Developing a CCS Communications Framework for Japan

August 2011

JGC Corporation

Executive summary

Knowledge sharing is a critical need for the CCS community and is an area in which the Global CCS Institute is playing a central role. Although the Institute is implementing a community-centric knowledge-sharing program through both digital and face-to-face channels, it is also willing to explore how additional knowledge management methodologies and tools may be used to support structured and effective knowledge sharing networks – particularly where the internationalization of knowledge can be strengthened.

The project "Developing a CCS Communications Framework for Japan" aims to test a prototype Knowledge Management System (KMS) on a pilot scale, with a view to more broadly utilizing the methodology in an international context. Central themes of the community explored through communication and collaboration among the network members include:

- How the Institute and its Members can collaborate to synthesize expert knowledge relating to issues identified, which is distributed over a wide variety of disciplines/research areas, into a coherent body of knowledge;
- How the Global CCS Institute can distill detailed expert knowledge and present it in a simpler form that can be understood by stakeholders with different levels of scientific/technical literacy.

Main outputs from the collaboration of community members are:

- Establishing a community of key staff from interested organizations, procedures for facilitating knowledge sharing and required communication tools, i.e., the Institute's digital platform;
- Specification of (possibly Japan-specific) requirements for promotion of CCS understanding;
- Compilation of a knowledge base of past communication efforts and an assessment of their effectiveness;
- Development of an action plan for improving CCS understanding and stakeholder participation in national dialogue;
- Development of an "Argumentation model" supporting CCS in Japan.

The compilation of a knowledge base of past communication efforts and the argumentation model are stored as nested sets of HTML documents with hyperlinks and have been uploaded to the Institute's digital platform for review by members of the Japanese network. All contents, with the exception of external links, have been translated to English and have been submitted to the Institute.

At the end of the exercise, lessons learnt in knowledge sharing activities are summarized for future reference by the Institute's Members. A key conclusion is that coordination of a successful knowledge sharing network requires:

- Recognition of clear benefits;
- Avoidance of conflict of interests;
- Commitment of members based on consensus;
- Accommodation of different views.

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2 Objectives of the project

Knowledge sharing is a critical need for the CCS community and is an area in which the Institute is playing a central role. Although the Institute is implementing a community-centric knowledge sharing program through both digital and face-to-face channels, it is also willing to explore how additional knowledge management methodologies and tools may be used to support structured and effective knowledge sharing networks – particularly where the internationalization of knowledge can be strengthened.

The project aims at testing a prototype Knowledge Management System (KMS) on a pilot scale, with a view to more broadly utilizing the methodology in an international context. This pilot program involves development of a Japanese Knowledge Sharing network made up of several Japanese Members of the Institute. The Institute envisages this network connecting to other networks worldwide as the KMS expands in scale.

3 Task 1: Project planning

An initial meeting was held in Yokohama, Japan on 16 November 2010 to allow the project objectives to be scoped and priorities established. Within the context established at this meeting, JGC and its partners developed a project plan for establishing a Japanese knowledge sharing network amongst several Japanese Members of the Institute.

3.1 Group discussion

During the 16 November meeting, where the Institute, JGC and its partners discussed the project objectives and priorities, the following themes were highlighted as potential areas for knowledge-sharing among members of the Japanese knowledge sharing network:

- Quality management and industry standards;
- Comparison of CCS with other countermeasures against global warming, e.g., nuclear energy;
- Communication of risk, e.g., CO_2 leakage;
- Impact of earthquake/seismicity to CCS and impact of injected CO_2 to seismicity;
- Standardization of regulations, models, etc.;
- Evaluation of CCS storage potential of Japan that can be utilized in near future;
- Development of CCS roadmap in Japan;
- Benefit of CCS for stakeholders, e.g., electric utilities;

- Cost of CO_2 transportation.

In order to outline a plan for the Japanese knowledge sharing network within the context established at the previous meeting, potential members of the network held a meeting in Yokohama on 6 January 2011. Mr. Mike Miyagawa gave a presentation on “knowledge sharing at the Institute”. He explained the objectives of the project (Section 1) and emphasized the importance of sharing practical knowledge that can support activities and decisions of the Institute’s member organizations. Prior to group discussion, Dr. Hiroyasu Takase who is assigned as the network facilitator, gave a talk on “Community-based knowledge sharing exercises for CCS” explaining themes and concepts of community-based knowledge sharing, including the approach of “blending” on-line and face-to-face communications (Appendix 1).

A group discussion on the way to organize the Japanese knowledge sharing network was carried out, following the series of presentations mentioned above. While all members present agreed to join the Japanese knowledge sharing network, some expressed concern aboutrevealing their know-how without knowing precisely how it is going to be treated. Some concerns expressed included, disclosure to their potential competitors who may also be a Member of the Institute, IP problems, and misuse of information beyond its remit. There was a consensus that there has to be recognition of a net benefit in participating to in the knowledge sharing network taking its pros and cons into account. This has led JGC and its partners to carry out a game-theory analysis on the knowledge sharing network among multiple (potentially competing) organizations that will be discussed in the next section.

By the end of the group discussion, it was agreed to start the knowledge sharing network with “Promotion of understanding of CCS for non-experts” as a “safer” option in which there is no foreseeable conflict of interests among the members or critical IP problems, while members benefit from sharing experience and know-how on explaining and disseminating a variety of CCS knowledge to non-experts.

3.2 A discussion on prerequisites for knowledge sharing between several organizations

As described in the previous section, there was a consensus that there has to be recognition of a net benefit in participating in the knowledge sharing network taking its pros and cons into account in order to encourage hesitant members. In Appendix 2, the situation is discussed from the standpoint of game theory to analyze the problem and formulate possible solutions.

The main outcomes of the analysis can be summarized as follows:

- From the standpoint of game theory, if the potential obstacles to knowledge sharing among organizations (including potential competitors) is considered to be similar to the “prisoner's dilemma”, the best strategy is to be non-cooperative (KS passive);
- As a measure to remedy the above situation, increasing the reward for successful knowledge sharing is not effective;
- Irrespective of whether knowledge sharing was successful or not, when a disclosing organization gains value by disclosing knowledge (such as compensation or recognition), so that the resulting benefits exceed any potential loss of competitive advantage, the best strategy is to actively participate in knowledge sharing (KS active);
- Measures such as "Minimizing loss caused by only one organization disclosing their knowledge" and "Prohibition of the unilateral use of the knowledge of other organizations" can create a situation where participation in knowledge sharing is, at least, not an unfavorable strategy (KS neutral). Members benefit by trusting each other’s commitment to knowledge sharing, which is encouraged by introducing specific mechanisms, e.g. good facilitation and consensus building, which encourage such commitment.

3.3 Plan for the Japanese CCS Communications Framework

Further thought and careful verification is needed before the analysis described in the previous section may be regarded as the basis of knowledge sharing. However, it seems reasonable to spend some time on designing a knowledge sharing framework that can create a KS neutral, or even a KS active, situation. While we suggest the Institute might consider measures such as "Prohibition of the unilateral use of the knowledge of other organizations" and “Rewarding disclosure of knowledge”, we adopted the option of "Minimizing loss caused by only one organization disclosing their knowledge", by selecting a theme where no significant conflict of interest is expected, as proposed in Section 3.1. In this case, as suggested in the previous

section, it is vital to design a mechanism by which network members can believe that others will actively participate in a KS neutral situation. There is a greater chance for these mechanisms to be acceptable and thus, functional in a KS neutral situation than in a KS passive situation.

3.3.1 SSM for definition of actions based on consensus

A practical approach to convincing members to actively participate withthe whole community in a KS neutral situation is to define goals and related actions of the community based on consensus. There are a number of studies on “consensus building”, including Susskind, McKearnan and Thomas-Larmer (1999)[1], and it seems appropriate to apply them to the Japanese knowledge sharing network test bed for the following reasons;

- Lessons gained in this exercise should be transferrable to other knowledge sharing activities that will be carried out by the Institute and its Members in the future;
- The methods for defining actions based on consensus are relatively new and they may provide opportunities of improving knowledge sharing elsewhere on the Institute’s digital platform.

For details, see Appendix 3.

3.3.2 Tentative plan for the Japanese knowledge sharing network

Following the ideas proposed in the previous section, the facilitator sent a letter describing the procedure of the discussion and the schedule to all network members on 11 May 2011. In the course of communication between the facilitator and the members, adoption of the following plan was agreed.

3.3.3 Stage 1: Development of an action plan

Through the following four steps, action plan and goals (probably more than one) will be set, so that all members can be convinced to work in Stage 2.

- Step 1-1 (via exchange of e-mails): each individual’s perception of the problem and thoughts for "promotion of understanding of CCS for non-experts" is solicited and integrated by the facilitator. Here, without reference to actual facts and data, each member will document their own understanding of the problem;

[1] Susskind, L., McKeanan, S., and Thomas-Larmer, J., (1999) The Consensus Building Handbook; A Comprehensive Guide to Reaching Agreement, SAGE publications.

- Step 1-2 (on-line discussion through the Institute's platform): Facilitator uploads all input from the members and, based on analysis and interpretation of the similarities and differences in opinion, a synthesized "concept" on how we should approach the goal of promotion of understanding is proposed. All members then discuss this proposal as a starting point, and this is iteratively revised until a consensus is reached (while allowing recognition of different viewpoints);
- Step 1-3 (on-line discussion through the Institute's platform): Based on the agreed concept, discussion focuses on comparison between the approach that the members recommend (outcome from the previous step) and actions that have actually been carried out in the past. This leads to identification of possible improvements in the individual steps described in the concept;
- Step 1-4 (on-line discussion through the Institute's platform): A draft action plan is proposed by the facilitator, based on the results of the previous steps. Through discussion among the members, this draft action plan is improved and priorities defined.

3.3.4 Stage 2: Implementation of actions based on the plan

The activities at this stage depend on the outcome of Stage 1, so these were not foreseeable in detail at the time Stage 1 was commenced. As proposed in the previous discussion, these may include production of communication materials for non-experts but, even so, deciding the target(s) of focused promotion of understanding, the kind of understanding that needs to be communicated and the actions necessary to achieve these goals need to be clarified in advance.

