Available online at www.sciencedirect.com

ScienceDirect

Energy Procedia 114 (2017) 7367 – 7378

Energy Procedia

13th International Conference on Greenhouse Gas Control Technologies, GHGT-13, 14-18 November 2016, Lausanne, Switzerland

Making the communication of CCS more "human"

Samuela Vercelli[a]*, Salvatore Lombardi[b], Federica Modesti[b], Maria Chiara Tartarello[b], Maria Grazia Finoia[c], Davide De Angelis[b], Sabina Bigi[b], Livio Ruggiero[b], Stefano Pirrotta[b]

[a]*Sapienza University of Rome - CERI, Dpt. of Civil, Construction and Environmental Engineering, Via Eudossiana, 18, 00184 Rome Italy*
[b]*Sapienza University of Rome - CERI, Department of Earth Sciences, P.le A. Moro, 5, 00185 Rome, Italy*
[c]*ISPRA, Intitute for Environmental Protection and Research, Via Brancati, 48, 00144 Rome, Italy*

Abstract

CCS communication has proven a tough challenge, particularly for the difficulty in raising interest for the technology, which is still unknown to the majority of the population, and for the complexity of conveying information about its potential for reducing emissions. In this paper we present a research based effort for bringing CCS nearer to people, through visual material developed taking into account emotional needs related to the technology. The production of a short introductory film on CCS is illustrated and its testing with a sample of 700 high school students.

Peer-review under responsibility of the organizing committee of GHGT-13.

Keywords: CCS communication, carbon capture and storage, CCS video, storytelling, public perception, emotion, McClelland, CO_2 storage, energy transition, GHG reduction

1. Introduction

The scope of this paper is to illustrate an approach to CCS communication and education that connects both to human and technical dimensions, giving due importance to affective and relational aspects. It explains how such an approach has been used to develop a dissemination tool for wide outreach, aiming to stimulate interest in a technology that is often perceived as something remote.

* Corresponding author. Tel.: +393472629398; fax: +390649914918.
E-mail address: samuela.vercelli@uniroma1.it

Peer-review under responsibility of the organizing committee of GHGT-13.
doi:10.1016/j.egypro.2017.03.1868

CCS can be considered a relatively mature technology, however research clearly indicates that it is still mostly unknown to the general public. Given the scale at which it should be deployed to be effective in significantly reducing CO_2 emissions, the present gap in public knowledge and understanding of the technology can be seen as a major obstacle, hindering the potential of the technology, which many experts consider today a cost effective way to reduce emissions.

The need for scientifically appropriate dissemination materials is therefore as urgent as ever. However the efforts to spread the word about CCS have often met with difficulties related to its very technical nature, the size of the installations and scale of deployment required, the scarce geological background of the majority of the population and also the rather indirect concept that geological sequestration represents, with regard to energy strategies and climate change. Last but not least, it has to be taken into account that the involvement of the public in CCS implementation, is less direct than for other technologies which can help us reduce CO_2 emissions, like solar, wind, geothermal, etc. In conclusion, the development of social representations [1, 2] of the technology is progressing very slowly as well as the necessary public participation in decision making processes. However, the widespread application of CCS, at the scale which is required to make a difference for the climate, cannot be imagined to take place without a consistent support of the public opinion. The technology needs investments and private companies are unlikely to adopt it unless it is either made mandatory (which implies complex evaluations of how to maintain industry competitiveness) and/or supported by public funds. Finding practical ways to communicate the technology could allow people to get acquainted, understand, evaluate the technology and participate to the social processes of meaning production about it, which forms the basis for decision making. Should then the technology be recognised with ample societal support as a key choice for the energy transition, progress in CCS communication would also serve the need to involve and train the new generation, which would thus be more prepared for undertaking CCS deployment. Should it not, this work would have been in any case useful to accelerate the societal reflection on this topic to ensure appropriate use of financial resources for implementing the preferred solutions for the transition of the energy system.

With our work, developed in the context of the European FP7 project "ECO_2 – Sub-seabed CO_2 Storage: Impact on Marine Ecosystems", we have therefore tried to address the need of easy to use and popular kind of scientifically based materials, that could help disseminate the concept of CCS, and CO_2 storage in particular, as part of a problem which involves and requires action by each and every individual. This is of course of particular relevance for the new generations. It will be them who will eventually put CCS in place, so they are the ones who, more than anybody else, need to be given the opportunity to come in contact with the idea of CCS and learn about it.

Recognising the great importance of visual communication for young people and also the strong impact that can be achieved through images, a short film appeared as the most interesting media to experiment with, to fulfil our objectives. The choice was made for producing a dissemination material that could bring the topic near to people and teenagers in particular, stimulating a holistic, conscious and unconscious, involvement and potentially awakening a personal sense of motivation to learn more and take action. Such a tool could be easily used both by science teachers, as a starting point for dedicated lessons, and also by other stakeholders, for free dissemination through social media and interested online communities. The video "CCS - A Bridging Technology for the Energy of the Future" was produced in Italian (it is available on Youtube at https://youtu.be/0sWpLlBj3Rk) and has been dubbed and made available in English https://youtu.be/RDU_PTKll_g, German https://youtu.be/krAa3w3FxK8 and French https://youtu.be/Li-vMd9iaKw). It was then tested on a sample of Italian high school students, who saw the video and filled a questionnaire after the vision, to understand whether or not it could be an effective tool for encouraging a first approach of the students with the topic.

