Department of Energy & Climate Change

Business Case and Intervention Summary

Carbon Capture and Storage: Accelerating developing country deployment

March 2013

Intervention Summary

What support will the UK provide?

The UK will provide £60m of finance from the International Climate Fund (ICF) to trust funds operated by the World Bank and Asian Development Bank and which have been established with the specific purpose of supporting developing countries to develop both the technical and institutional knowledge necessary to enable the deployment of Carbon Capture and Storage (CCS) technologies. The intervention uses a mix of RDel (Resource) and CDel (Capital) finance where CDel spend is required to enable the purchase of capital assets associated with pre-commercial demonstration activities.

Funding will be paid on the following timeline and be drawn from DECC's ICF allocation:

	DECC Spend		DECC Spend	
Recipient	2012/13 (£m)	% CDEL	2013/14 (£m)	% CDEL
World Bank	14.9	67%	10.1	0%
Asian Development Bank	35	43%		

The finance will be targeted to support capacity building activities in China, South Africa and Indonesia. In each country, a range of public and private sector actors stand to benefit both directly, in terms of the potential for them to receive UK finance but also indirectly from the key project outputs. A small residual allocation of finance being made available to support related activity in other rapidly industrialising nations. These second tier countries are where CCS is less of a near term priority but coal comprises a considerable share of the national energy mix and as a consequence CCS is likely to be a medium to long term requirement.

The ICF funding would help raise the level of technical understanding of CCS within these countries, leading to the establishment of necessary policy frameworks and incentive structures to support CCS demonstration and ultimately accelerate the deployment of CCS. The two CCS Trust Funds will support capacity building through pilot and demonstration activities. In particular:

Preparation and implementation of early-stage full scale integrated CCS pilot demonstration projects in developing countries that are part of low carbon development strategies and plans endorsed by respective in-country authorities to facilitate the fulfilment of their share in global climate change mitigation efforts. CCS Trust Funds will support incremental financing required for CCS planning & pre-investment, capital costs for CCS units and components, and CCS related post-completion & operation activities.

Development of geological site characterisation intended for integrated full scale CCS projects, both at the pilot and commercial demonstration scales to maximise knowledge on both near-term and future storage capacities.

Pilot and demonstration activities aimed at reducing the cost of the technology application across the CCS chain (excluding retrofit activities not associated with CCS).

Why is UK support required?

There is a very strong strategic case for using the ICF to support CCS capacity building. The widespread deployment of CCS technologies in developing countries in the near term is of critical importance and essential if we are to avoid dangerous climate change. The International Energy Agency (IEA) has estimated that on a least cost basis, CCS will be required to deliver 19% of the CO_2 savings required to enable us to keep global temperature rise at or below 2 degrees centigrade and so avoid the most damaging effects of climate change. To achieve this will require the construction by 2050 of approximately 3,400 plants worldwide with over 2,000 of these being built in non-OECD countries. On a nearer term time horizon, IEA's CCS Technology Roadmap (2009) estimated that of the 100 plants needed worldwide by 2020, 50% would need to be in non-OECD countries. At present

there are no large scale demonstrations in developing countries and political support to drive deployment of the technology remains low in all but a few countries.

In order to address this issue, the Asian Development Bank (ADB) have assessed that $5bn of public finance is required to stimulate and incentivise CCS demonstration in emerging economies. The ADB paper, presented at the Carbon Sequestration Leadership Forum ([CSLF] a dedicated Ministerial level forum established to promote the demonstration and ultimate deployment of CCS technologies representing 24 countries and the European Union) calls for the creation of a CCS Demonstration Fund at a scale large enough ($5 billion) to support multiple projects over a period of time (at least 10 years) in fossil fuel-based emerging economies. The UK has committed £60m to support CCS capacity building in developing countries. This pledge will go towards the global commitment made by international governments through the Carbon Capture, Use and Storage Action Group[1] to allocate $200m internationally to accelerate the deployment of CCS in the near term. To date approximately $40m of finance, a figure far below these requirements has been allocated by developed countries to support the ambitions of developing countries in this area, with the bulk of this money being channelled through two dedicated Trust Funds hosted by the ADB and World Bank. The provision of UK finance will not only cover the costs arising from a small number of activities that are need to be undertaken prior to any commercial demonstration in a developing country but also hopefully encourage others to provide further finance to support this important objective.

What are the expected results?

The allocation of finance from the ICF to support capacity building activities in developing countries will facilitate a number of activities to develop human and institutional capacity and create an enabling environment for CCS to be taken forward in key countries. Financial support would be channelled toward a range of projects in China, South Africa and Indonesia with the aim of ensuring sufficient political support is created to pave the way for full scale demonstration and ultimately the deployment of CCS.

The specific interventions have been identified with partner organisations and are consistent with the objectives of the host country governments:

- In China, financial support has in principle been earmarked to help underpin three demonstration activities in order to develop further knowledge and expertise within both industry and government partners. Each of the three projects looks at a different technology and is a precursor to any full scale commercial demonstration. All have support from the relevant Government Ministries but will not go ahead without external financing. Together they will provide evidence of the various options for CCS deployment as well as some of the potential means in which the economic losses associated particularly with CO_2 capture and transport can be reduced.

- In South Africa, the government sponsored South African Centre for Carbon Capture and Storage (SACCCS) has developed a roadmap toward the first commercial demonstration of the technology. The next step is to plan and carry out a CO_2 test injection, a critical stage in determining the viability of CCS in the country. UK financing via the World Bank CCS Trust Fund would be used to support this initiative.

- In Indonesia, the gas processing industry provides a large number of low cost opportunities to demonstrate the potential application of CO_2 capture and utilisation technologies. The Asian Development Bank is working with Indonesian partner organisations to develop a CO_2 capture project and demonstrate how readily high volumes of CO_2 can be sequestered.

As a consequence of the proposed interventions, the capacity of industrial actors in the various target countries to take forward CCS demonstrations will be increased. At the same time, it is anticipated that the level of technical understanding of CCS in the three target Governments will be raised and the geology of each country will be better understood. It is hoped that in time, this will lead to the

[1] The Carbon Capture, Use and Storage (CCUS) Action Group was established by the governments of Australia and the United Kingdom in 2010. It brings together governments, institutions, and industry to facilitate political leadership and provide recommendations to the Clean Energy Ministerial (CEM) on concrete, near-term actions to accelerate the global deployment of CCS.

establishment of necessary policy frameworks and incentive structures to support CCS demonstration and ultimately accelerate the deployment of CCS. This is set out in the Theory of Change on page 17.

Broader engagement delivered using ICF support with so called “second tier” countries is expected to ensure that prior to making any new investment in fossil fuel power infrastructure the potential to retrofit CCS has been considered and that plant is designed and built in such a way as to minimise emissions and the per unit cost of supplying electricity to the end user.

Business Case Contents

1 Strategic Case

1.1 Context and need for ICF intervention

The need for CCS as a mitigation technology

Total global fossil energy resources, i.e. those amounts that have been estimated to be available in various deposits without any assessment of either the technical or economic feasibility of extraction, comprise some 21,000 gigatonnes of carbon equivalent (Gtce). Of this amount, coal constitutes 78.5%, gas 18.6% and oil 2.9%. The energy reserves, i.e. those resources that should be recoverable and economically extractable using current technology under current market conditions, comprise some 1400 Gtce whilst the current usage rate is about 16 Gtce per annum. As such, fossil fuels sources are considered to be readily available. This is particularly the case for coal which due to its widespread geographical distribution, in combination with low extraction and utilisation costs is seen by many nations as an integral means to ensure the availability, reliability and security of their overall energy supply. Consequently, major infrastructure investments have been and continue to be made to ensure the steady production, transport and utilization of fossil fuels on a global basis.

Given ever increasing concerns about the role of greenhouse gas emissions in accelerating climatic change, there is an urgent need to establish ways to use fossil energy sources in a way that will minimise associated emissions of carbon dioxide (CO_2). The most promising way identified to date is carbon capture and storage (CCS). This is a technique for capturing CO_2 from large point source emitters such as fossil fuel power stations and industrial facilities that burn fossil fuels on site. The IEA estimates that on a least cost basis CCS should account for one-fifth of the total mitigation efforts required by 2050 in order to avoid dangerous climate change, making it the second largest single contributor to our emissions reduction effort after improvements in energy efficiency. Further, the IEA has estimated that not using CCS would increase the total costs of meeting climate change mitigation goals by at least 70%. Consequently, the IEA and others recognise that CCS is one of the core technologies for tackling climate change since even by 2050, fossil fuels are expected to supply over 50% of electricity generation, with gas- and coal-fuelled plants providing reliable, despatchable power.

The importance of CCS to developing countries

While the IEA estimates that CCS could account for 19% of all greenhouse gas emissions reductions by 2050, this would require the development of some 3,400 CCS projects worldwide, of which some 65% would need to be established in non-OECD countries. In many developing countries increasing demand for power is driving the introduction of new, higher efficiency modern coal fired plants, and such new generating fleets will not start to be decommissioned for at least forty years. These countries see the use of their large indigenous coal supplies as a means to underpin economic growth with competitive power generation, which directly and indirectly provides jobs for many of the population while also ensuring energy security. Many non-OECD countries contend that when compared to low cost fossil sources, renewable forms of generation are expensive and are less able to deliver against their primary objectives of providing reliable, despatchable power.

It is widely accepted that it is those individuals living in the poorest countries who will be most affected by the impacts of climate change and against that backdrop, the introduction of CCS, both for new plants but also retrofit facilities, offers a means to maintain economic sustainability while ensuring effective carbon mitigation. Consequently, the successful introduction of CCS in developing countries has profound and positive implications for future energy utilisation.

The status of CCS deployment in developing countries and the rationale for ICF spend

The International Climate Fund (ICF) is designed to provide climate change related aid over the period 2011-12 to 2014-15. It is intended to drive urgent action to tackle climate change by supporting low carbon growth and adaptation in developing countries, with the following priorities:
Demonstrate that low-carbon, climate resilient growth is not only feasible, but desirable;

- Support international climate change negotiations; and

- Recognise that climate change offers new opportunities for private sector partnerships, innovation, and sustainable development.

The scope of projects that can be covered by the fund includes building global knowledge and evidence, developing and scaling-up low-carbon and climate resilient programmes, building capacity in the public and private sectors.

The development, demonstration and deployment of CCS technologies to enable the utilisation of fossil resources in a sustainable manner is clearly consistent with the above objectives. While CCS demonstration programmes have been established in a number of developed countries, there has been a lack of similar co-ordination initiatives in developing countries. Some countries, such as China have made some significant technical advances but even here the technology continues to be viewed as one which is primarily for deployment by developed rather than developing countries.

CCS consists of three separate elements – CO_2 capture, CO_2 transport and sequestration into a suitable substrate. The entire CCS chain is therefore not something that can readily be packaged and sold as an off the shelf solution. Rather, there is a need to ensure that key developing countries have the capacity to deploy CCS when the conditions are right. This involves the formulation of appropriate policies, regulations and standards, careful consideration of the logistics of CO_2 transport if close to large population centres, and the careful characterisation of potential CO_2 storage locations, including test injection programmes, all of which lead to detailed feasibility and then engineering design studies.

It is crucial that capacity building programmes in developing countries are established in order that personnel can build up the necessary capability to undertake the sort of work outlined above. Such expertise is likely to take many years to be fully acquired and it is necessary before any nation moves from the development and demonstration phase to the point where a commercial scale CCS project can be considered. Without CCS deployment, there is a risk that projected new build activities will lead to a significant 'lock in' of high carbon emitting infrastructure. For this reason, supporting CCS activities in the near term will not only result in a greater aggregate reduction in emissions, but it will also be less costly, as evidenced by numerous IEA studies (key references in Bibliography).

Many developing country stakeholders consider CCS to be a technology for demonstration and deployment in developed rather than developing countries. But in the light of IEA's recommendation that over 2,200 plants should be built in non-OECD countries by 2050, there is a clear case to ensure that the relevant government and private sector stakeholders are appropriately resourced to take forward CCS demonstrations in the near term. Supporting such an effort will require considerable external finance, and yet even with relatively small sums of grant financing there is still a great deal that can be done.

To date, though there have been a number of capacity building initiatives established, the activities have been taken forward in a piecemeal way and hence there remains a clear need to be addressed. Approximately $40m has been made available to date (with the bulk of this coming from the Governments of Norway and Australia (via the GCCSI [Global CCS Institute]) and supplemented by a number of much smaller contributions including approximately £2.5m from UK. Previous UK money was used to support the Near Zero Emissions Coal (NZEC) project in China. Though sizable, it remains far below the required levels (given the high costs associated with CCS development, demonstration and deployment), and as such this intervention is critical to ensuring those developing country economies where CCS deployment has the potential to deliver transformational emissions reductions are appropriately positioned on the learning curve.

It is clear that CCS is a critical 'transformative' technology to combat climate change and demonstration in developing countries needs to take place in parallel to developed countries. However, the increased costs and energy penalty associated with operating CCS mean this is not a high priority for developing counties. Evidence from the Phase I of the NZEC project showed that capacity building activities can be effective at strengthening the policy debate on CCS and increasing capability at the technical level. Central governments (notably both South Africa and China) typically place low priority on CCS. Those areas of government, academia or civil society that are supportive of CCS do not have sufficient resources to undertake the analysis to underpin their arguments. The ICF funding for CCS capacity building projects will help raise the profile of CCS within their host

governments, build political support, increase technical capability and leverage funding to support CCS capacity building activities from other donors.

The bulk of finance allocated to date has been channelled to two capacity building funds, administered by the World Bank and Asian Development Bank. The objectives of these two dedicated Trust Funds established to provide support for CCS are very closely aligned with HMG's objectives to provide capacity building support in this area and they therefore represent an ideal vehicle for channelling UK finance.

At the 2nd Clean Energy Ministerial in Abu Dhabi in 2011, 11 Governments including the UK accepted a recommendation to make progress in ensuring developing countries were able to access finance in support of their efforts to develop CCS. A UK contribution from the ICF would be a valuable means of demonstrating progress against that objective and encouraging other committed governments to come forward with their own offers of finance.

