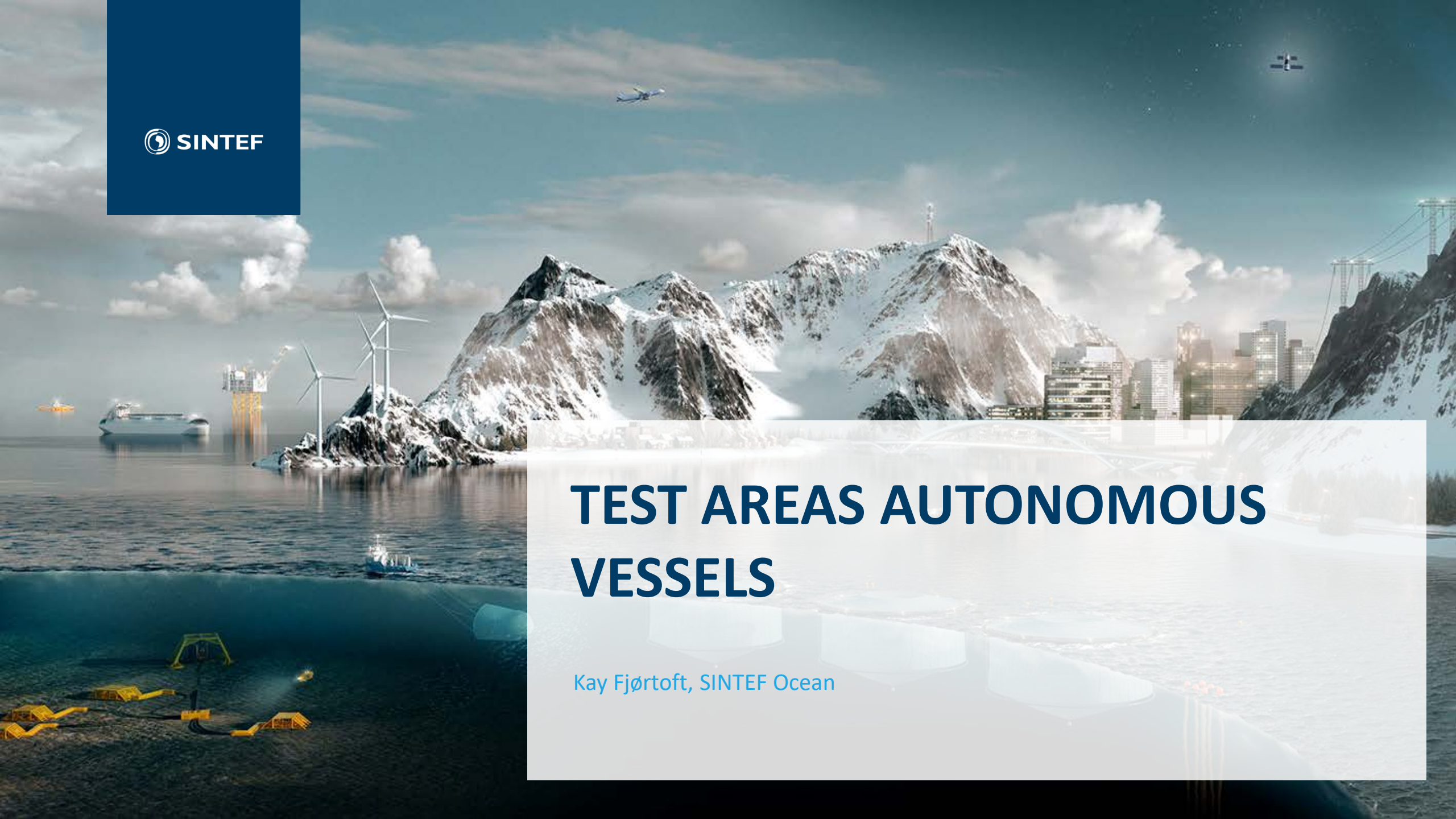


TEST AREAS AUTONOMOUS VESSELS

Kay Fjørtoft, SINTEF Ocean

Why autonomous shipping in Norway

- Background
- Current Norwegian status
- Digitalization
- Conclusions

Why autonomous shipping in Norway

- More logistics and control Centre focus
- The salmon price has dropped with about 30% since 1.1.17.
  - 45-65 NOK per kilo (4 - 6.5 Euro)
  - Still very optimistic regards the future
  - Exposed and land based farms
- New vessels for transport of fish
  - More **automation** and bigger
- The fishery sector is going well and the sector are optimistic for the future
- Environmental monitoring
- New contracts regards new vessels

