

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/day¹;
- 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 tCO₂/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 kW_{th} * 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:

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

where:

ER_y Emission reductions during the year y in t CO₂
B_y 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,CO₂ Emission factor for the substitution of non-renewable biomass by similar consumers locally, in t CO₂ / TJ biomass.

$$EF_{\text{non-renewable biomass,CO}_2} = \frac{\epsilon_{\text{stoves, biomass}}}{\epsilon_{\text{stoves, fossil}}} \cdot EF_{\text{CO}_2, \text{fossil}}$$

where:

- $\epsilon_{\text{stoves, biomass}}$ Average efficiency of stoves fired with biomass, use 20% as default value or local data if available
- $\epsilon_{\text{stoves, fossil}}$ Average efficiency of stoves fired with fossil fuels, use 50% as default value or local data if available
- $EF_{\text{CO}_2, \text{fossil}}$ CO₂ emission factor for the fossil fuel; 71.5 tCO₂/TJ for Kerosene, 63.0 tCO₂/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:

$$ER_y = 788,400,000 * 20 / 50 * 71.5 / 1,000,000 = 22,517 \text{ tCO}_2$$

Indicative Transaction costs²

- 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/tCO₂

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 fuel³.

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 W⁴/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 stove⁵= 32,400,000 MJ= 2,160,000 Kgs = 2,160 tons;
- CO₂ 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= (3,240,000/10⁶) * 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 devices (biogas plants/digesters) in the project: approx 9500;
- NRB fuel wood saved per biogas plant: 4 tons per annum (inferred data);
- CO₂ emissions from 1 Kg of NRB fuel wood: 1.83 Kg CO₂/Kg⁶ of NRB biomass;
- Emission reduction per device: 7.2 tons CO₂e per device (includes emission reduction from CH₄ savings: 0.32 ton CO₂e per device);
- Total net emission reduction per device is 7 tons of CO₂e after deducting fugitive emissions but the project assumes 4.99 tons CO₂e per device 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;
- EF_{non-renewablebiomass, CO2}= (0.2/0.5)*71.5= 28.6;
- Emission Reductions- **16,659 CO₂e (35% of ER of the registered project)**.

⁴ $P = (T_2 - T_1) * C_p * W / t$

$P = (100 - 20) K * 4.18 kJ/kg/K * 6 kg / (55 * 60s) = 0.6 kJ/s = 600 W.$

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