Renewable integration ad energy storage

Some examples

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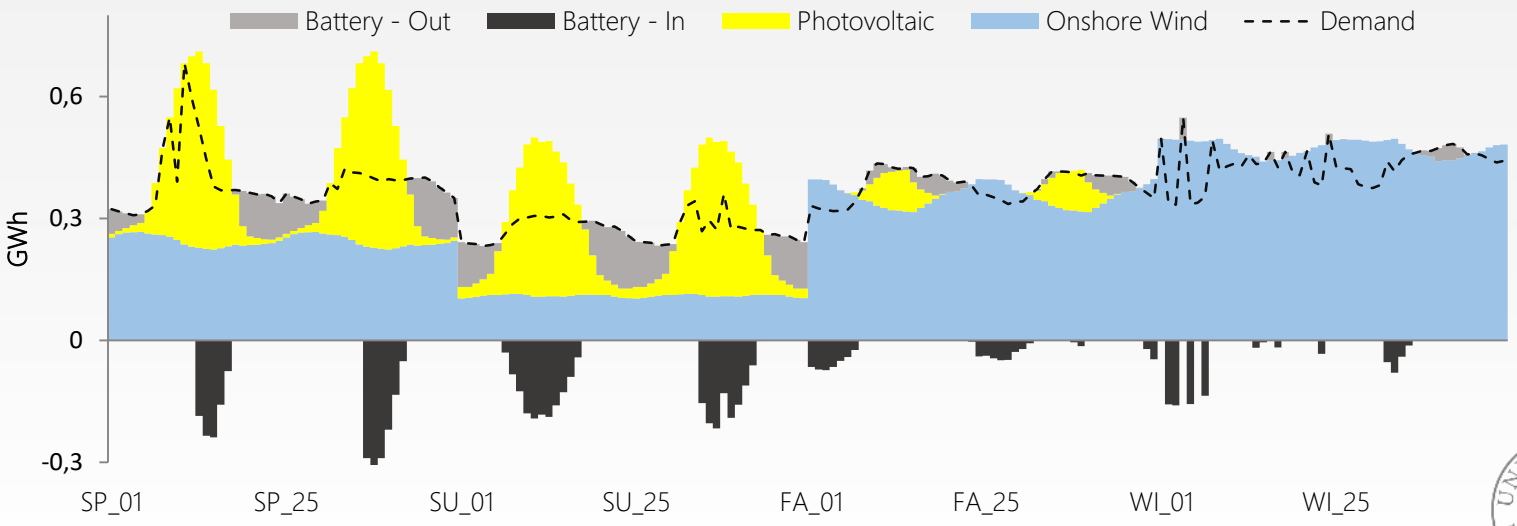
AGF-353 Sustainable Arctic Energy Exploration and Development (5 ECTS) at Unis (Svalbard)

- The course will provide an interdisciplinary survey of tools for assessing the merit, challenges, and risks of different potential renewable energy exploration and development choices in the rapidly changing Arctic.
- Total lecture hours: 30 hours
- Total group exercises and writing sessions: 16 hours
- Excursions and fieldwork: 2 days

Local focus

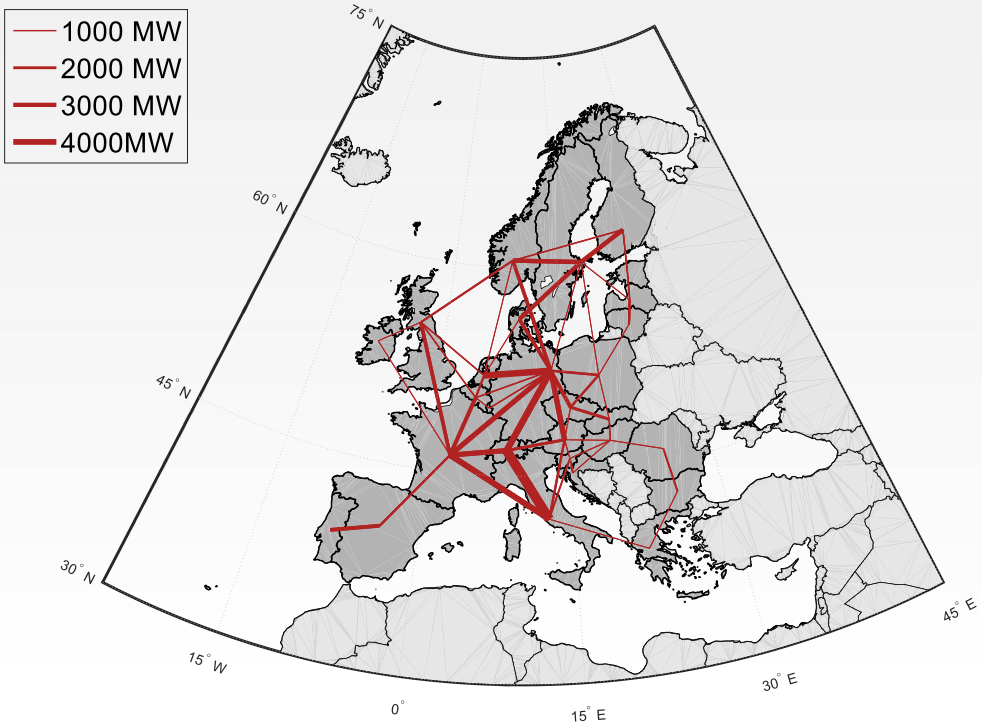
PhD candidate Hans-Kristian Ringkjøb's work

