



Opportunities and challenges for hydropower development in the high north

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CEDREN

Centre for Environmental Design of Renewable Energy

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Centre for environmental design of renewable energy - CEDREN



Ånund Killingtveit, NTNU, Centre Vice Director





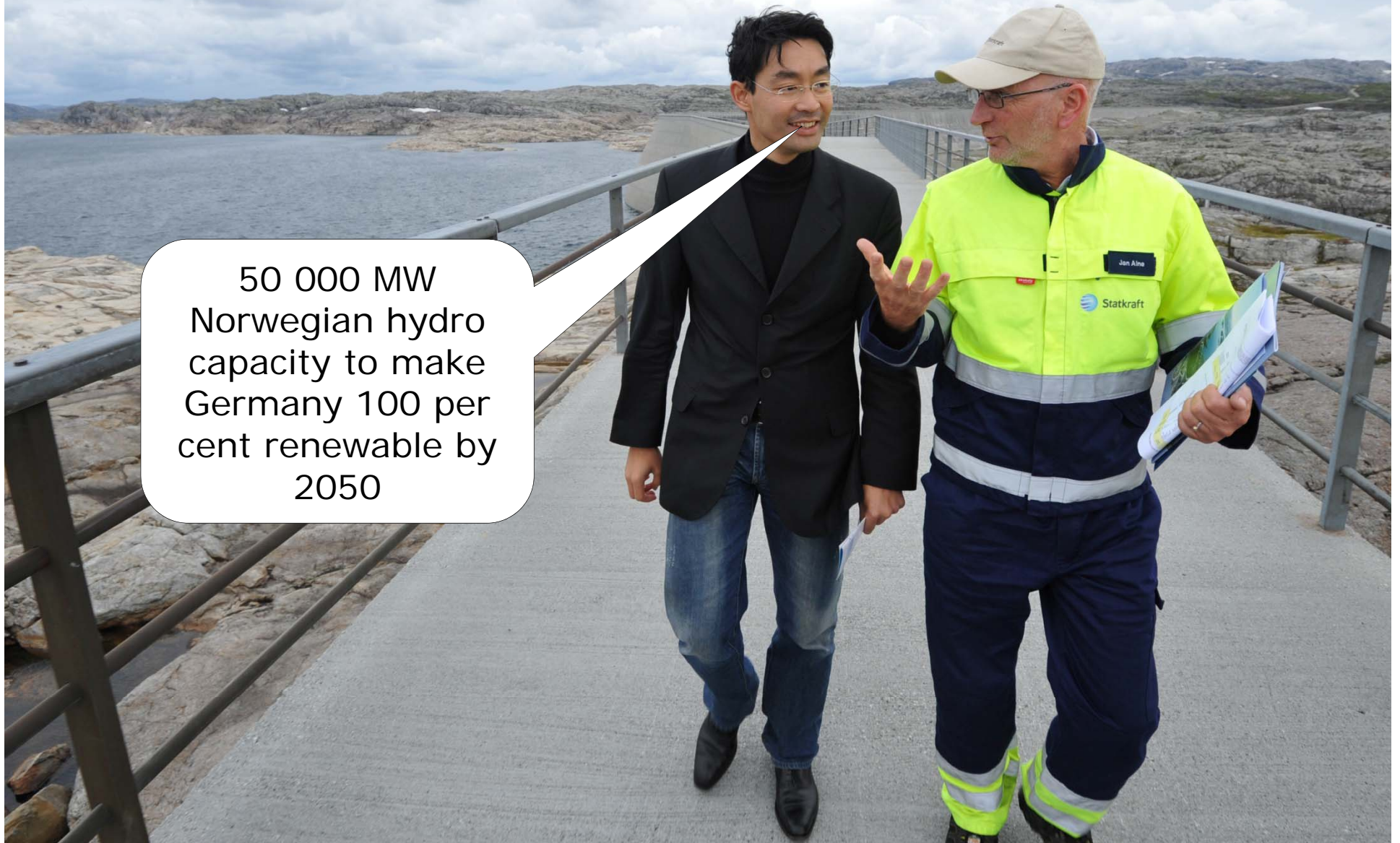
- ▶ 8 large research projects
- ▶ 7 Norwegian research partners
- ▶ 13 Industry partners and 2 management partners
- ▶ Budget: 320 MNOK
- ▶ 16 PhD and 4 Post-doc positions
- ▶ International student and professional collaboration

