CoolFish Workshop 14th Oct.


# Alternative fuels and propulsion systems

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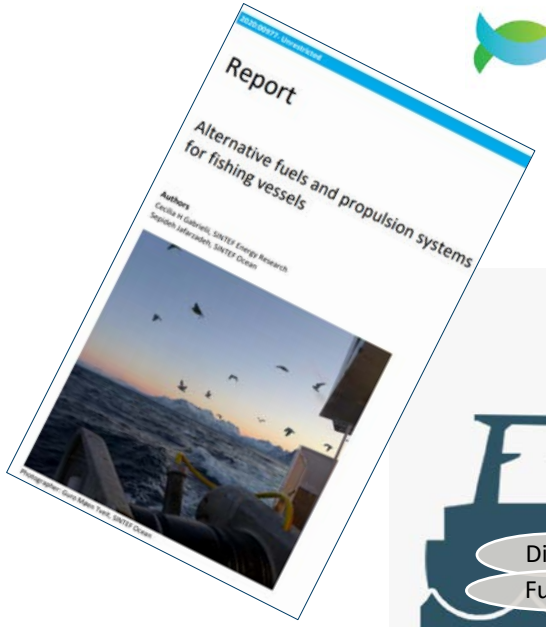
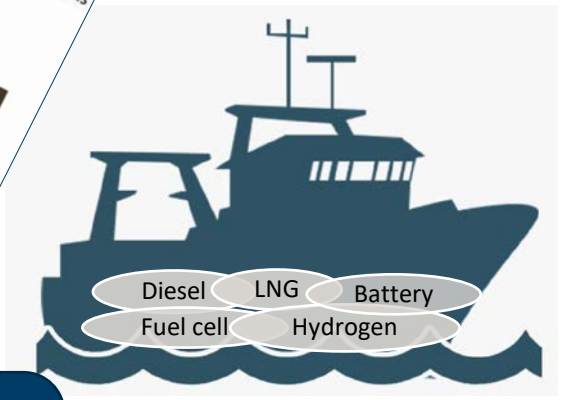
# The report – content and why




**Today's presentation is a brief summary of:**

- Propulsion systems
- Operating modes
- Fishing vessel examples
- Uptake of alternative fuels

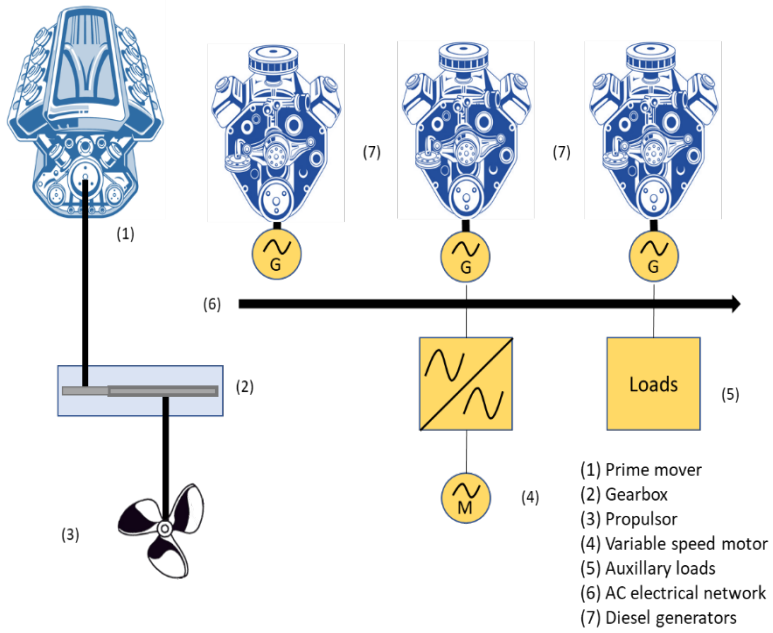
Why?

