Annex 1. Media Analyses

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Executive Summary

The **role of the media** in influencing the Carbon Capture and Storage (CCS) debate needs to be considered as public awareness and understanding of CCS is quite low. Lay citizens do not usually have direct experience with new technological developments, and the media do play a role in amplifying or attenuating the risk and opportunities associated with such technologies. In addition, digital infrastructure like Google and Wikipedia have assumed increasing importance in how people search for and access information in their daily lives. They have become a mediating infrastructure, making information available to the general public, but also shaping the condition in which this information is filtered and made visible. In sum, media analysis can provide insights into how the public may understand and respond to CCS.

This report deals with the **Media Analysis** carried out in **Task 6.2**. It aims to understand the conditions for public understanding and acceptance of CCS by focusing on what kind of information the public has access to when searching for CCS both in the traditional media (newspapers) and in the online media.

In line with previous research on CCS, our **press analysis** focuses on the identification of the type of discourse about CCS that the different media sources transmit in each of the studied regions (cross-country analysis), including the identification of actors involved in the CCS debate, the main arguments underlying the variety of discourses on CCS, and the possible differences among national, regional and local newspapers in each country.

Our **online media analysis** deals with the kind of content that the public/stakeholders would access in each country/location if looking for information on CCS in Wikipedia and Google Search. Importantly, in the current climate and energy crisis, technologies such as CCS may acquire greater relevance and the available information on the media may increase and change in the coming years.

Summary of findings

Regarding the **press analysis**, as far as the coverage of geological carbon storage in our three main regions is concerned, those are the most relevant findings:

- Small number of articles (but rising in recent years, particularly in France and Spain)
- Peak during COP
- Small size of articles
- CCS mostly as an allusion (not the central topic of the articles)
- Little technical information
- Few articles mention specific projects
- Focus is mostly international

In sum, carbon storage is not an issue in the current public debate as portrayed by the press in these three countries.

When the media does deal with CCS, those are the main insights with regards to the tone of such news articles:

- Mostly positive, followed by neutral or balanced

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- Positive articles: more frequent in Spain, in local/regional media, in interviews and opinion pieces, in more recent articles, in articles authored by business and politicians
- Negative articles: a minority, but more frequent in France, in national media, in interviews and long reports, in articles authored by NGO
- Arguments in favour: more frequently found, mostly related to climate, some to the development of rural areas in Spain
- Arguments against: rare, mostly related to cost and unproven technology, but also risks

A couple of final additional comments. The **scarcity of media/public debate** around geological carbon storage is also reflected in the interviews performed in the three main regions as part of Task 6.2. Notably, the absence of knowledge about the technology could make public engagement more difficult (methodological challenges).

As to the Wikipedia analysis, Carbon Capture and Storage is represented quite dissimilarly in the topic page of the four wiki projects both quantity and type of information:

Table 1. Carbon Capture and Storage in the topic page of the four wiki projects.

English-language page	French-language page	Spanish-language page	Portuguese-language page
Largest, + dynamic, + viewed. Text is mostly accessible, but it is long, somewhat fragmented. Focus on economic, political and social aspects of CCS. Criticism associated with indefinite fossil fuel usage. USA-centric + International	Detailed. European-centric Extensive information about CCS risks, limits, and criticism. Attention to CCS regulatory framework. Well-curated in its first years, but some of its sections have not been updated. (sub-page of carbon sequestration page)	Fragmented and less coherent Rather negative overall tone. Fragmented content results from a flawed initial translation process of the English page and from a deficient review of the page over the last decade	More recent and smaller (size and number of views). The content seems not to have been imported from other pages. The text, although very short and missing important dimensions of CCS, is easy to comprehend for the general public.

Our analysis shows that national interest or investment on CCS and Wikipedia local contributions and dynamics necessarily articulate the international flow of information between Wikipedia projects, making CCS pages a reflection both of cultural specificities and realities, and broader cultural, historical, and discursive mediations typical of online communicative practices (Rubira and Gil-Egui, 2017). These processes are central to understand not only the type of content but also the quality of the information available to the public about emergent technologies, like CCS.

Our analysis of **Google Search** results shows how information available to the public of CCS on the internet is dependent both on local dynamics, as well as specific affordances of Google Search

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Engine. In the first case interest and investment in the topic at the national level seems to be central. The diversity of actors and types of content, and the depth and quality of the information available in the articles promoted by Google search engines seem to reflect this reality.

Table 2. Information available to the public of CCS on the internet per country.

France	Spain	Portugal
+ balanced views on the topic, + different points of view. Content directed to specific audiences. The results included academic papers, and articles environmental online media initiatives independent, connected to NGOs, or private corporations	Different queries have dissimilar outputs. Results included several environmental online media. Considerable representation of NGOs, and a lower number of academic sources. Search for CCS risk resulted in a higher number of critical articles	Less structured information available. High number academic sources. + sources with a positive view of CCS. High number of foreign sources. Absence of results produced by NGOs or specialized environmental media.

Additionally:

- In the three countries, private corporations were one of the main actors promoted in the Google results, some being often present in the result list of different types of queries.
- Two main types of private corporations promoting information on CCS in the three countries: companies that work directly with CCS or carbon emissions and companies that work in the environmental/sustainability field and have Q&A informative content on many topics.
- Many of the webpages linked have hybrid formats (blogpost, Q&A, repost, etc.) that look quite similar despite being produced by different sources.
- Google suggested questions and featured snippets tend to privilege content in the form of Q&A that can be easily identified as relevant by the platform.
- Wikipedia pages tend to be presented and highlighted with an information box on the right of the results page when searching for CCS.
- Major media articles on CCS were almost completely absent from the results. Instead, the platform seems to give more visibility to articles published on online specialized media.
- Sources that have a positive view of CCS tend to highlight its importance to fight climate change and reducing the amount of CO2 in the atmosphere. Its complementary role to other climate technology, its relevance for some specific sectors like the cement, energy, and fuel industry, and the fact that it is a tested technology, among others.
- The most referred limitation of CCS mentioned by both the supportive and critical sources is the cost. Other negative aspects referred to are the uncertainties about the reliability of the geological storage site, the risk of leakages, seismic risk, and the acidification of the oceans. Most sources focusing on the negative aspects of CCS are from environmental media or NGOs.

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In conclusion, media representations of CCS do not provide a lot of information that helps citizens form an opinion on these technologies. Articles in the press are scant, small and with little technical information. Wikipedia pages differ much among themselves, but also mostly fail in terms of presenting accurate, up-to-date and balanced information. The results of Google searches also go little beyond promotional pages by companies, critical pages by environmental organisations and overly technical reports and thesis from academia. This lack of information is particularly acute in Portugal and a bit less so in Spain, whereas France does provide a much richer press and online material on CCS.

The media analysis thus provides us with valuable data on how to interpret the results of the interviews with stakeholders and the public opinion survey (namely the generalised unfamiliarity with CCS) and on how to prepare the following stages of community engagement.

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1. Introduction

The role of printed media in the CCS debate has increasingly called the attention of social sciences. A variety of studies on the role of printed media on CCS have been carried out in countries such as Germany (Van Alpehn et al, 2007, Fischedick et al 2009, Pietzner et al, 2014), Scotland and Poland (Brunsting et all, 2015), and Finland (Kojo & Innola 2017) among others. The main research topics include the perceptions and representations of CCS in the press, the discursive trends on CCS, the representations of CCS, or the level of press attention to CCS related conflicts, especially protests against CCS projects.

The main findings from previous CCS media-related research indicates that the overall tone of the news articles tends to be positive or neutral. An international review of the media coverage of CCS (2012) shows that the overall tone was positive or neutral, although the number of concerns about the technology was increasing. Earlier studies in the Netherlands (2007), Scotland and Poland (2015) confirm this overall trend of a positive/neutral coverage of CCS in the media. More recent findings from Finland (in 2017) show an even more favourable representation of CCS in the media, with 66% of the articles being positive or neutral, and a relatively low number of negative articles.

As could be expected, when the focus of the study is on CCS-related conflicts, i.e., protests against specific CCS projects, the overall tone clearly turns negative, as research on Germany illustrates (66.4% of articles with a negative tone, followed by 27.2% of neutral and only 6.4% positive ones). Other studies have specifically focused on understanding offshore oil and gas socio-environmental conflicts and the role of the media (Pinto & Castro, 2021). This Portuguese study identified the main actors pro and against oil and gas exploration as well as the nature of the arguments deployed to defend and/or oppose future extractions. As far as the actors were concerned, governments and private organizations were the most supportive ones, while citizen groups, national political parties, municipalities and communities of municipalities were the most reluctant ones.

Overall, the main arguments in favour of CCS as portrayed by the press relate to climate change mitigation, business opportunities, jobs generation, the availability of the technology or the alternative future to coal. The role of CCS in climate change mitigation clearly emerges as the main argument to support the technologies. The main concerns deal with costs, safety, risks and the lack of suitable public engagement processes.

In addition, our media analysis also considers digital infrastructures like search engines and Wikipedia as they have become central for knowing in contemporary societies. They do promote specific content, they shape the way information is shared and presented online, and in this process, they mediate the access to scientific information for most of the public. Both platforms, thus, offer an opportunity to study how the information about an issue like CCS is social and materially constructed online, but also, to reflect on how the content they present might shape the public perceptions of CCS. Our goal is to examine the kind of information the public has access to when searching on-line for CCS in the different countries involved in the project. This is particularly relevant in a topic such as CCS that is mostly unknown to most of the public, and that, because of its current relevance, is likely to see the information available and promoted online on the subject increase and change in the coming years. Once again, as far as we are aware, this kind of analysis has not been performed before in any of our three main regions: France, Portugal and Spain.

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In summary, social sciences have already analysed the media portrayed of CCS in a number of EU countries and identified the tone of the articles and the kind of arguments deployed by the main actors in the CCS debate. However, there are still a number of research gaps that we (partially) try to address by means of our media analysis. There is still much to do in terms of comparative research, such as cross-country studies and longitudinal analysis. Other interesting research topic deals with the need to address and compare the local/regional press with the national one. Finally, as far as we know there is no specific evidence on the media coverage of CCS in Spain or France, or Portugal.

This report presents the findings from the Media Analysis carried out in our three main regions: France, Portugal and Spain, addressing both traditional media (newspaper articles), and online media (Wikipedia & Google Search results). Notably, the online media analysis was not anticipated in our Grant Agreement, but following a suggestion by our Portuguese partner (ICS/UL) it has been included in Task 6.2.

2. Objectives

Our overall objective is identifying and understanding the kind of information that the public has access to when searching for CCS both in the traditional media (newspapers) and in the on-line media (Wikipedia and Google Search results) in our three main regions (France, Portugal, and Spain).

2.1. Press Analysis

In line with previous research on CCS, the main objective of our printed media analysis is the identification of the type of discourse about CCS that different media sources transmit in each of the studied regions (cross-country analysis). Other objectives include the identification of the different kind of actors involved in the CCS debate; the main arguments underlying the variety of discourses on CCS; and the possible differences among national, regional and local media in each country.

Notably, the identification of actors at the regional level is highly relevant not only for the media analysis but also as a means to detect potential interviewees for the subsequent activities in Task 6.2.

2.2. Online Media Analysis

In terms of the Wikipedia analysis, our goal is to identify and compare the content of the four CCS pages most likely to be accessed in the countries in analyse, namely in the English, French, Spanish, and Portuguese-language Wikipedias. These pages might have some similarities in terms of structure or content, but ultimately, they were independently written and changed throughout the years by volunteer users who speak these languages, leading to the information available for the public in these regions being sometimes quite different. The Wikipedia archive of these pages also allow us to understand the topic introduction and viewership over time in each country.

On the other hand, we look at the Google search engine results when searching for CCS in three of the PilotSTRATEGY countries: France, Spain, and Portugal, with two main aims: 1) understanding the kind of content that the public/stakeholders would access in each country/location if looking for

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information on this topic, and 2) examining the sources/content being promoted by search engines and Wikipedia in each country.

We are considering the possibility of repeating the analysis at the end of the project in order to understand if there is a change in the information presented and promoted by search engines and Wikipedia during this time, and it the PilotSTRATEGY project, or other related projects, has an impact on the information presented and promoted by search engines and Wikipedia in each country/location.

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3. Press analysis

3.1. Introduction & Objectives

As public awareness and understanding of CCS is low, the role of media in influencing the CCS debate needs to be considered. Lay citizens usually do not have direct experience with new technological developments, and the media do play a role in amplifying or attenuating the risk associated with such technologies, including CCS. Media analysis can provide insights into how the public may understand and respond to CCS.

Various theoretical models provide relevant insights in this regard, such as the social amplification of risk framework (Kasperson et al, 1998) or the media agenda-setting model, i.e. the way in which the media and the actors appearing in them define the prominence of CCS (Kojo & Innola 2017)

The role of printed media in the CCS debate has increasingly called the attention of social sciences. Thus, a variety of studies on the role of printed media on CCS have been carried out in countries such as Germany (Van Alpehn et al, 2007, Fischedick et al 2009, Pietzner et al, 2014), Scotland and Poland (Brunsting et all, 2015), and Finland (Kojo & Innola 2017) among others. The main research topics include the perceptions and representations of CCS in the press, the discursive trends on CCS, the representations of CCS, or the level of press attention to CCS related conflicts, especially protests against CCS projects.

The main findings from previous CCS media-related research indicate that the overall tone of the news articles tends to be positive or neutral. An international review of the media coverage of CCS (2012) shows that the overall tone was positive or neutral, although the number of concerns about the technology was increasing. Earlier studies in the Netherlands (2007), Scotland and Poland (2015) confirm this overall trend of a positive/neutral coverage of CCS in the media. More recent findings from Finland (in 2017) show an even more favourable representation of CCS in the media, with 66% of the articles being positive or neutral, and a relatively low number of negative articles.

As could be expected, when the focus of the study is on CCS-related conflicts, i.e., protests against specific CCS projects, the overall tone clearly turns negative, as research on Germany illustrates: 66.4% of articles with a negative tone, followed by 27.2% of neutral and only 6.4% positive ones. Other studies have specifically focused on understanding offshore oil and gas socio-environmental conflicts and the role of the media (Pinto & Castro, 2021). This Portuguese study identified the main actors pro and against oil and gas exploration as well as the nature of the arguments deployed to defend and/or oppose future extractions. As far as the actors were concerned, governments and private organizations were the most supportive ones, while citizen groups, national political parties, municipalities and communities of municipalities were the most reluctant ones.

Overall, the main arguments in favour of CCS as portrayed by the press relate to climate change mitigation, business opportunities, jobs generation, the availability of the technology or the alternative future to coal. The role of CCS in climate change mitigation clearly emerges as the main argument to support the technologies. The main concerns deal with costs, safety, risks and the lack of suitable public engagement processes.

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Key recommendations from these studies highlight the need to communicate the complex nature of CCS in an appropriate way, with balanced information on its risks and opportunities. In this regard, a neutral and transparent approach to the technology and its contribution to climate protection will be of paramount importance in a possible future discussion of CCS in the media.

In summary, social sciences have already analysed the media portrayed of CCS in a number of EU countries and identified the tone of the articles and the kind of arguments deployed by the main actors in the CCS debate. However, there are still a number of research gaps that we (partially) try to address by means of our media analysis. There is still much to do in terms of comparative research, such as cross-country studies and longitudinal analysis. Other interesting research topic deals with the need to address and compare the local/regional press with the national one. Finally, as far as we know there is no specific evidence on the media coverage of CCS in Spain or France, or Portugal.

This chapter presents the results from the PilotSTRATEGY press Media Analysis performed in our three main regions: The Ebro Basin, the Lusitanian Basin and the Paris Basin. Both the Ebro and the Lusitanian Basins include the respective offshore and onshore areas. The Media Analysis started in November 2021 and its findings were due to June 2022.

In line with previous media analysis research on CCS, our main objective is the identification of the type of discourse about CCS that different media sources transmit in each of the studied regions (cross-country analysis). Other objectives include the identification of the different kind of actors involved in the CCS debate, the main arguments underlying the variety of discourses on CCS, and the possible differences among national, regional and local media in each country. Notably, the identification of actors at the regional level is highly relevant not only for the media analysis but also as a means to detect potential interviewees for the subsequent activities in Task 6.2.

3.2. Method & Sample

Regarding the sampling, in each geographic area (Ebro Basin, Lusitanian Basin, and Paris Basin), national, regional and local newspapers were considered (Table 3). The Ebro and the Lusitanian Basin comprises two different areas (onshore and offshore) while the Paris Basin includes a single one (onshore). The selected time period covered the last 10 years (from January 1st 2011 to September 2021). In the case of Portugal this frame was widened, due to the very small number of articles found (none about CCS in regional and local media).

Table 3. Newspapers selected per region and type.

	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

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			Região da Nazaré Região de Cister

In Spain, El País and El Mundo, the two most read generalist newspapers in the first quarter of 2021 (AIMC, 2021), were selected as the national scope newspapers. At the regional/local level, for the Off-shore area we selected the most read regional newspaper (Diari de Tarragona), while for the onshore area we selected the most read local newspaper (Diario de Teruel) (AIMC, 2021).

MyNews was the database used in Spain. The keywords used to search in MyNews database were intended to capture the main discourses around CCS, the arguments underlying such discourses and the key actors involved in the CCS debate, at the national, regional, and local level. Some keywords were common for national, regional and local newspapers (CCUS, CAUC, CAC, Carbon capture, storage and use, Carbon capture and storage, Capture and CO2, Storage and CO2, CAC and CO2) while other keywords addressed specific issues relevant at the local/regional level (CCUS and Risk and seismic, Risk and seismic, Earthquake, CCUS and Earthquake, Capture and storage and risk and seismic; Fracking; Gas storage: Storage and gas; Climate Change: Floods; Oil exploration: Exploration and gas). A preliminary search with all keywords resulted in a very high number of results. Therefore, only those articles explicitly mentioning carbon capture and storage were selected.

In France Le Monde, Le Figaro and Libération, all of them national newspapers, were selected, as they are the most read newspapers in France. Libération was selected as a left-wing newspaper while Le Monde was selected as the more balanced one while Le Figaro is a right-wing paper. At local level, Le Parisien and la République de Seine-et-Marne were selected in order to understand the difference of CCS representations at different socio-cultural and administrative levels.

The database for the search was Europress and the keywords used for the search were "carbon capture", "carbon sequestration", "clean coal", "risks of carbon capture", 'benefits of carbon capture" and "carbon storage". The search produced a very high number of CCS related articles so only those explicitly devoted to CCS (even if allusively) were selected.

In Portugal, the two most read national newspapers were chosen. One of them, Público, is a quality newspaper, while the Correio da Manhã is a tabloid. For the local newspapers, ten different newspapers were selected. The search was done in every newspapers' website and was complemented with a Google search over the newspaper website. The keywords used were carbon capture and storage (not as acronym, because it is not used in Portugal). The number of articles was very low (zero in the case of local newspapers, with the exception of some articles pertaining to natural carbon storage in agriculture or forests), so there was no need to refine the results. An additional search with the keywords "climate change", "seismic risk", "gas storage", "oil and gas exploration", "underground" "and "caves" was done to complement the document analysis.

As illustrated in Table 4, we coded a total of 267 newspaper articles: 97 in Spain, 129 in France and 52 in Portugal.

Table 4. Number of CCS coded articles per country.

CCS coded articles	
Spain	97
France	129

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Portugal	52
Total	**278**

The design of the protocol was an iterative process between social partners in the selected regions, inspired by literature on CCS representations in the media (Van Alpehn et al, 2007, Fischedick et al. 2009, Pietzner et al., 2014, Brunsting et al., 2015, Kojo & Innola 2017), as well as previous work by some team members on emerging technologies (Schmidt et al, 2014, Oltra et al, 2014, Delicado et al, 2016). It should be noted that the PilotSTRATEGY social sciences team includes relevant experts in media analysis. Coordination work was essential to create a first draft version of the protocol. Each region made a pilot test with a reduced number of articles to guarantee a common understanding by the different coders, to identify possible weaknesses, and to test the inter-coder reliability. After the first pilot, all partners fine-tuned the protocol and started a new pilot test. This was repeated until the protocol was robust enough.

The protocol was structured in different sections (see Annex 1).

1. Newspaper characterization.
2. Article characterization
3. CCS characterization
4. Additional questions.

Data gathering took place between December 9th 2021 and March 11th 2022. The protocol was adapted to a Google Forms format, offering a collaborative environment for all coders. Results were automatically saved in a shared document. When previously selected articles were not suitable for coding, we registered them in a separate sheet with the title, newspaper and reason for rejection. The analysis of the database was performed with IBM SPSS.

3.3. Results

3.3.1. Characterisation of articles about Carbon Capture and Storage

Firstly, if we look at the country, 47% of the news articles come from France, 35% from Spain and 19% from Portugal.

78% of the coded newspaper articles are from quality newspapers (59% in France, 85% in Portugal and all from Spain), while 22% are from tabloid newspapers (42% in France and 15% in Portugal).

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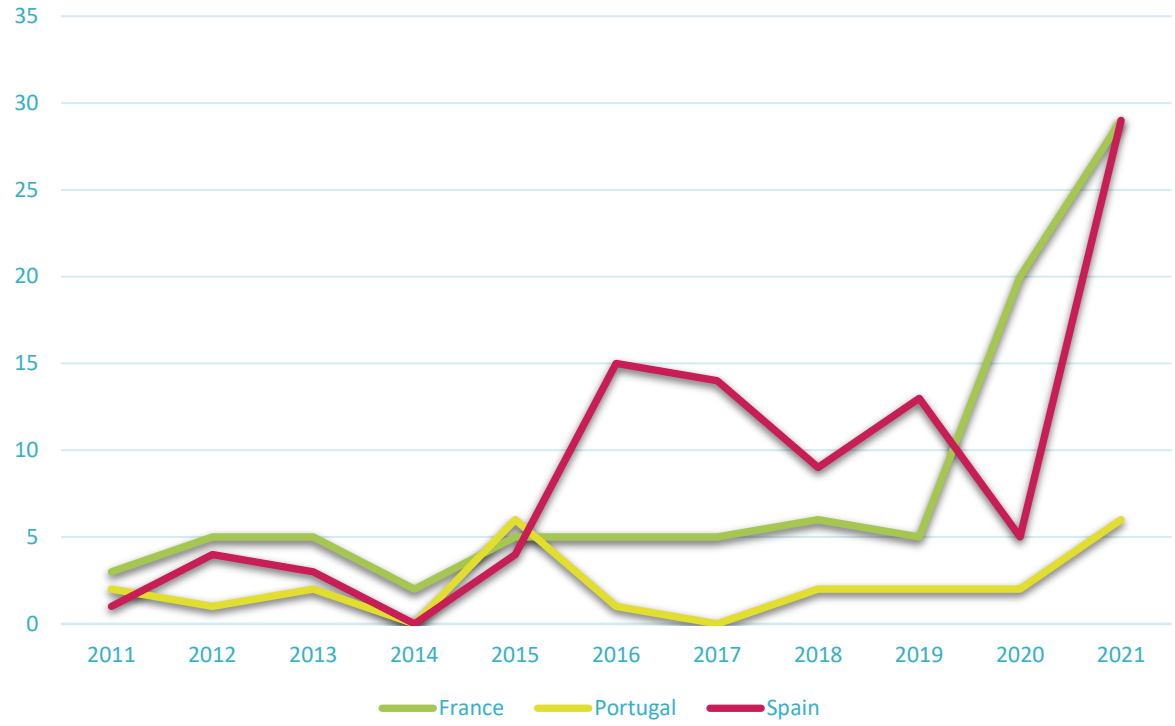

*Figure 1.*Articles about CCS by year and country

If we observe the number of articles about CCS per year, there are different temporal points of interest (Figure 1). In Spain there is an important increase in the number of articles published in 2016, then the number decreases and rises again in 2020 reaching the same point than in 2015. From 2020 to 2021 we find the biggest increase, from 5 articles to nearly 30 per year. In France, a similar pattern can be observed, but with the increase occurring between 2019 and 2021. In the case of Portugal, the temporal evolution does not seem to be so important. There is a little increase in 2015, in line with the other two countries and yet with an increase in 2021, but with a much lower magnitude.

As a preliminary hypothesis, the United Nations Climate Change Conferences (COP 2015 and COP 2021) could at least partially explain the increase of CCS related news articles in the three countries in both years. This needs to be further explored.

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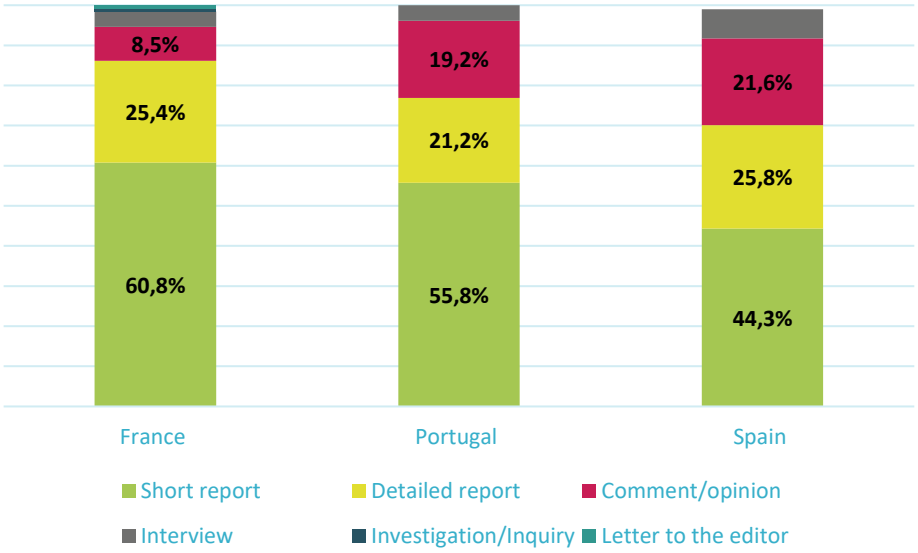

Figure 2. Articles about CCS by type of article and country

The type of article is also classified (Figure 2) as: Detailed report; Short report; Comment/Opinion; Interview; Letter to the editor; Editorial; and Other. The majority of our CCS articles are short reports (61% FR, 56% PT, 44% SP), followed by detailed reports (25% FR, 21% PT, 26% SP). The comments/opinions are found in a significant proportion in Portugal and Spain, while in France are less than a 10%. The number of interviews is considerable in Spain (7%), while the rest of types of articles are not significant.

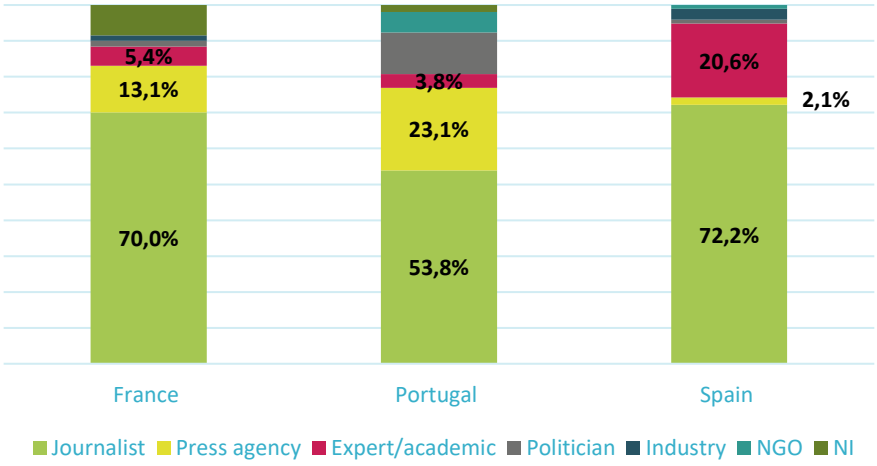

Figure 3. Articles about CCS by type of author and country

Regarding authorship, more than 67% in the three countries are written by journalists, mainly in France and Spain, with more than 70% in both (Figure 3). In Portugal, an important number of articles are written by press agencies, while in Spain more than a 20% of articles are elaborated by academics or experts. In Portugal 12% of articles are written by politicians while in France and Spain politicians only contributed with less than a 2%. Also in Portugal, it should be noted a 6% of articles are written by NGOs representatives.

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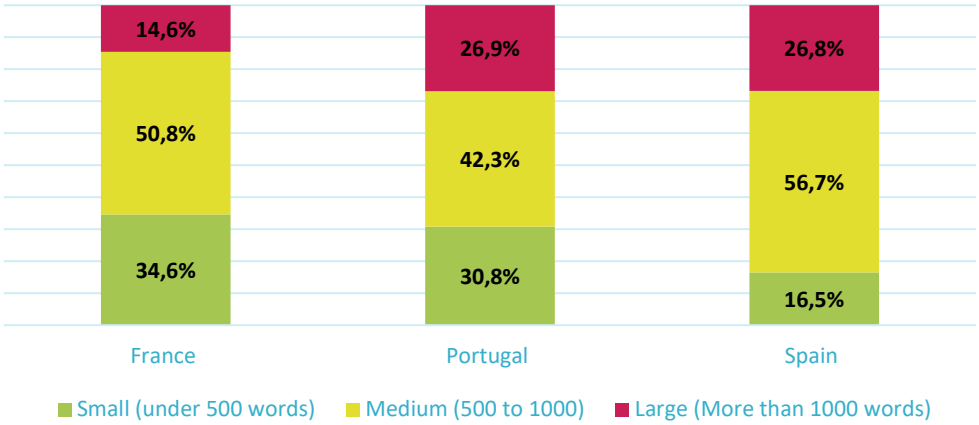

Figure 4. Articles about CCS by length of article and country

Regarding the length of the articles, half of them can be classified as medium (500 to 1000 words). In France and Portugal, a substantial amount of articles (around 30%) are considered as small (under 500 words). On the other hand, Portugal and Spain has a bigger amount of large articles (more than 1000 words) than France (Figure 4).

3.3.2. Characterisation of Carbon Capture and Storage in articles

If we take a look at the general scope of the article (Figure 5) we can observe that most articles, particularly in France and Portugal, address CCS at the international level. Spain stands out by the national focus of half its articles on CCS. In Portugal, there are no articles mentioning CCS at the regional or local levels, since there have been, so far, no concrete proposals for CCS projects, unlike Spain, where close to a fourth of the articles also have a regional scope.

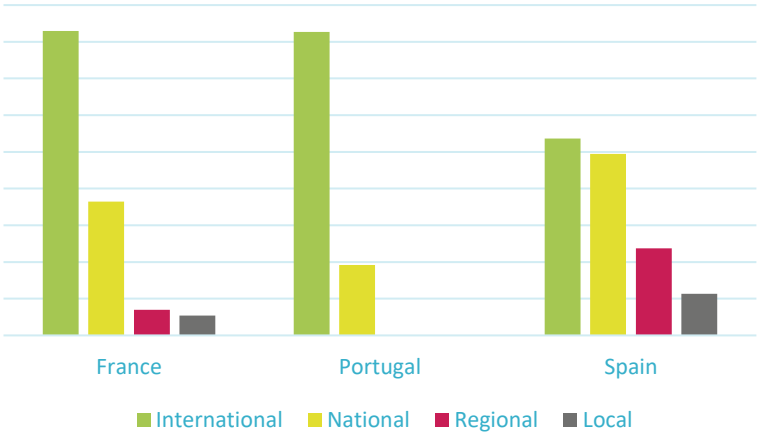

Figure 5. Articles about CCS by scope of article (multiple answers) and country (multiple answers)

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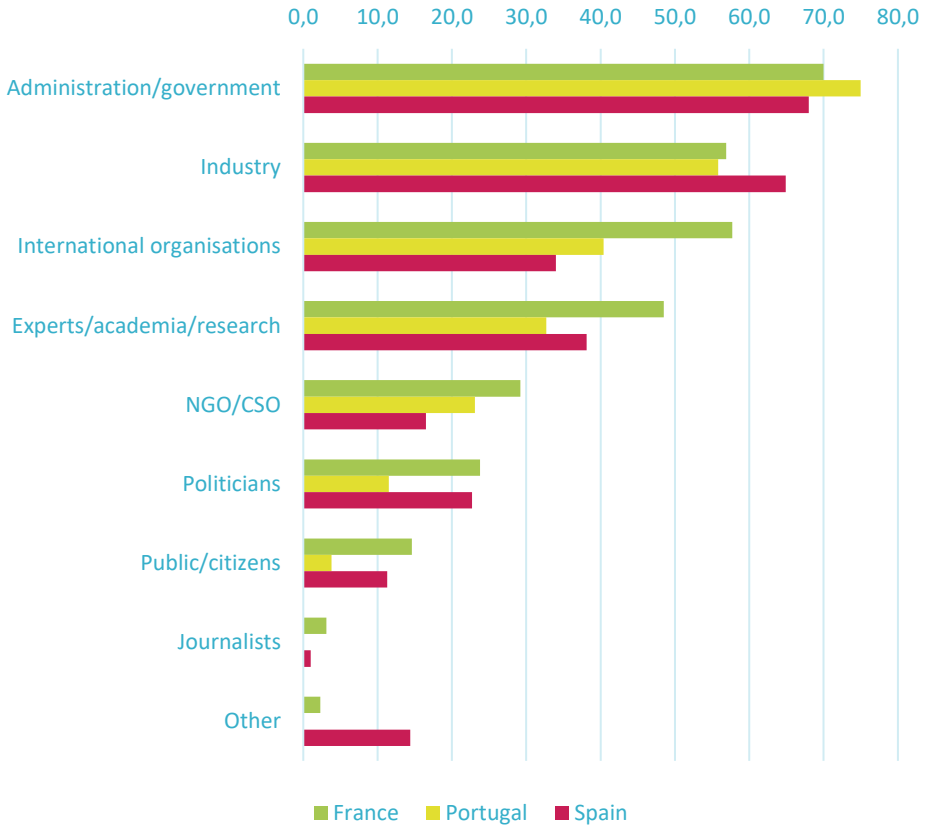

Figure 6. Main actors mentioned in the articles about CCS

Regarding the main actors mentioned in the articles (Figure 6), administration/government take the lead, with around 70% in all three countries. Industry takes the second place, with more mentions in Spain. Third, international organisations, which are found more frequently in French articles. Next, we can find the experts/academia/research, with more mentions in France and Spain. Then, there are NGOs, with France and Portugal leading the mentions. The two next groups, politicians and public/citizens are especially mentioned in France and Spain. Finally, we can find journalists, with more mentions in France and no mentions in Portugal. Finally, in the others section, Spain has a 14% of mentions.

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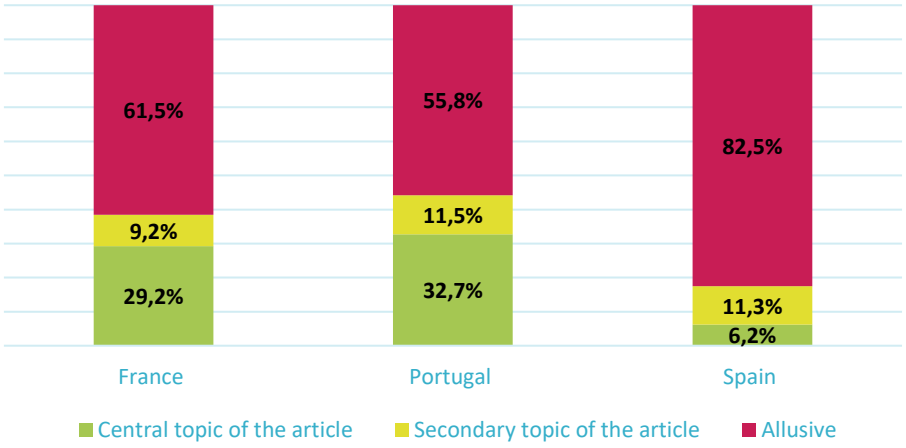

Figure 7. Articles by extent of focus on CCS

A very relevant finding is that the great majority of the news articles (78%) do not mention CCS in the title. In the case of Spain, this percentage goes up even more, reaching a 91% of the coded articles.

It should also be noted that in the majority of articles (68%), the extent of focus of CCS is only allusive, especially in Spain with 83% of allusive articles. CCS emerges as the central topic of the article in around a 30% of the articles both in France and Portugal, while in Spain is only 6% (Figure 7). CCS appears as secondary topic (not the main one) in 9 to 12% of the articles in the three countries.

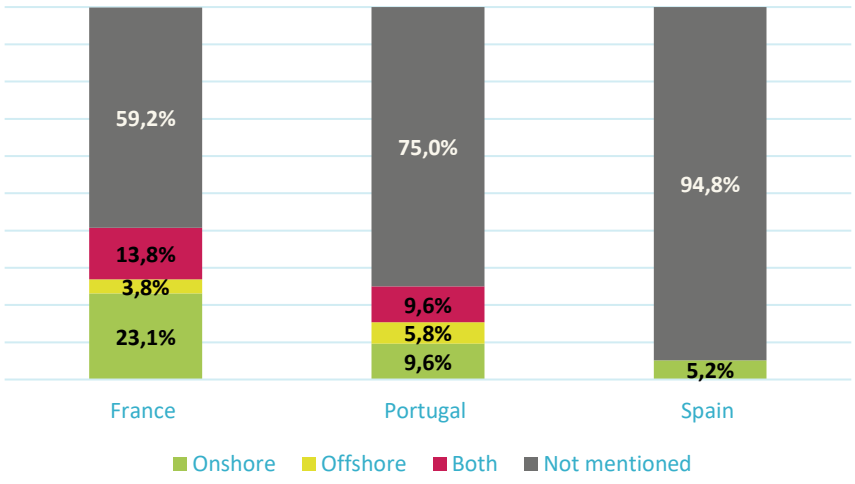

Figure 8. Articles by location of CCS mentioned

In the majority of articles, the location of CCS is not explicitly mentioned, and that is especially relevant in Spain, with 95% of articles not refereeing to any CCS location (Figure 8). In France and Portugal, the location is mentioned more frequently (41% FR, 25% PT). In France, 23% mention an onshore location, followed by 14% mentioning both and only 4% explicitly mentioning an offshore location. In Portugal, 10% mention onshore, 10% both locations and 6% offshore.

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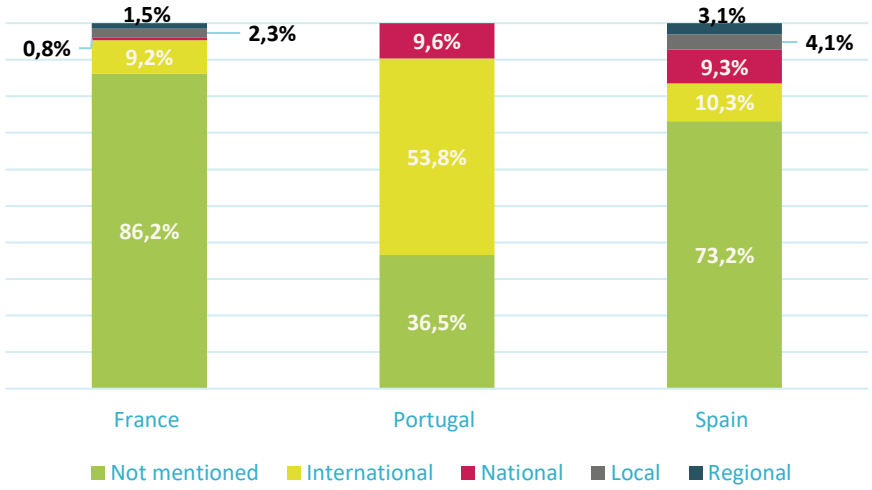

Figure 9. Geographical scope of CCS if explicitly mentioned

The geographical scope of CCS in the cases that is explicitly mentioned, is absent in nearly three quarters of articles across the three countries (Figure 9). Nonetheless, there are important differences among the three countries. While France and Spain stay in the average, in Portugal the articles where the scope is not mentioned are only 37%. On the other hand, in Portuguese articles, 54% are of an international scope, while it's only a 9 and 10% in France and Spain, respectively. Regarding the national scope there are important differences too. While in Portugal and Spain is nearly 10%, in France is less than a 1%. Local and regional are only mentioned in France and Spain, with percentages lower than a 5%.

Regarding the terminology used to refer to CCS, the most used terms are Carbon/CO2 capture and storage followed by Carbon/CO2 capture but with remarkable differences by country. For example, Carbon/CO2 capture and storage is found in 46% of Portugal's articles and 25% in Spain's and 15% in France ones. Carbon/CO2 capture is used in 32% in Spain's articles, 16% in France's and only a 4% in Portugal. Carbon/CO2 capture and sequestration is also used substantially in the three countries, especially in Portugal and France. Other terminology has appeared but is found only in few articles per country. The only one that needs to be highlighted is the use of clean coal in France, with 12% of articles referring to this term.

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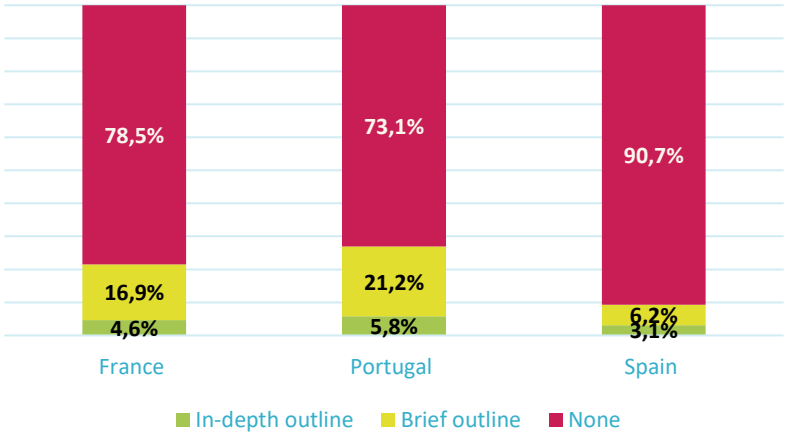

Figure 10. Articles by kind of technical explanation of CCS.

As far as technical explanations in the articles are concerned, the vast majority (82%) do not contain any kind of technical explanation (79% FR, 73% FR, 91% SP). In France and Portugal around a 20% of articles offer a brief outline, and only 6% in Spain. In all the three countries, less than 6% of the articles offer an in-depth outline of CCS (Figure 10).

If we look at the themes in the articles (Figure 11 and Figure 12), we can observe that Climate change, decarbonisation & CCS is one of the most mentioned ones in all the three countries, but mostly as a central topic. CCS and energy is also especially mentioned, as secondary theme in France. CCS research or experiments, new technologies or enhanced processes are also highly mentioned, especially as a central topic in Spain's articles. Information on specific CCS project or site is also mentioned in various occasions, especially in France as a secondary theme. It is also important to show the importance of Challenges, risks and problems of CCS and CO2 emissions market in the secondary themes of France and Portugal.

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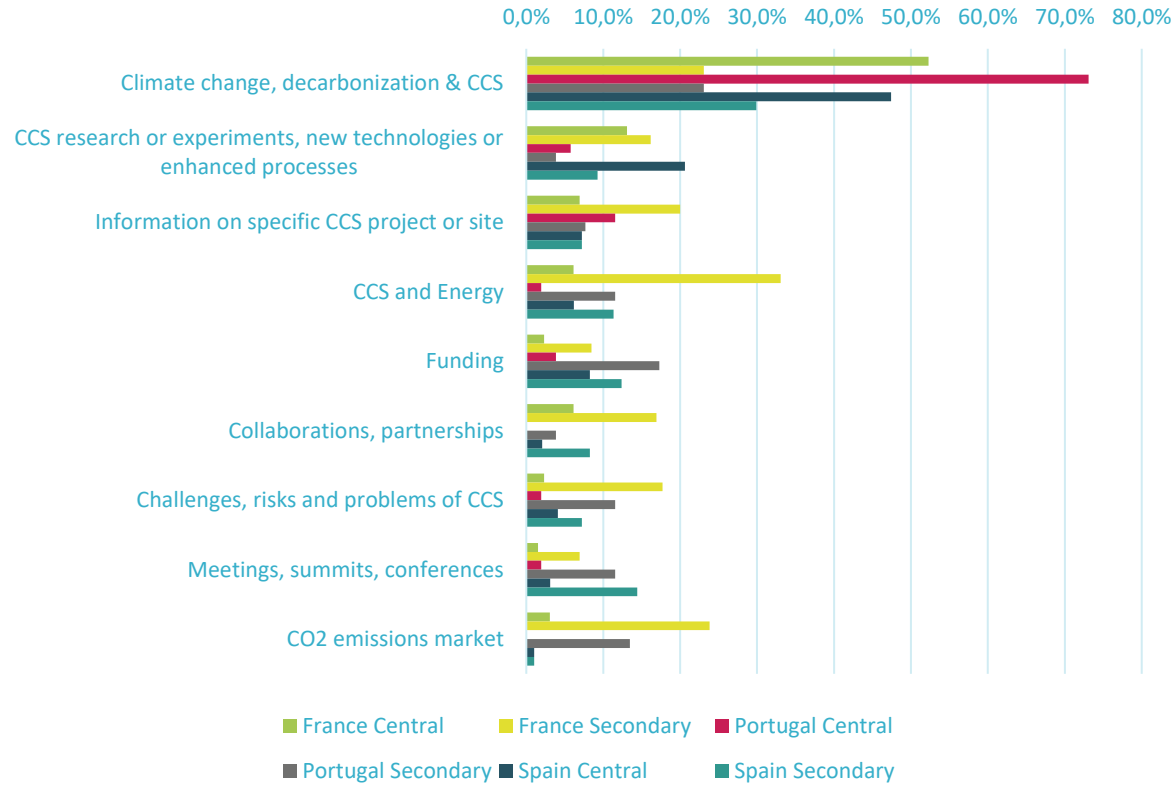

Figure 11. Articles about CCS by themes

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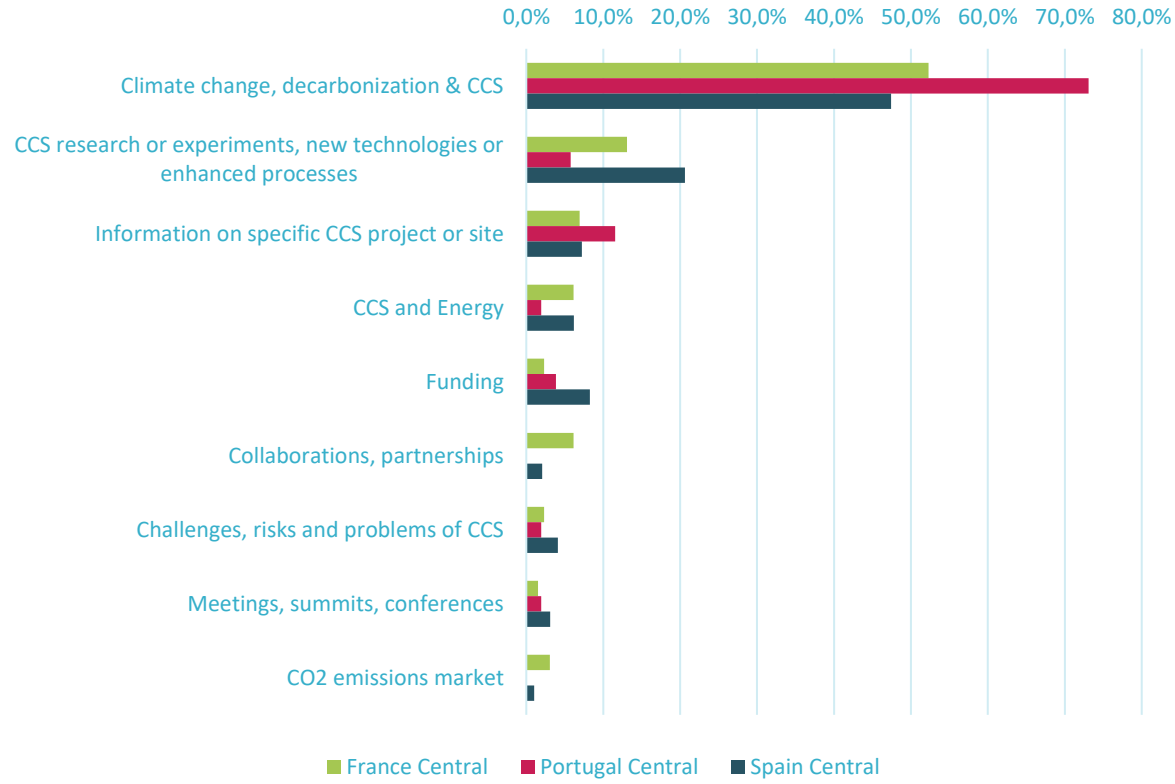

Figure 12. Articles about CCS by central themes

3.3.3. Valuation of Carbon Capture and Storage in articles

Regarding the arguments in favour of CCS, we find some relevant results (Figure 13). The most relevant argument in all countries is that CCS Reduces emissions, is climate friendly and mitigates climate change. This argument is found especially in Portugal and Spain. In France we find a remarkable number of articles without favourable arguments (60% FR, 15% PT, 14% SP). It also could be noted that in Portugal, 31% argue that CCS is an important means among others/part of energy portfolio. In Spain, a 24% have the argument that Enables continuing use of coal, coal is cheap/available/efficient. In the local press in Spain, some articles present CCS as a solution to rural problems (depopulated areas). It is also remarkable that a 15% in Portugal's articles says that the Technology already exists/is tested/is in use/is reliable.

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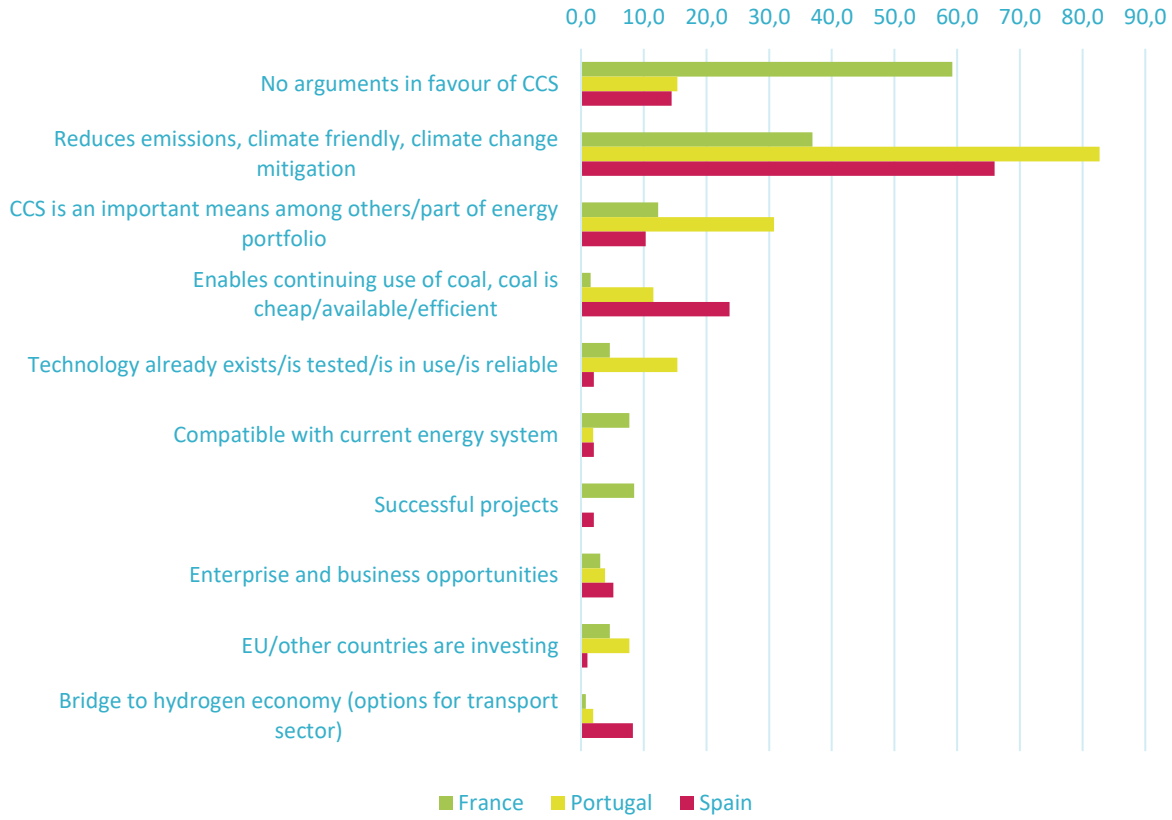

Figure 13. Main arguments in favour of CCS

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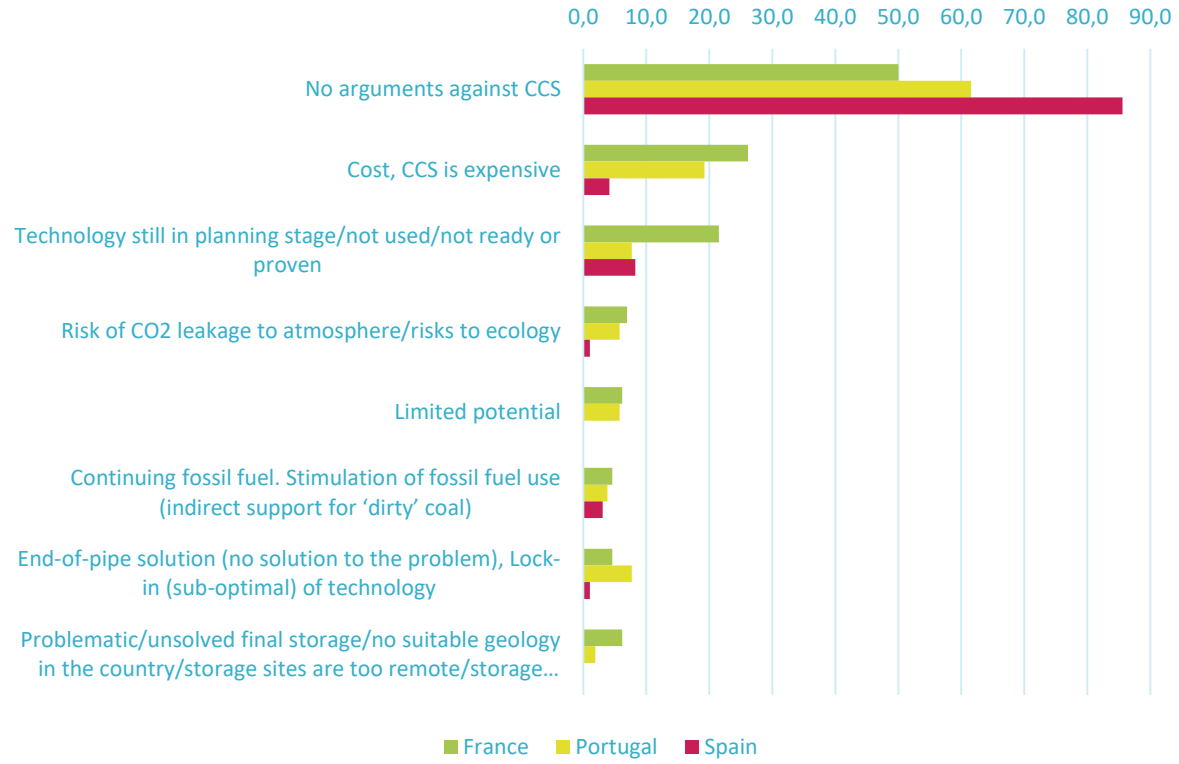

Figure 14. Main arguments against CCS

Regarding the arguments against CCS, in the majority of articles there are no arguments against (Figure 14). This is especially clear in Spain, with 86% of articles without arguments against CCS (61.5% PT, 50% FR). The cost and the fact the CCS is expensive is found in 26% of articles in France, 19% in Portugal and only a 4% in Spain. Another argument that appeared, mostly in France, is that the Technology is still in planning stage, not used, or not ready or proven.

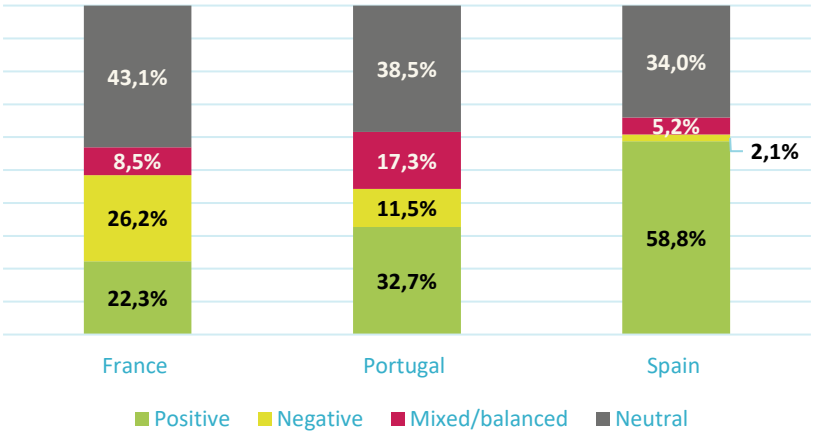

Figure 15. Articles by valuation of CCS and country

As to the tone of the article (Figure 15), the neutral and the mixed/balance account almost for 50% in all three countries. Spain shows the most positive one (59% SP, 33% PT, 22% FR). In France we find

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the most negative articles (26% FR, 12% PT, 2% SP). If we look at the mixed/balanced there is a 17% in Portugal, where in France is a 9% and in Spain a 5%. In the case of neutral articles, in France there are 43% while in Portugal is a 39% and in Spain a 34%.

It is worth exploring a little more in-depth the valuation of CCS according to some characteristics of the newspapers and the articles. In France and Spain (there were no articles on CCS in regional and local newspapers in Portugal), articles with a positive tone are more frequent in local and regional newspapers, whereas negative articles are more frequently found in national newspapers (Figure 16).

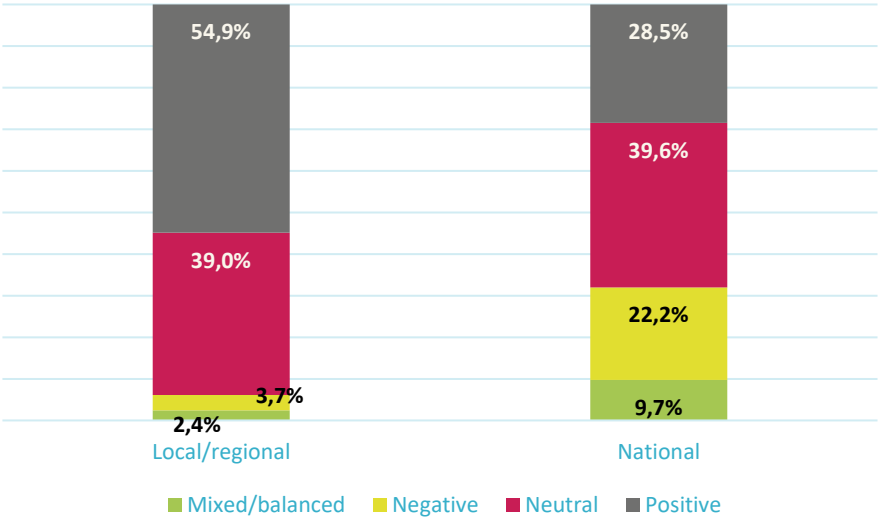

Figure 16. Articles by valuation of CCS and scope of newspaper

Regarding the type of article, a positive tone was found more frequently in interviews, a neutral or balanced one in long reports and a negative again in interviews (Figure 17). As to the type of author of the articles, journalists and press agencies, as well as politicians and experts, favour a neutral or positive tone, business actors a positive one and NGO a negative stance (Figure 18). However, this has to be interpreted with caution, since there are few articles authored by other than journalists or press agencies.

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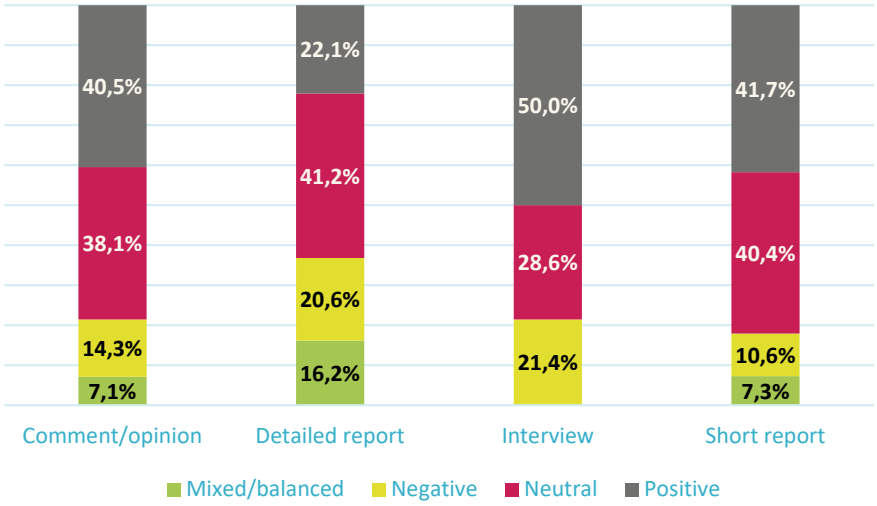

Figure 17. Articles by valuation of CCS and type of article

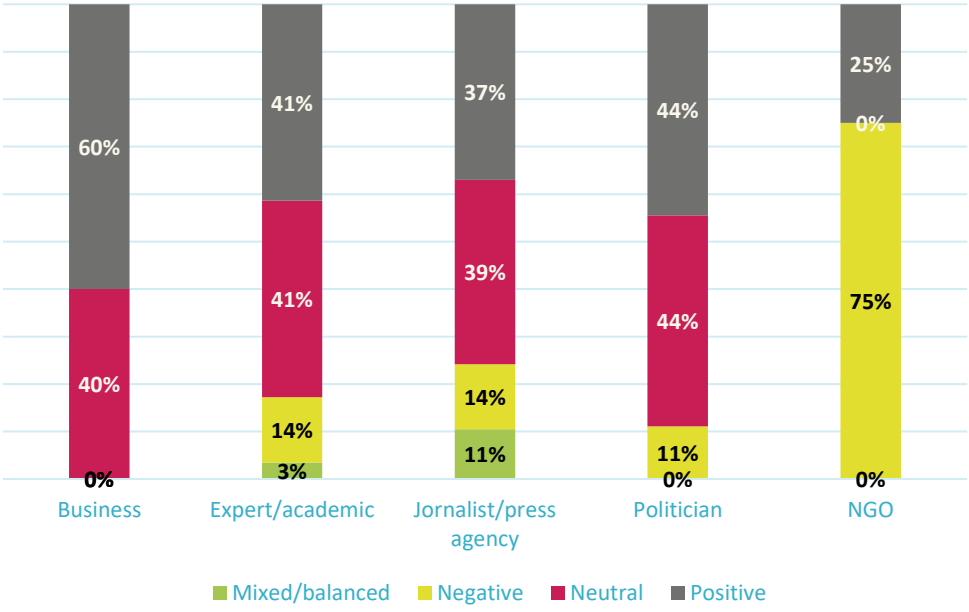

Figure 18. Articles by valuation of CCS and type of author

3.4. Summary of Findings

- Media attention to CCS is higher in France and in Spain than in Portugal
- 2015 and 2020 shows relevant increases in the number of articles in the three countries (COP 2015 and COP 2021 could at least partially explain this rise).
- Most articles are short reports and medium/small size (up to 1,000 words)
- Formal/institutional actors take the lead in the media portrayal of CCS, in particular administration and governments, industry, international organizations and experts.

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- CCS is not a hot topic: it does not appear in the headlines and most articles only include allusive references (just a few words) to CCS. This is especially true in Spain.
- Carbon/CO2 capture & storage and carbon capture are the terms more frequently used in the media narrative.
- Media coverage of CCS do not include technical explanation about the technologies.
- CCS is framed in terms of climate change and decarbonisation (as main topic), and in terms of energy (as secondary topic).
- The main arguments in favour of CCS are its climate friendly character and its potential for climate change mitigation. CCS as part of the energy portfolio is especially relevant in Portugal.
- Most articles do not include negative arguments towards CCS. This is particularly the case in Spain.
- The overall tone of the articles is neutral or mixed/balanced with relevant differences among countries. The Spanish media show the most positive overall tone towards CCS, the Portuguese media is more neutral and mixed/balanced, while the French press is more neutral to negative.
- The overall evaluation by scope of newspaper also shows important differences, with the national and the regional newspapers being more neutral, while the local ones show a more positive tone.

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4. Online media analysis: Wikipedia

4.1. Introduction & Objectives

In the last decades, Wikipedia has gained increased importance as a user-based knowledge encyclopaedia, becoming a central element on how people access to scientific information in contemporary societies (Thompson & Hanley, 2017). Maintained by the collaborative effort of a community of volunteers, Wikipedia is an open collaboration digital infrastructure maintained by volunteers through a wiki-based editing system, hosted by the Wikimedia Foundation (WMF), a non-profit organization registered in the USA. It hosts several websites known as the "Wikimedia projects", or Wikipedias, with content in more than 300 languages.

It is a language-based, free, constantly evolving database, that includes information from several different sources and that relies on the work of editors (Wikipedians) to determine whether specific content should be included or maintained (Tripodi, 2021). It is governed by three principal core content policies: "neutral point of view", "verifiability", and "no original research" ("Wikipedia: Core content policies", 2022). This means that "all Wikipedia articles and other encyclopaedic content must be written from a neutral point of view, representing significant views fairly, proportionately and without bias." ("Wikipedia: Core content policies", 2022, § 2), that the material must be attributed to a reliable, published source, and that "articles may not contain any new analysis or synthesis of published material that serves to advance a position not clearly advanced by the sources." ("Wikipedia: Core content policies", 2022, § 4). Because of its bottom-up approach to the construction of knowledge its pages often become an arena for public debate (Moe, 2019), channelling, sorting, and synthetizing information on specific topics from diverse sources to the general public. Its voluntary, collaborative, user-generated content-based nature, however, makes it particularly susceptible to cultural and social variation between the different projects, both in terms of concepts, links, or structures (Hecht and Gergle, 2010). This offers an opportunity to "understand cultural dissimilarities, not just on Wikipedia, but also at the societal level." (Moe, 2019, p. 181), as well as social inequalities in relation to the quality and quantity of information available on different subjects in the different language Wikipedias.

We consider that Wikipedia offers an opportunity to understand how information on CCS is introduced/produced to the public sphere through Wikipedia, and how it reflects specific dimensions of the countries in the analysis.

Our aim was twofold:

1. To understand what kind of content the public/stakeholders would access in each country if looking for information on this topic on Wikipedia.
2. To assess the topic introduction and viewership over time in the different Wikipedia projects.

Additionally, we also consider the possibility of repeating the analysis at the end of the project in order to understand if there is a change in the information presented Wikipedia in these language during this time period.

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4.2. Methods & Sample

Our analysis focus on the Wikipedia CCS pages most likely to be accessed in the regions in analysis, i.e., the pages in French, Spanish[1], and Portuguese-language. Additionally, because many people also access this information in English[2], for comparative purposes we also included the page from the English Wikipedia project (see Annex 2 for the list and link of Wikipedia pages).

These pages might have some similarities in terms of structure or content, but ultimately, they were independently written and changed throughout the years by volunteer users from different parts of the world, which leads to the information available in each to be sometimes quite different.

The comparative analysis of the four language pages was performed on two levels:

- Meta-level: history of the page in terms of size, contributors, and page views.
- Textual level: content of the page in terms of words, structure, meaning, etc.

To collect information about each page we created a common template that allowed us to understand the general differences between the pages, both in terms of size, structure, and content (see Annex 3). The template was filled in by a member of each national team and included the following points:

1. Terminology used to describe CCS
2. Length of the page
3. Length by section
4. Number of sections,
5. Number of references
6. Images used (number and content)
7. Information about CCS in the country (France, Spain and Portugal respectively)
8. Information about specific CCS projects
9. Mention onshore/offshore CCS
10. Mention the risks of CCS
11. Level of detail/accessibility of the technical explanations
12. Themes related to CCS mentioned
13. Social actors mentioned
14. Included arguments in favour of CCS
15. Included arguments against CCS

In terms of data gathering and analysis, the comparison was made on two levels: first, at a meta-level, we looked at the history of the page in terms of size, contributors, and page views.

The meta-analysis was done using information made available by Wikipedia, which can be accessed with tools like Xtool[3]. This data gives us information on the history of the page construction, as well as the viewership over time. For the content analysis, we looked at the framing of the technology in the four pages by comparing the introductions, structure, technical information, mentions of

[1] There is also a CCS page in the Catalan-language Wikipedia. However, because it was very recent (it was created at the end of 2021), we did not considered it in our analysis.
[2] The English-language Wikipedia is the oldest and largest of the Wikipedia projects.
[3] https://xtools.wmflabs.org/

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benefits, risks and criticisms, existing projects, and involved actors. This data was accessed between May and June 2022.

Second, at a textual level, we analyse the content of the page in terms of words, structure, meaning, etc. (Moe, 2019). The content of the individual reports produced by each national team was discussed between the members of the teams to better contextualize the information in the different pages. Based on this information we identified the main themes relevant for the comparative analysis, and when necessary, conducted additional readings of the pages.

As mentioned earlier, we may repeat the analysis at the end of the project to check both, the potential changes in the information presented and promoted in each country/location during this time period and the possible impact of PilotSTRATEGY (or other related projects) on the information presented and promoted by Wikipedia in the in each country/location.

4.3. Results

4.3.1. Carbon Capture and Storage Wikipedia pages views

If we look at the story and size of the different Wikipedia projects, the English-language one is the oldest and largest, ranking 1st in terms of the number of articles. Wikipedia in French is currently in 5th place in terms of size, and in Spanish in 8th. The Wikipedia in Portuguese is much smaller, currently ranking 18th.

There are currently pages in 36 languages on Carbon Capture and Store on the existing 327 language editions of Wikipedia. When ranked by page visits, the page in English (created in 2006) appears in first place ~~with more than 600 daily visits in average~~. The page in French is currently the 4th most visited page of the 36, and the one in Spanish is the 7th. The page in Portuguese has much lower views numbers, ranking currently in 19th place (Table 5). Between 25-02-2022 and 17-03-2022, the page in English had 14262 page visits, and an average of more than 600 daily visits. During the same period, the page in French had an average of 64 daily visits, the page in Spanish 39, and the page in Portuguese only 4.

Table 5. CCS pages in Wikipedia by views.

	Raking (1-36)	Name	Page Visits	Daily Average
EN	1.	Carbon capture and storage	14262	679
FR	4.	Séquestration du dioxyde de carbone	1345	64
ES	7.	Captura y almacenamiento de carbono	823	39
PT	19.	Captura e armazenamento de carbono	86	4

Data from: 25-02-2022 to 17-03-2022. Retrieved from: https://pageviews.wmcloud.org/langviews/?project=en.wikipedia.org&platform=all-access&agent=user&start=2022-02-25&end=2022-03-17&sort=views&direction=1&view=list&page=Carbon%20capture%20and%20storage

In terms of views timeline, available data[4] on the page in English show some consistency in the number of views throughout the years, with some occasional peaks (Figure 19). Views on the page in French show an increased interest in the subject in the last three years (Figure 20), contrasting with

[4] Pageviews Analysis only provides data from July 2015 forward.

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the page in Spanish, which shows a slight decrease in the same time period (Figure 21). Data for the page in Portuguese is available only from 2020 onwards (Figure 22) and shows a stable, but low number of views. It is relevant to notice that on all the four pages the higher number of views happened after Elon Musk tweeted that he was going to create a prize of $100m for the best carbon capture technology[5]. In the English language Wikipedia, for example, in the days following the tweet, the CCS page had an increase of more than 40,000 viewers.

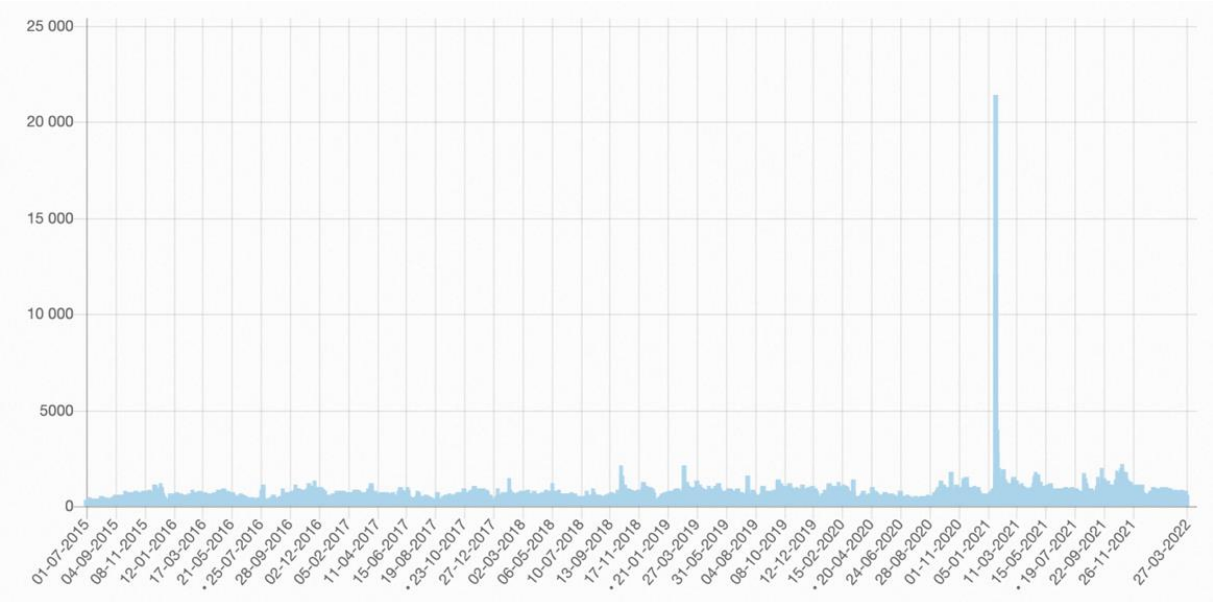

Figure 19. Views timeline 2015-2022: English-language page "Carbon capture and storage".

Note: Data from 01-07-2015 to 27-03-2022. 1 697 898 views in total. Extracted from: https://pageviews.wmcloud.org/?project=en.wikipedia.org&platform=all-access&agent=user&redirects=0&range=all-time&pages=Carbon_capture_and_storage

[5] https://twitter.com/elonmusk/status/1352392678177034242

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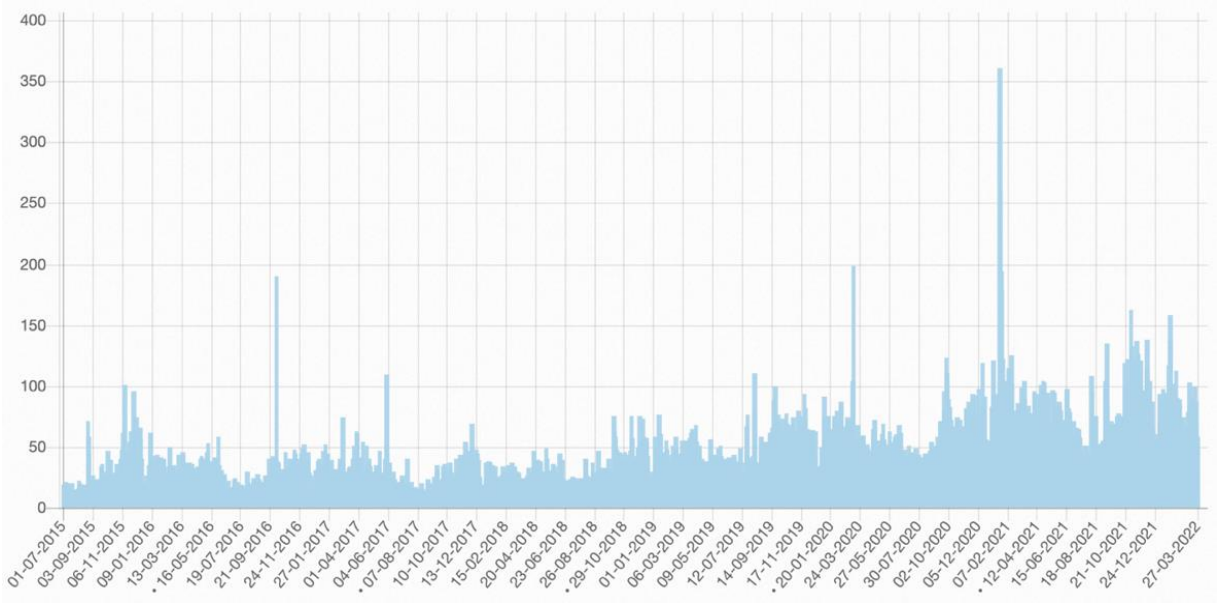

Figure 20. Views timeline 2015-2022: French-language page "Séquestration du dioxyde de carbone".

Note: Data from 01-07-2015 - 27-03-2022. 96 109 views in total. Extracted from: https://pageviews.wmcloud.org/?project=fr.wikipedia.org&platform=all-access&agent=user&redirects=0&range=all-time&pages=S%C3%A9questration_du_dioxyde_de_carbone

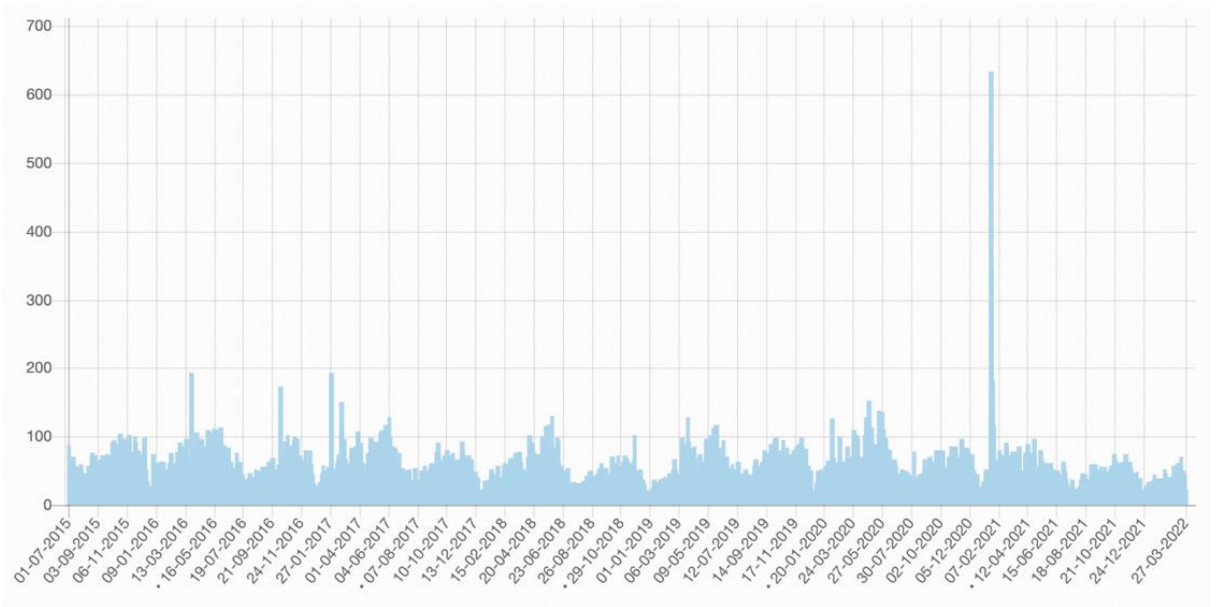

Figure 21. Views timeline 2015-2022: Spanish-language page "Captura y almacenamiento de carbono"

Note: Data from 01-07-2015 - 27-03-2022 · 118 305 views in total. Extracted from: https://pageviews.wmcloud.org/?project=es.wikipedia.org&platform=all-access&agent=user&redirects=0&range=all-time&pages=Captura_y_almacenamiento_de_carbono

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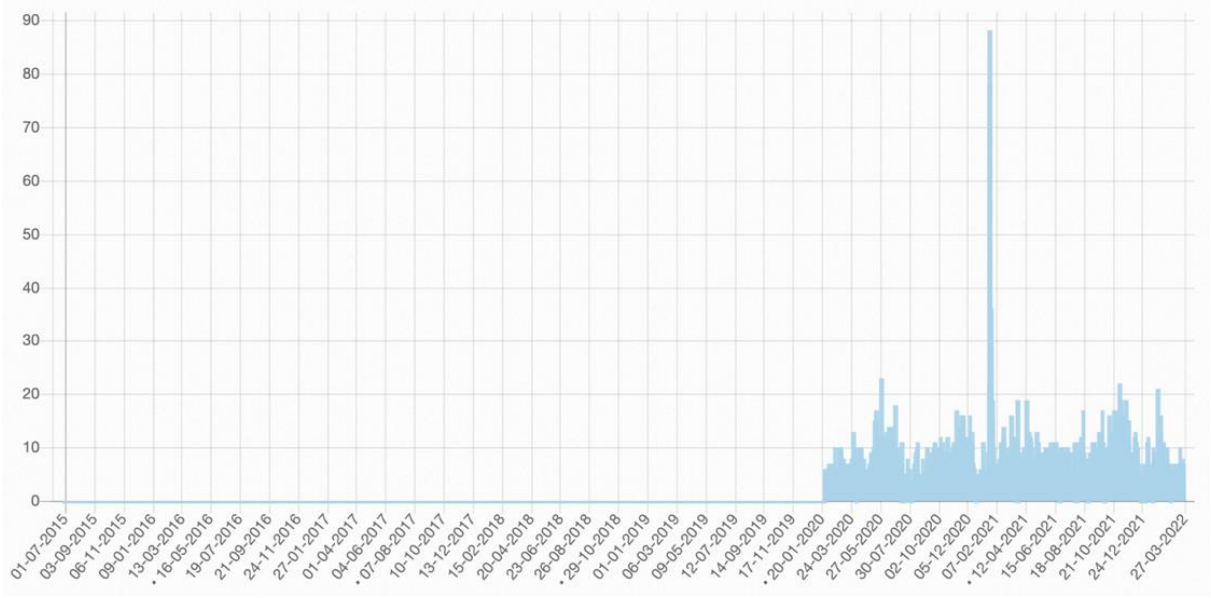

Figure 22. Views timeline 2020-2022: Portuguese-language page "Captura e armazenamento de carbono"

Note: data from 01-07-2015 - 27-03-2022 · 5220 views in total. Extracted from: https://pageviews.wmcloud.org/?project=pt.wikipedia.org&platform=all-access&agent=user&redirects=0&range=all-time&pages=Captura_e_armazenamento_de_carbono

It is important to notice that in the French-language Wikipedia the topic is presented differently from the others. According to Wikipedia, the page “Sequestration of carbon dioxide” is the one that corresponds to the CCS pages from other countries[6]. This page, however, has a broad focus on different technologies of carbon sequestration and a small section on CCS (there are similar pages on the other languages analyzed in this report). This section of the page links to another page in the French Wikipedia on the CCS called “Séquestration géologique du dioxyde de carbone”. This is the “detailed article” on the topic of CCS on the French-language Wikipedia. As the timeline in Figure 23shows, this page has similar dynamics that the page on carbon sequestration, but a lower number of views, especially in the last two years. Since this page is the one specifically about CCS in the French-language Wikipedia, we will consider its content in our subsequent analysis.

[6] See list here: https://pageviews.wmcloud.org/langviews/?project=en.wikipedia.org&platform=all-access&agent=user&start=2022-02-25&end=2022-03-17&sort=views&direction=1&view=list&page=Carbon%20capture%20and%20storage

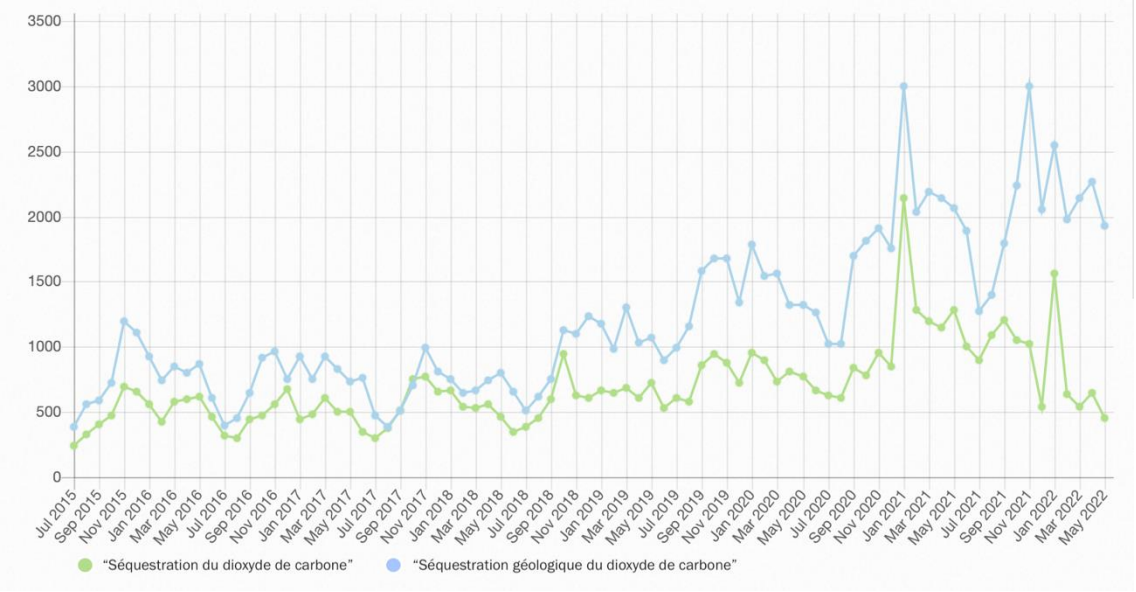

Figure 23. Views timeline 2015-2022 French-language pages "Séquestration du dioxyde de carbone" and "Séquestration géologique du dioxyde de carbone".

Note: Data from July 2015 to May 2022. Extracted from: https://pageviews.wmcloud.org/?project=fr.wikipedia.org&platform=all-access&agent=user&redirects=0&range=all-time&pages=S%C3%A9questration_du_dioxyde_de_carbone|S%C3%A9questration_g%C3%A9ologique_du_dioxyde_de_carbone

4.3.2. Carbon Capture and Storage Wikipedia page creation

The CCS page in English was created in 2006 and on the 25th of March 2022 it had been edited 2,456 times (Table 6). The page in French was also created in 2006 and had 458 total edits[7]. The page in Spanish was created in 2008 and had 104 edits. The page in Portuguese was created some years later, in 2012, and has had only 30 edits in total.

The number of total contributors to the page content is also very different. The page in English has been edited (minor and major edits) by 1,018 contributors, the one in French by 174, the one in Spanish by 67, and the one in Portuguese by 25. The average time between edits is 2.4 days on the page in English, 12.4 on the page in French, 46.6 days on the page in Spanish, and, finally, 86.4 days on the page in Portuguese. In the last year, the page in English was edited 271 times, the page in French 20, the one in Spanish was edited twice, and the one in Portuguese only once. This data illustrates the differences in the dynamics of the pages in the different Wikipedia projects.

Table 6. CCS pages in Wikipedia: creation and edits

	Year of creation	Contributors	Total edits	Average time between edits (days)	Edits last year
EN	2006	1018	456	2.4	271
FR	2006	174	458	12.4	20

[7] It is interesting to note that the page general on carbon sequestration was created in 2007 after the page on CCS. The "detailed article" on CCS also had more total edits that the main page on carbon sequestration (458 vs 322).

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ES	2008	67	104	46.6	2
PT	2012	8	30	86.4	1

Data retrieved from XTools (https://xtools.wmflabs.org/articleinfo) on 29/03/22

In terms of who added the information to the page, it is relevant to notice that according to XTools 92.2% of the Spanish page was created in 2009 by one user (who in 2019 was expelled from editing Wikipedia)[8]. Most of this content, however, was never visible to the viewer. In fact, in a revision in November 2009, this user transferred a large volume of information from the English-language page to the editing interface of the Spanish-language page, but only edited and translated a small fraction of it. The rest of the non-translated content was never published, remaining on the editing interface for several years, only to be later deleted by another user in 2018. So, although the data from XTools shows a large increase in its content in 2009 and an abrupt decrease in 2018, for the public it maintained a relatively constant size over the years (Figure 24).

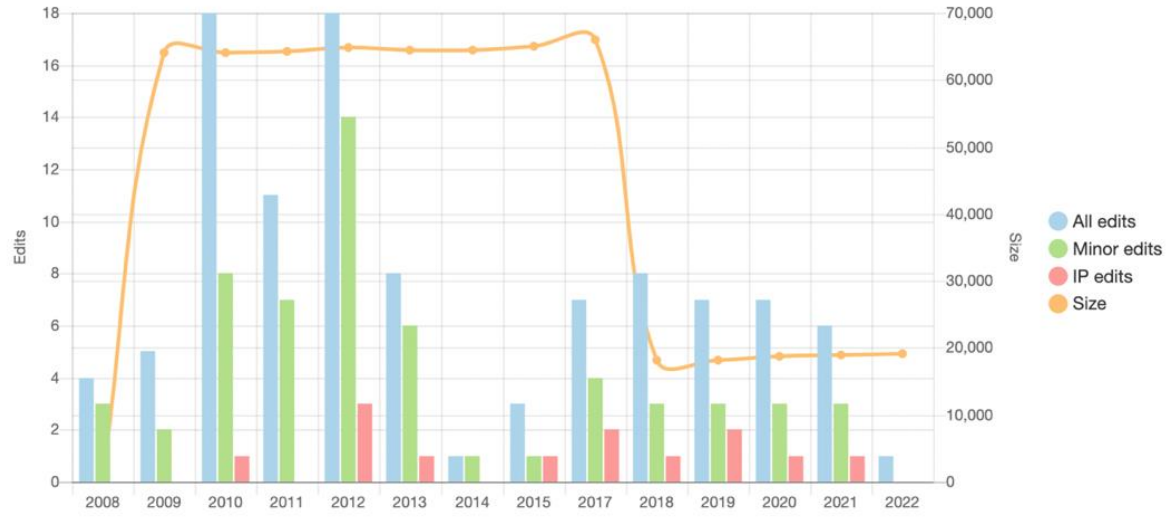

Figure 24. Spanish-language CCS page by year counts (2008-2022)

Extracted on 25/03/22 from:
https://xtools.wmflabs.org/articleinfo/es.wikipedia.org/Captura%20y%20almacenamiento%20de%20carbono

The Portuguese-language page has very little content, and 32.9% of the page content was created by a Brazilian user who on her page states she is doing a Ph.D. on CCS in Bacia de Santos (Brazil). The page in English has had many editors, and many of them indicate having a particular interest in climate change and renewable energy (they are members of several environmental-related Wiki initiatives, such as the "WikiProject Climate change", or the Wiki "Portal: Renewable energy"). The page in French is similar. It had several editors, many of whom indicate interest or connections to the environmental field in their personal pages.

A timeline of all the edits (by year count) shows that the page in English is the most dynamic, having been mostly edited in the years 2008-2011 and 2019-2021 (Figure 25). The page in French has had

[8] See revision from 29 November 2009: https://es.wikipedia.org/w/index.php?diff=31836998&oldid=30836073&title=Captura_y_almacenamiento_de_carbono. And revison from 2018: https://es.wikipedia.org/w/index.php?title=Captura_y_almacenamiento_de_carbono&diff=105612078&oldid=105604665

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continuous growth over the years in terms of size but it seems more stabilized in terms of the number of edits (Figure 3.8).9 The page in Spanish seems to have had some initial dynamic in terms of content (2010-2012) but is currently smaller in size and it seems more stagnant (Figure 26)10. The Portuguese-language page is smaller, in all aspects (Figure 27).

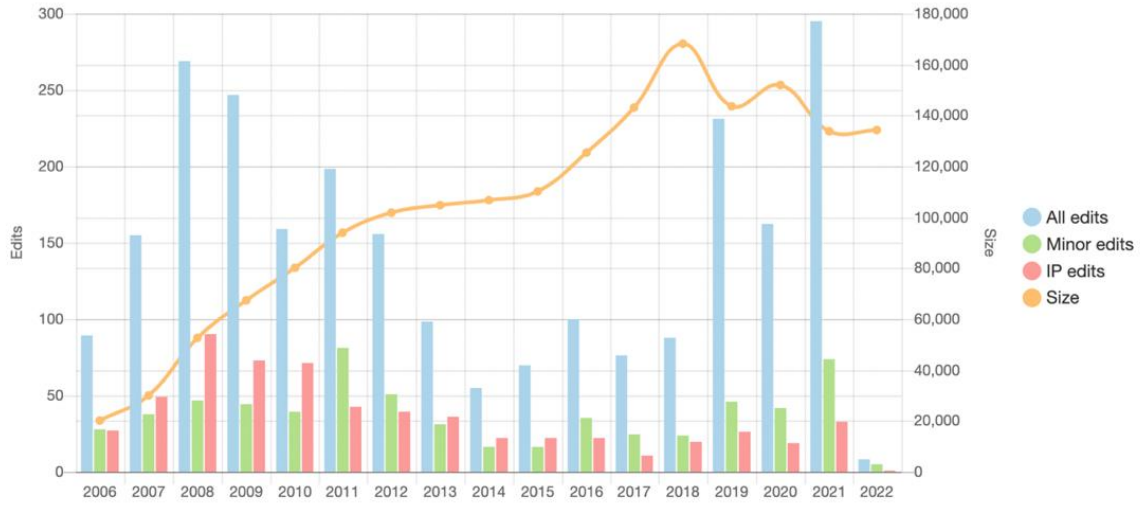

Figure 25. English-language CCS page by year counts (2006-2022)

Extracted on 27/3/22 from:
https://xtools.wmflabs.org/articleinfo/en.wikipedia.org/Carbon%20capture%20and%20storage

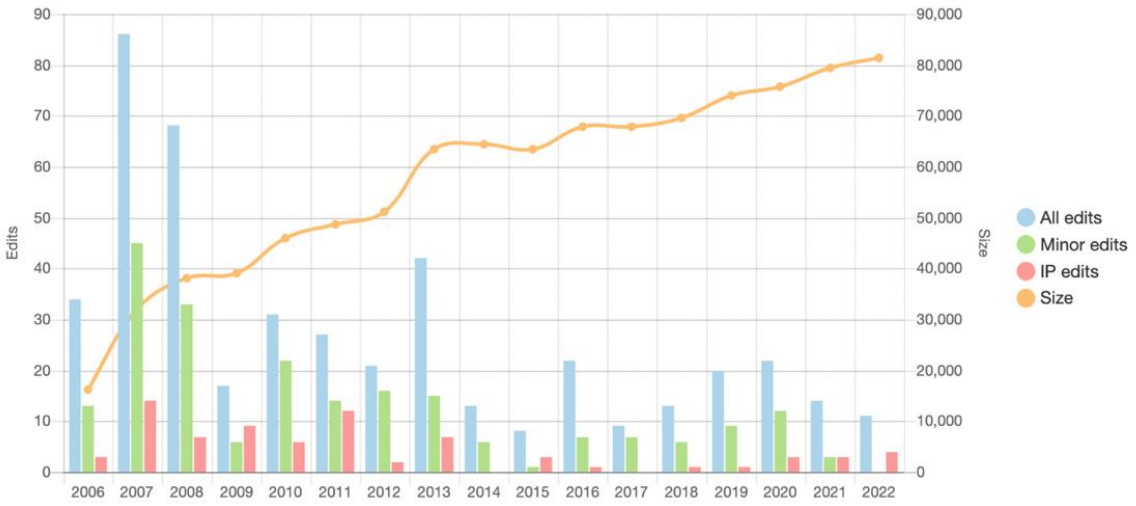

Figure 26. French-language CCS page by year counts (2006-2022)

[9] The page has a very clear structure that would explain the continuous growth despite a lower number of edits in the last years.

[10] The data added in 2009 to the page in Spanish seems to have been copied from the English page and most of it was never translated and was never visible to the public. This content in English that was subsequentially deleted in 2018.

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Extracted on 12/6/22 from:
https://xtools.wmflabs.org/articleinfo/fr.wikipedia.org/S%C3%A9questration%20g%C3%A9ologique%20du%20dioxyde%20de%20carbone#general-stats

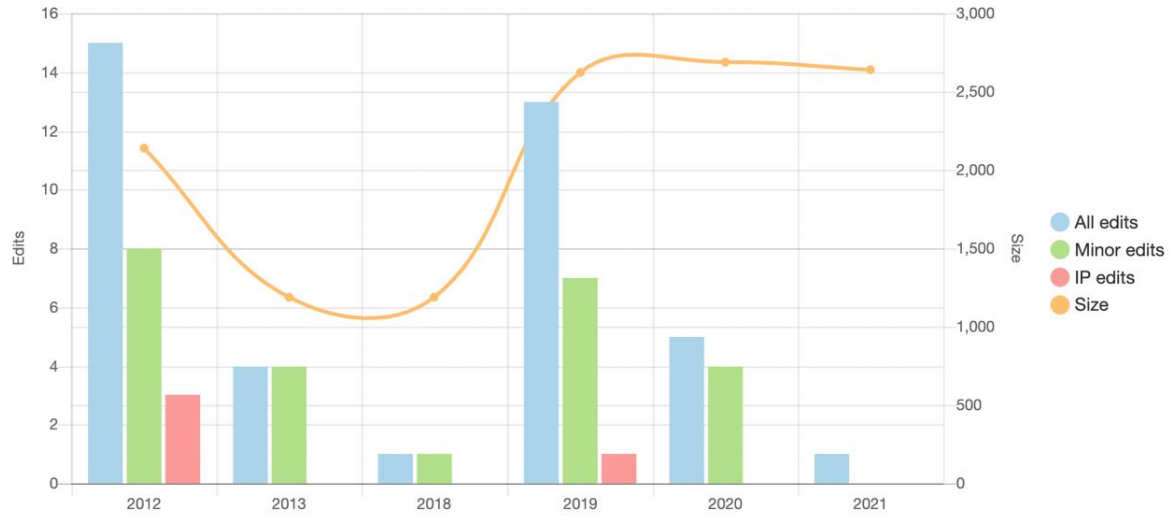

Figure 27. Portuguese-language CCS page by year counts (2012-2021)

Extracted on 25/03/22 from:
https://xtools.wmflabs.org/articleinfo/pt.wikipedia.org/Captura_e_armazenamento_de_carbono

4.3.3. Carbon Capture and Storage Wikipedia pages content

Differences between the pages are also reflected in their content, both in terms of size, structure, and type of content.

As we can see in Table 7, the English-language page is the largest, with 7,906 words. It also has more sections[11] (69) and more unique references[12] (54). The page in French has 4,902 words, 37 sections, and 70 unique references. The page in Spanish is smaller (796 words), and it has currently 8 sections. The page in Portuguese only has one section.

The page in English is mentioned (linked by) in 1,179 other Wiki pages, the page in French on other 101 Wiki pages, the page in Spanish on 70 wiki pages, and the CCS page in Portuguese are mentioned in only 8 other pages of the Portuguese-language Wikipedia. These differences indicate how the topic of CCS is mentioned in the different pages of the Wikipedia projects overall, but mostly reflects the dimensions of the Wiki projects themselves.

Table 7. CCS pages in Wikipedia: size and links

	Words	Sections	Unique References	Links to this page in in Wikipedia	Links from this page
EN	7,906	69	220	1,179	311
FR	4,902	37	70	101	200

[11] Wiki pages' structure tend to vary and have different presentations, and sections and references are not always comparable. The numbers presented were extracted from Xtools and reflect its criteria for what is considered a section.
[12] The numbers presented were extracted from Xtools and reflect its criteria for what is considered a reference. Reference presentation on the pages might differs.

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ES	796	8	4	70	52
PT	284	1	1	8	13

Data retrieved from XTools (https://xtools.wmflabs.org/articleinfo) on 29/03/22

It is also relevant to notice that the English page links at the beginning to other pages related to this topic. In particular one on "carbon sequestration", created in 2002[13] and one on "Carbon dioxide removal", created in 2009[14]. These pages are smaller and more technical than the one on CCS.

The page in English is quite long and includes several sections on capture, transport, sequestration, cost, environmental effects, leakage, monitoring, carbon capture and utilization (CCU), social acceptance and political debate.

The French-language page on CCS also links at the beginning to the "more general article" on Carbon Dioxide Sequestration, making explicit the connection between the two pages.

The CCS page from the French-language Wikipedia is also very detailed and includes 37 very structured sections. This includes sections 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, projects (European, North American and other projects and pilots in development), prospective, costs (again)

The page in Spanish is shorter with a fragmented introduction. It includes sections on CO2 capture, environmental effects, and criticism. The overall tone of the page, although mixed, is rather negative.

The page in Portuguese is very short and it only has one section with a brief explanation of the technology and its relation to climate change mitigation. It has no content box (Figure 28).

[13] https://en.wikipedia.org/wiki/Carbon_sequestration
[14] https://en.wikipedia.org/wiki/Carbon_dioxide_removal

Contents [hide]

1 Capture
- 1.1 Separation technologies

2 Transport
3 Sequestration (storage)
- 3.1 Geological storage
- 3.2 Algae/bacteria
- 3.3 Mineral storage

4 Cost
- 4.1 Business models

5 Environmental effects
- 5.1 Alkaline solvents
- 5.2 Gas-fired power plants
- 5.3 Coal-fired power plants

6 Leakage
- 6.1 Long-term retention
- 6.2 Sudden leakage hazards

7 Monitoring
- 7.1 Subsurface
- 7.2 Tracer
- 7.3 Surface

8 Carbon capture and utilization (CCU)
9 Social acceptance
- 9.1 Environmental justice

10 Political debate
- 10.1 Carbon emission status-quo
- 10.2 Environmental NGOs

11 Example projects
12 See also
13 References
14 Further reading
15 External links

Sommaire [masquer]

1 Enjeux
2 Principes de la séquestration
- 2.1 Captage du CO_2
- 2.2 Transport
- 2.3 Stockage

3 Coûts
4 Limites et risques
- 4.1 Limites
- 4.2 Risques
  - 4.2.1 Risques de fuites

5 Critiques
6 Aspects juridiques et de normalisation
- 6.1 En Europe
- 6.2 En France

7 Acteurs de la recherche et du développement
8 Sites opérationnels
- 8.1 Sleipner, Norvège
- 8.2 Weyburn, Saskatchewan, Canada
- 8.3 In Salah, Algérie
- 8.4 Snøhvit, Norvège
- 8.5 K12b, Pays-Bas
- 8.6 Blue Lake, Colorado, États-Unis
- 8.7 Zama, Canada
- 8.8 Al Reyadah, Abou Dabi
- 8.9 The Orca, Climeworks, Islande

9 Projets
- 9.1 Projets européens
- 9.2 Projets nord-américains
- 9.3 Autres projets

10 Prospective
11 Coûts
12 Conclusion
13 Notes et références
14 Voir aussi
- 14.1 Articles connexes
- 14.2 Liens externes
- 14.3 Bibliographie

Índice [ocultar]

1 Captura de CO_2
- 1.1 Fugas

2 Efectos ambientales
3 Críticas a la CAC
4 Véase también
5 Referencias
6 Bibliografía
7 Enlaces externos

Figure 28. Content boxes of Wikipedia CCS pages in English, French and Spanish (left to right).

Source: Wikipedia CCS pages. Extracted on 24/06/2022.

Table 8. Thematic sections or sub-sections of CCS Wikipedia pages in English, French, Spanish and Portuguese

	EN	FR	ES	PT
General introduction	X	X	X	X
Technical aspects of capture	X	X	X	
Technical aspects of transport	X	X		
Technical aspects of storage	X	X		
Costs	X	X		
Environmental effects	X		X	
Leaks	X		X	
Risks/Limits		X		
Monitoring	X			
Carbon Capture and Use (CCU)	X			
Social acceptance	X			
Political debate/criticism	X	X	X	
Legal and standardization aspects		X		

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Research and development actors		X
Projects	X[15]	X
Projects in development		X
Future prospective		X

If we compare the page in French with the one in English in terms of content structure, two differences stand out. The first is the section on legal and standardization aspects of CCS. This section is quite detailed and documented on the French-language page and includes technical and legal information on regulations about the issue in Europe as well in France. This topic is non-existent on the English-language page. The second is the section on research and development actors that on the French page links to some of the main public institutes and research centres working in the field both in France and French-speaking countries, English-speaking countries, and Switzerland.

4.3.4. Carbon Capture and Storage Wikipedia pages content

Introductions on Wikipedia pages are important not only because they often offer a general synthesis about the topic, but also because it is this text that Google often extracts and displays on the first results page of a specific search. When we look at the four pages, our analysis shows differences in how CCS technology is introduced to the readers.

The introduction of the page in English offers a general overview of the topic. It includes the definition of CCS, its aims, its relation to CCUS, its costs, references to different capture technologies, information about how many global CO2 emissions are captured by CCS in 2020, different types of geological formations used on CCS, information about US National Energy Technology Laboratory (NETL) report on North America storage capacity; and a brief mention of the (low) risk of leaks to the atmosphere. It ends by mentioning opponents' criticism that CCS is used as an excuse for indefinite fossil fuel usage, and the failed sequestration FutureGen program, that resulted from a partnership between the US federal government and coal energy production companies to produce carbon-free electricity from coal.

The page in French is much more technical. It introduces the technology by explaining that geological sequestration, also called carbon dioxide storage or containment, is a still-experimental process of carbon dioxide capture and storage, whose goal is to limit the acidification of the environment and the mitigation of climate change. It explains that the gas captured is not 100% carbon, since it contains up to 10% of other gases. According to the page, this is relevant because some of these gases can react with the rock in the reservoir, affecting its properties (porosity, rheology) during storage. The introduction ends with reference to the fact that CCS is the subject of a growing number of international projects with support from different countries and oil groups.

The CCS page introduction in the Spanish-language Wikipedia is more fragmented. It starts by explaining that CCS is a technique for removing carbon dioxide from the atmosphere or preventing it from reaching the atmosphere, through its capture and transportation to a geological storage site to isolate it from the atmosphere in the long term. It mentions the high cost of the chemical process of carbon capture and the fact that the process itself probably involves the emission of CO2, also indicating that the storage would only slow down the release of CO2 since this gas cannot be stored

[15] The page still has a section on projects witch content was moved to another page in June 2022.

indefinitely. The introduction then refers to two CCS initiatives in Europe, technical information on the potential of CO2 reduction emission, the IPCC estimates for the potential economics of CCS, and the increase in the fuel requirements of a coal-fired power plant with CCS. It also explains the use of deep geological formations in CCS, the risk of ocean acidification in the case of deep ocean storage and mentions a report of the National Energy Technology Laboratory (USA) from 2007. It then reiterates that long-term predictions on CCS storage are very difficult and uncertain, and the risk of leakage to the atmosphere. It ends with two paragraphs on Capturing carbon from biomass.

The CCS page in Portuguese consists only of the introduction section and has an overall positive tone. This section includes information on what is CCS, explaining that it aims to capture and store CO2 in deep geological formations "thus ensuring more effective storage of this greenhouse gas without harmful consequences for the environment." ("Captura e armazenamento de carbono", 2022, §1). It then refers that CCS has gained attention as international interest in climate change has grown, mentioning the relevance given by the IPCC reports to CCS to achieve the targets proposed in the Paris Agreement. It then ends by explaining the stages of CCS: the three main types of CO2 capture technologies; transportation by pipelines or ship; and the different types of geological formations suitable for CCS.

The four pages thus make a relatively diverse introduction to the topic, being broader (and US-centric) in the case of the English language Wikipedia, more technical in the case of the French language Wikipedia, more fragmented and critical in the Spanish language Wikipedia, and finally shorter and more positive in the Portuguese-language version.

It is also worth mentioning that although the four pages make the connection between the technology and its environmental benefits in the introduction, they do it in different ways. The English page, for example, indicates that "The aim is to prevent the release of CO2 from heavy industry with the intent of mitigating the effects of climate change." (Carbon capture and storage, 2022, §1). The page in French, as we have seen, includes a long paragraph explaining that the aim of carbon sequestration is "to limit the contribution of this gas to the acidification of the environment and to climate change, of which it is one of the causes" ("Séquestration géologique du dioxyde de carbone", 2022, §1). The page in Spanish is the only one that does not make any explicit reference to climate change, indicating in general terms that CCS's aim is to prevent CO2 from reaching the atmosphere. The page in Portuguese adds contextual information on CCS, explaining that its development is connected to the international concerns around climate change.

4.3.5. Images

The English, Spanish and Portuguese language pages also include images to explain, illustrate and contextualize CCS technology. These images are important because they not only frame the technology on the page, but they also tend to be promoted by Google on its first results page when searching for CCS.[16]

The CCS page in English Wikipedia has three images. The first one, in the introduction, is a chart with data referring to "Global proposed vs. implemented annual CO2 sequestration" created by a Wiki

[16] See next chapter.

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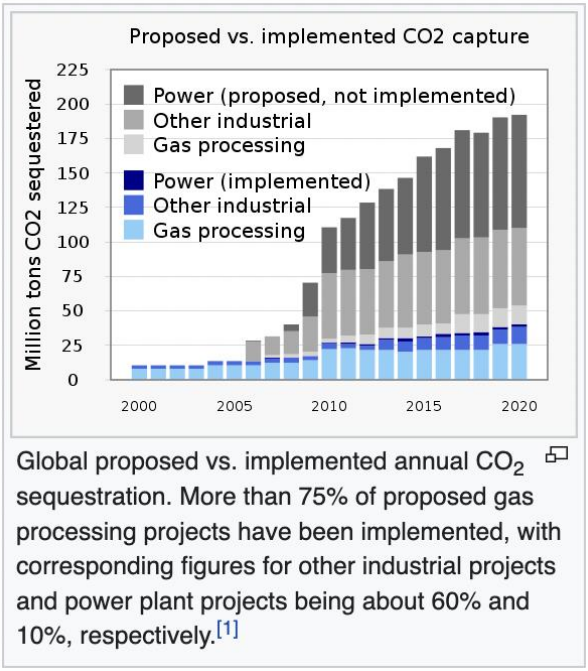
user based on an academic article about successful and failed investments in CCS in the USA (Figure 29).



Global proposed vs. implemented annual CO_2 sequestration. More than 75% of proposed gas processing projects have been implemented, with corresponding figures for other industrial projects and power plant projects being about 60% and 10%, respectively.[1]

Figure 29. Chart used on the English-language CCS page illustrating the Global proposed vs. implemented annual CO_2 sequestration

Source: Chart created on 13 April 2021 by a Wiki user based on data from Abdulla, Ahmed; Hanna, Ryan; Schell, Kristen R.; Babacan, Oytun; et al., (29 December 2021). "Explaining successful and failed investments in U.S. carbon capture and storage using empirical and expert assessments". Environmental Research Letters, 16 (1): 014036. Link: https://commons.wikimedia.org/wiki/File:20210413_Carbon_capture_and_storage_-_CCS_-_proposed_vs_implemented.svg

The second image is a figure illustrating the "Comparison between sequestration and utilization of captured carbon dioxide", also created by a Wikipedia user (Figure 30).

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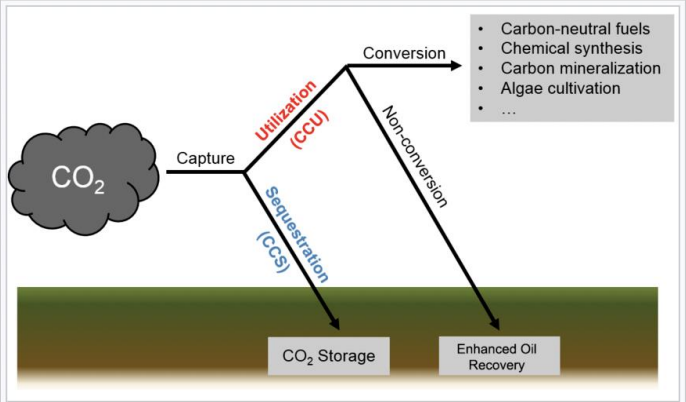

Figure 30. Diagram used on the English-language CCS page illustrating the difference between sequestration and utilization of captured carbon dioxide

Source: Diagram created on 7 December 2018 by a Wiki user.
Link: https://commons.wikimedia.org/wiki/File:CCU_vs_CCS.png

The last image is a photo of a NET Power Facility in Texas, used in the section with examples of CCS projects.

The page in Spanish includes two images. The first one is a schematic representation of different ways to store carbon dioxide (Figure 31). This image is used and translated into several pages on Wikipedia pages on CCS and related topics[17]. This is the case of the Portuguese-language page ("Captura e armazenamento de carbono", 2022), as well as the main French-language page on carbon sequestration ("Séquestration du dioxyde de carbone", 2022). It is interesting to notice that although the French, Spanish, and Portuguese pages use the same image, Wikipedia content creators felt the need to use different captions. In the Spanish one the image is described as a "Schematic of terrestrial and geological capture of carbon dioxide emissions from a coal-fired power plant" (Captura y almacenamiento de carbono, 2022). On the French-language page, as a "Schematic representation of some ways to store carbon dioxide" ("Séquestration du dioxyde de carbone", 2022). And in the Portuguese-language page as a "Schematic representing carbon sequestration in an underground geological formation from a coal plant. We can see in the picture that instead of all CO2 going to the atmosphere, some is stored in this underground formation" ("Captura e armazenamento de carbono", 2022). The captions are not very dissimilar in meaning but the differences illustrate the way content is reused and reinterpreted by Wikipedia editors in the different Wikipedia pages and projects.

[17] See: https://commons.wikimedia.org/wiki/File:Carbon_sequestration-2009-10-07.svg

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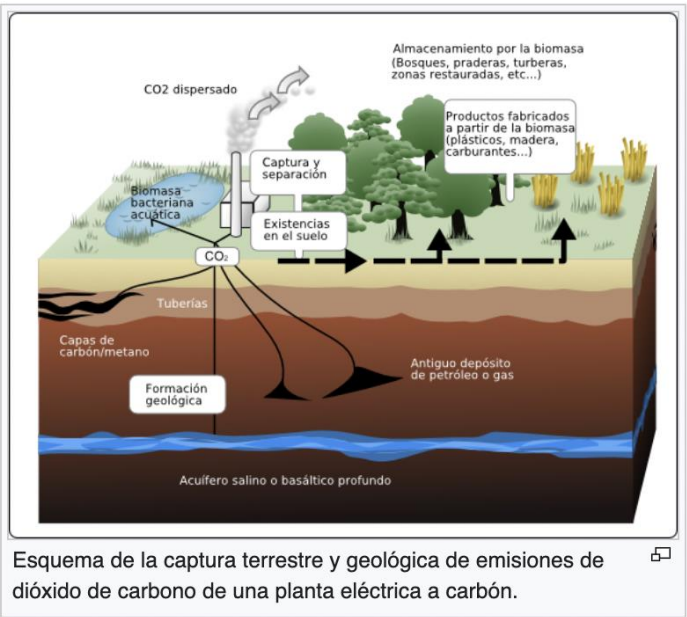

Esquema de la captura terrestre y geológica de emisiones de dióxido de carbono de una planta eléctrica a carbón.

Figure 31. Image used in the Spanish-language CCS page illustrating both terrestrial and geological sequestration of carbon dioxide emissions from a coal-fired plant

Source: Image created in 2009 by LeJean Hardin and Jamie Payne. License: CC BY-SA 3.0. https://commons.wikimedia.org/wiki/File:Carbon_sequestration-2009-10-07.svg

The second image on the Spanish-language page one is a little bit perplexing. It is an image of a cow suffocated by natural CO2 leakage in 1986 in Lake Nyos, Cameroon (Figure 32). This image is used on several Wikipedia pages about this tragedy, or on pages about volcanoes (Italian Wikipedia) but it is only used in connection to CCS in the Spanish-language Wikipedia. The image appears under the subsection “leaks”, but there is no other information on the topic of leaks. A search in the page history shows that the inclusion of the image in 2009 and subsequent upkeep on the page probably resulted from a flawed initial translation process of the English-language page and a deficient review of the page in Spanish over time.[18]

[18] The cow image was imported from the English-language page in 29 november 2009: https://es.wikipedia.org/w/index.php?diff=31836998&oldid=30836073&title=Captura_y_almacenamiento_de_carbono. It is possible to see that much on the English content on leaks was added to the page editing interface but never become visible for the viewer. This content in English was later deleted by another user in 2018: https://es.wikipedia.org/w/index.php?title=Captura_y_almacenamiento_de_carbono&diff=105612078&oldid=105604665. The Cow image was added to the English page in 17 June 2009 and substituted with a picture of lake Nyos in 5 October 2011.

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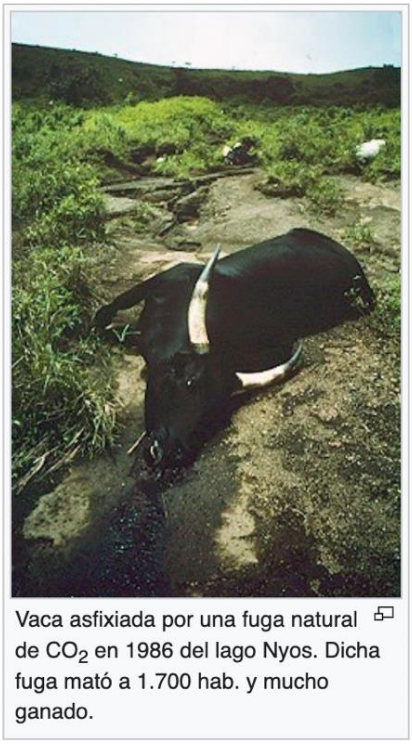

Figure 32. Image used in the Spanish-language CCS page illustrating a cow suffocated by natural CO_2 leakage in lake Nyos.

Source: Photo by Jack Lockwood of the US Geological Survey. Uploaded to Wikipedia in 2007. License: public domain. https://es.wikipedia.org/wiki/Captura_y_almacenamiento_de_carbono#/media/Archivo:Cow_killed_by_Lake_Nyos_gasses.jpg

The page in Portuguese only has one image: the translation of the image also used in the French and Spanish-language pages to illustrate different ways to store carbon dioxide (Figure 3.13). The French-language page on CCS has no images. However, as we have mentioned above, the page on carbon sequestration ("Séquestration du dioxyde de carbone", 2022) includes a translation of the image used in the CCS pages in Portuguese and Spanish (Figure 3.13).

4.3.6. Technical aspects: capture, transport, storage, costs, regulation

The English, French, and Spanish-language CCS pages on Wikipedia also include sections on different technical aspects of the technology, including information on cost, the different stages of CCS (carbon capture, transport, and storage), monitoring (EN), and regulation (FR).

The English-language one highlights the significance of costs for CCS development. In particular, it explains that CCS technology uses a significant proportion of the energy produced by a power station, increasing the costs of energy from a power plant with CCS by 30–60% (Carbon capture and storage, 2022, "Costs", §1). The section also includes possible business models for industrial carbon capture and explains that "Governments have provided various types of funding for CCS demonstration projects, including tax credits, allocations and grants" (Carbon capture and storage, 2022, "Costs", §6)

The French-language page has two sections on costs, the first including general information on the costs associated to CCS - "compris entre 50 et 180 €/t, dont la moitié est liée au captage du CO2" ("Séquestration géologique du dioxyde de carbone", 2022, "Coûts (I)", § 1) and a reference to the

higher price of the direct capture of CO2 from the air. The second section on costs includes more information on what processes incur cost on CCS – "They include the costs of collection and filtration, compression, transport, injection, as well as the costs of digging ad hoc cavities and the necessary monitoring and safety measures" ("Séquestration géologique du dioxyde de carbone", 2022, "Coûts (II)", § 1) - as well as ways to offset costs through the valorisation of recovered carbon.

The page in Spanish mentions the increase in the cost of energy to power plants with CCS, and it includes a table with "Estimated energy costs with and without CCS". The table is completely decontextualized on the page, and it is based on an IPCC report from 2005. The page in Portuguese has no information on costs.

In relation to the different stages of the CCS process, the pages include significant information. The page in English includes information on capture indicating that Capturing CO2 is most cost-effective at point sources (large carbon-based energy facilities, industries with major CO2, natural gas processing, synthetic fuel plants, and fossil fuel-based hydrogen production plants). It also has technical information on three different existent technologies: post-combustion, pre-combustion, and oxyfuel combustion. On transportation, the page mentions the possibility of using pipelines or ships and includes information on pipeline use in the USA and Norway, as well as pipeline use expiration in the UK. On the topic of sequestration, the page mentions different technologies: geological storage (injection of CO2 in underground geological formations), algae/bacteria, and mineral storage. In the case of geological storage, it includes information on the advantage of using saline aquifers: "their large potential storage volume and their ubiquity". However, it also states that its major disadvantage is that little is known about them. "To keep the cost of storage acceptable, geophysical exploration may be limited, resulting in larger uncertainty about the aquifer structure. Unlike storage in oil fields or coal beds, no side product offsets the storage cost." (Carbon capture and storage 2022, "Geological Storage", §3).

The page in French also has a section on "Principles of sequestration" that includes information on CO2 capture, transport, and storage. The section on capture highlights the cost of the technologies referring a report from 2012 from Ademe (Agence de la transition écologique) mentioning high costs and uncertain prospects for a decline. In relation to transportation, the page expands on the possibility of using pipelines or ships. In terms of storage, it includes information from IPCC on the perspective that injected CO2 could be stored for millions of years provided the necessary technologies are developed and validated. It also mentions several storage possibilities: saline aquifers, natural gas and oil deposit, methane from unmined coal seams, among others.

The page in Spanish does not have information on these topics, and the page in Portuguese, only mentions them in the introduction.

The French-language CCS Wikipedia page also has a specific section on "Legal and standardization matters". In this section, several issues related to a regulatory framework for potential geological storage of carbon are discussed, although the references are dated. The text refers, for example, that in 2012 the norms ISO for CCS were still in preparation, ("Séquestration géologique du dioxyde de carbone", 2022, "Aspects juridiques et de normalisation", § 1). It also included specific question regarding CCS that are posed by the development of technology, namely: who would be responsible

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for future damage caused by buried CO2 to humans, water, wildlife or ecosystems? Who owns the buried CO2 and is it still considered legal wastes, toxic wastes, or hazardous wastes if they are not inert? And to what extent should the state and the responsible or involved companies take precautions? ("Séquestration géologique du dioxyde de carbone", 2022, "Aspects juridiques et de normalisation", § 2-5). The section then has two specific subsections, one on European regulation and one on French regulation. It refers the directive européenne (2009/31/CE) sur la séquestration géologique, as well as the London Convention moratorium against geological disposal in underwater beds. In the subsection about France, it includes references to the Art 80 de la loi Grenelle II (2010), the decreet no. 2011-1411 du 31 October 2011, and the development of the ADEME research programme on this topic. These references, however, are old and appear not to have been updated since at least 2012.

There are no specific mentions of CCS norms and regulations on the English, Spanish and Portuguese-language pages.

4.3.7. Risks, limits, criticisms, and acceptability

The CCS pages in English, French and Spanish all include information on the risk, limits, criticism, and acceptability of the technology. In the three cases, these are referred to in different parts of the pages but are also included in specific sections on the issue.

The page in English, for example, has a paragraph in the introduction where the risk of leakage is mentioned, as well as a specific section on this issue. The information in this section focuses on perspectives on CO2 long-term retention, but also on the risk of sudden leakage hazards from CO2 pipelines.

The French-language page includes a section on limitations and another on leakages. Regarding limitations, the text mentions an Ademe report that addresses costs, the limits of storage capacity, environmental risks, as well as lack of population support. In the Risk section it refers to the risk of leakage: "a massive and sudden release of large quantities of CO2 in a valley or urban area would have immediate serious to fatal human and ecological consequences" ("Séquestration géologique du dioxyde de carbone", 2022, "Risques", § 1), as well as induced micro seismicity, and unknowns about the long-term chemical and geological behaviour and effects of geological storage. It also refers the possibility of CO2 leakage to the atmosphere and the risk of asphyxia, indicating the levels of toxicology of CO2, and mentioning a well-known CO2 natural disaster:

> "Nevertheless, natural leaks do occur, sometimes fatally, as in Lake Monoun (1984) or Lake Nyos where the sudden release of a huge CO2 "bubble" in 1986 killed more than 1700 people and thousands of animals. However, a configuration similar to Lake Nyos (meromictic crater lake) is extremely rare. There are also sealed CO2 deposits such as in Montmiral (Drôme, France) for example. ("Séquestration géologique du dioxyde de carbone", 2022, "Risques de fuites", § 1)

The CCS page in the Spanish-language Wikipedia also includes information about risks, having an overall negative tone about the technology. In addition to the leakage sub-section, illustrated with a dead cow, the page also includes a section on "Environmental Effects" and another on "criticism", that mentions significant energy demand & high cost, ocean acidification, air quality worsening (negative

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environmental effects) and the expectation that CCS could have irreversible effects for next generations.

The CCS page in Wikipedia in Portuguese is small and does not have any mention of risks (Table 9).

There is no section on the benefits of CCS, and the pages only mention it explicitly in the introduction in connection with the technology's role in mitigating the effects of climate change.

Table 9. Risks and criticism mentioned in CCS pages in English, French, Spanish and Portuguese.

	EN	FR	ES	PT
Cost, CCS is expensive	X	X	X	
Risk of CO_2 leakage to atmosphere/risks to ecology	X	X	X	
Leakages to sea/acidification/risks to sea ecology		X	X	
Human safety/health risks		X		
Environmental impacts		X	X	
Contamination of drinking water				
Visual impact				
Concerns with safety/security	X	X	X	
Problematic/unsolved final storage/no suitable geology in the country/storage sites are too remote/storage surveillance is not reliable enough/ Uncertainty about reservoir behaviour			X	
Technology still in planning stage/not used/not ready or proven		X		
Not profitable/deployable in decades	X	X		
Lessens plant efficiency/requires more energy	X	X	X	
CCS plants cannot function without public funding, government support needed				
CCS is unpredictable/more research needed about safety issues		X	X	
Raises costs of production/electricity/ energy penalty	X	X	X	
End-of-pipe solution (no solution to the problem), Lock-in (sub-optimal) of technology	X	X	X	
Threat for renewable energy/energy efficiency		X		
Continuing fossil fuel. Stimulation of fossil fuel use (indirect support for 'dirty' coal)	X			
Uncertain public acceptance	X	X		
Responsibility issues		X		
Against principle 'polluter pays'				
Spatial planning problems (well drilling)				
Seismic effects		X		
Limited potential	X	X	X	

In the section on "social acceptance", the English-language page mentions that risk and benefit perception are essential components of CCS acceptance and that people already affected by climate change, or those involved in the industry tend to be more supportive of the technology. People also trust NGOs more than stakeholders and governments on the subject. The page also mentions a study that indicates the issue of the public knowledge about the topic:

> "Few members of the public know about CCS. This can allow misconceptions that lead to less approval. No strong evidence links knowledge of CCS and public acceptance. However, one study found that communicating information about monitoring tends to have a negative

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> impact on attitudes. Conversely, approval seems to be reinforced when CCS is compared to natural phenomena. ("Carbon Capture and Storage", 2022, "Social Acceptance", § 5)

This section also includes the information that Elon Musk announced on 21 January 2021, that he was donating a $100m prize for best carbon capture technology. The section on political debate states that the topic is still divisive. Most criticisms of CCS mentioned on the English-language page are related to the idea that CCS is associated with "a shallow ecology worldview" ("Carbon Capture and Storage", 2022, "Social Acceptance", § 7). i.e., that "storage is a justification for indefinite fossil fuel usage disguised as marginal emission reductions" ("Carbon Capture and Storage", 2022, § 4). It is also referred that environmental NGOs are not in agreement regarding the CCS as a tool to fight climate change.

The CCS page in French includes the same information on the divisiveness between environmental NGOs regarding CCS. It includes two main arguments against CCS, that the financial investment in this technology could be better used on renewable energies, and that the technology itself consumes energy. It also includes the position of CCS supporters, namely that: 1) "there is no credible scenario for reducing CO2 emissions sufficiently to stabilize the climate solely on the basis of renewables and energy"; 2) "that sequestration is not a miracle solution, but can be part of a more general action including energy saving, renewables, reforestation and, a more controversial subject, the development of nuclear power; 3) "that the sites to be used can and should be chosen carefully after expert analysis of the reservoirs"; 4) "that critics forget to look at natural CO2 deposits, some of which are industrially exploited"; 5) "that coal reserves are still abundant and can provide energy independence for countries such as the US, China and India"; 6) "under the Kyōto Protocol, carbon sequestering companies would avoid taxes and be able to sell their emission rights, while being eligible for subsidies and research programmes"; 7) "that no one is able to say that the carbon that is present in the ground today as coal will not end up in the atmosphere tomorrow as CO2, thus contributing to the greenhouse effect". ("Séquestration géologique du dioxyde de carbone", 2022, "Critiques", § 6-12).

The Spanish-language page has a small section on CCS criticisms in which it states that in 2018 the European Academies' Scientific Advisory Committee ruled out carbon capture and storage as a climate change solution, stating that it cannot remove carbon dioxide from the atmosphere on the scale needed by some climate scenarios.

The English-language page also includes a separate section on monitoring that is not present on the other pages.

4.3.8. Carbon Capture and Storage location or projects

Some of the pages also include information on specific CCS projects. The page from the French-language Wikipedia has a long section on active and under development projects around the world. It also includes a specific section of projects on the European Community "currently involving only a few tens of thousands of tonnes per year and for a rather short period of time, aimed at validating the stability of geological formations and/or the technologies that can be used." ("Séquestration géologique du dioxyde de carbone", 2022, "Projets européens", § 2). Pilots under study in Europe include: Miller, United Kingdom; Ketzin, Germany; Lindach, Austria; «Casablanca » platform, Spain;

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Lacq, France (Aquitaine); Benelux ports. It also refers that more than thirty projects have been announced from 2018 to 2020, most of them in Europe, especially in the North Sea. It also mentions the announcement, in 2020, of a project led by BP, with the participation of Total Energies, Shell, Equinor and Eni, to capture carbon dioxide emitted by industries in the Teeside and Humber (UK), transport it by pipeline and store it in cavities at the bottom of the North Sea. In relation to France, the page includes information on a memorandum signed in 2021 by five industries from "Seine axe" (Air Liquide, Total Energies, Esso, Yara and Borealis) in which they commit to collectively capturing up to 3 million tons of CO2 per year by 2030 and to study the possibility of transport of CO2 to the port of Le Havre before being shipped to the North Sea.

On the English-language page, there was a section with project examples in several countries: Algeria, Australia, Canada, China, Germany, Netherlands, Norway, United Arab Emirates, United Kingdom, and the United States. The larger section is dedicated to the United States. This section however was large and on 8 June 2022 it was transferred to a stand-alone page on the subject ("List of carbon capture and storage projects", 2022).

The page in Spanish mentions two initiatives in the introduction: Weyburn (2000) and Schwarze Pumpe power plant in the district of the same name in the eastern German city of Spremberg (2008). The page in Portuguese has no mention of specific storage sites.

Neither the Spanish nor the Portuguese page mention CCS initiatives in Spain or Portugal. The French page has a specific section about projects in Europe, where it mentions at least one project in France.

In terms of information about the difference between onshore and offshore CCS technology, the English and French-language pages mention the issue very briefly. The first one refers to two geological types of carbon sequestration: the sequestration into the rocky geological foundations and the storage at the bottom of the ocean. The latter has some brief references to examples of onshore and offshore projects.

4.3.9. Actors

Only the French-language page has a specific section on CCS actors. In this section, the page lists the main actors in France and French-speaking countries - the Service géologique national (BRGM), Club CO2 Association, IFP Énergies Nouvelles, and the Direction Générale de l'Énergie et des Matières Premières (DGEMP) - , in English-speaking countries – EU project "CASTOR - CO2, from Capture to Storage", CCSA (Trade association promoting the commercial deployment of Carbon Capture, Utilisation and Storage), CO2GeoNet (not-for-profit Scientific Association on CO2 geological storage), and FutureGen - A Sequestration and Hydrogen Research Initiative[19]. It also links Climeworks, a Suisse start-up in the field of CO2 air capture.

Although the English-language page links to some actors when discussing some projects and initiatives, the information is not systematized. The page has a USA-centric perspective and many of the organisations mentioned are from this country. Both the Spanish and Portuguese-language pages are missing on these topics and have no information on national actors. It is also relevant to notice that the only organization mentioned in the four language pages is the IPCC.

[19] Many of the links to these projects are deactivated.

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4.3.10. Country comparison

Carbon Capture and Storage is represented quite dissimilarly in the four wiki projects both in terms of quantity of information and of type of information.

The English-language Wiki page is the most dynamic, largest, and most viewed. It has received a regular number of visitors throughout the years with occasional peaks. The overall text is accessible, but it is long, somewhat fragmented, and some parts are quite technical. This is probably a reflection of the greater dynamism in terms of content creation and the number of editors. It has detailed explanations on CCS, addressing issues related to capture, transport, and sequestration. The introduction is accessible and covers both technical issues, risks, and criticism. Most criticism of the technology is related to the idea that CCS is advocated because it allows for indefinite fossil fuel usage. Although it is quite USA-centric it still includes information on CCS around the world.

The French-language page, as we have seen, is also quite detailed. Some of the sections have some similarities with the English-language page, while others are completely different. It is very European-centric and includes information on the topic in France and in other European countries. It includes, for example, a section on CCS regulation in Europe and France that is completely missing from the other pages analysed. Its introduction is much more technical than the other pages and it has extensive information about CCS risks, limits, and criticism. It is also the only page that includes a conclusion. The information on the page is quite structured, however, some of the information is dated, most of the references being from 2007- 2013. This leads us to believe that although the page was well-curated in its first years, some of its sections have not been updated.[20.]

The Spanish-language page is quite fragmented and less coherent, and it has a rather negative overall tone. Its number of viewers has slightly decreased in the last few years. It seems not to have had any significant changes in the last years and its current state. Our analysis shows, however, that its fragmented content results from a flawed initial translation process of the English page and from a deficient review of the page over the last decade.

The Portuguese-language page is much more recent and smaller in terms of size and number of views. The content of the page seems not to have been imported from other pages and was mostly edited by a Wikipedia user that indicates being a CCS specialist. The text, although very short and missing important aspects of CCS, is easy to comprehend for the general public.

It is relevant to notice that these pages on CCS are among other pages related to climate mitigation and carbon sequestration in Wikipedia. Pages on these topics tend to link to each other and present similar/complementary content. The content and relation of these pages, however, differ between the different Wikis, and only a more in-depth analysis would allow characterizing overall how carbon capture is portrayed on the platform beyond this topic page.

Another thing to notice is sometimes these pages share a common history. Part of the content from the Spanish and French-language pages seems to have been translated/inspired from an older version of the English-language page. Some of the sentences and topics still have some similarities, but others have changed so much that they are no longer recognized as having the same origin. The story of the

[20] With some exceptions, like the section on “European projects”, that has more recent information.

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dead cow on the Spanish-language page is probably particularly illustrative of how content travels, moves, and changes throughout the years in different Wikipedia projects. The photo was added in June 2009 to the page in English together with the text on CO2 natural leaks referring to the tragedy of Lake Nyos, Cameroon, in which hundreds of animals and people died because of a natural CO2 leak. This text was imported to the page in Spanish in November 2009, but only the photo and its caption were translated and become visible for the readers. The photo was deleted from the English language Wikipedia in 2011 and replaced with a photo of lake Nyos. Reference to the Lake Nyos incident was completely deleted in the English text on 31 October 2021. There is still a reference to Lake Nyos in the French text but without any photo. The photo of the dead cow is still decontextualized on the CCS page of the Spanish-language Wikipedia. There was never any mention of this event on the Portuguese-language page.

Most of these content transferences are difficult to trace back and are invisible to the reader. For the reader of the page in Spanish, there is no explanation on why CCS is being connected to the death of a cow in Africa, but the presence of the photo on the page leaves the implication of this being an actual risk associated with CCS. This can have implications for the social acceptance of relatively unknown technologies like CCS. Although Wikipedia is not the only source of information available on this topic, its importance for the general public should not be underestimated, as demonstrated by the spike in the number of page views across all language projects following Elon Musk's tweet about CCS in January 2021[21]. What our analysis shows is that national interest or investment in CCS and Wikipedia local contributions and dynamics necessarily articulate the international flow of information between Wikipedia projects, making CCS pages a reflection both of cultural specificities and realities, and broader cultural, historical, and discursive mediations typical of online communicative practices (Rubira and Gil-Egui, 2017). These processes are central to understand not only the type of content but also the quality of the information available to the public about emergent technologies, like CCS.

4.4. Summary of Findings

- Carbon Capture and Storage is represented quite dissimilarly in the four wiki projects.
- The English-language one is the oldest, most complete and up to date, but is somewhat fragmented.
- The French-language one is detailed, Euro-centric, and includes some technical sections. Some sections are dated.
- The Spanish-language page is quite fragmented and less coherent, and it has a rather negative overall tone. Its current content results from a flawed initial translation process of the English page and from a deficient review of the page over the last decade. It includes a decontextualized photo of a cow suffocated by natural CO2 leakage in 1986 in Lake Nyos, Cameroon, with no explanation of its relation to CCS.
- The Portuguese-language CCS page is much more recent and smaller in terms of size and number of views.

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- The French-language page on geological CCS is indexed as a subpage of the more general page on carbon sequestration, making the page less visible for the general public.
- All four pages had a higher number of views after Elon Musk tweeted that he was going to create a prize of $100m for the best carbon capture technology in 2021.
- The images used on the pages are charts and diagrams from academic papers or created by Wiki Users. They are often translated and used in the different language-pages.
- The French-language page is the only one that mentions technical and legal information on CCS regulations.
- The English, French and Spanish-language pages include information on the CCS risks. Particularly, about the risk of leakage, induced micro-seismicity, long-term chemical and geological behaviour and effects of geological storage. The page in Spanish has a more negative tone and mentions ocean acidification, air quality worsening (negative environmental effects) and the expectation that CCS could have irreversible effects for the next generations.
- The pages in English and French also include information on criticism, and acceptability of the technology, namely that risk and benefit perception are essential components of CCS acceptance, that CCS is often associated with a shallow ecology worldview, and that environmental NGOs are not in agreement regarding the CCS as a tool to fight climate change. The French-language page also refers to the position of CCS supporters in view of this criticism.
- None of the pages have a section on the benefits of CCS, only mention it explicitly in the introduction in connection with the technology's role in mitigating the effects of climate change.
- The pages in French and English include information on several ongoing projects of CCS around the world, the French-language one having a specific section of projects on the European Community.
- The French-language page has a specific section on CCS actors in France and French-speaking countries. English-language page has a USA-centric perspective and many of the organizations mentioned on the page are from this country.
- The analysis of the four pages shows that the diversity of its content about CCS mostly results from a combination of national/regional interest in CCS and Wikipedia local dynamics and the international flow of information between Wikipedia projects.

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5. Online Media Analysis: Google search engine

5.1. Introduction & Objectives

Search engines like Google have assumed increasing importance in how people search for and access information in their daily lives. They have become a mediating infrastructure, making information available to the general public, but also shaping the condition in which this information is filtered and made visible. They are in this sense, not a neutral medium, often becoming a site of struggle for attention from different actors, and mirroring, simultaneously specific social and cultural dimensions of the content they provide (Eklöf, J., & Mager, A., 2013).

On Google, Information retrieval not associated with the content of the information (what it is about), as in traditional bibliographic information systems, but it's structured around several criteria: the user's needs, the relevance of the information judged in relation to those needs, (i.e. someone in a situation), the users' interaction with the platform and the amount of data available on which this system relies (Haider & Sundin, 2019). This affects not only how the information is selected on-page results (what links and sources are presented and how they are ranked) but how the search is orientated (auto-complete-suggestions, related questions, etc.), and how results are presented (extracting information from specific pages - websites, Wikipages - and presenting then on the result page). More and more accessing information through Google has become like accessing a database of facts "or fact-like statements" (Haider & Sundin, 2019, p. 25) where the original sources of information become more and more invisible to the users. It also means that increasingly Googles' algorithm selects content based on the user location or navigation story but also the terms the user uses to make a search.

Another issue to consider is that Google is a multisided company with economic interests, for whom users are not only the persons doing searches, but also those producing information, namely marketers, businesses, governments, and so on. All these groups are considered when defining relevance (Sundin et al., 2021). The criteria used for these processes end up having an important role in the way we access and think of scientific and technological information nowadays (Haider, 2016), especially because internet sources are increasingly used as a legitimate source of information on scientific and technological issues (Oltra et al., 2014).

It is also important noticing Google and Wikipedia significant interdependence. Not only Wikipedia pages are often promoted as the first result by Google and its content presented directly on the result pages, but Google also significantly relies on Wikipedia as criteria for search returns, becoming worse at retrieving content for many queries when it cannot surface Wikipedia content (McMahon et al., 2017).

In this section, we look at the Google search engine results when searching for CCS in three of the PilotSTRATEGY countries: France, Spain, and Portugal.

Our analysis had **two main aims**.

- To understand what kind of content the public/stakeholders would access in each country/location if looking for information on this topic.

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- to examine which sources/content are being promoted by Google in each country.

To achieve that, we wanted to provide a snapshot of the type of information people would access when searching for CCS in France, Spain, and Portugal at a specific moment, and understand if there are any significant differences in the results between the three countries. This includes analysing the list of results obtained in each country but also considers how the information is presented by Google on the page. We also wanted to understand if the keywords used to search for CCS had an impact on the type of results produced, i.e. someone searching for **CCS risks** would find results significantly different from someone searching for **CCS benefits**, for example.

5.2. Method & Sample

Our data includes the content of the first results page obtained when searching for CCS in the ~~four~~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.

Since we also wanted to understand if a different set of keywords associated with CCS would result in different results, for each country, we conducted the following four queries:

- Carbon capture and storage
- Carbon capture and storage risks
- Carbon capture and storage benefits
- Carbon capture and storage Spain OR Portugal OR France

To obtain similar data we created a template for synthesizing the results of the four queries in each country (see Annex 4). The template included two points that had to be repeated for each query. One regarding content that Google promotes directly on the results page (1) and one with a table to synthesize the content of each source in the results list (2). It also included a final one summarizing the country's results (3). Each point included several sub points:

1. Content extracted from sources and presented directly on the results by Google for each keyword combination
    i. Is Google directly presenting information extracted from other pages? (From what pages? what information is extracted?)
    ii. Is Google providing questions and answers on the topic? (What questions, what sources are used to answer the questions?)
    iii. Is Google providing alternative search terms? (What are the alternative search terms provided?)
    iv. Is Google promoting different kinds of content? (Videos, news bars, etc.)
2. Content analysis of the individual sources promoted
    i. Link (in ranking order)
    ii. Source
    iii. Type of content
    iv. Position towards CCS

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3. Sources promoted by Google on the first results page (Overview)
    i. What types of sources are being promoted? (types of sources, country, language)
    ii. Are there significant differences depending on the keywords' combination used?

The researchers conducting the queries were also asked to save the webpages on https://archive.org/, to archive a copy of the sources as it was at the time of the search.

We also considered that Google results tend to vary for each user based on their location, and navigation story, among other criteria. To avoid the results being personalized, the template included instructions on the preferred browser, and how to perform the query using an incognito window, clean browsing history and cookies.

The data was collected in the three countries during the last week of January 2022[22]. The searches were conducted in Paris, Barcelona, and Lisbon by a member of each national team ~~member~~, using www.google.fr, www.google.es, and www.google.pt, respectively. All the team members performed the queries on Google Chrome, in an incognito window, with history and cookies cleaned.

The searches were conducted in the national language of each country. In France the expression used was **capture et le stockage du carbone**, in Spain **captura de carbono y almacenamiento**, and in Portugal **captura e armazenamento de carbono**. For easier reading, we will refer to these queries in English[23] throughout the report regardless of the language in which they were executed.

Using the information on the templates, for each country and query, we compared all the elements of the 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, we ended up classifying each link in terms of source, type of actor, date it was published[24], type of content, as well as the overall evaluation of CCS. We went back to the original where necessary to clarify its origin, format and content.

We evaluated the sources' content using four classifications: Positive, when the overall position towards CCS is positive; balanced, when it includes both arguments pro and against CCS; neutral, when it does not include a specific position toward CCS; and negative, when the article has a clear critical view of CCS.[25]

We summarize the results for each country below separately. We then analyse transversal aspects of the CCS results page (information boxes, search alternatives, and advertisements). We conclude by comparing the results of the countries, identifying the main arguments in favour or against CCS, and

[22] The only exception was the query **CCS France** that was conducted on the 29th June 2022.
[23] We use the term **CCS**; **CCS benefits**; **CCS risks**, and **CCS France/Spain/Portugal**, respectively.
[24] The date of the webpage publication was found either on the document in analysis or through Google. In the case of website pages sometimes the date indicated by google refers to the last update, in other cases, the date is not available.
[25] In few cases we use more than one evaluation to classify a source when more than one criterion is met.

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highlighting important aspects of how Google affordances shape the information people access on the internet when searching for Carbon Capture and Storage.

5.3. Results

5.3.1. Google Carbon Capture and Storage search results in France

When searching for **Carbon Capture and Storage**, www.google.fr suggests several questions to the user: How to capture carbon? How to capture, store and add value to CO2? Where is CO2 stored? How does CO2 capture function?

The questions are answered with information from different sources. For example, the question "Where is CO2 stored?" is answered with a snippet from a Q&A article on CCS from the "Les Horizon: Media d'intelligence ecologique", an online media dedicated to the ecological transition and the climate. The snippet highlights different ways to store CO2 and makes the connection to the natural carbon cycle (Figure 33).

Figure 33. Snippet presented by Google to answer one of the suggested questions: "Where is CO_2 stored?"

Retrieved on 28 January 2022

When the user clicks on one of these questions to see the answer, Google tends to then suggest more questions on the topic, incentivizing the reader to continue reading on the topic directly on the Google results page. Ultimately, this means that the reader could obtain information on different aspects of CCS without having to actually click on any of the links promoted.

The results pages also include a specific section highlighting videos from YouTube (Figure 34).

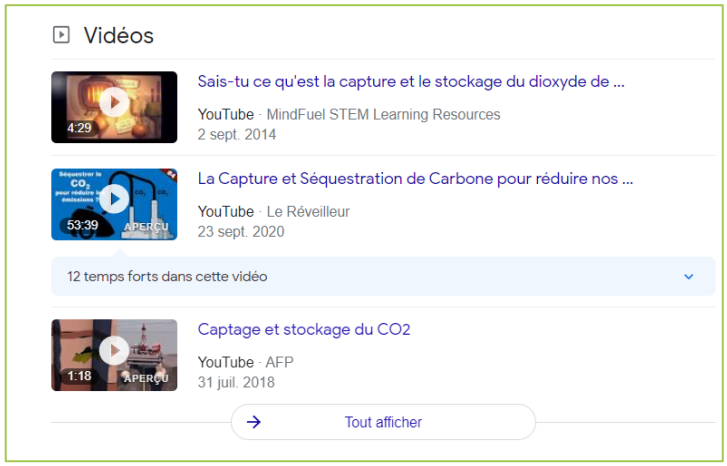

Figure 34. YouTube Videos highlighted by www.google.fr when searching for **Carbon Capture and Storage** in France

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Retrieved on 28th of January 2022

The three videos highlighted are very different one from the other. The first one is an animation film called "Do you know what carbon capture and storage is?"[26] from the MindFuel Foundation STEM initiative[27]. The short film (4m28s) is a learning resource aimed at a younger audience explaining the carbon capture and storage processes, and includes a link to an education website from Canada with games and activities.[28] The second video is from the YouTube channel Le Réveilleur, created by a science influencer. The channel focus on different aspects of the relationship between the environment, economy, and politics, and this video is part of a series about carbon. It is a long and extensively researched video (53m38s)[29] that presents a balanced view of the technology, and includes information on carbon sequestration, risks, energy transition models, existing CCS facilities; economic aspects; political aspects, CCS in Europe and France among others. The third video is a very short informative film on CCS created by the global news agency AFP using Total Energies, EDF and CO2storageslotion.com as sources.

The list of results obtained when searching for the **capture et le stockage du carbone** in www.google.fr is quite diverse (Table 10). There are two pages from private companies with extensive information on CCS, a blog post on CCS from the energy blog of Wavestone consultants, and a Q&A article on CCS from the Carbo company, specialized in web solutions for individuals and companies to manage their carbon footprint. None of the articles focus on the company services directly. The first one (presented in 1st place) focuses on the importance and urgency of the technology to fight climate change, as well as its viability. It is a long post that mentions the need for regulation and public subvention, the sensitive subject, and opposition of NGOs like Greenpeace because it considers CCS as a barrier to a more profound change to the global energy system, having also risks to soil and drinking water contamination. Since there seems to be limited development of the technology in Europe and USA, the article states that current attention is directed to China. The second one from Carbo (7th) is a long Q&A on CCS that includes information on the technical aspects of CCS, its application in the world, many investments, interest in the technology, energy efficiency, limitation of carbon emissions, circular economy, and reutilization of carbon, mitigation. It also mentions some limitations, namely its costs, uncertain reliability of geological zones, carbon leakage, and the fact that is not a carbon-neutral technology.

There are also several articles from media platforms: A Q&A article on CCS from "Les Horizon: Media d'intelligence ecologique", an online media dedicated to the ecological transition and the climate; an article from the media website "Connaissance des Énergies" a subsidiary of the Alcen industrial group (with activities in fossil fuels (oil and gas), renewables (solar) and nuclear); an article with a critical perspective on CCS from Reporterre, an independent media managed by a non-profit association dedicated to ecology. There is also a link to an informative report from ADEME (National energy agencies) on CCS from 2015, a blogpost on CCS from the website of the think-tank Open Diplomacy

[26] https://www.youtube.com/watch?v=9S0I09Y6avs&t=15s
[27] The MindFuel Foundation is a non-profit organization from Canada focused in developing and distributing online science, coding and entrepreneurial programs. See: https://mindfuel.ca/
[28] https://fr.wonderville.org/
[29] https://www.youtube.com/watch?v=AQlqQEhVi1M&list=PLhgpBc0hGjSsAg-hBEaIyZGPLC4DvKkL8&index=4

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working on the global governance of sustainability, the finally the link to the Wikipedia page on Carbon sequestration.

Overall, the information from these sources is quite detailed and covers several issues, including benefits and risks, limitations, public investment, as well as projects in development.

Table 10. Ranked list of results presented by www.google.fr when searching for **Carbon Capture and Storage** in France

	website	Source	Date	Content	Valuation
1.	energystream-wavestone.com	Private company (consultants)	2019	Blog article on CCS	Balanced
2	leshorizons.net	Media company	2021	Detailed article on CCS	Balanced
3.	ifpenergiesnouvelles.fr	Public Research institute	2022	Detailed article on CCS	Balanced
4.	connaissancedesenergies.org	Media part of industrial group Alcen	2014	Pedagogical sheet on CCS	Balanced/ positive
5.	reporterre.net	Independent environmental media	2021	Article on CCS	Negative
6.	ademe.fr	National energy agencies	2005	Informative report on CCS	Balanced
7.	hellocarbo.com	Private company (specialized on carbon footprint management)	2021	Q&A Blog post on CCS	Balanced
8.	open-diplomacy.eu	Think-tank organization (blog)	2021	Article on CCS	Balanced
9.	fr.wikipedia.org	Wikipedia page	2006	Informative text on carbon sequestration	Balanced

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Table 11. Ranked list of results presented by www.google.fr when searching for **Carbon Capture and Storage benefits** in France

	website	Source	Date	Content	Valuation
1.	leshorizons.net	Media company	2021	Detailed article on CCS	Balanced
2	cordis.europa.eu	EU research repository	2011	Article on the benefits of CCS from the EU project CO2SINK	Positive
3.	connaissancedesenergies.org	Media part of industrial group Alcen	2014	Pedagogical sheet on CCS	Balanced/ positive
4.	reporterre.net	Independent environmental media	2021	Article on CCS	Negative
5.	hellocarbo.com	Private company (carbon footprint management)	2021	Q&A Blog post on CCS	Balanced
6.	planete-energies.com	Blog of the private company TotalEnergies (energy)	2015	Collection of different articles about CCS and carbon valorization	Positive
7.	ifpenergiesnouvelles.fr	Public Research institute	2022	Detailed article on CCS	Balanced
8.	energystream-wavestone.com	Private company (consultants)	2019	Blog article on CCS	Balanced
9.	ademe.fr	National energy agencies	2005	Informative report on CCS	Balanced
10.	climate-chance.org/	Environmental Association	2019	Informative report on CCS	Balanced

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Table 12. Ranked list of results presented by www.google.fr when searching for **Carbon Capture and Storage risks** in France

	Website	Source	Date	Content	Valuation
1.	actu-environnement.com	Independent environmental media	2012	News article on CCS (behind paywall)	Negative
2	journals.openedition.org/vertigo	Academic journal	2013	Academic paper	Neutral
3.	halshs.archives-ouvertes.fr	Academic repository	2013	Academic paper	Neutral
4.	hellocarbo.com	Private company (specialized on carbon footprint management)	2021	Q&A Blog post on CCS	Balanced
5.	energystream-wavestone.com	Private company (consultants)	2019	Blog article on CCS	Balanced
6.	leshorizons.net	Media company	2021	Detailed article on CCS	Balanced
7.	erudit.org	Academic journal	2013	Academic paper	Neutral
8.	centre-cired.fr	CIRED International research center on the Environment and Development	2010	Academic report	Neutral
9.	fr.wikipedia.org	French-language Wikipedia	2006	Wikipage on carbon sequestration	Balanced
10.	sortirdunucleaire.org	Media of the environmental association Sortir du Nuclear	2009	Commentary	Negative

Retrieved on the 28th of January 2022

Table 13. Ranked list of results presented by www.google.fr when searching for **Carbon Capture and Storage France** in France

	website	Source	Date	Content	Valuation
1.	energystream-wavestone.com	Private company (consultants)	2019	Blog article on CCS	Balanced
2	leshorizons.net	Media company	2021	Detailed article on CCS	Balanced
3.	ifpenergiesnouvelles.fr	Public Research institute	2022	Detailed article on CCS	Balanced
4.	cairn.info	Academic Journal	2015	Scientific paper on political support of CCS in France	Neutral
5.	reporterre.net	Independent environmental media	2021	Article on CCS	Negative
6.	ademe.fr	National energy agencies	2005	Informative report on CCS	Balanced
7.	hellocarbo.com	Private company (specialized on carbon footprint management)	2021	Q&A Blog post on CCS	Balanced
8.	liberation.fr	Weekly legacy newspaper	2021	Detailed article	Negative
9.	connaissancedesenergies.org	Media part of industrial group Alcen	2014	Pedagogical sheet on CCS	Balanced/ positive

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The query **CCS benefits** (Table 11) obtained similar results as the more general CCS search. The only new links are an article on CORDIS, the platform that provides information on all EU-supported R&D activities, on the benefits of CCS based on the CO2SINK project, a link to a collection of different articles about CCS and carbon valorisation from the blog of the company Total Energies energy, and an Informative report on CCS from the environmental ONG Climate Change Association.

When searching for **CCS risks**, www.google.fr presents a featured snippet from the ONG Actu-environnement extracted from an article from 2012 titled "What are the risks of CO2 storage?". The snippet is not explicit on the risks, but indicates that CCS has different types of risks (Figure 35). The article itself highlights two major risks of CCS: impermeability risk of the injection wells and the presence of rifts.

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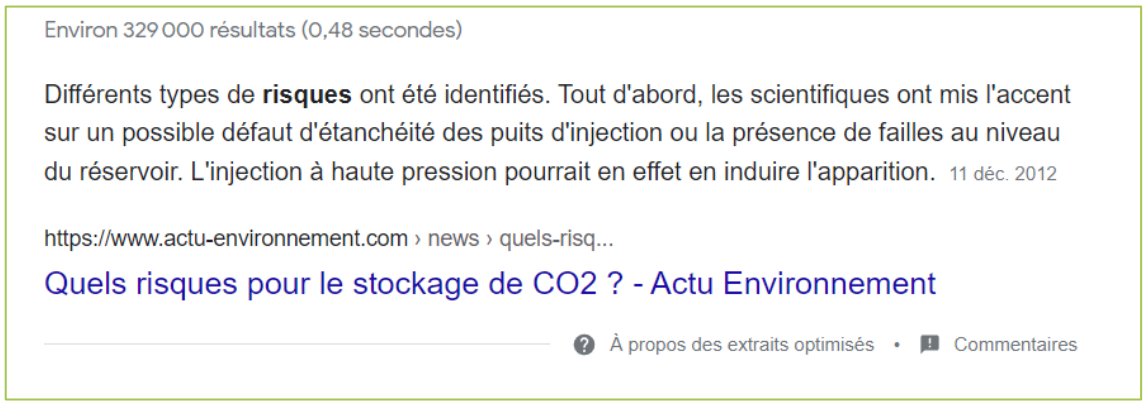

Figure 35. Featured Snippet presented by Google.fr when searching for **Carbon Capture and Storage Risks** in France

Retrieved on the 28th of January 2022

In terms of results, the list when searching for **CCS Risks** presents some differences in relation to the general search on **CCS** (Table 12). There are some repetitions, which are two pages from private companies - the Q&A article on CCS from the Carbo company specialized in web solutions for individuals and companies to manage their carbon footprint and blogpost on CCS from the energy blog of Wavestone consultants, in addition to the Q&A article on CCS from the "Les Horizon: Media d'intelligence ecologique" Wikipedia page on carbon sequestration. All these pages tend to present a balanced view on CCS, since their content includes information both on CCS benefits and risks.

There are also four links to academic sources. Three of them lead to the same academic paper: "Risque et démonstration, la politique de capture et de stockage du dioxyde de carbone (CCS) dans l'Union Europeenne" published in Vertigo, la revue életronique en science de l'environement in 2013. The article focuses on CCS risks of leakage, acidification of underground water, lack of long-term efficiency, and costs. The fourth one is the report "Captage et stockage du CO2: Risque et perception du public" focusing on the results of a survey on public perception of CCS in France in 2007, applied by CIRED - Centre International de Recherche sur l'Environnement et le Développement.

The links with the most critical view of CCS are from two environmental media projects. An article published in 2012 by Actu-Environnement, an independent news website specialized in the environment, entitled "What are the risks of CO2 storage?" mentions the risk of leakage, aquifers contamination, and environmental impact of the impurity contained in the combustion fumes (the article, however, is behind a paywall and only accessible to subscribers). There is also another article from 2009, "Is CO2 storage a solution to the greenhouse effect?" published under the section "false alternatives" by the Revue "Sortir du nucléaire" (the article is a translation of an article from L'Ecologiste magazine). This article considers that the CCS was, at the time, expensive, and inefficient, that it does not contribute to the fight against climate change and promotes dependence on fossil fuels. It also mentions risks of leakage, toxification of underground waters and seas, and impact on animals and people.

Overall, the difference between the search on CCS vs CCS risks is that in the second type of query the links have a clearer focus on risks. However, it is also relevant to notice that articles that have a balanced view on CCS can be quite different. In some cases, the negative aspects mentioned are its

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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[30].

When searching for **CCS France**[31] (Table 13) most of the results were not new and appear repeated from previous searches on CCS and CCS Risks[32]. There are only two exceptions. The academic paper "Politiques de soutien à la capture et au stockage géologique du carbone en France", identifies the public policies needed to achieve defined targets in the energy sector, and a detailed newspaper report from 2021 from le Journal Liberation, entitled "«France 2030»: capter et stocker le CO2 pour décarboner l'industrie, est-ce vraiment une bonne idée?" presenting a rather negative view on the CCS, presented as being an excuse for carbon utilization, very expensive, and with limited potential.

In total, the four queries we performed resulted in 20 different sources. There were 7 academic sources, three linking to the same academic paper. 5 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 different 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.

5.3.2. Google Carbon Capture and Storage search results in Spain

When searching for **Carbon Capture and Storage** on www.google.es, on the result page Google suggests several questions about CCS. Namely: How does carbon sequestration take place? What is carbon dioxide capture and storage? How is carbon stored? How does CO2 capture take place in plants?

These questions are answered with text snippets from very different websites: a Q&A page on CCS from Energyavm.es (a gas and electricity company from Spain); a post on CCS from Ecologistasenaccion.org (a confederation of more than 300 environmental groups from Spain); a page on "Carbon and Climate - Basic information on the major components of the carbon cycle" from Galenmckinley.github.io (the Spanish translation of an educational project on carbon cycle education led by Professor Galen A. McKinley, from Columbia University); and a post on effects on effects of

[30] Although some companies tend to focus on the first type of negative arguments of CCS, there are exceptions, and with such a small sample of articles that tend to be quite hybrid in terms of format and origin, it is not possible to make any clear connection between sources and arguments.
[31] This search was conducted on the 29th of June 2022.
[32] This contrasts with what happens in Spain and Portugal were the results for a search including the name of the country tend to be different from a general search on CCS. This mostly highlights differences in the information available on CCS in the online public sphere, with France having more information on CCS and CCS in France available.

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excess CO2 on plants from Enviraiot.es (a company in the development of solutions for monitoring environmental parameters and structural health in industrial, urban and agricultural environments).

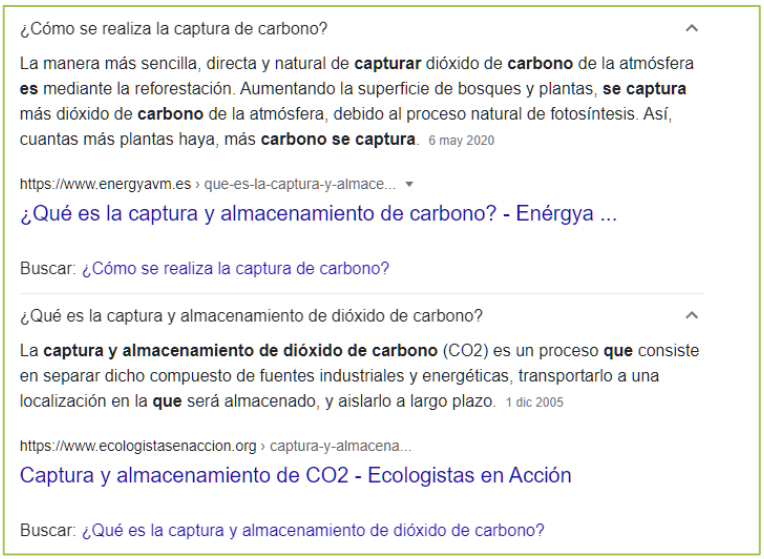

Figure 36. Example of two snippets used to answer the questions suggested by www.google.es when searching for **Carbon Capture and Storage** in Spain

Retrieved on the 29th of January 2022

The snippets are all very brief and do not give the user a complete reading of the original source. Of the four Q&A, only the second effectively links to a post on geological CCS. This is a post from 2005 with a very critical view on CCS from an environmental organization[33] that makes several criticisms of CCS, namely its impracticality; risk; big disappointment; price; and the fact that problems are often hidden. The other three are related to carbon sequestration but not necessary with geological CCS.

It is also important to notice that, as happens in the www.google.fr page results, when you click on one of the questions, Google quickly adds other questions to the list, making it possible for someone to explore different aspects of CCS technology without leaving the result page.

The list of results for **carbon capture and storage** on google.es includes pages of very different sources (Table 14). The first one is the CCS page on the Spanish-language Wikipedia, which has an overall negative tone on the technology[34]. There are also five links to pages of private companies. Some of these are companies that work in the energy and CCS field like Repsol (4th), WSP Spain (8th), or OSL Iberia (9th). There is also a link to an article on the private banking BBVA website (7º) offering a business perspective on CCS and a webpage with Q&A on CCS from the gas and electricity company Enérgya VM (2nd). Most of the companies' sources link to pages with 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 its development in Spain. When referring to negative aspects private companies mostly refer to the high costs and the need for government support.

[33] https://www.ecologistasenaccion.org/7815/captura-y-almacenamiento-de-co2/
[34] See previous chapter this report

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There are also links to the pages from ONG: the post with a reprint of a magazine article with a very negative view on CCS written by an environmentalist in 2013 from the blog of the environmental association "Ecologistas en Acción" that is presented in the second place; and the link to a page with information on CCS from project GreenFacts (5th), a non-profit that has as a mission present clear and factual summaries of complex scientific reports on health and the environment to non-specialists. The first one has a clear negative view of CCS highlighting economic impracticality; risks; from a big promise to big disappointment; the price of CO2; and the hiding of problems. The second is an information sheet with Q&A on CCS that focuses on technical aspects; its importance against climate change; the fact that it is one among many technologies of carbon emission reduction and that there are still barriers to its adoption, especially in developing countries. There is also a link to an article on CCS from a magazine specialized in climate change that was translated from the Fact-Checking project The Ferret. This article highlights CCS's impact on reducing emissions; its slow progress; the low impact of CCS; the high development costs; as well as information about CCS development in Scotland.

Table 14. Ranked list of results presented by www.google.es when searching for **Carbon Capture and Storage** in Spain

	website	Source	Date	Content	Valuation
1.	es.wikipedia.org	Spanish-language Wikipedia	2008	Wikipage on CCS	Neutral/ Negative
2	energyavm.es	Private company (energy)	N/A	Q&A on CCS	Positive
3.	ecologistasenaccion.org	Environmental NGO	2013	Repost of an opinion magazine article	Negative
4.	repsol.com	Private company (energy)	2020	Post on CCUS and the company Co2 initiatives	Positive
5.	greenfacts.org	International educational NGO	N/A	Q&A on CCS	Balanced
6.	climatica.lamarea.com	Specialized media on CC from the independent newspaper La Marea	2021	Repost of a Q&A on CCS from the Ferret fact Checking initiative (UK).	Balanced
7.	bbva.com	Private company (banking)	2020	Blog post on CCS	Positive
8.	wsp.com	Private company (consultant)	N/A	Post on CCS and the company work on the topic	Neutral/ positive
9.	osl-iberia.com	Private company (energy)	2020	Webpage on CCS and the company work on the topic	Positive
10.	blog.softtek.com	Private company in the digital field (Mexico)	2021	Blog post on CCS	Positive

Retrieved on the 29th of January 2022

Table 15. Ranked list of results presented by www.google.es when searching for **Carbon Capture and Storage Benefits** in Spain

	website	Source	Date	Content	Valuation
1.	greenfacts.org	International educational NGO	N/A	Q&A on CCS	Balanced
2	cordis.europa.eu	EU research repository	2011	Article on the benefits of CCS from the EU project CO2SINK	Positive
3.	tree-hugger8.net	Informative website about sustainability	2021	Article explaining CCS	Balanced
4.	repsol.com	Private company (energy)	2020	Post on CCUS and the company CO2 initiatives	Positive
5.	es.wikipedia.org	Spanish-language Wikipedia	2008	Wikipage on CCS	Neutral/ Negative
6.	es.wikipedia.org	Spanish language Wikipedia	2020	Wikipage on Bioenergy with CCS	Positive

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7.	ecologistasenaccion.org	Environmental NGO	2013	Repost of an opinion magazine article	Negative
8.	negociosostenible.camaravalencia.com	Chamber of commerce of Valencia	2021	Article on CCS	Positive
9.	www.climaterra.org	Website about the climate crisis	2021	Article on CCS	Balanced

Retrieved on the 29th of January 2022

Table 16. Ranked list of results presented by www.google.es when searching for **Carbon Capture and Storage Risks** in Spain

	website	Source	Date	Content	Valuation
1.	evwind.com	Online media about wind energy and electric vehicle	2010	Article analyzing a published academic study	Negative
2	foei.org	Environmental NGO	2021	Article on the Risks of bioenergy with carbon capture and storage	Negative
3.	greenfacts.org	international NGO	N/A	Q&A on CCS	Balanced
4.	ecologistasenaccion.org	Environmental NGO	2013	Repost of an opinion magazine article	Negative
5.	retema.es	Environment technical magazine	2020	Article about CCS.	Positive
6.	sisbib.unmsm.edu.pe	academic repository	2007	academic paper on CCS risk analysis	Neutral
7.	tree-hugger8.net	Informative website about sustainability	2021	Article explaining CCS	Balanced
8.	es.wikipedia.org	Spanish-language Wikipedia	2008	Wikipage on CCS	Neutral/ Negative
9.	technologyreview.es	Magazine published by the MIT	2021	Article about CCS	Negative
10.	archive.ipcc.ch	archived website of IPCC	2005	PDF on CCS Summary report for policy makers.	Balanced

Retrieved on the 29th of January 2022

Table 17. Ranked list of results presented by www.google.es when searching for **Carbon Capture and Storage Spain** in Spain

	website	Source	Date	Content	Valuation
1.	europapress.es	Europa Press Agency's news portal	2021	Article about a scientific study on the current development of CCS in Spain	Positive
2	xataka.com	Publication about gadgets and technology	2021	Article about a scientific study on the current development of CCS in Spain	Positive
3.	csic.es	Public Research Organism (OPI) News website	2021	Press release about a scientific study on the current development of CCS in Spain	Positive
4.	repsol.com	Private company (energy)	2020	Post on CCUS and the company Co2 initiatives	Positive
5.	verdeyazul.diarioinformacion.com	Environmental media	2021	Article about a scientific study on the current development of CCS in Spain	Positive
6.	elperiodicodelaenergia.com	Environment and energy media	2021	Article about the start of PilotStrategy project and the participation of Repsol.	Neutral/ Positive
7.	pteco2.es	Spanish CO2 Technology Platform	2021	Press release about a workshop on CCS in Spain with experts	Neutral

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8.	efe.com	News agency	2021	Article about a scientific study on the current development of CCS in Spain	Positive
9.	wsp.com	Private company (consultant)		post on CCS and the company work on the topic	Neutral/ positive
10.	ecologistasenaccion.org	Environmental NGO	2013	Repost of an opinion magazine article	Negative

Retrieved on the 29th of January 2022

When searching for **CCS benefits** (Table 15) the first thing Google presents is a "Featured Snippets"[35] from greenfacts.org. This is a website from a non-profit organization whose mission is to present clear and factual summaries of complex scientific reports on health and the environment to the non-specialist public. The extracted text is about the potential role of CCS in the fight against climate change and links the technology to increased energy efficiency and the use of fuels requiring less CO2 (Figure 37).

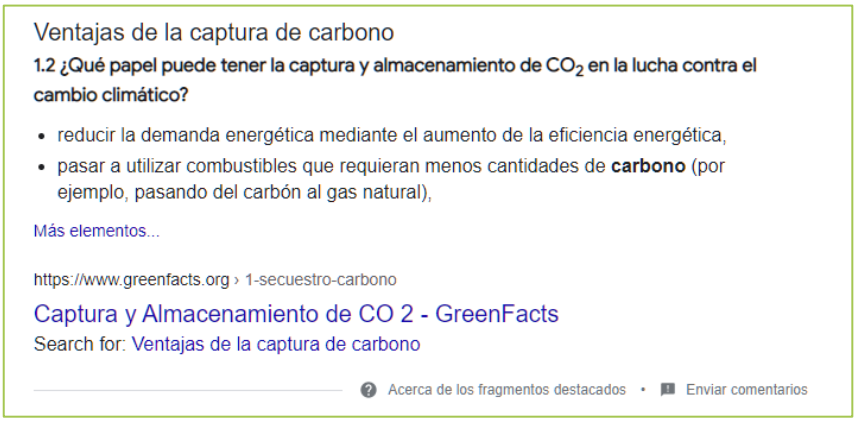

Figure 37. Snippet presented by google.es to answer one of the suggested questions: "What role can carbon capture and storage have in the fight against climate change?"

Retrieved on the 29th of January 2022

In addition to this snippet, Google also suggests other questions: How does CO2 capture and storage work? How is CO2 captured? How do we increase carbon capture? How does carbon storage occur?

The sources used to answer the questions are the environmental association Ecologistasenaccion.org, the private bank Bbva.com, and The Food and Agriculture Organization of the United Nations (FAO).

In terms of the list of results, there are some similarities with the general search on CCS, but the order is different and there are some new sources. In the second place, Google presents an article on Cordis on the benefits of CCS from the European financed CO2SINK project (present also in French searches, as seen above). This is a research project about the benefits of carbon storage through on-site demonstration and monitoring. The main focus of the project was the development and testing of monitoring techniques, accompanied by a public outreach programme. The article frames CCS as a promising technology to reduce CO2 emissions and mentions the project's work in raising public awareness of the benefits of CO2 geological storage.

[35] https://developers.google.com/search/docs/advanced/appearance/featured-snippets

There is also an article in English from the website tree-hugger with a Q&A on the pros and cons of CCS. As positive aspects, the article mentions that CCS can reduce emissions at source, that is easier to remove at one-off sources, and that CCS could reduce the social cost of carbon. As for negative aspects, it mentions the cost of CCS, that the use of CCS for oil recovery could defeat its purpose, that long-term CO2 storage capacity is uncertain, CO2 storage and transport sites can be dangerous, the risk of leakages, and that it is not easy to match sources of CO2 to storage sites. Also linked is another Wikipedia page, in this case focusing on "Bioenergía con captura y almacenamiento de carbono". Finally, there is also a page from the "Sustainable businesses – the sustainability portal of chamber of commerce of Valencia" with an article called "Capturing, storing and reusing CO2: engineering to fight climate change, highlighting its benefits for the economy and the environment.

On the other hand, when searching for **CCS Risks** another featured snippet is shown. In this case, the snippet from the post from 2010 from the REVE (Revista Eólica y del Vehículo Eléctrico) summarising a paper on CCS risk from Nature Geoscience. The article is quite critical of CCS and the snippet highlights the risk of ocean acidification (Figure 38).

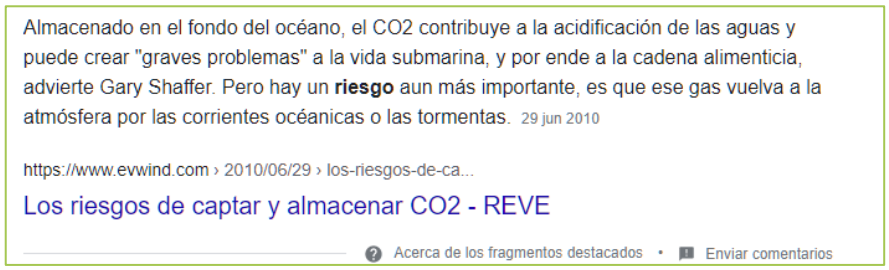

Figure 38. Featured Snippet presented by google.es when searching for **Carbon Capture and Storage Risks** in Spain

Retrieved on the 29th of January 2022

The list of sources presented by Google on the results page when searching for **CCS risks** in Spanish is different from a general search in CCS and includes several posts and articles that are quite critical of CCS (Table 16).

This is the case, for example of the article presented in second place, from the Spanish version of the website of the environmental association "Friends of the Earth International (FoEI)" highlighting the main points of their report "A Leap in the Dark: The Dangers of Bioenergy with Carbon Capture and Storage (BECCS)", that considers CCS a distraction, risky, expensive, dangerous. The posts promoted in 4th place from Ecologistas en Acción "Captura y almacenamiento del carbono: Las promesas y realidades de una tecnología puesta en solfa", highlighting the economic impracticality; risks and costs. The article presented in 9th place comes from the MIT Technical review, called "The dangerous trend of sequestering carbon instead of reducing emissions", that mentions how expensive and energy-intensive the technology is and how it could be a distraction from investing in renewable energies.

The other links present either a more balanced view on the technology (like the report on CCS from IPCC in 10th place, presenting both the risks and benefits of the technology), or they actively downplay the risks of CCS (like the article from Retema – Revista Técnica de Medio Ambiente called "CO2 capture

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and storage: why we do not need to fear leakage", that minimizes the risks of leaks and highlights the need to act.

It is relevant to notice that five of the ten links promoted by Google when searching for CCS Spain (Table 17) have similar content. They all result from a press release from CSIC (Consejo Superior de Investigaciones Científicas) about the study (conducted both by CSIC and the University of Barcelona), and they all mention the possibility that Spain could reduce their annual emissions by 21% with CCS. The actual press release is presented in 3rd place.[36]

The other links are either web pages on CCS from private companies working in the field (Repsol and WSP) or related to research on the CCS field articles. One of these articles, published by "El Periódico de la Energía" in June 2021, focuses on the Repsol participation in the European project PilotSTRATEGY, which is referred to as the first major European CO2 capture and storage project to be carried out in Spain. The last link of the results page is the post from "Ecologistas in Acción" with a reprint of a magazine article from 2013 with a critical perspective on CCS.

In total, the four queries we performed resulted in 28 different sources. Most were articles from online media (9), of which at least 5 specialized in environmental issues. 6 were websites of private companies, 5 to NGOs, and only 3 from academic sources. The sources promoted tended to be different depending on the keywords used in the queries, more than in the other 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 combination search. Among these, there are links to websites of actors like the industry (REPSOL), other private companies such as Enérgya VM, encyclopedic articles from Wikipedia, or environmental NGOs like Ecologistas en Acción, among others.

5.3.3. Google Carbon Capture and Storage search results in Portugal

When searching for CCS on google.pt, differently from what happens 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. It did present a specific section with three YouTube videos on CCS. The videos were posted by different sources, but on close inspection, it became clear that it was the same video:[37] a short film produced by the Agence France-Presse dubbed to Brazilian Portuguese.

When searching for **Carbon Capture and storage** the list of results Google promotes on the first page is relatively diverse (Table 18). It includes the Wikipedia page on CCS, private company pages, academic blogs or thesis, and UN News on the topic. Wikipedia is almost every time promoted on the first page. The private companies on the list were of two kinds: 1) companies working in the CCS field, like Veolia or Lind, or 2) eco-companies like Ecycle and Welltec that have websites with Q&A structured pages that tend to be promoted by Google when searching for specific topic or questions[38].

[36] https://www.csic.es/es/actualidad-del-csic/la-captura-y-almacenamiento-de-co2-bajo-tierra-podria-reducir-un-21-de-las

[37] https://www.youtube.com/watch?v=tnqZ9PRHGUM

[38] https://developers.google.com/search/blog/2018/12/rich-results-expands-for-question. https://letsdesignforyou.com/what-are-the-advantages-of-faq-structured-data/

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The academic sources were of different types: link to a Brazilian academic podcast where two CCS experts were interviewed; the link to a Portuguese university repository where a Master thesis on CCS is housed; and a page of a CCUS course at the Faculdade de Engenharia Mecânica (FEM) da Unicamp, Brasil.

In terms of content, all the pages have either a positive or balanced view on CCS. The first page promoted (from www.ecycle.com.br) is a Q&A page that includes the definition of CCS, as well information on its risks and benefits.

It is also worth noticing half of the sources promoted were from Brazil, including the one presented in the first place.

Table 18. Ranked list of results presented by www.google.pt when searching for **Carbon Capture and Storage** in Portugal

	Link	Source	Date	Content	Valuation
1.	ecycle.com.br	Eco-Company from Brazil	2020	Q&A article on CCS	Balanced
2.	pt.wikipedia.org	Portuguese-language Wikipedia	2012	Wikipage on CCS	Neutral
3.	veolia.pt	French Sustainable energy Company	2021	Blog post on CCS and the company´s work	Positive
4.	jornal.usp.br	Brazilian University online-newspaper	2019	Page introducing a podcast on CCS	Positive
5.	linde-gas.pt	Portuguese energy company	2012	webpage on CCS and the company's work	Positive
6.	run.unl.pt	Academic repository	2014	Portuguese Master thesis on CCS	Neutral
7.	welltec.com	energy company	2022	webpage on CCS and the company's products	Neutral/ positive
8.	hids.unicamp.br	International sustainable development HUB of a Brazilian university	2021	Blogpost on classes on CCS at the Faculdade de Engenharia Mecânica	Positive
9.	news.un.org	United Nations News website	2021	Post on a UN commission study on the urgency and the benefits of CCS	Positive

Retrieved on the 31st of January 2022

Table 19. Ranked list of results presented by www.google.pt when searching for **Carbon Capture and Storage Benefits** in Portugal

	Link	Source	Date	Content	Valuation
1.	ecycle.com.br	Eco-Company from Brazil	2020	Q&A article on CCS	Balanced
2.	veolia.pt	French Sustainable energy Company	2021	Blog post on CCS and the company´s work	Positive
3.	run.unl.pt	Academic repository	2014	Portuguese Master thesis on CCS	Neutral
4.	sustainablecarbon.com	Latin America company (emission reduction and greenhouse gas management)	2020	Blog post with information on CCS	balanced
5.	wribrasil.org.br	Brazilian research institute (private)	2019	Large article about soil carbon capture.	Not about CCS
6.	news.un.org	United Nations News website	2021	Post on a UN commission study on the urgency and the benefits of CCS	Positive

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7.	pt.wikipedia.org	Portuguese-language Wikipedia	2012	Wikipage on CCS	Neutral
8.	pantheon.ufrj.br	Repository from the Federal University of RJ (Brazil)	2013	Graduation project In CCS in Brazil	Neutral/ positive
9.	vogue.globo.com	Vogue magazine Brazil	2021	Article on CCS	Positive
10.	zurich.com.br	Insurance company (Brazilian website)	2021	Long blogpost on CCSU	Positive

Retrieved on the 31st of January 2022

Table 20. Ranked list of results presented by www.google.pt when searching for **Carbon Capture and Storage Risks** in Portugal

	Link	Source	Date	Content	Valuation
1.	ecycle.com.br	Eco-Company from Brazil	2020	Q&A article on CCS	Balanced
2.	run.unl.pt	Academic repository	2014	Portuguese Master thesis on CCS	Neutral
3.	veolia.pt	French Sustainable energy Company	2021	Blog post on CCS and the company´s work	Positive
4.	hids.unicamp.br	International sustainable development HUB of a Brazilian university	2021	Blogpost on classes on CCS at the Faculdade de Engenharia Mecânica	Positive
5.	wribrasil.org.br	Brazilian research institute (private)	2019	Large article about soil carbon capture.	Not about CCS
6.	goldenergy.pt	Sustainable energy company	2021	Short glossary entry	Balanced
7.	dgeg.gov.pt	Portuguese General Directorate of Energy and Geology	2020	Page with information on the legal framework and CCS projects in Portugal.	Neutral
8.	linde-gas.pt	Portuguese energy company	2012	webpage on CCS and the company's work	Positive
9.	pt.wikipedia.org	Portuguese-language Wikipedia	2012	Wikipage on CCS	Neutral
10.	ivar.azores.gov.pt	Azores research institute in vulcanology and risks	2016	repost of a BBC news article about CCS in Iceland	Neutral

Retrieved on the 31st of January 2022

Table 21. Ranked list of results presented by www.google.pt in when searching for **Carbon Capture and Storage Portugal** in Portugal

	Link	Source	Date	Content	Valuation
1.	dgeg.gov.pt	Portuguese General Directorate of Energy and Geology	2020	Page with information on the legal framework and CCS projects in Portugal.	Neutral
2.	icterra.pt	Research institute (Instituto de ciência da terra) University of Évora	2021	Post about the Projeto STRATEGY CCUS	Positive
3.	veolia.pt	French Sustainable energy Company	2021	Blog post on CCS and the company´s work	Positive
4.	dspace.uevora.pt	Academic repository	2015	Link to the "CCS roadmap" in Portugal	Positive
5.	linde-gas.pt	Private company energy (Portuguese website)	2012	webpage on CCS and the company's work	Positive
6.	run.unl.pt	Academic repository	2014	Portuguese Master thesis on CCS	Neutral
7.	bcsdportugal.org	Business Council for Social Sustainability Portugal	2013	Flyer on CCS from 2006	Balanced
8.	ria.ua.pt	Academic repository	2008	Master thesis on CCS application in Portugal	Neutral

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9.	ulusofona.pt	Private Portuguese university	2021	Webpage on an open course on CCS	Neutral/ positive

Retrieved on the 31st of January 2022

The main difference between the results of the search for CCS and the results of the search for **CCS benefits** and **CCS risks** is the fact that in the second case the page includes highlight snippets. In the results page for **CCS benefits**, Google extracts a snippet from the page "what is Carbon Capture and Storage?" of the Ecycle company (eco-company from Brazil) focusing on the part of the text about the aims of CCS. When searching for **CCS risks**, Google presents a snippet from the same page, but now focusing on the part of the text that mentions risks of earthquakes and leaks (Figure 39).

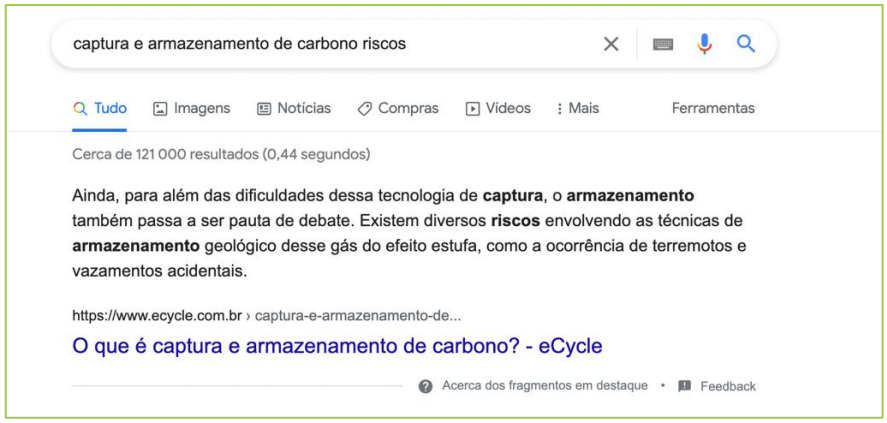

Figure 39. Fragment promoted by google.pt directly on the results page when searching for **carbon capture and storage risks**.

Retrieved on the 31st of January 2022

The list of results, however, were not significantly different from the one obtained when searching for **CCS**. When searching for **CCS benefits** many of the links in the first pages are the same, although they appeared in a different order (Table 19). The new results are all from Brazil and some are quite positive about the role of CCS, for example, the article from Vogue Brazil "Why is everyone talking about carbon capture and storage? This technology can transform and save our planet. Learn how" or the blog post from the Zurique company "How carbon capture can help large industries on the path to zero net emissions".

When searching for **CCS risks** there are also a few new entries with a neutral or balanced position on CCS (Table 20). The results did not include sources with a negative position towards the technology.

When searching for **CCS Portugal**, Google did not promote any specific question and answer on the page. The list of results includes several of the same links presented on the general search for **CCS**, but there are some differences, with the number of Portuguese academic sources increasing significantly (Table 21). The first link is to a page on Geological Storage of Carbon Dioxide from the website of the General Directorate of Energy and Geology. This page includes information on the legal framework of CCS in Portugal, as well as a list of projects currently under development. One of the projects listed is **PilotSTRATEGY**. The second page listed is a post from the Instituto de Ciência da Terra of Évora University about the Project **STRATEGY CCUS**. The other pages are from university repositories (linking to reports or master theses on the topic of CCS), two pages on CCS from energy companies working on the field of CCS (Veolia, Linde), a page from the corporate association Business Council for

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Sustainable Development Portugal sharing a flyer from 2006 on CCS, and the page of the course on CCS at Lusófona University.

In total, the four queries we performed resulted in 22 different sources. The majority of these were pages with academic-related content, either thesis on CCS, post and news related to CCS and CCS projects, or information on CCS courses (10), followed by web pages or blog posts from private companies (7). 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[39].

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 mention the risk of earthquakes and accidental spills.

5.3.4. Information boxes, search alternatives, and advertisements in France, Spain, and Portugal

When searching on CCS in the three countries Google makes several alternative suggestions both when typing words on the search box and, after the search, at the bottom of the results page. In the case of CCS suggestions, we found that they do not differentiate much between countries or queries.

In Portugal, for example, when searching for **CCS** in Portuguese on google.pt, the platform suggests several alternative search terms, related to CCS in Brazil, CCUS, CSS, and bioenergy, and, as the last option, problems associated with CCS (Figure 40). At the bottom of the page, Google also suggests searches. These are similar, but they also include specific phrases or questions, like “measures that can contribute to the CO2 reduction” and “what you need to do to decrease your concentration of CO2”.

[39] Some of the results in France and Spain included sources that are international. These however are mostly websites created for an international audience. Some of the Brazilian sources included in the results in Portugal, were more specific and included, for example, information about courses, and post graduations in Brazil.

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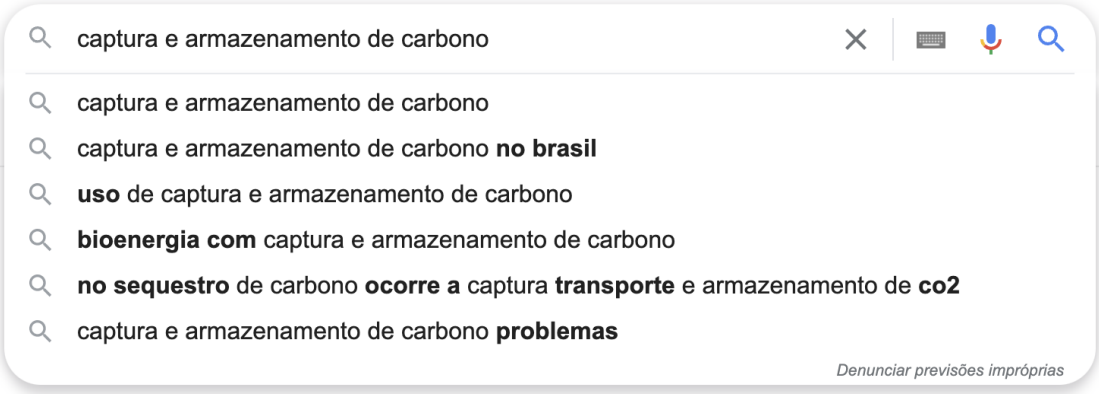

Figure 40. Alternative search terms proposed by google.pt when searching for **carbon capture and storage**

Retrieved on the 31st of January 2022

The same happens in France, when searching for **CCS** at the bottom of the results page Google suggests alternative searches. Most are quite generic and often related to other types of carbon sequestration. Some are more specific to the national context, like the one on CO2 capture by TotalEnergies (a French company), on google.fr (Figure 4.9), as well as "CO2 capture in Storage in Spain" on google.es.

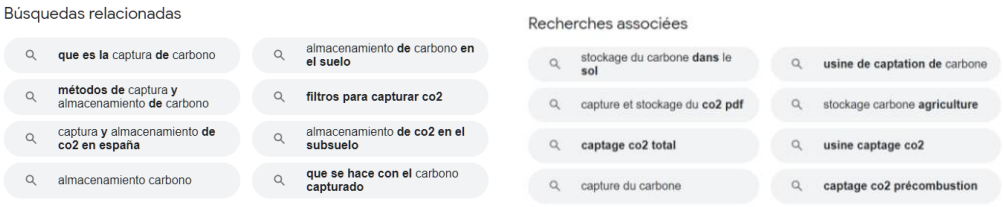

Figure 41. Alternative search terms suggested when searching for **carbon capture and storage** in google.es e google.pt

Retrieved on the 28th of January 2022

Google also presents an information box on CCS on the right side of the results page in almost all the searches. In the three countries, this information box includes content from Wikipedia. In the case of Portugal in Spain the content is extracted from the Portuguese and Spanish CCS page, respectively, and in the case of France from the more generic page on carbon sequestration[40]. The boxes include a text excerpt from the Wikipedia pages, as well as other photos from Google images. These images mostly show a graphic representation of the technology and have different sources. In the case of Portugal, for example, the images were from 1) Wikipedia; 2) an article from BBC news from 2016 republished by a Portuguese academic blog; 3) an image from a YouTube video of a presentation made by a Brazilian professor from the University of São Paulo (USP), Brazil and 4) an image from a CCS plant extracted from a Brazilian website (Figure 42).

The Spanish Wikipedia page on CCS, as we have seen, is fragmented, poorly structured, and has an overall negative tone about the technology[41]. This means that when someone searches CCS on

[40] This difference is due to the way the French pages on CCS and Carbon Sequestration are indexed on Wikipedia. See Chapter 3 of this report.
41 See previous chapter of the report.

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google.es in Spain the main content promoted both in the results list and in the information box, is a questionable information page resulting from a bad editing process of the wiki page.

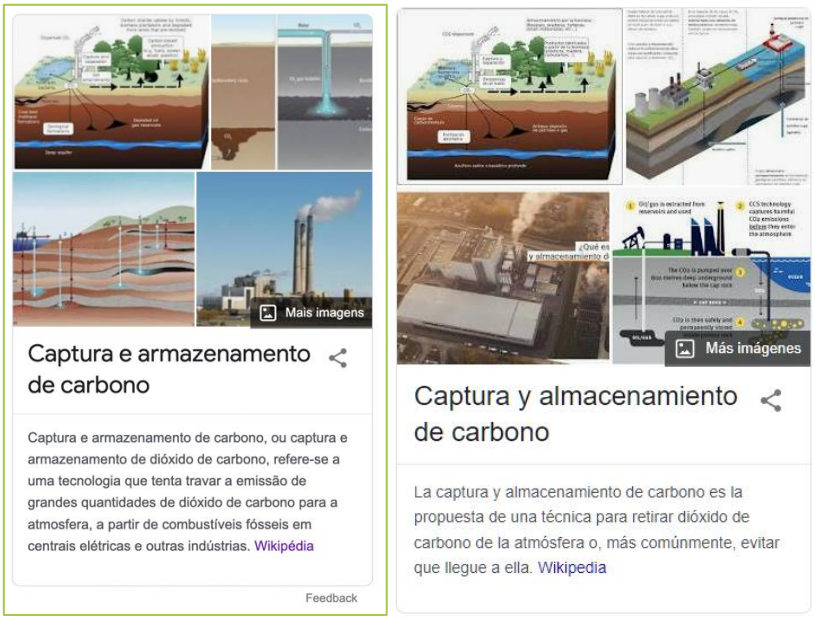

Figure 42. Information box presented on google.pt and google.es search results page when searching for **carbon capture and storage**

Retrieved on the 28th and 31st of January 2022

Finally, in all the countries, despite cleaning cookies and using an incognito window, the result pages end up displaying an advertisement from a company related to CCS at the end of the page, that links to a page on the company services in the CCS field (Geoscience expertise to accelerate the deployment of CCS) (Figure 43). This advertisement is in English and appears to target anyone searching for **CCS** in these countries regardless of the language used.

Figure 43. Image of the advert from CGG company from the www.google.es results page when searching **for Carbon Capture and Storage**

Retrieved on the 29th of January 2022

5.3.5. Country comparison

When searching for CCS in the three countries the public is confronted with a significant array of sources and content that differ in terms of source, format, and content. This includes Wikipedia pages, blog posts from private companies, articles from online media, informative webpages about companies working in the CCS field, academic articles and reports, NGO websites with Q&A, and opinion articles, among others. Some of this content is more technical, i.e., reports, academic articles,

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and theses, and not necessarily targeted at the general public. But most of it has a more public-oriented format, general reports, opinion articles and Q&A posts on CCS.

Our analysis shows how information available to the public of CCS on the internet is dependent both on local dynamics, as well as specific affordances of Google Search Engine. In the first case interest and investment in the topic at the national level seems to be central. The diversity of actors and types of content, and the depth and quality of the information available in the articles promoted seem to reflect this reality.

The results obtained in France included more balanced views on the topic, different points of view, and in the case of video, content directed to specific audiences. The results also included academic papers, and articles from several online media initiatives related to the environment, either independent, connected to environmental NGOs, or private corporations.

In the case of Spain, the results were more diversified, some of the queries having quite different outputs. Most of the results were from environmental online media, some being reposts/translations of articles on CCS written in other projects or countries. There was also a considerable representation of private corporations, NGOs, and a lower number of academic sources. It was the country where the search for **CCS risk** resulted in a higher number of critical articles on the technology.

Portugal, on the other hand, is the country with less structured information available on the internet among the three countries. This is apparent in the high representation of academic sources in the results list, but also in the presence of many web pages with scarce informative content. The results also included a higher number of foreign sources, focusing, for example on information about courses, research, and post graduations in Brazil. What is most striking, however, in comparison with other countries' results, is the absence of results produced by NGOs or specialized environmental media.

In the three countries, private corporations were one of the actors promoted in the Google results, not so much in terms of absolute numbers, but because they are often present in all the queries. We found two main types of private corporations promoting information on CCS. The first one is companies that work directly with CCS or carbon emissions. These often have web pages explaining what CCS is and what their initiatives in the field are, or more extended blog posts on the topic. The second type is companies that work in the environmental/sustainability field, but which do not have a direct relation with the topic of CCS. These companies tend to have informative websites on many environmental topics with pages often structured in the form of Q&A. Q&A pages are often SEO optimized and promoted by Google on the first page both on the results list and in the featured snippets.

In terms of content, we found that sources that have a positive view on CCS tend to highlight its importance to fight climate change and reducing the amount of CO2 in the atmosphere. Its complementary role to other climate technology, its relevance for some specific sectors like the cement, energy, and fuel industry, and the fact that it is a tested technology. More supportive articles also stress the urgency of public support for CCS and the importance of minimizing barriers to its development. They also highlight the potential to lower the costs, and its articulation with other technologies of carbon reutilization, which would allow for the valorisation of carbon and its integration in the circular economy.

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The most referred limitation of CCS, mentioned by both the supportive and critical sources, is the cost. CCS price is seen as a barrier to its development, not being profitable at the moment. Those that criticize the technology say that the investment made in the technology should be used in other areas, namely renewable energy and that financial investment in CCS is a way for the fossil fuel industry to not change their business models or lower their carbon emissions. Those defending the technology consider the cost of CCS a current limitation that has to be overcome for the technology to become viable.

Other negative aspects referred to are the uncertainties about the reliability of the geological storage site, the risk of leakages, seismic risk, and the acidification of the oceans. Also, the fact that there is no guarantee for long-term storage. A smaller number of sources also mention the social acceptance of technology as a barrier to CCS development. Most sources focusing on the negative aspects of CCS are from environmental media or NGOs.

The results of the different queries used show that the results when using different search words, share some similarities, but also have differences. Search for **CCS risk** and **CCS [name of the country]** tend to be more specific than the general search on **CCS** or on **CCS benefits**, for example. The **CCS risks** query results include more sources that have either a critical or balanced view of **CCS**. Academic sources are present in higher numbers when searching for **CCS risks in France** or **CCS Portugal**.

The query on **CCS risks** in France and Spain also highlights the importance of not ignoring the relevance of mentioning risks in CCS communication. If someone searches specifically for the risks of CCS, Google search engine optimization processes will search for and promote content that specifically mentions this aspect. This content has either a balanced view on CCS or a critical perspective on the subject.

It is also interesting to note that many of the pages are quite similar despite being produced by different sources. Blog articles from private companies on CCS have a similar format to articles from educational media projects. Media projects affiliated with corporate groups are often difficult to differentiate from independent media groups at first sight. The hybrid formats we find often on the internet (blogpost, Q&A, repost, etc.) make contextualization sometimes difficult for the general public. The risk of decontextualization is magnified by the increased reliance on suggested questions and snippets by Google.

Wikipedia pages on the topic tend to be presented and highlighted with an information box on the right of the results page when searching for CCS. In the case of France, however, there is a difference. Since, as we have seen in our analysis of the Wikipedia pages, the French page on CCS is indexed differently from the other countries, the page that is presented in the information box is the more general one on carbon sequestration (“Séquestration du dioxyde de carbone”, 2022), and not the one specifically on geological CCS (“Séquestration géologique du dioxyde de carbone”, 2022). This means that although the French-language page on geological CCS is quite informative and extensive on the topic, it is less visible to the public than, for example, the Portuguese and Spanish-language pages that are shorter or less technically correct.

The visibility given to Wikipedia pages is relevant for topics of this type. Not only they will be probably the first thing people will find on the subject, but studies have also shown that Google results often rely on Wikipedia to improve their results (McMahon et al., 2017). As we have seen, the Spanish-

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language Wikipage presents some issues in terms of tone and structure. Its promotion by Google has an impact on the quality of the information the general population in Spain might find on CCS.

Besides the information boxes, Google also particularly highlights some sources through their suggested Q&A, and their featured snippets. These seem to be selected based on how well Google matches content to a specific query, independently of the source of this content. There is also a preference for content in the form of Q&A that can be easily identified by Google as relevant. From the perspective of the public, this means that when searching for the topic of CCS they are confronted with information on the topic directly on Google's result page. This information is often short and decontextualized, and only if clicking on the source they will get a more in-depth understanding of information on CCS.

Another aspect that is worth noticing, is that, with the exception of an opinion article from the weekly newspaper Liberation resulting from one of the queries in France, the results list did not include any article on CCS from major newspapers. The results, of course, could be different if conducted on different times, in different locations or using more specific queries, but what our analysis showed, is that despite the fact several articles on CCS have been published in the media in the three countries[42] they are not easily accessible to someone searching for the topic on Google. Instead, the platform seems to give more visibility to articles published on online specialized media.

Finally, some considerations on the risk of amplification due to differences in the information available online on CCS projects and initiatives in the three countries. As we have seen, Google search results on CCS in countries where there is less information available on the internet tend to differ from those where the topic is more discussed. This means that new content produced on the topic has a bigger probability of gaining high visibility on the platform if published in sources Google tends to promote. This was the case, for example, of the press release from CSIC (Consejo Superior de Investigaciones Científicas) about a scientific study on the current development of CCS in Spain that ended up being promoted in five of the ten results of the query **CCS Spain**.

5.4. Summary of findings

- CCS searches on Google results in a significant array of links that differ in terms of source, format, and content.
- The diversity and quality of the Information available to the public of CCS on the internet reflects interest and investment in the topic at the national level, with the search in France resulting in more diversified types of content, in contrast to Portugal, where results included high number of foreign sources, and no content published by NGOs or specialized environmental media.
- Results obtained in France included more balanced views on the topic, different points of view, and in the case of video, content directed to specific audiences. The results also included academic papers, and articles from several online media initiatives related to the

[42] See Chapter 2 of this report.

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environment, either independent, connected to environmental NGOs, or private corporations.

