Department of Energy & Climate Change

International Carbon Capture and Storage

Second Annual Review

April 2015

URN 15D/495

Any enquiries regarding this publication should be sent to us at Hannah.rollason@decc.gsi.gov.uk.

Contents

Executive summary

Overall, the CCS Programme outputs have met expectation. Good progress has been made in achieving all project specific indicators, with some areas exceeding expectations. Planning for the four pilot projects is progressing well and on track to commence implementation in line with the target dates.

Summary

Title: International CCS Capacity Building Programme		
Programme Value: £60 million		**Review Date: April 2015**
Programme Code:	**Start Date: April 2014**	**End Date: March 2015**

Summary of Programme Performance

Year	2014	2015						
Programme Score	A	A						
Risk Rating	High	High						

Summary of progress and lessons learnt since last review

Overall, the CCS Programme outputs have met expectation. Good progress has been made in achieving all project specific indicators, with some areas exceeding expectations. Planning for the four pilot projects is progressing well and on track to commence implementation in line with the target dates.

Key achievements

World Bank (WB) funded Phase 1 projects aimed at capacity building and defining potential for CCS deployment have been completed in South Africa, Botswana, and Indonesia.

- In South Africa, the Phase 1 TA programme was completed in March 2015 and commenced Phase 2 pilot programme. $27.5m for the Phase 2 pilot programme was approved by the Bank in December 2014.

- In Indonesia, the Phase 1 programme addressed technical, economic and institutional aspects of installation of a CO2 capture facility and storage of CO2.

The World Bank held a South-South knowledge exchange between South Africa and Indonesia. The delegation from Indonesia visited Johannesburg, Pretoria and Cape Town to learn about the SA CCS Flagship Programme, CCS Road Map implementation and preparation for the two pilot CCS projects.

In Mexico, The WB commenced three studies required to develop and execute a pilot CO2 capture and utilisation project: i) regulatory framework assessment; ii) assessment on transitioning of CO2 Enhanced Oil Recovery (EOR) project into a permanent storage project; and iii) pre-feasibility study on a CO2 post combustion pilot capture plant. These activities are scheduled to be completed by December 2015.

GreenGen project, China: ADB is providing $800,000 for a CCS pilot project at the Tianjin Integrated Gasification Combined Cycle (IGCC) power plant. The technical, financial, economic, environmental, and

social due diligence of the carbon capture plant and the first potential CO2-EOR and CO2 storage sites were completed in December 2014.

Study on CCS on Natural Gas-Based Power Plants in China: ADB has completed a TA study on potential to deploy CCS on Natural Gas-Based Power Plants in China. This is a $1.8 million capacity development technical assistance to identify specific measures that need to be incorporated at the planning and construction stages to avoid carbon “lock-in” and allow for a smooth transition of CCS application in natural gas-based combined cycle power plants. A final workshop was held in March to (i) showcase the capture pilot supported by the TA, (ii) share test results of second generation capture technologies, (iii) disseminate key findings, and (iv) publicise key messages of the policy note on CCS ready.

Indonesia: The ADB has funded a $225,000 feasibility study to develop a CCS pilot project. This was completed in Q1/2015, and the results have been discussed and confirmed with the Government of Indonesia (GOI) and PERTAMINA (national oil and gas company). As a result, the GOI has formally requested the ADB to provide grant funding for the pilot and has assigned PERTAMINA to be the project host for the pilot project. A detailed engineering design is being prepared by PERTAMINA using its own resources. ADB has initiated preparation of an investment grant of about $14 million for the pilot and plans to submit to the ADB Board for approval in Q4/2015 or Q1/2016.

ADB Board has approved $1.8m to set up three CCS Centres (two in China and one in Indonesia). Two hosts have been provisionally selected in China: UK-Guangdong CCS Centre and Beijing Jiaotong University. Process is underway to award contracts to these two facilities.

Lessons learnt from the last review

- Delivery partners should take steps to reduce the risk of delay in implementation of CCS pilot and demonstration projects. It is recommended that both the World Bank and ADB look for opportunities to accelerate their internal approval processes and start the implementation phase of the CCS pilot projects.
- World Bank should explore fast-tracking the approval and development of the planned capture plant for the Phase II of the Mexico project on a natural gas-fired generating station, while ensuring appropriate due diligence are completed, including compliance with environmental safeguards.
- Where feasible and relevant, ADB and World Bank projects should analyse if the chosen approach to promoting CCS in the host country is the most cost-effective, including how CCS could fit into the long term strategy for reducing emissions in the power sector.
- The World Bank and ADB should consider how to engage with host governments and other key stakeholders to accelerate the timescale for implementing the pilot storage projects in South Africa and Indonesia, respectively.

Actions taken to address the recommendations from the last annual review

During the last 12 months both the WB and ADB have undergone an internal restructuring process, which created a new operational structure. Accordingly, approval procedures and policies have been modified, which affected the speed of approvals at the stages of both concept note and project appraisal. However, potential for acceleration is often limited because of the restricted capacity of the recipient countries. To address this, both the WB and ADB are supporting a number of TA programmes aimed at building capacity within host governments.

Both the World Bank and ADB have stepped up their activities to develop CCS pilot projects in four emerging economies, in line with the UK’s priority countries. The World Bank and ADB have agreed to take further steps to reduce the risk of delay in implementation of CCS pilot projects: including getting

government buy-in; ensuring funding is in place for the full costs of projects; initiate public engagement to de-mystify CCS; and collaboration with key stakeholders to learn lessons from other projects.

