



COLlective action Models for Energy Transition and Social Innovation

Validation Framework



July 2019



The COMETS project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 837722.



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This document serves as Deliverable D6.1 'Validation Framework of COMETS'.

It is connected to WP6 'Validation and research quality assurance', Task T6.1 'Building a validation strategy and validating the analytical framework' (Months: M1-M2).

Lead beneficiary: HVL

Due date: Month 2 (30 June 2019)

Submission date: 1 July 2019

Dissemination level: Public

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Suggested citation:

Schwanitz, V.J. and Wierling, A. (2019) COMETS Validation Framework. Torino: COMETS.



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Organizational chapter

Glossary of terms

CAI Collective Action Initiative

Scenarios Descriptions of possible and desirable futures at local, national and EU level will be able to inform policy planning produced by the integration among the participatory activities carried out with CAI members and the stakeholder-based approach.

Roadmaps Outlines of alternative strategies able to feed local, national and EU level strategies to support and inform the design of policies.

Contribution history

Version	Date	Comment	Contributors
v.01	27/05/2019	First draft version	HVL
v.02	19/06/2019	Internal commenting	All
v.03	26/06/2019	Internal review I	UJ
v.04	01/07/2019	Internal review II	UNITO

1 Introduction to the document

This document describes the validation strategy of the COMETS consortium. It has been developed during discussions among COMETS partners during a dedicated validation workshop (back-to-back with the kick-off meeting in May 2019). The workshop produced a joint understanding among the consortium on how to understand and operationalize scientific validation in the context of the COMETS project. This report includes a summary of the discussions from the validation workshop (**Chapter "Validation workshop"**), leading to the adopted validation framework (**Chapter "COMETS validation framework"**). The starting point for the discussions are the plans according to the proposal, which have been collected in the report as well (see the following **Chapter "Validation & research quality assurance"**).

2 Validation & research quality assurance (according to proposal, WP6)

2.1 Building a validation strategy; validating Analytical Framework (T6.1)

Responsible: HVL, All. [M1-M2]

Since scientific/educational backgrounds among the COMETS partners are diverse, a special workshop during the kick-off meeting will be organized. This workshop is dedicated to the development of a joint understanding on how to perform validation procedures. The first step of this workshop (2-3h) is dedicated to identifying the basic epistemic concepts, which the partners of COMETS are applying in their research. We discuss criteria for validated scientific knowledge and operational concepts leading to the same. For this purpose, we will make use of the dialogue-based toolbox available from <http://toolbox-project.org/workshops/>. The joint exercise helps to set up the project standards for the transparent documentation of methods and results, identifying the direct and indirect assumptions as well as exploring the range of applicability of methods and results. The second step of the kick-off workshop (3-4h) concerns the development and discussion of the validation strategy and the analytical framework. The draft for the discussion will be provided by HVL, who will suggest internal review procedures and standards ensuring the quality and robustness of results. The discussion supports the drafting of a robust working definition of CAIs (D2.1) as well as the collection and processing of data and information in all tasks that follow. The validation strategy will be formally adopted by all partners, members of the advisory board, and external experts from academia. The objective is to coherently integrated knowledge produced during the project.

2.2 Defining indicators for CAIs and SI in the Energy Transition (T6.2)

Responsible: UB, UNITO, HVL, ECOLISE, TREA [M3 – M7; M24]

The goal of this task is to derive at a harmonized understanding among the involved partners about the key indicators characterizing CAIs. While CAIs may differ in detail, they have an aggregate effect on the energy transition and they can be compared along their influence on the energy transition. UB will produce a preliminary set of indicators based on the working definition provided by T2.1 and updated according to the inputs from T2.2. The set of indicators will be discussed among all partners and, once agreed upon, will result in the ability for measuring the performance of CAIs (including their deep-layered impacts on the society). The performance indicators will account for the different dimensions described in the Analytical Framework and they will reflect results achieved from the discussion in T6.1. As a provisional description, the indicators will be grouped around the three traditional layers of sustainable development:

- **Economic dimension**, incl. economic sustainability of the initiative, savings accrued, income generated (both for members and relevant stakeholders/communities), income redistribution, economic spillovers.
- **Environmental dimension**, incl. kWh of clean electricity produced, CO2 emission reduction, improvement in air quality, improvement in ecosystem services.

- **Social dimension**, incl. level of citizens engagement (e.g. number of members, number of investors, number of citizens affected by service provision), fuel poverty alleviation, increase in social cohesion, increase in trust, reduction in gender gap.

The performance of CAIs will also be assessed by producing data and analysis on the timing and termination of CAIs, across typologies and countries (see WP2 and WP3).

2.3 Testing and validating the survey (T6.3)

Responsible: VITO, All [M8-M9]

To guarantee the quality of the information collected, the survey (T3.1) will be validated with respect to its comprehensibility (in terms of wording and formalization of the questions) and its contents (in terms of coherence of the questions with the specific objective). By adapting the guidelines provided by the European Statistical System (Brancato et al. 2006), the task is operationalized in a 3-step process:

1. **Expert validation.** Methodologists and subject-matter experts selected in and through the Advisory Board will evaluate the questionnaire for potential problems for either interviewers or respondents.
2. **Pilot testing.** Submission of the entire questionnaire to a randomized sample of CAIs subscribers of the Supporting Platform developed at T7.1 per each selected country to test how the questionnaire works.
3. **Representative sample test.** Utilizing the typology developed at T2.3, the survey sample will be tested for its representativeness. Thus, we will ensure that the limited sample of the survey reliably portrays reality.

2.4 Validation of the Inventory (T6.4)

Responsible: HVL, UNITO, UB [M7, M25-M30]

The inventory is subject to extensive validation procedures throughout the project, testing the validity of data contained in the inventory (Step 1) and the information processed from the inventory (Step 2). The lowest level of validation test is the compliance of data entered with the templates based on the ontology (e.g. testing whether the data formats are correct, adherence to common data standards). This test is automatically performed, when data are entered, but we also use the 4-eyes principle throughout the mining phase (T2.2.2). The next level of testing concerns the completeness of entries and the level of coverage for different countries. Here, we compare snapshots of the inventory against external sources identified in T2.1. These sources are for example, official registries or other databases utilized in the literature. Step 2 tests the performance indicators derived as well as the typology developed from the inventory (T2.3). Performance indicators will be discussed internally by comparing them against the performance indicators elicited in T3.3, and externally by gathering feedback from stakeholders and the Advisory Board during the annual workshop. Further details are described in T6.2. The typology derived from the inventory will be subject to critical comparison with the typology originating from the surveys (T3.3).

2.5 Participatory validation of scenarios and roadmaps (T6.5)

Responsible: UNITO, All [M33-M34]

By taking inspiration from the tradition of participatory democracy, a deliberative arena will be organized (Wiklund 2005, Gastil and Levine 2005). In the 6 countries, we will thus enable a structured discussion about scenarios and roadmaps defined at T5.2, T5.3 and T2.4. The objective of this co-development activity will be:

1. to validate general coherence and feasibility of scenarios/roadmaps,
2. to propose changes and improvements, and
3. to select the strategies more likely to be successful for the specific case and context.

Attendees to these arenas will be recruited by national partners among academics, experts and stakeholders not involved in the scenarios/roadmaps buildings activity (outside the National Research Teams). In selecting the attendees, attention should be paid to balance (disciplinary field, cultural and social background, gender, role in the energy chain). The activity will last for 1 day.

2.6 Deliverables

Deliverables

D6.1 – Report on the validation framework [M3]

D6.2 – Indicators for assessing CAIs performance [M7]

D6.3 – Indicators for assessing CAIs performance (update) [M24]

D6.4 – Report on validation of scenarios and roadmaps [M34]

3. Validation workshop

The workshop was dedicated to the development of a joint understanding on how to validate COMETS results. The first part of the workshop was dedicated to identifying the basic epistemic concepts, which the partners of COMETS are applying in their research. Criteria for validating scientific knowledge and operational concepts have been discussed, using results from a questionnaire submitted to the consortium members beforehand. The joint exercise led to setting up the overall validation framework for the project, including standards for the transparent documentation of methods and results, identifying the direct and indirect assumptions as well as exploring the range of applicability of methods and results.

