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Scope of Deliverable

To provide timely empirical insights with respect to the potential of transferring the innovative TILOS-Horizon 2020 energy model to other non-interconnected Greek islands – focusing specifically on whether islanders from across the Aegean are likely to accept this energy transition and the technologies/ infrastructures it involves.

Document History

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Executive Summary

Renewable and smart grid technologies promise to transform the Aegean into a "green" archipelago – with members of the internationally acclaimed TILOS-Horizon 2020 project seeking to transfer emerging knowledge beyond the island of Tilos itself. Nonetheless, research on public acceptability of green energy technologies suggests that local community opposition might undermine such ambitious plans. Hence, a crucial starting point for the research presented in this deliverable (D8.8) is the realisation of the timely need for an early stage 'upstream' exploration of whether islanders from across the Aegean are likely to accept prospective green energy interventions in order to minimize the problems and maximize the expected results of the anticipated transfers of technology. In this research, we draw on primary data from two questionnaire surveys (involving a representative sample of locals from across the Aegean Archipelago), and from a Deliberative Mapping exercise exploring possible energy futures for the region (involving a number of expert stakeholders and the lay public), to uncover the widespread acceptability of the green energy solutions put forth by the TILOS research consortium – especially in small and very small islands of the Aegean Archipelago. Simultaneously, though, we uncover how broad acceptability does not always translate into actual acceptance of specific proposals, especially when these affect the end-user. For three distinct energy user profiles that are variably supportive of local sustainable energy developments have been identified; namely the Potential Green Prosumers, the Potential Green Consumers, and a non-negligible quarter of locals opposing such developments altogether (i.e. the Opposers). In turn, we argue that these findings should inform future interventions in the region with the ultimate aim of securing public support to "green" the Aegean. Of particular importance is our key conclusion that we can no longer afford to ignore energy publics and their diverse attitudes, values and sensitivities; future interventions in the region should, first and foremost, include locals in decision-making. Islanders need innovative energy technologies, *but* innovative energy technologies also need islanders and, thus, every effort should be made to empower them when planning for the sustainable energy transition of the region.

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While renewable and smart grid technologies have existed for decades, they have gained increasing attention over the last years – with multiple countries across the globe undertaking initiatives to rollout smart grid and renewable infrastructures at an aggressive pace (Blumsack and Fernandez 2012). Globally, billions of pounds are spent each year upgrading existing energy infrastructure to create smarter, greener grids that change the way electricity is generated, delivered, utilised and priced (Tuballa and Abundo 2016). Common drivers for such innovative developments include policy objectives encouraging energy efficiency and greater energy independence, climate change and greenhouse gas emissions reduction priorities at both the national and the EU-level, a growing industrial commitment to integrate renewable energy into the power system, the growing maturity of sustainable energy technologies, as well as recent advancements in communication technologies (e.g. European Commission Directorate-General for Energy 2011; Pfenninger et al. 2013; Zafirakis et al. 2013).

This holds especially true for isolated energy islands (cf. Spataru 2019 for an overview). On the one hand, literature has tended to depict the energy supply in environments such as those encountered in the islands of the Aegean Archipelago as a highly problematic process – marked, amongst others, by the near impossibility of continental interconnections in the majority of cases, a high level of dependence on imported fuel, considerable demand fluctuations, high operational costs, the inevitably high levels of environmental pollution from fossil-fuel based plants, and unreliable energy supply (e.g. Haeder 2012; Strantzali et al. 2017; Zafirakis and Chalvatzis 2014; Spyropoulos et al. 2005; Ioannides and Chalvatzis 2017; Hills et al. 2018).

On the other hand, the recent concepts of the 'green' or 'smart' island provide new ways of looking at the role energy plays in everyday life and the evolving relationship between energy utilities and consumers, and their emergence may create further opportunities for a sustainable energy transition (e.g. Eftymiopoulos et al. 2016; Kuang et al. 2016; Sperling 2017; Vourdoubas 2017). Indeed, isolated islands or remote areas can be ideal testing grounds for mature low-carbon technologies since their indigenous low-carbon generation can be more cost effective in the long-term, and these potential technologies can also complement each other and can be matched in different ways to the electricity demand (Vallvé 2013). This also implies that these systems are at the forefront of smart energy transitions with the innovative use of storage and load management techniques (ibid.). As the European Commission's political declaration on clean energy for EU islands indicatively asserts:

> *'Islands are well placed to employ innovative solutions and attract energy investments that integrate local renewable production, storage facilities and demand response' (European Commission 2017).*

In particular, many real-world implementations exist that exemplify different transition pathways and allow insight into the pursuit of smart energy solutions on islands. Although attention has customarily been placed on the optimum sizing of centralised RES plants (e.g. Kaldellis et al. 2010; Papaefthymiou and Papathanassiou 2014), the concept of the green or smart grid that lately emerges has also attracted the attention of researchers (e.g. Zafirakis and Chalvatzis 2014; Chalvatzis and Ioannidis 2017; Ioannidis and Chalvatzis 2017). Specifically, practitioners in the field have put forth a myriad of suggestions and plans such as continental interconnections, smart micro-grid solutions, end-user efficiency measures, RES microgeneration, prototype energy storage solutions, and the establishment of energy cooperatives (e.g. Eftymiopoulos et al. 2016; Hills et al. 2018; Notton et al. 2017; Voudoubas 2017).

For example, multiple EU islands and peripheral territories – such as Pellworm and Samsø (ISRER 2010; Visit Samsoe 2017) – began to consider the decarbonisation of their electricity supply systems as back as the 1990s. Such low-carbon and smart grid projects are on the rise in continental Europe and in Europe's remote island territories (IEA 2013; Sawin, Seyboth and Sverrisson 2016; Eurelectric 2017). For instance, IRENA (2017) details over twenty-five low-carbon projects from islands and countries in the Pacific and Indian Oceans, the Mediterranean and the Caribbean. These projects illustrate many aspects of the smart energy transition to include projects for wind farms, solar farms and the use of energy efficiency and EVs for enhancing the energy security of the system and reducing their dependence on fossil fuels (e.g. ibid.; SmileGov 2009; IRENA 2014a, 2014b, 2015, 2017; ETI 2017). For as renewables became more commonplace within these systems and account for larger volumes of production, it becomes increasingly apparent that integration of multiple generating technologies could be done more effectively with smarter systemic approaches rather than the traditional passive approach – as exemplified by the internationally acclaimed TILOS-Horizon 2020 energy model that includes the development of an autonomous, smart, hybrid energy production and storage system on the island of Tilos (cf. Notton et al. 2017).

The practical challenges of such innovative energy transitions are predominantly addressed in small and large-scale modelling research (cf. Malekpoor et al. 2017; Malekpoor et al. 2018). Multiple econometric, energy equilibrium and optimization analytical and modelling tools have aided this smart energy transition within isolated electricity systems (e.g. HOMER, DER-CAM, PLEXOS and the Islands Playbook energy transition initiative) (cf. Owlia and Dastkhan 2012). Different aspects include capacity expansion investments and improving the decision making of the system such as grid balancing or energy policy analysis (e.g. Lalor 2005; Dimitrovski et al. 2007; Ilic, Xie and Liu 2013). For example, Weisser (2004) examined the main economic and technological obstacles for incorporating renewables within small island systems, while Parness (2011), Pina, Silva and Ferrão (2012) and Ilic, Xie and Liu (2013) studied test-bed systems for electricity grid balancing and unit commitment optimisation within remote grid systems.

These developments have informed a rich repository of readily available data useful for electricity system designers, policy makers and modellers alike wishing to assist in the sustainable energy transition of islands. Prior studies and practical interventions provide a useful perspective on the type and quality of future electricity system that is possible (e.g. IEA 2012). According to the Islands Energy Program (2016), projects and research programmes of this kind will create a blueprint that can be replicated in other isolated economies and possibly on other larger systems. Indeed whilst most research in the field focuses on specific islands, there is also a concerted effort to share knowledge and experience of integrated, innovative and smart solutions in the field of renewable and smart energy and energy efficiency beyond the narrow geographic realms of specific interventions.

For instance, whilst the TILOS project engages the islands of Tilos (Greece), Pellworm (Germany), La Graciosa (Spain) and Corsica (France), the ultimate goal of the project *'is to create a special platform that will enable technological know-how transfer between islands'* (Notton et al. 2017). Moreover, several (inter)national networks and research consortia are currently at the forefront of capitalizing on emerging knowledge in an attempt to stimulate further sustainable energy transitions for non-interconnected islands. These include, inter alias, the Dafni Network of Sustainable Greek Islands, the Smart Islands Initiative, the Global Sustainable Energy Islands Initiative, the Global Renewable Islands Network, and the Small Developing Island Renewable Energy Knowledge and Technology Transfer Network (cf. Spataru 2019 for an overview).

Nonetheless, and albeit considerable past experience of islandic energy transitions, this research asserts that energy experts continue to develop technologically-focussed solutions that will not necessarily work smoothly in the real world. A notable shortcoming of most extant research and interventions is how they tend to overlook the social dimensions of sustainable energy transitions: islanders, their values, preferences and sensitivities. On the one hand, energy users are undeniably being re-envisioned as essential components of effective energy transitions: a) as conscious consumers who respond to awareness raising campaigns by using electricity more efficiently (e.g. Kielichowska et al. 2017), b) as "smart" consumers who use smart energy feedback to reduce their overall consumption (e.g. Friedrich-Ebert-Stiftung 2016; Buchanan Russo and Anderson 2015), c) as "flexible" consumers accepting demand response (load management) systems that control their devices (e.g. Stathopoulos et al. 2014; Zizzo et al. 2017), and d) as primary energy prosumers (ibid.). On the other hand however, and with a few notable exceptions, there is limited interest in exploring whether islanders are actually willing to accept green/smart energy technologies and the new roles envisioned for them by energy experts.

Particularly, a fundamental concept informing the research documented in Deliverable 8.8 is that (islandic) energy systems *cannot* simply be viewed as assemblages of specific technologies and infrastructures, but as being deeply embedded within society – i.e. they are socio-technical systems. Indeed, energy technologies and energy publics continually interact and shape each other (Bijker and Law 1992). This is relevant to our focus on the societal acceptance of the TILOS-Horizon 2020 energy model because it highlights the fact that further technological developments across the Aegean are contingent upon wider social factors, and that otherwise promising technologies may fail or thrive as a result of the 'interactive complexity' of societies (Sovacool 2009). Placing wider societal acceptance in this wider socio-technical context makes visible important issues of sustainable energy transition that are otherwise left unseen (Miller et al. 2013). *Put more simply, islanders from across the Aegean Archipelago need innovative green energy technologies, but technologies also need islanders.*

Bearing this in mind, and given the research consortium's interest in transferring the innovative TILOS-Horizon 2020 to other non-interconnected Greek islands, the ultimate goal of this document is to provide an overview of public attitudes towards green and smart energy transitions in Greek islands. In so doing, it also aims to provide a socially sensitive blueprint for smart energy transitions in isolated and peripheral territories and to allow transferability of the methodology. In turn, the document aims to enable policymakers and stakeholders with the outlook and primary evidence to develop regional smart energy transition strategies for isolated and peripheral territories.

Specifically, this report proceeds as follows:

i. Section 2 provides an overview of past research on energy publics to emphasize the pivotal significance of public acceptability to the successful implementation of sustainable energy transitions for island territories.
ii. Section 3 outlines the unique methodological starting points informing the first ever exploration of public acceptability of green energy solutions across the Aegean

Archipelago.

iii. Section 4 proceeds to present the empirical of this research, highlighting that islanders are generally in favour of green energy transitions on the one hand, but not necessarily supportive of specific arrangements and technologies on the other.

iv. Finally, Section 5 explores the implications of this research, and focuses especially on discussing how this research is only a starting point when discussing the potential transferability of the TILOS energy model.

2. The societal dimensions of (islandic) energy transitions

A diverse array of proposals have been put forth with respect to the sustainable energy transition of non-interconnected islands (see Section 1). However, a critical starting point for this research is the realization that the energy experts involved in this process tend to overlook the deep entanglement of technologies and innovation with socio-cultural, political, and economic elements of sustainability transitions (cf. Etkins 2004; Rochracher 2018). Of particular interest is public support for sustainable energy technologies which constitutes one of the most studied themes in the field of energy and society (ibid.). This involves: '*a favourable or positive response (including attitude, intention, behavior and – where appropriate – use) relating to proposed or in situ technology or social technical systems by members of a social unit (country or region, community or town, and household or organisation' (Upham, Oltra and Boso 2015, 107).* Furthermore, it consists of three distinct components:

i. The general opinion of the public and key stakeholders as well as the political framework conditions (i.e. *socio-political acceptance*),
ii. The practical acceptance of specific projects, site selections within the affected communities (i.e. *community acceptance*), and
iii. The acceptance of renewable power production by consumers and investors in the energy market (i.e. *market acceptance*) (see Wustenhagen et al. 2007).

Given the complex financial and industrial arrangements that have built up around sustainable energy technologies and the centrality of such innovations to the achievement of ambitious climate change and emissions targets at the (inter)national level (e.g. European Commission Directorate-General for Energy 2011; Pfenninger et al. 2013; Zafirakis et al. 2013), we do not currently regard *market acceptance* and *socio-political acceptance* as key limiting factors. Nonetheless, we assert that *community acceptance* of sustainable energy innovations is not simply a "nice-to-have" factor that facilitates project development. Community opposition has been found to constitute one of the main challenges that hinder the adoption of otherwise promising novel energy technologies in households (Pothitou et al. 2016) and beyond (Zafirakis et al. 2014); thus, the transfer of best practice experience from the TILOS-Horizon 2020 across multiple non-interconnected islands should not be taken for granted. More specifically, the gap between national goals for a green energy transition and social acceptance has been discussed by several researchers, who have come to the conclusion that social disapproval can function as a restricting factor in achieving ambitious objectives (Biresselioglu 2018; Cohen et al. 2014; Devine-Wright 2008; Schweizer-Ries 2008; Wustenhagen et al. 2007).

Indeed, the opinion on and social acceptability of energy systems and technologies may strongly influence the time needed to complete an energy project (Mourmouris and Potolias 2013). For instance, an IEA study on policy considerations for deploying renewables (Müller et al. 2016) provides a multitude of specific examples of wind projects that were either significantly delayed or cancelled altogether due to strong public opposition. In addition, this is even the case given that wind power has been identified with the most favorable social impacts when compared to other competing technologies (Evans et al. 2009). A representative national example that highlights how a local society can affect negatively the promotion of RES technologies is the case of a Greek island, Euboea, where almost 200MW of wind farms were installed between 1998 and 2001. During this considerable introduction of wind energy installations, however, increased local opposition recorded (from environmentalists, cultural clubs, some municipal authorities, part of the local population, etc.), eventually led – in 2001 – to a virtual stand-still of any further wind farm development in many areas of southern Euboea (Kaldellis 2005).

The case of geothermal energy is even more telling of the detrimental impact public attitudes might have on sustainable energy transitions (see Karytsas et al. 2019 for an overview). Whilst Greece is a country with high geothermal energy potential, its utilization is exceptionally limited – being solely exploited through direct uses. This absence of power production through geothermal energy largely comes down to the local societies' opposition following the bad experience of the Milos Island pilot power plant (in the 1970–80s). Deficiencies and errors made during construction and operation led to environmental pollution, resulting to the strong and enduring reactions of both local residents and energy publics throughout the country against geothermal energy. Until recently, most attempts made for the exploitation of geothermal fields are characterised by the lack of local societies' awareness, involvement, engagement and/or support (ibid.).

In sharp contrast, emerging research seems to suggest that public attitudes do not presently undermine sustainable energy transitions. At an international level, recent Eurobarometer data (see Fig.1) point to exceptionally high levels of public support for the decarbonisation of energy supply, and especially for renewable energy solutions (such as wind, solar and hydroelectric energy) across the European Union.

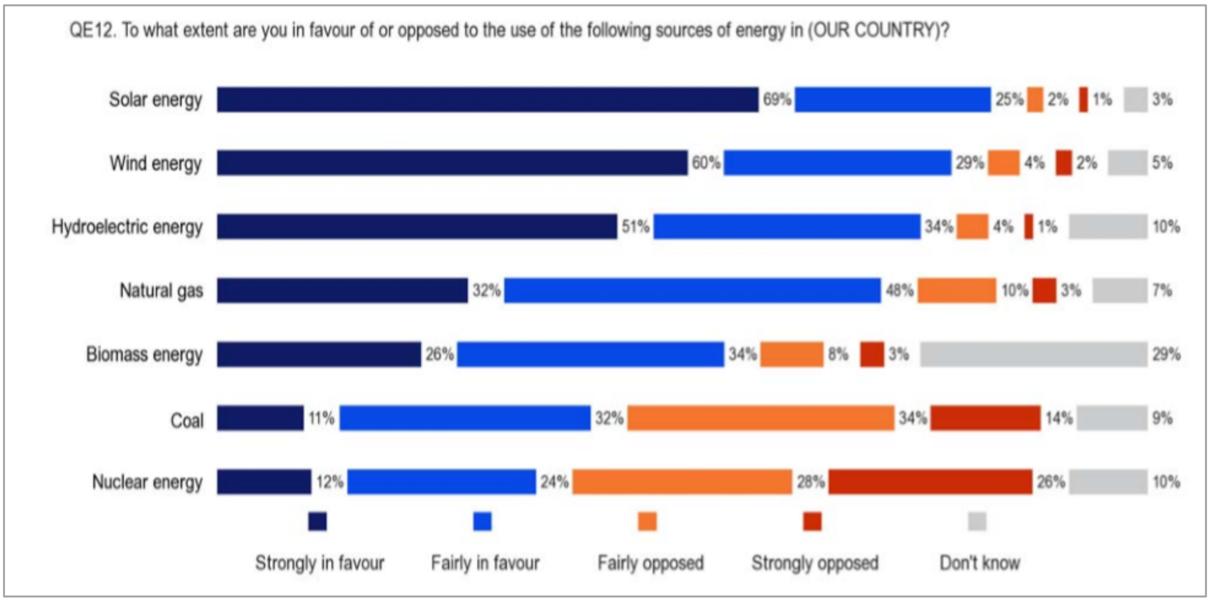

Figure 1: Public attitudes towards renewable and conventional energy sources in the EU *(Source: European Commission 2011)*

Similar are the trends recorded by multiple research programmes at a regional level. For instance, and albeit recording low levels of awareness of renewable energy technologies, Kaldellis (2005) points to the fact that islanders are especially supportive of local wind turbine installations, envisioning them as partial solutions to energy supply problems faced especially in the summer months. Similarly, research by Tsoutsos et al. (2009) exploring local acceptability of wind parks uncovers how the vast majority of islanders from Crete (Chania) are supportive of local developments. Furthermore, econometric analyses conducted by Zografakis et al. (2010) on the island of Crete suggest that: a) islanders are concerned by the environmental impacts of fossil fuel overexploitation, and b) are far more willing to pay for local renewable installations than for upgrades to conventional local power plants. Finally, recent empirical data from the island of Skyros suggest that the majority of locals support the implementation of renewable-based, small-scale projects corresponding to local energy autonomy scenarios (Pertrakopoulou 2017).

These recent positive attitudinal trends can be attributed to growing awareness of a series of perceived and objective benefits of local green energy installations. First, by far the most common motivation for accepting renewables in the literature has to do with the income that local installations such as wind turbines and solar farms can bring to communities. This involves, amongst others, the direct economic benefit of renting or selling off agricultural land (e.g. Anderson 2013; Bell et al. 2013; Brunt and Spooner 1998; Lombard and Ferreira 2013), income generation when energy cooperatives sell power to the national grid (e.g. Bell et al. 2005; Ek and Persson 2014; Wolsink 2010), local job creation in the energy sector (e.g. Carlisle et al. 2014; Delicado et al. 2016; Hall et al. 2013), or revenue generation across the local economy through increased numbers of visitors attracted by installations (e.g. Delicado et al. 2016; Lilley et al. 2010). Second, and despite the dominance of landscape preservation as an argument against green energy developments, these can also be perceived as an improvement in extant landscapes. For instance, industrialised communities or communities neighbouring conventional power stations see the arrival of green technologies as symbols of development and progress, as an opportunity for mitigating industrial stigma by acquiring green credentials, or even as a prospect to generate a new local identity (e.g. Delicado et al. 2016; Firestone et al. 2015; Krauss 2010). Furthermore, residents that support green energy development also base their stance in environmental values, such as contributing to fight climate change (e.g. Firestone et al. 2015; 2018; Delicado et al. 2016). Third, and finally, the generally positive attitudes of islanders towards renewable energy installation recorded in Greece can be explained by the significant energy supply security promises of increasing energy autonomy – in terms of experiencing both fewer power outages and voltage fluctuations (e.g. Kaldellis 2005; Tsoutsos et al. 2009; Zografakis et al. 2010).

Unfortunately, whilst recent research in Greece points to exceptionally high levels of acceptability for RES applications (e.g. Kaldellis 2005; Kaldellis et al. 2012; Sardianou and Genoudi 2013; Tampakis et al. 2013), research across Europe consistently highlights a renewables paradox: a sharp disparity between generally favourable attitudes to energy developments and acceptance of planned developments by those groups residing close to proposed project sites (e.g. Burningham 2000; Devine-Wright 2009; Huijts et al. 2012). In particular, there is no empirical evidence suggesting a connection between attitudes towards local developments and attitudes towards green energy in general (e.g. Ek 2005; Eltham et al. 2008; Warren et al. 2005). As decades of research in the field concludes, *there is often a social gap between supporting a technology in principle and accepting it in practice* (e.g. ibid.; Biresselioglu et al. 2018; Cohen et al. 2014; Devine-Wright 2008; Schweizer-Ries 2008; Wustenhagen et al. 2007). Subsequently, researchers focusing on public acceptance of novel energy technologies have, amongst others, warned practitioners in the energy field to differentiate between 'acceptability' as a broad, evaluative attitude towards green energy technologies and consumer 'acceptance', as an actual and/or anticipated behavioral response towards specific technological interventions (Huijts et al. 2012). These insights, thus, suggest that in order to minimize the problems and maximize the expected results of technological interventions, and prior to the strategic plans being drawn up and governmental decisions taken, it is imperative to research public opinion. In this way, the possibility of failed decisions and interventions is minimized (Tampakis et al. 2013).

2.1. From 'NIMBY' to public participation

Given the critical importance of local public support for green energy infrastructures, social scientists have developed a multitude of conceptual frameworks explaining local social acceptance. For instance, the 'NIMBY' (not in my backyard) hypothesis posits that although people, according to some opinion polls, tend to support RES projects in general, they are likely to oppose specific project plans in their local area for self-interest and particularistic reasons (cf. Devine-Wright 2007). They want to enjoy the benefits of clean, carbon-neutral energy, but not in their own 'backyards' where the plants are feared to be noisy, disturb the landscape and perhaps even harm the health of affected neighbours (e.g. ibid.; Fast 2013; Petrova 2013).

Furthermore, scholars in the field have moved significantly beyond the 'NIMBY' hypothesis which stigmatizes objectors as egoistic, short-sighted, ill-informed, and ignorant to the greater good (see Burningham 2000; Devine-Wright 2009; Wolsink 2006). Instead, a multitude of recent academic studies have investigated alternative explanations for public responses to local energy infrastructure developments. Especially in the past few years, researchers in the field have conceptualized and empirically validated how personal, contextual and project/ place-specific factors shape local public acceptance of energy-related interventions (e.g. Huijts et al. 2011; Devine-Wright 2009; Sardianou and Genoudi 2013; Steg et al. 2015; Wolsink 2006; 2010). These are detailed in Table 1 below.

Table 1: Factors influencing levels of public acceptance for innovative green energy technologies

Factor	**Description**
Person-related factors	Socio-demographic attributes (such as age, gender, education levels, income, home ownership, employment status, voting preferences, etc.) that have been found to influence acceptability of green energy technologies in context-specific manners (see Devine-Wright 2013).
Project-specific factors	Subjective perceptions over: a) the perceived fairness of the distribution of costs and benefits associated with a project (e.g. Haggett 2011; Wustenhagen et al. 2007), b) the capacity of local communities to influence and/or be fully informed in the decision-making process (e.g. Devine-Wright 2013; Firestone et al. 2015; Gross 2007; Wolsink 2007), and c) expectations over the positive and negative local impacts of particular developments (e.g. Bailey et al. 2005; Simas et al. 2012; Stokes et al. 2014; Waldo 2012).
Contextual factors	Wider energy policy contexts and institutional arrangements within which local energy projects are embedded. These include differences in institutional traditions, such as policy regimes, economic incentives and regulations that have been found to account for differences in green energy deployment rates and public acceptance (Agterbosch et al. 2009; Fast et and Mabee 2015; Jobert et al. 2007; Wolsink and Breukers 2010).