In South Africa, the WB structured the Phase 2 Programme as a combination of a Bank executed TA and recipient executed TA to enable capacity building and support to the implementing agency on the preparation and implementation of the two pilot CO2 storage and capture projects. In addition, for both SA and Mexico, the WB is exploring a suitability to apply an alternative financing approach, which is a relatively new financing instrument within the WB financing options, which could accelerate the preparation of the Phase 2 Programme.

At this stage, it is too early to assess whether these actions are leading to lowering of risks to the WB and ADB CCS programmes. It will take time to see meaningful benefits and we will review progress as part of the next annual review.

Summary of recommendations for the next year

The 2014 recommendations are still valid and we will work with both delivery partners (World Bank and ADB) and other donors (Norway and GCCSI) to ensure further actions are taken this year to minimise risks of delay as we move closer to the implementation phase of the four pilot projects.

The ADB and World Bank are both in the process of evaluating activities and projects funded from their respective CCS trust funds this year, and we will work with both delivery partners to ensure key recommendations are taken forward.

A. Introduction and Context

Link to Business Case:	https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/137705/ICF_Business_Case_-_Carbon_Capture__Storage_Accelerating_developing_country_deployment.pdf
Link to Log frame:	https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/137705/ICF_Business_Case_-_Carbon_Capture__Storage_Accelerating_developing_country_deployment.pdf

Outline of the programme

The UK has committed £60 million of finance from the International Climate Fund (ICF) to trust funds operated by the World Bank and Asian Development Bank (ADB) to support developing countries to develop both the technical and institutional knowledge necessary to enable the deployment of Carbon Capture and Storage (CCS) technologies. The ICF finance will support CCS capacity building through pilot and demonstration projects, with the aim of demonstrating the technology and reducing the cost of the technology application across the CCS chain. In particular, we will fund the incremental financing required for CCS planning & pre-investment, capital costs for CCS units and components, and CCS related post-completion & operation activities.

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:

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

The ICF finance is channelled towards a range of capacity building activities in China, Indonesia, South Africa and Mexico. These emerging economies are heavily reliant on fossil fuels and the evidence indicates that CCS will be needed for their medium-term low carbon emission strategies to be cost effective (and therefore more likely to happen). Given these economies rank highly in total emissions globally, significant emissions reductions from CCS in these emerging economies would have an impact on global emissions reductions.

The ICF funding will help raise the level of understanding of CCS within these countries, leading to the establishment of necessary policy frameworks, technical know-how and incentive structures to support

CCS demonstration and ultimately accelerate the deployment of CCS. The World Bank and ADB CCS Trust Funds will support capacity building through pilot and demonstration activities. In particular:

- Preparation and implementation of full chain integrated CCS pilot and 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).

B: Performance and Conclusions

Annual outcome assessment

Currently we are on track to achieve or exceed all project specific indicators.

Overall, the CCS Programme is progressing well as both the World Bank and ADB are developing a pipeline of projects to accelerate development of CCS in emerging economies, including through pilot projects in China, Indonesia, South Africa and Mexico. However, some key challenges remain:

- **Selecting projects / increasing disbursement rate.** The current disbursement rate is acceptable; however, both the World Bank and ADB need to explore options on how they can accelerate disbursement of funding for the four pilot projects.
- **CCS interventions are necessary but not sufficient to be transformational and do not alone significantly accelerate CCS deployment.** This is a long term risk. We are minimising this risk through working with the World Bank and ADB to develop four pilot scale projects to demonstrate potential of CCS in China, Indonesia, South Africa and Mexico, and help these countries down the critical path to CCS implementation.
- **Attract and where relevant incorporate additional finance from the private sector and other donors beyond the UK, Norway and Global CCS Institute.** It is a challenge to attract private finance as capacity building projects will not deliver immediate financial gains. However, the World Bank and ADB are working with state-owned companies to fund R&D projects, as well as contribute towards more expensive pilot projects.

Overall output score and description

A: Outputs met expectation.

Key actions

Key actions set out in the Summary Sheet.

Has the logframe been updated since the last review?

Yes, CCS logframe has been updated to reflect milestones achieved to date, as well as the timetable for the four pilot projects.

C: Detailed Output Scoring

Output Title	*Increased capacity in industry and key institutions to aid the development of CCS*		
Output number per LF	1	**Output Score**	***A***
Risk:	*High*	Impact weighting (%):	50%
Risk revised since last AR?	**No change**	Impact weighting % revised since last AR?	No change