Renewable energy respecting nature

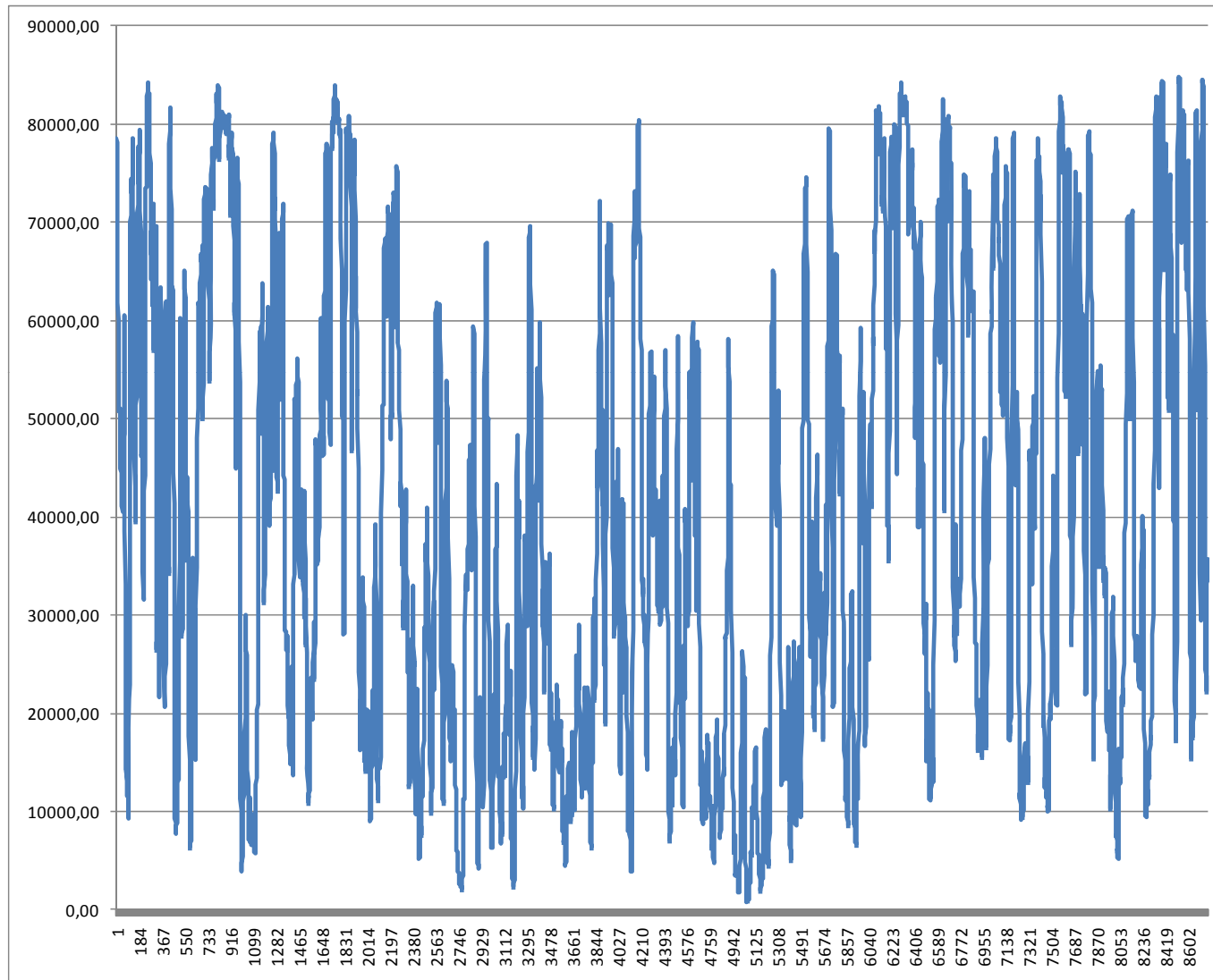


German Minister of Economy, Philipp Roesler, visiting the Blue battery of Norway – guided by Regional Statkraft Director and CEDREN Chairman of the Board, Jan Aine.

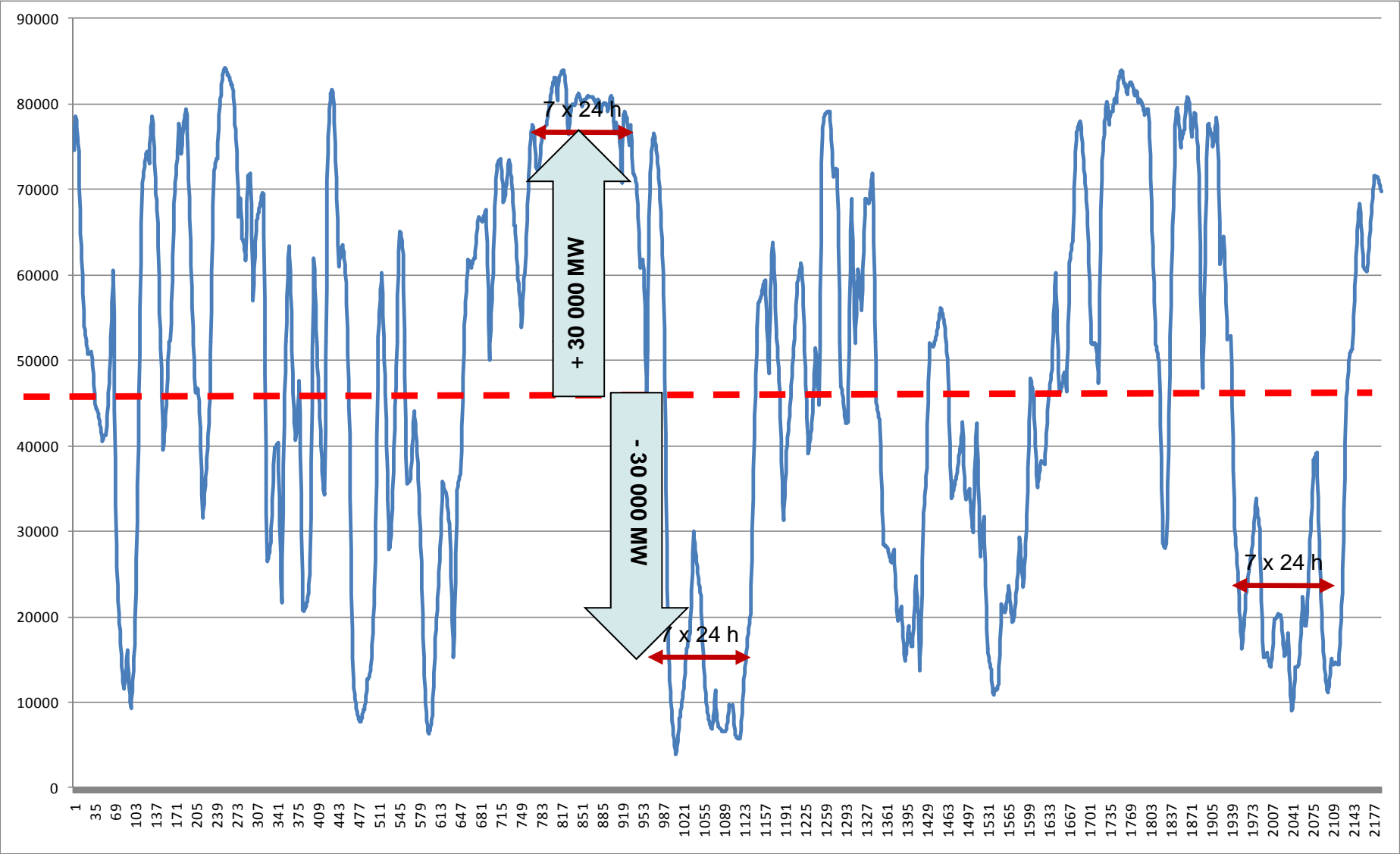
50 000 MW
Norwegian hydro
capacity to make
Germany 100 per
cent renewable by
2050