New propulsion systems / fuels imply **changes in**
- **waste heat characteristics**
- **heating and cooling load profiles**
- **carbon footprint**

- To achieve a full potential of efficiency and environmental benefits with new cooling, freezing and heating systems, the propulsion system and its operational mode must also be considered

# Propulsion system – "definitions" and examples

- Traditionally: diesel-fuelled mechanical propulsion with auxiliary engines for electric power supply.

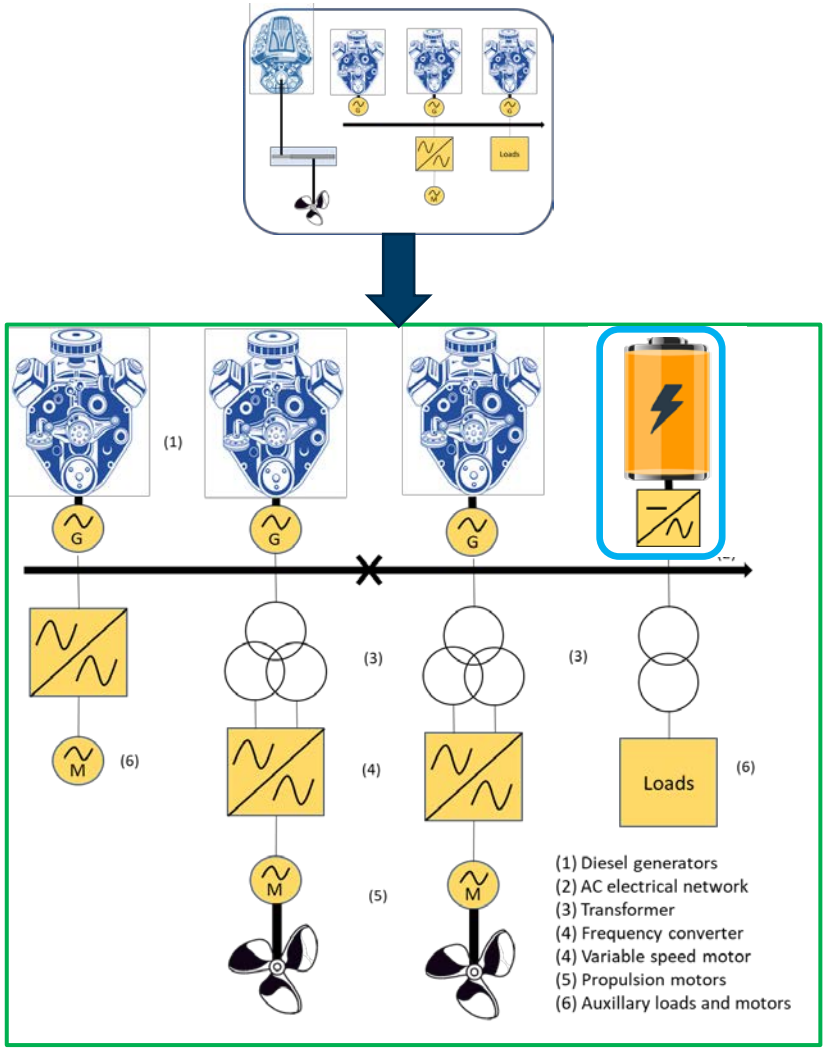



- **Development towards electric or hybrid propulsion - with hybrid power supply**