- Longyearbyen (78.2 ° N) has Norway's only coal-fired power plant
- Study investigates pathways to an energy system based on renewable energy sources in 2050 using a long-term energy model (TIMES)
- Applies stochastic modelling for an adequate representation of short-term wind and solar variability
- A combination of solar & wind with energy storage shows promise for the Arctic settlement

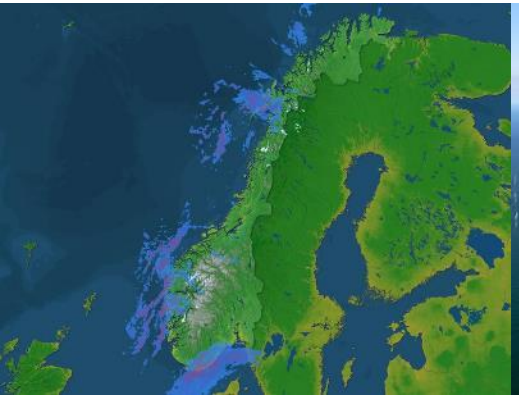


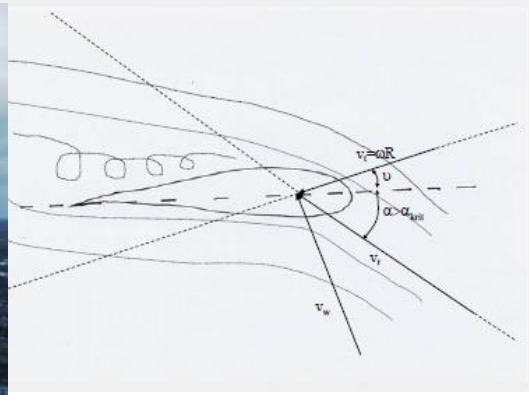
European focus

- Improve the representation of solar and wind variability in long-term energy models (TIMES)
- Increasing temporal resolution vs stochastic modelling
- Value of storage, grid and demand response for integrating variable renewables on a large scale



Improved production from offshore wind
An effort across scales and disciplines





Mesoscale	Park scale	Rotor scale	Blade scale
10000 -10 km Days -Hours	10 -1 km 20 min - 20 sec	200 - 50m 10 – 2 sec	5 - .5m 0.5 – 0.01 sec

Factor O(20*E06) on time and length scale

Courtesy: Finn Gunnar Nielsen

Providing skilled persons from Norcowe

- MSc (40) and PhD candidates (27).

Put the specialist competence into context:

- Summer schools for PhD students, 2010 -2015
- From special topics (LES, 2010) to a cross-disciplinary approach
  - *«Wind power engineering», «Offshore challenges», «Innovative methods and concepts», «Harvesting wind energy in a harsh environment»…*
- Creating a professional network
- Approx. 100 participants

Courtesy: Finn Gunnar Nielsen

Example: Hardingasete 2015

Topics:

- **Early Phase Development of a wind farm**, Kari Lurås, Statoil
- **Environmental data for planning & design,** Birgitte Furevik, Met
- **Harvesting the wind energy,** Trond Kvamsdal, NTNU
- **The design challenges,** Jørgen Krokstad, Statkraft
- **Control of wind turbines & wind farms,** Torben Knudsen, Aalborg University
- **Execution of a wind farm project,** Jan-Fredrik Stadaas, Statoil
- **The economics of wind power**, Jørgen Krokstad, Statkraft

