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SMARTEES local social innovation

Report No.2.1- SMARTEES-D2.1 SMARTEES Integrated Research White Paper: Version 1

Report

SMARTEES Integrated Research White Paper (Version1-2018)

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SMARTEES
local social innovation

Report

SMARTEES – Integrated Research White Paper – Version 1

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ABSTRACT

SMARTEES WORK PLAN OBJECTIVE

This paper will encompass: i) an assessment of cross-disciplinary terminology, ii) a definition of specific research questions to be challenged by the Integrated Consensus Paper, iii) a discipline-wise theoretical framework for the specific research questions, iv) a discipline-wise best practice methodology for addressing the research question and v) and identification of contradictions and consensus between disciplines along the theoretical/methodological dimension.

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Executive Summary

This deliverable constitutes the draft version of the SMARTEES Integrated Research White Paper, the purpose of which is to define and catalogue the interdisciplinary ecosystem of SMARTEES, including research questions, methods and theories. The purpose of the current paper in its draft form is to serve as a **starting point** and basis for building the research plan of the project, including the various agent-based modelling (ABM) efforts and the case studies of municipalities.

As a first step, the interdisciplinary terminology of SMARTEES was assessed, and it was found that many terms that are fundamental to the project are not equivalently defined between researchers and disciplines. In order to avoid the confusion that can accompany cross-disciplinary use of jargon and technical terms four best-practices are laid out that should be followed by the SMARTEES consortium:

- Define broad, semi-technical terms with additional qualifiers, e.g. “mathematical model”, or “theoretical model” instead of just “model”.
- Do not assume a technical term is understood by your readers or the partner organizations.
- Define key terms, either in a glossary or in the sentence where the term first appears, adhering to the definition guidelines presented in this document.
- Increase contact and communication with researchers in other disciplines and organizations from the consortium through more frequent teleconferences and email/document exchanges.

This deliverable also gives initial input on the research questions that can be tackled as a part of the project, including examples. As a part of this effort, the SMARTEES researchers were asked to complete a questionnaire stating their research perspective and the theories and methods that they may use to engage with energy-related social science topics. The results of this internal study showed that there are a variety of theories and methods that can be drawn on from within the consortium. Moving forward, research teams should interact to ensure that the results of their individual efforts are **comparable**. Task 2.3 and the final version of the Integrated Research White Paper will also work to ensure comparability and linkages between results, and thus enable cogent findings to be presented to policymakers at the end of the project. A workshop will be organized to decide on the project research questions and case-cluster research questions and ensure that there are clear linkages between the different levels of research questions in the project.

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1 Introduction and overview

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 in SMARTEES is its interdisciplinary character, in particular the merging of various social science disciplines with agent-based-modelling (ABM) and computer/informational sciences to give a more holistic understanding of citizens' engagement with the energy transition and their personal energy choices. The purpose of SMARTEES is presenting policymakers with cogent, unified decision support that is based on the best-practice methodologies and insightful theories from this variety of disciplines. This document is a draft version of the SMARTEES Integrated Research White Paper, which will help to define and guide the interdisciplinary knowledge creation process within SMARTEES.

1.1 Aim

This paper aims to provide an input to a solid and integrated theoretical framework, which is required for successful execution of the main activities in Work Packages 3 to 7 of the SMARTEES Project. This framework is to be further developed and adapted throughout the lifetime of the SMARTEES Project, while this version serves as the first step to a common and solid inter-disciplinary theoretical base.

As stated in the Grant Agreement of the SMARTEES Project, the development of a common theoretical framework aims at realigning social innovation research from its vertical focus towards a more horizontally and integrated approach to i) avoid disciplinary silos, ii) ensure exploitation of existing knowledge and related theories, and to iii) provide an exhaustive assessment of incentive structures and framework conditions. Thereby, the goal of this paper is to prepare the ground for the development of holistic energy transition strategies that fully incorporate the individual perspective and reassess the impact of existing framework conditions. At the final version of this paper, it will 1) formulate specific research questions, 2) provide a common cross-disciplinary ontology and 3) prepare the common theoretical framework for WPs 3 to 7. As a first step to reach this aim, this version assesses the cross-disciplinary terminology, research questions, research methods and theories that are represented in the SMARTEES consortium.

1.2 Background

The challenges of interdisciplinary research are well documented [Klein 1990; Sherif and Sherif 1969]. Common issues with interdisciplinary working groups include: differing expectations of output, poorly understood roles of individuals and teams, navigating different academic cultures, communication and comprehension, and valuing/using inputs of others [Mallaband, Wood, et al. 2017]. These challenges arise due to the historical development of the divide between disciplines, where most current social science disciplines have developed out of philosophy and had the need to (over)differentiate from this common starting place [Riesch 2014].

Despite the noted difficulties, interdisciplinary effort is worthwhile as it can "[…] accomplish a range of objectives: to answer complex questions, to address broad issues, to explore disciplinary and professional relations, to solve problems that are beyond the scope of any one discipline, to achieve unity of knowledge, whether on a limited or grand scale." [Klein 1990]

Such interdisciplinarity can also have a positive effect on the ability of the research team to translate their findings into actionable input for other sciences, and also for policymakers [Mallaband, Staddon, et al. 2017]. Thus, interdisciplinary research can increase the effectiveness of research efforts by taking into account input from various fields and presenting a more complete message for policymakers [Stephenson 2017]. However, in order for interdisciplinary social science research to be utilized to maximum effectiveness, the core skills of scientists should be employed, as opposed to asking a scientist to do something completely new in order to satisfy the interdisciplinary effort [Haarstad et al. 2018]. Thus, there is a fine line to walk in interdisciplinarity: on one side there is the precipice of disciplinary silos where knowledge is not effectively communicated and used between disciplines. On the other side is the precipice of over-immersion of scientists where they lose the ability to make valid inputs in an interdisciplinary environment since they can no longer use the tools they know best. In the middle of these two precipices is the goal of inter-disciplinary cooperation, where roles are clearly defined, inputs are respected and clearly communicated, and results are synthesized so that cogent unified findings can be presented to policymakers and external audiences. This is the goal of SMARTEES interdisciplinary cooperation and the aim of this paper is to begin the process of interdisciplinary planning and synthesis.

1.3 Using this paper and future development

As noted above, the current version of this paper is a draft of the SMARTEES Interdisciplinary Research White Paper. The final version of the Interdisciplinary Research White Paper will be produced in Month 30 of the project. This final version will fully define the specific research questions addressed and the theoretical frameworks and methods employed in SMARTEES. The specific research questions and associated theories and methodologies will come out of the applied research completed by the scientific WPs 3 to 7. What is currently given in this paper is the starting point for defining the interdisciplinary ecosystem of SMARTEES, which will ultimately be defined through an iterative and collaborative process intrinsic in the entire scientific endeavor of the project. The outcome of this dynamic procress will be documented in the final version of this document.

Thus, this current document has the role of an initial guide and discussion of interdisciplinary actions in the project. Section 2 assesses the state of interdisciplinary vocabulary within the SMARTEES consortium. Best practices for promoting good communication between disciplines within the consortium are put forth. Section 3 discusses the choice of research questions in SMARTEES and the theories and methods that are available within the consortium to answer such questions. Ideas are given for research questions that can be adopted or further specified by the case-study teams and agent-based modelers in the consortium. Finally, an overview of the methods and theories that may be useful in SMARTEES research are shown in Table 5, and a discussion of the important factors in theory and method integration are subsequently discussed. The information and the best practices identified by this paper can be used to guide the process of interdisciplinary cooperation for the duration of the SMARTEES project.

