Appendix 1　MRV

1-1 JCM proposed methodology(PV)

1-2 Spread sheet(PV)

1-3 JCM proposed methodology(RB)

1-4 Spread sheet(RB)

1-5 JCM proposed methodology(CR)

1-6 Spread sheet(CR)

1-7 JCM proposed methodology(TR)

1-8 Spread sheet(TR)

Joint Crediting Mechanism Proposed Methodology Form

Cover sheet of the Proposed Methodology Form

Form for submitting the proposed methodology

Host Country	The Republic of the Philippines
Name of the methodology proponents submitting this form	Oriental Consultants Co., Ltd
Sectoral scope (s) to which the Proposed Methodology applies	Energy industries (renewable/ non-renewable sources)
Title of the proposed methodology, and version number	Solar PV Systems Introduction to Closed Landfills Version number:01.0
List of documents to be attached to this form (please check):	☑ The attached draft JCM-PH-PDD: ☐ Additional information
Date of completion	14 February 2019

History of the proposed methodology

Version	Date	Contents revised
01.0	14 February 2019	

A. Title of the methodology

Solar PV System Introduction to Closed Landfills

B. Terms and definitions

Terms	Definitions
Solar photovoltaic (PV) system	An electricity generation system which converts sunlight into electricity by the use of photovoltaic (PV) modules. The system also includes ancillary equipment such as power conditioner required to change the electrical current from direct current (DC) to alternating current (AC).

Grid	Spatial extent of the power plants that are physically connected through transmission and distribution lines to the project activity (e.g. the renewable power plant location or the consumers where electricity is being saved).

C. Summary of the methodology

Items	Summary
GHG emission reduction measures	Displacement of grid electricity and/or captive electricity by installation and operation of the solar PV system(s).
Calculation of reference emissions	Reference emissions are calculated based on the AC output of the solar PV system (s) multiplied by either 1) the conservative emission factor of the grid, or 2) the conservative emission factor of captive power generator.
Calculation of project emissions	Project emissions are calculated based on the electricity consumption of the solar PV system(s) multiplied by either 1) the conservative emission factor of the grid, or 2) the conservative emission factor of captive power generator.
Monitoring parameters	(i)The quantity of electricity generated by the project solar PV system(s). (ii)The quantity of electricity consumed by the project solar PV system(s).

D. Eligibility criteria

This methodology is applicable to projects that satisfy all of the following criteria.

Criterion 1	Projects for construction and operation of a new solar PV system or capacity addition of an existing power generation unit that uses renewable energy sources.
Criterion 2	Projects that displacement of electricity that would be provided by a grid or captive power generator.
Criterion 3	Net electricity generated from the solar PV system can be measured and monitored.

Criterion 4	The PV modules are certified for design qualifications (IEC 61215, IEC 61646 or IEC 62108) and safety qualification (IEC 61730-1 and IEC 61730-2).
Criterion 5	Power conditioners in the solar PV system have efficiencies higher than 95%.

E. Emission Sources and GHG types

Reference emissions	
Emission sources	GHG type
Emission from consumption of electricity from the grid	CO_2
Project emissions	
Emission sources	GHG type
Electricity consumption of the system	CO_2

F. Establishment and calculation of reference emissions

F.1. Establishment of reference emissions

Reference emissions include only CO_2 emissions from electricity generation in power plants that are displaced due to the project activity. The methodology assumes that all project electricity generation above baseline levels would have been generated by existing grid-connected power plants or captive power generators.

F.2. Calculation of reference emissions

$RE_y = EG_{PJ,y} \times EF_{co2}$

RE_y	Reference emissions (tCO_2/y)
$EG_{PJ,y}$	Quantity of electricity generated by the project solar PV system during period y (MWh/y)
EF_{co2}	CO_2 emission factor of electricity (tCO_2/MWh)

G. Calculation of project emissions

On the other hand, the project emission is the CO_2 emission from the electricity consumption of the solar PV system and calculated as follows.

$PE_y = EC_{PJ,y} \times EF_{co2}$

RE_y	Reference emissions (tCO_2/y)
$EC_{PJ,y}$	Electricity consumption by the project solar PV system during period y (MWh/y)
EF_{co2}	CO_2 emission factor of electricity (tCO_2/MWh)

H. Calculation of emissions reductions

$ER_y = RE_y - PE_y$

PE_y	Emission reduction (tCO_2/y)
RE_y	Reference emissions (tCO_2/y)
PE_y	Project emissions (tCO_2/y)

I. Data and parameters fixed *ex ante*

The source of each data and parameter fixed *ex ante* is listed as below.

