



dam right WWF'S
DAMS INITIATIVE

Hydropower in a changing world



Global energy and environmental challenges

Global energy needs are rising rapidly, as are the greenhouse gas emissions from the energy sector. Climate change and the protection of freshwater ecosystems are key environmental challenges and our energy requirements need to be met through options that have the least aggregate environmental and social impact.

Hydropower is a renewable energy source, but hydropower plants can have huge impacts on freshwater ecosystems, fisheries, and flood dependent agriculture. Sixty per cent of the world's 227 largest rivers are already severely fragmented, with dams being one of the worst culprits. Many dams have a hydropower function, and hydropower currently supplies 19 per cent of global electricity needs. The UN estimates that only one third of feasible hydropower sites have been developed, with most of the potential new sites situated in developing countries.

These countries are also home to the estimated two billion people without access to electricity. As electricity demand in these countries grows, there will be increasing pressure to develop new hydropower schemes, with a strong potential for major negative impacts. New dams already threaten to damage some of the world's most ecologically diverse river basins such as the Amazon, the Zambezi and the Mekong. At the same time, plans for new hydropower plants pose a renewed risk for the few remaining unregulated rivers in areas where most rivers have already been dammed, for example in the European Alpine region.

Other energy options, in particular coal and nuclear power, also have significant negative or even unacceptable environmental impacts. In order to combat climate change and protect ecosystems, future energy supply needs to be based on sustainable renewable energy and highly efficient energy use.



Solar photovoltaic panels can make electricity accessible in off-grid rural areas

A new framework for decision-making – The World Commission on Dams

The World Commission on Dams (WCD), which reported in 2000, demonstrated the high and often unacceptable social and environmental costs of many large dams. It also found that of 63 large dams with a hydropower component, 55 per cent generated less power than projected. As large hydropower plants involve a huge capital outlay, such underperformance can pose a heavy economic burden, especially in developing countries.

To ensure better environmental, social and economic choices, the WCD recommended a new framework for decision-making, consisting of strategic priorities, policy principles and guidelines. WWF urges decision-makers to apply the WCD framework to the planning of new dam projects. The WCD recommendations were based on a comprehensive review of existing projects and took into account the views of dam proponents and dam opponents, thus presenting a balanced assessment. Key WCD proposals include the need to carry out a comprehensive needs and options assessment and full stakeholder involvement. Public acceptance must be demonstrable and affected people must be given a share of the benefits of projects. The assessment and mitigation of environmental impacts must be at a river basin level.

Energy and poverty

Poverty reduction is a core issue for many developing countries. Providing access to electricity is an essential element of reducing poverty and improving living standards. Four out of five people without access to electricity live in rural areas, mainly in South Asia and sub-saharan Africa. In most cases, their needs would be best served through decentralised energy systems, as the investment needed for large power plants and associated electricity transmission grids is simply unaffordable for most countries. Furthermore, the impacts of large hydropower dams on fisheries and agriculture downstream can be severe. Also, by destroying wetland ecosystems, they can seriously threaten the quality and security of drinking water. Renewable sources such as biomass, solar, wind and small hydropower are among the best options for alleviating energy poverty.

However, the developing world also has a need for more large-scale generating capacity to supply growing urban populations and a growing industrial sector. Not all these requirements can be met easily through small-scale or off-grid renewable options and, in some cases, a large hydro plant might emerge as the best option. Here, compliance with WCD principles is crucial to avoid the worst social and environmental impacts and to ensure that limited capital is invested effectively.



U GOLLIER / WWF-UK

Kariba dam has failed to benefit local communities displaced by the dam.

Failing to meet local needs

The Kariba dam on the Zambezi river is one of Africa's largest dams and, with an annual electricity production of 6,400GWh and a 5,500km² reservoir, there should be plenty of power and water for the surrounding areas. Yet, many of the tens of thousands of people displaced by the dam in the late 1950s still have no electricity or adequate water supply. Kariba has provided benefits but mainly to distant industries and cities.

Kariba is not an isolated case. Further downstream in Mozambique, Cahora Bassa's capacity of 2,075MW is in principle sufficient to supply the electricity needs of all of Mozambique, but 95 per cent of Mozambicans have no access to electricity. Instead, most of the power is exported at below market price to South Africa. At the same time, reduced river flow has decimated the once lucrative shrimp fisheries in the Zambezi delta, depriving local fishermen of a valuable income.

Small versus large hydropower

There has been much controversy surrounding large dam projects, especially those inundating large areas for storage reservoirs. This can involve habitat loss and the resettlement of large numbers of people. The downstream effects of such large plants are also considerable, as river flows and fish migration are severely disrupted.

Small hydropower plants (smaller than 15MW) generally do not involve storage reservoirs but can still have considerable impacts on river ecosystems. In fact, a large number of small hydro plants on a river and its tributaries can have a worse impact downstream by the "sum of their parts" being greater than one large hydropower dam. In countries where the potential for large hydro schemes has been exploited, further small schemes can cause considerable damage on the remaining unregulated rivers.

