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CARBON DIOXIDE CAPTURE AND STORAGE

CONCLUSIONS AND RECOMMENDATIONS FROM A STAP BRAINSTORMING MEETING, OCTOBER 17-18, 2007

(Prepared by the Scientific and Technical Advisory Panel)

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Introduction

This Scientific and Technical Advisory Panel Report to the GEF Secretariat, was informed by a small expert group meeting, convened at the GEF Secretariat, during October 17-18 2007, to support the STAP in the development of its advice to the GEF Secretariat.

The Report is supported by Annex 1, containing examples of awareness and capacity building activities, and by Annex 2, which contains the proceedings of the meeting, but any discussions or recommendations made in the meeting are not endorsed by STAP as its own position.

Background:

At the 11th Session[1] of the Conference of the Parties (COP) to the United Nations Framework Convention on Climate Change (UNFCCC), the Parties requested the Global Environment Facility (GEF) to consider whether supporting Carbon dioxide Capture and Storage technologies (CCS), in particular relevant capacity-building activities, would be consistent with its strategies and objectives and, if so, how these could be incorporated within its operational programs.

The strategy and work plan for GEF-4 [2] was developed for implementation between 2006 and 2010. In doing this GEF recognized that transferring immature, low-GHG technologies to developing countries is not appropriate because of the large extra costs and risks that would be imposed on the host countries' energy systems. However, it also recognized that it needed to keep abreast of developments in such technologies[3]. At that time, CCS was not recognized as being relevant to the GEF strategy so no resources are allocated to CCS in the current phase (2006-2010) of the GEF work program.

In response to the COP's request, the GEF is now re-examining its possible role in relation to CCS. This might include developing a small programmatic effort to enable appropriate specialists in relevant developing countries to inform themselves about CCS; it might also, perhaps, assist them in becoming involved in the development of CCS technology (such developments are currently largely being carried out in OECD[4] countries; several of these countries are also planning full-scale demonstrations of the technology). The purpose of this meeting was to find out if the opportunity for GEF activity had changed and, if so, to make recommendations for appropriate action.

[1] Held in Montreal, December 2005.
[2] The "Focal Area Strategies and Strategic Programming for GEF-4" can be downloaded at the following link - http://www.thegef.org/uploadedFiles/Focal%20Area%20Strategies_10.04.07.pdf
[3] The GEF supports pilot and demonstration projects for adaptation to climate change under the following funds – Strategic Priority on Adaptation (SPA), Least Developed Country Fund (LDCF), and the Special Climate Change Fund (SCCF).
[4] Organisation for Economic Cooperation and Development

Conclusions reached by STAP

Context:

The Intergovernmental Panel on Climate Change (IPCC), in its 4th Assessment report[5] and in its Special Report on CCS (SRCCS), recognized CCS as a potential element in the portfolio of mitigation technologies. The SRCCS found that CCS may contribute 15 to 55% of the overall mitigation effort this century (depending on the precise stabilization target) and could reduce costs by up to 30% compared with a situation where CCS was not available.

A number of features of energy systems have influenced the development of this view:

1. Fossil fuels will continue to dominate the energy supply systems for much of this century. In particular, coal is projected to remain the mainstay of electricity generation in many major economies – especially those where coal is the main indigenous, economically viable, source of energy.
2. Even in the context of extensive improvements in energy efficiency and deployment of renewable energy and other fuel switching measures, use of coal will increase for many years to come. In this context, CCS technologies are of interest because they have the potential to reduce the carbon footprint of a fossil-fuel based energy system.
3. The present driver for improving energy technologies in most developing countries is to increase the security and affordability of energy supply - rarely are energy technology developments driven by a wish to mitigate climate change.
4. The greatest contribution to mitigation from use of CCS would come from its application in power generation. Other applications of CCS have substantially lower mitigation costs but smaller global potential – nevertheless, they may provide opportunities for earlier deployment; examples include use of CCS in production of ammonia, hydrogen or synfuels, enhanced oil recovery or in natural gas clean-up.