Parameters	CO_2 emission factor of electricity. In the case of the PV system connecting to the national grid, a conservative grid emission factor is applied. In the case of the project replacing a captive power generator, the lower emission factor between the grid emission factor and a captive power generator is applied. EF_{CO2} = min (EF_{grid}, $EF_{captive}$)	Grid emission factor: Grid emission factor published by the host country (If there is no any requirement from Joint Committee) ((IGES's List of Grid Emission Factors updated in August 2017)). 0.670 tCO_2/MWh (Philippine Combined margin) Captive power generator (diesel power generator):

		(Table 2 I.F.1, Small Scale CDM Methodology: AMS I.F. ver.2). 0.8 kgCO2/kWh

Joint Credit Mechanism Proposed Methodology Spreadsheet Form (input sheet) [Attachment to Proposed Methodology Form]

Table 1: Parameters to be monitored *ex post*

(a) Monitoring point No.	(b) Parameters	(c) Description of data	(d) Estimated Values	(e) Units	(f) Monitoring option	(g) Source of data	(h) Measurement methods and procedures	(i) Monitoring frequency	(j) Other comments
(1)	$EG_{PJ,y}$	Quantiry of electricty generated by the project solar PV system	4,191,660	KWh/y	Option C	Monitored data	. Collecting the data with validated/calibrated monitoring devices and inputting data to a spreadsheet manually or electrically . Verified monitoring devices are installed and they are calibrated once a year . Verification and calibration shall meet international standard on corresponding monitoring devices.	Continuous	
(2)	$EC_{PJ,y}$	Electricty consumption by the project solar PV system	83,833	KWh/y	Option C	Monitored data	. Collecting the data with validated/calibrated monitoring devices and inputting data to a spreadsheet manually or electrically . Verified monitoring devices are installed and they are calibrated once a year . Verification and calibration shall meet international standard on corresponding monitoring devices.	Continuous	

Table 2: Project-specific parameters to be fixed *ex ante*

(a) Parameters	(b) Description of data	(c) Estimated Values	(d) Units	(e) Source of data	(f) Other comments
$EFco_2$	CO_2 emission factor of electricity	0.6700	tCO_2/MWh	Grid emission factor of Philippines	

Table3: *Ex-ante* estimation of CO_2 emission reductions

CO_2 emission reductions	Units
2,752	tCO_2/y

[Monitoring option]

Option A	Based on public data which is measured by entities other than the project participants (Data used: publicly recognized data such as statistical data and specifications)
Option B	Based on the amount of transaction which is measured directly using measuring equipments (Data used: commercial evidence such as invoices)
Option C	Based on the actual measurement using measuring equipments (Data used: measured values)

Payatas Landfill

Joint Credit Mechanism Proposed Methodology Spreadsheet Form (Calculation Process Sheet)

[Attachment to Proposed Methodology Form]

1. Calculations for emission reductions	Fuel type	Value	Units	Parameter
Emission reductions during the period of y		2,752	tCO_2/y	ERy
2. Selected default values, etc.				
CO_2 emission factor of electricty	Electricity	0.67	tCO_2/MWh	$EFco_2$
3. Calculations for reference emissions				
Reference emissions during the period of y		2,808	tCO_2/y	REy
Quanity of electricity generated by the project solar PV system		4,192	MWh/y	$EG_{PJ,y}$
4. Calculations of the project emissions				
Project emissions during the period of y		56	tCO_2/y	PEy
Electricty consumption by the project solar PV system	Electricity	84	MWh/y	$EC_{PJ,y}$

[List of Default Values]

Joint Crediting Mechanism Proposed Methodology Form

Cover sheet of the Proposed Methodology Form

Form for submitting the proposed methodology

Host Country	The Republic of the Philippines
Name of the methodology proponents submitting this form	Oriental Consultants Co., Ltd
Sectoral scope(s) to which the Proposed Methodology applies	Energy demand
Title of the proposed methodology, and version number	Replacement of Conventional Burners with Regenerative Burners for Reheating Furnaces in Steel Mills Version number: 01.0
List of documents to be attached to this form (please check):	☑ The attached draft PDD: ☐ Additional information
Date of completion	14 February 2019

History of the proposed methodology

Version	Date	Contents revised
01.0	14 February 2019	

A. Title of the methodology

Replacement of conventional burners with regenerative burners for reheating furnaces in steel mills

B. Terms and definitions

Terms	Definitions
Regenerative burner	Burner systems, which absorb exhaust gas heat to a reservoir and preheat combustion air using the absorbed heat in the reservoir to improve energy efficiency.

Conventional burner	Burner systems, which do not have combustion, air preheating facility.