# Diesel-**electric propulsion**

- Diesel (or LNG) generators supply propulsion and electric loads

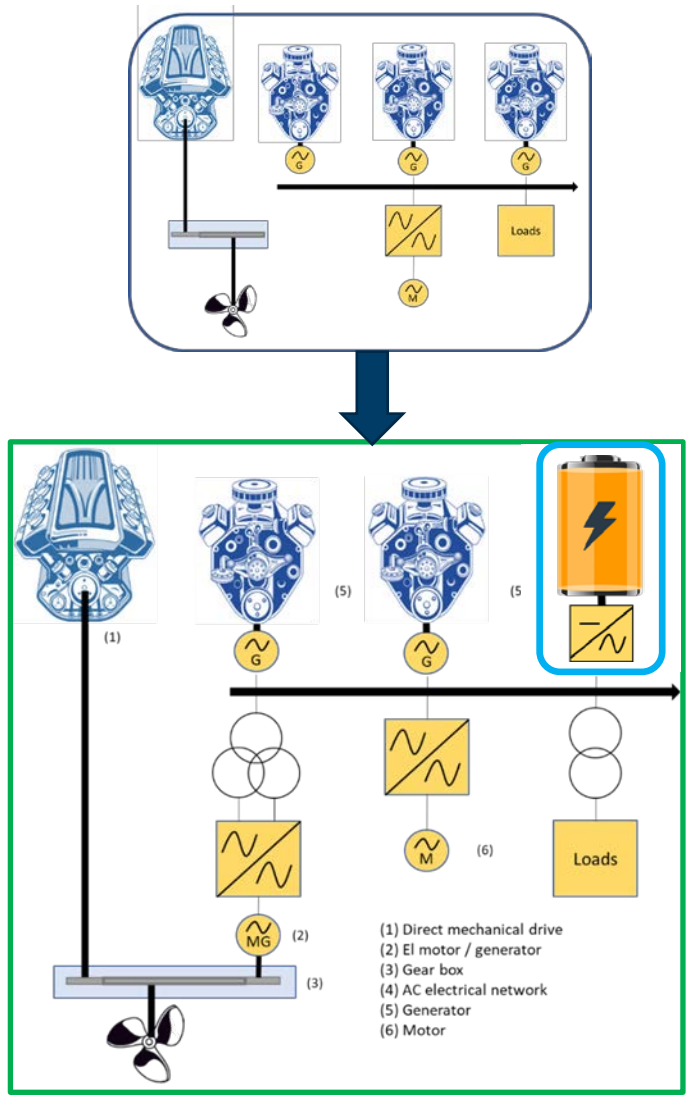
The first diesel-electric coastal fishing vessel (2009)




- Especially fuel-efficient for ships with:
  - **large utility (auxiliary) load**
  - **large variation in operation profile**

- Can also be equipped with hybrid power supply (batteries in addition to diesel gensets)

# **Hybrid propulsion** (mechanical-electrical)




- The ship can be propelled in two ways; electrical and mechanical
- Especially fuel-efficient for ships with:
  - **varying speed conditions**
  - **a "small" auxiliary load**
- For fishing vessels requiring high propulsion capacity:
  - diesel-mechanic propulsion for steaming to and from fishing field
  - electric propulsion for transit at lower speeds and fishing operations.


- Can also have battery capacity installed (i.e. hybrid power supply)

# **Hybrid power supply** (diesel/LNG gensets and batteries)

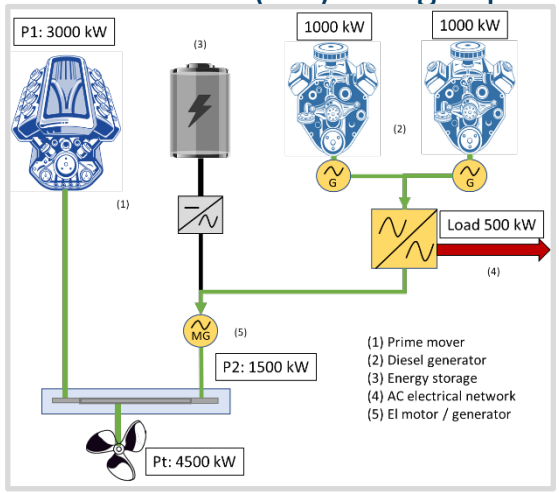
- The battery package can be designed to
  - handle power fluctuations, peak-shaving, and/or
  - enable switching off diesel generators/engines
    - → zero-emission operation and significant noise reduction.

