Research on the Prospect of the Building Sector in the Offsetting Mechanism for China's Carbon Market

Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

On behalf of

Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety

of the Federal Republic of Germany

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Published by

Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Registered offices

Bonn and Eschborn, Germany

Capacity Building for the Establishment and Development of a Technical and Institutional Infrastructure for Achieving China's 2020 Targets

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Beijing, November 2014

Overview

This report contains two parts – Chapters One through Three, which provide a systematic review of the offsetting mechanism in the Chinese carbon market and the second part, Chapters Four to Seven, which focus on analysing the prospects for the building sector in the offsetting mechanism for the Chinese carbon market.

The review of the offsetting mechanism in China's carbon market includes three parts:

1) **an overview of the background of the establishment of the Voluntary Emission Reduction market, the trading rules and current market development in China,**

2) **an analysis of the offsetting mechanism in the emissions trading pilots in China including the current development, potential effects on the pilot carbon market and their performances and**

3) **an analysis of the issues that need to be considered in developing the offsetting mechanism for a unified emissions trading system in China, such as coverage and scope and coordination with other rules in the system and other policies that are related to energy saving and emission reduction in China.**

In the second section on the inclusion of the building sector in the offsetting mechanism in the Chinese carbon market, this report provides the following:

1) **a quantitative analysis on China's building energy consumption and the related emission reduction potential,**

2) **the current situation of the global carbon market,**

3) **emission reduction methodologies in the building sector including those for large and small scale projects under the CDM mechanism and their applications, as well as the development methodology for heating-supply energy efficiency improvement in existing residential buildings in northern China and the establishment of an international standard for building-sector carbon emissions,**

4) **difficulties and barriers in establishing a baseline for emissions and the application of methodologies as well as an analysis on the barriers in methodology application and other difficulties and barriers to building sector emission reduction activity in the carbon market,**

5) **a summary of relevant laws and regulations, and**

6) **a further analysis of the prospect of building sector participation in the carbon market and suggestions for some policy recommendations on how to take advantage of the carbon market to promote energy-saving and emission reduction in the building sector.**

Content

1 CCER Trade (China Certified Emission Reduction)

1.1 Background on the development of the voluntary carbon market

Voluntary Emission Reduction (VER) refers to a means of trading in the voluntary carbon emission reduction market under which individuals, enterprises and governments purchase carbon credits to offset their greenhouse gas emissions and strive to achieve 'carbon neutrality'.

VERs can be used in both the voluntary and compulsory markets. In the voluntary market, which is based on social responsibility, enterprises or individuals usually purchase VERs to improve their social images. Market demands depend mainly on the willingness of various institutions and individuals to neutralise emissions which are not compulsory. In the compulsory market, VER is treated as an offset choice; that is, the purchased Certificated Emission Reductions (CERs) offset the CO_2 produced by one enterprise by using unused carbon credits from the production activities of other institutions. By doing so, enterprises or institutions can satisfy the demand for meeting their emission allowances and compliance requirements.

The transition and supplement of the Green House Gas (GHG) emissions trading market – the voluntary emissions market with flexible trading rules and standard systems – is a priority in the transition to a carbon market for the whole nation. Establishing an offsetting system which includes fields outside of the typical CER market (such as agro-forestry, transportation and civil buildings) will not only further improve the carbon emission trading system but also reduce the cost of achieving set goals.

There are two principle forms of carbon credits in the international carbon market, i.e. CERs issued by CDM EB under the Kyoto Protocol and VERs issued under other schemes. Actually, many problems exist in China's voluntary carbon market because it has developed on its own. Firstly, market demand is too low and fluctuates which has led to an imbalance in the supply-demand relationship. Secondly, a national oversight facility is necessary because a market without this facility will lack effective controls, weaken its credit base and will not be orderly. Thirdly, standards for China's VER market are lacking; for example, there are no unified standards for accreditation and certification entities. This obviously has a negative impact on market confidence. Finally, the same companies trade among themselves repeatedly and resources distribution throughout the whole trading chain remains unreasonable. Therefore, regulations and standards should be put into place as soon as possible in order to direct the operation of the VER marketplace.

In June 2012, NDRC (National Development and Reform Commission) issued 'China Certified Emission Reduction Trading Management Provisional Regulations' in order to guide volunteer emission reducing activities in an orderly way, motivate society as a whole to participate in carbon reduction activities, accelerate ETS market activities under the control of gradually established volumes and provide technological and regulation basics. The regulations will ensure that voluntary greenhouse gas emission trading is closely regulated using standard methodologies, with standards for approval and with clarified emission reductions, exchanges and third-party validating and verifying entities. The system for China's VER trading is called CCER (China Certified Emission Reduction).

1.2 Rules for CCER trading

As of November 2014, the main regulations issued by the Chinese government on CCER trading are listed in the table below:

Table 1: Main regulations for China's domestic voluntary carbon market

Laws and Regulations	Issuing Organisation	Issue Date	Major Content
China Certified Emission Reduction Trading Management Provisional Regulations	NDRC (National Development and Reform Commission)	13 June 2012	The coverage , methodology, requirements and processes of project application and recording, processes for emissions reduction examination and recording in CCER trading, Duties and working regulations of the national Authorities, registration qualifications for exchanges, validating and verifying entities and working processes
Validation and Verification Guidelines for CCER Projects	NDRC (National Development and Reform Commission)	9 October 2012	Providing more specific and detailed requirements for China Certified Emission Reduction Trading Management Provisional Regulations about the examination of qualifications, processes and regulations of validating and verifying entities

The introduction of the China Certified Emission Reduction Trading Management Provisional Regulations has established unified standards for the national management of offsetting emissions reduction. It will ensure the quality of emission reductions and make the offsetting mechanisms in ETS pilots much easier. It is not necessary for the ETS pilots for carbon emission rights trading to create specific regulations for their emission reduction projects, in order to maintain additionality, monitoring and permanency.

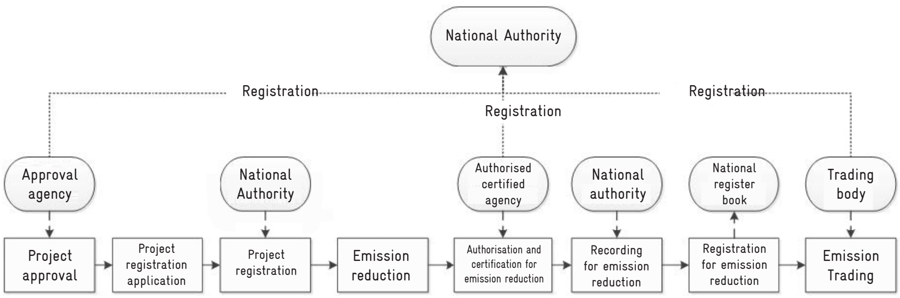
1) Coverage and Scope of the CCER System

Domestic and foreign institutions, enterprises, teams and individuals can be involved in CCER trade.

2) Major Procedures of CCER Trading

CCER projects should be registered in a nationally regulated project classification and conform to established registered methodologies. Applications for projects should be validated by a registered certificating entity before applying. Only after that should CCER projects be able to apply to the national authority for registration. The authorised certification entity will verify the emissions produced and provide a verification report. With that report, the project will be able to be approved by the National Authority. The CCER project is then entered in the national register and can trade with registered exchanges. The procedure flow for the CCER trading registration is listed in the following diagramme:

Diagramme 1: Main process of CCER authorization and trading



3) Major Requirements for CCER Project Applications

According to the China Certified Emission Reduction Trading Management Provisional Regulations, CCER projects applying for registration should have been initiated after 16 February 2005 and has to fall under one of the following classifications:

(1) adopting a VER project developed using the National Authority registration methodology,

(2) having required the approval of NDRC as the cleaning development mechanism (CDM) project but not registered with the UN CDM executive board,

(3) Pre-CDM, which having required the approval of NDRC as a CDM project and having established the emissions reduction project before registering it with the UN CDM executive board or

(4) **having completed the registration with the UN CDM executive board but with the emission reduction not yet issued.**

After receiving the registration materials for a CCER project, the National Authority will entrust relevant experts to assess and examine the project. If the project conforms to the following conditions, it will be registered in the national registry.

(1) **It must conform to relevant laws and regulations.**

(2) **It must belong to one of the project classifications regulated by this measure.**

(3) **The application materials must meet the requirements.**

(4) **The methodology application, baseline setting and the calculation and monitoring methods of the GHG emissions reduction must all be in place.**

(5) **It must provide additionality.**

(6) **Validating reports must be up to standard.**

(7) **It must make a contribution to sustainable development.**

4) Emission reductions filing and transaction rules

Before CCER project owners can apply for registration of their projects, they must submit a validating report on the emission reductions. Then the National Authority passes the application materials and the emission reduction report on to their experts for a technical evaluation. The application is then compared to the experts' assessment for evaluation.

To be approved, the project must meet the following conditions:

(1) **the project must be registered by the National Authority,**

(2) **the Emission Reduction validating Report should meet all requirements and**

(3) **the verified Emission Reduction Report should meet all qualifications.**

After registration, trades can be carried out through authorised exchanges on the basis of established trading rules. After completion of the transaction, the traded CCER is cancelled in the national register.

5) Management rules for validation and verification entities

Validation and verification entities for CCER must file an application to the National Authority through the development and reform departments of their registered provinces, autonomous regions or municipalities directly under the Central Government. The National Authority, after receiving application materials from applicants for validation and verification entities, should carry out an investigation after which the filling should be allowed for those agencies meeting the following conditions:

(1) **their establishment and operation should be in accordance with relevant national laws;**

(2) **normative regulations are required;**

(3) **they must have a proven history of achievements in the approval and certification field;**

(4) **they must employ a certain number of experienced auditors in the field of auditing with no bad records; and**

(5) **they must provide proof of economic solvency.**

The specific requirements for entities included in the Guidelines for Validation and Verification of Projects related to CCER are as follows:

(1) **Entities must be independent legal entities; the registered capital of enterprises cannot be less than RMB 30 million; initial funding for public institutions and social organisations cannot be less than RMB 20 million;**

(2) **They must have a permanent establishment, facilities and office conditions for carrying out business activities;**

(3) **Stable financial support and a comprehensive financial system for business activities and the ability to deal with risks are necessary to ensure that agencies can take reasonable and effective measures when facing risks that may be caused by approval and certification and must assume any corresponding economic and legal responsibility;**

(4) **Funds or insurance against risks (risk fund or coverage should be adapted to the business scale and not less than RMB 15 million) are required;**

(5) **A sound organisational structure and effective internal management system must be in place as well as standardised management of activities and decisions related to the approval and certification business;**

(6) **They must have at least 10 full-time approval and/or certified personnel of which five must have more than two years of related work experience in approval or certification of greenhouse gas emission reduction**

projects (such as for clean development mechanisms and voluntary emission reduction mechanisms) to ensure their ability to carry out the examination and approval and certification in allowed professional fields. Approval and certification personnel must be familiar with the laws, regulations and standards related to greenhouse gas emissions, understand the examination and approval and certification work procedures and their principles and requirements, and master any relevant professional knowledge and technology;

(7) A strong performance history in the approval and certification domain is required; and

(8) Approval and certification business activities can have no history of any violations.

The principles of impartiality and independence, openness and justice, seriousness, professionalism and good faith must be adhered to by the institutions when preparing, executing and providing reports on related work.

Processes for validation include: contract signing, preparation for validation, publicity of design documentation, documentation review, an on-site visit, validation report writing, an internal appraisal and the delivery of the validation reports.

Validation requirements include: CCER projects meeting the qualification conditions, project design documentation, a project description, selection methodology, project description, applied methodology, boundary and baseline identification, additionality analysis, and a calculating and monitoring plan.

The seven processes for verification are: contract signing, preparation for verification, publication of the monitoring plan, documentation review, an on-site visit, verification report writing, internal appraisal and the delivery of the verification report.

There are two requirements related to this:

(1) Verification requirements for emission reductions - the uniqueness of the emission reductions from CCER project reductions, conformity of project implementation and Project Design Documents (PDD), conformity of the monitoring plan and methodology, monitoring and inspection plan and calibration frequency, and the rationality of the emission reduction calculation.

(2) Requirements for temporary minor and permanent changes to the monitoring plan or methodology, correction of project information or parameters and the change of the start date for the crediting period as well as the project design.

The National Authority will order registered validating and verifying entities to make corrections when violations of the rules occur if the circumstances are not relatively serious. Otherwise, their violations will be published and their registrations revoked.

6) Management rules for exchanges

Applicant exchanges must apply to the National Authority through the development and reform commissions in relevant provinces, autonomous regions and municipalities directly under the Central Government. The National Authority will carry out the investigation on the filings of trading institutions which can meet the following requirements as part of the registration:

(1) They should be a legal entity registered domestically with at least RMB 100 million in capital;

(2) They must meet the requirements for the business premises, trading system, settlement system, and a submission system for business information, and other business-related facilities;

(3) Their personnel must be equipped with relevant professional knowledge and experience;

(4) They must have strict systems for inspection and auditing, risk control and for internal supervision; and

(5) Their trading rules content should be complete, clear and exercisable.

Trading institutions will be ordered to make corrections through the National Authority when violating the rules or regulations in the process of carrying out CCER trading activities if the circumstances are not relatively serious; otherwise, their violations will be published and their registrations will be revoked.

7) Registry

As stipulated in the China Certified Emission Reduction Trading Management Provisional Regulations, the National Authority should establish and manage a CCER registry for registering the approved CCER projects and CCERs including details such as basic information on projects and the filing, trading and cancellation of CCER, etc. within ten working days after the completion of registration. State level departments will guide the interested parties participating in CCER transactions. The transaction systems of registered exchanges can connect to the national register which can help with real-time record variations in CCER. The reductions projects should be cancelled in the national register after deals are completed.

The successful operation of the registration system is the key for getting information on and trading of CCER. This should ensure that each ton of CCER has been recorded and can be traced as well as including information on issuance, trading and cancellation, etc.

1.3 The present development situation of the CCER trading system

1) Registered exchanges and validation and verification entities

Exchanges:

As of 31 August 2014, the NDRC had registered and published the names of seven CCER exchanges. They are the Beijing Environmental Exchange Co., Ltd., Tianjin Climate Exchange Co., Ltd., Shanghai Environmental and Energy Exchange Co., Ltd., Guangzhou Carbon Emissions Exchange Co., Ltd., Shenzhen Climate Exchange Co., Ltd., Chongqing United Assets and Equity Exchange Group Co., Ltd., and Hubei Carbon Emission Trading Center Co., Ltd.

Validation and verification entities

As of November 2014, the NDRC has registered and published four batches of a total of nine certified and approved trading institutions for VERs. The first batch includes two institutions – the China Quality Certification Center and the Guangzhou Ceprei Certification Center Service Co., Ltd. The second batch contains only one company – the Central Joint (Beijing) Certification Center Co., Ltd. The third batch has three institutions – the Environmental Protection International Cooperation Center, China Classification Society Quality Certification Company and the Sino-Carbon Innovation and Investment Co., Ltd. The fourth batch includes three institutions – the Chinese Academy of Agricultural Sciences, Centre Testing International (Shenzhen) Co., Ltd. and China's Forestry Science and Technology Information Institute. The approval and certification fields are engaged in by all the institutions (see appendix 1).

2) The development of the registry

Being a part of the national ETS registration system, the register for CCER will be established at the same time as the national ETS registration system. The National Centre for Strategic Research and International Cooperation on Climate Change (NCSC) held a carbon trading registration joint adjustment training meeting in Beijing in October 2014. A comprehensive introduction to and explanation of the registration system were made as well as information on the whole process test.

The national ETS registration system was to have been officially launched at the end of 2014, which means CCER will be issued and trading can start immediately. Only when the registration system is implemented, can CCER be initiated and enter the key process of trading.

3) Methodologies

From March 2013 to April 2014, NDRC gradually passed and recorded four batches (for a total of 178) methodologies for CCER. The first batch includes 52 methodologies, the second 2, the third 123 and the last includes 1 (refer to Appendix 2). These methodologies cover multiple areas such as the energy, chemical, construction, manufacturing, transportation, waste disposal, agricultural and forestry industries, etc.

Among the CCER methodologies currently recorded there are 173 that come from CDM methodologies. The reason for this is that the two types of projects share many similarities and this has greatly reduced the difficulties for the approval, certification and transaction of CCER projects.

4) Projects recorded

As of 2 November 2014 there were 88 recorded and published CCER projects in total. Among these, 19 projects belong to the first category, 2 projects belong to the second category and 57 projects belong to the third category - the CDM (Clean Development Mechanism) project. The emission reductions produced in CDM projects supplement those generated in the crediting period. These projects mainly derive from the energy industry - especially the renewable energy industry. The proportion of various renewable energy projects and total amounts of emission reductions are shown in Charts 1 and 2. Projects cover the northeast, northern China, central China, the northwest, southeast, southwest, and many other areas. The proportions of projects in each province are shown in Chart 3. Emission reductions for the recorded projects are expected to reach 19 million tons of CO_2 equivalents per year and the emission reductions produced in the crediting period amounted to 39 million tons of CO_2 equivalent (see Appendix 3 for more information).

