



Centre for Environmental Design of Renewable Energy (CEDREN)



NATURHISTORISK MUSEUM
UNIVERSITETET I OSLO



*Atle Harby, SINTEF Energy Research
Director*



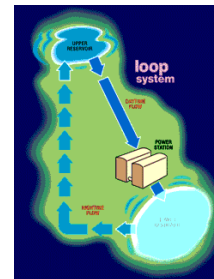


- ▶ 10 large research projects – two more from 2015
- ▶ 7 Norwegian research partners
- ▶ 16 Industry partners and 2 management partners
- ▶ Budget: ~35 MEuro (4,5 MEuro in 2015)
- ▶ 24 PhD and 7 Post-doc positions
- ▶ International student and professional exchange

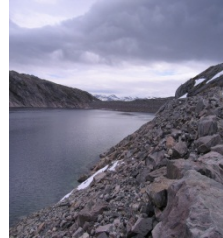
Renewable energy respecting nature



Hydropower technology



Environmental impacts of hydropower

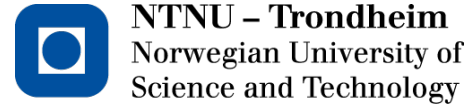


Environmental impacts of wind power and power transmission



How to reconcile energy and environment policy?

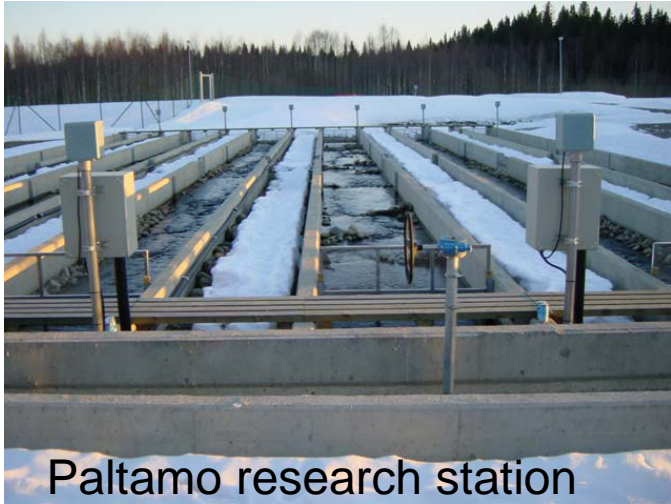




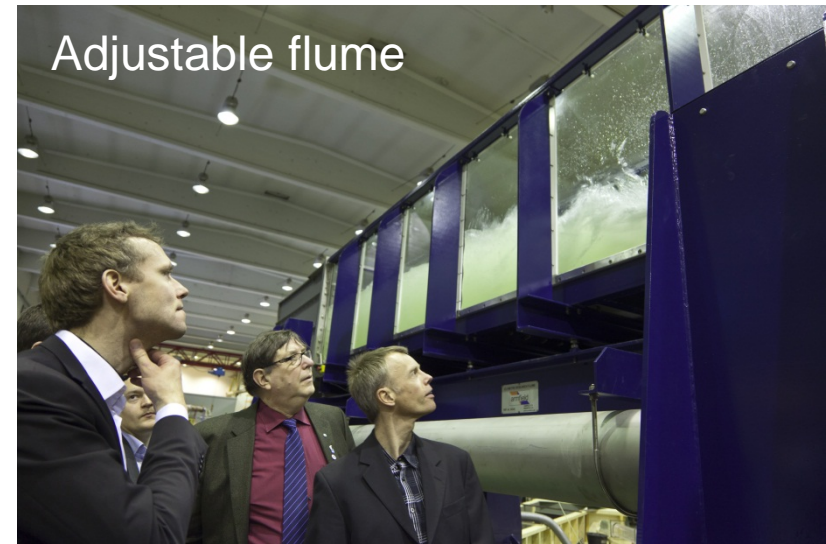
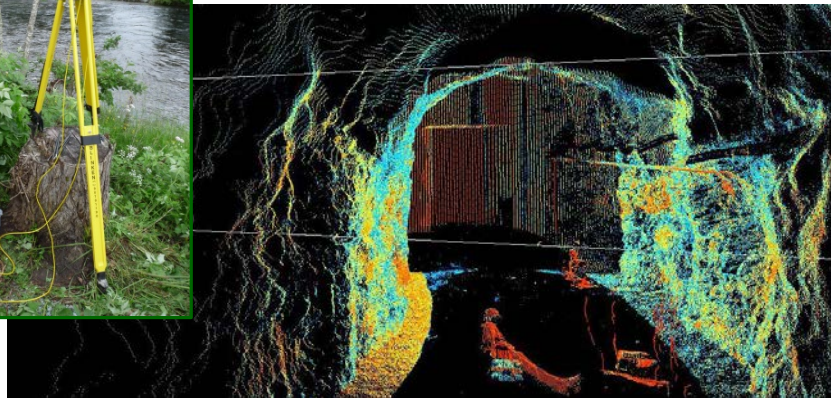
International partners:



Research facilities



Field equipment:
GPS and laser scanner



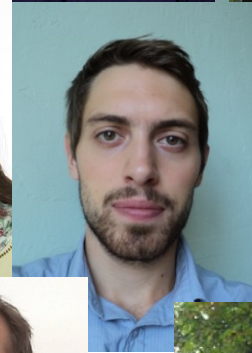




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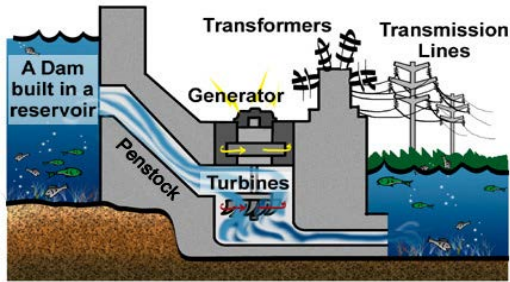




Meetings, workshops, dialogue and collaboration



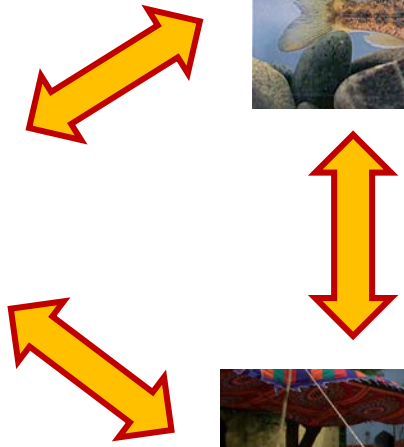
Collaboration



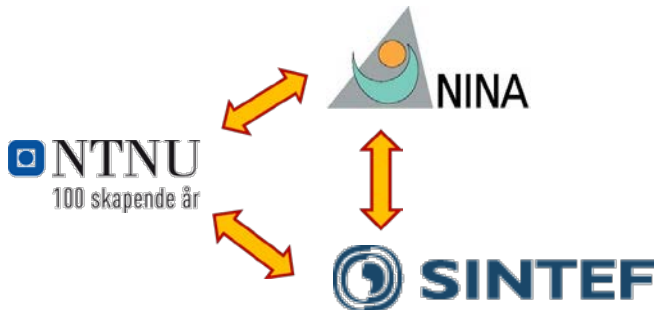
Nature



Technology



Society



International collaboration

- Access to high-level research
- International user partners
- Seminars, workshops for R&D, authorities and industry
- Together with Norwegian industry
- Case-studies to test our methods

HydroNet (Canada) – CEDREN seminar



CEDREN i Kina



The IPCC Special Report on Renewable Energy Sources and Climate Change Mitigation



