ÆRØ
The RESponsible Energy Island

Halfdan Abrahamsen

Project Manager, Ærø EnergyLab (Municipality of Ærø)

Contact: hab@aeroekommune.dk

Where is Ærø?

Locally owned renewable energy district heating

- Ærø's district heating plants are based on solar energy and biomass
- Marstal District Heating had the world's largest solar array in 1990s
- Cooperative ownership ensures high degree of acceptance of solar array
- Direct storage in water
- Storage in other forms of energy is inefficient (Power-to-X)

Locally owned wind turbines produce surplus electricity

6 x 2 MW turbines
125-40 % of the island's electricity use pr. year

640 fixed price shares owned by locals
Wind turbines: not too pretty, but quite beautiful when you own them yourself

Ærø has won numerous awards for it's pioneering work. First movers get the honors - and often the funding, too..

In 2021, the EU Commission awarded Ærø with the RESponsible Island Prize. The basis for this was Ærø's combination of grassroots and public work.

CONNECTING BLUE AND GREEN

E-ferry Ellen: Solving island emissions and transportation needs economically

Halfdan Abrahamsen
Project Manager,
Ærø EnergyLab (Municipality of Ærø)
Email: hab@aeroekommune.dk

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ÆRØFÆRGERNE

The E-ferry Ellen:

- Passengers: 147/196
- Vehicles: 31 cars
- Crew: 3/4 (no engineer)
- Cruise speed: 12,6 knots
- Up to 7 x 22nm per day
- Energy efficiency: 85 %
- No fossil fuel onboard

The Steamship Authority
Serving the Islands and You.

E-ferry is comparable to:
The M/V Katama
The M/V Gay Head

Eferry
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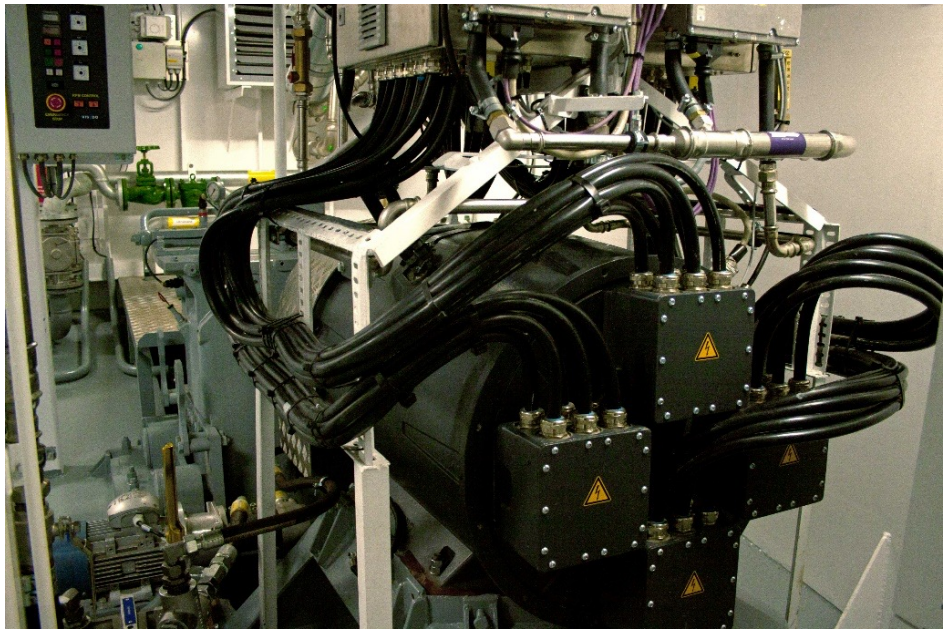
The fully electric E-ferry 'Ellen'



Built for low energy consumption: Long, slender, light

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NECTOR


Hertz

Why and how did we build the E-ferry?

Problem

- The transport sector needs innovative solutions to carry out the transition away from fossil fuels.
- The main hurdle for Ærø, and other islands, is the ferry operations.