The aquaculture and fishery market


BioMar styrker seg i fôrmarkedet

En ny stor kontrakt med Leroy og utvidelse av ferdigvarelager gjør at BioMar hevder seg i et tøft marked.


FISKERI

Rekordhøye kongekrabbepriser

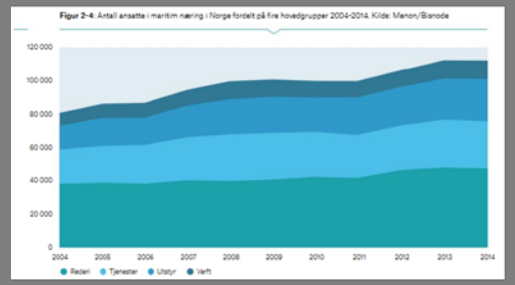

FISKERI

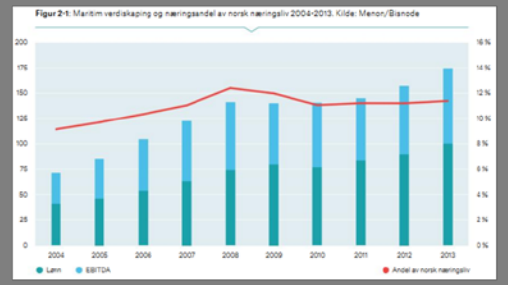
Skryter av årets Lofotfiske

Why autonomous shipping in Norway

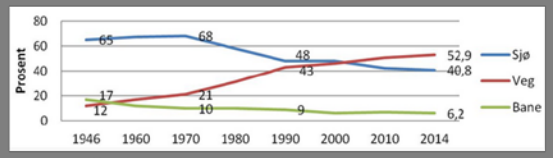
- Economy
- Industry
- Future industry

Maritim Verdiskapingsbok 2015, Maritimt Forum, Norge





14% of value creation from businesses
38 % of export (ex HC)



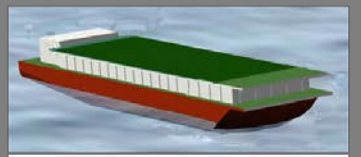
Still a big role in inland cargo transport –
that needs to be increased

