Research on CER Accounting and Trading for Woody Biomass Power Generation Under CDM

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Abstract: Based on the example of Anhui Chizhou Woody Biomass Power Generation Project under CDM, the paper studied the types of woody biomass used for power generation, the requirements of CDM development for such kind bio-energy, selection of baseline methodology, the procedure and the formulas for accounting the emission reduction, as well as the monitoring, verification and certification for CERs produced from the woody biomass power generation. And further, the paper forwarded proposals for the establishment of CERs trading system, such as regulations of purchase agreement, international standards, governmental control policies and transaction broker system, *etc*.

Keywords: Accounting methodology, CDM, CER, trading system, woody biomass.

1. INTRODUCTION

Woody Biomass refers to the woody plant based biomass, including woods (such as fuel wood forest, shrub forest, economic forest, energy forest, thinning woods), forestry “three residues” (forest harvesting residues, logging residues and wood processing residues), forest by-products and wastes (oil tree fruit, nut shell, fruit pits *etc*.), and wooden products wastes [1]. Woody biomass energy is the energy fixed and stored in woody biomass itself which is the chemical energy converted from solar energy. Through the approaches of gasification, liquefaction, carbonization and direct combustion process, the woody biomass energy can be converted into synthesis gas, fuel ethanol, bio-diesel, charcoal, heat, electricity and other new energy products [2]. In view of no pollution, the industrial development of woody biomass energy can directly promote the forest thinning, economic forest pruning, energy forest establishment and forestry waste utilization. The woody biomass energy industry can play a significant role to improve the forest health and the quality, reduce greenhouse gas emissions, protect the environment and realize the sustainable scientific development [3].

Clean Development Mechanism, referred to as CDM, is the regulation mechanism for emission limit of greenhouse gas, stated in the legally binding provisions of “United Nations Framework Convention on Climate Change”, regulated for the carbon dioxide quantified emission reduction. CDM encourages the implementation of the projects to reduce greenhouse gas emissions (such as renewable biomass, wind, hydro, solar and other energy products to replace coal, oil heating power supply), or by sequestering carbon dioxide elimination of greenhouse gases from the atmosphere in the projects (such as afforestation), obtaining Certified Emission Reductions (CER) and CarbonSink Index, regarded as the reduction of greenhouse gas emission. It also can introduce advanced technology and equipment to promote sustainable development, at the same time, to obtain income from CERs trading and Carbon Sink Index trading [4].

Woody biomass power integrated CDM emission reduction accounting should be regulated in to the Project Design Document (referred to as PDD). PDD is the standard file format of CDM project development, and is the necessary basis for applying CDM project’s eligibility, emission reduction verification and approval.

PDD includes project name, description of the project activity, the project participants, project technical specification, the project location, project categories, technical infrastructure and parameters, and project financing. At the same time, how to give a brief description of the proposed CDM project will achieve greenhouse gas emission reduction; the estimated annual emission reductions and that additional emission reduction projects in developed countries; when using public funds, the additional proof of funding sources, namely the use of the funds, should not affect the normal use of official development assistance funds.

2. GENERAL DESCRIPTION OF PROJECT

Chizhou 325 Power Plant Co. Ltd (briefed as CPP) is a State-owned power enterprise in Zhongpu Village, Guichi District in Anhui province of China. CPP was established by restructuring the former Guichi Power Plant in August 2004, which had produced electricity based on coal firing since 1974. In February 2007, in accordance with the circular of the “Administrative Licensing Decision of State Electricity Regulatory Commission”, CPP obtained power business permit issued by the State Electricity Regulatory Commission.

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In November 2007, electricity production stopped, due to a lack of profitability. CPP leased its state accorded electricity production right to four other coal power plants of the East China Power Grid. The electricity production right was accorded in the current State 5-year-plan but ended in 2010.

