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# PILOTING INTEGRATED HT/LT SYSTEM

## 600PAX RO-PAX VESSEL

12.11.2021

Trondheim

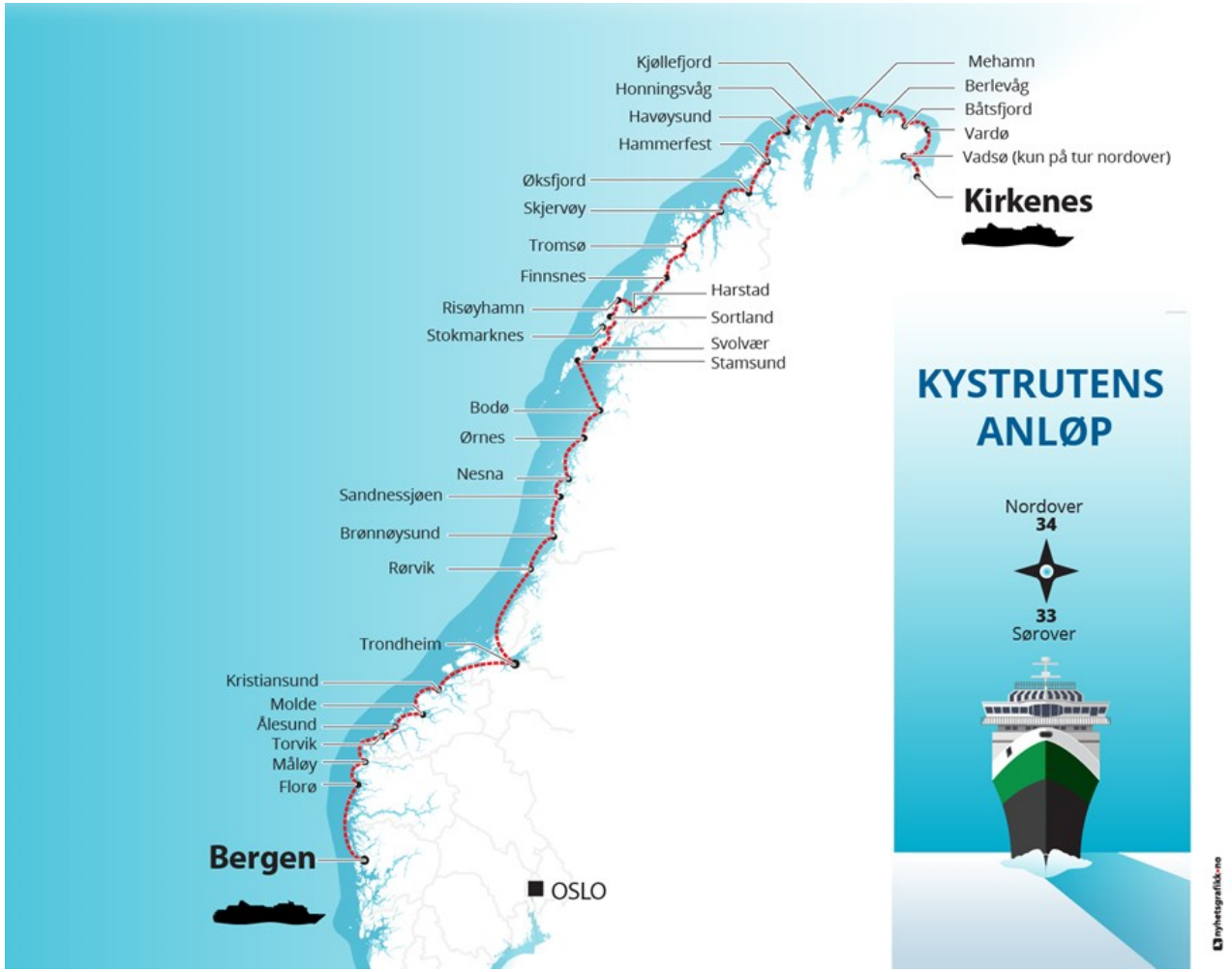
Workshop on Thermal Energy Storage for industry, buildings and marine applications

# COASTAL ROUTE BERGEN - KIRKENES

The Norwegian state purchases maritime transport services on the Bergen-Kirkenes route.