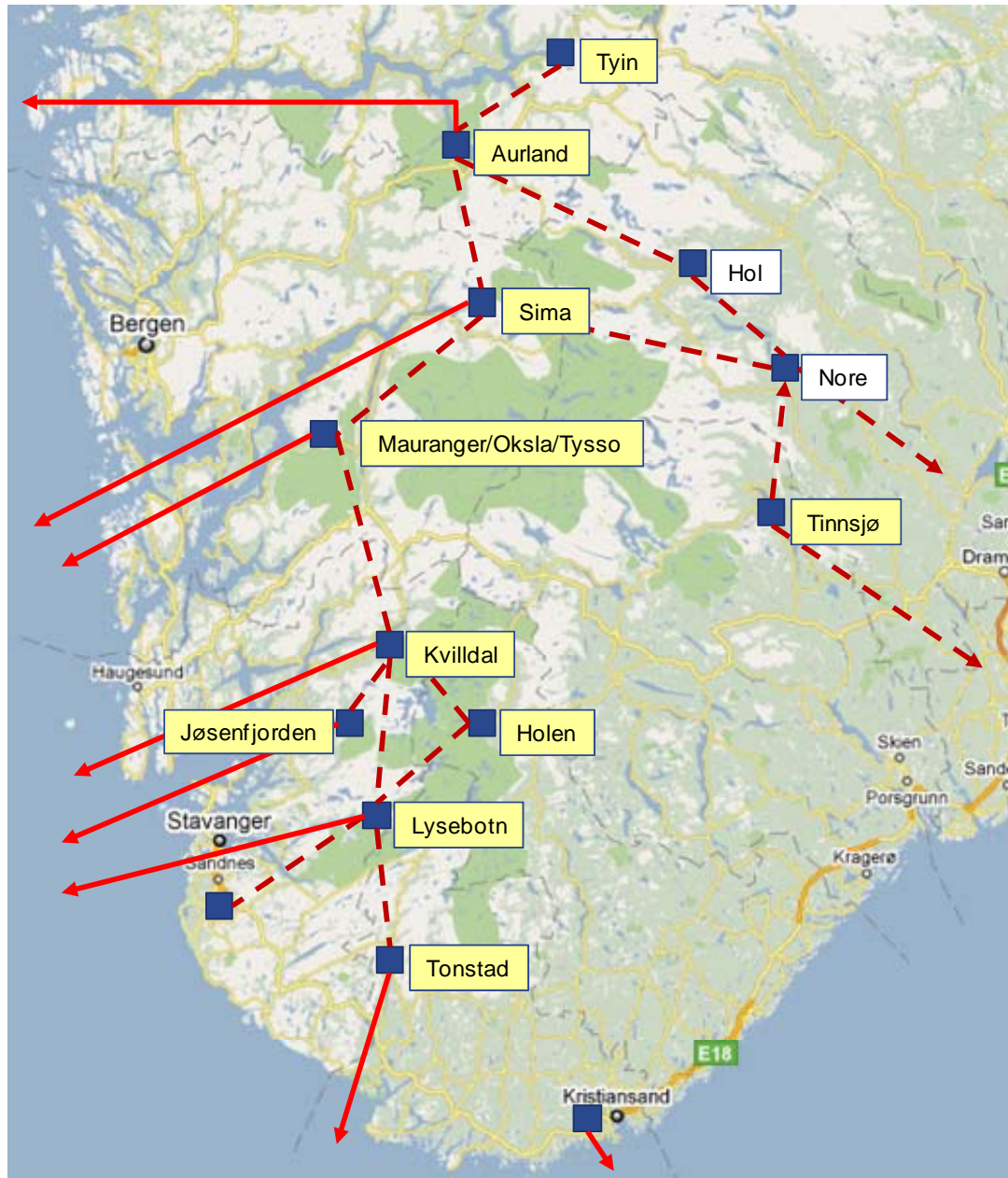


Simulated wind production in the North Sea area in 2030 – 100 000 MW installed capacity

