PilotSTRATEGY

Community Acceptance

Findings from community profiles and first local survey

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This deliverable has additional **Annexes** that are published separately

Annex 1: Media Analysis Report

Annex 2: Interviews with community members

Annex 3: Survey findings

Disclaimer

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2. List of Abbreviations

CCBN - Communauté de communes de la Brie nangissienne
CCS - Carbon Capture and Storage
CCU - Carbon Capture and Utilisation
CCUS - Carbon Capture Utilisation and Storage
CO_2 - Carbon Dioxide
CPNA - Council for the Protection of Nature in Aragon
D - Deliverable, i.e. project report
EIA - Environmental Impact Assessment
EU - European Union
EU ETS - European Union Emission Trading System
GHG - Greenhouse Gas
IPCC – Intergovernmental Panel on Climate Change
NGO - Non-governmental Organisation
RSC - Regional Stakeholder Committees
WP - Work Package
ZEP - Zero Emissions Platform, technical adviser to the EU on the deployment of CCS and CCU

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3. Executive summary

This deliverable by PilotSTRATEGY WP6 on Social Acceptance and Community Engagement reports work on understanding societal contexts in the regions under study in this Horizon 2020 project.WP6 has so far focussed on characterizing the overall setting in which the discussions around potential geological storage of CO2 take place. In a next step, WP6 will centre on actual engagement and participation with key stakeholders and other members of local communities.

The report focuses on the six relevant regions in the five PilotSTRATEGY countries (Portugal, Spain, France, Poland, Greece) and presents regional community profiles developed through interviews, media and documentary analyses, as well as results of a first wave of survey exploring community acceptance. The relevant regions are the Lusitanian Basin in Portugal including an onshore and an offshore area next to each other, the Ebro Basin in Spain, also including an onshore and an offshore area in different parts of the Basin, Spain's Ebro Basin, Spain's Ebro Delta, the Paris basin in France, and Upper Silesia in Poland and West Macedonia in Greece. In Portugal and Spain preliminary characterizations will lead to focus in the remainder of the project on just one of the two options. Overall, in Portugal, Spain and France smaller regions are considered than in Poland and Greece. Detailed enquiries from various perspectives (geological, technical, economic, and social) are intended to support the potential implementation of pilot storage sites in these three countries after the lifetime of the research project PilotSTRATEGY.

We report that with regard to societal preparedness that the levels of awareness and knowledge on carbon capture and storage (CCS) are very low. This applies to citizens, but also to some societal stakeholders. The implication of this finding is that opinions and preferences regarding CCS are still under development in societies, and current levels of acceptance are preliminary and likely subject to change. The results share some commonalities across countries and regions, while the analyses also detected a series of local specificities. Our surveys indicated that a majority of citizens and stakeholders state positive attitudes towards CO_2 storage as a climate mitigation measure. At the same time, negative views could be identified among the societal stakeholders interviewed, in certain media depictions, and also among relevant shares of citizens among the survey respondents. Important topics in the discussion are the expected environmental impacts as well as the opportunities to be offered for participation and engagement.

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4. Table of Contents

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5. Introduction

Carbon capture and storage (CCS) is viewed by the IPPC as an important contribution to mitigating climate change. The European Union (EU) research project "CO_2 Geological Pilots in Strategic Territories" (PilotSTRATEGY) supports future decision making by developing detailed insight on how geological storage sites for carbon dioxide (CO_2) could potentially take their place in five regions across Europe. This five-year international research endeavour investigates the feasibility of geological storage of CO_2 using deep saline aquifers. Building on the findings of earlier EU-funded projects, notably STRATEGY CCUS, PilotSTRATEGY carries out detailed characterization studies in regions situated in France, Portugal and Spain. While in France a specific region was determined upfront, in Portugal and Spain this is an ongoing process. In Portugal so far an onshore and an offshore potential storage place in the same region are considered. In Spain, two regions are under consideration. A selection will be made soon for the remainder of the project. In addition, PilotSTRATEGY enhances the knowledge of CO_2 storage options in two wider regions in Greece and Poland (see Figure 1). Especially in France, Portugal and Spain, the research could support the implementation of pilot storage sites for CO_2 in the regions studied – after the lifetime of PilotSTRATEGY, and in the case of favourable findings regarding geological, technical and economic conditions, and depending on decisions taken by political authorities. The project focuses on deep saline aquifers: porous rock formations filled with brine several kilometres below ground, which are viewed as likely offering a large capacity for storing CO_2 captured from clusters of industry. PilotSTRATEGY seeks to ensure that community perspectives are fully represented in the project by engaging with residents of the study areas, as well as with key stakeholders, i.e. persons and institutions directly involved with or interested in CCS. This work is mainly organized in Work Package (WP) 6 of the project.

Figure 1 Countries and regions under study in the first phase of PilotSTRATEGY

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This deliverable from WP6 on Social Acceptance and Community Engagement in PilotSTRATEGY sets the scene and reports work on understanding societal contexts, before WP6 moves to the next phase centred on actual engagement and participation with key stakeholders and other members of local communities. In the first 18 months of the project, WP6 focussed on characterizing the overall setting in which the discussions around CO_2-storage take place in our project. An analysis of the policy framework in the relevant countries and the European context was summarized in a first deliverable (Duscha, 2022). The present deliverable focuses on the six regions in five countries under study, presenting regional community profiles developed through interviews, media analyses and other approaches (task 6.2), and results of a first wave of survey exploring community acceptance (task 6.3). The relevant regions are the Lusitanian Basin in Portugal including an onshore and an offshore storage area next to each other, Spain's Ebro Basin including an onshore and an offshore storage area, and the Paris basin in France. The regions in Poland and Greece are Upper Silesia and West Macedonia. Figure 1 provides an overview of the geographic locations.

The development of profiles of the regions included several methodological approaches such as (a) a document analysis including the characterization of the affected region, (b) media-analyses for the main countries involving print media, Google search outputs and Wikipedia articles as well as (c) a series of interviews with societal stakeholders. These steps aim at getting to know the regions on a detailed level and to anticipate residents' and stakeholders' level of knowledge, prior experiences, concerns, needs and possible expectations regarding CCS development. The conceptualisation of all three steps was based in literature on participation and engagement around CCS. In addition, regional surveys were implemented to understand public acceptance conceptualized as the set of understandings, attitudes, intentions, behaviours and positions regarding CCS. The surveys were implemented using online questionnaires in Poland, Greece and France and phone surveys in Spain and Portugal. The aim was to assemble representative samples of persons living in the broader study regions to get an account of current perceptions and acceptance. Later in the project, a second survey round will take place in the main countries Portugal, Spain and France to learn about any changes in perception and acceptance as both the larger context and PilotSTRATEGY characterization research evolve.

Both steps, the regional profiles and the first survey round will be integrated into a comprehensive assessment of community acceptance in this deliverable and will inform the next steps, i.e., designing engagement strategies for application in the coming stages of the project from November 2022 onwards (tasks 4 and 5 of WP6). Engagement strategies in the project contain two main elements. Firstly, stakeholder engagement through regional stakeholder committees (RSC): these committees have already been constituted in the previous project STRATEGY CCUS (Preuß, Dütschke, Oltra, Goncales, Prades & Germán, 2022) and will continue in a revised and adapted form according to the new insights and in line with the objectives of the PilotSTRATEGY project. Secondly, a public engagement strategy will be developed and implemented, taking into account local culture and traditions as explored by the profiles. Furthermore, the goal is to reach out to citizens who are heterogeneous in terms of gender and ideally income and age groups. In particular, engagement should give them the opportunity to state and elaborate their perceptions of the costs and benefits of CO_2-storage, its impacts, and any changes impinged upon their daily lives (for better or worse). At the end of the lifetime of WP6 and the PilotSTRATEGY-project recommendations will be provided on how to continue engagement with local societies in each region outlining the situation and developments so far, anticipating future challenges in case of moving forward with the

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implementation of a CO_2-storage pilot as well as a preliminary list of stakeholders and groups to be involved. Figure 2 provides an overview on the steps outlined.

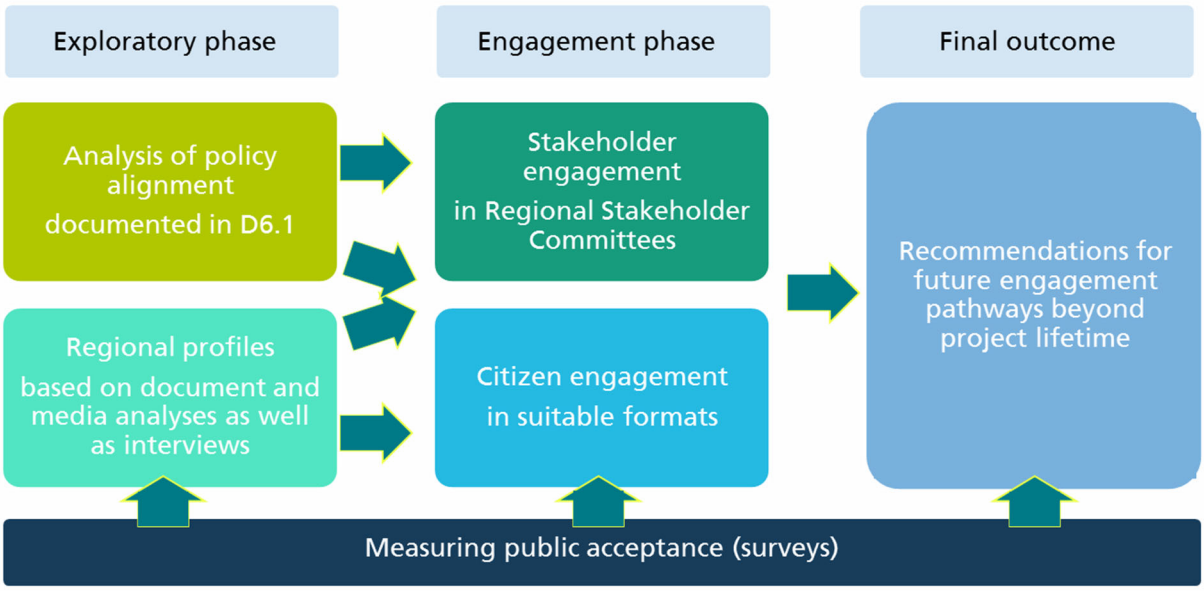

Figure 2 Concept for engagement and participation activities in WP6 in PilotSTRATEGY

As an over-arching activity a **trans- and interdisciplinary dialogue** is included as part of the project management in WP1 and is led by two of the partners from WP 6. This dialogue organizes reflexive interactions among the different scientific disciplines (engineering, natural sciences, and social sciences) and institutions (private research bodies, universities, and companies) represented in PilotSTRATEGY. By providing time and resources for such a dialogue the goal is to increase the understanding of the different perspectives, promoting mutual understanding. Methodologically, this includes for example dedicated sessions at each periodic consortium meeting. One of the outcomes of this dialogue was that the consortium documented its understanding of the project in a short manifesto that describes the project identity. It explicitly values the different perspectives involved but also defines its scope towards society and a potential implementation of CO_2-storage in the regions. This manifesto is a public information document that helps to frame the relations developed on the ground with local communities.

WP6 work also informs the project's choice of location for characterization in view of a pilot storage installation in Spain and Portugal where two options, one onshore and one offshore site, have been under consideration (milestones 2.1, 2.2 and 6.2 of the project). This selection process, which is to be completed in November 2022, takes into account technical, environmental, economic and geological factors and is supported by input from WP6 social studies. As will be outlined in more detail below, in the case of Spain the two optional sites are in different geographical areas, thus, two distinct regions were studied by WP6 in the first phase of the project. In the case of Portugal, the geographic area for the two considered options is roughly the same.

The present deliverable is structured as follows: First, sections 5.1 and 5.2 provide insight into "social acceptance" drawn from the literature of perception and engagement in the area of CCS. Chapter 6 then presents the social research methods through which we sought to understand the perceptions and baseline attitudes towards CCS in the communities relevant to the PilotSTRATEGY CCS characterization sites. Chapter 7 then presents the findings on perceptions and acceptance gained

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from the combination of different sources and approaches. Finally, Chapter 8 derives insights in a cross-cutting perspective, presents recommendations emerging from WP6 findings to contribute to the PilotSTRATEGY study site selection process in Portugal and Spain, reflects on regional specificities, and summarizes conclusions.

Across the different approaches a rich amount of data and analysis has been brought together; this report aims at concisely summarizing the main insights. For reasons of transparency and to make the full knowledge accessible, the annexes to this deliverable provide the detailed outcomes of the various methodological approaches applied by WP6, namely Annex 1: Media Analysis Report, Annex 2: Interviews with community members, and Annex 3: Survey findings. The annexes are published as separate documents on the PilotSTRATEGY website.

5.1 Social acceptance as a concept

Upham et al. (2015) describe (social) acceptance as "a favourable or positive response (including attitude, intention, behaviour and – where appropriate – use) relating to a proposed or in situ technology or socio-technical system, by members of a given social unit (country or region, community or town and household, organization)". The definition thus emphasizes

i. the variety of manifestation of acceptance in attitudes, intentions and behaviours (incl. use or application). Thus, acceptance has an attitudinal and a behavioural level. The attitudinal level includes the cognitive and emotional response, i.e., how individuals evaluate a technology and how they feel about it. These are often related, but not necessarily identical and both are open for ambiguity. I.e., one might feel positively excited about a technology, which does not necessarily mean that the person is no longer able to weigh pros and cons of this technology. Additionally, while – amongst other – emotions and attitudes influence behavioural intentions, these are also shaped by additional factors e.g., by control beliefs or personal and social norms. Finally, while behavioural intentions are valid predictors of behaviour, they are not fully determining it e.g., due to situational constraints or conflicting motives.
ii. the variety of objects of acceptance (e.g., a specific storage site, the related infrastructure or the more general energy transition including CO_2-storage as a pathway) and that these objects could have different levels of development (e.g., the mere idea or the actual implementation). It is important to disentangle as people might be sceptical towards CCUS in general but see it more positively as an option to explore in their region to secure employment in industries.
iii. the variety of subjects of acceptance as various social units, i.e., single persons or small groups (such as a household) but also larger collectives and populations (such as communities, association, regions, industries or nations). It is the notion that acceptance for an innovation or technology is manifested on the individual and the collective level and that these two levels influence each other. For example, socio-political acceptance is shared among a bigger group of citizens within a wider region or country; however, it may be rooted in prominently voiced opinions of relevant societal members. At the same time, literature has also pointed out that perceived social norms of a technology influence individual decision making on technology adoption (Dütschke, Upham & Schneider, 2017).

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Thus, the concept of social acceptance, as it is applied here, allows for a broad perspective on the roles of different actors, their expectations and interactions, and the diverse materialization of technologies at different scales (Devine-Wright & Batel, 2017). It should be noted that some conceptualizations of "acceptance" interpret it as a passive response to top-down intervention (such as actions by an infrastructure promoter), or distinguish supply and demand sides where the first is the creative innovator and the second the mere consumer. However, some scholars argue that the term can also be applied in a neutral, descriptive way (Upham et al., 2015). In addition, the term is frequently used in e.g. calls from European funding programmes to refer to the societal dimension of transitions and technology diffusion. We therefore choose to use the term, emphasizing our neutral understanding of "social acceptance" as a complex nexus allowing for active roles, perceptions, interactions and positioning.

5.2 State of research on CCS acceptance

Research into social acceptance of CCS had a peak together with the peak in technological projects around 10-15 years ago. Recently, interest has been rising again also due to the expansion of technological research into carbon capture and utilisation (CCU). The focus in the following is on CCS as the project is concerned with CO_2-storage, however, where relevant we will also refer to research on CCU. In addition, some studies do not differentiate more generally look into carbon capture, utilisation and storage scenarios (CCUS).

While a few studies have looked into specific groups of stakeholders and experts, the majority of social acceptance research focuses on the general or the local public. In the following we will therefore shortly summarize the state of knowledge on acceptance from the standpoints of the public and of involved stakeholders, and then move on to knowledge about engagement and participation in the field of CCS.

Public acceptance: Recent reviews (Dütschke, Wesche, Oltra & Prades, 2019) 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 be moderate on average. This is in line with findings from (social) media analyses, which revealed that the discussion mainly takes place in expert circles (Mander, Cunningham, Lever & Gough, 2017; Nuortimo, 2018, 2018). Regarding 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, Wohlfarth, Höller, Viebahn, Schumann & Pietzner, 2016). CCU is evaluated more positively than CCS (Arning et al., 2019; Linzenich, Arning, Offermann-van Heek & Ziefle, 2019; Whitmarsh, Xenias & Jones, 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 (Schumann, Duetschke & Pietzner, 2014), more recent research in the UK detected also more positive evaluations on the local level (Whitmarsh et al., 2019). The European countries studied most frequently include the UK, the Netherlands and Germany. For the countries in focus in the PilotSTRATEGY project, namely, France, Portugal, Spain, Greece and Poland, only a few studies are available. Most of them refer to Spain (Oltra, Sala & Boso, 2012a; Oltra, Sala, Solà, Di Masso & Rowe, 2010; e.g. Oltra, Upham, Riesch & et al., 2012b; Solá, Sala & Oltra, 2007) and a small number to Poland (Oltra et al., 2012b; Uliasz-Misiak & Przybycin, 2016; Xexakis & Trutnevyte, 2021) and France (Ha-Duong, Arnoux, Chaabane, Mardon, Nadai & Neri O'Neill, 2010; Ha-Duong, Nadaï & Campos, 2009).

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The STRATEGY CCUS-project as the preceding project to PilotSTRATEGY studied public acceptance through a survey implemented in Spain and France (Oltra, Preuß, Goncalves, Germán & Dütschke, 2021). The survey assessed levels of awareness, attitudes towards and acceptance of CCUS technologies in the public in Spain and France and in a selected region in each of the two countries. Representative samples on the national and regional level from each country (n = 1300) took part in the survey conducted online. The region studied in Spain, the Ebro basin, includes the region now studied in PilotSTRATEGY, while the French region is a different one. 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 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%) relative to CCS (50 %). Acceptance was higher in Spain (65 % for CCU and 54 % for CCS) compared to France (56 % for CCU and 46 % for CCS). Regarding the local acceptance of CCS and CCU projects, acceptance ranged from around 60 % for CCU to 48 % for CCS. Acceptance levels were higher for CCU projects (62 % in both regions) compared to CCS projects (45 % in France and 49 % 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.

Stakeholder acceptance: Stakeholder perspectives on CCS have been studied less often than public perceptions in the academic literature on CCS so far. Overall studies point to similar conclusions as for studies involving the public. The specific application case also plays an important role, for instance, Romanak et al. (2021) found that participants at climate negotiation events were critical of CCS for fossil fuels, but more supportive of its combination with bioenergy. Repeatedly, studies have concluded that CCS should be used as the final option when no other alternatives for decarbonization are available (Broecks, van Egmond, van Rijnsoever, Verlinde-van den Berg & Hekkert, 2016; Gonzalez, Mabon & Agarwal, 2021) and as a 'bridging technology' (Jones, Olfe-Kräutlein, Naims & Armstrong, 2017). Furthermore, there is some indication that certain stakeholder groups, such as the fossil fuel industry, are more open and supportive of CCUS than others, such as environmental NGOs (Gonzalez et al., 2021; Mabon & Littlecott, 2016; Romanak et al., 2021). In addition, studies have repeatedly identified the economics of CCUS as well as regulation and political framework conditions as major hurdles to its deployment (Gonzalez et al., 2021; Vreys, Lizin, van Dael, Tharakan & Malina, 2019). Based on a small expert sample, Karimi and Komendantova (2017) found that acceptance in Germany is perceived to be low and the need for CCS is questioned, while in two Scandinavian countries studied, namely Norway and Finland, concerns voiced by experts are more related to getting the implementation done, e.g., policy support or financial issues.

STRATEGY CCUS also looked into stakeholder views on the technology. Semi-structured interviews with selected members of the stakeholder groups were conducted in each of the study regions of the project. The overall number of interviewees was 102, consisting of 6 to 12 representatives in each of the study regions, an additional up to 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

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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 and similar to earlier literature and studies on public acceptance, more favourable attitudes towards CCU relative to CCS were found. 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. A minority of stakeholder representatives were opposed to 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, regional interviewees mentioned the need to consider the costs (financial viability), adequate public information and engagement, and policy support from the government (new and adequate legislation).

The role of local engagement and participation: In the literature, a significant body of research can be identified consisting of case studies around existing CCUS projects and the role of societal engagement and participation in the evolution of these projects (cf. summary by Rothkirch & Ejderyan, 2021). Oltra et al. (2012b) analysed five cases of local initiatives to develop CO_2-storage sites and came to the conclusion that engagement processes are one of several key factors that influence community responses to CCS (cf. Figure 3).

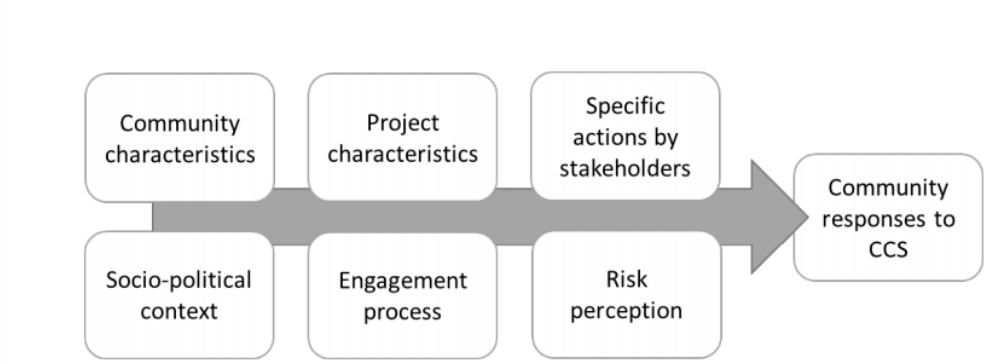

Figure 3 Factors influencing community responses from CCS (from Oltra et al., 2012b)

Other authors have taken a detailed look at the role of communication and developed it conceptually (e.g., Brunsting et al., 2011) while recent papers e.g., looking into views of CCS experts (Vercelli et al., 2017; Xenias & Whitmarsh, 2018) underline its relevance. Rothkirch und Ejderyan (2021) point out that factors such as (i) feeling heard by the government and playing a role in the decision-making process and (ii) having a positive established relationship with industry are frequent in an engagement process that is positively perceived.

6. Methods

The following chapters of this deliverable present findings of the regional community profiles elaborated in task 6.2 and the first wave of regional surveys on community acceptance from task 6.3. Task 6.2 includes several methodological steps: (a) a document analysis including the characterization of the affected region, (b) media analyses for the main countries involving print

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media, Google search outputs and Wikipedia articles as well as (c) a series of interviews with societal stakeholders. Detailed information about the methodological approaches can be found in the annexes to this deliverable. The next sections provide short overviews on the procedures and data bases used.

Overall, PilotSTRATEGY is implemented in six regions in five countries; however, the work is more intensive and detailed for three countries and their respective regions, namely, Portugal, France and Spain. This is also mirrored in the work conducted in this WP which is more comprehensive for these three countries. In Poland and Greece the media analysis was not performed and the document analysis and interviews were less detailed, while the survey approach was fully implemented. Figure 4 provides an overview on the different methodological approaches.

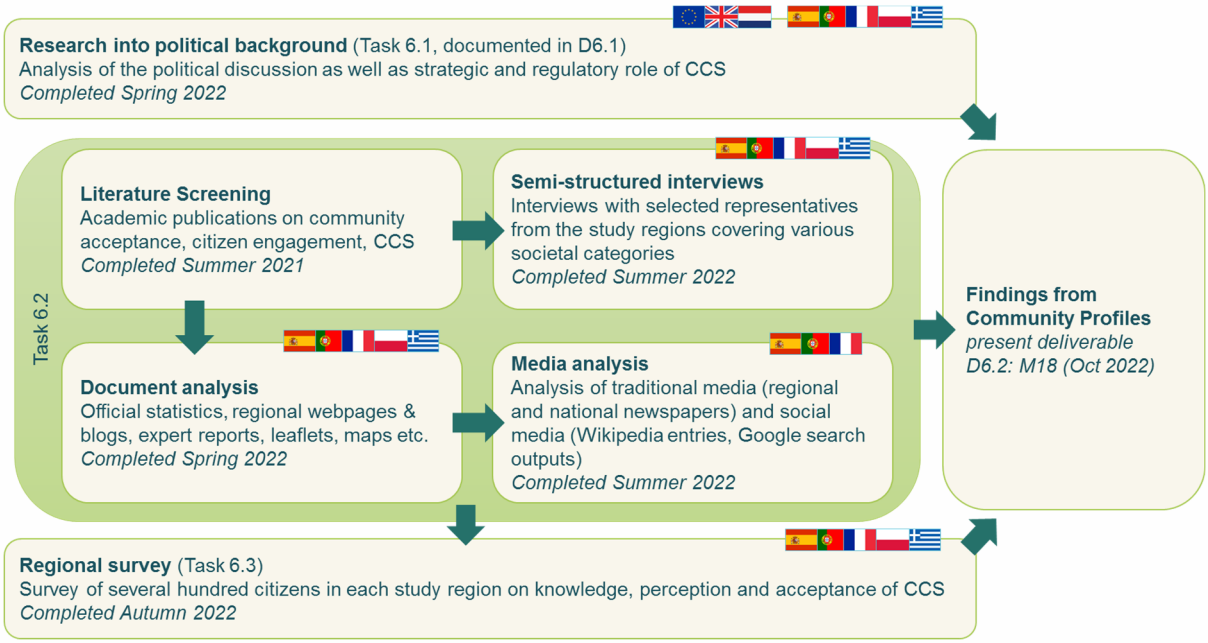

Figure 4 Overview on the methods implemented indicating country coverage and time of completion

6.1 Document analysis and definition of affected regions

The document analysis gathered preliminary insights on the territorial, geographical and perceptual aspects that may identify the communities relevant to the PilotSTRATEGY sites, and generated hypotheses on how the singularities of the regions under study may affect the public responses towards the potential storage sites. As part of the step, the 'affected region', i.e. the relevant area, was also identified combining geographical, cultural/ historic and administrative information. An interim report was developed and shared with the consortium as an internal/confidential report in March 2022. The approach to the document analysis was flexible and open and was implemented in close cooperation with other partners in the consortium involved in the regions. CIEMAT as the task lead provided guidance and templates for this step. Data sources used included (i) national and regional official statistics (ii) local and regional webpages or blogs such as from city councils, regional governments, local NGO (iii) scientific or expert reports and publications (iv) socio-economic reports (v) leaflets, books, maps of the area. The topics to be researched included gathering information on the technical scope of the potential CO_2-storage project, the geographical, administrative, regulatory, environmental and socio-economic scope as well as the identification of key actors.

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6.2 Media analysis

The media analysis combined several approaches. First of all, it looked into traditional print media in the three relevant countries Portugal, Spain and France. Second, given the decreasing relevance of such traditional media and the increasing relevance of online media, Wikipedia entries on CCS as well as Google search outputs were also analysed.

6.2.1 Print media analysis

Analysing print media is a classical approach for looking into information that is shared about a topic and to identify relevant streams of discussion. The assumption is that, on the one hand, the way and type of information presented shapes the public debate and, on the other hand, takes up discussions that are taking place.

Regarding the sampling, it was the aim to take into account at least one national, regional and local newspaper (Table 1). In Spain and Portugal, this included extensions to make sure that the onshore and the offshore areas are fully covered. The selected time period covered the last 10 years until September 2021. Data gathering took place between December 9th 2021 and March 11th 2022.

Table 1 Newspapers selected per region and number of articles analysed

	Spain	France	Portugal
National	El País El Mundo	Le Monde Le Figaro Libération	Público Correio da Manhã
Regional	Diari de Tarragona	Le Parisien	Região de Leiria
Local	Diario de Teruel	La République de Seine et Marne	Diário de Leiria Jornal de Leiria Jornal Marinha Grande Jornal Oeste O Figueirense O Portomosense O Alcoa Região da Nazaré Região de Cister
No of articles	97	129	52

On the national level, the focus was on the leading newspapers that are frequently read. On the regional and local level selection was made in a similar way. In Spain and France, it was possible to draw on data bases (MyNews in Spain and Europress in France) to identify articles while in Portugal websites of the selected newspapers as well as Google search was applied. Researches worked with a list of predefined keywords. The number of articles identified varied strongly between countries. While in France, the volume of potentially related articles meant that key words were restricted to yield a manageable set of articles focussing primarily on CCS, in Portugal the search focus had to be extended to procure a meaningful volume of returns.

For the analyses, the involved researchers agreed on a protocol in an iterative process, inspired by literature on CCS representations in the media as well as the group's own research on media representations (Brunsting et al., 2015; Delicado, Schmidt, Pereira, Oltra & Prades, 2015; Fischedick

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et al., 2009; Kojo & Innola, 2017; Oltra, Delicado, Prades, Pereira & Schmidt, 2014; Pietzner, Schwarz, Duetschke & Schumann, 2014; Schmidt, Horta, Pereira & Delicado, 2015; van Alphen, van Voorst tot Voorst, Hekkert & Smits, 2007). The analysis of the database was performed with IBM SPSS.

6.2.2 Online media analysis

The online media analysis focused on Wikipedia entries and on Google search outputs. The leading idea was to portray and analyse what citizens in the countries were likely to get as information if they search for it on the internet.

The Wikipedia analysis focused on the pages that are most likely to be accessed in the relevant regions, i.e., the CCS pages in the French, Spanish, and Portuguese-language Wikipedia projects. Additionally, many people also access this information in English[1]; thus and for comparative purposes, we also included the page from the English-language Wikipedia project. The comparative analysis of the four language pages was performed on two levels: (1) Meta-level: history of the page in terms of size, contributors, and page views. (2) Textual level: content of the page in terms of words, structure, meaning, etc. A standardized template with fixed categories was created and filled for each language. The data was accessed between May and June 2022.

The Google search analysis focused on looking into the content of the first result page obtained when searching for CCS in the three countries. This includes the list of results, but also suggested questions and answers, featured snippets, information boxes, search suggestions, alternative search terms, and advertisements. Four different queries were developed and implemented in all countries: (i) Carbon capture and storage; ii) CCS plus risks; iii) CCS plus benefits; iv) CCS plus country name. The searches were conducted in the national language of each country. For data analysis, templates to synthesize the results of the four queries in each country were developed. The extracted webpages were also saved on Internet Archive (https://archive.org/). The searches were conducted in Paris, Barcelona, and Lisbon by a member of each national team, using www.google.fr, www.google.es, and www.google.pt, respectively. All team members performed the queries on Google Chrome, in an incognito window, with history and cookies cleaned. Using the information on the templates, for each country and query, we compared all elements of the results page - search suggestions, suggested questions and answers, featured snippets, information boxes, alternative search terms, and advertisements – aiming to understand patterns, similarities, and differences. For the list of results of each query, we classified each link in terms of source, type of actor, date type of content, as well as the overall evaluation of CCS.

6.3 Interviews with regional societal stakeholders

The objective of this task was to map the perceptions, attitudes and points of views around a potential CCS project of the key stakeholders in the study communities. The goal was to explore the social acceptance, as well as the scope of critical issues and needs in each community under study. Thus, we a) identified the relevant actors for a social debate around CCS in each community and b) conducted semi-structured interviews with selected representatives of stakeholder groups in the studied regions. This step was implemented in a broader and more comprehensive way in Portugal, Spain, and France which resulted in a longer interview guideline and a more heterogeneous

[1] The English-language Wikipedia is the oldest and largest of the Wikipedia projects.

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selection of stakeholder categories as well as a higher number of interviewees than in Poland and Greece.

As we expected to find quite low levels of knowledge and familiarity with CCS technologies and CO_2-storage, social scientists and technical experts worked hand in hand to conduct the interviews and in Portugal and Spain usually both participated in the interviews. In Poland and Greece, the interviews were conducted by the technical partners after discussions with the leaders and co-leaders of social science WP6. To facilitate more informed conversations, the technical experts provided clarifications and explanations on the technical aspects (when requested) in a neutral and balanced way.

Overall, a total of 56 interviews with key stakeholders were conducted in the PilotSTRATEGY regions (see Table 2). Interview partners usually represented public administration, industry, and research in all countries[2] and additionally, NGOs and media in Portugal, Spain, and France. In Spain, two sets of interviews were conducted for the onshore and the offshore region respectively. Interviewees usually came from the regions under study in Portugal and Spain. In France, however, few regional stakeholders responded to the invitation, and the sample was therefore extended to representatives from another region in France experienced with CCS, as well as to experts from relevant fields such as an environmental activist. In addition, information from meetings and discussions with farmers that took place while accompanying activities of 3D seismic acquisition (part of actions of the WP2 – Geo-characterisation) in the region were documented and considered in the analysis for France.

Table 2 Number of interviews per region

	ES_on	ES_off	PT	FR	GR	PL	Total
Number of Interviews	10	9	18	8	6	5	56

Three different protocols were used for the three main categories of interviewees: local actors, key informants, and national actors. They all included a common core and specific questions about the following topics: i) Characterization of the community ii) Familiarity with CCS iii) Global benefits of CCS iv) Risks of CCS v) Local benefits and opportunities of CO_2-storage vi) Local negative impacts of CO_2-storage vii) Acceptance conditions viii) Key actors and public involvement ix) General position towards the CO_2-storage project. All the interviews were recorded and partially transcribed. The content was analysed using a thematic approach.

6.4 Regional surveys

The aim of the regional surveys was to have representative findings on the current levels of awareness and acceptance in the regions' general public as well as to identify expectations in terms of benefits and concerns to respond to them in the next steps. The original idea was to implement online surveys with sample sizes of 500 respondents in all six regions. The recruitment of participants was to be implemented through market research institutes as subcontractors. However, following the definition of the affected regions and country specifics with regard to research practices as well as available services from market research companies, the research team decided to implement phone surveys instead of online surveys in Portugal and Spain. According to the type

[2] Exceptions: No interview partner came from Industry in the case of Greece and none from Research in the case of Portugal

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of survey implementation, the survey length also had to be adjusted with shorter questionnaires for the phone surveys. Moreover, for France and the Spanish regions the sample sizes had to be adjusted to around 250 and 300 respectively (onshore and offshore) as higher numbers could not be guaranteed by service providers due to low population rates or lack of coverage in their contact data bases. Table 3 provides an overview on the final implementation and numbers of respondents achieved. A very small number of participants was excluded from the analysis due to a low quality of answers (e.g. very high rates of 'don't know' across all types of questions).

Representativity of the sample was aimed for in terms of age (using four categories) and gender. The soft quotas set up for this purpose were not crossed and were based on national statistics due to the low data availability for the tailored regions. Owing to this, a higher tolerance was set for the quota limits. In addition to the criteria mentioned above, the ratio of residents in the respective administrative units as well as the educational level of the participants were monitored on natural fall-out, i.e. no thresholds were set.

Table 3 Overview on study research design and sample sizes analysed

Country	Final sample size	Type of provision	Length
Portugal – onshore and offshore	N=497	Phone	10 min
Spain onshore	N=300	Phone	7 min
Spain offshore	N=303	Phone	7 min
France	N=243	Online	10 min
Poland	N=495	Online	10 min
Greece	N=489	Online	10 min

A modular questionnaire was developed by the research team that included a common identical core across all surveys to allow for cross-country comparison. In addition, some region-specific questions were added as well as some further topics for the longer online questionnaires. The phone survey in Portugal is longer than the phone survey in Spain, however, content-wise they are highly similar as the greater length in Portugal is mainly due to the fact that the Portuguese survey had to cover both the onshore and the offshore option. The topics covered in each regional questionnaire are displayed in Table 4.

The samples drawn aimed at representativity, but they are clearly biased: As outlined above only few socio-economic variables could be used for quota in the sampling and they were only fulfilled to a certain extent. This is mainly due to the limited number of people living in the respective area. With regard to the quota set, the regional samples well cover the targeted gender distribution in the population. This partly also applies to the age distribution in the four categories; however, the oldest category is underrepresented in the online survey. In addition, especially in Portugal, Spain and France where smaller region were included, it is likely that those who agreed to participate in the survey have different opinions from those who declined or were not interested in joining directories of market research institute. Thus, the final numbers obtained need to be interpreted with care. In this regard, country comparison is an important part of the interpretation. Therefore, statistics are presented in overall figures.

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Table 4 Overview on the survey content

Topics in the questionnaire	Portugal	Spain	France	Poland	Greece
Socio-economic variables	(x)	(x)	x	x	x
Place attachment	x	(x)	x	x	x
Climate change perceptions	x	x	x	x	x
Attitudes towards industry	x	x	x	x	x
Familiarity with CCS	x	x	x	x	x
(Informed) acceptance of CCS	x	x	x	x	x
Expected impacts of CCS	x	x	x	x	x
Conditions for acceptance	x	x	x	x	x
Expectations regarding the process	-	(x)	x	x	x
Trust in societal stakeholders	x	x	x	x	x
Preferred involvement of societal stakeholders	(x)	-	x	x	x
Preferred involvement in the process	x	x	x	x	x

x: included in full; (x): included in abbreviated form; -: not included

For the implementation as phone vs. online survey, we had to slightly adjust the wording of the questions, the instructions as well as the explanatory text in between. The surveys were implemented in national languages and fieldwork started in July 2022 and was completed in each region in September at the latest. Data analyses were conducted in IBM SPSS and mainly focused on descriptive statistics and cross-country comparisons. For this summary report, the main figures will be presented in section 7.1.5 to allow for comparisons across countries. This approach was taken as the relative patterns compared to the other samples are important to keep in mind for interpretation.

7. Community acceptance and perceptions

In the following, the findings yielded by the various study methods in each country are discussed. As indicated in the introduction, during the study period two storage options in the same area were considered in Portugal, and in Spain two regions. In autumn 2022 a single option will be selected in each of these two countries, and the future focus will be on the selected region only. The following section for each country first presents background information on the region(s) studied followed by a summary regarding the political framework. Next, a summary of the results from the media analysis is provided followed by regional stakeholder perceptions and results of the survey on public acceptance.

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7.1 Portugal

7.1.1 Region with offshore and onshore option under consideration

The study area covers a region in the central west coast of Portugal, approximately 100km north of Lisbon and 120km south of the second major city, Porto. Onshore and offshore sites face each other, therefore there is substantial overlap in the affected communities. The study area comprises seven municipalities, of which three are directly above the potential storage area and five have a coastal boundary facing the offshore target area (potential visual contact from the coast). Even though Portugal is not a regionalised country, above the municipal level (and below the national one) there are two other government levels that should be taken into consideration: regions and inter-municipal communities. The seven municipalities considered belong to two regions and three inter-municipal communities.

The study area comprises a population of around 400,000 inhabitants. In most of the seven municipalities, the population has decreased in the last decade. As in most of the country, the ageing index is above 160 (which means that there are 160 people over 65 for each 100 people under 18). Inland municipalities in the study area have a lower population density than coastal ones. In economic terms, some of the municipalities rely more on industry for employment (Marinha Grande), some on tourism (Nazaré) and some on agriculture (Alcobaça). The proportion of secondary residences is particularly high in the coastal towns Nazaré and Figueira da Foz. In all municipalities, the average monthly earnings of employees are below the national average and the unemployment rate is below the national average in all municipalities except the most industrialised ones (Figueira da Foz and Marinha Grande).

The study area includes three sites belonging to the Natura 2000 network, one onshore (a natural park, with several caves and geological monuments), two offshore. The study area includes also other natural heritage sites with a protected status. At the coast between Nazaré and Figueira da Foz, there are three National Woods (and a few smaller ones inland). Management plans restrict the types of activities that can be developed in protected areas.

Recent municipal elections, which are usually dominated by the two main parties, resulted in three municipalities changing their political colour, electing independents. The geographically defined study area is located in the central west of Portugal known as the “West Coast”, serviced by a railway line and a motorway of that name. This “imagined community” contains several overlapping ones, with diverse sources of collective identity and sense of place (potentially giving rise to place attachment): the sea, fishing and beach tourism; the UNESCO classified historical heritage of medieval castles and monasteries; the geological heritage of caves and paleontological monuments; agriculture and fruit production. This region also has a significant proportion of second homes, in line with the importance of tourism as an economic activity.

All the municipalities in the study area have industry, but this sector is particularly relevant in Marina Grande, Alcobaça and Porto de Mós. The most relevant industry in Marinha Grande is glass and crystal manufacturing (another strong source of collective identity), followed more recently by the plastics and mould industry. In Alcobaça, the most relevant kinds of industry are the building materials industry (ceramics, cement) and food industry. In Porto de Mós, the most relevant industry is non-metallic minerals. Thus, CCS projects would be most relevant for the high emitting industry of cement and glass factories in this area.

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Despite being a region with significant industrial activity, no evidence was found of serious industrial incidents or accidents that may have a significant impact on collective perceptions of risk. However, this region is rife with environmental conflicts that engender social mobilisation and protest. The one most closely connected to CCS is the resistance to oil and gas exploration. In the past decade, local communities and environmental NGOs successfully contested industry contracts to perform onshore and offshore oil and gas exploration. There have also been some instances of resistance to wind farms, industrial infrastructures, kaolin extraction, and pollution from swine farms.

7.1.2 National background

With roughly 80 Mt GHG emissions Portugal is a medium emitter in the EU (EEA GHG data viewer, 2021). The country has the target of reaching net-zero GHG emissions by 2050 in their long-term strategy published in 2019 (República Portuguesa 2019a). The low-carbon roadmap does not identify CCS as a solution for the Portuguese economy so far due to its very limited applicability and relatively high costs. Correspondingly, CCS is currently not very high on the political agenda, Portuguese politics does not see itself as a frontrunner in the development of CCS technology. As required, Portugal implemented the EU's CCS Directive into national law in March 2012 without additional specifications; no further activities to support the development of CCS activities in Portugal from the Government could be found. According to the Zero Emissions Platform (ZEP), there are currently no CCUS project planned or under development in Portugal.

At the national level, regulatory powers over CCS are held by the Ministry for the Environment and Climate Action, in particular the Secretary of State for Energy and its executive body, DG Energy and Geology (in charge of licensing CCS), and the Secretary of State for Environment, which presides over the Environment Agency (in charge of Environmental Impact Assessment). However, offshore activities are subjected to specific regulations and fall under a different government authority: the Ministry for Economics and the Sea and DG Marine Resources.

7.1.3 Depiction in media

The analysis of print media identified a low media coverage of issues on and around CCS. On a temporal scale, there is not much development over time. There is a small peak in 2015 and 2021, possibly in relation to the United Nations Climate Change Conferences. As in all three countries, short news articles (>50%) dominate followed by detailed news articles (>20%). Usually, CCS is not the main topic of the article. In the vast majority of articles, CCS co-occurs with climate change and decarbonisation as further topics. The largest share is authored by journalists, but articles from press agencies also play a significant role (>20%) which is higher than in the other two countries. Typically, articles take an international focus and only few refer to the national level, none to the regional or local. Three quarters of articles do not reveal the place of storage, if they refer to it, offshore is less often made explicit as onshore or both options. It is hardly ever mentioned that CO_2-storage could happen in Portugal. Similarly in all countries, the main actors referred to are administration and government as well as industry. To a lesser degree, international organisations are also referred to repeatedly, as well as experts/research. In most cases (>80%), CCS is connotated as reducing emissions and being good for climate change mitigation. The majority of the articles (>60%) does not mention arguments against CCS; if they do, then the cost argument is the most frequent one (nearly 20%). Most often articles are coded as neutral (nearly 40%) followed by positive articles (around one third), however a relevant number is seen as mixed (>15%) or even negative (>10%).

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With regard to Wikipedia, it is important to note that the Portuguese-language data base is overall smaller in number of articles compared worldwide or to the other languages under study. From 25-02-2022 to 17-03-2022. The page on CCS was visited on average about four times per day and thus much less frequently than the other language editions. The article is very short with >300 words structured in one section and very few links to other Wikipedia pages. The page in Portuguese provides only a brief explanation of the technology and its relation to climate change mitigation.

When searching for CCS on google.pt, differently from what happened in France and Spain, Google did not suggest any questions and answers on the topic, probably because there is less structured information available on the internet on CCS in Portuguese. In total, the four predefined queries resulted in 22 different sources. The majority of these were pages with academic-related content, either theses on CCS, posts and news related to CCS and CCS projects, or information on CCS courses, followed by web pages or blog posts from private companies. The results did not include any content produced by Portuguese NGOs or environmental media or even legacy media. It included several foreign sources (Brazil), especially in comparison with the other countries. Most of the results presented a positive or neutral position on CCS, highlighting different technical aspects of CCS, its importance for decarbonisation and fighting climate change, its urgency and feasibility, and its security. The critical aspects mentioned by the few sources that presented a balanced perspective were that CCS might reinforce an increase in the use of these fuels, uses too much energy, is expensive, it has no commercial viability in the short term. They also mentioned the risk of earthquakes and accidental spills. When searching for CCS Portugal, the list of results included several of the same links presented in the general search for CCS, with the number of Portuguese academic sources increasing significantly.

7.1.4 Regional stakeholder perceptions

Two key issues are to be highlighted from the Portuguese interviews: The overall low level of knowledge and familiarity with CCS and the high number of questions posed by the interviewees on the one hand, and the concerns about CCS risks on the other.

Several interviewees mentioned how the local community in the area of study opposed projects that had environmental impact in recent years: waste management facilities, oil and gas exploration, pig farms, paper mills, a natural gas underground storage facility. They mentioned the protest strategies used (demonstrations, roadblocks, and street protests) and how successful they were in some cases (oil and gas exploration). In other cases, after the initial resistance and successful information campaigns, population accepted the facilities in the end. For CCS, several interviewees expected that it will be met with resistance from the general public.

Opinions varied on whether onshore or offshore CCS would be preferable in Portugal and quite a few interviewees declined to elect an option due to the lack of information about the subject. Some stakeholders considered that the decision should be made based on technical, safety, and economic criteria. The offshore option was considered by many as the one that would lead to the less public resistance because it would not directly affect populations and would be less visible.

When asked about the potential opportunities of CCS for their region, most interviewees had difficulty in answering, due to their lack of knowledge about CCS. Some of them see no added value of CCS locally, but rather globally. One of the benefits mentioned by interviewees was that CCS can help local industries in their carbon transition. However, this was a minority position. The local

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impacts of a potential CCS project identified by the interviewees included: 1. Environmental impacts in protected areas; 2. Impacts on local aquifers; 3. Impacts on the quality of life in the region; 4. Impacts on tourism; 5. Overall impacts.

With regard to acceptance conditions, several interviewees indicated that to ensure acceptance it is important that the population will be compensated for the implementation of the project in their region. The need for transparency was also emphasized as well as for high-quality information on all aspects of the project that could impact the local population (risks, costs, economic benefits, business models, etc.) so that the public can make informed decisions. Finally, some of the interviewees pointed out that the location of the infrastructure is key for public acceptance. However, there was no consensus on what the most acceptable location is.

7.1.5 Public acceptance

Public acceptance was measured in Portugal by means of a phone survey. As outlined above, the affected region is largely identical for the onshore and offshore storage option and, thus, consists of one overall sample.

Summary figures (cf. Figure 5, Figure 6, Figure 7) are displayed below, providing the relative frequencies of answering options (excluding the 'don't know'-option). As outlined in section 6.4, numbers have to be interpreted with care as the samples are not fully representative. Therefore, we mainly read them in comparison to the other countries and the relative position of a region in this regard.

For Portugal, we find that the reported levels of familiarity compared to the other countries and respective regions are medium. Importantly, this shows that a majority indicated that they had never heard of CCS and only around 10% reported to be familiar with the technology.

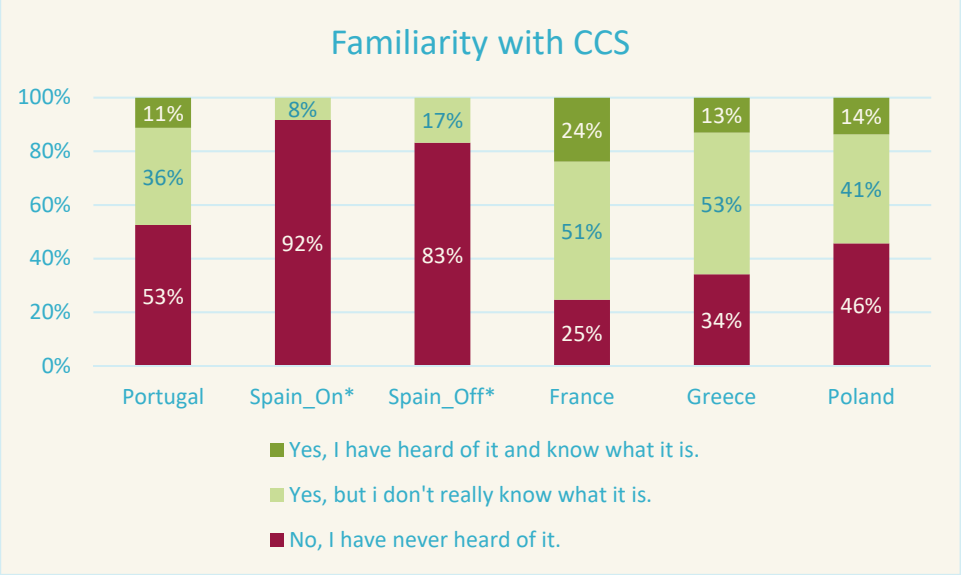

*Figure 5 Familiarity with CCS in all study regions (*in Spain the two Yes-categories were merged into one)*

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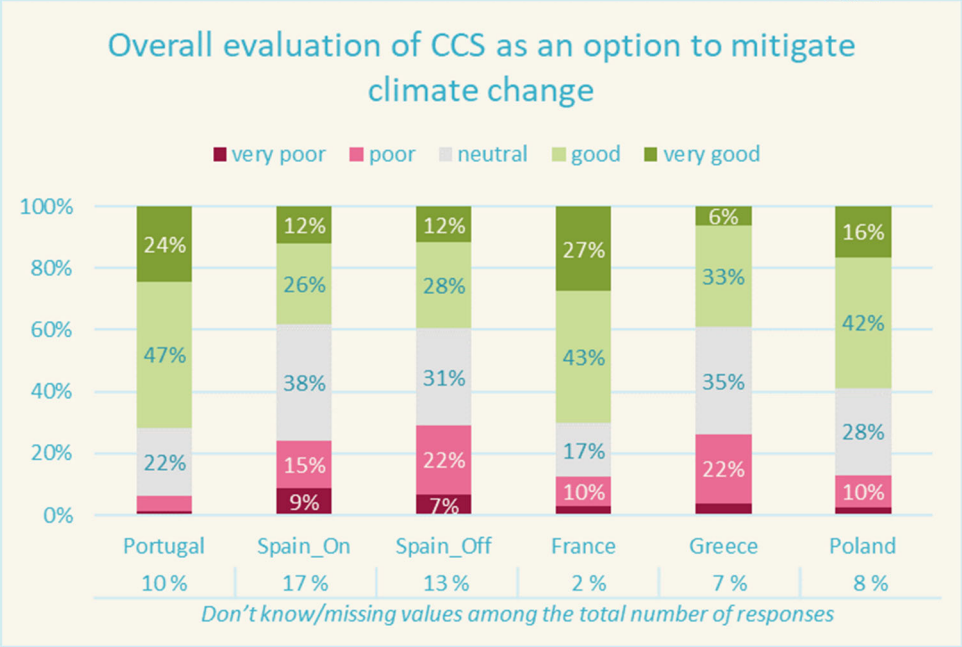

Figure 6 Overall evaluation of CCS as a technological option

The overall evaluation of Portuguese respondents of CCS as a technological option to tackle climate change is rather positive and together with the French respondents more positive than in the other countries, with more than 70 % of those providing an evaluation categorizing it as a good or very good option.

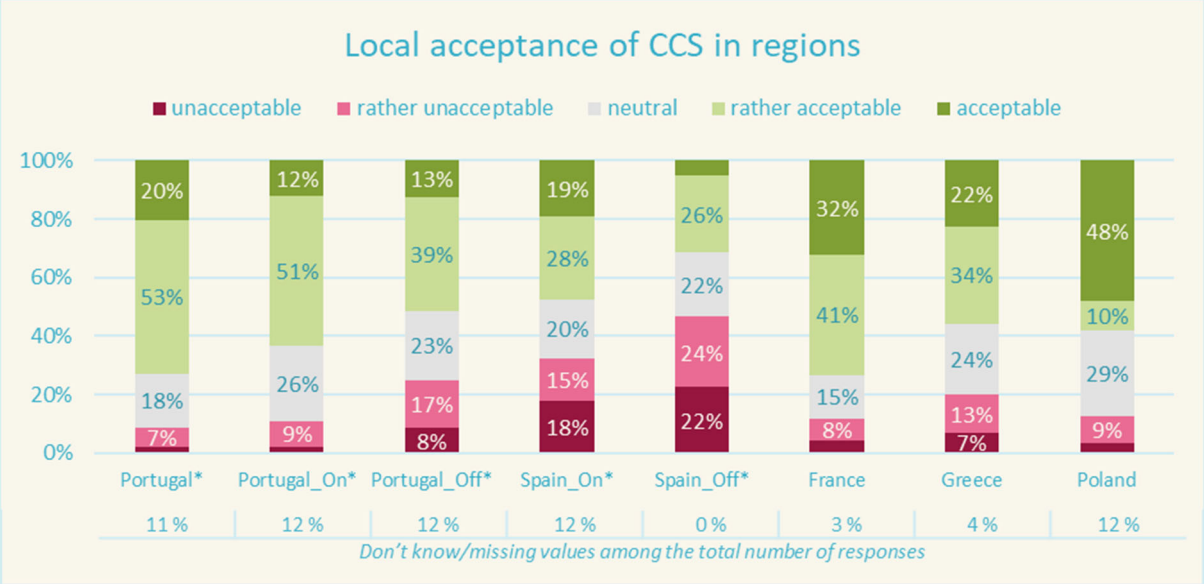

Figure 7 Local acceptance of CCS in the respective study regions (in the phone surveys, i.e. Portugal and Spain, the wording of scale was slightly different ranging from "totally unacceptable" to "totally acceptable")

With regard to a local implementation, respondents from Portugal reacted very positively to a potential implementation in the region, with more than 70% supporting it by answering with totally acceptable or acceptable. However, this share decreases if the potential storage location is specified as in the underground on land. Here, the rates of support are lower (>60%), with more respondents

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choosing the neutral-option (compared to the overall evaluation of CCS). If the storage site is specified as being under the sea, the shares of respondents choosing the answers “totally unacceptable” or “unacceptable” are more than double (support rates >50%). With regard to further topics in the survey, the Portuguese respondents report relatively high levels of attachment to the area.

As CCS is an unfamiliar topic, it is also relevant to look into the shares of respondents answering "I don't know". The pattern of the Portuguese respondents is not significant in this regard compared to the other countries; nevertheless, it is worthwhile to note that between 10-14% of respondents chose the don’t-know-option in the CCS related questions and they are not counted in the shares outlined above, thus, decreasing them relatively.

7.2 Spain

For Spain, two regions are so far under consideration for PilotSTRATEGY; however, they are embedded in the same national background.

7.2.1 Offshore and onshore region under consideration

The two Spanish regions under consideration are located next to each other in the North-East of Spain, South of the Pyrenees. The potential offshore storage site is in the Mediterranean Sea, thus the affected area is located at the coast, while the potential onshore storage site is situated towards the West and on the mainland. Both are near the river Ebro - in the onshore case at its basin, in the offshore case more towards its delta where the river flows into the sea. Both regions have potential industries to be used as CO_2 sources: paper and cement in the onshore area and petrochemical, chemical and cement in the offshore area.

7.2.1.1 Ebro Basin onshore

The Ebro Basin onshore area under study integrates *comarcas*[3] and municipalities located in the vicinity of the proposed geological site, from Zaragoza and Teruel provinces. The geological structure under research in the Ebro Basin onshore region is located in more than 1600 m depth in saline aquifers.

As the *affected community,* we consider the municipalities located in the vicinity of the potential storage site (30 km radius). Therefore, our affected comarcas include Campo de Belchite, Comarca Central (excluding the city of Zaragoza), Bajo Martín, Ribera Baja del Ebro and Los Monegros. The combined population of these *comarcas* is 807.869 inhabitants. However, as the radius considered is 30 km, not the entire comarca’s area and population is part of the study, but only the municipalities in the inner radius, with the exception of the city of Zaragoza that accounts for 675.301 inhabitants. Resulting is a total population of 104.406 inhabitants. Important in economic and cultural terms, the region used to be a coal district producing coal for nearby power plants over the past 40 years, so there is a strong tradition and familiarity with underground work.

[3] Comarcas are entities presenting an additional intermediate and supra-municipal administrative level. They were installed to allow for a considerate development of areas. So far, they have not developed into an entity providing identification for citizens.

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The territory is characterized by a low population density, a high number of small municipalities and a high concentration of population in the city of Zaragoza. The gender and age distribution of the population is fairly similar to the national one in Spain, but in the smallest municipalities which are in the target region of this analysis the population is relatively old and, in some cases, there is a total absence of young people. The region is widely known to be losing population and belongs to the so-called *Emptied Spain* (*España Vaciada*), a phenomenon that is becoming crucial in the national political agenda. Some people highlight that it is not *empty* but *emptied* as it was a human-made process that emptied these regions. Community identity is becoming a crucial issue through, among others, citizen movements like Teruel Existe (Teruel Exists) which emerged already in the 1990s. Recently, a variety of initiatives aimed at the repopulation of the area. It is important to note, that in the Teruel area more than 40 % of homes are second homes.

There were traditional mining areas nearby, but the closure of the last mine in 2003 and the closure of Andorra power station in June 2020 forced an industrial reconversion. People working in the mines decreased from 3.746 in 1986 to 430 in 2013. Notably, the area of Teruel is included in the Coal Regions in Transition Initiative, and in the reconversion Plan MINER, managed by the Spanish Ministry for Ecological Transition and Demographic Challenge. A few industrial and technological initiatives are taking place to reactivate the local economy, such as suppliers of automotive parts, the installation of several wind farms, or stoneware and ceramics companies. In the area under study, unemployment rates are lower than in Spain or Aragón; however, the numbers need to be interpreted with care due to the small number of citizens in the regions.

Since January 2019, several public protests have been held regarding the closure of the Andorra power plant without an alternative plan for the future of the mining basins. Demonstrators have conveyed the fear to a future with fewer and fewer people in the territory. At the same time, there is an increasing concern regarding the impact of renewable macro-projects on the landscapes and territories. In April 2021, a protest using a caravan of vehicles, with flags and green balloons, travelled the streets of the city of Teruel under the slogan *'For the future of Teruel. Renewable Yes, but not like this'*. Complaints relate to their perceived high environmental impacts but limited socioeconomic local benefits. The conservation of the territory and the landscape is becoming a crucial issue for the community. An important milestone in Aragon was the creation in 1992 of the Council for the Protection of Nature in Aragon (CPNA), a participatory body whose function is, among others, to report on the protection of new protected natural areas and their management plans. In addition to the Protected Natural Spaces, there are other areas integrated in the Natural Network of Aragon (Red Natura de Aragón). The region includes relevant natural spaces, Special Protection Areas for Birds, and special conservation zones.

7.2.1.2 Ebro Basin offshore

The tentative geological structure in the Ebro basin offshore area is located at 35-50 km from the Spanish Northern Mediterranean coast and 1500 m below the ground in a saline aquifer. The geographical area comprises the coastal municipalities that face the offshore target area, from the city of Tarragona (in the North) to the administrative border between Catalonia and Comunitat Valenciana (in the South). The population is 344.869 people in the last census in 2011, representing roughly 5% of Catalonia's population. Tarragona, with more than 130.000 inhabitants is the most populated city in the area.

The area of Tarragona is known both for industry and for tourism. These two different and quite opposite economic sectors coexist and shape the community's uniqueness. Tarragona is one of the

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main industrial poles in the fields of chemical, petrochemical and nuclear industries. Moreover, it is also the place of Costa Daurada, with many kilometres of beaches and coastal towns with millions of overnight stays per year. There are also highly valued natural areas, especially the Delta del Ebro. This coexistence is, however, related to constant tensions.

Tarragona, with a long industrial tradition, is home of the first chemical park in Southern Europe and represents 25% of the Spanish, and 50% of the Catalan chemical production. About half million inhabitants, mainly around the cities of Tarragona, Reus and Valls, live in the area of influence of the petrochemical pole. Local communities have a long tradition in living with major hazard industries, and they have had experiences both with acute (i.e., incidents/accidents) and chronic (i.e. pollution) risk, as well as with safety measures (Espluga Trenc, Farré Coma, Gonzalo Iglesias & Prades López, 2014). Although local environmental associations and environmental entities have promoted demonstrations against the Petrochemical Park and its risks, the level of citizen mobilization is low. Public Advisory Panels (PAP) have been established since 2003 to promote open dialogues between the chemical sector and the rest of society.

There are important natural spaces that attract family tourism from national and international locations, like the Delta del Ebro Natural Park, Badia dels Alfacs, Ebro river mouth, Els Ullals de Baltasar, La Foradada, La Gola de Migjorn, Montsià mountain range. The most special landscape in the area is the estuary of the River Ebro that forms the famous Delta de l'Ebre. Regarding the sea, the Costa Daurada (Tarragona's coast) is one of the most visited beach areas in the region, closing 2017 with the best overnight stay figures in history.

According to the key stakeholders interviewed in STRATEGY CCUS (Oltra, Preuß, Germán, Wesche, Dütschke & Prades, 2020), a key element for the social acceptance of the Ebro basin offshore site is the experience with the Castor Underground Gas Storage. It was run by a private company but launched by the national government in 2008. It led to induced seismicity which finally led to the closure of the site in 2019. It was a significant event in the recent history of the local communities triggering different forms and levels of social mobilization, from lawsuits, objections to the Environmental Impact Assessment (EIA), and court cases, to public campaigns and street demonstrations. Other key element for the local communities' perceptions of an offshore facility is the Casablanca Platform, in operation for more than four decades and just very recently (June 2021) closed down. While in operation, the Casablanca Platform generated up to 50 employees including Repsol and outsourced staff. Regarding the unemployment ratio, both in the selected *comarcas* and in Catalonia are lower than the Spain's average.

7.2.2 National background

Total greenhouse gas emissions in Spain in 2019 were estimated to be 296 Mt CO_2e (EEA GHG data viewer, 2021). This makes Spain the fifth largest emitter in the EU. In 2020, the Spanish government adopted a law to cut emissions to net zero by 2050. The role of CCU and CCS is specified in the documentation to Spain's long-term strategy (MITECO, 2020). The long-term strategy aims at a reduction of emissions by 90% by 2050. CCU and CCS are seen to be relevant in particular for the lime and cement production, for the production of fertilizers and in pulp and paper production as well as possibly steel and refineries. According to the overview on CCUS project provided by ZEP,

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there is currently one ongoing project in Spain focussing on CCU.[4] Until 2021, Spain was the only country having an active onshore injection site in the European Union which was officially recognized by the European Parliament as a key test facility.

The transposition of the CCS Directive into Spanish law took place in December 2010 by the adoption of the law on Geological Storage of CO_2 focusing on the storage but not transport or capture activities. Additional amendments have been made for environmental impact assessments, compatibility with the marine environment, integrated environmental authorization, authorization of greenhouse gas emissions under the European Union Emission Trading System (EU ETS) and environmental liability. Still missing is a regulatory framework for the permitting process of CCS activities at larger scale. To our knowledge, currently no additional national funding is available for the development of demonstration projects in Spain.

Finally, during the lifetime of PilotSTRATEGY elections in all administrative levels will take place in Spain. The first elections in May 2023 will decide the composition of city councils; in November, Spanish national elections will take place. Finally, in 2025, there will be Catalan regional elections.

7.2.3 Depiction in media

In Spain, at the beginning of the period under study, media coverage was low, but increased in 2015 to remain on a medium level and has increased again recently in 2021. As in all three countries, short news articles (>40%) dominate followed by detailed reports (>25%). Usually, CCS is not the main topic of the article. Typically, CCS co-occurs with climate change and decarbonisation as further topics. The largest share is authored by journalists, but articles from experts also play a significant role (>20%) which is higher than in the other two countries. The number of articles referring to the international and the national level is about the same which is quite different from the other two countries. Several articles also address the regional level and a few the local one. In contrast, articles rarely assign a location to CCS - in the few cases they do, it is onshore storage. It is hardly ever mentioned that storage could happen in Spain. Overall, the share of papers from the regional and local newspapers is higher in Spain than in the other two countries. Similarly in all countries, the main actors referred to are administration and government as well as industry. To a lesser degree, international organisations are also referred to repeatedly as well as experts/research. Frequently (>60%) CCS is described as reducing emissions and being good for climate change mitigation. The vast majority of the articles (>80%) do not refer to arguments against CCS. Overall articles are either positive or neutral.
Given that Spanish ranges fourth across spoken languages worldwide, the Wikipedia in Spanish is only 8th in number of articles. The CCS page, in particular, ranks 7th in terms of views among the 36 language pages on Carbon Capture and Store existing today on Wikipedia. Between 25-02-2022 and 17-03-2022 the number of the average daily page views was 39. Since it was created, in 2008, it was edited by 67 contributors and had an average time between edits of 46.6 days which means adaptations took place less often than in France or the English version. The page on CCS is relatively short compared to France or also the English article but more than 2.5 times the length of the Portuguese version. The page in Spanish consists of a fragmented introduction. It includes sections on CO_2 capture, environmental effects, and criticism. The overall tone of the page, although mixed, is rather negative. Its current content results from a flawed initial translation process of the English page and from a deficient review

[4] https://zeroemissionsplatform.eu/about-ccs-ccu/css-ccu-projects/ 26/09/22 - The project aims at capturing the CO_2 from a cement plant in Carboneras and to recycle the gas for use in the agricultural sector for accelerated crop production.

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of the page over the last decade. It includes a decontextualized photo of a cow suffocated by natural CO_2 leakage in 1986 in Lake Nyos, Cameroon, with no explanation provided of its eventual relationship with CCS.

The Google search analysis with the four standardized queries resulted in 28 different sources in Spain. Most were articles from online media (9), of which at least 5 specialized in environmental issues. 6 were websites of private companies, 5 from NGOs, and only 3 from academic sources. The promoted sources tended to be different depending on the keywords used in the queries, more than in the other two countries. This is particularly the case of the query "CCS risks" that returned results that are quite critical of CCS. Nevertheless, there are some sources that are repeated and appear in more than one keyword query. Among these, there are links to websites of actors like the industry (REPSOL), other private companies such as Enérgya VM, articles from Wikipedia, or environmental NGOs like Ecologistas en Acción, among others. The content of the pages tended to be very heterogeneous such as the Spanish-language Wikipedia CCS article, which has an overall negative tone on the technology. However, also several webpages from companies are promoted which tend to take a neutral or positive view on the topic, highlighting its role in emission reduction, its importance to the energy transition, and fighting climate change, the growing market, and in some cases the CCS development in Spain. It is relevant to notice that five of the ten links promoted by Google when searching for "CCS Spain" have similar content based on a press release from CSIC (Consejo Superior de Investigaciones Científicas).

7.2.4 Regional stakeholder perceptions - Onshore area

The onshore region interviewees perceived several characteristics of the region as favourable or supporting potential future CCS developments: The area is proactive in terms of sustainability and renewable energies, has a low population density and an increasingly reduced economic activity. They expected that these factors might contribute to a greater acceptance by the public, especially if the CO_2-storage project has clear socio-economic local benefits. On the other side, they also mentioned past experience with protests against some developments and a desire to preserve the rural character of the area.

The stakeholders mentioned several global benefits of CCS such as climate change mitigation and the sustainable transition of local industries. For others, CCS had no clear global benefits. In terms of local benefits, the interviewees mentioned the potential attraction of new companies and investments to the area bringing direct employment for the region. It was also considered that CCS projects could help the transition to sustainability of the companies currently operating in the region as well as the reputation and leadership of the region in climate change issues. The potential economic compensation for the municipalities and residents affected by a CO_2-storage was a main potential benefit for some stakeholders. However, interviewees were concerned about possible leaks of stored gas and seismic activity. In general, the interviewees were unaware of the risks to public health, but they consider that the population will be concerned about these issues.

As for the key conditions for the acceptance of the project, the interviewees mentioned the need for clear local economic benefits (the attraction of investments, the generation of local employment and compensations to the affected local community and/or residents), as a first necessary condition for its acceptance. Ensuring a very low environmental impact of the project was another necessary condition for acceptance, according to several interviewees. It should be noted, transparency, public involvement, and honesty (the majority of the interviewees considered the consultation,

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information and involvement of the community to be very important from the beginning of the project) as well as a having a good narrative for the project were also critical conditions.

7.2.5 Regional stakeholder perceptions - Offshore area

The Tarragona area is described by interviewees as constantly balancing requirements from a strong industrial sector with a strong tourism industry which is a continuous challenge. Local benefits from CO_2-storage perceived by the interviewees included, first, the possibility that CCS projects could bring wealth and economic benefits to the local region. These benefits could go along the lines of job creation and the future sustainability of current industries, and therefore the jobs of the petrochemical companies in the area. In relation to tourism it was discussed, that possibly CO_2-storage could lead to the positive perception to be a pioneer region in carbon neutrality.

As for local acceptance, it is expected that the population will be sceptical with regard to induced seismicity which they experienced in earlier infrastructural projects. Interviewees mentioned that there is significant opposition to any type of industrial project, especially in the Delta area. In relation to this opposition, the population of the Delta is believed to have a significant capacity for mobilization as they have previously been able to stop industrial projects that they saw as threatening to the territory. Overall in the region, there is a perception of unfair distribution of costs and benefits with a disproportionately high burden for the region. Risks associated with the idea of storing CO_2 locally mainly referred to little economic benefits or that initiative will be started but not implemented in the end.

The conditions of acceptance were thus that the project will generate local benefits. Another necessary condition was related to the need for transparency and communication with the different social actors and the public, in addition to establishing communication channels to reach agreed solutions.

7.2.6 Public acceptance

For Spain, two samples were recruited to measure public acceptance for CCS employing a phone survey. The summary figures (cf. Figure 5, Figure 6, Figure 7, see section 7.1.5) show the main findings based on the relative frequencies of answering options (excluding the ‘don’t know’-option). Familiarity is low in the two Spanish regions compared to the other countries and respective regions with >90% in the onshore and >80% in the offshore region answering that they have never heard of CCS.

The overall evaluation of Spanish respondents of CCS as a technological option to tackle climate change is undecided with a bit less than 40% seeing it as a (very) good option and 38% and 31% respectively in the onshore and the offshore regions rating it as neutral. The rate of sceptical respondents is >20%. The two regions do not differ in their answering patterns in a statistical sense.

This does not apply to the suggestion of an implementation in the respective region. Here the onshore region sees CCS clearly more positive than the offshore region. In the onshore region nearly half of the respondents (48%) regard it as acceptable. In the offshore region, only 31% of respondents considered a CCS project as acceptable. Instead, nearly half of the offshore respondents see it as unacceptable. This share is only about a third in the onshore region.

The respondents from the Spanish onshore region reported very high levels of place attachment (nearly 90% stating they are very attached) while those from the offshore area had average scores and answered very similar to all the other regions. In addition, the onshore respondents also

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associated a relatively low importance of energy-intensive industries (40% considering them as unimportant or slightly important) while the offshore again showed an answering pattern similar to the other countries or even slightly higher levels of perceived importance. The two regions also differed in their stated trust in societal actors such as industry, policy makers and administration on different levels, NGOs, trade unions. Levels of trust were consistently significantly lower for the offshore region.

Similar to the observations in Portugal, several people did not decide to give an opinion on CCS acceptance and preferred the *don't-know* option instead (up to 17% for the question on the general evaluation in the onshore sample). This resonates with low levels of familiarity (Figure 3).

7.3 France

7.3.1 Region under consideration

For France a single area, onshore, is considered for the pilot study. The site is in the vicinity of Grandpuits-Bailly-Carrois (Grandpuits for short) in the Seine and Marne department, part of the Ile de France region, some 60 km south-east of Paris. As many of the numerous municipalities in France are quite small in size and population, the French legislator has instituted an additional administrative category, the "Community of communes" (CC), a grouping of nearby municipalities ("communes") with the goal to mutualize and rationalize public management. The site of Grandpuits is part of the municipality of Grandpuits-Bailly-Carrois, itself part of the Community of communes of Brie Nangissienne (CCBN), a grouping of 20 municipalities counting a total of about 28,000 inhabitants.

The Grandpuits site combines auspicious geological conditions for the storage of CO_2 together with the proximity of a nearby industrial emitter. The geological reservoir susceptible to receive the injected CO_2 is in the Dogger aquifer of the Paris basin. The industrial emitter of CO_2 is Borealis; active since 1968 and employing 220 workers, the company produces fertilizers. The facility already captures more than 400 kt of CO_2 per year, with about 300 kt/year already available to be stored. From an economic point of view, the CO_2 capture already achieved and the short transport distance are factors of cost reduction for CCS.

In addition, there exists a local history of subsurface activity as well as present-day industrial practice. Some oil fields are still exploited, while others are depleted. DRIEAT (Regional and interdepartmental directorate for the environment, planning and transport) is the key actor for authorizations and permitting.

The population is limited in this rural area, with the presence of few second homes. Key elements in this community are local familiarity with technology and industry (including several Seveso sites, hence experience with risk information), the existence of underground exploitation projects (oil and geothermal), and awareness and sensitivity towards climate change issues (TotalEnergies carbon transition).

Nevertheless, the region is heterogeneous consisting of rural parts with large farms but with industrial activity as well, and with major cultural and touristic attractions, a sense of continuity being provided by the flatness of the landscape with villages and small towns sparsely distributed.

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A unifying factor might come from the Brie cheese. It has the name of the area (Brie) and of its inhabitants (Briards), is found in the name of the Community of communes, is associated to the name of several villages, and it creates a link between local identity, agriculture, product transformation and cheese connoisseurs all over the world. As parts of a place of contrast, the local communities have probably learned to debate the trade-off between heritage (what they have received from the past) and projects (dealing with anticipating the future).

Finally, the PilotSTRATEGY project will unfold during a period without local elections, which is important to note as the project could become a political focus of electoral campaigns. WP6 social science research accompanied a significant campaign to acquire 3D seismic data, conducted by PilotSTRATEGY geologists. During the discussions observed in this context, it emerged that a power struggle exists at the level of the CCBN board: the vice-president (who is as well deputy mayor of the larger local town) wants to take the place of the president who does not want to resign. This conflict, involving different political groups, takes the form of a polarization between the supporters of each camp. As we first established contacts with the president of the CCBN who welcomed us, we can hypothesize that his political opponents automatically oppose us and PilotSTRATEGY. Hence some delays and setbacks were experienced in e.g. obtaining right-of-way authorizations from several local farmers, although the real motivation remains unspoken and hidden behind circumstantial arguments. While it is not our role to take part in the local power struggle, we cannot ignore its existence and the issues it raises in terms of research and engagement.

7.3.2 National background

With 460 Mt CO_2e in 2020, France is the second largest absolute emitter in the European Union following Germany (EEA GHG data viewer 2021). As early as 2019, France adopted the target to become carbon neutral by 2050. Details of reaching this target are specified in the national low carbon strategy (Republique Francaise, 2020). Different objectives towards CCU and CCS are presented in that policy document. Sectoral roadmaps for steel, chemicals and cement explicitly name CCS as a lever for decarbonization, while no future role is seen for CCS in the energy sector after 2050. CCU is mentioned as a priority area for research. With regard to ongoing activities, currently three CCS projects are listed in the CCUS-project list by ZEP.[5] Some years ago, a CCS pilot-scale project in Lacq-Rousse was operated by Total (2006-2013) and injected more than 51 kt of CO_2 in 2010 and 2013 (Total, 2013).

The CCS Directive has been implemented into national law in 2011 (French national decree on the geological storage of CO_2 - Decree n°2011-1411). Further complementary legislation was also implemented, e.g. defining exploration permit principles and granting processes for storage sites. In addition to the approval, injection tests must include public consultations. Different sources can be accessed for the financial support of CCS projects including support for further research on CCUS (El Khamlichi, 2019) as well as state aid combining grants and refundable loans or via capital investments as part of a broader programme by ADEME.

7.3.3 Depiction in media

Media coverage on CCS was observed to be on a constant relatively low level, but never disrupted and show a strong increase in 2021. Similar to the other two countries, short news articles (>60%) dominate followed by detailed reports (>25%). Usually, CCS is not the main topic of the article, but co-occurs with climate change and decarbonisation as further topics. The largest share is authored

[5] https://zeroemissionsplatform.eu/about-ccs-ccu/css-ccu-projects/ 26/09/22

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by journalists, other author categories only play a minor role. The majority of articles takes an international focus and some a national one; very few relate to the regional and local level. A bit more than half of the articles do not mention a location for CO_2-storage, if they do, it is usually onshore storage, but sometimes also offshore and in rare cases both. Hardly ever it is mentioned that storage could happen in France. Similarly in all countries, the main actors referred to are administration and government as well as industry. In France, international organisations are also referred to very frequently as well as experts/research. Typically (>50%) CCS is presented neutrally without any arguments in favour, sometimes (>30%) it is connotated as reducing emissions and being good for climate change mitigation. In half of the cases, however, also no arguments against are mentioned, if they are, they refer to high costs (>25%) or the early stage of development (>20%). Most articles are categorized as neutral while about the same number of articles is coded as either positive or negative.

French- language Wikipedia ranks 5th in number of articles. From 25-02-2022 to 17-03-2022 the average daily page views for the article on CCS was 64 which is the highest frequency across the three countries. It has been updated relatively frequently (every 12 days in average) since it was first published in 2006. The French article is also more comprehensive than the ones in the other two languages, i.e. with the greatest number of words and number of sections as well as references. It also has more links to and from other Wikipedia pages than the other two. Content wise, the CCS page from the French-language Wikipedia is very detailed including sections e.g. on principles of sequestration (capture, transport and storage), costs, limitations and risks, criticism, legal and standardization aspects (in Europe and in France), research and development actors (France and French-speaking countries, English-speaking countries, and other countries), operational sites, and projects. It also discusses criticisms around CCS. It is the only one of the four pages analysed that mentions technical and legal information on CCS regulations.

The analysis of the Google search results led to the following observations: In total, the four queries we performed resulted in 20 different sources. There were seven academic sources, three linking to the same academic paper. Five articles come from online media, mostly from environmental specialized publications. These media projects, however, have different origins, being either independent, connected to environmental NGOs, or private corporations. Only one of the results linked to an article from a traditional legacy media (Liberation). Although only three links were from private companies, these links were highly promoted by Google, being present in almost all the queries. The Wikipage on carbon sequestration only appeared in one query. Overall, results for France showed that there is considerable information about the topic available online, coming from heterogeneous sources. Some of the articles were relatively long, explored different dimensions of CCS, and included information about France. The results also included videos and academic papers confirming this idea. Critical article of CCS came mostly from independent and environmental ONG related online media. It is also relevant to note that articles that have a balanced view on CCS can be quite different. In some cases, the negative aspects mentioned are its cost, lack of progress, need for more research, and the fact that it is a sensitive topic for populations. In other cases, the articles also mention environmental risks (leakage, seismic effects, acidification, etc.) and that it incentivizes the continued emission of carbon dioxide. When searching for “CCS France” most of the results were repeated from previous search queries.

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7.3.4 Regional stakeholder perceptions

Most of the interviewees doubted the efficacy of the technology. For example, they thought that the lack of familiarity by the public might create problems in terms of acceptance. The experts mentioned the potential local benefits of carbon storage, whereas other participants who did not share the same knowledge were not very supportive of it. Some expressed that CCUS could be used in favour of industrialists and their financial interests. For example, an environmental activist and another person having worked in various environmental research projects explained that CCUS would not encourage needed changes in lifestyles and the current economy. Some participants, particularly those positioned against CCUS, saw its risks as unknown or even unknowable, whereas experts mainly viewed that risks (even if unknown) can be assessed and that precautions or mitigations can be taken. For example, the activist points to the imponderables of nuclear waste storage.

According to the interviewees, there could be opportunities to engage stakeholders, and conditions for acceptance of a potential storage might be possible. The principal condition of social acceptability, according to the experts, is two-way communication.

7.3.5 Public acceptance

In France the questionnaire was filled in online by respondents. The summary figures (cf. Figure 5, Figure 6, Figure 7, see section 7.1.5) show the main findings based on the relative frequencies of answering options (excluding the 'don't know'-option). French respondents showed the highest level of familiarity. Only a quarter responded that they had never heard about CCS and nearly as many claimed to know what it is. This indicates a higher level of knowledge than in the survey study implemented in the STRATEGY CCUS-project (Oltra et al., 2021). Here a bit less than 60% answered they had never heard about it and around 10% reported to be familiar with the technology in the national and the regional sample. It is important to note that the French region studied in STRATEGY CCUS was a completely different one.

The overall evaluation of French respondents of CCS as a technological option to tackle climate change is positive with more than 70% seeing it as a (very) good option. The acceptance on the local level is also high with again 70% rating it as (rather) acceptable. This is more supportive than in the national survey and the survey of the other region in STRATEGY CCUS where 46% and 45% chose the comparable response options.

Further answering patterns in France are very similar to the patterns found in the other regions.

7.4 Poland

7.4.1 Region under consideration

The region of Upper Silesia is located in Southern Poland. It is situated within two Polish Voivodeships: Śląskie and Opolskie, and within the Czech Moravian-Silesian country. In the following, also data for the Śląskie (Silesian) Voivodeship will be included, because generally this is where both CO_2 emitters and potential CO_2-storage sites are located.

Four possible CO_2-storage sites have been identified in the region: two uneconomic coal beds - which are not prospective due to low storage capacity and environmental risk issues - and two deep saline aquifers (DSA). The DSAs are located in the area of Cieszyn/Skoczów/Czechowice (Skoczów DSA) and near Częstochowa (Ładzice DSA). The community profile of the region focuses mainly on the Skoczów

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onshore DSA as the most recognized and located in the vicinity of industrial plants in Silesia Voivodeship. It has an estimated storage capacity of 46.2 Mt.

The educational attainment levels in Silesia are among the highest in the country. Population density is about three times higher than in the rest of the country. It is the most coal-dependent region in Poland with mining playing an important role in the regional economy. However, the mining industry's share declined in recent years. Most of Poland's coal workers are based in the region and organised in unions. For them and for continuing employment the strategy taken with regard to CCS could become important. The current plans to close the mines met social resistance. There are large industrial emitters in the region, e.g. coal fired power and heating plants, steel mill, coking plant. Electricity and heat are produced mainly using hard coal and natural gas, however there is now a rapidly growing share of renewable energy sources. The Voivodeship is struggling with the problem of air pollution due to low-stack emissions and related to the significant industry sector.

Possible conflicts of interest relating to the use of that potential storage site area affect its fragments covered by NATURA 2000 areas, urban areas or small hydrocarbon fields occurring within it. Due to the degree of industrialization and urbanization, the Silesian Voivodeship is sometimes perceived as unattractive in terms of nature, while the broader region is extremely diverse in terms of nature and landscape. There are mountains, upland and lowland areas, as well as karst phenomena within the Voivodeship borders. There are landscape parks, nature reserves, protected landscape areas and nature and landscape complexes located in the Śląskie Voivodeship. Additionally, many smaller forms of nature protection have been established, namely ecological lands, documentation sites and natural monuments.

7.4.2 National background

GHG emissions in Poland were at 380 Mt CO_2e in 2019 (EEA GHG data viewer), fourth highest in the EU. For the time being, Poland has not implemented a net-zero target for 2050 yet and has also not formally endorsed the EU's 2050 climate neutrality goal. The role of CCS has not been formally defined. In October 2021 the Ministry of Climate and Environment launched public consultations on the role of CCS projects in Poland in the future. The transposition of the CCS Directive into national law took place in 2013 and some further regulation was implemented in the following years. Currently, underground storage of CO_2 is only allowed to conduct a CCS demonstration project. One offshore storage site in the Baltic Sea is currently approved for storage, onshore storage is hence currently banned. The ZEP platform currently lists one project looking into an interconnection to transport CO_2 to storage sites in the North Sea. In March 2021, the three-year project "CCUS.pl" (Strategy for the development of technologies for capture, transport, utilization and storage of CO_2 in Poland and the pilot of the Polish CCUS Cluster) of Ministry of Economic Development, Labour and Technology began. The project is concerned with the development of a disposal strategy, but may be an opportunity for faster amendment of the law for CCS in Poland. Currently, there is no national financial support framework for CCS in place in Poland.

7.4.3 Regional stakeholder perceptions

Upper Silesia was described as an area that is shaped by coal mining and the need for transition. Interviewees emphasized that it has a natural heritage and in parts is rural and suffering from depopulation while in other areas it is highly urbanized and dense. CCS was perceived to be in an early phase in Poland as a political strategy and a legislative framework are missing and other preconditions such as viable business models are lacking. The opinions from the interviewees

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covered the full range from strongly negative about CCS in general to positive for a variety of reasons. The main argument brought forward by several interviewees in favour of CCS was the potential economic benefits including the possibility of providing additional jobs, creating cooperation between various stakeholders, making the region attractive and competitive for future investors. However, it was also mentioned that CCS projects will probably not be a very large employer, but they may become an economically attractive niche for specialists such as engineers. The risk/cost that was repeatedly brought forward by several interviewees is the potential negative impact of CCS on the attractiveness of Silesia - which could affect economic development, e.g. tourism and agriculture or impact the natural environment. The possible reduction in regional attractiveness was also related to safety issues as concerns could drive people away from the, already in parts, depopulated area. Other concerns around potential negative impacts referred to prolonging the coal focused pathway instead of developing renewable energy as the better alternative. In line with responses to earlier initiatives about CCS in Poland, the interviewees tended to expect that residents, environmentalists and also some actors from the economic sector will be against a further CCS development.

A variety of conditions were mentioned in the interviews that influence acceptance. Some parts of the discussion on conditions of acceptance were less about project characteristics but more about pre-conditions that need to be fulfilled before an implementation is feasible, such as the implementation of the legislative framework or a viable business model. Several of the conditions mentioned elaborated on approaches to enable acceptance, such as public engagement and participation or compensation either to individuals or the community.

7.4.4 Public acceptance

In Poland the questionnaire was filled in online by respondents. The summary figures (cf. Figure 5, Figure 6, Figure 7, see section 7.1.5) show the main findings based on the relative frequencies of answering options (excluding the 'don't know'-option). Polish respondents showed medium levels of familiarity with CCS. More than 10% responded that they knew what it is and the rest was divided to never have heard it or to have heard it but not knowing more about it.

The overall evaluation of Polish respondents of CCS as a technological option to tackle climate change is overall positive with nearly 60% seeing it as a (very) good option. Compared to the other countries Poland is in between the answers provided by the other regions.

The share of respondents categorizing it as an acceptable option for their region was highest in Poland with nearly 50% stating full support, however, a very small share ticked rather acceptable, thus overall acceptance is not higher than in other countries. Further answering patterns in Poland are very similar to the patterns found in the other regions. However, across all items, Polish respondents had the highest probability of choosing the don't know option with an average of over 10% to do so.

7.5 Greece

7.5.1 Region under consideration

The Region of Western Macedonia is situated in North-Western Greece, bordering the Republic of North Macedonia and Albania. It is classified as a low-density populated region (30 inhabitants per km², as compared to the country's 82 per km² average). 82% of the total surface area is mountainous

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and semi-mountainous. The majority of the population (56%) lives in rural areas. The two potential onshore storage units are Pentalofos and Eptachori. Together they share a surface of 1547 km^2 and their maximum storage capacity has been estimated 1.15 Gt CO_2.

Parts of the natural protected area are located inside the storage area. However, many other natural protected areas are located directly outside of the storage border as well as touristic sites. The region has two National Parks, sixteen NATURA, eight lakes, gorges, rivers, interesting geological formations, two world trekking paths, remarkable traditional settlements, three ski centres, a significant number of archaeological sites and a plethora of Byzantine monuments of international interest.

Greece intends to close down all lignite plants by 2025, with most units representing more than 80% of the current installed capacity to be withdrawn by 2023 and to develop renewable forms of energy generation instead. Western Macedonia economy is intensely involved in lignite mining but also in steel and cement production, chromite mining and fur-leather production. This implies a large need for a transition of the labour market. Currently the region has one of the highest unemployed rates and is the poorest region in Greece. So far, agriculture, forestry and fishing constitute the most significant sector (21 % of employment). The region has rich natural resources, such as fossil fuels, ores, forests and the most significant surface water potential in Greece. Saffron and scarce European species of mushrooms grow in the region and high-quality wines are produced there. Education levels remain well below the national (25.4%) and EU27 (26.8%) averages.

7.5.2 National background

Emissions in Greece were 86 Mt CO_2e in 2019 (EEA GHG data viewer). Industrial installations under the EU ETS with annual emissions over 0.5 Mt are very limited (8 in 2020). Therefore, the applicability of CCS in industry in Greece is likely very limited. Transposition of climate neutrality into law is underway with consultations currently taking place. As required the CCS Directive has been implemented into national Greek law without extensions to the EU text. It restricts storage sites so that storage is not permitted in areas where the storage complex extends beyond Greek territory (Shogenova et al. 2014). Currently, no specific funding for CCU or CCS projects is in place and no running project could be identified.

7.5.3 Regional stakeholder perceptions

While the interviewees identified some challenges and sensitive topics, overall, they see an openness to further pursue CCS as an option - also in the wake of the declining coal industry. The interviewees agreed on a set of elements that allow us to characterize the community: The Greek government has decided to phase out coal and to shut down lignite mining and combustion which is dominant for Western Macedonia. This is connected to a high probability and related concerns of rising unemployment rates in the region. Interviewees observe disappointment in the region due to this (anticipated) development. There is a need to develop new job opportunities. The area also contains natural protected areas which are also important. The expected local benefit that was repeatedly mentioned by the interviewees were the potential positive effects on employment. Further local benefits mentioned included that CCS supports the existing coal fired power plants, contribution to energy autonomy by using local lignite and, finally, could trigger broader economic benefits also to tourism, agriculture/ fishing by reducing environmental pollution. Overall, interviewees mentioned several aspects as risks, concerns or barriers regarding CCS. The most prominent aspect was around leakages and how to prevent them. Half of the interviewees expected positive reactions from the affected communities, one pointed towards neutral perceptions while

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another expected a negative response. The reasons for these expectations varied between interviewees.

A variety of conditions were mentioned in the interviews that influence acceptance. The interviewees emphasized (i) the importance of accurate information and community involvement: (ii) that an experimental phase with a pilot facility is important; (iii) that aesthetics of the installation will play a role; (iv) that public discussions can take different routes and that in case of opposition a CCS pathway should be reconsidered; (v) that safety and expected environmental impact are very important including the impact on natural protected areas.

7.5.4 Public acceptance

In Greece the questionnaire was filled in online by respondents. The summary figures (cf. Figure 5, Figure 6, Figure 7, see section 7.1.5) show the main findings based on the relative frequencies of answering options (excluding the 'don't know'-option). Greek respondents showed medium levels of familiarity with CCS. More than 10% responded that they knew what it is, slightly more than half of them stating they have heard about it without further knowledge and a bit more than a third saying they have never heard about it.

The overall evaluation of Greek respondents of CCS as a technological option to tackle climate change is mixed. Nearly 40% state it could be a (very) good option; but nearly a third think it is a (very) poor option. Together with the Spanish respondents this is the lowest evaluation of CCS as a technology to fight climate change.

On the local level, however, the perception is clearly more positive with more than half of the respondents supporting it and less than 20% finding it unacceptable.

Further answering patterns in Greek are similar to the patterns found in the other regions.

8. Summary of findings and conclusions

8.1 Cross-country/ region summary and overall learnings

Summarizing our findings across countries and regions, we find a variety in preparedness regarding the regulatory framework (Duscha, 2022). However, none of the countries has fully spelt out a framework to actually implement capture, transport and storage of CO_2 or developed a detailed strategy regarding the role of CCS in their decarbonisation efforts. Overall, France and to some extent Spain have progressed more in this direction than the other countries. With regard to societal preparedness, an observation shared across countries is also the quite low level of awareness and knowledge on CCS. This applies to citizens, but also to societal stakeholders. This is underlined by the interviews as well as survey findings but also by the outcomes of the media analysis. Media rarely discusses or even mentions actual implementation in the country and usually frames CCS if at all as part of an international climate discourse. This points to similar conclusions as in a study by Mander et al. (2017) for the UK who emphasized that the discourse around CCS takes place in specialized niches. The implication from this finding is, that opinions and preferences regarding CCS are still under development in societies and levels of acceptance observed now are mainly a snapshot and cannot be expected to be stable. Nevertheless, in several of the countries we observe a larger group spontaneously stating positive attitudes towards CO_2-storage which opens a window of opportunity for discussion. At the same time, it is important to note that among societal stakeholders

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interviewed, sometimes in media contributions and also relevant shares of survey respondents are also critical. Furthermore, a significant group is explicitly undecided, ambivalent or neutral.

One of the concerns around CO_2-storage that is brought forward in all countries and regions is around environmental impacts and the possibility to disturb natural habitats. Conscientious examinations and a minimization of impact are therefore a pre-condition if the development of CO_2-storage is supposed to be driven forward.

In line with this, another precondition to a further development is the need for a transparent communication and high quality participation and engagement strategies - around research and pilot projects, but also with regard to the development of the political strategy around CCS and - if so - its implementation at larger scale. Trust in actors will play a crucial role here as well.

Furthermore, especially within groups stating positive opinions towards CCS, local socio-economic benefits are expected in the affected regions. This refers to seeing CCS as part of broader strategies to manage industrial transitions in regions or directly creating employment and business opportunities on the local level. So far, it is not clear in society if and in how far such benefits will be realized. We also observe a variety of narratives associated with CCS - some see it as a possibility to save fossil fuel industries, others as part of ambitions climate change mitigation strategies. In both cases this is associated with heterogeneous evaluations of CCS as a positive or negative development.

8.2 Input to selection of storage site

In Portugal and Spain, the decision is pending which site is to be explored further as a potential CO_2-storage. This section summarizes the arguments to be considered from the point of view of WP6 and its findings.

8.2.1 Portugal

In Portugal, there is only one region under consideration, although there is a choice to be made between onshore and offshore deposits. Onshore and offshore stakeholders and communities mostly overlap and thus it was possible to inquire them about preferences.

Stakeholder acceptance

Most of the stakeholder interviewed had never heard of CCS or had just a vague idea of what it meant and some declined to state a preference between onshore and offshore. The offshore option was considered by many stakeholders as the one that would lead to the least public resistance because it would not directly affect populations and would be less visible (“out of sight, out of mind”), particularly if it could not be visible from the shore. Some stakeholders alerted that onshore CCS could be seen by residents as “a bomb under our feet” and offshore as “the lesser evil”. Some also considered offshore storage to be more beneficial due to its larger storage capacity. Onshore was considered less expensive (so less of a burden on the tax payer) and swifter to achieve (in view of the urgency to reduce CO_2 emissions), with fewer regulation hurdles, fewer institutions to contend with and less construction, technical and transport challenges. Also, some consider it would be easier to monitor and would pose less risk. However, some stakeholders drew attention to the fact that onshore would have to be very well explained to the public to engender acceptance.

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Nature protection and environmental NGO stakeholders drew attention to the fact that onshore and offshore protected areas have the same status but offshore natural heritage is less well known and could be more sensitive to CCS impacts, with a higher degree of uncertainty. Industry stakeholders suggest that onshore storage could be done as a pilot, to test the technology, but the actual large-scale storage be done offshore due to its bigger capacity and higher social acceptance.

Public acceptance

In general terms, the survey indicates that onshore CCS is considered slightly more acceptable than offshore CCS. However, these results must be interpreted with caution, since the vast majority of respondents has little or no information on CCS beforehand and so barely any idea of the risks and advantages of CCS in either location.

Overall, there are social factors that can enhance or decrease public acceptance in both options. So the decision must rely mainly on technical factors and good communication and engagement with stakeholders and communities in the next stages of the project.

8.2.2 Spain

As mentioned above, the very same research strategy was implemented in the onshore and the offshore regions, and it provided meaningful evidence to support the decision-making process of the storage site. Two sub-criteria were considered from a social acceptance perspective: stakeholder's acceptance (based on the interviews, the document and the media analysis) and citizens' acceptance (based on the questionnaire-survey).

Stakeholder acceptance

The onshore region is considered as a particularly proactive area in terms of sustainability and renewable energy, with a low population density and decreasing economic activity, due to the progressive closure of the various mines and power plants in the area. These factors could contribute to a greater local public acceptance, especially if the CO_2-storage project contributes to job generation in the area. The recent local opposition to renewable energy projects, the defence of territorial identity and rural life by some local groups, and the negative experience with fracking projects in the community were characterized by the interviewees as threats to the acceptance of a potential CCS project.

The **offshore region** is considered as a region with an important industrial tradition with experience in the implementation of industrial projects. There is a coexistence between industry and tourism with synergies between them. However, the previous negative experience with the Castor Project is considered a decisive factor. There is a significant opposition to any type of industrial project, especially in the Delta area. In addition, the Delta population shows an important capacity for social mobilization and has already been able to stop industrial projects that they considered threatening to the territory.

Overall, there was **no single or clear community positioning** (supporters and opponents were identified in both regions).

Public acceptance

Regarding the local **public acceptability** (previous to implementation) of a hypothetical CCS project in the study regions, and taking into account the low levels of familiarity with CCS technologies and,

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therefore, the potential instability of the attitudes collected in the study (information about the technology was provided to survey participants to minimize this), the data from the survey of residents found, first, a low to medium level of public acceptance (less than 50%) and, second, a statistically significant difference between the onshore and the offshore regions in terms of public acceptance. Public acceptance varied from 47% in the onshore region to 31% in the offshore region.

To conclude, based on the findings presented, both communities have particularities that could potentially hinder or favour public support for a CO_2-storage project. The position of the stakeholders was not clearly established in the interviews: some stakeholders expressed a clear support for CCS developments in their region, whilst others were ambivalent or initially opposed to a potential CCS project. Initial public acceptability was found to be moderate to medium (31-47%) and significantly higher in the onshore community compared to the offshore community.

Overall, based on the data collected and given the characteristics of the study locations, the perceptions by the local stakeholders and the local population, the local research team for the Ebro basin selected **the onshore area** as pilot study area for the next steps in the project.

8.3 Regional specificities

In addition to the similarities outlined above, we also find some heterogeneity between the regions in the different countries (see Table 5 for a summary). In Portugal, so far, there is little experience on implementing CCS - from a political and regulatory point of view but also in terms of experience from implementations projects such as piloting storage. At the same time, due to the comparatively low levels of emissions from industry the need to implement CO_2-storage does not seem to be very high. In line with this, the societal debate is hardly existent and levels of awareness are low. Looking into the region under study, we see overall a high to medium acceptance for a regional project; onshore storage is (a bit) more acceptable to survey participants than offshore storage. However, given the little societal awareness, this can be interpreted as an openness to further discuss CCS as an option, given that there is a need for it. In addition, some groups / citizens in the relevant region have been engaged in protests against certain developments in the past. Thus, it can be expected that networks from this could be reactivated if CCS is perceived as a threat to region. At the same time, this is also an indication of active citizenship in the area and, possibly, this implies that the local population is interested in being engaged in regional developments.

Spain has collected some experiences with initiatives around CCS in the past including CO_2-storage. It has also implemented a suitable regulatory framework to some extent and has industries in need of decarbonisation for which CCS could be an option. The topic is also relatively regularly mentioned in the media, however, hardly with a focus on an actual implementation in Spain and always in a very allusive way. Across traditional and online media, we found also a variety of framings from positive to neutral and negative. Currently, the PilotSTRATEGY project considers two regions as potential places for further analysis with regard to piloting CO_2-storage. One is onshore in the Ebro basin, the other one offshore. Our analyses of these two regions show a high heterogeneity with regard to economic, social and cultural conditions in these regions. Overall, the data suggest that public acceptability is higher in the on-shore community compared to the offshore community, and that the local stakeholders in the on-shore community are more open to further discuss CCS and to negotiate conditions for acceptance. From the analysis of the offshore region, it seems that there is a fragile balance of diverging developments as well as (the perception of) past burdens from

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infrastructural developments. In our survey, we observed the lowest levels of acceptance for the idea of a local CCS development and comparatively low trust in actors.

For France, we see a regulatory framework for CCUS that is in an advanced stage, developing experience with past and ongoing activities in this field as well as relevant industries. PilotSTRATEGY research itself seems to mirror this status, with France's project plans most specific as they are developed around an already existing capture facility. The media regularly covers CCS topics in a relatively comprehensive way and with mostly neutral content. For public acceptance, we see an overall positive evaluation of CCS regarding its contribution to climate change mitigation, and medium to high acceptance for a regional project. Nevertheless, we observe also some tensions as CCS is partly perceived to be in conflict with other climate change mitigation options and offering a benefit mainly to certain industries. Such tensions may emerge in PilotSTRATEGY engagement activities. Engagement may also be influenced by the manner in which discussions or potential conflicts around CCS get (or do not get) connected with broader societal debates in France, or with particular local political themes.

Currently the situation for CCS-development is not very favourable in Poland, given that the legislative framework limits the implementation as it only allows for offshore storage of limited size. However, the development of decarbonisation pathways is an ongoing debate in Poland due to its heavy industry. The commitments of the Polish government are not clear in this regard. The region under study in the project combines many contrasts of largely urban areas, but also rural parts; the need for a transition of the industrial sector away from coal; natural heritage and industrialized areas. In this setting we found a relatively high acceptance in the public for CCS also as a regional development, but very mixed views from societal stakeholders. The few past initiatives towards developing CCS have been met by some resistance.

In Greece, the development of CCS is in an early stage. Its role in national strategies for decarbonisation is not defined yet which means it is also not clarified if there is a need for it. In addition, there is little experience from past or ongoing projects with the technology. With regard to the region analysed, stakeholders emphasized the ongoing transition away from coal that causes uncertainty. Here, there is a need for positive future visions creating employment – if there is a role for CCS in them is at best unclear at this stage. From the perspective of the public, we see a medium evaluation of CCS and high to medium acceptance of the proposition of a regional project.

8.4 Limitations and reflections

This report summarizes the findings from an extensive phase of social science exploration in the study regions of PilotSTRATEGY in five countries. It included a variety of methods and approaches applied in a relatively standardized way across regions, but was able to identify regional specificities and constellations. An in-depth analysis of the societal context was achieved, whose full richness becomes more evident in the various annexes to this report providing extensive detail. The degree of specificity sometimes hampered comparability across countries. The present analysis is limited too by the fact that it takes a snapshot across several months, while the future societal discussion will be dynamic and in constant evolution.

The aim of the PilotSTRATEGY project is to investigate potential geological CO_2-storage sites in industrial regions of Southern and Eastern Europe to support development of CCS. The project is a research project providing interdisciplinary analysis in this regard; however, the final outcomes are

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apt to vary between the regions due to the different levels of technological advancement and of political interest in CCS, as well as economic feasibility, geological suitability and societal acceptance. From several of these perspectives, the development towards actually implementing a pilot storage site after the end of the project is most advanced in France while the other countries are much more in an earlier exploration and research phase.

In addition, within the consortium as well as within society people and institutions have heterogeneous attitudes, fears, expectations and hopes regarding a potential implementation of CCS and its desirability. When presenting CCS to research participants, the researchers aimed at a neutral presentation and the ways of presentation and the selection of information shared was carefully reiterated and reflected. Nevertheless, this always involves taking certain decisions such as the framing of CCS. For example, in the survey CCS was presented as one option to contribute to tackling climate change. However, there was no framing in relation to the role it could play or not within an industrial transition.

It is important to note here, that the goal is not to create acceptance for CCS or to foster the actual implementation of a CO_2-storage site, but to support society in finding suitable ways to engage with potential developments to enable an informed decision making in society.

8.5 Conclusions and outlook

The findings summarized in this report are to prepare the next steps in the project. In Spain and Portugal they have contributed to selecting the potential site for further investigations in PilotSTRATEGY. In relation to public participation and engagement, the findings will be used to prepare the regional stakeholder committees (RSC) in all countries to involve representatives from society into the project, share findings and insights from the scientific project work and to take up their expectations, hopes and concerns. In the preparation of the engagement with the RSC the different levels of the societal debate will be taken into account. For Portugal, Spain and France it is foreseen to also directly engage with citizens. Suitable formats as well as contents specific to the national and regional situation will be developed in the next months.

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Table 5 Comparison of main findings in the regions and countries under study

	Portugal *On- and offshore option*	**Spain** *On- and offshore region*	**France**	**Poland**	**Greece**
Political dimension	Little need, superficial regulation, little experience from projects	Possibly relevant, regulatory framework developed to some extent, relevant past projects, relevant industries	Regulatory framework in advanced stage, past and ongoing CCUS activities, relevant industries	Limited possibilities for CO_2-storage in current law; high need for decarbonisation, but limited commitment; ongoing discussion; few experiences	Little need, national strategy under development, role for CCS not defined yet, little experience from projects
Depiction in media	Rare and less specific	Regular media coverage, but less discussion on implementation in Spain, mixed in tone (traditional vs. social)	Regular and increasing media coverage, comprehensive content, balanced content of online media	--	--
Regional stakeholders	Low levels of knowledge and awareness, expectation of (some) resistance	Onshore: Openness and conditional acceptance possible Offshore: Fragile balance of diverging developments, past burdens	Partly perceived as clashing with other mitigation strategies, and as a benefit for industry	Area combines many contrasts (rural-urban, economically, nature-industry); high need for transition; very diverse views	Transition away from coal causes uncertainty and positive future visions creating employment are needed – role of CCS unclear in this
Public acceptance	Positive overall evaluation of CCS; high to medium acceptance on regional project; onshore storage is (a bit) more acceptable	Onshore: Medium acceptance, less convinced of CCS Offshore: Lowest acceptance of the regions, low on trust	Positive overall evaluation of CCS; high to medium acceptance on regional project	Relatively high acceptance overall and for regional project	Medium evaluation of CCS; high to medium acceptance on regional project
Summarizing comments	No clear preference regarding on- vs. offshore	The onshore region appears to be more favourable for a potential CCS pilot project	Several developments towards a pathway for CCS, but societal tensions as well	Early stage and high need to decarbonize	Early stage

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