Briefing

Climate change; Energy

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Policy pointers

As public finance, climate funds are highly scrutinised and must uphold high standards of social justice and environmental sustainability. But they must also focus effectively on the transformation of systems for adaptation and mitigation outcomes.

Hydropower has, overall, not attracted major climate finance investment, given concerns about social and ecosystem outcomes, and reservoir emissions. The emergence then of transition hydropower as a subgroup that meets all of the criteria, presents a need for strategic refocusing of programming.

Although hydropower is not a new technology, hydropower's energy storage and ancillary grid services facilitate higher penetration of renewable energy, which is critical to the transformation of energy systems.

Climate finance investors should consider transition hydropower as a game changer for energy emissions, and an alternative to current short-term approaches that are unlikely to align with a 1.5°C pathway.

How climate finance can help repurpose hydropower

Climate funds should facilitate the transition to a low-carbon and climate-resilient future. Energy storage and ancillary grid services are critical to expanding the proportion of intermittent renewable generation on the electricity grid. Hydropower remains the largest and most cost-effective provider of bulk energy storage, offering the flexibility to provide most other recognised grid services. While sustainable hydropower may not broadly meet climate finance criteria, hydropower projects with the necessary characteristics for transition do meet these objectives and should attract climate finance support. Meanwhile, concerns about the social and ecological integrity of hydropower, such as impacts on local communities, provide more reasons for climate finance to incentivise hydropower designs that are socially, environmentally and technically appropriate for future conditions, supporting the shift to accessible, affordable, clean, distributed smart grids.

The role of climate finance in supporting the transition of the power sector

Commitments to provide climate finance were agreed in the Copenhagen Accord in 2009 as one way for the richer, big emitters to help the poorer, low-emitting countries reduce emissions and adapt to climate change (Box 1). The Paris Agreement further enshrined the expectations for a just transition — putting social justice at the heart of the response.

The potential for enabling the transformation to climate-resilient and low-emission futures is emerging as a criterion and should be universal — but to be usefully applied, it needs unpacking in context. Climate finance seeks to enable new energy pathways through supporting innovation in technologies and markets. It therefore has a role to incentivise the shift in hydropower design and operations that would increase hydropower's contribution to the transition to low-carbon and resilient energy.

Why hydropower is critical to reduce grid emissions

The current global average electricity grid emissions of 475g of CO_2 per kilowatt hour are not in line with meeting the Paris Agreement global warming target of well below 2°C, with the 1.5°C ambition further still. A near 90% reduction in grid emissions to 50g CO_2/kWh is required for any chance of achieving either target.

Hydropower plays vital roles in enabling the reduction of grid emissions. It is, in the majority of cases, low carbon — albeit with significant outliers — and can provide critical services for operating a reliable and affordable electricity grid with a high proportion of intermittent renewables. These services include the energy storage, load following and grid stabilisation needed with solar and wind generation. Batteries also offer bulk energy storage, but are more expensive, while gas provides other grid services but is higher carbon.

Hydropower plays vital roles in enabling the reduction of grid emissions

Despite the potential of climate finance to incentivise the development of hydropower that is operated to enable reliable, affordable, clean distributed smart grids, it is currently doing little to support this.

Current climate financing to hydropower

Climate finance investment in hydropower projects from 2003 to 2018 amounted to US\$693 million.[1] This compares with nearly US\$300 billion of public and private climate finance (US\$238 billion and US\$57 billion respectively) for renewable energy in 2016 alone — 90% of which was for wind and solar.

Of the multilateral climate funds, only four have provided any support to hydropower projects (Figure 1): the Clean Tech Fund (CTF), the Scaling-Up Renewable Energies Program (SREP), the Global Environmental Facility (GEF) and the Green Climate Fund (GCF). Figure 1 sets out the number of hydropower projects, and the level of climate finance committed by each fund.

How climate finance can assess hydropower projects

The lack of support from climate funds for hydropower suggests funders do not see its development as being in line with their mandates (Box 1). This is because it is a proven technology, with recognised downsides: high cost, long delivery time, variable emissions from its reservoirs, potential social and environmental impacts with reputational risks for investors.

However, a comparison of fund mandates against hydropower characteristics demonstrates that a distinct subset of sustainable hydropower projects, specifically transition hydropower, fully meets the objectives of climate finance. Sustainable hydropower projects are those that emerge from a basin-wide process and respect good practice (as defined by the International Hydropower Association). Transition hydropower is designed explicitly to support intermittent renewables on the grid through the provision of energy storage and grid ancillary services.

While sustainable hydropower characteristics alone do not meet climate finance criteria, projects that also embed the transition characteristics represent a critical investment to achieve a reliable low-carbon grid and should therefore attract support from climate finance. To understand whether a hydropower project is sustainable enough to attract green finance or transitional enough for climate finance, investors should assess projects against the following criteria.

