GLOBAL CCS INSTITUTE

FUNDING CARBON CAPTURE AND STORAGE IN DEVELOPING COUNTRIES

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CONTENTS

1 EXECUTIVE SUMMARY

There is a strong climate change case for supporting carbon capture and storage (CCS), whether this is in the power or industrial sectors, or the emerging bio-energy combined with CCS sector. The need to reduce emissions from fossil fuels is essential if the world is to achieve its emission reduction targets. As of 2012, CCS remains the option that can deliver the largest CO_2 emissions reductions from fossil fuel use.

Given the significant contribution CCS can make to global CO_2 emissions reductions, it is important that CCS is supported in the current 'demonstration' stage to help it progress to a point where the technology is more economically viable. Just as large-scale renewable energy projects need dedicated public funding to get them to a point where they are more economically viable, so does CCS. CCS is currently at a disadvantage because it has been actively excluded from some climate finance mechanisms, the most notable being the Clean Development Mechanism until December 2011.

There is currently only a relatively weak 'business case' for CCS in most developing countries. That is, there is a lack of commercial or market based incentives to justify the 'extra' costs and risks of CCS due to market failure. Therefore, in this 'demonstration' phase of CCS, public funding is required in order to address this market failure. There are two main market failures which public funding will address: the first is the failure of the market to put a price on carbon, the second is an imbalance between risk and reward for 'first movers'. In short, first movers take on all the risk, but it is the second and third movers that reap most of the reward when the technology costs come down.

Given CCS will help achieve global emissions reduction targets at least cost, it is in the global public interest to invest public funding in CCS. The main objectives of public funding are: 1) expanding knowledge and learnings of CCS; and 2) lowering the costs of CCS to a point where it is more economically viable.

Different public policy and funding mechanisms are appropriate at different stages of the technology development stage. Technology-specific funding mechanisms aimed at expanding knowledge and lowering the costs – such as capital grants and concessional loans – are most appropriate at the demonstration phase, compared to technology neutral mechanisms (i.e. price on carbon, emission restrictions, or performance standards). However, given the scale of funding needed for a CCS demonstration project (in the order of hundreds of millions of dollars per project) even in the demonstration phase a blend of funding mechanisms and incentives will most likely be needed to make a project economically viable. A blend of funding mechanisms and incentives have been utilised in all current planned and operational CCS demonstration projects. Nevertheless, capital grants and concessional loans will provide the backbone of economic viability for many CCS demonstration projects.

There is no precise way to predict how many CCS demonstration projects in developing countries will fulfil the funding policy objectives of knowledge expansion and cost reduction. It will depend on which capture technologies are demonstrated, how effective each project is in making advances in CCS application, and the effectiveness of knowledge sharing practices. The Group of Eight identified a realistic target of 20 projects by 2020. Therefore, the Working Group recommends that an appropriate target would be half of this, i.e. in the order of 10 large-scale demonstration projects in developing countries by 2022, spread across a 'portfolio' of industries, technologies and locations.

As with any large, complex industrial or power project, there is a significant amount of pre-investment work that needs to be undertaken before a CCS project is implemented. In addition to the usual scoping, pre-feasibility, feasibility and final investment decision process for any large project, there are a number of CCS-specific steps that need to be undertaken (e.g. geological storage assessments, pre-feasibility/feasibility studies specific to the CCS aspects of the project). Because integrated CCS is new to most countries, in addition to these pre-investment activities, there is also a number of enabling activities that need to be undertaken (e.g. development of legal, regulatory and financial and commercial frameworks, knowledge acquisition, as well as overall public engagement). This work can take several years and requires a comprehensive 'step-wise' approach.

In the short term (2012-2015), the scale of further dedicated CCS funding required in developing countries is in the order of $150-200 million for pre-investment and enabling activities, based on the broad assumption that pre-investment and enabling activities cost approximately $20-40 million per project. This should support between 5-10 demonstration projects in developing countries to proceed to a FID by about 2015. Funding should increase in the medium term to approximately $5 billion, based on the broad assumption that the 'extra' CCS costs of a project in a developing country are

$500 million for an industrial project, and in the order of $1 billion for a power project. $5 billion should therefore support those initial 5-10 projects to the operation stage.

There are a number of relevant funding 'vehicles' that can be utilised to deliver grants and concessional loans for CCS. It is expected that developed countries will want future funding for CCS to count towards their overall international commitments under the United Nations Framework Convention for Climate Change. In identifying appropriate vehicles through which grants and concessional loans could be channelled, the Working Group sought to complement existing international funding mechanisms.

Funding vehicles that the Working Group considered relevant included: existing dedicated CCS funds and programs, Clean Technology Fund, Global Environment Facility, bilateral and multilateral agreements, Green Climate Fund, and a new dedicated CCS Fund.

Based on a consideration of these, the Working Group makes the following recommendations.

RECOMMENDATIONS

SHORT TERM

1. **Donor countries to provide funding in the order of $150-200 million primarily for CCS enabling and pre-investment activities in developing countries, through topping up existing dedicated CCS funding programs.**

   Existing dedicated funds and programs which are able to easily accommodate such funding include:

   - Asian Development Bank's *Carbon Capture and Storage Trust Fund;*
   - Carbon Sequestration Leadership Forum's *Capacity Development Program;*
   - Global CCS Institute's *Capacity Development Program; and*
   - World Bank's *CCS Capacity Building Trust Fund.*

2. **Donor countries seek to lift the exclusion of CCS in the Clean Technology Fund.**
3. **Donor and developing countries to engage in bilateral and/or multilateral project support.**
4. **Developing countries to seek complementary funding for capacity building activities under the Global Environment Facility.**

MEDIUM TERM

1. **Donor countries to provide dedicated CCS funding in the order of $5 billion for the 'extra' CCS costs of construction and operation of demonstration projects in developing countries.**

   The Working Group has identified a number of potential vehicles through which funding can be channelled (listed below). Given the aim is to consolidate $5 billion of funds, it is therefore important that there is consensus between donor countries on which funding vehicle is preferred:

   1. Dedicated CCS funding window within the Green Climate Fund (noting that this is ultimately a decision for the Green Climate Fund Board).
   2. Portfolio approach to funding a range of technologies within the Green Climate Fund, with CCS included as a component of the portfolio (noting that this is ultimately a decision for the Green Climate Fund Board).
   3. Establish a new dedicated CCS Fund with its own governance arrangements, but which counts towards a country's climate funding commitments.
   4. Top up existing dedicated CCS trust funds or programs and make any changes to criteria to accommodate project support funding, and ensure it counts towards a country's climate funding commitments.

2 INTRODUCTION

At the Abu Dhabi Clean Energy Ministerial (CEM) in April 2011, Ministers recognised that significantly more funding was required to deploy CCS in developing countries to sustainably manage fossil fuel emissions at a level consistent with the United Nations Framework Convention on Climate Change's (UNFCCC) agreed ambitions. This reflected a report by the Carbon Capture Use and Storage Action Group (CCUS AG) which highlighted that there are currently insufficient funding mechanisms to support CCS in developing countries.

Following the CEM meeting, the Global CCS Institute agreed to coordinate with the World Bank, Asian Development Bank (ABD) and World Resources Institute (WRI) to further investigate the CCUS AG's Recommendation 2, to "identify and advance appropriate funding mechanisms to support the demonstration of large-scale CCS projects in developing economies[1]".

