Agenda Wednesday 23 October

13.00 - 15.15 **Recent research findings**

13.00 Welcome, background and introduction to the HydroBalance project *Michael Belsnes and Atle Harby*

13.45 Large-scale balancing and storage from hydropower and trends for the future *Ånund Killingtveit*

14.15 European situation and future needs of large-scale balancing and energy storage – seen from a researcher's view. *Ozge Ozdemir, ECN, Netherlands*.

14.45 European grid development and hydro balancing potential. *Julian Sauterleute*

15.00 Scenarios for the 2050 European energy mix and large-scale modelling of grid development and storage needs, *Ingeborg Graabak*

15.15 Break

Agenda Wednesday 23 October

15.45 – 17.45 **Plans, ideas and experience from the industry**

15.45 Current and potential future situation of large-scale balancing and energy storage needs – seen from Germany.
Michaela Harasta, E.ON, Germany

16.15 Storage in France today and overview of storage technologies and possible applications in the future.
Jean-Baptiste Bart, EdF, France

16.45 Benefit potential and regulatory risk for new interconnections to Europe from Norway. *Jan Bråten, Statnett, Norway*

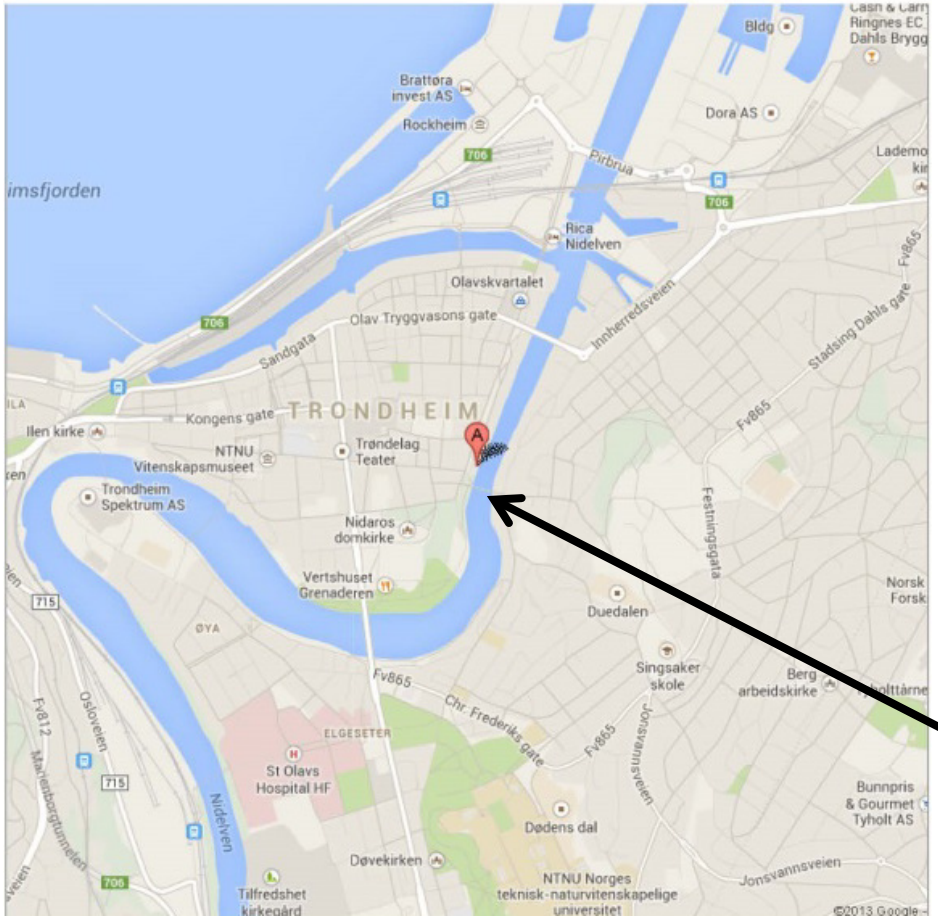
17.15 Challenges and opportunities for Norwegian hydropower to deliver large-scale balancing and energy storage to continental Europe and UK. *Tom Westgård, Statkraft, Norway*