C. Summary of the methodology

Items	Summary
GHG emission reduction measures	By replacing conventional burners with regenerative burners in reheating furnaces, consumption of fossil fuels can be reduced, which leads to reduction of GHG emissions.
Calculation of reference emissions	Reference emissions are the CO_2 emissions from the use of reheating furnaces with conventional burners, which are calculated based on the amount of steel production in the project and the energy intensity of reference furnaces
Calculation of project emissions	The project emission is calculated based on the fuel and electricity consumption of the furnaces in the project and the CO_2 emission factors of the electricity and fuel.
Monitoring parameters	The following parameters need to be monitored 1) The quantity of fuel consumed by furnaces in the project 2) The quantity of steel produced in the project 3) The quantity of electricity consumed by the project furnace

D. Eligibility criteria

This methodology is applicable to projects that satisfy all of the following criteria.

Criterion 1	Projects replacing conventional burners with regenerative burners in reheating furnaces in steel mills
Criterion 2	Projects targeting new, existing or additional facilities

E. Emission Sources and GHG types

Reference emissions	
Emission sources	GHG types

Combustion of fossil fuel in the reference furnace	CO_2
Project emissions	
Emission sources	GHG types
Combustion of fossil in the project furnace	CO_2
Power consumption by the project furnace	CO_2

F. Establishment and calculation of reference emissions

F.1. Establishment of reference emissions

The reference emission is the emissions from consuming fossil fuels to produce the same amount of steel bars in the project under a reference condition. In this methodology, energy intensity for reference scenario is determined ex-ante as a default value through surveys before project implementation.

CO_2 emissions from consumption of electricity by reference furnaces are not considered for conservativeness.

F.2. Calculation of reference emissions

$$RE_y = FC \times P_y \times NCV \times EF_{co2}$$

RE_y	Reference emissions (tCO_2/y)
FC	Energy intensity of a reference furnace (l/t)
P_y	The quantity of steel bars produced in the project (t/y)
NCV	Net caloric value of furnace fuel (TJ/Gg)
EF_{co2}	CO_2 emission factor of furnace fuel (tCO_2/TJ)

G. Calculation of project emissions

Project emissions are calculated based on the quantity of electricity and fuel consumed by a

project furnace and the respective CO_2 emission factors

$$PE_y = EC_{PJ,y} \times EF_{e,co2} + FC_y \times NCV \times EF_{co2}$$

PE_y	Project emissions tCO_2/y)
$EC_{PJ,y}$	Electricity consumption by a project furnace (MWh/y)
$EF_{e,co2}$	CO2 emission factor of electricity (tCO_2/MWh)
$FC_{PJ,y}$	Fuel consumption by a project furnace (t/y)
NCV	Net caloric value of furnace fuel (TJ/Gg)
EF_{co2}	CO_2 emission factor of furnace fuel (tCO_2/TJ)

H. Calculation of emissions reductions

$$ER_y = RE_y - PE_y$$

PE_y	Emission reduction (tCO_2/y)
RE_y	Reference emissions (tCO_2/y)
PE_y	Project emissions (tCO_2/y)

I. Data and parameters fixed *ex ante*

The source of each data and parameter fixed *ex ante* is listed as below.

Parameter	Description of data	Source
FC	Energy intensity of a reference furnace (liter/ton)	The most steel bar manufacturing plants in Philippine have fuel intensity over 450Mcal/t. For this project, 43 l/ton (411 Mcal/ton) is applied

$EF_{RE,i}$	CO_2 emission factor of electricity In the case of grid: 0.670 tCO_2/MWh In the case of captive power plant (diesel): 0.8 tCO_2/MWh	In the case of grid (Official data from Philippine Government). (IGES's List of Grid Emission Factors updated in August 2017). In the case of diesel captive power plant (Table I.F.1, Small Scale CDM Methodology: AMS I.F. ver.2).
NCV	Net caloric value of furnace fuel (TJ/Gg) Residual fuel oil: 39.8 TJ/Gg Coking Coal: 24 TJ/Gg Natural gas:40.9 TJ/Gg (lower case of default value)	2006 IPCC Guidelines for National Greenhouse Gas Inventories. Table 1.2, Chapter 1, Volume 2.
EF_{co2}	CO_2 emission factor of furnace fuel (tCO_2/TJ) Residual fuel oil: 75.5 tCO_2/TJ Coking Coal: 87.3 tCO_2/TJ Natural gas:58.3 tCO_2/TJ (lower case of default value)	2006 IPCC Guidelines for National Greenhouse Gas Inventories. Table 1.4, Chapter 1, Volume 2.