Focusing on the Greek context, five key factors have been found to undermine public acceptability of green energy solutions. First, there is a notable lack of (accessible) information on novel energy technologies and their economic, environmental and social benefits/ costs is reflected in the reluctance of locals for new energy supply programs (Kaldellis 2005; Oikonomou et al. 2009; Malesios and Arabatzis 2010). Second, multiple research programs uncovered an enduring public claim that local renewable energy installations can degrade otherwise unspoiled landscapes – especially in areas of high touristic importance, such as the island of Rhodes (e.g. ibid.; Dimitropoulos and Kontoleon 2009). Third, local societies are occasionally faced by proposals for large-scale renewable installations in their near vicinity that do not account for local eco-geographical idiosyncrasies (e.g. ibid.). Fourth, local communities oftentimes adopt a protectionist stance in light of their distrust of non-local, and allegedly corrupt and/or self-interested, developers and stakeholders who might be involved in 'clientistic' relationships (Fragkos et al. 2007). Fifth, and finally, there are multiple barriers to prosumption including, inter alias, significant recent feed-in-tariff cuts (Tselepis 2015), the ongoing dire economic circumstances that have greatly reduced public willingness to invest in micro-generation technologies (e.g. Kaplanoglou and Rapanos 2018; Papadelis et al. 2016), and the current immaturity of the economy, in terms of policy and business models, to empower consumers to produce and store clean energy at the local level (Nikas et al. 2018).

Against this backdrop, social scientists claim – and successfully demonstrate – that public opposition to planned local sustainable energy developments can be overturned, even without significant policy changes. First, the notion that information campaigns could reduce or even eliminate community backlash altogether is relatively common. There is a reasonable logic to information campaigns, because much of the public has limited awareness of renewable and smart energy technologies (Cass and Walker 2009). Sustainable energy advocates envision attitudes toward wind energy projects becoming more positive as the public learns more about the benefits of green energy and misconceptions about impacts are corrected. Indeed, in interviewing a variety of actors in the development of renewable energy projects, Cass and Walker (2009) and Burningham, Barnett, and Walker (2014) found ample evidence of information-deficit perspectives. In these studies, proponents of development felt that some opposition was caused by incorrect information spread by opposition groups and that providing correct information would lead to greater public support. Parks and Theobald (2013) found a similar stream of thought among wind energy advocates. The idea that information can create greater support for wind energy projects has been advocated by multiple authors as well (Jones and Eiser 2009; Kaldellis 2005; Krohn and Damborg 1999; Strachan and Lal 2004).

Second, it has recently been argued that the risks of public backlash in the face of green energy developments can be avoided through meaningful and timely public participation in decision-making (e.g. Walker et al. 2007; Natarajan et al. 2018; National Research Council 2008). In particular, it is claimed that the use of analytic-deliberative methods of public engagement, including mechanisms such as citizen's panels, at an early – or 'upstream' stage of proposed sustainable energy transitions, can truly and fully enable the integration of public values, concerns and sensitivities into decision-making, leading to enhanced legitimacy and trust (ibid.; Renn 2008). This involves the abandonment of technocratic planning perspectives, since the 'decide-announce-defend' approaches to local energy transitions have been denounced as contributing to social conflict, and leading to delays and/or even cancelled project proposals (Wolsink 2011).

Indeed, state-of-the-art research in the field demonstrates how active, early-stage community engagement and empowerment increases acceptance of sustainable energy technologies, especially in the context of local energy cooperatives (e.g. ibid; Aitken, Haggett and Rudolph 2016; Rowe and Frewer 2004). For instance a survey conducted in Scotland revealed increased acceptance on Giga Island where three wind mills are owned by the community (Warren and McFadyen 2010). Similarly, Skanavis and Kounani (2018) argue that the above-mentioned model could increase public support for windfarms in the island of Skyros and other parts of Greece. For the islanders considered would like to have access to an appropriate formal and/or informal environmental education that will help them increase their knowledge and obtain skills for critical thinking and vigorous contribution in energy-related decision-making and management (ibid.).

In particular, such an approach has been argued to be able to give a greater voice to local communities in identifying and defining the locally relevant energy-related challenges and solutions, thereby leading to more acceptable local projects (Whitton et al. 2015). Moreover, giving local communities a greater range of ways to contribute to achieving sustainable energy systems beyond the resentful acceptance of externally-designed, top-down imposed energy projects has been argued to offer a broader, more lasting contribution to sustainability (Barry and Ellis 2011). Sperling (2017) attributes the success of the internationally renowned Samsø Renewable Energy Island project to an intensive process of sensing and priming linked to the local population; to the integration of the project into the structure and needs of the local community. In practice, this implicated energy experts and local/national authorities working-with-and-for the local community, and involved: a) meaningful public participation throughout all stages of the project development and subsequent management, and b) expert and governmental commitment to provide the affected community with a 'toolbox' to draw resources from (e.g. with respect to different technological solutions, public participation methodologies, etc.) when deliberating their hoped-for energy future and during project management thereafter.

3. Problem positioning and research methodology

Whilst scores of papers have studied social acceptance of energy innovations, we argue that research and practice in the field continues to suffer in three key ways. First, and foremost, literature exploring local energy acceptability has overwhelmingly focused on local opposition to single wind energy projects (e.g. Devine-Wright and Howes 2010; Firestone and Kempton 2007; Kontogianni et al. 2013). Consequently, and with some notable exceptions (e.g. Mengolini and Vasiljevska 2013; Spence et al. 2015; Wolsink 2012), it has relatively little to say about support to smart and green grid developments that affect energy publics and their everyday social lives directly (cf. Sauter and Watson 2007; Wolsink 2012) and involve, amongst others: a) a redefinition of end-users from passive consumers to managers of their consumption and active 'co-providers' or 'prosumers', and b) automated demand-side management (DSM) mechanisms aiming to achieve a balance between electricity supply and demand. Second, previous work in this area has typically used single case studies to understand the emergence of opposition to specific local energy interventions, at a late stage in the implementation process (see Devine-Wright and Howes 2010; Firestone and Kempton 2007). In other words, there has been very limited effort to account for public values prior to specific technological interventions and, thus, projects that are not necessarily acceptable by local communities have emerged (Whitton et al. 2015). Third, whilst social scientists have put forth a plethora of public participation mechanisms that fully empower local energy publics and promise to eliminate opposition (see Section 2.1), a notably small number of island regions have adopted such techniques.

These shortcomings are closely reflected in research and practice on non-interconnected Greek islands. First, while recent studies and interventions move significantly beyond renewable energy production (e.g. Notton et al. 2017; Jørgensen et al. 2011) they apply multiple implicit and unfounded assumptions about the willingness of locals to live in and be part of green energy systems in the near future. Second, there is a notable lack of practical engagement with state-of-the-art public participation approaches that could, in principle, contribute towards securing a sustainable energy transition for the region. There is, in short, a timely need for an early stage 'upstream' exploration of whether islanders from across the Aegean Archipelago are likely to accept micro- or meso-level green and smart energy interventions in the future (following Whitton et al. 2015; Wilsdon and Willis 2004).

Against this backdrop, this section presents the methodology employed in this research to address the key research aims of: a) documenting public perceptions of proposed low-carbon energy innovations in the Aegean Archipelago – and particularly of the TILOS-Horizon 2020 energy model – at an early stage in the process of developing possible local energy projects, and b) developing a contextually appropriate blueprint for greater and more meaningful public engagement in future energy transitions in the region. Overall, this research adopts a mixed-methods, multi-strand approach to research, combining qualitative and quantitative research methods.

3.1. Research strand 1: Questionnaire surveys

The first, and most prominent, strand of the research adopted quantitative research methods, and aimed at developing a broad understanding of public attitudes towards sustainable energy innovations across the region. Specifically, two questionnaires surveys were used to collect information about the people from the people with respect to the possibility of transferring the innovative energy model of Tilos to other non-interconnected islands.

Drawing on past research on public acceptability of sustainable energy solutions (e.g. Devine-Wright 2007; Kaldellis and Kavadias 2004; Kaldellis et al. 2012), the first questionnaire survey (see Appendix A), conducted in September 2017, and had a number of closed-type questions exploring the following six broad topic areas:

i. Personal and demographic attributes that might influence energy-related attitudes and behaviours (see Question1; 2).
ii. Public attitudes with respect to the energy supply status quo and the relative importance of energy system failures (see Question 3).
iii. Public attitudes towards specific renewable and smart grid technologies and systems put forth by the TILOS-Horizon 2020 research consortium (see Question 5; 6; 7; 9).
iv. Perceived disturbance caused by conventional and green energy technologies on tourism (see Question 8; 14);
v. Public awareness of energy-related technologies (see Question 4; 10)
vi. Public willingness to support a sustainable energy transition – e.g. through RES-base micro-generation (see Question 11; 12; 13; 15; 16; 17).

Whilst following the same overall approach, the second questionnaire survey (see Appendix B) – conducted between December 2018 and January 2019 – both provided updated data on energy-related public perceptions in the region and moved significantly beyond the scope of our initial survey. Instead of exploring broad acceptability of sustainable and smart energy solutions, we focused on developing a more nuanced understanding of the likelihood of islanders actively supporting a sustainable and smart energy transition for the region. Specifically, alongside repeating a number of key question on the public acceptability of green energy solutions, we also explored six additional broad themes:

i. Current energy-related behaviours (see Question 7).
ii. Public awareness of the TILOS-Horizon 2020 project (see Question 4).
iii. The reasons underpinning potential acceptance or opposition to innovative energy solutions (see Question 8; 8.1; 8.2).
iv. The potential presence and strength of NIMBY (Not in My Back Yard) sentiments in the region (see Question 5; 6).
v. The anticipated local impacts of such developments in the region (social, economic, environmental) (see Question 9).
vi. Public views with respect to alternative proposals (scenarios) for the sustainable energy transition of islands in the region (see Question 13).

Alongside differing in terms of their scope, these two surveys also engaged with two partially different populations. The first survey studied the public attitudes of locals from islands with diverse sizes and geographic positions across the Aegean Sea and, thus, provided a broader overview of energy publics. Specifically, data was collected from the islands of Agios Eustratios, Astypalaia, Anafi, Donousa, Kastellorizo, Amorgos, Symi, Nisyros, Chalki, Milos, Sifnos, Rhodes, Santorini, Skyros and Ikaria. (See Fig.2).

The second survey focused exclusively on small (population size between 1000-5000 permanent residents) and very small (population ≤1000 permanent residents) Greek islands that were purposely selected because they share commonalities with the island of Tilos (e.g. in terms of size, geographical position, solar and wind energy potential, etc.) that render the *direct* transferability of the Tilos energy model technically and economically feasible. These include the Greek islands of: Nisiros, Kimolos, Oinousses, Folegandros, Leipsoi, Othonoi, Erikoussa, Kastellorizo, Ano Koufonisi, Psara, Anafi, Sikinos, Agios Eustratios, Shoinousa, Agathonisi, Donousa, Gavdos, Erakleia, Fournoi, Pserimos, Antikithira, Arkoi, Milos, Spetses, Kithira, Patmos, Symi, Skyros, Samothraki, Sifnos, Hydra, Amorgos, Kythnos, Serifos, Astypalaia and, finally, Kasos (see Fig.3).

Data collection for both surveys was conducted in cooperation with the highly trained personnel of MARC S.A., a national market research company and member of the European Society of Marketing Research (ESOMAR), that provided access to the target population through computer-assisted telephone interviews (CATI), with the expert researchers and supervisors involved employing a multidimensional random sampling technique that used a quota based on gender, age and geographical distribution. A phone-based survey was selected among other methods (e.g. personal interviews, postal or door-to-door questionnaires, etc.) since it was considered the most cost efficient for this particular case. Although there are several disadvantages to using CATI surveys (e.g. questionnaires need to be kept short, the method may be unsuitable where questions or answers are too specialized or where there is high difficulty in making alterations to or providing considered responses, etc. (cf. Carr and Worth 2011)), the method gave us the opportunity to speedily collect and analyse large amounts of data using standardized descriptive and exploratory statistical techniques.

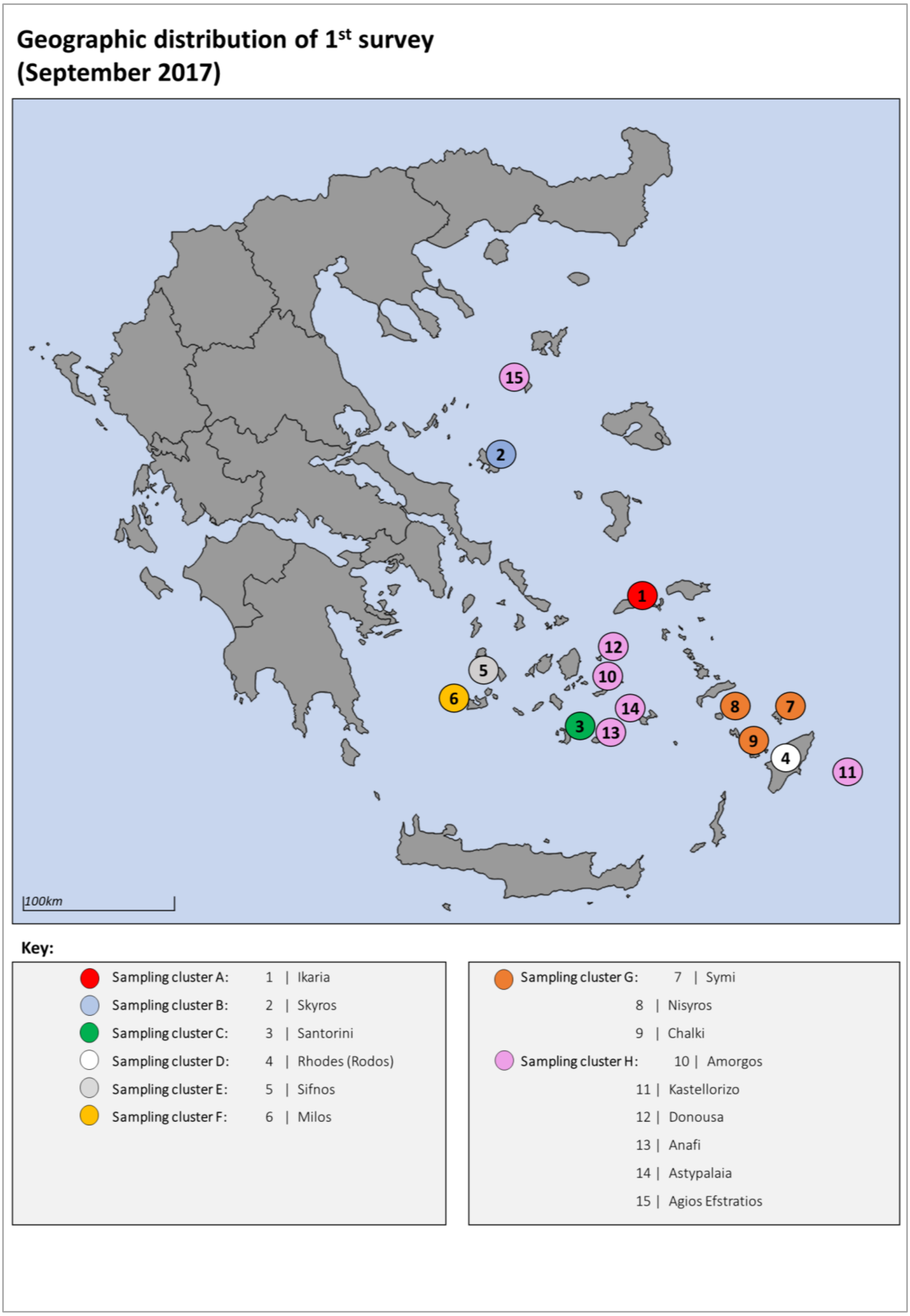

Figure 2: Geographic distribution of first questionnaire survey

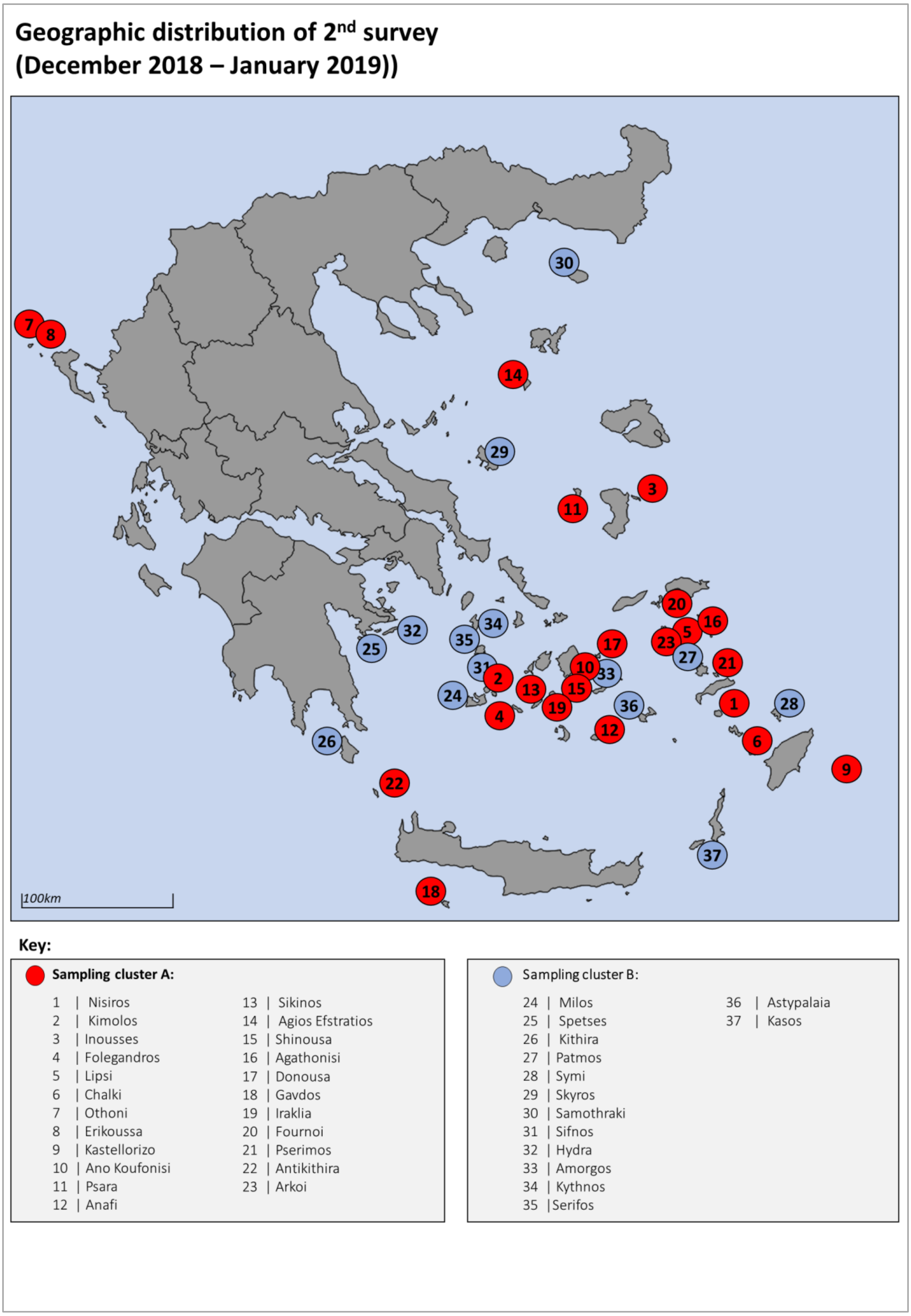

Figure 3: Geographic distribution of second questionnaire survey

As it is obvious, reliability of the results obtained from these surveys is strongly dependent on the size of the approved sample used, since the outcome uncertainty is normally decreasing with the square root of the sample size (Kaldellis and Kavadias 2004). We argue that the representative samples of 1001 and 806 households informing the first and second questionnaire survey respectively are considered adequate to provide a statistically-significant view of public perceptions of sustainable energy technologies and a marginal statistical error margin of ±3-4% (see for example the "sample-to-population" ratio adopted in other similar studies) (e.g. Devine-Wright 2007; Kaldellis and Kavadias 2004; Kaldellis et al. 2012). Nonetheless, given the small population size of many of the islands considered, statistical comparisons can – in most of the cases – only be made between specific sample clusters that share similar geographic and demographical characteristics rather than between individual islands (see Fig.1 and Fig.2).

The composition of our samples on the two questionnaire surveys is documented in Tables 2 and 3 below.

Table 2: Sample composition (first questionnaire survey)

Gender	Male	42.1%
	Female	57.9%
Age	18-24 years old	3.3%
	25-34 years old	12.0%
	35-44 years old	13.9%
	45-54 years old	21.8%
	55-64 years old	18.7%
	65 years old or older	29.4%
	DK/ DA	0.9%

Table 3: Sample composition (Second questionnaire survey)

Gender	Male	43.8%
	Female	56.2%
Age	18-24 years old	2.9%
	25-34 years old	3.7%
	35-44 years old	13.3%
	45-54 years old	21.2%
	55-64 years old	25.7%
	65 years old or older	32.6%
	DK/ DA	0.6%

3.2. Research strand 2: Deliberative Multi-Criteria Mapping

Admittedly, our CATI-based approach to research documented above allows consideration of a large, representative sample at the expense of developing a more comprehensive account of the subject matter. Specifically, recent work in the field of public acceptability of energy innovations has stressed the critical importance of including qualitative insights as these can provide in-depth accounts of the place- and context-specific factors underpinning support or opposition to specific energy innovations (e.g. Devine-Wright 2005; 2009; Devine-Wright and

Howes 2010; Haggett and Toke 2006). As this research only constitutes an initial exploration of energy-related attitudes in the region rather than an in-depth account exploring the transferability of the TILOS energy model to a specific island context, we felt that it was appropriate to only focus our efforts on including a representative sample of locals from across the Aegean Archipelago.

Nonetheless, to further inform a blueprint for the transfer of the TILOS energy model to other non-interconnected Greek islands, a second – parallel – strand of research involved gathering in-depth qualitative insights allowing us to better understand the complex phenomenon of local energy deliberations. In practice, this involved adopting deliberative participatory methods for sustainable energy appraisal. These took the form of public workshops and personal interviews, involving an array of expert stakeholders from across different fields and locals from the island of Tilos who were invited to elicit their views on and evaluate a number of scenarios concerning the future of energy supply in other non-interconnected islands across the Aegean Archipelago.

In particular, this report also presents findings from the first 'upstream' participatory appraisal of future energy visions for non-interconnected islands in the region to deliberately 'open up' consideration of proposals for the replication of the TILOS-Horizon 2020 energy model alongside a range of other options for transitioning to a sustainable energy system. We adopt an "analytic-deliberative" (A-D) approach to research that reconciles "technocratic" and "citizen-centric" approaches (Stern and Fineberg 1996). The analytic comprises *'ways of building understanding by systematically applying specific theories and methods that have been developed within communities of expertise' (*ibid. 97). Whilst discursive argument demands the exercise of logic and reasoning, here analytic refers mainly to scientific and technological data/methods of risk assessment in decision processes. Deliberation is defined as a communicative process: *'people confer, ponder, exchange views, consider evidence, reflect on matters of mutual interest, negotiate and attempt to persuade each other […]; deliberation implies an iterative process that moves towards closure'* (ibid. 73). A key driver for selecting this approach is the identified failure of technical-expert and bureaucratic-rationalist modes of appraising proposed islandic energy innovation to engage effectively with the knowledge, values and interests of stakeholders and wider society (see Introduction for an overview).

Specifically, we employ and test – in a novel geographical and cultural context – an innovative analytic–deliberative participatory appraisal method called Deliberative Mapping (DM) (Burgess et al. 2007), which has been successfully developed and applied to analogous emerging technologies such as xenotransplantation (Davies et al. 2003) and energy-related technologies (Bellamy, Chilvers and Vaughan 2016; Bellamy et al. 2013; Burgess et al. 2004). This methodology brings together the strengths of the expert–analytic approach Multi-Criteria Mapping (MCM) (Stirling and Mayer 2001) with those of the participatory–deliberative Stakeholder Decision Analysis (SDA) (Burgess et al. 1988). Compared to the aforementioned questionnaire surveys and techno-centric evaluations of the TILOS-Horizon 2020 energy model, the DM methodology has allowed us to open-up the issue for the first time to a diversity of options; involve citizens, experts and stakeholders together in a symmetrical, interactive and transparent process; and engage all participants in undertaking directly comparable multi-criteria appraisals that visually map out difference and similarity of responses.