Based on the enterprise strategy of sustainable development, in line with the full use of existing assets and the local abundant biomass resources, CPP invested RMB150 million Yuan (including German government loan of 13 million Euros) for producing woody biomass power generation of annual 162,500 MWh, by installing two new boilers of 75 t/h for biomass direct combustion, to take place of an existing coal boiler of 130 t/h circulating fluidized bed, and allocating to the existing configuration of 25 MW steam turbine generator, and annually using 175,500 tons of the small woods from forest thinning, sawdust, bark, cotton stalk, mulberry stem within a radius of 50 km. Fig. (**1**) shows the process of the woody biomass power generation system [5]. The project was approved by China National Development and Reform Committee (NDRC), and registered by the Executive Board (EB) of the United Nations Climate Changeon as CDM project on November 20, 2012. According to the agreement with German KfW bank, all the CERs generated will be sold to KfW Carbon Funds. The project is not only in line with national current energy policies and environmental protection requirements, and the consideration of the local economic development and new rural construction, but also it has better economic and social benefits. China State Forestry Bureau approved this project as a national demonstration project of forestry biomass energy development.

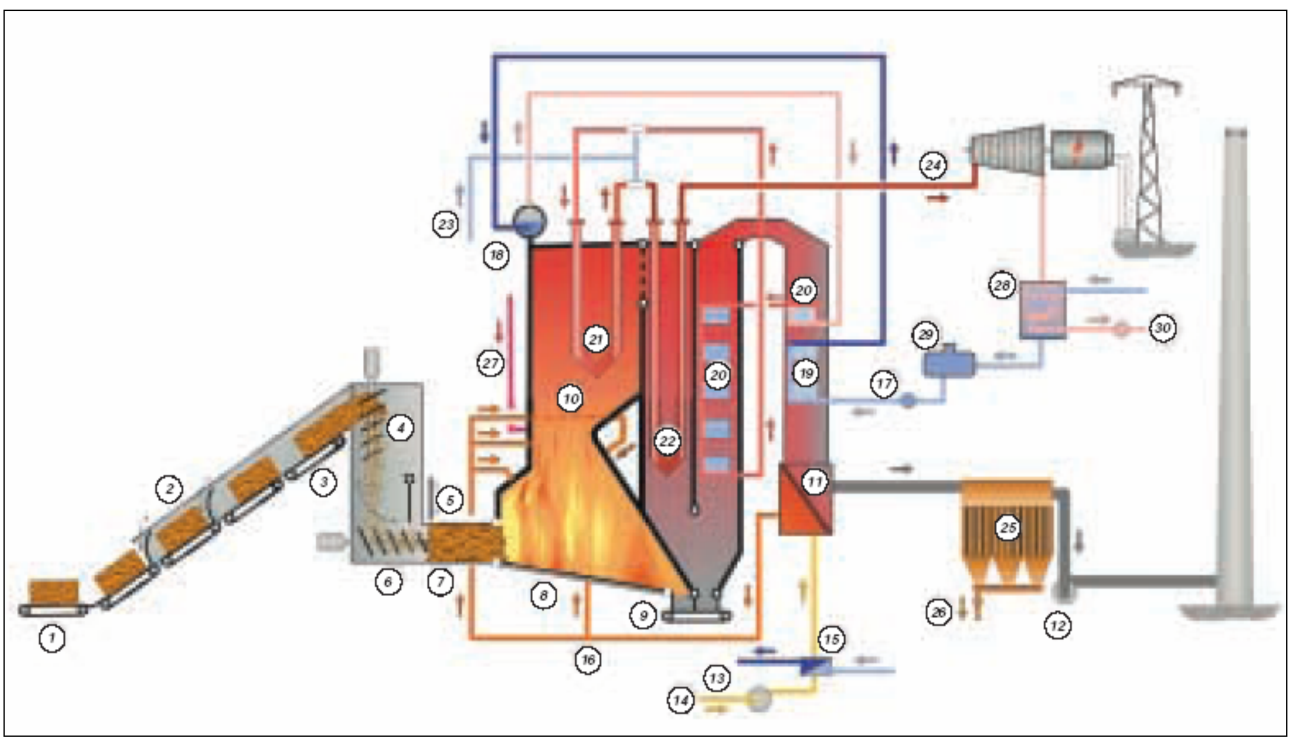
The following sketch shows the woody biomass power generation system [5]:

3. SELECTION OF BASELINE METHODOLOGY

Referring to EB approved baseline methodology, it should be clarified which baseline methodology can be adapted, and should be explained the reason of its application.

The approved baseline and monitoring methodology applied in the proposed project activity is: **ACM0018/ Version 01** *"Consolidated methodology for electricity generation from biomass residues in power-only plants"*. This consolidated methodology is based on elements from ACM0006 *"Consolidated methodology for electricity generation from biomass residues"*[6].

