
Calculation of Emission Reductions for Waste Gas/Heat Recovery Project

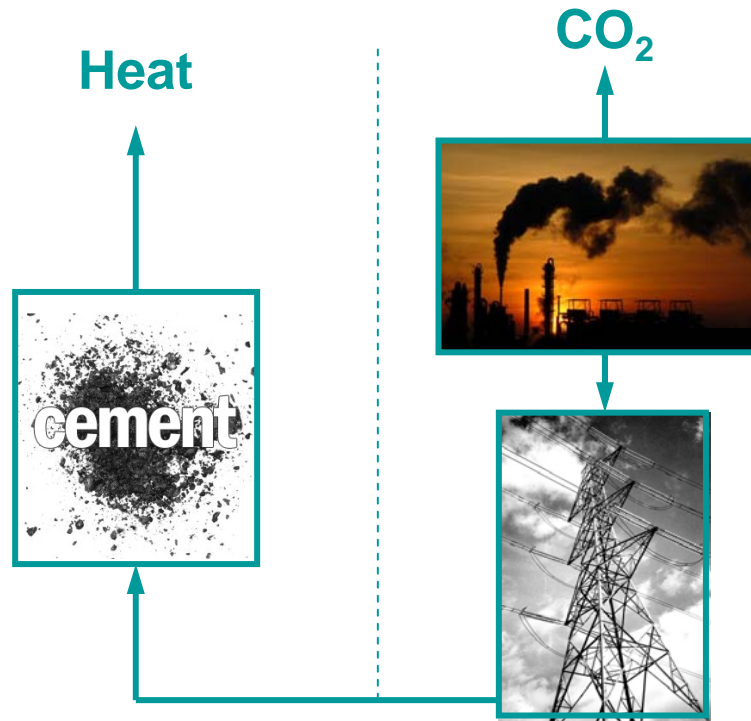
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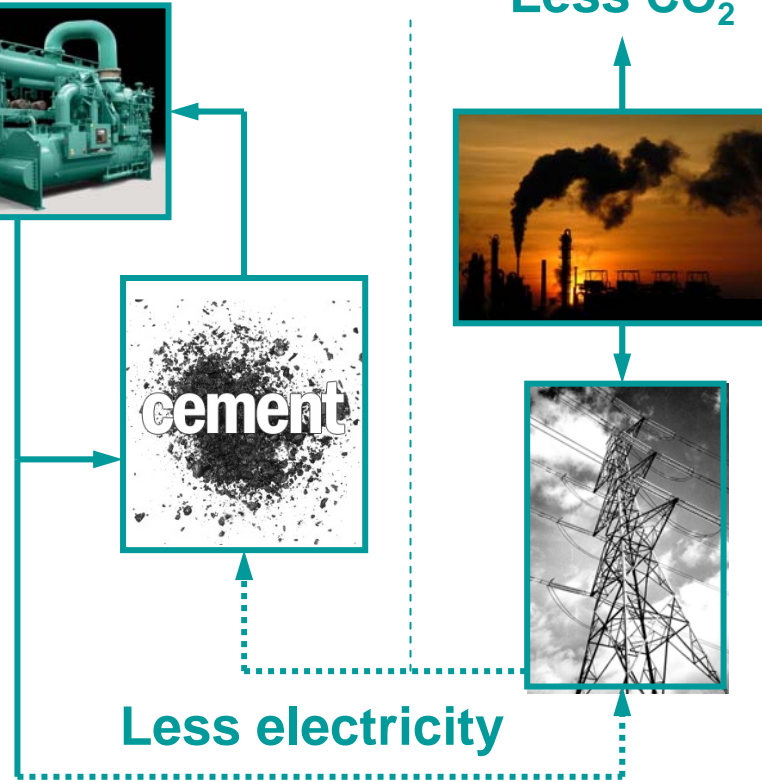
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Example: Cement Production



Without CDM project

Waste Heat Recovery System



With CDM project



How does “Waste Gas/Heat Recovery Project” reduce GHG?

- **Reduce fossil fuel consumption by generating renewable energy**
 - **Reduce power generation of thermal power plant by supplying power to the grid**
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Methodologies

■ Consolidated Methodologies

- ❑ **ACM0002**: Consolidated methodology for grid-connected electricity generation from renewable sources
- ❑ **ACM0004**: Consolidated baseline methodology for waste gas and/or heat and/or pressure for power generation
- ❑ **ACM0012**: Consolidated baseline methodology for GHG emission reductions from waste energy recovery projects
*(consolidated ACM0004 and AM0032)

■ Large Scale Methodologies

- ❑ **AM0024**: Methodology for GHG reductions through waste heat recovery and utilization for power generation at cement plants
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Exercises

- **Project type (s):**
 - Two lines cement production
 - Waste heat recovery captive power stations
 - **The emission reduction activity:**
 - Replace electricity from the power grid
 - **Methodology:**
 - ACM0024 version 02 “Methodology for GHG reductions through waste heat recovery and utilization for power generation at cement plants”
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Overview on Emission Sources

■ Included/Excluded from the project boundary

	Source	Gas	Included?	Justification/Explanation
Baseline	Grid Electricity Generation/identified specific generation source	CO₂	Included	Main emission source
		CH₄	Excluded	Excluded for simplification. This is conservative.
		N₂O	Excluded	Excluded for simplification. This is conservative.
Project Activity	On-site fossil fuel consumption due to the project activity	CO₂	Included	Main emission source
		CH₄	Excluded	Excluded for simplification. The emission source is assumed to be very small.
		N₂O	Excluded	Excluded for simplification. The emission source is assumed to be very small.



