SMARTEES: Deliverable 2.2 (Report)

# Catalogue of elements to be considered in modelling for comprehensive and exhaustive reflection of relationships between the relevant agents in the ABM (Version1-2018)

December 2018

Photo by Samuel Zeller on Unsplash

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 763912

| **Project Full Title** | **Social innovation Modelling Approaches to Realizing Transition to Energy Efficiency and Sustainability** | |
|---|---|---|
| Project Acronym | SMARTEES | |
| Grant Agreement No. | 763912 | |
| Coordinator | Norwegian University of Science and Technology (NTNU) | |
| Project duration | May 2018 – April 2021 (36 months) | |
| Project website | [www.local-social-innovation.eu](http://www.local-social-innovation.eu) | |
| | | |
| Work Package | WP2 Clusters of Case Studies of Social Innovation | |
| Deliverable | D2.2 Catalogue of elements to be considered in modelling for comprehensive and exhaustive reflection of relationships between the relevant agents in the ABM | |
| Delivery Date | 31.12.2018 (month 8) | |
| Author(s) | Cohen, J.; Reichl, J.; Azarova, V.; Kollmann, A. (all EI-JKU) | |
| Contributor(s) | | |
| Reviewer(s) (if applicable) | Klöckner, Christian A. (NTNU); | |
| Dissemination level: | Public (PU) | **X** |
| | Confidential, only for members of the consortium (CO) | |

**Keywords**
Agent-based modelling, mobility, energy islands, renewable energy, district regeneration, superblocks, energy efficiency, fuel poverty

This document has been prepared in the framework of the European project SMARTEES – Social Innovation Modelling Approaches to Realizing Transition to Energy Efficiency and Sustainability. This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 763912.

# Table of Contents

# Executive summary

A key facet of the knowledge base built by SMARTEES will be the merging of various social science findings with ABM frameworks. The main goal of this deliverable is to support the integration of social science perspectives with agent-based modelling (ABM) efforts, and the comparison of ABM frameworks from the various modelling teams. To reach this goal we applied a two-step procedure involving collection of partners' input and feedback on respective topics as well as primary literature research. Partners' involvement also contributed to the inclusion of interdisciplinary aspects in the literature review and this deliverable. In addition to targeted literature review, a so-called catalogue of elements that social science literature has identified as relevant to the uptake and success of the various social innovations is elaborated.

A catalogue of elements is given in the chapters below for each SMARTEES case-cluster topic: holistic mobility plans, islands and renewable energy, district regeneration, mobility in superblocks, energy efficiency and fuel poverty. With respect to holistic mobility plans, we identified factors that affect the success of mobility goals in specific contexts so that these factors can be considered by ABM modelling teams that may simulate related social innovations. The identified factors include determinants of EV uptake, travel mode and individuals behavioral patterns, factors determining intention to travel by bike or on foot. Further on, for islands and renewable energy the literature review on prosumerism and renewable energy acceptance as well as analysis of success factors of Samsø Island and the Canary islands are provided. The broad topic of district regeneration is defined in this deliverable as a set of measures which can promote localized renewable energy production in city contexts as well as prosumerism, energy savings and thus GHG savings, improvement of quality of life in disadvantaged city districts, including a reduction of unemployment as well as a more sustainable economic development at the district level. The social and cultural attributes are identified as crucial for the concept of mobility in superblocks. Together with such key factors as street connectivity and walkability, population density and frequency of private vehicles usage cultural and gender aspects have a significant impact in the context of mobility in superblocks. In terms of energy efficiency and energy poverty, we examined the origins of energy poverty as well as potential solutions using interaction of measures and increased communication and new technologies, also based on examples of projects like PEAKapp.

The catalogue of elements puts cross-disciplinary social science findings into the hands of the ABM modelling teams so that they can consider important factors in their modelling efforts. Further on, a discussion of the recording of important points about each ABM model is provided in Section 2 of this deliverable. This is meant to serve as a template for the ABM

teams so that each team can document the same set of facts, assumptions, and methods about their particular ABM architecture and conceptual approach.

The database of literature in bibtex format used in this deliverable can be downloaded by partners on the SMARTEES Sharepoint and the literature review itself can serve as in input in further SMARTEES tasks and documents.

# List of abbreviations

| **Abbreviation** | Full word |
|---|---|
| **ABM** | Agent-based modelling |
| **AC** | Activity corridor |
| **EV** | Electric vehicle |
| **LEC** | Local energy communities |
| **PV** | Photo-Voltaic |
| **UGS** | Urban green spaces |
| **WHO** | World Health Organization |
| **WTP** | Willingness to pay |

# 1. Introduction

The work of WP2 and this deliverable support the integration of social science perspectives with agent-based modelling (ABM) efforts, and the comparison of ABM frameworks from the various modelling teams. The SMARTEES project has the goal of understanding citizen acceptance of the Energy Union and responsiveness to socioeconomic incentives for increased ownership and prosumerism, in order to inform effective policymaking and increase the uptake of energy-related social innovation. A key facet of the knowledge base built by SMARTEES will be the merging of various social science findings with ABM frameworks. This deliverable supplies a catalogue of the elements that research has found are relevant to, and important in, driving the uptake of energy-related social innovations. Thus, the catalogue of elements puts cross-disciplinary social science findings into the hands of the ABM modelling teams so that they can consider important factors in their modelling efforts. A catalogue of elements is given in the chapters below for each SMARTEES case-cluster topic: holistic mobility plans, islands and renewable energy, district regeneration, mobility in superblocks, energy efficiency and fuel poverty.

Section 2 below discusses the recording of important points about each ABM model. This is meant as a template for the ABM teams so that each team can document the same set of facts, assumptions, and methods about their particular ABM architecture and conceptual approach. A consistent documentation of ABM approaches is necessary to ensure that the varied approaches of the ABM teams in SMARTEES can be compared and contrasted to gain an understanding of how modelling choices may affect results and/or make results less comparable between models.

## 1.1 Aim and methodology

The aim of this document is to support the ABM modelling teams with a literature review of relevant factors found in cross-disciplinary social science research of the factors that can affect the uptake or success of social innovations related to the SMARTEES case-cluster topics. The aim of the research effort behind this document was to complete a targeted, not exhaustive, review of the social science literature. This targeted literature review was completed in two ways. The first way was to solicit input from partners. To do so the WP2 team sent out an email with an attached document that explained the aim of this deliverable, and requested that partners send any papers or reports that may be relevant to this effort. The second method was a primary literature search. Search terms were words or groups of words from the case-cluster topic headings: holistic mobility plans, islands and renewable energy, district regeneration, mobility in superblocks, energy efficiency and fuel poverty. These core terms were augmented by topic related-terms that were common themes in the literature. For example, when finding literature for holistic mobility plans, additional terms included “electric vehicle adoption”, “public transit use”, and “travel mode choice”.

## 1.2 Background

The study of the factors that determine the success of energy-related social innovations is a wide and deep field that spans multiple social science disciplines and many types of innovation. The completed FP7 project MILESECURE 2050[1] studied the application of a variety of social innovations in energy across a wide geographic scope within Europe. Through qualitative interviews the project found that, in general, the group promoting the social change under consideration varied between contexts, and that local issues were often key drivers for these groups to begin promoting change (Caiati et al. 2014). These general findings are relevant to the ABM efforts here as they suggest that the potential advocates for any policy in a given city/region and the ability to link the potential social innovation to a local issue will be important factors in the success and uptake of the innovation.

Also at a broad level is the conceptual study of transformative social innovation, whereby a social innovation process is framed as co-evolution social innovation, technical innovation, and other aspects of change (Avelino et al. 2017). Importantly, the social innovation process can involve empowerment and marginalization of specific actors or groups of actors, which can cause opposition, social stress, or uneven outcomes. Thus, throughout any process of centrally-led change it is important to engage with the various stakeholder groups, and carefully consider the participatory nature of the change and the procedural aspects of engagement (Frantzeskaki & Rok 2018; Cohen et al. 2014). All of these factors are background issues with respect to social innovation and the ABM modelling thereof. This document goes on to engage with and catalogue more specific and concrete elements that may be considered for ABM modelling.

## 1.3 Using this paper

Section 2 below outlines some of the documentation that is needed from each ABM team regarding their specific modelling approach. This chapter should be used as a loose template for the assumptions, facts, and methods that need to be discussed and documented for each agent-based model developed in SMARTEES.

The rest of this paper, is meant to be useful primarily to the ABM modelling teams in SMARTEES, but can also be used as a background literature review for input into other SMARTEES tasks and documents. Each section includes a catalogue of elements that social science literature has identified as relevant to the uptake and success of the various social innovations. These elements can be considered for inclusion into agent-based models. The database of literature in bibtex format used in this deliverable can be downloaded by partners on the SMARTEES Sharepoint.