Chart 1: The quantitative proportion of various kinds of renewable energy registered projects

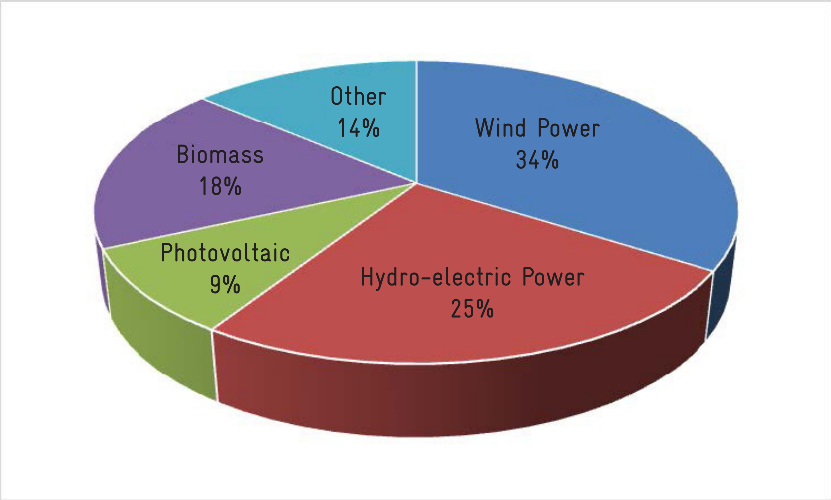


Chart 2: The emission reduction proportion of various kinds of renewable energy registered projects

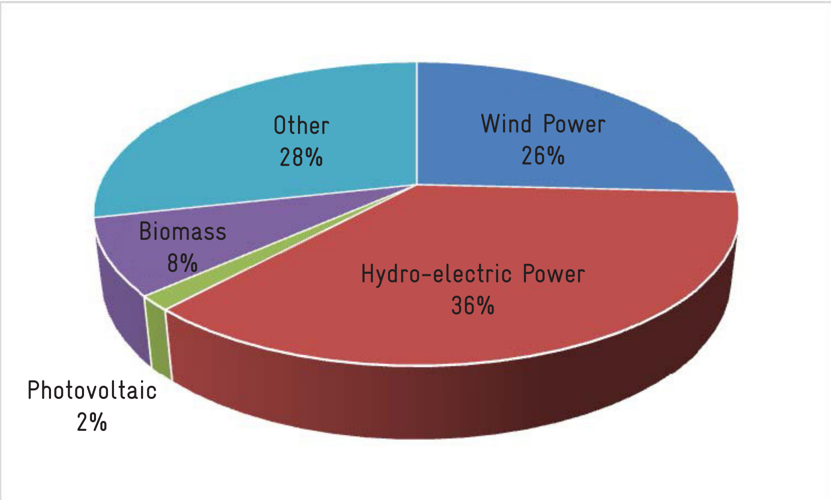
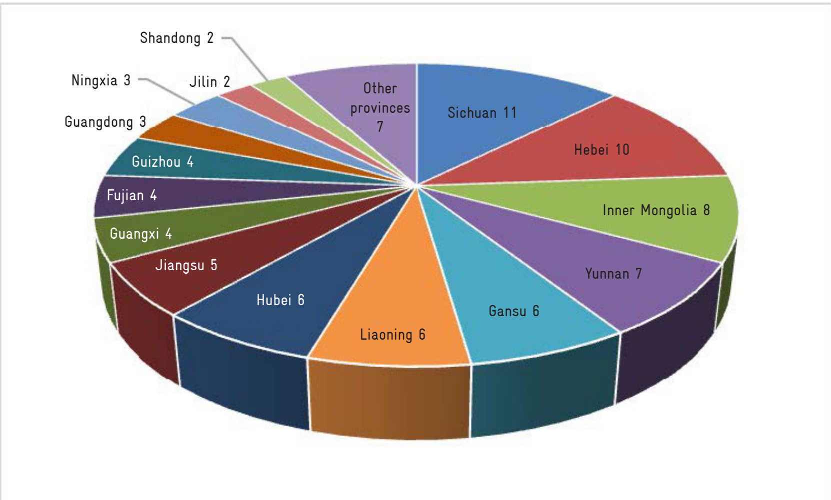


Chart 3: The number of CCER projects province by province



From Appendix 3, it can be concluded that, in terms of the classification of registered projects, NDRC still gives priority to wind power and hydro-electric power projects. There are 30 wind power projects accounting for one third of the recorded projects, which is the largest part of the projects. The 22 hydro-electric power projects make up nearly a quarter of the registered projects. But the project categories have gradually diversified. Agricultural biogas projects and photovoltaic power generation projects have increased, at 12 and 10 respectively. Other types of projects include: a biomass power generation project, a gas power generation project, a natural gas power generation project, oil to gas power generation project, a waste heat power generation project, a carbon black tail gas for power generation project, an LNG cold energy air separation project, a carbon sink afforestation project, etc.

Industry analysts have suggested that wind power and photovoltaic projects are more popular since the exploitation of wind power projects is relatively simple but with a large volume of emission reductions. Although the emission reduction amount of photovoltaic power projects is not large, its additionality is better and generates a slightly higher price. For forestry carbon sink and agricultural biogas projects, even though they have very high ecological and social benefits, the exploitation is difficult and the emission reduction volume is small. When put into a secondary market, these projects are not able to play a significant role for the emission reduction company to perform as per the agreement.

In terms of project classification, the first batch of emission reduction projects received, registered and reviewed belongs to the third classification project (pre-CDM projects). There are several reasons for this. This kind of project only needs a one-time issue and can deliver promptly. In addition, the time range for this type of project is short and has a relatively small risk. As to the CCER trading process, when compared with long-term and several-times issue projects, pre-CDM projects may differ in price, trading manner and negotiating strategy.

5) The issuance of CCERs

As of 4 November 2014, there were 39 registered CCER projects (including two in the public notice period) that have completed the first batch of monitoring reports on emission reductions, but no project has recorded its emission reduction (see Appendix 4). Statistics show that the 39 CCER projects' total amount of greenhouse gas emission reductions or artificial net carbon sink should reach 17 million tons of CO_2 equivalent during the monitoring period, accounting for 75.19% of the total registered projects emission reduction volume.

6) Trading situation

CCER, as a complementary mechanism of carbon emission allowances, is allowed to trade in the carbon market. Judging by the existing seven pilots, China's carbon market is still a simple allowance market. CCER does not play a substantial role in the first year's compliance of five pilots including Beijing, Tianjin, Shanghai, Shenzhen and Guangdong. So far, the completed CCER trading of the seven registered exchanges are shown in Table 2. (Note: "——" indicates no detailed information.)

Table 2: Domestic completed CCER trading

Time	Trading institution	Buyer	Emission control enterprise (Y/N)	Seller	Project name	Emission reduction/ton	Unit price(yuan/t)
June 2012	Shanghai Environment Energy Exchange	Shanghai Zero-Carbon Center	No	--	A wind power project in Heilongjiang	2,000	——
November 2013	Beijing Environment Exchange	Northeast Petro China International Business Co., Ltd.	No	Longyuan (Beijing) Carbon Asset Management Technology Co., Ltd.	Anxi Xiangyang wind power project in Gansu Province	10,000	16
December 2013	Guangzhou Carbon Emission Rights Exchange	Guangdong PetroChina International Business Co., Ltd.	No	CGNPC Wind Power Co., Ltd.	Mountain island wind farm project in Guangdong	10,000	20
June 2014	——	Wuhan Iron & Steel Group Corp.	Yes	China Wind Power Group	Four wind power projects in Zilingpu, Jinquang, Xiangzhou Yu Mountain, Zaoyang, Hubei Province	Emission reduction before 31 December 2015	7.5

October 2014	Tianjin Climate Exchange	Mission Hills World Celebrity PRO-AM	No	China's Water Conservancy Power Supplies Co., Ltd.	Ganmalu wind power project in Qiubei county, Yunnan Province	1,000	15
November 2014	Beijing Environment Exchange	Beijing Enterprises Real Estate Co., Ltd. (the constructor of APEC meeting venue)	No	Longyuan (Beijing) Carbon Asset Management Technology Co., Ltd.	Anxi Xiangyang wind power project in Gansu Province	4,000	——
November, 2014	Tianjin Climate Exchange	Tianjin Tianfeng Steel Co., Ltd.	Yes	Carbon in the Future (Beijing) Assets Management Co., Ltd.	——	60,000	——

2 The offset mechanism in seven ETS pilots in China

2.1 Impact of the offsetting mechanism for carbon market

Introducing CCER as an offset mechanism into the carbon market can reduce the compliance cost of the involved enterprises in ETS. It can promote the use of more cost-efficiency emission reduction approaches, can be a flexible mechanism reflecting market price adjustments, avoid the adverse effects of direct government market interference, and can stimulate the sectors that are not covered by ETS emission reduction, reducing the overall cost of social emission reductions, etc.

At the same time, the offset mechanism can also have adverse effects. It could influence the environmental integrity of the emission trading system and affect the market price of carbon market, thereby affecting the guiding role of the system for low carbon investment. It could also affect the actual emission reduction action of the system covering the entity, etc. In addition, if the offset credit requirements are not strict enough, the cost will be too low and lead to 'bad money drives out good money', affecting the market price. If the credit usage is too high, it will affect the actual emission reduction of ETS and the integrity of its targets.

Therefore, the existing 7 ETS pilot have allowed the use of CCERs as offsets. At the same time, to ensure environmental integrity, ensuring the permanence of project emission reductions, avoiding the excessive number of offsets that will affect the ETS market price and other considerations, ETS pilots will limit the type of offset projects and the amount of usage of CCER.

2.2 The present situation of offset mechanisms in 7 ETS pilots in China

1) Offsetting rules for domestic ETS pilots in China

In terms of rules, the requirements for each area are shown in Table 3 and the major differences lay in the offsetting index type, offsetting items, place for offsetting, time for setting the offsetting index and the proportion of offsetting.

For offsetting index type, seven pilots use CCER as the offset index. In particular, Beijing allows using carbon emission reductions from energy-saving and forestry carbon sink emission reduction projects as the offsetting index; Chongqing encourages enterprises to use emission reductions from forestry carbon sink projects.

In terms of offsetting items, the effect of hydropower project construction on the environment has been widely criticised and these projects will have a significant impact on markets with small capacities once they enter the market with their large volumes. In order to avert this risk, Beijing and Chongqing have both excluded hydropower projects.

For the place for offsetting, Hubei and Chongqing have stipulated that they will both use CCER for offsetting in areas under their administration, while 70% of areas in Guangzhou employ their own CCER. Beijing has stated that the usage of nonlocal CCERs should not be more than 50% and they prefer the CCERs from Hebei Province and Tianjin that have signed agreements on tackling climate change, ecological construction and atmospheric contamination control with Beijing. There is not a geographic restriction for Tianjin, Shenzhen and Shanghai on CCER. Except for Tianjin and Chongqing, other pilots further specify that locally generated CCERs should be beyond the boundaries of ETS. For the time for setting the offsetting index, Beijing has calculated the amount of emissions reduction from 1 January 2013, while Chongqing has restricted theirs to CCER projects put into operation after 31 December 2010.

In terms of the proportion of offsetting, Tianjin, Shenzhen and Chongqing base theirs on the gross of the actual emissions with a proportion of offsetting of 10%, 10%, and 8% respectively. Beijing and Guangdong base theirs on the gross of the obtained carbon emissions allowance with their proportion of offsetting of 5% and 10% respectively, while Shanghai bases theirs on the allocated allowances with a rate of 5%. Hubei's is based on the gross of their annual initial allocated allowances with their proportion of offsetting at 10%.

Table 3: Offsetting rules for each pilot

Pilot Project	Offsetting index	Offsetting items	Offsetting coefficient	Proportion of offsetting	Time for setting offsetting index	Offsetting proportion in local areas	Organisatio- nal boundary limitation
Beijing	CCER	Hydropower projects and other projects without using Hydro fluoro- carbons (HFCs), Total carbon fluoride (PFCs), Nitrous oxide (N2O), sulfur hexafluoride (SF6) gas	1:1	Lower than 5% of the carbon emission	Amount of emissions reduction since 1 January 2013.	The amount of certified emission reduction outside Beijing should not be more than 2.5% of the allowances. Beijing prefers the CER agreement signed with Hebei Province and Tianjin on tackling climate change, ecological construction and atmospheric contamina- tion control.	Emission reductions that are not from the fixed facilities of key emissions enterprises under the jurisdiction of the administra- tive regions of the municipality
	Energy- saving project carbon emission reductions	The reconstruct- tion of boilers and furnaces, usage of waste heat, motor system energy saving, energy system optimisation, reconstruc- tion of green lighting and building energy- saving reconstruc- tion are included but not limited. Additionally, the technologies, processes and products adopted are appropriate, and other energy- saving projects on outsourcing thermal are not needed.			Contract energy management project signed after 1 January 2013 or the energy- sa- ving techno- logical trans- formation project implemented after that time.	100%	Emission reduction amount from key emissions enterprises in administra- tive areas is excluded.
	Forestry carbon sink emission reduction	Carbon sink afforestation and carbon sink forest management project			Carbon sink afforestation project is non-forest land since 16 February 16 2005 and carbon sink forest management project is that implemented after 16 February 2005	100%	
Tianjin	CCER		1:1	Not more than 10% of the actual carbon emissions amount			
Shanghai	CCER		1:1	Not more than 5% of the allowances for the year			Same as Beijing
Shenzhen	CCER		1:1	10% – Not higher than 10% of the annual carbon emissions			Same as Beijing

Guangdong	CCER		1:1	Not more than 10% of the annual allowances of the enterprise		70%	Same as Beijing
Hubei	CCER		1:1	Not more than 10% of the annual initial allowance of the enterprise		100%	Same as Beijing
Chongqing	CCER	Energy saving and efficiency improving. Clean energy and non-regeneration energy, carbon sink energy, industrial production, agriculture, waste disposal	1:1	Not more than 80% of the approved emissions amount	Projects put into operation after 31 December 2010	100%	
	Forestry carbon sink emissions reduction						

The current status of CCER offsetting in the pilots and the prospects

Currently, China's carbon market is purely allowance in the market, and CCER, a low cost emission reduction and performance tool, did not play a substantial role in the five pilots of Beijing, Tianjin, Shanghai, Shenzhen and Guangdong in the first year. As of 27 October 2014, NDRC has held four CCER project auditing conferences and adopted 90 projects, including 14 projects which have been under auditing for their emissions reduction registrations and a reduced emissions amount of 8.94 million tons. The first projects are about to be signed and issued. The connection between a CCER registry and the trading systems of 7 ETS pilots is expected to be completed by the end of this year which will undoubtedly raise CCER into the market in all aspects. Table 4 shows the estimated effect of CCER offsetting in the carbon market for 2014.

Table 4: the estimated effect of offsetting in carbon market

Pilot Projects	Beijing	Tianjin	Shanghai	Shen zhen	Guang dong	Hubei	Chongqing	Total
Annual allowances for 2014 (10,000t)	5,000	16,000	16,000	3,300	40,800	32,400	13,000	12,6500
Offsetting proportion	5%	10%	5%	10%	10%	10%	8%	
The maximum demand (10,000t)	250	1600	800	330	4080	3240	1040	11340
Local CCER offsetting proportion	2.5%				70%	100%	100%	
The maximum local CCER demand(10,000t)	125				2,856	3,240	1,040	7,261
Local exiting CCER project of emission (10,000t)	27.88	None	109.27	17.39	8.55	45.54	None	208.63
Local existing CCER project on the total CCER demand	11.15%	0	13.66%	5.27%	0.21%	1.17%	0	

There are two carbon offsetting projects in Beijing. The first one is a gas thermal power project by Huaneng (Beijing) Thermoelectricity Co., Ltd. with an annual emissions reduction of 277,800 tons CO2e; the second is the first phase of an afforestation carbon sink project in the Shunyi district, with an annual emissions reduction of 1,000 tons CO2e. There is only one project in Shanghai – power generation from gas by Huaneng (Shanghai) Gas Turbine Power Plant – whose annual emission reduction is expected to be 1.0927 million tons CO2e. There is only one CCER project currently being registered which is a power generation from gas project by Shenzhen East Power Plant with annual emission reductions of 173,900 tons CO2e. There are two CCER projects in Guangdong – Fengdao Power and Guangdong Changlong Carbon Sink have total emission reductions of 85,500 tons CO2e. There are six CCER projects being registered in Hubei which are all wind power projects with an annual emission reductions amount of 455,400 tons CO2e. There are no CCER projects in Tianjin and Chongqing.

From the data, it can be seen that the demand in the CCER market will be 110 million tons next year (2014), including 72.61 million tons from pilots and 40.79 million tons from non-pilot areas. There are 90 projects registered with the NDRC with an annual estimated emission reductions amount of 20 million tons, including less than 3 million tons of annual emission reductions from the registered projects within pilot areas.

2.3 Assessment of offsetting mechanisms in China's emissions trading pilots

1) Design experience of offsetting rules

Using the experience of establishing rules for the pilot carbon markets, an offsetting mechanism for an emissions trading system can be developed. The mechanism requires defining key issues such as the permitted offset type, offset item types, use-ratio upper limit, and the producing time and place for offsets, etc.

When considering the offset type, consideration must be given to the possible influence that the cost of emission reductions, verifying standards and method of management for different types of offsets have on the carbon market. If different systems adopt the same type of emission reductions, they can be indirectly connected. Thus, the coordination of offset rules and system connecting rules must be taken into account. Due to the strict and unifying verification standards, CCER has become the most important offset product for the Chinese pilot carbon markets. Emission-control enterprises are especially encouraged to use Forest Carbon Sinks in Chongqing, but this kind of project is not underway yet. Encouraging the development of forest carbon sinks is good for environmental protection and effectively promotes the forestry economy due to the high added value, remarkable ecological benefits and social benefits. Carbon emission reductions from forestry carbon sink and energy conservation are allowed in Beijing because, in so doing, the market can be a means of promoting energy-saving transformation and forestry carbon sinks. Therefore, the synergistic effect of energy-saving and emission reductions can be exerted.

As for offset item types, the cost of emission reductions for different emission reduction projects varies, with those of the agricultural, forestry, transportation and building sectors being relatively high. Different project types possess different additive effects. For instance, forestry emission reduction is good for creating forest carbon sinks as well as soil conservation, etc. The carbon emission reduction from transportation will contribute to the reduction of conventional air pollutants such as N2O and PM2.5. The project type design of offsets has an influence on the cost of emission reductions of ETS and will promote emission reductions in industries that are not covered, affecting the overall social cost of emission reduction. Therefore, the design of project types must fully consider economic development, industrial competitiveness, industrial restructuring goals, greenhouse gas reduction goals and other environmental policy goals, etc.

The use ratio of offsets will directly affect the scarcity of emission allowances in ETS. It will affect the overall greenhouse gas emissions control and have an impact on the market price of allowances by increasing the indicator supply. Generally speaking, the price of emission reductions is lower than that of carbon emission allowances meaning that the use ratio of offsets will affect an enterprise's cost of compliance and the market price of allowances. The design of the offset mechanism's use ratio should fully consider the coordination between the upper limit and ETS's other key elements (such as the upper limit goal, compliance mechanism, market regulatory mechanism, etc.). If the upper limit goal of ETS is too arbitrary, the cost of emission reduction in the covered sectors will become too low and will result in no market requirement for the offsets. Offsetting mechanisms are also a type of flexible regulatory mechanism regulating and controlling market prices by changing the use ratio of offsets.

Offset proportion limits include offset gross criterion and offset ratios. Different gross criterion will generate different offset gross stimulatory effects that will be generated by differing complexities in calculation, the access of data and different criterion. For instance, in contrast to the initial allocated allowance, using actual annual emissions criterion might encourage enterprises to discharge more.

There are two reasons for limiting the occurring place for the offsets. Firstly, the cost of developing offset items in different areas is different. Without a limit, the emissions reduction of low cost projects will have an impact on the carbon market. Secondly, as some economically backward regions need capital and technological support, the development of offset projects is conductive to their low-carbon development.

The limit of organisational boundaries is to avoid double counting. CCER trading should fall under the direction of the National Authority; this and local pilot ETS projects are two independent systems. That means that, theoretically, companies involved in ETS pilots can develop CCER projects as well creating a double calculation risk i.e. enterprises can not only reduce the allowances amount required for the project but also obtain CCERs. The time limitation in the offsetting is mainly to ensure that the goal is achieved by practical action in emission reduction.