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Project Emission

$$PE_y = (EI_{P,y} - EI_B) * O_{clinker,y} * COEF_{fuel,y}$$

- EI_B is the pre-project energy consumption per unit output of clinker in TJ/ton of clinker produced (i.e. measured before the Project activity goes into operation).
- $EI_{P,y}$ is the ex-post energy consumption per unit output of clinker for given year, y, in TJ/ton of clinker produced.
- $COEF_{fuel,y}$ is the carbon coefficient (tCO₂ / TJ of input fuel) of the fuel used in the cement works in year y to raise the necessary heat for clinker production.
- $O_{clinker,y}$ Is the clinker output of the cement works in a given year y.
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Project Emission (Cont.)

$$EI_{P,y} = \frac{F_{P,y}}{O_{\text{clinker},y}}$$

$F_{P,y}$ is monitored annual energy consumption in a year y , expressed in TJ, of clinker making process;

$O_{\text{clinker},y}$ is monitored annual output, expressed in a year y , in tonnes of clinker.

$$EI_B = \frac{F_B}{O_{\text{clinker},B}}$$

F_B is the average annual energy consumption, expressed in TJ, of clinker making process prior to the start of operation of the project activity. At least one full year of data should be used.

If a year's worth of pre-Project Activity data is not available, then the Project Developer should outline the plan for ensuring conservativeness based on a combination of the ex-ante design estimate of energy consumption plus available measured data.

$O_{\text{clinker},B}$ is the average annual output, expressed in tonnes, of clinker prior to the start of operation of the project activity. At least one full year of data should be used.



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Project Emission (Cont.)

$$\text{COEF}_{\text{Fuel},y} = \text{EF}_{\text{CO}_2,\text{fuel},y} / \text{NCV}_{\text{fuel},y} * \text{OXID}_{\text{fuel}}$$

- $\text{NCV}_{\text{fuel},y}$ is the net calorific value (energy content) per mass or volume unit of a fuel used in clinker making process in year y;
- $\text{OXID}_{\text{fuel}}$ is the oxidation factor of the fuel (see Table 1-6, page 1.29 in the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories), expressed as percentage;
- $\text{EF}_{\text{CO}_2,\text{fuel},y}$ is the CO_2 emission factor per unit of energy of the fuel used in year y, expressed as tCO_2 per unit mass or volume unit.



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Baseline Emissions

$$EB_y = EG_{CP,y} * EF_{Elec,y} + EG_{Grid,y} * EF_{Grid,y}$$

$EG_{CP,y}$

is the electricity supplied from the project activity to the cement plant , expressed in MWh;

$EF_{Elec,y}$

is the emissions factor of the baseline electricity supply source, expressed as tCO₂ / MWh.
If in the baseline scenario electricity is supplied from the grid, then $EF_{Elec,y}$ is the emission factor of the grid - $EF_{Grid,y}$; if electricity is supplied from the identified specific captive power generation source, then $EF_{Elec,y}$ is the emission factor of it – $EF_{Captive,y}$

$EG_{Grid,y}$

is the electricity supplied from the project activity to the grid , expressed in MWh;

$EF_{Grid,y}$

is the emissions factor of the electricity grid, expressed as tCO₂ / MWh.



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Emission Reductions

$$ER_y = EB_y - PE_y$$

EB_y

The baseline emissions in year y , expressed in tCO_2

PE_y

The project emissions due to possible fuel consumption changes in the cement kilns, of the cement works where the proposed project is located, as a result of the project activity in year y , expressed in tCO_2



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Assumptions for Calculation

Project Emissions

The project activity recovers the waste heat which would otherwise be vented, and does not alter the clinker production process

- Average annual energy consumption: 6,300 TJ/year
- Average annual output: 1,800,000 t clinker/year

Fuel	$EFCO_{2fuel}$	NCV_{fuel}	$OXID_{fuel}$
	tCO ₂ /tonne	TJ/tonne	-
Coal, Anthracite, waste coal	2.24	0.022	0.98
Petrol coke	2.23	0.022	0.98
(Ultra) Heavy fuel	3.00	0.038	0.99
Lignite	1.74	0.017	0.98
Industrial waste	1.00	0.007	1.00
Other biomass	0	0.013	1.00



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Assumptions for Calculation

Baseline Emissions	All electricity produced from the project activity will be supplied to the cement works, there will be no electricity supplied from the project activity to the grid
	<ul style="list-style-type: none">■ Emission factor: 0.5187 tCO₂/MWh■ Power generator capacity: 16 MW■ Annual operation hours: 5,320 hours