ER calculation for Xinjiang Midong Tianshan Cement Co.Ltd's 1600t/d Utilization Calcium Carbide for Cement Clinker Project

The procedure and database of selecting sample plant in the project region and the calculation of Baseline Emission and Project Emission are summarised as follows. The information provided includes data, data sources and the underlying calculations.

According to ACM0015, the proposed project uses "Option 1" to select the sample. The clinker plant complying with the baseline scenario with the lowest emission is selected to be the sample. All the cement plants in the Wuchang Region which includes Urumqi City and Changji Hui Autonomous Prefecture are listed as followings. Therefore, the 2000t/d clinker line of Xinjiang Tianshan Cement Co.Ltd is selected as baseline sample.

Table 1 Statistic data of cement plants in Urumqi & Changji Region

No.	Company name	Technology and scale	Main raw material
1	Xinjiang Tianshan Cement Co.Ltd.	Outside Precalcining Kiln with capacity of 2000t/d	Limestone
2	Xinjiang Xiyu Cement Limited		Limestone
3	Xinjiang Qingsong Cement Limited	Outside Precalcining Kiln with capacity of 2000t/d	Limestone
4	Urumqi Xinguan Cement Limited	Hollow Kiln	Limestone
5	Urumqi Yanerwo Cement Limited	Outside Precalcining Kiln with capacity of 1000t/d	Limestone
6	Urumqi Huanpeng Cement Manufacture Limited	Hollow Kiln	Limestone
7	Urumqi Wenguang Cement Plant	Hollow Kiln	Limestone
8	Urumqi Mining Bureau Cement Plant	Outside Precalcining Kiln with capacity of 400t/d	Limestone
9	Urumqi Xingongdi Cement Plant	Hollow Kiln	Limestone
10	HongyanCement Plant	Hollow Kiln	Limestone
11	Urumqi Tunhe Cement Limited	Hollow Kiln and Outside Precalcining Kiln with capacity of 400t/d	Limestone
12	Tianlong Mining Co.Ltd	Hollow Kiln	Limestone
13	Tunhe Jinbo Cement Limited	Outside Precalcining Kiln with capacity of 400t/d	Limestone
14	Tunhe Gucheng Cement Plant	Outside Precalcining Kiln with capacity of 400t/d	Limestone

Source: Xinjiang Building Materials Designing Institute

According to the National Cement Clinker Standard (JC/T 853-1999) and the resources in the project region, the properties of certain raw

materials for producing the same type of clinker are similar. Therefore, in the project region, the properties of limestone are similar in the different plants which use limestone as raw materials, and as a result, the emissions caused by limestone calcination are similar for clinker plants in the region. Therefore, the differences of energy consumption are used to select the plant with the lowest emission.

Among Table 1, the 2000t/d clinker line of Xinjiang Tianshan Cement Co.Ltd is the line with the lowest energy consumption. Therefore, it is selected to be the baseline of the proposed project.

Step1. Calculating Baseline Emissions, BE_y

The statistical data of the 2000t/d clinker line of Xinjiang Tianshan Cement Co.Ltd in 2007 is used to calculate the baseline emission. According to the conservative requirement, all the CaO and MgO in the raw material, except limestone and clay, are considered to be non-carbonated.

a) Baseline CO_2 emissions from Calcination of carbonates (BE_{Calcin}):

Table 1-1 Statistical data of clinker and raw material of the 2000t/d clinker line of Xinjiang Tianshan Cement Co.Ltd in 2007

