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Minh Ha-Duong
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Gilles Mardon

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Centre International de Recherches sur l'Environnement et le Développement
ENPC & CNRS (UMR 8568) / EHESS / AGROPARISTECH
/ CIRAD / MÉTÉO FRANCE
45 bis, avenue de la Belle Gabrielle
F-94736 Nogent sur Marne CEDEX
Tel : (33) 1 43 94 73 73 / Fax : (33) 1 43 94 73 70
www.centre-cired.fr

Social aspects of Total's Lacq CCS pilot project

Abstract

This case study describes the social aspects of Total's CO2 integrated capture, transport and storage pilot project in Frontsouthwestern France, from the initial press conference February 8th, 2007 to the announce of its end in 2013. The economic and social context was favorable. The company proactively conducted an outreach campaign relatively large for a 50 m€ investment. It was followed by an effective involvement of stakeholders, if not of the general public, through a formal continuous deliberation process led by the public authorities. Some neighbors used their rights to protest and challenge legally the project. It did not become an issue at the national level.

Keywords : CCS, pilot project, outreach, communication, France, case study.

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Aspects sociaux du projet pilote de CSC réalisé par Total à Lacq

Résumé

Cette étude de cas décrit les aspects sociaux du projet pilote intégré de captage, transport, stockage du CO2, réalisé par Total dans le Sud-Ouest de la France, de la première conférence de presse le 8 février 2007 à l'annonce de la fin d'injection en 2013. Le contexte économique et social était favorable. L'entreprise a conduit une campagne de sensibilisation proactive relativement importante pour un investissement de 50 m €. Cette campagne a été suivie par une implication effective des parties prenantes, sinon du grand public, à travers un processus de délibération formelle continue menée par les pouvoirs publics. Certains voisins ont manifesté contre et contesté juridiquement le projet, sans parvenir à l'arrêter ni à en faire un problème de niveau national.

Mots-clés: CSC, projet pilote, sensibilisation, communication, France, étude de cas.

Social aspects of Total's Lacq CCS pilot project

Minh Ha-Duong[a,*] Michèle Gaultier[b] Benoît de Guillebon[b] Gilles Mardon[a]

[a] CIRED/CNRS, 45 bis avenue de la belle Gabrielle, 94734 Nogent sur Marne, France

[b] APESA, 2, Avenue Pierre Angot, 64053 Pau, France

February 12, 2013

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1. Introduction

Total's CO_2 capture, transport and storage (CCS) research pilot project in Lacq –inaugurated in 2010– was not only a technical experiment, but also a social and legal innovation. Apart from enhanced oil recovery projects or projects where the captured CO_2 is a fatal byproduct of another industrial process, this was one of the first integrated CCS projects in the world at this scale, and the first to be authorized in France. During the two years of the experiment, about 30 000 metric tons of CO_2 per year were captured from a steam production unit retrofitted with oxycombustion in collaboration with Air Liquide. The captured gas was compressed to 27 bars and transported for about 30 km reusing an existing natural gas pipeline. The gas was then injected at about 50 bars through a reworked existing well into the depleted natural gas field of Rousse 1 rock formation 4 500 meters underground. Injected CO_2 quantities are low compared to initial natural gas quantities: The reservoir pressure, currently 30 bars, should be increased to 50-70 bars post injection, which remains well below the initial pressure of 480 bars.

* Corresponding author. Tel. +33-143-94-7381. Email < haduong@cired.fr. >

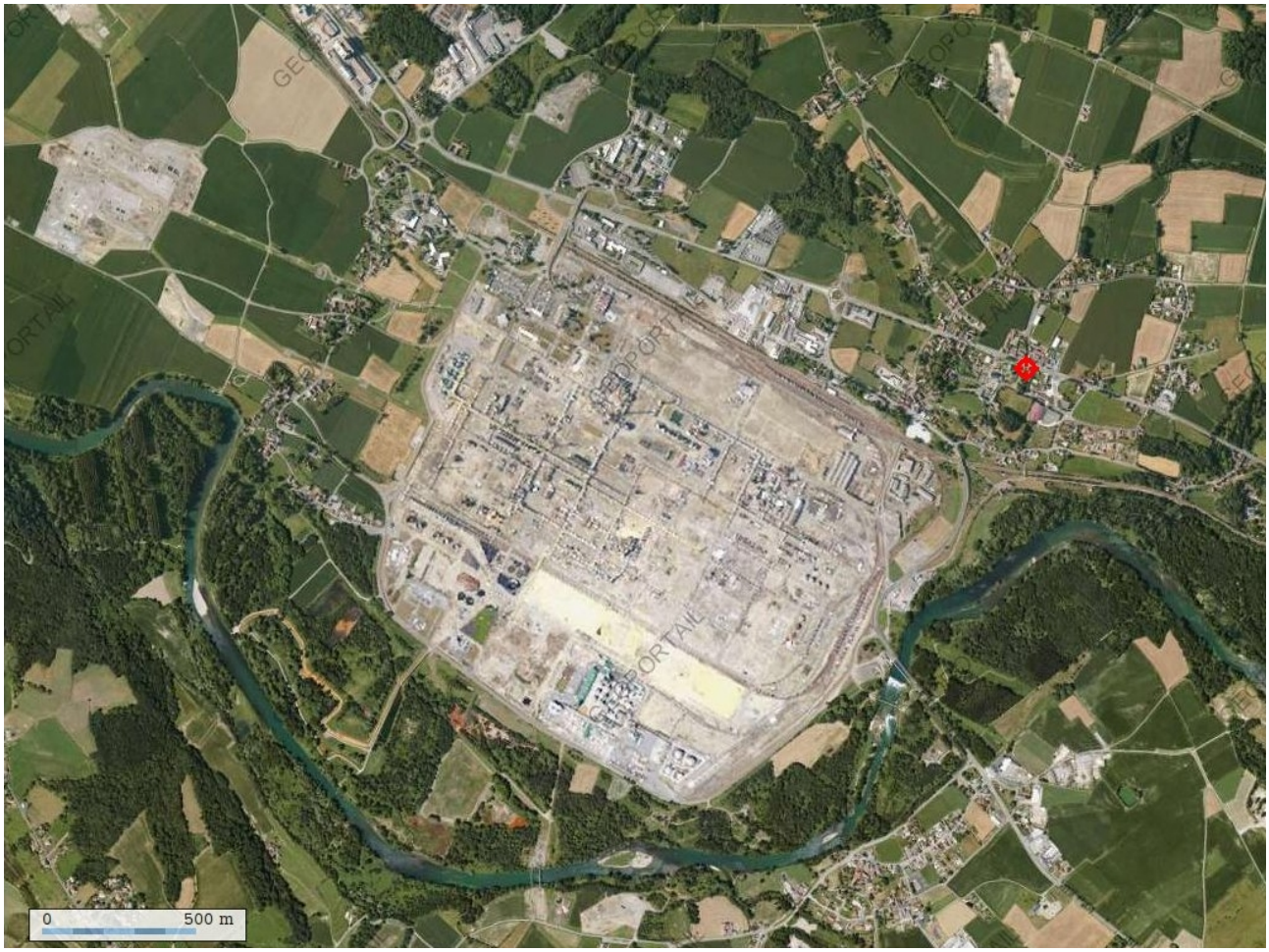

Illustration 1: Aerial view of the Lacq natural gas processing plant. Empty lots show the decline in industrial activity. Industrial risk and harmful effects do not prevent people from living close to the site (red dot). Image (c) Geoportail.

The project was conducted at Total's Lacq plant, in southwestern France. It included a comprehensive monitoring network. And in addition to the research based on science and engineering, it contributed to advances on the legal and social aspects of CCS in France and in Europe. The social aspect's significance arise from the relatively high stakes: a large population lives close to the storage area, in the city of Pau, 85 000 inhabitants in 2007. In the immediate surroundings of the storage area, the population is semi-urban or rural with low history of industry. After describing the context, this text will introduce the national and local actors. The project's story will be told in three parts: before and after the official permit request, and operations. The final sections will analyze broader impact as seen through the press coverage, summarize the lessons learned and conclude. Interactive versions of the timeline (Illustration 3) and the map (Illustration 6) are published as additional online material[1].

2. Local history

Total's integrated CCS pilot project takes place in a valley along the *Gave de Pau* river, in the *Béarn* cultural area, in the Pyrénées Atlantiques (64) department of France, see Illustration 6. The Lacq natural gas field was discovered accidentally at -3 550 m while digging for oil in 1951. It has been an important national asset for France, providing up to one third of the domestic natural gas consumption. Production peaked in 1982 at 33 million m³/day. But the flow has declined to under

1 Additional electronic material is located at http://minh.haduong.com/Lacq_CCS_Pilot/.

Illustration 2: Aerial view of the Rousse 1 CO_2 injection site in 2009, busy with equipments revising the well before injection (arrow). Surrounding landscape is hills covered with low density residential lots, wineyards, fields and patches of wood. In the background the cities of Jurançon and Pau are at approximately 5 km. Image (c) Total, used with permission.

10 million m^3/day by 2009, and the end of the field's economic life is announced for 2013. As Illustration 1 shows, there are now many empty lots in Lacq's processing plant. After 50 years of natural gas bonanza, economic development plans for the valley are being reinvented. Several specialty chemicals production facilities, a bioethanol plant, a carbon fiber plant and a combined cycle power plant have been attracted or are under consideration. In this context where the economic future of the area is at stake, Total's announcement of the carbon capture and storage project had a clear value to the community. The project fits with the firm's broader strategy to manage responsibly the plant shutdown, not only by supporting local small and medium enterprises through its subsidiary Total Développement Régional (Total DDR) but also by directly investing in training and R&D activities on the platform.

Lacq's natural gas is very dangerous, because it contains 16% H_2S and 10% CO_2. The gas is so corrosive that when the plant opened in 1957, special steels had to be developed (Lerat 1957). Yet the processing plant's safety record shows no fatal accident outside it, even though some inhabitants live very close as Illustration 1 shows. The risk is not only present near the plant. The gas field extends dozens of kilometers beyond Lacq, reaching under the city of Pau. Consequently there is a wide network of collection pipelines in the area. These may have a low impact for newly installed inhabitants, especially since some of them are no longer in operation, like in Rousse. But local citizens can have a memory or direct knowledge of the visual, air and noise pollutions that come from living in a valley rich in heavy industries (Briand 2006). Local institutions have experience with managing dangerous gases and pipelines risks.

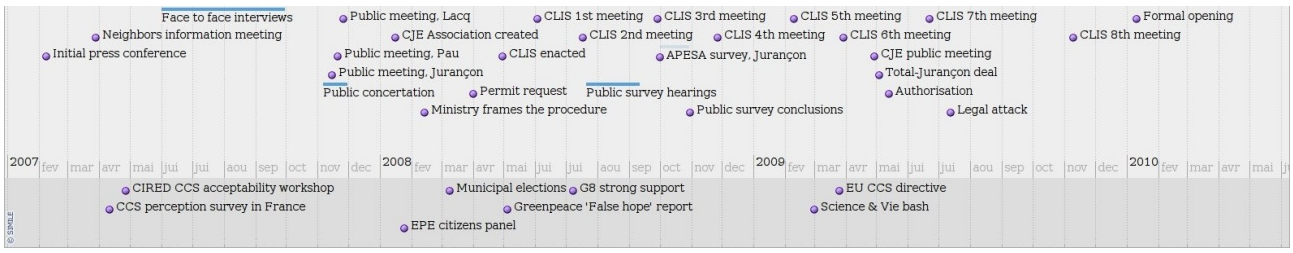

Illustration 3: Timeline of the Lacq pilot CCS project's concertation context. Events in the top part of the timeline are directly related to the project, while events in the lower part relate to the broader context of CCS in France. An deeper interactive timeline is at http://minh.haduong.com/Lacq_CCS_Pilot/timeline/.

According to (Grimot et al. 2002), since the beginning of oil and gas production in the area, various liquid streams have been re-injected in the geologic structures. Some of these liquids came from the underground fields themselves, some came from the processing plant. Injection of liquid waste from other chemical plants in the industrial park is presently authorized in the geologic formation known as "Crétacé 4000". Injection rate were maximal in 1978-1979 at about 1 000 m^3/day, at a cost around 10 €/t. This is an economic opportunity, as some chemical waste streams would require up to 600 €/t to process otherwise. According to (CCI Pau Béarn, Service Etudes & Aménagement du Territoire 2004) that opportunity is a significant asset for the region, as only 2% of the disposal capacity has been used up in 40 years. Following a recommendation by the French national commission on public debates (CNDP), in 2001-2002 a concertation took place on whether to renew the Cretacé 4000 permit (Maginot 2005), (Metras 2001). Even if all this was not tied to the CCS project technically, legally or administratively, it contributed to the local political culture of concertation about industrial risk and geological injection.

3. National actors

The Lacq CCS research pilot has attracted the attention of a number of different social groups. Each had its own representation of the technology, its benefits and the risks associated. The next section will describe these groups at the local level, this section describes the groups at the national level.

In 2008 the governmental view on CCS was supportive. France participated in international workgroups declaring that the development of this technology was an important option fore mitigation (Commission Of The European Communities 2008) (G8 2008). At the national level, three public institutions have a special interest on CCS:

- Bureau des Recherches Géologiques et Minières (BRGM), France's leading public institution in Earth science applications.
- IFP Energies nouvelles (IFPEn), a public research, innovation and training institution, whose mission is to develop efficient technologies, economic, clean and sustainable in energy, transport and environment.
- Agence de l'Environnement et de la Maîtrise de l'Energie (ADEME), the public agency on environment, energy and sustainable development. ADEME is under the control of three ministries: Ecology, sustainable development transport and housing (MEEDDAT); Higher education and research; Economy, finance and industry.

In 2002, these three public institutions created together the Club CO_2, to improve the coordination of French research in the field of carbon capture and storage. According to its chairman (Moisan 2011) "The members of the Club, which is chaired by ADEME, are all key players in industry, research and development. As a clearinghouse for information, dialogue and good practices among its members in the area of research and technological developments concerning CO_2 capture,

Public agency or public research institution	7	ADEME, BRGM, CNRS (INSU), Ecole des Mines de Paris, IFPEn, INERIS, IPGP (Institut de Physique du Globe de Paris)
Local business development organisation	3	Avenia, Grand Port Maritime de Marseille, Pôle Risques
Businesses (> 10.000 workers)	15	Air Liquide, Alstom, ArcelorMittal, Bureau Veritas, EDF,GDF SUEZ, Lafarge, Rhodia, SARP Industries (Veolia group), Saipem (group ENI), Schlumberger, SNET (E.ON France group), Technip, Total et Veolia Environnement.
Businesses (< 10.000 workers)	6	Geogreen, Oxand, SARP Industries, Setaram Instrumentation (KEP Technologies group), Sofregaz (Maire Tecnimont group), Soufflet

Tableau 1 : Club CO_2 membership, September 2011.

transport and storage, the Club encourages cooperation at national level between the public and private sectors, and several research projects have been started under its initiative."

Large, national-scale environmental non-governmental organisations (ENGO) were not members of the Club CO_2, as Tableau 1 shows. While by 2007, the ENGOs did not have a public position for or against carbon capture and storage, the following year Greenpeace demonstrated a disapprobative viewpoint in the "False Hope" report (Rochon & others 2008). That report's ideas were injected in the public debate around the Lacq CCS project by an article in a popular science magazine published in March 2009 (Gaullier 2009). Other ENGOs were less strongly negative. France Nature Environnement (FNE) was called in 2007 by local ENGOs around Lacq to take a position on CCS (Pépin 2009). The association questionned the long-term reliability and local risks of CSC; and stressed that the large financial flows for its development could be used for renewables, but suggested that in principle CCS could be admitted when other solutions are not available (Delacroix 2008). The Réseau Action Climat France (RAC-F), a coordination of leading ENGOs concerned about climate change, noted that the technology could reduce CO_2 emissions, but will be efficient only if it belongs to a set of measures based on legally binding and ambitious commitments, concluding that "CCS should not be an excuse to slow energy efficiency improvement actions and the development of renewable energy sources" (Moussally 2010).

A scientific follow-up comitee was created, to allow for the dissemination of the project's results outside Total and Air Liquide. This "open for outside research" policy was effective, more than a dozen research projects were conducted on site, many involving international partners. The French academic community was particularly mobilized by the project. Scientists participated in public discussion panels at townhalls meetings during the project's concertation phase. Several research seminars and open workshops were organized in Pau (December 12-13th 2007, September 4th, 2009; November 22-23rd, 2010). These manifestations were opportunities to disseminate up to date knowledge about CCS to local actors.

4. Local actors

When the project was started, Total was the fifth largest publicly-traded integrated international oil and gas company. It operated in more than 130 countries and had 96 950 employees (Total 2009). According to Chempark (2006), 861 persons were directly working for Total Exploration Production France in Lacq. In addition, the main research center of Total dedicated to oil and gas exploration (Centre Scientifique Jean Feger) was located in Pau, with more than 2 000 employees

(Total and subcontractors) working in this research center. Total is widely established in the Pyrénées-Atlantiques territory, and beyond its own employees it supports a network of economic actors. The balance of local economic and political power clearly tilted towards the largest French multinational.

Locally, the Direction Régionale de la Recherche de l'Industrie et de l'Environnement in Aquitaine (DRIRE)[2] administration represents the interest of the State. DRIRE has the responsibility to investigate the injection authorization request and prepare the decision by the Prefect, accounting for the national public good as well as the local communities and businesses. The DRIRE's key role in organizing the public dialogue will be discussed further in section 7.

The civil society directly engaged in or impacted by Lacq's CCS project involves neighbors, local communities and their elected representatives. The project spreads on 11 cities (see Illustration 6). This makes for a diverse panel of stakeholders and local interests, which can be summarized in three classes of communities:

- Communities close to the capture site benefit from industrial jobs at the Lacq plant. Their economic life directly benefits from the natural gas field, and what to do when it is exhausted is a critical question for them. The direct implication of Total in the local society, education, associations is also a source of positive company reputation. As a measure of the corporate solidarity demonstrated by Total, Arquizan (2008) writes that over 30 years, Total DDR lend 140 million euros to 500 starting companies in the department.
- The picture is different the other end of the pipeline. The population of wine growers and farmers is less affected by the employment situation in the Lacq industrial area. They belong to a territory of about 10 km² (1000 ha) officially recognized as producing "Vin du Jurançon", an Appelation d'Origine Controlée (AOC) quality label wine. This is an old tradition, as the first recorded sale of Jurançon wine at the abbey of Saint Vincent dates back to year 988 CE. Through the century Jurançon white wines have undergone ups and downs. Jurançon's royal fame goes back to 1553, when infant Henry IV's lips were rubbed with garlic and wet with wine from the local region at his baptism.
- Patches of the Jurançon territory have started to become residential neighborhoods for the larger Pau city.

The position of elected representatives reflects this variety of interests. Mayors in the Lacq basin publicly took position for the project from the start, and made it known to other players at the first CLIS meeting held on June 3, 2008. Mayors from the Jurançon hillsides did not take side during the project's concertation, which occured during the campaign period for municipal elections. After the March 2008 elections, the new Mayor took a stance by questioning Total's responsibility after its departure from the site. This would remain his main negociating position. The strength of the question was backed by the Mayor's position as a professional judge in Toulouse's administrative court, and its seriousness was recognized by the project's management.

Given the industrial history of the region, there are existing environmental NGOs watching over new industrial developments. At the start of the project, they had no defined position on CCS. Two existing associations jointly articulated an explicit argumentation opposing the project : Santé-Environnement-Bassin de Lacq and SEPANSO Bearn. In addition to the arguments against CCS as a technology expressed by FNE, they argued that the project was mostly useless, expensive and risky for neighbors considering the population density and seismic activity (Mauhourat & Lambert-Habib 2008). In addition, a specific association named Coteaux de Jurancon Environnement (CJE) was created by the citizens concerned by the injection project, in order to get informed and mobilize

2 This branch of the administration was renamed in January 2011 the Direction Régionale de l'Environnement et de l'Aménagement et du Logement (DREAL).

Highest influence			Préfecture des Pyrénées-Atlantiques DRIRE Aquitaine IFP, INERIS, BRGM	European Commission MEDDAT / DGEMP Lacq basin industrial companies
High influence		Coteaux Jurançon Environnement Santé Environnement du Bassin de Lacq Sepanso Béarn / France Nature Environnement	Conseil Général des Pyrénées-Atlantiques Pau town council	Communauté des communes de Lacq
Low influence	Neighbors National press	Jurançon town council Laroin town council	Monein town council	Mourenx town council
Lowest influence	Greenpeace international	WWF		Université de Pau et des Pays de l'Adour
	No support	Low support	High support	Highest support

Table 2 : Influence - support mapping of the stakeholders for the Lacq CCS project.

themselves. CJE and Sepanso actively participated in the official public discussions at a level where isolated citizens could not have attended directly.

To structure the list of actors, we organized a stakeholders analysis around the Lacq CCS project, independently from the consulting company hired by Total. Our study was based on face to face interviews in the field conducted in the first semester of 2007, participation at discussion workshops and a bibliographic survey (Pfeifle & A. S. Campos 2008). This describes the situation around September 2008, at the end of the public enquiry phase.

Based on that work, Table 2 locates the various stakeholders in the Influence / Support plane. The key players are those with both a high influence and a high degree of support for the project. They are located towards the upper right of the matrix. They appear to be the industry actors, institutions and experts. They are allied for the development of the field of CCS in France, and expect that the success of the pilot Lacq will only reinforce this position. Medias, national ENGOs and most but not all town councils had a minor role in the discussions. Ignorance about a new technology could explain why these players did not have a clear position and influence for the future of the industry. Overall, the top-left corner is empty. This shows that no opposition has been influential in the upstream phase of the implementation of pilot. The social context was favorable.

5. Residents of the Jurancon area around the injection site

We send a questionnaire survey to the fraction of the population of the city of Jurancon who lives in the area where the CO_2 was to be injected. The area is a mix of a rural area with agricultural activity (mainly vineyard) and a low density residential area with mainly wealthy families and a significant proportion of retired people.

The survey was sent nominatively, with a stamped return envelope. Jurancon city has a population of more than 7 000 inhabitants : the survey reached 1 206 mailboxes concentrated in the area of the pilot project. That is roughly one third of the mailboxes of the city.

The survey was send out in october 2008, after the formal public dialogue but before the authorization. At that time, most inhabitants could have been aware of the project either through the concertation organized by Total in 2007, or through the public inquiry which took place in the summer 2008.

The response ratio to the survey was 14%. Compared to the 8 to 10% response ratio expected for this type of survey, this was satisfying: 167 survey came back, 153 being completed, 14 with clear indication that they were not willing to respond. Those 14 correspond probably to the most radical part of CJE association, who did not want to participate to a survey which was seen as a way to weaken their position.

Given the population of the area, the proportion of retired people in the respondents was a high 42%. The share of respondents salaried in private companies was 28%, salaried in a public organization 12%, independent workers 12%, and unemployed 3%. This response ratio is also good considering also the survey's length: 89 questions. We organized them in 5 parts: general questions about the context, information about the CCS pilot, the concertation organized by Total, the formal dialogue (public enquiry and CLIS), social acceptance.

5.1. Context. The first set of questions was about the general and local context of the CCS pilot. We meant to evaluate the sensibility of the respondents to the global environmental and social issues.

To the question "Among the environmental issues, which do you feel to be the more worrisome? (two possible answers)", climate change came first (48%), before water pollution (29%), air pollution (26%), forest destruction (21%), over exploitation of agricultural resources (15%), soil contamination (13%), ozone layer reduction (10%), GMO (9%), and noise (5%).

At the next questions, 82% completely agree or agree with the idea Humankind is completely responsible for the climate change and 91% completely agree or agree that it is urgent to act against climate change. When asked the question of what to do, the respondents massively answer renewable energies and reduction of energy consumption. Among the CO_2 sequestration techniques, the respondents choose the biological solutions first (storing carbon in forests), before the geological storage.

This result may reflect a simplistic vision of a biological solution where the CO_2 is "destroyed", as opposed to a vision of the geological disposal, where CO_2 is only stored with the risk of leakage.

After the series of questions on the global issues, the survey goes into questions on local issues. And the answers are significantly different than for global questions. When asked which of the local problems is the most worrisome, climate change comes only in seventh position after poverty and exclusion, environmental degradation, globalization, unemployment, technological risks and safety/terrorism.

5.2. Information about the CCS pilot. Although information has been spread through newspapers, meetings organized by TOTAL, and the formal public dialogue, there was still 7% of the respondents who said they had no information. About 40% indicated that they became first informed in 2007 (concertation organized by TOTAL), another 9 % at the beginning of 2008, 28% in the summer of 2008 (during the public inquiry) and 16% in fall 2008 (at the time of the survey).

When asked about how they were informed about the project, 41% of respondents cited the local press and other media. Total's newsletter sent by mail and the information meetings were the information source for 27% of the respondents. The rest got mainly their information by word of mouth (24%). Only 10% of respondents declared to have accessed Total internet site or others internet sites. Yet 55% of the respondents declared that the information they have on the pilot is not sufficient.

When asked to indicate the interesting aspects of the pilot (several answers permitted), the

respondents massively cite the scientific interest (65 responses). The economical development (29 responses), employment (27 responses), industrial attractivity (23 responses) are also cited, but less.

5.3. The concertation organized by TOTAL. 40% of the respondents knew that Total organized concertation meetings. This information came to them mainly by the press (57% of respondents). Only 13% of the respondents were present at those meetings. Even less (7%) had knowledge of the proceedings and outcome of the the meetings.

When asked "which information source can provide you additional information on the project" (several answers permitted), Scientists come first (60 answers). National environmental associations come second (35). The less often answered information sources were Total, the local politicians and the local associations, with about 20 citations each.

5.4. Formal public dialogue (organised by the Prefect). 70% of the respondents said that a public inquiry was important to take account of the neighbors' interest in the project. But only 9% said that they participated effectively to the public inquiry. 33% of the respondents declared that they have heard about the existence of the Commission locale d'Information et de Suivi (CLIS), and only 10% had been informed of the results of its first meetings.

5.5. Social acceptance The storage of CO_2 is re-using an old gas extraction well. People in Jurançon are used to see in the landscape gas wells and gas pipe manifolds which have been operating for more than 40 years. When asked if they felt that Total had a good risk management on those wells and pipes: 40% responded yes, 18% no, and 40% did not know. 31% declared having experienced some nuisance from these installations, while 69% had no nuisance.

We asked if there was still a need to negotiate on the pilot's implementation: a majority of respondent (51%) were positive. A small minority (15%) felt there was no need for additional negotiation, and one third had no opinion. These answers come after the public consultation.

Asked about who should participate in the negotiations on the pilot's implementation, respondents covered a wide range of stakeholders as follows: Neighbors and their associations (35%), local elected representatives (25%), environmental associations (22%), local services of the State (13%), and other interested industrials (5%).

Finally, we asked under which conditions could the respondent subscribe to the project (several answers permitted). Environmental protection guarantees came first (72 answers), along with safety guarantees (68 answers) andguarantees on the long term future of the injection site (51 answers). A few responses mentioned respect of the cultural heritage (21 answers), jobs creation (20 answers), and financial compensation (15 answers). Five respondents answered that the existing conditions were enough, as opposed to 32 who indicated that they would not accept the pilot under any condition.

Results to the questionnaire confirm the wide mental difference between the local and the general scales. Locally, social issues and local environmental issues are felt more important than climate change, probably seen as too far from immediate concerns of people.

Results on information shows that it arrives mostly through mass media (the press) and word of mouth. There is a low proactivity in the search of information. Results also suggests that people have well constrasted opinions on the quality of their information sources. The low use of the available information could be due in part to the mistrust in information provided by TOTAL. Our results here are similar to those found by (Huijts et al. 2007) and other opinion surveys reviewed by (A. sofia Campos et al. 2010).

Having started at the beginning of 2008 before the public inquiry, the CLIS had met several times at the time of the opinion survey, its proceedings were available on the web. Answers about the CLIS and about the public enquiry corroborate the idea that, except for radical opponents, people have

low motivation for direct participation in the formal public dialogue organized by the law. This result fits with the general conclusion of (Fourniau 2011) that the French model of public debate is waiting for a rebound (Pancher 2011).

Since most people do not engage themselves in the concertation, to them the cost of negotiation is very small. This may explain why the demand is so high. Even after the significant diligence of the industry and administration, most respondents asked for more discussions regarding environment, safety and long term follow-up. This points at the relevance of an enduring negociation commission, the CLIS, as opposed to the one-shot public enquiry.

6. Announcement, social characterization and concertation (2007)

Illustration 3 shows the project's timeline. The final investment decision was taken at the end of 2006, and the first press release occured on February 8th, 2007 (Total 2007b). The project initially aimed to inject up to 150 000 t CO_2 starting at the end of 2008. The costs –60 million euros capex, plus 10M€ per year opex– are supported privately by Total. A scientific committee advises the project and allows to maximize the research spillovers to the academic world. All leading geological research institutions in France: Institut Français du Pétrole (IFP); Bureau de Recherches Géologiques et Minières (BRGM); Institut National de l'Environnement Industriel et des Risques (INERIS); University of Pau Pays de l'Adour (UPPA); Institut de Physique du Globe de Paris (IPGP) as well as TNO are scientifically collaborating.

Total's outreach activities, comprehensively reported on their website (Total 2008) were voluntary and started well in advance of the administrative process. C&S Conseils, a specialized communication consulting company from Paris, helped to study the social context, define the methods, conduct the concertation and write the associated materials. The initial announcement was closely followed by a public information meeting held at Jurançon in March 2007. This was held with neighbors of the Rousse future injection site. Globally, there was no negative feelings at this meeting. The discussions were rather questions about the possible consequences, noise or visual impacts, zoning change and financial compensations for the city.

A social characterization study to organize the concertation was performed next. Between June and September 2007, C&S Conseils conducted about forty interviews with local and regional actors: elected representatives including all the mayors of the cities crossed by the pipeline, administrations, associations, businesses; and with the members of the project's scientific follow-up committee. The study led to the concertation itself, that included:

- Commitment to a "Charte de la concertation" (Total 2007a) in which the company states the transparency guidelines according to which it promises to conduct the concertation. A guiding principle was that "All participants to public dialog do not take part in the final decision but all participants in the decision making take part in the public dialogue. "
- Publication of a 52 pages brochure (C&S Conseils 2007a) and its 8 pages synthesis (C&S Conseils 2007b) The documents are organized around four topics: climate change; the CCS technology; the goals and characteristics of the pilot project; and the impacts and conditions of implementation.
- A section of about 10 pages on climate change, CCS and the project on Total.com web, and an exhibit on the project displayed at meeting places and at the Pau airport.
- Oral presentations and Questions/Answers sessions at three public meetings organized in the town-halls of Jurançon, Pau and Mourenx. A total audience of about 300 participants attended the meetings, each about two and a half hours. Talks by Total representatives were complemented and discussed by national experts from outside the project.

Meeting summaries were published on Total's website (Total 2008). Discussions with the public about local effects were related to security, land value, image risks for other activities like wine growing and visual impact on the site. Discussions on regional effects centered on economic attractivity, industrial development, jobs and fiscality. General discussions on CSC examined its costs, scale, additional energy needs, regulation, public subsidies, long term responsibility and risk control.

According to (Total 2008) the outcome of the concertation was first a clarification the agreements and disagreements. All participants agreed that: climate change is an urgent issue; increasing energy conservation, efficiency and renewables is more important than CCS; a governance open to civil society is a goal to reach; the project contributes to the economic renewal of the area; and security and mastering the risks is an absolute priority. There was two points of dissent: the potential of CCS against climate change; whether CCS should be regulated under the Mining code or the code of the Environment, a point liked with the question of the legal status of CO_2 (waste or not).

There was several substantive outcomes of the concertation. First, an information day on climate change and its mitigation was decided, held on October 2nd, 2008 in Pau's historical congress center (Penot 2008). Second, it was agreed to continue the dialogue by setting up a local commission on information and follow-up (Commission Locale d'Information et de Suivi, CLIS). Third, Total promised they "will help local projects related to climate change mitigation (provided they are supported by the city)", and that discussions on taxes could be opened. Fourth, after the concertation the project's neighbors formed an association: Coteaux du Jurançon Environment (CJE), officially registered on January 16th, 2008. Fifth, the technical plan was amended to decrease the visual impact and the noise. It was decided to locate the compressor at the injection site inside a shelter.

7. Formal dialogue and authorization (2008-2009)

In France, large industrial projects have traditionnally been justified by public service (*utilité publique*) and technical progress. The State had the ultimate authority, caring for the general interest in the second half of the twentieth century under the overarching goal of building a modern nation. Today, this centralized viewpoint is fading in popularity. Civil society demands more and more to be associated in decision-making processes on spatial planning or large industrial projects. This opening of the public decision to include more the citizens has been formalized in a stream of legal rules started in the mid-seventies with the environmental impact assessment law (République Française 1976) and reviewed by (Pelchat 2002) in the context of the Aarhus convention.

Total filed the formal authorization request (Demande D'Autorisation d'Exploiter) with the Prefecture des Pyrénées Atlantiques in April, 2008. The Préfecture des Pyrénées-Atlantiques, representing locally the French State, was in charge of examining the permit request. This was the first CCS project to be processed in France. The central ministry send a framing note to the Prefect (circulaire MEDDAAT du 14 février) early 2008. This note was based on the existing national regulations on mining, waste, industry and transportation, and closely considered the draft of the EU Directive on CCS was closely considered, even if it was not legally in place yet.

At the same time, the construction of the legal framework was informed by the available expertise on CCS, such as the one provided by the BRGM for example. France's comments on the EU CCS Directive draft, accounted for the hearings of the managers of Total's project. Thus, the project contributed to the formation of the legal and social regulation of CCS in Europe.

During the spring of 2008, Total continued the communication and dialog meetings with mayors and neighbors, including a workshop with the Jurançon municipal council in July 2008, and an open site visit complemented with an information letter to neighbors in December 2008. Total maintained

a dedicated telephone line for enquiries about the project, and published a quarterly newsletter.

Formal discussions on the project were conducted mostly at the CLIS ad-hoc commission. It was officially enacted on April 30th, 2008 by the Préfecture des Pyrénées Atlantiques. In the absence of CCS law, the CLIS was created using the legal model of commissions established to follow-up landfills and the Crétacé 4000 CLIS. It includes the various components of the social body: 1 State representatives; 9 locally elected officials; 2 delegates from workers' unions; 4 from associations; 5 experts and 4 Total employees. The CLIS was established to discuss the authorization request and will sit at least for all the project's life. It met 8 times between June 2008 and December 2009.

The CLIS hears formal reports on the project from Total and experts like the BRGM. Its website (Commission Locale d'Information et de Suivi 2010), hosted in Préfecture's official website, provides access to the discussions reports and a significant range of supporting material. The CLIS visited the installations twice. At the first visit, it discussed on site with neighbors, ultimately making a press release about the project, but did not conduct a formal public meeting at the storage site. The CLIS also asked for and heard a report on the history of accidents with natural gas in the area, reviewed the monitoring plan, security exercises, a local perception survey. It reviewed and improved the authorization document draft.

Associations opposing the project, CJE and SEPANSO Béarn (a federation affiliated to France Nature Environment), participated actively in CLIS meetings. At the outset, CJE was initially motivated to learn and understand. Its approximately 120 members are from diverse socio-professionnal background, and includes both rural people established in Jurançon from a long time and newly arrived inhabitants. Moderate members are ready to discuss with Total. At the end of the summer 2008, the association was not ready to organize big demonstrations, but could mobilize reliably a more radical fraction in total opposition to the project, protesting for example in front of the injection site during the CLIS site.

- CJE's scientific advisor summarized the objections in a column published in a leading national newspaper (Pépin 2009). Total was generally depicted as a big bad corporation that cannot be trusted to develop CCS acceptably, viewing its concertation efforts as mostly marketing and communication. The risk analysis was criticized for not considering massive release scenarios, and the security exercise for not directly involving neighbors.
- Opponents to the project questioned the independence of the BRGM, involved both in the project and in reviewing Total's permit request. CJE argued that the project could have been reviewed by an inter-disciplinary panel including foreign experts. BRGM replies with four arguments. First, BRGM is legitimate to examine the permit request because it is the public reference establishment for geosciences. Providing technical expertise to the administration is one of the core missions for which it has been created by the government. Second, the assessment was made only for the aspects in which the BRGM was competent, the expertise was conducted by a newly created unit of 13 specialists of security and impacts of CO_2 storage (Bureau de Recherches Géologiques et Minières 2009). Third, this unit's personnel was not implicated in site selection and characterisation studies, and BRGM's researches currently led in partnership with Total at the Rousse site are disjunct from the injection permit request. Finally, it would have been difficult to find CCS experts, that were never involved in a joint research project with Total.
- Disagreements about the share of CCS in climate policies persisted. Opponents stated for example that IEA CCS scenarios are over-optimistic. SEPANSO raised these issues. They were not accepted as relevant by the CLIS, as they pertains to a national debate on policy choices between energy efficiency, renewables and cleaner fossil fuels.
- The opposition requested more technical reports release. Total argued commercial reasons to

keep some documents non-public, but invited the experts to consult them on their premises. The CLIS president noted that the legal recourse against the permit may hinder transparency.

An administrative public enquiry was held from July 21 to September 22, 2008 in 4 cities. Participation was very weak in Lacq, weak in towns along the pipeline, 90% of the comments were received in Jurançon. CJE criticized this administrative public enquiry on the grounds that it was conducted during the summer vacations, and the final advice was positive while 56 out of the 60 recorded comments were negative (Préfecture des Pyrénées Atlantiques 2008). The surveyors indeed assessed that the replies by the project-holder to the objections raised by the citizens were satisfying. The survey is not a vote, and 60 self-selected voices, that is less than 1% of the population, are not representative.

A final technical problem had to be examined before injection: signals from the three seismic sensors at the bottom of the well were lost, probably because a broken optical fiber. Total proposed to replace the sensors, but since that would take 9 months, to start the injection in the meantime. Without the sensors at the bottom of the well, the seismic monitoring network would comprise only the 7 sub-surface sensors, buried 200 meters. The permit specified that it was the operator's responsibility to determine the necessary number of sensors. Total's case that the incomplete network would be enough to monitor the site integrity was reviewed positively by two independant experts teams, so the Prefect did not cancel the autorization.

Municipal elections were held in March 2008.The project was not a stake of the campaign debates, as it was a politically risky topic with little to gain. The newly elected mayor in Jurançon initially took a stance against the project, backed by an unanimous vote of the municipal council. The building permit for works needed at the injection site was not granted immediately, it had to be revised.

Besides Jurançon's Mayor and the Lacq's cities community (communauté de commune de Lacq), other local elected leaders were mostly abstent from the negociations. Starting from that tense relationship, after several discussion meetings and site visits the Jurançon's Mayor position evolved and became favorable to the project. The move dissatisfied a fraction of the population. A partnership agreement was signed in April 2009. The agreement was described by Total (De Marliave, personnal communication, 6/10/2010, our translation) as follows:

> *Total has signed multiple patronage and sponsorship agreements in the Aquitaine region for decades, and Total Exploration Production France (TEPF) has a 50 years history on these oil production sites. This new storage project was hence framed in the broader context seeing the end of TEPF activities in Lacq and the satellite fields by the end of 2013, due to gas reserve depletion. This decline of an historical activity important for the region is subject to a policy of support and assistance in regional re-industrialisation. It is also notable that the CO_2 injection required to stop the natural gas production from the well, which was modest but nevertheless represented a direct income for the town.*
>
> *Within this overall framework and without any mention of specific Rousse pilot, a sponsorship agreement in the amount of € 1.5 million was signed with the municipality of Jurançon to assist in the implementation of community projects especially in the field of sustainable energy (solar panels). More recently, the press echoed a sponsorship agreement of TEPF for the Region (an amount of €5 million was mentionned). This agreement is linked to the reduced activity of TEPF due to the end of the gas exploitation, and its connection with the storage project is all the more tenuous that the project has been underway since May 2009.*

We found indeed that the sponsorship agreement was not all new money specific to the new storage project, but rather a consolidated reapraisal of already granted helps.

The capture, transport and storage project was permitted on May 13, 2009, that is 27 months after the initial press conference. There are no injection taxes. On January 11, 2010, Valérie Letard, State secretary in charge of green technologies and climate negociations, with Christophe de Margerie, Total CEO, inaugurated the carbon capture and storage research pilot.

8. Operations (2010-2012)

The following summary of the project's operational phase is based on Monne (2012). At the Lacq plant, an existing boiler (constructed in 1957) was revamped for oxycombustion, adding recirculation. With four 8 MW burners, the 30 MWth oxyboiler produced 40 t/h of high pressure water vapor at 60 bars, 450°C. This boiler was fed by an Air Liquide's Air Separation Unit (ASU) which produced 240 tO_2/day. The flue gas was then processed through a cooler, a wet CO_2 compressor and a dehydration unit.

All those treatments allowed to produce a gas containing 92% CO_2, 4% O_2, 3,7% Ar and 0,3% N_2 which was then transported through an existing pipeline to the injection site in Rousse.

At the Lacq plant, the ASU worked to nominal specifications, the boiler worked well. The main technical problem encountered was corrosion in the wet stream compressor which led to a significant downtime in 2010. Temperature and pressure conditions at the third stage of the compressor make water and NOx remaining in the stream to condense as corrosive nitric acid. After various modifications (lowering of the cooling point, increasing drying) , the system restarted in August 2010. During the rest of 2010, it was cautiously operated below maximum capacity. The problem could have been avoided by using a stainless steel compressor, or by using glycol washing rather than water washing. These options would have been significantly more expensive, and engineers did not expect the concentration of NOx at the boiler's exhaust to be as high as 500ppm.

At the Rousse platform, the gas was compressed to be injected in the reservoir at -4000m. The injection compressor worked on design, but an operation error during a restart led to particles entering the cylinder and required repairs.

One of the main concerns being the rupture of the well due to a seismic event, a comprehensive seismic monitoring system was operated: three microseismic sensors at the bottom of the well and a network of seven 200 m wells with four microseismic captors each. The system was sensitive enough to localize a magnitude -1 seismic event with a 250m error margin. Operation rules prescribed to stop injection in case of an event of magnitude 3 or higher[3].

The three microseismic sensors at the bottom of the well failed to function before the beginning of operations.Opponents argued that this was a cause to cancel the project's authorization. In reply, Total demonstrated that the surface microseismic network provided good enough monitoring, to the satisfaction of the administration. After one year of operations, the failed bottomhole sensors were replaced during a well workover. Inspection of the tubing during this workover showed no corrosion in the tubing.

Seismic monitoring in operation recorded three events with magnitude between -1 and -0,3. The bottomhole sensors recorded numerous seismic events with a magnitude between -3 to -1,5 which is too low to impact reservoir's integrity and hard to localize. Their interpretation and attribution to natural or man-made causes is ambiguous because there was no baseline with bottomhole sensors. The seismic baseline was acquired with the surface network only, and showed the activity of the

3 The energy contained in earthquakes is qualified using the Richert magnitude scale. A magnitude -1 event releases about 2 kJ. This is the muzzle energy of a standard NATO rifle round. The scale is base 10 logarithmic. A magnitude 1 event releases a thousand times more energy than a magnitude -1 event, and a magnitude 3 event a million times more than a magnitude -1 event. Events with magnitude lower than 2.0 are called microearthquakes and normally cause no damage to life or property, and are very rarely felt by people.

nearby Pyrénées mountain range.

The pressure in the reservoir increased with injection and is forecast to reach around 100 bars at the end of 2013. This is consistent with the higher of the two model simulations performed before observations. There is no evidence of either increase or decrease of the injectivity index. This is also in line with theoretical studies. It is forecasted that in two or three centuries, most carbon dioxyde will slowly fall towards the bottom of the reservoir, leaving the well area methane-rich.

Monne (2012) argued that the majority of theses issues are normal operational risks for this kind of engineering projects, not specific to the CCS innovation. He also reported that because this was an innovative project, the company was expected to reply to the media urgently when anything out of order happened.

A comprehensive ecological monitoring plan was conducted. Concentration, fluxes and isotopic composition of CH_4 and CO_2 in the ground were measured in 35 places, twice a year in autumn and winter. Water was analyzed in four springs every six months, five rivers and aquifers. Annual flora and fauna inventories revealed no change since 2009.

To sum up, until October 2012 the project injected 47 000 t of CO_2, demonstrating the technical and social feasibility. The closing and post-closure phases will also be innovations, from technical and administrative point of views.

9. The broader social impact, evidence from the press

To assess the project's social impact beyond the Lacq - Jurançon axis, we researched the main newspapers in France, looking in their online archives for mentions about CCS, over 2005-2012.

At the national scale, we looked at three influential general news titles *Le Monde*, *Liberation* and *Le Figaro*, and the two influential business news titles *La Tribune* and *Les Echos*. We observed that the Lacq project was mentionned only sporadically, always in the context of the more general question of CCS. More precisely, since 2007 on average CCS is mentioned about once per month in these journals (about 15 times per 3 months, for 5 journals), with the exception of the last quarter of 2009 when the Copenhaguen conference was discussed. We conclude that this local project never became an object of debate at the national level.

In the region of Aquitaine, the dominant newspaper is *Sud Ouest.* This daily journal, founded in 1944, is France's third largest regional newspaper with about a million paper and online readers according to themselves (Sud Ouest, 2013, based on an Audipresse One 2011 study). Over the 2005-2012 period we found 126 articles mentioning the project. The median text length was 281 words, average 322, minimum 41, maximum 1 410. The sample includes about 15 duplicates (generally not published on the same day), since the journal shares editorial content in its 21 local paper editions and its website. Illustration 4 shows the time distribution of these articles.

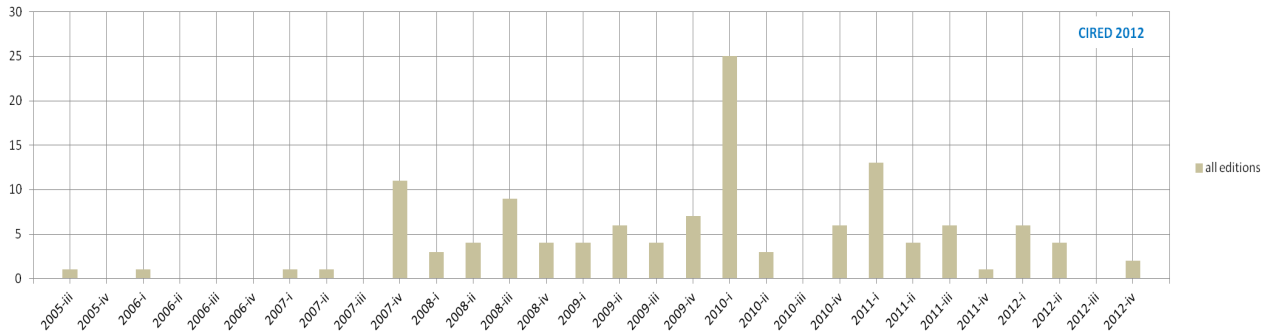

Illustration 4: Mentions of Total's pilot CCS project in the journal Sud Ouest.

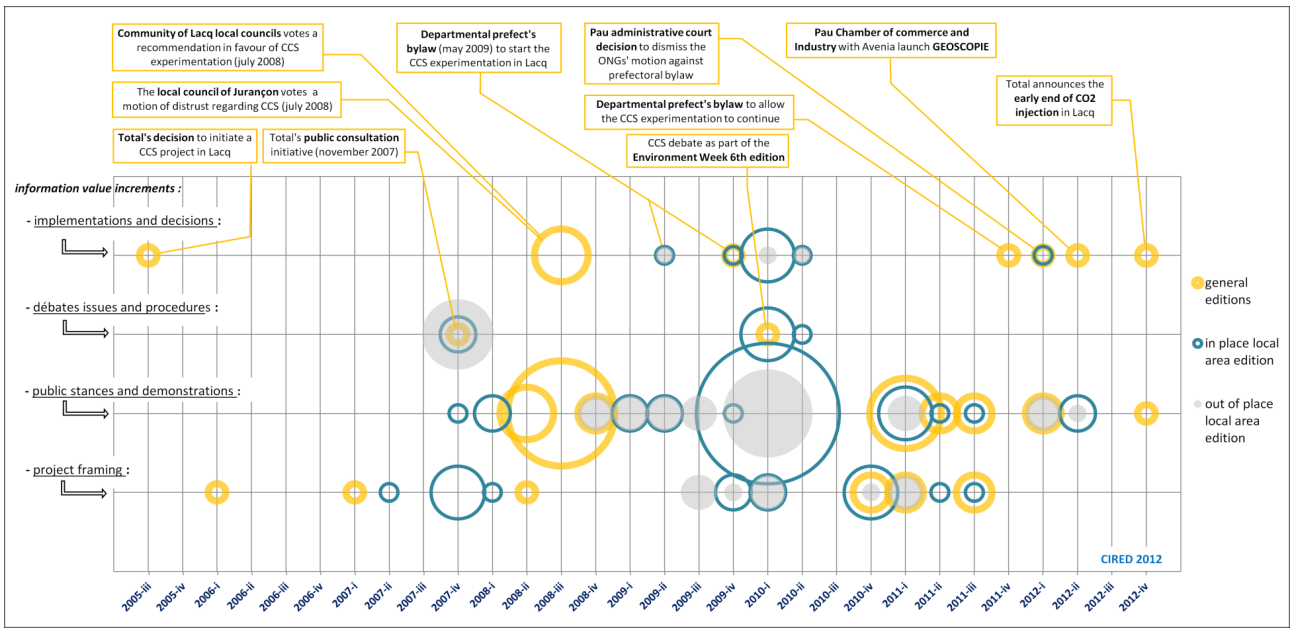

Illustration 5: Angle of the papers about Total's CCS project in Sud Ouest

We analyzed the content by encoding it along two dimensions. First, was it published (i) only in the local editions for Lacq, Rousse and Pau ; (ii) in another local edition ; or was it published (iii) on the web or in newspaper pages common to all editions ? Second what was the angle of the paper ? We distinguished four possible angles: (i) Framing about the project, (ii) Framing about the public stances, demonstration, or opposition. (iii) Framing about the debate issues and procedures, (iv) Implementation and decision. These four angles correspond to stages of a social political decision process. These stages are not irreversible steps in a waterfall decision-making procedure: deliberative processes can iterate back and forth as needed.

Illustration 5 shows the distribution of articles over time along these two dimensions. The project had four defining events. These correspond to the local maximum in Illustration 4, the times where the project was discussed relatively more in the press, and from an higher angle. They are:

- The concertation organized by Total in the final quarter of 2007.
- The positive vote of the local city's association of Lacq (communauté de communes de Lacq) on July 3rd, 2008. A few days later, the city of Jurançon voted a motion of distrust (despite being represented at the local city's association of Lacq).
- Inauguration in January 2010. Surprisingly the inauguration was treated as a news of local interest, as opposed to the July 2008 vote which had been reported in the general editions of the regional press.
- Debates in 2011 about wether the injection permit, initially given for two years, should be extended. The administration's positive answer on November 14, 2011 remained a low importance news item. The extension permitted injection up to July 8, 2013. It restricted the total quantity of CO_2 injected to 90 000 t instead of the 120 000 t previously granted. This was in agreement with norms defined by the newly published European directive on CCS research projects and did not threaten the project's technical or scientific value.

Overall, we conclude that in the regional press the project existed as a news topic between 2007 and 2011. A public debate existed before and after the public consultation period. But while the debate about the after-Total and the industrial future of the area remain active, the debate about the local consequences of the CCS project was sidelined during 2012.

10. Discussion, lessons learned and conclusions

In this case, Total demonstrated a strong will to engage a concertation, allocating significant resources early on: hiring a consulting firm and allocating senior engineers time to answer the questions. The concertation covered the whole territory from Lacq, where acceptability was likely from the start, to Jurançon where things were more delicate. The social conditions were very favorable to the project. For two generations, the operator has been the first economic and therefore political power in the area, and has consistently demonstrated that it could control higher risks. The project answered local needs for economic development directly and indirectly, in the long run context of the gas field depletion. Research on CCS is supported nationally and internationally by scientists and States. All these reasons contribute to explain why the permit was obtained.

Still there are lessons to be learned. Total's position would have been stronger if its permit request had been expertised by a different team, and if it had more specific long-term plans. Because concertation meetings were held before elections, the local officials could only take a non-commited stance. Using a parisian consulting firm to moderate the discussion, and employing hostesses to hand out the information packages was not appreciated by the people of Jurançon. Total, following the advice of the president of the national commission on public debates, did not mass-mail the community with information on the project. Consequently, citizens came to the meetings to receive information, not to defend a stance in a debate. Another reason why the public participation in the discussion was low is that smaller formats might have been more interactive.

This case exposes the difficulty of modern governance. A balance between concertation, information and representativity has to be found for each issue, depending on local ethics and customs as well science and technology. As concluded by Ha-Duong and Chaabane eds. (2010) this balance can only be found pragmatically. Technology policy is progressive and interactive, it needs projects to go forward. The project contributed to the regulation framework itself. The CLIS worked well, but the formal public survey came late in the procedure and did not interest much the citizens. Risk management studies were revised, and landscape integration in the environment was improved. Landscaping is the sensory interface with the community.

The process of consultation which aims to be a process of open dialogue was strengthened and legitimized by the foundation of the residents' association CJE. The radicalization of CJE's position during the concertation process impacted the balance of the public discussions with the project holders at CLIS. Total had to adjust its position, and could not do without an understanding of the values expressed by the public at meetings of the association.

It might have been presumed that since geological storage is a highly technical subject, there was some rationality in technocratic decision making, where executive powers are delegated to elected representatives and State's engineers. Most citizens know little to no geoscience, and might err on the side of too much precaution when asked about an R&D project, since research means that there is a knowledge gap somewhere. In this case, the argument needs discussion, since some neighbors were perfectly knowledgeable about the Rousse reservoir, having worked at Total. We observed that the citizens tied with Total, retired or still active, exercised self-restraint in the public debates.

The case also highlights the issue of independance. As for many new technologies or drug assessments, CCS experts generally have an interest in the development of CCS. And local people in the administration, the industry and even the environmental associations mostly belong to the same social network. We believe that far from being a problem, strong communication links on the human side is an asset for governance. Beyond sharing knowledge, a key to the successful co-construction of a social innovation is the widening and deepening of the social network behind it. In this case, giving information empowered the local community to act. Having concerned citizens ask pointed questions to the experts balances power. The fact that the concertation led the neighbors to create an association of opponents probably improved the quality of the CLIS debates.

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12. Appendix: supplementary illustration

Illustration 6: Map of the CO_2 pipeline from capture at the Lacq natural gas processing plant (north-west) to the Rousse 3 injection site in Jurançon (south-east). The 29 km gas pipeline starts in Lacq (legal population 716, according to). It then crosses the cities of Abidos (pop. 237); Aubertin (649); Artiguelouve (1 505); Lagor (1 241), Os-Marsillon (494); Mourenx (7 734); Mont (977); Noguères (154); Parbayse (249); Pardies (959); Laroin (946); Saint Faust (781) and arrives in Jurançon (population 7 241, density about 370 people/km²). Pau, the big city just north of Jurançon, has 86 772 inhabitants. Source: CIRED, cartographic data (c) OSM. Inset map (c) Wikimedia commons.

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