Taking place during the summer and autumn of 2018, the DM process comprised two parallel strands of engagement: one for citizens and the other for experts and stakeholders (specialists). Following online and in-person recruitment, the citizens' strand began with a two-day citizens' panel workshop where they: a) discussed with energy experts the prospects and implications of sustainable energy transitions for non-interconnected islands, and b) collectively evaluated a series of possible future energy supply scenarios, drawing on their recent experience of the TILOS-Horizon 2020 project. Following a series of scoping telephone interviews, 10 senior experts and stakeholders were recruited who held an appreciation of the international context of islandic energy transitions, an in-depth knowledge of the energy systems of non-interconnected Greek islands, as well as a diversity of perspectives in relation to their (1) working sector (academia, civil society, industry or government), (2) disciplinary specialisms (natural or social science perspectives relating to general or specific options) and (3) their personal attitudes to sustainable energy transitions. The specialists' strand began with 1- to 3-hour face-to-face interviews.

Both strands followed a four-step multi-criteria option appraisal process in which participants:

i. Selected and defined possible future energy scenarios appraise,
ii. Characterised a set of criteria against which they would appraise those options,
iii. Scored the performance of the options against those criteria, and
iv. Assigned weightings to the criteria to indicate their relative importance.

The DM process was framed as an *'exploratory, participatory exercise in responding to the energy supply problems of non-interconnected Greek islands'* that aimed to:

i. Move beyond the narrower frames of previous appraisals of specific technologies and broaden the context to include a range of options for sustainable energy transitions, and
ii. Explore the potential applicability of the technique when considering the transferability of the TILOS energy model to specific island contexts.

An important first step in this process was the consideration of possible future energy supply scenarios for the region that responded to the multiple challenges of the extant energy systems. A comprehensive review of peer-reviewed and grey literature on the energy future of the islands of the Aegean Archipelago and other islands at an international level produced an extensive range of options for responding to these challenges, including the TILOS-Horizon energy model itself. These were subsequently screened for diversity in terms of strategy, likely governance, policy instruments and novelty/maturity. As a result of this analysis, a set of six options to be appraised by all participants were defined (see Table 4 overleaf for a succinct overview).

While the respondents were inevitably self-selecting, a range of selection criteria were employed to ensure a diversity of perspectives among those selected for full participation. Making the most of survey findings from the 'temporal studies' leg of this research, we selected participants who help ensure broad sociodemographic representation for the island of Tilos. This involved accounting for their demographic characteristics – namely age, sex, education level and disposable income – as well as for their recorded perception of green energy sources and smart grid solutions. Respondents with environmental or technical expertise were excluded from citizen recruitment, owing to such expertise gaining representation through the stakeholders in the specialist strand of the process.

Table 4: Core options for the sustainable energy transition of non-interconnected Greek islands

	SCENARIO	DESCRIPTION
1	Optimised local grids	A vision of a future that includes: a) the upgrade of conventional power stations in non-interconnected islands, and b) the introduction of advanced grid and supply management systems to enable somewhat greater exploitation of readily available renewable sources.
2	Continental interconnections	A vision of a future defined by the extensive integration of non-interconnected systems into the continental transmission system to achieve continuous energy supply at an allegedly low environmental cost.
3	(TILOS model) Autonomous smart islands	A vision of a future where non-interconnected or internally interconnected islands solely generate energy from local green sources that is either supplied directly to consumers through local smart grids, or captured in storage batteries and released to the grid when necessary.
4	Synergistic energy production	A vision of a future where synergies among electricity production/ management and other local activities are planned, supported and developed through coordination of the various actors active in non-interconnected islands (e.g. renewable energy used to cover consumer needs for both electricity and mobility and/or desalination).
5	Democratic energy supply	A vision of a future where civil society actors have more of a say over what happens with the energy system. Upstream public participation in decision-making and the establishment of local energy cooperatives are prioritized to deliver appropriate solution, reduce opposition to renewables and, thus, deliver a democratic energy system.
6	Off-grid local communities	Making the most of tax deduction schemes for residential off-grid renewable energy systems, this constitutes a vision of a future where local communities live completely off-grid.

4. Results and discussion

Having detailed the methodological approach adopted in this research, the section moves on to outline the key findings of our research activities. Specifically, sub-section 4.1 presents findings from the Deliberative Mapping strand of the research. In so doing, it highlights: a) how expert stakeholders and locals from Tilos alike are in favour of an energy future whereby the TILOS-Horizon 2020 energy model is replicated in other non-interconnected islands, and b) the critical importance of moving beyond expert evaluations and accounting for public attitudes when designing the energy future of the region. Sub-sections 4.2-4.5 then move on to present the key findings of our two questionnaire surveys: a) uncovering widespread public support for the Autonomous Smart Island future energy supply vision and the technologies involved in enacting it, and b) detailing how a transition to such an energy model is, nonetheless, likely to face backlash by a non-negligible proportion of islanders opposing renewable energy technologies and prosumption practices.

4.1. Deliberative Mapping of future energy visions for non-interconnected islands

Both specialist stakeholders and locals from the island of Tilos involved in the Deliberative Mapping strand of this research developed a rich diversity of 32 different appraisal criteria, which have been coded into eight main meta-criteria groups against which the six core future energy supply scenarios were discussed and evaluated. These meta-criteria groups spanned both technical and social issues and included considerations around: economic efficacy, technical efficiency, technical availability, environmental impact/performance, energy supply security, public acceptability, local social impacts/benefits, and the likelihood of securing support from policy-makers and/or business actors.

To begin with, in evaluating the six core future energy supply scenarios for the Aegean against this set of self-defined evaluation criteria, the expert stakeholders involved in the Deliberative Mapping process collectively demonstrated high levels of uncertainty with respect to how the six future energy supply scenarios might pan out – as demonstrated by the consistent extensive range of arbitrary scores allocated to most energy scenarios considered. This reflects their nuanced and in-depth understanding of the energy sector: their core understanding that *'there are no perfect energy supply systems' (Expert stakeholder 11).* For '*either of these scenarios might be environmentally, socially and/or economically sustainable as long as certain preconditions are met' (Expert stakeholder 9).*

Nonetheless, the experts involved in the process were still able to produce an overall performance evaluation for the six core scenarios developed by the research team (see Fig.4 below).

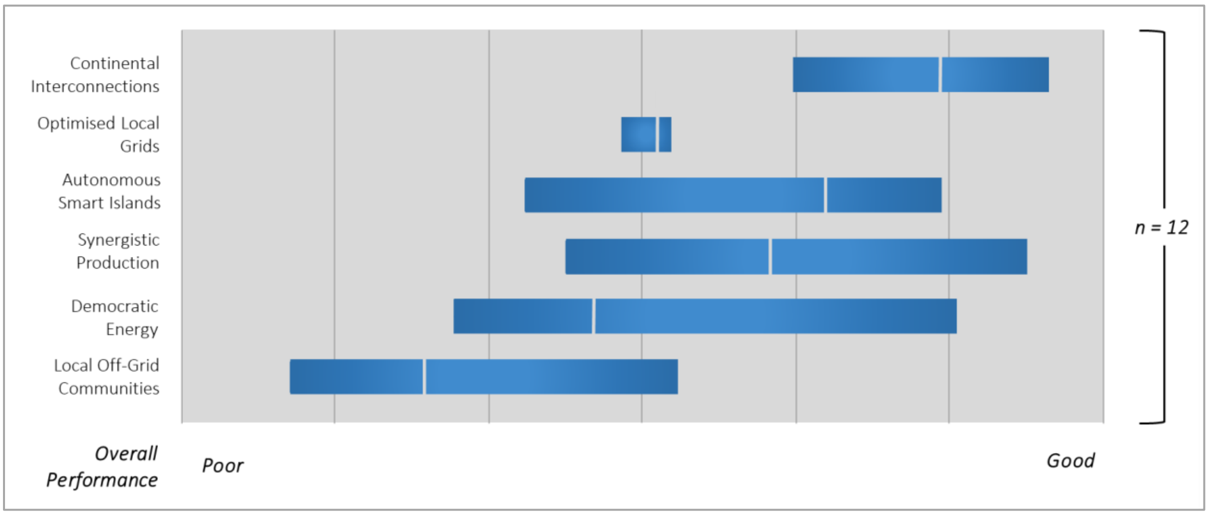

Figure 4: Stakeholders' aggregate final rankings of core future energy supply scenarios.

* *Frequency of participants appraising (n) is indicated to the right of the graphic. Performances increase on an arbitrary subjective scale to the right (subjective evaluation score range: 20 – 50). Bar length represents the range between the most optimistic mean score of the corresponding participants and the most pessimistic mean score of the corresponding participants. The grey bar dissecting the ranges is the grand mean for the corresponding participants.*

Specifically:

i. The scenario of extensive continental interconnections was repeatedly ranked as the best performing option, largely owing to the technical feasibility of the system and pre-existing policy commitments to interconnections.
ii. When taking into account the grand mean of arbitrary scores for the corresponding participants, the 'Autonomous Smart Islands' scenario manifests itself as the second best option for future energy supply in the islands of the Aegean. While all research informants celebrated schemes such as those currently under development in Tilos there was, nonetheless, a common concern that such systems are not as economically efficient as yet – owing to prohibitive initial installation costs that cannot be met without external funding at present.

iii. ‘Synergistic Production’ was ranked as the third best option when taking into account the individual evaluation scores provided. This largely comes down to the fact that this energy system might have a greater potential to achieve environmental sustainability on the one hand (in that in does not only involve producing green energy for electricity), but it requires significant capital and infrastructural investments and a more radical rethinking of the energy supply system.

iv. Taking into account the mean evaluation score, the optimisation of existing fossil fuel plants manifests itself as the fourth best option for the region. In a nutshell, it was argued that this system might be more economically and technically feasible when compared against alternative proposals, but it performed especially poorly when evaluated against the environmental criterion – owing to the limited scope for additional carbon emission reductions and low levels of RES penetration in the energy mix.

v. The ‘Democratic Energy’ model was, almost exclusively, discussed as *‘an especially interesting scenario that guarantees that public views, values and needs are fully taken into consideration when planning and managing future energy transitions’ (Expert Stakeholder 3)*. Nonetheless, the scenario performed particularly poorly, ranking fifth. As the expert stakeholders asserted, this largely comes down to the great uncertainties and risks involved in fully engaging the public in the energy supply system. This holds, according to the research informants, particularly true when considering the likely high levels of public opposition to local RES installations, in spite of generally favourable attitudes towards such systems at the conceptual level (the much-cited ‘NIMBY’ – Not in My Back Yard Response).

vi. Finally, the expert stakeholders we spoke to were particularly unconvinced by the off-grid energy model – consistently giving it the lowest arbitrary scores. Amongst others, they believed that: a) the scale of this system made it exceptionally inefficient in economic and technical terms, b) that the public would not be willing to accept a more active role as energy “prosumers”, and c) that, given the present economic climate and policy commitments, individuals seeking to develop off-grid communities would not receive much external support.

Nevertheless, in evaluating the six core future energy supply scenarios for non-interconnected islands against this set of self-defined evaluation criteria, the members of the public involved in the workshops favoured a partially different vision for the energy future of non-interconnected Greek islands – consistently demonstrating and qualifying their preference for the ‘Autonomous Smart Island’ scenario that was initially informed by the TILOS energy model itself (see Fig.5 overleaf). Owing to positive experiences of this system during the installation of the infrastructure and its trial operation, and the multiple anticipated benefits of the system following its full launch, the participants regarded this energy scenario as *‘a win-win situation of achieving greater energy security whilst protecting the environment’ (Participant 5).*

Notably, however, this preference towards the replication of the TILOS energy model on other non-interconnected Greek islands was *‘contingent upon respecting the local communities affected and their needs in decision-making and implementation’ (Participant 10).* Indeed, in line with research asserting that project-specific factors affect public acceptability of green energy solutions (e.g. Haggett 2011; Wustenhagen et al. 2007; Devine-Wright 2013; Firestone et al. 2014; Gross 2007; Wolsink 2007), many of the discussions held during the Deliberative Mapping workshops revolved around *‘the positive experience of the [TILOS-Horizon 2020] project that ought to be replicated – if and when – the [TILOS] energy model is transported* *elsewhere' (Participant 3).* This involved, inter alias: a) respecting local needs and attitudes prior to developing specific projects, b) enduring interaction of local authorities with project developers to ensure that social needs are being met, c) dissemination of information to the affected communities, d) development of infrastructures that minimally affect local communities (both during construction and during operation in the long-term), and d) availability and willingness of project developers to respond to questions and/or concerns.

Simultaneously, the locals involved in the process also expressed an overwhelmingly positive attitude towards the 'Synergistic Production' and 'Democratic Energy Supply scenarios, which ranked second and third respectively in the citizens' evaluation, arguing that they represented the ultimate expressions of local sustainable development and community empowerment respectively. Nonetheless, and in spite of a generally positive attitude towards these future energy supply scenarios, the workshop participants were less convinced of the actual possibility of developing such radically different energy systems in the near future. For instance, whilst the 'Synergistic Production' model was seen *as 'a panacea to the many problems faced by islanders' (Participant 2)*, there were significant concerns with respect to the economic efficacy of a system that would require large amounts of start-up capital and extensive infrastructural changes. Similarly, whilst the 'Democratic Energy' model was anticipated to better cater to the needs of local populations on the one hand, it was unanimously argued that it could render decision-making and management of the respective systems ineffective. Moreover, the large range of scores recorded on the arbitrary subjective scale of Fig.5 for the 'Democratic' model indicates the high levels of uncertainty with respect to whether members of the public would likely agree on an environmentally sustainable energy mix for their respective localities.

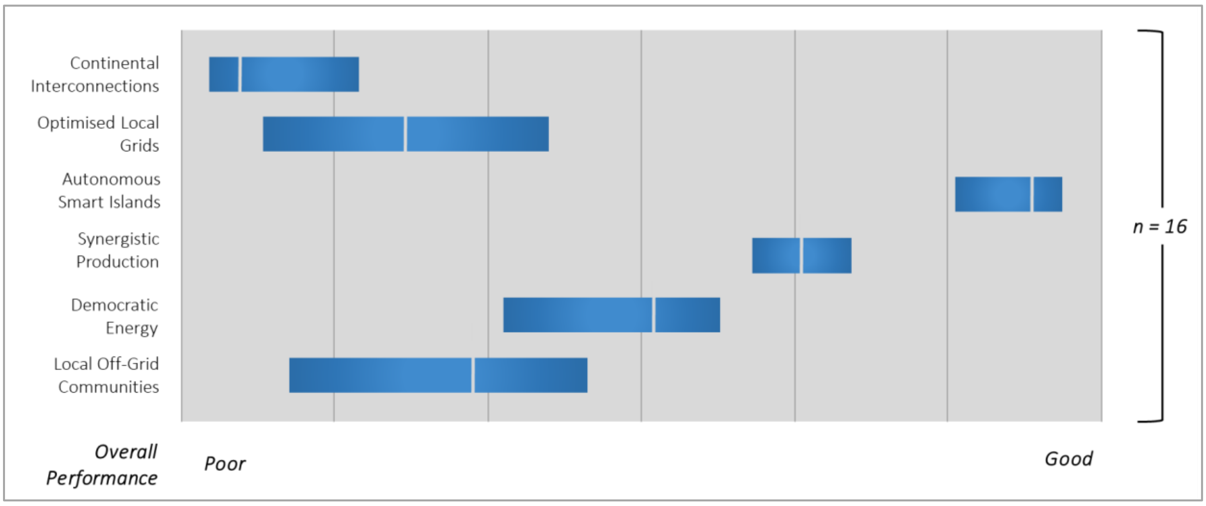

Figure 5: Citizens' aggregate final rankings of core future energy scenarios.

**Frequency of participants appraising (n) is indicated to the right of the graphic. Performances increase on an arbitrary subjective scale to the right (subjective evaluation score range: 20 – 50). Bar length represents the range between the most optimistic mean score of the corresponding participants and the most pessimistic mean score of the corresponding participants. The grey bar dissecting the ranges is the grand mean for the corresponding participants.*

Conversely, and in partial contrast to the views of expert stakeholders, lay participants were generally unconvinced by the future energy scenarios involving either extensive continental interconnections, the optimisation of existing fossil fuel-based local power stations, or the establishment of multiple localised off-grid communities. Not only were there higher levels of uncertainty with respect to the anticipated performance of such systems (as demonstrated by the extensive range of scores recorded on the arbitrary evaluation scale), but members of the public involved in the workshop also expressed serious concerns with respect to: a) the environmental performance, b) the energy supply security, and c) the possible disturbances to everyday life of such energy systems. For such scenarios *'simply constitute a marginal improvement to the current situation' (Participant 7)*: *'there are no guarantees that islanders won't experience any blackouts when seabed cables are [...] inevitably damaged' (Participant 1)*, and *'improving existing power plants just missed the trick of producing electricity without harming the environment' (Participant 3).*

Interestingly, whilst the scores allocated to these three energy scenarios where considerably lower when compared against those allocated to alternative scenarios (e.g. the 'Autonomous Smart Island' scenario), there was general consensus amongst the participants that these scenarios did not perform as poorly as they would have wished for. Specifically, there was a core argument that none of these energy scenarios challenged vested policy and business interests – either because they involved the improvement/ expansion of existing infrastructures, or because they would operate at a scale that would not pose a significant threat to the energy supply status-quo of Greece.

The implications of this account are twofold. First, it is clear that expert stakeholders and citizens alike are largely in support of the research consortium's vision to transfer the innovative energy model of Tilos to other non-interconnected islands. For both stakeholders and locals from Tilos were largely in agreement that the 'Autonomous Smart Islands' scenario constituted one of the best possible visions of future energy supply in isolated territories. Second – and most importantly – alongside uncovering, quantifying and qualifying generally favourable public and expert attitudes towards solutions involving renewable and smart energy technologies, the discussions we had during the public workshop highlighted how the Deliberative Mapping approach to decision-making began to open-up the diverse framings, knowledges and pathways bearing upon these complex issues of future energy supply. As a direct consequence of this study, a fundamentally different view of the hoped-for energy future of non-interconnected Greek islands has emerged, with the option for establishing autonomous smart islands performing higher than alternative scenarios favoured by experts – most notably the scenario involving extensive continental interconnections. This is exactly why the islanders involved in the process felt that *'such innovative public participation methodologies should form an integral part of decision-making in the future' (Participant 4)*; how *'such public consultations might be challenging and time-consuming, but they are also the only way of understanding local communities and, thus, of guaranteeing that public values and preferences are taken into full consideration when designing for the future' (Participant 13)*.

In a nutshell, this account suggests that there is considerable scope for the transferability of both the TILOS-Horizon 2020 energy model and of the Deliberative Mapping methodology itself to other non-interconnected Greek islands. However, in spite of uncovering public acceptability of the proposals put forth by the TILOS consortium, this narrative continues to fall significantly short of accounting for public attitudes from across the Aegean Archipelago. As such, the remainder of this results section (see sub-sections 4.2-4.5) focuses on providing a detailed overview of public acceptability of the green energy technologies/infrastructures of the TILOS energy model through the in-depth description of the findings of our two questionnaire surveys. It is highlighted that the two sections have been and remain in an open dialogue, informing and being informed by each other both during the research design and during the implementation and post-research phases.

4.2. Public attitudes in favour and against a sustainable energy transition for the islands of the Aegean Archipelago (Results of first questionnaire survey)

Against a backdrop of widespread expert and lay public support for a future energy supply system dominated by ‘Autonomous Smart Islands’, the results obtained through our first attitudinal study suggest that locals from across the Aegean Archipelago are also largely supportive of a transition to a sustainable energy system involving many of the technologies of the TILOS-Horizon 2020 energy model. It is indicative that when asked to choose between energy supply from fossil fuel based stations or from hybrid RES and storage systems, preference for RES is overwhelming – especially in islands such as Rhodes where there are plans for the expansion of existing power stations (Kaldellis and Zafirakis 2007). Specifically, a statistically significant majority of islanders (73.7%) prefer covering the everyday needs for electricity by using energy produced through RES technologies. Conversely, only a minority of respondents (11.8%) cite their preference for electricity supply through fossil fuel power stations (see Fig.6a). In certain cases, such as the island of Rhodes, support of a RES-based energy mix is almost universal, with 81% siding in favour of a RES-based system, and only 8.2% siding in favour of maintaining the energy supply status quo (see Fig.6b). This reaffirms past claims that communities neighbouring conventional power stations overwhelmingly welcome green infrastructures as they see the arrival of such technologies as symbols of development and progress (e.g. Delicado et al. 2016; Firestone et al. 2015; Krauss 2010).

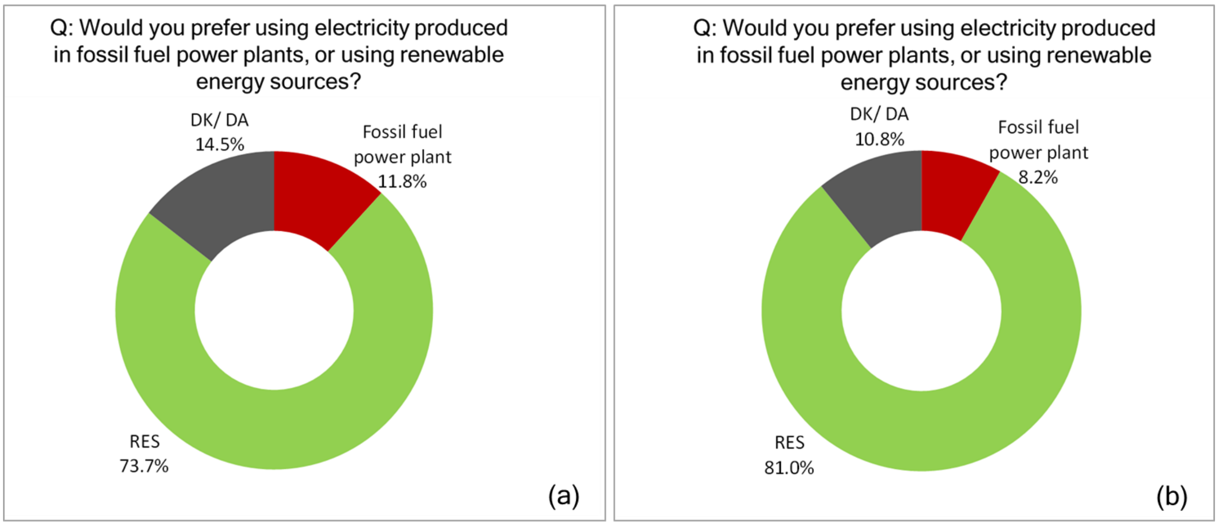

Figure 6: Stated preference for electricity produced using either fossil fuels or renewable sources for (a) all islands included in the study, and (b) for the island of Rhodes

Moreover, and as demonstrated through Fig.7, the statistically significant majority of islanders participating in our questionnaire survey are also in favour of the TILOS-Horizon 2020 energy model that combines RES technologies and battery storage. When asked to state whether they agree with the development of such systems on their islands, 61.9% responded ‘yes’, with a further 21.1% of survey participants stating that they mostly agree with the possible replication of the TILOS energy model on their island. Conversely, only 2.0% of respondents would thoroughly oppose such infrastructural changes (see Fig.7).

