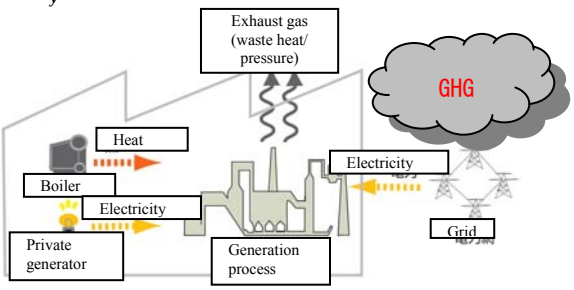
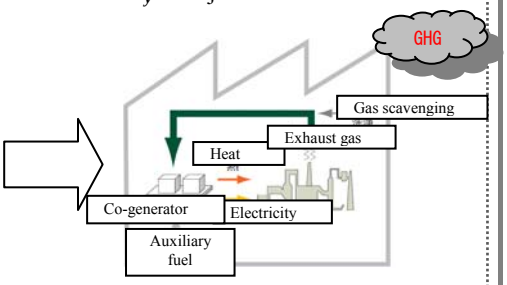
1.Typical Project Outline	The project intends to directly suppress electricity/fuel consumption and reduce GHG emissions in industrial facilities, such as steel plants and cement plants, through recovery and utilization from waste energy (waste heat, waste gas pressure).
2.Applicability	* The project should be aimed at GHG emission reduction through installation, upgrading and improvement of facilities, which recover and utilize waste energy from industrial facilities. * The project should promote utilization of waste energy by electricity generation or heat generation.
3.Methodology on Emission Reduction	GHG emission reduction through waste energy recovery and utilization in industrial facilities shall be determined as the difference between the baseline emissions before the project starts and the emission after the project. Emission shall be calculated for electric power generation and heat generation through waste energy recovery and utilization. $$ER_y = BE_y - PE_y \quad (t\text{-}CO_2/y)$$ ER_y : GHG emissions reduction in year y achieved by project (t-CO_2/y) BE_y : GHG emissions in year y without waste energy recovery and utilization (t-CO_2/y) (Baseline emission) PE_y : GHG emissions in year y with waste energy recovery and utilization (t-CO_2/y)(Project emission) BE_y : Baseline emission  Emissions generated by electric power to cover waste energy release without utilization PE_y : Project emission  Emissions utilized by recovery and utilization of waste energy for heat generation or heat supply (1) Baseline Emission Baseline CO_2 emissions factor is defined as the average emission factor of all power plants supplying the grid in the country where project activity is implemented.(Ref. Annex C-1) If the national default average emission factor of the current materials is not available from the existing data or not obtained from interviews with concerned parties, it should be calculated using the net electrical output of all plants supplying the grid in the targeted country, fuel type, net fuel consumption, net calorific value and CO_2 emission factor. (Ref. Annex C-4) Emission factor should be separately defined in the presence or absence of privately owned electrical power facilities. $BE_y = \underbrace{BE_{elec,y}}_{\text{(Baseline emissions from electric power)}} + \underbrace{BE_{ther,y}}_{\text{(Baseline emissions from heat)}}$ $=(EG_{PJ,y} \times EF_{BL,y}) + (HG_{PJ,y} \times EF_{heat})$

(Continuation)

Type	Items	Description
Output	BE_y	Baseline emission： GHG emissions without waste energy utilization (t-CO_2/y)
Input	$EG_{PJ,y}$	The quantity of electricity generated with waste energy recovery and utilization by the project (MWh/y)
	$EF_{BL,y}$	CO_2 emissions factor of the electricity(t-CO_2/MWh)
	$HG_{PJ,y}$	The quantity of heat recovered and utilized after the project(TJ/y)
	EF_{heat}	CO_2 emission factor of heat(t-CO_2/TJ)

Determination of $EF_{BL,y}$

【Case: currently owned or has plan to install private generating facility】

In the environment where the waste energy collecting facilities are installed with private generating facilities, or where waste energy collecting facilities are newly constructed and private generating facilities are planned to be installed, select whichever higher by comparing with the CO_2 emissions factor for the grid supplying electricity.

The emissions factor should be determined base on one or two typical plants among existing power plants in the target grid.

The emissions factor should be obtained through interview to the electric power management entity concerned.

In selecting the target power plant, confirm that the emissions factor is comparable to the average grid emission factor based on published values in the target country, data adopted by Kyoto Mechanism or IEA (Ref. Annex C-1).

If CO_2 emission factor is not available, it should be calculated using the annual electrical output of the target plant, fuel type, annual fuel consumption, average net calorific value, and caloric CO_2 emission factor (Ref. Annex C-4).