In **March 2018**, a subcontract with **four routes** was awarded to **Havila Kystruten AS**, while Hurtigruten Cruise AS was awarded two subcontracts with three and four routes, respectively.

Contract period: **2021-2030**

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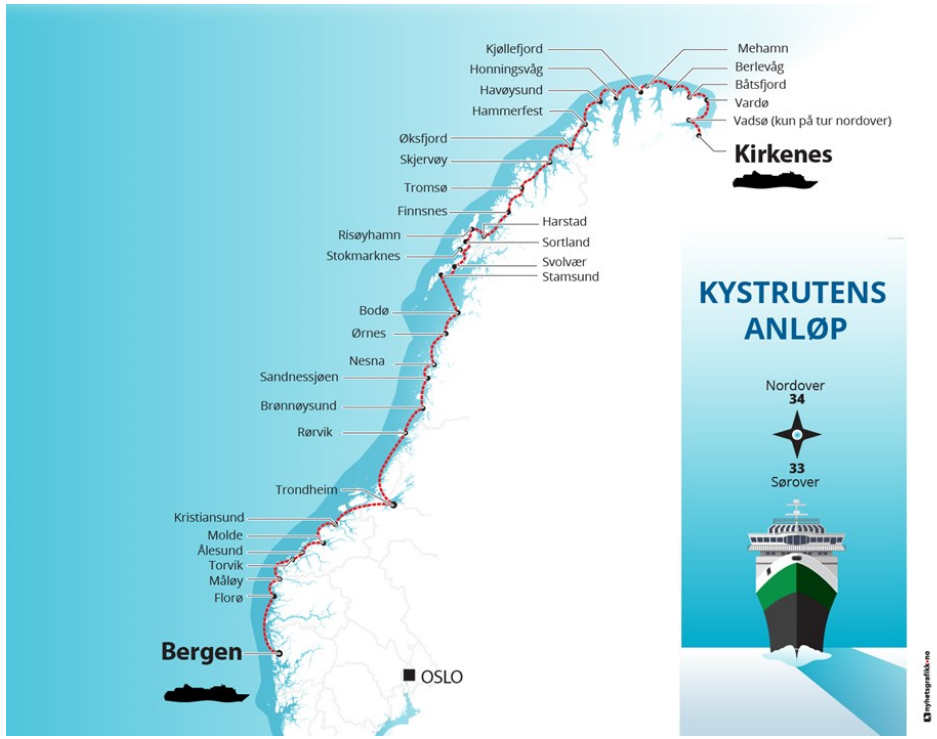
# COASTAL ROUTE BERGEN - KIRKENES




Overarching goal:

**Reduce CO2 intensity for the transport services with 25%**

«Owner»

HAVILA

«Designer»

HAVYARD
Improving life at sea

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# ULMATEC PYRO

## - 70 YEARS OF KNOW-HOW IN MARINE THERMAL SYSTEMS

- **1951**: **Pyrofabrikken AS established**
- 1999: Ulstein Group was acquired by Vickers Plc, later by Rolls-Royce Plc
- 2000: Ulstein Marine Technology AS (“Ulmatec”) established
- 2009: Acquired a majority stake in Pyro in 2009
- 2011: Introduced automatic waste energy recovery systems (WERS)
- 2021: Mobilizing for “green shipping”
  - 45 employees
  - Installed base: 20 000 ships

