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Lessons learned from a long term collaborative research process with a group of Dutch citizens: towards societally embedded CO_2 geological storage projects

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Contents

1 Summary – lessons learned from a long-term collaboration with a citizens' group in the Netherlands on CO_2 geological storage

As part of the EU project ENOS (Enabling Onshore CO_2 Storage in Europe), TNO has been responsible for setting up a long-term participatory research process with a group of citizens in the Netherlands. The main objectives of this collaboration were to gain better insight in the perspectives, questions and concerns of the citizens regarding the development and implementation of CO_2 geological storage, as well as to derive lessons for a better societal embeddedness of future CO_2 storage initiatives. In addition, the research has yielded valuable experiences on how to design and facilitate a long-term collaboration process with a group of citizens (May 2017 – December 2019).

The collaborative research process with the Dutch citizens' group took place in a changing policy context regarding CO_2 geological storage. At the very beginning of the ENOS project, there was an actual CO_2 storage initiative in the Netherlands (the ROAD project), which helped to explain the relevance of the collaboration process with citizens (Spring 2017). Nevertheless, this initiative was cancelled (June 2017) just before the kick off meeting with the citizens was going to take place (November 2017). This made it challenging to clarify the value of the collaboration. Later on, when the work with the citizens was ongoing, and after a few years of minimal CO_2 storage developments in the Netherlands, a new CO_2 storage initiative was launched (April 2018). Parallel to this, the role of CO_2 storage in the Dutch energy policy became manifest, as part of the negotiation process for the National Climate Agreement for the Netherlands.

Participatory research approach

The main research question for the collaboration process with citizens was: what can we learn from the questions, concerns and perspectives citizens have regarding CO_2 geological storage and how can we make use of these insights for a better societal embeddedness of future CO_2 storage initiatives?

In order to answer this research question, the following step-by-step participatory research approach was developed (figure 1.1):

Figure 1.1. Steps in the collaborative research process between a group of Dutch citizens and the ENOS social research team.

1. **Organizing commitment for ENOS research approach.** At first, the researchers who were going to set up the collaboration with citizens needed to organise internal and external commitment for their own work. Their management as well as employees from the Dutch Ministry of Economic Affairs knew little about the planned collaboration with a group of Dutch citizens within ENOS. They were wondering if the collaboration process could influence industrial developments regarding CCS, like the ROAD project in the Rotterdam area, in a negative way.
2. **Preparing information.** Prior to recruiting citizens, the EU partners in the ENOS team jointly composed a document with background information regarding the ENOS project and various technological oriented topics related to CO_2 geological storage[1].
3. **Recruitment of citizens.** To recruit citizens, the social research team reached out to an existing citizens association which was active in the development process of an actual CO_2 storage project in the Netherlands. A tailor made invitation letter was sent to all members of this association, resulting in a positive response of 10 citizens.
4. **Identifying interests of citizens.** The topics of interest to the citizens have guided the determination of the subjects discussed in the research program.
5. **Designing program series of citizen meetings.** Based on the identified interests TNO composed a comprehensive program with a logic order of topics.
6. **Organizing citizen meetings.** In two years 10 meetings were held with the Dutch citizens' group.
7. **Meeting reports.** Headlines of presentations, conversations and discussions among researchers, invited experts and citizens were captured in detailed meeting reports.
8. **Analysis and writing**. At the end of the series of meetings, an analysis was made of the questions, concerns and perspectives on CO_2 storage of the group of citizens.
9. **Validating outcomes.** A draft version of this report has been discussed with the group of citizens with the aim of validating the analysis and conclusions.

Two research principles were key during the set up and execution of the collaboration process: 1) an adaptive program for the series of meetings and 2) a reflective research approach.

Adaptive programming. The function of the adaptive programming was to stay flexible for new needs and insights, changing interests and new developments regarding CO_2 storage. This approach led to several adjustments in the programming of the series of meetings. The needs and interests of the citizens were leading in this process of adaptation (figure 1.2).

[1] Booklet 'Participating in CO_2 geological storage research' in four languages. See www.enos-project.eu

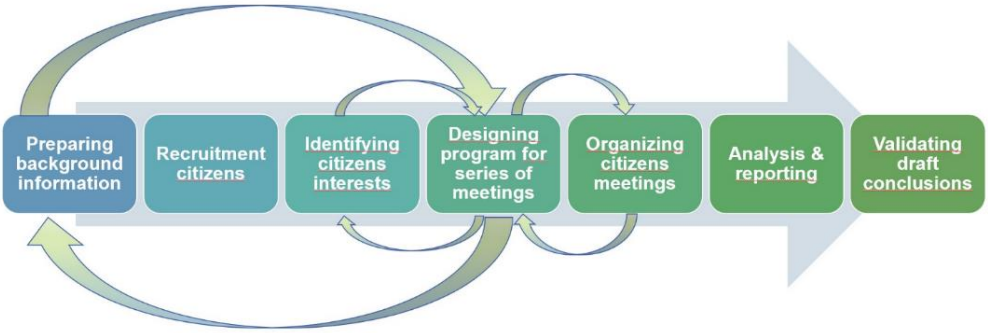


Figure 1.2. Iteration steps in the design of the program for the series of meetings with multiple feedback loops.

Reflective research approach. An important part of the research approach was the ongoing reflection on the research process and the collaboration with the citizens' group. This reflection was organized both with the European research partners of the ENOS project as well as within the TNO organization. In ENOS a specific task was dedicated to the coordination and joint reflection of the four country teams on the collaborative process with citizens in the UK, Italy, the Netherlands and Spain. The partners shared the different approaches, discussed and agreed the way forward, exchanged experiences and first findings. Within the TNO organization, the researchers who were responsible for the collaboration process with the Dutch citizens' group, initiated an interdisciplinary research team with TNO colleagues to jointly reflect on the set up of the citizens' group. The reflective research approach (figure 1.3) was meant to explore comparable approaches for the work with citizens in four countries without losing an eye on the local dynamics, which required tailored strategies.

Figure 1.3. During the participatory research process with Dutch citizens various reflection activities have been organized.

Experiences in the collaboration process with citizens

Reflecting on the collaboration process the researchers involved highlighted the following aspects that shaped and/or influenced the course of the collaboration: the characteristics of the citizens' group; the intensive preparations for each meeting; the adaptive programming; the changing policy context; and a new industrial CCS initiative in the Port of Rotterdam: Porthos. These aspects are described below.

Characteristics of the citizens' group. All participants were highly motivated and interested in collaborating with TNO in the ENOS project. Although the citizens were recruited from an existing and well-organized citizens association, they have all participated from a personal interest, not as a representative of the association. Several participants had a technical background in the oil and gas industry or shipping industry. All participants were highly educated. Several participants were societally and/or

politically active in their municipality. The majority of the group was retired. 80% was male and 20% was female. The participants were very eager to gain new knowledge and facts and figures regarding CO_2 geological storage. The group had a positive but critical attitude towards CO_2 geological storage. On the one hand, their understanding why CO_2 geological storage is needed in order to meet the Paris Agreement grew during the series of meetings. On the other hand, they had concerns regarding the operations of CO_2 geological storage projects as well as regarding the impact of CO_2 storage initiatives towards their environment. The participants were positive about the collaboration process within ENOS. They experienced curiosity and openness from the researchers involved towards their questions, concerns and interests.

Intensive preparations. Every citizens meeting was prepared carefully in order to optimally align the program to the questions and needs of the citizens (figure 1.4). The social research team shaped the basic agenda for the build-up of knowledge regarding the topic for that specific meeting, to optimally connect to the citizens' questions regarding the topic of the meeting, as expressed in previous meetings. Experts were selected who could provide the required information, based on their expertise and skills to communicate complex topics to a lay public. See figure 1.4 for all steps in the process for each citizen meeting.

Figure 1.4. Process of preparation – facilitation – reporting – organising follow up per meeting in the series of Dutch citizens meetings.

Adaptive programming. Meeting the needs and interests of the citizens was an important objective of the adaptive programming. Furthermore, the researchers involved thought it was important to have the opportunity to respond to new developments and actualities. Therefore, they were flexible to put forward new topics on the agenda during the series of meetings. At the start of every meeting the following steps were taken:

- Showing the citizens the overview with topics of their interest, as collected during the kick-off meeting;
- Asking whether the content of the program for the series of meetings still met their needs and/or new developments;
- Double checking if the program required changes in order to connect best to their needs and/or new developments.

In addition, the researchers involved took the flexibility to adapt the order of topics based on their own insights and experiences during the process.

Changing policy context. The collaborative research process with the Dutch citizens' group took place in a changing policy context regarding CO_2 geological storage. At the very beginning of the ENOS project, there was an actual CO_2 storage initiative in the Netherlands, which helped to explain the relevance of the collaboration process with citizens. Nevertheless, this initiative was cancelled just before the kick off meeting with the citizens was going to take place. The main argument was that there were no favourable circumstances in the Netherlands for the required investments in CO_2

storage. Later on, when the work with the citizens was ongoing, and after a few years of minimal CO_2 storage developments in the Netherlands, a new CO_2 storage initiative was launched. Parallel to this, the role of CO_2 storage in the Dutch energy policy became manifest as part of the negotiation process for the National Climate Agreement for the Netherlands. (figure 1.5).

Figure 1.5. Overview of events influencing the policy context regarding CO_2 geological storage.

The changing context was explicitly discussed in the citizens' group during an extra reflection session (February 2019). This reflection both enriched the program and helped to revalue the participative research approach: what is the value of the input of citizens within this changing context for developing CO_2 storage initiatives.

New industry project: Porthos. Halfway through the collaboration, the plan to develop a new CO_2 storage project in the Port of Rotterdam was introduced: Porthos, an initiative of the Port of Rotterdam, Gasunie and EBN. Although the collaboration between the citizens and the ENOS research team was based on the fictional situation that a new CO_2 storage project might be developed in the future - after all, the ROAD project had just been cancelled at the start of the collaboration and no prospect of a new initiative - this new initiative changed the nature of the questions posed by the citizens' group and the importance attached to ENOS research. It brought the conversations between citizens and researchers closer to reality. This led, among other things, to a strategy from the citizens' group to also want to share the insights from ENOS research with Porthos.

What Citizens like to know about CO_2 geological storage

Based on the inputs of the citizens during the kick off meeting, the social research team identified 8 clusters of interest:

- What is the role of CO_2 storage in the Dutch energy policy?
- How does CO_2 storage work in the subsurface? What happens in the subsurface?
- How is the safety of CO_2 storage guaranteed?
- What role does monitoring play in managing the risks of CO_2 storage?
- How are the costs and benefits of CO_2 storage distributed? Who pays?
- What does the communication process of new CO_2 storage initiatives towards citizens looks like?
- What roles do government, industries and citizens have during the development process of new CO_2 storage projects?
- What lessons can be learned from other (energy) projects regarding public acceptance and societal embeddedness?

These clusters have been translated in the following program for the series of citizens meetings (figure 1.6).

Figure 1.6: Planning and program of the series of citizens meetings, showing all topics of citizens' interests regarding CO_2 geological storage.

All questions, concerns and perspectives of the citizens which were collected during the 10 meetings have been captured into key insights. These key insights are described below, following the order of topics as part of the program for the whole series of meetings. The insights regarding the role of monitoring (meeting November 2018) and the approach for participatory monitoring (meeting June 2019) have been combined into one topic. Furthermore, 2 topics have been added to the list of key insights: insights regarding the new industrial initiative Porthos and insights on how the citizens experienced the collaboration and dialogues as part of the ENOS project.

Key insights regarding the role of CO_2 storage in the Dutch Energy Policy
The two questions most often posed by the citizens were 1) why is CO_2 storage necessary? 2) what alternatives are there to reduce CO_2 emissions? Answering these two questions at the start of the collaboration or dialogue with citizens contributed to a better understanding of the role and context of the technology. The understanding of this concept could be used and built on during the rest of the collaboration process.

Key insights regarding geological aspects of CO_2 storage: what happens in the Subsurface?
Most questions of the citizens were about the impact of CO_2 injection in the deeper subsurface. Where could CO_2 be stored in the deeper subsurface? Which criteria define which geological layer is suitable for CO_2 geological storage? And what are the risks of CO_2 geological storage? To make this complex story more tangible and visible for a lay public, various types of stone samples were shown to the citizens to visualize the required characteristics of different geological layers for CO_2 geological storage. We experienced that visualizing what happens in the deeper subsurface helped to create better understanding of geological processes.

Key Insights regarding how to Guarantee Safety of CO_2 geological storage
Remarkable in the conversations about the safety aspects of CO_2 geological storage was that the questions and concerns of the citizens were mainly about the ***governance***

and ***supervision*** of the safety aspects of CO_2 geological storage operations. On the one hand, this stemmed from the way the speakers structured their stories. On the other hand, this resulted from various negative experiences of the citizens themselves with the supervision of other geo-energy projects in their area. The questions of the citizens mainly focused on the capabilities and quality of the supervising authorities. Based on previous experience they question if the supervising authorities have up-to-date knowledge, since the technology has not yet been implemented on a large scale in the Netherlands *("how can they know what they don't know")*. Furthermore, the fact that different authorities are responsible for regulating the safety of CO_2 geological storage caused many questions and concerns. The citizens questioned how the fragmented legislative frameworks for licensing, implementation and monitoring of CO_2 storage projects contributes to monitoring safety and managing risks. For the citizens it was not clear when the responsibilities for the operation of CO_2 storage projects go from one authority to another, as a consequence of fragmented legislation.

Key insights regarding Risk management and the role of monitoring
Monitoring plays an important role in risk management. The design of a monitoring program for CO_2 storage projects is based on a thorough feasibility study on the geological characteristics of the deeper subsurface, which gives insight in the main risks and safety aspects of CO_2 geological storage at the foreseen location (gas field). The citizens concluded that experts seem to have sufficient knowledge to recognize and manage the technical, geological risks as well as to design an appropriate monitoring program to reduce the identified risks. Their concern was mostly with the operational risks of a project. How is the monitoring program executed and how are monitoring data used to improve the operations of a project? Who decides on this and when?

The citizens appreciated that they were offered a realistic and transparent presentation on the risks of CO_2 storage as well as the approach to deal with these risks. What contributed to creating trust among the participating citizens was showing the risks as well as events where things had gone wrong and what has been learned from these events in order to improve the operations of CO_2 geological storage.

In a second meeting about monitoring, the value of participatory monitoring was explored. The main research question in this meeting was if the citizens thought that an approach for participatory monitoring could be a way of including citizens' questions, concerns and perspectives into the strategy for developing a new CO_2 storage project. The citizens emphasized that their interest to be involved in the design and implementation of a monitoring program would increase when trust in the operators and/or authorities is low. When trust in the operators and/or authorities is not an issue, they had less interest to become involved. They would, however, like to have more insight in what happens with the collected monitoring data. Who takes the decision whether more or less CO_2 is injected? Or that a project is being cancelled? These questions connected to the use of data during the operation of a CO_2 storage project.

Key insights regarding Communication and Public Acceptance
The citizens emphasized that open and transparent communication is crucial for the societal embeddedness of a CO_2 storage project. They stated that poor communication and insufficient transparency on how the proposed project takes into account the questions, concerns and interests of local stakeholders, is harmful for creating trust in the initiators of the foreseen project. The citizens emphasized that they need the whole story. This includes transparency on the possible risks and the measures taken to

reduce and remove these risks. Based on their experience in their own local environment, the citizens emphasized that showing the impact of a project or activity on the environment as well as taking into account the interests of local stakeholders in the decision-making is necessary to create trust in the initiators and their decisions. They emphasized that the development and realization of energy projects requires an inclusive stakeholder process; all stakeholders who could be influenced by the foreseen project should be part of the stakeholder process. The openness of the invited experts about the possible risks of CO_2 storage, previous mistakes and the lessons learned was highly appreciated by the citizens. This gave them the feeling that no information was withheld and that they were given the true story.

Key insights regarding new knowledge gained by the citizens
At several moments in the process, the citizens were asked which new insights they had gained based on the presentations and shared information so far. Their participation in the ENOS project brought them many new insights about the necessity and the impact of CO_2 storage as well as the possible risks. The project has given them confidence in the expertise of the experts who were invited to share their knowledge in the citizens' meetings. The presentations of CCS experts during the meetings so far have learned them that an offshore CO_2 storage project could take place safely.

According to the citizens, the presented knowledge showed that the required techniques for CO_2 storage are already there and have been applied for years in the oil and gas industry. They learned that CO_2 geological storage makes use of techniques that have been applied for many years in other domains, like the oil and gas industry. In addition, the citizens expressed the belief that people who are confronted with CO_2 storage in their own local environment should proactively look for information on the technology in general and on the project in particular. The citizens emphasized that they strongly believe that if people acquire enough information, they will eventually realize that *"there are no other alternatives on the short term for reducing CO_2 emissions"*. One of the participants said *"At the start of the project I was sceptical; I now realize CO_2 storage is really needed, there is no alternative"*. The citizens emphasized that the safety of citizens should always be paramount in the development of geo-energy projects.

Key insights Who pays What? How are Costs and Benefits Distributed
Frequently asked questions were about the necessity to invest in CO_2 storage and what alternatives are available. The citizens noticed that CO_2 storage is not yet cost-effective and could only be realized with governmental subsidies. As a consequence, citizens will contribute to the investment in CO_2 storage projects (via the subsidies), whereas the industry benefits from the reduced CO_2 emissions and less CO_2 taxes. This means that citizens pay the costs and the industry enjoys the benefits. How could this be explained? The citizens expressed their need for more insight in the distribution of costs and benefits between different stakeholders involved. In addition, they would like to have more insight in how the business case of a CO_2 storage project is designed. Who pays and who benefits? Finally, they mentioned that the market for CO_2 emissions is a rather complex story. It would help to develop an understandable story about the different aspects that co-define the distribution of costs and benefits of CO_2 storage.

Key insights regarding Combining CO_2 storage with other Economic activities
The most important conclusion of the citizens was that the combination of CO_2 geological storage with other economic activities, such as buffering CO_2 for the horticultural sector in the Netherlands or the combination with oil production, could be

an important step in the upscaling of CO_2 storage. These projects could serve as small scale pilot projects, which would provide important experiences with the different techniques for CO_2 injection. The citizens emphasized the importance of a step by step learning process starting with small scale pilot projects without immediate large-scale application of the technology (quote of one of the participants: *"large projects large mistakes; small projects small mistakes"*). In addition, the citizens had the impression that there is little incentive for the industry to reuse CO_2; emitting the CO_2 remains the cheapest alternative on the current CO_2 market. However, when emitting CO_2 becomes more expensive in the future, CO_2 buffering and reuse might become more interesting. The citizens were positive about the combination of CO_2 storage with other activities; although they emphasized that it differs if CO_2 storage is reused for the horticulture sector or combined with oil production. The assumption of the citizens was that buffering CO_2 for reuse in the horticultural sector would be more successful for creating public acceptance than the combination with oil production with the objective to produce more oil.

