

US-China MRV workshop  
Washington D.C. · USA



# MRV Construction of CO<sub>2</sub> Emission for China Cement Industry

**China Building Materials Academy**  
**June 4<sup>th</sup> 2012**

# China Building Materials Academy



- Founded in 1950, owned by the central government.
- The largest comprehensive R&D organization in the fields of building materials and inorganic non-metal materials in China.
- ◆ Over 3000 scientific researchers out of 5000 staff.
- ◆ Among the first group of institutes authorized by the Academic Degree Committee of the State Council to award Master's degree and Doctorate.



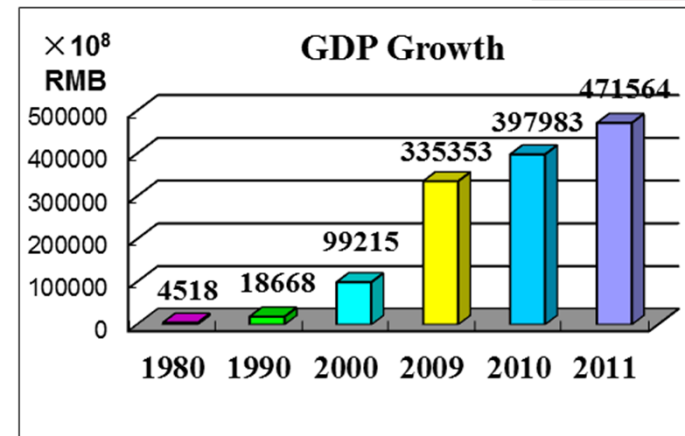
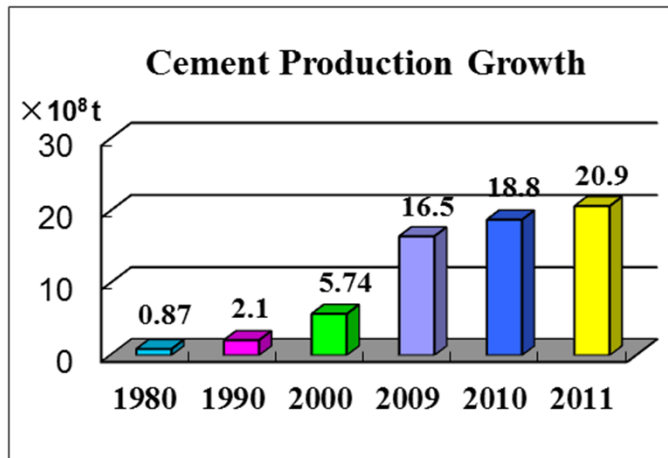
- About **500** ministerial and higher level awards granted by government, including over **100** national prizes
- 9 technical standardization committees, including National cement technical standardization committee

## Major Business Field

- GHG reduction technology R&D, GHG inventory, national standard of CO<sub>2</sub> emission calculation method, CO<sub>2</sub> Verification & Certification, GHG standardization
- R&A typical business examples, explore low-carbon development model of cement manufactures, provide technical service for government decision-making and enterprise development



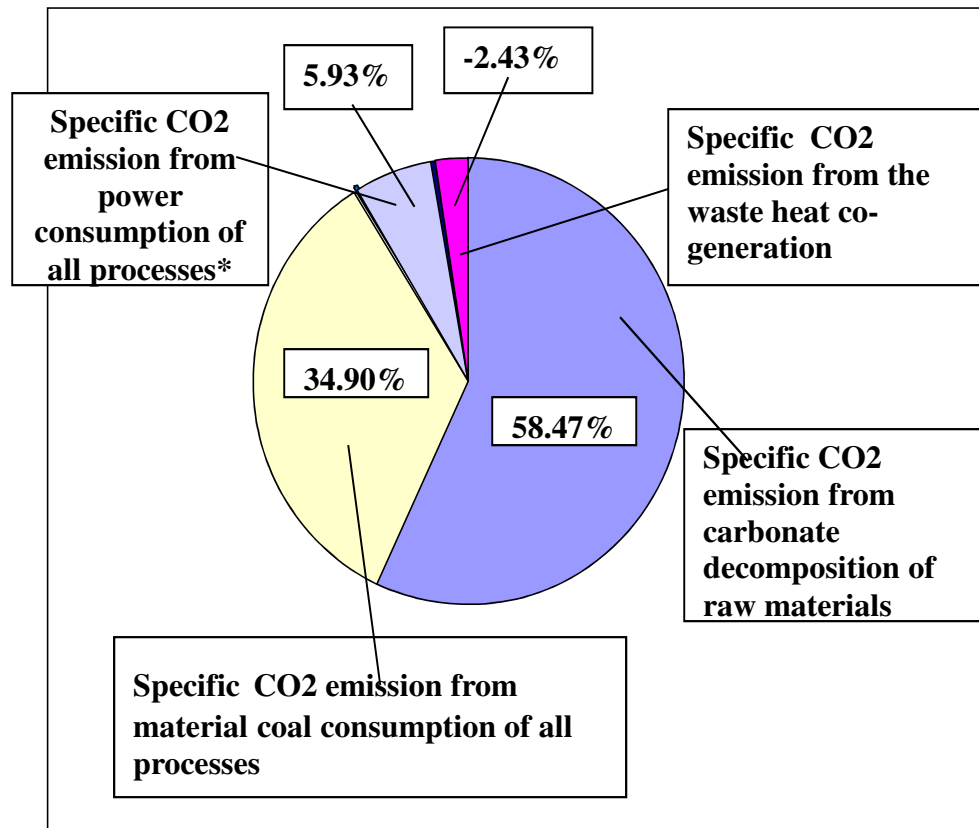
# China Cement Industry



## Requirements based on social development

- Cement is hugely used as building material
- China experiences quick economic growth
- Much investments are put into infrastructure construction
- Urbanization is speeding up
- Residential structures increase significantly
- Cement production of 2015 may exceed 2.2 billion ton

# CO<sub>2</sub> Emission of Cement Industry



\*Each cement production processes includes raw meal preparation, clinker burning, cement grinding, waste heat co-generation, mining and auxiliary operation

For each ton of cement clinker, about **0.863** ton of direct CO<sub>2</sub> emission releases, of which **0.320** ton from fuel combustion, **0.533** ton from the carbonate decomposition of raw materials.

