SMARTEES
local social innovation

Report on barriers towards and drivers of energy equality in the energy union

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Table of Contents

List of Tables

Executive summary

D6.3, "Report on barriers towards and drivers of energy equality in the energy union", is part of WP6, concerning "Equality and the Energy Union: Data and knowledge analysis" and is based on desk research, as well as qualitative and quantitative data collected at several stages during the whole project. Following the overarching objective of WP6, the data is synthesised, structured, harmonised, and analysed with a particular focus on energy equality to deliver policy recommendations relevant for fostering just social innovations.

In order to fulfil this aim, a literature review was undertaken on the issues of energy equality and energy justice in Europe and based on this review, a template for data analysis was created, considering the possible effects of actions taken in energy social innovations (i.e., the social innovation influencing equality through direct or embodied energy consumption interventions) on energy equality through the satisfaction of three categories of needs (i.e., existence/sustenance, social and value-based needs).

Based on the analysis performed at each SMARTEES case and case cluster level, it appears that most of the interventions had a positive influence on energy equality, at least within the affected area covered by the SI (e.g., most SMARTEES cases are related to just one or only a few issues), by facilitating the satisfaction of citizens' needs. The satisfaction of physiological and safety needs (existence/sustenance) was facilitated through investments for improving sustainable mobility opportunities, investments for reducing energy consumption in buildings and their associated costs, and/or finally, financial aids. At the same time, the satisfaction of citizens' needs to belong and relate with one another was facilitated through actions favouring family and social relations by encouraging the use of public spaces, encouraging the use of public transports and cycling, and participatory processes of citizens' engagement. Moreover, the SMARTEES cases showed that several interventions seemed to facilitate the satisfaction of value-based needs through interventions that allowed citizens to pursue actions coherent with their environmental aspirations, attachment to their local area, or ambition to better their condition.

We conclude with a discussion and recommendations that could support social innovations and energy equality policies by adopting distributional, procedural, and recognition justice principles. Specifically, the importance of adequate public funding to support and maintain actions favouring low-income households and the general population is discussed concerning distributional justice outcomes in social innovations. About procedural justice, the importance of participatory and co-design methods is highlighted concerning benefits such as social engagement, an increase of social acceptability and increased social capital in neighbourhoods. Citizens' organizations are also regarded as essential for social innovations and procedural justice. Thus, recognizing these organizations by the municipalities and engaging them early on could greatly promote social innovations. Finally, because it is hard to reach vulnerable groups, we also stress the importance of targeted approaches, with specific activities and trained or skilled individuals to engage these groups actively.

SMARTEES policy recommendations to improve distributional justice in relation to Energy Equality:

- Financial solutions need to take into account a differentiated pattern of managing and consuming energy according to income households (from low-income to high-income)
- Provide sufficient public funding for financing and long-term maintaining the SI's interventions in cases where the community is not able to finance these themselves (at least partially)
- Build a financial system resilient to financial crises as a part of energy justice as crises affect marginalized households disproportionally

SMARTEES policy recommendations to improve procedural justice in relation to Energy Equality:

- Strengthen regulations that foster early-stage consultation and co-creation of SIs through prescribing a participatory process whenever the SI is led by local authorities and public bodies.
- Involve citizen organizations early on in the process to unburden individual citizens.
- Create dedicated seed funding schemes in local authorities to support citizens organisations led SI projects.

SMARTEES policy recommendations to improve recognition justice in relation to Energy Equality:

- Acknowledge various needs, rights and experiences of individuals, households, groups or neighbourhoods
- Vulnerable groups must have a voice, their needs must be visible and accounted for.
- Build trust to vulnerable groups which are less likely to engage in participatory processes and acknowledge cultural differences in who is trusted
- Develop targeted approaches to engage silent or underrepresented vulnerable groups with contact persons close to the target group (both physically and culturally)

Introduction

The SMARTEES project has researched energy-related social innovation cases across several European countries through a novel mixed-method approach combining desk research, qualitative interviews, surveys, and agent-based modelling.

Our research has focused on the following five clusters:

1. **Holistic, shared and persistent mobility planning.** A defining feature of this social innovation is the participatory development and adoption of a holistic and persistent mobility plan, in which all city development and planning follows a coordinated approach focussed on making the city mobility efficient and sustainable. Reference cases analysed: Zürich (Switzerland) and Groningen (the Netherlands).

2. **Island renaissance based on renewable energy production.** This social innovation centres around the mobilization of island residents and public and private stakeholders to achieve energy independence through renewable energy production and energy efficiency measures, thus becoming a means to revive island communities. Reference cases analysed: Samsø (Denmark) and El Hierro (Spain).

3. **District regeneration.** This social innovation triggers district regeneration through hard and soft measures, such as local energy production and energy efficiency, urban green spaces, transport system transition measures and citizen participation. Reference cases analysed: Malmö and Stockholm (Sweden).

4. **Urban mobility in superblocks.** Superblocks are an urban innovation that introduces low-carbon mobility practices through the reorganization of urban space, which minimizes the use of motorized modes of transportation. Superblocks help reorganise urban space into car-free areas to maximize public space and foster social and economic interactions at the street level while keeping private cars and public transport outside the neighbourhoods. Reference cases analysed: Vitoria-Gasteiz and Barcelona (Spain).

5. **Fighting energy poverty through energy efficiency.** This social innovation is characterized by public authorities working in coordination with supply companies and civil society organisations to implement energy efficiency measures for houses and buildings to fight fuel poverty with a tailored and inclusive approach. Reference cases analysed: Aberdeen (Scotland) and Timișoara (Românía).

Beyond the heterogeneity of methodology and cases, the project has used several perspectives to shed light on the investigated social innovations' genesis, development, and replicability. In previous deliverables, such varied approaches have been explored. For instance, in D3.4, "Five models of social innovation", a theoretical model for each cluster of social innovation providing a general description of the different phases characterizing the adoption of each social innovation was created. In D5.2, "Elaboration of Policy Recommendations for each cluster of case-studies and an online tool for the coproduction of energy policy and simulations", a set of policy recommendations for adaptation for each local case were laid out by individuating the best strategies to engage citizens in sustainable transitions to support stakeholders' decision-making. In D6.1, "Report on social innovation drivers, barriers, actors and network structures", we looked at the drivers and barriers affecting the social innovations across the five clusters. In D6.2, (still in the making), we will use selected cases of agent-based models' simulations to discuss the evolution of the theory of social innovations.

In this deliverable D6.3, we shed light instead on the contribution of social innovations towards advancing energy justice and energy equality and the policy implications resulting in that respect from the analysis of the SMARTEES cases.

1 Energy, inequality and energy justice

1.1 Energy services and inequality

Energy is essential for satisfying basic human needs such as mobility, communication, education, health, (food) security; thus, it is central to today's social development challenges in these areas (Nussbaumer, Bazilian, & Modi, 2012). It was found that across most countries within Europe, populations with low energy affordability are more likely to report poor health and emotional well-being (Thomson, Snell, & Bouzarovski, 2017). Today, there are still billions of people around the globe without access to necessary energy or clean cooking facilities (therefore, one among the 17 United Nations Sustainable Development Goals – SDG7 is "Affordable and Clean Energy: Access to renewable, safe and widely available energy sources for all"). It is estimated that in Europe alone, about 50 to 125 million people are in "fuel poverty" (Bollino & Botti, 2017). Electricity prices, unemployment and the percentage of people in poverty, and the country's GDP per capita, were found to influence individuals' access to energy and energy poverty (Halkos & Gkampoura, 2021). If this trend continues, and no changes in policies and financial investments in this area are implemented, more people will be without access to energy in 2030 than today (IEA, 2010).

The economic, social and environmental implications of distributive justice are essential and should be taken into consideration, as it was shown that about 20% of the global population holds 60% of global appropriation of final energy (Grubler et al., 2012). Deep inequalities of energy consumption and CO_2 emissions are found across and within nations (Gore, 2015; Pachauri and Spreng, 2012; Ritchie, 2018). About 50% of global carbon emissions are attributable to the 10% of wealthiest individuals on the planet, while the 50% poorest of the global population only contribute to 10% of GHG emissions and reside in the most vulnerable countries to climate change (Gore, 2015).

Energy poverty, in particular, is still a problem in several European countries, where about 11% of the European population was found unable to keep their home adequately warm in 2012 by the EU Survey on Income and Living Conditions (Pye et al., 2015). Despite policy-makers trying to address the issue, especially in light of the recent economic crisis, energy poverty has increased across Europe (Halkos & Gkampoura, 2021). This state of affairs is regrettable because access to energy services such as heating, lighting, transportation, or cooking represents a "key prerequisite to a decent quality of life" and thus can be seen as a basic human right (Bazilian, Nakhooda, & Van De Graaf, 2014, p. 2017).

Energy is considered an 'instrumental good' as it enables the fulfilment of services such as thermal comfort, indoor lighting, cooking, and washing (Gillard, Snell, & Bevan, 2017). However, not only access to energy services is problematic when considering energy consumption. While the lack of access to modern energy services results in underconsumption and poverty from not having enough energy, too much energy leads to waste, overconsumption, and pollution, with some serious environmental issues (Wilkinson, Smith, Joffe, & Haines, 2007). In other words, the exploitation of fossil fuels contributed significantly to an increase in living standards but produced burdens in the form of illnesses through pollution of environments and is the leading cause of climate change. Wilkinson and colleagues (2007) made it clear that any solutions to the problems associated with the energy system are not going to be easy or simplistic because the current global energy system is both a means for expanding opportunities and raising standards of living and a structure that degrades both human health and the environment. Thus, the two perspectives, one concerned with energy poverty and the other related to overconsumption, should be addressed jointly.

Energy inequality and energy poverty can exacerbate other forms of inequality, such as economic, social, or political. Lack of access or limited access to energy services impacts peoples' educational

opportunities, access to natural resources, health and health services, political representation, or economic opportunities (Sovacool et al., 2014). Moreover, climate change effects resulting from how energy is currently generated and used mainly affect people already in a position of energy insecurity and poverty (Wilkinson, Smith, Joffe, & Haines, 2007). Not only underdeveloped or developing countries face issues related to energy poverty or inequality. The increase in extreme economic inequality in developed countries is believed to affect energy consumption, too, observed in the form of less privileged groups losing access to essential energy services (i.e., household heating, affordable transportation), which lead to disparities in GHG emissions between groups of people with different economic power (Calvin, 2019). Therefore, energy can be seen as an instrumental good that should be carefully regulated and governed.

Energy governance involves a multi-level (i.e., individual, local/regional, national, global) and multi-actor process, encompassing actors (e.g., governments, NGOs, civil society groups, corporations, citizens, citizen groups), institutions and processes/rules shaping how decisions are made about how to provide energy services to beneficiaries (Florini & Sovacool, 2011). Based on the complexities of the issues related to energy regulation, it was also made a case for global energy governance, but to date, energy policy remains at the state and sub-state level (Dubash & Florini, 2011). Nonetheless, there is a myriad of global institutions attempting to promote global energy governance, such as the International Energy Agency (IEA), the Group of Eight (G8), the Asian Development Bank (ADB), or the Renewable Energy and Energy Efficiency Partnership (REEEP) (Florini & Sovacool, 2009). In this context, there is the scope for a growing role of the European Union to strengthen its energy policy for member states to overcome the challenges highlighted, thereby achieving effective international energy governance on the European continent, providing that it succeeds in settling long-standing internal differences (Weko, 2021; Pellegrini-Masini et al., 2020b).

Regardless of the level of governance, social innovations appear a suitable instrument to advance energy justice, providing that supportive institutional environments are created by adequate policies suitable to harness local social energies (Hiteva and Sovacool, 2017).

1.2 Energy justice and Energy Equality

1.2.1 Energy justice

Energy poverty, earlier mentioned, is the most striking example of energy injustice, but energy justice has been discussed at length in the literature with regards to several other societal domains of energy consumption, production, and its environmental effects (Heffron and McCauley, 2017; Sovacool et al., 2016). Energy justice was defined as aiming "…to provide all individuals, across all areas, with safe, affordable and sustainable energy." (McCauley et al., 2013, p. 1). The earliest definition of energy justice belongs to Guruswamy (2010, p .233): "Energy justice seeks to apply basic principles of justice as fairness to the injustice evident among people devoid of life sustainable energy, hereinafter called the energy oppressed poor". Both perspectives acknowledge the disparities between groups of people and argue for access to safe, sustainable and affordable energy for all. More recently, Sovacool and Dworkin (2015, p.436) defined energy justice "…as a global energy system that fairly disseminates both the benefits and costs of energy services and one that has representative and impartial energy decision-making."

Energy justice was conceptually based on three tenets: distributive justice, procedural justice, and recognition justice (McCauley et al., 2013). Distributional justice (McCauley et al., 2013) refers to the equity in distributing goods and services among individuals and was defined as justice in the

distribution of economic goods between the members of a society (Bojer, 2003). Procedural justice instead relates to fair processes, it is based on the concept of procedural or formal equality (Pellegrini-Masini et al., 2020a), it advocates for fair participation in processes of energy policymaking, for determining and contesting the distribution of said goods and services. Whereas distributional aspects encompass issues such as income, energy prices and energy efficiency, procedural aspects are related to information access, decision-making and legal rights. Finally, recognition justice deals with recognising and repairing injustices suffered by some groups or places (Jenkins et al., 2016) and is concerned with vulnerability, needs, and respect (Gillard, Snell, & Bevan, 2017).

Equity of distribution of goods, (i.e., distributional justice), and more specifically, of energy services rather than energy itself, was argued to be one of the core issues in energy poverty, making a case for securing both an understanding of what exactly is distributed unequally and paying attention to the interrelated factors supporting distributional inequalities (Walker & Day, 2012). The ability to secure warmth, as an issue in energy poverty, is linked to the presence or rather the absence of other assets, such as money (i.e., a shortage in income), the price of energy or fuel per unit (i.e., affordability of energy for individuals with different income levels), and also the price for energy efficiency upgrades of housing units, heating systems, and other energy-consuming technologies. Related to the costs of heating households, the UK Fuel Poverty Monitor (UKFPM) (NEA and EAS, 2020) states that following the Scottish Government definition, for a household to be in energy poverty, it needs to spend more than 10% of its disposable income on energy costs. Therefore, individuals in fuel poverty cannot afford to adequately warm their homes, pay their bills for energy/fuel, or need to spend a large portion of their income to cover these costs. Moreover, because a good portion of the households' income is spent on securing a given level of warmth within the home, the ability to afford other essentials is impaired. These individuals find themselves in a "heat or eat" conundrum, where a choice has to be made between securing heating the home and securing food for the family (Frank et al., 2006). In recognition of the issues regarding distributional justice, the United Nations embarked on a mission to ensure accessibility and affordability of reliable, sustainable and modern energy technologies by 2030 (SDG 7, as already mentioned above).

While distributional justice is related to material outcomes, procedural justice is rather concerned with the associated processes through which equal or unequal distributional outcomes are produced and supported regarding access to information, legal process, and effective influence in decision-making (Walker & Day, 2012). Access to information is inherently crucial for taking action, whether the governing bodies or individuals take the said action. In other words, knowing the scale, occurrence and patterns of fuel poverty is crucial in being able to address it through policy, schemes, and campaigns, whereas having access to information on energy prices or on more efficient ways for using energy is also essential in formulating responses and tackling issues of energy consumption from individuals, especially for those in vulnerable positions. Laws and regulations addressing energy/fuel poverty are also important per se, but also the individuals and especially the vulnerable groups should be supported to use the legal system to enforce these laws and regulations. Regarding access to and meaningful participation in decision making, the scholars drew attention to its implications: "the interests of those affected by fuel poverty need to be properly represented in a variety of relevant decision-making processes – in energy policy and strategy, energy pricing and market regulation, housing policy, energy efficiency policy and so on – if they are to be given some priority alongside other concerns and addressed effectively" (Walker & Day, 2012, p.72). Because a lack of cultural diversity recognition and a lack of involvement or influence in the process of decision-making on energy services are closely related, it was previously argued that procedural justice and recognition justice are interconnected (Day, 2010, Walker & Day, 2012).

Recognition justice, however, is usually understood to go beyond general participation, ensuring that different groups' needs and rights are fairly taken into account, represented and respected. Recognising differential needs means a step forward in accessing energy services of different groups that are generally socially and politically marginalised, such as the very young, the old, immigrants, minorities, the disabled, or the ill. It is much harder for these particular groups to have their needs recognised (Walker & Day, 2012). As scholars noted, without recognition, specific needs and vulnerabilities can remain hidden and neglected in the formulation of policy interventions. Moreover, the injustice of fuel poverty can also be understood as a lack of recognition of the needs of specific groups, which are usually already vulnerable and underrepresented.

From a policy perspective, it is important to determine those who benefit or lose from the improvements in energy access. It was suggested that energy justice could be achieved through social protection policies and programs/interventions aimed at reducing multidimensional poverty (i.e., promotion of efficient labour markets, reduction of risk exposure, enhancement of socio-economic capability to manage unemployment, discrimination, infirmity, disability, retirement), as well as through policies that promote the incorporation of renewable energy technologies into the energy mix (Sarkodie & Adams, 2020). Energy justice cannot be achieved without government intervention. Achieving energy justice in developing countries was also especially problematic because of issues related to corruption or government inefficiency (Estache, 2008; Poloamina & Umoh, 2013).

Applying energy justice principles in practice is not an easy task. As noticed by Sovacool, Burke, Baker, Kotikalapudi, & Wlokas (2017, p. 685), "too often, the impacts of energy interventions—even those that have a net social good, or attempt to reach justice principles—have devastating impacts on vulnerable groups." The accident at the Fukushima nuclear power plant raised public awareness of the unequal distribution of environmental damages and risks as well as of intergenerational justice issues, which rippled throughout Japan, in the region (i.e., South Korea, Taiwan), as well as in Western Europe (i.e., Germany) (Kockler et al., 2017; Walker, 2012). The case of India, where the attempts to address energy poverty through the expansion of coal-fired generation increased the coal-mining industry and child labour, is another example where those vulnerable are exposed to the damages of energy production and use. Or here in Europe, we could mention the case of Sami reindeer breeders who are resisting the installation of wind farms in their areas and branding them as climate injustice (Strzyżyńska 2021), on the grounds that these would scare away the reindeers, threaten their livelihoods and their cultural heritage.

Further, in Europe, specifically in the UK, which was considered a success story in tackling energy poverty through programs such as the Warm Front in increasing affordability of energy, the governmental interest in environmental justice has declined in recent years, reflecting changes in the government as well as severe cuts to the funding and responsibilities of government departments and agencies (Kockler et al., 2017; Walker, 2015).

Further conceptualisations of energy justice (Sovacool et al., 2017; Sovacool and Dworkin, 2015) go beyond the three tenets of distributional, procedural and recognition justices, just discussed, and are based instead on lists of ten building principles: "availability", "affordability", "due process", "transparency and accountability", "sustainability", "intragenerational equity", "intergenerational equity", "responsibility", "resistance", and "intersectionality" (see Table 1).

Table 1: Ten principles of Energy justice (Sovacool et al., 2017, p.687)

Availability	"People deserve sufficient energy resources of high quality (suitable to meet their end uses)"
Affordability	"All people, including the poor, should pay no more than 10% of their income for energy services"
Due process	"Countries should respect due process and human rights in their production and use of energy"
Transparency and accountability	"All people should have access to high quality information about energy and the environment and fair, transparent, and accountable forms of energy decision-making"
Sustainability	"Energy resources should be depleted with consideration for savings, community development, and precaution"
Intragenerational equity	"All people have a right to fairly access energy services"
Intergenerational equity	"Future generations have a right to enjoy a good life undisturbed by the damage our energy systems inflict on the world today"
Responsibility	"All actors have a responsibility to protect the natural environment and minimize energy-related environmental threats"
Resistance	"Energy injustices must be actively, deliberately opposed"
Intersectionality	"Expanding the idea of recognitional justice to encapsulate new and evolving identities in modern societies, as well as acknowledging how the realization of energy justice is linked to other forms of justice e.g. socio-economic, political and environmental"

Availability is related to high-quality energy resources, to which all individuals deserve access to meet their needs. The affordability principle sets a threshold of 10% of individuals' income to pay for their energy services. Due process means that countries should uphold due process and human rights in the production and use of energy. Transparency and accountability refer to the principle that all individuals, without exceptions, should have access to information about energy and the environment and access to a fair, transparent and accountable decision-making process. Sustainability refers to how humanity should use energy resources, with care for savings, community, and precaution. Intragenerational and intergenerational equity involves the rights of individuals to fair access to energy services and the rights of future generations to "enjoy life" without the negative impact our energy systems have on the environment. As humans, we have rights and responsibilities related to all cycles of energy services, specifically, to protect the environment and to minimise energy-related environmental damage. Resistance in this framework is seen as an urge to stand up to energy injustice, to actively and deliberately oppose it, while intersectionality is understood in terms of recognising how energy justice is connected with other forms of justice impacting humans (e.g., socio-economic, political) and non-humans (e.g., environmental).