This report presents the key messages and recommendations of a Working Group on CCS Funding Mechanisms for Developing Countries, chaired by the Institute. In addition to the organisations noted above, this Working Group also included the International Energy Agency (IEA), Clinton Climate Initiative, the Australian Department of Resources, Energy and Tourism, and the UK Department of Energy and Climate Change.

3 CASE FOR CCS

KEY MESSAGES

- Reducing CO_2 emissions from fossil fuels is essential if the world is to achieve its emission reduction targets.
- CCS can deliver the largest CO_2 emissions reductions from fossil fuel use in the fuel transformation, industry and power generation sectors, and even negative emissions from bio-energy combined with CCS.
- CCS can contribute between 15 and 55 per cent of the required abatement to the year 2100.
- If CCS is <u>not</u> part of the climate change solution then there are three potential consequences: a) difficulty in reaching global emission reduction targets at all (due to a predicted increase in fossil fuel use and capacity constraints of alternative low-emission technologies' ability to take more of the load); b) potential increase in emissions even assuming fuel switching to combined-cycle gas turbine plants; or c) the cost of abatement to achieve global emission reduction targets increases.

The need for CCS as part of the portfolio of mitigation technology options to combat climate change is well documented. The world agreed at the 2010 climate change talks held in Cancun to strive to hold the global average temperature rise to 2°C relative to pre-industrial levels to avoid dangerous climate change. This is dependent on a revolutionary scale of mitigation that could see CCS contribute between 15 per cent and 55 per cent of the required abatement to the year 2100 (IPCC 2005).

Demand for fossil fuels is on the rise, especially in developing countries where a significant percentage of the population currently has no access to electricity. Of the world's energy-related CO_2 emissions, electricity sourced from fossil fuels accounts for more than 40 per cent (IEA 2011a). Another 25 per cent comes from large-scale industrial processes such as iron and steel production, cement making, natural gas processing and petroleum refining (Global CCS Institute 2011b). Although fossil fuel use as a *percentage* of overall energy consumption is expected to decline in the coming decades, the *absolute volume* of fossil fuel use is expected to increase (IEA 2011b). This increase in fossil fuel volume is driven by global population growth and industrialisation. The fact that energy infrastructure (e.g. pipelines, port facilities, power stations, transmission lines, meters etc.) is already in place in most countries makes "rapid shift to other [large-scale] energy sources extremely difficult" (Almendra 2011).

[1] For this report, the term 'developing countries' will be used to refer inclusively to all Non-Annex 1 countries under the UNFCCC.

Given fossil fuel currently accounts for approximately 65 per cent of CO_2 emissions today, and the volume of fossil fuel use is expected to *increase* in many countries in the coming decades, the need to reduce emissions from fossil fuels is essential if the world is to achieve its emission reduction targets. As of 2012, CCS remains the single largest option available to mitigate greenhouse gas (GHG) emissions from fossil fuel use in fuel transformation, industry and power generation. But it is not a panacea, and should be used in addition to a broad range of other options including energy efficiency and renewable energy.

The IEA BLUE Map scenario models a least cost mix of mitigation technologies to achieve the world's emission reduction targets. This modelling concludes that CCS will need to contribute 19 per cent of the necessary emissions reductions to achieve stabilisation of GHG concentrations in the most cost-effective manner (IEA 2009). Of this, 10 per cent is estimated to be CCS associated with power generation, and nine per cent is estimated to be CCS associated with industry. In addition to power and industrial applications of CCS, when bio-energy is combined with CCS (known as BECCS) this can lead not only to reduced emissions, but a net removal of CO_2 from the atmosphere – or negative emissions.[2] While more work is required to quantify the potential of BECCS solutions, the resulting negative emissions could play an important role in the fight against climate change.

Like any new energy related emissions abatement technology, CCS has significant challenges to overcome. For instance, it is currently an expensive technology (although competitive with other mitigation options offering comparable scale abatement potential). In association with power facilities it also has an 'energy penalty', that is, the process of capturing the CO_2, compressing and transporting it utilises energy that cannot therefore be utilised in the grid. Reducing this energy penalty is a prime objective of CCS technology demonstration and development.

These challenges, however, must be managed effectively, for it remains the case that CCS has the potential to enable large-scale emissions abatement in conjunction with increasing energy demand for fossil fuel power stations and industrial plants.

What happens if CCS is not deployed?

If CCS is *not* part of the climate change solution there are three potential consequences:

- difficulty in reaching global emissions reduction targets;
- potential to lead to an overall increase in emissions; and
- an overall increase in the cost of abatement, even assuming alternative low emissions technologies could replace fossil fuel power generation (noting that there are no alternatives to fossil fuel use in some industrial sectors).

Given it is widely predicted that the volume of fossil fuel use will increase (even though as an overall percentage it may decrease) it is questionable whether global targets can be met *without* CCS as part of the portfolio of technologies. That is, the world cannot have fossil fuel use in the order of 65 per cent, and in some countries increasing volumes of fossil fuel use, and meet emissions reduction targets without reducing emissions from that fossil fuel use. It is important to note that while there might be alternatives to fossil fuel power generation, there are *not* alternative technologies to fossil fuel use in many key industrial sectors. As noted above, CCS combined with bio-energy has the potential to provide *negative emissions*, in the order of 10+ gigatones (GT) per annum by 2050 (IEA 2009).

Given the vast quantities of CO_2 that CCS can prevent from entering the earth's atmosphere, if CCS is *not* part of the climate change mitigation solution, this puts greater pressure on other mitigation technologies to 'fill the gap'. These mitigation technologies are already going to have to deliver very ambitious outcomes to fulfil global targets, and there are real constraints on how much additional emissions abatement these technologies could additionally contribute to fill a gap left by CCS. For instance, hydroelectricity, wind power, and even solar power, require a suitable local environment.

If CCS is *not* part of the climate change mitigation solution then there is potential that this will lead to an overall increase in emissions. In the absence of CCS associated with traditional coal and gas plants, the next most likely climate change friendly alternative is a switch to combined-cycle gas turbine plants. Even assuming this switch to combined-cycle gas turbine plants, the IEA estimates that this could "lead to an increase in CO_2 emissions of over 140Mt in 2035 – equivalent to the

[2] For more information on BECCS refer to the 'Bio-energy with CCS Factsheet'; http://cdn.globalccsinstitute.com/sites/default/files/publications/25921/fact-sheet-3-bioccs-v4.pdf

annual emissions of around 65 million cars in Europe today – and a cumulative increase of 1 GT of CO_2 emissions over [2010-2035]" (IEA 2011b). That is, even though combined-cycle gas turbine plants produce fewer emissions than traditional coal and gas plants, traditional coal and gas plants *with* CCS would provide extra emissions abatement.

If CCS is *not* part of the climate change mitigation solution, then the global cost of abatement increases. The IEA estimates that without CCS, the cost of global abatement will increase. For every dollar not spent on CCS between now and 2015, the IEA estimates we would need to spend another $4 in order to get us back on the path to avoid dangerous climate change (this assumes other technologies could 'fill the gap').[3] A gradual move towards achieving the 2°C goal would require a $36.5 trillion investment in energy infrastructure by 2035. Furthermore, a 10-year delay in introducing CCS would add $1.1 trillion to the bill.

