Ministry of Industry and Trade
General Directorate of Energy

LCEE LOW CARBON TRANSITION IN THE ENERGY EFFICIENCY
Vietnam-Denmark government cooperation in the energy sector

Embassy of Denmark

GREEN INVESTMENT FACILITY (GIF)

TSP Guideline

CHANGING FROM TRADITIONAL RICE-HUSK BRICK KILN TO CONTINUOUS KILN

Approved by The Project Director of LCEE

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ENERGI STYRELSEN

VNEEP

CONTENTS

Abbreviation

AMU	Administrative and Management Unit of GIF
EDK	Embassy of Denmark in Vietnam
EE	Energy Efficiency
ESA	Energy Saving Award
GIF	Green Investment Facility
LCEE	Low Carbon Transition in Energy Efficiency
LCTU	Low Carbon Transition Unit
LPG	Liquid Petroleum Gas
PMU	Project Management Unit
SEC	Specific Energy Consumption
SFC	Specific Fuel Consumption
SMEs	Small and Medium Enterprises
TSP	Technical Service Providers
VNEEP	Vietnam National Energy Efficiency Programme

1 Introduction

Green Investment Facility (GIF) is LCEE project's financial mechanism for promoting energy efficiency solutions for SMEs in brick, ceramic and food processing industries.

The guideline for EE solutions is mainly in technical point of view so that the TSP can use this guideline for their work in producing Pre check and Post check Reports following GIF requirements. In addition, the guideline sometimes provides information for SMEs to understand the specific requirements of the project in order to be eligible for support.

TSP should use Application, Pre-check and Post-check Forms when following this Guideline.

In order to apply for GIF, the following steps need to be done by involving stakeholders:

The First step: SMEs, independently or with support from consultants, propose project idea to AMU with explanation of the solutions for Energy saving or CO2 emission reduction and their expected investment plan. AMU will proceed to check the eligibility of the project idea with help from PMU (project management unit) if needed.

Result of this step: SMEs agree to prepare their applications and submit them to AMU. Standard Application Form will be provided to SMEs by AMU.

The Second step: SMEs submit their applications and required documents to AMU. AMU check and accept their applications and transfer them to TSP for pre-check of the EE project in SME.

Result of this step: SME application at TSP.

The Third step: TSP, as an independent inspector, goes to inspect in SME. The main duty of TSP is to foresee factors that can affect the success of project implementation; to check and estimate energy saving potentials of the proposed EE project, as well as check and revise investment items related to investment in proposed EE solutions and their total cost so that they are reasonable. After completion of the checking process, TSP completes Pre-check Report and sends it to AMU.

Result of this step: Pre-check Report at AMU office.

The Third step: AMU will send Pre-check report to PMU and PMU will evaluate them, and then inform Evaluation results to AMU- if all eligible criteria are met. AMU will inform SME to carry out borrowing procedures and invest in EE solutions. AMU will inform EDK for approval of loan guarantee and EDK will request Fund Holding Bank to issue Letter of Guarantee to lending banks for SMEs. In the most cases, the work can be done in parallel with pre-check work of TSP, and SME's application to lending bank and preparation for investment implementation.

Results of this step: SME invests in EE solutions, borrows loan and get loan guarantee from GIF.

The Fourth step: After EE solutions are implemented and in operation for at least 800 working hours, AMU will request TSP to go to the field to inspect the actual situation of the EE

implemented solution check and calculate real percentage of energy savings of those EE solutions. After checking, TSP will finalise their Post-check Report and submit to AMU. AMU will send it to PMU to get approval.

Result of this step: Satisfaction by AMU and PMU; Post Check Report written by TSP is at AMU Office.

The Final step: AMU, based on criteria, informs EDK about EE award level and amount of money, so EDK will request FHB to transfer money to the SMEs loan account at lending bank.

Result of this step: Eligible SME receive EE awards and money transferred to reduce SME's loan at lending bank.

The following standard forms are available at AMU office and on LCEE Website **http://www.lcee.vn:Application Form, Pre-check Form, and Post check Form.**

Based on some previously done solutions, the guideline has been prepared for known solutions. The above formats are only for general cases; there will be some difficulties in applying to each EE solution. In the future, the Guideline will be improved to cope with arising issues and Guideline for new upcoming EE solutions will be developed.

