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 CERAMIC KILN TO CONTINUOUS KILN

Approved by The Project Director of LCEE

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ENERGI STYRELSEN

VNEEP

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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 Guideline describes the works that need to be done by TSP when inspecting ***"solution of changing from traditional ceramic kiln using rice husk as a fuel to continuous ceramic kiln using rice husk as a fuel".***

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.

Rice husk continuous ceramic kiln is a type of ceramic kiln that can be set in the way that the firing process can happen in continuous mode, for that the firing place could be continuously moving along the ceramic setting stable in the kiln. With the continuous mode, the kiln operation could happen in the way that along air and fuel gas flowing direction, the heat released from hot ceramic products setting before the firing zone could be used to heat up the air supplying for the combustion process in firing zone. The heat released from the firing zone could be used for preheating and drying for green ceramic products setting after firing zone, and by that principle, energy could be saved.

Air and flue gas flowing direction could be in different shape such as zigzag path, circular, ellipse, chain of chambers etc.; depending on the actual design favored by local area or new design accepted by SMEs, as well as adapting to requirements of fired products.

The kiln may be used for brick making in some specific targets but mainly for ceramic making purpose.

The tunnel kiln is one other type of kiln for that even the kiln works in continuous mode, but ceramic products move along the constructed tunnel with 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 ceramic kiln(s)

when the new continuous kiln is constructed instead of traditional rice husk ceramic 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 with the purpose of keeping the kiln continuously run.

The measure does not include building construction material 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 including VSD, valves, grates, scrubber, thermo couple for temperature measurement, etc., that serve the normal operation and fire control of the kiln.

Investment of 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

Continuous kilns using rice husk as a fuel, as defined in articles 1 above, can save energy by using released heat from different zone. However, the actual savings is unknown at present. Nevertheless, when transforming from traditional batch operation to continuous operation, energy savings can reach up to more than 50% depending on specific design, construction of each kiln as well as appropriate operation.

Request for description of Potential of energy saving and CO2 reduction

Describe the actual situation of enterprises including technical information of original traditional kiln (Size, capacity, type of product have been produced until now); proposed continuous kiln (Size, capacity, type of products will be produce)

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 conditions and can save energy while 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 labour 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.

Estimation of potential 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 is described below in article 7.

5 Possible factors affecting the success of the project

- The kiln may not be able to operate in continuous mode due to different reasons such as lack of dried green products, lack of skilled labors, market availability, weather conditions etc. TSP should interview SME to identify all factors that can affect the kiln's operation in continuous mode to ensure that SME is prepared for those situations.
- For one or possibly up to 3 rounds of operation, ceramic 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 at the third round of operation after kiln construction.
- There is a difficulty of evaluating specific fuel consumption to produce ceramic for award decision for the investment since the actual situation at field site
- There is a difficulty of evaluating investment for giving loan guarantee since the kiln structure is complicated and ability of technical supplier to give enough information

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. This means that all description of the kiln structure and methodology of construction should be suitable for the kiln operation.

All facilities should show that they can provide input resources to the kiln equal to or more than the kiln's capacity. The following could be included in more detailed description:

- Labor arrangement should consider labor work for all production lines and the fire masters and supporters who work continuously day and night to control and maintain combustion process in the kiln.

- Raw material should be prepared in advance for that the green product could be available all the time.
- Drying yard should have a good design or space or if necessary they should equip with artificial dryer so that the dry product always ready for loading in the kiln to run in continuous mode
- Final products storing places and brief explanations about the available market of product should be useful to evaluate the ability of continuous running of the kiln.
- Methodology of environmental treatment should be also presented.

7 Financial 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 normal operation and fire control of the kiln
- Drying system which uses biomass as a fuel or extracts hot air from ceramics in cooling zone, exhaust gas for drying purpose

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

For pre check evaluation: TSP should check the design, list of materials and equipment, give comments if there is any doubt about the material costs, equipment costs. Type of materials and type of equipment that the enterprise uses when constructing the kiln are also taken into account.

Evaluation of benefits

In addition to the value of energy cost savings, the following co-benefits should be considered 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 cost

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 (SEC) calculated in MJ/kg product. The procedure for calculation is as following:

For the traditional ceramic kiln

- Contact with the enterprise to prepare one trial batch for calculation.
- Count and weight each product to calculate weight of one batch
- Ask SME to store rice husk at a place so that the volume of rice husk fuel could be measured in m3.
- Measure volume of rice husk used in one batch, and then calculate to Mass of rice husk used for one batch using the data that 1m3 of rice husk weighed 120kg.
- Calculate the specific fuel consumption (SFC) for one kg of product by the following formula

$$SFC = \frac{\text{Mass of rice husk used for one batch}}{\text{Mass of product fired in the kiln for one batch}}$$

The specific energy consumption (SEC) could be calculated using the following formula.

$$SEC = SFC \times Q$$

Where

Q: Lower Heating Value of rice husk could refer to the number of 3300 kcal/kg or 13.8 MJ/kg.

For continuous ceramic kiln

- Contact with the SME to prepare measurement, in which the following points should be considered:
  - Time of measuring should be in the third round of kiln operation and during normal operation so that the firing process is in continuous mode without any problem for at least 4 days.
  - Fuel necessary for two chambers should be prepared in a place that volume of fuel could be measured.
- Measuring and calculating mass of fuel consumption during the firing of 2 chambers.

- Measuring and calculating total mass of ceramic products in two chambers.
- Calculate SFC and SEC following formula described in traditional kiln.

Note

Depending on the actual situation of local conditions, other ways of measuring mass of rice husk fuel could also be accepted. However, TSP should describe their methodology of measuring in the reports.

9 TSP responsibility in pre-check and post-check

In Pre check

Desk check

- Check the application form for that all the technical minimum criteria should be adapted.
- Check the list of materials, equipment in the loan guarantee to make sure that all investment is within eligible range.

Field check

- Going to the site and interview responsible persons from SME with prepared questionnaire regarding to SME's awareness of the minimum technical criteria and how they will prepare for ceramic 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.
- Contact with SME to conduct necessary measurements for calculating SEC following the guidance given in article 7.
- Propose procedure for post check with SME. Prepare appropriate table for that the SME can record necessary information with the suitable duration for evaluating specific energy consumption in relatively long period of time.
- Record the baseline measurements/data for comparison with the post-check measurements/data

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 as benefits obtained 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 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		

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 by phone, email or other types of communication to know about the situation of SME during implementation of the project. Mark the important information from pre check to post check.
- Get recorded information from SME and pre calculating specific energy consumption.
- Identify suitable time and carrying out measurement check to calculate SEC of continuous kiln for award decision based on the policy of project.
- Comment on the percentage of energy saving 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 CO2 emission reduction as benefits obtained 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