3.1 Agenda

Workshop objectives:

- Develop a joint understanding on how to validate COMETS results
- Adopting the validation framework in project consortium

Output:

- Report from the discussion of how to define CAI
- Table describing COMETS validation approach
- Draft for validation report (D 6.1, M3)

Preparation:

- To all partners: Answering online survey on epistemological background of COMETS partners. It takes about 10 min, the link to the questionnaire is sent around on 1st day)
- HVL: Preparation of draft validation framework for COMETS and slides for workshop to guide the group discussions

Agenda:

- 9.00-10.00 **Understanding epistemological background of partners.** About 30 min discussion in smaller groups using survey results. Followed by reporting back to plenary. Development of overall COMETS epistemological understanding.
- 10.00-10.20 **Presentation of framework for COMETS validation (draft).** Relating to the five main fields of COMETS activities (CAI performance indicators, surveys, inventory, scenarios & roadmaps, estimate of aggregated CAI contribution).
- 10.20-10.30 Break to grab coffee*
- 10.30-11.00 **Joint brainstorming on first draft of "Working definition for CAI".** While drinking coffee, collecting key terms for developing CAI terminology.
- 11.00-12.30 **Developing COMETS validation framework I.** Specifying tools & methods, key assumptions (if applicable: hypothesis), possible validation approaches for each of the main fields of COMETS activities. Discussion takes place in small groups.
- 12.30-13.30 Lunch*
- 13.30-14.30 **Continuation: Developing COMETS validation framework II.** Specifying conclusions for COMETS data and research storing & reporting (e.g. templates) and communicating results (incl. uncertainties).

14.30-15.30 **Plenary discussion of validation framework.** Groups present their work and the overall validation strategy is built. Output: table describing COMETS validation approach and first draft for validation report (D 6.1).

15.30-16.00 **Formal adoption of validation framework.** Discussing suggestions for advisory board (academic experts, CAI members, ...?).

3.2 Questionnaire

The questionnaire is a tool for the validation workshop to guide discussions. Only aggregated data are of interest. All individual data will be deleted after aggregation. The questionnaire will be repeated throughout the COMETS project, also including consortium external stakeholders. It is meant to support the development of a joint understanding of the epistemological background of all COMETS stakeholders, also helping to identify areas of alternative perspectives around key issues of COMETS.

Section 1: Background information

Are you a member of the COMETS consortium? Yes/No

What is your institutional background?

- Academia (Education & Research)
- Non Governmental Organisation
- Governmental Organisation
- Other

*What is your discipline? **

- Social sciences and humanities
- Natural Sciences & engineering
- Law & medicine
- Interdisciplinary
- Other

Section 2: Research objectivity

Likert scale from 1 (strongly disagree) to 6 (strongly agree). Posed statements are:

- Objectivity implies the absence of values by the researcher.
- Scientific results are useful, even if they do not represent objective reality.
- Value-neutral scientific research is possible.

Section 3: The role of research

Likert scale from 1 (strongly disagree) to 6 (strongly agree). Posed statements are:

- Often the decision of what should be integrated into models (mental and analytic models) and what should be omitted is guided by practicability; in other words: taking the easy route.
- The principal value of research stems from its potential to make basic discoveries.
- The principal value of research stems from the potential application of the knowledge gained.
- COMETS research results are more relevant if they contribute to the energy transition.

- Scientists should provide knowledge and not interfere with the decisions of policy-makers or CAIs.
- COMETS research results are relevant for the short-term (up to 5 years).
- COMETS research results are relevant for the longer-term (e.g. accomplishing SDGs by 2030).
- The members and stakeholders of COMETS share similar views considering the role of research.

Section 4: Scientific approach towards CAIs

Likert scale from 1 (strongly disagree) to 6 (strongly agree). Posed statements are:

- Indicators are able to measure and provide a comprehensive description of the subject being studied.
- Common indicators to analyse the contribution of CAIs to the energy transition exist.
- It is possible to estimate the aggregated contribution of CAIs to the energy transition.
- A portfolio of methods is needed to study the contribution of CAIs to the energy transition.
- Quantitative as well as qualitative methods are needed to study the contribution of CAIs to the energy transition.
- It is sufficient to study only a few representative cases of CAIs for understanding their dynamics and contribution to the energy transition.

Section 5: Participatory research

Likert scale from 1 (strongly disagree) to 6 (strongly agree). Posed statements are:

- The technical process of COMETS main methods (i.e. CAI surveys, roadmaps & scenarios, inventory, aggregation method and performance indicators) should be subject to stakeholder scrutiny and input of stakeholder expertise.
- Due to the complexity of the real world, it is indispensable to include stakeholder knowledge.
- Due to the complexity of the real world, it is indispensable to involve stakeholders more in depth in the generation of scientific knowledge.

Section 6: Scientific validation

Likert scale from 1 (strongly disagree) to 6 (strongly agree). Posed statements are:

- It is not possible to validate research results of COMETS.
- There is no ultimate validation method. Instead, many testing options need to be exploited on a continuous basis.
- A formal agreement should be reached among COMETS partners on how to scrutinize research results of the project.
- Documentation and transparency of research results are key to building trust into COMETS research results. Therefore, open science approaches should be favored.
- Validation requires testing by third parties.

Section 7: Communication of results

Likert scale from 1 (strongly disagree) to 6 (strongly agree). Posed statements are:

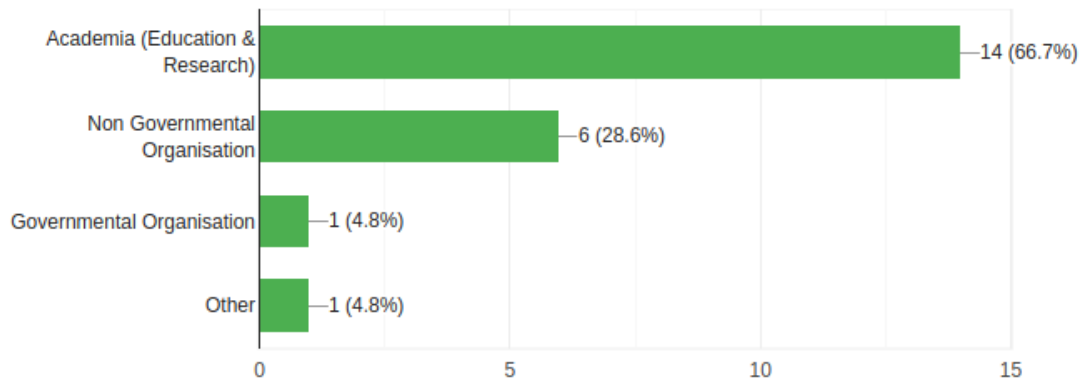
- Results of COMETS are only useful if uncertainties/ranges of applicability are explored.
- Results of COMETS are only useful if uncertainties/ranges of applicability are communicated to the research community and beyond.
- Results of COMETS should follow common communication standards.
- Reports of COMETS to H2020 should undergo internal peer-review.

3.3 Results from questionnaire

There were 20 responses from COMETS consortium members (100%), also a student from UNITO participated. The total number of responses is therefore 21. Aggregated results are:

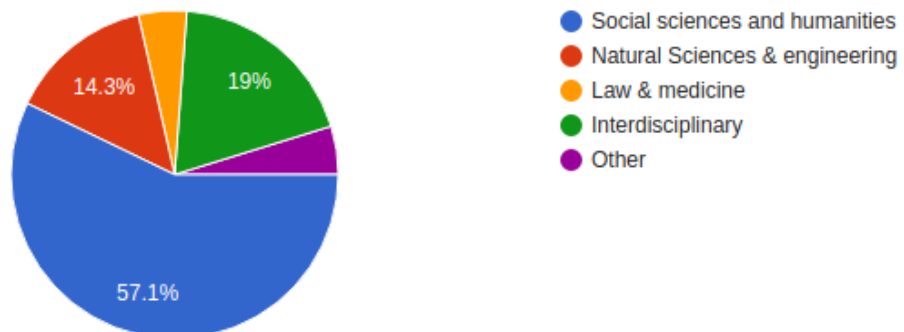
What is your institutional background?