	Unit	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average	Total
Raw material consumption	10^4 t	0.97	4.63	7.73	7.70	8.15	7.68	8.11	7.66	9.17	6.73	8.11	8.91	7.69	92.28
Loss of raw material	%	34.98	35.19	35.10	35.09	34.96	34.92	34.67	34.72	34.60	34.62	34.63	34.92	34.86	
Clinker production	10^4 t	0.63	3	5.02	5	5.3	5	5.3	5	6	4.4	5.3	5.8	5.01	60.1309
Non-carbonated CaO & MgO content in the raw materials															
Black shale	%	2.6341%	3.9024%	4.8780%	4.8780%	5.8537%	9.9512%	9.7561%	12.9756%	9.7561%	14.6341%	15.9024%	14.6341%	9.9699%	
where：CaO	%	0.1243%	0.1842%	0.2302%	0.2302%	0.2763%	0.4697%	0.4605%	0.6124%	0.4605%	0.6907%	0.7506%	0.6907%	0.4706%	
MgO	%	0.0740%	0.1097%	0.1371%	0.1371%	0.1645%	0.2796%	0.2741%	0.3646%	0.2741%	0.4112%	0.4469%	0.4112%	0.2802%	
Silica sand	%	0.3902%	0.4878%	0.0000%	0.0000%	0.0000%	0.4878%	0.4878%	0.0976%	0.0976%	0.0976%	0.0000%	1.1707%	0.2683%	
where：CaO	%	0.0016%	0.0020%	0.0000%	0.0000%	0.0000%	0.0020%	0.0020%	0.0004%	0.0004%	0.0004%	0.0000%	0.0049%	0.0011%	
MgO	%	0.0007%	0.0009%	0.0000%	0.0000%	0.0000%	0.0009%	0.0009%	0.0002%	0.0002%	0.0002%	0.0000%	0.0021%	0.0005%	
Copper rasidus	%	1.9512%	1.4634%	0.9756%	1.1707%	0.9756%	0.0000%	0.7805%	0.1951%	0.0000%	0.0000%	0.0000%	0.0000%	0.4624%	
where：CaO	%	0.1500%	0.1125%	0.0750%	0.0900%	0.0750%	0.0000%	0.0600%	0.0150%	0.0000%	0.0000%	0.0000%	0.0000%	0.0356%	
MgO	%	0.0874%	0.065	0.0437%	0.0524%	0.0437%	0.0000%	0.0350%	0.0087%	0.0000%	0.0000%	0.0000%	0.0000%	0.0207%	

			6%												
Oil shale	%	9.1707%	0.3902%	0.0000%	7.9024%	7.3171%	3.3171%	3.3171%	0.0000%	3.1220%	0.0000%	0.0000%	0.0000%	2.4037%	
where：CaO	%	0.4622%	0.0197%	0.0000%	0.3983%	0.3688%	0.1672%	0.1672%	0.0000%	0.1573%	0.0000%	0.0000%	0.0000%	0.1211%	
MgO	%	0.2944%	0.0125%	0.0000%	0.2537%	0.2349%	0.1065%	0.1065%	0.0000%	0.1002%	0.0000%	0.0000%	0.0000%	0.0772%	
Grey shale	%	0.0000%	0.3902%	7.0244%	0.0000%	0.0000%	0.0000%	0.0000%	0.0000%	0.0000%	0.0000%	0.0000%	0.0000%	0.6636%	
where：CaO	%	0.0000%	0.0083%	0.1489%	0.0000%	0.0000%	0.0000%	0.0000%	0.0000%	0.0000%	0.0000%	0.0000%	0.0000%	0.0141%	
MgO	%	0.0000%	0.0061%	0.1096%	0.0000%	0.0000%	0.0000%	0.0000%	0.0000%	0.0000%	0.0000%	0.0000%	0.0000%	0.0104%	
Vitriol rasidus	%	0.0000%	2.3415%	1.4634%	1.2683%	1.7561%	1.2683%	1.2683%	0.2927%	2.1463%	1.3659%	1.2683%	1.0732%	1.3859%	Total
where：CaO	%	0.0000%	0.0796%	0.0498%	0.0431%	0.0597%	0.0431%	0.0431%	0.0100%	0.0730%	0.0464%	0.0431%	0.0365%	0.0471%	0.6896%
MgO	%	0.0000%	0.0602%	0.0376%	0.0326%	0.0451%	0.0326%	0.0326%	0.0075%	0.0552%	0.0351%	0.0326%	0.0276%	0.0356%	0.4245%
Clinker															
where：CaO	%	64.65%	65.11%	65.14%	65.07%	64.72%	64.74%	64.63%	64.56%	64.37%	64.70%	64.37%	64.47%	64.69%	
MgO	%	2.45%	2.47%	2.39%	2.33%	2.25%	2.12%	2.08%	2.17%	2.22%	2.17%	2.24%	2.25%	2.24%	