Status of CCS:

5. There is a variety of different approaches and routes for CCS, with differing characteristics in terms of cost, technology status and uncertainties. Options for capturing CO_2 include pre- and post-combustion capture and use of oxy-fuel combustion[6]. Geological storage of CO_2 is considered to be the best storage option – use of depleted or producing oil or gas reservoirs is fairly well understood; storage in deep saline water-bearing formations and in unminable coal beds are less well characterized – in the latter case this could lead to sterilization of the coal measure; other concepts are only now being researched, such as storage in basalt formations which will depend on confirmation of the presence of an impervious cap-rock.
6. The relevance of CCS varies between countries depending, especially, on the potential for geological storage and on the availability of large CO_2 point sources.
7. Capturing CO_2 from power plants will incur extra cost (in terms of energy as well as capital and operating expense) which will increase the cost of power generation. Significant advances in technology may be needed to reduce these additional costs. Some of the extra cost might be

[5] Report of IPCC WG3

[6] Various technologies may be used for capture including chemical or physical solvent absorption, adsorption, membrane separation or cryogenics depending on the particular capture option used.

offset in certain circumstances, if CCS is associated with Enhanced Oil Recovery (EOR). Injection of CO_2 could also be used to enhance the recovery of Coal Bed Methane (ECBM). However, ECBM, which may involve artificial fracturing of the coal-bed, is unlikely to be compatible with permanent storage of CO_2. Even if it were to be so, in order for the CO_2 to remain underground, the coal reserves would effectively be sterilized and no longer available for production.

8. Almost all stages of CCS make use of existing technologies – IPCC recognized them as mature or almost-mature[7]. Nevertheless, because these technologies were developed in a few OECD countries, they may be unfamiliar to scientists and engineers in other countries and there are very significant challenges in scaling-up. No utility company would accept a technology as "mature" unless it has actually been done at the scale at which it is proposed for deployment. The issue of maturity in terms of the underlying science is quite different from the issue of maturity of a technology for deployment. There is currently much interest in reducing costs; the risks of long-term storage, especially the permanence of storage, also need to be clarified. Increasing amounts of R&D in these areas are now addressing such questions. There may be significant opportunities for collaborative R&D which might have the potential for more rapid technology convergence and deployment. In addition, a clear regulatory framework will be required which *inter alia* must address any potential liabilities.

Role of the GEF:

9. Through its role as the operating entity of the financial mechanism of the UNFCCC, the GEF promotes in its climate change focal area a watching brief as to what happens in the markets for technologies of greatest relevance. As new technologies are developed, the GEF must continue to clarify whether it has a role in helping open, develop, and transform the markets for these new "beyond the horizon" low-GHG technologies. Whether that technology is entirely renewable, such as concentrating solar or geothermal power, or is a clean fossil-fuel option, such as integrated gasification combined-cycle (IGCC) technologies, or deals with long-term emission storage, such as carbon dioxide capture and geological storage (CCS), there is a need for the GEF to keep abreast of these developments and to consider revising its strategy and reformulate its strategic programming in response to these changes.

10. In order to achieve its strategic objectives, the GEF supports work programs of mitigation projects, but CCS is not currently eligible for GEF support. In the near-term, responding to opportunities might involve approvals made on an exceptional basis; in the longer term, it would be appropriate to consider whether CCS should be addressed by changes to GEF's strategic objectives

[7] Please refer to table SPM.2 of the SRCCS Summary for Policymakers for an overview.

Recommendations of STAP to the GEF Secretariat:

11. Given the potential relevance and importance of CCS to the mitigation of climate change, it would be appropriate for the GEF to develop some "enabling" interventions in respect of this technology - one course of action might be to maintain a "watching brief" with regard to CCS.
12. GEF could promote capacity building or enabling activities on CCS in developing countries. These countries may wish to equip themselves with suitable capacity in respect of these technologies, so as to be able to be fully-informed in taking their own decisions.
13. In view of the wide range of national circumstances, it would be appropriate for GEF to consider interventions across the spectrum from developing awareness through to capacity-building. This might be through the Special Climate Change Fund, which has a provision for supporting non-investment activities in new and emerging mitigation technology areas through capacity building and information generation.
14. With regard to raising awareness, some activities have already taken place through the activities of various international organizations, such as the Carbon Sequestration Leadership Forum (CSLF) and the IEA Greenhouse Gas R&D Programme (IEA GHG), as well as international and bilateral programs such as the EU/China cooperative research project (COACH) on clean coal technologies[8] and the China-UK Near Zero Emissions power plant project (NZEC). Further and more comprehensive awareness creation could be assisted by the GEF, for example through an information clearing-house, sponsored short courses or more focused actions. Such activities might require expenditure of c.US$2000/person. It is noted that any of these events would need to be repeated periodically to address advances in technology and to reinforce the interest in the topic. Examples of recent awareness-raising activities are given in Annex 1.
15. In order for national governments, institutes and industry to form a view on the potential relevance of CCS to their circumstances, it may be necessary for them to enhance the knowledge-base of their scientific and engineering communities, to improve the institutional capability to regulate and promote CCS (if appropriate), and to expand systemic capabilities, such as by developing a regulatory regime. Many countries are supporting research on CO_2 capture and storage technologies, and expect to develop a pool of technical manpower for all GHG technologies. Some examples of recent capacity-building activities are listed in Annex 1. In practice, the need for capacity-building will vary between countries and will continue through all stages of the development cycle
16. It suggested that the GEF should report to the COP that it might stimulate the Parties to provide information that would help to identify the needs for awareness-creation and capacity-building activities in relation to CCS.
17. STAP could periodically update GEF and liaise with SBSTA about the scientific and technological developments in CCS related activities in OECD as well as developing countries. STAP could consider a Targeted Research program on CCS.

[8] COACH was launched in November 2006; it is a 3 year programme of work involving 20 European and Chinese partners.

Annex 1: Examples of Awareness-raising and Capacity-building activities

Awareness-raising examples

1. Two regional workshops were held in Africa in September 2007, to raise awareness and share information on CCS, as well as to build capacity on CDM. The locations were Dakar in Senegal and Gaborone in Botswana. About 60 people participated in each one. Most of the participants had no prior experience of CCS. The workshops were organised by the Energy Research Centre of the Netherlands (ECN), the Energy, Environment and Development (ENDA) organisation, and Energy, Environment, Computer & Geophysical Applications (EECG) of Botswana. The total budget was US$235,000 (i.e. roughly US$2000/participant). Shell, Statoil, the UK Department for Business, Enterprise and Regulatory Reform, and the Norwegian Ministry of Foreign Affairs provided funding. More information is at: www.ccs-africa.org.

Capacity-building examples

2. Brazil has organized several capacity-building events recently, at an average cost of around $US1,900 per person:

- 1st International Seminar on Climate Change and Carbon Sequestration in Brazil, held in Rio de Janeiro, in August 2006, with 320 Brazilian participants and 80 international CCS specialists, cost around $US 806,000 for a 3 day event.
- 1st Brazilian Seminar on Climate Change and Carbon Sequestration, held in Natal in April 2007 with 300 Brazilian participants, cost about $US 445,000 for 4 days including CCS technical courses.
- 1st Brazilian Middle-West Seminar on Climate Change, held in Cuiabá in August 2007 with 100 Brazilian participants cost about $US 139,000 for 4 days including 2 days of CCS technical courses.
- 3 day CSLF Workshop for Capacity Building for Emerging Economies in Porto Alegre in October 2007 with 85 Brazilian participants and 25 international CCS specialists, cost about $US 215,000.
- Workshop on CO_2 Geological Storage and Ethics, held in Rio de Janeiro in November 2007 with 45 Brazilian participants and 35 international CCS specialists, cost around $US 204,000 (3 days).

3. PETROBRAS/PUCRS has already built a Carbon Storage Research Center (CEPAC) and is under discussion with the Carbon Sequestration Leadership Forum (CSLF) to build a CCS Advanced Training Center for Emerging Economies in Brazil, it requires the expenditure of $US 1,000,000. CEPAC/PETROBRAS is already developing an agreement with Geoscience Australia to share geologic information to provide data to use for the CCS training.

4. In 2006 the IEA GHG R&D Programme ran a summer school on carbon capture and storage. The summer school covered every aspect of CCS including technical information on capture, transport and storage of CO_2, and non-technical issues such as economics, regulation and public acceptance. A total of 55 students from over 20 countries attended the school which went for 6 days. The students had their travel to and from the event, accommodation and meals paid for. The budget for the event was approximately €100,000.