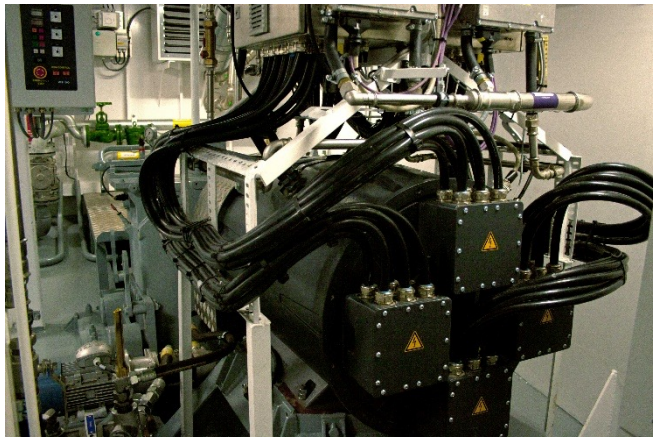
Idea

- Ship architects and e-enthusiasts on Ærø sketched out an idea for a fully electric ferry.
- It would need to break the distance world record x7 to replace an Ærø ferry.

Solution

- Ærø Municipality identified partners who could deliver needed innovation and tech, and applied EU H2020 for support.
- H2020 agreed to the project and set goals for the project.

Batteries and engines: Dual systems give redundancy



Batteries:
2 x 420 Lithium Graphite/NMC
2 x 10 seperate strings
Total capacity: 4.3 MWh

Engines:
Main engines: 2 x 750 kW (1000 HP)
Bow thrusters: 2 x 250 kW

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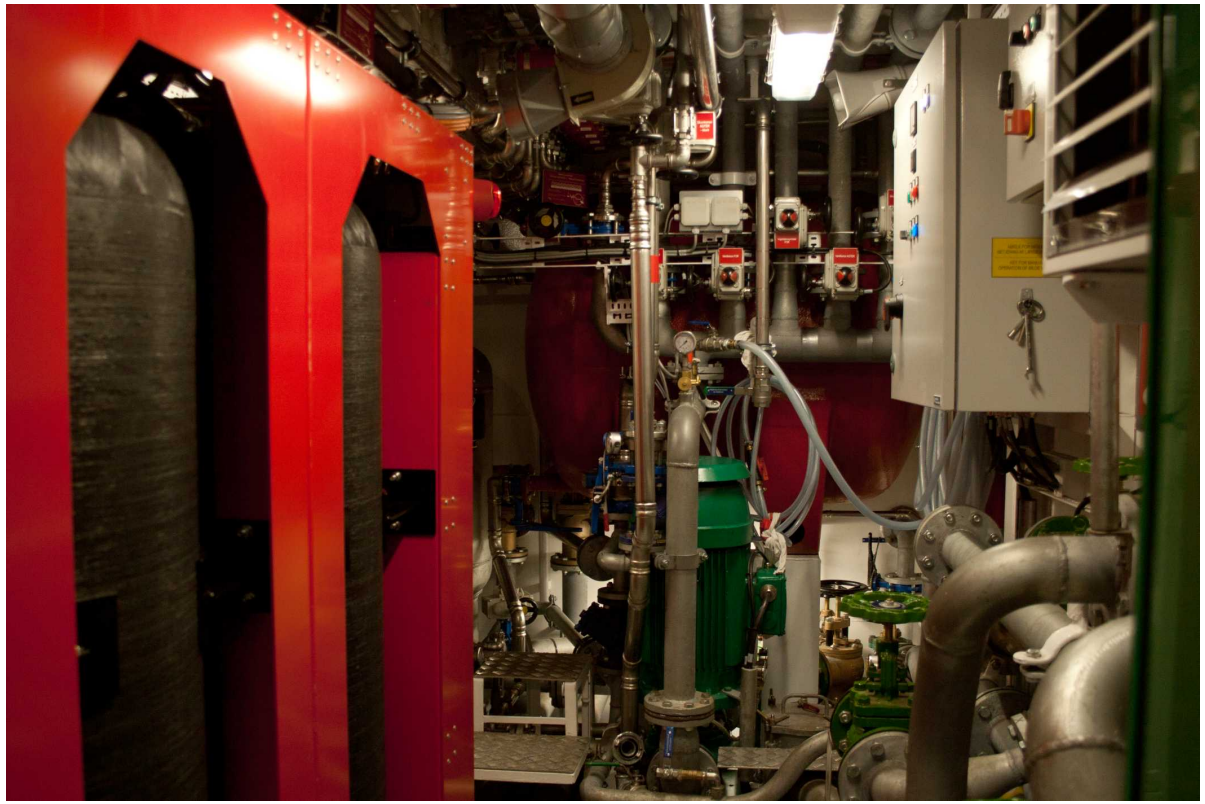
Safety: Water cooling and non-toxic foam



