Stakeholder engagement findings:

Roadmap and final recommendations

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Executive summary

Introduction

This deliverable aims to provide an overview of the most important findings on stakeholder consultation as well as to provide recommendations of participatory formats for stakeholder engagement in regional CCUS projects. Thus, we (a) present the processes and results from the regional stakeholder committee (RSC) workshops as part of the stakeholder engagement activities in STRATEGY CCUS and (b) outline recommendations for stakeholder participation beyond the lifetime of the project based on a synthesis of all stakeholder engagement results in STRATEGY CCUS regarding social acceptance. The focus of this deliverable is on social acceptance but in the RSC workshops, we focus mainly on stakeholders instead as on the public. Key stakeholder act as informants within the region of interest and thus, can play a special role in social acceptance processes.

Method

Regional stakeholder committees (RSC) made up of key stakeholders were established in each of the eight regions of STRATEGY CCUS. Stakeholders from all identified stakeholder categories (see D3.1) were part of the RSC. The number of stakeholders per RSC ranged between 6 and 20 participants with most stakeholders from the industry. In some countries, it was difficult to include NGOs, researchers, support organizations and interest groups. Established stakeholder engagement and problem structuring methods from the social sciences were applied to ensure reliable and scientifically high-quality outcomes of the stakeholder engagement process. After each RSC workshop, the stakeholders were asked to complete a short evaluation questionnaire to gather their perception of the workshop and what we need to consider for the next workshop.

A total of three RSC workshops were held in all regions during the course of the project STRATEGY CCUS. The first workshop, conducted end of 2020, focused on building a connection between stakeholders as well as getting familiar with the STRATEGY CCUS project. The second RSC workshop took place in spring 2021 and aimed to strengthening the stakeholder network and receive their first opinion on the CCUS scenarios developed for the respective region. Here, a visioning exercise was implemented. The third RSC workshop, conducted at the beginning of 2022, aimed to present and discuss the final scenarios with the stakeholders including the economic assessment of the CCUS implementation and a SWOT (=strength, weaknesses, opportunities, and threats) analysis.

For the preparation, implementation and documentation of the RSCs, we established a constant exchange and strong cooperation between the WP lead, the regional teams as well as the technical team. This was necessary for the successful implementation of the RSC workshops and to implement them with the flexibility needed during the pandemic. The RSC workshops were conducted by the regional team ensuring a workshop implementation in the national language (except in Romania) and to provide a safe space for every stakeholder to speak up and mention its opinion regarding the implementation of CCUS in the region. To further nurture a safe space for exchange, we monitored the implementation of an informed consent form which was signed prior to participation by the stakeholders.

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Results

The first workshop had some methodological challenges caused by the shift from a face-to-face design to an online format due to the upcoming COVID-19 pandemic. However, the online RSC workshop was successfully implemented as indicated by the RSC members' evaluations. As results of the first RSC workshop, the main drivers of CCUS implementation expressed by the RSC members in the regions were the existence of CCUS-relevant industry in the region as well as the positive reduction of CO_2 emissions. As main barriers, the stakeholders mentioned the economic feasibility and the impact for the environment as well as the lack of clear regulations and distribution of responsibilities. Overall, the first RSC workshop was perceived as a great opportunity to connect with other CCUS-related stakeholders.

In the second RSC workshop, a first version of the scenario was presented and discussed. Besides this, the second workshop aimed to strengthen the network between the stakeholders. Most RSC members in most regions liked and confirmed the presented scenarios, they found them interesting and a good starting point. Most stakeholders highlighted that the scenario needs to be developed further by including additional information - especially on the economic assessment. Thus, in most countries, there was a discussion of the economic feasibility as well as on the (expected/anticipated) social acceptance (mostly with a focus on the social acceptance of storage). The RSC members also highlighted the importance of implementing a pilot as a starting tool for technical, institutional, social, environmental and financial feasibility. Their views of the future of CCUS differed between a key role in decarbonisation and a secondary role (as end-of-line solution) if there is no other option to decarbonize specific industrial processes, reflecting the results from the interviews in T3.2.

The results of the third RSC workshop validated and deepened the results from the two other RSC workshops: Although, there were minor region-specific discussion, most RSC members across the regions considered the economic feasibility, the social acceptance from the public, the environmental impact as well as the required political and regulatory framework as main problems for the scenarios in the SWOT analysis. The economic evaluation of the scenarios was the most discussed aspect. Overall, the scenarios from the project were perceived as rather realistic and interesting. Some RSC members expressed ideas for some adjustments or had specific opinions about decisions for refinement, most stakeholders had questions about the economic evaluation.

Conclusion and recommendations

Overall, the participatory format of RSC workshops was very welcomed and RSC members were happy to be part of a diverse board discussing the potential implementation of CCUS. The stakeholders were highly engaged and motivated to express their opinion to contribute to the strategic planning of CCUS in their region.

As recommendations for future participatory activities with stakeholders around CCUS developments, the following aspects have proven to be valuable:

- ✓ establishing a strong team for conducting the workshops regarding social science methodologies, CCUS experts, technical support and a regular exchange with the regional teams conducting the workshops.
- ✓ leaving enough time for discussions and region-specific modifications
- ✓ conducting the RSC workshops in the local language

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- ✓ implementing suitable data protection processes (i.e., a short informed consent form) to guarantee a safe space for exchange and a small hurdle regarding administrative issues for the stakeholders

Although we implemented these aspects, we see potential for improvement. For instance, the foci of the RSC workshops were impacted by the discipline of the regional teams conducting the workshop. Thus, the involvement of additional social science teams would have enhanced the implementation of participatory formats for stakeholder engagement. In addition, integrating a more balanced set of stakeholders (e.g. more stakeholders from NGOs and representatives from local communities) could have led to further insights and should be considered in subsequent projects. In general, we recommend to identify and involve key stakeholders in projects early on.

Regarding the synthesis of social acceptance findings from the STRATEGY CCUS project, we recommend to consider and apply the following aspects:

- For CCUS to be considered as an option in regional and national policy strategies for the energy transition, there is still a high need to raise awareness for the benefits and risks around the technology, also with societal stakeholders.
- Acceptance for CCUS in the public is not clear but overall, many people state to support CCUS as far as they know about it. This implies that opinions depend on the development of the debate and it is open yet whether or not CCUS strategies will find societal support.
- Acceptance for CCUS seems to be conditional (e.g., it strongly depends on the CO_2-source, perceived socio-economic benefits, environmental and safety risks, social trust). This emphasizes that engagement processes are important to find out which options are supported by society (or not) and to enable the emergence of trusted relationships.
- For the general public as well as for key stakeholders, enabling discussions and the chance to obtain and provide information is, therefore, strongly recommended for the future.
- Projects such as STRATEGY CCUS or its follow-up project PilotSTRATEGY are valuable in this regard: Through the scientific evaluations on the regional level, the debate about CCUS also comes to the regional level. Moreover, these projects include work on high-quality stakeholder involvement. It is important to note that stakeholder engagement does not mean to convince stakeholders on (certain options of) CCUS, but to provide a platform to exchange on scientific evaluations, ensure transparency and enable to build trust around the project, as a basis for taking a political decisions on regional pathways for decarbonisation - including CCUS or not.

The approach of combining an exploration and scoping phase to learn more about the relevant regions and technological options and also to make a first step towards the stakeholders has proved valuable and is highly recommended to future projects.

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Table of Contents

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Stakeholder engagement findings: Roadmap and final recommendations

1 Objectives and structure of this deliverable

This deliverable aims to provide an overview of the most important findings on stakeholder consultation and engagement as well as to give recommendations and indications of how relevant stakeholders can be further involved and engaged in the future. Thus, the aims of this deliverable are two-fold:

(a) to present the processes and results from the regional stakeholder committee (RSC) workshops as part of the stakeholder engagement activities in STRATEGY CCUS and

(b) to outline recommendations for stakeholder participation beyond the lifetime of the project based on a synthesis of the stakeholder engagement results from the STRATEGY CCUS project regarding social acceptance.

Consequently, this report contains two parts. First, we present the developed structure for participatory formats of stakeholders, the three regional stakeholder committee workshops, as well as how they were implemented in the eight regions and - most importantly - their outcomes. Second, we provide a synthesis of the results from the STRATEGY CCUS project on social acceptance including a summary of the results from the interviews conducted in Task 3.2 as well as the surveys implemented in Ebro Basin (Spain) and Rhône Valley (France) in Task 3.4 and we will outline recommendations regarding social acceptance and the engagement of stakeholders in the process of implementing CCUS.

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2 Part I: Regional stakeholder committees

This first part of the deliverable presents the objectives of the regional stakeholder committees (RSC) as an activity for stakeholder engagement. In each region, namely the Rhône valley and the Paris basin in France, the Ebro basin in Spain, the Lusitanian basin in Portugal, Upper Silesia in Poland, the West Macedonia area in Greece, the North of Croatia and the Galati area in Romania (at least) three RSC workshops were conducted.[1] Thus, this part also outlines the structure, methodology and results of each of the three workshops with the RSCs. In addition, we will reflect on the implementation of the RSC workshops including the impact of COVID-19 and end this part with a conclusion regarding the RSC workshops.

2.1 Objectives and establishing the regional stakeholder committees

The objective of Task 3.3 was to develop and explore the implementation of participatory formats for the engagement of regional, national and European level stakeholders. This led to the establishment of RSC and related workshops, a participatory format that was specifically designed for the scope of STRATEGY CCUS and its aim.

The aims of establishing the RSC in each region were

- to engage with stakeholders not as passive recipients but as actively shaping the project's outcomes,
- to reach out early on to stakeholders in the regions under study so that they can monitor the strategic planning of CCUS in the region,
- to provide up-to-date information on the progress of STRATEGY CCUS since the RSC members also act as informants within their regions
- to integrate them in decision making whenever possible by asking for their advice,
- to consider the regional concerns, expectations and inputs.

Consequently, in each of the eight dedicated regions of the STRATEGY CCUS project a regional stakeholder committee (RSC) consisting of 10-15 key stakeholders was implemented. These committees met at least three times during the project and were coordinated by the regional STRATEGY CCUS consortium partner (in short: local teams) to ensure that the workshops were conducted in national language. The local teams consisted of the partners from the respective country involved in the project. They represented a variety of institutions and individual background with a majority from technical fields and natural sciences. Fraunhofer ISI and CIEMAT-CISOT as social science teams and work package (WP) leads developed an overall structure for the RSC including participatory methods and instructions for each of the RSC workshops that were applicable in all regions. The aim of this content-related coordination was to keep the regional outcomes similar and thus partly comparable. However, we took regional specificities into account to make the outcome of the RSC for each region as successful as possible. This means that specific modification to meet the regional specificities were applied in close collaboration between the local teams and WP leads.

[1] For more detailed information on the regions see D3.1 and D3.2. For the technical specifications of the respective CCUS scenarios refer to the outcomes of further WPs of the project.

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Thus, in several bilateral meetings before each RSC workshop, Fraunhofer ISI and CIEMAT-CISCOT provided input on participatory methods and formats and supported the regional teams to adjust the overall structure to the country's and region's specificities.

The RSC consisted of 10-15 regional, local as well as few national key stakeholders from different categories. These stakeholder categories were defined in Task 3.1 based on existing actor frameworks for innovation systems and the adaption of this framework to fit the project's scope considering the regional, national and European level (for details see D3.1). The aim was to achieve a broad representation of societal actors in relation to the CCUS innovation system. Consequently, the stakeholders and participants of the RSC workshops consisted of representatives

- from industry, i.e. the demand and supply side,
- from research and education,
- from politics and policy making / public administration, as well as
- from NGOs, support organisations and individuals from local / regional communities that presented influencers.

Most members of the RSC also participated in the interviews in Task 3.2 based on the stakeholder mapping in Task 3.1. Based on these preparatory steps, the regional teams had already established contact to the key stakeholders relevant for each region. Thus, the final RSC members were selected built on input from Task 3.1 and 3.2. Since the RSC workshops were spread across the lifetime of the project and new relevant key stakeholders could have been identified, the RSC members were not fixed: Throughout the lifetime of the project, it was possible to include additional stakeholders if this turned out to be beneficial and/or relevant due to changes in the political context and/or the RSC members positions.

2.2 Overall structure and objectives for each RSC workshop

As outlined, three RSC workshops in each region were planned and conducted. Originally, only two mandatory RSC workshops were planned, however, due to unforeseen changes, we adjusted the number of RSC workshops to three mandatory workshops for each region: The planning of the first RSC workshop started in fall 2019 and was further elaborated in spring 2020. However, due to the starting **COVID-19 pandemic** in spring 2020, the initial plan for the RSC workshops needed to be adjusted - from a face-to-face format to an online format. Of course, the change from a face-to-face to an online format led to (small) disadvantages, but also advantages in interacting with the stakeholders. However, beside national pandemic rules, it was crucial to ensure the health and safety of everyone involved. Thus, (at least) two of the three RSC workshops were conducted in an online manner. In one country (Croatia), the third RSC workshop took place in a hybrid format, but most participants still attended virtually. The required change and methodological adjustment to an online format required additional efforts regarding planning as well as the involvement and strong collaboration with the Romanian partner from the College of Communication and Public Relations (Scoala Nationala De Studii Politice Si Administrative, SNSPA) who ensured the technical feasibility of the virtual RSC workshops, shortly before and mainly during the RSC workshops (e.g., providing the respective link, helping RSC members to connect and to how to use the online tool, monitoring the chat and potential technical problems during the RSC workshop).

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As outlined, a constant exchange and cooperation between WP leads and the regional teams was necessary for the successful planning of the RSC workshops: The input material as well as instructions were developed by Fraunhofer ISI and CIEMAT-CISOT. The RSC workshops were moderated by the regional teams from the respective country. This ensured to conduct the workshops in the national language and to provide a safe space for every stakeholder to speak up and mention its opinion regarding the implementation of CCUS in the region.