5. The EU/China COACH project, which was launched in November 2006, includes a work-package on knowledge sharing and capacity building, in which workshops and conferences are being organized, and visits are being arranged for scientists and engineers. The overall budget for COACH is US$3.7M over 3 years.

Annex 2. Proceedings

Proceedings of the Scientific and Technical Advisory Panel
Brainstorming Meeting on Carbon Dioxide Capture and Storage (CCS)
October 17th-18th 2007, Washington, D.C.

1. Introduction to the Proceedings

These Proceedings are intended to be a record of the discussions held at the Meeting, but are not an endorsement by the Scientific and Technical Advisory Panel (STAP) regarding the views and positions of participants to the meeting; neither do they commit the GEF Secretariat to any course of action that may have been discussed.

2. Welcome and brief introduction to the meeting, purpose and objectives

Doug Taylor, STAP Secretary, welcomed the participants to the meeting, and briefly summarized the meeting objective – to develop scientific and technical guidance for the GEF to enable it to respond to the request made by the Conference of Parties to the United Nations Framework Convention on Climate Change (UNFCCC) at their 11th Session in Montreal, December 2005. He also noted the meeting products would be a report capturing the brainstorming discussions, and STAP's recommendations on Carbon Dioxide Capture Storage (CCS).

Richard Hosier, Team Leader Climate and Chemicals, GEF Secretariat, specified UNFCCC's request to the GEF - to consider whether supporting CCS technologies, in particular capacity-building activities, would be consistent with its strategies and objectives, and if so, how they could be incorporated within its operational programs.

Because of the "Focal Area Strategies and Strategic Programming for GEF-4" (October, 2007), Richard Hosier emphasized that CCS is not a strategic focus of the climate change strategy in the current phase of the GEF (2006-2010). Nonetheless, he emphasized that STAP's advice was still needed on how to maintain developing countries abreast of CCS technology, as it develops further and becomes commercialized. The GEF Secretariat, therefore, asked the participants to consider capacity building on CCS for developing countries, in particular the following aspects:

i. Capacity building for what - what is going to be useful to developing countries?
ii. How can the GEF help facilitate this capacity building?
iii. When should the GEF target capacity building efforts?

Richard Hosier informed the group the GEF had considered funding a CO_2 re-injection project in Argentina in the late 1990s, but the project did not continue due to uncertainty as to whether there was really any incremental cost involved in the project as it seemed it would pay for itself anyway. Despite this brief experience with re-injection, the GEF Secretariat, nonetheless, noted that it accepts the challenge that CCS will be an important component to reducing greenhouse gas (GHG) emissions. Therefore, it encouraged the group to develop advice on capacity building, responding to the aforementioned three points.

Heleen de Coninck, Energy Research Centre of the Netherlands (ECN), asked whether the GEF had stories of success in climate change, and if so, what these were.[9] Richard Hosier noted these

[9] Heleen de Coninck is also a PhD student at the Institute for Environmental Studies, VU University of Amsterdam (IVM)

successes as wind energy investments in India during the 1990s, assisting China and Mexico draft their laws on renewable energy, and investing in rural photovoltaics.

3. Reflections from the UN Expert Group Meeting on CCS and Sustainable Development on developing country needs

Paul Freund, Independent Consultant, briefed the group about a recent Expert Group Meeting on "Carbon Capture and Storage and Sustainable Development", convened by the United Nations Department for Economic and Social Affairs (UNDESA), 10^{th}-11^{th} September 2007. The group consisted of representatives from Brazil, China, Europe, India, Japan, North America, Kazakhstan, and South Africa. The participants considered the challenges of deploying and transferring CCS, and the options to overcoming the barriers faced by CCS. [10, 11]

One key message that resulted from the UNDESA expert meeting was the recognition of certain "low-hanging fruit" – low cost opportunities to reduce CO_2 emissions from sources other than the power sector, the largest emitter. To illustrate this point, Paul Freund discussed a CCS project run by BP in Algeria, in partnership with Sonatrach and Statoil – this is at the In Salah natural gas field[12]. In response, the GEF Secretariat accepted that "low-hanging fruit" might be relevant to future activities in CCS, and encouraged the group to think further how this approach could be useful in structuring what could be done on CCS.