[1] http://www.milesecure2050.eu/

# 2 Template for ABM Descriptions

## 2.1 List of key pieces of information needed from each ABM team

| Model Purpose and Value-added of Agent-based Modeling: |
|---|
| What specific problem is the model being developed to address? |
| What specific questions should the model answer? |
| What kind of information should the model provide to help make or support a decision? |
| Why might agent-based modeling be a desirable approach? |
| What value-added does agent-based modeling bring to the problem that other modeling approaches cannot bring? |
| **All About Agents:** |
| Who should the agents be in the model? |
| How many agent types are there and how different are they? |
| Who are the decision makers in the system? |
| What are the entities that have behaviors? |
| Where might the data come from, especially on agent behaviors, for such a model? |
| **Agent Data:** |
| What data on agents is simply descriptive (static attributes)? |
| What agent attributes are calculated endogenously by the model and updated for the agents (dynamic attributes)? |
| What is the agents' environment? How do the agents interact with the environment? |
| Is agent mobility through space an important consideration? |
| **Agent Behaviors:** |
| What agent behaviors are of interest? |
| What decisions do the agents make and what information is required to make such decisions? |
| What behaviors are being acted upon? |
| What actions are being taken by the agents? |
| How would we represent the agent behaviors? By If-Then rules? By adaptive probabilities, such as in reinforcement learning? By regression models or neural networks? |
| **Agent Interactions:** |
| How do the agents interact with each other? |
| How do agents select whom to interact with? |
| How do the agents interact with the environment? |
| How expansive or focused are agent interactions? |
| How does agent interaction change parameters within agents? |
| **Agent Recap:** |
| How do we design a set of experiments to explore the importance of uncertain behaviors, data and parameters? |
| How might we validate the model, especially the agent behaviors and the agent interaction mechanisms? |

# 3 Holistic Mobility Plans

## 3.1 Topic description and explanation of the challenge

Sustainable municipal mobility plans can encompass a multitude of different policies and goals, but usually try to stimulate a decrease in conventional fuel vehicle use and/or overall travel time in automobiles. Popular goals include an increase in green public transportation (e.g. hydrogen or biofuel vehicles), an increase in electric vehicles (EVs), and an increase in pedestrian or bike traffic, and corresponding decreases in personal automobile and conventional fuel use. These policies hope to contribute to improved air quality, cleaner cities, healthier people, and, in some cases, more convenient travel. In SMARTEES the emphasis is on holistic, i.e. comprehensive, mobility plans at the local/regional level. The purpose here is to identify factors that affect the success of mobility goals in specific contexts so that these factors can be considered by ABM modelling teams that may simulate related social innovations.

## 3.2 Review of recent literature

We begin by looking individually at the research on the specific goals and policies: personal electric vehicle adoption, sustainable public transit, and travel mode choice. These goals often contribute to a holistic mobility plan and have been given significant study by scientists and policymakers. We then discuss briefly the experiences of specific cities in instituting holistic mobility innovations.

### 3.2.1 Personal electric vehicles

For the mobility plans involving the replacement of the current stock of conventional fuel vehicles with EVs, the main challenges are in increasing adoption of EVs amongst private car owners, and developing charging infrastructure to enable a full transition away from gasoline. Despite substantial efforts and subsidy schemes to increase EV uptake across Europe, battery-electrics, and plug-in hybrids enjoy a market share of only about 1% of vehicle purchases (ICCT 2017). This level of market uptake lags significantly behind EU objectives (Biresselioglu et al. 2018). Recent reviews of the literature under the Horizon 2020 ECHOES project[2] have identified numerous barriers to consumer adoption of EVs that explain the observed low levels of adoption (Biresselioglu et al. 2018; Hardman et al. 2018). The literature review paper of Biresselioglu et al. (2018) finds that "[...] lack of charging infrastructure is considered one of the main barriers to EV market diffusion" across a multitude of studies. Other major barriers to uptake are technical restrictions related to charging, such as charging time requirements, battery range, and battery lifetimes (Biresselioglu et al. 2018). Another review paper from Hardman et al. (2018) identifies five

[2] https://echoes-project.eu/

key insights on consumer preferences for EVs, four of which directly relate to consumer access to charging points and related costs. These insights are: "[...] (1) the importance of [charging] infrastructure at home, work, and public locations, (2) consumers access to charging infrastructure, (3) the cost to charge a PEV, (4) how many charge points are needed to support the introduction of PEVs [...]" (Hardman et al. 2018). Aside from charging concerns, return-on-investment (ROI) and other financial factors have been shown to be important drivers of a household's choice to adopt an EV (Sierzchula et al. 2014). Specifically, high initial costs and income barriers have been shown to deter EV adoption (Rezvani et al. 2015). Furthermore, individual and communal environmentalist attitudes, as well as comfort levels with new technologies, have been shown to drive or hinder EV adoption (Rezvani et al. 2015; Egbue & Long 2012; Schuitema et al. 2013).

Vliet et al. (2010) address the question of reducing fossil fuel use in land travel directly via an agent based model that simulates each agent's demand for various fuel types subject to fuel supply characteristics (e.g. price). Agents make their decisions using simple heuristics and a stage-by-stage elimination of potential fuel types as purchase options. During this process agents consider driving costs, environmental concerns, fuel performance, and "[…] the extent to which the fuel fulfils social needs or identity needs" (Vliet et al. 2010). The results of these simulations suggest that alternative fuels will continue to occupy low market shares (<5%) unless sustained interventions are imposed on the system. Another agent based model simulation study of electric car adoption uses the CONSUMAT framework for agent decision making processes (Kangur et al. 2017). CONSUMAT is discussed in SMARTEES Del. 7.1, and will be a part of the conceptual basis for agent based modelling in SMARTEES. The model in Kangur et al. (2017) assumes a scenario where access to charging infrastructure improves, and household budgets for car purchases increase, thus assuming that the two major hurdles to EV adoption referenced in the preceding paragraph are at least partially overcome. Under these assumptions, the simulated agents adopt a market share of 12% of EVs by 2024 in the Netherlands.

Research using psychometric methods has found that owning an EV can have an increasing effect on car usage, as EV owners feel a reduced moral obligation to reduce car use (Klöckner et al. 2013). A similar study has shown that the decision to purchase an EV is made in stages, where each stage is preceded by a changing of intentions, norms and emotions (Klöckner 2014).

### 3.2.2 Sustainable public transit

Development and/or decarbonisation of public transportation is also a much-discussed goal of local sustainably measures and mobility plans, and can also be used as a means or influencing urban development patterns (Cervero & Dai 2014). A first step in more sustainable public transportation is often hybrid vehicles that use both electric motors and gasoline. While many cities across the globe have adopted these to some degree, it has been shown that hybrids do not significantly reduce GHG emissions and are better seen as a stepping stone to a fully-electric sector (Mahmoud et al. 2016). In contrast, hydrogen fuel cell electric buses greatly reduce GHG emissions and local pollution, and are being tested in cities across the World (Hua et al. 2014). The challenges identified from the European test cases of hydrogen buses include: a lack of spare parts and developed supply-chain, a need to train support staff and mechanics, and, similar to the case of the EV, a high need for new hydrogen-fuel supply and refuelling infrastructure (Hua et al. 2014). Despite these challenges, public opinion towards hydrogen bus adoption is largely positive. For instance, in a survey-based study of Luxembourg, Berlin, and London, it was found that bus users would pay about €0.25 more per bus fare for the cleaner hydrogen buses (O'Garra et al. 2007). Similar results were found in the Italian city of Perugia, and in Korea (Bigerna & Polinori 2015; Heo & Yoo 2013). The Horizon 2020 ECHOES project completed a survey across 31 European nations that includes questions about the importance of low-carbon, clean public transit to respondents. These forthcoming results may also be useful to the SMARTEES consortium for any potential modelling of improvements in the public transportation sector.

The final specific policy goal to be discussed is that of changing travel mode choice to reduce the number of personal automobiles in use, and subsequently reduce traffic, improve air quality and health outcomes.

#### 3.2.3 Travel mode choice

Applied psychologists have investigated the psychological factors that influence travel mode choice using observations from panels of university students (Klöckner & Friedrichsmeier 2011; Klöckner & Blöbaum 2010). Key in these discussions is the development of the Comprehensive Action Determination Model, which frames the choice of individual behaviour as determined by intentional, situational, and habitual factors (Klöckner & Blöbaum 2010). The method illustrates that car use habits are related to personal norms and social norms (Klöckner & Friedrichsmeier 2011), and that subjective and objective constraints play a role in travel mode choice (Klöckner & Blöbaum 2010).

Similar psychometric surveys from the city of Vitoria-Gasteiz, Spain, found that individuals who self-identified as 'cyclists', social identity, and motivational factors contributed to an intention to commute to work via bicycle (Lois et al. 2015). Concrete factors such as journey times, costs, and distance were also related to the decision to begin cycling (Lois et al. 2015). A further analysis of Spanish cycling behaviour has shown that cyclers are often motivated by a desire for physical fitness, and that the environmental benefits of cycling are not strong drivers of this behaviour (Lois et al. 2016). Furthermore, the risk of accidents is a strong deterrent against commuters switching to bicycle use (Lois et al. 2016). These facts may suggest that educational campaigns on bicycle safety and health benefits, as well as safer biking paths could increase ridership.

Similar to biking, walking as a primary form of transportation can offer health, environmental, and social benefits. Improving walkability, the ease and speed of pedestrian based mobility, is one way to increase the amount of travel done by foot. The superblock initiative of Vitoria-Gasteiz was shown to reduce pedestrian travel times by 4-5%, as discussed in the Superblock section of this paper (Delso et al. 2018).

The Swedish city of Malmö has pursued an aggressive agenda of sustainable renovations, coupled with improved infrastructure for trade (e.g. harbours and bridges), which has resulted in improved economic opportunities for citizens (Anderson 2014). Malmö leadership has taken a largely top-down approach to these changes, but has involved citizens in the planning process through an innovation platform that connects different stakeholders with a common goal of improving the city (McCormick & Kiss 2015).

Vitoria-Gasteiz, Barcelona, and Madrid are other cities that are pursuing new visions of holistic mobility plans. Vitoria-Gasteiz, a case study city in SMARTEES, has had a particularly strong implementation of new mobility plans spurred by the challenges brought about by urban growth, experienced by the city in previous decades (Munoz-Lopez & Rondinella 2016). The plan has largely functioned, and resulted in fewer pedestrian and bicycle accidents per trip, and a reduction of the relative usage of personal cars for transport (Munoz-Lopez & Rondinella 2016).