ACM0018 methodology is applicable to project activities that generate electricity in biomass residue (co)fired power-only plants. The project uses biomass residues in the form of by-products from the forest production process like thinning material, tree tops, low quality stems with no market outlet, branches, or stumps, and to a much lesser extent agricultural residues like stalks from various crops. But only in the raw material crushing, transportation and maintenance of boiler biomass fuel ignition, the project can use a small amount of fossil fuel.



1 = Fuel transportation machine; 2 = Straw stalk fuel; 3 = Front hopper; 4 = Field fuel machine; 5 = Fireproofing damper; 6 = Spiral feeder; 7 = Secondary air; 8 = Primary air; 9 = Slag off; 10 = Furnace; 11 = Air heater; 12 = Induced-draft fan; 13 = Blower ventilator; 14 = Air; 15 = Steam air heater; 16 = Hot air; 17 = Feed water pump; 18 = Steam drum; 19 = Economizer; 20 = Low temperature super heater; 21 = Platen super heater; 22 = High temperature super heater; 23 = De-superheating water; 24 = Primary steam; 25 = Dust catcher; 26 = Dust off; 27 = Down comer; 28 =Dry pipe; 29 = De-aerator; 30 = Recirculation cooling water.

Fig. (1). The process of woody biomass power generation system.

4. CER CREDITING PERIOD

Taking into consideration that the different technological progress, industrial structure, energy structure and policy factors in various countries have important effects on the reference baseline, the resulting emission reductions of CDM project activities will vary with the changes of these factors, so that the CDM project investment and emission reduction benefits are achieved under all kinds of uncertainty and risk. Therefore, the EB puts forward two kinds of CDM project accounting activities: available time and credits, included in the period of the method. The one option is to update the crediting period for two times, each time of 7 years; the need is to update the reference baseline for each update, and to provide the start date of emissions crediting period and the length of crediting period. The other is a fixed crediting period for not more than 10 years, without updating the reference baseline; the requirement is to provide the start date of emissions crediting period and crediting period length.

Regarding CPP CDM project, the CER crediting period could be a better option to update the crediting period for two times, due to the factors such as the boiler and turbine service life and the continuous supply of woody biomass. So the CER production and trade of continuous 3 crediting periods for 21 years can increase the benefits from emission reduction [6].

5. PROJECT EMISSION REDUCTION ACCOUNTING

The emission reductions of the project activity are described in the following equation [7] of ACM0018:

$$ER_y = BE_y - PE_y - LE_y \tag{1}$$

ER_y	tCO_2	Emissions reductions of the project activity during year *y*.
BE_y	tCO_2	Baseline emissions during year *y*.
PE_y	tCO_2	Project emissions during year *y*.
LE_y	tCO_2	Leakage emissions during year *y*.

5.1. Baseline Emissions

Baseline emissions are calculated as follows:

$$BE_y = BE_{EL,y} - BE_{BR,y} \tag{2}$$

BE_y	tCO_2e	Baseline emissions in year *y*.
$BE_{EL,y}$	tCO_2	Baseline emissions due to generation of electricity in year *y*.
$BE_{BR,y}$	tCO_2e	Baseline emissions due to uncontrolled burning or decay of biomass residues in year y. Conservatively excluded, therefore $BE_{BR,y} = 0$.

The baseline emissions from electricity generation are determined as follows:

$$BE_{EL,y} = EG_{PJ,y} \times EF_{BL,EL,y} \tag{3}$$

$BE_{EL,y}$	tCO_2	Baseline emissions due to generation of electricity in year *y*.
$EG_{PJ,y}$	MWh	Net quantity of electricity generated in all power plans which are located at the project site under the project scenario and included in the project boundary in *y*.
$EF_{BL,EL,y}$	tCO_2/MWh	Emission factor for electricity generation in the baseline in year *y*.

Under the chosen methodology, it is assumed that transmission and distribution losses in the electricity grid are not influenced significantly by the project activity and are therefore not accounted for.