A reminder was raised that many developing countries may not want to use CCS now because they may wish to understand better its potential, because they may not be aware of the technology, or because reducing GHG emissions is not a priority, amongst other reasons. A similar point was recognized by the UNDESA expert group - currently, CCS is being used in four countries Norway, Canada, the Netherlands, and Algeria; that meeting also heard about activities to understand the potential of CCS technology in China, Brazil, India and South Africa .

Nonetheless, there was initial discussion on what advice might be suitable for those countries interested in CCS - that is, should old power plants be retrofitted to capture carbon dioxide (CO_2), or should new power plants be built that are "capture-ready"? The group agreed a prudent approach would be for new plants to be constructed so as not to exclude CCS – this would involve leaving sufficient space around the power plant for the later installation of CO_2 capture technology, as well as siting the power plant close enough to a storage site for economic transport of CO_2.

4. CCS in India – a developing country perspective

Anand Patwardhan, Technology Information, Forecasting and Assessment Council, (TIFAC), delivered a presentation on the "Status of Carbon Capture Technologies in India". The presentation raised some of the research and development initiatives that India is undertaking on Integrated Gasification Combined Cycle (IGCC), proposed Enhanced Oil Recovery (EOR) efforts in the Ankleshwar field, Enhanced Coal Bed Methane Recovery (ECBM), as well as efforts to identify suitable deep saline aquifers to store CO_2.

[10] Further information about the meeting can be found at: http://www.un.org/esa/sustdev/sdissues/energy/op/ccs_egm/ccs_egm.htm
[11] Presentations made at the STAP brainstorming meeting, including Paul Freund's presentation, are available at: www.unep.org/stapgef
[12] The gas produced from this field contains CO_2 which has to be removed before the gas can be sent to market; accordingly it is relatively inexpensive to reinject the CO_2, rather than letting it escape to atmosphere as would normally be done. In this way around 1 million tones/year of CO_2 is kept out of the atmosphere.

Discussion focused on the potential barriers for developing countries to adopt CCS. Anand Patwardhan grouped the barriers into three types:

i. Financial barriers
ii. Science and technology barriers
iii. Institutional barriers

One potential financial barrier is the high capital cost of retrofitting capture to coal-based power plants versus other available technologies, such as IGCC, or Underground Coal Gasification (UCG). From a developing country perspective, the cost of generating power is also likely to be a determining factor in respect of adopting CCS. It is likely that CCS will be considered primarily as an energy supply technology by developing countries, rather than as a mitigation option. Thus, CCS as an energy supply technology may be more costly to India, and other developing countries, than other alternative and lower-cost energy technologies.

As for science and technological barriers, an example discussed is that CCS has not been commercially demonstrated with large point sources of CO_2; thus, its potential is not yet known. The potentials of EOR and ECBM also need to be carefully assessed, and established. Another barrier is the lack of a complete map of storage capacities, as is the risk/uncertainty of long-term storage.

On institutional barriers, regulatory and monitoring systems were discussed at length. Developing countries need to strengthen their capacity to monitor storage sites, including in the long-term, and on what regulations would apply to them.

As a concluding remark, Anand Patwardhan discussed the need, and possibility of, reducing CCS technology costs to spur wider adoption in developing countries. Also, he suggested the possibility of joint-collaborative research and development initiatives as a way to reach technology convergence. On capacity building, Anand Patwardhan discussed several ideas that could be considered by the group. These included conducting a CCS technology assessment, developing an information sharing and exchange network, and the possibility of developing a targeted research proposal on storage assessment of CO_2.

5. Review of status of CCS Research & Development and implementation in developing countries

Clean Coal Technologies in South Africa

Anthony Surridge**,** South African National Energy Research Institute, (SANERI), presented on "Clean Coal Technologies in South Africa". He raised the current and future energy needs in South Africa – a coal-based economy – and the need for guidance on whether CCS would be suitable for South Africa. He stressed that, in some respects, South Africa's geology is well-known but less is known about whether there is potential for CCS for mitigation purposes in South Africa.

He emphasized that CCS should not be seen as an excuse to continue using fossil fuels. Instead, considering reliable forecasts of continued and increased use of fossil fuels (in spite of increasing use of renewable energy and energy efficiency measures) that CCS could in that circumstance assist to mitigate CO2 emissions. Moreover, CCS should be viewed as one of a range of greenhouse gas

emission mitigation options, the choice being made on cost and country specific requirement considerations.