- Most beneficial for ships with:
  - **varying power demand and much low-load operations**
  - **large electric power demands in port**

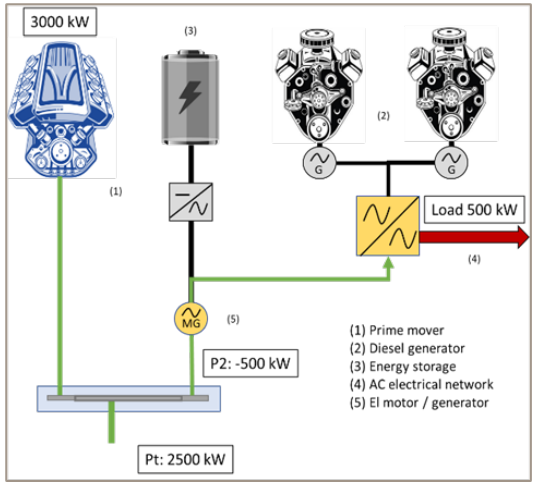
- Additional benefits with battery implementations
  - facilitates intermittent renewable power (solar, wind) production on-board
  - enables storing regenerated energy from heavy winches for fishing gears

# Hybrid ships – operating modes

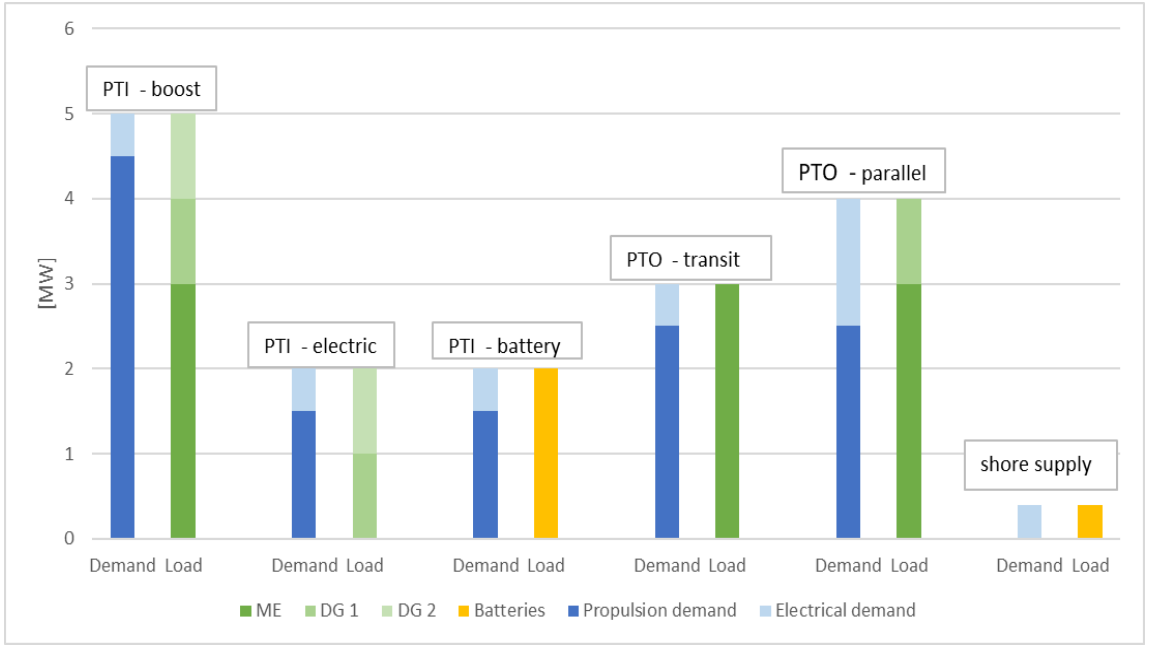
- Power-take-in (PTI) at high speeds (boost)



