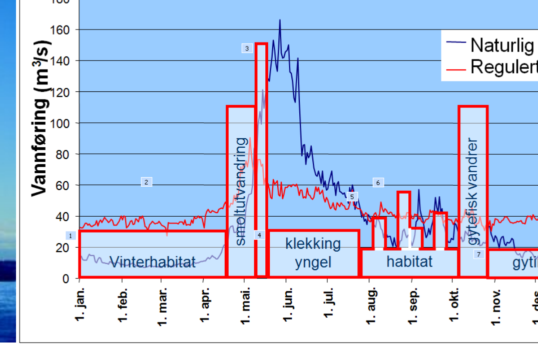


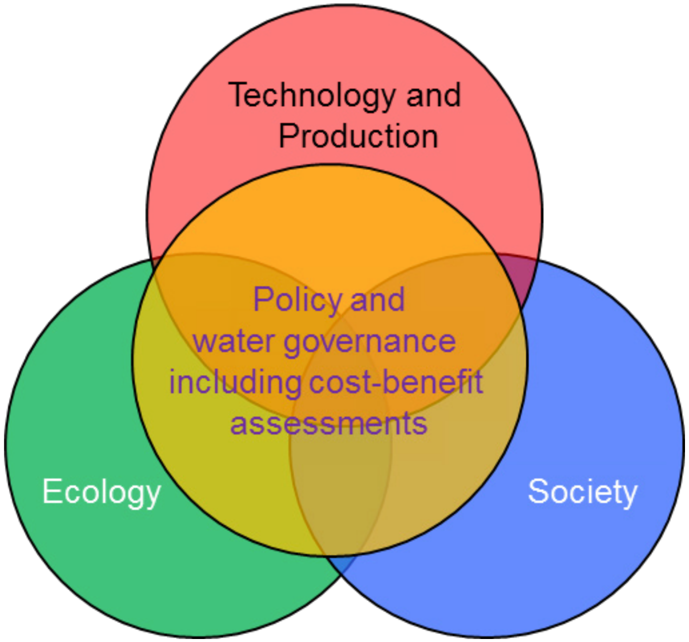
Centre for environmental design of renewable energy - CEDREN

SINTEF
NTNU
100 skapende år
NINA
NATURHISTORISK MUSEUM
UNIVERSITETET I OSLO
NIVA
uni Research

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.

Policy and water governance including cost -benefit assessments

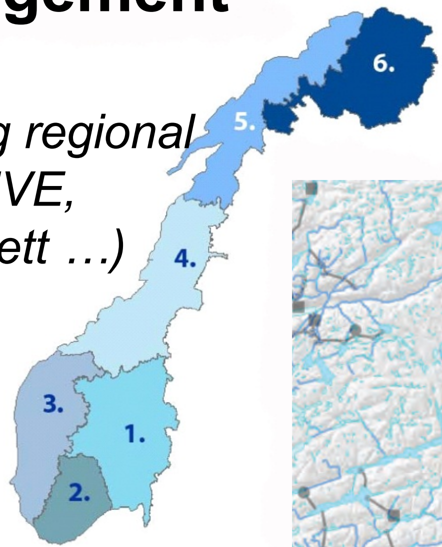
Regulatory efforts are made to improve the environmental quality of regulated river basins, but the actual impacts and outcomes vary significantly

Identify major constraints in the current regulatory landscape.

Method: Comparative assessments

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

Existing regional data (NVE, Vann-nett …)