2. Methods and approach

The approach taken for developing the video is based on the integration of different kinds and levels of research and professional input:

- Psychological
- Geological
- Science communication
- Script
- Film direction

- Cartoon and animation.

First of all attention was dedicated to find a formula for the video which would work from a psychological point of view, with respect to the objective of raising interest for the technology, which could pave the way for further involvement. From a geological point of view, it was necessary to identify the key concepts that had to be included and to define both their verbal and visual expression to ensure scientific correctness. A functional approach for science communication was also key, that could ensure an appropriate translation of the psychological approach in the communication mode; this also implied a long and laborious process for the development of the script and checking its appropriateness for the psychological, geological and science communication dimensions; participation of researchers to the film direction choices and to the development of the cartoons and their animation was also part of the process. Finally, methodological issues were not the only challenge, since the video had to be made on a low budget.

2.1. Psychological framework

For the psychological component the basis for the video lies in the public perception studies conducted in the context of the ECO_2 project together with the colleagues of the University of Edinburgh and in collaboration with the colleagues of the Plymouth Marine Laboratory. These studies showed that people often perceive the technology and the world of energy as something remote and detached from their everyday life [3, 4, 5] and that visual materials related to CCS generally lack the presence of humans [6]. The analysis of the emotional dimensions, conducted on free association interviews with Emotional Text Analysis [7], also highlighted the need to connect the technology to everyday life and experiences to be able to make sense of it and find out about its possible meaning for individuals and society. Another relevant emotional area concerns the need to establish contexts and relationships within which to exchange opinions and information, to overcome the feeling of powerlessness that can easily take over when people are faced with the very high complexity of CCS. Being alone with the difficulty of the subject does not help and people would need opportunities for discussing it with other people, and possibly with the participation of experts, to better understand its different facets. Related to these emotional dimensions there is a clear need of placing the consideration of CCS in the context of the wider energy system issues and other related societal challenges of our time, such as the dilemma between economy and environment, trust in the authorities, crisis of the economic model of development, etc. The knowledge and awareness matured through these studies has been translated into the choices made for creating the video, from script to aesthetics.

2.2. Geological foundations

From a technical point of view, we built on the experience made, together with the other members of the ZEP Communication Task Force, for producing the ZEP videos, available at http://www.zeroemissionsplatform.eu/, which took benefit of many time consuming consultations and discussions to clarify the geology and transpose the topic in the video with scientific precision. Bringing that experience a step further, an important innovation for the video "CCS - A Bridging Technology for the Energy of the Future" was the decision to show the full cycle of carbon dioxide and related chemical reaction, from extraction as part of fossil fuels to storage after fossil fuels combustion. The complete representation of this cycle provides a more accurate concept of the geological storage of CO_2. From the point of view of the geological content a difficult decision that we had to make, for communication reasons, from the beginning was to concentrate all efforts on one main message. The key concept of the technology had to be prioritised, leaving to the initiative of the viewer to look for more. Also, in some cases a symbolic rather than a realistic and detailed representation was adopted. Another very significant experience of our group that contributed to the development of the geological part of the video is the production of many dissemination documents together with the colleagues of CO_2GeoNet, the European Network of Excellence on the Geological Storage of CO_2, in particular the CO_2GeoNet brochure "What does CO_2 Geological Storage really mean?" (http://www.co2geonet.com/NewsData.aspx?IdNews=44&ViewType=Old&IdType=18). Once the main geological messages for the video have been defined, a tight selection of content was made to convey a correct and complete technical message in a very short time.

2.3. Telling the CCS story

With regard to the science communication methodological aspects, we opted for a storytelling approach, which could satisfy both the need for effective science communication [8] and the psychological need to elicit connection and involvement mechanisms that could bring people closer to CCS. Storytelling can make science more easily understandable by using identification, symbolic and intuitive mechanisms. Communication of science has usually scarce impact when it is limited to mere illustration of contents, however easily explained. Our mind, faced with new information, keeps looking for meaning, a thread to cling to. A story works as a trail, that guides the audience towards the unknown theme as through a dense forest, without feeling lost, indeed spurring the audience to move forward. A story, in this sense, is a kind of experience replacement, that allows people to get involved in an issue through imagination and identification with the story characters. For these reasons, a narrative process was identified as the most effective way to introduce CCS and the science behind it.

2.4. Video development

With regard to the technical aspects of the video production, the choice was made for combining live action and cartoons (**Errore. L'origine riferimento non è stata trovata.Errore. L'origine riferimento non è stata trovata.**). Cartoons were necessary to represent the underground but were also a good media to convey a humoristic flair, which could help make the topic lighter and more attractive. The caricature of the two actors was meant to reinforce the possible identification mechanisms and affective involvement during the vision; also the geological structures and storage operations were made somehow more "friendly" through the style of the representation, similar to childlike drawings and little details like the dinosaurs in the underground layers. The live action was determined by the importance of including real people and of representing a realistic dialogue between them, since these two dimensions, as we said above, appear to be the most absent in present CCS communications or in societal exchanges on CCS more generally. The animation part presented significant challenges particularly for calibrating the effect of going underground to see what happens when the CO_2 is injected.

