RV Aranda and new technologies; Fuel Cells and Hybrid System

ERVO Annual Meeting

Bucharest, September 2022

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25 VUOTTA ÅR YEARS

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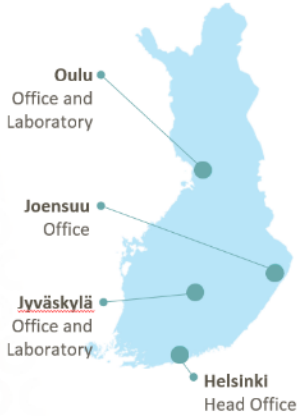
SYKE – Finnish Environment Institute

About SYKE



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

2

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%)

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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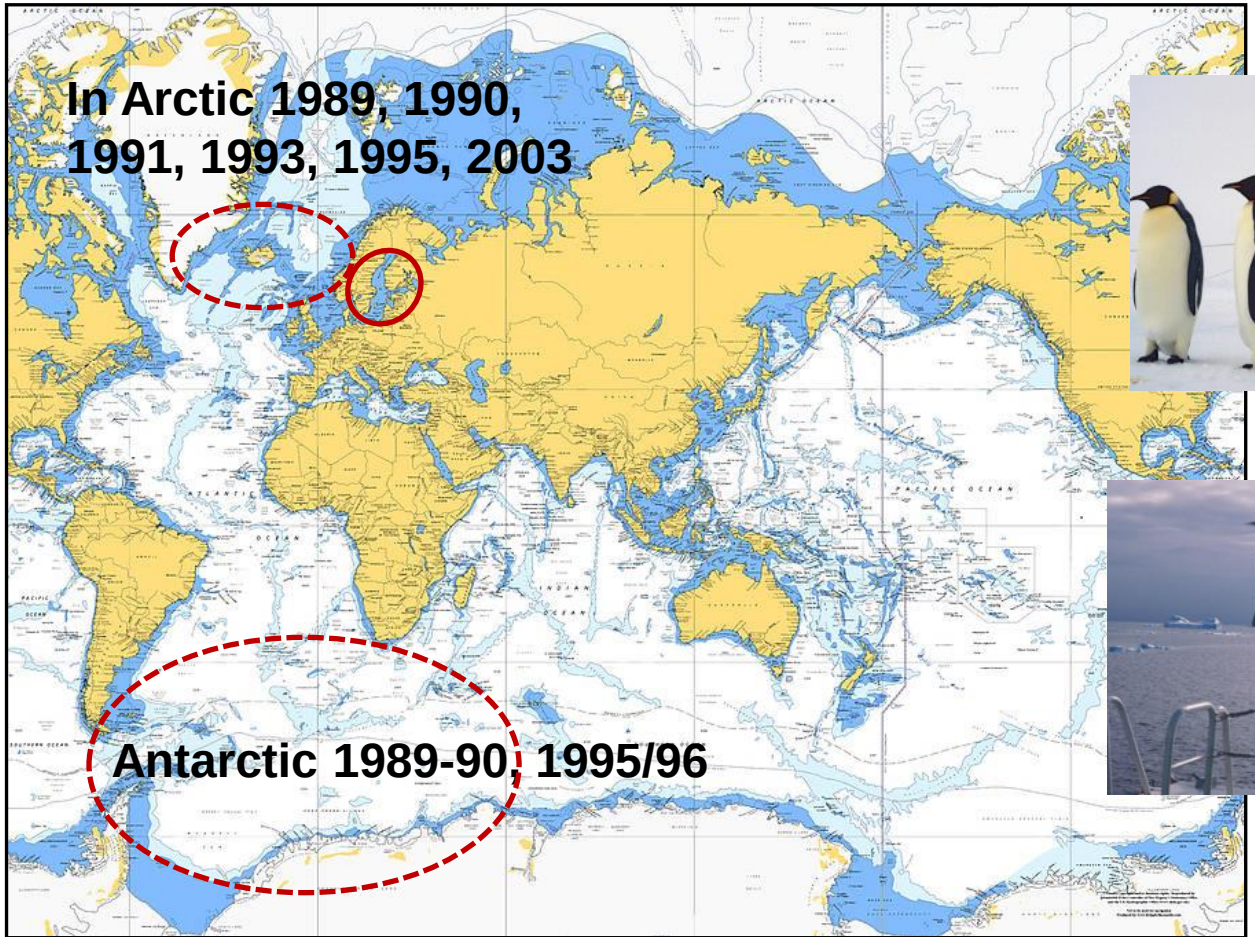
RV Aranda – Background and History



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Modernization / Refurbishment 2017-2018

Modernization focus on:

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

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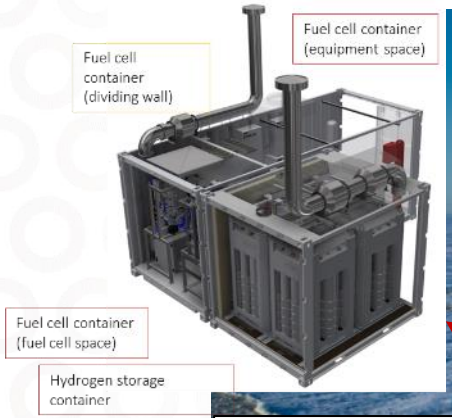
Aranda – Hybrid and Fuel Cell system projects



Hybrid system;

- 200kWh (net) battery pack
- Power electronics for up to 2000kW battery pack.
- Operation modes;
  - 20-30min ”silent operation” with support of auxiliary generator.
  - Ice-boosting / Peak-shaving
  - Emission-free arrivals with expanded battery pack.