It is important to mention that all relevant data protection guidelines were in place, thus, before participating in the first RSC workshops, all members of the RSC signed an informed consent form including the statement that they will not share information provided by members of the RSC. In addition, all information will only be shared in an aggregated and anonymized way (as here in the deliverable) and will be exclusively used for research purposes. Besides meeting the required data protection guidelines for H2020 projects, this also ensured to create a safe space for openly sharing all concerns and needs within the RSC workshops. Signing this informed consent from also applied for new RSC members that entered the workshops later in the course of STRATEGY CCUS.

2.2.1 Timing and overview of objectives and methodologies

The following figure (Figure 1) shows the timing and the main objectives as well as the applied methodology for the three RSC workshops. In some countries (Spain and France Paris Basin), a **fourth RSC** workshop was planned and conducted since the need for further exchange was rated as high by the local teams and/or the stakeholders themselves. However, the present deliverable will focus on the first three RSC workshop to ensure a common structure as well as - to some extent - to compare the results of the RSC workshops. Nonetheless - as outlined - region-specific modifications applied and needed to be taken into consideration.

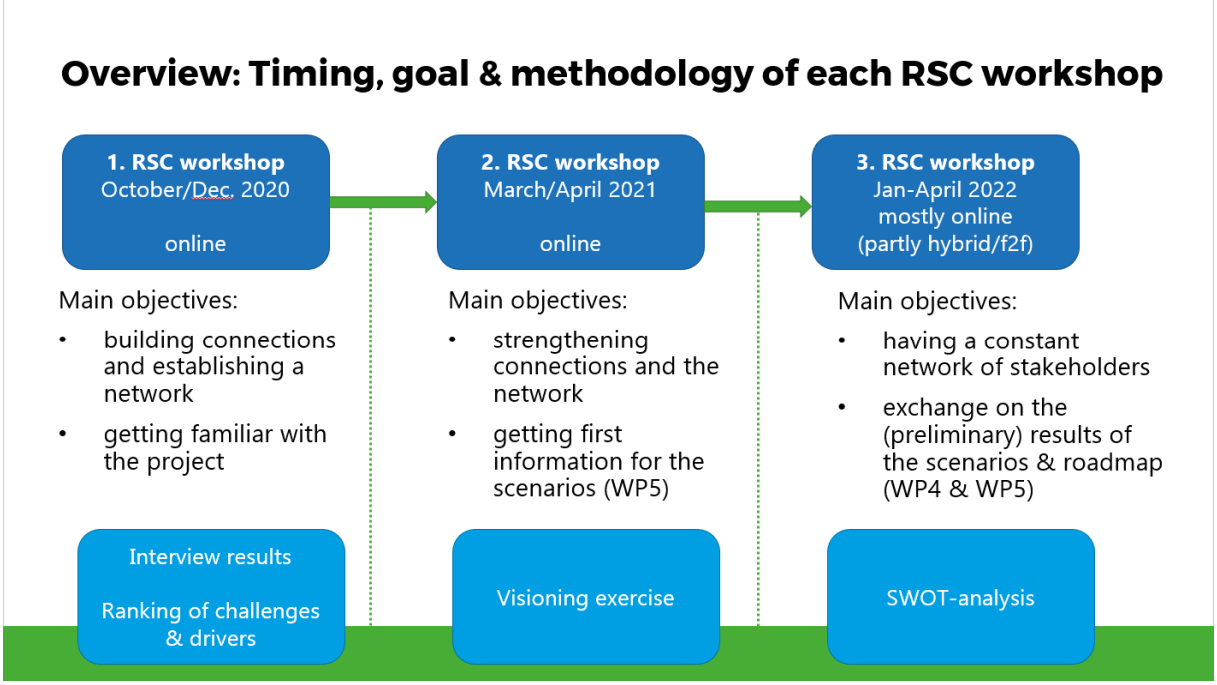

Figure 1. Overview of timing, objectives and applied social science methodology in the three RSC workshops (that were adjusted to region- and stakeholder-specific conditions)

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2.2.2 Methodological design of the RSC workshops

Before each RSC workshop, all RSC members were invited well in advance and were informed about the purpose and structure of the meeting: RSC members received an invitation email containing the date, time as well as the dial-in link. In addition, this email often also included additional material such as a leaflet about STRATEGY CCUS and the informed consent form as well as a summary of the last RSC workshop. These additional materials ensured that also new RSC members that participated for the first time in an RSC workshop received the respective information and that the ground for discussions during the RSC workshop was the same for every stakeholder. In several cases, this additional information was also accompanied by a call from the local team to brief new RSC members.

The WP leads/social science teams from Fraunhofer ISI and CIEMAT-CISOT provided a suggested agenda for each RSC workshop including not only presentations about the project's status but also interactive elements to engage with the stakeholders and to hear their concerns and thoughts. For this, established methodologies from social sciences were applied to ensure reliable and scientifically high-quality outcomes of the stakeholder engagement process. Thus, the regional teams translated the provided material in the local languages and discussed required modifications to fit the RSC and the region-specific adjustments. To provide a few examples, the used tools for the online workshops differed between the regions because in some countries it was common to use Microsoft Teams, while in others, stakeholders used mainly zoom. Also, the length of the workshop was adjusted to the RSC members however, still ensuring that the most important aspects of the RSC workshop's outline were covered: In some regions, after the first RSC workshop, stakeholders asked for more time to discuss the relevant aspects, while in other regions, stakeholders mentioned their very limited time and to shorten the next RSC workshop. This information was taken from the evaluation questionnaires that was prepared from Fraunhofer ISI and CIEMAT-CISCOT, adjusted for the content of each RSC workshop, translated by the local teams, and applied at the end of each RSC workshop. The evaluation questionnaire also contained questions on the overall rating of the RSC workshop as well as on potential key stakeholders that were missing. An example of the RSC evaluation questionnaire (in English) is displayed in the Appendix 4.1. The outcomes of the evaluation questionnaire presented very valuable sources to fine-tune the next RSC workshop(s) and to constantly improve the RSC members' experiences.

After each RSC workshop, the regional teams translated the outcomes of the participatory and interactive parts and provided a comprehensive report for the WP leads including the final agenda, the list of actual participants (stakeholder category), a summary of the workshop as well as their perceptions and lessons-learned for the next RSC workshop. The details of these regional reports ensured anonymity for the stakeholders and present the basis for the results described in this deliverable.

In the following sections, we will present the overall aims and objectives of each RSC workshop as well as the suggested agenda. We will also outline the social science methodology that was applied as well as the results of each RSC workshop including region-specific circumstances whenever applicable and relevant.

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2.3 RSC workshop 1

2.3.1 RSC workshop 1: Aims and process

One focus of the first RSC workshop was to start building a network. Specifically, this RSC workshop aimed to build a network within each region by bringing together the different stakeholders and discussing their views and perceptions to integrate their ideas and to consider their concerns for the strategic planning of CCUS projects in the regions. Thus, one major aim of the first RSC workshop was to join forces of relevant CCUS players and regional stakeholders. The idea was first to give an overview of STRATEGY CCUS and CCUS as a technology and to build a connection with and between key stakeholders by interacting and engaging with them. What was done to achieve this goal? After an introduction of all participants and a round of the table including an optional personal information, the invited key stakeholders became familiar with the project's overall structure and aims by receiving information about the project and CCUS in general. In the next step, they received up-to-date information on the progress of STRATEGY CCUS in their region.

The second major aim of the first RSC workshop was to discuss, elaborate and rank drivers and barriers of the implementation of CCUS within the region. The stakeholders were provided with the interview results from the region in which many of them have participated. Moreover, the RSC members were able to add important challenges and drivers; thus, they actively provided additional regional concerns, barriers and drivers that need to be considered in the strategic planning. A first input about potential barriers and drivers was presented based on the outcomes from the interviews which were conducted in task 3.2 (see Deliverable D3.2 for details). Based on these outcomes, the RSC members added and refined the drivers and barriers and assessed the most important challenges as well as the most important drivers for the implementation of CCUS by ranking them by relevance.

The suggested agenda including timing of the first RSC workshop is displayed in Figure 2.

When	What
(5-10 minutes)	**1. Arrival in GoToMeeting**
(15 minutes)	**2. Welcome, general information/logistics & Introduction**
(20 minutes)	**3. Introducing CCUS technologies & "Strategy CCUS"**
(10 minutes)	**4. Questions & Answers**
(10 minutes)	**5. Short presentation of the results from interviews**
(20 minutes)	**6. Discussion in Google Presentation concerning the implementation of CCUS in the regions**
(10 minutes)	**7. Wrap-up & summary**
(15 minutes)	**8. Evaluation questionnaire for attendees**
(5 minutes)	**9. Thank you & closing**

approx. 120 minutes (incl. buffer time in case of technical problems)

Figure 2. Table of suggested agenda of the first RSC workshop

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The following sections will outline the methodology and how this structure was implemented in the eight different regions and - most importantly - present the results of the first RSC workshop. For instance, it is noteworthy that the RSC workshops in Romania were conducted in English because a few relevant stakeholders were not able to speak Romanian. This is a region-specific modification of the supposed and developed agenda for the RSC workshops.

2.3.2 RSC workshop 1: Methodology

Originally, the first workshop was planned for spring 2020 but was postponed due to the COVID-19 situation. Since no one at this point of time was able to anticipate the actual duration of the pandemic, we decided to hold the first RSC workshop in fall 2020. Due to the necessary COVID-19 adjustments to the originally planned methodology, we shortened the length of the first workshop and focused on a successful workshop in an online environment including the use of interactive tools like the google presentation for ranking. Hence, the social science methodology in the first RSC workshop was not a very complex and elaborated one but mainly focused on an easy approach in which everyone (stakeholders and local teams) was able to participate and to get familiar with the so far not highly established online tools for interactions. Thus, similar to a whiteboard, the google presentation provided RSC members the opportunity to enter additional barriers and drivers of CCUS implementation in written and elaborate on them in the discussion afterwards. Moreover, we prepared symbols, i.e. stars in different colors, for each RSC member in the google presentation to rank the drivers and barriers once the collection was completed.

The discussion during the collection as well as afterwards focused on the following three aspects:

- Do the results of the interviews **miss** any other important aspect?
- Were there any **past discussions** on CCUS in the region or on national level? On what exactly?
- Which aspects regarding CCUS and its implementation in the region would you **like to discuss further** (e.g. in the next meeting)?

These questions were fixed to keep the structure of the RSC in each region similar. Nonetheless, the local teams were able to add a fourth question in case of region-specific questions. However, this did not apply in the first RSC workshop.

An overview of the dates of the first RSC workshop, the number of participating stakeholders as well as the rating in the evaluation questionnaire is displayed in Table 1.

Table 1. Overview of dates, numbers of RSC members and ratings per region for the first RSC workshop

RSC I	FR (Rhône)	FR (Paris)	ES	PT	PL	GR	HR	RO
Date	12.10.20	26.01.21	20.10.20	17.11.20	20.10.20	27.10.20	16.10.20	11.11.20
No. of stake-holders	12	13	19	15	10	8	15	11

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RSC I	FR (Rhône)	FR (Paris)	ES	PT	PL	GR	HR	RO
Overall rating	3,7 / 5 (n = 5)*	4,2 / 5 (n = 5)	4,5 / 5 (n = 8)	4 / 5 (n = 6)	4 / 5 (n = 4)	4,6 / 5 (n = 8)	4,1 / 5 (n = 12)	4,5 / 5 (n = 6)

Note: * in FR Rhône Valley a programming error occurred leading to the lack of the first question (see below), thus, this evaluation summarizes the RSC members evaluation on the other six questions only.

The first RSC workshop took part between October 2020 and January 2021. It is noteworthy that 7 of 8 regions were able to conduct their first RSC between 12.10.2020 and 17.11.2020. Only in one region, there was a small delay due to the availability of stakeholders. The number of RSC members ranged between 8-19 between the regions representing a mix of the established contacts between regional teams and key stakeholders; the number of participants may also present an indicator of the stakeholders' interest in CCUS and/or their availability to participate in the RSC workshops. The following results are based on the regional reports that were delivered in English from the local teams who conducted the workshop to the WP leads. The reports were analysed regarding their main outcomes by the WP leads and findings were aggregated across stakeholders to ensure anonymity.

2.3.3 RSC workshop 1: Summary of results

First, regarding the drivers and barriers for CCUS developments in the region, we derived the following results after presenting the interview results, adding additional drivers and barriers and ranking them from analysing the local team's reports. As main barriers and/or challenges the following aspects were mentioned (country-specific results are marked with the country code in brackets).

- economic issues and economic feasibility (mentioned in all region, except in GR), e.g. cost of capture
- environmental feasibility, impact on the environment and safety (FR Paris Basin, PT, PL, GR)
- lack of political support, lack of a regulatory and legal framework of the entire chain (FR, ES, HR) including a clear responsibility regarding the administration and bureaucracy (FR Paris Basin, ES)
- lack of social acceptance (FR Rhône Valley, ES, HR)
- lack of (technical) knowledge / feasibility (FR, PT, HR)
- distance between emitters and potential storage sites (ES)

Moreover, region-specific problems were identified such as the closing of lignite units in Greece, the large distance between emitters and potential storage sites in Spain, and the availability of permissions and data in Romania.

As main strengths and/or drivers of CCUS in the regions, the stakeholders participating in the first RSC workshop mentioned the following aspects:

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- the reduction of CO_2 emissions in the region
- existence of emitters and CCUS-related industry (mentioned in all countries, except in GR) including
    - the increased demand of CCUS (partly also from politics and the general public population, FR)
    - the availability of storage capacity (ES)
    - the future demand of CO_2-related products synthetic fuels (PT)
    - CCUS may help to slow down the decline in coal industry and thus to keep jobs and/or create new jobs (PL)

2.3.4 RSC workshop 1: Evaluation

Regarding the RSC members' evaluations of the first RSC workshop, one can see that the first workshop was evaluated as good or very good in all regions. The overall rating displayed in the table presents the average evaluation across the following seven questions:

1. In general, I liked the workshop
2. I believe that the people who have been part of the workshop have been a fair representative sample of the relevant stakeholders of the CCUS in the region
3. I think that the people who have moderated the workshop have not promoted any specific point of view about CCUS technologies
4. The way in which the workshop has been carried out has allowed me to express my opinion
5. I was clear about what I was supposed to do during the workshop
6. During the workshop there has been enough time for all those who wanted to contribute to the discussion to express their opinion
7. I think the workshop discussions have been interesting

On a 5-point scale ranging from 1 = do not agree at all (negative) to 5 = agree very much (positive), the overall rating varied between 3.7 to 4.5 depending on the region. It is noteworthy that not all RSC members completed the evaluation questionnaire[2] (see given n below the overall rating in brackets), thus, this rating is more reliable if more RSC members completed it. The evaluation questionnaire of the first RSC workshop also contained open questions on what the RSC members liked the most and they would like to change for the next RSC workshop. On these qualitative questions, the stakeholders mentioned the following:

[2] Reasons for the fact that some stakeholders did not complete the evaluation questionnaire may be technical issues and/or time restrictions. In addition, participation in the RSC workshops and all subsequent activities was completely voluntary and the completion of the evaluation questionnaire was fully anonymous, thus, we were not able to further examine the reasons for not completing the evaluation questionnaire.