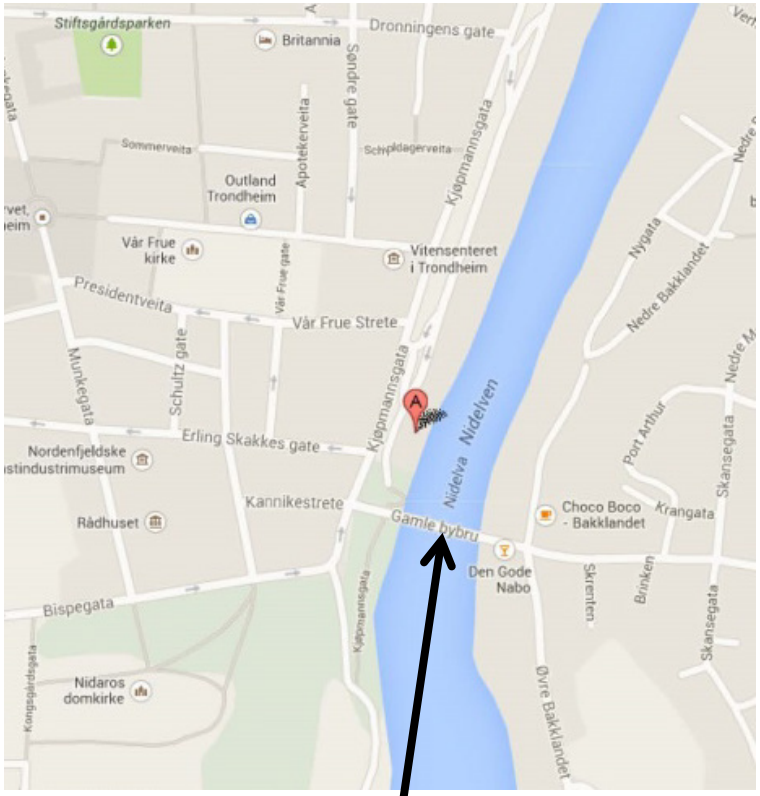
17.45 Discussions and wrap-up

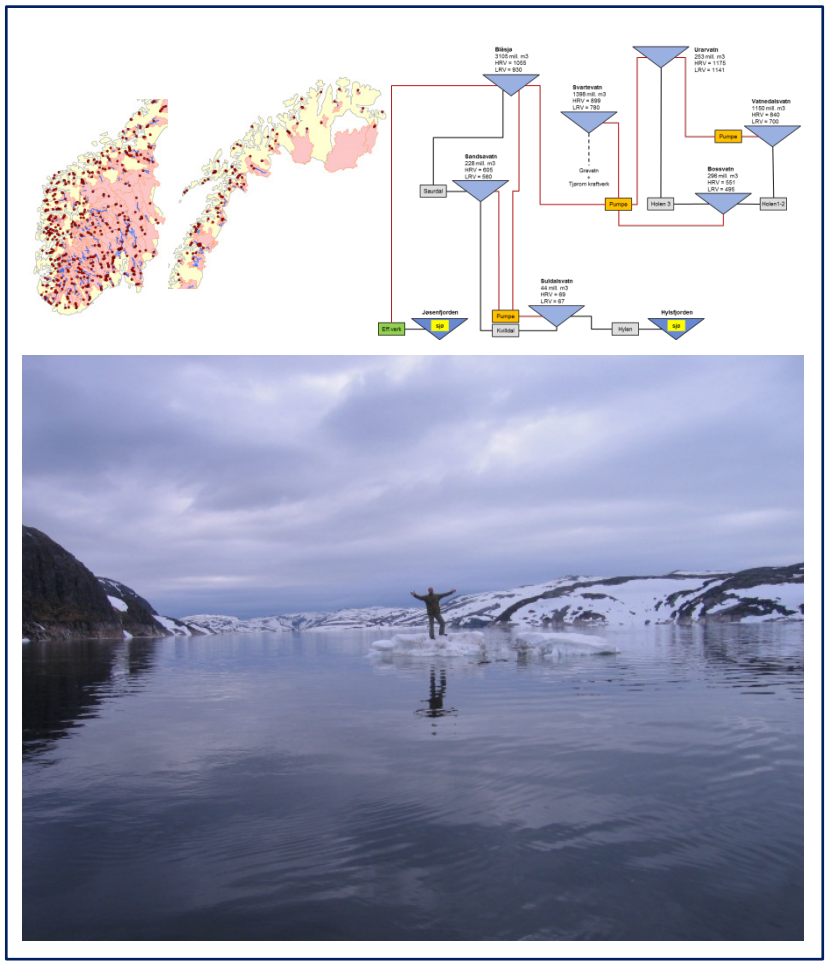
18.00 End of day 1.

20.00 Dinner at Havfruen restaurant, Kjøpmannsgata 7
(on the city side of the old town bridge)

Havfruen restaurant: 20.00







HydroBalance

Kick-off 23 Oct 2013

Atle Harby, SINTEF Energi
Director CEDREN





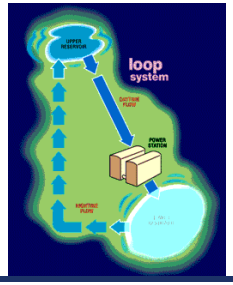
CEDREN - Renewable energy respecting nature

- 9 large research projects 2009-2017
- 7 Norwegian research partners + many international
- 13 Industry partners and 2 management partners
- Budget: 36 MEuro (6 MEuro in 2013) – financed by the Research Council and the Energy industry
- Passed mid-term evaluation with very good marks

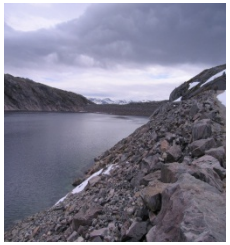


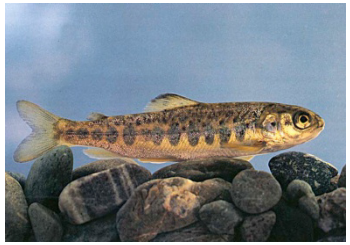



Hydropower technology



Environmental impacts of hydropower





Environmental impacts of wind power and power transmisson

How to reconcile energy and environment policy?

SINTEF

NINA

NTNU – Trondheim
Norwegian University of
Science and Technology

International partners:

eDF

e·on

uniResearch

NIVA

NATURHISTORISK MUSEUM
UNIVERSITETET I OSLO

Forskningsrådet

NVE

MILJØ-
DIREKTORATET

EnergiNorge

Statkraft

Statnett

agder energi

Sira·Kvina
KRAFTSELSKAP

Hafslund

Eidsiva

TrønderEnergi

ECO

ICH

TROMS KRAFT

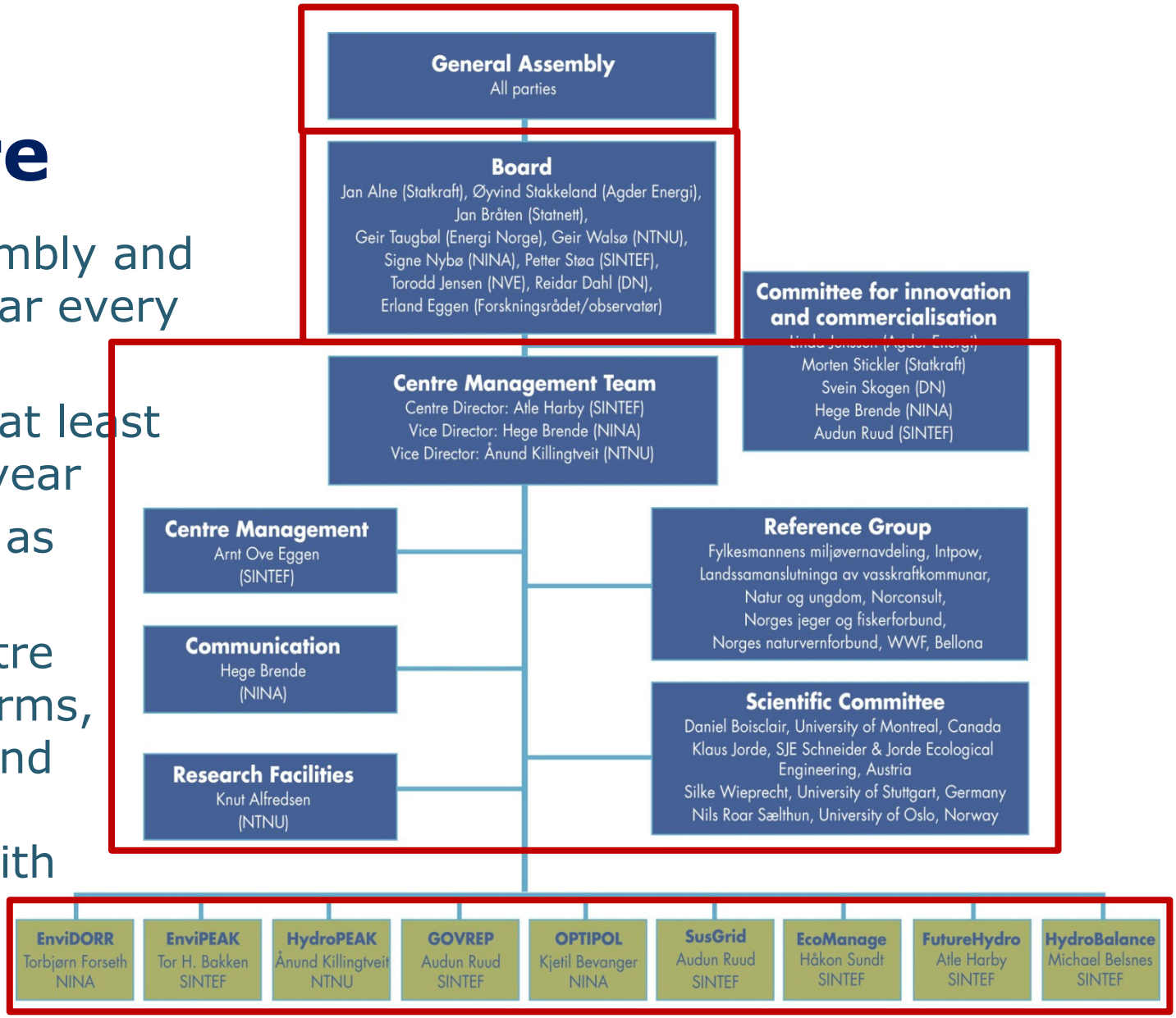
HYDRO

NTE

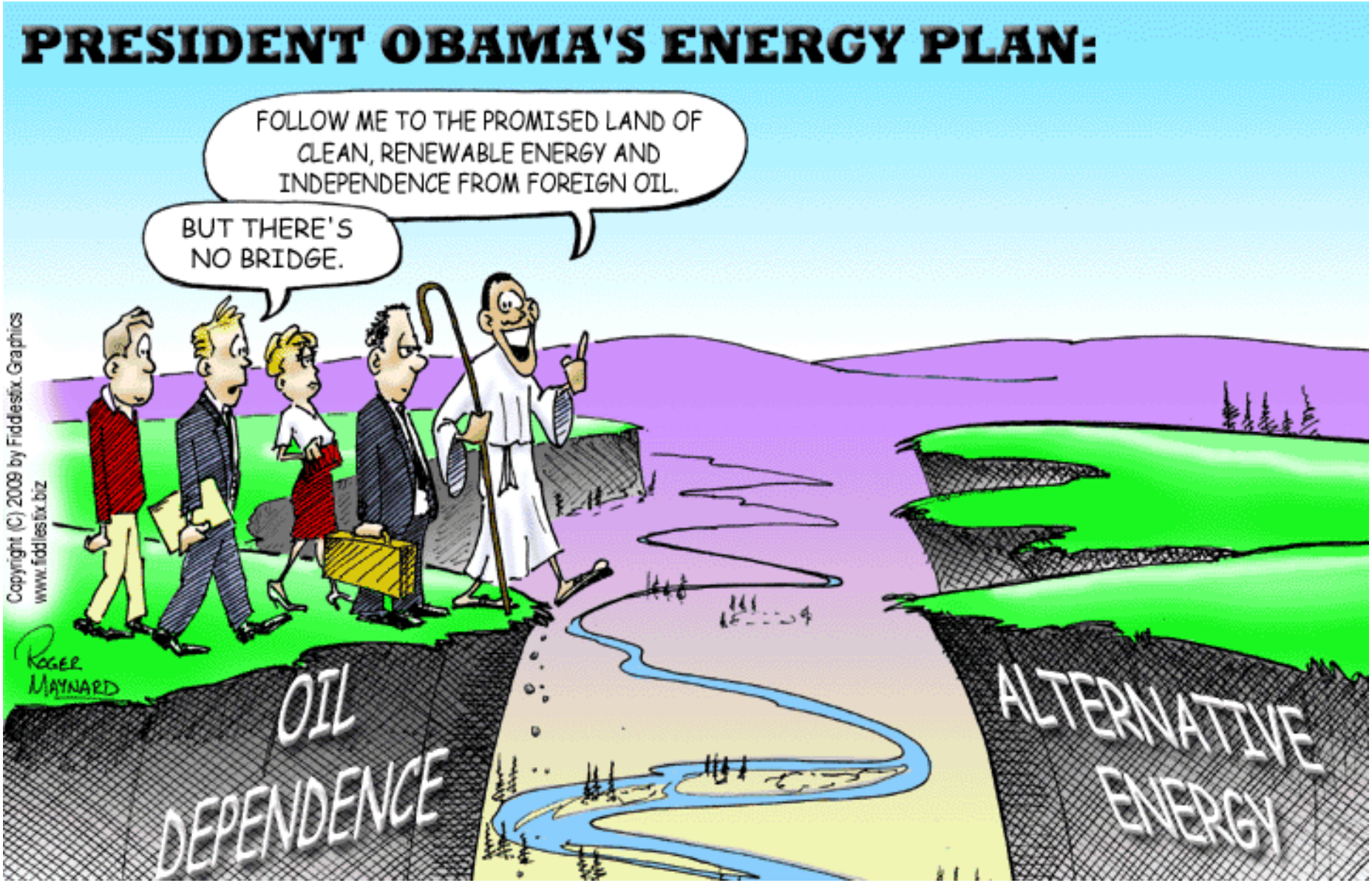
BKK

CEDREN Structure

- General Assembly and annual seminar every year
- Board meets at least four times a year
- Activities run as projects
- Common centre activities informs, coordinates and implements
  → together with scientists and end-users



