to expand the discussion on other initiatives and emerging networks. The new hybrid ownership model is becoming more predominant in many countries and various settings and thus, further research is needed to investigate the potential of this model in other particular spaces and landscapes, but also its endurance over time.

Insofar, it is difficult to say which of the analyzed cases will survive, to what extent they will achieve their aims, and the influence they will have on the overall energy transition nationally and globally. Various challenges will have to be overcome as the projects move from the trans-local to the global phase, but there are indications that this transition is already happening in the countries of southern Europe. The initiatives discussed here offer a promising alternative to the established regime and with the required attention and support can have the potential to contribute to a shift on the energy generation field.

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Appendix A

Table A1. List of criteria for the selection of the case studies.

1.	Located on islands in southern European countries
2.	Not connected to the main grid; thus, they are good examples of decentralized energy systems
3.	They aim to achieve 100% electricity self sufficiency
4.	Are considered pioneers
5.	Include participation of the local communities, but they represent various forms of ownership, different spatial contexts, and receive funding from different sources
6.	Eco-villages—consisting of people who moved to a certain place voluntarily—have been excluded as they often include religious, ideological, spiritual communities, and/or have other aspirations that go beyond the aim of this research
7.	Energy cooperatives were excluded as often the members are not directly related to the community (e.g., Somenergia or Retenergie)
8.	Projects that are still in the very initial stage, have vague ambitions, and lack concrete planning were excluded

Table A2. List of participants and their affiliations.

Reference	Project	Organization
I1	El Hierro	University
I2	El Hierro	Gorona del Viento
I3	El Hierro	Gorona del Viento
I4	El Hierro	Local government
I5	El Hierro	Endesa
I6	Tilos	NGO
I7	Tilos	Eunice
I8	Tilos	Municipality
I9	Tilos	HEDNO
I10	Tilos	University
I11	Tilos	University
I12	Graciosa	Graciolica
I13	Graciosa	Graciolica
I14	Graciosa	Younicos
I15	Graciosa	Leclanché SA

Table A3. Sample of open-ended questions.

Theme	Questions
General	What was your role in the project?
	What was the goal of the project?
	What were the main obstacles during the implementation of the project?
	To what extent are current national policies in line with the development of the project? Do you think there are legal gaps?
	Did you encounter any opposition from the residents or from energy companies?
Motivation and expectations	What was the initial motivation and inspiration for the project?
	Has this changed during the implementation? If yes, why?
	How did the expectations of the various partners influence the project and its upscaling?

Table A3. *Cont.*

Theme	Questions
Networking	In your opinion, who were the most important actors (key actors) in the project (in design and implementation)?
	How was the interaction among the partners?
	What was the role of the local government?
	Did the partners change? Were new partners added to the project?
Learning	How was knowledge disseminated among the institutions and the various project partners?
	Was there an exchange of knowledge with other similar projects? If so, indicate with whom and how the knowledge exchange was carried out.
	What type of learning occurred in the project? How was it organized?

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6.2 Section A- **Chapter 2**

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"From local island energy to degrowth? Exploring democracy, self-sufficiency, and renewable energy production in Greece and Spain"

Marula Tsagkari [a,*], Jordi Roca [a], Giorgos Kallis [b]

[a] Department of Economics, Faculty of Economics and Business, University of Barcelona, Av. Diagonal, 696, 08034 Barcelona, Spain
[b] ICTA-UAB, Institut de Ciència i Tecnologia Ambientals, Universitat Autònoma de Barcelona, Research and Degrowth, Spain

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ABSTRACT

The energy sector is at the center of the current economic system, and of literature and activism on degrowth, which questions the sustainability of current models of energy use. Local and small-scale energy systems may have the potential to reduce energy and resource consumption and to advance degrowth-related ideals of energy democracy, self-sufficiency, and local production. In the present paper we link a discussion on degrowth and local energy projects, using two case studies from southern European islands, El Hierro in Spain, and Tilos in Greece. These pioneer local energy initiatives have a complex ownership model that includes various public and private actors, and aspirations that go beyond merely electricity production to other economic and social goals. We look into the promise of these initiatives in transforming insular areas and promoting an alternative way of living, comparing attributes of the processes involved to four degrowth principles. We conclude that despite the degrowth potential of these local energy projects, their prospects are limited to revitalizing local economies and empowering local communities, but not necessarily reducing energy use or creating an alternative to the growth orientation of the islands.

1. Introduction

Climate change demands a radical change in fossil fuel-based energy systems, which are the primary sources of global greenhouse gas (GHG) emissions. The availability and increased access to renewable energy has opened up the possibility for new energy arrangements, like decentralized energy production on a small scale much closer to use. Islands, where access to fuels is scarce and costly, but local conditions like topography and natural resources are often favorable to wind and solar energy, can be ideal laboratories for clean energy transitions. Islands can be considered as micro-worlds of larger topographies, which make them particularly well-suited for demonstration and pilot projects [1]. Many insular areas are lagging behind the mainland economically - especially urban centers – with low incomes, high unemployment rates, lack of opportunities for young people and depopulation/lack of human capital. Dissatisfaction with conventional development has led many islands to look for alternative strategies and local energy (LE) projects, some argue, that can help empower islands economically, culturally, and socially [2].

Economic growth depends on energy use [3]. Many scholars, policymakers, and activists call for a change, not only in energy technologies, but also in the centralized and monopolized energy system, combined with a broader change in the current capitalist system and the predominant lifestyles the latter promotes [4]. The Degrowth Movement, drawing upon the fields of ecological economics and environmental justice, emerged as a response to interrelated socioeconomic and environmental crises. Given their small size, towns, villages, neighbourhoods, and islands offer ideal set-ups for experimenting with – and reflecting upon - ideas of degrowth [5] and clean energy transition [6]. Degrowth points not only to energy efficiency and cleaning/decarbonizing energy supplies, but also to reducing energy use, and thus facilitating the decarbonization of a smaller, rather than larger, energy system [7]. Small-scale, community-owned or local renewable energy projects are, then, interesting studies to investigate from a degrowth perspective, as they combine low-scale energy systems, often with a sufficiency orientation and, potentially, elements of democracy and local control.

Despite this potential, there is still little evidence on how degrowth ideas can relate to local contexts. Along these lines, we link a discussion on degrowth and LE on islands, using two case studies from southern Europe, El Hierro in Spain, and Tilos in Greece. These islands are international examples of energy transition, as they aim to become self-

* Corresponding author.
E-mail address: marula.tsagkari@ub.edu (M. Tsagkari).

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sufficient in terms of their electricity needs using renewable energy technologies. Their aspirations go beyond simple electricity production and include socioeconomic goals, like increased participation from local populations in decision-making, and revival of the local economy through tourism and job creation.

These islands see energy infrastructures as an opportunity to construct new modes of living and new identities. These opportunities, however, come with emerging challenges and dilemmas. New projects are inevitably characterized by uncertainty as "the effects of human actions can never be fully anticipated or predicted, and their outcomes [are] never completely known [8]". Even the best-defined goals of local energy projects are open to interpretation and can have distinct results, which are shaped through negotiations conflict, empowerment, political regimes, cultures and diverse perceptions of past and future change [9]. For this reason, although the goals of the LE projects examined here are not defined in degrowth terms, we argue that such goals can be related to degrowth principles. Thus, in the present paper, we aim to further explore this potential, and to examine the complex relationship between degrowth, islands and local energy. We do this by envisioning whether and how degrowth could emerge in the current arrangements, under what conditions, and what obstacles – evident and hidden – it will encounter.

In the next section, we present the concept of LE, followed by a short discussion on four degrowth and LE hypotheses. In Section 4, we explain the methodology for data collection and analysis, and present the two case studies. In Section 5, we report the results, and in Section 6 we discuss our findings. The final section concludes and reflects on the possibilities for degrowth based on our case studies.

2. Background and theory

2.1. Contextualizing local energy

The term Local Energy (LE) is quite broad and encompasses initiatives "involving a range of public, private and community organisations for the benefit of local consumers operating within a defined area" [10]. Devine-Wright [11] uses the term LE to describe the new social arrangements of mixed business models around renewable energy (usually wind, solar, and hydro), that rely mostly on local authorities and local enterprise partnerships with a focus on local needs, like job creation, skills training, new infrastructure, and development of the area.

These initiatives have emerged – and received attention - as a response to centralized energy systems. While huge investments are undertaken in the name of green growth, frontline communities make significant efforts to develop different types of local energy, distributed generation, energy storage systems and demand-side participation through smart grids. However, lack of resources, funding and knowledge often lead local authorities and communities to form partnerships with private organizations and intermediate actors. Such ownership models, known as 'hybrids', can be useful contractual arrangements for islands and small remote communities [12], that can be positioned in the spectrum between a strict capitalist model and alternative economic practices [13].

These types of LE projects become ever more predominant in various countries [11,14], creating a need for further analysis of these new arrangements. Various scholars argue that LE projects are vehicles, not only for an energy transition, but also for a bigger societal transition [4,15]. Others are more skeptical, claiming that, in most cases, these projects function inside the mainstream economy [16,17], making it less likely that they will promote citizen participation and produce strong and cohesive communities, as they prioritize economic growth through investments in clean energy [11].

Many renewable energy projects, despite their local character, may exacerbate inequalities, sustain individualistic materialism and increased material use, as well as contribute to the commodification of labor, local cultures, and land. On the other hand, even though techno-centric projects, positioned within the prevalent capitalist model, can create problems, LE projects can, in certain instances, create "spaces of intersection with non– or post-capitalist projects" [18].

The present study contributes to this debate by analyzing two operating LE projects, evaluating how they work, and assessing to what extent they could contribute to new social arrangements on the islands, beyond economic growth. As a normative vision of societal transformation, we focus on the theory of a degrowth approach, presently gaining attention, which is ideally suited as a framework for thinking – and assessing – the radical potential of the LE projects at stake.

2.2. Degrowth and local energy

Degrowth calls for a socially sustainable downscaling of production and consumption of environmentally- damaging goods in overdeveloped countries to remain within planetary boundaries and enhance human and environmental wellbeing. Although degrowth started as an environmental concern, it soon became a deeper critique of capitalism, modernization and unsustainable growth [19]. The degrowth literature offers empirical and theoretical evidence that challenges assumptions that infinite growth and environmental sustainability can be achieved only through innovative technologies and eco-efficiency as argued from the eco-modernist perspective [20-22].

The transformation of energy is a central point in the degrowth literature, and thus local energy projects and degrowth ideas can be examined in tandem, as some of the social innovations found in the degrowth discourse can also be embodied in LE projects. In past years there have been efforts to define sets of concrete degrowth principles (see [19]) and some attempts to operationalize 'degrowth' especially in alignment with social movements like transition towns, alternative food networks, and eco-housing [18,23,24]. Nonetheless, there are few studies that connect degrowth ideas with energy projects in local contexts.

As an example of this phenomenon, the research of Alarcón Ferrari and colleagues [25] examined how close a local project in Sweden aligned with the broader ideas of degrowth, energy democracy and technology, concluding that the initiative is still very much growth-oriented. In their study, they used a critical discourse analysis approach, but did not engage in-depth with degrowth ideas. Similarly, the research of Kunze and Becker [16] found that small-scale local energy projects have little degrowth potential, as they follow the profit maximization logic enforced by the energy market, and did not envision how a degrowth local energy project would look in their case studies. In a more comprehensive approach, Rommel et al. [26] defined certain "aims" of degrowth that can be applied in the arena of renewable energy, including local production, new business models, equity and fairness, sustainable consumption, convivial use of technology and a strong sense of community. The authors juxtaposed these hypotheses with the German case of the citizen energy movement *Bürgerenergie* and found that only a few initiatives embraced these degrowth ideas.

Adopting a similar approach for this study, we chose to focus on four degrowth principles related to LE energy projects and their concrete goals, namely: "energy democracy", "energy self-sufficiency", "localized production", and "revitalization of the local economy" without a single emphasis on economic growth. The parallels between each of these degrowth principles and LE is examined below.

2.2.1. Energy self-sufficiency

For degrowth theory, the question is not only how to meet present demands with new technologies, but how to reduce energy demand to a level that could be provided by renewable resources. Efficiency improvements, by themselves, are not enough, as they can also have countereffects and negative externalities [27]. Recent research [28], for example, shows that the tight coupling between GDP and energy use can be explained by economy-wide rebound effects, and that feasible climate mitigation scenarios involve not only decarbonizing energy supply, but

also a dramatic reduction of energy use and a slowing down of economies [21].

Renewable energy and efficiency, in other words, are necessary, but not sufficient if the economy keeps growing at 2 or 3% each year [20]. Decarbonization is easier if economies do not grow or grow slower than they would otherwise would. Furthermore, given the important demand of renewable energies for materials [29], a lower energy use, and, by extension, a slower rate of growth for the economy, are necessary for broader sustainability. This brings into focus the question of sufficiency, over and above that of efficiency. We understand sufficiency here to mean reducing energy use towards the minimum level necessary for meeting basic human needs [30]. Efficiency is welcome, but degrowth postulates, in addition, the goal of sufficiency – a decent living using the minimum amount of energy necessary.

Thus, from a degrowth perspective, any local sustainable energy system should not only pay attention to the supply side, but also to the demand side, as well as to the broader economic transformation that makes wellbeing within limited energy use possible.

2.2.2. Energy democracy

Questions of equity, autonomy and democracy are central in degrowth [31-33]. Local, small-scale and self-sufficient energy systems with hybrid organization and are often seen as potential paths for energy democracy [16,25]. This is because these systems keep workers and users under direct control more easily and allow for broader participation from the local community. Direct participation, through voting and real power to influence decisions and change outcomes, is, according to Arnstein [34], the highest level of citizen empowerment and the core of energy democracy. The energy democracy concept aligns with degrowth ideas as they both require a re-imagining of energy politics, in which authority for decision-making is placed in the hands of the local population, energy consumers become energy citizens and energy a common good, democratically governed [35,36].

2.2.3. Re-localization of production

The importance of localized production has been a central point in the degrowth literature. Re-localization of production can reduce transport costs by minimizing the distance between production and consumption, can increase local control over production and can create community resilience, energy reliability, and self-sufficiency [37,38]. Re-localization implies that many of the stages of the life cycle of energy provisioning happen in the local community. It doesn't mean walling off the community from the outside world, but using local resources, recruiting local workers, serving local consumers/users and becoming less dependent on imports [39]. Various local low-tech ideas, like wood stoves, pedal washing machines, and small wind turbines that can be maintained by non-experts, have been discussed in the degrowth literature as convivial energy tools [40], since they are self-built and have low material and financial cost.

2.2.4. Re-vitalization of the local economy

Many peripheral areas, like the small islands that are of interest here, have not followed the rapid economic growth of mainland cities in the last decades, and have lived through a prolonged "recession" or stagnation period. Food production through unsustainable agriculture and farming, extraction of raw materials, large scale renewable energy projects, or unsustainable mass tourism are some of the forms of exploitation peripheral and insular areas face in the pursuit of economic development [41,42]. Traditional ways of living have been retreating, and land and human relations are being increasingly commodified, ostensibly to catch up economically with the centers of economic activity. However, this is not the only path, and there are good arguments as to why local economies can be "revitalized" without succumbing to "growthism". Revitalization can take the form of new economies that do not reinforce the logic of capital accumulation, but center on sovereignty, self-sufficiency, and well-being. Social and cultural regeneration can lead to rural revivification [43]. The creation of employment in small business and local cooperatives, sustainable and organic agriculture that covers local needs, sustainable and slow tourism, local currencies, and co-housing are some examples.

3. Methodology

3.1. Case study approach

For our analysis, we chose the case study approach, suitable for examining a phenomenon in a real life context [44]. The case studies were not chosen because they were positive examples of projects with degrowth aspirations, but rather, because we were interested in understanding to what extent, and how, as local energy projects, they could follow or contribute to degrowth openings. We believe that social failures can also provide useful insights for energy social science research and, although the two cases represent small and isolated cases, big changes often come from marginalized places [45].

While we cannot generalize on the basis of just two cases, they offer sufficient material for an in-depth analysis [46] and confident findings [47]. The two case studies share similarities that allow us to examine them in parallel and to compare insights. For instance, they function within similar policy environments [48], have similar mixed ownership models that include local, corporate, and governmental involvement in project development and ownership [14], they aim to achieve 100% electricity self-sufficiency, and aspire to incorporate social, environmental and locally-oriented values.

3.2. Data collection and analysis

The analysis was based on data obtained through document analysis (energy statistics, public reports, policy papers at national and state level, review of the available scholarly literature and internet sources). The results were supplemented with findings from open-ended conversations with key actors. Between January and May 2020, we conducted 25 interviews with municipality representatives, technical staff, research partners, private companies and representatives of environmental organizations and business owners. We acknolwedge that our results rely on a limited number of interviews, thus some voices may not have been included.

Interviewees were given the opportunity to remain anonymous, however, in Appendix A, we provide information regarding the project and the organization to which they belong. By using a semi-structured methodology and open-ended questions, we gave interviewees space to develop and expand upon topics that were relevant for them and/or the researcher [49].

The main goals and motivations of the projects were identified from a review of relevant documents and reports and were related to the degrowth hypothesis presented in Section 2. In this way, we created four thematic sections that guided the interviews to investigate how much affinity these projects have with degrowth ideas, and how degrowth can be positioned in these initiatives. The main questions asked concerned the performance of LE projects, the role of the local community and the local government in the process, and the socioeconomic benefits of the project. A schema of the general research questions that guided the interviews is presented in Appendix B. All interviews were transcribed and entered into the Atlas.ti software to code the sections and align them with thematic headings for each case. This "template coding" approach [50], where codes are created beforehand, has the advantage of allowing the researcher to filter large areas of data when focusing on a specific research problem [51].

3.3. Island presentation

3.3.1. El Hierro

The island of "El Hierro" is located on the Atlantic Ocean seaboard

and is the smaller of the Canary Islands with an area of 268.7 km^2. The island has a total population of 10.162 people living in three municipalities. Prior to the implementation of the renewable energy system, the island imported about 40,000 barrels of oil annually and was dependent on nine diesel units located in the Llanos Blancos to cover the local electricity demand. Due to isolation, this system was one of the most expensive in the Canary Islands and highly polluting. Currently, there are no plans for connecting the system with other islands. The annual electricity demand of El Hierro is about 44 GWh (2018), with a daily peak of around 7 MW. Most of this demand is for domestic needs and water desalination. Throughout the year, more than 20.000 tourists visit the island, as can be seen on Fig. 1, there are small peaks in energy demand during the summer months.

In 1997, the island Council adopted the "El Hierro Sustainability Plan", aimed at making El Hierro the first island in the world to be completely powered by renewable energy sources, and, at the same time, to improve the quality of life for local people, revitalize the local economy, and preserve its cultural and natural heritage. In 2014, a hydro-wind plant (total power 11.3 MW) started operation. The project combines a wind farm and a pumped-storage hydroelectric power station. The water is stored in an upper reservoir and can be used when there is no wind to switch on the turbines or to generate electricity to cover demand [52-54]. The project is managed by a mixed private–public company, "Gorona del Viento El Hierro S.A", founded in 2004. The majority of shares are publicly-owned through the Island Council of El Hierro (Cabildo of El Hierro) (65,82%), the Canary Islands Government (3,23%) and the Technological Institute of the Canary Islands (7,74%). Corporate participation includes the private electric utility company Endesa (23,21%). This public–private partnership is unique for the Spanish energy system. After 50 years, the company will become solely public, with the Cabildo of El Hierro as the only shareholder.

The initial investment was covered by the Spanish Government through the Institute for Diversification and Energy Saving (IDEA) (35 M€), while the Cabildo de El Hierro, the Ministry of Industry of the Government of the Canary Islands and Endesa contributed 20 M€ as stakeholders. A bank loan of 25,6 million euros was obtained and repaid after three years of operation. The economic gains resulted from selling energy in the wholesale electricity market and from guaranteed capacity payments ("garantia de potencia"), a subsidy payment to ensure that the facility would be paid off in time. These subsidies are calculated annually taking into account various parameters, such as the initial investment cost and the cost of operation and maintenance, defined in Order IET/1711/2013 (see also [48]). These subsidies are paid indirectly by consumers throughout Spanish territory.

Part of the economic gains is distributed among the shareholders. The local government is the majority shareholder, and thus receives the largest share of Goronás profits. As the price of electricity in Spain is regulated through a unified price system, meaning that the price of electricity is unified over the country to avoid inequalities, the residents of El Hierro have not seen a reduction in their monthly electricity bill. However, the local government re-invests the financial gains in social projects for the islanders, such as subsidies for LED lights and campaigns to reduce plastic bag use and promote recycling, while a part is used to subsidize electricity costs of the most vulnerable households, or to contribute to actions to improve the energy efficiency of buildings.

3.3.2. Tilos

The island of Tilos is located in the southeast Aegean sea, with a total area of 61.49 km^2 and a population of 780 people. The island is part of the Kos-Kalymnos autonomous grid system that consists of 9 islands in total. In past years electricity demand was covered by two oil stations of 120 MW, one in Kos (102 MW) and one in Kalymnos (18 MW), supplying Tilos via an underwater cable. This connection is rather unstable, with many regular and long-term blackouts, especially during the summer months. Due to the island's small size and the distance from the mainland, there are currently no plans for further interconnection. The total annual electricity consumption remained steady over recent years at around 3GWh, of which 300 MWh emanate from public use (e.g., streetlights and water pumps). The remaining consumption is residential and commercial use, mostly for heating and cooling [55]. The cost of imported fuel corresponds to 75% of the total expenditures for the Kos-Kalymnos system. The average electricity price in 2019 was 153 €/MWh, significantly higher than the mainland where the cost was 58.2 €/MWh [56].

In 2015, the local government decided to develop and operate an innovative renewable energy project as part of the island's sustainability plan. The energy plan has become the main strategy against unemployment, migration, stagnant economic growth, degrading of common identity and mass tourism. The system is a hybrid photovoltaic/wind/storage energy system that consists of a wind turbine (800 kW), a PV park (60 kW), distributed heat storage to control domestic electrical water heaters, and smart meters that monitor and regulate residential and community energy loads [57]. NaNiCl2 batteries (2MWh) are used to store excess energy to ensure security of supply and ancillary services. The battery storage system can provide up to 12 h of energy autonomy for Tilos without any other electricity source. By switching to renewable energy, the project will reduce annual CO_2 emission by almost 1.5 kilo tons (-0.39%) in the non-interconnected islands and is expected to reduce the electricity price in the system by 350.000€ annually. In contrast with El Hierro, the island of Tilos has a shorter tourist season, and the arrival of about 1000 tourists between June and August increases the energy demand almost threefold (Fig. 2). During these peaks, the project will be able to cover about 80% of energy demand, while the remaining energy requirements will be imported from Kos. In contrast, the expectation is that during windy and sunny days with less demand, excess power could be passed to Kos.

The project is a multinational European demonstration and research project engaging 13 participants (4 industrial partners, 7 academic and research partners, 2 distribution system operators and 1 non-

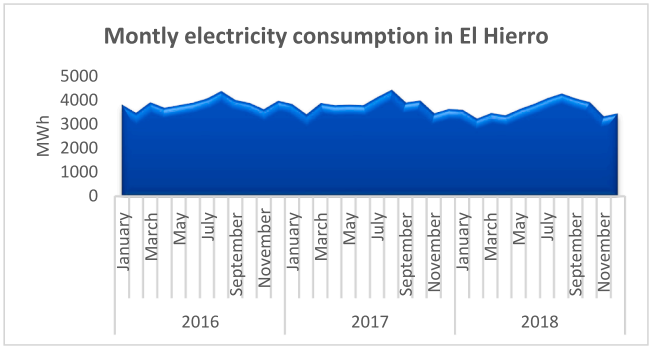

Fig. 1. Profile of monthly energy consumption on El Hierro (Jan 2016-Dec 2018). (Source: Instituto Estadistico de Canarias, 2021).

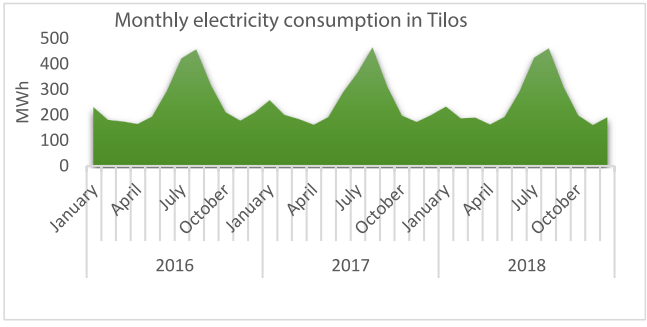

Fig. 2. Profile of monthly energy consumption in Tilos (Jan 2016-Dec 2018). (Source: HEDNO).

governmental organization). Tilos has the first contract for the sale of electricity from a hybrid station in Greece signed by the Hellenic Electricity Distribution Network Operator (HEDNO) and the private energy group Eunice Energy Group (EEG), which operates the project. The project was funded with 11 m€ from Horizon 2020, and 4 m€ from private funds. According to Law 3468/2006, 3% of the total net gain from selling energy to HEDNO returns to the municipality. A third of this is deducted from the bill to cover the residents on the island. For the first year of operation. this amount was 2.055,66 euros [58]. The remaining two-thirds are allocated to the municipality and are dedicated to other projects on the island, that will improve the quality of life of the islanders (books for the library, improvement of the community center, new infrastructure, recycling etc.).

4. Analysis

The two LE projects share similar broad goals and aspirations. These are not inherently aligned or against degrowth, but depending on the design and implementation model, they could fulfill certain degrowth principles, as discussed in Section 2. The two projects, then, can serve as tools for envisioning a potential degrowth path in small communities, similar to those assessed here. This conceptual framework is presented on Table 1. By connecting degrowth to the goals of the projects in the conceptual framework, we seek to embrace the plasticity of the degrowth concept and to explore realistic degrowth pathways. Note that the table below is intended as an example of a potential path adopted for these specific cases, but one need not assume that this is the only degrowth path.

4.1. Energy democracy

The TILOS and Gorona del Viento projects have been praised for the high involvement of local populations [59,60]. They offer alternatives to the centralized energy system within which local communities had no voice, and, as a result, both the reported projects are characterized by high levels of community acceptance (with no opposition or complaints reported). However, these characteristics are not enough to ensure a democratic project, especially under a hybrid ownership model where various actors interact, compete, and negotiate towards shared goals.

In Tilos, the community participated in the design of the project through direct public consultations. As a result, there was a change in the location of the windmill to a less favorable one to protect an endemic bird species, and so as to not disrupt the soil close to agricultural land by the installation of the concrete bucket. Information about the project was disseminated through leaflets, brochures, and the project's webpage. A T.I.L.O.S-info kiosk was installed and equipped with a small PV-roof system. Meetings between all project partners were held every six months, including workshops and roundtables. Moreover, educational projects were organized for schools, and training for adults on issues of environmental awareness and energy savings. Nonetheless, there was only a small core of about 50 people from the island who participated actively in the project design through the public consultation and the remaining population did not have an active role. Many of the discussions among the local people about the project occurred in informal settings, such as the public square and the neighborhoods. These discussions were then transferred to the municipal meetings through the small core of active residents.

Table 1
Potential degrowth paths.

Projects' goals	Potential degrowth paths
Active engagement of users	Energy democracy
Self-sufficiency and energy reliability	Reduction in energy consumption and increased energy efficiency
Re-localization of electricity production and energy autonomy	Low-tech and locally-produced alternatives for electricity production
Re-vitalization of the local economy	Support of small businesses, cooperatives, slow tourism, etc.

During the installation of the smart meters, people showed an increased interest as they felt that they were part of the project. By using smart meters, they believed they could control their consumption, adopt energy saving behaviors and see a decrease in their monthly electricity bills. The option to be notified to turn off unnecessary devices to avoid a blackout was one of the bigger motivations for the local people to install smart meters, and this gave them agency over their own consumption patterns. In some cases, there were concerns regarding the criteria upon which it was decided which households would get meters. In the next step, more smart meters will be installed to avoid discrimination. The next phase also includes the installation of photovoltaics on private houses in order to not only increase the use of renewable sources, but also to further create space for the participation of the local population in the project. Initial ideas for open assemblies and for organizing the project through an energy cooperative were not fulfilled in the first stage due to the requirements of EU funding, however, the creation of a cooperative in the upcoming months is expected to enhance a more democratic model of governance.

For Gorona del Viento transparency is an important aspect of the project. All information, as well as official documents, are available on the webpage of the project. The local population was involved from the very beginning, with a first public consultation held in 2004 during the design phase. Many worries expressed by the local population were considered during the design process. However, according to the local environmental organizations (I8) "*The interest of the local people at the beginning was high, however bureaucratic delays and lack of transparency at the initial stages alienated the local population.*" Initially it was expected that the local people would install solar panels on their rooftops and supplement the energy of Gorona del Viento. This was delayed due to the high economic cost of the project that absorbed all the available funds, and due to the royal Decree 900/2015 that added a tax on solar energy produced in households. With the suspension of the decree and the repayment of the bank loan to Gorona del Viento, the installation of solar panels on households and companies is the next step. The local population is also showing an increased interest in this idea – as one interview put it: "*we will all be happy if some of the income gained is used to subsidize the households with solar panels. Then we could talk about energy democracy and energy independency because it will affect us more closely*" (I9).

Initial complaints regarding the visual and aesthetic impact of the use of cement were resolved by covering the concrete massifs with stone and other materials that blend in with the surroundings. Some of the local environmental organizations requested a detailed environmental impact assessment after the presentation of the initial plant, which then led the Canary Islands Government to set 18 conditions for the project. Many people also voiced concerns that the project did not leave any money for the community and did not reduce energy bills. As one interviewee put it "*the economic impact on our pockets is the same but at least we know [that electricity] comes from a sustainable source*" (I10). In response, the local government ensured that part of the investment return (around 1 million euros annually) will be used for energy upgrade projects in old houses, as direct payments to households that face energy poverty, and to subsidize solar panels in warehouses and public buildings.

