White Book of Low Carbon Emission Development of Huaxin Cement Co., Ltd

As a fundamental building material of national economy, cement is hard to be replaced. Huaxin Cement is one of the oldest cement enterprises in China. To respond to the call of Carbon Peak, Carbon Neutrality of national government and actively cope with the climate change, Huaxin made the strategy of sustainable development. Huaxin will research on the technology breakthrough in the field of alternative fuels, alternative raw materials, clinker factor optimization, fuel efficiency, low carbon clinker development, energy utilization, green mining, new energy development, carbon capture, utilization and storage, contributing to the sustainable growth of the cement industry and striving to be the frontrunner in carbon neutrality of China.

I. The history of carbon emission and current situations of Huaxin

(I) Review of the history of carbon emission

The main products of the Company are clinker, cement, ready-mixed concrete and others. The production process of clinker and cement brings about the main energy consumption and carbon dioxide emission. Concrete is the finished product and the most important application of cement. Cement, aggregate, mineral powder or fly ash, water, admixtures are mixed to produce concrete to provide strength protection for buildings. The Company mainly focuses on the carbon emissions of clinker, cement and concrete (see Figure 1).

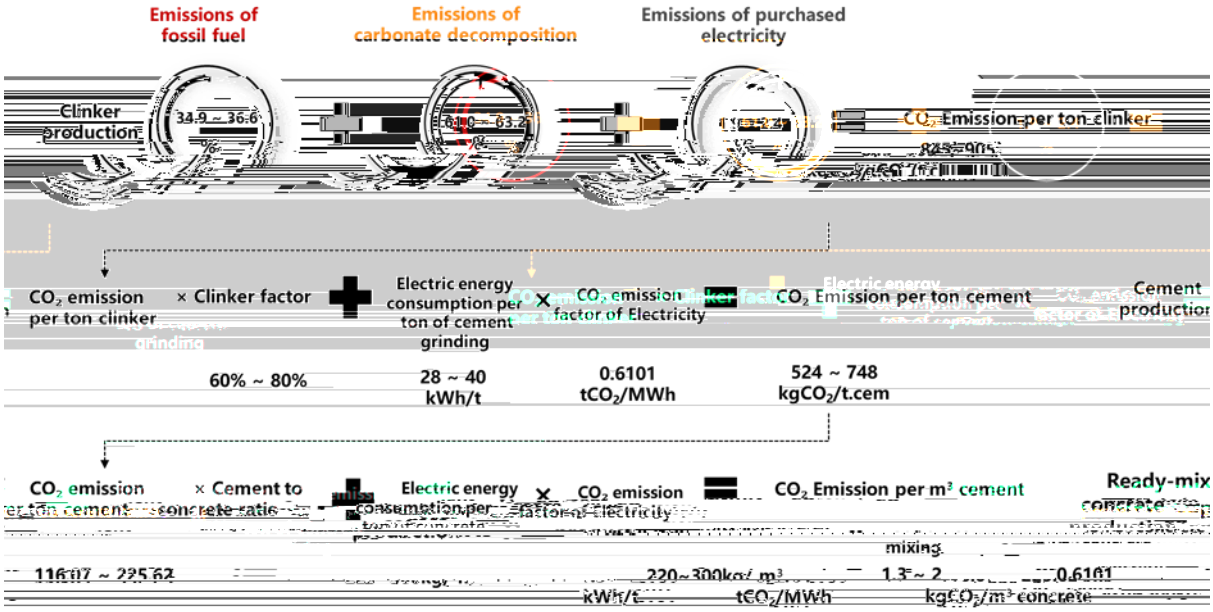

Figure 1 Main Source of Carbon Emission of Huaxin

The company reviewed the production and energy consumption data of the cement business in key years of 1990, 2000, 2005, 2010, 2015 and 2020. The review of carbon emissions of the company's clinker kiln lines as follows (see Figure 2). Since 1990, the company's cement business has continued to grow. The carbon emission intensity per unit product output value has shown a downward trend, and the carbon emission intensity of cement and clinker has decreased overall.

