Environmental design of hydropower

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Dams

- Migration barrier
- Loss of connectivity
- Less access
- Loss of biodiversity











Degraded habitat in bypassed sections

Change in downstream flow regime

Landscape effect Impacts on wildlife

Foto: NINA





Greenhouse gas emission control

Resettlement



Lack of undisturbed nature?

How much water is needed?



for hydropower and ecology





Flow and the environment





Flow and the environment

environment





Variation important

900,00

800,00

700,00

600,00

500,00

400,00

300,00

200,00

100,00

0,00

01.01.1981

01.05.198



- 01.09.1984 - 01.09.1984 - 01.05.1984 - 01.05.1984 - 01.05.1983 - 01.01.1983 - 01.01.1983 - 01.01.1983 - 01.05.1982 - 01.01.1982

flow

Stable low flow in winter

Foto: NTNU





Eco Hydrology

Hydropower



- 10 large research projects two more from 2015
- 7 Norwegian research partners
- 16 Industry partners and 2 management partners
- Budget: ~350 MNOK (47 MNOK in 2014)
- 21 PhD and 7 Post-doc positions
- International student and professional exchange

Renewable energy respecting nature



Hydropower technology







Environmental impacts of hydropower







Environmental impacts of wind power and power transmisson







How to reconcile energy and environment policy?









Mitigation

Fishway for upstream migration

Avoid fish coming into turbines and intakes when migrating downstream



Weirs

Minimum flow and weirs limit loss of water covered area – but do they create natural riverine habitats?

Mitigation by constructing habitat in combination with compensation flows



Weirs, diverters, artificial pools and riffles, substrate changes, etc - must be maintained





Handbook for environmental design in regulated salmon rivers

Editors: Torbjørn Forseth and Atle Harby

- Guidance developed for Atlantic salmon
- Methods suitable for other species and end users
- Download free copy:

www.cedren.no

CEDREN Centre for Environmental Design of Renewable Energy





...take the river system to the doctor!





Design solutions

Sometimes the use of water is most important, sometimes habitat mitigation measures are more important – in most cases both are necessary







Design solutions – use of water







Water release



Habitat mitigation



Hydropower production

Renewable energy respecting naturel

Environmental design







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