The net quantity of electricity generated in the project plant during the year *y* is calculated as follows:

$$EG_{PJ,y} = EG_{PJ,gross,y} - EG_{PJ,aux,y} \tag{4}$$

$EG_{PJ,y}$	MWh	Net quantity of electricity generated in all power plants which are located at the project site under the project scenario and included in the project boundary in year *y*.
$EG_{PJ,gross,y}$	MWh	Gross quantity of electricity generated in all power plants which are located at the project site and included in the project boundary in year *y*.
$EG_{PJ,aux,y}$	MWh	Total auxiliary electricity consumption required for the operation of the power plants at the project site and equipments included in the project boundary in year *y*.

$EG_{PJ,aux,y}$ shall include all the electricity required for the operation of equipment related to the preparation, storage and transport of biomass residues (*e.g.* for mechanical treatment of the biomass, conveyor belts, driers, *etc*.) and electricity required for the operation of all power plants which are located at the project site and included in the project boundary (*e.g.* for pumps, fans, cooling towers, instrumentation and control, *etc*.). These values are monitored directly. The following equation is only for ex-ante calculation:

$$EC_{PJ,aux,y} = EG_{PJ,gross,y} \times ESC_{PJ,EG,y} + \sum_{m} (BR_{m,y} \times EC_{Chipping,m,y}) \times 10^{-3} \tag{5}$$

$EC_{PJ,aux,y}$	MWh	Total auxiliary electricity consumption required for the operation of the power plants at the project site and equipments included in the project boundary in year *y*.
$EG_{PJ,gross,y}$	MWh	Gross quantity of electricity generated in all power plants which are located at the project site and included in the project boundary in year *y*: **146,250 t**.
$ESC_{PJ,EG,y}$	dimensionless	Electricity self-consumption factor for all power plants located at the project site in year *y* : **0.1**
$BR_{m,y}$	t	Quantity of biomass residues (20% humidity) processed in chipper of type *m* during the year y (estimation of feasibility study): over $\sum_{m}$ = **175,500 t**.
$EC_{Chipping,m,y}$	kWh/t	Quantity of electricity consumed per ton for biomass residue (20% humidity) by chipping machine type *m* in year y: ex-ante estimated average **6.7 kWh/t**.

According to the past experience, about 10% of the gross generated power is self-consumed during the production process. This share ($ESC_{PJ,EG,y}$) will be monitored during the crediting period.

The quantity of electricity consumed by chipping machines is estimated ex-ante based on the total annual quantity of biomass (175,500 t) and the electricity requirements of chipping machines (6.7 kWh/t).

As electricity generation in the baseline take place in the public power grid, Step 1.2 of ACM0018 methodology stipulates that the emission factor corresponds to the combined margin CO_2 grid emission factor:

$$EF_{BL,EL,y} = EF_{grid,CM,y} \quad (6)$$

$EF_{BL,EL,y}$	tCO_2/MWh	Emission factor for electricity generation in the baseline in year *y*.
$EF_{grid,CM,y}$	tCO_2/MWh	Combined margin CO_2 emission factor for grid-connected electricity generation in year *y*.

According to ACM0018 methodology, $EF_{grid,CM,y}$ should be determined using the latest approved version of the "*Tool to calculate the emission factor for an electricity system*". There, the following steps are prescribed:

5.1.1. Step 1. Identify the Relevant Electric Power System

It is stipulated that "if the DNA of the host country has published a delineation of the project electricity system and connected electricity systems, these delineations should be used." In compliance with the delineation published by the Chinese DNA, the project activity situated in Anhui province will be connected to the East China Power Grid (ECPG). The ECPG includes the sub-grids of the provinces of Anhui, Fujian, Jiangsu, Zhejiang, and Shanghai.

5.1.2. Step 2. Select a Method for and Stipulate the Operating Margin (OM)

In China the low-cost/must-run resources constitutes less than 50% of the total grid generation in average of the five most recent years.

In the proposed project activity the emission factor will be calculated using the **ex-ante option with a 3-year generation weighted average**, based on the most recent data available at the time of submission of the PDD to the DOE for validation, without requirement to monitor and recalculate the emission factor during the crediting period. Presently, the most recent data is published in the "*Announcement for the Emission factor in the Chinese Regions in 2009*" (Chinese DNA 2009) where a three years average (2005-2007) of $EF_{grid,OM,y} = 0.8825$ is given for the East China Power Grid.