Social innovations and energy justice
The social dimension of innovation in the sense of new ways of collaboration, decision-making and of mobilising society was broadly defined as "new ideas that work in meeting social goals" (Mulgan, Tucker, Ali, & Sanders, 2007). In the energy sphere, innovations usually mean technical or techno-economic innovations such as new technology for generating or storing energy or new technologies related to "smart energy systems" (Hoppe & DeVries, 2019). A recent study concluded that there is an

impending need to move away from this approach where energy is seen as a purely technical issue, because in this way, policymakers will continue to rely on technology and economics only, ignoring possible solutions to encompass social, political and cultural problems which address more realistically energy policy objectives (Sovacool et al., 2017).

On the bright side, in the last years, social innovations received increased scholarly and political interest and attention in the energy field, for example, regarding cases of community energy and renewable energy cooperatives, which use novel models of participation in conjuncture with energy technological developments (Brummer, Herbes, & Gericke, 2017; Maruyama, Nishikido, & Iida, 2007; Pellegrini-Masini, 2020).

Further, Sovacool (2013), among others, applied concepts from justice theories to today's energy policy problems, illustrating solutions through case studies; one of such cases is about the Danish energy policy and the role that self-organised groups of cooperatives played in decision-making, lobbying policymakers to create policies in favour of decentralised wind farms instead of centralised large power plants. Hiteva and Sovacool (2017) examined how energy justice can be incorporated into the development of innovative business models for energy services, equipment, and supply, showing how elements of justice can inform innovative practices, such as energy service companies that obtain benefits from helping to eradicate energy poverty or cooperatives co-investing in energy projects.

1.2.2 Energy Equality

In this report, we have attempted to analyse SMARTEES energy social innovations' impact based on the concept of Energy equality. Energy equality is a new working concept (Pellegrini-Masini, 2019; Pellegrini-Masini et al., 2021) rooted in energy justice. Energy equality emphasizes the importance of distributive justice and substantive equality, and it could be argued as a radical stance of energy justice (Pellegrini-Masini et al., 2021). It was conceived as a concept advocating for "providing all individuals with equal opportunities to use energy services, energy technologies, and consuming energy and embodied energy to satisfy personal needs and holding capabilities" (Pellegrini-Masini, 2019, p. 144). Taking these two influential perspectives of energy justice into consideration (McCauley et al., 2013; Sovacool et al., 2017), it was argued that equality stands at the root of the concept of energy justice (Pellegrini-Masini et al., 2020a) and that energy equality could be seen as a radical stance of energy justice stressing the importance of distributional justice, which is central for addressing fairly environmental pollution and climate change (Pellegrini-Masini et al., 2021). The definition of energy equality builds both on energy justice conceptualisations and takes under consideration needs theories and capabilities theories. Day, Walker and Simcock (2016, p.260) have brought the capabilities approach within the area of energy justice, defining energy poverty as "an inability to realise essential capabilities as a direct or indirect result of insufficient access to affordable, reliable and safe energy services, and taking into account available reasonable alternative means of realising these capabilities".

For the sake of this deliverable, we will refer to theories of needs only, bearing mind that as Sen (1979, p.218) puts it "…what is at issue is the interpretation of needs in the form of basic capabilities. This interpretation of needs and interests is often implicit in the demand for equality", thereby meaning that needs and capabilities are mirroring one another and are central in any quest for equality. The choice of focusing on needs is also consistent with the theoretical approach used in SMARTEES in earlier deliverables and specifically in D7.2, where describing the HUMAT simulation model we read (Antosz et al., 2019, p.13): "The initiation of agent activity starts with the needs being satisfied (or not) by different behavioural alternatives. Several theories on needs offer different yet overlapping taxonomies on what drives human behaviour (Maslow 1954; Max-Neef 1992; Kenrick, Griskevicius, Neuberg & Schaller, 2010)."

Needs are broadly understood as conditions in which something is required or wanted. More specifically, needs represent a nutrient essential for adjustment, integrity, and growth (Ryan, 1995), which, if frustrated, increase the risk for passivity, ill-being, and defensiveness (Ryan and Deci 2000; Vansteenkiste and Ryan 2013). According to the American Psychological Association (APA), psychological needs represent any need that is essential to mental health or that is not a biological necessity, which can be generated internally (e.g., the need for pleasure), or by interactions between the individual and the environment (e.g., social approval, justice).

1.2.3 A template for data analysis

For space reasons, we will not dwell on competing theories of needs and share the view of earlier project work (D7.2) (Antosz et al., 2019) that maintains that different taxonomies of needs can be sourced in the literature, which in many cases show overlaps. For the sake of the analysis of the empirical work collected in SMARTEES carried out purposefully for this deliverable, we will then use the taxonomy presented in D7.1 (Antosz et al., 2018) and D7.2 (Antosz et al., 2019), which distinguishes between existence/sustenance needs, social needs and value-based needs (Antosz et al., 2018, p. 10):

> *1) existence/sustenance (related to safety); 2) social belonging and status (group position); and 3) personal preferences (taste, beliefs). The need to exist is related to having means to prevail, e.g., food, income, housing. Agents act in order to avoid depletion of these resources over time. Social belonging and status needs are associated with having interactions with others, belonging to a group, and maintaining/achieving social status. Personal preferences refer to satisfying one' personal taste with respect to overall life values and norms, e.g., environmental protection, altruism, or enjoyment of life.*

Drawing on the definition of energy equality put forward by Pellegrini-Masini (2019) which establishes a direct link between needs' satisfaction and equal opportunities to use energy services, technologies, and consuming energy and embodied energy, we propose a simple analytical template in order to assess if our SI's have the potential to increase energy equality in the SMARTEES cases researched. This template is based on the following definitions of needs:

Existence/sustenance (physiological and safety) needs. Physiological needs are thought to be the most important, as these requirements are essential for human survival on a biological level. For example, air, water, sleep and food, are metabolic requirements for survival, while clothing and shelter provide necessary protection from the elements. When a person is struggling to meet their physiological needs, they are less likely to seek out the fulfilment of other human needs such as their sense of belonging, esteem or self-actualisation. Safety needs represent the second tier of needs in the pyramid (Maslow, 1954); once the physiological needs are (relatively) satisfied, the safety needs take precedence and dominate human behaviour. Examples of such needs are physical safety (i.e., personal security, which could be threatened by natural disasters, war, etc.), economic safety (i.e., financial security which could be influenced by economic crisis or lack of work opportunities), health and well-being, safety against accidents or illnesses.

Social needs refer to belongingness (Baumeister, Leary 1995), relatedness (Deci, Ryan 2000), i.e., to feel close and accepted by significant others and within perceived significant groups.

Value-based needs refer to the need of striving for consistency with one's personal goals. Goal-framing theory holds that individuals appear to act following a goal orientation (Lindenberg and Steg, 2007); these goals are stated by Lindenberg and Steg (2007, p.119) in the following three categories: 1) Normative goals, "to act appropriately" (e.g., following pro-environmental or prosocial values and

attitudes), 2) Gain goals "to guard and improve one's resources", (e.g., improving personal finances, improving the status of the local area and of the community), which in turn would likely lead to stronger place attachment, positive place identity, and increased community pride, and 3) Hedonic goals: "to feel better right now" (e.g., pursuing comfort).

Based on the needs' categories, we have proposed a non-exhaustive table of exemplified interventions regarding direct and embodied energy consumption, whose implementation is assumed to improve equality in access to energy services and energy consumption towards the satisfaction of the three categories of needs (Table 2).

Table 2: Examples of SIs' actions and their relevance for citizens' needs related with energy equality

Needs	SIs affecting equality through <u>direct energy consumption</u> interventions	SIs affecting equality through <u>embodied energy consumption</u> interventions
Existence/ sustenance • physiolo-gical • safety	• Energy poverty (fuel poverty) targeting actions o Satisfaction of basic heating, cooling, cooking and warm sanitary water needs • Actions towards increasing personal safety perception (e.g., improving street lighting).	• Provision of goods or services that support basic needs satisfaction (e.g., public transport, cycling schemes) • Provision/refurbishment of public housing

Social
 	
• belonging-ness
• relatedness
	• Actions favouring mobility for family and social relations.
	• Participatory activities regarding SIs
	  o Events for the discussion and/or co-creation of interventions
	  o Discussion and reflection on energy consumption and environmental issues
	• Energy community schemes
	  o Joint renewable ownership schemes such as co-operatives generate networks and social interaction
		• Actions to improve the availability and quality of public spaces for socialising
		  o Biking facilities
		  o Community facilities
		  o Refurbishment of public spaces (e.g., gardens, parks)
		  o Creation of traffic-free areas (e.g., superblocks)

Values
 	
• hedonic
• gain
• normative
	• Actions providing education/ information on direct energy consumption
	  o Education for reducing direct use of energy
	  o Awareness campaigns
	  o Provision of information materials/websites
	• Other energy-related actions that might increase the community "pride", place attachment, or perceived self-worthiness of the community
	  These can be any energy interventions on the built environment and energy infrastructure that are perceived a positive for the identity of the neighbourhood/community
		• Actions providing education/information and raising awareness on embodied energy consumption
		  o Reducing embodied energy use (e.g., purchasing less energy-intensive goods such as cars, etc.)

2 Analysis of the SMARTEES cases

Drawing on the template for data analysis presented in the previous section, SMARTEES case researchers reviewed the case documents, earlier project deliverables and qualitative and quantitative data collected through semi-structured interviews, focus groups and surveys, and compiled for each case an analytical discussion of whether social innovation interventions affected the level of energy equality for the residents involved.

The analysis is presented in the following paragraphs cluster by cluster and case by case through a description of the interventions, a discussion of their impacts on energy equality and its related needs and by adapting Table 2 to each case.

2.1 Cluster 1: Holistic, shared and persistent mobility plans

2.1.1 Synthetic description of case interventions relevant for Energy Equality

Cluster 1 "Holistic, shared and persistent mobility planning" refers to the case of Zürich and Groningen. Both cases are characterized by a very long life (around 40-45 years until today) and are both centred on mobility (based on high-quality public transport and propagation of bikes and bike lanes; mainly the first in Zürich, mainly the latter in Groningen) with little interest on the main other sectors of energy consumption (e.g., housing, industry, etc.) or on energy production. In both cases, the "starting point" is in the '70s of the 20th century (mobility strategy to speed up trams and buses in Zürich; design and launch of a new Traffic Circulation Plan/TCP in Groningen aimed at limiting the use of cars). In both cases, the main actor was (and still is) the municipality. Both approaches were participative.

Case: Zürich, Switzerland

In Zürich, the implementation of the mobility strategy governance is rooted in a very strong system of direct democracy characterized by the celebration of various referenda (promoted either by public local authorities or by citizens) and traditional consultations of citizens at the local level). In general, the city of Zürich and all the other local planning authorities try to engage stakeholders and do engage them in formal and informal fora as much as they can. Before the final decisions are taken, normally, there is a formal request for comments where most of the formal actors get a chance to be involved.

Case: Groningen, Netherlands

In Groningen, there was an important evolution of the governance model of mobility. The organisation of city planning has changed completely because of the paradigm shift in the 1970's. Basically, the top-down approach by the technical planning experts has been changed towards a holistic planning process, where plans are being developed including many relevant sustainability dimensions such as well-being and involvement of the citizens, energy use and economic viability. Consequently, citizens and shopkeepers/entrepreneurs are increasingly being involved in planning processes. In the beginning without important influences in the decision-making, later (especially since the 1990s) influencing also decisions thanks to referenda and local consultations more or less binding. An important tipping point in this evolution process was the referendum held in 1994 on the closing of Noorderplantsoen Park for through car traffic.

2.1.2 Discussion of the main impacts on Energy Equality and its related needs

In both cases (Zürich and Groningen), big changes in citizens' mobility behaviour towards new much more pro-environmental behaviour are well documented. The big difference is that: (a) in Zürich the transition has been from cars to firstly public transports and, secondly, to bikes and walking, and (b) in Groningen the transition has been from cars, firstly to bikes and, secondly, to public transports and walking. This difference between Zürich and Groningen concerns all age groups (e.g., most young people in Groningen ride bike because it is convenient, while in Zürich they prefer public transport because of comfort and WiFi availability). In both cases, the change in mobility behaviour fits into a wider trend of behaving more environmentally friendly (e.g., separating waste, limiting water use, insulating housing, joining energy cooperations and the like).

Case: Zürich, Switzerland

The story of the Zürich Mobility Strategy goes back to the 1970s. Until the 1970s, public spaces in Zürich were designed primarily to handle automobiles (a car-friendly city as a symbol of progress). In the 60s and 70s, the city administration developed two different projects for underground solutions for short-distance public transport. Both projects have been rejected in referendums. This vote against large investments in new technologies made clear that tax-payers wanted the existing surface public transport system working better and more efficiently instead of leaving the surface to cars and adopt a two-level (surface and underground) mobility system. In this regard, immediately after the second referendum (1973) a "people's initiative" was launched for projects to speed up trams and buses. As a matter of fact, this initiative marked a discontinuity in the development of the city and gave the important impulse that a majority of the population expressly agreed to a policy aimed at improving urban space for people, with a residential area very attractive decreasing traffic congestion through an improvement of surface public mobility. It is upon this impulse that the Zürich Mobility Strategy is rooted.

Since the beginning, the main actor was (and still is) the municipality. Many other actors are involved, such as the canton, transport enterprises, the business community, car groups, bike groups, Quartierkonferenzen (networks of local associations), "street communities", and the scientific community. The governance of the mobility strategy is rooted in a very strong system of direct democracy characterized by the implementation of various referenda (promoted either by public local authorities or by citizens) and traditional consultations of citizens at the local level. In general, the city of Zürich and all the other local planning authorities try to engage stakeholders and do engage them in formal and informal fora as much as they can. Before the final decisions are taken, there normally is a formal request for comments where most of the formal actors get a chance to be involved (e.g., the Quartierkonferenzen in each of the 12 sub-areas of Zürich are always asked formally to comment and cooperate with the local authorities). Some further features of this social initiative are: (a) Proceed gradually, step by step, avoiding too fast and too big changes in a short time, avoiding almost always radical measures. (b) Negotiate constantly with citizens or specific groups (e.g., the representatives of the main important business groups) on specific measures. (c) Adopt targeted policies (e.g., with contact persons for mobility consultations in large companies). (d) Give priority to "pull" measures (such as intensive improvement of public transport or the set-up of bike lanes) over "push" measures, which have however been implemented, but with less emphasis (such as the increase of the parking price).

Big changes in citizens' mobility behaviours towards new behaviours much more pro-environment were well documented (despite some resistances) until the Covid-19 restrictions, which entailed a strong reduction in the use of public services (now mitigated, but still persistent) and more bikes and

walk); but also a "return to cars"; that could represent a consolidated phenomenon in people behaviour.

In the long history of this case, there is no direct reference to issues affecting energy equality. However, the "core" of the mobility strategy was the strengthening of the public transport network (currently very efficient). This is a strategy that promotes the best possible equality in mobility (paying due attention also to weak people such as disabled persons, the elderly or people living in the most marginal areas). And since mobility is one of the main areas of the energy sector, it can be said that the increase of equality in mobility should be considered an important element in the broader frame of "energy equality increase".

As already stated, the Zürich Holistic, shared and persistent mobility planning case did not deal and does also today not deal directly with energy equality; but (perhaps) indirectly since it dealt and deals with equality in mobility. Equality in mobility has been pursued continuously and accurately with the constant expansion of the public transport network, which currently reaches even the most remote and marginal areas. This network is of the highest quality and allows you to reach any location in a relatively short time from any point in the city and its suburbs. The public transport network has been extended in a participatory way (e.g., by discussing with the inhabitants of the neighbourhoods on the location of the stops/stations) and is easily accessible even to the weakest subjects such as elderly and disabled people. The network is of high quality (it is almost always possible to find an empty seat, the frequencies of trains/buses/trams are intense, connections are guaranteed in line changes, the stops are equipped, you can use the internet onboard, etc.). Such a public transport network represents a factor in promoting equality with respect to mobility needs (allowing/facilitating mobility and related family and social relations to everybody).

This public transport network was complemented by the construction of bike lanes (a further element that promotes equality with respect to mobility needs).

However, mainly in the centre of the city, the promotion of public transport and bikes entail a conflict in the use of space: some streets are too narrow for allowing a lane for public transports, a lane for bikes, a space for walking, and a lane for cars (many streets/roads are still open to car traffic, albeit with restrictions in the speed and with high costs for parking). This issue is, somehow, a limit in the promotion of equality in transport.

Case: Groningen, Netherlands

The persistent holistic policy to support cycling and walking in the city of Groningen has brought forward a strong cycling culture in the city. Hence, we will reflect much on cycling in Groningen, as this is a social innovation that can be fruitfully implemented in many more cities.

Whereas in general the Dutch are known for riding bicycles as a common and convenient means of transportation, Groningen is at the forefront in facilitating biking by developing high-quality infrastructure for riding and parking bikes. The closing of the Noorderplantsoen for car traffic was one of the several interventions since the 1970's introduction of the Traffic Circulation Plan that made a difference and created a new situation from where additional developments became possible. As a result, Groningen performs very well in terms of low energy usage for local transportation, and also general terms of sustainability and quality of life. Groningen tops three categories in a 2015 EU survey of the quality of life in 79 European cities (Flash Eurobarometer, 2016), with 94% of the Groningers reporting to be (very) satisfied with the public space.

An important lesson from the Groningen case is that whereas a policy vision is needed to set a course, adaptation and adjustment of plans requires a more flexible policy approach to grow in the direction of the desired future. For example, the popularity of cycling has resulted in problems concerning bike parking capacity in the city centre. And in busy shopping streets, sharing space between cyclists and

pedestrians had to be limited to avoid traffic irritations and accidents. This requires implementing additional policy, and these policies sometimes fail and require adaptive adjustment. For example, closing a street for cyclists in the spring of 2020 because of covid resulted in irritations among cyclists who were confronted with a limitation of their freedom. Especially when the market was closed for bikes, many shoppers using their cycle to carry goods expressed how inconvenient this was. To avoid further conflicts between cyclists and law enforcement, it was decided to reopen this route for cyclists. In the following, a reflection will be given on the current status of the need satisfaction of the general population. This is a qualitative reflection based on the research we conducted, the framework we applied to the case and the personal experiences of the researchers living in this city.

The closure of the Noorderplantsoen for car traffic is a social innovation that has been a focus in the Groningen case study. Both in the empirical case study as in the simulation studies, it became clear that this intervention was received somewhat differently by different groups of residents. For details on this, we refer to D6.2. The general picture was that people favouring the closure of the park were living closer to the park, younger, and had a middle or higher education level. The people living the furthest away (Hoogkerk, Lewenborg) were more positive about keeping the park open for cars. It is obvious that the people living near the park are the ones that reap the benefits from closing the park for car traffic the most. However, one should bear in mind that in particular at the beginning of this intervention some people living nearby the park could experience more car traffic in their street due to car drives searching for alternative routes. This may result in a lower experienced satisfaction concerning safety and noise.

Given the initial 50/50 divide between proponents and opponents for the closure of the park, after 25 years of park closure, a vast majority of 95% of the citizens favours keeping the park closed for car traffic. Obviously, there is a cohort effect, as in particular, the older generation grew up with the private car as a symbol for prosperity and individual freedom. Currently, the car has less such an iconic cultural meaning in society, and especially in a student city as Groningen a large proportion of the population is less involved concerning the freedom a car offers, as they do not (need to) possess a car. Next to the cohort effect, also an effect of adaptation may play a role. Many people prefer what they know over what they do not know, which often explains part of the resistance against any change. The closed park being the status quo for 25 years now makes it a situation people are adjusted to, and they may not like a change. Next, the reputation and experience of Groningen as a great biking city will have contributed to a positive evaluation of policies that benefit the safety and comfort of biking. And finally, the quality of the Noorderplantsoen has improved significantly, and it is likely that people that originally objected to the closure for cars now have had some positive experiences in the park, and may have adjusted their opinions accordingly.