Joint Credit Mechanism Proposed Methodology Spreadsheet Form (input sheet) [Attachment to Proposed Methodology Form]

Table 1: Parameters to be monitored *ex post*

(a) Monitoring point No.	(b) Parameters	(c) Description of data	(d) Estimated Values	(e) Units	(f) Monitoring option	(g) Source of data	(h) Measurement methods and procedures	(i) Monitoring frequency	(j) Other comments
(1)	P_y	Quantiry of steel produced in the project	218,400	t/y	Option B	Monitored data	.Collecting the data from production logbook and inputting the data to a spreadsheet manually . Cross check with sales records	Daily	
(2)	$FC_{PJ,y}$	Fuel consumption by the project furnace	8,330	t/y	Option C	Monitored data	. Collecting the data with validated/calibrated monitoring devices and inputting to a spreadsheet manually or electrically . Verified monitoring devices are installed and they are calibrated once a year . Verification and calibration shall meet international standard on corresponding monitoring devices.	Daily	
(3)	$EC_{PJ,y}$	Electricity consumption by the project furnace	0	MWh/y	Option C	Monitored data	. Collecting theelectricty consumption data with validated/calibrated monitoring devices and inputting to Verified monitoring devices are installed and they are calibrated once a year . Verification and calibration shall meet international standard on corresponding monitoring devices.	Continuous	

Table 2: Project-specific parameters to be fixed *ex ante*

(a) Parameters	(b) Description of data	(c) Estimated Values	(d) Units	(e) Source of data	(f) Other comments
FC	Energy intensity of the reference furnace	42.38	Kg/ton	Factory	
$EF_{e,co2}$	CO_2 emission factor of electricity	0.67	tCO_2/MWh	Grid emission factor of Philippine	

Table3: *Ex-ante* estimation of CO_2 emission reductions

CO_2 emission reductions	Units
2,781	tCO_2/p

[Monitoring option]

Option A	Based on public data which is measured by entities other than the project participants (Data used: publicly recognized data such as statistical data and specifications)
Option B	Based on the amount of transaction which is measured directly using measuring equipments (Data used: commercial evidence such as invoices)
Option C	Based on the actual measurement using measuring equipments (Data used: measured values)

Cathay Pacific Steel

Joint Credit Mechanism Proposed Methodology Spreadsheet Form (Calculation Process Sheet)

[Attachment to Proposed Methodology Form]

1. Calculations for emission reductions	Fuel type	Value	Units	Parameter
Emission reductions during the period of y		2,781	tCO_2/y	ERy
2. Selected default values, etc.				
Net caloric value of furnace fuel	Heavy oil	39.80	TJ/Gg	NCV
CO_2 emission factor of furnace fuel	Heavy oil	75.5	tCO_2/TJ	EF_{fuel}
3. Calculations for reference emissions				
Reference emissions during the period of y		27,810	tCO_2/y	REy
Quantity of steel produced in the project		218,400	t/y	Py
Energy intensity of the reference furnace		42	Kg/t	FC
Net caloric value of furnace fuel		39.80	TJ/Gg	NCV
CO_2 emission factor of furnace fuel		75.5	tCO_2/TJ	$EFco_2$
4. Calculations of the project emissions				
Project emissions during the period of y		25,029	tCO_2/y	PEy
Emission from the project furnace		25,029	tCO_2/y	PEy
Fuel consumption by the project furnace		8,330	t/y	$FC_{PJ,y}$
Electricity consumption by the project furnace		0	MWh/y	$EC_{PJ,y}$
CO_2 emission factor of electricity		0.670	tCO_2/MWh	$EF_{e,co2}$

[List of Default Values]

Net caloric value of heavy oil	39.8	TJ/Gg	
CO_2 emission factor of heavy oil	75.5	tCO_2/TJ	

Joint Crediting Mechanism Proposed Methodology Form

Cover sheet of the Proposed Methodology Form

Form for submitting the proposed methodology

Host Country	The republic of the Philippines
Name of the methodology proponents submitting this form	Oriental Consultants Co., Ltd
Sectoral scope (s) to which the Proposed Methodology applies	Energy demand
Title of the proposed methodology, and version number	Condensate Recovery and Utilization in Food Processing Factories Version number: 01.0
List of documents to be attached to this form (please check):	☑ The attached draft PDD: ☐ Additional information
Date of completion	14 February 2019

History of the proposed methodology

Version	Date	Contents revised
01.0	14 February 2019	

A. Title of the methodology

Condensate Recovery and Utilization in Food Processing Factories

B. Terms and definitions

Terms	Definitions
Condensate	Condensate is the liquid formed when steam passes from the vapor to the liquid state. In a heating process, condensate is the result of steam transferring a portion of its heat energy, known as latent heat, to the product, line, or equipment being heated.

