Annex 10

DRAFT THRESHOLDS AND CRITERIA FOR THE ELEGIBILITY OF HYDROELECTRIC RESERVOIRS AS CDM PROJECTS

Based on the technical paper "Options for Monitoring Emissions of GHGS: Providing Thresholds and Criteria for Hydroelectric Reservoirs", by Marco Aurélio dos Santos and Luiz Pinguelli Rosa, the following observations can be made:

1) Bacterial decomposition (both aerobic and anaerobic) of organic matter and other processes in water reservoirs produce CO_2, CH_4 and N_2O. Also, some non-organic materials present in the area may also create conditions for GHG emissions;
2) The gases emitted from the decomposition of flooded biomass constitute only a fraction of the total of gases emitted by a reservoir. Also, only a fraction of total emissions are anthrophogenic;
3) The gases emitted by the reservoirs that originate from the decomposition of biomass can be of two different origins: the original flooded biomass and other biomass formed during the ongoing photosynthesis always under way in the reservoir. The decomposition of the original biomass progressively reduces the stock of carbon and moves towards biological inertia, and thus its proportion of the emissions diminishes over time. The gas emitted as a result of plankton has an essentially constant rate over time because its source is constantly renewing;
4) The oxygenated layer of the reservoir is a sink for methane, and even has the capacity to absorb methane contained in the atmospheric air, if a flow of methane from air to water is established. Similarly, photosynthesis forms a sink for carbon dioxide, and there can also be a flow of CO_2 from the atmosphere to the reservoir;
5) The intensity of gas emissions in a reservoir is not invariant over time. There are fluctuations with irregular periods of duration. However, the variation is modulated by a set of factors, including temperature, wind regime, sun exposure, physical and chemical parameters of the water, biome and composition of the biosphere. For CO_2, these influences could combine in such a way that emissions could be a tenuous function of latitude, such that in higher latitudes reservoirs would tend to have lower emissions;
6) As a reservoir floods different areas, emissions should be counted as net, which requires some measurements of the emissions from the reservoir site prior to impoundment. Direct measurements only capture gross emissions;
7) A better knowledge of the carbon cycle in reservoirs is needed for the situations before and after flooding at various levels (reservoir level, watershed level and after dam impoundment);
8) A significant improvement in the understanding of carbon budgets in hydro reservoirs in tropical, boreal, arid, semi arid and temperate climates is needed before net emissions from reservoirs can be accurately determined;
9) Experimental measures and assessment of specific sites can give only a partial view, as reservoirs vary greatly from one to another and only transects and few measurements have been made so far in reservoirs of various shapes. More studies are necessary to supply data on the variability issue, and so as of today the problem has to be treated in a case-by-case basis;
10) Operation of a dam also impacts emissions from a reservoir, as it may have a substantial influence on the level of water and on the regrowth of the biomass in the borders of the reservoirs. As such, emissions may arise from the exposure and submersion of biomass in the borders, but part of these emissions may come from decomposition of biomass produced by the change in level of water;

11) Also noting that:

- Out of a database of 245 hydro plants in operation in the world today, with at least 30 MW of installed capacity, the average power density is 2.95W/m2 and the average capacity factor is 49%, although these numbers have been improving since 1990;

- Hydroelectric reservoirs are also used for other purposes (e.g. irrigation, navigation, water supply) and as such, emissions cannot be credited to power generation alone;

- Data for the average of two surveys for measuring GHG emissions from seven hydroelectric power plants in Brazil show:
  a) Low end: 2,896.94 kg CO_2 equiv/km2/day (for Segredo Hydro Dam, with 8,78 kg/km2/day of CH_4 and 2,695 kg/km2/day of CO_2);
  b) High end: 10,990.28 kg CO_2 equiv/km2/day (for Tucurui Hydro Dam, with 109.36 kg/km2/day of CH_4 and 8,475 kg/km2/day of CO_2);
  c) Applying this interval to an hypothetical power density of 10 W/m2, we end up with the interval of 2.9-11.0 gCO2 /m2/day.

- Values which lead to a range of 20.14-76.4 gCO2eq/kWh from a hydro with 10W/m2 and a capacity factor of 60%;

- A combined-cycle natural gas power plant with a thermal efficiency of 50% and a steam coal power plant with a thermal efficiency of 37% apply in a range of emissions of 404-920 gCO2eq/kWh;

- The 10 W/m2 threshold, if the Brazilian range here presented is used, leads to GROSS emissions from a hydroelectric power plant in the range of 5.0-18.9% of a combined-cycle natural gas equivalent power plant per kWh produced.

12) While noting the scientific uncertainties still surrounding the subject, and the fact that those uncertainties will probably not be resolved shortly, the Meth Panel recommends that simple and transparent criteria, based on thresholds in terms of power density (W/m2), are used to determine the eligibility of hydroelectric power plants for CDM projects. The recommended thresholds are the following:

- Hydroelectric power plants with power densities up to 5 W/m2: cannot use current methodologies;
- Hydroelectric power plants with power densities higher than 5 W/m2 but lower than, or equal to, 10 W/m2: are candidates to apply as CDM projects, but with project emissions equal to 100 g CO_2/ kWh;
- Hydroelectric power plants with power densities higher than 10 W/m2: project emissions may be neglected.