TØI rapport 1454/2015

Yards and equipment

KYSTVERKET
Sjøfartsdirektoratet
Norwegian Maritime Directorate

Shipping & services

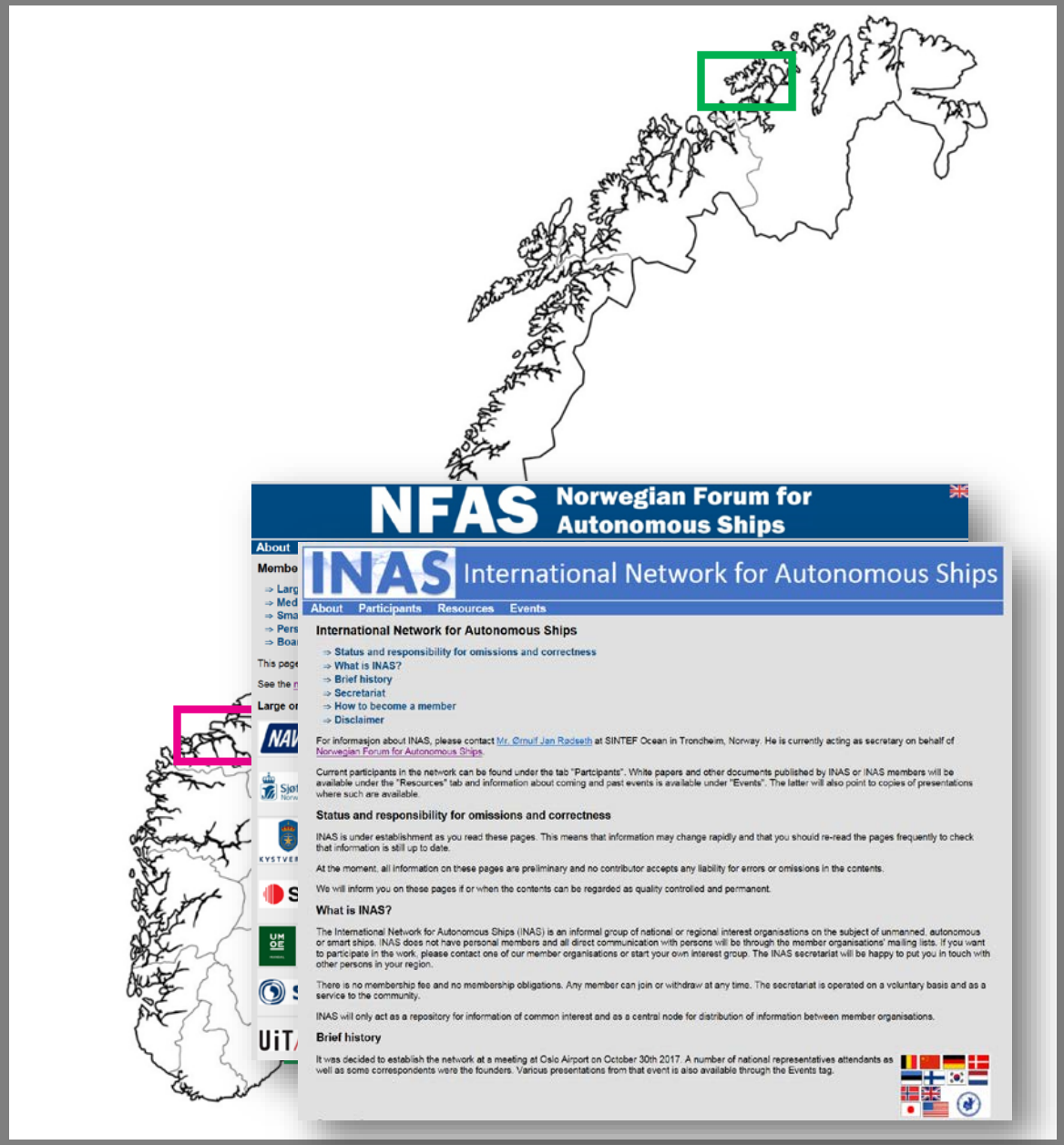


New transport systems

Test areas - Status

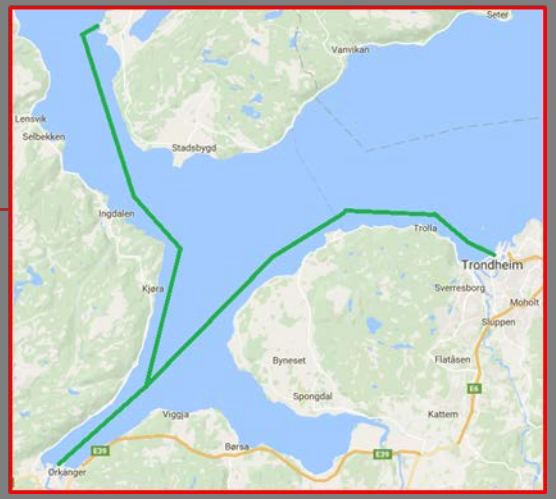
- Trondheimfjorden
- Storfjorden
- Horten and Grenland
- Tromsø possibly next