Finally, and acknowledging that this is not a driver for ODA spend, it is anticipated that the targeted use of ICF finance to support the development of knowledge and capacity in developing countries may well deliver incidental project related learning(s) which could be drawn upon to aid delivery of the UK's own domestic CCS demonstration programme.

Where should UK effort be focused?

Our primary objective is to support those major developing economies that are at the stage where CCS demonstration is appropriate in the near term. However, CCS demonstration and subsequent deployment will only occur at sufficient scale if a much broader set of countries become engaged and prepare the ground for this to happen. In order to meet this need, some money needs to be allocated to support activities designed to help smaller but rapidly developing countries, such as those in South East Asia, address in more general terms the way in which they use fossil fuel resources to generate power.

In order to accelerate the development, demonstration and deployment of CCS technologies in developing countries, the bulk of our effort needs to be focused on those countries that have large carbon footprints, have already been engaged on CCS and indicated a willingness to initiate demonstration projects. In these countries, though there is some interest, competing priorities for both finance and human capital acts as a brake on CCS development. A comparative analysis of the potential impact of ICF spend in six countries is included at ANNEX A.

Three developing countries are identified on the basis of this analysis as suitable for further engagement, namely China, Indonesia and South Africa. All are vulnerable to adverse effects from climate change and also priority countries for ICF spend. All are major fossil fuel users and suppliers, with domestic economies that are primarily underpinned by coal. Their involvement to date and chosen means to pursue CCS though are different, both in terms of technology considerations and the institutional approaches to determining its suitability for demonstration and deployment. For each country CCS remains a second or third order priority and without a globally binding deal on CO_2 mitigation it is unlikely that a programme of domestically financed capacity building will be undertaken. However, in each case, the national government:

- has established policies to counter climate change and has recognised the potential importance of CCS as a mitigation technique;
- has undertaken various CCS capacity building activities, most of which have been supported with bi-lateral and multi-lateral funding;
- has made sufficient progress along the technology development curve such that a demonstration project can be considered; but
- has other declared priorities including poverty alleviation, such that major financial support and assistance will be necessary to take things forward.

- There are different reasons why in each of the three countries CCS has not yet become such a priority that the Government will spend domestic finance in this area. However, for all three countries the lack of progress to date is a combination of the following factors:
- the high capital cost of CCS demonstration and deployment;

- the energy penalty associated with the operation of CCS plant – best estimates are that CCS will require in the region of 20% more coal to be burned per unit of electrical power generated;
- the fact that for most developing countries, the need to expand power supplies to both urban and rural communities remains a priority and therefore limits the level of resource available to deal with environmental issues; and
- the technology has yet to be deployed at scale even in developed countries.

China's projected CO_2 emissions will dwarf those of every other developing country and it is essential that it is fully involved in all processes to establish low carbon economies. China is engaging significantly at an international level on climate change issues, which reflects an increasing realisation of the need to establish a sustainable energy policy. However, economic growth is underpinned by increasing coal use. China's vision for 2020 includes reducing carbon intensity by 40-45% from 2005 levels (supported by a major energy efficiency improvement programme in the energy intensive sectors) and meeting 15% of its total 2020 energy demand with non-fossil fuel. Even so, in order for China to reduce its aggregate CO_2 emissions then the introduction of CCS in the period from 2030 to 2050 will be essential. CCS has therefore been recognised as a key technology for development in China although further evidence is required that it can be applied efficiently and costs bought down before the Government will endorse its application.

The Indonesian economy is seen as the third most vulnerable to climate change and the Government has increasingly raised its concerns about impacts on the developing world. The Government has issued the National Action Plan Addressing Climate Change, which sets out Indonesia's intention to reduce greenhouse gas emissions from energy sector, land use, land use change and forestry while also identifying CCS as a key means to reduce CO_2 emissions. This included a non-binding commitment to reduce CO_2 emissions in the range 26%-41% by 2020. With regard to CCS, this is a policy objective in the National Energy Plan, with a high-level blueprint for its deployment. There have been and continue to be a number of investigative studies undertaken involving various national stakeholders, with some form of international cooperation, as described in the sections below but some sort of external impetus will be needed in order to drive up interest and galvanise action.

South Africa's energy sector is critical to the economy as the country relies heavily on its large scale, energy-intensive mining industry. The country has only small deposits of conventional oil and natural gas and uses its large coal deposits for most of its energy needs. Thus coal is the prime indigenous energy resource base. In 2010, the country produced some 250 Mt of which it used some 182 Mt, with the remainder being exported to China, India, and Europe. Of the coal used domestically, about 53% is used for electricity generation, 33% for the synthetic fuels industry, 12% for metallurgical industries and 2% for domestic heating and cooking. Recently, the government published a White Paper on Climate Change Strategy, in which CCS has been designated a National Flagship Programme. In order to take this forward, the Department of Energy has established an interdepartmental CCS committee that will determine the appropriate strategic way forward. The other key departments that are engaged in CCS policy development are Environment and Mineral Resources. The South African Centre for CCS (SACCCS) has been established by the Government to help co-ordinate and drive forward the development and deployment of CCS technology in South Africa. It is therefore essential that any support provided is consistent with their assessment of need. The SACCCS has established a Roadmap for CCS which includes the need to take forward a test injection of CO_2 and therefore activities that support this work are likely to be the main focus of any efforts here.

As set out above, in order to pave the way for the deployment of CCS, it is important that some resource is dedicated to undertaking initiatives to ensure that the rapidly developing emerging economies which are responsible for much the new coal infrastructure being developed at present is scaled to ensure that it is as efficient and sustainable as possible. As with China, South Africa and Indonesia, it is clear that there are a large number of second tier countries which will continue to use coal for a long time to come. Early engagement with these countries will help ensure they take appropriate actions to deliver both cost savings and carbon emissions reductions as well as ensuring that the investments they make are best able to cope with the current adverse efficiency impact of CCS which threatens to limit deployment.

1.2 Impact and Outcome that we expect to achieve

The use of ICF money to support capacity building activity relating to CCS is expected to lead to the inclusion of CCS in any national emissions reduction strategy produced by the government of each target country and so, in time, accelerate the timetable for the deployment of the technology.

There are a wide range of capacity building activities that can be undertaken, in order to accelerate the demonstration and deployment of CCS technologies in developing countries. The precise blend of activities that will bring greatest benefits will vary from country to country, depending on the current understanding of CCS in that country and their internal assessment of the available opportunities for both demonstration and deployment. However, the ICF funding will be used to raise the level of technical understanding of CCS within these countries, leading to the establishment of necessary policy frameworks and incentive structures to support CCS demonstration and ultimately accelerate the deployment of CCS. The two CCS Trust Funds will support capacity building through pilot and demonstration activities. In particular:

- Preparation and implementation of early-stage full scale integrated CCS pilot demonstration projects in developing countries that are part of low carbon development strategies and plans endorsed by respective in-country authorities to facilitate the fulfilment of their share in global climate change mitigation efforts. CCS Trust Funds will support incremental financing required for CCS planning & pre-investment, capital costs for CCS units and components, and CCS related post-completion & operation activities.

- Development of geological site characterisation intended for integrated full scale CCS projects, both at the pilot and commercial demonstration scales to maximise knowledge on both near-term and future storage capacities.

- Pilot and demonstration activities aimed at reducing the cost of the technology application across the CCS chain (excluding retrofit activities not associated with CCS).

More detail for China, South Africa and Indonesia is also presented in the sections below.

In generic terms the purpose of capacity building around CCS is to develop the information, tools, skills, expertise and institutions required to implement CCS demonstration projects and ultimately accelerate the timetable to commercial deployment. The **outcomes of capacity building** are to strengthen the understanding, knowledge, abilities and skills of individuals, organisations, industry and governments to enable them to facilitate the deployment of CCS. The nature of developing capacity in an untested and innovative technology means that we cannot specify the exact knowledge, lessons or success, and there are project risks in individual activities. However it is also important to note that overall success does not require every activity to succeed - valuable lessons can be learnt from failures provided these contribute to overall advances. General success needs to include the creation of the following **outcomes**:

- government understanding of legal and policy issues and their regulatory application;
- technical knowledge and skills in engineers, geologists, and project managers;
- understanding financial and commercial issues, risks and incentives by policy makers, lenders, and companies in order to overcome supply chain issues associated with demonstration; and
- the ability of companies and governments to effectively and genuinely engage with the public and local stakeholders around a specific CCS project.

The projects this intervention is seeking to support will also contribute significantly to the existing global body of knowledge around CCS. While many of the lessons learned and information developed through these projects will be regionally specific, there will be a lot which is relevant to projects around the world. The importance placed on the global exchange of information arising from projects has been recognised by many governments and is evidenced by the establishment of the Global CCS Institute with a remit to accelerate the deployment of CCS by facilitating knowledge sharing. Many of the proposed activities present a direct opportunity for involvement of representatives from other countries, and HMG will endeavour to disseminate all other non-proprietary information through its own networks and those of the Global CCS Institute.

The success of these outcomes will also depend on the level of industry and government buy-in to the capacity building activities. The selection of China, South Africa and Indonesia was made on this basis – as these are countries that have demonstrated significant interest in developing CCS.

In addition the precise outcome that can be achieved will vary between each of the three countries. The current situation and anticipated progress in each of the countries is therefore set out below.

China

Extensive international cooperative activities have increased Chinese capacity and raised awareness of CCS among many stakeholders concerning the viability of the technology as well as the hurdles to enabling deployment. That said, it seems essential that further such engagement will be needed, not just to take forward the development work but also to establish demonstration and ultimately deployment in China.

Key Government decision makers in China's National Energy Administration (NEA) and National Development and Reform Commission (NDRC) are currently yet to be convinced that CCS is an appropriate technology for deployment in China because of the high operational energy penalty and the capital/operational cost implications. At the same time, China's Ministry of Science and Technology (MOST) and a number of key State Owned Energy Enterprises are interested in undertaking further research and development activities around the technology in order to exploit the long term commercial potential that could be gained if China was to position itself at the forefront of the technology development curve. However, China lacks a domestic policy framework that will enable these businesses to build on their impressive R&D progress to deliver full chain CCS demonstrations, at least in the near term.

It is clear that there is an interesting government position evolving both NDRC and MOST appear to be committed to supporting further CCS demonstrations and doing so at an increasing scale but their justification for doing so is based upon the potential value associated with CO_2 utilisation activities, specifically the potential to increase oil yields and so reduce China's import dependency rather than CO_2 sequestration. One of the primary objectives of any intervention in China will be to shift the focus beyond utilisation and to encourage the development of policy incentives capable of supporting CCS and deliver larger scale climate benefits.

There are a range of specific activities that could help accelerate China's progress toward CCS deployment. These include but are not limited to the preparation of a comprehensive national atlas of CO_2 storage options, covering oil and gas reservoirs in all regions of China, as well as a rigorous assessment of saline aquifer storage capacities. Such work would include:

- National and regional storage mapping, e.g. a CO_2 storage atlas for China, including defining site selection criteria and site characterisation methodologies;
- Detailed scientific, technological and engineering assessments of CO_2 Enhanced Oil Recovery opportunities;
- Depleted oil- and gas-field storage assessment, which could cover capacity and availability, as well as facilities, integrity and re-use; and
- Aquifer storage mapping, assessment of capacity and integrity, and site characterisation.

In addition, there will be a need for detailed geological surveys to estimate CO_2 storage capacity in regions where possible CCS operations might be implemented.

At the national policy level, the creation of a suitable legal and regulatory framework is essential to determine that CCS applications may be implemented safely and in a manner that delivers genuine emissions reductions. It is therefore critical that any intervention should seek to encourage the Government of China to undertake work in this area.

At a more regional scale, there remains considerable scope to raise awareness about CCS amongst key stakeholders which could be delivered through broader outreach type activities.

The most effective way to accelerate capacity building is to support the demonstration of CCS at a suitable scale in either the coal power sector or in the coal to chemicals sector, the latter being a lower cost opportunity in the near term. There are several such possibilities being developed at

present and it is clear that additional funding will need to be mobilised either through multilateral channels such as the International Development Banks or bilaterally in order to ensure they move forward. In providing additional finance either directly or indirectly to China, the key near term goal should be to secure political support for the demonstration and deployment of CCS. This will necessitate the creation of a robust roadmap where CO_2 utilisation is no more than a means to an end rather than an end in itself, along with the development of suitable enabling measures such that the framework for deployment can be established. It is anticipated that UK ICF finance could be used to address this need.

Indonesia

In principle, the technical potential for CCS in Indonesia is the highest in all of South East Asia as the technology offers a means for significant CO_2 removal from the various energy intensive sources within Indonesia. However, the make-up of the coal power sector, comprising numerous small units in individual locations that are mostly relatively distant from potential CO_2 storage sites means that the likely cost of demonstration and deployment on coal infrastructure would be disproportionately high, particularly whilst the technology remains under development.

As in many developing countries, the current priority for the government is enhancing energy access and sustaining energy security. Indonesia has committed to reduce its GHG emissions by 26% unilateral or 41% with international support by 2020 and has published a President Regulation for National Mitigation Actions in October 2011. The National Planning Agency that is in charge of developing the regulation into Indonesian Nationally Appropriate Mitigating Action (NAMA) framework considers CCS as one of the options that might be available to reduce emissions from power plants in the future.

The Indonesian Government already has aspirations for CCS and a number of first level capacity building activities (i.e. studies and workshops) have been undertaken. There is now a growing body of evidence that suggests the Government acknowledges the need for a robust policy and regulatory framework to be put in place as well as appropriate financial incentives for CCS. The creation of a comprehensive capacity building programme in Indonesia is necessary to support this growing interest. However because the achievements to date are limited, it is essential that the next phase of activities remain sufficiently broad in scope and address the full range of issues associated with CCS demonstration and deployment.

There is a significant industrial interest in developing necessary technical and engineering capacity to undertake a CO_2 capture demonstration, isolating CO_2 at the time of natural gas extraction. Although the Ministry of Energy and Mineral Resources is supportive of the need for research activities in this area, as a means of enabling Indonesia to build experience of CCS operations, there are currently no policies in place to underpin the necessary investment. Even in the event that the resultant CO_2 stream were used for the purposes of Enhanced Oil Recovery (EOR) (an activity which enhances the economics of CCS by developing a new revenue stream for the operator), it is still not cost effective.