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Most liked aspects	Potential for improvement
Space for and quality of discussions (FR, Paris Basin)	More time for discussion & elaboration (FR, both regions, ES, GR, HR, RO)
Promoting a climate of open participation and constructive spirit (ES, RO)	Minor technical issues such as the option to raise one's hand / a problem with the sound to be checked beforehand (HR)
The participation of everyone / that everyone was able to present their views (GR)	Live participation instead of online (HR)
The initiative / The involvement of different sectors and stakeholders in one place "I think the presence of different stakeholders is already outstanding." (HR, RO)	Sharing a written summary of the workshop and a list of participants and their contact details (HR)

It is noteworthy that only a few stakeholders of those who completed the evaluation questionnaire (see Table above) also answered the open, qualitative questions, thus, the open answers are not reflecting the opinions of all but only some stakeholders.

Overall, RSC members liked and valued the idea of bringing all CCUS-related stakeholders of one region together and discuss their views, experiences and problems regarding the implementation of CCUS in the region. **As potential for improvement**, the RSC members mentioned the online mode: They would **prefer a face-to-face format** and had small(er) technical issues in the online tool. Most RSC members would like to **spend more time to discuss** the relevant aspects and would like to get information on an example of a successful CCUS project. As outlined, we also asked RSC members whether they know stakeholders that should be involved and that we should get in contact with. Here, it was highlight that in some countries, it was difficult to include NGOs, support organizations (e.g., financial institutions, network organizations, consultants) and interest groups.

As successful outcomes of the first RSC workshop, stakeholders stressed that they liked the initiative of the workshop, to get different stakeholders and sectors together to assess the implementation of CCUS and the idea of building a network. This shows that the aim to start building a network of relevant stakeholders for the implementation of CCUS in the region was achieved and the stakeholders appreciated the given opportunity due to the participatory format.

The moderators and organizers of the regional teams reported to perceive an increased awareness of the project STRATEGY CCUS and the implementation of CCUS after the workshop by presenting the project results.

2.3.5 RSC workshop 1: Conclusion

The first workshop had some methodological challenges and delays due to the COVID-19 pandemic, however, the online RSC workshop was successfully implemented as indicated by the RSC members' evaluations. Main drivers of CCUS implementation in the regions were the existence of CCUS-

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relevant industry in the region as well as the contribution of CCUS to a reduction of CO_2 emissions. As main barriers, the stakeholders mentioned the question regarding the economic feasibility and the impact for the environment as well as the lack of clear regulations and distribution of responsibilities. Overall, the first RSC workshop was perceived as a great opportunity to connect with other CCUS-related stakeholders and thus, the first RSC workshop achieved its pre-determined goals.

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2.4 RSC workshop 2

The second RSC workshop took place in spring 2021, about five months after the first RSC workshop. Due to the ongoing COVID-19 pandemic and the overall good experiences from the first RSC workshop with online participation, it was decided to again conduct the workshop in an online format. This ensured the safety and no health risk for the local teams and the stakeholders. Its preparation and implementation required again a strong collaboration between (1) the WP leads and social science teams Fraunhofer ISI and CIEMAT-CISOT, (2) the regional teams in the respective region, and (3) SNSPA as consortium partner providing the technical support. In this second RSC workshop, also consortium partners and WP leads from WP5 were involved to ensure a high quality of the content, namely the presentation of the regional scenarios.

2.4.1 RSC workshop 2: Aims and process

The two major aims of the second RSC workshop were (a) to strengthen the connection between RSC members and thus the stakeholder network and (b) to get a first evaluation and additional information regarding the scenarios developed in WP5. Thus, the workshop firstly presented information about the current progress of the STRATEGY CCUS project but it also provided interactive formats to engage with stakeholders and consider their advice and concerns regarding the strategic planning of CCUS in the region.

The suggested agenda including timing of the second RSC workshop is displayed in Figure 3.

When	What
10 min.	**1. Welcome**
10 min.	**2. Updates about the project**
10 min.	**3. General Introduction to scenarios**
30 min.	**4. Exercise I. Visioning exercise**
15 min.	**5. Presentation of the regional scenario**
50 min.	**6. Discussion of the regional scenario**
5 min.	**7. Take-home messages**
10 min.	**8. Feedback questionnaire**
5 min.	**9. Next steps & closing**

Total: approximately 2,5h

Figure 3. Table of suggested agenda of the second RSC workshop

Based on the provided feedback by the stakeholders in the evaluation questionnaire of the first RSC workshop, we developed the suggested agenda leaving more time for discussions. However, we kept a similar structure including a short welcome, a presentation on up-to-date information about the project and the respective regional planning as well as setting the focus on the interactive parts. The

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participatory formats were here realized with a visioning exercise and a long discussion of the regional scenario. At the end, the moderation of the local teams provided a summary of the workshop by stating take-home messages. Finally, the feedback or evaluation questionnaire was distributed among the RSC members for completion. The presentation of the scenarios was split in two parts: The first part contained an introduction to scenario building and a general overview of the scenarios' aims, namely to establish realistic detailed plans and techno economic evaluations for CCUS at different geographical and timescales. This presentation was constant across regions and prepared by WP5. Afterwards the visioning exercise followed and then, the regional team together with experts on the regional scenarios (differing for each region) presented the current status of the region-specific scenario. This approach left space for regional specificities and at the same time kept a constant basis to compare between regions.

The following sections will outline the methodology and present the results of the second RSC workshop.

2.4.2 RSC workshop 2: Methodology

The methodological approach that was implemented in the second RSC workshop was **the visioning exercise**. The visioning exercise and its implementation in the second RSC workshop consisted of different parts: First, stakeholders were asked to answer the following question for themselves in written "Imagine that it is ten years from now and the region is transitioning towards a low-carbon and sustainable economy. **What role would ideally CCUS play?**" After the moderator had read the question, all RSC members accessed a link (provided in the chat) to an online survey repeating the question. In 5 minutes, every stakeholder reflected on their ideal or desired role for CCUS to play in the region, wrote their answer in the form, and submitted it. After this individual thinking and once all stakeholders had submitted their visions, the RSC members shared their visions briefly with the group (in 60 seconds). While presenting, the moderator collected important bullet points from the visions and clustered them by topic and relevance while sharing their screen. To keep the focus of this second RSC workshop's discussion on the regional scenario, a discussion of the visioning exercise was not included. The visioning exercise helps stakeholders to create a vision of the future including barriers to overcome but also including chances that are related with the envisioned development - in the current case with the development of CCUS plans in the region. With the visioning exercise, the stage for an in-depth discussion of the regional scenario was set.

The second interactive part was the long discussion of the regional scenarios after the respective presentation to include the RSC members' thoughts and advice. The regional teams received the following instructions to ensure a mostly standardized start of the discussion:

1. All participants access the link (provided in the chat).
2. The moderator reads the first question and invites participants (in 5 minutes) to answer individually in a post-it.
3. Brief discussion on the topic. (To stimulate the discussion, the moderator can read some of the comments or/and ask participants if they want to explain their answers in more detail).
4. This procedure is repeated for each of the questions. This exercise should be done in 50 minutes.

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To start and structure the discussion of the regional scenarios, the following questions were asked regarding the scenarios:

- **What do you think** of the proposed scenario for the region?
- Which aspects do you consider the **most likely** and thus should remain in the scenario?
- Which aspects do you consider **unlikely**?
- Is something **missing** in the scenario (e.g., regarding infrastructure, uses of CO_2)? If yes, what should be considered additionally?

The first three questions were fixed and common to all regions to keep the structure of the RSC in each region similar. The last question was optional. In addition, the regional teams were able to add one to three further questions for region-specific evaluations. For instance, the regional team in Poland decided to ask in addition "What do you think about CO_2 storage in uneconomical coal seams in Upper Silesia?". Moreover, the regional teams had the opportunity to present an alternative scenario and discuss it, when applicable.

Since the presentations of the regional scenarios were very detailed focusing on technical aspects, the regional teams and scenario experts received the following instructions from the social scientists. This aimed to ensure the best possible presentation of the scenarios and, consequently, a high understanding of the regional scenario for RSC members and their possibility to provide feedback and advice. Three instructions regarding the discussion to the local team and the moderator were provided:

- Make the presentation visual, attractive and simple (e.g., avoid too many Excel files)
- Experts presenting the scenario should NOT take a leading role in the discussion, they should answer the questions in a short and clear way but should NOT defend their work (too much).
- It is important that the stakeholders can express their personal opinions freely (we receive it without much commenting; if we adapt to it or not will be discussed later)

An overview of the dates of the second RSC workshop, the number of participating key stakeholders as well as the rating in the evaluation questionnaire is displayed in Table 2.

Table 2. Overview of dates, numbers of RSC members and ratings per region for the second RSC workshop.

RSC II	FR (Rhône)	FR (Paris)	ES	PT	PL	GR	HR	RO
Date	19.03.21	04.06.21	18.03.21	06.04.21	28.04.21	22.04.21	26.04.21	31.03.21
No. of stake-holders	21	11	18	15	9	6	11	9

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RSC II	FR (Rhône)	FR (Paris)	ES	PT	PL	GR	HR	RO
Overall rating	4.3 / 5 (n = 5)	4.1 / 5 (n = 5)	4.3 / 5 (n = 12)	4.0 / 5 (n = 12)	4.9 / 5 (n = 7)	---	4.4 / 5 (n = 11)	4,7 / 5 (n = 2)
Ratings of scenario	7.4 / 10 (n = 5)	7.7 / 10 (n = 7)	7.3 / 10 (n = 11)	5.9 / 10 (n = 12)	6.1 / 10 (n = 7)	---	7.7 / 10 (n = 11)	7.5 / 10 (n = 2)

Note: In Greece, the evaluation questionnaire was shared with the RSC members after the RSC workshop has ended. This led to the unfortunate fact that it was not completed by the RSC members. Thus, it is a lesson learned to not ask for additional time outside the RSC workshop but to put everything within the workshop.

The following results are based on the regional reports that were delivered in English from each of the local teams who conducted the workshop to the WP leads. The reports were analysed regarding their main outcomes by the WP leads and findings were aggregated across stakeholders to ensure anonymity.

2.4.3 RSC workshop 2: Summary of results

Regarding the **visioning exercise**, the RSC members' visions were mixed: Some stakeholders perceived the role of CCUS as fundamental to continue the industrial process while decarbonizing it, other stakeholders perceived CCUS as one option among others that should only be applied to a very selected part of industry for which other decarbonisation options are nearly or hardly available (e.g. due to technical, economic, regulatory guidelines and rules). Social acceptance issues, public and political support as well as the economic and environmental feasibility were again mentioned as main barriers (reflecting the first RSC workshop's results). However, for instance, stakeholders in Portugal agreed that CCUS pilots will be implemented in the region by 2030 in their visions. Especially in Poland and the transition away from the currently predominate coal industry, the visions of the stakeholders were mixed: Some perceived CCUS as a solution for new energy, others had doubts and preferred other ways of decarbonisation. In many countries, the reference to H_2 was mentioned in the RSC members' visions as well as the perception of CCUS as bridging technology. In Croatia, Romania and Greece, there was doubt about the implementation of CCUS in the next ten years. One Croatian RSC member summarized their vision as follows, highlighting the conditions for CCUS deployment: "The role of CCUS in a low-carbon economy depends on legislation and the new ETS Directive, and the technical and commercial viability of projects."

In Romania, only three stakeholders completed the visioning exercise, this might be due to technical issues that could not be solved during the meeting, because also the evaluation questionnaire was only completed by two RSC members in Romania.

Regarding the **feedback from the RSC members on the regional scenarios**, as shown above by the average rating of the scenario in the evaluation questionnaire and the mixed visions, stakeholders' views differed. For instance in Poland, the perceptions differed largely: Some stakeholders evaluated the scenario as positive, some as negative, some as mixed. There was no consensus on whether

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CCUS technologies present a solution for decarbonizing the industry or whether other options for decarbonisation should be considered first. Similarly, in Portugal, the RSC members were not clear whether CCUS will be needed as a major solution. Here, also the time horizon for the implementation of CCU was discussed, for some it was too soon, for others too far away.

However, most RSC members in most regions liked and confirmed the presented scenarios, they found them interesting and a good starting point. Most highlighted that the scenario needs to be developed further by including additional information - especially the economic assessment. Thus, in most countries, there was a discussion of the economic feasibility as well as on the social acceptance (mostly with a focus on the social acceptance of storage). For instance, in the Upper Silesia (PL), it was mentioned that public knowledge is missing and should be considered in the scenario: "There is very little public information about CCU and the pros and cons of clean coal technologies." This aspect of missing knowledge regarding CCUS was also highlighted by RSC members in Rhône Valley (FR).

In other regions, the discussion focused more on storage and transport (e.g., in Spain). In the French region Paris Basin, the transport by boat was an option that the RSC members mentioned. In Rhône Valley, the stakeholders expressed interest in offshore storage and a consideration of this option in the scenario. In some region, the conflicts/synergies with other underground activities were also highlighted when discussing the scenarios and additional aspects to consider (e.g., FR Paris Basin, PT, PL).

