

STAKEHOLDER ACCEPTANCE AND UNDERSTANDING OF CO₂ GEOLOGICAL STORAGE

S. Vercelli and R. Tambelli

Dipt. di Psicologia dinamica e clinica; Università di Roma "La Sapienza", Rome, Italy

Abstract: CO₂ geological storage constitutes a relatively recent scientific technology which could play a major role for the solution of global warming. More research is needed, however at the same time already-available scientific knowledge has scarcely been disseminated. Thus researchers who work in this area are faced with two main problems: 1) get their work to be known and its relevance understood also outside research and academic circles 2) avoid possible misconceptions in the understanding of their research, which could result in negative reactions in public opinion and consequently to the refusal of geological storage. This contribution addresses the need to spread knowledge and make this technology better known for the exploitation of its potentialities. Methodological questions about effective dissemination are dealt with. A psycho-sociological approach is presented and discussed, focusing on: 1) how to develop in the public a positive attitude and interest for learning about geological storage; and 2) how to develop in the public a correct understanding of what geological storage is. This kind of approach works on both the cognitive and emotional levels, beginning with the scientists' representations of their own work and followed by studying the interactions people can develop when coming in contact with a new topic, what kind of reactions are stimulated and how they can be understood depending on specific social contexts, etc. Language study and image issues are explored with specific reference to geological research. Based on Italian experiences for geological research dissemination the role of cultural contexts and psycho-social representations are illustrated. The importance of the analysis of emotional processes is explained. The role of information, communication, storage sites' image and social context in relation to stakeholders decisions is analysed. A possible proactive image strategy is outlined.

Key words: geological storage, climate change, carbon dioxide, scientific dissemination, stakeholders, psychosocial representations, cultural models

1. INTRODUCTION

The environment we live in keeps changing all the time. As human beings we participate in this change, trying to understand it, sometimes trying to influence it. We try to understand what happens in the air, on the earth, inside the earth, in the universe. We try to create better environmental conditions, modifying natural features, using our imagination to make the earth a better place to live on. We have to adapt to environment changes, but we are also agents of change.

Change, though, can take unpredictable directions, which sometimes force us to recognise that our influence on natural environment, instead of being beneficial, can become dangerous for our own species.

In 1963 there was a terrible disaster up in the mountains of Lavarone, in the north of Italy. A large piece of the mountain detached itself, fell into the waters of the Vajont dam reservoir, which was a piece of high engineering skill. The water was displaced and flooded the villages in the valley below, causing the death of thousands of people. It was a shock, and we didn't know that it was just one of many disasters still to come due to an unhappy interaction between natural phenomena and man's work. After so many years the dam is still there, empty, useless, perfect in its technological beauty, reminding us how delicate the environmental balance is and how dependent we are, for our life and well being, on the maintenance of its equilibrium.

But the impact of man's work is not always so evident. It can be much more difficult and complex to explain the controlling factors, in human-nature interaction, that can produce negative effects on the environmental balance. A lot of work is being done to precisely evaluate the consequences of our decisions regarding development and the growing need for energy production, but how much of this work comes to be known, how much of this work is really understood outside academic circles?

When the issues are so complex, as is the case for climate change, scientific communication and dissemination is a particularly delicate matter. CO₂ geological storage (CO₂GC) is part of this conceptual context, a context in which it is becoming more and more difficult for common people to understand what's going on and what we should do to avoid being ourselves the cause of major natural catastrophes.

The present paper aims to contribute to the understanding of the issues that have to be considered when communicating such complex subjects.

2. CO₂GS: THEMES AND QUESTIONS

When introducing the subject of CO₂ geological storage numerous other complex and socially-important issues immediately come up.

First of all, CO₂ excess is a world-wide problem and thus it needs to be addressed globally. This is not easy, not only because it is a long and difficult task to find an agreement among all countries, but also because we are just beginning to learn how to face problems that involve a global context. The number of factors which need to be taken into account is great and local policies are no longer local, but rather they get their meaning in relation to many other local policies. If we are dealing with a world problem, how can a “world – scale way of thinking” be developed?

Another major and extremely complex theme is energy production: fossil fuels, nuclear power, renewables, etc. (each with its different advantages and disadvantages) have social, environmental, economic features and costs that form the context within which CO₂GS is going to be evaluated (Shackley et al., 2004). How is CO₂GS to be considered in relation to the general energy situation? What kind of solutions can it offer? How can it help? From the economic point of view, what are the costs to implement this technology and how do they compare to those of other technologies?