4 Task 2: Community-based knowledge sharing exercise

An on-line community was formed as a Japanese knowledge sharing test-bed. This involved key staff (10 to 15) at major CCS-related organizations in Japan. The Institute provided its digital platform to enable members of the community to communicate in Japanese. Face-to-face meetings were also held to maximize communication amongst the members, forming a complement to continuous on-line collaboration.

Central themes of the community are to explore the following through communication and collaboration among the network members:

- How the Institute can collaborate to synthesize expert knowledge relating to the issues

identified in Task 1, which is distributed between a variety of disciplines/research areas, into a coherent body of knowledge. This includes:

- Definition of the knowledge inventory owned by the partners and preliminary assessment of the current (and expected future) content;
- Establishment of a common, prioritized list of requirements by knowledge users;
- Establishment of links to the knowledge-bases of Japanese CCS partners;
- Definition of specifications for knowledge sharing platforms;
- How the Institute can distill detailed expert knowledge and present it in a simpler form that can be understood by stakeholders with different levels of scientific/technical literacy. This includes:
    - Identification of the concerns to key non-technical stakeholder groups;
    - Establishing rigorous argumentation schemes that address such issues (using “argumentation models”, for example);
    - Translating technical argumentation into knowledge products that are tailored to different stakeholder groups.

4.1 Theme for collaboration and approach identified in Task 1

In Task 1, "promotion of understanding of CCS for non-experts" was agreed to be the subject of the knowledge sharing project. Here, the key is that the members are setting the goal of actually initiating actions to promote understanding (such as creating explanatory materials). Members of the network have been working on this subject in the past and, through such "involvement", recognized specific challenges and developed approaches to tackle them. The priority of this trial is to clarify how the individual members conceptualize goals and required actions for such promotion of understanding and how they can integrate their knowledge to form an action plan based on a consensus. Also, if there are different views among the members, effort is made to accommodate the different views in the action plan, so that all members remain motivated for active participation. This is seen as a vital prerequisite of community-based knowledge sharing. Therefore, in setting the goal and required activity, the discussion is as flexible as possible, taking an iterative approach to develop consensus.

From this basis, the procedure of discussions and collaboration described in the previous section was implemented.

4.2 Summary of Stage 1

4.2.1 Step 1-1

Individual members of the network described how they view goals, actions and current status relating to "promotion of understanding of CCS for non-experts" in notes sent to the facilitator. There are three coupled issues: definition of CCS itself, current level of understanding by non-experts and the processes (or actions) to promote understanding. These are compared, analyzed and structured in the following.

4.2.1.1 Recognition of CCS

a) Role of CCS as a measure for mitigating global warming

Positive:

- CCS contributes to minimizing environmental impact while taking advantage of fossil fuels:
  - By application to power generation, contributing to “clean” power generation;
  - CCS is a clean back-end option for a wider range of fossil fuel usage;
  - One option is to take the consistent position that it is an approach to make other technologies “clean”. In particular, this position could be considered in order to avoid the impression of non-productivity and to increase social awareness. For example, “New IGCC with CCS!!”
- CCS is a realistic and competitive technology:
  - Energy issues usually discussed in terms of alternatives ("renewable energy or fossil fuels"), but CCS can provide a realistic middle path;
  - CCS can reconcile the goals of preventing global warming and utilizing the best energy mix at the same time;
  - CCS can be combined with other approaches to combat global warming issues;
  - Change from fossil fuels to renewable energy is time consuming and, as a bridge for the time being, CCS is needed.

Negative:

- The use of renewable energy, such as solar and wind power, is potentially a cleaner approach and, if they can generate sufficient energy, CCS is not required.

b) Relationship with the use of fossil fuel

Positive:

- CCS expands options for the use of fossil fuels:
  - Wide range of CCS technology provides choices on the use of fossil fuel technology;
  - Allows multistep use of fossil fuel (refrigeration);
  - Mitigates environmental constraints to innovative uses of gas (e.g. fuel cells);
  - By assuming the use of CCS, more efficient strategies for the use of fossil fuels can be developed.
  - CCS enables stable and continuous use of fossil fuels:
    - By suppressing global warming due to the use of fossil energy, the option of using such resources will be available for future generations;
    - Will contribute to stable supply of energy; by using environmentally friendly fossil fuels e.g. coal.

Negative:

- CCS leads to prolonged use of fossil fuels, which could be considered a retrogressive step.

c) Technical Feasibility

Positive:

- Many CCS-related technologies have been established already through the development/use in the oil and natural gas industries;
- Returning CO_2 underground during (or after) extraction of oil and natural gas has been implemented in many projects worldwide;
- A number of CCS projects are promoted internationally and demonstration of the related technology is ongoing;
- By taking advantage of the Clean Development Mechanism (CDM), underground storage can be carried out at suitable sites outside of Japan.

Negative:

- Japan has a small number of suitable geological storage sites.

d) Benefits to society

Positive:

- CCS will open new possibilities for the use of underground space;
- CCS symbolizes change in fossil fuel usage;
- CCS is a reasonable compensation for the benefits gained from fossil fuels;
- There are ancillary benefits, such as contribution to the revitalization of Enhanced Oil Recovery (EOR).

Negative:

- CCS is not a new technology, and thus it is not an innovation;
- It is difficult to guarantee long-term safety.

4.2.1.2 State of public understanding of CCS

Positive (successful examples so far):

- By explanation of the functions of the cap rock, non-experts understood intuitively that CO_2 is unlikely to leak;
- When it is explained that CCS is required as a measure against global warming, people tend to accept this.

Negative:

- Poor awareness:
  - CCS is not included in school curriculums or textbooks, therefore students know very little about CCS (about 10% of students know the term CCS. There is an estimate that the number may be lower);
  - Information material on CCS is rarely accessed, even on the internet;
  - There are no patron scholars promoting CCS;
  - There is no parliamentary lobby for CCS in the Japanese National Assembly;
  - Since there are only a few cases of implemented CCS, there are few chances to gain awareness of CCS;
  - Even staff in regulatory agencies and related organizations have little understanding of the technology.
- Misunderstanding:
  - CO_2 and carbon monoxide are often confused;

- Many misunderstand the term “geological storage” of CO_2. Many think that this is achieved by storing CO_2 in underground tanks;
- From examples like the Nagaoka pilot experiment/Chuetsu earthquake/response made by Niigata Prefecture, the press picked wild arguments made by pseudo-scientists, leading the general public to develop a false image of CCS.

- Difficulties in understanding:
  - Very few have seen the supercritical state of CO_2, so the public do not know what it is like (they do not know how it “feels”);
  - No visible product;
  - CO_2 storage is underground, therefore people cannot see it;
  - People do not feel the danger of global warming in their everyday life, so do not understand the urgency for CCS.
- Fears and anxieties:
  - CO_2 is a light gas, so it would leak and rise from underground;
  - CO_2 will leak from underground in the case of earthquakes;
  - Vague anxiety that something catastrophic may happen;
  - There are only a few examples of CO_2 storage; therefore the public cannot be sure how it will behave underground;
  - Difficult to provide technical explanations to dispel concerns about possible large-scale catastrophic leakage.
- Doubts and distrust:
  - Imagery of hiding inconvenient things underground;
  - CCS can make lots of money for the promoting groups, so expert opinion may be biased;
  - Solar and wind power have a cleaner image;
  - Do not have enough information to compare the ways to tackle global warming in a comprehensive manner, including the costs involved.

4.2.1.3 Promotion of understanding of CCS

a) Promote understanding by the general public

i. Accurate and meaningful sources of information

- Dissemination of accurate information through the media:
  - Television is an essential tool to promote public understanding, but it generally results only in temporary dissemination of information. For a breakthrough, intensive dissemination with clear targets is needed;
  - Television's influence is so large that it may negatively affect the public when based on biased opinion (e.g. Barendrecht project). Information dissemination must be neutral and unbiased;
  - Media literacy must be improved, for both receivers and providers of information;
  - Visualizing the effects of CCS as a measure combating global warming (e.g. "in a number of Tokyo domes", "Equivalent to the energy of one million households");
  - Explain the fast-acting effects of CCS against global warming;
  - Demonstrate the impacts of global warming in everyday life;
  - Related to underground storage experiment in Nagaoka: images of the underground storage have been requested by magazines for elementary school students, exhibition at the National Museum of Emerging Science and Technology, scientific articles, and local newspapers, but the number of requests reduced after the experiment ended;
  - If Japan CCS Co. develops a large-scale demonstration in Japan, CCS may be introduced to a variety of media.
  - Visualized information (brief description with catchy pictures) is required for public websites (currently there are few resources of this type).
  - Many people do not even know the types of batteries such as solid polymer, alkaline, solid oxide, and molten salt-type. Even "hydrogen and oxygen" does not seem to be penetrating enough. Conversely, it might be sufficient enough if the name of CCS in form of "__ with CCS" is recognized. (For that, television commercials are the best).

ii. Explanation based on records of experience

- As a similar technology to CCS, accumulation of experience in EOR, in and out of the country, should be publicized.
- If actual projects begin, visibility should naturally increase.

iii. Discussion and dialogue

- A forum for discussion of, and briefing on CCS is needed.
- In lectures and case study sessions, sometimes it may be difficult to evaluate the effect of the information following the session.
- Opportunity to discuss freely by interactive symposia is needed.

iv. Improvement of energy literacy

- In addition to non-experts, so-called "experts" (specialists or generalists who do not understand the entire picture) should be provided with the basis for understanding the fundamentals of energy production, prior to introducing a discussion of CCS.

v. Education

- Teaching global warming and CCS in schools.
- It is important for younger generations to understand that CCS long-term solution and commitment.
- If global warming is included in elementary social studies or science textbooks, it is expected to be effective in broadening understanding amongst the general public, in the form communicated further from child to parent.
- The effect of promulgation to peers is large when young teens get interested.
- It is necessary to introduce the latest technology to children, even by self-publishing.

