RV Aranda and new technologies; Fuel Cells and Hybrid System

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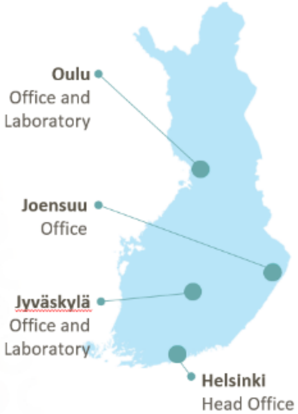
SYKE – Finnish Environment Institute

About SYKE



- Nature
- Water
- Consumption and Production
- Climate Change
- Sea
- Environmental Information
- Built Environment
- Urbanisation
- Circular Economy

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Our Networks

Politicians	Media
Ministries	Citizens and NGO's
Cities and Local Authorities	Research Partners
Business	International and EU Networks

Personnel and Funding 2021

689 Personnel	63,8 M€ Total Funding
27,5 M€ Direct Budgetary Funding	36,3 M€ External Funding (56%)

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Aranda – Ocean Class Research Vessel

Class Notation (DNV): 1A, Battery(Power), E0, Ice(1A), Research Ship

- NB Year 1989
- Modernization 2017-2018
- Length 66,3m
- Beam 13,8m
- Draft 5,0m
- Cruising speed 10-12kn
- Crew 5-13
- Scientists 27
- Laboratory spaces 260m2

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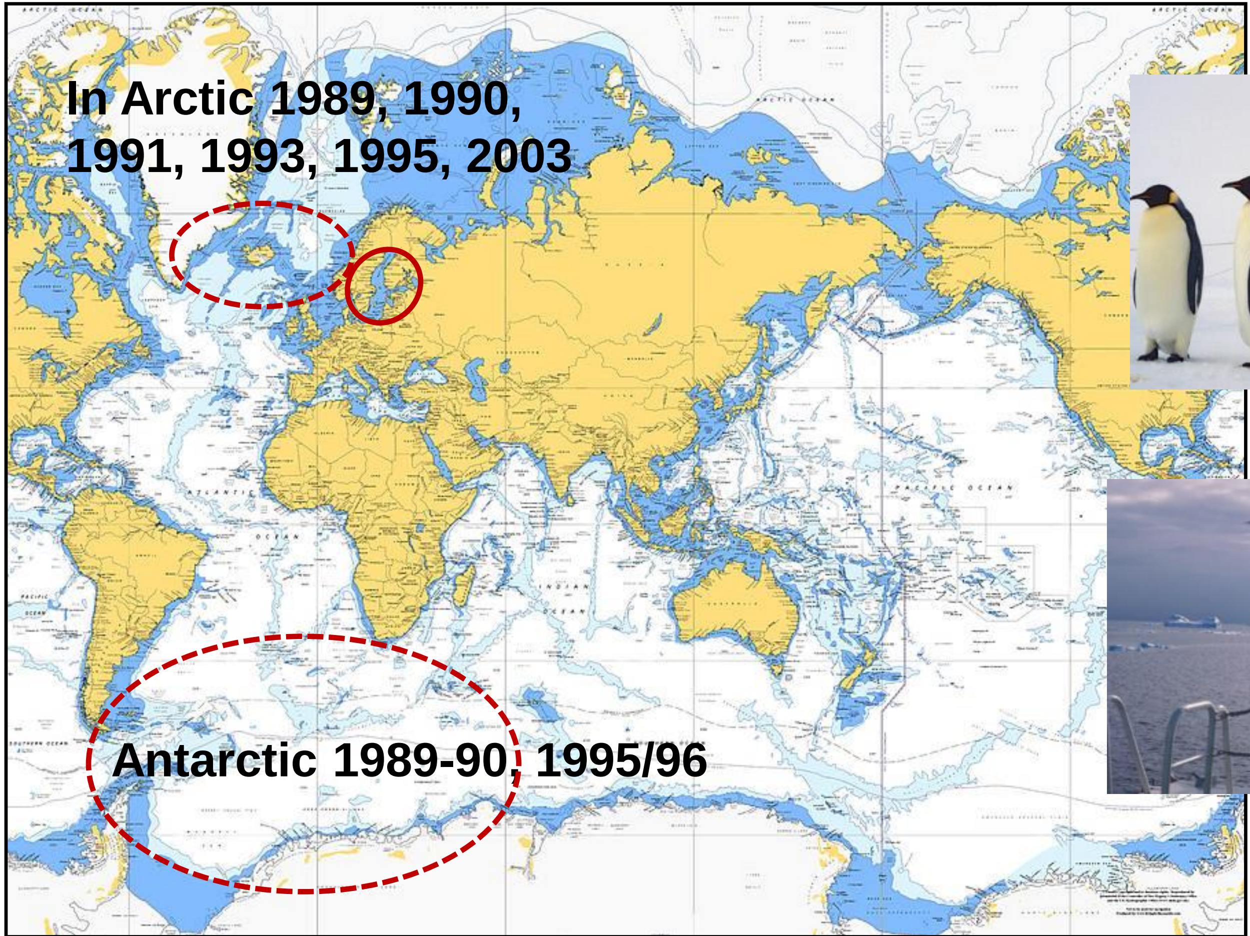
RV Aranda – Background and History



