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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 FOSSIL FUEL FIRED BOILER TO BIOMASS FIRED BOILER

Approved by The Project Director of LCEE

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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 required works by TSP when inspecting “solution of changing from fossil fuel fired boiler to biomass fired boiler”.

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 Scope of standard solution

This measure applies

- when a biomass boiler replaces one or several fossil fuel based boilers.
- when a new biomass boiler is installed instead of a fossil fuel based boiler.

The acceptable biomass could be used for boiler including every agricultural residue; accepted forest residues, accepted plantation forest; waste products from industries; pellets and briquettes made from residues, waste and from accepted plantation forest. The acceptable biomass excludes wood fuel from natural forest.

For the biomass fuels that have contaminants that result in environment pollution, the boiler system needs to demonstrate method for environment treatment, therefore all emissions should adapt to environment standards given in Vietnam.

The solution includes investments in boiler and related equipment, as well as possible upgrade investments in the heat supply system which might be recommended during pre-check.

The solution applies to boilers installed by the heat consuming entity as well as to boilers owned and operated by a third party for supply of heat to end-users. In the later case, the third party should meet the criteria of SME's as laid out in GIF operational guidelines. In addition, the third party should take responsibility for any upgrade required at end-users installations.

3 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

This solution addresses two different types of energy efficiency improvement potentials:

Shift from fossil fuel to biomass

The substitution of coal by biomass itself does not reduce energy consumption. In fact, biomass boilers may have slightly lower energy efficiency than coal boilers and particularly as compared to fuel oil boilers. However, since biomass is considered CO₂ neutral, the shift to biomass will have a significant impact on CO₂ emissions.

Upgrading of the heat distribution system

Many existing industrial heat systems suffer from great heat losses in the distribution systems. Poor insulation as well as malfunctioning steam traps are typical examples of heat losses. In some cases steam systems could be changed to hot water systems with significant efficiency improvements as a result.

Request for description of Potential of energy savings and CO₂ reduction

- Describe the actual situation of enterprises including technical information of original fossil fuel fired boilers; proposed technical information of biomass fired boiler
- Describe in more details about related points that ensure the new installed biomass boiler could be operated sustainably (sources of fuel, characteristic of fuel, methodology of environment treatment for flue gas). Describe the steam distribution system in existing conditions and expected retrofit after implementation of the project to ensure heat loss through steam distribution system could be minimized (the steam distribution system only includes the piping system, not for end users)

4 Possible factors affecting the success of the project

A common risk factor for biomass boilers is the possible lack of fuel supply. The investor should secure supply for an extended period of time, for example through long-term contract with a supplier or through a thorough assessment of the local biomass market to ensure that the supply risk is minimal.

The other risk factor of biomass boiler is pollution control of SPM in flue gas and CO content in flue gas higher than the emission standards. The investor and TSP should request boiler supplier to present their methodologies for environment treatment system.

Some type of fuels such as cashew nut, rubber wood or waster residues can cause environment pollutions, the methodologies for environment treatment for each type of contaminants should be clear so that it does not affect local environment by smell, toxic gas or SPM (Suspended Particulate Matter)

5 Minimum Technical criteria

(Referring to:

Pre-check report par 2

Post-check report par 1)

Efficiency of utility systems

The utility systems, including the water treatment system as well as the steam distribution system, should be up to standards and well functioning.

Boiler equipment

- The boiler system must comply with the government safety standards applied for boiler and pressurized vessel.
- The boiler must be equipped with an economizer/combustion air pre-heater with the follow criteria and exceptions:
 - In case condensate water is contaminated by chemical or additives, economizer for feed water supply is a must;
 - In case, condensate water recovery system recovers equal or more than 90% of boiler capacity; economizer for feed water supply can be optional for the enterprise; combustion air pre-heater or economizer generating hot water for other purpose (domestic hot water supply purpose, cleaning purpose...) is to consider;
 - Combustion air pre-heater can be either primary or secondary air supply;
 - For the boiler generating saturated steam temperature below 150°C and/or flue gas temperature below 160°C, economizer and combustion air pre-heater can be optional for the enterprise.
- There must be automatic feed water supply to the boiler with alarm devices to protect the boiler against low water level.
- There must be a water treatment system installed to the feed water supply. The capacity of water treatment system should be capable for capacity of the boiler. The water treatment system is either new or existing that is suitable to the capacity of the boiler.
- In case condensate water does not contaminate by chemicals or additives, there must be a condensate recovery system.
- The flue gas treatment system must ensure compliance with relevant emission standards (Environment standard) QCVN 19-2009/BTNMT:
 - Flue gas temperature in design mode operation should be no more than steam outlet temperature or it should not go over 160°C;
 - CO emission must be with the range of Environment standard for flue gas emission as stated in QCVN 19-2009/BTNMT.
 - O₂ content in flue gas should not be more than 12%.
 - the Suspended particulate matter (SPM) should not be higher than 200mg/m³.
 - Other emission parameters normally do not exist in flue gas from biomass fired boiler.
- For boilers with more than 5 MW or 6.5 Tons of steam/hour of output capacity, they must be equipped with a lambda monitoring and/or control system to secure a continuous optimization of the ratio of fresh air supply to fuel supply.
- The boiler should be equipped with suitable steam distribution system so by brief checking, heat loss through steam distribution system is within reasonable range, i.e, outer surface temperature of boiler and steam distribution pipes should not exceed 60°C.
- The boiler must be equipped with approximated metering and monitoring equipment/devices for environmental and energy monitoring and audit.
 - Feed water supply meter;

- Drainage water meter;
 - Flue gas temperature gas;
 - Vortex steam flow meter for the boiler / boiler system that its capacity is equal or larger 10 ton of steam per hour.
- The boiler must be equipped with approximated safety devices as specified by related government safety standards.