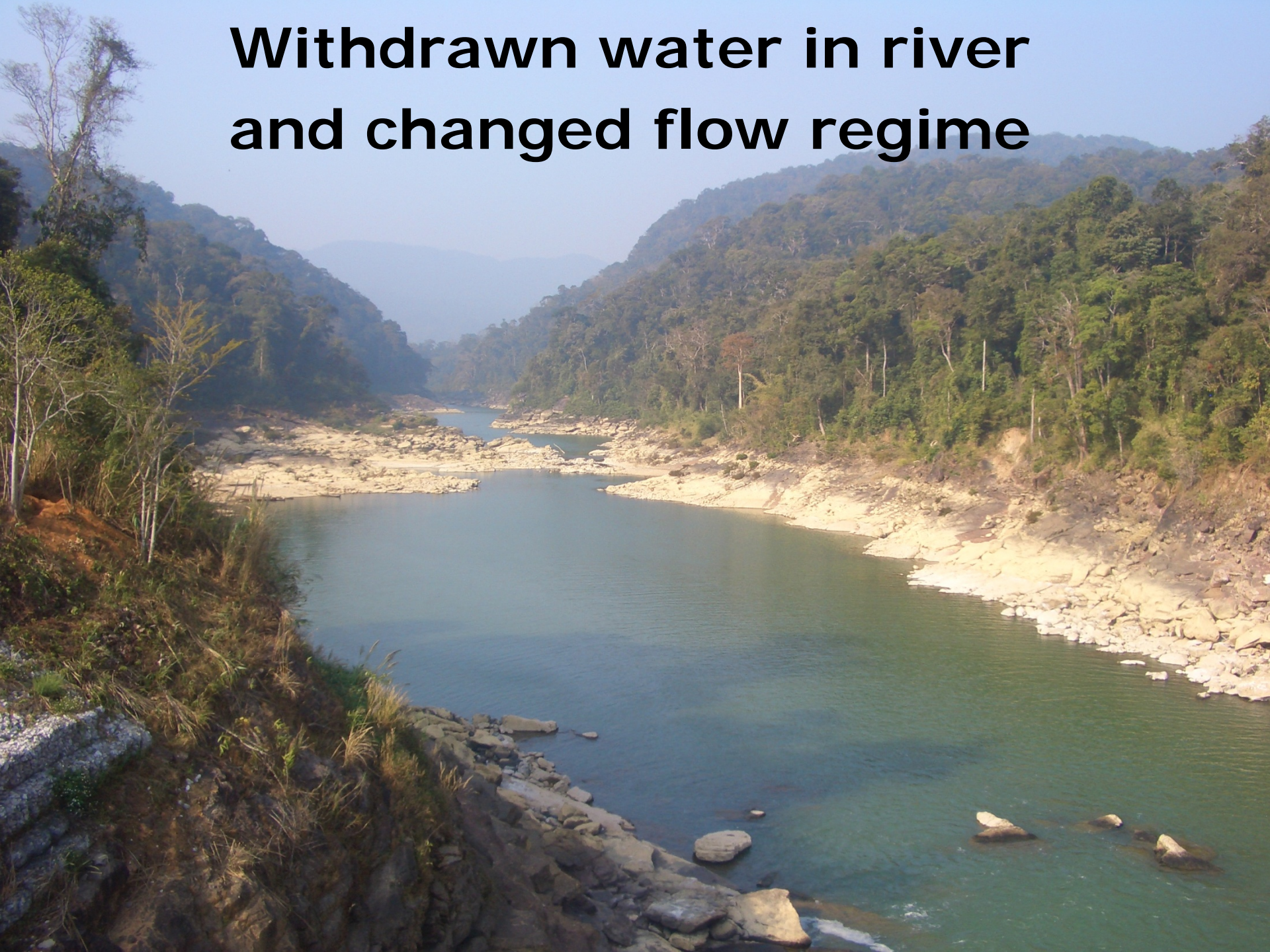
End-user meeting in India

Dams

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



Withdrawn water in river and changed flow regime





Degraded habitat in bypassed sections

An aerial photograph of a landscape featuring a large river flowing through a valley. The river is dark and occupies the lower center of the frame. On the right bank, a dam structure is visible, with water cascading over it. The surrounding land is covered in dense forest, showing a mix of green and brownish-yellow tones, suggesting a transition in vegetation or a specific type of forest. The terrain is hilly and rugged. A semi-transparent white box is overlaid on the upper part of the image, containing the title text.

Landscape effect Impacts on wildlife

Foto: NINA





How much water is needed?



for hydropower
and ecology





Eco Hydrology



Hydropower

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

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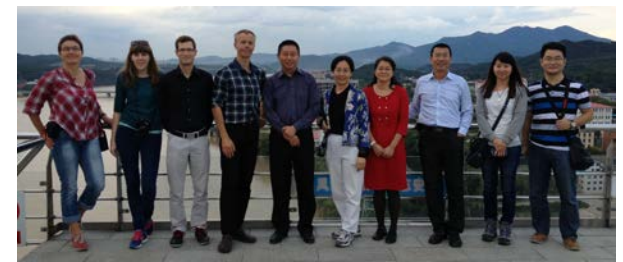
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Environmental design of hydropower

- Environmental flows in regulated rivers
 - New methods
 - Awareness for authorities, NGOs, stakeholders and developers
 - Training in application
 - Applied to Devolli project in Albania and Adjari project in Georgia
- Meetings, seminars and conferences organized in many countries
- Greenhouse gas control in reservoirs
 - Seminars, workshops
 - Training in methods
 - On-site investigations
- University collaboration
 - Teaching, student exchange

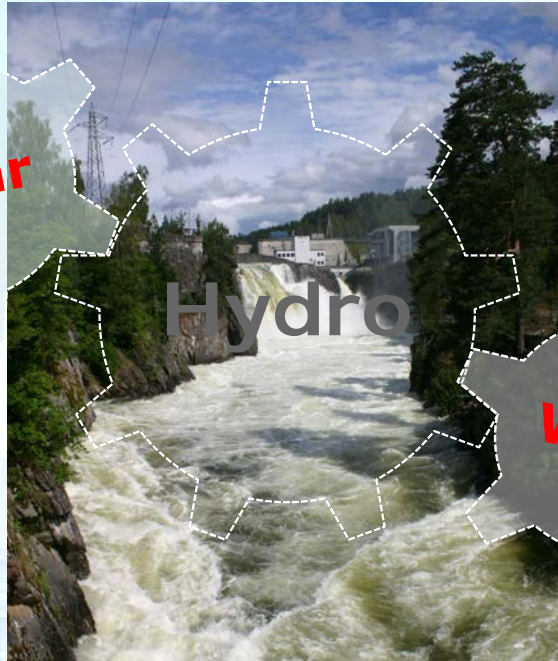




Hydropower – supporting other renewables



Solar



Hydro

Wind



New role for hydropower - still need for environmental design!