CEDREN
Centre for Environmental Design of Renewable Energy


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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ROGER MAYNARD
OIL DEPENDENCE
ALTERNATIVE ENERGY

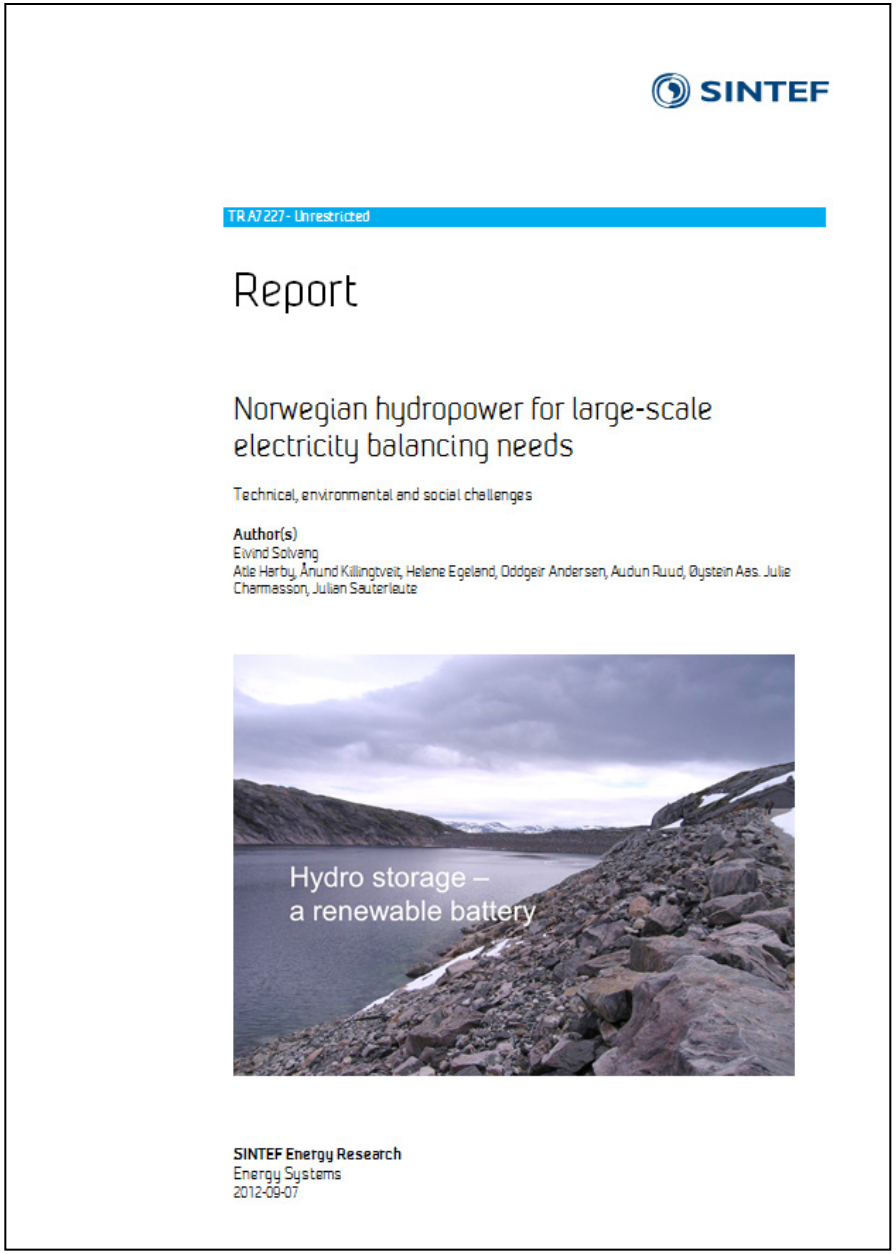
Previous work

- Technical potential and brief analysis of energy systems, GIS-method for location, environmental impacts and social acceptance
- Produced scientific papers, reports, articles in newspapers, magazines, web, TV, radio, etc
- Participated in many international and national seminars and meetings
- Discussions with end-users and authorities and many others like: EERA, EASE, EU, scientists, journalists, stakeholders

Workshop Düsseldorf

Norwegian hydropower for large-scale electricity balancing needs

- Balancing needs from variations in wind power production
- 20 000 MW of increased capacity
  - Using existing reservoirs between HRWL and LRWL
  - New tunnels and new hydropower and pumped storage plants
- Societal legitimacy
  - Stakeholders' interest and concerns
- Impacts on water volume, stage and area in reservoirs
  - Model description, three cases, results
- Impacts on CO_2 emissions
- Grid development challenges
- GIS-based method for evaluation of plant sizes and locations


SINTEF

TR A7227 - Unrestricted

Report

Norwegian hydropower for large-scale electricity balancing needs

Technical, environmental and social challenges

Author(s)
Eivind Solvang
Atle Harby, Ånund Killingtveit, Helene Egeland, Oddgeir Andersen, Audun Ruud, Øystein Aas, Julie Charmasson, Julian Sauterleute