Concerning interventions regarding the Noorderplantsoen case at this stage, no policies need to be considered as a large majority supports the status quo. Concerning the current situation in the continuous development of the transportation system in the city, some concerns are being ventilated. First of all, the current development of reducing public transportation in the core of the inner city, and having stops only at the border of the city centre is meant to further reduce traffic in the inner city and make it more safe and pleasant to walk and bike. However, concerns are that people with lower mobility will find it more difficult or impossible to visit certain areas and shops in the inner city because of increasing walking distances.

Table 3: Case Zürich: impacts of the SI on EE

Needs	SIs affecting equality through <u>direct energy consumption</u> interventions	SIs affecting equality through <u>embodied energy consumption</u> interventions
Existence/ sustenance • physiolo-gical • safety	No No	A very effective provision of a large and diffused network of public services, which satisfies effectively and to a great extent the mobility needs (complemented by the construction of bike lanes)
Social • belonging-ness • relatedness •	Actions favouring mobility for family and social relations, thanks to an extended, accessible and effective network of public transports There were along the "history" and still are frequent discussion and co-creation events with many actors involved, such as business community, car groups, bike groups, Quartierkonferenzen (networks of local associations), "street communities", scientific community. However, nothing directly related to energy consumption (in the frame of the mobility strategy; and the inclusion of this strategy in the broader energy transition policy is still weak)	Some actions to improve the availability and quality of public spaces for socializing (closure of streets/places to cars – e.g. closure of Limmatquai to cars[1] – development of the banks and docks of the Limmat river, bike lanes, etc.). However, mainly in the centre of the city, the promotion of public transport and bikes entail a conflict in the use of spaces: some streets are too narrow for allowing a lane for public transports, a lane for bikes, a space for walking, and a lane for cars (many streets/roads are still open to car traffic, albeit with restrictions in the speed and with high costs for parking)
Values • hedonic • gain • normative	Nothing directly related to energy consumption (in the frame of the mobility strategy along the years). However, many actions that increased/increase the community "pride" place attachment[2] (such as the high quality of public transports, one of the highest in the world); periodical (effective) awareness campaign for promoting the use of public transports (and also bike lanes, albeit to a lesser extent); as well as the continuous production of information materials	See the left column. Since the examples are not related to energy equality, they (if relevant as it seems on the basis of §2 above) can be classified in both columns.

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[1] These actions would seem to benefit from a growing degree of satisfaction from citizens. Closing Limmatquao was the object of a Referendum held on June 13, 1999. A majority vote of 59.5% decided in favour of a permanent closure. Apparently, today (according to the findings of a SMARTEES survey implemented in the first quarter of 2020) the favourable responses make 84.2%.

[2] In the survey implemented in the frame of the SMARTEES project at the beginning of 2020, a question was related to level of agreement with the statement: "I am very attached to Zürich city"; practically all interviewees declare themselves attached to Zürich city (90%), while dividing themselves, almost equally, among those who agree completely with the proposed sentence (a kind of "citizen nationalism") and those who have a more aloof attitude. Those who disagree are, however, a completely negligible number.

	and the continuous updating in the web with this same goal.	

Table 4: Case Groningen: impacts of the SI on EE

Needs	SIs affecting equality through <u>direct energy consumption</u> interventions	SIs affecting equality through <u>embodied energy consumption</u> interventions
Existence/ sustenance • physiolo-gical • safety	Comfort: The cycling roads are of a high quality, providing a smooth ride. Comfort: Traffic lights are adapted for cyclists. On a few main crossings cyclists from all directions are having green light simultaneously. This allows for longer periods of green light for cyclists without hindering motor traffic. This was experimentally tested, and the "organic cycling culture" in Groningen was developed enough to make sure the cyclists interacted with one another to avoid collisions. In Rotterdam a similar experiment failed, indicating that the cycling culture was not ready for implementing these self-organizing traffic management principles. Comfort: Traffic lights prioritise cyclists when detected (street sensors) when it rains. Comfort: The auditive quality of the city is very good due to the very low level of cars in the city, providing a comfortable soundscape (intensive traffic noise can be related to a basic feeling of unsafety and higher stress hormone levels) Comfort/safety: Due to an almost absence of cars in the inner city and the electrification of public transportation the air quality is very good. Safety: The infrastructure has been set up to be safe. When the speed difference between cyclists and motorized traffic is too large (areas with max speed above 30 Km/h), cycle lines are physically separated from motor traffic lane, and a buffer is usually in between as a safety guard. The maintenance of cycling roads is a	

	top priority. Also, when there is snow, cleaning cycle lanes is a top priority.	
Social • belonging-ness • relatedness	Cycling is a "normal" mode of transportation. Cycling is part of the culture, and virtually all people that are physically capable of cycling are using their bike. The type of bike people ride can express a certain "social identity", and certain subcultures can be identified, such as "retro bikes" and "hi tech bikes". Yet most bikes are the "regular bikes", and also the popular Swapbikes do not cater for biking subcultures. Just as walking, cycling facilitates chance meetings between friends and acquaintances, and in this way contribute to the social fabric of the city and neighbourhoods.	
Values • hedonic • gain • normative	Whereas being a cyclist can be a strong identity in several countries as being someone who is environmentalist and sporty, in The Netherlands in general and Groningen specifically cycling is regarded as a normal activity just like walking. Moreover, basically all car drivers also are cyclists, so no real chasm exists between the values of car drivers and cyclists. Whereas cycling is not considered as something very special because people are used to it, it can be noticed that Groningen people express a certain pride in their city when it comes to the success and quality of cycling and cycling infrastructure Concerning environmental values and energy conservation it can be assumed these values are not of key importance for deciding to cycle. Cycling is just too regular and convenient to elaborate too much about less noticeable effects. However, when asked people may mention environmental and energy related outcomes as values Concerning hedonic values related to car driving, the holistic traffic plans have made it increasingly difficult for car drivers to drive through the city	

| | centre. Yet it can be observed that a small group of car aficionados enjoy driving around the city centre, and entering/leaving the city centre through the roads that allow limited access. Concerning the hedonic value related to biking there seems to be a larger group of citizens enjoying the biking infrastructure as part of a relaxed city life-style. | |

2.2 Cluster 2: Island renaissance based on renewable energy production

2.2.1 Synthetic description of case interventions relevant for Energy Equality

Case: El Hierro, Spain

"El Hierro 100% renewable energies" is the energy project launched in the 90s by El Hierro (Canary Islands), which pursues the sustainable development of the island based on the production and management of renewable energies (Sustainable Development Plan, 1997). This project, promoted by the island authority, the Cabildo de El Hierro, aimed to become an energy self-sufficient territory based on renewable sources, reducing the vulnerability of the islanders. The project aimed to guarantee electricity and water self-sufficiency on the island, as well as decreasing the reduction of CO_2 emissions from fossil energies. To achieve this goal, a new energy company, "Gorona del Viento SA" was founded in 2004, which is a public-private enterprise owned by the island government with the partnership of the regional government, the Technological Institute of the Canary Islands (ITC) and the private energy company operating on the isle (Endesa). Both Gorona del Viento and the island administration have developed strategic interventions to increase the island's energy capacity and enhance renewable energy self-consumption on households, farms, public buildings and enterprises, to be able to supply the current and future electric needs of the island with renewable sources.

Construction and development of Gorona del Viento wind pumped hydropower station

The main intervention of the project consisted of the development of a wind pumped hydropower station on the island of El Hierro (inaugurated in 2015). The system is composed of two water tanks, a wind farm, a hydroelectric plant, a pumping station and a diesel engine centre. The operating philosophy is based on supplying the island's electricity demand with renewable sources, guaranteeing the stability of the electricity network. With the hydroelectric plant, it is possible to transform an intermittent energy source into a controlled and constant supply of electricity, maximizing the use of wind power. The diesel engine plant takes over when there is neither wind nor enough water to produce the demanded energy. The plant is able to supply electricity for approximately 11,000 residents, an additional number of tourists, and three water desalination facilities.

Since 2018, Gorona del Viento has become a profitable project that benefits the island's population through the distribution of share capital among Gorona's shareholders, among whom the Island government is the majority shareholder. The island government used part of these benefits to launch several pilot measures focused on enhancing renewable energies' adoption among residents and visitors. For example, increasing resident's mobility with electric cars by installing charging points on the island for electric vehicles and facilitating subsidies for residents that want to change their regular car for an electric car.

The complementary measures developed by El Hierro are described below:

- Subsidies for renewable energy self-consumption installations in farms and homes. El Hierro Council has recently launched a series of financial incentives aiming at the engagement of the population in self-consumption behaviour. For instance, the island government granted farmers, hotels and other business sectors the installation of solar panels.

- Renovation of old household appliances. Climate conditions in El Hierro allow high levels of comfort in households, while there are no heating issues due to permanent warm temperatures. However, in order to improve energy efficiency in disadvantaged homes,

subsidies were given for residents to change their old home appliances (e.g., refrigerators) for A++ and purchase energy-efficient appliances.

• Energy-saving behaviours in households. Gorona del Viento has distributed over 4,200 low-energy lightbulbs with LED technology among the Island's school population as part of the company's campaign to raise awareness of energy saving.

• Increase resident's mobility with electric cars by installing charging points on the island for electric vehicles. El Hierro has displayed a network of electricity charging points to fulfil the demand for existing electric vehicles on the island. The use of electric vehicles will prevent emissions and reduce the demand for fossil fuels on the island. The use of this electric charging network is free of charge for residents and visitors.

• Subsidies for electric mobility options. The authorities are aware that price is usually an impediment to buying an e-automobile because they are usually more expensive than combustion engine cars. Then, the Cabildo of El Hierro facilitate subsidies for residents that want to change their regular car for an electric car. Subsidies are up to €7.000 for residents that want to buy an electric car. The purchase of an electric bicycle is also subsidized.

• Energy literacy actions. Environmental educational campaigns have been also launched by both the island government and the energy plant encouraging energy-saving behaviours in schools, in the public sector and towards the general population. Gorona del Viento offers also guided visits to residents, schools and visitors, and informative material is also available in the local facilities. The plant organizes "open doors days" inviting citizens to visit the plant and see by themselves the dimension of the project and according to the promoters, "about 1,000 citizens and tourists visit the island per year including students and researchers".

Table 5 Case El Hierro: Overview of policy instruments and measures implemented

CASE-STUDY: EL HIERRO (ISLAND RENAISSANCE BASED ON RENEWABLE ENERGY PRODUCTION)		
Policy instrument	**Types of policy measures/interventions**	**Examples of policy measures**
Infrastructure and technology upgrade measures	Public and private infrastructures and technological innovations	Wind pumped hydropower station on the island of El Hierro. It consists of five wind turbines capable of producing 11.5 megawatts of wind power to supply electricity for approximately 11,000 residents, an additional number of tourists, and three water desalination facilities Installation of a network of electric vehicle recharging points distributed across the main localities in the isle and those intents to meet the demand of existing electric vehicles on the Island as well as to encourage tourists to choose this type of car
Financial incentives for the market and individuals	Financial support (Subsidies, grants, contests, awards)	Subsidies for low-income households' exchange of old home appliances (e.g., fridges) for efficient ones Subsidies for residents that want to change their regular car for an electric car (subsidies are up to €7.000) Financial support for renewable energy self-consumption facilities (e.g., solar panels, photovoltaic installations, etc.) in farms, businesses and buildings. Subsidies allowed the educational population on the island carrying on international training activities.
Consumer awareness, decision-aid, & empowerment policies	Information and education campaigns	Informative material and dissemination of news in local media, excursions with schools and associations for the elderly, specialized days with participation of social and cultural representatives of the Island, etc. The plant organizes "open doors days" inviting citizens to visit the plant and see by themselves the dimension of the project and according to the promoters Energy-saving education activities (e.g., distribution of 4,200 low-energy light bulbs with LED technology among the island's school population)
	Monitoring/ evaluation	Periodic information about the performance of the energy plant and the fulfilment of the objective of becoming a 100% renewable island

Source: Lema-Blanco & Dumitru (2019). D5.1. Theoretical framework for definition of policy scenarios. SMARTEES project.

Case: Samsø, Denmark

The case of Samsø was implemented with the purpose to achieve a renewable energy island covering 100% of its energy use from renewables. One of the leading implementations regarded the building of four district heating plants burning straw and wood chips in the villages of Tranebjerg, Norgby-Mårup, Onsbjerg and Ballen-Brundby. Financially the district heating plants made sense because even accounting for the investment costs, the heating fuel costs sustained by households were estimated to be lower than those incurred by using oil and electricity. Further, the national association for energy savings 'Energisparefonden' gave grants to consumers who converted from electrical heating to district heating (Jørgensen et al., 2007). Households received a subsidy of up to 30% of the investment when converting to solar thermal, biomass or heat pump installations if the local tradesmen employed for these conversions had the national certifications and used state-authorized units to install these systems (Jørgensen et al., 2007; Sperling, 2017).

Further actions regarded campaigns targeting heat savings: Samsø Energy Company, Samsø Energy and the Environment Office ran five campaigns targeting energy savings. These campaigned were aimed at informing and demonstrating interventions on residential buildings suitable to reduce energy consumption. One of these campaigns addressed pensioners directly and aimed at promoting the adhesion to the Danish Energy Authority grants for pensioners for energy-saving renovations in their homes. The campaign was started with a letter sent by the municipality to all 444 pensioner households on Samsø and consisted of home visits to the households whenever interested pensioners requested one. Thanks to this campaign, improvements were made to 192 houses on the island, and local craftsmen increased their revenue by more than 8 million DKK (1.1 million EUR) (Jørgensen et al., 2007). Other campaigns were aimed at all households and targeted specifically dwellings in areas not served by the district heating network. Free home visits by energy advisors were carried out in 113 homes in the villages of Ballen-Brundby, where district heating was also promoted. In this latter case, the Danish Energy Authority subsidised the campaign, which also financed the demonstration of alternative insulation materials in several houses (Jørgensen et al., 2007).

Another central area of intervention was the realization of wind turbines onshore and offshore. Eleven 1-MW windmills across 3 clusters were constructed. To facilitate public support for these wind turbines, an ownership scheme open to citizens' investment was proposed and adopted by the Samsø Wind Energy organization, which in agreement with landowners, made sure that a quota of the shares of the wind farms was reserved to the public. Further, landowners and future wind turbine owners signed an agreement to establish a fund to further other forms of renewable energy with part of the wind farms' revenue (Jørgensen et al., 2007). The Samsø project also consisted of 10 2.3MW offshore turbines. The municipality owns 5 wind turbines, while Samsø's citizens own one through a share investment scheme, another is owned by small shareholders of Samsø and three are owned by larger investors (Jantzen, 2011; Jørgensen et al., 2007). The municipality invested to reuse the revenue in further sustainable energy projects and to offset the carbon emissions produced by the island's transport sector.

On top of the sustainable energy interventions and campaigns described, the case of Samsø is characterized by a broad process of citizens' and stakeholders' participation that started from the early stage of the project. Two organizations, the Samsø Energy and Environment Office that was founded in 1997 to promote renewable energy and counselling island citizens who wishes to establish renewable energy projects and the Samsø Energy Company, which was founded in 1998 to implement the projects, organized many meetings focusing on objectives, technical solutions and finances.

It has been estimated that DKK 468 million (62.4 million EUR) were invested. 70% of the total invested came from local investors, meaning that each islander invested on average 100,000 DDK (14,000 EUR) (Caiati et al., 2019; Jørgensen et al., 2007). Clearly, this demonstrates that a vast consensus and level of involvement was achieved across all sectors of the islandic society, even though some groups, i.e., the farmers and other local businesses, led the investments besides the municipality (Caiati et al., 2019).

2.2.2 Discussion of the main impacts on Energy Equality and its related needs

Case: El Hierro, Spain

The main impact of this SI was to transform El Hierro as a frontrunner island in the implementation of self-sufficiency energy systems based on clean and renewable energy sources, fostering the social and economic development of the island with a strong commitment to sustainability. Through the project "El Hierro 100% renewable energy island", El Hierro has gained autonomy and resilience in energy supply and reduced dependence on external fossil energies. The project was able to solve the issue of renewable energy production being intermittent, which is a major problem on an island whose energy grit is not connected to any continental electricity network, as it is not interconnected with any of the other Canary Islands.

Previously, El Hierro had a weak and isolated electrical network that depended on external resources because the electricity supply of the island was dependent on a conventional thermal power plant that used diesel fuel that is transported to the island by boat. The weakness of this network jeopardized the access to electricity or water supplies in households, specifically, when climate conditions (e.g., storms) impeded boats to approach the harbour. This situation led to blackouts and limited access to drinking water on an island affected by drought in the past because water supply depends on desalination plants that use 45% of the total energy production on the isle. The project contributes also to guarantee water self-sufficiency on the island, reducing the vulnerability of islanders concerning access to basic needs such as energy and water supply.

Enhancing energy self-sufficiency and guaranteeing access to basic needs like energy and water supply**.** Gaining energy sufficiency is a major goal for the island in terms of energy equality because it allows El Hierro islanders to increase their power autonomy and reduce energy costs. Thus, pilot interventions like the subsidies destined for the improvement of the energy efficiency in disadvantaged homes, the acquisition of electric vehicles or the installation of solar panels for self-consumption in farms and wine cellars have contributed to energy equality. The financial measures adopted by the island council have increased people's accessibility to more sustainable energy-related services (e.g., e-mobility) and the adoption of renewable energies, partially overcoming the existing barriers to adoption of renewable energies in farms, vineyards and buildings by subsiding the costs of home solar power installations. However, these pilot lines of subsidies should be able to reach to a larger number of residents to have a real impact in terms of energy equality.

Fostering economic sustainability**.** El Hierro has historically suffered from "a double isolation" due to the small size of the island, peripherical within the Canary island archipelago and fully reliant on energy imports. El Hierro low level of economic development is strongly dependent on the primary sector (agriculture, fishing). Moreover, the lack of natural resources like water historically forced dramatic periods of emigration, decreasing the number of inhabitants on the isle. In specific, young generations had to emigrate to other islands or even other countries. The key informants participating in the

interviews conducted in SMARTEES emphasize that this SI guarantees the island population to live and work on the island and also, to permit new generations to come back to their family's homeland.

The Gorona del Viento energy plant has become crucial for job creation and economic development. It employs a significant number of people in plant exploitation (for example, the high school of the island has implemented new programs training students in electrotechnical and automated systems that later enter to work for the plant). Since 2015, when the plant commenced its normal operation, a tourism activity linked to science was raised on the island with thousands of visitors (researchers, students, regular tourists) attracted by its innovative facilities, which has a positive impact on the local economy. Then, Gorona del Viento has become a new attraction for people who travel to the island due to the interest generated by this project.

Satisfying the need for environmental quality. According to the promoters, local politicians were concerned about the development of other Canary Islands in the 90s (e.g., Tenerife, Gran Canaria), based on tourism and land occupation for housing and tourism development. To preserve El Hierro's environmental quality, they were convinced that the economic development of the isle should be based on natural conservation and sustainable exploitation of its natural resources. Thus, the reduction of carbon emissions from energy production based on renewable energies, as well as a decrease in car emissions by substituting automobiles with electric cars is considered a main impact of this SI.

In terms of reduction of contaminant emissions, the promoters estimate that Gorona del Viento has saved more than 24,000 tonnes of CO_2 emissions and more than 7,000 tonnes of diesel fuel that no longer needed to be consumed by the isle in 2018 and 2019. However, these impacts depend on windmill energy generation, which is fluctuant, depending on the wind sources. Further, the network of electric vehicle recharging points distributed across the main localities in the isle intends to meet the demand of existing electric vehicles on the island as well as to encourage tourists to choose this type of car. As the use of this network is free of charge, it also reduces the transport costs for residents and visitors. However, this SI is still under development and becoming a zero-emissions isle has not been achieved yet.

Fulfilling citizens´ pro-environmental values. El Hierro has been historically a sustainable and self-sufficient island due to its isolation from the archipelago and the peninsula. The islanders are very sensitive to environmental issues, being pioneers, several decades ago, on sustainable fishing or organic agriculture. El Hierro focuses its economic development on building a community with high rates of autonomy, self-sufficiency, cultural and human development, aiming to "live in harmony and balance with nature" (El Hierro, 1997). Therefore, the energy project of Gorona del Viento builds upon these pro-environmental values and strengthens the island commitment to biodiversity conservation. It fosters rapid energy transition to renewable energies and enhances air quality by reducing greenhouse gas emissions and fossil fuel dependence.