4 CCS IN DEVELOPING COUNTRIES

KEY MESSAGES

- The IEA estimates that 50-60 per cent of CCS deployment will need to occur in non-OECD countries to achieve global emission reduction targets.
- Many developing countries with a heavy, and growing, reliance on fossil fuel based energy sources will need CCS as part of their mitigation portfolios if they are to achieve their reduction targets.
- With the significant, but manageable, challenges associated with CCS, many developing countries are taking a 'wait and see' approach.
- Given the long lead times associated with implementing CCS projects, countries should start undertaking the pre-investment and enabling activities now, in order to be in a position to benefit from CCS in the future.
- While there are some aspects of CCS that can be 'transferred' from developed to developing countries, some aspects need to be tested domestically, which mitigates against a 'wait and see' approach.
- These aspects include an understanding of the local geology, and development of a regulatory framework.
- In 2011, the Global CCS Institute's annual survey identified 74 large-scale integrated CCS projects around the world either operating, under construction or in planning stages. Only 10 of these are in developing countries.
- Some developing countries are strategically placed to be CCS first-movers.

In order for CCS to play its role in reducing global CO_2 emissions on a significant scale, it will need to be deployed in developed and developing countries, particularly given that it is expected that all of the net fossil fuel growth (and associated CO_2 emissions) will be in developing countries in the coming decades (IEA 2011b).The IEA's BLUE MAP scenario estimates that 50-60 per cent of deployment will need to happen in non-OECD countries to achieve global emission reduction targets.

4.1 Why now?

In order to achieve domestic CO_2 reduction targets, many developing countries with a heavy and *growing* reliance on fossil fuels (whether in the power or industrial sectors) will most likely need CCS as part of their technology mitigation portfolios if they are realistically to achieve their reduction targets. Developing countries will be the most adversely affected by the impacts of dangerous levels of climate change, and as such, many have already pledged to play their role in reducing global emissions to avoid the catastrophic effects of climate change. CCS not only positions them to prepare their fossil fuel dependent economies to take advantage of the global

[3] Unless otherwise specified, all dollar references are in US dollars.

drive to a clean energy future but also provides local economic benefits such as skills transfer, job creation and access to reliable power (through the ability to continue to utilise often indigenous fossil fuels).

Given the significant, but manageable, challenges associated with implementing CCS projects, many developing countries are rationally opting to take a 'wait and see' approach – in terms of proving the technological reliability, community acceptability and affordability of CCS projects. So why should developing countries start the process of demonstrating CCS now? Given the long lead times associated with implementing CCS projects, developing countries should start undertaking the pre-investment, enabling and demonstration activities now (many of which will need to address country-specific requirements), in order to be in a position to benefit from emission reductions from CCS in the coming decades. For CCS to be sustainably deployed, developing countries should be supported to engage directly in 'testing' CCS at a large demonstration scale before moving towards its wider deployment when the costs and energy penalty have decreased. By participating in this 'learning-by-doing' demonstration phase, skills and knowledge will be transferred to the local community allowing for indigenously based solutions to be sourced to address identified challenges.

There are some aspects of CCS that are 'transferrable' from developed to developing countries. However, there are some things that must be tested domestically, which mitigate against taking a wait and see approach. Key among these is an understanding of the local geology to identify geological basins and sites that are suitable for permanent, safe geological storage of CO_2 which is essential for CCS. Storage characterisation from a basin down to a site specific level, can take 3-6 years depending on how much is already known. Developing appropriate legislative and regulatory frameworks for implementing CCS can also take considerable time, depending on the individual circumstances of each country or region.

Avoiding the 'wait and see' approach is particularly relevant for developing countries which have an on-going interest or reliance on fossil fuel from the perspective of: "securing revenues from fossil fuel production; consuming fossil fuels to promote economic growth; promoting energy security; promoting regional cohesion; and facilitating foreign-policy objectives, such as earnings from CCS technology exports" (Meadowcroft and Langhelle 2009).

4.2 Status of CCS in developing countries

In October 2011, the Institute released the latest results of its comprehensive survey of CCS projects around the world. The *Global Status of CCS: 2011* report identifies 74 large-scale[4] integrated CCS projects around the world, 15 of which are either operating or under construction. Of the 74 projects, 11 are in developing countries, which is an increase of three projects from 2010. Of the 10 projects in developing countries, seven are in China, three are in the United Arab Emirates (UAE) and one is in operation in Algeria.[5]

These figures confirm that CCS is already considered a viable mitigation option, and it is encouraging that there is activity in developing countries. However, in most circumstances it underscores that the technology is still in its pre-commercial demonstration phase. With just one operational CCS project in a developing country, the need to generate more operational knowledge from location specific demonstration projects is required.

Demonstration in developing countries is particularly important in countries where a) there is significant and growing fossil fuel emissions, and b) where opportunities for cost reductions might be the greatest. There are some developing countries where CCS makes strategic sense and are in a position to be 'early movers', due to characteristics such as: very high – and growing – fossil fuel emissions; have an active oil and gas industry from which to draw relevant technical expertise, have potential storage capacity that is accessible from major emissions sources, have 'low hanging fruit' sites, where capture is already part of an industrial process or there is potential cost offsets due to CO_2 utilisation.

[4] 'Large-scale' is defined as storing over 800,000 tonnes annually for a coal-based power plant and over 400,000 tonnes annually for industrial facilities.

[5] These figures are as of December 2011. A full list of the 74 large-scale integrated projects (including the 11 in developing countries) can be found on the Institute's website: http://www.globalccsinstitute.com/projects/map.

There are currently approximately 17 developing countries that have undertaken, or are undertaking, CCS activities. Some countries are more advanced in these activities than others. As noted above, China, UAE and Algeria have projects in the planned or operational stages, while other countries such as South Africa, Mexico and Brazil are actively investigating pilot projects.

It is also important to note that funding for CCS in developing countries has been at a disadvantage compared to other low-emission technologies, because it has been either not eligible, or actively excluded, from existing climate mitigation funding mechanisms. It has only been since the Seventeenth Conference of Parties (COP 17) held in December 2011, that CCS has finally become eligible to generate tradable carbon credits under the CDM. While the Working Group welcomes this news, this mechanism on its own will not be enough to fund large-scale CCS demonstration and deployment in developing countries. However, the inclusion of CCS in CDM has additional value in that it recognises CCS as a viable abatement technology, and that many of the concerns regarding CCS can be appropriately managed.

5 RATIONALE FOR PUBLIC FUNDING

KEY MESSAGES

- While there is a strong climate change case for CCS, there is currently only a relatively weak 'business case' for CCS in most developing countries.
- There are two main reasons why private sector financiers will not invest in CCS at this demonstration stage: 1) there is a lack of policy incentives or requirements, and 2) the risks of a CCS project are high compared to a 'business as usual' project.
- In the absence of private sector financing, there is a need for public funding to address market failures.
- The two main market failures which public funding will address are: 1) failure of the market to put a price on carbon, and 2) an imbalance between 'risk and reward' for first-movers.
- Given CCS will provide significant help in achieving global emissions reduction targets, it is in the global best interest to invest public funding in CCS.
- The main objectives of public funding are: 1) expand knowledge and learning of CCS, and b) to lower the costs of CCS.
- The contribution of demonstration projects to CO_2 emission reductions can be substantial: the eight operating large-scale CCS projects are already storing 20 million tonnes of CO_2 per year, which would have otherwise been released into the atmosphere.
- The Working Group recommends an appropriate aim would be in the order of 10 large scale demonstration projects in developing countries by 2022, half of the G8 goal of 20 projects by 2020.

