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Schumann, Diana

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# Design for assessing public perception of a Pilot Case for a European CO<sub>2</sub> transport infrastructure

*Diana Schumann*

Forschungszentrum Jülich, Institute of Energy and Climate Research - Systems Analysis and Technology Evaluation (IEK-STE), D-52425 Jülich, Germany

## Executive Summary

In order to facilitate a successful planning, construction and implementation of the Rotterdam Nucleus project which was chosen by the GATEWAY project consortium as Pilot Case for a European CO<sub>2</sub> transport infrastructure, a reliable assessment of its public perception is essential. The concepts, indicators, and methods which can be used in the future for the assessment of the public perception of the Rotterdam Nucleus project are described in this report.

## Keywords

Public perception, Pilot Case, European CO<sub>2</sub> transport infrastructure

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## I Introduction

CO<sub>2</sub> capture and storage (CCS) is seen worldwide and in the European Union (EU) as an essential part of the climate solution [IEA, 2015]. However, the pace of development and uptake of CCS has been below expectations, and a contributing reason for this is that a number of CCS deployment projects have been restructured, postponed and cancelled [Stigson et al., 2012]. Among several reasons such as policy obstacles or investment hurdles [Stigson et al., 2012], this is also due to strong public opposition regarding CCS deployment projects in some countries [cf. e.g. Dütschke, 2011, Fischer, 2014, Terwel et al., 2012]. A lack of public acceptance may also be a potential show stopper for the realization of the Rotterdam Nucleus project which was chosen by the GATEWAY project consortium as Pilot Case for a European CO<sub>2</sub> transport infrastructure. Therefore, a reliable assessment of public perception of the Rotterdam Nucleus project is essential in order to facilitate a successful planning, construction and implementation of the Pilot Case. This report describes how such an assessment can be performed.

However, at present the definition of the Rotterdam Nucleus project is not yet very much elaborated. This is due to the fact that the Rotterdam Nucleus project will be refined and developed during the remaining period of the GATEWAY project. The final definition of the project along with the Business Case will only be presented in April 2017. Due to the lacking details of the definition of the Pilot Case, the descriptions of the concepts, indicators, and methods explained in this report cannot be specifically applied to the Rotterdam Nucleus project. But, whenever possible, the concepts, indicators, methods and examples are explained with regard to the assessment of public perception of CCS or CO<sub>2</sub> pipelines with the purpose of giving as much as possible information at hand how the tools and methods can be used in the future for the assessment of the public perception of the Rotterdam Nucleus project.

## II Definition and delimitation of the subject of assessment

In scientific research as well as in political and public debates the term “public perception” is frequently used, but rarely defined, because it is regarded as being self-explanatory. The majority of the studies on public perception of CCS also use the term “public perception” without defining it. However, in order to assess public perception of CO<sub>2</sub> transport infrastructure it is necessary to define and delimitate the subject of assessment.

First of all, a distinction must be made between the concept of “perception” and that of “acceptance”. In the Oxford Living Dictionaries perception is defined as “the way in which something is regarded, understood, or interpreted”.<sup>1</sup> In the Farlex Partner Medical Dictionary “perception” is defined as “the mental process of becoming aware of or recognizing an object or idea; primarily cognitive rather than affective or conative, although all three as-

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<sup>1</sup> <https://en.oxforddictionaries.com/definition/perception>

pects are manifested".<sup>2</sup> These definitions make clear that awareness is an indispensable prerequisite for forming or having a perception of an object or issue. Furthermore, the process of perception has the effect that the information coming from outside is unconsciously structured and classified in a particular way into the system of knowledge of the information recipient. Perceptions are, therefore, selective-subjective records of the external environment.<sup>3</sup> Perceptions are well researched with regard to risks [cf. Renn, 1998, Renn & Benighaus, 2013].

In contrast, acceptance can be generally understood as passive or active approval [Schubert & Klein, 2006]. The public acceptance of technologies, however, can be broken down into three different forms depending on what technology sector is being dealt with [Renn, 2005]. In the case of product and everyday technology, acceptance is shown by purchasing the respective products. In the case of work technology, acceptance is reflected in the active use of a product by the employees in a company. In the case of large-scale technologies<sup>4</sup>, which include energy technologies such as CCS technologies, acceptance means that the respective facilities are tolerated by those concerned [Renn, 2005]. It is not necessary for those concerned to have a positive attitude towards the technology.