21 responses



What is your discipline?

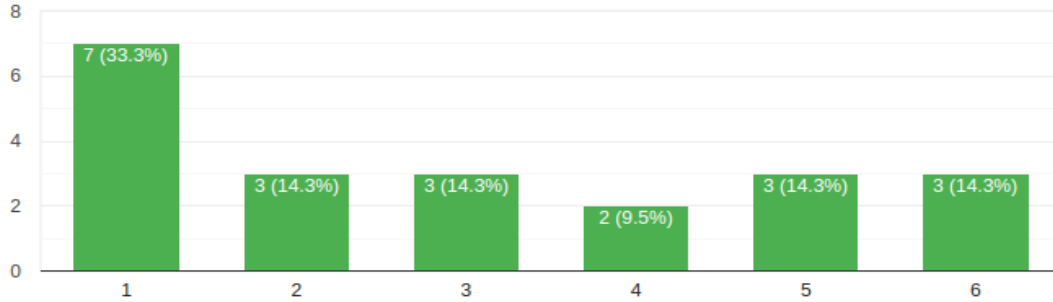
21 responses



Research objectivity

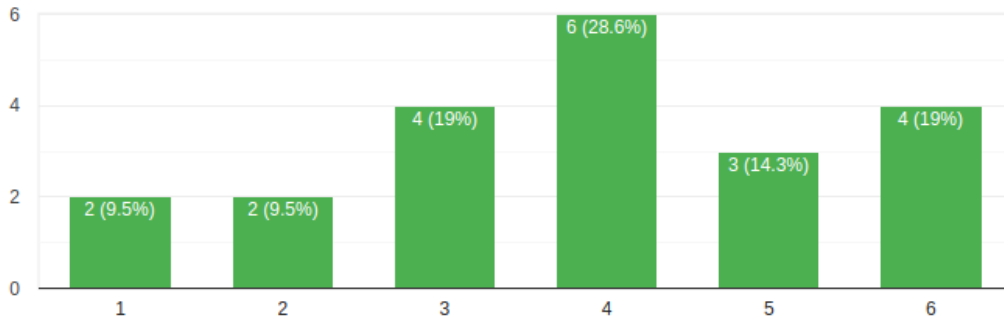
Objectivity implies the absence of values by the researcher.

21 responses



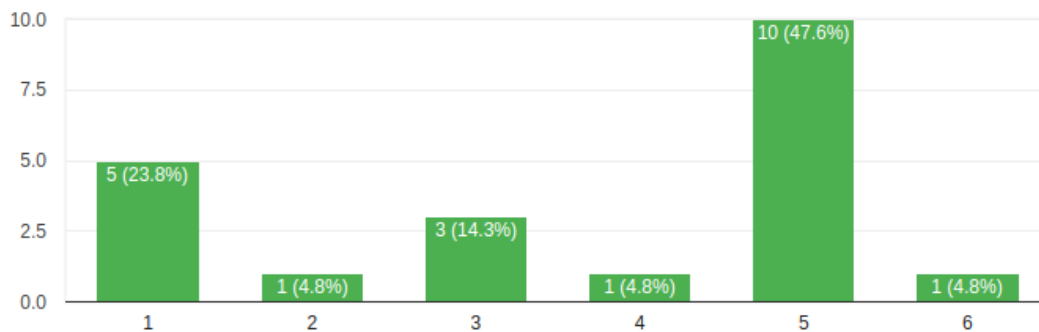
Scientific results are useful, even if they do not represent objective reality.

21 responses



Value-neutral scientific research is possible.

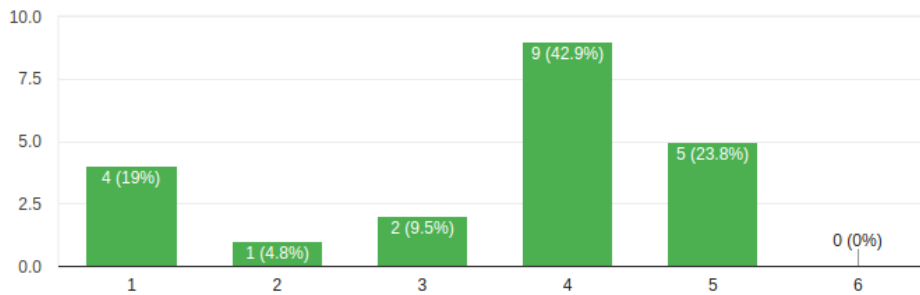
21 responses



Role of research

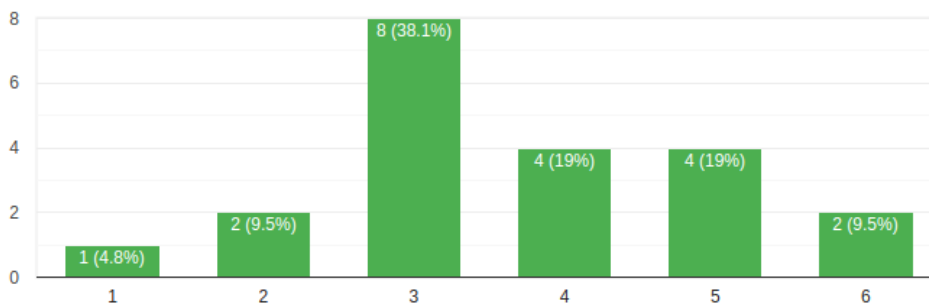
Often the decision of what should be integrated into models (mental and analytic models) and what should be omitted is guided by practicability; in other words: taking the easy route.

21 responses



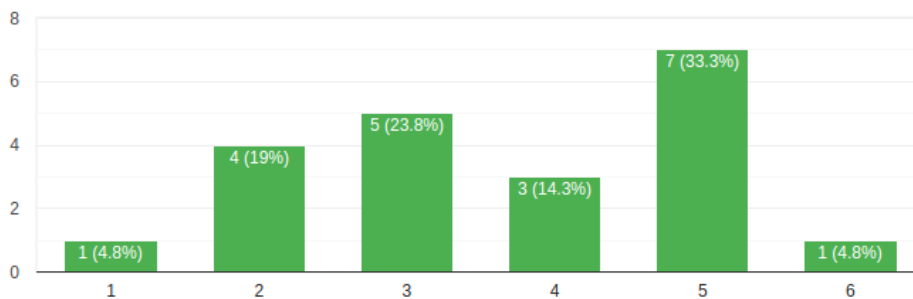
The principle value of research stems from its potential to make basic discoveries.

21 responses



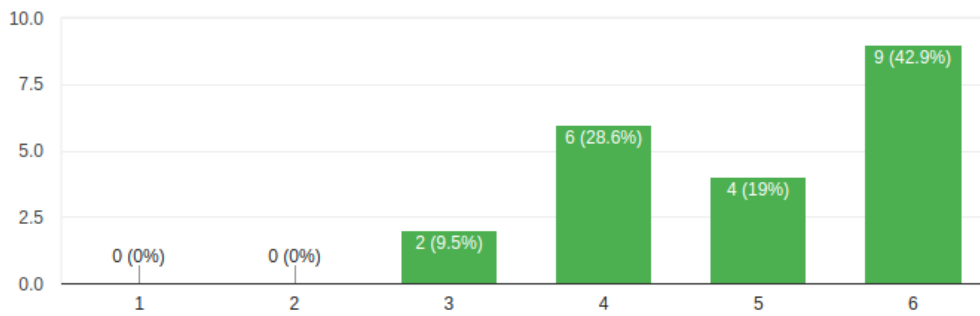
The principle value of research stems from the potential application of the knowledge gained.