While there is a strong climate change case for CCS, there is currently only a relatively weak 'business case' for CCS in most developing countries. That is, there is a lack of financial incentive to justify the 'extra' costs and risks of a CCS project. In those 74 large-scale, integrated CCS projects worldwide, the right policy settings, government funding support and/or revenue returns from enhanced oil recovery (EOR), provide the basis for the projects being economically viable (Global CCS Institute 2011a). None of the 74 projects have secured 'debt-based' private financing for the 'extra' CCS costs of the project.

The different parts of the CCS chain (CO_2 capture, compression, transport, injection and storage) have been utilised commercially for decades. However, integrating the CCS chain for the purposes of long-term isolation of emissions from atmosphere, at scale, is still in the demonstration stage.

There are two main reasons why private sector financers will not invest in CCS at this demonstration stage. The first reason is a current lack of policy *incentives* or policy *requirements* to invest in CCS in most, if not all, developing countries. The second is the high risks of a CCS project compared to a 'business as usual' project. **Table 1** below identifies the keys risks of a CCS project compared to a business as usual power project.

TABLE 1: Comparison of risks between a new build CCS demonstration power project with a conventional power project

PROJECT STAGE	RISK CATEGORY	IMPACT ON FINANCING RISK FOR CCS	DESCRIPTION OF RISKS
PRE-CONSTRUCTION	Storage identification	Additional	Identifying suitable storage
	Liability	Additional	Storage liability must be dealt with up front
	Permitting	Higher	Potential for public opposition higher
CONSTRUCTION	Cost overrun or delay	Higher	Price premiums for fixed price and schedule
	Performance	Higher	Focus on component guarantees
	Interest and exchange rate variation	Same	Currency and financial market exposure
	Force majeure	Same	Weather, industrial relations, equipment delivery risk
OPERATION	Regulatory	Higher	Storage regulation untested
	Operational performance	Higher	No reference plants to prove reliability
	Fuel supply	Higher	Management of oversupply if plant unreliable
	Electricity off-take	Higher	Supply shortfall penalties if plant unreliable
	CO_2 storage off-take	Additional	Possible costs of storage off-take unreliable or minimum supply volumes not met
	Interest and exchange rate variation	Same	Currency and financial market exposure
	Force majeure	Same	Weather and industrial relations risk
CLOSURE	Storage closure and ongoing monitoring	Additional	Liability dealt with up front

Adapted from Global CCS Institute 2011a

In the absence of private sector financing, there is a need for public funding. Public funding is provided where there is a strong argument that funding will address a market failure that is in the public good. The first market failure underpins the problem of climate change per se. That is, the market has failed to put a price on emitting GHG which has a negative effect on the rest of the world. This is called a 'negative externality'.

Coupled with this negative externality market failure, there has been a 'policy failure' (or 'government failure') in adequately addressing this problem. The international community is committed to keeping global temperature increases to below 2°C relative to pre-industrial levels to avoid dangerous climate change. There are a number of ways that both developed and developing countries are contributing to this objective domestically through both policy *incentives* and *requirements*. A list of policy incentives and requirements are in **Table 2** below. There are also international funding mechanisms aimed at supporting action towards this global goal (some of which are discussed further in Section 7). However, these policy mechanisms are not yet enough (arguably in any country) to deliver the required amount of investment in low-emissions technologies at a scale required to achieve emission reduction targets. More policy remedies are required.

Table 2: Common Policy Mechanisms

POLICY MECHANISMS
Price on Carbon
Economy wide cap and trade scheme
Economy wide carbon tax
Baseline and credit scheme
Sector specific fee-bate scheme
Sector specific emissions performance standard
Policy mechanisms that promote learning

Investment tax credits
Production subsidy
Production tax credit
Feed-in tariff
Premium feed-in tariffs
CCS portfolio obligation
Waivers of permit fees
Government acceptance of liability and insurance

The second market failure is created by the imbalance between 'risk and reward' for early movers and innovators in the low-emission energy sector. In short, early movers take on all the risk, but it is the second and third movers which reap most of the reward. Investment in new low-emissions technologies is expensive, but it is essential to demonstrate the technology at scale in order to gain experience and push the costs of the technology down – which is in the public good. First movers are the organisations that invest the required money and take on the risk in order to gain this knowledge and find ways to push the costs down – in this case in CCS. When the cost of the technology comes down, other technology providers (i.e. the second and third movers) benefit from the experience and lower technology costs gained by the first-movers. This situation leaves little incentive to be a first-mover in technology demonstration – without public funding assistance. This is particularly the case in the electricity industry, where profit margins are already low and the product (electricity) is undifferentiated, i.e. it is the same product whoever generates it, and therefore consumers will naturally prefer the cheaper provider of electricity.

Public policy mechanisms (whether domestic or international) is justified to address both these market failures. Different mechanisms are relevant at different times. Public funding is what is needed now (refer to Section 7: Funding Mechanisms and Vehicles). There are many mechanisms globally that have been implemented to support renewable energy, but very few to support CCS. It is unlikely that renewable energy would have developed to the point it has today, without this public funding help.[6] CCS needs the same support. In the absence of this support, CCS might take substantial time to develop, or might not even happen at all. It might, like many technologies, not make it past the 'valley of death' (i.e. move from the demonstration stage to the deployment stage). Given the significant contribution CCS can make to emissions reductions, this is not in the global best interest. All low-emission technologies will be needed if the world is to reach global emission reduction targets.

International public funding aimed at developing countries is justified to address these market failures in the global public good, i.e. to reduce emissions in countries where there are significant (and often growing) emissions from fossil fuels (given emission reductions accrue globally no matter where it occurs). Since learning-by-doing is best done in-country, it is best to do it where it is most needed.[7] There may also be greater progress made in some developing countries to drive down costs of CCS, given their usually lower costs of production (IEA 2012).

While the justification for public funding lies in addressing market failures in the global public good, the main *objectives* of a public funding mechanism have been mentioned above: a) helping key market participants up the experience curve, and b) pushing technologies down the cost curve (UNEP and SAFI 2008). It is vitally important that knowledge and experience gained from projects that have been publically funded is shared, and the technology is 'diffused', i.e. other organisations and countries can gain access to it, whether through buying it or learning from others' experience in order to implement it themselves.

[6] It is often argued that CCS is too expensive, with the implication being that funding should not be provided and should go to 'cheaper' options. It is worth noting that a) renewables would also be 'too expensive' if it was not for decades of public funding around the globe, and b) large-scale solar PV (an often quoted alternative option) is currently *more expensive* than CCS. This is not to say that funding should not be provided to renewable. It should be, along with CCS.

[7] Experience and learning can have different goals: the main aim of 'learning from diversity' is to validate the main available technological options; while 'learning by doing' aids replication (Newbery 2009). Newbery et al argue that at the demonstration phase, learning from diversity should take precedence. While this may be the case, there is also significant value in learning by doing in countries where the replication of CCS can make a significant impact on global emission reductions, and replication create the opportunities to push the price down.

Key learning and knowledge sharing goals at the demonstration stage include: expanding knowledge of implementing CCS technology, identifying successful technologies, reducing costs, and establishing commercial arrangements between capture, transport networks and storage. Early projects generate information on the viability of CCS in all these areas, which is valuable to countries worldwide.

