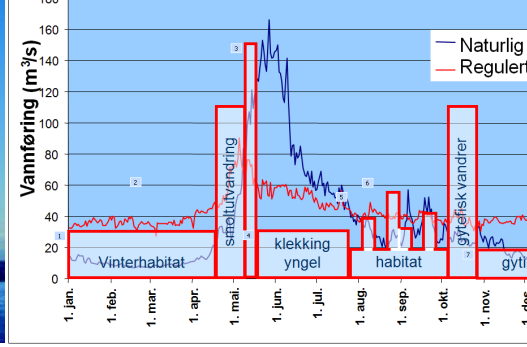






Centre for environmental design of renewable energy - CEDREN

SINTEF

NTNU
100 skapende år

NINA

NATURHISTORISK MUSEUM
UNIVERSITETET I OSLO

NIVA

uni Research

Atle Harby, SINTEF Energi, senterleder





Program formiddag

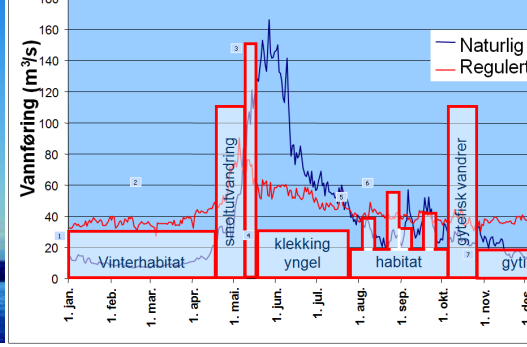
PROGRAM		
1000	Velkommen	
1010	Oversikt over CEDREN og noen høydepunkter	Atle Harby Atle.Harby@sintef.no
1030	Rollen til norsk vannkraft i 2050 – scenarioer for Norge som leverandør av balansekraft	Julian Sauterleute Julian.Sauterleute@sintef.no
1050	HydroPEAK – kort rapport fra tre PhD prosjekt som nå er fullført: Hydrologiske modell - Erosjon ved effektkjøring - Modellering av is i vassdrag	Ånund Killingtveit anund.killingtveit@ntnu.no
1110	Grønt, gult eller rødt lys for effektkjøring i elver?	Julian Sauterleute Julian.Sauterleute@sintef.no
1130	Hvordan vil fremtidenes klima påvirke lakseproduksjon? Case Mandalselva	Line Sundt-Hansen line.sundt-hansen@nina.no
1150	LUNSJ	

Program ettermiddag

1230	Tiltak og virkemidler for mer bærekraftig nettutvikling – resultater fra SusGrid	Øystein Aas (oystein.aas@nina.no) Audun Ruud (Audun.Ruud@sintef.no)
1250	Om vannforbruk og drivhusgassutslipp i kraftverksmagasin (EcoManage)	Ånund Killingtveit anund.killingtveit@ntnu.no
1310	Multikriterieanalyse av kompenserende tiltak (EcoManage)	David Barton David.Barton@nina.no
1330	KAFFEPAUSE	
1350	Verktøy for bedre lokalitetsvalg av vindkraft og sentralnett. Oppsummering fra OPTIPOL LCP og veien videre	Frank Hanssen Frank.Hanssen@nina.no
1410	Offshore vind og fugl	Espen Lie Dahl EspenLie.Dahl@nina.no
1430	Nye prosjekter, nytt FME og veien videre Diskusjoner	Atle Harby Atle.Harby@sintef.no
1515	Oppsummering og refleksjoner fra NVE	Torodd Jensen
1530	Avslutning – takk for oss!	







- 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





SINTEF

NINA

NTNU – Trondheim
Norwegian University of
Science and Technology

International partners:

eDF

e·on

uni Research

NIVA

NATURHISTORISK MUSEUM
UNIVERSITETET I OSLO

Forskningsrådet

NVE

MILJØ-
DIREKTORATET

EnergiNorge

Statkraft

Statnett

agder energi

Sira·Kvina
KRAFTSELSKAP

Hafslund

TROMS KRAFT

TrønderEnergi

BKK

ICH

Eidsiva

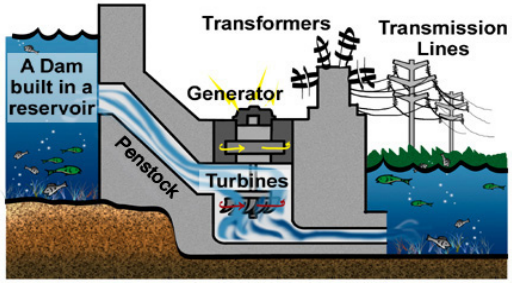
HYDRO

NTE

ECO

Lyse

Collaboration



Nature

Technology

Society

NTNU
100 skapende år

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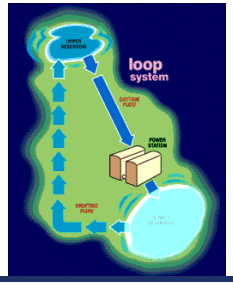
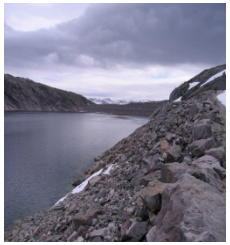
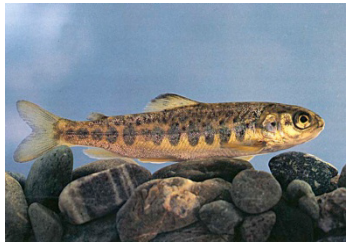
Hydropower technology



Environmental impacts of hydropower



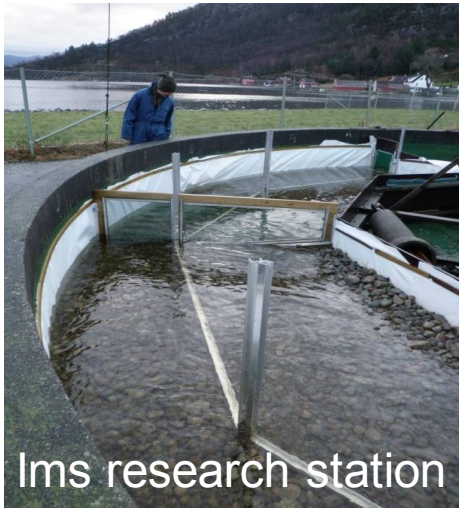


Environmental impacts of wind power and power transmisson

How to reconcile energy and environment policy?