SINTEF Energy Research
Energy Systems
2012-09-07

Energy scenarios

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

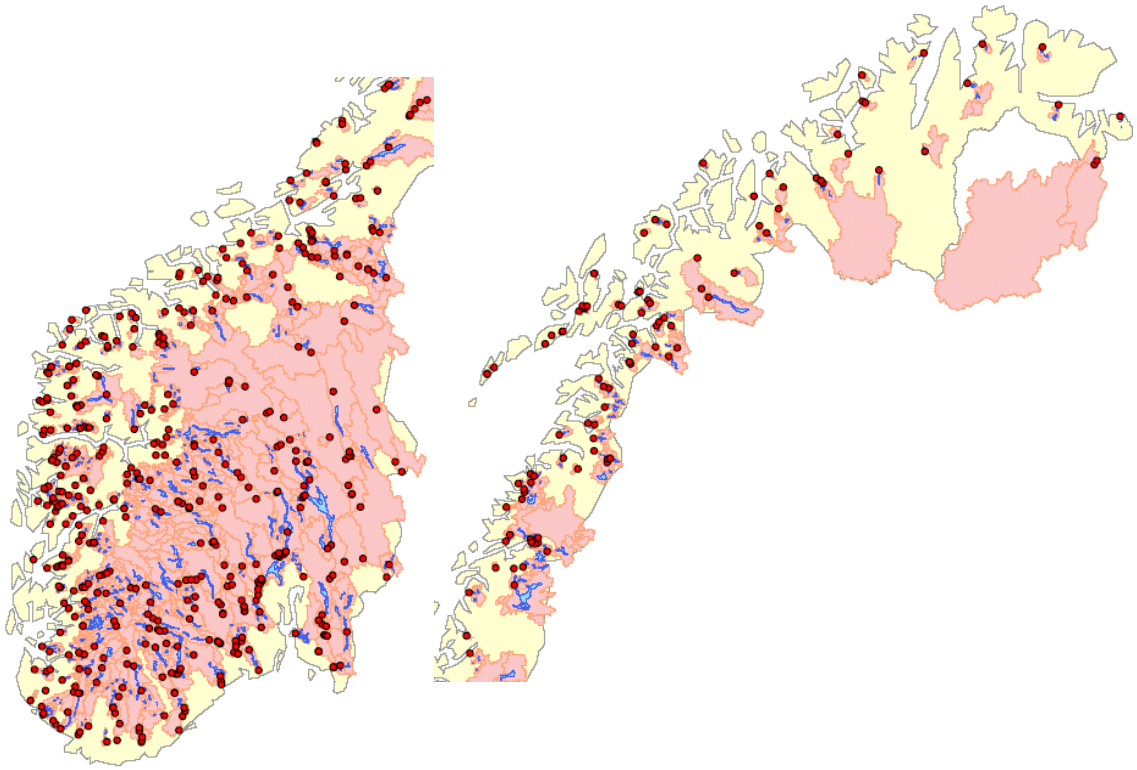
Maybe as much as 340 TWh of storage volume and 150 GW of balancing capacity needed in Europe by 2050

Win-win situation?