Condensate recovery and utilization	Practices of recovering high temperature condensate from steam traps and returning the condensate directly to boilers or through boiler feed water tank in the purpose of reducing boiler fuel and water consumption

C. Summary of the methodology

Items	Summary
GHG emission reduction measures	The quantity of fossil fuel used for producing steam in a boiler can be reduced through sending back condensate to a boiler feed water tank. Reduction in boiler fossil fuel consumption leads to reduction of GHG emissions from food processing.
Calculation of reference emissions	Reference emission is calculated based on the quantity of energy being recovered and utilized, the efficiency of the boiler and the CO_2 emission factor of the fossil fuel used for providing energy to production processes. The conservative values of the parameters are used to ensure a reference emission is lower than BaU emission
Calculation of project emissions	The project emission is calculated based on the electricity consumption of a condensate recovery system and the CO_2 emission factor of electricity.
Monitoring parameters	The following parameters need to be monitored. 1) The temperature of feed water to a boiler in the project 2) The quantity of feed water to a boiler in the project 3) The quantity of electricity consumed by a condensate recovery system.

D. Eligibility criteria

This methodology is applicable to projects that satisfy all of the following criteria.

Criterion 1	Condensate recovery from production processes in existing or new food processing factories.
Criterion 2	Appropriate technologies, which can ensure safe recovery of high temperature

	condensate, are applied. Such as specialized centrifugal pumps with ejectors.

E. Emission Sources and GHG types

Reference emissions	
Emission sources	GHG types
Fossil fuel consumption for generating the same amount of energy recovered from condensate	CO_2
Project emissions	
Emission sources	GHG types
Electricity consumption by the condensate recovery system	CO_2

F. Establishment and calculation of reference emissions

F.1. Establishment of reference emissions

The reference emission is the emissions from consuming fossil fuels to retain the same amount of energy recovered from the project

F.2. Calculation of reference emissions

$$RE_{\mathrm{y}} = (FWT_{ta} - MWT_{ta}) \times \mathrm{W}_{th} \times \mathrm{MW}_{\mathrm{y}} \times \frac{1}{\mathrm{Ef}} \times \mathrm{EF}_{\mathrm{CO2,fuel}} \times 10^{-6}$$

RE_y	Reference emissions (tCO_2/y)
FWT_{ta}	Boiler feed water temperature in the project (℃)
MWT_{ta}	Boiler feed water temperature in the reference (℃)
MW_{y}	The quantity of boiler feed water in the project (t/y)
W_{th}	Heat capacity of water (kJ/kg.℃)
Ef	Boiler heat efficiency (%)

EF_{co2}	CO2 emission factor of boiler fuel (tCO_2/TJ)

G. Calculation of project emissions

Project emissions are calculated based on the quantity of electricity consumed by the condensate recovery system and the CO_2 emission factor of electricity.

$$PE_y = EC_y \times EF_{elec}$$

PE_y	Project emissions (tCO_2/y)
$EC_{PJ,y}$	Electricity consumption by the condensate recovery system (MWh/y)
EF_{elec}	CO_2 emission factor of electricity the system using (tCO_2/MWh)

H. Calculation of emissions reductions

$$ER_y = RE_y - PE_y$$

PE_y	Emission reduction (tCO_2/y)
RE_y	Reference emissions (tCO_2/y)
PE_y	Project emissions (tCO_2/y)

I. Data and parameters fixed *ex ante*

The source of each data and parameter fixed *ex ante* is listed as below.

Parameter	Description of data	Source
Ef	Boiler efficiency	Factories (100% is used for conservativeness)

MWT_{ta}	Boiler feed water temperature in the reference (℃)	Average temperature based on the data gained through field surveys at least for 3 months before project implementation
$EF_{CO2,fuel}$	CO_2 emission factor of the fuel used for steam generation Coal: 87.3 tCO_2/TJ Natural gas: 58.3 tCO_2/TJ (lower case of default value)	2006 IPCC Guidelines for National Greenhouse Gas Inventories. Table 1.4, Chapter 1, Volume 2.
EF_{elec}	CO_2 emission factor of electricity In the case of grid: 0.670 tCO_2/MWh In the case of captive power plant (diesel): 0.8 tCO_2/MWh	In the case of grid (Official data from Philippine Government). (IGES's List of Grid Emission Factors updated in August 2017). In the case of diesel captive power plant (Table I.F.1, Small Scale CDM Methodology: AMS I.F. ver.2).