Figure 2 Review of the History of Carbon Emission of Huaxin

For the definition of scope 1, please refer to the below.

(II) Current situation of carbon emission

1. Scope of carbon emission

We refer to the GHG Protocol calculation system to categorize the carbon emission into Scope 1, Scope 2, Scope 3.

Scope 1 refers to direct emission including decomposition of carbonate in raw materials, fossil fuel consumption during cement production, on-site power generation, etc.; Scope 2 refers to indirect emissions of energy converted from purchased electricity, heat, and steam; Scope 3 refers to other indirect emissions, such as refinement and production of purchased materials and fuels, vehicle transportation, employee commuting, etc.

2. Clinker carbon emission

As of June 30, 2021, the company has 58 new dry-process clinker production lines in 9 provinces and cities and 5 overseas countries. Based on the current calculation method of carbon emissions per unit of clinker in the cement industry*, and calculating the CO_2 emissions per ton of clinker, the company's carbon emissions in the past three years are as follows(see Table 1):

Table 1 Carbon emission of clinker line unit $kgCO_2/t.cl$

Year	2018	2019	2020
Emission intensity	860.52	852.46	853.63
Direct emission(Scope 1)	F q362.78 329.14 8:		

2 cement carbon emissions to formulate low-carbon development goals.

4. Concrete carbon emission

In 2020, the output of concrete of Huaxin was 4.61 million m^3. The direct emission of CO_2 per unit concrete (Scope 1) was 196kg, calculated by the direct emission of cement carbon emission intensity.

(III) Current technologies of carbon emission and measures in practice

1. Roadmap of overseas carbon emission reduction technologies

(1) International Energy Agency (IEA)

In the *2050 Cement Industry Low-Carbon Transition Technology Roadmap*, the IEA clarified that the main carbon emission reduction measures of the cement industry are: improving energy efficiency, developing co-processing technologies, reducing clinker factor, and applying new technologies including carbon capture and other alternative cementitious materials.

(2) Cembureau

Cembureau highlighted in the *2050 Cement Industry and Low Carbon Economy* that European cement industry will achieve the 2025 net zero emission target through the value chain of cement and concrete and 5 technology roadmaps. (see Figure 3)

