DRAFT - Approved baseline methodology AM00XX

"Analysis of the least-cost fuel option for seasonally-operating biomass cogeneration plants"

Source

This methodology is based on the TA Sugars Proposed Sugar Cogeneration Plant and Fuel Switch Project whose baseline study, monitoring and verification plan and project design document were prepared by Winrock International India (WII) and the Prototype Carbon Fund (PCF).

For more information regarding the proposal and its consideration by the Executive Board please refer to case NM0028: "TA Sugars Proposed Sugar Cogeneration Plant and Fuel Switch Project" on http://cdm.unfccc.int/methodologies/approved.

Selected approach from paragraph 48 of the CDM modalities and procedures

"Emissions from a technology that represents an economically attractive course of action, taking into account barriers to investment."

Applicability

This methodology is applicable to the refurbishment and fuel-switch of biomass cogeneration projects connected to the grid with the following conditions:

- The proposed project activity has access to biomass that is not currently used for energy purposes;
- The project activity proposes to operate existing equipment using other fuel(s)[1] during the off-season (when bagasse is not being produced);
- Project must operate in seasonal mode;
- The proposed baseline methodology is applied for each separate plant location.

Baseline

The baseline scenario is the use of the least cost fuel use during the off-season, when no biomass from the plant operation is available, to generate electricity (see "Additionality section" for how to find out least-cost option).

To calculate baseline emissions, BE_y in a year y, one needs to determine the emission factor of producing one kWh of electricity using the least cost fuel, $EF^{LCF}\_CO_{2\_y}$, and multiply the factor by the total quantity of electricity generated during off-season using biomass.

$$BE_y\ (t\ CO_2) = EF^{LCF}\_CO_{2\_y}\ (t\ CO_2/kWh) * EL^{\text{Biomass}}_y\ (kWh)$$

This involves the following two steps:

Step 1: Determine the emission factor of producing one kWh of electricity using the least cost fuel option (in t CO_2/kWh). This can be calculated based on a) historic data of least cost fuel consumption and electricity output, or b) calorific content of least cost fuel and efficiency of the plant. In both cases, the carbon content of the least cost fuel also needs to be known and should be obtained from the supplier or monitored.

[1] In the event that more than one fuel are used, monitoring methodology shall monitor types and quantities used.

Step 2: Determine the amount of electricity generated from biomass. In order to estimate this amount *ex ante*, the expected electricity production during off-season can be used, corrected for the amount of electricity that is expected to be generated from left-over bagasse. During project operation, this variable is subject to monitoring.

Project Activity

The project activity is to implement complete or partial fuel switching from fossil fuel to biomass. Project emissions, PE_y, are calculated by multiplying the project's consumption of fossil fuel(s) in year y, $FF_{k,y}$, by their carbon content, $CC_{k,y}$.

$$PE_y\ (t\ CO_2) = \sum_k (FF_{k,y} * CC_{k,y})$$

Leakage

The project boundary is defined as the physical boundaries of project sites. Potentially two sources of indirect emissions can be identified for the switch of fossil fuel to renewable biomass. First, leakage can occur in the form of transport emissions from the collection of biomass to the project site. Second, the use of biomass at the project site can potentially lead to a crowding out of biomass and consequentially an increase in the consumption of fossil fuel at other plants in case the supply of biomass is short of demand.

The PP shall use one of the two following options to take into consideration potential leakage from the diversion of biomass from other uses.

Option 1: Macro level analysis (as specified in AM0004)
The first option is an analysis at the macro level. Project participants should demonstrate that biomass is abundant in the area from which biomass will be sourced. For this option, the following steps need to be followed:

The main source of potential leakage is that the project diverts biomass from other users and thereby increases fossil fuel use.

A proposed project activity must demonstrate that:
- The project will not deplete the supply of the biomass in question to the extent that it will affect the construction of planned biomass power plants;
- There is no competition for supply of the biomass that will result in a decrease in the load factor of other biomass-fuelled plants;
- The project will not deplete the supply of biomass to current users.

To ensure that there is an abundance of surplus biomass a proposed project activity shall demonstrate that:
- The surplus supply of biomass, for which there is no use is more than double the biomass required to fuel all grid-connected electricity generating plants (including the proposed plant) using same biomass;
- The surplus supply in this calculation is equivalent to the total biomass minus biomass consumed for conventional purposes (i.e. other than for grid electricity generation).