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Modernization / Refurbishment 2017-2018

Modernization focus on:

- <u>Extend the lifetime</u> of the vessel to 2030's
- <u>Reduction of UW noise</u> through more silent propeller blades and new bow thruster.
- <u>Decreasing emissions</u> through reshaped (aft) hull and diesel-electric machinery.
- <u>Increasing laboratory space</u> by lengthening the vessel and installing drop keel.

Aranda – Hybrid and Fuel Cell system projects

Prototype EU funded FC project;

- Two fuel cell modules a' 85kW
- 60kg CH2 storage @ 200bar
- Full power operation 5-6h
- Electrical efficiency ~45-50%
- Waste heat utilized in ship's heating system

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- Ice-boosting / Peak-shaving
- Emission-free arrivals with expanded battery pack.

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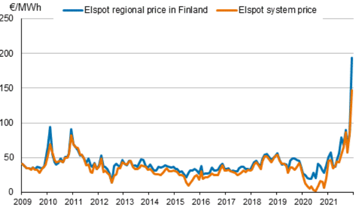
Hybrid and Fuel Cell systems – our view

Batteries & Hybrid Systems

- ”Business as usual” for small, all electric installations.
- Rules and regulations in place.
- Hybrid systems are technically difficult (integration) and the possible benefits depend heavily on use-case.
    - ”5% fuel saving by peak shaving”
- For larger installations CAPEX and space / weight requirements are obstacles
    - Example calculation for RV Aranda;
        - 7 days operation, 300kW average load
        - 7d x 24h x 300kW = 50 400kWh = 50MWh
        - Total investment magnitude for ESS 50 MUSD (1 MUSD / MWh)
    - In comparison; 3MW DG CAPEX 1-2 MUSD

3 Class notation Battery(Power)

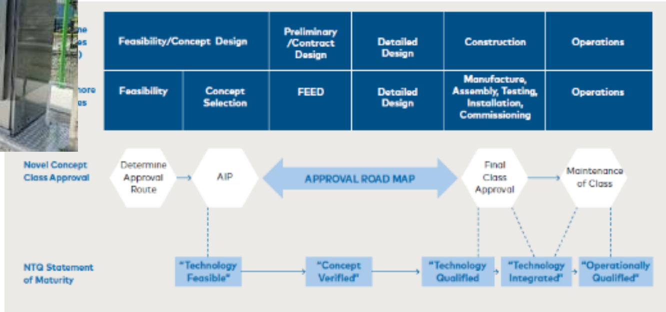
2 Class notation Battery(Safety)

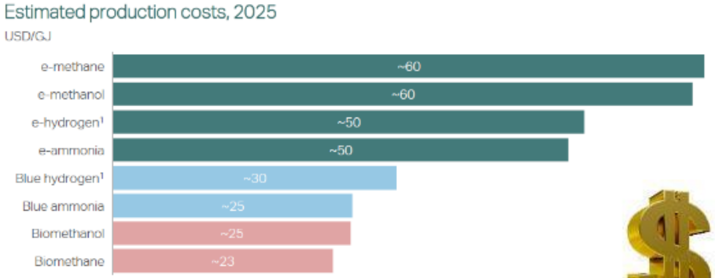


Hybrid and Fuel Cell systems – our view

Fuel Cells

- Thousands of units in operation shoreside, mostly stationary.
- ”Marinized” equipment being developed, prototypes in operation.
- Rules and regulations in development
  - Preliminary rules and guidelines in place
  - IMO Alternative Design route – slow and heavy process
  - Fixed rules expected towards end of the decade.
- Hydrogen containment – as compressed gas or liquid – the single biggest obstacle after fuel availability.
- Cost perspective





Source; ”Industry Transition Strategy, Oct. 2021” by Maersk Mc-Kinney Moeller Center for Zero Carbon Shipping

Conclusions

- Energy future is complicated; there is no ”silver bullet” solution
- When planning a new vessel, or a major refit, power plant & energy carrier upgrade need to be carefully evaluated.
  - MGO with biofuel option as basis (and difficult to beat!)
  - Exhaust gas aftertreatment to reduce air emissions (except CO2)
    - SCR for NOx
    - DPF for PM
- Hybridization might be beneficial – depending on intended operation profile
- LNG and methanol the most realistic – however not CO2 neutral – alternatives to MGO?
- Hydrogen not realistic for research vessels in the foreseeable future (unless very local and small operations)

- Energy efficiency is of utmost importance; the less fuel one needs, the less emissions & fuel costs

Thank you!