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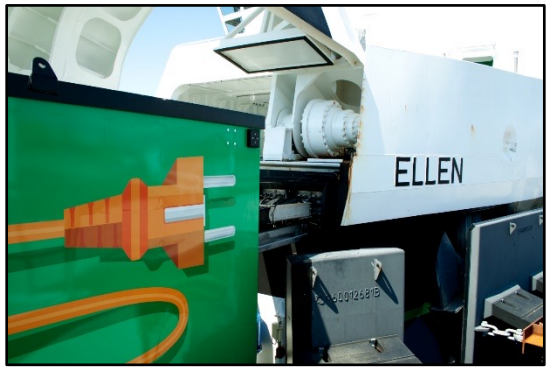
The charger and how to achieve high frequency service

- Ramp-based DC charger
- 4 MW peak charge (1C)



Possible buffer for grid:

State-of-charge during the day:

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The 4 charging lines are fed by 4 large transformers

- 4 x 1.1MW transformers feed 4 charging lines
- Very expensive connection fee (approx. 1 mill. $)

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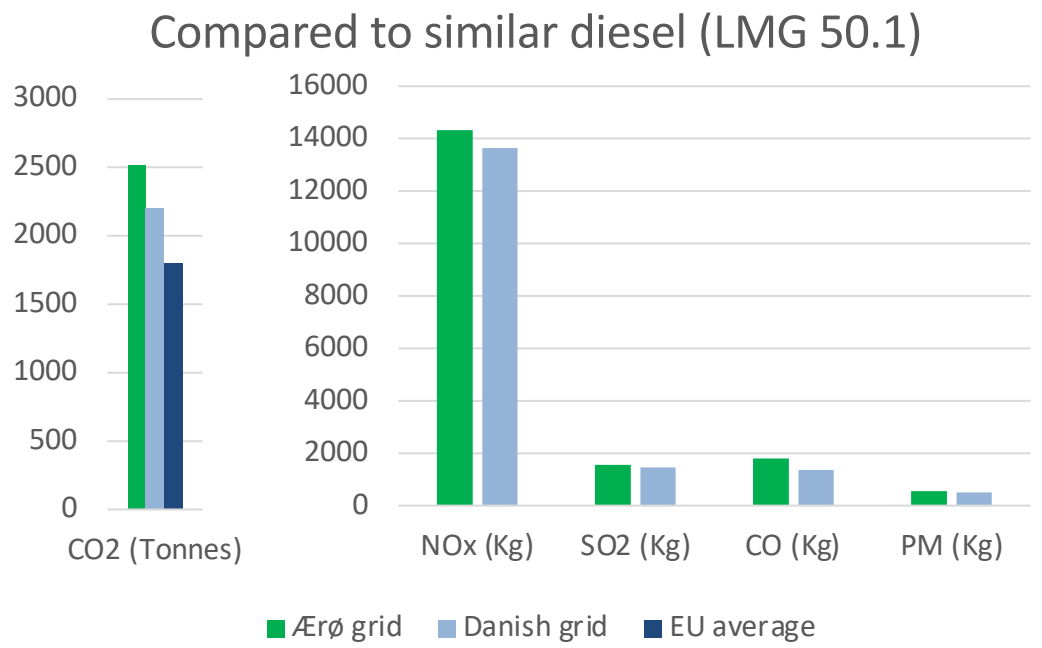
Emissions reductions as a function of going electric