The organization and facilitation of the training by experienced non-governmental organizations, such as WWF and Red Cross, was a way to spark the interest of the local people. The training aimed to familiarize people with the energy project, and to educate them on the efficient use of energy and resources. In Tilos, WWF ensured the involvement of local people and organized public consultation as well as training on the use of smart meters.

The role of the local governments as a connector between the local community and the project was highlighted by participants in both cases. Local governments not only represented the needs of their people,

but also ensured a fair and just allocation of the benefits through the redistribution of the revenues to other socioenvironmental projects. On the other hand, private actors, it was felt, served as an impediment to participation and left little space for negotiation about the direction of the projects, especially after the design phase.

The projects enhance some of the notions of energy democracy, and, in that sense, they are interesting, but they cannot be considered as representative of a deep democracy and, by extension, of degrowth. Although the primary goal of the projects is not profit-maximization, there are no democratic mechanism in place, such as assemblies, elected citizen members on the board or the ability to directly discuss public petitions. This is because surplus revenue is still distributed as private profit to the actors. This is more evident in the case of El Hierro, where the main private company, Endesa, is also responsible for the operation of the thermal station on the island, raising questions regarding a financial interest of the consortium against generating too much renewable electricity [61]. In order to move closer to the notion of energy democracy as a degrowth principle, these projects should find ways to embed participatory approaches in decision-making, either through the creation of energy cooperatives, or through direct participation and voting. Similarly, the allocation of the benefits should be fair, transparent, and aligned with local needs.

4.2. Electricity self-sufficiency and reliability

The two islands aim to reduce their dependence on fuel imports and to become electrically self-sufficient. For this to be achieved, and insisting here on the degrowth perspective, a decrease in energy demand should be one of the main objectives, but this is not the case. On the contrary, some of the other goals surrounding the projects imply an increase in energy demand, as, for example, plans for more new tourist activities, opening of new businesses and increased in-migration. Such plans raise doubts about reaching energy independency in the long term. Both islands still rely on conventional diesel generators as backup engines, especially for days with high demand and low wind. In Tilos, the back-up diesel generator (1.45 MW) is manually operated [55].

As can be seen from Fig. 3, in El Hierro there was an increase in electricity consumption per capita until 2012, although this has stabilized since the beginning of the project, in 2012. Renewable energy still does not cover all the demand of the island (Fig. 4). El Hierro was covered for 596 consecutive hours. Between July 13 and August 7, 2019, all electricity demand from renewable sources. But it is now clear that the project has reached its full capacity, covering around 50–60% of the island's annual demand, and unlikely to reach 100% cover. The hydro-pump system has significant energy losses due to sharp fluctuations in load, the small capacity of the lower reservoir, the inappropriate location of the turbines and their small size [62]. The managers whom we

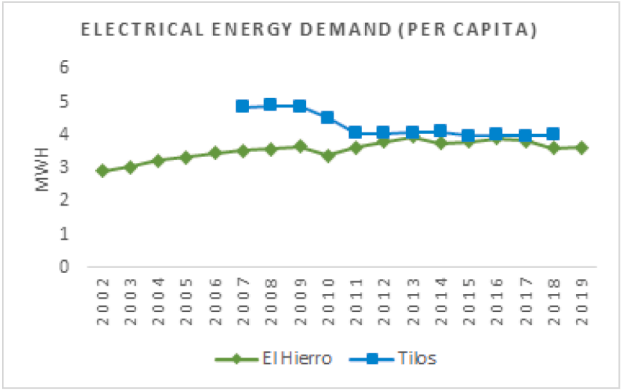

Fig. 3. Electricity consumption per capita for the years 2002–2019 (Sources: Instituto Estadistico de Canarias 2021, HEDNO 2021).

interviewed accepted technical obstacles and miscalculations, but claimed that the project is showing increased performance, claiming that "*difficulties are inevitable in innovative projects like this*" (I8). These problems are expected to be resolved with new investments that will "*reinvent the project*" (I8), including smart meters similar to those in Tilos, by reducing the demand when the turbines are no longer spinning by notifying people to reduce their consumption and turn off unnecessary devices. In this way, the island's hydro reserves will last longer. The installation of solar panels on houses and businesses will also help the island to work towards its target of 100% renewable electricity.

In Tilos, the total annual electricity consumption of the island decreased between 2008 and 2011, due to the economic crises and out-migration. But, in recent years, it remained stable at around 3GWh, with a peak load demand of around ~ 900 kW and an average load of 350 kW. It is difficult to draw conclusions regarding energy savings, as there is lack of available data regarding the real population on the island, as a significant number of people registered as residents live outside during the winter. The results of the trial period between 1/9/2018 and 20/1/2019 [63] indicate that the hybrid station can cover the electricity needs of the island for several days, especially during the windy month of December, when the RES achieves an average monthly penetration of about 90%, that, in some cases, allows the export the excess of energy to Kos [64]. However, there were still periods of deficit where energy had to be imported, especially during summer when there are no strong winds, and the energy demand is high. To cope with these periods of high energy demand, about 100 smart meters were installed, offering the potential to manage 15–20% of the peak load demand of the island. With these smart meters, the load demand of the island can adapt to better match the available RES production and avoid blackouts.

In both cases interviewees share the belief that increases in energy demand can be compensated for by increases in energy efficiency. For example, in Tilos, "*investments in new and more efficient devices*" (I8) and "the *purchase of upgraded and more efficient electric supplies*" (I19) is expected to reduce energy demand. Indeed, there are some efforts to push for behavioral change towards more sustainable consumption. In Tilos, education programs regarding electricity consumption, the distribution of LED lights, and the use of smart meters aim in this direction. According to one interviewee (I15): "*the use of smart meters that are already installed in various households will help regulate the energy demand and achieve 100% energy autonomy*", as they will allow people to modify their electricity consumption based on the available levels of renewable energy. This type of regulation of consumption on the demand side is important because "*people value more energy excessiveness and pay less attention to energy efficiency*" (I12).

In El Hierro there are also efforts to raise awareness regarding energy consumption, especially, as in the first phase, a misunderstanding led the local population to believe that energy produced with water and wind is free, that they could pay less than before, and, thus, that they could consume more; an indication of a rebound effect. Since 2019, Gorona del Viento implemented action to adjust demand behavior, acknowledging that energy efficiency does not only depend on how energy is generated or distributed, but also how consumers use it.

Additionally, both projects aim to invest in electric vehicles. El Hierro approved a plan to subsidize 50% of the cost for the purchase of private electric cars and motorcycles. In Tilos, the priority is a public electric bus and electric vehicles for the municipality. The use of electric cars, while reducing CO2 emissions, also increases electricity consumption and the extraction of resources. Some of the environmental organizations in El Hierro raise significant questions regarding the ambitions of the local government to simply swap the 6,000 conventional petrol and diesel cars for electric ones over the next 10 years, without promoting alternatives such as car sharing or improving public transportation. The example of Tilos, that aims to promote public transport instead of the purchase of new cars, lies closer to a degrowth spirit.

As the goal to achieve 100% electricity self-sufficiency seems unattainable under the current project design, more "high tech solutions" are

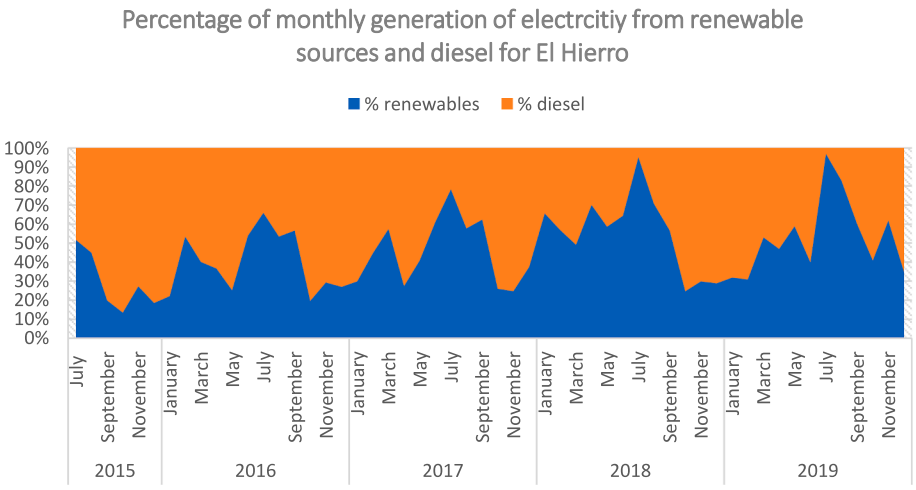

Fig. 4. Percentage (%) of monthly generation of electricity from RE and diesel for El Hierro (Jul 2015-Nov 2019).

put on the table. Instead of trying to find ways to further decrease energy consumption, the expansion of technological solutions is being considered to cover the increased demand resulting from the economic growth of the communities.

The idea fostering innovation and testing new technologies under the ecological modernization banner is supported mostly by the private sector and the research institutions who see these projects as an ideal way to test and promote new smart renewable energy solutions. This has overshadowed the idea of simpler low-tech initiatives and has given less attention to consumption. This is contrary to the spirit of degrowth, that claims that energy efficiency improvements are not enough and, thus, more radical changes in consumption patterns are required [65].

A better degrowth approach to achieve the goal of self-sufficiency would include small-scale, simpler technological solutions with a stronger focus on the demand side and changes in social norms and lifestyles. There are several alternatives that could help the islands reduce their electricity consumption and achieve their goal of 100% electricity autonomy, from biking and public transport to communal cooking and DIY projects.

4.3. Re-localization of production

The projects promised a re-localization of electricity production. Currently, the two cases have partially achieved this, in that a portion of the operation and maintenance has indeed been localized. The experienced staff for the construction, however, came from outside the islands. In Tilos, there is one trained person to maintain the installations, while in El Hierro the staff of Endesa operates the Llanos Blancos thermal station and are responsible for the maintenance of the renewable energy project. The control rooms with the software for demand forecasting and real time management are not located on the islands. Most interviewees claimed that this outsourcing is reasonable given that the lack of people on the islands with the relevant knowledge to work in the projects. This, together with the lack of local funds, has led the projects to depend on external funding and big private actors. Some respondents were sceptical, claiming that, although some of the processes had to be outsourced, such as the construction of solar panels and aerogenerators, the possibility remained to install control rooms on the island, and to train local people to operate the projects, thereby avoiding dependence on either Endesa, or Eunice.

Degrowth advocates for localized production, whether publicly or communally governed, minimize the distance between production and consumption and enhance community autonomy. This analysis indicates that this ideal is challenging for the periphery as far as renewable energy is concerned. Islands have been traditionally dependent to a high degree on bigger urban centers. And the technologies used, at least in the two cases studied here, depend on external support and funding that make private–public partnership necessary, although it inevitably limits local autonomy. However, even under this partnership, there could be space for more degrowth approaches focusing on supplementary low-tech initiatives, training and employing local people, relying more on inhouse expertise and circulating free knowledge through workshops that will restructure and re-localize the production. Instead of focusing on creating only green employment as a consequence of innovative technologies, degrowth advocates focus on local sustainable production and a better work-life balance.

4.4. Revitalization of the economy

By linking the energy sector to other dimensions of society, feedback loops bring side effects and indirect benefits. Investments in RE can attract more capital, and drive population growth through reduction of out-migration and increase of in-migration, because of better public infrastructure, better public services, and new job openings. They can also enhance community cohesion and boost local entrepreneurship. On both islands, the investment in the energy project was envisaged as part of broader plans to create longer-term economic benefits.

By moving in this direction, the income from selling energy will be used for other local projects that can revitalize the local economy under the supervision of the municipality. Apart from the two direct new job openings in Tilos and eight in El Hierro, employment opportunities were also created in other sectors, like or example in the local museums and visitor centers. Gorona del Viento, in partnership with Red Cross, during 2020, trained 17 people on energy saving measures, energy efficiency, electrical risk in homes, and other related skills. Eventually, these trained people will carry out inspections and audits to identify vulnerable households that suffer from energy poverty. According to one respondent from the island (I3): "*it is important that the local government decides how to re-invest part of the gains. Because of that, social goals are a priority compared to the private interest which is mostly profit-oriented.*" In El Hierro these gains will be significant, as the local government is the main stakeholder and, thus, allows for further investment in other social projects and endogenous growth of the communities. In Tilos, gains are estimated at around 5.000 euros annually, while still offering some indirect benefits to the local community with small projects such as improvements in road infrastructure, public lighting, and similar municipal initiatives.

In Tilos, the lack of employment opportunities and the difficulties related to infrastructure and education pose difficulties for young people. The project provided income diversification and an increased

standard of living. Indeed, Tilos was one of the islands that reported an increase in population over recent years; the number of permanent registered residents increased from 271 in 1991 to 823 in 2013 [66]. Although this cannot be directly associated with the energy project, the local government claims that it is a result of the broader sustainability plan of the island, the main pillar of which is the renewable energy project, which has improved living conditions overall and the opportunities that people can see for themselves on the island. Access to reliable energy with fewer blackouts is expected to favor the establishment of small-scale industries and new businesses that will stimulate income generation activities. For instance, one of the members of the local cheese cooperatives mentioned that access to secure energy allows them to increase their milk and cheese production, knowing they can keep their products in good condition until they sell them. They also claimed that, after the recognition of the island as a sustainable destination, their products have gained publicity.

In El Hierro, the Gorona de Viento and the Natural Biosphere Reserva have joined forces for the purpose of "*maintain(ing) the traditions and idiosyncrasies of the Herreño people*" with "*new development projects, which demonstrate the integration of the population in the territory, with the responsible use of its resources*." These projects put an emphasis on the promotion of local products as part of a brand entity, that will revive the island's cultural identity, and support local business and sport activities [67].

Tourism was another sector that benefited indirectly from the energy project. Secure energy supply reduced the frequent blackouts that were harming the tourist sector and the reputation of the island. Additionally, energy tourism is being promoted as a new concept. This form of tourism includes visits to energy sites, visitor centers and educational programs promoting the energy project. Both Tilos and El Hierro combined the energy projects with programs of environmental education, summer schools and conferences, in order to attract technologically-curious, environmental-friendly and 'off-the-beaten-path' tourists.

Additionally, public advertising of the islands using energy projects as a tourist marketing strategy, has led to an increase in tourist arrivals. For instance, since the beginning of the project, tourism in El Hierro has jumped from 5773 visitors at the beginning of the project in 2013 to 9028 in 2019, while Tilos has extended its tourist season by 2 months (May and September). One interviewee from Tilos (I11) mentioned that: "*we had many loyal visitors who (have) come for about 30 years. However, (we) now see more young people coming who found out about Tilos because of the renewable energy project and they want to express their support.*" Every summer, energy demand in Tilos almost triples because of tourist arrivals, however, project managers do not expect this demand to increase further as: "*Many of our tourists are camping or spend the whole day outdoors, not using air-conditioning or other electric devices*" (I11). For this reason, with the installation of private solar panels, the island expects to manage the demand from renewable sources even during most of the tourist months.

Similarly, "sustainable tourism" was a central objective in El Hierro over the past two decades, and "*the energy project has sparked the interest of tourists, who want to visit the small island*" (I9). To protect against mass tourism, the number of visitors is regulated through limited available accommodation options that include mostly eco-friendly hotels and hostels, eco establishments, agrotourism, etc. Further, the island has strict regulations regarding hotel and taxi licenses. As with Tilos, El Hierro has no international airport or cruise port making access difficult. Sailing has recently been promoted as a low impact alternative for visiting the island. By regulating tourist activities, the project managers claim that there will be no excess energy demand from tourism in the coming years.

Tourist activities are not inherently against degrowth. Indeed, many forms of tourism can help communities achieve locally defined goals which go beyond income and economic growth. In our case studies, there was an explicit orientation towards 'slow tourism', community-owned tourism and energy tourism, with the energy projects being successfully used as promotional tools. The increase in tourism is regulated to avoid peaks in energy consumption. In this way, we can conclude that the two energy projects support a tourism economy that is not incompatible with the ideal of degrowth towards economic diversification and revival. Tourist activities on the two islands are not focused solely on an economic bottom-line, but, on the contrary, can help achieve long-term community goals that include strengthening the primary sector, cultural reclamation, and environmental protection.

5. Discussion

This study has examined in-depth two LE projects located on islands in southern Europe. The rapid growth of LE projects in Europe and the increased attention on islands as socio-technical imaginaries, make the present paper relevant to the discussion of energy politics, democracy, and societal transformation. Despite their small size and local boundaries, LE projects have the transformative power to lead the energy transition and to push for new social imaginaries [68]. Degrowth provides a promising post-capitalist imaginary, but it still lacks a concrete connection with LE initiatives in real life settings. Our research draws such parallels and while pointing out the caveats.

More concretely, on the one hand, local governments can exercise some leverage in negotiations for new pathways for local development, exploring ways to benefit the community. This aligns with expectations that local government can play an important role in local bottom-up RE initiatives [69]. On the other hand, private companies ensure that funds and knowledge are available, while using the islands as laboratories for new technologies. Our research challenges the notion that the roles and relationships between actors are scripted a priori, and points to a more experimental model that blurs the boundaries between corporate, public, and civil roles, leaving space for greater social change. In the 'hybrid' arrangements studied in the present paper, corporate interests were associated mostly with profit and promotion of renewable technologies, but they also supported social development to a degree, and engaged with the aspirations of the communities. On the other hand, there was limited interest from the local population to engage in decision-making in formal settings.

The incentives for the projects are not incompatible with degrowth objectives of clean energy, sufficiency, and localization, however, certain outcomes remain tied to an economic growth mindset. For instance, increased energy demand is met with energy efficiency measures, not sufficiency or demand-side management. The present inability of the projects to reach 100% electricity self-sufficiency will continue to be encountered as additional investments in renewable energy technology come on stream.

Despite expectations that a more inclusive, just participation can be achieved through re-municipalization and decentralization, these desires were not reflected in the two cases examined here. On the contrary, we share the skepticism among scholars [11,16,25,70] that, although local voices are encouraged, they have little actual influence in decision-making, with their role limited to consultation, implying a lack of real energy democracy and justice in these local energy projects. The role of citizens was limited; they did not hold power through direct participation, but were mostly represented through the municipalities. At the moment, the focus on clean technology investments in line with the strong presence of private actors, leaves little space for direct democracy and community empowerment, despite the efforts of local governments. Thus, we can assume that the higher level of energy democracy through deliberative democratic mechanisms, which is a prerequisite for a degrowth-oriented transition, has not yet been achieved in these projects.

Although there was an increased focus on the local character of the projects, these are still highly dependent on the mainland and global capital and knowledge flows. This dependency, although inevitable to a certain degree, is also a result of the private involvement in the projects and goes against the goal of increasing self-sufficiency. This finding

aligns with similar findings from other research, such as that of Cebotari and Benedek [71], who also reported a strong dependence of peripheral LE projects on core urban centers, where many of the companies providing capital and know-how are located. Alarcón Ferrari and Chartier [25] mention that, although the shift to renewables led to higher self-sufficiency, the community of Vaxjo is still dependent on imported fuels for transportation to access the biomass. Findings from Indonesia also indicate that energy projects did not ensure capacity-building for the communities involved [72].

Local energy projects seem to create opportunities for community activities through endogenous development, supported mainly by local governments. Considering the relationship between tourism and degrowth, the two case studies are good examples of an alternative form of slower tourism. Although the islands used the energy projects as place-branding for tourism, the local population and municipalities designed tourist plans that avoided mass tourism and attendant increased energy and resource consumption.

In the light of what has been discussed so far, one might wonder how these initiaves would look under the lense of degrowth. One would imagine local energy projects with much more direct involvement of local communities (through regular assemblies), and with democratic control of the technological system, through, say, a municipal cooperative, or some similar scheme. One would further expect a noticeable reduction in energy use as a result of the implementation of the projects, and greater appreciation among inhabitants of energy sufficiency by curbing unnecessary excess energy use. Finally, the projects would act as loci for local economies – acting both as multipliers for local activities (such as tourism or small commercial ventures), while creating employment opportunities for locals or for people wishing to move there to live. From this benchmark, it is clear that, while the two projects do not yet live up to this standard, there are many nascernt elements – from the greater degree of public participation to the revitalization of slow-pace local economic activities – that suggest that local energy projects may be a vehicle for 'slowing down' energy systems and opening up alternatives.

We agree here with Kunze and Becker [16] that local projects may have the potential to embrace some degrowth ideas, but for this to happen, communities must explicitly embrace such potential. A Degrowth-compatible model would focus on engaging more actively with the local community to redifine their role as energy citizens [36,73]. Efforts for democratizing energy systems can use informal arenas to involve the local population. [74]. Further, the fetihization of modern technology and the belief that simply more technology can solve the socio-economic problems that these islands face, can paradoxically lead to undemocratic processes and higher dependence on profit organizations and experts, thereby actually reducing the autonomy of the local population. Now that implemeted technologies are nearing matureity, the focus of the projects should shift to reorganizing social practices and fostering new values. The local government and the private companies involved can shepherd this new direction by re-investing profits in low-tech initiatves, free workshops, communal kitchens, and similar initiatives. As a matter of fact, there are exampes of for-profit organizations that have undertaken similar actions, blurring the distinction between for-profit and not-for-profit orientations [75]. Thus, the islands should take advantage of these multi-sector coalitions to grasp the mutual benefits that will improve local energy system [76], and redirect local economies away from growth determinism.

6. Conclusion

Despite similarities in their respective goals and management models, the two case studies cannot be reduced to a single dynamic. In fact, in each case, we find ideas and approaches that align with degrowth, such as the push for public transport and bikes in Tilos, or the training of young people in energy savings measures in El Hierro. However, the similarities beween the two cases indicate a trend in the organization and function of local energy projects, at least in island settings [77]. The degrowth momevent should critically engage with these new arrangements, point out structural problems, and tranfer good practices from one case to another via networking. It is important that these partnerships work to avoid creating mistrust that would, in turn, hinder future efforts, as observed in other cases [42].

Of course, beyond degrowth, one should not overlook or underestimate the achievements of Tilos and Gorona del Viento. Their initiatives embrace innovative technologies and new forms of ownership in novel settings. The energy projects give insular areas a way out of the socio-economic crisis they have faced in the past years and suggest a greater potential for a quick recovery in a post-Covid era. They open up both a path of modernization, and commodification, with a conventional opportunity for the islands to 'catch-up' with urban centers. But they also open up a degrowth path based on sufficiency, democracy, and collectivity. The story told in this paper can is an important step for local communities to follow a degrowth lead and head societal transitions.

A final reflection from our work, is that future studies are needed to explore the potential of varied organizational models of energy for degrowth, the challenges they face, their transformative potential in the era of green growth and mega-projects, and the role of the different and varied actors involved.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A

Interviewee	Case	Affiliation
I1	El Hierro	Gorona del Viento
I1	El Hierro	Gorona del Viento
I2	El Hierro	Gorona del Viento
I3	El Hierro	University
I4	El Hierro	University
I5	El Hierro	Endesa
I6	El Hierro	Cabildo de el Hierro
I7	El Hierro	Cabildo de el Hierro
I8	El Hierro	Environmental organization
I9	El Hierro	Business owner

(*continued on next page*)

(*continued*)

Interviewee	Case	Affiliation
I10	El Hierro	Business owner
I11	Tilos	Municipality
I12	Tilos	Municipality
I13	Tilos	University
I14	Tilos	University
I15	Tilos	University
I16	Tilos	University
I17	Tilos	Eunice
I18	Tilos	Eunice
I19	Tilos	WWF
I20	Tilos	HEDNO
I21	Tilos	Public worker
I22	Tilos	Cooperative
I23	Tilos	Business owner
I24	Tilos	Business owner
I25	Tilos	Business owner

Appendix B

Open ended questions sample for the interviews

- Describe the project
- What are the main short-term and long-term goals?
- Have they changed during the implementation? If yes, why?
- What is the role of the local community?
- How did the local community participate in the design and implementation?
- Did any of the outcomes change after consulting with the local community?
- How did you ensure that the project is inclusive?
- What are the benefits for the local community?
- Are there any other environmental initiatives on the island? If so, which ones?
- Since the beginning of the project did you see any changes in the behavior of the people or way of thinking towards sustainability?
- Which were the main obstacles during the implementation of the Project?
- How are you dealing with these obstacles?
- Many of the goals you mentioned imply an increase in energy demand. How will you cope with this?
- Among the main goals is the revitalization of the community. Explain
- What was the role of the local government in the design and implementation of the project
- What are the next steps for the projects

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6.3 Section B- **Chapter 3**

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RESEARCH ARTICLE

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Sustainability of local renewable energy projects: A comprehensive framework and an empirical analysis on two islands

Marula Tsagkari[1] | Jordi Roca[1] | Phedeas Stephanides[2]

[1]Department of Economics, Faculty of Economics and Business, University of Barcelona, Barcelona, Spain

[2]School of Environmental Sciences, University of East Anglia, Norwich, UK

Correspondence
Marula Tsagkari, Diagonal 696, 08034 Barcelona, Spain.
Email: marula.tsagkari@ub.edu

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Abstract

Local energy projects have been associated with several benefits for the local community like social cohesion, economic gains, new skills, and environmental awareness. Yet, there is limited research on whether the projects fulfill their sustainability promises, and how the local community perceive the benefits. This research introduces a novel framework to assess the success of a local renewable energy project based on the perceptions of the local population and the initial ambitions of the projects. Using this framework two innovative local renewable energy projects are assessed; one in Tilos island in Greece and the other in El Hierro in Spain. An online questionnaire was used to assess the impact of the project on people's lives, their overall assessment of the project and their willingness to support similar future initiatives. The data show that the economic benefits are not significant when people assess the project, while on the contrary other factors like the environmental benefits, sense of pride, technical parameters institutional seem to have a greater effect. The environmental and institutional factors are also among the ones that influence people's willingness to support and participate in future projects. Overall, we reveal that the two projects are quite successful in the eyes of the local population and offer good case studies with several implications for policymakers and future initiatives.

KEYWORDS
impact evaluation, islands, local energy, local impact, sustainability

1 | INTRODUCTION

Decentralized small scale energy systems that bring closer energy generation and consumption can play an important role in the energy transition. Local renewable energy, especially when coupled with smart grid and storage technologies, holds new possibilities for insular and isolated areas that face multiple challenges the past years. High level of unemployment, land degradation, lack of resources and out-migration combined with lack of affordable, secure, and reliable energy supply are some of the reasons that lead insular communities to look for alternative strategies to promote development (Connell, 2018; Kaldellis & Zafirakis, 2020).

Alongside addressing the energy trilemma (i.e., affordability and access, energy security and environmental sustainability), a sustainable plan centered around a renewable energy project can have multiple local benefits for the communities: new income streams, job opportunities, increase in social cohesion, and new skills and knowledge. These plans are often built around the three main sustainability

pillars, namely environmental, social, economic and they include additional dimensions like cultural, technical, and institutional. As the economic and institutional barriers for small scale renewable energy projects are lowering, many islands around the world with favorable conditions explore these opportunities (Jaramillo-Nieves & del Río, 2010; Kaldellis & Zafirakis, 2020; Al Katsaprakakis et al., 2019; Stuart, 2006).

In relevant literature there is an increased discussion around the factors that influence people's willingness to accept renewable projects, the public attitudes prior to the project implementation, as well as the potential benefits that can result from these initiatives. Among others, scholars in the field have moved significantly beyond the "NIMBY" (Not-In-My-Backyard) hypothesis which stigmatizes objectors of local renewable energy projects as egoistic, misinformed, and ignorant, arguing instead that the perceived fairness in the distribution of relevant costs and benefits and emerging relationships with project developers influence community acceptance (Devine-Wright, 2013; Guan & Zepp, 2020; Segreto et al., 2020; Sloot et al., 2019). Surprisingly however, there is little attention given on the levels of satisfaction with the projects post-implementation. In an attempt to cover this gap, we present a new framework to assess the early-stage performance of a given project considering both specific goals set prior to implementation and emerging ones linking to the notion of "living" projects. We also take our analysis one step further and try to understand which factors tend to affect people's perception regarding the overall, early-stage success of a project and the factors that can influence their willingness to support further initiatives in the future.

An established stream of literature that addresses sustainability at a local level (Hartmuth et al., 2008; Shi et al., 2021). This is because sustainability is not only a global issue and communities are often considered the appropriate level to discuss many sustainability issues (Rae & Bradley, 2012). The present study focuses on two case studies from the small islands of Tilos (Greece) and El Hierro (Spain) that have recently implemented innovative and ambitious renewable energy projects in order to cover the local electricity needs. The results are based on online surveys that were launched on the two islands with questions regarding the success of the project, the impact it has on people's lives, as well as their attitudes towards future projects. The overall aim of the study is to answer the following questions:

1. How successful are the projects according to the local population in each of the sustainability pillars in their early stage of operation?
2. (a) Which factors influence people's perceptions regarding the overall "success" of the projects? (b) Which factors influence people's willingness to support future similar initiatives?
3. What are the possible recommendations for improving the acceptance of similar projects from the communities and how can existing solutions be striven towards producing more benefits for local communities?

The rest of the paper proceeds as follows: in Section 2 we start with a review of the available literature on sustainability analysis of local energy projects with a focus on the relevant frameworks. In Section 3 we introduce the two case studies and the framework. In Section 4 we present the methodology and data collection approach and in Section 6 we present the results of the analysis, which are then discussed in Section 7.