21 responses



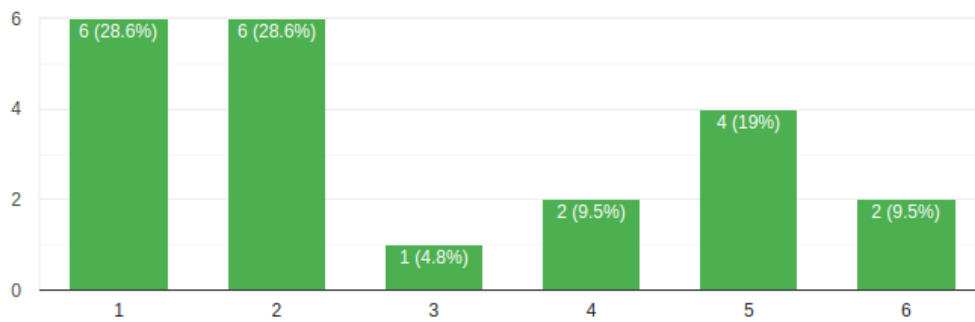
COMETS research results are more relevant if they contribute to the energy transition.

21 responses



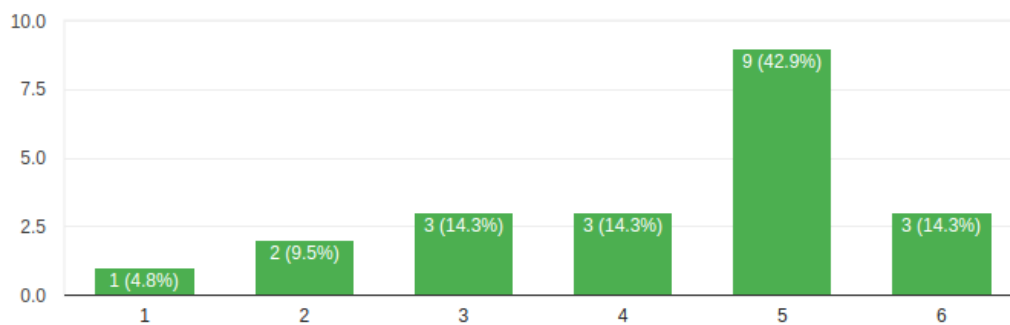
Scientists should provide knowledge and not interfere with the decisions of policy-makers or CAIs.

21 responses



COMETS research results are relevant for the short-term (up to 5 years).

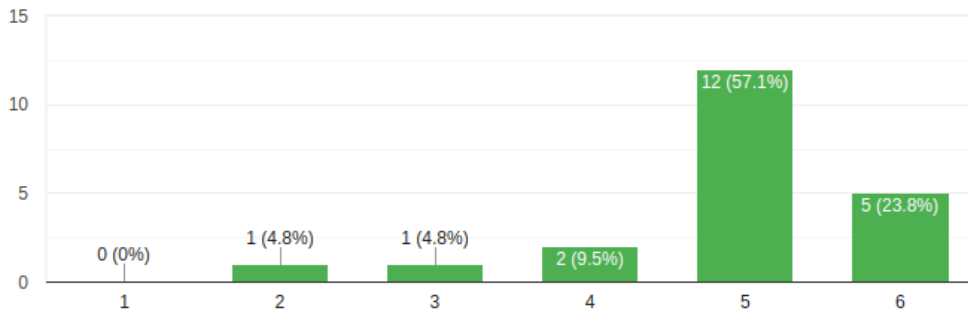
21 responses



COMETS research results are relevant for the longer-term (e.g. accomplishing SDGs by 2030).



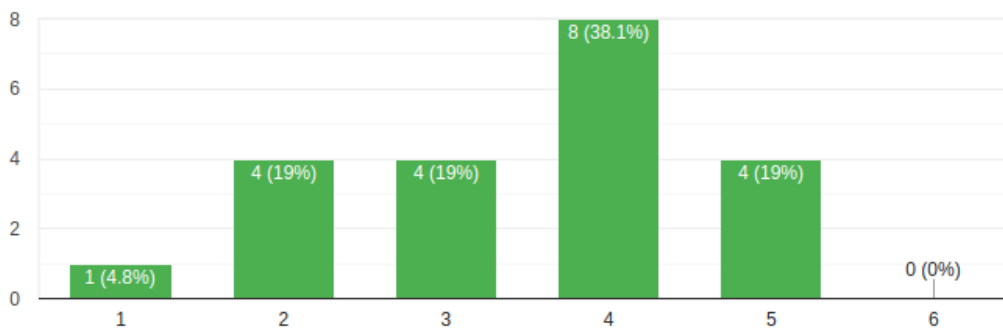
21 responses



The members and stakeholders of COMETS share similar views considering the role of research.



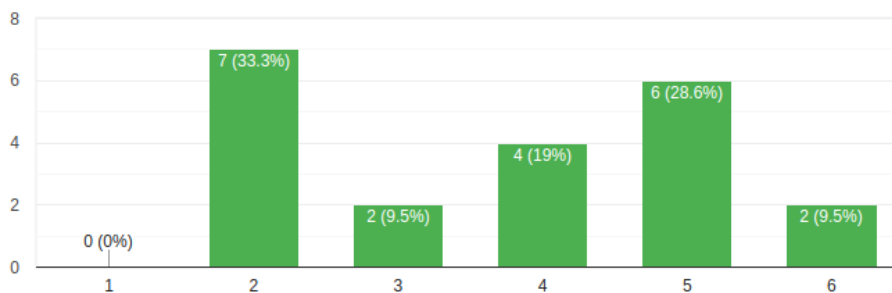
21 responses



Scientific approach towards CAI

Indicators are able to measure and provide a comprehensive description of the subject being studied.

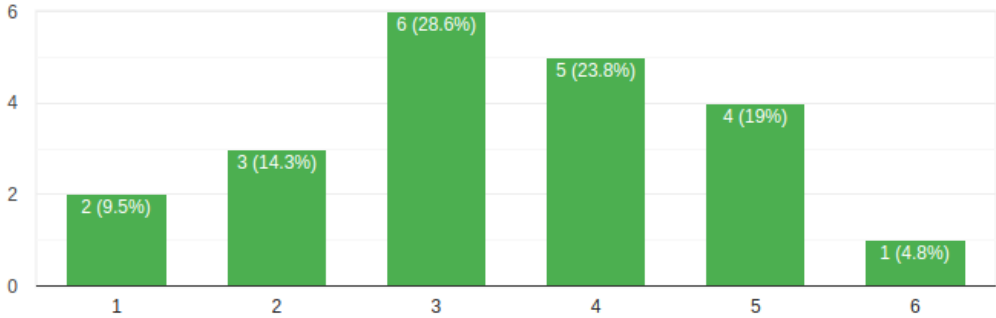
21 responses



Common indicators to analyse the contribution of CAIs to the energy transition exist.

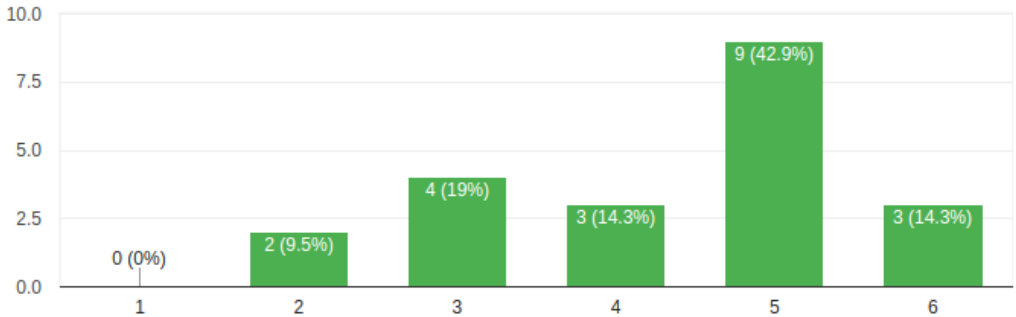


21 responses



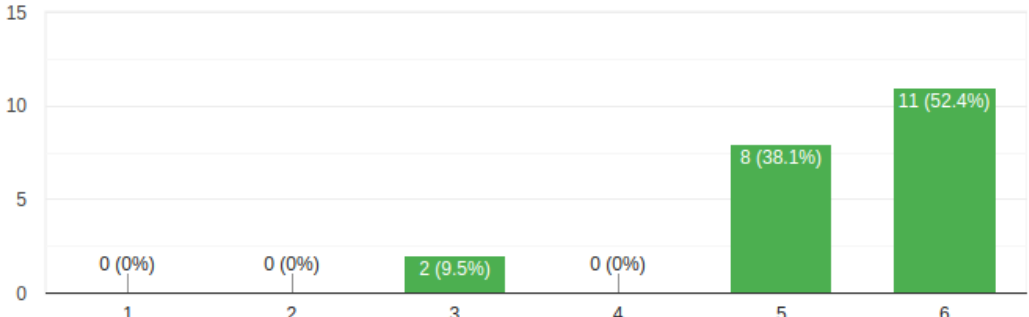
It is possible to estimate the aggregated contribution of CAIs to the energy transition.

