Application of the CCQI methodology for assessing the quality of carbon credits

This document presents results from the application of version 3.0 of a methodology, developed by Oeko-Institut, World Wildlife Fund (WWF-US) and Environmental Defense Fund (EDF), for assessing the quality of carbon credits. The methodology is applied by Oeko-Institut with support by Carbon Limits, Greenhouse Gas Management Institute (GHGMI), INFRAS, Stockholm Environment Institute, and individual carbon market experts. This document evaluates one specific criterion or sub-criterion with respect to a specific carbon crediting program, project type, quantification methodology and/or host country, as specified in the below table. Please note that the CCQI website Site terms and Privacy Policy apply with respect to any use of the information provided in this document. Further information on the project and the methodology can be found here: www.carboncreditquality.org

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Criterion:	**4.1: Enhancing adoption of low, zero or negative emissions technologies and practices**
Project type:	**Hydropower (dam and run-of-river)**
Date of final assessment:	**12 September 2023**
Score:	**Hydropower (dam): 3** **Hydropower (run-of-river): 5**

Assessment

Relevant scoring methodology provisions

The scoring approach assesses the degree to which the technologies or practices applied under the project type facilitate the transition towards net zero emissions (see table 1). The main consideration is whether the project type employs negative, zero or low emissions technologies or practices. Moreover, it is considered whether the project type poses risks for locking-in technologies or practices that may result in an increase in GHG emissions in the long-term, thereby undermining the achievement of net zero emissions, or whether the project type employs innovative technologies or practices which may accelerate the transition to net zero emissions. See further details on the scoring in the methodology.

Table 1 Scoring approach for enhancing adoption of low, zero or negative emission technologies and practices

Technology type	Score
Negative emissions technologies and practices	
Description: Technologies and practices that remove CO_2 from the atmosphere, such that more CO_2 is sequestered in the process than greenhouse gases are emitted:	
• Direct air carbon capture and storage (capture of CO_2 from the atmosphere and storage in long-term reservoirs) (DACCS)	5
• Bioenergy with carbon capture and storage (BECCS)	4
• Afforestation, reforestation and restoration (ARR)	5
Zero emissions technologies and practices	
Description: Technologies and practices that result in net zero GHG emissions during their operation. **Exception:** A score of 4 applies to technologies or practices that are less innovative than the best available technology. For example, this holds for biomass power generation using less efficient plants than the best available technology.	
• Cement production with renewable energy sources combined with carbon capture and storage (CCS) with high efficiency rate (e.g., >90%)	5
• Fuel switching to zero-emitting technology (e.g., fuel switch from natural gas to "green" hydrogen produced from renewable energy sources and with minimal hydrogen leakage throughout the value chain)	5
• Change in practice or components along the process or production cycle leading to change from high to zero emissions (e.g., steel production using "green" hydrogen produced from renewable energy sources and with minimal hydrogen leakage throughout the value chain)	5
• Zero emissions renewable energy generation, such as o Wind and solar power generation o Hydro power generation from run-of-river plants or dams with negligible CH_4 and CO_2 emissions o Geothermal energy use with negligible fugitive emissions	5
• Use of biomass residues or other forms of sustainable/renewable biomass using best available technology	4
Avoided emissions technologies and practices	

Technology type	Score
Description: Technologies and practices that generate indirect upstream or downstream emission reductions as a result of the use of technology or practice, or practices that intervene with the release of existing of terrestrial carbon stocks. **Exceptions:** A score of 4 applies to technologies or practices that have a superior alternative or do not represent the best available technology, for example, because they are less energy efficient than already available alternatives (e.g., compact fluorescent lamps (CFLs) compared to light-emitting diodes (LEDs)).	
• Highly efficient demand side technology (e.g., LED lamps)	5
• Efficient demand side technology (e.g., CFL lamps)	4
• Battery or pump storage enabling greater renewable electricity generation	5
• Recycling of waste	5
• Composting of organic waste	5
• Reducing emissions from deforestation and degradation	5
Low emissions technologies and practices	
Description: Technologies and practices that emit comparatively lower levels of GHG emissions during their operation. The default score is 3, given that these technologies or practices lead to continuous GHG emissions and could thus compromise the goal of achieving net zero emissions in the future. A score of 4 applies to technologies or practices that use best available technology, and for which the risk of locking-in investments that lead to continuous GHG emissions is low. This holds, for example, for the use of landfill gas for energy generation from already closed landfills. In the case of closed landfills there is no risk that, as a result of the project, landfilling is continued rather than embarking on more sustainable waste handling practices, such as recycling and composting. A score of 2 applies to technologies or practices that do not use best available technology and for which the risk of locking in investments which lead to continuous GHG emissions is significant. This holds in particular for technologies with a long lifetime, such as fossil fuel-based power plants.	
• Carbon capture and storage (CCS) from fossil fuel fired power plants Rationale: While CCS can avoid any direct emissions from fossil fuel fired power plants, the continued use of fossil fuels causes unavoidable emissions from their mining, exploration, processing and transportation, such as CH_4 emissions from coal mining and oil and gas exploration. Given that power plants may operate for decades, there is a significant risk of locking-in investments that may undermine achieving net-zero emissions in the future. In addition, superior alternatives, such as renewable power generation in combination with storage systems, are already available.	2
• Fuel switching to a less carbon intensive fossil fuel (e.g., from coal to natural gas)	3
• Carbon capture and utilization (CCU)	3
• Use of landfill gas from closed landfills for energy generation	4
• Use of landfill gas from open landfills for energy generation	3
• Waste to energy	3
• Landfill gas flaring	3
• Greenfields natural gas power plants	2
• Use of "blue" hydrogen from fossil fuel sources combined with carbon capture and storage (CCS)	3