【Case: currently not owned or has no plan to install private generating facility】

Where the existing waste energy generating facilities have no private generating facilities or such facilities are not planned to be installed in new waste energy generating facilities, CO_2 emissions factor in the grid supplying electricity should be used.

Determination of EF_{heat}

EF_{heat} shall be recalculated by the following equation:

$$EF_{heat} = ws \frac{EF_{CO2}}{\eta_{EP}}$$

EF_{CO2} : CO_2 emission factor of the boiler fuel consumed without the project

η_{EP} : Boiler efficiency

ws : Rate of total heat from boiler without the project to heat capacity with waste energy recovery and utilization

(2) Project Emission

To calculate project GHG emission, monitor electricity consumption and supplemental fuel consumption from facilities with waste energy recovery and utilization. That measured consumption is multiplied by their respective emission factors.

$$\boldsymbol{PE_y} = \underset{\text{(Emission with electricity consumption)}}{PE_{elec,y}} + \underset{\text{(Emission with fuel consumption)}}{PE_{i,y}}$$

$$= (PC_y \times EF_{BL,y}) + (PC_{i,y} \times NCV_i \times COEF_i)$$

Type	Items	Description
Output	$\boldsymbol{PE_y}$	Project emission： GHG emission after project activity (t-CO_2/y)
Input	PC_y	Electricity consumption after project in year y(MWh/y)
	$EF_{i,y}$	CO_2 emissions factor of electricity(t-CO_2/MWh)
	$FC_{i,y}$	Fuel consumption i after the project in year *y* (kL, m^3, t etc./y)
	NCV_i	Net Calorific Value of fuel i (GJ/kL, m^3, t etc.)
	$COEF_i$	CO_2 Emission Factor of fuel i(t-CO_2/TJ)

4.Data required for estimation and monitoring

Data Type		Description of Data	Data Acquisition Methods			
			Baseline Emissions		Project Emissions	
			Before the Project Starts	After Project Completion	Before the Project Starts	After Project Completion
Amount of electric power supply with waste energy recovery and utilization (後：$EG_{PJ,y}$)		Amount of electric power supply with waste energy recovery and utilization by the project activity (MWh/y)	Planned data	Measured data	(Not necessary because data is not involved in the calculation)	
CO_2emission factor(Before：$EF_{BL,y}$)	Either higher rate of factor in the followings where the case【currently own the private generating facilities or plan to install】					
	CO_2 emissions factor of electricity	Emissions factor of a typical power plants (t-CO_2/MWh)	Data availability is validated in the following order in selecting the typical power plant and obtaining CO_2 emissions factor specific to the target. i) Interview to the electric power management entity concerned ii) Published values in the target country			
	CO_2 emission factor in private generating facilities	CO_2 emission factor every fuel type (t-CO_2/TJ)	Interview with power management entity			
	CO_2 emission factor supplying to grid for the case where【currently do not own the private generating facilities nor plan to install】					

(Cont)

Data Type		Description of Data	Data Acquisition Methods			
			Baseline Emissions		Project Emissions	
			Before the Project Starts	After Project Completion	Before the Project Starts	After Project Completion
Amount of heat with waste energy recovery and utilization (After : $HG_{PJ,y}$)		Amount of heat with waste energy recovery and utilization by the project activity (TJ/y)	Planned data	Measured data	(Not necessary because data is not involved in the calculation)	
CO_2 emission factor(Before : $EF_{heat,y}$)	Before : EF_{CO2}	The CO_2 emission factor of the boiler fuel consumed without the project (t-CO_2/TJ)	Data availability is validated in the following order because it should preferably be calculated using data and information unique to the project: i) Unique data obtained from interview with power management entity ii) National default IPCC Guideline default data (AnnexC-3)		(Not necessary because data is not involved in the calculation)	
	Heat efficiency (η_{EP})	Heat efficiency from boiler(%)	Data availability is validated in the following order: i) Unique data from interview with power management entity ii) Measured data of similar case			
	Heat ratio (*ws*)	Rate of total heat from boiler without the project to heat capacity with waste energy recovery and utilization	Heat capacity with waste energy recovery and utilization equal to heat capacity from boiler without the project The ratio is "1".			
Amount of electricity consumption by the project activity (After : PC_y)		Amount of electricity consumption by the project activity (MWh/y)	(Not necessary because data is not involved in the calculation)		Planned data	Measured data
Amount of fuel consumption by the project activity (After : $PC_{i,y}$)		Amount of fuel consumption by the project activity for every fuel type (kL/y、m^3/y、t/y)	(Not necessary because data is not involved in the calculation)		Planned data	Measured data
Other factors	Net calorific value of each fuel type (NCV_i)	Net calorific value of each fuel type (GJ/kL, m^3,t etc.,)	Data availability is validated in the following order because it should preferably be calculated using data and information unique to the project: i) Unique data obtained from interview with power management entity ii) National default iii) IPCC Guideline default data (Annex C-2,3)			
	CO_2 emissions factor of each fuel type ($COEF_i$)	CO_2 emissions factor of each fuel type (t-CO_2/TJ)				

5.Others

(1) Project Boundary

The physical boundary for measuring GHG emissions includes power facilities where project activity is implemented.