Key Insights regarding a new CCS Initiative: Porthos

Halfway the long-term collaboration process with the Dutch citizens, a new CCS initiative in the Netherlands was launched. As a consequence, the conversations about the various aspects of CO_2 geological storage became intertwined with the development of this new CCS initiative. The most important questions of the citizens with regard to this initiative were on 1) the scale of the project and to what extent the project would support the possibility to learn and to work via smaller intermediate steps towards a large-scale project (*"learning from small intermediate steps seems to be skipped with this initiative"*) and 2) the distribution of costs and benefits and who pays what. Last, the citizens expressed the need for more clarity on how safety was going to be monitored and guaranteed as well as more insight in the business case of the Porthos initiative.

Key messages regarding Collaboration and Dialogue with citizens

Two important, returning questions were *"what will happen with all the input and questions you get from us?"* and *"who will benefit and learn from all that we share here and the insights we develop?"*. The answer to this question became gradually more concrete as the collaboration progressed. For example, 1) through the meetings with the stakeholder management team of the Porthos project as well as 2) through the contributions of the ENOS social research team to a new policy project of the Ministry of Economic Affairs aiming at drawing recommendations for industries and governments to improve engagement with societal stakeholders as well as the societal embeddedness of new CO_2 storage projects. Both parallel initiatives contributed to the motivation of the citizens to see that the insights from the ENOS project were of value in different contexts.

In addition, the citizens emphasized that answering their questions should not only be rational and factual but also be focused on the emotion behind the question "*irrational questions don't have a rational answer*". Show interest in the question behind the question, what makes this question so important to the person asking the question? During the collaboration the citizens experienced sincere curiosity of the social research team in their questions and perspectives regarding CO_2 geological storage. *"I never had the feeling that we were facing each other; in practice that is often the case"*.

Societal impact of the ENOS research

Given the fact that previous CCS initiatives in the Netherlands (i.e. in Barendrecht as well as in the North of the Netherlands) have faced strong opposition from society, CCS is a societally and politically sensitive topic. This history caused the ENOS research with citizens got immediate attention both from the TNO management and from the Ministry of Economic Affairs. At the start of the ENOS project, they had little knowledge on what the focus was of the collaborative research with citizens, how the social research team was going to set up the collaboration with citizens and how the ENOS research could support (or hinder) ongoing industrial CCS developments in the Netherlands. Therefore, the social research team organised several conversations with both their management and the Ministry to introduce the ENOS project and to jointly explore how the ENOS project could be of value for industrial developments and/or policy processes. This exchange led to the active support and involvement of both stakeholders.

The social research team and a small group of policy advisors regarding CCS from the Ministry of Economic Affairs met on a regular basis, to inform each other about the progress of the ENOS project and new policy processes. This exchange led to two spin offs of the ENOS research: 1) interaction between ENOS social research team (Netherlands) with the stakeholder management team of the Porthos project (Summer 2018) and 2) the contribution of the ENOS social research team to a new policy process of the Ministry of Economic Affairs for developing strategies for industries and governments aiming at improving the societal embeddedness of future CO_2 storage projects (Spring 2019).

Best practices towards a better societal embeddedness of CO_2 geological storage projects

Four clusters of best practices have been identified:

1. How to set up a collaboration process with citizens?
2. Societal requirements to be taken into account in the development of future CO_2 storage research and projects' implementation.
3. What industries and governments could do during the different phases of development, implementation and operation of a CO_2 storage project to improve the societal embeddedness of a project?
4. Basic principles for citizens engagement based on the collaboration experiences with Dutch citizens in ENOS.

1. How to set up a long term collaboration process with citizens?

The experiences from the collaboration with the Dutch citizens' group as part of the ENOS project show that setting up a **long-term collaboration** with citizens and **creating confidence** in decisions require:

- Development of a step-by-step approach for organizing and facilitating a long-term collaboration process with a group of citizens, tailored the local situation and local (stakeholder) dynamics
- Joint identification of clusters of interest as a basis for the key topics on the agenda
- The joint determination of (the topics on) the agenda.
- That questions, concerns and interests of citizens are leading in this.
- A flexible and adaptive programming for the agenda for (the series of) citizens meeting(s) in order to be able to respond to new developments

- Careful design of the process for each meeting, including preparation – facilitation – reporting – follow up activities.
- An optimal connecting between the level of knowledge of citizens and the way information is presented.
- Openness about insecurities and possible risks.
- Transparency in the considerations and final decisions.

2. Societal requirements to be taken into account into future CO_2 storage projects

The collaboration with the Dutch citizens' group as part of the ENOS project provides insight into **the topics that** CO_2 geological storage research and projects' developers need to address to meet the needs of local communities. The following **societal requirements** have been derived from all inputs of the Dutch citizens' group. Citizens ask for:

- Clarity about the value and necessity of CO_2 geological storage within the context of the Dutch energy policy as well as possible alternatives to reduce CO_2 emissions.
- Clear explanations about to what extent a CO_2 geological storage project contributes to reducing CO_2 emissions.
- Comprehensive communication about possible risks ('the true story') and which guarantees are built in to minimize risks and to guarantee safety.
- Transparency of the process for choosing a site location for CO_2 geological storage; what is taken into account? which criteria are leading in choosing a site?
- Supervision of the implementation and operation of CO_2 geological storage projects to ensure safety.
- Information on how monitoring data is used to improve the operational execution of projects and to decrease the risks.
- A step-by-step approach towards large scale implementation of the technology; what can be learned from small scale projects?
- Insight in how authorities and operators learn from previous projects and experiences, and how these learnings help improving the regulations and monitoring procedures.
- Well prepared regulators, ensuring their knowledge is up to date.
- Open and transparent communication by authorities and operators on the impact of the project towards environment and society.
- Opportunities for solid knowledge build-up in order to better understand the technology as well as to form a well-informed opinion.
- Transparency on the choices concerning the distribution of costs and benefits and their effect on the identification of investments in the intended CO_2 geological storage project

3. What could industries and governments do to improve societal embeddedness of a CO_2 storage project?

- Show real interest in questions, concerns and perspectives of citizens. "*In reality we often face each other. That does not help*", as one of the citizens in the Dutch citizens' group said.
- Give sincere consideration to citizens' input to enrich and improve the project strategy or design.
- Be transparent in how citizens' input will be used in the project strategy and/or project design.
- Strive for a successful societal embeddedness of the foreseen project.

- Take into account citizens' questions, concerns and perspectives while developing a monitoring program
- Share information in an open and transparent way.
- Provide insight in how decisions are made.
- Calculate budget for stakeholder management as part of the project strategy.

4. Basic principles for citizens engagement based on the experiences in ENOS.

- It is important to openly discuss and clarify what the influence of citizens engagement will be on the overall project strategy. What level of participation is foreseen? How will their input be taken into account in the project development?
- It would help creating a better societal embeddedness of the project if questions, concerns and perspectives of citizens would be identified in a very early stage of the project development, in order to make sure that also societal questions will be taken into account during the feasibility studies and design of the project strategy.
- Be open about unforeseen circumstances or events at/near the project site as well as about measures how to overcome these and to prevent that these might happen again.
- Citizens have the need to be heard; they want their questions and concerns to be taken into account seriously.
- Citizens have local knowledge and experience, which could be valuable to improve the societal embeddedness of the project and to better shape the project in its societal and environmental context. They often experience the opposite "We often face each other".

Conclusions and main reflections

The 2-year collaboration with the Dutch group of citizens has been an interesting and valuable journey. Getting started with the collaborative research was a challenge in itself, as many stakeholders in the Netherlands have lively memories of the dynamic societal debates regarding previous CCS developments. Another interesting learning process was how to connect the research objectives from the ENOS project to the needs and interests of the citizens' group. The adaptive way of working and programming brought two advantages: 1) drafting the program for the whole series of meetings offered a certain predictability to the citizens and 2) we kept flexible for tailoring the programming to new dynamics within the citizens' group or their local environment. Another challenge in the collaboration process with the Dutch citizens' group was how to stay independent and at the same time share the insights from the ENOS project with other stakeholders in order to make use of these insights for new CCS initiatives. The collaborative approach based on an open exchange and honest recognition of all inputs, helped us to find a way to share the learnings from the citizens' meetings in a satisfactory way for all. Finally, working with the Dutch group of citizens taught us a lot about how to create an open and in-depth dialogue with citizens who are very active in following new developments and protecting their local environment from unsustainable developments and/or unfair decision-making processes. Our main reflection based on all inputs from the citizens and experiences with the collaboration process is that developing societally embedded CO_2 storage projects only partly depends on the technological aspects of CO_2 storage. It also relies on the impacts of the foreseen CO_2 storage project on the local environment, on supportive and transparent energy policies and regulations, on the approach for stakeholder engagement and last on the distribution of costs and benefits.

2 Introduction

ENOS. Since September 2016, TNO has been involved in the European research project ENOS, an acronym for 'Enabling Onshore CO_2 Storage in Europe'. A research project on the onshore possibilities for CO_2 geological storage in Europe. ENOS wants to contribute to the development of CO_2 storage from different perspectives. The research in ENOS is focused on the technical, economic and social questions related to CO_2 storage. ENOS is financed by the European Commission. 29 European research institutions, including TNO, participate in the project. Within TNO different research groups participate in the ENOS project, starting from various backgrounds, disciplines and knowledge areas.

The social research team Environmental Planning of TNO's department Strategy and Policy has been responsible for setting up a long term participatory research process with a group of citizens in the Netherlands. This participatory research took place from autumn 2016 up to December 2019. The main objective of the collaboration with the Dutch citizens' group was to learn from their questions, concerns and perspectives regarding CO_2 geological storage, contribute to the development of ENOS best practice guidelines for the implementation of CO_2 geological storage and thus improve the societal embeddedness of future CO_2 storage projects.

CO_2 storage in the Netherlands. The Netherlands has a strong research portfolio on CO_2 Capture Transport and Storage. An important research programme to build-up knowledge for accelerating CO_2 geological storage projects is the Dutch national research programme CATO, the acronym for CO_2 Afvang, Transport en Opslag, which is Dutch for CO_2 capture, transport and storage. The CATO1 program ran from 2004 - 2009, followed by CATO2 from 2009 – 2014 and several new national and European research programs on CCS under the umbrella of CATO3 since then. In CATO-1, 17 participating parties from industry, research institutes, universities and NGOs had established a knowledge platform, providing a leading position of the Dutch programme in the international community. CATO2 aimed to underpin Dutch participation in international research communities, such as the European Technology Platform for Zero Emission Power plants (ETP-ZEP). Moreover, CATO-2 was expected to provide the basis for realising two large-scale CCS[2] demonstrations in the Netherlands by 2015 - as was the goal formulated back in 2009.[3] The development and implementation of these large-scale CCS demonstration met many difficulties, mainly because of strong societal opposition and the lack of a straightforward energy policy regarding CCS.[4] As a result of these difficult societal dynamics, the national government made the decision to mainly focus on offshore CO_2 storage projects. This history with many polarized societal debates made that the work with citizens as part of the ENOS project soon had the attention from several stakeholders in the Netherlands. Both authorities and industries had questions about the value of the ENOS project for new CCS developments in the Netherlands and how these developments could benefit from the

[2] CCS: CO_2 Capture and Storage

[3] www.co2-cato.org

[4] B. van Engelenburg and H. Puts (2013). Definitieve leergeschiedenis van het CO_2 opslag initiatief in Noord Nederland. Resultaat van CATO2 onderzoek naar het verloop van het besluitvormingsproces van het CO_2 opslag initiatief in Noord Nederland. (Translation: Learning History of CO_2 storage initiatives in the North of the Netherlands. Lessons learnt from the decision making process through the perspectives of multiple stakeholders involved; final report of a research project as part of the CATO2 program).

insights of ENOS. Especially, because there was a running CCS initiative along the Dutch coast (the ROAD project) at the time the TNO team was going to kick off with the Dutch citizens' group as part of the ENOS research. Therefore, the researchers who were going to set up the collaboration with citizens first needed to organise internal and external commitment for their ENOS activities. Their management as well as employees from the Dutch Ministery of Econmic Affairs were wondering if the project could influence industrial developments regarding CCS in the Netherlands in a negative way. After the ENOS researchers introduced the aim of the work with citizens and how they were going to approach the collaborative research both the TNO management and the Ministry of Economic Affairs better understood the potential value of the ENOS research.

CO_2 storage in the Rotterdam area. The existence of a running CCS initiative in the Rotterdam area, the ROAD project, helped to recruit citizens for the collaboration process within ENOS and to explain the relevance of collecting input from citizens regarding the societal aspects of CO_2 geological storage.

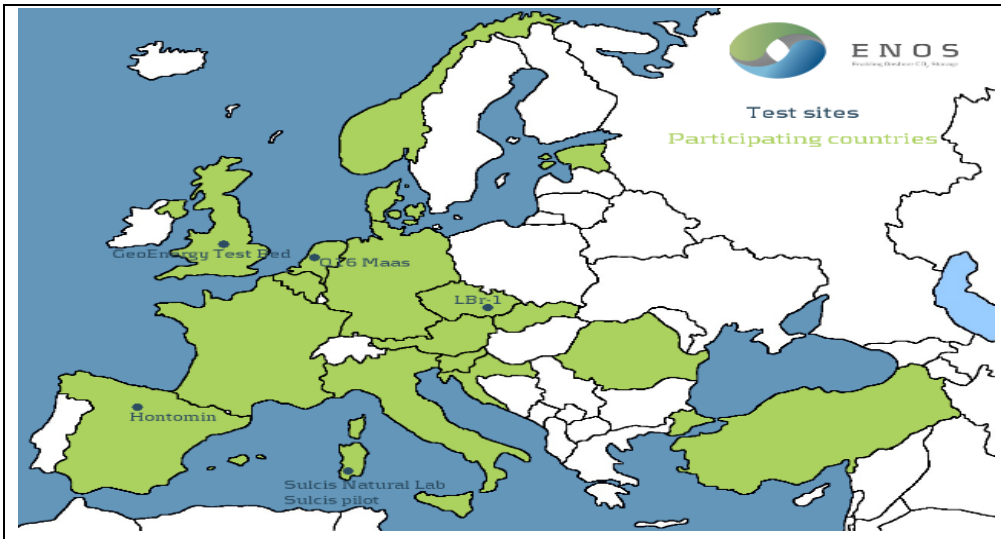
Changing societal context. However, the ROAD project was cancelled (June 2017), right after a group of 10 citizens had responded positively on the invite to participate in the ENOS project. This made it more challenging to clarify the value of the collaboration. Luckily, the cancellation did not change the interest of the citizens to participate in the ENOS project. Later on, when the work with the citizens was ongoing, and after a few years of minimal CO_2 storage developments in the Netherlands, a new industrial CO_2 storage initiative in the Port of Rotterdam was launched (April 2018). Parallel to this, the role of CO_2 storage in the Dutch energy policy became manifest, as part of the negotiation process for the National Climate Agreement for the Netherlands.

RESEARCH AREAS WITHIN THE EUROPEAN RESEARCH PROJECT ENOS[5]

The following research activities are carried out within ENOS:

1. Better strategies for monitoring CO_2 behaviour: protecting the environment and groundwater.
2. The development of safe CO_2 storage sites.
3. Reducing risks to an acceptable level.
4. Contribute to reducing CO_2 storage costs.
5. Explore how CO_2 storage can bring economic benefit in addition to reducing CO_2 emissions.
6. Improve the concept and practice of CO_2 storage monitoring.
7. Helping people to be informed and to follow the development of a storage pilot.
8. Managing the complexity of CO_2 storage through modelling.
9. Fostering international cooperation on CO_2 storage.
10. Increasing the preparation of researchers and professionals in the field of CO_2 geological storage.

[5] For a full illustration see ENOS info pack "Participating in CO_2 Geological Storage Research" http://www.enos-project.eu/participating-in-co2-geological-storage-research/



Figuur 2.1. Overview of EU member states participating in the ENOS research project

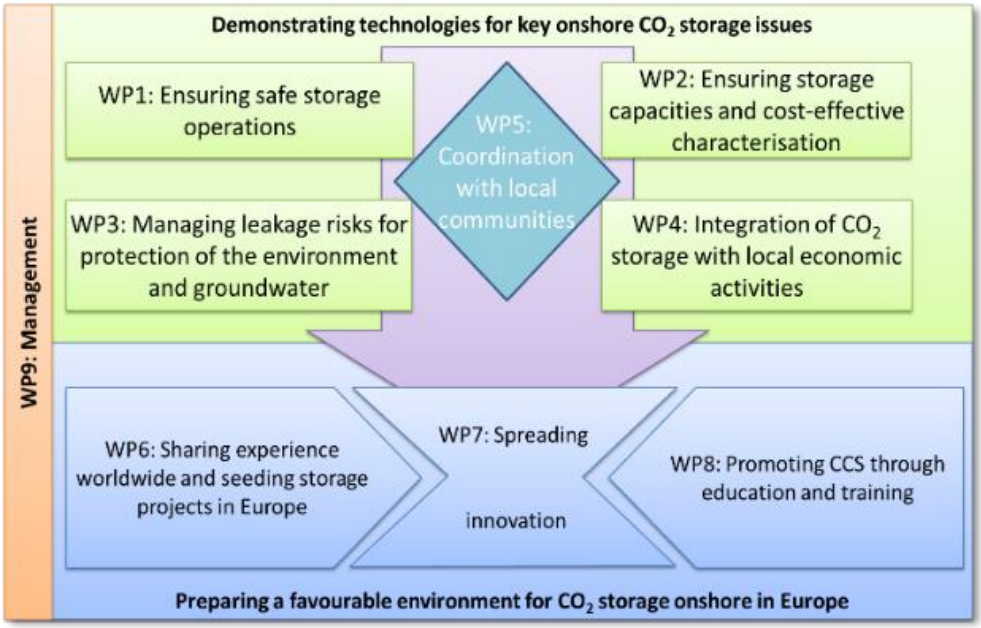


Figure 2.2. Overview of how all ENOS research topics are organized and interlinked. The collaboration with the Dutch citizens' group is part of work package 5 'coordination with local communities'

See www.enos-project.eu for more information on the research project.

How to read this report. This research report presents the outcomes of a 2-year collaboration with a group of Dutch citizens on identifying the main questions, concerns and perspectives of these citizens regarding CO_2 geological storage. Chapter 3 elaborates how the participatory research approach was designed. Chapter 4 presents the experiences with the collaboration process with the Dutch citizens and chapter 5 gives insight in what citizens like to know about CO_2 geological storage and the key messages they defined per topic. Chapter 6 describes best practices for improving the societal embeddedness of future CO_2 geological storage projects. And chapter 7 gives insights in the main conclusions of the research team involved in the collaboration process with the Dutch citizens' group.