A demonstration, supported by the ICF and looking at CO_2 capture on a gas processing facility, if accompanied by robust monitoring and verification, will provide a very public example of the value of CCS. This value add will be demonstrated both in terms of the short term revenue stream arising from EOR but more importantly in the longer term, clear evidence that CO_2 can remain stored securely in a geological formation. However, in order to create a platform for the wider deployment of the technology it would need to be complemented with other a programme of other activities that:

- engage with the international community on CCS issues to identify opportunities for engagement both within the country and elsewhere;
- raise awareness of the role of CCS with stakeholders in industry and various institutes; engaging in more general public outreach initiatives, to explain the consequences of global inaction on climate change and how CCS can provide a valuable mitigation tool;
- undertake detailed geological surveys to estimate national storage capacity, particularly in regions where possible CCS demonstrations and deployment might be implemented;
- begin to establish a suitable legal and regulatory framework so that CCS applications may be implemented with confidence;
- robust techno-economic studies for all promising CO_2 capture and storage options taking into account future energy growth.

If by 2025 CCS should be applied to the various natural gas deposits that are projected to be exploited at that time, the annual potential reduction in CO_2 emissions would be in the range 285-345 Mt and the demonstration of CCS in this sector could well provide a driver to then introduce it for coal power applications.

The IEA Clean Coal Centre estimate in their 2009 report that the average coal fired unit in Indonesia is just 150-200MWe. Their research identified that the size of new build units has been growing over time and included evidence to demonstrate that the next generation of coal plants (in excess of 20 were planned at the time of the report) would be considerably larger. This planned up-scaling would not only have the effect of making CCS technology more viable through economies of scale, but also indicated an additional potential reduction in CO_2 emissions, which could be as great as 255-310 Mt. As such, the introduction of CCS in Indonesia is a very worthwhile objective.

South Africa

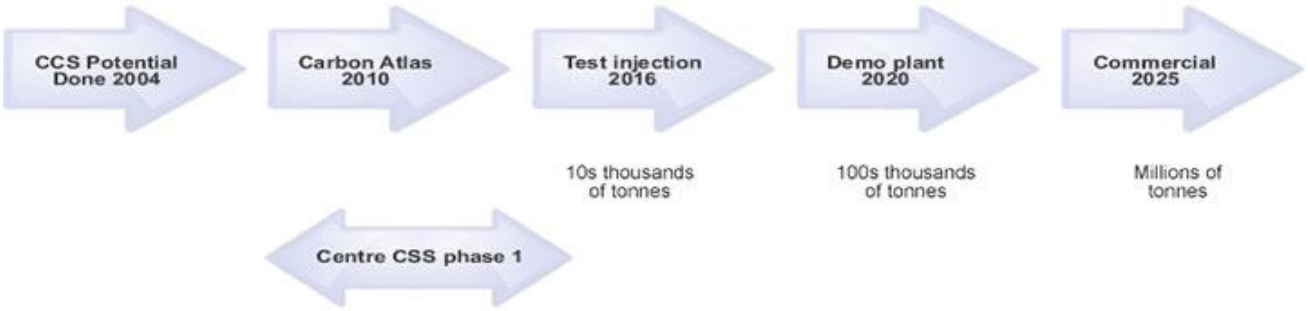
South Africa is the 25th-largest country on a geographic basis and ranked by the World Bank as the 28th-largest economy in the world. However, its economy is mixed with about a quarter of the population unemployed and low GDP per capita. South Africa's extensive use of coal (182Mt in 2010 accounting for 71% (with peat) of primary energy) to underpin a developing economy means that South Africa will become increasingly dependent on CCS if it is to mitigate its emissions.

The South African government's near term focus is on GDP growth and job creation. At the same time, it has committed the country to reduce CO_2 emissions. The government published a White Paper on Climate Change Strategy, in which CCS has been designated a National Flagship Programme. In order to take this forward, the Department of Energy has established an interdepartmental CCS committee to determine the appropriate strategic way forward.

Various studies have sought to assess the comparative costs between various technologies. Though these vary on a geographical basis and to some extent on the assumptions made, studies by DECC, the IEA and the USA Energy Information Administration (EIA) as well as technology providers such as Alstom all broadly agree that coal- and gas-fired plants with CCS deliver electricity at comparable costs to nuclear and onshore wind, even before the system costs necessary to provide back-up for intermittent generation technologies are taken into account. Consequently the South African Centre for Carbon Capture and Storage (SACCCS) have concluded that the deployment of CCS will help to prevent major electricity price increases in the future thereby maintaining the competitiveness in the manufacturing industry and protecting local jobs.

In addition to the Department of Energy, the Department of Environment and Mineral Resources also has a stake in CCS policy. The use of CCS will allow continued use of fossil fuels while achieving deep reductions in CO_2 emissions such that the technology will bridge the gap until such time that the existing energy infrastructure is replaced with non-fossil fuel based power generation. In the near term, CO_2 emissions will continue to rise, reflecting the increased use of coal as the country seeks to improve access to electricity for its citizens.

Fig 1: Timeline to Commercial Deployment of CCS in RSA (SACCCS)



South Africa is in a reasonable position to further the development of CCS with good awareness, interest and buy-in amongst a number of industrial stakeholders having been established in a short period of time. There also appear to be strong, well defined Government objectives to determine the feasibility of CCS for South Africa, with, the existence of an in-principle plan to move forward to CCS demonstration and ultimately commercial deployment.

The creation of SACCCS as a Division of the National Energy Research Institute (SANERI) has provided a focus on the South African initial activities and though questions remain about the volume of available storage in the country, there exist a number of high level capacity building activities that need to be taken forward in the near term in order to maintain momentum. These include:

- support/guidance to ensure effective public engagement /outreach, both internationally and especially in South Africa with the diverse population and related demographics. This needs to include raising awareness about CCS amongst stakeholders, particularly in various institutes and academic institutions; there is a need to explain the consequences of global inaction on climate change and how CCS can provide a valuable mitigation tool, especially in countries like South Africa;
- the need to undertake detailed geological surveys to estimate national storage capacity, particularly in regions where possible CCS demonstrations and deployment might be implemented; this can be undertaken by international oil and gas companies since, for example, South Africa cannot draw on a domestic oil and gas industry to provide the skills and techniques relevant to CCS that are traditionally drawn from that sector in many other countries;
- engagement in the international activities to establish appropriate legislation and regulation both for demonstration and commercial opportunities.

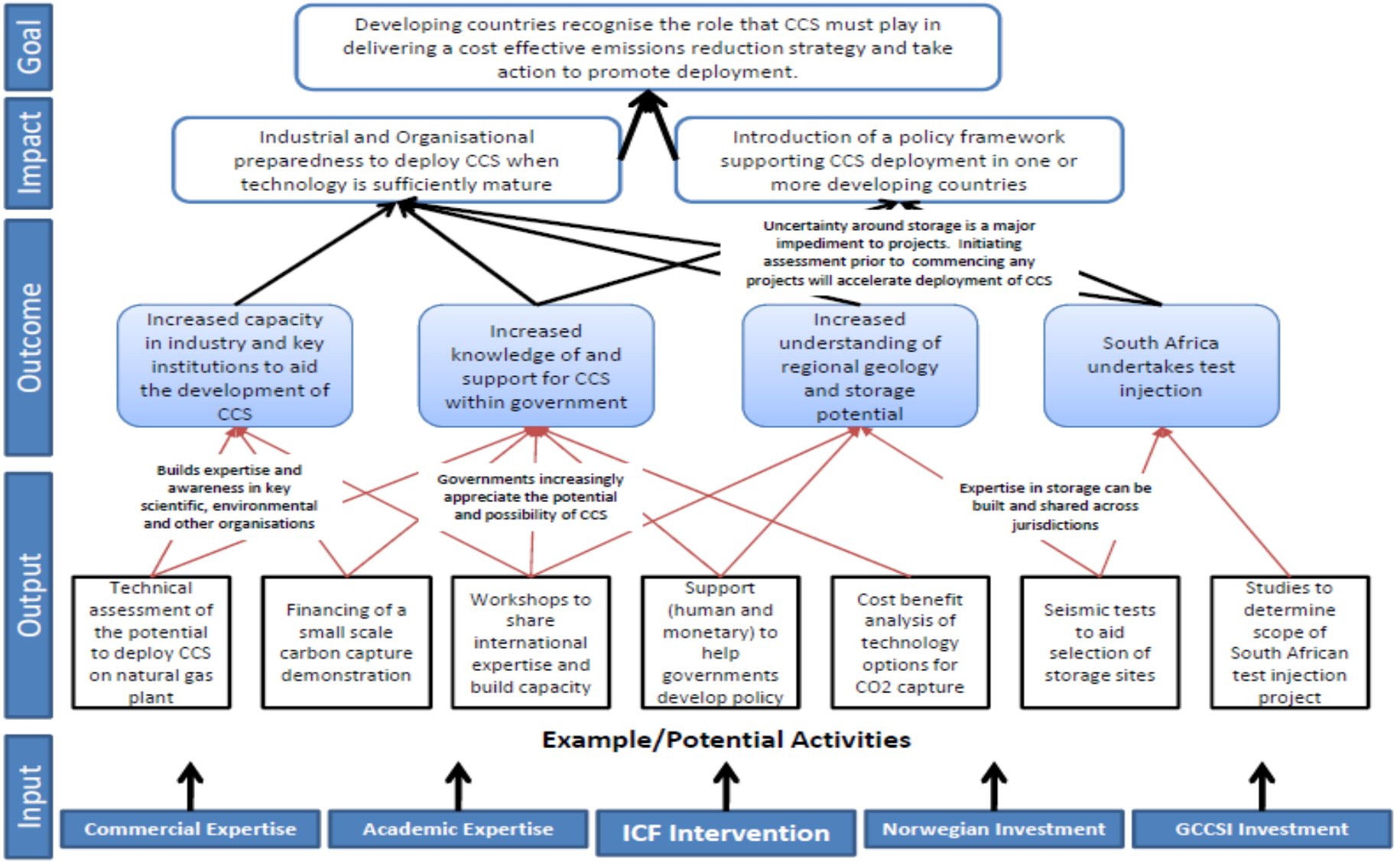
In addition to undertaking a range of generic capacity building activities, it is evident that there is a clear need for additional finance to accelerate the timeframe to a test injection and ultimately create the evidence base needed to support full scale demonstration and deployment. The purpose of the test injection will be to demonstrate that CO_2 can be safely stored in South Africa and will necessitate the injection of CO_2 into South African reservoirs with appropriate monitoring so as to determine the suitability of the local geology as a storage medium, including an assessment of the CO_2 dispersion and transformation reactions and its effects on the surroundings. Prior to the injection itself, funding is required to support the seismic testing and drilling activities. UK ICF funding will enable seismic testing to go ahead and then enable the purchase of equipment (CDEL finance) required to undertake CO_2 injection tests.

The findings of the test injection will support the deployment of CCS in South Africa and to an extent reduce the costs of projects associated with identifying and characterising storage potential, but will also provide valuable data and experience for the global CCS community. While the results will be highly regionally specific, knowledge of the behavior of CO_2 plumes in different geological conditions is highly valued by the research community and CCS projects around the world. There is also significant value in developing storage characterisation capacity which can be applied to other similar projects globally.

Conclusion

Given there are currently no large scale CCS projects operational in developing countries, there is a strong need to build in country knowledge and understanding both the role of CCS in delivering CO_2 mitigation but also how to operate and deploy the technology. Although the specific interventions that will be undertaken in each country will by necessity be different, each will deliver institutional capacity that is essential to creating an enabling environment and facilitating CCS deployment. The timely creation of both technical knowledge and policy frameworks will be critical to enabling CCS to be deployed at scale in each of our target countries. As such it is anticipated that this intervention will bring forward the likely timeframe for demonstration and ultimately deployment by a number of years.

FIG 2: THEORY OF CHANGE setting out how it is anticipated that ICF finance will deliver progress toward the intervention goal



Assumptions underpinning CCS Theory of Change:

- **Inputs:** ICF funds are accompanied by Norwegian and GCCSI Investment and suitable commercial and academic expertise. Norwegian and GCCSI investments total approximately $40m have been pre-committed and are certain.

- **Outputs:** Financing of capacity building will facilitate many activities, as outlined above. These activities develop the information, tools, skills, expertise and institutions of individuals, organisations, industry and governments required to implement CCS demonstration projects. By nature, exact successes cannot be specified, but these are intrinsically linked to facilitating outcomes.

- **Outcomes:** These are contingent on the assumption that the capacity building yields lessons and progress on CCS technology, there is government buy in and a pipeline to take projects forward to demonstration. Such a pipeline and buy-in has already been identified in China, Indonesia, and South Africa – for example South Africa's government sponsored roadmap, and next step which is to undertake a CO_2 test injection. (For additional detail on the pipeline please see the section above). ICF financing will also fund broader engagement with 'second tier' countries to facilitate these outcomes on a wider reach.

- **Impacts and Goal:** Contingent on successful outcomes, on small scale demonstration and capacity and knowledge, and in context with an overall global mitigation strategy to limit climate change, will lead to the establishment of the necessary policy frameworks and incentive structures to support CCS demonstration on commercial scale and ultimately the deployment.

The theory of change is built on the assumption that increased technical capacity and institutional awareness in the three target countries will enable CCS physical deployment. This assumption needs to be tested through an independent evaluation. Assumptions will need to be tested and lessons leant on how activities best facilitate the outcomes highlighted. (See Monitoring and Evaluation section on page 40 for further detail).

See annex B for the LogFrame of this project.

2 Appraisal Case

In assessing the economic case of the optimal level of support for CCS in developing countries from the ICF there are three levels of consideration:

1. The case for investment in CCS as **cost-effective and critical technology** in developing countries for mitigation and development;
2. The case for capacity building as **a feasible and appropriate level of technology support**; and
3. An assessment of the **most effective delivery mechanism/partner** to facilitate capacity building.