In Greece, there was high interest in the scenario and its details but only little feedback on considering the plans of the new government to close lignite units and to consider the possibility of district heating from the industry in the scenario. In Romania, four different scenarios were presented, leaving little time for discussion. In Spain, the RSC members also highlighted the importance of implementing a pilot as a starting tool for technical, institutional, social, environmental and financial feasibility. This might be a valuable step to cover also the other conditions and circumstances mentioned in the other regions.

In the following, we present a summary as well as some quotes from the reports of the regional teams on the second RSC workshop:

Question: **What do you think** of the proposed scenario for the region?

- “I have doubts that the storage will be positive for the chosen territories, very affected by depopulation and with high natural values” (ES)
- "We might have a real problem of lack of knowledge on the part of the public. ... We need to know what we collectively need to fear the most” (FR Rhône Valley)
- "The regional scenario looks quite promising and has a lot of potentials to reduce emissions." and " a great start of a very complex project" (HR)
- "Looks like a reasonable approach and suited to local specificities (presence of 3 big emitters and location in relation to the storage sites)" (FR Paris Basin)

Which aspects do you consider the **most likely** and thus should remain in the scenario?

- "CCUS will most likely be used for enhanced oil recovery (EOR)" (HR)

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Which aspects do you consider **unlikely**?

- "transport to the coast and pipeline/ship transfer" (PL)

Is something **missing** in the scenario (e.g., re. infrastructure, uses of CO_2)? If yes, what should be considered additionally?

- "It is necessary to have a notion of costs to fully understood a CCUS scenario" (PT)
- In the Spanish region Ebro Basin, the scenario was perceived as interesting and complete. However, social acceptance should be considered as a crucial issue that may question the credibility of the scenario. Moreover, the RSC members mentioned that institutional support is fundamental.

In most regions, **additional region-specific questions** were asked. In the following, we present the responses in Upper Silesia as well as in the French region of Rhône Valley as examples:

In Poland, the responses to the region-specific question on whether CO_2 storage in the empty coal mines should be considered in the scenario were mixed. A few highly agreed on it, others were sceptical regarding the safety and considered potential leakages. One RSC member stated "Without a reliable risk assessment of such an operation and forecasting the effects of long-term storage + monitoring of free storage, it seems high risk and socially unacceptable."

The French local team in Rhône Valley asked the stakeholders about their preferred transport option from Lyon to Paris Basin. On average, the stakeholders preferred pipelines, new ones or existing ones. Also, they were asked to rate their preferences for industrial clusters implementing CCUS: Most RSC members preferred an industrial cluster only in Marseille, followed by all clusters. However, they mentioned that the decision should be based on the economic assessment. Regarding the question "Which industrial sectors should be considered first? (steel – cement – refinery – waste incineration – chemistry – paper/glass)", the steel sector scored highest, followed by the cement and chemical sector. The French regional team had implemented these additional questions by using an interactive online tool, namely mentimeter[3]. Other RSC workshops did not use any tool for these discussions - these decisions were based on the RSC stakeholders' familiarity with online tools and the progress of each RSC workshop (e.g., only little use of links and time constraints in Romania).

2.4.4 RSC workshop 2: Evaluation

In the evaluation questionnaire, we included two questions to assess quantitatively the stakeholders' perceptions of the scenario. Thus, we asked "Do you consider the scenario for the region as… 1 = totally unlikely to 10 = totally likely" and "Overall, you would consider the scenario for the region as... 1 = totally undesirable or negative to 10 = totally desirable or positive". The average across these two items is displayed in Table 2. The average evaluation of the scenarios by the RSC members shows that most developed regional scenarios are not unrealistic and all scenarios were

[3] Mentimeter is an online tool to receive anonymized real-time answers from the audience via their smart phones on prepared questions. The answers can be presented by the moderator immediately, nurturing discussions.

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evaluated positively, demonstrated by averages above the scale's midpoint (=5). Interestingly, the evaluations differed largely between RSC members of one region, for instance, in Portugal the same question was answered with 2 from one stakeholder and with 10 from another. The same applied for the RSC members in Poland. This highlights the diversity in the set of RSC members and their range of views.

In addition, the evaluation questionnaire contained three closed and one open question regarding the evaluation of the second RSC workshop. In each region, it presented the stakeholders the following statements and asked them to rate their agreement on a 5-point scale ranging from 1 = totally disagree to 5 = totally agree

- I found the discussion during the workshop interesting.
- The way the workshop/committee was run allowed me to have my say.
- I feel that the people running the workshop/committee were not promoting a specific view of issues concerning CCUS.

The average rating on these questions - which were kept similar to the evaluating question in the first RSC workshop - are displayed in Table 2. It is important to consider the number of RSC members who completed the evaluation questionnaire, in Romania, only two RSC members responded to the questions.

As a last open question with qualitative character, the evaluation questionnaire asked for additional comments and remarks. Here, the following answers were given. The majority of comments were on the positive side, only a few mentioned minor aspects for improvement.

Positive statements	**Potential for improvement**
The workshop was conducted in a professional manner and was characterised by a large amount of factual information concerning CCUS. (PL)	More participation from government is needed in the RSC workshops (RO)
It will certainly be worthwhile to raise environmental issues, as well as the most cost-effective solutions available for CO_2 capture (PL)	More time should be allocated for discussions to try to establish new ways of cooperation for the development of CCUS in the region and at country level. (RO)
Most of the RSC members appreciated the opportunity to express their opinion and views. (RO)	Perhaps it would be more convenient and productive to have the information available prior to the workshop in order to study it (ES)
Very satisfied with the interesting discussions (FR Rhône Valley) The discussion was fruitful (HR)	

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Very good animation in this virtual meeting context (FR Rhône Valley) Excellent discussion session! It's great to have so many visions together (ES) Excellent workshop approach, moderation and participation tools (ES) Very meaningful and high quality work (PT)	

In the RSC in Paris Basin, some RSC members expressed their gratitude for the provided information, however, they did not experience themselves as experts regarding CCUS and thus, were less involved in the discussions. In some countries, the RSC members provided additional data to be implemented in the regional scenario, thus, highlighting valuable information to the project consortium.

It is noteworthy that in Greece only six RSC members participated. Unfortunately, six other RSC members who initially agreed on the time and date, were spontaneously not able to participate due to other obligations. The RSC members in the Greek region mentioned the largest time restrictions for their participation (compared to the other regions and RSC members). Again, the Romanian RSC workshop was held in English language due to participating stakeholders who did not speak Romania.

2.4.5 RSC workshop 2: Conclusion

The results of the second RSC workshop validated and deepened the results from the first RSC workshop: Although, there were minor region-specific discussion, most RSC members across the regions considered the economic feasibility, the social acceptance from the public, the environmental impact as well as the required political and regulatory framework as main problems for the scenarios. Their views of the future of CCUS differed between its key role in decarbonisation and its secondary role (as end-of-line solution) if there is no other option to decarbonize specific industrial parts, reflecting the results from the interviews in T3.2.

Overall, the scenarios were perceived as realistic, complete and interesting and as a good starting point. Some RSC members expressed ideas for some adjustments or had specific opinions about decisions for refinement, most stakeholders had questions about the economic evaluation followed by concerns regarding the social acceptance.

From an operational perspective, our results show that RSC members had only limited time and availability, however, they preferred to spend most of the time on discussions. Here, it appeared important to use a methodological strategy that involves all stakeholders to avoid having a few stakeholders speaking most of the time (which is especially important in an online setting).

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2.5 RSC workshop 3

The third series of RSC workshops within each region was conducted in the first quarter of 2022. Although the number of COVID-19 infections were decreasing and the experiences of the pandemic showed that careful face-to-face meetings were possible, most of the RSC workshops were conducted in an online manner. There are three main reasons for the decision to organize online workshops: (1) to avoid health risks for the stakeholders and the local teams, (2) to improve the planning of the RSC in case infection rates increased shortly before the workshop and (3) to keep the structure of the RSC workshops between regions as comparable as possible. Only the RSC workshop in Croatia was implemented in a hybrid format, however, this required even more preparation and effort from a technical perspective and at the end, most RSC members chose to participate online. In addition, the close collaboration - as outlined for the second RSC workshop - between social scientists/WP leads, local teams, technical support and WP lead of WP5 continued and was expanded by including also the WP lead of WP4. Originally, the third RSC workshop was planned for fall 2021, however, due to the pandemic, the research in WP4 and WP5 was a bit delayed and thus, also the third RSC, building on the results of WP4 and WP5.

2.5.1 RSC workshop 3: Aims and progress

The major aim of the third RSC workshop was two-fold: (1) to further establish the developed stakeholder network so it can continue beyond the project's lifetime (e.g., in the follow-up project PilotSTRATEGY) and (2) to exchange on the (final) results of the scenarios and the economic evaluation from WP4 and WP5. Hence, given the stakeholder's interest in the economic feasibility expressed in the first RSC workshop and the economic results from the research in STRATEGY CCUS, the motivation and the potential for discussions was high in this third RSC workshop.

The overall structure for the third RSC workshop remained comparable with the two earlier workshops. However, in this third RSC workshop, we extended the space for region-specific modifications, i.e., the regional teams were able to slightly modify the workshop's objectives to match the regional needs and specificities. Nonetheless, most RSC workshops were conducted in the suggested manner with slight adjustments. For instance, the Spanish team adjusted the second objective slightly by modifying it in "Exchange views on the results of the regional economic and socio-economic impact of the project"; some local teams did not implement the evaluation questionnaire[4]; in Romania, the SWOT analysis was not conducted[5]. The suggested agenda including timing of the first RSC workshop is displayed in Figure 4. Moreover, the presentation of the social acceptance results was optional; thus, it was skipped in most regions (except in Poland and Greece) to have more time for the region's focus (which was on the economic results in most cases). Thus,

[4] The space for region-specific modifications in this third RSC workshop was larger than in the previous workshops. Moreover, the number of RSC members completing the evaluation questionnaire in these regions was already low in the previous RSC workshop; thus, stakeholders' motivation to filling in the questionnaire was rather low in these regions.

[5] due to time and technical constraints from the stakeholders.

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region specific adjustments applied to meet the region's needs; these are summarized in the results sections of the third RSC workshop.

When	What
15 min.	**1. Welcome**
20 min.	**2. Presentation of final scenarios**
30 min.	**3. Discussion / Feedback to different parts of scenario**
10 min.	**4. Short summary of results regarding social acceptance**
50 min.	**5. Exercise: SWOT analysis – mentimeter (incl. overall rating with semantic differential)**
5 min.	**6. Take-home messages**
10 min.	**7. Feedback questionnaire**
10 min.	**8. Next steps & closing**

Total: approximately 2,5h

Figure 4. Table of suggested agenda of the third RSC workshop

It is important to note that the final point on the agenda also included the very brief introduction of the project PilotSTRATEGY in which similar RSC workshops are planned. Hence, the stakeholders were informed of next steps and the possibility to engage further with CCUS projects in their region/country.

The following sections will outline the methodology and present the results of the third RSC workshop.

2.5.2 RSC workshop 3: Methodology

As in the previous RSC workshops, we implemented methodologies from the social sciences to ensure a scientific participatory format. This time, we used (1) a semi-structured discussion after the presentation of the final scenarios for each region and (2) the so-called SWOT analysis for the structured evaluation of the scenario and the implementation of CCUS in the region.

During the preparations of the third RSC workshops, several regional teams mentioned that they were afraid that only the same stakeholders expressed their opinions in the discussion, while other stakeholders remained quiet. Thus, we suggested to start the semi-structured discussion with a round of the table to engage with everyone and ask them for a short insight in their thoughts on the scenario (“snapshot”) without other stakeholders commenting the expressed opinions.

Consequently, for the discussion of the final scenarios, the local teams were well prepared - also given the fact that they have implemented a very similar discussion successfully in the second RSC workshop. Thus, the focus of the support on the social science methodology was on the SWOT analysis: Here, after the presentation of final scenario and its discussion, we planned an overall

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evaluation of the scenario regarding economic, social, and technical aspects. The SWOT analysis focuses on four aspects namely, the strengths, weaknesses, opportunities and threats - in our case regarding the implementation of CCUS in the respective region. As social scientists, we provided the local teams with the following instruction on how to integrate the SWOT analysis in the RSC workshop:

After presenting a scenario in which CCUS is successfully implemented in the region, follow the eight steps outlined below:

1. Create a four-square matrix using four sheets of flip-chart paper or in the virtual manner use four slides in an interactive online tool.
2. At the top left of the matrix (in the virtual case: the first slide), write the word "STRENGTHS". Ask RSC members to take 5–10 minutes and quietly generate ideas about strengths they have with respect to the presented scenario and write them on sticky notes - one idea per sticky note.
3. When you sense a lull in sticky-note generation, read out the notes.
4. With the RSC members' collaboration, sort the ideas (verbally) based on their affinity to other ideas. For example, if they produced three sticky notes that say "good sharing of information," "information transparency," and "people willing to share data," cluster those ideas together. Create multiple clusters until you have clustered the majority of the sticky notes. Place outliers separate from the clusters but still in playing range.
5. At the bottom left of the matrix (in the virtual case: the second slide), write the word "WEAKNESSES". Ask RSC members again to take 5–10 minutes to quietly generate ideas about weaknesses around the scenario and write them on sticky notes. Then, perform step 3 and 4 regarding weaknesses of the scenario.
6. At the top right of the matrix, write the word "OPPORTUNITIES". Ask RSC members to take 5–10 minutes to write ideas about opportunities on sticky notes. Then, perform step 3 and 4 regarding opportunities of the scenario.
7. At the bottom right of the matrix, write the word "THREATS". Ask RSC members to use this last set of 5–10 minutes to generate ideas about perceived threats and write them on sticky notes. Then, perform step 3 and 4 regarding threats of the scenario.
8. Summarize the overall findings in a conversation with the RSC members and ask them to discuss the implications around the desired end state.

The way the SWOT analysis was performed in the RSC workshops differed between the regions: Some used an interactive online tool, others collected ideas just by the moderators based on the RSC members' inputs. The results of the SWOT analysis as well as the discussions in the third RSC workshop is outlined in the next section.

An overview of the dates, the number of RSC members participating and the rating of the evaluation questionnaire of the third RSC workshop is presented in Table 3.