Anthony Surridge discussed several factors under the title of "country-readiness" that would enable the implementation of a carbon capture and storage pilot project in South Africa. Amongst these was capacity building of technical know-how, human capacity, and outreach. South Africa is working towards "country-readiness" by undertaking capacity building on technical know-how with the inputs of the Carbon Sequestration Leadership Forum (CSLF), and International Energy Agency Greenhouse Gas Programme (IEA-GHG). This capacity building on CCS will complement its extensive geological expertise centered on the Council for GeoScience. Capacity building could also be facilitated by creating a Chair of CCS at a University.

Having considered whether CCS might be relevant to South Africa's needs – and receiving a positive responses, the development of a CCS atlas would be a valuable next step. This would address a scientific and technical barrier that has also been noted by Anand Patwardhan. Establishment of a professorial chair in university could have a number of benefits and would stimulate the growth of a body of trained people. Co-funding of an in-country demonstration project, say 20,000 tonnes of CO_2 injected per year for two years would build confidence in the feasibility of this option.

The industries that are likely to implement CCS are conservative – their primary mission is to provide energy products such as electricity and liquid fuels. In order for an industry to undertake CCS as part of its operation, it would like to see a large plant in operation on an international scale, and also to experience a small scale feasibility project in its own country.

Potential areas of collaboration between SANERI and multilateral or bilateral organizations were also discussed.

Africa Workshops on CCS and CDM Capacity Building

Brendan Beck, IEA-GHG Programme, and Heleen de Coninck briefed the group about two workshops on CCS and the Clean Development Mechanism (CDM) in Africa[13]. The objectives of the workshops were to increase knowledge and access to information on CCS in African countries, and to build capacity on CDM within the African context. The workshops were held in Senegal and Botswana, September 2007, in response to an invitation extended by the Conference of the Parties to the UNFCCC at their meeting in Nairobi, 2006.

Some of the main points that emerged from the workshops were as follows:

- Climate change mitigation is not a priority for Africa. Therefore, CCS for mitigation purposes is not a priority. However, CCS linked to energy supply could be an option in the light of economic development efforts taking place in Africa. For this reason, tapping into CCS technologies should not be ruled out.
- A number of questions were raised on who will pay for CCS technologies. Incentives will need to be created to overcome the costs.
- Institutional capacity and CCS technology know-how were identified as key barriers. Generally, more capacity building efforts are needed.

[13] Please go to http://www.ccs-africa.org/ for further information

- The need to develop an atlas of suitable storage sites was raised.
- Demonstration projects could help increase knowledge about CCS technologies and regulatory systems in Africa.

After the briefings, several questions were raised about the potential of CDM projects in Africa, and where they are most likely to develop. Within this context, several questions were raised about potential opportunities of IGCC projects in Africa.

Brazil´s readiness: barriers and opportunities for future activities

Joao Miguel Faim, Carbon Storage Research Center (CEPAC) at the Pontifical Catholic University of Rio Grande do Sul (PUCRS), and Rodolfo Dino, Petrobras, presented on "Brazil's readiness for carbon capture and geological storage (CCGS) – the opportunities, barriers for future activities". They discussed several on-going and future initiatives on CCGS research and development, as well as capacity building activities. Amongst these is an upcoming workshop on developing a CCGS roadmap in November 2007, and the implementation of four research and development centers on CCGS in 2007-2008.

The presenters noted that the goal of Petrobras's Climate Change Mitigation Technologies Program (PROCLIMA) for 2007-2012 is to provide technological solutions to mitigate the effects of Petrobras' activities on climate change. In doing so Petrobras noted that it has the experience to transfer EOR technologies, but that further capacity building is needed on other CCGS applications. As a result, Petrobras is investing in a number of capacity building initiatives, including through Ph.D. or Master's degree programs, as well as by attending training courses sponsored by CSLF, and IEA-GHG Programme.