This Revised Guideline describes required works by TSP when inspecting "solution of changing from traditional rice-husk brick kiln to continuous kiln".

It is in effect from the date of approval for this revised Guideline and it is not applied for projects approved before the approval date of this Guideline.

2 Definition of rice husk continuous kiln

The rice husk continuous brick kiln is the type of brick kiln that can be set so that the firing process can happen in continuous mode, therefore the firing place could continuously move along the brick setting stable in the kiln. In continuous mode, the kiln operation could happen so that along the way of air and flue gas flowing direction, the released heat from hot brick setting before the firing zone could be used to heat up the air supplying for the combustion process in firing zone, the released heat from the firing zone could be used for preheating and drying of green brick setting after firing zone and by that principle, energy could be saved.

The path of air and flue gas flowing direction could occur in different shape such as zigzag path, circular, eclipse, chain of chambers etc.

The kiln is only used for brick making, not for ceramic making.

The tunnel kiln is type of kiln for that even kiln working in continuous mode but the brick moving along the constructed tunnel that has fixed firing zone is not considered in this solution.

3 Scope of standard solution

(Referring to:

Application form 4.1 and 4.2
Pre-check form par. 2 and 2.1),

This measure applies

- when the new continuous kiln replaces one or several traditional rice husk brick kiln
- when the new continuous kiln is constructed instead of traditional rick husk brick kiln in new setting bricks making enterprises.

The measure includes the kiln itself as well as supporting installations such as grates, burners, scrubber at the chimney, fans, connection to flue gas system; drying system that uses biomass or hot air extracted from hot brick in cooling zone, or exhaust gas for drying purpose in order to maintain continuous running of the kiln.

The measure does not include building construction materials or works related to any building. It also does not include costs of upgrading infrastructure, such as access roads, electricity supply capacity; extruding system etc.

The portable guarantee may cover loan for the following:

- Investment costs of the kiln including necessary auxiliaries such as draft Fan, SD, Valves, grates, scrubber, Thermo couple for temperature measurement, etc. that serves the normal operation and fire control of the kiln.
- Investment in drying system that uses biomass as a fuel, hot air extracted from hot brick in cooling zone, exhaust gas for drying purpose.

4 Technical description of standard solution

(Referring to:

Application form 4.1 and 4.2,

Pre-check report par 2

Post-check report par 1)

Principles of energy savings and greenhouse gas emission reduction

For the locations that are using traditional rice husk burned brick kilns, the specific fuel consumption is 400 – 500g rice husk/brick. Continuous kilns using rice husk as a fuel, as defined above in articles 2, can save energy by using released heat from different zone. The specific fuel consumption could be reduced by up to 150g rice husk/bricks by the performance of continuous chain chambers created at Vinh Long Province. Depending on specific design, construction of each kiln as well as the suitable operation, energy savings can have different figures.

Request for description of Potential of energy savings and CO_2 reduction

- Describe the actual situation of enterprises including technical information of original traditional kiln (Size, capacity, type of products that have been produced until now); proposed continuous kiln (Size, capacity, type of products that will be produced)
- Describe in more details the main structure of the proposed continuous rice husk kiln with the design or other methods to demonstrate that the continuous kiln is suitable for local condition and can save energy, not wasting energy in other ways.
- Describe the arrangement of the whole plant with the plant-view drawing of the process, from clay storing, machinery, drying yard, kiln, final product yard for sale etc.
- Describe labours arrangement for kiln operation proposed by SME.
- Describe sources of clay materials, fuel supplier and weather conditions in which SME can operate the kiln in continuous mode
- Potential of Energy savings and CO2 reduction will be based on the Specific Energy Consumption (SEC) calculated in MJ/kg product or kg CO2 emission/kg product. Calculation methodology will be described below in article 8.

5 Possible factors affecting the success of the project

- The kiln may not operate in continuous mode due to different reasons such as lack of dried green brick, lack of skilled labors, market availability, weather conditions etc. TSP should interview SME to identify all factors that can affect the kiln operation in continuous mode to ensure that the SME is prepared for those situations.
- For one or possibly up to 3 rounds of operation, brick quality could be low with high breakage rate; energy consumption is also high during this period. In this situation, the post check should be done at least during the third round of operation after kiln construction.