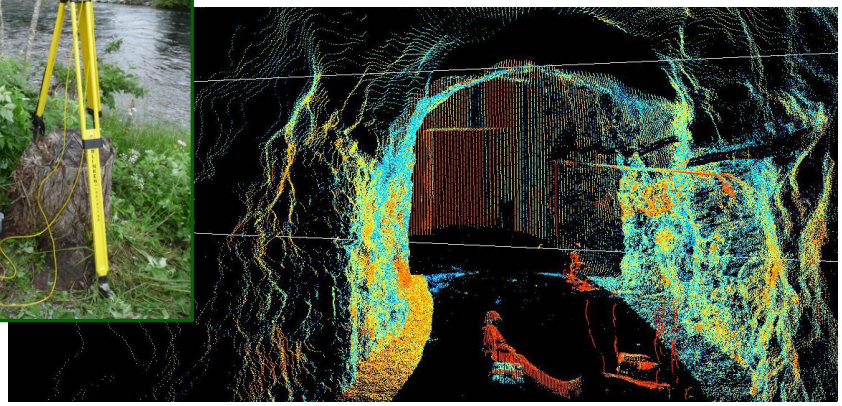
Research facilities

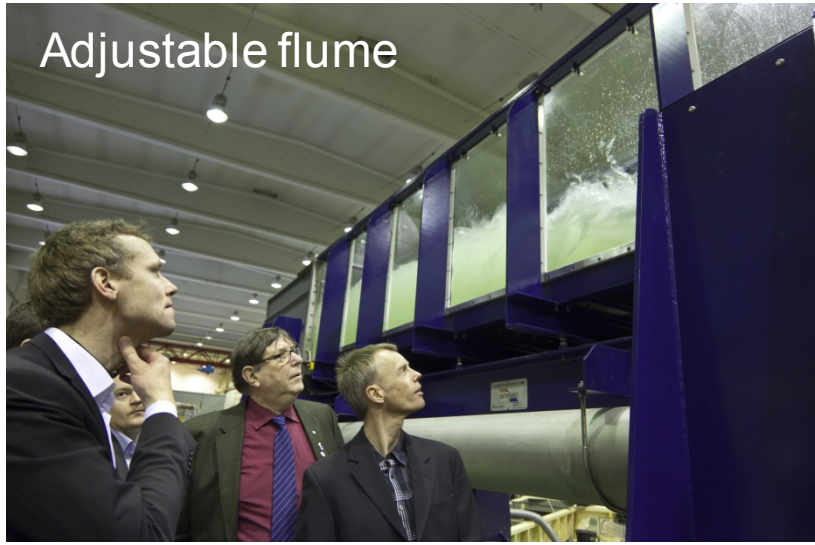

Paltamo research station


Ims research station


Bird radar

Field equipment:
GPS and laser scanner




Adjustable flume

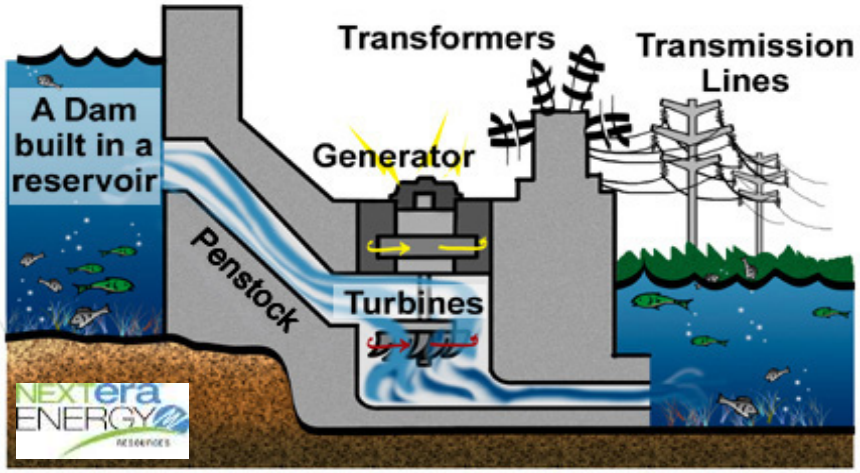
CEDREN Centre for Environmental Design of Renewable Energy

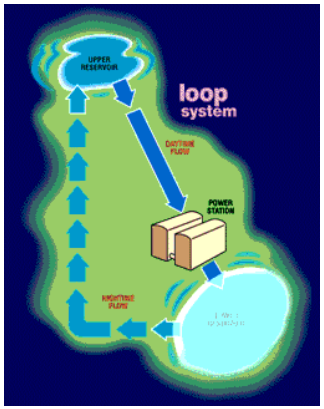



Meetings, workshops, dialogue and collaboration

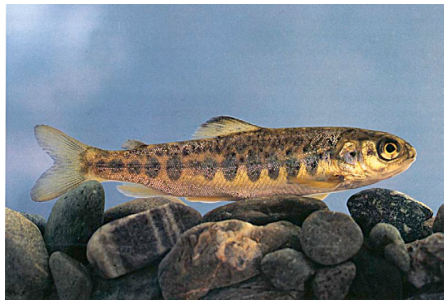



Future hydropower

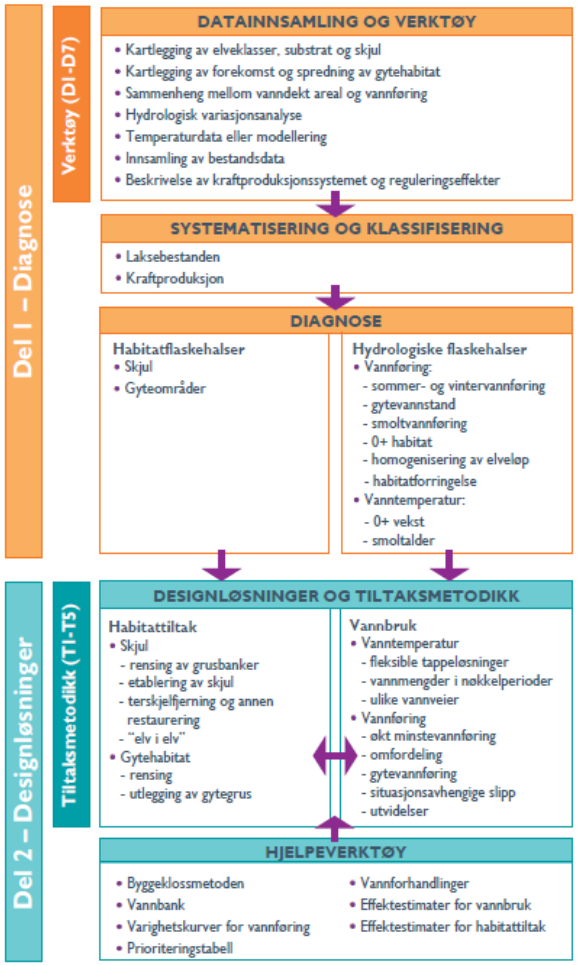




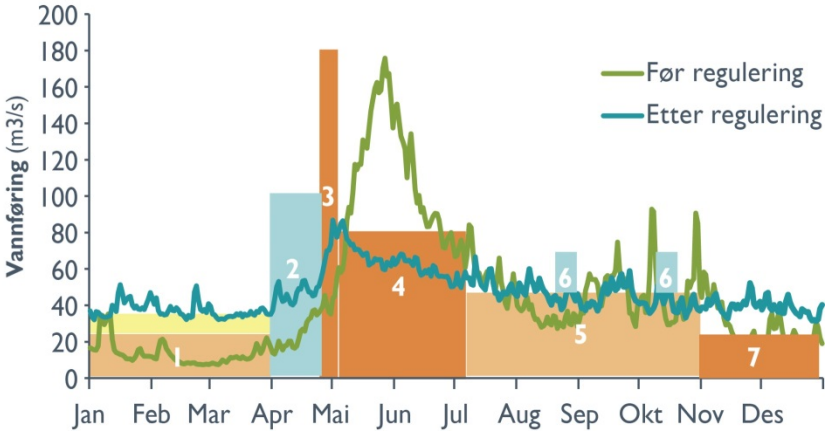
How much water is needed?



