FY2016 JCM and Other Infrastructure Development Study Project

Feasibility Study on Introducing a Hybrid GHG Reduction Technology for the Cement Sector Using Green Climate Fund (GCF) in South Africa

Final Report

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Executive Summary

1. **Background and Purpose of the Study**

In 2009, the government of the Republic of South Africa (“South Africa”) pledged that it would reduce 34% of its greenhouse gas (GHG) emissions by 2020 and 42% by 2025. The same target was stated in its “National Climate Change Response Policy White Paper” and “National Climate Change Response Green Paper”, which were both announced in 2011. South Africa submitted their Intended Nationally Determined Contribution (INDC) to the Secretariat of United Nations Framework Convention on Climate Change (UNFCCC) in 2015, aiming to cut down GHG emissions by 398 to 614 Mt CO$_2$ eq. between 2025 and 2030 (assuming an increase of 20 to 82% from the 1990 emissions level, excluding LULUCF)$^1$. South Africa is currently in its final process of introducing a carbon tax. The cement sector in South Africa has been working to achieve its own goal of “reducing emissions by 34% from the 1990 level by 2020,” but it needs to implement innovative low carbon technologies for further reducing GHG emissions. Requested by the Association of Cementitious Material Producers (ACMP) of South Africa for technical support and cooperation, the government applied to the Climate Technology Centre & Network (CTCN) for the technical assistance (TA) in conducting a “feasibility study for substantial GHG emissions reduction in the cement industry by using waste heat recovery combined with mineral carbon capture and utilization” in December 2015. As of March 2017, the TA is in the implementation phase. The CTCN was established in December 2010 within the operation of the UNFCCC for the purpose of accelerating transfer of environmentally-sound technologies for low carbon and climate resilient development.

This study aims at examining the possibility of utilizing the Green Climate Fund (GCF) for the implementation of target low carbon technologies of CTCN’s TA while a team of Japanese experts cooperates with the South African government and relevant local participants, including cement and concrete companies, in order to realize these initiatives.

2. **Target technologies (hybrid low carbon technology for the cement sector)**

The technology to be examined in this study is a hybrid low carbon technology wherein waste heat recovery (WHR) technology for a cement kiln is used for generating electric power is combined with a mineral carbon capture and utilization (MCC&U) technology recently developed in Japan. WHR technology was also developed in Japan in the 1980s and has since been widely installed in many plants throughout the country, and is currently listed in the “Technology Library” compiled by the CTCN$^2$. Energy efficiency can be maximized by installing WHR system next to a cement kiln for generating power for in-house consumption the cement production process by using the recovered waste heat, which would

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$^1$ This INDC became the country's Nationally Determined Contribution (NDC) in November 2016 as per South Africa's ratification of the Paris Agreement.

otherwise be simply released into the air. The use of electricity generated for cement production also enables a reduction of indirect emissions from the cement plant. The second technology utilizes alkaline earth metal components (Ca, Mg, etc.) contained in concrete sludge, generated from ready-mixed concrete plants or secondary concrete product plants, to produce stable and useful carbonates through chemical reaction with exhaust gas from the cement kiln, resulting safe reduction of CO₂ emissions without adding chemical agents. The by-products obtained from the above process can be also used as environmental remediation agents to improve the quality of soil and water.

The hybrid low carbon technology—combining energy saving technology with carbon sequestration technology—that the South African government requested to the CTCN not only substantially reduces CO₂ emissions from the cement sector but also enables to facilitate toward achieving zero emissions in the supply chain through the effective utilization of waste materials released from the concrete industry. Therefore, the hybrid low carbon technology is an innovative technology which may bring about a paradigm shift in South Africa’s cement and concrete industry. Moreover, in-house power generation utilizing waste heat can mitigate the power demand on the electric power grid, while the by-products from the mineral carbon capture process can improve the country’s environment by applying them as environmental remediation agents, thus presenting the prospects of environmental and economic co-benefits.

![Fig. 1: Overall Scheme of Hybrid Low Carbon Technology](image-url)

3. Consideration of GCF Investment Criteria
GCF lists six investment criteria used to rate a project. The table below presents how the hybrid technology satisfies the criteria required by GCF.