People, and especially stakeholders, need to learn about CO₂GS, to be able to decide on its potential and because public collaboration is needed for its implementation. In this respect there are a number of concepts that are crucial for a correct understanding. They need to be studied not only to find scientific information, but also to outline the kind of relationship we feel with them. For example, what is CO₂, what has it come to mean, what is geological storage, how does one imagine it, and how is the effect on the earth (or with a particular territory) felt and characterized?

With some differences among the various countries, some of which are moving forward more quickly than others, the present situation is a preliminary phase to the possible adoption of CO₂GS as a mean for the reduction of excess CO₂ in the atmosphere.

Any decision regarding energy issues will have an enormous impact on society in terms of quality of life and well – being, economic costs and profits, environmental exploitation and protection, social safety and risks, etc.. Thus it is socially very relevant that complete and correct information is available on the various technological opportunities in order to help take decisions. At the same time all the different social groups, with their specific requests, need to enter into the learning process to be able to participate in the decision-making process (Shackley et al., 2004).

The type of information requested on CO₂GS will vary in relation to the needs of different social subjects. For example environmentalists and citizen

associations will probably be more interested in safety and health-related issues, politicians to costs and implementation times and plans, industries to costs and advantages such as incentives, and local administrators to control and monitoring of sites, etc.

3. WHY A COMMUNICATION STRATEGY IS NEEDED

CO₂ geological storage is a relatively new technology which is still very little known by the public at large. In the United States just 4% of the population seems to have heard about CO₂GS (Curry et al., 2004). We don't have data for Europe but probably the situation is similar. At the same time, however, CO₂GS is believed to be quite a crucial technology for the reduction of excess CO₂ in the atmosphere.

CO₂ production is expected to increase globally in the future. Newly industrialised countries, such as China, are expected to further contribute to a situation that many observers already consider very dangerous for the earth's health and for our well – being. There is a lot of debate on how to deal with this very serious health and environmental issue, but one point seems to be clear: CO₂ emissions need to be controlled and reduced.

To reduce emissions we must find, improve or increase new ways of energy production that do not result in massive CO₂ production. In the intervening time, during which the new technologies will be developed, we must do all we can to deal with CO₂ that is still being produced through the use of fossil fuels. It is here that CO₂GS comes to be regarded as a safe technology that can potentially have a major role in avoiding the release of large quantities of CO₂ from present technologies into the atmosphere.

We have a problem, CO₂ excess, and we have a potential partial solution to that problem in the form of CO₂GS. What is needed to implement this solution and thus improve the overall situation of CO₂ in the atmosphere? Certainly more research is needed, more studies need to be done on how this technology can best be implemented, on where and how storage sites must be constructed, how they must be monitored and how local populations are to be involved in site selection and implementation. We need technical, legal, economic, and socio – psychological guidelines to be able to facilitate a wide exploitation of this technology (de Conink and Huijts, 2004). But what is probably needed more at this stage is that this technology is better known and understood, both by the public at large and by decision-makers dealing with the problem of excess CO₂.

A correct dissemination of information on CO₂GS issues is fundamental for the promotion of social support and funding, which are both essential for

further development and exploitation of this technology. Making CO₂GS better known means:

- **positioning it in the minds of the public as one available option for reducing CO₂.** At the moment most people don't even know about the existence of CO₂GS, therefore it can hardly be considered an option. Furthermore, one has to take care that people get acquainted with the new technology through positive and correct information.
- **facilitating communication with stakeholders.** Stakeholders would find it very difficult to make decisions concerning a technology that is very little known, and therefore implies the risk of a lack of consensus. Clear and tested guidelines can greatly facilitate becoming familiar with the technology and taking appropriate decisions.
- **facilitating communication with the public living near potential sites.** Public consensus is a decisive factor for the construction of new sites. The exploration of the demands and needs of people living near a potential site is required. It is of no use to develop sophisticated technologies if one cannot find a place to put them because people don't know how to evaluate them, and therefore are afraid and don't want them. Getting people to know what CO₂GS is all about must then be a major goal of any policy regarding CO₂GS (Bradbury and Dooley, 2004).

4. STAKEHOLDERS

When we consider the problem of social acceptance we must be careful to take into account any social agency that could be concerned with our problem. In this respect "stakeholders" is a key concept.