For each ton of cement, about **0.06** ton of indirect CO<sub>2</sub> emission results, due to power consumption.





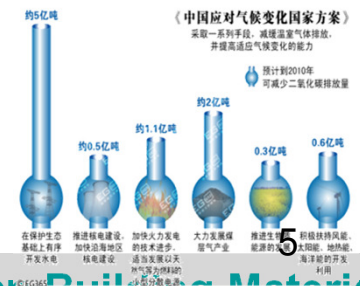
# China's Response to Climate Change

## National Action Plan for coping with climate change

——The carbon intensity per unit GDP needs to be reduced at least **40% ~ 45% from 2005 to 2020**, which as a binding target of the medium-and long-term plans for national economic and social development.

## Work Program on the Control of Greenhouse Gas Emissions during the Twelfth Five-Year

——The Program aims to reduce the carbon dioxide emission per unit of GDP by **17% in 2015** compared to **2010** proposed by the Outline of **the Twelfth-Five Year Plan**, Tackling climate change as a major strategy of economic and social development, as a significant opportunity to accelerate the transformation of economic development, economic restructuring, and new industrial revolution.



# China's Response to Climate Change

## Work Program on the Control of Greenhouse Gas Emissions during the Twelfth Five-Year

- ❑ Urges to comprehensively use **various control measures** , develop **low-carbon cement**;
- ❑ Carry out a **pilot study** of low-carbon development, explore the establishment of a **carbon emissions trading market**;
- ❑ Accelerate the establishment of **statistics and accounting system** of greenhouse gas emissions;
- ❑ Widely develop **international cooperation**, strengthen the scientific and technological personnel support , strengthen the research and development of the economic and affordable **low-carbon technologies**.



# MRV Construction of Cement CO<sub>2</sub> emission

- ◆ Establish the MRV systems of CO<sub>2</sub> emission, Standardize the monitoring and auditing methods for CO<sub>2</sub> release sources with cement production, guarantee the reliable and accurate calculation of CO<sub>2</sub> emission.
- ◆ Based on the emission data analysis, conduct the assessment for low carbon projects, and auditing the results of retrofitting.

measurable

reportable

verifiable

MRV



《Calculation Method of CO<sub>2</sub> Emissions with Cement Production 》 (draft)

《Assessment and verification of CO<sub>2</sub> emission reduction project and CO<sub>2</sub> emission reduction for cement industry》 (draft)

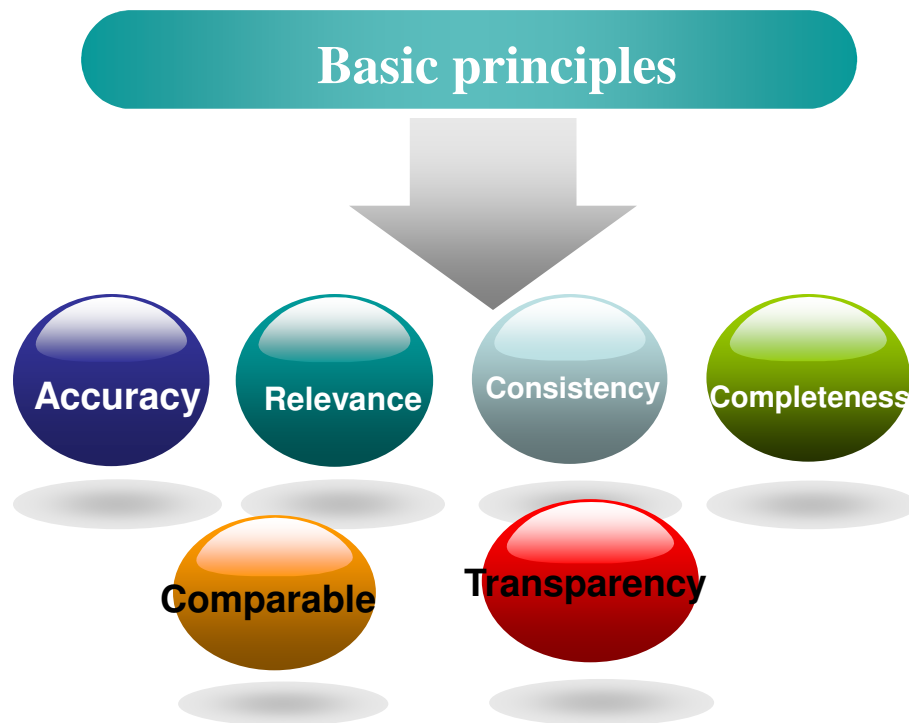
《Technical Code of Environmental labeling products---Low-carbon cement 》 (draft)

《 Assessment and evaluation Method for carbon emission goal responsibility of cement manufactures 》 (draft)