21 responses



A portfolio of methods is needed to study the contribution of CAIs to the energy transition.

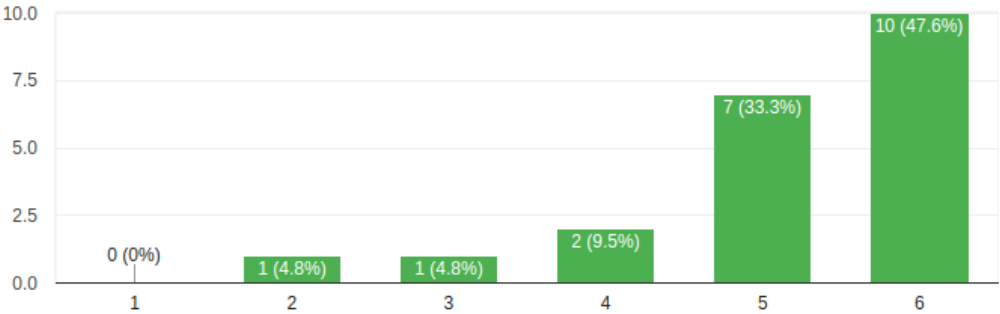
21 responses



Quantitative as well as qualitative methods are needed to study the contribution of CAIs to the energy transition.

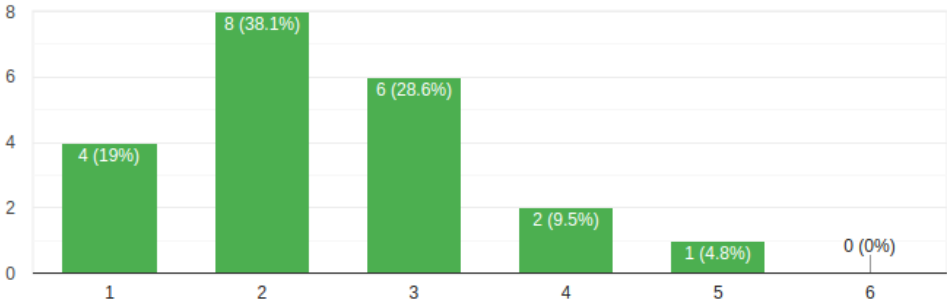


21 responses



It is sufficient to study only a few representative cases of CAIs for understanding their dynamics and contribution to the energy transition.

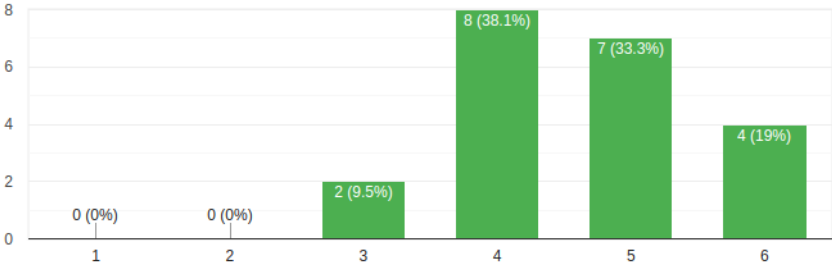
21 responses



Participatory research

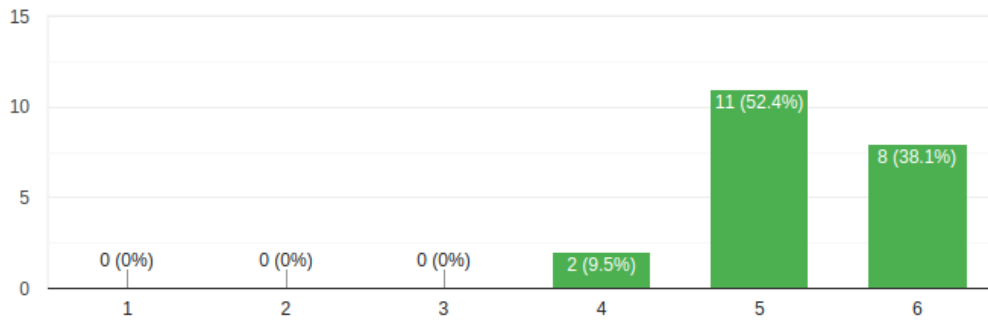
The technical process of COMETS main methods (i.e. CAI surveys, roadmaps & scenarios, inventory, aggregation method and performance indicators) should be subject to stakeholder scrutiny and input of stakeholder expertise.

21 responses



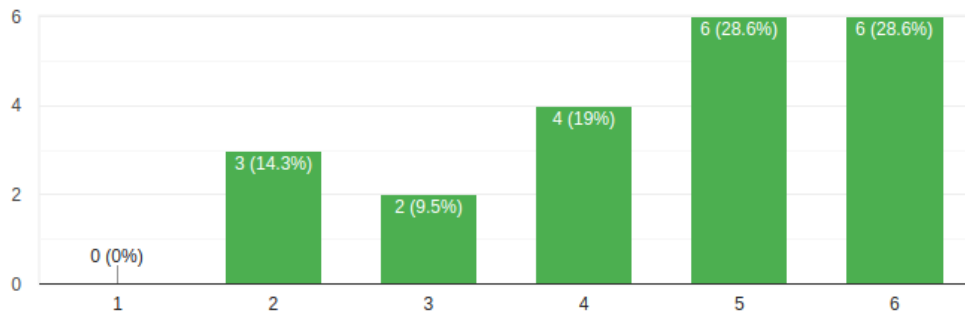
Due to complexity of the real world, it is indispensable to include stakeholder knowledge.

21 responses



Due to complexity of the real world, it is indispensable to involve stakeholders more in depth in the generation of scientific knowledge.

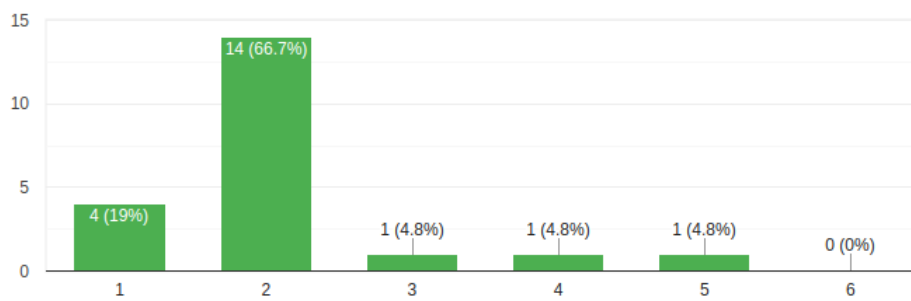
21 responses



Scientific validation

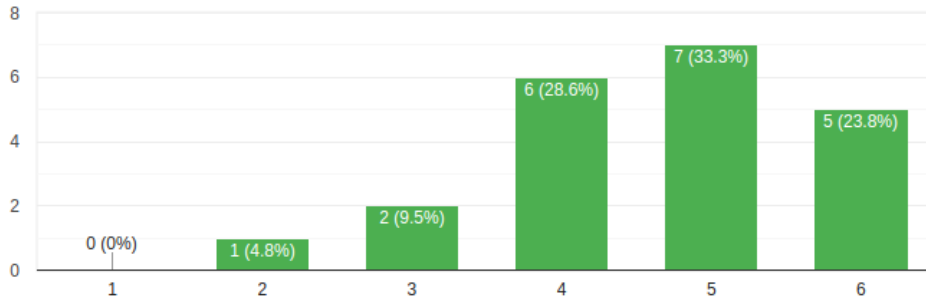
It is not possible to validate research results of COMETS.