Joint Credit Mechanism Proposed Methodology Spreadsheet Form (input sheet) [Attachment to Proposed Methodology Form]

Table 1: Parameters to be monitored *ex post*

(a) Monitoring point No.	(b) Parameters	(c) Description of data	(d) Estimated Values	(e) Units	(f) Monitoring option	(g) Source of data	(h) Measurement methods and procedures	(i) Monitoring frequency	(j) Other comments
(1)	FWT_{ta}	Temperature of boiler feed-water in the project	61	℃	Option C	Monitored data	. Collecting the data with validated/calibrated monitoring devices and inputting the data to a spreadsheet manually or electrically . Verified monitoring devices are installed and they are calibrated once a year . Verification and calibration shall meet international standard on corresponding monitoring devices.	Continuous	
(2)	MW_y	Quantity of boiler feed-water in the project	46,804	t/y	Option C	Monitored data	. Collecting the data with validated/calibrated monitoring devices and inputting the data to a spreadsheet manually or electrically . Verified monitoring devices are installed and they are calibrated once a year . Verification and calibration shall meet international standard on corresponding monitoring devices.	Continuous	
(3)	$EC_{PJ,y}$	Electricity consumption by the condensate recovery system	25	MWh/y	Option C	Monitored data	. Collecting electricty consumption data with validated/calibrated monitoring devices and inputting the data to a spreadsheet electrically . Verified monitoring devices are installed and they are calibrated once a year . Verification and calibration shall meet international standard on corresponding monitoring devices.	Continuous	

Table 2: Project-specific parameters to be fixed *ex ante*

(a) Parameters	(b) Description of data	(c) Estimated Values	(d) Units	(e) Source of data	(f) Other comments
Ef	Boiler efficiency	1.00	Ratio	1 is taken for ensure conservativeness	
MWT_{ta}	Temperature of feed-water in reference	34	℃	Average value based on the ex-ante survey	
EF_{elec}	CO_2 emission factor of electricity	0.67	t CO_2/MWh	Grid emission factor of Philippine	

Table3: *Ex-ante* estimation of CO_2 emission reductions

CO_2 emission reductions	Units
445	tCO_2/p

[Monitoring option]

Option A	Based on public data which is measured by entities other than the project participants (Data used: publicly recognized data such as statistical data and specifications)
Option B	Based on the amount of transaction which is measured directly using measuring equipments (Data used: commercial evidence such as invoices)
Option C	Based on the actual measurement using measuring equipments (Data used: measured values)

Joint Credit Mechanism Proposed Methodology Spreadsheet Form (Calculation Process Sheet)

[Attachment to Proposed Methodology Form]

1. Calculations for emission reductions	Fuel type	Value	Units	Parameter
Emission reductions during the period of y		445	tCO_2/y	ERy
2. Selected default values, etc.				
The specific heat of water	Water	4.18	kJ/kg.℃	W_{th}
CO_2 emission factor the fossil fuel that is used to provide energy	Coal	87.3	t CO_2/TJ	$EFco_2$
3. Calculations for reference emissions				
Reference emissions during the period of y		462	tCO_2/y	REy
Temperature of boiler feed water in the project		61	℃	PWT_{ta}
Temperature of boiler feed water in the reference		34	℃	MWT_{ta}
Boiler efficiency		1.00	ratio	Ef
Quantity of boiler feed-water in the project		46,804	t/y	MWy
4. Calculations of the project emissions				
Project emissions during the period of y		17	tCO_2/y	PEy
Emission from electricty consumption by the condensate recovery system				
Electricity consumption by the condensate recovery system		25	MWh/y	$EC_{PJ,y}$
CO_2 emission factor of electricity		0.670	tCO_2/MWh	EF_{elec}

[List of Default Values]

Specific heat	W_{th}	
Water	4.184	kJ/kg. ℃
CO_2 emission factor of boiler fuel	EF_{CO2}	
Coal	87.3	t CO_2/TJ

Joint Crediting Mechanism Proposed Methodology Form

Cover sheet of the Proposed Methodology Form

Form for submitting the proposed methodology

Host Country	The Republic of the Philippine
Name of the methodology proponents submitting this form	Oriental Consultants Co., Ltd
Sectoral scope (s) to which the Proposed Methodology applies	Transport
Title of the proposed methodology, and version number	Vehicle Engine Retrofitting through Introduction of Diesel-Dual-Fuel (DDF) System Version number: 01.0
List of documents to be attached to this form (please check):	☑ The attached draft PDD: ☐ Additional information
Date of completion	14 February 2019

History of the proposed methodology

Version	Date	Contents revised
01.0	14 February 2019	

A. Title of the methodology

Vehicle Engine Retrofitting through Introduction of Diesel-Duel-Fuel (DDF) System

B. Terms and definitions

Terms	Definitions
Diesel Duel Fuel (DDF) engine	The engine, which uses both conventional diesel fuel and liquefied petroleum gas (LPG) fuel, is referred to as 'LPG–diesel dual fuel engines'. Diesel engines are modified to engines, which use primary fuel as diesel and secondary fuel as LPG.

Overhaul	An overhauled engine is an engine which has been removed, disassembled (torn down), cleaned, inspected, and repaired as necessary and tested using factory service manual approved procedures.