# 《Calculation Method of CO<sub>2</sub> Emissions with Cement Production》 (draft)



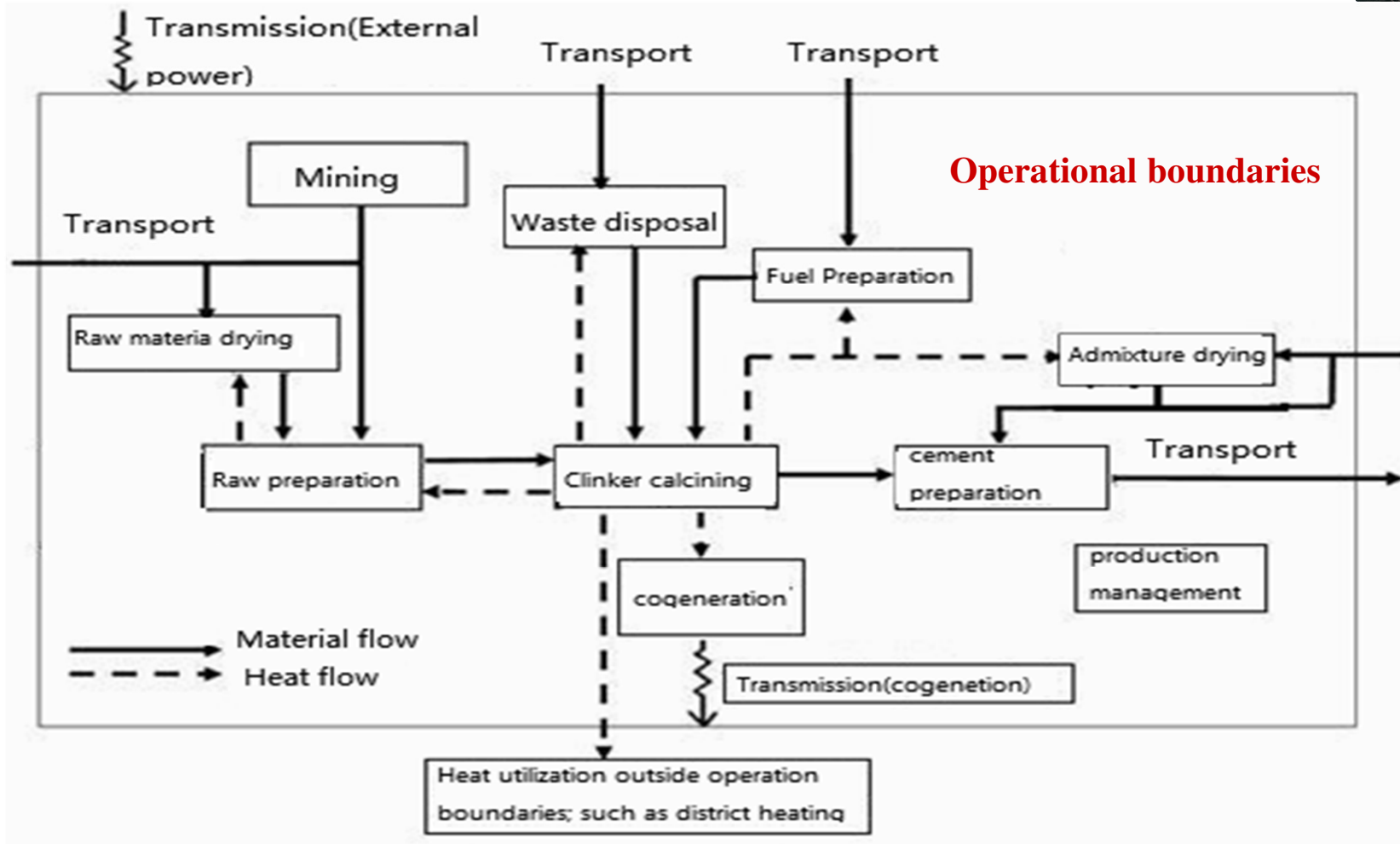
## Basic principles and Emission Factor of CO<sub>2</sub> emissions accounting



Species	CO <sub>2</sub> emission factor	Unit
Raw material	$C_a O \cdot \frac{44}{56} + M_g O \cdot \frac{44}{40}$	t/tcl
standard coal	2.75	t/tce
Electricity	0.86	kg/kW·h
FRP(AF)	0.083	kg / MJ



# 《Calculation Method of CO<sub>2</sub> Emissions with Cement Production》 (draft)



# 《Calculation Method of CO<sub>2</sub> Emissions with Cement Production》 (draft)



## Calculation Items of CO<sub>2</sub> emissions in cement production enterprises

Calculation units	Production process	Calculation items
1	Mining	<p>Fuel consumption from self-owned vehicles transportation</p> <p>Power consumption in production processes</p>
2	Preparation of raw meal, clinker burning, co-generation, waste disposal, office building and others	<p>Decomposition of carbonates in raw meal</p> <p>Combustion of non-fuel carbon in raw meal</p> <p>Consumption of material coal in the production process</p> <p>Consumption of alternative fuels in the production process</p> <p>Combustion of non-fuel carbon in waste co-processing</p> <p>Fuel Combustion from vehicles transportation</p> <p>Power consumption in production processes</p> <p>Waste heat utilization of cement kiln exhaust</p> <p>Purchased or sold cement clinker</p>
3	Cement manufacturing	<p>Consumption of material coal in the production process</p> <p>Fuel consumption from vehicles transportation</p> <p>Power consumption in production processes</p> <p>Purchased or sold slag powder</p>
4	Production and management	<p>Fuel consumption from vehicles transportation</p> <p>Power consumption in production processes</p>

# 《Calculation Method of CO<sub>2</sub> Emissions with Cement Production》 (draft)



## Reporting of CO<sub>2</sub> emissions accounting

1. enterprise information	xxx cement plant			
2. enterprise production information				
3. operational boundaries	mining and auxiliary equipment, raw meal preparation, clinker burning, cement preparation, auxiliary production and management, waste heat co-generation and waste co-processing			
4. the statistical period				
Production process	Direct CO <sub>2</sub> emissions (t)	Other direct CO <sub>2</sub> emissions (t)	indirect CO <sub>2</sub> emissions (t)	CO <sub>2</sub> emissions of biomass (t)
Mining and ancillary facilities	+1770.1		5681.5	
Preparation of raw meal	+928723	+16422.44	4723.12	
Clinker burning	+1257688	+5597.02	45350.12	
Preparation of cement	+135.1		31104.4	
Auxiliary production and management	0		5385.7	
Waste heat utilization	-728716.7	+728696	- 59623.8	
Waste co-processing	0		-2950.8	+65855.74
<b>Total</b>	<b>1459599.5</b>	<b>750715.2</b>	<b>320195.3</b>	<b>65855.74</b>

# CO<sub>2</sub> emissions calculation software of cement production, carbon emissions directly submitted



### 注册信息

用户名:  \*

密码:  \*

重复密码:  \*

[提交到下一步](#)

**注意:** 请记录下您的登陆帐号!  
 用户名: 不超过8个汉字或16个字节(数字、字母、符号)  
 密码: 可选用4-8个字节(数字、字母、符号)  
 重复密码: 再次准确填入选用密码

### Emission Inventory

#### 水泥生产企业CO<sub>2</sub>排放量统计计算基本信息

企业名称:

上一级公司:

企业地址:  填报日期: 2008-11-7

填报人:  电话:  电子邮箱:

审核人:  电话:  电子邮箱:

统计范围:  原料开采及输送  生料制备及发送  水泥熟料煅烧  余热发电  
 其他余热利用  水泥制备及发送  水泥生产辅助工艺过程

统计年限:  2001  2002  2003  2004  2005  
 2006  2007  2008  2009  2010

### User Information 用户确认信息

企业名称: 您公司的名称

上一级公司: ×××

企业地址: ×××

填报人: ××× 电话: ××× 电子邮箱: ×××

审核人: \*\*\* 电话: ××× 电子邮箱: ×××

统计年限: 2002

统计范围: 水泥制备及发送  
其他余热利用

[提交](#)

### 水泥生产企业 CO<sub>2</sub> 排放量统计计算

#### CO<sub>2</sub> Emission Inventory With Cement Manufacturing Company

水泥生产企业CO<sub>2</sub>排放量统计计算基本信息

在我国的工业生产中,水泥工业CO<sub>2</sub>的减排有着举足轻重的作用。实现水泥工业CO<sub>2</sub>的减排是我国应对气候变化的重要措施和重点任务,是我国水泥工业可持续发展的必然要求。实现水泥工业CO<sub>2</sub>的减排也是水泥工业进行产业结构调整、加强生产管理、提高能源、资源利用效率的重要途径。

遵照“两建”方针,统一的节能降耗和污染减排行动计划,我国水泥行业将秉承“两建”方针,中国建材科技研究院

用户名:  密码:  [登陆](#) [注册](#) [帮助](#)

中国建筑材料科学研究院  
China Building Materials Academy  
中国企业联合会可持续发展工商委员会  
China Business Council for Sustainable Development

### 水泥生产企业 CO<sub>2</sub> 排放量统计计算

#### Emission Inventory

##### 水泥生产原料用量

年用量(吨)及其他参数

生产用原料	2001年	2006年
水泥生产用原料添加	0	0
水泥混合料添加	0	0
水泥产量添加	0	0
电力添加	0	0
水泥熟料添加	0	0
窑炉用燃料添加	0	0
非窑炉用燃料添加	0	0

生料中CO<sub>2</sub>含量(%) 0 0  
 生料中H<sub>2</sub>O含量(%) 0 0

[统计计算](#)

### CO<sub>2</sub> Emission Inventory With

#### Emission Inventory

##### 水泥生产原料用量

年用量(吨)及其他参数

生产用原料	2001年	2007年
水泥生产用原料修改	1	11
水泥混合料修改	1	1
水泥产量修改	11	1
电力修改	1	1
水泥熟料修改	1	1
窑炉用燃料修改	11	1
非窑炉用燃料修改	1	1

生料中CO<sub>2</sub>含量(%) 1 1  
 生料中H<sub>2</sub>O含量(%) 1 1

统计结果: 184.4419 3046.641

[统计计算](#)

### 水泥生产企业 CO<sub>2</sub> 排放量统计计算

#### Emission Inventory

##### 水泥中石膏和混合料用量

年用量(吨)及其他参数

水泥中石膏和混合料用量	2001年	2006年
石膏用量	0	0
石灰石用量	0	0
砂子用量	0	0
粉煤灰用量	0	0
火山灰质材料用量	0	0
其它混合料用量	0	0
其它混合料用量	0	0
其它混合料用量	0	0

[统计计算](#)

### CO<sub>2</sub> Emission Inventory With

#### Emission Inventory

##### 水泥中石膏和混合料用量

年用量(吨)及其他参数

水泥中石膏和混合料用量	2001年	2007年
石膏用量	2	22
石灰石用量	268	2
砂子用量	2	2
粉煤灰用量	2	706
火山灰质材料用量	2	2
其它混合料I用量	2	2
其它混合料II用量	222	22
其它混合料III用量	2	22
计算结果	502	870

[统计计算](#)

### 水泥生产企业 CO<sub>2</sub> 排放量统计计算

#### Emission Inventory

##### 水泥产量

年用量(吨)

水泥产量	2001年	2006年
硅酸盐水泥	0	0
普通硅酸盐水泥	0	0
矿渣水泥	0	0
粉煤灰水泥	0	0
火山灰水泥	0	0
复合水泥	0	0
其它水泥品种I	0	0
其它水泥品种II	0	0

[统计计算](#)

# 《Assessment Method for carbon emission goal responsibility of cement manufactures》 (draft)

## Targeted to be completed (60 points)

- Strengthen organizational leadership, establish and improve the management and security system (15 points)
- Establish a statistical system, implement carbon emissions data directly submitted (15 points)
- Carry out low-carbon action, complete carbon reduction goals for company(15 points)
- Achieve significant carbon emissions, complete trade of carbon emissions (15 points)

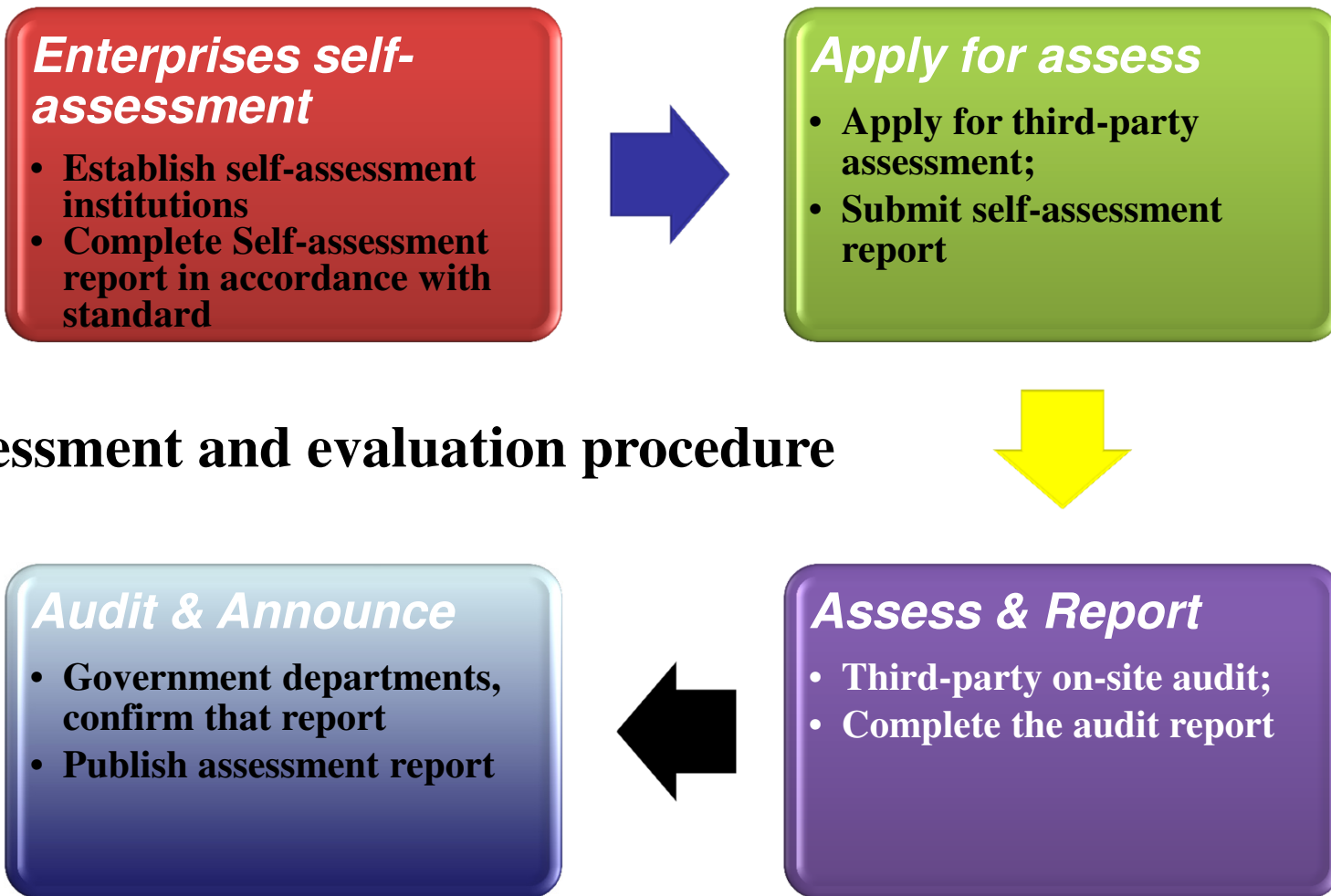


## Emission control measures to be implemented(40 points)

- Implement energy management center , reduce carbon emissions intensity (10 points)
- Full utilization of resources, reduce direct CO<sub>2</sub> emissions (10 points)
- Utilize energy-saving and low-carbon technologies, promote technological transformation (10 points)
- Carry out advocacy and training, establish long-term carbon emission reduction mechanism (10 points).



# 《Assessment Method for carbon emission goal responsibility of cement manufactures》 (draft)



# 《Technical Code of Environmental labeling products---Low-carbon cement》 (draft)

- To promote low-carbon development of cement industry, and to encourage enterprises use AFR, waste heat power generation, increasing admixture, waste co-processing and other carbon reduction measures,
- National Environmental Protection Ministry has developed the national standard *Technical Code of Environmental labeling products---Low-carbon cement*.
- Under the guide of standard, carry out **low-carbon production auditing around the whole cement industry**, which promote China cement industry developing towards low-carbon, low power consumption, low pollution, sustainable and beneficial to human health.



# 《Technical Code of Environmental labeling products---Low-carbon cement》 (draft)

- Based on actual data for cement companies, the standard estimates the advanced unit comparable CO<sub>2</sub> emissions value of common Portland Cement, specified on the right table
- Limit value of CO<sub>2</sub> emission per unit clinker: ≤880 kg CO<sub>2</sub>/t clinker;



Types	Strength Grade	Limits of carbon dioxide emissions per unit of product (kg/t)
Portland Cement	42.5 ( R )	≤785
	52.5 ( R )	≤795
	62.5 ( R )	≤840
Ordinary Portland cement	42.5 ( R )	≤665
	52.5 ( R )	≤755
Portland blastfurnace-slag cement	32.5 ( R )	≤240
	42.5 ( R )	≤410
	52.5 ( R )	≤665
Portland – pozzolana cement	32.5 ( R )	≤485
	42.5 ( R )	≤580
Portland fly ash cement	52.5 ( R )	≤665
Composite Portland cement	32.5 ( R )	≤460
	42.5 ( R )	≤580
	52.5 ( R )	≤665

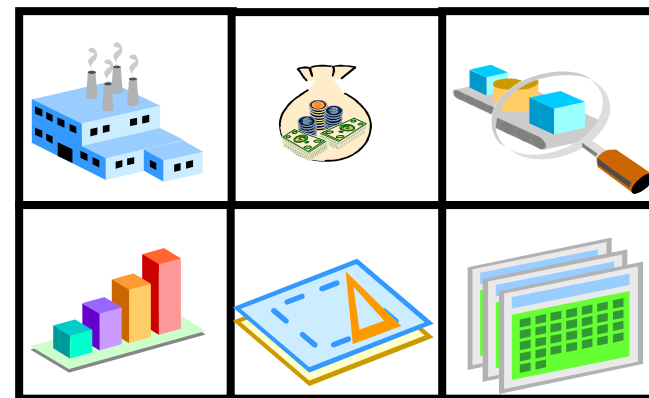
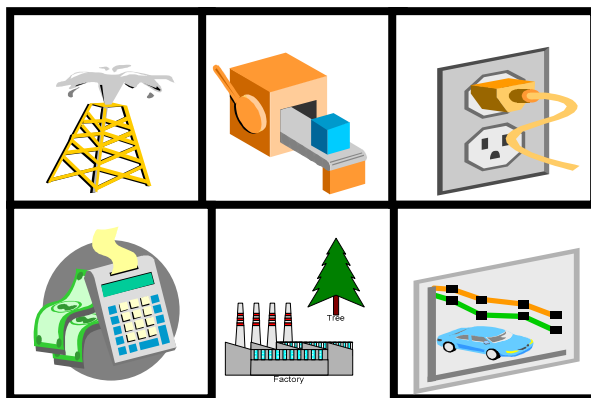


# 《Assessment and verification of CO<sub>2</sub> emission reduction project for cement industry》 (draft)

**Projects of CO<sub>2</sub> reduction** : AFR, Waste co-processing, Waste heat utilization, high-volume admixture, process optimization.

**Assessment**: CO<sub>2</sub> emission analysis pre-project and CO<sub>2</sub> emission estimation post-project.

**Verification** : After the implementation of the project, calculate CO<sub>2</sub> emission reduction of projects, according to the verification test data, calculation procedures and methods.



# MRV system demonstration application

- According to **MRV standard systems** , carbon emissions of cement companies are measured, reported and verified tentatively;
- **On-site verification** of carbon emissions statistics and financial information for cement enterprises;
- **Field sampling and measurements** on actual test data of cement enterprises;
- According to the on-site verification data and measurement data, carbon emissions **report** of cement company is completed.



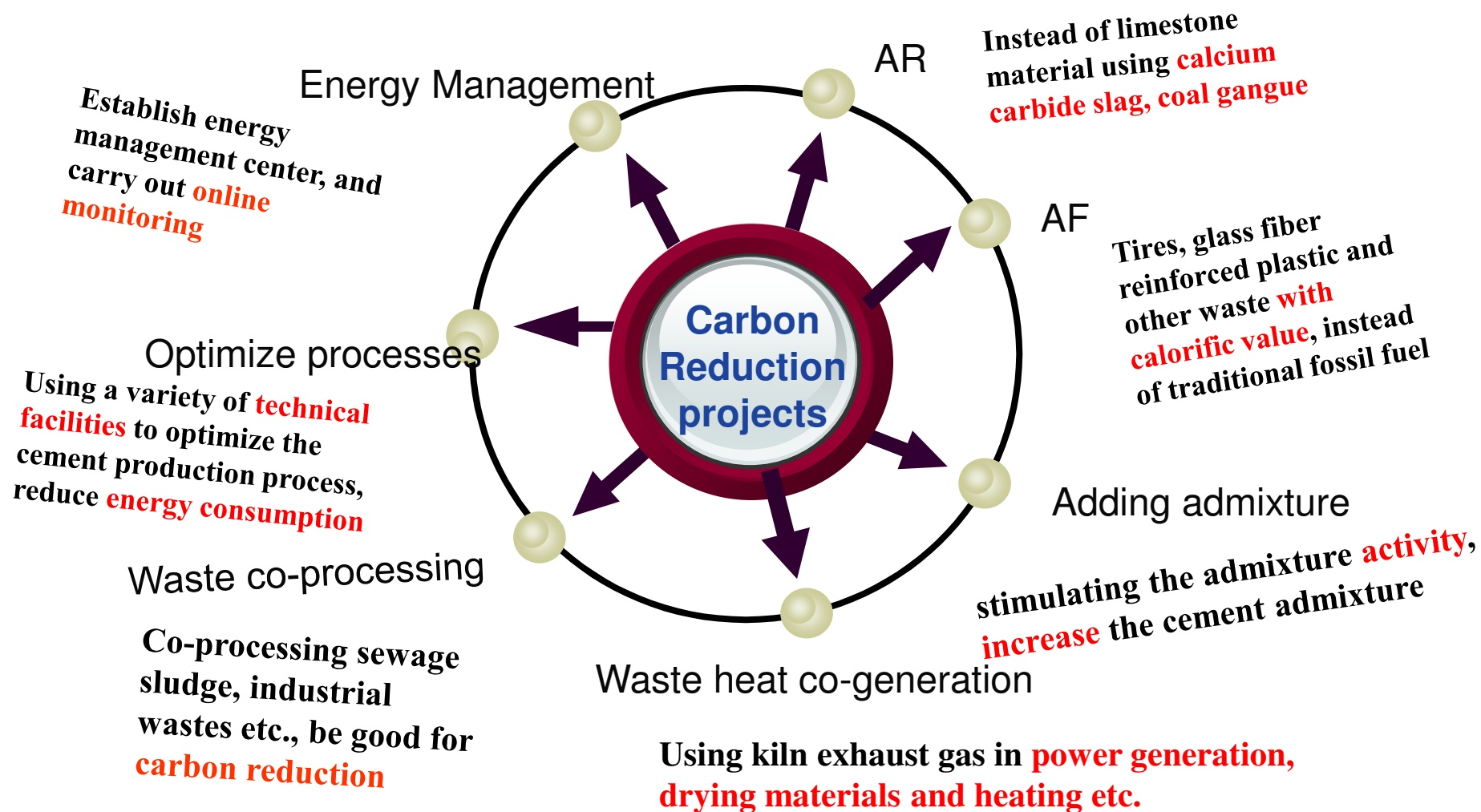
# MRV system demonstration application



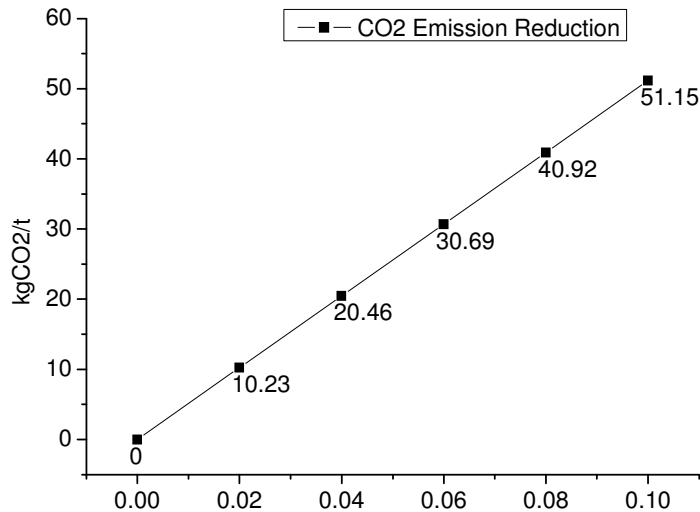
Through establishment of standard system, research, verify and audit carbon emissions of cement **manufacturer representatives on different years**, come to the results of CO<sub>2</sub> emissions range for cement companies, and verify the emission reductions of typical carbon reduction projects.

Plant/Year	Annual clinker output, ×10 <sup>4</sup> t	Direct CO <sub>2</sub> emission per unit clinker, kgCO <sub>2</sub> /tclinker	Other direct CO <sub>2</sub> emission per unit clinker, kgCO <sub>2</sub> /t clinker	Indirect CO <sub>2</sub> emission per unit clinker, kgCO <sub>2</sub> /t clinker
1/A	402.74	~ 823.39	~ 5.61	~ 37.92
2/B	1025.25	~ 846.36	~ 6.26	~ 45.66
3/C	240.46	~ 857.75	~ 5.57	~ 97.18
4/D	150.13	~ 866.46	~ 8.91	~ 75.66
5/E	182.53	~ 877.94	~ 14.99	~ 97.92
6/F	140.36	~ 883.62	~ 5.57	~ 77.02
7/G	189.08	~ 890.32	~ 5.57	~ 38.55

# Typical carbon reduction projects of cement production enterprises



# Typical carbon reduction projects of cement production enterprises - AR



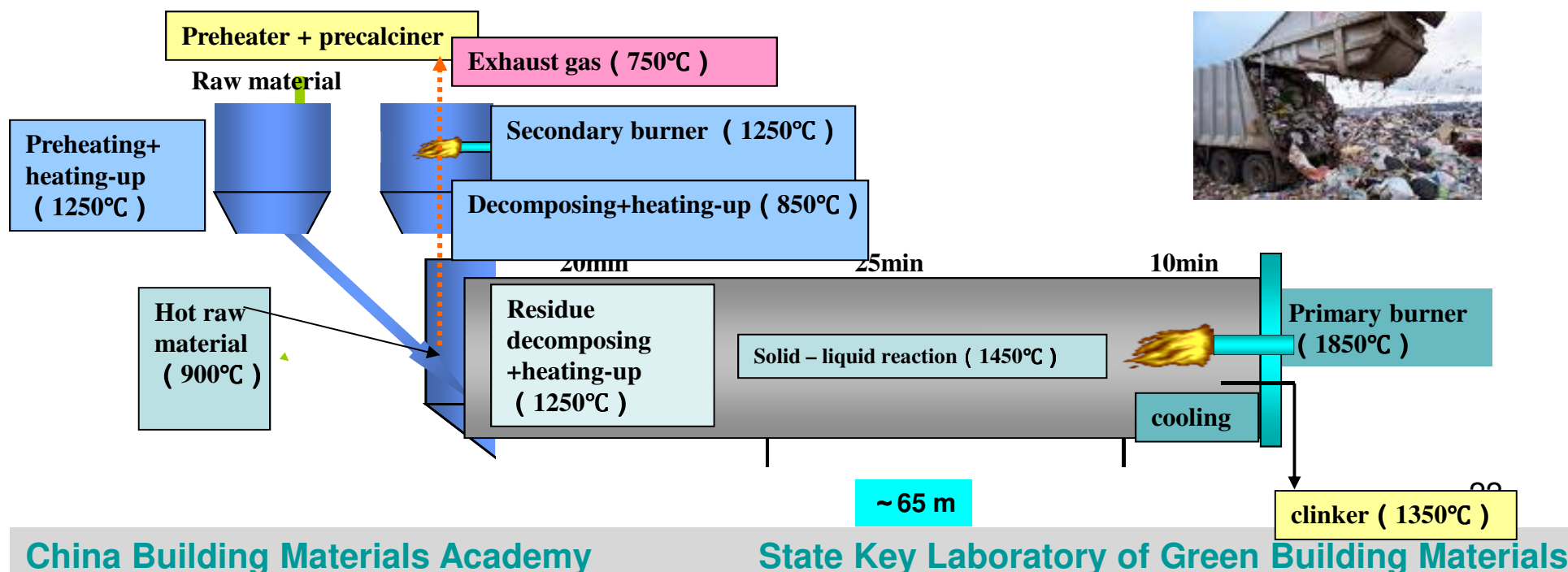
Calculations show that the carbide slag content for each additional 2% in raw materials, carbon dioxide emissions can be reduced by about 10kgCO<sub>2</sub> / t clinker.

## Actual carbon emission reductions

Cement Plant	AR	Carbon reduction ( kgCO <sub>2</sub> /tclinker )
1	Fly ash, coal gangue	13.1
2	Sulfuric acid residue, iron tailings, copper slag	22.0
3	Sulfuric acid slag, coal gangue	14.1

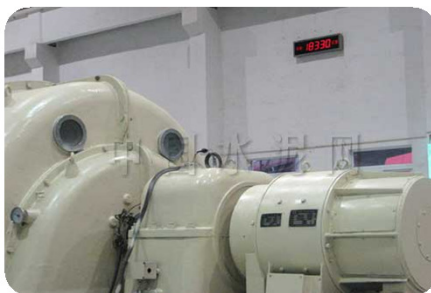
# Typical carbon reduction projects of cement production enterprises - AF

- ❑ A cement plant using alternative fuels (**glass fiber reinforced plastic and industrial waste**) 5000-6000 tons a year, 2% substitution of coal, reducing CO<sub>2</sub> emissions by 24 thousand tons.
- ❑ Alternative fuels is made of waste paper, waste plastics, gloves, paint residue, cotton and silk, with high calorific value.



# Typical carbon reduction projects of cement production enterprises – co-generation

Cement Plant	Net power production per ton of clinker ( kwh )	Carbon reduction from Co-generation ( kgCO <sub>2</sub> /tck )
1	31.6	27.1
2	33.2	28.5
3	22.4	19.3
4	29	25
5	32.5	28
6	38.3	33
7	26	22.4



# Typical carbon reduction projects of cement production enterprises – adding admixture

Type	Code	Component,%				
		Clinker + Gypsum	granulated blast furnace slag	Pozzolantic blending materials	Fly ash	Limestone
Portland blastfurnace-slag cement	P.S-A	$\geq 50$ & $< 80$	$> 20$ & $\leq 50$	-	-	-
	P.S-B	$\geq 30$ & $50$	$> 50$ & $\leq 70$	-	-	-
Portland-pozzolana cement	P.P	$\geq 60$ & $< 80$	-	$> 20$ & $\leq 40$	-	-
Fly ash cement	P.F	$\geq 60$ & $< 80$	-	-	$> 20$ & $\leq 40$	-
Composite Portland cement	P.C	$\geq 50$ & $< 80$	$> 20$ & $\leq 50$			-

A cement plant produce PO42.5R cement, mixed with slag, fly ash, limestone and other admixture and FGD gypsum (retarder).



Through high-efficient grinding technology, admixture can replace 25% clinker, reduce 205kg CO<sub>2</sub> emissions per ton of cement.



# Conclusion

- **MRV system of cement industry for CO<sub>2</sub> emission control is under construction.**
- **The implementation of MRV systems has a significant role on energy-saving and emission-reduction development and response to climate change.**
- **According to UNFCCC and Kyoto Protocol, to strengthen international cooperation and promote low carbon development, in line with the principle of "common but differentiated responsibilities" , is our common efforts.**



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**State Key Laboratory of Green Building Materials  
China Building Materials Academy**

**National Technical Committee on standardization for  
Cement of PRC**

**Wang Lan, Professor and Doctoral tutor of China  
Building Materials Academy.**

**With long-time research in cement production  
engineering and energy-saving and emission reduction  
technologies, he was awarded the 2<sup>nd</sup> prize of National  
Scientific and Technological Progress.**

**He is the author of *the Handbook for Cement Engineers*.  
Currently, he is conducting the national key fundamental  
R & D program, the 12<sup>th</sup> five-year plan national key  
scientific programs, national natural science fund  
program and international cooperation etc.**

**THANK YOU !!!**