3 Participatory Research Approach

First of all, this chapter provides a description of the research approach for entering into a long-term cooperative relationship with a group of citizens in the Netherlands (3.1). In addition, the chapter shows the time planning of the different research activities (3.2).

3.1 Collaboration process with citizens

ENOS. The objective from the ENOS research project was to build a long-term collaborative relationship with a group of citizens with the aim to:

- Collect questions and reflection of citizens about the different (technical) research subjects studied in ENOS.
- Learning from the input of citizens for future and current research and commercial CO_2 storage projects.
- Formulate recommendations for improving the societal embeddedness of future CO_2 storage initiatives based on input from meetings with citizens.

In ENOS, participatory research with citizens is planned in four European member states (UK, the Netherlands, Italy and Spain). The basis of the research approach in the four cases is comparable. In addition, each national research team has developed tailor-made approaches to their national context and local dynamics. This report is about the approach and results of the Dutch case.

Dutch case study. The collaboration process with the Dutch citizens' group has been organized via a step-by-step participatory research approach, consisting of the following steps:

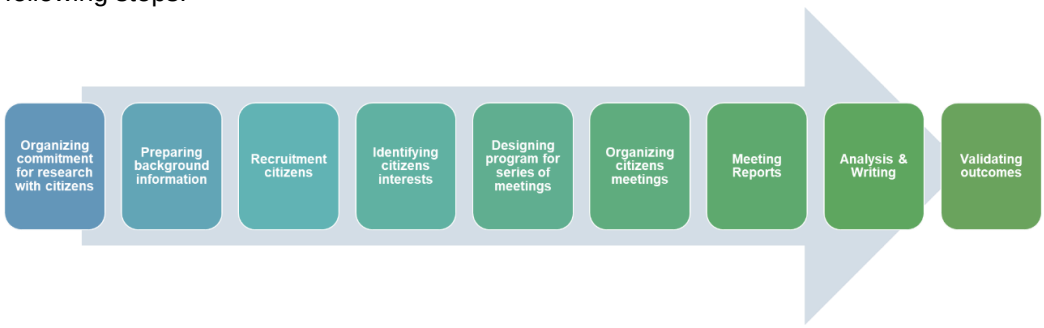


Figure 3.1. Steps in the collaboration process with a group of Dutch citizens around CCS

1. **Organizing commitment for ENOS research approach.** At first, the researchers who were going to set up the collaboration with citizens (from here: 'the social research team') needed to organise internal and external commitment and support for their own work, both within their own organisation (TNO) and within the Dutch Ministry of Economic Affairs. Both their own management and the responsible policy advisors on CCS at the Ministry Of Economic Affairs knew little about the purpose and design of the collaborative research process with a group of citizens within ENOS. Furthermore, they were wondering if the project could influence industrial developments regarding CCS in the Netherlands in a negative way. After an informative meeting in which the social research team introduced the objectives and approach of the work with citizens, the value of the ENOS research was better

recognized and understood. Last, the appointment was made that communication experts of both organisations would support the social research team in providing facts and figures on CCS towards the citizens.

2. **Preparing information.** As a preparation of the collaboration with citizens, the EU partners in the ENOS team jointly composed a document with background information regarding CCS and the various research areas in the ENOS project[6]. This document was produced through an iterative process with an interdisciplinary team of experts; the experts were all involved in the ENOS research project. Factual accuracy was central; as well as the objective to present information. After the experts agreed on the content of the document, the text was reviewed by lay people with little or no knowledge of the subject (colleagues and citizens). Consequently the text was published in four languages to be used in the four case studies in which collaboration processes with citizens were planned – besides a case study in the Netherlands, there were also citizens' groups planned in United Kingdom, Italy and Spain. For the Dutch case study a context specific introduction was written, in line with the Dutch CCS policy and actualities regarding the ROAD project which was in development during the recruitment of the Dutch citizens in the Rotterdam area. For the Dutch translation an external copywriter was asked to turn the technical text into lay terms to ensure that a lay public would be able to understand the complex content.

3. **Recruitment of citizens.** For the recruitment of a group of 10-12 citizens, the TNO team decided to reach out to existing citizen initiatives. There were multiple options, mainly citizen initiatives connected to large geo-energy projects or infrastructural developments. The decision was made to contact the citizens' group that was also active regarding the development of the CO_2 storage project 'ROAD', in the Rotterdam area. The TNO team contacted the stakeholder manager of the ROAD project and asked if he was open for introducing the ENOS project to the citizens he was working with. His suggestion was to connect the social research team to the board members of this citizen initiative, the so-called 'Association of Worried Citizens Voorne' (in Dutch: Vereniging Verontruste Burgers Voorne (VVBV)). After a first introduction to the board of this association, the TNO team sent out an invitation letter to all members of this Association asking who would be interested in collaborating with TNO in the ENOS project[7]. This resulted in the recruitment of 10 citizens from Voorne (an island within the Province of South-Holland in the Netherlands).

4. **Identifying interests of citizens.** During the kick off meeting of the collaboration process with the citizens, the social research team and the citizens explored the fields of interest of the citizens regarding CO_2 geological storage. The main question was: what would you like to know about this subject? The inventory yielded a number of topic clusters. These were leading in determining the content of the research program.

5. **Designing program series of citizens meetings.** The social research team which was responsible for designing and facilitating the collaborative process with citizens, invited a few colleagues with different backgrounds and expertise regarding CCS to jointly determine the content of the series of meetings with the

[6] Booklet "Participating in CO_2 Geological Storage Research", in four languages. See www.enos-project.eu
[7] The invitation letter can be found in Annex 1.

citizens. The researchers in this interdisciplinary team brought forward experience in the following fields of research and CCS development: monitoring of CCS, coordination of (inter)national public-private research programs on CCS, reservoir modelling, implementing the Dutch Mining Law, stakeholder engagement, public policy mediation, legal aspects of CCS and public communication. This interdisciplinary team drafted a logical sequence and combination of topics regarding CCS. For drafting the program for the series of citizens meetings, the citizens' interests were matched with the research topics of the ENOS project.

6. **Organizing citizens meetings.** 10 citizens meetings in total were held with the Dutch citizens' group, the 1st meeting in November 2017, the last one in December 2019. Organizing each meeting has been a careful process, starting with drawing the basic agenda for the build-up of knowledge regarding the topic for that specific meeting for the meeting, followed by the invitation of experts[8], joint preparation of presentations and selection of approaches for facilitating the dialogues. Each meeting was evaluated by the citizens by filling in a questionnaire, at the end of the meeting.

7. **Meeting Reports.** Headlines of discussions as well as questions, concerns and perceptions of the citizens were captured in a detailed meeting report for every meeting. The reports have been written based on notes of the social research team and their memories. No transcripts have been made. The reports reflected what had been discussed and shared during the meetings. Questions and remarks of the citizens have been captured literally as much as possible. Summaries of the 'stories' (or presentations) of the invited experts were also included. As so, these reports served as research data for the social research team for the final analysis of all inputs. Furthermore, these reports also served as background documents for the citizens. The social research team composed draft versions of each meeting report. Experts who contributed to the meeting reviewed the reports, to check if the presented facts and research developments had been captured correctly. In addition, each meeting report was reviewed by a strategic communication expert from TNO as well as by a policy maker on CCS from the Ministry of Economic Affairs. This additional review was one of the outcomes of the first steps in the research process: 'organizing commitment for ENOS research approach'. This review role strengthened their interest and involvement in the research process. The aim of these additional reviews was to support the social research team and to contribute to the clarity and correctness of formulations, given that the topic is highly sensitive in the Netherlands and previous CCS initiatives led to highly polarized societal debates. Therefore, everyone was keen on sharing correct information. The strategic communication expert from TNO mainly focussed on how things were being formulated, to avoid any ambiguity; the policy maker from the Ministry made a check on facts and figures. The research coordinator ensured that questions and concerns as posed by the citizens were not changed or adjusted by the communication experts. The last and final review was done by the citizens themselves, to check if the social research team captured their views in the right way. In the end the citizens decided on approval of the meeting reports, so it could then be taken in as research data for the ENOS project.

[8] Annex 2 gives an overview of all experts involved in organizing the citizens meetings

8. **Analysis and writing.** At the end of the series of meetings, an analysis was made of the questions, concerns and perspectives about CO_2 storage of the group of citizens. In addition, the collaboration process has been analysed. This report reflects the main lessons learned, conclusions and recommendations of the collaboration process with a group of citizens.

9. **Validation outcomes.** The final step in the collaboration with the group of citizens was the validation of the outcomes of the analysis made by the social research team. Therefore, the social research team presented draft outcomes of the analysis and asked the citizens to reflect on the draft conclusions and recommendations and to improve or sharpen them were needed.

Adaptive Programming

The content of the series of the 10 meetings has been open for sharpening and adjusting throughout the collaboration process, depending on the changing interests of the citizens or new developments regarding CO_2 geological storage. The first characteristic of participatory research in ENOS is the adaptive programming (figure 3.2).

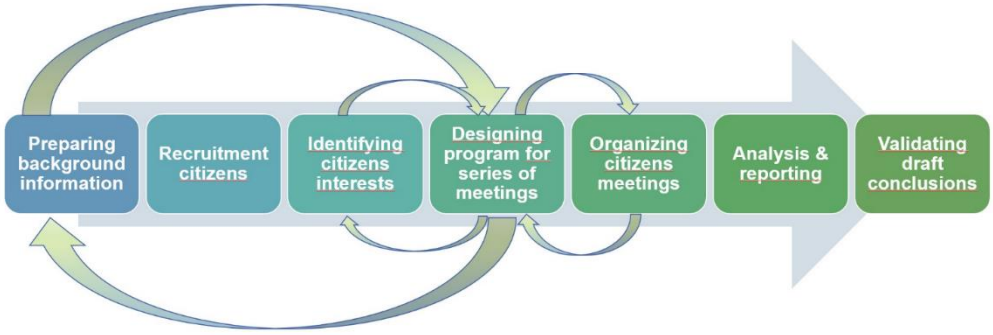


Figure 3.2. Iteration steps in the collaboration process with citizens with multiple feedback loops.

The first feedback loop was the continuous validation with the citizens' group whether the content of the program was still reflecting their interest and was still in line with the current events. And if not, the determination what changes were required. The second feedback loop was the reflection by the social research team on every individual meeting and the current developments around CO_2 geological storage. The content of the program has therefore been adjusted at a number of moments in the collaboration process.

The last feedback loop was the information provision to the citizens. Frequently, the questions and conversations in the meetings showed new information needs among the citizens. The social research team attempted to facilitate these information requests in different ways: adjusting the content of the meetings, inviting experts on the topics of interest but also by for example sharing available publications, bringing interesting events about CO_2 storage to the attention of the citizens and opening up their own network.

Reflection on the research

A second characteristic of participatory research in ENOS is the structured reflection process on the approach and the applicability of preliminary results from the collaboration with the citizens. See figure 3.3 below.

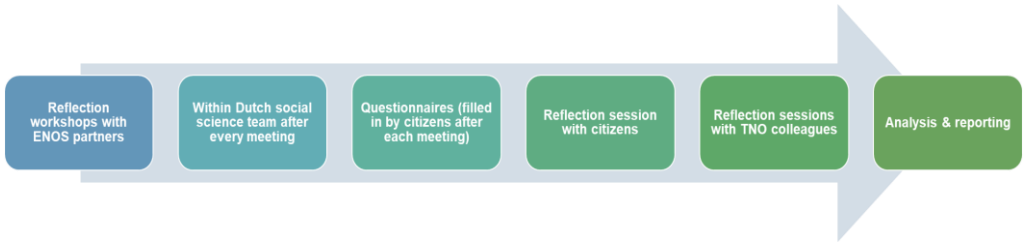


Figure 3.3. Structured reflection process to support the participatory research with citizens.

Between the European partners participating in ENOS. The participatory research is carried out in the context of ENOS WP5, where the four country teams engaged with citizens and also several other technical partners participated. Reflection on research took place both at the level of the country teams and with the other partners. The international team of Italian, Spanish, British and Dutch experts on communication, stakeholder involvement and social embedding of CO_2 storage met at an initial two days' workshop to discuss and coordinate the research approach. Subsequently monthly phone calls, two days workshops and other in-person meetings with all WP5 partners provided the opportunity for constant exchange, discussion and reflection on the research development and on insights from the citizens meetings.

Within the Dutch social research team. The social research team that shaped and guided the collaboration process with the citizens' group evaluated each meeting afterwards. How did it go? Did the information that was provided match the needs? Was the program of the meeting as intended? Were there enough opportunities for the citizens to ask their questions? What can we do differently next time i.e. content, working formats, interaction or conversation techniques? And also: what aftercare was needed towards the citizens?

By citizens via Questionnaires. The Dutch social research team was responsible for designing a citizens questionnaire, to collect feedback from the citizens after each meeting on their experiences and insights gained during the meeting. These questionnaires were developed in collaboration with the international research team that was involved in research with citizens. The purpose of the questionnaire is to 1) give citizens the opportunity to provide feedback anonymously; 2) to be able to better prepare each (next) meeting on the basis of feedback received; 3) to compare the course of the collaboration process and the learning curve of citizens between the four cases.

Reflection meeting with citizens. After a number of meetings with the citizens on various aspects of CO_2 storage, the citizens drew their own story about CCS and highlighted the most important questions from the perspective of the resident in a reflection meeting. The question for drawing their own story was "what would you tell your neighbours and friends what they should know about CO_2 storage in case a new CCS project would be developed in your local environment?". The stories gave a good view on the knowledge and insights acquired up to then by the citizens, as well as the most important questions and concerns that this group of citizens (up to then) had identified.

Reflection with fellow TNO researchers. The social research team frequently organized reflection moments with an interdisciplinary team of TNO experts. These moments were used to discuss the progress of the collaboration with the Dutch group

of citizens and to reflect on the insights that resulted from the collaboration and the value of these insights to current and future research projects.

Analysis and writing. The analysis of the collected insights were discussed in intermediate steps, in various compositions; first of all within the social research team that has collaborated with the group of citizens for 2 years; within the international ENOS team that was involved in participatory research with citizens in four countries; and also within an international network of social science experts who also conduct research into CCS. This report represents the outcomes of the analysis for which the conversations within the different groups of (inter)national researchers brought valuable insights and suggestions.

3.2 Time Lines

The participatory research process with the Dutch citizens' group was a complex process which required and led to interaction not only with the citizens but also with policy and industry stakeholders. To give insight in the different 'environments of interactions', we will distinguish five areas of work: the international collaboration with the ENOS partners, the meetings with the citizens, the meetings with the Ministry of Economic Affairs, the information exchange with the stakeholder management team of the Porthos initiative in the Port of Rotterdam and a new policy process to which we were invited to contribute – that developed strategies for both government and industries – to improve the societal embeddedness level of new CCS projects in the Netherlands.

These five types of contacts and relationships are clarified below as well as the timelines for the meetings with these different contacts. The timelines show how these different relationships interacted with the ENOS research process.

International collaboration ENOS partners. The ENOS research started in the fall of 2016. The information phase ran from fall 2016 to fall 2017. Exchange between the ENOS partners took place via e-mail, via monthly teleconference calls with the researchers involved in the citizens work and via face-to-face 2/3 days meetings and workshops. Reflection on the research took place throughout the length of the research process.

Collaboration process Dutch citizens. Recruiting the citizens for the collaboration with TNO in ENOS was started in spring 2017 and resulted in a group of 10 participants in the summer of 2017. The first introductory meeting with the citizens' group took place in November 2017, after which four meetings in 2018 and five in 2019 followed. In total 10 meetings were held. The analysis and reporting phase started in the fall of 2019 and is completed in March 2020. The validation of the analysis and the final meeting with the citizens took place in December 2019.

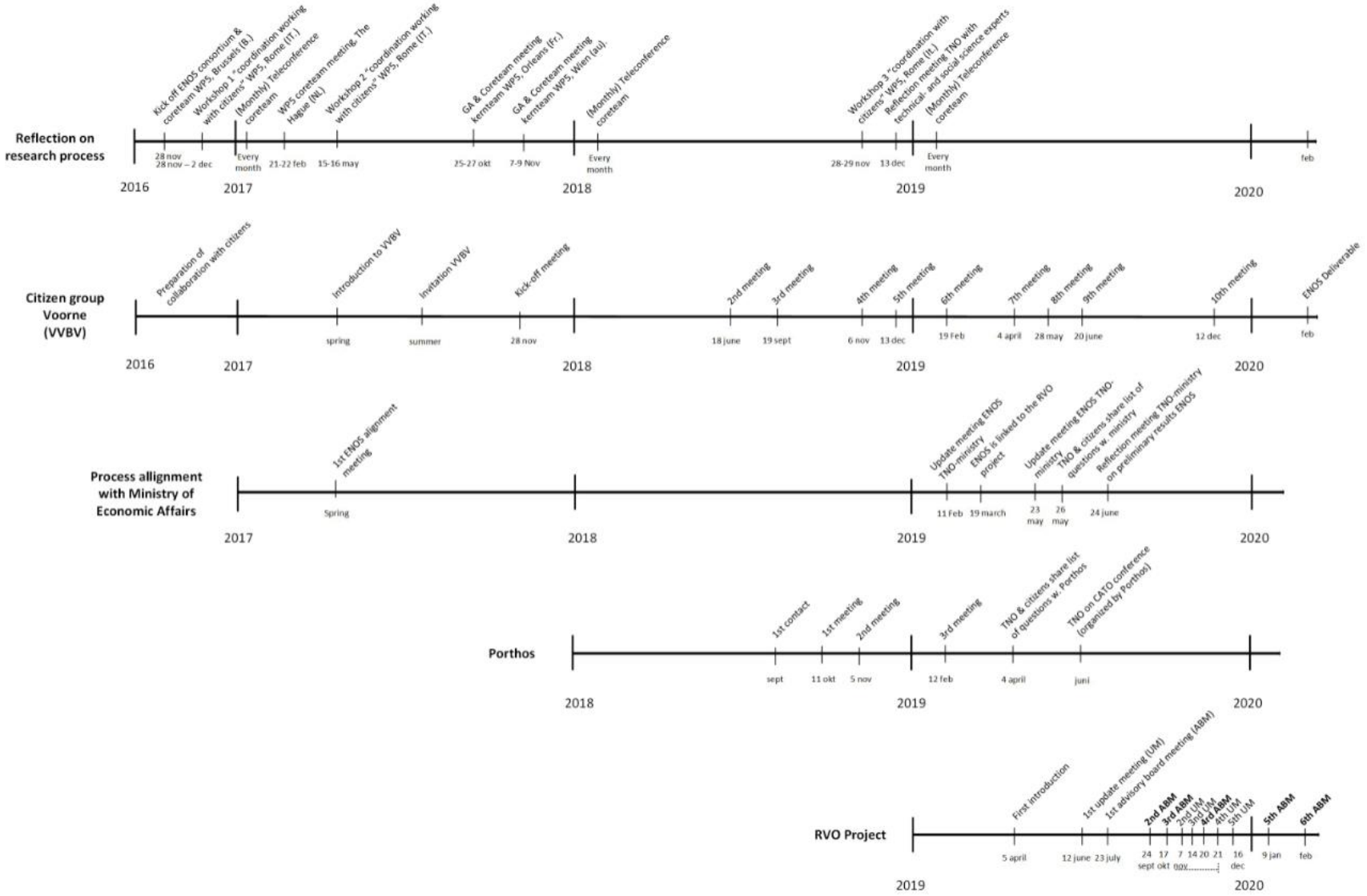
Coordination with Ministry of Economic Affairs. Already during the preparation of the participatory research process, the social research team consulted the Ministry of Economic Affairs to ensure the alignment of ENOS with parallel policy development processes, industrial initiatives for new CCS projects and other research projects as well as to prevent negative mutual influence. The conclusion of the alignment was that the ENOS research did not seem to influence the current issues and parallel processes and could start as planned. Simultaneously, an agreement was reached that TNO and the Ministry would inform each other about current and new developments. This early

consultation was also used to determine how the strategic communication teams of TNO and the Ministry could best support the ENOS social research team.