While the learning outcomes listed above are the key 'public goods' being sought at the demonstration stage, the actual contribution of the demonstration projects to CO_2 mitigation should not be underestimated. There are eight large-scale CCS projects currently in operation globally, and seven more currently under construction. These eight operating projects are already storing approximately 20 million tonnes of CO_2 each year. When the seven projects under construction go live by 2015, this figure will be increased to approximately 35 million tonnes of CO_2 per year. To put this into perspective, this means that more abatement is happening from just eight projects than the total country-level abatement achieved in either Australia, Japan, and not far behind that of the UK through all their climate efforts today.[8]

5.1 Demonstration projects required

There is no precise way to determine how many CCS demonstration projects are needed in developing countries to fulfil the funding objectives above. It will depend on which capture technologies are demonstrated, how effective each project is in making advances in CCS application, and how effective knowledge sharing practices are. The Group of Eight (G8) identified a realistic target of a minimum of 20 projects by 2020. Therefore, the Working Group recommends that an appropriate target would be half of this, i.e. in the order of 10 large scale demonstration projects in developing countries by 2022. Coupled with demonstration projects in developed countries (which could number around 20), this should give a solid foundation in progressing CCS along the technology development lifecycle, from the demonstration to deployment stage.

The CCS demonstration projects deployed will need to consist of an appropriate 'portfolio', covering a mix of industries, capture technologies and locations. According to the World Bank, "CCS projects are highly heterogeneous, with considerable variations in marginal abatement costs, reflecting differences in energy requirements and unitary costs of technology, capital and operating costs and project scale factors. The costs of CCS vary significantly across regions and sectors, from as little as US$7-8/ton CO_2 for some early opportunities (e.g. upstream gas processing and chemicals) to more than US$120/ton CO_2 in more complex applications (power in other industrial sectors)"[9] (World Bank 2011). Therefore, a "portfolio will provide a framework to ensure that the different hurdles (technology-related, regulatory, political, financial) to a broad based deployment of CCS are addressed. It also provides a framework to increase CCS knowledge, bring down costs and build public confidence in the technology as a viable carbon abatement strategy" (L.E.K. 2099). A portfolio approach is aimed at addressing the policy funding goals identified above.

In order to achieve such a portfolio, funding needs to be allocated carefully and in a coordinated fashion to ensure an appropriate spread across industries, technologies and locations. The Working Group has given initial thought to the type of funding criteria that may therefore be suitable to achieve this portfolio. Funding for geological exploration is particularly important given it is completely location specific. WRI's Working Paper *CCS Demonstration in Developing Countries: Priorities for a Financing Mechanism for Carbon Dioxide Capture and Storage* provides a good summary of the key issues to consider (Almendra 2011).

6 SCALE OF FUNDING

KEY MESSAGES

- In the short term (2012-2015) the scale of funding required is in the order of $150-200 million

[8] Abatement figures for these countries are based on estimates, published by the Australian Productivity Commission (May 2011), of the amount of abatement occurring within the electricity sectors.

[9] Refer to the World Bank report *Carbon Capture and Storage (CCS) in Developing Countries: A Perspective on Barriers to Deployment* for abatement cost curves by sector.

to support pre-investment and enabling activities for 5-10 demonstration projects in developing countries. This assumes that pre-investment and enabling activities cost in the order of $20-40 million per project.

- Pre-investment and enabling activities can take several years and require a comprehensive 'step-wise' approach (e.g. geological storage assessments, pre-feasibility/feasibility studies specific to the CCS aspects of the project).
- It is only worth undertaking pre-investment and enabling activities as a step towards large scale demonstration.
- Therefore, in the medium term, funding in the order of $5 billion is required to support between 5-10 projects, assuming that the 'extra' costs of a CCS project is approximately $500 million for an industrial project and up to a $1 billion for a power project.
- There are currently about 17 developing countries that have undertaken or are undertaking pre-investment and enabling activities, highlighting that there is an appetite for this funding in the short and medium term.

It is expected that the scale of funding needed to implement CCS demonstration projects in developing countries will come down over time (depending on prevailing climate change regimes and continuous improvements in technology experience curves). However, in the short term (2012-2015) the scale of funding required is in the order of $150-200 million, increasing in the medium term to approximately $5 billion. It should be noted that this funding is for the 'extra' or 'additional' costs of the CCS components of an industrial or power sector project, (i.e. not the whole costs, or the 'business as usual' costs, of an energy or industrial project).

As with any large, complex industrial or power project there is a significant amount of pre-investment work that needs to be undertaken before a CCS project is implemented. In addition to the usual scoping, pre-feasibility, feasibility and final investment decision process for any large project, there are a number of CCS-specific steps. Because integrated CCS is new to most countries, in addition to these pre-investment activities, there are also a number of enabling activities that will be required. This pre-investment work can take several years and entails a comprehensive 'step-wise' approach that includes:

- **assessment** – establishing appropriate objectives and an overall strategy for CCS within broader domestic climate change strategies (e.g. Nationally Appropriate Mitigation Actions (NAMAs));
- **enabling** – development of 'enabling' policies; legal, regulatory, and financial and commercial frameworks, as well as the requisite capacity development and public engagement; and
- **pre-investment** – geological storage assessments, from theoretical to site-specific characterisation, pre-feasibility/feasibility studies and front end engineering and design (FEED) studies specific to the CCS aspects of the project.

Donor countries will rationally avoid making major financial commitments that are likely to sit in 'limbo' for years before they can be allocated to large-scale demonstration projects while the necessary pre-investment is being undertaken. There are currently about 17 developing countries that have undertaken, or are undertaking, these pre-investment and enabling activities. This highlights that there are opportunities in many developing countries to realistically absorb more funding in the short-term, allowing them to progress through these pre-investment and enabling activities and build on the momentum of existing initiatives. The quantum of funding required by most individual developing countries for such activities in the next 2-3 years is in the order of tens of millions of dollars.

The actual quantum of funding for these pre-investment/enabling activities per country differs markedly depending on how much information is already available, industry, site location, existing capacity etc. Nevertheless, broadly speaking, funding in the order of $150-200 million (based on an indicative cost for these activities of $20-40 million per project[10]) should support the pre-investment

[10] There is currently no analysis of average costs of pre-investment and enabling activities. These will be highly variable based on country, project location, and existing information available (particularly geological information). However, assuming a $2-5 million pre-feasibility study, a $3-10 FEED study and a $15-25 million geological study – this estimates pre-investment costs could be in the order of $20-40 million.

and enabling activities for 5-10 of the target 10 demonstration projects in developing countries to proceed to a FID by about 2015. This level of increased funding could also support the small number of countries that have advanced to the demonstration stage in the nearer term.

Given CCS has longer lead times to implement than most low emission technologies (particularly in identifying suitable storage), there is some urgency in the need for this initial funding, if these projects are going to come online and contribute significantly to the climate change target of keeping global temperature rise below 2°C compared to pre-industrial levels.

It is only worth undertaking these pre-investment and enabling activities as a step towards large-scale demonstration projects. As such, there is an imperative that funding assistance on a much larger scale is made available for actual projects within the medium term (Almendra 2011). As the ADB notes, "without such funding, CCS would remain unaffordable and attract a low priority, with marginal activities in developing countries, delaying its uptake" (Bhargava 2011).

Based on the broad assumption that the 'extra' CCS costs of a project in a developing country is $500 million for an industrial project and approximately $1 billion for a power project, $5 billion should support between 5-10 projects moving ahead in the medium term.[11] This should be made available for capital and operational expenditure of demonstration projects in developing countries, to address the lack of private sector financing for CCS projects in developing countries. This funding should be aimed at the same 5-10 projects supported in the pre-investment/enabling phase, to ensure these projects move from planning to actual operation to reap the learning-by-doing and cost reduction benefits.