Regional scale

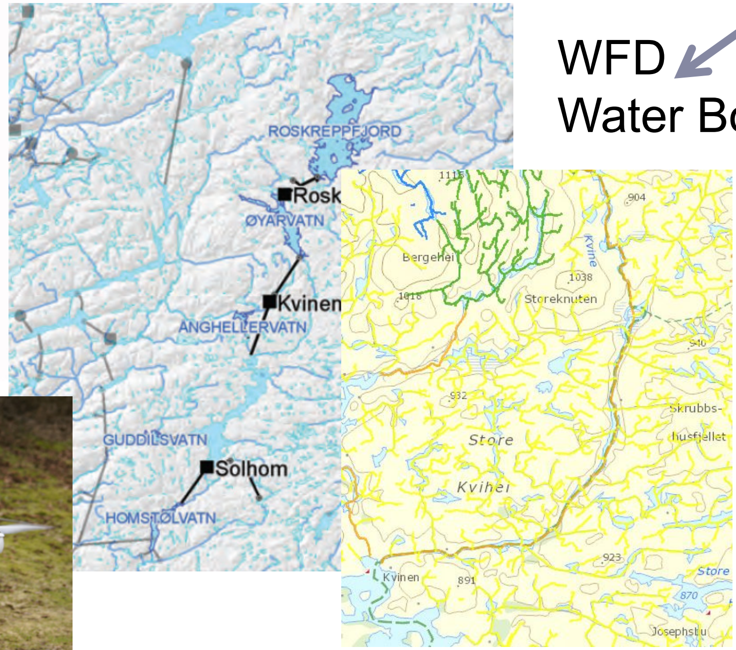
Up- and downscaling

River reach scale

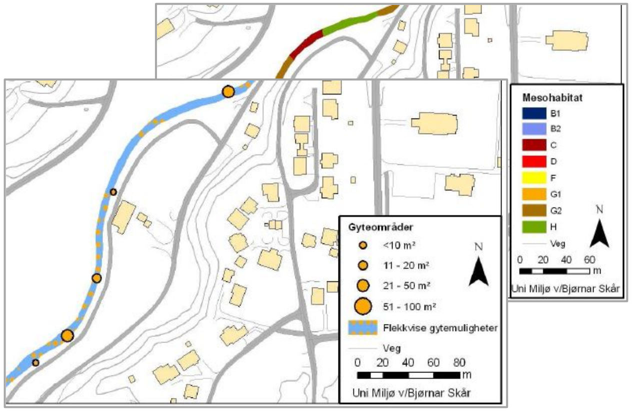
WFD Water Body

Up- and downscaling

Mesohabitat-scale



New technologies, e.g. UAV



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

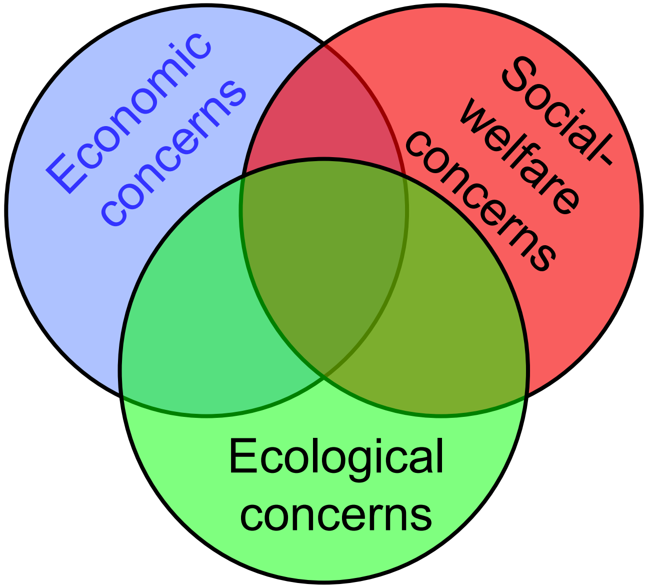
Existing and new detailed data to identify bottle-necks

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

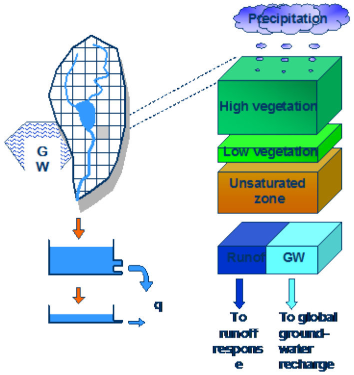
- Propose a *checklist* of indicators suitable for conditions in Norwegian river basins matching the Ecosystem Goods and Service framework in the Water Framework Directive context

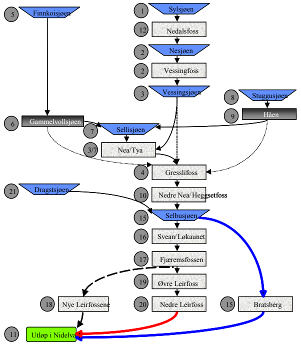


WP 4: Framework for decision support

- 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

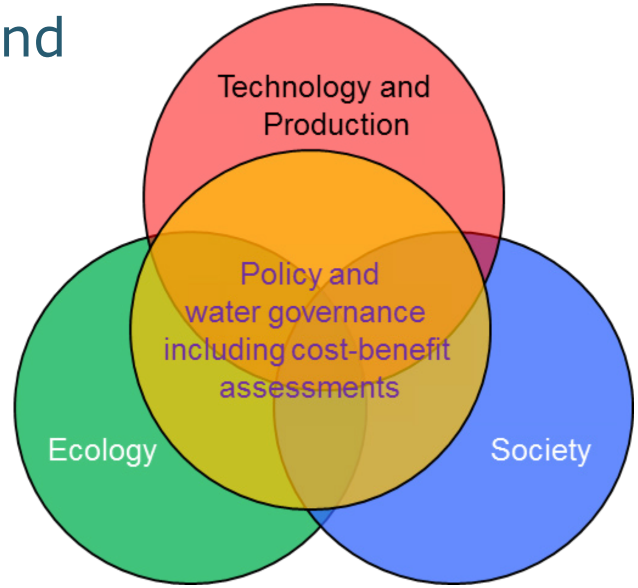




- Formulate a framework for decision support within the river basin

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.

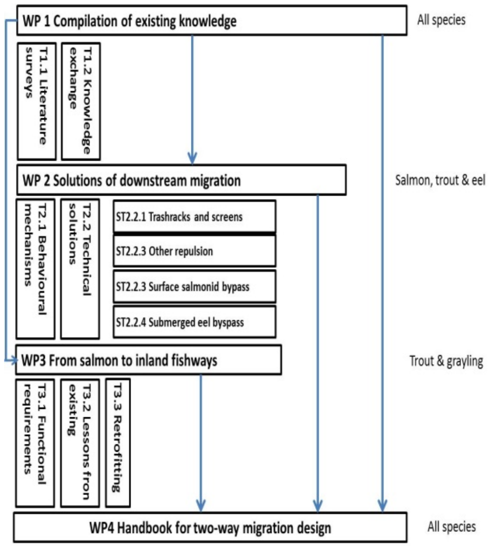


Activities:

- 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

SafePass 2015-2018

- 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



NSERC HydroNet CRSNG

Chris Katopodis Ana Silva

Daniel Boisclair

KARLSTAD UNIVERSITY

KAU.SE EDUCATION FUTUR

Olle Calles

Technical University of Denmark

DTU Aqua
National Institute of Aquatic Resources

Niels Jepsen Henrik Banktoft

eDF Eric de Oliveria
& Veronique Gouraud

BOKU
Universität für Bodenkultur Wien

Helmut Mader, Stefan Schmutz

SafePass Work Packages

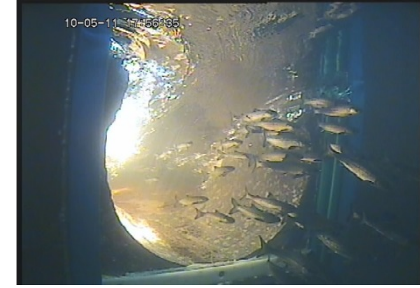


Foto: Anders Lamberg

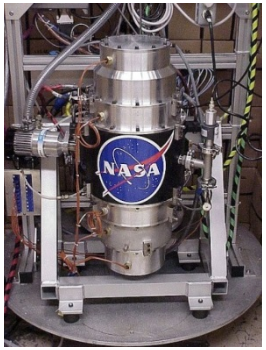
- Compilation of existing knowledge
  - Exchange of international experiences and competence
  - Compilation, validation and adaptation of existing knowledge
- Solutions for downstream migration
  - Behavioral mechanisms
  - Promising technical solutions
- From salmon to inland fishways
  - Functional 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 <u>infrastructure</u>
- ❑ Energy <u>storage</u> technologies
- ❑ Demand side <u>management</u>
- ❑ Improved <u>forecasting</u> 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



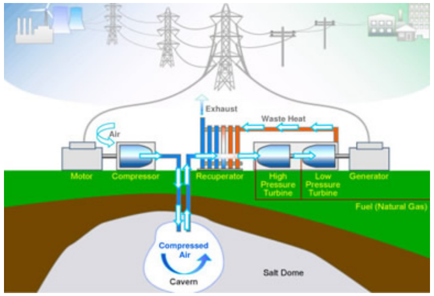
1) **Electrochemical Storage**
   Batteries, Super Capacitors

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**

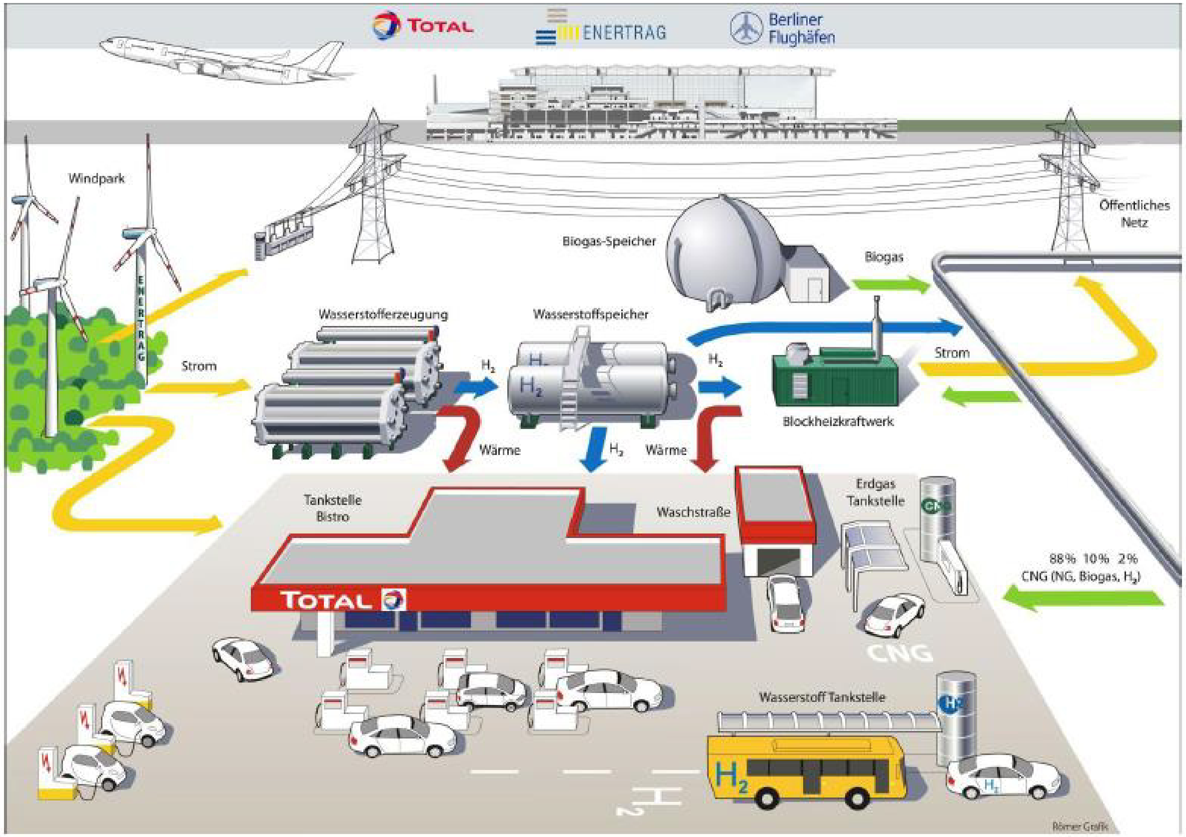


Duke Energy Notrees Wind Storage Demo Project, USA: 36 MW, 20 MWh

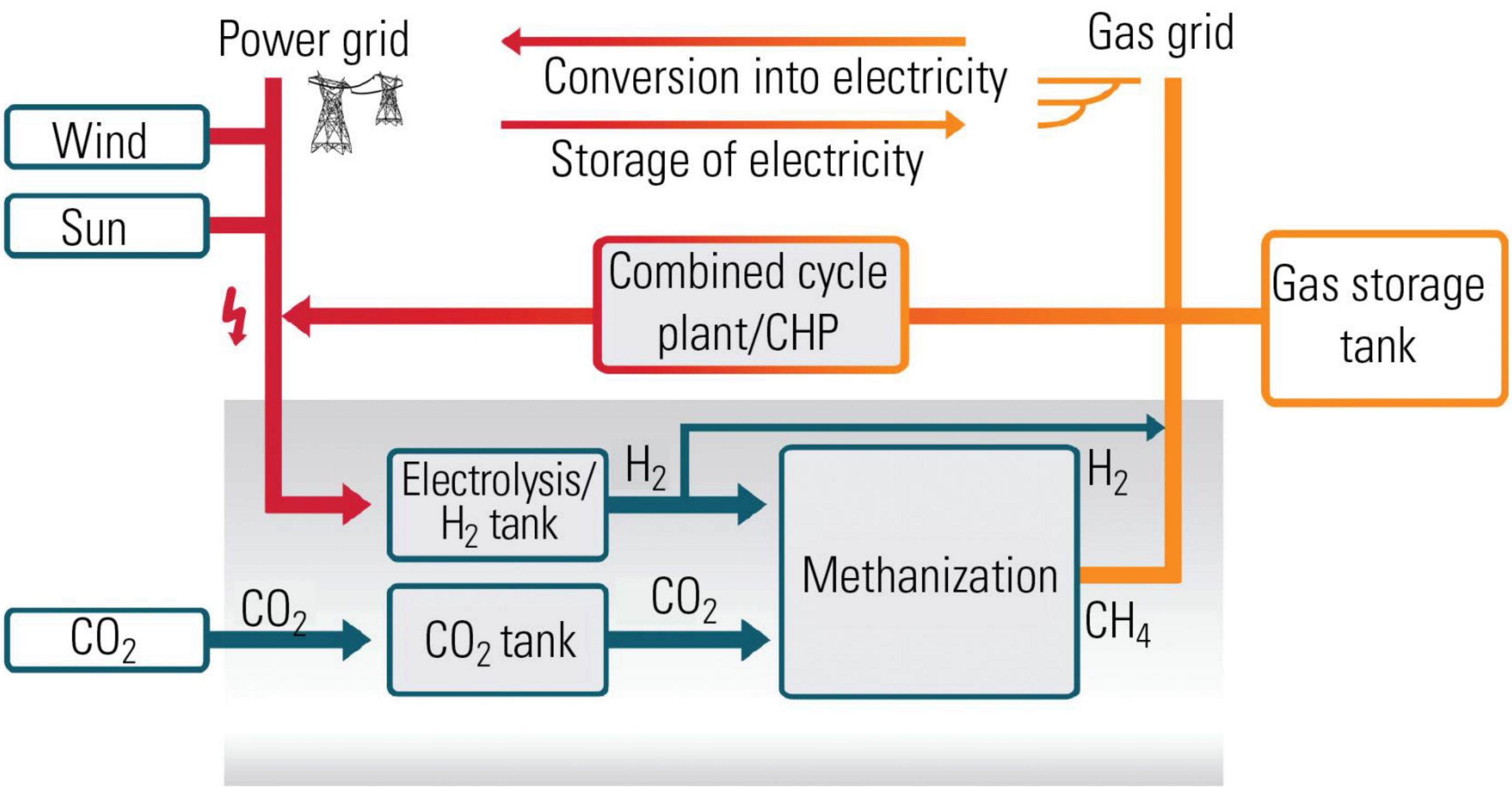
Flow batteries:
Gills Onions, California: 600kW, 3.6 MWh

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

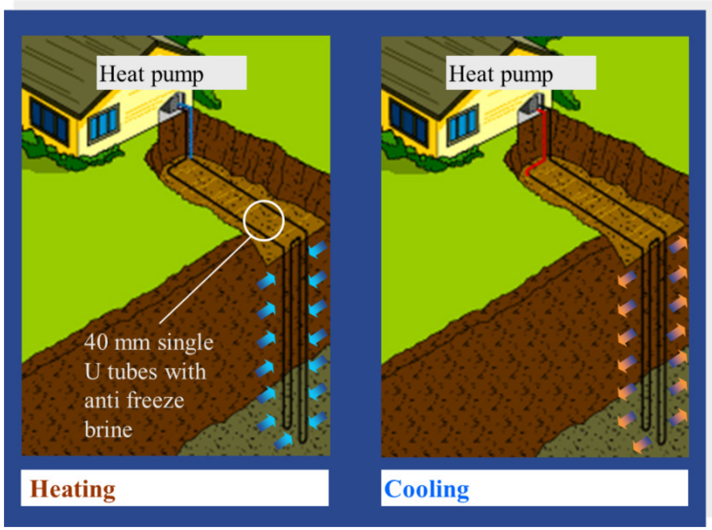
Steam accumulator,
Aerated concrete
manufacturing

Cowper storage,
blast furnace
industry >500 ºC

Molten salt storage,
Andasol power plant,
Spain: up to 400/565 ºC

Cold storage (ice)

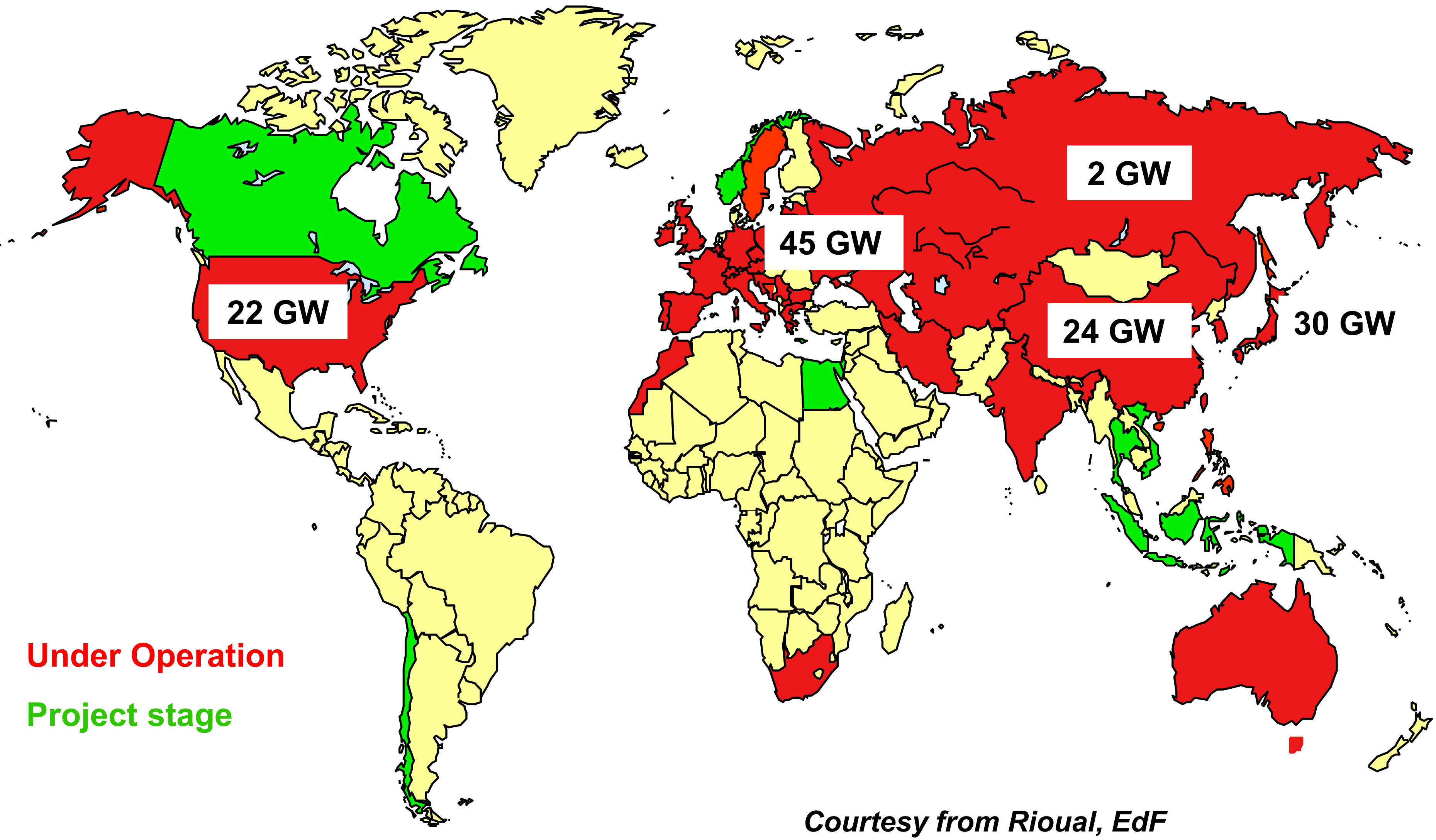
Underground storage



Mechanical storage

Hydro	Compressed air	Flywheels
		
• Operates typically on weeks to hours • Many applications for both energy and storage • World-wide potential	• Operates typically on hours • Two commercial energy storage plants • Need for more research	• Operates typically on seconds to minutes • Used a lot in many other sectors • Few large-scale energy storage applications

Installed PSH world-wide: ~140GW



Courtesy from Rioual, EdF

The H2020 call LCE-09-2015

CALL FOR COMPETITIVE LOW-CARBON ENERGY

H2020-LCE-2015-3 — Sub call of: H2020-LCE-2014-2015

Planned Opening Date	10-12-2014		
Publication date	11-12-2013	Deadline Date	05-05-2015 17:00:00 (Brussels local time)
Total Call Budget	€175,350,000	Main Pillar	Societal Challenges
Status	Forthcoming	OJ reference	OJ C361 of 11 December 2013

Topic: Large scale energy storage — LCE-09-2015

- **Contribution from the EU in the range of EUR 16-20 M€**
- **Innovation Actions**

- **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.

The H2020 call LCE-09-2015

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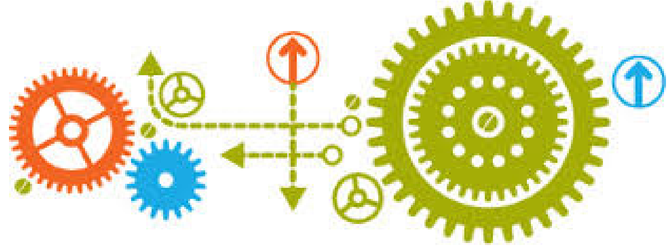
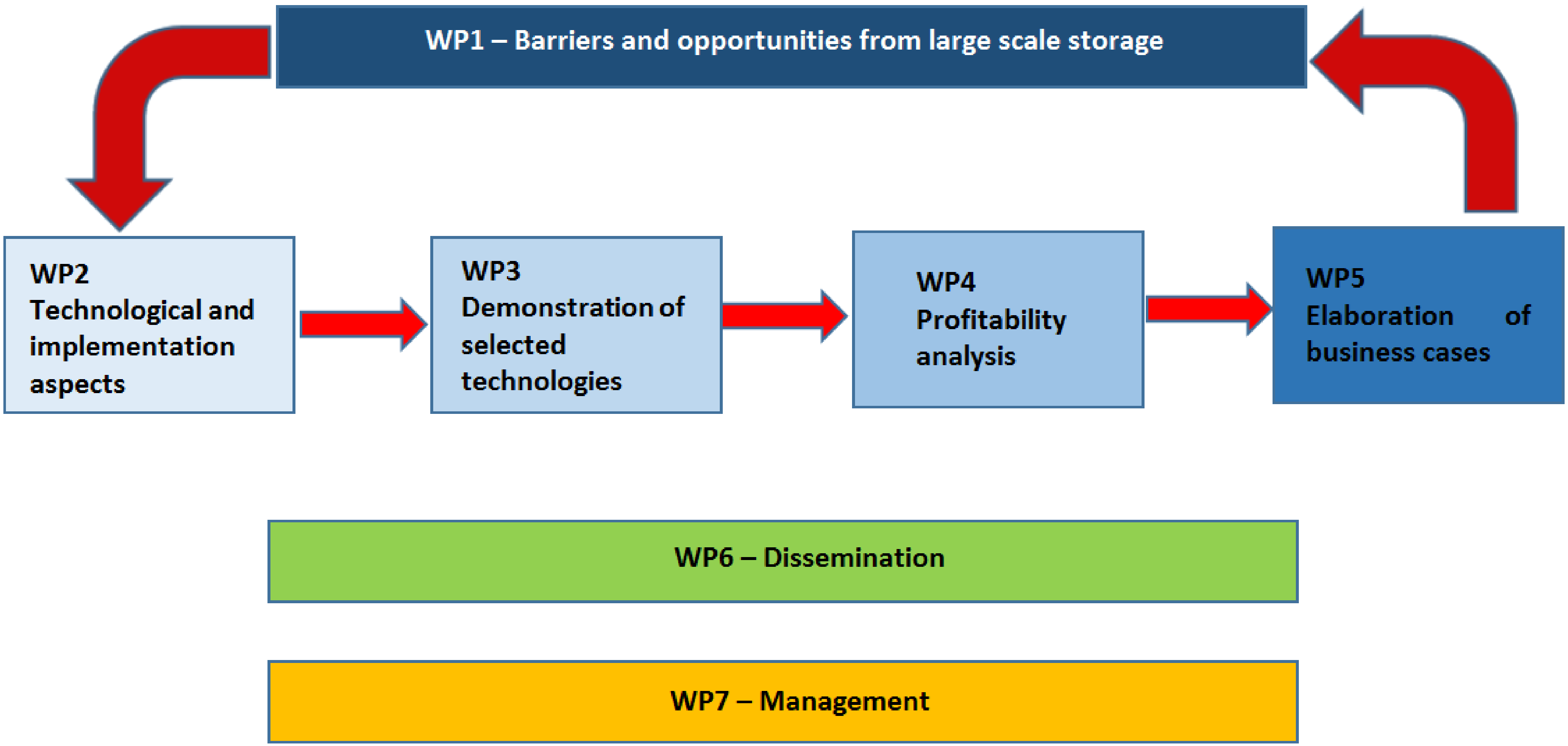
Status	**Forthcoming**	**OJ reference**	OJ C361 of 11 December 2013

Topic: **Large scale energy storage** **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





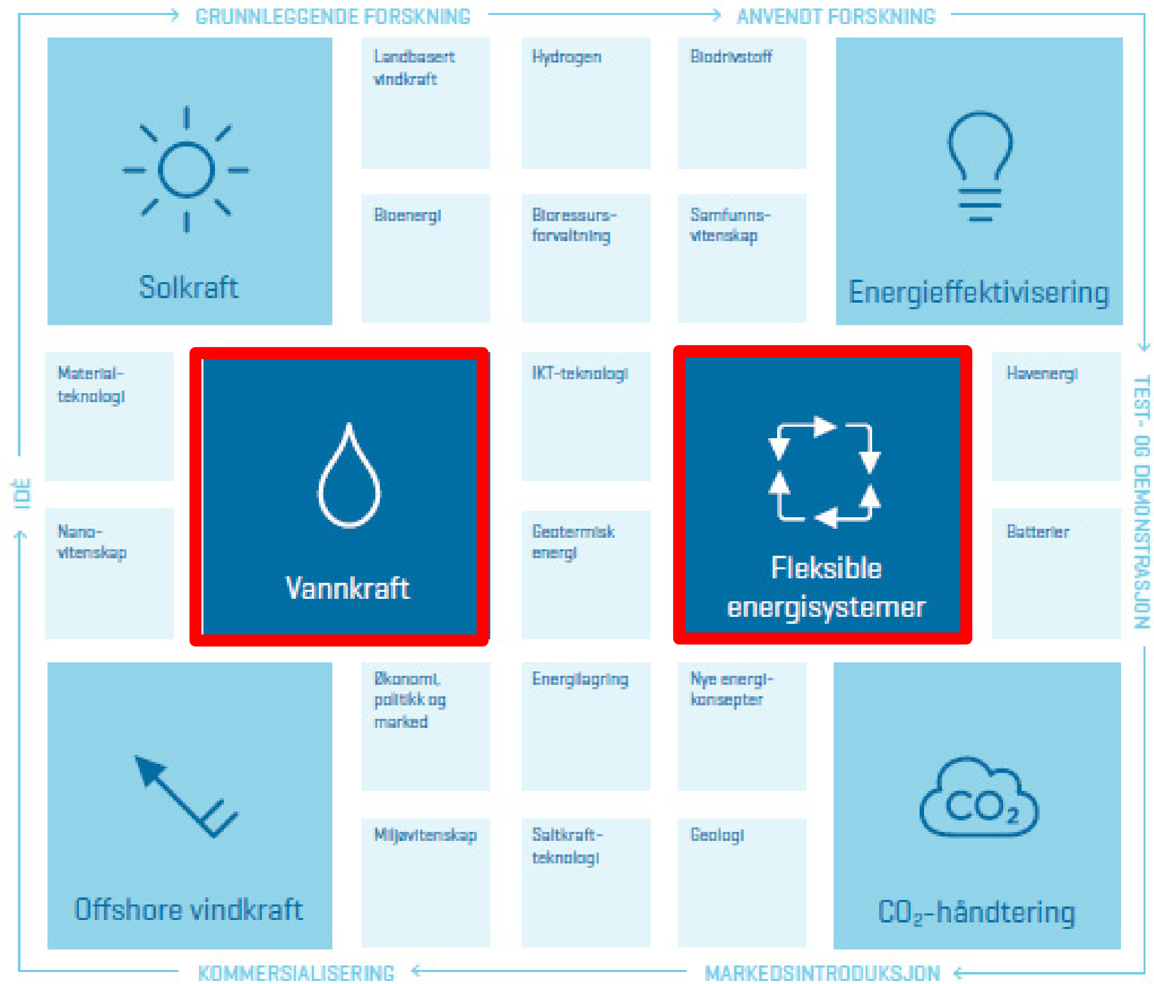
Tiden etter 2014

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

SINTEF NINA NTNU – Trondheim Norwegian University of Science and Technology

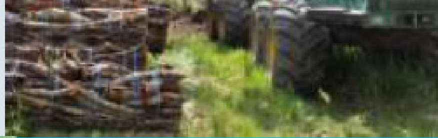
ENERGI 21

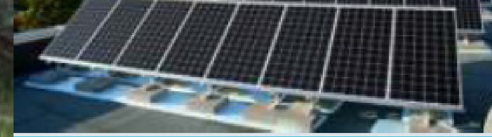
Strategi 2014
Nasjonal strategi for forskning, utvikling, demonstrasjon og kommersialisering av ny energiteknologi
DEL 1/2
energi21

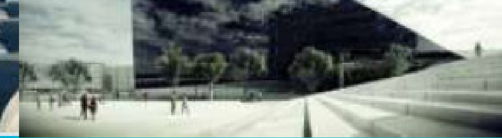


GRUNNLEGGENDE FORSKNING
ANVENDT FORSKNING
TEST- OG DEMONSTRASJON
MARKEDSINTRODUKSJON
KOMMERSIALISERING
IDÉ
Solkraft
Landbasert vindkraft
Hydrogen
Biodrivstoff
Energieffektivisering
Bioenergi
Bioressurs-forvaltning
Samfunns-vitenskap
Material-teknologi
Vannkraft
IKT-teknologi
Fleksible energisystemer
Havenergi
Nano-vitenskap
Geotermisk energi
Batterier
Offshore vindkraft
Økonomi, politikk og marked
Energilagring
Nye energi-konsepter
CO_2-håndtering
Miljøvitenskap
Saltkraft-teknologi
Geologi

The Research Council of Norway







Forskningssentre for miljøvennlig energi

Planlegging av ny utlysning

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

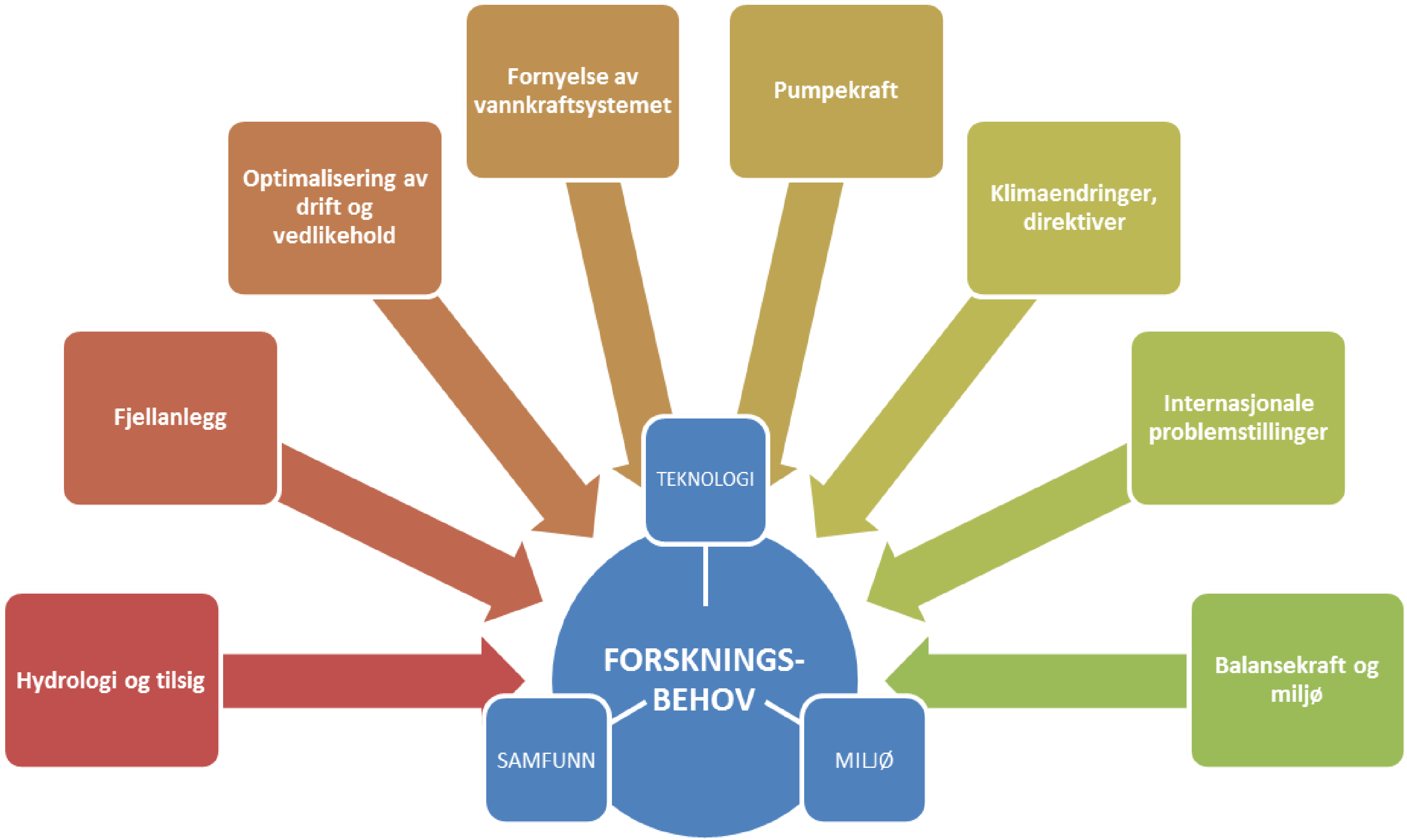
Mai 2016: Offentliggjøring av resultat

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

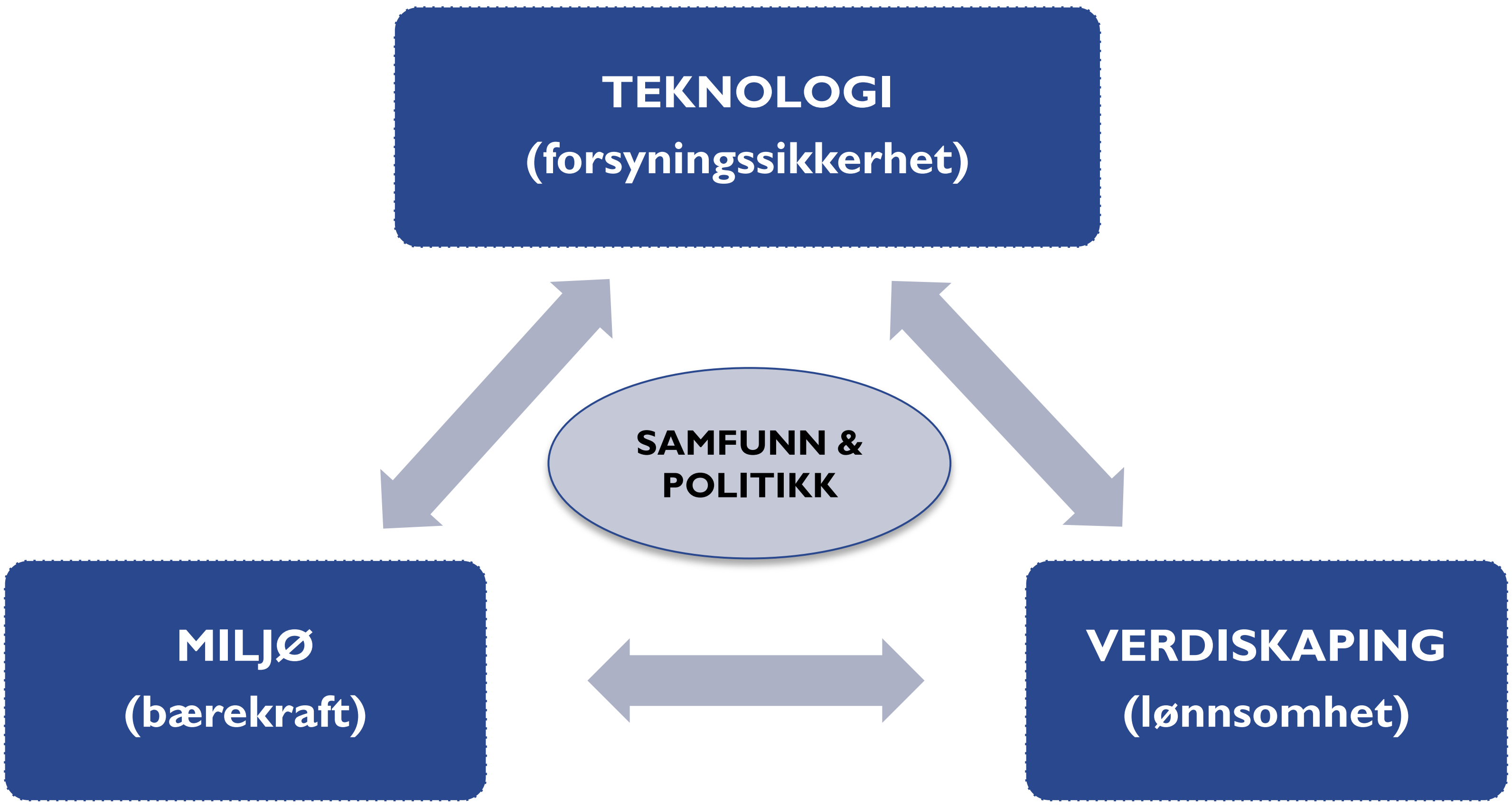
DRIVKREFTER

Klimaendringer
Markedsendringer
Globalisering
Robusthet

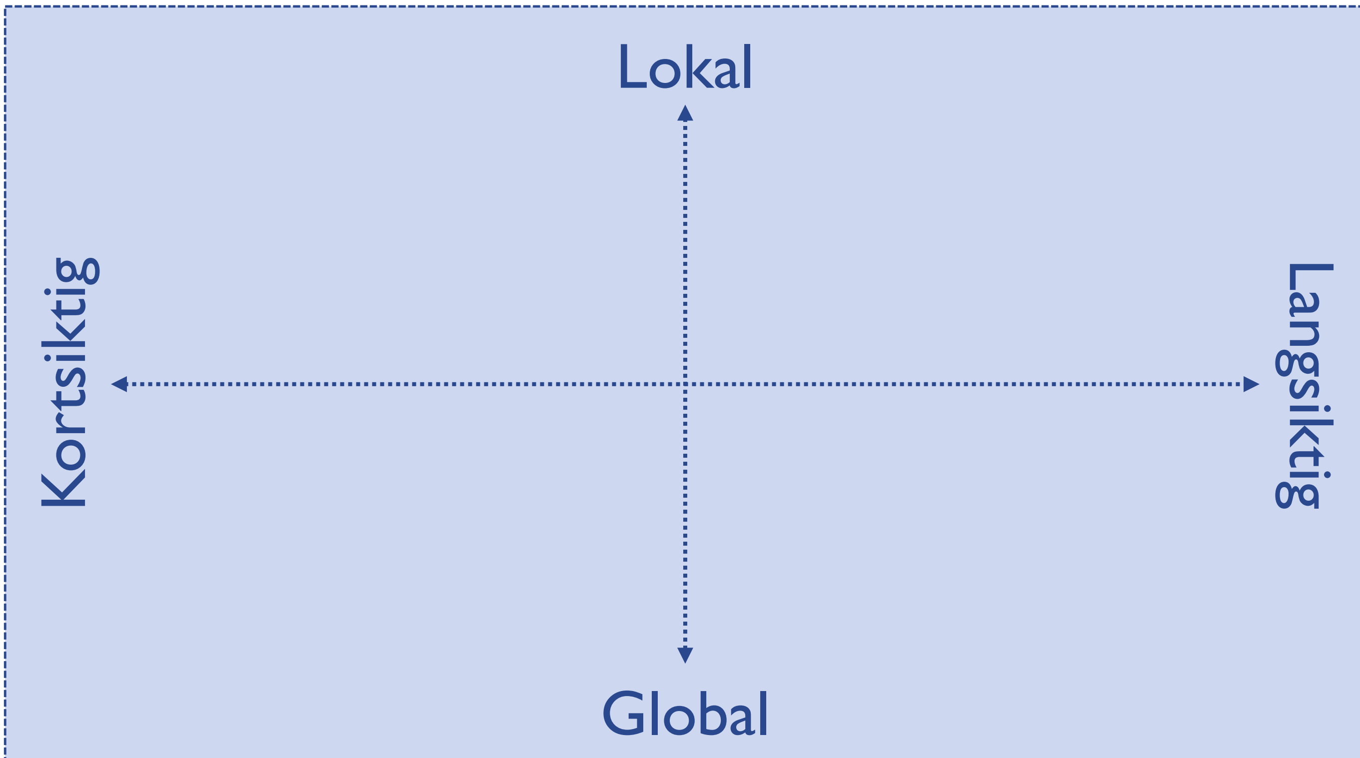
MÅL

Klimatilpasning
Verdiskaping
Bærekraft
Fleksibilitet

Fire grunnpilarer



Mulige forskningsakser



Fagtema

Policy

Internasjonal vannkraft

Fleksibilitet i vannkraftsystemet

Miljødesign

Oppgradering og utvidelse

Energidisponering

Klima

Utfordringer

	Teknologi	Miljø	Verdiskaping	Samfunn
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.
Veien videre