2 | LITERATURE REVIEW

Many renewable energy projects set broader societal goals that go beyond mere electricity production. Local small-scale projects have been praised for the positive impacts they can have on the local communities like income generation effects, in-migration, education, productive diversification, social cohesion, human development, industry creation and income distribution, among others (Hong & Abe, 2012; Jaramillo-Nieves & del Río, 2010; van der Waal, 2020). Participants may be more inclined to get involved in the completion of these aims (Schmid et al., 2016; Seyfang et al., 2014; Strunz, 2014). Towards this direction, regular assessment of project goals implementation as well as of ambitious targets beyond the initial project scope is encouraged in order to seek for excellence and capitalize on project outputs. There is a lot of prior research on the implementation of the projects but very few studies look to what degree projects have managed to achieve sustainability in a broader context. There is also not a commonly accepted method to measure the impact of the projects on local sustainability dimensions. The few available frameworks applied in the literature are either only qualitative (e.g., del Río & Burguillo, 2008) or tend to focus on just one subset of issues like economic (Maqbool et al., 2020), justice and equity (Siciliano et al., 2021; Zhang et al., 2021), and employment (Heinbach et al., 2014), ignoring the holistic nature of sustainability. Gjorgievski et al. (2021) call for more research that combines economic, environmental and technical indicators under a common framework to assess the community impacts of projects. Additionally, project evaluations often come from outsiders—political, technical actors, and fail to include local voices (Ikejemba & Schuur, 2020; Maqbool et al., 2020; Yuan et al., 2021). Various authors have questioned that sustainable development and thus, relevant indicators are "subjective" and call for public participation as a central component in the evaluation of sustainability progress (Bell & Morse, 2003). For instance, McAlpine and Birnie (2006) from the Island of Guernsey highlights the need to "take the indicators into the community" meaning to engage proactively the local population in the design and evaluation of local indicators.

Some recent research has tried to fill this gap with the presentation of new frameworks that include different stakeholders and aspects of sustainability, but mostly in less affluent settings. For instance, Dauenhauer et al. (2020) apply a new sustainability framework to evaluate 65 solar projects in Malawi. They combine a survey and interviews with key stakeholders and use project centric indicators as an assessment tool. Their work is complementary to Katre and Tozzi (2018) who proposed a novel framework based on different metrics and scoring methodology to assess 40 off-grid projects in India. In other research Bhandari et al. (2018) used five sustainability themes and 54 sub-indicators that were weighted from the

community to assess the sustainability of a micro-hydro plant. Terrapon-Pfaff et al. (2014) reviewed 23 local development projects post implementation in various developing countries. The authors conclude that despite the different geographical, social, economic, political, and cultural contexts there are some similarities on the factors that influence mid-term sustainability, like sense of ownership, knowledge capacity, network connections and commitment. In the work of Shoaib and Ariaratnam (2016) in rural Afghanistan, several indicators were used to measure the socioeconomic impacts of community energy at the household level through questionnaires disseminated in the local community. The results indicate that only "modest improvement" was observed, and economic indicators seem to have the lowest improvement scores. In another study from Indonesia the authors concluded that micro hydro projects perform well in most sustainability indicators except economic, as they do not have an economic scheme in place (Purwanto & Afifah, 2016). Armanios (2012) proposed three sets of indicators economic, engineering, and environmental to assess three village water projects in Egypt. The innovation of his approach is the use of a framework that includes the community-of-practice (CoP) approach and the capability approach (CA), while he distinguishes between project goals and practices.

However, the most prominent research that uses indicators to assess the sustainability of renewable energy projects is the one by Ilskog (2008). Using 39 indicators from the five dimensions of sustainability, namely technical, economic, social, environmental, and institutional, the author created a comprehensive method for sustainability evaluation. Since this publication, the framework has been used by various authors, but has also received various criticism. According to Dauenhauer et al. (2020) the indicators used, are more relevant in the country level while often indicators represent the authors conceptualization of sustainability and not the real project results. Additionally, the framework is centered around rural electrification in developing settings and has been applied widely in African countries (Ilskog & Kjellström, 2008) and in other less affluent countries like Nepal, Peru and India (Bhandari et al., 2018; Yadoo & Cruickshank, 2012). The same frameworks cannot be applied to more developed areas where access to electricity, school education and access to clean water are less of an issue.

One of the few studies in more developed settings is the recent analysis of van der Waal (2020) that examined the impact of a community wind project on the local population in Scotland using the changing mapping approach. The authors highlight the need for a comprehensive evaluation framework claiming that often the literature is uncritically positive when it comes to energy communities and their impacts. In another study by del Río and Burguillo (2008, p. 1317) a theoretical framework developed by the authors was used to assess the impact of renewable energy projects on local sustainability in three cases in Spain. The approach includes various stakeholders and 11 indices namely: impact on education, employment, income generation, demographic impacts, energy accessibility, social cohesion and human development, tourism and use of indigenous resources. The study found that the projects have a positive impact on employment and that they can improve the standard of living, and the social cohesion of the communities.

Hicks and Ison (2011) focused only on community-owned projects and analyzed two case studies: Community Energy Scotland and Minwind, Minnesota, USA. Their analysis is qualitative using data from interviews with project directors, project managers, engineers, volunteers, researchers, and other involved actors. The results include technical benefits like energy reliability, but also social benefits like social cohesion, the creation of a common response to problems and economic benefits to the community especially on local labor and business. The review of Jaramillo-Nieves and del Río (2010) is the only article that focuses solely on islands. The authors synthesize ex-ante and post-ante evaluations from small islands around the world. They discuss the importance of small islands as renewable energy hubs and highlight the lack of multicriteria studies that focus on the three dimensions of Sustainable Development (SD), as well as the need for more quantitative and in-depth case studies.

A second extensive pathway of research analyze the factors that influence people's perceptions on renewable energy and their willingness to accept and support projects on their area. This research that emerged as a response to the literature that was treating communities as an obstacle in the implementation of renewable energy projects focusing on the NIMBY. This new approach argues that project specific factors influence public acceptance. These factors can include the local impacts, the levels of trust and familiarity with the management organization, and issues of procedural and distributive justice (Devine-Wright, 2013; Guan & Zepp, 2020; Segreto et al., 2020; Sloot et al., 2019). Demographic variables like gender, education and age, have been found to also play an important role influencing acceptance of energy projects (Devine-Wright, 2013; Ek & Persson, 2014). However, this research stream is limited on the pre-implementation stage.

Very few studies discuss how a positive experience with RE can increase the acceptance and willingness to support further projects. For instance, van der Horst (2005) found that people who live closer to a wind turbine changes people risk perception while Bauwens and Devine-Wright (2018) argue that the attitudes are different for people who live in proximity to a proposed project compared to those who live close to an existing project. In this line, the present study focuses on areas that already have implemented energy projects and explores the willingness of the local population to support and participate in future similar initiatives.

3 | THE CASE STUDIES AND THE FRAMEWORK

3.1 | Overview of the case studies

For the present study we tested a proposed framework in two real-life settings. As del Río and Burguillo (2008, p. 1317) put it: "Case studies allow the identification of economic and social relationships which are hidden in quantitative studies." In our study the use of two case studies allows us to capture the detailed social, environmental, and economic effects which will be otherwise difficult to capture.

The territorial dimension is the local level, and the indicators are evaluated on the island level. With the term community we refer to

the people who reside permanently within the island territory. The two islands chosen for this study are the island of El Hierro in the Canary Islands in Spain, and the island of Tilos, in Dodecanese in South-East Aegean Sea, in Greece. These islands are pioneers in the renewable energy transition with aspirations that could be considered as of going beyond simply renewable energy and touch upon social, economic, and environmental issues. Additionally, they are the two flagship projects of renewable energy innovation on Southern European islands that are currently in the implementation stage (Tsagkari, 2020). Although the boundaries of the island allow us to define the community and facilitate the research design a word of caution from Connell (2018, p. 2) is appropriate as "islands are far from synonymous with community; they involve diverse and contested interests and contain hierarchies, conflicts, tensions and resistance to 'outsiders,' both people and projects."

Tilos with a population of about 500 people is not interconnected with the mainland grid but belongs to the Kos-Kalymnos electricity system that relies on two thermal stations. To deal with the so-far dominant, oil-based energy model in the Aegean Sea, an innovative, local scale RES-based energy storage system was designed and implemented. The project consists of a wind turbine a photovoltaic park, $NaNiCl_2$ batteries for energy storage, energy management that extends to capture water-energy nexus aspects, and introduction also of clean electromobility elements. The project not only provides clean energy and electricity autonomy but according to Boulogiorgou and Ktenidis (2020, p. 399): "Tilos island offered as a natural living lab where are examined the sustainability and the interoperability of the energy solution." Other aspirations of the project include the creation of a sustainable tourism model locally, new employment opportunities, income generation, pro-environmental behavior and in-migration of young people to the island. In order to enhance a sustainable behavior among the local population several educational and training activities were organized at the initial stages of the project. An important component of the Tilos project is the design of a Demand Side Management and an intelligent Energy Management program that will manage the demand. However, the smart meters in the households are still at a very initial/pilot stage and for this reason are not included in the analysis.

Gorona del Viento is the flagship project of the El Hierro island, the smallest of the Canary Islands. Before the implementation of the project, the island relied on diesel consumption with elevated costs and emissions. Currently, a hydro-wind power plant that combines a wind farm along with a pumped-storage hydroelectric power station operates on the island. The Gorona del Viento project has a mixed ownership; the Local Government Council (Cabildo) a 60%, the private energy company Endesa (30%) and the regional government of the Canary Islands (10%). El Hierro has a strong sustainability profile (Garcia Latorre et al., 2019). A sustainability plan is designed since 1996, and the island was declared a Biosphere Reserve in 2000 making it worldwide known as the "Sustainable Island." This plan along with the Gorona del Viento project aim to make the island energy self-sufficient, support sustainable tourism, boost green growth, and protect the natural and cultural history of the island (del Viento, 2020). Similarly with the case of Tilos, environmental campaigns and trainings ensure that people are aware and informed.

3.2 | The framework

Inspired from previous research and the relevant literature gaps, discussed in Section 2, we designed an innovative framework to analyze people's perceptions on the success of the project post-implementation and their willingness to support future projects adapted to the island specific cases and oriented towards the project-specific goals. The framework is focused on the local sustainability impacts and does not include a measurement of global environmental, social, and economic effects. The survey questions reflect the five dimensions of sustainability namely economic, institutional, social, technical, and environmental (after Bhattacharyya, 2012; Ilskog, 2008). The use of indicators allows us to evaluate the progress towards specific initial and emerging goals. In order to choose the adequate indicators, we followed the criteria proposed by Shaaban and Scheffran (2017) and Ilskog (2008) presented in Table 1.

We organize the Factors under the main five sustainability Dimensions. In each Dimension there are several Factors, and each Factor is further characterized through a set of Indicators. Each Indicator is then associated with a question for the questionnaire (Appendix A). We used a Likert scale that ranged from 1 (strongly disagree) to 5 (strongly agree) for positive statements regarding the effect of the project on the indicator examined. The overall scores corresponding to each variable and each Dimension were then aggregated. As seen in Table 2 some Factors (economic and technical) have only one Indicator. This is because these Factors are easier to measure with one question, while others, like the social and institutional, are more complex and multidimensional. Thus, in order to avoid oversimplification, we chose multiple Indicators.

Multiple linear regression was conducted in Python 3.8.5 to test the relative importance of the variables on people's perceptions on the success of the project and their willingness to support and participate in future projects. Except from the indicators presented in Table 4, we also included Gender and Island as dummy variables, with "men" and "El Hierro" as reference categories, respectively.

3.3 | Economic dimension

The economic dimension measures the project's contribution to income-generating activities. The direct economic benefits are some of the more well-studied in the relevant literature (Allan et al., 2011; Slattery et al., 2011) and include reductions in the electricity bill and direct payments and/or compensations. The indirect economic benefits like job openings, and productive diversification of the area are more difficult to measure. In El Hierro there were no direct payments to the community due to the unified price system in the Spanish territory (see Tsagkari and Jusmet (2020). In the case of Tilos there was a small reduction in the electricity bill of the community that lead to economic savings. In our framework the economic dimension is expressed as "new economic opportunities" and is associated with the projects' ambition to boost the economy on the respective islands indirectly and mostly through tourist activities.

3.4 | Environmental dimension

The environmental dimension at the local level deals with the way the projects affect the environment directly, like the impact on the local environment and the land esthetics. Opposition to local energy projects due to the impact on land esthetics has led to cancelation and delays of projects worldwide. Although some impact of the renewable energy is unavoidable, a careful spatial design can minimize the visual and esthetic impacts. Beyond that, local renewable energy projects can have also indirect environmental impacts as they can encourage sustainable behaviors at personal and household level, reduce energy consumption and promote energy conservation (Gubbins, 2007; Rogers et al., 2008). Such behaviors can be included in the environmental dimension (Ilskog, 2008). Thus, in our study the environmental dimension consists of four items grouped under one factor: reliable energy, clean energy, energy savings, minimum impact on land esthetics, increased awareness about climate change, and awareness about renewable energy post-implementation.

TABLE 1 Selection criteria of indicators

Selection criteria	Description
Data availability	The possibility to collect data from surveys.
Consistency with objective	The ability to reflect the ambitions and expectations of the projects.
Independency	Indicators should not have an inclusion relationship at the same level.
Measurability	The indicators should be measurable.
Robust	The indicators shall be formulated clearly enough to be replicable in their application.
Comprehensive	The indicators need to cover all major aspects of sustainable development.
Simplicity	Ease of understanding by the local community.
Sensitivity	Capacity for allowing trend analysis.
Reliability	Unbiased and apt to capture both positive and negative issues.

Source: Adapted from Ilskog (2008) and Shaaban and Scheffran (2017).

3.5 | Institutional dimension

The institutional dimension refers to the organization issues of the project and the interactions between actors which shape the decision making and the power dynamics (Hoppe et al., 2015). The institutional sustainability is central for local projects, and it requires effective local governance structures which are also inclusive ensuring participation from all the members of the community (Katre & Tozzi, 2018). In our analysis we aim to capture this dimension with four indicators: active participation of the local population, active participation of the local government, effectiveness of the local government, and inclusion of different voices, grouped under the variable "organizational structure."

3.6 | Social

The social outcomes are less tangible and thus, more difficult to measure. Some of the social benefits observed in the literature include the increase of self-confidence and autarky of the population and their

TABLE 2 The framework with the dimensions, factors, indicators and the relevant project goals

Sustainability dimension	Factors	Indicators	Relevant project goals	Question number (Appendix A)
Economic	Economic benefits	New economic opportunities	Boost the economy on the islands	Q5
Social	Social cohesion	Sense of community	Energy independence, community building	Q6
	Sense of pride for the island	Sense of pride for the island		Q7
	Autonomy	Feeling less dependent from the mainland		Q8
Environmental	Environmental development	Energy savings	Provide the islands with clean and reliable energy with minimum environmental impact and create sustainable behaviors on the island.	Q9
		Clean energy		Q10
		Increased awareness about climate change		Q11
		Increased awareness about renewable energy		Q12
		Esthetics		Q13
Institutional	Organizational structure	Community involvement	Participation of the local inhabitants and the local authorities	Q14
		Inclusion		Q15
		Participation of local governance		Q16
		Effectiveness of local governance		Q16
Technical	System design	Appropriative system design to cover the local needs.	Innovative systems	Q30

level of engagement in other local initiatives, increased social cohesion, and immigration of young people to the area (Süsser & Kannen, 2017). Especially in the isolated environment of islands, the energy projects can help the community function and prosper without being dependent on energy imports from the mainland (Rae & Bradley, 2012). The social impacts are quite diverse making the creation of a single factor difficult. For this reason, the social dimension consists of three separate factors: "social cohesion," "autonomy," and "sense of pride."

3.7 | Technical

The technical dimension refers to specific technical issues, many of which are difficult to be captured from the local community or are interrelated with other dimensions (Ilskog, 2008). In our research we chose to refer to the system design (combination of hydro and wind energy for El Hierro and batteries and wind/solar energy for Tilos) and the satisfaction of the users with this design as the adequate solution to cover their electricity needs.

3.8 | Dependent variables

Two items measured respondents' satisfaction with the project: "Overall Project Assessment" and "Overall impact of the Project on Personal life" (Cronbach Alpha: .82). In order to measure people's view towards similar future projects we used two items, namely: "Support similar initiatives in the future" and "Participate in similar initiatives in the future" (Cronbach Alpha: .73).

4 | METHODOLOGY

4.1 | Data collection

The design of our survey is based on the methodology proposed by Oppenheim (1992). We developed the applied questionnaire in an interactive approach to assure its appropriateness and applicability (Preston, 2009). The first draft of the questionnaire was reviewed by experts and the changes considering wording, question order and clarity were incorporated in the second draft. The questionnaire was then translated into Greek and Spanish respectively from native experts, A pilot study was conducted in June 2019, when 22 questionnaires were collected in Tilos. Certain changes were incorporated after the pilot study leading to a third draft that was then reviewed again by experts.

The initial plan to conduct door to door surveys was not possible due to covid restrictions. Instead, the questionnaires were designed and disseminated online through the platform Survey Anyplace (Edegem, Antwerpen). Various local collaborators led the dissemination including municipalities and local newspapers. The surveys were also posted on social media. The online surveys took place between December 2020 and February 2021. In the case of Tilos where the is a big percentage of elderly population, in parallel with online questionnaires, hard copies were also collected with the support of the local municipality.

TABLE 3 Key characteristics of the survey respondents for El Hierro ($N = 145$) and Tilos ($N = 50$)

	N	
Variable	**El Hierro (%)**	**Tilos (%)**
Age		
<25	8	4
25–34	22	12
35–44	24	58
45–54	20	14
55–64	17	10
>65	8	2
Education		
Primary education	1	4
Secondary education	28	68
Bachelor or master's degree	56	24
Doctorate degree	2	4
No educational level	3	0
Other	10	0

In total, 145 questionnaires were collected from El Hierro and 50 from Tilos. For the small population of Tilos (<500 adult permanent residents) we calculated the sample size with the rule of the 10%, meaning we needed at least 30 responses. According to (Sovacool et al., 2018) a sample < 100 can be adequate for small population whose viewpoints are often excluded in the literature. For El Hierro, where the adult population is about 7000 people, we defined the sample size based on marginal error with confidence level of 95%. According to Data Star, "acceptable" margin of error used by survey researchers falls between 4% and 8% at the 95% confidence level. Thus, our sample of 145 is acceptable at the 95% confidence level with a margin error ± 8. The demographics of the sample are summarized in Table 3. Comparison with census data indicated that the sample is representative in terms of gender and education, however people above 55 yo are under-represented in our sample in both cases. We followed a random sampling technique, in order to avoid human bias in selecting samples but also because this technique requires minimal knowledge of the population compared to other methods (Acharya et al., 2013). Nonetheless, we acknowledge that a potential limitation associated with online surveys is that non-responses can lead to sample selection bias, as often those with a strong positive or negative opinion about the energy project are those who complete the questionnaire.

5 | RESULTS

We conducted a mixed ANOVA to compare the mean ratings of financial, technical, environmental, and institutional performance for El Hierro ($F(3, 576) = 28.07$, $p < .001$) and Tilos ($F(3,196) = 10.15357$,

p <.001). Post hoc comparisons using the Tukey HSD test (Figure 1) indicated that the mean score for the economic pillar for E Hierro is significantly lower than the environmental ($\Delta M = 0.789$, $p < .001$), the institutional ($\Delta M = 0.440$, $p < .001$), the social ($\Delta M = 0.903$, $p = .001$) and the technical ($\Delta M = 1.0828$, $p < .001$). The institutional pillar is significantly more successful than the social for El Hierro ($\Delta M = 0.463$, $p < .001$) and the environmental ($\Delta M = -0.3487$, $p < .05$). For Tilos the environmental dimension is found to be marginally less successful than the economic ($\Delta M = 0.3952$, $p < .05$) and the institutional ($\Delta M = 0.6404$, $p < .05$). Overall, the Tilos community rates the project on their island as more successful in all four of the pillars, compared to El Hierro. The aggregated scores of each project in each dimension of sustainability are presented Figure 2.

Confirmatory Factor Analysis (CFA) was used to examine the relationship between the institutional and environmental indicators and the factors that we assigned to them (Appendix B). In this way we examine if the observed items share a common cause. We set the threshold at 0.7 and all the factors scored higher (Appendix A). Finally, using variance inflation factors (VIFs) we confirmed that multicollinearity was not an issue (maximum VIF = 2.34, Appendix C).

The multiple regression analysis indicated that the institutional factors are positively related with people's perception on the success of the project and their interest to support and participate on future projects (Table 4). The feeling of pride about the island as a result of the project make people consider the project overall more successful. Perceived environmental impacts were very positively related with people's perceptions on the project success and had a significant impact on their interest to join

TABLE 4 The effects and (standard errors) for two models

	Project satisfaction	Future project
Intercept	0.9578 (0.622)	1.7389 (0.768)
Economic	0.1978 (0.1161)	0.0818 (0.1246)
Social cohesion	0.0464 (0.1250)	−0.0462 (0.1342)
Autonomy	−0.0065 (0.1407)	0.0496 (0.1235)
Sense of pride	0.2950 (0.1453)*	−0.0008 (0.1510)
Environmental	0.1767 (0.0445)**	0.1735 (0.0478)**
Institutional	0.2195 (0.1798)*	0.7177 (0.1931)**
Technical	0.4307 (0.1184)**	0.4046 (0.1271)*
Age	−0.1313 (0.0832)	0.0186 (0.0893)
Gender	−0.4062 (0.2166)	−0.5114 (0.2325)*
Island	0.4348 (0.2603)	−0.8949 (0.2795)*

*p < .05; **p < .001.

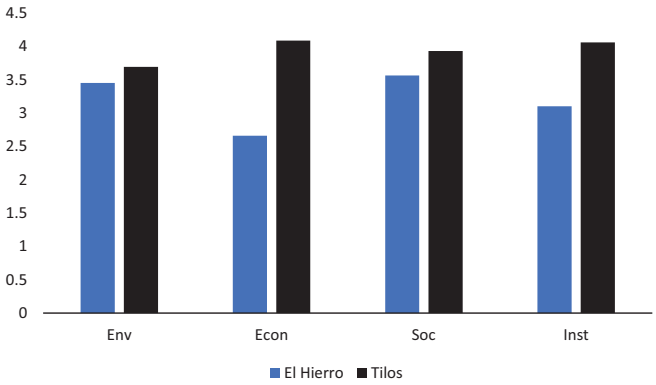

FIGURE 1 Tukey test results for El Hierro (left) and Tilos (right)

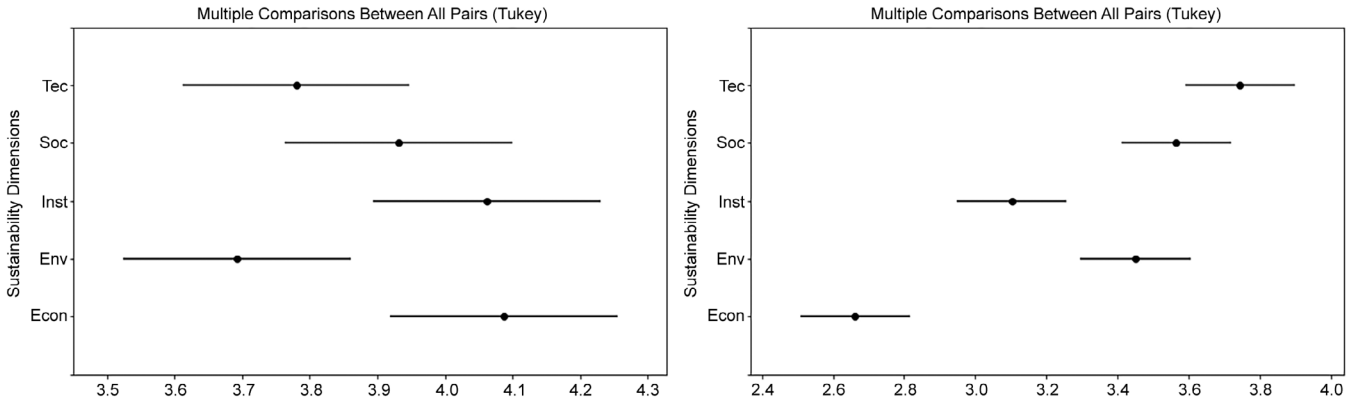

FIGURE 2 Aggregated scores of each dimension for each project

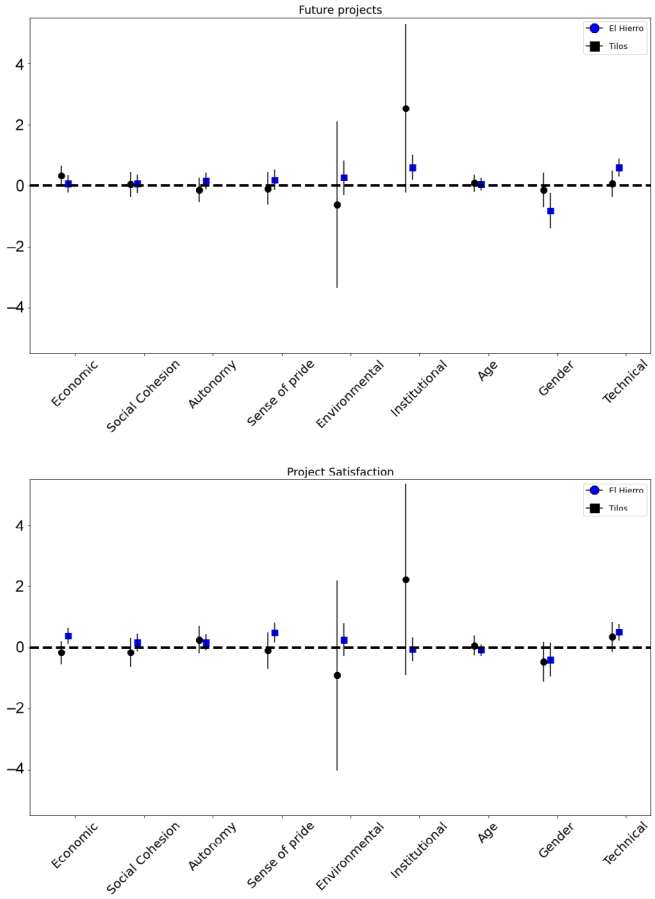

FIGURE 3 Effects of different factors on people's assessment of satisfaction with the project (A) and willingness to support and participate in future projects (B) for El Hierro and Tilos. On the vertical axis are independent variables and on the horizontal axis the size and the direction of the effect

and support future projects. Regarding the socio-economic factors, women seemed to be less interested to be involved in a future project. Age did not seem to play an important role during the pre-implementation phase. In Figure 3 we present the effects of the independent variables on the two models. In line with our research question, we chose not to present the intercepts and the island effect on the graph.

6 | DISCUSSION

In this paper, we proposed a comprehensive framework to assess local energy sustainability indicators. Instead of following a predetermined set of indicators, we designed a set of indicators with the focus on community perceptions and based on the goals of the projects. The framework considers the five main sustainability dimensions: economic, environmental, social, institutional, and technical.

The two projects examined on the present study are considered pioneers in the sustainability transition. However, as in many cases there is a lack of post-implementation assessment that can shed light on the actual early-stage success of the project, not only with regards to its initial targets, but also concerning the emerging expectation and new sets of goals. In the present study we examined how successful these two projects are in each of the sustainability dimensions. We concluded that overall, the projects are quite successful as they score > 2.5 in most of the dimensions.

In El Hierro, the economic dimension seemed to be the less successful. This is in line with our initial predictions as the direct economic benefits for the communities are minimal due to the policy design of the unified electricity price system in the Spanish territory (see Tsagkari and Jusmet (2020) for more details). On the contrary, in Tilos the economic benefits were ranked quite high, indicating that the reduction in the electricity bill although small is important. At the same time, El Hierro is bigger than Tilos, making the distribution of economic benefits more difficult. Regarding Tilos, the rest of sustainability dimensions outscored the environmental one, which might be explained by the presence of more radical views concerning the environmental impact of an even limited in footprint RES installation, and/or the fact of high awareness of the residents concerning the rich fauna and rare bird species present on the island. This aligns with the results of Stephanides et al. (2019) who also reported high levels of environmental concerns among the residents of Tilos, which nonetheless, did not translate into negative attitudes towards the renewable energy project.

Relevant literature has discussed that the economic impacts are often limited and less visible, (Munday et al., 2011; Terrapon-Pfaff et al., 2014), however this does not seem to affect people's perception regarding the success of the project. Despite the initial beliefs that economic motives are one of the main reasons why people support local renewable energy projects, more recent studies claim that financial considerations are not the only factors underpinning support (Jager, 2006; Korcaj et al., 2015; Sloot et al., 2019) and are often supplemented by environmental and social motives. According to Rogers et al. (2008) people do not have high expectations of direct economic benefits from local energy projects. Our research adds an extra layer to this discussion by assessing the factors that influence people's perception of a "successful project" post-implementation and during the early stages of operation. Economic benefits are not significant when people assess the project, while on the contrary the environmental benefits seem to play an important role. This resonates with the relevant research on sustainable behavior that defends the idea that environmental reasons can be more effective in promoting sustainable behavior than financial (Sloot et al., 2019).

The social aspects were examined separately due to their high heterogeneity that did not allow us to group them in one Factor. The social dimension scored high in both cases indicating that the organizational structure was perceived as successful. Sense of pride for the island, which is a result of the recognition and attention the islands gained from the project, were important factors for the assessment of the project as successful. In both cases, the projects served as a marketing strategy for the islands promoting sustainable tourism and attracting scientists and environmental conscious visitors. The relationship between a sense of pride and renewable energy projects is rather neglected in the relevant literature. Walker et al. (2010) briefly refer to the sense of pride as an important outcome of a renewable energy project according to the local population. This can explain the importance our participants gave to this sentiment as a significant factor that makes the project successful.

The institutional factors which are often excluded from similar research, were proven to influence positively people's perceived success of the project. The positive role of the local government and its ability to solve effectively disputes as well as the participation and inclusion of the public seem to make a project successful in the eyes of the community. This is in line with the relevant literature that has highlighted the important role of the local authorities in energy transition as well as the importance of community consultation and engagement in order to ensure the project's acceptance overtime (D'Souza & Yiridoe, 2014; Guan & Zepp, 2020; Hanley & Nevin, 1999; Hoppe et al., 2015; Kooij et al., 2018).Thus, our findings complement a growing body of literature that argues that more direct participation from local people and a stronger local government increases social acceptance and improves their experiences.