The supply of biomass must be monitored to ensure that an abundant surplus of biomass is maintained for the duration of the crediting period.

Option 2: Micro-level analysis (to assess the impact of the project on other actual biomass consumers who potentially would be affected by the proposed project activity):

In this option, the project proponent should determine the percentage of biomass that would meet economic and social needs (e.g. cooking, feedstock, biomass cogeneration etc.) and the percentage of biomass that would meet no social and economic needs (e.g. biomass would be left to rot, be burned, decompose, etc). These percentages shall be established for the project's actual sources of biomass supply.

The project proponent should follow this approach:

- Detail the sources from which biomass will be procured;
- Describe the most common uses and practices with respect to biomass from these sources (e.g. open field burning, collection of agro-waste by households, etc.);
- Establish the percentage of biomass that would meet economic and social needs and the percentage that would meet no economic or other social needs;
- Unless the project proponent can present persuasive evidence to the contrary, it should be assumed that the project would preclude other users' consumption of biomass from the same sources and that the affected users instead would demand biomass from other sources. This is a conservative assumption because other sources of biomass may in fact be able to meet increased social or economic needs for biomass;
- The percentage of used biomass shall be used as a proxy for the leakage due to the project. E.g., if 30% of the biomass serves other social or economic needs, the amount of emission reductions shall be discounted by 30%.

The analysis needs to be made transparent and verified by the DOE.

Emission Reductions

The emission reductions ER_y is obtained by

$$ER_y = BE_y - PE_y - Leakage$$

BE_y and PE_y have been defined above.

Additionality

The identification of baseline scenario and demonstration of additionality for each separate plant location are provided by following the steps:

1. Identify possible fuel options for the baseline scenario;
2. Select plausible fuel options taking into account the commercial operations of the project plants as well as national regulations; and
3. Estimate the profit margin from the sale of electricity using each plausible fuel (without CER revenue). Use method [a] to calculate the unit margin of each fuel if the fuel switch is to be implemented in one go. Use method [b] to calculate the unit net present value (NPV) of each fuel if the fuel switch will be implemented gradually.

Method [a]: Unit Analysis for Fuel Switch

Unit Analysis for Fuel Switch

Fuel 1 - Baseline			
Annual Net Generation	MWh	Ge	
Fuel 1 Unit Cost	US$/ton	X	
Combustion Efficiency	ton/MWh	Y	
Unit Generation Cost	US$/MWh	Z = X * Y	
Other Variable Costs	US$/yr	U	(supplies, replacements, manpower, etc)
Unit Other Variable Cost	US$/MWh	T = U / Ge	
Total Unit Cost	US$/MWh	S = T + Z	
Energy Sales Price	US$/MWh	R	
Unit Margin	**US$/MWh**	**P = R - S**	

Fuel 2 - Project			
Annual Net Generation	MWh	Ge	
Fuel 2 Unit Cost	US$/ton	A	
Combustion Efficiency	ton/MWh	B	
Unit Generation Cost	US$/MWh	C = A * B	
Other Variable Costs	US$/yr	E	(supplies, replacements, manpower, etc)
Unit Other Variable Cost	US$/MWh	F = E / Ge	
Investment Cost	US$	IC	(new facilities, etc)
Lifetime	years	H	
Discount Rate	%	I	(for the energy sector of the country)
Capital Cost per Unit	US$/MWh	J = Payment(rate=I, nper=H, Present Value=IC) / Ge	
Total Unit Cost	US$/MWh	K = C + F + J	
Energy Sales Price	US$/MWh	L	(premiums included if any)
Unit Margin	**US$/MWh**	**M = L - K**	
COMPARE	**M and P**		

