NORDIC PARTNERSHIP INITIATIVE PILOT PROGRAMME FOR SUPPORTING UP-SCALED CLIMATE CHANGE MITIGATION ACTION IN VIETNAM'S CEMENT SECTOR

Final Readiness Plan for the Cement Sector in Vietnam [P-III.3]

The Final Readiness Plan is the presentation of the key findings and recommendations of the NAMA cement project. The Readiness Plan reflects also feedbacks from relevant stakeholders through consultations during 2016. The key findings and recommendations are presented in the five building blocks 1) Database and MRV, 2) Baseline and Mitigation Options, 3) Legal and Institutional Framework, 4) Financing Arrangements and 5) Stakeholder Engagement and Capacity Building. Based on this a proposal for a roll-out of the Readiness Plan is proposed.

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ACRONYMS

ADB	Asian Development Bank
BAT	Best Available Technology
BATP	Best Available Technology and Practice
BOD	Biochemical Oxygen Demand
CC	Climate Change
CO_2	Carbon dioxide (a reference greenhouse gas)
COD	Chemical Oxygen Demand
CSI	Cement Sustainability Initiative
CFTF	Carbon Finance Task Force
DMHCC	Department of Meteorology, Hydrology and Climate Change
DOC	Department of Construction
DONRE	Department of Natural Resources and Environment
ECRA	European Cement Research Academy
EE&C	Law on Energy Efficiency and Conservation
FCP	Facility for Credit Purchasing
GBFS	Granulated blast furnace slag
GCF	Green Climate Fund
GNR	Getting the Numbers Right
ICB	Inter-ministerial Coordinating Board
IEA	International Energy Agency
KfW	German Development Bank
KP	Kyoto Protocol
KPI	Key Performance Indicator
kWh	Kilo Watt hour
LEP	Law on Environment Protection
MBI	Market Based Instruments
MEPS	Minimum Energy Performance Standards
MIC	Mineral Component
MJ	Mega Joule
MOC	Ministry of Construction
MOC CCAP	MOC Climate Change Action Plan
MOH	Ministry of Health
MOIT	Ministry of Industry and Trade
MONRE	Ministry of Natural Resources and Environment
MPI	Ministry of Planning and Investment
MRV	Measurement, Reporting and Verification
Mt	Million tonnes

NAMA	Nationally Appropriate Mitigation Action
NCCC	National Committee on Climate Change
NCCS	National Climate Change Strategy
NDA	National Designated Authority
NDF	Nordic Development Fund
NIE	national implementing entity
NOU	NAMA Operating Unit
PHPC	Pre-heater with pre-calciner
PMU	Project Management Unit
RBF	result-based financing
SAP	State of the Art Paper
SBV	State Bank of Vietnam
SEC	Specific Energy Consumption
TOE	tonne of oil equivalent
TP	Technology Paper
UNFCCC	United Nations Framework Convention on Climate Change
USD	United States Dollar (currency)
VDB	Vietnam Development Bank
VEA	Vietnam Environment Administration
VGGS	Vietnam Green Growth Strategy
VGGS-AP	Vietnam Green Growth Strategy and Action Plan
VICEM	Vietnam Cement Industry Corporation
VNCA	Vietnam National Cement Association
VND	Vietnam Dong (currency)
WB	World Bank
WBCSD	World Business Council for Sustainable Development
WHR	Waste Heat Recovery

EXECUTIVE SUMMARY

The sustainable and low carbon development of the cement sector is a high priority for the Ministry of Construction of Vietnam (MOC) and MOC has gained support from the Nordic Development Fund (NDF)under the framework of the Nordic Partnership Initiative with the project "Pilot Programme for Supporting Up-scaled Climate Change Mitigation Action in Vietnam's Cement Sector". The project was initiated primo 2014 and it will be finalised in 2016.For the Nordic Council of Ministers (2015), the objective of the Readiness Plan is to strengthen Vietnam's ability to prepare, propose and implement a full-scale scheme of a clearly specified NAMA in the cement sector.

This Final Readiness Plan is the presentation of the key findings and recommendations found during the first 1½ years of the NAMA cement project. The Readiness Plan has been developed in close co-operation with the involved stakeholders and under the overall coordination of MOC. This process will be continued and a final version of the Readiness Plan is expected in the first half of 2016. The key findings and recommendations are presented in the five building blocks 1) Database and MRV, 2) Baseline and Mitigation Options, 3) Legal and Institutional Framework, 4) Financing Arrangements, and 5) Stakeholder Engagement and Capacity Building. Based on this, a proposal fora roll-out of the Readiness Plan is made.

The preparatory work for the Readiness Plan for the Cement Sector has concluded that there is a significant number of commercial viable CO_2 reduction efforts that can be taken by cement plants, but many of them are not implemented for various reasons. Therefore, the Readiness Plan also defines the enabling activities in order to eliminate or overcome the existing barriers to implementation of appropriate mitigation in the cement sector.

A number of actions and innovative ideas with significant mitigation potential can be initiated in the short term. The implementation of these actions is contingent on international support and MOC should accordingly discuss with potential sponsors/donors whether there is a possibility to (further) support the NAMA beyond its feasibility stage and to engage in implementation of selected actions proposed in this final Readiness Plan. To avoid delay and gaps between this contract and an eventual follow-up phase it is important to clarify the next actions accordingly and preferably within the next few months. . This can be done through bilateral meetings and workshops (organized by MOC and other partners) in Vietnam, or in international events like the COPs and other UNFCCC meetings.

The roadmap for the roll-out of the Readiness Plan has been structured along with the proposed prioritization of mitigation actions in short-term, medium-term and long-term perspectives (see table 1) In total, four groups of mitigation actions have been defined by prioritization of their implementation activities over the NAMA time horizon and required support: 1) enabling activities and results-based public incentives (e.g., carbon procurement tender) or 2) additional capex-related financial support/incentives (loans, subsidies, revenues from market mechanisms).

Table 1 Summary and prioritization of mitigation actions for the cement NAMA in Vietnam by their time horizon and required enabling activities

	Mitigation actions that can be catalyzed via enabling activities and results-based public incentives	Mitigation actions that can be catalyzed by additional capex-related financial support/incentives (loans, subsidies, market mechanisms)	Required enabling activities
Short-term actions no-regret, no- or low-capex (2016-2020 with initial readiness activities in 2016-2017)	**Group 1** • 1a) Process knowhow, control and management & 1b) Diagnostic energy audits • 11) Blending: Pozzolana • 12) Blending: Limestone	n/a	• Establishing NAMA Operating Unit at MOC; • Setting up NAMA MRV system; • Revising the MOC Cement Master Plan and developing policy incentives for: balancing cement capacity with demand, EE improvement and reducing clinker content in cement; • Feasibility studies on various mitigation actions; • Strategic study on AFR use in Vietnam; • Designing carbon procurement tender; • Capacity building activities.
Mid-term actions (implementation after 2020 with readiness activities in the short term)	**Group 2** • 2) Modern automation and control systems • 3) Clinker cooler modification • 8) Retrofit to modern multi-channel burner • 9) Blending: GBFS as cement constituent • 10) Blending: Fly ash as cement constituent	**Group 3** • 4) Waste heat recovery (WHR) • 7) BAT for alternative fuels - replacing fossil fuels	• Developing waste management regulations and infrastructure in Vietnam; • Pilot phase of the carbon procurement tender; • Introducing financial instruments, including performance guarantees for WHR; • Facilitating access to existing EE funds (for WHR); • Merging small cement plants into a number of larger companies and establishing EE technical centre(s); • Capacity building activities, especially for AFR.
Long-term actions (implementation after 2025 with readiness activities in the mid term)	n/a	**Group 4** • 5) Adding a pre-calciner to existing pre-heater kiln • 6) Additional Pre-heater cyclone	• Developing policy and financial incentives for mitigation actions under Group 4; • Capacity building activities.

The financing of different activities shall be organized in accordance with the above-proposed phasing of mitigation actions and should focus on realization of the enabling activities and relevant incentives. The below table describes the key financing mechanisms that could drive NAMA implementation in the short and mid-term.

Table 2. Financing mitigation actions and enabling activities under the cement sector NAMA

	Mitigation actions that can be catalyzed via enabling activities and results-based public incentives	Mitigation actions that can be catalyzed by additional capex-related financial support/incentives	Required enabling activities
Short-term financing (2016-2020)	**Group 1** 1. Capital markets, balance sheets of cement companies. 2. Results-based payments from the pilot phase of the carbon credit procurement tender; 3. Existing domestic and international EE support funds.	n/a	1. International (e.g., NDF, NAMA Facility, GCF, etc.) and domestic public funding of the initial enabling activities. Special attention should be given to: • Updating cement Master Plan, • Developing policies and regulations, • Developing waste management infrastructure in Vietnam; • Core budget for NAMA Operating Unit, • Setting up Facility for Credit Purchasing (FCP) and preparing pilot phase of carbon credit procurement, • Capacity building, engagement of cement plants, • MRV at plant-level. 2. Budget for the pilot phase of carbon credit procurement tender (international and domestic finance). 3. Cost recovery mechanism to fund the operational costs of NAMA Operating Unit and FCP via: • a small share of energy savings (ESCO model), • a fee per carbon credit added to the carbon price, • a fee (or tax) on the use of coal.
Mid-term and long-term financing (2021-2025)	**Groups 1, 2** 1. Capital markets, balance sheets of cement companies; 2. Results-based payments from FCP; 3. Pre-payments against the future delivery of carbon credits from the Facility for Credit Purchasing (FCP) 4. Existing domestic and international EE support funds; 5. International carbon market.	**Group 3 (and 4 in long-term)** 1. Capital markets, balance sheets of cement companies; 2. Results-based payments from FCP; 3. Instruments to de-risk performance and facilitate access to capex funds (e.g. performance guarantees); 4. Waste disposal fee; 5. EE investment support facility; 6. Existing domestic and international EE support funds; 7. Loans from international climate finance facilities (e.g. GCF) 8. International carbon market.	1. Cost recovery mechanism to fund the operational costs of NAMA Operating Unit, FCP, EE support fund via: • a small share of energy savings (ESCO model), • a fee per carbon credit added to the carbon price, • a fee (or tax) on the use of coal.

The above table presents the needed readiness activities in the cement sector prepared by the Consultants after initial consultation with the Vietnamese stakeholders. The focus will now be to consult further especially with the Vietnamese stakeholders to ensure a final Readiness Plan for the cement sector in early 2016. The comments received in the next months will be integrated in the final version of the Readiness Plan.

After a preliminary consultation with MOC special attention should be given to: clarifying the following 1) Updating the Cement Master Plan, 2) Developing policies and regulations, 3) Core budget for NAMA Operating Unit, 4) further clarification of setting up Facility for Credit Purchasing (FCP) and preparing pilot phase of carbon credit procurement, 5) Capacity building and engagement of cement plants, 6) MRV at plant-level, and 7) Mobilizing international climate finance and carbon market funds.

MOC shall consult with potential donors to support the above mentioned activities in the short term. The different characteristics of the donors should be explored with the aim that they can cover different type of enabling activities.

The COPs and UNFCCC meetings as well as international carbon fairs are also a market place for potential support and MOC should use this opportunity to attract further funds to the cement sector in Vietnam.

The approach, methodology and selected documents underpinning the Final Readiness Plan for the Cement Sector in Vietnam should be shared with the international community to contribute the further development of the cement NAMAs in other countries.

1 INTRODUCTION

1.1 Background

The sustainable and low carbon development of the cement sector is a high priority for the Ministry of Construction of Vietnam (MOC), and MOC has gained support from the Nordic Development Fund (NDF) under the framework of the Nordic Partnership Initiative with the project "Pilot Programme for Supporting Up-scaled Climate Change Mitigation Action in Vietnam's Cement Sector". The project was initiated in early 2014 and it will be finalised in 2016.

The consortium consists of 5 companies – NIRAS, South Pole, Perspectives, VNEEC and NIRAS Vietnam (RCEE-NIRAS)- supporting the development of this project.

This report – the final Readiness Plan for the Cement Sector in Vietnam – is based on a significant number of products prepared within this project.

A final Readiness Plan for the Cement in Vietnam has been finalised in 2016 after the consultation and review process.

1.2 Definition of NAMA Readiness Plan

Internationally understood by readiness plan

The readiness plan serves during the preparation phase of a project (programme or policy), here the NAMA in the Vietnamese cement sector. It refers to the assessment of key design elements that are necessary for the implementation of this project.

The objective is to evaluate the gap between the current status of those key elements and the status required for the implementation of the project. It can be used for very different purposes and sectors.

The readiness plan includes the analysis of different components; some of them being directly related to the project itself, for example the actions that will be implemented (which usually refers to technical inputs) and others relating to the overall framework within which the project will be implemented, tackling for example regulatory, organizational and financial components.

The readiness plan should clearly target the activities that have to be undertaken to starting the NAMA implementation and help defining the roadmap for this implementation.

The readiness plan proposed by the World Bank (2014) under the Partnership for Market Readiness for Vietnam market readiness focuses on climate related topics, at a sectoral level (steel and solid waste sector) but it focuses on establishing a climate market. The three main components are 1) Strengthening capacity for carbon pricing approaches, 2) Readiness to pilot selected market-based instruments and 3) Program management and stakeholder engagement facilitation. As the focus is the market based on carbon pricing and market-based instruments this readiness study is more seen as an input to evaluate the readiness of the financial arrangements.

OECD (2010) focus on market readiness of domestic market mechanisms (e.g. emissions trading system) and crediting-based mechanisms (e.g. NAMA-crediting). The market readiness is analysed along three categories: 1) Technical building blocks, i.e. the bare bones of a market instrument, 2) policy building blocks, related to the ambition of the environmental goal and the policy measures needed to deliver on the goal and 3) Institutional and legal building blocks necessary for the stability of the system and its effective operation.

A Nordic proposal for how to structure a readiness plan

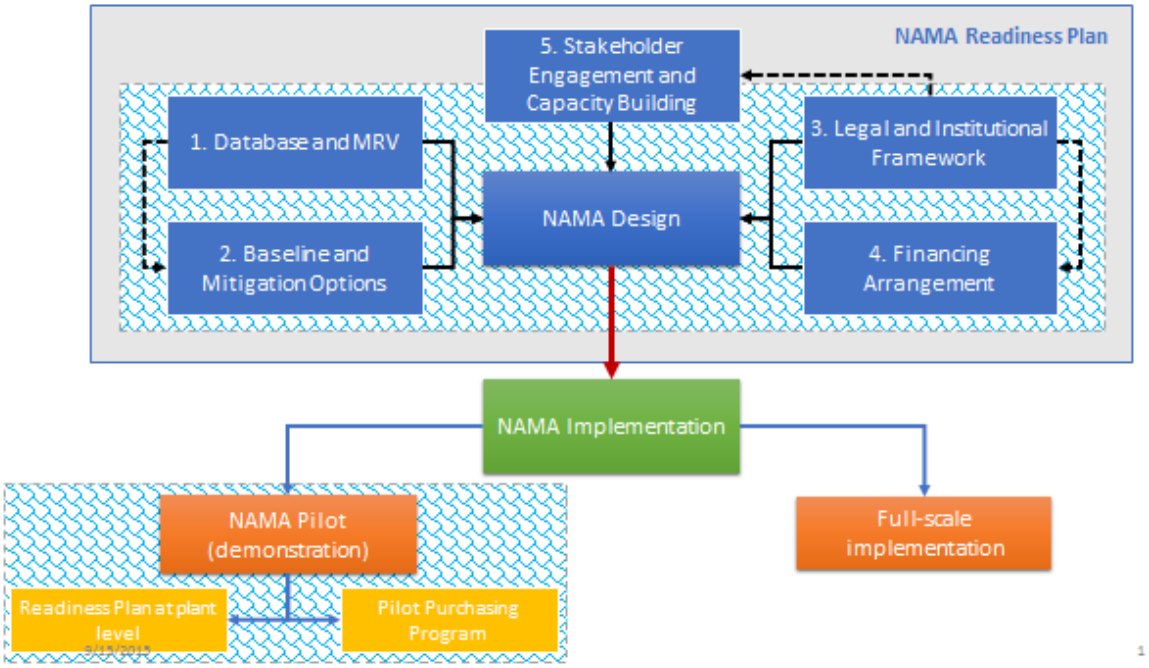
For the Nordic Council of Ministers (2015), the objective of the Readiness Plan is to strengthen Viet Nam's ability to prepare, propose and implement a full-scale scheme of a clearly specified NAMA in the cement sector. The expected readiness activities are the following ones:

- Collection of up-to-date data on emission reduction potential;
- Development of baseline emission projections;
- Estimation of emission reduction impact of mitigation actions;
- Developing a measurement, reporting and verification (MRV) system for emissions;
- Identification of barriers to mitigation actions and proposals to overcome them;
- Identification of appropriate support instruments for mitigation actions;
- Relevant institutional arrangements, capacity building and training.

1.3 Proposed structure of the Readiness Plan for the NAMA in the Cement sector

Based on the presentation and evaluation of the different options for developing a readiness plan in the above section it has been decided to structure the readiness plan in 5 different building blocks 1) Database and MRV, 2) Baseline and Mitigation Options, 3) Legal and Institutional Framework, 4) Financing Arrangements, and 5) Stakeholder Engagement and Capacity Building. Based on this a proposal of a roll out of the readiness plan is proposed, as called a proposal for NAMA implementation. See Figure 1-1 below.

Figure 1-1: Schematic overview of NAMA Readiness Plan



This assignment has been structured by prepared different products which are in line with the structure of the readiness plan. For each building block the main underlying reports is indicated. Each building block is structuring by first indicated the context, key findings and afterwards present the recommendation of the readiness activities.

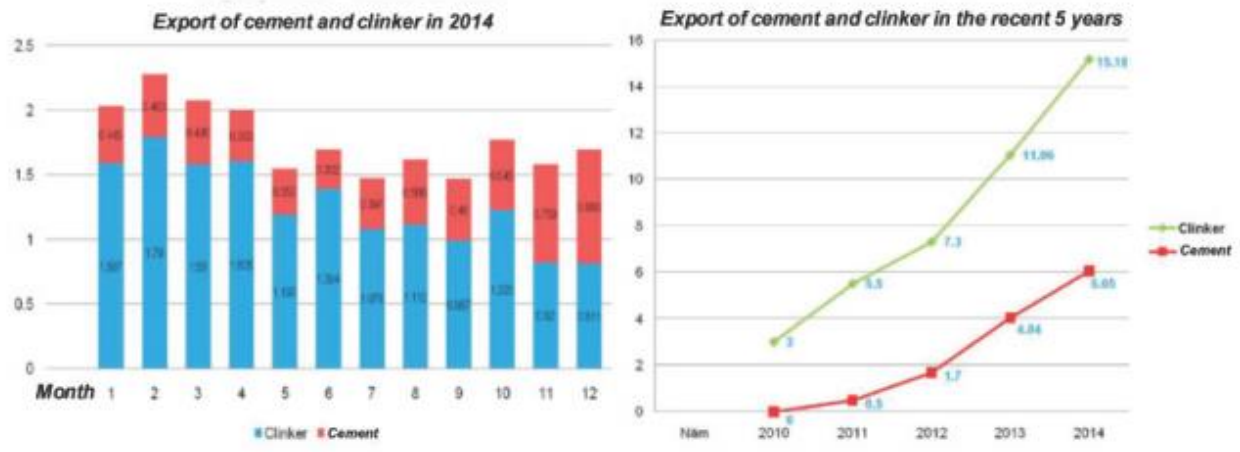
2 OVERVIEW OF THE CEMENT SECTOR IN VIETNAM

The cement Industry in Vietnam has been developed for over 100 years. The first cement plant with vertical kiln was built in Hai Phong in 1899. Since the day of unification in 1975, the Government decided to invest in more cement plants with higher capacity to meet the demand of rebuilding the country and now there are 55 cement plants with rotary kilns in Vietnam.

Vietnam is among the top cement consumers and producers worldwide[1].By the end of 2013 the 55 cement plants in operation in Vietnam produced about 59 million tonnes in 2013, equivalent to 653 kg cement per capita per year.

Vietnam has imported cement in the past, but since 2010 Viet Nam has been an exporter. In year 2014 the total cementitious products exported was about 21 million tonnes, among which over 6 million tonnes of cement.

Figure 2-1: Export of cement and clinker in year 2014 (a) and in the recent 5 years (b)



Source: Vietnam Cement Report, 2014

PCB30 and PCB40 Portland cement are the most popular cement products in Vietnam market. PC40 and PC50 cement products and other special cement products are only produced per request.

Vietnam has different forms of ownership: state, private owned or joint-venture with foreign companies. VICEM, state owned company, is the largest producer with installed capacity estimated to 45% of the overall market in Vietnam.

MOC has the overall administration of the cement sector, which among others include: 1) develop and revise the cement master plan, 2) Monitor and directing the development of the cement industry, 3) Leading and coordinating with the MONRE to measure indicators of environmental requirements in cement production, in order to limit the impact on the landscape, ecology and restrictions small-scale projects without advanced technology and 4) Leading and coordinating with the MOST, MONRE research institutions to build the product quality standard systems in consistent with international standards; promulgate norms of raw materials, standards and environmental standards based on modern cement technology and 5). Conducting survey

[1]International Cement Review (www.cemnet.com)

plans, research materials/mining for cement production, enabling the development of cement production in the long term.

The main legislation which governs the cement industry in Vietnam is the Master Plan for development cement industry. It is revised periodically. It shows a strong effort of the government to satisfy demand with local production. The cement demand is expected to grow in the coming year. Vietnam has good reserve of the limestone for development of the cement industry. The current cement Master Plan following Decision 1488/QD-TTg ("Master Plan 1488") includes an expansion of cement production capacity for the domestic market and about 10% cement export, leading to about 1'200 kg cement per capita per year cement production capacity.

There is limited legislation specifically on sustainable development of the cement industry, no regulation on MRV of the GHG emissions as such applied in the sector.

Cement production is a highly energy intensive industry, resulting in significant GHG emissions, particularly CO_2. The majority of CO_2 emissions from cement production are from the production and use of clinker, which is used to create Portland cement. Overall the CO_2 originates from two main sources: The decomposition of limestone (so called process CO_2), which accounts for approximately 50-60% of emissions, and the combustion of fuels such as coal which are burnt to reach the high temperatures (fuel CO_2) and account for around 40% of emissions.

3 DATABASE AND MRV

The database development is mainly presented in the reports "P-I.2.3-4 Assessment of availability and quality of the data and gap analysis" and "P-I.2.5-I.2.6 Data collection and database system including first version of database." The MRV aspect is presented in report "P-I.4.1-4 Setting up sector-level MRV system of international standard for the cement sector in Vietnam(a general guiding document for NAMA implementation)".

3.1 Database

a) Country Context

There is no national database in the cement sector in Vietnam that is publicly accessible and regularly updated, except data reported in the National GHG Inventories which provided relevant data in some aspects. However, they provide only data on a couple of general parameters on clinker and cement production, which are mostly estimated on the basis of default values e.g. estimated clinker volume, cement production, etc. and GHG estimations of the sector. As they approach used is IPCC Tier 1 data have high uncertainty. The data provided in the Inventories is not aggregated directly from a facility level but from materials provided by different institutions and/or organizations e.g. Statistical Year Books.

Cooperation of different ministries and authorities for data collection and management could be improved. Different ministries/agencies may have their own data to serve specific management purposes, for instance, report of cement production and product market to MOC, report of annual electricity consumption to MOIT, report of environmental observation and monitoring to MONRE; however the sharing of data within the government authorities is not a regular practice.

Some sectoral data on cement production and cement market in Vietnam is also available at the VNCA.

At the facility level, operational performance indicators are being monitored and archived automatically, GHG emission data are not yet paid adequate attention.

b) Summary of key findings

Develop the first sectoral database named "Vietnam cement energy and CO_2 database system"

According to the List of Rotary Kiln Cement Plants annexed to the Cement Master Plan, there were in total 56 cement plants under operation as of 31 December 2010 in Viet Nam including X77 which was a cement plant owned by 77 Joint Stock Company directly under Ministry of Defence. The Company at that time produced cement for both commercial and military purposes. The Company has recently been converted to serve the military purpose solely and thus been removed from the List of Energy Intensive Enterprises managed by MOIT. Therefore, the Company is also removed from the commercial cement sector managed by MOC.As a result, the first sectoral database of the cement sector named "Vietnam cement energy and CO_2 database system" developed under this project takes into account55cement plants with rotary kiln (installations) operating in total in Vietnam as of September 2015.

All plants have received a questionnaire under the NAMA project Site visits to collect and cross-check data have been conducted at 4 cement plants in August 2014 and 12 other plants in April 2015.

The resulting database covering 5 year-consecutive data is based on feedback from 47plants and the data are included in the third version of the Vietnam cement energy and CO_2 database

(the latest version up to date of this report) representing 87% of total clinker volume of the industry.

This excel-based database is a simplified version of the CSI MRV system which makes it compatible with the current international industry best practice and also current domestic context.

This is the first effort to establish a sector database for the cement sector in Vietnam. Further effort is needed to continuously update and improve the database.