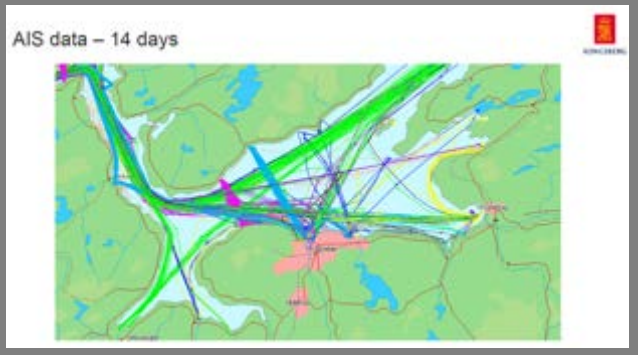
- NFAS and INAS



Test area - Trondheimsfjorden

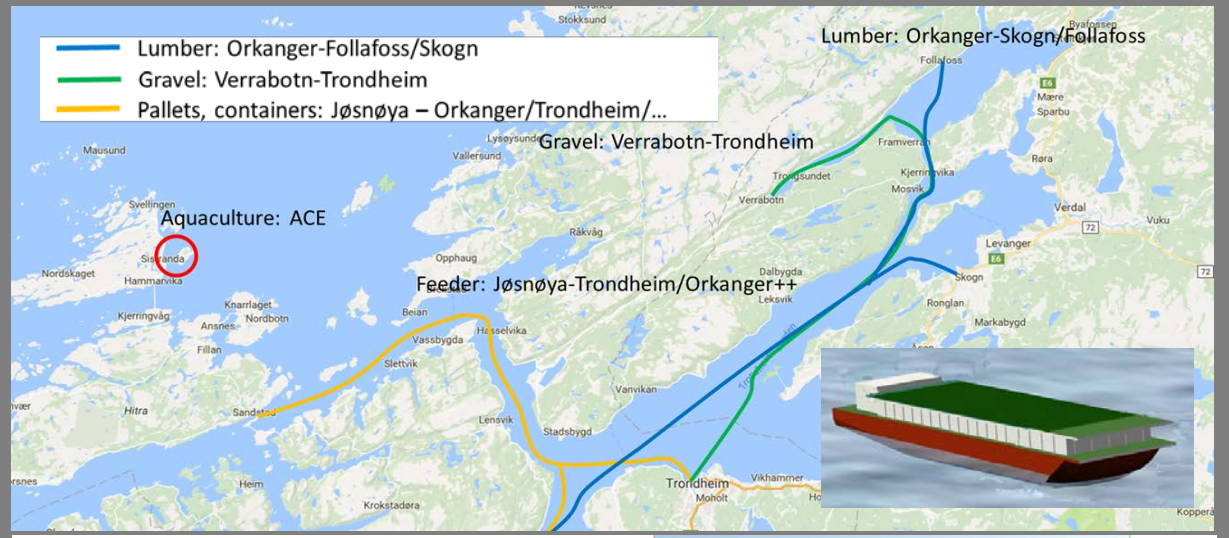
- Established September 30th 2016
  - Industry, university, research
  - Port of Trondheim
  - Norwegian Maritime Administration
  - Norwegian Coastal Administration
- Area covers Trondheimsfjorden
  - Permits
  - Instrumentation and communication
  - Navigation
  - Safety
  - Exchange of experience





Test area - Trondheimsfjorden

- ASTAT
  - Short voyages
  - 12-50 TEU
  - Inland, fjords/sheltered
  - Low cost: Wait in port
  - Legs 4-12 hours
  - Port cranes
  - Automated berthing
  - Batteries
- Highway car ferries
- Hrönn: Unmanned offshore vessel



AMOS - NTNU

- Milliampere
  - On-demand passenger ferry
  - Max 12 persons + bicycles
  - Electrical propulsion, battery
  - Inductive charging at quay

NTNU AMOS

NTNU AMOS
Centre for Autonomous Marine Operations and Systems

- Supported by Norwegian Research Council
- Norwegian "Centre of Excellence"
- Established 2013
- Planned for 10 years
- Total budget approx. EUR 80 million