Questions?

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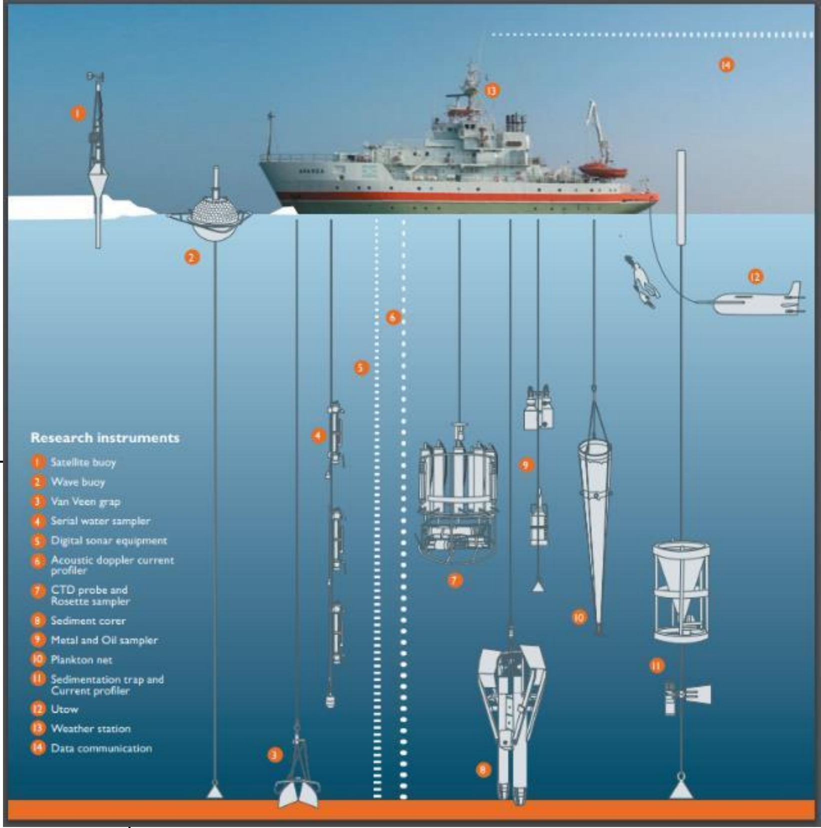
R/V ARANDA

Photo: Panu Hänninen

OWNER	FINNISH ENVIRONMENT INSTITUTE
COMMISSIONED	1989, HELSINKI, FINLAND
MAJOR REFIT	2018, RAUMA, FINLAND
HOME PORT	HELSINKI, FINLAND
LENGTH (LoA)	66.30 m
BEAM	13.80 m
DRAFT	5.00 m
GROSS TONNAGE	1969 GT
POWER	3215 kW
CRUISING SPEED	10 - 12 KNOTS
MAXIMUM ENDURANCE	60 DAYS
SCIENTISTS	27 PERSONS
CREW	5- 13 PERSONS

LABORATORIES AND SCIENTIFIC AUXILIARY SPACES	
CTD room	16 m²
Chemical laboratory (2)	25 m² and 20 m²
Nutrient laboratory	19 m²
Salinity laboratory	6 m²
Biological laboratory	30 m²
Isotope laboratory	8 m²
Wet (incl. benthos sieving)	9 m²
Sample handling room	18 m²
Server room	5 m²
Sounding laboratory	7 m²
Acoustics laboratory	5 m²
Library	4 m²
Instrument workshop	2 m²
Mechanical workshop	5 m²
Scientific hold	68 m²
Refrigerated sample store	2x2,5 m² and 1x5,3m² (+4 C - +8 C)
CTD Hangar (inside)	30 m²
Aft deck	110 m², the hatch on the aft deck 1,55m x 2,3m and the lift 1,5m x 2,0m Side scan sonar operation shaft/space
Container spaces	2 x 20 ft and 2 x 10 ft on the boat deck 2 x 10 ft container and 1 x storage container (on board) on the research (aft) deck. Storage container can be replaced with a 20 ft container.
Available containers	General lab container and sampling container



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