## 3.3 Catalogue of elements

| Element / Factor | Related Literature | Findings / Notes |
|---|---|---|
| EV uptake: charging infrastructure, charging times, and battery range are critical barriers | (Biresselioglu et al. 2018), (Hardman et al. 2018) | |
| EV uptake: high initial costs and uncertain paybacks (e.g. savings on fuel costs), individual and communal environmentalist attitudes, comfort levels with new technologies are other barriers | (Rezvani et al. 2015; Egbue & Long 2012; Schuitema et al. 2013). | EV purchase decision is made in stages, where each stage is preceded by a changing of intentions, norms and emotions (Klöckner 2014). |
| Hydrogen buses: survey-based studies find that bus users would pay more for hydrogen buses | (O'Garra et al. 2007), (Bigerna & Polinori 2015; Heo & Yoo 2013) | Surveys cover cities of Luxembourg, Berlin, London, Italian city of Perugia, and Korea |
| Travel mode: Individuals' behaviour is determined by intentional, situational, and habitual factors, including personal norms, social norms, subjective and objective constraints | (Klöckner & Blöbaum 2010), (Klöckner & Friedrichsmeier 2011) | |
| Biking intention: Increased by self-identification as 'cyclist', social identity, motivational factors, journey times, costs, and distances | (Lois et al. 2015) | |
| Travel by foot intention: Distance, safety, ease of trip matter | (Delso et al. 2018) | |

# 4 Islands and Renewable Energy

## 4.1 Topic description and explanation of the challenge

Topics related to renewable energy such as, propensity to become a prosumer, willingness to pay a premium for 'green' power, and acceptance of new renewable energy generators have been studied extensively in recent years. Especially in the context of energy islands, where the security of energy supply is dependent on expensive oversea imports of fuel, building a fully renewable energy-based system is enticing. This section reviews the literature on renewable energy issues, and explains the cases of a few noteworthy energy islands. The purpose is to identify important factors for in individual's decision-making process as to whether to join a renewable energy initiative or oppose it.

## 4.2 Review of recent literature

A mass of past literature has shown that some consumers have a preference for renewable energy and thus may be more likely to accept social innovations that increase the supply of 'green' electrons available to them. For instance, it has been shown that welfare varies with the electricity production mix across countries and over time (Welsch & Biermann 2014). In particular, a greater share of solar and wind power and a lesser share of nuclear and coal power increases welfare across all income levels (Welsch & Biermann 2014). The negative welfare impact of nuclear power increased drastically after the Fukushima accident. A similar finding from Korean shows that consumers have a strong preference to avoid "dangerous" sources of electricity, such as nuclear (Byun & Lee 2017). Other authors estimate the WTP for electricity generation mix in Spain (Gracia et al. 2012). They find that generally, Spanish consumers have near-zero WTP for increased renewables in the generation mix but that a subset (~20%) of consumers exists that would pay more for renewable power. The authors also find that preferences for solar and wind power are heterogeneous throughout the Spanish population (Gracia et al. 2012). Similarly, estimates of the WTP of German citizens for the following attributes of electricity provision: shares of regional generation, power provider type, and electricity mix, show that Germans prefer locally generated renewables and provide some evidence that regional generation and providers are preferred to more distant entities (Kalkbrenner et al. 2017). A similar paper from Germany also finds that consumers have positive WTP for energy generated by cooperatives or municipally-owned utility companies (Rommel et al. 2016). It has also been shown using discrete choice experiments that consumer preferences in regard to energy technology are relatively stable over time, heterogeneous within populations, and sensitive to labelling (e.g. the names of technologies) (Rijnsoever et al. 2015).

Regarding the acceptability of island-based or 'synthetic' islands of renewable electricity cooperatives the literature also paints a generally positive picture of consumer views. Sagebiel et al. (2014) finds that electricity consumers are willing to pay for specific organizational attributes of electricity suppliers. Most notably, consumers have positive WTP for transparent pricing, participation in the decision process, and local suppliers, especially electricity cooperatives. In a similar study, Vecchiato & Tempesta (2015) find that electricity consumers have positive WTP for renewable-sourced electricity, in particular electricity from solar and to a lesser extent biomass.

For citizens to directly participate in a renewable energy island, such as through investment, the literature shows that the nature of the participatory process and the specifics of the investment are important drivers of the success of this social innovation. The results of a German study suggest that households are willing to invest in micro-cogeneration and that longer contract durations had a weak negative association with acceptance of micro-cogeneration contracts (Rommel & Sagebiel 2017). Funkhouser et al. (2015) analyse business models that lead to community-based solar adoption in the U.S. They find that policy and regulatory conditions and the utility company's strategy with respect to grid greenification are important drivers of the success of the community-solar model. Interestingly, they find that community based solar is used by utility companies to offset revenue loss from residential solar instalments. Noll et al. (2014) investigate the role of solar community organizations on the adoption of solar power at the residential level. Importantly, these organizations generally do not organize group investments in solar, but instead aid the community with the solar acquisition process. They find that these organizations are successful in increasing solar adoption and that this success is due to spreading valuable information and leveraging trusted community networks.

Other papers have investigated which characteristics of investment opportunities in renewable energy will improve acceptance, though these papers are not contextualized with community-based or island investments (Balcombe et al. 2014; O'Keeffe 2014; Bauner & Crago 2015; Mills & Schleich 2009; Simpson & Clifton 2015). This literature generally finds that return on investment and related financial concerns are strong drivers of solar adoption. Oft-cited ancillary concerns include trust in the overseeing entity (utility company or government), policy (un)certainty, and perceived fairness of the subsidy system.

Case studies or renewable energy acquisitions on islands are also available. Kuang et al. (2016) give a good overview of this literature and explain the reasoning behind the academic and policy interest in island power grids. A comparative study of various island cases shows that the availability of renewable resources, especially wind and power is critical in determining the success of a renewable energy island (Colmenar-Santos et al. 2013). Furthermore, the comparative study revealed that regulatory schemes can also drive success, especially schemes that involve incentives (Colmenar-Santos et al. 2013). Similarly, the availability of energy storage technologies, or favorable geography in the case of pump-hydro storage, is also important to a successful energy island (Rodrigues et al. 2014).

Perhaps the most famous success case is the Danish Island of Samsø. Researchers attribute the high citizen engagement and success of Samsø's transition to a fully renewable autonomous energy island to the following factors: "As external contextual conditions, we identify *guiding visions and plans, governmental technology support, governmental process support, and expert assistance*. Internal contextual conditions include *local traditions and history of cooperative projects, sense of locality and responsibility, community spirit, entrepreneurial individuals, networks, as well as guiding visions and plans*" (Sperling 2017). It is hypothesized that strong participation in Samsø's transition was also brought about through 'material' participation, whereby citizens of the island were interested in preserving the viability of the area and saw the renewable investment as an opportunity to do so (Papazu 2016).

Beyond Samsø, the Canary Islands are also a frequently referenced case of a successful renewable energy island. In the context of these islands, it has been noted that tidal-based energy sources also can exhibit strong seasonal variation with high energy winters and low energy summers, which could potentially be used to balance out the seasonal solar potential variation (Iglesias & Carballo 2011). Other research has noted that the installation of combined wind and pump-hydro storage facilities on Canary Islands has resulted in nearly a doubling in electricity prices for the first few years after installation (Latorre et al. 2019). This may have implications for the acceptance of such renewable energy island concepts.

## 4.3 Catalogue of elements

| Element / Factor | Related Literature | Findings / Notes |
|---|---|---|
| Availability of wind / solar / tidal resources and their seasonality | (Iglesias & Carballo 2011; Colmenar-Santos et al. 2013) | |
| Geography favourable for pump-hydro storage | (Rodrigues et al. 2014) | Can make renewable island grids cheaper/easier to realize |
| Expected / actual effects on electricity price can be substantial | (Latorre et al. 2019) | People may oppose new renewables if they think it will increase their electricity price |
| Governmental technology and financial support | (Sperling 2017) | Such support can positively affect the process |
| Sense of local responsibility and that energy transition can help long-term viability of community | (Sperling 2017; Papazu 2016) | An internal driving force for positive change through energy transition. |
| Return on investment, payback period, holding period. | (Balcombe et al. 2014; O'Keeffe 2014; Bauner & Crago 2015; Mills & Schleich 2009; Simpson & Clifton 2015); (Rommel & Sagebiel 2017) | Better financial conditions lead to higher rates of participation in community or island group financing of renewable energy infrastructure. |
| Preferences for 'green' or micro-generated electricity | (Welsch & Biermann 2014; Gracia et al. 2012; Kalkbrenner et al. 2017; Sagebiel et al. 2014; Vecchiato & Tempesta 2015; Rommel et al. 2016) | This can possibly offset, to some degree, the concerns for higher prices from some renewable configurations, and opposition to investment requirements. |

# 5 District Regeneration

## 5.1 Topic description and explanation of the challenge

In the SMARTEES project we assess how public-private-citizen alliances can trigger district regeneration. Tyler (2010) defines the drivers behind district regeneration projects in very broad terms and divides it in the following main categories: (1) worklessness, skills and business development; (2) industrial and commercial property and infrastructure; (3) homes, communities and the environment. Although in the SMARTEES project we mostly focus on the third category, also this category includes a broad variety of measures “enhancing livability, creating community, expanding opportunity, promoting equality and fostering sustainability” (Furlan et al. 2018). SMARTEES uses a holistic perspective on this social innovation which in our understanding includes hard and soft measures to transform a district by enforcing i) local energy production and energy efficiency measures, ii) urban green spaces, iii) transport system transition measures and iv) increased citizen participation. Thereby, alliances for district regeneration can promote localized renewable energy production in city contexts as well as prosumerism, energy savings and thus GHG savings, improvement of quality of life in disadvantaged city districts, including a reduction of unemployment as well as a more sustainable economic development at the district level. This social innovation not only includes an environmental or energy system perspective, but also a social and economic one. It forms “alliances” between (at least) three main actors: the public (municipality), private sectors (constructor, housing companies, refurbishment business, etc.), and citizens (residents). The latter group is of particular relevance in this process especially with regard to ensuring that their needs and expectations are fully accounted for. Finally, a successful implementation of this social innovation recognizes that the economic and social development in the area needs to be accompanied by behavioral change of residents toward more environmentally sustainable and energy efficient way of life. Thereby, district generation is a cross-cutting topic that includes many (if not all) of the other case-cluster topics discussed in this deliverable and the elements considered there are relevant for district generation as well.

## 5.2 Review of recent literature

We begin by looking individually at the research on the specific goals and policies: i) local energy production and energy efficiency measures, ii) urban green spaces, iii) transport system transition measures and iv) increased citizen participation.