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Table 3. Overview of dates, numbers of RSC members and ratings per region for the third RSC workshop.

RSC II	FR (Rhône)	FR (Paris)	ES	PT	PL	GR	HR	RO
Date	24.01.22	03.02.22	18.01.22	22.03.22	06.04.22	10.02.22	15.02.22	07.03.22
No. of stake-holders	15	15	19	17	7	8	7	11
Overall rating	4.2 / 5 (n = 2)	--	4.3 / 5 (n = 12)	4.4 / 5 (n = 15)	4.8 / 5 (n = 7)	--	3.8 / 5 (n = 7)	--
Ratings of scenario*	7.5 / 10 (n = 2)	--	5.8 / 10 (n = 6)	7.6 / 10 (n = 15)	7.6 / 10 (n = 7)	--	8.9 / 10 (n = 7)	--

* Different questions led to these ratings of the scenarios, thus, the scores cannot be compared between regions.

The following results are based on the regional reports that were delivered in English from the regional teams who conducted the workshop to the WP leads. The reports were analysed regarding their main outcomes by the WP leads and findings were aggregated across stakeholders to ensure anonymity.

2.5.3 RSC workshop 3: Summary of results

First, all regional teams presented the scenarios including pictures like the following one from Ebro Basin (Spain, see Figure 5). In most regions, several scenarios were presented to assess which one is the most adequate one from the stakeholders' points of view.

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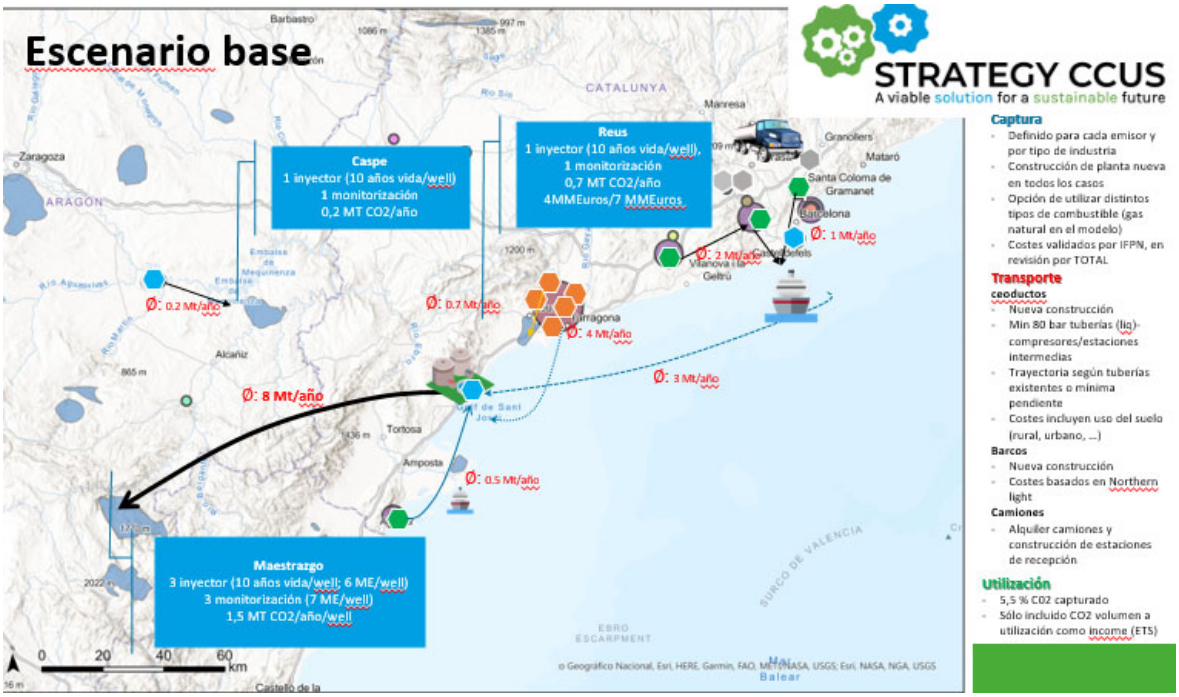

Figure 5. Example imagine of the presentation of the scenario (here for the Spanish region).

In the following, we provide a short summary of the scenario evaluation in each region.

In *Rhône Valley (France)*, several scenarios were presented and the so called "alternative scenario" indicating CCS in Paris basin was perceived as most realistic by the RSC members. In addition, in Rhône Valley, an interactive online tool was implemented to have the RSC members express their opinion in an anonymized way that was not primarily impacted by the opinions expressed by other stakeholders. For instance, from the transport point of view, the scenarios were evaluated. Of three options (adequate, inadequate and no opinion), most of the responses (8 of 10) considered the transport options integrated in the scenario as appropriate. The majority of participating RSC members also evaluated the capture in the scenario as adequate (8 of 11) as well as the storage (6 of 10); however, the storage was perceived more heterogeneous.

In *Paris Basin (France)*, the regional team also presented several scenarios and used an interactive online tool for the evaluation. The transport options, location of emitters and the storage sites were perceived as (mostly) adequate using a ranking via an interactive online tool. However, the RSC members in Paris Basin did not have a clear vote for a specific scenario: 6 of 7 RSC member had no opinion on whether they would choose the main or alternative scenario. This result may be caused by the slight difference between the two scenarios, namely, the storage in two different types of saline aquifers as main difference. Most assumptions in the scenario were confirmed by the RSC members and/or evaluated as appropriate.

In *Spain*, besides the main scenario, an alternative scenario was presented. The difference between the main and alternative scenario was that the alternative scenario included only emitters with a sector plan or company plan that includes CCUS. This alternative scenario was evaluated as more realistic from the RSC stakeholders.

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In *Portugal*, there were also two scenarios presented, the alternative scenario differed from the main scenario because it considered a higher amount of offshore storage and thus, may have greater social acceptance. The evaluation of the scenarios was mostly influenced by economic aspects (more sensitivity analyses and more details) and the timeline for CCUS development. While some stakeholders found that the implementation until 2050 was too slow, and called for some 'fast-track' approach, others considered that many years of works are still ahead to improve the maturity of CC technologies and to characterize the geological reservoirs.

In *Poland*, the presented scenario was perceived as unrealistic regarding the economic evaluation. The RSC members mentioned that it is very important to clarify the way of calculating costs. It was also noted that the CCUS costs in the scenario may be underestimated due to the fact that emission reductions of local CO_2 resources may not be sufficient. Despite some reservations, however, stakeholders emphasised that the methodological process was not a weakness of the scenario.

In *Greece*, two scenarios were presented, one short-/mid-term and one long term scenario. The stakeholders discussed the economic feasibility critically. Moreover, they expressed the wish for considering additional social impacts in the scenarios. Moreover, one stakeholder mentioned the importance to think about cyber security issues of the project and the potential use of artificial intelligence to monitor potential leakage of CO_2.

In *Croatia*, all stakeholders agree that the investment costs for capturing CO_2 is too low, and overall capture costs decrease as the technology is improved (learning rate). CCUS requires a lot of energy which may lead to the construction of a new energy plant (based on water energy). In addition, the RSC members in Croatia mentioned that the legislation and fiscal framework are not encouraging for CC(U)S projects. Moreover, the stakeholders perceived joint investments as a good solution for smaller emitters because they cannot even cover the transport costs.

In *Romania*, the time for the discussion of the scenarios was very limited since the presentations required more time than expected. However, the RSC members outlined the importance of final economic analyses which were not finalized by the time of the third RSC workshop in Romania. Moreover, it was mentioned that the scenario was built mainly on public data. There are many uncertainties related to the construction of new gas-fired power plants, the level of emissions available for CCS, or the prices of electricity. Thus, more data and less assumptions are needed for a realistic scenario regarding CCUS implementation.

In order to analyse and discuss the presented scenarios, the **SWOT analysis** was conducted: Most regions used an interactive online tool for this activity. Thus, participants analysed the scenario in terms of the *strengths* of the scenario (favourable scenario characteristics), the *weaknesses* (own limitations), the *opportunities* (positive external factors) and the *threats* (negative external factors). Participants reflected and responded individually to each criterion and then a group discussion was moderated based on their input.

Overall, the results of the SWOT analysis were rather similar across regions and different only in a few region-specific aspects. For an overview, the results are summarized in Figure 6. Across regions, the aspects mentioned as strengths and opportunities of the scenario as well as the issues mentioned as weaknesses and threats were similar and sometimes used interchangeably.

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Regarding **strengths**, the mentioned aspects ranged from *existing storage capacity in close proximity to emitters* (FR Paris Basin, HR, PT), *existing infrastructure and transport options via pipeline* (FR Rhône Valley) to the installation of an actors network (ES, FR Rhône Valley & Paris Basin) and economic benefits such as job creation (FR Paris Basin, HR, GR). The stakeholders perceived the benefits for the economy and the environment as topics to make the region more attractive (FR Paris Basin, HR). The network of different actors through (existing) pipelines could lead to adding further regions to the CO_2 storage network and potentially also to a reduction of costs (HR, PL). In Spain, the creation of a hub and the concentration of only one or two locations were perceived as a potential to increase social acceptance. In Croatia, stakeholders saw a strength in their operating and legislative experience in CO_2 injection and their existing experiences with enhanced oil recovery (EOR).

Regarding **weaknesses**, the high investment and operating costs were discussed in most regions (PT, PL, HR, GR) including the costs for monitoring as well as building and maintaining the pipelines (HR), especially when long transport distances are required - for instance for offshore solutions (PL). Also, the complex transport option via ship (together with pipelines) were mentioned in France as well as in Spain.

Since the results on the economic assessment were still preliminary during the presentation in many regions, several of the remarks of stakeholders referred to the economic aspect. The RSC members asked for more details on the economic assessment including the carbon pricing/EU-ETS (which were provided in the fourth RSC workshop when a fourth workshop was implemented).

A large part of the weaknesses also focused on social acceptance issues (FR Rhône Valley, ES). Specifically, the risk of non-acceptance of onshore storage in both the Paris basin and the Camargue (national park) was mentioned. References were also made to the lack of a regulatory framework, legislation and administrative support (ES) as well as insufficient public information (GR).

In Spain, also the imbalance of job increase between industry/emitters and storage was discussed by the stakeholders, because CCUS implementation would lead to a low increase in the poor storage areas. Another aspect that was mentioned as a weakness was the timeline and the installation time of storage facilities.

Regarding **opportunities**, the RSC members in most regions mentioned mainly environmental aspects without specific references to the scenario (FR, ES, PT). They perceive CCUS implementation as one of the important elements leading to the decarbonisation of the country and increasing the attractiveness of the area. This highlights that CCUS is seen as one option among many. Besides this aspect, the use of CO_2 for hydrogen production was also discussed in the RSC workshops in Portugal and Greece.

Region-specific opportunities were the following: In Spain, the development of a small storage pilot was discussed to demonstrate to the public that CCUS is feasible, safe and has a positive impact on society. In Croatia, the RSC members like the opportunity to extend the lives of oil fields due to CCUS deployment and to build a common infrastructure for transport and reduced costs through sharing but also through potential state-/co-funded costs. In Greece, energy autonomy through CCUS was mentioned by the stakeholders as an opportunity.

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Regarding **threats**, most RSC members mentioned the high costs (HR, PT, FR), an intransparent future carbon price and uncertainties regarding various factors such as energy prices, emissions quotas and the establishment of storage sites (HR). Hence, some stakeholders mentioned that other options and technologies that are less cost-intensive may be on the rise before CCUS (FR Rhône Valley, PT). In some countries, it was also discussed that an agreement among different (small) actors (within the cluster) would be necessary for a successful CCUS implementation but difficult to achieve.

In addition, in Romania and Greece, the risk of CO_2 storage was pointed out as something uncertain with potential for leakages and earthquakes. However, this could be solved by further explanations. Consequently, it is necessary to constantly inform the public about the advantages of CCUS technology. In Poland, stakeholders mention the fear of attempts to unjustifiably extend the operation of coal blocks in the region in view of climate policy objectives due to CCUS deployment. Moreover, it has been discussed in some regions that the timeline is crucial: For instance, it is important to consider long periods for licensing and construction of storage and/or capture sites.

In general terms, the main threats to the successful development of the proposed scenarios are seen in terms of social acceptance (and potential protests by local communities, ES), the lack of political and financial support (PL, ES, FR), focusing mainly on various economic aspects (FR).

Figure 6. Summary of the results from the SWOT analysis in the third RSC workshop across regions

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2.5.4 RSC workshop 3: Evaluation

In the third RSC, **the evaluation questionnaire** received less attention than in the other RSC workshops. In three regions (FR Paris Basin, GR, RO), it has not been used at all. In some regions in which it was implemented, it was only completed by a small number of RSC (e.g., two participants in Rhône Valley, France). In Paris Basin, France as well as in Spain, a fourth RSC workshop was planned and conducted (in Paris Basin on March 10th, 2022; in Spain on May 18th, 2022).[6]

The structure of the evaluation questionnaire resemble the structure of the questionnaire in the previous two RSC workshops: It presented the following statements to the stakeholders and asked them to rate their agreement on a 5-point scale ranging from 1 = totally disagree to 5 = totally agree

- I found the discussion during the workshop interesting.
- The way the workshop/committee was run allowed me to have my say.
- I feel that the people running the workshop/committee were not promoting a specific view of issues concerning CCUS.

The average rating on these questions are displayed in Table 3 labelled "overall rating".

In addition, in France and Spain, RSC members were asked about their evaluation of the economic impacts of the scenario with the statement "I consider the economic parameters of the scenario as... 1 = very negative to 10 = very positive". The mean value of this evaluation is also presented in Table 3, labelled as "rating of scenario". In Portugal, the scale and rating was similar ranging from 1 = not important to 10 = very important, however, the question for the evaluation focused on the *socio-economic impacts* of the scenario for the region. In Poland and Croatia, the question behind the rating of the scenario displayed in Table 3 was "Overall, I consider the scenario as... 1 = very negative and totally undesirable to 10 = very positive and totally desirable".