5.1.3. Step 3. Calculate the Build Margin Emission Factor

The build margin emission factor is the generation-weighted average emission factor (tCO_2/MWh) of all power units during the most recent year *y* for which power generation data is available. Presently, the most recent data is published in the "*Announcement for the Emission Factor in the Chinese Regions in 2009*" (Chinese DNA 2009) where for the East China Power Grid an $EF_{grid,BM,y}$ of 0.6826 for 2007 is given.

5.1.4. Step 4. Calculate the Combined Margin Emission Factor

The combined margin emission factor is calculated as follows:

$$EF_{grid,CM,y} = EF_{grid,OM,y} \times w_{OM} + EF_{grid,BM,y} \times w_{BM} \quad (7)$$

$EF_{grid,CM,y}$	tCO_2/MWh	Combined margin CO_2 emission factor for grid connected electricity generation in year y.
$EF_{grid,OM,y}$	tCO_2/MWh	Operating margin CO_2 emission factor for year *y:* **0.8825** (East China Power Grid 2005-2007 by Chinese DNA, 2009).
w_{OM}	%	Weighting of operating margin emissions factor.
$EF_{grid,BM,y}$	tCO_2/MWh	Build margin CO_2 emission factor in year *y*: **0.6826** (East China Power Grid 2007 by Chinese DNA, 2009).
w_{BM}	%	Weighting of build margin emissions factor.

In line with the above mentioned tool, the following default values are used:

$w_{OM} = 0.5$ and $w_{BM} = 0.5$ for the first crediting period, and $w_{OM} = 0.25$ and $w_{BM} = 0.75$ for the second and third crediting period.

5.2. Project Emissions

Project emissions will be calculated with the following equation:

$$PE_y = PE_{FC,j,y} + PE_{TR,y} + PE_{BR,y} + PE_{WW,y} \quad (8)$$

PE_y	tCO_2e	Project emissions during the year *y*.
$PE_{FC,j,y}$	tCO_2	CO_2 emissions from fossil fuel combustion in process *j* during the year *y* at the project site
$PE_{TR,y}$	tCO_2	Emissions during the year *y* due to transport of the biomass residues to the project plant.
$PE_{BR,y}$	tCO_2e	Emissions from the combustion of biomass residues during the year *y*.
$PE_{WW,y}$	tCO_2e	Emissions from wastewater generated from the treatment of biomass residues in year *y*.

In this project activity, emissions from the combustion of biomass residues and from wastewater are neither significant nor taken into account; hence $PE_{BR,y} = 0$ and $PE_{WW,y} = 0$.

The following combustion processes *j* should be included in determining CO_2 emissions from fossil fuel combustion $PE_{FC,j,y}$:

- Emissions from on-site fossil fuel consumption for the generation of electric power. This includes all fossil fuels used at the project site in heat generators (*e.g.* boilers) for the generation of electric power; and
- Emissions from on-site fossil fuel consumption of auxiliary equipment and systems related to the generation of electric power. This includes fossil fuels required for the operation of auxiliary equipment related to the power plants (*e.g.* for pumps, fans, cooling towers, instrumentation and control, *etc.*) which are not accounted for in the first bullet, and fossil fuels required for the operation of equipment related to the preparation, storage and transportation of fuels (*e.g.* for mechanical treatment of the biomass, conveyor belts, driers, *etc.*).

The latest approved version of the "*Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion*" should be used to calculate $PE_{FC,y}$. All combustion processes *j* as described in the two bullets above should be included in the following equations.

$$PE_{FC,j,y} = \sum_i FC_{i,j,y} \times COEF_{i,y} \quad (9)$$

$PE_{FC,j,y}$	tCO_2	CO_2 emissions from fossil fuel combustion in process *j* at the project site during the year *y*.
$FC_{i,j,y}$	t	Quantity of fuel type *i* combusted in process *j* during the year *y*.
$COEF_{i,y}$	tCO_2/t	CO_2 emission coefficient of fuel type *i* in year *y*

In the project case, the following processes *j* are present and included as follows:

For 10 boiler start-ups per year, an amount of **0.1 t** of diesel oil is needed.