vi. Risk perception

- Authorities are likely to avoid the term “risk”. This is not always the case, but is targeted for criticism. The impression of "hiding information" can result from this approach.
- In the case of the nuclear industry in Japan, people tend to say, "if there is a non-zero risk, the project should be abandoned", thus the scientific debate reaches a dead end and probabilistic assessment is no longer accepted. Audiences should be fully aware of the various types of risks that are inherent in everyday life.
- It is necessary to consider to what extent the risk should be explained in a quantitative manner. When thinking about the environment, Japanese society tends to emphasize the existence of an effect more than the actual size of the numbers. In that case, no matter how small the risk, its very existence will block further discussion. The hope that individuals

would judge individual risks by themselves does not match general experience. The impact of all information should be considered well before it is decided how it will be communicated to the public.

b) Promote understanding of CCS amongst local residents

- Need to promote understanding of CCS amongst local residents
  - In choosing a site for the next large-scale CCS demonstration by Japan CCS Co., agreement by the local government will be required and this has to be supported by understanding within the local community.
- Building trust
  - Build partnerships with local stakeholders for example municipal companies, and fishery cooperatives.
  - Build links with trusted local institutions.
  - Be a “known face” to local residents.
  - Global warming and CCS commitments made by local government/regulatory agencies should be publicly visible to the entire community.
  - Publicity must include forums like the Rotary Club, where representatives of local industries gather.
- Explain the local benefits
  - Regional development.
  - Positive reputation in environmental initiatives.
  - Economic benefits of emissions trading.
- Avoid notions of “not in my backyard” (NIMBY)
  - A complete solution to NIMBY will be difficult, but all approaches to minimizing it should be pursued.
  - Even if awareness within the general public is low, if the understanding of CO_2 underground storage by local residents is high, then projects may be promoted.
- Representation of risk
  - The importance of clearly explaining risks to local stakeholders is often stated; but how many items from what risk category is introduced from the beginning, how much risk in what category is presented in a quantitative manner, and how much risk in what category is communicated as "small risk" or "almost no risk"? These issues should be well considered before initiating communication. This is not suggesting “hiding”

something but designing information according to scientific literacy and risk perception is important.

4.2.2 Step 1-2

The network facilitator uploaded all input from the members to the Institute's platform for discussion. After a week of on-line discussion surrounding analysis and interpretation of the similarities and differences of opinions, a synthesized "concept" on how we should approach "promotion of understanding of CCS for non-experts" was proposed. All members then discussed this proposal as a starting point, and this was iteratively revised until a consensus was reached. The final version of the "concept" is presented in the following pages.

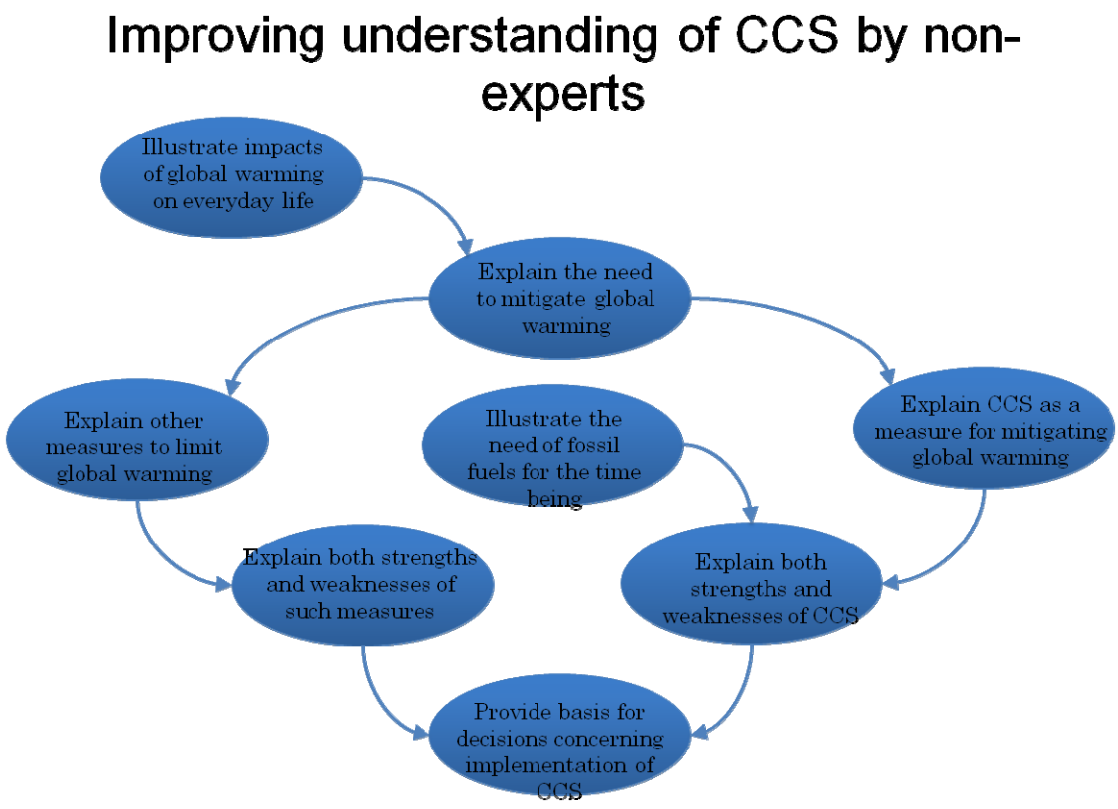

Figure 1. Concept for approach to expediting non-expert understanding of CCS (1/2)

4.2.2.1 Illustrate the impacts of global warming on lifestyle

Messages:

- The impact on lifestyle will depend on the degree of global warming.

How to communicate:

- Clearly from a neutral and objective position, through media such as television;
- Providing continuously updated catchy images and visual information through a public website;
- Incorporate into school education, aiming to impact the younger generation so that the messages can spread from children to parents.

4.2.2.2 Explain the need for mitigating global warming

Our Concept

Goal:

- General public find value in preventing global warming;
- General public willing to make some sacrifice (cost and risk) in order to prevent global warming

How to acheve the goal:

- Establish forum for free discussion, e.g. interactive symposium;
- Clearly communicate from a neutral and objective position, through media such as television;
- Providing continuously updated catchy imags and visual information through a public Website;
- Incorporate into school education, aiming to impact the younger generation so that the messages can spread from children to parents;
- Introducing key arguments using twitter. Reply to influential celebrities (e.g.Softbank president Son) and interest groups.

4.2.2.3 Explain CCS options as measures for mitigating global warming

Our Concept

Messages:

- Explain CCS options: variants for separation/capture of carbon dioxide, its transport and sequestration, potential locations and timescales for implementation;
- Effectiveness of CCS to suppress global warming?
- Basic technical concepts: what is CO2 at a supercritical state? How can CO2 be safely stored underground?

How to Communicate:

- Clearly from a neutral and objective position, through media such as television;
- Providing continuously updated catchy images and visual information through a public Website;
- Incorporate into school education, aiming to impact the younger generation so that the messages can spread from children to parents;
- Focus initially on opinion makers, politicians etc. so that they spread the key messages further.

4.2.2.4 Explain other measures to combat global warming

Our Concept:

Alternative measures:

- Energy and power saving;
- Renewable energy such as wind and solar power;
- Nuclear power;
- Cleaner use of fossil fuels.

How to communicate:

- Clearly from a neutral and objective position, through media such as television;
- Providing continuously updated catch images and visual informatino throu a public Website;
- Incorporate into school education, amning to impact the younger genreation so that the messages can spread from children to parents.

4.2.2.5 Illustrate current need of fossil fuels

Our concept

Messages:

- Need of fossil fuels as renewable energy cannot cover all requirements (even when oil prices shot up in 2008, new fossil fuels were developed (e.g. shale gas / CBM / heavy oil) instead of actually reducing the use of fossil fuels);
- Use of fossil fuels required in industries other than power generations (e.g. steel);
- Some countries lack the infrastructure for rapid conversion to nuclear power and renewable energy, so continuous use of fossil fuels is unavoidable.
- Objective assessment confirms and essential role of fossil fuels in energy supply;
- CO2 produced by fossil fuel needed not be problematic (CO2 that cannot be incorporated into the natural carbon cycle can be managed by CCS);

How to communicate:

- Clearly from a neutral and objective position through media such as television;
- Providing continuously updated catchy images and visual information through a public Website;
- Incorporate into school education, aiming to impact the younger generation so that the messages can spread from children to parents.

4.2.2.6 Explain strengths and weaknesses of CCS

Our Concept

Strengths:

- Can have an immediate effect if implanted at a large enough scale;
- Maintains a clean environment while using fossil fuels;
- Expands the choices of fossil fuel usages: allows continuous and stable use of fossil fuel;
- Realistic, proven and competitive technology;
- Impact and efficiency can be amplified by combining with biomass (e.g. if captured CO2 is converted to biomass, it can reduce energy penalties);
- International efforts can be implemented by using the framework of CDM;
- In a maritime nation like Japan, deep-water reservoir may be found within 200 miles.

How to communicate:

- Clearly from a neutral and objective position through media such as television;
- Providing continuously updated catchy images and visual information through a public Website;
- Incorporate into school education, aiming to impact the younger generation so that the messages can spread from children to parents;
- Demonstration tests conducted in Japan and wide communication of their results.

4.2.2.7 Explain strengths and weaknesses of CCS (Continued)

Our Concept

Weaknesses:

- May prolong the use of fossil fuels;
- Not many suitable sites are found for geological storage in Japan
- High cost (however, similar to renewable energy, cost should drop with increased scale of implementation);
- Hard to exclude the possibility of large-scale leakage and significant environmental impacts, especially when earthquakes occur (although the selection of appropriate sites, sealing the injection well, and leakage monitoring can reduce the risk).
- The injection of CO2 may induce earthquakes;
- CCS is not a new technology, so only small ripple effect of innovation is expected;
- Extra energy is used for capture and storage (energy penalty).