In this section the evidence base for these three levels of consideration are presented and considered in turn to assess the economic case for 1) an intervention related to CCS, 2) capacity building, and lastly an options appraisal based on multi-criteria analysis to consider the most effective delivery mechanism and partner.

The evidence base used to inform this analysis is subject to inherent uncertainty and limitations – in particular uncertainty in technology development and innovation results in uncertainty in forecasting abatement potential and costs to society overtime. Results presented in this evidence base are best estimates based on the suite of models available. These are based on central assumptions around exogenous factors such as GDP growth, fossil fuel prices, and carbon prices.

The benefits of capacity building are inherently difficult to quantify and measure, and the evidence base is not sufficiently granular or robust to undertake conventional cost-benefit analysis for each option and prescribe a precise level of support for CCS – but multi-criteria analysis (MCA) can suggest which options may be closest to an effective level of support and investment.

The criteria against which the different options have been evaluated are:

- **Investment leveraging potential** – an appraisal of the likelihood of other donors supporting capacity building activities being taken forward for each option;
- **Value for money** – the relative net benefits of a project per level of HMG spend, in appraising CCS capacity building this is considered as the cost-effectiveness of delivering, in particular taking into account the overheads that are associated with each option;
- **Geographical coverage of institution** – an assessment of the ability of that organisation to target key countries or regions either as defined now or in the future;
- **Capacity to disperse funds** – an assessment of the project pipeline and likelihood of finance being spent in a timely way for each funding route;
- **Potential for replication / accelerating deployment** – an assessment of the potential that a successful intervention could be replicated by that organisation / funding route either in that country or elsewhere; and
- **Risk to delivery of objectives** – an assessment of the level of risk associated with each option.

A populated MCA table is set out below. On the basis of the MCA, it is proposed that finance is channelled through both the Asian Development Bank and the World Bank. This ensures our money reaches those countries where CCS is most needed whilst at the same time ensuring impact, without incurring a high administration cost within government.

2.1 Is CCS a cost-effective and crucial technology for low carbon development?

a. Mitigation is crucial for avoiding damages and development:

The Stern Review found that the negative impact of climate change could be equivalent to a fall in global per capita consumption of 5-20% now and forever. This is as a result of adaptation costs (such as increased heating and cooling bills, and flood defences) and impacts which cannot be adapted to (such as health impacts and increased flood damages). In comparison it is estimated that the long-run costs of global action to stabilise atmospheric CO_2e and avoid catastrophic climate change to be around 1-2% of per capita consumption by 2050. Given negative impacts will be felt disproportionately in developing countries mitigation is net beneficial and pro-poor (see box below).

Africa is highly vulnerable to climate change with the areas of particular concern being water resources, agriculture, health, ecosystems and biodiversity, forestry and coastal zones. For example, a decline in rain-patterns could result in a decline in agricultural production of up to 50% by 2020 in some parts of the region, leading to exacerbated malnutrition. Climate models also show that between 75 and 250 million people are projected to be exposed to an increase of water stress due to climate change by 2020[i]. Health effects will include a rise in cholera and malaria – factors superimposed upon existing weak health systems[ii].
In the case of Latin America, climate vulnerability stems from melting of the glaciers, increased incidence of catastrophic weather events and impacted livelihoods through loss of ecosystem services. This is expected to result in a negative effect to the region's GDP of up to 18.2% by 2050, which could increase poverty by up to 3.2% (and as high as 40% in parts of Brazil)[iii]. This again points to an increased investment potential in climate resilient infrastructure; one study, for example, identifies water markets and insurance markets as being among the key growth opportunities in Latin America[iv].
Climate change poses serious risks to the economic growth, development and health and safety of all of developing Asia according to the Asian Development Bank (ADB)[v], who warn[vi] that the total economic cost of climate change threats could be equivalent to an annual loss of between 6% and 7% of these countries' GDPs by the end of the century and predicted impacts are more severe for certain regions and countries.
World Bank (WB) research predicts that poverty in India will be 3-4 percentage points higher than it would otherwise be in 2040 on account of the impact of climate change on agriculture and food process[vii]. For the last decade, Bangladesh, India, the Philippines and Vietnam have topped the list of countries facing serious climate risks, and cumulative losses as a result of natural disasters have averaged nearly $20 billion over the same period.
The cumulative impacts of climate change over the next two or three decades have the potential to reverse much of the progress made towards attainment of the Millennium Development Goals[viii].

b. <u>CCS is a critical and cost-effective technology to mitigate CO_2 emissions:</u>

A significant number of leading institutions and bodies have cited CCS as a critical and cost-effective mitigation technology:

- The joint report[2] by the International Energy Agency (IEA), the Carbon Sequestration Leadership Forum (CSLF), in co-operation with the Global CCS Institute (GCCSI) concluded that CCS is **"crucial to mitigating climate change."** CCS is needed to capture the emissions from the continued use of fossil fuels, especially in the emerging economies, and to provide a cost effective way of reducing emissions looking ahead.
- The Intergovernmental Panel on Climate Change (IPCC)[3] special report on CCS identified CCS as a critical technology to stabilise GHG emissions – concluding that **CCS could contribute 15-55% of cumulative mitigation** effort by 2100 while **reducing the costs of stabilisation by 30% or more**.

[2] IEA/CSLF (2010) Report to the Muskoka 2010 G8 Summit, prepared with the co-operation of the Global CCS Institute 'Carbon Capture and Storage, Progress and Next Steps' http://www.iea.org/index_info.asp?id=1418

[3] IPCC (2005), Carbon Dioxide Capture and Storage, http://www.ipcc.ch/publications_and_data/publications_and_data_reports.shtml

- The International Energy Agency (IEA) have undertaken detailed work based on their global energy models, on the technological and economical feasibility of cutting emissions, and **identified CCS as one of the key 17 technologies** for energy efficiency, power generation and transport that require widespread deployment if we are to achieve our greenhouse gas emission goals.[4]

IEA analysis shows that CCS will need to deliver 19% of the total greenhouse gas (GHG) emissions reductions we need to achieve in 2050 if we are to cost-effectively stabilise GHG concentrations in the atmosphere at an acceptable level. **Failure to invest in CCS would reduce the number of available low-carbon abatement opportunities and likely increase the cost of mitigation.**

IEA modelling shows that without CCS less abatement occurs at a higher cost - based on the IPCC assessment of CCS mitigation potential, **costs to achieve a 50% reduction in CO_2 emission in 2050 would increase by 70%** (equivalent to $1.28 trillion annually). Furthermore citing that CCS technologies have an advantage over other technologies in that their large scale deployment could reconcile the continued use of fossil fuels over the medium to long term with the need for deep cuts in emissions. Allowing the continued use of some fossil fuels is important as it guards against the risk of falling fossil fuel prices falling which could undermine the pricing and deployment of low carbon technologies, especially where there is no agreement on a global carbon price.[5]

There are also notable wider co-benefits from CCS for a country, including helping to underpin national energy security objectives by allowing governments to exploit indigenous fossil fuel resources, by protecting jobs associated with the fossil fuel industry, delivering air quality improvements and the creation of a small number of jobs relating to the CCS industry itself.

c. CCS must be pursed in developing countries in parallel with developed countries.

The IEA suggests that an efficient allocation of global mitigation from CCS in 2050 is 64% of mitigation to be in developing countries (only 9% would be in Europe), and of the IEA estimate of 100 CCS projects required to be operational to 2020 to achieve the necessary scale up, 50% should be in developing countries.

The IEA[6] CCS Roadmap identifies that significant additional investment of over $2.5-3 trillion from 2010 to 2050 is required in CCS globally to achieve a 50% reduction in GHG emissions by 2050 (about 6% of the overall investment needed), and that expanded international collaboration and financing for CCS demonstration in developing countries at an average annual level of $1.5-2.5bn from 2010 to 2020 is required.

Capacity building and demonstration in developing countries is crucial to build operational experience, develop regulation and explore storage potential. We **cannot rely on 'exporting' from developed countries** as it is not possible to buy a complete 'CCS solution' as power stations and industrial installations vary. CCS is at the pre-commercial stage; there are still a large number of uncertainties around its use and as such it needs to be trialled in different countries with different industries and sectors.

The risks of lock-in to high carbon infrastructure are also greatest in emerging economies where demand for fossil fuel is steadily increasing. Most future investment in new energy infrastructure are to be made in emerging economies such as India and China and engagement with CCS at an early stage will help promote its usage, and prevent emissions lock in resulting from the construction of power stations that are not suitable for CCS retrofit. Ensuring that new power infrastructure either is fitted or at the very least can be retrofitted with CCS will be critical to ensuring the costs of technology deployment do not spiral.

[4] Energy Technology Perspectives 2008 and 2010.
[5] See The Stern Review p213
[6] http://www.iea.org/papers/2009/CCS_Roadmap.pdf

It would also most likely be cheaper to demonstrate CCS in a developing country because resource and material costs are lower. For example, MacNaughton[7] (2011) found that European costs of CCS for coal fired power plants will be in a broad range, with an average of US$120/MWh, whilst the equivalent Chinese number from the NZEC study[8] is US$70/MWh - this is equivalent to a cost of avoided emissions of about $42 per tonne of CO_2. Since this report, the China Huaneng group sponsored pilot scale CO_2 capture demonstration plant at Shidongkou has provided evidence to suggest that the Chinese advantage could actually be greater – with capture costs of approximately $30/tCO_2$. It is generally estimated that capture represents some 70-75% of the overall cost of CCS. In summary there is a lot of evidence that CCS via China will be a lot less expensive than from OECD countries.

Overall the evidence in the section above presents a clear case that CO_2 mitigation is crucial for sustainable development, that CCS is a critical 'transformative' technology for CO_2 mitigation and that support for CCS in developing countries is key to retaining the option value for meeting a 2 degree stabilisation scenario cost-effectively.

2.2 What is the case for supporting capacity building?

CCS technology is currently at the pre-commercial stage. The deployment of CCS on a power plant raises the up-front capital costs and its operation delivers an ongoing energy penalty compared to conventional coal or gas energy supply. Therefore, in the **absence of a carbon price, its deployment is not commercially cost-effective**. Demonstration is essential in order to drive down costs.

Companies are unwilling to take on the full risk of paying to demonstrating the technology at scale, given the risks and uncertainties involved. It is not realistic to expect a developing country trying to ensure that its consumers have access to adequate energy to shoulder the costs of a novel technology like CCS without international support. It has been clear from experience in the UK and EU that to deliver CCS with the urgency needed, public funding is needed.

Capacity building for CCS is an appropriate level of support under the ICF. To invest in even a single demonstration plant would be a significant undertaking for the UK. The first UK competition was predicated on there being £1bn made available to support a single demonstrator and even though the costs would likely be less in a developing country, such a large allocation of finance to single objective would jeopardise the ability of the ICF portfolio of projects to meet the full range ICF stated objects and post a significant delivery risk which would be difficult to defend publically.

Supporting capacity building in given countries places them nearer the technological frontier through enabling countries to have a low cost option to demonstrate and deploy CCS, enabling a low cost option to effectively mitigate in future and thus making them more competitive in a carbon constrained world.

For example, Mott MacDonald (2009) assumed that it was unlikely to be either economically viable or technically feasible to retrofit CCS technologies to plants in India that had not been designed as CCS Ready. The report estimated that the capital costs of preparing a plant as capture-ready (a design compatible with the later retrofit of CCS technologies) would be in the region of 1% of reference plant CapEx for a 4,000 MW plant, with the key additional cost elements being local studies, design time and balance of plant.

[7] http://www.ukccsc.co.uk/Meetings/industry-readiness-June-2011/04_MacNaughton_CCS_costs_as_presented.pdf -

[8] NZEC, 2009. China-UK Near Zero Emissions Coal Initiative: Summary Report
The NZEC study noted that the more promising, near term options are post-combustion capture in a state of the art Pulverised Coal power plant and pre-combustion capture in an Integrated Gasification Combined Cycle unit. Under Chinese conditions, the cost of electricity generation (which takes into account capital and operating costs and assumes a storage site 200km from the power plant) would be 470 RMB (~US$70) per MWh for both types of plant (within the uncertainties of such estimates). On this basis, either of these capture options together with the transport and storage of the CO_2 would increase the cost of electricity generation by around 200 RMB (~US$30) per MWh compared with a Pulverised Coal power plant without CCS.

Therefore, whilst capacity building is not in itself going to directly result in investment in CCS technology in the near term the intervention provides a platform to ensure developing countries do not construct expensive power generation facilities that risk becoming stranded assets under a global climate framework or locking in significant emissions for the future lifetime of the plant (potentially 40 years). Each plant designed as CCS Ready would essentially retain the option value of later CCS retrofit, potentially lowering the risk of stranded assets/prolonging the operational life, and potentially reducing the costs of future mitigation.

There are however risks that capacity building does not enable further deployment of CCS - either in failure of this specific intervention, or the lack of a conducive environment for investing in CCS in future. In which case there will be no benefits from this capacity building projects – but provided the capacity building itself is successful it remains as an option value.

2.3 What are the feasible options that address the need set out in the Strategic case?

The following options are based on the assumption that the case for change and need for an intervention as set out in the Strategic case can be defended and that the logic that underpins the selection of China, Indonesia and South Africa and supported by a wider outreach programme is endorsed.

Option	Description	ICF Funds
BAU	**Do nothing**	**N/A**
A	**Contribute to the CCS funding windows of multilateral development banks**	**£60m**
A1	**Contribute funding to the ADB only**	**£38m**
A2	**Contribute funding to the World Bank only**	**£60m**
B	**Fund bilateral or plurilateral project interventions directly**	**Not known**
C	**Direct finance through a combination of direct bilateral interventions and interventions through MDBs**	**£60m**

The volume of finance proposed for this intervention is based on research undertaken by a consultant and commissioned to inform the development of this Business Case. The figures are derived from indicative costing relating to a pipeline of projects that have been identified in key countries and the proposed split of funds per country is included in the Summary Report provided to DECC by Andalin Consulting.