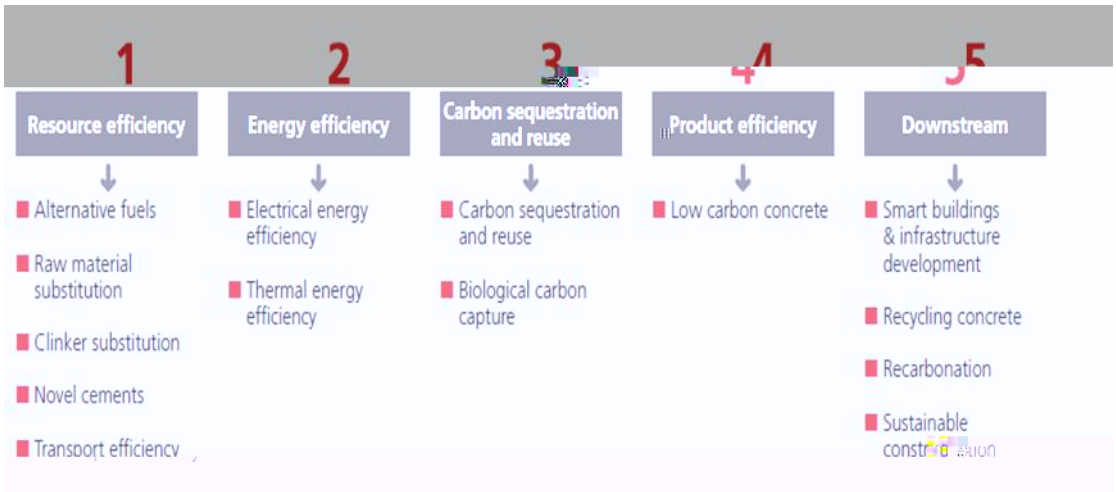

Figure 3 Carbon Emission Technologies of Cembureau

2. Current technologies of carbon emission and measures in practice of Huaxin

(1) Lower emission through alternative fuels

The company has fully studied the characteristics of waste, combined with the technological advantages of the clinker kiln system, and used the clinker kiln to carry out co-processing. "Clinker Kiln Efficient Ecological Co-processing of Solid Waste Technology and Application" was awarded the Second Prize of National Science and Technology Progress Award in 2016. "Ecological Pre-treatment of Household Waste and Clinker kiln Co-processing Technology" was listed in the 2019 National Industrial Energy-saving Technology and Equipment Recommendation Directory. In 2020, seven cement clinker plants of Huaxin

consumption industries of the

Ministry of Industry and Information Technology. Among them, Xinyang plant's comprehensive energy consumption of clinker at comparablBDC BT1 0 0 1 308.28 494.(n)-6(BDC (en-US)

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utilization efficiency of wastes, refuse burning is less than 20% while co-processing in the clinker kiln is about 70%. The company's efforts in the field of alternative fuels have accumulated experience and established a demonstration for carbon emission reduction in the domestic cement industry.

(2) Lower emission through alternative raw materials

Huaxin actively searched for alternative raw materials, using various industrial by-products such as fly ash, slag, coal gangue, sulfuric acid slag, phosphorous slag, and municipal sludge to reduce the consumption of natural raw materials and effectively reduced process emissions. In 2020, 4(i)5 70.824 543.0214.19 Tm[a)-8(ccu)-8(m)29(u-8(0)13(2)-8(0T4,C25(r)7a)-8(t)1)293(e

the performance of the strength of cement in the early phase, the efficiency of clinker utilization and the reduction of clinker consumption can be achieved, and the overall carbon emissions of cement production can be reduced.

(4) Lower emission through cogeneration of cement, wall material and other integrated projects

Through independent research and development, the company uses waste heat steam and hydrothermal reaction technology to produce high-performance wall materials by large-scale utilization of mine waste residues, so as to fully utilize

has been actively engaged in carbon trading and fulfilled all carbon quota contracts. Meanwhile, Huaxin explored quota trusteeship, CCER (forwards) swap and fulfilled the social responsibility of coping with climate change.

II. Carbon reduction roadmap and goal of Huaxin

(I) Technology measures of carbon emission in cement industry

Huaxin

production, waste disposal, waste heat recovery to cement production, deliberated the practice adopted by domestic and overseas leading enterprises as well as other carbon reduction technology implemented and predicted by the Company. Hereby Huaxin analyzed the potential of each technology:

Table 2 Carbon reduction technology and potential in cement industry ***

No	Technology roadmap	Remarks	Potential of carbon reduction $kgCO_2/t.cl$	
			low	high
1	Green mining	Part of the carbon sink is realized through afforestation, forest management, vegetation restoration, etc.	0.1	0.3
2	Alternative raw material	The non-carbonate industrial by-productss that replace natural carbonate ore raw materials are mainly industrial by-products residues, high-temperature calcination waste residues, or raw materials that clearly do not contain calcium carbonate or magnesium carbonate.	4	7
3	Alternative fuel	Domestic waste, sludge cake, industrial and biomass, the current industry heat replacement rate is less than 2%.	140	285
4	Efficiency of fuel	Six-stage preheater, low-resistance high-efficiency decomposition pre-heater, high-efficiency clinker grate cooler, multi-channel high-efficiency burner, oxygen-enriched combustion, new thermal insulation materials and other combustion system improvement technologies.	20	50

5	Waste heat recovery	The existing waste heat recovery technology has low thermal efficiency, the steam produced by high-temperature smoke can steam integrated high-performance wall materials to improve the waste heat thermal efficiency.	30	45
6	Clinker factor $kgCO_2/t.cem$	Superfine grinding + separate grinding, using natural/industrial active waste slag as a mixture, LC3-calcined clay, etc. instead of cement clinker.	120	170
7	Low carbon clinker development	Alite-sulfoaluminate clinker, silicate clinker for carbonization reaction, etc.	40	70
8	Energy utilization rate	Process pipeline design with low wind resistance, high-efficiency fan motor, energy		

carbon reduction potential and lowering the utilization coefficient of clinker; stepped efforts in improving energy efficiency, clinker kiln waste heat utilization technology, alternative raw material technology, and intelligent manufacturing technology, and actively developed low carbon clinker.