Indicator(s)	Milestones	Progress
Indicator 1.1: No. of small-scale demonstration projects established in developing countries	2018: South Africa undertakes a small scale CO2 pilot capture project 2019: Mexico undertakes a small scale CO2 pilot capture project 2019: 4 pilot projects established in China, Indonesia, South Africa and Mexico	On track to meet the milestones. Project specific milestones are being met (see under Key points), and overall all four pilot projects remain on track to start implementation in line with the target dates. During the development of the business case, it was envisaged that two small-scale pilot projects will be funded. However, the ICF finance has enabled the World Bank and ADB to develop four pilot projects in China, Indonesia, South Africa and Mexico. The logframe has been updated to reflect the raised ambitions of both the World Bank and ADB programmes. If all four CCS pilot projects go ahead as planned then we would exceed against this indicator. However, there is significant risk that delay could occur during the implementation phase. At this stage we do not have certainty that these projects will go ahead as planned. We will work with the World Bank and ADB to review these projects at Steering Committee meetings to ensure we identify risks early and take necessary actions to ensure these projects go ahead as planned.
Indicator 1.2: Technical assessment of the potential to deploy CCS on natural gas plant completed	2015: MDBs to carry out a technical assessment of the potential to deploy CCS on natural gas plant completed 2016: Potential natural gas plant identified 2016: Develop proposal to fund a CCS pilot capture plant on a natural gas plant	On track to meet the milestones. The logframe sets out that delivery partners would carry out a technical assessment of the potential to deploy CCS on natural gas plants, and to select a natural gas plant to pilot CCS technologies by 2018. We are on track to meet this output. Potentially two projects will look to do this: i. the World Bank funded Phase II of the Mexico project is planned to support the deployment of a up to 10MW capture pilot plant associated with a natural gas power plant. The optimal size of the pilot plant and its associated cost will be defined at the completion of the pre-feasibility study at the end of 2015. This will be the first such plant in the developing world. ii. ADB has completed a TA study on potential to deploy CCS on Natural Gas-Based Power Plants in China. This is a $1.8 million capacity development technical assistance to identify specific measures that need to be incorporated at the planning and construction stages to avoid carbon “lock-in” and allow for a smooth transition of CCS application in natural gas-based combined cycle power plants. A workshop was held in March to (i) showcase the capture pilot supported by the TA, (ii) share test results of second generation capture technologies, (iii) disseminate key findings, and (iv) publicize the key messages of the policy note on CCS ready.

Key Points

China: This is a pilot-scale full chain CCS demonstration project. In stage 1, a small amount of CO2 – between 3,000 tonnes to 5,000 tonnes – will be injected into each of the identified sites; and in stage 2 between 30,000 tonnes to 50,000 tonnes of CO2 will be injected. ADB is working with the Huaneng

Group (one of the five largest state-owned electric utility enterprises in China), and cooperating with the China National Petroleum Corporation to implement the project.

Overall, the ADB will fund $11m: $6m towards the construction of the capture plant; $3m for storage; and $2m for transport (although this could go up). However, with the change in storage sites (see below), the cost estimates may change. China's Ministry of Science and Technology (MOST) has also agreed to provide $4.5m towards the cost of the capture plant. The operating costs (approx. $37m) will be fully funded by the Huaneng Group. This project is a great example of how the ICF is enabling and leveraging additional funding for CCS development in China.

The technical, financial, economic, environmental, and social due diligence of the carbon capture plant and the first potential CO2-EOR and CO2 storage sites were completed in December 2014. The construction of the capture pilot plant at the Tianjin has been making very good progress in the past 12 months. The ground was prepared, the foundations constructed and by the end of May 2015, the water gas shift reactors, the acid gas removal system, the CO2 absorption towers were installed. The compressor, cryogenic CO2 storage tanks, and hydrogen storage tanks are still under construction.

However, the project experienced some delay as the original storage testing sites proved to be unsuitable. Firstly, the initially identified sites at Dagang Oilfield were considered unsuitable for a first-of-its-kind pilot project, and the technical due diligence indicated that geological formations were only marginally favourable for CO2-EOR and CO2 storage. Alternative sites in Jidong Oilfield, located about 150 kilometres (km), from the Tianjin IGCC were identified as more suitable in terms of technical feasibility. As a result it is likely that the overall costs, in particular transport cost, will go up. However, now that alternative storage sites have been identified, we are back on track to start implementation in line with the target date.

Indonesia: This pilot will involve capturing about 10,000 tonnes of CO2 annually from a gas processing plant at Gundih, Java, transporting the gas to a nearby pilot injection site, and injecting it into a target saline aquifer formation over a 2 year period. The feasibility study has been successfully completed. The government has since formally requested ADB's grant assistance for undertaking test injection and has assigned PERTAMINA, the national oil and gas company and operator of the field to conduct the pilot. The project experienced some delay in 2014 due to the change of government in Indonesia but the ADB is confident that test injection will start as planned in 2017. ADB is currently preparing for its Board consideration a proposal to provide up to $14 million in grant funding for the pilot, in conjunction with the Japan International Cooperation Agency (JICA) which has already provided $5 million in grant funding. This is a good example of how UK funded CCS activity is leveraging funding from international partners.

South Africa: The government sponsored South African Centre for CCS (SACCCS) has developed a roadmap toward the first commercial demonstration of the technology. The next milestone is to plan and carry out a CO2 test pilot storage project, a critical stage in determining the viability of CCS in the country, and the ICF funding via the World Bank is supporting this project. A separate pilot capture pilot project is also planned as part of the World Bank supported operation. The total funding from the WB CCS Trust Fund towards the pilot storage project and the initiation of a pilot capture project is $27.5 million.

Mexico: The World Bank is supporting Mexico to develop both capacity and technical knowledge needed to deploy CCS technology at scale to fully realise its benefits. The most critical step is to finalise the preparatory work to enable the start of the planned capture pilot project, which will create the basis for a larger demonstration project and advance the application of CCS in the power generation and oil and gas sectors.