In case using industrial waste incinerator as an additional fuel supply to biomass boiler, the follow, but not limited to, regulations and standards have to comply:

- QCVN 05:2009/BTNMT - National standards for ambient air quality;
- QCVN 06:2009/BTNMT - National regulations for allowing concentration of some toxic gases;
- QCVN 30:2010/BTNMT - National technical regulations on emission of industrial waste incinerator;
- QCVN 61-MT: 2016/BTNMT - National regulations on domestic solid waste incinerators.
- Any other effective related Vietnam or international regulations and standards

SME must have local authority approval/permit certificate to certify the compliance of the installed biomass boiler to the regulations/standards regarding the pressurized vessels, flue gas and solid ashes/waste.

6 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 the GIF:

- System design
- Boilers and supporting equipment such as flue gas cleaning systems, pumps, feed water treatment system etc.
- Biomass storage facility and handling system (not civil construction)
- Connection to steam distribution system
- Steam distribution system upgrade

Land preparation and building construction costs are not eligible.

7 Calculation of energy savings award

(Referring to post-check report par. 3)

Provided that the post-check report proves compliance with technical minimum criteria specified in article 5 – Minimum technical criteria, the SME will be awarded for the loan value for the qualified invested items as the follow:

No	Type of	Energy saving award
1	Conversion from any kind of fossil fuels to biomass boiler	30%
2	Upgrade or change new biomass boiler to existing biomass boiler to achieve at least 20% energy saving	In accordance with achieved energy saving percentage
3	New biomass boiler or expansion capacity of biomass boiler to existing fossil boiler	30%

8 TSP responsibility in Pre-check and post-check

Necessary activities of pre-check:

- Checking that there is a functional water treatment system or, if not, that such system is included in the project
- Checking the steam distribution system with regards to faults, such as insufficient insulation of pipes, valves etc., malfunctioning steam traps, condensate traps in the steam supply system, leakages and the likes. Surface temperature of the pipes should be no more than 60°C.
- Checking that the project complies with all minimum criteria.
- Giving necessary pictures showing existing situation before implementation.
- Giving the indication of feasibility of project implementation's technical aspect.
- Check the proposed boiler system and fuel resources to foresee environment pollution contaminants and methodologies of environment treatment to give comments.
- Propose/design templates/forms that help the SME to keep the required data/measurements if any required for conducting the post-check.
- 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 project				
	A	B	C	D
	Energy carrier or fuel	Annual Energy consumption before 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 (Σ 2...5, 8)	TOE/year	TOE/year	
10	Total Renewable Energy (RE) (Σ 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. For example, if a new biomass boiler output capacity is two times higher than the old fossil fuel boiler, the baseline coal consumption should be adjusted to correspond to this new production capacity:

- Specific energy consumption for baseline multiplied by number of product output units for the new solution.
- the specific energy consumption for baseline must be determined in accordance with the decision No. 78/2013/QĐ-TTg dated 25 December 2013 and TCVN 8630:2010 as the follow:

Table: Minimum boiler efficiency

No	Type of boiler	Solid fuel	Liquid or gas fuel
1	Boiler with or without heat recovery from flue gas	70%	75%

Necessary activities of the post-check:

- Check that the installed system complies with minimum criteria and with the quality level described in the project proposal.
- Check also the design and investment items as proposed in the project application;
- Check if the biomass fuel used is acceptable or not and environment protection facilities is acceptable or not.
- Check the faults of distribution system
- Report on advantages and disadvantages of project implementation (specific comments to SME's situation are valuable).
- Report on the quality of the biomass boiler after 800 hours of operation with necessary pictures.
- 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 beneficent from the project. The below table needs to fulfill:

Energy savings and CO ₂ reductions obtained from project				
	A	B	C	D
	Energy carrier or fuel	Annual Energy consumption before project implementation	Annual savings	CO ₂ 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	TOE/year	TOE/year	

	Energy (Σ 2...5, 8)			
10	Total Renewable Energy (RE) (Σ 6...7, 8)	TOE/year	TOE/year	
11	Total Energy Saving (C1+C9+C10)	TOE/year		
12	Conversion to RE	<i>(C9 in conversion projects)</i> TOE/year		
13	Total CO2 Reduction (D1+D8+D9)	Ton/year		

9 Annexes

Annex 1: Application Form

Annex 2: Pre-check Form

Annex 3: Post-check Form