Decisions on the development and use of work and large-scale technologies are usually not made by the actors directly or indirectly affected by the use of the technologies [Gloede & Hennen, 2005]. For this reason, acceptance in the case of work and large-scale technologies also means the 'active or passive approval of decisions or actions of others' [Schubert & Klein, 2006]. It is expressed in the attitudes and behavior of individual or complex actors<sup>5</sup> and can be measured at a given point in time [Dierkes & von Thienen, 1982].

The *public acceptance of CCS* can therefore be defined as the passive or active approval of the development, the large-scale demonstration or the implementation of CCS technologies and its components, such as CO<sub>2</sub> pipelines, which is reflected in the attitudes and behavior of individual or complex social actors, and which can be measured at a certain point in time [cf. Schumann & Simon, 2009]. This means that public acceptance of a CCS project is already given if no active resistance against it exists. A positive attitude of the citizens is not needed.

In contrast, *public perception of CCS* can be defined as the way in which CCS technologies and its components, such as CO<sub>2</sub> pipelines, are regarded, understood, or interpreted, which is reflected in the awareness, knowledge, and attitudes of individual or complex social actors

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<sup>2</sup> <http://medical-dictionary.thefreedictionary.com/esthesia>.

<sup>3</sup> <https://de.wikipedia.org/wiki/Perzeption> (webpage in German).

<sup>4</sup> Large-scale technologies are also referred to as 'external technology' ('technology as your neighbour') by [Renn & Zwick, 1997].

<sup>5</sup> A collection of individuals can be understood as a complex actor, if all of those concerned intend to acquire a shared product, to achieve a shared objective, or realize a shared interest [Scharpf, 2000].

and which can be measured at a certain point in time. According to this definition, awareness, knowledge and attitudes are the main indicators for assessing public perception of CO<sub>2</sub> pipelines. The concepts of these indicators are explained in the next section.

### III Indicators for measuring public perception of the Pilot Case

*Awareness* is an indispensable prerequisite for forming or having a perception regarding a person, object or issue. This is particularly important with regard to objects or issues, which are largely unknown among the general public such as CCS. An established concept for measuring awareness of CCS is asking the general public via a representative poll whether they had heard or read about CCS [Curry et al., 2007, Curry et al., 2005, European Commission, 2011, Pietzner et al., 2011, Schumann et al., 2014a]. In such polls, respondents reported their awareness of CCS by answering the question of whether they had heard about it by choosing between the different predefined answers “no, never heard of it”, “yes, heard of it, but know nothing or just a little bit about it” or “yes, heard of it and know quite a bit or a lot about it” (cf. Example 1). Accordingly, the results on public awareness which can be collected by such a type of survey question are results concerning “self-reported awareness”.

#### Example 1: Question: “Have you heard about the following topics?”

	No, never heard of it	Yes, heard of it, but know nothing or just a little bit about it	Yes, heard of it and know quite a bit or a lot about it
Storage of CO <sub>2</sub> in onshore repositories			
CO <sub>2</sub> capture and storage, carbon capture and storage or CCS			
Storage of CO <sub>2</sub> under the seabed			
Enhanced Oil Recovery			
Enhanced Gas Recovery			

Source: Survey “CCS Chances”; cf. [Schumann et al., 2014a]

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*Knowledge* of an object or issue can be measured on a subjective level or on a factual level, cf. [European Commission, 2008]. An established concept for measuring the subjective knowledge of the general public is to ask them via a representative poll to assess how well informed they think they are about the respective object or issue [European Commission, 2008]. This kind of knowledge can be understood as “self-reported knowledge”.

The *knowledge on a factual level* can be measured by asking the general public in a representative poll to say whether a set of statements regarding an objective or issue are true or false [European Commission, 2008, European Commission, 2011, Schumann et al., 2014a,

Schumann et al., 2014b] (cf. Example 2). Such statements should contain information which is evaluated by experts with different opinions regarding the object or issue as true, because it can be assumed that this will enhance the trust of the public in the truth content of the information.