### 5.2.1 Local energy production and energy efficiency measures

One of the main cornerstones of the energy transition is prosumerism, the decentraliation of energy production. A natural outcome of the wide-spread and cost-efficient provision of renewable energy production facilities and the accompanying opening of the energy markets to new players is the arising of local energy communities (LEC) which is “an association, a cooperative, a partnership, a non-profit organisation or other legal entity which is effectively controlled by local shareholders or members, generally value rather than profit-driven, involved in distributed generation and in performing activities of a distribution system operator, supplier or aggregator at local level, including across borders".[3] At the moment these communities are being formed all over Europe[4], taking on different organisational structures and goals. In all cases, LEC are a visible sign of what has been called the new concept of energy democracy. The factors influencing the involved actors do not differ from what has already been discussed in Section 4.2 but the potential positive effect on district regeneration needs to be highlighted. Also, LEC models usually involve some form of ownership of the actual production facility which increases involvement, interest and acceptance and may thereby positively influence the uptake of district regeneration projects.[5] LEC are one possibility to greening local energy consumption and implementing energy efficiency strategies.

### 5.2.2 Urban green spaces

A recurring subject in the discussion about how to align the continuing urbanisation with the needs and wishes of the population for a sustainable, healthy and safe living environment, are urban green spaces (UGS). The WHO considers places "such as parks and sports fields as well as woods and natural meadows, wetlands or other ecosystems […]" which "[…] facilitate physical activity and relaxation, and form a refuge from noise" as green urban spaces. Among the multitude of benefits of UGS, WHO highlights the positive effect of trees (oxygen production, air pollution filtering), water reservoirs (moderate temperatures) and parks and gardens (physical activity, social interaction and recreation) which form green urban spaces and increase the overall well-being of citizens (Bertram & Rehdanz 2015). The positive effects of urban green spaces on human well-being are not challenged in literature, but as UGS are in strong competition with other forms of land-use (Sánchez et al. 2018), any alliance for district regeneration needs to find a balance between the interests and complex interaction of the involved groups of agents. Biernacka & Kronenberg (2018) list six groups of actors involved in the provision of UGS (urban green spaces): 1) individuals, 2) informal groups of people, 3) formalized groups of people, 4) community council, 5) city authorities responsible for UGS management and the related administrative activities, 6) national governmental and non-governmental organizations. The management of these actors is a key success factor that if possible, should already be part of the planning of UGS (BMI 2017).

---

[3] European Commission, 2016, Proposal for a Directive of the European Parliament and of the Council on common rules for the internal market in electricity, COM(2016) 864 final/2, p.52.

[4] See e.g. the steeep-website: http://www.steeep.eu/lecs/

[5] A growing body of literature analyses the effects of ownership models on various aspects of local energy communities; a recent systematic review is given in Berka and Creamer (2018).

### 5.2.3 Transport system transition measures

Sustainable municipal mobility plans have been discussed in Section 3.1. There, the focus was on different policies and goals that may stimulate a decrease in conventional fuel vehicle use and/or overall travel time in automobiles. Such goals naturally include an increase in green public transportation, an increase in electric vehicles (EVs), as well as an increase in pedestrian or bike traffic. Rethinking the transport system within a district certainly includes all the mobility plans discussed there and also shares the overall goal of improving air quality, residents' health, well-being and convenience.

For many cities in Europe (and elsewhere), transport system transition plans need to overcome barriers arising from urban morphology. The post-war period in urban construction is said to have been dominated by the adjustment of urban areas to the needs of car and auto mobility (McLeod & Curtis 2018; Zee 2015). This adjustment meant less space for pedestrians, cyclists and public areas. With the current economic and ecologic situation, there is a need to readjust or regenerate the cities to become more balanced and sustainable. Today's concept of district regeneration is directly related to this notion of sustainable urbanism and its core principles. Similar to what has been discussed above for UGS, redesigning transport systems involves tackling land-use competition, ownership structures and legal/regulatory aspects of urban planning.

McLeod & Curtis (2018) propose using the Activity Corridor (AC) concept as a redevelopment form for "dispersed, car-centric cities". The AC concept aims at improving sustainability for cities seeking to increase connectivity to certain districts by reducing the so-called urban sprawl (Gavrilidis et al. 2019; McLeod & Curtis 2018). AC proposals include investment in improved public transportation, often in a form of a more efficient surface line as well as solutions for the "first mile" and "last mile" problem. (McLeod et al. 2017). Based on a case study of a district along an urban arterial road in Perth, Western Australia, McLeod & Curtis (2018) identified residents' attitudes to increasing development intensity in exchange for varying public transport provision scenarios. Based on the survey results authors suggest that the residents were more supportive of increasing development intensity if public transport was improved.

### 5.2.4 Increased citizen participation

District regeneration goals can be also defined in a less broad way as an adaption of available infrastructure to current environmental and ecological issues, making it more efficient, sustainable and "livable" also for future generations. In other words urban regeneration refers to an effort to solve urban socioeconomic problems such as for example exclusion of physically declining areas. Hwang (2014) defines the concept of urban regeneration as a „form of comprehensive management intended to continuously improve economically, socially, and physically declined areas via partnerships between the public and civil sectors on a strategic plan frame for the progress of the whole city". Therefore, urban regeneration may include measure for communities' vitalization, job creation, and an increase of income, as well as the improvement of built environments. In most of the recent research papers district regeneration is often related to improvement of the transport situation (either increasing connectivity or improving the public transport system), or regeneration of historic or declining industrial district. However, as suggested in Furlan et al. (2018), a successful district regeneration requires an interdisciplinary planning approach taking into account demographic, environmental, social and economic issues and involvement of the local community.

There are innovative approaches available to tackle the issue of citizen participation like the solution suggested by Malmö Innovation Platform, which brings together municipal, business, academic and community actors to build a joint innovation capacity in the renovation of existing apartment buildings in Southeast Malmö in Sweden (McCormick & Kiss 2015). The Malmö Innovation Platform provides diverse real-time learning environments in a local context, by combining physical and virtual spaces, more over it allows active participation of Master students side by side with experts and industrial project partners.

In his study, Hwang (2014) provides examples of so-called culture-led urban regeneration, meaning that the core of such regeneration is to find unique urban identity for the considered district. Further on, based on three case studies from Korea, Hwang (2014) provides guidelines for such a culture-led regeneration including the following 5 phases: (1) the diagnosis of decline; (2) understanding the reasons for decline and local characteristics; (3) making a database and establishing a direction; (4) applying various techniques suitable in the context and (5) monitoring and feedback. These guidelines allow better understanding of the reasons for district decline as well as to involve the residents and as a result to provide more suitable solutions. The participation of residents in making relevant decisions is identified as a crucial part of successful urban regeneration (Hwang 2014).

A similar idea is supported by Wang et al. (2013) claiming that a sustainable development is not about construction and transport system, but it’s about finding internal local values and identities, and supporting competitiveness of local development. In this respect a special approach, integrating the fuzzy Delphi method, the interpretive structural modelling and the analytic network process with the benefits, opportunities, costs, and risks is developed to reconstruct the district spatial structure, improve its infrastructure, and foster its natural functions (Wang et al. 2013).

As suggested in an article by Fontenot (2018), who provides an overview of 30 inspiring urban renewal projects in the US, urban regeneration and redevelopment are “crucial to the success of the city because it stimulates the economy, enhances property values, instills a sense of civic pride, reduces crime, and helps current businesses and attract new ones.” Although there is no unified approach to successful district regeneration and all the cases require prior data collection and investigation of local specifics, based on the available literature, we can conclude that the main goal of district regeneration is urban sustainable progress which is only possible with high involvement of industry, policy makers, resident and researchers.

## 5.3 Catalogue of elements

| Element / Factor | Related Literature | Findings / Notes |
|---|---|---|
| Environmental and Socio-economic attributes of the district (job situation, age and composition of population, main production activities, connectivity etc) | (Hwang 2014) | Research and data collection on socio-economic characteristics of the district should be a prior step for district regeneration strategy definition |
| Land-use competition | (Sánchez et al. 2018) | To account for available land and estimate potential for regeneration and balanced use |
| Management of actors | (BMUB 2017) | Importance to guarantee cooperation among all the involved stakeholders |
| Indicators to account for urban morphology | (Biernacka & Kronenberg 2018), (McLeod & Curtis 2018; McLeod et al. 2017) | Accounting for the available leeway in strategy design |
| Stakeholder involvement | (BMUB 2017) | Accounting for the share of involved stakeholders vs. potential stakeholders |
| Local values and identities | (Wang et al. 2013) | Accounting for local values of the district important in the success of district regeneration. Increased acceptance and involvement of residents |

# 6 Mobility in Superblocks

## 6.1 Topic description and explanation of the challenge

The idea of a superblock is not a new one, even though it is currently gaining renewed interest across European cities. Initially, the idea for a superblock came out of the vision of a modernized city, where cities would be rationally organized into blocks based on function with open spaces in between that could improve citizen living standards. The idea for a superblock based city was first formalized in Paris in 1925, and is perhaps most famously evident in the transformation of New York City, which included the creation of a network of parks and highways within the dense urban area. The idea of superblocks in cities is still being developed and improved as a social innovation concept (Fishman 2011).

In this deliverable, and in the SMARTEES project, we focus on a narrower definition of superblocks that applies centrally to mobility. This version of the superblock concept is well exemplified by the recent interventions in the SMARTEES case-study city of Vitoria-Gasteiz in Spain. This medium-sized dense city began in 2007 to implement a pedestrian-based superblock approach. The interventions have set up areas within the city that are effectively shut-off from automobile traffic, and thus attempt to promote easier pedestrian and bicycle access (Delso et al. 2018). In this way, one of the key goals of the superblock is to reorganize the mobility in such a way that the exterior main roads surrounding the block are used for motorized mobility. Meanwhile, the interior roads are closed to through traffic and open to residents, public transport, disabled people, emergency vehicles and, in some streets, bicycles (Albaina & Escudero 2017). Such a reorganization of urban infrastructure is required by current transport and environmental, and the mobility plan should be adjusted to the needs of the cities and citizens (Zee 2015).