Multiple key points regarding the future development of this document into the final version of the SMARTEES Integrated Research White Paper have been identified. First and foremost, is the process for the development of research questions both at the general (project) level and at the specific, operational (case-study) level that is defined in Figure 3. This process will include all scientific partners in SMARTEES and requires constant communication between partners. These interactions will be planned, at least partly, under Task 2.3, and will include research teleconferences and a workshop meeting.

Through these interactions, and the contemporaneous meetings between individual research groups and their case, or case-cluster, partner(s), the targeted research questions for SMARTEES will be formed.

The final version of the Integrated Research White Paper will then explain these research questions and the process used to form them. In addition, the paper will list the theories and methods used by each research group in each case, and explore any dependencies or inconsistencies between them. Finally, the paper will discuss generally any difficulties encountered with interdisciplinary work in SMARTEES, how these challenges were overcome, and what role the integrated research process can play in future projects.

2 Interdisciplinary vocabulary in SMARTEES

Previous interdisciplinary efforts have noted the inherent difficulties in trans-disciplinary communication [Mallaband, Wood, et al. 2017; Bracken and Oughton 2006]. In one energy-related research consortium with similar disciplinary composition as SMARTEES it was found that difficulties with communication accounted for about one-fifth of the problems experienced by the consortium [Mallaband, Wood, et al. 2017]. This included difficulties in understanding words that are jargon, technical terms that are defined within the discipline, and the greater complication of multiple meanings for a single word.

Scientific disciplines are rife with jargon. Opening an intermediate level textbook from almost any scientific field of study the reader will find many technical terms that they are likely unfamiliar with. This is compounded with the fact that many textbooks may contain the same or similar words that are defined differently across disciplines. There is a reason for disciplinary jargon: scientists discuss complex and technical concepts and develop terms to reference these concepts to each other to speed communication within disciplines. So, while jargon improves communication within a given discipline, it often hinders it when cross-disciplinarity is desired. In this section, we analyze the state of interdisciplinary vocabulary in the SMARTEES project. Specifically, Task 2.1 performed a document analysis on the terminology used in the SMARTEES Grant Agreement, and also developed an internal survey. The methods and findings of these exercises are presented below.

2.1 Terminology assessment

As suggested in Mennes [2018], multi-disciplinary projects such as SMARTEES are frequently challenged by “problematically ambiguous terms” (terms that have multiple meanings and for which it is not always clear what meaning is meant), thereby generating communication problems. Cases of such terminological ambiguity were mentioned in past research [Ranade et al. 2011; Bracken and Oughton 2006; File and Dugard 1997]. One of the main sources of this ambiguity is the discipline-specific jargon, in the case that the terms are used by several disciplines but do not share the same meaning or concept across the disciplines. Such ambiguity in terminology not only complicates the communication within the project, but can also harm the whole project’s results by leading to misinterpretation or incorrect application of the results from one part of the project to another part of the project. In order to alleviate these problems a procedure that can help **to identify** and **to resolve** such terms should be elaborated [Mennes 2018].

In order to identify such terms and to resolve the potential issues caused by their ambiguity, a series of analyses were performed. The first being that the SMARTEES Grant Agreement was analyzed in order to identify the most frequently used cross-disciplinary terms. This analysis took the form of pulling out n-grams from the document. An n-gram is a grouping of words that contains *n* number of words. In this analysis $1 <= n <= 3$, meaning that the groups of words contain between one and three words. The n-grams were extracted from the Grant Agreement based on two criteria, frequency and familiarity. For the frequency criteria n-grams were chosen if they satisfied the criteria: $e^2 < \text{frequency} < e^4$, which gives the list of n-grams that are frequent within the document, while also omitting many common prepositions and articles, such as “the” or “a” that have frequency greater than e^4. Familiarity is a measure of how common the n-gram is within English vocabulary. Specifically, familiarity is defined by the number of “synsets” the n-gram is a member of in the Wordnet Ontology [University 2010]. A synset is defined by Wordnet as a “set of cognitive synonyms”, and is thus a group of words that relate to a similar concept. An n-gram was

pulled from the Grant Agreement if it met the following familiarity criteria: 0 <= familiarity < mean familiarity, where “familiarity” is the familiarity measure for the current n-gram and “mean familiarity” is the average familiarity measure for all n-grams in the document. Looking specifically at unfamiliar n-grams focuses the study on more technical terms, or jargon words, and cuts out the many common phrases that would otherwise come out of such a document analysis.

Figure 1 shows the results of the document analysis for unigrams, an n-gram where *n* equals one, of interest. The red lines in the figure give the mean familiarity and mean frequency across all unigrams in the document. The unigrams are shown in the figure, with the color of the words being arbitrarily assigned to make the words more legible. Items were manually pulled from all available unigrams to construct a list of 50 items that may have different interpretations across the SMARTEES disciplines. The initial list of 50 terms was cleaned and narrowed down to 14 of the most relevant cross-disciplinary terms. This list of 14 terms is shown in

Table 1, along with an economics-based definition of the term. Economics is used as the baseline definition throughout this paper, since the main authors of this draft version are most strongly grounded in this field. Note that the listed terms are all semi-technical terms that are used in multiple disciplines and fields. For this reason, it was believed that many of these terms might have inconsistent definitions across the disciplines in SMARTEES and could thus lead to confusion between the partners. We test this possibility using an internal survey in the next subsection.