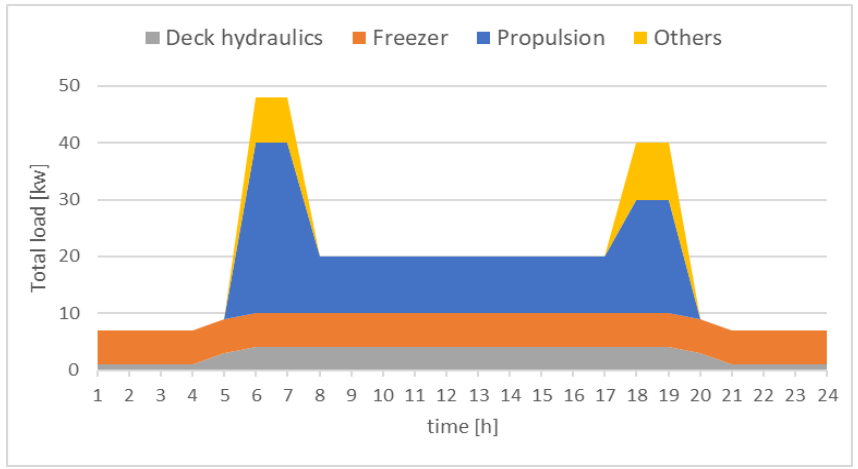

- Power-take-out (PTO) at lower speeds (transit)