The variance in the level of financing to be provided (as set out in the table above) reflects the changes in the scale and breadth of the intervention rather than changes in value for money criteria. Whilst it would be possible to undertake a programme of capacity building using a smaller quantum of funding, to do so would either reduce the likelihood of securing progress against the goal (set out in the Theory of Change above) or necessitate a reduction in the number of countries that we are engaging with.

'BAU': Do nothing / Business as Usual Counterfactual - Make no CCS interventions

Currently levels of financial support for CCS in developing countries are low – to date only $40m has been mobilised. This is significantly below the IEA[9] CCS Roadmap estimate that expanded international collaboration and financing for CCS demonstration in developing countries is required at an average annual level of USD 1.5 to 2.5 billion from 2010 to 2020. In addition in the current economic climate limited additional donor funding is expected to come forward on the urgent timescales required to mitigate.

[9] http://www.iea.org/papers/2009/CCS_Roadmap.pdf

As discussed earlier, CCS is the only technology available to abate the emissions from the huge projected growth in fossil fuel powered generation capacity in China, Indonesia and South Africa and will only be deployed if sufficient pre-investment work is undertaken. The business as usual scenario in terms of CCS deployment, will be for developing countries to wait until the technology has been demonstrated and deployed in developed countries prior to investing in their own CCS industry. This is the likely scenario if the described intervention is not made, and will lead to a lengthy delay in the final deployment of CCS resulting in significant CO_2 emissions remaining unabated.

The counterfactual case for an intervention in CCS in developing countries would be to do 'nothing on CCS' – and assume no advance by others. Hence the below MCA assesses the effectiveness of the options relative to no investment in the near term.

There is also an opportunity cost to HMG, as the ICF funds (from the total £2.9bn budget) could be spent on other projects. Alternatives for Low Carbon Development spend could include investing in other low emissions generation technologies such as wind, geothermal or solar power, or through funds such as the WB Clean Technology Fund. Such an intervention would most likely focus on capital deployment and lead to near term quantifiable emissions reductions, energy poverty alleviation and job creation. It is difficult to draw a direct comparison between the two as an investment in CCS is a longer term prospect (hence comparisons are not made).

For the purpose of informing a high-level comparison of whether capacity building is a suitable trade-off of against immediate benefits;

- taking expected results from the CTF as a benchmark, £38-60m of public funds could lead to illustrative GHG emission savings in the region of 1.8 to 2.9 $MtCO_2e$ from range of renewable and energy efficiency projects, and leverage in around £6.5 of co-financing per £1 of UK investment.
- If CCS capacity building were to lead to deployment of a single commercial scale CCS demonstration on a 1GW power plant then, for illustration, this would contribute annual emission savings in the region of 5 $MtCO_2$[10].

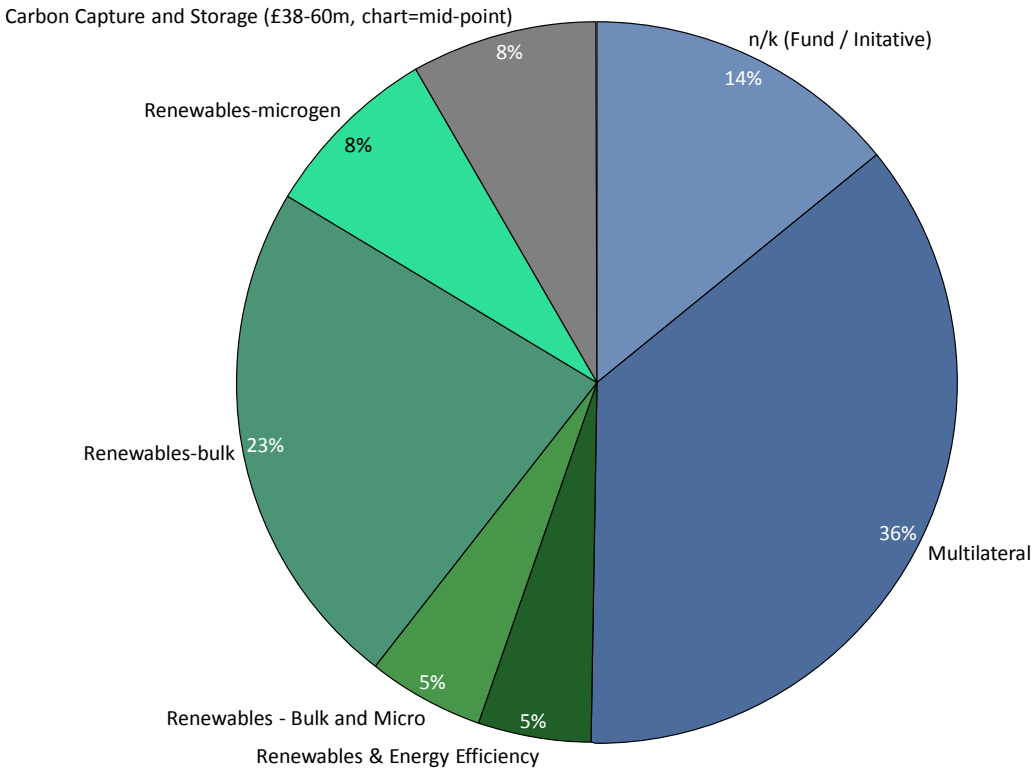
It is also important to note that investment in CCS helps to diversify the ICF portfolio – and meets a key ICF objective of innovative and transformative investments.
To date:

- Of approved and upcoming ICF LCD bilateral projects in the pipeline to date, almost all spend is concentrated on energy supply projects – largely renewables.
- Around 50% of LCD projects are delivered through multilateral projects and funds and initiatives where by nature we cannot forecast the exact mix of technologies that will be taken up. Whilst we anticipate that significant spend in low carbon power generation – this is very unlikely to be in CCS – and will also include investments in upstream technologies, energy efficiency and transport.

As such investment in CCS would significantly diversify the portfolio compared to investing in other renewable technologies which are already significantly represented – a £38-60m investment in CCS could represent 7-10% of the existing LCD portfolio to date, and 1-2% of the overall ICF budget.

Figure 3: Technology Split of existing ICF LCF portfolio of approved and pipeline projects

[10] This is based on an the assumption that the plant uses UltraSuperCritical (USC) technologies, burns bituminous coal with resulting emissions of 790g/kWh, does not burn biomass and has a capture efficiency of 90%



A. Contribute to the CCS trust funds operated by multilateral development banks

The first feasible option for addressing the needs set out in the strategic case would be to provide finance for the CCS activities of MDBs active in the target countries with strict stipulations on the direction and governance of its expenditure. The Asian Development Bank (ADB) has an existing CCS window and a pipeline of projects in both China and Indonesia which broadly address the needs set out in the strategic case along with a programme of outreach to other South East Asian nations. There is also an existing relationship between the World Bank CCS Trust Fund and the South African CCS industry which would provide a useful channel for funding the work of the South African Centre for CCS (SACCCS).

The ADB pipeline of projects in China seek to demonstrate and increase the domestic capabilities for CO_2 capture, and offer an opportunity to mount the argument for full chain CCS. As set out in the strategic case, the primary focus for intervention in China should be to change the focus of the Government from CO_2 capture only for EOR and other utilisation to the full CO_2 capture and storage chain with utilisation only a means to the end of permanent geo-sequestration.

The provision of support for the ADB activities also avoids initiating new programmes in China, which risk overlapping existing work. The ADB has an existing pipeline of CCS projects, which have Government buy-in –an important factor in the success of projects in China. The existing engagement with the Chinese Government removes the need for negotiating the politics of the complex Chinese administrative architecture.

The ADB has also been working closely with the Indonesian Government in developing their CCS development agenda. The CCS industry in Indonesia is not as advanced as in China which is reflected in the ADB pipeline of projects for Indonesia. The ADB has a strong relationship with the Indonesian Government and as trusted advisor is capable of influencing the shape and direction of the deployment of CCS in Indonesia. The ADB engagement with the Government on CCS would ensure a certain level of Indonesian buy in to their programme of activities, and also provide an avenue for the UK to exercise influence over the future CCS direction.

The ADB is a proven and effective delivery partner, which was reflected in the high ratings the Multilateral Aid Review (MAR) gave the ADF (the ADB major loans and grants programme). Investing in the ADB pipeline of projects diversifies the project risk facing HMG as it spreads the intervention across a variety of projects. It also allows a greater degree of flexibility as funding can be redirected to other projects if a single project is at risk. The ADB also offers a strong value for money proposition as it charges administrative fees of 2% for capital support and 5% for administering technical assistance, but would remove the administrative burden of monitoring and verification from HMG.

The South African Ministry of Energy and the South African Centre for CCS (SACCCS) has been established with a clear mandate to coordinate the development of CCS in South Africa, and has been consulting with the World Bank on CCS, and as such offers the best MDB financing channel for interventions. The SACCCS has a clear roadmap of CCS projects which demonstrate a clear pathway to commercial deployment. ICF finance through the World Bank Trust Fund is a good conduit for intervention in to the SACCCS work programme.

The World Bank has an existing CCS project in South Africa and an existing relationship with both the Government and the SACCCS. There has been some sensitivity in the past over the World Bank's approach which at times was seen to impose its approach without much tailoring to local priorities; however the SACCCS and the Ministry of Energy are both engaged with the World Bank on CCS so this should not present a material risk. The World Bank CCS Trust Fund levies a 10% administration fee on all its projects and therefore does not present as strong cost-effectiveness delivery proposition as the ADB, however the 10% must be weighed against the increased risk associated with either operating bilaterally with inherently higher costs falling to HMG to ensure compliance or the potential climate impact of failing to engage with South Africa.

The administrative burden on DECC of implementing and monitoring interventions would be significantly reduced if funding were to be allocated through existing MDB Trust Funds as this would capitalise on the resources and expertise of the MDBs in administering projects.

A1. Contribute funding to the ADB only

One option would be to channel all interventions through the ADB. The Multilateral Aid Review identified the ADB as a highly credible delivery partner. The ADB has a strong record of engagement and delivery in both China and Indonesia. The ADB pipeline of projects in both China and Indonesia demonstrate a capacity to utilise a significant investment within their existing scope of projects and in new interventions.

The ADB charges administrative fees on all monies that pass through the CCS Trust Fund at a rate of 2% for capital support and 5% for administering technical assistance. However, these costs would in some way be offset by a reduction in the administrative burden of monitoring and verification from HMG.

Due to the regional remit of the ADB, it would not be able to administer funds or projects in South Africa and as such interventions would be limited to China and Indonesia with broader capacity building activities across the rest of South East Asia.

A2. Contribute funding to the World Bank only

The entire ICF investment could be channelled through the World Bank CCS Trust Fund with specific direction on the countries and projects to be targeted. The World Bank is an experienced delivery partner in CCS, and has an ongoing relationship with the SACCCS.

The World Bank does not have as a strong a presence in the CCS space in China and Indonesia, and as such would be unlikely to deliver as efficiently, effectively or rapidly as the ADB in these jurisdictions.

The World Bank does not enjoy the same level of buy in from the Chinese and Indonesian Governments on CCS, but this is likely to be due to a lack of engagement and not any institutional

risk. The World Bank remains an active and trusted body in Asia and would be able to constructively engage, however, it would be doing so from a 'lower' base than the ADB.

B. Fund bilateral or plurilateral project interventions directly

This option would see finance provided directly to partner agencies or departments on a project-by-project basis. This approach would ensure a more focused design and targeting of the interventions toward HMG priorities with potential reward in terms of value for money; but would also entail a greater level of risk and a much larger administrative burden for DECC.

There is a wide range of existing projects in China which could be supported on a bilateral or plurilateral basis. These range from existing capacity building and technological assistance programmes to commercial scale demonstration programmes. One option for an intervention in a commercial scale project would be to provide a further contribution to the second phase of the NZEC project. While this approach may strengthen the level of HMG control over the intervention, the administrative burden associated with NZEC has always been sizeable and would present an added administrative cost. As set out in the strategic case there is a need for a significant programme of technical assistance in China to investigate storage opportunities and to quantify the potential of EOR. These smaller scale and novel projects would require significant lead time in negotiating their terms through the Government and developing a monitoring and verification process. There is also a risk of duplicating or overlapping existing efforts when developing novel small scale technical assistance interventions.

The project risks associated with direct bilateral interventions is greater than that arising from investments through the MDB CCS windows due to the relative lack of diversification. In the case of China, these risks can be somewhat mitigated through securing Government buy in to projects in order to harness the significant weight of political will. The volume of projects in China which are potential targets of interventions gives some flexibility in terms of responding to failing projects; however not to the extent that the ADB would offer. There are few implications for the extent of HMG influence in projects when compared to the MDB case as the agenda will largely be determined by the Chinese Government in both instances.

The support for CCS in Indonesia could be provided through a series of specific interventions in existing and novel capacity building projects. CCS in Indonesia is quite immature and as such activity needs to focus on creating the political and governmental will and capacity to move towards deployment. A number of organisations, including the ADB, have been working closely with the Indonesian Government to develop this capacity, and any intervention in this area would need to be designed in close collaboration to avoid duplication or cross-cutting messaging.

Interventions in South Africa would be provided as bilateral contributions to the SACCCS. The SACCCS has also developed a clear roadmap of activities, starting with storage assessment and capacity building activities and moving towards a test injection, making a clear and strategic case for a direct intervention. The SACCCS is an agency under the South Africa National Energy Development Institute (SANEDI) which reports to the South Africa Energy Minister, but has not yet been in existence long enough to establish a strong record as a delivery partner.

There is significant increase in the risk associated with projects in South Africa if the SACCCS is engaged directly as a delivery partner due to their lack of experience. There is likely to be a much stronger Government buy in to projects however, as direct interventions may be seen as less intrusive by the host country than those made by the World Bank. The value for money proposition may be improved through this direct approach as it avoids the 10% administrative levy of the World Bank, however this would need to be weighed against the added cost of HMG ensuring compliance.

Direct interventions allow for clear and targeted support for the domestic priorities of target countries, but increase the risk that HMG incur a legal or financial liability and as a consequence require a more complex system of monitoring and governance. Direct funding of bilateral projects would increase the visibility of the UK's role in the interventions and also enable HMG to ensure that the expertise and experience of the UK CCS industry was best utilised in projects and therefore bringing benefits to both the UK and target countries. The risks associated with any direct intervention will need to be assessed on a case by case basis.