## 6.2 Review of recent literature

The paper analyzing the outcomes of the Vitoria-Gasteiz pedestrian-oriented superblocks has shown that the superblocks improved walkability of the city and reduced travel times by 4-5% on average, while the greatest potential for improvement is found through reduction of walking obstacles in city centers and streets linking important residential areas with the city center (Delso et al. 2018). Apart from that, Albaina & Escudero (2017) show that further developments of the superblock model, including the implementation of traffic calming, had a positive impact on reduction of car speed and noise and gave more confidence to cyclists and pedestrians in the inner streets of the superblocks. At the same time the average car speed in the network surrounding the superblock increased by almost 20%, allowing savings in time and money on transportation. The impacts of implementing the superblock are evaluated through data on the traffic flows of vehicles, bicycles and pedestrians in the pilot superblock. A telephone questionnaire with citizens was executed in order to investigate the awareness and acceptance of the implemented measures. Results of the survey reflect high levels of acceptance (70%) and awareness (89%), suggesting a support for the introduced changes among the population.

Another example of superblocks' positive impact on mobility is through increased walkability, based on the case of Abu Dhabi (Scoppa et al. 2018). The authors consider connectivity of street networks an important factor contributing to increased walkability and reduced car dependence. The connectivity of ten superblocks is analysed focusing on "sikkak", narrow alleyways between plots. Walkability is studied using "Pedestrian Route Directness" and the associated Route Directness Test, in terms of the efficiency of the street network in providing short and direct pedestrian routes. The results of this methodology allow estimation, in terms of percentages, of how much longer the actual routes in a street network take compared to the shortest possible distances. Importantly, by addressing length and directness, this measure is able to address key elements behind the decision to walk because it captures a layout's ability to provide direct and short routes to destinations (Scoppa et al. 2018). According to the discovered results, "sikkak" make strong contributions to the efficiency of superblocks' pedestrian street networks. This example shows how paying attention to country/city-specific infrastructure and local context plays an important role in the context of mobility in superblocks.

A qualitative study of the propensity for the bicycle to be the transport mode to travel to the workplace was completed from twenty-one semi-structured interviews in two Spanish cities, Vitoria-Gasteiz and Madrid. The results indicate that the bicycle is considered a reliable and flexible transport mode in instrumental terms, and that providing objective information about its advantages could increase its attraction for non-cyclists. Other intrinsic benefits, such as its effects on physical fitness, are highly valued. The benefits of bicycle usage on the environment do not seem to be aspects that directly motivate its use (Lois et al. 2016). These symbolic beliefs contribute to its revaluation as a transport mode, and may increase the acceptance of public policies favoring it. The analysis also shows a prototypical image of the cyclist as a young, active, and socially aware person (Fishman 2011).

However, not only infrastructural attributes, but also cultural ones matter. As Souza et al. (2018) suggest in their recent paper, the gender aspect is highly important while considering mobility in superblocks as in the context of walkability women have different preferences than men. The paper uses qualitative research methods to investigate the quality of the urban environment including innovative superblocks infrastructure in the city of Brasilia, Brazil from the point of view of local women. Based on a survey of 233 respondents, authors suggest that women's mobility around the city is rather different from men's: often, except for going to work, women's paths are related to performance of various household activities (like bringing children to school or going to the supermarket), which can be situated in different parts of the city. Further on, the perception of walkability is also rather different for women than for men, especially when it comes to the safety issues.

Cheshmehzangi & Butters (2016) examines another important dimension related to mobility in superblocks, namely the density of population. While researchers are unanimous about the fact that the goal of mobility in superblocks is to increase walkability and non-motorized mobility, the ways of reaching this goal are rather different (Scoppa et al. 2018; Albaina & Escudero 2017; Zee 2015). The high-rise superblocks, while achieving higher population density, should not overlook the fact that high urban density only makes sense combined with low car usage. The opposite case: very low densities – the "suburban sprawl" paradigm – usually related to high transport emissions is also undesirable. Comparing the cases of Vauban housing model, Freiburg, Germany and Ningbo Block in China, Cheshmehzangi & Butters (2016) suggest that with superblocks the high density and lower car usage goals may be reached without high-rises, while keeping a focus on sustainable development and improvements in walkability.

As suggested in Joanneum-Research (2015) superblocks are urban organizational units, with a size of around 400 x 400 m, comprised of several smaller blocks. The idea behind the superblock is to reorganize the mobility in such a way that the exterior roads are used for motorized mobility, while the interior roads are closed to through traffic and open to residents, public transport, disabled people, emergency vehicles and, in some streets, bicycles (Albaina & Escudero 2017). In this way the superblocks projects aim to provide many benefits from sustainable urban mobility to the optimization and intelligent management of the use of resources. While the positive outcomes of superblocks are rather straightforward, the possible negative outcomes should be also taken into account. For instance, X. Chen (2017) shows, based on examples from China, how superblocks can actually lead to increased isolation and disconnection within the city. The study stresses the importance of high levels of integration and interconnection in urban infrastructure for its effective functioning. A similar idea is demonstrated in (Charmes 2010); based on the case of Radburn the authors criticize superblocks for their exclusion, isolation, and "assertion of specific territorial rights by their residents". Charmes argues that suggested in superblocks road network layout (for example, more no-through streets) can be associated with the so-called sociospatial segregation. Yet, more research is certainly needed in this sphere, especially, since the case of Radburn is very specific and its practical influence may be overstated. However, authors claim that the road network layout, prevalent in most contemporary suburbs and exurbs and present in superblocks is based on a logic of residential territorialisation, which is unlikely to contribute to an increase of public spaces as well as to social inclusion.

Another study from China based on 1,417 respondents analyzing individuals' walk/bike preference for travelling to food markets reveals that, after controlling for the effect of personal socioeconomic and trip characteristics, traditional neighborhoods present the largest walk/bike catchment area, followed by enclave neighborhoods and superblock neighborhoods (Y. Chen 2017). Moreover, only 30% of respondents residing in superblocks walked further than 600 meters to a market in the superblock neighborhood, while 51% and

48% of respondents did this in traditional and enclave neighborhoods, respectively. The trends for bike distance comparison by neighborhood are similar to those for walking routes, although the average distance of cycling is longer. Apparently, in this specific context, the residents of superblocks tend to use motorized ways of mobility more than residents of traditional neighborhoods, which is the opposite of the whole idea of the superblock. Nocera et al. (2018) also report mixed results with respect to outcomes of superblocks introduction in Barcelona. For instance, the authors find a 2.1% increase of usage of private vehicles in superblocks in Barcelona in 2017 compared to 2013 despite the expected decrease of at least 14%, although the superblock process adaptation was still ongoing at that time.

## 6.3 Catalogue of elements

| Element / Factor | Related Literature | Findings / Notes |
|---|---|---|
| Density | (Cheshmehzangi & Butters (2016)) | Population density is important factor impacting the mobility in superblocks |
| Street connectivity | (Charmes (2010), and X. Chen (2017), Joanneum Joanneum-Research (2015)) | Crucial for successful realization of superblocks, ideally data in terms of traffic flow and speed to be collected before and after introduction of superblocks |
| Public area, Walking & Cycling network | (Scoppa et al. 2018; Cheshmehzangi & Butters 2016; Joanneum-Research 2015; Albaina & Escudero 2017; Zee 2015) | Increase in the availability of public areas and cycling network is one of the major measured of success of superblocks concept |
| Frequency of private motorized and non-motorized vehicles usage | (Albaina & Escudero 2017; Zee 2015) | Mixed results found in studies for superblocks. But considered one of the key factors that superblocks are targeting is to reidentify the balance between motorized and non-motorized private vehicles |
| Cultural & local aspects of mobility (gender, local context, residents involvement) | (Souza et al. (2018)) | Important to be taken into account. Analysis on individual level. |

# 7 Energy Efficiency and Fuel Poverty

## 7.1 Topic description and explanation of the challenge

Energy poverty is widely recognised as a distinct societal and policy challenge in the EU. However, none of the existing definitions of energy poverty is left unchallenged and no indicator for the measurement of energy poverty has been established as a standard metric in scientific and policy debates (Herrero 2017). For the remainder of this chapter we relate the term energy poverty to the very core of the concept, i.e. households for whom the payment of energy bills is a significant challenge, at least from time to time.

The topic of energy poverty is particularly relevant in light of environmental policies and measures for mitigating climatic change, as several of these instruments have amplified the financial pressure on people we today call the energy poor. Environmental taxes on energy carriers, levies for supporting the extension of renewable electricity, or the provision of significant financial resources for subsidizing pro-environmental actions that are by far out of range for lower income households (e.g. subsidies for PV or electric vehicles), all induce burdens on the financial situation of those with scarce resources. While this group of households has financial problems with paying their energy bills anyway, they usually lack the immediate financial capacities to invest in appliances or technologies that will bring down their energy consumption sustainably. Thus, while there may be certain low-hanging fruits with respect to achieving energy savings, such as replacing antiquated appliances, their financial situation may prevent them from taking measures to improve their energy balance.

For these reasons, increasing the energy efficiency of the energy poor is a challenge requiring a targeted, yet sensitive, approach to achieve mutual benefits for the environment and the energy poor. Developing successful social innovations requires a good understanding about the functioning of respective candidate measures on the decision making of the energy poor. The reminder of this chapter reviews related literature and completed and ongoing research projects to derive some key elements when making such an assessment.

## 7.2 Review of recent literature

A significant number of innovation projects addressed the issue of energy poverty[6] in the past. These projects have identified various social innovations and respective support schemes to address the topic of energy efficiency with a special focus on low income households.

[6] In many literature sources *fuel poverty* is used synonymously to *energy poverty*.