The calculation results for KPIs are presented in the table below:

Table 3-1: Summary of calculation result for Key Performance Indicators (KPI) from current database with 47 plants

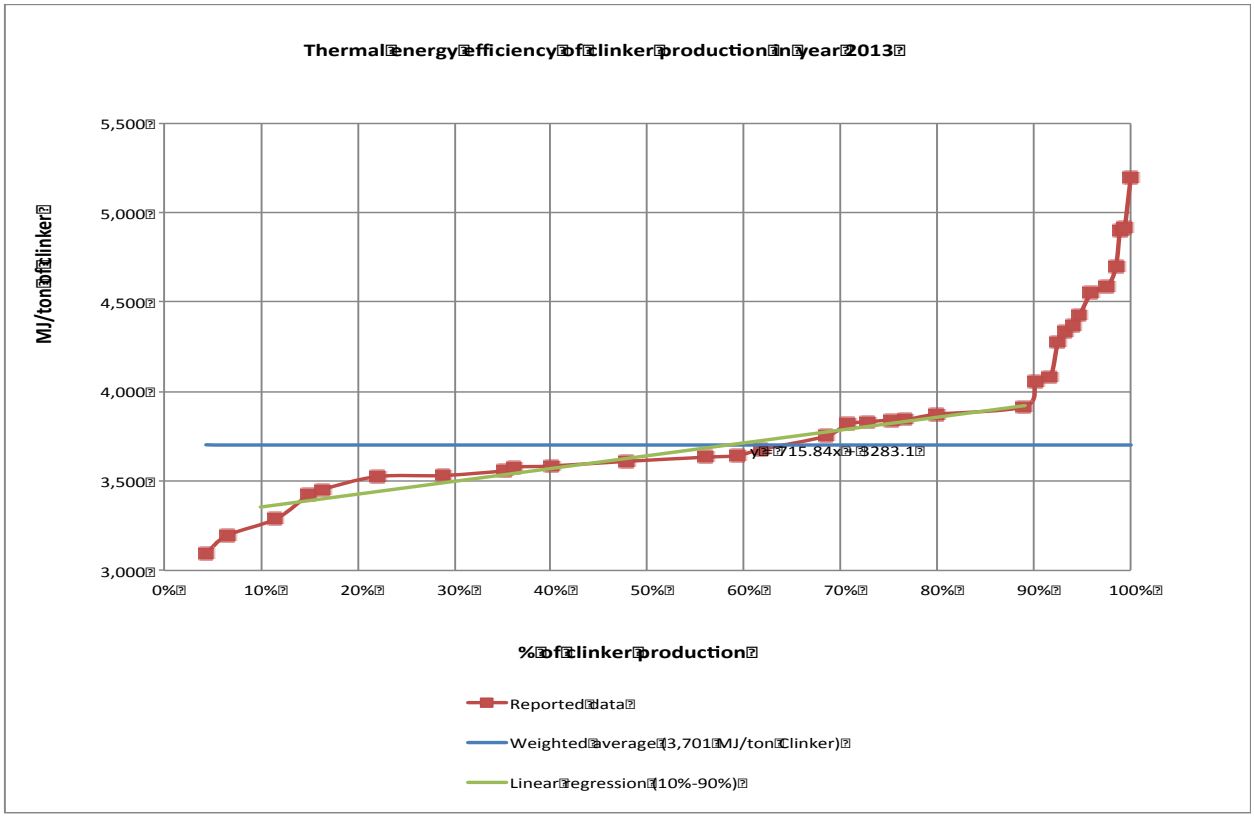
No.	Variable	Unit	Year				
			2009	2010	2011	2012	2013
1	Number of plants/ installations	Number	19	26	34	37	47
2	Number of companies	Number	19	26	34	37	47
3	Total clinker production	Mt of clinker	20,412	32,515	39,685	42,055	47,490
4	Total cementitious product production	Mt of cementitious product	24,062	37,867	46,113	49,050	55,554
5	Total MICs volume	Mt of MICs	3,650	5,353	6,428	6,996	8,064
6	Gross CO_2	Mt CO_2	17,965	28,636	35,379	37,355	42,306
7	Net CO_2	Mt CO_2	17,965	28,635	35,379	37,355	42,291
8	Specific Gross CO_2 per t clinker	kg CO_2/t clinker					
	Maximum value		996	993	1,032	1,034	1,034
	Weighted average value		880	881	891	888	891
	Minimum value		851	815	836	837	833
9	Specific Net CO_2 per ton clinker	kg CO_2/t clinker					
	Maximum value		996	993	1,032	1,034	1,034
	Weighted average value		880	881	891	888	891
	Minimum value		851	815	836	837	833
10	Specific Gross CO_2 per ton cementitious	kg CO_2/t cementitious product					
	Maximum value		892	917	935	957	956
	Weighted average value		747	756	767	762	762
	Minimum value		641	627	601	647	630
11	Specific Net CO_2 per ton cementitious	kg CO_2/t *cementitious product					
	Maximum value		892	917	935	957	956
	Weighted average value		747	756	767	762	761
	Minimum value		641	627	601	647	630
12	Specific Gross CO_2 per ton cement equivalent	kg CO_2/t cement					

No.	Variable	Unit	Year				
			2009	2010	2011	2012	2013
		(equivalent)					
	Maximum value		861	911	915	900	892
	Weighted average value		734	741	753	741	738
	Minimum value		641	627	601	573	606
13	Specific Net CO_2 per ton cement equivalent	kg CO_2/t cement (equivalent)					
	Maximum value		861	911	915	900	892
	Weighted average value		734	741	753	741	738
	Minimum value		641	627	601	573	606
14	Clinker substitution (Clinker to cement ratio)	%					
	Maximum value		95.0%	96.6%	96.7%	96.5%	97.6%
	Weighted average value		83.4%	84.2%	84.5%	83.4%	82.9%
	Minimum value		70.0%	63.2%	60.2%	63.3%	67.1%
15	Thermal energy efficiency	MJ/t clinker					
	Maximum value		4,788	4,752	5,172	5,194	5,193
	Weighted average value		3,598	3,602	3,708	3,673	3,698
	Minimum value		3,285	2,910	3,133	3,138	3,096
16	Electric energy efficiency for clinker production	kWh/t clinker					
	Maximum value		117.2	86.6	91.4	104.0	91.3
	Weighted average value		60.0	59.7	59.0	60.5	60.2
	Minimum value		31.6	33.9	33.7	35.5	34.7
17	Electric energy efficiency for cement production	kWh/t cement					
	Maximum value		117.2	119.7	133.9	125.5	123.7
	Weighted average value		92.2	88.6	84.6	84.3	84.2
	Minimum value		57.8	71.1	57.1	64.6	57.4

*t = metric tonne

Analysis can be performed from the data presented in the Vietnam cement energy and CO_2 database for comparative assessment among the cement companies as well as sector-planning and policy making. It could be used for benchmarking purposes and setting up Minimum Energy Performance Standards (MEPS) for the cement sector as illustrated in the figure below.

Figure 3-1: Performance Distribution Curve for the thermal energy consumption per ton clinker in year 2013



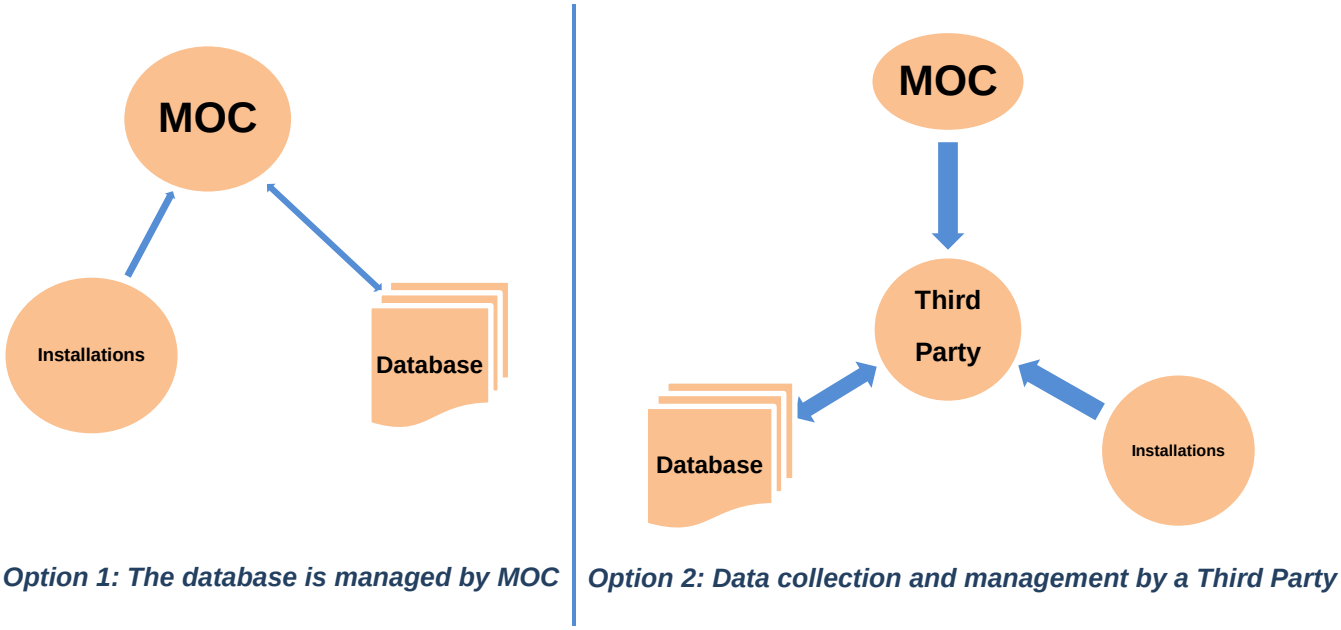
c) Summary of recommendations

Management of the sectoral database

To ensure on the one hand efficiency and transparency, but on the other hand sufficient confidentiality of a database system, it is important to have a good management methodology that fits to the country's circumstances and requires reasonable resources. The MOC will make the final decision on the methodology that then regulate on how the practices of the data collection, confidentiality agreement and management of database as well as reporting the results obtained from the database will be conducted.

The project study recommends two options for data collection and management methodologies that give an adequate balance between the objective of the system, the protection of confidential information, the speed of implementation, the likelihood of companies to participate and the roles and responsibilities of all involved stakeholders in order for the MOC to decide on.

Figure 3-2: Two models for database management



Option 1: The database is managed by MOC

Option 2: Data collection and management by a Third Party

This database should be periodically updated and compared to baseline and emission reduction projections during the NAMA development and implementation.

The data collection for updating the database shall be aimed at all operating cement companies. The MOC should have a detailed approach for data collection to the different groups of cement companies in order to increase the feedbacks from them. Furthermore, the MOC should set up a suitable rule to share the results obtained from the analysis of database to the cement companies who have provided the data. Such synthesized data is helpful for companies in their management decision-making processes so they will have stronger motivation to provide data at high quality and frequency. The publication of data should take into account the need for confidentiality of commercially relevant data at the plant level.

In a long term for the Readiness Stage (after ending this Pilot Project), the MOC should decide and develop an appropriate Option for data upgrading and management based on the two Options presented.

Furthermore, in NAMA Design Phase, because data on heat value are not provided sufficiently by cement plants the default heat value has been applied. In the future, with improved awareness and participation by cement companies, actual heat value should be collected and applied for calculations of energy and CO_2 emissions in order to improve the data accuracy.

3.2 MRV system

a) Country Context

To date, no consistent MRV system has been established and operated for the cement sector in Vietnam; hence no MRV institutional arrangement existed so far. Measurement is carried out mostly based on company's needs. Reporting of energy data and environment indicators to MOIT and provincial DONREs respectively, are required based on two laws: Law on Energy savings and Law on Environment protection. However, its measured data are still far from being sufficient for operating the MRV of the cement NAMA.

b) Summary of key findings

Set up the MRV system

The MRV system for the NAMA in the cement sector in Vietnam is structured into two sub-components including:

- ***MRV of GHG emissions (and emission reductions)***
- ***MRV of non-GHG parameters (including co-benefits and support)***

And it is divided into two levels, namely (1) *installation (plant) level* and (2) *sector level*.

At a plant level, the measurement of 29 indicators (similar to CSI indicators) on energy consumption and CO_2 emissions is current practiced as part of regular measurement activities in cement plants in Vietnam. Although the procedures and frequency for record and data archive are varied by cement plants, this measurement practice is a good starting point for a standard MRV in the cement sector. There are minor gaps in data needs at a plant level between the requirements in the designed MRV and the current practice at cement plants in Vietnam. The current measurement practice usually uses indirect methods. The biggest challenge here is to increase of the accuracy of data monitored. In order to improve the accuracy of reported data, additional installation of direct measurement devices and improvement in data management practice is required to ensure high data quality.

Based on the international standards and reflected the national circumstances of cement production in Vietnam, each measuring parameter and frequency, calibration frequency – to calibrate metering devices, purpose of each parameter at plant level and sectoral level have been described in the Reports I.2.5-6, I.4.1-2-3-4 and III.2.2-5 in the tables of each monitored parameter..

With regard to reporting, the reporting of data measured is mainly limited within a cement plant for management purposes but not to external entities (except to the VNCA for its members and mother companies of VICEM and foreign owned plants). Currently, there is no formal request to report such data to both local and national authorities.

The verification at a plant level is limited to the internal QA/QC but not yet involving an independent third party's verification mode.

The MRV system of GHG emissions at a cement plant level is based on the already existing practices at almost all cement plants in Vietnam.

The importance of non-GHG impacts is seen differently depending on the stakeholder. The selection of which non-GHG impacts to be MRV-ed very much depends on the consensus of the national authorities and international donors and the level of willingness and commitment of cement installations as well as the resources available to do MRV. Due to the different perceptions on the role of co-benefits, the question who pays for the co-benefit monitoring needs to be tackled. The companies should not be burdened, and thus it is suggested that the cement companies are reimbursed by the NAMA coordinator / MONRE for the monitoring outlays. These monitoring outlays should be accounted in calculating the budget request to implement a specific NAMA proposal in which the demand for co-benefits monitoring will be defined in details

Meanwhile, the designed MRV of co-benefits covers a much wider range including four major groups, namely: economic, social, environmental, and technological co-benefits with 10 parameters shall be monitored at sector-level and 7 parameters monitored at plant-level.

Table 3-2: Summary of Co-benefit Indicators

No.	Indicator	Chosen parameter	Monitoring
1	Leverage multiple	VND mobilized per VND of public funding provided for the project	Yearly *Project owners:* providing the plant's data of equity/loan mobilised for the project vs. funded sources *NOU:* synthesizing and calculating sectoral data
2	Foreign exchange saved	USD equivalent of foreign exchange saved compared to business-as-usual	Yearly *NOU:* synthesizing and calculating sectoral data mainly based on SN 3 reported by each cement plant
3	Reduced fossil fuel consumption	TOE saved differentiated by fuel type	Yearly *Project owner:* plant level *NOU:* synthesizing for sectoral level
4	Land use	Hectare of land freed due to the project. For example avoided land usage for dumping biomass or waste	Yearly *Project owner:* The volume of each alternative fossil fuel/Biomass fuel *Environment centre/DONRE and NOU:* calculating provincial and sectoral data accordingly
5	Number of jobs created	Number of jobs differentiated according to functions	Yearly *The project owner:* providing employment registry of plant and company
6	Number of indirectly created jobs	Number of jobs differentiated according to functions	Yearly *MONRE/statistical office:* providing statistical employment records
7	Health benefits	Disability adjusted life years gained	Yearly *MOH/statistical office*: Public health statistics
8	Air quality	Dust, exhaust gases, and other air pollutant	Continuous measurement, compiled annually *Project owner:* plant level *Environment centre*: synthesizing for provincial level *NOU*: synthesizing for sectoral level
9	Discharged water quality and quantity	m^3 discharged, Chemical Oxygen Demand (COD), Biochemical Oxygen Demand (BOD) and heavy metal content per m^3	Continuous measurement, compiled annually *Project owner:* plant level *Environment centre*: synthesizing for provincial level *NOU*: synthesizing for sectoral level

No.	Indicator	Chosen parameter	Monitoring
10	Technology transfer and technological self-reliance	- Source of technology applied in the project, if necessary disaggregated according to technology types - Number of training workshops provided by equipment suppliers and staff trained - Number of new technology imported from abroad - Training activities involving international experts	Once after investment has been completed (tech documentation), annually for training workshops *Project owners:* providing manufacture's documents *NOU*: synthesizing for sectoral level

Moreover, the MRV system of support shall be designed according to the specific requirements of the donors.

Overall, the application of the MRV system at a sector level is a new management practice for both the NAMA operating entity (MOC) and other relevant authorities, e.g. MONRE as the national focal point for climate change and overall NAMAs implementation and MOIT who is in charge of energy and industrial management, etc. The regular update on data of MRV system should be conducted at least on annually basis. This should be one of the major activities targeted in the following-up activities after ending this project.

c) Summary of recommendations

Institutional arrangements for MRV

To implement the designed MRV system at the plant level in Vietnam at the international standard, the highest priority is to standardize the MRV system and formally regulate the implementation of this MRV system at the plant level.

A new regulation on mandatory GHG reporting should be developed and adopted that regulates the major aspects including:

- description of the reporting procedure and requirements,
- mandatory reporting format for the companies to present the data in line with the centralized MRV system requirements,
- incentives for companies to provide reports.

We recommend to include GHG emission and emission reduction monitoring provisions in the revision of the current cement sector Master Plan.

To address the major gap in data needs and practices of MRV of non-GHG emissions at the sector level, MOC should take the leading role to propose a practice on designing and implementing the MRV at the sector level in a close consultation and consensus with other relevant authorities as well as the donors once they are identified.

A NAMA design should create sufficient incentives and/or rewards to cement plants/companies who voluntarily reduce their GHG emissions beyond business as usual. Such incentives will increase the willingness and commitment to perform MRVs from cement companies.

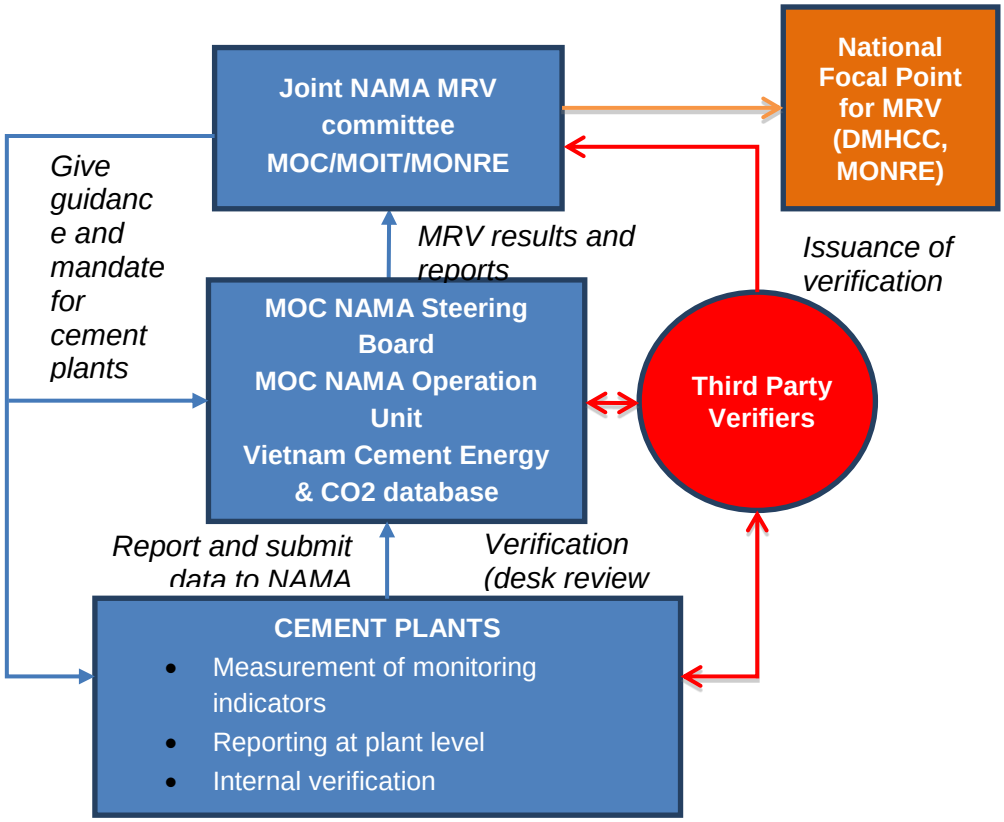
Providing suitable training, capacity building for technicians and people in charge in the cement plants on MRV should be conducted in parallel in order to achieve the effective and proper MRV practices as designed.

At the sectoral level, the basic technical infrastructure - the database that meets the international (CSI) standard has been set up under this project activity. The most challenging is to update the database at regular basis. The roles of MOC and different options to manage the database have been elaborated in the previous section.

The second challenge is to define a suitable structure and roles for entities to perform regular verification at both levels - plant and sector. To certain extents, MOC as a management agency of the MRV system could take over the task, especially at a plant level. However, it is highly recommended to allocate and regulate the verifications so that an independent third party(s) can perform the service that will reduce the burden on resource demands from the governmental budget on one hand and increase the transparency and creditability of the system on the other hand.

Appropriate MRV institutional arrangements for the desired MRV system for NAMA cement in Vietnam should be set up as shown in Figure 3-3.

Figure 3-3: Institutions for MRV NAMA cement in Vietnam



4 SCENARIOS AND MITIGATION OPTIONS

The baseline and emission scenarios are proposed in Report I.3 "Energy and CO_2 emission scenario analysis of the Viet Nam cement industry" and mitigation actions are analyzed and recommended in report I.5.2-4 "Various mitigation actions for the cement sector".

4.1 Scenarios

Historical energy consumption and CO_2 emission of Viet Nam cement sector

Based on the database of 47 cement plants described in the previous section, there are some findings on specific energy consumptions and GHG emissions from the cement sector of Vietnam as follows:

1) *Specific thermal energy consumption*

Specific thermal energy consumption of most cement plants in 2013 varied between 3,500 and 3,800 MJ/t clinker but that of the 10% most energy intensive production consumes as muchas 4'000 to 5,200 MJ/t clinker. This is a thermal consumption typical for old semi-wet and wet kilns but not for modern preheater/precalciner (PHPC) kilns.

The average thermal energy consumption of the sector is estimated at 3'700 MJ/t clinker.

2) *Specific electric power consumption*

The cement sectoral average electric power consumption is around 59 kWh/t clinker and 87 kWh/t cement with little variation over 5-years. This Viet Nam sector average electric power efficiency is 27% better than the worldwide averages and 12% better than the South East Asia averages (CSI GNR).

3) *Specific CO_2 emission*

The combination of a relatively high thermal energy intensity with CO_2 intensive fuels leads to high CO_2 emission varying between 880 and 890 kg CO_2 per t clinker, and between 725 and 750 kg CO_2 per t cement, about 15% higher than the global average.

4) *Total CO_2 emission*

In total, the estimated historical CO_2 emissions for the cement sector amount to approx. 4.6 $MtCO_2$ in 1995 and 46.2 $MtCO_2$ in 2013(applying the specific weighted average value of kg CO_2/t cement (equivalent) for the years 2009-2013). In average 94% of the emission is direct emission (process and thermal energy related), and about 6% relates to electricity consumption from the national power grid.

5) *Production capacity and Capacity Utilisation*

In 2013 the installed cement production capacity in Vietnam was almost 650 kg cement per inhabitant per year, but had already increased to about 800 kg/i/y by 2015. This results in a high and increasingly unsustainable excess production capacity. Despite clinker and cement export at depressed prices amounting to as much as 30% of production, the capacity utilisation remains below 80% capacity utilisation factor, which is long-term economically unsustainable. Report I.3 shows that most countries worldwide have less than 750 kg/i/y capacity and only a handful reach or exceed 1,000 kg/i/y.

Report I.3 has identified 18 scenarios in total (from "Viet Nam National Business-as-Usual", BAU, to "Best Available Technology and Practice", BATP) resulting from three production scenarios (1,200 kg, 800 kg and 650 kg cement per capita per year) and six energy and CO_2 intensity scenarios.

Report I.5.2-4 has selected the most appropriate scenarios (4 out of 18 scenarios) for mitigation options assessment. The four identified scenarios are based on:

- Viet Nam Cement Master Plan: projecting 1'200 kg cement per capita per year production including a cement export strategy combined with National Business-as-Usual with policy measures Intensity scenario **(VN-BaU-1200)**.
- Best Available Technology and Practice (BATP) Intensity scenario combined with the 1'200 kg cement per capita per year (Master Plan) production scenario **(BATP-1200).**
- Best Available Technology and Practice Intensity scenario combined with the more-balanced 800 kg cement per capita per year production scenario **(BATP-800).**
- Best Available Technology and Practice Intensity scenario combined with the most ambitious 650 kg cement per capita per year production scenario **(BATP-650).**

Taking account of the numerous comments received during the December 2015 and January 2016 stakeholder consultations, the first and most important recommendation from this project is to limit the cement installed capacity in Viet Nam. However, due to the new capacity that came in operation since 2014, the 650 kg scenario is already out-dated and even the 800 kg scenario has already been reached. Hence, following the request of PMU a *preliminary* estimation of the BATP-1000 scenario with 1,000 kg cement production capacity per inhabitant per year has been added in this final report. More details on the BATP-1000 scenario can be found in Annex A of this report.

4.2 Mitigation options

1) Analysis from international experience and global best practice

CSI and ECRA (2009) provides an overview of 33 technologies to reduce energy consumption and CO_2 emissions, not limited to currently economically available existing technologies but also including a series of options that could be developed over the next decades. Each technology is described by a specific Technology Paper (TP), and categorized into respective State of the Art Papers (SAP) which summarize the expected development in the major technological fields, namely thermal energy efficiency, electric energy efficiency, use of alternative fuels and biomass, reduction of the clinker content in cement, and CO_2 capture and storage.

The "Getting the Numbers Right" database (GNR) of the Cement Sustainability Initiative (CSI) of the World Business Council for Sustainable Development (WBCSD) contributes to quantification of the achievable performance levels of the Key Performance Indicators and this is also the basis for the Viet Nam cement sector database.