2) Overall assessment

In general, the offsetting mechanism should, at a minimum, meet the four requirements of environmental integrity, cost effectiveness, consistency and transparency. The following sections will evaluate the CCER trading system and offsetting mechanism in seven pilots from these four aspects.

(1) Environmental integrity

The setting of the rules for the CCER trading system – the methodology, project, and validating and verifying standard for emissions reduction amounts are consistent in China. As the exchanges and certification bodies are both approved and managed by the central government, the quality of CCER projects and emission reductions can be guaranteed. With the same strict certifying standards for CCER and CDM projects, the environment integrity can be ensured.

China has strict rules for the operation of its CCER trading system. For example, according to the standards, all registered CDM projects can get CCER certification but, in practical operation, the National Authority has made stipulations on the starting date of emissions reduction for these CDM projects.

The offsetting rules for pilots require that they further limit their CCER in administrative areas beyond the boundaries of the local enterprises involving ETS to effectively avert the risk of double-counting and ensuring the environmental integrity of the carbon market.

(2) Cost effectiveness

It is difficult to estimate the cost to develop a CCER project but a common method is to consider the price of the CCER in the voluntary carbon market to estimate the cost. The cost effectiveness of offsetting can be obtained by comparing the price of emission reductions in the CCER market and that of allowances in pilots.

The trade volume in the CCER market is still limited but, based on current trading, the price of CCER emission reduction is about RMB 7.5 – 20/t.

The price of allowances in pilot markets is RMB 48.00 – 76.71/t in Beijing and RMB 17 – 50.11/t in Tianjin. In the Shanghai carbon market the allowance price is RMB 25 – 46/t and in Shenzhen it is RMB 28 – 143/t. The price of first-grade carbon is RMB 60 – 81/t in Guangdong and that of second-grade carbon is RMB 26 – 68.6/t. The price of carbon ranges from RMB 19.83 – 29.25/t in Hubei and RMB 30.74 – 30.74/t in Chongqing.

Preliminary comparisons indicate that the price of CCER is lower than that of allowances which proves that CCER projects can meet the requirement of cost effectiveness.

(3) Consistency

Since the participation of the CCER projects and the calculation of the emissions amount need to be filed and registered with the National Authority, and the exchange and certification body both need to be registered with the National Authority as well, local governments have no right to make final decisions. Therefore, under unified management, the consistency of CCER emission reduction can be guaranteed.

(4) Transparency

The establishment, auditing and trading process of CCER trading and rules for the carbon market should be publicised using their own platform to guarantee a transparent market.

3) Characteristics and trends for using CCERs in pilot areas

A review of the offsetting CCER amounts in pilot areas indicates that the offsetting mechanism has not played a substantial role in the carbon market in 2014 and predictions are that the supply of CCER in 2015 will not be able to satisfy the needs of the carbon market. The reasons can be attributed to the fact that the establishment of CCER started late and the registration requests of the first projects are still being audited. Market activities mainly rely on mandatory regulations for enterprises to reduce emissions and the carbon market is still not mature in pilot areas. With the weak pressure for emission reduction in the beginning, enterprises still have a limited demand for CCER. What's more, the carbon market in pilot areas imposes minimal restrictions on the offsetting mechanism. For example, most areas apply policy preferences on CCER projects, which can further cause a lack of supply of CCER.

In the current market, most buyers are brokers, the price is not transparent and the main trading scheme is OTC (over the counter). Since the end buyers in the carbon market are only those emission controlled enterprises with compliance requirements, they focus only on CCER spot trading in the future mature market. Few of them are interested in taking part in the first stage of the CCER project development and are unable and unwilling to shoulder the risk with CCER owners for development costs and policy risks. Brokers normally select projects that are in the first stage so that they will have stock in hand for sales and be able to seize more opportunities when the CCER market is available. Price negotiations between distributors and projects are mainly OTC and the price is not transparent.

Most registered CCER projects are wind power and hydroelectric projects; traders are focusing mainly on wind power and photovoltaic projects. Wind power projects are relatively easy to develop and the volume is significant while the cost of photovoltaic projects is higher with better additionality, although the volume is smaller. Beijing and Chongqing pilots exclude hydroelectric projects, making CCER buyers more cautious about purchasing. Although the forestry carbon sink and farm-oriented biogas projects have good ecological and social benefits, they are difficult to develop and have tiny volumes. In addition, they hold minimal trading attractiveness for ETS involving enterprises in the secondary market. Since the rules in the carbon market have a significant effect on the items and trade volumes of CCER, the establishment of national unified market rules should fully consider the potential effect of items in an offsetting mechanism of the CCER market.

3 Issues to be considered in developing the offsetting mechanism in China's unified national emissions trading system

3.1 Restriction of the coverage of the offsetting mechanism

In order to guarantee environmental integrity, the continuance of emission reductions and avoid excessive offsetting affecting market price for an ETS, ETS needs to set restrictions for the offsetting index type, items type, and the appropriation of the offsetting and project areas.

With regard to offsetting index types, CCER is the most important VER index in China and each pilot uses this index. This provides a unified auditing standard with strict management and it should be the focus of a national unified carbon market offsetting index. The use of emission reductions from energy saving projects and forestry carbon sink needs to be carefully considered. In addition, considering the potential connection between the Chinese carbon market and the international market, using the international index, such as CER, should be considered.

For the offsetting items type, given the rules in the carbon market on the voluntary market, factors in project development cost, difficulty in auditing and technological development circumstances need to be considered. Using forestry projects as an example, with their potential problems of impermanence and risk exposure, EU ETS, the world's largest carbon trading system, imposed many restrictions on such forestry projects. Australia and New Zealand, which have high rates of carbon emissions in agriculture and forestry, have established a special mechanism to stimulate carbon emission reductions in those fields. ETS and RGGI in California also allow the use of a forestry emission reduction, but its market scale is limited and they impose strict requirements on projects. NDRC has approved two methodologies for forestry projects – carbon sink forestation project methodology and bamboo reforestation carbon sink project methodology. Forestry carbon sink has become one of the sources for CCER.

In general, there are few emission reduction projects for forestry, building and transportation in the carbon market in China. This can be attributed to the small scale of emission reductions, too many stakeholders, complicated methodologies, a lack of basic data and the high cost of trading. The requirements of MRV cause these types of projects to require more effort and the performance of emission reduction is low even it is managed successfully. It is hard for these types of projects to attract the attention of relevant organisations and there is no mechanism to guarantee that all stakeholders can benefit.

However, for projects related to agriculture, building and transportation, other external benefits for the environment and society can be realised. In order to compensate for the high development or trading cost, development subsidies may have to be offered, trading costs should be discussed and price limits should be set in order to encourage increased development and trade.

Projects for reducing the emissions of industrial gases, such as HFC23, will have a significant impact on the market and hinder the development of other projects if they are allowed to enter the market due to their large emission amounts and low emission reduction cost. In the future carbon market in China, this source of projects should be restricted; for example, no industrial gas emission reduction projects should be allowed to enter the market.

3.2 The coordination between offsetting mechanisms and other rules in the carbon market

The coordination between offsetting and connection mechanisms

Since the offsetting mechanism is an indirect means of connecting carbon markets, its establishment should carefully consider its consistency with the connection mechanism.

The coordination between offsetting and market adjustment mechanisms

As an offsetting mechanism, the emission credit supply can be added in the ETS and reduce the price of the allowance enabling the offsetting mechanism to be used for adjusting the price. The effect can be controlled by setting different emissions indexes, project areas and differing prices under different price situations.

3.3 The coordination between the offsetting mechanism and the assessment for the performances of emission control

The central government has instructed all provinces and cities to reduce GHG emissions intensity and will conduct evaluations on their performances. At present, the government is examining their performances based on their actual emissions. If interregional trade is not evaluated, provinces and cities will lack the motivation to follow through. However, the problems not only occur in offsetting mechanisms, the trans-provincial allowance trade also faces the same issue. Only coordination between emission trading and regional emission control performance evaluation systems can help solve this problem.

3.4 The coordination between offsetting mechanisms and other energy-saving policies

Since the offsetting mechanism interacts with energy-saving and the carbon emissions reduction policies, except ETS, when establishing the mechanism other relevant policies in China and the coordination between them should be considered.

The 'Action of Saving Energy and Low Carbon among Enterprises' is an example. Although ETS compliance can be completed by purchasing allowances and certified emission reductions, this is only concrete energy saving action to achieve the energy-saving target. The 'Action' recognises that there will be special occasions: 1) The first is that, although enterprises covered by ETS use the CCER to offset their emissions (completing the task of ETS), they lack the practical application to achieve their final goal of energy-saving. 2) The second is that enterprises might apply for CCER registration, completing their goal and earning revenues by selling CCER, or they could sell extra allowances which would result in double accounting. At present, ETS and energy-saving evaluation are regarded as two independent policies and there is no connection between their implementation and evaluation. According to the requirements of additionality, CCER applications should be limited to only emission reductions beyond those that enterprises are obligated to achieve. As a result, ETS should impose restrictions on the applications for CCER with consideration to the baseline of the CCER project.

4 Energy consumption and emissions reduction potential in the Chinese building sector

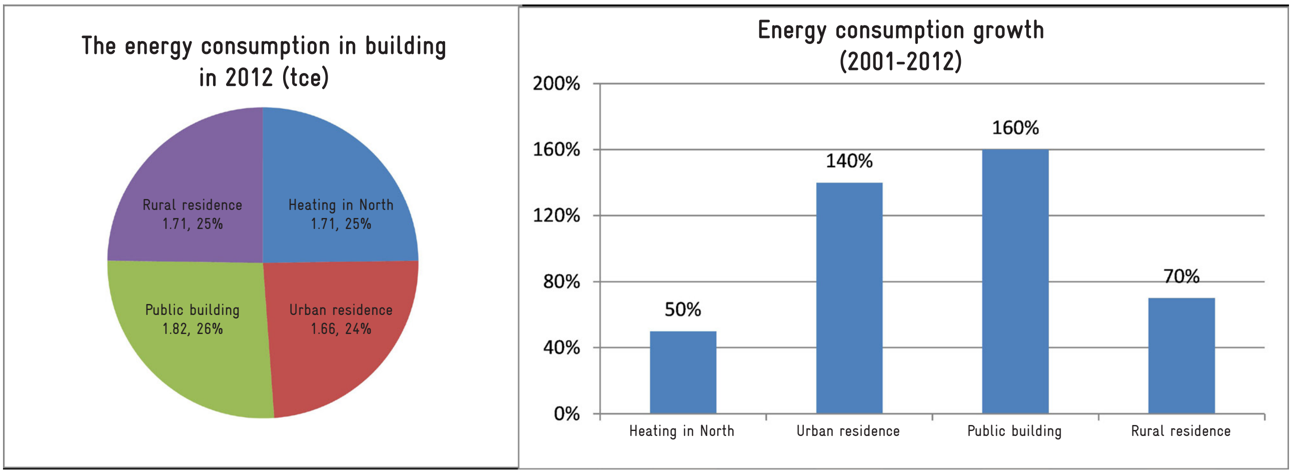
4.1 Current energy consumption

'Buildings' provide people with living and working space and mainly includes residential and commercial/public buildings. The consumption of energy in buildings mainly consists of heating, cooling, ventilation, lighting, hot water heating and use of home appliances. There are four main sources of energy - coal, oil, natural gas and electricity. Geographically, there are five main areas - severe cold areas, cold areas, hot-summer and cold-winter areas and hot-summer and warm-winter areas. In particular, the energy consumption for heating can reach more than 50% in severe cold and cold areas.

Statistically, the total 2012 energy consumption in buildings (biomass energy excluded) was 690 million tce, making up 19% of the total used in China. If biomass energy had been included, the total energy consumption would have been 807 million tce. Considering the differences between heating systems in the north and south of China, urban and rural buildings, residential and commercial/public buildings and lifestyles, the energy consumption in China can be broken down into four types - urban heating energy consumption in the north, urban residential energy consumption (heating energy consumption in the north is excluded), commercial/public building energy consumption (heating energy consumption in the north is excluded) and rural residential energy consumption (Source: Annual Report on China Building Energy Efficiency, 2014)

The left panel of Chart 4 shows that, in 2012, the energy consumption of heating in the north, urban residential buildings, commercial/public buildings and rural residential buildings each accounted for about a quarter of the total. Among these, 171 million tce was for heating in the north - accounting for 25%. 166 million tce was for urban residences – accounting for 24% (which included 378.7 billion kWh of power consumption). The energy consumption of commercial/public buildings was 182 million tce - accounting for 26% (which includes 490 billion kWh of power consumption). The commercial energy consumption for rural residences was 171 million tce - accounting for 25% of the total consumption (including 159.4 billion of power consumption).

Chart 4: Chinese building consumption and the growth rate



From the growth range, compared to 2001, the energy use for heating in the north, urban residential buildings, commercial/public buildings and rural residential buildings increased by 50%,140%,160% and 70% respectively. (Source: Annual Report on China Building Energy Efficiency, 2014). Reasons for the significant increase are as follows:

In the north: Firstly, heating space doubled. Secondly, the heating energy consumption per unit of space decreased by 30%. The heating energy intensity was lowered due to improvements in building insulation performance, higher penetration of efficient heating sources and improvements in the efficiency of heating supply systems.

Urban residence energy consumption: Firstly, there was fast population growth in urban areas causing building areas to expand by 50%. Secondly, the demand for energy for air conditioning, household appliances and hot water heaters has increased and the growth rate for each household has been 50%. Thirdly, the residential heating energy consumption has increased south of the Yangtze River.

Commercial/public building energy consumption: Firstly there has been a 33% growth of energy density per unit of floor space. Secondly, commercial/public building areas have doubled.

Rural building energy consumption: Firstly, with the development of urbanisation, the population in rural areas decreased from 800 million in 2001 to 640 million in 2012, while the per capita housing floor space increased by about 50% and the rural residential total floor space grew by about 15%. Secondly, with the improvement in income in rural areas, the number of home appliances has increased, resulting in the rapid growth of power consumption. Meanwhile, more and more biomass was replaced by coal and other commercial energy so that the rate of biomass energy dropped rapidly from 69% in 2001 to 41% in 2012. However, the energy consumption for each household did not appear to have an obvious change if it is seen from the point view of a family unit.

4.2 Energy-saving and emission reduction potential in the building sector

According to the statistics from 'Annual Report on China Building Energy Efficiency, 2014', there were 51 billion square metres of buildings in China in 2012, with an annual increase of 1.5 - 2 billion square metres. Projections are that this will grow to 70 billion square metres in the future. The building sector in China shows the most promise for energy-saving in the future. However, according to the 'Medium and Long Term Special Plan on Energy Efficiency', compared with the standard set for 1980/1981, the energy-saving for new buildings was expected to be 50%, and 65% for directly-controlled municipalities by 2010. As a matter of fact, China announced an indicative target for building energy efficiency of 30%, 50% and 65% for 1986, 1995 and 2005 respectively, but the effect of the implementation varied across the nation and at a slower pace. The Ministry of Housing and Urban-Rural Development issued 'Administrative Regulations on Residential Buildings' in 2006 which specified further details on the standards for energy efficiency and enhanced the mandatory regulations and implementations. According to statistics for 2010, 99.5% and 94.5% of newly constructed buildings had met the energy efficiency standard in the design and construction stages, which were 42% and 71% higher than those in 2005 (Source: The Twelfth Five-Year Plan on Building Energy Efficiency, 2012)

1) Comparison of building energy consumption between China and foreign countries

According to the Annual Report on China Building Energy Efficiency in 2014, using the same comparable definition terms, the comparison of building energy consumption between China and foreign countries is as follows:

For total consumption, China's building energy consumption is only 20% of the energy consumption - much lower than that of developed countries - but rapid growth is expected in the future. According to data provided by IEA, building energy consumption accounts for 35% of the total energy consumption in the world and is the largest sector of energy consumption. In particular, the proportion of building energy consumption reached about 40% in some developed countries such as the United States, the UK, France, Germany, Italy and Japan.

With regard to per capita residential floor space, Americans have the largest per capita residential floor space at over 70 square metres and Europe and Japan follow with about 40 square metres. In 2012 in China, the per capita residential floor space in cities was 33 square metres and 37 square metres in rural areas, increasing by 1 square metre every year. If this continues, the per capita residential floor space in China in 2020 will reach a level similar to that of Europe and Japan.

The energy consumption per household in the United States is much higher than other countries at more than 7 tce. Energy consumption per household remains close in the developed countries at about 2 – 4tce, while that in developing countries is less than 1tce, showing the same trend as per capita residential floor space.

The energy consumption intensity per unit of floor space in developed countries such as the United States (except Russia) is about 35 kgce/m^2, while that in developing countries is about 15 kgce/m^2. Both the energy consumption intensity per household and per unit in developing countries is lower than that of developed countries.

Russia and South Korea rank first in energy consumption in public buildings at 150 kgce/m^2 and 110 kgce/m^2. The energy consumption in public buildings per unit area in China is the lowest at 28 kgce/m^2 and that in other countries continues to be about 60 – 80 kgce/m^2.

Since there is a large area of central heating supply in north China, the heating energy intensity remains at a low level with high efficiency compared to other countries. The heating energy intensity is over 60 kgce/m^2 in Finland, while in Poland, Russia and South Korea it remains at about 30 kgce/m^2. The heating intensity in Denmark, Canada and China is 15 – 20 kgce/m^2

Historically, building energy consumption changes periodically in the United States and Japan as per capita GDP increases. When the per capita GDP reaches USD 5,000, building energy consumption is about 20 kgce/m^2 and it will experience rapid growth with the increase of per capita GDP. When the per capita GDP reaches USD 10,000, building energy consumption will stabilise. The per capita GDP in China is about USD 6,000 and building energy consumption is about 20 kgce/m^2. The per capita building energy consumption in China will match the level in developed countries in the future and the total amount of energy consumption will see rapid growth indicating that energy saving in the building sector has a high growth potential.

2) Qualitative analysis on energy-saving and emission reduction

With the implementation of the 50% energy standard and through comparing the JGJ26-95 standard and the local general building standard of 1980/81, the contribution of the building envelope structure and heating supply system to the improvement of heating energy-saving was 35% and 15% respectively.

The potential of energy saving and emission reduction mainly comes from the following three categories:

Reducing final energy demand: Improving the energy efficiency of end-use equipment including replacing incandescent bulbs with energy-saving bulbs and installing energy-saving electric appliances and other energy efficiency equipment. For example, using CFL and LED lamps to replace incandescent bulbs can save 50% - 75% of the usual power.

Improving thermal insulation performance of the building envelope structure: A building envelope structure includes the wall, roof, basement, windows and doors. Improving the building envelope structure can meet the requirement of saving 35% of the energy. The thermal insulation performance needs to be improved in order to prevent heat from coming inside in summer and leaking outside in winter, keeping the inside of the building warm and humid. This will aid in lowering the energy consumption for heating, cooling and ventilation to reasonable levels. Without insulation measures, half of the heat will be dispersed through the wall and 25% of the heat is lost through traditional double-pane windows. By optimising the distribution of pipes and the hot water system, more energy can be saved and carbon dioxide emissions can also be reduced.