The quantity of fuel (diesel) is estimated at 300 t per year used by machines to handle the biomass in the 5 biomass residue centres. This amount will be monitored during the crediting period.

$$COEF_{i,y} = NCV_{j,y} \times EF_{CO2,j,y} \quad (10)$$

$COEF_{i,y}$	tCO_2/t	CO_2 emissions from fossil fuel type *i* in year *y*. **Diesel: 3.1605** (calculated).
$NCV_{j,y}$	GJ/t	Weighted average net calorific value of fuel type *i* in year *y*. **Diesel: 42.652** (China Energy Statistical Yearbook 2007).
$EF_{CO2,j,y}$	tCO_2/GJ	CO_2 emission coefficient of fuel type *i* in year *y*. **Diesel: 0.0741** (IPCC 2006 Guidelines for GHG Inventories).

Project participants shall determine CO_2 emissions resulting from transportation of the biomass residues to the project plant. In the project case transportation is undertaken by vehicles. According to ACM0018 methodology, project participants may choose between two different approaches to determine emissions: an approach based on distance and vehicle type (Option 1) or on fuel consumption (Option 2). Option 1 approach is chosen and CO_2 emissions resulting from transportation are calculated as follows:

$$PE_{TR,y} = BR_{TR,y} \times TL_y^{-1} \times AVD_y \times EF_{km,y} \quad (11)$$

$PE_{T,y}$	tCO_2	Project emissions due to transport of the biomass residues to the project plant during the year *y*.
$BR_{TR,y}$	t	Quantity of biomass residues (20% humidity) transported to the project site during the year *y* (estimation of feasibility study): **175,500 t**.
TL_y	t	Average load of trucks used during the year *y* for biomass residue transportation: **10 t**
AVD_y	km	Average round trip distance (from and to) between the biomass residue fuel supply sites and the site of the project plant during the year *y*: **104 km**.
$EF_{km,y}$	tCO_2/ km	Average CO_2 emission factor for the trucks measured during the year *y*: IPCC 2006 default value for heavy duty diesel vehicles: **0.001011 tCO_2/km**.

As all biomass residue centres are within an average radius of 52 km, the conservative value of 104 km is applied for the roundtrip.

5.3. Leakage Emissions

According to the stipulations prescribed in ACM0018 methodology, the main (and only) potential source of leakage for this type of project activity is as an increase in emissions from fossil fuel combustion or other sources due to diversion of biomass residues from other uses to the project plant as a result of the project activity. Changes in carbon stocks in the LULUCF sector are classified to be insignificant since the methodology is limited to biomass residues.

In case of less than half or the agricultural residues, leakage shall be calculated with equation 12. This equation aims at adjusting emission reductions for leakage effects in a conservative manner, assuming that this quantity of biomass residue is substituted by the most carbon intensive fuel in the country.

$$LE_y = EF_{CO2,LE} \times \sum_n BR_{PJ,n,y} \times NCV_{n,y} \quad (12)$$

LE_y	tCO_2	Leakage emissions during the year *y*.
$EF_{CO2,LE}$	tCO_2/GJ	CO_2 emission factor of the most carbon intensive fuel used in the country. Provisionally, the IPCC 2006 value for sub-bituminous coal (**0.0961 tCO_2/GJ**) is taken. For verification, the value should be taken from the most recent China Energy Statistical Yearbook.
$BR_{PJ,n,y}$	t	Quantity of biomass residues of category *n* used in the power plant located at the project site and included in the project boundary in year *y* dry matter).
$NCV_{n,y}$	GJ/t	Net calorific value of the biomass residues category *n* (dry matter) in year *y*. Ex-ante, the average value from the feasibility study (**16.2 GJ/t**) is applied. Specific values will be applied during the project activity for the specified biomass residue types, which fall under leakage.
n	none	Categories of biomass residues for which B8 has been identified as the baseline scenario.