Finally, this SI has contributed to fulfilling citizens´ need for recognition and prestige. Gorona del Viento is perceived as positive for strengthening the identity of the island as a sustainable place and a pioneer territory in renewable energies. External recognition gained by the energy project is a source of pride for the promoters (and a majority of the islanders) who highlight that the project is being replicated by other islands and territories in the world (an example is the isle of Gran Canaria, also in the Canarian archipelago). El Hierro has received interest from Japan and Indonesia, and the press covered the visits of representatives from Seychelles, Indonesia, Japan, and Aruba (Caribbean Sea), in specific from countries that are interested in starting an energy transition based on renewable energies and want to learn from El Hierro experience.

Case: Samsø, Denmark

Existence/sustenance needs
Regarding existence and sustenance needs, the social innovations implemented had an impact chiefly allowing citizens to have domestic energy, particularly for heating purposes, at a lower energy bills level than before. Importantly, this would reduce the gap between heating costs on the island and elsewhere in Denmark, where 80% of homes are supplied by district heating (Danish Energy Agency, 2021), while on the island of Samsø, many homes were supplied by dirtier and more expensive individual oil burners. Even for many homes not supplied by the district heating local projects, it was possible to benefit from grants covering up to 30% of the cost to install individual biomass and solar thermal systems.

Further, the significant investment of the municipality in the offshore wind turbines development has created revenue that the municipality can use for further sustainable energy services and investments that otherwise might never happen, thereby allowing a rural community comparably, on average, less wealthy than many inland Danish municipalities to sustain local investments.

In addition, the interventions carried out are estimated of having 20 person-years of employment per year in the period 1998 – 2007 only, through a total investment of about 425 million DKK (57 million EUR) (Jørgensen et al., 2007). Further investments that happened following that date are not accounted for in this estimation; therefore, the impact on the local job creation is undoubtedly higher. It was also reported that the project had generated a new form of renewable energy tourism interested in Samsø's experience, thereby strengthening the already existing local tourism industry and increasing its revenue (Jørgensen et al., 2007).

Social needs
The interventions were promoted in Samsø through a highly participatory process that was implemented through many meetings arranged by several organisations now gathered under the umbrella of the Energy academy and with the involvement of the municipality. The meetings allowed Samsø's residents and business owners to have a say on the project since its inception and throughout its development. This participatory model is still ongoing and aims at keeping residents up to date and involved with the most recent developments, while new methods like social media platforms for involving younger and new residents are now considered and explored, as emerged in the SMARTEES workshops held with stakeholders of the project (see D5.2, Dumitru et al., 2021). Further, the involvement of many residents and business owners in community ownership schemes for the district heating plants and wind turbines has implied that many residents are serving as members of the boards of the community companies. This highly participative model has undoubtedly facilitated opportunities to support the satisfaction of needs such as relatedness, belongingness to the community and, more generally, community cohesion; even though the participatory process described is not per se an energy intervention, it was nevertheless ancillary to sustainable energy interventions.

Another intervention that has contributed to fulfilling the social needs of the island has been the construction of the building of the Energy Academy in 2006, which serves as a community hall for meetings regarding the sustainable energy interventions on the island.

Values-based needs
The interventions allowed Samsø's citizens to practice their environmental values and their place attachment while at the same time chasing their goals of reviving the declining economy.

Our interviews and workshops (reported in D3.1, Caiati et al., 2019, and D5.2, Dumitru et al., 2021) reported that place attachment was an attitude displayed by residents in Samsø, where it was made clear that the community is quite cohesive and connected. This place attachment might have translated in a sense of duty on the part of the citizens of Samsø to act to reverse the decline of the economic and demographic situation that the island was suffering and that an agency like the Samsø Development Office sought to address (Jørgensen et al., 2007). In this respect, the job creation generated and, more generally, the successful interventions, particularly the district heating plants and the wind farms, might have given a chance to many Samsø's residents to feel a sense of accomplishment of their normative values to act in favour of their own community.

On a more individual level, gain goals related to the necessity to find work for some otherwise declining local businesses and the wish to save on fuel bills have undoubtedly strengthened the motivation of citizens, as the SMARTEES workshops highlighted (Dumitru et al. 2021); in this respect, the achievements in terms of job creation for tradesmen have certainly supported gain goals that some might have had.

Table 6: Case El Hierro: impacts of the SI on EE

Needs	SIs affecting equality through <u>direct energy consumption</u> interventions	SIs affecting equality through <u>embodied energy consumption</u> interventions
Existence/ sustenance • physiolo-gical • safety	• Gorona del Viento satisfies the island's electricity demand with renewable sources, guaranteeing the stability of the electricity network and reducing community vulnerability. • Satisfaction of need for water resources • Improving energy efficiency in disadvantaged homes (public funds for renovation of old household appliances) • Subsidies for renewable energy self-consumption installations in farms and homes	• Provision of a network of electricity charging points to fulfill the demand of existing electric vehicles on the Island • Subsidies for electric mobility options • Reducing energy consumption by subsidizing e-cars and e-bikes purchase. • Fostering economic sustainability (direct job creation and fostering touristic activity) • Energy-saving behaviours in households: distribution of over 4,200 LED lightbulbs
Social • belonging-ness • relatedness		• Increase the community need for recognition and prestige: Gorona del Viento is perceived a positive for strengthening the identity of the island as a sustainable place and a pioneer territory in renewable energies
Values • hedonic • gain • normative	• Conservation of environmental quality and climate change action: reduction of CO2 emissions • Fulfilling citizens´ pro-environmental values	• Actions providing energy literacy and raising awareness for reducing direct use of energy • Awareness campaigns

Table 7: Case Samsø: impacts of the SI on EE

Needs	SIs affecting equality through <u>direct energy consumption</u> interventions	SIs affecting equality through <u>embodied energy consumption</u> interventions
Existence/ sustenance • physiolo-gical • safety	• Energy poverty (fuel poverty) targeting actions District heating plants, campaigns to upgrade heating systems and subsidies (up to30%) on household heating systems' renovation, were all measures that contributed to reducing heating costs and possibly energy poverty • Jobs creation The interventions were sustained by a significant investment that generated 20 person-years of employment per year in 1998 – 2007 only, certainly more considering the following years.	
Social • belonging-ness • relatedness	• Participatory activities regarding Sis Meetings with residents and stakeholders for the discussion and co-creation of interventions were held since the start of the project and are ongoing • Energy community schemes Community ownership was developed for some of the district heating plants and some offshore turbines. This has led many citizens to serve on the boards of the companies and, more generally, to take up a more active role, thereby interacting with fellow residents and strengthening community networks	• Actions to improve the availability and quality of public spaces for socialising The building of the Energy Academy was built in 2006, and it serves as a community hall for meetings regarding sustainable energy interventions on the island
Values • hedonic • gain • normative	Actions providing education/ information on direct energy consumption have strengthened normative pro-environmental values Awareness campaigns have been carried out, particularly regarding sustainable energy upgrades in residential buildings More generally, the many meetings organised with residents and stakeholders have raised awareness on the environmental issues of the island	

	The sustainable energy interventions carried out fostered a sense of pride, thereby strengthening the already present feelings of place attachment	
	Some specific interventions, particularly regarding district heating and wind energy, were good opportunities for income generation for local companies and farmers, thereby fulfilling the gain-oriented values of some individuals	

2.3 Cluster 3: Alliance for a district regeneration based on energy transition

2.3.1 Synthetic description of case interventions relevant for Energy Equality

Case: Augustenborg, Malmö, Sweden

Augustenborg was a neighbourhood that was run down and not a popular place to live. There were both social and economical problems in the neighbourhood and especially flooding was a recurring issue. The City and municipal housing company MKB wanted to do something about this and created the concept of "Ekostaden Augustenborg" (the Environmental city of Augustenborg), starting from 1998. The primary intervention was a combination of an aware decision to have the residents involved from the start in an ambition to not only lift the neighbourhood status to match that of other neighbourhoods in Malmö but to make it into an ecological "demonstration site" which would become highly attractive for residents.

A dedicated team and a communication officer were assigned to the area to connect with the residents and ensure that they were actively involved in the change process. A participatory process was started to provide input into some of the technical issues in the project such as improving the drainage to fix the flooding problem, energy efficiency of buildings, electric street trains, and recycling of waste. In addition, local people were involved in identifying their own ideas and opportunities, leading to later initiatives such as the solar energy programme, or measures to decrease heavy traffic in the area and the community carpool. At a later date, MKB built a new house in the neighbourhood called "the Greenhouse" in which people could apply to become residents while agreeing to contribute to the "green profile" of the new building in particular, but also to the neighbourhood in general. The Greenhouse was also part of a car-sharing solution that was included in the rent (obligatory, and you were not allowed to own your own car) and also had electric transport bikes accessible. The Augustenborg residents were involved throughout a deep participatory process and gave input on the open water solutions and the upgrade of the buildings. Gardening courses to grow vegetables in the neighbourhood public green areas were held, and also dialogue meetings for resident participation in the general transformation from a run-down neighbourhood with problems and into the "Environmental city of Augustenborg". The neighbourhood had a run-down centre which was considerably improved, and local businesses were offered to move in with a subsidised rent level to encourage local initiatives.

Notable in the process was that it instigated initiatives from residents starting off their own businesses, such as an immigrant woman who started her own child daycare centre that was flexible with regards to whom could use the service and why, and their support of sustainable local business initiatives (such as gardening services).

Case: Järva, Stockholm, Sweden

The primary intervention carried out in Järva regards the refurbishment of flats owned by Svenska Bostäder, the municipality-owned building company of Stockholm. These renovation interventions sought to improve, among other aspects, the energy efficiency of 350 flats in seven building blocks of the neighbourhood to halve annual energy consumption from 180 to 88 kWh/m^2 (Environment and Health Administration, 2010). Further interventions regarded sustainable mobility, specifically refurbished cycle paths and a "loan-a-bike" facility in Akalla, along with cycling courses.

One of the most significant interventions was the development of the "Järva Dialogue", which was developed as a response to the negative reactions of an initial letter that went out to residents stating that they would have to move out of their apartments for the energy upgrading that was going to be carried out. People protested, and the city and municipal housing company took a step back, realizing that the Järva neighbourhood residents had a strong place attachment and needed to be involved in the whole process. This process happened through hiring a special communications officer and involving residents in a deep participatory process where residents were not only invited to decide about the energy upgrades and voting for different levels of "standards", which reflected rent levels but also being involved in a general improvement of the neighbourhood as a whole. Each house block had designated households that were responsible for informing the other tenants in their house and that also presented three different levels of upgrades for the buildings and shared areas. These levels were put to a vote and were only implemented if they got a majority amongst all tenants. Each household was also allowed to make personal choices for their own flat, and their voluntary extra choices, if any, of upgrades that gave a higher standard was reflected in their personal rent level for the flat.

The Järva dialogue consisted of events arranged for the discussion and co-creation of the interventions to include all residents recruited through existing social networks in the neighbourhood. The meetings were arranged at family-friendly hours to include also families with small children and with the information included in different languages Discussions and reflections on energy consumption and environmental issues were also part of the Järva dialogue thereby facilitating behavioural change towards energy-saving practices.to facilitate the participation of attendants. Discussions and reflections on energy consumption and environmental issues were also part of the Järva dialogue thereby facilitating behavioural change towards energy-saving practices.

Special efforts to include women of immigrant background and children in the SI's actions included bicycling courses and workshops to improve the feeling of safety in the neighbourhood, and they helped to turn a negative first communication into a deep, long-term engagement amongst the residents. Thanks to the implemented energy solutions, the neighbourhood has transformed considerably, and the social interventions have generated an increased feeling of safety and well-being.

2.3.2 Discussion of the main impacts on Energy Equality and its related needs

Case: Augustenborg, Malmö, Sweden

Existence/sustenance needs
The interventions have resulted in a considerably more popular neighbourhood and are now a showcase for greening neighbourhoods and for open-water management solutions which contributed to satisfaction of existence/sustenance needs. With regards to distributional justice, new local businesses have developed and are driven by residents. Also, the new "Greenhouse" showcases a version of a "future sustainable house". Local initiatives were encouraged in this process and a child/youth club service was set up by a local resident to enable people who were studying or in skills training to find the time to develop their careers. Local growing of vegetables is now managed by the residents themselves, and also the "Greenhouse" has its own growing of vegetables included in the concept. Beehives are placed on the "Greenhouse" roof and are managed by the residents. Part of the hot water and electricity demand is now met by solar energy, a mixture of hard and soft measures that have contributed to decreasing heat and hot water use in existing buildings. Heavy traffic through the neighbourhood has decreased significantly.

Social needs

The sustainable measures and participation interventions have also contributed to the improved integration of vulnerable groups, based on an aware approach to change the general impression of the neighbourhood into that of an attractive green neighbourhood without contributing to gentrification. Existing residents were invited into the whole change process, and even though the newly built "Greenhouse" largely hosts residents who are originally from other neighbourhoods, it has largely become part of the neighbourhood and is a showcase for local green solutions.

Values-based needs

A much-improved general impression of the neighbourhood was achieved and especially for the outdoor open water solutions; which contributed along with sustainable energy interventions to increase the pride of the community and its perception of self-worth because the sustainability profile of interventions would be consistent with normative environmental values and the place attachment of residents, hence supporting the satisfaction of values-based needs.

Case: Järva, Stockholm, Sweden

Existence/sustenance needs

The interventions have resulted in a perception of increased safety in the neighbourhood, thereby contributing to the satisfaction of existence/sustenance needs; this was achieved by implementing better lighting in public places and shared facilities and refurbishing the building blocks' entrances to make them perceived as safer.

On the level of distributional justice, the project's achievements should not be understated. Halving the energy consumption of flats per square meter has significantly reduced energy bills, thereby reducing costs for tenants, an important aspect, considering that the Järva neighbourhood has a relatively low-income resident population. Further, these upgrades have meant that the residents had access to energy technologies, like solar PV panels, that otherwise would have been likely inaccessible due to their investment costs. These sustainable energy interventions in Järva's blocks of flats arguably contributed towards the satisfaction of existence/sustenance needs, making energy access cheaper for Järva residents.

Social needs

The sustainable mobility and participation interventions have also contributed to the improved integration of vulnerable groups, especially women from different cultures living in the area that now appear to be participating more in the neighbourhood. The local participation generated by the Järva dialogue process during the project appears to have increased participation in the general elections and decreased the "distance" between the housing company and its residents, again supporting residents to fulfil social needs of relatedness and integration.

Sustainable mobility interventions, like refurbished bike paths, bicycle courses, and a loan-a-bike facility in Akalla (Järva), fostered the mobility of vulnerable groups, particularly women, while supported more generally the relationships of the individuals who took up cycling and could reach farther distances and thereby interact with more subjects for leisure or work.

Values-based needs

A much-improved general impression of the neighbourhood was achieved and especially for the facades and outdoor areas; this contributed along with sustainable energy interventions to increase

the pride of the community and its perception of self-worth because the sustainability profile of interventions would be consistent with normative environmental values and the place attachment of residents, hence supporting the satisfaction of values-based needs.

Gain oriented individuals would possibly consider the cost-free interventions as improving their living conditions and delivering savings on future energy bills. Indeed, additional costs were a concern at the time of the initial protests, which was also defused thanks to clarifications regarding the costs of interventions.

Table 8: Case Malmö: impacts of the SI on EE

Needs	SIs affecting equality through <u>direct energy consumption</u> interventions	SIs affecting equality through <u>embodied energy consumption</u> interventions
Existence/ sustenance • physiolo-gical • safety	Energy poverty (fuel poverty) targeting actions: • Improved insulation of the houses • Installation of solar panels on house roofs Actions towards increasing personal safety perception: • Leading heavy transport away from the neighbourhood (city planning) • More accessible and enjoyable public outdoor spaces • Building a modern and accessible laundry room for all residents of the "Greenhouse" building. • Including a bike-repair unit next to the laundry room in the Greenhouse building. • Rejuvenating the center so it includes sustainable local business (who get subsidised rents)	Provision of goods or services that support basic needs satisfaction: • Upgrading the houses in general to improve resident satisfaction • Open-water solutions with ponds and green areas • Improved laundry rooms and garden sheds for tools et cetera. Provision/Refurbishment of public housing: • General face-lift of the neighbourhoods and public areas
Social • belonging-ness • relatedness	Actions favouring mobility for family and social relations: • Improvement the public areas with local growing of vegetables • Participatory activities regarding SIs • Events for the discussion and co-creation of interventions were arranged through the participation process. Involving residents directly and also through existing social networks in the neighbourhood Discussions and reflections on energy consumption and environmental issues	Actions to improve the availability and quality of public spaces for socialising: • Refurbishment of public spaces in general • Rejuvenation of the center with subsidized rents for local businesses. • Improvement of the neighbourhood with particular focus on not contributing to gentrification

	was included as part of public meeting targeting the residents.	
Values • hedonic • gain • normative	Actions providing education/ information on direct energy consumption: • All households were provided with information on how to reduce direct use of energy Other energy-related actions that might increase the community "pride", place attachment, or perceived self-worthiness of the community: • The refurbishment of the houses – a visual face-lift of the buildings • The installment of solar panels • General face-lift of the area with regards to public spaces, especially the open water solutions and local growing of vegetables.	Actions providing education/information and raising awareness on embodied energy consumption: • As part of the participatory process, the households were given information on energy saving measures

Table 9: Case Järva, Stockholm: impacts of the SI on EE

Needs	SIs affecting equality through <u>direct energy consumption</u> interventions	SIs affecting equality through <u>embodied energy consumption</u> interventions
Existence/ sustenance • physiolo-gical • safety	Energy poverty (fuel poverty) targeting actions: • Improved insulation of the houses • Installation of solar panels on buildings' roofs • Actions towards increasing personal safety perception: • Installing better lighting in public areas of poor lighting • Improving the access and lighting of the laundry rooms to support the feeling of safety	• Replacement and upgrading of white goods and the kitchens in residential units • Improved bike paths in the area • Improved laundry rooms, including their entrances to improve visibility and increasing perceived safety. • Restructuring of the square, so women do not feel they are being watched from cafes around the square and when leaving or entering the subway • General face-lift of the neighbourhood and public areas, including removing obstacles, improving lighting and other elements that contribute to feeling unsafe. • Rebuilding of the buildings' entrances to improve visibility to increase perceived safety
Social • belonging-ness • relatedness	Actions favouring mobility for family and social relations: • Bicycle courses for all but especially targeting women • Biking facilities were improved considerably, and lighting as well. • Improvement of bike paths	Actions to improve the availability and quality of public spaces for socialising: • General upgrading of apartments standards to improve resident satisfaction • Refurbishment of public spaces in general • Restructuring of the square to improve access for all residents without the unsafe feeling • Participatory activities for the discussion and co-design of sustainable energy interventions in the residential buildings (Järva dialogue)
Values • hedonic • gain • normative	Actions providing education/ information on direct energy consumption: • All households were provided with information on how to reduce the direct use of energy • Awareness campaigns were included in the Järva dialogue Other energy-related actions that might increase the community "pride", place attachment, or perceived self-worthiness of the community: • The refurbishment of the houses – a visual face-lift of the buildings	Actions providing education/information and raising awareness on embodied energy consumption: • As part of the Järva dialogue, the households were given information and courses in reducing their carbon footprint.

	• The installation of solar panels • General face-lift of the area with regards to public spaces, walking and cycling-paths, lighting and a restructuring of the square to improve the feeling of safety and community.	