C. Summary of the methodology

Items	Summary
GHG emission reduction measures	DDF helps improve in fuel efficiency, reduce the quantity of fossil fuel consumption and partly replace diesel with LPG, which has a lower CO2 emission factor than diesel.
Calculation of reference emissions	Reference emission is calculated based on the distance of a target vehicle travelled, the fuel efficiency of the vehicle before retrofitted and the CO2 emission factor of diesel.
Calculation of project emissions	The project emission is calculated based on the quantity of fuel consumed by a vehicle and the CO2 emission factors of the fuels.
Monitoring parameters	The following parameters need to be monitored. 1) The quantity of fuel consumed by a vehicle in the project 2) The distance traveled by a vehicle truck in the project

D. Eligibility criteria

This methodology is applicable to projects that satisfy all of the following criteria.

Criterion 1	Diesel engine vehicles such as trucks, buses, jeepneys
Criterion 2	Vehicle kilometer travelled (VKT) and the quantity of fuel consumed by target vehicles can be grasped
Criterion 3	Conform and clear the related regulations and standards of host countries

E. Emission Sources and GHG types

Reference emissions	
Emission sources	GHG types

Fossil fuel consumption of target vehicles for traveling the same distance as did in the project	CO_2
Project emissions	
Emission sources	GHG types
Fuel consumption by target vehicles	CO_2

F. Establishment and calculation of reference emissions

F.1. Establishment of reference emissions

The reference emission is the emissions from fossil fuel consumption of target vehicles for travelling the same distance as happened in the project

F.2. Calculation of reference emissions

$$RE_y = \sum_i RE_{i,y} \quad (1)$$

$$RE_{i,y} = PD_{i,y}/FE_{RE,i,diesel} \times De_{diesel} \times NCV_{diesel} \times EF_{co2,diesel} \times 10^{-6} \quad (2)$$

RE_y	Reference emissions (tCO_2/y)
i	Target vehicle
$RE_{i,y}$	Reference emission of a target vehicle i (tCO_2/y)
$FE_{RE,i,diesel}$	Fuel efficiency of a target vehicle i (Km/l)
$PD_{i,y}$	Distance travelled by a target vehicle i (Km/y)
De_{diesel}	Density of diesel (Kg/l)
NCV_{diesel}	Net caloric value of diesel (TJ/Gg)
$EF_{co2,diesel}$	CO_2 emission factor of diesel (tCO_2/TJ)

G. Calculation of project emissions

Project emissions are calculated based on the quantity of fuel consumed by target vehicles and

the CO_2 emission factors of the fuels

$$PE_y = \sum_i PE_{i,y} \quad (3)$$

$$PE_{i,y} = (FC_i \times Ra_{diesel,i} \times NCV_{diesel} \times EF_{co2,diesel} \times 10^{-3}) + ((FC_i \times Ra_{LPG,i} \times NCV_{LPG} \times EF_{co2,LPG} \times 10^{-3}) \quad (4)$$

PE_y	Project emissions (tCO_2/y)
i	Target vehicle
$FC_{i,y}$	The quantity of fuel consumed by a target vehicle i (t/y)
$Ra_{diesel,i}$	Ratio of diesel in the fuel of a vehicle i in the project
NCV_{diesel}	Net caloric value of diesel（TJ/Gg）
$EF_{co2,diesel}$	CO_2 emission factor of diesel (tCO_2/TJ)
$Ra_{LPG,i}$	Ratio of LPG in the fuel of a vehicle i in the project
NCV_{LPG}	Net caloric value of LPG（TJ/Gg）
$EF_{co2,LPG}$	CO_2 emission factor of diesel (tCO_2/TJ)

H. Calculation of emissions reductions

$ER_y = RE_y - PE_y$

RE_y: Reference emissions (tCO_2/y)

PE_y: Project emissions (tCO_2/y)

I. Data and parameters fixed *ex ante*

The source of each data and parameter fixed *ex ante* is listed as below.

Parameter	Description of data	Source
$FE_{RE,i,diesel}$	Fuel efficiency of a target vehicle (Km/l)	Field survey data (calculated based on the measured distance and fuel consumption of a target vehicle)
$EF_{co2,diesel}$ $EF_{co2,LPG}$	CO_2 emission factor of fuels consumed by vehicles: Diesel: 72.6 tCO_2/TJ LPG:61.6 tCO_2/TJ	2006 IPCC Guidelines for National Greenhouse Gas Inventories. Table 1.4, Chapter 1, Volume 2. (Table 1.4) Lower
NCV_{diesel} NCV_{LPG}	Net caloric values of fuels consumed by vehicles Diesel: 41.4 TJ/Gg LPG: 44.8 TJ/Gg	2006 IPCC Guidelines for National Greenhouse Gas Inventories. Table 1.4, Chapter 1, Volume 2. (Table 1.2)
De_{diesel}	Density of diesel Diesel: 0.832 Kg/l (Average density)	Philippine National Standards on Petroleum, Department of Energy (DOE) Density at 15 ℃: 0.820-0.860 Kg/l.