From the point of view of the script, the first task was to find a hook to establish a connection with the viewer, suited for young people. We tried to imagine something that is really important to them that could be used as a starting point for the story. It was found in the need young people have to be in constant contact with their peers and the fact that the smartphone is for them an important mean to satisfy this need. This was the founding stone for developing the story, showing, through it, the importance of energy and its production in our life and the possible role CCS could play in this framework. This choice was also coherent with the emotional need of connecting CCS to everyday life and helped to highlight the relevance of our actions in the complex chain of processes which lead to the decisions concerning the energy system.

Fig. 1 Two screenshots of the video showing the dialogue between the protagonists and the cartoon style.

2.5. Verification

After its production, the video has been tested with high school students (further opportunities of verification will be sought in other countries).

To this end a questionnaire was developed, that was administered in the classroom by teachers, immediately after the projection of the video. The questionnaire is based on Likert type scales, and comprises questions regarding the emotional reaction to the video, the perception of the technology and the interest raised for CO_2 storage and related topics. A four point scale was adopted to push the respondents towards either a positive or a negative answer (slightly or strongly positive, slightly or strongly negative). These are examples of how the scales were presented: "Not at all -- - + ++ A lot" or "very dissatisfied 1 2 3 4 very satisfied". In analysing the results we will often consider the answers in polarised terms, unless the outcomes within the positive or the negative pole present a particular interest. The results have been elaborated with simple statistics like percentages and ranking index, as defined in *(1)*:

$$Sj = \frac{\sum_{i=1}^{n} Xij}{nr} 100 \qquad (1)$$

Where

- n is the number of respondents
- xij is the score of the respondent i for the item j
- r is the maximum possible score for that item.

This index was introduced to determine the importance of various items within each question and expresses the weight percentage that the score obtained by the j response has with respect to maximum possible score for the answer. The ranking index is from 0 to 100.

Finally, chi square test was applied to verify wheter frequency counts were distibuited identically across different categories in the same population.

3. Questionnaire results

The video, with its combined verbal and not verbal, intuitive, communication process was offered to the teachers as an educational tool, which could link to the learning process on a number of topics, not just CCS, but also environmental and energy issues. They were asked to show the video and immediately after ask the students to fill the questionnaire, to avoid the influence of other factors on the video "effect". This was facilitated by the structure of the video itself, as at the end of the it the spectator is stimulated to reflect on his/her own point of view about the issues raised and the technology just introduced. Thus, the opportunity was given to the viewers to express their reactions by answering the questionnaire.

The questionnaire was administered to a sample of 708 students. The type of high school attended is Scientific Lyceum (76%) and Technical Institute (24%). Concerning gender there is a prevalence of boys (63%) with respect to girls (37%), as this type of schools are often preferred by boys. The age of respondents spans from 14 to 22 years old, with a majority of 17-18 years old (Fig. 2a). The area of residence is Rome (80%) and other provinces (20%). All the results are significant at the chi square test with $P<0.05$.

The first question "Are you satisfied with looking at this video", aims at an overall verification of the satisfaction of the students about the video experience (see Fig. 2b), which is for the vast majority positive, only 26% of the respondents are dissatisfied. Looking at the results of question 2 and 3 we will try to better understand what this satisfaction is probably related to.

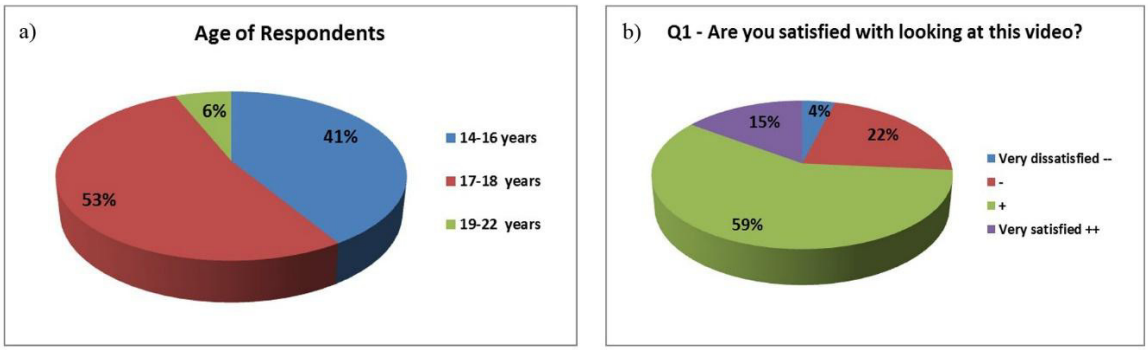

Fig. 2 Pie chart of respondents'age percentages and answers to question 1.

Question 2 "How do you feel after seeing this film?", investigates the feelings that the video may have raised, with the use of adjectives that relate to the emotional dimensions the video was meant to address, stimulating interest and involvement on the themes proposed to the attention of the students. The answers to question 2 (Fig. 3a) provide an interesting and coherent feed-back. More than 70% of the students feel somehow curious after seeing the video (this is coherent with about the same percentage not feeling bored). The majority also has a positive feeling of trust and of now being better informed. About half of them feel involved. Only 14% feel bored and 16,7% confused. Two thirds do not feel "worried" or "doubtful", which is coherent with a similar percentage of "trusting". If we look at the S1 ranking score (Fig. 3b) the results are further confirmed, with curious being the most important item in this question group, followed by trusting and better informed. If we consider these results together with those of question one, we can hypothesise that satisfaction of the video experience probably relates to the pleasure of coming in contact and learning about something new and interesting, which also offers a positive outlook. We will see that the answers to some of the following questions further reinforce this consideration. Overall these outcomes give an encouraging feed-back to the efforts for making a video which would raise interest, support the establishment of a positive and constructive relationship with the themes proposed, offer some scientific information.