2.4 Cluster 4: Urban Mobility with Superblocks

2.4.1 Synthetic description of case interventions relevant for Energy Equality

The Superblocks model in both Vitoria-Gasteiz and Barcelona reference cities draws upon Salvador Rueda's "Ecological Urbanism" approach that sustains those public spaces, considering all city living space should be planned to maximise the public areas available for citizens' daily uses. The Superblocks model claims a more "accessible, comfortable, safe, and multifunctional public space where people can be citizens and exercise in the public space the rights to interchange, culture, leisure, expression, and demonstration, besides the right to move" (Rueda, 2019[3]). Thus, this SI is conceived as the basis for municipal policies to enhance the ecological, social and economic urban sustainability while:

> "A typical superblock will consist of a three-by-three-block square made from nine existing blocks. Circulating traffic will be limited to the streets on its perimeter. Intersections at every 400 meters (1,300 ft) will maintain steady traffic flow and allow development of nodes to intersect with the bus and bicycle networks. Within the superblocks, cars will be limited to ten kilometres per hour (6 mph) and restricted to one-way lanes" (Source: Urbanland, 2017[4])

Case: Barcelona, Spain

Barcelona is a dense and compact Spanish city that faces environmental and public health issues, such as high air pollution levels, traffic noise, traffic injuries, lack of green areas, and few spaces that are suitable to establish relationships between residents (Paléncia et al, 2020). The impact of motorized traffic on the health of the population was studied in the Metropolitan Area of Barcelona. For example, in a study conducted in 2007, it was estimated that air pollution caused 3.500 premature deaths per year, 5.100 cases of chronic bronchitis in adults, 31.100 cases of children bronchitis, and 54.000 asthma attacks among children and adults (Künzli and Pérez, 2007). The same study points to a clear impact of the car traffic on the morbidity of the citizens of Barcelona. Further, black asphalt and car emissions are responsible for the urban heat island effect, which increases the temperature more than 2° (during summer, 5°), which is especially painful, and in several cases mortal, for the most vulnerable people, elderly, children, and sick people, particularly when heat waves occur because of climate change (Rueda, 2019).

To tackle the aforementioned challenges, in May 2016, the Barcelona city council approved the measure "Omplim de vida els carrers" (*"let's fill streets with life"*), to expand the superblocks across the city. The transformative ambition of the Superblock Model in Barcelona is to re-design the city´s neighbourhoods to foster a reappropriation of urban space by residents. The plan is being implemented by the Municipality of Barcelona, which formed a technical secretariat to lead the programme, receiving also technical support from other municipal areas, neighbourhood stakeholders, residents' associations, specific groups of interests, district NGOs and third-sector entities.

Barcelona city is planned to be organised into 503 superblocks. The main interventions in these superblocks concern urban planning measures that foster low carbon mobility patterns in cities by reversing the current distribution of public areas between vehicles and people, establishing a new

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[3]Source: Rueda S. (2019) Superblocks for the Design of New Cities and Renovation of Existing Ones: Barcelona's Case. In: Nieuwenhuijsen M., Khreis H. (eds) Integrating Human Health into Urban and Transport Planning. Springer, Cham. https://doi.org/10.1007/978-3-319-74983-9_8

[4] Source: https://urbanland.uli.org/planning-design/barcelonas-experiment-superblocks/#

hierarchy for the distribution of mobility in the city, giving priority to the city residents. As stated by Barcelona City Council:

> "The prevailing criteria used here underscore what is already in existence: public spaces as a common asset; protecting neighbourhoods from through traffic; reducing pollution and accidents; strengthening pedestrian rights and social cohesion. On the other hand, re-naturalising new public spaces with planted elements (tactical urbanism) and soft (permeable) surfaces is another important factor for the urban design of these new spaces. This enables us to deal with the problem of increased and excessive impermeability in urban areas." (Barcelona city, 2018: C40blog).

To date, five superblocks have been fully or partially implemented (Sant Antoni, Poblenou, Horta, Hostafrancs, Les Corts-La Maternitat i Sant Ramón) and participatory processes have been organized for the co-definition of three more superblocks (Girona i entorns, Consell de Cent-Germanetes, and Sant Gervassi de Cassoles). Barcelona's superblocks programme is taking a step ahead in 2021, aiming at the creation of a network of green areas where pedestrians have priority. This new vision will be first applied in the Eixample district (Cerdà section), transforming the area into 21 green streets and 21 new squares. Eixample will gain a total of 33.4 hectares of new pedestrian areas and 6.6 hectares of urban green areas in the current densest district in the city, which suffers from the most pollution and noise. The outcomes of the superblocks programme have been assessed in three pilot interventions, measuring positive outcomes in the following dimensions: improvement of environmental and public space conditions, increase in green areas, enhancement of social activity and social interaction in the neighbourhood. El Poblenou's Superblock received a "special mention" at the 2018 European Prize for Urban Public Space.

Briefly, the relevant interventions developed in the city of Barcelona are listed below:
- Participatory framework and stakeholder engagement in urban planning. Barcelona organizes participatory processes with the purpose to involve residents, social and economic actors in the co-design of the superblock. A "promoting group" is established in each superblock involving a series of stakeholders, social and political actors in the definition of the actions and measures to be adopted, which leads to the approval of the "Superblock Action Plan." Furthermore, a series of participatory meetings with residents and neighbourhood associations facilitates citizens' participation in the designing of the plan.

- Infrastructural measures. Once the action plan is approved, infrastructural interventions (structural and tactical urbanism) are implemented. These interventions aim to transform public spaces dedicated to car use into new social and green spaces (urban furniture, green infrastructures and nature-based solutions). Interventions pursue also increasing the level of the walkability of the area and incentivising pedestrian and bicycle traffic. Pedestrian networks and green networks are enhanced through superblocks.

- Improvement of public transport services and active mobility facilities. Bike lines and actions fostering the connectivity of the city are infrastructural and technological measures adopted in the city like completing more than 200km of bike lanes and implementing a new 'orthogonal' bus network for the whole city.

- Monitoring and evaluation. Barcelona assesses the impact at the superblock level, developing a system of indicators to measure the results in terms of public space, green areas, environmental quality, and citizens' perception of health impacts.

Table 10: Case Barcelona: Overview of policy instruments and measures implemented

CASE-STUDY: BARCELONA (URBAN MOBILITY WITH SUPERBLOCKS)		
Policy instrument	**Types of policy measures/interventions**	**Examples of policy measures**
Normative and regulatory approaches	Technical and regulatory documents	Public commitments: The "Barcelona Mobility Pact" Council of Barcelona Government measure: "Let's fill streets with life. Establishing Superblocks in Barcelona" (2016). Barcelona Urban Mobility Plan for 2013-2018 Barcelona Green and Biodiversity Plan for 2020
	Obligation schemes	Low-speed zones in superblock areas Car circulation prohibition in some streets inside the superblock
Infrastructure and technology upgrade measures	Public and private infrastructures and services	Infrastructural and tactical urbanism measures in superblocks restricting car mobility, prioritizing active mobility and public areas for pedestrians Modification of public transport services related to the mobility inside superblocks and increase connections between superblocks and other areas of the cities Enlargement of the cyclist mobility network across the city E-bike programs and increase the offer of public bicycles in the city Green infrastructures in superblocks
Consumer awareness, decision-aid, & empowerment policies	Participatory approaches	New model of organizing the general public's participation, pursuing the "co-responsibility" of residents in the co-designing of the superblock in each area and the definition of the Action Plan.
	Monitoring/evaluation	Ad-hoc assessment tools with a system of indicators for the impact assessment grouped in five domains: Habitability, Mobility, Green spaces and biodiversity, Economic activity, and Demography The Barcelona Health Agency are conducting a specific study to measure the impact of the superblocks on beneficiaries and neighbours' health

Source: Lema-Blanco & Dumitru (2019). D5.1. Theoretical framework for definition of policy scenarios. SMARTEES project.

Case: Vitoria-Gasteiz, Spain

In Vitoria-Gasteiz, the Superblocks Model has been defined in the 'Sustainable Mobility and Public Space Plan' (2007) elaborated by the Council of Vitoria-Gasteiz, which establishes a hierarchical outline that conditions every public space intervention or road regulation (in accordance with the "superblocks" distribution). The overall goal is to implement the superblock model at the whole city level. Thus, the plan organizes urban mobility through a network of main roads along which all private and public motorized vehicles (cars, buses, trams, taxis) circulate while traffic is discouraged in the inner streets of each superblock through vehicle access restrictions and traffic-calming measures. The actions in the three complete superblocks were more integral in terms of the reformation and pedestrianization of streets and squares. Since the 2008 financial crisis, more economic solutions ("tactical urbanism") were put forward which did not entail the complete reformation of the street, but more than fifty streets benefited from traffic-calming measures and new cycling lanes.

Several relevant actors and stakeholders participated in the Sustainable Mobility and Public Space Plan' at different stages. Local politicians and city stakeholders signed first the 'Citizens' Pact for Sustainable Mobility' (2007). A series of participatory meetings with residents and neighbourhood associations facilitate information and citizens' participation in the designing of the new public transport system (2009). Simultaneously, traffic restrictions and new parking regulations were implemented in the central superblocks (2009-2012), despite the resistance and protest received from the retail sector and businesses allocated in the affected areas. The political consensus guaranteed that the superblock's plan was developed and sustained over time. Citizen participation was articulated through the 'Sustainable Mobility Forum,' a deliberative body in which the different mobility policies are presented and discussed, receiving feedback from local associations, citizen's platforms and individuals that join the forum.

To date, three superblocks (Central, Sancho El Sabio and Médico Tornay-Judimendi superblocks) have been completed and actions have been implemented in 20 of the 77 superblocks scheduled in the Plan. Five more interventions are planned to be implemented in the period 2021-2023 (in the Zabalgana neighbourhood). The evaluation and assessment of the plan report the positive impact of mobility policies on the environmental quality of the city due to the relevant decrease in the use of private cars and the increase in sustainable transportation inside the city (public transport, bicycle, walking). Besides, superblocks have become calm areas for spare time, shopping or sports and population claim the extension of the plan to new areas of the city. Vitoria-Gasteiz was awarded the title of "European Green Capital" (2012) as well as the "UN Global Green City Award" (2019). The Plan for Sustainable Mobility and Public Space was rated "Best Practice" by Un-Habitat.

Briefly, the relevant interventions developed in the city of Vitoria-Gasteiz are listed below:

● Normative and regulatory approaches. The Sustainable Urban Mobility and Public Space Plan (Vitoria-Gasteiz) includes restrictions to car circulation inside superblocks, accompanied by tax measures (e.g., car parking restrictions or increasing parking fees).

● Infrastructure and technology upgrade measures. Infrastructural interventions for the improvement of public transport services, bike lines and actions fostering the connectivity of the city with perimetral suburbs and surrounding industrial areas are measures adopted in Vitoria-Gasteiz.

● Consumer awareness, decision-aid and empowerment measures. In Vitoria-Gasteiz, several communication strategies were defined by the City Council for gaining social support and changing citizens' patterns of mobility behaviour. First, under the claim "I join. It's worth it!" a communication and behavioural change campaign was launched inviting the citizens to

participate in the plan. This campaign included advertising in newspapers, bus shelters, radio and the Internet. Besides, an "ambassador group" was formed, consisting of volunteers from the Vitoria-Gasteiz City Council, the Environmental Studies Centre as well as students from the University of the Basque Country. The city council has organized a series of environmental education activities to raise awareness on mobility and the sustainable use of transport, as the "European Car Free Day" (since 2000) or the "European Mobility Week". Bike driving courses in schools focused on increasing youth population competencies for cycling on streets and interurban roads.

● Citizen, political and expert engagement in mobility planning. In Vitoria-Gasteiz, a specific participatory body, the Sustainable Mobility Forum engaged public and private actors, experts, and individuals in the co-designing of the Sustainability Mobility and Public Space Plan. Furthermore, a series of participatory meetings with residents and neighbourhood associations facilitate citizens' participation in the designing of the Plan.

● Monitoring and evaluation measures. Vitoria-Gasteiz publishes impact reports of the Sustainability Mobility Plan at the city level and conducts periodic surveys measuring citizens' patterns of mobility and satisfaction with public transport and mobility facilities. Barcelona assesses the impact at the superblock level, developing a system of indicators to measure the results in terms of public space, green areas, environmental quality, and citizens' perception of health impacts.

Table 11: Case Vitoria-Gasteiz: Overview of policy instruments and measures implemented.

CASE-STUDY: VITORIA-GASTEIZ (URBAN MOBILITY WITH SUPERBLOCKS)		
Policy instrument	**Types of policy measures/interventions**	**Examples of policy measures**
Normative and regulatory approaches	Technical and regulatory documents	Public commitments: 'Citizens' Pact for Sustainable Mobility' (2007) Sustainable Urban Mobility and Public Space Plan The update of the Municipal Ordinance of Traffic and Circulation restricting motorized traffic inside the superblocks (with exceptions) Drafting of the Ordinance of Cyclist Mobility Drafting of the Special Plan of Cycling Lanes
	Obligation schemes	Low-speed zones in superblock areas Car circulation prohibition in some streets inside the superblock
	Penalization measures	Increase of the parking fees in the superblocks
Infrastructure and technology upgrade measures	Public and private infrastructures and services	Infrastructural and tactical urbanism measures in superblocks restricting car mobility or speed limits providing safer roads for bikes and pedestrians New green areas in superblocks

		New tramway lines and renovation of the city's public transport system
		Main cyclist mobility network
		Increase the offer of bicycle parking in the public streets as well as commercial areas, public institutions, industries, and other private activities
	Technological innovations	Information System for the management of the infrastructures of cyclist mobility
		Design and development of the computer application for managing the bicycle registration system
Consumer awareness, decision-aid, & empowerment policies	Information and education campaigns	Campaigns related to the bicycle: "Bicycles are for all year"; Vitoria-Gasteiz bicycle week; photography competition "Vitoria-Gasteiz, the bike and you"; bike campus campaign
		Communication of the new regulation regarding the use of bicycle
	Consumer empowerment initiatives	Courses for the use and maintenance of urban bicycles.
		Road safety education campaign in school centres
	Participatory approaches	Public participatory bodies: 'Sustainable Mobility Forum'
		Participatory processes before the implementation of the Sustainability Mobility and Public Space plan, aiming at neighbourhood and residents' participation in the design of the measures adopted in the plan
		Ongoing participatory process about the revision of the Sustainability Mobility and Public Space plan (2019)
	Monitoring/evaluation	Elaboration of 'Evaluation report of the Sustainable Mobility and Public Space Plan and the Master Plan for Cyclist Mobility of Vitoria-Gasteiz. 2006-2016'
		Municipal survey on mobility patterns (panels and telephone survey conducted every 4 years)
		Elaboration of the report on the status of cyclist mobility
		Annual revision of the Cyclist Master Plan

Source: Lema-Blanco & Dumitru (2019). D5.1. Theoretical framework for definition of policy scenarios. SMARTEES project.

2.4.2 Discussion of the main impacts on Energy Equality and its related needs

The Superblocks model contributes to energy equality and contributes to the achievement of the Sustainable Development Goals (UN 2015), in specific the SDG 11 that defines a sustainable city and community development as a pressing issue and leverage point to overcome global challenges related to climate change, environmental degradation, inequality, poverty, prosperity and justice (Mueller et

al, 2020). Confronting the current model of urban mobility which dedicates most of the public space to road transport, superblocks maximize the rate of public space dedicated to citizens´ liveability. Superblocks are more comfortable places, which democratize the accessibility to healthy and comfortable places to live and stay in, with independence of the economic development of these areas or the affordability of the residents (especially if this SI is developed in deprived areas).

Concerning the main impacts of the SI, new patterns of mobility were reported by the participants in the qualitative study conducted in SMARTEES. Both Vitoria-Gasteiz and Barcelona have increased the rates of use of the bicycle (instead of private car/motor bikes), especially among people who work in other areas of the city, children and young people while elderly people walk around car-free streets. By improving the walkability and bike connectivity within and among the different city districts, Vitoria-Gasteiz reduced the distances for citizens and made the urban develop around the neighbourhood area without the need for a private car, which becomes an experiential need that this SI fulfils.

Satisfaction of the need for safety. Superblocks have produced relevant outcomes that contribute to providing citizens with equal opportunities of using low-carbon mobility services while addressing the satisfaction of social, psychological, and experiential needs. First, superblocks satisfy the need for safety by increasing road safety and reducing traffic accidents which turns into the best quality of the urban fabric. For example, superblocks facilitate the sense of safety because cyclists feel safer, specifically children and young people when no cars are around. Moreover, superblocks facilitate safe and independent child play. Especially in Barcelona, while in regular streets there are no children, in superblocks children play now on the streets that become new playgrounds for young and elderly people to stay.

Satisfaction of the need for comfort. Superblocks are more comfortable places to live and stay in, with less noise, less air pollution and with better thermal comfort. Therefore, superblocks directly increase the acoustic comfort, removing the vehicular traffic by the inner streets and thermal comfort by increasing substantially the rate of biodiversity and green areas in the neighbourhood.

Satisfaction of the need for leisure, culture and entertainment. Superblocks are usually more accessible and attractive places in which a high diversity of activities are displayed, and new space is liberated for citizens to socialize. Superblocks encourage the reuse of the empty spaces through community projects and activities related to leisure time, ensuring the opportunity to occupy and use the public space to relax, read, talk, walk, work, etc. Several interventions fulfil these needs, like new sports facilities in the superblock, playgrounds, urban gardens managed by neighbourhood associations. Superblocks contribute also to satisfy the cultural and entertainment needs of citizens. For example, free areas in the Poblenou superblock (Barcelona) allow the organization of environmental education activities, cinema on the street, concerts, cultural festivals, popular fairs etc. further, the presence of activities in the public space generates physical attraction, contributing to reduce the feeling of insecurity and the desertification of the streets as reported by several residents in Poblenou interviewed in the SMARTEES project. For example, in several areas of the Poblenou superblock, neighbours are said to spend more time on the street, and spaces used before for circulating or parking are used now to have lunch, children playground, ping-pong competitions and even dinners and parties. Birthday parties and dinners are being self-organized by citizens on one of the streets, the one close to the kindergarten.

Satisfaction of need for connectedness. Superblocks facilitate social interaction and therefore contribute to social cohesion when recreational spaces are increased and residents' participation in the community activities, which creates a higher sense of community and improve social networks. Several residents in Superblock Poblenou have described the main impact of superblocks in terms of social interaction as well as in the improvement of environmental conditions. It has been pointed out

that this specific superblock is allocated in a neighbourhood with low rates of population and most of the residences have been acquired by "newcomers" (young people and families that have moved from other parts of the city), who experienced lack of connectedness with the neighbourhood. As a result of the superblock, they feel more attached to their neighbourhood, and some have established friendship relations with other residents.

Satisfaction of the need for participation in the decisions that concern and affect them. Fitting in the SMARTEES Social Innovation definition, superblocks build upon the process of change in social relationships, interactions, and/or the sharing of knowledge that broadens/deepens the engagement of individual stakeholders with energy topics and leads to, or is based on, new environmentally sustainable ways of producing, managing and consuming energy to meet societal challenges. Superblocks have enabled the emergence of new types of relations forged among the different actors involved. First, new intergroup relationships are built between the so-called "promoters," those people and groups involved in the promotion of social innovations. Strong intergroup connectedness provides an enabling environment for social innovation based on collaboration, shared motivation, and mutual support. In Barcelona, the promoters stress a positive feeling of being part of a united group that pursues a common goal, despite the internal discussions and differences of opinion that they might had along the project. The functional implementations adopted permitted to easily change the urban design of the pilot superblocks according to the neighbourhood needs, as claimed by residents' associations.

Satisfaction of need for economic sustainability. The Council of Barcelona conducted in 2018[5] an internal evaluation of the impact of Superblocks in Poblenou in the period 2016-2016 that reports that the number of active economic activities on the ground floor has gone from 65 to 85, which represents an increase of 30.7%, which contributes to the revitalization of the area. According to Paléncia et al (2020), superblocks might favour commerce in inner streets. However, despite such impacts can make the neighbourhood more attractive, housing and living affordability can be negatively affected and produce additional effects such as gentrification and displacement.

Satisfaction of the need for wellbeing and healthy living conditions. Superblocks are SI innovations that address the need for wellbeing and health, integrating human health into urban and transport planning. Participants in the SMARTEES qualitative research reported a positive impact of the pilot superblocks already implemented in both Barcelona and Vitoria-Gasteiz. The key informants reported the increase of environmental conditions in the affected areas like the reduction of traffic noise, the reduction of air pollution and the reduction of the "heat-island effect" in the summertime because of the new green areas created. However, these interventions in pilot superblock are not sufficient to be perceived in a large city such as Barcelona. These results are consistent with a recent study conducted in Barcelona by Mueller et al (2020) which concludes that the "Barcelona Superblock model is a promising public health measure that helps the city to become cleaner, greener, more physically active and climate change resilient". According to these authors, superblocks have the potential to reduce the premature mortality burden and increase live expectancy considerably, through reductions in air pollution, noise and heat and increased access to green space and transport-related services. Superblocks contribute to urban resilience and climate change adaptation through the provision of ecosystem services (Mueller et al, 2020).