Figure 1: Unigrams of interest from the SMARTEES Grant Agreement

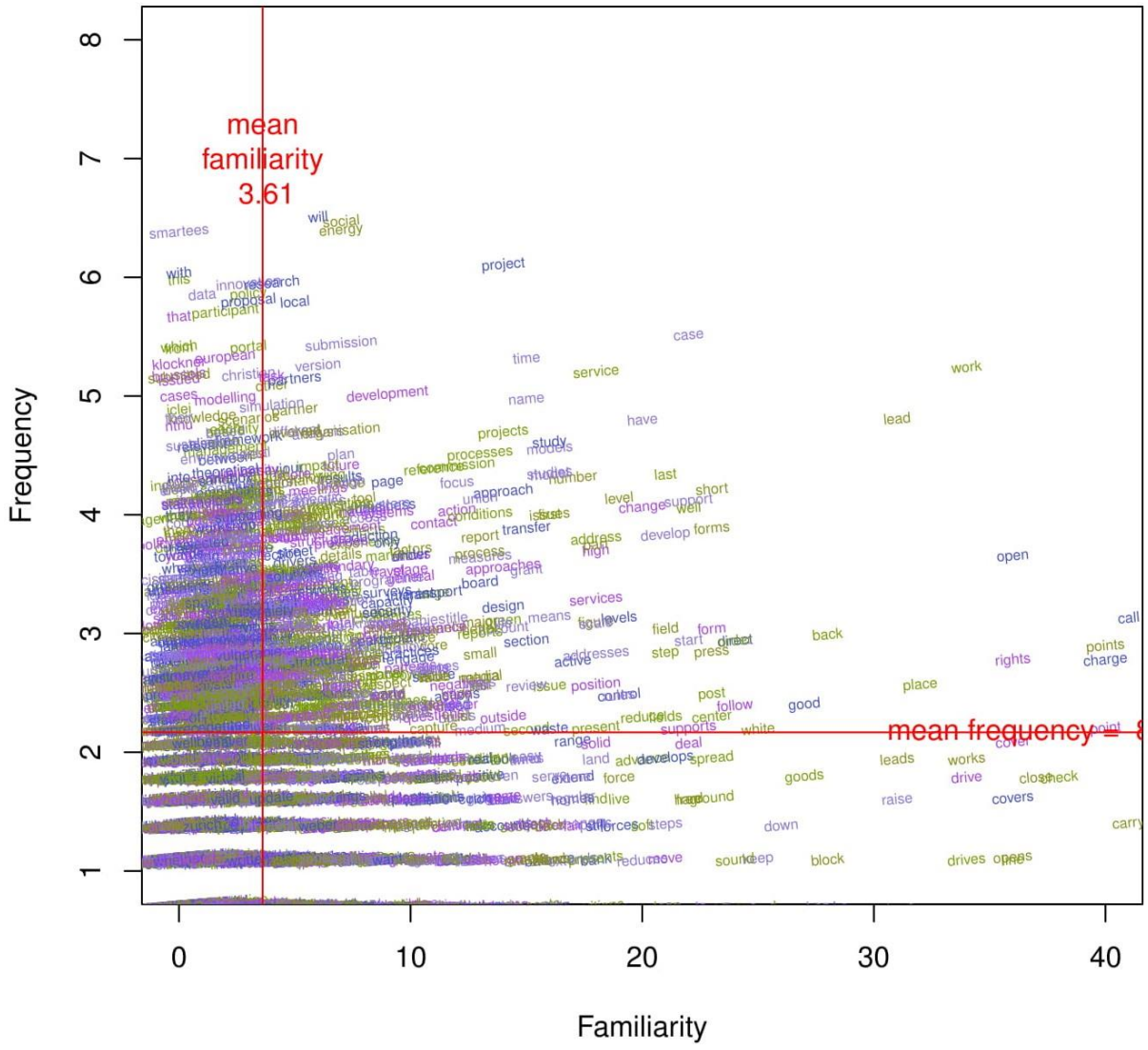


Table 1: Most frequently used common terms

Unigram	Associated Phrase	Economics Definition
acceptability	Social Acceptance	A state of being where an individual or a group are welfare neutral with respect to a proposed change

agent-based	Agent-based model	A simulation technique where the actions or choices of individual simulated agents are observed under varied decision rules and structural parameters
case-study	Case-study	An in-depth investigation of a specific instance of a phenomenon of interest
empirically	Empirical research	An investigation into a topic that relies on data and analysis methods that are objective with respect to the researcher
incentive	Socio-economic incentive structures	The array of positive and negative stimuli based in social factors or economic factors that an actor is subject to when faced with a decision
metadata	Metadata	Secondary datasets or descriptive text that explains the contents and structure of a primary dataset.
modelling	Model	A mathematical representation of a process
pro-environmental	Pro-environmental behavior	Choices and actions that contribute to a healthier, cleaner, more sustainable ecosystem or biosphere
prosumerism	Energy prosumer	An actor who consumes and produces energy
quantitative	Quantitative methods	Research methods that rely primarily on deductive reasoning through analysis of data that is objective with respect to the researcher
qualitative	Qualitative methods	Research methods that rely primarily on inductive reasoning, anecdotal data, and subjective analysis
superblock	Superblock	A space in a city that is larger than a usual block and is usually closed to automobile traffic

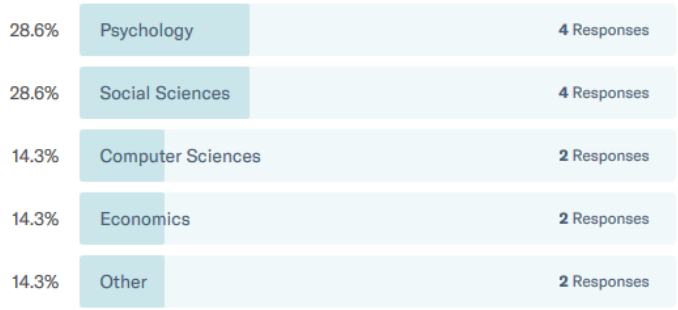
theory	A scientific theory	A set of propositions that explain a given phenomenon that is still subject to scientific inquiry and experimentation.
validation	Validation methods	Quantitative methods that are used in an attempt to show that the proposed model is the true model representing a real-world process

2.2 Internal survey of cross-disciplinary terminology

As a next step an internal survey was developed and distributed to the SMARTEES consortium. The first seven of the terms in

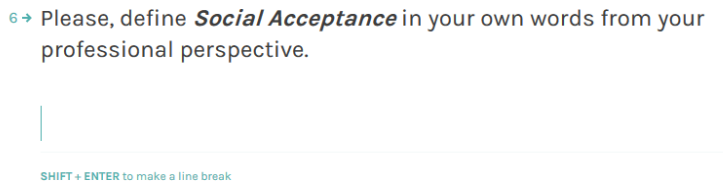
Table 1 were put into the survey, and respondents were asked to define each term from their disciplinary perspective, as explained below. The goals of this exercise are three fold. Firstly, we wanted to get an official data collection of the disciplines that are represented in the SMARTEES consortium. Secondly, we wanted to see if the chosen terms were in fact subject to different interpretations and definitions across disciplines, or perhaps across people even within a single discipline. Thirdly, we wanted to define the seven chosen terms so that, at least for these terms, SMARTEES partners will have a reference for what a given term means in a specific context. To accomplish these goals we carried out a survey among the researchers involved in the project using the Typeform online platform. The survey was answered by 14 respondents representing eight project partners with different scientific backgrounds including psychology, sociology, social science, computer sciences, economics, and environmental management. The interdisciplinary breakdown of the survey sample is shown in Figure 2.

Figure 2: Scientific background of respondents

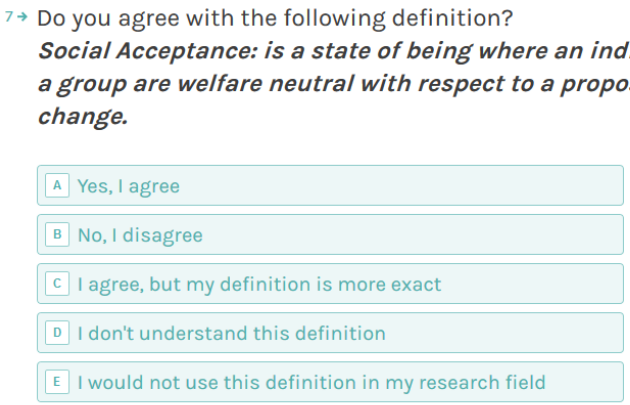


The online survey to identify the terminology ambiguity included seven terms of the 14 terms in

Table 1. The respondents were first asked to provide their own definition of a respective term, as shown below for the example term “social acceptance”:



Afterwards, they were shown a definition of the term from the economic perspective and were asked to identify whether they, as a representative of their discipline, would interpret the term in a different way, as shown in the example below:



The procedure was repeated for each of the first seven terms of the list given in

Table 1. Based on the results of the survey, as expected, we find evidence for ambiguity in the use of terms among the scientific perspectives represented in the project. We summarize the results of agreeing or disagreeing with the given economics definition across all seven tested terms and all respondents in

Table 2. As it can be seen from the summary of the survey results out of seven definitions only two did not cause major disagreement among different research fields representatives: “Case-study” and “Metadata”. The terms with the highest disagreement rates are “empirical research”, “model” and “social acceptance”.