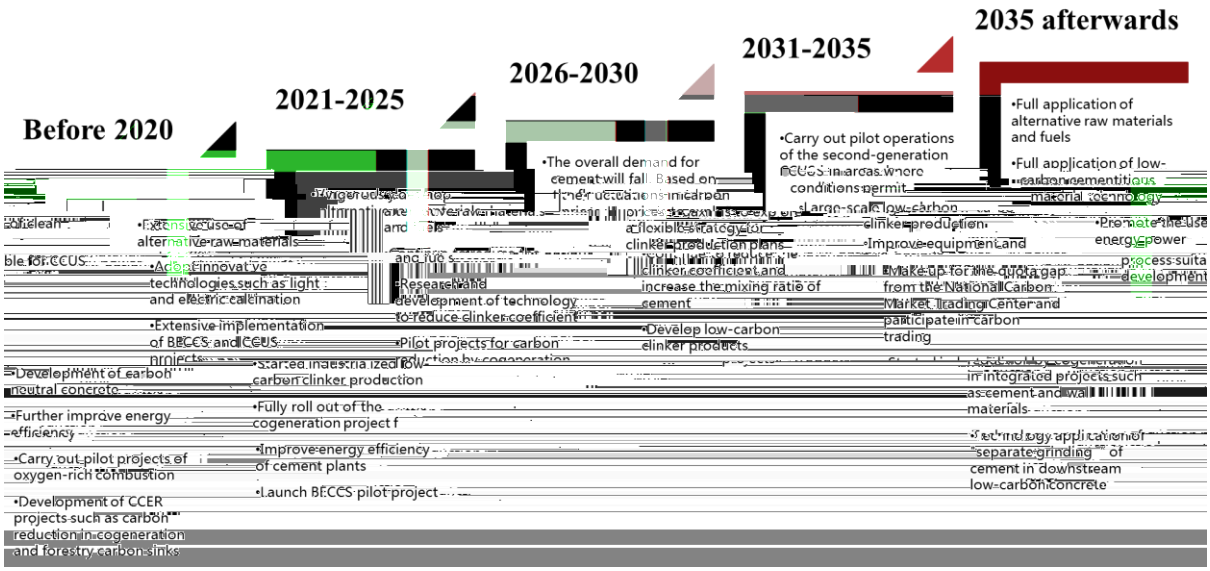

Figure 4 Future Roadmap of Huaxin Carbon Reduction

For the carbon reduction technologies emphasized currently, Huaxin proposes the following short-term quantitative targets, and at the same time the proposed emission reduction measures for Scope 3 carbon emissions:

1. Vigorously develop clinker kiln co-processing technology. The company's alternative fuel energy will account for more than 25% of primary energy in 2030, reducing 60kg CO_2/t.cl per unit of clinker; the number will reach 30% in 2035, reducing 75kg CO2/t.cl per unit of clinker.

2. Extensive use of active industrial solid waste and natural materials as mineral components and the application of superfine grinding technology to reduce the clinker factor. In 2025, the company's clinker factor of the same grade cement will drop by at least 5 percentage points.

3. Actively promote low-carbon concrete application technologies, such as "separate

grinding" in cement preparation, digital support system for concrete business, new admixtures, and materials from industrial solid waste processing. In 2030, the cement amount of the same grade concrete will reduce by 10-15%.