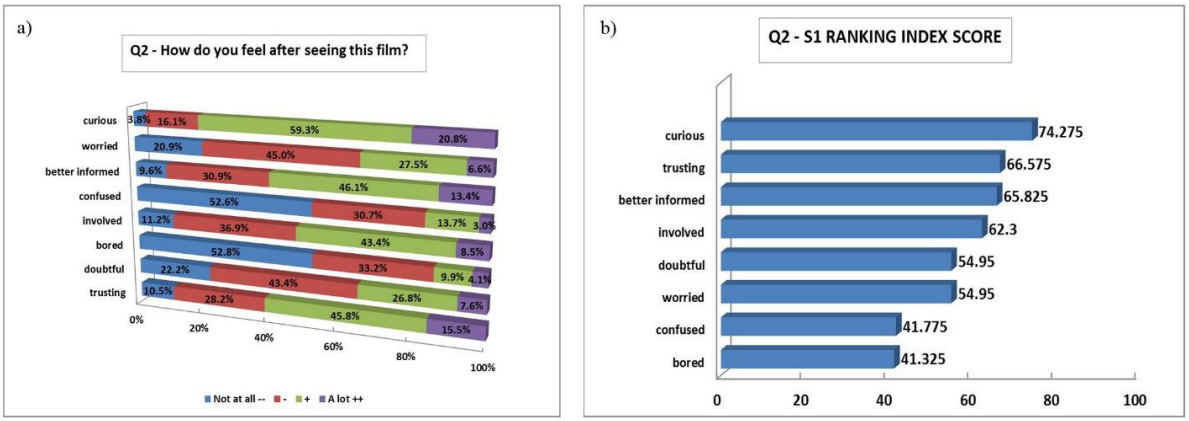

Fig. 3 Bar charts of the answers to question 2. The order of the items in 3a is the same as used in the questionnaire.

With question 3 "To what extent has seeing this video been for you…enjoyable/important/interesting" we explore the main motivational needs as categorised by McClelland [9, 10, 11] in terms of need for Affiliation, which focuses on human affective relationships, need for Power which relates to the drive to control and influence other people's behaviour or the environment around them, and need for Achievement, when the main force guiding man's

behavior is concerned with doing something better and with the search for a solution to individual and social problems.

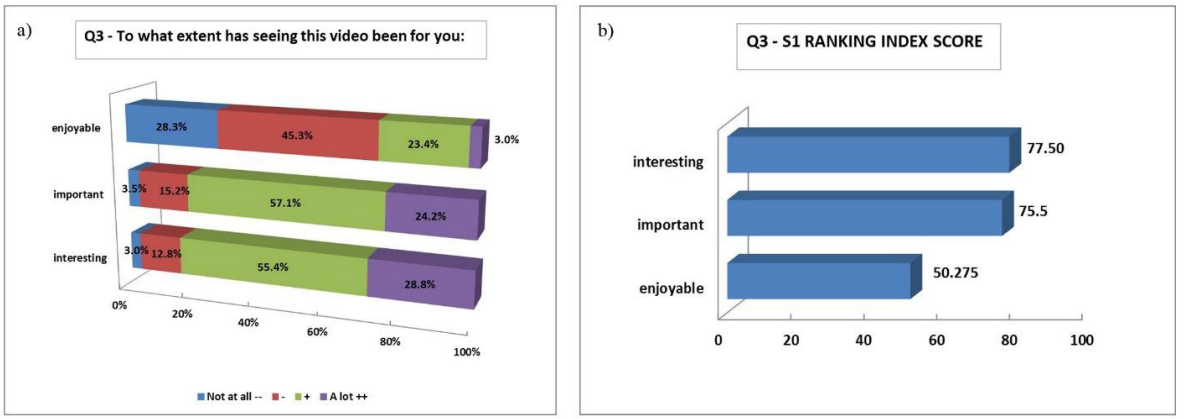

Fig. 4 Bar charts of the answers to question 3.

The three adjectives for question 3 have been selected to represent each one of the motivational dimensions: affiliation/enjoyable, power/important, achievement/interesting. The very high scores of "important" and "interesting" (see Fig. 4a) seem to confirm what emerged from the two previous questions. Satisfaction about the video probably relates to a feeling of empowerment and of participation in finding solutions to societal problems from a new perspective. Most important, as shown by the S1 ranking (see Fig. 4b) is the need for achievement, which has been stirred.

Question 4 "How understandable is the information presented in the film?" scores very high, the information presented in the film is considered very understandable by the respondents (see Fig. 5a). Considering the complexity of the topics introduced both from the technological and the overall conceptual framework point of view, the result is very comforting. Of course this is a subjective evaluation of the students themselves, which has not been tested, also with regard to the following questions, since the objective of the experience was not learning per se but rather stimulating interest for the topic which could later lead to a search for more information and proper learning.

Looking at the results of question 5 "Had you ever heard about the geological storage of CO_2?", we see that the vast majority of the students (87%) had no previous knowledge of the geological storage of CO_2 (Fig. 5b). The numbers are similar to those for the adult population in Italy [12, 13] and confirm that the technology continues to be unknown at societal level.