As suggested by Mennes [2018] the next step after having identified the potential terminology ambiguity that is required is to find a way to resolve it in order eliminate the misinterpretation of the terms and to assure smooth execution of the project. Our solution to this step is to create a glossary based on the seven surveyed terms of cross-disciplinary vocabulary, which can be used throughout the project. Using the input from the survey we have created such a vocabulary for the seven terms, the results of which are is given in Table 3. As it can be seen from Table 3, even for such general terms as “empirical research” each of the disciplines uses a different concept: for economists the key accent is on objectivity, while psychologists and social scientists suggest the main idea behind empirical research is to observe real-world occurrences.

Table 2: Summary of survey responses for agreement with the economics definition of terms

	Social Acceptance	Agent-based models	Case-study	Empirical research	Metadata	Incentive Structure	Model
Yes, I agree	14.3%	64.3%	84.6%	28.6%	71.4%	64.3%	21.4%
I agree, but my definition is more exact	14.3%	7.1%	15.5%		28.6%		28.6%
No, I disagree	14.3%	21.4%		50.0%		7.1%	35.7%
I don't understand the definition	42.9%	7.1%		7.1%			
I would not use this definition in my research field	14.3%			14.3%		28.6%	14.3%

Table 3: Terminology use across disciplines in SMARTEES

Empirical Research	
Research Field	***Definition***
Economics	An investigation into a topic that relies on data and analysis methods that are objective with respect to the researcher
Psychology	Empirical research is studying a real world phenomenon using data collected from the real world, includes gathering of data from sources other than literature
Social sciences	Empirical research refers to systematic observation and analysis of a real-world phenomenon
Computer sciences	Empirical research is a study whereby there is a comparison or evaluation of the subject material against observations from the real world with a sense of 'adequacy'. Critically, empirical research can be judged in relation to that adequacy by a third party
Agent-based model	
Research Field	***Definition***
Economics	A simulation technique where the actions or choices of individual simulated agents are observed under varied decision rules and structural parameters
Psychology	An ABM is a computer simulation where a number of individual agents (e.g., representatives of households) make decisions based on inputs generated from boundary conditions and other agents' behavior (incl. communication). The decision making of the agents is formalized in mathematical equations with input and output variables. ABMs include spatial and temporal information and they run iteratively.

Social sciences	Simulation approach where the actions or choices of individual simulated agents with different features are observed, considering varied decision rules
Computer sciences	An agent-based model is a computer simulation in which numerous heterogeneous individual entities and their interactions are explicitly represented, typically with a view to observing the dynamics of the system as a whole under various influencing conditions.
Social Acceptance	
Research Field	***Definition***
Economics	A state of being where an individual or a group are welfare neutral with respect to a proposed change
Psychology	Social acceptance is a population's willingness to accept an intervention of some sort (e.g. building a solar power plant). I would measure acceptance by asking participants in a survey how willing they are to accept x (most likely with a Likert-type rating scale). I would assume that social acceptance is a blend of individual factors (e.g. attitudes) and social factors (social norms).
Social sciences	Social acceptance is the level of consensus (or availability to accept) a new technology or a new behaviour from people (different actors) living in a territorial area where this new technology is introduced/this new behavior is proposed.
Computer sciences	The closest in computing science is "user acceptance", which means the user has accepted the software (and any associated infrastructure) in the sense that they will sign off on the contract that built it. "Social acceptance" from a common-sense (rather than specialist) perspective would be some measure of whether or not society at large accepts something; for businesses, this might mean that they will buy it, or that they will not campaign against whatever it is (e.g. through boycotts). For policy, acceptance might be measured by whether people vote against political parties who will introduce or maintain whatever it is.
Case study	
Research Field	***Definition***
Economics	An in depth investigation of a specific instance of a phenomenon of interest
Psychology	In psychology, a case study would be a study where one instance of an interesting event/development (e.g. implementation of a super-block) is studied in detail to understand how the processes lead to the observed outcome.
Social sciences	Case-study is an in-depth investigation of a specific situation of various related phenomena in a specific territorial or sectorial area (or in many specific areas similar according to the investigated phenomena)
Computer sciences	A case study could be an example of a previous installation or implementation of a software system and the outcomes it generates.
Metadata	
Research Field	***Definition***

Economics	Secondary datasets or descriptive text that explains the contents and structure of a primary dataset.
Psychology	Meta-data is data about data
Social sciences	Any data that supports (description, explanation, additional categorisation, laying out relationships) the main dataset/or many datasets (e.g. relational tables) of interest
Computer sciences	Metadata is information about data.
Incentive Structure	
Research Field	***Definition***
Economics	The array of positive and negative stimuli based in social factors or economic factors that an actor is subject to when faced with a decision
Psychology	Incentive structure is the layout of rewarding aspects that make a desired behaviour more likely. Incentives can be monetary, social, etc.
Social sciences	It's a set of structural condition (so referred to social structure) that facilitate the actors (both individual or collective) in pursuing their goal
Computer sciences	A collection of motivations linked to desired outcomes.
Model	
Research Field	***Definition***
Economics	A mathematical representation of a process
Psychology	A model is a representation of an empirical phenomenon/entity
Social sciences	A model is a framework linking constructs together in a theoretically informed way, and can be conceptual or empirical in nature
Computer sciences	A model is an abstract, formal representation of a concept or phenomenon of interest.

2.3 Takeaways regarding interdisciplinary terminology

The main findings of this exercise regarding interdisciplinary terminology are discussed here. First and foremost, the survey results showed that in fact within the SMARTEES consortium there exists a "vocabulary gap" whereby relevant terms for the project are defined differently by different researchers and disciplinary groups. What is interesting here is that the terms that will suffer from this vocabulary gap are not always obvious. Of the seven terms tested by the internal survey of cross-disciplinary terminology it was found that some of the more technical terms, such as "metadata", had a widely agreed upon definition. In contrast, terms that are thought to be less technical, such as "empirical research" and "model", had very low rates of agreement between survey respondents. This could point to the idea that less technical and less specific terms have more subjective and discipline-specific interpretations. For instance, a "model" in some areas of study has a much broader definition than in others, as shown by the differing responses in Table 3. Furthermore, the term "model" is very broad and can take different meanings across disciplines. Thus, the first takeaway here is that in SMARTEES partners should define

broad, semi-technical terms with additional qualifiers, e.g. “mathematical model”, or “theoretical model” instead of just “model”.

Flowing from this first takeaway is the second takeaway, which is that partners should not assume that others understand the terms they use in the way that they understand them. This can easily be seen in the differing responses to the internal survey.

A third suggestion from this work is to define key terms, either in a separate glossary for each deliverable, or within the sentence where the term appears. There was some initial discussion around this deliverable that a SMARTEES definition for key terms could be agreed upon and used. However, given the number of unfamiliar terms found in Section 2.1 Terminology assessment, it seems unlikely that the consortium would be able to agree on definitions for each term and then remember to use the agreed upon definition in every case. Thus, we suggest that instead the consortium members should observe the best practices listed below when communicating internally, in deliverables, teleconferences, and other communication media.

The final takeaway then comes from the best practices of prior research into inter-disciplinarity and shows that increased contact and communication between teams can be used to remedy confusion due to inconsistent vocabulary [Mallaband, Wood, et al. 2017]. This is the case since during longer discussions and contact, terms that are initially unclear can become clear due to context clues and repeated usage of the terms. Also, getting to understand the broader disciplinary perspective from partners helps to better understand their application of language.