21 responses



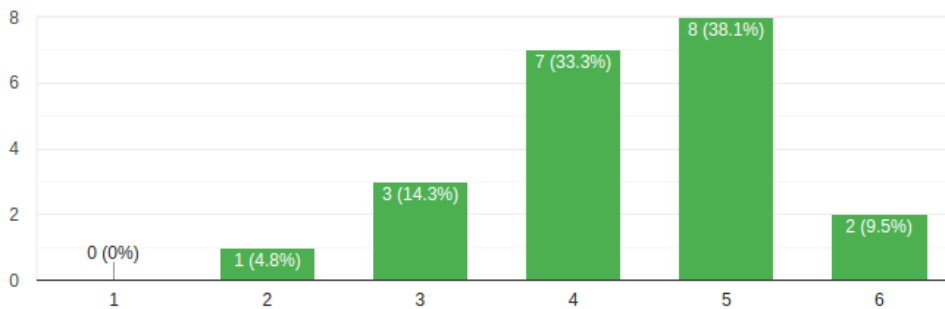
There is no ultimate validation method. Instead, many testing options need to be exploited on a continuous basis.

21 responses



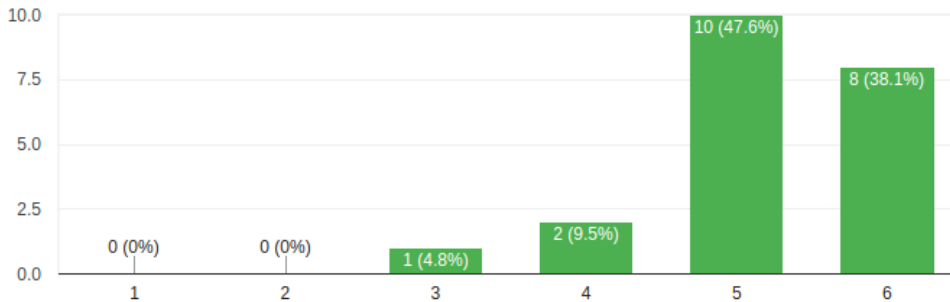
A formal agreement should be reached among COMETS partners on how to scrutinize research results of the project.

21 responses



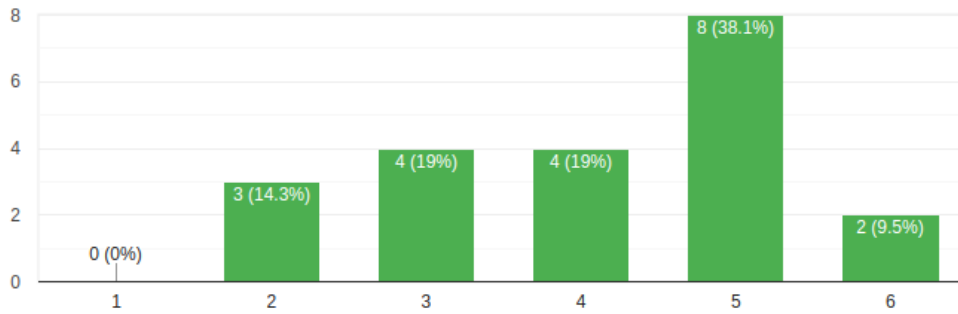
Documentation and transparency of research results are key to building trust into COMETS research results. Therefore, open science approaches should be favored.

21 responses



Validation requires testing by third parties.

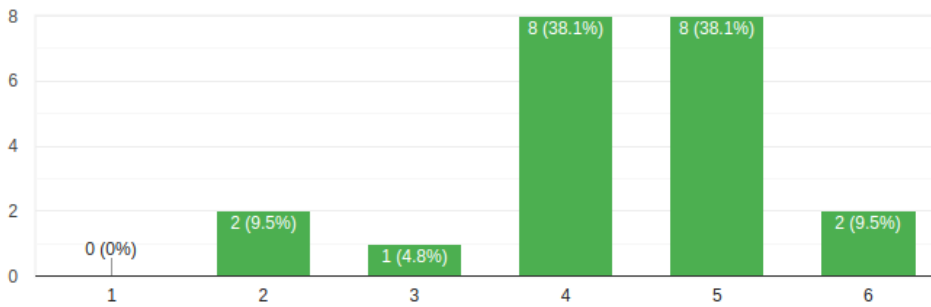
21 responses



Communication of results

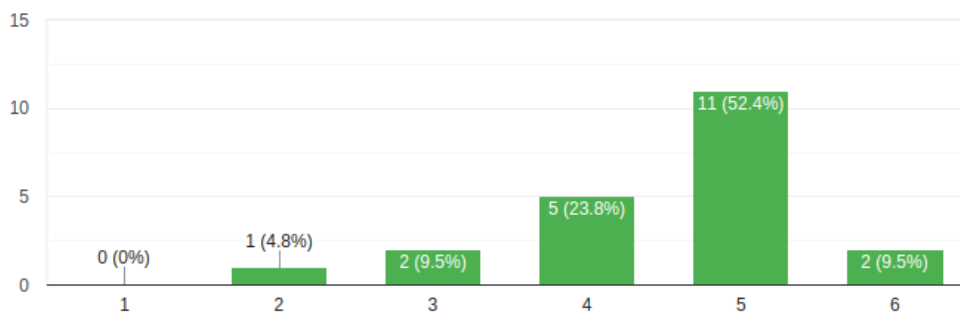
Results of COMETS are only useful if uncertainties/ranges of applicability are explored.

21 responses



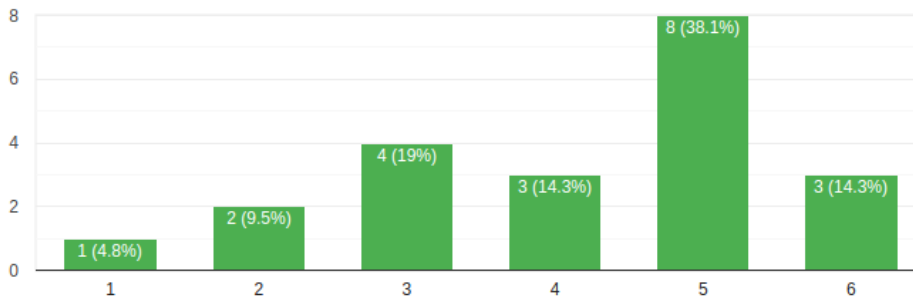
Results of COMETS are only useful if uncertainties/ranges of applicability are communicated to the research community and beyond.

21 responses



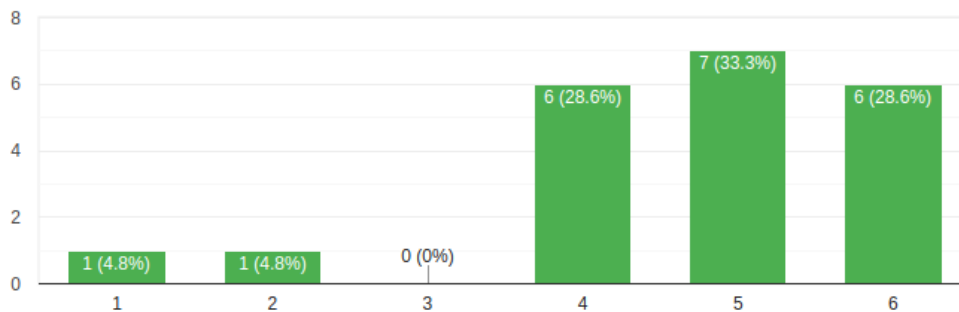
Results of COMETS should follow common communication standards.

21 responses



Reports of COMETS to H2020 should undergo internal peer-review.

21 responses



3.4 Notes from discussion

The group discussion focussed on questions where the answers were not unanimous. These were identified from high standard deviations in the answers.

Epistemological understanding in the consortium, reflections from group discussions:

Group 1: Three main questions have been explored:

1. **Role of values.** All share the view that we are value-driven. However, this fundamental issue does not pose a problem if applying common standards to ensure research quality and if continuously reflecting upon the progress of the project. With such awareness and action, neutrality in research methods and results can be achieved. It was noted that the motivations to initiate collective actions can be very broad (e.g. ideologically driven). Therefore, it is necessary to investigate the values of CAIs, as well as the value-driven motivation within communities.
2. **Policy related issues.** The possibility for CAIs to start and implement activities depends strongly on a country's set-up (from legal to economical and cultural conditions). CAIs therefore are organized in different ways. As a consequence, results of COMETS should be shared with policy-makers at an early stage. Also, to support the creation of a cooperative spirit between policy-stakeholders and the COMETS consortium. The group

stressed that they agree on the need to empower the civil society. The focus is to improve the civil society. A key is to bring policy-makers on board.