Exchange with Porthos project. After the new CO_2 storage initiative in the port of Rotterdam – the Porthos project – was published, the ENOS social research team was contacted by the stakeholder and communication manager of the Porthos project. The first meeting with the stakeholder and communication team of Porthos took place at the end of the Summer in 2018. At that time, the Porthos team was preparing meetings and interactions with several stakeholders as part of the formal permit procedures. The Porthos team was informed about the ENOS project and the collaboration with a group of citizens from Voorne, which is an area close to the new CO_2 storage initiative. The Porthos team was wondering if and how the ENOS project was related to their industrial initiative. Furthermore they had interest in the insights and outcomes of the work with citizens as part of the ENOS project. The meetings between the ENOS researchers and the Porthos team aimed at exploring how and when the insights from ENOS could be used for the development of the Porthos project and the formal procedures.

Contribution to new national policy process. In Spring 2019, the coordinator of the Dutch ENOS team was invited by the Ministry of Economic Affairs to contribute to a new policy process with the aim to develop strategies for national, regional and local governments as well as industries to improve the societal embeddedness of future CCS projects in the Netherlands as one of the measures to lower CO_2 emissions. This policy process was led by The Netherlands Enterprise Agency (RVO), which operates under the auspices of the Ministry of Economic Affairs and Climate Policy[9]. The question to the ENOS social research team was to tailor the insights and outcomes of the collaboration with the Dutch citizens to this policy process.

[9] The Netherlands Enterprise Agency (RVO) supports entrepreneurs, NGOs, knowledge institutions and organisations. We aim to facilitate entrepreneurship, improve collaborations, strengthen positions and help realise national and international ambitions with funding, networking, know-how and compliance with laws and regulations. RVO is a government agency which operates under the auspices of the Ministry of Economic Affairs and Climate Policy. Its activities are commissioned by the various Dutch ministries and the European Union. More information on www.rvo.nl


Reflection on research process
Kick off ENOS consortium & coreteam WP5, Brussels (B.)
Workshop 1 "coordination working with citizens" WP5, Rome (IT.)
(Monthly) Teleconference coreteam
WP5 coreteam meeting, The Hague (NL)
Workshop 2 "coordination working with citizens" WP5, Rome (IT.)
GA & Coreteam meeting Kernteam WP5, Orleans (Fr.)
GA & Coreteam meeting Kernteam WP5, Wien (au).
(Monthly) Teleconference coreteam
Workshop 3 "coordination with citizens" WP5, Rome (It.)
Reflection meeting TNO with technical- and social science experts
(Monthly) Teleconference coreteam
28 nov
28 nov – 2 dec
Every month
21-22 feb
15-16 may
25-27 okt
7-9 Nov
Every month
28-29 nov
13 dec
Every month
feb
2016
2017
2018
2019
2020
Citizen group Voorne (VVBV)
Preparation of collaboration with citizens
Introduction to VVBV
Invitation VVBV
Kick-off meeting
2nd meeting
3rd meeting
4th meeting
5th meeting
6th meeting
7th meeting
8th meeting
9th meeting
10th meeting
ENOS Deliverable
spring
summer
28 nov
18 june
19 sept
6 nov
13 dec
19 Feb
4 april
28 may
20 june
12 dec
feb
2016
2017
2018
2019
2020
Process allignment with Ministry of Economic Affairs
1st ENOS alignment meeting
Update meeting ENOS TNO ministry ENOS is linked to the RVO project
Update meeting ENOS TNO-ministry
TNO & citizens share list of questions w. ministry
Reflection meeting TNO-ministry on preliminary results ENOS
Spring
11 Feb
19 march
23 may
26 may
24 june
2017
2018
2019
2020
Porthos
1st contact
1st meeting
2nd meeting
3rd meeting
TNO & citizens share list of questions w. Porthos
TNO on CATO conference (organized by Porthos)
sept
11 okt
5 nov
12 feb
4 april
juni
2018
2019
2020
RVO Project
First introduction
1st update meeting (UM)
1st advisory board meeting (ABM)
2nd ABM
3rd ABM
2nd UM
3rd UM
4th ABM
4th UM
5th UM
5th ABM
6th ABM
5 april
12 june
23 july
24 sept
17 okt
7 nov
14
20
21
16 dec
9 jan
feb
2019
2020

4 The collaboration experiences with the Dutch citizens' group

In this chapter we provide an overview of the most important experiences and insights of the collaboration process with the group of Dutch citizens, over a period of more than 2 years (November 2017- December 2019). The experiences are clustered as: characteristics of the citizens' group (4.1), the process of preparation, execution and closure of each meeting (4.2), experiences with the adaptive programming (4.3) and finally how we dealt with the changing policy context in the Netherlands during the research period (3.4).

4.1 Characteristics of the citizens' group

The recruitment of citizens among the members of the Association Worried Citizens Voorne (VVBV) has led to the participation of 10 citizens. A collaboration process was set up with this group as part of the ENOS project. The citizens who responded positively on the invite to collaborate within the ENOS project were driven by their personal interests and motivation; they did not participate as representatives of the Association.

Some characteristics of this group of citizens:

- Highly motivated and interested.
- Not representative: 90% retired and academically educated, male, socially and or politically active with a background in oil and gas industry.
- Receptive for knowledge and facts.
- Positive-critical during meetings and with regard to CO_2 storage.

In the first year, at the beginning of every meeting the citizens were asked what their motivations were to take part in the ENOS research. The wordcloud (Figure 4.1) visualizes the motivations mentioned by the citizens throughout the research. In the figure, the larger words are visualized, the more citizens have mentioned these words in their motivation. The figure was repeatedly shown to the citizens and questioned if they still identified with the words in the wordcloud. The motivations have not changed, only some were added as members (re)joined the citizens' group.

Figure 4.1: an overview of the most important motivations of the citizens participating in the Dutch citizen group to take part in the ENOS research.

4.2 Experiences during the series of meetings

In chapter 3.1 the research approach for collaborative research approach has been explained and discussed. The organization of each meeting proved to be an intensive process. The main priority of the social research team was to create optimal connections between the questions and needs of the citizens and the agenda including the presentations of the invited experts.

In the preparation of each meeting, we intended to tailor the narrative for the meeting as much as possible to the questions and concerns of the citizens as identified in previous meeting(s). The storyline or narrative for each meeting was built on expert presentations as well as working methods to facilitate exchange and dialogue between invited experts, the citizens and the ENOS social research team. The aim of the storyline was to optimally facilitate the build-up of knowledge regarding the topic for that specific meeting. The narratives for each meeting also referred to questions that were asked on this subject in previous meetings. This resulted in a solid build-up of knowledge and understanding about the various aspects of underground CO_2 storage. The invitation of experts and selection of working methods for stimulating dialogue aimed at meeting the knowledge and information needs of the citizens as well as creating an open atmosphere for reflection and expressing questions, concerns and perspectives.

Dealing with the questions from citizens.
The main objective of the collaborative research with citizens was to collect their questions, concerns and perspectives on different topics regarding CO_2 storage and from there to derive best practices for improving citizens engagement in future CO_2 storage (research) projects.
Nevertheless, the social research team aimed at answering the posed questions as much as possible and as far as they met the scope of the ENOS research. This process was taken up in the meetings as follows:

- Start the conversation on the question during the meeting with the expert(s) present
- When the expertise was available during the meeting, answer the questions immediately
- Gain insight into the underlying thoughts and the context of a certain question
- Make an inventory of what is needed to meet the (information) demands of the citizen(s)
- List questions explicitly in reports
- Organize follow-up if required:
    - Use meeting reports to provide additional information (presented in specific text boxes underneath a listed question)
    - Return to the question in next meeting (s)
    - Connect with other experts / organizations

The aim of the collaboration was not to generate all the answers to the questions asked. The collaboration was mainly focused on retrieving all questions, concerns, interests and perspectives from citizens around CCS. Next to that, the aim was to gain experience and formulate advice on good routes to deal with those questions, concerns, etc.

Reporting and closure. Extensive reports were made of each meeting (the "data" on the basis of which the social research team performed the analysis). The reports served two goals: 1) capturing what had been discussed during the meeting and which questions, concerns, interests and perspectives citizens had brought in; and 2) providing additional information referring to questions from the meeting which couldn't be answered during the meeting itself. As such, the meeting reports served as research data for the social research team as well as background information documents for the citizens. It also occurred that citizens expressed an interest in getting into contact with other experts or responsible authorities about a certain topic. In some cases these requests could be included in the agendas of next meetings. In some cases these requests did not fit with the scope and objectives of the ENOS research. Nevertheless, also in these cases the social research team took the responsibility to introduce the citizens to other experts and/or authorities; for this purpose the social research team used its own professional network as much as possible to make these follow-up contacts possible. Last, the social research team also drew the citizens' attention to potentially interesting external meetings, such as information meetings or conferences and symposia.

4.3 Adaptive programming

An important goal of adaptive programming was to connect the content of the series of meetings as closely as possible to the interests and needs of the citizens during the entire collaboration. Although the social research team drew an overarching program for the series of meetings with a logic order of topics regarding CO_2 geological storage, this program wasn't set in stone. To keep the program adaptive, the following steps were taken during the entire collaboration process:

- In every meeting, show the citizens an overview of the subjects of their interest, as identified during the very first meeting with the citizens.
- In every meeting, ask whether citizens wanted to add new topics to the list of interests based on actual developments or new insights.
- In every meeting, check with the citizens whether the programming of the entire series still met their needs and new developments.
- In every meeting, ask whether the program needs adaptation.

As a result of this adaptive approach the order of subjects was changed a number of times to be able to focus on new questions and / or new events.

In addition, the social research team retained the possibility to change the order of subjects at its own discretion or to have subjects return multiple times in the program of the series of meetings, depending on the outcome of previous meetings. This adaptability was aimed to optimally shape the overarching build-up of knowledge and links between the various topics and meetings and so to contribute to a solid knowledge accumulation among citizens on a complex subject such as CO_2 geological storage as effectively as possible.

The social research team experienced that the adaptive programming of the series of meetings met their initial intentions and contributed to the overarching build-up of knowledge:

- Every meeting built on the previous one
- Repetition of the topics contributed to improving sticking of knowledge
- Possibility to refer to questions of previous meetings

Adaptive programming also helped to deal with current events. The social context that prevailed when the collaboration with the participatory research started gradually changed considerably. First of all, the ROAD project was cancelled in the summer of 2017, just after TNO had recruited a group of citizens through the invitation to all members of the Association of Worried Citizens Voorne (VVBV). The ROAD initiative was a starting point and important motivation to work with this citizens' group in that region. This meant that TNO had to think again and articulate the value of the collaboration with citizens from this region, despite the fact that there was no longer a concrete initiative. After a relatively calm period - in which no new initiatives were launched - the Porthos initiative was announced in the autumn of 2018, which suddenly made CCS very topical again in the Rotterdam region. Other developments in the Netherlands also showed that underground CO_2 storage was placed higher on the political and industrial agenda.

The impact of this changing social context was explicitly discussed with the citizens' group during a reflection meeting in February 2019. The conclusion of this reflection meeting was that it was not necessary to change the programming of the series of meetings. The current developments did not lead to other or additional topics on the agenda of interests of the citizens. However, the citizens emphasised that they would like to find a way to share the insights they had gained within the ENOS project with the stakeholder management team of the Porthos project. Therefore, the social research team and the citizens jointly defined a strategy to make the insights from this research process available for the Porthos team and possibly other parties. As the collaboration process had not ended yet, and the start of the analysis of all inputs from the citizens was planned months later, it was only possible to compile an overview of posed questions per meeting. It was not an option to wait until the collaboration process as well as the analysis had finished, because the formal process of preparing the permits was already ongoing. Waiting for a few months would have meant that the window of opportunity to share inputs from the citizens would have been missed. Therefore, the citizens asked if the social research team could compose the overview with all questions, concerns and perspectives that had been raised up to then on the topics that had been programmed up to that point. In April 2019 this overview the social research team and the citizens' group jointly shared the overview with the Porthos team as well as with the Ministry of Economic Affairs. This was done in a written document by e-mail. Later on, when the social research team was asked to contribute to the policy process led by the Netherlands Enterprise Agency (RVO), the list was also shared with RVO.

A new CCS initiative in the Port of Rotterdam – PORTHOS.

In the summer of 2018, the stakeholder management team of the Porthos project (the Porthos team) contacted the ENOS social research team to be informed about the research activities with citizens as well as to explore possible interferences with the development and formal licensing process for this new CCS initiative in the Port of Rotterdam. The citizens who were participating in the ENOS research all live in the Municipality of Voorne, which is very close to the Port of Rotterdam. Furthermore, they are all active members of the Association of Worried Citizens Voorne, which is known as an active citizens association that is eager to actively participate in local developments in their region. The Porthos team assumed that there was a high probability that a number of citizens from the ENOS citizens' group would become actively involved in the formal information and stakeholder participation process around the Porthos project. To get insight in how the ENOS meetings and the public information hearings were planned in time, the Porthos team asked the social research

team if they could be informed about meeting dates for new citizens meetings as part of the ENOS project. The social research team asked if they could be informed about formal steps in the permit procedures as well as public Porthos events for which the citizens from Voorne would be invited. Therefore Porthos team and the ENOS social research team agreed to inform each other about contact moments with the citizens. This was done to facilitate that both the ENOS research and the development of the Porthos project could continue in parallel making optimal use of each other's planning.

From the moment the Porthos initiative was announced, the conversations between the social research team and the citizens' group were given a new perspective; the programmed subjects and associated questions, concerns and perspectives of the citizens were suddenly no longer generic - "imagine that a new CCS initiative is being developed here in the Rotterdam area, what are your most important questions, concerns and perspectives?" - but for a specific current case. Although it must be stated that after the announcement of the Porthos initiative, the social research team continued to set up the content of the presentations and discussions independently and neutrally. Nevertheless, it happened that the citizens linked the questions or the programmed subject to Porthos: "how would Porthos deal with this?", Or "which one do we have to ask Porthos to get a good idea about this?". It made the conversations and topics more tangible and brought questions about possible consequences or uncertainties of CCS as technology closer to the perception of the citizens' group.

5 What do citizens like to know about CO_2 geological storage?

During the kick off meeting with the Dutch citizens' group (November 2017) the ENOS social research team made an inventory of the interests of the participating citizens. This long list of interest was clustered into the following 8 clusters of topics related to CO_2 geological storage:

- What is the role of CO_2 storage in the Dutch energy policy?
- How does CO_2 storage work in the subsurface? What happens in the subsurface?
- How is the safety of CO_2 storage guaranteed?
- What role does monitoring play in managing the risks of CO_2 storage?
- How are the costs and benefits of CO_2 storage distributed? Who pays?
- What does the communication process of new CO_2 storage initiatives towards citizens looks like?
- What roles do government, industries and citizens have during the development process of new CO_2 storage projects?
- What lessons can be learned from other (energy) projects regarding public acceptance and societal embeddedness?

These 8 clusters have been used to set up the content of the series of meetings with the citizens' group. In close cooperation with an interdisciplinary team of CCS experts within TNO, the following program was designed:

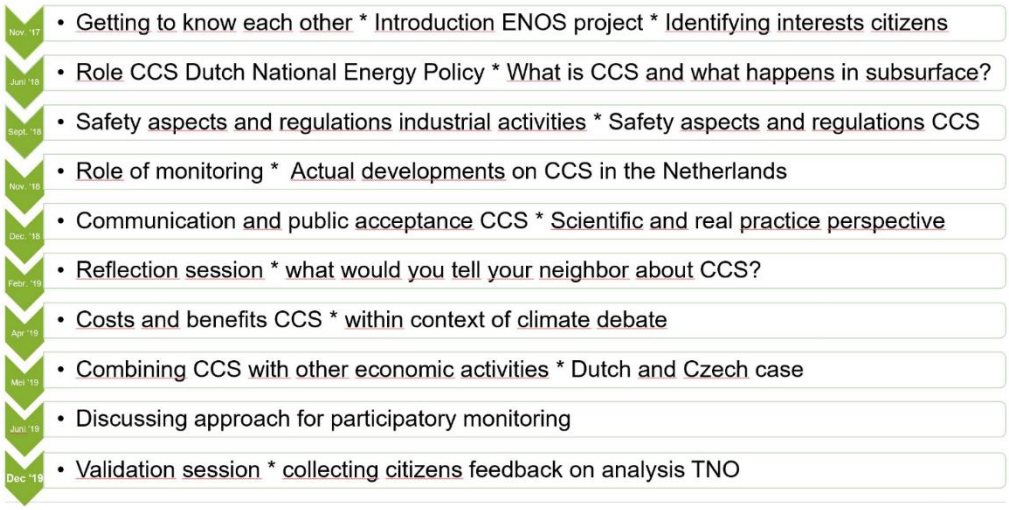


Figure 5.1. Planning and program of the series of citizens meetings, showing all topics of citizens' interests regarding CO_2 geological storage.