- E-ferry vs. modern diesel



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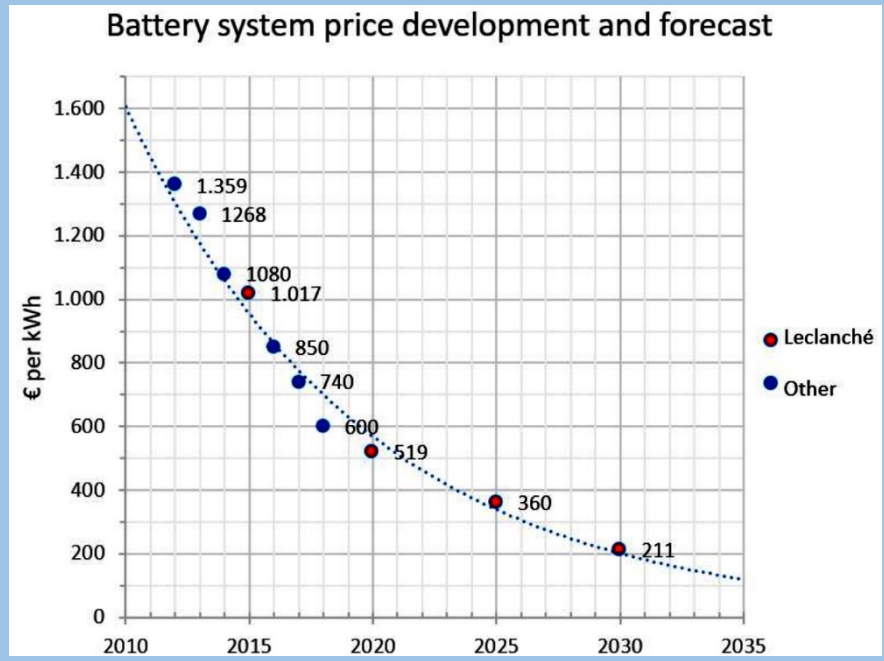
Economomy: E-ferry versus a diesel ferry

New Ellen II: About 14 mill dollars or about 15 % more than a comparable diesel

The business case shows that sailing electric is the cheapest solution, in comparison to a similar diesel ferries:

Battery system prices falling



The E-ferry after 3 years in operation

Passenger and crew satisfaction:
- The crew is still fond of the electric ferry, it reacts quickly.
- Passenger satisfaction is very high: ferry is smooth, quiet, and smog-free. Feels good sailing emissions-free.

Systems:
- The system has continued to operate reliably, batteries appear to wear predictably for a 10 year life-span.
- String isolation is excellent.
- Software has been refined, in relation to crew feedback and in relation to keeping batteries jogged equally.
- Problems with blown components in the charging house because of stray currents. Solved by going more old-school.

Energy consumption remains on target:
- 1600 kWh for a round trip
- One 22nm round trip costs 150 USD in electricity

Barriers for the transition to electric

- Land systems and chargers are very expensive and the technology is immature
- Higher upfront price
- Taxes and fees: High connection fees and old regulations
- Lack of experience, lack of knowledge

Benefits of going electric

- Lower fuel prices
- Lower maintenance costs
- Smaller crew
- Life-cycle economy is better
- CO2 emissions related to battery production is quickly 'paid' back
- Reduced noise, vibrations and pollution
- Higher passenger satisfaction: 86 % either *very* or *extremely* satisfied

Contact information and references

Halfdan Abrahamsen

Ærø EnergyLab (Municipality of Ærø)

Ellenet 10, DK-5960 Marstal, Ærø, Denmark

Tel. +45 63 52 50 64

E-mail: hab@aeroekommune.dk

Youtube-kanal, Ærø EnergyLab
https://bit.ly/3kNwHBc

LinkedIn, Ærø EnergyLab
https://bit.ly/3DviMqG

E-ferry homepage:
www.aeroeenergylab.dk

E-ferry evaluation report:
E-ferry homepage