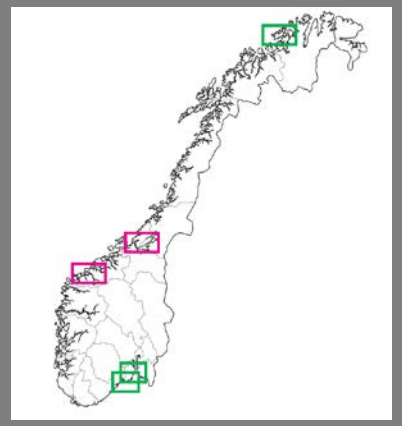
https://www.ntnu.edu/amos

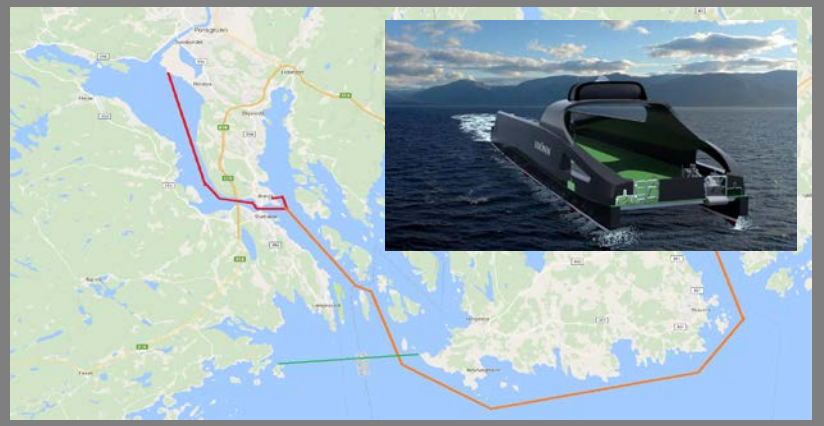
- Sensortypes
  - Requirements are high update rate, < 1 sec
  - Navigation types: GNSS, GNSS Compas, INS/MRU
  - Anti collision types: Radar, Camera, LIDAR)
  - Instruments types: Propulsion, technical monitoring
  - Augmented AIS
- LIDAR and RADAR
  - Must detect small and high-speed objects/targets
  - Direction sensitive
  - Need input such as wind and wave hight
  - Radar network
- ICT Network
  - Vessel
  - Navigation
  - Dokking
- Successes
  - Risk analysis and preparedness plans, high degree of monitoring
  - Automatic control on vessels and passengers
  - Access control
  - Anti-collision control
  - Redundancy
  - Easy to use, operation year around, efficient and robust


I am an ocean farming installation. Please respect my position and safety zone
I am on my way to Trondheim. Please provide me instructions for navigation
I am about to dock in Verdal. Please give me navigation - proximity data
I am a small vessel. Have you seen me? Can you tell me your navigation plans?
I am an autonomous vessel doing bay metric measurements. Give me navigation instructions
I am a autonomous ferry serving an island. The locals can call me on demand.
We are doing underwater research. Inform mariners and keep distance
We are two autonomous drones to be used for test and demonstrations
I am the autonomous bicycle ferry operating in the channel of Trondheim
We are the local monitoring centre for autonomous shipping in Trondheimsfjorden
Stokksund
Mausund
Svellingen
Hammarvika
Knarrlaget
Uthaug
Brekstad
Leksvik
Mosvik
Røra
Sandstad
Stjørd
Sluppen

Test area – Horten / Grenland

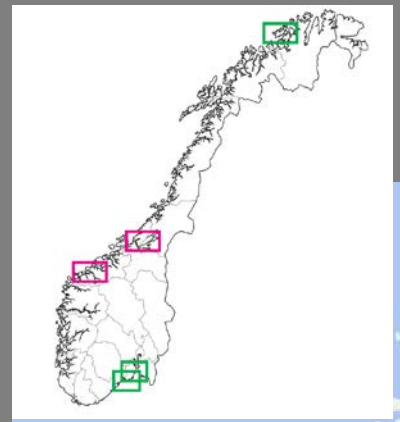
- Yara Birkeland
  - Yara fertilizer
  - Fully electric, 100-150 TEU, 70 m x 15 m
  - Replaces 40 000 truck trips a year
- Staged implementation
  - Manned after 1 year, Remote after 2 year, Autonomous after 3 year
- Operational area
  - Herøya-Brevik – 7 nm, Herøya-Larvik – 30 nm, Within Brevik VTS area