4. Use Carbon Capture, Utilization and Storage (CCUS) as basic technology to test the carbon reduction effect of cement. The company will develop O_2/CO_2 combustion + CCUS for the whole clinker kiln system, carry out CO_2 capture and utilization projects in 2025; in 2030, develop in Sichuan, Chongqing, Guangdong, Western Hubei and other regions with geological and ocean storage potential (all oxygen combustion +) CCUS pilot project; after the second-generation CCUS technology gradually matures in 2035, CCUS will be gradually promoted in the company's suitable clinker kiln

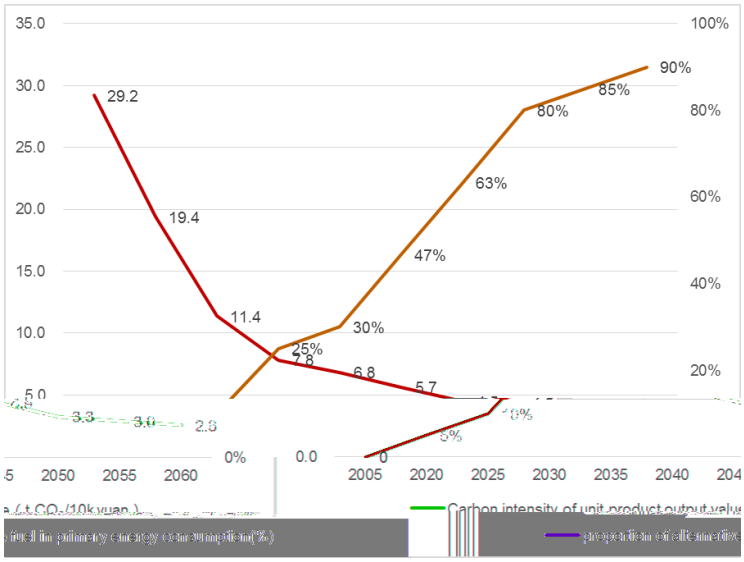

Figure 5 Goal of Carbon Intensity Output Value Per Unit Product and Alternative Energy Consumption

Huaxin will take an open and forward look at carbon reduction technologies, exploring the potentials of various technologies and laying out and reserving leading edge carbon reduction technologies. Huaxin looks forward to the pilot and industrialized application of carbon reduction technologies to drive the low carbon growth of the company. By 2030, direct CO2 emission intensity per ton cement (Scope 1) will be reduced to 475 kg, direct CO2 emission intensity per m^3 concrete (product carbon footprint, Scope 1) will be reduced to 124 kg. Huaxin plans to invest 10.5 billion Yuan between 2020 and 2030 for the technology research and productions system upgrade of carbon reduction emission. By 2060, CCUS and other innovative technologies will guarantee the net zero emission target of Huaxin, neutralize remaining carbon emission. Carbon reduction brought by BECCUS/CCUS will not be included into carbon intensity goal. (see Figure 6, Figure 7)