Based on these above-mentioned documents and two official documents mention best achievable techniques and practices for environmental protection: The European Union BAT Reference document dated 26 March 2013 (*EU BAT 2013*) and two BAT reference documents from UNEP (*UNEP/CHW, 2011* and *UNEP/SC, 2011*), and combined with the professional industrial and regulatory experience and knowledge of the authors, the Consultant has described the various theoretical technical mitigation options, their costs and benefits and the potential and barriers to their implementation in Vietnam. The study leads to the ranking of different mitigation from high priority to low priority as follows:

Table 4-1: Ranking of mitigation options for NAMA cement

Best potential – First priority	Uncertain potential – Secondary priority	Low potential option
Thermal Energy Efficiency (SAP 1)		
1. Process knowhow, control and management – Economy of scale 2. Diagnostic energy Audits 3. Installation and utilisation of modern automation and control system	4. Additional Pre-heater cyclone 5. Clinker cooler modification 6. Adding a pre-calciner to an existing pre-heater kiln	7. Changing from wet or long dry to PHPC technology 8. Increase of the kiln capacity 9. Oxygen enrichment technology
Fuel switch and Alternative fuels (SAP 3)		
1. Best Available Practice for Alternative Fuels 2. Best Available Technology for Alternative fuels 3. Infrastructure for alternative fuels storage, dosing, feeding and burning 4. Multi channel burner 5. Product and process control systems	6. Shredding, mixing and blending waste pre-treatment installations 7. Mechanical and Biological Treatment of Municipal Solid Waste 8. Sewage sludge drying 9. Installation of chlorine bypass system at the clinker kiln	10. Traditional fossil fuels switch (from coal to gas or oil)
Lowering the clinker content in cement (SAP 4)		
1. Optimising the ratio of clinker production and cement grinding installed capacity 2. Granulated Blast Furnace Slag as cement constituent: investment in slag granulation at blast furnaces of the Vietnamese iron and steel industry 3. Fly Ash as cement constituent	4. Pozzolana as cement constituent 5. Limestone as cement constituent	
Other options		
1. Cement grinding with vertical roller mills and roller presses 2. Variable speed drives 3. Waste Heat Recovery 4. Alternative, decarbonated raw materials for clinker production 5. Separate grinding of raw material components 6. Impact of very high or very low lime saturation factor 7. Other R&D options		

2) MAC analysis

Marginal abatement cost (MAC) analysis is part of multi-criteria analysis, to help decision makers cut through the complexity of mitigation efforts of climate change. This type of tools helps analyse the cost effectiveness of the mitigation options available, considering their GHG emission reduction potential and the associated marginal abatement cost that would result from their implementation.

In consultation with relevant stakeholders, the team has conducted an in-depth assessment with a number of criteria to ensure the applicability and technical appropriateness to the Viet Nam's context and selected 12 out of 40 options for MAC analysis as follows:

Table 4-2: Selected mitigation options for MAC analyses

1. Thermal energy efficiency of clinker production	1a) Process knowhow, control and management	1b) Diagnostic energy audits	2) Modern automation and control systems	3) Clinker cooler modification	4) WHR	5) Adding a pre-calciner to existing pre-heater kiln	6) Additional Pre-heater cyclone
2. Alternative fuels	7a) Best Available Technology (BAT) for Alternative fuels - replacing fossil fuels		7b) Best Available Practice (BAP) for Alternative fuels - replacing fossil fuels		8) Retrofit to modern multi-channel burner		
3. Lowering the clinker content in cement	9) Blending: GBFS as cement constituent		10) Blending: Fly ash as cement constituent		11) Blending: Pozzolana	12) Blending: Limestone	

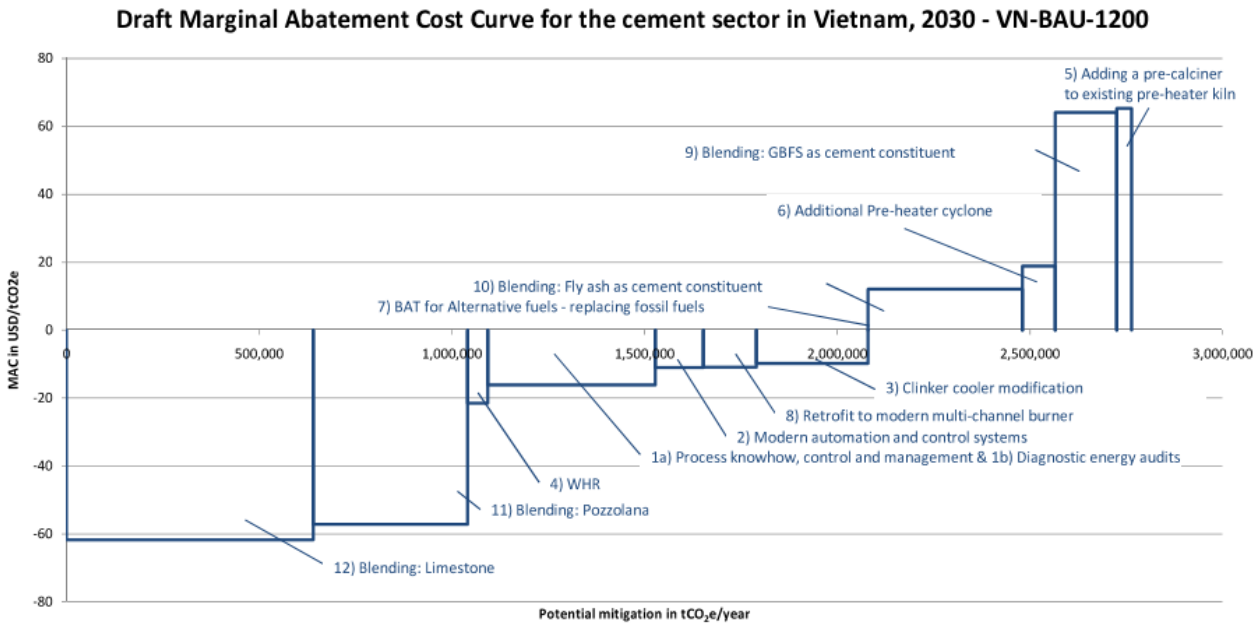
The results of the MAC analysis show that most mitigation options have negative MAC, which means they are economic viable. The most attractive option is the blending of limestone and pozzolana, as the material is rather favourable compared to clinker and no additional investment costs are required. WHR appears quite beneficial, but only larger plants with reasonable amount of recoverable heat are considered.

Scenario VN BaU-1200:

By implementing all options in scenario VN-BAU-1200, the total emission reductions expected would be 4.9 million tCO_2 by 2020 and 40 million tCO_2 by 2030, respectively. The total initial investment required for all 12 options would be around US$ 253 million.

VN BaU-1200	**Marginal Abatement Cost**	**Mitigation Potential**	**Cumulative Mitigation Potential 2020**	**Cumulative Mitigation Potential 2030**	**Initial Investment**
	USD/tCO_2e	*mil.tCO_2e/a*	*mil.tCO_2e*	*mil.tCO_2e*	*mil.USD*
1a) Process knowhow, control and management & 1b) Diagnostic energy audits	-16	0.44	0.62	6.53	6.80
2) Modern automation and control systems (TP 8)	-11	0.12	0.24	1.87	11.00
3) Clinker cooler modification (TP4)	-10	0.29	0.58	4.34	28.60
4) WHR (TP5)	-22	0.05	0.10	0.79	50.57
5) Adding a pre-calciner to existing pre-heater kiln	65	0.04	0.07	0.57	66.00
6) Additional Pre-heater cyclone (TP6)	67	0.04	0.07	0.53	64.35
7) BAT for Alternative fuels - replacing fossil fuels (TP10)	0	-	-	-	-
8) Retrofit to modern multi-channel burner (TP13)	-19	0.08	0.15	1.17	8.80
9) Blending: GBFS as cement constituent (TP21)	-46	0.16	0.30	2.40	2.40
10) Blending: Fly ash as cement constituent (TP24)	-47	0.40	0.76	6.00	5.76

Figure 4-1: MACC considering current plants under VN-BaU-1200



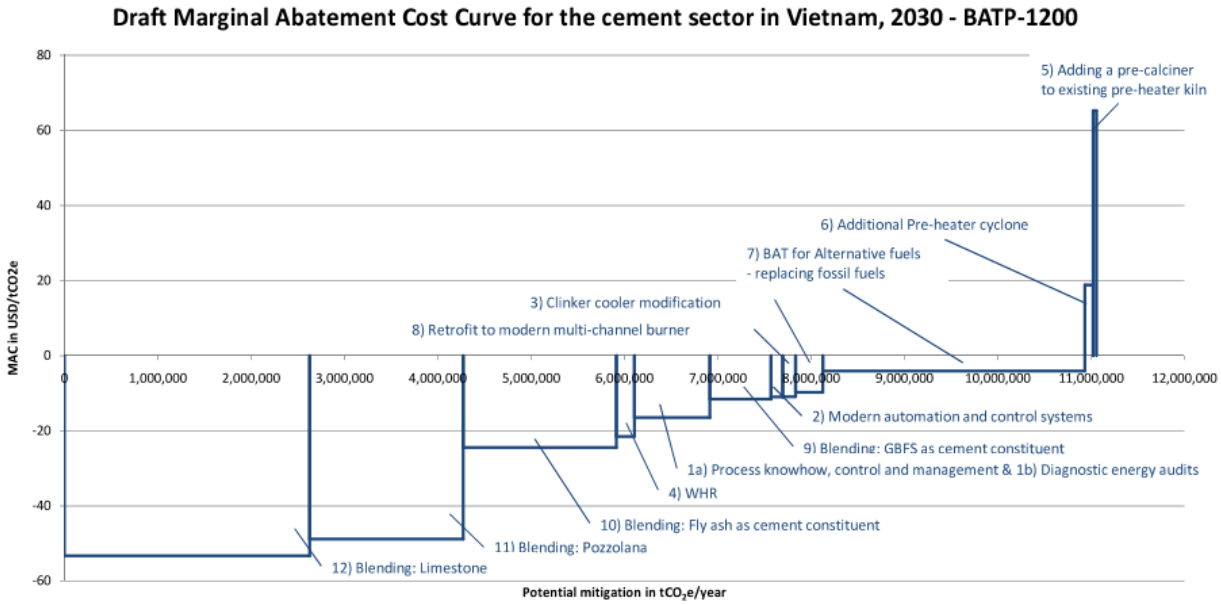
Scenario BATP-1200

A "true" mitigation scenario, BATP-1200, is presented in following table with significant contributions to the reduction of GHG emission in the sector through the implementation of the same 12 options but at a higher level of magnitude. By implementing all options in scenario BATP-1200, the total emission reductions expected would be 20 million tCO_2 by 2020 and 164 million tCO_2 by 2030, respectively. The total initial investment required for all 12 options would be around US$ 906 million.

BATP-1200	Marginal Abatement Cost	Mitigation Potential	Cumulative Mitigation Potential 2020	Cumulative Mitigation Potential 2030	Initial Investment
	USD/tCO2e	*mil.tCO2e/a*	*mil.tCO2e*	*mil.tCO2e*	*mil.USD*
1a) Process knowhow, control and management & 1b) Diagnostic energy audits	-16	0.81	1.15	12.11	8.00
2) Modern automation and control systems (TP 8)	-11	0.12	0.24	1.87	11.00
3) Clinker cooler modification (TP4)	-10	0.29	0.58	4.34	28.60
4) WHR (TP5)	-22	0.19	0.36	2.89	186.24
5) Adding a pre-calciner to existing pre-heater kiln	65	0.04	0.07	0.57	66.00
6) Additional Pre-heater cyclone (TP6)	67	0.04	0.07	0.53	64.35
7) BAT for Alternative fuels - replacing fossil fuels (TP10)	-4	2.81	5.31	42.15	517.00
8) Retrofit to modern multi-channel burner (TP13)	-19	0.08	0.15	1.17	8.80
9) Blending: GBFS as cement constituent (TP21)	-38	0.66	1.24	9.86	2.40
10) Blending: Fly ash as cement constituent (TP24)	-39	1.64	3.11	24.64	5.76

11) Blending: Pozzolana (TP25)	-49	1.64	3.11	24.64	2.40
12) Blending: Limestone	-53	2.63	4.97	39.42	5.57

Figure 4-2: MACC considering current plants and avoided capacity addition through blending (BATP-1200)



Scenarios BATP-800 and BATP-1000

Similarly, in the situation that the Master Plan would be adjusted to lower cement per capita (800 kg/inh/y or 1000 kg/inh/y), by implementing all options in scenarios BATP-800 and BATP-1000 the total emission reductions expected would be 17 million tCO_2 by 2020 and 138 million tCO_2 by 2030 (BATP-800), or 14 million tCO_2 by 2020 and 112 million tCO_2 by 2030 (BATP-1000). However, the mitigation potential would be added up by the avoided emissions of 33 million tCO_2/y (BATP-800) or 17 million tCO_2/y (BATP-1000) from reducing clinker production. The total initial investment required for all 12 options would be around US$ 903 million for BATP-800 and US$ 906 million for BATP-1000.

BATP-800	**Marginal Abatement Cost**	**Mitigation Potential**	**Cumulative Mitigation Potential 2020**	**Cumulative Mitigation Potential 2030**	**Initial Investment**
	USD/tCO2e	*mil.tCO2e/a*	*mil.tCO2e*	*mil.tCO2e*	*mil.USD*
1a) Process knowhow, control and management & 1b) Diagnostic energy audits	-17	1.02	1.45	15.25	8.40
2) Modern automation and control systems (TP 8)	-11	0.12	0.24	1.87	11.00
3) Clinker cooler modification (TP4)	-10	0.29	0.58	4.34	28.60
4) WHR (TP5)	-22	0.19	0.36	2.89	186.24
5) Adding a pre-calciner to existing pre-heater kiln	65	0.04	0.07	0.57	66.00
6) Additional Pre-heater cyclone (TP6)	67	0.04	0.07	0.53	64.35
7) BAT for Alternative fuels -	-4	2.81	5.31	42.15	517.00

BATP-800	Marginal Abatement Cost	Mitigation Potential	Cumulative Mitigation Potential 2020	Cumulative Mitigation Potential 2030	Initial Investment
	USD/tCO2e	*mil.tCO2e/a*	*mil.tCO2e*	*mil.tCO2e*	*mil.USD*
replacing fossil fuels (TP10)					
8) Retrofit to modern multi-channel burner (TP13)	-19	0.08	0.15	1.17	8.80
9) Blending: GBFS as cement constituent (TP21)	-9	0.46	0.87	6.93	2.40
10) Blending: Fly ash as cement constituent (TP24)	-10	1.16	2.18	17.33	5.76
11) Blending: Pozzolana (TP25)	-19	1.16	2.18	17.33	2.40
12) Blending: Limestone	-24	1.85	3.49	27.73	5.57

BATP-1000	Marginal Abatement Cost	Mitigation Potential	Cumulative Mitigation Potential 2020	Cumulative Mitigation Potential 2030	Initial Investment
	USD/tCO2e	*mil.tCO2e/a*	*mil.tCO2e*	*mil.tCO2e*	*mil.USD*
1a) Process knowhow, control and management & 1b) Diagnostic energy audits	-17	1.02	1.45	15.25	8.40
2) Modern automation and control systems (TP 8)	-11	0.12	0.24	1.87	11.00
3) Clinker cooler modification (TP4)	-10	0.29	0.58	4.34	28.60
4) WHR (TP5)	-22	0.19	0.36	2.89	186.24
5) Adding a pre-calciner to existing pre-heater kiln	65	0.04	0.07	0.57	66.00
6) Additional Pre-heater cyclone (TP6)	67	0.04	0.07	0.53	64.35
7) BAT for Alternative fuels - replacing fossil fuels (TP10)	-4	2.81	5.31	42.15	517.00
8) Retrofit to modern multi-channel burner (TP13)	-19	0.08	0.15	1.17	8.80
9) Blending: GBFS as cement constituent (TP21)	-26	0.55	1.05	8.31	2.40
10) Blending: Fly ash as cement constituent (TP24)	-26	1.38	2.62	20.77	5.76
11) Blending: Pozzolana (TP25)	-36	1.38	2.62	20.77	2.40
12) Blending: Limestone	-40	2.22	4.19	33.24	5.57

Figure 4-3: MACC considering current plants and avoided capacity addition through blending (BATP-800)

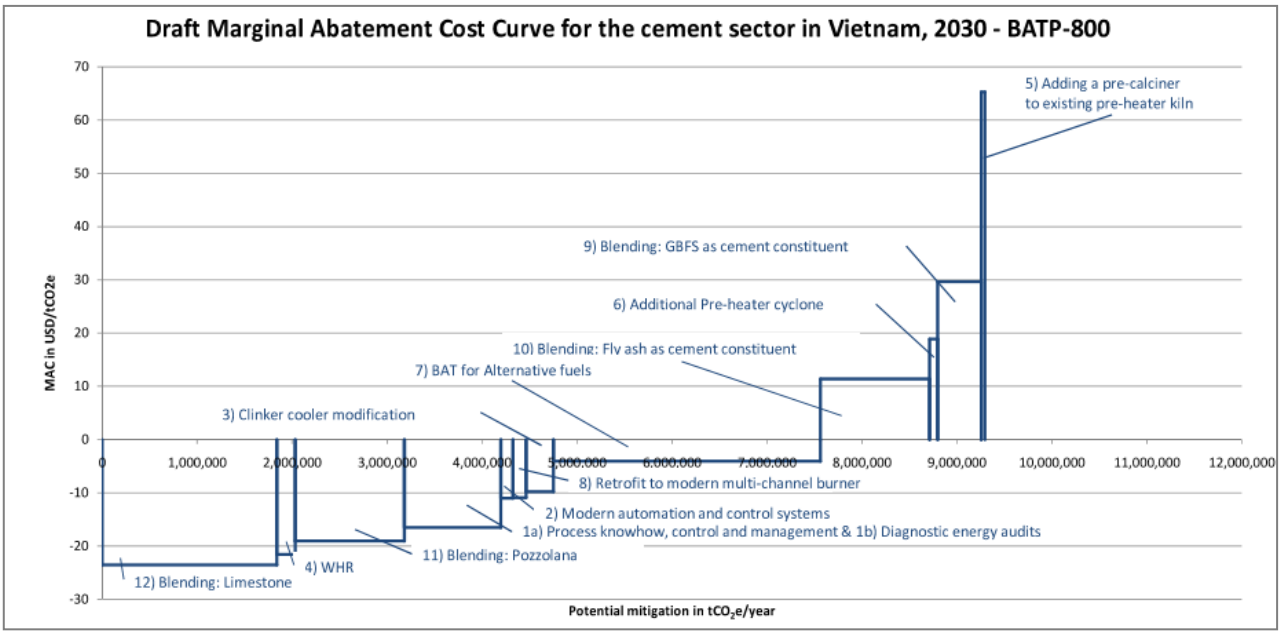
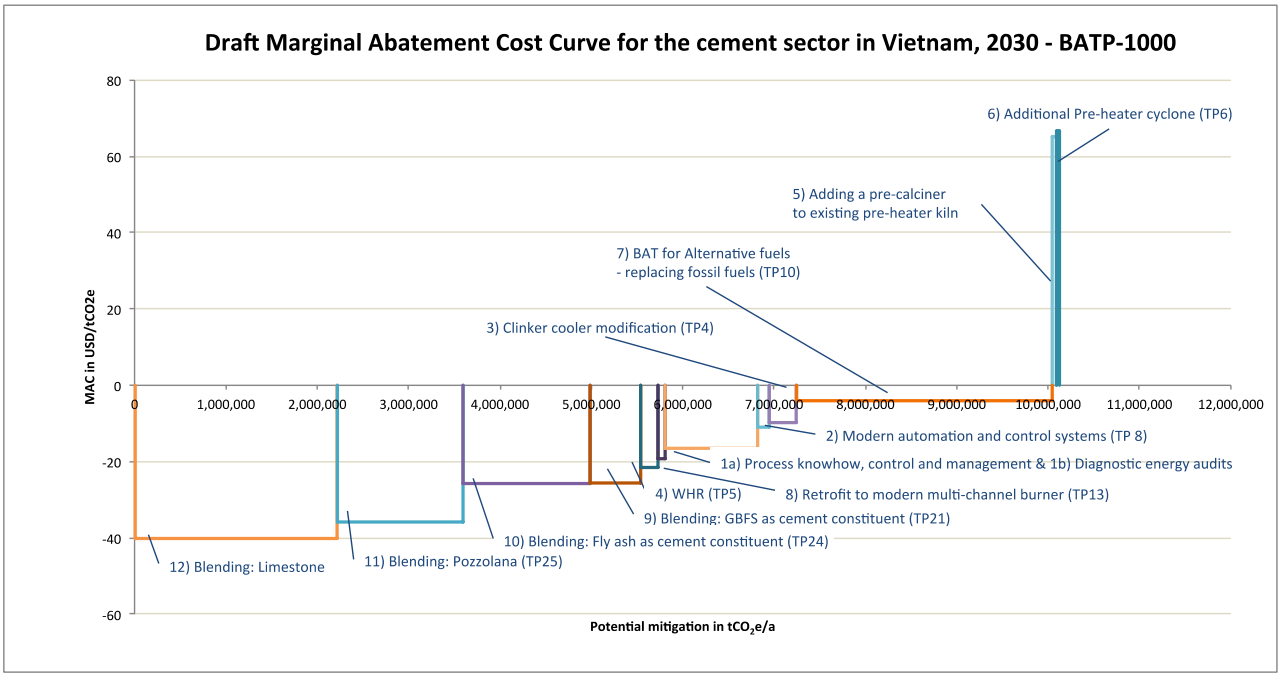


Figure 4-4: MACC considering current plants (BATP-1000)



Summary of recommendations:

This MACC study reveals that the most effective and cost efficient energy and CO_2 mitigation levers are (in order of decreasing CO_2 mitigation potential):

1. To limit the cement production capacity to about 800 or maximum 1,000 kg cement per inhabitant per year and refrain from building excess new clinker installations that expand Vietnam's cement production capacity to 1,200 kg cement per capita per year, which is an economically and environmentally unsustainable high production volume.

2. To reduce the sector average content of clinker in cement from the current 83% to about 69%, making a portfolio of cement products with more slag, fly ash, pozzolana and limestone as main constituents.
3. To substitute coal by alternative, waste and biomass derived fuels.
4. To improve thermal energy efficiency by roughly 9% mainly through measures of management and operational best practice, requiring limited upfront investment in equipment.

5 LEGAL AND INSTITUTIONAL FRAMEWORK

The legal and Institutional framework are described under Report I.5.1 for policy assessment; 1.6.3 and 1.4 for NAMA & MRV Institutional arrangements; and Report 1.7.4 for projects/programs that are relevant for coordinating with NAMA cement regarding financial resources.

The selected methodology to carry out the tasks is based on an integration of bottom-up and top-down approach focusing on gap analysis between current and desired framework. Together with studies of international best practices and experience, the outcomes of gap analysis will serve the Consultant to come up with recommendations to fill in these gaps.

5.1 Legal Framework

5.1.1 Current status of the Legal framework in the cement sector of Vietnam:

1) The role of MOC

MOC is the Ministry responsible for public management of the cement industry, in charge of developing and proposing the development of Master Plan of the cement industry to the Prime Minister for approval and supervises its implementation upon approval. MOC also proposes mechanisms and policies for the sustainable development of the cement industry. MOC needs to cooperate with MONRE and MOIT in the assessment of mineral mining use and application for the cement production. And finally, MOC bears also the responsibility to promulgate technical regulations for the production of cement.

2) The key climate change related legal documents for cement sector

The Law on Energy Efficiency and Conservation (EE&C): Under this law, the cement plants are categorized as high energy intensive facilities and the plants have to carry out the energy audit and reporting energy data to MOIT periodically.

The new Law on Environment Protection (LEP): In terms of climate change and green growth, the law stipulates that the ministries are responsible for incorporate its master plan with GHG emissions reduction strategy and action plan. MONRE in collaboration with different ministries will take actions for monitoring, reporting and verification of GHG emissions. The revised LEP also regulate the integration of climate change response and green growth into socio-economic strategies and plans, sectorial development plan.

The National Climate Change Strategy (NCCS): For a country particularly vulnerable to the effects of climate change and sea level rise like Vietnam, mainstreaming this issue into development plans ministries, agencies and localities is one of the highest priorities in responding to climate change. The strategy states as specific objective that a low-carbon economy and green growth will become a primary trend in sustainable development

Vietnam Green Growth Strategy (VGGS) and MOC Green Growth Action Plan: On September 25, 2012 the Prime Minister approved the Vietnam Green Growth Strategy and Action Plan (VGGS-AP) which sets forward emission reduction targets:

- For the period 2011-2020 to reduce intensity of GHG emissions by 8-10% as compared to 2010, reduce energy consumption per unit of GDP by 1-1.5% per year and reduce GHG emissions in the energy sector by 10% relative to BAU and by a further 10% with international support;
- Orientation towards 2030: Reduce GHG emissions by 1.5-2% per year. Reduce GHG emissions in the energy sector by 20% relative to BAU and by a further 10% with international support;

- Orientation towards 2050: Reduce GHG emission by 1.5-2% per year.

MOC shall allocate resources to develop its ministerial action plan for the construction sector in general and cement sector in particular based on the process of setting up targets, analysis of MACC, consultation and recommended actions. Target to reduce GHG emission in cement sector should be set forward. GHG emission target for key sectors including cement should be set in the action plan and the action to meet the target should be taken from the result of the NAMA cement projects.

MOC Climate Change Action Plan (MOC CCAP): The MOC CCAP set out 3 mains targets including assessment of sea-rising and climate change with the construction sector, capacity building for Climate change adaption and finally reducing GHG and energy consumption in building material sub-sector; promoting Green building, Green community. The document provides a list of program that shall be implemented for the period 2014-2020, of which programs relating to cement GHGs are energy audit; GHG emissions assessment; Energy efficiency and energy saving solutions; fuel-based energy replacement; technology modernization.

Decision No. 1696/QD-TTg issued by the Prime Minister, on solution for treatment of ash, slag, and gypsum from coal fired power chemical, fertilizer plants to produce building materials: The decision decides some solutions for treatment of the industrial wastes for use in building material production. The goal is to treat the large volume of wastes produced by coal fired power, chemical and fertilizer plant to be able to use as building materials, define road map for these plants invest in their owned waste management, limit import of gypsum and develop domestic market for handling these wastes.

3) *The Master Plan for development of Vietnam cement industry for the period 2011-2020, and vision to 2030 the most strategic document to regulate the Vietnam cement sector;*

The Master Plan for the development of Vietnam cement industry for the period 2011- 2020 and vision to 2030 (Cement Master Plan) sets actions for development of cement industry sector in Vietnam also including actions that could reduce GHG emissions. The Cement Master Plan sets development overview as follows: using advanced technology with high level of automation, maximally saving raw material and energy in production, continuing the conversion of vertical kiln cement production technologies to rotary kiln technologies with an aim of stopping the use of vertical kilns in 2015, investing into WHR to generate electricity and studying co-processing industrial waste and municipal waste as fuel for energy saving and environmental protection.