Completion of this project will comprise a critical step in Mexico's CCS roadmap, demonstrate the feasibility and potential of CO2 capture in Mexico, provide an indicative measure of CO2 capture costs in Mexico, build human capacity and experience, engage national and local stakeholders, and strengthen international linkages. Three studies required for the preparation and planning for the Phase 2 Programme are underway:

- a regulatory framework assessment that aims at delivering an in-depth review of the recently amended legal and regulatory framework applicable to a planned CO2 capture pilot in Mexico; CO2 transport options to potential storage sites; identification of key gaps and barriers to CCUS implementation in the legal, regulatory and permitting regime that is in place after September 2014; a provision of recommendations and a timeline on how to overcome these critical gaps and barriers;
- an assessment on "Transitioning of CO2 Enhanced Oil Recovery Projects into Permanent Storage Projects" to assist PEMEX (Mexican state-owned oil company) on ensuring that future CO2-EOR operations in Mexico are recognised as permanent storage projects and, therefore, that the net amount of CO2 injected and stored is counted towards Mexico's emission reduction targets; and enabling future CO2-EOR projects to generate verified CO2 emission reduction units potentially eligible for national and/or international use; and
- a pre-feasibility study on a CO2 post combustion pilot capture plant with the objectives of completing a critical step in Mexico's CCUS roadmap; demonstrating the feasibility and potential of CO2 capture from NGCC power plants under the Mexican conditions; building technical capacity, know-how and experience in Mexico; providing an indication of CO2 capture costs in Mexico; and providing a platform for legal and regulatory development.

These studies are scheduled to be completed by December 2015, and will enable the next phase of the project to be taken forward.

Summary of responses to issues raised in previous annual reviews (where relevant)

Both the World Bank and ADB have stepped up their activities to develop CCS pilot projects in four emerging economies, in line with the UK's priority countries. The World Bank and ADB have agreed to take further steps to reduce the risk of delay in implementation of CCS pilot projects: including getting government buy-in; ensuring funding is in place for the full costs of projects; initiate public engagement to de-mystify CCS; and collaboration with key stakeholders to learn lessons from other projects.

Recommendations

Same recommendations as 2014 Annual Review.

Overall, both the World Bank and ADB have stepped up their activities to develop CCS technologies. However, there is a significant risk that delay could occur during the implementation phase. Delivery partners should further take steps in 2015 and 2016 (e.g. government buy-in, necessary funding is in place for the full costs of these projects, public engagement to de-mystify CCS, collaboration with key stakeholders to learn lessons from other projects) to reduce the risk of delay in implementation of CCS pilot projects.

It is recommended that both delivery partners look for opportunities to accelerate, where possible, their internal approval processes and start the implementation phase. However, potential for acceleration is often limited because of the restricted capacity of the recipient countries. Through TA programmes, the WB and ADB should look to build capacity within host governments to plan and deliver CCS projects.

This will be essential if we are to truly demonstrate the potential of CCS in emerging economies, and thus accelerate the development and deployment of CCS.

Output Title	*Increased knowledge of and support for CCS within government*		
Output number per LF	2	**Output Score**	***A***
Risk:	Medium	Impact weighting (%):	20
Risk revised since last AR?	No change	Impact weighting % revised since last AR?	No change

Indicator(s)	**Milestones**	**Progress**
Indicator 2.1: No. of well-attended workshops on CCS focusing on demonstration and lesson learning	3 workshops by end of 2014 6 workshops by end of 2016 10 workshops by end of 2020	**Achieved** 5 achieved to date: 3 in China in April 2013, October 2013, and January 2014; and two in Indonesia in November 2013 and March 2014. On track to meet 2016 and 2020 targets.
Indicator 2.2: Cost benefit analysis of technology options for CO2 capture produced	2013: Published a report on the potential for CCS in Southeast Asia 2016: Complete feasibility study for a CO2 capture plant in Mexico	**Achieved** In September 2013, the ADB published a report on the *Potential for Carbon Capture and Storage in Southeast Asia*, which focused on an assessment of the CCS potential in Thailand, Vietnam, Indonesia and the Philippines. It contains inventories of CO2 emission sources, estimates of overall storage potential, and an analysis of existing policy, legal, and regulatory frameworks with a view toward supporting future CCS operations. The report also presents a comparative financial analysis of first-mover CCS projects, highlights possible incentive schemes for financing CCS, and provides an actionable road map for pilot, demonstration, and commercial CCS projects. (http://www.adb.org/publications/prospects-carbon-capture-and-storage-southeast-asia) The pre-feasibility study for a CO2 capture plant in Mexico will be completed by December 2015. The feasibility study approach will be assessed within the following two options: 1) to carry out a feasibility study as part of the recipient executed TA (Phase 2) or 2) to include a feasibility study as part of an EPC contract for the pilot plant.

Key Points.

The ADB has funded five workshops – three in China in April 2013, October 2013, and January 2014; and three in Indonesia in November 2013, March 2014 and March 2015. The ADB plans to hold four further workshops: at least two additional large-scale workshops in China, one in Indonesia and one in Pakistan (date to be confirmed).

The World Bank plan to hold two workshops in South Africa, as part of the prospective Programmatic Technical Assistance during 2015-16. One workshop will be part of the biannual CCS week planned for October 2015 (and to be financed through the WB executed PTA). The timeline of the other workshop(s) will be discussed with the implementing agency, SACCCS, and included into the recipient executed TA.

As CCS technology is complex, unproven at-scale in the power sector, and in its early stage of development in the Asia Pacific Region, it requires upstream analytical work, capacity development, piloting and the realisation of demonstration projects. To address these barriers, the ADB is financing a $2.2 million technical assistance programme that will consist of two components: a) formulate a roadmap for CCS demonstration and deployment, and b) feasibility assessment of an oxy-fuel combustion CO2 capture technology, one remaining critical gap for the formulation of a comprehensive CCS roadmap. Both of these activities are scheduled to be completed by 31 December 2015.

As well as funding workshops to share lesson learning, both the World Bank and ADB are working with host governments and wider stakeholders to develop strategic partnerships to increase capacity and capability within host governments (see below).

Summary of responses to issues raised in previous annual reviews (where relevant)

As part of the Phase I of the South Africa project, the World Bank has committed to fund a $1.35m project to develop capacity within the South African government and key industries. The project delivered the following:

- Development of CCS regulatory approaches that fits within South Africa's existing regulatory framework, allowing the execution of a CO2 test Injection and further commercial application of CCS technology in South Africa;
- A techno-economic analysis for implementation of CCS in the industrial and electricity generation sectors including matching potential carbon dioxide emission sources against prospective sinks and an assessment of applicable capture technologies;
- Building institutional capacity by conducting expert workshops, training, technical classes and study tours for government, industry and energy sector stakeholders; and
- Initiating public and community engagement on the issues related to CCS deployment including potential environmental and social impacts.

All deliverables of Phase 1 Programme in SA have been completed. The Phase 1 completion report is finalised for internal review and will be shared with donors at the next Steering committee meeting.

The ADB is also in the process of setting up three CCS centres (two in China and one in Indonesia). The aim is to increase our collaboration with the Chinese Government and local partners. ADB is leading on this, with support from the British Embassy in China and the Global CCS Institute. The aims are to:

- conduct R&D on CCS;
- promote knowledge sharing in the region;
- strengthen collaboration in the region; and
- foster leadership in capacity development, including government policy and regulatory system needed for development and deployment of CCS.

Recommendations

The World Bank and ADB should be encouraged to ensure approved projects have stakeholder engagement plans, and/or knowledge sharing dissemination mechanisms, and to report back regarding those mechanisms. The World Bank and ADB should provide a summary of the outcomes of CCS workshops to donors.

Where feasible and relevant, ADB and World Bank projects should analyse if the chosen approach to promoting CCS in the host country is the most cost-effective, including how CCS compares to other low-emission technologies such as solar (on a non-subsidised basis).

Output Title	*Increased understanding of regional geology and storage potential*		
Output number per LF	3	**Output Score**	***A***
Risk:	*High*	Impact weighting (%):	10
Risk revised since last AR?	**No change**	Impact weighting % revised since last AR?	No change

Indicator(s)	**Milestones**	**Progress**
Indicator 3.1: Appropriate number of seismic tests leading to the selection of suitable storage sites undertaken	2014: Locations for seismic testing identified in Indonesia 2017: Commence pilot storage project to inject CO2 in to a saline aquifer formation (Indonesia) 2019: Complete pilot project	Feasibility study has been successfully completed. The government has formally requested continued ADB grant funding for the test injection and has assigned PERTAMINA, the national oil and gas company and the operator of the field, to carry out the pilot.

Key Points

This is on track to meet the output set out in the logframe. Two projects have been identified to demonstrate the potential of permanent storage of CO2 – in South Africa (funded by the World Bank) and Indonesia (funded by the ADB). For both projects, CO2 storage sites have been identified.

The World Bank is supporting the South African Centre for CCS (SACCCS) to plan and carry out a Pilot CO2 Storage Project. The World Bank has allocated $27.5 million for the Phase 2 Programme, which includes the preparation and implementation of a Pilot CO2 Storage Project. The first injection is currently scheduled for 2017. It will be the first time that CO2 is injected into a South African geological formation. See Output 4 for further details on this project.

ADB is providing $225,000 for a small-scale capacity development technical assistance (Stage 1) that will develop pilot activities in Indonesia – in particular, a pilot storage project. The project will undertake the following activities for the pilot CCS project in Gundih gas field, Central Java, Indonesia: (i) develop preliminary engineering design and cost estimates for transport infrastructure, surface facilities, and test injection infrastructure, (ii) analyse financial viability, and (iii) review legal and regulatory issues related to CCS pilot. Stage 1 was completed in March 2015. In Stage 2, construction of surface facilities, test injection and CO2 monitoring will be carried out in 2017. See Output 1 for further details on this project.

Summary of responses to issues raised in previous annual reviews (where relevant)

A change in government in Indonesia and replacement of senior officials both within the Directorate General of oil and gas, and PERTAMINA in mid-to-late 2014 led to a delay in processing a formal request from the government to ADB for funding for Stage 2. In May-June 2015, following the appointment of new officials both within the Directorate General for oil and gas, and PERTAMINA, all necessary requests from the government and formal permission from the government to PERTAMINA for the pilot has been received.

The Department of Energy within the South African Government (SA DOE) is the recipient of the TA, while the government entity, South African Centre for CCS (SACCCS) is the implementing agency. The SA DOE and SACCCS participated in the review meeting for the two Concept Notes (Bank executed and

recipient executed TAs) held on December 1, 2014. The SA DOE will lead implementation of a legal and regulatory framework to enable the pilot CO2 storage project, including the test injection.

Recommendations

Same recommendations as 2014 Annual Review. The World Bank and ADB should continue to engage with host country counterparts to accelerate the timescale for implementing the pilot storage projects in South Africa and Indonesia. Through TA programmes, the WB and ADB should look to build capacity within host governments to plan and deliver CCS projects.

Output Title	*South Africa undertakes test injections*		
Output number per LF	4	**Output Score**	***A***
Risk:	High	Impact weighting (%):	20
Risk revised since last AR?	No change	Impact weighting % revised since last AR?	No change

Indicator(s)	**Milestones**	**Progress**
Output 4.1: Study to determine scope of South African test injection project	2013: Commence pre-feasibility study 2016: Pre-Feasibility Study completed. 2017: Feasibility study completed: based on the basin exploration to characterise and select an injection site.	On track. The Pre-feasibility Stage (Stage 3, see below) assessments started in 2013 and due to be completed in mid-2016.
Output 4.2: South Africa undertakes test injection on accelerated timeline	2015: Capital spend associated with test injection made in 2015 2017: Test injection project commences	Programme spend has been agreed between the WB and South African government. The total cost of this project is estimated at $50m, with a minimum of $27.5 million from the World Bank CCS Trust Fund, and $20 million from the South African Department of Energy. We are on track to commence test injection in 2017.

