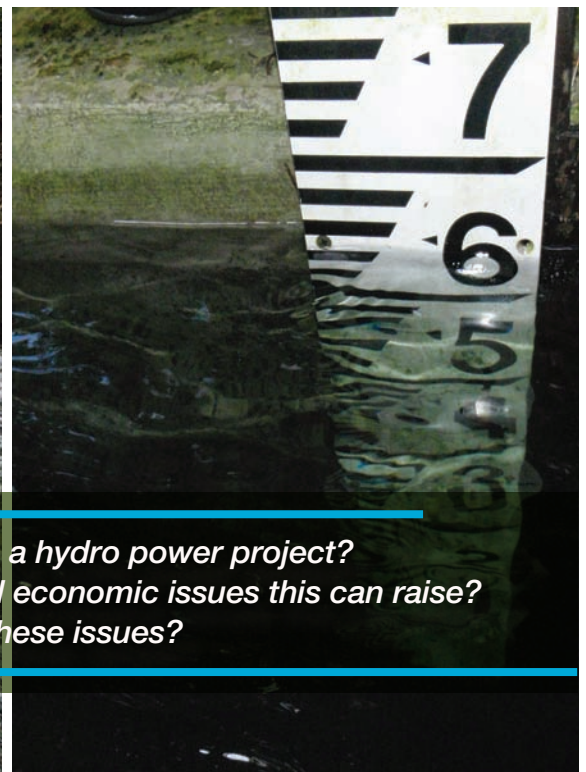


# Small scale hydro power

Pacific energy projects: Impacts on nature and people



*Are you planning to fund, build or manage a hydro power project?  
Have you considered the environmental, social and economic issues this can raise?  
Are you prepared to manage these issues?*

## TYPICAL HYDRO POWER PROJECTS

Hydroelectric power uses water that has a height differential (head) to move a turbine, converting the kinetic energy to electricity, and releasing it at an outlet (spillway). In the Pacific, both reliable water supply and elevation are typically found on volcanic islands. As the scale and nature of hydro power projects can vary dramatically, so can their impacts – for example modifying an existing dam can have negligible impacts. Water management by a hydro power project falls into two categories:

- **Storage** – the water flow is controlled, typically using a dam, to provide a consistent supply of water and electricity. This approach permanently floods the area behind the dam, modifies natural cycles of high and low flows, and restricts sediment movements and migrating species.
- **Run-of river** – the natural flow is diverted, but with negligible time delay or storage facilities. A weir, small dam, canal, penstock and other structures may be used to direct the water to a turbine, under pressure and then is released.

## HYDRO POWER PROJECT DEVELOPMENT

### Planning

The best time to build positive outcomes and avoid negative impacts is during development and design, and this is especially true for hydro power projects. These tend to have long lead times, requiring many years of rainfall and river flow data for the design, but are hard to change once built. In addition to the social aspects that are typical of energy projects, hydro power projects can impact on the catchment and distribution routes, and may have secondary impacts such as promoting irrigation.

### Research

Overall, a hydro power scheme adapts the natural variability of a river and its availability to species, and gives this power to people. This requires careful and ongoing thought as consequences can be far-reaching. Hydro power projects should consider the catchment affected, which requires an understanding of the environment and any patterns of change, sometimes over a wide area. Bigger storage and more heavily manipulated water flows usually have bigger impacts while run-of-river schemes can avoid or reduce most of these effects, and are therefore much lower impact.

## ◆ Environmental impacts

Hydro power provides continuous renewable energy, avoiding the need for diesel or batteries. Even small systems however will need concrete and clearing for construction, will divert water, and will need an electricity network as the system itself must be near a river. If a dam is required, changes to stream flow can affect ecosystems, sediment movements and flooding patterns. Hydro power may require protection of upstream catchment, which can be positive for the environment.

## ◆ Social impacts

The technology for hydro power is well developed, with information available on designing, building and maintaining various systems. The power is continuous, not intermittent like other sources, and its reliability is particularly useful for productive activities. Hydro power can raise issues of ownership and access rights for both water and land, and should be considered against current and future demands such as agriculture, drinking water supplies, fishing and ecosystem health. These interactions, together with the environmental impacts, can complicate decisions.