3. **Indicators and criteria:** There are mixed views on whether indicators and criteria *exist* in principle to measure the performance of CAIs (ranging from fundamental philosophical objections to accepting applied perspectives). Indeed, the understanding of the word "exist" itself may be ambiguous. First, the respondent could understand that the indicators are available in the literature or scientific practice and only a systematic review would be enough to reach them. Secondly, it can be understood epistemologically as a potential existence: Common indicators are hypothetically possible to create and can be used in science. It could have an effect on the unanimous results in the survey. A compromise lies in ensuring that indicators and criteria chosen are purpose-driven and useful. The group agreed that it will be possible within COMETS to derive useful indicators and criteria - qualitative and quantitative (e.g. in terms of low carbon energy installed, energy saved, number of members, degree of social integration, contribution to awareness, indicators describing diffusion dynamics). It is important to recognize that values are part of the research questions, because social integration is key to achieve valuable results in cooperation with stakeholders.

Group 2: The group shares the views expressed by group 1 and adds their discussion points:

- **Objectivity/neutrality of research.** Objectivity does not exist, because we are all influenced by values and our social environments. The discussion therefore focussed on exploring how it is possible to achieve neutrality of observers of social processes. It is important to be aware that there are influences from the start of research, in particular as the subject of study concerns social innovation. It was proposed to anchor the project's validation framework within the theoretical background of post-normal science.
- **Prerequisite is to clarify the definition of CAIs:** Is COMETS only targeting the analysis of energy cooperatives? The availability of reliable data for this type of CAI (as opposed to less formalized initiatives) as well as the focus of the project of energy transition speaks in favor of focussing on energy cooperatives. It was proposed to intensively discuss with the project consortium on how to define CAIs that are of interest to COMETS and also where to draw the line.
- **Performance indicators and criteria:** A fundamental question is - whether the project should start from scratch or whether we should be building on existing work (e.g. the current state of the inventory of CAIs). Starting from existing work (e.g. the database) would mean to accept the idea of definition/typology of CAIs that is behind the database. For example, is the database too much framing the research agenda? It was discussed that the typology/definition of CAIs should start from a draft (also using the current database structure), but be refined throughout the COMETS project (e.g. using input from surveys, stakeholders and other COMETS activities, also case studies will lead to indicators). A conclusion is that the design of the database should allow for the necessary flexibility.
- **Quantitative and qualitative validation.** It was discussed that the validation framework of COMETS should go beyond technical tests (e.g. identifying errors in database entries or statistics exploited). To validate the consistency of data, it is necessary to understand outliers. The value of having tests by third parties and experts (e.g. through the advisory board) has been stressed.

Group 3: The group shares the views expressed by group 1 and 2, adding their discussion points:

- **Objectivity vs. values.** All agree on one conclusion in the end: Values should not affect the research activity, but they are there a priori. It is an active effort to keep objective when doing research.
- **Reality vs. model.** A model is never representing reality. Usefulness of a model should be measured by the models ability to approximate reality (fitness measure).
- **Relevance of results.** COMETS results more valuable if contributing to energy transition? This was a controversial discussion. Agreement was achieved regarding issues: 1) There are other important objectives of COMETS (e.g. investigating what the role of CAIs for communities is), 2) One needs to be realistic about COMETS impact (expectations).

Group 4: The discussions were evolving around various validation topics. The group shares the views expressed by other groups before, adding the following discussion points:

- Again, it was stressed that **values** are there, but that is normal for social science (unavoidable due to the matter of study). Pluralism in values helps to create **objectivity**. It was compared to the functioning of judges in trial. Awareness to the issue of objectivity of research will be particularly important when building the roadmaps - there objectivity might enter a grey zone.
- **Role of modeling vs. qualitative type of research.** Exchange of experiences is important to explore the different perspectives (e.g. with regard to energy modeling: many social scientists are sceptical on how modeling results are generalized by policy makers; overall, the communication of uncertainties is poor). It is necessary to complement energy models by qualitative research (to account for social, political and other dynamics; to allow decision-making in a real world that is not fully quantifiable; to allow generating the, bigger picture). The question is, what comes first - should a linear/circular/parallel approach be carried out? For example, qualitative SSH analysis or process-based modeling - what is the impact of starting with "a" discipline? Methods to integrate sciences are necessary and need to be shared. Suggestion was made on how to approach action research in COMETS: build in a similar direct feedback loop, e.g. using the method of the questionnaire as an idea from the validation workshop to engage stakeholders.

Group 5: The group shares the views expressed by other groups before, adding the following discussion points:

- Re-emphasizing the shared view: we are **value-driven**. Values might differ (also in the extent they play out in activities). Shared values identified were: There is a need for transformative social-cultural change. CAIs can have an important role in driving/supporting this change in a sustainable way. All share the value of scientific integrity. Differences on values within the group concerned for example the role of markets for transformative change as well as the relative weighing of sustainability criteria (strong vs. weak sustainable development concepts).
- A **suggestion** was put forward to the plenary and discussed among all: Shall COMETS make an effort to make values evident? For example, with displaying values shared within the consortium as well as a statement on values where there are different opinions. It

could have the form of a statement as part of the validation framework or even on reports. After longer discussions, it was agreed in the Consortium to not make such an attempt. Even though, this could be a measure to increase transparency, the risks of being wrongly perceived is too high since such a statement is not common practice. Therefore, it might even be counter-productive (scientific integrity is given and there is no wish to advocate science to any political review. Moreover, CAIs are neutral per-se as they may be ideologically driven). Moreover, common research quality assurance standards are followed regardless (e.g. peer-reviewing, best-practice standards for SSH) and consortium members underlined the role of continuous self-reflection to what extent values/personal choices impact research throughout the implementation of COMETS. A proper integration of activities and work packages is key for achieving this (and here we start with the exchange of the starting points of COMETS participants). Finally, a clear distinction between values and statements is necessary. Unfortunately, the Post-normal science (PNS) approach suggests that "escape from value" in science is not possible. PNS suggests that the more uncertainty and systemic irritability grows, the more postulative scientific outcome becomes. Moreover, PNS is located in the context of 'crisis disciplines' (Michael Soulé, 1985) what indicate approaches addressing fears like one that the world is facing ecological collapse. In our opinion, COMETS is included in this paradigm. The selection of scientific arguments means consent to the existence of a kind of crisis state, and even the choice of the topic is dictated by the value system. However, it should be emphasized that PNS does not exclude the reliability and validity of scientific measurement. Reference: M. Soulé, 1985: What is conservation biology? *BioScience* 35, 727-734.

- The issue of the need to **discuss COMETS definition of CAIs** (e.g. natural persons as members, also corporates?) was raised. The discussion was taken up further in the plenum discussion. See discussion of results below.

Overall conclusions:

- Exchange on background of consortium members (epistemological background, scientific approaches, methodological background, values) is very useful and should be continued throughout the project's implementation.
- It is necessary to dedicate sufficient time to jointly develop the COMETS definition of CAIs. The starting point is the discussion at the kick-off meeting (draft), which will continuously be refined throughout the implementation of COMETS.
- The discussion of the validation framework will be continued through commenting on the draft, which is based on the validation workshop.

4. COMETS validation framework

4.1 Validation statement and framework

Validation statement of COMETS consortium:

COMETS is applying an **overarching validation framework** to:

- Deploy multiple methods for maximizing objectivity of research activities, while ensuring optimal linking and integrating research activities and results carried out in different Work Packages with the aim to achieve robust research results.
 - Use joint communication standards to inform stakeholders and the general public as well as to open up its findings to assessments by stakeholders. Special attention is given on the proper communication of uncertainties and/or ranges of applicability of research results.
-

Validation framework of COMETS:

The general structure of COMETS validation framework is outlined in the Table below. Afterwards, the validation framework is detailed for each of the activity groups, specifying key assumptions, tools and methods to be deployed, validation activities to be carried out and communication standards adopted. COMETS activities have been grouped into main research activities (“activity groups”).