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[5]https://ajuntament.barcelona.cat/santmarti/ca/noticia/amb-la-superilla-el-poblenou-ha-guanyat-mes-de-25-000-metres-quadrats-despai-per-al- ciutada_714967

Table 12: Cases Vitoria-Gasteiz and Barcelona: impacts of the SI on EE

Needs	SIs affecting equality through <u>direct energy consumption</u> interventions	SIs affecting equality through <u>embodied energy consumption</u> interventions
Existence/ sustenance • physiolo-gical • safety	• Actions towards increasing personal safety: improving road safety for cyclists and pedestrians, especially children and elderly people • Interventions towards increasing healthy and environmental quality in living areas, removing the vehicular traffic by the inner streets increasing biodiversity and green areas • Interventions towards increasing the comfort of the neighbourhoods (e.g., and thermal comfort, tackling "heat-island effect" in summer)	• Provision of goods or services that support basic needs satisfaction: public transport network, cycling schemes, biking facilities • Increasing walkability conditions within and between neighbourhoods • Increasing local commerce activity (economic sustainability)

Social
 	
• belonging-ness
• relatedness
		• Deliberative and participatory processes that engage citizens in the decisions that affect them.
		  • Working groups for the discussion and co-designing of superblocks
		  • Permanent participatory bodies to channelize citizen´s demands
		
		• Availability of high-quality public spaces for socialising
		  • Creation of traffic-free areas
		  • Refurbishment of public spaces (e.g., gardens, green corridors, new squares)
		  • Community facilities (e.g., urban gardening projects sustained by the community)
		  • Public furniture
		  • New sports areas
		
		• Availability of public spaces for culture, education, and entertainment in the living areas (neighbourhood)

Values • hedonic • gain • normative		• Actions providing education/information and raising awareness on energy and climate • Actions providing information and raising awareness on health and environmental quality

2.5 Cluster 5: Energy efficiency against fuel poverty

2.5.2 Synthetic description of case interventions relevant for Energy Equality

This social innovation is characterized by public authorities working in coordination with supply companies and civil society organisations in order to implement energy efficiency measures for houses and buildings with the aim of fighting fuel poverty with a tailored and inclusive approach. The reference cases analysed within the scope of SMARTEES are Aberdeen from Scotland and Timișoara from Romania.

Case: Aberdeen, UK

The Aberdeen social innovation represents a leading-edge attempt to improve energy equality in the city in a way that is tailored to the requirements of the local area.

The main focus of the Aberdeen case study is an intervention to improve Energy Equality through the provision of affordable heating and warmer homes to city residents who have been living in fuel poverty. The intervention comprises the rollout of district heating (through the Aberdeen Heat Network) to some of the most deprived areas of the city, in which hot water is generated at a central plant and carried to buildings and residences through a network of pipes. Once inside the property, the hot water is pushed through an internal central heating system to the radiators and taps. Currently, most of the heat for the Aberdeen Heat Network is created by natural gas with some also generated from waste. The energy-from-waste plant processes non-recyclable waste from Aberdeen City, Aberdeenshire and Moray councils and the heat generated is being used to feed the heat network development in the neighbourhood of Torry, one of the most deprived areas of the city.

In addition to the rollout of the physical heat network, other features of the social innovation that influence Energy Equality in the city include: a wider programme of improvements to the energy efficiency of the housing stock; the establishment of a novel, not-for-profit energy services company; the introduction of personalised energy tariffs that consider individuals' financial circumstances; City Council engagement with affected individuals and wider communities; and the presence of Scarf, an energy advice service that supports residents to make positive choices regarding the fuel efficiency of their homes. These features are discussed in section 2.5.3 and summarised in Table 18 below.

Case: Timișoara, România

Timișoara's SI is related to developing an action plan in order to reduce fossil energy use and decrease carbon intensity. Because energy costs challenge a significant proportion of its inhabitants, it is necessary to combine energy transitions with measures addressing fuel poverty. In order to achieve these objectives (i.e., fighting fuel poverty), a tailored and inclusive approach is taken, where public authorities are working in coordination with supply companies as well as civil society organisations to implement energy efficiency measures for residences and various. Five issues should be underlined:

1) Presence of financial incentives for energy efficiency in houses and other buildings

2) High rate of coordination between public, private and civil society players

3) The activation of a two-way, continuous, and multilevel (formal and informal) communication strategy between affected residents and other players

4) Tailoring of the intervention on the basis of individual needs and constraints

5) The same importance given to economic aspects is given to the needs of privacy, security, comfort and convenience

For short, the Municipality of Timișoara is committed to providing citizens access to secure, sustainable and affordable energy with the support of the local district heating company, the Federation of Owner's Associations in Timișoara, the Agency for Energy Management, and the Romanian Sustainable Energy Cluster (ROSENC) (Lema-Blanco & Dumitru, 2019 D5.1).

It must be underlined that in Timișoara, energy poverty is not mainly a problem related to adequate physical access to clean and modern energy; it is rather an issue of affordability and energy efficiency. Energy poverty/vulnerability, therefore, describes a condition wherein households cannot get or afford an adequate level of energy services (D3.1).

Table 13: Case Timișoara: Overview of policy instruments and measures implemented.

CASE-STUDY: TIMIȘOARA (COORDINATED, TAILORED AND INCLUSIVE ENERGY EFFICIENCY SCHEMES FOR FIGHTING FUEL POVERTY)		
Policy instrument	**Types of policy measures/interventions**	**Examples of policy measures**
Normative and regulatory approaches	Technical and regulatory documents	Sustainable Energy Action Plan 2014-2020 for Timișoara Municipality ("Planul de Acţiune pentru Energia Durabilă a Municipiului Timişoara")
Infrastructure and technology upgrade measures	Public and private infrastructures and services	Energy renovation works in privately owned buildings: construction of the thermal envelopes. Specific actions fighting energy/fuel poverty/vulnerability in buildings inhabited by the citizens

Source: Lema-Blanco & Dumitru (2019). D5.1. Theoretical framework for definition of policy scenarios. SMARTEES project.

2.5.3 Discussion of the main impacts on Energy Equality and its related needs

Case: Aberdeen, UK

The main case interventions affecting energy equality in the Aberdeen social innovation are discussed below in terms of their direct and embodied impacts on physiological, social and value-related needs.

Rollout of district heating
The primary aim of the Aberdeen social innovation is to reduce fuel poverty – a form of energy inequality that is experienced directly by the affected individuals by feeling uncomfortably cold at home and/or having to spend a large proportion of their income on warming their homes. The innovation directly addresses residents' physiological needs by providing affordable heating to multi-storey blocks through a heat network, with connected residents benefiting by being able to warm their homes more economically.

The Aberdeen Heat Network is the result of a series of Aberdeen City Council strategies dating back to 1999, when it published its Affordable Warmth Strategy, which evolved into a Fuel Poverty Strategy in 2002, encompassing wider environmental goals. These strategies address the fact that, although Aberdeen is a relatively affluent city, there are nonetheless stubborn pockets of deprivation and high levels of fuel poverty, which are evident among residents of the council's housing stock: a survey

carried out in 1999 found that around 70% of such households were spending more than 10% of their income on energy costs and could therefore be classed as living in fuel poverty. At the time, some of the housing stock was damp and poorly insulated and was heated by inefficient electric heating systems, leading residents to voice concerns about the quality of the accommodation and their inability to heat their homes adequately as a result. The City Council realised that the investment in affordable warmth for tenants of the affected buildings would bring benefits on several fronts, easing the impact of economic deprivation, improving the quality of the housing stock, and lessening the health problems caused by living in damp conditions. Following an appraisal of options for tackling fuel poverty in high rise council housing blocks, district heating was selected as that most likely to achieve the dual goals of reducing energy consumption and expenditure in the most poorly performing buildings, directly improving the living standards of the affected residents and lifting their energy expenditure out of the "fuel poverty" category.

The first phase of heat network development took place in the Stockethill area of Aberdeen between 2003 and 2005 and delivered a combined heat and power system serving four high-rise blocks of flats, connecting 268 households to district heating. These buildings were selected based on their poor condition, the technical feasibility of installing the district heating system, and considerations of acceptability among the residents. Since then, similar systems have been developed in the areas of Hazlehead, Seaton, Tillydrone and Torry, with plans to link the networks across the city in the future. A new Action Plan, "Powering Aberdeen", was published in 2016, and sets out a target to eliminate fuel poverty by 2030, as well as making carbon emissions reductions (from a 2005 baseline) of 31% by 2020 and 50% by 2030. The continued rollout of the heat network, incorporating new technologies such as energy-from-waste, is a key action in the plan.

In terms of the impact of this intervention, to date 50 of the 59 council-owned high-rise blocks have been connected to the network, amounting to around 3,000 customers.[6] A city-wide survey conducted for the SMARTEES project during 2019 found that residents who had experienced heating hardship (i.e., they indicated difficulty in heating their home affordably) were more likely to join a district heating scheme in the future, suggesting that the solution remains relevant – and is palatable – to others in fuel poverty whom the network has not yet reached.

Establishment of Aberdeen Heat and Power & individualised tariffs
The development of the heat network was made possible by Aberdeen City Council working in partnership with key organisations. Most notably, in 2002, the Council established Aberdeen Heat and Power, a not-for-profit energy services company, to take forward the proposed developments in the council's high-rise housing stock. Initial loans to Aberdeen Heat and Power for the first phase of heat network development were underwritten by the City Council, which was a novel approach to financing but meant that a favourable interest rate was secured.

This innovative arrangement also enabled the energy supplied through the heat network to be charged to the customer at cost price rather than market value, resulting in more equitable energy access for Aberdeen residents. Whereas previously, residents paid national energy providers standard rates per unit for inefficient electric storage heating (resulting in unaffordable bills and insufficiently heated properties), now their tariffs were calculated on an individualised basis, taking into consideration households' particular circumstances. This was made possible by the energy service provider (Aberdeen Heat and Power) being a not-for-profit organisation. In practice, Aberdeen Heat and Power charges Aberdeen City Council a connection fee for each household; thereafter, there are two billing models. Residents of multi-storey blocks and sheltered housing schemes pay a flat-rate charge to Aberdeen City Council through its "Heat with Rent" scheme. This provides unlimited heat, removes

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[6] Energy Action Scotland (2021). Energy Review, Spring 2021 (available by subscription).

uncertainty about heating bills regardless of the level of use, and means that residents of properties that are harder to heat are not penalized. A second billing model involves individual heat meters, with costs calculated based on the actual heat consumption of the property in the previous year. This is reviewed annually through a benchmarking exercise to ensure residents remain out of fuel poverty.

Cost savings from belonging to the heat network, as experienced by connected households, are estimated at "up to 40%".[7] It is important to consider these figures in light of the fact that many homes would have been underheated prior to joining the heat network due to the prohibitive cost and inefficiency of the previous electric heating systems. As reported in D3.2, a board member of Aberdeen Heat and Power observed when interviewed for SMARTEES in 2019 that the fabric of connected buildings had started to improve and incidents of cold-related illnesses had reduced, which should certainly be included in any consideration of the impact of the heat network as a social innovation.

It is worth noting that, although connected residents have access to more affordable heat, they do not have a choice of energy provider, since they are no longer connected to the wider market. Additionally, low, fixed-rate tariffs mean that there is no economic incentive for residents to reduce their energy use. With this in mind, the Council is implementing a project to better understand how households connected to the heat network are using their energy, through the installation of indoor temperature and energy monitors. Aberdeen City Council will work with tenants to reduce their use of energy where is considered to be beneficial.

City-wide schemes
While for the purposes of the SMARTEES project we have focused on district heating, in practice the network is being rolled out alongside a suite of related initiatives through Aberdeen City Council's Action Plan, "Powering Aberdeen", which aims to transform Aberdeen into a "smart, low carbon city". This includes a focus on the energy performance of public buildings, energy monitoring programmes, insulating and externally cladding properties and building energy-efficient homes and schools. These measures are being supported with awareness-raising and behaviour change campaigns. As such, the heat network is part of a much broader approach to fuel poverty and carbon reduction across the city.

Of particular relevance to fuel poverty among recipients of the heat network, seven multi-storey blocks in the Seaton area were externally added to improve their thermal efficiency. The tenants of these properties, therefore, benefited from both thermal improvement as well as a more efficient heating system through the heat network, providing them with affordable heat.

Social needs

Individual engagement
The rollout of the heat network has been accompanied by citizen engagement to ensure residents of the affected buildings understand the changes happening in their buildings and properties and have opportunities to ask questions or raise concerns. Aberdeen Heat and Power contact each resident individually and a designated Residential Connections Services Manager has the task of ensuring that customer engagement is maintained on an ongoing basis.

Aberdeen Heat and Power also monitor minimum income levels and costs on an ongoing basis, through a partnership with Energy Action Scotland. If they identify that individuals are at risk of not affording their heating (i.e., if they are estimated to be paying more than 10% of their income on fuel costs), they are contacted by Aberdeen Heat and Power directly and given information about additional support, including referral to other organisations to check their entitlement to benefits.

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[7] About - Aberdeen Heat & Power (aberdeenheatandpower.co.uk)

While the heat network provides a technologically identical solution to all properties in a block, such engagement means that the support provided to residents is highly individualised, in the context of wider economic constraints, and that issues of deprivation and fuel poverty are treated as evolving over time, according to personal circumstances and the economic landscape.

Wider community engagement
The development of the Aberdeen Heat Network has also been accompanied by a programme of wider community engagement to enhance the profile of the network in areas where it is available, to elaborate plans for implementing the network, and to respond to residents' questions. The form of engagement is tailored to the building, the nature of the development and the type of connection.

Aberdeen City Council has worked with local community centres, credit unions and schools to promote the district heating scheme, to provide general energy saving advice and to encourage financial planning and saving. If accommodation has a communal area, Aberdeen Heat and Power will hold events during daytime and evenings for residents, at an early stage of development, to show plans and how they propose to implement changes. In the case of council-managed properties, community engagement involves partnership working with the building's Housing Officer. This allows an approach that can be tailored to the specific needs of the community.

Awareness of the heat network has been raised more widely, in Aberdeen as a whole, through the Aberdeen Heat and Power website, articles in the local newspaper about new developments, business associations, and participation of Aberdeen Heat and Power in local community planning and corporate social responsibility events. This broader, community-wide engagement ensures that the motivation and rationale behind district heating are understood by local residents, including its cost-saving, energy efficiency and environmental benefits, such that citizens are informed and fuel poverty is discussed collectively as a social issue.

Value-related needs

Partnership with SCARF as a trusted organisation
A further aspect of the innovation that responds to residents' social needs is the partnership between Aberdeen City Council, Aberdeen Heat and Power and Scarf, a charitable energy advice organisation that has a strong presence in the local area. The partnership between the three bodies represents an innovative relationship between a local authority, a supply company and a charitable organisation to implement a heat network with the aim of eradicating fuel poverty across the city.

Scarf delivers the "Home Energy Scotland" initiative in north-east Scotland, which provides free, impartial and tailored energy advice and support to help residents to manage their fuel spend, including through the heat network, and to access other forms of energy-related support such as government grants and loans for home insulation and renewables schemes. It has a strong history of engagement, having worked closely with local people and organisations since 1985. It has formed close collaborations with local community leaders, which have been useful in communicating new energy initiatives to Aberdeen residents and in engaging with future potential clients. It collaborates closely with Aberdeen Heat and Power, with some staff members straddling both organisations.

Responses to the SMARTEES survey in Aberdeen show relatively high levels of trust in the organisation (after family and friends, but higher than energy suppliers or the City Council), suggesting that the council's partnership with Scarf may play a role in generating trust in the heat network, giving residents a sense of confidence in the intervention. The role of trust in social innovations has emerged as an important theme throughout the SMARTEES case studies, its absence acting as a barrier to success (refer to D6.1).
Case: Timișoara, Romania

In Timișoara, the SI has not yet generated new behaviours since it still cannot record significant environmental or economic effects. However, we can already note an improved propensity towards better community engagement and a genuine partnership approach, building on existing relationships built up through previous collaborative projects. Moreover, some trends can be observed from the data gathered so far in SMARTEES as well as other surveys conducted in Timisoara, and some prognostics/inferences can be made from the activities and actions carried out so far related to energy poverty and energy equality in the city

A study conducted by researchers at the University of West Timișoara, coordinated by university professor Marius Matichescu, questioned residents over 18 years old from all neighbourhoods of Timișoara. From 2016 to 2020, more than 1,000 people were interviewed annually. Related to respondent's perceptions on access to facilities fulfilling existence/sustenance needs, this study's results show that whereas 62% of the citizens are satisfied with the education and their living environment, half of the respondents are satisfied with schools and health services, and a big proportion (81%) of respondents are dissatisfied with the closure of food markets. Even if more than half of the respondents (60% of people) are satisfied with public transport in the city, the most used means of transport in Timișoara is the car, followed by walking. On the other hand, the boats for public transport are rarely used. These results are counterintuitive and must be interpreted with caution because even if a majority is satisfied with public transportation, this is still not used.

The study also shows that over 70% of respondents trust their neighbours, find a quick job in Timișoara and feel safe in the city. This can be considered a positive trend related to personal safety perception (existence/sustenance needs) as well as financial possibilities related to access to jobs. Regarding the satisfaction with environmental issues in Timișoara, related to the fulfilment of basic, existence needs such as provisions of clean water and good air quality, the satisfaction with amenities related to availability and quality of public spaces for socializing (related to social needs), and the values of the city (i.e., cleanliness of the city related to the community "pride", place attachment, or perceived self-worthiness of the community), the results show that only half of the people are satisfied with the noise level, the quality of the tap water, the cleanliness and the air quality. Specifically:

- tap water quality - 52% satisfied, 47% dissatisfied;
- air quality - 50% satisfied, 49% dissatisfied;
- green spaces and parks: 73% satisfied, 26% dissatisfied, noise level 53% satisfied, 46% dissatisfied;
- the degree of cleanliness - 53% dissatisfied, 46% satisfied.

The study also analysed the perception of people from the 24 neighbourhoods of Timișoara. Those in Freidorf, Lipovei and Soarelui areas are dissatisfied with schools and kindergartens. People in the Kuncz, Stadion and Complex, Fabric - Lunei and Simion Bărnuțiu areas do not trust the people in the neighbourhood, and the Steaua Fratelia and Torontalului areas say that the mayor's office does not know their problems well enough. People from the UMT, Dorobanti, Fabric, Lidia, Steaua - Fratelia and Freidorf areas complain about the air quality, while those from the Aradului - Lipovei, Bucovina, Circumvalațiunii, Blașcovici and Complex-Stadion areas complain about the water quality. The Elisabetin - Bălcescu and Stadion - Complex areas are not satisfied with the homes in which they live.

It must be specified that in most of these areas a big portion of the vulnerable individuals in Timișoara are living, being the same residents most affected by energy poverty and inequalities, such as low-income and/or minorities (i.e., Freidorf, Kuncz, Fabric – Lunei, Fratelia, UMT). Moreover, the districts of Freidorf, Fabric and Fratelia, as well as Elisabetin are also some of the historic areas of Timișoara,

being founded between 1718 and 1950 (www.primariatm.ro). For example, the Kuntz and Fratelia areas are historically occupied by low-income, marginalized people, initially developed as labour colonies for employees in various factories built there, at the outskirts of the city. In Kuntz, the predominant ethnic groups are Romanian (50%), Roma (40%), Hungarian, German and Serbian (cumulative 9%) (https://ro.wikipedia.org/wiki/Kuncz). UMT is quite similar, even if it is a newer neighbourhood; in the area the UMT factory is located, and because it had an impressive number of employees, the area received its name. Fabric, founded in 1718, is also an area historically occupied by labourers employed in the factories built there, its name translated in English being most suggestive: Factory.

The survey data collected for the SMARTEES project offer more detail in relation to energy equality in the Timișoara case study. From the questionnaire, we identified several questions which could relate to energy equality, such as respondent's perceptions on their household income (i.e., "How do you feel about your household's income nowadays?", where response options are ranging from "Living comfortably on present income" to "Very difficult on present income"), worries related to energy prices (i.e., "How worried are you about energy being too expensive for many people in Timișoara", where response options are ranging from "Not at all worried" to "Extremely worried"), worries about Timișoara being too dependent on using energy generated by fossil fuel (i.e., "How worried are you about Timișoara being too dependent on using energy generated by fossil fuels such as oil, gas and coal", where response options are ranging from "Not at all worried" to "Extremely worried"), worries on power cuts (i.e., "How worried are you about power cuts in Timișoara", where response options are ranging from "Not at all worried" to "Extremely worried"), and if the respondent identifies as belonging to a minority group (i.e., "Do you belong to a minority ethnic group in Romania?", where response options are "Yes", "No", "Not sure", and "Prefer not to say").