- Difficulty of evaluating specific fuel consumption to produce brick for award decision for the investment.
- Difficulty of evaluating investment for giving loan guarantee.

6 Minimum Technical criteria

(Referring to:

Pre-check report par 2

Post-check report par 1)

The following requirements should be met by the proposed project:

- The kiln design should be proposed by experienced technical suppliers so that all description of the kiln structure and methodology of construction should be suitable for the kiln operation.
- The project should demonstrate the ability for continuous running of the kiln with the capacity given in the proposed project, therefore the whole brick making system should be presented from source of clay, clay raw material storage, situation of fuel supplying, drying yard area, extruding machine system, kiln construction description, labor arrangement.
- All facilities should demonstrate that they can provide input resources to the kiln equal to or more than the kiln's capacity. The following could be in more detailed description:
- Clay storage should have the capacity to supply materials for at least 1 month of operation in case the local area has easy access to readymade raw materials and 3 months of operation in case the local area uses normal raw materials which need some time for weathering.
- Drying yard should have the capacity to supplying dry green brick at 1.5 time kiln's capacity, so that it can secure the brick supplying in poor weather conditions.
- Extruding machine needs to have the capacity of producing brick at 1.5 times of kiln's capacity so that we can supply secure green brick to the kiln.
- Dry green brick storage should have the capacity of storing 7 days of kiln running condition.
- Labor arrangement should consider the labor work for all the production lines as well as the fire masters and supporters who work continuously day and night to control and maintain combustion process in the kiln.

7 Economic assessment

(Referring to application form 4.4 - 4.6.

Pre-check report 2.1 and 3

Post-check report par 3)

Investment costs

The following types of costs are eligible for support from GIF:

- New kiln including design, materials, construction and necessary auxiliaries such as draft Fan including VSD, Valves, grates, scrubber, Thermo couple for temperature measurement, etc. for the normal operation and fire control of the kiln
- Drying system that uses biomass as a fuel or extracted hot air from brick in cooling zone, exhaust gas for drying purpose

Other costs related to changing or expansion of production are not eligible.

For pre-check evaluation: TSP should check the design, list of materials and equipment and give comment if there is any doubt about the material costs and equipment costs. Types of materials, types of equipment that enterprise uses when constructing the kiln should also be taken into account.

Evaluation of benefits

In addition to the value of energy cost savings, the following co-benefits should be recognized and included in the economic assessment:

- Possible increased product value due to improved quality / reduced loss
- Possible increased production output capacity
- Possible reduced specific labor costs

8 Calculation of energy savings award

(Referring to post-check report par. 3)

(Referring to:

Pre-check report 2.1

Energy calculation for the award should be in term of specific energy consumption calculated in MJ/kg brick. The procedure of calculation is as followed:

Determining fuel consumption for one brick (kg fuel/kg brick) in the following steps:

- Make sure that kiln operation is in continuous mode for at least three rounds after starting burning.
- Measuring mass of fuel consumption from the time of starting to fire in one chamber and the time of moving the fire to the next chamber.
- Measuring the number of bricks in one chamber.
- Calculate mass of fuel used for one brick by dividing total mass of fuel consumption to the number of bricks
- Measuring the average mass of bricks.
- Calculating specific energy consumption of brick firing in (MJ/kg brick) by the following formula

$$\text{Specific energy consumption} = \frac{\text{fuel used per brick x fuel lower heating value}}{\text{mass of brick}}$$

Baseline of specific energy consumption for traditional kiln in average can take value of 6 MJ/kg. Result of SEC less than 3 MJ/kg brick could be accounted as 50% of energy saving and award of 30%. SEC should not be more than 4 MJ/kg brick - the upper limit of the kiln performance. Award given should be as followed:

SEC < or = 3MJ/kg, Award given is 30%

SEC = 3.6 MJ/kg, Award given is 23%

SEC = 4.2 MJ/kg, Award given is 16%.