Comparing the 8 clusters of interests of the citizens with the topics on the program of the series of meetings shows that: *) some clusters of interest are combined within one meeting, i.e. the questions regarding communication aspects and the questions regarding lessons learned from previous (energy) projects; *) the topic 'monitoring' is scheduled multiple times; *) the subject 'combination of CO_2 storage with other economic activities' is added to the program, although it was not on the interests list of the citizens. We did program this topic because it was one of the research topics on the ENOS project. *) It is also noticeable that the topic "what role do government, industry and citizens have in underground CO_2 storage" is not programmed as a

separate topic. This decision was made following the assumption that this topic, the roles of different parties, would become part of the discussions on various other topics on the list of interests. *) Finally, two reflection meetings were held; one halfway through and one at the end of the collaboration.

This chapter gives an overview of the inputs of the citizens during the series of meetings: their questions, concerns and perspectives on the topics regarding CO_2 storage as programmed in the series of meetings. These inputs have been described below and structured following the order of topics of the program for the whole series of meetings. The inputs regarding the role of monitoring (meeting November 2018) and the approach for participatory monitoring (meeting June 2019) have been combined into one paragraph on monitoring. Furthermore, analysing all the data from the citizens meetings, two additional topics were identified: 1) inputs regarding the new industrial initiative Porthos and 2) inputs on how the citizens experienced the collaboration and dialogues as part of the ENOS project.

As such, the inputs of the citizens are described along the follow list of topics:
- The role of CO_2 geological storage in the Dutch energy policy (5.1)
- Geological aspects of CO_2 geological storage (5.2)
- Guaranteeing safety with CO_2 geological storage (5.3)
- Risk management and the role of monitoring (5.4)
- Communication and public support (5.5)
- New knowledge gained by the citizens (5.6)
- Who pays what? How are costs and benefits distributed (5.7)
- Combining CO_2 storage with other economic activities (5.8)
- The new CCS initiative: Porthos (5.9)
- Collaboration and dialogue with citizens (5.10)

5.1 Citizens inputs on the role of CO_2 geological storage in the Dutch Energy Policy

Approach meeting. One of the CO_2 geological storage experts talked with the citizens on the role of CO_2 geological storage in the Dutch energy policy. On behalf of the Ministry of Economic Affairs, he supervised a previous process with over 65 stakeholders in order to set up the so-called CO_2 geological storage roadmap. During an interactive presentation, the citizens were step-by-step talked through the necessity and value of CO_2 geological storage to realize the climate ambitions set in the Paris agreements.

Key questions asked by citizens.
- You can only spend every euro once, why would you spend it on CO_2 storage?
- Are there more effective techniques to reduce CO_2 in the atmosphere?
- What fundamental alternatives (besides CCS) are available to reduce CO_2 emissions on the longer term?
- What are the actual contributions of these solutions to the reduction of CO_2?
- To what extent is the impact of investments on the energy transition monitored? How do we know which choices were effective?
- What is the urgency of CO_2 storage?
- What stakeholders are involved in CO_2 storage, and what is their role?
- What is the influence of the government, the market and the citizen on CO_2 storage?

During this meeting, more questions regarding the role of CCS in the Dutch energy policy were asked by the citizens. All questions have been listed in appendix 3. In this chapter we only show the key questions.

Reflections of researchers.
The citizens asked many questions about the necessity of CO_2 storage and alternative ways to reduce CO_2 emissions. It helped to discuss the role of CO_2 storage in Dutch policy to clarify the context of CO_2 storage. By drawing the context, citizens gained a better understanding about the contribution of CO_2 storage to achieve (inter)national climate agreements.

In addition, the questions gave an indication of the level of knowledge of the citizens on CO_2 storage. The questions indicated technical knowledge on the geological techniques of CO_2 storage. The questions were more in regard to why you would implement CO_2 storage, what alternatives are available and how safety is guaranteed and how risks are controlled in CO_2 storage projects. This insight enabled the social research team to optimally connect the agendas and information provision in each meeting to the information needs and information level of the citizens.

In addition, the group's experience is that in large-scale energy projects the attention in participation trajectories is mainly focused on the rational side of the questions that are asked by citizens. The participants emphasized the importance to pay attention to the emotion behind the questions.

CONCLUSION**:** The two questions most often posed by the citizens are 1) why is CO_2 storage necessary? 2) what alternatives are there to reduce CO_2 emissions? Answering these two questions at the start of the collaboration or dialogue with citizens contributed to the understanding of the role and context of the technology. The understanding of this concept could be used and built on during the rest of the collaboration process.

5.2 Citizens inputs on the geological aspects of CO_2 geological storage

Approach. This subject was discussed with a CO_2 geological storage expert, working at TNO; step-by-step, at the level of knowledge of the citizens. Supported by visual elements the expert explained which conditions the subsurface has to meet to store CO_2 and how the CO_2 is injected in the subsurface. To make this complex story more tangible and visible for a lay public, various types of stone samples were shown to the citizens to visualize the required characteristics of different geological layers for CO_2 geological storage.

Key questions asked by citizens.
- Where can CO_2 be stored in the deeper subsurface?
- How is it determined which geological layer is suitable for CO_2 geological storage?
- And what are the risks of CO_2 geological storage?
- Do we monitor during the storage?
- What monitoring criteria are used?

During this meeting, more questions regarding the geological aspects of CO_2 storage were asked by the citizens. All questions are listed in appendix 3. In this chapter we only show the key questions.

Reflections of researchers.
The information demand of the citizens on the geological aspects of CO_2 storage was high. The high level of knowledge about the technical side of CO_2 storage of the participants helped to quickly develop an understanding of the topics and explanation during the meeting. The combination of an expert presentation and the physical stone samples helped to make the complex explanation of the geological aspects of CO_2 storage tangible to the group.

CONCLUSION**:** Most questions of the citizens connected to the impact of CO_2 storage in the deeper subsurface. Visualizing what happens in the deeper subsurface helped to create better understanding of the geological processes.

5.3 Citizens inputs on guaranteeing safety with CO_2 geological storage

Approach. In order to discuss the safety aspects of CO_2 geological storage in its broader context, a safety expert at the Joint Environmental Protection Agency of the Province of South Holland DCMR elaborated on the safety aspects in a general sense. Subsequently, a strategic advisor on the Mining Act of TNO provided insight in the safety aspects on CO_2 geological storage and how these are safeguarded in the legal procedures related to licensing and supervision.

Key questions asked by citizens.
- Who has the responsibility for the safety of CO_2 storage in the subsurface; also after the injection time has ended?
- Where does the supervision of one Dutch supervision authority stop and does it transfer to another?
- How is it possible that industries themselves are responsible for applying industry standards, rules and legislation?
- How can we be confident that the supervisor and regulator have sufficient knowledge and will act with care in CO_2 geological storage projects?

During this meeting, more questions regarding guaranteeing safety with CO_2 geological storage were asked. All questions are listed in appendix 3. In this chapter we only show the key questions.

Reflections of researchers.
Remarkable in the conversations about the safety aspects of CO_2 geological storage was that the questions and concerns of the citizens mainly concerned the ***governance*** and ***supervision*** of the safety aspects of CO_2 geological storage operations. The questions of the citizens mainly focused on the capabilities and quality of the supervising authorities. They doubted if the supervising authorities have up-to-date knowledge, since there is no experience with large-scale implementation of the technology (“how can they know what they don’t know”). Furthermore, the fact that different authorities are responsible for regulating the safety of CO_2 geological storage caused many questions and concerns. The citizens questioned how the fragmented

legislative frameworks for licensing, implementation and monitoring CO_2 storage projects contribute to monitoring safety and managing risks. For the citizens it was not clear where the responsibilities for the operations of a CO_2 storage project go from one authority to another, as a consequence of fragmented legislation.

After negative experiences with other energy projects in the subsurface in the area, it is not so easy to restore truest in the competencies of the bodies involved. The recovery of trust is difficult. Participants believe that visible knowledge and knowledge accumulation by the regulator are crucial for (restoring) confidence in the supervision and implementation of CCS projects. This means acknowledging mistakes made in previous projects and making explicit what lessons have been learned.

CONCLUSION**:** The questions and concerns of the citizens mainly were about the ***governance*** and ***supervision*** of the safety aspects of CO_2 geological storage operations. Transparency in the regulation and supervision of CO_2 storage projects and the mistakes made and the lessons learned by the authorities in the past, are crucial to restore trust.

5.4 Citizens inputs regarding Risk management and the role of monitoring

Approach. Two meetings were held on risk management and the role of monitoring. During the first meeting a TNO expert with years of research experience into monitoring and monitoring techniques for underground CO_2 storage gave citizens insight into the role of monitoring in the management of risks as well as available monitoring techniques. The second meeting explored the concept of participatory monitoring. Another TNO expert discussed a participatory monitoring approach for geo-energy projects. The approach aims to include the interests, questions and concerns of local stakeholders when drawing up monitoring programs for geo-energy projects.

Key questions asked by citizens.
Monitoring:

- How is it determined whether a location (gas field) is suitable for CO_2 geological storage?
- What is the chance of CO_2 leakage? And what does that look like? "*If you have to believe public narrative, CO_2 would cause the earth to explode. People fear a deadly cloud of CO_2*".
- Is it conceivable that CO_2 will react with the geological materials?
- How does the operator guarantee the safety of a CO_2 storage location?

Participatory monitoring:

- Is it possible to determine "the perfect way" to involve citizens?
- How do you tackle misplaced perception? If a subject is already polarized, you might not be able to get citizens to participate.
- How do you process the results of participatory monitoring in the implementation of the CO_2 storage project? Does our input actually make sense?
- How does participatory monitoring contribute to more knowledge?
- What is the monitoring frequency? Does this change during the process?

During the meetings, more questions regarding (participatory) monitoring were asked by the citizens. All questions are listed in appendix 3. In this chapter we only show the key questions.

Reflections asked by researchers. Monitoring plays an important role in risk management. The design of a monitoring program for CO_2 storage projects is based on a thorough feasibility study on the geological characteristics of the deeper subsurface, which gives insight in the main risks and safety aspects of CO_2 storage at the foreseen location (for instance a gas field). The citizens concluded that the experts involved in the ENOS research seem to have sufficient knowledge to recognize and manage the technical, geological risks as well as to design an appropriate monitoring program to reduce the identified risks. Their concern was mostly with the operational risks of a project. How is the monitoring program executed and how are monitoring data used to improve the operations of a project? Who decides on this and when?

In the second meeting about monitoring, the value of participatory monitoring was explored. The question in this meeting was if an approach for participatory monitoring could be a way of including citizens' questions, concerns and perspectives into the strategy for developing a new CO_2 storage project. The citizens emphasized that their need to become involved in the design and implementation of a monitoring program will increase when trust in the operators and/or authorities is low. When trust in the operators and/or authorities is not an issue, they have less need to become involved. They would, however, like to have more insight in what happens with the collected monitoring data. Who takes the decision whether more or less CO_2 is injected? Or that a project is being cancelled? These questions concern the use of data in the operations of a project.

The citizens appreciated that they were offered a realistic and transparent presentation on the risks of CO_2 storage as well as the approach to deal with these risks. Showing the risks as well as events related to other technologies, where things have gone wrong and what has been learned from these events in order to improve the operations of CO_2 geological storage contributes to creating trust.

CONCLUSION**:** The questions of the citizens indicated mostly concerns with the operational risks of a CO_2 storage project, not so much the geological risks. The need of citizens to participate in the monitoring of a CO_2 storage project depends on the level of trust in the operating party. The level of trust in a party is fostered by transparency in risks and communication on mistakes and lessons learned.

5.5 Citizens inputs regarding Communication and Public Support

Approach meeting. During the first kick off meeting (November 2017), the citizens had posed many questions on communication and public support with CO_2 geological storage projects. Their questions were for example about the availability of information, the organization of communication with citizens or what lessons on creating public support for subsurface activities have been learned in previous projects. To discuss these topics with the citizens the social research team invited two experts. An academic researcher with years of research experience on the public perception of CO_2

geological storage and an expert with years of experience in the field of stakeholder management in large energy and infrastructure projects.

Key questions asked by citizens.

- How do you ensure that the interests of all relevant stakeholders are reflected in your project?
- How do you ensure that you have internal and external legitimacy for your role as an stakeholder manager?
- Is it effective and worthwhile to appoint a stakeholder manager to a project?
- Who actually bears the costs for communication and public support? Is it part of the project budget?

During this meeting, more questions regarding communication and public support were asked by the citizens. All questions are listed in appendix 3. In this chapter we only show the key questions.

Reflections of researchers. Based on experience in their own environment, the citizens emphasized that showing the impact of a project or activity on the environment as well as taking into account the interests of the environment in the decision-making are necessary to create confidence in the implementing parties and their decisions. The latter requires an inclusive stakeholder process: do not exclude stakeholders who will possibly bear the impact (i.e. on the local environment or daily life) of the project. Poor communication and insufficient evidence that the project takes into account the interests of the environment and its citizens, is harmful for the level of trust.

The citizens emphasized they need the whole story. This includes transparency on the possible risks and the measures taken to reduce and remove these risks.
The openness offered in ENOS about the possible risks of CO_2 storage, previous mistakes and the lessons learned was highly appreciated by the citizens. This gave them the feeling that no information was withheld.

The citizens' group emphasized the fragility of trust: trust is easily lost and difficult to restore. The group provided several examples of cases in which trust was lost as a result of the approach taken by the (public) organization involved:

- In Groningen the lack of transparency heavily damaged the trust of the residents of Groningen in the operating organizations (public and private). The trust was lost as the negative impact of the gas drillings on the surroundings had been denied and ignored by the operating stakeholders during the implementation and operation of the projects.
- The realization of wind turbines in the south of Rotterdam shows the counterproductivity of a poorly executed communication and participation process. The wind turbines were realized during the summer holiday season when many residents were unable to respond and provide input to the project proposal. In addition, the turbines were positioned on the border of the municipality. Residents just outside the municipality border were excluded from the project and the participation trajectory. These decisions caused a negative feeling of citizens towards the execution and output of the project.
- During a public hearing for a new geothermal project in the area of Voorne the citizens of this group experienced the cruciality of adequate communication. The stakeholder manager of this project was able to create trust among his audience in the project. On the contrary, the moment the project director took the stage, the present participants lost their trust in the project approach as the project director

mainly reasoned from his own interests without having eye for the interests of his audience.

CONCLUSION: According to the citizens, open and transparent communication by the implementing parties on the impact of the project towards the environment and its citizens (those directly affected) is crucial for public support. Experiences taught the citizens that public support depends on the level of trust in the operating party, however trust is easily lost and difficult to restore.

5.6 Citizens inputs regarding new knowledge gained by the citizens

Process. At several moments in the process, the citizens were asked which new insights they had gained based on the presentations and shared information so far. In addition, in a specific reflection meeting attention was paid to reflect on the insights obtained from the perspective of the citizens. The citizens were given the assignment to jointly write down what they would tell the neighbours about CO_2 geological storage at a neighbourhood drink.

Reflections researchers.
The participation of the citizens in the ENOS project has brought them many new insights about the necessity and the impact of CO_2 storage as well as the possible risks. Overall, the collaboration has shown them that a CO_2 storage project can take place safely.

The project gave them confidence in the expertise of the experts who were invited to share their knowledge in the citizens meetings. In addition, the presented knowledge showed them that the required techniques for CO_2 storage are already there and have even been applied for years in the oil and gas industry. The citizens learned that CO_2 storage might seem a new technology, but that the industry has experience with the techniques in other domains.

The citizens expressed their belief that people who are confronted with CO_2 storage in their environment should proactively look for information on the technology more general and on the project more specific. They strongly believe that if people acquire enough information, they will eventually realize that *"there are no other alternatives on the short term for reducing CO_2 emissions"*. One of the participants shared: *"At the start of the project I was sceptical; I now realize CO_2 storage is really needed, there is no alternative"*. The citizens emphasized that the safety of citizens should always be paramount in the development of geo-energy projects.

CONCLUSION: The ENOS collaboration helped the citizens of Voorne to gather new insights and form their own opinion on CO_2 storage projects. The citizens concluded that it gave them the insight that CO_2 storage is safe and that they recommend other citizens in such a process to gather information proactively.

5.7 Citizens inputs regarding Who pays What? How are Costs and Benefits Distributed?

Approach meeting. In the preparation of this topic, the TNO team concluded that the costs and benefits of CO_2 geological storage are closely related to the broader debate on climate. To introduce the conversation on costs and benefits of CO_2 geological storage to the citizens the managing director of a large national research program on CO_2 geological storage was invited. During the introduction it was discussed that there are different views on the funding of the energy transition and that there are various figures and numbers in circulation about the costs and benefits of the various solutions for the climate ambitions. The objective of the conversation was to gain insight in what aspects of the financial business case for new CO_2 geological storage projects are of importance to the citizens.

Key questions asked by citizens.

- What are the costs of CCS? And who will ultimately pay the costs?
- What are the benefits? For whom are the benefits?
- Are there other (more efficient / cheaper) measures to reduce CO_2?
- What is the role and contribution of the government in sharing the costs and benefits?
- How does the CO_2 market work?
- Why are the CO_2 costs not passed on in the products on the market?
- What is the basis for giving a subsidy?
- Does the subsidy not disturb the transition?

During this meeting, more questions regarding the distribution of costs and benefits were asked by the citizens. All questions are listed in appendix 3. In this chapter we only show the key questions.

Reflections of researchers.

Frequently asked questions were about the necessity to invest in CO_2 storage and what alternatives are available. The citizens noticed that CO_2 storage is not yet cost-effective and can only be realized with governmental subsidies. The consequence is that citizens contribute to the investment in CO_2 storage projects (via the subsidies), while the industry benefits from the reduced CO_2 emissions and less CO_2 taxes. This means that the citizens pay the costs and the industry enjoys the benefits. How can this be explained? The citizens had a need for more insight in the distribution of costs and benefits between different stakeholders involved. In addition, they liked to acquire insight in how the business case of a CO_2 storage project is designed. Who pays and who benefits? Finally, they mentioned that the market for CO_2 emissions is a rather complex story. It would help to develop an understandable explanation regarding the different aspects that co-define the distribution of costs and benefits of CO_2 storage.

CONCLUSION: Transparency is needed about the distribution of costs and benefits in CO_2 geological storage to increase understanding of the choices made in a project. The citizens now feel that mainly the industry enjoys the benefits.

5.8 Citizens inputs regarding Combining CO_2 storage with other Economic activities.

Approach meeting. One of the technical research packages within the ENOS project is about the combination of CSS with other economic activities. For this meeting the TNO expert coordinating this research topic was invited. In the presentation, two possible solutions were discussed: CO_2 geological storage as buffer for the horticulture sector of the Netherlands and CO_2 geological storage in combination with oil extraction. The objective of this meeting was to collect the questions, concerns and perspectives of the citizens on the combination of these activities with CO_2 geological storage. Would such combined projects contribute to gaining support for underground CO_2 storage?