The results show that most of the respondents (51.9 %) are coping with their household's income during this time.

Table 14: Case Timișoara: Frequencies - How do you feel about your household's income nowadays?

Levels	Counts	% of Total	Cumulative %
1 = Living comfortably	157	35.8 %	35.8 %
2 = Coping	228	51.9 %	87.7 %
3 = Difficult	49	11.2 %	98.9 %
4 = Very difficult	5	1.1 %	100.0 %

Regarding the worries respondents have on several issues related to energy prices, usage and consumption, respondents worry that the energy is quite expensive for many people in Timișoara (26 %), that Timișoara is being too dependent on using energy generated by fossil fuels (i.e., oil, gas, coal) (26 %), but mostly worry about power cuts in their city (26.2%).

Also, the majority of the respondents are not belonging to a minority ethnic group (86.8%).

A correlation analysis was performed for all the variables above. The results show that significant and positive associations are between perceptions related to energy being too expensive and household income (r(437) = .16, p= .001), thinking that Timișoara is too dependent on fossil fuel (r(437) = .67, $p <$ .001), the perceptions that there are too many power cuts (r(437) = .56, $p <$ .001), as well as between Timișoara as dependent on fossil fuels and worries related to power cuts in the city (r(437) = .52, $p <$ .001). Identifying as a minority was not significantly correlated to any of the proposed variables. Thus, those who are the most impoverished (barely coping with the household income), are the most affected by energy prices, as the most vulnerable group in terms of energy poverty. Moreover, those who worry about energy prices (the energy bill being too expensive), worry also about power cuts and dependence of the city on fossil fuel.

Table 15: Case Timișoara: Frequencies - Energy being too expensive

Levels	Counts	% of Total	Cumulative %
1 = 1 Not at all worried	13	3.0 %	3.0 %
2	10	2.3 %	5.2 %
3	25	5.7 %	10.9 %
4	86	19.6 %	30.5 %
5	114	26.0 %	56.5 %
6	100	22.8 %	79.3 %
7 = Extremely worried	91	20.7 %	100.0 %

Table 16: Case Timișoara: Frequencies of residents dependent on using energy generated by fossil fuels such as oil, gas and coal

Levels	Counts	% of Total	Cumulative %
1 = 1 Not at all worried	10	2.3 %	2.3 %
2	13	3.0 %	5.2 %
3	33	7.5 %	12.8 %
4	97	22.1 %	34.9 %
5	114	26.0 %	60.8 %
6	82	18.7 %	79.5 %
7 = Extremely worried	90	20.5 %	100.0 %

Table 17: Case Timișoara: Frequencies of power cuts

Levels	Counts	% of Total	Cumulative %
1 = 1 Not at all worried	16	3.6 %	3.6 %
2	12	2.7 %	6.4 %
3	28	6.4 %	12.8 %
4	91	20.7 %	33.5 %
5	95	21.6 %	55.1 %
6	82	18.7 %	73.8 %
7 = Extremely worried	115	26.2 %	100.0 %

Table 18: Case Timișoara: Frequencies - Belonging to a minority ethnic group

Levels	Counts	% of Total	Cumulative %
1 = Yes	22	5.0 %	5.0 %
2 = No	381	86.8 %	91.8 %
3 = Not sure	19	4.3 %	96.1 %
4 = Prefer not to say	17	3.9 %	100.0 %

Table 19: Case Aberdeen: impacts of the SI on EE

Needs	SIs affecting equality through <u>direct energy consumption</u> interventions	SIs affecting equality through <u>embodied energy consumption</u> interventions
Existence/ sustenance • physiological • safety	• Rollout of a district heating network to provide affordable heating to residents living in fuel poverty; • Establishment of a not-for-profit energy services company (AHP); • Introduction of individualised domestic energy pricing tariffs.	• City-wide schemes, including a wider programme of improvements to the energy efficiency of housing stock.
Social • belongingness • relatedness	• ACC/AHP direct engagement with affected individuals; • Wider community engagement; • Establishment of Scarf improves trust in the SI.	
Values • hedonic • gain • normative	• Scarf provides free and tailored energy advice and support to help residents manage their fuel spend	• Scarf/Home Energy Scotland provides advice on, e.g., installing home renewables and making homes more energy efficient.

Table 20: Case Timișoara: impacts of the SI on EE

Needs	SIs affecting equality through <u>direct energy consumption</u> interventions	SIs affecting equality through <u>embodied energy consumption</u> interventions
Existence/ sustenance • physiolo-gical • safety	The municipality of Timișoara ensures all citizens with the basic energy services in order to guarantee a decent standard of living for residents such as: • public lighting, • heating through the Local District Heating Company, • public transport and mobility, • access to the energy grid Among the actions put forward by the Sustainable Energy Action Plan, a couple that could be highlighted are: • Promoting the installation of solar panels in order to provide domestic hot water to south facing homes/residential buildings, at a rate of 2% / year of all buildings with southern exposure in Timișoara Municipality; • Promoting the installation of off-grid photovoltaic panels with power between 1 and 3 kW for electricity production, at a rate of 2.5% / year of buildings with southern exposure in Timișoara Municipality.	Timișoara approved the Sustainable Energy Action Plan 2014-2020 for Timișoara (Sustainable Energy Action Plan 2014-2020 for Timișoara), whith the aims to: • Increase energy efficiency (of public buildings, buildings in the tertiary sector, private buildings, transportation – including the expansion of the network of cycling lanes, etc.) • Increase the use of renewable energy • Rehabilitate public spaces and green areas in the downtown area, urban agriculture, etc. The Municipality of Timișoara has undertaken energy renovation works in privately owned buildings, consisting in the construction of the thermal envelopes (especially for the buildings constructed in the communism period), which have reduced the energy consumption by 65-70%, the thermal comfort increased significantly and the indoor climate was improved
Social • belonging-ness • relatedness	In order to implement an innovative solution, clusters of actors have been established at a local level including a wide range of organizations, institutions and experts interested in developing renewable energy sources in the housing sector. At the same time, in order to facilitate the implementation of building renovation measures, roadmaps have been developed that include an analysis of the inhibitors. This analysis is based on the actual situation of the renovation of residential buildings in Romania from the point of view of main stakeholders (government, local authorities, energy suppliers, construction firms, proprietary / engineering / consulting organizations etc). Thus, an overview of the existing situation has been	

	developed which has enabled effective collaboration among stakeholders.	
Values • hedonic • gain • normative	Citizen-oriented actions already included in the Plan, such as: • Organizing information workshops and encouraging stakeholder involvement (at least once a year) • Carrying out information and awareness raising activities among citizens regarding the benefits of projects for improving the energy efficiency of residential buildings (at least once a year) • Organizing awareness campaigns on the advantages of centralized heating compared to other alternative heating sources • Informative and awareness raising actions for the owners/residents living in single family households.	

3 Discussion, Energy Equality in energy social innovations

The following paragraphs will discuss how the case analyses regarding the effects of SIs' interventions on energy equality might present commonalities or differences and whether these are related to diverse social and institutional contexts. We will discuss the three categories of needs used to exemplify the effects of interventions on energy equality separately.

3.1 Existence/sustenance needs

Existence/sustenance needs were earlier in this document defined as physiological and safety needs. In the previous chapter it was detailed case by case and for each cluster how these interventions were "providing equal opportunities to use energy services, energy technologies, and consuming energy and embodied energy" (as per our definition of energy equality, Pellegrini 2019) to satisfy existence/sustenance needs among others. In some cases, the evidence for the effectiveness of the interventions in rising energy equality was more evident than in others, but in all the cases, some interventions appeared to work towards this aim.

In cluster one, holistic, shared, and persistent mobility plans, which includes the cases of Groningen and Zürich, the primary interventions that had an impact in terms of energy equality were investments improving sustainable mobility opportunities. Particularly the extension of bike lanes, the closure of car traffic to areas previously largely occupied by car traffic, and the extension of public transport services reaching farther away into peripherical neighbourhoods that were previously poorly served (Zürich). The safety of cyclists was also indicated as an objective of several interventions, which was pursued through a system of traffic lights for cyclists and the realisation of dedicated bike lanes physically separated by safety features to protect the cyclists on those roads where the speed of car might be much higher than bicycles (Groningen). Nevertheless, few critical aspects were noted, particularly the rise of the use of e-bikes led to more accidents in Groningen, although this does not relate directly with the interventions adopted, and, in Zurich, the narrow size of some streets have generated a conflict between different modes of transport, because these streets cannot host a bus lane, a cycling lane, a sidewalk and a car lane. However, overall, the result of these interventions was to create an urban environment that was generally healthier and safer.

In cluster four, urban mobility with superblocks (whose focus is on mobility like for cluster one), we again find interventions that could be argued to be in favour of providing citizens with ways of consuming energy that facilitate the satisfaction of existence/sustenance needs. The interventions that are relevant consist in the restriction of car traffic, with positive effects on safety and the reduction of local pollution, the extension of bike lanes, the improvement of road safety for cyclists and pedestrians, the expansion of and modulation of public transport, including the realisation of infrastructure to facilitate the modal transport exchange between superblock areas and the rest of the city, interventions promoting bike-sharing and electric cycling, new bicycle parking spaces, cycling and bicycle maintenance courses, road safety educational campaigns and even technological interventions (in Vitoria-Gasteiz) such as an information system for the management of the infrastructures of cyclist mobility and an application for managing the bicycle registration system. Critical aspects of these interventions could be expected regarding an increase of car traffic on the perimetry of superblocks; further, the gains obtained within the superblocks might generate some increased inequality between

those residents that live within the superblock area and those who reside in other areas of the city. Nevertheless, these critical aspects appear mitigated by the expansion and modulation of public transport and the growing application of the superblock policy to vast parts of the city with the same characteristics.

In essence, the mobility measures adopted in the social innovations of clusters one and four served to reduce inequalities in the transport system in terms of access to transport, quality of the transport experience, and safety. The measures facilitated the mobility of low-income and marginalised individuals living in the cities affected the interventions: this happened both through the expansion of the public transport system and the increase of the bike lanes network. The improvement of access to transport presumably favoured the opportunity of many socially disadvantaged individuals to participate more, economically and socially, in the city environment, thereby favouring the satisfaction of their sustenance (and relational) needs. The limitations to car traffic and the facilitation of cycling worked to reduce the gap between the benefits of using cars versus using public transport and bicycles, again reducing the gap between socially advantaged and disadvantaged individuals while promoting a safer and cleaner city environment for everyone.

In clusters three, district regeneration, and five, fighting energy poverty through energy efficiency, we find interventions that share several commonalities, i.e., energy interventions on or serving residential buildings, along with complementary social interventions suited for similarly socially deprived neighbourhoods. In cluster three, district regeneration, the satisfaction of existence and substance needs was favoured by interventions that increased the safety of residents, for example, tackling the problem of flooding (Augustenborg) or increasing the quantity and quality of lighting in public spaces (Järva). Further measures increasing safety have regarded changes in the outline of some public spaces and buildings' entrances (Järva) to increase the perception of safety by residents both outdoor and in buildings. In both Augustenborg and Järva, measures to decrease the car traffic, improve public transport services and foster cycling were put in place, which all contributed to increasing the safety on the neighbourhoods' streets while decreasing local air pollution. In both cases, the energy efficiency of residential units has been improved, thereby reducing energy consumption by 50% in Järva and by 20% in Augustenborg, consequently lowering energy bills, helping low-income residents make ends meet. In both cases, renewable energy interventions were realised through the installation of solar PV panels. Finally, in Augustenborg, local businesses were also encouraged to stay through a scheme of subsidized rents, helping the neighbourhood's economy thrive.

In cluster five, fighting energy poverty through energy efficiency, similarly to cluster three, an improvement on energy efficiency in buildings was an essential aspect of the interventions, which were purposefully addressing the problem of energy poverty in both Aberdeen and, to a lesser extent in the Timișoara case. In the case of Aberdeen, the primary intervention was developing the district heating network, which reached fifty council-owned high-rise blocks that were connected, thereby allowing around 3,000 customers to benefit from cheaper heating bills. This action was further supplemented by a policy of individualised tariffs for disadvantaged households and energy efficiency interventions. In Timișoara, the focus of actions affecting existence/sustenance needs satisfaction has regarded the promotion of solar panels, both thermal and photovoltaic, and the improvement of energy efficiency in building, with targeted interventions on old public and private buildings realised during the socialist period, which have been retrofitted with thermal envelopes, therefore, achieving a substantial reduction in energy consumption of up to 70%.

The urban cases of clusters three and five share the primary aspect of increasing distributional justice through building improvements suitable for reducing energy consumption and, consequently,

residents' energy bills. In all four cases, the individuals most affected are low-income households whose resulting financial condition is improved by the interventions. The cases of cluster three, Järva and Augustenborg, have a wider variety of interventions, which include chiefly sustainable mobility features and improvement of public spaces and their safety. They are good examples of acting simultaneously on several aspects of neighbourhood life to address evident deficits affecting basic needs, i.e., reducing economic disadvantage and improving safety.

The last cluster discussed here with regards to energy equality and existence/sustenance needs is number two, island renaissance based on renewable energy production. These cases, El Hierro and Samsø, stand out because islands present a distinct social environment with relatively stable cohesive communities and a strong sense of place attachment. In both cases, renewable energy installations appear as the primary intervention for both cases. In Samsø, these also include biomass-fired district heating plants, which have delivered cheaper heating to the households of the villages supplied. In both cases, several schemes have sought to improve energy efficiency in buildings, in Samsø through the delivery of subsidies for the installation of household heating systems, in El Hierro instead through grants targeting low-income households to substitute old home appliances with new low consumption models. In both cases, a spillover effect was the creation of local jobs; in Samsø, local businesses were involved in the installation and maintenance of the energy interventions, and on both islands, tourism benefited from the renewed image of the islands as pioneers of renewable energy. In both cases, municipalities were part of the ownership of renewable energy installations, thereby benefiting from the revenue generated by the projects. On a critical note, it could be added that Samsø's innovations in many cases benefited from the local private investment of households or firms; these investments, primarily in wind farms, were rightfully rewarded by the revenue generated, thus clearly maintaining the gap between different social groups in the island. Even though, as mentioned, the municipality was the main investor in the offshore wind turbines project, thereby ensuring some degree of collective benefit and even, possibly, redistribution if the income generated was spent on local social assistance.

From the standpoint of distributional justice, both cases attempted to lower the energy costs sustained by households, in Samsø focusing on household heating costs and in El Hierro through targeting the upgrade of appliances of low-income households. In the case of Samsø, the progress could be seen in relation to Denmark's broader context where district heating was already widespread, hence with a reduction of the gap between Samsø and the rest of the country. While in EL Hierro, targeting deliberately low-income households might have contributed to reducing the energy bills' cost gap within the island. More generally, in Samsø and to an extent in El Hierro, the interventions seem to have contributed to revitalising the local economy, therefore supporting the satisfaction of sustenance needs for all the economic actors involved, local companies and single individuals who could benefit from the jobs created locally. Finally, the municipalities gained revenue from the renewable installations, which could support further long-term interventions benefiting the citizens with targeted support and more services.

In conclusion, all the clusters presented interventions that appeared to increase levels of energy equality within the area affected, or concerning the broader societal context (urban or even national), by facilitating the satisfaction of existence/sustenance needs. Said that the social innovation projects' different aims and interventions inevitably show that the impacts might be more or less profound. Cases that deliberately targeted the energy-poor or the economically disadvantaged presumably delivered a broader impact on energy equality in relation to existence/sustenance needs, simply because this was one of their main aims. It might be worth stressing that these results, when present, were clearly tied to interventions that benefited from a complete or substantial public financing scheme. In this respect, energy social innovations could be argued as complementary redistributive

policies that target locally and simultaneously several co-benefits, including among them the support of economically disadvantaged communities or households.

3.2 Social needs

Besides securing all individuals with energy at reasonable costs in order to heat their homes and fulfil their basic human needs of warmth or food, for example, the SI's can also have an impact on citizen's social needs to belong (i.e., form and maintain stable relationships) and to relate to one another (i.e., feel close and accepted by peers and significant others), either directly or indirectly through the interventions carried out.

In the first cluster, related to new mobility patterns, in both Zürich and Groningen, the SI is affecting equality through direct energy consumption interventions (i.e., actions favouring mobility for family and social relations encouraging the use of public transports and bikes), as well as through indirect, embodied energy consumption interventions. The long history of participatory decision-making in the two cities favoured a shared identity of citizens as "public transport users" or "bike users". Thus, residents can feel closer to other community members by using public transportation or biking throughout the cities. Moreover, biking and the use of public transportation, compared to car use, for example, can facilitate meeting other people and relate to one another, as proximity is still a fundamental way for people to connect, and even can facilitate chance meetings between significant others. However, even if strong pro-bike and pro-public transportation policies have clear societal advantages, they can create disadvantages for other groups of individuals who cannot bike or use these modes of transport, for example, the elderly or the disabled. In Zürich, an embodied energy consumption intervention was also identified. Specifically, actions were taken to improve the availability and quality of public spaces for citizens to meet in a pleasant and relaxing natural environment (e.g., development of the banks and docks of the Limmat river).

The fourth cluster, also concerned with innovative mobility patterns, includes the innovations in Vitoria-Gasteiz and Barcelona. In this cluster, embodied energy consumption interventions related to equality were identified, such as the availability of high-quality public spaces for socialising, availability of public spaces for culture, education, and entertainment in the living areas (neighbourhood), and, similar to the first cluster, deliberative and participatory processes that engage citizens in the decision-making. Superblocks, the social innovation characterising this cluster, are more accessible and attractive places for citizens to share positive experiences (leisure, culture, entertainment), as well as spaces being liberated by traffic for individuals to meet, socialize and be together. For example, the opportunity to occupy and use the public space to work, for relaxation and leisure activities, sports, translated into interventions such as new sports facilities, playgrounds, ping-pong competitions, urban gardens managed by neighbourhood associations, organization of social events such as cultural festivals, cinema on the streets, or self-organized dinners or parties. All these interventions and activities allow the citizens to meet, spend time together, and have fun through positive affective, emotional force. With so many opportunities for social interactions, the need to connect and belong to one another and the neighbourhood is seconded. Nonetheless, even with these positive impacts of the SI on the social life of the citizens inside superblocks, where the living conditions are better for people in terms of pollution, noise, or traffic, for example, for those living outside these areas, the situation might not be ideal. At least in the transition period, outside superblocks, the car traffic can increase as a result of closing traffic inside the superblocks. There might be some costs associated with implementing the SI for those living inside the superblocks. On one hand, the businesses and retail sector were affected by traffic restrictions and parking regulations implemented in the central superblocks, made evident by the resistance and protests in Vitoria-Gasteiz. Moreover, housing and

living affordability can be negatively affected inside superblocks, with an increase in gentrification and displacement of residents not affording to live in these areas no more (Paléncia et al., 2020). On the other hand, increased commercial activities, increased social activity in the superblocks, may have occasional negative effects for those living in the area.

In the second cluster, island renaissance based on renewable energy production, including the islands of Samsø and El Hierro, both direct and embodied energy consumption interventions were identified, which can potentially impact the social needs of the residents, affecting equality. In both cases strengthening the identity of the island as a sustainable place was an important objective. For El Hierro, this shared identity as "islanders" translated into an increase in the community's pride and cohesion, generating several educational initiatives to showcase the island to school children and visitors. In Samsø, a highly participative model of decision-making, which begun at the very start of the project, served as a means for citizens to have their voice heard, and ultimately it contributed to a feeling that they belong in the community they are shaping together, which is reflected by the fact that many of them serve as members on the boards of the renewable energy community companies. Moreover, this participatory practice helped enhance the general community cohesion on the island. For all these engagement activities, the building of the Energy Academy was built and is used as a community hall to discuss the sustainable energy interventions on the island.