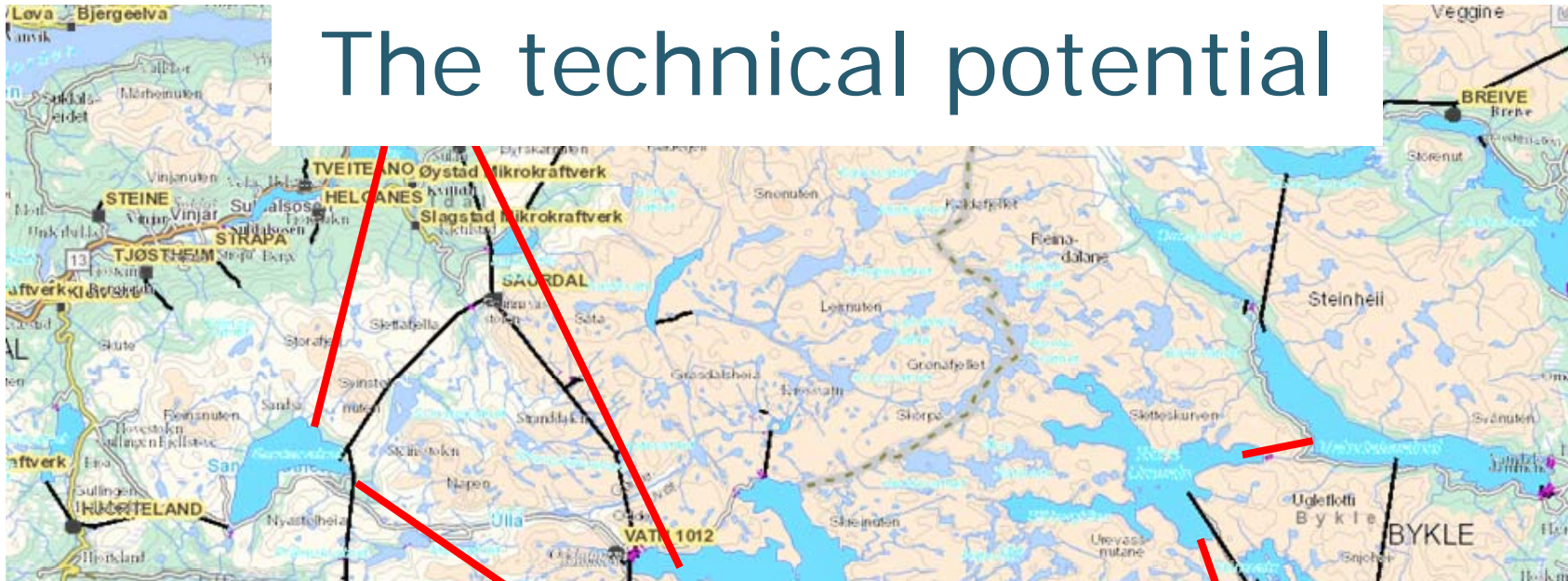


Wind Power North-Sea Region - Jan – March 2001

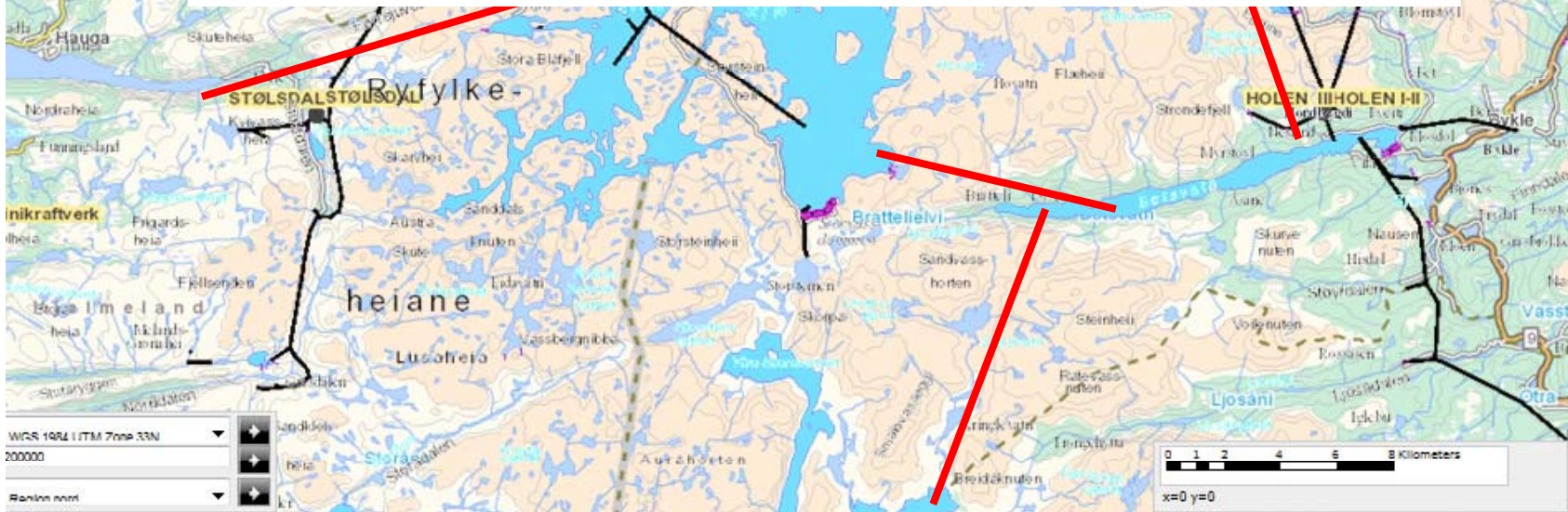




The technical potential



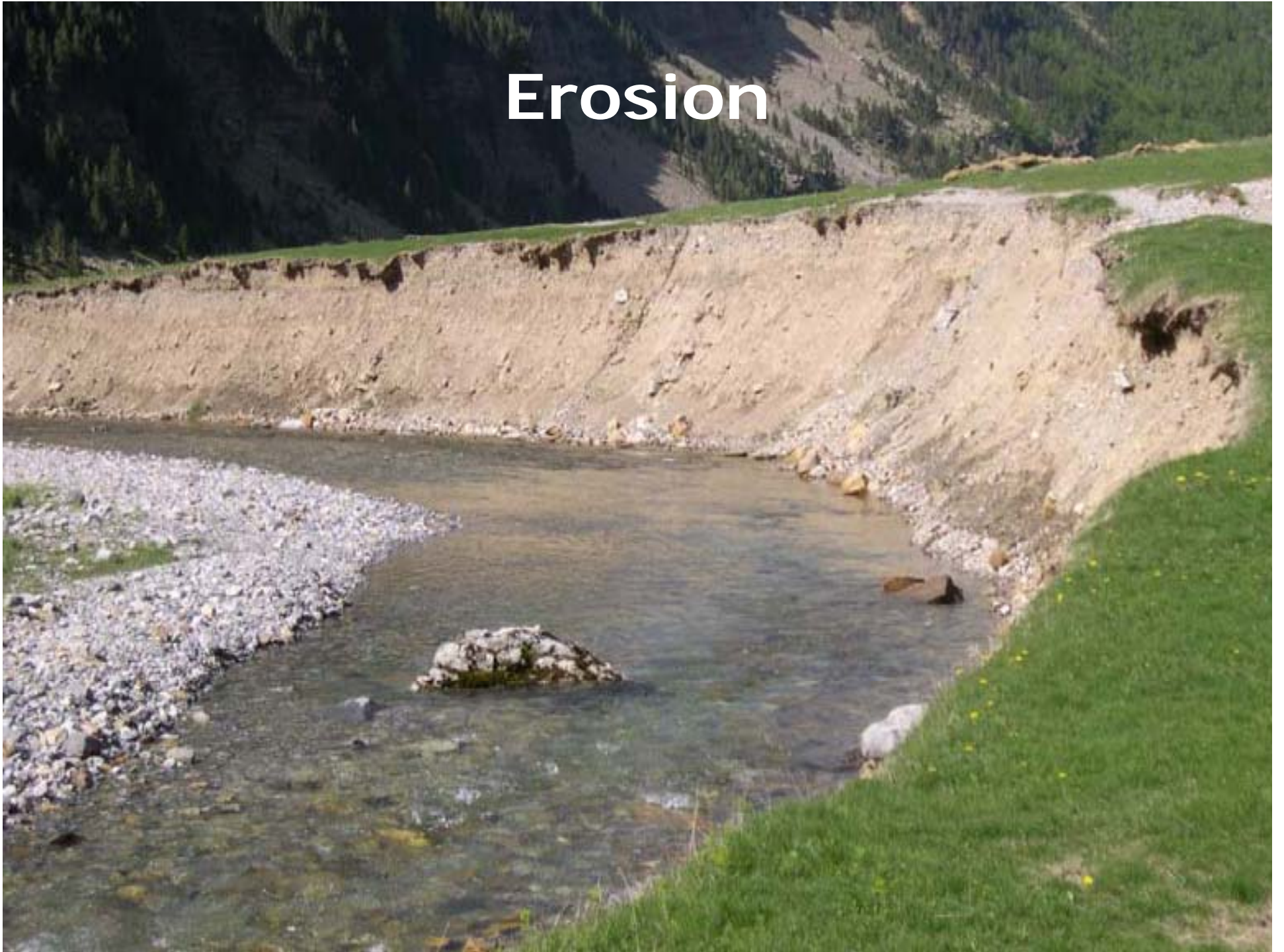
20 000 MW in southern Norway possible



Environmental impacts



Erosion