Key questions asked by citizens.

- Are there positive spin-off effects to do something useful with CO_2 instead of just costing money?
- Why invest in experiments with little direct effect on reducing CO_2?
- Why would oil companies inject CO_2 into their field if it is not cost efficient? How do you ensure that parties participate?
- Does CO_2 storage make an actual contribution to achieving climate objectives?

During this meeting, more questions regarding the combination of CO_2 geological storage with other economic activities were asked by the citizens. All questions are listed in appendix 3. In this chapter we only show the key questions.

Reflection of researchers.

The most important conclusion of the citizens was that the combination of CO_2 storage with other economic activities, such as buffering CO_2 for the horticultural sector in the Netherlands or the combination with oil production, could be an important step in the upscaling of CO_2 storage. These projects could serve as small-scale pilot projects, which provide important experiences with the different techniques. As a result, learning takes place on a smaller scale without immediate large-scale application of the technology (quote of one of the participants: *"large projects large mistakes; small projects small mistakes"*). However, the citizens had the impression that there is little incentive for the industry to reuse CO_2; emitting the CO_2 remains the cheapest alternative on the current CO_2 market. When emitting CO_2 becomes more expensive in the future, CO_2 buffering and reuse might become more interesting. The citizens were positive about the combination of CO_2 storage with other activities; however, they emphasized that the type of project influences the level of public support for the combined activities. For example, the story on buffering CO_2 for reuse in the Dutch horticultural sector (NL) has a better appearance than CO_2 geological storage in an oil field with the objective to produce more oil.

CONCLUSION: Combining CO_2 storage with other economic activities is felt by the citizens to be interesting when it can play a role in the upscaling. Learning from small-scale projects, helps to develop a next step in large-scale developments. However, the citizens do doubt if the industry has enough incentives at this point to reuse CO_2, as emitting remains the cheapest alternative. In addition, they stated that probably not all combinations of CO_2 storage with other economic activities would contribute to improving public support for CO_2 storage. They preferred the combination of CO_2 storage with re-use of CO_2 rather than CO_2 storage combined with oil production as the latter does not contribute to the reduction of CO_2 emissions.

5.9 Citizens input regarding the new CCS Initiative: Porthos

Process. Along the way, the discussions about the various aspects of CO_2 storage became intertwined with the development of the Porthos initiative in the Port of Rotterdam. Within the ENOS collaboration there have not been specific meetings with the citizens focussing on this new initiative. However, since the announcement of the Porthos initiative, a number of citizens have started to delve into the developments and - as a (board) member of the Association of Worried Citizens Voorne - have come into contact with the stakeholder management team of Porthos. This gave a new perspective on the conversations between the social research team and the citizens' group. The programmed subjects and associated questions, concerns and perspectives of the citizens were suddenly no longer generic - 'imagine that a new CO_2 geological storage initiative will be developed here in the Rotterdam area: what are your most important questions, concerns and perspectives?' - but it continuously happened that the citizens connected the topic of the meeting to the development of the Porthos initiative. Before the announcement of the Porthos initiative, the discussions within the ENOS collaboration were about fictional situations.

Key questions of the citizens.
The main questions the citizens asked about the Porthos project concerned *) the size of the project and how the operators and authorities would deal with unforeseen situations; *) the balance between the learning process regarding the development of a CO_2 geological storage project at this level of scale and the commercial interests of the participating industries; *) the CO_2 sources; and last *) the business case of the Porthos project. Another important issue for the citizens was how the Porthos team could learn from the conversations and insights between the social research team and the citizens' group as part of the ENOS project. They wanted to inform the Porthos team about questions they had already asked within the ENOS collaborative research process ("*it would be a waste of our time if we should have the same conversations again with the Porthos team*").

Reflections of researchers.
The most important questions of the citizens with regard to this initiative were on 1) the scale of the project and to what extent the project would support the possibility to learn and to work via smaller intermediate steps towards a large-scale project (*"learning from small intermediate steps seems to be skipped with this initiative"*) and 2) the distribution of costs and benefits and who pays what. Last, the citizens expressed the need for more clarity on how safety was going to be monitored and guaranteed.

CONCLUSION: Concerning the new initiative, Porthos, the citizens focused their questions on three topics: 1) learning effect of the initiative, 2) distribution of costs and benefits, 3) safety and monitoring of the initiative.

5.10 Citizens inputs regarding Collaboration and Dialogue with citizens

Process. After every meeting, the social research team reflected on how the citizens had experienced the meeting and how the conversations were facilitated. By observing how the citizens behaved during the meetings as well as by asking them directly what they found important in this collaboration and what the social research team could do to further improve the exchange with the citizens.

Key questions asked by citizens
Two important, returning questions were "what will happen to all the input and questions you get from us?" and "who will benefit and learn from all that we share here and the insights we develop?". The answer to this question became more and more concrete as the collaboration progressed. For example through the contacts that were established with the stakeholder management team of the Porthos project or via the contribution to a new national policy process in which the ENOS social research team was asked to translate the insights and outcomes of the collaboration with the Dutch citizens' group to this policy process.

Reflections of researchers.
Connection that was made to other initiatives (as described above), contributed to the motivation of the citizens to see that the insights from the ENOS project were of value in different contexts.

The citizens emphasized that answering their questions should not only be rational and factual but also be focused on the emotion behind the question "*irrational questions don't have a rational answer*". Show interest in the question behind the question, what makes this question so important to the person asking the question? During the collaboration the citizens experienced openness and eagerness to learn about the questions and perspectives of the citizens with regard to CO_2 storage. "*I never had the feeling that we were facing each other; in practice that is often the case*".

CONCLUSION: Citizens want to be taken seriously, their questions and needs need to be taken seriously. It is not only about their need for facts and figures, but also about emotions and feelings behind a question.

6 Best practices towards societally embedded CO_2 storage initiatives

This chapter describes the societal impact the ENOS research with citizens has already gained (5.1). Next, we present main lessons learnt from the collaboration with the Dutch citizens' group with regards to improving the societal embeddedness of CO_2 storage initiatives in the Netherlands (5.2).

6.1 Societal impact of ENOS research with citizens

Given the fact that previous CCS initiatives in the Netherlands (i.e. in Barendrecht as well as in the North of the Netherlands) have faced strong opposition from society, CCS is a societally and politically sensitive topic. This history caused the ENOS research with citizens got immediate attention both from the TNO management and from the Ministry of Economic Affairs. At the start of the ENOS project, they had little knowledge on what the focus was of the collaborative research with citizens, how the social research team was going to set up the collaboration with citizens and how the ENOS research could support (or hinder) ongoing industrial CCS developments in the Netherlands. Therefore, the social research team organised several conversations with both their management and the Ministry to introduce the ENOS project and to jointly explore how the ENOS project could be of value for industrial developments and/or policy processes. This exchange led to the active support and involvement of both stakeholders.

The social research team and a small group of policy advisors regarding CCS from the Ministry of Economic Affairs met each other on a regular basis, to inform each other about the progress of the ENOS project and new policy processes. This exchange led to two spin offs of the ENOS research: 1) interaction between ENOS social research team (Netherlands) with the stakeholder management team of the Porthos project (Summer 2018) and 2) the contribution of the ENOS social research team to a new policy process of the Ministry of Economic Affairs for developing strategies for industries and governments aiming at improving the societal embeddedness of future co2 storage projects (Spring 2019).

Exchange with Porthos team.
At the time the ENOS social research team and the Porthos team first met, the Porthos team was studying the feasibility of their CCS initiative and was preparing the underlying impact assessments as part of the formal permit procedures. As part of these formal procedures, they were also preparing and planning meetings and interactions with local stakeholders and the general public. The Porthos team had heard about the ENOS project and was eager to learn more about the collaboration with the Dutch citizens' group. Especially because the members of the Dutch citizens' group were recruited via the Association of Worried Citizens Voorne, which is an active and well-organized citizens' initiative close to area where the Porthos project is being developed. The value of the ENOS citizens' group for the Porthos team was twofold: 1) it was very likely that a number of citizens from the ENOS citizens' group would become actively involved in the formal information and stakeholder participation process around the Porthos project; and 2) the Porthos team wanted to learn from the insights from the collaboration with the citizens so far and the main questions and

concerns of the citizens. As the ENOS research was still ongoing and would last for a few more months, the social research team had to come up with a strategy for sharing insights which was acceptable for the members of the Dutch citizens' group. After all, the analysis of the collected questions, concerns and perspectives regarding different CO_2 storage related topics was planned not before all meetings had been held. Furthermore, from the perspective of the social research team, the 'ownership' of all the input laid by the citizens' group; it were their 'data'. Therefore, the social research team actively involved the citizens in finding a way to share insights from the meetings with the Porthos team. Furthermore, the Porthos team set up their own interactions with members of the ENOS citizens' group as part of their stakeholder strategy for the development of the Porthos project. The challenge for the social research team in these interactions with the Porthos team was to stay independent and to keep the open and trustful relationship that the researchers had built with the citizens during the series of meetings. By involving the citizens in defining a strategy on how and when to share what kind of information from the ENOS collaboration process, the citizens had a strong say in what was shared and when.

Contribution to new policy process.

As a consequence of the Dutch Climate Agreement, which is a translation of the Paris Agreement to the Dutch context and the result of an extensive negotiation process on the national level with multiple stakeholders from multiple policy domains, new CCS developments along the Dutch coast arise. In order to be prepared to the implementation of these new CCS initiatives, in Spring 2019, the Ministry of Economic Affairs started a new policy process with the aim to develop strategies for national, regional and local governments as well as industries to improve the societal embeddedness of future CCS projects in the Netherlands. The Ministry introduced the coordinator of the Dutch social research team to the project leader of this new policy process, assuming that the experiences with and insights from the ENOS project would be valuable for defining these strategies. The social science team shared the ENOS insights in different ways. First of all, by having regular conversations with the project coordinator of the policy process and jointly exploring how the experiences with the collaboration with the ENOS citizens' group could be tailored to his policy project. Second, by participating in an advisory board with CCS experts from the national government, industries and research institutes. The aim of the advisory board was to jointly reflect on research outcomes and proposal of the policy team towards strategies for improving the societal embeddedness of future CCS projects in the Netherlands. During conversations with the members of the advisory board it was possible to bring in the citizens' perspectives and societal aspects to be included in the foreseen strategies. And last, the Netherlands Enterprise Agency who was leading this policy process asked the social science team to draft a report on best practices from the ENOS research and how to apply them to this policy process[10].

For the project leader of the policy process the value of the ENOS experiences became manifest in *) the tailored collaborative research process as well as in *(the topics

[10] Puts, H. en C. Brus (2020). TNO report (reference TNO 2020 R10264) "Recommendations for a better societal embeddedness of CO2 storage projects in the Netherlands – lessons learned from a long term collaboration with a Dutch citizens' group." In Dutch: "Aanbevelingen voor een betere maatschappelijke inbedding van ondergrondse CO2 opslag projecten – inzichten uit langjarig participatief onderzoek met bewoners in Nederland". TNO rapport met kenmerk TNO 2020 R10264. Uitgevoerd in opdracht van RVO.

regarding CO_2 storage the Dutch citizens wanted to know more about and their questions, concerns and perspectives on these topics. For example the steps for shaping and facilitating the series of meetings with the Dutch citizens' group has been translated to recommendations for governments and industries on how to engage local communities in the decision making and development of future CCS projects in the Netherlands. For the ENOS social science team, interacting with both the members of the advisory board and the project coordinator of this policy process from the Netherlands Enterprise Agency was very valuable for structuring the outcomes of two years of research with citizens within ENOS and for selecting highlights which could be of value for other stakeholders working on CCS research of projects.

6.2 Lessons learned from collaborative research process with Dutch citizens' group

Based on the collaboration process with the group of Dutch citizens we identified several lessons learnt regarding how to better include societal aspects of CO_2 geological storage into future CO_2 storage research and/or industrial projects. Based on the ENOS research we can distinguish the following clusters of lessons learnt:

- How to set up a collaboration process with citizens? (6.2.1.)
- Societal requirements to be taken into account in the development of future CO_2 storage research and projects' implementation (6.2.2)
- What industries and governments could do during the different phases of development, implementation and operation of a CO2 storage project to improve the societal embeddedness of a project? (6.2.3)
- Basic principles for citizens engagement based on the collaboration experiences with Dutch citizens in ENOS. (6.2.4)

These four clusters of best practices are described below.

6.2.1 How to set up a long term collaboration process with citizens?

The experiences from the collaboration with the Dutch citizens' group as part of the ENOS project show that setting up a **long-term collaboration** with citizens and **creating confidence** in decisions require:

- Development of a step-by-step approach for organizing and facilitating a long-term collaboration process with a group of citizens, tailored the local situation and local (stakeholder) dynamics
- Joint identification of clusters of interest as a basis for the key topics on the agenda
- The joint determination of (the topics on) the agenda.
- That questions, concerns and interests of citizens are leading in this.
- A flexible and adaptive programming for the agenda for (the series of) citizens meeting(s) in order to be able to respond to new developments.
- Careful design of the process for each meeting, including preparation – facilitation – reporting – follow up activities.
- An optimal connecting between the level of knowledge of citizens and the way information is presented.
- Openness about insecurities and possible risks.
- Transparency in the considerations and final decisions.

6.2.2 Societal requirements to be taken into account into future CO_2 storage projects

The collaboration with the Dutch citizens' group as part of the ENOS project provides insight into **the topics that** CO_2 geological storage research and projects' developers need to address to meet the needs of local communities. The following **societal requirements** have been derived from all inputs of the Dutch citizens' group. Citizens ask for:

- Clarity about the value and necessity of CO_2 geological storage within the context of the Dutch energy policy as well as possible alternatives to reduce CO_2 emissions.
- Clear explanations about to what extent a CO_2 geological storage project contributes to reducing CO_2 emissions.
- Comprehensive communication about possible risks ('the true story') and which guarantees are built in to minimize risks and to guarantee safety.
- Transparency of the process for choosing a site location for CO_2 geological storage; what is taken into account? Which criteria are leading in choosing a site?
- Supervision of the implementation and operation of CO_2 geological storage projects to ensure safety.
- Information on how monitoring data is used to improve the operational execution of projects and to decrease the risks.
- A step by step approach towards large scale implementation of the technology; what can be learned from small scale projects?
- Insight in how authorities and operators learn from previous projects and experiences and how these learnings help improving the regulations and monitoring procedures.
- Well prepared regulators, ensuring their knowledge is up to date.
- Open and transparent communication by authorities and operators on the impact of the project towards environment and society.
- Opportunities for solid knowledge build-up in order to better understand the technology as well as to form a well-informed opinion.
- Transparency on the choices concerning the distribution of costs and benefits and their effect on the identification of investments in the intended CO_2 geological storage project.

6.2.3 What could industries and governments do to improve societal embeddedness of a CO_2 storage project?

- Show real interest in questions, concerns and perspectives of citizens. "*In reality we often face each other. That does not help*", as one of the citizens in the Dutch citizens' group said.
- Give sincere consideration to citizens' input to enrich and improve the project strategy or design
- Be transparent in how citizens' input will be used in the project strategy and/or project design.
- Strive for a successful societal embeddedness of the foreseen project.
- Take into account citizens' questions, concerns and perspectives while developing a monitoring program.
- Share information in an open and transparent way.

- Provide insight in how decisions are made.
- Calculate budget for stakeholder management as part of the project strategy.

6.2.4 Basic principles for citizens engagement based on the experiences in ENOS.

- It is important to openly discuss and clarify what the influence of citizens engagement will be on the overall project strategy. What level of participation is foreseen? How will their input be taken into account in the project development?
- It would help creating a better societal embeddedness of the project if questions, concerns and perspectives of citizens would be identified in a very early stage of the project development, in order to make sure that also societal questions will be taken into account during the feasibility studies and design of the project strategy.
- Be open about unforeseen circumstances or events at/near the project site as well as about measures how to overcome these and to prevent that these might happen again.
- Citizens have the need to be heard; they want their questions and concerns to be taken into account seriously.
- Citizens have local knowledge and experience, which could be valuable to improve the societal embeddedness of the project and to better shape the project in its societal and environmental context. They often experience the opposite “We often face each other”.

7 Conclusions and reflections for future research

The 2-year collaboration with the Dutch group of citizens has been an interesting and valuable journey. Getting started with the collaborative research was a challenge in itself, as many stakeholders in the Netherlands have lively memories of the dynamic societal debates regarding previous CCS developments in Barendrecht and the North of the Netherlands. Taking time for organising internal and external commitment for the research with citizens contributed to creating support for the ENOS research and even active involvement of some relevant stakeholders. The stakeholder meetings every 4-6 months also helped addressing the value of the collaborative research approach as well as the inputs from the citizens for real practice.

Another interesting learning process was how to connect the research objectives from the ENOS project to the needs and interests of the citizens' group. Although there had been some joint thinking with the international team of ENOS partners about how to approach the work with the citizens in each of the case studies, it appeared to be very important to tailor the research approach in the Netherlands to the local dynamics and the history we have with CCS initiatives in the Netherlands. The adaptive way of working and programming the topics for the series of meetings with the citizens turned out to have two advantages. On the one hand, it gave us the opportunity to give the citizens insight in the long term programming, although we did not know everything beforehand. This offered a certain predictability to the citizens. Furthermore, designing the long-term program for the whole series of meetings was also a way of giving them feedback on how we adapted their input in the programming of the meetings. On the other hand, depending on new developments or insights we kept the flexibility to tailor the programming to new dynamics within the citizens' group or their local environment.

Another challenge in the collaboration process with the Dutch citizens' group was how to stay independent and at the same time share the insights from the ENOS project with other stakeholders, in order to make use of these insights for new CCS initiatives (i.e. the policy process as well as the new industrial initiative in the Port of Rotterdam). It was very clear for the social research team that we wanted to keep the open and trustful relationship we had built with the citizens. We therefore involved the citizens in developing suitable strategies for sharing the insights from the series of citizens' meetings with others. The collaborative approach based on an open exchange and honest recognition of all inputs, helped us to find a way to share the learnings from the citizens' meetings in a satisfactory way for all. The researchers involved continuously asked themselves the question: what could we learn from the input from the Dutch citizens' group in order to improve the societal embeddedness level of future CO_2 storage projects?