What do we mean by stakeholders? In general they can be thought of as those people who have an interest in a particular decision, either as individuals or as representatives of a group of people. This includes people who influence a decision, or can influence it, as well as those who are affected by it. In other words any social group which is directly or indirectly involved with the matter can be viewed as a stakeholder, such as all people living in a site area, all people concerned with environmental issues, all people working in the energy field, all people living in large polluted cities, etc. This way to define stakeholders permits us to take into consideration the various components that contribute to the formation of public opinion and, even more importantly, to avoid neglect of such factors which could arise should our subject strike any sensitive topics in the public. What we mean is that strong reactions can sometimes be elicited and action be taken by previously unknown and unconsidered social groups. It is important to be

able to anticipate whether a certain subject could cause particular reactions in the public, in people who are not usually active in taking decisions. Social decisional processes are quite complex and being able to understand the factors which could have a determining influence is greatly facilitating.

Let us consider an example. Recently in Italy it was possible to observe what can happen when stakeholders (in its broadest sense) are not taken into account and thus are not consulted, informed or prepared. In Scanzano, Basilicata, the government had decided to create a dangerous-waste disposal landfill in a site which was considered very safe from a scientific point of view. Unfortunately the local public had not been consulted and no one suspected that a very strong feeling against this waste disposal could arise. In fact, the reaction was so strong that the entire population in the region was actively involved, and for weeks the main roads and railway lines were blocked (with many people sleeping under the stars) until the government had to finally change its decision. What had happened? The area is still a rather well-preserved, uncontaminated region with beautiful landscape, where tourism is expected to increase, and has recently seen the substantial development of organic agriculture. The development potential of this area therefore relies on it being a clean environment. Radioactive waste disposal, even the disposal of low level radioactive waste (such as medical and radiological waste), did not fit with the idea of the local population as how to preserve a clean environment. It was felt that the central government was just interested in discharging at this site something “they didn’t know where to put”. One can easily understand why this waste disposal site had then come to be considered as such a life threatening issue.

A more common definition for stakeholders is all those social agencies that, in one way or another, have a recognised power to decide or to influence decisions regarding a certain subject, such as local or central administrators, politicians, environmental associations, citizens’ associations, scientific centres, etc.. In an even more restricted meaning we can also consider the so called “opinion makers” to be stakeholders, such as specialised journalists, eminent scientists or writers, singers or actors etc.

5. CONSENSUS

Social consensus is a crucial issue for research development and application. It is easily understandable that the greater the interest and the approval a population holds for a certain research domain, the higher the possibilities that that research will be supported. This support will manifest itself not only through research funding, but also in the processes that concern the research being carried out and applied.

Social consensus for research can very often not be an explicit issue. To get an idea of its importance, one can think about television programs organised to raise funds for medical research into particular, and sometimes very rare, illnesses. Looking at one of these programs one can easily understand that the fact that most people feel involved with the researcher's goals makes it possible to raise quite large sums of money, while at the same time ever increasing the interest of people for this kind of research.

It can be quite interesting to reflect on this striking observation: a population's health depends greatly on a safe and clean environment, having clean air to breathe, clean water to drink, good shelter and so on; we also know that the incidence of many illnesses is reduced by living in a healthy environment. Nevertheless it is much easier for the general public to get concerned and involved over certain specific illnesses rather than over issues that can have a much greater influence for the health of entire populations, not to say for the entire global population.

Climate changes can adversely affect the life of millions of people. But to date we haven't seen any television shows raising funds for research on this very subject. How can we understand the scarce involvement and activation level towards issues that can have a massive impact on the public's well-being? Is there a correct distribution of resources with respect to the relative importance of the various problems? From this simple example one can realize the fundamental role of social consensus and its relevance for the development of different scientific domains.

Social consensus can be regarded as an expression of the level at which research goals are shared and understood. That is, there are both an emotional and a cognitive side to the building of consensus.

6. STUDY OF THE IMAGE OF CO₂GS

CO₂GS is presently very little known by the public at large, and thus we have the opportunity to work on its potential image to facilitate its understanding and acceptance. Working on the image implies the identification of the core aspects that qualify a certain subject and the communication goals to be pursued. (Vercelli, 1989).

The image of a given subject is formed both on available information and on the attitude that the object stimulates in the receiver. The first response of the receiver to the image subject can be positive or negative, depending on the feeling and the affective encoding that will be activated. It is very important to get a positive reaction when first contact with the subject takes place. A positive reaction opens the way to further communication, to the demand for more information, to the gradual construction of a relation with

the subject that can evolve in time. To summarise we could describe the positive attitude as “tell me more”.