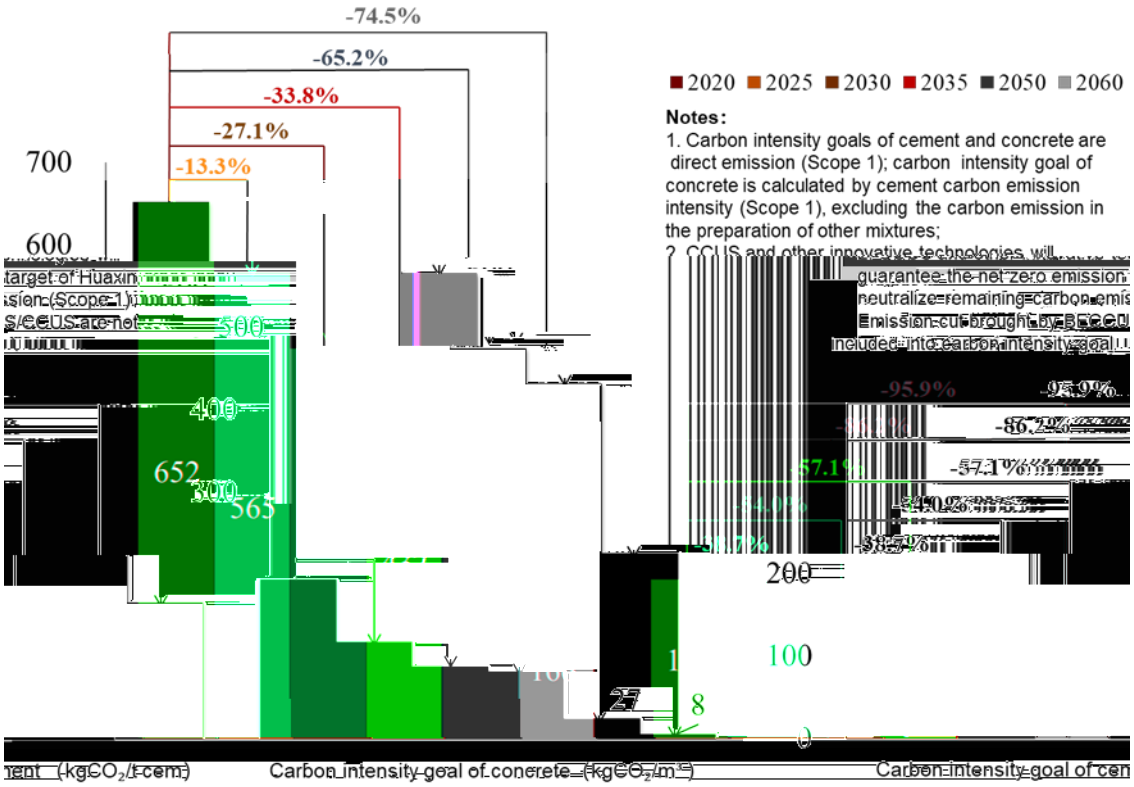

Figure 6 Carbon Intensity Goals of Cement and Concrete of Huaxin

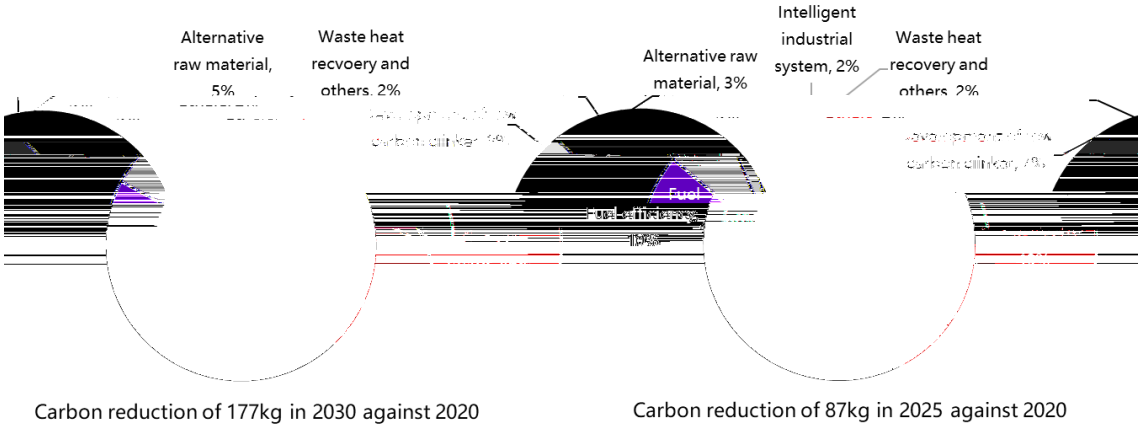

Figure 7 Contributions to the Goals of Carbon Intensity Reduction of Cement in 2025, 2030 (%)

Huaxin follows closely on the formulation and publication of Carbon Emission Policy and Standard by national government and building material industry, actively promotes the establishment of low carbon standard, and consistently to promote the third party audit for carbon emission and will launch the certification of carbon targets in due time. Huaxin will regularly update and improve its white book of low carbon development based on the

neutrality the latest carbon emission calculation method

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Carbon Reduction Plan of Wuxue Plant (2025-2030)

Unit: kg CO_2/ t.cem

2025 cement carbon emission target (Scope 1) 539.27 kgCO_2/ t.cem

2030 cement carbon emission target (Scope 1) 471.37 kgCO_2/ t.cem

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