Through the data collection, processing and analysis, the complete accounting process of the emissions reductions of the project activity during year y is as follows: **The annual emission reduction is 104,180 tCO_2, the total emission reduction of the first crediting period (7 years) is 729,260 tCO_2** [6].

$$ER_y = BE_y - PE_y - LE_y \quad (1)$$

$$104{,}180\ tCO_2 = 113{,}528\ tCO_2 – 2{,}794\ t_{CO2} – 6{,}554\ tCO_2$$

Baseline emissions in year y:

$$BE_y = BE_{EL,y} - BE_{BR,y} \quad (2)$$

$$113{,}528\ tCO_2 = 113{,}528\ tCO_2 – 0\ tCO_2$$

Baseline emissions due to generation of electricity in year y:

$$BE_{EL,y} = EG_{PJ,y} \times EF_{BL,EL,y} \quad (3)$$

$$113{,}528\ tCO_2 = 145{,}074\ MWh \times 0.78255\ tCO_2/MWh$$

Net quantity of electricity generated in all project power plants in year y:

$$EG_{PJ,y} = EG_{PJ,gross,y} - EG_{PJ,aux,y} \quad (4)$$

$$145{,}074\ MWh = 162{,}500\ MWh – 17{,}426\ MWh$$

Total auxiliary electricity consumption required for the operation of the power plants at the project site and equipments included in the project boundary in year y:

$$EC_{PJ,aux,y} = EG_{PJ,gross,y} \times ESC_{PJ,EG,y} + \sum_{m} (BR_{m,y} \times EC_{Chipping,m,y}) \times 10^{-3} \quad (5)$$

17,426 MWh = 162,500 MWh × 0.1 + 175,500 × 6.7 × 10-3

Emission factor for electricity generation in the baseline in year y:

$$EF_{BL,EL,y} = EF_{grid,CM,y} \quad (6)$$

0.78255 tCO_2/MWh = 0.78255 tCO_2/MWh

Combined margin CO_2 emission factor for grid connected electricity generation in year y:

$$EF_{grid,CM,y} = EF_{grid,OM,y} \times w_{OM} + EF_{grid,BM,y} \times w_{BM} \quad (7)$$

0.78255 tCO_2/MWh = 0.8825 tCO_2/MWh × 0.5 + 0.6826 tCO_2/MWh × 0.5

Project emissions during year y:

$$PE_y = PE_{FC,j,y} + PE_{TR,y} + PE_{BR,y} + PE_{WW,y} \quad (8)$$

2,794 tCO_2e = 948 tCO_2 + 1,845 tCO_2 + 0 tCO_2e + 0 tCO_2e

CO_2 emissions from fossil fuel combustion in process j at the project site during year y:

$$PE_{FC,j,y} = \sum_{i} FC_{i,j,y} \times COEF_{i,y} \quad (9)$$

948 tCO_2 = 300.1 t × 3.1605 tCO_2/t

CO_2 emissions from fossil fuel type i in year y:

$$COEF_{i,y} = NCV_{j,y} \times EF_{CO2,j,y} \quad (10)$$

3.1605 tCO_2/t = 42.6520 GJ/t × 0.0741 tCO_2/GJ

Project emissions due to transport of the biomass residues to the project plant during year y:

$$PE_{TR,y} = BR_{TR,y} \times TL_y^{-1} \times AVD_y \times EF_{km,y} \quad (11)$$

1,845 tCO_2 = 175,500 t × 10-1 t × 104 km × 0.001011 tCO_2/km

Leakage emissions during year y:

$$LE_y = EF_{CO2,LE} \times \sum_{k} BR_{PJ,k,y} \times NCV_{k,y} \quad (12)$$

6,554 tCO_2 = 0.0961 tCO_2/GJ × 5,000 t × 13.6392 GJ/t

6. EMISSION REDUCTION MONITORING, VERIFICATION AND CERTIFICATION

The project owners need to provide monitoring methodology and detailed monitoring plan, in order to estimate or measure emissions generated within the project boundary, to determine the net changes in emissions baseline and outside the project boundary. The monitoring plan shall also provide the quality control of the monitoring data (QC) and quality assurance (QA) program; intermediaries will verify the information provided and the accuracy and comparability of data quality, completeness and validity.

The CPP general manager takes full responsibility for the monitoring of woody biomass energy CDM project, and the CDM monitoring group is responsible for the supervision, inspection measurement and record of the purchase and sale, collect data, calibration of measuring instruments, submit monitoring reports and documentation, *etc*.

Verification is to do periodic review and determine the process to the registered CDM project emission reductions by the qualified and responsible independent institutions. According to the monitoring data, the calculation procedure and method, the quantity of emission reduction is verified. Certification refers to the written report issued by the qualified independent organization, which shows that the project obtains certified emission reduction (referred to CER) in a period, and conveys the results to related stakeholders.