*Production site at Gamlem, Søvik.*

*Maritime Cluster in the north-west of Norway*

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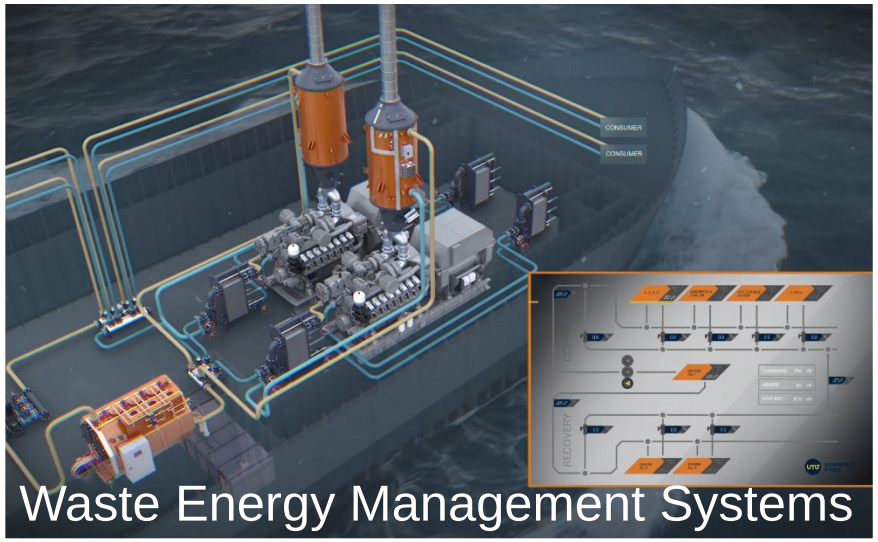
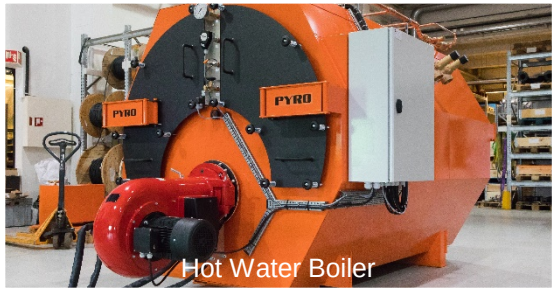
# ENERGY EFFICIENT THERMAL SOLUTIONS



Waste Energy Management Systems



Hot Water Boiler


Economizers

## Systems

- Waste Energy Recovery Systems (WERS)
- Waste Energy Cooling Systems (WECS)
- Heat to Power Systems (HTPS)
- Integrated Waste Energy Management Systems:
  - WERS + WECS + HTPS + Control & Monitoring

## Products

- Fuel Fired Heaters
- Exhaust Gas Economizers
- Heat Pumps
- Heat to Power Modules
- Indirect Heat Storage Modules
- Accessories

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# The Idea:

## Maximum utilization of available energy at sea

WIND ENERGY


SOLAR ENERGY

WAVE ENERGY

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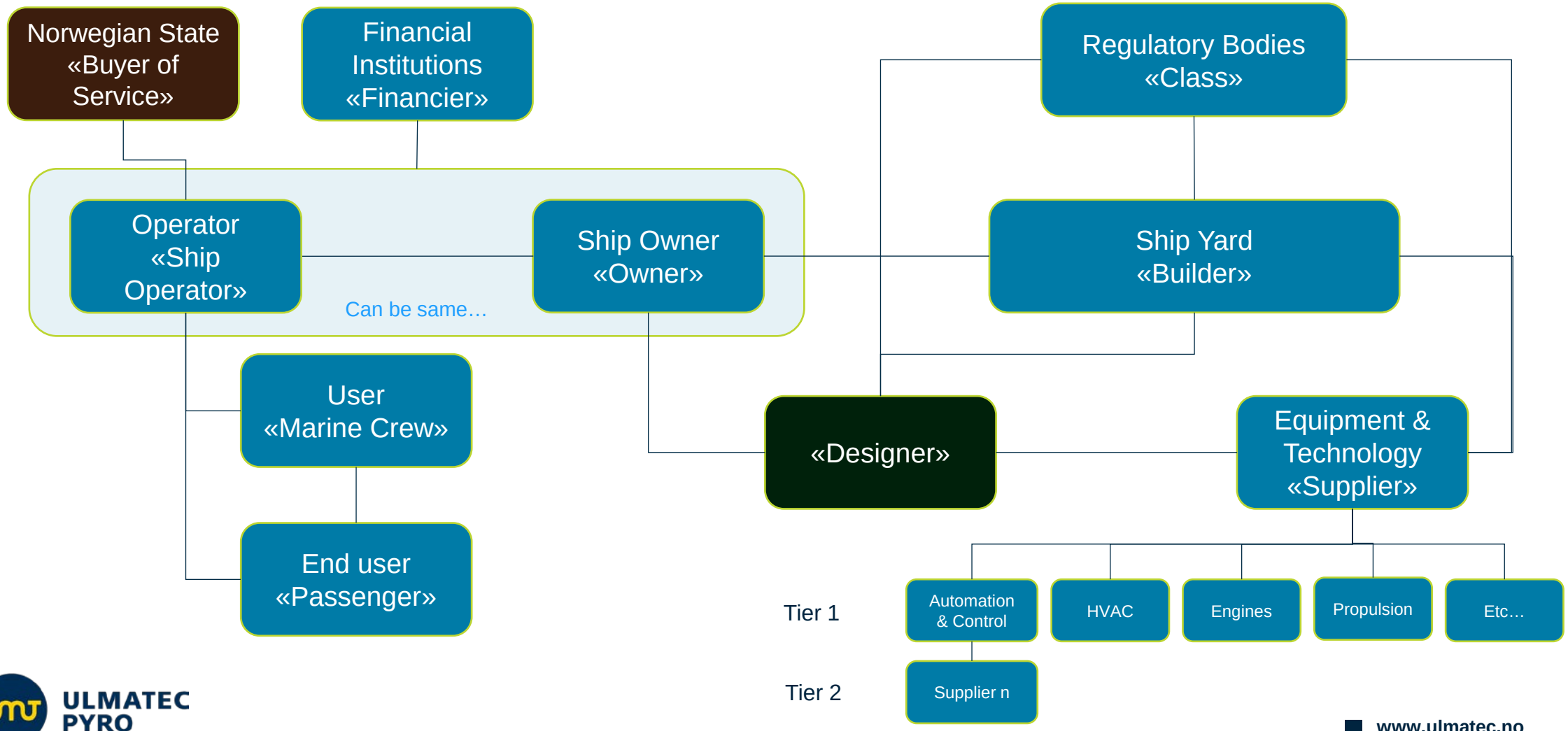
# STAKEHOLDERS – SHIPBUILDING PROJECT

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# VESSEL SPECIFICATIONS

- The world's largest battery packs
- Four hours' sailing with zero emissions
- Energy-efficient hull design
- Locally sourced ingredients
- Heat recovery from the sea and cooling water
- Charging current from hydropower at the quay
- Liquid natural gas that cuts $Co_2$ emissions by 25 %
- NOx emissions reduced by 90%

| Passengers | Cabins | Length | Beam | Built |
|---|---|---|---|---|
| 640 | 179 | 124 m | 22 m | 2021 |

**Havila Capella**

**Havila Castor**

**Havila Polaris**

**Havila Pollux**

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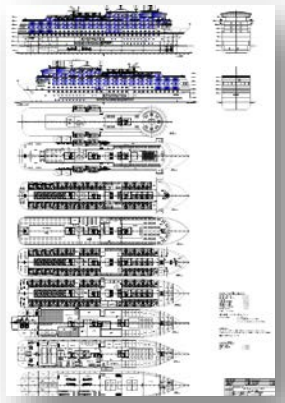
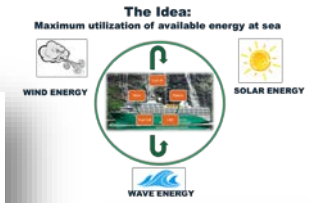
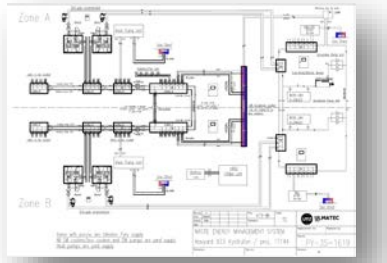
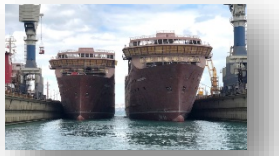
# TIMELINE





2016

- Initial ideas

2017

- General Arrangement & Ship Specification

2018

- Award of contract for 4 routes to Havila Kystruten AS
- 2 x Building contracts for Hijos de J. Barreras
- 2 x Building contracts for Tersan Shipyard
- Ulmatec Pyro awarded contracts