Technical factors seem to significantly influence people's perception satisfaction with the projects, as well as their willingness to support similar initiatives in the future. Indeed, it has been discussed that the use of adequate technology is an important factor when it comes to public acceptance of a renewable project as different types of technologies can also have different impacts (Bergmann et al., 2006; del Río & Burguillo, 2008) Bergmann et al., 2006; del Río and Burguillo (2008). In the case studies examined here the technical dimension scored quite high meaning that the technology chosen was seen as the best option to cover the needs of the islands. In line with Terrapon-Pfaff et al. (2014) we can also argue that in small scale and local projects, technology only cannot define the sustainability of a project.

Regarding the impact of gender in the willingness to participate in future projects our results are in line with the previous research of Stephanides et al. (2019) in Tilos, who also reported that men are more supportive towards RES than women and more likely to be involved. Observations from other countries (e.g., Fraune, 2015) report similar results. Gender-sensitive energy research is a rather new field that draws from the feminist literature and social sciences and studies the gender gap in citizen participation in renewable energy projects and how it is related with structures of power like the gender wealth gap. Further analysis is needed in this direction. This aspect further highlights the importance of socio-economic factors play in people's perceptions regarding local renewable energy projects.

7 | CONCLUSIONS AND POLICY IMPLICATIONS

The results of the present study can be used as a planning tool to guide local energy projects. By assessing people's perceptions on the success of energy projects we identified areas that can play a key role for the acceptance of future similar projects. In this way we provide a basis for actions that will satisfy these criteria. Firstly, instead of addressing only energy related needs social, economic and environmental issues should be considered. For instance, the sense of pride that we found to be an important factor for a successful project can be enhanced through successful management strategies, and promo campaigns. Additionally, practitioners can appeal to the environmental motives in order to ensure acceptance and the success of the project.

Another important aspect is the role of the local government and the inclusion of the local population. Building strong support among the community members and working closely with the local government can help practitioners design and operate successful projects. Providing quality information regarding the project and allowing the public to voice their concerns should be built through transparent processes and continue even after the design phase. Targeting women through specific empowerment and involvement campaigns and ensuring their participation can be an effective strategy to overcome the gender divide regarding the willingness to support and participate in future projects. Our results enhance the idea that project related factors can increase the acceptance of a renewable energy project pre- and post-implementation. These factors are complex and case specific and the project design should be adapted in the specific local context and the needs of the communities.

Local energy projects can produce real and important benefits for the communities and have tangible sustainability impacts, despite their

small size. In the present research the two projects are quite successful in the eyes of the local communities. To a large degree they managed to respond effectively to expectations and goals in a broader sustainability context, stressing the important role that local RES projects may play in small-scale remote island communities. People in both cases based their evaluations of the project mostly on environmental, social, and institutional factors while the economic benefits were not important. Along with the environmental benefits, factors like sense of pride for the island provide a way to influence the success of the projects. Based on that, we also identified a number of policy approaches that can improve the acceptability of future interventions.

The present study focuses on two small islands, which are "testbeds" for new technologies and "sustainability hubs." Their controlled environment allows for experimentation with new technologies that will then be transferred in other areas and scale-up. For this reason, the present analysis offers some useful insights on the impact of the projects on local sustainability issues that can improve the design of future similar initiatives.

In terms of methodological approach, the present study employed a novel framework to assess projects post-implementation considering the perceptions of the local communities and the aspirations of the projects. We acknowledge that our indicators cannot be generalized as they are project specific, however we encourage future research that will develop its individual set of indicators but within a common structure allowing for comparisons. The two projects examined here are still at an initial stage and continually evolving through time and our research captures the public opinion at a specific point of time. Longitude surveys will shed light on how people's perceptions might change over time as the projects mature and to highlight any actions for improvement of the projects.

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APPENDIX A

Questionnaire (translated in English)

Q1	What gender do you most identify with?	• Male • female • other
Q2	What is your age?	• 25–34 years old • 35–44 years old • 45–54 years old • 55–64 years old • 65–74 years old •75 years or older
Q3	What is the highest level of education you have completed?	• Primary education • Secondary education • Bachelor or Master's degree • Doctorate degree • No educational level • Other
Q4	What is your employment type?	• Full-time employment •Part-time employment •Unemployed •Retired •Student •Other
Q5	The project increased the economic opportunities you see for yourself on the island	1 = Strongly Disagree, 2, 3, 4, 5 = Strongly Agree
Q6	The project brought you closer with other people on the village/island	1 = Strongly Disagree, 2, 3, 4, 5 = Strongly Agree
Q7	The project made you feel less dependent on the mainland	1 = Strongly Disagree, 2, 3, 4, 5 = Strongly Agree
Q8	The project made you feel proud for the island	1 = Strongly Disagree, 2, 3, 4, 5 = Strongly Agree
Q9	The project motivated you to conserve energy	1 = Strongly Disagree, 2, 3, 4, 5 = Strongly Agree
Q10	So far, the Hybrid Power Station is fully operational, producing local clean energy	1 = Strongly Disagree, 2, 3, 4, 5 = Strongly Agree
Q11	After the completion of the project, I am more familiar with the topic of climate change	1 = Strongly Disagree, 2, 3, 4, 5 = Strongly Agree
Q12	After the completion of the project, I am more familiar with the topic of renewable energy	1 = Strongly Disagree, 2, 3, 4, 5 = Strongly Agree
Q13	The project did not affect the landscape esthetics	1 = Strongly Disagree, 2, 3, 4, 5 = Strongly Agree
Q14	The community was actively involved in the project	1 = Strongly Disagree, 2, 3, 4, 5 = Strongly Agree
Q15	I feel that my voice was heard and respected during the design and implementation of the project	1 = Strongly Disagree, 2, 3, 4, 5 = Strongly Agree
Q16	The local government contributed to the project design and implementation	1 = Strongly Disagree, 2, 3, 4, 5 = Strongly Agree
Q17	The role of the local government on the project was positive	1 = Strongly Disagree, 2, 3, 4, 5 = Strongly Agree
Q18	The system design (combination of Wind, solar and batteries) is adequate and suitable for the island?	1 = Strongly Disagree, 2, 3, 4, 5 = Strongly Agree
Q19	Considering the impact of the project on your personal life, I am	1 = Not satisfied at all,2,3,4,5 = Very satisfied
Q20	Taking into account all the information and your current knowledge, my overall evaluation of the project?	1 = Very Negative,2,3,4,5 = Very Positive
Q22	Knowing what I know now, I would you support similar projects in the future	1 = Strongly Disagree, 2, 3, 4, 5 = Strongly Agree
Q23	Knowing what I know now, I would you support similar projects in the future	1 = Strongly Disagree, 2, 3, 4, 5 = Strongly Agree

APPENDIX B

Confirmatory Factor Analysis Results (for Environmental and Institutional Dimensions).

Variables	Factor 1	Factor 2
Community involvement	1.01	
Participation of local government	0.70	
Effectiveness of local government	0.88	
Inclusion	1.099	
Awareness about climate change		0.81
Awareness about renewable energy sources		0.79
Energy savings		0.81
Esthetics		0.80
Clean energy		1.15

APPENDIX C

Variance inflation factor (VIF)

Const	33.85071
Econ	1.648397
Social cohesion	1.805292
Autonomy	1.979295
Sense of pride	1.994733
Technical	2.309763
Env	2.355711
Inst	2.229551
Gender	1.156952
Age	1.107552

6.4 Section B- **Chapter 4**

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The need for gender-based approach in the assessment of local energy projects

Marula Tsagkari *

Department of Economics, Faculty of Economics and Business, University of Barcelona, Spain

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ABSTRACT

Local renewable energy initiatives, that involve the local population, can help empower the communities, economically, culturally, and socially. In many cases, the ambitions of energy projects go beyond mere electricity production and involve issues of energy justice, environmental awareness, and environmental citizenship. However, these aspirations are often forgotten during project assessments, or they fail to include local voices, especially those of women and other marginalized groups. Gender has been given little attention in the energy scholarship and especially during the post-implementation assessment of energy projects due to the belief that energy technologies are gender neutral and beneficial for the whole community. The present study, with a focus on two local energy projects with mixed ownership, challenges this notion. The two case studies are the islands of El Hierro in Spain and Tilos in Greece. A detailed survey based on a series of indicators drawn from the energy justice framework is used to evaluate women's perceptions. By following a feminist approach, this work draws attention on the difference experiences of women and how these are often not acknowledged during the assessment of renewable energy projects. Local renewable energy does not automatically imply energy justice and pluralism. More effort is needed from policy makers to include women in the decision making and to ensure a fair distribution of the benefits of the projects.

Introduction

The gender dimension is gaining a lot of attention in the energy literature, especially in light of the global and EU commitment to the Sustainable Development Goals (SDGs) with both SDG 5 (gender equality) and SDG 7 (affordable and clean energy). The gender-energy nexus literature has focused on how renewable energy (RE) can improve the wellbeing of the local population and especially of women. Most of this research is on less affluent settings and the focus is on improving the practical ability of women to perform their reproductive and care duties in a safe and healthier way (Balakrishnan, 2000; Oparaocha & Dutta, 2011). In the European context more attention is given on the role of women as agents of change, and their underrepresentation in energy communities, in the renewable energy workforce, and policy making (Atina Arbi, 2020; Fraune, 2015; Pearl-Martinez & Stephens, 2016).

So far, there are not any studies analyzing the effect of a renewable energy project post-implementation with a focus on gender aspects in the Global North. Even when the project assessments include local voices, they fail to adopt a gender-based approach or gender is just one of many variables in regression models (Baruah, 2015; Skutsch, 2005). For this reason, various authors call for a gendered approach on energy transition and more concretely around RE projects (Allen et al., 2019; Feenstra & Özerol, 2021; Pearl-Martinez & Stephens, 2016; Skutsch, 2005; Standal & Winther, 2016). The present study is a response to this call and aims to shed light on the differences in the involvement, inclusion and benefits perceived by women and men. Although it's acknowledged that the results are also influenced by individual preferences and perceptions, it's shown that there are significant differences in the expectations and benefits between men and women and these can be traced back to social dimensions like gender inequalities and social roles. This is especially relevant nowadays that the COVID-19 emergency has exacerbated the undervaluation of care work, gender domination and oppression and proved to be a big challenge for gender equality. In the aftermath of the COVID-19 crisis, it is becoming urgent to include gender and energy in national recovery plans and energy planning (Carli, 2020; Sarrasanti et al., 2020).

The focus of this study is on local energy projects that involve various actors like municipalities, public, and private entities. These 'mixed ownership' initiatives aim to provide clean energy, but also to enhance citizen participation and to offer benefits for the local communities. The two case studies are the islands of El Hierro in Spain, and Tilos in Greece. In order to evaluate people's perceptions on the project and

* Diagonal 696, 08034 Barcelona, Spain.
E-mail address: marula.tsagkari@ub.edu (M. Tsagkari).

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the effect it has on their lives, a detailed survey with questions driven from the energy justice framework was designed. Using this data, it's discussed if and how renewable energy developments benefit women and strengthen their role in the broader development of the islands, especially compared to men.

The rest of the paper proceeds as follows: Section 2 discusses the relevant literature on gender, RE projects and energy justice, Section 3 introduces the case studies and Section 4 the methodology. Section 5 presents the results; Section 6 offers an in-depth discussion while Section 7 concludes.

Theoretical background

The role of energy in our societies is central as it shapes the sociocultural environment we live in. With the energy transition to renewable sources, new opportunities have opened up as we move away from the 'petro-masculinity' era that is based on a strong relationship between fossil fuels and white patriarchy (Daggett, 2018) to more bottom-up, small scale, decentralized and inclusive projects. These multifaceted projects not only have various benefits for the respective communities, but they can also pave the way for a new dimension of innovative technologies as means for societal transformation (Seyfang & Haxeltine, 2012). According to Avelino & Wittmayer (2016 p. 638) *"is not only about a socio-technical transition from fossil-based fuels to renewable energy, but it is also a socio-political transition from centralized for profit energy companies, to decentralized, not-for-profit community-based and/or Third Sector-based energy cooperatives*".

However, under the current neoliberal growth practices, technological advantages can reinforce long-existing biases and further obfuscate the need for sustainability, health and wellbeing of women and other marginal groups. To embrace the opportunity that local RE projects offer it is important to design inclusive programs that subvert social inequalities. Just by assuming that access to electricity or renewable energy will translate to women empowerment and gender equality, fails to acknowledge the structural problems that have traditionally shaped gender roles. As Mkenda-Mugittu (2003, pp 462) put it: "*the impact of introducing new technologies is generally negative on women's work burdens and serves simply to reinforce their subordinate status and position relative to men*."

Energy justice

A stream of literature that aims to shed light on the inequalities and the impacts energy projects have on different socio-economic groups is energy justice. The concept of energy justice is an established field of study that emerged from the environmental justice movement. Since then, energy justice has been used widely as a framework in academic research (Sovacool & Dworkin, 2015), has been applied in different contexts and with different methodologies (i.e., practice-orientated, quantitative and qualitative), has influenced energy policies and decision-making. This focus on energy justice in policy discussions provides an in-depth analysis of various justice issues present in the energy debate and asks normative questions regarding the burdens of energy transitions, the fair allocation of benefits and the opportunities for participation in the energy systems.

The concept of energy justice is multifaceted and includes i) procedural justice that focuses on inequalities in the process and governance ii) distributive justice that discusses the unequal distribution of benefits and burdens that result from an energy development and iii) recognition justice that addresses the representation of various stakeholders and the diversity of their needs (Jenkins et al., 2016). The three aspects of energy justice are interconnected and failure in one aspect can trigger failure in another aspect. This three-tenet framework offers a conceptual tool that can help researchers and policy makers to situate the values and expectations of an energy project and to assess the outcomes (Jenkins, 2018). According to Sovacool et al. (2017) it can also be an analytical tool that allows researchers "to understand how values get built or marginalized into energy systems or to resolve common energy problems." Despite the longer history of the environmental and climate justice framework, the energy justice approach was used in the present work as a framework with a "key" concept (energy) and a set of concrete principles, and it's focus on policy relevance (Jenkins, 2018). Additionally compared to the wider "sustainability framework" and "gender-energy" nexus approach, the energy justice framework focuses on where (in)justice occurs within energy systems, and how justice might be achieved. Other frameworks like women in environment (WED), and ecofeminism deal preliminary with issues of poverty and are not yet fully developed to allow the application in issues like energy (Clancy et al., 2003) Furthermore, the local and decentralized character of the case studies and the specific focus on gender further support the effort to bring together energy and gender scholars through the application of the energy justice framework (a more detailed analysis is offered at Lacey-Barnacle et al., 2020). For these reasons, the energy justice framework was chosen as the underlying conceptual framework in the present study to shed light on gender justice issues emerging from local scale renewable energy projects.

Energy justice and gender

Despite the parallelism between energy justice and other justice issues, the discussion around gender equality in the process of a just energy transition is limited (Lieu et al., 2020). The concept of procedural energy justice is mostly discussed in the context of decentralized local projects that aim to achieve high levels of energy democracy. It is concerned with dismantling the existing power structures and enhancing broader public participation and pluralism in energy decisions. Procedural energy justice calls for a more equal and inclusive system, away from the patriarchal structures that are embedded in the old fossil fuel arrangements. However, very rarely it has recognized the gender dimension and the inclusion of those who have been historically excluded from the decision making. Women empowerment is not only a result of access to resources, like clean energy, but it is also involvement in decision making and participation in deliberative processes (MacEwen & Evensen, 2021). Even if their opinions and expectations are heard during the design phase, women's voices are often excluded in the project assessments which are mostly done by technicians, managers, and governments. Who often refer to the impact of a technology on "people", or "communities" in a gender-blind approach (Clancy et al., 2011).

Project success is also gender specific and women and men have different energy needs and priorities. This is mostly due to the social roles attributed to genders, with women being the primary caretakers and house keepers. For instance, Räty and Carlsson-Kanyama (2010) examined the different patterns of energy use of men and women in four countries and found that men use more energy for travelling and eating out, while women have bigger energy needs related with hygiene and household chores. This indicates different consumption patterns, resulting from different needs and societal roles. Mang-Benza (2021) refers to this as 'Gender Blindness' in energy policy and argues that it can perpetuate and amplify the already existing inequalities. (Boyd et al., 2019)use the term 'hangover legacy' to refer to renewable energy systems that mimic the legacies of the male dominated fossil industry. Clancy and Feenstra (2019) argue that "*There is a growing interest in the gender-energy nexus literature in the potential role of women as agents of change, either as energy entrepreneurs, or as decision-makers in energy policy, or as employees in the energy sector. However, there is limited evidence related to the European Union, as to whether or not the energy transition is benefitting from greater gender equality*".

Indeed, most of the few available studies come from the Global South where energy is often associated directly with a better quality of life, more free time, increased income, and entrepreneurship opportunities (Balakrishnan, 2000; Oparaocha & Dutta, 2011; Zahnd & Kimber, 2009). A healthier environment in the house is another

important benefit as women are often impacted using unsafe indoor heating and cooking (Mohapatra et al., 2018). Thus, given that energy poverty is also a gendered issue and women can gain more benefits than men from clean energy (Nguyen & Su, 2021), sustainable energy and technologies are also associated with women empowerment. However, this is not always the case.

Historically women have been less favored in expanded development plans (Shiva, 1992; Sultana, 2009). For instance, post-implementation research on an Indian biogas program revealed that women and men have different perceptions on the benefits of the projects (Cecelsk, 2000). In another research in India, the authors mention that the solar park "*exacerbates the gendered social, economic and political asymmetries of adjacent villages*" burdening mostly the lowest caste women (Stock & Birkenholtz, 2020). A report from a solar project in Southern Morocco also indicates that despite the aspirations to promote gender equality, the observed outcome was not as expected and women were generally underrepresented, while their role in the society did not change significantly (Wuppertal Institute; Germanwatch, 2015). In their research of a solar mini grid in rural northern Zambia, Johnson et al. (2019) found that although there were many benefits for the local community these were not evenly distributed among men and women. As a result of an electrification project, women in Peru found themselves with extended working time and more care responsibilities (Fernández-Baldor et al., 2014). Similarly, Wiese (2020) examined gendered aspect of micro micro-hydropower projects in Sidama, Ethiopia. They conclude that women were less included in the process, enjoyed less benefits, and their energy needs were not sufficiently recognized and addressed. Amorim and Teixeira (2018) in their policy brief of energy transition in Brazil, South Africa, China, and India report that the energy transition policies do not ensure fair allocation of benefits for women. All the aforementioned studies highlight the need for more gendered energy studies and the need for sex-disaggregated data that will guide policy.

Looking in the Global North, the idea that women and men in the have the same relationship to energy has been widely questioned. Various concerns have been raised around the exacerbation of these differences as a result of the energy transition (Fathallah & Pyakurel, 2020). Some of the topics studied sparsely in the literature include different patterns of energy consumption, different practices as well as differences in the willingness to change established energy practices (Feenstra & Özerol, 2021). These differences are important in the context of gender equality and justice (Fraune, 2018) and challenge the idea that energy discussions in the global North are gender neutral. The present paper aims to answer some of the questions posed by (Clancy & Roehr, 2003 pp. 17):

> 'Are the lives of women and men affected differently in terms of the energy forms they use? If gender differences towards energy exist, are women and men able to exercise choices that reflect those differences about energy? Do women and men in the North have different preferences for energy policy?'

The use of the energy justice framework on gender related topics has been an emerging field of research. Feenstra and Özerol (2021) offer a comprehensive review of literature and conclude that despite the limited available research, the energy justice framework can be applicable in analyzing energy policy through a gender lens. Feenstra (2002) when discussing the essential elements for a gender sensitive energy policy refers to an approach that takes into consideration the energy needs of both genders, increases the participation of women in the sector, and uses gender-disaggregated data to guide the principles of the policy. In this line., in this study I highlight the need to embed a gender approach in all the stages of a project's life cycle from design to evaluation under the energy justice principles and the need for sex-disaggregated data. By applying the energy justice framework in two specific case studies in affluent settings I aim to open up a discussion around gender aspects of the energy transition in the Global North.

Case studies

The two case studies chosen are the islands of El Hierro, in Spain and Tilos, in Greece. These islands were chosen as they are worldwide examples of renewable energy projects on small islands, with ambitions that do not only include electricity production, but also socio-economic benefits for the communities (European Union, 2021). Additionally, both cases have been praised for the great public acceptance and participation of the local communities (Boulogiorgou & Ktenidis, 2020; Frydrychowicz-Jastrzębska, 2018). Both islands belong to the EU periphery, which faces high levels of poverty and economic stagnation (Bouzarovski & Tirado Herrero, 2017). For the present study the focus is on island territories as their communities are generally well defined and the effects of a project easier to measure. However, by referring to communities one should not assume that they are homogenous, as islands are also arenas for contested power, hierarchies, and conflicts (Connell, 2018). In fact, is this, heterogeneity that interests us. The two case studies were selected based on their similarities rather than differences (Mills et al., 2012), which allows to me to point out some patterns and common issues around gender aspects and the RE projects and thus open up a relevant discussion.

Tilos, also known as the first 100% renewable island in the Mediterranean, is a small island, with about 500 inhabitants. Women in Tilos are a smaller group than men, but they are an active part of the society working in municipality, tourist business, agriculture, and food cooperatives. The innovative RE project is a hybrid system working with batteries that are recharged by a wind turbine and a solar park. The project is led by the research team of Soft Energy Applications & Environmental Protection Laboratory (Piraeus University of Applied Sciences PUAS), the Hellenic Electricity Distribution Network Operator (HEDNO), and the private company Eunice. Prior to the implementation of the project, the island was relying on electricity from an underwater cable through a very unstable connection that resulted in frequent blackouts. The high cost of diesel was a burden not only for the residents of Tilos but for the whole country as the difference in the price was subsidized from the mainland (Marula Tsagkari & Roca Jusmet, 2020). The project is part of the bigger sustainability plan of the island that aims to revitalize the local economy, create jobs, attract young people on the island and boost economic growth without compromising the environment (Boulogiorgou & Ktenidis, 2020; Notton et al., 2017). The project managers made significant efforts to include the local population throughout the process, mostly though open meetings, educational campaigns, and consultation (Tsagkari et al., 2020). WWF was the responsible organization for these activities and all the relevant information around the consultations and trainings is available online.[1]

El Hierro, is the smallest of the Canary Islands, with a registered population of around 10.000 people. In reality, the population of permanent residents on the island is around 6.000 people (private communication with the local government). Due to the distance from the mainland the electricity demand of the island was covered through imported oil. In an effort to take advantage of the full potential of the island's ideal conditions, to become more autonomous, and to reduce the electricity costs, the island implemented an innovative RE project. Nowadays, a hydro-wind power plant with a wind farm and a pumped-storage hydroelectric power station supplies the island with clean energy. The project has a mixed ownership model including the El Hierro Island Council, the private company Endesa, the Canary Islands Institute of Technology and the Autonomous Community of the Canary Islands (Tsagkari, 2020). The initiative aims to make El Hierro the first electricity self-sufficient island that does not rely on imported fuels and costly thermal stations (Frydrychowicz-Jastrzębska, 2018; Garcia Latorre et al., 2019). The project goals also include benefits for the local community like new income opportunities, tourist activities, social cohesion, and less dependency

[1] https://www.tiloshorizon.eu/tilos-deliverables/leaflets-and-guides.html.

from the mainland. The local population was involved through public consultation and open meetings (Tsagkari et al., 2020).

Methodology

Research design

The analysis is based on online- surveys sent to the local populations between November 2020 and March 2021 and complemented with an analysis of the relevant technical reports and policy briefs. The overall purpose of the online survey was to evaluate the effect of the projects on people's lives. However, for the present study the statistical analysis is focused on gender differences in binary terms due to the methodological limitations. In total 145 questionnaires were collected from El Hierro (45.5% men, 53.8% women and 0.69% other, response rate 42%) and 50 from Tilos (54% men, 46% women, response rate 51%). The surveys were disseminated through the platform Survey Anyplace and with the support of the local municipalities. The survey response rate was calculated as the number of returned questionnaires divided by the total sample who were sent/given the survey initially. A limitation of the methodology that needs to be acknowledged, is the idea that the ones who replies the survey are the ones most involved with the topic (French, 1981).

Overall, given the small size of the population on the islands modest sample sizes are acceptable (Sovacool et al., 2018). In the case of Tilos, with a population less than 1000, we calculated the sample size as the 10% of the population (Albaum et al., 1985). In case of El Hierro the sample is accepted for the adult population (based on Instituto Nacional de España, 2022) of the island at 95% (+/− 8).

Participants were asked to use a 5-points Likert Scale of a disagreement (1) and agreement (5) with a positive affirmation regarding the project. *t*-Tests were used to compare the mean of the subsamples with a significance level of 0.05. Nonetheless, due to the small sample size this can lead to misjudgments. Especially for small sample sizes it is essential to identify outliers and distribution of quartiles. For this reason, boxplots were used to visualize the results.

The sample was not disaggregated by gender from the begging to avoid bias. By using gender in the present study, the focus is on the women-men binary, and the roles and privileges attributed to each, which however are not biologically determined. Respondents were asked their 'gender identity' and the options included 'male', 'female', 'other'. Almost all of the participants (99,5%) identified with the two first categories which is why the analysis is limited in those two. Other authors have examined the role of other sociodemographic variables like age, income, and education in the public opinion about energy projects and the results provide some support for the argument that personal variables can influence the acceptance of projects. Although the present study focuses mostly on gender, it is important to control also for other personal variables to avoid biases.

A Seemingly Unrelated Regression (SUR) is used to estimate the effects of gender on the three dependent variables, while controlling for educational level, income, and age (see Appendix A). SUR was developed is used to estimate models with more than one dependent variables, and accounts for contemporaneous correlation (Zellner, 1962). We choose SUR over simple OLS to account for between-regression variance. SUR is more robust compared to ordinary least squares (OLS) with regards to the specification of heteroscedastic disturbances. SUR consists of multiple regression equations it's of which corresponds to one response variable and incorporates a correlated error matrix. In this study, the SUR model was applied to test the effect of various demographic variables on three dependent variables: success, benefits, and participation in the projects. The SUR model can be written as:

$$Y = Xb + U \quad (1)$$

with:

$$\begin{matrix} Y_1 \\ \Gamma Y_2 \urcorner_{3Cxl} \\ Y_3 \end{matrix} = \begin{bmatrix} X_1 & 0 & 0 \\ 0 & X_2 & 0 \\ 0 & 0 & X_3 \end{bmatrix}_{3Cxk} \begin{bmatrix} \beta_1 \\ \beta_2 \\ \beta_3 \end{bmatrix}_{kx1} + \begin{bmatrix} u_1 \\ u_2 \\ u_3 \end{bmatrix}_{3Cx1.}$$

where Y1 is 'Benefits', Y2 is 'Success' and Y3 is 'Participation'; Xi is the matrix of explanatory variables. The vector βi are the different coefficients to be estimated with k1, k2 and k3 coefficients for the respective equation such that the total number of coefficients is k = k1 + k2 + k3. U is the vector of residuals E(U) = 0;

Thus, the covariance matrix W of all the error terms is:

$$E(UU\prime) = \Omega = \Sigma \otimes I \quad (2)$$

with Σ error covariance matrix with elements σij, where σij, = EUiUl′, i, l = 1,2,3, ⊗ = Kronecker product. If cj is the jth respondent in the sample this structure assumes that the errors are correlated across the indicators for each respondent, and uncorrelated across different respondents, where C is the total number of respondents in the sample.

The framework

The framework draws on the energy justice concept with its three dimensions, namely, distributional, procedural, and recognition as those were presented in Section 1. This framework is widely used in studies that aim to connect issues of social justice to the energy system and to highlight how costs and burdens of the energy production are unequally disseminated in the society. The analysis is based on the approach of Wiese (2020) with a focus on the gender aspect. For this analysis, justice of recognition is related with the specific expectations of women from the energy project. The small number of categorical data and the number of different categories does not allow us to perform statistical analysis for this indicator. For this reason, this indicator is qualitative and thus discussed only at a theoretical level.

Procedural justice discusses the equal inclusion and participation of women in the decision-making processes (Sovacool & Dworkin, 2015). Here I distinguish between inclusion and participation as two different sides of procedural justice. This is because being included in the discussion does not equal participation in the decision making (Jenkins et al., 2016) Distributional justice refers to the allocation of benefits and opportunities. I chose to refer to social and economic benefits as those were some of the initial ambitions of the projects. In the relevant literature economic and social benefits are important parameters in the success and acceptance of a project (Bauwens & Devine-Wright, 2018; Segreto et al., 2020; Stadelmann-Steffen & Dermont, 2021; Walker et al., 2010). Especially factors like social cohesion and feeling of autonomy that are recently gaining attention in the energy literature were included (del Río & Burguillo, 2008; Šahović & Da Silva, 2016; van der Waal, 2020). This is because by introducing a new technology to a place is also an "intervention(s) in a space of social relations" (Standal & Winther, 2016). An overview of the framework is presented in Table 1. Although the three energy justice elements differ, there is degree of interrelation and mutual reinforcement between them (Hanke et al., 2021). For this study, the energy justice framework is the conceptual tool that helps discuss and analyze the results.

Results

When asked about their expectations from the project of clean energy most women in both islands rated as number one reason the 'access to reliable energy'. This can be explained from the time that women spend in their houses as primary care takers and housekeepers. Additionally, many of the women in the sample, own small business (tourist shops, handicrafts, clothes etc.) which are being mostly hit from power cuts. In both cases women rated higher "climate change

Table 1
I indicators assigned to each energy justice framework aspect, the null hypotheses, and the corresponding survey question.