More specifically, the Cement Master Plan sets a target for cement plants with the capacity of 2,500 tons clinker/day or more to own-produce 20% of its electricity consumption from 2014 onwards and agrees timeframes for cement plants to investing into WHR systems. Also, in regards to co-processing of wastes, the Cement Master Plan directs the cement plants to invest into co-processing of industrial and municipal solid wastes as fuel for energy saving and environmental protection. Also, the use of industrial waste such as fly ash from coal fired power plants or slag generated from steel or other industrial plants is encouraged with the targets of using 15-20 million tons in a year.

The Cement Master Plan was developed in 2011, projecting 1’200 kg cement per capita per year production including a cement export strategy. However, as analysed in the previous section, 1’200 kg cement per capita is an economically and environmentally unattainable high production volume. It’s recommended to limit the cement production capacity to about 650 to 800 kg cement per inhabitant per year and refrain from building excess new clinker installation that can be stated in the revision of the Cement Master Plan.

5.1.2 Key findings

1) *Insufficient enforcement mechanism*

The Cement Master Plan provides a potential framework for a target based approach, although it currently does not contain any GHG or energy efficiency targets. Moreover, the Cement Master Plan does not currently have legislative force and is not legally binding on either the government or industry. There is insufficient enforcement mechanism to ensure the goal and target stated in this document. Regarding MRV procedure, there exist no protocols to verify the data submitted by the plants to the authorities except the electricity consumptions, and the current legal framework does not provide any enforcement mechanism in case the plants do not submit or only submit inadequate data.

Other policies that could incentivize reductions in energy consumption and GHG emissions are the Energy Efficiency and Conservation Law and the Law on Environmental Protection, although it should be noted that neither piece of legislation directly aims at the reduction of GHG emissions. Moreover, enforcement of these laws is only partial and needs further attention for their aims to be achieved.

2) *Lack of incentives for mitigation actions in cement sector*

There is lack of incentives for cement plant to invest in energy efficiency solution, use alternative fuels, and blend more slag and fly ash. Existing document such as the decision No. 1696/QD-TTg has not been actively and strictly implemented due to insufficient enforcement mechanism but also lack of incentives for stakeholders.

3) *There is insufficient coordination between the MOC and other ministries regarding energy and GHG emission data*

Under the Law on Energy Saving and Conservation, MOIT has released some circulars specifying Minimum Energy Performance Standards (MEPS) for electrical products, transportation vehicles. MOIT also carried out industrial sectors energy benchmarking and set Specific Energy Consumption (SEC) for some industrial products, for example: chemicals, steel. Some other industrial sector is under development: Pulp & Paper, Steel, Plastic, and Beverage. Cement sector is one of the highest energy consumption; however, the development of SEC for cement sector is not in the planning. The cement sector is under the line management of MOC, thus, it has to be developed under collaboration MOC-MOIT.

5.1.3 Recommendations to enhance the Legal framework

1) *Carbon emission and Energy consumption Target:*

The targets for energy consumption and CO_2 emissions for cement sector should be stated clearly and consistently in all legal and regulations documents including Master Plan, MOC Climate Change Action Plan, MOC Green Growth Strategy and Action Plan. In order to archive such targets, MOC may consider proposing the cement stakeholders to implement mitigation options as studied in this programme.

2) *MRV obligation*

A joint circular should be created to give guidance on the cement plant for reporting energy and GHG emission data to relevant authorities. Such a circular would simplify cement plants reporting works and create consistence database for sectoral management purposes. This body may organise under a working group form that includes representatives from three ministries, namely MOC, MOIT and MONRE.

3) *Enforcement Protocol*

Enforcement protocols, including penalties should be established for non-compliances in relation to mitigation action and MRV obligation. The level of penalty should be sufficient to incentivise the compliance.

4) Incentive mechanisms

MOC may consider elaborating further on supporting policy to create incentive for cement plant to invest in mitigation options. Suggested mechanisms are Climate Change Levy, Climate Change Agreements with cement sectors or Energy Savings Opportunity Scheme. However, such policy or mechanism can only be implemented effectively with a strong institutional and legal framework, including MRV obligation and enforcement protocol as above mentioned.

5) New standards and regulations regarding PCB, slag and fly-ash

In order to promote using of blast furnace slag and fly ash to reduce clinker ratio and CO_2 emissions, MOC may consider to strictly and actively implement the solutions regulated in the decision no. 1696/QD-TTg; establish mechanism for dividing value of using slag/fly ash/gypsum in building materials; set up new standards for fly ash cements and new code for application of the fly ash cement in construction; application of green label criteria in Vietnam.

5.2 Institutional framework

5.2.1 Current status of the Institutional framework in regard to NAMA implementation in cement sector of Vietnam

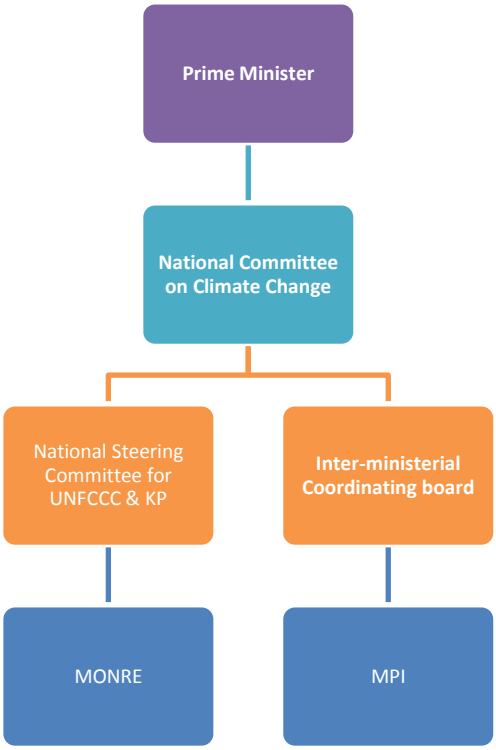
In accordance with **Decision No. 43/QD-TTg** dated 09 January 2012 issued by the Prime Minister, a National Committee on Climate Change (NCCC) has been established in order to assist the Prime Minister in:

- carrying out Climate Change research;
- making recommendation to the PrimeMinister about CC adaptation and mitigation activities;
- management and collaboration among Governmental agencies including ministries for the implementation of inter-sector strategies, national target program on CC, green growth program, energy efficiency, and other CC related programs;
- management of international cooperation programs and mobilization of donors' funding for CC activities;
- Issuing governmental legislative framework for Climate Change issues.

Under this National Committee, there are Steering Committees that are in charge of Climate Change and Green Growth Strategies:

- The National Steering Committee for UNFCCC & KP -Headed by the Minister of MONRE: The Committee will assist MONRE in performing these tasks related to GHG emission management and carbon credits management program as well as other activities under UNFCCC & KP.
- Under Green Growth Action Plan framework, an Inter-ministerial Coordinating Board (ICB) for implementation of the GGS is being established under the National Committee on Climate Change to direct the implementation of the green growth strategy. The Board will have the Deputy Prime Minister as its Head. The Minister of Planning and Investment will be the Standing vice Head of the Inter-ministerial Coordinating Board and four other vice-Heads are leaders of ministries: Finance, Industry and Trade, Agriculture and Rural Development, Natural Resources and Environment. ICB members include representatives of some ministries, sectors and local authorities and representative of some associations. The supporting office for the ICB is located in the MPI.

Figure 5-1: Institutional Framework for NAMA Implementation



NAMA related issues including institution, MRV and finance are still in readiness development phase:

The Ministry of Natural Resources and Environment (MONRE) as the focal point for climate change in Vietnam shall develop an overarching MRV system and supporting framework for all NAMAs in Vietnamincluding institutional arrangements for coordination of NAMAs (with a possibility of establishing a specialized service centre) and centralized NAMA knowledge management system NAMA.

The Ministry of Planning and Investment (MPI) was designated as National Designated Authority (NDA) for Green Climate Fund (GCF) – a financing mechanism of the UNFCCC. MPI will approve NAMA project/program and facilitate/coordinate the communication between different stakeholders. Projects can be submitted to the GCF through so-called Implementing Entities (IEs) or Intermediaries (both also called as Accredited Entities). These entities could be international, regional or national, public or private organizations. The accreditation procedure to approve one entity as IE by GCF takes at least 6 months. The only candidate right now is Vietnam Development Bank (VDB).

Other ministries and provinces including the MOC are responsible for developing their own GHG reduction programs and incorporate them into the sector strategies/action plans/social-economic planning in accordance with the VGGS.

5.2.2 Recommendations to enhance the Institutional framework:

1) A non centralized model for NAMA institutional set-up

The institutional set-up for NAMA cement should be based on a non-centralized model: MOC operates and manages the daily activities of NAMA cement; other ministries shall support MOC in supporting issues of NAMA, including NAMA MRV (MONRE/MOIT), NAMA framework (MONRE), reporting procedure to UNFCCC (MONRE), financing arrangement and disbursement (MPI and MOF).

2) NAMA Operating Unit under MOC

A NAMA Operating Unit should be established within MOC to regulate and implement NAMAs under MOC's supervision, including NAMA cement. MOC will be responsible for managing the stakeholders, setting up policies, establishing standards for cement stakeholders. This Unit also represents MOC to hold the authority to collect data from cement stakeholders to conduct the MRV in accordance with MONRE's MRV framework. A Joint NAMA MRV Working Group (MONRE/MOIT/MOC) will issue a Joint Ministerial Circular (as above mentioned in the legislation framework to mandate the reporting and relevant quality criteria

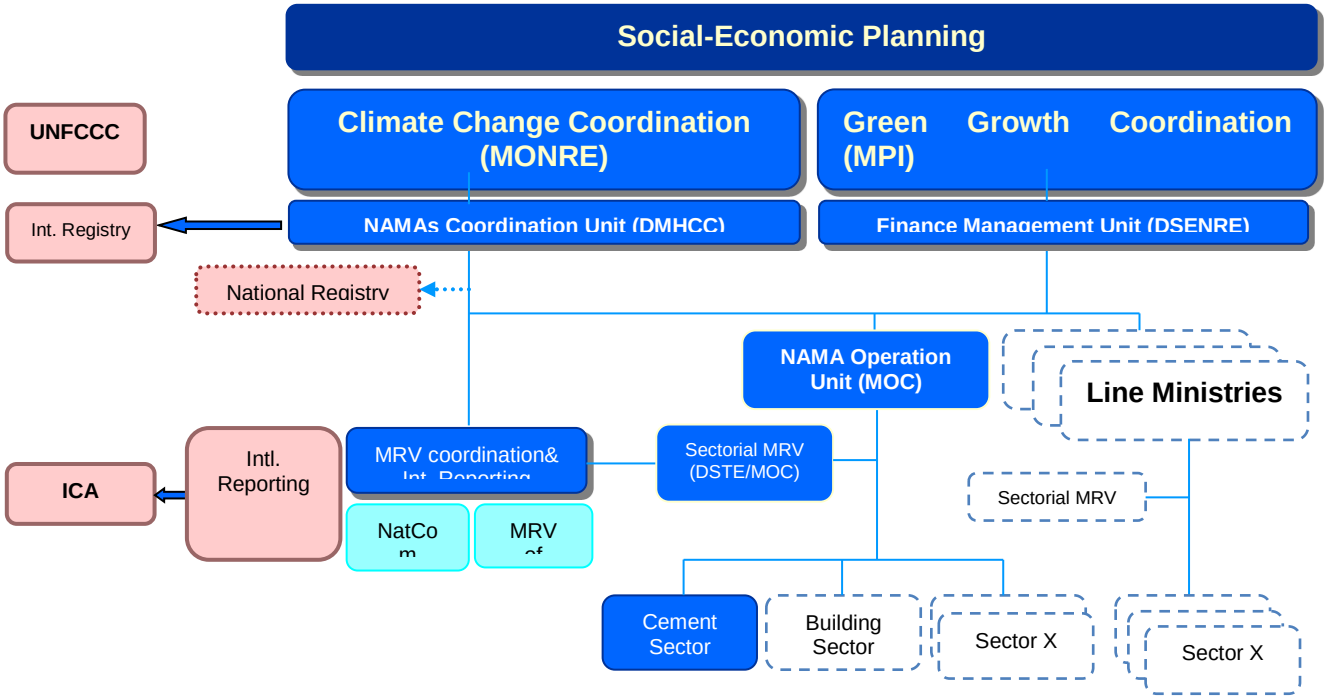
3) Integration of NAMA cement into the national development planning process

The Cement NAMA, like other mitigation programs shall be integrated in development planning processes (Social-economic plan) with the responsibility for implementation lying with the ministries responsible for policy-making. Coordination among responsible ministries to ensure synergies and alignment with the national climate change/green growth/energy policies will be an important task for NAMA institutional setting-up. The Cement NAMA whose activities are coordinated by NAMA Operating Unit shall coordinate with other ministries at higher level to ensure that the activities under the NAMA are embedded in other national program, especially the budget's allocation and approval. The Consultant team proposes that MOC shall do the coordination through Green Growth Inter-ministerial Coordinating Board – which is established under the National Committee on Climate Change to manage the implementation of Green Growth Strategy.

The Consultant team proposes a decentralized institutional model for operating the NAMAs in Vietnam with the highest policy document is the Social-Economic Planning that directs the strategy of both Climate Change and Green Growth programs. The National NAMA Coordination Unit is under MONRE and the Finance Management Unit is under the management of MPI. The two agencies will support NAMA Operating Unit under MOC to implement NAMA cement for MRV/national and international reporting and financial management.

The following figure and table describes the NAMA and MRV institutional arrangements as well as details of functions of each entity:

Figure 5-2: Recommended NAMA institutional arrangement



Source: Report I.6.3

Table 5-1: Recommended functions of ministries for coordinating NAMA activities

NAMA institution	Responsible authority	Responsibilities
Climate Change Coordination	**MONRE**	Establish the national climate change policy Accountability for implementation of CC strategies and accountable to National Climate Change Committee
Green Growth Coordination	**MPI**	Establish the national green growth strategy Accountability for implementation of GG strategy and accountable to the Prime Minister
NAMAs coordinating unit	**MONRE**	UNFCCC focal point for NAMA Accountability for BURs and INDC reporting Approve NAMA proposals
MRV Coordination and International reporting	**MONRE**	Development of guidelines for sectorial MRV Coordinating MRV NAMAs from line ministries and process to international reporting Accountability for INDC
Climate Finance Coordination Unit	**MPI**	Evaluate the NAMAs to ensure their consistency with national policy and international requirements Mobilize funds and financial resources for NAMAs Coordinate various financial resources for NAMAs
State budget and finance management unit	**MOF**	Manage the state budget financial management procedure
NAMA Operating Unit	**Line ministries**	Accountability for NAMA design and NAMA operating. Supervising the NAMA executing entities Responsible for data collection and sectorial MRV Reporting to MPI and MONRE about the implementation of all NAMAs within the sectors

5.2.3 Recommendations for national submission & evaluation procedure

Figure 5-3: Recommended national submission procedure

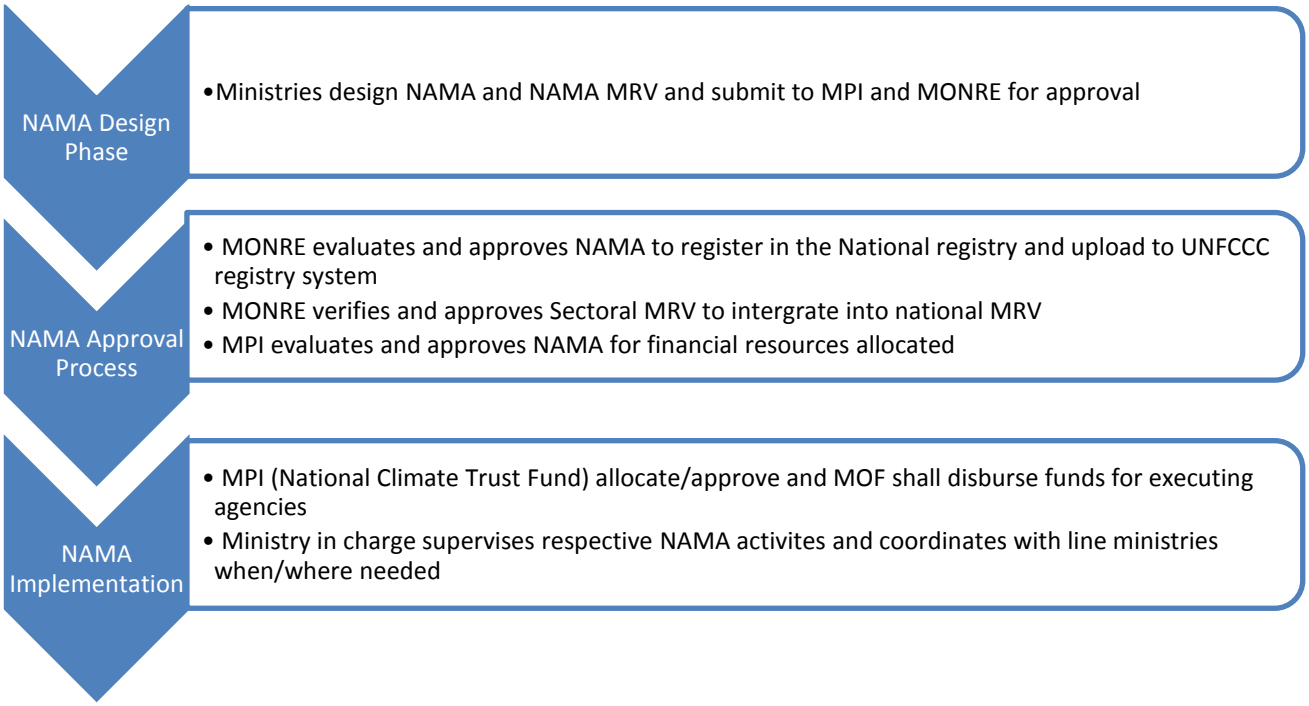
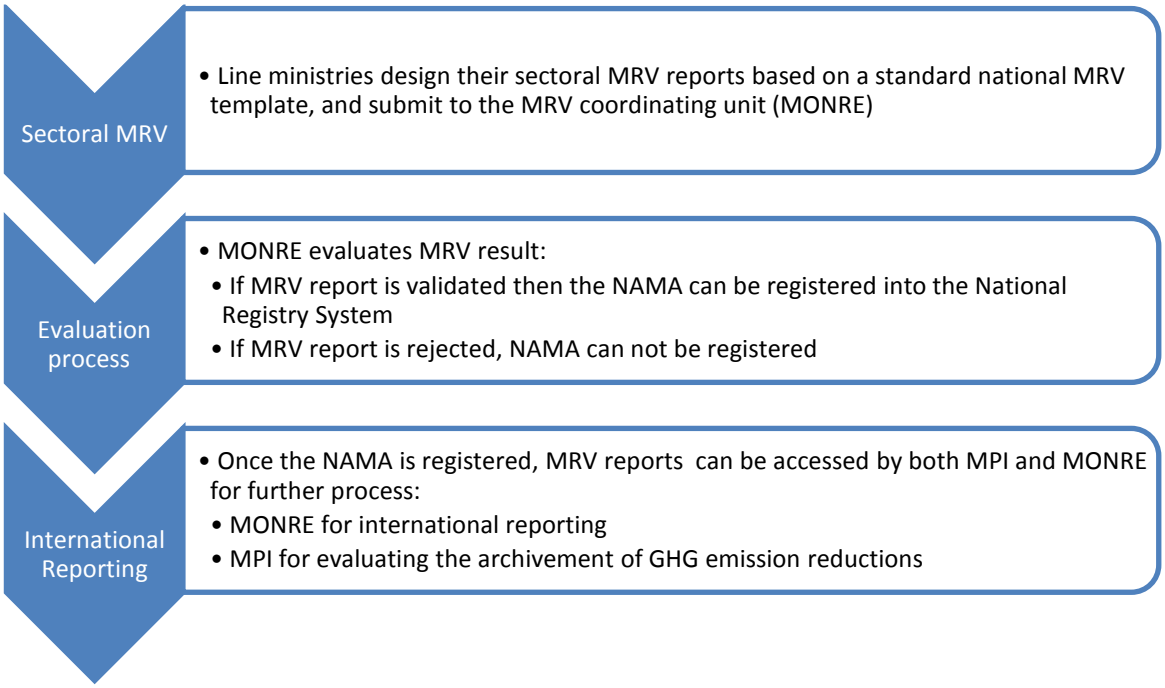


Figure 5-4: Recommended national evaluation procedure



6 FINANCING ARRANGEMENTS

This chapter is built on several sub-products described in earlier chapters of this report. The key documents for this chapter include the final version of sub-product I.7.1 Existing and potential financing sources, instruments and interest to support mitigation action in Vietnam's cement sector and the draft version of the sub-product [P-I.7.2, I.7.3, I.7.5] Definition of NAMA financing needs, analysis of carbon market mechanisms and results-based approaches to finance the NAMA and setting up a NAMA financial plan.

6.1 Country context

6.1.1 Domestic funding

A clear definition of climate finance has not yet been established by the government of Vietnam and therefore tracking and monitoring the related financial flows is difficult. The Government climate finance to relevant ministries however may be covered under the following budget items[2]:

- Budget for investment and development allocated to relevant ministries;
- Budget for environmental protection work allocated to relevant ministries;
- Budget for the National Targeted Program for Response to Climate Change (NTP-RCC) under the Green Growth Strategy[3];
- Budget for the Targeted Program for Energy Efficiency (VNEEP).

The prime source of climate financing in Vietnam is the state budget. In addition to the state budget, the major flow of funds for meeting climate change objectives is still largely sourced fromthe Official Development Assistance (ODA)or from various international, multilateral development agencies and through climate, clean energy and sustainable development funds. Private sector and carbon market play very small role in financing mitigation activities.

Carbon market

Vietnam has been quite active in the CDM market, having its first project registered in February 2006. Up to date, 253 projects from Vietnam have been registered by the CDM Executive Board: the majority (i.e. 199 projects, or over 78% of the total) has been developed in the hydropower sector, followed by methane avoidance (22 projects) and biomass energy (15 projects). Only 2 cement-related activities have been registered: 2 small scale Waste Heat Recovery projects[4], "Hon Chong Waste Heat Recovery Power Plant", reference number 7738, and "Nghi Son Waste Heat Recovery and Utilization Project", reference number 9641.

Also implementation of PoAs has been relatively strong in Vietnam, with 9 PoAs currently registered and one under validation. Again, the main sector covered by PoAs is renewable energies (3 small hydropower programs, 1 wind, 1 solar water heaters, 1 biomass energy programs and 1 hybrid-renewables programs). The remaining two PoAs relate to efficient building materials and methane avoidance (biogas digesters). One PoA still under validation is targeting the landfill gas sector. It is worth noting that the last PoA registration happened on March 2013. A total of 31 CDM Program Activities (CPA) have been registered to date[5].

Recently, Vietnam has joined WB Partnership for Market Readiness Programme (WB PMR). The PMR will support Vietnam in designing and piloting carbon market mechanisms in the steel, solid waste, and power (EE) sectors.

[2]http://www.chinhphu.vn/portal/page/portal/chinhphu/solieungansachnhanuoc
[3]Decision No.403/QD-TTg dated 20 March 2014 of the Prime Minister
[4]Source: UNEP/Risoe CDM pipeline, downloaded on 26th May 2015
[5]Source: UNEP/Risoe PoA pipeline, downloaded on 26th May 2015.

There is some potential for the carbon market expansion in Vietnam including for the cement sector with the right incentives in place, e.g. a planned eco tax on fossil fuel consumption could create further incentives for the private sector to engage in climate mitigation. Other schemes like feed-in-tariffs, emissions trading systems, tax incentives, etc. could attract private investment to climate change objectives.

6.1.2 NAMA applications to seek support from international donors/fund

Vietnam BUR-1 provides information on the development of NAMA proposals in Vietnam. Several preparatory activities for NAMAs have been conducted and a number of NAMA proposals are also being developed by relevant agencies in Vietnam with support from international donors. Recently three NAMA proposals have been submitted to the second call for NAMA Facility:

- NAMA in the Waste Sector: Waste to Resources for Cities in Vietnam
- Operational Solutions to GHG reduction from Ruminant Production in Vietnam
- Renewable Energy Development Facility (REDF)-GET FiT Vietnam

Regretfully none of the above-mention NAMAs was successful to receive support from NAMA Facility: two of the three projects were rated as “non-eligible” while the GET FiT project still lacked some readiness.

6.2 Summary of key findings

6.2.1 Financing needs for the cement NAMA

The assessment of financing needs for the cement sector NAMA in Vietnam are summarised in the below table.

The table summarizes sectoral consolidated financial figures assuming that the Vietnam cement sector will implement all mitigation levers by the year 2030. This financial summary is based on three out of four production and efficiency scenarios and the marginal abatement cost curves (MACC) described in the reports I.3 and I.5 plus the additional preliminary BATP-1000 scenario calculations.

This financial assessment is thus obviously bound to the same assumptions, estimations and uncertainties as described in the MACC calculations of report I.5. As mentioned in section 3.1.1, this first iteration assumes a linear pace of implementation from 2016 to 2030, knowing that reality will be different.

It is thus legitimate to emphasize that these figures are thus neither accurate nor precise up to the last digit, but they give a sufficiently reliable big picture of what is financially at stake when implementing the energy and CO_2 mitigation measures technically feasible in the Vietnam cement industry, as proposed in this NAMA. The strategic conclusions that can be concluded from this table should thus be valid.

Table 6-1The Table 6-1 summarizes the following financial aspects of the NAMA for three milestone years 2020, 2025 and 2030:

a) Absolute annual investment costs, operational costs and savings

- The annual capital investments needed *to implement the mitigation levers progressing from BaU to BATP performance*. The tabled investment figures are the same for each year because, as mentioned, this first iteration assumes a linear implementation.