2019

- Building contracts cancelled for Hijos de J. Barreras
- Transferred to Tersan Shipyard

2020

- Commissioning & Sea Trials
- Havila Capella delivered, scheduled to sail 1st of December

2021

- 3 next vessel to be delivered…

2022

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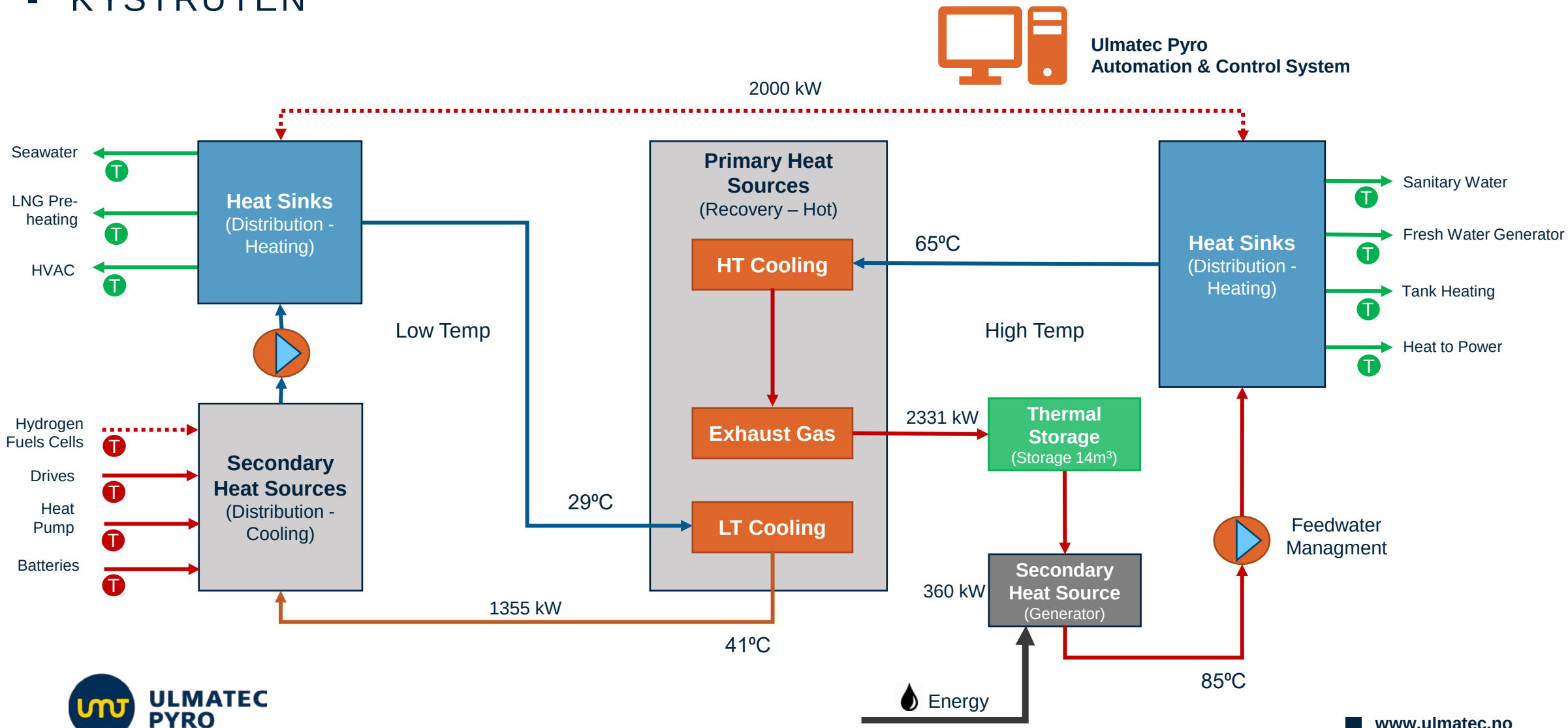
# SYSTEM SPECIFICATION