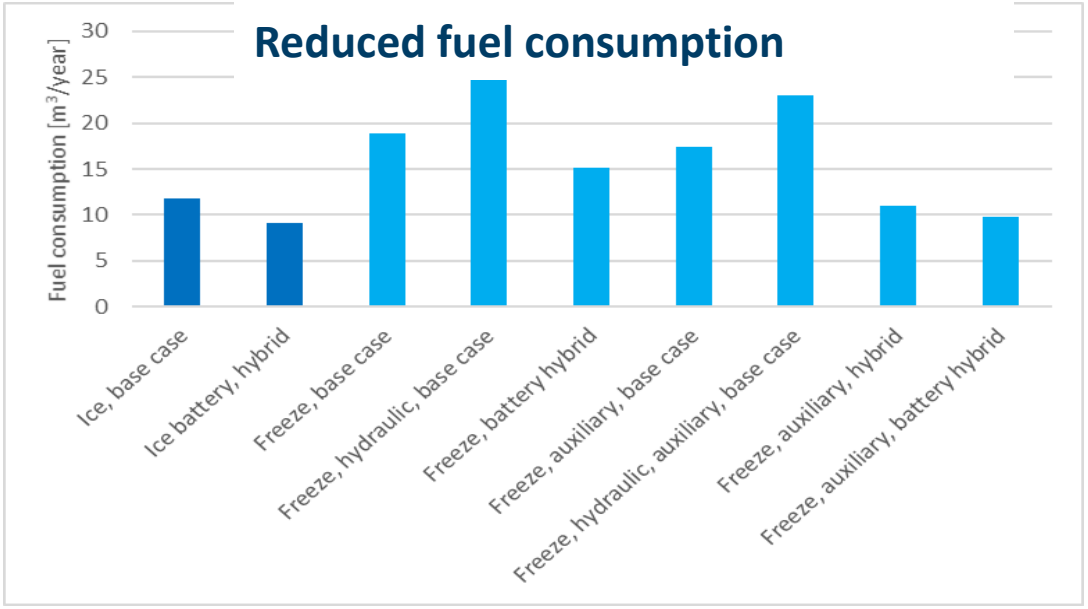


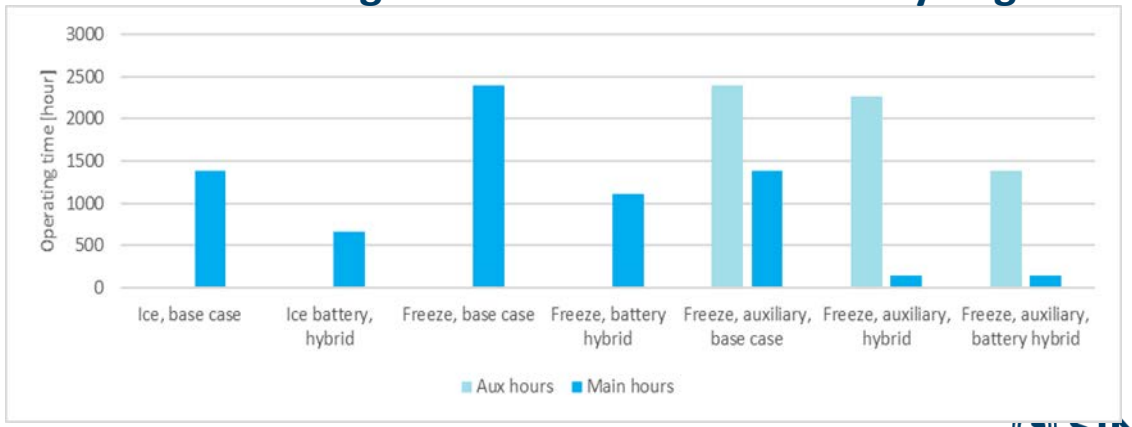

- Many possible operating modes → flexible, fuel-efficient operation.
- But implies challenges in relation to
  - **waste heat availability**
  - **sizing of heating and cooling equipment**
  - **need for thermal storage**