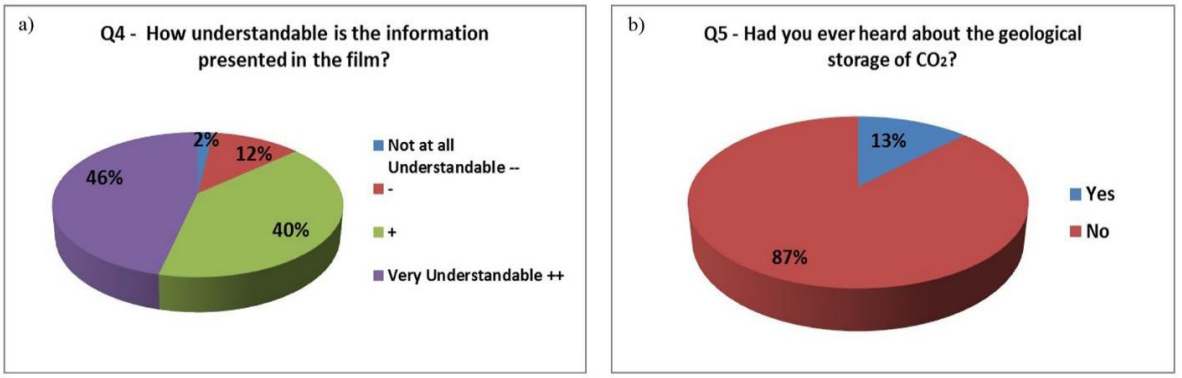

Fig. 5 Pie charts of the answers to question 4 and 5.

However, this has a positive implication for the present questionnaire, as the reaction to the technology is clearly related to the experience of the video. It is also appropriate with respect to the overall approach of presenting CCS as a new technology, as it is really new for the overwhelming majority of the sample.

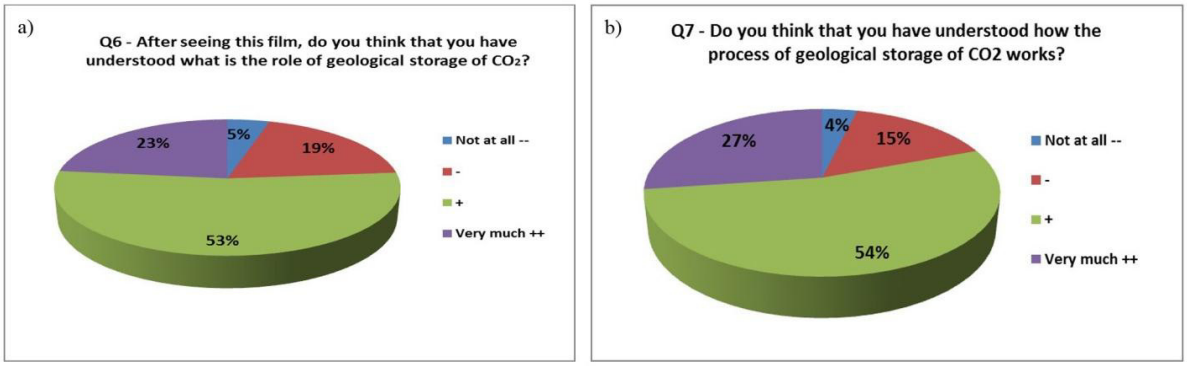

Fig. 6 Pie charts of the answers to questions 6 and 7.

Question 6 “After seeing this film, do you think that you have understood what is the role of geological storage of CO_2?” and 7 “Do you think that you have understood how the process of geological storage of CO_2 works?” (see Fig. 6) investigate the subjective evaluation of the respondents own understanding of the role and of the functioning process of the geological storage of CO_2. In both cases the scores are very positive, slightly less so for the role of storage. As only 14% of respondents found the information provided in the short film not understandable (question 4, Fig. 5a), it could be argued that the slightly higher percentage of negative answers in question 6 and 7, especially for the role of CCS, indicate that some kind of reflection has started, which makes some students aware of the complexity of the theme and the fact that the information in the video is insufficient and more information on the topic is necessary to better understand.