  The investment figures are obviously higher for the BATP-1200 scenario compared to BaU-1200 because investments are needed to improve from BaU to BATP. They however do not differ much between the three BATP production scenarios, because (as mentioned in report I.5) we assume that *new additional* capacity will be at BATP (not BaU) performance level. There is a note of caution here however: it is unlikely that the new capacity that came on stream from 2014 to 2016 (causing the increase from 650 to 800 kg/i/y capacity) included already the step change improvement from Vietnam-BAU to BATP performance, for instance concerning the BATP energy efficiency, alternative fuels and clinker content in cement.

  The capital needed for capacity expansion with *new additional* clinker installations is not included in part a) of this table.

- The annual additional operation and management costs needed for the implementation of the BATP investments.
- The annual additional material and fuel costs needed for the operation of the BATP practices, as described in the technology options in report I.5.
- The annual energy and material cost savings plus the annual revenues from waste derived fuels, resulting from the operation of the BATP practices.
- The costs for enabling activities, as described in section 3.1.2. The expenses for enabling activities are largely at the start of the NAMA implementation period, which is obvious because the precisely are intended to enable the subsequent mitigation actions. These "starting costs" for enabling activities are reported in year 2020 (though they will mostly be spent in the 2016 – 2019 period).
- The sum of all annual variable operational costs (i.e. O&M, material and fuel costs, energy and material cost savings and enabling activities), being the *change of variable costs due to the BaU to BATP conversion*.

These costs, savings and revenues increase year-by-year (unlike the investment costs) in parallel with the linear implementation of the BATP practices.

- Finally, the list of absolute costs also includes the avoided investment cost, resulting from not having to build new additional clinker and cement capacity when adjusting the installed capacity to expected domestic market demand, in case of the 800 and 1000 kg/inhabitant and year scenarios.

b) Annual clinker and cement production and CO_2 mitigation volumes

- Clinker production volume
- Cement production volume
- CO_2 mitigation volume

c) Financial Key Performance Indicators

The table subsequently gives the following financial key performance indicators for the gradual implementation of the BATP mitigation options:

- Annual capital investment cost per ton cement
- The change of variable operational costs due to the BaU to BATP conversion per ton cement
- Annual capital investment cost per ton CO_2 mitigated
- The change of variable operational costs due to the BaU to BATP conversion per ton CO2 mitigated

d) Finally, section d) of the table also gives the additional new clinker capacity and the corresponding capital investments that are needed to meet the capacity scenarios. These are very high to enable the two 1,200 and 1,000 kg/inhabitant/y scenarios, but low for the 800 scenario. As already mentioned, the CO_2 scenarios assume that this additional new capacity will as from the start operate with BATP performance, not only with respect to energy efficiency, but also alternative fuels and clinker substitution.

Table 6-1: Summary of the financial assessment for the Vietnam cement sector per scenario, assuming that all 12 mitigation options of the MACC analysis are gradually implemented towards full implementation in 2030

	VN BaU-1200			BATP-1200			BATP-1000			BATP-800		
Year	**2020**	**2025**	**2030**	**2020**	**2025**	**2030**	**2020**	**2025**	**2030**	**2020**	**2025**	**2030**
a) Absolute annual investment costs, operational costs and savings for BaU to BATP conversion in million USD per year												
Mitigation actions												
Capital investments	18	18	0	64	64	0	64	64	0	64	64	0
O&M costs	0.3	0.7	0.9	3	6	8	3	6	8	3	6	8
Material and fuel costs	11	22	31	63	126	176	56	111	156	49	98	137
Revenues / cost savings	-131	-264	-370	-484	-968	-1,360	-348	-698	-979	-221	-444	-584
Total of variable costs	-120	-241	-338	-418	-836	-1,170	-289	-581	-815	-169	-340	-439
Enabling activities	3.7	0.3	0.3	3.7	0.3	0.3	3.7	0.3	0.3	3.7	0.3	0.3
b) Annual clinker and cement production and CO_2 mitigation volumes due to implementation of mitigation actions in million ton per year												
Cement production	105	121	126	105	121	126	74	88	103	69	76	82
Clinker production	84	97	101	81	88	87	57	64	71	53	55	57
CO_2 mitigation potential[6]	1.7	3.4	4.9	6.9	14	20	6.3	13	18.5	5.8	12	17

[6] The figures for the total cumulated emission reductions achievable when combining the entire set of mitigation actions are likely to be overestimated: this is due the interactions among the different measures, where the implementation of one solution could affect the performance of another (e.g. thermal energy optimization measures could affect the amount of heat available for the WHR equipment).

	VN BaU-1200			BATP-1200			BATP-1000			BATP-800		
Year	**2020**	**2025**	**2030**	**2020**	**2025**	**2030**	**2020**	**2025**	**2030**	**2020**	**2025**	**2030**
c) Financial key performance indicators in USD per ton cement and per ton CO_2 mitigated												
Capital investment cost per ton cement for BaU to BATP conversion[7]	0.17	0.14	0	0.60	0.52	0	0.86	0.72	0	0.92	0.84	0
Change of variable cost per ton cement due to BaU to BATP conversion	-1.14	-2.0	-2.7	-4.0	-6.9	-9.4	-3.9	-6.6	-7.9	-2.5	-4.5	-5.4
Capital investment cost per ton CO_2 mitigated	11	5	0	9	5	0	10	5	0	11	5	0
Change of variable cost per ton CO_2 mitigated	-70	-71	-70	-61	-60	-60	-46	-45	-44	-29	-29	-27
d) Investments needed for additional new capacity to meet the 1,200 kg/inh/y scenario and avoided CO_2 emissions due to avoided capacity growth												
Additional new clinker capacity required compared to the 2013 levels, million t	29	42	46	26	33	32	2	9	16	0	0	2
Required investments into additional clinker production vs. current levels, million USD[8]	1,003	450	138	900	242	0	69	242	242	0	0	69
Additional CO_2 mitigation due to avoided growth of cement capacity, $MtCO_2e/y$[9]	0	0	0	0	0	0	22.9	24.4	17.0	26.6	33.3	32.6

Source: Authors' own elaboration based on the MACC (report I.5.2-I.5.4) and Annex A

[7] Excluding investments into additional new clinker capacity.
[8] The MAC tool estimates the costs into increased production as USD 173/t clinker. The investment costs are given as average per year during 5-year periods.
[9] The current level of cement production in Vietnam is 59 Mt/year. Emission factor is 0.74 tCO_2/t cement equivalent. The avoided emissions are calculated as the difference between cement production under 1,200 kg/inh/y scenario for a certain year and production forecasts under 800 kg/inh/y and 1000 kg/inh/y scenarios multiplied by the emission factor.

Important observations

A number of essential important observations can be drawn from this financial assessment:

1. The key observation from the NAMA finance assessment is that **the improvement from BAU to BATP performance can be profitable under all scenarios even if all priority mitigation actions are implemented** (including the high-cost options). In fact, the potential gain can be even higher if only commercially viable mitigation technologies and practices are included in the NAMA scope.
2. **The absolute cost savings of the BATP scenarios are much higher** considering the reduced coal consumption due to the use of AFR, not envisaged in the BaU-1200 scenario, as well as more ambitious energy efficiency improvements.
3. The cost savings and the improvement of the total variable cost (in absolute units as well as cost per ton cement) are better for the BATP-1200 scenario than for the BATP-800 and BATP-1000 scenarios because of three reasons: 1) larger volumes of clinker substitution, and especially substitution of additional clinker capacity; 2) the initial investments can be spread and amortized over a larger cement volume and 3) there are more revenues from a larger volume of alternative fuels.

   This doesn't however mean that the BATP-1200 or BATP-1000 scenarios would be economically more attractive than the BATP-800 scenario. Indeed, multi-billion dollar investments in additional new clinker capacity must be added to the cost of the BATP-1200 and BATP-1000, but not to the BATP-800 scenario.

   Furthermore, market demand will certainly be much smaller than the 1200 and even the 1000 kg/inh/y capacity. This does not only apply to the Vietnamese domestic market but also including the international export market. Globally, international cement prices decreased about 10% year-on-year in 2015, and even 23% out of China. Increasing Vietnam production capacity to 1000 or 1200 kg/i/y could lead to close to 100% overcapacity and will certainly lead to further severe erosion of cement prices, margins and profitability and will jeopardize the financial viability of these two scenarios. A quantification of the financial and economic impact of the excess capacity is however beyond the scope of this project.
4. **The capital investment per ton cement to progress from current BaU to BATP performance ranges between 0.1 and 1.0 USD/ton cement, which is lower than 1% of the capital investment needed for a new clinker-cement installation (173 USD/ton)**. Aggregated over the total annual cement production, this capital investment ranges then between USD 18 and 64 million per year. Though this is not a small amount of money, it is just a fraction of the USD 200 to 1,000 million that would be needed annually to 2025 for the capacity expansion for the 1,200 kg/inh/y scenarios, but is undoubtedly way too much to be fully funded by international donors.
5. The change of variable production cost per ton cement is – averaged over the entire sector and all mitigation levers – negative and ranging between 2.5-4.5 USD/t cement (with extremes up to as high as 7 to 9 USD/t cement). **This is a very significant (10 to 18%) reduction of the operational cost** compared to a typical 25 USD/t variable cement production cost. **Combined with the mentioned investment cost per ton cement, this means that the proposed mitigation actions under the NAMA are economically attractive for the Vietnamese cement sector.**
6. As most of the proposed mitigation options for the cement NAMA are, in fact, profitable, the capital investments can be financed by the shareholders of the Vietnamese cement companies and by the cash flow generation of their activities. National and international finance institutions may perhaps provide favourable loan conditions via for instance green bonds or other preferential finance; the government of Vietnam (with the support of

international donors) can introduce policy and financial incentives, including carbon market mechanism, to encourage the investments by the industry. But in any case, **the cement companies themselves should cover the main capex**.

7. The cost for the enabling activities consists of several parts: 1) an initial 'readiness budget' of around USD 3 million over the 2016-2017, 2) annual NAMA O&M costs of around USD 0.3 million per year until 2030, and 3) USD 10 million for the pilot phase of the carbon procurement mechanism (2018-2020). While the overall budget for readiness activities (USD 15 million) is very small compared to the capital investments into mitigation actions, its leverage potential in terms of enabling CO_2 mitigation is very large. The size and the effects of this readiness budget for enabling activities make it certainly very adequate to be funded by international donors (with some funding from the domestic public sector).

The NAMA Finance Assessment Matrix can be updated and transformed into the NAMA budget with sequential deployment of mitigation technologies and practices (and inflation-adjusted numbers).

6.2.2 Baseline options for the cement NAMA

The financing need for the NAMA is the difference in financing in the baseline scenario and the desired mitigation scenario. Any scenario listed in Table 6-2 below (except for the VN BaU-1200 scenario, which represents the policy status quo[10]) - could be considered either a) a more ambitious and "dynamic" baseline scenario, or b) a domestically funded mitigation scenario, or c) a domestically and internationally supported mitigation scenario.

This means that there are a total of 6 baseline/mitigation action scenario combinations, as shown in the table.

Table 6-2: Incremental financing needs for the cement NAMA under various scenario combinations

	Scenarios			
	VN BaU-1200	**BATP-1200**	**BATP-1000**	**BATP-800**
	Finance needed per scenario, USD million			
Investments into mitigation actions	252	903	906	906
Additional investments into increased production capacity	7,950	5,709	2,760	346
Total financing needs	**8,202**	**6,612**	**3,666**	**1,252**
	Finance needed to move from BaU to BATP scenarios, USD million			
Additional investments into mitigation actions under BATP	**-**	651	654	654

The table shows a) the investment required to achieve the baseline scenario and then the additional financing that needs to be added to "upgrade" from a baseline to a more ambitious mitigation scenario. These figures are derived from the financing needs assessment.

The selection of a baseline must inherently be seen within the context of its use. For instance: the VN BAU-1200 scenario can be the baseline *of this project*, because the Vietnam Master Plan

[10] Since current industry performance lags behind official policy, fully implementing the existing master plan policy would already be an improvement with respect to the latest documented performance

with capacity expansion up to 1200 kg/i/y and energy efficiency target was valid at the start of and during this project.

The baseline scenario and the domestically supported and the internationally co-supported mitigation scenarios for the cement NAMA proposal must be the result of the Vietnam government policy process and negotiations with international NAMA supporters. This will determine which actions will already be implemented in the absence of the NAMA with existing, funded policies (= the baseline) and which actions represent additional levels of ambition.

6.2.3 Comparing the envisioned NAMA financing needs against other NAMAs

In order to interpret the financing needs for the NAMA cement in Vietnam, the comparison of the overall scale of the mitigation potential and financing needs of the Vietnam's cement sector NAMA against other registered NAMAs from different sectors and countries of the world has been conducted.

The following sources of information were used:

- **NAMA Registry** under UNFCCC[11]. Participation in the NAMA Registry is voluntary and only information that has been specifically requested for recording is found in this platform.
- **NAMA database**[12] supported by Ecofys. Generally, the database only tracks NAMAs that are seeking international support and includes NAMAs that indicate specific actions.
- **UNEP DTU NAMA pipeline**[13].

Eventually, 6 NAMAs have been selected for the sectoral comparison: 4 NAMAs in the cement industry (in Tunisia, Indonesia, Mongolia and Dominical Republic) and 2 NAMAs in the waste sector with the waste-to-energy component (in Chile and Pakistan). Besides the sectoral relevance, other important criteria for selecting these NAMAs wereavailability of information on the cost structure. The comparison of the cement NAMA in Vietnam (various scenarios) against other NAMAs in the NAMA database has been performed.

The main observations are as follows:

1. The volume of cement production in Tunisia, and especially in Dominican Republic and Mongolia is much smaller than in Vietnam[14], hence lower is the absolute mitigation potential for the cement sector NAMAs in these countries: 0.4-2.4 $MtCO_2$/year as opposed to 5.7-6.9 $MtCO_2$/y by 2020 under Vietnam's NAMA BATP scenarios.
2. Though Indonesian sector's scale is comparable to the Vietnamese, the cement NAMA in Indonesia so far includes only activities aimed at creating favorable environment for the use of AFR. Therefore, the overall GHG emission reductions by 2020 are estimated to be only 0.8 $MtCO_2e$/y, and the mitigation potential up to 2030 and beyond has to be assessed as part of the NAMA design programme.
3. The only NAMA in this comparison exercise that has higher mitigation potential by 2020 than the Vietnamese cement NAMA is the Chilean National Programme for Catalyzing Industrial and Commercial Organic Waste Management that also stipulates waste-to-energy measures. One of the explanations is a more advanced readiness stage of the Chilean NAMA, hence the emission reductions may be calculated from the earlier date than for the Vietnam's cement industry. Other cement and waste sector NAMAs are far from these two in terms of the expected absolute emission reductions, both annual and overall.

[11] NAMA Registry. http://www4.unfccc.int/sites/nama/SitePages/Home.aspx
[12] NAMA database. http://www.nama-database.org/index.php/Main_Page
[13] UNEP DTU NAMA pipeline. http://namapipeline.org/
[14] Cement production in 2012: Mongolia – 0.35 Mt/y, Dominican Republic – 4.1 Mt/y, Tunisia – 7.2 Mt/y, Indonesia – 51.0 Mt/y, Vietnam – 55.5 Mt/y. Retrieved from: http://www.indexmundi.com/en/commodities/minerals/cement/cement_t22.html

4. In terms of the relative mitigation potential to the cement production in the country, the Vietnam's NAMA (0.15-0.25 tCO_2e/t cement/y under BATP scenarios) is comparable with other NAMAs in Tunisia (0.3 tCO_2e/t cement/y) and Dominican Republic (0.2 tCO_2e/t cement/y).
5. Regarding the total required investments, the Vietnamese NAMA is one of the most costly, taking into account it's scale. Only Tunisian cement NAMA has higher capex, mostly because it envisages application of the high-cost wind energy technology, which also translates in the very high financing requirements for the Tunisian NAMA per ton of reduced GHG emissions (36 USD/tCO2e).
6. The anticipated costs of enabling activities (USD 15 million) for the cement sector NAMA are higher than for other NAMAs. That is because the Consultant includes here the budget for the carbon procurement tender of USD 10 million (see Section **Error! Reference source not found.** for more details). Without the carbon procurement tender budget, the cost of enabling activities for the cement sector NAMA in Vietnam would be USD 5 million, which is lower than in Tunisian and Indonesian cases.
7. Some cement sector NAMAs (in Tunisia and Dominican Republic) suggest an application of a range of mitigation levers, while others (Mongolia and Indonesia) focus only on one particular technology (AFR and supplementary cementitious materials respectively).
8. Waste co-processing is proposed as one of the key (or the only, in case of Indonesia) mitigation lever in all cement sector NAMAs except the Mongolian.
9. Unfortunately, there is no information on the share of domestic finance vs. requested international support for all six NAMAs. From the available data, three NAMAs have requested 100% of the initial investments and enabling activities costs to be covered by the international donors; while only Chile plans to finance up to 81% of the NAMA from the domestic sources. There is no information on the Tunisian and Indonesian NAMAs in the UNFCCC NAMA Registry, which means that these NAMAs have not yet officially applied for the support, but might do this at the later stage of NAMA design and implementation.
10. The requested support per NAMA ranges between USD 2.42 to 30 million. So far, there is no information receiving any international support by these six NAMAs with the exception of the initial grants for NAMA design and first readiness activities.

The comparison shows that in case all priority mitigation technologies and practices under any BATP scenario are fully implemented, the cement sector NAMA in Vietnam will be one of the most ambitious among all NAMAs around the world in terms of the total avoided GHG emissions and especially by overall required investments.

From the comparison analysis, a mix of various sources of funding/finance for the cement sector NAMA is recommended.

6.3 Financing structure and financing plan for the cement sector NAMA

As the result of the NAMA needs assessment, mitigation actions have been prioritized based on their mitigation potential, MAC, required finance and enabling policy/financial incentives for their deployment. In total, 4 groups of mitigation actions have been defined by their implementation priority over the NAMA time horizon. Every group requires a tailored financial plan.

Table 6-3: Summary and prioritization of mitigation actions for the cement NAMA in Vietnam by their time horizon and required incentives

	Mitigation actions that can be catalyzed via enabling activities and results-based public incentives	Mitigation actions that can be catalyzed by additional capex-related financial support/incentives (loans, subsidies, market mechanisms)
Short-term actions (no-regret, no- or low-capex)	**Group 1** • 1a) Process knowhow, control and management & 1b) Diagnostic energy audits • 11) Blending: Pozzolana • 12) Blending: Limestone	n/a
Mid-term actions	**Group 2** • 2) Modern automation and control systems • 3) Clinker cooler modification • 8) Retrofit to modern multi-channel burner • 9) Blending: GBFS as cement constituent 10) Blending: Fly ash as cement constituent	**Group 3** • 4) Waste heat recovery (WHR) • 7) BAT for alternative fuels - replacing fossil fuels
Long-term actions	n/a	**Group 4** • 5) Adding a pre-calciner to existing pre-heater kiln • 6) Additional Pre-heater cyclone

The financing structure and plan include a) the financial needs associated with the implementation of mitigation actions and enabling activities in order to catalyze the finance and implement GHG emission reduction actions under the cement sector NAMA in Vietnam, and b) the financial flows between the stakeholders involved in catalyzing these actions. It describes the origin of finance for different activities, the entity(s) managing the money flows and their use.

Four types of enabling activities are defined including:

1. Policies, incentives, technical assistance to remove barriers to no-regrets actions,
2. NAMA and mitigation-action level MRV operational readiness,
3. NAMA operating capacity, and
4. Capacity building and awareness raising of stakeholders.

The proposed financial flows are:

a) Domestic support is channelled to MOC via the MoF.

b) International support is channelled to MOC via the MoF (bilateral support) and MPI (for GCF and multilateral funding), following the NAMA endorsement by MONRE and MPI.

c) The MOC manage the use of funds to facilitate the implementation of enabling activities.

d) The MOC NAMA Operating Unit facilitates the engagement of energy efficiency / cement plant performance management experts via a dedicated competence center and/or on the basis of discrete/project-based engagements.

e) The MOC NAMA Operating Unit is tasked with the implementation of the MRV system for the cement NAMA and the organization of various capacity building events under the NAMA.

6.3.1 Financing enabling activities and short-term no-regret actions

The associated enabling activities are expected to a) create operational readiness for the MOC NAMA Operating Unit and be sufficient to catalyze the implementation of mitigation actions 1a), 1b), 11), 12).

Table 6-4: Overall budget to support enabling activities and expected outcomes associated with no-regrets actions that can be implemented in the short term

	Avg. annual budget for enabling activities (USD million)	Avg. annual capex (USD million)	Avg. annual mitigation impact (million tCO2 avoided)	Annual variable costs when fully operational (USD million)	Annual savings when fully operational (USD million)[15]
Scenario VN BaU-1200	2.5 in 2016-2020, 0.3 in 2018-2030	1.1	1.5	6	221
Scenario BATP-1200	2.5 in 2016-2020, 0.3 in 2018-2030	1.1	5.1	23	744
Scenario BATP-1000	2.5 in 2016-2020, 0.3 in 2018-2030	1.1	4.6	19	501
Scenario BATP-800	2.5 in 2016-2020, 0.3 in 2018-2030	1.1	4.0	16	270

A total budget of around USD 13 million over the 2016-2020 period (av. USD 2.5 million per year) is required for enabling activities followed by annual NAMA O&M costs of around USD 0.3 million by 2030 related mostly to operating of the NAMA Unit at MOC, MRV system and organization of regular capacity development activities. This is a relatively small investment in comparison to the expected energy cost savings and mitigation impacts. In addition, these enabling activities will create favourable conditions for the uptake of the mid-term mitigation actions. Therefore, their actual leverage potential will be even higher.

The average savings from implementation of the low-cost no-regret mitigation actions could range from USD 221 million under BaU-1200 to USD 744 million under BATP-1200 when the technologies and practices are fully rolled-out.

6.3.1.1 Budget for the MOC NAMA Operating Unit

The implementation of the enabling activities calls for an overall core budget of USD 1.3 million for the NAMA Operating Unit (which will be used for creating policy and financial incentives, preparing feasibility studies, setting MRV system and organization of capacity building activities during the first 2 years), as well as USD 233K/year for operation of the Unit. The funding and organization of capacity development activities (USD 36-39K/y starting from 2018) can be also managed by the NAMA Operating Unit and can be included into its budget, bringing the average annual operation costs to up to USD 272K from year 2018 and beyond.

In the first three years of operation, the core budget is funded by the international support and the recurring annual operating budget via domestic sources. After that the operating budget of the NAMA Operating Unit should be funded domestically via the achieved energy cost savings.

[15] The savings do not include avoided investments into increased production of clinker under BATP-800 and BATP-1000 scenarios.

6.3.2 Financing needs for mid-term no-regret and low-capex mitigation actions

As can be seen below, the financing needs, average annual savings and mitigation potential for the mid-term no-regret and low-capex mitigation actions are the same in all scenarios. The required policy and capacity building enabling activities for these actions can be undertaken at the earlier stage of the NAMA implementation.

Table 6-5: Financial needs in different scenarios

	Avg. annual capex (USD million)	Avg. annual mitigation impact (million tCO2 avoided)	Annual variable costs when fully operational (USD million)	Annual savings when fully operational (USD million)[16]
Scenario VN BaU-1200	4.0	1.1	25	133
Scenario BATP-1200	4.0	2.9	103	405
Scenario BATP-1000	4.0	2.4	86	267
Scenario BATP-800	4.0	2.2	71	143

6.3.3 Financing mid-term capex-intensive mitigation actions

This section describes financing needs associated with removing the barriers to the implementation of capex-intensive mitigation actions that can be implemented in the mid-term. The associated measures are expected to then catalyze the implementation of mitigation actions of type 4) and 7).

Table 6-6: Overall investment to finance mid-term capex-intensive mitigation actions

	Avg. annual capex (USD million)	Avg. annual mitigation impact (million tCO2 avoided)	Annual variable costs when fully operational (USD million)	Annual savings when fully operational (USD million)
Scenario VN BaU-1200 *(only WHR)*	3.6	0.1	0.7	12
Scenario BATP-1200	49.5	3.0	58	204
Scenario BATP-1000	49.5	3.0	58	204
Scenario BATP-800	49.5	3.0	58	204

The mitigation potential, financing needs, and annual savings from application of the mid-term capex-intensive mitigation actions will be similar under all BATP scenarios. The VN BaU-1200 envisages only introduction of WHR technology at 8 plants.

The average annual coal cost savings due to the application of AFR could reach USD 162 million. If the value of possible co-benefits of waste co-processing both at the cement plants and upstream is taken into account, the potential gain could be even higher.

The main barriers to implementing these actions are a) perceived risks related to the performance of WHR technology (for action 4), b) short-comings within existing regulations regarding the use of AFR in cement kilns (action 7), and c) lack of access to capex investment funds.

[16] The savings do not include avoided investments into increased production of clinker under BATP-800 and BATP-1000 scenarios.

6.3.3.1 Action-specific enabling activities

The MOC NAMA Operating Unit would coordinate the execution of studies and facilitate the adjustment of regulations that would make it possible for cement factories to play a more active part in waste management and use of alternative fuels.

The NAMA Operating Unit would also manage a budget to assist cement plants with accessing existing EE investment support funds, such as the WB/IFC industrial EE support facility.

6.3.3.2 WHR performance guarantees

Such performance guarantees de-risk the investment for cement plants and lenders. Performance guarantees have been used successfully for this purpose. This instrument would need to be developed in cooperation with an international financial partner and use of climate finance, such as the GCF. The performance guarantee ensures a minimum cash-flow to lenders that either results from the saved energy costs, or – if performance is below a certain threshold – through payouts by the guarantee issuer.

6.3.3.3 Implementing a NAMA-specific EE investment support facility

Considering the substantial investment opportunity (about USD 1 billion over 15 years), it is proposed to examine the possibility of creating a dedicated capex investment support facility for this NAMA that could include blended finance from commercial and public (climate finance) sources. Such facility could be created through cooperation with an international IFI (such as ADB, KfW, WB) and with GCF funding.

6.3.3.4 Service fee on waste disposal

Another instrument that can support the use of AFR are the waste disposal fees. The fee can be charged per load, per tonne, or per item depending on the source and type of the waste.

6.3.4 Financing long-term capex-intensive mitigation actions

The implementation of long-term capex-intensive mitigation actions within the context of NAMA design is not suggested due to the high initial investment.