# Evaluation of hybrid propulsion - Alaska Troll Fisheries



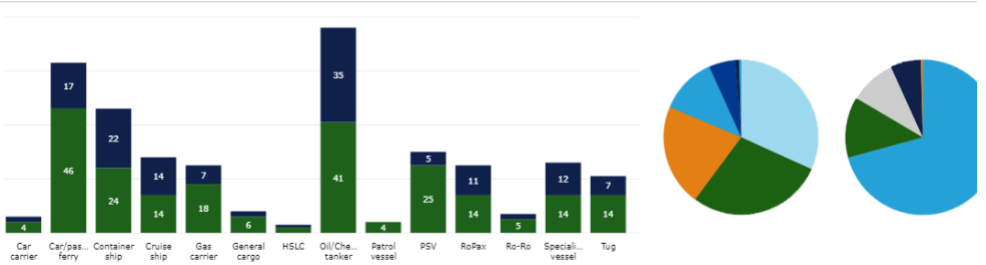



# Uptake of Alternative fuels – the AFI platform


## MAP

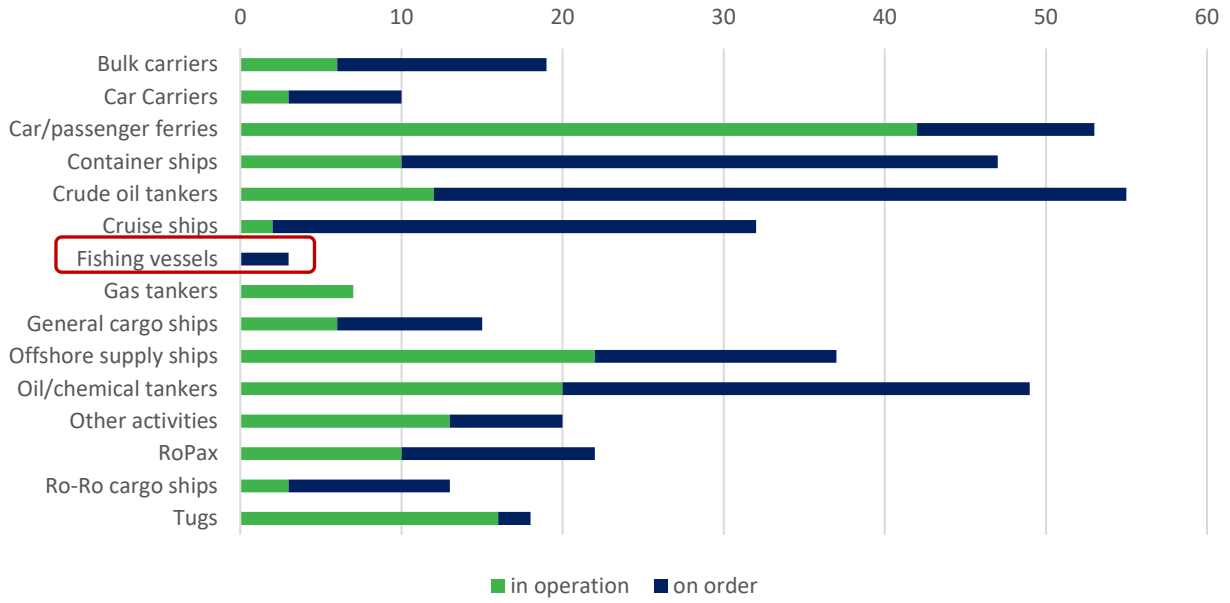
Explore the development of bunkering infrastructure for alternative fuels.