On the other hand, if the first reaction is negative, it will be very difficult to change it, as a negative reaction is bound to activate defences toward something which is regarded as inimical. If the first feeling when coming in contact with the given subject is unpleasant, then any further information might not be taken into account. Thus we could describe the negative attitude as “I’m not interested”.

So, the first and fundamental goal is to find a formula to present our subject in such a way that the majority of people will react wanting to know more.

Our message should be:

- Easy: anybody can feel involved
- Simple: anybody can understand (language).

As we said before the matter we are working on is particularly complex and relatively unknown by the majority of people. At present we can study the image of CO₂GS in the scientific community, looking at some stakeholders which have already been involved (like some environmentalist associations) in those areas where it has already been implemented and in the natural analogues areas . This kind of work will enable us to identify the core aspects that characterise CO₂GS with respect to the way people think and feel about it.

At the same time, the fact itself of conducting this kind of study provides a new context within which the feelings and thoughts related to CO₂GS enter into a process of psycho-social elaboration.

7. PSYCHO-SOCIAL REPRESENTATIONS

7.1 Thinking

When first contact with a new concept or area of knowledge takes place, a process begins which involves the integration of the new information in a pre-existing cognitive network. Previous knowledge, its type and complexity, interacts with the new concepts or data. Depending on the already-assimilated information it can be more or less difficult to understand the new concepts. For example, if I have some knowledge about the earth, how it is constituted, what are the physics of the subsurface, I have a cognitive basis within which geological storage can fit. In the same way people who are used to the scientific approach will have a different comprehension from people who have another cultural background, etc..

Language is also a central issue. It plays an important role in making new knowledge more or less understandable. Terms that are new or particularly relevant require a clear and simple definition. In particular when non-technical stakeholders need to be involved it can be quite crucial that correct information is expressed in simple and everyday language.

7.2 Feeling

On a different level, the new information is categorized on the basis of its affective value. Do I feel this could be meaningful for me, do I feel it can be advantageous or do I feel it might possibly be dangerous? etc... Whereas the basic categorization is friendly/inimical, it is subsequently elaborated depending on specific personal and context variables. This elaboration takes the form of representations that express the kind of relationship with the given subject (Carli and Paniccia 1981; Carli and Paniccia, 2002).

Let us consider an example. In a study for the dissemination of data from the EC-funded Geochemical Seismic Zonation project (Lombardi and Vercelli, 2000), two different groups were studied: one living in Spoleto, a high seismic risk area of central Italy; and one living in Rome, a low seismic risk area.

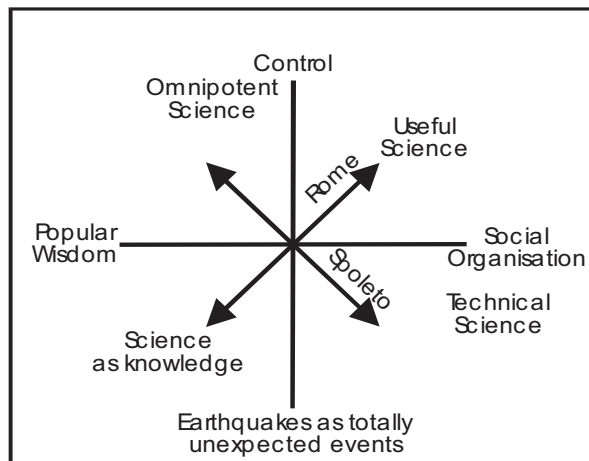


Figure 1. Symbolic dimensions of earthquake culture and science image.

The two groups expressed several earthquake representations, which were linked differently to the image of science and what they expected from

science. As can be seen in fig.1, earthquake culture was organized on two main axes.

The first one regarded earthquakes as being, at one extreme, totally unexpected events, that is something we can have no control over whatsoever. This idea was linked to an image of science as something without practical consequences, just knowledge for its own sake, or alternatively to a technical image of science, for example being able to tell how to construct buildings but with no potential for prediction.

At the other end there was a cultural dimension of getting total control over the natural phenomena of earthquakes. This could give place to two opposed conceptions of science, depending on how the community was represented. In a situation in which it was felt that everybody was left to themselves, that the frame of reference was constituted by popular sayings and stories, lived experiences and historical data, science could become a sort of omnipotent ideal. On the opposite side science was felt to be able to supply a certain degree of control, of mastery, when the phenomena was considered something that had to be faced through social organization. The four images of science that emerged help us understand the socio - cultural context and how new information is going to be processed.