7 FUNDING MECHANISMS AND VEHICLES

KEY MESSAGES

- There are many different types of policy and related financing mechanisms that can be utilised to support or catalyse investment in mitigation technologies.
- Different mechanisms are relevant at different stages of technology development. At the demonstration stage, technology specific mechanisms, such as grants and concessional loans, are the best way to achieve the public funding objectives of knowledge acquisition and push costs down.
- Given the scale of funding needed, even at the demonstration stage, a mix of funding mechanisms will be needed to support any one demonstration project, but grants and concessional loans will provide the backbone of economic viability.
- There are a number of relevant funding vehicles that can be utilised to deliver grants and concessional loans for CCS.
- Funding vehicles that the Working Group considered relevant included: existing dedicated CCS funds and programs, Clean Technology Fund, Global Environment Facility, bilateral and multilateral agreements, the Green Climate Fund, and a new dedicated CCS Fund.

7.1 Financial and policy mechanisms

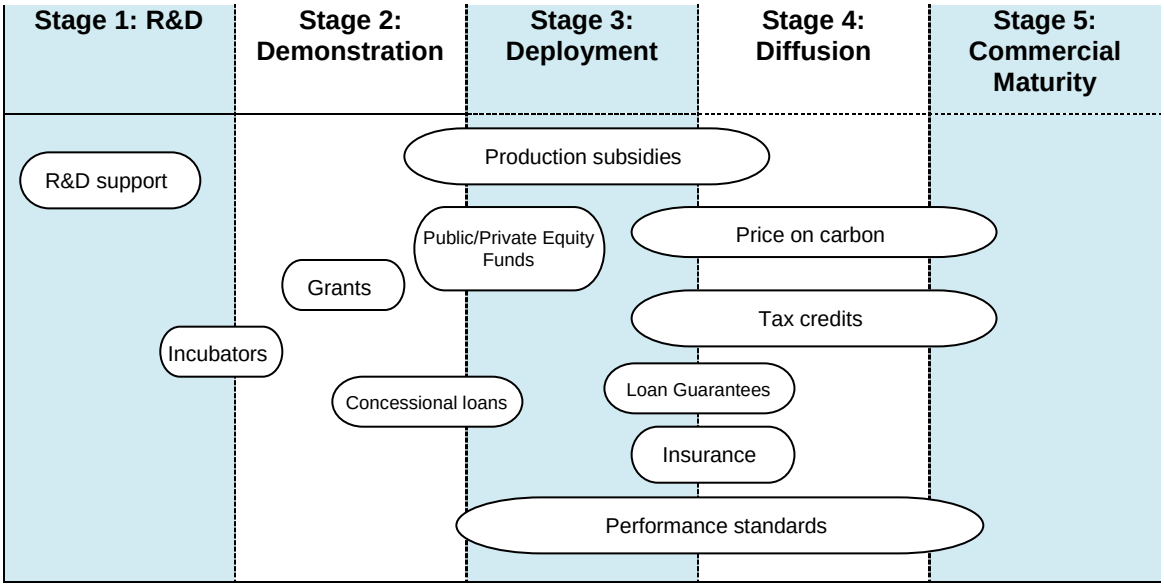
There are a range of policy and funding mechanisms that can be, and in some cases have been, utilised to leverage investment in low emissions technologies. However, few of these policy mechanisms have been applied to CCS. As discussed, even where these mechanisms are in place, they are currently not able to generate enough investment to meet the emission reduction targets. This is also true for CCS.

Policy and funding mechanisms can take a number of forms, including those listed in Table 2, as well as loan guarantees, operating subsidies, and more conventional grants and concessional loans (i.e. very low interest loans). Different mechanisms are appropriate at different times of

[11] Analysis undertaken by the ADB indicates that the additional costs of CCS in China for instance, are $134 million for a 400MW integrated gasification combined cycle plant, and $350 million for a 600MW supercritical coal plant (ADB, 2011). Therefore the estimated allocation of costs between $500 million and $1 billion per project is reasonable, and allows significant increases on these estimates to account for regional and project specific differences.

technology development, as depicted in **Figure 1** below (noting that this is not an exhaustive list). What is needed at the CCS demonstration stage is *technology-specific* support, such as grants and concessional loans, to "determine its technical viability and to demonstrate that it is an affordable option when deeper emission cuts are required" (IEA 2012). Technology neutral funding mechanisms, such as a carbon price, are more appropriate when the technology has been successfully demonstrated, and the main policy objective becomes abatement at the lowest possible cost.

Figure 1: Public policy and funding mechanisms at different stages of technology development



However, given the scale of funding needed (in the order of hundreds of millions of dollars), even in the demonstration phase a blend of funding mechanisms and incentives is likely be needed to make a project economically viable. A blend of funding mechanisms and incentives have been utilised in all current planned and operational CCS demonstration projects. However, capital grants and concessional loans will provide the backbone of economic viability for many CCS demonstration projects. These technology-specific grants and/or concessional loans should be utilised to fund the 'extra' CCS costs, i.e. costs above business as usual.

What is important to note, is that even if mechanisms such as an economy wide carbon tax, investment tax credits, emission restriction performance standards (or other blends of incentives/policy mechanisms) were in place in developing countries, at this stage, substantial grants and concessional loans would still be needed.

To take a simplified example, let us assume a country had a carbon price of $10 per tonne (this price is higher than the proposed or actual price in some countries, but lower than the proposed or actual price in others). For a power project proposing to store over 800,000 tonnes of CO_2 per annum, this effectively puts a carbon price on the project of $8 million per annum. Let us assume the 'extra' costs of CCS is $800 million for our example power project, and let us assume that the project will operate for 30 years. The carbon price of $10 would effectively put a carbon price on the project of $240 ($8 million x 30 = $240 million). This still leaves a financial gap of $560 million. Even with a policy incentive framework in place (a carbon price) it would still make more economic sense for the company to pay the carbon price than invest in the CCS plant. Therefore further financial support is needed at this stage, as it will be for large-scale renewable power plants.

Analysis undertaken by the World Bank showed that even a carbon price of $50/ton CO_2, will required concessional funding between US$26million and US$662 million, depending on the type of CCS project. At the current carbon price of US$10/ton CO_2 in the EU Emissions Trading Scheme (EU ETS), the incremental funding requirement will be much higher. In addition it should be noted that the EU ETS presently is the only potential market for purchasing certified emission reduction credits (CERs) from CCS projects in developing countries. However, the availability of this market will be restricted due to the recent European Commission ruling to allow purchases of CER under the EU ETS only from the least developed countries. Potential markets for generating CERs from CCS projects in developing countries are located in high to mid income developing countries (e.g.

China, Indonesia, South Africa, Mexico etc). This fact makes it relatively unrealistic to obtain revenues from selling carbon credits generated by CCS projects in developing countries in the near to medium term.

Even if this financial gap was removed by setting the carbon price at a level to make the company indifferent between the choice of paying the tax or investing in CCS, at the demonstration phase, the current risks of deploying CCS (see Table 1 above) and debt capacity constraints in developing countries make financial support via grants, concessional loans etc necessary to allow development projects to proceed.

7.2 Funding vehicles

There is a number of funding 'vehicles' that can be utilised to deliver grants and concessional loans, including multilateral development banks, dedicated CCS capacity building programs, existing global climate finance facilities, and bilateral or multilateral partnerships.