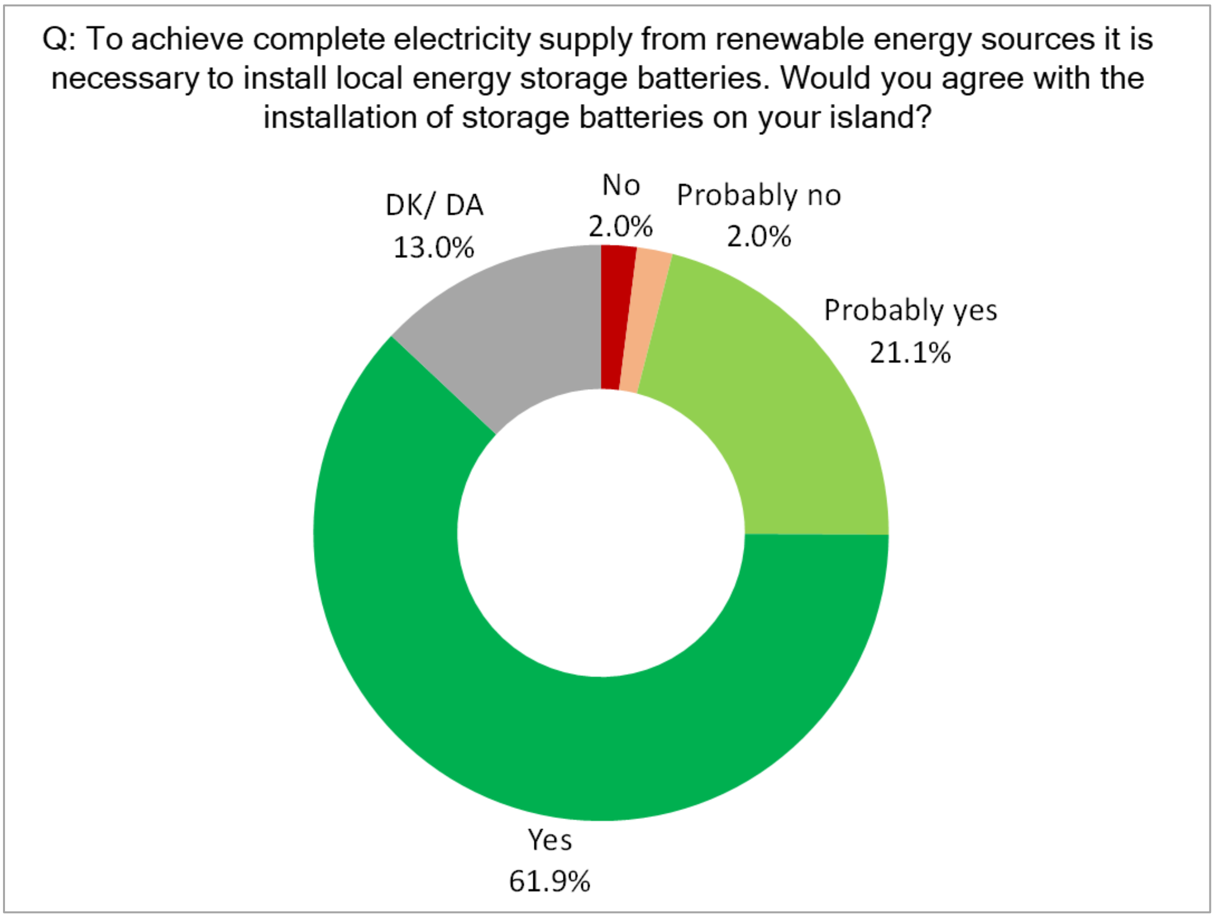

Figure 7: Public acceptability of a RES-based energy system with battery storage capabilities

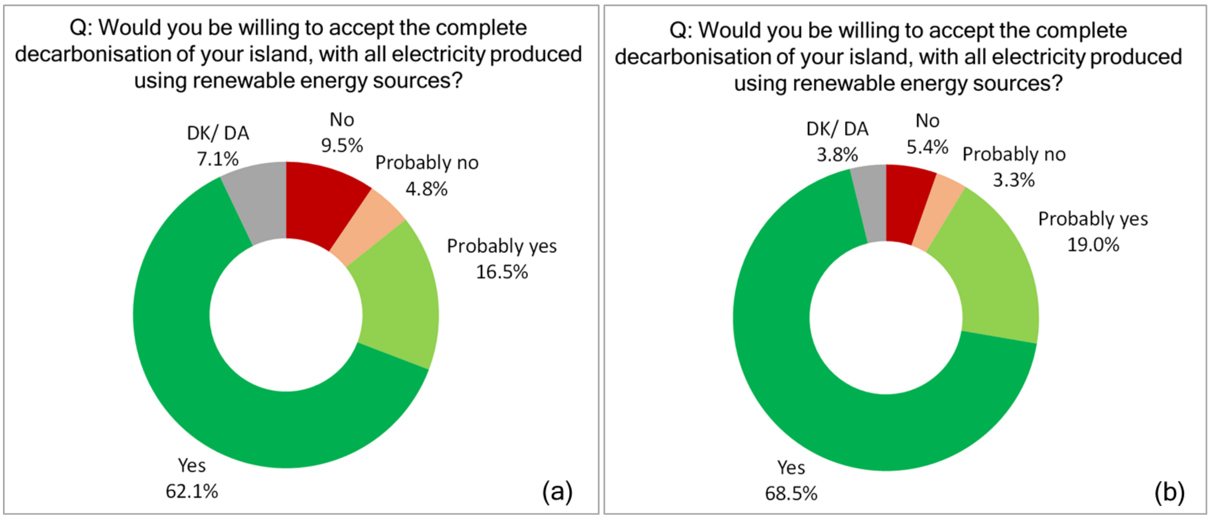

Figure 8: Stated preference for complete electricity supply decarbonisation for (a) all islands included in the study, and (b) for the island of Rhodes

Promisingly, our research also documents how the general public of the Aegean Archipelago gives its provisional support to the complete decarbonisation of electricity production in the region. Most research informants (78.6%) are strongly or probably in favour of a complete energy transition to renewables, against a mere 9.5% of respondents who oppose such a radical change in energy supply and production (see Fig.8a). The example of Rhodes is indicative, with only 5.4% of survey respondents opposing this transition and, thus, providing their de facto support to the maintenance and expansion of existing fossil fuel power plants (see Fig.8b).

Moreover, in line with past academic research (e.g. Kaldellis 2005; Tsoutsos et al. 2009; Zografakis et al. 2010; Pertrakopoulou 2017) and primary findings from Deliverable 8.7, the survey debunks the myth that islanders are particularly worried by the prospect of RES infrastructures in their near proximity (cf. Dimitropoulos and Kontoleon 2009) – and, subsequently, the much cited 'NIMBY' myth as a whole (refer to Section 2.1 for an overview). Specifically, and as detailed in Fig.9, when asked to provide their views on the possibility of developing RES installations (such as PV parks and wind turbines) in their region, a statistically significant majority of respondents (62.1%) responded positively – with a further 14.6% of survey participants indicating that this was a somewhat positive prospect. Conversely, only 11.8% of respondents felt that this prospect was either negative or somewhat negative.

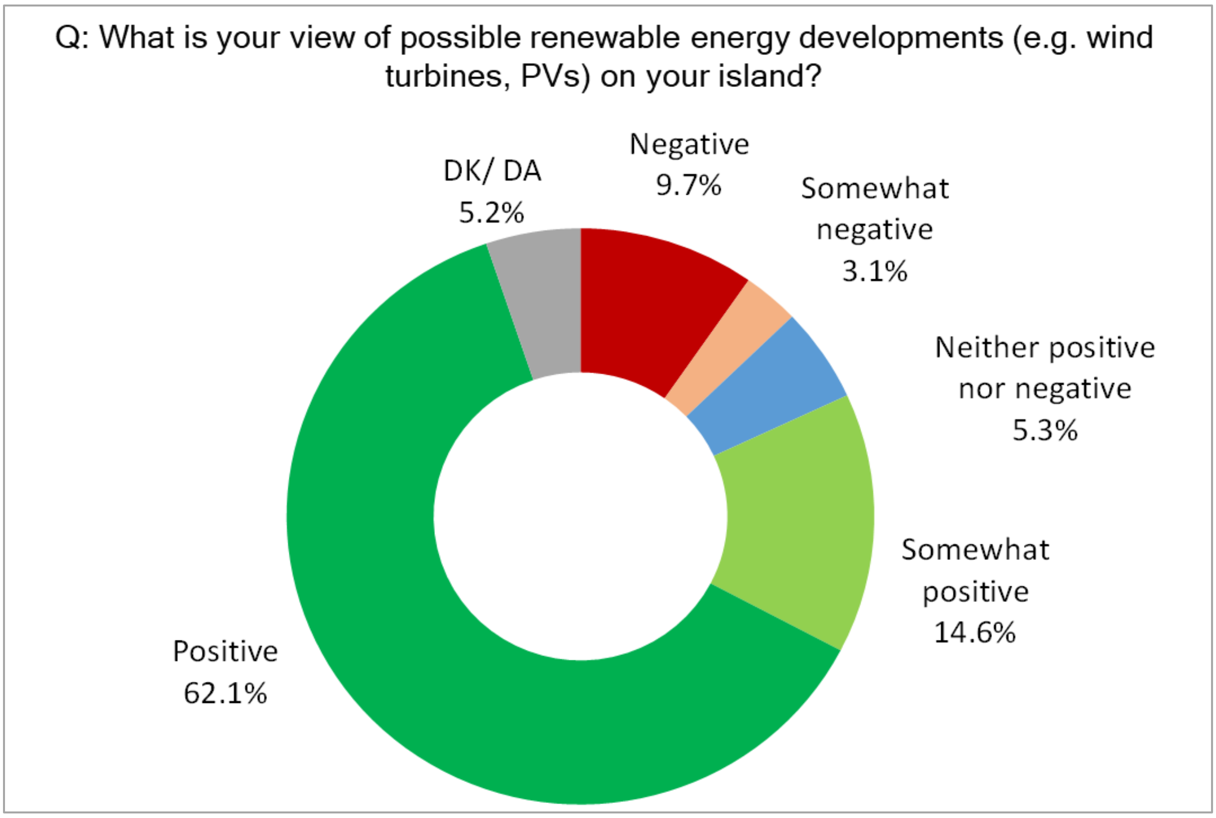

Figure 9: Public acceptability of local RES installations

Our assertion that Greek islanders support, at least in principle, RES developments in their near proximity is further validated through closer consideration of survey findings from specific island clusters. Whilst past research around public acceptability of RES installations documents considerable opposition in areas of touristic importance (cf. Dimitropoulos and Kontoleon 2009), our findings suggest that the public would support a sustainable energy transition even in emblematic tourist destinations. Specifically, based on the findings of the public survey, there appears to be evidence of an apparent inverse NIMBY – or YIMBY (Yes in my backyard) – effect (e.g. Fokaides et al. 2014; Wolsink 2000), as local residents are more supportive of local renewable infrastructures than expected under a NIMBY scenario. Indicatively, Fig.10a and Fig.10b below exemplify how islanders from Santorini and Rhodes – two of the top five tourist destinations in Greece (SETE Institute 2017) – are more supportive of local RES installations than the survey sample as a whole (refer to Fig.9). Up to 69.9% of islanders from Santorini and 71.4% of respondents from Rhodes are strongly supportive of such developments. Moreover, we recorded the lowest levels of public opposition to renewables in these two localities, with 4.3% and 5.4% of respondents from Santorini and Rhodes respectively sharing their negative attitudes towards possible local RES installations.

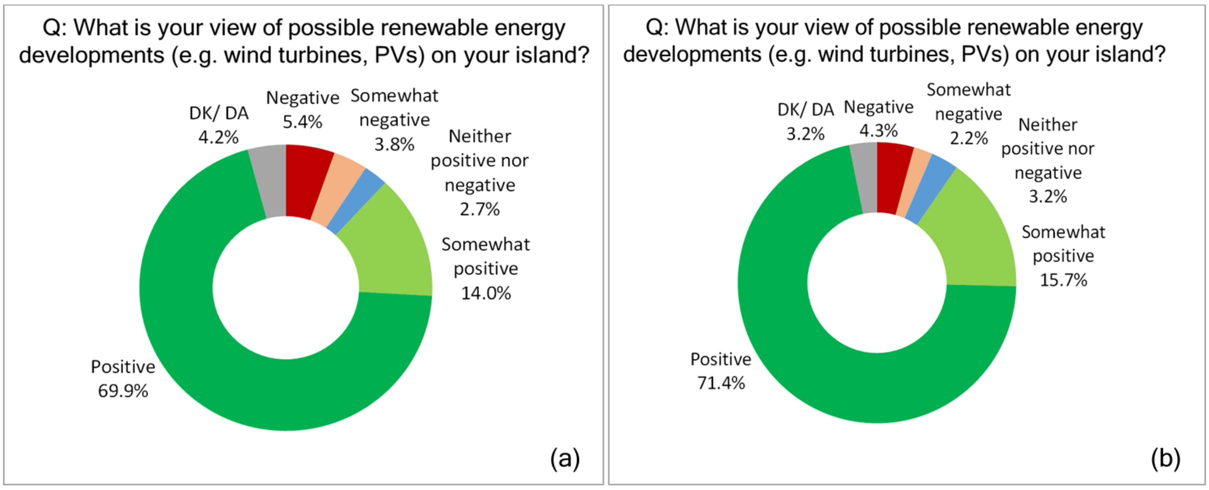

Figure 10: Public acceptability of local RES installations in the islands of (a) Santorini, and (b) Rhodes

These high levels of public acceptability for regional sustainable energy developments are far from surprising. In line with well documented assertions that public acceptance is contingent upon anticipated positive local impacts of particular developments (e.g. Bailey et al. 2005; Simas et al. 2012; Stokes et al. 2014; Waldo 2012), our questionnaire survey also recorded widespread anticipation that such local infrastructures – and especially RES installations – would benefit local societies. Indicatively, there is general agreement that RES installations cause significantly less disturbance to local communities when compared against existing fossil fuel power stations in operation in the region. For instance, only 9.6% of respondents believe that disturbance from wind turbines is significant, whilst up to 54.8% of respondents state that disturbance from fossil fuel based stations is either significant or somewhat significant (see Fig.11). Moreover, as Fig.11 outlines, all renewable-based solutions consistently perform better when compared against either fossil fuels plants or plans for continental interconnections via seabed cables, with PV solutions manifesting themselves as the most favoured forms of energy supply (a statistically significant 65.6% of respondents believe that disturbance from PV installations is negligible).

In keeping with these overall trends, Rhodes – an island where fossil fuel power plants have recently been upgraded (Kaldellis and Zafirakis 2007) – manifests itself as an indicative case-study. For most local respondents believe that disturbance caused by such plants is significantly more important than disturbance caused by RES infrastructures. For instance, the majority of locals (65.6%) believe that disturbance caused by fossil fuel plants is (very) significant. Conversely, a statistically significant majority (66.3%) of respondents believe that local disturbance caused by PV installations is insignificant.

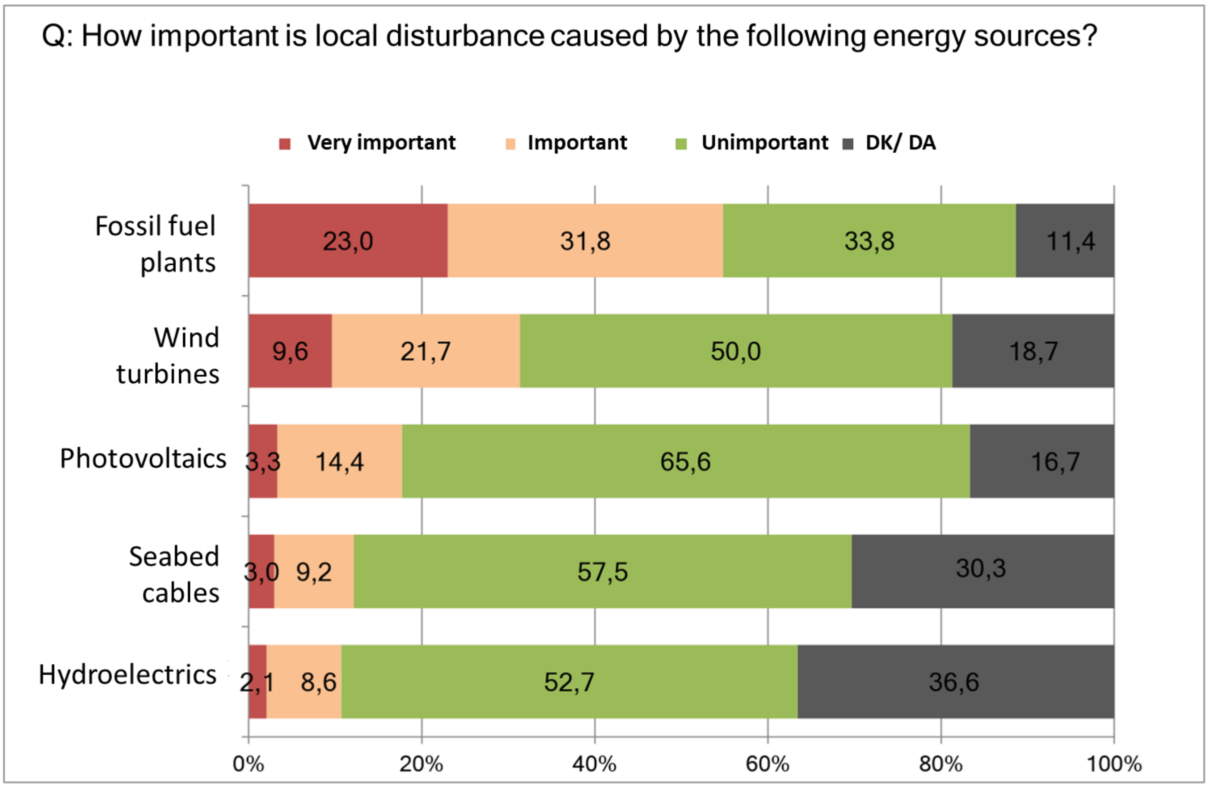

Figure 11: Subjective evaluation of local disturbance caused by a selection of energy sources

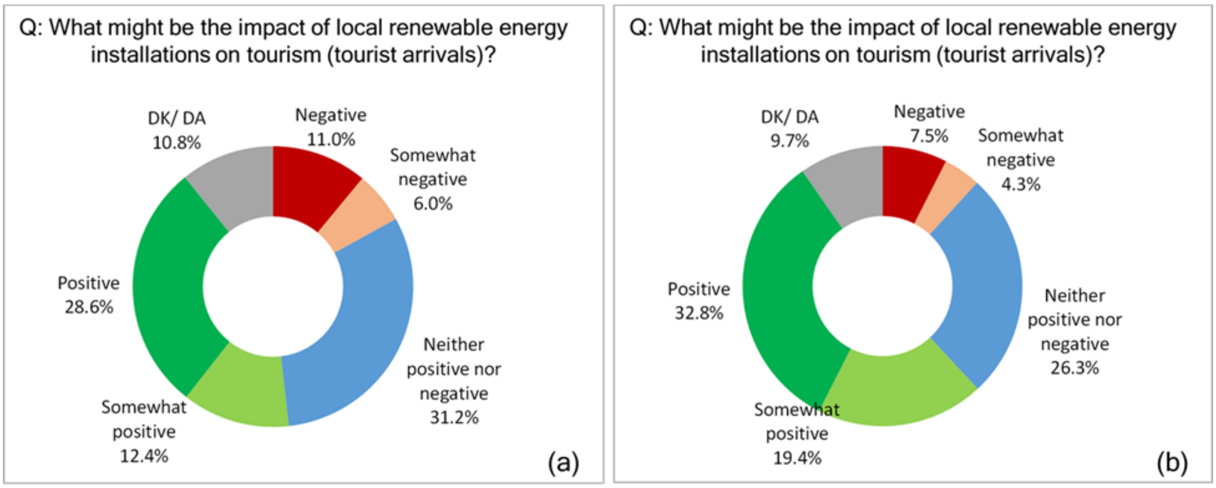

Figure 12: Anticipated impacts of RES infrastructure on tourism for (a) all islands included in the study, and (b) for the island of Santorini.

In line with past academic work documenting how RES infrastructures might act as touristic attractions (e.g. Frantal and Kunc 2011; Lilley et al. 2010), the majority (41%) of survey respondents even believe that the installation of RES infrastructures (e.g. wind turbines) will definitely or likely have a positive impact on their local touristic activities (see Fig.12a). Furthermore, whilst 11% of respondents believe that tourism will be negatively affected by such developments, up to 31.2% of respondents feel that tourism will not be undermined by such infrastructures. This holds true even in emblematic tourist destinations, such as Santorini, where up to a statistically significant 42% of survey respondents believe that RES installations will benefit the tourist industry, compared to a mere 19.4% who are concerned about potential negative effects on tourism (see Fig.12b).

Simultaneously, though, the questionnaire survey findings empirically validate the need to distinguish between ‘acceptability’ as a broad, evaluative attitude towards green energy technologies and consumer ‘acceptance’, as an actual and/or anticipated behavioural response towards specific technological interventions (Huijts et al. 2012). With our first questionnaire survey also uncovering widespread public opposition to smart or green energy solutions that form an integral part of the TILOS energy model and affect the end user directly, our findings remind us of the timely need to discuss social acceptance in all its forms: attitudes, behaviours and – importantly – actual or possible investments (following ibid.).

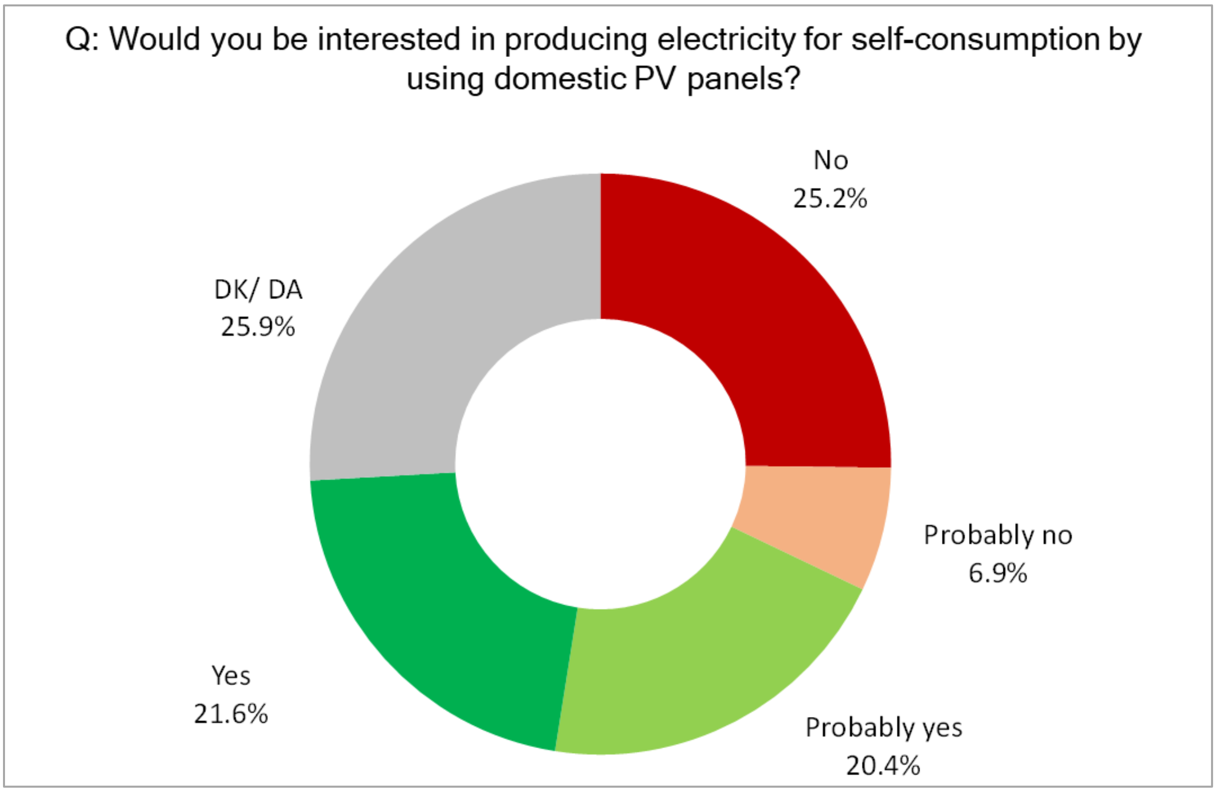

Figure 13: Public acceptability of prosumption

Specifically, with novel technological interventions such as those put forth by the TILOS-Horizon 2020 consortium demanding far more than passive consent for implementation, the fact that many respondents are not willing to accept plans that affect them directly (e.g. external demand-side management in the interest of avoiding frequent power outages, participation in a local community energy cooperative, co-provision of renewable energy) raises concerns. For instance, whilst Fig.13 documents a statistically significant majority (42%) of respondents from across the 15 islands studied who would probably or definitely be interested in producing their own electricity through domestic PV panels, it also suggests that the generally positive attitudes towards renewables does not translate into behavioural intention to invest in micro-RES units. Up to 32.1% or survey respondents indicating that they would not or probably not be willing to produce their own energy from domestic PV panels.