How to communicate:

- In an appropriate manner, depending on the level of knowledge and sensitivity of different audiences 9e.g. in some cases more qualitative presentation of risks better);
- Even if it does not directly encourage acceptance, such risks and cost should be presented quantitatively and accurately;
- Issues of energy penalty should not lead to a misunderstanding of CCS done only to gain profit.

4.2.2.8 Explain the strengths and weaknesses of other measures to combat global warming

Our Concept

Strengths (to be assessed for each measure considering the total life cycle):

- Clean energy
- Small risks
- Small costs
- Small impact on the economy and daily life
- Technology is already proven
- Not much time is needed to start, so immediate response is expected
- Large scale implementation is possible
- Suitable sites available in our country

Weaknesses (again, assessed for each measure):

- Opposite of the above elements

4.2.2.9 Provide basis for decisions concerning implementation of CCS

Our concept

Goal:

- The Japanese public should appreciate the necessity of CCS (including CDM) as a bridge for the time being, during the period of change from fossil fuels to renewable energy, on the basis of information summarized on the previous slides;
- Based on this understanding, consensus is developed in society as a whole regarding the necessity of implementation of CCS in Japan.

How to achieve the goal:

- Through comparison of cost (including energy penalties), risk and technical feasibility with other measures to combat global warming;
- Establish forum for free discussion e.g. interactive symposium;
- As policy proposals from the public;
- Through voting in elections, with introduction of global warming issues;
- Through opinion polls and surveys;
- Through Twitter and other social media;
- Through games introducing global warming issues and counter-measures.

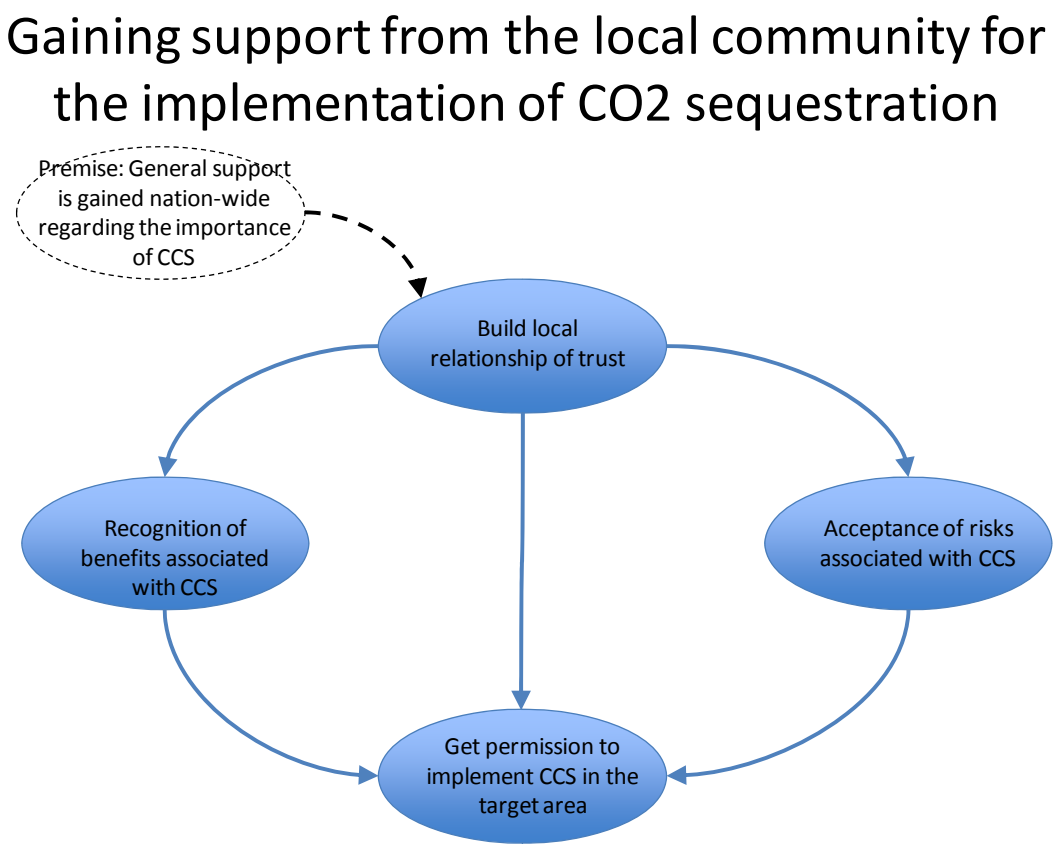

Figure 2. Concept for approach to expediting a non-expert's understanding of CCS (2/2)

4.2.2.10 Build local relationship of trust

Our concept

Goal:

- The proponent is seen to explain honestly the advantages and disadvantages of CCS: gains trust in the organization and its dealings with local stakeholders;
- The national responsible for CCS is seen from a long-term perspective and the commitment to support of the local community will be maintained for a long-term.

How to achieve the goal?

- Building partnerships with local stakeholders (municipalities, fishery and agriculture trade organizations, industries,…) and trusted institutions;
- Provide facilities to encourage dialogue, identification of issues of concern and developing collaborative solutions.

4.2.2.11 Acceptance of risks associated with CCS

Our Concept

Goal:

- To convince local stakeholders that risks associated with the implementation of CCS are known, small and acceptable.

How to achieve the goal:

- Through dialogues with local government and the public, utilizing a 'space where issues can be shared and solutions can be considered together', focusing on local considerations and lifestyles;
- Explain that all possible risks have been examined and in particular, assessment of large earthquakes shows that environmental impacts are within those established in safety guidelines;
- Illustrate potential risks in a manner depending on the level of knowledge and sensitivity of different audiences, showing commitment to work together to eliminate fear and anxiety.

4.2.2.12 Recognition of benefits associated with CCS

Our Concept

Goal:

- To clearly show that CCS projects not only serve a national need, but also bring direct benefits to the host community.

How to achieve the goal?

- List and quantify:
- National benefits (including contribution towards solving a global problem);
- Compensation & tax income;
- Employment and opportunities for local industry.

4.2.2.13 Get permission to implement CCS in the target area

Our concept

- Goal
- To be accepted in the target region, with certainty that the risk of CCS is very small in comparison to its benefits, based on national and local consensus.
- How to achieve the goal?
- By the implementing agency building relationships with the local community to convince them that risks are small and benefits are large;
- Through residents' participation in decision-making process (thus they buy into the project)

4.2.3 Step 1-3

Based on the concept that was agreed at Step 1-2, the approach that the network members recommend (outcome from the previous step) and what has actually been done in the past were compared. For this purpose, another two-week session was held and the network members were encouraged to introduce as much relevant information as possible. This included;

- Books and technical papers,
- Websites,
- Advertisements and brochures,
- Newspapers and magazines,
- TV programs,
- Games.

In addition, one of the members introduced a new technique for visualizing intrinsically 3D data[2], e.g., evolution of plume of CO_2 stored underground, on a 2D screen by using a fractal expansion (Appendix 4), which may prove useful in communicating scientific information to non-experts.

Comparison of the proposed "concept" and these existing examples is depicted in the following pages. Most of the information gathered by the members is in Japanese, but brief outlines of the material are translated into English and included in Appendix 5.This should lead to identification of possible improvements in the individual steps described in the concept.

[2] Introduced by Dr. Someya of AIST.

4.2.3.1 Illustrate the impacts of global warming on lifestyle

Our concept

Messages:

- The occurrence of global warming will change our lives in Japan;
- The impact on lifestyle will depend on the degree of global warming;

How to communicate?

- Clearly from a neutral and objective position, through media such as television;
- Providing continuously-updated catchy images and visual information through public Website;
- Incorporating into school education, aiming to impact the younger generation so that the messages can spread from children to parents.

Examples:

- Increased risk of drought, heavy rain, storm, flood; increased intensity of typhoons (Refer Appendix 5: Advertisement/Brochures 3, 4, 5, Book/Papers 9);
- Deterioration of water quality of lakes, saltwater contamination of wells (Refer Appendix 5: Advertisement/Brochures 5);
- Loss of Beaches (Refer Appendix 5: Advertisement/Brochures 3, 4, 5, Book/Paper 9);
- Increased pest damage and decrease in rice and fruit quality (Refer Appendix 5: Advertisement/Brochures 3, 4, 5, Book/Paper 9);
- Blight of forest (Refer Appendix 5: Advertisement/Brochures 3, 4, 5, Book/Papers 9);
- Increase in occurrence of heatstroke and heat stress (Refer Appendix 5: Advertisement/Brochures 3, 4, 5, Book/Papers9);
- In EU, about half the people know the cause and effects of global warming to some extent (Refer Appendix 5: Books/Papers8);
- In EU, 80% of the people believe that the main sources of information for global warming is TV (Refer Appendix 5: Books/Papers 8);
- In a general survey in Japan, 70% of the people understand that global warming is occurring (Refer Appendix 5: Books/Papers 11).

4.2.3.2 Explain the need for mitigating global warming

Our concept

Goal:

- General public find value in preventing global warming;
- General public willing to make some sacrifice (cost and risk) in order to prevent global warming.

How to achieve the goal?

- Establish forum for free discussion, e.g. interactive symposium;
- Clearly communicate from a neutral and objective position, through media such as television;
- Providing continuously-updated catchy images and visual information through a public Website;
- Incorporate into school education, aiming to impact the younger generation so that the messages can spread from children to parents;
- Introducing key arguments using Twitter. Reply to influential celebrities (e.g. Softbank president Son) and interest groups.

Examples:

- Explain the need for adaptation to / mitigation of the impacts of global warming through websites and brochures which can be downloaded by relevant ministries (Refer Appendix 5: Advertisement/Brochures 3, 4, 5, 7, 8);
- In a general survey in Japan, 80% of the people think that lack of effort to reduce emissions of CO2 or the decision of not taking any measures to combat global warming will lead to burdens on future generations (Refer Appendix 5: Books/Papers 10, 11).