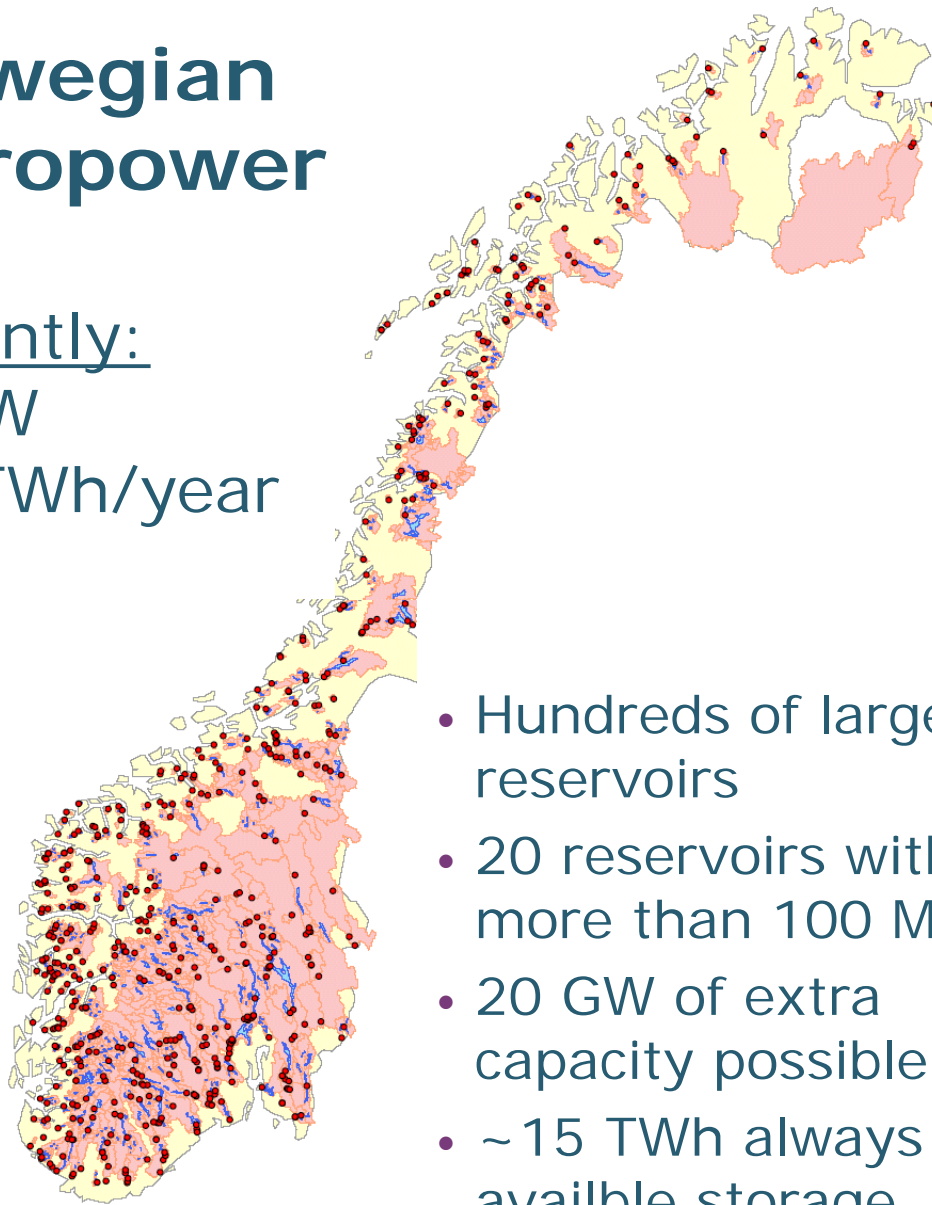


Norwegian hydropower

Currently:

32 GW

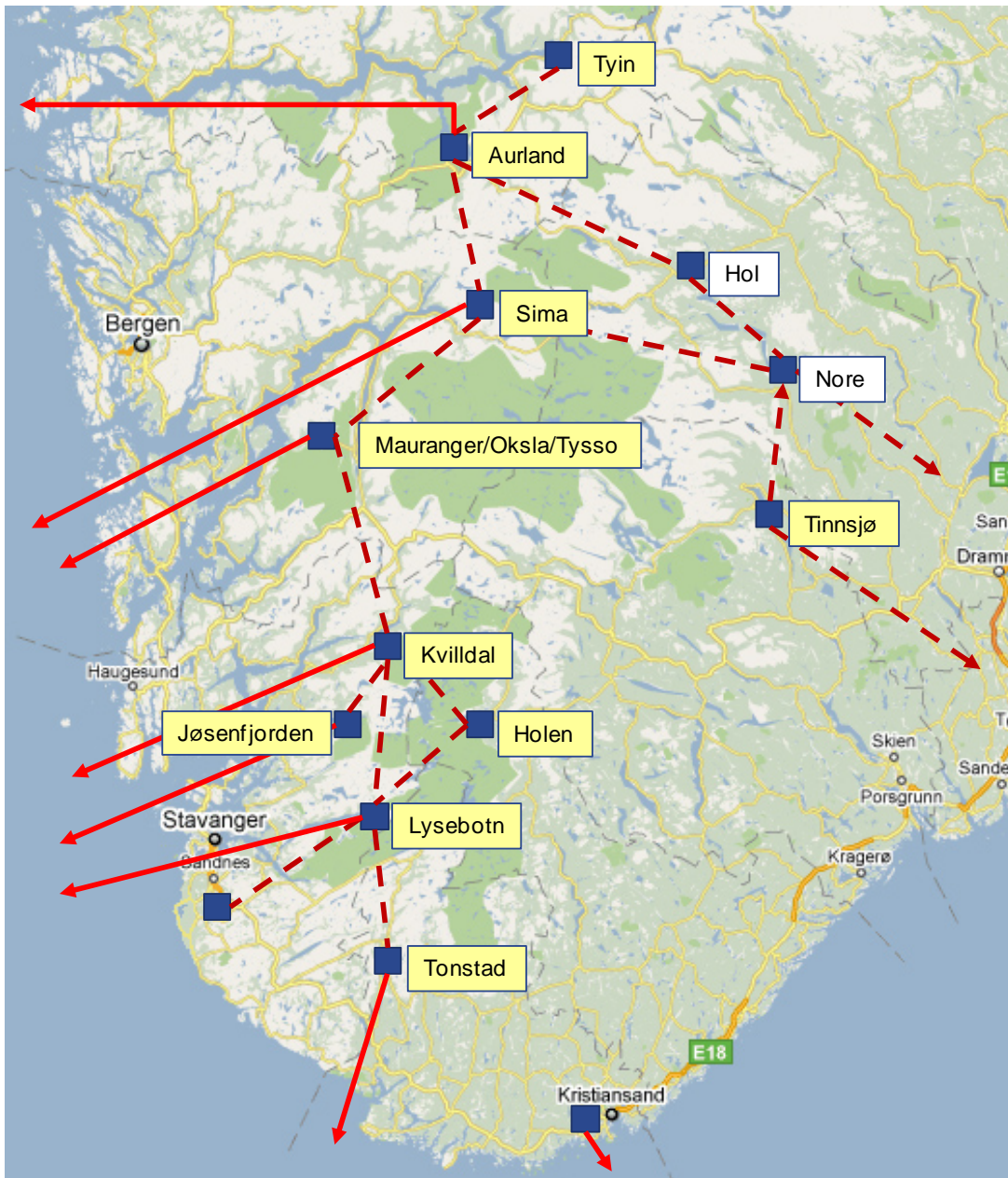
130 TWh/year



- Hundreds of large reservoirs
- 20 reservoirs with more than 100 Mm³
- 20 GW of extra capacity possible
- ~15 TWh always available storage