**Table 1: Investment Criteria of GCF to which Hybrid Technology Corresponds**

<table>
<thead>
<tr>
<th>GCF investment criteria for mitigation projects</th>
<th>Project under investigation (introduction of hybrid technology)</th>
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<tbody>
<tr>
<td><strong>Criterion</strong></td>
<td><strong>Coverage area</strong></td>
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<tr>
<td>Potential impact of contributing to the achievement of GCF’s objectives and result areas</td>
<td>• Mitigation impact</td>
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<td>Paradigm shift potential</td>
<td>• Potential for scaling up and replication, and its overall contribution to global low-carbon development pathways being consistent with a temperature increase of less than 2 degrees Celsius</td>
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<td>Degree to which the proposed activity can catalyze impact beyond a one-off project or program investment</td>
<td>• Potential for knowledge and learning</td>
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<td>• Contribution to the creation of an enabling environment</td>
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<td>• Contribution to the regulatory framework and policies</td>
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### Sustainable development potential

**Co-benefits in a wide variety of fields such as environment, society, economy and gender**

- Environmental co-benefits
- Social co-benefits
- Economic co-benefits
- Gender-sensitive development impact

- Environmental co-benefits: effective utilization of exhaust gases and industrial waste and the production of environmental remediation agents as by-products of MCC&U technology, etc.
- Social co-benefits: indirectly increased supply power capacity to the private sector and to other consumers; and contribution to South Africa’s employment creation policies, etc.
- Economic co-benefits: mitigation of power demand; expansion of production volume; and economic spin-off from construction demand, etc..

### Needs of the recipient country

**Vulnerability and financing needs of the beneficiary country and population**

- Vulnerability of the country
- Vulnerable groups and gender aspect
- Level of socioeconomic development of the country and the affected population
- Absence of alternative sources of financing
- Need for strengthening institutions and implementation capacity

- Strong interest in introducing CO$_2$ reduction technologies in early stages for achieving the CO$_2$ emissions reduction goal in the cement industry and preparation for the introduction of carbon taxation.
- In the increasingly competitive cement industry, the financial burden of capital investment is relatively heavy, and thus there are needs for new financing schemes especially for introducing waste heat power generation facilities.

### Country ownership

**Contribution to strengthening the autonomy and capacity of the beneficiary country to implement a funded project**

- Existence of a national climate strategy
- Coherence with existing policies
- Capacity of accredited entities or executional entities to deliver
- Engagement with civil society organizations and other relevant stakeholders

- When the South African government submitted a request for technical assistance to the CTCN, the request was confirmed as being coherent with national strategy for climate change response.
- The Development Bank of Southern Africa (DBSA) has been accredited since March 2016 without any experience as yet, but it has managed the “Green Fund” of the South Africa’s Department of Environmental Affairs.
- Industrial Development Corporation (IDC) has not been accredited yet, but it is an institution which has taken the lead in promoting and assisting industrial development. IDC has demonstrated its management capability with the African Development Bank's the “Green Energy Fund” and other initiatives.

### Efficiency and effectiveness

**Economic and financial soundness of the program / project**

- Cost-effectiveness and efficiency regarding financial and non-financial aspects
- Amount of co-financing
- Financial viability of the program / project and other financial indications

- Though varying by the generation capacity of WHR power plant, based on the scale of the plant under this study, the initial investment for WHR power generation and MCC&U technologies is about JPY 1.45 billion and JPY 200 million, respectively.
- Since the WHR power generation and MCC&U technologies have not been introduced in South Africa...
4. Consideration of Reducing Investment Burden through Utilization of GCF

GCF accepts requests for funding only from the accredited entities (AEs). Preparation of the designated application form (called a Funding Proposal) requires close communication between the AE and the project developer, and for that reason, AEs which have office in South Africa were investigated. South Africa has two AEs: one is the Development Bank of Southern Africa (DBSA), which is capable of handling projects for both mitigation and adaptation, and the other is the South African National Biodiversity Institute (SANBI), which only deals with adaptation projects. In addition, Industrial Development Corporation (IDC), which is under the process of accreditation, may be a possible candidate for preparing a Funding Proposal for the project under consideration.

In order for an accredited entity to prepare a Funding Proposal for submission to GCF, the target project must meet with mandates of their AE and the entity's internal approval be added to its existing project pipeline. The hybrid low carbon technology has been confirmed as satisfying the mandates of both the DBSA and IDC. The hybrid technology is targeting the entire cement sector of South Africa; however, the industry in this country is exposed to severe competition. Consequently, the cement producers need to be financed under more advantageous conditions than in standard corporate financing schemes, and they strongly expect to receive favorable conditions either concessional loans or close to concessional loans from external funding sources such as GCF. In view of the above, a new funding program may be established for the cement sector, or the existing funding framework managed by each of the AEs may be utilized. An interview was conducted with both DBSA and IDC, and they both agreed to continue discussing on details of the implementation of the hybrid technology based on the results of the TA report by the CTCN.