Joint Credit Mechanism Proposed Methodology Spreadsheet Form (input sheet) [Attachment to Proposed Methodology Form]

Table 1: Parameters to be monitored *ex post*

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
Monitoring point No.	Parameters	Description of data	Estimated Values	Units	Monitoring option	Source of data	Measurement methods and procedures	Monitoring frequency	Other comments
(1)	$Pd_{i,y}$	Distance travelled by the target truck in the project	8,395	Km/y	Option C	Monitored data	.Collecting the data with validated/calibrated monitoring devices (GPS) and inputting data to a spreadsheet manually or electrically . Verified monitoring devices are installed and they are calibrated once a year . Verification and calibration shall meet international standard on corresponding monitoring devices.	Daily	
(2)	$FC_{i,y}$	Quantity of fuel consumed by the target truck in the project	9	t/y	Option C	Monitored data	. Collecting the data with validated/calibrated monitoring devices and inputting data to a spreadsheet manually . Verified monitoring devices are installed and they are calibrated once a year . Verification and calibration shall meet international standard on corresponding monitoring devices.	Daily	

Table 2: Project-specific parameters to be fixed *ex ante*

(a)	(b)	(c)	(d)	(e)	(f)
Parameters	Description of data	Estimated Values	Units	Source of data	Other comments
$FE_{RE,i,diesel}$	Fuel efficiency of the target truck in reference	0.60	Km/l	Truck company	
$Ra_{LPG,i}$	Ratio of LPG in the fuel of the target truck in the project	0.432	tCO_2/MWh	Grid emission factor of Philippine	

Table3: *Ex-ante* estimation of CO_2 emission reductions

CO_2 emission reductions	Units
10	tCO_2/y

[Monitoring option]

Option A	Based on public data which is measured by entities other than the project participants (Data used: publicly recognized data such as statistical data and specifications)
Option B	Based on the amount of transaction which is measured directly using measuring equipments (Data used: commercial evidence such as invoices)
Option C	Based on the actual measurement using measuring equipments (Data used: measured values)

Joint Credit Mechanism Proposed Methodology Spreadsheet Form (Calculation Process Sheet)

[Attachment to Proposed Methodology Form]

1. Calculations for emission reductions	Fuel type	Value	Units	Parameter
Emission reductions during the period of y		10	tCO_2/y	ERy
2. Selected default values, etc.				
Net caloric value of diesel	Diesel	41.40	TJ/Gg	NCV_{diesel}
CO_2 emission factor of diesel	Diesel	72.60	tCO_2/TJ	$EF_{CO2,diesel}$
Density of diesel	Diesel	0.83	Kg/l	De_{diesel}
Net caloric value of LPG	LPG	44.80	TJ/Gg	NCV_{LPG}
CO_2 emission factor of LPG	LPG	61.6	tCO_2/TJ	$EF_{CO2,LPG}$
3. Calculations for reference emissions				
Reference emissions during the period of y		35.0	tCO_2/y	REy
Distance travelled by a target truck in project		8,395	Km/y	PDi,y
Fuel efficiency of the truck in reference		0.6	Km/l	$FE_{Re,l,diesel}$
CO_2 emission factor of diesel		72.6	tCO_2/TJ	$EF_{CO2,diesel}$
Net caloric value of diesel		41.4	TJ/Gg	NCV_{diesel}
Density of diesel		0.832	kg/liter	De_{diesel}
4. Calculations of the project emissions				
Project emissions during the period of y		25	tCO_2/y	PEy
Quantity of fuel consumed by the target truck		9	t/y	FCi
Net caloric value of diesel		41	TJ/Gg	NCV_{diesel}
CO_2 emission factor of diesel		73	tCO_2/TJ	$EF_{CO2,diesel}$
Net caloric value of LPG		45	TJ/Gg	NCV_{LPG}
CO_2 emission factor of LPG		62	tCO_2/TJ	$EF_{CO2,LPG}$
Ratio of LPG in the fuel of the target truck		0.432		$Ra_{LPG,i}$

[List of Default Values]

Net caloric value of diesel	41.4	TJ/Gg	
CO_2 emission factor of diesel	72.6	tCO_2/TJ	
Density of diesel	0.832	Kg/l	
Net caloric value of LPG	44.8	TJ/Gg	
CO_2 emission factor of LPG	61.6	tCO_2/TJ	