- Machinery:
  - 4 main engines, total power: 7770 ekW
  - 2 x 2330 ekW + 2 x 1555 ekW
- Fuel
  - Liquefied natural gas (LNG)
- Battery pack:
  - Energy storage capacity of 6 x 1000 kWh
- Prepared for Fuel Cells:
  - Main switchboard is prepared for implementation of a future fuel cell of max. 1600 ekW
- Class:
  - DNV GL: + 1A1 - EO - CLEAN DESIGN - NAUT AW - COMF-C(2)-V(2) - BIS – DPS-1 PASSENGER SHIP – BATTERY POWER – GAS FUELLED
- Safe Return to Port (SRtP)

- **Waste Energy Management System**
- Main purpose:
  - "*Cool machinery systems, recover the energy and use this energy to heat the accommodation in a closed, pressurized fluid circulation system*"
- Automatic Control & Monitoring of thermal heat balance
- **System components – Ulmatec Pyro Scope of Supply**:
  - 2 x Exhaust Gas Economizers (630 kW)
  - 2 x Exhaust Gas Economizers (470 kW)
  - 1 x Fuel Fired Heater (300 kW with 80kW electric heat)
  - 8 x Flow Control Unit
  - Heat exchangers & accessories
  - Control & Monitoring System
- Other System components
  - 2 x Heat Pump (545 kW)
  - 1 x Heat to Power Unit (150 kW)

# INTEGRATED WASTE ENERGY MANAGEMENT

## - "KYSTRUTEN"

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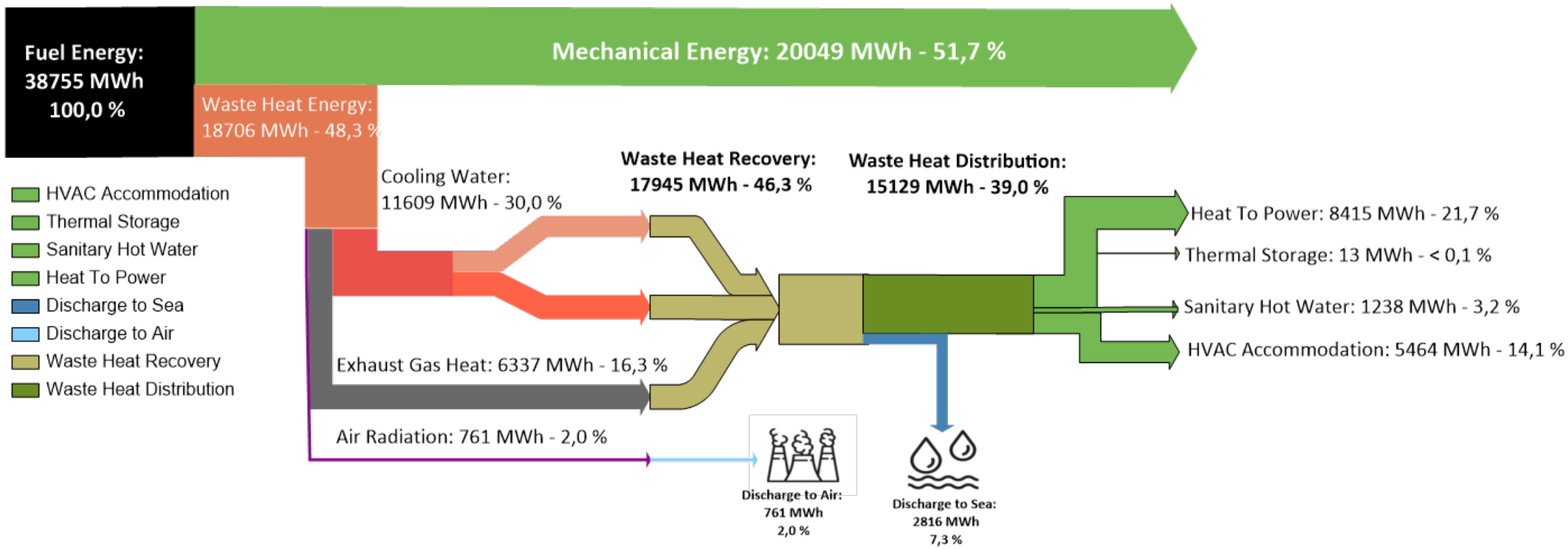
## "Kystruten", 80% load, 2 Gensets, 34 round trips/year