Table: General approach towards validation in COMETS.

Activity groups:	Approaches to validation for each activity group:
Performance indicators	<ul style="list-style-type: none">• Key assumptions (if applicable: hypothesis)• Tools & methods deployed• Validation activities• Communication standards for results and uncertainties
Survey	
Case studies	
Roadmaps & scenarios	
Inventory	
Aggregated estimate of CAI contribution	

Performance indicators:

1. Key assumptions and hypothesis:

- The performance of CAIs is measurable through qualitative and quantitative indicators.

2. Tools & methods:

- Desk based research and literature review to search for indicators already defined and used in the literature (benchmarking);
- Adaptation to CAI of performance indicators used in other sectors (e.g. agriculture, food production);
- Definition of CAI specific indicators and, whether and where appropriate, of indexes (compound of indicators).

3. Validation activity:

- Assessing the robustness of indicators by applying the definition to the CAIs across typologies and countries, using the inventory and the survey. The indicators are grouped around the main sustainability dimensions (i.e. economic, environmental and social).

4. Communication standards for results & uncertainties:

- When measurement of indicators would be uncertain, the results would be presented in ranges and uncertainties contextualized and explained (in particular in the case of quantitative indicators).
- Taxonomy of CAI performance indicators would become a standard framework for CAI assessment and valuation which:
 - i. Would allow robust and consistent assessment of CAIs surveyed and subject as case studies within the projects;
 - ii. Could be used by actors and stakeholders beyond this project.

Survey:

- 1. Key assumption and hypothesis:** We assume there is sufficient interest among CAIs to participate in the survey so that findings are representative for the wider community of CAIs. We also assume the survey can deliver relevant insights on the CAI characteristics and key performance indicators to be explored more in-depth under WP4 for a selection of CAIs. In other words, we assume reliability and accuracy of measurement.
- 2. Tools & methods:** Following the "Recommended Practices for Questionnaire Development and Testing Methods in the European Statistical System" (Brancato et al. 2006), we will design a structured questionnaire of about 50 questions. The number of questions will be adopted to the resumed retention rate. It will use open source online software (e.g. limesurvey) and explore the main dimensions of analysis as revised and

defined in T2.1 (working definition of CAIs). Special attention is paid to measure the performance of CAIs by adopting the indicators developed at T6.2. The survey itself will undergo internal and external quality tests in T6.3.

3. Validation approach:

- The survey is validated with respect to its comprehensibility (in terms of wording and formalization of the questions) and its contents (in terms of coherence of the questions with the specific objective).
- Expert validation: Methodologists and subject-matter experts selected in and through the Advisory Board will evaluate the questionnaire for potential problems for either interviewers or respondents.
- Pilot testing. Submission of the entire questionnaire to a randomized sample of CAIs subscribers of the Supporting Platform developed at T7.1 per each selected country to test how the questionnaire works.
- Representative sample test. Utilizing the typology developed at T 2.3, the survey sample will be tested for its representativeness. Thus, we will ensure that the limited sample of the survey reliably portrays reality. Surveys will be translated into the languages of the corresponding CAI countries. Earlier studies will allow us to estimate populations (number and structure of CAIs) which is necessary to build the sample. This is linked to the inventory.

- 4. Communication of results & uncertainties:** Communication on survey results will be presented on the support platform. Uncertainties can be presented in quantitative ranges, but it's equally important to contextualize and explain uncertainties in lay-terms (see also T6.2). Participants will be informed about the use of data and handling of data and as well about the final results (feedback).

Case studies:

- 1. Key assumptions and hypothesis:** We assume that the consortium benchmarking process will lead to higher degrees of community engagement (incl. CAI activities) and produce knowledge in a rigorous way. There is no intention of testing this assumption; we fall back on the literature (Schiele and Krummacker, 2011).

2. Tools & methods:

- Consortium Benchmarking: Detailed methodology and strategy will be co-developed with the comparative and participatory case studies during the first collective meeting. Prior to the training day in Brussels, other relevant methods will be researched as a fallback. The 2-day training workshop using the consortium benchmarking process will be carried out for the national partners: UNITO (Italy), TECNALIA (Spain), VITO (Belgium), RUG (Netherlands), JU (Poland), and TREA (Estonia). National Research Teams select the participatory case study within their respective countries (T4.2); and are in charge of carrying out the engagement activities. All activities will be conducted in the local languages (T4.3).

- 3. Validation approach:** Validation happens by examining the conditions and indicators of success or failure of CAIs in delivering impact to the energy transition. Engagement levels and knowledge transfer between the participatory case studies and the comparative

case studies during the visit tours of the comparative case studies will also be tested. This will be a qualitative approach to validation. Further validation would come at the end of the project to determine, longitudinally, if the changes (including the transition actions and engagement level) have enhanced, continued or reversed.

- 4. Communication of results & uncertainties:** We will look at the specific case studies and assess the performance, success and failure across different implemented strategies. The failure rate will be based on the validation approach, and will include ratios of the comparative case studies that had enhanced, continued or reversed their energy transition actions and engagement level.

Roadmaps and Scenarios:

- 1. Key assumptions and hypothesis:** Processes for a successful development of CAIs in the energy field should consider the complex interplaying of many diverse actors and perspectives. The validation of roadmaps and scenarios will be therefore provided by involving a group of heterogeneous experts that will be able to provide a 'third party' evaluation of the consistency of the strategies defined.

- 2. Tools & methods:**

- Inspired from the tradition of participatory democracy, validation activities will be facilitated by deliberative arenas (see Wiklund 2005, Gastil and Levine 2005) to be held in the 6 selected countries where the participatory case studies have been carried out. Deliberative methods, e.g. advisory forum, deliberative focus groups, distributed dialogues and general deliberative workshops will be used. Attendees to these arenas will be recruited by national partners among academics, experts and stakeholders not involved in the scenarios/roadmaps definition. In selecting the attendees, attention should be paid to balance disciplinary field, cultural and social background, gender, role in the energy chain.

- 3. Validation approach**

The validation of the scenarios/roadmaps will focus on:

- Checking coherence and feasibility of scenarios/roadmaps,
- Incorporating changes and suggested improvements,
- Developing strategies and policy recommendations more likely to be successful for the specific case and context.

- 4. Communication of results & uncertainties:**

Although the aim of the validation activity itself is to find a shared vision on the strategies defined, a certain level of uncertainty has to be considered as unavoidable given the complexity of the processes under scrutiny. Instead of being forced to a solution, the eventual dimensions of uncertainty will be clearly identified during the process as 'caveats' and as potential sources of variety to be considered in the final definition of roadmaps.

Inventory of Collective Action Initiatives:

1. Key assumptions & hypothesis:

- A representative sample of CAIs can be identified and collected with sufficient quantitative and qualitative attributes.
- The activities of CAIs are measurable through qualitative and quantitative indicators.

2. Tools & methods:

- Mining of qualitative and quantitative data (by hand and automated) and involvement of local research leaders.

3. Validation approach:

- Testing typology (contrast inventory typology with typology originating from surveys in T3.3).
- Testing data validity (template-based, FAIR data standards - automated & 4-eyes principle). Linked to T2.2.2.
- Testing of completeness of entries and level of coverage across countries (against external data & literature, linked to T2.1)
- Testing information processing & performance indicators (contrasting T2.3 and T3.3 results, comments from advisory board and other experts)

4. Communication of results & uncertainties:

- Present estimate with upper and lower bound

Aggregated estimate of CAI contribution:

1. Key assumptions and hypothesis:

- Typology of CAIs as a means to identify common features

2. Tools & methods:

- Multi-dimensional regression analysis, clustering, interpolation, sparse data modeling, primary and secondary data analysis

3. Validation approach:

- Comparison with literature and alternative estimate
- Turing test by confronting with expert results

4. Communication of results & uncertainties:

- Communication of quantified uncertainties
- Communication of representativeness of sample used