Landscape effect Impacts on wildlife



Foto: NINA

Impacts on fish ?



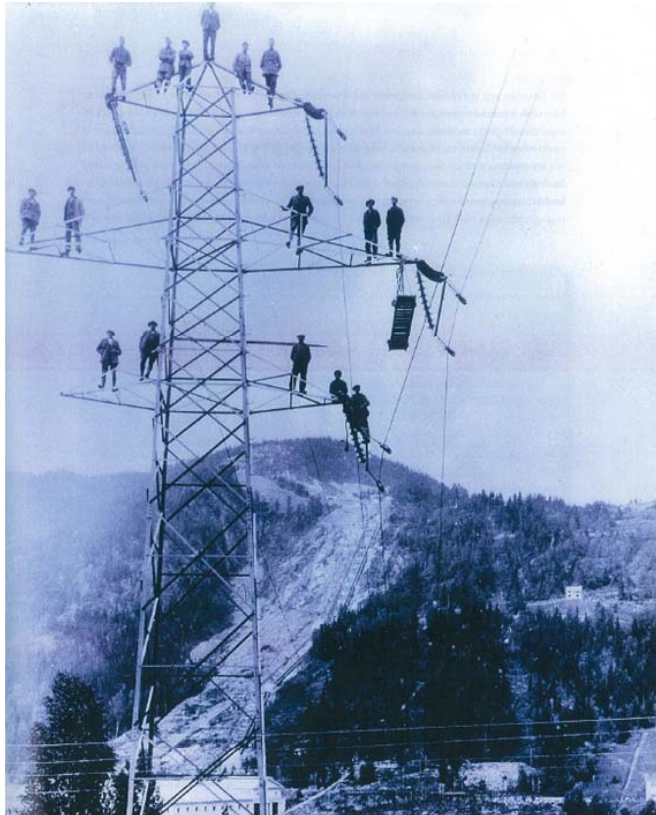
Unsafe ice conditions ?



Threatening biodiversity ?



More overhead power lines



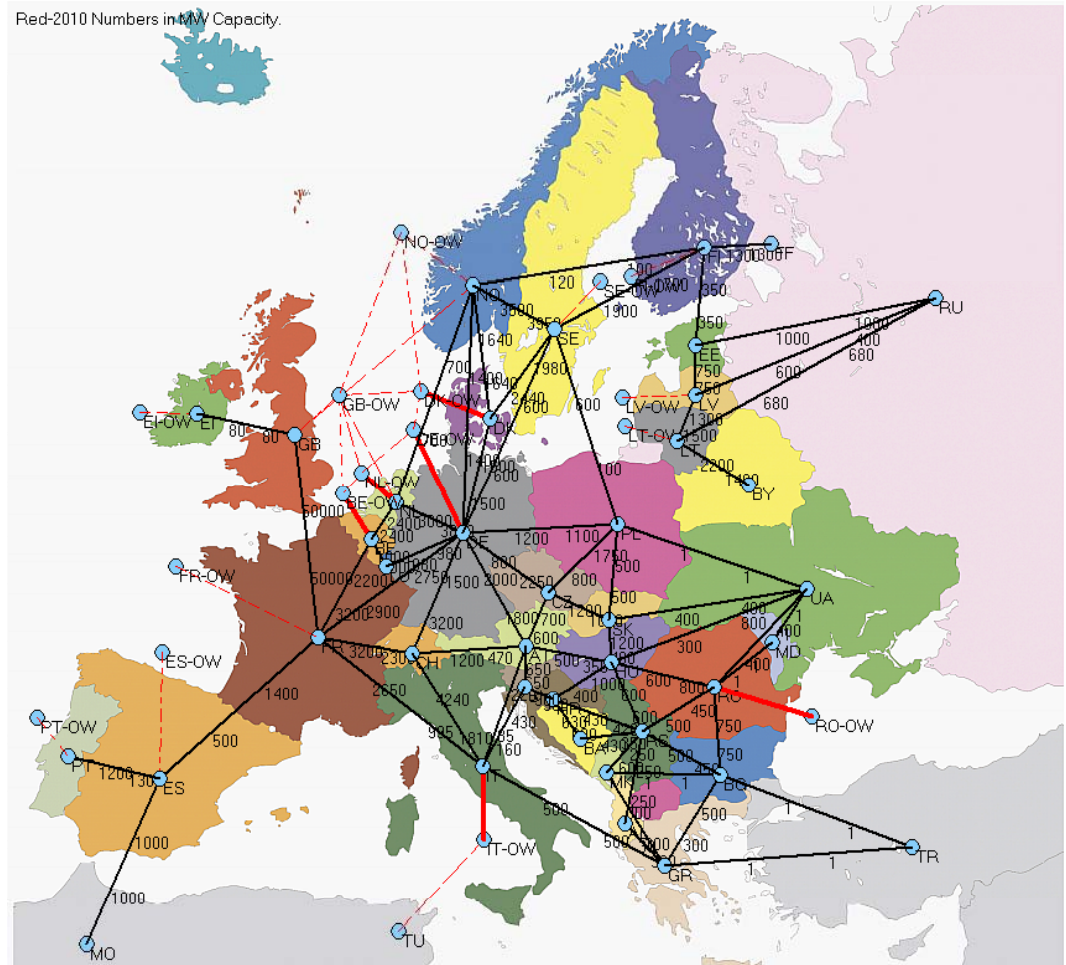
Collision risk for birds and other wildlife impacts