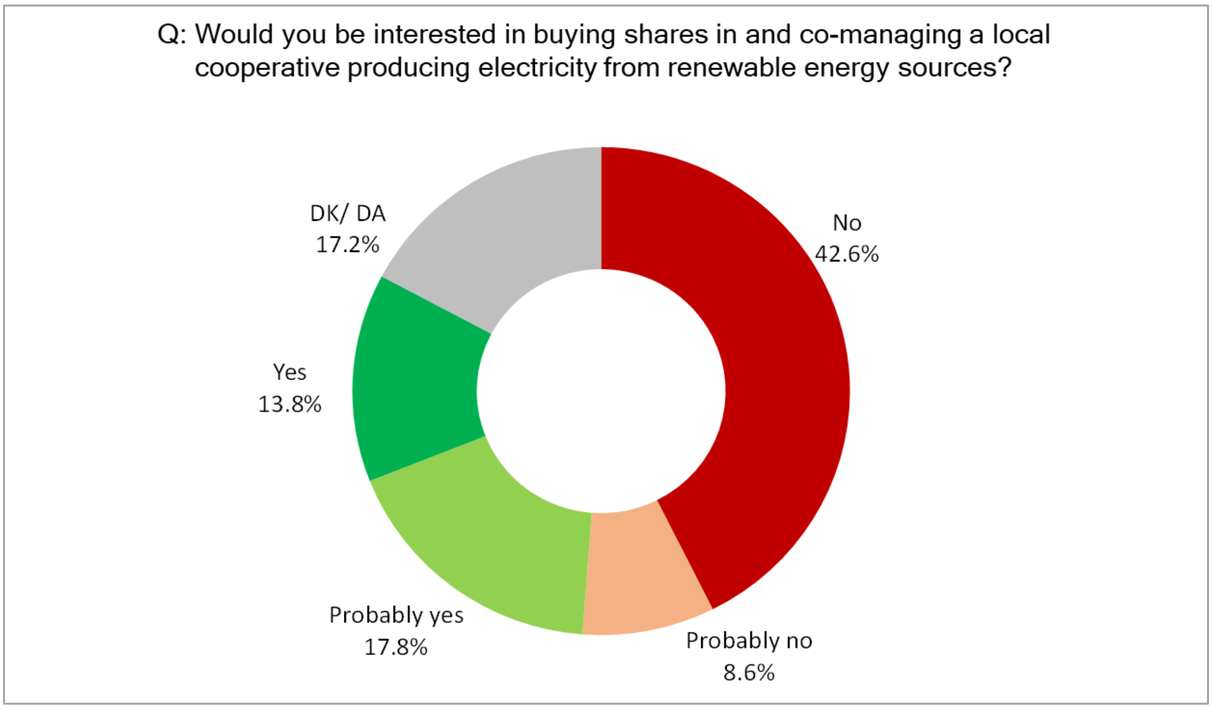

Figure 14: Public willingness to participate in a local energy cooperative

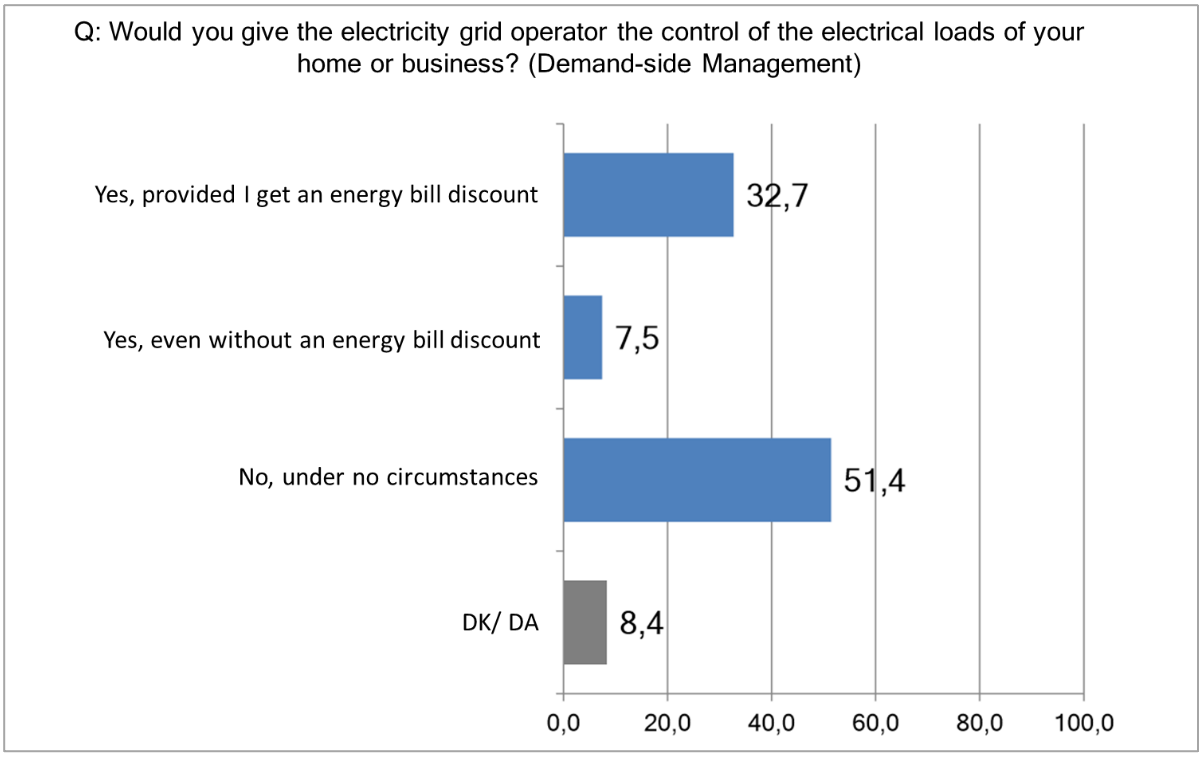

Figure 15: Public willingness to accept Demand-side management

Moreover, whilst state-of-the-art research on energy publics demonstrates how active, early-stage community engagement and empowerment increases acceptance of sustainable energy technologies, especially in the context of local energy cooperatives (e.g. Aitken, Haggett and Rudolph 2016; Rowe and Frewer 2005), our survey findings suggest there is limited scope for such participatory practices. Up to 52.6% of survey informants from across the Aegean Archipelago would not or probably not be willing to buy shares and co-manage a local energy cooperative producing energy from RES (Fig.14).

Similarly, and as suggested by Fig.15 a statistically significant majority of 51.4% of respondents would under no circumstances accept external DSM, believing that it would act out to the detriment of their energy use experience. Conversely, a minority (7.5%) of respondents would accept imposed DSM provided that they benefited from an energy bill discount.

Finally, the challenging nature of securing a sustainable energy transition for the Aegean Archipelago is further reflected in an apparent information-deficit (e.g. Parks and Theobald 2013; Jones and Eiser 2009; Kaldellis 2005; Krohn and Damborg 1999; Strachan and Lal 2004). In particular, many islanders are currently unable to provide their informed support to such developments – because of multiple knowledge gaps, uncertainties and, thus, a persistent lack of formed opinions with respect to specific interventions.

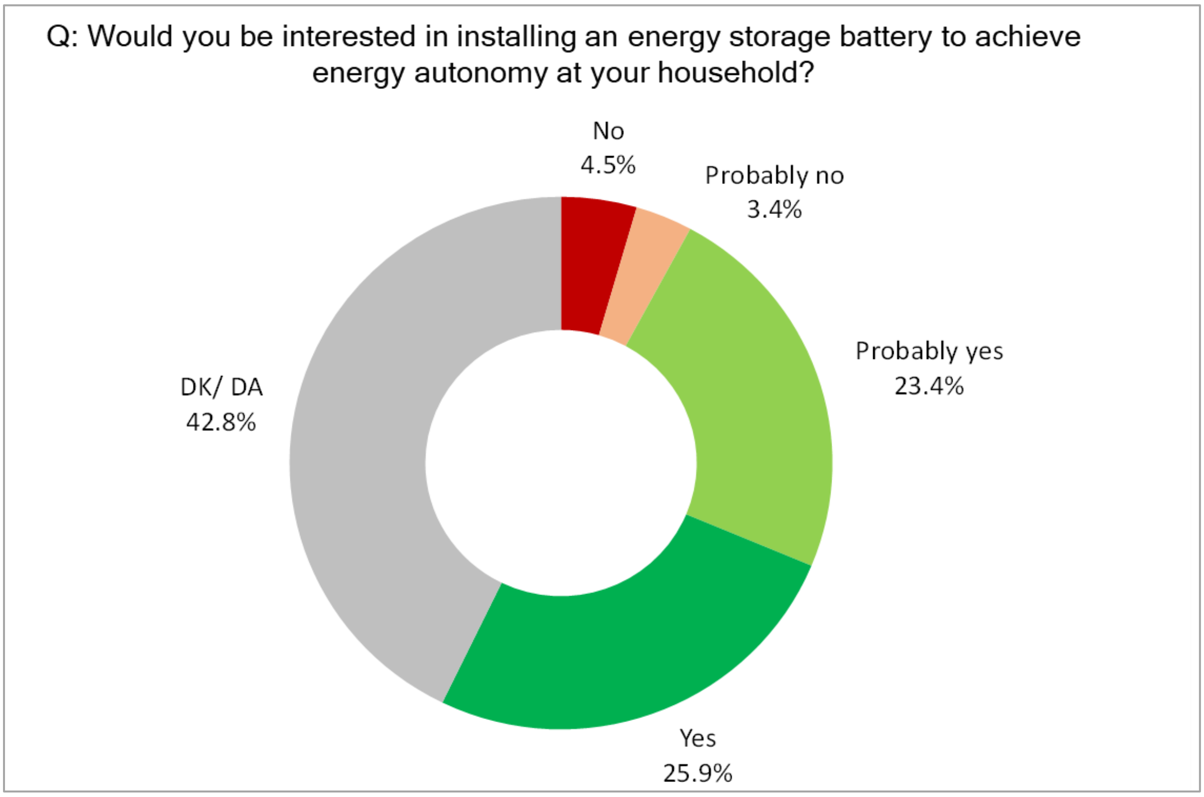

Figure 16: Public willingness to install domestic energy storage batteries

For example, up to 25.9% of respondents remain uncertain on whether they would be interested in installing domestic PV panels – arguing, inter alias, that there is no certainty they will receive any financial support to cover initial installation costs (see Fig.13). Moreover, a statistically significant majority of the sample (42.8%) remain uncertain on whether they would be interested in installing domestic energy storage batteries to achieve personal energy autonomy – citing, amongst others, a lack of understanding of the technology and their uncertainty with respect to the economic and other costs of this investment (Fig.16).

Most indicatively, an overwhelming majority (83.3%) of survey respondents do not know, as yet, what a smart energy meter is (Fig.17). With current scholarship on sustainable energy systems placing great emphasis on the role of smart energy feedback as a powerful tool permitting end-users to efficiently manage and reduce their overall energy demand (cf. Wilson et al. 2015), this finding suggests that islanders might be able to be part of a green grid on the one hand, but are far from ready to become smart energy users in a smart island grid on the other.

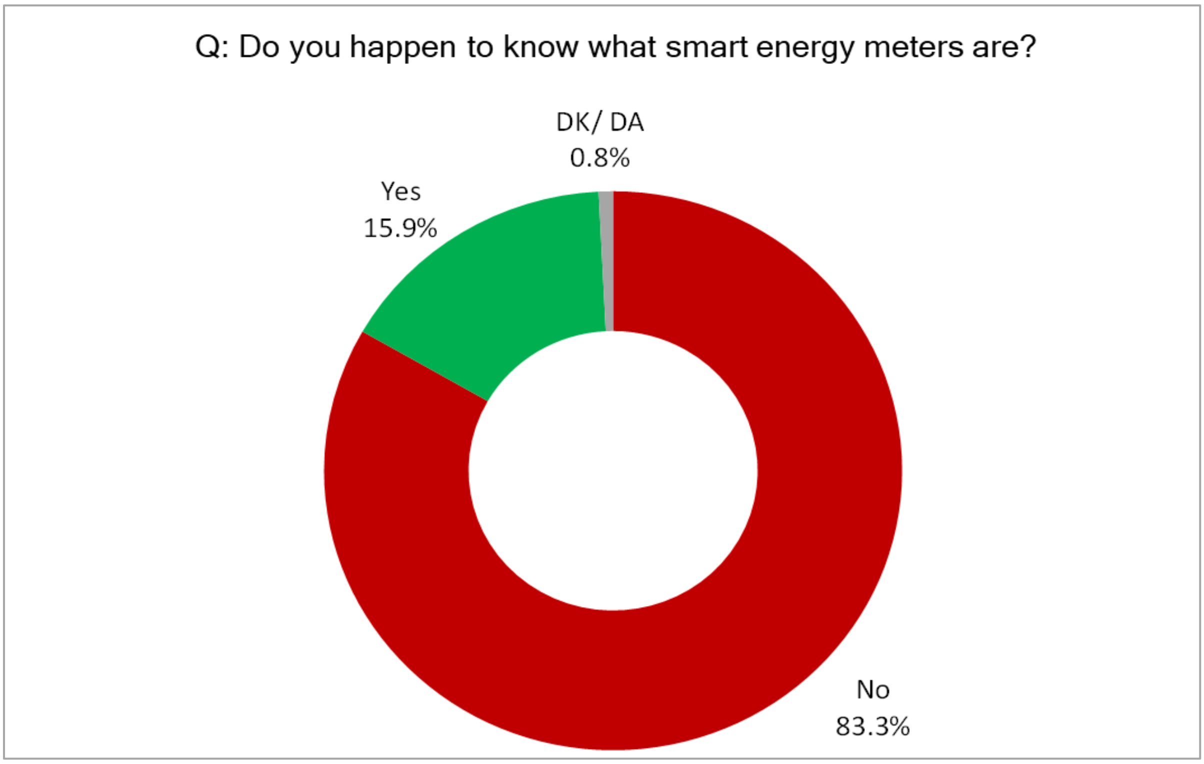

Figure 17: Public awareness of smart meters

4.3. Variability in the recorded attitudes of different respondent classes

Whilst Section 4.2 above detailed the overall attitudinal trends recorded as part of our studies, this section moves on to detail how support or opposition to green or smart energy technologies differs significantly between different analytical classes; how prospective host communities should not be treated as homogeneous units. For closer analysis of the survey outputs reveals how the recorded energy-related beliefs and attitudes of the islanders studied differ repeatedly across demographic classes. Whilst general trends were comparable across all the demographic categories considered, the cross-tabulation and subsequent descriptive analysis of the available data using Pearson's chi-squared test helped uncover multiple statistically significant differences between our key demographic classes.

In particular, we recorded statistically significant differences between our eight island clusters. We can, thus, indicatively assert that:

i. Whilst islanders from across the Aegean Archipelago have an overwhelmingly positive attitude towards possible local RES developments, some island clusters appear to host more supportive energy users than others (x^2: 102.873; df: 38; sf .000) – thus rendering energy system transitions sensitive to specific attitudinal contexts. For instance, a vast majority of 71.4% of individuals from Rhodes (Rodos) are positive towards such installations, and only 4.3% of respondents have a generally negative attitude towards such developments. Conversely, up to 21.4% of respondents from Ikaria have a generally negative attitude, with only 46.4% of individuals having an overwhelmingly positive attitude of possible local RES infrastructures.
ii. Islanders from sampling clusters 1, 4 and 5 are, generally, more supportive of a complete energy system transition to a RES-based model than islanders from sampling clusters 2, 3, 6, 7 and 8. For instance, whilst the vast majority (75.6%) of respondents from sampling cluster 1 are fully in support of such a transition, only half (52.25) of islanders from Skyros (sampling cluster 7) are wholeheartedly in favour of such an energy supply future (x^2 value: 83.079; df: 28; sf: .000).
iii. Islanders from across the eight sampling clusters are not equally reassured that wind turbine installations cause minimal disturbance. Indicatively, a statistically significant minority of islanders from Milos (4.8%) and up to 24.3% of islanders from Ikaria believe that local disturbance caused by wind turbines is very significant (x^2: 99.345 – df.: 21; sf: .000).

Moreover, we recorded small yet statistically significant differences in the responses provided by men and women in multiple occasions. As the nine indicative examples cited below suggest, women are, more likely to challenge a hoped-for energy transition than men. In particular, men appear to be more supportive of a sustainable energy transition than women from across all the islands considered for the purposes of this study – either in terms of their acceptability of RES infrastructures or in terms of the willingness to become active supporters of an energy transition. Indicatively:

i. Men are more supportive of local RES developments than women (x^2: 29.456; df: 5; sf: .000). Specifically, 13.4% more men than women have a positive attitude towards such possible future developments.
ii. Men are, generally, more supportive of a complete transition to a RES-based energy system than women. For instance, whilst 69.9% of men are completely in favour of such a transition, a significantly smaller majority of women (56.4%) are thoroughly supportive of this future energy supply scenario (x^2 value: 31.576; df: 4; sf: .000).
iii. Men are, generally, more supportive of a RES-based system with storage capabilities than women – e.g. 74.3% of men and 52.7% of women are in favour of such an energy system (x^2 value: 53.837; df: 4; sf: .000).
iv. Men are more supportive of local wind turbine installations than women. For example, whilst 55.6% of men believe that disturbance from wind turbines is insignificant, only 45.9% of women remained thoroughly unconcerned by possible disturbance (x^2 value: 14.288; df: 3; sf: .003).
v. Men are more reassured than women that local PV installations will not cause any disturbance (x^2 value: 38.207; df: 3; sf: .000). Indicatively, 13.2% more men than women believe that local disturbance caused by PV installations is insignificant.
vi. Whilst islanders are generally reluctant to partake in a local energy cooperative, men

are more willing than women to become involved in such schemes (x2: 18.076; df: 4; sf: .001). For instance, whilst only 10.4% of women would be wholeheartedly willing to partake in an energy cooperative, up to 18.5% of men appear willing to invest time and money in a locally-owned energy system.

vii. More men than women believe that the tourist industry will benefit from local RES installations (x2: 19.451; df: 5; sf: .002). Indicatively, whilst 31.7% of men believe that RES technologies will benefit tourism, only 26.3% of women share a similar belief.

viii. More men than women are concerned by the disturbance caused by existing oil-burning local power plants (x2: 9.983; df: 3; sf: .019). For instance, 15.2% more men than women believe that disturbance to the local community caused by fossil fuel plants is very significant.

ix. Many more men than women are interested in installing domestic energy storage batteries (x2: 10.661; df: 4; sf: .031). For example, 10.2% more men than women have indicated their possible interest in such innovative technologies.

Furthermore, there is considerable evidence to suggest that, as a rule of thumb, younger individuals are slightly more supportive of a sustainable energy transition for the region than older islanders. Particularly, and in line with past academic research at an international level documenting the demographic determinants of public acceptability for energy innovations, we assert that:

i. Individuals between 18-54 years old are, generally speaking, more supportive of a complete transition to a RES-based energy system than against individuals who are 55 years old or older. For example, up to 66.9% of individuals aged between 18-54 years old and 57.2% of islanders who are 55 years old and older are supportive of such a transition (x^2 value: 43.171; df: 24; sf: .010).

ii. Younger people (between 18-54 years old) are, across all islands studied, less concerned that PV installations will cause any local disturbance when compared against older individuals (55 years old or above). For instance, 13.3% more individuals aged between 18-54 years old believe that disturbance caused by PV installations is insignificant when compared against the 55+ years old demographic group.

iii. Older individuals (55 years old or older) tend to be more reluctant with respect to becoming active energy prosumers when compared against younger individuals (x2: 93.188; df: 24; sf: .000). Indicatively, the statistically significant majority of research informants who are 55 years old or older are against prosumption practices (34.3%). Conversely, only 16.8% of the 18-54 years old demographic is against such practices.

Bearing, however, in mind that the trends recorded above are statistically significant yet small, we argue that a better way of eliciting differences in the questionnaire sample is through consideration of the responses provided by individual participants across all survey questions. In particularly, in order to best describe islanders' attitudes towards green and smart technology infrastructures, we applied a two-step clustering technique to reveal natural groupings (or respondent clusters) within the dataset that would not be apparent otherwise (see Table 5).

As outlined in Table 5, most survey respondents (Silhouette measure of cohesion and separation: Good; 92% of cases) can be associated with three distinct natural groupings of islanders (see Table 5):

i. Potential green energy consumers (53.2% of survey respondents),

ii. Potential green energy prosumers (21.6% of survey respondents), and

iii. Potential opposers (25.2% of survey respondents).

Table 5: Two-step cluster analysis of findings (Silhouette measure of cohesion/ separation: Good; 92% of cases)

	Cluster	**Potential green consumers *(53.2%)***	**Potential green prosumers *(21.6%)***	**Potential opposers *(25.2%)***
Predictor Inputs (In order of importance)	Willingness to partake in an energy cooperative	Importance= 1.00 Most frequent category: DK/ DA (100%)	Importance= 1.00 Most frequent category: Yes (100%)	Importance= 1.00 Most frequent category: No (100%)
	Disturbance caused by fossil fuel plants	Importance= 0.80 Most frequent category: Significant (59.8%)	Importance= 0.80 Most frequent category: Very significant (100%)	Importance= 0.80 Most frequent category: Insignificant (100%)
	Acceptance of RES installations with storage	Importance= 0.80 Most frequent category: Yes (100%)	Importance= 0.80 Most frequent category: Probably yes (100%)	Importance= 0.80 Most frequent category: DK/ DA (51.5%)
	Willingness to install domestic PVs	Importance= 0.60 Most frequent category: DK/ DA (48.7%)	Importance= 0.60 Most frequent category: Yes (100%)	Importance= 0.60 Most frequent category: No (100%)
	Willingness to install domestic storage batteries	Importance= 0.50 Most frequent category: Probably yes (48.7%)	Importance= 0.50 Most frequent category: Yes (100%)	Importance= 0.50 Most frequent category: DK/ DA (100%)
	Acceptance of RES installations/ storage in place of oil-based plants	Importance= 0.45 Most frequent category: Yes (100%)	Importance= 0.45 Most frequent category: Yes (94.5%)	Importance= 0.45 Most frequent category: Fossil fuels (46.8%)
	Disturbance caused by PVs	Importance= 0.30 Most frequent category: Insignificant (90%)	Importance= 0.30 Most frequent category: Insignificant (82.4%)	Importance= 0.30 Most frequent category: Significant (57.1%)
	View of potential local RES installations	Importance= 0.25 Most frequent category: Positive (80%)	Importance= 0.25 Most frequent category: Positive (90.5%)	Importance= 0.25 Most frequent category: Negative (39.5%)
	Acceptance of complete RES transition	Importance= 0.20 Most frequent category: Yes (80%)	Importance= 0.20 Most frequent category: Yes (90%)	Importance= 0.20 Most frequent category: No (38%)
	Perceived impact of RES installations on tourism	Importance= 0.04 Most frequent category: Neither positive nor negative (58.6%)	Importance= 0.04 Most frequent category: Positive (100%)	Importance= 0.04 Most frequent category: Negative (100%)
	Perceived disturbance caused by wind turbines	Importance= 0.03 Most frequent category: Insignificant (53.4%)	Importance= 0.03 Most frequent category: Insignificant (100%)	Importance= 0.03 Most frequent category: Very significant (38.1%)
	Interest in learning about smart meters	Importance= 0.02 Most frequent category: Probably yes (53.4%)	Importance= 0.02 Most frequent category: Yes (100%)	Importance= 0.02 Most frequent category: No (59.1%)

Specifically, Potential Green Consumers constitutes a class of individuals who are willing to accept most renewable technologies but are reluctant to adopt or reject altogether prosumption practices. Conversely, Potential Green Prosumers accept both large-scale RES technologies and are especially interested in actively supporting a green energy transition – either by partaking in a local energy cooperative, by their interest to invest in micro-generation and battery storage equipment, and by their interest to learn more about the use of smart energy meters. Whilst both these respondent clusters would, one way or another, support a green energy transition, a third cluster of respondents – what we indicatively label as the Opposers – is expected to pose a significant social barrier to hoped-for energy futures for the region. For they are unconcerned by the use of fossil fuels for electricity generation and, thus, reject all green or smart energy infrastructures.

From information available at the time of data collection, it appears that willingness to partake in an energy cooperative, perceived disturbance caused by fossil fuel plants, level of acceptance of RES installations with storage capabilities, willingness to install domestic PVs and/or domestic storage batteries, and acceptance of RES installations with storage in place of fossil fuel plants, are the five primary predictors of cluster participation. Indicatively, the more concerned an individual is by the burning of fossil fuels for electricity generation, the more likely (s)he is to support active energy user engagement in a potential green energy transition. Notably, and in sharp contrast to past research in this field (cf. Devine-Wright 2013a for an overview), there is no ground for suggesting that key socio-demographic attributes – namely age and gender – influence acceptability of green energy technologies in context-specific manners.

4.4. Public attitudes in favour and against a sustainable energy transition for the islands of the Aegean Archipelago (Results of second questionnaire survey)

Against the partially favourable social context for the enactment of a sustainable green energy transition of non-interconnected Greek islands documented in Sections 4.1, 4.2 and 4.3, results obtained through our second questionnaire survey across an altogether different sample of Greek islands appear – at first glance – to paint a less optimistic picture with respect to the hoped-for green energy transition for the region.

Indicatively, Fig.18 and Fig.19 suggest that islanders from across small and very small islands of the Aegean Archipelago are both satisfied with the energy supply status quo, and overwhelmingly unaware of otherwise widely discussed green energy innovations such as the TILOS-Horizon 2020 energy model. Specifically, up to 52.9% of islanders believe that electricity supply on their islands is adequate, with blackouts and voltage fluctuations not believed to cause much inconvenience (see Fig.18). Furthermore, the statistically significant majority of respondents (61.3%) are not at all aware of the TILOS energy model. These assertions appear to challenge Kaldellis' (2005; see also Tsoutsos et al. 2009; Zografakis et al. 2010) hypothesis that islanders are acutely conscious of the setbacks of their energy supply status-quo and, consequently, more aware of innovative green energy solutions.