As a side note, it is worth mentioning that many definitions provided in the survey do not follow the requirements of a definition itself, where we refer to Wikipedia for a summary of what is called “Fallacies of definition” in this context. There[1], the following **definition guidelines** are raised:

1. *A definition must set out the essential attributes of the thing defined.*
2. *Definitions should avoid circularity. To define a horse as "a member of the species equus" would convey no information whatsoever. For this reason, Locking adds that a definition of a term must not consist of terms which are synonymous with it. Note, however, that it is acceptable to define two relative terms with respect to each other. Clearly, we cannot define "antecedent" without using the term "consequent", nor conversely.*
3. *The definition must not be too wide or too narrow. It must be applicable to everything to which the defined term applies (i.e. not miss anything), and to nothing else (i.e. not include any things to which the defined term would not truly apply).*
4. *The definition must not be obscure, and should use words that are commonly understood and whose meanings are clear. However, sometimes scientific and philosophical terms are difficult to define without obscurity.*

[1] https://en.wikipedia.org/wiki/Definition#Issues_with_definitions, last accessed on october 23rd 2018.

5. *A definition should not be negative where it can be positive. We should not define "wisdom" as the absence of folly, or a healthy thing as whatever is not sick. Sometimes this is unavoidable, however. For example, it appears difficult to define blindness in positive terms rather than as "the absence of sight in a creature that is normally sighted".*

Following this listing of potential shortfalls of definitions, some issues with the definitions as provided in Table 3 are obvious. For example, defining “social acceptance” as peoples’ readiness to “accept” the subject matter is not addressing the knowledge gap for which a definition is sought after. In this respect, definitions as required in SMARTEES may need a round of revisions when the final Integrated Research White Paper is developed during the next year.

In order to avoid the pitfalls of cross-disciplinary terminology, we suggest the SMARTEES consortium adopt the following best practices with respect to vocabulary use.

List of best practices for SMARTEES Terminology use

- SMARTEES partners should
    - define broad, semi-technical terms with additional qualifiers, e.g. “mathematical model”, or “theoretical model” instead of just “model”.
    - not assume a technical term is understood by your readers or your partner organizations.
    - define key terms, either in a glossary or in the sentence where the term first appears, adhering to the definition guidelines presented in this document.
    - increase contact and communication with researchers in other disciplines and organizations from the consortium through more frequent teleconferences and email/document exchanges.

3 Defining SMARTEES research questions and applicable theories and methodologies

This section discusses the three remaining aims of this document: definition of specific research questions, harvesting the discipline-wise theoretical framework for the specific research questions, and discipline-wise best practice methodology for addressing the research questions. These research questions are central to the SMARTEES project, and in particular the input that the project can have on improving social innovation uptake within the energy sector in Europe.

The **aim** of this current draft of the Integrated Research White Paper is to give a starting point for deciding on the research questions that will be tackled in SMARTEES and the theories and methods that will be used. These points cannot be answered by the WP2 team alone, and not at such an early stage, as research plans for each SMARTEES case study are still developing. Thus, the goal of this section is to give some structure to the conversation of research questions, theories, and methods, and to suggestions for possible research questions. The final version of the Integrated Research White Paper (D2.3), will define concretely these important structures.

To begin defining research questions the requests of the grant call are referenced below, as well as the points of interest for the theory and modelling integration that will take place in Task 2.3.

Call Text: LCE-31-2016-2017

Proposals should address one, or a combination, of the following issues (a comparative perspective, with case studies or data from at least three European Union Member States or Associated Countries, will be considered an advantage):

- Socioeconomic incentive structures that encourage or discourage energy-responsible behaviour;
- Political, institutional, and organizational frameworks that condition and structure citizen participation, including questions of inclusiveness, gender, democracy, organizational formats and business models.

The proposed research will provide a better understanding of these factors and their interrelations with technological, regulatory, and investment-related aspects, which is crucial for the further advancement of the energy transition and ultimately the success of the Energy Union.

Points of interest from Task 2.3 Work Plan:

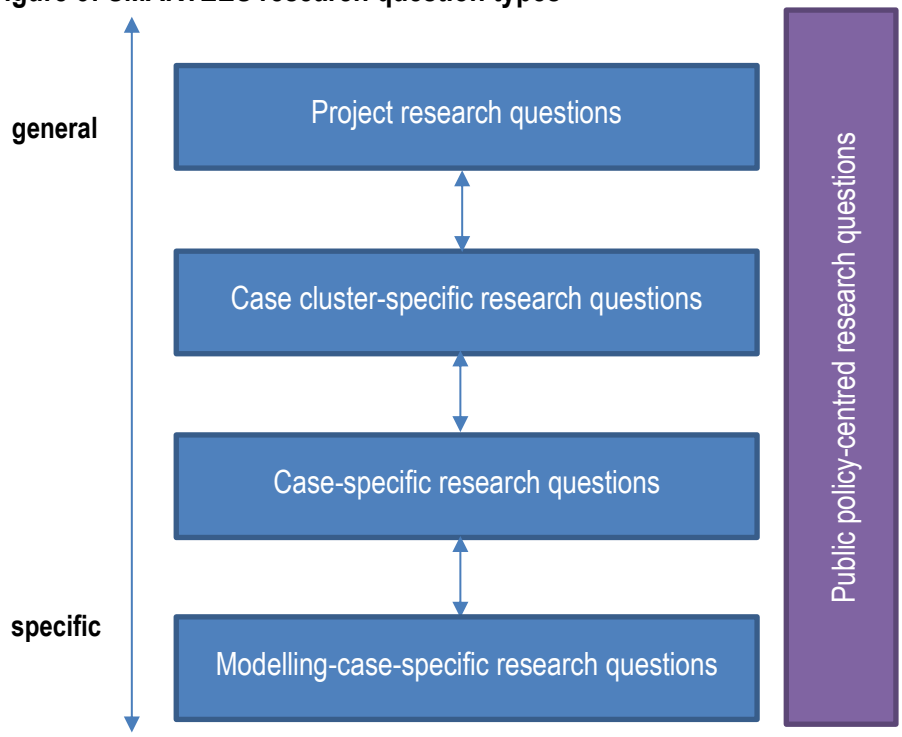
1. Enhancing collective engagement in energy related Climate Change actions: empowerment of consumers (supporting prosumers) – community-led social innovation approaches.
2. How to gain public acceptability of energy (Climate Change) policies
3. Comprehension of social dynamics and factors that determine collective energy-use patterns at local and wider scale: social influence and social norms.

Using the above inputs we have distilled down some research questions that could become the focus of SMARTEES outputs. The research questions are discussed below in Section 3.2. Initial partner input into the general forms of the research questions was obtained via an internal questionnaire. This questionnaire also obtained information about the theories and methods that are available and of interest to each partner research group, and how a partner would conceptualize a research plan to answer the general research questions. The results of the internal questionnaire are presented and discussed in Section 3.3.

3.1 SMARTEES research question types

In SMARTEES there are various levels of relevant research questions that range from general to very specific. This range reflects the research tasks in SMARTEES, some of which deal with specific case-studies or case-clusters, and others which deal with unification of theories and output for policymakers. All of the questions need to address the abovementioned knowledge-creation goals of the project and the grant call, while remaining relevant for policymaking and maintaining a link and comparability with other research efforts in the project. Here we offer a definition of SMARTEES research question types in an attempt to clarify the distribution of responsibilities between partners and the interlinking of research tasks. Figure 3 gives a representation of the interrelationships in research questions. The terms referenced in the figure are defined beneath it.