Social acceptance



Market design

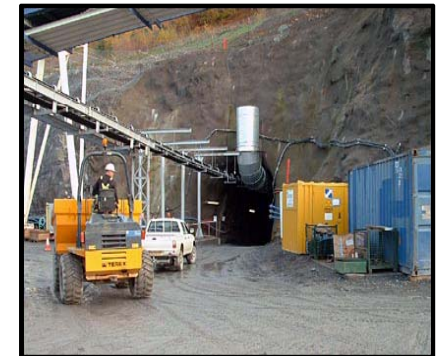
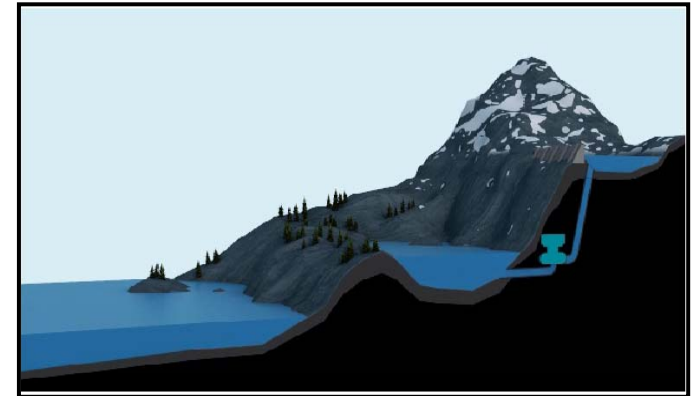
- Inter-governmental agreements
- Benefit for all parties:
 - Reservoir owner
 - Cable connection owner
 - Energy company on the continent
 - Local communities
 -and climate!



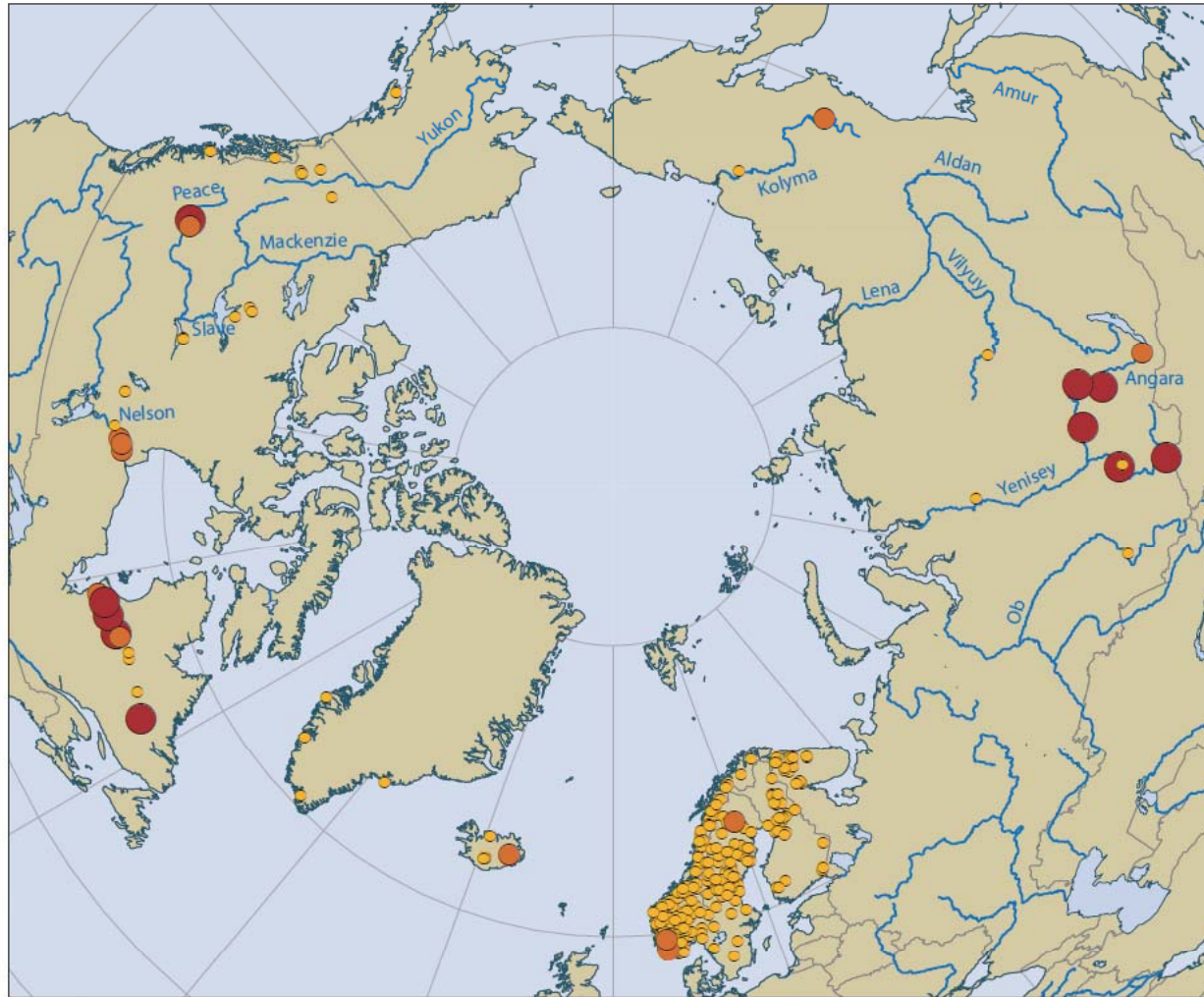


Business development opportunities

- Energy companies
- Constructing industry
- Equipment
- Engineering
- Consultants
- Trade
- Support services