Nonetheless, and against Kaldellis' (2005) attempted relational association between levels of experienced energy insecurity and levels of acceptance for green energy solutions, the corpus of our survey findings suggests that small and very small Greek islands might constitute the best candidates when considering the transfer of the TILOS-Horizon 2020 energy model – at least from a social acceptability perspective. In particular, the overwhelming majority of respondents (72.1%) believe that the prospect of renewable energy installations on their respective islands constitutes a positive development, with only 6.7% of respondents being thoroughly concerned by the prospect (see Fig.20). Notably, support for RES infrastructures at the island level is significantly greater for (very) small islands than for larger islands (refer to Section 4.2, Fig.9) included in our first questionnaire survey (x^2: 25.846; df.: 5; sf.: .000).

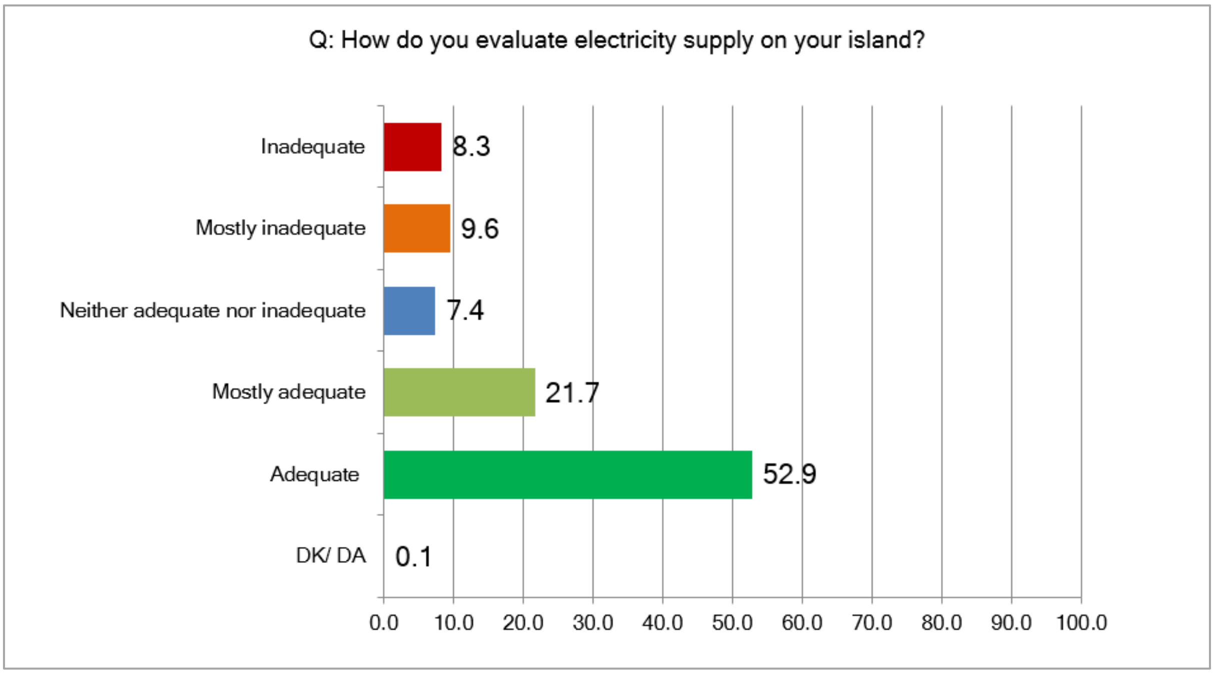

Figure 18: Subjective evaluation of current energy supply

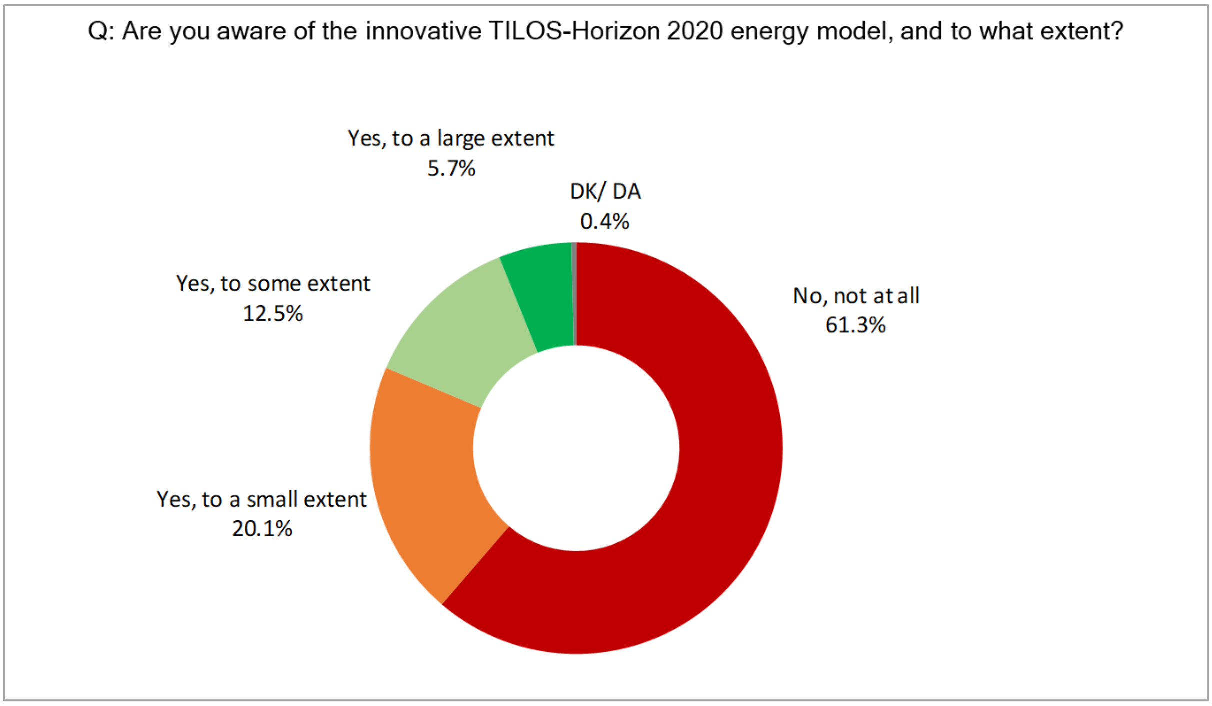

Figure 19: Public awareness of the TILOS-Horizon energy model

Moreover, and in line with recent international research criticizing NIMBY theory (see Burningham 2000; Devine-Wright 2009; Wolsink 2006), we also recorded extensive support for renewable energy infrastructures even when these are developed in the near vicinity of islanders (see Fig.21).

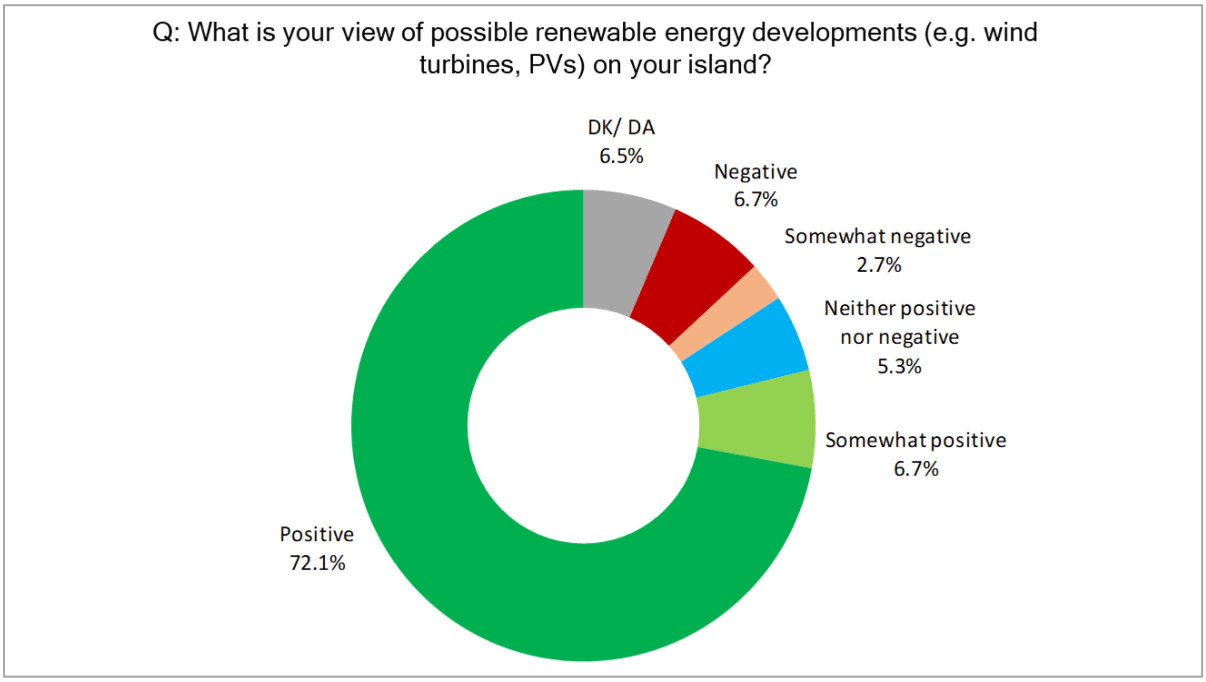

Figure 20: Public acceptability of local RES installations (at the island level)

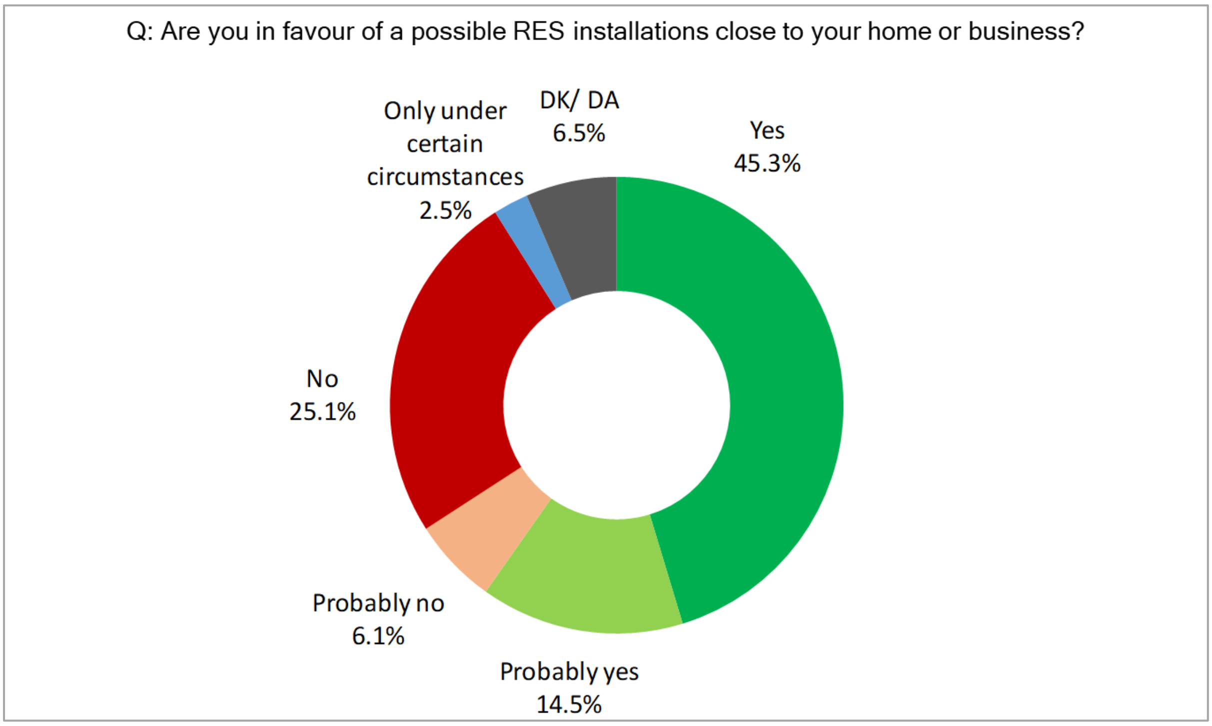

Figure 21: Public acceptability of RES installations in near vicinity

In contrast to the first questionnaire survey that only invited respondents to comment on the prospect of developing such infrastructures on their island, we intentionally phrased our questions to suggest that such infrastructures might be developed in the near vicinity of places of residence of work. Nonetheless, the statistically significant majority (45.3%) of our survey respondents would still accept such infrastructures, even when they are not out of sight. A further 14.5% and 2.5% of respondents would probably or provisionally accept such developments respectively. Conversely, only 25.1% of research informants would fit the typical NIMBY profile (e.g. Fast 2013; Petrova 2013) by unequivocally opposing such installations in fear of negative personal impacts.

The fact that most islanders would accept local RES infrastructures is further validated through their recorded preferences with respect to the energy futures of their islands (see Fig.22). Fig.22 clearly demonstrates how the majority of survey respondents are in favour of an energy model that moves significantly beyond the burning of fossil fuels. Indicatively, the majority of islanders (52.7%) are either against or probably against the expansion and upgrade of conventional power plants in their region, with only 22.7% of locals being thoroughly in favour of the optimisation of the existing energy system. Nonetheless, and whilst a statistically significant percentage (57.4%) of respondents would support extensive continental interconnections, we argue that most islanders prefer relying on smart and renewable energy technologies to cover their energy needs – most of whom state their preference for an energy system that replicates the innovative TILOS-Horizon 2020 energy model. In particular, an overwhelming majority (72.8%) of survey respondents wholeheartedly support transitioning to energy future in line with the TILOS-Horizon 2020 energy model that involves the development of autonomous smart islands supplied through renewable resources. The islanders we spoke to are even in favour of a sustainable transition across multiple domains, such as the development of energy systems that supply renewable energy to cover consumer needs for both electricity and transport. Specifically, as shown in Fig.22, up to a statistically significant majority (66.7%) of respondents are in favour of this future energy supply scenario.

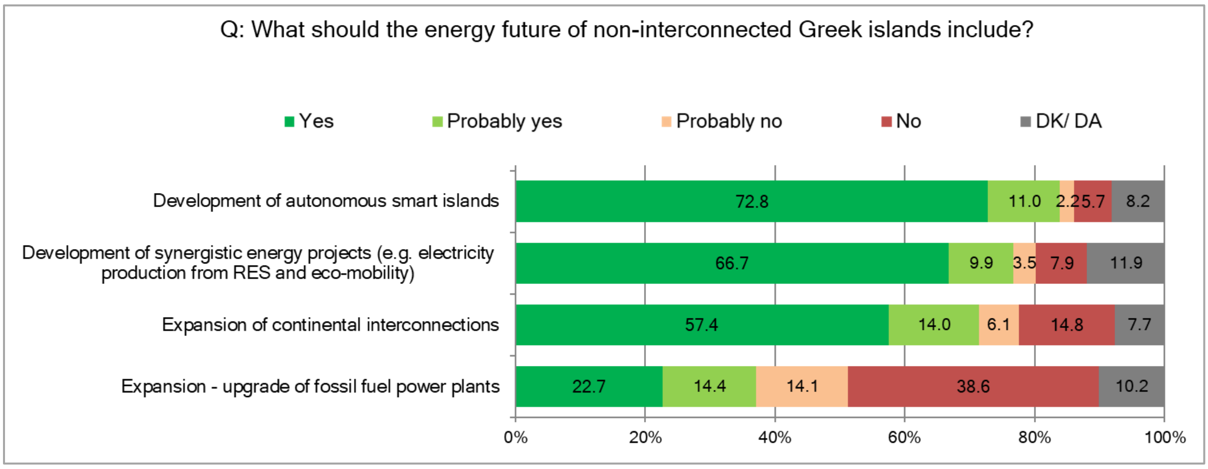

Figure 22: Public attitudes with respect to future electricity supply in non-interconnected Greek islands

These high levels of acceptability of sustainable energy solutions can be attributed to the general feeling that such developments would benefit local islandic communities across multiple domains (see Fig.23). Expanding on work completed as part of the first questionnaire survey (see Sections 4.2 and 4.3) that only focused on the anticipated benefits to the tourist industry and lower levels of local disturbance by RES installations when compared against conventional power plants, the second survey provides ample evidence that islanders also anticipate significant benefits for: a) their energy supply security (anticipation of fewer power cuts and/or voltage fluctuations), b) the local economy as a whole (through the creation of new jobs), and c) the natural environment/ atmosphere. Indicatively:

i. A statistically significant majority of respondents (51.9%) believe that RES installations will have significant environmental benefits;
ii. Up to 54% of respondents believe that the tourist industry would certainly, or probably, benefit from such developments – with only 12.9% of islanders believing that touristic activities might be undermined;
iii. Most (54.5%) of islanders included in the study believe that the local economy would definitely benefit, with a further 19% of respondents believing that it might benefit by such infrastructural developments;
iv. Finally, and albeit considerable uncertainty and generally high levels of satisfaction with the energy supply status quo, the statistically significant majority (39.6%) of respondents believe that RES installations will significantly improve their energy security (see Fig.23).

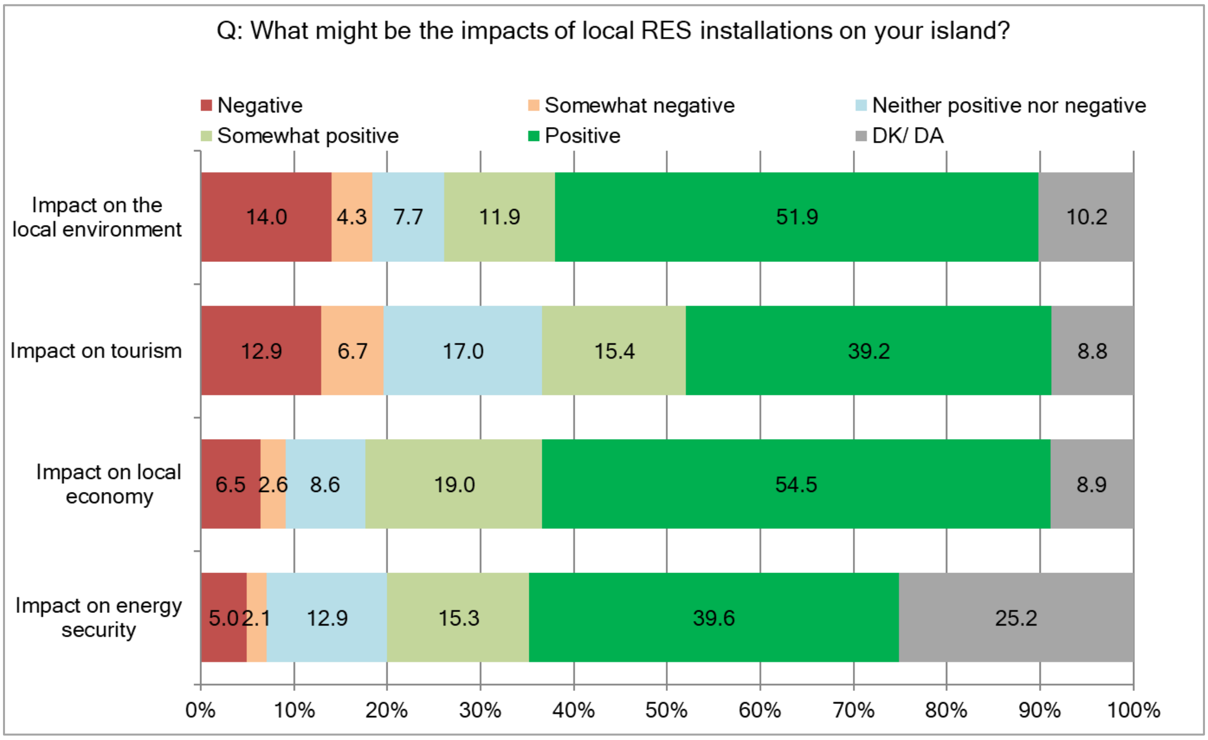

Figure 23: Anticipated local impacts from RES installations

Adding to these, our second questionnaire survey also recorded high levels of acceptability for energy models and technologies that affect the end user directly – including, but not limited to, smart meters and demand-side management. Given the focus of the TILOS-Horizon 2020 research consortium on distributed and/or smart green energy technologies, as well as the growing importance of "active" approval of green energy solutions in the form of an active involvement of energy users in sustainability transitions at an international level (e.g. Wolsink 2012), there is considerable scope for optimism.

In particular, and in line with the general trends recorded in the first questionnaire survey, a statistically significant majority (48%) of research informants would definitely accept installation of a smart meter at their household and/or business, with only 14.4% of respondents opposing such technologies altogether (see Fig.24).

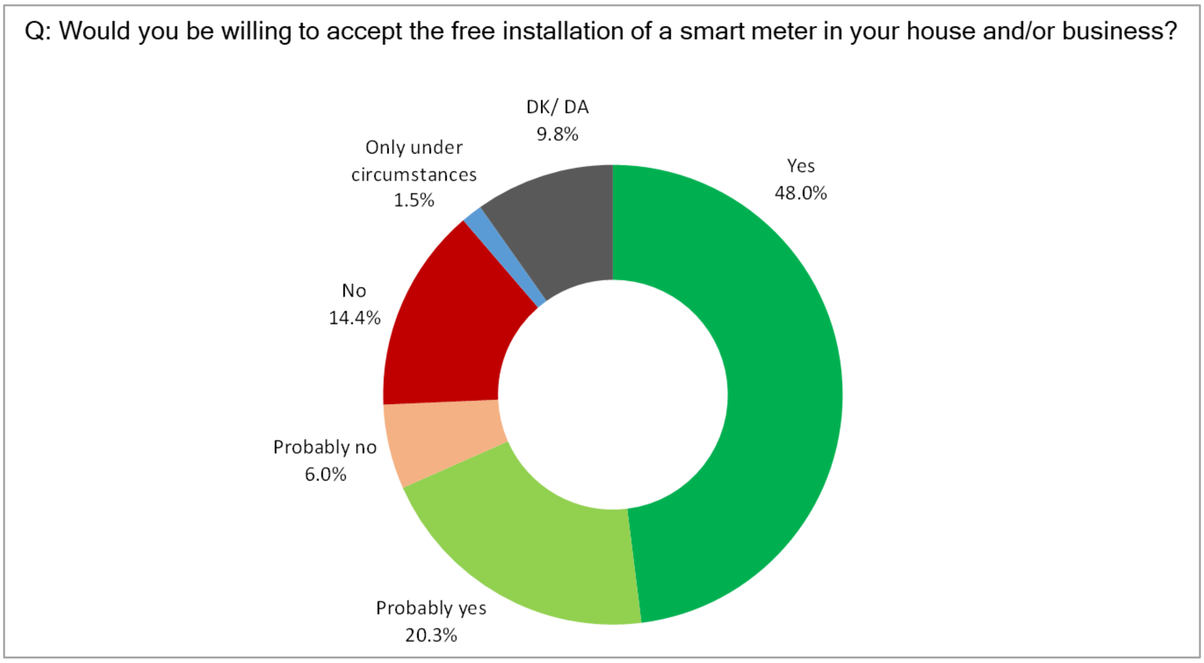

Figure 24: Willingness to accept smart meters

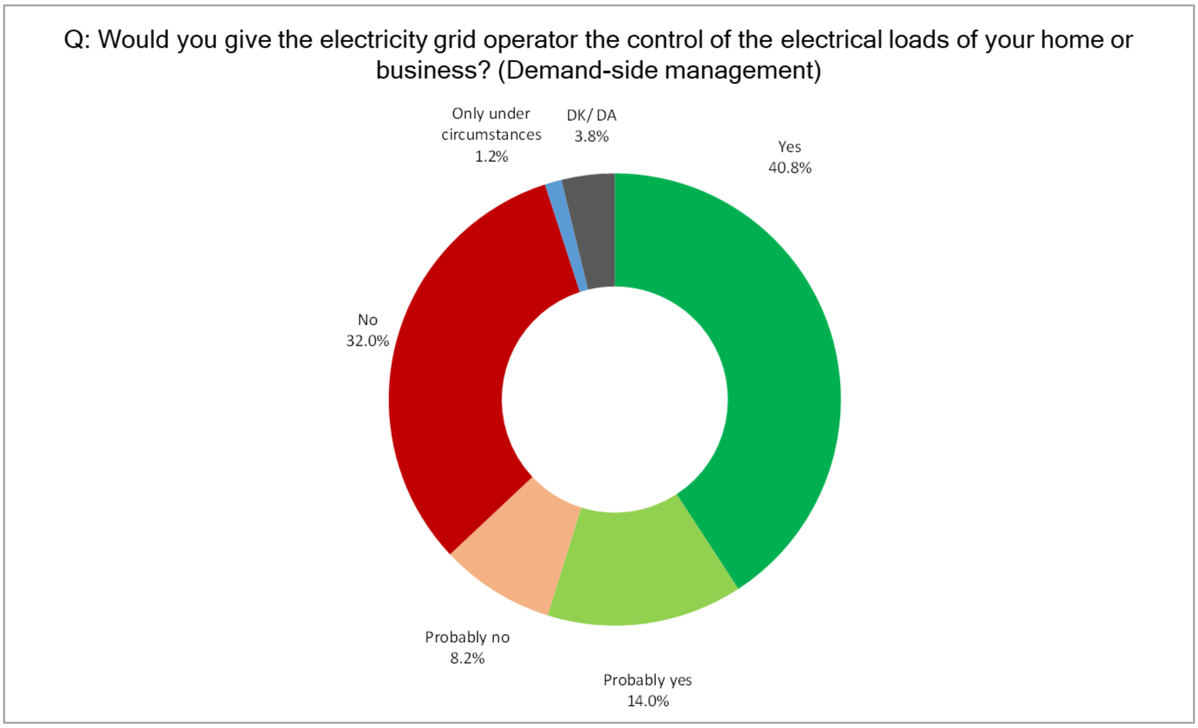

Figure 25: Willingness to accept demand-side management

Most importantly, we recorded much higher levels of acceptability for local energy cooperatives and demand-side management than in our first attitudinal survey (x^2: 22.843; df: 5; sf.: .000; refer also to Fig.14 and Fig.15 in Section 4.3 respectively). This suggests that innovative public participation models celebrated by extant scholarship on the societal dimensions of sustainability transitions (e.g. Aitken, Haggett and Rudolph 2016; Rowe and Frewer 2004; Sperling 2017) might also have a future in Greece – at least in the context of (very) small island communities.