Figure 3: SMARTEES research question types



Project research questions - Broad research questions that address the general interests of the project and the requirements of the grant call. These questions are reflected in case-specific research questions for all cases.

Case cluster-specific research questions - Research questions specific for each case cluster are a subgroup of Case-specific research questions, that both cases share. These research questions will be agreed upon between partners, who are leading the main-reference and supporting reference cases within a case cluster. It is to be decided to what extent the partner leading the main follower case should be involved in co-creating these research questions.

Case-specific research questions - Research questions specific for each case. These questions will be the focus of empirical work (secondary data, primary data) for each leading partner.

Modelling case-specific research questions - Modelling case-specific research questions are a subset of case-specific research questions that are directly related to achieving the goals of modelling in each of the cases and are agreed upon between a leading partner and a main modelling team for each case.

Public policy-centred research questions - A sum of subgroups of cluster-specific research questions that are related to the description of the process of implementing the social innovation with the involvement of the local municipality. Questions are cluster-specific, as cases within a cluster share an innovation (and possibly implementation strategies). These research questions should be agreed upon between leading partners responsible for main reference cases, supporting reference cases, main follower cases, main modelling team/teams and WP5.

Two facts should be stressed from Figure 3. Firstly, that the definition of research questions of various types requires a lot of communication between various research and leadership groups within the SMARTEES consortium. Secondly, with respect to research cases, main research partners have the freedom to set research questions, but these questions have to be at least partially aligned with modelling research questions. Furthermore, compatibility between the case-specific and case-cluster-specific research questions should be ensured so that the more general policy and project research questions can be answered to a satisfactory degree.

3.2 Suggested project research questions

The research questions introduced below are organized in terms of their generality, with more general questions being at the higher order and shown with a capital letter. Very general research questions are usually not able to be answered by scientific inquiry, and thus the lower order items make the general research questions more specific and thus operational and applicable to research cases and research groups within SMARTEES. This categorization corresponds to the definitions given above, where higher order items could be considered project research questions and lower order items could be used as case-specific research questions. These questions comprise a suggested list of initial research topics for SMARTEES that will be further refined and defined through the work of the scientific partners and the illustrative cases.

A. Which types of informal or formal organizations can be shown to increase the propensity for collective actions?

i. Defining specific organizations of interest can make this question more tractable.

a. Formal organizations: home owners groups, sport or fitness groups, advocacy groups, charity groups

b. Informal organizations: groups of friends, families, neighborhoods, and networks of colleagues

ii. Defining specific types of collective actions makes this research question more actionable.

a. Examples of collective actions: joint purchases of energy efficient or renewable energy items (e.g. solar collectives), pooling resources for building renovations (e.g. community ESCo model), Bulk purchases of energy-related goods to get a better price (e.g. solar purchase cooperatives)

B. Which methods of public involvement can reduce opposition to local energy-related changes?

i. More specifically, which actions of (gender) inclusion and democratic process can reduce opposition local energy-related changes?

C. What types of energy-based societal changes can expect local opposition? Can the degree of opposition as a function of the characteristics of the proposed change be predicted?

i. ABM may be useful to simulate how people will sort into "opposed" groups and how this dynamic may play out over time.

D. Which combinations of informational, procedural and monetary measures will lead to the least-cost, most-efficient solution to local opposition to energy-based changes?

i. ABM is also useful here as it can simulate different combinations of measures and see how society reacts to them over time.

E. Which policies, including those that influence social factors and organization, can improve citizen engagement in the energy transition?

i. How do/can these policies influence adoption of the prosumer model?

ii. How do/can these policies influence investment in household energy efficiency measures?

iii. How do/can these policies influence the ability or willingness of populations to adapt their energy demand?

3.3 Internal theory and methodology questionnaires

Task 2.1 completed an internal questionnaire of the research teams in the SMARTEES consortium. The full questionnaire as it was presented to respondents is reproduced in the Appendix. The purpose of the questionnaire was to obtain initial partner input into the general forms of the research questions, and information about the theories and methods that are available and commonly used in each discipline or research team when tacking energy-related research questions. Responses from 11 different researchers within the consortium were obtained.

3.3.1 General input on theories and methods relevant to SMARTEES

The first part of the internal questionnaire had respondents state their research discipline(s), and then asked them some general questions about the theories and methods that are common in the discipline. The purpose of this part of the questionnaire is three-fold. Firstly, it is to see which disciplines are familiar with ABM (agent-based modelling), as it will be the main quantitative methodology used in SMARTEES research. Secondly, a purpose was to see if there are standardized theories and methods in each discipline and whether or not these are used to make quantitative predictions. Quantitative predictions are of interest to SMARTEES, since the project tries to understand and predict the uptake of social innovations under various circumstances. Thirdly, the questionnaire had the purpose to see if researchers within the disciplines had consistent answers about these issues. As different researchers were educated at different institutions and have different specialties, favored methods and theories can differ substantially even within a discipline.

The answers to these initial questions are tabulated as raw data in Table 4. Each row of the table represents a completed questionnaire by a researcher. We see from the table that computer science and to a lesser extent, psychology researchers are well versed in ABM, while sociology, social science, and economics researchers are less familiar with this method. In terms of a dominant theory on decision-making the computer scientists agree that one does not exist, while sociologists and psychologists seem to disagree on whether or not a dominant theory exists. Sociologists however agree that there are not standardized sets of assumptions available, while the pure psychologists group agree that such a standardized set does exist. On the agreeable side, the majority of researchers surveyed believe that theories can be used to develop quantitative predictions of behavior, with only one sociologist, one psychologist, and one computer scientist disagreeing on this point. Finally, all researchers believe that empirical methods are common and valid within the discipline, which is one area of strong commonality between the research approaches.

Table 4: Results of internal questionnaire regarding discipline-specific theories and methods

Discipline	Is there a dominant theory on decision-making?	Can the theory give quantitative predictions?	Are empirical methods common?	Are methods standardized?	Is ABM used?
Sociology	yes	no	yes	no, varied assumptions	only in some branches
Sociology	yes, both macro and micro theories	yes	yes	no, varied assumptions	not really
Sociology/ Psychology	no	not really	NA	no, varied assumptions	only a small minority
Psychology	no	yes	yes	yes, generally	yes
Psychology	yes	yes	yes	yes	not really
Social science	no	yes	yes	no, varied assumptions	no
Psychology/ social science	no	no	yes	no	yes
Computer Science	no	yes	yes	no	yes
Computer Science	no	no	yes	yes, but these are not yet established	NA
Computer Science	no, but various applicable theories	NA	yes	yes, with minor differences	yes
Economics	yes	yes	yes	yes	Somewhat

3.3.2 Methods and theories applied to general research questions of interest

The second part of the internal questionnaire asked respondents to consider three general research questions that are of interest to SMARTEES. These general questions were distilled from the questions shown in Section 3.2. The reason for more general questions was so that respondents can focus on the theories and methods that they might apply in this research endeavor without being caught up in the specifics of the context. For some respondents this was problematic, as they felt that they needed context and specifics for the research questions to begin to build a research plan. An example from the economics discipline was provided for each research question to give respondents an idea of how to phrase their response. The purpose of this exercise was to gain an initial list of the theories and methods that are available in the tool-kits of the researchers that comprise SMARTEES. The secondary purpose was to see where these theories may be compatible and where they may contrast. The general research questions that partners were asked to consider are:

1. How can local organizations (formal or informal) be used to increase the propensity for collective actions?
2. Which methods of public involvement can reduce opposition to local energy-related changes?