Improving efficiency of the energy supply: Improving efficiency of the energy supply of heat, electricity and gas and reducing heat loss can improve the overall efficiency of the heating supply system and meet the 15% target of energy-saving. In particular, enhancing the energy efficiency of boilers and reducing the heat loss in heating pipeline transmission is useful. An example of measures for the improvement of distributed boilers, include using low-temperature and condensate boilers to replace traditional ones to improve the energy supply efficiency and reduce the loss of heat. Using gas fuel to replace coal for heating will reduce 50% of the CO_2 emissions while improving efficiency. By updating the performance of district heating boilers, the loss of heat can be reduced by 30%. With newer boilers, the efficiency of heating generation can be improved 10% - 12%. Compared to old boilers, new boilers can improve the efficiency by 35%. A survey on heating systems by the Beijing municipal administration in 2006 identified some problems: 1) more than 70% of the pipe networks lacked control apparatus and metering devices and the operation was uneconomical because of the mass flow with a small temperature difference which caused a huge loss of energy; 2) 20% of the thermal energy was lost during the transmission through old pipes while the loss is only 5% through new pipes.

3) Quantitative analysis of energy-saving and emission reduction

Over the period of the Eleventh Five Year Plan (2005 - 2010), 100 million tons of standard coal were saved in the building sector. The standard penetration for energy efficiency in new buildings reached 95.4% in the construction stage - 71% higher compared to that of 2005. About 4.857 billion square meters of floor space of energy efficient buildings were constructed during this period and resulted in an energy-saving capacity of 46 million tons of standard coal. 182 million square metres of existing buildings in the north were retrofitted and resulted in an energy-saving of 2 million tons of standard coal. Currently about 217 projects on low energy consumption and green buildings and green ecology areas are under construction. Promotion of construction and renovation of energy monitoring systems in government office buildings and large public buildings is underway and energy consumption dynamic monitoring has been carried out on 1,500 buildings. There are about 386 demonstration projects on renewable energy applications in the building sector, 210 projects on solar photovoltaic buildings, 47 projects on renewable energy cities and 98 demonstration counties. (Source: The Twelfth Five-Year Plan on Building Energy Efficiency, 2012)

During the Twelfth Five Year Plan period (2011 - 2015), new building floor space will reach 4 - 5 billion square metres in urban areas in China and, at the end of that period, there will be 116 million tons of standard coal-saving capacity. Of this, an energy-saving capacity of 45 million tons of standard coal will come from developing green buildings and new buildings. An energy-saving capacity of 27 million tons will come from heating supply system retrofitting, metering and charging in north China. An energy-saving capacity of 14 million tons will result from the installation of monitoring systems in public buildings and operation management improvement. Construction of buildings should integrate renewable energy and develop a capacity of 30 million tons of substituted conventional energy. (Source: The Twelfth Five-Year Plan on Building Energy Efficiency, 2012)

If each ton of standard coal produced 2.7 tCO_2 of emissions, the potential for CO_2 emission reductions during the Eleventh Five Year Plan period was 270 million tCO_2. The plan is to achieve a 310 million tCO_2 emissions reduction during the Twelfth Five Year Plan period which should generate revenues of RMB 11 - 15 billion and RMB 12.5 - 18.5 billion from emission reductions, if the price in the carbon market is RMB 40 – 60/tCO_2.

In addition, according to a Sino-US Joint Statement on Climate Change during the APEC meeting in 2014, China will reach its peak in carbon dioxide emissions in 2030 and China's industry sector should work hard to reach that goal before 2030. The sectors with the largest potential for emission reduction are building and transportation.

4.3 Building sector in the global carbon market

As of October 2014, according to statistics provided by the UNEP Risø Centre, about 139 CDM projects in the building sector throughout the world (including residential and commercial/public buildings) have been successfully registered. It was initially expected that cumulative emission reductions by 2012 would be 3.2 million tCO_2, while the actual issued certified emission reduction was for 550,000 tCO_2. In Chart 5, it can be seen that, at 1.60%, the building sector has only a small share of the global carbon market based on the number of projects. Of these emission reduction and actual issued CERs were 0.14% and 0.04% respectively. The shares are so small that they can be ignored, which is obviously consistent with the large potential of energy-saving in the building sector.

From the distribution of CDM projects in the building sector shown in Chart 6, the projects succeeding in registering CDM are mainly those in household energy-efficient lighting, household energy-efficient stoves, energy-efficient retrofitting of commercial/public buildings, new energy-efficient buildings and HVAC retrofit projects, with 45, 38, 8, 6 and 5 projects respectively. The total is 102 projects, which comprises 80% of the CDM projects in the building sector of which only three types of projects have been issued - 9 projects on household energy-efficient lighting, 4 projects on household energy-efficient stoves and 2 projects on new energy-efficient buildings. (This classification is based on the types of projects. Some projects may be involved in several methodologies, so the total number may be different).

Chart 5: CDM projects from the building sector

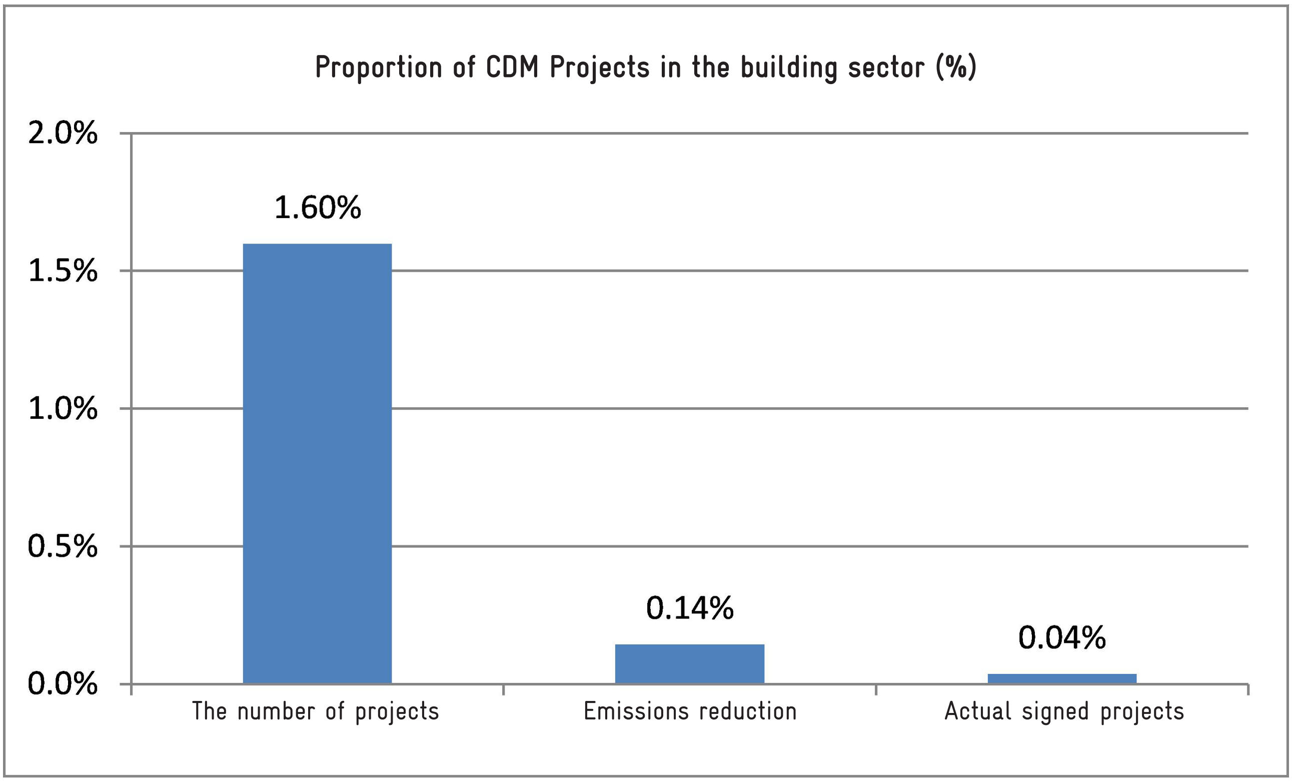
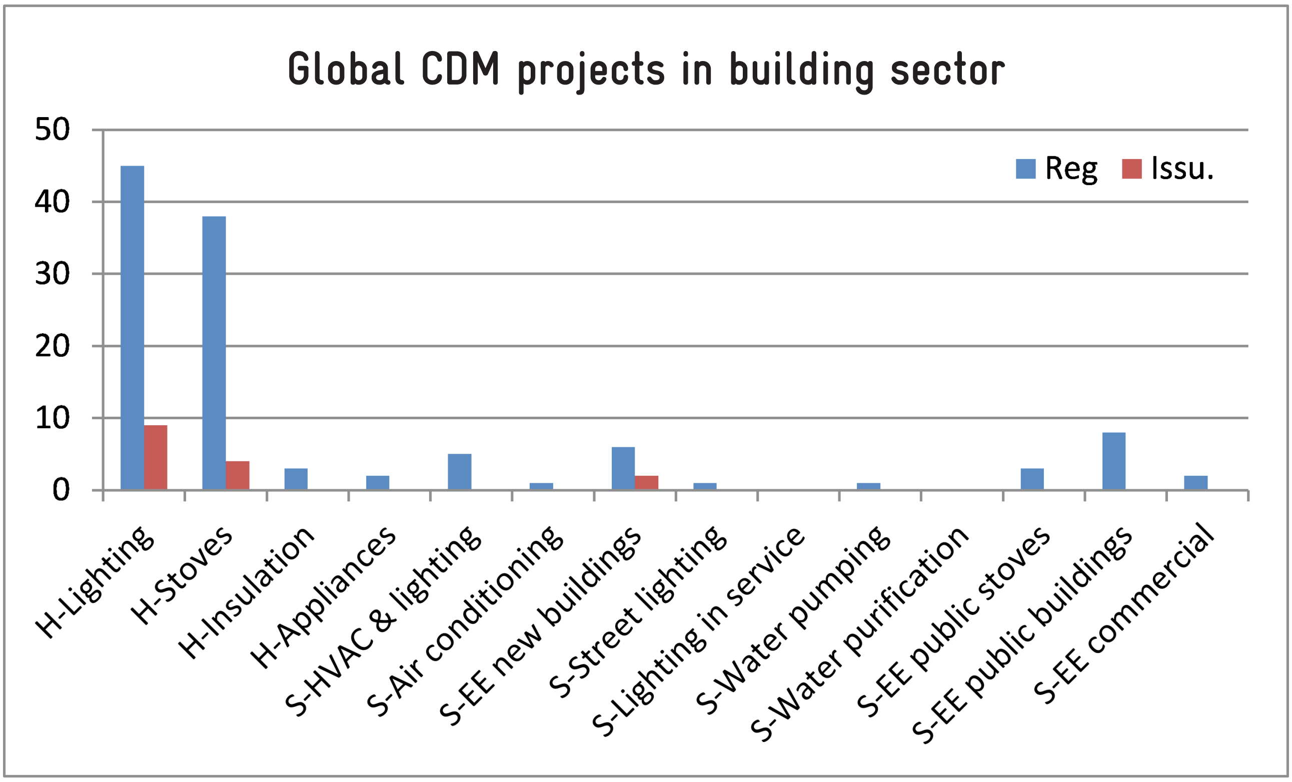


Chart 6 Types of CDM projects in the building sector



5 Emissions reduction methodologies related to the building sector

Energy use in buildings involves heating, air conditioning, ventilation, lighting, hot water and the power for equipment. The demand for and supply of energy and the building envelope structure are also involved. But there is no methodology approved by EB that is fully suitable for the building sector. The energy saving and emission reduction mechanism is relatively complicated in the building sector. As mentioned previously, it includes three types – improvements to end-use efficiency and reducing the final energy demand, improvements to the building envelope structure and the enhancement of energy supply efficiency. The emissions reduction methodologies are complicated as well and few of them have practical applications. In addition, the methodologies in the Chinese voluntary carbon market are generally similar to those of CDM methodologies which will be discussed in detail below. If the methodology is only focused energy efficiency measures on the heating supply for residential buildings, the calculation of energy consumption and emission reductions can be simplified greatly.

5.1 Cases of large scale project methodologies and their application

For specific energy conservation and emissions reduction technology, the building sector includes the following reduction methodologies of large scale projects: AM0044, AM0046, AM0058, AM0070, AM0072, and AM0091. (The numbers in parentheses below are the corresponding number to the domestic CCER methodology.)

AM0044 (CM-018-V01) Energy efficiency improvement projects - boiler rehabilitation or replacement in industrial and district heating sectors: This methodology is based on energy efficiency improvements carried out by an energy service company (ESCO) in Ulaanbaatar, Mongolia, to replace old boilers with new ones. Without other changed parameters, replacing the boilers improves, boiler thermal efficiency thereby reducing energy consumption and greenhouse gas emissions. The annual emission reduction for this project amounts to 23,000 tCO_2. China currently has only one registered project that is successfully applying this methodology in EB and it anticipates annual emission reductions of 160,000 tCO_2.

AM0058 (CM-019-V01) refers to the introduction of a new primary district heating system as a heating supply for residents and business users. The reduction mechanism is the use of high-efficiency cogeneration (boilers) as the main source of a primary district heating network, instead of using an inefficient decentralised small boiler heating supply which will result in fossil fuel consumption savings. China now has 11 projects successfully registered in EB, and each project has a relatively large scale of reductions with heating supply areas from 0.4 million to 17 million square metres and an annual reduction scale of between 0.06 million and 2 million tCO_2, of which four projects were issued successfully.

AM0046 (CM-043-V01) refers to 'distribution of efficient light bulbs to households'. This methodology applies to project activities which improve the energy efficiency of household lighting. Projects are carried out by project coordinators as members of project participants who donate or sell compact fluorescent lamps (CFL) to a particular region of households as an alternative to less efficient light bulbs at a lower price. Residents using CFLs are not project participants. They exchange previously used light bulbs for new CFLs to project coordinators. There is a current project relying on this methodology that has been successfully registered in EB with a scale of annual emission reductions of 440,000 tCO_2. Emission reductions are calculated at a particular level of service using a formula of the statistical difference of power consumption between a baseline scenario and project activities (CFLs) * power * carbon dioxide emission factors.

AM0070 (CM-021-V01) refers to the manufacturing of energy efficient domestic refrigerators through project activities on improvements to refrigerator energy efficiency. India currently has 2 successfully registered projects using this methodology in EB. The project scale of emission reductions is between 280,000 tCO_2 and 580,000 tCO_2.

AM0072 (CM-022-V01) refers to fossil fuel displacement by geothermal resources for space heating. This one applies to the introduction of geothermal resources in district heating systems for space heating in existing buildings and new facilities or expanding existing district pipelines. China now has two projects using this methodology successfully registered in EB. The project scale of emission reductions is between 70,000 tCO_2 and 100,000 tCO_2.

AM0091 (CM-052-V01) refers to energy efficiency technologies and fuel switching in new and existing buildings. This methodology is applied to project activities which intend to carry out energy efficiency measures and fuel alternative activities in newly-built buildings, including energy-efficient equipment, high-efficiency lighting systems, efficient HVAC (heating ventilation air-conditioning) systems, passive solar design, BEMS (building energy management systems) and smart energy metering, etc. So far, no projects using this methodology are successfully registered in EB.

5.2 Small-scale methodologies and their application cases

Generally speaking, building sector projects have small GHG emission reductions. Their reductions can be calculated by adopting a variety of small-scale methodologies approved by EB which can simplify the validation and verification procedure and also save both time and transaction costs. Project scales can also be expanded by bundling a number of small-scale projects or programmes of activities (PoA)

In order to reduce transaction costs, small-scale CDM projects have simplified some modalities and procedures including project design documents (PDD), validation, registration, monitoring, verification, and certification. The definition of small scale is as follows:

1) **Renewable energy project activities must have a maximum output capacity of 15 MW;**

2) **Improvements in energy efficiency must be limited to those with a maximum output of 60 GWh per year; or**

3) **Other project activities must be limited to those that result in emission reductions of less than or equal to a 60,000 tCO_2 equivalent annually;**

Small-scale methodologies related to building energy efficiency and emission reductions are as follows:

AMS-I.C (CMS-001-V01) refers to thermal energy production with or without electricity. This methodology involves renewable energy technologies that supply users (i.e. residential, industrial or commercial facilities) with thermal energy that displaces fossil fuel use. These units include technologies such as solar thermal water heaters and dryers, solar cookers, energy derived from renewable biomass and other technologies that provide thermal energy that displace fossil fuel.

AMS-II.A (CMS-006-V01) refers to supply-side energy efficiency improvement in transmission and distribution.

AMS-II.B (CMS-007-V01) refers to supply-side energy efficiency improvement in generation. The application is a decentralised heating station reconstruction project in Mongolia, which was registered in July 2006 with an annual reduction of 12,000 tCO_2.

AMS-II.C (CMS-064-V01) refers to demand-side energy efficiency activities for specific technologies. This methodology can be widely applied to activities that involve the installation of new, energy-efficient equipment (e.g. lamps, ballasts, refrigerators, motors, fans, air conditioners, pumping systems, and chillers) at one or more project sites.

AMS-II.E (CMS-029-V01) refers to energy efficiency and fuel switching measures for buildings. This applies to any energy-efficiency and fuel switching measures implemented in a single building (such as a commercial, institutional or residential building), or group of similar buildings (such as schools, district or universities).

AMS-II.K (CMS-031-V01) refers to installation of co-generation or tri-generation systems supplying energy to commercial buildings. This applies to installation of fossil fuel based co-generation or tri-generation facilities that simultaneously produce electricity and cooling (e.g. chilled water) and/or heating (e.g. steam or hot water) for supplying energy to commercial and non-industrial buildings.

AMS-II.N (CMS-013-V01) refers to the installation of energy-efficient lighting and/or controls in buildings. This includes the use of more energy-efficient lighting, lamps and/or ballasts instead of existing lighting fixtures, lamps and/or ballasts, the permanent removal of lighting equipment installed with or without mirrors, and equipment for lighting control systems such as indoor sensors and timer devices reducing electric lighting time.

AMS-III.AE (CMS-041-V01) concerns energy efficiency and renewable energy measures in new residential buildings. This includes activities that lead to reduced consumption of electricity in new grid connected residential buildings (single or multiple-family residences) through the use of one or more of the following measures - efficient building design practices, efficiency technologies and renewable energy technologies. Examples include efficient appliances, high efficiency heating and cooling systems, passive solar design, thermal insulation, and solar photovoltaic systems. All equipment and building materials used in the project-related residences must be new and not transferred from another project. All project residences must comply with or exceed applicable standards and regulations (e.g. building codes).