CER requests should be submitted to EB for approval, and only the approved CER can enter into the international market. After EB receives CER request, if any of the project participants or at least three members of EB have no application for reviewing the verification report within 15 days, the request is automatically approved, and EB issues CERs. If any of the project participants or at least three members of EB have application for reviewing the verification report within 15 days, the request should be reviewed to find out if there is fraud, malfeasance and qualification problems from the independent agencies. The review should be determined to finish in 30 days from the start date of the review, and decide whether to approve the issue of CERs request.

7. CERs TRADING

7.1. Establishment of CERs Purchase Agreement

Since the beginning of the CDM project preparation, CPP built the good relationship with German KfW Carbon Funds to negotiate and sign CER purchase agreement, clearly clarified the rights and obligations and responsibilities for both sides, and enhanced the project schedule and project financing support.

7.2. Insisting on International Standards for CERs Accounting and Monitoring

CER is calculated by PDD, so PDD must be complied by a qualified technical advisory body, must be reviewed by NDRC, verified by a qualified independent agency, and finally approved by EB if there is no confusion from the project participants and the members of EB. All the consultants, verifiers, monitors, managers and the regulations should be in accordance with the international standards, so that CERs can enter the international market for trading.

7.3. Establishing a National Carbon Funds and a National Carbon Trading Platform

Because of the actual situation of CERs trading in single pairs in China, especially for the woody biomass power CDM projects, which will cause obvious loss and potential losses of the benefits to the project investors, it is suggested to build up a national formulating investment standard of woody biomass power CDM projects, including the accounting of emission reduction, carbon trading standards, and establishing a national carbon funds and a national carbon trading base [1], *etc*., so that the international or domestic investment can go into the national carbon funds, for standardized investment in approved woody biomass power CDM projects, and the project generated CERs can go into the national carbon trading platform to ensure the justification of the CERs trading.

7.4. Government Regulation and Policy Support

China, based on "common but differentiated responsibilities", put forward a plan for 2020 than for 2005 to reduce the goal of carbon emission intensity reduction 40%~45%. In the adjustment of industrial structure, improving energy efficiency and emissions trading market mechanism to create a flexible, effective, economic, financial and legal means to carry out innovative energy-saving emission reduction attempt. In order to avoid the CER transaction risk, based on the existing laws and regulations on the basis of the national organization, to study and formulate recommendations of woody biomass energy CDM management methods, production technology standards for major energy products and quality standards, woody biomass power integration way of financing, the country should encourage woody biomass energy products investment criteria, financial subsidies standards, measures of preferential tax treatment and carbon fund management methods, emission reductions and carbon sequestration transaction management *etc*. [8].

7.5. Nurturing CER Transaction Broker System

CER transaction characteristics of international, professional, technical, multilateral and persistence, determining the CER transaction, is the need of the agent system. The general investors engaged in the CER deal, on the project's source, standards, certification, subscription funds whereabouts, CER's existence are to have no ability and effort to investigate and understand. As securities brokers, real estate brokers, investors and the developer of the project or enterprise, need CER broker intermediary services. CER brokers need to have a high professional quality and professional knowledge, and must go through professional training to hold a qualification. Regulators may encourage the cultivation of the establishment of the CER trade association, training and certification in the CER agent.

CONCLUSION

From the case study on CPP woody biomass power CDM project, it is known that it annually uses 175,500 tons of biomass residues in the form of by-products from the forest production process like thinning material, tree tops, low quality stems, branches, or stumps, and to a much lesser extent agricultural residues like stalks from various crops. ACM0018 methodology is applicable to project activities that generate electricity in biomass residues (co)fired power-only plants. The emission reduction of the project activity is accounted for in the procedure and equations of ACM0018, and monitored, verified and certified. The annual emission reduction is 104,180 t of CO_2; the total emission reduction of the first crediting period (7 years) reaches 729,260 t of CO_2. The certified emission reduction can be legally traded in the government-supported exchange platforms, which need regulations of purchase agreement, international standards, governmental control and transaction broker system, *etc*. The study provides an example for accounting and trading of CERs produced from such kind woody biomass energy under CDM development.

CONFLICT OF INTEREST

The authors confirm that this article content has no conflict of interest.

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