**Example 2: Question: “I now read to you different statements about storage of pipelines. Please tell me to the best of your knowledge whether each statement is true or false.”**

Statement	True	False	Don't know
The overall length of existing pipelines for natural gas and mineral oil in Germany is more than 25,000 kilometres.			
Pipelines onshore are normally at a depth of not less than one metre below ground.			
In Germany, approximately 80 percent of crude oil for the production of petrol, diesel, kerosene and heating oil is transported via pipeline.			
The transport of large quantities of carbon dioxide via pipeline would be much more expensive than transport by train or lorry.			
As yet there is no pipeline worldwide for the transport of carbon dioxide.			

Source: Survey “CCS Chances”; cf. [Schumann, 2016b]

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In analyzing the results of such knowledge questions, it could be distinguished between what the respondents correctly knew and what they incorrectly believed [cf. Schumann et al., 2014b]. Correct answers can be understood as “factual knowledge”, whereas incorrect answers can be understood as “misconceptions” [European Commission, 2008, European Commission, 2011, Schumann et al., 2014a, Schumann et al., 2014b].

Knowledge about an object or issue is not a prerequisite for having an attitude to or opinion about this object/issue. This has been impressively shown by the research on “pseudo-opinions” or “nonattitudes”, e.g. [Bishop et al., 1980], which has revealed that people who are completely unaware of an object or issue do not necessarily refrain from giving their opinion about it when asked [Bishop et al., 1980]. Such uninformed opinions are referred to as “pseudo opinions” or “non-attitudes” [ibid.] Pseudo opinions or nonattitudes are of low quality<sup>6</sup> in that they are highly unstable and easily changed by contextual information or by

<sup>6</sup> Opinion quality is an umbrella term which has multiple indicators, such as opinion stability and opinion consistency [Price & Neijens, 1997]. Opinion stability can be defined as “the extent to which opinions are stable over time” [Price & Neijens, 1997]. Opinion consistency can be de-

slight alterations in the general mood [Daamen et al., 2006, De Best-Waldhober et al., 2008, ter Mors et al., 2013]. Therefore, in order to assess whether people are expressing pseudo-opinions it is necessary to relate their opinions to their factual knowledge, particularly in the case of an object or issue which is largely unknown among the public such as CCS.

In general, *attitudes* can be regarded “a general favorable, unfavorable, or neutral evaluation of a person, object or issue” [Petty & Cacioppo, 1986]. Usually, public attitudes are measured in representative polls using a Likert scale to assess the level of agreement or disagreement. For this purpose, respondents may be offered a choice of five to seven or even nine pre-coded responses with the neutral point being neither agree nor disagree. For example, a seven-level Likert scale for measuring an opinion regarding CO<sub>2</sub> pipelines may range from “1=very negative” to “7=very positive” (cf. Example 3).

**Example 3: Question: “Overall, how do you assess the idea of CO<sub>2</sub> transport via pipeline?”**

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1 Very negative	2	3	4	5	6	7 Very positive

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Source: Survey “CCS Chances”; cf. [Schumann, 2016b].

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*Initial attitudes* are attitudes which are reported by respondents with very limited information about the respective object or issue [cf. e. g. Pietzner et al., 2011]. This is for example the case if respondents of a standardized survey were presented with short information about CCS and then asked how they overall assess the idea of CO<sub>2</sub> capture and storage [cf. e. g. Schumann et al., 2014a].

Verbalized attitudes that are usually expressed by words, but can also be expressed by symbols or other signs (e.g. gesture, facial expression) [Schultze, 2002, Urbig, 2003], are defined as *opinions*.

If the self-reported awareness, subjective or factual knowledge about CO<sub>2</sub> transport is low among the public which will be affected by the Pilot Case it will be absolutely necessary to apply methods that allow for informing the public about the Rotterdam Nucleus project, before measuring their attitudes, because otherwise pseudo opinions will be collected (cf. Section 5). Using such methods will make it possible to survey informed public opinions which are “likely of higher quality than uninformed opinions, and thus more stable over time and more predictive of future opinions, intentions, and behavior” [ter Mors et al., 2013].

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defined as “the extent to which opinions are consistent with evaluations of related variables” [Price & Neijens, 1997].