As a response to the final open qualitative question of the evaluation questionnaire, the RSC members expressed a positive perception of the third RSC workshop. Across regions, the stakeholders did not mention additional potential for improvement. Only in Romania, a RSC member asked for more time for discussions. Although the suggested agenda proposed larger time periods for discussion, the presentation of the scenario in some regions took more time than expected. In general, the following positive aspects were expressed in the evaluation questionnaire, highlighting that the third RSC workshop was successful:

“It will be very important to share and disseminate the assumptions and results of this study in order to feed and inform the review of national strategies in the medium long term, and the parameters/values/assumptions considered should be made public” (PT)

[6] The opportunities for region-specific modifications in this third RSC workshop was higher than in the previous workshops. Moreover, the discussion focused on the economic feasibility of CCUS implementation and the economic assessment in the developed scenarios. Since the discussions on this topic were very interactive in most regions, the time for completing the evaluation questionnaire was short and/or the link to the questionnaire was sent after the RSC workshop has finished.

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“Congratulations on the excellent workshop” (PT)

“Very interesting workshop, very varied participants and very good opportunity to get to know other opinions.” (ES)

“As mentioned during the meeting, the proposed scenarios suggested that storage in the Paris basin would be much easier than storage in the Camargue area. The highlights of the Paris basin study and the results at the same level of detail could be useful to analyse the scenarios. Thank you for this work” (FR Rhône Valley)

One RSC member in Croatia mentioned in the evaluation questionnaire "I would like to know more about the details of the costs considered in the calculations." This already outlines the main aspect of the discussions regarding the scenarios, namely, the economic evaluation and costs related to the implementation of CCUS.

2.5.5 RSC workshop 3: Conclusion

The third RSC workshop provided more space for region-specific modifications, also because the focus was set on region-specific future scenarios and pathways. Thus, the results are less comparable across regions. For instance, results on the social acceptance were presented in two regions.

In most regions, two scenarios were presented and the alternative scenario was most of the time perceived as more realistic (than the main scenario). The most important aspect for the stakeholders was the economic feasibility of CCUS deployment, it provided the largest aspect for discussions regarding the scenarios. In almost all regions, the aspects of CO_2 use for hydrogen production, the impact of carbon pricing and the need for financial funding were discussed when examining the presented the scenarios. In the SWOT analysis, the social acceptance as well as the lack of political frameworks and support and the environmental benefits of CCUS were mentioned as crucial aspects besides the economic costs. Most stakeholders participating in the third RSC workshop expressed the intention to participate in further workshops planned in the PilotSTRATEGY project.

The follow-up project PilotSTRATEGY (https://pilotstrategy.eu/) examines the potential for CCUS pilots and aims to advance understanding of deep saline aquifers (DSA) for geological CO_2 storage in five European industrial regions in Southern and Eastern Europe, namely in Paris Basin (France), Lusitanian Basin (Portugal), Ebro Basin (Spain), Upper Silesia (Poland) and West Macedonia (Greece). During its 5-year lifetime PilotSTRATEGY will also include participatory formats with stakeholders and local communities similar to the RSC workshops.

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2.6 Reflection on the RSC workshops

Based on the scope of STRATEGY CCUS, namely the strategic planning of a potential implementation of CCUS and related industry clusters, the focus of this task, establishing RSCs and conducting RSC workshops was set on societal stakeholders instead of the general public. The **focus on key stakeholders** appears relevant due to the following reasons: Key stakeholders also act as informants within the region, they present an important channel for social acceptance issues within the region (e.g., they are likely to have a high knowledge about the regions and potential expectations and concerns of at least some actor groups; they may be interviewed by media representatives and spread their opinion and knowledge about the implementation of CCUS within the general public through the media; they may be asked by other representatives of the general public about their perception of CCUS which may impact the creation of acceptance or resistance within the general public.). Thus, the chosen approach in the RSC workshops and its participants seems reasonable. Nonetheless, when plans and research about implementation become more intensive, future participation and engagement approaches should broaden the societal participation in RSC workshop, for example by including also local communities (see PilotSTRATEGY) or by providing a stronger role to NGOs.

As a recommendation for participatory formats, one can state that for the adjustment from a face-to-face to an online format (in our case due to the COVID19 pandemic), a **strong collaboration** between social scientists (WP3 team), local teams, technical support (SNSPA) and content-quality control (WP4 and WP5) appears crucial to conduct successful workshops. Designing adequate participatory and problem structuring techniques was instrumental in collecting relevant data on stakeholders' views and concerns as well as in allowing relevant discussions and group work among stakeholders. Moreover, as a practical aspect, it is essential to consider general data protection regulations (GDPR) for the interaction with stakeholders. Although, at first sight, it might provide a hurdle and barrier for some stakeholders to participate, it is essential to implement formal procedures such as (1) signing the informed consent form and (2) completing the evaluation questionnaires. The latter for research reasons, the former mainly for data protection, ethical and security reasons. In some cases, it was difficult to enforce these data regulation procedures, however, from our point of view, these procedures are necessary to guarantee a safe space for open exchange between stakeholders.

It goes without saying to take the evaluation questionnaires and the related stakeholders' responses seriously. This implies to consider them for the next participatory format. Furthermore, our experience also showed that the specific stakeholder groups are also likely to have different needs (e.g. for the desired length of the meetings).

Regarding the views of the RSC members, we derive the following recommendations and reflections: First, it is important to have in mind that if you ask for advice or comments, you need to consider and implement them. Choose wisely and differentiate clearly whether you want to inform the stakeholders only or whether you want to hear their opinions. In the latter case, you should consider the stakeholders' feedback - at least to a certain extent. If you do not plan to integrate their perspectives and/or cannot implement their remarks, do not ask for it (principle of parsimony). At the same time this points to the need to also install feedback loops, such as pointing out the

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concerns about the financial feasibility to the researcher doing the economic assessment. Especially when the stakeholders explain in detail why they have concerns, this could potentially provide important input to the experts or at least help them prepare for such kind of questions.

On a similar note, regarding **timing**, we suggest providing plenty of time for discussions. Especially in virtual environments, starting a discussion could take more time than expected. In addition, reserve enough time for a short "snapshot" as a first round of the table before the discussion. This methodological approach has been proven to be beneficial for allowing everyone to express their views, ensuring that each stakeholder feels heard and no one's view will be overheard. Semi-structured discussions have also proven to be insightful: This means that you prepare a few guiding questions, but topics are not so strictly predefined, leaving room for the stakeholders to raise questions they feel are worth discussing.

In addition, it appeared important to **plan the RSC workshops well ahead of time** to ensure that relevant stakeholder are able to participate. Moreover, although an overall RSC structure for all regions was developed, **leaving space for adjustments to country and regional specificities** appeared crucial. This points out that while a standards approach simplifies preparations and increases comparability and, ultimately, drawing conclusions, regional adaptations (as allowed for) are very important to keep stakeholders' motivation high. In addition, we initially planned to incorporate a constant exchange between the stakeholders to strengthening the network. However, realising a common platform for exchange (such as LinkedIn or other digital forums) appeared challenging due to country- and stakeholder-specific preferences in using different platforms. Thus, the main communication happened via emails. However, to develop a concept for such additional exchange platforms could be an interesting avenue for future projects.

The use of interactive online **tools**, such as mentimeter, in the RSC workshops was valued by many stakeholders, although in early RSC workshops its use was very limited (due to technical issues and/or the familiarity of the RSC members with online tools). Some interactive online tools were preferred over others by the stakeholders across regions. One reason for this preference could be that discussions via certain online tools (mainly used for presentations) were perceived as somewhat impractical and in single cases, the RSC members accidentally deleted the slides and the answers of other stakeholders, leading to confusion and additional time requirements.

2.6.1 Limitations and potential for improvement

When analyzing the results of the RSC workshops, we noticed that the focus of each regional RSC workshop was slightly impacted by the discipline/background of the local team conducting the workshop (e.g., geologists are experts regarding the underground for CCUS implementation and thus, subconsciously talk more about it and set a focus on this aspect). This shows that it would be best if the RSC workshops were conducted by social science teams - especially for comparison of different regions and workshops - but in very close cooperation with experts from the region and on technology assessment. Although we implemented a strong and successful collaboration within the consortium guaranteeing high-quality information within the RSC workshops, it could be valuable to have a social science team speaking the national/regional language to conduct a neutral participatory workshop. This applies especially for using social science methods and/or for strategies to engage everyone in the participatory format.

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Similarly, although the social sciences team as well as the regional teams tried to encourage a balanced set of stakeholders for the participation in the RSC workshops, the final set of participating stakeholders also depended on the stakeholders' availabilities and further responsibilities. As in other participation and engagement activities, this means that stakeholders for instance from companies that are pressured to move forward with decarbonisation are more likely to be able to participate and their chances are higher to make resources available than, for example, civil society organisation depending on volunteers. Consequently, it could be relevant for future projects to find ways to compensate time and effort at least for some stakeholder categories.

Moreover, although T3.1 aimed to ensure a structured mapping of the relevant CCUS-related stakeholders, it might be the case that we missed some stakeholders and/or a change in positions/responsibilities occurred which may have led to a gap of a stakeholder category. This is especially relevant, as the research aimed at identifying stakeholders with a potential interest in the topic. Given that societal awareness about CCUS is low, this could mean that certain groups are overlooked but will turn out to be relevant in the future. To mitigate this challenge, we asked the stakeholders in the first RSC whether they know additional stakeholders that should participate in the RSC workshop. If it appeared beneficial, additional or new stakeholders were invited to the RSC workshops. Here, it was crucial to ensure a smooth "integration". Thus, all new RSC members received information about STRATEGY CCUS and the prior RSC workshops from the local teams via email and/or a bilateral call. Moreover, they had to sign the prepared informed consent form to guarantee a safe space for exchange. This ensured that everyone had more or less the same level of knowledge regarding the project and the provided information about CCUS.

In addition, one needs to consider the **virtual environment** to which we had to adapt the workshop design: Although the pandemic increased the usage and the familiarity with available tools for online meetings, we might have missed stakeholders who were not able to participate due to a lack of digital knowledge and/or equipment. Besides this aspect, we also recommend - in line with the feedback from the local teams and partly also from the stakeholders - that stakeholder meetings should be organised in a face-to-face manner, whenever possible without risk, ensuring a higher commitment and reinforcement of the stakeholder network. The feedback of the regional teams stated clearly that some workshop participants were more willing to take part in face-to-face discussions than in (more anonymous) interactive exercises using online tools. Based on the local teams' feedback, exercises involving 'solo' work resulted in a drop of participants' activity and required more (preparation) time. The local teams assumed that in face-to-face meetings, participants are more active and willing to speak, and perceive live discussion as more fruitful and an excellent opportunity to exchange views and emerging doubts. Furthermore, they also allow for more side-communication such as raising topics outside the plenum in the coffee break as well as establishing personal relationships which are beneficial for building trust.

2.6.2 Stakeholder categories and fluctuation between RSC workshops and across regions

Since the RSC workshops were conducted during the STRATEGY CCUS project between October 2020 and April 2022, the key stakeholders changed slightly due to changing positions, leaving companies, time constraints to participate in the next RSC workshop and further reasons (see also details outlined above). Consequently, the number of stakeholders in each region and each stakeholder

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category differed slightly from one RSC workshop to the other. Table 4 provides an overview of the participating stakeholders and their category; it also shows the number of new RSC members in each RSC workshop.

Table 4. Overview of the numbers of RSC members and stakeholder categories participating in the three RSC workshops across regions

	FR (Rhône)	FR (Paris)	ES	PT	PL	GR	HR	RO
No. of stake-holders	**RSC 1 / 2 / 3**	**RSC 1 / 2 / 3**	**RSC 1 / 2 / 3**	**RSC 1 / 2 / 3**	**RSC 1 / 2 / 3**	**RSC 1 / 2 / 3**	**RSC 1 / 2 / 3**	**RSC 1 / 2 / 3**
Industry (supply, demand)	4/ 10/ 7	8 / 7 / 5	8/ 9/11	7/ 6/ 10	3 / 4 / 1	3 / 2 / 3	6 / 5 / 6	9 / 6 / 6
Research & education	0 / 2 / 1	0 / 0 / 1	2 / 2 / 2	2 / 3 / 2	2 / 1 / 3	3 / 2 / 3	1 / 0 / 0	0 / 0 / 0
Public admini-stration	5 / 6 / 4	2 / 2 / 6	4 / 5 / 4	3 / 3 / 2	1 / 0 / 1	5 / 2 / 1	4 / 3 / 1	1 / 2 / 4
Support organi-zations	2 / 2 / 3	2 / 0 / 0	3 / 1 / 2	2 / 2 / 2	2 / 1 / 1	1 / 0 / 1	2 / 1 / 0	0 / 0 / 0
Influencer	1 / 1 / 0	1 / 2 / 3	2 / 1 / 0	1 / 1 / 1	2 / 1 / 1	0 / 0 / 0	2 / 2 / 0	1 / 0 / 0

In most countries, the number of stakeholders decreased during the project, however in a few regions, the number of participating stakeholders increased. This might be due to different ways of contacting the stakeholders by the regional teams as well as country-specific differences caused by the pandemic. It is important to note that it is not the number of participating stakeholders but the quality of their statements and their involvement which makes a RSC workshop successful.

In addition, it is noteworthy that the majority of stakeholders participating in the RSC workshops were from the industry (i.e., demand and supply side) and from the public administration (i.e., politics and policies). This applies across regions. In most regions, it was rather difficult to include

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researchers and support organizations as well as influencers. In future CCUS research with stakeholders and social acceptance aspects, these groups and their involvement should receive a special focus of attention.

2.7 Conclusion regarding the RSC workshops in STRATEGY CCUS

The participatory format of RSC workshops in STRATEGY CCUS focused on stakeholders (mainly from the industry) instead of on the general population. A reason for this is the project's scope, namely the early strategic planning of CCUS implementation. As the established RSCs consisted mainly of industry related stakeholders, it appeared more difficult to engage members of NGOs. However, future research (e.g. in PilotSTRATEGY) and especially projects that are further developed regarding the implementation of CCUS should focus more on the general public, communities, NGOs and influencers in the respective region.