# > 90% energy utilization!

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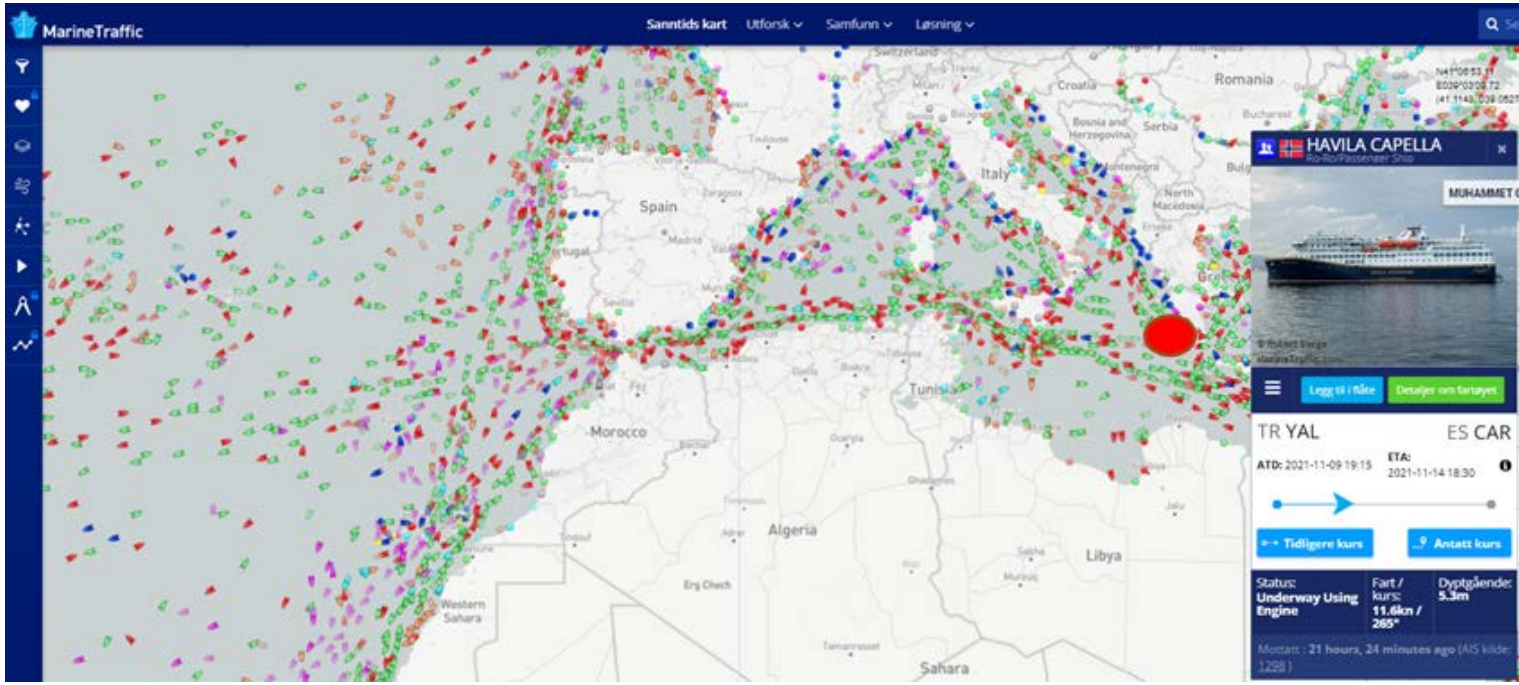
# LESSONS LEARNT

- **System complexity**
  - Define system boundary
- **System V&V**
  - Is it a robust design with all operational scenarios accounted for?
- **System integration**
  - Interface control
  - Many stakeholders…
  - Physical integration - shipyard
- **Test & Launch**
  - Sea trials are not necessarily representative
  - System will require tuning during “normal operation”




Friday 12.11.2021, 07:30