#### IV Measuring risk perceptions, benefit perceptions and trust

Previous studies on the acceptance of risks and technologies verified that the acceptance of technologies by the general public is greatly influenced by the intuitive perception of risks, as well as by the perception of benefits and trust [Renn, 2005, Renn & Zwick, 1997, Siegrist, 2000, Siegrist et al., 2007]. In their review of 42 studies on public perception of CCS in general, [L'Orange Seigo et al., 2014] found out that many of the studies confirmed the finding that risk and benefit perceptions are two of the main predictors of the acceptance for CCS. For the perception of CO<sub>2</sub> pipelines this is confirmed by the study of [Schumann et al., 2014a].

For technology acceptance in general, trust is recognized as a key variable [Renn, 2005, Renn & Zwick, 1997, Siegrist, 2000, Siegrist et al., 2007]. This is confirmed by the studies on public perception of CCS, reviewed by [L'Orange Seigo et al., 2014]. Trust can have direct positive effects on acceptance or mediated effects through perceived risks or benefit perceptions [L'Orange Seigo et al., 2014]. To the best of our knowledge, the influence of trust on the acceptance of CO<sub>2</sub> pipelines has not yet been systematically tested. However, because [Gough et al., 2014] showed that their results on public perception of CO<sub>2</sub> transportation in pipelines are consistent with previous findings on CCS acceptance, it can be assumed that trust is an important predictor as well for the acceptance of CO<sub>2</sub> pipelines. Therefore, it can be concluded that it will be necessary to assess the risk perceptions and benefit perceptions among the public with regard to the Rotterdam Nucleus project. Additionally, it will be essential to explore if and to which extent the project developers are trusted by the public and whether the process and the outcome of the project siting are evaluated as fair [cf. e. g. L'Orange Seigo et al., 2014, Terwel et al., 2012].

In general, “technological risk perception denotes the processing of physical signals and/or information<sup>7</sup> about potential hazards and risks associated with a technology and the formation of a judgment about seriousness, likelihood, and acceptability of this technology [...]” [Renn & Benighaus, 2013]. Risks of technologies are furthermore “judged by people using mental models and other psychological mechanisms (e.g. cognitive heuristics and risk images) which are internalized through social and cultural learning and constantly moderated (reinforced, modified, amplified, or attenuated) by media reports, peer influences, and other communication processes” [ibid.].<sup>8</sup>

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<sup>7</sup> “Physical signals refer to direct observation by human senses and information refers to verbal and nonverbal exchange of messages about uncertain consequences of the substances or the event” [Renn & Benighaus, 2013].

<sup>8</sup> The different schools of psychological risk perception research are described in [Renn & Benighaus, 2013].

This definition makes clear that lay perceptions of risks of CO<sub>2</sub> pipelines noticeably differ from calculating individual and societal risks arising from the pipeline route proposed by performing a Quantitative Risk Assessment (QRA) [cf. Gough et al., 2014]. Lay person's risk perceptions of the Pilot Case can be either qualitatively explored or quantitatively assessed. In order to explore risk perceptions qualitatively moderated group discussions or qualitative in-depth interviews can be used, whereas representative polls can be performed in order to assess risk perceptions quantitatively (cf. Section 5).

In this context, it is advisable to differentiate between the perception of the personal risk, this means how risky the respondent think the Pilot Case would be to him and his family and the perception of the societal risk, this means how risky the respondent think the Pilot Case would be to society in general [Schumann, 2015, Schumann et al., 2014a]. For this purpose, respondents of a representative public opinion poll may be offered a seven-level Likert ranging from "1=very low risk" to "7=very high risk" (cf. Example 4). However, prior to this question, the respondents should be provided with information about the Pilot Case including positive, neutral and negative aspects of the project.

**Example 4: Question: "If CCS would be used in Germany, how risky do you think CO<sub>2</sub> transport via pipeline would be....."**

	1 Very low	2	3	4	5	6	7 Very high
(a) for you and your family?"							
(b) for society in general?"							

Source: Survey "CCS Chances"; cf. [Schumann, 2016b]

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In order to assess benefit perceptions among the public with regard to the Rotterdam Nucleus project, similar approaches can be applied: moderated group discussions or qualitative in-depth interviews for exploring benefit perceptions qualitatively and representative polls for measuring benefit perceptions quantitatively. For the assessment of benefit perceptions it should also be differentiated between the perception of the personal benefit, this means to what extent the respondent think the Pilot Case would benefit him and his family, and the perception of the societal benefit, this means to what extent the respondent think the Pilot Case would be to society in general. For this purpose, respondents of a representative public opinion poll may be offered a seven-level Likert ranging from "1=very low benefit" to "7=very high benefit" (cf. Example 5). Again, prior to this question, the respondents should be provided with information about the Pilot Case including positive, neutral and negative aspects of the project.