A successful example is the residential energy-saving renovation project that was registered in Kuyasa, South Africa in May 2005. Three small-scale methodologies are involved - AMS-I.C, AMS-II.C and AMS-II.E. Measures include heat preservation and heat insulation of ceilings, installation of solar water heaters and efficient lighting. Annual reductions amount to 6,580 tCO_2, which is considered small.

The energy-saving renovation project in the Indian Hotel, Sonar Banglar, is another example of using AMS-II.E, whose annual emissions reduction is 2,987 tCO_2. Other similar projects in commercial buildings in Mumbai, India, are mainly aimed at heating, ventilation, HVAC systems, lighting, etc. Their annual reductions amount to 1,785 tCO_2.

An example of applying AMS.II-K is a triple generation system used in a 52 storey office building in Saudi Arabia with annual reduction amounts of 6,515 tCO_2.

To summarise, the scale of building energy-efficient projects is relatively small. Calculations show that the average indoor temperature of the northern region ranges from 16°C to 20°C while the energy-saving potential per unit of floor space is approximately 21 $kgce/m^2$ (70 kWh/m^2). Assuming the average housing floor space is 100 square metres, the average household savings potential should be 2.1 tce and the annual emission reduction is 5.6 tCO_2. Therefore, residential communities with a total household of 10,000 to under 1 million square metres meet the definition of small-scale emission reduction projects which simplifies the use of appropriate procedures.

5.3 The determination of baseline emissions

With reference to the provisions of paragraph 48 of the Marrakech Accords, baseline emissions can be determined by the following three approaches:

1) **Existing actual or historical emissions;**

2) **Emissions from a technology that represents an economically attractive course of action, taking into account barriers to investment and**

3) **The average emissions of similar project activities undertaken in the previous five years in similar social, economic, environmental and technological circumstances and whose performances are among the top 20% of their categories.**

According to these approaches, existing building energy-efficiency projects can adopt the first one to determine the baseline emissions while new building projects can adopt the second or the third ones to determine the baseline emissions. Taking the new building-related standards and regulations into account, alternatives may include:

- New residential buildings comforming to the general design standards of 1980 and 1981,

- New residential buildings under (JGJ26-86) at 30% of the energy-saving design standard,

- New residential buildings under (JGJ26-95) at 50% of the energy-saving design standard and

- New residential buildings at 65% of the energy-saving design standard.

Given that the past 10 years have been and the next 10 years will be a boom time for building construction in China, along with the energy-saving standard achieved by newly built buildings, the baseline for emissions can be determined. For example, in Beijing, where the implementation of energy efficiency is good, 50% is used as the baseline, while other areas might use 30%. The revenue from emission reduction can be used to mitigate the increase in cost, making the new energy-efficient buildings more feasible and attractive to investors which will help to promote the development of energy efficiency in the building sector in China.

Unfortunately, the setting of a baseline still presents many difficulties, including the availability of relevant data and the challenges of uncertainty. For example, the historical data for existing buildings can provide records of power and heating but sample statistics for setting a baseline for newly built buildings is hard to obtain.

Methodologies for setting baseline emissions in the building sector that are developed by research institutions and issued by EB are mainly based on a professional point of view employing theoretical calculations and sector baseline methodologies, creating more methods with more complicated requirements. Since the actual application is quite difficult, few projects use the methodologies and it is hard to obtain benefits from the global carbon market. As a result, participants don't actively promote building energy efficiency and emission reduction projects in the carbon market.

However, in Beijing, more than half of the key players in local ETS are related to the building sector – especially large public/commercial buildings – which means that the building sector has actually been active in the carbon market without using the complicated methodologies.

The setting of baseline emissions in pilot carbon markets is mainly based on historical records or other reasonable average values. This approach is easy to implement but it faces some contention as well. The major concern is that this approach is unfair to those companies that have already done well in energy efficiency and emission reduction.

5.4 Issues in and barriers to the application of methodologies

There are many barriers to the application of methodologies in the building sector. The major key barriers are complicated methodology, lack of statistics, differences between design standards and actual performance and the high transaction cost. Details are as follows:

1) **Complicated methodology and difficult application**

There are many methodologies for energy efficiency in the building sector including large and small scale methodologies, which cover most of the energy efficiency measures related to buildings. However, the energy consumption of a building involves the envelope structure, heating, cooling, ventilation, lighting, hot water heaters and equipment. So, in general, a complicated methodology is inevitably needed in order to determine the actual emission reduction.

Single energy efficiency technology is already relatively mature in China but, since China is a big country with different climatic characteristics, along with different locations of buildings and different energy efficiency levels in various regions, it is hard to establish a single baseline emission amount. Even if an average emission can be chosen from similar projects, it is hard to get the specific data from similar sample buildings.

2) Lack of fundamental statistics and hard to determine baseline emission

On one hand, both the national and local authorities provide various design standards and regulations on energy efficiency for buildings, but they do not provide the energy consumption quantified indicator for unit floor space of bhe various types of existing buildings on their energy consumption levels. Because the building sector lacks published, reliable information on energy efficiency technology and its performance, it is hard to set a baseline emission for buildings. It is difficult to evaluate specific energy efficiency building projects since the necessary workload is high and the results can be seen as dubious with no convincing baseline for comparison.

The survey on heating energy consumption for office buildings in Beijing shows that the energy consumption for similar office buildings can vary with differences of two or three times. The average energy consumption is about 87 kWh/m^2, with the highest being 149 kWh/m^2 and the lowest at 16 kWh/m^2.

3) The difference between design standards and actual operation performance

There is difference between the design standards and actual operation performance. There is no problem for single energy efficiency technology, but it hard to guarantee the building energy efficiency quality because of the variety of aspects. The quality of energy-efficient houses should be guaranteed by the various aspects including design, construction, supervision and acceptance checks. According to a survey conducted by the Ministry of Housing and Urban Rural Development of 16 provinces and cities on their 3,000 ongoing construction buildings, about 80 – 90% met the energy efficiency standard for new buildings in the heating region in the north at the design stage, while about 50% met the standard at the construction stage. However, fewer than 15% of buildings reached the energy standard of 50% when put into operation.

According to continuous monitoring conducted by the China Academy of Building Research on energy-efficient buildings in Beijing during the heating period of 2003 to 2005, the actual energy efficiency of buildings meeting the energy efficiency standard of 50% was only 37%; and only 7.2% of buildings met an energy efficiency standard of 30%. This shows that there were still major issues in building quality and only a small percentage were consistent with energy-efficient buildings of 50%.

During the Eleventh Five Year Plan period, the percentage of new buildings meeting the energy efficiency standard increased greatly during the design and construction stages. Over 95% met the standard and were, 42% and 71% respectively higher than those in 2005. However, energy efficient buildings only make up 23% of the total existing buildings in urban areas and the mandatory energy efficiency standard is low to some extent. Even with the ongoing three-step plan, the standard is only equal to the level of Germany in the early 1990's, while the energy consumption per unit floor space is twice that of Germany. Old buildings in the north are still fairly uncomfortable and the share of district heating is less than 50%. (The Twelfth Five-Year Plan on Building Energy Efficiency, 2012)

6 The specific methodology and emission standard for buildings

At present, the following methodology and international emissions standard are used in preparation for the energy efficiency renovation of existing buildings in northern China.

Methodology: heating energy-efficiency retrofit for existing buildings

International standard: International standard for building carbon emission calculation

Compilation of the baseline calculation tools and a case study have been completed. The report has been the NDRC.

The international standard is at the design stage of standardisation, and the approach is to use a full life cycle assessment, which still has a long way to go to achieve actual application. In particular, the calculation of carbon emissions in buildings requires a long time if a third party is to accept this standard.

6.1 Emission reduction methodology of heating energy efficiency retrofits for existing buildings

This methodology is sponsored by Germany's GIZ and China's Ministry of Housing and Urban Rural Development. Currently a draft version has been completed with an ample supply of research on samples. The draft has been submitted to the Ministry of Housing and Urban Rural Development but not to the NDRC climate division. Therefore it is still uncertain if this methodology can be applicable in the China carbon market or the CCER market.

Conditions for the application of this methodology are energy-efficient retrofits of heating systems in existing buildings in the north, including their heating supply systems and envelope structure. The improvement is mainly from envelope structure since the improvements reduce the demand for heat. Before the retrofits, the baseline was 18°C. Since the comfort level of a building is hard to quantify, it is not considered. By using the actual measurements of buildings in Tangshan, Hebei Province, per unit floor space can save 30% of the energy after retrofits.

As there is no heat metering instrument for most buildings before retrofits, the setting of baseline emissions is calculated through empirical formula and the project activity emission after retrofits is monitored and measured. The basic approaches of setting baseline emissions are as follows:

On the basis of a large number of samples, the per unit heating energy consumption can be provided for 10 types of retrofitted buildings in 210 cities in the north, given the three key factors including layers of building, thickness of the walls and types of wall material and by classifying existing buildings into 10 – 16 types considering heat loss, internal heat gain, days for heating and local weather information.

According to a case study using this methodology, buildings of about 1 million square metres with 4 – 8 layers, have an annual emission reduction of about 9,000 tCO_2 and the emission reduction scale is relatively small. Based on the estimated price in the carbon market of RMB 50/tCO_2, the revenue from the annual emission reduction is about RMB 450,000.

The advantage of this methodology is that it simplifies the setting of baseline emissions for residential buildings and it is easy to calculate the baseline emission if the building type is known. As long as the parameters, including the days for heating and local weather information are provided by professional institutions and can be publically accessed, the methodology can be applied more easily since the project emissions can be easily obtained after the actual energy consumption is monitored.

There are also potential issues for the methodology. It is commonly understood that the actual measurement result after retrofitting is in accordance with the calculation using the methodology tools, with a variance of about 5%. However, there is still uncertainty between the actual heating energy consumption before retrofits and the baseline emissions calculation (the uncertainty among samples is about 20 – 40%). This can be attributed to the complexity in the heating supply system including the uncertainty of resident behaviours. This issue can be mitigated by experience and sample accumulation so that the uncertainty in the setting of baseline emissions can be reduced to an acceptable level.

6.2 International standard for carbon emissions calculations in buildings

Environmental performance of buildings — Carbon metrics of buildings, ISO/TC 59/SC 17/WG 4 is the actual name of the standard. This is an ISO standard and its major objective is to provide unified methods in the calculation of carbon emissions in buildings. The China Institute of Building Standard Design & Research (CIBSDR), playing the role of management for China's standards, is involved in part of the work, as is Tongji University. The establishment of the standard is still ongoing since the cycle of ISO standards is fairly long.

The standard, even if it is established, should provide some general key principles but not go into the implementation stage. At present, the China Architecture Design & Research Group (CAG) has carried out detailed research and a draft of the standard was completed in 2013 with some calculation examples.

The calculation cases include residential and public/commercial buildings and both new and existing buildings. The emission calculation employs the full life cycle analysis method, covering the energy consumption and emissions from various aspects of building materials and operations, which is quite complicated. Non-building professionals could not use this method.

7 Prospects of building energy-efficiency and emission-reduction projects in the China carbon market

7.1 Barrier analysis of building energy-efficiency and emission-reduction projects participating in the carbon market

In addition to the barriers that exist in building methodology as stated above, the others are summarised as follows.

1) Investment barriers

Building energy-efficiency develops slowly because the initial high cost of implementing it in new buildings as well as for renovations to existing buildings create investment barriers. According to some statistics, the investment per square metre of newly built residential buildings with 50% energy savings in northern towns is about RMB 100 higher than that of local commonly designed standards from 1980/1981 (only covering the building envelope structure). If the cost of the heating system renovation and heat metering at RMB 50/m^2 is added, the total cost of RMB 150/m^2 is about 10% of the construction cost. If this were to be increased to a 65% energy-efficiency standard, the cost would be increased by about 12 - 14% (similar to that stated in the Twelfth Five-Year Plan on building energy-efficiency) meaning that the renovation cost of the envelope structure, heat metering and pipeline heat balance would be over RMB 220/m^2. As for energy-efficiency renovation for existing buildings, based on the GTZ's demonstration projects in Tangshan, Hebei Province, the average cost of a heating system renovation is RMB 590/m^2, and the average cost of using insulation measures to achieve an energy-saving effect is RMB 200/m^2. Correspondingly, the cost of carbon dioxide emission reduction of insulation measures is equivalent to RMB 3,400/tCO_2. If one were to include the energy-efficiency renovation of boilers and pipe networks, the emission reduction cost would reach RMB 6,480/tCO_2. This emission reduction cost is far higher than the price of CCER in the current domestic pilot carbon market, which is RMB 40 - 60/tCO_2 and also far higher than the emission reduction of renewable energy alternatives to coal-fired electricity, which is about RMB 200/tCO_2.

2) Difficult to coordinate the stakeholders

Energy-efficient building stakeholders including building developers, building operators, housing owners, and energy bill payers often have differences and inconsistent interests, creating the problem that energy-efficiency investment and benefit are inconsistent and difficult to coordinate with stakeholders. Generally, developers have no enthusiasm for building energy-efficient buildings and the public pays little attention to building energy-efficiency. Improvements to energy efficiency don't benefit the project developer directly since he is not the direct user so the developer loses enthusiasm for developing energy-efficiency projects. This is the contradiction that is faced by investors and users in building energy-efficiency. For existing residential buildings, dispersed ownership and lack of management resources and organisational capacity are the problem. For new buildings, developers are really concerned about the selling points and profitability of buildings, not the energy-efficiency technical measures and their effects.

Energy savings in residential buildings are remarkable when there is strict compliance with the standards for energy-efficiency but the cost will also go up by about 10%. Accordingly, at the same selling price, the developer's profit will be reduced by about 10% lowering the developer's enthusiasm. If this cost can be transferred to the final buyers, the selling price could encompass the developer's cost to make them more cooperative but the recovery time for the buyer's initial energy-efficiency cost investment is very long with a high degree of uncertainty so the buyer does not want to pay extra cost. Therefore, many domestic energy-efficient residential demonstration communities depend on overseas development companies and government funds to subsidise the incremental cost in order to make the housing sales price more acceptable.

3) Management barriers, lack of incentive policies

For Chinese energy-efficiency buildings, the first reason for slow progress is the attitude of 'the developer unwilling, people do not care' caused by a weakness in government supervision. The main reason is that the existing laws and regulations are inadequate and there is not enough enforcement. During the past 20 years of rapid residential building growth, the popularity rate of energy-efficient residential property is very low in many cities. Because of the large investment required for new building and renovations, it is difficult to reach the targets when relying solely on the will of building developers and final users, so relevant economic policies by the government are needed to encourage and guide the market and optimise the resources allocation.

The economic incentive policies for existing energy-efficiency buildings are insufficient and no market mechanism has been formed to promote energy-efficiency buildings. This has led to the insensitivity of the real estate development market to the index of energy efficiency and a low degree of ordinary consumer attention to this matter.

The most important measure, heating metering, develops slowly and affects the overall development of energy-efficient buildings. Because heating companies charge based on floor space, building owners do not have the motivation to save heating energy because, even with energy-saving, payments are no less.

4) **Emission-reduction scale is too small, transaction cost is too high**

Although there is interest in building energy-efficient projects participating in the carbon market, it is difficult to make significant progress in the short term because of the small emission-reduction scale and the high transaction cost.

The transaction cost is often regarded as a small factor and ignored in evaluations of emission-reduction benefits, but due to the complexity of building energy-efficiency, it plays a very important role in the carbon market competition. For large public/commercial buildings which often only have a building owner or manager, it is relatively easy to carry out the work required. But even so, CDM project experience shows that projects with annual emission-reductions below 10,000 tCO_2 find it difficult to cover the transaction cost from CDM revenue. For residential building projects, due to the necessity for coordination of the unit owners and varying energy consumption in each household, the energy-efficiency renovation costs and the sharing of energy-efficiency revenue will actually lead to higher transaction costs providing no economic attraction to the coordinator.

Taking the Beijing residential community as an example, assume a 50% heating energy-saving every heating season with a saving of heating energy at 12.5 kgce/m^2. If each residential household averages 100 square metres, each annual household energy-saving would be 1.25 tce and the annual emission reduction would be 3.3 tCO_2. To reach a CDM small scale project threshold, the annual emission-reduction can be no more than 60,000 tons of CO_2, and the residential community floor space would be about 1.8 million square metres, involving 18,000 households. Even according to the simplified procedure of CDM small projects, the transaction cost of the application – registration to issuance would be more than RMB 1 million, and this cost does not include the monitoring costs during the implementation period.

In order to make building energy-efficiency projects more attractive, the project must have a certain scale for emission reduction. As well, the revenue of emission reduction must be at least enough to cover the relevant transaction cost by the coordinator which includes the expenditure for the project application, review and approval, design, validation and verification. Therefore, after considering transaction costs, there is a certain emission reduction threshold for building energy-efficiency projects. The current pilot market price of the allowance is RMB 50/tCO_2, which means the scale of the annual emission reduction must be more than 20,000 tCO_2, equivalent to the residential floor space of 600,000 square metres or 6,000 households.

The main barrier of the transaction cost comes from the project itself (emission reduction supplier) since the emission reduction exchange and the buyer transaction costs are relatively low. The management fee of the exchange is low – similar to that of a stock exchange. And it also provides an open and transparent transaction platform which is easy for a buyer to navigate. Therefore, the cost for the exchange fee and finding a buyer can be negligible. However, the development cost for the emission-reduction supplier is greatly different from other sectors because projects with a large emission reduction scale, simple methodology and mature market experience (such as power and industrial sector projects) have relatively low transaction costs. In contrast under the current rules for CCER, suppliers of building, transportation, forestry and other energy projects have a much higher development cost. This situation can be improved by opening the carbon trading market, accumulating experience and improving methodology so that the costs will be reduced to reasonable levels and are more acceptable. Aside from that, when development costs are lower, project quality can be guaranteed through random inspection, independent third party verification and other means.

7.2 Related Regulations on Energy Conservation and Emissions Reduction in the Building Sector

In April 2008, the Energy Conservation Law of the People's Republic of China was promulgated with revised implementation, especially one chapter with seven clauses that specified the supervision and administration of building energy-efficiency work and the main tasks. Both the original and the revised one provide a legal basis for building energy conservation.

In October 2008, the residential building energy efficiency regulations were enacted as specialised laws and regulations to guide building energy conservation work. Six chapters and 45 articles detailed regulations on the supervision and administration of building energy efficiency, their working content and responsibility. The promulgation and implementation of the residential building energy-efficiency regulations promote comprehensive work on building energy conservation and its legalisation throughout the country.

The building energy efficiency standards system is improving and basically covers all aspects of the design, construction, acceptance, operation and management. It covers new residential and public buildings and existing residential and public building energy retrofits (The

Twelfth Five Year Plan on Building Energy Efficiency, 2012).