4.2.3.3 Explain CCS options as measures for mitigating global warming

Our Concept

Messages:

- Explain CCS options: variants for separation/capture of carbon dioxide, its transport and sequestration, potential locations and timescales for implantation;
- Effectiveness of CCS to suppress global warming;
- Basic technical concepts: what is CO2 at a supercritical state? How can CO2 be safely stored underground?

How to communicate:

- Clearly from a neutral and objective position, through media such as television;
- Providing continuously-updated catchy images and visual information through a public Website;
- Incorporate into school education, aiming to impact the younger generation sot that the messages can spread from children to parents;
- Focus initially on opinion-makers, politicians, etc, so that they spread the key messages further.

Examples:

- Animations illustrating the mechanism of underground confinement using anthropomorphic characters (CO2) (Refer Appendix 5: Website 1);
- Game to manage CO2 from emissions of Alberta (Refer Appendix 5: Game 2);
- Videos that explain the needs, mechanisms, and related techniques of CCS (Nagaoka demonstration project) (Refer Appendix 5: Website 2);
- TV program explaining the needs and mechanisms of CCS, including the Nagaoka demonstration project (Science zero) (Refer Appendix 5: TV1);
- Article on sequestration projects related to CO2, terminology and research databases from RITE (Refer Appendix 5: Website 3);
- Commentary, “Carbon sequestration is a first aid until a clean energy society emerges” (Refer Appendix 5: Website 4);
- Easy story about CO2 capture and CCS (Refer Appendix 5: Website 5);

- 10% of the people in the EU know of and understand CCS (Refer Appendix 5: Books/Papers). This percentage is 13% in Japan in interest in other global warming measures is weak; however this number is starting to increase (Refer Appendix 5: Books/Papers 11);
- about half the people in the EU know about CO2, but about 10% confuse it with carbon monoxide (Refer Appendix 5: Books/Papers 8);
- Outline of CCS (Refer Appendix 5: TV 2, Newspapers/Magazines 3);
- Status of CCS in Norway (Refer Appendix 5: Newspaper/Magazines 5).

4.2.3.4 Explain other measures to combat global warming

Our Concept

Alternative Measures:

- Energy and power saving;
- Renewable energy such as wind and solar power;
- Nuclear power;
- Cleaner use of fossil fuels.

How to communicate?

- Clearly from a neutral and objective position, through media such as television;
- Providing continuously updated catchy images and visual information through a public Website;
- Incorporate into school education, aiming to impact the younger generation so that the messages can spread from children to parents.

Examples:

- About half the people in the EU know little about global warming (Refer Appendix 5: Books/Papers 8);
- Not many people in the EU know the percentage contributions of renewable energy compared to all other sources of energy (Refer Appendix 5: Books/Papers 8);
- In the EU, solar and wind power have the highest awareness of all low-carbon technologies (50% - 60%) and there is belief that their use should be promoted (80% - 90%) (Refer Appendix 5: Books/Papers 8);
- According to surveys, the situation is similar for Japan (Refer Appendix 5: Books/Papers 11).

4.2.3.5 Illustrate current need of fossil fuels

Our concept

Messages:

- Need of fossil fuels, as renewable energy cannot cover all requirements (even when oil prices shot up in 2008, new fossil fuels were developed (e.g. shale gas /CBM/heavy oil) instead of actually reducing the use of fossil fuels);
- Use of fossil fuels required in industries other than power generations (e.g. steel);
- Some countries lack the infrastructure for rapid conversion to nuclear power and renewable energy, so continuous use of fossil fuels is unavoidable;
- Objective assessment confirms an essential role of fossil fuels in energy suppy;
- CO2 produced by fossil fuel need not be problematic (CO2 that cannot be incorporated into the natural carbon cycle can be managed by CCS);

How to communicate:

- Clearly from a neutral and objective position, through media such as television;
- Providing continuously updated catchy images and visual information through a public Website;
- Incorporate into school education, aiming to impact the younger generation so that the messages can spread from children to parents.

Examples:

- In the EU, about half the people think that the use of fossil fuels would continue even after the year 2050 (Refer Appendix 5: Books/Papers 8).

4.2.3.6 Explain strengths and weaknesses of CCS

Our Concept

Strengths:

- Can have an immediate effect if implemented at a large enough scale;
- Maintains a clean environment while using fossil fuels;
- Expands the choices of fossil fuel usages: allow continuous and stable use of fossil fuel;
- Realistic, proven and competitive technology;
- Impact and efficiency can be amplified by combining with biomass (e.g. if captured CO2 is converted to biomass, it can reduce energy penalties);
- International efforts can be implemented by using the framework of CDM;
- In a maritime nation like Japan, deep-water reservoirs may be found within 200 miles.

How to communicate:

- Clearly from a neutral and objective position, through media such as television;
- Providing continuously updated catch images and visual information through a public Website;
- Incorporate into school education, aiming to impact the younger generation so that the messages can spread from children to parents;
- Demonstration tests conducted in Japan and wide communication of their results.

Examples

- More significant reduction of CO2 emissions through a combination of biomass and CCS (Refer Appendix 5: Advertisement/Brochures 2/ Newspapers/Magazines 4);
- CO2 capture by algae and use of artificially grown algae in diverse applications (Refer Appendix 5:: Books/Papers 8);
- About half the people in the EU believe that the most reliable sources of information for CO2 sequestration are universities and research institutions (Refer Appendix 5: Books/Papers 8);
- Organizing the technical/economical/political issues for CCS, from the perspective of electricity industry and steel industry (Refer Appendix 5: Books/Papers 13);
- Questions of feasibility of CCS for Japanese situation, where use of EOR is difficult (Refer Appendix 5: Books/Papers 8).

Weaknesses:

- May prolong the use of fossil fuels;
- Not many suitable sites are found for geological storage in Japan;
- High cost (however, similar to renewable energy, cost should drop with increased scale of implantation);
- Hard to exclude the possibility of large-scale leakage and significant environmental impacts, especially when earthquakes occur (although the selection of appropriate sites, sealing the injection well, and leakage monitoring can reduce the risk);
- The injection of CO2 may induce earthquakes;
- CCS is not a new technology, so only small ripple effect of innovation is expected;
- Extra energy is used for capture and storage (energy penalty).

How to communicate:

- In an appropriate manner, depending on the level of knowledge and sensitivity of different audiences (e.g. in some cases more qualitative presentation of risks is better);
- Even if it does not directly encourage acceptance, such risks and costs should be presented quantitatively and accurately;
- Issues of energy penalty should not lead to a misunderstanding of “CCS done only to gain profit”.

Examples:

- In the EU, about half of those who received a lecture on CCS feel that it would be effective to combat global warming; about half said that it would have a considerable impact on the environment (Refer Appendix 5: Books/Papers 8);
- In the EU, more than half of the people consider that CCS will leave risks to future generations (Refer Appendix 5: Books/Papers 8), over 70% of people in Japan consider the same) Refer Appendix 5: Books/Papers 10);
- In a general survey in Japan, over 70% of the people have concerns about the impact of leakage of CO2 (Refer Appendix 5: Books/Papers 10).

4.2.3.7 Explain the strengths and weaknesses of other measures to combat global warming

Our Concept

Strengths (to be assessed for each measure considering the total lifecycle):

- Clean energy;
- Small risks;
- Small costs;
- Small impact on the economy and daily life;
- Technology is already proven;
- Not much time is needed to start, so immediate response is expected;
- Large scale implementation is possible;
- Suitable sites available in our country.

Weakness (again, assessed for each measure):

- Opposite of the above elements.

Examples:

- Comparison of cost over a full lifecycle for different power generation technologies (Refer Appendix 5: Books/Papers 1);
- Comparison of lifecycle CO2 emission of power generation technologies (Refer Appendix 5: Books/Papers 1);
- Consideration depending on the cost of various renewable energy (RE), evaluation of CO2 emission, comparison against other energies, and inclusion of RE to society (Refer Appendix 5: Books/Papers 7);
- Accidents like Chernobyl will never happen in Japan (Refer Appendix 5: Advertisement/Brochures 1);
- CO2 emissions from electric vehicles are equivalent to gasoline vehicles (Refer Appendix 5: Newspapers/Magazines 2).

4.2.3.8 Provide basis for decisions concerning implementation of CCS

Our Concept

Goal:

- The Japanese public should appreciate the necessity of CCS (including CDM) as a bridge for the time being, during the period of change from fossil fuels to renewable energy, on the basis of information summarized on the previous slides;
- Based on this understanding, consensus is developed in society as a whole regarding the necessity of implementation of CCS in Japan.

How to achieve the goal:

- Through comparison of costs (including energy penalties), risk and technical feasibility with other measures to combat global warming;
- Establish forum for free discussion, e.g. interactive symposium;
- As policy proposals from the public;
- Through voting in elections, with introduction of global warming issues;
- Through opinion polls and surveys;
- Through Twitter and other social media;
- Through games introducing global warming issues and counter-measures.

4.2.3.9 Build local relationship of trust

Our Concept

Goal:

- The proponent is seen to explain honestly the advantages and disadvantages of CCS: gains trust in the organization and its dealings with local stakeholders;
- The national responsibility for CCS is seen from a long-term perspective and commitment to support of the local commitment to support of the local community will be maintained for a suitably long time.

How to achieve the goal?

- Building partnerships with local stakeholders (municipalities, fishery and agriculture trade organizations, industries, …) and trusted institutions;
- Provide facilities to encourage dialogue, identification of issues of concern and developing collaborative solutions.

Examples:

- In the EU, if CCS was to be executed locally, around 60% of the people would want to participate in decision making (40% directly and 20% through other NGOs) (Refer Appendix 5: Books/Papers 8);
- In the EU, around 75% of the people believe that it is necessary to supervise the collection and storage of CO2 (Refer Appendix 5: Books/Papers 8);
- A transparent system is needed to explain the current state of CCS to the people in Japan (Refer Appendix 5: Books/ Papers 10, 11);
- In Japan, professionals with a clearly neutral position need to explain the safety of CCS (Refer Appendix 5: Books/Papers 10, 11);
- In Tomakomai, the city established a council ton consider investment in CCS activities (Refer Appendix 5: Website 6, 11).