Reaching renewable targets

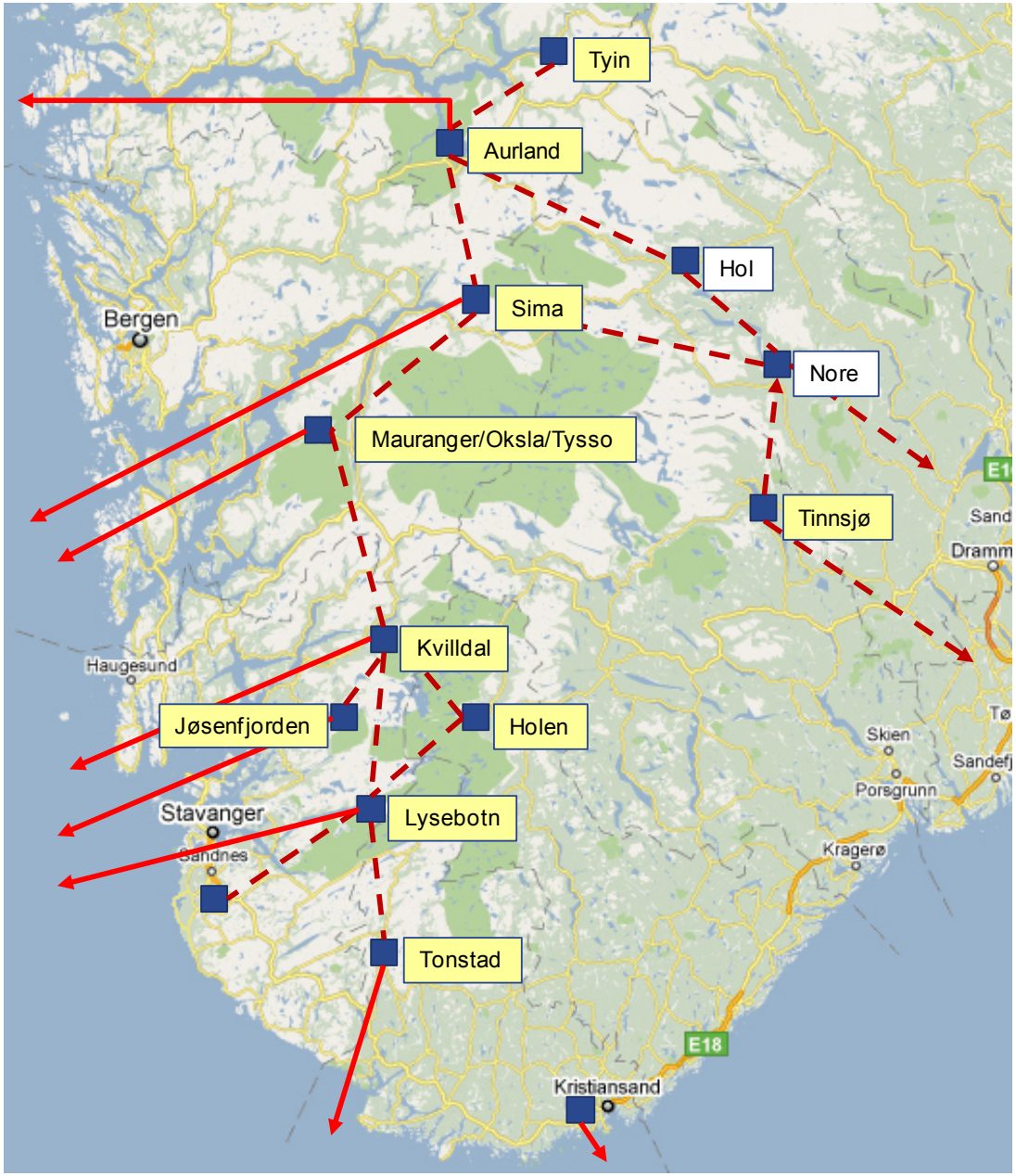
Business development

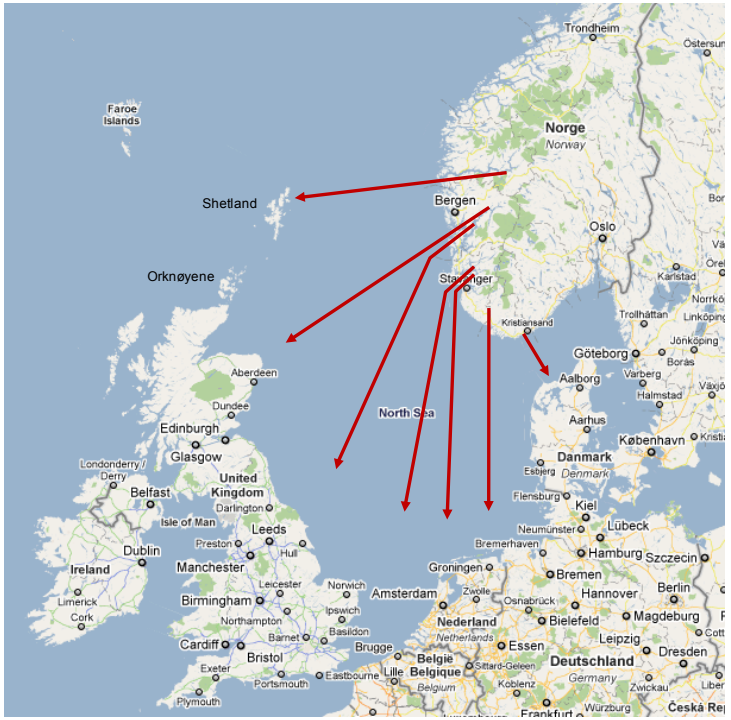
Norwegian hydropower



- Hundreds of large reservoirs
- 20 reservoirs with more than 100 Mm^3 both up- and downstream

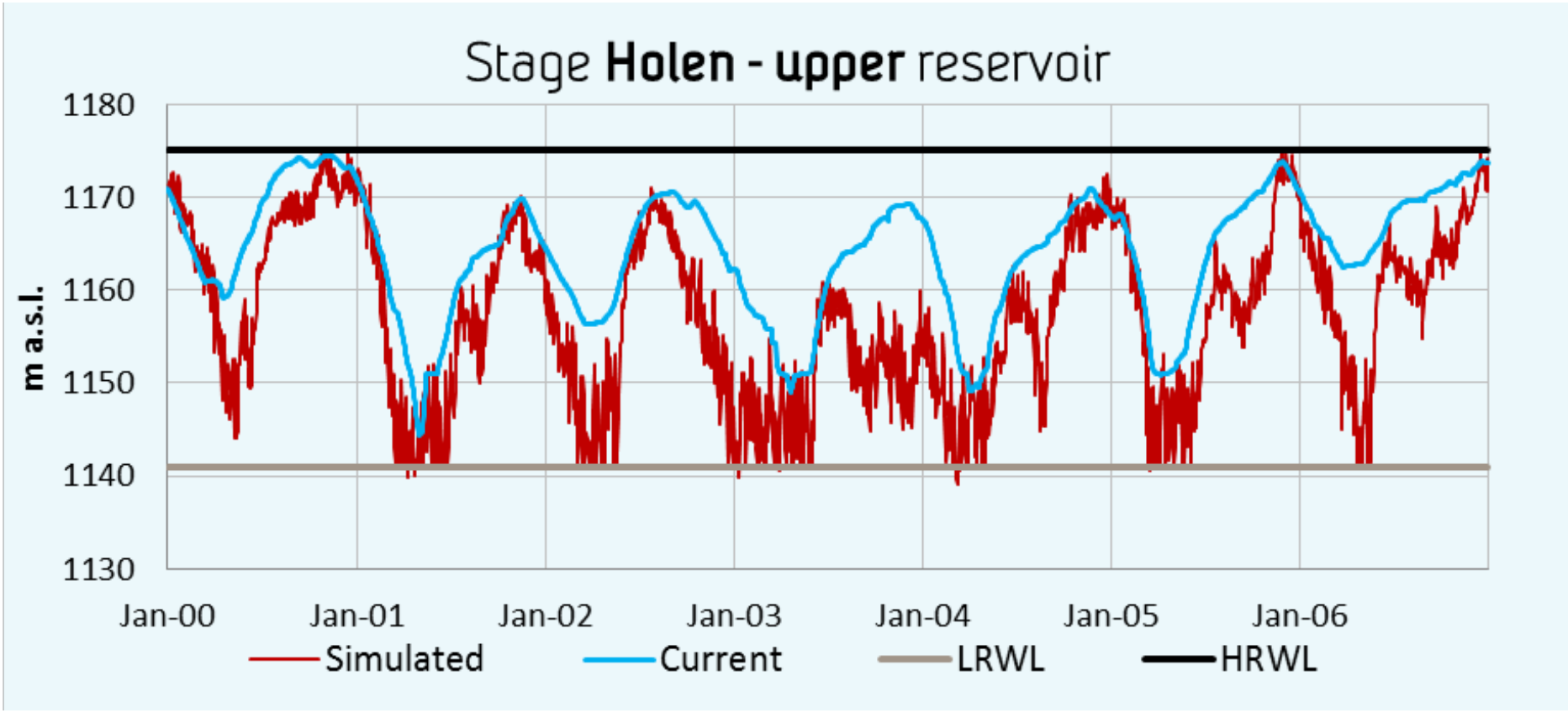
CEDREN Case study 2030 → 20 GW in southern Norway possible