C. Direct finance through a combination of direct bilateral interventions and interventions through MDBs

A hybrid approach would be to split funding between direct bilateral interventions and contributions to MDB CCS programmes. This approach would capitalise on both the opportunities to support large scale projects and the organisational capacity of the MDBs to conduct technical assistance (TA) and execute their pipeline of projects.

In China, a portion of the ICF finance could support the critical large scale demonstration programs such as NZEC or the project being developed by the Australian Government with the NEA directly; and the other portion to contribute to the ADB CCS agenda in China. Any interventions to establish new projects or initiatives would necessitate a significant effort in securing Government buy in, as securing administrative support can be a long and complex process.

The majority of the intervention into Indonesia would still be channelled through the ADB CCS window to support their ongoing activities which closely align with those needed to address the needs set out in the strategic case. There would then also be an opportunity for a number of independent technical assistance and capacity building interventions.

Interventions in South Africa would be made through both the World Bank's CCS Trust Fund and direct support to the SACCCS. The World Bank is a trusted and reputable delivery partner currently engaging on CCS in South Africa and as such provides a lower risk channel for interventions, but these could be supported by direct interventions on specific SACCS activities. The direct intervention into the SACCCS presents a notable institutional risk as it remains an unproven delivery partner. It is worth noting that this option does not provide any further flexibility as the work programme will be determined by the SACCCS in consultation with DECC regardless of the delivery partner. It would however provide a higher level of Government buy in as they will feel freer to drive in accordance with their regionalisation policy.

Predominantly, the risks and benefits associated with this blended response reflect a proportional blend of the risks and benefits associated with the two single avenue approaches. As mentioned above, specific consideration will need to be given to the risks to HMG associated with any legal or financial liability arising from bilateral engagement.

Conclusions

The multi-criteria analysis (MCA) set out at Table 1 below, attempts to allow comparison of each of the above options for delivering ICF spend.

After considering all options, we propose to fund £60 million from the International Climate Fund (ICF) to CCS Trust Funds operated by MBDs. We will channel £35m and £25m respectively to Asian Development Bank and World Bank Trust Funds to support CCS capacity building projects in developing countries – primarily in China, Indonesia and South Africa.

TABLE 1: MULTICRITERIA ANALYSIS ASSESSMENT OF THE BEST VEHICLE FOR ICF SPEND						
	Investment leveraging potential	**Value for money**	**Geographic coverage of institution**	**Capacity of institution to disperse funds**	**Potential for replication/ accelerating deployment**	**Risk to delivery of objectives**
Bilateral	Moderate – It is more difficult to attract third party investment to individual bilateral projects than broad CCS funding windows.	Moderate – imposes significant administrative and monitoring burden on HMG	Strong – theoretically the reach extends to all countries with a strong working relationship with the UK. However current approach is piecemeal and each intervention has high transaction costs.	Weak – HMG is participating in a small number of projects in developing countries, however this would need to be significantly increased to facilitate the proposed level of intervention	Strong – HMG can ensure that non-proprietary knowledge developed in projects can be shared with other projects and proponents	Strong – Individual bilateral interventions are likely to involve partnerships with less experienced organisations or those without a strong track record of performance. The risk is also concentrated in projects and not spread across a pipeline, and both legal and financial risks rest largely with HMG as the primary funder.
ADB	Strong – The ADB CCS window has already attracted significant investment from the Global CCS Institute in its pipeline of projects.	Strong – 2 to 5% administrative fees and removes administrative burden from HMG	Strong – Strong relationships with Governments across Asia including many potential CCS intervention targets. Excludes South Africa	Strong – ADB have pipelines of projects in various stages of implementation in a number of potential target countries. Very strong capacity to	Strong – Project knowledge will be applied to other projects in the pipeline, and replicated in similar pipelines in other	Weak – Strong relationships with Governments in target countries and proven experience of delivery in CCS capacity building.

			and other non-Asian priority nations.	utilise funding	target countries	Also diversifies risk both across projects and across funders
World Bank	Strong – Norway and the GCCSI have invested in a pipeline of projects, but investments to date have not exclusively focused on priority countries. Capacity to attract further contributions from developed countries in all regions.	Moderate – levies 10% of investment for management costs, but removes administrative burden from HMG	Strong – Global reach and experience in delivering projects in developing countries	Strong – Global pipeline of CCS projects, but some investment has been targeted at non-priority countries. Strong capacity to utilise funding	Strong – Project knowledge will be applied to other projects in the pipeline, and replicated in similar pipelines in other target countries	Weak– proven experience in delivery of CCS projects and capacity building. Also diversifies risk both across projects and across funders. Some anecdotal accounts of less effective government engagement on CCS.
Blended approach – bilateral and MDBs	Uncertain – Depends on the composition of above elements	Uncertain – Depends on the composition of above elements	Strong – able to leverage MDB and HMG networks and experience to deliver optimal results	Uncertain – Depends on the composition of intervention blend	Strong – HMG can ensure that all projects contribute either to the global body of knowledge or will be carried through the pipeline of projects	Uncertain – Depends on composition of intervention blend. The extent of any risk will need to be assessed on a case by case basis. Direct interventions will by necessity require greater management resource (including legal)

3 Commercial Case

Indirect procurement

3.1 Value for money through procurement

The two Trust Funds are operated by MDBs and therefore follow the MDBs' procurement policies and procedures. As both the ADB CCS Trust Fund and WB CCS Trust Fund are small they were not subject to any particular scrutiny process in the MAR (Multilateral Aid Review) and both are operated in a manner consistent with general bank practices. Key findings of the MAR related to the relevant MDB's approach to procurement, in terms of whether procurement is driven by cost control, targets for procurement savings, and monitoring and reporting on prices, are summarised below.

Overall, the MDB (Multinational Development Bank) approach to procurement aims to ensure open and fair competition in all tenders, to procure high quality goods and services at the lowest cost. Procurement of goods and services goes through International Competitive Bidding (with limited exceptions) and as such it will in most cases be possible for UK contractors to bid to provide services. The MAR, however, notes that these procurement procedures are criticised by recipients and donors for their imposition of high transaction costs, delays, and uncompetitive prices.

We are content that measures are being taken by the MDBs to address concerns, for example, the World Bank has begun a review of its procurement policies and practices to address these concerns and better align procurement with the World Bank's development objectives. This includes around the possibilities of using country systems to lower transactions costs and avoid duplications, which is dependent upon robust, rigorous systems that meet international standards being in place.

In addition to the findings of the MAR, we have carried out a Delivery Partner Review of both the ADB and World Bank which incorporates some assessment of the social and environmental practices under which they operate.

Asian Development Bank (ADB)
ADB has restrictions on procurement from non-member countries; this constrains its ability somewhat to pursue economy and efficiency. The ADB requires implementing partners undertake and internationally competitive bidding process for all procurement, however it does provide for procurement of domestic goods and services in certain circumstances through the domestic preference scheme. Procurement procedures are criticised by recipients and donors for imposing high transaction costs, delays and uncompetitive prices.

The ADB procurement process revolves around the procurement plan developed by the implementing partner and agreed by the ADB, which outlines the goods, works and services for at least the first 18 month of the project and is updated annually or more regularly if needed.

World Bank Group
World Bank procurement policy is driven by "economy and efficiency" as outlined by their Articles of Agreement. In IDA, international competitive bidding is used for all contracts (with exceptions only if the nature of the procured goods or services, or the size of the country, justifies them). There is anecdotal evidence that IDA contract prices are higher than contracts elsewhere, but IDA does not monitor the impact of its procurement on local market prices. In the IFC, competitive procurement is mandatory for all operational procurement above $50K and must be advertised. In order to further assure value for money, certain steps are required for procurement above specified threshold values. IFC is implementing a new, mandatory, web-based procurement tool (eConsultant2), which will further ensure compliance. IFC has also introduced a number of sustainability measures into its procurement policy, such as green office design criteria for country office construction.

The World Bank CCS Trust Fund (WB TF) procurement process provides a balance between ensuring good governance and preventing corruption and allowing the in-country implementing partner the space to capitalise on and develop local capacity. Under the terms of the Project Concept

Note (PCN), developed by the implementing partner and the World Bank and reviewed by the donor, the implementing partner develops a procurement plan for equipment and services. The World Bank reviews the plan and then either provides no objection or feedback if there are any issues. The implementing partner then produces Requests For Proposals which are also reviewed by the World Bank, which issues either a no objection response or provides feedback. The implementing partner then undertakes the procurement process as defined in the plan and presents a Bid Evaluation Report (BER) to the World Bank, which again either issues feedback or a no objection response.
Throughout this process the World Bank monitors for any suspected corruption, which if detected, is investigated by the internal team of procurement specialists.

There is considerable oversight and scrutiny of World Bank procurement operations; around 5% of procurement operations are reviewed internally and a smaller amount of operations go to external review every year. The World Bank has begun a review of its procurement policies and practices to address concerns and better align procurement with the World Bank's development objectives.

4 Financial case

4.1 What are the costs, how are they profiled and how will you ensure accurate forecasting?

The UK will provide a total of £60 million to support the accelerated development and deployment of CCS in developing countries over FY 2012-13 & 2013-14 - £35m to the ADB Trust Fund and £25m to the World Bank CCS Trust Fund. The funds will come from the £2.9bn International Climate Fund which is made up from a combination of capital and resource funding. The figure of £60m is broadly consistent with a known pipeline of projects that are being developed by the partner organisations.

The volume of finance proposed for this intervention is based on a research undertaken by Dr Andrew Minchener of Andalin Consulting to inform the development of this Business Case. In preparing the report, Dr Minchener took a bottom up approach to determining the volume of finance required to support capacity building projects in developing counties.

A total of £35m of RDEL finance will be disbursed in 2012/13 and 2013/14 fiscal years and £25m of CDEL finance will be disbursed in 2012/13. Though the intervention focuses on the delivery of capacity building activities, there will by necessity be capital investments made to facilitate this. For example, to support the delivery of a CO_2 test injection in South Africa dedicated plant will need to be purchased. It is anticipated that the capital assets will remain in country post the conclusion of the work.

Both the ADB and World Bank Trust Funds charge a management fee. For the ADB, this equates to 2% on capital investments and 5% for technical assistance. For the World Bank, the management fee is 10%.

The proposed spend profile for this intervention is set out below:

	DECC Spend		DECC Spend	
Recipient	**2012/13 (£m)**	**% CDEL**	**2013/14 (£m)**	**% CDEL**
WB	14.9	67%	10.1	0%
ADB	35	43%	-	-

The contribution is a fixed contribution. No additional finance will be required and our contribution will not involve contingent liabilities.

The management of this contribution will require oversight from the DECC project team in order to ensure that the projects chosen maximise value for money for the UK. As set out in Section B of the management case, this is estimated to be 0.5 FTE staff time (i.e. 0.4 FTE SEO & 0.1 FTE Grade 7) for the life of the intervention. The SEO will be responsible for day-to-day project management through engaging delivery partners and scrutinising financial and activity reporting. The Grade 6 will engage at strategic points in the project including bi-annual World Bank CCS Trust Fund Steering Committee meetings and six-monthly review meetings with the ADB CCS Trust Fund team. Existing DECC admin resource can accommodate this requirement.

4.2 How will it be funded: capital/programme/admin?

The funds will come from the £2.9bn International Climate Fund. The contribution will be split across two years with two delivery partners, and will be 58% resource and 42% capital. This split will enable delivery partners to undertake project investment activities once necessary host country knowledge has been developed.

The administrative resource required will come from existing and agreed DECC budgets. No additional allocation is required.

4.3 How will funds be paid out?

A promissory note (PN) signed on behalf of DFID or DECC is an irrevocable undertaking by HM Government to provide to the named beneficiary any amount up to the specified limit that the beneficiary may demand, at any time. The department lodges the promissory note with a depository (The Bank of England) who is instructed to make payment of any such amount demanded by the beneficiary from the department's Bank of England Promissory Note Account.

Although promissory notes stipulate that the amount concerned, or any part of it, is payable on demand, prior to issuing the PN we will sign a Channel Financing Agreement with each of the MDB partners, agreeing a payment schedule in writing. The schedule sets out the amounts and dates of the payments that the beneficiary will request.

Paying funds via a contribution arrangement and promissory note is the standard means for Government to fund multilateral institutions. It enables us to deliver finance on the basis of need, provide certainty for the recipient, while also enabling manageable accounting process for such a large volume of funds. The promissory note is non-interest bearing and non-negotiable.

4.4 How will expenditure be monitored, reported, and accounted for?

All spend will be monitored by the DECC project team and specifically the project manager in accordance with wider ICF protocols.

The UK will provide £60m of finance from the International Climate Fund (ICF) to trust funds operated by the World Bank and Asian Development Bank. Both the ADB and World Bank have robust procedures in place for tracking expenditure and comprehensive protocols to ensure funds are not misappropriated. Regular reports are produced for donors to illustrate how and where funds are being used, illustrating how and where donor money has leveraged further investment and how it has been used to deliver against agreed objectives.

5 Management Case

5.1 Oversight

Both Trust Funds have been established specifically to accelerate the physical deployment of carbon capture and storage demonstration projects and facilitate the inclusion of carbon capture and storage in national low carbon growth strategies. Both the World Bank and Asian Development Bank have provided a wealth of information to DECC as part of a Delivery Partner Review (DPR) process. As such, DECC is satisfied that the financial vehicles operate in a manner consistent with HMG requirements to mitigate risk against programme objectives and ensure financial propriety. The key staff of both the World Bank (International Bank of Reconstruction and Development / International Development Association arms) and Asian Development Bank are well known and are trusted and respected partners. Both organisations actively engage in meetings and with platforms working to create broader political momentum for the development and deployment of CCS as well as taking forward a programme of project interventions using existing ODA spend in those countries where they perceive potential to ensure progress against core objectives. As an example, the ADB recently produced a paper calling on the governments of developed countries to initiate a new, dedicated CCS fund to support capacity building and CCS demonstration activities in developing countries.