- Results obtained in Spain, were diversified, most of them being from environmental online media. There was also a considerable representation of private corporations, NGOs, and a lower number of academic sources. Spain was the country where the search for CCS risk resulted in a higher number of critical articles on the technology.
- In Portugal results included a high number of foreign sources, private corporations, academic sources, but also many web pages with scarce informative content.
- We found two types of private corporations promoting information on CCS: companies that work directly with CCS or carbon emissions and companies that work in the environmental/sustainability field and have Q&A informative content on many topics.
- Many of the webpages on CCS promoted had hybrid formats (blogpost, Q&A, repost, etc.) that look quite similar despite being produced by different actors.
- Wikipedia CCS pages tend to be presented and highlighted both on an information box on the right of the results page when searching for CCS.
- Major print media was almost completely absent from the results. Instead, the platform seems to give more visibility to articles on CCS published on online specialized media.
- Sources that have a positive view of CCS tend to highlight its importance to fight climate change and reducing the amount of CO2 in the atmosphere, its complementary role to other climate technology, its relevance for some specific sectors like the cement, energy, and fuel industry, and the fact that it is a tested technology, among others.
- The most referred limitation of CCS mentioned by both the supportive and critical sources is its cost. Other negative aspects mentioned were no guarantee for long-term storage, the reliability of the geological storage site, the risk of leakages, seismic risk, and the acidification of the oceans. A smaller number of sources also mention the social acceptance of technology as a barrier to CCS development.
- Most sources focusing on the negative aspects of CCS are from environmental media or NGOs. Some of this content are articles on CCS translated or reposted from other media projects or countries.
- Some queries resulted in more specific results. The **CCS risks** query results included more sources that have either a critical or balanced view of **CCS**. Academic sources are present in higher numbers when searching for **CCS risks in France** or **CCS Portugal**.
- Google suggested several questions about CCS in the results page in France in Spain. These tend to be answered with content in the form of Q&A on CCS that can be easily identified as relevant by the platform, independently of the source.
- In all countries Google presented snippets of text directly on the results page to answer suggested questions and to highlight the most relevant results. This increases the risk of decontextualization of information about CCS since the reader can access these extracts without clicking on any of links.
- All the pages included alternative searches, but they did not differentiate much between countries or queries.

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- In all the countries the result pages end up displaying an advertisement from a company related to CCS at the bottom.

6. Conclusion

In order to investigate the social acceptance of CCS, media analysis can provide relevant information on the representations of CCS the public are exposed to. Our overall objective was to identify and understand the kind of information that the public has access to when searching for CCS both in the traditional media (newspapers) and in online media (Wikipedia and Google Search Engine) in our three main regions (France, Portugal, and Spain).

In line with previous research on CCS, the main objective of our **printed media analysis** was the identification of the type of discourse about CCS that different media sources transmit in each of the studied regions (cross-country analysis). Other objectives include the identification of the different kind of actors involved in the CCS debate; the main arguments underlying the variety of discourses on CCS; and the possible differences among national, regional and local media in each country.

Overall, what we found was that press attention to CCS is higher in France and in Spain than in Portugal. In terms of trends over time, the years 2015 and 2020 show relevant increases in the number of articles in the three countries, which can be partly explained by COP meetings. The length of press articles on CCS is quite small (up to 1,000 words). Formal/institutional actors are more often mentioned in the media portrayal of CCS, in particular administration and governments, industry, international organizations and experts.

CCS far from being a hot topic in the press: it does not appear in the headlines and most articles only include allusive references (just a few words) to CCS. This is particularly true in Spain. Carbon/CO2 capture & storage and carbon capture are the terms more frequently used in the media narrative and most articles present no technical explanation about the technologies.

CCS is framed in terms of climate change and decarbonisation (as main topic), and in terms of energy (as secondary topic). The main arguments in favour of CCS are its climate friendly character and its potential for climate change mitigation. CCS as part of the energy portfolio is particularly relevant in Portugal. Most articles do not include negative arguments towards CCS. This is particularly the case in Spain.

Generally, the tone of the press articles is neutral or mixed/balanced with relevant differences among countries. Spanish media show the most positive tone towards CCS, the Portuguese media is more neutral and mixed/balanced, while the French press is more neutral to negative. The overall evaluation by scope of newspaper in Spain and France also shows important differences, with the national and the regional newspapers being more neutral, while the local ones show a more positive tone.

Regarding the Wikipedia analysis, our goal was to identify and compare the content of four **CCS** pages most likely to be accessed by the public in the three countries, i.e. pages from the English, French, Spanish, and Portuguese-language Wikipedias. These pages were independently written and changed throughout the years by volunteer users from different parts of the world, leading to the information available for the public in these regions being sometimes quite different. The Wikipedia archive of these pages also allowed us to understand the topic introduction and viewership over time for each language.

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In general terms, Carbon Capture and Storage is represented quite dissimilarly in the four wiki projects. The English-language one is the oldest, most complete and up to date, but is somewhat fragmented. The French-language one is detailed, Euro-centric, and includes some technical sections, but some of its sections are dated. However, the French-language page on geological CCS is indexed as a subpage of the more general page on carbon sequestration, making the page less visible for the general public. The Spanish-language page is quite fragmented and less coherent, and it has a rather negative overall tone. Its current content results from a flawed initial translation process of the English page and from a deficient review of the page over the last decade. It includes a decontextualized photo of a cow suffocated by natural CO2 leakage in 1986 in Lake Nyos, Cameroon, with no explanation of its relation to CCS. The Portuguese-language CCS page is much more recent and smaller in terms of size and number of views.

Viewings of the four pages are fairly low, but all had a spike in views after Elon Musk tweeted that he was going to create a prize of $100m for the best carbon capture technology in 2021. The images used on the pages are charts and diagrams from academic papers or created by Wiki Users. They are often translated and used in the different language-pages. The French-language page is the only one that mentions technical and legal information on CCS regulations.

The English, French and Spanish-language pages include information on the CCS risks. Particularly, about the risk of leakage, induced micro-seismicity, long-term chemical and geological behaviour and effects of geological storage. The page in Spanish has a more negative tone and mentions ocean acidification, air quality worsening (negative environmental effects) and the expectation that CCS could have irreversible effects for the next generations.

The pages in English and French also include information on criticism, and acceptability of the technology, namely that risk and benefit perception are essential components of CCS acceptance, that CCS is often associated with a shallow ecology worldview, and that environmental NGOs are not in agreement regarding the CCS as a tool to fight climate change. The French-language page also refers to the position of CCS supporters in view of this criticism.

None of the pages have a section on the benefits of CCS, only mention it explicitly in the introduction in connection with the technology's role in mitigating the effects of climate change.

The pages in French and English include information on several ongoing projects of CCS around the world, the French-language one having a specific section of projects on the European Community. The French-language page also has a specific section on CCS actors in France and French-speaking countries. The English-language page has a USA-centric perspective and many of the organizations mentioned on the page are from this country.

The analysis of the four pages shows that the diversity of its content about CCS mostly results from a combination of national interest in CCS and Wikipedia local dynamics and the international flow of information between Wikipedia projects.

Finally, we looked at the **Google** search engine results when searching for CCS in three of the PilotSTRATEGY countries (France, Spain, and Portugal), with two main aims: 1) understanding the kind of content that the public/stakeholders would access in each country/location if looking for

information on this topic, and 2) examining the sources/content being promoted by the search engine in each country.

Overall, we found that CCS searches on Google in different countries result in a significant array of links that differ in terms of source, format, and content. The diversity and quality of the information available to the public of CCS on the internet reflects interest and investment in the topic at the national level, with the search in France resulting in more diversified types of content, in contrast to Portugal, where results included high number of foreign sources and no content published by NGOs or specialized environmental media.

Results obtained in France included more balanced views on the topic, different points of view, and in the case of video, content directed to specific audiences. The results also included academic papers, and articles from several online media initiatives related to the environment, either independent, connected to environmental NGOs, or private corporations.

Results obtained in Spain, were diversified, most of them coming from environmental online media. There was also a considerable representation of private corporations, NGOs, and a lower number of academic sources. Spain was the country where the search for CCS risk resulted in a higher number of critical articles on the technology.

In Portugal results included a high number of foreign sources, private corporations, academic sources, but also many web pages with scarce informative content.

We found two types of private corporations promoting information on CCS: companies that work directly with CCS or carbon emissions and companies that work in the sustainability field and have Q&A informative content on many environmental topics.

Many of the webpages on CCS promoted had hybrid formats (blogpost, Q&A, repost, etc.) that look quite similar despite being produced by different actors. Wikipedia CCS pages tend to be presented and highlighted both on an information box on the right of the results page when searching for CCS. Major print media was almost completely absent from the results. Instead, the platform seems to give more visibility to articles on CCS published on online specialized media.

Sources that have a positive view of CCS tend to highlight its importance to fight climate change and reducing the amount of CO2 in the atmosphere, its complementary role to other climate technology, its relevance for some specific sectors like the cement, energy, and fuel industry, and the fact that it is a tested technology, among others.

The most often referred limitation of CCS mentioned by both the supportive and critical sources is its cost. Other negative aspects mentioned were the absence of guarantees for long-term storage, the reliability of the geological storage site, the risk of leakages, seismic risk, and the acidification of the oceans. A smaller number of sources also mention the social acceptance of technology as a barrier to CCS development. Most sources focusing on the negative aspects of CCS are environmental media or NGOs. Some of this content are articles on CCS translated or reposted from other media projects or countries.

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Some queries resulted in more specific results. The CCS risks query results included more sources that have either a critical or balanced view of CCS. Academic sources are present in higher numbers when searching for CCS risks in France or CCS Portugal.

Google suggested several questions about CCS in the results page in France in Spain. These tend to be answered with content in the form of Q&A on CCS that can be easily identified as relevant by the platform, independently of the source. In all countries Google presented snippets of text directly on the results page to answer suggested questions and to highlight the most relevant results. This increases the risk of decontextualization of information about CCS since the reader can access these extracts without clicking on any of the links. All the pages also included alternative searches, but they did not differentiate much between countries or queries. In all the countries the result pages end up displaying an advertisement from a company related to CCS at the bottom.

In a nutshell, media representations of CCS do not provide a lot of information that helps citizens form an opinion on these technologies. Articles in the press are scant, small and with little technical information. Wikipedia pages differ much among themselves, but most fail in terms of presenting accurate, up-to-date and balanced information. The results of Google searches also go little beyond promotional pages by companies, critical pages by environmental organisations and overly technical reports and thesis from academia. This lack of information is particularly acute in Portugal and a bit less so in Spain, whereas France does provide a much richer press and online material on CCS.

The media analysis thus provides us with valuable data on how to interpret the results of the interviews with stakeholders and the public opinion survey (namely the generalised unfamiliarity with CCS) and on how to prepare the following stages of community engagement.

Repeating the media analysis at the end of the project may allow us to understand if there is change in the information presented and promoted by press, search engines and Wikipedia during this time, and it the PilotSTRATEGY project, or other related projects, has an impact on the information in each country/location.

7. References

AIMC (2021). Marco General de los Medios en España. 2021. Asociación para la Investigación de los Medios de Comunicación (AIMC).

Brunsting, S., Mastop, J., Kaiser, M., Zimmer, R., Shackley, S., Mabon, L., & Howell, R. (2015). CCS acceptability: social site characterization and advancing awareness at prospective storage sites in Poland and Scotland. Oil & Gas Science and Technology–Revue d'IFP Energies nouvelles, 70(4), 767-784.

Delicado, A. Schmidt, L. Pereira, S. Oltra, C. Prades, A. (2016) Media analysis of the representations of fusion and other future energy technologies, In: 2015 4th International Conference on Advancements in Nuclear Instrumentation Measurement Methods and their Applications (ANIMMA), pp.1-7IEEE

Eklöf, J., & Mager, A. (2013). Technoscientific promotion and biofuel policy: How the press and search engines stage the biofuel controversy. Media, Culture & Society, 35(4), 454–471. https://doi.org/10.1177/0163443713483794

Fischedick, M., Pietzner, K., Supersberger, N., Esken, A., Kuckshinrichs, W., Zapp, P., ... & Idrissova, F. (2009). Stakeholder acceptance of carbon capture and storage in Germany. Energy Procedia, 1(1), 4783-4787.

Haider, J. (2016). The structuring of information through search: Sorting waste with Google. Aslib Journal of Information Management, 68(4), 390–406. https://doi.org/10.1108/AJIM-12-2015-0189

Haider, J., & Sundin, O. (2019). Invisible Search and Online Search Engines: The Ubiquity of Search in Everyday Life (1.a ed.). Routledge. https://doi.org/10.4324/9780429448546

Hecht, B., & Gergle, D. (2010). "The Tower of Babel Meets Web 2.0: User-Generated Content and Its Applications in a Multilingual Context." Paper presented at the CHI: 2010: Language 2.0 Conference, Atlanta, GA, USA, April 10-15.

Kasperson, J. X., Kasperson, R. E., Pidgeon, N., & Slovic, P. (2012). The social amplification of risk: Assessing 15 years of research and theory. Social contours of risk, 217-245.

Kojo, M., & Innola, E. (2017). Carbon capture and storage in the finnish print media. Risk, Hazards & Crisis in Public Policy, 8(2), 113-146.

McMahon, C., Johnson, I., & Hecht, B. (2017). The Substantial Interdependence of Wikipedia and Google: A Case Study on the Relationship Between Peer Production Communities and Information Technologies. Eleventh international AAAI conference on web and social media

Moe, H. (2019). Wikipedia as an arena and source for the public: A scandinavian comparison of "Islam". Javnost - The Public, 26(2), 177–193. https://doi.org/10.1080/13183222.2019.1587703

Oltra, C., Delicado, A., Prades, A., Pereira, S., & Schmidt, L. (2014). The Holy Grail of energy? A content and thematic analysis of the presentation of nuclear fusion on the Internet. Journal of Science Communication, 13(04), A01. https://doi.org/10.22323/2.13040201

The PilotSTRATEGY project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 101022664

Pietzner, K., Schwarz, A., Duetschke, E., & Schumann, D. (2014). Media coverage of four Carbon Capture and Storage (CCS) projects in Germany: analysis of 1,115 regional newspaper articles. Energy Procedia, 63, 7141-7148.

Pinto, B., & Castro, P. (2021). Contesting political decisions involving environmental issues: A case study in Portugal based on the press about offshore oil and gas drilling. Frontiers in Marine Science, 700.

Rubira, R. & Gil-Egui, G. (2017). "Wikipedia as a Space for Discursive Constructions of Globalization." The International Communication Gazette. doi:10.1177/1748048517736415.

Schmidt, L. Horta, A. Pereira, S. (2014) The Fukushima nuclear disaster and its effects on media framing of fission and fusion energy technologies, Ambiente e Sociedade, Vol. 17, 4, pp.233-250

Sundin, O., Lewandowski, D., & Haider, J. (2021). Whose relevance? Web search engines as multisided relevance machines. Journal of the Association for Information Science and Technology, asi.24570. https://doi.org/10.1002/asi.24570

Thompson, N., & Hanley, D. (2017). Science Is Shaped by Wikipedia: Evidence from a Randomized Control Trial. SSRN Electronic Journal. https://doi.org/10.2139/ssrn.3039505

Tripodi, F. (2021). Ms. Categorized: Gender, notability, and inequality on Wikipedia. New Media & Society, 14614448211023772. https://doi.org/10.1177/14614448211023772

Van Alphen, K., tot Voorst, Q. V. V., Hekkert, M. P., & Smits, R. E. (2007). Societal acceptance of carbon capture and storage technologies. Energy Policy, 35(8), 4368-4380.

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Annex 1: Press analysis protocol

1. Country	
2. Coder identification	Name of the coder
France	
Portugal	
Spain	
Newspaper Characterization	
3. Newspaper	Name of the Newspaper
El País	
El Mundo	
Diari de Tarragona	
Diari Més Digital	
Diario de Teruel	
Heraldo de Aragón	
O Público	
Correo da Manhã	
O Portomosense	
Le Monde (national)	
Le Figaro (national)	
Libération (national)	
Le Parisien (regional-local)	
La République de Seine et Marne (local)	
4. Type of newspaper	
Quality	
Tabloid	
Not identified	
Other	
5. Scope of newspaper	
National	
Regional	
Local	
Other	
Article Characterization	
6. Title of the article	Title of the article (without lead)
7. Date of publication	

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8. Type of article	
Detailed report	Long format article
Short report	Short format article
Comment/Opinion	comment opinion signed by the comment author.
Interview	
Letter to the editor	
Editorial	
Other	
9. Author of the article	Author of the article. Multiple answers in the case of interviews.
Journalist	Identified by name or not
Press agency	
Politician	
Expert/academic	
NGO	
Public/citizens	
Other	
10. Length of article (number of words)	Ideally All. Including title and lead Use Sergi software: https://countwordsfree.com/
11. Main theme	
12. Secondary theme	
13. Scope of the article (in general)	Main geographical focus of the article (might be multiple)
International	
National	
Regional	
Local	Specific project at the national level
14. Main actors mentioned in the article	National/international related to the argument of the article
Industry	
Administration/government	National and EU
Experts/academia/research	
NGO, CSO	
International organisations	
Politicians	not in government
Journalists	
Public/citizens	
Other	
15. Event triggering the article	

CCS Characterization	
16. CCS mentioned in the article title or lead	
Yes	
No	
17. Extent of focus on CCS	
Central topic of the article	
Secondary topic of the article	1 or 2 paragraphs
Allusive	1 sentence
18. Location of CCS Explicitly mentioned	Explicitly mentioned (not mandatory)
Onshore	
Offshore	
Both	
Not mentioned	
19. Scope of CCS if explicitly mentioned	Main geographical focus of the article
International	
National	
Regional	
Local	Specific project at the national level
20. Terminology used to refer to CCS	Exact reference
Carbon/CO2 capture	
Carbon/CO2 sequestration	
Carbon/CO2 storage	
Carbon/CO2 capture and sequestration	
Carbon/CO2 capture and storage	
Underground carbon/CO2 storage	
Technological carbon skin	
Geological carbon/CO2 sink	
Geological carbon/CO2 storage	
Clean coal	
Other	
21. Technical explanation	Article includes technical explanation about CCS?
None	
Brief outline	
In-depth outline	
22. Themes related to CCS:	Main (single answer - not mandatory)/secondary (multiple)
Climate change, decarbonization & CCS	including reference in a larger portfolio
Information on specific CCS project or site	Specific locations
CCS research or experiments, new technologies or enhanced processes	technological experiments

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Collaborations, partnerships	
Meetings, summits, conferences	
Policy, legal and regulatory frameworks	Including references to carbon roadmaps and policies. Policy documents
Funding	
CCS support or pressure (in favour)	Including awards
Opposition or protest against CCS	General opposition to CCS and actions (demonstration, petition, etc.)
Public outreach or engagement	Specific initiatives or projects (related to citizens)
Challenges, risks and problems of CCS	
Alternative solutions/technologies to CCS	Alternative option for decarbonization
CCS and Energy	
CO2 emissions market	
Other	
23. Arguments in favor of CCS	
Reduces emissions, climate friendly, climate change mitigation	
Enables continuing use of coal, coal is cheap/available/efficient	
Enterprise and business opportunities	
Job creation	
EU/other countries are investing	
Technology already exists/is tested/is in use/is reliable	
CCS is an important means among others/part of energy portfolio	
Consumption of fossil fuels will continue/increase	
Usage in bioenergy production is an asset/double capture	
Storing of CO2 supports oil industry	
Cost-effectiveness (compared with renewable energies)	
Successful projects	
Well-sealed reservoirs available	
Alternative to nuclear	
Short-term option	
Bridge to hydrogen economy (options for transport sector)	
Less dependent on fossil fuel imports (security of supply)	
Compatible with current energy system	

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Answer to growing global fossil fuel demand (India, China)	
Other	
24. Arguments against CCS	
Cost, CCS is expensive	
Risk of CO_2 leakage to atmosphere/risks to ecology	
Leakages to sea/acidification/risks to sea ecology	
Human safety/health risks	
Environmental impacts	
Contamination of drinking water	
Visual impact	
Concerns with safety/security	
Problematic/unsolved final storage/no suitable geology in the country/storage sites are too remote/storage surveillance is not reliable enough/ Uncertainty about reservoir behaviour	
Technology still in planning stage/not used/not ready or proven	
Not profitable/deployable in decades	
Lessens plant efficiency/requires more energy	
CCS plants cannot function without public funding, government support needed	
CCS is unpredictable/more research needed about safety issues	
Raises costs of production/electricity/ energy penalty	Installing capture technology will make products or electricity more expensive
End-of-pipe solution (no solution to the problem), Lock-in (sub-optimal) of technology	Cutting corners.
Threat for renewable energy/energy efficiency	
Continuing fossil fuel dependency, Stimulation of fossil fuel use (indirect support for 'dirty' coal)	
Uncertain public acceptance	
Responsibility issues	Who takes the blame (responsability) in case of accident
Against principle 'polluter pays'	
Spatial planning problems (well drilling)	
Seismic effects	
Limited potential	Only a small % of CO2 taken from the atmosphere

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Other	
25. Tone of the article/valuation of CCS	Article includes explicit valuation of CCS
Positive	Includes positive explicit valuation
Negative	Includes negative explicit valuation
Neutral	Does not include Explicit evaluation
Mixed/balanced	Includes both positive and negative arguments
Additional Questions	
26. Comments by readers (y/n)	only relevant if it is an in-depth report on CCS
27. Additional comments	
28. Potential names for interviews	

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Annex 2: Wikipages

Captura e armazenamento de carbono (2022). In Wikipedia. Retrieved June 10, 2022, from https://pt.wikipedia.org/wiki/Captura_e_armazenamento_de_carbono

Captura y almacenamiento de carbono (2022). In Wikipedia. Retrieved June 10, 2022, from https://es.wikipedia.org/wiki/Captura_y_almacenamiento_de_carbono

Carbon capture and storage (2022). In Wikipedia. Retrieved June 10, 2022, from https://en.wikipedia.org/wiki/Carbon_capture_and_storage

List of carbon capture and storage projects (2022). In Wikipedia. Retrieved June 10, 2022, from https://en.wikipedia.org/wiki/List_of_carbon_capture_and_storage_projects

Séquestration du dioxyde de carbone (2022). In Wikipedia. Retrieved June 10, 2022, from https://fr.wikipedia.org/wiki/S%C3%A9questration_du_dioxyde_de_carbone

Séquestration géologique du dioxyde de carbone (2022). In Wikipedia. Retrieved June 10, 2022, from: https://fr.wikipedia.org/wiki/S%C3%A9questration_g%C3%A9ologique_du_dioxyde_de_carbone

Wikipedia: Core content policies (2022). In Wikipedia. Retrieved June 10, 2022, from: https://en.wikipedia.org/wiki/Wikipedia:Core_content_policies

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Annex 3: Wikipedia analysis protocol

1) Save **complete page as pdf**: Print -> Save as pdf.

2) Save page to **internet archive** (for possible future use.):

   a) Go to: https://web.archive.org/save/
   b) Paste link
   c) Save the link of snapshot captured.
      LINK:

   (Example of the snapshot of the EN page: https://web.archive.org/web/20220114155846/https://en.wikipedia.org/wiki/Carbon_capture_and_storage)

   (Note: Don't need an account to use the **internet archive**, but if you want you can create one to manage all your saved links)

Content analysis

1.1) Terminology: What terms does the page use to define CCS?

1.2) Length: How many words?

1.3) Structure: How many sections?

1.4) References: How many references?

1.5) Does the page include images? What do the images represent?

2.1) Does the page Include information about CCS in your country?

2.2) Does the page include information about specific storage sites?

2.3) Does the page explicitly mentions onshore/offshore CCS?

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2.4) Does the page mentions the risks of CCS?

2.5) Would you describe the technical explanation contained on the page…

2.4.1) Short/detailed/very detailed

2.4.2) Easy/accessible/difficult to understand to the general public

2.6) What of the following themes related to CCS are included on the page?

- Themes related to CCS
- Central (single answer)
- Secondary (multiple answers)
- Climate change, decarbonization & CCS
- Information on specific CCS project or site
- CCS research or experiments, new technologies or enhanced processes
- Collaborations, partnerships
- Meetings, summits, conferences
- Policy, legal and regulatory frameworks
- Funding
- CCS support or pressure (in favour)
- CCS Opposition or protest against
- Public outreach or engagement
- Challenges, risks and problems of CCS
- Alternative solutions/technologies to CCS
- CCS and Energy
- CO2 emissions market
- Other
- Climate change, decarbonization & CCS
- Information on specific CCS project or site
- CCS research or experiments, new technologies or enhanced processes
- Collaborations, partnerships
- Meetings, summits, conferences
- Policy, legal and regulatory frameworks
- Funding
- CCS support or pressure (in favour)
- CCS Opposition or protest against
- Public outreach or engagement
- Challenges, risks and problems of CCS
- Alternative solutions/technologies to CCS
- CCS and Energy
- CO2 emissions market

2.7) What other relevant themes are included on the page?

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2.8) What actors are mentioned on the page? Please Identify (National/international)

- Industry
- Administration//government
- Experts/academia/research
- NGO, CSO
- International organisations
- Politicians
- Journalists
- Public/citizens
- Other
- Industry
- Administration//government
- Experts/academia/research
- NGO, CSO
- International organisations
- Politicians
- Journalists
- Public/citizens
- Other
-

2.9) What of the following arguments in favor of CCS are included?

- Reduces emissions, climate friendly, climate change mitigation
- Enables continuing use of coal, coal is cheap/available/efficient
- Enterprise and business opportunities
- Job creation
- EU/other countries are investing
- Technology already exists/is tested/is in use/is reliable
- CCS is an important means among others/part of energy portfolio
- Consumption of fossil fuels will continue/increase
- Usage in bioenergy production is an asset/double capture
- Storing of CO2 supports oil industry
- Cost-effectiveness (compared with renewable energies)
- Successful projects
- Well-sealed reservoirs available
- Alternative to nuclear
- Short-term option
- Bridge to hydrogen economy (options for transport sector)
- Less dependent on fossil fuel imports (security of supply)
- Compatible with current energy system
- Answer to growing global fossil fuel demand (India, China)
- Other:

2.10) What of the following arguments against CCS are included?

- Cost, CCS is expensive

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- Risk of CO2 leakage to atmosphere/risks to ecology
- Leakages to sea/acidification/risks to sea ecology
- Human safety/health risks
- Environmental impacts
- Contamination of drinking water
- Visual impact
- Concerns with safety/security
- Problematic/unsolved final storage/no suitable geology in the country/storage sites are too remote/storage surveillance is not reliable enough/ Uncertainty about reservoir behaviour
- Technology still in planning stage/not used/not ready or proven
- Not profitable/deployable in decades
- Lessens plant efficiency/requires more energy
- CCS plants cannot function without public funding, government support needed
- CCS is unpredictable/more research needed about safety issues
- Raises costs of production/electricity/ energy penalty
- End-of-pipe solution (no solution to the problem), Lock-in (sub-optimal) of technology
- Threat for renewable energy/energy efficiency
- Continuing fossil fuel. Stimulation of fossil fuel use (indirect support for 'dirty' coal)
- Uncertain public acceptance
- Responsibility issues
- Against principle 'polluter pays'
- Spatial planning problems (well drilling)
- Seismic effects
- Limited potential
- Other:

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Annex 4: Google analysis protocol

Aims

Q1: to understand what kind of content the public/stakeholders would access in each country/location if looking for information on this topic.

Q2: to understand what sources/content is being promoted by search engines and Wikipedia in each country/location

Methodological considerations:

- For comparative reasons, the data collections should be done on the same week for all the countries involved.
- We should all use the same browser (suggestion: Google Chrome);
- Search should be performed in an incognito window, with history and cookies cleaned.
- You could also check results in different computers to see if there are any significant differences.

Focus: Content promoted by Google when using a particular combination of keywords at the national level (example for Portugal: www.google.pt. Location: Portugal)

Suggested key words:

Carbon capture and storage
Carbon capture and storage benefits
Carbon capture and storage risks
Carbon capture and storage (country name)

(you can search for other keywords if relevant)

Suggestion: Take screenshots of the complete result page AND save page as PDF.

Analysis

The PilotSTRATEGY project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 101022664

1) **Content extracted from sources and presented directly on the results by Google for <u>each keyword combination</u>**

<u>Suggestion: take screenshots of the relevant part of the page</u>

a. Is Google directly presenting information extracted from other pages? (From what pages? what information is extracted?)

b. Is Google providing questions and answers on the topic? (What questions, what sources are used to answer the questions?)

c. Is Google providing alternative search terms? (What are the alternative search terms provided?)

d. Is Google promoting different kinds of content? (Videos, news bars, etc.)

2) **Content analysis of the individual sources promoted**

For <u>EACH</u> link of the first Google result page please indicate:

a) LINK:
   a. Save page as pdf
   b. Suggestion: For future comparisons also Internet Archive.
      d) Go to: https://web.archive.org/save/
      e) Paste link
      f) Save the link of snapshot captured.
      LINK:

b) Source (private company, ONG, newspaper, academia, national authority, etc.)

c) Type of content (news article, website page, academic study, etc.)

d) Content analysis (overall position in relation to CCS)

Example

Search term: Carbon capture and storage

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Link (in ranking order)	Source	Type of content	Position towards CCS
https://welltec.com/pt/renewables/carbon-capture-and-storage/	Company	Definition of CCS Technical explanation (detailed) Products sold by the company connected to CCS Company projects	Positive: CO2 reduction, safety

3) Sources promoted by Google in the first results page (overview)

a. What types of sources are being promoted? (types of sources, country, language)

b. Are there significant differences depending on the keywords' combination used?