Finally, working with the Dutch group of citizens taught us a lot about how to create an open and in-depth dialogue with citizens who are very active in following new developments and protecting their local environment from unsustainable developments and/or unfair decision-making processes. We learned how they think and what they find important regarding CO_2 geological storage. It appeared that they did find it interesting to learn about the topics on the research agenda of the ENOS project, but that their questions and concerns were also on the policy, governance and financial aspects of CO_2 geological storage. It was not an option to tell the citizens that we could

not talk about these topics because these were not on the ENOS research agenda. We did it the other way around. We organised meetings about topics they were interested in and held discussions within the research team on what their questions, concerns and perspectives could mean for the topics on the ENOS research agenda, the research approach as well as the dissemination of research outcomes. We experienced that starting from the interests and questions of the citizens broadened their field of interest. As a consequence it was possible to address more technically oriented topics during the meetings. *You first need to have ears, before you can listen.*

In the collaboration process with the Dutch citizens' group we have experienced that the interests of the citizens partly overlapped with the topics on the research agenda of the ENOS project (see figure 7.1).

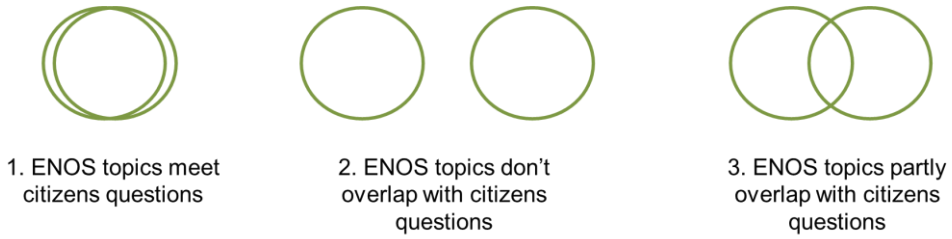


Figure 7.1: Different outcomes of the comparison between topics on the ENOS research agenda and the questions citizens could ask about CO_2 geological storage. In the Dutch case study, option 3 was the case, topics on the ENOS agenda partly overlap with the interests of the citizens.

Our main reflection based on all inputs from the citizens and experiences with the collaboration process is that developing societally embedded CO_2 storage projects only partly depends on the technological aspects of CO_2 storage. It also relies on the impacts of the foreseen CO_2 storage project on the local environment, on supportive and transparent energy policies and regulations, on the approach for stakeholder engagement and last on the distribution of costs and benefits. Researchers should ask themselves more often how and which research outcomes could contribute to all these aspects, that influence how well future CO_2 storage projects will be embedded in their societal context.

8 Acknowledgements

We would like to thank all people who have contributed in some way to the collaborative research process with a group of Dutch citizens and the results described in this report.

First of all, we are very grateful for the commitment, openness and dedication of the Dutch citizens who participated in the ENOS research. We have learned a lot from them and have enjoyed the 2-year collaboration.

We would also like to thank all CCS experts who were invited for the citizens' meetings in the Netherlands for sharing their knowledge and expertise. We really appreciated your enthusiasm and openness towards the citizens and the research process.

Next, we would like to thank all ENOS partners for their collaboration and the valuable conversations during our monthly teleconference calls as well as the face-to-face reflection workshops we had as a team. We have learned a lot from your perspectives and suggestions for organising the work with the Dutch citizens' group. A special thanks goes to Samuela Vercelli for her dedicated coordination of and guidance for the work with the citizens. We would also like to mention the researchers from the United Kingdom Mathew Humphrey and William Knight for the exchange of ideas on how to approach the work with the citizens and for jointly exploring how we could best analyse and structure the outcomes of the research. It was nice to have you as sparring partners in the team.

Furthermore, we have learned a lot from our TNO colleagues who were willing to jointly design the adaptive program for the series of meetings with us. It was a pleasure working with you and tapping from your expertise and experiences in the field of CCS.

We would also like to say thanks to the researchers who reviewed several draft versions of this report, Geiske Bouma and, especially, Samuela Vercelli. Your suggestions for improvements in structuring the report and sharpening the best practices and conclusions have been very valuable.

Last, we would like to thank the project leader at the Netherlands Enterprise Agency for her enthusiasm regarding the ENOS work and her trust in the value of the outcomes of the research. The many conversations we had have really helped us in translating the outcomes of our research process to the policy process which aimed at drafting strategies for governments and industries for improving the societal embeddedness of future CCS projects in the Netherlands. Jointly exploring how the ENOS insights could be applied to this policy process has been inspiring and fun.

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ANNEX 1 – INVITATION LETTER TO RECRUIT CITIZENS FOR THE DUTCH CITIZENS' GROUP.

The letter below has been sent to all members of the 'Association of Worried Citizens Voorne' (in Dutch: Vereniging Verontruste Burgers Voorne (VVBV)) with the question who would be interested in collaborating with TNO in the ENOS project. Find below the English translation of this letter. The original invitation was – of course - sent in Dutch.

INVITATION LETTER

INTRODUCTION

TNO is seeking citizens to participate in a working group for its ENOS project, a European research project on CO_2 geological storage

The Hague, July 2017

A great deal of research is being undertaken in Europe on ways to tackle climate change issues. Those studies don't only relate to energy savings, alternatives for natural gas, and other sources of energy (e.g. wind, solar, geothermal energy and biomass), but also to ways to prevent gases escaping into the air which cause climate change (such as CO_2). TNO is involved in many of those studies with various disciplines and areas of knowledge. This invitation is about a project that researches the possibilities of CO_2 geological storage in Europe. The research project is called ENOS. ENOS wants to contribute to further development of CO_2 geological storage in Europe from various perspectives. The ENOS research focuses on technical, economic and social issues relating to CO_2 geological storage, which is financed by the European Commission. TNO is one of several European research institutions to carry out research. More information about ENOS can be found on the project website, www.enos-project.eu.

INVITATION TO MEMBERS OF THE VOORNE CONCERNED CITIZENS' GROUP TO CONTRIBUTE IDEAS AND SUGGESTIONS IN RESEARCHING CO_2 GEOLOGICAL STORAGE

This is an invitation to you as members of the Voorne Concerned Citizens' group, to participate in our research project. Through a long-lasting joint cooperation with citizens, we want to carry out research within ENOS into social issues concerning CO_2 geological storage. This is a new way of doing research, which, until now, has not been applied very often. This cooperation with citizens will take place in four countries: United Kingdom, Spain, Italy and the Netherlands. Within ENOS, TNO is responsible for cooperation with citizens in the Netherlands.

AIM OF THE ENVISAGED COOPERATION WITH CITIZENS IN THE ENOS RESEARCH PROJECT

Our aim is to learn and to jointly explore how we can address the concerns that you have about CO_2 geological storage in future research, and the further development of

CO_2 geological storage in Europe. How do we envisage this cooperation with you? We would like to discuss what you consider as being important in the development of future CO_2 geological storage projects. By developing a relationship through a long-term cooperation we want to gain insight in:

- Your questions and concerns about CO_2 geological storage;
- How to address those concerns in the further development of this technology in research projects like ENOS;
- How and when would citizens like to be involved in the future development of CO_2 storage projects in the Netherlands and Europe.

What's important for us, is that we work together to create an agenda of topics to be addressed at the meetings. In this way the topics which are most relevant and important to you are dealt with in the meetings. If necessary, other (TNO) experts will also be present at the meetings to share their knowledge and to answer your questions. The meetings will be highly interactive and focus around the input put forward by you.

We will use these results to draw up a recommendation to the European Commission together with the ENOS researchers from the other citizen groups (England, Italy and Spain) for inclusion of the civilian perspective in the further development of CO_2 geological storage in Europe. Where possible, together with the other ENOS researchers, we will explore how your input can already be applied within the ENOS research itself. If you decide to participate, you will have influence on European research into CO_2 geological storage.

NEWS ON THE ROAD PROJECT

The recent development that the ROAD project in your own vicinity has been cancelled, does not have any influence on our research. We notice that European research into CO_2 geological storage is high on the European Commission's agenda. In the Netherlands too, a lot of research is being conducted looking for possibilities on CO_2 geological storage. So it is quite conceivable that new (pilot) projects will be developed in future, also in the Netherlands. We consider this period, where there are no definite plans as of now, as an opportunity to examine what citizens consider as being important in the development of this technology and the possible development of CO_2 storage projects in the Netherlands.

YOUR ROLE IN THE PARTICIPATIVE ENOS RESEARCH

What are we asking from you?
We are thinking of organizing five and perhaps more meetings with a fixed group of participants of about 10 – 15 people in 2017 – 2018. Each meeting lasts about 2 to 3 hours and will be held at a location in Westvoorne at a time that suits you. Catering will be taken care of by TNO. At the first meeting we will identify which topics are of interest to discuss. Possible topics for the series of meetings are:

- Effectiveness and necessity of CO_2 geological storage
- Communication to citizens about CO_2 geological storage
- Costs and benefits of CO_2 geological storage
- Safety and risks of CO_2 geological storage
- Monitoring technologies for CO_2 geological storage
- A combination of CO_2 geological storage with other economic activities

We recently had an initial conversation with four members of the board of the Voorne Concerned Citizens' group. On the basis of this conversation we propose to address the effectiveness and necessity of CO_2 geological storage at this first meeting. The aim of the first meeting is to get to know each other, to explain what the ENOS research project is and to jointly determine the agenda for the whole series of meetings. Our idea is to organize the first meeting in September 2017, for example at the Tenellaplas. The exact date and time will be decided in consultation with the interested participants.

HOW CAN YOU PARTICIPATE?

If you are interested in taking part of this process, please sign up with Tara Geerdink at TNO. We would be grateful if you could sign up by no later than August 20, 2017. It is important for our research that we build up a long-lasting relationship with you; that is why we ask you to seriously consider whether you are prepared to participate in all meetings (5 or more). If you have any further questions about this invitation, please don't hesitate to contact us. We hope to meet you in September and look forward to a sound cooperation.

ANNEX 2 – OVERVIEW OF EXPERTS INVOLVED IN ORGANIZING THE MEETINGS WITH DUTCH CITIZENS' GROUP.

Members social research team

- Hanneke Puts (TNO - coordinator of the ENOS research process with Dutch citizens' group)
- Celine Brus (TNO)
- Barend van Engelenburg (DCMR)

Involved experts

Through the whole series of citizens meetings, the social research team collaborated with 11 experts. Below, all experts are named who have given their permission to be included in the report.

- Jaap Breunese (TNO)
- Peter Couwenberg (TNO)
- Independent advisor on stakeholder involvement
- Maarten de Hoog (DCMR)
- Jan Hopman (TNO)
- Marielle Koenen (TNO)
- Emma ter Mors (Leiden University)
- Filip Neele (TNO)
- Joelle Rekers (Ministry of Economic Affairs and Climate Policy)
- Hans Warmerhoven (Energie Beheer Nederland EBN)
- Ton Wildenborg (TNO)

ANNEX 3 – OVERVIEW OF ASKED QUESTIONS BY MEMBERS DUTCH CITIZENS' GROUP.

This Annex shows a detailed overview of all questions asked by the citizens of the Dutch citizens' group during all meetings. The questions are structured per meeting.

Dutch abbreviations used in questions:

- **DCMR**: joint environmental protection agency of the province of South Holland). The DCMR works at the request of local and regional authorities, and aims for a liveable and safe region for the people who live and work there. We do this by:
  - Imposing environmental and safety rules and monitoring compliance;
  - Issuing permits;
  - Monitoring environmental quality;
  - Advising on environment and safety;
  - Taking action against nuisance and incidents.
- **SodM**: National Supervision of the Mines
- **EZK**: Ministry of Economic Affairs and Climate Policy
- **PM**: participatory monitoring

1st Meeting (November 17, 2017)

Theme:

- *Kick off meeting | Getting to with each | Introduction ENOS project*
- *Inventory of expectations of citizen group as well as questions and topics on CO_2 storage that citizens want to discuss with the social research team in ENOS.*

QUESTIONS ASKED BY CITIZENS:

- How does CO_2 geological storage work in the subsurface?
- What is the role of this technology [CO_2 geological storage] in the energy transition?
- Why do we need this [CO_2 storage]?
- What are the causes of the high CO_2 emissions in the Netherlands?
- What are possible solutions [for reducing CO_2 emissions]?
- How is CO_2 storage used for economic profit in the horticultural sector?
- What political decisions have been made about CO_2 geological storage?
- How does the market of CO_2 geological storage function?
- What are the costs of CO_2 geological storage?
- What about the safety and risks of CO_2 geological storage?
- What is the role of CO_2 geological storage in Dutch energy policy and in Europe?
- What role do the different stakeholders play in CO_2 geological storage (government, market, citizens)?
- What about communication on CO_2 geological storage? Can we expect open communication and information exchange?
- How does the storage of CO_2 work in the subsurface?
- What are the risks and uncertainties associated with CO_2 geological storage, including financial risks?

- How to deal with the consequences of these risks in CO_2 geological storage?
- What is the urgency of storing CO_2 in the subsurface?
- Why is CO_2 geological storage seen as a (temporary) solution in reducing CO_2 emissions?
- Why is CO_2 geological storage part of the Dutch energy policy?
- What are the costs of CO_2 geological storage and what are the benefits?
- To what extend are citizens willing to pay for CO_2 geological storage?
- What are the burdens of CO_2 geological storage, and how are costs and benefits distributed? For example, the impact on the value of real estate.
- Is it possible to apply compensation measures and what are the options?
- Who pays for CO_2 geological storage and possible compensation measures?
- What is the role of the government in this?
- What are the roles of the various parties involved in CO_2 geological storage?
- Why are Dutch citizens negative about CO_2 geological storage? What causes the opposition? What causes the fear for CO_2 storage projects?
- What lessons can be learnt from previous initiatives for CO_2 geological storage?
- What can be tlearn from other geo-energy projects? Like salt production. Or the production of geothermal energy?
- What do we learn from [the problems with seismicity due to the natural gas production in] Groningen?
- How much trust can we have in the supervising authorities?

2nd Meeting (June 18, 2018):

Theme:
- *What is the role of CO_2 geological storage in Dutch energy policy?*
- *How does CO_2 geological storage work in the subsurface?*

QUESTIONS ASKED BY CITIZENS:

On the inventory of motivations to participate in this citizen' group:
- What possibilities do we have to counter the ever-growing energy consumption, or to tackle its effects?
- Concerns about how geo-energy projects are implemented: legislation can be correct and prescribe that it is done safely; but does that actually happen in real practice? Who monitors the operations and it this done well?
- Are there other solutions for removing CO_2 from the atmosphere than CO_2 geological storage?
- What about the timing of phasing out fossil fuels and the introduction of sustainable alternatives?
- What is achieved when ENOS is completed and what happens with the results?
- What is the perspective of CO_2 storage when the fossil powerplants close?

On "the role of CO_2 geological storage in Dutch energy policy"
- Every euro can only be spent once; so why would we spend it on CO_2 geological storage instead of alternatives?
- How much energy does it actually cost to produce alternatives energy sources? For example hydrogen? We have read that the production of alternative energy sources for i.e. petrol and diesel costs more energy than the energy production from fossil fuels. If this is true, to what extent do these alternatives contribute to CO_2 emission reduction?

- The same goes for electric driving. How sustainable is this alternative if the electricity is produced in coal-fired power stations?
- What happens if the objectives for CO_2 emission reduction will not or only partly be achieved?
- To what extent are the effects of the energy transition monitored? How do we know that choices / investments in alternatives for fossil fuels are effective?

Intermezzo: what questions does the 2nd theme of this meeting raise to you: what is CO_2 geological storage and how does it work in the subsurface?

- Is CO_2 geological storage sufficient [for CO_2 emission reduction]?
- What if [CO_2 geological storage] goes wrong?
- Do we monitor during CO_2 geological storage?
- Which geological layers [gas fields] are suitable for CO_2 storage and which aren't?
- What criteria are being used [to select a field for CO_2 storage]? Technology, legislation, security, politics?
- Is there public support for the common set of criteria?
- Which gas / oil fields are suitable?
- What risks [from CO_2 geological storage] are there in the short and long term?
- The gas / oil fields were stable for hundreds of years, is this not enough evidence? [that CO_2 storage can be done safely]
- Why should we store CO_2 passively? Why not dissolve in O_2 and C?
- Is the risk of a CO_2 burst acceptable?
- How much CO_2 could be stored in the subsurface in comparison to the total CO_2 in the atmosphere?
- Do we have insight into the effect when the CO_2 targets have been reached?
- What do we do with the CO_2 emissions from the aviation sector?

3rd Meeting (September 19, 2018):

Theme:

- *Safety aspects and safeguards in industrial activities (generic)*
- *and for CO_2 geological storage (specific)*

QUESTIONS ASKED BY CITIZENS:

On the inventory of motivations to participate in this citizen group:

- [I have a] General feeling of concern about what type of developments are allowed in our local environment; is it heading in the right direction with all those industrial activities?
- Concerns about how geo-energy projects are developed and operated: the legislation may be correct and prescribe that it is done safely; but does that actually happen in real practice?
- How will the impact of geo-energy activities on the local environment be managed?
- How can we make use of other (geo-energy) projects? For example, from the CO_2 storage project in Barendrecht that was canceled due to local opposition.
- Better understand how CO_2 geological storage fits into European policy and what role the Netherlands can play in this?
- Is there a risk for the Netherlands that we come in the situation that CO_2 that is produced in other countries will be stored in the Netherlands? Is that a preferable situation?
- How does ENOS research contribute to shaping European policy regarding CCS?

Lecture "safety and living environment quality of industrial activities in general and how is it guaranteed?"

- Isn't it the case that industries have too many responsibilities for developing their own safety regulations? Is it preferable that authorities monitor the safety regulations industries have drafted themselves?
- How can companies themselves indicate how they should operate industrial processes and how they apply regulatory frameworks?
- What role does the Joint Environmental Protection Agency (DCMR) has in this?
- Which possibilities do regulators have to change permits if new insights come up?
- Is it possible to adjust a permit after it is issued, for example on the basis of new insights or newly available techniques or data?
- What can citizens do if they find out that the data which have been used for the licensing process are not up-to-date and that this turns out to be of important information after the license has been issued? (outdated technique; incorrect data used about the technique, ...).
- Shouldn't it be possible to adapt a permit to the actual data?
- Shouldn't it be possible to update permits based on new insights, both in terms of technology (improved technologies) and in terms of impacts on the local environment?
- For which type of industrial activities is DCMR the responsible authority?

On lecture "what about the safety aspects of geo-energy activities and CO_2 storage more specific and how is safety guarenteed?"

