Centre for environmental design of renewable energy - CEDREN

Nye prosjekter, nytt FME og veien videre
Sustainable governance of heavily regulated river basins - SusWater

Background:
- Implementation of Water Framework Directive
- Re-licensing of hydropower
- Refurbishing and upgrading hydropower

• SusWater will seek to develop a generic and transparent approach of evaluating and comparing alternative watershed management regimes

• SusWater will mainly conduct research in Norway, but comparisons will be made particularly with Sweden.

Total Budget: 18 mill NOK
5 mill NOK from user partners
WP 1: Regulatory framework and policy implementation

Actual approaches of reconciling conflicting economic, environmental and social interests are often randomly chosen due to lack of knowledge.

Regulatory efforts are made to improve the environmental quality of regulated river basins, but the actual impacts and outcomes vary significantly.

Identify major constraints in the current regulatory landscape.

Method: Comparative assessments
WP 2: Techno-ecological methods for sustainable river basin management

Existing and new detailed data to identify bottle-necks

Regional scale

Up- and downscaling

River reach scale

Up- and downscaling

Mesohabitat-scale

Existing regional data (NVE, Vann-nett …)

Find correlations between
1) Q and physical parameters
2) Physical parameters and fish/biota

New technologies, e.g. UAV
WP 3: Socio-economic indicators for sustainable river basin management

- Explore appropriate and efficient ways of *valuing* water ecosystem services function.

- Compare *socio-economic impacts* across water use interest.

- Propose a *checklist* of indicators suitable for conditions in Norwegian river basins matching the Ecosystem Goods and Service framework in the Water Framework Directive context.
WP 4: Framework for decision support

- Enhance formal decision-support methods at the water body scale
- Developing suitable Multi Criteria Decision Analysis (MCDA) methods for the river basin scale
- Examine the deliberative planning dimension of multi-criteria decision methods
- Formulate a framework for decision support within the river basin
WP 5: Towards improved watershed governance

The overall aim is to find the ‘best solutions’ and collaboration models enabling the pursuit of win-win solutions for energy production and environmental qualities.

Activities:
- Testing the techno-ecological protocol;
- Towards Good Ecological Potential with legitimacy and comprehensive support – feasible water allocation scenarios;
- The challenge of licensing – formulating a tool-kit to encompass different concerns.
• Laks, ørret, harr og ål
• Budsjett: 22,9 mill
  ▪ 14 mill fra NFR (søkt 15,6)
  ▪ 8,1 mill fra bransjen
  ▪ 0,8 mill fra Miljødirektoratet/NVE
• En stipendiat (utlyses)
• En post doc – Ana Silva
• NINA, SINTEF, NTNU & Uni Miljø
• Fem internasjonale partnere
• Energi Norge, 10 selskap, Mdir og NVE
SafePass Work Packages

- Compilation of existing knowledge
  - Exchange of international experiences and competence
  - Compilation, validation and adaptation of existing knowledge
- Solutions for downstream migration
  - Behavioral mechanisms
  - Promising technical solutions
- From salmon to inland fishways
  - Functional requirements of fishways for brown trout and grayling
  - Lessons from existing inland fishways
  - Strategies for retrofitting
- Handbook for two-way migration design
  - Diagnosis
  - Solutions
Energy scenarios

- Transmission and distribution infrastructure
- Energy storage technologies
- Demand side management
- Improved forecasting of resource availability

Maybe as much as 340 TWh of storage volume and 150 GW of balancing capacity needed in Europe by 2050
Energy storage technologies

1) Electrochemical Storage
   Batteries, Super Capacitors

2) Chemical Storage
   Hydrogen, Methanol, Ammonia

3) Thermal and Geothermal Storage
   Heat, Advanced Fluids, PCM, Cold

4) Mechanical Storage
   Hydro, Flywheels, Compressed Air

5) Superconducting Magnetic Energy Storage
AES Laurel Mountain, USA
Li-ion
32 MW, 8MWh

Pb-acid

Duke Energy Notrees Wind Storage Demo Project, USA: 36 MW, 20 MWh

Rokkasho Village Wind Farm, Japan
NaS: 34 MW, 238 MWh

Flow batteries:
Gills Onions, California: 600kW, 3.6 MWh
Power to gas: Hydrogen

- Hydrogen as energy storage medium links stationary sector to transportation
Power to gas: Synthetic natural gas
Thermal Energy Storage

High temperature storage

- District heating, Theiß, Austria
- Steam accumulator, Aerated concrete manufacturing
- Cowper storage, blast furnace industry >500 °C
- Molten salt storage, Andasol power plant, Spain: up to 400/565 °C

Cold storage (ice)

Underground storage

- Heat pump
- 40 mm single U tubes with anti freeze brine

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Mechanical storage

Hydro
- Operates typically on weeks to hours
- Many applications for both energy and storage
- World-wide potential

Compressed air
- Operates typically on hours
- Two commercial energy storage plants
- Need for more research

Flywheels
- Operates typically on seconds to minutes
- Used a lot in many other sectors
- Few large-scale energy storage applications

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Installed PSH world-wide: ~140GW

Under Operation
Project stage

Document courtesy from Rioual, EdF
The H2020 call LCE-09-2015

**CALL FOR COMPETITIVE LOW-CARBON ENERGY**

- **Challenge:** demonstration activities in large scale energy storage to balance the production and consumption of high quantities of electricity and during longer time periods. Reduce the barriers (technological, economic, regulatory, environmental, social and other acceptance, etc.) associated with the deployment of existing or new storage concepts.

- **Scope:** focus on storage systems that reached already TRL 5 and bring them to TRL 6-7. Anticipation of potential market and regulatory issues with due consideration to the environmental and socioeconomic aspects. Direct electricity or indirect storage (electricity with other energy vectors). Integrated Power to Gas concepts are eligible. Interfaces for integrating storage in grid management. Synergies between electricity grid, other energy grids, storage and final energy use.

- **Contribution from the EU in the range of EUR 16-20 M€**
- **Innovation Actions**
The H2020 call LCE-09-2015

- **Technology priorities**
  - **pumped hydro storage** in new locations such as underground storage concepts, storage using seawater or similar concepts addressing large scale applications aiming at GWh scale;
  - **storage with compressed air**, liquid air, and similar concepts aiming at the large scale (ideally > 100 MWh scale if appropriate);
  - **retrofitting of existing hydro dams** with pumped hydro or other storage to enable flexible operation, large scale balancing and storage, while applying environmentally friendly design and operation;
  - **integrated management** of existing or retrofitted pumped hydro storage (with variable speed pumps/turbines) also across national borders (e.g. smart grid concepts across alpine (or other) borders and enclosing many existing facilities)
  - **linking** with the development of the Northern Seas, Mediterranean ring and other Trans-European grid infrastructure concepts may be envisaged.
Project structure and WPs

WP1 – Barriers and opportunities from large scale storage

WP2
Technological and implementation aspects

WP3
Demonstration of selected technologies

WP4
Profitability analysis

WP5
Elaboration of business cases

WP6 – Dissemination

WP7 – Management
Tiden etter 2014

- Pilotprosjekter
- Nye prosjekter: SafePass, SusWater
- Brukerfinansierte prosjekter
- EU-prosjekter
- Rådgiving og kunnskapsoverføring
- Bilaterale spin-off prosjekter
- Nytt FME etter 2016
Strategi 2014

Nasjonal strategi for forskning, utvikling, demonstrasjon og kommersialisering av ny energiteknologi

DEL 1/2

ENERGI 21

Grunnleggende forskning

Anvendt forskning

Vannkraft

Fleksible energisystemer

Offshore vindkraft

CO$_2$-håndtering

Materialteknologi

Havenergi

Batterier

Nanovitenskap

IKT-teknologi

Gassviterknapper

Geotermisk energi

Energisystem

Energilagring

Nye energi- og forbruker

Oekonomi, politikk og marked

Miljøviterknapper

Saltviterknapper

Geologi

CO$_2$-håndtering

Kommersialisering

Markedsintroduksjon

Test og demonstrasjon
10. des.: DS vedtar utlysning forprosjekt
Des.-jan.: Utlysning forprosjekt
1. april 2015: Frist forprosjektsøknad
15. mai 2015: Respons NFR
Sommer 2015: FME hovedutlysning
25. nov. 2015: Frist hovedsøknad
Mai 2016: Offentliggjøring av resultat
FME modell og innretning:
- Brukerinvolvering
- Internasjonalt fokus
- Fleksibilitet i finansieringen
- Ramme: 120-125 mnok/år (tot. pott)
- Antall senter: 6-8
Varighet: 5+3 år
Tema for FME innen vannkraft

Samarbeid SINTEF – NINA – NTNU fortsetter
Samarbeid mellom Norsk vannkraftsenter og CEDREN
Drivkrefter - mål

**DRIVKREFTER**
- Klimaendringer
- Markedsendringer
- Globalisering
- Robusthet

**MÅL**
- Klimatilpasning
- Verdiskaping
- Bærekraft
- Fleksibilitet

Nytt FME Vannkraft 2017 - 2024

Centre for Environmental Design of Renewable Energy
Fire grunnpilarer

TEKNOLOGI
(forsyningssikkerhet)

SAMFUNN & POLITIKK

MILJØ
(bærekraft)

VERDISKAPIING
(lønnsomhet)
Mulige forskningsakser

Kortsiktig

Langsiktig

Global

Lokal
Fagtema

- Fleksibilitet i vannkraftsystemet
- Miljødesign
- Oppgradering og utvidelse
- Energidisponering
- Klima

Policy

Internasjonal vannkraft

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Utfordringer

- Økt fleksibilitet i det norske vannkraftsystemet
- Miljødesign nasjonalt og internasjonalt
- Oppgradering og utvidelse av dagens system
- Energi- og effektdisponering i nye markeder
- Konsekvenser av klimaendring og tilpasning til nytt klima
All din kunnskap handler om fortiden. Alle dine beslutninger handler om fremtiden.