Source：analytical data in laboratory of the 2000t/d clinker line of Xinjiang Tianshan Cement Co.Ltd

As shown in the above table, baseline's operation in January is not normal. Therefore, exclude data of January from calculation and use the average data (as in the Average column of Table 1-1) of the rest 11 months as January data to complete the whole year calculation. With conservative consideration, all the five raw materials, other than limestone, are considered non-carbonated. According to Table 1-1, BE_{Calcin} is calculated as:

$$BE_{Calcin} = \frac{CLNK_y}{CLNK_{BSL}} \cdot (0.785 \cdot (CaO_{CLNK,BSL} \cdot CLNK_{BSL} - CaO_{RM,BSL} \cdot RM_{BSL}) + 1.092 \cdot (MgO_{CLNK,BSL} - MgO_{RM,BSL} \cdot RM_{BSL})) = 248{,}073.8 tCO_2e$$

b) Baseline CO2 emissions from combustion of fuels in the kiln for calcination (BE_{FC_Calcin}):

Table 1-2 the energy consumption data of the 2000t/d clinker line of Xinjiang Tianshan Cement Co.Ltd in 2007

	Unit	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
Real coal consumption	kg/t clinker	168.73	170.3	172.11	184.38	183.09	182.5	180.75	182.26	191.18	195.84	197.42	195.21	185.00
Standard coal consumption	kg/t clinker	124.4	127.21	125.37	125.93	126.1	127.91	126.35	125.11	124.76	126.99	126.88	126.74	126.30

for fuel preparation	kg/t clinker	6.34	6.36	6.64	6.3	6.32	6.91	6.36	6.88	6.3	6.39	6.6	6.34	6.49
for calcination	kg/t clinker	118.06	120.85	118.73	119.63	119.78	121	119.99	118.23	118.46	120.6	120.28	120.4	119.81
Electricity consumption by kiln	kwh/t clinker	87.17	45.63	42.07	40.81	40.44	40.39	40.1	40.59	39.09	40.5	40.5	50.34	41.86
Electricity consumption for preparing materials	kwh/t clinker	94.23	26.58	26.41	27.42	26.67	27.27	24.74	26.69	26.15	26.8	27.07	27.2	26.64
Clinker production	10^4 t	0.63	3	5.02	5	5.3	5	5.3	5	6	4.4	5.3	5.8	5.01

Source：statistical data in Operation Office of the 2000t/d clinker line of Xinjiang Tianshan Cement Co.Ltd

Table 1-3 the energy consumption calculation of the 2000t/d clinker line of Xinjiang Tianshan Cement Co.Ltd in 2007

	Unit	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average	Total
Real coal consumption	t	5109.00	8639.92	9219.00	9703.77	9125.00	9579.75	9113.00	11470.80	8616.96	10463.26	11322.18	9305.69	111668.34
Standard coal consumption	t	3816.30	6293.57	6296.50	6683.30	6395.50	6696.55	6255.50	7485.60	5587.56	6724.64	7350.92	6325.99	75911.94
for fuel preparation	t	190.80	333.33	315.00	334.96	345.50	337.08	344.00	378.00	281.16	349.80	367.72	325.21	3902.56
for calcination	t	3625.50	5960.25	5981.50	6348.34	6050.00	6359.47	5911.50	7107.60	5306.40	6374.84	6983.20	6000.78	72009.38
Electricity consumption by kiln	MWh	1368.90	2111.91	2040.50	2143.32	2019.50	2125.30	2029.50	2345.40	1782.00	2146.50	2919.72	2093.87	25126.42
Electricity consumption for preparing materials	MWh	797.40	1325.78	1371.00	1413.51	1363.50	1311.22	1334.50	1569.00	1179.20	1434.71	1577.60	1334.31	16011.73