However, new building energy efficiency standards are implemented differently. Overall, during the period of the Eleventh Five Year Plan, China's implementation of building energy conservation standards was to reach a 50% energy-savings, which meant that the energy-efficiency standard level was still relatively low. From the implementation results of the building energy efficiency standard, the construction phase was worse than in the design phase, small and medium-scale cities were worse than large cities, less developed areas were worse than economically developed areas. Among them, buildings built before 2000 are less energy-efficient. On average, the wall thermal insulation performance of residential buildings is only 1/3 that of developed countries at the same latitude in Europe. Estimates are that more than 2 billion square metres of existing buildings in the north need to be retrofitted.

In addition to the related regulations of building energy conservation, the current domestic pilot carbon markets have actually large public buildings emissions. In Beijing, for example, a public building of more than 20,000 square metres has been included as a major control emitter. Therefore, from this perspective, the rest of the energy efficiency and emission reduction projects in the building sector can participate in the carbon market through the offset mechanism.

In general, building sector projects do not hold a strong economic attraction in the carbon market. CCER aims to find a way for CDM projects but current pilot carbon markets have set certain limitations so it is still a limited market for CCER. In addition, in the pilot carbon market in Beijing, large public buildings have been incorporated into the allowance market so large public buildings may become carbon market demanders, rather than the originally expected supplier. There is limited potential for other residential buildings to participate in the carbon market but, if regional integration, such as the integration of the Beijing-Tianjin-Hebei region were to be considered in the future, energy-efficiency emission reduction projects in the building sector could change that.

Although the indirect emissions from the building sector may also be included in the allowance market, there are no double counting issues because when determining the baseline emission, indirect emissions are included. For a specific project, as long as the emission sources are consistent before and after, there is no impact on the project. Furthermore, the reasons for this approach is that the current domestic electricity price cannot be transferred to final consumers when adding the emission cost to power companies; therefore, the direct and the indirect emissions in the carbon market are considered to promote the realisation of domestic energy conservation and emissions reduction targets and to avoid double counting issues through technical measures.

7.3 The prospect of building projects participating in the carbon market

Building projects are already participating in the carbon market. In Beijing, for example, there are more than 400 emission control enterprises participating in the carbon market. Among them, nearly half are associated with the building sector, especially large public/commercial buildings. From the exchange perspective, all of the energy-efficiency and emission-reduction projects from the building sector could join in the carbon market for trading – even on a small scale of several tons. For buyers and sellers, the exchange only provides a transparent trading platform. Different types of emission-reduction projects make little difference to the exchange and buyers as long as the carbon price is the same as for other CCER projects.

At the same time, a fact that must be faced is that, under the current rules, the carbon market and carbon trading can't be the inner impetus for energy-efficiency and emission-reduction in the building sector. This is because, through the exchange's platform, the carbon price of the building sector can't be too high otherwise; the building sector can't compete with other carbon emission-reduction projects. Cost-conscious buyers will purchase the cheaper one if the rules allow. Therefore, to maintain comparable carbon market pricing, building projects should focus on improving the competitiveness of the supply of emission reduction.

However, because of the high cost of building emission-reduction compared to that of the power and industry sector, and the fact that the carbon price is probably less than 1/10 of the current building energy-efficiency retrofit cost, the market competitiveness of building energy-efficiency and emission-reduction projects is obviously a lot lower. Attempting to drive building energy-efficiency and emission-reduction development totally through carbon market revenue is unrealistic. With the reform of national resources and energy prices, in the future both the prices of resources and energy will probably rise and government energy-efficiency and emission-reduction efforts will increase, so the carbon market price will probably also rise.

Building energy-efficiency and emission-reduction involves many environmental and external benefits. But market failure issues do exist. A market mechanism cannot and indeed, should not, be the only means of promotion and implementation. It needs to be combined with government regulation but simply relying on government regulation would also not work because ultimately taxes would have to be raised to cover the cost rather than the market mechanism achieving cost efficient emission reduction and low carbon technology promotion.

From another perspective, many energy-efficiency and emission-reduction projects in the building sector have already received massive subsidies from the government and also projects have already been implemented even without carbon market benefits. In these cases, participating in the carbon market would help building energy-efficiency and emission-reduction projects raise the public awareness of these initiatives while reducing the burden of government subsidies. For example, many building energy-efficiency renovation projects are funded by the government and the investment is actually a sunk cost. The carbon market can provide a platform for demonstration and popularisation of energy-efficiency renovation projects and help promote a mentality of energy-efficiency and emission-reduction in society as a whole.

The potential for energy-efficiency and emission-reduction in Beijing from industries is a very small industry sector – the building and transportation sectors provide the main potential for energy efficiency and emission reductions but with an unattractive high cost and low input-output ratio. The coordination cost of the residential building community is very high and difficult to achieve. Even if the government pays for the renovation costs, residents may not accept it for many reasons so the feasibility of the implementation is poor. From the perspective of an offsetting mechanism, energy-efficiency renovation in Beijing's old existing communities has the best potential but would be very difficult to implement.

7.4 Policy suggestions for promoting building energy-efficiency and emission-reduction through the carbon market

1) Improving the classification statistics of building energy-efficiency

There is a shortage of systematic classification statistical data for building energy-efficiency because of the current lack of classified and comparable quantitative data and evaluation of energy-efficiency standards for new buildings and energy-efficiency renovations of existing buildings.

2) Formulating comparable energy-efficiency standards for buildings

By formulating comparable energy-efficiency standards for buildings, it is easy to determine the baseline emissions of energy-efficiency buildings. A deep analysis of the existing building energy consumption based on classification statistics according to categories to determine the baselines of building energy consumption and emissions is required in order to accurate quantify the energy saving and emission reduction of energy-efficiency measures.

3) Simplifying the methodology of building energy-efficiency

Currently, the relevant methodology for building energy-efficiency is too complicated since they are developed mainly from a professional viewpoint on the building sector and the actual application is quite difficult or is difficult to verify by a third-party because it's too complicated and professional. Analysis and research should be carried out to understand the major factors to make it less difficult and the design and emissions reduction calculation should be simplified in order to make it easy for a third-party to validate, verify and promote.

It should combine the historic and benchmark approaches, considering both social fairness and implementation feasibility, which should be the direction for building energy-efficiency and emission reduction projects to take part in the carbon market.

4) Reducing the cost of building energy-efficiency projects

The emission reduction scale of building energy-efficiency is relatively small, meaning that the benefits of emission reduction are also relatively small. Preferential and encouragement policies to lower the cost could improve the attraction of building energy-efficiency projects to take part in the carbon market. Depending on the individual sector characteristics, technical guidance on project development with regard to scope, processes, emission reduction opportunities, and monitoring after registration would be helpful. If possible, technical service teams in the specialised industry need to be established.

5) Encouraging and supporting building energy-efficiency stakeholders to participate actively.

Many steps must be taken to encourage and support building energy efficiency stakeholders. Among these are: establishing policies such as creating a friendly policy environment for building energy-efficiency and offering favourable incentives to enhance competitiveness. Establishing a system of training for building energy personnel training, improving sustainability, publicising building project experience and sharing and facilitating these types of project developments are also necessary.

6) Choosing the right coordinator and management agency

Building energy-efficiency projects requires choosing the appropriate coordinators and management agencies because of the involvement of many project participants and interested parties, such as PoA CDM projects. These coordinators and management agencies should not only carry out the will of the owners with regard to the benefits of energy-efficiency and emission-reduction but also guarantee that they will perform the related obligations (such as cooperating with monitoring). Government agencies and their subordinate bodies, building industry associations, real estate companies, property management agencies, etc. can become coordinators and management agencies. Through market innovation, designing a win-win mechanism will ensure that the project organiser, the project owner and the third-party can all benefit from energy-saving and emissions reduction.

7) Encouraging and supporting specifically the co-benefits of building energy efficiency and emissions reduction

Similar to the transportation energy-efficiency projects and forestry projects, building sector energy-efficiency projects do provide co-benefits which can help to encourage and support these projects. For example, besides energy efficiency and emissions reduction, improvements to the comfort levels of offices and living space is co-beneficial to people's health and well-being.

8) The relationship between the carbon market and government regulations

At present, in addition to the emission controlled enterprises, many financial investment and other agencies take part in the carbon market through investment and speculation by actively finding markets – and this simply can't be ignored. When establishing a carbon market, the government needs to determine how to achieve their targets of domestic energy-efficiency and emissions-reduction as well as achieve industrial transformation and upgrading through the market mechanism. Ultimately, an emission trading system is a way to achieve social targets through a market mechanism, making the government an introducer but not a controller considering that full control not market behaviour.

However, the demand for and dynamics of a carbon market are currently generated by government regulation behaviour. Therefore, the allocation and adjustment of allowances are dominated and regulated by the government, because if the government doesn't make it mandatory, there may be no market and therefore no demand.

Ideally, the carbon market supply should mainly be generated through a market mechanism which will naturally find the lowest cost energy-efficiency and emissions-reduction projects. However, pertinent rules and methodologies should be prepared and compiled by the government.

Acknowledgements

During the preparation of this report, suggestions and comments were received from many experts including: Qi Jiuhong (Beijing Environment Exchange), Liu Gang (China Architecture Design & Research Group), Wang Shuling, Cai Jing (Centre of Energy-efficiency and Emission-reduction in Beijing Transportation), Wei Zhihong (Tsinghua University), Zhou Jian (Tsinghua University), Xu Yue (GIZ), and Bao Yuan(GIZ).

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Annual Report on China Building Energy-efficiency 2014

China Certified Emission Reduction Exchange Info-Platform

http://cdm.ccchina.gov.cn/ccer.aspx

http://cdm.unfccc.int

Appendix 1 Registered Validating and Verifying Entities of CCER and their approved scopes for projects classification

No.	Professional Field	China Quality Certification Center	Guangzhou Saibai Certification Center Co. Ltd.	Zhonghuan Lianhe (Beijing) Certification Center Co., Ltd.	Ministry of Environmental Protection Environmental Protection International Cooperation Center	China Classification Quality Certification., Ltd.	Beijing Zhongchuan Carbon Investment Technology Co., Ltd.	Chinese Academy of Agricultural Sciences	ShenZhen Huace International Certification Co., Ltd.	China's Forestry Science Research Institute of Forestry Science and Technology Information Institute
1	Energy industry (renewable energy/non-renewable energy)	√	√	√	√	√	√	√	√	
2	Energy distribution	√	√	√		√	√		√	
3	Energy demand	√	√	√		√	√		√	
4	Manufacturing	√	√	√	√	√	√		√	
5	Chemical industry	√	√	√	√	√	√		√	
6	Buildings	√		√		√	√		√	
7	Transportation	√	√	√		√	√		√	
8	Minerals	√	√	√		√			√	
9	Metal products	√	√	√		√			√	
10	Liquid fuel emissions (solid fuel, oil and natural gas)	√	√	√		√				
11	Carbon compounds and sulphur hexafluoride production and consumption of liquid emissions	√		√	√	√				
12	Use of solvents	√		√		√			√	
13	Disposal of trash	√	√	√	√	√	√		√	
14	Afforestation and reforestation	√	√	√		√	√	√		√
15	Agriculture	√	√	√			√	√		
16	Carbon capture and storage									

Note: Statistical information as of 4 November 2014

Appendix 2: CCER Methodology

	Methodology Number	VER Methodology Number	Chinese Name	Translated Version Number
The first batch	ACM0002	CM-001-V01	Power generation of renewable energy	Ver.13.0.0
	ACM0005	CM-002-V01	Proportions of mixed material in cement production	Ver.7.1.0
	ACM0008	CM-003-V01	Coal bed methane, coal gas and ventilation and gas recycling used for generating electricity, power, heating or are decomposed through torch or flameless oxidation	Ver.7.0
	ACM0011	CM-004-V01	Fuel material transformation from coal and fuel oil to natural gas	Ver.2.2
	ACM0012	CM-005-V01	Reduction of emissions of greenhouse gas through recycling waste energy	Ver.4.0.0
	ACM0013	CM-006-V01	Reconstruction of low-carbon technology and grid fossil fuel power plants	Ver.5.0.0
	ACM0014	CM-007-V01	Emissions of greenhouse gas in the process of waste water treatment	Ver.5.0.0
	ACM0015	CM-008-V01	Use of non-carbonate raw material to produce cement clinker	Ver.3.0
	ACM0019	CM-009-V01	N2O emissions produced in the process of Nitric acid	Ver.1.0.0
	AM0001	CM-010-V01	HFC-23 waste gas incineration	Ver.6.0.0
	AM0019	CM-011-V01	Substitution of part of the power of renewable energy projects with single fossil fuel power generation projects	Ver.2.0
	AM0029	CM-012-V01	Grid connected electrical generation plants using natural gas	Ver.3.0
	AM0034	CM-013-V01	N2O catalytic decomposition of ammonia nitrate plant oxidation furnaces	Ver.5.1.1
	AM0037	CM-014-V01	Reduction of the setting off or emptiness of associated gas in oil fields to be used as raw material	Ver.2.1
	AM0048	CM-015-V01	New cogeneration projects to supply electricity or heat to multiple users and replacement of fuel grid with high carbon or off-grid steam and electricity production	Ver.3.1.0
	AM0049	CM-016-V01	Gas based energy generation in industrial facilities	Ver.3.0
	AM0053	CM-017-V01	Injection of biological methane into natural gas pipeline network	Ver.3.0.0
	AM0044	CM-018-V01	Improvement of energy efficiency through renovation or institution in industrial or regional heating departments	Ver.2.0.0
	AM0058	CM-019-V01	Introduction of new central heating in a network system	Ver.3.1
	AM0064	CM-020-V01	Recycling or destruction of mine or none-mine methane	Ver.3.0.0
	AM0070	CM-021-V01	Manufacturing of residential energy-saving refrigerators	Ver.3.1.0
	AM0072	CM-022-V01	Alternate fossil fuels with geothermal energy in providing heating	Ver.2.0
	AM0087	CM-023-V01	New natural gas plant that provides electricity to power grids or individual users	Ver.2.0
	AM0089	CM-024-V01	Production of diesel using a mixed feedstock of gas and vegetable oil	Ver.1.1.0
	AM0099	CM-025-V01	Existing cogeneration power plant with installed gas turbine	Ver.1.1.0
	AM0100	CM-026-V01	Combined cycle power plant using solar energy and fuel gas	Ver.1.1.0
	AMS-I.C	CMS-001-V01	Thermal energy production with or without the use of electricity	Ver.19.0
	AMS-I.D	CMS-002-V01	Power generation of grid renewable energy	Ver.17.0
	AMS-I.F	CMS-003-V01	Power energy of self-use and micro grids	Ver.2.0
	AMS-I.G	CMS-004-V01	Production of vegetable oil for use as energy in fixed facilities	Ver.1.0
	AMS-I.H	CMS-005-V01	Production of biodiesel for use as energy in fixed facilities	Ver.1.0
	AMS-II.A	CMS-006-V01	Supply-side energy efficiency improvements on transmission and distribution	Ver.10.0
	AMS-II.B	CMS-007-V01	Energy efficiency and fuel switching measures for industrial facilities	Ver.9.0
	AMS-II.D	CMS-008-V01	Measures to increase efficiency and fuel material transformation in industrial facilities	Ver.12.0
	AMS-II.F	CMS-009-V01	Measures to increase efficiency and fuel material transformation in agricultural facilities	Ver.10.0
	AMS-II.G	CMS-010-V01	Efficiency measures that use non-renewable biomass	Ver.4.0
	AMS-II.J	CMS-011-V01	Demand-side efficient lighting technologies	Ver.4.0
	AMS-II.L.	CMS-012-V01	Efficient outdoor and street lighting	Ver.01

	AMS-II.N	CMS-013-V01	Installation of energy-saving lights or control device in buildings	Ver.1.0
	AMS-II.O	CMS-014-V01	Dissemination of efficient household appliances	Ver.1.0
	AMS-III.AN	CMS-015-V01	Conversion of fossil fuel in existing manufacturing	Ver.2.0
	AMS-III.AO	CMS-016-V01	Recycling of methane through controlled anaerobic decomposition	Ver.1.0
	AMS-III.AU	CMS-017-V01	Reduction of methane emissions through adjustments to water supply management in rice cultivation	Ver.3.0
	AMS-III.AV	CMS-018-V01	Water purification systems in treating emissions of low greenhouse gases	Ver.3.0
	AMS-III.Z	CMS-019-V01	Fuel conversion, improvement and energy efficiency in the production of brick	Ver.4.0
	AMS-III.BB	CMS-020-V01	Supply of electricity to communities through the expansion of power grids and new micro power grids	Ver.1.0
	AMS-III.D	CMS-021-V01	Methane recycling in animal waste management	Ver.19.0
	AMS-III.G	CMS-022-V01	Landfill gas collection	Ver.8.0
	AMS-III.L	CMS-023-V01	Avoidance of biomass decay production of methane by controlling pyrolysis	Ver.2.0
	AMS-III.M	CMS-024-V01	Reduction of electricity consumption through soda produced in the process of recycling paper	Ver.2.0
	AMS-III.Q.	CMS-025-V01	Waste energy recycling project (waste gas/waste heat/waste pressure)	Ver.4.0
	AMS-III.R	CMS-026-V01	Methane recycling of family or small farm agricultural activity	Ver.3.0
The second batch	Methodology Number		Name of The Methodology	
	AR- CM-001-V01		Methodology in Carbon Sequestration Forestation Projects	
	AR- CM-002-V01		Methodology in Bamboo Reforestation Carbon Sink Projects	
The third batch	Voluntary Emissions Methodology of Regular Projects			
	CDM Methodology Number	Voluntary Emissions Methodology Number	Chinese Name	Translated Version Number
	ACM0007	CM-027-V01	Single cycle transformation into a combined cycle power generation	Ver.06.1.0
	ACM0016	CM-028-V01	High-speed bus projects	Ver.03.0.0
	AM0009	CM-029-V01	Set off or empty recycled associated gas in oil fields	Ver.06.0.0
	AM0014	CM-030-V01	Natural gas cogeneration	Ver.4.0
	AM0028	CM-031-V01	Destruction of N2O in the tail gas of caprolactam production plants	Ver.05.1.0
	AM0031	CM-032-V01	High-speed bus system	Ver.04.0.0
	AM0035	CM-033-V01	SF6 emission in power grid	Ver.01
	AM0061	CM-034-V01	Innovation and energy efficiency of existing power plants	Ver.2.1
	AM0088	CM-035-V01	Separation of air through cold energy in LNG gasification	Ver.1.0
	AM0097	CM-036-V01	Installation of high voltage direct current transmission lines	Ver.1.0.0
	AM0102	CM-037-V01	Cooperation facility supplying electricity & steam to an industrial consumer and exporting excess electricity to a grid or project customer	Ver.1.0.0
	AM0107	CM-038-V01	New gas cogeneration power plants	Ver.2.0
	AM0017	CM-039-V01	Improvement of efficiency of steam systems through steam valve replacement and condensed water recovery	Ver.2.0
	AM0020	CM-040-V01	Improvement of energy efficiency in pumping	Ver.2.0
	AM0023	CM-041-V01	Reduction of leakages in gas compressors or gates	Ver.4.0.0
	AM0043	CM-042-V01	Reduction of gas pipeline leakage through adoption of polyethylene to replace old cast iron pipe	Ver.2.0
	AM0046	CM-043-V01	Distribution of efficient light bulbs to households	Ver.2.0
	AM0050	CM-044-V01	Ammonia - raw material conversion in urea production	Ver.3.0.0
	AM0055	CM-045-V01	Waste recycling in refineries	Ver.2.0.0