Method [b]: NPV analysis for Fuel Switch

Net Present Value Analysis for Fuel Switch

Fuel 1 - Baseline						
Annual Net Generation	MWh	Ge	Ge_1	Ge_2	Ge_i	Ge_n
Fuel 1 Unit Cost	US$/ton	X	X1	X2	Xi	Xn
Combustion Efficiency	ton/MWh	Y	Y1	Y2	Yi	Yn
Unit Generation Cost	US$/MWh	Z = X * Y	Z1	Z2	Zi	Zn
Other Variable Costs	US$/yr	U	U1	U2	Ui	Un
Unit Other Variable Cost	US$/MWh	T = U / Ge	T1	T2	Ti	Tn
Total Unit Cost	US$/MWh	S = T + Z	S1	S2	Si	Sn
Energy Sales Price	US$/MWh	R	R1	R2	Ri	Rn
Unit Margin	**US$/MWh**	**P = R - S**	P1	P2	Pi	Pn
Annual Margin	**US$/yr**	**N = P * Ge**	N1	N2	Ni	Nn
Discount Rate	%	I				
Net Present Value	US$	NPV_1$ = NPV(rate = I, Ni (i = 1 to n))				
Net Present Value of Energy Sold	MWh	NPV_E = NPV[rate= I, Ge_i (i = 1 to n)]				
Unit Net Present Value	**US$/MWh**	**M = NPV_1$ / NPV_E**				

Fuel 2 - Project			Year 0	Year 1	Year 2	Year i	Year n
Annual Net Generation	MWh	Ge		Ge_1	Ge_2	Ge_i	Ge_n
Fuel 1 Unit Cost	US$/ton	X		X1	X2	Xi	Xn
Combustion Efficiency	ton/MWh	Y		Y1	Y2	Yi	Yn
Fuel 1 Proportion	%	V		V1	V2	Vi	Vn
Fuel 2 Unit Cost	US$/ton	A		A1	A2	Ai	An
Combustion Efficiency	ton/MWh	B		B1	B2	Bi	Bn
Unit Generation Cost	US$/MWh	C = X * Y * V + A * B * (1-V)		C1	C2	Ci	Cn
Other Variable Costs	US$/yr	E		E1	E2	Ei	En
Unit Other Variable Cost	US$/MWh	F = E / Ge		F1	F2	Fi	Fn
Total Unit Cost (before investment cost)	US$/MWh	K = C + F		K1	K2	Ki	Kn
Energy Sales Price	US$/MWh	L		L1	L2	Li	Ln
Unit Margin	**US$/MWh**	**M = L - K**		M1	M2	Mi	Mn
Annual Unit Margin	**US$**	**N = M * Ge**		N1	N2	Ni	Nn
Investment	US$	IC	IC				
Discount Rate	%	I					
Net Present Value	US$	NPV_2$ = NPV[rate = I, Ni (i = 1 to n)] - IC					
Net Presente Value of Energy Sold	MWh	NPV_E = NPV[rate= I, Ge_i (i = 1 to n)]					
Unit Net Present Value	**US$/MWh**	**D = NPV_2$ / NPV_E**					

Compare	**D and M**

4. Compare the unit margin / unit NPVs of the fuel that is proposed under the CDM project with the unit margin / unit NPV of other plausible options. If the unit margin / unit NPV of the project scenario is lower than that of other options, conclude that the project is not economically attractive and the fuel switch to biomass therefore not the most likely future development. If the project's unit margin / unit NPV is equal or higher than that of other identified alternatives, conclude that the project is expected to be implemented as part of the baseline scenario.

The correctness of data requirements from the projects (fuel costs and costs of required investments of each plausible fuel option, energy sales price) is to be confirmed by a Designated Operational Entity.

5. The method [a] and [b] shall be supplemented by an analysis of other activities similar to the proposed project. This consists of:

Providing a sufficiently comprehensive analysis of any other activities implemented previously or currently underway that are similar to the proposed project activity. Projects should be considered similar, if they are in the same country and rely on a broadly similar technology, are of a similar scale, and take place in a comparable environment with respect to regulatory framework, investment climate, access to technology, access to financing, *etc*. Provide quantitative information where relevant.