The level of energy poverty in a country or the propensity of an individual to be(come) energy poor can be affected via three channels (K. Rademaekers 2016), a) physical infrastructure. Most importantly in this category is the building stock of a country/region as well as the related infrastructure, which determine the environment and the domain of options available to households. b) policy interventions. This are usually programs defined by the (local) government, but also energy utilities, to aid poor households to cope with their energy expenditures. c) demographics. While income is the driving factor of poverty, demographics factors may be a relevant determinant too. The number of children in a household, or the distance between job and residential addresses, may be decisive in the risk of being energy poor as well.

A recent research effort funded by the European Commission (S. Pye 2015) assesses how the Member States of the European Union address energy poverty with national policies, if at all. The authors identify 4 categories of measures, starting with (1) financials instruments, followed by (2) additional consumer protection, (3) energy efficiency measures and (4) information provision. A comprehensive overview of measures taken to support the energy poor is provided by the European Commission's EU Energy Poverty Observatory[7].

About 40% of EU nations provide financial (1) aid to the energy poor. They do so by subsidizing energy costs, special electricity tariffs, or social transfers. While eligibility for any financial aid program is individually controlled, some programs require the energy poor to actively claim support, while others do the pay-out autonomously. The level of engagement required from the energy poor to collect their benefits has proven to be decisive for the level of utilization of such programs. While financial support is the most straightforward aid scheme, it may leave a relevant portion of the addressees unsupported. Additionally, while importance for support to the energy poor is unquestioned, the provision of financial support without any further knowledge based assistance may not be optimal from an environmental point of view. The impact of the financial support could create mutual benefits for the poor and the environment, if not just used to survive the next payday, but to effect the households' energy consumption on a more sustainable level. Measures achieving such double-dividend may be individualized concepts helping the households to transform their energy consumption in the long term, e.g. making plans to substitute inefficient equipment and provide financial support for the substitution process.

The category of additional consumer protection (2) covers measures on several levels, such as specific regulation for protecting the energy poor from being cut-off from energy supply, e.g. through their electricity company. Such measures are implemented in about 30% of the Member States, 20% use them as their primary measure for protecting the energy poor. However, this category also covers less obvious measures, such as subsidies for grid

[7] https://www.energypoverty.eu/policies-measures

operators for extending the gas grid in poor rural areas (UK). Summarizing the impact of such measures comes with similar criticism as those comprising of financial aid only: while the energy poor may experience benefits through these measures at least in the short term, long term environmental impact is not necessarily achieved.

Energy efficiency measures/interventions (3) for the energy poor most prominently come in form of programs for targeted retrofit. These provide grants, loans, or tax incentives and make more than 60% of measures in this category. While financial subsidies from (1) are providing support more independently for what the aid money is used for, in this category there is a strict intended use. Thereby, not only financial pressure is soothed but also impact on the energy consumption is realised. However, while these measures combine individual benefits with environmental benefits, some level of financial capacities is required on the side of the beneficiary, as not all costs of the energy efficiency improvements are covered by the measures.

The last category, information provision (4) is based on the assumption that limited time for dealing with the energy topic, in addition to educational constraints, leaves the energy poor at a low level of knowledge about the consequences of their own energy related behavior and how they can change something about it. Since a certain degree of respective knowledge is paramount for taking any energy efficiency action, the energy poor are not in the position to identify and implement measures to reduce their energy demand. To overcome the lack of knowledge, certain social innovations try to support them to understand the relationship between their behavior and their energy consumption. Traditionally, the issue has been addressed by means of specific energy audits or other feedback schemes, printed information materials, and more recently by online videos and courses (Murphy 2014; Darby 2001).[8] However, with the advent of smart metering technologies emerge to support and involve the energy poor on a continuous level compared to taking away the financial pressure from bill to bill only. The resource of smart metering allows providing households with information tailored for their specific consumption behavior. While it may be a limiting factor that these solutions usually come in form of smart phone apps or online tools, and thereby exclude those not having access to these technologies, no further investments are needed if this precondition is met. The SMART-UP initiative[9] has developed a training program for installers, social workers and other frontline staff in contact with vulnerable people, so that they can inform vulnerable consumers about the benefits brought about by smart metering. The project PEAKapp[10]

[8] The Belgium Initiative https://www.energiesnoeiers.net/index.html is an example of a programm to help households cope with their energy costs through energy audits.

[9] SMART-UP is funded under the Horizon 2020 programme of the European Union. Details are found here: https://www.smartup-project.eu/

[10] PEAKapp is funded under the Horizon 2020 programme of the European Union. Details are found here: http://www.peakapp.eu/.

developed a smart phone app exploiting smart meter data to inform households about individual energy saving opportunities and to forward them clean and low-priced electricity during times of high renewable production. Thereby, households are provided with all information to safe electricity and money by means of behavioral change, while also teaching them the expected monetary savings when inefficient appliances are substituted by newer ones. The app has finally been tested with more than 3000 households form Austria, Estonia, Finland and Sweden.

These tests of information provision measures (4) confirm that energy consumption as well as expenditures for energy can be significantly reduced via behavioral change. Most importantly, information provision has to come in an easily understandable way, the more immediate feedback about the consequences of their actions is provided the better, and educational measures in general shall avoid being patronizing but at eye level – if done personal and through the appearance of the chosen digital media.

## 7.3 Catalogue of elements

| Element / Factor | Related Literature | Findings / Notes |
|---|---|---|
| Origins of energy poverty | K. Rademaekers et al. (2016) | To identify and model effective measures for fighting energy poverty, its origins must be understood. These are usually a combination of factors, such as income in relation to the number of children and the quality of the building stock available to low-income households. |
| Interaction of measures | S. Pye et al. (2015) | To achieve mutual benefits for the energy poor and the environment, combinations of measures seem more promising than e.g. just providing financial aid for coping with energy bills. Supporting such financial instruments with information provision may lead to a sustainable transformation of behaviour. |
| Style of communication | Darby (2001) and Murphy (2014) | Foster positive response to information provision through a qualified communication style at eye level with the energy poor. |
| Exploitation of new technology | PEAKapp, Smart-Up | Communication with a broad audience of energy poor at low costs can be achieved through exploitation of new technology, such as smart phone apps utilizing smart meter data. |

# 8 Conclusions and Common Themes

The main goal of this deliverable is to support the integration of social science perspectives with agent-based modelling (ABM) efforts, and the comparison of ABM frameworks from the various modelling teams. To reach this goal we applied a two-step procedure involving collection of partners' input and feedback on respective topics as well as primary literature research. Partners' involvement also contributed to inclusion of interdisciplinary aspects in the literature review and this deliverable. Supplementary to targeted literature review, a so-called catalogue of elements is elaborated.

This catalogue of the elements includes factors and attributes that research has found are relevant to, and important in, driving the uptake of energy-related social innovations. Thus, the catalogue of elements puts cross-disciplinary social science findings into the hands of the ABM modelling teams so that they can consider important factors in their modelling efforts. The catalogue of elements is structured according to each SMARTEES case-cluster topics: holistic mobility plans, islands and renewable energy, district regeneration, mobility in superblocks, energy efficiency and fuel poverty.

With respect to holistic mobility plans, we identified factors that affect the success of mobility goals in specific contexts so that these factors can be considered by ABM modelling teams that may simulate related social innovations. The identified factors include determinants of EV uptake, travel mode and individuals behavioral patterns, factors determining intention to travel by bike or on foot. Further on, for islands and renewable energy the literature review on prosumerism and renewable energy acceptance as well as analysis of success factors of Samsø Island and the Canary islands are provided. The broad topic of district regeneration is defined in this deliverable as a set of measures which can promote localized renewable energy production in city contexts as well as prosumerism, energy savings and thus GHG savings, improvement of quality of life in disadvantaged city districts, including a reduction of unemployment as well as a more sustainable economic development at the district level. Such social innovation should not only include an environmental or energy system perspective, but also a social and economic one, which is reflected in the respective part of the catalogues of elements. The social and cultural attributes are also identified as crucial for the concept of mobility in superblocks. Together with such key factors as street connectivity and walkability, population density and frequency of private vehicles usage cultural and gender aspect have a significant impact in the context of mobility in superblocks. In terms of energy efficiency and energy poverty, we examined the origins of energy poverty as well as potential solutions using interaction of measures and increased communication and new technologies, also based on examples of projects like PEAKapp.

These mentioned-above factors for each of the SMARTEES case-cluster topics can be considered for inclusion into agent-based models. The database of literature in bibtex format used in this deliverable can be downloaded by partners on the SMARTEES Sharepoint and the literature review itself can serve as in input in further SMARTEES tasks and documents.

# 9 Bibliography

Albaina, A. & Escudero, J.C., 2017. *The Sustainable Urban Mobility Plan of Vitoria Gasteiz. Summary*, Civitas prosperity. Available at: http://sump-network.eu/fileadmin/user_upload/SUMPs/PROSPERITY_Vitoria_Gasteiz_SUMP_summary__EN.pdf.

Anderson, T., 2014. Malmö: A city in transition. *Cities*, 39, pp.10–20. Available at: http://www.sciencedirect.com/science/article/pii/S0264275114000146.

Avelino, F. et al., 2017. Transformative social innovation and (dis)empowerment. *Technological Forecasting and Social Change*. Available at: http://www.sciencedirect.com/science/article/pii/S0040162517305802.

Balcombe, P., Rigby, D. & Azapagic, A., 2014. Investigating the importance of motivations and barriers related to microgeneration uptake in the UK. *Applied Energy*, 130(Supplement C), pp.403–418. Available at: http://www.sciencedirect.com/science/article/pii/S030626191400542X.

Bauner, C. & Crago, C.L., 2015. Adoption of residential solar power under uncertainty: Implications for renewable energy incentives. *Energy Policy*, 86(Supplement C), pp.27–35. Available at: http://www.sciencedirect.com/science/article/pii/S030142151500227X.

Bertram, C. & Rehdanz, K., 2015. The role of urban green space for human well-being. *Ecological Economics*, 120, pp.139–152. Available at: http://www.sciencedirect.com/science/article/pii/S0921800915004218.