Key Points

The Pilot CO2 Storage Project is scheduled to inject 10,000 tonnes of CO2 per year into a selected geological storage site. The first injection is currently scheduled for 2017. The source of CO2 will most likely to be from an industrial facility (a chemical plant). However, a stand-alone pilot capture plant will also be supported by the World Bank CCS Trust Fund.

Two sites have been selected, and the next stage is field exploration, leading to a site selection and further characterisation. The World Bank will support the SACCCS to carry out the following five stages of this project:

1. Project Initiation, completed
2. Pre-Feasibility Study [Basin Exploration 2013-2016]

3. Feasibility [Site Characterization 2016-2017]: Based on the Basin Exploration, this component will characterise and finally select an injection site.
4. Schematic Engineering Design (if the Decision Point in Stage 3 is passed, i.e. a storage site recommended);
5. Procurement, Construction, Operation, Closure and Post Closure [2015-2018]: Design, the actual undertaking of the injection, monitoring, analyses and determination of CCS potential within a particular basin.

The total cost of this project is estimated at $50m, with $27.5 million from the World Bank CCS Trust Fund, $20 million from the South African Department of Energy. The timeline for the pilot storage project is rather complex, i.e. the major part of the required time for the activities is to do the preparatory work. This includes the analysis of the available data, collection of new data through seismic modelling and defining the technical parameters of the pilot storage project (e.g. a location, the amount of wells, depth of the wells, costs, etc.). Therefore, the actual physical "drilling" is set at Stage 5 – Procurement and Construction, which is at the very end of the project, and there is very little scope for accelerating this timeline.

Summary of responses to issues raised in previous annual reviews (where relevant)

The implementation of the Bank executed TA has begun. The request for expression of interest for the Technical Management Advisory Services contract has been posted, and the shortlisting process is complete with the invitation to seven short listed companies to submit full proposals. The Technical Management Advisory Service contract is planned as a two phase contract that will support the following: 1) under Phase 1, the Technical Management Adviser will provide technical support to the SACCCS (the implementing agency for the recipient executed TA) on the analysis and interpretation of the geological data to define a storage location for the pilot storage project; and 2) to support the SACCCS on the execution of the CO2 pilot storage project (to be funded under the recipient executed TA).

With regard to the recipient executed TA, the appraisal preparation is under way. In particular, as part of the appraisal preparation the implementing agency is working on a framework environment and social impact assessments, planning for public consultation meetings, and procurement assessment, including a request for a waiver to the SA National Treasury from the requirements of the Public Procurement Act. The completion of the appraisal for the recipient executed TA is planned by December 2015.

Recommendations

As per the stakeholder engagement plan already developed, the World Bank to support the SACCCS to engage with key partners to build awareness of CCS, and engage the national public and communities living in the vicinity of storage sites.

The World Bank to work with the SACCCS to explore whether any further actions can be taken to maintain progress towards commencing the test injection phase in 2017. The World Bank CCS Trust Fund Manager and the project lead to update on progress at the next Steering Committee meeting.

D: Value for Money and Financial Performance

Key cost drivers and performance

The World Bank and ADB are operating within their maximum allocated service charge, which covers incremental cost for the administration, management, supervision and operation of the Trust Funds.

VfM performance compared to the original VfM proposition in the business case

Economy (*Are we or our agents buying inputs of the appropriate quality at the right price?):* There is no reason that the economic arguments in favour of delivering the CCS Programme in cooperation with the World Bank and ADB have changed since the approval of the Business Case. Financing through the World Bank and ADB allows funding to be channelled to ICF priority countries that do not have HMG programme delivery capability in Posts, or expertise to plan and deliver CCS projects. Both delivery partners have existing safeguards and investments criteria in place to ensure that projects costs are minimised. The Donors, including DECC, sit on their respective steering committee, which enables donors to challenge investment decisions and costing of projects.

Efficiency (*How well do we or our agents convert inputs into outputs?*): The ADB charges a service fee of: i) 5% of the amount disbursed for grant components of investment projects up to US$ 5 million, or 2% (with a minimum of US$ 250,000, whichever is greater) of the amounts disbursed for the same type of grants above US$5 million; and ii) 5% of the amounts disbursed for technical assistance operations. The fees are charged based on actual project disbursements, however, the equivalent amount for the entire project is already set-aside/earmarked as soon as the project is approved by ADB but will only be drawn from when disbursements are made. At project completion, undisbursed amounts including undisbursed fees are returned to the fund as savings. Total contribution from donors to the ADB CCS Trust Fund stood at $41.1m at July 2014, with $10.6m committed and the total fees charged is $0.25m.

The World Bank will charge 2% of contributions received to cover the standard costs of trust fund administration incurred by the Bank. In addition, for costs incurred by the Bank for CCS Trust Fund programme management, the Bank may charge up to a maximum of 8%. Total commitment from donors to the World Bank CCS Trust Fund stood at $58.3m[1] at July 2014, with $**8.45**m allocated to Phase I work programs, $**39.5**m targeted to Phase II work programs in South Africa and Mexico and the total fees charged is $1.1m.