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This project has received funding from the Fuel Cells and Hydrogen 2 Joint Undertaking under grant agreement No 735717. This Joint Undertaking receives support from the European Union's Horizon 2020 research and innovation programme, Hydrogen Europe and Hydrogen Europe Research.

Hybrid and Fuel Cell systems – our view

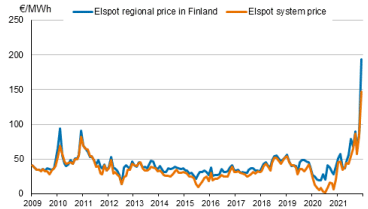
Batteries & Hybrid Systems

- ”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

DNV

3 Class notation **Battery(Power)**

2 Class notation **Battery(Safety)**



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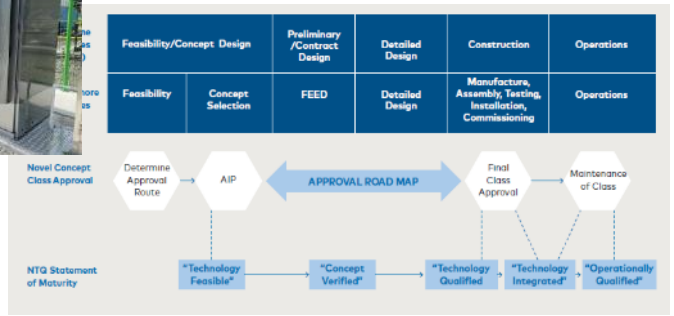
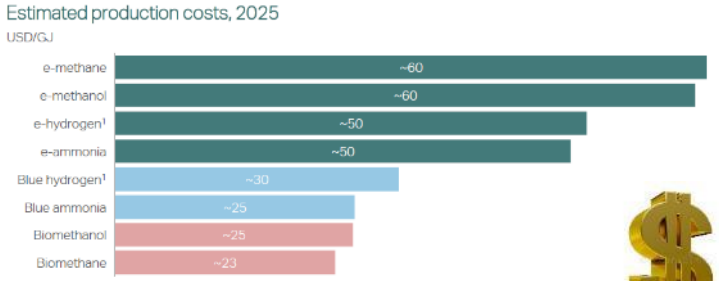
Hybrid and Fuel Cell systems – our view

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

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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

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Thank you!

Questions?

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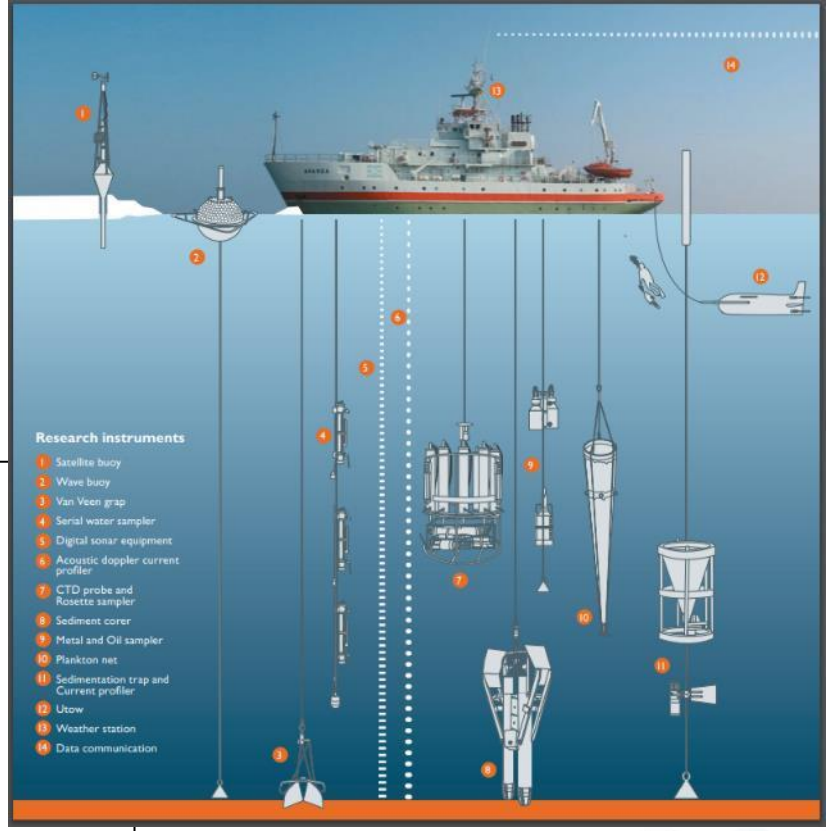
R/V ARANDA

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 m^2
Chemical laboratory (2)	25 m^2 and 20 m^2
Nutrient laboratory	19 m^2
Salinity laboratory	6 m^2
Biological laboratory	30 m^2
Isotope laboratory	8 m^2
Wet (incl. benthos sieving)	9 m^2
Sample handling room	18 m^2
Server room	5 m^2
Sounding laboratory	7 m^2
Acoustics laboratory	5 m^2
Library	4 m^2
Instrument workshop	2 m^2
Mechanical workshop	5 m^2
Scientific hold	68 m^2
Refrigerated sample store	2x2,5 m^2 and 1x5,3m^2 (+4 C - +8 C)
CTD Hangar (inside)	30 m^2
Aft deck	110 m^2, 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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