Energy justice framework	Indicator	Null hypothesis	Questions
Justice of recognition	Expectations	Women and Men have similar expectations from the project	Choose what is your main expectation from the project
Participatory justice	Participation	Women and Men felt equally included and consulted in the various phases of the project.	I felt my voice was heard in all the stages of the project. I felt that the local community was actively involved in the design of the project.
Distributive justice	Success	Women and Men assess similarly the success of the project.	Overall, I assess the Project as unsuccessful (1)- successful (5)
	Benefits	Women and Men perceive equally the benefits of the project	The project increased the economic opportunities I see for myself on the island The project made me feel less dependent on the mainland The project brought me closer with other people on the island The project connected me with the land and the island

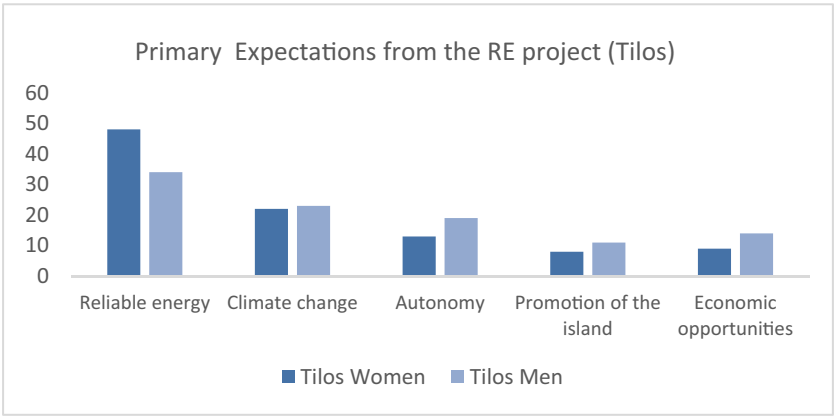


Fig. 1. Different expectations from the RE projects by gender for Tilos.

mitigation" as an expectation from the project. On the contrary, men in both islands ranked higher than women the economic opportunities and the autonomy of the island (Figs. 1 and 2).

Participation & inclusion

In El Hierro women rate their participation in the project design and implementation significantly lower than men [$M_M = 2.81$, $M_F = 2.30$, two-sample $t\ (142) = 1.98$, $p = 0.02$]. They also felt their voice was less heard throughout the process [$M_M = 2.88$, $M_F = 2.49$, two-sample $t\ (142) = 1.98$, $p = 0.05$. Similarly, Tilos women also rate significantly lower their participation [$M_M = 4.15$, $M_F = 3.60$, two-sample $t\ (48) = 2.01$, $p = 0.008$]. However, they felt their voice was included sufficiently during the processes [$M_M = 4.37$, $M_F = 4.35$, two-sample $t\ (48) = 2.01$, $p = 0.91$]. This is an indication that although women were involved in the deliberative process and expressed their views, they were not actively involved in the process (Figs. 3–6).

Benefits

The benefits were divided into economic benefits and social. The economic benefits for both cases were expected to be mostly indirect

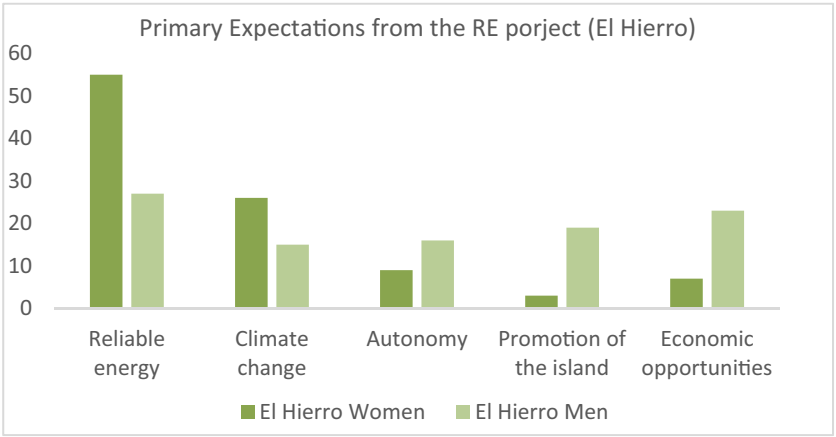
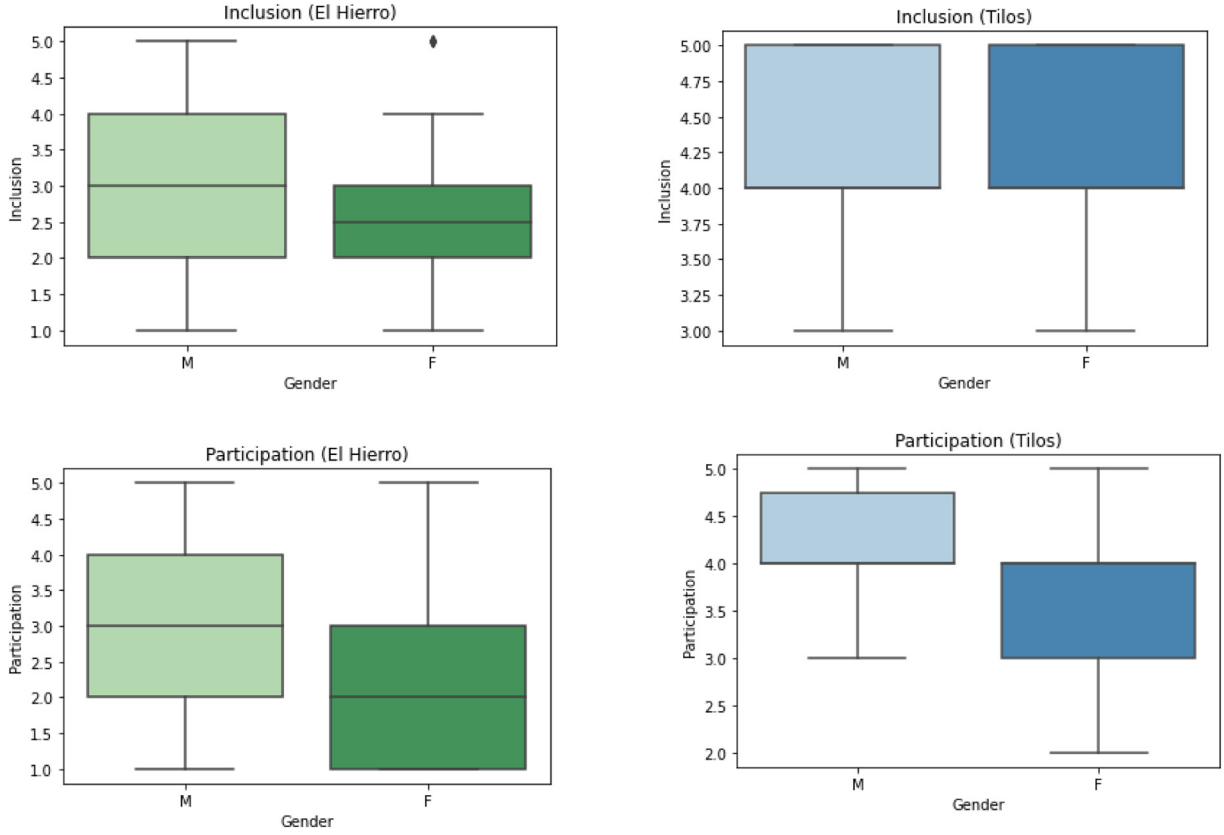


Fig. 2. Different expectations from the RE projects by gender for El Hierro.



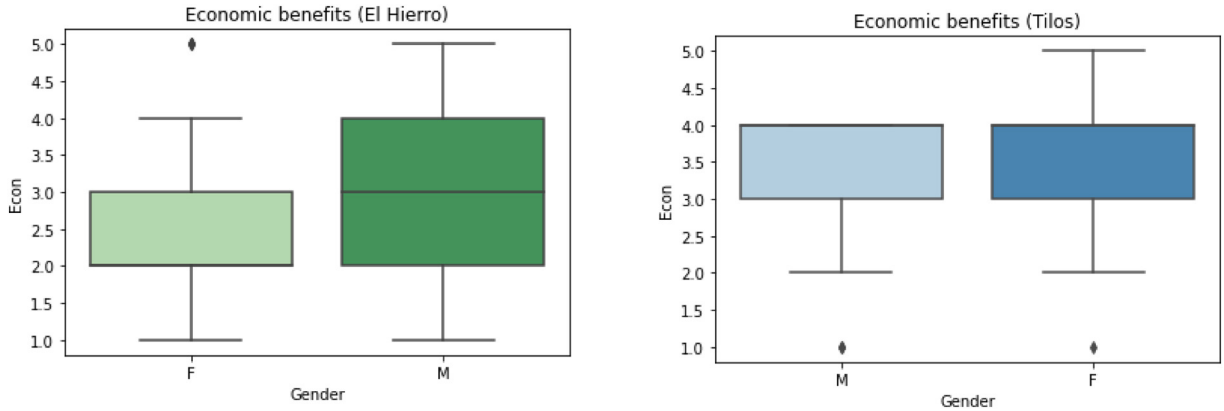
Figs. 3–6. Boxplots of participation and Inclusion by gender in El Hierro (green) and Tilos (blue).

as there was not direct payments to the residents. Indirect benefits include new job opportunities, increase of tourist arrivals, attractive business environment etc. The residents of the islands were asked if the project "Increased the economic opportunities they see for themselves on the island". For the case of El Hierro one can observe that women rate the perceived economic benefits lower than men [$M_M = 3.03$, $M_F = 2.49$, two-sample t (142) = 1.97, p = 0.008], while for Tilos there was not a significant difference at the 0.05 level [Tilos ($M_M = 3.35$, $M_F = 3.35$, two-sample t (48) = 2.01, p = 0.91)] (Figs. 7–8).

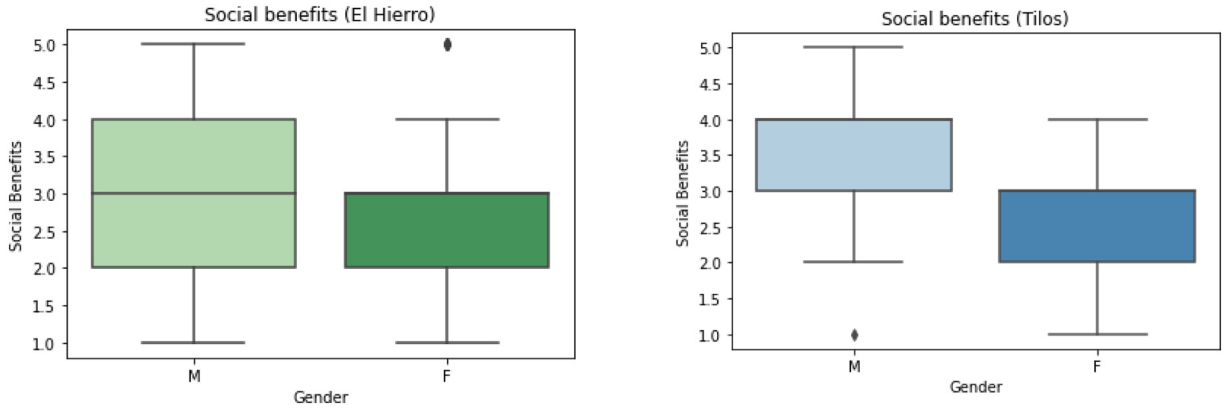
The projects were expected to have a social effect mostly by increasing the social cohesion of the residents, enhancing their feeling of autonomy and connection with their land. The local communities were asked questions regarding social cohesion, feeling of independency and connection with the land. Then the mean score of all questions was calculated to create the variable "Social Benefits". The results indicate that women claim to perceive fewer social benefits than men in El Hierro [$M_M = 2.79$, $M_F = 2.77$, two-sample t (142) = 1.97, p = 0.092], however the difference is not significant at the 0.05 level. In Tilos the difference is higher and significant at the 0.05 level, according to the *t*-test [$M_M = 3.56$, $M_F = 2.73$, two-sample t (48) =2.01, p = 0.008] (Figs. 9–10).

Success of the project

The success of a project is difficult to measure and depends on many factors especially the different expectations of women and men from



Figs. 7–8. Boxplots of economic benefits by gender in El Hierro (green) and Tilos (blue).



Figs. 9–10. Boxplots of social benefits by gender in El Hierro (green) and Tilos (blue).

the project. Overall women were less satisfied with the project than men in both El Hierro [$M_M = 3.78$, $M_F = 3.13$ two-sample t (142) = 1.97, p = 0.0002] and Tilos [$M_M = 4.56$, $M_F = 4.17$, two-sample t (48) = 2.01, p = 0.042]. This can be explained because reliable energy, which was a primary expectation for women requires a fully functional system without power cuts. In Tilos there are still frequent power cuts due to technical and bureaucratic reasons that go beyond the RE project. In El Hierro the project is also not yet mature enough as a stand-alone system. On the contrary, the economic benefits that ranked higher above men, are already visible mostly due to the advertisement of the islands worldwide in the pre-implementation phase (Figs. 11–12).

In order to ensure that gender is an important factor among other personal variables a Seemingly Unrelated Regression including both islands. A variance inflation factor (VIF) analysis was used to detect multicollinearity (Appendix B) and residual plots and Q-Q plot to control for linearity an normality (Appendix C). The internal consistency of the scales is acceptable (Cronbach alpha >0.70)

The results are presented in Table 2 and one can observe that the explanatory variable "Gender" remains significant at the 0.05 level in all three cases. The variable "Island" is always significant indicating that there are significant differences between the two islands. Interestingly the variable "Income" is statistically significant for the perceived benefits meaning that people with higher income tend to feel they perceive more benefits from the RE projects.

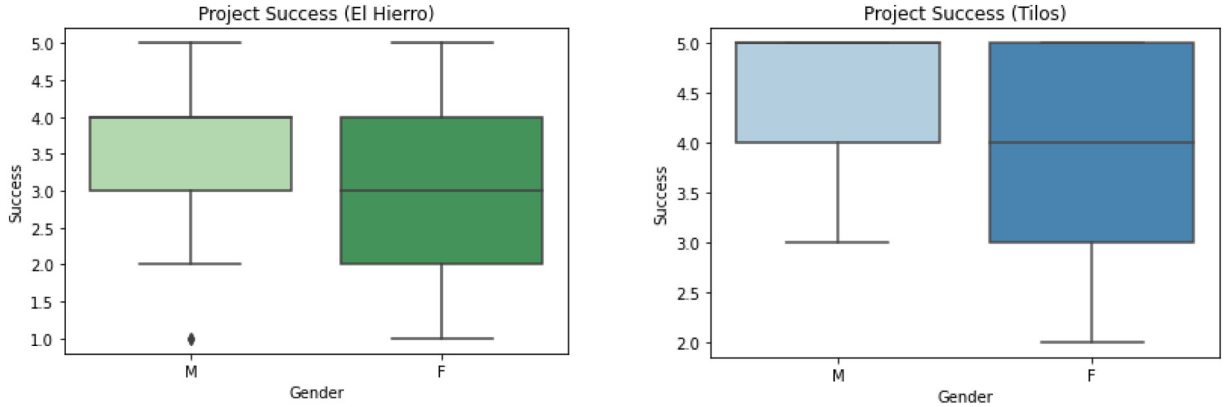
Discussion

In the present study sex disaggregated data is used to shed light on the various gender aspects around two RE projects and to discuss to what extend gendered energy justice is achieved. From participation and inclusion of women during the initial stages, to their expectations and from actual benefits and the success of the project to future perspectives, the results show that there are significant differences between men and women in almost all aspects.

Justice of recognition

Overall, the two projects seem to be aligned with the needs of the local people and recognize the local community as an important factor in the success of the project. The main expectations of woman were the need for clean and reliable energy followed by climate change mitigation. This is line with the relevant research of the past decades that highlights that women have a greater concern about environmental issues and are more eco-conscious (Dietz et al., 2002; Pearson et al., 2017; Tranter, 2011). Access to reliable energy is another important concern for women, associated with their social roles as caretakers and housekeepers, but also with their entrepreneurship and occupation in small business.

The results confirm previous research that has pointed out that energy needs and priorities are gender specific and thus, men and women have different aspirations from RE projects (J Clancy et al., 2012; Wiese, 2020). It also adds on the research on the wider lack of recognition of women's needs in the process and distribution of social goods including leisure, health and education (Fraser, 1995). The projects took into consideration women's energy needs, however, did not include sex-disaggregated data. Some of the goals are also common for both gender which means that these goals are not related with the need to empower women.



Figs. 11–12. Boxplots of project success assessment by gender in El Hierro (green) and Tilos (blue).

Table 2
Seemingly Unrelated Regression (SUR) results.

	Parameter	Std. Err.	p-value
Dependent variable: benefits			
const	1.3427	0.3906	0.0006
Gender	−0.3019	0.1479	0.0412[b]
Education	−0.0816	0.0817	0.3178
Income	0.5745	0.0648	0**
Island	1.0055	0.1782	0**
Age	0.0368	0.0585	0.5288
Dependent variable: success			
const	3.2791	0.3899	0**
Gender	−0.9115	0.1476	0**
Education	0.1876	0.0815	0.0214*
Income	0.069	0.0647	0.2858
Island	0.5345	0.1778	0.0026**
Age	−0.0352	0.0584	0.5467
Dependent variable: participation			
const	3.2115	0.3763	0
Gender	−0.6479	0.1424	0*
Education	0.1818	0.0787	0.0209*
Income	0.0469	0.0624	0.4523
Island	0.9078	0.1716	0**

[b] *p 0.05 **p 0.01.

Procedural justice

The procedural justice analysis refers mostly to the design and implementation stages and the involvement and inclusion of women. The technical documents indicated that the communities were consulted and participated in the initial stages in an effort to minimize complaints and enhance energy democracy.

Despite that, women overall, felt less included in the initial stages and even if they felt that their voices were heard they did not participate actively. This indicates lower level of energy democracy and participatory energy justice and highlights the fact that a simple bottom-up approach does not guarantee energy justice if it's not concerned with the equitable participation of all groups and during the whole process. Especially in the case of Tilos, it is obvious that inclusion of the different voices needs to be translated into actual participation in the decision making in order to ensure participatory energy justice. This research indicates that there is need for actions that focus mostly on enhancing the participation of women. For instance, in other similar cases where there were specific training programs, campaigns targeting specifically women (Balakrishnan, 2000; Osnes, 2013), this led to broader participation and inclusion. These results are not unique in the field and underline the long standing practices of unequal gender roles and power structures in the decision making (Alston & Whittenbury, 2013; Karvonen, 2017).

Distributive justice

Regarding the economic and social benefits of the project that can enhance distributional justice, the analysis concludes that women perceived less benefits than men. This is in line with (Wiese, 2020) who reported that women gained less benefits than they expected and less benefits than men. The present study, being the first one to examine the benefits of an energy project post-implementation clearly shows that even in the Global North women perceive less the benefits of innovative energy projects than men. This could be attributed to the more long- term expectations of women (e.g., climate change mitigation), as well as their feeling of exclusion that alienated them from the projects. In Tilos, both men and women rate the economic benefits as successful and there is not a significant difference between the genders. This can be explained by the demographics of the island as there are many couples who perceived economic benefits as a household. At the same time, all the households had a small reduction of 3% in their monthly bill which made the benefits on the island more tangible (Tsagkari & Roca Jusmet, 2020). In El Hierro both genders rated the economic benefits really low, however there was not a significant gender difference. This lack of economic benefits can be attributed to the early stage of the project and the specific circumstances of COVID-19 that has affected especially the tourist industry.

In terms of social benefits, men in Tilos seemed to believe that the project enhances their connection with the community and the land, while they feel less dependent from the mainland. This feeling of autonomy was one of the main expectations for men. At the same time, they are the ones who spend more time outside their houses working or at the local coffee shop where discussions around the project and involvement with the managers was taking place in informal settings.

Conclusion

New technological innovations are often seen as gender neutral, while energy interventions are often assessed in a gender-blind way. The present study is a primary effort to shed light into the gender aspect of local energy projects using sex-disaggregated data. By focusing on the various stages of a project's lifecycle one can argue that a gender approach should be embedded in every step consultation and design to post-implementation assessment and benefit allocation. This research not only underlines the need for more similar studies and approaches, but also paves the way for more bottom-up policies, that take into consideration the needs of various groups. By examining two case studies in Europe, I highlight the fact that engendering the energy transition is a relevant policy issue not only for the Global South as often assumed (Fathallah & Pyakurel, 2020) but also for the Global North.

Although there is some preliminary evidence that women's participation in the energy transition can have a positive impact due to their greater perception of risk and environmental awareness the discussion is still preliminary (Carlsson-Kanyama et al., 2010; Clancy & Roehr, 2003; Fraune, 2016; Offenberger & Nentwich, 2010). Given the results of the present study, the need for programs and policies should focus on dismantling the current power structures and increase the participation of women in the energy transition is important in order to avoid the masculinization of the renewable energy sector.

In line with Rosenberg et al. (2020) this study also provides evidence that SDG 7 (energy access) and SDG 5 (gender equality) should be examined in parallel as there are complex and underlining asymmetries that should not be overlooked. Access to clean and reliable energy through an innovative project might not benefit equally women and men in the community. If a project wants to be thriving and successful in the local community should not be designed and evaluated in a gender-neutral way, but rather pay attention to these groups that have been traditionally marginalized and excluded from the processes. Energy transition is a feminist issue and should be studied as such. Through the lenses of a feminist energy justice perspective, one can see different pathways that can build new energy systems and healthy communities. Only in this way the benefits of the energy transition will be equally distributed in the communities in line with social justice claims (Cecelsk, 2000; Oparaocha & Dutta, 2011)

This study cannot claim generalizability as the results, although may show a trend, are not applicable to other settings. This is because of the specific cultural and social characteristics in the research areas as well as the specific design of the projects. However, our cases might point to a number of emerging issues regarding gender aspects in the energy transition in the Global North and call for further studies that analyze the effects of power imbalances in energy transition and discussions on why gender differences might occur.

Gender differences were presented in binary terms due to the methodological limitations and the specifics of the case studies. By considering women as a homogenous group with similar views, we overlook the intersectionality of feminism and exclude other forms of oppression like ethnicity, class, and ability. Additionally, there are important limitations in the use of close ended questions that give limited insight on complex issues living no space for further elaboration. Despite these limitations the present study highlights the need for more sex disaggregated data that can guide energy policies. Future studies should expand the focus on the different variations of female identities and on other traditionally overlooked groups as well as on different geographies.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Categories of explanatory variables used in multiple regression

Variable	*N*	
	El Hierro (%)	Tilos (%)
Gender		
Male	45,5	54
Female	53,8	46
Age		
<25	8	4
25–34	22	12
35–44	24	58
45–54	20	14
55–64	17	10
>65	8	2
Education		
Primary education	1	4
Secondary education	28	68
Bachelor or master's degree	56	24
Doctorate degree	2	4
No educational level	3	0
Other	10	0
Monthly gross income		
<1000 euros	24	43%
1001–2000	35	32%
2001–3000	23	12%
3001–4000	10	6%
4001–5000	5	4%
5001–6000	1	1%
>6000	2	2%

Appendix B. Variance inflation factor (VIF)

const	33.99241
Gender	1.07428
Education	1.264276
Income	1.115197
Island	1.215928
Age	1.177397

Appendix C

Figure: Residual plot. The normal probability plot of the residuals is approximately linear supporting the condition that the errors are normally distributed.

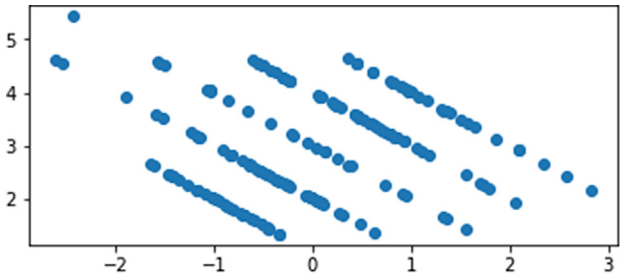
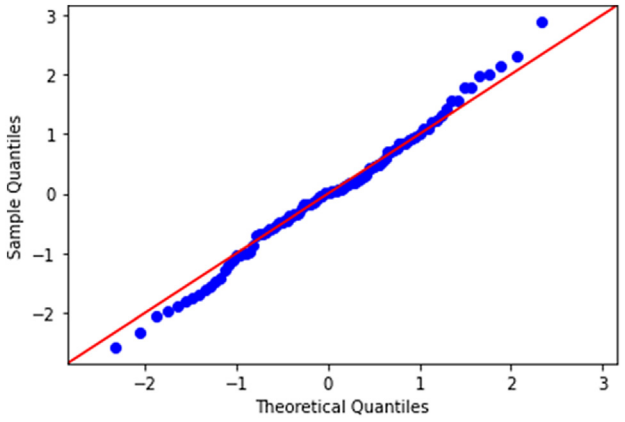


Figure: "quantile-quantile" plot (Q-Q plot) indicating that the data distribution is close to normality.



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6.5 Section C- **Chapter 5**

Clean Energy for EU Islands and Insular Degrowth: Rethinking development and sustainability on islands

ABSTRACT

Islands all around the world face several socio-economic challenges related to their isolation, small size, and vulnerabilities to climate change. While they struggle to balance sustainability and development, islands are often conceptualized as experimental sites for sociotechnical transitions like green growth or imaginaries for socio-ecological alternatives like degrowth. The aim of this paper is to point at the contradictions between these two narratives. In order to avoid misconceptions around the ideas of degrowth and its applicability to less developed areas like small islands, I introduce the term 'Insular Degrowth' and envision what a degrowth approach might look like in these social environments. In the second part, I compare the idea of 'Insular Degrowth' with the predominant EU policy; the Clean Energy for EU islands. While in the Clean Energy for EU islands the focus is on technological fixes that will boost economic growth on islands, an Insular Degrowth approach prioritizes low-tech clean forms of energy with democratic planning, social well-being, and cooperation, in line with the history and identity of the islands. Through this discussion, I aim to open up a dialogue between degrowth and EU policy circles.

Keywords: Islands, Degrowth, European policy, clean energy, periphery

INTRODUCTION

The term island refers to "a piece of land that is completely surrounded by water" (Oxford dictionary). However, the definition of an island is not always that straightforward. Islands can be pieces of land surrounded by peatlands or emerging from tides (Rackham, 2012). In literature, islands are often used metaphorically as images for escapism, experimentation, remoteness, and primitivism (Gugganig & Klimburg-Witjes, 2021). In sociology, the idea of "islands" is associated with boundedness, smallness, and isolation. Islands could also include other remote places found in mountains, valleys, jungles, deserts, borderlands, and war zones (Ronström, 2021). A distinction between 'literal' and 'metaphorical' islands is hard to make as "the 'island' is constituted by the constant and wayward sliding between the physical places we call islands, and all the figures of thought that we attach to such places" (Ronström, 2021). Thus, although the present paper

focuses on islands with the geographic term, I invite readers to apply the ideas presented here to other existing or fictional "Islands".

Islands have long been depicted as utopian dreams or as nightmares (Gillis, 2007). Islands and especially those in ultra-periphery, have served as alternative imaginaries for the idea of a simple but prosperous life liked with frugality, sufficiency, cohesive communities, strong sense of belonging, frequent social interactions, and the continuation of traditional values (Armstrong & Read, 2000; Connell, 2003; Hay, 2006; O'Leary & Tuan, 1975; Ronström, 2021). Turner & Ash (1975) refer to them as "peripheries of pleasure" while according to Baldacchino (2013) "islands have become, unwittingly, the objects of what may be the most lavish, global and consistent branding exercise in human history." Islands have also been used by states as places for experimentation, environmental manipulation, power demonstration (e.g., military bases and prisons), and economic status symbols (tax heavens) (Mountz, 2015). The issues of insularity, ultra-peripherality, and remoteness are central in the Island Studies (Briguglio et al., 2009; Moncada et al., 2005). Andriotis (2004) summarizes the disadvantages of islands as follows:

"*By their very nature islands face a number of inherent disadvantages. They are small in size with declining populations; they suffer from isolation, peripherality, external dependency and diseconomies of scale; they are rural in character; and they have a scarcity of resources, meaning mainly that their alternatives for industrialisation and self-sustaining growth are limited*."

In the recent era of globalization and modernization, these characteristics have a dual narrative. On the one hand, they are seen as 'handicaps' for the development of islands compared to the mainland, and on the other hand, they make islands desirable as ideal, serene, and quiet places, far from the stress of modern urban life, ideal for cultural, political, and social experimentation (Ronström, 2013, 2021). Based on that, new narratives have been shaped around islands and the two of the most predominant visions in the recent literature are: the vision of islands as labs for scientific-technological projects (Gugganig & Klimburg-Witjes, 2021; Laurent et al., 2021; Skjølsvold et al., 2020b) and the vision of islands as post-growth imaginaries (Tsagkari et al., 2021). These two visions are discussed here in concrete terms under the lenses of the two relevant policy approaches: the Clean Energy Package for EU islands and Degrowth.

The present study serves a two-folded purpose. Firstly, to discuss the core ideas of a degrowth approach in insular areas and to envision how an insular degrowth community might look like. Secondly, based on a critical review of the literature on degrowth and an in-depth analysis of the relevant EU policies on Islands, I highlight the differences between the two approaches and distinguish aspects that can provide a common ground. The focus is on the recent Clean Energy Package for Islands which is currently the main policy pillar about islands in the EU. By comparing

the two alternative strategies I argue that although sustainability is at the center of the EU policy it is also a neoliberal approach centered around economic growth.

The rest of the paper proceeds as follows: Section 2 offers a discussion on islands and their current challenges, mostly related to their economic stagnation and poverty. In Section 3, I present the Degrowth ideas and discuss if and in what form they can be relevant for insular areas under an "Insular Degrowth" approach. Section 4 presents the relevant European policies and the EU vision for insular areas. In Section 5 I compare the two approaches – degrowth and the Clean Energy Package for EU islands- and highlight the differences but also the common ideas. The article ends with conclusions.

BACKGROUND

Today, 72% of the EU-28 population lives in cities and urban areas, while 16 million Europeans live on the 2,200 inhabited islands in the EU, which corresponds to around 4% of the EU's total population. While some countries have higher levels of urbanization than others (e.g., above 80% in Italy and the Netherlands but just about 50% in Romania and Croatia) the countryside is shrinking rapidly (United Nations, 2018). Cities now act as nodes in a global network of business, investments, and tourism offering multiple opportunities (Storper, 2013). At the same time, the EU countryside is languishing. In 2050, it is expected that the population in urban centers will increase by 24.1 million people while the population in rural areas will decrease by 7.9 million (United Nations, 2018).