6.3.5 Summary of findings / financing plan for the cement NAMA

Following table summarises the mix of financing sources and instruments to catalyze implementation of different groups of mitigation actions that were identified in previous sections. All sources and instruments are phased-out over short-term (2016-2020) including readiness (2016-2017), mid-term (2021-2025) and long-term (2025-2030) time periods.

The key conclusion is that the cement NAMA will need international support only over the short term (by 2020), with the major injections needed during the first years of readiness (2016-2017). International finance will be crucial for the initial enabling activities that will incentivise the investments into low-carbon technologies and practices by the plants. After the first 2-3 years, the NAMA management costs can be covered through one of the cost recovery options as described in section 5.1.2.

MOC has also expressed the willingness of the Government of Vietnam to fund 50% of the NAMA operating costs after the readiness phase (if there is a net cost that is not covered through repayment mechanism).

Due to the considerable amount of savings that could be generated through the cement NAMA, the Consultant predicts that already in the mid-term (staring from 2021), the NAMA could be fully funded by domestic sources (primarily, the cement companies).

	Mitigation actions that can be catalyzed via enabling activities and results-based public incentives	Mitigation actions that can be catalyzed by additional capex-related financial support/incentives	Required enabling activities
Short-term financing (2016-2020)	**Group 1** 1. Capital markets, balance sheets of cement companies. 2. Results-based payments from the pilot phase of the carbon credit procurement tender; 3. Existing domestic and international EE support funds.	n/a	1. International (e.g., NDF, NAMA Facility, GCF, etc.) and domestic public funding of the initial enabling activities. Special attention should be given to: • Updating cement Master Plan, • Developing policies and regulations, • Developing waste management infrastructure in Vietnam; • Core budget for NAMA Operating Unit, • Setting up Facility for Purchasing Credits (FPC) and preparing pilot phase of carbon credit procurement, • Capacity building, engagement of cement plants, • MRV at plant-level. 2. Budget for the pilot phase of carbon credit procurement tender (international and domestic finance). 3. Cost recovery mechanism to fund the operational costs of NAMA Operating Unit and FPC via: • a small share of energy savings (ESCO model), • a fee per carbon credit added to the carbon price, • a fee (or tax) on the use of coal.
Mid-term and long-term financing (2021-2025)	**Groups 1, 2** 1. Capital markets, balance sheets of cement companies; 2. Results-based payments from FPC; 3. Pre-payments against the future delivery of carbon credits from FPC; 4. Existing domestic and international EE support funds; 5. International carbon market.	**Group 3 (and 4 in long-term)** 1. Capital markets, balance sheets of cement companies; 2. Results-based payments from FPC; 3. Instruments to de-risk performance and facilitate access to capex funds (e.g. performance guarantees); 4. Waste disposal fee; 5. EE investment support facility; 6. Existing domestic and international EE, climate and green growth support funds; 7. Loans from international climate finance facilities (GCF); 8. International carbon market.	1. Cost recovery mechanism to fund the operational costs of NAMA Operating Unit, FPC, EE support fund via: • a small share of energy savings (ESCO model), • a fee per carbon credit added to the carbon price, • a fee (or tax) on the use of coal.

6.4 Carbon market mechanisms and results-based approaches to finance the cement sector NAMA

Although all actions under the NAMA are no-regret (and could therefore be implemented on existing merit without support), the evidence from CDM show that additional incentive is required to motivate action, especially in relation to energy efficiency investments. This section identifies a suitable mechanism for the cement sector in Vietnam that will help in mobilizing public and private financing of mitigation actions.

The cement sector, due to its specific characteristics, is well suited for a crediting mechanism: the final outputs can be clearly identified and have specific characteristic (cementitious products, mainly clinker and cement) and also production processes are very similar within one country and internationally. There are several emission sources but they are relatively limited in number (i.e. each cement plant) and could be covered by one or more mechanism.

A project-based crediting mechanism, based on carbon reduction targets (tCO_2/t cement) is introduced here. Under this mechanism, credits will accrue directly to the cement companies that actually improve their energy or emission performance. Credits could be issued also to the partner companies that implement energy efficiency (or carbon reductions) measures at cement plants (e.g. Energy Service Companies, ESCOs). Other actors that don't implement mitigation actions to achieve the targets will not receive any penalty, but would slowly lose ground in competing with the companies that would benefit from the trading mechanism (i.e. the latter would probably develop a better resource management and optimization system, get additional revenues from the credits, better position themselves in the market highlighting the environmental efforts to the customers and so on).

The mechanism is based on the result-based financing (RBF) concept that means the payments are made only after the project is actually implemented, monitoring has been performed, and actual reductions are verified. The credits verified by a third party will then be allocated to each cement company that improved its energy/carbon intensity.

A second component of this mechanism would be the establishment of a Facility for Credit Purchasing (FCP), open for finance from public, private and international sources. FCP would buy the credits generated by the cement company under the RBF scheme. This would ensure a financial reward to those companies that implemented mitigation measures, incentivizing them to bear the initial investments that would reduce GHG emissions. FCP plans for purchasing credits would reduce the uncertainty of the revenues related to the achievement of the carbon intensity targets.

The proposed scheme needs however to take into account the actual national and international context. One main variable should be considered: the level of commitment at the international level. The existence of a stringent agreement at international level is necessary to stimulate CO_2-related credits and revitalize the carbon markets.

6.4.1 Budget and mechanism for the procurement of carbon credits or energy efficiency certificates from eligible mitigation activities

A baseline and credit mechanism with, ex-post verification and payments will make payments to cement companies and/or their implementation partners that implement such no-regret actions (e.g. ESCOs) and can demonstrate, via a defined MRV procedure, that they have achieved energy/carbon savings. Such a scheme could be "denominated" in either "saved energy units" or carbon credits (compared to a baseline). The qualifying procedures could be based on CDM methods. The scheme could be operated by the Vietnam Environment Protection Fund (VEPF), which has experience with the CDM procedures and the management/disbursement of CDM fees. Another option is Vietnam Development Bank (VDB) who is the nominated candidate as the

national implementing entity (NIE) of GCF in Vietnam. VDB has strong capacity and experience in managing and disbursement of funds, especially on the disbursement of funds against performance (as part of a MOIT-funded scheme to reward producers of green energy). Alternatively, it could also be operated by the NAMA Operating Unit or third-party service providers under its mandate.

The overall mitigation potential of actions in this category varies between 1.5 and 5 million tCO_2 avoided per year (depending on scenario). Over a 15-year duration, this scheme could facilitate the origination (and purchase) of up to 75 million carbon credits.

In order to pilot this scheme, a budget to purchase the first 2 million carbon credits within the first 3 years of operation is proposed. Additional funding requests could be made after this initial pilot phase has been evaluated and the origin of financing for additional purchases has been determined. A target price range of between 2 and 5 USD/carbon credit, representing an overall (maximum) budget of 10 million USD is proposed. The scheme can either use a competitive process for price finding (for example auctioning) or a fixed price for every round of procurement tenders, with the possibility to adjust the price between tenders.

The funding for these purchases could come from the same sources identified above. Other funding sources could be international NAMA supporters, i.e. via a “credited NAMA” design.

Due to the pilot nature of this activity, the active involvement of an international NAMA donor to support the design of this procurement mechanism is necessary.

6.4.2 Cost recovery mechanism to fund the NAMA Operating Unit

As mentioned above, the implementation of these short-term, no-regret actions will create substantial energy cost savings. It is proposed that entities (cement plans) participating in actions facilitated under the NAMA agree to pay a small share of the resulting energy cost savings (which are monitored and verified as per NAMA rules) to fund the operation of the MOC NAMA unit. This approach is similar to a standard ESCO agreement. The share of energy cost savings for this purpose is less than 1% of the total savings (annual operating costsof the NAMA Operating Unit ofUSD 272K / annual savings of USD 125-421 million depending on scenario), if fully funded by cement industry.

To function fully, the NAMA Operating Unit should also be co-financed by the beneficiaries of this NAMA via a fee per carbon credit that is added to the carbon credit purchase price. Assuming that carbon credits from this cement NAMA are purchased by its beneficiaries (international supporters, MOIT, MONRE, etc.), the cost of operating the NAMA Unit will thus be shared with them. According to the first estimation, this fee would amount to USD 0.1 / carbon credit (USD 272K operating budget / an average CO_2 saving 4.3 million for BATP scenarios, if fully funded by NAMA beneficiaries.

The design of this cost-recovery mechanism must be discussed and agreed with the key NAMA stakeholders and beneficiaries.

6.4.3 Budget and mechanism for the procurement of carbon credits or energy efficiency certificates from eligible mitigation activities

It is suggested to add the procurement of carbon credits from these mitigation actions to the proposed financing mechanisms. The overall mitigation potential of actions in this category is projected to be 550,000 tCO_2/year. Over a 15-year duration, this would lead to the origination (and purchase) of up to 8.25 million carbon credits.

Within the context of the pilot, a budget is proposed to purchase the first 250,000 carbon credits during the first 3 years of operation. Additional funding requests could be made after this initial

pilot phase will have been evaluated and the origin of financing for additional purchases will has been determined.

6.4.4 Climate finance to support capex investment into energy efficiency actions

Considering the existing capex investment requirements (even though small) to implement actions in this category and the existing barriers to fund capex investments for energy efficiency investments, the Facility for Purchasing Credits (FPC) is proposed to make pre-payments against the future delivery of carbon credits. These pre-payments can be used to fund the capex investments.

6.4.5 Summary of financial instruments

The table below summarizes the mix of financial instruments and budgets that constitute how financial incentives are made available to catalyze the implementation of mitigation actions.

Table 6-7: Overview of the financial instruments to incentivize implementation of mitigation actions by their time horizon

	Mitigation actions that can be catalyzed via enabling activities and results-based public incentives	Mitigation actions that can be catalyzed by additional capex-related financial support/incentives (loans, subsidies)
Short-term actions (no-regret, no- or low-capex)	**Group 1** • International and domestic public funding of the enabling activities; • Budget for a NAMA Operating Unit; • Carbon credit procurement facility (payment on delivery).	n/a
Mid-term actions	**Group 2** • Carbon credit procurement budget (including the ability to make results-based payments).	**Group 3** • Climate finance instruments to de-risk performance and facilitate access to capex funds. • Service fee on waste disposal.
Long-term actions	n/a	Not recommended for the NAMA

6.5 Institutional set-up and MRV of finance for the cement NAMA

A NAMA is likely to be financed by various sources; it is then the responsibility of the NAMA operating entity to ensure that the overall funding is adequate, that it is effectively allocated and its use is reported transparently to those that provided funding to thus increase the trust among stakeholders.

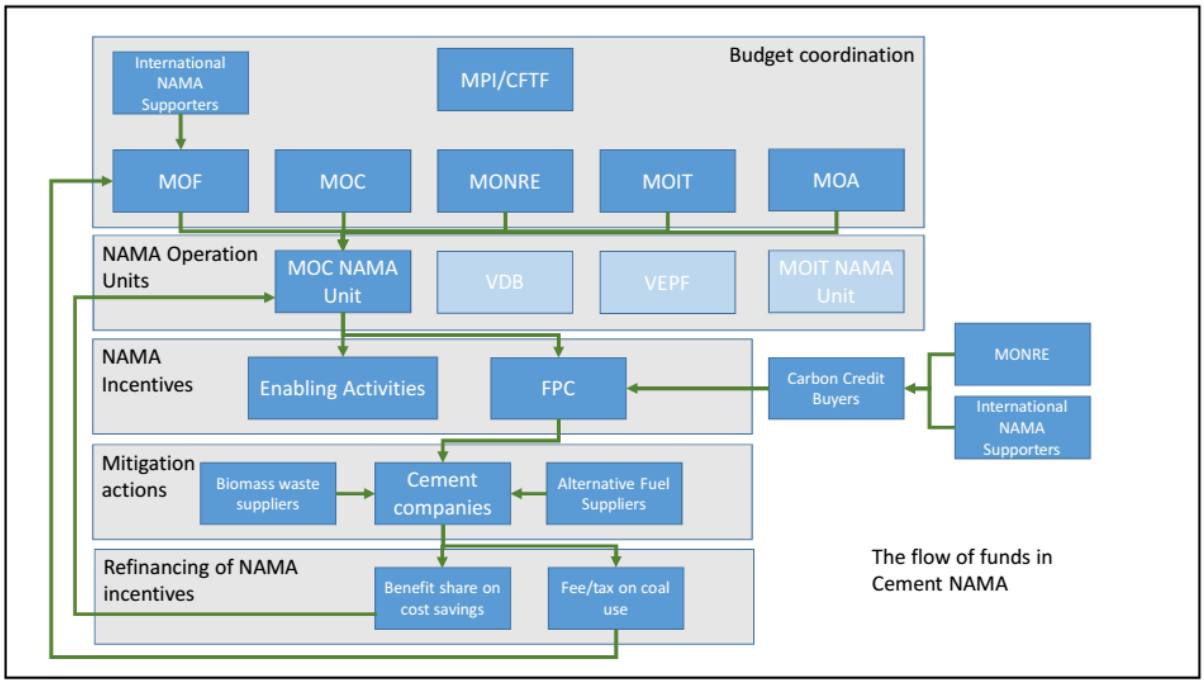
The figure below illustrates this institutional arrangement: MOC initiates a process through the NAMA Inter-Ministerial Steering Committee by which other line ministries are requested to provide domestic support for its NAMA which is catalysed by the Carbon Finance Task Force (CFTF). MOC also initiates a process to request international support, which is to be endorsed by MPI and MONRE.

MOC also requests the endorsement of MPI regarding the setup of the proposed NAMA financial incentive structure, namely the funding/budget support for a MOC NAMA Operating Entity and the Facility for Purchasing Credits, which is established either as a new unit within the MOC, as a

unit jointly operated by the MOC and MOIT or integrated into the operation of the VEPF. In relation to international support and the sale of carbon credits to international supporters, MONRE is required to provide its approval as well.

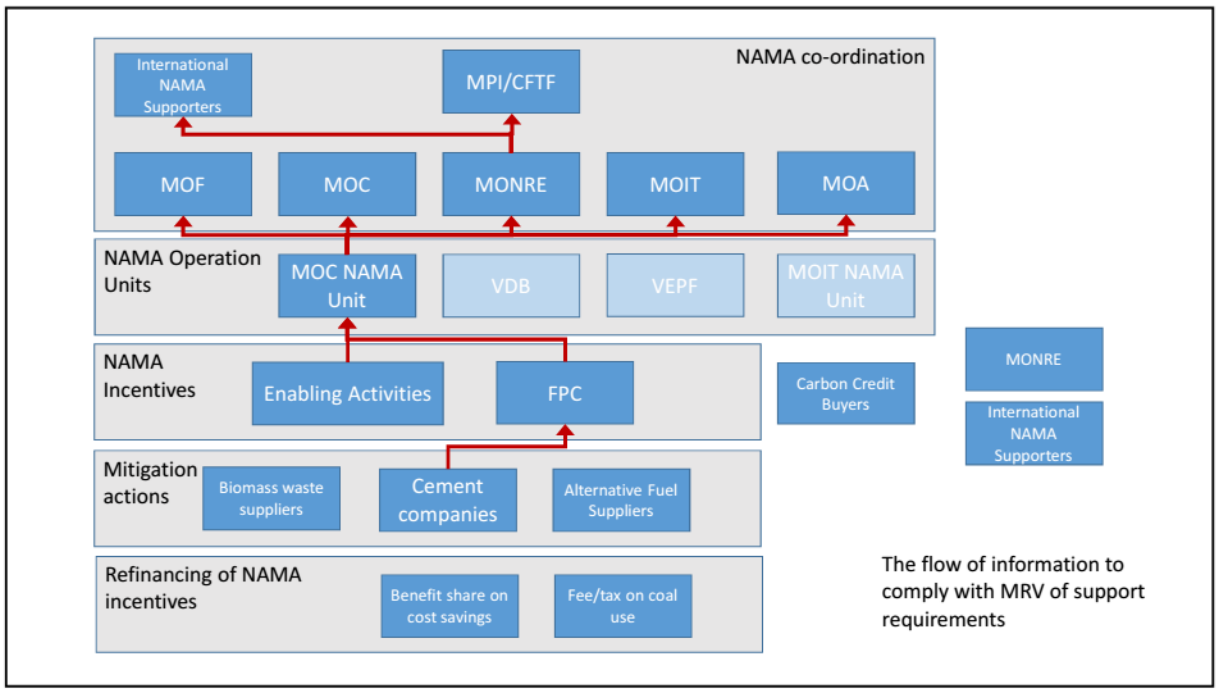
In relation to international support to finance capex-support facilities, the MOF would need to approve any suggested design. This has already happened for existing financial instruments, such as the WB/IFC-operated USD 200 million EE investment support facility.

Figure 6-1: Institutional Arrangement to Coordinate Financial Flows



The MRV of support corresponds to the flow of financial resources. Figure below illustrates the flow of information under an MRV of support system.

Figure 6-2: MRV of Support



Cement companies report data to the MOC NAMA Unit (via the FCP) that is required to quantify and verify realized emission reductions, against which they receive results-based payments. They also report supplemental financial data to establish the total amount of funding used to implement mitigation actions and to establish the amount of co-benefits that were created as a result of the NAMA. The MOC NAMA Unit aggregates this data and also provides information related to the use of funds and impacts of implementing enabling activities to MONRE (in its capacity as NAMA Focal Point). The MOC NAMA Unit also shares data re: the co-benefits that were created with the domestic beneficiaries of these co-benefits (such as total amount of avoided coal use, amount of avoided landfilled waste, etc.). These beneficiaries are the other line ministries.

MRV requirements will need to be in line with the expectations and prioritizations from and/or bilaterally negotiated with domestic authorities and international funders.

6.6 Potential risks and barrier analysis for financing the cement NAMA

6.6.1 Key risks and barriers

The critical risks/barriers to financing NAMA implementation are:

- **Ability to secure international support to fund set-up and initiate the implementation of pilot actions under the NAMA** (especially short-term no-regrets actions) given the number of different entities in Vietnam are currently developing NAMA proposals with the objective to secure international support (around 28 such proposals at the time of writing this report) and the small number of international NAMA donors and no prioritization criteria for NAMA proposals to apply for the international support. This creates the risk that the limited number of international NAMA supporters are potentially flooded by proposals from Vietnam, making it difficult for the cement NAMA to compete on this NAMA-support market.

- **Ability to successfully organize inter-ministerial cooperation in the context of arranging the domestic financefor NAMA implementation**. The implementation of this cement NAMA requires substantial domestic support in the early phase of implementation (before it becomes self-financed). While a process for inter-ministerial cooperation for NAMA design and implementation has been created, it has not been tested in practice.
- **Material relevance of the provided incentives to catalyze pro-active engagement of the cement industry.** The financial instruments do not yet exist in practice and it is therefore unclear if they are tangible enough to motivate the cement industry's participation.
- **Double counting of carbon credits.** With an increasing fragmented market, the risk of having a number of different mechanisms in place is very high.

6.6.2 Risk mitigation actions

6.6.2.1 International support

This NAMA has the benefit of intensive preparation including readiness activities. International supporters are interested in such very concrete, implementation-ready NAMA proposals that have a strong buy-in/commitment of the key domestic stakeholders. This commitment needs to be conveyed through the appropriate channels and by the relevant stakeholders. Recent efforts to increase the profile of this cement NAMA within the context of Vietnam's INDC serve this purpose very well.

In addition, the achieved readiness status of this NAMA needs to be well documented in the (to be prepared) NAMA proposals to international supporters. The current project does not have a budget for the preparation of a high quality, detailed NAMA proposal. The team suggests to discuss (with NDF and MOC) if and what resources could be made available for this purpose.

The international visibility of this NAMA concept should be raised to a level where there is a broader awareness of it within the international NAMA support community. This includes a listing in the UNFCCC NAMA Registry and its presentation at international climate policy events (e.g., UNFCCC COPs) with participation of the relevant domestic stakeholders (especially MOC).

6.6.2.2 Inter-ministerial cooperation

MOC has been highlighting the strategic relevance of the cement NAMA and its contribution to key development priorities to MONRE within the context of Vietnam's INDC stakeholder consultation process. This initiative could play an important role in initiating a wider discussion on the inter-sectoral impacts and benefits of this NAMA and is thus conducive to inter-ministerial cooperation.

Going forward, the MOC should take a more pro-active role in the Inter-ministerial Steering Committee, introduce the proposed NAMA design to its members and request for inter-ministerial coordination and cooperation with the related line ministries for the cement NAMA at the earliest convenience.

In addition, a NAMA Steering Board under MOC to review the NAMAs under MOC's supervision will help to enhance the coordination between the key cement NAMA stakeholders.

6.6.2.3 Relevance of incentives

The Consultant proposes to maintain the ongoing consultation process with the cement companies to thus validate on an ongoing basis that the design of the proposed financial incentives is attractive to them.

6.6.2.4 Double counting

From a broader point of view, one of the main requirements for new market mechanisms (especially when considering potential for international linkage and scaling up) is the set up of an appropriate accounting system: accounting is intended as the set of rules necessary to compare mitigation results with a country's emission targets. This implies the consideration of the rules for GHG inventory, how new crediting systems should be included in the GHG inventory and ultimately in the national communications, how to ensure that each credit cannot be used for more than one target, traceability of the information of each credit issued and how these information can circulate among different systems, nature of the credits and GHG covered by each mechanism.

6.7 Summary of recommendations

The following recommendations are provided to the next steps (some of these activities need to be carried out in parallel):

1. The cement industry to implement Monitoring, Reporting and Verification of production, energy consumption and CO2 emissions on an annual basis at installation, company and sector level using the MRV and organizational systems, including the improvements (such as using real instead of default heating value), described in this NAMA project.
2. For MOC, to initiate a coordination process with other relevant stakeholders who will be involved with co-financing and implementing the actions outlined here. These are MOIT, MONRE, MPI, MOF, MARD (regarding wastes from agricultural sector). The outcome of this coordination process is an agreed NAMA design that outlines the respective roles of the key stakeholders. The process should be organized via the NAMA Steering Committee.
3. For MOC, NDF and the Consultant team to initiate the discussion on a budget for the preparation of concrete NAMA support proposals for international NAMA supporters, namely NDF (and associated NAMA support agencies in the Nordic countries), the NAMA Facility and the GCF.
4. To complete the design of the envisioned financial mechanisms for this NAMA: the budget and activities for the MOC NAMA Operating Entity, the support budget (or financing mechanism) provided by domestic public stakeholders, the expected financing from the industry, design of the refinancing mechanism, design of the Carbon Procurement Facility, design of the capex support facility and/or proposal to the WB/IFC investment support facility.
5. To develop alternative baseline and mitigation scenarios that could be used 1) for the NDC submission to the UNFCCC, 2) for domestic NAMA projects and 3) be accepted by international donors for internationally supported emission reductions.
6. To review and possibly strengthen the INDC-related submission of the MOC to MONRE to highlight the strategic relevance of this NAMA and its contribution to climate mitigation and non-climate related key policy objectives.

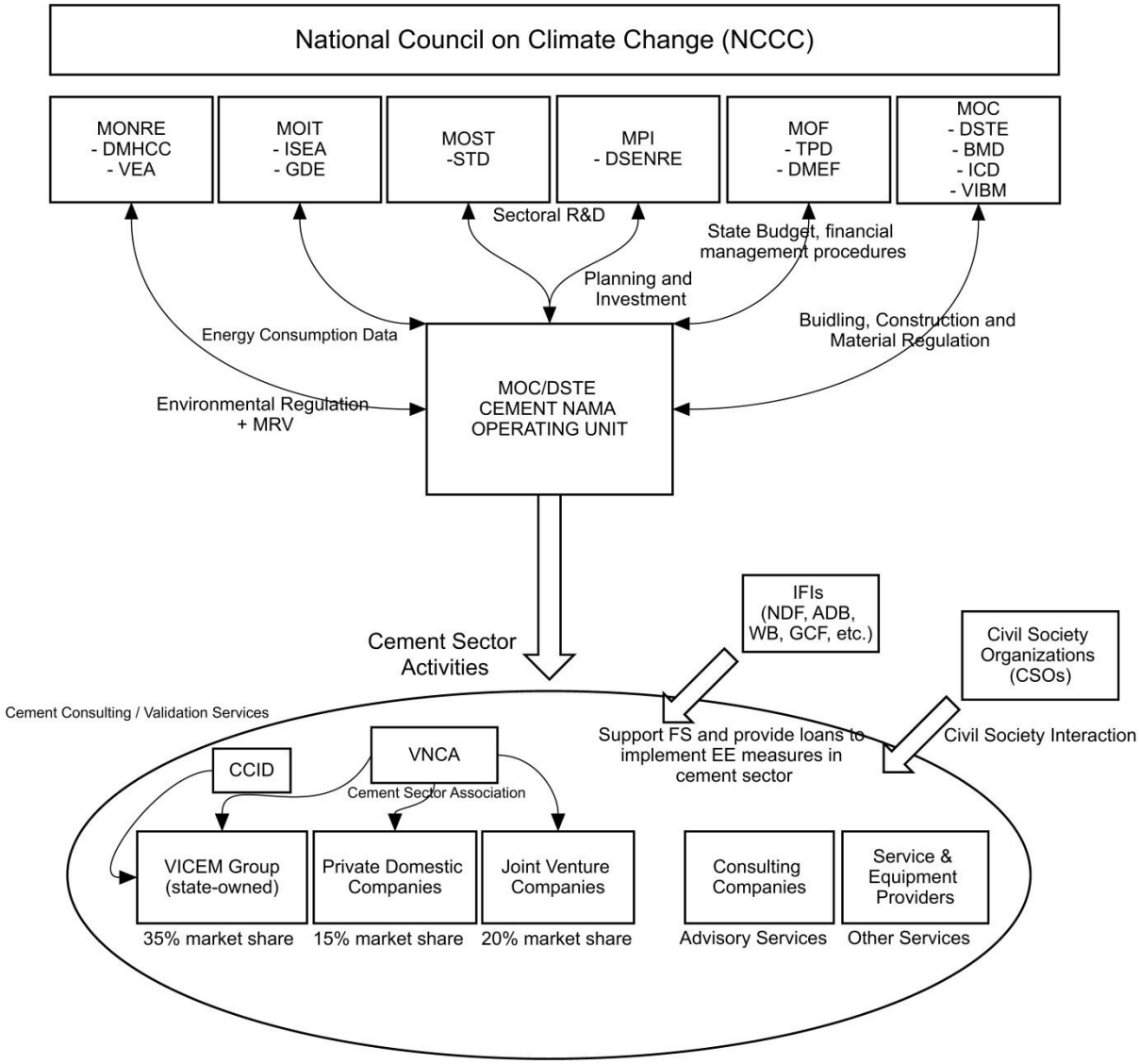
7 STAKEHOLDER ENGAGEMENT AND CAPACITY BUILDING

Based on the previous sections, the current Stakeholder Map for cement sector is described for an overview of the country context. The NAMA design elements discussed in previous sections also allow the identification of Desired Stakeholder Map for NAMA cement and corresponding capacity building needs. Suggested activities to engage key stakeholders into cement NAMA design and implementation are provided in the Stakeholder Engagement Plan. Successful implementation of this Stakeholder Engagement Plan will be considered finalization of Readiness Activities for up-scaled mitigation actions in the cement sector of Vietnam.

a) Country context

There are many existing and potential players among public authorities, cement industry, non-governmental organizations, financial institutions in Vietnam and international organizations who should be engaged in the cement sector NAMA in the country. Although their functions and responsibilities have been clearly defined in the existing legislation, the specific roles and cooperation needs to realize the NAMA cement project have not yet been formally discussed.