Biernacka, M. & Kronenberg, J., 2018. Classification of institutional barriers affecting the availability, accessibility and attractiveness of urban green spaces. *Urban Forestry & Urban Greening*, 36, pp.22–33. Available at: http://www.sciencedirect.com/science/article/pii/S1618866718300529.

Bigerna, S. & Polinori, P., 2015. Willingness to Pay and Public Acceptance for Hydrogen Buses: A Case Study of Perugia. *Sustainability*, 7(10), pp.1–20. Available at: https://ideas.repec.org/a/gam/jsusta/v7y2015i10p13270-13289d56513.html.

Biresselioglu, M.E., Kaplan, M.D. & Yilmaz, B.K., 2018. Electric mobility in Europe: A comprehensive review of motivators and barriers in decision making processes. *Transportation Research Part A: Policy and Practice*, 109, pp.1–13. Available at: http://www.sciencedirect.com/science/article/pii/S0965856417311771.

BMUB, 2017. White Paper: Green Spaces in the City. Available at: https://www.bmi.bund.de/SharedDocs/downloads/DE/publikationen/themen/bauen/wohnen/weissbuch-stadtgruen-en.pdf?__blob=publicationFile&v=4.

Byun, H. & Lee, C.-Y., 2017. Analyzing Korean Consumers' Latent Preferences for Electricity Generation Sources with a Hierarchical Bayesian Logit Model in a Discrete Choice Experiment. *Energy Policy*, 105, pp.294–302. Available at: http://search-1ebscohost-1com-1erglft1i027b.han.ubl.jku.at/login.aspx?direct=true&db=ecn&AN=1654555&site=ehost-live.

Caiati, G. et al., 2014. *Deliverable 2.2 Report on comparative analysis*, MILESECURE - 2050.

Cervero, R. & Dai, D., 2014. BRT TOD: Leveraging transit oriented development with bus rapid transit investments. *Transport Policy*, 36, pp.127–138. Available at: http://www.sciencedirect.com/science/article/pii/S0967070X14001802.

Charmes, E., 2010. Cul-de-sacs, Superblocks and Environmental Areas as Supports of Residential Territorialization. *Journal of Urban Design*, 15(3), pp.357–374. Available at: https://doi.org/10.1080/13574809.2010.487811.

Chen, X., 2017. *A Comparative Study of Supergrid and Superblock Urban Structure in China and Japan*. The University of Sydney.

Chen, Y., 2017. Neighborhood form and residents' walking and biking distance to food markets: Evidence from Beijing, China. *Transport Policy*. Available at: http://www.sciencedirect.com/science/article/pii/S0967070X1630748X.

Cheshmehzangi, A. & Butters, C., 2016. Sustainable Living and Urban Density: The Choices are Wide Open. *Energy Procedia*, 88, pp.63–70. Available at: http://www.sciencedirect.com/science/article/pii/S1876610216300844.

Cohen, J., Reichl, J. & Schmidthaler, M., 2014. Re-focussing research efforts on the public acceptance of energy infrastructure: A critical review. *Energy*, in proof. Available at: http://dx.doi.org/10.1016/j.energy.2013.12.056.

Colmenar-Santos, A. et al., 2013. The impact of different grid regulatory scenarios on the development of renewable energy on islands: A comparative study and improvement proposals. *Renewable Energy*, 60, pp.302–312. Available at: http://www.sciencedirect.com/science/article/pii/S0960148113002772.

Darby, S., 2001. Making it Obvious: Designing Feedback into Energy Consumption. In P. Bertoldi, A. Ricci, & A. de Almeida, eds. *Energy Efficiency in Household Appliances and Lighting*. Springer Berlin Heidelberg, pp. 685–696.

Delso, J., Martin, B. & Ortega, E., 2018. A new procedure using network analysis and kernel density estimations to evaluate the effect of urban configurations on pedestrian mobility. The case study of Vitoria-Gasteiz. *Journal of Transport Geography*, 67, pp.61–72. Available at: http://www.sciencedirect.com/science/article/pii/S0966692317305513.

Egbue, O. & Long, S., 2012. Barriers to widespread adoption of electric vehicles: An analysis of consumer attitudes and perceptions. *Energy Policy*, 48, pp.717–729. Available at: http://www.sciencedirect.com/science/article/pii/S0301421512005162.

Fishman, R., 2011. Companion to Urban Design. In T. Banerjee & A. Loukaitou-Sideris, eds. Routledge Companions. Routledge. Available at: https://www.taylorfrancis.com/books/e/9781136920097/chapters/10.4324%2F9780203844434-11.

Fontenot, A., 2018. 30 Inspiring Urban Renewal Projects. *Social Work Degree Guide*. Available at: https://www.socialworkdegreeguide.com/30-inspiring-urban-renewal-projects/.

Frantzeskaki, N. & Rok, A., 2018. Co-producing urban sustainability transitions knowledge with community, policy and science. *Environmental Innovation and Societal Transitions*, 29, pp.47–51. Available at: http://www.sciencedirect.com/science/article/pii/S221042241730117X.

Funkhouser, E. et al., 2015. Business model innovations for deploying distributed generation: The emerging landscape of community solar in the U.S. *Energy Research & Social Science*, 10(Supplement C), pp.90–101. Available at: http://www.sciencedirect.com/science/article/pii/S2214629615300104.

Furlan, R. et al., 2018. The urban regeneration of west-bay, business district of Doha (State of Qatar): A transit-oriented development enhancing livability. *Journal of Urban Management*. Available at: http://www.sciencedirect.com/science/article/pii/S2226585618301742.

Gavrilidis, A.A. et al., 2019. Methodological framework for urban sprawl control through sustainable planning of urban green infrastructure. *Ecological Indicators*, 96, pp.67–78. Available at: http://www.sciencedirect.com/science/article/pii/S1470160X1730691X.

Gracia, A., Barreiro-Hurl, J. & Perez, L. Perez y, 2012. Can renewable energy be financed with higher electricity prices? Evidence from a Spanish region. *Energy Policy*, 50, pp.784–794. Available at: http://search-1ebscohost-1com-1erglft1i027b.han.ubl.jku.at/login.aspx?direct=true&db=8gh&AN=82108219&site=ehost-live.

Hardman, S. et al., 2018. A review of consumer preferences of and interactions with electric vehicle charging infrastructure. *Transportation Research Part D: Transport and Environment*, 62, pp.508–523. Available at: http://www.sciencedirect.com/science/article/pii/S1361920918301330.

Heo, J.-Y. & Yoo, S.-H., 2013. The publics value of hydrogen fuel cell buses: A contingent valuation study. *International Journal of Hydrogen Energy*, 38(11), pp.4232–4240. Available at: http://www.sciencedirect.com/science/article/pii/S036031991300298X.

Herrero, S.T., 2017. Energy poverty indicators: A critical review of methods. *Indoor and Built Environment*, 26(7), pp.1018–1031. Available at: https://doi.org/10.1177/1420326X17718054.

Hua, T. et al., 2014. Status of hydrogen fuel cell electric buses worldwide. *Journal of Power Sources*, 269(Supplement C), pp.975–993. Available at: http://www.sciencedirect.com/science/article/pii/S0378775314009173.

Hwang, K.H., 2014. Finding Urban Identity through Culture-led Urban Regeneration. *Journal of Urban Management*, 3(1), pp.67–85. Available at: http://www.sciencedirect.com/science/article/pii/S2226585618300840.

ICCT, 2017. *EUROPEAN VEHICLE MARKET STATISTICS Pocketbook 2017/18*, International Council on Clean Transportation. Available at: https://www.theicct.org/publications/european-vehicle-market-statistics-20172018.

Iglesias, G. & Carballo, R., 2011. Wave resource in El Hierro - an island towards energy self-sufficiency. *Renewable Energy*, 36(2), pp.689–698. Available at: http://www.sciencedirect.com/science/article/pii/S0960148110003915.

Joanneum-Research, 2015. *Superblocks, Barcelona, Spain - Smart Cities good practice (Transport and Mobility, Governance, Biodiversity, Social Inclusion*, Pocacito Project. Available at: : http://www.energy-cities.eu/db/Barcelona_Pocacito_Superblocks_2016_en.pdf.

K. Rademaekers, N.A. J. Yearwood A. Ferreira S. Pye I. Hamilton P. Agnolucci D. Grover J. Karasek, 2016. Selecting Indicators to Measure Energy Poverty. Report provided under the Pilot Project ’Energy Poverty – Assessment of the Impact of the Crisis and Review of Existing and Possible New Measures in the Member States. *Funded by the European Commission under Framework Contract ENER/A4/516-2014.*

Kalkbrenner, B.J., Yonezawa, K. & Roosen, J., 2017. Consumer preferences for electricity tariffs: Does proximity matter?. *Energy Policy*, 107, pp.413–424. Available at: http://search-1ebscohost-1com-1erglft1i027b.han.ubl.jku.at/login.aspx?direct=true&db=8gh&AN=123758524&site=ehost-live.

Kangur, A. et al., 2017. An agent-based model for diffusion of electric vehicles. *Journal of Environmental Psychology*, 52, pp.166–182. Available at: http://www.sciencedirect.com/science/article/pii/S0272494417300026.

Klöckner, C.A., 2014. The dynamics of purchasing an electric vehicle: A prospective longitudinal study of the decision-making process. *Transportation Research Part F: Traffic Psychology and Behaviour*, 24, pp.103–116. Available at: http://www.sciencedirect.com/science/article/pii/S1369847814000539.

Klöckner, C.A. & Blöbaum, A., 2010. A comprehensive action determination model: Toward a broader understanding of ecological behaviour using the example of travel mode choice. *Journal of Environmental Psychology*, 30(4), pp.574–586. Available at: http://www.sciencedirect.com/science/article/pii/S0272494410000289.

Klöckner, C.A. & Friedrichsmeier, T., 2011. A multi-level approach to travel mode choice: How person characteristics and situation specific aspects determine car use in a student sample. *Transportation Research Part F: Traffic Psychology and Behaviour*, 14(4), pp.261–277. Available at: http://www.sciencedirect.com/science/article/pii/S1369847811000076.

