From Reservoir Greenhouse Gas Emissions to Hydropower Carbon Footprint: Methodology, and Advances

zhe li

Chongqing Institute of Green and Intelligent Technology, Chinese Academy of Sciences

Chongqing, China

Dam construction and reservoir creation provide not only freshwater resources but also renewable energy. With these outstanding multiple services, reservoirs have become important infrastructures to mitigate the negative effects of global change. However, the potential greenhouse gas (GHG) emissions due to reservoir construction and operation have been a global concern over the past decades. At present, there are still uncertainties and ambiguous aspects in the evaluation of the net GHG emissions of reservoirs and the carbon footprint of hydropower. To this end, the paper firstly illustrated that reservoir construction and operation would regulate GHG emissions through the four effects, i.e., inundation, obstruction, reconstruction, and consumption. Following the conceptual framework proposed by the Intergovernmental Panel on Climate Change, the paper discussed the scientific connotation and existing questions in the evaluation of reservoir net GHG emissions. The technical approach to evaluate pre and post-impoundments GHG emissions of the reservoir was also suggested. In addition, it clarified that hydropower carbon footprint was the total GHG emissions, in terms of carbon dioxide equivalents (CO2eq), from all anthropogenic activities during the life cycle of the hydropower project. After a review of global cases, it discussed that the life cycle of a hydropower project should include four phases, i.e., preparation, construction, operation and maintenance, and decommissioning. Yet, there need more research and applications to answer the questions on methodology development, system boundary, and interpretation of hydropower carbon footprint. Soon, it suggests setting up the standard system for monitoring and evaluation of reservoir GHG emissions, as well as the assessment of hydropower carbon footprint. Basic scientific research on carbon cycling and carbon fluxes in reservoirs need to be deepened to support the evaluation of reservoir net GHG emissions. The innovation in the carbon management system is suggested to be based on the improvement of the eco-environmental performance management system of hydropower enterprises. Further activities are required to help the hydropower industry to find the right position and make breakthroughs and innovations in the path of mitigating climate change and achieving the "double carbon goal".