According to the stakeholders participating in the RSC workshops, the main drivers of CCUS implementation in the regions were the existence of CCUS-relevant industry in the region as well as the positive reduction of CO_2 emissions. As main barriers, the stakeholders mentioned the economic feasibility and the impact for the environment as well as the lack of clear regulations and distribution of responsibilities. Overall, the first RSC workshop was perceived as a great opportunity to connect with other CCUS-related stakeholders.

The results of the second RSC workshop validated and deepened the results from the first RSC workshop: Although, there were minor region-specific discussions, most RSC members across the regions considered the economic feasibility, the social acceptance from the public, the environmental impact as well as the required political and regulatory framework as main problems for the scenarios and a potential implementation of CCUS. Their views of the future of CCUS differed between a key role of CCUS in the decarbonisation and its secondary role (as end-of-line solution) if there is no other option to decarbonize specific industrial parts, reflecting the results from the interviews in T3.2.

Similarly, in the third RSC workshop, the economic evaluation of the scenarios was the most discussed aspect. The SWOT analysis confirmed the results from the other tasks and workshops. Overall, the scenarios developed in the project were perceived as realistic, complete and interesting and as a good starting point. Some RSC members expressed ideas for adjustments or had specific opinions about decisions for refinement, most stakeholders had questions about the economic evaluation followed by concerns regarding social acceptance.

From an operational perspective, our results show that RSC members had only limited time and availability, however, they preferred to spend most of the time on discussions. Here, it appeared important to use a methodological strategy that involves all stakeholders to avoid having a few stakeholders speaking most of the time (which is especially important in an online setting).

The involvement of additional social science teams would enhance the implementation of participatory formats for stakeholder engagement. Nonetheless, the participatory format of RSC workshops was very welcomed and RSC members were happy to be part of a diverse board of stakeholders discussing the implementation of CCUS. The stakeholders were highly engaged and motivated to express their opinion to contribute to the strategic planning of CCUS.

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3 Part II: Roadmap and recommendation to social acceptance

The aim of this part of the deliverable is to integrate the learnings from the regional stakeholder committees (RSC) with the findings on further work on social acceptance from the project and to develop conclusions beyond the timeline of the STRATEGY CCUS project (see also Appendix 4.2 for WP-related summaries for each region). In the following, we therefore provide a short summary of the different findings from the steps in the work package. Figure provides an overview of them.

The first step was an actor-centred scoping of the innovation system of CCUS in the countries under study. This included a review on the state of knowledge from the academic literature regarding social acceptance and societal engagement. In addition, the regions under study were explored and a first identification exercise for potentially relevant stakeholder was implemented. In a next step, the scoping was extended in order to identify the expectations and concerns of regional and national stakeholder via interviews. These interviews were also extended to the European level to explore the alignment of views between the governance levels. This exploration provided input to organizing the regional stakeholder committees that were presented above as well as for a public survey in two of the countries and their regions, namely in Spain and France. The next section summarizes the findings from these steps before they are integrated into overall recommendations from the project.

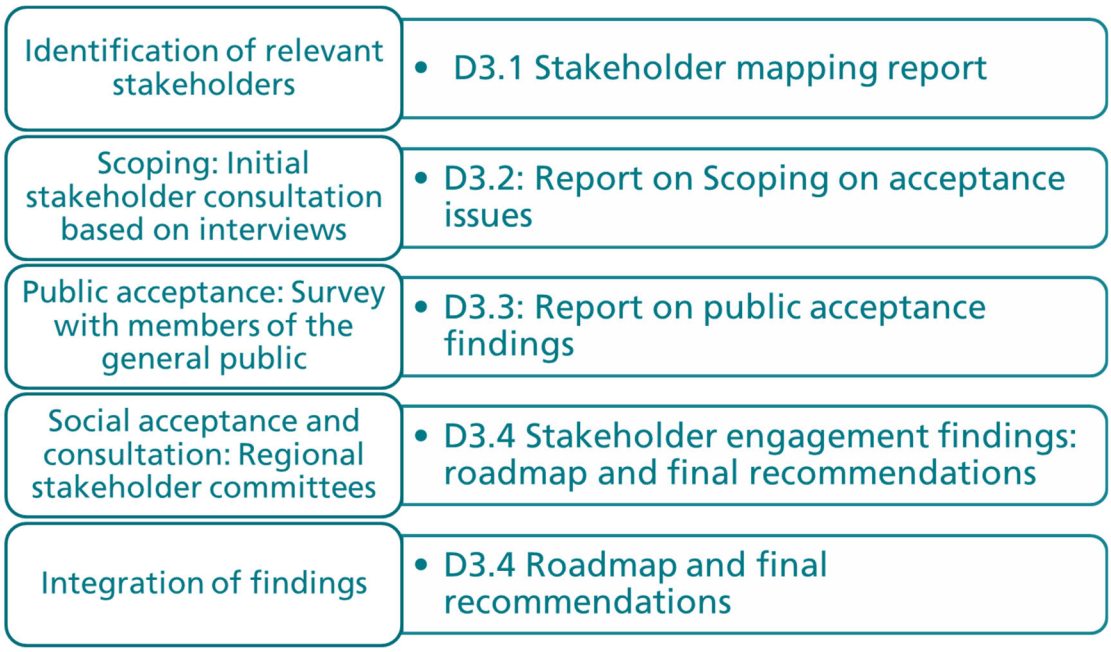

Figure 7. Overview on the different steps in WP3

3.1 Summary of results from WP3

3.1.1 Synthesis of T3.1: Literature review and stakeholder mapping

The review on the research on CCS and CCU applications showed, that the awareness of CCS and CCU technologies in the broader public continues to be low and that acceptance levels are found to

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be moderate on average. Regarding the local acceptance, the literature points out that social acceptance is also influenced by the CO_2 source and its evaluation. Specifically, combining coal-fired power plants with CCUS is less embraced by the public than e.g. integration in heavy industries (Dütschke et al. 2016). CCU is evaluated more positively than CCS (Whitmarsh et al. 2019; Linzenich et al. 2019; Arning et al. 2019). On a national level, some variety in social acceptance was found. While in the past community acceptance for CCS was found to be lower than on the national level e.g. for Germany, more recent research in the UK detected also more positive evaluations on the local level (Whitmarsh et al. 2019). While a few studies have looked into different groups of stakeholders and experts, the majority of social acceptance research focuses on the broader or the local public. Regarding stakeholders, most studies so far involve only very small samples and a differentiation between stakeholder categories is therefore difficult to draw. A more detailed analysis of stakeholder perceptions is therefore part of the second task of this WP.

Specifically for engaging stakeholders in the countries and regions of STRATEGY CCUS, a desk research was performed that was informed by a combination of innovation system theories and social acceptance research (cf. Burghard et al. 2022 for the framework). Through the research stakeholders from all subsystems in the innovation system were identified but it also turned out that, that the number CCUS actors from industry is limited. Additionally, the structures and number of CCUS related stakeholders varied strongly between the countries. For instance in Spain there are a number of governmental bodies that deal with CCUS related topics, while this was not the case in some of the Eastern and South-Eastern European countries. The regional analysis showed that the focus regions have very different points of departure for the successful implementation of CCUS applications. For example, the regions differ in size, population density, economic development, CO_2 sources and opportunities for CO_2 sequestration or use respectively. No earlier social acceptance research could be identified that focused specifically on the regions under study. Overall, relatively little publications refer to the countries under study (exceptions include e.g. Oltra et al. 2010; Reiner et al. 2012).

3.1.2 Synthesis of T3.2: Stakeholder consultation through interviews

Semi-structured interviews with selected members of the stakeholder groups were conducted in each of the study regions to identify stakeholders' overall evaluation of CCUS technologies, their level of acceptance of CCUS developments in their regions, sources of concern, perceived benefits and costs of the development of CCUS to the region, conditions for acceptance, perceived barriers and enablers to the development of CCUS in the study regions and preferences and expectations for energy futures. The overall number of interviewees was 102, consisting of 10 and 12 representatives in each of the study regions, an additional three key informants at the national level in each country and finally four EU-level interviews.

Most of the stakeholders consulted in the regions expected that the implementation of CCUS technologies would help in climate change mitigation and decarbonisation by significantly reducing emissions in the industry. In countries such as Spain and Portugal, interviewees emphasized the potential role of CCUS in reducing CO_2 emissions from the process industries (cement, steel and glass). In France as well as in other countries, interviewees emphasized that CCUS should be considered as one among the many options to reduce CO_2 emissions. Overall, we found a more

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favourable attitude towards CCU relative to CCS, although some interviewees perceived CCU as promising in the long term but currently insufficient to result in significant reductions in CO_2 emissions Stakeholders in the eight regions outlined the environmental global benefits (climate change mitigation) as well as the potential regional benefits of developing CCUS projects. The socioeconomic benefits of implementing CCUS technologies were a key topic of discussion in the eight regions. Overall, there was the perception, not shared by all the stakeholders, that CCUS technologies would bring potential regional benefits in terms of job creation and the generation of new industries in the region. As for the potential costs and risks of implementing CCUS in the regions, economic considerations as well as the potential risks for the environmental were raised by stakeholders in all the studied regions. The societal impacts of carbon capture and storage were also considered by the stakeholders.

Overall, most of the interviewees in the eight regions were rather positive about the development of CCUS technologies. Support for the deployment of CCUS in the regions was based on a favourable attitude towards CCUS technologies as well as on a recognition of the potential socioeconomic benefits of CCUS projects for the region. Only a minority of stakeholder representatives were opposed or sceptical about the introduction of CCUS projects in their region. These interviewees reported a negative attitude towards CCS, preferred alternative technologies to reduce CO_2 emissions and were sceptical about the potential regional benefits of CCUS projects. As conditions for acceptance, interviewees regions mentioned the need to consider the costs (financial viability), acceptance issues (adequate information and engagement), and support from the government (new and adequate legislation).

Regarding the barriers for CCUS deployment in the various studied region, most of the interviewees referred to financial and economic barriers (economic feasibility of CCUS projects), lack of socio-political acceptance and technical feasibility. In Spain, Croatia and Romania, lack of support and interest from authorities, political actors, and administration was considered a critical barrier. Lack of technological know-how as well as limited CO_2 storage possibilities were also barriers mentioned in countries such as Romania and Poland. Regarding the enablers for the development of CCUS projects, interviewees in the various regions generally pointed out to the existence of process and petrochemical industries potentially interested in implementing CCUS technologies as well as to the onshore geological storage capacity.

3.1.3 Synthesis of T3.4: Findings on public acceptance

Employing a survey, we assessed levels of awareness, attitudes towards and acceptance of carbon capture, utilization and storage (CCUS) technologies in the public in Spain and France and in a selected region in each of the two countries (the Ebro Basin and the Rhône Valley). Representative samples on the national and regional level from each country (n= 1300) took part in the survey conducted online.

Most respondents reported not having heard about CCUS technologies before participating in the study. Only around one out of ten respondents reported being familiar with CCS or CCU technologies. There were no significant differences in levels of familiarity between study populations. After being informed about the main features of CCS and CCU technologies, respondents in the four study populations provided a more positive evaluation of CCU compared to

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CCS. On average, more positive emotions towards CCU than towards CCS were stated. CCU was perceived as more innovative, necessary, economical, safe, less tampering with nature and more beneficial for the regional and national economies by respondents relative to CCS.

At the national level, more than half of respondents would accept the development of CCUS technologies in their country. Acceptance levels were higher for CCU (60 per cent) relative to CCS (50 per cent). Acceptance was higher in Spain (65 per cent for CCU and 54 per cent for CCS) compared to France (56 per cent for CCU and 46 per cent for CCS).

Regarding the local acceptance of CCS and CCU projects, acceptance ranged from around 60 per cent for CCU to 48 per cent for CCS. Acceptance levels were higher for CCU projects (62 per cent in both regions) compared to CCS projects (45 per cent in France and 49 per cent in the Ebro Basin).

The main individual-level predictors of acceptance of CCS and CCU included the perception about the economic impacts of CCUS developments as well as prior pro-technology beliefs.

3.2 Recommendations regarding stakeholder engagement & social acceptance

3.2.1 Practical considerations for the implementation of stakeholder engagement

The following steps were identified as relevant to consider for the implementation of participatory activities and stakeholder engagement formats.

From a practical point of view, it appeared very valuable to integrate stakeholders early on in the project. As a first step, it is important to start with a **structured screening of stakeholder categories and a mapping of relevant regional stakeholders**. Once they are identified and willing to participate in a participatory activities have in mind that these key stakeholders **act as informants** in the region about the project and the CCUS plans and the other way round. It is important to raise awareness within the stakeholder group and to communicate clearly so that the stakeholders can spread the information and social awareness within the general public. In our case the stakeholders were enthusiastic to get in touch with other stakeholders interested in the topic and deployment of CCUS. Thus, it is essential to **bring stakeholders from different sectors together and to have regular exchange**, establishing a stakeholder network. For this the stakeholder need to agree on an (implicit) common goal and create a shared level of knowledge in order to be on the same page. This can be facilitated by applying the relevant methods fostering exchange and discussions. When the stakeholder network develops, ensure a successful integration of new stakeholders in the group through written material and/or calls before the first meeting with new stakeholders. Then, everyone has the same status of knowledge about the project and the common goal.

These aspects lead to further administrative aspects that should be considered when implementing stakeholder engagement formats. We recommend to

1. Involve social scientists for the methodological preparation as well as local teams with contacts to relevant stakeholder for organizing, planning and evaluating the stakeholder events

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2. Update the list of stakeholders regularly to ensure to not miss any relevant key stakeholders; also by considering the contacts of participating stakeholders
3. Consider GDPR by implementing an informed consent form to create a safe space for an open exchange
4. Plan well ahead of time and reserve plenty of time for discussions
5. Integrate measures that ensure that all participants mention their views
6. Leave enough space for region-/country-specific adjustments (or Plan B)
7. Differentiate between informing and receiving feedback: If you ask for feedback, you have to consider it
8. Stay in touch with stakeholders regularly (e.g., send updated information between the meetings and/or - if possible - create a space for exchange between the stakeholders)

3.2.2 Integrated summary from findings on social acceptance

The following aspects were identified from the synthesis of findings from the social acceptance research in WP3 of the STRATEGY CCUS project (as outlined above).