3. Which policies can improve citizen engagement in the energy transition?

Researchers gave their responses to each of the above three research questions in a narrative form. The highlighted theories and methods from each response were pulled out from the narrative response and put into Table 5 in a shortened form. Each row of the table is from a separate response from a researcher representing the discipline(s) stated. In some cases researchers attempted to give a cohesive answer to the research question, instead of just stating the theories and methods that they would use to investigate the research questions. This bit of confusion led to some empty cells being present in Table 5, and also may have contributed to the high variety of answers to each question.

Table 5 paints an eclectic picture of consortium methods and theories. On the theoretical side, we see a highly varied response pattern where almost no theory was referenced by more than one researcher. The exception here is economic welfare/utility theory that was referenced by an economist and a psychologist. On the methodology front, there are also highly varied responses, though these have a few more similarities than the theories. Surveys were mentioned as a viable method by two psychologists and an economist. Interestingly, all three computer scientists cited different methods: pattern recognition, ontology (knowledge-web) development, and ABM. Psychologists had a bit more homogeneity with two of them mentioning surveys. Sociologists often discussed similar themes, though they did not often point to specific methodologies that could be used, perhaps due to a lack of context in the research questions.

Table 5: Theories and methods applicable to general research questions in SMARTEES

	Research question 1		Research question 2		Research question 3	
Discipline	**Theory**	**Methods**	**Theory**	**Methods**	**Theory**	**Methods**
Sociology	Investigation of context needed		Considering the 'social process' and avoiding an 'idealistic view' of public engagement		Considering the 'social process' and avoiding an 'idealistic view' of public engagement	
Sociology/ Psychology	Welfare/utility theory, where welfare includes non-material components	Survey to determine which elements drive choice	Perception of change is crucial quantity; active vs. passive opposition	Survey of two cases one with proposed change one without, or longitudinal survey before and after change	Strengthening pro-environmental attitudes, reducing the perception and entity of costs and magnifying the perception and entity of benefits	
Psychology	Comprehensive Action Determination Model	Survey of perceived efficacy, values, attitudes, norms, etc.	Procedural justice and participation in change-making		Comprehensive Action Determination Model	Randomized control trials comparing specific policy designs
Social science	Decision-making is not viewed solely as a rational cognitive process, but highly dependent on individual's emotional states (psychological, social and structural factors)		Effective public engagement is dependent on the context and type of change		Need for tailored place-based solutions with pluralistic approaches	

Psychology/ social science	Social identity theory		Social identity theory and place-based planning		social patterns of activity and behavioral habits	
Computer Science	Callon's theory of translation to simulate the emergence of institutions from collectives of agents who have gathered around a common identified problem. Methods: ABM		Formalization of public engagement processes	ABM	Policy context and motivation is relevant here	ABM
Sociology	Collective vs. social action		Communication across the spectrum (informal to institutional)		Integrated/holistic approaches	
Computer Science	Knowledge/information theory	Develop a formal ontology	Create and compare ontologies where energy transitions have occurred and ones where it has not		Continued production of mutually comprehensible ontologies of the progress and aims of energy transition.	
Computer Science	Pattern recognition techniques applied to data on various outcomes under varied treatments		Pattern recognition techniques applied to data on various outcomes under varied treatments		Pattern recognition techniques applied to data on various outcomes under varied treatments	
Psychology	Self-determination theory or Theory of Implementation Intentions		Consistency Theory, which highlights the person's need for consistency; Social Judgment Theory; Cognitive Dissonance Theory		Psychological Empowerment Theory as represents a motivational factor that has the potential to enhance positive individual and organizational outcomes	
Economics	Expected costs vs expected benefits calculation	Ex-post analysis of real world pseudo-experiment or survey	Economic utility maximization theory	Statistical comparison of opposition across areas with different public involvement strategies	Economic utility maximization theory	Statistical comparison of engagement across areas with different policies

3.4 Towards an integrated theoretical framework

Initial findings from the research questionnaire show that within the consortium, and even within disciplines, there is a wide-variety of research theories and methods that are in use by the researchers. On one hand, this is a positive for the project as there is a wealth of theories to choose from, but on the other hand, the observed heterogeneity may make it difficult to form an integrated theoretical framework. For this reason, we would suggest that the way forward is not to create a strict theoretical framework that all research partners must adhere to in their research efforts. Instead, we would suggest that theories and

methods be chosen by the individual research teams, based on their preferences and capabilities, and to take into account the context of the specific case study that the research team is working with. However, this does not mean that research teams should make the choice of methods and theories applied in a silo; these choices should be made through a communicative process that considers linkages to project-wide research questions.

The suggested plan for developing project research questions involves interactions between research teams within the consortium organized, at least partly, under Task 2.3, and will include research teleconferences and a workshop meeting. Through these interactions, and the contemporaneous meetings between individual research groups and their case, or case-cluster, partner(s), the targeted research questions for SMARTEES will be formed using the following suggested process.

Individual research teams are responsible for contacting their case representatives and coming up with lists of potential case-specific research questions. The in-person workshop will then present the cases in detail, and ask partners for inputs on how they would address the topics relevant to each case. At the workshop, working groups for each case cluster will try to define a common theoretical background and validate the agreed-upon framework in the whole group against the other clusters. Furthermore, case-specific research questions will be compared from each case study group to try to identify common themes within the questions that can then be generalized to form project research questions. Thus, a 'bottom-up' process is suggested for creating the research questions, where the themes of the project inform the creation of a list of potential case-specific research questions, which are then linked across cases and case clusters to sum up to project research questions.

The most important factor in the choice of research theories and methods then becomes the **comparability of results**. As each research team will be working with a different case-study municipal partner, and perhaps on different specific research questions, the findings of each research team will be of interest in their own right. However, these findings become much more powerful when they are able to be compared, and unified to create cogent, policy-relevant findings that are generalizable to other EU cases. To do this the comparability of results must be ensured. In this case, **comparability means that the research outputs and predictions should be in similar units, and should endeavor to measure similar, comparable quantities**. Some elements, such as the variables and assumptions used, should be common to all cases, which will further ensure comparability between cases. As WP2 works towards a final version of this Integrated Research White Paper under Task 2.3, research plans from the various research teams will be compared, and methodologies and theories assessed to ensure that the research outputs maintain comparability across the studied cases.

4 Bibliography

Bracken, L. J., and E. A. Oughton. [2006] What Do You Mean?' The Importance of Language in Developing Interdisciplinary Research. *Transactions of the Institute of British Geographers* 31(3): 371–382.

File, P.E., and P.I. Dugard. [1997] Misunderstanding between knowledge engineers and domain experts: a re-evaluation of the use of induction for medical experts. *International Journal of Medicine* 46(2): 113–118.

Haarstad, Håvard, Siddharth Sareen, Tarje I. Wanvik, Jakob Grandin, Kristin Kjærås, Stina E. Oseland, Hanna Kvamsås, Karin Lillevold, and Marikken Wathne. [2018] Transformative social science? Modes of engagement in climate and energy solutions. *Energy Research & Social Science* 42: 193–197. DOI: https://doi.org/10.1016/j.erss.2018.03.021.