In the third cluster, district regeneration based on energy transition in Malmö and Stockholm, several actions taken were identified as positively impacting energy equality and the social needs of the residents. In both cases, it was shown that participation in decision-making by valuing the knowledge, skills, and personal perspectives of residents could catalyse improvements in community cohesion and equality. For example, in Augustenborg, Malmö, the development towards a "green neighbourhood" was mindfully done so that it would not contribute to the gentrification of the area; while in Järva, the sustainable mobility interventions contributed to the improved integration of vulnerable groups, especially women from different cultures to the extent that now, these women are more involved in the community, and participated in larger numbers in the elections. Some of the direct actions taken in these two cities impacting social integration and relatedness of the residents regard the improvement of the public areas with initiatives such as the growing of vegetable gardens (Malmö), or bicycle courses especially targeting women (Järva). Regarding actions for improving the availability and quality of public spaces for socialising, some examples are noteworthy: the general upgrading of apartments standards (Järva), the rejuvenation of the neighbourhood's square and the refurbishment of other public spaces and common areas of buildings (Malmö and Järva). In Malmö, the actions taken to improve the neighbourhood's centre and encourage local businesses to move in resulted in some residents starting their own businesses, such as an immigrant woman creating her daycare centre.

In the fifth cluster, energy efficiency against fuel poverty (cases of Aberdeen and Timișoara), direct energy consumption interventions were identified affecting energy equality and the social needs of the residents. Specifically, in this cluster, individual and wider community engagement represents the main action taken towards ensuring that the SI's are affecting fairly and equally their residents. As already argued in the introductory section of this document, the processes through which equal distribution of outcomes is ensured, by creating space for the interests of those affected by energy poverty to be represented in decision-making (i.e., procedural justice), represents an important component of energy equality. In Aberdeen, special attention was given to those at risk of not affording their heating through a joint collaboration between Aberdeen Heat and Power and Energy Action Scotland, by treating the issues of energy poverty and deprivation together, taking into account the individual circumstances and socioeconomic context. In this way, a proactive attitude was taken regarding energy poverty, not only focusing on building or infrastructure interventions but

encompassing a wider community engagement approach, through which the issue of energy poverty was discussed collectively as a social issue. This approach favoured the effect of removing the social stigma or shame associated with not affording paying bills, thereby lessening the impact of energy poverty on fostering associated vulnerabilities, such as the lack of social support (Marí-Dell'Olmo et al., 2017). This result is a crucial achievement because even if support policies are available, the fear of stigmatization can prevent some households from revealing their situation and accessing support or advice (Reid, Mckee, & Crawford, 2015).

3.3 Value-based needs

Value-based needs were earlier in this document defined as "needs of striving for consistency with one's personal goals". Regarding value-based needs, individuals appear to act following a goal orientation (Lindenberg and Steg, 2007, p.119) belonging to three categories: normative goals, gain goals, and hedonic goals. The previous chapter detailed case by case and for each cluster how these interventions were "providing equal opportunities to use energy services, energy technologies, and consuming energy and embodied energy" (Pellegrini, 2019) to satisfy value-based needs among the residents. In all cases, several interventions seemed to have worked towards satisfying value-based needs concerning energy equality. However, some interventions seemed to work towards satisfying value-based needs in different ways with regards to the three different categories in all cases.

In the "holistic, shared and persistent mobility plans", cluster 1, which includes the cases of Groningen and Zürich, interventions to improve sustainable mobility opportunities had a substantial impact on energy equality. Especially the extension of bike lanes and the closure of car traffic to areas previously largely occupied by car traffic, and the extension and enhancement of public transport services reaching farther away into peripherical neighbourhoods that were previously marginalized contributed. With regards to Groningen, cycling is not regarded as something very special or as strongly representing environmental or moral aspects as compared with the country as a whole (NL). In this case, cyclists do not adhere to specific normative goals as a group. However, in Groningen and the Netherlands, cycling is a popular and common way of travelling, and there is no contradiction between being a cyclist and a car driver. Nevertheless, the Groningen people still express a particular pride in the success and quality of cycling and its infrastructure. In this context, people may still refer to environmental and energy-related outcomes as an advantage. Bearing this in mind, the case is still considered relevant in satisfying normative value-based goals. Also, the interventions in Groningen contribute to satisfying both comfort-, safety- and convenience- goals amongst the citizens, which all relate to gain-goals. For instance, the air quality and soundscape is more pleasant due to the decrease of car traffic, and traffic lights are programmed to make cycling smoother. Also, the separation of car and bicycle lanes and, of course, the decrease in car traffic in general, make it safer to cycle. The easy access to bike repairs and availability of swap-bikes contribute to satisfying gain-goals. However, regarding safety, the increase in e-bikes has contributed to more cycling accidents, especially amongst the elderly, due to higher speeds.

In Groningen, the interventions mainly contributed to negative hedonic values related to car driving, decreasing car access to inner city locations. However, a larger group of citizens now seems to be enjoying the biking infrastructure contributing to hedonic values. In Zurich, the interventions contributed to normative, and to a smaller extent, hedonic goals, due to the improved (and very high) quality of public transport. This and periodical awareness campaigns for promoting use of public transport and bicycle lanes increased the community pride and place attachment. Here, the improved public transport system mainly contributed to improving comfort, hence contributing to gain goals.

In cluster four, "urban mobility with superblocks", which also focuses on mobility, we again find interventions that influence value-based goals regarding all three categories: Normative goals, Gain goals, and Hedonic goals.

With regards to value-based needs, the interventions contributed to a restriction of car traffic and improving cycling infrastructure and convenience and also public transport, with positive effects on safety and air quality, contributing to gain goals. Also, information campaigns and other interventions for improving road safety contributed. Hence, the interventions in cluster 4 contributed to both normative goals, making cycling more attractive and "normal" and accessible, gain-goals, by improving the air quality, soundscape and accessibility without a car to and from, and also internally within the neighbourhood (bicycle parking et cetera), and also hedonic goals by improving the comfort of the neighbourhoods in general.

In essence, the mobility measures adopted in the social innovations of clusters one and four contributed positively to a wide variety of value-based needs amongst the residents. Both the expansion of the public transport system and the increase and improvement of cycling infrastructure has, together with awareness campaigns, contributed to normative goals by making cycling more accessible and desirable. Regarding gain goals, the improvement of the air quality, soundscape and traffic safety contributed considerably to increased community pride and a stronger place attachment. With regards to hedonic goals, the interventions in both clusters contributed to pursuing improved comfort in the neighbourhoods.

In the "Island renaissance based on renewable energy production", cluster 2, which includes the cases of Samsø and El Hierro, self-sufficiency energy systems based on clean and renewable energy sources was implemented. In El Hierro, the project was thereby able to solve the issue of intermittent renewable energy production, which is a major problem on an island whose energy grid is not connected to any continental or other islands electricity network. Here, the project also contributed to guarantee water self-sufficiency. Investments in energy production and improved access to energy and water, and subsidies for home solar power installations reduced the vulnerability concerning access to basic needs. In addition, actions providing energy literacy and raising awareness were carried out. The implementations contributed to creating jobs and educational opportunities in the fields of energy and engineering, which has enabled especially the younger generation to stay on the island – or return – instead of emigrating from the island due to lack of opportunities. The campaigns and information contributed to value-based goals as it contributed to seconding pro-environmental values and attitudes. However, the main contributions to satisfying value-based needs were in the form of seconding gain and normative goals, as the SI improved comfort by improving the access to energy and water. This also improved the status and prospects of the island as a community while strengthening place attachment and place identity. Nevertheless, hedonic goals were also met by pursuing comfort for the islanders.

On Samsø, the very access to energy and water was not an issue. However, the island had similar problems as El Heirro regarding lack of job opportunities, especially for the younger generations. An ambitious plan for transforming Samsø into a renewable self- sufficient energy island was hatched and followed up. Providing district heating plants burning straw and wood chips, grants to households that converted from electrical- to district heating, subsidies for households converting to solar thermal, biomass or heat pump and the implementation of on- and offshore wind turbines with an ownership scheme open to citizens contributed to gain-goals. In addition, free home visits by energy advisors also indirectly boosted job opportunities for smaller local businesses and entrepreneurs. The interventions allowed Samsø's citizens to practice their environmental values and their place attachment while at the same time chasing their goals of reviving the declining economy, hence contributing to hedonic goals. However, as in El Hierro, the main value-based needs at play were related to normative goals and gain goals, as the interventions fostered both a sense of place attachment and identity while improving the prospects and job opportunities for the islanders. Local economy and businesses

flourished as the energy island - identity and interventions created new jobs and business-opportunities. Hedonic goals were not very prominent on Samsø, but the more positive future prospects of the island and its economy certainly contributed to an increased optimism.

In clusters 3, "alliance for a district regeneration based on energy transition", and 5, "energy efficiency against fuel poverty", we find interventions of a similar character, i.e., energy interventions on or serving residential buildings, along with complementary social interventions suited for similarly socially deprived neighbourhoods. In both Järva and Augustenborg, especially gain-goals were prominent as the interventions improved both the status and comfort of the neighbourhoods. In Augustenborg, the safety and convenience of residents were improved by tackling the problem of flooding, and in Järva by improving the quantity and quality of lighting in public spaces. Also, changes in the outline of some public spaces and buildings' entrances (Järva) increased the safety – and the perception of it – by residents both outdoors and in the buildings' shared spaces. In both Augustenborg and Järva, measures to decrease the car traffic, improve public transport services and foster cycling contributed to increase the neighbourhood safety and decreasing local air pollution. In both cases, the energy efficiency of residential units was improved and solar PV panels were installed, which consequently lowered energy bills, hence contributing to gain-goals. In Augustenborg, local businesses were encouraged to stay through a scheme of subsidized rents, helping the neighbourhood's economy thrive, hence contributing to gain-goals. In both cases, normative goals were also met by campaigns, courses, and an ambitious participatory process, that strengthening pro-environmental and prosocial values and attitudes. With regards to hedonic values, the interventions contributed to the wellbeing and level of comfort in the neighbourhoods.

In cluster 5, the improvement of the energy efficiency in the buildings was also an essential aspect of the interventions. However, here the expressed purpose of both Aberdeen and Timisoara was to address the problem of energy poverty specifically, while in cluster 3, this was not focused explicitly on. However, both clusters still had ambitions to address energy poverty-related issues by improving the general status of the neighbourhood without contributing to gentrification.

In Aberdeen, the development of the district heating network, has allowed 3,000 customers to benefit from cheaper heating bills. This action has been further supplemented by a policy of individualised tariffs for disadvantaged households and energy efficiency interventions. This improved the comfort and lowered the costs, hence contributing to gain-goals.

In sum, while Clusters 1, "holistic, shared and persistent mobility plans", Groningen and Zurich, and 4, "urban mobility with superblocks", Vitoria-Gasteiz, Barcelona, are addressing all three categories of value-based needs with their focus on mobility and improvement of the neighbourhoods' comfort as a whole, Cluster 3 also addresses all three categories of value-based needs, but does this in an even more holistic way as the interventions are addressing both the general safety, neighbourhood status and access to public areas. Cluster 2 instead appears to implement interventions seconding the fulfilment of needs related to both normative and gain goals by strengthening place attachment and identity and by improving the local economies. Finally, Cluster 5, however, mainly seems to have contributed to gain-goals by improving the financial situation of its residents, although hedonic goals were also addressed (improved comfort).

4. Policy recommendations

Drawing from previous sections of the present document, and especially from the discussions section, we can infer some conclusions which could inform policy actions. Specifically, we take into consideration the three tenets of justice (distributional - the distribution of environmental benefits and ills and their associated responsibilities; procedural – access to decision-making procedures that ensure equitable outcomes; and recognition – the fair representation of individuals, who are free from physical threats, and offered complete and equal political rights), the needs of the citizens (existence/sustenance needs, social needs and value-based needs), as well as the actions taken in the SMARTEES cases in relation to energy equality. Social Innovations appear to be well suited to carry out locally targeted interventions to address deficiencies concerning distributional, procedural and recognition justices. This is reflected by the analysis of the cases that we have conducted in section two and that we have synthesized and discussed in the previous section. The potential of social innovations to advance energy justice has been highlighted in previous research where they are indicated as suitable instruments to address issues in social relations (process changes) and addressing social needs (outcomes changes) (Hiteva and Sovacool, 2017).

4.1 Distributional justice and energy equality: providing sufficient public funding for social innovations

Economic power (i.e., wealth) influences the demand and consumption of residential energy, with wealthier groups being more energy intensive than their less affluent counterparts (Fournier et al., 2019). Moreover, in the SMARTEES cases, financial resources played an important role in enabling the SI's, in the sense that if the necessary public funding was lacking, the actions taken would not be possible, and the SI would not be started or implemented (D6.2). Thus, appropriate financial solutions should consider a differentiated pattern of managing and consuming energy between low- and high-income households. In this regard, it is worth distinguishing between financial resources benefiting low-income households directly and indirectly; both are useful, but the former has a greater impact in addressing distributional injustices and should always be included in any social innovation project that wishes to address effectively such injustices.

Considering low-income households, it is of importance to have sufficient public funding in place for financing and long-term maintaining the SI's interventions. In short, a lower cost of capital for low-carbon generation can mean that more low carbon energy is affordable for households and businesses (Newbery, 2016). In the Aberdeen case, Aberdeen Heat and Power in a partnership with Energy Action Scotland, constantly monitor minimum income levels and costs, and if individuals are identified at risk of not affording their energy, they are directly contacted and offered information and support, including referral to other organizations to check their entitlement to benefits. Considering high-income households and neighbourhoods, it could be possible to foresee some community investment schemes through energy service companies, like it was implemented in the Samsø case. There are some similar investment schemes in several countries for energy efficiency refurbishment that work as tax breaks. For example, from January 2020, Germany provides homeowners with tax incentives for energy-efficient renovations, allowing them to deduct 20 percent of the costs for renovations of up to 40,000 euros from their taxes. Italy has a plan put in place through which homeowners can finance 110% of energy efficiency renovation works through tax deductions.

Special attention must be given to financial processes in relation to energy transitions. There is the argument that designing energy policy to serve the emergent financial monoculture, not resilient to crises, can expose energy transitions to investment cycles in the wider financialised economy (i.e., financial booms and crashes) (Polzin et al., 2017). These effects could be taken into account in the way of including financial system resilience as a principle of energy justice in the complex issue of energy and finance (Hall et al., 2018).

SMARTEES policy recommendations to improve distributional justice in relation to Energy Equality:

- Financial solutions need to take into account a differentiated pattern of managing and consuming energy according to income households (from low-income to high-income)
- Provide sufficient public funding for financing and long-term maintaining the SI's interventions in cases where the community is not able to finance these themselves (at least partially)
- Build a financial system resilient to financial crises as a part of energy justice as crises affect marginalized households disproportionally

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4.2 Procedural justice and energy equality: embedding participatory methods, co-creation and civic organizations' engagement in social innovations

In terms of procedural equality, and energy equality, the social innovation cases considered show that substantial benefits can be accrued from the active participation of citizens in the social innovation, particularly when citizens are consulted or even involved in a co-creation process. A process of consultation and co-creation generates a better understanding of the aims of the SI and gives to citizens the chance to make their voices heard and their preferences stated. It allows promoters to understand underestimated barriers or neglected citizens' needs that have to be addressed for developing a successful SI project.

As pointed out in earlier deliverables (e.g., D5.2, Dumitru et al. 2021), these activities facilitate the social acceptability of social innovations and the building of a sense of trust and cooperation between the stakeholders. Further, a high level of engagement of citizens and citizens' organisation has a relational value in itself and it is likely to contribute to creating stable networks of individuals that can engage in further community activities and projects, thereby increasing local social capital and possibly facilitating further social innovations (Morrison and Ramsey, 2019; Pellegrini-Masini, 2020). Finally, it should be considered that a solid participatory process would strengthen the political legitimacy of those SIs that are led by local authorities (Voorberg et al., 2015).

Policymakers should consider strengthening regulations that foster early-stage consultation and co-creation of SIs, this might happen through prescribing a participatory process, whenever the SI is led by local authorities and public bodies, such as municipalities, regional authorities, municipal companies. For private organisations leading SIs, such a provision would be burdensome and unrealistic, but policies of support for such participatory processes of co-creation could be put in place with dedicated funding created by local authorities to support participatory processes led by civic organisations.

A further closely related point, regarding procedural justice, refers to the importance of having a broad involvement of citizens' organisations, as partners or leaders of the SI project. In the case of Samsø specifically, arguably the most citizens led of all the SIs researched in SMARTEES, the leading role of citizens organisations appeared to deliver an added value to the project generating a remarkable

involvement of the sectors of the local society that arguably contributed to maximising the benefits of the SI. However, further SMARTEES cases underlined the importance of citizens' organisations for the success of the SI, either in the capacity of partners or consulted subjects. Citizens' organisations, since long recognised as catalysts of social change (Henderson, 1993), might, in fact, offer individuals the opportunity to convey their voice in an organised and effective way, unburdening individuals of the need of having the skills to take part directly as individuals in consultation meetings and events, in a process that has been described in the context of social innovations research as "bottom linked governance", meaning with that "new forms of democratic governance collaboratively built between SI initiatives and activists, their scalarly dynamic networks and state institutions and agencies" (Moulaert et al., 2019, p.62). Further citizens organisations hold within themselves valuable skills and visions of problems and opportunities that can be complementary with those public bodies (Ostling, 2017).

Hence policymakers should consider fostering the involvement of citizens organisations, seeking them out for early engagement whenever a social innovation project is considered. Moreover, the institutional environment surrounding citizens organisations should be capable of sustaining their actions in relation to SIs. One policy that could be considered would be to create dedicated seed funding schemes in local authorities to support citizens organisations led SI projects. This could allow citizens organisations to overcome a resource problem that might prevent citizens organisations to carry out the scoping work necessary to generate an SI project from a leading position.

SMARTEES policy recommendations to improve procedural justice in relation to Energy Equality:
• Strengthen regulations that foster early-stage consultation and co-creation of SIs through prescribing a participatory process whenever the SI is led by local authorities and public bodies.
• Involve citizen organizations early on in the process to unburden individual citizens.
• Create dedicated seed funding schemes in local authorities to support citizens organisations led SI projects.

4.3 Recognition justice and energy equality: a targeted approach for engaging and benefiting vulnerable groups in social innovations

Recognition justice, or the fair representation of individuals, implies knowledge about the specificities of groups and individuals living in neighbourhoods. First of all, it requires the acknowledgement for "various needs, rights and experiences" of individuals, households, groups or neighbourhoods affected by energy decisions (Gillard et al., 2017, p.54). For example, some particular social groups require greater amounts of energy to satisfy their basic needs than other groups, such as the elderly or disabled (Walker & Day, 2012). Second, attention must be paid to which individuals or groups are "privileged" and which individuals or groups are "ignored". For example, it was documented the tendency to dismiss those opposed to wind energy projects as not in my back yard (NIMBY), and not take their counter-arguments as is (McCauley et al., 2013). Thus, the potentially vulnerable groups (with ethnic and gender components, for example), must have a voice, their needs must be visible and accounted for.

Probing for the specificities of needs of vulnerable groups may prove not to be an easy task. These groups can be harder to reach, and largely do not spontaneously engage. For example, the issues can stem from language barriers, putting ethnic groups in difficulties during decision-making, as it might be harder to understand the nature of the intervention or highly technical aspects, which are usually

accompanied by a highly technical language describing them. Because trust is culture-dependent (Tyler et al., 2000), some cultural aspects can also play a role, as cultural differences regarding perceived trust towards local authorities can impact the engagement in and support for the SI.

Targeted approaches could have a positive impact if specific activities are designed, and trained and skilled individuals engage actively these potentially vulnerable groups. In the Malmö case, a communication officer and a dedicated team were assigned to the neighbourhoods with the specific objective to connect with the residents and make sure that they are actively involved in the change process driven by the SI. Similarly, in the Timișoara case, an area manager will be designated to each of the neighbourhoods to be a liaison between the City Hall and the residents. These kinds of positions could be of tremendous help, on one hand, to collect opinions, views and needs of vulnerable groups and on the other hand, to ensure that they have a voice in decisions affecting them.

All things considering, we agree that "a recognition-based approach can help to identify the particulars of energy injustice for different groups and strengthen a political response" (Gillard et al., 2017, p. 55).

SMARTEES policy recommendations to improve recognition justice in relation to Energy Equality:

- Acknowledge various needs, rights and experiences of individuals, households, groups or neighbourhoods
- Vulnerable groups must have a voice, their needs must be visible and accounted for.
- Build trust to vulnerable groups which are less likely to engage in participatory processes and acknowledge cultural differences in who is trusted
- Develop targeted approaches to engage silent or underrepresented vulnerable groups with contact persons close to the target group (both physically and culturally)

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