Another objective of PROCLIMA is to promote policies and regulations, as well as increase knowledge and awareness about the opportunities for CCGS as a mitigation option. Currently, a pressing need in Brazil is to develop a monitoring and regulatory system, so that questions can be answered as to who will be responsible for the storage, and who will be responsible for monitoring it in the long-term. Further discussions ensued about the responsibilities of governments to develop and be responsible for monitoring and regulatory systems once the private sector has developed and implemented CCGS (which should include rigorous testing of its suitability). Several concerns were noted about the geological risks that might develop over time so a key issue would be the need for monitoring and responsibility for the storage site once injection had finished.

6. Discussion on key issues and needs for CCS capacity building in developing countries

Note: many of the following discussion points are broad in scope and are not intended as STAP recommendations.

The main points that emerged from a brainstorming discussion on what could be considered in the advice to the GEF on CCS capacity building in developing countries are as follows:

- Even for developed countries CCS is only 10 years old, with relatively few experts to call upon therefore. For developing countries with less experience there is a need to enable outreach to developing countries to achieve a critical mass of practitioners, but should this be at national or regional scale?

- For the majority of developing countries (and for many developed countries also), CCS is still a premature option for reducing CO_2 emissions compared to renewable energy options. In addition, national circumstances will determine the relevance, applicability, of CCS. As a result, a lot of developing countries will not be interested in CCS.

- Capacity building on CCS is needed at three levels – human resources, institutional and systemic. These could include –

    i. Strengthening capacity on CCS and its relevant disciplines at the university level.
    ii. Sustainable technology development and transfer – this will be successful only if a country can reproduce it with little or any external support.
    iii. Follow-up to CCS symposiums – e.g. Africa workshops.
    iv. Institutional capacity on regulatory systems – potential source may be University College London's legal database.
    v. Atlas of possible storage, and a map of storage facilities, or formations.
    vi. Development of regulations and laws and the repeal of perverse incentives.
    vii. Development of CCS demonstration pilot projects – what capacity will be required to develop and launch a demonstration pilot project?
    viii. Development of standards, such as through the International Organization for Standardization (ISO), and methodologies which meet the requirements of the CDM Executive Board.
    ix. Knowledge-awareness of CCS opportunities – e.g. in Africa.

- Who are the different actors that could move CCS ahead? – What roles can the industry play, and how could the GEF become an active player to help achieve these? What capacity building will governments need in the future, and how could the GEF support these?

- The media and outreach sources have an important role to play on capacity building.

- Capacity building efforts should build on the on-going work of the CCS active community - e.g. Africa workshops, IEA-GHG newsletter and CCS database, University College London's legal database (regulatory issues).

- Cost is not just a CCS problem – cost constraints apply across all forms of climate change mitigation. Therefore, putting the cost of CCS into a broader context which considers the percentage of GHG emission reductions a country is trying to achieve will assist in assessing

the CCS cost relative to other forms of mitigation. CCS cost information in this context might be helpful to the GEF.

- Ensuring the integrity of storage sites is a priority that needs to be addressed. It should be noted that the IEA-GHG Programme is working on defining measures that test the appropriateness of a storage site.

- Uncertainty remains as to how CCS will evolve, particularly with respect to the integrity of storage. Particular issues are long-term liability, including determining who has responsibility for CO_2 stored on behalf of others, and whether independent observers are required to assess claims regarding storage capacity and its integrity

- Should the GEF regard CCS as an energy supply issue (which may be the perspective of some developing countries), or mitigation issue (developed country perspective)? CCS is regarded by the GEF as a sustainable development option – that is, produce energy without adding GHG to the atmosphere. The more pressing question for the GEF is how soon should it invest its resources in CCS?

- The GEF's starting point on CCS could be to contribute to a country's efforts to consider CCS as an option. Within this, assessing the country's "readiness" for CCS will be a critical factor in determining further GEF investment. It would be relevant to consider including CCS as one of the options in future Technology Needs Assessments.

- A first and useful (to the GEF) step would be to know whether CCS is a concern, or not, to individual countries. One way the GEF could obtain this information is to request the COP and the Subsidiary Body for Scientific and Technological Advice (SBSTA) for greater input on CCS. This could be helpful for developing a country-driven approach.

- Further consideration of CCS by the GEF would be assisted by an understanding of the level of resources which would be required for different levels of activity – for example, summer schools, capacity building, atlas, injection pilot, monitoring, capture pilot using slip stream, capacity building for technology development.

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