The Working Group considered the relevance of a number of funding vehicles for dedicated CCS funding, some of which are more appropriate for funding in the 'short term' and some more appropriate for funding in the 'medium term'.

It is expected that developed countries will want future funding for CCS to count towards their overall international commitments under the UNFCCC to provide climate change financing to developing countries (e.g. counting toward the Copenhagen Accord commitment of $100 billion per year by 2020). The initial level of 'short-term' funding could possibly be supported by some of the outstanding pledges by developed countries as part of their collective commitment under the UNFCCC to transfer $30 billion in 'new and additional' Fast Start Financing in 2010-12. To access 'medium-term' funding, developing countries will most likely need to identify CCS as a priority in their overall climate change strategies. This includes their NAMAs prepared under the UNFCCC.

Relevant funding vehicles for the short and medium term are discussed in more detail below. The importance of 'counting' CCS commitments to overall climate change funding commitments was a key consideration, noting that some existing climate finance facilities do not *in principle* preclude support for CCS, while others currently do.

Funding instruments relevant in the short term

Existing dedicated CCS funds and programs

There is currently a number of dedicated CCS funds and programs – four key programs are listed in the table below. These funds and programs are currently focused on capacity building and pre-investment activities (such as techno-economic, FEED studies, possibly geological studies etc.).

While the governance arrangements of some of these funds/programs may have to be amended to enable funding the full range of pre-investment activities, the process would be fairly straightforward and could be done quite quickly with the support of existing donors.

TABLE 3: Existing CCS funds and programs

FUND	Description
Asian Development Bank (ADB) – Carbon Capture and Storage Trust Fund	CCS Trust Fund under the ADB's Clean Energy Financing Partnership Facility. Includes support for capacity building, and scope for directly supporting demonstration projects (e.g. FEED studies). Activities currently in China, Indonesia, Philippines Thailand and Vietnam • Selection of projects based on assessment against criteria (identified by donors) and approved within ADB governance arrangements • $17.3 million in contributions from the Global CCS Institute to date
Carbon Sequestration Leadership Forum (CSLF) – Capacity Development Program	For CCS capacity building in emerging economy members of the CSLF. Activities supported in Brazil, China, Mexico, and South Africa • Proposals reviewed by CSLF Capacity Building Taskforce and funding approved by CSLF Capacity Building Governing Council • $3 million in contributions to date to the Program from UK, Canadian, Norwegian Governments and Global CCS Institute

Global CCS Institute – Capacity Development Program and Project Support	The Institute works with 'countries of focus' to undertake a capacity development assessment and helps develop and deliver a tailored capacity development program of activities for those countries. Activities currently in China, India, Indonesia, Malaysia, Mexico and South Africa. In addition, the Institute supports other international capacity building efforts • Contributed over AU$25 million to capacity development activities including to the ADB, CSLF and World Bank funds • However, funding from other donors is expended according to work program/criteria/to projects agreed with donor
World Bank Group – CCS Capacity Building Trust Fund	Dedicated CCS Fund focusing on capacity building and knowledge sharing, pre-investment support, and carbon asset creation services. Activities currently in Botswana, China, Egypt, Jordan, Kosovo, Maghreb, Mexico and South Africa • Selection of projects based on assessment against criteria (identified by donors) and approved within World Bank governance arrangements • $11 million in contributions to date to the CCS Trust Fund from Norwegian Government and the Global CCS Institute

Clean Technology Fund (CTF)

The CTF was established to provide concessional grants and lending for the demonstration, deployment, and transfer of low-carbon technologies with significant potential for long-term GHG emissions savings. It is based on leveraging co-financing from the public and/or private sectors for investments in 'transformational' projects 'at scale'. Financing is channelled through various multilateral development banks, including the World Bank which is the CTF's Trustee. Total pledges to the CTF by eight donor countries are over $4 billion.

CCS is currently not eligible for CTF co-financing because it has been deemed as being in the 'pre-commercial stage' of technology development. The CTF's current rules and Investment Criteria Guidelines, agreed to by its Management Committee, stipulate that the CTF will not support technologies that are still "in the research stage, but should focus on deployment which may include commercial demonstration of new low-carbon technologies". Furthermore, "priority will be given to proposals for commercially available, significant mitigation potential technologies" (CIF, 2009).

However, a case could be made for making amendments to allow CCS to qualify for CTF funding, especially given CCS has been accepted as a viable low emissions technology in CDM. Such a case would be based on CCS being a critical high abatement technology, for which opportunities are starting to emerge for demonstration on a large scale in developing countries. In addition, CCS has significant 'transformational' potential and development impact. This could especially apply for applications in the industrial sector that are arguably 'commercially' available – such as CO_2 capture with natural gas processing or on a coal-to-liquids plant.

As such, allowing CCS to be eligible under the CTF may stimulate some of the early-mover pilot or large-scale demonstration projects in developing countries to have access to the financing necessary in the short- to medium-term (e.g. 3-7 years), in advance of being able to access similar levels of financing under the GCF or other funds.

There is often a concern that CCS will 'absorb' significant parts of available funding given its high cost. It should therefore be noted that only very few CCS projects in developing countries will be advanced enough to require CTF funding in the foreseeable future. In addition, making amendments to include CCS under the CTF would also set an important precedent – just as it has done in the CDM. This may be particularly important given that the CTF is likely to be eventually merged with the GCF.

Global Environment Facility (GEF)

The GEF is an independent financial organisation that serves as the financial mechanism for various UN conventions, providing grants for projects related to the environment, including a Special Climate Change Trust Fund. A key objective of this Fund is to "promote the demonstration, deployment, and transfer of innovative, low carbon technologies" (GEF) that are identified as priorities by recipient countries". While CCS was initially listed as an eligible technology, it is not currently listed. However, this does not necessarily preclude CCS. Countries could therefore

potentially access funding for CCS under the GEF. For instance, the Renewable CO_2 Capture and Storage from Sugar Fermentation Industry in Sao Paulo State (RCCS) project in Brazil sought GEF funding (even though the project did not go ahead).

Bilateral and multilateral project support

Bilateral and multilateral arrangements (i.e. agreements directly between Governments) have been utilised extensively for climate change projects globally. These types of projects have the advantage of focusing on projects that are in the mutual interest of all countries involved, and can be taken forward, without having to go through a competitive process required by some funds. The China Australia Geologic Storage of CO_2 (CAGS) project between Australia and China is a good example of a bilateral CCS project.

The Commonwealth Scientific and Industrial Research Organisation (CSIRO) and the China Huaneng Group are currently coordinating on a CCS feasibility study that will look at site selection, capture technology, storage, finance and timelines. This study builds on the successful collaboration between China and Australia on the Gaobeidian post-combustion capture project, the first carbon capture demonstration project in China.

Funding instruments relevant in the medium term

Green Climate Fund (GCF)

The GCF is being positioned to become the main global fund for climate change finance, and in time will seek to leverage additional private and public finance. The GCF Transitional Committee's proposed 'instrument' for the Fund was endorsed at COP 17. The instrument includes funding for a broad set of eligible activities, including: capacity building, technical assistance for 'readiness' activities, such as preparing climate change related strategies, and technology development and transfer. CCS was explicitly stated as being eligible. It is also recommended that the GCF have 'thematic windows', initially for mitigation and adaptation, with the GCF Board considering the need for more specific windows as the GCF evolves. The types of financing provided would be both grants and concessional lending. National, regional, and international entities such as multilateral development banks would be eligible for accreditation as 'implementing' bodies.