4.2.3.10 Acceptance of risks associated with CCS

Our Concept

Goal:

- To convince local stakeholders that risks associated with the implementation of CCS are known, small and acceptable.

How to achieve the goal:

- Through dialogues with local government and the public, utilizing a 'space where issues can be shared and solutions can be considered together', focusing on local considerations and lifestyles;
- Explain that all possible risks have been examined and, in particular, assessment of large earthquakes shows that environmental impacts are within those established in safety guidelines;
- Illustrate potential risks in a manner depending on the level of knowledge and sensitivity of different audiences, showing commitment to work together to eliminate fear and anxiety.

Examples:

- In the EU, around 40% think that implementation of CCS would cause detriments to the host region, and around 60 percent of the people are worries is CCS is done within 5km from residence (Refer Appendix 5: Books/Papers 8);
- In Japan, a survey concluded that a clear justification of 'the reason for a chosen site' is considered necessary (Refer Appendix 5: Books/Papers 10, 11);
- In the same survey, it has been pointed out that there are concerns on the use of new, untested technologies and that the underground environment cannot be understood in sufficient detail (Refer Appendix 5: Books/Papers 10).

4.2.3.11 Recognition of benefits associated with CCS

Our Concept

Goal:

- To clearly show that CCS projects not only serve a national need, but also bring direct benefits to the host community.

How to achieve the goal:

- List and quantify:
    - National benefits (including contribution towards solving a global problem);
    - Compensation & tax income;
    - Employment and opportunities for local industry.

Examples:

- Experience from sites where demonstration projects have been accepted.
- Assessments of potential benefits to host communities.

4.2.3.12 Get permission to implement CCS in the target area

Our Concept

Goal:

- To be accepted in the target region, with certainty that the risk of CCS is very small in comparison to its benefits, based on national and local consensus.

How to achieve the goal:

- By the implementing agency building relationships with the local community to convince them that risks are small and benefits are large;
- Through residents' participation in decision-making process (thus they buy into the project);

Examples:

- Survey showing examples where CCS projects were cancelled due to the absence of trust in the region, lack of public participation, lack of flexibility of planning and investigating, and public concern on the risks of storage sites near residences (Refer Appendix 5: Books/Papers 3);
- Sharing results and lessons learnt from the public outreach in six CCS demonstration projects in Europe (Refer Appendix 5: Books/Papers 12);
- Case studies on how the locals see CCS (Refer Appendix 5: Website 10).

4.2.4 Step 1-4

The first half of Step 1-4 was a two-week on-line discussion between the network's members, through the Institute's platform, to identify potential areas for improvement in future activities based on the comparison between the proposed "concept" and the existing examples shown in the previous section. The following requirements were identified in the discussion:

- A portal to enable easy and efficient access to the information relevant to the theme, which is distributed throughout a variety of media as noted in the previous section.
- A structured set of arguments supporting CCS as an effective measure to mitigate global warming in Japan, together with a variety of supporting evidence. Questions, open issues and typical criticisms should also be accommodated in this package, so that a balanced basis for the decisions to be made by non-expert stakeholders can be provided.
- Research and development to understand relationships between CCS and seismicity, as limited information on this topic is currently available. Many members commented that this may become crucial, especially after the recent earthquake and tsunami in Northeastern Japan.
- Audio-visual presentation of key scientific/technical information, specifically designed to expedite understanding of non-experts, can be seen in some websites and brochures but nothing available at present covers all relevant aspects.
- A channel for discussion between non-experts and experts that allows interactive exchanges of information, knowledge, experience, interest, and concerns.

Based on this list, a draft action plan was proposed by the network facilitator which focuses on issues 1, 2 and 3, as issues 4 and 5 were judged to be beyond the remit of the current project. This draft action plan was improved and prioritized in a final two-week session of on-line discussion on the Institute's platform. The final action plan agreed by the members is described in the following sections.

4.2.4.1.1 Action 1: Development of a portal to support activities for expediting non-experts' understanding of CCS

The objective of the action is to provide a "toolkit" for Institute Members in Japan who, from time to time, are asked to explain what CCS is, why it is needed, how mature the relevant technologies are, where potential sites for geological storage in Japan may be found, what the expected environmental and economical impacts will be, and its competitiveness against alternative measures for mitigating global warming. At the moment, relevant information is distributed between homepages of a number of organizations and research areas, but none of the members of the Japanese network have access to all the necessary information in a suitable, internally compatible format. Therefore, there is a danger that member's may waste time finding appropriate information that others have previously found. Furthermore, explanations by members may be inconsistent or contradictory due to insufficient and heterogeneous presentation of the information or that failures in the past are forgotten and then repeated.

The "toolkit" is to be designed as a portal to provide the following:

- Concept for the approach to expediting non-experts' understanding of CCS (Figures 1 and 2) with description of what should be done (and how) in each process (balloons in the figures),
- Materials that are potentially useful for explanation, hyperlinked to the individual balloons in the "concept" (sources of information, current status, and cases of similar attempts in the past).

There was also a suggestion from a member that users should be able to rate value of the individual entries, so that useful and reliable information can be found more efficiently as experience is gained.

4.2.4.1.2 Action 2: Construction of an argumentation model supporting CCS as an effective measure to mitigate global warming in Japan

CCS is a typical multidisciplinary project consisting of a number of technologies supported by a very diverse range of scientific research. In addition, decisions relating to its implementation require understanding of a variety of arguments in many non-technical fields. This can be seen clearly in the “argument map” produced in CatO2 project (Figure 3). Although this argument map provides a useful bird’s eye view of arguments relating to CCS, it requires explanation of background knowledge, evidence and quantitative datato convince non-experts – and even experts in only one of aspect of CCS.

Through this action we will construct a structured set of arguments supporting CCS as an effective measure to mitigate global warming in Japan, linked to a variety of supporting evidence. Questions, open issues and typical criticisms will also be accommodated in this package so that it can be seen to provide a balanced basis for the decisions to be made by non-expert stakeholders. All the key arguments are structured in a hierarchy together, with hyperlinked contents and links to external web sites, with CatO2’s argument map as a starting point, so that a large amount of information can be understood efficiently in a coherent context.

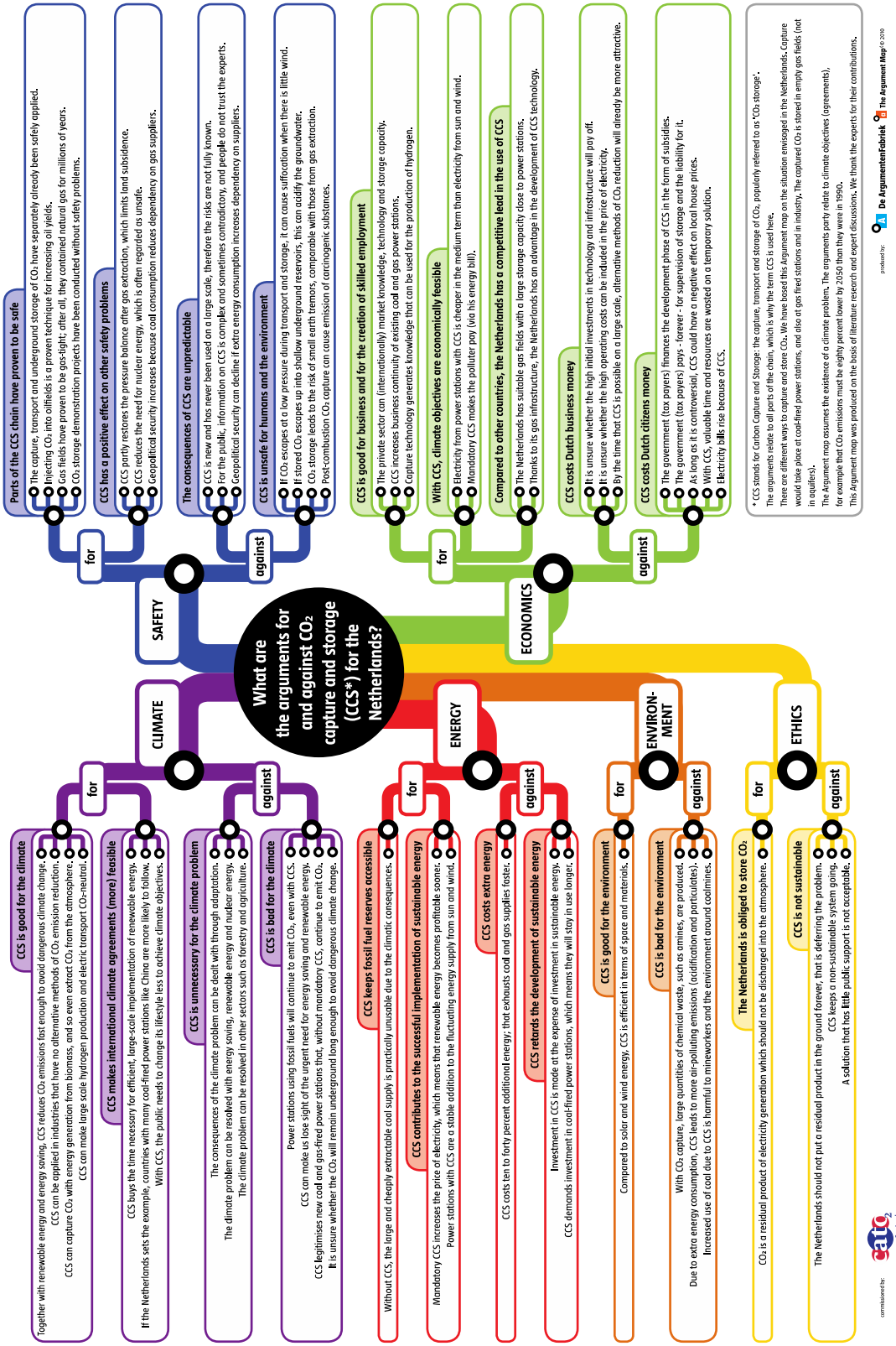

Figure 3. Argument Map for CCS (CatO2 project)[3]

[3] http://www.co2-cato.nl/cato-2/publications/publications/argumenten-map-english

4.2.4.1.3 Action 3: Collation of information on the relationship between CCS and seismicity

With respect to the relationship between CCS and seismicity, little relevant information is currently available. However, many network members commented that this may become critically important for gaining public acceptance of CCS, especially after the recent earthquake and tsunami in Northeastern Japan.