**Example 5: Question: “If CCS would be used in Germany in order to capture CO<sub>2</sub> from industrial processes, to transport and store it in onshore repositories or under the seabed, to what extent do you think CCS.....”**

	1 Very low	2	3	4	5	6	7 Very high
(a) would benefit you and your family?"							
(b) would benefit society in general?"							

Source: Survey “CCS Chances”; cf. [Schumann, 2016a]

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Beside risk and benefit perception, trust in relevant stakeholders<sup>9</sup> have been found to be a reliable predictor of the acceptance of new technologies [L’Orange Seigo et al., 2014]. This is particularly due to the fact that knowledge about new technologies among the public is very low. One way to cope with this lack of knowledge is to rely on trust to reduce the complexity of risk management decisions [Siegrist, 2000]. That is why trust in the developers of the Rotterdam Nucleus project will be a crucial factor for the perception among the citizens who will be affected by the Pilot Case.

Similar to risk and benefit perception, trust can generally qualitatively explored by moderated group discussions or qualitative in-depth interviews or quantitatively measured by public opinion polls. However, it is advisable to use qualitative methods in order to assess the trust in the project developers of the pilot case, because they allow exploring the levels of and the reasons for trust and distrust in more detail.

## **V Methods for assessing public perception of the Pilot Case**

In order to assess public perception of the Pilot Case, qualitative methods of empirical social research, quantitative methods of empirical social research or a mixed-method approach, i. e. combining qualitative or quantitative methods, can be applied. Furthermore, experimental approaches can also be useful for assessing public perception of the Rotterdam Nucleus project. In the following, the most frequently used qualitative and quantitative methods as well as experimental approaches are briefly explained.

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<sup>9</sup> Stakeholders are societal actors who have a professional interest in CCS [De Coninck et al., 2006, Shackley et al., 2009, Van Alphen et al., 2007]. Hence, mostly they are representing industry, NGOs, governments or research institutions.

## V.1 Qualitative methods

Qualitative methods of empirical social research which can be performed in order to assess public perception of the Rotterdam Nucleus project are mainly moderated group discussions or qualitative in-depth interviews. Moderated group discussions, also called “participatory group based techniques” [ter Mors et al., 2013] or “deliberative mini-publics” [Fischer-Hotzel & Schumann, 2016], comprise for example workshops, citizens’ panels, regional dialogues or focus groups<sup>10</sup> [cf. e.g. Ashworth & Gardner, 2006, Ashworth et al., 2006, Roberts & Mander, 2010, Shackley et al., 2004a, Shackley et al., 2004b].

The advantages of moderated group discussions for assessing public perception of the Pilot case are that lay people are informed about a topic with which they were previously unfamiliar, discuss it intensively, and form opinions on it during this discussion. In addition, group discussions also offer an opportunity to ask the experts who spoke about the topic directly for clarification. In order to enhance the trust in the process it is advisable that experts with different opinions regarding the Pilot Case are invited to the group discussions so that the information about the project cannot be evaluated as biased.

The disadvantages of moderated group discussions are that even a good moderator cannot always prevent situations where individual people do not form their own opinion but instead adapt their own views to conform to the assumed group opinion [Janis, 1972]. Furthermore, group discussions are disadvantageous in that the number of participants is usually very small<sup>11</sup>, which means that the findings cannot be generalized. Group discussions are therefore suitable for exploring the awareness, knowledge, initial attitudes, risk and benefit perceptions of lay people concerning the Pilot Case, but are rather unsuitable for identifying causal relationships between relevant influencing factors and attitudes towards the Pilot Case.

In-depth interviews can also be performed for exploring the awareness, knowledge and initial attitudes regarding the Rotterdam Nucleus Project. Usually, qualitative interviews can be open or semi-structured. Open means that the interviewer only asks a standardized initial question while the course of the interview is then determined by the interviewee’s response. Semi-structured interviews use a standardized set of questions and an open part [Gläser & Laudel, 2010].