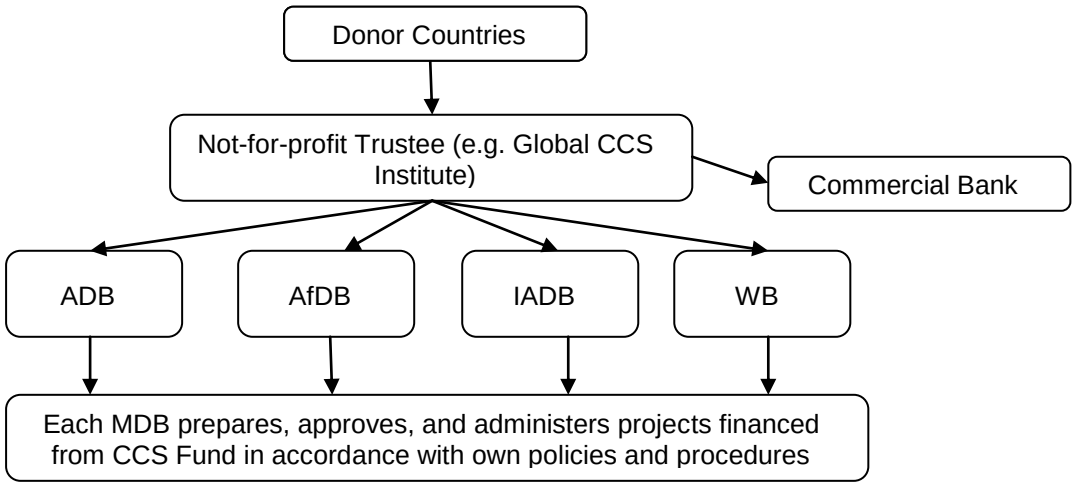
It is also proposed that the GCF's Board will develop mechanisms to draw on appropriate expert and technical advice, including from relevant 'thematic bodies' established under the UNFCCC as appropriate. While not specified in the Transitional Committee's report to COP 17, these thematic bodies *could* include networks or 'technology centres' that would be established under commitments made at COP 16 to develop a Technology Mechanism to provide advice and facilitate the large-scale diffusion and transfer of mitigation and adaptation technologies. A special focus and dedicated expertise on CCS under the Technology Mechanism could help to ensure that:

- the ongoing evolution of the GCF is informed on the overall considerations for CCS to remain eligible for funding, including the appropriate design of mechanisms for advancing large-scale demonstrations; and
- that funding for CCS activities under the GCF is supported by an on-going and dedicated body that provides advice on implementing CCS programs. This advice could include, but is not limited to, the essential aspects of monitoring, measurement and verification of safe, long term storage of CO_2,, aspects that have been of particular focus of concern during the debate on CCS's eligibility into these financial mechanisms.

Dedicated CCS Trust Fund

A dedicated CCS Trust Fund could be established by several donors. A not-for-profit (NFP) legal entity could act as a Trustee of this CCS Fund. This approach would allow donors to dictate the Fund's objectives, selection criteria and governance arrangements. A NFP legal entity could enter into legally binding agreements. Donors would have a lot of flexibility in how the fund is managed. A possible structure is outlined in Figure 2 below.

FIGURE 2: Possible CCS fund structure



8 RECOMMENDATIONS

Based on the considerations outlined above, the Working Group makes the following short and medium term recommendations.

8.1 Short-term recommendations

1. **Donor countries to provide funding in the order of $150-200 million primarily for CCS enabling and pre-investment activities in developing countries, through topping up existing dedicated CCS funding programs.**

   This funding is for the 'extra' or additional costs of the CCS components of an industrial or power sector project. Existing dedicated funds and programs which are able to easily accommodate such funding can be applied to project specific pre-investment and enabling activities:

   - ADB's *Carbon Capture and Storage Fund;*
   - Carbon Sequestration Leadership Forum's *Capacity Development Program;*
   - Global CCS Institute's *Capacity Development Program; and*
   - World Bank's *CCS Capacity Building Trust Fund.*

   For efficiency and speed, additional funding in the short term should be channelled through existing mechanisms and programs dedicated for CCS. While some of these existing mechanisms may have to be amended in order to fund activities beyond just capacity building, the process would be straightforward and does not pose a significant challenge.

2. **Donor countries seek to lift the exclusion of CCS from the Clean Technology Fund.**

3. **Donor and developing countries to engage in bilateral and/or multilateral project support.**

4. **Developing countries to seek complementary funding for capacity building activities under the Global Environment Facility.**

8.2 Medium-term recommendation

5. **Donor countries to provide dedicated CCS funding in the order of $5 billion for the 'extra' CCS costs of construction and operation of demonstration projects in developing countries.**

   This funding is for the 'extra' or additional costs of the CCS components of an industrial or power sector project. This $5 billion funding could be channelled through a number of funding vehicles,

each of which will have, or does have, its own governance arrangements. Four options are identified below for CEM Ministers' consideration.

Ultimately, it is a decision for each donor country to choose which funding vehicle they prefer. However, given the aim is to consolidate $5 billion of funds, it is therefore important that there is a consensus on which funding vehicle is preferred between donor countries.

TABLE 4: Funding vehicle options

FUNDING VEHICLES	PROS/CONS
Dedicated CCS funding window within the Green Climate Fund	This option has the advantage of dedicated CCS funding, but sits within what is likely to become the largest climate funding facility, and will clearly count toward a country's climate change contributions. Saudi Arabia has already supported this approach at the COP17 negotiations. It may be easier to leverage private sector funds under the GCF in time. It is ultimately the GCF Board's decision to have dedicated funding windows, and they may decide not to take this approach, preferring all technologies to 'compete equally' against a common set of criteria. It should be noted however, that CCS has been at a disadvantage by being excluded from existing mechanisms, until recently.
Portfolio approach to funding a range of technologies within the Green Climate Fund, with CCS included as a component of the portfolio	This option has the advantage of working within what is likely to become the largest climate funding facility, and will clearly count toward a country's climate change contributions. It also avoids the possible concern of CCS not 'competing equally' with other technologies, but ensures that some CCS projects do get funded under the GCF. Ultimately this is the GCF Board's decision.
Establish a new dedicated CCS trust fund with its own governance arrangements, but which counts towards a country's climate funding commitments	This option has the advantage of not being dependent on potentially lengthy negotiations and establishment of governance arrangements required for the GCF. Interested donor countries can more quickly and easily establish a dedicated CCS Fund, identifying governance arrangements and selection criteria tailored specifically to CCS. Donor countries can choose how the dedicated funding will be administered. However, a new fund will take time to establish when there are available alternatives.
Top up existing dedicated CCS Trust Funds and make any changes to criteria to accommodate project support funding, ensure it counts towards a country's climate funding commitments	This option has the advantage of utilising existing mechanisms and by-passes the need for establishing new governance arrangements etc. This may mean that 'new' donor countries have less flexibility in establishing governance arrangements of their choosing.

9 NEXT STEPS

During the course of developing this paper, the Working Group commenced consultations with prospective developing country recipients and potential donor countries. While CEM Governments consider their actions in response to the above recommendations, it is proposed that the Working Group:

1. consults further with developing and developed country governments regarding which funding vehicle they prefer and why, and what the key principles and funding criteria might be under each funding vehicle; and
2. identify any barriers preventing implementation of the recommendations, and if applicable, make recommendations to Clean Energy Ministers and officials to address these barriers.

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