Although current members of the Japanese network do not necessarily cover all required expertise, effort will be made to gather relevant information and knowledge, which will then be integrated within the argumentation model developed in “Action 2”.

4.3 Outputs from Stage 2

4.3.1 Portal to support activities for expediting non-experts’ understanding of CCS

All the information provided by the network’s members is structured according to the concept illustrated in Figures 2 and 3, together with hyperlinked contents and links to the external web sites. Contents are structured as a set of HTML documents and uploaded to the Institute’s digital platform for review by members of the Japanese network (also included in the CD appended to this report). All contents, except external links, have been translated to English and an English version will also be available on the Institute’s website following submission of this report.

A screenshot of the front page is shown in Figure 4.

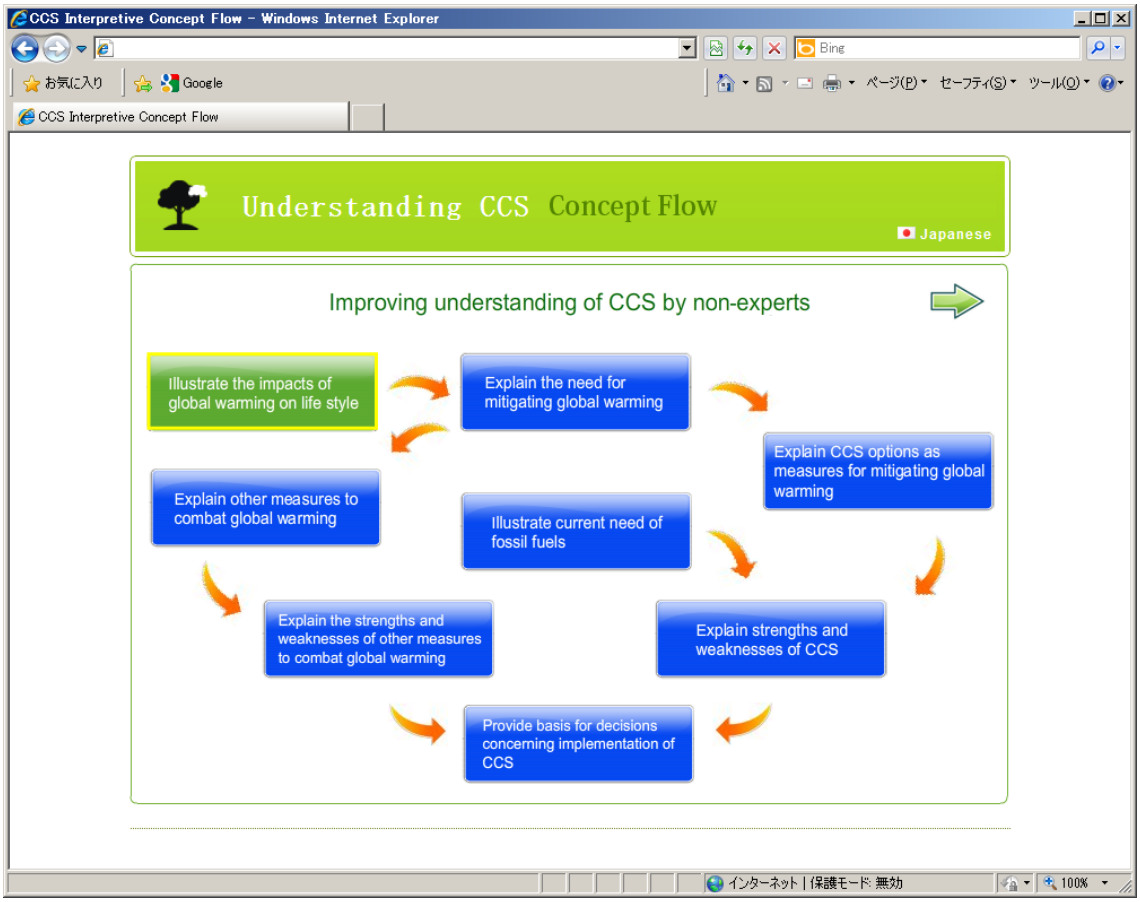

Figure 4. Screen shot taken from the portal to support activities for increasing understanding of CCS

4.3.2 Argumentation model justifying CCS as an effective measure to mitigate global warming and its effects on Japan

Arguments, evidence and criticisms that were identified through on-line discussion were structured to form an argumentation model that overviews the justification for the claim that CCS is an effective measure to mitigate global warming and its effects in Japan. The argumentation model is constructed by using commercial software (MindMap produced by MindJet) which allows users to link information in a variety of file types and also link to external web sites. The full argumentation model is shown in Figure 5, although text is not readable because of its size. For details readers are invited to see a PDF contained in the CD attached to this report.

An interactive version of the argumentation model was also developed as a nested set of HTML documents, with hyperlinks, and has been uploaded to the Institute's digital platform for review by members of the Japanese network. All content, except external links, has been translated to English and an English version will be loaded onto the Institute's website shortly after submission of this report. Starting from the claim summarized as "CCS is an effective measure to mitigate global warming in Japan", users can select any question from the list and follow the chain of arguments that answer it. They can follow explanations or external links to a level of detail that depends on their specific interests and technical background. Proceeding in this manner, users can explore the components of the argumentation model that correspond to their own questions on the justification of CCS for Japan.

An example screenshot taken from this interactive version is shown in Figure 6.

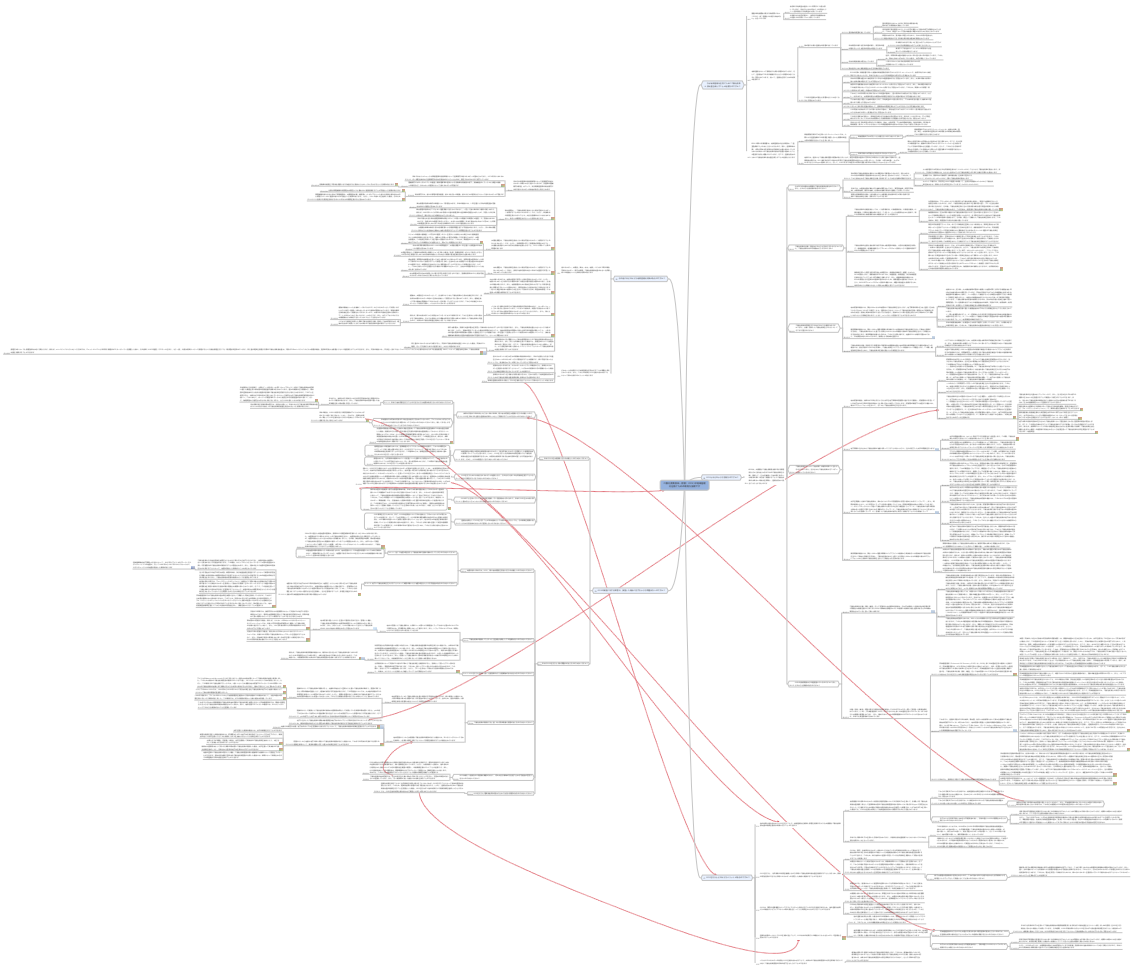

Figure 5. Argumentation model justifying CCS as an effective measure to mitigate global warming in Japan