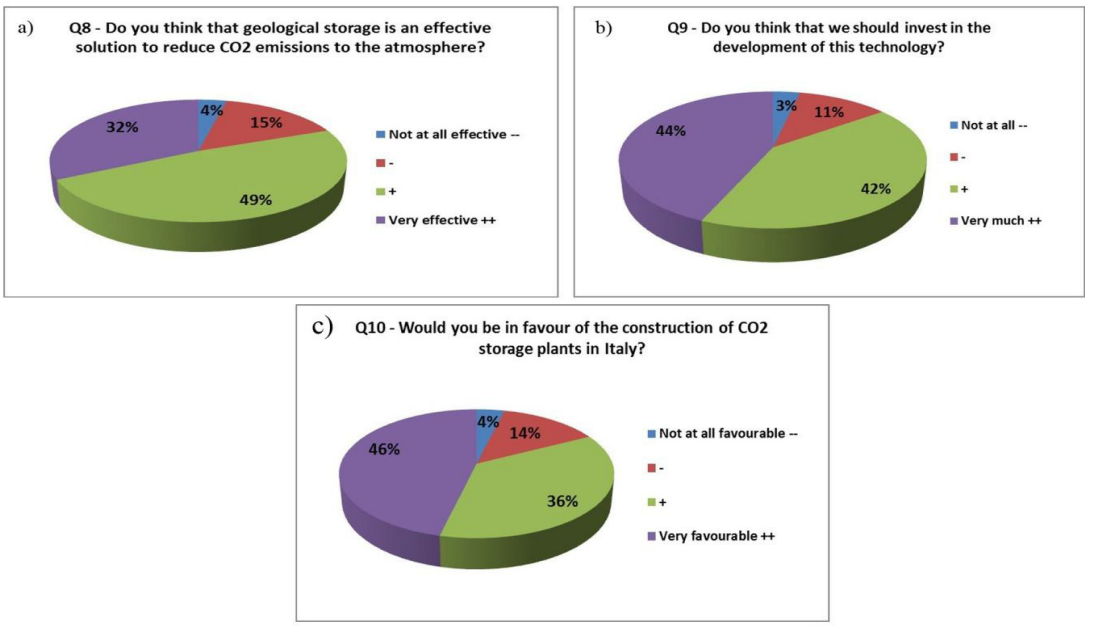

Fig. 7 Pie charts of the answers to questions 8, 9, 10.

Questions 8 “Do you think that geological storage is an effective solution to reduce CO_2 emissions to the atmosphere?”, 9 “Do you think that we should invest in the development of this technology?” and 10 “Would you be in favour of the construction of CO_2 storage plants in Italy?”offer the possibility to the students to express their opinion on the technology. The vast majority appreciate the effectiveness of CCS for reducing emissions (Fig. 7a) and have a very positive attitude towards investments and implementation of the technology in Italy (**Errore. L'origine riferimento non è stata trovata.**b, c). Of course the value of these opinions is limited being the result of a very limited experience, where the students could only be introduced to the basic principles of CCS; however it is noteworthy that the technology has raised positive interest. This can provide a good basis for a more objective evaluation of the technology when also additional information is searched for or encountered [14].

Question 11 “Express your level of agreement with the following statements. The geological storage of CO_2:…” explores the respondents agreement/disagreement with a number of statements which refer to the concepts presented in the video or to controversial issues mentioned in the ECO_2 interviews or in the literature. If we look to Fig. 8a and to the S1 ranking in figure (Fig. 8b) we see that the students have a high level of agreement with two main messages of the video: CCS “is needed together with other methods to reduce pollution” and “is useful for reducing CO_2 emissions coming from large power plants”. The answer to the item “will contribute to an improvement of your life” and its ranking, seem to confirm the importance and the positive connotation of the personal involvement felt during the vision of the video and the interest raised by it. Also the issue of the renewal of the energy system seems to have been captured in its complexity, as a certain mix of positive and negative answers seems to indicate. For the other items, which were not part of the content of the video, the interest was to see if the students, after having been introduced to CCS through the video, would be sensitive to some common conflictual themes over the technology. The answer to the item “is a technology in equilibrium with nature”, although the majority of respondents is positive about it, shows that there is a certain degree of uncertainty, which confirms the need of reflection on this point that we found with the ECO_2 interviews. With regard to the possibility that CCS “will increase the costs of energy” once again the students show a certain propensity for reflection, although the majority does not agree. In fact these two items are the only ones, in this group of questions, which present low values at both extremes, as if the students perceive that on these points they need to know more to be able to give a definite answer. The item “is difficult to understand” is coherent with the answer given to question 7, most of the respondents don’t find it difficult to understand. Within the limits of the video experience, this is a very positive feedback. Being introduced to the topic in a way which does not create feeling of incompetence, powerlessness, conflict, etc., allows a better concentration on understanding, encourages reflection and reasoning and of course leaves the door open to further exchange. For the last two items “further complicates things” and “is a way to continue to pollute”, there is strong disagreement, it could be a small but significant confirmation that probably it is not the technology concept per se that raises these problems in the wider stakeholder and societal discussion on CCS.

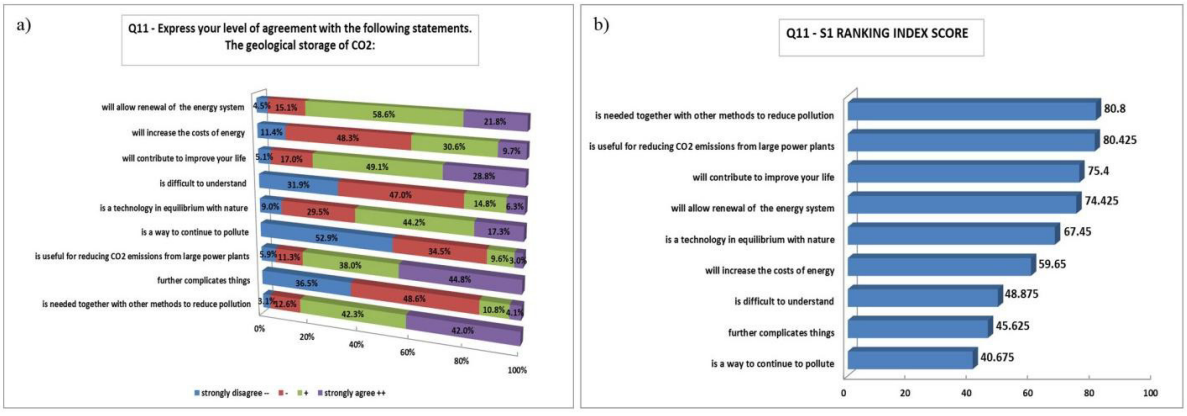

Fig. 8 Bar charts of the answers to question 11.