Source: Table 1-2

Table 1-4 parameters of fuel

Type	NCV	EF_{CO2}	$OXID$
Unit	kJ/kg	tc/TJ	%
Standard coal	29270.6	25.8	100

Source: "Notification on Determining Baseline Emission Factor of China's Grid", Office of NCCCC, 2008-12-30.

China Energy Yearbook 2007

According to Table 2, Table 3 and Table 4, BE_{FC_Calcin} is calculated as following:

$$BE_{FC\_Calcin} = SKF_{BSL} \frac{\sum (FC_{I,Calcin,y} \cdot NCV_i \cdot EF_{CO2,i})}{\sum (FC_{i,Calcin,y} \cdot NCV_i)} \cdot CLNK_y = 159{,}167.8 \text{ tCO}_2\text{e}$$

c) Baseline emissions due to discarded dust from bypass and dedusting units (CDK) system (BE_{Dust}):

The baseline is a new dry processing line which doesn't have bypass system and will reuse all the dust collected by dedusting system. Therefore, it will not produce any GHG emission through bypass and dedusting unit (CDK).

BE_{Dust} = 0 tCO_2e

d) Baseline emissions from fuel consumption for drying of raw material or fuel preparation (BE_{FC_Dry}):

According to Table 1, Table 2 and Table 3, BE_{FC_Dry} is calculated as following:

$$BE_{FC\_Dry} = \frac{\sum (FC_{Dry,i} \cdot NCV_i \cdot EF_{CO2,i})}{CLNK_{BSL}} \cdot CLNK_y = 8{,}626.13 \text{ tCO}_2\text{e}$$

e) Baseline emissions from grid electricity consumption for clinker production (BE_{Elec_Grid}):

Table 1-5 the emission factor for Northwest China Grid

	OM	BM	0.5OM+0.5BM	Unit
Northwest China Grid	1.1225	0.6199	0.8712	tCO_2e/MWh

Source: "Notification on Determining Baseline Emission Factor of China's Grid", Office of NCCCC, 2008-12-30

According to Table 2, Table 3 and Table 5, BE_{Elec_Grid} is calculated as following:

$$BE_{Elec\_Grid} = \frac{(EC_{RM,Grid} + EC_{Feed,Grid} + EC_{KO,Grid}) \cdot EF_{CO2,Elec\_Grid}}{CLNK_{BSL}} \cdot CLNK_y = \frac{(EC_{Fual} + EC_{Calcin}).EF_{CO2,Elec\_Grid}}{CLNK_{BSL}} CLNK_y = 28{,}609.2 \text{ tCO}_2\text{e}$$

f) Baseline emissions from self-generation of electricity for clinker production (BE_{Elec_SG}):

The baseline scenario uses electricity totally from connected grid.

BE_{Elec_SG} = 0 tCO_2e

In conclusion:

$$BE_y = BE_{Calcin} + BE_{FC\_Calcin} + BE_{FC\_Dry} + BE_{Elec\_Grid} = 444{,}477 tCO_2 e$$

Step 2. Calculating Project Emissions, PE_y

a) Project emissions from Calcination of carbonates ($PE_{Calcin,y}$):

As Copper Residues and CCR are wastes from chemical procedure, no carbonated CaO or MgO could be stably included, and, according to the characteristic of Silica Sand, also no carbonated CaO and MgO would be in it. Therefore, conservatively, consider all the CaO and MgO in the Black Shale are carbonated and include them into Project Emission.