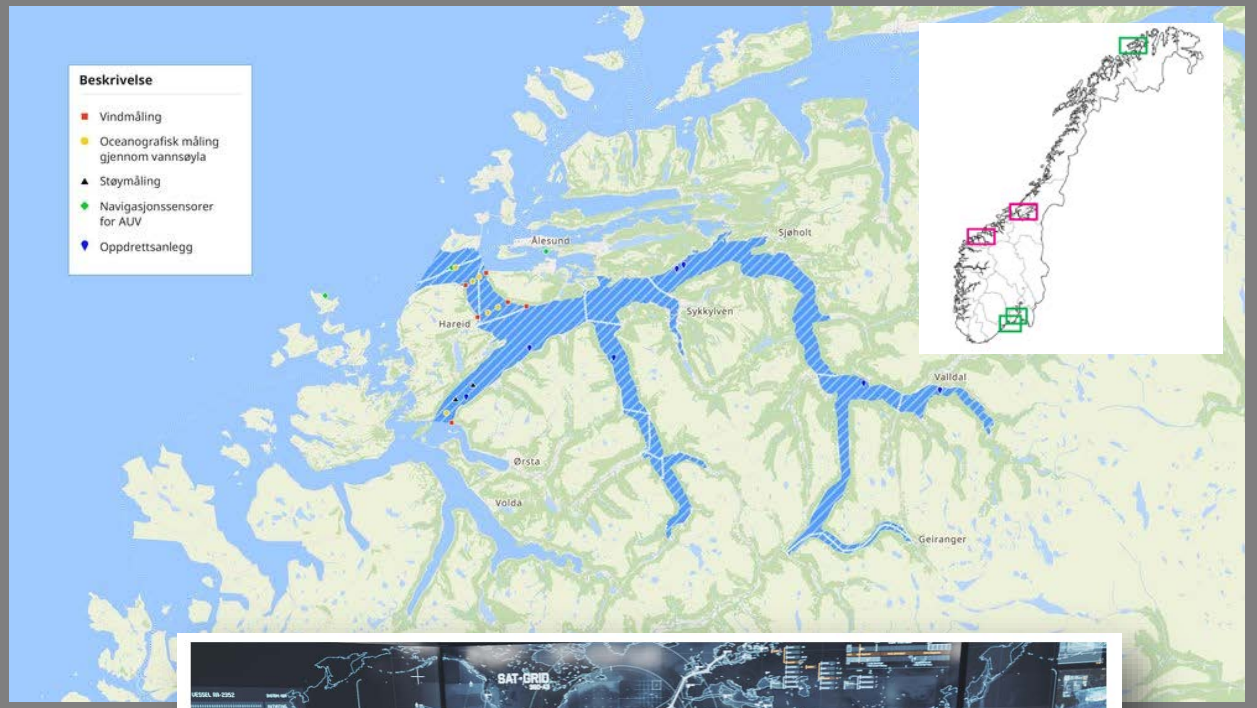
Test area – Tromsø

- Aurora
  - The Aurora test ecosystem is designed for verifying and validating new ITS solutions and innovations in real extreme weather conditions..
- Ocean test area
  - 69,5 degrees north
  - Arctic



Test area – Storfjorden

- GCE Blue Maritime and Rolls-Royce are drivers
- A test area connecting deep ocean with fjords
- In the area you find 14 yards, 20 ship owners, ferries and commercial shipping