	AM0063	CM-046-V01	Replacement of fossil fuels used in the production of CO_2 to recycle CO_2 recycled from industrial wasted gas	Ver.1.2.0
	AM0065	CM-047-V01	Use of other protective gases to replace SF6 in the magnesium industry	Ver.2.1
	AM0071	CM-048-V01	Residential refrigerator manufacturing and maintenance using low GWP value refrigerant	Ver.2.0
	AM0074	CM-049-V01	Building of new grid connected power plants by using permeate gas previously flared and/or vented	Ver.3.0.0
	AM0078	CM-050-V01	Point of use abatement device for reduction of SF6 emissions in LCD manufacturing operations	Ver.2.0.0
	AM0090	CM-051-V01	Cargo transportation shift from road transport to water or railway transport	Ver.1.1.0
	AM0091	CM-052-V01	Energy efficiency and fuel conversion in newly built buildings	Ver.1.0.0
	AM0092	CM-053-V01	Substitution of perfluorinated compounds (PFC) gases for cleaning chemical vapor deposition (CVD) reactors in the semiconductor industry	Ver.1.0.0
	AM0096	CM-054-V01	Installation of emission reductions of CF4 in semiconductor production facilities	Ver.1.0.0
	ACM0017	CM-055-V01	Production of biodiesel for use as fuel	Ver.2.1.0
	AM0018	CM-056-V01	Optimisation of steam systems	Ver.3.0.0
	AM0021	CM-057-V01	Decomposition of N2O in existing adipic acid	Ver.3.0
	AM0027	CM-058-V01	Replacement of fossil or mineral sources of CO_2 with renewable alternative sources of CO_2 in the production of inorganic compounds	Ver.2.1
	AM0030	CM-059-V01	Reduction of PFC emissions by reducing the anode effect in aluminum smelting	Ver.4.0.0
	AM0045	CM-060-V01	Net connection for independent grid systems	Ver.2.0
	AM0051	CM-061-V01	Secondary catalytic decomposition of N2O in nitric acid plants	Ver.2.0
	AM0059	CM-062-V01	Reduction of greenhouse gas emissions in aluminum smelting furnaces	Ver.1.1
	AM0062	CM-063-V01	Improvement of the energy efficiency of power plants through retrofitting of turbines	Ver.2.0
	AM0076	CM-064-V01	Implementation of cogeneration projects on fossil fuels in existing industrial facilities	Ver.1.0
	AM0077	CM-065-V01	Recycling of emptied or set off oil gas and supplying it to end users	Ver.1.0
	AM0079	CM-066-V01	Use of insulated electrical equipment to recycle SF6 in testing facilities	Ver.2.0
	AM0095	CM-067-V01	Combined cycle power generation based on new steel mill waste gas	Ver.1.0.0
	AM0098	CM-068-V01	Use of ammonia plant off gas to produce steam	Ver.1.0.0
	AM0101	CM-069-V01	High-speed passenger rail systems	Ver.1.0.0
	ACM0003	CM-070-V01	Use of alternative fuels or part of low carbon fuels to replace fossil fuels in cement or lime production	Ver.7.4.1
	AM0007	CM-071-V01	Lowest cost analysis of seasonal biomass cogeneration plants	Ver.1.0
	ACM0022	CM-072-V01	Alternative waste treatment processes	Ver.1.0.0
	AM0036	CM-073-V01	Use of biomass waste alternatives to replace fossil fuels in heating boilers	Ver.4.0.0
	AM0038	CM-074-V01	Improvement of the efficiency of electric current submerged arc furnaces in the processing of silicon alloy and ferroalloy production	Ver.3.0.0
	ACM0006	CM-075-V01	Biomass waste cogeneration projects	Ver.12.1.0
	AM0042	CM-076-V01	Grid connected electricity generation using biomass from newly developed dedicated plantations	Ver.2.1
	ACM0001	CM-077-V01	Landfill gas projects	Ver.13.0.0
	AM0054	CM-078-V01	Improvement of the efficiency of boilers by introducing oil/water emulsion technology	Ver.2.0
	AM0056	CM-079-V01	Improvement of energy efficiency through the replacement or modification of fossil fuel steam boilers or possible alternative fuels	Ver.1.0
	AM0057	CM-080-V01	Avoidance of emissions from biomass waste used as feed stock in pulp and paper, cardboard, fiberboard and bio-oil production	Ver.3.0.1
	AM0060	CM-081-V01	Power saving through replacement of energy efficient chillers	Ver.1.1
	AM0066	CM-082-V01	Reduction of greenhouse gas emissions by using waste heat in the preheating of raw materials in sponge iron production	Ver.2.0
	AM0067	CM-083-V01	Installation of efficient transformers in distribution grids	Ver.2.0
	AM0068	CM-084-V01	Innovation of ferroalloy production facilities to improve energy efficiency	Ver.1.0
	AM0069	CM-085-V01	Use of bio-based methane as raw material and fuel for the production of city gas	Ver.2.0
	AM0073	CM-086-V01	Reduction of emissions of greenhouse gases through collective treatment after collection from multiple sites	Ver.1.0
	ACM0009	CM-087-V01	Fuel switching from coal or oil to natural gas	Ver.4.0.0
	AM0080	CM-088-V01	Reduction of emissions of greenhouse gases by treating sewage in aerobic waste water treatment	Ver.1.0
	AM0081	CM-089-V01	Flare or vent reductions at coke plants through their conversion of waste gas into dimethyl ether for use as fuel	Ver.1.0
	ACM0010	CM-090-V01	Greenhouse gas emissions from waste management systems	Ver.2.0.0

AM0083	CM-091-V01	Avoidance of landfill gas emissions through ventilation	Ver.1.0.1
ACM0018	CM-092-V01	Electricity generation from biomass waste in power-only plants	Ver.2.0.0
ACM0020	CM-093-V01	Co-use of biomass waste products for heat or power generation grid connected power plants	Ver.1.0.0
AM0093	CM-094-V01	Avoidance of landfill gas emissions through passive ventilation	Ver.1.0.1
AM0094	CM-095-V01	Distribution of biomass based stoves and/or heaters and the supply of biomass briquettes for household or institutional use	Ver.2.0.0
Voluntary Emissions Methodology for Small Projects			
CDM Methodology Number	Voluntary Emissions Methodology Number	Chinese Name	Translated Version Number
AMS-I.J	CMS-027-V01	Solar water heating (SWH systems)	Ver.1.0
AMS-I.K	CMS-028-V01	Household solar cooker	Ver.1.0
AMS-II.E	CMS-029-V01	Measures on energy efficiency and material conversion of buildings	Ver.10.0
AMS-III.AQ	CMS-030-V01	Introduction of biological compressed natural gas in transportation	Ver.1.0
AMS-II.K	CMS-031-V01	Combined heat and power cogeneration systems providing energy to commercial buildings	Ver.2.0
AMS-III.AG	CMS-032-V01	Transformation from use of high carbon grid power to low carbon fossil fuels	Ver.2.0
AMS-III.AR	CMS-033-V01	LED lighting systems replacing lighting based on fossil fuels	Ver.3.0
AMS-III.AY	CMS-034-V01	Introduction of LNG buses to existing and new bus routes	Ver.1.0
AMS-I.B	CMS-035-V01	Mechanical energy for the user with or without electrical energy	Ver.10.0
AMS-I.L	CMS-036-V01	Electrification through the use of renewable energy in rural communities	Ver.1.0
AMS-II.H	CMS-037-V01	Improvement of energy efficiency by centralising facilities which provide energy services to industrial equipment	Ver.3.0
AMS-II.I	CMS-038-V01	Efficient utilisation of waste energy from industrial equipment	Ver.1.0
AMS-III.AA	CMS-039-V01	Use of technology to improve traffic efficiency	Ver.1.0
AMS-III.AB	CMS-040-V01	Avoidance of HFC emissions in stand-alone commercial refrigeration units	Ver.1.0
AMS-III.AE	CMS-041-V01	Improvement of energy efficiency and renewable energy utilisation in new residential buildings	Ver.1.0
AMS-III.AI	CMS-042-V01	Reduction of emissions by recycling used sulfuric acid	Ver.1.0
AMS-III.AK	CMS-043-V01	Biodiesel production and utilisation in transportation	Ver.1.0
AMS-III.AL	CMS-044-V01	Conversion of single-cycle to combined cycle power generation	Ver.1.0
AMS-III.AM	CMS-045-V01	Fossil fuel switch in a cogeneration/trigeneration system	Ver.2.0
AMS-III.AP	CMS-046-V01	Improvement in traffic efficiency by using post-fit idle stop devices	Ver.2.0
AMS-III.AT	CMS-047-V01	Improvements to energy efficiency through the installation of digital tachographs on commercial vehicles	Ver.2.0
AMS-III.C	CMS-048-V01	Emissions reduction achieved by electric and hybrid cars	Ver.13.0
AMS-III.J	CMS-049-V01	Avoidance of fossil fuel combustion for CO_2 produced as a raw material for industrial processes	Ver.3.0
AMS-III.K	CMS-050-V01	Avoidance of methane release from coke production through mechanisation	Ver.5.0
AMS-III.N	CMS-051-V01	Avoidance of HFC emissions in the production of polyurethane rigid foam	Ver.3.0

	AMS-III.P	CMS-052-V01	Recycling and utilisation of exhaust gases in smelting facilities	Ver.1.0
	AMS-III.S	CMS-053-V01	Introduction of low emissions vehicles/technology to commercial car teams	Ver.3.0
	AMS-III.T	CMS-054-V01	Production of vegetable oil and its utilisation in transportation	Ver.2.0
	AMS-III.U	CMS-055-V01	Cable cars for use in mass rapid transit systems	Ver.1.0
	AMS-III.W	CMS-056-V01	Methane capture and destruction in non-hydrocarbon mining activities	Ver.2.0
	AMS-III.X	CMS-057-V01	Increase to household refrigerator energy efficiency and recycling of HFC-134a	Ver.2.0
	AMS-I.A	CMS-058-V01	Self-power generation projects	Ver.15.0
	AMS-III.AC	CMS-059-V01	Generation of power or heat by fuel cells	Ver.1.0
	AMS-III.AH	CMS-060-V01	Conversion from high carbon to low carbon fuels	Ver.1.0
	AMS-III.AJ	CMS-061-V01	Recycling of material from solid waste and reuse	Ver.3.0
	AMS-I.E	CMS-062-V01	Switch from non- renewable biomass for thermal applications by users	Ver.4.0
	AMS-I.I	CMS-063-V01	Family/small user apply biogas/biomass to produce heat	Ver.4.0
	AMS-II.C	CMS-064-V01	Demand-side energy efficiency activities for specific technology	Ver.13.0
	AMS-III.V	CMS-065-V01	Installation of installed dust/waste recycling systems in steel mills to reduce the consumption of coke in their blast furnaces	Ver.1.0
	AMS-III.A	CMS-066-V01	Reduction of the use of synthetic nitrogen fertilizers by using inoculants in the cycle of bean and grass planting in existing acidic soil	Ver.2.0
	AMS-III.AD	CMS-067-V01	Reduction in hydraulic lime production	Ver.1.0
	AMS-III.AF	CMS-068-V01	Avoidance of methane emissions by excavating and composting rotten municipal solid waste (MSW)	Ver.1.0
	AMS-III.AS	CMS-069-V01	Conversion of fossil fuels to biomass in existing manufacturing facilities	Ver.1.0
	AMS-III.AW	CMS-070-V01	Supply of power to rural communities through grid expansion	Ver.1.0
	AMS-III.AX	CMS-071-V01	Construction of a methane oxidation layer in solid waste disposal sites	Ver.1.0
	AMS-III.B	CMS-072-V01	Fossil fuel conversion	Ver.16.0
	AMS - III.BA	CMS-073-V01	Recycling and reuse of electronic waste	Ver.1.0
	AMS-III.Y	CMS-074-V01	Separation of solids from sewage or waste treatment systems to avoid methane emissions	Ver.3.0
	AMS-III.F	CMS-075-V01	Avoidance of methane emissions through composting	Ver.11.0
	AMS-III.H	CMS-076-V01	Recycling of methane from waste treatment	Ver.16.0
	AMS-III.I	CMS-077-V01	Use of alternative anaerobic and aerobic systems to avoid the generation of methane in the process of waste water treatment	Ver.8.0
	AMS-III.O	CMS-078-V01	Use of extracted methane from marsh gas to produce hydrogen	Ver.1.0
	Voluntary emissions methodology for agriculture and forestry projects			
	Methodology Number		Methodology Name	
	AR-CM-003-V01		Carbon Sink Project Methodology on Forest Management	
	AR-CM-004-V01		Gas Emissions Measurement and Monitoring Methodology on Sustainable Grassland Management	
The fourth batch	Methodology Number		Methodology Name	
	CM-096-V01		Gas Insulated Metal-enclosed SF6 Combination Emissions Measurement and Monitoring Methodology	

Note: Statistical information as of 4 November 2014.

Appendix 3 registered CCER projects

Code	Name	Type	Place	Annual Estimated Emission Reduction	/tCO_2e Total Emission Reduction During Monitoring Period	Owner	is owner belong to "enterprises"	Project types
001	Xiangyang Wind Power Projects in Anxi	Energy Industry	Gansu Province	88,842	1,430,039	Gansu Xinan Wind Power Co., Ltd.	NO	III
002	300 MW of Wind Power Projects in Bayannur	Energy Industry	Inner Mongolia Autonomous Region	759,771	331,045	Mongolia Jing Energy Wind Power Co., Ltd.	NO	III
003	First Phase 49.5 MW Project in Sun Mountain Wind Power Plant	Energy Industry	Ningxia Autonomous Region	80,789	71,050	Ningxia Jing Energy New Energy Co., Ltd.	NO	III
004	Hydropower Project in Xiangqi, Yongzhou	Energy Industry	Hunan Province	230,154	209,345	Huaneng Hunan Xiangqi Hydropower Limited Liability Company	NO	III
005	49.5 MW Wind Power Project in Qianguo Wangfu Station Wind Plant	Energy Industry	Jilin Province	97,174	159,472	The Qianguo Fuhui Wind Power Co., Ltd.	NO	III
006	Silin Hydropower Station in Wu River	Energy Industry	Guizhou Province	2,298,814	2,229,535	Guizhou Wu River Hydropower Development Co., Ltd.	NO	III
007	Seergu Hydropower Project	Energy Industry	Sichuan Province	432,880	347,490	Aba Hydropower Development Co., Ltd.	NO	III
008	China's Liuping Hydropower Project	Energy Industry	Sichuan Province	341,043	435,414	Aba Hydropower Development Co., Ltd.	NO	III
009	Shawan Hydropower Project in Dadu River	Energy Industry	Sichuan Province	1,173,838	2,051,805	Sichuan Shengda Hydropower Development Co., Ltd.	NO	III
010	CMM Power Generation Project in Panjiang	Liquid fuel emissions (minerals and fossil fuels)	Guizhou Province	452,904	1,443,088	Guizhou Panjiang Coal Bed Methane Development And Utilization Limited Liability Company	NO	III
011	The Second Phase of Low Concentration CMM Power Generation Project in Panjiang	Liquid fuel emissions (minerals and fossil fuels)	Guizhou Province	328,730	552,988	Guizhou Panjiang Coal Bed Methane Development And Utilization Limited Liability Company	NO	III
012	The third phase of CMM Power Generation Project in Panjiang	Liquid fuel emissions (minerals and fossil fuels)	Guizhou Province	288,093	442,006	Guizhou Panjiang Coal Bed Methane Development And Utilization Limited Liability Company	NO	III
013	The second phase of Power Project in Zhenlai	Energy Industry	Jilin Province	101,673	199,179	MengDong Zhenlai Town The First Wind Power Co., Ltd.	NO	III
014	Jiujie Beach Hydropower Project in Da County	Energy Industry	Sichuan Province	122,798	129,526	Sichuan Bading Energy Development Co., Ltd.	NO	III
015	Hua Jiaopo Hydropower Station in Shangri La County	Energy Industry	Yunnan Province	45,351	145,743	Shangri La County of ZhongJi Energy Co., Ltd.	NO	III

016	Qubei Ganmalu Wind Projects	Energy Industry	Yunnan Province	66,761	10,060	Datang Qiubei Wind Electric Co., Ltd.	NO	III
017	Zi Lingpu Wind Projects in Jinmen	Energy Industry	Hubei Province	76,322	534,254	Jingmen Xiehe Wind Power Co., Ltd.	NO	I
018	The second phase of Wuyueshan Wind Farm Project of CGN in Dawu	Energy Industry	Hubei Province	74,929	524,503	CGN Hubei Dawu Wind Power Co., Ltd.	NO	I
019	Leigufeng Wind Farm Project of CGN in Dawu	Energy Industry	Hubei Province	76,714	536,998	CGN Hubei Dawu Wind Power Co., Ltd.	NO	I
020	49,500 kw Wind Power Project in Ulanqab	Energy Industry	Inner Mogolia Autonomous Region	107,434	94,036	Shangdu County Tianrui Wind Power Co., Ltd.	NO	III
021	Guangdong Changlong Carbon Sink Afforestation Project	Afforestation and reforestation	Guangdong Province	17,365	347,292	Guangdong Cuifeng Landscaping Co., Ltd.	NO	I
022	Yunnan Sayutuo 60MW Hydropower Station	Energy Industry	Yunnan Province	160,873	395,352	Sichuan Yibin Yili Group Hengjiang Power Generation Co., Ltd.	NO	III
023	Xiamen Eastern Gas Power Plant Project	Energy Industry	Fujian Province	752,442	2,838,663	East Asia Power (Xiamen) Co., Ltd.	NO	III
024	The fourth Wind Farm of 200 MW Project of North Bridge in Guazhou	Energy Industry	Gansu Province	449,486	204,311	Jiuquan Jiuquan Huineng Wind Power Development Co., Ltd.	NO	III
025	74 MW Hydropower Project in Hekou	Energy Industry	Gansu Province	244,390	488,780	Gansu Diantou Binglin Hydropower Development Co., Ltd.	NO	III
026	20 MW Grid Photovoltaic Power Projects of The Sun Energy Co., Ltd. in Golmud	Energy Industry	Qinghai Province	27,987	195,909	The Solar Energy (Qinghai) Co., Ltd.	NO	I
027	Fujian LNG CHPP Project	Energy Industry	Fujian Province	65,165	151,754	CNOOC Air Chemical Products (Fujian) Co., Ltd.	NO	III
028	Wind farm project in Quanyangou country	Energy Industry	Liaoning Province	102,464	102,464	Three Gorges New Energy Diaobing Shang Wind Power Co., Ltd.	NO	III
029	Hubei Lichuan Tianshangping 48 MW Wind Power Project	Energy Industry	Hubei Province	68,831	481,817	Three Gorges New Energy Lichuan Wind Power Co., Ltd.	NO	I
030	Hydropower Project in Huogu of Muchuan County	Energy Industry	Sichuan Province	88,527	44,870	Sichuan Muchuan Qixinggu Hydropower Development Co., Ltd.	NO	III
031	The first phase of the Heiyanzi Wind Farm of Hua Energy in Tangshan	Energy Industry	Hebei Province	47,149	330,043	Huaneng New Energy Co., Ltd.	NO	I
032	Bailong River Hydropower Station in Guangyuan	Energy Industry	Sichuan Province	139,955	79,755	Datang Sichuan Chuanbei Electric Power Development Co., Ltd.	NO	III
033	WuYiQiao Hydropower Station in Jiulong County, Ganzi State	Energy Industry	Sichuan Province	373,851	878,806	Sichuan China Railway Energy WuYiQiao Hydropower Co., Ltd.	NO	III
034	Hydroelectric Project in Songlin River, Mianshi County	Energy Industry	Sichuan Province	288,134	572,320	Sichuan Pine River Basin Development Co., Ltd.	NO	III