5. South African Government’s Policy for GCF and Procedure for Issuing Letter of No-Objection

In 2016, the South African government began examining the policies and procedures regarding GCF. In the government, Climate Change Flagship Programmes--a division in charge of realizing low carbon and resilience society and assisting the implementation of National Climate Change Response Policy White Paper and other relevant policies in the Department of Environmental Affairs--is responsible for GCF. On the other hand, Department of Science and Technology is responsible for CTCN.
In October 2016, following interviews with the government officials responsible for GCF and climate change issues at South Africa’s Department of Environmental Affairs, the study team learned from the officials that the government was currently working on preparing a project pipeline for GCF by compiling and summarizing a list of possible projects from the AEs. The government officials also stated that they were now considering the process for issuing a Letter of No-Objection, though the detailed information on this has not yet been released to the public as of March 2017. The interview with the South African government indicated that it will primarily examine the consistency with governmental policies on climate change for issuing the Letter of No-Objection.

The South African government officials responsible for GCF also showed a keen interest in the hybrid technology in this study. However, with regard to the MCC&U technology, they requested to share the results of the CTCN TA and also to conduct a demonstration project due to uncertainties related to its technical viability to local conditions in South Africa. As for the demonstration project, further consideration will be given regarding the possibility of utilizing either domestically or internationally available demonstration assistance funds, in order to examine how to promote the project after the implementation of the CTCN's TA.

6. Recommendations for Future Developments

For introduction of the hybrid low carbon technology through the utilization of GCF, there are technical and procedural issues. A summary of the recommendations for those issues is described below for the future consideration with the South African government and ACMP.

<Recommendations for technical aspects>

1) Development of a calculating method for GHG emissions reduction

   Since MCC&U technology is a newly developed innovative technology, there is no methodology available for calculating the GHG emissions reduction for this technology. It is thus necessary to urgently develop the methodology in line with domestic regulations, especially for applying the amount of CO₂ emissions reduction by MCC&U to reduce the carbon tax, which is expected to be introduced in South Africa from 2017. The designing of policy framework to incorporate the methodology in the country's NDC is also expected.

2) System structuring for substantial GHG reduction

   The main cement plants in South Africa are located near the production areas of coal used as a thermal energy source; therefore, a system for collecting concrete sludge needs to be structured. In other words, possible methods of efficiently collecting sludge generated in the dispersed ready-mix concrete production plants and secondary product manufacturing plants must be considered. Moreover, possible methods of generating carbonates by recycling the fine powder of crushed and powdered waste concrete must also be considered, as well as a method to search for waste materials that contain Ca and Mg.
3) Development of applications of by-products

In order to reduce the GHG marginal abatement cost, it is necessary to sell the by-products. Calcium carbonate must be studied for its possible use in the cement and concrete production field, either as an additive for plasticized concrete or as a minor additional constituent of Portland cement. On the other hand, environmental remediation agents may require onsite testing at mining sites or sewage treatment plants for purifying mine wastewater or sewage, with a view toward commercialization.

<Recommendations for utilization of GCF>

1) Risks involved with innovative technology

There are a few issues regarding the introduction of the hybrid low carbon technology to South Africa through the utilization of GCF. It is deemed necessary to implement additional measures in order for private companies to deploy such an innovative low carbon technology that can bring about a paradigm shift as promoted by GCF. With privately initiated mitigation projects, it is generally difficult for innovative technologies to be funded due to the associated high risks with or without GCF’s financially assistance. Innovative technologies can be introduced and paradigm shifts can be realized only when GCF accepts the risks associated with such projects that cannot be borne by development banks or private financial institutions. However, at present, GCF tends to accept assuming only the same level of risks as the co-financing institutions. This will only result in promoting the introduction of conventional technologies and thus interferes with the creation of a paradigm shift. Therefore, the role of GCF for promoting innovation must be reconsidered.

2) Innovative technologies and assistance for demonstration

The risk is not the only issue linked with innovative technologies. It is necessary to conduct a demonstration test or analyses based on a marketing survey and other relevant data for utilizing GCF, in order to introduce an innovative technology such as the hybrid low carbon technology discussed in this study, although lacking the funding for implementing such initiatives. The possibility of commercializing this technology will become higher by incorporating an additional function in GCF to provide assistance to such initiatives.

3) Proactive collaboration with technical mechanisms such as CTCN

CTCN's TA comes with tools for evaluating the investment effect, including monitoring parameters, such as measuring contributions to the SDG goals, whereby many assessment items examined in the screening process of GCF are already carefully examined in the CTCN procedure. Upon the completion of the CTCN's TA, the project will be capable of highly contributing to SDGs. If such a project can be financed by GCF, it will prove to be a practical case of connecting the CTCN with GCF.