Annex 7

Scenarios of Emission Reductions and Transaction Costs of a Hypothetical Project Activity Applying Draft Categories for Switch from Non Renewable Biomass (NRB) to Renewable Biomass (RB)

Emission reduction scenarios are illustrated with three cases applying the draft NRB to RB categories. While Project 1 is a hypothetical project activity, Project 2 and Project 3 are hypothetical situations where draft categories are applied to registered projects.

Project 1
The project is a hypothetical activity to introduce solar cookers to displace use of non-renewable biomass for cooking.

Assumptions:

- Nominal power of the solar cooker: 3 kW_{th}/device;
- Average operational time per day: 4h/day[1];
- The number of devices: 10,000;
- Total output/capacity of the project activity: 30 MW_{th} (<45MW_{th});
- Average efficiency of stoves fired with non-renewable biomass: 20%;
- Average efficiency of stoves fired with fossil fuels: 50%;
- Fossil fuel commonly observed with local consumers, for meeting similar thermal energy needs: Kerosene (71.5 tCO_2/TJ);
- 1 kWhr = 3.6 MJ and 1 Kg of NRB biomass= 15 MJ (taking IPCC values for wood fuel).

Emission reductions:

Total amount of thermal energy generated by solar cookers for cooking is calculated as follows:
3 kWth * 4 h/day * 365 day/year * 10,000 devices = 43,800 MWh/year = 157,680,000 MJ/year.

In the baseline case, the consumption of non-renewable biomass is estimated as 788,400,000MJ (=157,680,000MJ / 0.2).

From the draft Category I.E., Emission reductions would be calculated as:

$$ER_y = B_y \cdot NCV_{biomass} \cdot EF_{non-renewable\,biomass,CO2}$$

where:

ERy	Emission reductions during the year y in t CO_2
By	Quantity of non-renewable biomass that is substituted or displaced in tonnes, calculated as:

(i) the product of the number of appliances multiplied by the estimate of average annual consumption of non-renewable biomass per appliance (tonnes/year). This can be derived from historical data or a survey of local usage.

OR

[1] Assumed peak sunshine hours. A real project may be able to use a better value derived from a reliable weather database

(ii) The quantity of renewable biomass used in the project activity corrected for differences in calorific values.

NCVbiomass	Net calorific value of the non-renewable biomass that is substituted (IPCC default for wood fuel, 15 MJ/Kg)
EFnon-renewable biomass,CO_2	Emission factor for the substitution of non-renewable biomass by similar consumers locally, in t CO_2 / TJ biomass.

$$EF_{\text{non-renewable biomass,CO2}} = \frac{\varepsilon_{\text{stoves, biomass}}}{\varepsilon_{\text{stoves, fossil}}} \cdot EF_{\text{CO2, fossil}}$$

where:

εstoves,biomass	Average efficiency of stoves fired with biomass, use 20% as default value or local data if available
εstoves,fossil	Average efficiency of stoves fired with fossil fuels, use 50% as default value or local data if available
EFCO_2, fossil	CO_2 emission factor for the fossil fuel; 71.5 tCO_2/TJ for Kerosene, 63.0 tCO_2/TJ for LPG or the IPCC default value of the fossil fuel commonly observed with local consumers

In the case of above hypothetical project (By. NCV biomass) = 788,400,000 MJ.

Therefore the annual emission reduction is estimated as follows:

ERy = 788,400,000 * 20 /50 * 71.5 / 1,000,000 = 22,517 tCO_2.

Indicative Transaction costs[2]

- PDD preparation cost: 20,000 USD;
- Validation cost: 20,000 USD;
- Share of proceeds: 15,000 * 0.1 + (22,517 – 15,000) * 0.2 = 3,003 USD;
- Verification and certification cost: 20,000 USD;
- Total transaction cost: 63,003 USD or 2.8 USD/tCO_2

Reference from two registered projects:

In the section below Emission Reductions of two registered projects are calculated for a hypothetical situation where the draft NRB to RB categories are applied to these projects. For the sake of comparison, emission reduction calculations based on carbon content of NRB saved is done first i.e. qty of non renewable biomass saved times the IPCC emission factor for wood fuel[3].

Project 2 is the registered project no. 218 which saves annually approx 3500 tons of CO2e. (http://cdm.unfccc.int/Projects/TUEV-SUED1135345789.43/view.html).

Project 3 is the registered project No.136 which saves annually approx 47000 tons of CO2e (http://cdm.unfccc.int/Projects/DNV-CUK1132666829.52/view.html).

[2] The cost figures were derived using inputs from registered project number 218 and the experience of a working group member

[3] Using information provided or implied in the PDD. Figures are for illustration and may not reflect the data of the project accurately.

Emission reductions of Project 2:
Based on Carbon Content of NRB or applying the methodology that remained valid till end 2005:

- Peak power of the solar cooker: 600 Wth [4]/device;
- Number of devices: 1,000 (total output/capacity of the project activity: 0.6 MW);
- Usage of the cookers: 4h/day (annual 1,500 hrs operation at peak sunshine);
- Thermal output of all solar cookers: 1,000 x 0.6 x 1,500= 900,000 kWhr= 3,240,000 MJ;
- Non renewable biomass to produce same heat output in a 10% efficient stove[5]= 32,400,000 MJ= 2,160,000 Kgs = 2,160 tons;
- CO_2 emissions per Kg of Non Renewable Biomass= 1.644 Kgs/Kg of Wood fuel (IPCC values used);
- Total emission reductions from 1,000 cookers= **3,551 tons CO2e**;
- Emission reduction per cooker= 3.5 tons CO2e.

If the draft NRB categories are applied to the above project:

- Emission reductions during year y for 1,000 cookers= (3,240,000/10^6) * 0.5* 71.5= **463.32 tons CO2e** (**13%** of ER of the registered project);
- If the biomass stove efficiency figures in the PDD are disregarded and the default efficiency values for stoves in the methodology i.e. 20% are used, Emission reductions during year y for 1,000 cookers= **926 tons CO2e** (**26%** of ER of the registered project).

Emission reductions for project 3

Emission reduction calculations based on carbon content of NRB:
- Number of devises (biogas plants/digesters) in the project: approx 9500;
- NRB fuel wood saved per biogas plant: 4 tons per annum (inferred data);
- CO_2 emissions from 1 Kg of NRB fuel wood: 1.83 Kg CO_2/Kg[6] of NRB biomass;
- Emission reduction per devise: 7.2 tons CO2e per devise (includes emission reduction from CH_4 savings: 0.32 ton CO2e per devise);
- Total net emission reduction per devise is 7 tons of CO2e after deducting fugitive emissions but the project assumes 4.99 tons CO2e per devise to be conservative;
- Total ER for the project: 9,500*4.99= **47,500 CO2e**

If the draft categories are applied to this project
- Total NRB fuel wood saved: 38,832 tons per annum;
- Thermal energy content of the NRB saved: 582.5 Tera Joules;
- EFnon-renewablebiomass, CO2= (0.2/0.5)*71.5= 28.6;
- Emission Reductions- **16,659 CO2e** (**35% of ER** of the registered project).

4 P = (T2 - T1) * Cp,W * mW / tb
P = (100 - 20) K * 4.18 kJ/kg/K * 6 kg / (55 * 60s) = 0.6 kJ/s = 600 W.

5 PDD states the stoves being replaced have 5 to 15% efficiency and assumes a 10% average efficiency

6 This is higher than the value used under project 2