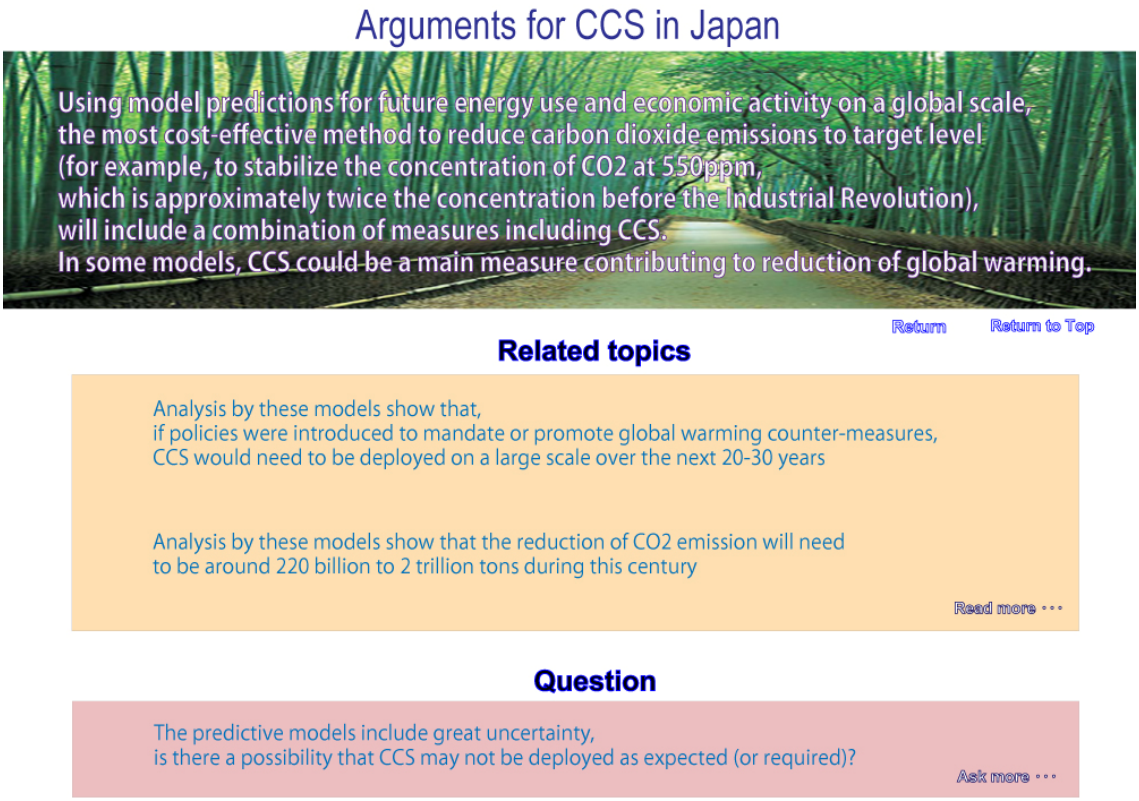

Figure 6. Screenshot taken from the interactive version of the argumentation model

4.3.3 Information concerning the relationship between CCS and seismicity

Although available information concerning relationships between CCS and seismicity is limited and the members of the Japanese network do not necessarily cover all the required expertise, relevant information was gathered as much as possible under the current boundary conditions. This includes:

- Examples of seismicity induced by injection of fluids, e.g., liquid waste and water,
- Development in rock mechanics to avoid induced seismicity including understanding of the mechanisms for induced seismicity, assessment of critical injection pressure, control of fluid pressure and monitoring of micro-seismicity ,
- Behavior of Nagaoka CCS pilot plant during and after Chuestu earthquake in 2004 whose epicenter was only 20 km away from the site.

The information was structured in the same format as the argumentation model developed in Action 2 and included therein.

4.3.4 Use of the resources by network participants

The resources that were described in the previous sections were uploaded onto the Institute's digital platform for review by the network participants. Below is a summary of how participants may use the resources in the context of their own work.

4.3.4.1 Enhancement of knowledge outside specific fields of expertise

Since CCS is such a multidisciplinary subject, it is recognized by the participants that coverage of the entire topic by any individual is difficult. Although they are aware that existing documents contain most of the relevant information, e.g. the Intergovernmental Panel on Climate Change (IPCC) Special Report, it is not an easy task for them to find and extract information blocks required for their specific applications. This is particularly true in the case that the area of interest does not belong to their field of technical expertise. In this context, the argumentation model provides efficient and systematic access to key information and links to a supporting knowledge base focused on issues relevant to implementation of CCS in Japan.

4.3.4.2 Communication across boundaries between disciplines

It has proven to be difficult in the past to develop consistent views of problems on which a number of experts from different disciplines are working together. Here development of the argumentation model can help resolve this situation by facilitating development of consensus on the relationships between key issues that overlap a variety of different research/business areas in a clear and structured representation.

4.3.4.3 Education and training

Some of the network participants are involved with universities and stressed the value of using the argumentation model in lectures so that students can understand the big picture and access relevant supporting information in a structured and user-friendly manner. Furthermore, this approach would provide opportunities for project work by university students, involving them attempting to expand/restructure/modify the model according to their own understanding of the key issues associated with global warming and the associated implementation of CCS.

4.3.4.4 Planning and designing communications with non-experts

The “tool kit” now contains suggestions for CCS communication procedures with non-experts which have:

- clearly defined goals,
- suggestions of how communication can be implemented in a stepwise manner ,
- a case-base of past communication efforts, related to each step towards establishment of dialogue.

This supports planning of future communications activities by the participants and encourages collaboration and sharing of resources. In addition, the argumentation model provides key messages that are to be communicated in a form that is readily incorporated into stakeholder dialogue.

4.3.5 Recommendations for next steps

In this section, suggestions/recommendations of the next steps in each of the actions and for use on the Institute’s knowledge platform to further develop the network’s output are summarized.

4.3.5.1 Action 1: Development of a portal to support activities for expediting non-experts’ understanding of CCS

Key messages to be communicated at each step described in the “Concept for an approach to expediting non-expert understanding of CCS” (Section 4.2.2) are included in the argumentation model. An obvious target for the next step is to convert these key technical messages into a format that can be shared and understood by stakeholders with different levels of scientific/technical literacy. For this purpose, the following tasks are identified;

- Map arguments in the argumentation model onto the steps described in the “Concept for an approach to expediting non-expert understanding of CCS”, so that key messages to be communicated at each step can be highlighted,
- Define a clear ontology to resolve current ambiguities in definitions of components of CCS in both Japanese and English which, in the latter case, should be consistent with international usage as summarized on the Institute’s website.
- Distill technical messages into a simpler form and design their presentation in an audio-visual manner that is focused on modern electronic media,
- Develop a program of public engagement by blending communication/education using the

content mentioned above and exercises such as technology assessment and soliciting public comments on policies, which encourages and supports non-expert stakeholders to deliberate on the issues identified for each step,

- Initiate a dry run to assess the program.

Functions required to support collaboration among the members on these tasks are readily available on the Institute's digital platform. For full-scale implementation of this program, a "social-ware" that can be opened to anonymous users is required. However, for the dry run, a relatively small community of non-expert stakeholders working directly on the Institute's digital platform should be sufficient.

4.3.5.2 Action 2: Construction of an argumentation model supporting CCS as an effective measure to mitigate global warming in Japan

The argumentation model described in the previous sections should be regarded as a first draft and iterative discussions among the network participants and, possibly, feedback from non-expert stakeholders will provide input to improve its consistency and comprehensiveness. The improved model should also incorporate the established ontology to facilitate its uptake by all disciplines active in this project. To support such discussion amongst the network's members, a tool (or additional function for the Institute's platform) that allows users to edit and comment on the continuously evolving argumentation model is needed, together with a simple ontology editor to ensure that internal consistency is maintained.

Presenting the argumentation model to non-expert stakeholders in the course of the "dry run" mentioned above provides opportunities to review/challenge it from a variety of perspectives and, thus enhance its comprehensiveness. A related topic is "visualization" of argumentation models for non-expert users, which should also be dealt with in the members' collaboration program.

4.3.5.3 Action 3: Collation of information on the relationships between CCS and seismicity

Through discussion among the members on seismicity induced by injection of CO_2 and the impact of seismicity on any component of CCS, geological storage in particular, it is recognized that knowledge of the current members on such technical issues is limited. On the other hand, few experts on seismicity are familiar with CCS. Hence this is an area that requires active knowledge sharing to bridge the gap. One possible way forward would be to invite an expert on seismicity with some experience in the field of CCS to give a “webinar” for the network participants on the Institute’s platform. Indeed, provision of such an opportunity for the participants to learn new, relevant knowledge could be a good way to reward them for their participation and dedication.

5 Lessons learnt from the Japanese knowledge sharing test bed and suggestions to the Institute

Through the series of exercises conducted by members of the Japanese knowledge sharing network, a number of lessons have been learnt. Some of these may be specific to the subjects that we chose or closely linked with the cultural issues. However there are some observations that should be transferrable to other knowledge sharing activities carried out by the Institute’s Members

The Institute’s digital platform proved to have sufficient functionality and user-friendliness to expedite on-line discussion and collaboration throughout this exercise. There were no additional “wishes” from the members in this regard. However, it was recognized that careful consideration of the following key aspects was needed when organizing a knowledge sharing network utilizing the digital platform.

5.1 Recognition of clear benefits

There was a consensus that there has to be a clear net benefit in participating in the knowledge sharing scheme, taking pros and cons into account, in order to encourage hesitant members. In this respect, it is crucial to choose a theme for which all members can see clear benefits. In our case, after group discussion, it was agreed to start the KS network with “Promotion of understanding of CCS for non-experts”, where members could see clear benefits in sharing experience and know-how.

5.2 Avoidance of conflicts of interest

Some members expressed concern about revealing knowledge and experience without knowing precisely how it would be treated, for example disclosure to potential competitors who are also Members of the Institute, IP problems, and misuse of information beyond its remit. In this respect, it is often useful to choose a “safe” topic in which there are no foreseeable conflicts of interest among the members or critical IP problems.

5.3 Commitment of members based on consensus

Much effort is required before knowledge gathered through collaboration reaches a “critical mass” and becomes useful to the community. It is important that such efforts are shared among the members in a reasonable manner. From this perspective, it is vital to design a mechanism by which members can see that others actively participate. In our case, a transparent procedure of consensus building based on the SSM (see Section 2) played such a role.

5.4 Accommodation of different views

If there are different views amongst the network’s members, effort should be made to accommodate all such views in the action plan, so that all members remain motivated for active participation. This may be seen as a vital prerequisite of community-based knowledge sharing. Therefore, in setting the goals and required activities, discussion should be as flexible as possible, taking an iterative approach to develop consensus.