Klein, Julie Thompson. [1990] *Interdisciplinarity: History Theory and Practice*. Wayne State University Press, Detroit, Michigan, USA.

Mallaband, B., S. Staddon, and G. Wood. [2017] Crossing transdisciplinary boundaries within energy research: An "on the ground" perspective from early career researchers. *Energy Research & Social Science* 26: 107–111. DOI: https://doi.org/10.1016/j.erss.2017.01.021.

Mallaband, B., G. Wood, K. Buchanan, S. Staddon, N.M. Mogles, and E. Gabe-Thomas. [2017] The reality of cross-disciplinary energy research in the United Kingdom: A social science perspective. *Energy Research & Social Science* 25: 9–18. DOI: https://doi.org/10.1016/j.erss.2016.11.001.

Mennes, Julie. [2018] Sense Disclosure: A new procedure for dealing with problematically ambiguous terms in cross-disciplinary communication. *Language Sciences* 69: 57–67.

Ranade, Saidas M., Hector Salazar, and Luis Andres Rodriguez. [2011] Back to Basics: Relearning terms, concepts for process control.

Riesch, Hauke. [2014] Philosophy, history and sociology of science: Interdisciplinary relations and complex social identities. *Studies in History and Philosophy of Science Part A* 48: 30–37. DOI: https://doi.org/10.1016/j.shpsa.2014.09.013.

Sherif, Muzafer, and Carolyn Sherif. [1969] *Interdisciplinary Relationships in the Social Sciences*. Routledge, New York.

Stephenson, Janet. [2017] What does energy mean? An interdisciplinary conversation. *Energy Research & Social Science* 26: 103–106. DOI: https://doi.org/10.1016/j.erss.2017.01.014.

University, Princeton. [2010] Wordnet.

5 Appendix

5.1 Internal questionnaire regarding research questions and Interdisciplinary methods

Task 2.1 developed a questionnaire that aimed at better understanding the research disciplines, methods, and theories that are represented in the SMARTEES consortium. Three research questions were chosen from the longer list in presented in Section 3, and were reduced to a more general form so that they would be broadly applicable to different research methodologies. The questionnaire was sent out to the SMARTEES consortium, and consortium members were asked to complete from the point-of-view of their research perspective. The full questionnaire as it was sent out to the consortium is reproduced below:

SMARTEES Task 2.1 Questionnaire

Interdisciplinary theories and methods for answering general research questions

This questionnaire is interested in the various disciplinary theories and methodologies that are represented in SMARTEES. Responses will be used to illustrate areas where disciplines agree and where they contradict, and lead to a better understanding of the interdisciplinary research goals and practices of SMARTEES.

Based on the 12 responses to the SMARTEES Task 2.1 Vocabulary Survey that was completed during August 2018 there are 5 academic disciplines represented in SMARTEES:

1. Sociology
2. Psychology
3. Computer Science
4. Economics
5. Environmental Science

Please state the academic disciple that you represent:

Please state the SMARTEES partner organization where you work:

From the perspective of your discipline, we would like to ask you some general questions about the **theories and methods** you consider relevant when doing social science research.

Theoretical Framework:

a) Is there a specific dominant theory in your discipline about how humans decide to take actions or make decisions?

b) Can or is this theory used to derive quantitative predictions of behaviour?

Best Practice Methodology:

a) Do the discipline's best practice methodologies include empirical methods; i.e. methods relying on observations or measurements made on earlier instances of the behaviour under investigation?

b) Do the best practice methodologies in your domain foresee a standardized produce for setting needed assumptions, or do assumptions often vary between researchers and papers?

c) Is agent-based modelling well accepted in you discipline? Are papers applying agent-based-modelling appear in highly ranked journals of your discipline?

Formulated below are three possible general research topics that SMARTEES can evaluate that are based off the aims of the grant agreement, the grant call, and possible applications to ABM frameworks. For each question, please state which **methods and theories** you, as a representative of your discipline, would use to answer each of the questions. Please try to briefly define disciplinary jargon when it is used in your answer, but if you reference a popular theory we can easily look up, feel free to leave it undefined. An example from the economics discipline has been provided for each question. Your answers may be reproduced in Deliverable 2.1 in an anonymous format.

Deliverable 2.1, due in M6, is the first draft of the Integrated Research White Paper, and has an objective of defining general research topics of interest to SMARTEES work. These research topics are meant as general guidelines for the development of ABM models and case-study programs, and are not meant to hinder or confine the possible options for future research questions. The final version of the Integrated

Research White Paper will be submitted in M30, and will define the final generalized research topics of SMARTEES. These general questions will encompass the specific research topics addressed by the ABM models and case studies. Thus, the defining research questions should be viewed as an iterative, interactive and collaborative process, of which this is a first step.

I. How can local organizations (formal or informal) be used to increase the propensity for collective actions?

Your Response:

Economics Example Answer: Economic theory on this subject would be based on a mathematical model of individuals and groups. From the micro-economic perspective, a simple theory would state that an individual would join in a collective action when the cost to the individual of joining the action is less than the expected benefit gained by the individual from joining the action. The costs and benefits would be measured by welfare, following economic utility theory. In theory, formal organizations can increase the propensity for an individual to engage in collective action by lowering the cost of engagement, through facilitation, and increasing the expected benefits, by ensuring that many others also participate and thus increasing the probability that benefits are realized.

This theory would be tested using empirical methods analyzing a natural pseudo-experiment ex-post. The analysis would likely compare the collective action response to a similar policy initiative across different geographic locations, which have different formal organizations present. Ideally, the formal organizations considered would be imposed from an outside source (e.g. national govt.) to reduce endogeneity concerns, and other differences between the geographic areas would be controlled for using a suite of control variables, or difference-in-differences statistical method. When such a natural experiment is not available, a survey could be used asking respondents if they would participate in a specific collective action, some respondents could be members of a relevant organization to see if this group has systematically different responses.

II. Which methods of public involvement can reduce opposition to local energy-related changes?

Your Response:

Economics Example Answer: The first step here is to define what "opposition" means. Two definitions present themselves: a.) Opposition is observed when an individual or group take an action against the change (e.g. demonstration, purchasing signs and campaigning, etc.), or b.) Opposition is not observed as an action, but can be inferred from related data and is a state where an individual or group is welfare negative in relation to the change, i.e. they are worse off than they are before. Definition b.) is purely grounded in economic utility theory, and a.) can also be discussed in utility-theoretic terms as the individuals' assessment of expected costs versus expected benefits of taking an action.

Empirical analysis can be the method used to analyse public involvement that reduces opposition under definition a.). Data from multiple instances of energy-changes would need to be collected, including the public involvement methods used and the number of actions taken by citizens against the planned change (e.g. number of demonstrations). Empirical analysis under definition b.) would need auxiliary data, such as home values or numbers of people moving away, or a survey, to estimate the welfare change to the local citizenry. The welfare change estimated would then be correlated with the used methods of public involvement across multiple instances of energy-related changes.

III. Which policies can improve citizen engagement in the energy transition?

Your Response:

Economics Example Answer: The economic utility maximization theory can be used to show that policies that make engagement cheaper (e.g. solar subsidies) would improve engagement.

This can be tested by collecting data on a specific engagement with the energy transition, for example buying an electric vehicle (EV). We could then compare the proportion of people buying EVs across geographies where different policies are in place. This would result in an estimate of which policies positively influence EV purchases, and by how much.

Do you have any comments or suggestions regarding the three research questions presented above? Do you think they represent the themes and research goals of SMARTEES?