Information sources considered

1 IEA (2021) Hydropower special market report - Analysis and forecast to 2030. https://www.iea.org/reports/hydropower-special-market-report

2 Deemer et al. (2016) Greenhouse Gas Emissions from Reservoir Water Surfaces: A New Global Synthesis. In: BioScience, volume 11, issue 11, pp. 949-964. https://academic.oup.com/bioscience/article/66/11/949/2754271

3 Yadi et al. (2022) Knowledge domain of greenhouse gas emissions from hydropower reservoirs: Hotspots, frontiers and future perspectives. In: Frontiers in Environmental Science. https://www.researchgate.net/publication/

4 Ocko & Hamburg (2019) Climate Impacts of Hydropower: Enormous Differences among Facilities and over Time. In: Environmental Science & Technology. https://pubs.acs.org/toc/esthag/53/23

Assessment outcome

The project type is assigned a score of 5 for hydropower (run-of-river) and 3 for hydropower (dam).

Project type

The assessment refers to the following project types:

Hydropower (dams):

"Installation of a new hydro power plant by building a new dam or the installation of additional power generation capacity at an existing reservoir. The electricity is fed into a national or regional electricity grid. This project type does not include pumped-storage hydropower. The project type reduces emissions by displacing more greenhouse gas intensive electricity generation. "

Hydropower (run-of-river):

"Installation of a new hydro power plant with no or minimal storage. The plant harvests energy from flowing water, such as rivers or streams. The electricity is fed into a national or regional electricity grid. The project type reduces emissions by displacing more greenhouse gas intensive electricity generation."

Justification of assessment

According to the scoring methodology, 'hydro power generation from run-of-river plants or dams with negligible CH_4 and CO_2 emissions' counts among zero emissions renewable energy generation. This would correspond to a score of 5.

However, the caveat 'with negligible CH_4 and CO_2 emissions' implies that hydropower plants with substantial methane or carbon dioxide emissions do not qualify as a zero-emission technology.

According to the International Energy Agency, hydropower is essential for the transition to a net zero economy (Source 1). However, literature points towards a large variability and uncertainty regarding the technology's GHG emissions, specifically methane emissions from reservoirs. Because of their characteristics, reservoirs can be a substantial source of GHG emissions through several pathways. For example, the flooding of large stocks of organic matter can lead to microbial decomposition, and the fluctuations of water level can cause CH_4 bubbling (Source 2). An analysis by Ocko and Hamburg (2019) shows that while some hydropower plants can even be carbon sinks, more than 100 of the analyzed 1,473 hydropower plants have an equal or higher carbon footprint than fossil fuels. The extent of GHG emissions depends on a variety of factors, age, area, volume of the reservoir, as well as temperature and precipitation and characteristics of the submerged vegetation and soil (Source 4). In addition, the risk of a lock-in effect is mitigated by the fact that there is a decline of emissions after the first decades (Source 4). For a comprehensive review on the current state of research, see the work of Yadi et al. (Source 3).

Reservoirs are relevant in the context of dams, whereas run-of-river plants have only small or minimal storage. We therefore deem that there is no risk of significant CH_4 or CO_2 emissions in the case of run-of-river plants and accordingly assign this project type a score of 5.

In the case of dams, emissions from reservoirs vary greatly and can be substantial, and can thus not be considered negligible. Hence, we consider hydropower dams as a 'low emission technology'. This corresponds to a scoring of either 2, 3 or 4. The exact score depends on the lock-in risk of the technology and if it is the best available technology (see Table 1).

The above literature suggests that the risk of locking in investments that lead to continuous GHG emissions in the case of hydropower dams is not necessarily "low". Hydropower plants can exist for up to 100 years, and thus lead to continuous emissions over this time frame (Source 1). Therefore, a score of 4 does not apply. Likewise, a scoring of 2 may not apply, as the risk for continuous emissions varies substantial, depending on the specific plant, and is not in all cases "significant". We therefore assign hydropower dams the default score of 3.