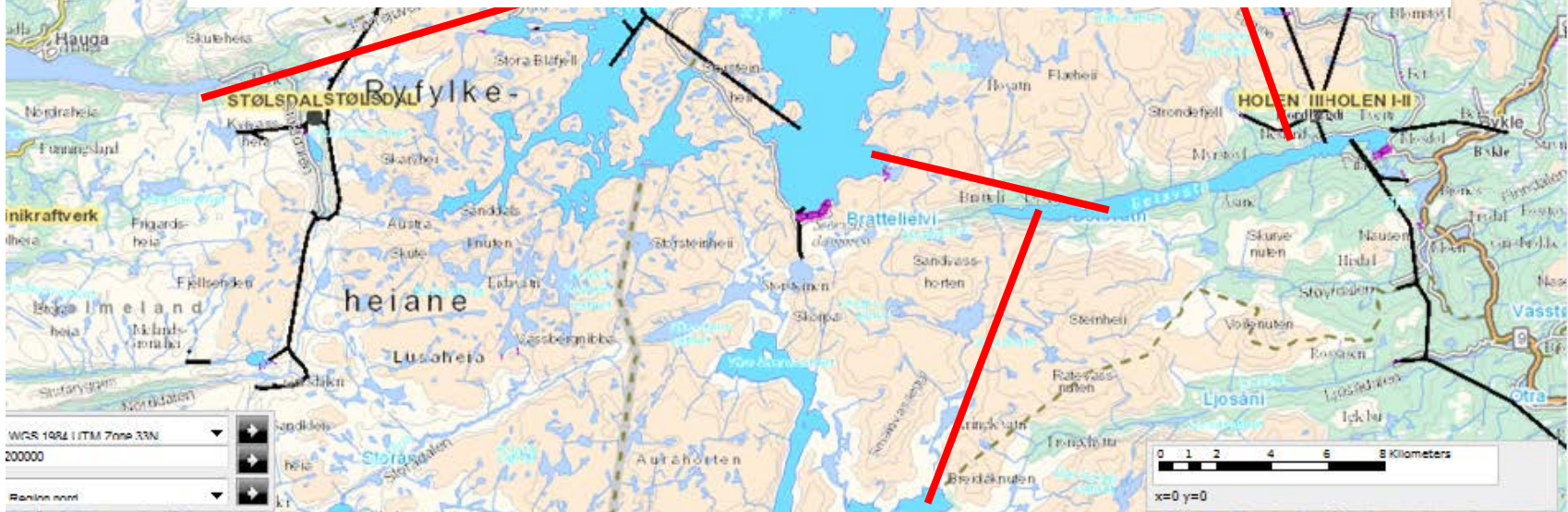
CEDREN Case study 2030



The technical potential



20 000 MW in southern Norway possible



Environmental and social impacts

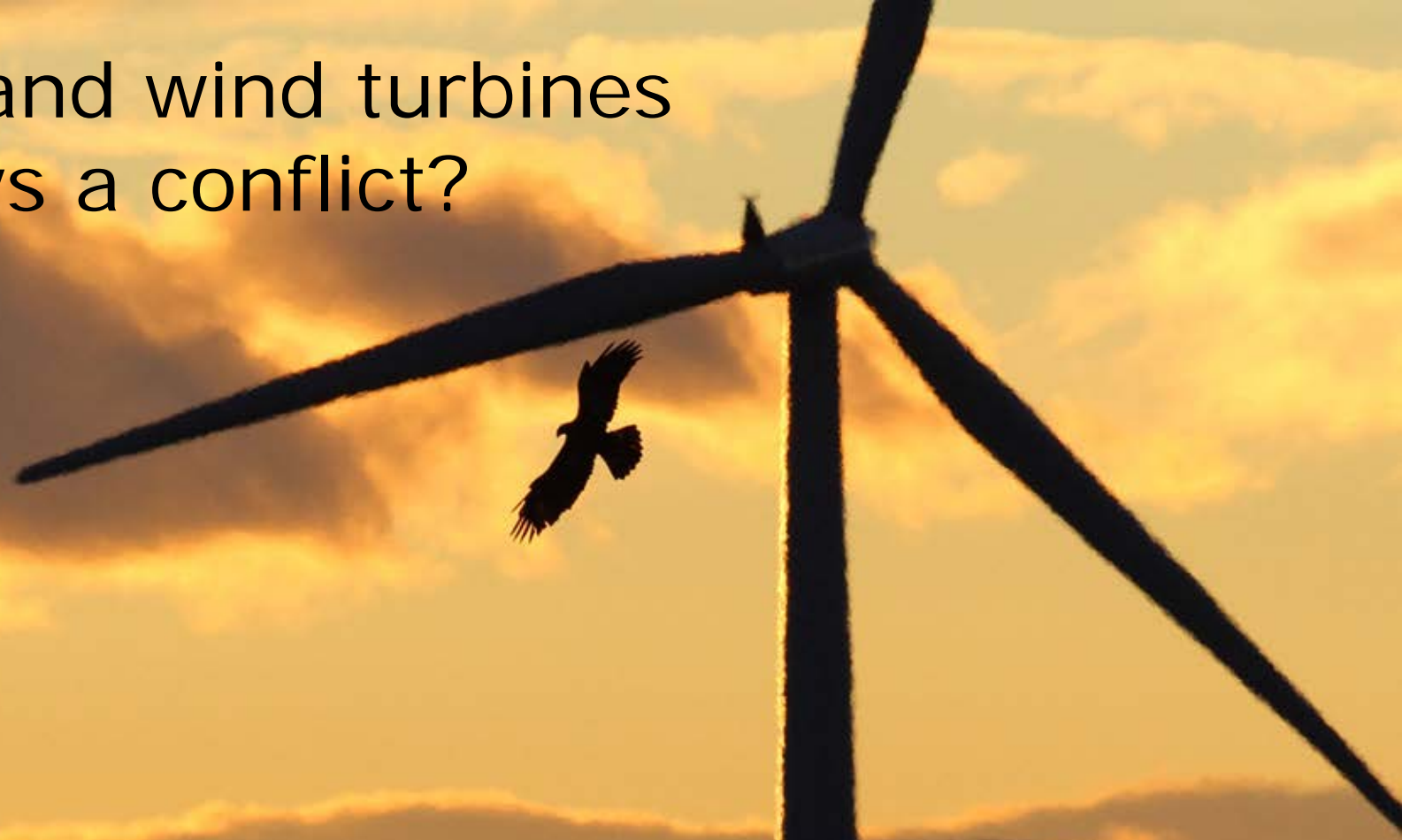


Remember: Fish only dies once!

- Look for bottlenecks
- Combine technology – nature – society needs