## ◆ Cumulative impacts

Large catchments may be suitable for multiple hydro power systems, especially pico or nano hydro (a few kW or less). Installing multiple systems on a river can add up to catchment level impacts, particularly during droughts or heavy rainfall (like cyclones). Access roads, poles and wires for distribution all contribute to the impacts of hydro power projects. The influence of the project may create secondary impacts, through access and influencing land use.

## KEY ISSUES

**Land and water use** – Constructing a hydro power project can formalise the availability and use of land and water in the catchment, such as water for drinking, agriculture (especially if irrigated), flood mitigation, environment or other uses. Upstream land use affects water quantity, flow rate, and quality such as sediment levels, for example requiring controls on clearing. Downstream from the project, land must be available for the pipes, powerhouse, access paths, and electricity lines. Water should be returned to its own catchment, as interbasin transfers affect multiple catchments negatively. Given the practical and social consequences on future land use choices and livelihoods, it is encouraged to apply catchment management principles and consult the various stakeholders.

**Water flow and quality** – A hydro power project alters water flow (hydrology) by the diversion and storage of water, affecting the speed water travels through a catchment (retention time). As a result flood patterns and seasonal flows can change, for good or bad. Hydrology and the physical structures together control erosion and sediment movements. Rivers may shift, and fertile soil may not be moved to downstream flood areas. Any sediments cleared

from the dam or structures are oxygen-reduced and must be placed so they do not smother plants and fish. Indirect effects like additional agriculture may add to pollution. Storing and pressurising water, through weirs, dams and pipes can affect water quality. Temperature and pressure can affect water chemistry, such as dissolved oxygen available to organisms. The impacts and their significance are usually site and project specific, and may need study.

**Ecosystems** – Both water quality and flow patterns affect the ecosystems in the river and floodplain areas. Flow patterns can affect seasonal ponds and migratory species. Changes to water quality may discourage some species or encourage competing species. The structures may also be a barrier or danger to fish, this can be reduced using through design like fish ladders, and clearing structures regularly.

**Safety and cyclones** – Consideration should be given to safety throughout the project. The design should enable safe access for the necessary maintenance. If there is a drought, or extreme rain (especially in cyclones), the structures should not fail or add to any problems. Users should be prepared for the consequences of drought.

## FOR FURTHER INFORMATION

- 1 *World Commission on Dams*, ground-breaking cooperative study of large dams, which led to UNEP's Dams and Development project <http://www.unep.org/dams/WCD/>
- 2 *International Rivers*, an NGO aiming to protect rivers and human rights <http://www.internationalrivers.org/>
- 3 *Layman's guide on how to develop a small hydropower*, European Small Hydropower Association, mainly a technical document, with a chapter on environmental impact <http://ec.europa.eu/energy/library/hydro/layman2.pdf>
- 4 *Guide to environmental approach to Small Hydro Power Schemes*, (EU funded guide) this is comprehensive from design to EIA [http://www.energiasrenovables.ciemat.es/suplementos/minihidraulica/guide\\_to\\_env\\_approach\\_to\\_shps.p.pdf](http://www.energiasrenovables.ciemat.es/suplementos/minihidraulica/guide_to_env_approach_to_shps.p.pdf)
- 5 *Why do fish need to cross the road, guide to waterway crossings (NSW Fisheries)* <http://nla.gov.au/nla.arc-42188>
- 6 Refer to the relevant EIA and other environmental legislation in your country, such as an Environment Management Act. See <http://www.paclii.org> or the website of the country

*Please note, this factsheet provides general guidance only and is not legal advice. Please see the references and seek assistance for technical or legal advice for your specific needs.*

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### CONTACT US:

International Union for Conservation of Nature  
Oceania Regional Office  
Private Mail Bag, 5 Ma'afu St, Suva,  
Fiji Islands

P: (+679) 3319 084  
F: (+679) 3100 128  
E: [oceania@iucn.org](mailto:oceania@iucn.org)  
[www.iucn.org/oceania](http://www.iucn.org/oceania)