Figure 7-1: Current Stakeholder Map for cement sector



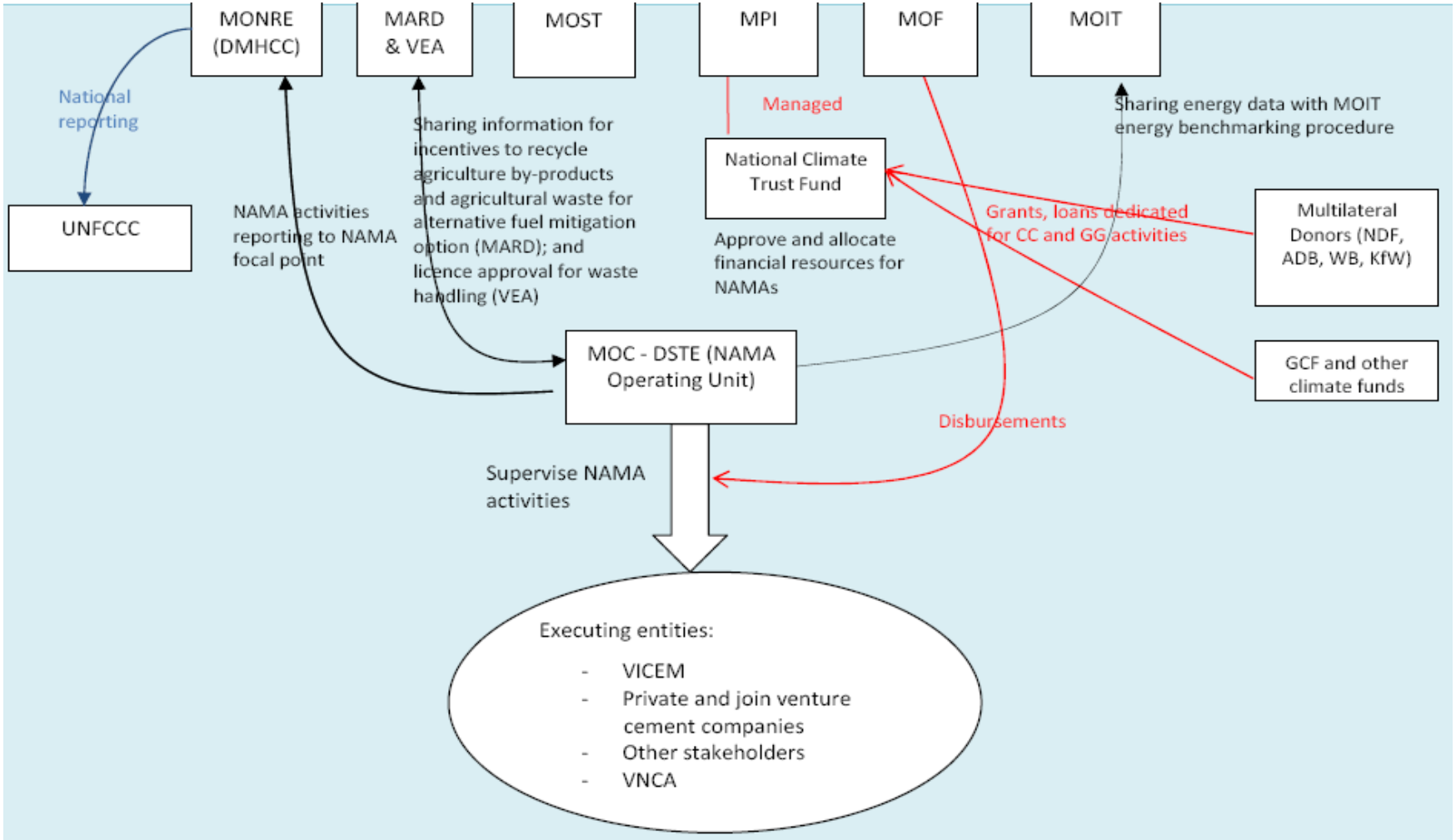
b) Summary of key findings

Desired Stakeholder Map

The desired Stakeholder Map defines the ideal institutional and regulatory framework that will be needed to put in place to support the NAMA for the cement sector in Vietnam.

Its purpose is to explain how the relative status of the key stakeholders, their roles, their responsibilities, the nature of their operations in relation to the cement sector, and their interaction will have to be adapted or incorporate NAMA-specific requirements and aspects for the initiative to be successful and comply with the requirements of: (i) the NAMA international donors / supporters; and (ii) the UNFCCC.

Figure 7-2: Desired Stakeholder Map for NAMA cement



c) Summary of recommendations

Referring to their existing functions and responsibilities and the results of related sub-products under this project, the Consultant has identified a number of activities that have to be undertaken to develop the capacity and enhance cooperation between the stakeholders for the effective implementation of the cement sector NAMA. These activities are presented in the form of the Stakeholder Engagement Plan. It is in the Consultant's view that the MOC should take the lead in realizing the proposed Stakeholder Engagement Plan, the key objective of which is to establish platforms for information exchange and building capacity among the key stakeholders in Vietnam for the design and effective operationalization of the NAMA in the cement industry. This will ensure that the stakeholders will be well informed and prepared to play their specified roles in the project; and necessary resources/factors will be mobilized as needed for the smooth implementation of the NAMA cement.

Table 7-1: Key stakeholders and Engagement Plan

#	Name of organization	Goals, motivations and role	Action	Engagement plan
I	**Public sector**			
1	**Ministry of Construction (MOC)** ***Science, Technology and Environment (DSTE)***	**NAMA Cement Operating Unit** • Accountability for NAMA design and NAMA operating. • Supervising the NAMA implementing entities. • Responsible for design and implementation of sectoral MRV including data collection from plants and reporting to MONRE, MOIT and MPI about the implementation of the NAMA. • Coordinate the development of the cement NAMA regulatory & institutional framework. • Develop and submit NAMA proposal for international donors (with support of MPI). • Coordinate with BMD for MRV of NAMA cement	Key involvement into NAMA design and implementation	• Small group discussions the outcomes of the NAMA Design Stage with MOC's head and key experts • Organize and participate in capacity building workshops on: - NAMA management, - MRV, - co-benefits, - mitigation options, - NAMA regulatory framework, - financial and market-based incentives for mitigation actions (including carbon market), - NAMA finance and donors' requirements, etc. • Develop joint circulars between MOC and other key public sector stakeholders stating roles, responsibilities and MRV coordination in NAMA cement. • Organize and participate in regular inter-ministerial coordination meetings. • Organize a round table to discuss NAMA regulatory & institutional framework with other key stakeholders • Prepare NAMA proposal(s) for international NAMA donors. • Organize public hearings of NAMA cement concept • Organize cement NAMA awareness raising activities
2	**Ministry of Construction (MOC)** ***Building Material Department (BMD)***	• Composing, revision and supervision of the implementation of cement sector development master plan. • Developing NAMA regulatory framework. • MRV of NAMA cement.	Key involvement into NAMA design and implementation	• Small group discussions the outcomes of the NAMA Design Stage with MOC's head and key experts • Participate in capacity building workshops on: - NAMA management, - MRV, - co-benefits, - mitigation options, - NAMA regulatory framework, - financial and market-based incentives for mitigation actions (including carbon market) • Participate in a round table to discuss NAMA regulatory & institutional framework with other key stakeholders

				• Participate in regular inter-ministerial coordination meetings
3	**Ministry of Natural Resources and Environment (MONRE)** ***Department of Meteorology, Hydrology and Climate Change (DMHCC)***	**NAMA National Focal Point, coordination of MRV system and reporting to UNFCCC.** • Establishing national NAMA registry. • Approval of NAMA proposals and their registration. • Setting up and coordinating NAMA knowledge/information management system. • Establish overarching MRV system for NAMAs in Vietnam; verification and approval of the cement sector NAMA MRV to integrate it into national system. • Collect data from MOC and process to international reporting. • Organizing the National GHG Inventory. • Preparing and submitting National Communications and BURs to UNFCCC. • Accountable for INDCs and responsible for aligning NAMAs with INDCs in the country.	• Key involvement into NAMA design, NAMA approval, NAMA MRV system • Request for guidelines on national reporting standards	• Small group discussions with MONRE/DMHCC's head and key experts the outcomes of the Design Stage of the project • Bilateral meetings with MOC DSTE and DMHCC on: - NAMA MRV system, - co-benefits, - use of MSW as AF for cement plants, - policy/regulatory interventions to encourage mitigation actions under NAMA cement. • Participate in development of the joint circular between MOC and MONRE stating roles, responsibilities and MRV coordination in NAMA cement. • Participate in regular inter-ministerial coordination meetings • Participate in a round-table to discuss NAMA regulatory & institutional framework with other key stakeholders • Support MOC in organizing and participate in capacity building workshops/trainings on MRV for NAMA managers, NAMA implementers (plants) and verificators: - MRV of GHG emissions and emission reductions, - MRV of SD co-benefits, - MRV of financial support, - Trainings for verificators (3 days x 2) including testing a few companies and developing a positive list of eligible verificators • Assist MOC in organizing public hearings of NAMA concept • Assist MOC in organizing awareness raising activities on the NAMA
4	**Ministry of Natural Resources and Environment (MONRE)** ***Vietnam Environment Administration (VEA)***	• Developing enabling framework for use of waste as AF at cement plants. • MRV of co-benefits (co-processing of waste in cement plants, pollution)	• Key involvement into design of NAMA regulatory framework • NAMA approval and NAMA finance operation	• Participate in development of joint circular between MOC and MONRE stating roles, responsibilities and MRV coordination in NAMA cement. • Participate in regular inter-ministerial coordination meetings • Participate in a round table to discuss NAMA regulatory & institutional framework with other key stakeholders, especially issues related to waste management • Support MOC in organizing and participate in capacity building workshops on utilizing waste as AF for the cement plants • Support MOC in organizing and participate in capacity building workshops

				on MRV of co-benefits
5	**Ministry of Planning and Investment (MPI)** ***Department of Science, Education, Natural Resources and Environment (DSENRE)***	**NAMA Finance Coordination Unit** • Evaluating the NAMA to ensure its achievement of GHG emission reductions and non-GHG related objectives (SD co-benefits and support), as well as its consistency with national policies (including Green Growth Strategy) and international requirements. • Evaluating and approval of NAMA budget. • Mobilization of funds for a NAMA under National Climate Trust Fund. • Approval of funds disbursement. • Development/approval of co-benefit targets for NAMAs. • Development of financial and market-based incentives for NAMAs. • Focal point for GCF and other programs/initiatives that could be used for NAMA financing.	• Key involvement into NAMA design, NAMA approval and NAMA finance operation • Request criteria for NAMA approval	• Small group discussions with MPI's head and key experts on the outcomes of the Design Stage of the project • Bilateral meetings with MOC and MPI on: - NAMA approval criteria, - NAMA finance issues (including discussion of potential application for GCF and other donors), - co-benefits, - policy/regulatory interventions to encourage mitigation actions under NAMA cement. • Participate in development of joint circular between MOC and MPI stating roles, responsibilities and coordination in MRV of support (if required by donors) in NAMA cement. • Participate in regular inter-ministerial coordination meetings • Support MOC in organizing and participate in all activities related to NAMA Finance including but not limited to: - Discussions on setting up NAMA financial mechanism (jointly with MOC, MOF); - Capacity building workshop on NAMA finance to discuss donors' requirements, criteria and procedures for proposal submissions, especially GCF process; - Political support for NAMA proposal submissions; - policy/regulatory interventions needed to set up financial incentives for mitigation actions in the sector • Participate in a round table to discuss NAMA regulatory & institutional framework with other key stakeholders • Assistance and political support in preparing and submitting proposal(s) for international NAMA donors.
6	**Ministry of Industry and Trade (MOIT)** ***Industrial Safety techniques and Environment Agency (ISEA)***	Focal point to coordinate the National target Program to respond to CC (NTP-RCC).	• Involvement into design of sectoral MRV system • Involvement into design of NAMA regulatory framework for EE and AF	• Small group discussions with MOIT's head and key experts on the outcomes of the Design Stage of the project • Participate in development of joint circular between MOC and MOIT stating roles, responsibilities and MRV coordination in NAMA cement. • Meetings between MOC and MOIT on: - sectoral MRV system and - development of regulatory framework and incentives for EE enhancement & use of AF. • Participate in regular inter-ministerial coordination meetings • Participate in a round-table to discuss NAMA regulatory & institutional framework with other key stakeholders, especially with regard to incentives

				for EE enhancement & use of AF. • Support MOC in organizing and participate in capacity building workshops/trainings on MRV for NAMA managers, NAMA implementers (plants) and verificators: - MRV of GHG emissions and emission reductions, - MRV of SD co-benefits, - MRV of financial support, - Trainings for verificators (3 days x 2) including testing a few companies and developing a positive list of eligible verificators • Assist MOC in organizing a workshop on EE mitigation technologies and practices for cement plants.
7	**Ministry of Industry and Trade (MOIT)** ***General Directorate of Energy (GDE)***	• Oversight of the energy sector including initiatives related to renewable energy, energy efficiency and conservation. • Coordination of energy audits. • MOIT is collaborating with MONRE on GHG inventory work.	• Involvement into design of sectoral MRV system • Involvement into design of NAMA regulatory framework for EE and AF	• Small group discussions with MOIT's head and key experts on the outcomes of the Design Stage of the project • Participate in development of joint circular between MOC and MOIT stating roles, responsibilities and MRV coordination in NAMA cement. • Meetings between MOC and MOIT on: - sectoral MRV system and - development of regulatory framework and incentives for EE enhancement & use of AF. • Participate in regular inter-ministerial coordination meetings • Participate in a round-table to discuss NAMA regulatory & institutional framework with other key stakeholders, especially with regard to incentives for EE enhancement & use of AF. • Support MOC in organizing and participate in capacity building workshops/trainings on MRV for NAMA managers, NAMA implementers (plants) and verificators: - MRV of GHG emissions and emission reductions, - MRV of SD co-benefits, - MRV of financial support, - Trainings for verificators (3 days x 2) including testing a few companies and developing a positive list of eligible verificators • Assist MOC in organizing a workshop on EE mitigation technologies and practices for cement plants.
II	**Cement Companies**			
1	**Vietnam Cement Industry Corporation (VICEM)**	• NAMA participant/beneficiary • Implementer of NAMA Actions	• Participation in NAMA capacity development activities • Implement NAMA actions and report as per established MRV	• Small group discussions on the outcomes of the NAMA Design Stage • Participate in capacity building workshops on: - Implementation of NAMA Actions (GHG ER actions) - MRV of NAMAs, - co-benefits of NAMAs (and how to MRV them), - NAMA regulatory framework,

			system requirements	- market-based incentives for mitigation actions (including carbon market), - NAMA finance and donors' requirements, etc. • Participate in a round-table to discuss NAMA regulatory & institutional framework with other key stakeholders
2	**Private domestic and joint-venture cement companies**	NAMA implementers	• Participation in NAMA capacity development activities • Implement NAMA actions and report as per established MRV system requirements	• Small group discussions on the outcomes of the NAMA Design Stage • Participate in capacity building workshops on: - Implementation of NAMA Actions (GHG ER actions) - MRV of NAMAs, - co-benefits of NAMAs (and how to MRV them), - NAMA regulatory framework, - market-based incentives for mitigation actions (including carbon market), - NAMA finance and donors' requirements, etc. • Participate in the round table to discuss NAMA regulatory & institutional framework with other key stakeholders
3	***Vietnam National Cement Association (VNCA)***	• NAMA participant/beneficiary advisor	• Participation in NAMA capacity development activities	• Participate in capacity building workshops on: - Implementation of NAMA Actions (GHG ER actions) - MRV of NAMAs, - co-benefits of NAMAs (and how to MRV them), - NAMA regulatory framework, - market-based incentives for mitigation actions (including carbon market), NAMA finance and donors' requirements, etc.
III	**Financial institutions in Vietnam**			
1	***State Bank of Vietnam (SBV) and commercial banks***	In relation to the NAMA cement project, SBV will cooperate with MPI and MOF to allocate domestic public funding for implementation of mitigation actions (at the proposal of MOC). Commercial banks can also be involved in the disbursement process of state budget or international finance.	• Involvement into NAMA finance. • Involvement into development and provision of NAMA financial incentives	• Participate in meetings to develop disbursement mechanisms for financing of the NAMA cement. • Participate in all activities related to NAMA Finance including but not limited to: - Discussions on setting up NAMA financial mechanism (jointly with MOC, MOF); - policy/regulatory interventions needed to set up financial incentives for mitigation actions in the sector
IV	**International developmentagencies, partnerships and funds**			

1	***Nordic Development Fund (NDF)***	• Support for NAMA design and Readiness. Potential (co-)funding of NAMA piloting and implementation	Key involvement	• Small group discussions on the outcomes of the NAMA Design Stage with MOC DSTE's head and key experts, NDF's senior management, and high level political bodies of the Government of Vietnam • Organization of capacity development workshops • Co-organize and participate in all activities related to NAMA Finance including but not limited to: - Discussions on setting up NAMA financial mechanism (jointly with MOC, MOF); - Capacity building workshop(s) on NAMA support to discuss donors' requirements, criteria and procedures for proposal submissions, especially GCF process; - Political support for NAMA proposal submissions; - policy/regulatory interventions needed to set up financial incentives for mitigation actions in the sector • Participate in a round-table to discuss NAMA regulatory & institutional framework with other key stakeholders • Assistance and political support in preparing and submitting proposal(s) for international NAMA donors.
2	***Asia Development Bank (ADB)***	Potential (co-)funding of NAMA piloting and implementation. Assistance in applying for GCF.	• Potential involvement into NAMA finance	• Participate in all activities related to NAMA Finance including but not limited to: - Discussions on setting up NAMA financial mechanism (jointly with MOC, MOF); - Capacity building workshop(s) on NAMA support to discuss donors' requirements, criteria and procedures for proposal submissions, especially GCF process; - Political support for NAMA proposal submissions; - policy/regulatory interventions needed to set up financial incentives for mitigation actions in the sector • Assistance and political support in preparing and submitting proposal(s) for international NAMA donors.
3	**NAMA Facility**	Potential (co-)funding of NAMA piloting and implementation.	Potential involvement into NAMA finance	Awaiting next call for proposals, prepare and submit NAMA concept according to NAMA Facility requirements.
4	**GCF**	Potential (co-)funding of NAMA piloting and implementation.	Potential involvement into NAMA finance	Preparing and submission of the proposal
5	**WB**	Potential (co-)funding of NAMA piloting and implementation (currently pledge US$200m for waste heat recovery at Vietnam	Potential involvement into NAMA finance	• Participate in all activities related to NAMA Finance including but not limited to: - Discussions on setting up NAMA financial mechanism (jointly with MOC, MOF);

		cement plants)		- Capacity building workshop(s) on NAMA support to discuss donors' requirements, criteria and procedures for proposal submissions, especially GCF process; - policy/regulatory interventions needed to set up financial incentives for mitigation actions in the sector • Assistance and political support in preparing and submitting proposal(s) for international NAMA donors.
6	**KfW**	Potential channel to submit the NAMA cement proposal to GCF (accredited as an implementing entity for GCF)	Potential involvement into NAMA finance	• Participate in all activities related to NAMA Finance including but not limited to: - Discussions on setting up NAMA financial mechanism (jointly with MOC, MOF); - Capacity building workshop(s) on NAMA support to discuss donors' requirements, criteria and procedures for proposal submissions, especially GCF process; - policy/regulatory interventions needed to set up financial incentives for mitigation actions in the sector • Assistance and political support in preparing and submitting proposal(s) for international NAMA donors.
V	**Third party verifiers and auditors**			
1	**Third party verifiers**	National or international agencies that can serve as Third party verifiers of the cement NAMA	Key involvement into NAMA MRV	Participate in trainings for verificators on MRV
2	**Third party auditors**	National or international agencies that can serve as Third party auditors of the Cement NAMA financial management	Key involvement into NAMA Financial Management	Participate in capacity building workshops/trainings for the auditing of NAMA financial management procedures

The suggested stakeholder engagement activities include: a) establishing platform(s) for cooperation and information/knowledge exchange between the stakeholders for the cement sector NAMA development and operation domestically and with international partners; b) signing joint circulars or high-level cooperation agreements between MOC and the key stakeholders stating roles, responsibilities and mutual benefits of participating in the NAMA cement; c) workshops, trainings, round table discussions, bi-lateral and multi-lateral meetings, and other activities to involve and build capacity and awareness of various stakeholder groups for NAMA managing, implementation or support.

In order to receive the buy-in of various stakeholders, it will be key to show them clearly how a NAMA creates outcomes that are relevant to them, whether these are achieving domestic policy objectives, developing new business opportunities, improving the living conditions and welfare of the local communities, etc.

8 ROLL-OUT OF THE READINESS PLAN

The roadmap for the roll out of the Readiness Plans based on the key findings of all the building blocks presented in this report and especially the more detailed findings presented in report "[P-I.7.2, I.7.3 andI.7.5] Definition of NAMA financing needs, analysis of carbon market mechanisms and results-based approaches to finance the NAMA and setting up a NAMA financial plan"

8.1 Roadmap for the roll out of the Readiness Plan

The selected low-carbon technologies and practices for the NAMA in the cement sector have been prioritized based on their mitigation potential, MAC, required finance and enabling policy/financial incentives for their deployment. Some mitigation actions can or even necessarily should be implemented quickly, while others will take more time and will require a lot of readiness work.

The roadmap for the roll-out of the Readiness Plan has been structured along with the proposed prioritization of mitigation actions in short-term, medium-term and long-term periods (see table below). The short-term actions cover the period 2016-2020 with initial readiness activities in 2016-2017. The implementation of medium term actions will start in 2021 with readiness activities taking place already in the short term period. Long-term activities will be implemented after 2025 with readiness activities in the mid-term period. In total, four groups of mitigation actions have been defined by their implementation priority over the NAMA time horizon and required support: 1) enabling activities and results-based public incentives (e.g., carbon procurement tender) or 2) additional capex-related financial support/incentives (loans, subsidies, market mechanisms).

For each group of the mitigations actions in a time period the required enabling activities have been identified (see table below).

Table 8-1: Summary and prioritization of mitigation actions for the cement NAMA in Vietnam by their time horizon and required enabling activities

	Mitigation actions that can be catalyzed via enabling activities and results-based public incentives	Mitigation actions that can be catalyzed by additional capex-related financial support/incentives (loans, subsidies, market mechanisms)	Required enabling activities
Short-term actions no-regret, no- or low-capex (2016-2020 with initial readiness activities in 2016-2017)	**Group 1** • 1a) Process knowhow, control and management & 1b) Diagnostic energy audits • 11) Blending: Pozzolana • 12) Blending: Limestone	n/a	• Establishing NAMA Operating Unit at MOC; • Setting up NAMA MRV system; • Revising the MOC Cement Master Plan and developing policy incentives for: balancing cement capacity with demand, EE improvement and reducing clinker content in cement; • Feasibility studies on various mitigation actions; • Strategic study on AFR use in Vietnam; • Designing carbon procurement tender; • Capacity building activities.
Mid-term actions (implementation after 2020 with readiness activities in the short term)	**Group 2** • 2) Modern automation and control systems • 3) Clinker cooler modification • 8) Retrofit to modern multi-channel burner • 9) Blending: GBFS as cement constituent • 10) Blending: Fly ash as cement constituent	**Group 3** • 4) Waste heat recovery (WHR) • 7) BAT for alternative fuels - replacing fossil fuels	• Developing waste management regulations and infrastructure in Vietnam; • Pilot phase of the carbon procurement tender; • Introducing financial instruments, including performance guarantees for WHR; • Facilitating access to existing EE funds (for WHR); • Merging small cement plants into a number of larger companies and establishing EE technical centre(s); • Capacity building activities, especially for AFR.
Long-term actions (implementation after 2025 with readiness activities in the mid term)	n/a	**Group 4** • 5) Adding a pre-calciner to existing pre-heater kiln • 6) Additional Pre-heater cyclone	• Developing policy and financial incentives for mitigation actions under Group 4; • Capacity building activities.

The financing of different activities shall be organized in accordance with the above-proposed phasing of mitigation actions and should focus on realization ofthe enabling activities and relevant incentives. The below table describes the key financing mechanisms that can be taken into account during NAMA implementation in the short and mid-term.