(2) Leakage

Recovery and utilization of waste energy in industrial facilities:
the indirect emissions that potentially lead to leakage due to activities such as product manufacturing or materials transport.

This corresponding emission is temporary and negligible considering the project scale. Therefore, this can be ignored.

(3) Reviewed Methodologies and Major Differences

1) ACM0012(ver4.0.0) : Consolidated baseline methodology for GHG emission reductions from waste energy recovery projects

【Differences】

* Waste energy is utilized in the project. Thus, without the project, waste energy flared or released into the atmosphere should be proved by directly measuring the amount of waste energy over three years before project implementation. This formula excludes these conditions.
* Reviewed methodology adopts several formulas depending on current situations and projects; however, in this formula, it is simplified by multiplying the electric power supply from waste energy with CO_2 emissions factor.
* In the reviewed methodology, the CO_2 emission factor of the electricity is the grid average value calculated by the "Tool to calculate the Emission Factor for an electricity system" for CDM. In this methodology, emissions factor of electricity is defined as the emission factor of one or two typical power plants existing in the gird to calculate easily.
* This formula does not consider the leakage because the reviewed methodology also mentions that there is no leakage to be considered.

2) AM0024(ver02.1)：Baseline methodology for GHG reductions through waste heat recovery and utilization for power generation in cement plants

【Differences】

* Though the reviewed methodology is applied to waste heat recovery and utilization during clinker making process in cement plants, the formula in this section is also applied to plants other than cement plants.
* In the reviewed methodology, the CO_2 emission factor of the electricity is the grid average value calculated by the "Tool to calculate the Emission Factor for an electricity system" for CDM. In this methodology, emissions factor of electricity is defined as the emission factor of one or two typical power plants existing in the gird to calculate easily.
* Though the reviewed methodology is applied to waste heat recovery and utilization during clinker making process in cement plants, the formula in this section is applied to waste gas not limited to waste heat.
* Emission from gas leak from the construction of power plants or fuel processing facilities may be considered as leakage which can be ignored in the reviewed methodology. This formula also ignores it the same manner.

3) ACM0013(ver4.0.0)：Consolidated baseline and monitoring methodology for new grid connected fossil fuel fired power plants using a less GHG intensive technology

【Differences】

* Though the reviewed methodology excludes new facilities as element, new facilities are used in this formula.
* Regarding the baseline emission based on the reviewed methodology, applicability of the formula is for fossil fuel used in the absence of the project, which is more than 50% of the net electricity power supply in the last three years. This formula excludes these conditions.
* In the reviewed methodology, the CO_2 emission factor of the electricity is one of the value calculated by the caloric CO_2 emission factor of each fuel type and efficiency in power generation or the value calculated by the amount of power generation, type of fossil fuel, amount of fuel consumption, net calorific value, caloric CO_2 emissions factor of each fuel type. In this methodology, emissions factor of electricity is defined as the emission factor of one or two typical power plants existing in the gird to calculate easily.
* This formula does not consider the leakage because the reviewed methodology also mention that there is no leakage to be considered.

4) AMS-III.Q(ver4.0)：Waste Energy Recovery (Gas/Heat/Pressure) Projects

【Differences】

* The formula in the reviewed methodology is applied to approve methodologies for small-scale CDM projects, which aim at 60 GWh or less annual electricity reduction, through energy efficiency improvement. There is no restriction in applying the formula from this methodology.
* In the reviewed methodology, the CO_2 emission factor of the electricity is calculated by the caloric CO_2 emission factor of each fuel type and efficiency in power generation. In this methodology, emissions factor of electricity is defined as the emission factor of one or two typical power plants existing in the gird to calculate easily.

	* In the reviewed methodology, if the power plants are transferred from other projects, leakage should be considered. However, this formula excludes these conditions. 5)J-MRV003: Methodology for waste energy recovery and utilization project (Revised on February 2011) 【Differences】 *Any of the methods on data acquisition can be selected from reviewed methodology where several methods are available; however, in this formula, prior selection is clearly defined. * In the reviewed methodology, the formula for baseline emission is intended for electricity use. This formula here also includes heat use. * In the reviewed methodology, the CO_2 emission factor of the electricity is the average of all power plants in the target country. In this methodology, emissions factor of electricity is defined as the emission factor of one or two typical power plants existing in the gird to calculate easily. * The reviewed methodology excludes the leakage potential unless there are great influences. This formula also excludes the leakage in the same manner.