035	45 MW Wind Power Projects in Sun Mountain	Energy Industry	Ningxia Hui Autonomous Region	73,644	186,027	China Ningxia Energy Group Co., Ltd.	NO	III
036	Oil and Gas Transformation Project of Fengda Electronic Co., Ltd.	Energy Industry	Guangdong Province	68,155	138,364	Huizhou Deep Energy Feng Da Electric Co., Ltd.	NO	III
039	30 MW waste Gas Power Generation Project in Handan	Energy Industry	Hebei Province	122,877	160,919	Handan Black Cat Carbon Black Co., Ltd.	NO	III
040	CHPP Expansion Project of Hua Energy Beijing Thermal Power Plant	Energy Industry	Beijing	277,828	281,634	Huaneng Beijing Thermal Power Co., Ltd.	NO	III
041	2*18 MW Waste Heat Power Generation Project of Conch Cement Co., Ltd. in Wuhu	Energy Industry	Anhui Province	194,830	699,255	Wuhu Conch Cement Co., Ltd.	NO	III
042	Hebei Wuqiao Biomass Power Generation Projects	Energy Industry	Hebei Province	144,552	276,466	China Wuqiao Biomass Power Co., Ltd.	NO	III
043	Biomass Power Generation Projects in Ningyang	Energy Industry	Shandong Province	141,851	275,156	National Energy Ningyang Biomass Power Co., Ltd.	NO	III
044	Hanwang Hydroelectric Project in Bailong River	Energy Industry	Gansu Province	93,352	653,464	Longnan City Hua Transcripts Water and Electricity Co., Ltd.	NO	II
045	49.5 MW Wind Power Project in Erenhot	Energy Industry	Inner Mongolia Autonomous Region	107,359	751,513	Mongolia National Electricity New Energy Co., Ltd.	NO	II
046	49.5 MW Wind Farm Project of Beijing Energy International Co.,Ltd. in Huitengxile	Energy Industry	Inner Mongolia Autonomous Region	110,881	151,114	Mongolia Jing Energy Wind Power Co., Ltd.	NO	III
047	Huaneng Gas Turbine Power Plant	Energy Industry	Shanghai	1,092,688	3,394,817	Huaneng Shanghai Gas Turbine Power Generation Co., Ltd.	NO	III
048	Huaneng Eryuan Shi Pu Pond Wind Farm Project	Energy Industry	Yunnan Province	93,448	654,136	Huaneng Eryuan Wind Power Co., Ltd.	NO	I
049	Huaneng Shamaoshan wind farm project in Dali Prefecture	Energy Industry	Yunnan Province	88,655	620,585	Huaneng WeiShan Wind Power Co., Ltd.	NO	I
050	The second phase of 49.5 MW Wind Farm Project of Beijing Energy International Co.,Ltd. in Huitengxile	Energy Industry	Inner Mongolia Autonomous Region	76,661	59,017	Beijing Jing Energy New Energy Co., Ltd.	NO	III
051	The first phase of 49.5 MW Wind Farm Project in Huolinhe Area B	Energy Industry	Inner Mongolia Autonomous Region	127,801	84,384	Mongolia, Jing Energy Huolingole Wind Power Co., Ltd.	NO	III
052	The first phase of Wind Farms in Shangdu	Energy Industry	Inner Mongolia Autonomous Region	112,727	125,699	Mongolia, Jing Energy Shangdu Wind Power Co., Ltd.	NO	III
053	30 MW Solar Photovoltaic (pv) Grid Power Generation Projects of Um Philippines New Energy Co., Ltd.	Energy Industry	Gansu Province	51,461	30,437	Um Philippines New Energy Co., Ltd. (DCS)	NO	III
054	Wind Power Projects of National Electricity in Diaobingshan	Energy Industry	Liaoning Province	105,861	210,562	National Electricity Hefeng Wind Power Development Co., Ltd.	NO	III
055	Wind Power Projects of National Electricity in Yangtun	Energy Industry	Liaoning Province	102,886	258,484	National Electricity Hefeng Wind Power Development Co., Ltd.	NO	III

056	Wind Power Projects of National Electricity in Fangshan	Energy Industry	Liaoning Province	104,519	262,873	National Electricity Hefeng Wind Power Development Co., Ltd.	NO	III
057	Natural Gas Power Generation Project in Eastern Shenzhen	Energy Industry	Guangdong Province	173,852	753,358	Shenzhen Energy Group Co., Ltd.	NO	III
058	Hydroelectric Project in Kezhou	Energy Industry	Xinjiang Province	125,268	876,876	Kezhou Xinling New Energy Development Co., Ltd.	NO	I
059	Hydropower Project in Dehong	Energy Industry	Yunnan Province	506,690	724,636	Dehong Longjiang Hydropower Development Co., Ltd.	NO	III
060	CGN Wind Farm Project in Wuyueshan	Energy Industry	Hubei Province	82,609	578,263	CGN Hubei Dawu Wind Power Co., Ltd.	NO	I
061	CGNPC Wind Farm Project in Lichuan BaiYangBa	Energy Industry	Hubei Province	76,031	532,217	CGN Hubei Lichuan Wind Power Co., Ltd.	NO	I
062	49.5 MW Wind Power Project in Shangdu County	Energy Industry	Inner Mongolia Autonomous Region	84,809	85,971	Mongolia,Jing Energy Shangdu City Wind Power Co., Ltd.	NO	III
063	10 MW Photovoltaic Roof Grid-connected Power Generation Project in Dingzhou	Energy Industry	Hebei Province	10,305	72,135	Yingli Energy (China) Co., Ltd.	NO	I
064	Hydroelectric Project in Diqing	Energy Industry	Yunnan Province	130,749	275,111	Jianghai of Yunnan Investment and Development Co., Ltd.	NO	III
065	Lu Ding Hydroelectric Project in Dadu River	Energy Industry	Sichuan Province	2,778,853	2,124,109	Sichuan Huadian LuDing Hydropower Co., Ltd.	NO	III
066	Hydropower Station Project of Sichuan Huadian Xihe Electric Development Co., Ltd.	Energy Industry	Sichuan Province	414,172	692,178	Sichuan Huadian Xihe Electric Development Co., Ltd.	NO	III
067	District 50 MW Grid Photovoltaic Power Projects in Liangzhou District of China Hydropower Construction Group New Energy Development Co., Ltd.	Energy Industry	Gansu Province	62,267	19,788	China Hydropower Construction Group Wuwei Photovoltaic Power Generation Co., Ltd.	NO	III
068	Shuijinguan Hydroelectric Project in Ya'an	Energy Industry	Sichuan Province	216,525	494,153	Huadian Ya'an Power Generation Co., Ltd.	NO	III
069	The second phase of 49.5 MW Wind Power Project in Gongsi Bao	Energy Industry	Ningxia Hui Autonomous Region	88,660	84,045	Ningxia Silver Star Energy Co., Ltd.	NO	III
070	Jinzao Bridge Hydropower Station in Pingnan	Energy Industry	Fujian Province	114,765	182,995	Fujian Golden Bridge Hydropower Co., Ltd.	NO	III
071	20 MW Hydropower Station Project in Pingnan	Energy Industry	Fujian Province	44,706	184,205	Pingnan Hengli Hydropower Co., Ltd.	NO	III
072	The first phase of 49.5 MW Sihong Xiehe Wind Farm	Energy Industry	Jiangsu Province	70,816	495,712	Sihong Xiehe Wind Power Co., Ltd.	NO	I
073	The second phase of 20 MW Grid connected Photovoltaic Power Station Project in Pizhou	Energy Industry	Jiangsu Province	18,252	127,764	Han Energy Pizhou Solar Power Co., Ltd.	NO	I
074	9 MW Photovoltaic Power Station Project in Pei County	Energy Industry	Jiangsu Province	8,454	59,178	Peixian Xiehe New Energy Co., Ltd.	NO	I

075	6 MW Photovoltaic Power Station Project of Peixian County Xiehe New Energy Co., Ltd.	Energy Industry	Jiangsu Province	5,571	38,997	Peixian Xiehe New Energy Co., Ltd.	NO	I
076	The first phase of 9.8 MW Photovoltaic Power Station Project in Liulaozhuang, Huaian	Energy Industry	Jiangsu Province	8,804	61,628	Huaian Sino Energy and Environment Photovoltaic Power Co., Ltd.	NO	I
077	Rural Household Biogas Project (HB1) in Laoting County And Luannan County in Tangshan City	Energy Industry	Hebei Province	29,707	104,993	Beijing National Farmers Well-off Low-carbon Industry Investment Co., Ltd.	NO	III
078	Rural Household Biogas Project (HB2) in Fengnan District and Luannan County in Tangshan City	Energy Industry	Hebei Province	29,814	104,145	Beijing National Farmers Well-off Low-carbon Industry Investment Co., Ltd.	NO	III
079	Rural Household Biogas Project (HB3) in Zunhua and Luannan County in Tangshan City	Energy Industry	Hebei Province	34,809	123,885	Beijing National Farmers Well-off Low-carbon Industry Investment Co., Ltd.	NO	III
080	Rural Household Biogas Project (HB4) in Xingtang County and Pingshan County in Shijiazhuang City	Energy Industry	Hebei Province	32,841	116,878	Beijing National Farmers Well-off Low-carbon Industry Investment Co., Ltd.	NO	III
081	Rural Household Biogas Project (HB5) in Xinle County and Gaocheng County in Shijiazhuang City	Energy Industry	Hebei Province	36,241	127,194	Beijing National Farmers Well-off Low-carbon Industry Investment Co., Ltd.	NO	III
082	Rural Household Biogas Project (HB6) in Luancheng County and Gaocheng County in Shijiazhuang City	Energy Industry	Hebei Province	32,184	113,748	Beijing National Farmers Well-off Low-carbon Industry Investment Co., Ltd.	NO	III
083	Rural Household Biogas Project (LN1) in Heishan County, Jinzhou City	Energy Industry	Liaoning Province	26,051	92,924	Beijing National Farmers Well-off Low-carbon Industry Investment Co., Ltd.	NO	III
084	Rural Household Biogas Project (LN2) in Linyuan City	Energy Industry	Liaoning Province	29,846	106,221	Beijing National Farmers Well-off Low-carbon Industry Investment Co., Ltd.	NO	III
085	Rural Household Biogas Project (GX1) in Dahua County, Hechi City	Energy Industry	Guangxi Zhuang Autonomous Region	38,112	135,431	Beijing National Farmers Well-off Low-carbon Industry Investment Co., Ltd.	NO	III
086	Rural Household Biogas Project (GX2) in Leye, Tianlin and Longlin County	Energy Industry	Guangxi Zhuang Autonomous Region	39,563	139,715	Beijing National Farmers Well-off Low-carbon Industry Investment Co., Ltd.	NO	III

087	Rural Household Biogas Project (GX3) in Hepu County, Beihai City	Energy Industry	Guangxi Zhuang Autonomous Region	29,241	104,067	Beijing National Farmers Well-off Low-carbon Industry Investment Co., Ltd.	NO	III
088	Rural Household Biogas Project (GX4) in Fuchuan County and Zhaoping County, Hezhou City	Energy Industry	Guangxi Zhuang Autonomous Region	36,957	129,097	Beijing National Farmers Well-off Low-carbon Industry Investment Co., Ltd	NO	III
089	1* 30 MW Biomass Power Generation Project of Jinan Weiquan Biomass Power Co., Ltd.	Energy Industry	Shandong Province	115,462	808,234	Jinan Weiquan Biomass Power Power Generation Co., Ltd.	NO	I
090	Biomass Power Generation Projects in Jun County	Energy Industry	Henan Province	141,009	432,300	National Energy Biomass Power Generation Co., Ltd.	NO	III

Note: Statistical information as of 4 November 2014.

Appendix 4: Estimated emission reductions and actual emission reductions of registered project during monitoring period

Registration no.	Project name	Monitoring period	/t CO_2e Estimated emissions reduction in monitoring period	/tCO_2e Actual emissions reduction in monitoring period	Remarks
001	Xiangyang Wind Power Projects in Anxi, Gansu Province	2008.2.16 to 2011.11.20	331045	251252	
002	300 MW Wind Power Project in Bayannur, Inner Mongolia Autonomous Region	2009.7.11 to 2011.8.8	1,430,039	989,895	
003	The first phase of the 49.5 MW Project in Sun Mountain Wind Power Plant in Ningxia Hui Autonomous Region	2011.02.05 to 2011.12.22	71,050	78,678	
004	Hydropower Project in Xiangqi, Yongzhou, China	2011.12.19 to 2012.11.14	209,345	107,958	
005	49.5 MW Wind Power Project in Qian Guowangfu Station Wind Plant in Jilin Province	2010.4.9 to 2011.11.2	159,472	153,327	
006	Silin Hydropower Station in Wu River, Guizhou Province	2011.12.30 to 2012.12.17	2,229,535	2,199,311	
007	Seermu Hydropower Project in Sichuan Province	2009.6.20 to 2010.4.8	347,490	309,094	
008	China's Liuping Hydropower Project in Sichuan Province	2008.12.19 to 2010.03.29	435,414	378,369	
009	Shawan Hydropower Project in Dadu River, Sichuan Province	2009.4.18 to 2011.1.15	2,051,805	1,978,283.93	
010	CMM Power Generation Project in Panjiang, Guizhou Province	2009.9.23 to 2012.11.28	1,443,088	1,153,352	
011	The second phase of the CMM Power Generation Project in Panjiang, Guizhou Province	2011.4.1 to 2012.12.4	552,988	346,403	
012	The third phase of the CMM Power Generation Project. in Panjiang, Guizhou Province	2011.5.26 to 2012.12.5	442,006	305,485	
013	The second phase of Wind Power Project in Zhenlai, Jilin Province	2011.01.01 to 2012.12.16	199,179	142,303	
014	Jiujietan Hydropower Project in Daxian, Sichuan Province	2011.8.19 to 2012.9.6	129,526	124,657	
015	Huajiaopo Hydropower Station in Shangri La County, Yunnan Province	2007.6.26 to 2010.9.10	145,743	150,111	
016	Wind Projects in Qiubei, Yunnan Province	2012.10.12 to 2012.12.5	10,060	10,012	
018	The second phase of CGN Wind Farm Project in Wuyueshan	2013.10.23 to 2014.7.31	74,929	47,026	
019	CGN Wind Farm Project in Leigutai	2013.12.21 to 2014.7.31	76,714	20,761	
020	49,500 kw Wind Power Project in Ulanqab Region, Inner Mongolia Autonomous Region	2011.7.18 to 2012.9.6	107,434	88,445	
022	60 MW Hydropower Station in Sayutuo, Yunnan Province	2009.1.1 to 2011.6.16	395,352	397,588	
023	Eastern Gas Power Plant Project in Xiamen, Fujian Province	2009.03.08 to 2012.12.13	2,838,663	2,433,185	
024	200 MW the Fourth Wind Farm Project in Guazhou, Gansu Province	2011.1.18 to 2011.9.22	204,311	170,066	
025	74 MW Hydropower Project in Hekou, Gansu Province	2010.12.28 to 2012.12.26	488,780	432,588	
026	20 MW Grid Photovoltaic Power Projects of The Sun Energy Co., Ltd. in Golmud, Qinghai Province	2011.12.17 to 2014.7.26	73,072	68,157	
028	Wind farm project in Quanyangou country, Liaoning Province	2010.12.13 to 2012.3.31	133,344	115,524	
030	Huogu Hydropower Project in Muchuan County, Sichuan Province	2012.1.22 to 2012.7.24	44,870	46,037	
032	Bailong River Hydropower Station in Guangyuan, Sichuan Province	2012.5.24 to 2012.12.17	79,755	105,188	
033	WuYiQiao Hydropower Station in Jiulong County, Ganzi state, Sichuan Province	2009.1.1 to 2011.5.8	878,806	761,872	
034	Hydroelectric Project in Songlin River, Mianshi County	2009.5.25 to 2011.5.19	572,320	500,428	

035	45 MW Wind Power Projects in Sun Mountain, Ningxia Province	2008.4.2 to 2010.10.10	186,027	177,102	
039	30 MW waste Gas Power Generation Project in Handan	2011.9.8 to 2012.12.28	160,919	115,398	
040	CHPP Expansion Project of Hua Energy Beijing Thermal Power Plant	2011.12.27 to 2012.12.31	281,634	124,665	
041	2*18 MW Waste Heat Power Generation Projects by Conch Cement co., Ltd. in Wuhu, Anhui Province	2008.4.30 to 2011.11.30	699,255	629,514	
043	Biomass Power Generation Projects in Ningyang, Shandong Province	2011.1.19 to 2012.12.27	275,156	283,818	
044	Hanwang Hydropower Project in Bailong River, Gansu Province	2013.4.1 to 2014.7.31	124,554	137,376	
045	Guodian 49.5 MW Wind Power Project in Erenhot Inner Mongolia Autonomous Region	2011.5.27 to 2014.7.19	338,254	274,222	
047	Hua Energy Gas Turbine Power Plant in Shanghai	2006.5.16 to 2009.6.22	3,394,817	587,465	
059	Hydropower Project in Denghong, Yunnan Province	2008.8.11to 2010.1.14	724,636	454,877	Being consulted
064	Hydroelectric Project in Diqing, Yunnan Province	2010.11.10 to 2012.12.16	275,111	355,229	Being consulted

Note: Statistical information as of 4 November 2014