for hydropower
and ecology



	Habitatflaskehals	Produktivitet (1-3)
gel	Gyte	1
gel	Gyte	1
gel	Gyte	1
gel	Gyte	2
gel/parr	Begge	1
gel/parr	Begge	1
r	Skjul	2
r	Skjul	2
r	Skjul	2
en	Ingen	3
en	Ingen	3
gel	Gyte	2
gel	Gyte	1
gel	Gyte	2



Vannbruk

+

Habitattiltak

+

Kraftproduksjon

=

Renewable energy respecting nature!

Miljødesign

Hva kan oppnås? Kvina

- Opp til 140 GWh ny kraft
- Lakseproduksjon og fiske minst like godt som før regulering (dobling fra i dag)

Og dette er ikke Science fiction!

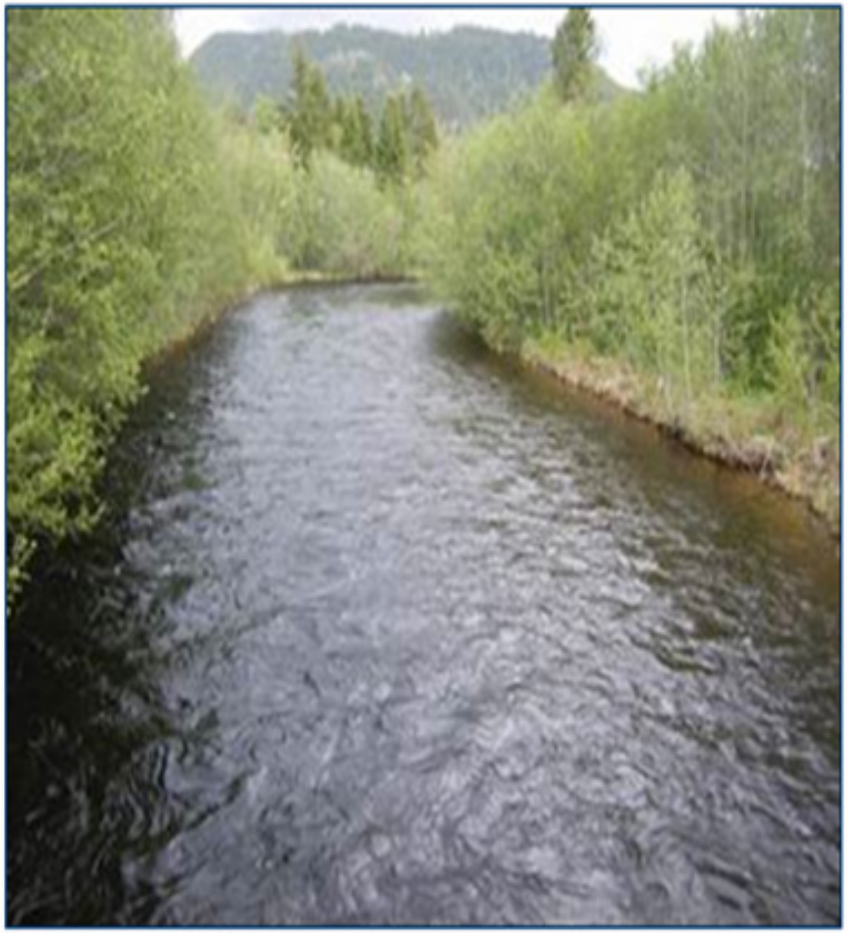
Vår dato: 10 FEB 2014
Vår ref.: NVE 201003953-31 kv/emb
Arkiv: 312/ 025.Z
Deres dato:
Deres ref.:

Saksbehandler:
Eilif Brodtkorb

Fastsetting av konsekvensutredningsprogram for planene om overføring av Knabeåna og Sollisåna til Homstølvatn.

Ved å øke og fordele restvannføringen bedre over året, forlenge eksisterende lakseførende strekning, samt gjennomføre biotopforbedrende tiltak på lakseførende strekning er det antatt at produksjonen av smolt kan dobles i forhold til dagens produksjon. Denne tiltakspakken benevnes som *Miljødesign Kvina* og antas å kunne ivareta forholdene for laksen i Kvina tiltross for at det fraføres mer vann fra vassdraget.

Hydropeaking – rapid flow change in downstream river




Hydropower –
a renewable and
rechargeable
battery

Birds and wind turbines - always a conflict?

Power transmission

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

Holder kraftledningen i Ogndalen bestanden av skogsfugl nede?

Henrik Brøseth

Linjetaksering og DNA-prøver for å beregne skogsfuglbestanden i mars-april

CEDREN Centre for Environmental Design of Renewable Energy

Søk med spesialtrent hund langs ledningen for å finne kollisjonsoffer (1-2 ukers intervall)

År1 (2011-2012) - 14 søksrunder
År2 (2012-2013) - 17 søksrunder
År3* (2013-2014) - 18 søksrunder

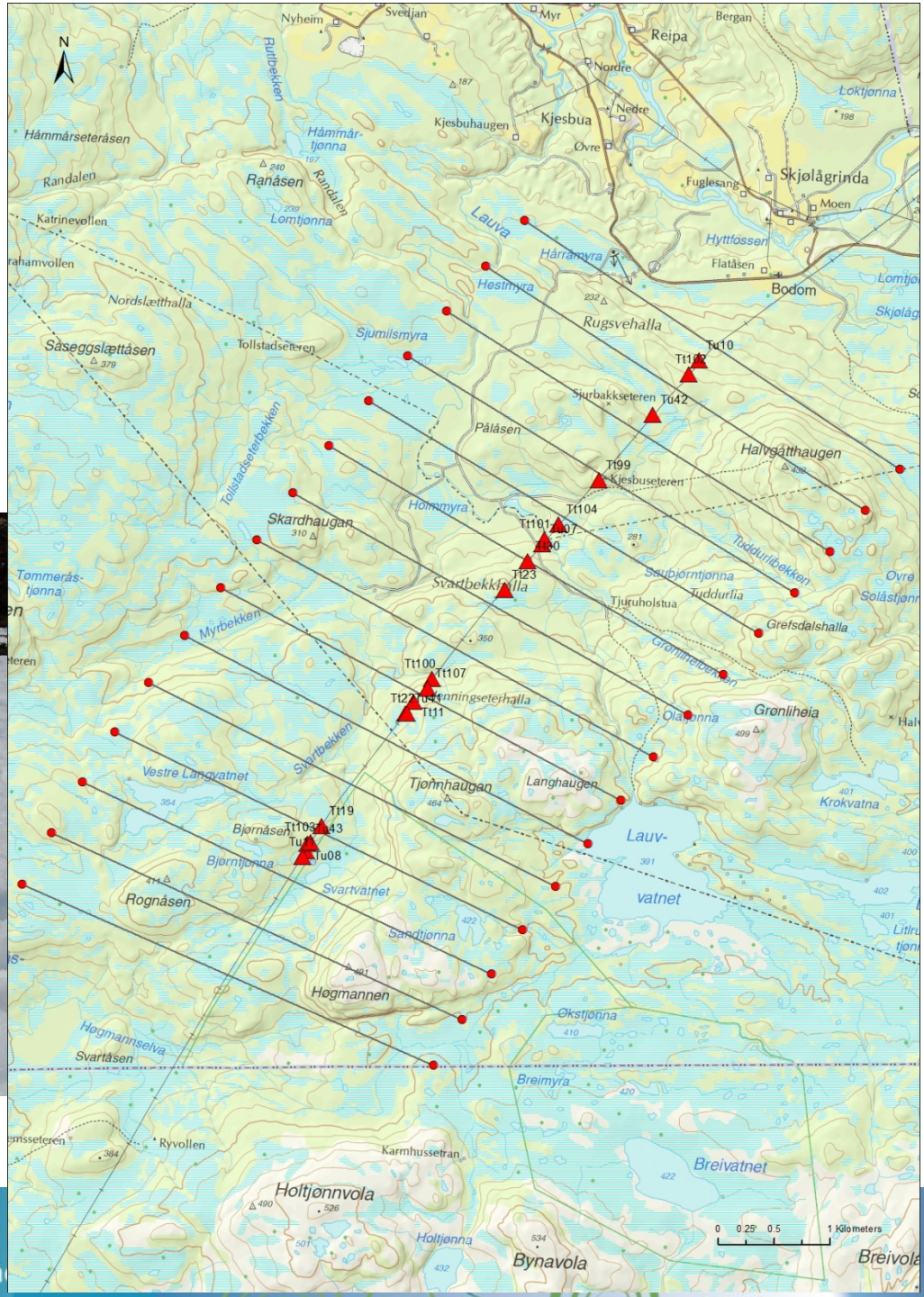
Rase: Wachtelhund
f. 16.09.2009

Kollisjonsfunn helfugl

Kollisjonsfunn – fjærrester

Funn av skogsfugl

Antall individer kollidert		
År	**Antall storfugl**	**Antall orrfugl**
2011	**4**	**4**
2012	**3**	**1**
2013	**1***	**8***

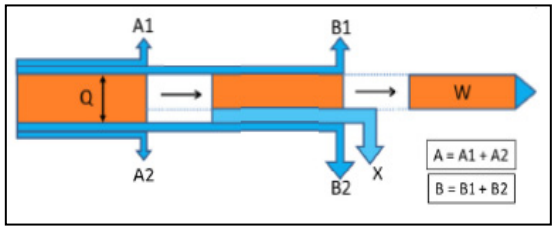


Bestandseffekt

Storfugl			
År	Antall SF	Antall kollidert	%
2011	34	4	11,8
2012	56	3	5,4
2013	24	1*	4,2

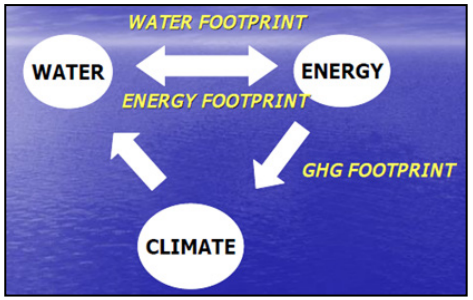
Orrfugl			
År	Antall OF	Antall kollidert	%
2011	86	4	4,7
2012	70	1	1,4
2013	99	8*	8,1

EcoManage highlights



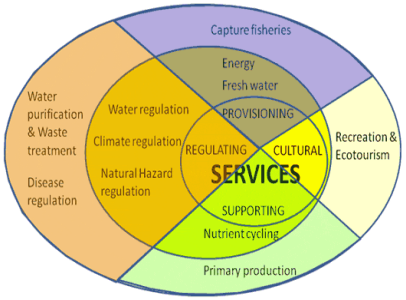
Energy-efficient electricity production:

How to calculate and what are the 'true' numbers?



Water consumption from hydropower:

How to calculate and how to minimize water losses?



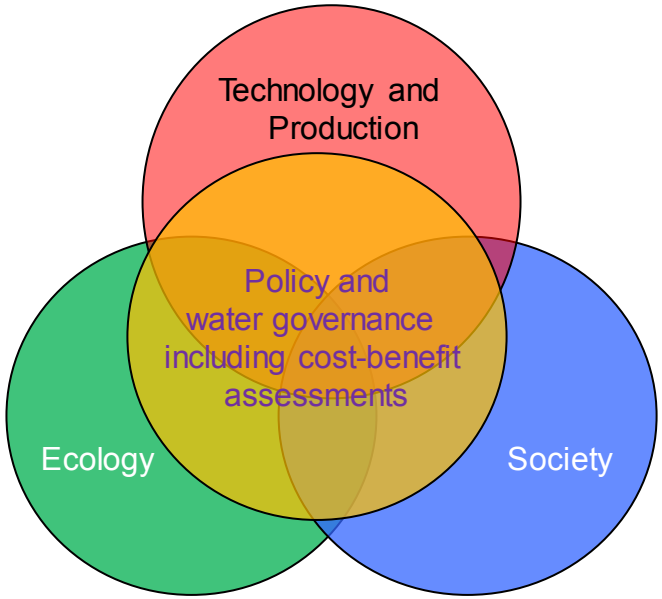
Ecosystem services:

How can this be applied in the context of regulated rivers?

SafePass

Safe and efficient two-way migration past hydropower structures

Nye EnergiX-prosjekter med oppstart 2015



Sustainable governance of heavily regulated river basins - SusWater

Background:

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

CEDREN in China

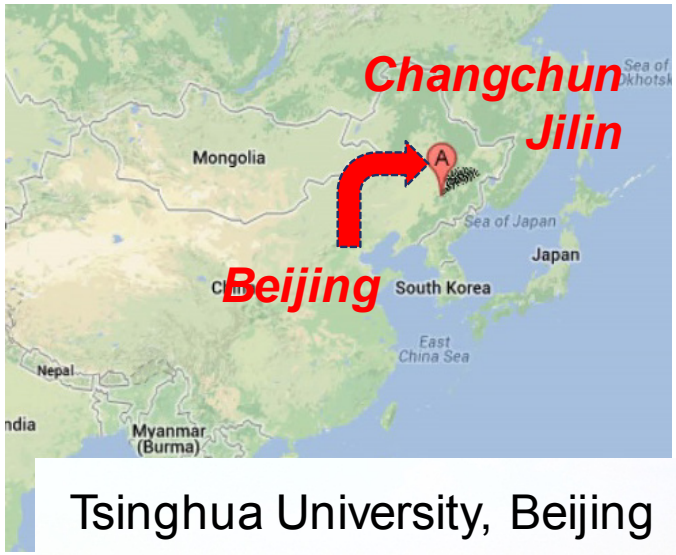
FutureHydro

Visit to Beijing and Fengman Hydropower

Presentations, Discussions

New dam to be constructed at Fengman

Group work



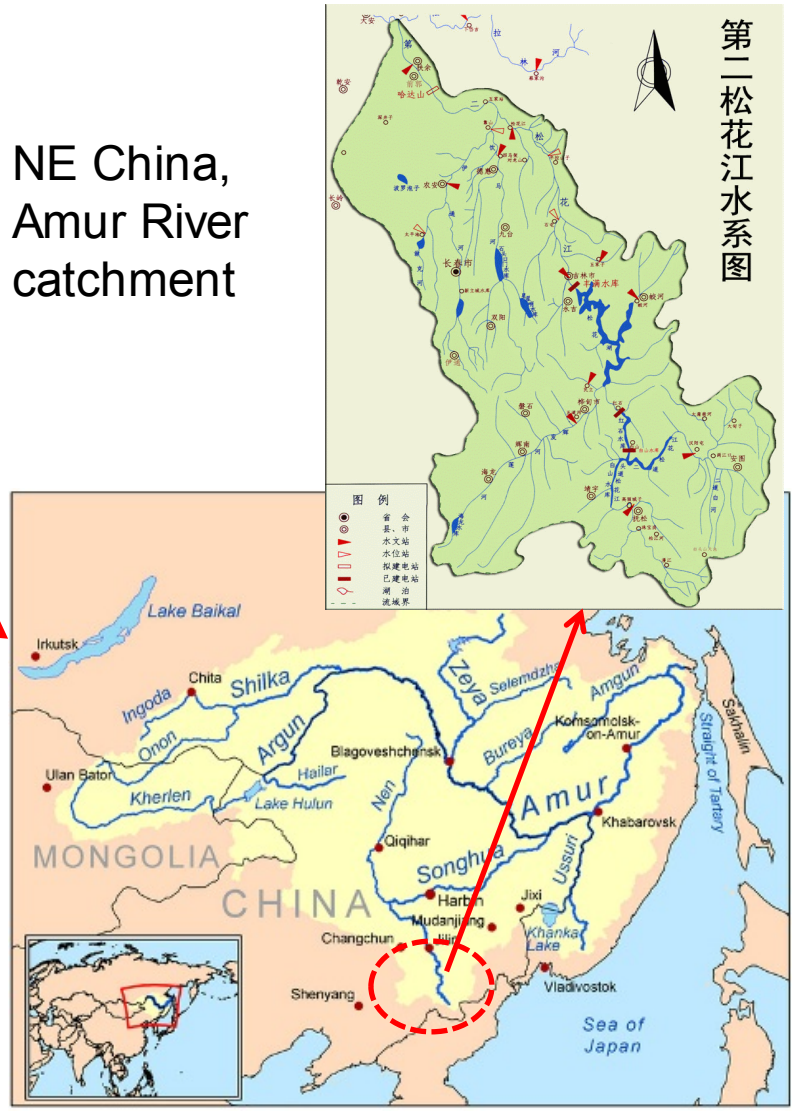
Beijing ➡ Fengman

Tsinghua University, Beijing

Jilin, on the bus

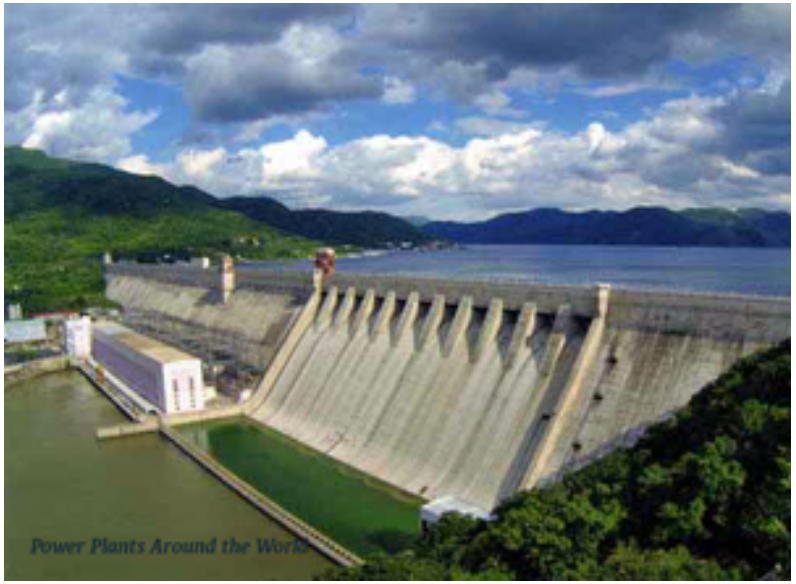
Fengman site visit

NE China,
Amur River
catchment



Fengman dam & power plant

- Built by the Japanese in 1937-42 as part of hydro-power development for their puppet state Manchuko
- Dam damaged toward the end of World War II; almost all of the hydroelectric plant was removed to the Soviet Union
- After 1949 restoration works by the Chinese government; dam was extended and strengthened; power generation equipment was restored with Soviet aid
- Afterwards several upgrades and reinforcements, but still problems with dam safety - need for better solutions!



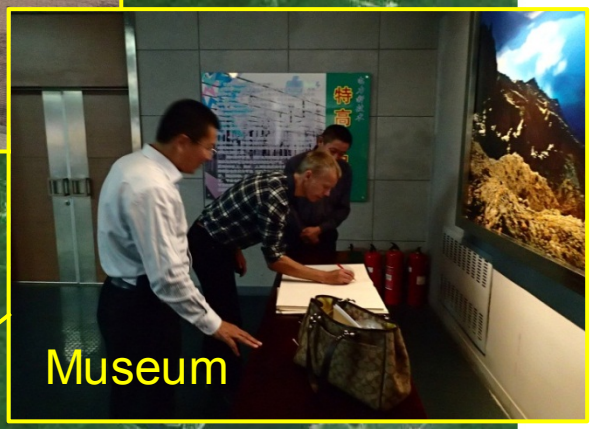
- Massive concrete dam, 91 m in height, 1080 m long
- Reservoir storage volume 88.5×10^8 m^3
- Multi-purpose (mean flow 430 m^3/s)

Fengman dam reconstruction project

- Built a new dam 120 m downstream of the original dam
- Recover the original station's functions without changing the reservoir's characteristic water level
- Build 6 new sets of 200 MW Francis turbine generator units and remain two older units, new total capacity 1480 MW
- Use 10-15 % of the budget for environmental measures, such as fish passages

Existing dam

Planned new dam

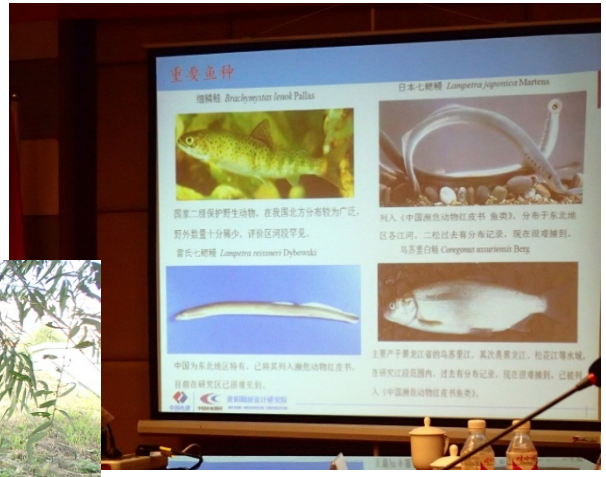


Fengman, Jilin,

Image © 2014 CNES / Astrium
Image Landsat
Image © 2014 DigitalGlobe

Re-regulation dam

Purpose:
dampening of
hydro-peaking



Discussing the
planned position of
the fishway at the
re-regulation weir

Fengman power company

Day 4,
Meeting with Fengman power company

Among the special requirements which the power company has to fullfil:
Release of water for the "Ice Tree Festival" during night time over three months.

ISE 2014

Trondheim

10th International Symposium on Ecohydraulics 2014

Norwegian University of Science and Technology

Trondheim, Norway, June 23rd - 27th

#ecohyd

SINTEF

Supported by CEDEX

TrønderEnergi

CEDREN

NINA Norwegian Institute for Nature Research

NTNU

Hydropower typology, covering all scales of development

Run-of-river hydro

Storage hydro

Pump-storage hydro

Seminar at World Water Week, Stockholm, Sep 2014

From Taylor, IHA

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

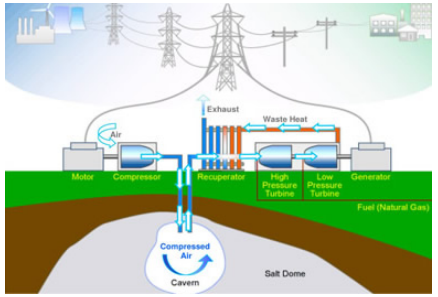
1) **Electrochemical Storage**
Batteries, Super Capacitors

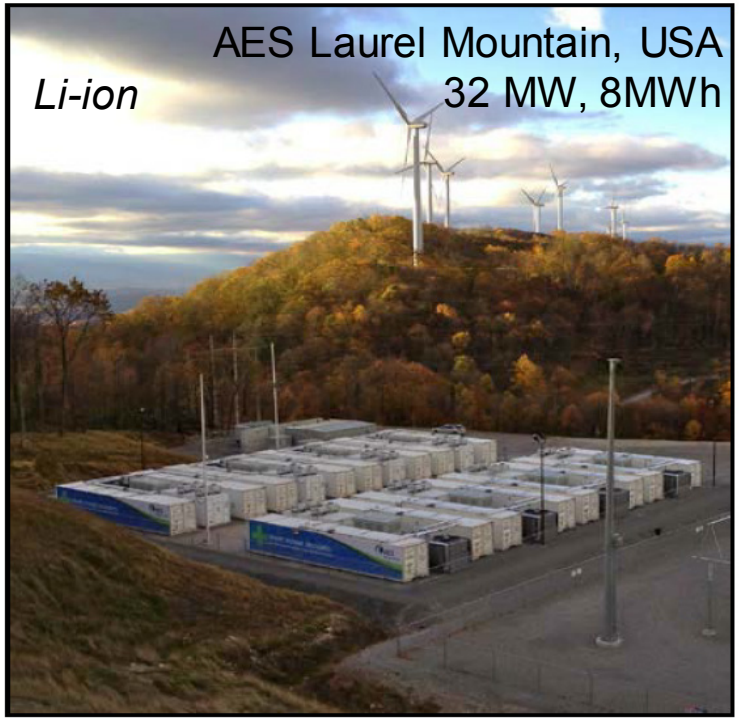
2) **Chemical Storage**
Hydrogen, Methanol, Ammonia

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

4) **Mechanical Storage**
Hydro, Flywheels, Compressed Air

5) **Superconducting Magnetic Energy Storage**



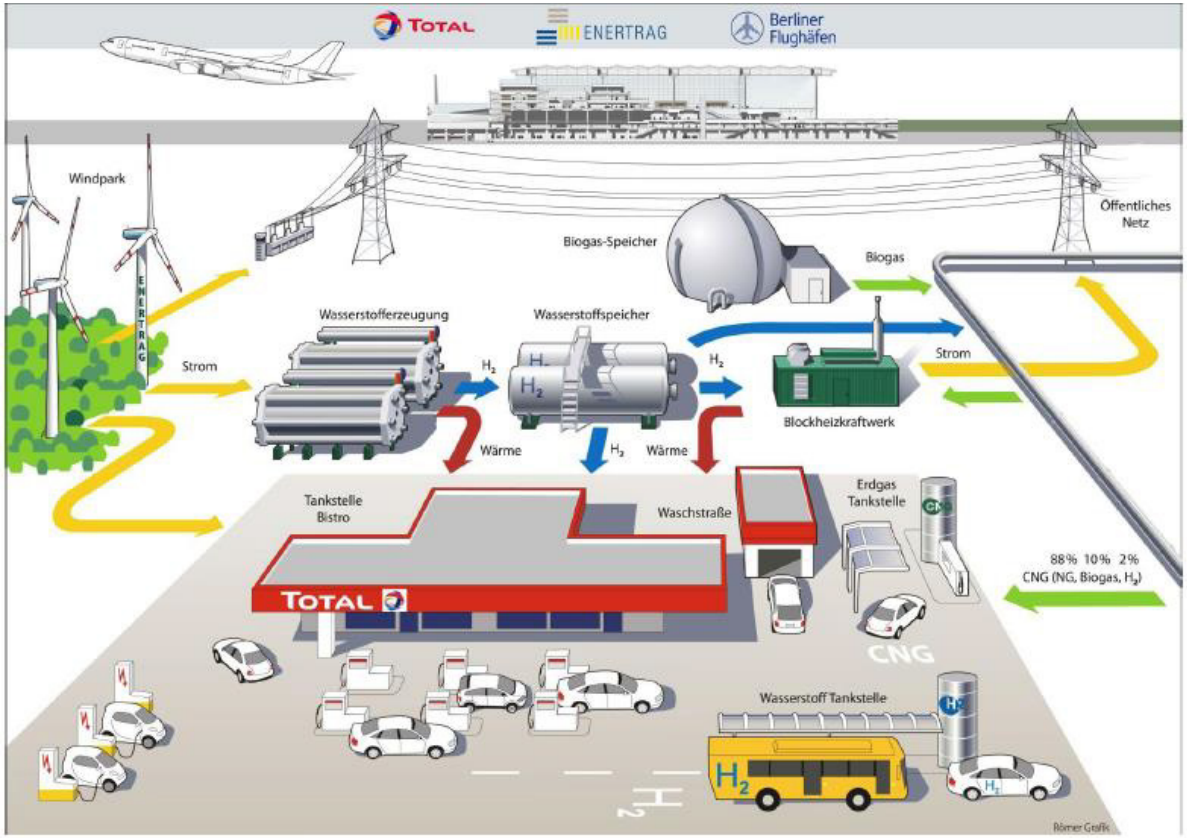


Duke Energy Notrees Wind Storage Demo Project, USA: 36 MW, 20 MWh

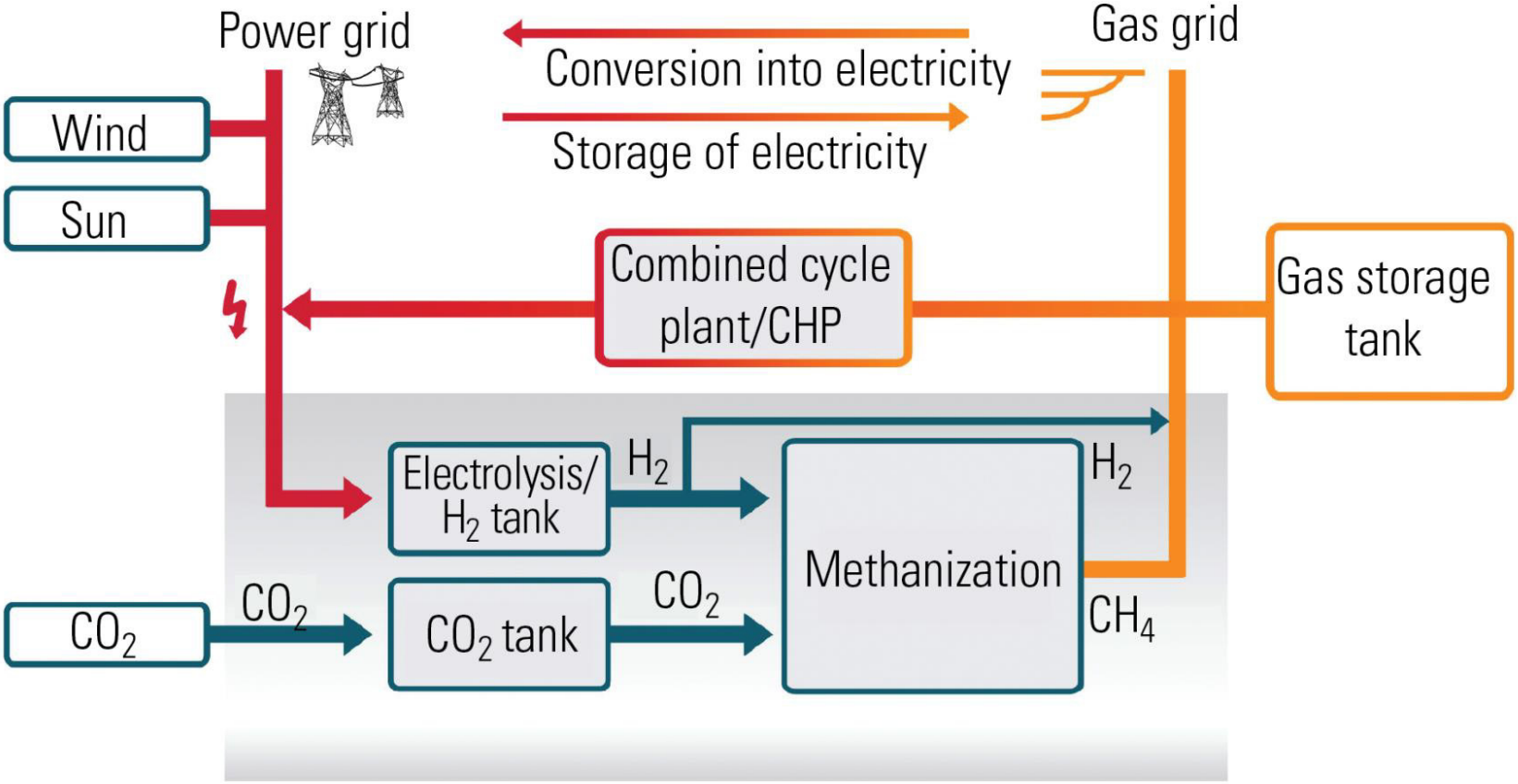
Flow batteries:
Gills Onions, California: 600kW, 3.6 MWh

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

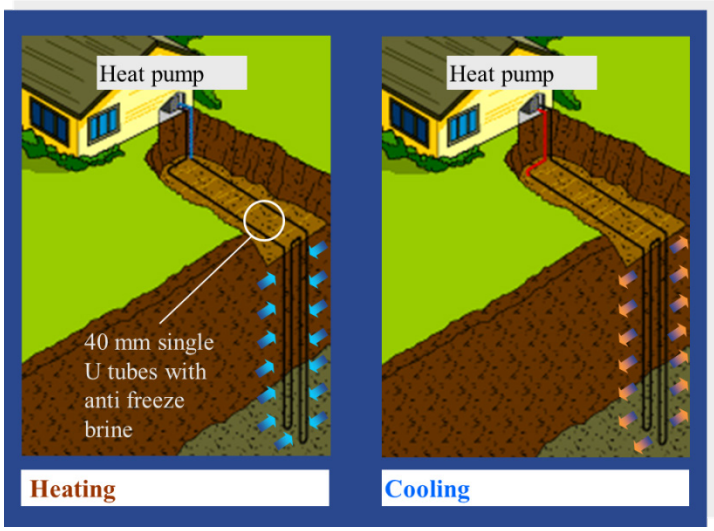
Steam accumulator, Aerated concrete manufacturing

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

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

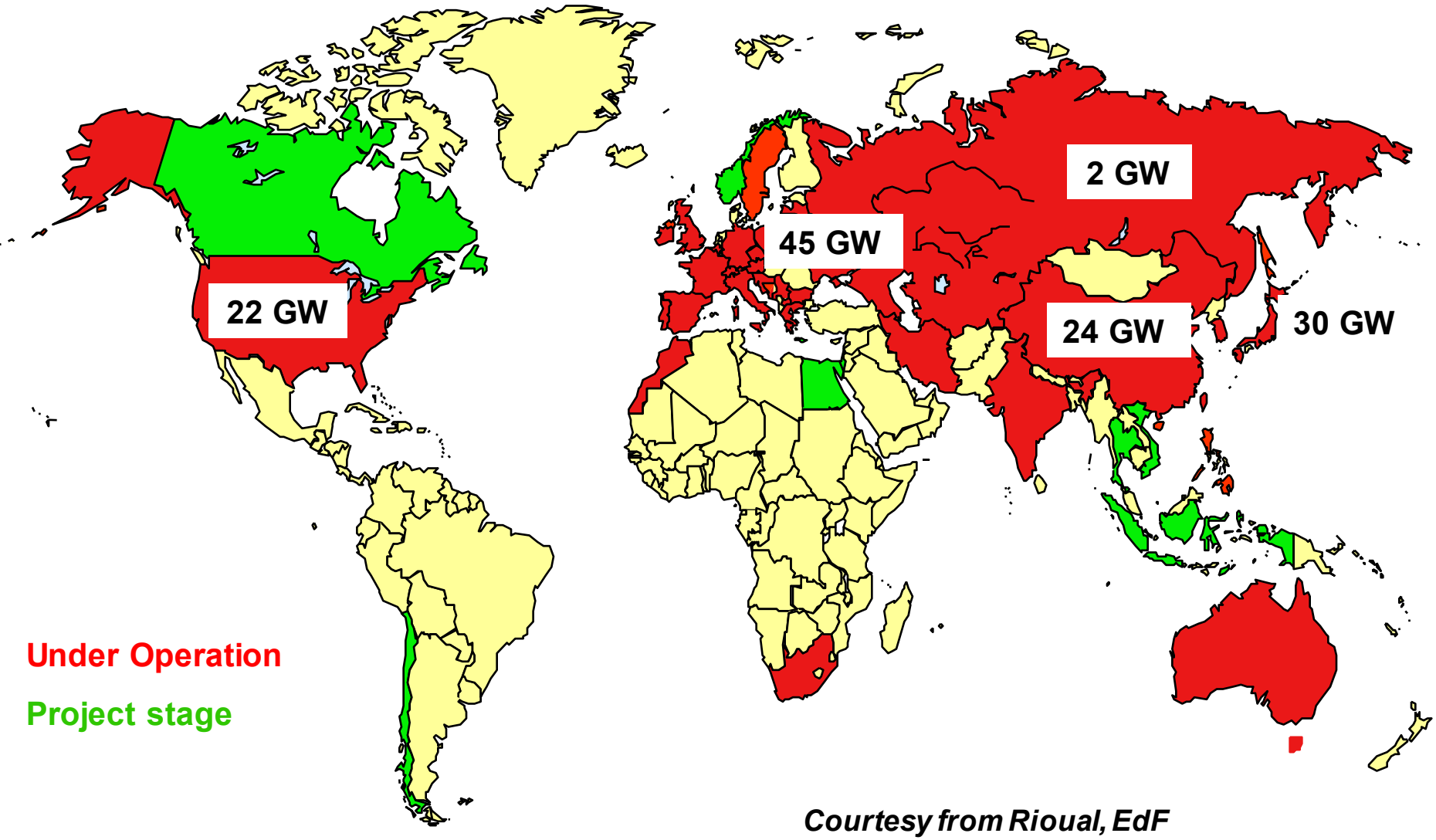
Compressed air

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

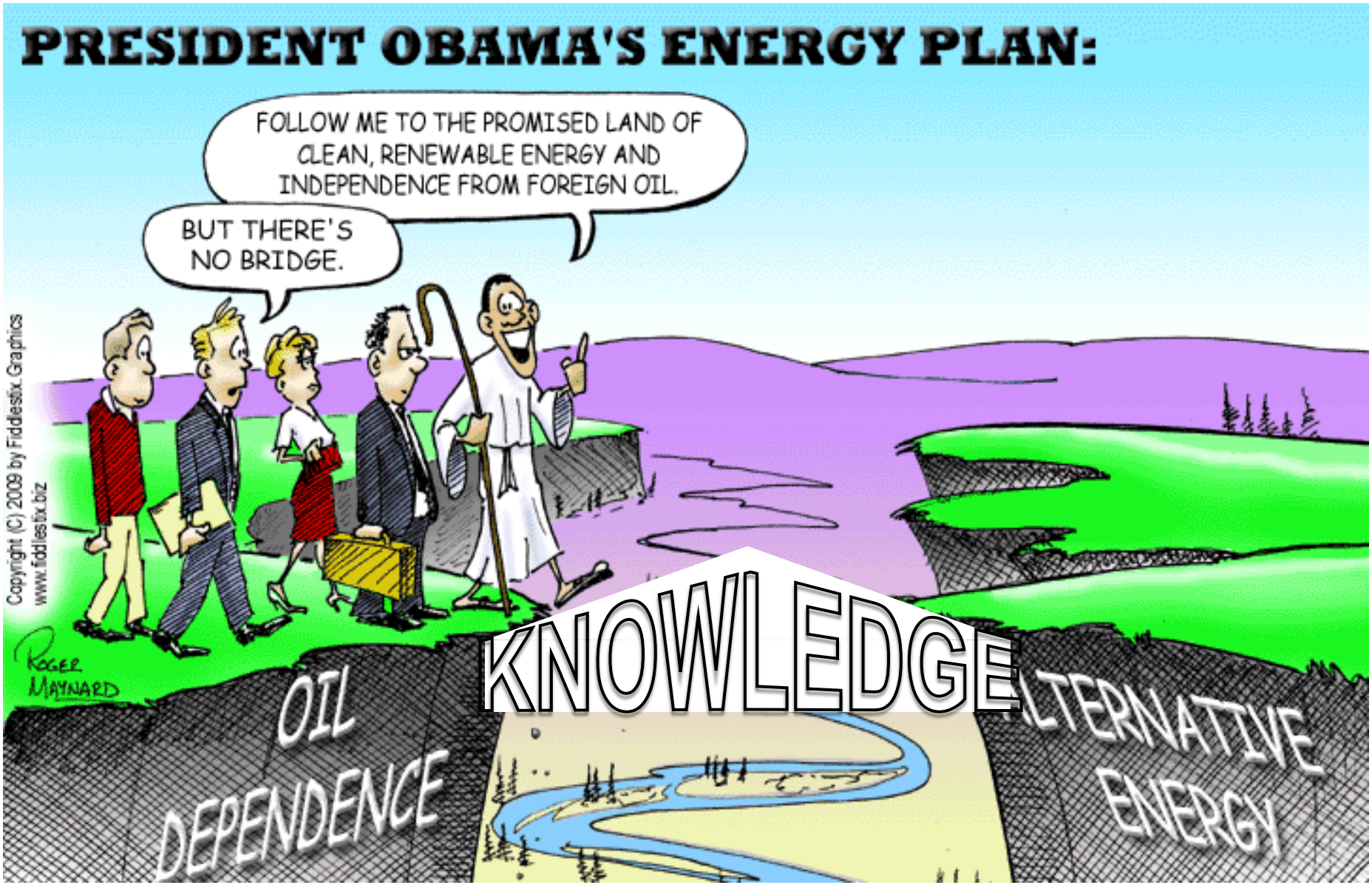
Flywheels

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

Installed PSH world-wide: ~140GW



Courtesy from Rioual, EdF


PRESIDENT OBAMA'S ENERGY PLAN:
FOLLOW ME TO THE PROMISED LAND OF CLEAN, RENEWABLE ENERGY AND INDEPENDENCE FROM FOREIGN OIL.
BUT THERE'S NO BRIDGE.
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OIL DEPENDENCE
ALTERNATIVE ENERGY





www.cedren.no

Contact: atle.harby@sintef.no

SINTEF

NTNU
100 skapende år

NINA
Norsk institutt for naturforskning

NATURHISTORISK MUSEUM
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