First, up to 54.8% of respondents would definitely, or probably, accept demand-side management in the interest of energy security, with a further 1.2% of respondents indicating that they would accept this under certain circumstances (such as receiving a discount on their electricity bill) (see Fig.25). Second, a statistically significant majority of respondents (37%) would be interested in partaking in a local energy cooperative, with a further 19.5% of islanders indicating that they would probably be interested in this (see Fig.26a). For the overwhelming majority of islanders (76.7%) would welcome some type of active engagement in energy-related decision-making (see Fig.26b).

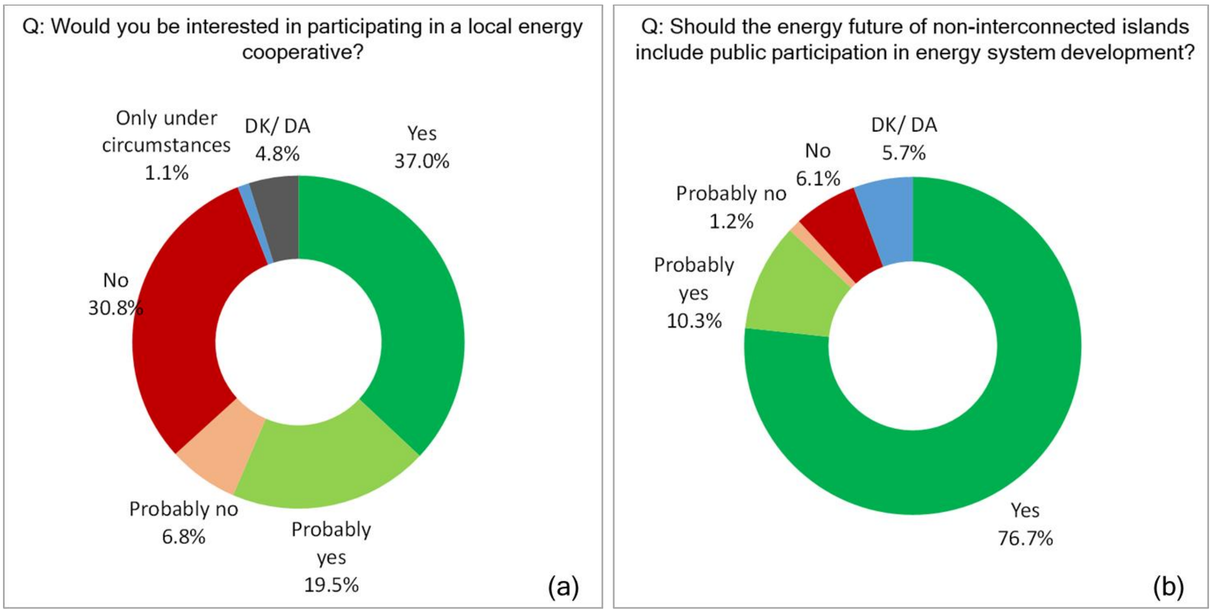

Figure 26: Interest in active public participation in (a) local energy cooperatives, and (b) future energy system development

Furthermore, the second questionnaire survey informs a more optimistic account of public opposition to domestic micro-generation than that afforded by the first questionnaire survey. Evidently, owing to our question wording that implied actual intention to install domestic RES rather than general acceptability of such technologies, we recorded much higher levels of opposition to domestic micro-generation than those recorded in the first questionnaire survey: a statistically significant majority of respondents (48.9%) do not intend to install any micro-RES technologies in the near future, whilst only 19.4% of respondents intend to do so (see Fig.27). Nonetheless, up to 36.5% of survey respondents would definitely, or probably, invest in domestic RES technologies due to the multiple anticipated benefits of microgeneration – most notably, its better environmental performance when compared against conventional electricity supply systems, its economic advantages, and its household-level energy security guarantee (see Fig.28).

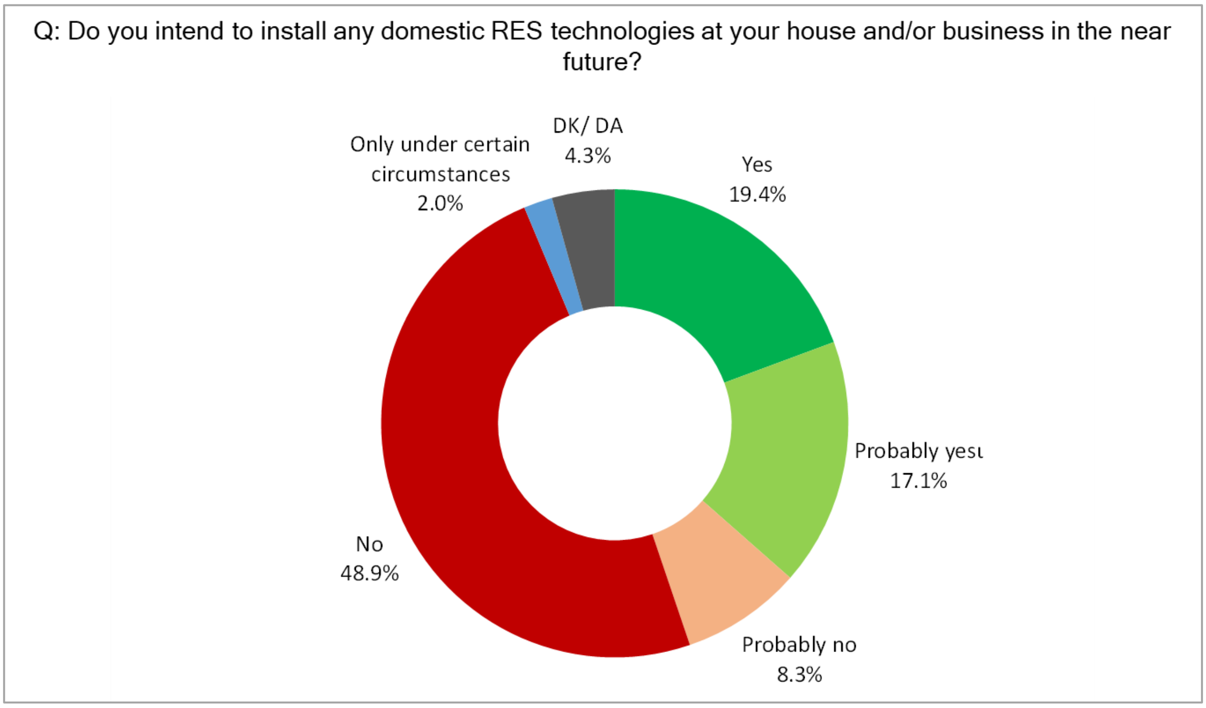

Figure 27: Stated intention to invest in RES micro-generation

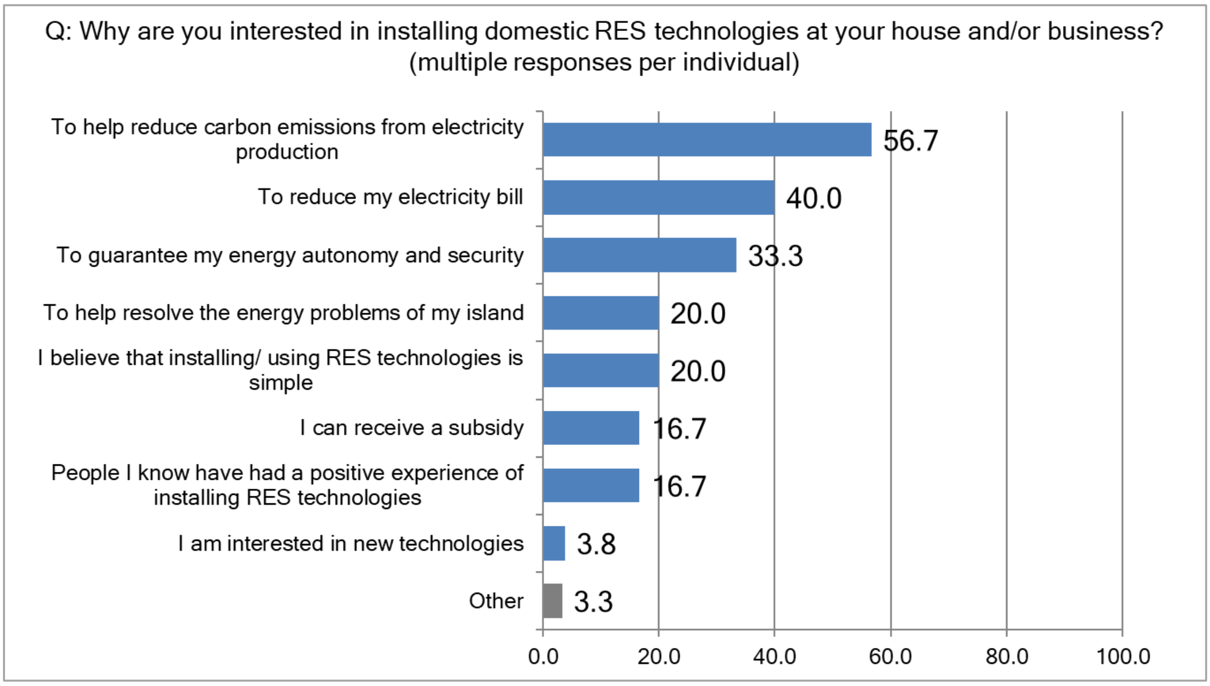

Figure 28: Rationales for investing in microgeneration

Furthermore, we can now assert that this lack of intention to invest in micro-generation technologies does not exclusively come down to public opposition for such installations. For only a third (30.4%) of those survey respondents not intending to invest in micro-generation attribute this to either their lack of interest or to their general opposition to such technologies (see Fig.29). Instead, and as detailed in Fig.29, this lack of intention to invest in micro-generation largely comes down to significant contextual and situational barriers to action that are beyond the immediate control of individual energy users and could, to a great extent, be overcome through appropriate legislative interventions, institutional support or up-to-date information dissemination.

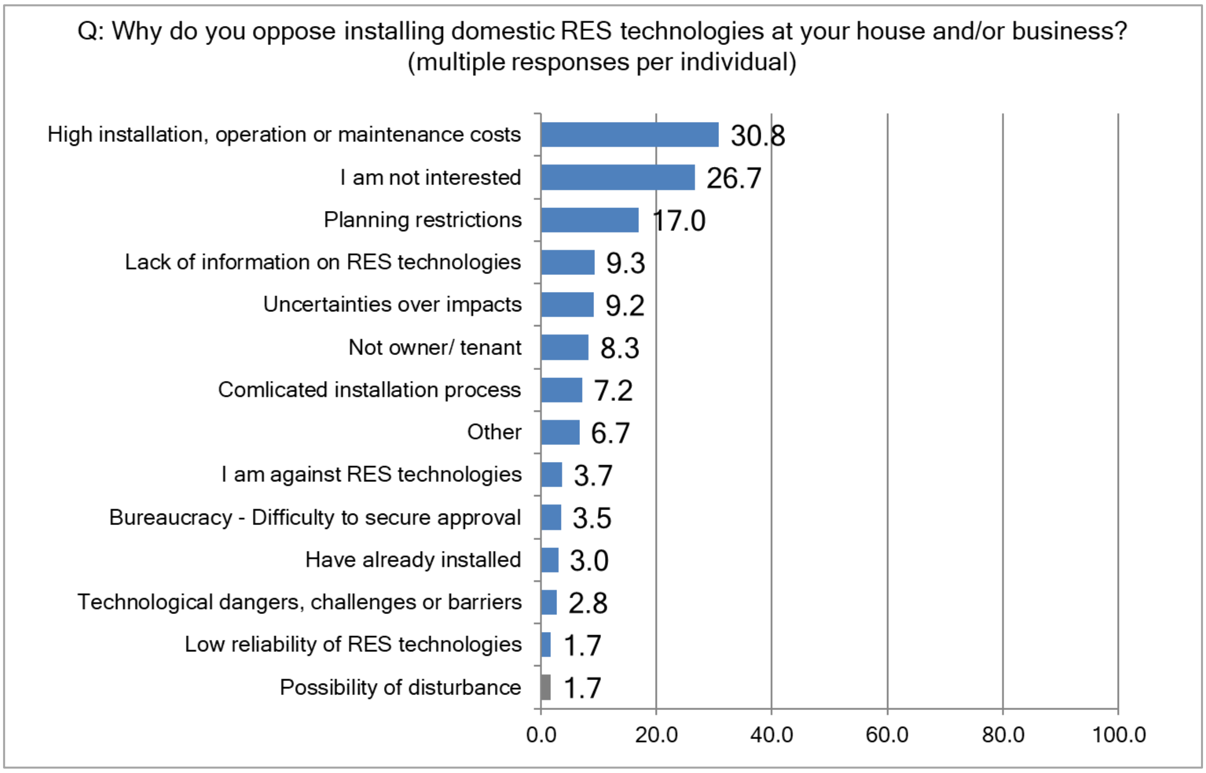

Figure 29: Rationales for public opposition to domestic microgeneration

Six key barriers to action are worth highlighting (see Fig.29) as they reaffirm past research findings on the key roles of consumer awareness and affordability (especially in the context of the present dire economic climate and feed-in-tariff cuts) (e.g. Kaldellis 2005; Oikonomou et al. 2009; Malesios and Arabatzis 2010; Tselepis 2015). First, and foremost, most individuals (30.8%) who are not interested in micro-generation claim that the installation, operation and/or maintenance costs of such technologies is prohibitive. Second, up to 17% of islanders are under the misconception that micro-RES installations are still forbidden in traditional settlements such as those encountered in most Greek islands[1]. Third, up to 9.3% of respondents claim that their lack of intention to invest in micro-generation comes down, amongst others, to the lack of information on such technologies and, thus, to their lack of understanding of the steps involved

[1] The installation of small scale renewable technologies (namely solar heater panels and PVs) is currently allowed in traditional settlements and/or protected buildings, as long as they are not visible from the street level and/or within the boundaries of protected natural areas (following a relevant amendment of Law 36720/25.8.2010 by the (former) Greek Ministry of Development in 2012).

in becoming an energy prosumer. Fourth, and related, 9.2% of islanders discuss their uncertainties over the impacts, costs and energy security afforded by such installations as a key barrier to becoming an energy prosumer. Fifth, 8.3% of survey respondents are unable to invest in micro-generation because they do not own their house/ flat of residence. Sixth, 7.2% of respondents are discouraged by the allegedly complicated installation process – with a further 3.5% of islanders detailing how they are overwhelmed by the bureaucratic hurdles in securing planning approval.

Against this backdrop, it comes as no big surprise that most islanders partaking in the questionnaire survey are also especially supportive of future action that would help improve the local energy landscape (see Fig.30). Indicatively, an overwhelming majority (91.6%) of respondents argue in favour of extensive dissemination of information on energy and energy-related technologies such as renewables. Furthermore, 82.9% of islanders believe that EU subsidies for energy efficiency measures and for the installation of micro-RES technologies should be guaranteed in the future in order to allow them to play their part in securing the sustainability of their local energy systems. Moreover, a statistically significant majority of respondents (81.4%) believe that networking/ cooperation between islanders in the interest of sharing insider knowledge of innovative energy solutions should be further encouraged in the near future.

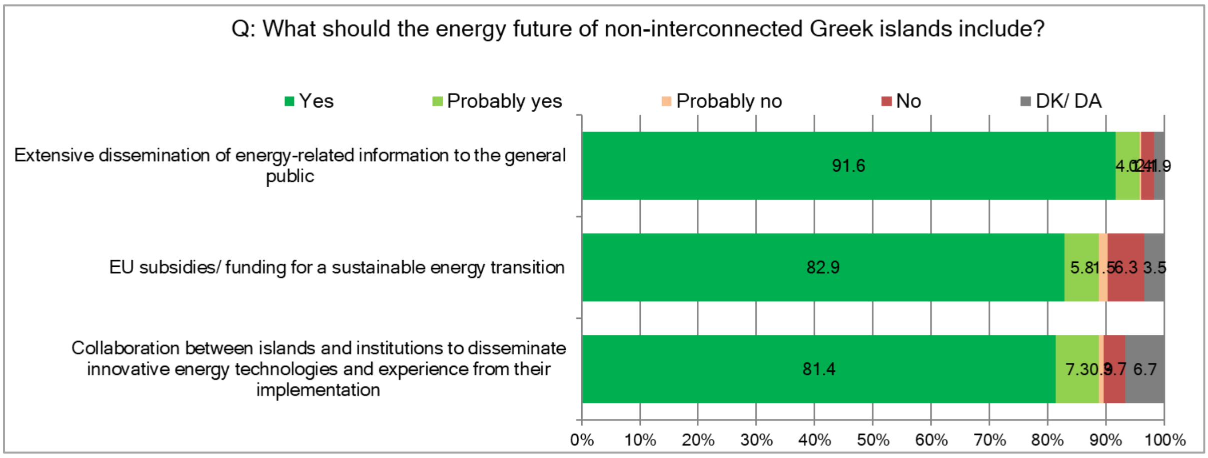

Figure 30: Public interest in measures that could improve the local energy landscape

4.5. Variability in the recorded attitudes of different respondent classes (outputs of second questionnaire survey)

Alongside the general attitudinal trends recorded in the section above, our second questionnaire survey confirms findings from the first survey with respect to statistically significant differences between different analytical classes. Whilst general trends were consistently comparable across all the demographic categories considered, the cross-tabulation and subsequent descriptive analysis of the available data using Pearson's chi-squared test helped uncover multiple statistically significant differences between our key demographic classes. Whilst no noteworthy differences were recorded between our two island clusters we, nonetheless, uncovered statistically significant differences between younger and older participants and between men and women.

In particular, and in line with findings form the first 'geographical' study, the data suggests that male islanders are – generally speaking – more supportive of a green and smart energy transition for the region and better informed with respect to energy-related issues than women. Indicatively:

i. Men are more accepting of local RES installations than women. Whilst 51.0% of men would wholeheartedly accept such installations in the near vicinity of their house and/or business, only 40.8% of women are willing to do so (x^2: 25.846; df: 5; sf .000). For a much larger majority of men (49.6%) than women (30%) are against the expansion/ upgrade of existing fossil fuel power plants in the region (x^2: 46.310; df: 4; sf .000).
ii. Men are more convinced than women that local RES installations will have a positive impact on their islands. For instance, up to 6.8% more women than men believe that such infrastructures will impact the tourist industry in a negative manner (x^2: 102.873; df: 38; sf .000).
iii. 13.8% more men than women would wholeheartedly accept a transition to a RES-based electric system (x^2: 26.558; df: 4; sf .000).
iv. Men appear more supportive of prosumer practices than women, with 11.3% more men than women indicating that they would definitely be interested in partaking in a local energy cooperative (x^2: 18.221; df: 5; sf .003).
v. Men appear to have a higher awareness of the TILOS energy model than women. A significantly smaller majority of male respondents (58.9%) are completely unaware of the TILOS energy model than female respondents (63.1%) (x^2: 15.298; df: 4; sf .004), with up to 23.8% of men even indicating that they have sufficient or comprehensive knowledge of the program, its details, and development.

Furthermore, there is considerable evidence suggesting that younger individuals (aged between 18-50 years old) are more supportive of green energy transition than their older counterparts (50 years old and above). For instance:

i. 10.9% more individuals in the 18-50 age group are willing to accept RES installations in their near proximity than older individuals, and 9.1% more individuals in the 50+ age group are entirely against such local developments than younger individuals (x^2: 15.157; df: 5; sf .010).
ii. Younger individuals are somewhat more accepting of an energy future in line with the TILOS energy model than older individuals. Whilst a vast majority of young respondents (89.7%) are in favour of the TILOS model, a considerably smaller majority (79.8%) of older individuals would prefer the future energy supply scenario (x^2: 24.566; df: 4; sf .000).
iii. 11.9% more young individuals would wholeheartedly accept a transition to a RES-based electric system when compared against older individuals who appear far more uncertain of the prospects of this development (x^2: 36.775; df: 4; sf .000).
vi. Considerably more (11.7%) younger than older individuals are interested in partaking in a local energy cooperative (x^2: 19.784; df: 5; sf .001).
iv. Considerably more (14.6%) younger than older individuals would accept free installation of a smart energy meter (x^2: 25.222; df: 5; sf .000).
v. Younger individuals appear more supportive of practical interventions that might encourage a sustainable energy transition than older individuals. Specifically, up to 9.2% more young than older individuals are strongly in favour of the democratization of energy-related decision-making and management (x^2: 14.256; df: 4; sf .007). Moreover, 10.1% more individuals belonging in the 18-50 years old demographic

group are supportive of future subsidies in the interest of energy efficiency improvements and RES installations when compared against the 50+ years old demographic category (x^2: 27.949; df: 5; sf .000). Finally, 10.6% more young than older individuals are in favour of intra-island networking to support energy-related innovations (x^2: 29.874; df: 4; sf .000).

Nonetheless, we argue that age and sex difference only play a small role in the recorded heterogeneity of our survey sample. Through a two-step clustering analysis we managed to reveal three distinct natural groupings (or respondent clusters) within the dataset that were not immediately apparent. These respondent clusters reflect, to a large extent, findings from our first questionnaire survey (refer to Table 5). Most survey respondents (Silhouette measure of cohesion and separation: Good; 79.3% of cases) can be associated with largely the same, and similarly sized, distinct natural groupings of islanders emerging from analysis of the first 'geographical' survey – namely:

i. Concerned green consumers (54.3% of survey respondents),
ii. Potential green energy prosumers (22.6% of survey respondents), and
iii. Opposers (24.1% of survey respondents) (see Table 6).

Specifically, and in line with our previous cluster analyses, concerned Green Consumers constitutes a class of individuals who are considerably supportive of most renewable and smart energy technologies – even in their near vicinity – but are somewhat uncertain and/or concerned of the possible implications of installing or investing in such technologies. Conversely, potential Green Prosumers are more assured of the positive impacts of a sustainable energy transition and overwhelmingly accept a part of the responsibility for securing this. Finally, a considerable proportion of individuals who oppose most or all sustainable energy technologies has, once more, been uncovered.

Notably, however, these three distinct respondent clusters are qualitatively different to those identified through analysis of the outputs of our first questionnaire survey. In particular, from information available at the time of data collection, it appears that willingness to invest in domestic micro-generation, support for RES installations near one's business or house, willingness to accept demand-side management, support for RES-based autonomous island futures, and perceived environmental impact of RES technologies are the five primary predictors of cluster participation. This holds especially true for the Green Consumers clusters, as uncertainty/ concern over green technologies and their implications manifests itself as an overarching qualitative feature across most attitudinal responses. Furthermore, there is also evidence to suggest that age and gender are also marginal determining features of the three energy user clusters emerging from our analyses for small and very small islands of the Aegean Archipelago – as suggested by previous research at an international level (see Devine-Wright 2007 for an overview). In sharp contrast to the statistical analyses of the first questionnaire survey that did not identify age and gender as predictors of respondent cluster participation, we assert that: a) Green Prosumers is a group dominated by young men, b) Green Consumers is a group dominated by young women, and c) Opposers is a group that mostly comprises of older men. In other words, the provisional arguments raised earlier on in this section concerning statistically significant differences between different age and gender groups have been re-affirmed.

Table 6: Two-step cluster analysis of findings – Second questionnaire survey (Silhouette measure of cohesion and separation: Good; 79.3% of cases)

Cluster	Potential green prosumers *(22.6%)*	Concerned green consumers *(54.3%)*	Potential opposers *(24.1%)*
Intention to install domestic RES	Importance= 0.90 Most frequent category: Yes (89.8%)	Importance= 0.90 Most frequent category: Probably yes (46.7%)	Importance= 0.90 Most frequent category: No (100%)
Support for RES installations in near vicinity	Importance= 0.80 Most frequent category: Yes (100%)	Importance= 0.80 Most frequent category: Probably yes (27.2%)	Importance= 0.80 Most frequent category: No (100%)
Willingness to accept DSM	Importance= 0.75 Most frequent category: Yes (100%)	Importance= 0.75 Most frequent category: Probably yes (26.3%)	Importance= 0.75 Most frequent category: No (100%)
Support for future autonomous smart islands	Importance= 0.50 Most frequent category: Yes (100%)	Importance= 0.50 Most frequent category: Yes (96.1%)	Importance= 0.50 Most frequent category: Probably yes (11.0%)
Perceived environmental impact of RES installations	Importance= 0.45 Most frequent category: Positive (100%)	Importance= 0.45 Most frequent category: Positive (56.8%)	Importance= 0.45 Most frequent category: Negative (55.8%)
Perceived impact of RES installations on energy security	Importance= 0.45 Most frequent category: Positive (100%)	Importance= 0.45 Most frequent category: DK/ DA (47.1%)	Importance= 0.45 Most frequent category: Neither positive nor negative (51.4%)
Willingness to accept smart meters	Importance= 0.40 Most frequent category: Yes (100%)	Importance= 0.40 Most frequent category: Probably yes (38.1%)	Importance= 0.40 Most frequent category: No (57.4%)
Perceived impact of RES installations on tourism	Importance= 0.20 Most frequent category: Positive (100%)	Importance= 0.20 Most frequent category: Neither positive nor negative (31.9%)	Importance= 0.20 Most frequent category: Negative (51.4%)
Age	Importance= 0.10 Most frequent category: 18-49 (61.2%)	Importance= 0.10 Most frequent category: 18-49 (67%)	Importance= 0.10 Most frequent category: 50+ (78%)
Gender	Importance= 0.05 Most frequent category: Male (57%)	Importance= 0.05 Most frequent category: Female (54.3%)	Importance= 0.05 Most frequent category: Female (58%)

5. Discussion and conclusions

Drawing on a core claim that public opinions make or break sustainable energy transitions, this research set out to explore whether islanders from across the Aegean Archipelago are likely to support the replication of the innovative TILOS-Horizon 2020 energy model on their islands. To address this research aim, this exploration started from three original positions. First, we moved significantly beyond current scholarship on public acceptability of green energy infrastructures that overwhelmingly focuses on local opposition to single wind energy projects (e.g. Devine-Wright and Howes 2010; Firestone and Kempton 2007; Kontogianni et al. 2013) – considering, instead, public attitudes to hybrid energy models that combine renewable and smart grid technologies and even attempt to redefine energy end-users as active 'co-providers' or 'prosumers'. Second, with previous work in this area typically using single case studies to understand the emergence of opposition to specific local energy interventions, at a late stage in the implementation process (see Devine-Wright and Howes 2010; Ellis et al. 2007; Firestone and Kempton 2007), our multi-sited exploration of public attitudes is uniquely situated to help understand energy publics across the Aegean prior to the development of specific plans. Third, and given limited attention to the societal dimensions of sustainable energy transitions in island contexts, our research – and specifically the Deliberative Mapping strand of our research activities – set out to qualify public attitudes and to explore whether innovative public participation techniques should form an integral part of future interventions in the region.

By addressing each of these four research aims, our exploration informs a number of key conclusions with respect to whether and how a sustainable energy transition for the Aegean Archipelago might be made possible. First, the research findings appear to challenge past academic research and media coverage highlighting that local resistance to green energy solutions – and especially to wind energy – is particularly acute in the context of Greek non-interconnected islands (cf. Dimitropoulos and Kontoleon 2009). In particular, according to the data obtained through our two questionnaire surveys and our Deliberative Mapping exercise, public attitudes towards green energy technologies across the islands studied are generally supportive of interventions such as those made possible through the TILOS project –with most of the respondents arguing in favour of a transition to an energy system that is completely supplied by RES, and recognizing that renewable technologies are likely to improve the local environment when compared against highly disturbing fossil fuel based power plants. Nonetheless, broad acceptability of such technologies does not equate to universal, unconditional acceptance of all long-term interventions put forth by the TILOS research consortium. This holds particularly true for possible interventions beyond centralized renewable installations, such as demand-side management and prosumption that directly affect the energy user experience. Moreover, a general lack of understanding of key smart technologies such as smart meters further hinders the actual ability of islanders to take on a more active role in the proposed smart energy transitions.

Second, the evidence presented in this report appears to suggest that the Aegean Archipelago is a considerably homogeneous region. While respondents from small and very small islands appear somewhat more supportive of green energy developments when compared against their counterparts from across the Aegean Archipelago, we identified relatively consistent attitudinal trends across all islands included in our research activities. In particular, whilst some statistically significant differences were recorded between different islands (or island clusters), we assert that most attitudinal variability can be attributed to distinct respondent profiles. Specifically, in considering the entire corpus of data collected through the two questionnaire surveys, we assert that a fifth of islanders are consistently in favour of all sustainable energy solutions put forth by the TILOS consortium – including, but not limited, to renewable and smart grid technologies, demand-side management and even prosumption from domestic renewable sources. Simultaneously, though, we cannot ignore: a) a majority of respondents from both surveys who would only accept green energy solutions that do not affect them directly, b) around a quarter of respondents from both questionnaire surveys who would thoroughly oppose such developments altogether. With past research in Greece and beyond documenting how public opposition to green energy technologies and infrastructures can bring otherwise promising projects to a virtual standstill, we must closely account for diverse public attitudes when envisioning the replication of the TILOS-Horizon 2020 energy model on other islands.

Third, the Deliberative Mapping strand of the research might have also uncovered general support for a regional transition based on the TILOS-Horizon 2020 energy model, but it simultaneously highlights how public opinions and priorities can differ substantially to those of energy experts. Appraisals of emerging sciences and technologies are increasingly recognised as needing to constitute part of a much wider framework for responsible innovation (Guston and Sarewitz 2002; Wilsdon and Willis 2008; Barben et al. 2008; Stilgoe et al. 2013). This research confirms this assertion by demonstrating how the lay public has a fundamentally different view of possible energy futures for the region, with the TILOS energy model performing higher when appraised by the citizens instead of energy experts. Most importantly, and in line with past research on public acceptance of green energy technologies (e.g. Devine-Wright 2013; Firestone et al. 2014; Gross 2007; Wolsink 2007), it highlights how process matters; how the public also chooses to support or oppose an energy system drawing on subjective perceptions of fairness and inclusiveness in decision-making.

Admittedly, caution must be taken in drawing too many conclusions from this research. In spite of our best intentions and consideration of public attitudes at different moments in time and across different geographical locations, the research inevitably faced a number of practical constraints. These include, amongst others, the small number of experts and citizens that were willing and available to participate in the Deliberative Mapping process, and pragmatic considerations with respect to how many questions to include in the CATI-based questionnaire surveys. Most importantly, the generic framing of the research implicates that generally positive attitudes towards green energy technologies documented in this report will not necessarily translate into actual support of specific projects on the ground. Indeed, Johansson and Laike (2007) and Wolsink (2012) warn us that attitudes toward green energy in general and attitudes toward specific projects will understandably differ, as they are different attitude objects. Each carries a different set of associations in the minds of community members. Where people may consider issues such as energy security and environmental quality when thinking about green energy in general, they think about specific impacts (e.g. noise, construction traffic, and a changed landscape) when such developments are actually proposed in or near their community (ibid.).

However, setting these limitations aside, it is important to reiterate that this research has provided a radically different insight into sustainable energy transitions in island contexts – moving beyond techno-centric narratives and reconsidering transitions as a socio-technical process. As such, the research documented in this report can also be seen to lay the groundworks for a future research and policy agenda.

In particular, we argue that it is critically important to better understand how islanders with distinct profiles view sustainable energy technologies, as this would yield important information on how the design of a technology or the way a technology is implemented should be adapted, and how the technological intervention should be communicated, such that acceptance increased and implementation is smoother (e.g. through targeted marketing to specific energy user segments). Bearing in mind that our research program uncovered distinct islander profiles, future research in the field should aim to better understand the determinants of public support or opposition. In particular, the concept of 'place-technology fit' (Brittan 2001; McLachlan 2009) should be used to open up the ways in which diverse potential local energy projects may be represented to 'fit', enhance or threaten socially and geographically embedded communities of energy users. All this implies an increased interest in the wider context of local energy development – something which addresses existing calls for more contextualised social psychological research (Clayton et al. 2015). This involves accounting for person-, project- and context- related factors influencing public attitudes (see Table 1; see also Devine-Wright 2013 for an overview). These approaches are especially useful in this future research agenda as they have been found to be able to offer a conceptual tool for understand both support and opposition to local energy projects (e.g. Devine-Wright 2011; McLachlan 2009). Furthermore, this future research agenda would adopt a mixed method approach, combining qualitative and quantitative research methods to inform a more comprehensive account of the subject matter. While qualitative methods are better suited to understanding and exploring complex phenomena (such as local energy deliberations), quantitative methods allow a more focused investigation of specific relations and hypotheses and, thus, permit generalisation to wider populations (following Devine-Wright 2005; 2009; Haggett and Toke 2006).

This future research agenda involves posing the following five timely research questions:

1. Given the inconclusive assertions on the associations between gender/ age and public acceptability recorded in this study and other research at an international level (see Devine-Wright 2007 for an overview), what might be the association between additional socio-demographic characteristics (e.g. income, social class, levels of education, etc.) and public acceptability?
2. Are higher levels of awareness of green energy technologies associated with higher levels of public acceptability, and how might the dissemination of new information impact upon community acceptance of sustainable energy transitions?
3. Might socio-psychological factors (e.g. pro-environmental attitudes, political beliefs, levels of place attachment/protectionism, etc.) be associated with levels of public acceptability?
4. How might contextual- and project-related factors (e.g. levels of trust to authorities/developers, perceived fairness in decision-making, etc.) impact upon public acceptability?
5. Might consideration of such personal, socio-psychological, contextual and project-related influences better inform our accounts of distinct islander profiles?

Moreover, from a transition governance perspective – and given the considerable knowledge gaps documented in this report – we argue that there is also a pressing need for information dissemination. We, as a research consortium, are committed to ensuring that the prototype TILOS intervention plays an important role, through the dissemination of information or through expert-led site visits, in helping islanders across the Aegean archipelago develop a better understanding of promoted technologies. By clarifying uncertainties and demonstrating the positive impact such interventions have on local populations (see Deliverable 8.7: Temporal Studies), such disseminated information is expected to stimulate further support to sustainable energy technologies.

This notion that information campaigns or opportunities for public deliberation could increase public support of green energy technologies is relatively common (Bell et al. 2005). Specifically, renewable energy advocates envision attitudes toward projects becoming more positive as the public learns more about the benefits of green energy and misconceptions about impacts are corrected (Cass and Walker 2009; Burningham, Barnett and Walker 2014). Given, however, widespread criticism that a knowledge-deficit model of opposition is too narrow (Ellis et al. 2009; Haggett 2011a; Wolsink 2011; Jones and Eiser 2009), this knowledge dissemination is only intended to: a) strengthen generally positive attitudes toward green energy, and b) enable individuals who are partially or completely unaware of such technologies and their implications to form opinions. In other words, knowledge dissemination does not involve the portrayal of opponents as ignorant or poorly informed – and, thus, it does not delegitimize their beliefs and values.

Finally, given both the positive public experience of our Deliberative Mapping activities and the considerable diversity of attitudes towards green energy technologies, there is also a strong instrumental rationale for an 'upstream' approach to public participation in sustainable energy transitions in place of a 'tokenistic' (Arnstein 1969) imposition of the TILOS-Horizon 2020 energy model on other islands in the region. This involves empowering diverse energy publics and their voices; opening-up wider public discourses and dialogue around what changes are acceptable or desired in a particular place and under which conditions (following Bidwell 2016). Specifically, public engagement that is 'upstream' in energy infrastructure decision-making processes could broaden understanding of the context in which public responses are being shaped, by emphasizing energy policy alternatives including supply and demand-side alternatives. It may open-up views on the relative acceptability of various local sustainability actions, rather than focusing on single projects that are the result of expert-level discussions establishing the energy-related 'problems' or 'challenges' at hand (Whitton et al. 2015). Instead, it poses questions around how local energy technology evaluation plays out when local communities consider the full range of alternative configurations of contribution to local and global sustainability. This could for instance open up broader questions such as: What kind of local energy options are preferred? Are decentralised options preferred over centralised options? Are supply side measures preferred over demand-side measures? What kind of technology 'fits' best in the historical or cultural local context? Importantly, the argument here is not to give local communities ultimate responsibility for achieving local sustainability – which may be impractical for large project development. Instead, the point is that by engaging communities early and broadly – rather than 'downstream', in the context of an existing, designed project – communities are empowered to express their full range of views on the desirability of multiple local energy options.

In conclusion, whist the transfer of the TILOS-Horizon 2020 energy model to other non-interconnected islands of the Aegean Archipelago appears technically feasible, we should not assume that this process will be straightforward. We can no longer afford to ignore diverse energy publics; a sustainable energy transition for the region can only ever be achieved through the development of projects that truly and fully understand and respect local publics, their attitudes, values and sensitivities.

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7. Appendix A: First Questionnaire Survey (translated from Greek)

PART A: Demographic information

1. Gender:

☐ *Male* ☐ *Female* ☐ *DK/ DA*

2. Age:

☐ *18 – 24 years old* ☐ *30 – 39 years old* ☐ *50 – 59 years old*

☐ *25 – 29 years old* ☐ *40 – 49 years old* ☐ *60 years old and above*

PART B: The energy supply present and future of non-interconnected Greek islands

3. How important are the following problems for your island?

	Very unimportant	*Unimportant*	*Important*	*Very important*	*DK/ DA*
Inadequacies in health sector					
Water shortage					
Electricity supply problems/ energy insecurity					
Unemployment					
Inadequate sea/air connections					

4. How is electricity produced/ supplied on your island?

☐ *From oil* ☐ *From wind turbines* ☐ *Other*

☐ *Via seabed cables* ☐ *From PV parks* ☐ *DK/ DA*

☐ *From lignite* ☐ *From natural gas*

5. What is your view of possible renewable energy installations on your island?

☐ *Positive* ☐ *Neither positive nor negative* ☐ *Negative*

☐ *Somewhat positive* ☐ *Somewhat negative* ☐ *DK/ DA*

6. Would you be willing to accept the complete decarbonisation of your island, with all electricity produced using renewable energy sources?

☐ *Yes* ☐ *Probably no* ☐ *DK/ DA*

☐ *Probably yes* ☐ *No*

7. To achieve complete electricity supply form renewable energy sources it is necessary to install local energy storage batteries. Would you agree with the installation of storage batteries on your islands?

☐ *Yes*

☐ *Probably yes* ☐ *No*

☐ *Probably no* ☐ *DK/ DA*

8. How important is local disturbance caused by the following energy sources?

	Very unimportant	*Unimportant*	*Important*	*Very important*	*DK/ DA*
Fossil fuel plants					
Wind turbines					
Photovoltaics					
Seabed cables					
Hydroelectrics					

9. Would you prefer using electricity produced in fossil fuel plants, or using renewable energy source?

☐ *Fossil fuel power plants*

☐ *RES*

☐ *DK/ DA*

10. Are you aware of smart energy meters?

☐ *Yes*

☐ *No*

☐ *DK/ DA*

11. *[If you selected "Yes" in Question 10]:* **Would you be willing to install one at your house?**

☐ *Yes*

☐ *Probably yes* ☐ *No*

☐ *Probably no* ☐ *DK/ DA*

12. *[If you selected "No" in Question 10]: **Would you be interested in learning about smart energy meters?***

☐ *Yes*

☐ *Probably yes* ☐ *No*

☐ *Probably no* ☐ *DK/ DA*

13. To avoid extensive blackouts on non-interconnected islands, there are proposals for the automatic, short-time shutdown of certain household appliances (see air conditioners, water heater, electric heating / radiators) by the utility operator (so-called "Demand-Side Management" plans). **Would you give the electricity grid operator the control of the electrical loads of your home or business?**

☐ *Yes, provided I receive an electricity bill discount*

☐ *Yes, even without an electricity bill discount*

☐ *No, under no circumstances*

☐ *DK/ DA*

14. A lot of people believe that local renewable energy infrastructures can reduce the number of tourist visiting our islands, whilst other believe that the tourist industry will benefit from such developments. **What might, in your view, be the impact of such installations on tourism?**

☐ *Positive*

☐ *Somewhat positive*

☐ *Neither positive nor negative*

☐ *Somewhat negative*

☐ *Negative*

☐ *DK/ DA*

15. With the new national framework on "Energy Communities", businesses, local authorities and cooperatives of private shareholders have the option to become primary electricity producers, which they will either sell to the national grid or use themselves. **Would you be interested in joining an energy cooperative in your island?**

☐ *Yes*

☐ *Probably yes*

☐ *Probably no*

☐ *No*

☐ *DK/ DA*

16. Would you be interested in producing your own electricity via domestic photovoltaic panels?

☐ *Yes*

☐ *Probably yes*

☐ *Probably no*

☐ *No*

☐ *DK/ DA*

17. Would you be interested in installing a domestic energy storage battery to guarantee your energy supply autonomy?

☐ *Yes*

☐ *Probably yes*

☐ *Probably no*

☐ *No*

☐ *DK/ DA*

8. Appendix B: Second Questionnaire Survey (translated from Greek)

PART A: Demographic information

1. Gender:

☐ *Male* ☐ *Female* ☐ *DK/ DA*

2. Age:

☐ *18 – 24 years old* ☐ *30 – 39 years old* ☐ *50 – 59 years old*

☐ *25 – 29 years old* ☐ *40 – 49 years old* ☐ *60 years old and above*

PART B: The energy supply present and future of non-interconnected Greek islands

3. Electricity suppliers must ensure that the consumer's basic consumer needs for electricity are continually covered. **How do you assess the supply of electricity in your island?**

☐ *Inadequate – Problematic (I.e. Very frequent/ extended power cuts or voltage fluctuations that cause a great deal of inconvenience)*

☐ *Somewhat inadequate – Problematic (I.e. Frequent/ extended power cuts or voltage fluctuations that cause considerable inconvenience)*

☐ *Neither adequate nor inadequate (I.e. Occasional power cuts or voltage fluctuations that cause some inconvenience)*

☐ *Somewhat adequate (I.e. Rare power cuts or voltage fluctuations that do not cause much inconvenience)*

☐ *Adequate (I.e. Very rare power cuts or voltage fluctuations that do not cause any inconvenience)*

☐ *DK/ DA*

4. As part of Tilos' innovative energy program (TILOS-Horizon 2020) an attempt is being made to combine renewable energy production (photovoltaics and wind turbines) and battery storage in order to provide electricity to consumers at times when renewables (sun and wind) are not available or insufficient to meet the demand for electricity. **Are you aware of the TILOS energy model, and to what extent?**

☐ *No, not at all (I.e. I have never heard about the project)*

☐ *Yes, to a small extent (I.e. I know about the project, but in no much detail)*

☐ *Yes, to some extent (I.e. I know about the project, and I am aware of some of its details)*

☐ *Yes, to a large extent (I.e. I follow the development of the problem, and I know a lot of details about it)*

☐ *DK/ DA*

5. In recent years an effort has been made to improve the electrical infrastructure of Greek islands through the development of RES installations (e.g. photovoltaics, wind turbines). **What is your view of possible renewable energy installations on your island?**

- ☐ *Positive*
- ☐ *Somewhat positive*
- ☐ *Neither positive nor negative*
- ☐ *Somewhat negative*
- ☐ *Negative*
- ☐ *DK/ DA*

6. **Are you in favour of a possible RES installation close to your home or business?**

- ☐ *Yes*
- ☐ *Probably yes*
- ☐ *Probably no*
- ☐ *No*
- ☐ *DK/ DA*
- ☐ *Only under certain circumstances (Please specify)* ____

7. **Do you currently use any RES technologies in your house and/or business? (Please select all that apply)**

- ☐ *No, I do not use any RES technologies currently*
- ☐ *Solar heater*
- ☐ *Domestic PVs*
- ☐ *Domestic wind turbines*
- ☐ *Geothermal energy*
- ☐ *Biofuels*
- ☐ *Electric or hybrid vehicles or motorcycles*

8. **Do you intend to install any RES technologies in your house and/or business in the near future?**

- ☐ *Yes*
- ☐ *Probably yes*
- ☐ *Probably no*
- ☐ *No*
- ☐ *DK/ DA*
- ☐ *Only under certain circumstances (Please specify)* ____

8.1. *[If you selected "Yes" or "Probably Yes" in Question 8]:* **Why are you interested in installing domestic RES technologies at your house and/or business? (Please select all that apply)**

- ☐ *I am interested in new technologies*
- ☐ *To help reduce carbon emissions from electricity production and use*
- ☐ *To guarantee my energy autonomy and security*
- ☐ *To cut my electricity bills*
- ☐ *I can receive a subsidy*
- ☐ *To help resolve the energy problems of my islands*
- ☐ *I believe that installing/ using RES technologies is simple*
- ☐ *People I know have had a positive experience from installing RES technologies*
- ☐ *Other (Please specify)* ____________________

8.2. *[If you selected "No" or "Probably No" in Question 8]:* ***Why do you oppose installing domestic RES technologies at your house and/or business?*** **(Please select all that apply)**

- ☐ *I am not interested in RES technologies*
- ☐ *I am against such installations*
- ☐ *High installation, operational and/or maintenance costs*
- ☐ *Lack of information on RES technologies*
- ☐ *Low reliability of RES technologies*
- ☐ *Complicated installation process*
- ☐ *Technological dangers and/or challenges*
- ☐ *Bureaucracy – Difficulty in securing approval*
- ☐ *Possibility of disturbance*
- ☐ *Other (Please specify)*____________________

9. What might be the impact of local RES installations in your island?

	Negative	*Somewhat negative*	*Neither positive nor negative*	*Somewhat positive*	*Positive*	*DK/ DA*
Impact on tourism						
Impact on the local economy						
Impact on energy security						
Impact on the natural environment						

10. New technology "smart" digital electricity meters can provide consumers and power companies with continuous electricity consumption. **Would you accept the free installation of a "smart" meter in your home or business?**

☐ *Yes*

☐ *Probably yes*

☐ *Probably no*

☐ *No*

☐ *DK/ DA*

☐ *Only under certain circumstances (Please specify)* ____

11. To avoid extensive blackouts on non-interconnected islands, there are proposals for the automatic, short-time shutdown of certain household appliances (see air conditioners, water heater, electric heating / radiators) by the utility operator (so-called "Demand-Side Management" plans). **Would you give the electricity grid operator the control of the electrical loads of your home or business?**

☐ *Yes*

☐ *Probably yes*

☐ *Probably no*

☐ *No*

☐ *DK/ DA*

☐ *Only under certain circumstances (Please specify)* ____

12. With the new national framework on "Energy Communities", businesses, local authorities and cooperatives of private shareholders have the option to become primary electricity producers, which they will either sell to the national grid or use themselves. **Would you be interested in joining a local energy cooperative?**

☐ *Yes*

☐ *Probably yes*

☐ *Probably no*

☐ *No*

☐ *DK/ DA*

☐ *Only under certain circumstances (Please specify)* ____

13. What should the energy future of non-interconnected Greek islands include?

	Yes	*Probably yes*	*Probably no*	*No*	*DK/ DA*
Expansion – upgrade of existing fossil fuel power plants					
Expansion of continental interconnections with seabed cable					

Development of autonomous smart islands (100% electricity production from renewable energy sources)					
Development of synergistic energy projects (e.g. electricity production from renewable sources and development of electric vehicle network)					
Extensive dissemination of energy-related information to the general public					
Active public participation in energy-related decision-making/ management (e.g. through public consultations)					
EU subsidies/ funding for a sustainable energy transitions					
Collaboration between islands and institutions to disseminate innovative energy technologies and experience from their implementation					