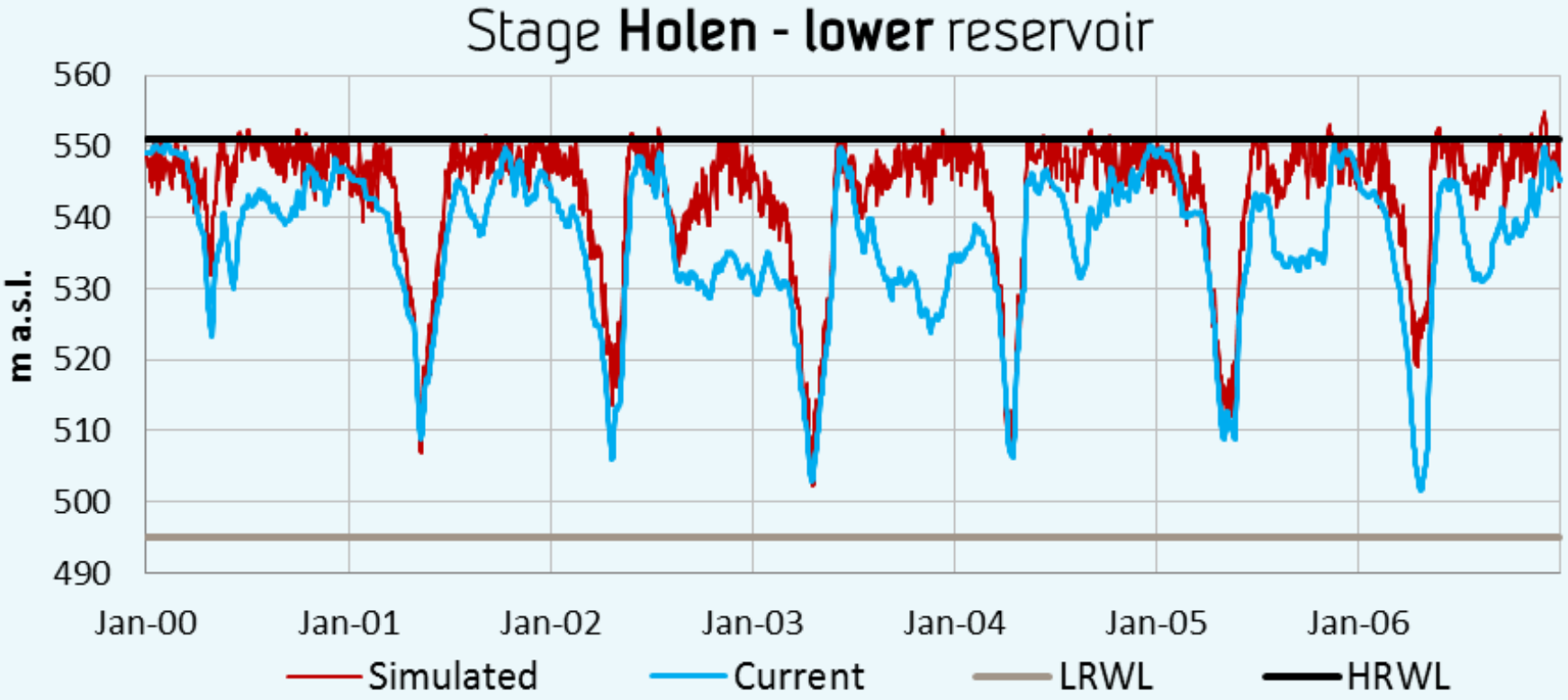


Environmental impacts

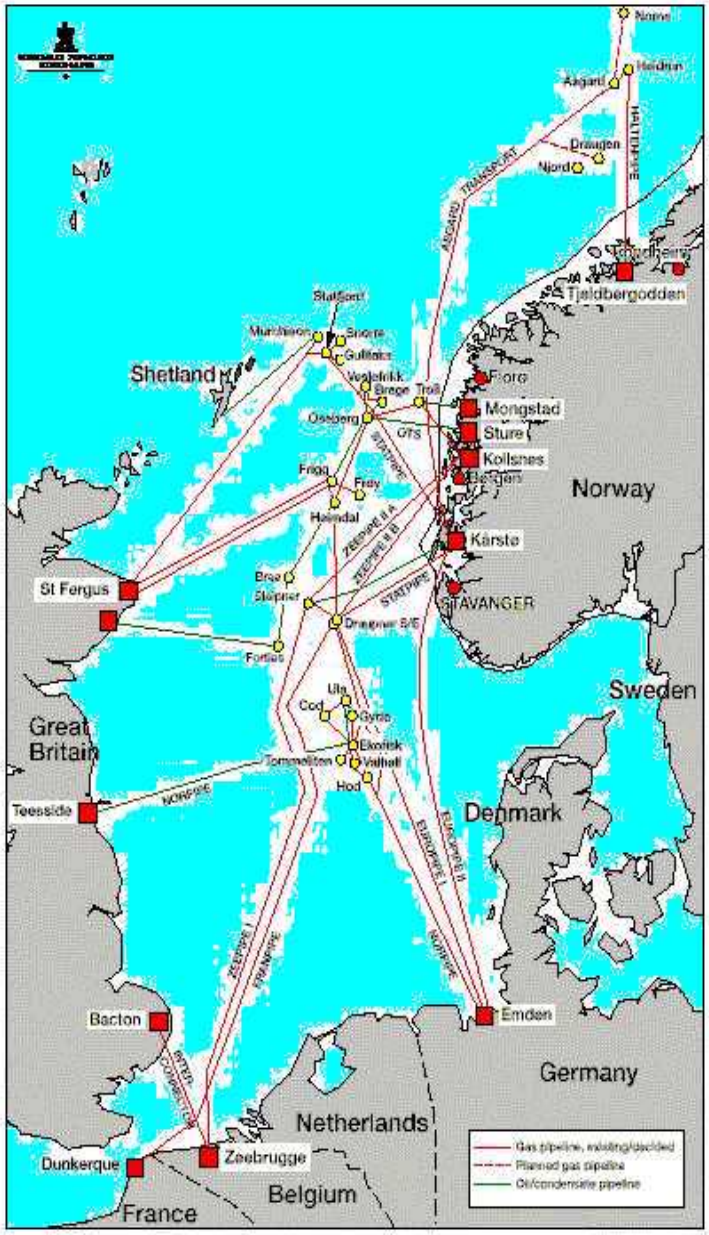
Water level variations



Water level variations

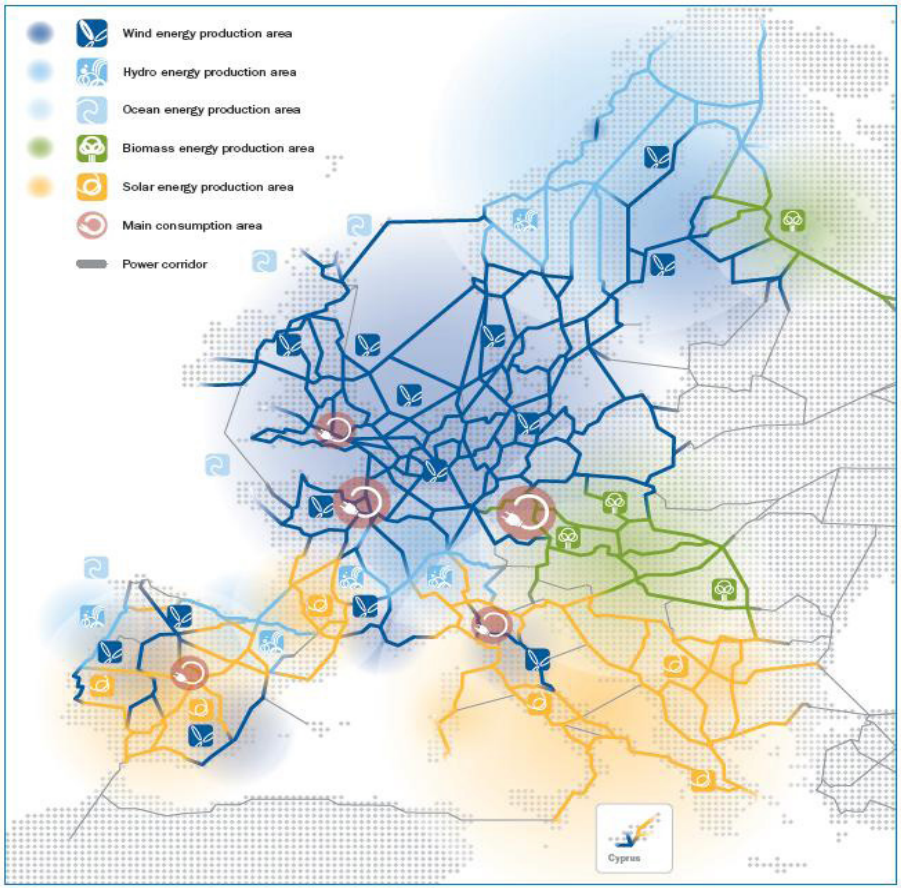


Social acceptance



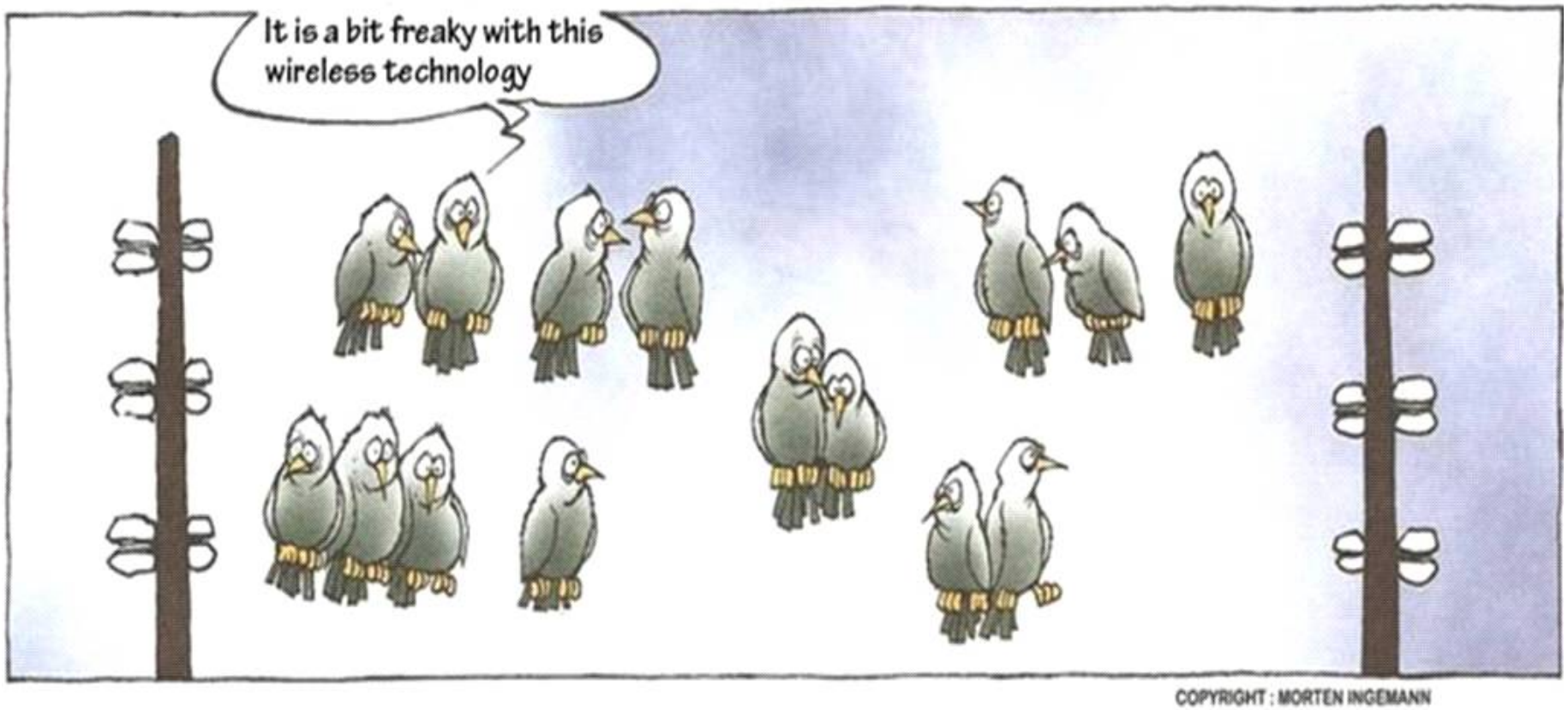
← Natural gas grid today

Can we establish a similar *electricity* grid for exchange?



Hydropower from the north - example

- > 15 000 MW in La Grande system, Canada
- Several reservoirs and power plants built step-by-step
- Provides electricity to Quebec → security of supply
- DC line to Boston, USA → export and peak power



- Uncertain future – many scenarios
- Rapid changes may come (…Fukoshima)
- Hydro reservoirs = always an excellent energy storage
- We probably need governmental agreements and new markets
- Opportunity for Norway to investigate - Europe also to benefit?