Both the World Bank and ADB funds are managed using matrix management drawing on staff expertise from across the respective institutions. As a consequence it is not possible to include team organograms here.

The ADB fund is managed by the ADB's Regional and Sustainable Development Department in consultation with the Interdepartmental energy sector community of practice and the operations Directors with responsibility for clean energy projects. A clean energy working group (CWEG) has been established to oversee the day to day operations of the fund and to make policy recommendations regarding the strategic direction of the Fund. The ADB's Office of Cofinancing Operations facilitates contributions to the fund. Donors have an opportunity to shape the activity taken forward by the Fund by ensuring that the project selection criteria used by the Fund reflect donor priorities. The ADB produce a biannual report at the level of their Clean Energy Partnership Facility (of which the CCS Trust Fund forms a component part) with details of both activities and financial accounts.

The World Bank CCS Trust Fund is governed by a Steering Committee (SC) and managed by the Carbon Finance Unit and Energy Unit of the World Bank's Sustainable Development Vice Presidency. Any donation in excess of $1m gives the donor two representatives on the SC. The SC meets twice a year and serves the function of providing strategic direction on the operation of the Trust Fund and also proposing project activities that might be undertaken. In 2010 the World Bank held over $11bn in Trust Funds and produces an Annual Report on the operation of the funds. In addition, the Bank provides Donors with an annual report on the progress of activities financed through the CCS Trust Fund. To date Norway and the Global Carbon Capture and Storage Institute have been the only donors to capitalise the Fund and therefore the UK would have considerable ability to shape the forward work programme. The Activity Identification approach that has been established by the Bank to help ensure projects deliver tangible results is broadly consistent with UK priorities.

5.2 Management

The Senior Reporting Officer for this project will be Director, International Climate Change.

The Project Manager will be an SEO in the International Climate Policy and Finance team.

The Project Manager will be overseen by the Head of International Climate Fund Project Development (Africa and Asia) (Grade 7) who reports to the Head, International Climate Policy and Finance (SCS PB 1).

The Project Manager will draw on expertise from the UK's Office for Carbon Capture and Storage based in DECC to maximise value for money of proposed investments and to share learning from the UK's domestic CCS programme.

The Project Manager will allocate 0.4 FTE to the project. The resource requirements for the project may decline in later years as the project (and supporting systems and processes) is established.

The Project Manager will responsible for:

- day-to-day management and liaison with delivery partners (WB and ADB Trust Fund teams, the South African Centre for CCS and other donors);
- scrutinising regular financial and progress reporting from delivery partners;
- carrying out six monthly progress meetings with the ADB CCS Trust Fund team;
- representing the UK on the bi-annual World Bank CCS Trust Fund Steering Committee;
- engaging with other donors to mobilise additional funding for CCS activity in developing countries to improve the UK's burden share;
- producing Annual Reviews on the project for the ICF Programme Management office;
- updating the monthly ICF programme management reporting tool on the project for the DECC ICF Programme Management office which involves updating the project's financial forecast, milestone tracking and a risk register;
- escalating issues and risks to the Head of the International Low Carbon Technology team and highlighting any concerns with project delivery.

The Head of International Climate Fund Project Development (Africa and Asia) will allocate 0.1 FTE to the management of the project, including:

- representing the UK at bi-annual World Bank CCS Trust Fund Steering Committee meetings to ensure appropriate oversight of UK funds;
- participating in bi-annual project review meetings with the ADB CCS Trust Fund team, arranged by the Project Manager;
- regular monthly review meetings with the Project Manager to oversee the project.

5.3 Conditionality

There is no conditionality to the funds. Further finance could be made available if this was assessed as an area of continuing importance. However, any bid would be assessed on the basis of its own merit.

5.4 How will progress and results be monitored, measured and evaluated?

At this stage the precise nature and number of the capacity building activities in each country cannot be specified since it will be decided in common with the beneficiaries and the MDBs. However, based on the theory of change we have a clear idea what we want to evaluate and what data is needed to provide evidence on the effects of our contribution.

The monitoring strategy for this intervention will rely upon the provision of regular financial and non-financial reporting by delivery partner organisations in combination with publically available information. Assessment will be in line with the Theory of Change on p13 of the Strategic Case.

The monitoring strategy will be consistent with the emerging ICF Results Framework. The intervention will report on the relevant Key Performance Indicators, which are predominately directly attributable output indicators. Many of these 15 KPIs are not directly applicable to CCS capacity building, but the following are of relevance:

- Number of technologies supported – this will assess the number of test demonstrations directly financed from ICF funds
- Number of direct jobs created – this will reflect the job opportunities created directly through capacity building activities

- Volume of finance, public and private, leveraged (reported separately)
- Level of institutional knowledge or awareness of climate change issues as a result of ICF support (qualitative assessment)
- Level of integration of climate change in national planning as a result of ICF support (qualitative assessment)
- Degree to which the intervention is 'transformational' (qualitative assessment)

Given the innovative nature of CCS and the limited finance in supporting CCS to date the expectation is that many of these indicators will start from a zero baseline. In addition to the KPIs, this project will also report on a series of indicators of specific relevance to the project drawing on the MDB reporting.

Both the ADB and World Bank produce regular reports setting out the activities supported by Trust Fund monies and including financial statements. These reports will be made available to the UK Government in order to demonstrate that funds are not being misappropriated and are being spent in a manner consistent with donor expectation. The production of reports will also facilitate ongoing performance review.

The Role of Evaluation:

A formative evaluation will prove useful to launch in the middle of the programme to inform us how to improve it and give an insight on what works best in each national context.[11] To assess the effects of UK finance, the evaluation questions will analyse the following:

- increased knowledge amongst governments, academe and civil society of the role and relevance of CCS in enabling fossil fuels to be used to supply power sustainably
- increased investment of developing country finance in CCS initiatives and research
- increased attention given to the development of policy frameworks to support CCS in developing countries
- increased level of commercial activity relating to CCS in key markets
- increased investment from other donor countries to support the development and deployment of CCS in developing countries

To avoid duplication with monitoring and evaluation activities of the two MDBs, we will coordinate with the MDBs on their evaluation activities planned and take part in a joint evaluation.

Key short term and long term milestones

The table below sets out the key near term milestones associated with the project as well as detailing activities associated with the longer term administration of the funds:

Key Milestone	Completion Date
DECC Ministers to formally announce the UK's contribution to both the ADB and WB Trust Funds at the Clean Energy Ministerial	April 2012
DECC to review Project Selection Criteria and priority countries for both ADB and World Bank CCS Trust Funds to ensure these meet HMG objectives and ambitions	April 2012
DECC ICF Programme Management Office to commission detailed Delivery Partner Review of South African Centre for CCS (SACCCS) from external financial experts	July 2012
DECC SRO to sign Memorandum of Understanding on Channel Financing for the ADB CCS Trust Fund	December 2012
DECC SRO to sign the Trust Fund Administration Agreement with the WB for the CCS Trust Fund	December 2012
DECC to formally lodge 2 Promissory Notes with the Bank of England for the UK contribution to both Trust Funds	December 2012

[11] Note that the exact budget of an evaluation could not be forecast precisely in advance before having a clear idea of the project activities. As a general benchmark a minimum 1% of programme funding should be devoted to monitoring and evaluation.

DECC to attend the ADB Annual Donor Consultation meeting	March 2013
DECC to be represented on the annual WB CCS Trust Fund Steering Committee	April 2013
DECC Project Manager to undertake six-monthly formal review	September 2013
DECC to receive externally audited financial statements from ADB and WB on eligible activities and administrative expenses on Trust Fund records and accounts	April 2014
DECC to attend annual donor meetings arranged by the WB and ADB	March/April 2014
DECC Project Manager to complete Project Annual Review	April 2014
DECC Project Manager to undertake six-monthly formal review	September 2014
DECC to receive externally audited financial statements from ADB and WB on eligible activities and administrative expenses on Trust Fund records and accounts	April 2015
DECC to attend annual donor meetings arranged by the WB and ADB	March/April 2014
DECC Project Manager to complete annual review	April 2015

The table above goes out until 2015. However, it is expected that engagement with the relevant administrators of each Trust Fund will continue until such time as all monies have been disbursed. The schedule for delivery of meetings and reports will be agreed with the respective institutions and other donors if support for this intervention is agreed.

There are some regular milestones / activities that have not been included in the table above. These include:

- current financial information on the World Bank's CCS Trust Fund relating to receipts, disbursements and fund balance in the holding currency of the Trust Fund with respect to the Contributions via the World Bank's Trust Funds Donor Center secure website;
- regular monthly programme reporting to the DECC ICF Programme Management office

5.5 Risk assessment

The main risks associated with the proposed intervention are set out in the table below:

Risk Register: Description of Risks, proposed mitigation action and Responsible Owner
1. Delay to delivery of project outputs – programmes stall due to lack of either recipient country /MDB capacity or expertise
Mitigated by: a. DPR process determines that MDB partners have sufficient resource available to manage proposed projects and funds and that a lack of internal resource will not delay delivery. b. The decision to channel funds to two MDBs, towards multiple countries and a range of pipeline activities should mean that if one project suffers delay suitable alternatives can be identified relatively quickly to keep spend on track and ensure progress against outcomes. Owned by: DECC Project manager and lead staff within MDB partner organisations
2. Recipient countries governments, NGOs and other stakeholders hold and communicate negative views on supported CCS projects
Mitigated by: c. The MDBs will select project interventions in consultation with developing country stakeholders. The UK will track this process and seek where possible to ensure developing country perspectives are addressed d. Careful engagement with the full set of in country stakeholders prior to commencing any project should help to ensure these risks are fully understood and can be addressed. Owned by: Lead staff within MDB partner organisations with oversight from DECC project manager
3. A delivery partner is unable to complete a supported project
Mitigated by: e. The UK CCS demonstration provides evidence that even where it is not possible to complete a project, there can be benefits to be gained from careful project planning and

design. Should a project intervention fail to progress beyond the design / planning stage, both DECC and delivery partners will seek to disseminate any outputs. f. Careful project design with clear and frequent milestones should help to ensure that even where a project does not progress to completion the learning can be captured. g. The development of a clear pipeline of projects by delivery partners should help ensure that even where a project fails to deliver, ICF spend continues to drive efforts toward the overarching goal. Owned by: Lead staff within MDB partner organisations with oversight from DECC project manager
4. A project within an MDB pipeline is unable to be completed
Mitigated by: h. As above. In this instance the development of a clear project pipeline by MDBs and other delivery partners, with suitable options to ensure project delivery should mean that money can be readily redirected toward another downstream intervention that will secure progress toward the goal. Owned by: Project manager and lead staff within MDB partner organisations
5. Risk of fraud/corruption in MDB administered funding
Mitigated by: i. The DPR process which provided considerable evidence of policies being in place with the MDBs to address this concern. j. HMG oversight of Trust Fund accounts and engagement in project design should help assurance. Owned by: Project manager and lead staff within MDB partner organisations
6. Insufficient HMG human resources to effectively manage interventions through MDBs
Mitigated by: k. Strong buy-in from SRO and ICF staff. Owned by: DECC SRO
7. CCS interventions are not judged to be transformational and do not significantly accelerate CCS deployment
Mitigated by: l. Strong DECC engagement in project design and delivery will ensure spend is targeted toward activities likely to leverage greatest results. Owned by: Project manager working in conjunction with MDB partner organisation staff
8. CCS interventions are not scored as ODA
Mitigated by: m. Norway, the World Bank and the Asian Development Bank have agreed criteria for spend to support CCS capacity building that they consider compatible with OECD DAC criteria. DECC, working closely with delivery partners should ensure funding is channelled toward appropriate activities Owned by: DECC project manager
9. Project slippage in South African test injection results in allocated funding not being expended (and scored) in the necessary timeframe.
Mitigated by: n. The planned Delivery Partner Review of the SACCCS will consider their ability to disburse finance in a timely way. o. Money to be disbursed through the World Bank CCS Trust Fund. Any test injection activity will necessitate the purchase of a great deal of capital assets. It should be possible to procure these in advance of the timetable for injection. Owned by: Project manager working with senior SACCCS staff
10. Risk of fraud/corruption in direct capital investment in South African test injection

Mitigated by: p. DPR process determines that SACCCS are capable of disbursing the appropriate volume of finance and have necessary due diligence processes in place q. Finance will be paid through the World Bank CCS Trust Fund, thus minimising the risk to the UK. Owned by: WB and Project manager to oversee SACCCS activity
11. Risk of SACCCS closing or being transformed prior to completion of work plan
Mitigated by: r. The South African Department of Energy are committed to developing CCS in RSA and have established the SACCCS to aid in the delivery of this objective. Regular checks will be undertaken to ensure political support for SACCCS is retained. Owned by: World Bank and Project manager, working with the British High Commission in Pretoria as appropriate.

An assessment of the Impact and Probability of these risks is set out in the schematic that follows:

	Developing Country CCS Risk Analysis			
High	5 & 10	9 & 7		
Impact	3, 4, 6 & 11	8		
Low		1	2	
	Low	**Likelihood**	High	

Of the risks identified, only two are judged to have a high likelihood and three are assessed to pose a significant threat to the delivery of the intervention objectives. The nature of the proposed intervention, working with multiple delivery partners has a significant effect on the likelihood of any single risk damaging the programme's effectiveness.

For example, even those issues which are assessed as high risk can be overcome in a relatively straightforward manner. Two of the risks relate to the potential for funds to be used fraudulently or in a manner that is inconsistent with the objectives of the programme. The two MDB operated Trust Funds already have a large number of checks in place to help reduce the risk of financial impropriety. One of the high likelihood risks relates to the potential that an intervention is assessed not to have delivered transformational results. Here for example the use of a portfolio of project interventions should mean that at least some of the money put forward is spent on activities that are genuinely additive and drive the development and deployment of CCS. Close monitoring of progress from the UK and other donors should help to ensure that where projects are not progressing well, problems can be addressed at a relatively early stage and if necessary funds be redirected.

Overall, the risk relating to the proposed investment is judged as medium / high. Individuals employed at the two beneficiary institutions (ADB and World Bank) are committed to working with HMG to ensure that money is used in accordance with UK requirements and delivers additional value on the ground which is particularly important in such a comparatively new area.