The advantage of in-depth interviews are that initial attitudes, risk and benefit perceptions as well as trust in the project developers can be explored in more detail. The disadvantage is, similar to moderated group discussion, that the number of persons who can be interviewed

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<sup>10</sup> Focus group discussions are the most frequently used qualitative method to study public opinions and perceptions of CCS and are explained in more detail e.g. in [ter Mors et al., 2013].

<sup>11</sup> For example, a group of six to ten people is recommended for focus groups (cf. e.g. [Lamnek, 1995]).

is very small. This means that the findings of the interviews cannot be generalized for all residents who will be affected by the Pilot Case.

## V.2 Quantitative methods

Quantitative methods of empirical social research which can be employed for assessing public perception of the Pilot Case are standardized surveys. Standardized surveys include a set of closed-ended questions<sup>12</sup> posed to a sample of a certain population. In order to draw conclusions from statistical analyses of the samples of standardized surveys for the population it is necessary that the samples are representative, gathered by a random selection procedure. Additionally, the sample should include a sufficient number of respondents, which means usually a minimum of 1000 respondents. Such representative samples can be used to apply methods of descriptive statistics, inductive statistics and more complex, multivariate methods of statistical analysis, such as structural equation modelling (SEM).

The main statistical methods that have been used in CCS acceptance studies to date include descriptive statistical analysis (frequencies, means, standard deviations, correlations) regression analysis, analysis of variance (ANOVA), mediation analysis, and path analysis [Huijts et al., 2007, Miller et al., 2007, Sharp et al., 2009, Terwel et al., 2011, Tokushige et al., 2007, Wallquist et al., 2010]. The data basis for these statistical methods generally comprised the findings of standardized surveys.

A major advantage of using the findings of standardized surveys and the application of statistical methods for assessing public perception of the Pilot Case is that compared to group discussions a larger number of cases can be incorporated into the analysis. However, conventional opinion polls carry the risk to collect “pseudo-opinions” (cf. Section 3) if the self-reported awareness, subjective or factual knowledge about CO<sub>2</sub> transport is low among the participants of the survey. Therefore, survey instruments should be used in which respondents are provided with written information before they are asked for their overall opinion.<sup>13</sup>

## V.3 Mixed-method approaches

The possibilities for combining qualitative and quantitative methods for assessing public perception of the Rotterdam Nucleus project are manifold. Generally, it is possible to conduct first qualitative interviews or focus groups in order to get basic information about the awareness, knowledge, risk perceptions, benefit perceptions and initial attitudes regarding the pilot case among a small group of residents who will be affected by the Pilot Case. The results gathered by the interviews or focus group sessions can be introduced into a ques-

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<sup>12</sup> Closed-ended is a question for which a researcher provides a suitable list of responses which can be answered for example with “yes” or “no” or rated on a Likert scale e.g. ranging from 1 (=strongly disagree) to 7 (=strongly agree).

<sup>13</sup> “The most elaborate form of such ‘surveys of informed public opinion’ [...] is the information-choice questionnaire (ICQ) [...]” [ter Mors et al., 2013, p. 257], which is described in more detail in [ter Mors et al., 2013].

tionnaire for a representative survey of the citizens affected by the Pilot Case. This survey would be performed with the intention to investigate how awareness, knowledge, risk perceptions, benefit perceptions and initial attitudes are distributed across the affected regions and which factors determine the perception of the Pilot Case among the residents.

On the other side, it is also possible to perform first a representative survey among the residents in the regions affected by the Pilot Case with the intention to get information about the shapes and distributions of awareness, knowledge, risk perceptions, benefit perceptions and initial attitudes. The results of the survey would reveal which aspects should be investigated in more detail for getting more information for example which reasons are relevant for that project developers are trusted or not. For this purpose in-depth interviews would be one of the most suitable instruments.

#### **V.4 Experimental approaches**

Experimental approaches can be applied for assessing the public perception of the Pilot Case, particularly with the aim of examining and identifying processes which influence the trust of the affected residents without contaminating the target population for future communication [cf. Terwel, 2009]. With experimental designs it is for example possible to try different types of communication strategies and their effectiveness ahead of time, without interfering with the real-life decisions procedures concerning the Rotterdam Nucleus project [ibid.]. Furthermore, the major strength of an experimental approach in comparison to traditional surveys, focus groups or face-to-face interviews is, as emphasized by [Terwel et al., 2011], that it allows for conclusions about causal relationships between variables.