- All countries under study are developing CCUS under the same EU-regime, however, they largely differ in their strategic plans and political aims towards CCUS as well as the state of play regarding the decarbonisation of the energy system and other industries. Thus, considering the state of play of the national innovation system for CCUS is very important. From our stakeholder perspective, we found that these differences are also mirrored in the number and density of stakeholders involved on CCUS.
- From the literature, we know that citizens prefer CCU to CCS while overall levels of knowledge and awareness are low. This was confirmed by our survey study in France and Spain. However, contrary to earlier findings in the literature, most citizens stated that they would accept the further development of CCUS. Acceptance levels were a bit lower in the respective regional samples then in the national ones, but nevertheless positive. The feedback from stakeholders interviewed or participating in the RSC was mostly favourable although they also raised some concerns.
- Citizens were more positive towards CCUS if they thought that it will contribute to further economic development and if they had more positive beliefs in the benefits of technologies. This is on the one hand in line with expectations in the interviews where stakeholders also hoped for positive economic effects by CCUS on the regional level. On the other hand, it resonates with the attention that economic aspects received in the RSC workshops.
- Concerns were raised by the stakeholders interviewed around public acceptance, the political framework as well as the costs for the technological options in relation to CCUS. These findings are in full alignment with the discussions in the regional stakeholder committees.

3.2.3 Conclusions

- For CCUS to be considered as an option in regional and national policy strategies for the energy transition, there is still a high need to raise awareness for the benefits and risks

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around the technology, also with societal stakeholders to decide in how far this option is supported or not by societies - also in comparison to alternative options to decarbonize. Our analysis points to a gap between the development of the debate on the European level and the one on lower governance levels. Thus, in general, a stronger societal engagement on this topic is needed to trigger a further development (or abandonment) of the innovation system.

- This also leads to the need that regulatory frameworks are aligned or set up at all on the respective levels which is not case yet.
- Acceptance for CCUS in the public is not clear but overall, there seems to be a window of opportunity for an open-ended discussion about CCUS. This implies that opinions are not stable yet and depending on the development of the debate, public support could emerge (but also opposition). Enabling discussions and the chance to obtain information as in the regional stakeholder committees was appreciated and is, therefore, strongly recommended for the future.
- Acceptance for CCUS seems to be conditional - as suggested by the literature and our empirical work, it strongly depends on the CO_2-source and other potential acceptance conditions (perceived socio-economic benefits, environmental and safety risks, social trust, good communication and participation). This again emphasizes that engagement is important also to find out which options are supported (or not) by society and why (not).

Projects such as STRATEGY CCUS or its follow-up project PilotSTRATEGY are helpful in this regard as by the scientific evaluations on the regional level the debate also comes to the regional level. As these projects include work on stakeholder involvement, this opens the chance to implement high-quality stakeholder engagement. It is important to note that stakeholder engagement does not mean to convince stakeholders on (certain options of) CCUS, but to provide a platform to exchange on scientific evaluations and build trust around research projects, as a basis for taking a political decisions on regional pathways for decarbonisation - including CCUS or not.

Specifically, the approach of combining an exploration and scoping phase to learn more about the relevant regions and technological options and also to make a first step towards the stakeholders has proved valuable and is highly recommended to future projects. This also includes to design an engagement process as a two-way dialogue between project partners and stakeholders including the general public. For the future, it is especially important to also make sure to enhance the local embeddedness of the project as well as to engage with the political process around CCUS as the political framework needs further developed that should be informed by the discussions around the projects.

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4 Appendix

4.1 Evaluation questionnaire implemented after the first RSC workshop

Feedback - Regional Stakeholder Committee Workshop I

We would be grateful if you would help us by filling out this short questionnaire, so that we can find out what you thought about the workshop in which you have just participated.

For each statement below, please tick the box that most closely represents your view. Please tick only **one** box per question, and try to give a response to each statement.

1. Overall, I liked the workshop.

very strongly disagree	❒	❒	❒	❒	❒	very strongly agree

2. I think that the people taking part in the workshop/committee were a fair cross-section of relevant CCUS stakeholders in the region.

very strongly disagree	❒	❒	❒	❒	❒	very strongly agree

3. I feel that the people running the workshop/committee were not promoting a specific view of issues concerning CCUS.

very strongly disagree	❒	❒	❒	❒	❒	very strongly agree

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4. The way the workshop/committee were run allowed me to have my say.

very strongly disagree	❒	❒	❒	❒	❒	very strongly agree

5. It was clear to me what I was supposed to be doing throughout the workshop.

very strongly disagree	❒	❒	❒	❒	❒	very strongly agree

6. The workshop seemed to provide sufficient time for everyone who wanted to contribute to the discussion to have their say.

very strongly disagree	❒	❒	❒	❒	❒	very strongly agree

7. I found the discussion during the workshop interesting.

very strongly disagree	❒	❒	❒	❒	❒	very strongly agree

For the next questions, please write the answer in the provided space.

8. Do you have any further comments about the group/committee and the issues that were discussed?

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_____

9. What did you like best?

_____

10. What would you like to change for the next workshop?

_____

11. In your opinion, who else should participate in the group/committee and the discussions? (Please think about people who could be additionally invited.)

_____

Many thanks for your time and participation in the workshop!

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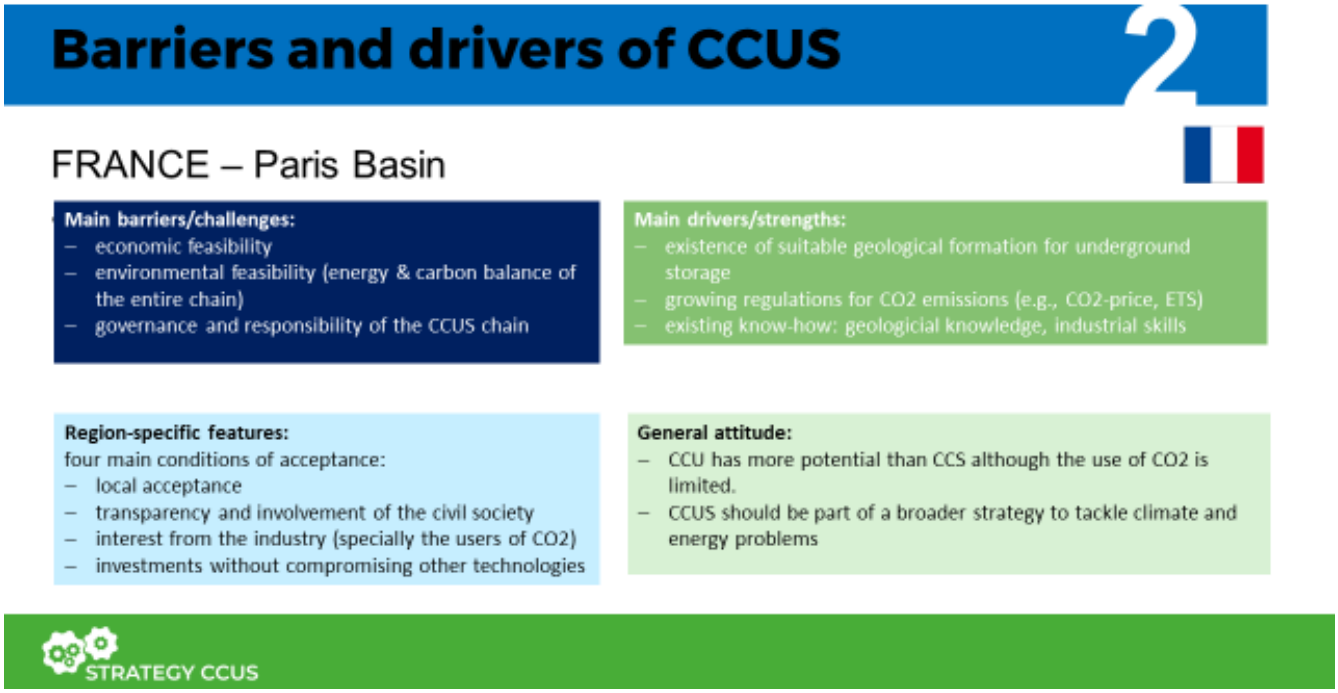
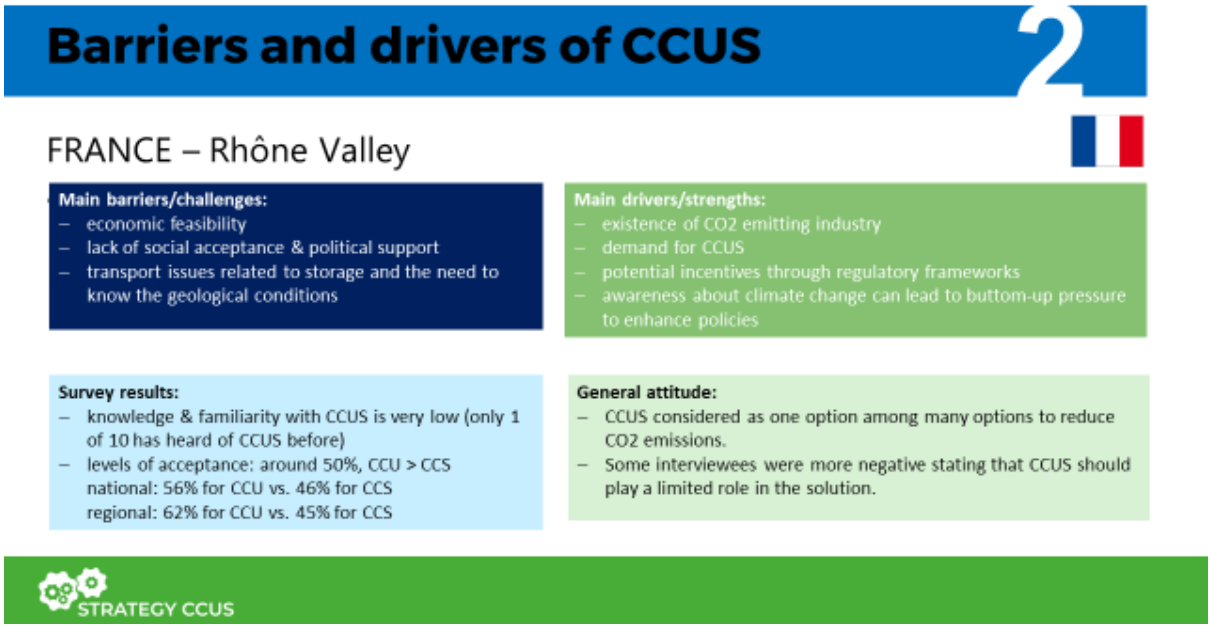
4.2 Region-specific summaries of the research results on social acceptance of CCUS





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Barriers and drivers of CCUS

PORTUGAL – Lusitanian Basin

Main barriers/challenges:
- economic feasibility (e.g. cost of capture)
- uncertainty regarding safety & environmental impacts
- heterogeneity and small size of industry

Main drivers/strengths:
- demand of products resulting from CO2 conversions (e.g. synthetic fuels)
- interested industry
- CCUS as a relevant back up solution (if other options fail)

Region-specific features:
- no alternatives perceived for the process industry (e.g. cement, petrochemical, glass)

General attitude:
- The interviewees were divided between support and ambivalence regarding the implementation of CCUS within the Lusitanian Basin.

STRATEGY CCUS

Barriers and drivers of CCUS

SPAIN – Ebro Basin

Main barriers/challenges:
- public resistance to underground storage
- lack of political support
- high effort in administrative procedures

Main drivers/strengths:
- interest & presence of industry in CCUS
- existing underground storage capacity
- existing infrastructure
- low density of the population

Survey results:
- knowledge & familiarity with CCUS is very low
- acceptance of CCUS higher than in Rhône Valley, FR
- levels of acceptance: CCU > CCS & national > regional
  national: 65% for CCU vs. 54% for CCS
  regional: 62% for CCU vs. 49% for CCS

General attitude:
- mostly favorable (only a few were rather sceptical)

STRATEGY CCUS

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Barriers and drivers of CCUS

POLAND – Upper Silesia

Main barriers/challenges:
- economic feasibility (high costs)
- environmental feasibility & safety
- limited CO2 storage possibilities
- more political support & NGOs

Main strengths/drivers:
- existing large emitters
- new employment opportunities in the CCUS-related industries
- slowing down the decline in coal industry (keep jobs)
- sufficient know-how from universities & research centers

Region-specific features:
- high population density
- high identification with the coal industry

General attitude:
- rather positive but partly mixed

STRATEGY CCUS

Barriers and drivers of CCUS

GREECE – West Macedonia

Main barriers/challenges:
- economic feasibility
- fear to guarantee safety of CO2 storage
- resistance of the local population

Main drivers/strengths:
- economic growth (job creation)
- environmental protection (awareness for CO2 reduction)

Region-specific features:
- closing of lignite units => lack of CO2 emitters

General attitude:
- positive

STRATEGY CCUS

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Barriers and drivers of CCUS

CROATIA – Northern Croatia

Main barriers/challenges:
- economic feasibility (lack of funding & political support)
- public resistance requires engagement
- lack of (technical) knowledge & expertise

Main drivers/strengths:
- existing large emitters
- economic growth (job creation)
- reputational benefits for companies

Region-specific features:
- less knowledge on stakeholder-side

General attitude:
- positive
- most interviewees supported a CCUS project in the region of Northern Croatia

STRATEGY CCUS

Barriers and drivers of CCUS

ROMANIA – Galati region

Main barriers/challenges:
- lack of technological know-how
- lack of support from authorities, political actors, and administration
- difficulties to obtain permits

Main drivers/strengths:
- economic growth (job creation)
- involvement of research & education
- CCS perceived as an option for EOR (enhanced oil recovery)

Region-specific features:
- low awareness for climate change in the population
- more information and a communication is required
- bad experiences with other technologies & related earthquakes

General attitude:
- positive, only two of stakeholders were rather neutral or partly sceptical

STRATEGY CCUS

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