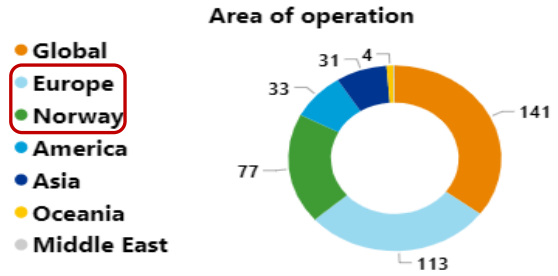
## STATISTICS

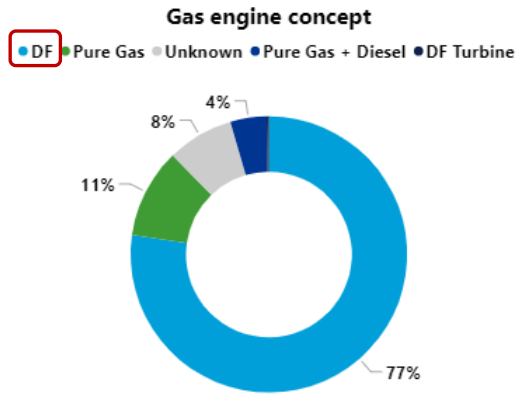



Get detailed insights to the uptake of alternative fuels and technologies

# Alternative Fuel Insight - LNG

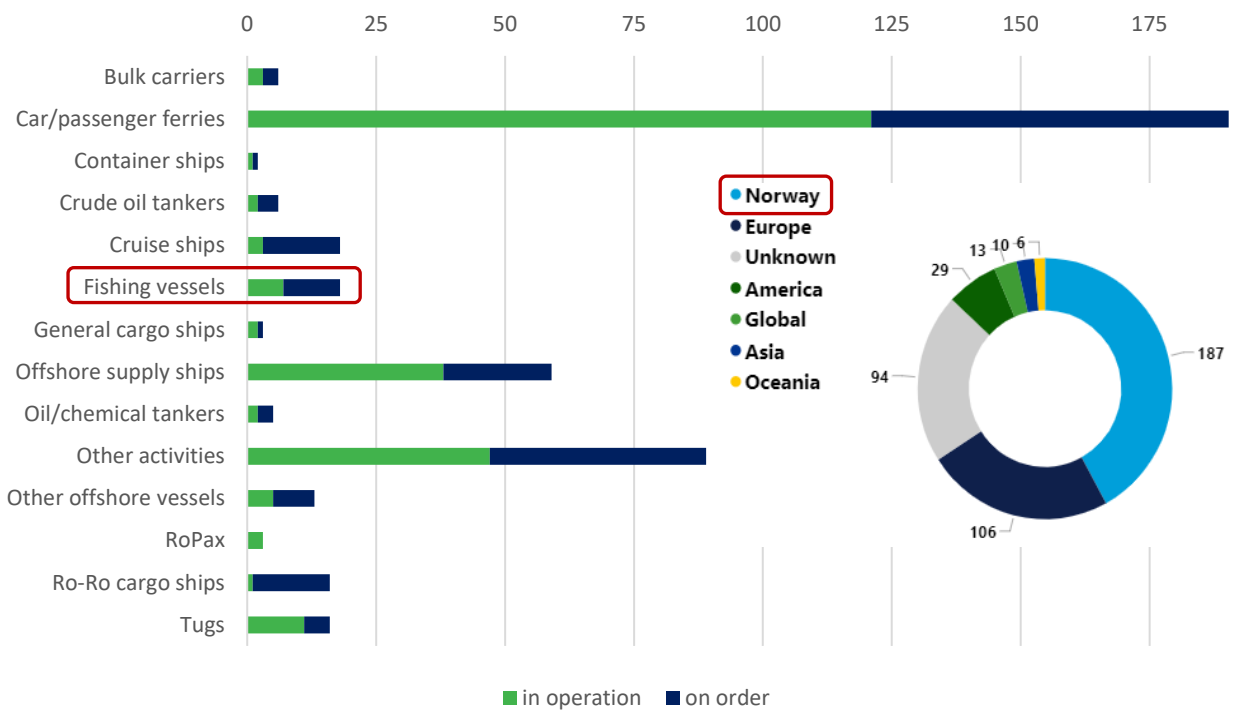


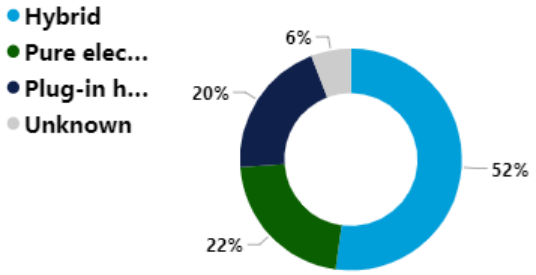




Indian pilot project -
LNG-fuelled fishing vessel

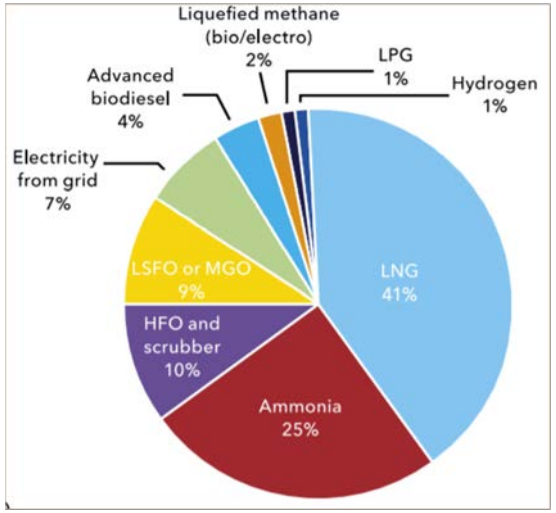
# Alternative Fuel Insight - Batteries




- **Hybrid**
  - uses batteries to increase its engine performance
  - does not use shore power to charge its batteries
- **Pure electric**
  - operates solely on batteries
  - recharged with shore power
- **Plug-in hybrid**
  - able to charge its batteries using shore power
  - has a conventional engine in addition.

# Future uptake of alternative fuels




- **Whole shipping sector 2050** (DNV-GL)
  - LNG is dominating
  - Ammonia - most promising carbon-neutral long-term solution

- **Norwegian fishing fleet towards 2030** (Grønnt Kystfartsprogram, DNV-GL, Fiskebåt)
  - Evaluation of technical feasibility and emission impact (high/medium/low)

| | