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"If something breaks, who comes here to fix it?": Island narratives on the energy transition in light of the concept of practice architectures

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ABSTRACT

Islands are often depicted as ideal locations for the development of renewable microgrids. However, island populations may encounter impediments on the path to the energy transition, due to the remoteness of islands and energy infrastructures not always adjusted to their environmental and socio-economic settings. Having conducted four months of fieldwork on two islands located off the west coast of Ireland, we empirically apply the concept of practice architectures to study how material conditions as well as situated institutional and economic infrastructures impact the adoption of renewables and may affect the idea of energy autonomy. We do this by exploring the following aspects: first, we look at the challenges faced by prosumers with photovoltaic panels (PVs), especially at how different heating and cooking practices co-exist in the transition to cleaner energy production; second, we explore how local conditions on these islands may affect the idea of energy autonomy; finally, in utilising the concept of practice architectures to help frame the previous two aspects, we aim to understand the challenges and opportunities for these islands in the transition. This analysis serves to present a wider picture of how the context and practice architectures of a place contribute to shaping everyday practices related to the development of renewables in the path to the energy transition. To conclude, we examine how these island communities have adopted strategies that go beyond technical solutions, thus proposing new narratives for the energy transition that can also be applied to other geographical contexts.

1. Introduction

Due to the intensifying socio-political instability of energy-key regions such as Russia and the Middle East, many areas in affluent countries and cities that can generally count on the provision of a continuous and secure energy supply have recently experienced an increase in energy prices and more marked insecurity in supply.[1] The instability of such infrastructures is likely to increase in future years due to the higher frequency of extreme weather conditions caused by climate change [1,2] and to economic and socio-political crises, contributing to unforeseen changes in the lives of people who live in countries highly dependent on fossil fuels for their energy provision [3].

On the other hand, many areas in the world have always faced disruptions of this kind: islands, remote villages in the global North and South and mountainous regions are some good examples of such areas. Islands – which account for 6 % of European territory and roughly 14 million people [4] – are the focus of this study. They are geographic locations that, due to their natural isolation, are accustomed to unpredictable and uncertain energy delivery, and have subsequently developed resilient strategies to face such external events. Furthermore, predicted rises in sea levels make islands among those areas in the world expected to be most severely affected by climate change [5]. Focus is then often placed on their structural and ecological fragility [6] and their economic disadvantage, taking into account factors such as seasonal fluctuations in population numbers, higher infrastructure costs, socio-geographical isolation, poor service provision facilities, limited resources and geographic dispersion and isolation from markets [7–10].

Eurostat reports that, in 2021, domestic households accounted for 27 % of the final energy consumption in the EU [11], a substantial market share that needs to be taken into account when planning climate mitigation strategies. Ireland represents an interesting case study because of the numerous communities, including islands, actively involved in such actions aimed at mitigating climate change. Aligned with EU climate action plans, the Government of Ireland aims to reach

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[1] Recent intensification of the Russo-Ukrainian conflict after the Russian invasion of Ukraine, and the subsequent reductions in the oil supply to several European countries, is a vivid example of this.

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net zero emissions by 2050, and one of the measures necessary to achieve this includes reducing emissions from the residential sector by 40 % [12]. There is thus a need to develop ways to shift everyday consumption and change daily practices. However, the ways in which houses are built and energy is transmitted to buildings depend on a set of local, interconnected infrastructures (including economic and institutional norms) that define the ways in which people perform their daily routines and can shape how they consume energy. These infrastructures and the institutional, economic and socio-cultural arrangements associated with them are identified by Kemmis [13] as practice architectures. This concept, a part of practice theories that emphasises the infrastructural and contextual part of what enables and constrains practices, will be further described, used and tested in this paper.

The present paper, a case study on two of the Aran Islands, islands located off the west coast of Ireland, aims to contribute to building new narratives for describing islands and their participation in the energy transition.[2] We seek to depict them not merely as vulnerable and fragile locations, but rather as places where frequent disruptions have led to unique practice adaptations.

Using the empirical results that emerged from fieldwork conducted over a four-month period, we investigate everyday practices of households with solar PVs and their contextual practice architectures, to address islands' opportunities and challenges in shifting to renewable sources for energy production and use. Examples of practice architectures include planning permissions, energy infrastructures, availability of grants and challenges in getting expert technicians due to higher costs and difficult logistics in reaching the islands. All these are instances of factors and dimensions that affect everyday practices related to PV usage. Our analysis will also explore the co-existence of practices related to the use of renewables, with practices that still rely, for instance, on the use of gas for cooking and turf or wood for heating. Specifically, we will look into some of the elements that hold practices together: materials, competences and meanings [14]. With materials, we identify products and technologies, e.g. solar PVs, inverter, turf, stove, etc.; with competences we mean the embodied skills that allow people to make use of the materials; finally, with meanings, we refer to the engagements and beliefs that make people become involved in a certain practice, e.g. how they feel about topics such as energy security or energy autonomy. Considering the peculiarities of our case study, as will be shown later, with energy autonomy, we refer to a series of strategies (involving both individual households and the entire community) aimed at achieving greater self-sufficiency in energy generation, storage and transmission [15].

In this paper, we aim to address the following research questions:

1) How do different heating and cooking practices co-exist in the process of transitioning to cleaner energy production, and how is this reflected in the challenges faced by prosumers?
2) How do such practices' co-existence and the local conditions on these islands affect the idea of energy autonomy?

Finally, we aim to explore how the concept of practice architectures may help in framing the previous two research questions, specifically:

3) How can we use the concept of practice architectures to understand the challenges and opportunities of these islands in the energy transition?

The focus on practices will show how the islanders adopt a range of competences and materials to cope with conditions, such as power cuts and the low availability of skilled workers to install and fix technical equipment, that hinder the full adoption of renewables in everyday life. The paper will detail the delicate balance between, on the one side, a willingness to adopt new practices related to using renewables and phasing out former practices that are still tied to fossil fuels and, on the other, the necessity and convenience of sticking with fossil fuels. After seeing how this, combined with specific local conditions, may affect ideas of energy autonomy, we will present examples to show how practice architectures hinder the development of practices connected to the use of PVs, as well as other examples that show how practice architectures can facilitate their evolution. Some of these practice architectures affect these island communities specifically, which will lead to the argument for the necessity of having architectures suited to local conditions. At the same time, examples of practice architectures that can also affect areas on the mainland (e.g. PVs not working during blackouts) will be presented in order to render this research usable for studies that work with different communities.

This paper is subdivided into the following sections: Section 2 defines the theoretical concept of practice architectures within the wider framework of practice theories. Section 3 presents background studies on the development of renewables on islands and in remote communities. Section 4 introduces the case study central to this research and the methods employed in the fieldwork. Section 5 presents the empirical findings and the discussion. Section 6 proposes our conclusions and summarises the main results of this paper.

2. Theoretical background: a glance at practice theories and practice architectures

Practice theories were chosen as a valid analytical framework to help define and situate our analysis in a wider theoretical debate, as they are a good alternative for overcoming the agency-structure dualism in the study of everyday life. In this theoretical framework, practices, rather than individuals, are the main unit of analysis. These are defined as routinised behaviours, nexuses of doings and sayings [16], that constitute people's daily lives [17]. In performing socially and culturally rooted everyday practices, people reproduce socio-cultural structures: from this perspective, change takes place through everyday practices.

Previous literature on practice theories focused on how practices evolve and change, and how this can provide new understandings of the changes needed to face the climate crisis [18–22]. In particular, Shove and colleagues suggest that practices change when the elements that hold them together (materials, competences and meanings) change [14]. The installation of PVs is perceived as a strategy that can help households reduce consumption, for example, by giving them access to a new set of materials, competences and meanings [14]. However, households also depend on an interconnection of infrastructures that can "petrify people's practices" [13,p. 42]. Shove explains this by writing that "certain forms of demand are unavoidably inscribed, for example, in the design and operation of electricity and water infrastructures and in the architecture of the home itself" [21,p. 1278]. Thus, there are external contexts, conditions and factors that shape people's everyday practices and that also need to be changed [23]. Susan Star, in her work, shows how these infrastructures are usually invisible, becoming visible only when they break [24]: except for these breakdown moments, people rarely need to engage with them in their daily life, even though such infrastructures shape and prefigure consumption [25].

On this matter, Kemmis and colleagues are specifically interested in how people do not perform their practices in a vacuum, but rather in historically and geographically prefigured contexts, "shaped by the conditions that pertain in a particular site at a particular time" [26,p. 33]. This is to say that practices are carried out and evolve in contexts that have "cultural, discursive, social, material and economic dimensions" [22,p. 25]. These dimensions are not static, but also evolve over time and change according to the place in which they are set. Kemmis then postulates that practice changes presuppose a transformation of the conditions that make such practices possible, and he

[2] We use the term "energy transition" to describe the global goal of shifting from a fossil fuel-based energy sector to one founded on renewable energy sources.

calls these conditions practice architectures. The theory of practice architectures, enriching the classic definition given by Schatzki [16], defines practices as nexuses of sayings, doings and relatings, which are determined by their corresponding arrangements in situated practice architectures found in or brought to a particular site: sayings are enabled by cultural-discursive arrangements, doings by material-economic arrangements and relatings by socio-political arrangements [13]. In other words, there is a need to change not only the sayings, doings and relatings – and the elements that hold them together – but also the respective arrangements that make them possible (i.e. to change practices, practice architectures need also to evolve).

Learning is an integrated part of changing practices and practice architectures. People thus may learn to practice differently, but simultaneous changes in practice architectures need to take place as well. From this perspective, change happens over time and via learning processes, where learning is defined not as the mere acquisition of knowledge, but rather as a "process of hybridization" [13,p. 42], where the performance of old practices happens alongside the enactment of new ones, allowing an evolutionary process of "reproduction with variation that paves the way for transitions and transformation" [13,p. 51]. In our case study, this "process of hybridization" is reflected in the co-existence of different practices, to see, for instance, why people who have PVs and a heat pump still rely on a gas cooker, a kerosene stove and/or a fireplace, and continue to buy turf and/or wood. The co-existence of different sources has also been explained by Masera and colleagues [27] through the multiple fuel model, in opposition to the energy ladder that indicated simple progression from one energy source to the next and best option.

Additionally, there is a considerable amount of literature describing how households adapt to breakdowns by adopting practices that rely on a range of competences and materials [1–3,28–31]. For instance, Wethal [28] shows how, during power failures, people build links between technologies, embodied knowledge and new meanings, in this way reassembling practices' elements. Similarly, Heidenstrøm and Hansen [1] highlight how embodied competences acquired in life influence preparedness for crisis, and Baker [29] writes about the concept of implicit practices, i.e. activities that people engage in normally in day-to-day living and that can become potentially useful in disaster or risk preparedness, reaction and recovery. This last aspect relates also to the concept of practice memories [32–38], i.e. how previously embodied practices (e.g. from childhood) affect the performance of practices in new settings (for instance, through the re-integration of elements from "old" practices into "new" practices).

3. Background studies: opportunities and challenges of renewables adoption in island communities

Increasing the reliance of islands on renewable energy sources appears to be an optimal way not only to improve their resilience through energy autonomy but also to foster their active participation in climate mitigation strategies. Previous research into the deployment of renewables in island communities to form micro-grid systems, views islands as ideal laboratories and testbeds for experimenting with the implications of the transition to cleaner energy production and smarter consumption. Islands are usually considered suitable as laboratories because conditions and changes are traceable, due to their circumscribed geographic and social network boundaries, which also make technical implementations and in-depth, qualitative studies more feasible [39–41]. Furthermore, factors such as the higher cost of fuel delivery and electricity imports, and the instability that often characterises the link to the mainland grid, may contribute to making islands more inclined to experiment with initiatives set up to provide them with alternative solutions [39,42].

Another parallel metaphor to the laboratory sees islands as lighthouses, in the sense that they may predict and show what energy transitions can look like. Following Marczinkowski's [43] work on islands and their role in the energy planning, where islands are identified as lighthouses, we refer to this last concept with the aim to further underline their importance in the energy transition. Their relevance as lighthouses rests on the fact that, although islands are unique places with unique characteristics, it may be possible to upscale solutions applied to such areas for implementation on other sites that are or will be affected by increasing barriers to energy trading or by climate change, and that aim to build stronger local resilience [4,41,43].

Due to islands' remoteness and heightened exposure to weather extremes [10], island power supplies are often structurally unstable. For example, they may have a weaker electricity grid structure that is more sensitive to e.g. frequency and voltage deviations [4,8]. In fact, islands, being geographically dislocated from the loci, usually on the mainland, where energy is generated, typically develop more complex and interwoven energy infrastructures, that may be subject to long-term and more frequent breakdowns [1,30] and to less efficient energy supply. Developing renewable solutions while minimising islands' dependence on imported fossil fuels is therefore perceived as a means to reduce costs, augment energy security and facilitate islands' economic development, as well as contribute to climate change mitigation strategies.

However, some studies highlight the technical risks implied in increasing renewable assets and establishing local microgrids. For example, Chen and colleagues [44] point out that the introduction of solar and wind energy into the electrical grid potentially risks worsening power supply fragility, due to the intermittency, variability and volatility of natural resources, such as the wind and sun [8]. Furthermore, when islands are connected through a subsea cable to the mainland, as is the case of most Irish islands, energy production costs and storage may be problematic, as it is not currently possible to export energy that exceeds cable capacity, and there is no adequate support for stand-alone storage systems [45]. Reporting the results of his study of 11 French islands, Notton believes that these factors currently prevent the development of solely renewable systems on islands, without provisional backup from conventional fossil fuels or "guaranteed renewable plants as hydraulic ones" [4,p. 265]. Meanwhile, comprehensive renewable projects – hydraulic plants, solar farms, wind turbines – are not exempt from problems as they often face local opposition and conditions unfavourable to their construction [46].

Other studies adopted mixed method approaches to investigate communities' perspectives and the levels to which the populations on islands and in remote areas with scarce to no access to electricity accept renewables, taking into account the influence of various interrelated factors on renewable projects. The focus of these studies is on the misalignment between national policies, which often have larger scale development in mind, and local conditions that are not always fully acknowledged and contextualised [43,47]. Gevelt and colleagues [48,p. 198] analysed the impact of the interactions between technical, economic and institutional factors, and the unsuitability of "one-size-fits-all" approaches for dealing with these factors. Similarly, Lozano and Taboada [49] and Marczinkowski and co-authors [47] express criticism of risk assessments based solely on technical and economic aspects that omit other socio-political factors that might put at risk the electrification of off-grid island communities.

Jafar [50], on a similar note, opposes the "one-size-fits-all" national approaches to community involvement, promoting instead situated knowledge and engagement to develop better solutions that suit the local context. Likewise, Heaslip and Fahy's interdisciplinary study [40] focuses on perspectives collected from households to design community energy plan scenarios that take into consideration the issues that the community itself considers more urgent to tackle. They also highlight the importance of increased participation and involvement of local communities in national policy discussions, as "communities' perceptions and understandings of energy are complex and place-based in cultural and political contexts" [40,pp. 153–154]. Additionally, some studies have highlighted the importance of involving local communities in the maintenance of energy systems [51], e.g. by training local people and transferring technical expertise [52,53]. This is a matter well examined in the study of regulatory barriers for renewables' development on Irish islands, a document by the Clean Energy for EU Islands secretariat [45], central to issues analysed in this paper. This study also highlights as major issues the frequent gaps in the legal framework that render national policies inadequate and often at odds with local conditions on islands, as well as the higher costs related to the introduction and maintenance of installations, and difficulties accessing a skilled workforce [45].

The revised literature shows how islands provide interesting case studies for testing the development of renewables. However, it also highlights the importance of gaining improved understandings of the localised challenges that may affect this shift to cleaner forms of energy production, and strategies to overcome them.

4. Methods

4.1. Presentation of the case study

The Aran Islands are three islands located in the Atlantic Ocean off the west coast of Ireland, about 48 km from Galway Bay (Fig. 1). The three islands are Inis Mór (Árainn), Inis Meáin and Inis Oírr. The islands have a characteristic landscape, comprised primarily of lime-scale formations. They are part of the Gaeltacht, Irish-speaking areas that receive government funds because they play a crucial role in keeping the Irish language and culture alive. All these unique characteristics contribute to making them an attractive tourist destination. The Aran Islands have approximately 1300 permanent residents (about 820 on Inis Mór, 184 on Inis Meáin and 343 on Inis Oírr) [54] with a peak in the summer months due to the tourist season, where the populations almost triple, with over 3000 daily visitors [55].

To meet their energy needs, the islands import fuel from the mainland, e.g. kerosene, turf, coal and gasoil [56]. They are connected to the national grid on the mainland via a 3 MW undersea cable that delivers electricity to Inis Mór. From there, electricity is distributed to the other two islands (see Fig. 2). Before the cable connection reached Inis Mór in 1996 and Inis Meáin and Inis Oírr in 1997, the islands relied on diesel generators [45]. Interestingly, the Aran Islands were among the last places in Ireland to be electrified. In the period 1946–1964 the first phase of the Rural Electrification Scheme started. It was promoted by the ESB (Electricity Supply Board, a state-owned electricity company) and planned to bring electricity to rural areas. The scheme then continued until the mid-1970s, when a plan named "post-development" was introduced to establish new connections to other rural areas. The map on the ESB website [57] that displays the various phases in the country's electrification shows how most islands became part of the national grid only in the late 1990s or early 2000s. This demonstrates how national policies that are designed to have an impact on the entire country, must take into consideration local peculiarities and constraints that might hinder, or at least delay, its successful operation in all areas, including the islands.

The islanders perceive the relatively recent subsea cable as a great achievement. However, it is not exempt from problems. For example, in 2016 the cable was damaged and two of the islands – more than 400 residents – suffered a power outage that lasted about four days. As reported in [58], it took several days to bring in generators as a temporary backup, and around two months to fix the cable link. This also affected economic activities on the islands, as tourists left and bookings were cancelled, and there were other issues related to food and medicine storage. Furthermore, subsea cables are often inefficient because substantial amounts of energy are lost in the energy transmission. In the case of the Aran Islands, 50 % of total energy is lost in energy transfer [58].

From the administrative point of view, the Aran Islands fall under County Galway's jurisdiction, and they have no local authorities. However, each island has a Development Cooperative that plays a central role in the administration of the island on a day-to-day basis [45] on any matter regarding their socio-economic development (e.g., waste management, road maintenance, etc.). Inis Mór hosts also the Comharchumann Fuinnimh Oileáin Árann (CFOAT, or Aran Islands Energy Co-op), which is a community-owned organisation established in 2012, with the primary purpose of decarbonising the three islands, by gradually reducing and possibly eliminating their dependency on fossil fuels and by establishing, eventually, a community-owned local microgrid, for the community to be in control of the energy generated locally [59]. The CFOAT is a partner in the project that financed this study and they functioned as the principal gatekeeper of the research carried out in the islands (especially on Inis Mór). Thanks to the CFOAT and Development Co-ops, the Aran Islands are involved in several European and national-based projects to facilitate their path in the energy transition.

As island communities, they are eligible to receive grants from several schemes that allow various groups of households to retrofit their homes and to install, for example, solar PVs or heat pumps. These projects aim to achieve various goals at different scales, for instance, by helping households reduce energy costs and make their homes more comfortable, while also working with local cooperatives to help the islands achieve greater energy autonomy. Moreover, these projects are part of a national strategy to reach carbon reduction targets of 51 % by 2030 and net zero by 2050 (aligned with EU climate action plans). To achieve this aim, the Climate Action Plan 2023 for Ireland [12] sees it as a prerequisite, among other measures, that the share of renewables in energy assets is increased to 80 % by 2030[3] and that residential sector emissions are reduced by 40 %. Furthermore, according to the National Climate Action Plan 2019, each local authority must identify and develop plans for one Decarbonisation Zone under their administrative area [60]. The Aran Islands are designated as County Galway Decarbonisation Zones, and are therefore at the centre of plans to decarbonise their energy system, even beyond their local aims of being energy autonomous.

The "Our Living Islands" policy document [10] is an Irish government strategy that has the aim of framing better policies to support island communities in Ireland while reversing depopulation trends. This document states that many of the challenges faced by island communities are similar to those faced by other rural areas on the mainland, but the challenges experienced by islanders are more pronounced due to their physical separation and distance from the mainland. Abundant energy assets and great potential for renewable energy generation are cited as examples of the strengths and opportunities available to the islands. Among the threats, the policy document cites lack of employment opportunities, poor infrastructures and difficult planning permissions. For example, the Aran Islands are designated as Special Areas of Conservation for biodiversity. As decarbonisation area, it may be challenging to find the right balance between nature conservation and clean energy generation. In the case of wind turbines, for example, it may be difficult to introduce renewables at a medium or larger scale in areas designed for natural and culture sites' protection. The abundance of renewable resources combined with inadequate infrastructures and policies is essentially problematic, as a successful energy transition initiated locally requires the adequate presence of both.

4.2. Fieldwork and methods

A total of four months of fieldwork was conducted for this research project, as shown in Table 1 (Appendix A). The researcher (first author of this paper) resided on Inis Mór and made frequent visits to Inis Oírr. These two of the three islands were chosen as case studies. The researcher believed it important to include the bigger island, where most of the population resides and where the CFOAT is, and the smallest of

[3] In 2020, renewable energy accounted for 42 % of total energy generation [68].

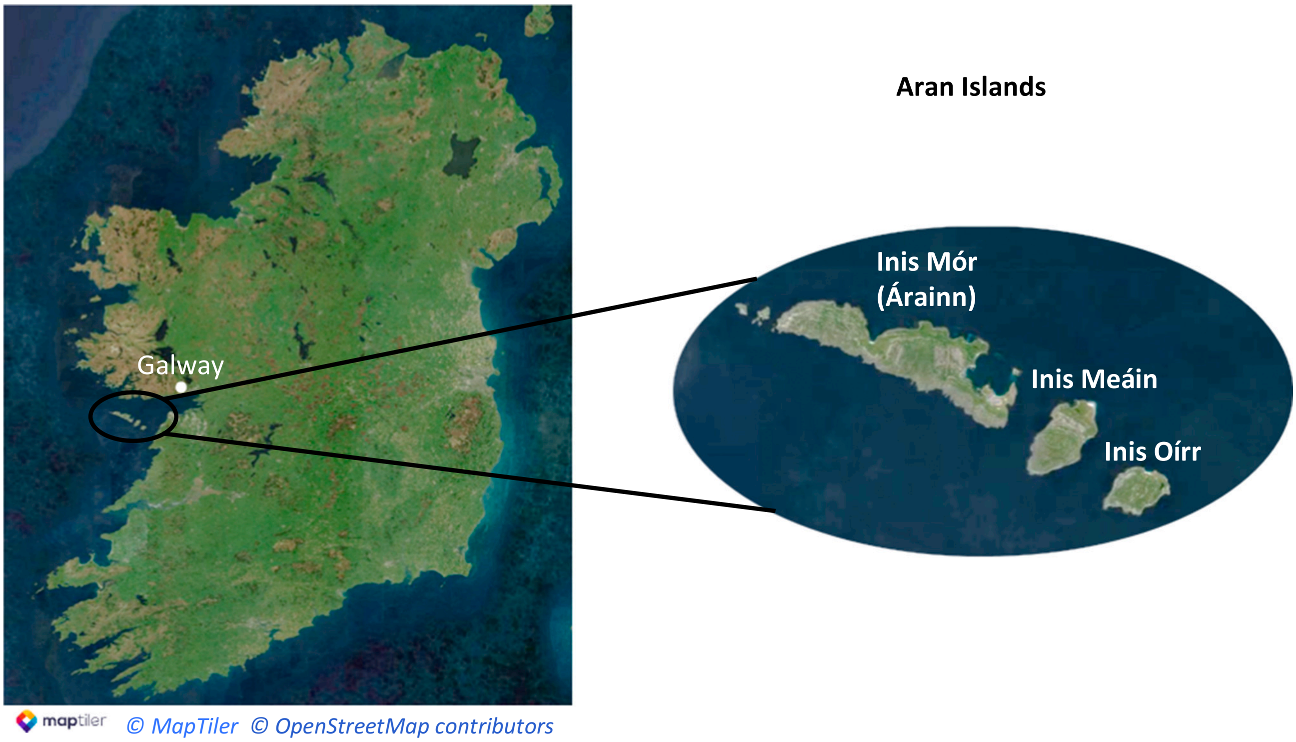

Fig. 1. Location of the Aran Islands in Ireland.
On the right, details on the three islands and location of Inis Mór and Inis Oírr.

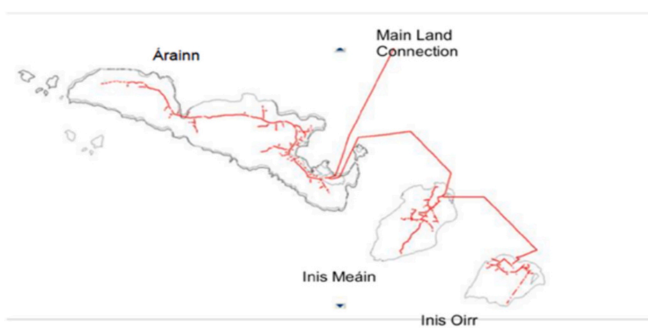

Fig. 2. Detail on the subsea cable connection.
Source: Energy Master Plan, Árainn and Inis Meáin 2018 [56].

the three islands, an interesting case because it has a relatively high number of homes that have solar PVs.

15 households with solar PVs were recruited, ten on Inis Mór, five on Inis Oírr. For more information on the recruitment process, see Appendix B. The part of the fieldwork that is reported in this paper derives from a first round of interviews and house tours that took place in Autumn 2022. House tours were conducted at the same time as the interviews, in the form of "walk-along interviews". The informants were asked to show the researcher around the house, focusing particularly on how each room, each appliance and each technical device present there is used. The walk-along part of the interview focused on daily habits and routines, so the interviewees were asked to describe a normal day for them, illustrating where each activity takes place, at what time of the day, etc. In the analysis presented in Section 5, quotes are made with reference to household numbers and pseudonyms. See Table 1 Appendix C for more details on the households and their main heating and cooking materials.

The empirical results presented here derive mainly from topics that often arose spontaneously when interviewees shared their experiences with PV installations and the islands' energy transition, and during the house tours, which prompted the informants to reflect on the type of appliances and devices they possess and how they use them. This in turn inspired the interviewees to reflect on the multiple fuel usage evident in almost every home. The interviews were semi-structured, following a guide with specific questions. The interviewer also adopted a narrative approach [61] that was deemed appropriate to use when investigating various matters in the context of everyday life, as it encourages interviewees to tell a story. The narrative approach proved useful especially in the house tours. While the interviewer followed the interview guidelines, study participants were free to talk and say anything that came to mind while moving around their houses. This approach was also applied as it positions the interviewee as an expert on topics like day-to-day life and energy use on the islands; in fact, it proved useful as the informants brought up topics that initially were not included in the design of the study. In the data analysis section, by reproducing the interviewees' narratives and reflections, our aim is to provide the reader with a clear picture of the stories collected from the interviews.

During the house tours the researcher took photos, which were analysed together with the interviews. The analysis combines the data collected based on the research questions and matters brought up by the interviewees that may offer novel, relevant perspectives on the research questions. The data were transcribed and analysed using NVivo software. The researcher used an inductive coding method, starting with the notes and images taken during the interviews and house visits, and continuing more systematically on NVivo, where codes were created to organise the data into categories and subcategories. The codes and subcodes utilised specifically for this paper are listed in Appendix A. Data collection, including recordings, text and pictures, followed ethical and legal rules set out by our university according to General Data Protection Rules (GDPR) for personal data protection, consent and anonymity.

5. Empirical data analysis and discussion

The empirical analysis will follow the three research questions posed in the introduction, first looking into the challenges of prosumers and the co-existence of cooking and heating practices reliant on different fuel sources (Section 5.1), then exploring matters of energy autonomy (Section 5.2) and finally focusing on the usefulness of the concept of practice architectures in investigating the challenges and opportunities of these islands in the energy transition (Section 5.3).

5.1. Challenges faced by prosumers: the co-existence of different heating and cooking practices in the process of transitioning to cleaner energy production

The fact that the islands were connected to the national grid later than the rest of the country and that even middle-aged people remember times prior to the introduction of electricity, contributes, together with all the geographic factors that affect the islands' energy delivery and maintenance, to the perception of energy as volatile. In the minds of many informants, the unpredictability of energy delivery affects the perception of energy itself (recalling Star's work on the invisibility of infrastructures until they break [24]).

When producing energy in homes, whether by means of solar PVs, a fireplace or a gas cooker, a combination of materials, competences and meanings are applied. In practice theory studies, energy production is often not indicated as a practice, since energy is rather seen as part of the materiality of the practices which consume that energy. However, and also following Strengers [62] and Reid et al. [63], we suggest that energy production (and prosumption) should be considered a part of the practices performed by the householders. In fact, in producing energy in their everyday lives, households perform activities composed of various elements that bring energy production closer to the households themselves, as opposed to it being something merely delivered invisibly through infrastructures.

Energy production cannot be considered separate from the everyday practices that it enables (cooking, heating, showering, etc.) through its use and consumption. Depending on the materials utilised, as well as the meanings and competences intertwined with it, energy production practices can be performed in very different ways. For example, in the case of heating, if the householders time-shift heat pump usage to align with PV production, this includes a combination of different elements. Materials, such as PVs, inverter, heat pump, etc.; competences, i.e. knowing how the system works and when to make best use of the energy produced through the PVs; meanings, i.e. the motivations that lay behind the choice of time-shifting the heat pump usage to match PV production. By installing PVs and heat pumps, it is possible that practices may evolve towards reduced energy consumption. However, these same households' practice changes need to be backed up by changes at the level of practice architectures. In more than half of the homes interviewed, heat pumps are the main source of heating.[4] In these homes, PVs had often been installed to reduce heat pump costs. Nonetheless, householders face certain issues when they plan to rely exclusively on PV production and electricity in general; in fact, all the homes visited use a mix of sources for heating production, such as wood, turf and coal (see: Fig. 3; Table 1 in Appendix C).

> "Oh I have the stove and… […] I have another stove in the dining room. So, that's the thing, if you get rid of the oil, what happens when your electric heating doesn't work? […] You're going back to the old fire, you're going back to coal, you're going back to oil […] but that's short term like, you couldn't go back to that full time […]. We've been… like, we were lucky we had turf and, and as I say, I had got coal as back up […]. So you can't get rid of everything, you know, you have to have a little bit of everything in the island like, you can't just go completely electric or, completely diesel or, completely… coal or, whatever you have, you have to have a little bit of everything. You know so, if one thing doesn't work, you have plan B or Plan C or Plan D. […] Still, don't throw out your stove because if there's a power cut, you can't go a hundred percent renewable." (Bryanna, Household 7).

The presence of a mix of energy sources within the households is perceived as a local strategy that enables householders to access energy during disruptions due to blackouts and lack of technical support. This energy mix is a fine example of the hybridisation process mentioned by Kemmis [13], where old energy production (and associated consumption) practices are performed even when new ways of producing (and consuming) energy are available. This mix of energy sources also brings us back to the multiple fuel model of Masera et al. [27], although, in the Aran Islands, cost-related and cultural factors are only a few of a series of motivations in which habits and practices seem to play an important role.

From the previous quote, Bryanna (Household 7) refers to a reliance on coal and turf as feasible only in the short-term, as a form of back-up that allows for multiple alternative plans in case something does not work; nonetheless, she refers to these sources of energy as something that a householder would not go back to full-time. This indicates that, when adopting new practices, people form new meanings regarding what comfort is for them. This sheds light not only on the energy mix in terms of materials used, but also in terms of a mix of competences and meanings that form these different practices. Bryanna, similarly to the other households with a heat pump, stated that, in her home, they feel more comfortable because the heat pump spreads heat uniformly all around the house, compared to the stove, which is used mainly to heat only one room. On the other hand, in the following quotes we notice the persistence of meanings originating in the past that express some form of attachment to heating with turf or wood. Many interviewees made this point, some explicitly stating that they found it difficult to give up lighting a fire, as it reminded them of old practices when electricity was not there and it brought back childhood memories of when the fireplace was still the "focal point of the house" – recalling the concept of practice memories.

> "When my parents were alive, you know, the fire was always this focal point to the house. There was always a fire in the house, always a fire, morning till nighttime. […] I found it very hard to stop putting down a fire, 'cause it was so in me, even though I, I knew it was silly to be putting on a fire, and it was very expensive like!" (Brigid, Household 13).

> "Christmas time, we burn turf. It's a thing from the past, we still like it. […] It's funny, it's… to be honest with you, we, we didn't throw out anything, we just added [laughing]. Because you see in the, in the living room, we still have the kerosene stove. […] We were very new with the heat pump so, we didn't want to throw out the old, without, not being used to the new… in case it broke down or… then we were left with no heating. So we kind of, we kept everything." (Murphy, Household 5).

On the one hand, when householders introduce new technical devices, they find it important to have a back-up. On the other, this embodiment of practices ("it was so in me") may be related to concepts of comfort and embodied past experiences that make it difficult for the householders to break the habit of lighting the fire, despite being adversely affected by the cost.

Cooking is another good example, as it is a practice that needs a secure backup and may rely on various forms of energy delivery (see: Fig. 4; Table 1 in Appendix C). Almost all interviewees referred to the importance of having gas for cooking, and some also use kerosene.

[4] In three cases combined with solar thermals – also used for heating water.

Fig. 3. On the left, examples of solar inverter, solar PVs and heat pump; on the right, examples of different heating sources (stove and fireplace, turf and wood) from households on Inis Mór and Inis Oírr.

Fig. 4. Examples of kerosene stove (on the left) and gas used for cooking from households on Inis Mór and Inis Oírr.

"It's an electric and gas [cooker]. You need both, because if one goes at least you have the other. If you have a storm, and the electricity goes out, well at least you get gas to allow you, to make some hot water." (Ciarán, Household 14).

"We only have gas ovens, we have gas cookers […] most of the cooking is done with gas. […] On an island, if the electricity goes, you have the gas to boil the kettle, to cook the bread, you have gas and it's a gas bottle. It's not on a pipe. It's not mains gas, it's on a bottle, a canister, and you can go to the shop and you can get another bottle if that bottle runs out. So, you have self-sufficiency regardless, and that, to an islander, to a person living in an island is very-very important. They need to have a number of different sources of, uh, energy to do whatever job they're doing at all times, above all heating and cooking […]" (Eamon, Household 1).

Together these stories show how both heating and cooking practices include the co-existence of older types of energy provision, even after the installation of new greener types of delivery. Understanding this co-existence includes looking both at culture and embodied comfort norms as well as issues of energy autonomy.

5.2. How do the local conditions on these islands affect the concept of energy autonomy?

It is interesting to note that Eamon (Household 1) refers to the concept of "self-sufficiency" as having the opportunity to access multiple energy sources in order to be free to do any activity at any time. This provokes reflections on the relation between concepts such as autonomy and clean energy – as part of the energy transition strategies. At the household level, it seems that these two concepts are not always compatible, with autonomy not necessarily being linked to the use of clean energy, but rather to a sense of having consistent access to energy. At the community level, energy autonomy is associated with the idea of using local resources, which, in the case of the Aran Islands, include wind and sun. No source of fuel is available locally. However, the Aran Islands aim to reach more autonomy in energy generation, although not necessarily in its transmission. This means that the islanders appreciate the value of the subsea cable as an important back-up and as an opportunity to sell excess energy back to the grid. Delivering excess energy would also provide additional economic revenue to the islands, a substantial help on their path to decarbonisation.

In the examples reported in Section 5.1, we note that blackouts are a cause of concern. All houses on the islands are connected to the national grid, even those with PVs. Very few households have solar batteries, due to their high cost on the market. Considering that the solar inverter is connected to the main fuse board in the house, introducing PVs does not effectively resolve the blackout issue, as PVs do not work during a power cut. This applies to every home in Ireland, but due to the relatively higher frequency of blackouts and additional problems with regard to fixing faults on the islands, it is a pressing issue. If a fault occurs in the national grid system, the Aran Islands are usually affected by the same type of blackouts that occur on the mainland, in which case the fault is usually fixed as rapidly as possible and, in case of scheduled maintenance jobs, announced beforehand. However, the islands are often also affected by their own blackouts, due to more frequent storms and faults in the transformers in their system.

Another issue on the islands regards the possibility of getting qualified workers, due to the high cost and the logistics that often discourage mainland workers from investing their time and resources in travelling to the islands. In the "Our Living Islands" document [10], there is a section dedicated to "skilled trades" and the issue of the shortage of skilled tradespeople on the islands, together with the high costs of sourcing them from the mainland.[5] For instance, in autumn 2022, the heat pump fan in Household 7 – installed a few years ago as part of a community deal – broke, and it took more than a month to find somebody to fix it:

> "[…] it's broken now, so I rang… four, maybe five people to try and get parts. 'You live on an island', they're like, 'it's gonna cost you 200 to come out…' […] That's the worst I think about living on the island, it's the after-service. […] And the more technology you bring in, there's more that can break. […] I asked somebody to come out and he said, 'It's gonna cost you too much, really!'. But, four weeks later I'm gonna go, 'Hey, I still haven't got sorted, I will pay whatever'…" (Bryanna, Household 7).

In this quote, we can also read a challenge to adding new technical solutions. If more technology is introduced on the islands as part of the energy transition, suitable practice architectures must also be introduced to not only support technological development, but also sustain its maintenance. Maintaining the systems is one of the biggest challenges on the islands because of the costs of securing external workers from the mainland and the logistics that restrain these workers from coming (e.g. especially in winter, the cancellation of transport to and from the islands due to storms and bad weather conditions can happen quite frequently). This is part of practice architectures that need to be suited specifically to islands' conditions: installing PVs is perceived as a way to decarbonise energy systems and something that can lead to practices' evolution towards reduced consumption. However, factors like installation and maintenance of technology and materials on the islands require specific attention – and this may ultimately affect the path of the energy transition not only at the household level, but also at the island communities' one, while also impacting concepts of energy autonomy itself. All the interviewees agreed that autonomy, in the sense of self-sufficiency, should be the ultimate goal to achieve, as it is a means to secure reliable and continuous access to energy as well as empower the community. However, most of them expressed concern that other problems might occur in this process of decarbonisation, and they consider the cable a constant, secure backup.

> "[…] the one time that it did break [the cable] […] the facilities were there to repair it fairly fast! […] It's good to be connected to the national grid, I think. […] I know it makes sense to have our own [energy], and I see no reason for not having a wind generator, or solar panel. But with the wind, we also get lots of calm days. So, we would remain without power […]. So, uh, we would need both systems […]." (Máirtín, Household 9)

> "Well, I think it's something that we [as an island] are determined to do [being autonomous]. Um, not that we want to get rid of the cable under the sea, that will always be there, but we'd like a stronger one. It's, it's not good enough, the one that's there, but we don't want to get rid of it and just be that independent. But we want to have enough energy, from our own generation, to supply our own needs. […] It makes more sense, even from an electrical point of view, because […] the closer the generation of the energy is to the use of the energy, the more efficient it is and the less loss of energy there is on the cabling." (Devon, Household 15)

> "I hope it'll happen [becoming energy autonomous as an island], but I can't see it happening for a long time. […] Um, 'cause it's just a big risk to take, if one thing went wrong, it's all technologies, it's all computers, if one thing went wrong with no power on the islands … and again, again, you're on an island, so how long you wait for someone to go to fix it. And so it, like, it's a 50/50 call, it would be a great thing, would be absolutely brilliant, but then you can understand the risk side of, the fear side of it." (Jack, Household 8)

Máirtín (Household 9) describes how being energy autonomous through the use of locally available sustainable resources would be a great achievement, but also links this to the need for continuous access to the benefits of the cable, as it is a reliable connection with the mainland grid, should a local system break down. Devon (Household 15) addresses the issue of the quality and strength of the current cable, which prevents the possibility of having a microgrid where the extra power produced is sold back to the grid, as this would overcome the cable capacity. This perspective expresses the willingness to develop a renewable energy system on the islands, where the connection to the cable would not only constitute a reliable back-up, but also serve as a source of economic revenue for the communities through selling excess energy into the national grid. Jack (Household 8) addresses the problem of technology maintenance, i.e. that having their own system would imply dealing with its maintenance. Some policies currently under public consultation are good examples of this: for instance, Private Wires [64] is a consultation conducted by the Department of Environment, Climate and Communication (DECC) of the Irish government that would give private citizens, companies and communities the opportunity to own and operate their own electricity infrastructures, i.e. an occasion to go off-grid. This seems a reasonable option for island communities, as it gives them the opportunity to handle and trade energy with other communities (and within the community) – in this way also overcoming the problem of exporting surplus electricity that exceeds the cable capacity. What could be the implications of this policy? The current cable is owned by the ESB, which is responsible also for its maintenance. However, if the community got to own and operate their own

[5] Worth mentioning here is the new act established by the European Commission called "right to repair", which intends to help and enable consumers "to repair products themselves", as a way to facilitate the "development of a circular economy" [69]. See also [40] for the need claimed by this study's participants for "simple technologies" that can be fixed locally.

infrastructure, then the maintenance and related costs would be their responsibility, with the implied issues of getting experts to the islands, and the lack of local technicians.

Going back to analysing the household level, one interviewee had a defective solar inverter. He expressed frustration by stating that it is really difficult to get someone to fix it because "they're not sort of gonna come out for one day for… one person, you know?" (Bob, Household 6). Therefore, when it comes to getting contractors to install solar PVs or any sort of specialised technician to the islands, it makes sense to gather a group of people in need of such work. This is beneficial in many ways, but may also entail certain inconveniences:

> "And then he [the inspector] said, 'I'll come back and I'll sort it', but then, because they're doing 10 houses, they're under pressure to get the 10 done and 'Oh, I haven't forgotten you, I'll come back the next time I'm here'. And then, it kind of gets forgotten about…" (Bryanna, Household 7, talking about their new heating system)

The islands currently find it hard to locate contractors willing to travel to install solar PVs, so the issue of higher costs and troublesome logistics touches on several job categories. When travelling to do these jobs on the islands, many factors must be addressed, including storing the materials, accommodation, the fact that the journey to and from the islands may be impossible in inclement weather,[6] and consequently higher costs. During winter, there is only one ferry company operating, with one ferry arriving on the islands in the morning and one leaving in the late afternoon. Travel by air is also possible, although flights may be cancelled due to fog or strong winds. An example of the problem of getting contractors to the islands can be read in the March 2023 newsletter published by the CFOAT (Energy Co-op):

> Of the two companies that expressed an interest in working with us, one decided not to bid for the job and the other proved too expensive. We are continuing to work on alternative ways of securing reasonable solar PV for the island […]. [65]

The September 2023 newsletter reported that a group of households finally got PVs installed. The article mentions the experience reported by the contractor responsible for sending the team of technicians to the islands:

> He had not fully anticipated the challenge of getting equipment, a van and solar panels to the island and the additional cost of this as well as that of accommodation and would keep this in mind when planning future jobs. [66]

Then, the contractor specified that in the future he would screen properties before travelling and have one of his workers available to work "off the tools" to oversee the job. The perspectives shared by Devon are very indicative of the issue of securing contractors, and the current energy crisis exacerbates this problem even more:

> "We can't get contractors to come in and do the work. […] I suppose, there are lots of reasons for it but one of them is that, um, the, because of the amount of money that's available now in grants for people to refurbish their homes all over the country, and there's a shortage of contractors to do that work for them, who are properly skilled and properly qualified, um, then, these contractors can pick any job they like. There are plenty of people applying to them and that, they pick the one that both suits them. And very rarely, does it suit them to go out to an island like that's 10 miles off the coast because there's extra costs involved, um, and there's lots of things that can go wrong. You can have a storm or… your workers can be stranded on the island and they need to have overnight B&B, and, where do you store your, your things that need a shelter, like cement and stuff, if you don't live here, or you don't have a yard that you can store stuff in, you know, all sorts of problems for contractors, so it's very hard to get them. […]" (Devon, Household 15)

Due to rising energy prices, more people now seem interested in getting solar PVs to reduce their energy bills. The lack of contractors who can do the job and the fact that, considering costs and logistics, those who can tend to prioritise the requests they receive from mainland customers, affect and delay islanders' possibilities for having solar installations.

5.3. Using the concept of practice architectures to understand the challenges and opportunities of these islands in the energy transition

In introducing the concept of practice architectures, Kemmis reported how changes in practices must be supported by changes in the corresponding practice architectures. Taking inspiration from this, we seek to experiment with changes at the level of material-economic and socio-political arrangements that could support the development of practices towards decarbonisation on these islands. The development of such practices can be affected both by disruptive events – such as power cuts and PV systems not functioning when they occur – and by infrastructures that are not built to respond to such events or that are inappropriate for local conditions – for instance, inadequacy of grants and planning permissions, and low availability of installers. For example, a recent change in planning permissions allows solar installations to cover the entire roof. The fact that households can now install more PVs – and of a better quality – can affect the evolution of practices towards increased use of renewable energy, as more kW can be produced (covering more energy demand). Improvements may be made on a larger scale, such as the availability of more frequent and accessible grant schemes, and more binding projects for companies to secure a guaranteed after-service. For example, grants for energy efficiency projects foresee a grant uplift of 50 % for islands, so island communities can access 50 % more funding for energy efficiency renovations [45]. This applies only to a few systems, however, including heat pumps and internal and external insulation; solar PV installations are not included.

Some material-economic arrangements may work well in some geographical areas, but less well when applied in places that have different characteristics. An example of this concerns some policies to access grants for PV installations established by the SEAI.[7] On their website, we can read: "Get your BER[8] arranged immediately after your solar PV has been installed. This will speed up your grant payment" [67]. Getting BER on islands might imply more challenges than getting it done in most areas on the mainland, because of high costs and low availability of assessors to travel to the islands, so it might not always be possible to have it done "immediately after" the installation is finished. This can thus present problems for households that rely on this grant to sustain the high costs of the installations, and that might be in trouble if such payment is delayed. Gathering a group of households needing the BER assessment may be one way to make it easier to find an assessor to come to the islands and assess multiple homes during one visit.

Furthermore, following some of the points also raised in "Our Living Islands" document [10], solutions may be developed locally, e.g. creating local jobs and training courses, which might concomitantly alleviate other significant concerns on the islands, such as depopulation. The quote below refers to the possibility of local courses initiated by the Development Co-op to train local people and create job opportunities locally:

[6] Especially on Inis Meáin and Inis Oírr.

[7] Sustainable Energy Authority of Ireland.

[8] Building Energy Rating Certificate.

"You could train somebody, the co-op could pay somebody to do that course […]. That'd be another job for a local person. You have people staying in community. The community gets bigger, you know? […] Like do you know the way you train as electrician? You could train into the… heat pump system […]." (Bryanna, Household 7)

Household 9 reported the positive case of a local man who has experience in installing Mitsubishi heat pumps:

"There's a local lad who installed Mitsubishis, and uh, they, they seem to be working good. And he's around, and he'll arrive, to try and fix it if anything goes wrong, and he kind of gives a guarantee." (Máirtín, Household 9)

Máirtín states that having locally trained people able to install, maintain and fix systems, in some ways guarantees the functionality of the system, simply by the technician's living permanently on the islands being a guarantee that islanders can get support at any time needed. The interviewees thus see the development of local jobs not only as a way of addressing the issue of getting workers to the islands to install or fix technical equipment, but also as a way to help boost the islands' population. Interestingly, in recalling the 10-year goals of the CFOAT [59], Devon, who is also a member of the co-op, explained how even the concept of energy autonomy is not something strictly confined to energy:

"But we want it [being energy autonomous] from a much broader sense than that. We want to be carbon neutral. We want to be a clean island in every sense. We want to be a more comfortable place to live, a more attractive place to, for tourists to visit. And, ultimately we want it to be a prosperous island based on our own energy sources, because that can be a source of wealth. […] So when I speak about, um, our energy, our energy transition, here on this island […] I speak about it in terms of keeping the population alive on the island, creating jobs, preserving the language and the culture. 'Cause they are the things that are most important to the people here, and if they see how our work and the co-op can help to do, to achieve those with major aims, which they have, then they'd be more supportive. […] It's not energy, in a way it's not energy at all! It's, it's the future of the islands, but energy happens to be an opportunity for now, to ensure that future." (Devon, Household 15)

This quote raises something interesting, bringing reflections on the interconnection between practice architectures (as arrangements) and practices (as nexuses of doings, sayings and relatings). The material-economic arrangements of practice architectures, as reported by Kemmis [13], may enable the doings of a practice: if people wish to install PVs and start shifting to a system based on renewables, then they need appropriate infrastructures that can support this change, for instance the availability of grants, access to maintenance services, etc. In general, as Shove and colleagues suggested [14], changes in practices and their elements may affect other practices: we argue that the same applies between practice architectures and related practices. For instance, the material-economic arrangements may enable not only the doings, but also the sayings (e.g. affecting discourses around the concept of energy autonomy). Similarly, the socio-political arrangements not only affect the relatings of a practice, but may also affect the doings. For example, some EU and national projects have dealt with installing solar systems in households. Despite the issues involved (e.g. after-service), these projects are also valuable in terms of costs and community involvement, as they encourage people to join programmes and have new technologies, e.g. PVs installed in their homes:

"It was good to be involved in it. And it was easier to get grants and the paperwork. They looked after the paperwork. So, instead of being an individual, you're part of a group." (Murphy, Household 5)

"I think, I think, if I had to go, if I went looking for them [PVs] and to pay for them and all that, I probably wouldn't do it. So why I, I just did it, not because it was free, but it was just part of a project." (Bob, Household 6)

Being involved in a project as a community, may influence whether people change their doings, for example by choosing to install PVs. This is also true in relation to participant support and social mechanisms within the community in question. Generally, the importance of having community support was also highlighted where household appliances and trying out new technologies were concerned. One interviewee, Jack, who has a professional technical background, said:

"It's good for them [people on the island] too [to install PVs] because if anything did go wrong, they can call me first and I know who to call straight away so it's good, be a big benefactor to help encourage people to get more, more and more stuff on the island." (Jack, Household 8)

In fact, many informants said that they actually refer to Jack when it comes to PV installations, and more generally to fix appliances and technical equipment. All these instances highlight the relevance of socio-political arrangements in affecting practices, not only in their relatings, but also in the doings and sayings. The extent that support can be found at the national, local and community levels, together with access to and availability of grants (economic arrangements) and appropriate infrastructures suited to the local area (material arrangements), will affect not only local and national decarbonisation plans in pursuit of meeting climate reduction goals, but also whether people will change their practices, e.g. by installing solar PVs and time-shifting their consumption.

It is important to note that some households emphasised that openness to change and to learning from other places' experiences are one of the strengths of these islands in connection with their participation in the energy transition:

"Well, it has to [change], to survive. You know, a lot of little islands, they just die off. The community dwindles. And I think in order for it to survive, I think this community's very open to a lot of different people from different countries coming in and settling and living. […] having different people bringing in different ideas is, is good for that." (Anne, Household 4)

Eamon mentioned the visit to Samsø[9] (which he defined a "Samsø moment") as inspirational for the energy programme started on Inis Oírr:

"[…] we could do a version of Samsø here, not a copy of it, but we could do a version of it […]" (Eamon, Household 1)

This last quote refers to the importance of taking local characteristics and factors into account. Projects must be developed to accommodate regional idiosyncrasies. Learning experiences gathered elsewhere must be adapted to place.

"Because, in one part of the country, you can do one thing, in another part it's a different thing. And each county is different." (Ciarán, Household 14)

"The islanders are the people who left the island as it is. […] We built those walls, we, you know, made those roads and kept the island as it is, and why should we harm it now? Um, so, yeah, that's the big problem. […] as happens very often, [they] didn't listen to local knowledge, to who we knew best." (Máirtín, Household 9)

[9] A Danish island, known for its development of a renewable energy system and now considered one of the first renewable energy islands.

In this last section, we have highlighted problems that can also affect people's usage of PVs on the mainland – e.g. the modification that can be done at the level of the material-economic arrangements in practice architectures, such as having PV systems functioning even during power cuts and removing restrictions on how much of a roof can be dedicated to PVs, or adapting practices to accommodate blackouts. If the islands can learn from other places, it follows that other places can learn from the islands. In this sense, the sum of these results and topics may be useful not only for island case studies, but also rural and remote communities in general, and even for urban areas that experience disruptions due to the environmental and socio-political crises that currently affect energy provision in more and more areas of the world.

6. Conclusion

The aim of this paper was to provide an overview of the energy transition currently taking place on the Aran Islands, through three main aspects. First, we looked at the challenges faced by prosumers, reflected especially in the co-existence of cooking and heating practices, related to previous and emerging forms of energy provision. Second, we explored how the concept of energy autonomy may be affected by the local conditions of the place where it is pursued. Finally, we empirically applied the concept of practice architectures to understand the challenges faced by communities on the Aran Islands on the path to the energy transition, and strategies for overcoming them.

On the Aran Islands, the installation of PVs in homes is not only of benefit to individual households seeking to reduce their energy costs, but has also become part of a common, local strategy to increase energy autonomy and, indeed, part of a national strategy to address climate change. When people install PVs in their homes, they have access to a range of new materials, whose correct use depends on the development of certain competences based on people's beliefs and engagements (including their interest in reducing electricity bills, their willingness to contribute to combating climate change, their aim to be off-grid, etc.). If adequately supported, new materials, competences and meanings (i.e. practices' elements) can lead to the formation of new doings and sayings (i.e. practices), where individuals not only embrace and adopt new practices as part of daily life, but also phase out older practices connected to fossil fuel usage. However, recalling Masera and colleagues' multiple fuel model, old modes of producing energy are not interrupted simply because new opportunities arise. The concept of hybridisation proposed by Kemmis is also useful here, as, in the process of evolving practices, new and old practices co-exist for a certain amount of time. In the case of the households on the Aran Islands, the co-existence of new and old practices constitutes the application of resilient strategies in which people have adapted to blackouts and the low availability of technical support. In short, people make use of what they already have. At the same time, this also shows, at least in some cases, meanings that persist over time, in the form of practice memories.

The co-existence of different energy practices sheds light on the path of the Aran Islands in the energy transition, demonstrating that a successful shift towards renewable energy usage demands more than the adoption of new practices and technologies: there is also the concomitant need to phase out fossil fuels. The low availability of contractors and the challenges in getting experienced technicians, the insufficiency of available grants – all these are practice architectures that can affect islanders' willingness to install PVs and adopt new practices related to their usage. We have also provided some narratives describing how people are enabled to embrace new practices thanks to certain elements of those architectures that can be strengthened, e.g. local job creation, reciprocal support within the community and availability of grant schemes for island communities. Hence, changes at the level of practice architectures are also required and, in order to enable successful practice changes, these practice architectures need to suit the local conditions of a place – architectures that work well in one area may need to be re-adapted for application elsewhere, i.e. in another place that has different socio-geographical characteristics. If they are to contribute successfully to the energy transition, each locality and community must have access to the right tools and appropriate measures. In this sense, although the transition is a global aspiration, it needs to be implemented locally.

The concept of energy autonomy, also central to this paper, has a variety of implications, and practice architectures themselves can affect the meanings of the practice of being autonomous, demonstrating how changes at different levels of practice architectures can affect each other. For example, material-economic arrangements affect sayings and doings of practices, while socio-political arrangements affect not only the relatings, but also the doings of a practice. At the household level, making use of solely renewable sources – something usually related to the concept of energy autonomy – indeed seems to partially constrain personal autonomy. For example, if people do not have access to technicians to fix broken equipment or cannot use PVs during a power outage, this limits opportunities to be free to do whatever they wish at any given time. This begs two more general questions: should individuals have complete freedom to consume energy whenever they want to? Or do we need to develop new meanings of convenience and comfort, in order to develop less energy-consuming practices? These questions connect to broader concepts of people's lifestyles and expectations. At the community level, the concept of energy autonomy is not a matter of the islanders wishing to completely disconnect from the national grid and have their own microgrid. Having control over the energy generated locally, while remaining connected to the national grid as both a backup and as a source of income can provide new forms of (economic) autonomy in itself.

The autonomy matter also provoked new reflections on energy production as a practice: when aiming to decrease dependency on fossil fuels, energy becomes something noticeable, not just an invisible part of life that allows the performance of other practices. Energy production can be considered as a practice in itself, formed of different elements such as materials, competences and meanings.

While some of these issues are peculiar to islands, others can also be found on the mainland. Hence, islands and remote communities anticipate certain challenges that are becoming relevant for other areas: they have been dealing with energy issues long before other places started to worry about wars and climate change affecting energy prices. For this reason, they may act like lighthouses for all places that are or will be experiencing, due to the environmental and socio-political crises affecting the planet, similar kinds of challenges.

Suggestions for future studies include the opportunity to investigate the effects of newly developed practice architectures on practices, for example, by examining the effects of changes in planning permissions and new opportunities provided to island communities, such as grants that take into full consideration the challenges faced by islands. This may also serve as a possibility to see if changes at the level of practice architectures can enable practices related to PV usage to become prevalent in the "process of hybridization". Lastly, it would be interesting to obtain more insights into how practice architectures as complexes of arrangements have interlinked effects on practices as nexuses of doing, sayings and relating (so how doings can be affected not only by material-economic arrangements, but also by socio-political arrangements, and so on), and whether and how this, in time, might further affect concepts related to energy autonomy.

CRediT authorship contribution statement

Chiara Tellarini: Writing – review & editing, Writing – original draft, Visualization, Validation, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Kirsten Gram-Hanssen:** Writing – review & editing, Supervision, Funding acquisition, Conceptualization.

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.

Data availability

Fully anonymizing the transcripts would remove text to an extent that their comprehensibility could be compromised. This is due to the small size of the close-knit communities subject of this study.

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Appendix A. Fieldwork timeline

Table 1
Fieldwork timeline.

February – March 2022 (1 week)	End of August – End of November 2022 (3 consecutive months)	March – April 2023 (3 weeks)
Preliminary visit in the fieldwork location, to meet Energy Co-op's members and decide which islands to include in the research.	Internship with Energy Co-op and main fieldwork: recruitment workshops; first round of interviews and house tours (15 households); smart plugs installations for energy data collection and energy feedback (8 households). **Topics of the interviews**: solar panels' usage; everyday life and energy-consuming practice changes; technology interaction and understanding; island community's living experiences; relations with nature.	Second round of interviews for households that got the smart plugs (8 households). **Topics of the interviews:** changes in energy–related practices (since last visit); experiences with the smart plugs and the energy feedback provided.

Interviews' length varied between one and three hours: nine interviews lasted between two and three hours; six interviews lasted between ca. one and one hour and a half.

For this paper, the main codes (and subcodes) that were used are: background information of the household; energy consumption (with subcode for heating consumption); energy autonomy; everyday routines and practices (with subcodes: materials, competences, meanings); house information (subcode: heating system); house tour; future of the islands – fears and hopes; socio-geographical background of the islands (subcode: blackouts and breakdowns of daily routines); info on solar PVs (subcode: grants availability and planning permissions); island life (subcode: problems related to living on islands). The combination of these codes helped in framing the paper and its main topics, combining the experiences of living in these islands' context with having PVs and the performance of everyday practices.

Appendix B. Recruitment of study participants

Two workshops (one for each of the two islands) to recruit participants were advertised through the major media channels (Facebook, WhatsApp, CFOAT newsletter) with the support of the CFOAT on Inis Mór and of the Comhar Caomhán Teo (the Development Coop) on Inis Oírr. Flyers describing the project were handed out at central locations (post office, noticeboard in the shop, etc.) and the CFOAT helped in providing the Irish translation of the English text.

During the workshops, the researcher gave a presentation of the project that included some exercises to engage the audience. Then a form was distributed to the audience: it included a brief questionnaire to get some initial information about the characteristics of the households interested in participating (e.g. who has solar PVs, the type of meters and appliances present in the households, type of heating system, appliances, etc.). Some of this information is presented in Table 1 in Appendix C. At the end of the questionnaire, informants could sign by ticking whether they agreed to be contacted by the researcher and join the project. From here, an initial selection of participants was made. The principal requirement was for households to have solar PVs, so participants who were about or intended to install solar PVs were excluded and kindly notified of deselection. Further participants were recruited in subsequent weeks, mainly through snowball sampling and door-to-door recruitment.

In spring 2023, during the researcher's final visit to the islands to conduct a second round of interviews with the households that got smart plugs installed, the participants received gifts to thank them for being part of the project.

Appendix C. Households' information

All houses are detached single-family houses with solar PVs. Only the households' residents living permanently in the home have been considered as part of the household, so children living elsewhere on the island or on the mainland, even if visiting frequently (with the exception of one case where the child also participated to the interview), were not considered. With "main informant" we refer to the person that participated to the first round of interviews that took place in Autumn 2022.

Table 1
Information on household members and main heating and cooking sources in use.

Households	Location	Household composition and members	Heating sources	Cooking sources mostly used
Household 1*	Inis Oírr	2 adults and 2 children. **Main informant**: Eamon, man in his 60s.	Heat pump; solar thermals; fireplace.	Gas oven; gas hob; microwave; toaster; gas kettle.
Household 2	Inis Mór	Meghan, woman (age not disclosed).	Wood burner stove; fireplace; heat pump.	Gas oven; gas hob; toaster; electric kettle; microwave.
Household 3	Inis Mór	2 adults and 1 child. **Main informant:** Claire, woman in her 50s.	Oil boiler; multi-fuel stove (mostly turf and coal).	Gas hob; electric oven; microwave; electric kettle; gas kettle.
Household 4*	Inis Mór	2 adults and 2 children. **Main informant:** Anne, woman in her 40s.	Geothermal heating (underfloor); heat pump; solid fuel stove; solar thermals.	Gas hob; gas oven; gas kettle; electric kettle; microwave; slow cooker; rice cooker.
Household 5*	Inis Oírr	2 adults and 2 children. **Main informant:** Murphy, man in his 50s.	Heat pump; fireplace; multi-fuel stove (turf).	Gas hob; gas oven; microwave; kerosene stove; toaster; electric kettle.
Household 6*	Inis Mór	Bob, man in his 40s.	Electric storage heaters; electric stove.	Electric hob; electric oven; electric kettle; microwave.
Household 7*	Inis Oírr	3 adults and 1 child. **Main informant:** Bryanna, woman in her 40s.	Oil boiler; back boiler; heat pump; solar thermals; fireplace; multi-fuel stoves (coal, turf); electric space heater.	Gas hob; electric oven; electric kettle; gas kettle; toaster; fryer; microwave.
Household 8*	Inis Oírr	2 adults. **Main informant:** Jack, man in his 30s.	Heat pump; wood burning stove.	Electric hob; electric oven; electric kettle; microwave; toaster.
Household 9*	Inis Mór	2 adults. **Main informant:** Máirtín, man in his 70s.	Oil boiler; fireplace; electric space heaters.	Gas hob; electric oven; air fryer; electric kettle; microwave; toaster.
Household 10	Inis Mór	2 adults. **Main informant**: Saoirse, woman in her 50s.	Heat pump; multi-fuel stove (coal, wood).	Gas hob; electric oven; gas kettle.
Household 11	Inis Mór	2 adults and 1 child (not living permanently at home). **Main informants:** Patrick, man in his 20s; Paul, man in his 60s; Marianne, woman (age not disclosed).	Oil boiler; kerosene stove; heat pump; multi-fuel stove (turf).	Gas hob; kerosene stove; electric oven; electric kettle; toaster; air fryer; gas kettle.
Household 12	Inis Mór	2 adults. **Main informant:** Gerald, man in his 70s.	Oil boiler; multi-fuel stoves (coal, wood).	Gas hob; electric oven; microwave; gas kettle; electric kettle.
Household 13*	Inis Oírr	1 adult and 1 child. **Main informants:** Brigid, woman in her 50s; Kenneth, man in his 30s.	Oil boiler; multi-fuel stove (wood, coal, turf); electric space heater.	Gas hob; electric oven; microwave; toaster; gas kettle.
Household 14*	Inis Mór	2 adults and 1 child. **Main informant:** Ciarán, man in his 40s.	Diesel; wood burning stove.	Gas hob; electric oven; electric kettle; microwave.
Household 15*	Inis Mór	2 adults. **Main informant:** Devon, man in his 70s.	Heat pump; electric storage heaters.	Gas hob; gas oven; kettle.

* Households whose specific quotes were mentioned in this paper.

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