Hydropower in the north



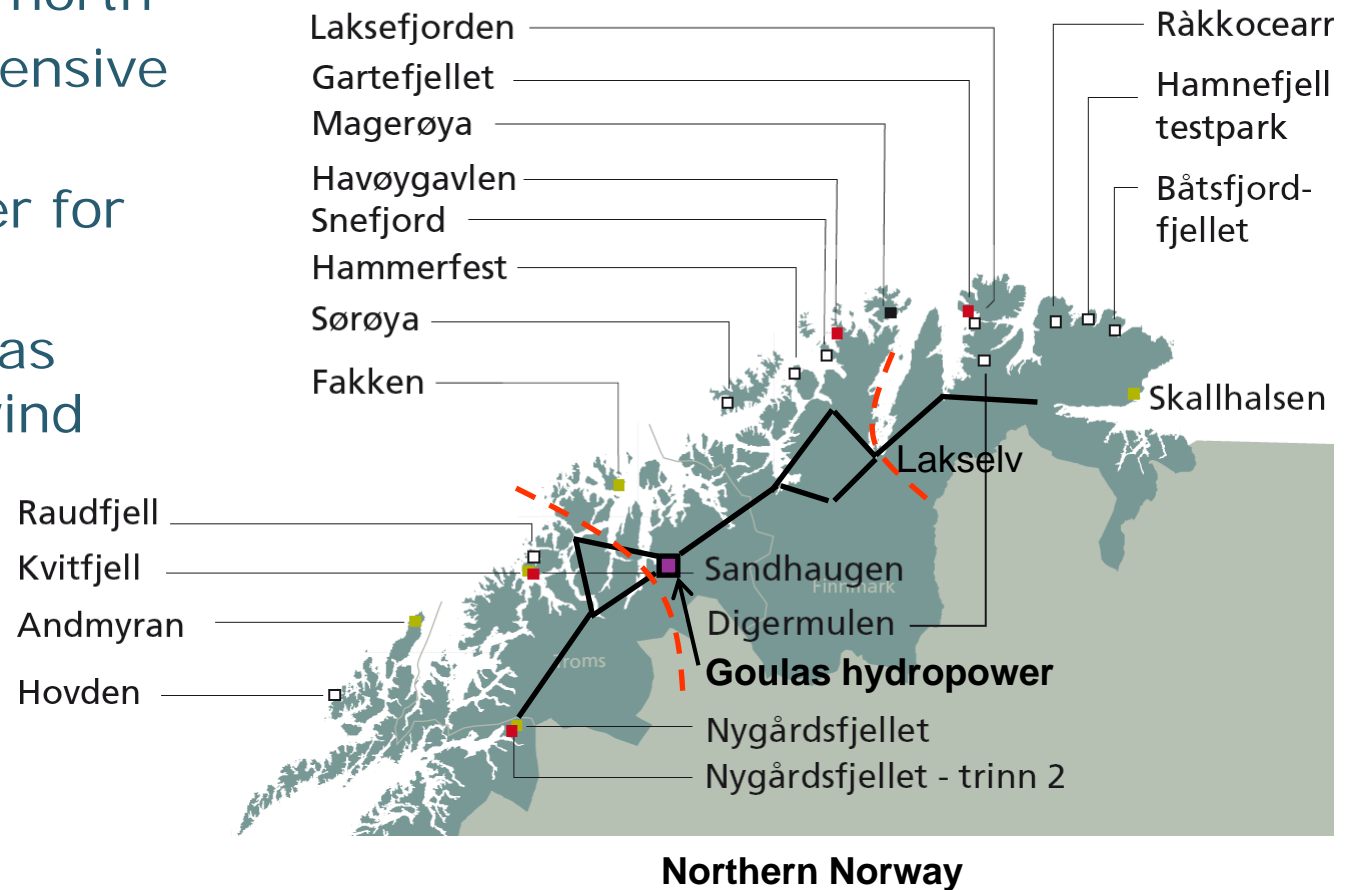
Hydropower from the north - example

- > 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

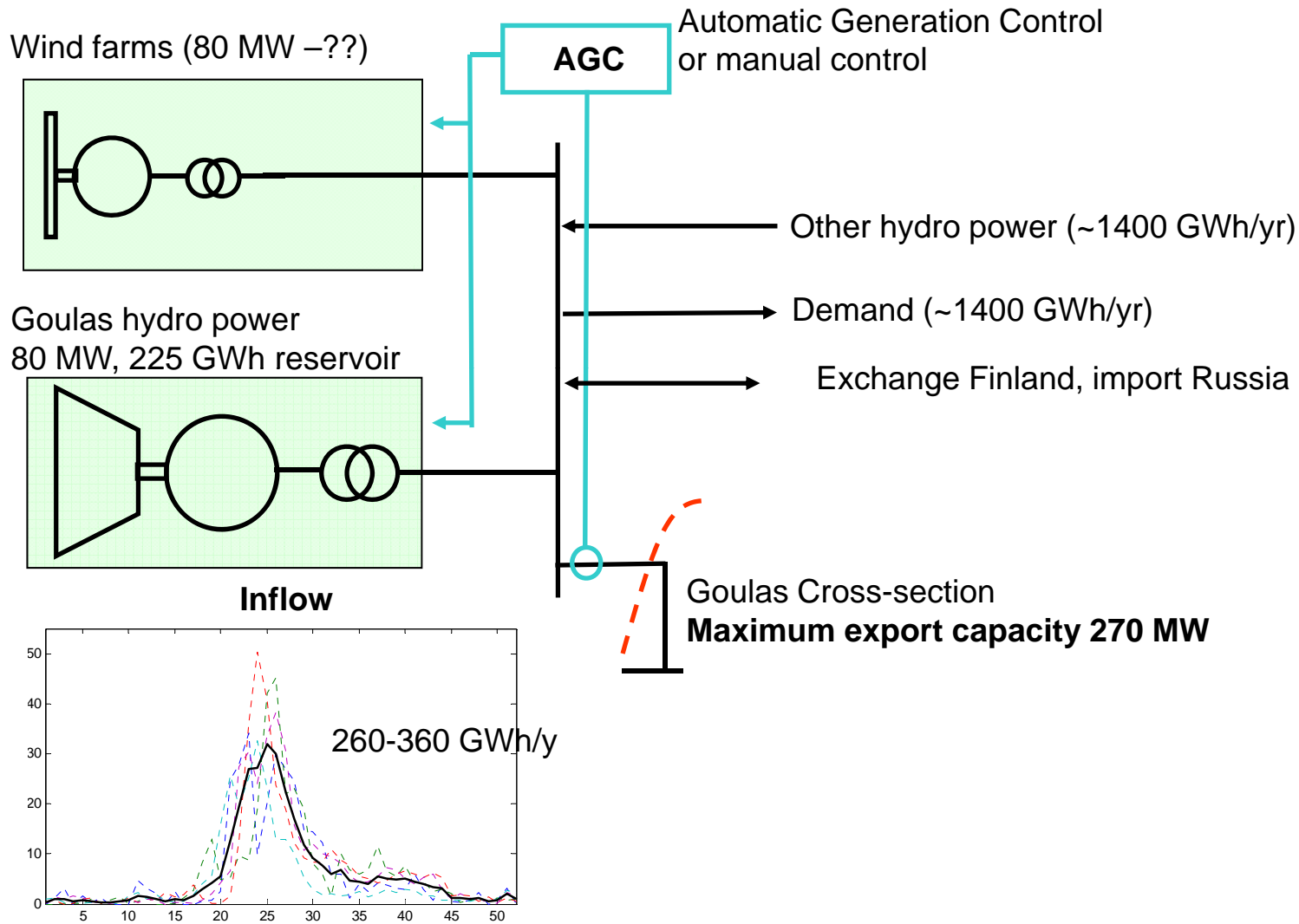


Renewable energy in the high north

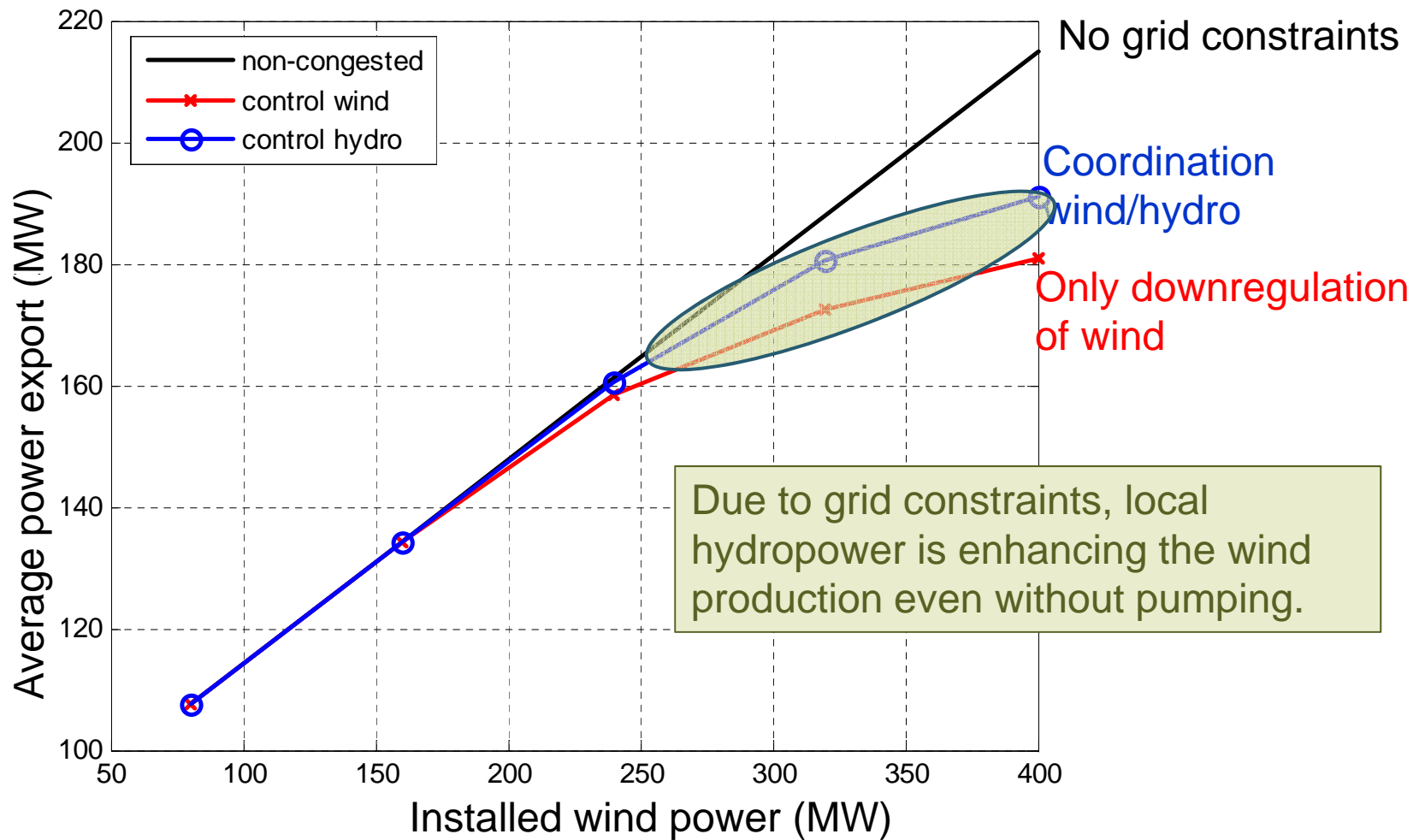
- Abundant wind resources in the north
- Remote and expensive grid connection
- Local hydropower for balancing
- Case study Goulas hydropower + wind



Case study Goulas



Power export can be increased by wind-hydro coordination



Hydropower in the high north

- Large unused potential
- Increased runoff with climate change
- Small scale hydro in remote areas
- Large-scale balancing power for export to the south
- Local scale balancing with other renewables





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