Social and ecological integrity. Hydropower has the potential to significantly impact both communities whose land is flooded by the reservoir and downstream ecosystems, meaning the balance of costs and benefits has often proved controversial. A minimum standard of social and ecological integrity must be met for eligibility, but this is still not enough to justify climate finance support.

There is widespread agreement that the negative impacts of hydropower are best managed at basin scale, avoiding sensitive areas, rather than at project level, where the margin for manoeuvre is more limited. Basin managers can ensure the benefits for irrigation, energy, water, ecosystems and local communities through good quality strategic basin assessments. These should consider a range of scenarios to optimise development objectives through the placement, design and operation of hydropower.

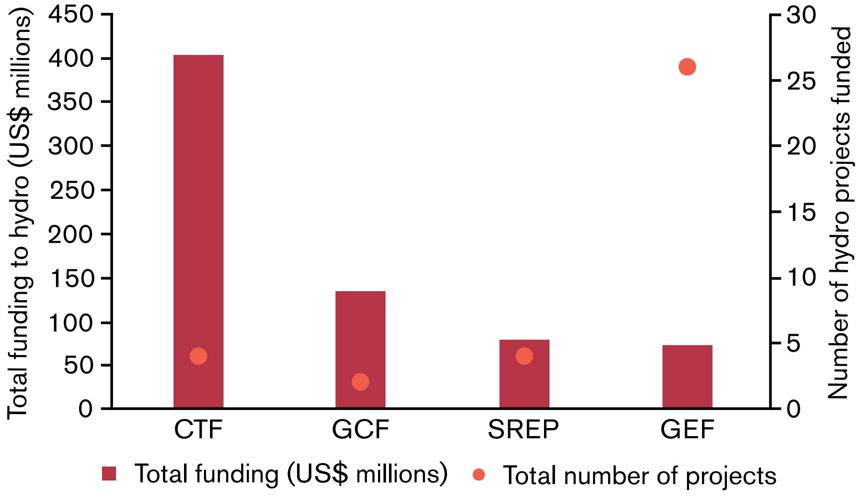
The Hydropower Sustainability Assessment protocol is a tool that climate funds can use to assess sustainability and they should expect projects to achieve a ‘good practice' level of 3 against all parameters.[2]

Low-emission renewable energy. Hydropower usually produces low-carbon electricity. A 2018 review of 178 single-purpose dam reservoirs and 320 multipurpose dam reservoirs found the global median lifecycle greenhouse gas emission intensity to be 18.5g CO_2 eq/kWh, while 84% of reservoirs exhibited emissions less than 100g CO_2 eq/kWh.[3] This is comparable to the median

Box 1. Climate finance criteria: the background

- In theory, climate finance is expected to support adaptation and mitigate emissions, additional to business as usual
- In practice, global climate fund decisions indicate the need to demonstrate social and environmental sustainability, by considering possible impacts from the planning stage onwards and reducing negative impacts as far as possible
- As climate finance is a relatively small flow, global funds also expect investments to demonstrate the potential to mobilise or influence larger funds and enable system transformation
- Practical experience demonstrates that the mandate of climate finance is to tip climate action — mitigation or adaptation — into viability. This can be through extra resources to ensure meaningful social and environmental sustainability, through de-risking of wider investment or through supporting experimental and innovative approaches as proof of concept.

Figure 1. The multilateral climate funds financing hydropower projects[1]



lifecycle carbon equivalent intensity of other renewables and significantly lower than that from fossil fuel energy. Estimating the lifecycle emissions of any hydropower system requires analysis of its specific context to understand the carbon intensity of the electricity it produces.

The G-res Tool allows climate funds to assess 'reservoir emissions'.[4] The International Hydropower Association and UNESCO have developed this standardised methodology for assessing potential greenhouse gas emissions from reservoirs.

Contribution to resilience. Changing precipitation patterns and variability in river flow affect the power output of dams. These hydrological risks to the energy system can therefore affect the resilience of the energy systems they serve — whether national or regional grids. However, when well-designed in a basin system, these risks can be managed so that reservoirs also support adaptation through water supply and management services.

Robust analysis and strategic basin assessments are tools to assess hydrological risk. As with the evaluation of ecological and social integrity, these assessments offer the best assurance of climate resilience through specifying the placement, design and operations of projects. But, at a minimum, climate funds should expect a hydropower project to undertake robust analysis of hydrological futures. Given the limits of forecasting models, they should also expect regular assessments of hydrological risk over the lifetime of the project, with adjustments made in response.

Transformation potential. Grids must carefully manage voltage and frequency to balance demand, transmit electricity efficiently and reliably provide the right voltage of power to households. To increase intermittent renewables on a grid, its systems have an ever-greater need for energy storage and ancillary services such as flexible generation and grid stabilisation. Hydropower dams can be developed and operated to provide these services.