The shrinkage of the countryside has multiple negative effects on the living conditions in these areas, like high unemployment, low educational levels, lack of economic opportunities, and skilled labor. In addition, many of the EU insular areas face several challenges mostly related with limited resources, high vulnerability to climate change, and frequent hazards (Aguiar et al., 2018; European Network for Rural Development, 2021). The abandonment of the countryside and insular areas has led to territorial inequality not only among countries but also inside countries and regions. Rural and insular poverty have been given less attention than urban poverty, while national indicators fail to include for spatial heterogeneity. In their analysis, Copus et al. (2015) reported that in 10 European countries and especially in the Mediterranean members (Spain, Portugal, Greece, and Italy) there was a strong correlation between poverty rates and remote rural regions and islands. Similarly, Iammarino et al. (2019) observed that the very-high-income groups in the EU are concentrated in metropolitan areas and highly urbanized areas.

Indeed, insular areas and mountainous regions, often have the lowest GDP per capita compared to the respective average. According to the OECD data on ´Regional GDP per capita´ for 2018, Corsica ranks last in the GDP per capita (excluding oversea French territories) with a GDP 28.200€

compared to the 35.000€ of the French average and with poverty rates at 18.5 per cent, four points above the national average. Similarly, Sicily had a GDP per capita just 17.800€ in 2018, among the second lowest in the country, below Italian average (29.200€) and below other regions of Southern Italy like Cantabria (18.600€) and Ampulia (19.000€) and only above the mountainous Calabria (17.400€). Sardinia's GDP per capita (21.200€) is also below the average of the country. Portugal the islands of Azores and Madeira are the regions with the highest values of income inequality and poverty. Similarly in Spain the risk of poverty in the Canary Islands is 29.9%, only above the sparsely populated Extremadura with the harsh landscapes. In Greece where the GDP per capita 17.200€, among the poorest regions are the islands of North Aegean with a GDP per capita of just 11.800€, like some of the mountainous areas like Epirus and Thrace.

These regional disparities and structural inequalities, magnified by the 2008-2009 global financial crises and the recent COVID-19 pandemic, had led to deeper poverty, societies less resilient to external shocks, decay of social rights, greater social polarization and political instability reflected in events like Brexit and the growing protest and populist/nationalist movements (Iammarino et al., 2019; Rodríguez-Pose, 2018; Sayek Böke, 2021). Piketty (2014) mentions that:

"*Inequality in the ownership of capital brings the rich and poor within each country into conflict with one another far more than it pits one country against another*"

Especially regarding small islands, with an area less than 2000 km2 and width less than 10km (Falkland, 1991), traditional economic indicators such as GDP cannot capture the structural difficulties and the lack of economic resilience arising from the relative inability of small islands to face external shocks (Briguglio, 1993). Activities like recreation on a mass scale and abuse of the natural resources through unsustainable agriculture and livestock, have exhausted the local environment and deteriorate the living conditions of the local communities on islands globally. European Islands face profound economic, cultural, and political challenges. The arrival of migrants and refugees from Africa and Asia to Greek and Italian islands, the economic crises in Cyprus, the extreme weather phenomena like the cyclone and floods in Sicily, and the autonomist movement in Corsica show that nowadays islands are icons of some of the biggest EU failures (Baldacchino, 2013; L. Fletcher, 2011). As a response to these challenges, many insular areas have designed diverse development strategies to balance sustainability and development and to pave the way for an economic recovery.

ISLANDS AS ICONS OF SUSTAINABILITY

New plans for "sustainability", mostly centered around renewable energy have emerged to revitalize the local economies. These new development strategies focus on a range of economic sectors like the construction of renewable energy projects, renewing of traditional sectors such as agriculture, livestock, knitwear, and diversification of the tourist sectors (eco-tourism, slow tourism, wine tourism, etc.) (Horlings & Kanemasu, 2015). Pioneer islands like El Hierro in Spain, Samsø in Denmark, Tilos in Greece, and Ameland in the Netherlands have embraced the sustainability agenda and have designed and implemented green energy projects (Frydrychowicz-Jastrzębska, 2018; Kippers et al., 2011; Sperling, 2017; Tsagkari et al., 2021). These islands see in these sustainable development plans an opportunity to overcome the previous economic stagnation and promote economic growth. New economic opportunities through the creation of jobs and attraction of tourists using the brand of "sustainable island" are some of the promised benefits (del Río & Burguillo, 2008; Terrapon-Pfaff et al., 2014).

In this reality, the "classic divide" between economic growth and environmental sustainability, has emerged (Sjöstedt & Povitkina, 2017). The "techno-optimistic" sustainability approach powered by the neoliberal faith in technology and engineering and the belief that economic growth can be decoupled from its ecological impact is the dominant narrative (Fletcher & Rammelt, 2017). These sustainability plans are mostly top-down, interventionist approaches that leave little space for negotiations and discussions with the local communities. For instance, the research of Xie et al. (2020) on the Chongming island that is part of the Chinese eco-Islands plan, reports that, despite the promises that development will not come at any cost of environmental protection and social coherence, the local community suffered various negative mostly through reclamation and destruction of the land. At the same time, the local knowledge was not included in the project design. In the case of Sumba Island, Fathoni et al. (2021) report that the local energy project did little to dismantle existing power relations and to ensure democratic processes.

Important questions on how we can plan the development of insular areas, while at the same time protecting the local environment, the local history, and identity and achieving social justice and sustainability have led to multiple different approaches. In the next sessions, I present two of the most predominant narratives, Degrowth and The EU policy on Clean Energy for EU islands.

ISLANDS IN THE EU POLICIES

The European Union groups islands in three categories 1) islands that belong to 'overseas countries and territories' (such as Greenland, French Polynesia, and Bermuda) 2) the 'outermost remote

regions' that includes French overseas departments, the Azores, Madeira, and the Canary Islands and 3) continental EU islands. The EU islands belong to 13 Member States, namely: Poland, Germany, Denmark, Sweden, Estonia, Finland, Netherlands, Italy, France, Greece, Spain, Portugal, and Croatia (Ireland, Malta and Cyprus are insular Member States). Some of these islands are close and well connected to the mainland, while others like Dodecanese Islands, Canary Islands, Azores, Foula are more remote.

The initial recognition of islands as heterogeneous spaces with different needs and cultural uniqueness is stated in Articles 174 and 349 of the Treaty on the Functioning of the European Union (TFEU). Later, The Amsterdam Treaty in Article 2 refers to "the structural social and economic situation of the French overseas departments, the Azores, Madeira and the Canary Islands, which is compounded by their remoteness, insularity, small size, difficult topography and climate, economic dependence on a few products".

Regarding the third category of islands, continental islands, until recently they were mostly recognized in other sectoral policies like the Common Agriculture Policy (CAP) and the Common Fisheries Policy (CFP). The EU Regulation 1698/2005, on European Agricultural Fund for Rural Development (EAFRD), underlines the need 'to mitigate the specific constraints and structural problems in farming and forestry activities and in adding value to agricultural and forestry products as a result of remoteness, insularity or distant location'

Another important document with special mention to islands is the EU Cohesion Policy. In this policy, islands belong to the "less developed" regions with 'handicaps', a category that also includes mountain regions and sparsely populated areas. In the core of this policy lies the idea of balancing the development of the various EU areas through a Europeanisation of urban policy (Avdikos & Chardas, 2016; Dukes, 2008; Rauhut & Humer, 2020). Cities are seen as "the clearest path from poverty to prosperity" as the returns to investments in innovation are higher in cities (Combes et al., 2012). Thus, investing in metropolitan areas is the best way to promote growth. This growth will then have a spillover effect in smaller cities and later in rural and insular areas. For the case of isolated islands that are far away from the mainland the focus was given on urban centers of bigger islands as intermediary nodes (Christofakis & Papadaskalopoulos, 2011). This idea is also present in the Territorial Agenda 2020 (European Union, p. 5) where it is clearly stated that:

"*Cities which function as regional centers should cooperate as parts of a polycentric pattern to ensure their added value for other cities in rural and peripheral areas with specific challenges and needs (e.g., structurally weak parts of islands, coastal zones, and mountainous areas)*."

Later, the focus shifted from the needs and difficulties of insular areas to their potential for 'endogenous growth', with a approach based on local resources and participatory approaches that will boost the local development (Lowe et al., 1998). This idea plays a central role in the recent European Green Deal with a focus on concepts like sustainability, modernization, and circular economy.

In 2017, in Nicosia (Cyprus) the European Energy Research Alliance (EERA) hosted a workshop in focusing on the role of islands in energy transitions. Some months later, with the Valletta Declaration of 2017 islands were recognized as forerunners in the clean energy transition forming the Smart Islands Programme and supported with £10.8 million co-financed by the European Regional Development Fund. This program set the foundations for islands to become hubs of a smart energy transition and has inspired various EU policies like the Clean Energy for EU islands and the communication on the Blue Economy both centered around economic growth. These new narratives focus on the untapped potential of islands as "engines of a sustainable Europe".

The Clean Energy for EU islands policy is part of the Clean Energy for all Europeans Package and has 5 priorities, namely 1) reduced energy costs and increased renewable energy production 2) advancement of energy storage and demand response management 3) increased energy security 4) lower GHG emissions and less impact on the natural environment and 5) creation of new jobs and business opportunities centered around technological fixes and modernization. The core idea of the policy is that investments in renewable energy will have spillover effects that will boost economic growth on the islands.

"*EU islands have the potential to be pioneers of the clean energy transition and this Island initiative puts citizens at the heart of the energy transition bringing tangible benefits such as local jobs creation, economic activity and lower energy bills. It contributes to the reduction of energy dependence thanks to the sustainable exploitation of local resources. It will also support the EU's post-COVID economic recovery efforts*." (European Commission, 2020).

The Clean energy for EU islands initiative describes a new era for the EU insular territories, one of transformative development and economic opportunities. In fact, it is an economic strategy, which identifies islands as active drivers of the 'green economy'

ON DEGROWTH

The idea of degrowth is rooted back in 1972 and the term "decroissance". The term, initially introduced by André Gorz, brought together the political ecology critique of productivism (Gorz,

1975) and pos-development scholars who critiqued the imperialism and colonialism of the international development practices (Escobar, 1995). Since then, the idea of degrowth has matured, and in 2020 more than 70 academic articles were published on the topic (Scopus search). Nowadays, degrowth is a relevant and expanding research field and a vibrant social movement (Demaria et al., 2013).

The degrowth idea is rooted in the belief that perpetual economic growth is incompatible with the biophysical limits of the planet. Abundant evidence has demonstrated that "green growth" or "ecological modernization" promises of decoupling the GDP from emissions are not feasible on time to prevent the climate crisis (Hickel & Kallis, 2020). Degrowth, however, is more than a criticism to economic imperative; it offers a radical alternative based on a planned reduction of energy and resource use. In this way, not only humanity will live in balance with the environment, but it will also benefit from higher levels of equality and well-being. For this reason, degrowth is not equivalent to economic recession or unplanned events like the COVID-19 pandemic, as it requires a voluntary self-limitation and a planned downscaling of the economy (Hickel, 2020). Degrowth calls for a new paradigm, build around decommodification, conviviality, care, and frugality (Giacomo D'Alisa, 2014).

As Degrowth is mostly focused on reductions in energy and resource use, it is mostly applied to economies in the North that have long based their economic growth on excess consumption and colonialism (Hickel, 2020). However, Degrowth is also relevant for the Global South to create a new approach to development away from the Western neo-liberal practices. According to Latouche (2004): "*Degrowth must apply to the South as much as to the North if there is to be any chance to stop Southern societies from rushing up the blind alley of growth economics*." The author urges the Global South countries to follow a different path for development, one that is not based on relations of production dictated by capitalism but rather based on local capacities, and the natural and cultural wealth. The discussions on the relevance of Degrowth for the Global South that started with the First North-South Conference on Degrowth in Mexico in 2018, continue with various arguments and different perspectives (Dengler & Seebacher, 2019; Gerber & Raina, 2018; Hickel, 2020; Lang, 2017; Rodríguez-Labajos et al., 2019).

Ideas and practices of degrowth are often unpopular among people in less affluent countries who see degrowth as an impediment to their progress (Chiengkul, 2018). When one lives already in poverty the idea of reducing consumption is not appealing. Growth is a desirable outcome, and it can be achieved through increasing productivity and innovation. On the contrary, Degrowth has (mistakenly) been associated with something negative. For instance, Rodríguez-

Labajos et al. (2019)report that people in the South, as well as marginalized and poor communities in the North, do not feel connected with the idea of degrowth as they see it as another European intellectual term alienated from their realities, needs, and struggles. Demaria et al. (2019) respond to this by stating that "*Poverty and underdevelopment are not growth waiting to happen, but the ugly sides of growth and development*". For the authors, growth creates poverty through destructive and extractive processes and thus, the relevant question is how people can challenge the growth imperative and what are the alternative imaginaries. Thus, degrowth in the context of less affluent areas does not argue for lower levels of consumption and production, but rather for a novel alternative developmental path.

However, one should not forget that there is "North in the South" and vice versa. Many insular and peripheral areas in the EU have high levels of poverty and are being left behind in the national development of their respective countries. In the past years, degrowth has engaged with various concepts and social struggles like Blue Degrowth (Ertör & Hadjimichael, 2020; Hadjimichael, 2018), agrarian studies (Gerber, 2020), feminist perspectives (Dengler & Lang, 2021; Paulson et al., 2020; Saave-Harnack et al., 2019), aviation justice (Stay Grounded, 2019), urban planning (Xue, 2021) and public health (Ouimet et al., 2021). Islands are absent from these discussions, despite their unique characteristics and the emerging socio-ecological struggles in insular areas. The two notable exceptions are the work of Tsagkari et al. (2021) on a Greek and a Spanish island, around energy sulf-sufficiency, democracy, and degrowth as well as the work of Bogadóttir and Olsen (2017) on Faroe Islands related to the local tradition of pilot whaling known as grindadráp. Other scholars have focused on the discussion between tourism and islands but often fail to propose a holistic degrowth approach for the insular areas (Andriotis, 2018). The concept of Blue Degrowth discusses issues related to islands like fishery policies (Hadjimichael, 2018) and port development (Nogué-Algueró, 2020) however, it is relevant for all coastal areas and not specific on the needs and challenges of islands

THE IDEA OF AN INSULAR DEGROWTH

At a first glance, degrowth might not be attractive for islands and especially for those than have been left behind in the development plans of their respective countries. For this reason, and to avoid misconceptions, I propose a degrowth approach 'tailormade' to these areas. By putting forward the idea of "Insular Degrowth", I do not aim to create a division between land and islands, but in contrast to engage with various literature streams relevant for island studies like agrarian studies, blue degrowth, tourism and degrowth as well as with the extensive literature on island sustainability studies. I do not propose insular degrowth as an umbrella term, but as an exercise to envision how a degrowth approach might look like on insular socioeconomic environments. At

the same time, I acknowledge that islands are complex sites which differ significantly between and within themselves and for this reason any insular degrowth approach should recognize and embrace these unique identities.

(1) Alternative lifestyles

In the center of the degrowth movement lies the idea of sustainable lifestyles through voluntary simplicity, frugality, and self-limitation. In other words, degrowth advocates for living better with less. The alternative lifestyles proposed by Degrowth often center around changes in mobility, food consumption, and consumerism behavior. Bikes, community gardens, low-tech and DIY alternatives are ways of 'living degrowth' in a slower pace. The term 'Island Time' is used in the Caribbean islands to describe the slower pace of life in contrast to the "Speed-Up Society" in urban centers Nowadays, many islands around the world embrace these ideas focusing on promoting "alternative lifestyles." Islands around the world are 'Reclaiming local food production and traditional plant-based diets', consume locally (Small Island Food Network), promote non-monetary value of small-scale fishing, are proving that a life without a car is possible (e.g., Hydra Island, Mackinac Island) and experiment with co-housing networks (e.g. Vashon Cohousing). Generation of self-employment with initiatives like bread baking, bike repairing, beer brewing etc.) which are common in insular and rural spaces due to the isolation and smaller scale of the economies, offer an opposition to the profit-driven waged labor. Thus, the limits of insularity can be translated into stronger communities, collective self-limitations, and a commitment towards self-sufficiency.

A special mention is needed around tourism and insular degrowth, as tourism is still the main economic pillar for many islands (Baldacchino & Ferreira, 2013). Within the degrowth paradigm an alternative lifestyle is also reflected to the lifestyle of travelers and tourists who visit the islands. Against the idea of mass tourism that commodifies places, alternates traditional values, and pollutes the environment many islands have turned to the idea of "sustainable tourism". For islands like El Hierro and Samso, sustainable tourism forms part of their sustainable development plans and they seek competitive advantage through 'green branding'. Grydehøj & Kelman (2017) refer to this as the 'eco-island trap' and argue that often this iconic sustainability fails to deliver the expected outcomes and is counterproductive. For instance, the island of Tofino, British Columbia branded itself as an ecotourism destination but has done little to deal with the problems of water shortages, waste management, and land-use conflicts (Dodds, 2012). As long as the underlying

aim is to grow the tourist market and to increase the arrivals of tourists as a quick 'fix' to economic stagnation, little is done to deal with issues of equity and justice. According to (Wheeller, 1993, p. 122):

"*Sustainable tourism does provide the answer. Unfortunately it is the wrong question. Rather than effectively addressing the complexities of tourism impact, what it is actually achieving is the considerably easier task of answering the question – 'How best can we cope with the criticism of tourism impact?' – as opposed to the impact itself* "

An insular degrowth should not be limited only on discussions around slow tourism and ecotourism that often descend into "greenwashing", but a totally new idea around tourism detached from the 'culture-ideology of consumerism' (Higgins-Desbiolles, 2020), corporate profits, and growth. Insular Degrowth moves away from the idea of islands as commodities to be consumed for touristic recreation activities or as remote unspoiled paradises that can offer an escape from modernity. Tourism under an Insular Degrowth approach will have at the center the local communities and their environment and will have the form of tourism cooperatives, community tourism, and volunteer activities.

(2) Nurturing the commons

Islands are also arenas of social and ecological struggles against extractivism, exploitation, and rapid modernization. For instance, in the Environmental Justice Atlas, more than 20 cases are located on islands, from island-states like Jamaica, Barbuda, Maldives and Indonesia to smaller islands like Chios Island in Greece, Lastovo Islands in Croatia, and Mallorca in Spain. Many of these struggles are centered around the idea of 'Reclaiming the commons' which is also a central policy for degrowth. Arguing against the "Tragedy of the Commons" various scholars, including the Nobel Prize winner Elinor Ostrom have used evidence and case studies to prove that communities can sustainably manage common resources without private property and governmental intervention (Ostrom, 1999, 2015). Many of these cases can also be found on islands like the common agriculture land in the village Lun situated at the northernmost tip of the island of Pag in Croatia (Kale, 2019), the community energy system operating on the Scottish island of Eigg, and the island (Caramizaru & Uihlein, 2020) or the common resource fish quotas in Shetland islands (Cunningham & Bostock, 2005).

Most degrowth advocates recognize that some form of development is needed in these areas, but they reject modernizations based on uncritical developmental models. Infrastructure like water supplies and reliable electricity as well as basic services like shops, schools, healthcare, and

public transport and digital advancements are essential to ensure a good quality of life. Nurturing the commons translates into local associations, cooperatives, and other local networks can run these services, promoting local action and participatory approaches.

(4) Local and plural

The seek for immediate economic growth and the need to catch up with the economic development of more affluent areas can have important environmental, social, and economic costs. However, as Tsagkari et al. (2021) argue this is not the only path; to respond to the contemporary challenges islands can revitalize their economies without 'succumbing to growthism' (Tsagkari et al., 2021) through social and cultural regeneration that can lead to rural revivification. Local currencies, small family farms, cooperatives, and local networks of consumers, farmers, and markets offer examples of a 'relocalized' economy. Additionally, the 'revitalization' of old customs like the Greek custom of 'charáki' that refers to the old commoning practice of shepherds to share cheese and milk (Lekakis & Dragouni, 2020), the gift economy on the Danish island Samso (Thygesen, 2019), the convivial economic and women's cooperatives in Lesvos (Karides, 2016), the traditional family farms in Sicily and Sardinia (Galluzzo, 2017), and the participatory artisanal fishers' organizations (cofradias) in Canary islands (Corral & Manrique de Lara, 2017), align with an insular degrowth approach. The case of Faroe Islands Bogadóttir, 2020; Bogadóttir & Olsen (2017) offers a great example on how degrowth in insular areas can be rooted in old practices. The ideas of localism, sufficiency, and revival of indigenous knowledge should not be seen as adhesion to the past or against progress, but on the contrary, they can be the foundations of alternative development.

(3) Saving resources

Islands often have limited resources, especially land and water. The recognition of the limits of development and the need to protect the finite natural resources is central in the degrowth discussion. At the same time many islands around the world have abundant waves, sun and air making them ideas sites for renewable energy production, an idea reflected also in the relevant EU policies. Despite this great interest around the protection of the non-renewable island resources and the exploitation of the clean energy potential, there is not an extended discussion on the topic in the degrowth literature.

Degrowth does not accept renewable technologies uncritically and challenges the promises that they will fully replace fossil fuel and boost economic growth. GDP growth is fueled by an increase in energy use, while often new energy sources are used to cover an increase in energy consumption rather than replacing the old energy sources, a well-studied phenomenon known as "energy addition" (Fressoz and Bonneuil, 2013). The research of York (2012) in a timeframe of 50 years of electricity generation showed that for each unit of clean electricity production less than one-tenth of fossil-fuel production was replaced. Degrowth does not reject the advancements in renewable energy technologies but shifts the focus on reduction in energy demand through low tech alternatives, low carbon public facilities, and public transport among others (Alexander & Yacoumis, 2018; Mastini et al., 2021). In fact, as argued by Tsagkari et al. (2021), islands can offer ideal sides for a degrowth approach centered around small scale, democratically owned energy projects.

At the same time activism has emerged in defense of the natural resources and the commons from the "tragedy of enclosure" (see Anguelovski and Martínez Alier, 2014; Escobar, 2015). For instance, in many Greek islands, the local population stood against the construction of industrial wind energy projects. The organization "Movement against windmills on small islands'' has successfully blocked till now the "Aegean Project" as they saw their land being degraded, commodified, and sacrificed for rapid profit at any cost. The community through assemblies, dissemination of information, organized resistance, and protests fought for the protection of their land (EJ Atlas, 2022.; Spais & Beltran, 2018). In the Canary Islands, the local communities stood against the construction of the Granadilla port that will affect the local biodiversity and opposed the installation of a high-voltage line in Tenerife (Armas-Díaz et al., 2020; Armas-Díaz & Sabaté-Bel, 2020). For Martinez-Alier (2021) these socio-ecological struggles are niches for degrowth or what he calls 'degrowth in practice', as they stand against and often stop neoliberal, growth-oriented projects against the unequal distribution of costs and benefits of mega-projects and other forms of "neoliberal conservation" (Igoe & Brockington, 2007) in insular areas in the Global North.

After doing the exercise to envision how Degrowth can be applied to small islands that have been left behind in the developmental process, I proceed to a discussion on the differences between the EU approach as this is outlined in the relevant policies and the Insular Degrowth idea.

BRINGING INSULAR DEGROWTH IN THE CLEAN PACKAGE FOR EU ISLANDS

In this section I compare the two narratives on island development namely the Clean Package for EU islands and Degrowth and I identify points of tension but also possibilities for convergence.

The main focus of the Clean Package for EU is on the clean energy transition through innovative clean technologies that transform islands into testbeds and engines for green growth. In this vision, renewable energy technologies will help the islands flourish and create opportunities for growth mostly through new job opportunities and tourism. On the contrary, degrowth focuses on a more holistic approach with plural, diversified models of alternative development, rejecting a uniform model that is imposed top-down (Latouche, 2004, p. 62).

While the Clean Energy for EU aims to address the question of "what type of technology the community wants", degrowth asks what will be made through this technology, and community and wellbeing are some of the answers. This means that simply "benefiting" or "involving" the communities does not "make" a community. In the words of Watts (2019) about Orkney Island "Rather than asking how the islands were making (or not) three wind turbines in the islands, I could ask how the proposed wind turbines were making the Energy Islands". This is rooted in the belief that crafting and building structures can enhance social relations as these place-based technologies become entangled with the lives of the islanders.

Additionally, renewable energy can mitigate some environmental problems but exacerbate others. Many of these externalities have been well studied by degrowth research, like environmental conflicts for the control of natural resources (Scheider et al., 2020) and land-use changes (Capellán-Pérez et al., 2017), and local pollution in the mines where rare metals are extracted (Alonso-Fradejas, 2021; Sonter et al., 2020). Although most of the new RE projects on islands are still at a very early stage, some initial results (Tsagkari et al. 2022, in Chapters 3 and 4 of the present dissertation), indicate that communities perceive limited benefits, while certain groups like women report higher levels of dissatisfaction. For this reason, a policy like the 'Clean Energy package for Islands' that is solely focused around RE energy and puts uncritical faith in the use of technology, ignores the aforementioned realities and does little to deal with the social inequalities that can be exacerbated by the development of eco-projects (Xie et al., 2019, 2020).

A degrowth approach moves beyond clean energy production as the main pillar of development and sustainability. Policies on job guarantee, access to health and education, and issues like environmental justice, energy democracy, and commoning are central (Parrique & Timothée, 2019). Especially the creation of new jobs, which is a desired outcome of the EU Clean Energy Package should not be only on the precarious tourist industry with low payments but on a variety of sectors especially in care, craft, culture, and with provisions for a balance between work and free time. For degrowth, the goal is the well-being of the communities with respect to the planetary boundaries and not the short-term opportunistic growth.

The Clean Energy for EU islands takes a step in the right direction by recognizing the importance of the local communities in the energy transition and the sustainable development of the islands. However, the recent research of Tsagkari et al. (2021) has shown that simply including the local community in the discussions does not equate to energy democracy or ensures a top-down approach. Additionally, a 'community' project is often owned only by a few members of the community leading to disputes between community members and perpetuating already existing power structures (Walker et al., 2010). For this reason, the Clean Energy for the EU Package by seeing communities as homogenous with a common vision does not acknowledge the social divisions and tensions between members of the communities and social groups, which are often results of contested interests and hierarchies (Connel, 2018). In this context, a degrowth approach with its attention to care offers a slow innovation approach with a moral commitment for social cohesion and a sense of 'togetherness'. As Watts (2019) puts it "local community-making infrastructure projects have a temporality that cannot be hurried for them to bear fruit, and to go on bearing fruit into the future."

In line with the arguments of Mastini et al. (2021) around Degrowth and the Green New Deal, I also argue that social ownership of energy investments can promote a more democratic control over energy and the economy. The democratic control of RE through energy communities, cooperatives, and other forms of collective ownership is gaining attention in the Degrowth literature (Alarcón Ferrari & Chartier, 2018; Kunze & Becker, 2015; Tsagkari et al., 2021). Despite the attention to the local communities the Clean Energy for EU islands fails to include clear instructions for the role of the various actors in the project, which can lead to misinterpretations and alternate the character of these projects (Tsagkari, 2020). Devine-Wright (2020) distinguishes between community initiatives which are "initiatives with strong citizen participation, local ownership, and collective benefit sharing" and local energy projects that focus on growth, job creation and are led by a consortium of public and private actors. In contrast with the EU approach, degrowth does not position citizens as consumers with a passive role for the energy transition but as citizens working cooperatively to share benefits.

The Clean Energy for islands policy prioritizes pilot projects that produce knowledge that can be transferred to other areas. In this narrative, islands are depicted as ideal sites for testing innovative solutions which will soon scale up to the mainland and urban centers. This happens through joined projects among public and private actors which prioritize the replicable solutions over the specific local needs and fail to include local knowledge. This idea can foster more neo-colonial private projects which are often masked under the term "local energy projects". The recent research of Kallis et al. (2021) mentions that the view of islands as places with distinctive attributes well-suited

to testing new energy technologies" can lead to tensions and difficulties as a replication of a project to a different setting can be unsuccessful. Grydehøj & Kelman (2017) claim that the impact of sustainability on small islands is minimal on a global scale and while it is unlikely that these islands will serve as models for similar initiatives in the mainland, their success will be appropriated by political and economic interests on the mainland.

A response to this, degrowth focuses on place-based approaches to address local priorities and needs in an approach that considers local social conditions. Thus, instead of seeing islands only as potential ´testbeds´ due to their vulnerabilities, a degrowth approach should focus on embracing these vulnerabilities to create new narratives. For instance, the creation of strong networks community cohesion, traditional knowledge, and rich natural heritage can be some of the orientation ideas that degrowth could further explore.

From the aforementioned, it is becoming obvious that the two narratives class in various points. The Clean Energy Package for EU islands, despite the efforts to promote a sustainability framework that solves the challenges of islands, fails to address injustices and conflicts, while it underestimates the needs and values of local communities, and ignores the complexities of the current socio-economic systems. However, there are also a few points of convergence with an insular degrowth approach like the recognition of islands as experimentation sites, the importance of the local communities in the energy transition, and most importantly the urgent need to address the underdevelopment of insular areas through a revitalization of the economies. The question that remains is what developmental path will lead to these objectives.

CONCLUSIONS

The first purpose of this article was to introduce the idea of insular degrowth as an alternative to the growth-driven policies for the development of the EU islands. Many of the EU islands have been left behind in the national development plans which lead to vulnerable economies, high levels of poverty, and limited development opportunities. Currently, many islands worldwide are in a crossroad trying to balance sustainability and development. Insular Degrowth can offer an alternative to the growth-driven EU policies. However, given the criticism of degrowth in less developed areas and the multifaceted dimension of degrowth I introduce the term insular degrowth to help us envision how degrowth in islands might look like.

I argue that islands can revitalize their economy without the 'growth-mania' that has proven catastrophic for big cities and urban centers. Insular degrowth offers an alternative development model that centers around local traditions, old practices, cultural revivification, commoning and social struggles. However, it is important to draw a note of caution to avoid dreaming of a

mythical past and romanticize the insular life. Although islands with their unique environment and remoteness might be associated with a 'romantic nostalgia' (Gillis, 2004; Lowenthal, 2007) this nostalgia often becomes utopian. Islands form part of the globalized world and have certain expectations around what consists of a good life. For this reason, insular degrowth does not reject all development and modernity. For instance, technological advances (internet connection and reliable electricity) and infrastructure development (bike lines, hospitals, schools) are still necessary to ensure a good life on the islands.

In the second part of the paper, I analyzed the relevant EU policies on islands, with the focus on the ambitious Clean Energy for EU islands package. Driven by the idea of ecological modernization and the belief that economic growth is compatible with environmental sustainability, the Clean Energy for EU islands overlooks the needs and aspirations of the local communities and turns a blind eye to cases of land appropriation and profit-driven interventions from big actors, all in the name of green growth.

Both the EU policy and the Degrowth discourse have overlooked the needs and potential of islands in the past. The Clean Energy for EU islands policy is the first attempt of the EU to design tailormade policies for islands and for this reason the aim is not to minimize the potential and importance of the Clean Energy for EU islands policy but rather to open up a dialogue with an alternative vision like Insular Degrowth. The Clean Energy for EU islands, and if carefully implemented and supplemented with other policies can lead to a win-situation for islands by balancing development and sustainability. Degrowth offers a next step in this direction, a more advanced and radical approach within the limits of the planet and the with clear limits for the growth of the economy. By doing the exercise of envisioning an insular degrowth approach I present some of the "cooking material" and not a recipe as diverse strategies and approaches can lead to important social transformation. With this purpose, I hope that the idea of insular degrowth will initiate further discussions both in the Degrowth and EU policy circles.

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7. GENERAL DISCUSSION

The transition to renewable energy has led to new social arrangements around energy systems. The emergence of local and decentralized renewable energy projects raised expectations that go beyond electricity production, like community empowerment, social cohesion, economic benefits, job openings, etc. (del Río & Burguillo, 2008; van der Waal et al., 2018). This romantic view of local renewable energy projects as vehicles of societal transition often fails to draw attention to issues of injustice and dispossession (Forman, 2017; Simcock, 2016).

Recently, there have been efforts to ensure ethics in real- world energy decisions and to account for unintended and unfair impacts from energy projects. When it comes to renewable energy projects, however, these are mostly focused on issues of public opposition and environmental injustices during the project's design phase. On the contrary, there is little attention given to how people perceive the impact of the projects on their lives post-implementation. The few available assessments are done by external actors -managers, technicians- and/or are based solely on technical and economic indicators (Terrapon-Pfaff et al., 2014). Local voices and social aspects like justice and fairness are often overlooked. The energy arena has a great diversity of opinions and local energy projects, despite their niche character, are not an exception; different groups of people experience and conceptualize energy differently (Frigo, 2017). How the energy project is perceived depends not only on who owns the project but also on other factors like the type of technology, previous experiences with other projects, landscape values, and other sustainability impacts (van der Waal et al., 2018)

In this concluding chapter, I will discuss five topics in relation to the analytical framework, the methodology, and general results. Firstly, I reflect on the organization of the case studies and the various actors (cf. Subchapter 7.1). Secondly, I will reflect on the results around the impact of the project on people's lives (cf. Subchapter 7.2). Thirdly, I will discuss the applied framework and its implications for energy ethics (Subchapter 7.3) and the current impact and future potential of the case studies (Subchapter 7.4). Finally, in the fifth section, I will present the limitations of this thesis and directions for future work (Subchapter 7.5)

7.1 CONTRASTING VIEWS

In this concluding section, I map the different actors of the projects and discuss their opinions regarding the outcomes of the initiatives and the impact they have on their lives. Overall, the point of the thesis was not to discuss if these projects are successful or not - in fact, I challenge the notion of success per se. The approach aimed to highlight the contrasting views among the different actors and underline the idea that it is rare that one project can fulfill all the expectations simultaneously. In traditional terms, "project success" is measured in terms of economic gains, time efficiency, and quality (Bryde, 2005). The introduction of more complex outcomes related to sustainability goals requires a more complex, multi-dimensional framework that recognizes how different stakeholders will assess the project using different criteria and indicators.

The scope of the present thesis moves beyond the idea of strictly "community" projects and explores new arrangements that include various actors like local governments, NGOs, the private

sector, and public institutions like universities. These new arrangements are becoming predominant alternatives to the centralized energy systems and are supported by relevant legislation (Devine-Wright, 2019; Tsagkari, 2020). Following the distinction by Devine-Wright (2019) I use the term "Local Energy" (LE) to refer to these new arrangements and to distinguish them from "Community Energy" (CE). The two case studies that are the focus of this research, Tilos and El Hierro, promote renewable energy production to increase sustainability in the community and to achieve side benefits like new income streams and increase in tourism (Frydrychowicz-Jastrzębska, 2018; Kaldellis & Zafirakis, 2020; Notton et al., 2017). Before diving into the different perspectives, the work started with a stakeholder analysis to map the priorities, interests, and objectives of the various actors and their roles in the various stages of the project (**Chapter 1**). The actors of the case studies are summarized in the following table:

Table1: *List of the actors of the RE projects*

National Governments
Municipality
National Corporations
International Corporations
Electricity Distribution Operators
European Union
Universities
NGOs

Local governments were successful in advocating for new decentralized systems, imagining how they could boost the local economy and social cohesion, managing decision-making processes, and establishing networks. Thus, one can conclude that these figures were the "niche managers" (Hoppe et al., 2015; Kemp & R., 1998). Like the observations of Osti (2012), the local governments both cases partially played the role of mediator between the communities and the external actors, and they represented the communities in various formal and informal settings. Especially in Tilos, the figure of the "green mayor" played an important role in the design and implementation of the project. The mayor envisioned the project and acted as a "policy entrepreneur" (Young & Brans, 2017). These findings come to further support the literature that has underlined the importance of local governments (Hoppe et al., 2015; Mey et al., 2016) and more concretely of mayors (Fraser et al., 2022)

The work of intermediary actors has also been well studied in the transition literature, and there is evidence of the central role these actors play in the development of grassroots initiatives through the diffusion of learning and networking that connects niches with regimes (Bush et al., 2017). In the context of this thesis, the role of intermediaries was taken up by universities (e.g., University of West Attica) and NGOs (e.g., Red Cross, WWF), which aim to balance different interests and values, establish a common vision, and create bridges of communication, contributing that way actively to the learning process. Additionally, these actors supported the technology transfer and policy 'translation', offering skills that were not present in the local community. Thus, in line with other researchers (Geels & Deuten, 2006; Hargreaves et al., 2013) I also conclude on the importance of intermediaries in helping to build and scale-up niches.

One last (heterogenous) actor that needs special mention is the local community. Although the Tilos and El Hierro projects cannot be considered strictly "communitarian", they aimed to involve the local population actively in the design and implementation of the projects. The drivers that motivated the local community to support the projects were not only economic benefits, but also social, like a feeling of autonomy, independence, and pride, as well as environmental benefits. These results are coherent with previous work that has stressed the importance of identification with place-based communities and a sense of belonging (Bauwens & Devine-Wright, 2018; Haggett & Aitken, 2015; Hoffman & High-Pippert, 2010; Rogers et al., 2012; Walker, 2008). These feelings can be a primary motivation but also an outcome of the projects, as seen in the present case studies (**Chapter 3**).

From the surveys with the local population and with multiple stakeholders in this last section, I present the median scores the different actors gave to the distinct sustainability aspects of the projects. The scoring methodology and the indicators are the same as presented in **Chapters 3** and **4** and are measured against the desirable outcomes of the projects. This approach allows for an interpretation of the results and useful insights into the perspectives of the various stakeholders (Katre & Tozzi, 2018). By collecting data from multiple stakeholders, I was able to validate information across different levels and to include different values and opinions in the analysis. The different median scores for each sustainability indicator and for different stakeholders are summarized in Tables 2 and 3.

Tables 2&3. *Overview of the median scores given on each Sustainability Indicator by the different groups for Tilos and El Hierro*

Tilos						
	Community	Municipality	Companies	Managers	NGOs	**TOTAL**
Technical	3.5	5	4	4	4	**20.5**
Economic	3	5	4	4	4	**20**
Social	4	4.5	4	4	4.5	**21**
Environmental	4	4.5	4.5	4.5	4.5	**22**
Institutional	3.5	3.5	4	4	4	**19**
TOTAL	**18**	**22.5**	**20.5**	**20.5**	**21**	

El Hierro						
	Community	Municipality	Companies	Managers	NGOs	**TOTAL**
Technical	3	4	4	3	3	**17**
Economic	3	4	4	4	3	**18**
Social	3.5	4.5	3.5	4	3.5	**19**
Environmental	4	4	4	4	3.5	**19.5**
Institutional	4	4	4.5	4	4	**20.5**
TOTAL	**17.5**	**21**	**20**	**19**	**17**	

From the scores given by different actors on the success of the project, and from the discussion in the previous published chapters, the main conclusion of this work is that a wide range of interests, ideas, values, and norms shape the projects. Although already in 2008 del Río & Burguillo (2008) envisioned a comprehensive framework for local RE projects, it was not until 20 years later that Katre & Tozzi (2018) applied an advanced framework that includes data from various stakeholders and focuses on the sustainability pillars. However, their analysis is still explorative and not analytical and does not answer questions around potential injustices, like: Whose voices are heard, what does the framework reveal, and what does not allow us to see?

Each of the social groups presented here has different perceptions of project success, based on their values, ideology, and legal constraints. This strengthens the argument that the idea of "success" is not normative but rather subjective and depends on the different actors. Especially in the field of renewable energy projects' assessments, there has been little effort to create co-production of knowledge and to include multiple stakeholders in the process of the evaluation.

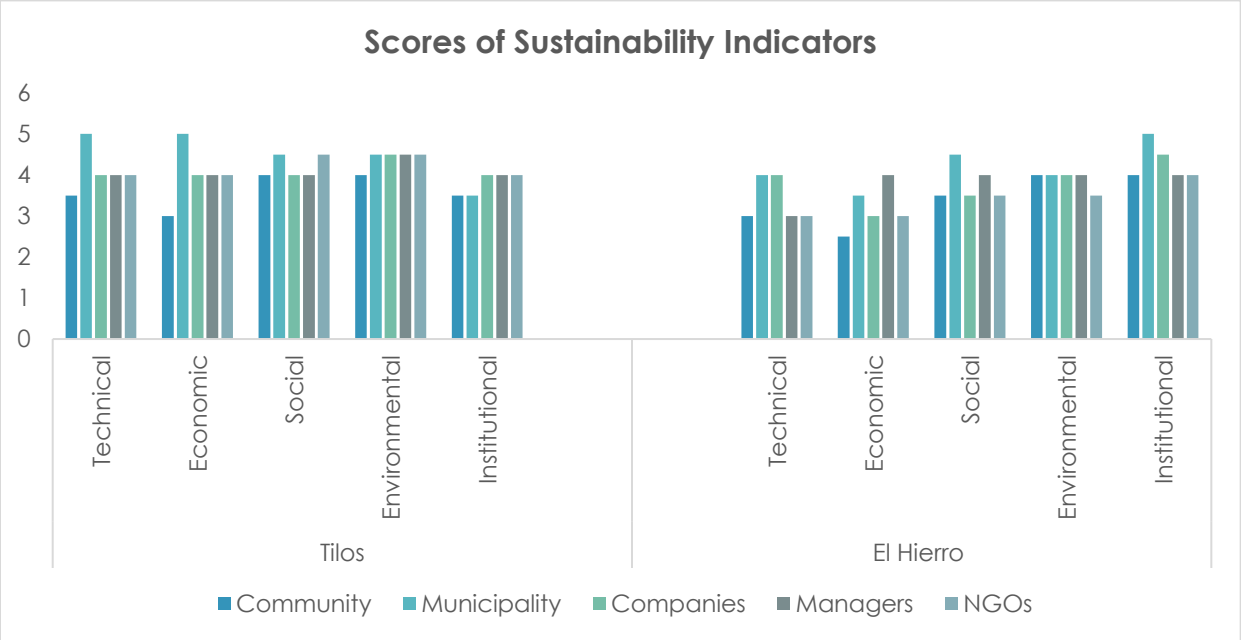

Figure 1. *The median score given on each Sustainability Indicator by the different groups for Tilos (left) and El Hierro (right)*

As one can easily observe in Tables 2 and 3, external actors like managers and private companies seem to rate the success of the projects higher than the local communities. In the eyes of these actors, the projects have delivered to a satisfactory degree on their promises. Interestingly, the municipalities also rank the projects' success higher. For municipalities and companies, these projects serve as a statement of their political and corporate commitment to low-carbon energy transitions. Especially for local governments, these projects are the vehicles that will help them achieve their political objectives (mitigate climate change, improve the local economy, etc.) and gain popularity. Moreover, the local governments, companies, and managers, knowing the inside technical aspects of the projects, might have more realistic expectations than the local community. In fact, as discussed in **Chapters 3** and **4,** the involvement of the local population in

the projects was limited, and thus their expectations that drive the assessment might not align with the projects' realities.

On a second level, the present thesis sheds further light on the "success" of the projects through the eyes of the local communities. Very often, the post-implementation assessments are done by experts and managers based on a series of pre-determined indicators and fail to include the local communities. In the cases examined here, the local population was given the opportunity to evaluate the projects through a series of indicators designed around the initial goals of the projects and the sustainability pillars. I observe that people tend to value highly certain aspects of the projects, like the sense of autonomy and the role of the local government. An important finding regards the economic benefits, which are often discussed as one of the main motives for the support of renewable energy project (Bauwens, 2016; Bergman & Eyre, 2011). However, this study argues that economic benefits are not significant in the assessment of a project as "successful." This is in line with emerging research on the financial motivations of local populations to accept RE projects (Korcaj et al., 2015; Sloot et al., 2019). Additionally, projects can enhance social cohesion and other cultural aspects, and local benefits derive from the development of community capacity around the RE project. Lessons learned through involvement in RE projects can expand in other collaborative activities which will increase social capital and will create shared community goals (Adams & Bell, 2015; Park, 2012). The local communities seem to value high these outcomes.

During the initial result analysis, it became evident that there are some interesting differences between men and women in both cases, especially regarding their willingness to support and participate in different projects. These differences were further explored in **Chapter 4** using the energy justice framework and a gender-based approach. This additional analysis also aimed to respond to some of the recent calls in the academic community to pay attention to the different gender inequalities in the energy transition and to highlight differences in energy patterns, expectations, and involvement (Clancy & Feenstra, 2019; Feenstra & Özerol, 2021; Hanke et al., 2021). The results support the initial hypothesis that there are significant differences in the perceptions of energy projects between genders and highlight the need for more gender-based approaches.

The analysis of the case studies illustrates not only the diversity within the projects but also between the projects. Overall, the Tilos project received higher scores than El Hierro from all actors. This can be attributed to the smaller scale of the island that makes the benefits more directly visible to the local community. Additionally, the project is on a smaller scale and thus, has a lower environmental impact. Of course, part of the success of the project could be attributed to the greater involvement of the local community and the stronger involvement of the local authorities. In Tilos, the overall score for the positive impact of the project on the environment is higher than the other sustainability pillars, meaning that all the actors value highly the way the project helps reduce CO_2 emissions through clean energy. Interestingly, in El Hierro, the Institutional aspects hold the higher score, meaning that all the actors value the institutional organization of the project, and more concretely, the role of the local government and the way disputes and conflicts are solved. In Conclusion, each project had to face different challenges, conflicting understandings, and values around distinct technologies. Nonetheless, the evident similarities between the two cases show a trend in the organization and operation of the projects in insular environments.

Of course, the success of the projects also depends on wider determinants, including relevant policy and legal constraints, which should not be overlooked. As discussed in the introduction, several policy barriers can be identified in the relevant policies that are obstacles to the success of the projects (see also Appendix C). As van der Waal et al (2018, p9) suggest: "*impacts need to be enabled by the wider context of the project, such as grid capacity and energy policy*." Especially for small-scale projects that are highly dependent on external parameters, mostly due to their limited skill set, financial-specific policies and territorial strategies that aim to support these local initiatives are necessary.

To my knowledge, the work presented in **Chapters 3** and **4** offers the most complete analysis up to date on the evaluation of RE projects post-implementation. Drawing from two frameworks, namely 'sustainability', and 'energy justice' these chapters jointly offer an overview of the impact of local RE projects on people's lives. The shared methodology of these two chapters was a survey analysis that allowed me to evaluate people's opinions. These two chapters also highlight the need to include the local communities not only in the design of RE projects but also in the evaluation post-implementation. Indeed, it has been argued that projects that promise community participation and involvement include the local population only in the initial design phase, often as listeners or consultants. However, many people might feel disappointed with the project, and thus, a continuous evaluation and an assessment based on knowledge co-production are essential.

7.2 ETHICS AND JUSTICE IN THE ASSESSMENT OF RE PROJECTS

The engagement of humanities scholars and social scientists with energy issues has been primarily required by the growing awareness that concrete energy issues do not happen only theoretically, but are practically entangled with ethical, economic, and socio-political dimensions. For quite some time psychological, behavioral, ethical, and socio-political aspects of energy have been, for instance, ignored, dismissed, or not seriously considered.

The present thesis challenges the idea that energy solutions are purely technological and deals with the philosophical and ethical dimensions of energy projects. I aim to draw attention to the need for ethics in energy research, and more concretely to the structure, power, and interests that shape actual energy policies and institutional responses. By diving into this debate, I highlighted the need to move away from myopic project assessments driven by ''normal'' science into more complex and pluralistic approaches that question the established moral and ethical frameworks. More concretely, the "feel-good talk of participation" (Cornwall, 2008) should be substituted with a real participatory process that creates community knowledge and includes various (often difficult to measure) values and perceptions. Thus, any project assessment should be seen as a "negotiation arena" over what constitutes "success" and how to best practice "local sustainability".

As Sovacool (2013) writes in the conclusion of his book Conceptualizing Energy Justice: "*choosing to ignore the ethical implications of our energy system is not a decision free from value … doing nothing sides with and validates the oppressive system*" (p. 227). As seen in the analysis of the published **Chapter 3,** the idea of a "successful project" is rooted in priori assumptions on what constitutes a success, which are different among different actors. Through the energy ethics lens,

one can assume that people experience the energy project and, by extension, the different technologies differently.

Following the *suggestion of* Smith & High (2017, p2), "*Rather than applying a preexisting framework to evaluate a particular context, we identify how people themselves judge the rightness and wrongness of energy*." Thus, the biggest contribution of this thesis is the proposal of an alternative and more complex framework for the assessment of energy projects. This framework involves various actors, their initial expectations, and their point of view regarding the impact of the projects on their lives. This framework is driven by energy ethics and can be applied in parallel with other frameworks like the energy justice framework (**Chapter 3**) or Strategic Niche Management (**Chapter 1**). This also means that this framework does not advocate for certain technologies, or certain organizational management forms, but rather for a pluralistic approach in the assessment of the projects. The role of the researcher is neither critiquing nor advocating for the different opinions expressed by the people of the study, but rather aims to combine them in a holistic framework that gives the bigger picture regarding the intended and unintended consequences and assembles the various opinions and ideologies.

Another important finding of the present work is the important role of the local community and the caution in the use of the term "community". As Pesch (2019) states, inspired by Dewey & Rogers, (2012)"*publics emerge in reaction to the issues that affect them as a collective*" (p3). This means that there is not a pre-existing idea of community, but in many cases, the projects make the communities. By viewing communities as homogenous actors with common ideas and visions, researchers and decision-makers often refer to "community perceptions" by selecting several members from the community as representatives. This assumes that the "public" represents one idea and one assessment (Pesch, 2019) and can create tensions, as researchers tend to overlook certain groups often the marginalized ones. On the empirical ground, this thesis aimed to counter the tendency to homogenize the community as one actor with common ideas about what is good for the community. As it has been demonstrated elsewhere, participatory opportunities in renewable energy projects are often exploited by certain actors from higher socio-economic groups, leading to injustices and the exclusion of certain members (Catney et al., 2014; Park, 2012). In Chapter 4, this was explored through the gender lenses, and it was highlighted that women and men have different expectations from the projects and experience their involvement differently. More concretely, women felt less included in the project and that they did not have active participation. They also reported perceiving fewer benefits than men. These results indicate low levels of distributive and participatory justice in terms of gender. It also strengthens the idea that a bottom-up approach does not guarantee energy justice.

This work also challenges the paradigm that the evaluation of energy projects should be based only on measurable, quantifiable properties of energy. As seen in the analysis, other values like the sense of pride and autonomy, which are not easy to measure, are important factors in the "measurement of success." These values, which are often forgotten in the assessment of the projects, can pave the way to a new conceptualization of energy, moving away from the "traditional energy paradigm" to the view of energy as a "common" with social value and political impacts. In this line, the combination of qualitative and quantitative methods under one framework can be a useful methodology. Contributing to the current debate around qualitative

and quantitative approaches in social science, this thesis underlines the importance of a mixed-methods approach.

7.3 ALTERNATIVE ENERGY IMAGINARIES

The thesis offers a guideline to a pluralistic, post-normal project assessment, and a view on cases that have the potential to develop an alternative energy imaginary around renewable energy. In both **Chapter 1** and **2** the discussion focuses on sociotechnical imaginaries and their potential to change the current energy system. Despite the small scale of the case studies, in this work, they are treated as seeds of change that can pave the way for new energy imaginaries around energy practices towards a desirable future. By looking at these initiatives through the lenses of "imaginaries" and by doing the exercise to envision how they can scale up and what will be their bigger impact, I contribute to the understanding of how energy transitions evolve and unfold as social projects transformed by and transforming social relations.

Especially in **Chapter 2**, the focus is on the degrowth potential of the case studies. Degrowth was chosen as a radical alternative to the present growth-driven system. Degrowth advocates for small-scale, decentralized energy systems in which the focus is not on technological determinism and ecological modernization, but rather on values, conviviality, and justice. With this as a starting point, I searched for degrowth ideas in the case studies and did the exercise to envision what a more degrowth perspective might look like. This idea was driven by other relevant studies, like the work of Papazu (2016),who explored how the Danish Island of Samsø used the energy project to enhance ideas of community ownership and to create a new societal arrangement, and the work of Alarcón Ferrari & Chartier (2018) and Kunze & Becker (2015), who explored the relationship between local energy arrangements and degrowth. To my knowledge, **Chapter 2** offers the first attempt to apply degrowth in real life communities around local energy projects. Both Tilos and El Hierro showed evidence of approaches that align with degrowth. Nonetheless, I agree with Kunze & Becker (2015), that these projects, although they have the potential to embrace the degrowth ideas, are not there yet. They need to realize this potential and engage more with the local communities to imagine and live in line with degrowth principles. This idea was further developed in **Chapter 5** with the introduction of the concept of "Insular Degrowth" to describe alternative degrowth imaginaries in insular environments. The concept of "Insular Degrowth" emerged from the discussion in **Chapter 2** but was further enriched with other ideas like common ownership, low-tech alternatives, and empowerment of local communities. This approach allows us to imagine a different approach to the development of islands, one that does not focus solely on technological innovation but includes also social and economic parameters like the ones identified in the other Chapters.

A note of caution is also needed to avoid the "idealization" of certain places. In particular, islands like Samsø have been praised as spaces that "*crystallize the benefits of a sociotechnical option*" (Chateau et al., 2021 p5). In contrast with this idea, the present research approaches these imaginaries with caution. As also explained in detail in **Chapter 3**, the case studies of this work are far from ideal. The analysis in **Chapters 3** and **4** further supports this idea by highlighting specific energy controversies and injustices in projects, that on the surface, are quite successful. Turning back to islands, the idealization of specific cases (like the ones presented here) especially in the public media is often used to legitimize the use of islands as testbeds for energy innovations while highlighting the potential generalizability of these solutions. Thus, a main conclusion of the present

work is the need to dive into the specifics of each case and to avoid the idealization of places and projects.

The most important question resulting from an in-depth analysis of local small-scale RE projects is, without a doubt, the potential to scale up. Especially in the case of islands, there are various debates on the extent to which these initiatives can be duplicated in other settings. In line with the debate over "imaginaries," the debate over the ability to scale-up projects is frequently limited to the concept of "niches." These initiatives often seem almost "condemned" to acting at the margins of the energy system (Markantoni, 2016). Despite the recent policy changes, large corporations are still favored over small-scale movements which are trapped in 'a dependence relationship with harder energy paths' (Strachan et al., 2015, p 106). According to Pohlmann (2018), these arrangements remain "niches" and have little potential to scale-up. Although I agree with this observation, my work points out the importance of networking and "brand management." As discussed in **Chapter 1**, the networking among the case studies and the existence of common actors has created a strong network with the potential to scale up. Additionally, the benefits of the project have been widely discussed and have motivated other islands to start similar initiatives. Of course, these projects operate in hostile policy environments and face several policy barriers (discussed in the Introduction) that limit their impact and their potential for scaling-up. Despite that, both projects offered useful policy guidelines and led to tailor-made policies for specific needs. Thus, despite their small scale, the case studies discussed here had a big impact.

Since the beginning of the thesis, a few other projects with similar characteristics were identified as potential case studies but were not chosen as they did not fulfill the criteria (Appendix A). Looking back ON these cases now, I see that most of them have advanced sufficiently following the example of Tilos and El Hierro. In Greece, some of the examples are Sifnos, Kithira, Spetses, Kasos, Samos, Symi, Patmos, Amorgos, Zakynthos, and Crete, which form part of the Clean Energy for EU Islands. In Spain, La Palma, Mallorca, Menorca, Eivissa, and Illa de Arousa have plans for RE installations in various stages. The islands of Tilos and El Hierro, are reference points for all these islands. Thus, this dissertation offers valuable feedback for these less mature initiatives, especially around the democratization of energy systems and the need to involve actively the local population, especially women. For more advanced projects like Tilos and El Hierro other activities and initiatives like workshops, low carbon transport, etc. can be pushed by local governments to move beyond the local energy system and redefine the idea of local development.

7.4 LIMITATIONS

As in most cases, the present thesis also has certain limitations. First, the methodological approach is based on a limited number of responses. Although the data is sufficient to perform statistical tests, the sampling size is small. As it is also highlighted in **Chapters 3** and **4**, one cannot assume random sampling. Despite the researchers' efforts, the people who respond to online surveys frequently have stronger opinions on the subject. In this case, one can assume that the sample consists mostly of people who tend to be strongly positive or negatively towards the project. This limitation was exacerbated because of the COVID-19 restrictions that did not allow door-to-door sampling as initially planned. Another limitation is the spatial limitation of the case studies.

Although the islands chosen as case studies for this thesis are relevant cases for renewable energy initiatives, especially in the European context, a generalization of the results is not easy. These two islands have specific cultural contexts that influence the acceptability and expectations of the population. As mentioned in **Chapter 3**, the people in Tilos have high levels of environmental awareness and thus, although they are overall positive towards the projects, they also worry more about the impact they can have on the natural environment.

Thirdly, the framework used for the surveys was driven by specific aspects of sustainability. Although these were identified from the specific ambitions of the projects, many issues may have not emerged in the surveys, as these were based on close- ended questions. Additionally, the same methodology includes mostly impacts that the local population was aware of and able to identify. Sometimes it is difficult to distinguish between different sustainability aspects due to their intrinsic commonalities (Hong & Abe, 2012). For instance, an increase in tourism can have both social and economic and environmental impacts.

Fourth, the proposed framework is adapted to the "closed and remote" insular systems of these two islands, where sustainability is shaped by remoteness and there are limited opportunities for development. In these specific contexts, and as discussed in **Chapter 3**, sustainability can be seen as a path to promoting economic development. Strong social engagement and local government are key aspects in the design and long-term success of the small-scale local energy projects discussed in this thesis. Additionally, in these small and remote locations, the impact of the projects can be made more visible to the population.

Another particularity of the case studies is the 'hybrid' organization model. This model has emerged as an alternative to the centralized model of energy production and involves various actors. As argued in **Chapter 1**, this model might be the most adequate for the remote islands that often lack the capacity and knowledge to implement community-owned projects. With the participation of intermediary actors like NGOs and universities, the projects not only ensure public participation but also enforce networking and learning. However, these specific arrangements depend greatly on the specific organization and the actors involved. To our knowledge, there is so far limited research around these new arrangements, which, however, are expected to play an important role in the future. Thus, to be able to draw more clear results around the specifics of these new forms of energy management and to measure their impact, more research in this direction is needed.

Finally, the present study is limited to a specific point in time. The questionnaires were disseminated at the end of the pilot phase and at the beginning of the full operation of the projects, meaning there were still issues that remained unaddressed. For instance, the smart meters in Tilos were not fully operational and the project in El Hierro was showing certain malfunctions. As the projects mature, many of these issues will be overcome, and thus one can expect that the local people's assessment of the projects and the impact they see on their lives will change. Unfortunately, the fieldwork was also conducted during the COVID-19 pandemic, which led many countries to close borders and impose lockdowns. The impact of these measures was even more severe in the already remote areas like Tilos and El Hierro which rely heavily on tourism. This might have influenced people's perceptions to a degree as they failed to see the promised benefits of the projects.

7.5 POLICY RECOMMENDATIONS AND FUTURE RESEARCH

This thesis started with the idea of proposing a more systematic and pluralistic framework for the assessment of local projects, with the aim of informing policymakers on how positive impacts from the projects can be enhanced and negative ones diminished. This section discusses how the evidence for this thesis can inform policymaking.

Firstly, any policy approach needs to include various actors in the post-implementation assessment of the project. These assessments and the relevant projects need to be updated and reviewed continuously to include the different values and opinions. A project is not a static idea but should evolve and improve in time. Thus, the present thesis argues for a policy design that allows for feedback loops between the project design and implementation and a discussion among the various actors. Future projects will have to align their objectives with the aspirations of the community early during the design phase, and these will have to be adjusted and aligned along the way. Policies need to be based on assessments that include evidence from the whole community, not just from the most active members.