Experimental approaches can be employed in the lab [cf. e.g. Terwel, 2009] or via online tools such as representative online surveys [cf. e.g. Duetschke et al., 2014]. In both cases experimental conditions should be varied and participants should be randomly assigned to one of the varying conditions. The advantage of using online tools is that large samples can be realized which allows for more differentiated statistical analysis. Additionally, statistical analyses of the results of representative surveys, generated by an online experimental approach, allow for drawing conclusions for the population (cf. Section 5.2).

In CCS acceptance studies experimental approaches have been applied for example to investigate the influence of trust in stakeholders on the acceptance of CCS [Terwel, 2009, Terwel et al., 2011], the influence of stakeholder collaboration on the effectiveness of CCS communication [Ter Mors et al., 2010, Ter Mors, 2009], the effectiveness of different methods of communication [ter Mors et al., 2013] and the relevance of the type of CO<sub>2</sub> source, transport and storage location for the public perception of CCS [Duetschke et al., 2014].

## **VI Recommendations for performing the assessment of public perception of a Pilot Case for a European CO<sub>2</sub> transport infrastructure**

Based on the explanations and descriptions in this report, the recommendations for performing the assessment of public perception of the Rotterdam Nucleus project can be summarized as follows:

- The persons responsible for carrying out the assessment should be first of all aware that public perception and public acceptance are not the same. Public perception can be defined as the way in which an object or issue is regarded, understood, or interpreted, whereas public acceptance means passive or active approval of an object or issue. This means, that assessing public perception of the Pilot Case will provide information whether or not the project is positively perceived by the affected public which will be helpful during the siting of the project. However, a positive perception of the Rotterdam Nucleus will not automatically guarantee that it will be accepted by the affected citizens. This is due to the fact that the siting of the project will be a complex process during which, amongst others, procedural and distributive fairness will be important factors for the public acceptance of the Pilot Case [cf. e. g. L'Orange Seigo et al., 2014, Terwel et al., 2012].
- One of the first steps of the assessment of the public perception of the Pilot Case should be the assessment of the awareness and knowledge about CO<sub>2</sub> transport among the public affected by the project. This is relevant in order to assess whether people would express pseudo-opinions if they were asked about their attitudes regarding the Rotterdam Nucleus project. The assessment of the awareness and knowledge should be done by a representative survey of the affected public with the purpose of drawing conclusions for the populations in the respective regions.
- If the self-reported awareness, subjective or factual knowledge about CO<sub>2</sub> transport is low among the public which will be affected by the Pilot Case it will be essential to apply methods that allow for informing the public thoroughly about the Rotterdam Nucleus project, before measuring their attitudes, because otherwise pseudo opinions will be collected. For this purpose, moderated group discussions, qualitative in-depth interviews, survey instruments in which respondents are provided with written information before they are asked for their overall opinion or mixed-method approaches should be used.
- The systematic review of 30 existing studies on public perception of CO<sub>2</sub> transport which was carried out in order to identify which factors would be important for the public perception of the Pilot Case (cf. Deliverable D2.1 – Part 1), pointed out that it is very likely that the public perception of the Pilot Case will be influenced to a large extent by the risk perceptions, benefit perceptions and trust of the public who will be affected by the CO<sub>2</sub> transport network. Therefore, it will be indispensable to carry out an assessment of the risk perceptions and benefit perceptions regarding the Rotterdam Nucleus project as well as an assessment of the trust in the project developers and the siting process among

the citizens in the respective regions. For the assessment of the risk and benefit perceptions moderated group discussions, qualitative in-depth interviews, survey instruments in which respondents are provided with written information before they are asked for their overall opinion or mixed-method approaches should be used. For the assessment of the trust in the project developers moderated group discussions, qualitative in-depth interviews or experimental approaches would be more suitable.

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Leitung/Head: Prof. Jürgen-Friedrich Hake

Forschungszentrum Jülich

Institute of Energy and Climate Research

IEK-STE: Systems Analysis and Technology Evaluation

52428 Jülich

Germany

Tel.: +49-2461-61-6363

Fax: +49-2461-61-2540,

Email: [preprint-ste@fz-juelich.de](mailto:preprint-ste@fz-juelich.de)

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