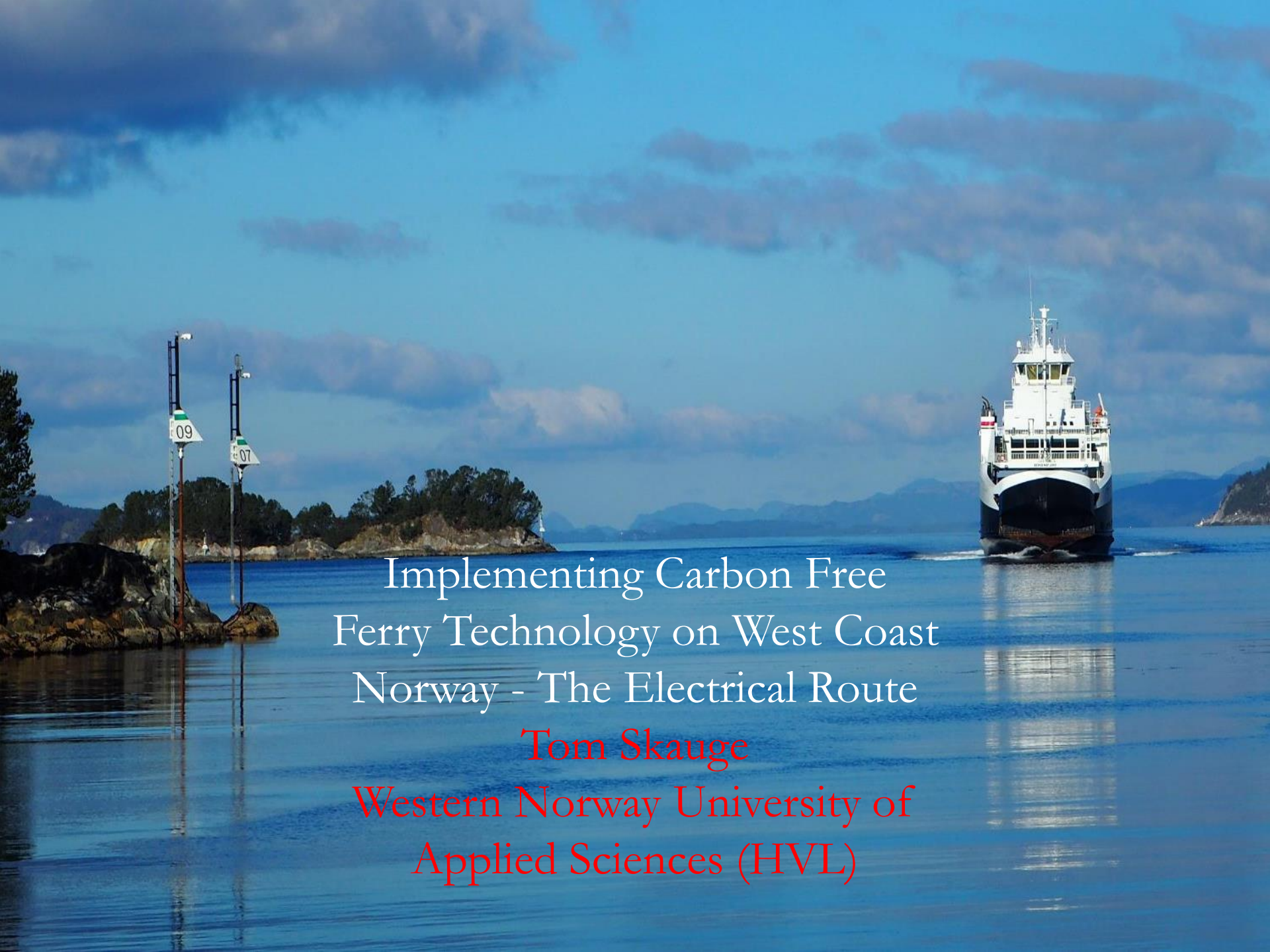
Hardingasete 2015

Courtesy: Finn Gunnar Nielsen

A student's reflection

- *"Talking with the teachers from the industry gives a perspective we do not experience very often in academia. In addition, it is valuable to get acquainted with scientists working with other topics than yourself".*

Courtesy:
Finn Gunnar Nielsen



Implementing Carbon Free Ferry Technology on West Coast Norway - The Electrical Route

Tom Skauge
Western Norway University of Applied Sciences (HVL)

Ferry Connections Hordaland West Coast

"Rutepakke" Packages for tender	Current / former technology	New technology	Expected CO_2 reduction	Expected energy reduction	In traffic from
Package 1: • Krokeide - Hufthamar • Krokeide - Hufthamar • Husavik - Sandvikvåg • Halhjem - Våge • Sløvåg - Leirvåg • Fedje - Sævrøy • Hatvik - Venjaneset • Langevåg - Buavåg	7 diesel ferries, 1 LNG ferry refitted with plug-in hybrid propulsion	8 ferries where an electrical battery is the main energy source, with a biodiesel-generator as back-up for electrical propulsion	87 %	60 %	3 ferries from 01.01.2018, the rest from 01.01.2020
Package 2: • Skjersholmane - Ranavik • Skjersholmane - Ranavik • Jektevik – Nordhuglo -Hodnanes • Gjermundshamn - Varaldsøy - Årsnes • Jondal - Tørvikbygd	4 diesel ferries, 1 rebuilt diesel-electric hybrid	4 ferries where an electrical battery is the main energy source, with a biodiesel-generator as back up for electrical propulsion, will be built. 1 ferry has been rebuilt for induction charging	90 %	65 %	01.01.2020
Package 3: • Klokkarvik - Lerøy - Bjelkarøy - Hjellestad • «Fjellbergsambandet»	2 diesel ferries	High degree for electrification	86 %	58 %	01.01.2020
Package 4: • Masfjordnes - Duesund	Cable ferry with diesel generator	Fully-electrical ferry	88 %	65 %	01.01.2020
Package 5: • Kvanndal - Utne • Kinsarvik - Utne • Skånevik - Matre – Utåker	3 diesel ferries	High degree for electrification	92 %	74 %	01.01.2020

What factors can explain?

How niche electrical technology have been standardized to a new hegemonic sociotechnical regime?


Political
Pull


Community
acceptance


Technologically
developed,
Industrial
clusters

Clean Maritime Transport

- Combining technical, political, social, economic and legal aspects
- Multi-disiplinary approach
- Tripple helix approach
- Summer school
- Internships