- Hydropower and water reservoirs are needed



Birds and wind turbines - always a conflict?



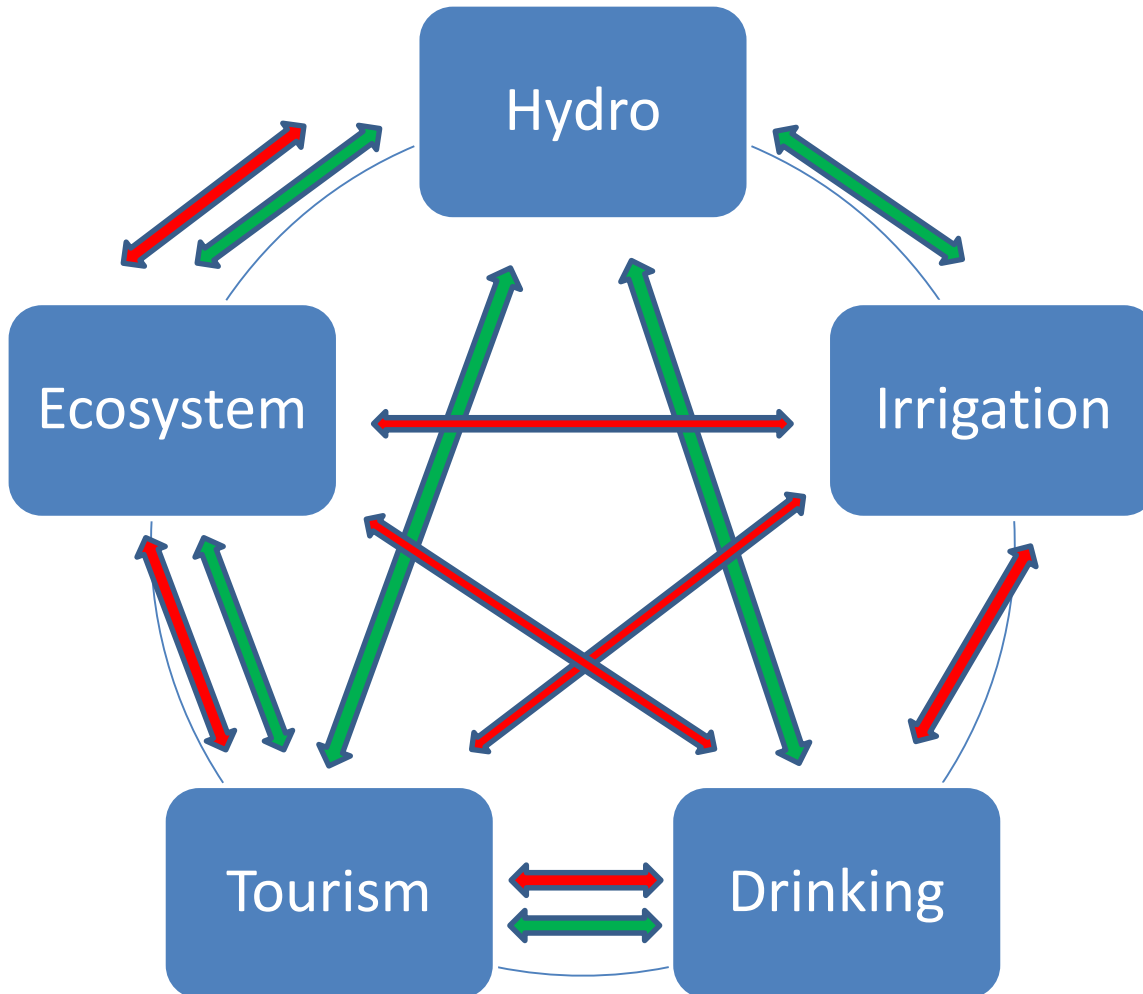
Power transmission

- Environmental impacts
- Reducing conflicts
- Sustainable grid development
- Public acceptance





Various water uses: competitive or synergetic?