Table 8-2: Financing mitigation actions and enabling activities under the cement sector NAMA

	Mitigation actions that can becatalyzed via enabling activities and results-based public incentives	Mitigation actions that can becatalyzed by additional capex-related financial support/incentives	Required enabling activities
Short-term financing (2016-2020)	**Group 1** 1. Capital markets, balance sheets of cement companies. 2. Results-based payments from the pilot phase of the carbon credit procurement tender; 3. Existing domestic and international EE support funds.	n/a	1. International (e.g., NDF, NAMA Facility, GCF, etc.) and domestic public funding of the initial enabling activities. Special attention should be given to: • Updating cement Master Plan, • Developing policies and regulations, • Developing waste management infrastructure in Vietnam; • Core budget for NAMA Operating Unit, • Setting up Facility for Credit Purchasing (FCP) and preparing pilot phase of carbon credit procurement, • Capacity building, engagement of cement plants, • MRV at plant-level. 2. Budget for the pilot phase of carbon credit procurement tender (international and domestic finance). 3. Cost recovery mechanism to fund the operational costs of NAMA Operating Unit and FCP via: • a small share of energy savings (ESCO model), • a fee per carbon credit added to the carbon price, • a fee (or tax) on the use of coal.
Mid-term and long-term financing (2021-2025)	**Groups 1, 2** 1. Capital markets, balance sheets of cement companies; 2. Results-based payments from FCP; 3. Pre-payments against the future delivery of carbon credits from	**Group 3 (and 4 in long-term)** 1. Capital markets, balance sheets of cement companies; 2. Results-based payments from FCP; 3. Instruments to de-risk performance and facilitate access to capex funds (e.g. performance guarantees);	1. Cost recovery mechanism to fund the operational costs of NAMA Operating Unit, FCP, EE support fund via: • a small share of energy savings (ESCO model), • a fee per carbon credit added to the carbon price, • a fee (or tax) on the use of coal.

	the Carbon Credit Procurement Facility; 4. Existing domestic and international EE support funds; 5. International carbon market.	4. Waste disposal fee; 5. EE investment support facility; 6. Existing domestic and international EE support funds; 7. Loans from international climate finance facilities (GCF) 8. International carbon market.	

9 SHORT SUMMARY AND RECOMMENDATIONS

The Readiness Plan for the Cement Sector has been developed in close co-operation with stakeholders and under the overall coordination of MOC.

MOC has in due time forwarded input of the NAMA for the cement sector to MONRE for consideration in the INDC and this highlights the strategic relevance of this NAMA and its contribution to climate mitigation and non-climate related policies. It is important to continuously support the process as mitigation from the cement sector should be a high priority in Vietnam.

The preparatory work for the Readiness Plan for the Cement Sector has concluded that there are a significant number of commercially viable CO_2 reduction efforts that can be taken by cement plants, but that they are frequently not implemented for various reasons. It can be cost-effective to focus on the elimination of these barriers which can at least partially be done through enabling activities.

The Readiness Plan for the Cement Sector proposes priority actions and innovative ideas, which can be initiated accordingly. These enabling activities will need international support and MOC should accordingly discuss with potential sponsors/donors whether they could support the implementation of the NAMA in the cement sector. To avoid a delay and a gap between this contract and a follow-up phase it is important to clarify the next actions accordingly. Some of the highest priority enabling activities which shall be initiated accordingly are specified in table 8.2.

After a preliminary consultation with MOC special attention should be given to: clarifying the following 1) Updating the Cement Master Plan, 2) Developing policies and regulations, 3) Core budget for NAMA Operating Unit, 4) further clarification of setting up Facility for Credit Purchasing (FCP) and preparing pilot phase of carbon credit procurement, 5) Capacity building and engagement of cement plants, 6) MRV at plant-level, and 7) mobilizing international climate finance and carbon market funds.

MOC needs to clarify urgently how it shall revise the Master Plan as the most important document to regulate and develop the cement sector in a sustainable. It is recommended that NDF, or other potential donors supports MOC in identifying funds to support the revision of the Cement Master Plan.

A pilot project should be implemented in the short term period up to 2020. It should be a combination of enabling activities and concrete implementation and investments at cement plants. A Facility for Credit Purchasing (FCP) administrated under MOC should be established to facilitate this. A NAMA Operating Unit can be set up accordingly and can support the development of the Facility for Credit Purchasing (FCP).

The set-up of a NAMA Operating Unit and first years of operation need international support. Based on the consultants experience the following can be recommended: the first 3 years donor funding, year 4-5 a 50-50% split between donor and Vietnamese sources (cement plants and public funds) and from year 6 100% Vietnamese funding.

The MRV at plant-level needs to be improved and a MRV system using the simplified CSI tool at selected plants should be implemented and tested. As part of the pilot activity the main content should be to prepare monitoring template, implementation guidelines, training and integrating with other management systems ISO 9000, 14000, 50000, etc.

MOC shall consult with potential donors to support the above mentioned activities in the short term. The different characteristics of the donors should be explored with the aim that they can cover different type of enabling activities.

The COPs and UNFCCC meetings as well as international carbon fairs are also a market place for potential support and MOC should use this opportunity to attract further funds to the cement sector in Vietnam.

The approach, methodology and selected documents underpinning the Readiness Plan for the Cement Sector in Vietnam should be shared with the international community to contribute the further development of the cement NAMAs in other countries.

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ANNEX A: MITIGATION SCENARIO BATP-1000

As requested by MOC, a new mitigation scenario, namely BATP-1000, was developed to reflect the options on technical improvements plus the change in cement production from 1200 kg cement/ per capita (as described in the Master Plan 1488) to a lower rate of 1000 kg cement per capita.

Key parameters for mitigation options development

As identified and described in section 4.2, 12 low carbon options are selected for further cost/benefit analysis thanks to their appropriateness with Vietnam context. In order to simulate the MAC curve, general assumptions related to KPI of plants, emission factors, economic parameters and energy prices need to be made. Moreover, specific options will require additional specific assumptions. A list of assumptions as well as their sources shall be provided in this section.

A. General assumptions

Table A-1: General assumptions for the MAC analysis

	Unit	Value	Comments	Source
Thermal energy efficiency				
Thermal energy efficiency (current)	*MJ/ton clinker*	3700	Thermal energy KPI as per project data base	Project database
Thermal energy efficiency (2030)	*MJ/ton clinker*		Thermal energy KPI assumption for 2030 under different Scenarios	
VN BaU-1200		3600		
BATP-1200		3400	Global average thermal consumption of PHPC kilns	BATP scenario of report I.3
BATP-1000		3300	Average thermal consumption of BAT for 5 cyclone PH	
Alternative fuel use rate				
AF-TSR (current)	*%*	0	Alternative fuel substitution rate; applied under VN BaU-1200 scenario	Project database
AF-TSR (2030)	*%*	28	Alternative fuel substitution rate; same as BATP-1200 scenario	BATP scenario of report I.3
Cement production scenario; cement capacity per capita per year under different scenarios				
VN BaU-1200 / BATP-1200	*t cem/cap*	1.2	Production scenario with 1,200 kg cement capacity per capita per year by 2030, equivalent to 126 million tons of cement produced.	Vietnam Master Plan
BATP-1000	*t cem/cap*	1	Production scenario with 1000 kg cement per capita per year by 2030, equivalent to 103 million tons of cement produced.	

	Unit	Value	Comments	Source
Clinker content in cement				
Clinker Factor (current)	*% cli/cem*	83%	Clinker content in one ton cement	Project database
Assumed Clinker Factor (2030) – VN BaU-1200	*% cli/cem*	80%	Assumption	BAU scenario of report I.3
Assumed Clinker Factor (2030) - BATP-1000	*% cli/cem*	69%	Same value as BATP-1200	BATP scenario of report I.3
Emission factors				
Direct process emission	*tCO_2/t clinker*	0.525	IPCC default	IPCC 2006
Grid emission factor	*gCO_2/kWh*	560	For the analysis and assessment the officially published GEF is considered.	DMHCC/ MONRE
Coal	*tCO_2/TJ*	98.3	IPCC default values	IPCC 2006
NCV Coal	*GJ/t*	26.7	IPCC default net calorific values (NCVs)	IPCC 2006
Energy prices				
Electricity	*USD/kWh_e*	0.07	Circular 12/2014/TT-BCT dated 31 March 2014 guiding the calculation of average tariff indicates that EVN could propose a hike in tariff from 7-10% annually for ERAV to approve.	Circular No. 16/2014/TT-BCT dated 29/5/2014 by MOIT
Coal	*USD/GJ*	2.6	Dust coal price: 1.48Million VND/ton	Report I.3
Cost of blending material				
Cost of slag (FOB)	*USD/t*	*23*	*Imported slag from Japan. The cost of imported blast furnace slag from Japan is quite high with 21- 24USD / ton (incl. transport)*	*Report 1.5.1a*
Cost of fly ash (FOB)	*USD/t*	*22*	*Interview with Song Da Cao Cuong JSC: depending on the volume of order, the price EXW could be as low as 300'000-350'000 VND/ton (without transportation)*	http://gachnhescl.com/?thamso=chitiet_tintuc&id=56795
Cost of pozzolana (FOB)	*USD/t*	7	Cost of pozzolana around 150'000 VND/ton (inclusive transportation, i.e. on site delivery)	MOC website[17]
Cost limestone	*USD/t*	0	Assumed to be zero: assuming crushing/drying/blending	

[17] http://www.xaydung.gov.vn/vi/web/guest/trang-chi-tiet/-/tin-chi-tiet/Z2jG/86/31118/phu-gia-khoang-trong-cong-nghiep-san-xuat-xi-mang.html

	Unit	Value	Comments	Source
			system/silos already existing.	
Financial parameters				
Discount rate / cost of capital	*%*	10%	Vietnamese practice: Discount rate = 10% Weighted average cost of capital (2014) = 9,7%	Decision No. 2014/QD -BCN dated 13/6/2007 issued by MOIT.
Inflation rate	*%*	2.5%	Historical data: 2012: 9.1; 2013: 6.6; 2014: 4.1	Asian Development Outlook 2015 - ADB[18]
Assessment period for mitigation	*Years*	15	Until 2030 - in order to ensure consistency with the BAU scenario.	In compliance with VGGS[19].
Exchange rate	*USD/EUR*	1.1	As of June 2015	As of June 2015
Exchange rate (2015)	*VND/USD*	21'630	Period of reference: 2015	MOF (June 2015)[20]

B. Specific assumptions

Table A-1: Specific assumptions for the MAC analysis

Mitigation option	Penetration/application	Energy/CO_2 savings	Costs
Process knowhow, control and management And Diagnostic energy audits	The combined option was considered for plants that have thermal energy consumption higher than the current sector average or BATP level: **PHPC Plants** can reach BATP benchmarks of 3'300 MJ/ton clinker (BATP-1000 scenarios), and 3'600 MJ/ton clinker (VN-BaU-1200) respectively; **PH Plants** can reach on average 3'700 MJ/ton clinker. Total 34 plants under VN-BaU-1200, and 42 plants under BATP-1000 scenarios are considered	Each PHPC installation will be able to reach 3'300 MJ/ton clinker and PH plants 3'700 MJ/ton clinker. Energy saving is the difference between the current performance and these benchmarks. For plants where no information on current energy consumption from the database is available due to only recent commissioning (4 plants), the sector	Initial cost per plant: USD 200'000 [21] O&M costs: USD 5'000 per plant and year.

[18] http://www.adb.org/countries/viet-nam/economy

[19] Vietnam Green Growth Strategy: "National Strategy on Green Growth for the period 2011- 2020 with vision to 2050". Two milestone years: 2020 and 2030 with specific targets on emission reductions

[20] http://www.mof.gov.vn/portal/page/portal/mof_vn/1641775?p_folder_id=156835847&p_recurrent_news_id=171138968

[21] WB LCDOA, MOIT, VICEM

Mitigation option	Penetration/application	Energy/CO_2 savings	Costs
	under this option.	average was applied.	
Modern automation and control system	Under this option we assume that all installations that consume more than 3'700 MJ/ton clinker of thermal energy need to install automated control systems and execute diagnostic audits There are 20 plants falling under this option (all scenarios).	Reduce energy consumption: by 100 MJ/ton for those that currently consume up to 3'800 MJ/ton clinker and 250 MJ/ton for those that consume 4'000 MJ/ton clinker or more.	USD 550'000 investment cost[22] per plant
Clinker cooler modification	Option was considered for installations with a capacity greater than 1.5 Mt/year of clinker production, Additionally, only plants that have a specific thermal energy consumption of more than 3'400 MJ/ton were considered. There are currently 13 plants meeting this criterion.	Thermal energy reduction of -200 MJ/ton clinker (ECRA, 2009: 100 – 300 MJ/ton clinker) is assumed and applied to the current energy consumption of each plant covered.	Investment costs are USD 2.2 Million on average. O&M costs are related to an increase of electricity consumption of average 4 kWh/ton clinker.
Waste Heat Recovery	We a assumed a minimum theoretical amount of recoverable electric power of 10 kWh_{el}/ton clinker to be eligible for WHR. Second, we considered the size of the installation. Only the large ones should consider WHR. Hence, the option was considered only for > 2,500 ton clinker per day installations, as per master plan. There are currently 22 plants meeting these criteria (BATP-1000), for which the total theoretical installed capacity (gross) of WHR is estimated at around 93 MW_{el}.	The "assumed theoretical amount of recoverable electric power" (ATAREP) resulting from the calculation is in the range of 12 – 62 kWh/ton (average 19 kWh/ton). This electricity is multiplied by the grid emission factor for the Vietnamese power grid to estimate the CO_2 reduction potential.	Investment costs are assumed to USD 2 Million per MW_{el}.[23] O&M costs are estimated to 1.45% of investment cost.
Adding a pre-calciner to existing pre-heater kiln	The option was considered only for installations with pre-heater kilns without pre-calciner and capacity greater than 1.5 Mt clinker per year. There are currently 4 plants meeting this criterion.	Thermal energy reduction of -250 MJ/ton clinker (ECRA, 2009: 200 – 300 MJ/ton clinker) is assumed and applied to the current	An average investment costs of 15 Million EUR (USD 16.5 Million) was

[22] ECRA, 2009
[23] VNCA, 2015

Mitigation option	Penetration/application	Energy/CO_2 savings	Costs
		energy consumption of each plant covered here.	applied.
Additional Pre-heater cyclone	The option was considered only for installations with a commissioning year older than 10 years. There are currently 9 plants meeting this criterion.	Thermal energy reduction of -90 MJ/ton clinker (ECRA, 2009: 80 – 100 MJ/ton clinker) are assumed and applied to the current energy consumption of each plant covered under the option.	An average investment cost of 6.5 Million EUR (USD 7.15 Million) was applied.
BATP for Alternative fuels – replacing fossil fuels	The option is considered to be feasible to all plants. Fossil fuel savings (coal) and CO2 mitigation are reached by replacing coal with AF. In the absence of relevant Vietnamese information on all those aspects for the estimation of the CO2 mitigation cost through AF, the consultants have opted for a generic and conservative approach where the 28% BATP thermal substitution rate is achieved by an undefined mix of all these waste types. For this MACC calculation, one third of the 28% TSR is obtained by a mix of type 1 wastes with average heating value 15 GJ/ton AF and 20 USD/ton positive gross AF cost; one third is formed by type 2 waste with on average 11 GJ/ton AF and 15 USD/ton gross AF cost (i.e. the service fee does not cover the (pre)processing cost) and one third is type 4 waste with 15 MJ/ton AF and USD 16/ton negative gross AF cost (i.e. the service fee exceeds the (pre)processing cost). Technical details for each type of waste should be found in Report P I.5.2/4.		An average of 10 Million EUR (USD 11 Million) per cement company was applied. AF pre-treatment, processing and administrative costs are included in the scenarios for the gross AF cost above. Other O&M costs relate to an increase of electricity consumption of about 0-3 kWh/ton clinker as per ECRA, 2009 (we assumed 1.5 kWh/ton clinker).
Retrofit to modern multi-channel burner	The option was considered only for PHPC kilns installations that have been in operation before 2010. We assume that more recent installations have MCB. There are currently 16 plants meeting this criterion.	Thermal energy reduction of -50 MJ/ton clinker (ECRA, 2009: 25 – 75 MJ/ton clinker) is assumed and applied to the current energy consumption of each plant covered under the	Investment costs are estimated to 0.5 Million EUR (USD 0.55 Million) was applied

Mitigation option	Penetration/application	Energy/CO_2 savings	Costs
		option.	(ECRA, 2009).
Clinker substitution: GBFS, Fly ash, Pozzolana and limestone	The option was considered to be feasible to all plants. For the cost estimation: we exclude the R&D and marketing cost as well as CAPEX needed for processing installations outside the cement plant, and assuming that crushing/drying/blending system/silos for limestone, pozzolana and slag already exist at the plant.	As a scenario the composition of clinker substitution we assume a clinker content in cement at sector level of 69% for BATP-650/800 and BATP-1200 by 2030 (down from 83% in 2014), this means 69% clinker in the cement portfolio and the rest being the sum of gypsum, pozzolana, limestone, slag and fly ash. For the MAC we assumed a combination of slag, fly ash, limestone and pozzolana but considering only the additional amount of substitutes (83%-69% = 14% additional) compared to current practices.	The CAPEX are estimated to be USD 116'000 for limestone (additional silo and conveying system), and USD 50'000 for pozzolana and slag (additional storage only) as cement constituent. For fly ash, as new bulk silos and conveyors are required, the investment costs are expected at USD 120'000.

Summary of results from MACC analysis

The results of the MAC analysis show that most mitigation options have negative MAC, which means they are economic viable. The most attractive option is the blending of limestone and pozzolana, as the material is rather favourable compared to clinker and no additional investment costs are required. WHR appears quite beneficial, but only larger plants with reasonable amount of recoverable heat are considered. In the following sections, MAC results will be summarized for 12 mitigation options under 4 selected scenarios.

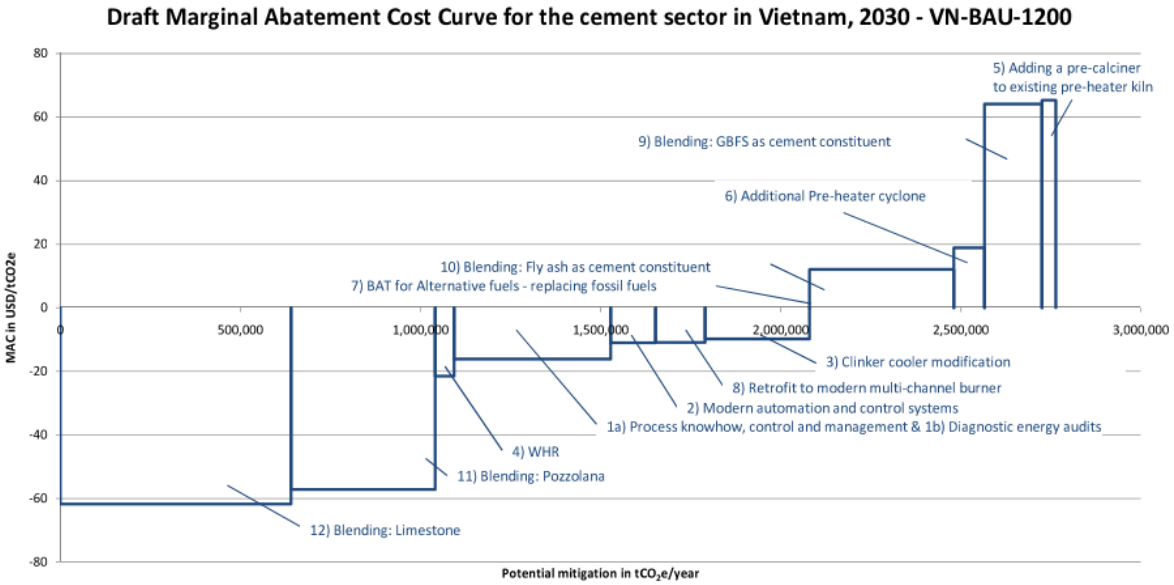
The Consultant emphasizes that in addition to the mitigation options 1) to 12) under the scenario BATP-800 and BATP-1000 additional CO_2 emission could be avoided due to clinker capacity that does not have to be installed to meet the expected demand under the Mater Plan production scenarios: Cement capacity under Master Plan (1200 kg/cap) will require 126 Mt/y in 2030; if the demand increase can be reduced (to 800 kg/cap) the current clinker capacity (55 Mt/y) will be sufficient. Hence, up to 46 Mt/y of clinker capacity would not need to be built.

A. Business-as-usual scenario

Error! Reference source not found. summarizes key results and mitigation indicators under scenario VN-BAU-1200, presenting initial efforts by both public and private sectors in introducing low carbon development in the cement sector of Viet Nam, taking into account recent legal

requirements and programs as discussed in report P-I.5.1[24]. The total initial investment required for all 12 options would be around USD 253 million.

Figure A-1: MACC considering current plants under VN-BaU-1200



B. BATP with lower cement production capacity (BATP-1000)

Similarly, in the situation that the Master Plan would be adjusted to lower cement per capita (1000 kg/cap), by implementing all options in scenarios BATP-1000 the total emission reductions (compared to BAU-1200) are expected nearly 14 million tCO_2 by 2020 and 112 million tCO_2 by 2030, as presented in **Error! Reference source not found.**. However, the mitigation potential would be added up by the avoided emissions of 17 million tCO_2/y from reducing clinker production (Table A-2). The total initial investment required for all 12 options would be around USD 906 million. Compared to BAU-1200, the total incremental abatement costs would be USD 654 million.

[24] A number of legal requirements such as the Law on Energy and Efficiency, or Vietnam Green Growth Strategy (VGGS) were promulgated and in effect during the period 2011-2014 that would be counted under "mitigation framework" for the cement sector, given that the base year for comparison is 2010. The concept was re-confirmed in the recently submitted INDC report to the UNFCCC by the Government of Viet Nam.

Figure A-2: MACC considering lower production capacity (BATP-1000)

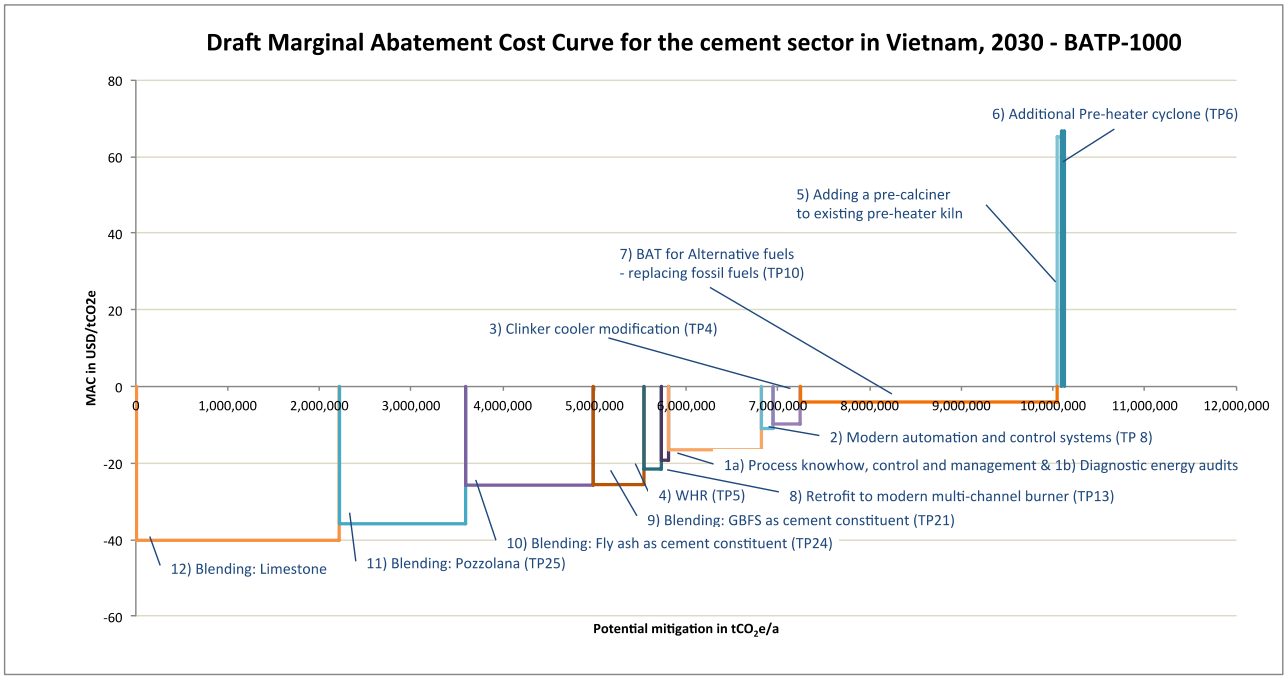


Table A-2: Key cost-benefit parameters from MACC analysis of the BAU-1200 and BATP-1000 scenarios

Category	Sub-category	VN-BaU-1200		BATP-1000	
		MACC USD/ tCO_2	Avoided emission $MtCO_2$/year	MACC USD/ tCO_2	Avoided emission $MtCO_2$/year
Improving thermal energy efficiency of clinker production	1a) Process knowhow, control and management & 1b) Diagnostic energy audits	-16.1	0.44	-16.5	1.02
	2) Modern automation and control systems	-11.0	0.12	-11.0	0.12
	3) Clinker cooler modification	-9.8	0.29	-9.8	0.29
	4) Waste heat recovery (WHR)	-21.5	0.05	-21.5	0.19
	5) Adding a pre-calciner to existing pre-heater kiln	65.3	0.04	65.3	0.04
	6) Additional Pre-heater cyclone	66.6	0.04	66.6	0.04
Use of alternative	7) BAT for Alternative fuels - replacing fossil fuels	0.0	-	-4.0	2.81

fuels	8) Retrofit to modern multi-channel burner	-19.2	0.08	-19.2	0.08
Reducing clinker content in cement	9) Blending: GBFS as cement constituent	-46.3	0.16	-25.6	0.55
	10) Blending: Fly ash as cement constituent	-46.5	0.40	-25.8	1.38
	11) Blending: Pozzolana	-56.9	0.40	-35.8	1.38
	12) Blending: Limestone	-61.3	0.64	-40.3	2.22
Sub-total			***2.65***		***10.12***
Avoided CO_2 from avoided clinker capacity (1,000 kg/cap vs. 1,200 kg/cap)			0		17.0
Total			**2.65**		**27.12**