SEC = 4.8 MJ/kg, Award given is 10%

SEC > 4.8 MJ/kg, No award given.

9 TSP responsibility in pre-check and post-check

In Pre check

Desk check

- Check the application form so that all technical minimum criteria are adapted.
- Check the list of materials, equipments in the loan guarantee to make sure that all investment is within eligible range.

Field check

- Go to the site and interview with responsible persons from SME with prepared questionnaire about the awareness of SME of technical minimum criteria and how they will prepare for brick producing in continuous mode.
- Check the land area and location of each functional part.
- Check SME's plan to carry out the project.
- Comment on the ability of SME to follow the project with and without the help from GIF.
- Propose procedure for post check with SME. Prepare suitable table in which the SME can record necessary information during suitable period for evaluating specific energy consumption in large period of time.

Monitoring:

- Submit the estimated energy saving calculation table and below summarized result table in excel format containing all calculation formula for monitor and evaluation purpose.
- Calculate estimated total annual energy savings and total annual CO2 emission reduction beneficent from the project in the table below:

Estimated Energy savings and CO2 reductions obtained from the project				
	A	**B**	**C**	**D**
	Energy carrier or fuel	**Annual Energy consumption before the project**	**Annual savings**	**CO2 reduction**

		implementation		(tons/year)
1	Electricity	MWh/year	MWh/year	
2	Coal	TOE/year	TOE/year	
3	Oil	TOE/year	TOE/year	
4	LPG	TOE/year	TOE/year	
5	Natural gas	TOE/year	TOE/year	
6	Biomass	TOE/year	TOE/year	
7	Solar	TOE/year	TOE/year	
8	Other	TOE/year	TOE/year	
9	Total Fossil Energy (∑ 2…5, 8)	TOE/year	TOE/year	
10	Total Renewable Energy (RE) (∑ 6…7, 8)	TOE/year	TOE/year	
11	Total Energy Saving (C1+C9+C10)	TOE/year		
12	Conversion to RE	(C9 in conversion projects) TOE/year		
13	Total CO2 Reduction (D1+D8+D9)	Ton/year		

If the output capacity of the new solution differs from the baseline situation, the baseline energy consumption must be reduced or increased to the equivalent of the output capacity of the new solution.

Post check

- Regularly contact with SME via phone, email etc. to know about the situation of SME during project implementation. Mark the important information during the time from pre check to post check.
- Get recorded information from SME and pre calculating specific energy consumption.
- Identify suitable time for sudden check of specific energy consumption so that the process of determining fuel consumption can be done following the energy savings guide. Weather conditions should also be considered when doing sudden check for SME: the check should not be done in period of long rain.
- Comment on the percentage of energy savings and give an award.
- Check that the installed system complies with the design and investment items as proposed in the project application.
- Verify investment costs and payback period from application form and suggest revision if necessary
- Submit the energy saving calculation table and below summarized result table in excel format containing all calculation formula for monitor and evaluation purpose.
- Calculate total annual energy savings and total annual CO_2 emission reduction beneficent from the project. The below table needs to fulfill:

Energy savings and CO2 reductions obtained from the project				
	A	**B**	**C**	**D**
	Energy carrier or fuel	**Annual Energy consumption before the project implementation**	**Annual savings**	**CO2 reduction (tons/year)**
1	Electricity	MWh/year	MWh/year	
2	Coal	TOE/year	TOE/year	
3	Oil	TOE/year	TOE/year	
4	LPG	TOE/year	TOE/year	
5	Natural gas	TOE/year	TOE/year	
6	Biomass	TOE/year	TOE/year	
7	Solar	TOE/year	TOE/year	
8	Other	TOE/year	TOE/year	
9	Total Fossil Energy (∑ 2…5, 8)	TOE/year	TOE/year	
10	Total Renewable Energy (RE) (∑ 6…7, 8)	TOE/year	TOE/year	
11	Total Energy Saving (C1+C9+C10)	TOE/year		
12	Conversion to RE	(C9 in conversion projects) TOE/year		
13	Total CO2 Reduction (D1+D8+D9)	Ton/year		

10 Annexes

Annex 1: Application Form

Annex 2: Pre-check Form

Annex 3: Post-check Form