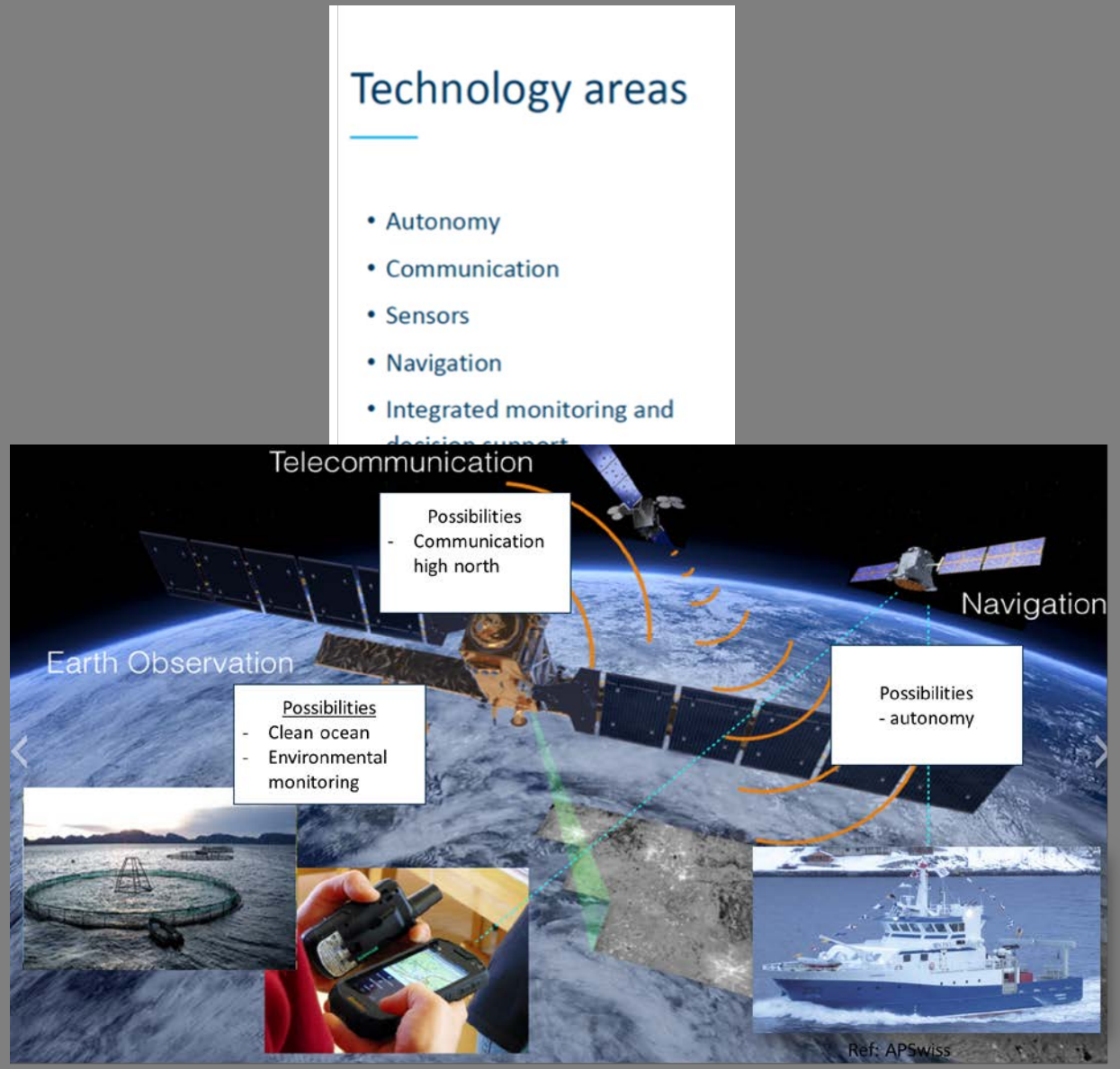
viteter. (Bilde: Rolls-Royce/VTT)

senter i

SINTEF

Digitalization

- Huge investment in digitalization within the maritime segment
- Maersk invests up to 100 million dollar in digitalization
- Internet of things, clouds, security and communication is of high importance.
- The Norwegian shipping association



Summary

- Norway has autonomy prioritized
  - Collaboration between Government, Industry and Academia
  - Collaboration between sectors
  - Collaboration with other countries
- NFAS and INAS
  - Standardization and taxonomy
  - Environmental profile is one of the drivers
- The test areas will be important for the development of autonomy

Autonomy gives possibilities for a more efficient and safer maritime sector

SINTEF

SINTEF

Technology for a better society