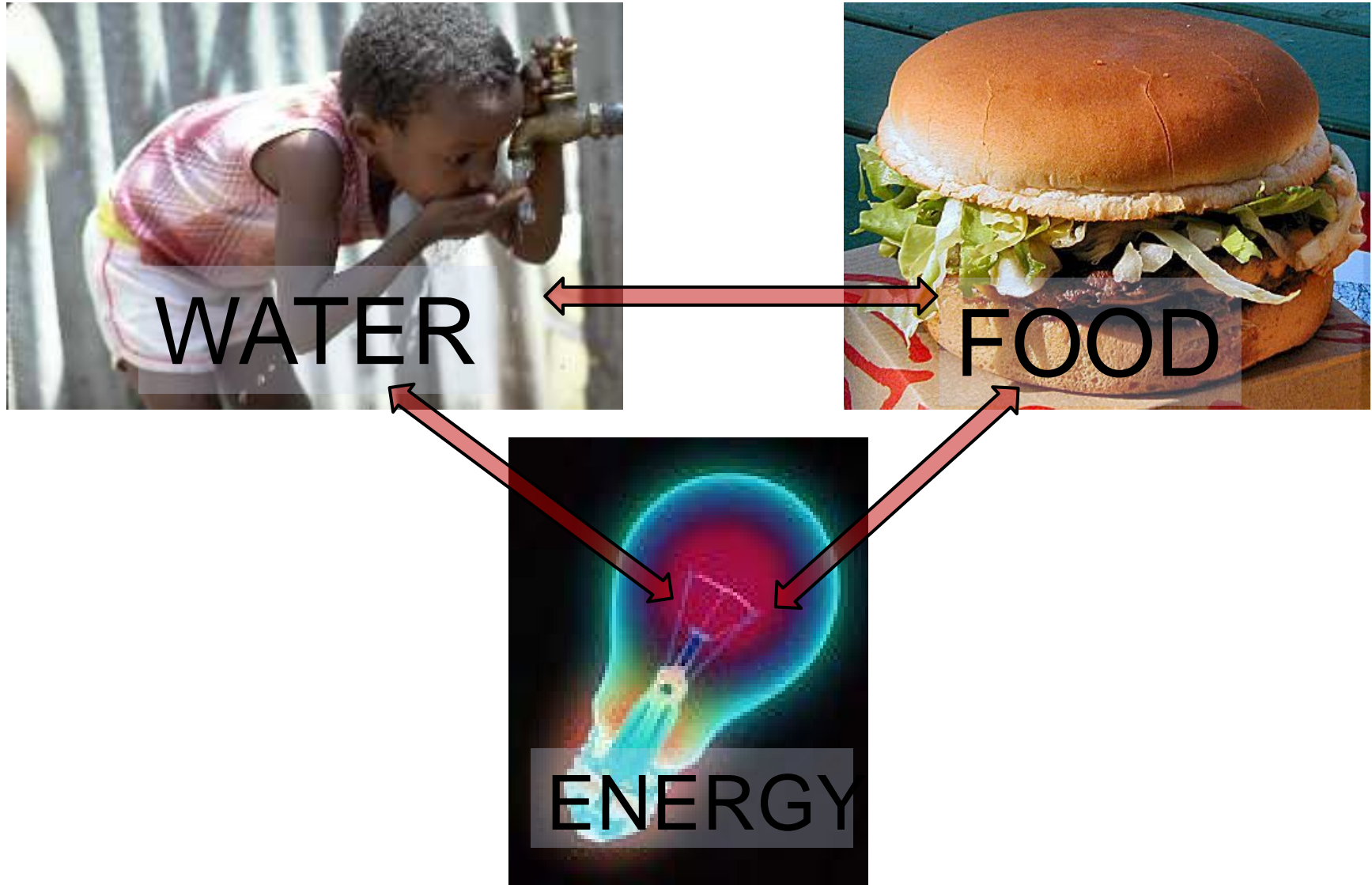


Balancing needs
requires:

- Integrated tools
- Data/monitoring programmes



Social and societal impacts





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Contact: atle.harby@sintef.no



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