Effectiveness (*How well are the outputs from an intervention achieving the desired outcome on low carbon development?)*: At this stage there is limited information to support this section of the review. However, the UK contribution of £60m – which is significant but not enough to meet the desired outcomes of accelerating development and deployment of CCS in emerging economies – added to the contribution from other donors and host government could deliver the four planned pilot and

[1] The Bank of England exchange rate as of June 30 2014 (1.7097 USD/GBP) has been used for the purposes of converting the receivables of GBP 15 million from the U.K.

demonstration projects, and show that CCS is a viable option for emerging economies like China, Indonesia, South Africa and Mexico. When the four planned projects are implemented the CCS Programme could have a transformational impact.

Assessment of whether the programme continues to represent value for money

Yes, the CCS Programme has been successfully developing four small to large-scale pilot and projects, and has met or exceeded nearly all output indicators to date. Therefore it has demonstrated value for money in terms of achieving its objectives.

During the March, 2015 ICF results collection the CCS Programme received a score of 3 against ICF transformational change KPI which suggests that “tentative evidence points to likely transformational change”.

Quality of financial management

The World Bank and ADB are expected to draw down the full £60m by the end date of December 2018. The World Bank and ADB are developing a pipeline of projects consistent with the CCS log frame. Four pilot and demonstration projects have been identified in China, Indonesia, South Africa and Mexico. The full allocated ICF finance will be used to support these projects.

Date of last narrative financial report	WB October 2014 ADB: December 2014
Date of last audited annual statement	WB for period ending June 2014 ADB: July 2014

E: Risk

Overall risk rating:

High. This project is a high investment risk due to the assumptions underpinning the effectiveness of capacity building activities in influencing developing country governments. However, this project is in line with the risk appetite for the ICF as the potential reward of success is high.

Overview of programme risk

Key risks to the Programme:

- **Selecting projects / increasing disbursement rate.** The current disbursement rate is acceptable; however, both the World Bank and ADB need to explore options on how they can accelerate disbursement of funding for the four pilot projects in China, Indonesia, Mexico and South Africa in 2015.
- **CCS interventions are necessary but not sufficient to be transformational and do not alone significantly accelerate CCS deployment.** This is a long term risk. We are minimising this risk through working with the World Bank and ADB to develop four pilot scale projects to demonstrate potential of CCS in China, Indonesia, South Africa and Mexico, and help these countries down the critical path to CCS implementation.
- **Attract and where relevant incorporate additional finance from the private sector and other donors beyond the UK, Norway and Global CCS Institute.** It is a challenge, and at present beyond our control, to attract private finance as capacity building projects will not deliver immediate financial gains. However, the World Bank and ADB are working with state-owned companies to fund R&D projects, as well as contribute towards more expensive pilot projects.

F: Commercial Considerations

Delivery against planned timeframe

CCS programmes developed by the World Bank and ADB remain on track against planned timeframe. Although there are inherent risks during implementation phase of the pilot projects, which we will review at Steering Committee meetings and take remedial actions when needed.

Performance of partnership(s)

The project has delivered a strong result in terms of developing effective relationships between donors (UK, Norway and Global CCS Institute) and recipient countries to share knowledge and expertise in development and deployment of CCS.

We are developing a strategic partnership with host governments, through working with the World Bank, ADB, Global CCS Institute, FCO and DFID country offices to increase collaboration on development of CCS technologies. We are also working with the ADB to set up three CCS Centres (two in China and one in Indonesia) to increase our collaboration with the Chinese and Indonesian governments and industries. Funding channelled through World Bank is being used to set up a CCS Centre in Mexico, similar to the one which operates in South Africa.

Asset monitoring and control

The employment and supervision of consultants and the procurement of services financed by trust funds shall be the responsibility of the World Bank and ADB shall be carried out in accordance with their policies and procedures. We have also agreed that the World Bank and ADB will promptly inform DECC of any situation which interferes, or threatens to interfere, with their administration of the CCS Trust Funds

G: Monitoring and Evaluation

Evidence and evaluation

We have agreed that both the World Bank and ADB will carry out two evaluations each: a mid-term evaluation in 2015 and an end of programme evaluation in 2018/19. The ADB commissioned this in May 2015 and scheduled to produce a report in the summer. The World Bank is in the process of developing a plan and hopes to share this with donors at the next Steering Committee meeting (autumn).

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.

The monitoring strategy is consistent with the ICF Results Framework. Targets for the following KPIs will be developed in partnership with the World Bank and ADB:

- 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)
- Volume of finance, public and private, leveraged (reported separately)
- Number of direct jobs created – this will reflect the job opportunities created directly through capacity building activities
- Degree to which the intervention is 'transformational' (qualitative assessment)

There are a number of project specific indicators, as set out in the log frame (see Annex A).

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 CCS Programme will also report on a series of project specific indicators.

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.

Monitoring progress throughout the review period

The following stakeholders/organisations were consulted for this annual review: World Bank; ADB; Global CCS Institute; Norway; FCO post China; FCO post South Africa; UK Climate Change Unit Indonesia.

H: Transformational Change

Rating

3: Tentative evidence of change – transformation judged likely

Evidence and evaluation

Qualitative assessment of progress against the transformational indicator.

1) Fostering political will to act on climate change
    - Developing countries recognise the role that CCS must play in delivering a cost effective emissions reduction strategy and take action to promote deployment
    - Introduction of a policy framework supporting CCS deployment in one or more developing countries
    - Increased knowledge of and support for CCS within government

Progress update: South Africa is actively engaged in CCS deployment. The South African Centre for CCS (SACCCS) (a government agency) has developed a CCS Roadmap identifying the five milestones toward the commercial demonstration of the technology. This Roadmap has been endorsed by the South African Government. The first two steps have successfully been undertaken; the next major milestone in the Roadmap is to implement a CO2 test pilot storage project in 2017 and a stand-alone pilot capture project in 2019 (tbc), a critical stage in determining the viability of CCS in the country. The total cost of this project is estimated at $50m, with $25-27 million from the World Bank CCS Trust Fund, $20 million from the South African Department of Energy and $5 million from Norway.