In 2011, the Transmission System Operators in Ireland and Northern Ireland looked at the services required to meet the challenges of safe, secure and efficient operation of the grid while facilitating higher levels of renewable energy.[5] They identified 14 system services, including inertia response, operating reserves and fast frequency response. Hydropower can provide 13 of the 14 system services identified.

While hydropower is a mature and proven technology, designing and operating it to provide these services, and developing markets that incentivise them, facilitates transformation. Climate funds should invest in projects with this intention as the central criterion of transition hydropower.

How hydropower projects can present their case for climate finance. Table 1 explores how a hydropower project was justified as meeting climate fund criteria. The Solomon Islands' Tina River Hydropower Development Project was approved for support by the Green Climate Fund in July 2017 and is building a 15MW dam-tunnel

Table 1. Tina River Hydropower Development Project case study

GCF criteria[6,7]	How does the project meet the criteria?
1. Impact potential	The hydropower will reduce greenhouse gas emissions by 49,500t CO_2 equivalents per year.
2. Paradigm shift potential	This project enables a shift from 97% diesel to >65% (of 120 GWh demand projected in 2022) renewables and facilitates further integration of solar power onto the grid.
3. Sustainable development potential	The project doubles the number of households with energy access by 2021, and reduces the cost and volatility of a diesel-dependent electricity tariff. Access to reliable and affordable energy enables savings and investment by businesses.
4. Needs of the recipient	As the Solomon Islands is a least developed country, funding is critical for financial viability. The project requires concessional finance due to the high cost of capital and the low cost of diesel, given recent low oil prices.
5. Country ownership	The project agreed a land acquisition process with local indigenous groups through a benefit sharing agreement. The Solomon Islands government will have full ownership of the project after the 34-year concession period. The project aligns with the country's climate goals and policies.
6. Efficiency and effectiveness	The annual greenhouse gas emission reduction potential of the project is over two and a half times the government's commitment in the Nationally Determined Contributions. Given estimated costs of US$233.98 million, the emissions reduction per dollar over the project life is 10.6kg CO_2equivalents.

hydropower plant that includes access roads, transmission lines and technical assistance to the regulator. It is contracted through build–own–operate–transfer (BOOT), under a project company owned in partnership between a tendered private company and the government.

What does this mean for climate finance?

Climate finance can justifiably support transition hydropower. Accordingly, climate funds should be mandated to support the development of hydropower projects with these transition characteristics. Climate finance should therefore:

- **Support basin assessments for strategic hydropower development.** High quality strategic basin assessments should consider a range of hydrological risk scenarios and optimise development objectives (irrigation, energy, water and ecosystems), thereby minimising negative impacts of hydropower development through careful placement, design and operation.
- **Increase performance of existing hydropower for climate objectives.** Rehabilitation of existing hydropower can provide low-carbon energy and expand the transition services required to increase intermittent renewables on the grid in a cost-effective and low-carbon way.
- **Restructure markets to reward transition services.** Transition hydropower enables the transformation of electricity grids to a clean energy system built around intermittent renewables via grid services, such as energy storage, dispatch and stabilisation. Energy markets need to identify, value and pay for these services.
- **Reduce the cost of capital for transition hydropower.** Hydropower projects are high risk and expensive to construct. Climate funds can mobilise private financing by balancing risks across public and private sector interests, optimise social and environmental outcomes, and ensure attractive revenue streams for private investors at affordable tariffs.
- **Set clear criteria for the hydropower projects that climate finance will support.** Climate financiers are inconsistent in interpreting how hydropower fits their mandates.. Through better guidance, climate financiers can reduce ambiguity and incentivise project developers to design their projects with the required transition characteristics.

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Notes

[1] From the Climate Funds Update database. https://climatefundsupdate.org/data-dashboard (data accessed November 2018) / [2] www.hydrosustainability.org / [3] International Hydropower Association (2018) 2018 Hydropower Status Report. See www.hydropower.org/publications/2018-hydropower-status-report / [4] https://g-res.hydropower.org / [5] EirGrid and SONI (2017) Consultation on DS3 System Services Enduring Tariffs: DS3 System Services Implementation Project. See www.eirgridgroup.com/site-files/library/EirGrid/DS3-System-Services-Enduring-Tariffs-Consultation-Paper.pdf / [6] GCF (2019) How we work. www.greenclimate.fund/how-we-work/funding-projects / [7] GCF/B.09/23 Annex III: Initial investment framework: activity-specific sub-criteria and indicative assessment factors. www.greenclimate.fund/documents/20182/239759/Investment_Framework.pdf/eb3c6adc-0f24-4586-8e0d-70aa6fb8c3c8