- Do the figures that show the need for CO_2 geological storage also take into account the CO_2 that could be retained by trees? So if you would plant a lot of new trees that can capture and retain CO_2, would that mean that you need less CO_2 storage capacity in the subsurface?
- Is it possible to maintain and inspect existing oil and gas infrastructure that – at a later date - could be reused for CO_2 geological storage?
- What are the risks of increasing the pressure in a gas field through CO_2 injections?
- And when the pressure in a gas field is increased, could this cause new seismic activities in the subsurface? Would that be a risk of CO_2 injection?
- What can be learned from other CO_2 storage projects internationally regarding induced seismicity after [CO_2] injection? For example in the US?
- How can we as citizens trust the regulating authorities in monitoring new CO_2 geological storage initiative, while we have recently seen that things could have gone so wrong with a geothermal energy project in this area?
- The citizens think it is important that the regulation authorities show that they have build-up new knowledge by learning from previous project, that the authorities acknowledge the mistakes that have been made in some projects and, finally, that the tasks and mandate of governmental authorities are better separated. Through the perspective of the citizens the Ministry of Economic Affairs combines multiple roles, i.e. the role of project developer, policymaker, licensing authority and supervisor.
- When does the responsibility transfer from the one authority to another in supervising the development and operation of geo-energy projects?

4th Meeting (November 6, 2018)

Theme:

- *Current developments in the Netherlands regarding CO_2 geological storage.*
- *Monitoring of CO_2 geological storage.*

QUESTIONS ASKED BY CITIZENS:

Review and current developments.

- How are the results of ENOS, also from the other European citizen' groups, shared with us [citizens in the Netherlands]?
- Why was the choice made in the previous meeting to have someone from DCMR (environmental permits and supervision organization) giving a presentation on the safety aspects of industrial activities instead of someone from SodM?
- Is it possible to invite someone from SodM to these ENOS meetings to exchange ideas with them about the safety of CO_2 geological storage projects and the supervision thereof?
- Aren't there other ways to solve the climate problem and reduce CO_2 emissions? We can't continue to consume like this for example.
- Could we add the exchange of new developments regarding CO_2 geological storage as a topic on the agenda for one of the meetings next year?
- For the next meeting, when we will talk about what we could learn from other energy or infrastructural projects, is it possible to pick cases that we are familiar with because they come from our local area?

On the lecture on monitoring in CO_2 geological storage:

- Is it true that the first three requirements for a storage location [capacity, injectivity, sealing] are not a challenge? And that you mainly need geological knowledge for that?
- What are the biggest challenges in finding a suitable CO_2 storage location?
- Is the standard procedure for CO_2 geological storage to fill up the gas field to the original pressure in the field (like before gas production)?
- Can CO_2 react with other substances in the reservoir and cause damage?
- Is there also a chance of a side reaction from the injection, such as cracks in the earth?
- Which type of wells could be used for CO_2 geological storage? Only operational wells or also abandoned wells?
- Do we know the location of all abandoned wells?
- When you use an old well, it is probably closed without pressure; how does an older plug react to increased pressure in the field due to CO_2 injection?
- How does a plug from a sealed well react to the pressure of CO_2? In the 1960s / 70s these wells were of course not sealed with the intention of CO_2 storage. The wells are closed without gas pressure.
- What is the chance of CO_2 leakage?
- How does CO_2 escape in the case of a leak?
- How much CO_2 is released in the case of a leak?
- Participants express their concerns about the possibility of CO_2 leakage.
- Participant indicates that he appreciates that the invited speaker also shows that things can go wrong, but that they have learned from it and that you know how to prevent it.
- Can we locate all closed wells?
- Which period of time is taken into account for CO_2 storage?

- How will an operator guarantee safety at such a storage location?
- Which international regulatory standards for supervising geo-energy projects will be used by SodM?

5th Meeting (December 13, 2018)

Theme:

- *What can we learn from other geo-energy projects when it comes to social support? And what role does communication play in this?*
- *With insights from scientific research and the practice of a stakeholder manager.*

QUESTIONS ASKED BY CITIZENS

Review of previous meetings.

- At the first meeting, we discussed that it would be a good idea to make this group a more diverse group, with more diversity in backgrounds of the participants in the group; what has been done with this suggestion so far?
- Can't we use the knowledge that we [the Netherlands] build up about this technology [CO_2 geological storage] to contribute something to the world? Maybe it helps to create public support? Would you like to turn a threat into an opportunity and turn knowledge into an export product?

On "what can we learn from scientific research on public support of geo-energy projects? And what role does communication play in this? "

- Nice that you also show examples of projects that people díd want in their backyard / village / neighborhood. Have you also examined why people wanted these projects?
- Does it happen in reality that parties involved in a project jointly communicate their message to the public?
- We are now assuming that CO_2 is the big problem; but who actually knows what the impact on our environment is of methane? Who has the objective knowledge? Who knows the facts on these kinds of topics? These are not discussed openly because of political processes.
- Who actually bears the costs? Who pays for these projects? I guess that will be the citizens again?
- Have your research projects also looked at the efficiency of projects? How do you know that your investment [in stakeholder management/ communication] has been effective?

On "What can we learn from experiences of an advisor in stakeholder engagement regarding public support for geo-energy projects? And what role does communication play in this? "

- Is it expensive to appoint a stakeholder manager?
- Is it worthy to appoint a stakeholder manager?
- Is it effective to appoint a stakeholder manager?
- How do you know that you have involved all relevant stakeholders?
- How do you ensure that your role as stakeholder manager is legitimized?

Concerns of the citizens- not questions

- Participants name various projects within their own local environment that have insufficiently taken into account the impact of a particular project on the environment (and public).
- The goal of involving everyone in a process does not always seem genuine. The windmills that are placed on the southern border of Rotterdam are a good example of this. The windmills were built in the middle of summer when everyone was celebrating summer holidays. In addition, people who lived just across the border from the municipality had no say. We doubt that the right people were involved in the decision making process for this windmill project?
- A lack of transparency is damaging to trust. As in Groningen public support was damaged because the health of the environment and the population has been denied there.
- It is very important who communicates with the public. In the same project, 2 people can have very different effects on the level of trust of citizens. I [one of the citizens] remember a public hearing for a geothermal project in this area. When the stakeholder manager was speaking, I had the feeling I could trust him. This was different from the moment the project director took the stage, my trust in the project decreased. The director mainly reasoned from his own interests and was not tuned to his audience.

6th Meeting (February 19, 2019)

Theme:

- *Recent developments regarding CCS*
- *Reflection on insights and lessons learned after 5 meetings.*
  - *From the perspective of the citizens involved in the ENOS research*
  - *From the perspective of the ENOS social research team*

QUESTIONS ASKED BY CITIZENS

On recent developments:

- What is the relationship between Porthos and the ENOS research project?
- What communication is there between Porthos and the ENOS research project?
- It would be a shame if Porthos would need to reinvent the wheel, while we are already learning so much here.
- How could Porthos learn from what we discuss here during the ENOS meetings?
- What could we [the citizens involved] share from the ENOS meetings with Porthos?

On inventory of new knowledge questions (from citizens) based on insights gained so far:

- What is the cost of CO_2 geological storage: who pays what?
- What makes the investment in CO_2 geological storage worthwhile?
- Do we first need a disaster to realize the urgency of CO_2 geological storage? When do people wake up?
- How is our [the Netherlands] effort to realize CO_2 geological storage related to other global developments?
- Is CO_2 geological storage in the Netherlands useful and valuable as long as we have an economy dominated by capitalism?
- How much knowledge do experts have about CO_2 geological storage?

- What role should national and local institutions play to ensure safety in CO_2 geological storage projects?
- What are the risks of CO_2 geological storage and how should you make choices based on this?
- What consideration do you make when choosing CO_2 geological storage?
- How do you balance the risks of CO_2 geological storage with the need to learn for a larger-scale application?

Linked to the inventory of new knowledge questions, questions arise about Porthos:

- The ROAD project had the objective to learn- if such a project doesn't go well, you can stop it. Porthos is a commercial project, which increases the pressure to deliver. Which risks arise from this?
- Normally you have a step-by-step process for upscaling new technologies. But our impression is that this large scale project [Porthos] already is the product of such a learning process, while the learning process itself haven't taken place.
- How can a large-scale CO_2 storage project be realized - without a learning and development process preceding it? Is it going well if you tackle it on a large scale without intermediate steps? You don't know what you're going to encounter?
- How can large-scale CO_2 storage be realized, while so much is still unknown and uncertain?
- Does the fact that Porthos is a commercial project affect the operations of the project? Is there a risk that other choices will be made regarding the operations because of financial interests?
- What are the influences of commercial interests in a large-scale commercial CO_2 storage project?
- What measures could be taken to ensure the safety of large-scale commercial projects (such as Porthos)?
- What are the possibilities for adjusting the permit and improving the operations of a large-scale commercial project if there will be new research outcomes, new monitoring data or other new insights and?
- Can the financial interests of participants in a commercial CO_2 storage project threaten safety? Does safety remain paramount?
- Is the knowledge of the parties involved in the Porthos project sufficient to develop and operate the project safely?
- Who guarantees safety in a large-scale CO_2 storage project, such as Porthos?
- Is SodM the appropriate regulator to guarantee the safety of large-scale CO_2 storage projects? Is their knowledge up-to-date?
- Who guarantees the implementation (broader than safety) of a large-scale CO_2 storage project, such as Porthos?
- Are there other CO_2 storage projects to learn from?
- Is there enough attention for learning via small steps?
- How to maintain the technical system [infrastructure] when several big industries supply CO_2 into 1 pipe?
- How to guarantee the quality of the supplied CO_2 if it comes from different industrial sources?
- Can you grant permits to activities that you are still researching?
- Why can't you adjust permits in projects with such new techniques?
- What are the gaps in the legislation and regulations for CO_2 geological storage projects?
- How would the governance for supplying the CO_2 look like?
- How can you make decisions without having enough knowledge?
- How is a decision made to start a large-scale CO_2 storage project?

On overview of lessons learned from the perspective of involved ENOS researchers

- Why do some (technical) experts find it challenging to talk to citizens?
- Could citizens help experts to think out of the box?
- How can citizens help a project or expert to be more open to suggestions from others?

7th Meeting (April 4, 2019)

Theme:

- *Recent developments*
- *Costs and benefits of CO_2 geological storage*
    - *Discussed from a broader perspective and current debates on the climate objectives from Paris, the Dutch climate agreement, the energy transition, business climate for industry, ETS system, CO_2 taxes, etc.*

QUESTIONS ASKED BY CITIZENS

On news about CO_2 geological storage in the Rotterdam region:

- Is the Porthos project cost-effective?
- Why is a subsidy needed for the Porthos project?
- How is it possible that the Porthos project is not cost effective?
- Is it true that the benefits of CO_2 geological storage mainly go to the large oil companies (less CO_2 tax) and the costs to the government and citizens?
- What is the role of the government? What are the costs and benefits of the government in realizing CO_2 geological storage?
- How does the ETS system work?
- Why is not the cheapest option chosen to solve the climate problem? Why would you now invest in subsidizing CO_2 storage if there are cheaper options in other industries? Which options [for CO_2 emission reduction] pay off the most?
- Why not switch from fuel oil to natural gas in the shipping industry to reduce CO_2 emissions? Isn't this a cheaper option than CCS? Why isn't this being used on a large scale?
- How do you guarantee the purity of CO_2 gases supplied in the system that Porthos provides?
- From the information meeting on 7th of March of Porthos in Oostvoorne, I concluded that Porthos will capture the CO_2 at existing (and still to be built) hydrogen factories. Why?
- How will the Ministry guarantee the safety of Porthos? I have little confidence in that. I have a strong impression that CO_2 storage in the mining law is not properly regulated, as was the case with geothermal energy, and that SoDM is not yet ready for it.

On the introduction to various aspects and debates about costs and benefits of CO_2 geological storage:

- Who will ultimately pay the costs?
- What are the benefits of CO_2 geological storage?
- Who are the benefits for?
- What are the benefits for citizens?
- Can citizens influence what the costs will be for citizens?
- Do we [citizens] have to pay for the benefits of the industry? Why are the CO_2 costs not passed on in the consumption products on the market?

- We now pay tax to reduce CO_2 emissions in the Netherlands while the products are sold on the European market.
- Why are the costs [of CO_2 emissions] not passed on to the user / consumer?
- How can CO_2 be included in end products on the market?
- Why are large companies unaware of the urgency of reducing CO_2 emissions themselves?
- How come large companies do little to reduce CO_2 emissions?
- What other measures are needed to achieve the climate goals?
- What is the urgency of climate problems compared to other urgent world problems, such as terrorism?
- What is the urgency of climate problems for the Dutch with regard to other social issues and daily affairs, such as paying the bill?
- How can it be so difficult to arrive at a joint vision and a joint approach to solving the climate problem, such as was successful for the construction after WWII? Then a common urgency was felt.
- What do you have to do as a government to make people and companies realize the long-term urgency of the climate problem?
- What is the influence of our political (democracy) and economic system (capitalism) on climate policy?
- Are windmills reducing CO_2 in the end?
- How efficient are the various measures to reduce CO_2?
- Why don't we put our money in other alternatives to reduce CO_2?
- Why are politics not transparent about the costs of the various options for reducing CO_2?
- What are the influences of the world market for oil and CO_2 geological storage on the policy choices that are made?
- What are the costs of dismantling an oil or gas platform?
- What would it mean for the settlement of the larger industries in the Netherlands if we do or don't invest in CO_2 geological storage?
- What is the return of investment period for investments in CO_2 geological storage?
- How do you choose the site location for CO_2 geological storage?
- What does CO_2 geological storage mean for the competitive position of Dutch industries?
- What roles do the different stakeholders play in CO_2 geological storage?
- What do we mean by "the market" for CO_2 geological storage?
- There seems to be no incentive for investments in CO_2 geological storage. Why is that?
- Are market mechanisms desirable for solving the climate problem?
- Who is compensated for CO_2 geological storage and with what kind of compensation measures?
- What is the role of the government? Compensation, guarantees, regulations, monitoring?
- How exactly does the ETS system work? And how do the CO_2 taxes relate to the necessary investments in CO_2 geological storage?
- Which pricing mechanisms work best to stimulate CO_2 geological storage?
- Which choices have the most effect on CO_2 emission reduction?

On "what aspects or arguments would you like to see in the explanation of the costs and benefits of a CO_2 geological storage project?"

- What are the total construction costs of the project? And what is the government's contribution to these costs?
- What are the maintenance costs / operational costs for a CO_2 storage project per year? What is the government's contribution to these costs?
- Will CO_2 suppliers also co-invest in a CO_2 geological storage project?
- What is the relationship between investment and benefits of the CO_2 suppliers?
- As a citizen, do we have a say in the amount of the governmental contribution to a CO_2 storage project?
- Why is the project appropriate at this moment and at this location?
- Where in the process is optimization of the operations build-in?
- Why are not all industries in the Port of Rotterdam involved in Porthos?
- What is the capacity/ focus area of Porthos (pipes, compressor, the field)?
- Shouldn't the government take much more responsibility in solving the climate problem? (because it is a collective problem that cannot be solved locally?)
- Shouldn't the government demonstrate that a CO_2 geological storage project can be developed cost-effectively?
- What makes the intended project a good project?
- How does the intended project contribute to the higher goal [CO_2 emission reduction & climate objectives]?
- Does the project [Porthos] also contribute to the optimization of the entire CO_2 chain?
- Why is it necessary to provide a subsidy for CO_2 geological storage?
- If something is a good investment, doesn't it pay for itself?

8th Meeting (May 23, 2019)

Theme:

- *Combining CO_2 storage with other economic activities.*
  - *CO_2 storage as a stimulation of oil production in the Czech Republic.*
  - *Storage and use of CO_2 in Dutch horticulture.*

QUESTIONS ASKED BY CITIZENS

On current CO_2 storage affairs in the Rotterdam Region:

- Storage of natural gas doesn't seem to be a problem. But when it comes to CO_2 geological storage, much more opposition becomes manifest. Why is that? Everything is about the perception of citizens. How do you deal with that?
- Are there positive spin-off effects for doing something useful with CO_2, rather than just costing money?

On combining CO_2 storage with other economic activities:

- What is the contribution of this technique in solving the climate problem?
- CO_2 storage is only a small part of the solution. The question remains, "why would you do this?"

Case I: enhanced oil production in the Czech Republic

- Why was the Czech Republic chosen as a case? You want to make the research attractive to public, the Czech Republic is not a catchy case.

- It is interesting to calculate the complete process; which amount of CO_2 reduction could be achieved with this project?
- Why would you invest in questionable experiments, which don't contribute to removing CO_2 from the air directly?
- Because you keep a field active you can eventually put more CO_2 into it. Is this the case with all fields?

Case II: CO_2 buffering for use in horticultural greenhouses

- Is this a small solution for a very big problem?
- How do you ensure that parties participate? There must be a trade-off for industry to capture CO_2 in the OCAP pipeline instead of emitting it. The CO_2 from the industry has to be processed before it is of value for other projects, which makes CO_2 emissions still cheaper. A political incentive is required to allow companies to use or store CO_2. For example, by increasing the tax on CO_2 emissions
- Horticulturists are extremely anxious about the quality of the CO_2. We have also asked Porthos this question, how do you guarantee this quality?
- Why not two CO_2 storage fields? One for high and one for low quality CO_2.

9th Meeting (June 20, 2019)

Theme:

- *Participatory monitoring of geo-energy projects.*

QUESTIONS ASKED BY CITIZENS

Following introduction and current affairs:

- Is the Porthos project cost-effective?
- As long as Porthos is not cost-effective, we are paying while the benefits go to the CO_2 emitters. How do you balance that?

On the approach for participatory monitoring (PM) for geo-energy projects

- One of the citizens notices that two things play the main role in conversations about CO_2 geological storage in his environment:
    - Safety: what are the risks?
    - Who is responsible? If these risks go wrong, who is responsible the damage? The level of trust in the government to take this role has been breached.
- Is it a problem that we, as a group, are not representative for all Dutch citizens?
- Is it possible to establish one correct way of involving citizens in a project?
- How do you tackle a misplaced perception?
- So far, there is no support in the Netherlands for CO_2 geological storage. Now we are working on it, but what is next?
- Who will do something with the results of this project? Does our input actually make sense?
- It seems difficult to quantify the advantages and disadvantages with this subject (CO_2 geological storage)?
- How do you make sure you don't overlook a group?
- Participatory monitoring increases trust, how do you then incorporate this into the PM program of the project?
- How much knowledge does an operator of a CO_2 geological storage project have?
- And how does participatory monitoring contribute to more knowledge?

- What is the price tag of this participatory monitoring program for your project?
- On the other hand, what are the costs if you don't do this and you run into resistance and a potential deadlock?
- What is the monitor frequency? Do you reduce it after some time and increase it when their will be leakage or seismic activities?
- Why do you start PM, for what purpose and what do you need? Why would you make a stakeholder analysis, for example. Who are you doing this for?
- What are the risks of the PM system and how can you deal with it?
- What if an important stakeholder walks away from the project and never comes back? How do you deal with that?
- How do you keep the people you need interested and motivated to participate?
- What are the do's and don'ts for PM?
- Who is PM interesting for?

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