Until recently, China saw CCS as too expensive. Moreover, the slow progress in demonstrating the potential of commercialisation of CCS in OECD countries created a wait and see attitude of policy-makers vis-à-vis the promotion of CCS demonstration in China. However, we are now seeing a positive change towards willingness to develop CCS demonstration projects. The Chinese Government has given the green light to develop a pipeline of CCS projects, including to those supported by the UK ICF funding through the ADB CCS Trust Fund. The World Bank CCS Trust Fund is also supporting CCS capacity building, including working with the China Power Investment Corporation, one of the biggest power producers in China. China currently has 21 large-scale projects already in various stages of planning (http://www.globalccsinstitute.com/projects/browse).

China recognises the potential of CCS on reducing air pollution and GHG emissions, as reported on the Global CCS Institute's website: "CCS was identified in [China's] *Outline for National Medium and Long-term Science and Technology Development Plan Towards 2020* as one of the leading-edge technologies for further development. CCS has also been supported under China's science and technology programmes during the 10th and 11th five-year planning periods, and support for the technology has

increased under the current *12th Five-Year Plan (FYP)*." (http://www.globalccsinstitute.com/location/ccs-china)

The UK is well placed to push this agenda further. Most significantly, our support for the ADB CCS Trust Fund will provide a major new opportunity for greater UK influence on CCS development in China.

There also significant interests from the Indonesian government. They have approved a pilot storage project to be developed by the ADB. This pilot project will involve capturing about 6000-8000 tonnes of CO2 annually from a gas processing plant at Gundih, Java, transporting the gas to a nearby pilot injection site, and injecting it into a target saline aquifer formation over a 1-2 year period. ADB will fund $14m, with Japan International Cooperation Agency (JICA) funding $5m. Test injection is scheduled to commence in 2017.

In Mexico, the World Bank is working with the Mexican government to implement its CCS Roadmap, establish a CCS Centre and support a comprehensive range of activities, including legal and regulatory developments, public engagement, and support for a pilot-scale capture project. The pilot-scale project will provide technical know-how to facilitate the translation to a demonstration scale project. We have provisionally allocated $12m to build a small-scale capture plant in 2017. The World Bank is also negotiating with the Mexican government to co-finance this project - approx. $10m (tbc). If this is agreed then it will demonstrate commitments from the Mexican government to develop CCS technologies.

2) HMG supported activities are encouraging innovation and testing new approaches and ideas
    - At least one developing country takes forward a full chain CCS demonstration at scale
    - No. of small-scale capture plants and storage projects established in developing countries

Progress update: The GreenGen project in Tianjin, China, is a pilot-scale full chain CCS demonstration project, which will consist of construction of a CO2 capture plant with the capacity to capture up to 100,000 tonnes of CO2 per year, when fully operational. This has the potential to be transformational and demonstrate the potential of CCS in China.

We are also supporting test pilot and demonstration projects in South Africa, Indonesia and Mexico. In total, ICF finance will support four pilot projects.

3) HMG supported activities are being replicated by others
    - Increased understanding of regional geology and storage potential
    - No of well-attended workshops and conferences on CCS focusing on demonstration and lesson learning
    - Other countries explore potential to replicate UK-funded projects.

Progress update: We are working with the ADB to set up three CCS centres (two in China and one in Indonesia). The aim is to increase our collaboration with the Chinese Government and local partners. ADB is leading on this, with support from the British Embassy in China and the Global CCS Institute. The aims are: conduct R&D on CCS; promote knowledge sharing in the region; strengthen collaboration in the region; and foster leadership in capacity development, including government policy and regulatory system needed for development and deployment of CCS. This will significantly increase understanding of regional geology and storage potential in the region. Funding channelled through the World Bank is being used to set up a CCS centre in Mexico, similar to the one which operates in South Africa.

The log frame sets out that six workshops would be funded by the World Bank and ADB CCS trust funds by 2016. Currently, we are on track to exceed this target. The ICF finance enabled the World Bank and ADB to raise their ambition and develop four pilot and demonstration projects, and as part of this they have also arranged workshops to engage with key stakeholders.

The ADB has funded five workshops – three in China in April 2013, October 2013, and January 2014; and two in Indonesia in November 2013 and March 2014. The ADB plan to hold four further workshops: at least two additional large-scale workshops in China, one in Indonesia and one in Pakistan (date to be confirmed).

The ADB is developing a proposed $1 million TA project in Pakistan. The project aims to develop enabling policies, legal and regulatory frameworks for CCS development. It is envisaged that this will contribute to the scaling-up of CCS activities in Pakistan, and foster sustainable transition towards low-carbon development.

The World Bank is also working with the government of Botswana to integrate CCS into their sustainable development plan. Currently the government of Botswana has indicated a preference for a regional approach to CCS (e.g. to become a member of the South Africa Centre for CCS) to share knowledge and build on the experience of South Africa.

Monitoring progress throughout the review period

This is monitored throughout the year, with a detailed analysis carried out during the results collection exercise and annual review.

Department of Energy & Climate Change
3 Whitehall Place
London SW1A 2AW
www.gov.uk/decc
URN **15D/495**