With question 12 “Thinking again about the themes discussed in the film, to what extent are you in agreement with the following statements?” the focus moves to the wider context and conceptual framework proposed in the short film, to explore the relationship that the students feel with them after seeing the video. As can be seen in figures 9a and 9b the items “they are themes that involve all of us” and “they are themes that we must deal with” score very high. The themes proposed are considered relevant by the students, something that touches them personally and something they can do something about. This is also confirmed by the answer to the item “they are too big issues for me” which scores low and “they are themes about which we can all do something” and “they are themes that stimulate interest and curiosity”. The value of the experience is emphasised by what emerges with the answer to the item “they are themes one often thinks about”: although the themes are important and we must deal with them, for the majority of the sample they are not something we often think about. The item “they are themes that are difficult to understand” confirms the more specific answer already seen for CCS. Once again, even if only within the limits of the video experience, the proposition of complex themes has been effective in raising interest without causing a feeling of powerlessness, one of the relevant emotional dimension that was identified with the Emotional Text analysis of the ECO_2 interviews as something potentially hindering the learning process about these topics.

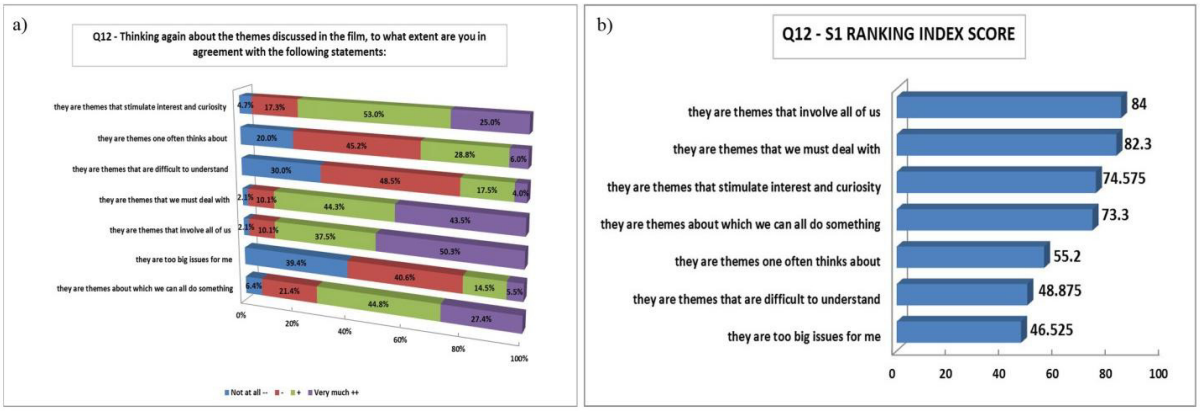

Fig. 9 Bar charts of the answers to question 12.

Question 13 “Please indicate which of the following themes you are interested to learn more about” (Fig. 10) aimed to get some insight about the thematic areas of greater interest for the students among those proposed, in different ways, in the video. All topics get a very good score, with the exception of the more geological item “how the subsurface is constituted”. Although about half of the sample shows interest, the students are much less eager to learn on this topic than on the others. The highest ranking answer is for “new energy technologies”, which adds information about the reasons for satisfaction with seeing the video. The main goal of the short film, i.e., the proposition of information about a new technology seems to connect to an important learning need of the students, coherent also with the answers to question 2 and 3. Second and third in the S1 ranking we find “how the energy system works” and “geological storage of CO_2”. Once again this is a very positive feed-back, both in absolute terms and considering the choices that were made, based on the ECO_2 interviews results, to place CCS in context and link its presentation to the wider energy and environment issues to which it is related. While the learning interest for the first ranking item (new energy technologies) probably stems from spontaneous and natural curiosity of the young students, “how the energy system works” and “geological storage of CO_2” seem to rank second and third as if born from a more conceptual interest stimulated by the vision of the video. In other words, from a psychological point of view, it appears that the video has first of all had an effect of raising the curiosity for innovation, the pleasure of discovery. Then, with some thought, this interest sort of focuses on the need to better understand both how the energy system works and the new technology which has been proposed.

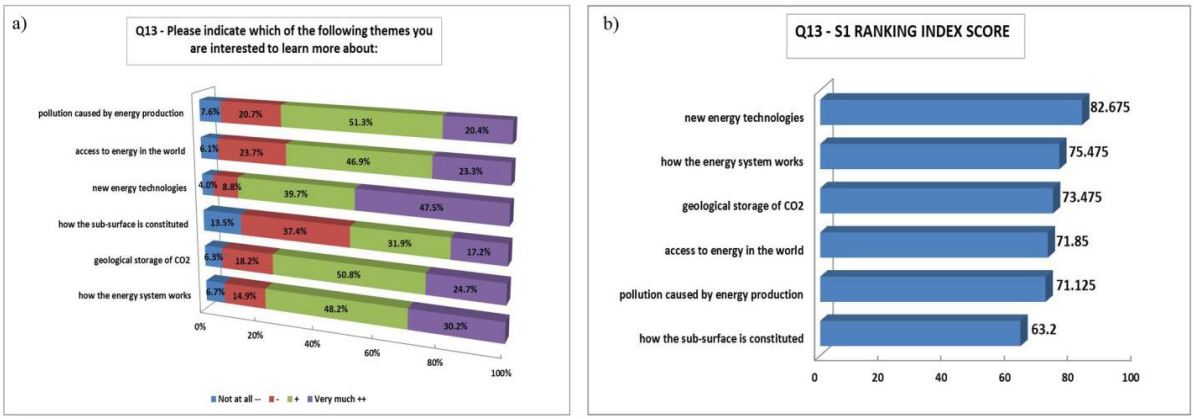

Fig. 10 Bar charts of the answers to question 13.