6 Annex A: Rationale for country selection

CHINA		
Criteria	Comment	Score(range of 1-5)
CO_2 energy based emissions footprint 2010/2025-2030 (BAU)	Largest global coal user. BAU annual CO_2 projection is 8,000/14,000 Mt. While increased energy efficiency and renewables may limit level to 9,000 Mt, all projections show that CCS will have to be deployed if emissions are to fall after 2030.	5
Government policy support for CCS development	Government commitment to reduce carbon intensity by 40-45% from 2005 levels. CCS development is a major technology development priority	5
Opportunity to work with stakeholders	Stakeholders are familiar with working with external organisations due to the extensive range of international cooperation projects that have been/are underway involving industry, policy groups and universities	5
Poverty alleviation potential through CCS deployment	With extensive CCS deployment, major employment opportunities will arise both directly (pipelines, injection sites) and indirectly (infrastructure)	4
Strong range of CCS activities	Major and world leading CCS development work underway together with strong comprehensive R&D programme	5
Potential to absorb ICF support	Very high, due to experience gained from current and previous wide ranging actions. Both bilateral and multilateral options would be possible.	5
Potential multiplier potential	If China can demonstrate technologies, there are clear indications that likely costs for CCS can be lowered significantly from OECD estimates, thereby enhancing potential global take up.	5
	Total (maximum 35)	34

INDONESIA		
Criteria	Comment	Score(range of 1-5)
CO_2 energy based emissions footprint 2010/2025-2030 (BAU)	Major fossil fuel user and supplier. BAU annual energy based CO_2 projection is 380/1,150 Mt for 2025 over all sectors. Increased renewables use and reduction in oil use may lower emissions to 950 Mt. Significant further reductions in the range 255-310 Mt will require introduction of CCS to the gas processing and coal power sectors.	5
Government policy support for CCS development	Government commitment to reduce carbon intensity by 26-41% from 2005 levels over all sectors. CCS is a policy objective, with a high-level blueprint for its deployment.	5
Opportunity to work with stakeholders	Reasonable range of activities undertaken, with some form of international cooperation	4
Poverty alleviation potential through CCS deployment	Reasonable potential, with some direct and indirect opportunities in the coal power sector while gas processing will be offshore which mostly requires specialist skills.	3
Strong range of CCS activities	Various investigative studies undertaken involving various national stakeholders, with an appropriate focus on gas processing and EOR.	4
Potential to absorb ICF support	High due to experience gained from current and previous actions	4
Potential multiplier potential	Indonesia offers some significant near term opportunities that will have replication potential in SE Asia and elsewhere.	4
	Total (maximum 35)	29

SOUTH AFRICA		
Criteria	Comment	Score(range of 1-5)
CO_2 energy based emissions footprint 2010/2025-2030 (BAU)	Large coal user and supplier. BAU annual CO_2 projection is 500-600/800-1200 Mt. While increased energy efficiency, nuclear and renewables may hold levels close to 600 Mt, CCS will have to be deployed if emissions are to fall after 2030, possibly to 400 Mt by 2050.	5
Government policy support for CCS development	Government commitment to reduce CO_2 emissions with a reduction target of 42% by 2025 from business as usual levels CCS will allow continued use of fossil fuels while achieving deep reductions in CO_2 emissions such that the technology will bridge the gap until such time that the existing energy infrastructure is replaced with non-fossil fuel based power generation.	5
Opportunity to work with stakeholders	CCS development and capacity building programme is built around the SACCCS with good industrial buy-in and good international support.	4
Poverty alleviation potential through CCS deployment	Poverty alleviation opportunities appear extensive with major direct and indirect employment opportunities.	4
Strong range of CCS activities	Well structured development programme, focusing on storage as this will be the critical issue to determine whether deployment will be viable.	5
Potential to absorb ICF support	Reasonable. Multilateral engagement is preferred provided Government wish for localisation can be accommodated.	3
Potential multiplier potential	If South Africa can establish a viable way forward, there should be scope to engage positively with other African nations.	3
	Total (maximum 35)	29

INDIA		
Criteria	Comment	Score(range of 1-5)
CO_2 energy based emissions footprint 2010/2025-2030 (BAU)	Large coal user. BAU annual energy based CO_2 projection is 1500/5000-/6500 Mt. Increased energy efficiency, nuclear and renewables may reduce levels by ~20%. Scope for CCS not technically promising.	2
Government policy support for CCS development	Government commitment to reduce carbon intensity by 20 to 25% from 2005 levels by 2020. No policies nor legislation to encourage the development, deployment and regulation of CCS technologies	1
Opportunity to work with stakeholders	Country's involvement in CCS via the Government is very limited, and currently very little interest from industry.	2
Poverty alleviation potential through CCS deployment	Poverty alleviation opportunities appear via CCS deployment currently very limited.	1
Strong range of CCS activities	Some interesting CCS technology R&D, almost all of which is linked to various international collaboration initiatives	2
Potential to absorb ICF support	In general terms, this is good although some public doubts that such support is necessary.	3
Potential multiplier potential	Not at all clear	1
	Total (maximum 35)	12

BRAZIL		
Criteria	Comment	Score(range of 1-5)
CO_2 energy based emissions footprint 2010/2025-2030 (BAU)	**In the energy sector**, CO_2 emissions in 2010 were 345Mt of which the very great proportion was from transport. Likely level in 2030 is 445 Mt, due to greater use of oil and natural gas following recent discoveries, even if plans to implement better energy efficiency in industry and regional integration are implemented.	2
Government policy support for CCS development	Brazil does not have any integrated policies or legislation dedicated to either encouraging the development of CCS technologies or regulating the implementation of CCS projects in Brazil	1
Opportunity to work with stakeholders	Petrobras is the leading stakeholder and involved in several international initiatives, as are certain universities that it supports.	4
Poverty alleviation potential through CCS deployment	Poverty alleviation opportunities via CCS deployment currently very limited.	1
Strong range of CCS activities	Petrobras is committed to capture and prevent release of CO_2 when oil and gas are extracted from new deep pre-salt oil deposits. It is undertaking a large scale EOR trial. Petrobras is also obliged to invest 0.5% of its revenue arising from the major oil fields on R&D and has established the Carbon Storage Research Centre to undertake research into storing CO_2 in depleted coal mines, oil and gas fields and saline aquifers. It also established the Carbon Sequestration and Climate Change Thematic Network, which comprises 13 universities	4
Potential to absorb ICF support	In general terms, this is good.	3
Potential multiplier potential	Not at all clear	1
	Total (maximum 35)	16

MEXICO		
Criteria	Comment	Score(range of 1-5)
CO_2 energy based emissions footprint 2010/2025-2030 (BAU)	**In the energy sector**, CO_2 emissions in 2009 were 400 Mt mostly from oil and gas use. Likely BAU 2030 levels are 600 Mt, although it has been suggested that emissions could be stabilised close to 2010 levels by efficiency improvements and move away from coal and oil towards natural gas.	3
Government policy support for CCS development	National Plan on Climate Change calls for 30% reduction in CO_2 emissions by 2020 and 50% by 2050 across all sectors. Proportion from energy use not clear. The government has listed CCS as a national priority for energy generation and use, as well as mitigation R&D. Activities aimed at development and deployment of CCS technology in the power and hydrocarbon exploration and production sectors are expected.	3
Opportunity to work with stakeholders	State oil and gas company, PEMEX, is involved in various initiatives, as are various institutes. Some cooperation with USA/Canada.	4
Poverty alleviation potential through CCS deployment	Poverty alleviation opportunities via CCS deployment may be reasonable.	3
Strong range of CCS activities	Government has implemented a preliminary assessment of CO_2 storage potential. Small scale projects for CO2 stripping from natural gas for EOR have been undertaken. Pilot scale project for CO_2 capture from natural gas power plant with EOR are being considered, with multi-lateral donor discussions underway. These will build on smaller scale projects undertaken previously. Government has announced the establishment of a CCS Innovation Centre.	4
Potential to absorb ICF support	In general terms, this should be good although public doubts have been expressed about accountability.	3
Potential multiplier potential	Not at all clear, although work may complement natural gas CO_2 removal EOR projects in other countries.	2
	Total (maximum 35)	22

7 Annex B: LogFrame

Logframe: Carbon Capture and Storage: Accelerating developing country deployment							
IMPACT	**Impact Indicator 1**		**Baseline**	**Milestone 1**	**Milestone 2**	**Target (date)**	
Developing countries recognise the role that CCS must play in delivering a cost effective emissions reduction strategy and take action to promote deployment	At least one developing country establishes legal framework for CCS in order to enable projects to move forward	**Planned**	No developing country has a legal framework to support the safe development of CCS technologies	Announcement by developing country government of intent to produce legislation	Legislation passes through relevant government process	2020	
		Achieved					
			Source				
			FCO Network / Delivery partners / CCS industry players				
	Impact Indicator 2		**Baseline**	**Milestone 1**	**Milestone 2**	**Target (date)**	
	At least one developing country takes forward a full chain CCS demonstration at scale	**Planned**	No demonstrations exist	Demonstration launched on power plant including CO2 capture and storage	Construction commences	2020	
		Achieved					
			Source				
			Delivery partners / FCO network / CCS Industry players				

OUTCOME	**Outcome Indicator 1**		**Baseline**	**Milestone 1**	**Milestone 2**	**Target (date)**	**Assumptions**
1. Industrial & organisational preparedness to deploy CCS when technology is sufficiently mature 2. Introduction of a policy framework supporting CCS deployment in one or more developing	Increased level of private finance channelled toward CCS Research Demonstration and deployment activities in key developing countries	**Planned**	Private R&D finance allocated toward CCS very limited (scale unknown at this time)	Private companies in at least one key developing market make public statement of support for CCS R&D	Finance committed	2016	Contingent on successful outcomes, on small scale demonstration and capacity and knowledge, and in context with an overall global mitigation strategy to limit climate change, will lead to the establishment of the necessary policy frameworks and incentive structures to support CCS demonstration on
		Achieved					
			Source				
			MDB analysis / FCO network / S&I officers				
	Outcome Indicator 2		**Baseline**	**Milestone 1**	**Milestone 2**	**Target (date)**	

countries	At least one developing country develops a policy framework for CCS	**Planned**	Few if any developing countries publically acknowledge CCS as a technology for deployment, though some reference to the importance of R&D is made	Announcement by developing country government of intent to produce legislation	Legislation passes through relevant government process	2020	commercial scale and ultimately the deployment. ICF funds are accompanied by Norwegian and GCCSI Investment and suitable commercial and academic expertise.
		Achieved					
			Source				
			Delivery partners / FCO network				
INPUTS (£)	**DECC (£)**		**Govt (£)**	**Other (£)**	**Total (£)**	**DECC SHARE (%)**	
	£60m ($95m)		**$40m**	**N/A**		**70%**	
INPUTS (HR)	**DECC (FTEs)**						
	0.5						

OUTPUT 1	**Output Indicator 1.1**		**Baseline**	**Milestone 1**	**Milestone 2**	**Target (date)**	**Assumption**
Increased capacity in industry and key institutions to aid the development of CCS	No. of small-scale demonstration projects established in developing countries	**Planned**	China is currently the only one of the three target countries to have any CCS demonstrations. None are full chain and applied to power station technologies	The delivery of a CO2 capture demonstration in Indonesia	South Africa undertakes a small scale CO2 demonstration on a power plant	2018	Increased technical capacity and institutional awareness will enable CCS physical deployment. This assumption needs to be tested through an evaluation.
		Achieved					
		Source					
		Delivery partners / FCO network / CCS Industry players					
	Output Indicator 1.2		**Baseline**	**Milestone 1**	**Milestone 2**	**Target (date)**	
	Technical assessment of the potential to deploy CCS on natural gas plant completed	**Planned**	No assessment has been carried out on the potential to deploy CCS on a natural gas plant	MDBs to carry out a technical assessment of the potential to deploy CCS on natural gas plant completed	Potential natural gas plant identified	2018	
		Achieved					

		Source	RISK RATING

OUTPUT 2	Output Indicator 2.1		Baseline	Milestone 1	Milestone 2	Target (date)	Assumptions
Increased knowledge of and support for CCS within government	No of well-attended workshops on CCS focusing on demonstration and lesson learning	Planned	0	3	6	2016	Capacity building accelerate the demonstration of CCS technology, and there is government buy in and a pipeline to take projects forward to demonstration.
		Achieved					
		Source	Delivery partners / FCO network / CCS Industry players				
	Output Indicator 2.2		Baseline	Milestone 1	Milestone 2	Target (date)	
	Cost benefit analysis of technology options for CO2 capture produced	Planned	No country specific analysis of CO2 capture options has been produced for either Indonesia or South Africa				
		Achieved					
		Source	Delivery partners / FCO network				RISK RATING

OUTPUT 3	Output Indicator 3.1		Baseline	Milestone 1	Milestone 2	Target (date)	Assumption
Increased understanding of regional geology and storage potential	Appropriate number of seismic tests leading to the selection of suitable storage sites undertaken	Planned	No seismic tests have been carried out	Locations for seismic testing identified	Tests undertaken	2016	Capacity building will facilitate many activities, including develop the information, tools, skills, expertise and institutions of individuals, organisations, industry and governments required to increase understanding of regional geology and storage potential.
		Achieved					
		Source	SACCCS / FCO network / BGS or industry partners				

OUTPUT 4	Output Indicator 4.1		Baseline	Milestone 1	Milestone 2	Target (date)	Assumptions

	Study to determine scope of South African test injection project	**Planned**	Study yet to be carried out	Study initiated	Report produced and fed back to RSA Govt	2016	South African government continue to support the SACCCS work programme.
		Achieved					
		Source					
		SACCCS / FCO network					
South Africa undertakes test injections	**Output Indicator 4.2**		**Baseline**	**Milestone 1**	**Milestone 2**	**Target (date)**	
	South Africa undertakes test injection on accelerated timeline	**Planned**	Current plan makes provision for test injection in 2016. Finance is not secure	Capital spend associated with test injection made in 2013/14	Test injection project completed	2016	
		Achieved					
		Source					
		SACCCS / FCO network					

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