Table 2-1 Designed statistic data for Black Shale

	Unit	Value
Raw material	kg/t clinker	1230
Black Shale	%	18%
where：CaO	%	1.06%
MgO	%	0.56%

$$PE_{Calcin} = 0.785 \cdot (CaO_{CLNK,y} \cdot CLNK_y - CaO_{RM,y} \cdot RM_y) + 1.092 \cdot (MgO_{CLNK,y} - MgO_{RM,y} \cdot RM_y) = 8517.69 \text{ tCO}_2\text{e}$$

b) Project emissions from combustion of fuels in the kiln for calcination ($PE_{FC\_Calcin,y}$):

$$PE_{FC\_Calcin,y} = SKF_y \frac{\sum (FC_{i,Calcin,y} \cdot NCV_i \cdot EF_{CO2,i})}{\sum (FC_{i,Calcin,y} \cdot NCV_i)} \cdot CLNK_y$$

As the proposed project uses surplus heat to dry the raw materials and fuel, while the baseline uses fuel to dry the fuel, in order to compare the energy used, the SKC_{BSL} is calculated based on the whole fuel consumption, including consumption for kiln and dry procedure. According to Table 2, Table 3 and Table 4, SKC_{BSL} is calculated as following:

$$SKC_{BSL} = \frac{\sum (FC_{i,Calcin} \cdot NCV_i)}{CLNK_{BSL}} = 3.695 \text{ GJ/t clinker}$$

The designed SCK_y of the proposed project indicated in PAR is 3595 KJ/kg clinker which is lower than SCK_{BSL},.

According to ACM0015, as $SCK_y \leq SCK_{BSL}$, use the SCK_{BSL} as SCK_y to calculate $PE_{FC\_Calcin,y}$.
Therefore:

$$PE_{FC,y} = \sum (FC_{i,y} \cdot EF_{CO2,i} \cdot NCV_i) = BE_{FC\_Calcin} + BE_{FC\_Dry} = 167,793.93 tCO_2e$$

c) Project emissions due to discarded dust from bypass and dedusting units (*CDK*) system ($PE_{Dust,y}$):

The proposed project is a new dry processing line which doesn't have bypass system and will reuse all the dust collected by dedusting system. Therefore, it will not produce any GHG emission through bypass and dedusting unit (CDK).

$PE_{Dust,y} = 0 \text{ tCO}_2\text{e}$

d) Project emissions from fuel consumption for drying of raw material or fuel preparation ($PE_{FC\_Dry,y}$):

The proposed project uses surplus heat generated in rotary kiln and reciprocating grate cooler to dry raw material and prepare fuel, therefore, the proposed project will not generate GHG emission by drying of raw material or fuel preparation.

$\boldsymbol{PE_{FC\_Dry,y}}$ = 0 tCO_2e

e) Project emissions from grid electricity consumption for clinker production ($PE_{Elec\_Grid,y}$):

According to the PAR of the proposed project, the designed synthetic power consumption rate is 69 kWh/t (clinker) which is lower than the average value of 77.91 kWh/t (clinker) based on the one-year recorded data for the baseline scenario. Therefore, according to ACM0015, the $PE_{Elec\_Grid,y}$ is calculated as following:

$$PE_{Elec\_Grid,y} = BE_{Elec\_Grid,y} = 28,609.2 tCO_2e$$

f) Project emissions from self-generation of electricity for clinker production ($PE_{Elec\_SG,y}$):

The proposed project will use electricity totally from connected grid.

$PE_{Elec\_SG,y}$ = 0 tCO_2e

In conclusion:

$$PE_y = PE_{FC\_Calcin} + PE_{FC\_Dry} + PE_{Elec\_Grid} = 204,920.9 tCO_2e$$

Therefore, $ER_y = BE_y - PE_y = 239,556.2 tCO_2e$