In Rome, the low risk area, the “science as knowledge” and “useful science” images were prevalent. Here we have important elements derived from the city’s history that “tell” the Romans that usually earthquakes are not too destructive for the city and that there are hundreds of ancient buildings still standing (even if the ground level might have sunk a bit). In this context the scientific contribution could be considered as being scarcely relevant (science as knowledge). What facilitates learning and stimulates an interest is the feeling that society as a whole is taking care of the problem and organizing itself to face it, going beyond the boundaries of one’s own area and getting involved in the problem even if one is not personally touched by it (useful science).

In Spoleto, the high seismic risk area, the social representations highlighted quite a different cultural climate. Science images were mostly those of “omnipotent science” and “technical science”. In this case the risk was that scientific information could be easily devaluated if it did not meet the expectation of having absolute and certain answers. In this community we would have expected to find more of the “useful science” image. Given the very real risk of earthquakes a good social organization based on updated scientific data could make a significant difference for the community. But this dimension seems at the moment lacking, whereas a more technical approach is more reassuring: we might have no control whatsoever but we can perhaps become more organized towards earthquake consequences.

Here (“technical science”) we find more realistic expectations, which positively evaluate the contribution of social organization. It is then possible that an approach that couples scientific data with more technical information will facilitate learning and gradually help develop a more functional cultural representation (could be “useful science”).

The way it “feels” can make a great difference in the degree of interest for learning about a new subject. And the study of psycho–social representations can help us understand which is the better way to stimulate positive feelings and thus create a connection with people and stakeholders that will facilitate communication, learning, exchange of ideas and the discussion of problems (Carli, 1987; Carli et al., 1988).

The study of the cultural dimension we enter into, as we start talking about CO₂GS, allows us to identify the possible obstacles to good communication. In this way we get to know the context factors that will influence the way people will look at what we are presenting. There is, though, an even more important outcome. As we start the study of psycho–social representations we give attention to something people live but haven’t yet shared, expressed or thought about. We start to make connections and bring into the open issues that constitute implicit ties that need to be discussed. In this way we open a space where scientific data and research can become, and be felt as, the community’s property. In other words we actively stimulate the process that allows research to be assimilated into the general culture. At the same time scientific research development is promoted through an open flux between the academic community and the rest of society (Gregory and Miller, 1998).

8. CONCLUSIONS

Geological storage has the potential to be a very valuable technology to help us face the problems that arise from excess CO₂ in the atmosphere. At the moment, however, not only the great majority of the general public but also many relevant stakeholders know very little or nothing about it.

The scientific concepts and data that support this technology are not yet integrated into everyday culture. The way people are going to understand and react when coming in contact with this technology needs to be studied. This is particularly true for people who might be directly involved (because they are living in a potential site area) and for all stakeholders (that is the decision-makers who have the power to implement CO₂GS).

The moment is favourable. Since the matter is for most totally new, there is the opportunity to reach the public with correct information without it already being prejudiced. This same fact, though, makes it particularly

difficult to find the right communication channel that can prevent negative reactions and enhance learning and understanding.

CO₂GS is just one aspect of the efforts that are being made to face climate change and that part of it that depends on human activities. It is a potential technology that people need to learn more about, as part of a wider range of measures that can be adopted (Shackley et al., 2004). An organised image strategy is desirable both to meet the demands of stakeholders and the public, and to help the scientific community in the effort of communicating.

Stakeholders acceptance and understanding is the basis for a social decisional process that correctly evaluates advantages and disadvantages of each possible solution. It is essential to understand that cultural dimensions play a fundamental role in social decisional processes. When the gap between new concepts and the current way of thinking is large, it may be very difficult to recognise the social relevance of new technologies and solutions.

The implementation of CO₂GS requires the construction of a context where all different social parties, all stakeholders, can meet and elaborate together a new cultural dimension that takes into account all available information and “reads” it in the light of shared feelings and impressions. This kind of process forms the basis for the understanding of what we, as society, really consider valuable and therefore worth achieving.

The study of psycho-social representations can provide a starting point for such new context, in that it brings to light at least some aspects of the network of thoughts and feelings that are socially shared on a certain subject in a certain social group. In so doing, new symbolic representations and new cognitive networks are stimulated and a new culture can develop where climate change, geological storage and CO₂ issues are presented in such a way that everybody is enabled to understand what is being discussed and which solutions are wise to choose.

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