Klöckner, C.A., Nayum, A. & Mehmetoglu, M., 2013. Positive and negative spillover effects from electric car purchase to car use. *Transportation Research Part D: Transport and Environment*, 21, pp.32–38. Available at: http://www.sciencedirect.com/science/article/pii/S1361920913000278.

Kuang, Y. et al., 2016. A review of renewable energy utilization in islands. *Renewable and Sustainable Energy Reviews*, 59, pp.504–513. Available at: http://www.sciencedirect.com/science/article/pii/S1364032116000423.

Latorre, F.J.G., Quintana, J.J. & Nuez, I. de la, 2019. Technical and economic evaluation of the integration of a wind-hydro system in El Hierro island. *Renewable Energy*, 134, pp.186–193. Available at: http://www.sciencedirect.com/science/article/pii/S0960148118313661.

Lois, D., Lopez-Saez, M. & Rondinella, G., 2016. Qualitative Analysis on cycle Commuting in Two Cities with Different Cycling Environments and Policies. *Universitas Psychologica*, 15(2), pp.175–195.

Lois, D., Moriano, J.A. & Rondinella, G., 2015. Cycle commuting intention: A model based on theory of planned behaviour and social identity. *Transportation Research Part F*, 32, pp.101–113. Available at: https://www.sciencedirect.com/science/article/pii/S1369847815000807?via%3Dihub.

Mahmoud, M. et al., 2016. Electric buses: A review of alternative powertrains. *Renewable and Sustainable Energy Reviews*, 62(Supplement C), pp.673–684. Available at: http://www.sciencedirect.com/science/article/pii/S1364032116301290.

McCormick, K. & Kiss, B., 2015. Learning through renovations for urban sustainability: the case of the Malmö Innovation Platform. *Current Opinion in Environmental Sustainability*, 16, pp.44–50. Available at: http://www.sciencedirect.com/science/article/pii/S1877343515000639.

McLeod, S. & Curtis, C., 2018. Contested urban streets: Place, traffic and governance conflicts of potential activity corridors. *Cities*. Available at: http://www.sciencedirect.com/science/article/pii/S0264275118307121.

McLeod, S., Scheurer, J. & Curtis, C., 2017. Urban Public Transport: Planning Principles and Emerging Practice. *Journal of Planning Literature*, 32(3), pp.223–239.

Mills, B.F. & Schleich, J., 2009. Profits or preferences? Assessing the adoption of residential solar thermal technologies. *Energy Policy*, 37(10), pp.4145–4154. Available at: http://www.sciencedirect.com/science/article/pii/S0301421509003322.

Munoz-Lopez, B. & Rondinella, G., 2016. *Evaluation report of the Sustainable Mobility and Public Space Plan and the Master Plan for Cyclist Mobility of Vitoria-Gasteiz*, Centro De Estudios Ambientales.

Murphy, L., 2014. The influence of energy audits on the energy efficiency investments of private owner-occupied households in the Netherlands. *Energy Policy*, 65(C), pp.398–407. Available at: https://ideas.repec.org/a/eee/enepol/v65y2014icp398-407.html.

Nocera, S., Dianin, A. & Cavallaro, F., 2018. Chapter Nine - Greenhouse Gas Emissions and Transport Planning: Toward a New Era? In Y. Shiftan & M. Kamargianni, eds. *Preparing for the New Era of Transport Policies: Learning from Experience*. Advances in Transport Policy and Planning. Academic Press, pp. 245–280. Available at: http://www.sciencedirect.com/science/article/pii/S254300091830009X.

Noll, D., Dawes, C. & Rai, V., 2014. Solar Community Organizations and active peer effects in the adoption of residential PV. *Energy Policy*, 67(Supplement C), pp.330–343. Available at: http://www.sciencedirect.com/science/article/pii/S0301421513013141.

O'Garra, T. et al., 2007. Is the public willing to pay for hydrogen buses? A comparative study of preferences in four cities. *Energy Policy*, 35(7), pp.3630–3642. Available at: http://www.sciencedirect.com/science/article/pii/S0301421506005143.

O'Keeffe, L., 2014. A choice experiment survey analysis of public preferences for renewable energy in the United States. *Journal of Environmental and Resource Economics at Colby*, 1(1), pp.1–19. Available at: https://EconPapers.repec.org/RePEc:bes:jnlasa:v:98:y:2003:p:533-544.

Papazu, I., 2016. Authoring Participation. *Nordic Journal of Science and Technology Studies*, 4(1). Available at: https://www.ntnu.no/ojs/index.php/njsts/article/view/2169.

Rezvani, Z., Jansson, J. & Bodin, J., 2015. Advances in consumer electric vehicle adoption research: A review and research agenda. *Transportation Research Part D: Transport and Environment*, 34, pp.122–136. Available at: http://www.sciencedirect.com/science/article/pii/S1361920914001515.

Rijnsoever, F.J. van, Mossel, A. van & Broecks, K.P.F., 2015. Public acceptance of energy technologies: The effects of labeling, time, and heterogeneity in a discrete choice experiment. *Renewable & Sustainable Energy Reviews*, 45, pp.817–829. Available at: http://search-1ebscohost-1com-1erglft1i027b.han.ubl.jku.at/login.aspx?direct=true&db=8gh&AN=101929390&site=ehost-live.

Rodrigues, E.M.G. et al., 2014. Energy storage systems supporting increased penetration of renewables in islanded systems. *Energy*, 75, pp.265–280. Available at: http://www.sciencedirect.com/science/article/pii/S0360544214008949.

Rommel, J., Sagebiel, J. & Muller, J.R., 2016. Quality uncertainty and the market for renewable energy: Evidence from German consumers. *Renewable Energy: An International Journal*, 94, pp.106–113. Available at: http://search-1ebscohost-1com-1erglft1i027b.han.ubl.jku.at/login.aspx?direct=true&db=8gh&AN=114697186&site=ehost-live.

Rommel, K. & Sagebiel, J., 2017. Preferences for micro-cogeneration in Germany: Policy implications for grid expansion from a discrete choice experiment. *Applied Energy*, 206(Supplement C), pp.612–622. Available at: http://www.sciencedirect.com/science/article/pii/S0306261917312503.

S. Pye, P.D. A. Dobbins C. Baffert J. Brajkovi? I. Grgurev R. Miglio, 2015. Energy poverty and vulnerable consumers in the energy sector across the EU: analysis of policies and measures. *Policy Report of the INSIGHT_E project funded under grant no. 612743 under the 7th Framework Programme of the European Commission.*

Sagebiel, J., Muller, J.R. & Rommel, J., 2014. Are consumers willing to pay more for electricity from cooperatives? Results from an online Choice Experiment in Germany. *Energy Research and Social Science*, 2(Supplement C), pp.90–101. Available at: http://www.sciencedirect.com/science/article/pii/S221462961400036X.

Sánchez, F.G., Solecki, W.D. & Batalla, C.R., 2018. Climate change adaptation in Europe and the United States: A comparative approach to urban green spaces in Bilbao and New York City.

*Land Use Policy*, 79, pp.164–173. Available at: http://www.sciencedirect.com/science/article/pii/S0264837717314278.

Schuitema, G. et al., 2013. The role of instrumental, hedonic and symbolic attributes in the intention to adopt electric vehicles. *Transportation Research Part A: Policy and Practice*, 48, pp.39–49. Available at: http://www.sciencedirect.com/science/article/pii/S0965856412001437.

Scoppa, M., Bawazir, K. & Alawadi, K., 2018. Walking the superblocks: Street layout efficiency and the sikkak system in Abu Dhabi. *Sustainable Cities and Society*, 38, pp.359–369. Available at: http://www.sciencedirect.com/science/article/pii/S2210670717313616.

Sierzchula, W. et al., 2014. The influence of financial incentives and other socio-economic factors on electric vehicle adoption. *Energy Policy*, 68, pp.183–194. Available at: http://www.sciencedirect.com/science/article/pii/S0301421514000822.

Simpson, G. & Clifton, J., 2015. The emperor and the cowboys: The role of government policy and industry in the adoption of domestic solar microgeneration systems. *Energy Policy*, 81(Supplement C), pp.141–151. Available at: http://www.sciencedirect.com/science/article/pii/S0301421515001019.

Souza, A.C.S., Bittencourt, L. & Taco, P.W.G., 2018. Women's perspective in pedestrian mobility planning: the case of Brasilia. *Transportation Research Procedia*, 33, pp.131–138. Available at: http://www.sciencedirect.com/science/article/pii/S2352146518302400.

Sperling, K., 2017. How does a pioneer community energy project succeed in practice? The case of the SamsÃ¸ Renewable Energy Island. *Renewable and Sustainable Energy Reviews*, 71, pp.884–897. Available at: http://www.sciencedirect.com/science/article/pii/S1364032116311789.

Vecchiato, D. & Tempesta, T., 2015. Public preferences for electricity contracts including renewable energy: A marketing analysis with choice experiments. *Energy*, 88(Supplement C), pp.168–179. Available at: http://www.sciencedirect.com/science/article/pii/S0360544215004909.

Vliet, O. van et al., 2010. Multi-agent simulation of adoption of alternative fuels. *Transportation Research Part D: Transport and Environment*, 15(6), pp.326–342. Available at: http://www.sciencedirect.com/science/article/pii/S1361920910000374.

Wang, W.-M. et al., 2013. An integrated decision making model for district revitalization and regeneration project selection. *Decision Support Systems*, 54(2), pp.1092–1103. Available at: http://www.sciencedirect.com/science/article/pii/S0167923612002904.

Welsch, H. & Biermann, P., 2014. Electricity supply preferences in Europe: Evidence from subjective well-being data. *Resource and Energy Economics*, 38(Supplement C), pp.38–60. Available at: http://www.sciencedirect.com/science/article/pii/S0928765514000426.

Zee, R. van der, 2015. How Groningen invented a cycling template for cities all over the world. Available at: https://www.theguardian.com/cities/2015/jul/29/how-groningen-invented-a-cycling-template-for-cities-all-over-the-world.