However, small hydropower plants can play an important role in a sustainable energy mix, especially in developing countries where they can be a cost-effective way of providing electricity to the rural poor. It is thus not possible to make generic statements about the desirability of small versus large

hydropower plants. Each scheme needs to be judged on its own merits in relation to the site-specific situation, including river basin-wide impacts.

Improving existing hydropower plants

Many older hydropower schemes were developed without proper environmental assessment and mitigation measures. However, mitigation measures can often be introduced retrospectively. The WCD stressed the importance of addressing the social and environmental problems caused by existing dams, in particular where new dams are planned in the same river basin.

Introducing environmental flow regimes can partially restore downstream ecosystems. Furthermore, older hydroelectric plants can often be refurbished and upgraded, resulting in additional electricity generation capacity and reducing the need for new dams.

Environmental flows in the Kafue Flats

WWF's *Partners for Wetlands* programme is working with Zambia's Ministry of Water and Energy Development and the Zambian Electricity Supply Company to introduce environmental flows at the Itezhi Tezhi dam, upstream of the Kafue Flats wetland. The Kafue Flats are home to abundant birdlife and wildlife, including the unique Kafue lechwe, a semi-aquatic antelope. The natural flooding regime of the flats has been altered by the operation of the Itezhi Tezhi and Kafue Gorge, dams built in the 1970s. This has reduced the area flooded and changed the timing of the flooding. The result has been reduced water resource availability, less cattle grazing area, negative impacts on wildlife and fish, and reduced potential for tourism. Changing the operational regime of the upstream dam will have limited impacts on power generation at Kafue Gorge but will have huge benefits for people and wildlife in the Kafue Flats.



S BLACK / WWF-CANON

Dams have affected the natural flooding regime in the Kafue Flats wetlands in Zambia

No-go rivers

In many countries, river fragmentation by dams means that there are few rivers left in their natural state. This has resulted in an enormous loss in wetlands and other freshwater ecosystems. WWF believes that governments should designate some of the remaining unregulated rivers in areas of high conservation value as “no-go” areas for hydropower schemes. For example, in Iceland, where the Kárahnjúkar hydropower plant will cause considerable damage to two glacial rivers, WWF is urging the Icelandic government to afford protection to a third glacial river, Jökulsá á Fjöllum, including its designation as a Ramsar site. In Brazil, WWF is campaigning to get the Purus and Negro rivers in the Amazon basin declared as “free flowing” rivers.

Hydropower and climate change

Hydropower produces few greenhouse gas emissions overall, although there is evidence of high emissions from some tropical reservoirs, particularly shallow ones. More research into these emissions is needed urgently and caution is necessary in promoting hydropower as a solution to climate change while this uncertainty persists.

There has also been some concern that a few large hydropower projects could absorb a major proportion of the limited funds available under the Clean Development Mechanism (CDM) and Joint Implementation (JI) provision of the Kyoto Protocol. Several of these projects would probably be built anyway, even without Kyoto Protocol support. Allocating CDM / JI funding for such projects would thus not result in additional CO₂ reductions. WWF thus supports the *Gold Standard*, an independent best practice benchmark for the CDM and JI. It includes small hydropower schemes (<15MW) that meet WCD guidelines, and projects that need to demonstrate “additionality” and deliver added environmental and social benefits.



Construction site for the Kárahnjúkar dam in the East Icelandic highlands

WWF's top 10 guiding principles for sustainable hydropower:

1. Proposals for new hydropower plants must conform to the strategic priorities and policy principles of the World Commission on Dams.
2. Governments and international agencies must prioritise investment to service the two billion people globally that are without access to electricity. More investment in small-scale, decentralised renewable energy solutions is needed.
3. CDM and JI hydropower projects should meet *Gold Standard* criteria.
4. Some of the remaining unregulated rivers in areas of high conservation value should be designated by governments as “no-go” areas for hydropower schemes.
5. Siting decisions for new hydropower plants need to consider impacts in the whole river basin and opt for sites of minimum environmental impact.
6. Efficient hydropower sites that minimise the area flooded per unit of energy produced should be given preference.
7. The capacity of existing hydropower plants should be upgraded wherever possible, so as to minimise the need for new capacity.
8. Comprehensive environmental mitigation measures (such as environmental flow regimes, habitat restoration and protection and fish ladders) need to be included in all planned and existing hydropower plants.
9. Small hydropower plants can play an important role as a renewable energy source, especially for supplying rural areas in developing countries. However, they must include strict environmental mitigation measures and the cumulative impacts of a large number of small hydro plants must be considered.
10. Project developers must include all stakeholders in decision-making and ensure fair and sensitive resettlement procedures in accordance with WCD principles.



WWF's mission is to stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature, by:

- conserving the world's biological diversity
- ensuring that the use of renewable resources is sustainable
- promoting the reduction of pollution and wasteful consumption

Taking action for a living planet

DamRight!

WWF's Dams Initiative

Panda House, Weyside Park
Godalming, Surrey GU7 1XR
t: +44 (0)1483 426444
f: +44 (0)1483 426409
e: dams@wwf.org.uk
www.panda.org/dams