This may be further complemented by a supplementary examination of the additionality of the proposed project using the analytical tools and approaches identified by the tenth meeting of the CDM EB, July 29, 2003 (CDM-EB-10, Annex 1).[2]

[2] Please refer to the annex 1 of report he tenth meeting of the CDM Executive Board, web address: http://cdm.unfccc.int/EB/Meetings/)

Approved monitoring methodology AM00XX

"Monitoring emission reductions due to off-season use of biomass in existing cogeneration plants"

Source

This methodology is based on the TA Sugars Proposed Sugar Cogeneration Plant and Fuel Switch Project whose baseline study, monitoring and verification plan and project design document were prepared by Winrock International India (WII) and Prototype Carbon Fund (PCF).
For more information regarding the proposal and its consideration by the Executive Board please refer to case NM0028: "TA Sugars Proposed Sugar Cogeneration Plant and Fuel Switch Project" on http://cdm.unfccc.int/methodologies/approved.

Applicability

This methodology is broadly applicable to fuel-change projects in situations where use and availability of different energy sources varies by season. In case separately located plural plants are concerned, each plant should be monitored separately.

Monitoring Methodology

The monitoring methodology involves monitoring of the following:

Project emissions:
The methodology foresees monitoring of the consumption of fossil fuels as well as of the specific carbon content of the procured fuels, in case the use of fossil fuel is not completely substituted by renewable biomass fuels. Project emissions are calculated by multiplying the consumption of fossil fuel by their carbon content.

Baseline emissions:
For estimation of baseline emissions, the emission factor for producing one kWh of electricity using the least cost fuel alternative as well as the amount of electricity generated using biomass need to be known. Data to be collected include electricity generation from biomass (not including bagasse), and the amount of biomass (not including bagasse) fed into the boilers. If the project still partially uses the least cost fossil fuel, the carbon content which is monitored for project emissions can also be used here.

Project emissions

ID number	Data type	Data variable	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	For how long is archived data to be kept?	Comment
1. $FF_{k,y}$	Fossil fuel used	Fossil fuel procured	MT	m	each delivery	> 95%	electronic	Till completion of crediting period	
2. CC_k	Carbon content of procured fossil fuel	Carbon content of procured fossil fuel	Kg C/MT	Obtained from supplier	each delivery	> 95%	electronic	Till completion of crediting period	

Baseline emissions

ID number	Data type	Data variable	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	For how long is archived data to be kept?	Comment
3. $EL^{Biomass}_{y}$	Electricity	Electricity generation from non-bagasse biomass	kWh	m	continuous	>95%	electronic	Till completion of crediting period	
4. $T^{Biomass}_{y}$	Biomass	Non-bagasse biomass used as fuel	Tons	m	each delivery	>95%	electronic	Till completion of crediting period	

ID number	Data type	Data variable	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	For how long is archived data to be kept?	Comment
5. CC_k (= 2.)	Carbon content	Carbon content of procured fossil fuel	Kg C/MT	Obtained from supplier	each delivery	> 95%	electronic	Till completion of crediting period	

Leakage

The main identified source of leakage is the diversion of biomass from other uses.

If project participants follow *Option 1: Macro level analysis*, the following data should be collected and archived:

ID number	Data type	Data variable	Data unit	Measured (m), calculated (c) estimated (e)	Recording frequency	Proportion of data monitored	How will data be archived? (electronic/ paper)	For how long is archived data kept?	Comment
6.	Quantitative	Amount of grid electricity generated using same biomass as the project	MWh	Obtained from official data	annually	100%	electronic	Minimum of two years after last issuance of CERs	
7.	Quantitative	Biomass required for grid electricity generation	t	c	annually	100%	electronic	Minimum of two years after last issuance of CERs	
8.	Quantitative	Surplus biomass supply	t	Obtained from official data	annually	100%	electronic	Minimum of two years after last issuance of CERs	

If project participants follow *Option 2: Micro-level analysis*, the following data should be collected:

ID number	Data type	Data variable	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	For how long is archived data to be kept?	Comment
9.	Sources	Sources from which biomass is procured	n.a	n.a.	annually	>95%	electronic	Till completion of crediting period	
10.	Percentage	Biomass used for other commercial or non-commercial purposes	%	estimated	annually	Sample basis	electronic	Till completion of crediting period	

Quality Control (QC) and Quality Assurance (QA) Procedures

Data	Uncertainty level of data (High/Medium/Low)	Are QA/QC procedures planned for these data?	Outline explanation why QA/QC procedures are or are not being planned.
1	Low	No	Amount of fossil fuel procured is a reliable indicator subject to routine checks
2	Low	No	Supplier has accurate information on carbon content of coal
Others	Low	No	