Another important implication is the need for further collaboration among the actors to achieve a bigger change. Significant reforms to national legislation and regulation are still needed to make social participation an integrated part of decision-making. Additionally, the future expansion of the niches requires more support from various actors, especially from intermediary organizations that can promote networking and learning. By creating and maintaining an environment in which expectations are well articulated and reflexive learning processes take place, the niches can expand and be scaled.

The discussion in **Chapter 4** sends a strong signal on the need to include sex-disaggregated data and to use gender-based approaches in the assessment of the energy projects and in energy studies in general. This recognition that energy policies are not gender-neutral and can have different implications for men and women can drive policies that take into consideration the unique energy needs of women and the underlying societal inequalities. Integrating gender equality perspectives in the energy policy can also have further economic, environmental, and social benefits for the local communities. **Chapter 5** focuses on two policy approaches namely on Degrowth and the Clean Energy Package for EU islands. Through the analysis, I propose some concrete ideas for the EU policy to align more with the Degrowth ideas to ensure islands balance sustainability and development. The idea of "Insular Degrowth" centers around the revitalization of the local economies through small scale-energy projects, energy democracy and commons among other aspects.

In the present dissertation, some issues that emerged during the analysis remained beyond the scope of this work and can offer directions for future research. Firstly, there is the need to consider the underlying values that drive public attitudes and positive and negative views around a particular technology and project. Secondly, sustainability is a long-proven concept that shows results over time. Currently, there is limited research on projects that have been in place for enough time to allow for long-term evaluations. Longitudinal surveys can allow researchers and policymakers to explore how the projects are advancing and how people's perceptions change over time. Moreover, research in different settings will allow for greater generalizability and a broader discussion of the impact of local RE projects on people's lives. In particular, a more

concrete focus on gender aspects is necessary. Similar approaches to the one employed here can be used to shed light on how marginalized groups perceive the benefits of energy projects. Gender discussions that go beyond the men-women binary are also required to ensure a feminist approach to energy project design and implementation of energy projects.

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8. CONCLUSIONS

In the present study, I used a case study approach of local energy projects at an early stage. The focus was on islands that have clear community boundaries and make it easy to identify the various actors involved. The underlying motive was to unveil the complexity of the contemporary energy debates at a local scale and to look at the different values and opinions that shape people's understanding of the success of renewable energy projects (within the same, or among different projects), and to discuss the future of these initiatives. The study also reveals the opinions of various actors regarding the impact the energy projects had on various sustainability aspects. Specific attention was given to the gender aspects of the energy projects with the use of sex-disaggregated data to highlight the different expectations and involvement of men and women in the project.

The transformative potential of the case studies was analyzed through two different frameworks: Strategic Niche Management (SNM) and the Degrowth approach. In the first case, the conclusions indicate that the initiatives are still in the inter-local phase, forming a network of common ambitions and actors. In fact, these emerging alternatives offer a promising site of innovation for sustainability. Local governments, intermediary actors like universities and NGOs, and the policy environment play an important role in this. When looking at these alternatives under the degrowth lenses, it was concluded that although these initiatives embrace some of the degrowth ideas, they cannot be labeled as degrowth as they fail to achieve high levels of community involvement, which is hindered by the presence of stronger actors. Further efforts and new radical initiatives are needed to redirect these economies towards more degrowth principles. This idea should be further supported by the relevant legislation that should not perceive islands only as imaginaries for sustainable transition and testbeds for new technologies.

The insular character of the case studies influences the results in all possible aspects. The peculiarities of the insular environment, with its high levels of isolation, remoteness, high electricity costs, unstable grids, highly involved communities, and economic stagnation, create a peculiar environment that does not allow generalization. These characteristics can be seen as an obstacle but also as an opportunity; an opportunity to move beyond the idea of ecological modernization and create islands that resist the current growth-driven economic system, islands as niches for radical change and transformation.

9. APPENDIX

9.1 APPENDIX A

List of the relevant literature on post-implementation assessment of energy projects at local level

Authors	Year	DOI	TITLE	Location (Country)	Research Methods/ Theories
George William AND Hong Naoya Abe	2020	https://doi.org/10.1016/j.rser.2011.07.136	Sustainability assessment of renewable energy projects for off-grid rural electrification: The Pangan Island case in the Philippines	Pangan Island, Philippines	Interviews + survey
lAlan Colin Brentab AND David E.Rogers	2010	https://doi.org/10.1016/j.renene.2009.03.028	Renewable rural electrification: sustainability assessment of mini-hybrid off-grid technological systems in the African context	Lucingweni Village, South Africa	Interviews
Cristina Acosta, Mariana Ortega ,Till Bunsen ,Binod Prasad Koirala , and Amineh Ghorbani	2018	https://doi.org/10.3390/su10020366	Facilitating Energy Transition through Energy Commons: An Application of Socio-Ecological Systems Framework for Integrated Community Energy Systems	Ramplaankwartier, Harleem, Netherlands	Feasibility study + Interviews
Pablo del Río and aMercedes Burguillob	2009	https://doi.org/10.1016/j.rser.2008.08.001	An empirical analysis of the impact of renewable energy deployment on local sustainability	Maranchón, Spain & Tarancón (Cuenca), Spain & La Puebla de Montalbán (Toledo province), Spain	stakeholder analysis methodology. Interviews
M.MillingerT.Mårlind and E.O.Ahlgren	2012	https://doi.org/10.1016/j.esd.2012.08.005	Evaluation of Indian rural solar electrification: A case study in Chhattisgarh	Chhattisgarh (India)	Field survey conducted in eleven villages with 158 respondents, interviews with engineers and operators, and technical factors.
Charles Kirubi Arne Jacobson Daniel M.Kammen and Andrew Mills	2009	https://doi.org/10.1016/j.worlddev.2008.11.005	Community-Based Electric Micro-Grids Can Contribute to Rural Development: Evidence from Kenya	Mpeketoni Electricity Project (MEP), Kenya	Combination of surveys of SMEs, interviews with key informants, and direct observations of electricity uses.
Jennifer C. Rogers, Eunice A. Simmons, Ian Convery, Andrew Weatherall	2011	10.1016/j.enpol.2011.11.081	Social impacts of community renewable energy projects: findings from a wood fuel case study	Eskdale, England	Data collection was qualitative and longitudinal, based on 12 semi-structured

					interviews with 20 people from 16 households
Snigdha Chakrabarti and Subhendu Chakrabarti	2002	https://doi.org/10.1016/S0301-4215(01)00057-X	Rural electrification program with solar energy in remote region–a case study in an island	'Sagar Dweep' in West Bengal, India	
Esther C.van der WaaL	2020	https://doi.org/10.1016/j.enpol.2019.111193	Local impact of community renewable energy: A case study of an Orcadian community-led wind scheme	Scottish island Shapinsay in Orkney	Fieldwork, surveys with community members, in-depth interviews and change mapping workshops with community
Max Munday, Gill Bristow, Richard Cowell	2011	10.1016/j.jrurstud.2010.08.003	"Wind farms in rural areas: How far do community benefits from wind farms represent a local economic development opportunity?"	Wales	Interviews with experts and local authorities

9.2 APPENDIX B

Table of Indicators, questions, type of data, type of questions, answers

	Type	Indicator Name	Description	Type of data	Source of data	Literature	Motivation	Question
#1	Descriptive	Sex	Sex of the respondents	categorical variables	Questionnaire			What gender do you most identify with?
#2	Descriptive	Age	Age range	categorical variables	Questionnaire			What is your age?
#3	Descriptive	Education	Educational level	categorical variables	Questionnaire	I: https://www.lisdatacenter.org/dataaccess/webtabulator/variables/		What is the highest level of education you have completed?
#4	Descriptive	Employment	Type of employment	categorical variables	Questionnaire			What is your employment type?
#7	Technical	Annual energy consumption	% of change in consumption / baseline year	Hard data	Database		cover 100%	
#8	Technical	Change in electricity price (%)	% of change in price/baseline year (REAL price not unified)	Hard data	Database		cheaper electricity	
#9	Technical	% of RES (historic)	% of energy produced from RES / total energy	Hard data	Database		cover 100%	
#10	Technical	Reliability	Power outrages	yes/no	Questionnaire	Katre and Tozzi (2018), del Rio and Burguillo (2008)	Reliable energy	So far, the system been able to provide electricity continuously and reliably to the island
#11	Technical	Electricity consumption patterns	Awareness of energy use		Questionnaire	Rogers et al (2012)	cover 100%	The project motivated you to conserve energy
#12	Economic	Tourism	Increase of tourism (%)	Qualitative	Questionnaire	Lilley, Firestone and Kempto	Increase tourism	The project led to an increase on the arrival of tourists on the island

			Impact of the project on tourism	Qualitative	Questionnaire	n (2010); del Rio and Burguillo (2008)	Advertise the island	As a result of the project the island gained more public attention
#13	Economic	Energy affordability						
			Inability to pay energy bills since the begging of the project	yes/no	Questionnaire	Santamouris et al. (2013), Katre and Tozzi (2018)	Reduce energy poverty	Have you ever been unable to pay for the electricity bill at time of collection?
#14	Economic	Fairness	Fair price	Qualitative	Questionnaire	Katre and Tozzi (2018)	Reduce energy poverty	The energy service is fairly charged
	Economic	New business opportunities	Opening of new business	yes/no	Questionnaire	Katre and Tozzi (2018)	Economic Development	Have you been able to start a new business since the implementation of the project?
#15	Economic	Income generating effect	Economic activities generated by the intervention that contribute to economic development at the island level	Qualitative	Questionnaire	Katre and Tozzi (2018), Reddy et al (2006), del Rio and Burguillo (2008), Bohn and Lant (2009)	Economic Development	The project provided economic benefits to you and your family
#16	Social	Demographic impact	impact of the project on migration and immigration	Qualitative	Questionnaire	Reddy et al (2006), del Rio and Burguillo (2008)	New job openings-attract young people	The project increased the economic opportunities you see for yourself on the island
#17	Social							
#18	Social	Employment	Number of employees from the local community (direct jobs in construction and operation phase /O&M	Hard data (percentage of local population)	Interview	Cameron et al (2015), Hillebrand et al (2006), del Rio and Burguill	New job openings	

						o (2008), Bergmann et al (2006),		
#19	**Social**	Education	specific training	Qualitative	Questionnaire	Katre and Tozzi (2018)	Educate the population	Did you have any specific training related with the project?
#20	**Social**		Effectiveness of training	Qualitative	Questionnaire	Katre and Tozzi (2018)	Educate the population	If yes , the training was effective
#21	**Social**	Community connectedness	Connection with the outside world	Qualitative	Questionnaire	Katre and Tozzi (2018)	Increase social cohesion	The project made you feel more connected with the outside world
#22	**Social**	Autarky	Sense of being less depended on other communities or the mainland	Qualitative	Questionnaire	Woch et al (2014), Schmidt et al (2012)	Become self-sufficient	The project made you feel less dependent on the mainland
#23	**Social**	Social cohesion	Feeling of unity and connection	Qualitative	Questionnaire	del Rio and Burguillo (2008),	Increase social cohesion	The project brought you closer with other people on the village/island
#24	**Environmental**	CO2 emissions	Reduction in CO2 emissions	Hard data	database	Broad	Reduce CO2 emissions	
#25	**Environmental**	Land use change	Previous land use	Qualitative	Interview	Outka (2010), Vasishth (2010)	Increase env. Awareness	The project has positively affected the way you perceive renewable energy
#26	**Environmental**	Aesthetics	Impact on the aesthetics of the island	Qualitative	Questionnaire	Patel (2009), Klæboe and Sundfør (2016), P. Devine-Wright, Y. Howes (2010), Olson-Hazboun (2016)	Have minimum impact on the environment	The project did not affect the landscape aesthetics
#27	**Environmental**	Awareness	Increase of environmental awareness	Qualitative	Questionnaire	Rogers et al (2012), Bergma	Increase env. Aware	The project made you more aware on environmental issues

						n and Eyre (2011), Middlemiss (2008), del Rio and Burguillo (2008	ness on the island	
#28	**Environmental**	Environmental impact assessment	An env. Impact assessment conducted pre-implementation	yes/no	Interview	Larsen (2014), Musall et al (2011)	Have minimum impact on the environment	
#29	**Institutional**	Community involvement	Involvement from all members of the community at all stages of the intervention	Qualitative	Questionnaire	Kalkbrenner (2016), Boon and Dieperink (2014), Rogers et al (2012)	Energy democratization	The community was actively involved in all the stages of the project
#30	**Institutional**	Community involvement	Inclusion	Qualitative	Questionnaire	Kalkbrenner (2016), Boon and Dieperink (2014), del Rio and Burguillo (2008	Energy democratization	Your voice was heard and respected during the project design and implementation
#31	**Institutional**	Institutional capacity	Ability to solve issues	Qualitative	Questionnaire	Katre and Tozzi (2018)		Have there been any disputes or disagreements in the village regarding the project These were handled effectively by the project manager/operator
#32	**Institutional**	Effectiveness of local governance	Role of local government	Qualitative	Questionnaire	Mey et al (2016), Nilsson et al (2003), Busch and McCormick (2004) , del Rio		The local government contributed in the project design and implementation

						and Burguillo (2008)		
#33	**Institutional**	Effectiveness of local governance	Role of local government	Qualitative	Questionnaire	Mey et al (2016), Nilsson et al (2003), Busch and McCormick (2004)		The role of the local government on the project was positive
#34	**Satisfaction**	Success of the project	Overall satisfaction	Qualitative	Questionnaire			Considering the impact of the project on your personal life, how happy are you with the project?
#35	**Satisfaction**	Success of the project	Pave the way for future sustainability projects	Qualitative	Questionnaire			Knowing what you know now, would you advocate for similar projects in the future?

9.3 APPENDIX C

Law Environment and Development Journal
LEAD

HOW GREECE UNDERMINED THE IDEA OF RENEWABLE ENERGY COMMUNITIES: AN OVERVIEW OF THE RELEVANT LEGISLATION

Marula Tsagkari

COMMENT

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Marula Tsagkari, University of Barcelona, Faculty of Economics, Diagonal 696, Spain. Email: marou.tsagari@gmail.com

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1 INTRODUCTION

The energy sector is undergoing an important transformation under the pressure of climate change which renders the transition to clean forms of energy urgent. Through the idea of energy communities (EC), citizens, businesses, and local governments can become actively involved in the process of energy transition. At the same time, the idea of ECs has not only gained ground as an important driver towards energy transition but also as an alternative to the centralized energy system that can foster energy democracy. The ECs can identify local needs and bring together the local population to achieve common goals, such as self-sufficiency and self-determination, and increase public acceptability of RES installations. Additionally, various side benefits for the communities have been highlighted in the literature, such as employment opportunities, an increase in environmental awareness, and the opening of new businesses.[1] ECs have boomed in Europe in the past few years following the EU Directive 2008/2001 and 2019/944, especially in Germany, the Netherlands, UK and, Denmark, where the regulations have favoured ECs.[2] Yet they are still underdeveloped in Southern Europe, where the pertinent model is focused on big investments on large scale RES.[3] Generally, the importance of an adequate framework that can promote energy communities has been discussed broadly in the literature.[4]

In 2018, Greece adopted an innovative regulation in an effort to promote energy communities and to achieve decentralization. Despite the initial efforts, private investors took advantage of the Greek legislation and the available funds forming part of energy communities. There is little evidence that the country is actually moving towards energy decentralization and democratization.

1 Pablo del Río, Mercedes Burguillo, 'Assessing the Impact of Renewable Energy Deployment on Local Sustainability: Towards a Theoretical Framework' (2008) 12/5 Renewable & Sustainable Energy Review 1325–44; Gabriella Dóci, Eleftheria Vasileiadou and Arthur C Petersen, 'Exploring the Transition Potential of Renewable Energy Communities' (2015) 66 Futures 85–95; Valeriya Azarova and others, 'Designing Local Renewable Energy Communities to Increase Social Acceptance: Evidence From a Choice Experiment in Austria, Germany, Italy, and Switzerland' (2019) 132 Energy Policy 1176–83; Jurgen Deutschle and others, 'Energie-Autarkie und Energie-Autonomie in Theorie und Praxis' (2015) 15 Zeitschrift Für Energiewirtschaft 151–62.

2 Marieke Oteman, Mark Wiering, Jan-Kees Helderman, 'The Institutional Space of Community Initiatives for Renewable Energy: A Comparative Case Study of the Netherlands, Germany and Denmark' (2014) 4 Art No. 11 Energy, Sustainability and Society <https://energsustainsoc.biomedcentral.com/track/pdf/10.1186/2192-0567-4-11>; J Dubois and others, 'Safety Cost of a Large Scale Hydrogen System for Photovoltaic Energy Regulation' (2013) 38(19) International Journal of Hydrogen Energy 8108-16; Gill Segyfang and Alex Haxeltine, 'Grassroots Innovations: Exploring the Role of Community-based Initiatives in Governing Sustainable Energy Transitions' (2012) 30 Environment and Planning C: Government and Policy 381-400; Henk-Jan Kooij and others, 'Between Grassroots and Treetops: Community Power and Institutional Dependence in the Renewable Energy Sector in Denmark, Sweden and the Netherlands' (2018) 37 Energy Research Social Science 52–64.

3 Giorgio Osti, 'The Uncertain Games of Energy Transition in the Island of Sardinia (Italy)' (2018) 205 Journal of Cleaner Production 681–9.

4 Campos Inês and others, 'Regulatory Challenges and Opportunities for Collective Renewable Energy Prosumers in the EU' (2020) 138/111212 Energy Policy <https://www.sciencedirect.com/science/article/pii/S0301421519307943/pdfft?md5=d2fc83801bdab3246f98152a7de826ff&pid=1-s2.0-S0301421519307943-main.pdf>; J Lowitzsch, CE Hoicka and FJ van Tulder, 'Renewable Energy Communities under the 2019 European Clean Energy Package – Governance Model for the Energy Clusters of the Future?' (2020) 122/109489 Renewable and Sustainable Energy Reviews <https://www.sciencedirect.com/science/article/pii/S1364032119306975/pdfft?md5=2faf2cd5047b2a8f9b966536ced2965f&pid=1-s2.0-S1364032119306975-main.pdf>.

Since 2018 and this innovative law which, however, brought little results, the legislation has advanced and the idea of energy communities has been undermined and substituted by the idea of 'local energy' projects that can promote big investments and hinder growth. In these projects various public, private, and third sector actors can participate in a combined management model. This is currently observed in cases like Tilos[5] and Fournoi.[6] Additionally, of the 374 registered Energy Communities (EKOIN) that emerged after the introduction of the law 4513/2018, the majority are still struggling at the various stages of licensing and only 35 are currently active. Of those, only 20 are organized by municipalities while the rest are private. A similar trend was also observed recently in the UK, where a significant change in the pathways of energy transition is expected as ECs are being substituted by local energy projects.[7]

There is still no comprehensive research on the Greek legislation regarding energy cooperatives and communities, and most importantly on how the Greek regulation moved from a supportive framework for energy communities to a new focus on 'local energy' with strong participation from private companies and local authorities.

2 COUNTRY PROFILE

Greece is a country with high renewable energy potential, but it has traditionally been heavily dependent on lignite and oil.[8] Since the liberalization of the energy market with the Directive 96/92/EC through Law 2773/1999, Greece has adopted a number of regulations in an effort to modernize the environmental regulation in line with the European Directives, focusing especially on the promotion of RES. However, the relevant regulation has repetitively been criticized as complex, bureaucratic, and inconsistent.[9] The example of EC presented in this paper further stresses this inconsistency and instability. Despite this, Greece has taken significant steps to promote renewable energy development. The share of RES in the energy mix has increased from 6.9 per cent in 2004 to 18 per cent in the last few years, which was also the European target for the country. Solar and wind followed by large scale hydro have been the main renewable energy investments.[10]

3 RELEVANT LEGISLATION

3.1 Law 4513/2018 on Energy Communities and Other Provisions

The law was introduced in 2018 by the Ministry of Environment and Energy in an effort to deal with the increased energy poverty and to strengthen the social economy and innovation in the country. The law uses the terminology 'energy community' instead of 'energy cooperative', in line with the European directives on

5 Gilles Notton and others, Tilos, The First Autonomous Renewable Green Island in Mediterranean: A Horizon 2020 (15th International Conference on Electrical Machines, Drives and Power Systems 2017) 102–5.

6 M Bertsiou and others, 'Water Management and Electricity Output of a Hybrid Renewable Energy System (HRES) in Fournoi Island in Aegean Sea' (2018) 118 Renewable Energy 790–8.

7 Patrick Devine-Wright, 'Community versus Local Energy in a Context of Climate Emergency' (2019) 4 Natural Energy 894-6.

8 Marula Tsagkari, 'Energy Governance in Greece', in M. Knodt, J. Kemmerzell (eds), Handbook of Energy Governance in Europe (Springer, 2020) <https://link.springer.com/content/pdf/10.1007%2F978-3-319-73526-9_12-1.pdf>.

9 ibid 15; Antonis Metaxas and Michael Tsinisizelis, 'The Development of Renewable Energy Governance in Greece. Examples of a Failed (?) Policy' (2013) 23 Renewable Energy Governance 155-68.

10 Eurostat Statistics Explained, Renewable Energy Statistics (Eurostat 2020).

renewable energy. In Article 1, energy community is defined as a 'cooperative solely aiming at promoting social and solidarity-based economy and innovation in the energy sector, addressing energy poverty and promoting energy sustainability, generation, storage, self-consumption, distribution and supply of energy as well as improving end-use energy efficiency at local and regional level'.

Energy communities, according to this law, should undertake some mandatory activities like energy provision services, energy management and storage, use of electric vehicles, and production of raw materials for biomass, among others. Apart from the mandatory activities, the Law 4513/2018 in Article 4 para 2 also includes some optional activities like managing funding programs, raising awareness, and supporting vulnerable groups against energy poverty. Other than the aforementioned mandatory and optional activities stated in paras 1 and 2 of Article 4, no further activity can be exerted by an EC (art. 4.2 L. 4513/2018). This clearly limits the scope of ECs by excluding other activities like agriculture. This provision is in contrast with the nature of cooperatives which (as also stated in cooperative law R. 193/2002) often have a wide range of activities related to the social economy. Additionally, there is a strict divide between profit and non-profit EC, thus failing to acknowledge the broader purpose of energy communities which is to go beyond profit and contribute to the common good of the community. Through this provision, the ECs are seen as investors as they are permitted to allocate all the surpluses as well as the remainder after dissolution/liquidation.[11]

A unique innovation of this legislation was allowing the participation of local authorities, which was forbidden or contested in the previous relevant laws. With the Law 4513/2018, the involvement of local authorities is not only allowed but also encouraged. In Article 2 it is stated that local authorities can form or join an EC. The empowerment of the local authorities is a significant improvement as they can provide capacity and funding. However, in some cases, in order to facilitate the participation of local authorities, the law allows for the lowest possible membership, especially in less populated island regions of the country. In some cases, only three members, two of which can be local authorities, can form an energy cooperative (EC. Art. 2 para 2 L. 4513/2018). This, along with the restrictions in the membership, poses significant questions regarding the opportunities for participation of local communities as well as the open door principle according to which 'cooperatives are voluntary organisations, open to all persons able to use their services and willing to accept the responsibilities of membership, without gender, social, racial, political or religious discrimination'.[12]

3.2 Government Gazette Â/940/20.3.2020

The regulation Â/940/20.3.2020 focuses on the promotion of renewable energy in the lignite dependent areas in an effort to boost the energy transition. In particular, the regulations of ministerial decisions aimed at resolving the delays observed in the previous years in the licensing process of new power plants as well as the upgrade of electricity networks in order to facilitate the connection of new power plants. However, it also included a number of ambiguous regulations regarding energy communities.

Article 2 distinguishes the categories of power plants from RES, which will be classified into five groups, and based on this categorization the applications of the project bodies will be examined and the final connection offers will be granted. In this context, the

11 Ifigeneia Douvitsa, 'The New Law on Energy Communities in Greece' (2019) 40 Cooperativismo e Economía Social 31–58.

12 International Cooperative Alliance, 'Cooperative Identity, Values & Principles' (COOP) <https://www.ica.coop/en/cooperatives/cooperative-identity>.

priority that was previously given to applications submitted by ECs is being significantly reduced to one month. Only an EC in which the Local Government Organizations participate, profits are not distributed, and more than 60 members participate are still eligible for 4 months priority in the licensing procedure. A possible retroactive application of the law can have a big negative impact on the already submitted application. This approach can also be incompatible with the EU Energy Policy, as the European Commission has repeatedly criticized the application of retroactive measures and their effect on the RES development (in the Directive 2009/28/EC and the relevant Position Paper).

3.3 Regulation 4685/2020

The controversial law 4685/2020 titled 'Modernization of Environmental Legislation' was adopted by the Greek parliament in May 2020, during the global lockdown due to the COVID-19 pandemic. Among other provisions, the law has been accused to hinder the achievements of the previous law on energy cooperatives and small producers while promoting large scale investments. More concretely, the law simplifies the process for large producers of renewable energy sources but not the development prospects of small producers and energy communities. For instance, Article 17 states that the obligation to pay an environmental fee is reduced by half for 'institutions, as well as legal entities, public or private law for public benefit purposes, except for energy communities, such as hospitals, health centres, and schools of all levels'. At the same time, specific milestones are set from the moment the certificate is awarded until the project is complete. So, although now the right to produce energy can be obtained 'faster', it is also possible to lose it if the project is not ready on time. The priority in the licensing process, introduced by Law 4513/2018, is only maintained for those energy communities in which the Local Government Organizations participate, profits are not distributed and those that have more than 60 members. This will put extreme pressure on those energy communities that have more complicated decision-making mechanisms through assemblies and more difficult access to funding and fund release through processes that are time-consuming.

4 CONCLUDING REMARKS

From the above analysis, it is evident that the new regulatory packages in Greece will have an important impact on the renewable energy communities and the energy transition path. Despite the initial positive steps taken by the laws preceding and including Law 4513/2018, there is currently an inverse trend that undermines energy communities. In Table 1 we present an overview of the related legislations and the main provisions regarding ECs. The recent regulations are mostly driven by the need to promote big investments, with the participation of various players like private companies and municipalities that will reduce investment risks and hinder growth. At the same time, the importance of energy communities, which can represent the interests of the local population and have a significant positive impact, is not being acknowledged. Of course, the removal of unjustified administrative and bureaucratic barriers in the Greek regulation was more than welcome, but with an understanding of the different ways in which energy communities organize and operate and the inherent challenges they face, that call for a special regulation in the first place. One can expect more 'local energy projects' to appear in the coming years. However, these projects not only often fail to represent the needs and aspirations of the local society but are also short-lived.[13] This new regulation will undoubtedly have detrimental effects on energy communities which remains to be seen.

13 Devine-Wright (n 7) 895.

LAW		**PROVISIONS REGARDING ENERGY COMMUNITIES**
Law 3852/2010	New Architecture of Local Government and Decentralized Administration	More administrative power was given to the local authorities.
Law 3851/2010	Accelerating the development of Renewable Energy Sources to deal with climate change and other regulations addressing issues under the authority of the Ministry of Environment, Energy and Climate Change	Special credit for household consumers within the administrative borders of the municipal or community district in which the R.E.S stations are installed.
Law 4430/2016	Social & Solidarity Economy	RES treated as social cooperative enterprises and thus, were exempted from the rules of the antagonism, along with prioritizing administrative preferences and having to pay smaller guarantees.
Law 4513/2018	Energy Communities and other provisions	Sets the main regulatory framework for ECs, including benefits like a priority in the licencing process, special remuneration and allows the participation of the local authorities, citizens, and private companies.
B/940/20.3.2020	Modernization of Environmental Legislation	Limits the priority given to applications submitted by ECs and a fixed remuneration scheme is applied.

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10. SUPPLEMENTING MATERIAL

1) Consent form for the survey participants

¡Hola!

Estamos interesados en conocer su opinión sobre cómo el proyecto de energía renovable (en adelante, "el proyecto") afectó su vida, a través de unas breves preguntas.

Utilice los botones o arrastre la barra para indicar cuánto está de acuerdo o en desacuerdo con algunas de las sugerencias.

Por favor responda solo si es residente en el Hierro

Su participación en la encuesta implica que está de acuerdo con la publicación de los datos y sus resultados, siempre que la información sea anónima.

Este cuestionario forma parte de una investigación doctoral en la Universidad de Barcelona, que tiene como uno de sus objetivos evaluar las opiniones de los vecinos de el Hierro sobre el proyecto de energías renovables y su impacto en sus vidas.

La participación en el trabajo es voluntaria. Puede interrumpir su participación cuando lo desee.

No dude en hacer preguntas sobre el propósito de la investigación y cómo se realiza el trabajo. Si tiene alguna duda o consulta, pídanos que le demos explicaciones adicionales en el correo electrónico: islandssurvey@gmail.com

2) Consent form for interviews

The University of Barcelona attaches high priority to the ethical conduct of research. We therefore ask you to consider the following points before signing this form. Your signature confirms that you are willing to participate in this study, however, signing this form does not commit you to anything you do not wish to do, and you are free to withdraw your participation at any time.

- I understand the contents of the Participant Information Sheet
- I have been given the opportunity to ask questions about the study and have had them answered satisfactorily.
- I understand that my participation is entirely voluntary and that I can withdraw from the study at any time without giving an explanation and with no disbenefit
- I understand who will have access to my data, how it will be stored, in what form it will be shared, and what will happen to it at the end of the study.
- I understand that I will be able to withdraw my data before 1st April, and I understand that if my data has been anonymized, it cannot be withdrawn
- I agree to take part in the above study

Audio-visual recordings

I understand that part of this research involves recording audio-visual. These will be kept securely and stored separately to any identifiable information, i.e., consent forms and questionnaires.

o I agree to being audio-visually recorded

o I agree to my audio-visual material (transcribed and pseudonymized) to be published as part

of this research.

o I do NOT agree to be audio-visually recorded, however, I agree to be audio-recorded.