4. Conclusions

The research approach followed to produce an introductory video on CCS, taking into account psychological, geological, media communication research indications has produced interesting results. Communicating CCS and introducing the "human" factor required the openness to experiment with an innovative process. We have learnt a lot, especially on the challenges of multidisciplinary collaboration on such a complex subject and on the pathways to integrating in a unique product so many contributions, from many people, belonging to different contexts.

The holistic approach taken, with attention to psychological components, storytelling, inclusion of human characters with whom the end-users could identify, embedded geological information, has shown to have a good potential in the introduction to the "dry" subsurface concepts and the complex issues of CO_2 emission reduction, stimulating the curiosity and interest of the students for energy innovation and CO_2 storage. Finding ways to connect CCS to everyday and personal life but also placing it in the wider framework of energy and environment issues appears to be rewarding. Creating opportunities for the dissemination of the video and further testing of it in other countries will be the next step.

With a narrative approach that carries a dialogic dimension at the centre we have provided a symbolic forum which we hope will encourage more real life exchange on this topic. Helping people, and the young generation in particular, find their place in the discussion on the CCS technology, would probably be beneficial to all stakeholders. The ECO_2 video is a little example of how it is possible to work in this direction, creating tools for improving communication about CCS, which in turn can help make clear decisions about its implementation.

Acknowledgements

The project "ECO_2 – Sub-seabed CO_2 Storage: Impact on Marine Ecosystems" has received funding from the European Union Seventh Framework Programme for research, technological development and demonstration under grant agreement n° 265847.

We would like to thank you all the ECO_2 colleagues with whom we shared so many fruitful discussions and in particular Simon Shackley, Kelvin Boot, Leslie Mabon, Emily Creamer, Carly Maynard, Benjamin Evar. A special thank you to Simon for helping us in revising the English version of the questionnaire.

Many heartful thanks to all the people involved in the production of the video Pietro Laino, Giandomenico Curi, Francesca Laino, Marco Palange, Luca De Francesco, Simone De Gasperis, Matteo Storti, Daniele De Luca, Giulia Luciani, Katie McGovern, Laurence Belgrave, Stan Beaubien, Gisella Lombardi, Ennio Lombardi, Ludovico Watson, Pamela Vercelli, Miriam Sottili, and in the questionnaire administration Filippo Giuliano, Gaia Scafetta, Donato Ruggiero, Alessandro Ricci, Laura Fabiani, Serena Di Giacinto and all the other teachers and the students

who answered the questionnaire. This beautiful adventure would not have been possible without you.

References

[1] Moscovici S. *La psychanalyse: son image et son public.* Paris: PUF; 1976.
[2] Jodelet D. (Ed.). *Le rappresentazioni sociali*. Liguori: 1992.
[3] Mabon L, S Vercelli, S Shackley, J Anderlucci, N Battisti, C Franzese, K Boot. "Tell me what you think about the geological storage of carbon dioxide": towards a fuller understanding of public perceptions of CCS. *Energy Procedia* 2013; 37:7444-7453.
[4] Vercelli S, S Pirrotta, C Maynard, F Modesti, L Mabon, S Bigi, SE Beaubien, S Lombardi. Deliverable 6.3 – *Identified public perception factors – Core factors and processes in the public perception of CO_2 geological storage: the ECO_2 study on the Italian and UK context*. July 2015, 51 pages.
[5] Vercelli S, S Pirrotta, C Maynard, S Shackley, F Modesti, SE Beaubien, S Bigi, S Lombardi. *The Geological Storage of CO_2: and what do you think? – Findings from the ECO_2 project about the public perception of CO_2 geological storage.* Lay report ECO_2 D6.4 , April 2015, 24 pp., ISBN 979-12-200-0199-1.
[6] Shackley S, V Scott, AM Dowd, L Mabon, B Evar, R Howell, N Markusson, K Boot. *Key Messages and Briefing Notes on Carbon Capture and Storage*. IEAGHG, 148 pp.
[7] Carli R, RM Paniccia. *L'analisi emozionale del testo. Uno strumento psicologico per leggere testi e discorsi*. Milano: FrancoAngeli; 2002.
[8] Haven KF. *Story proof: The science behind the startling power of story*. Greenwood Publishing Group; 2007.
[9] McClelland DC. *Human motivation*. CUP Archive; 1987.
[10] McClelland DC. *Studies in motivation*. New York: Appleton-Century-Crofts; 1955.
[11] McClelland DC. *The achieving society*. Princeton: D. Van Nostrand; 1961.
[12] Eurobarometer. *Public Awareness and Acceptance of CO_2 capture and storage*; 2011. http://ec.europa.eu/public_opinion/archives/ebs/ebs_364_en.pdf
[13] Cavicchioli C, P Federici. Public acceptance e analisi della normativa europea sullo stoccaggio geologico di CO_2 (CCS). 2010
[14] Bruine de Bruin, W & Wong-Parodi, G. The role of initial affective impressions in responses to educational communications: The case of carbon capture and sequestration (CCS). *J. of Experimental Psychology: Applied*, 2014; 20(2):126.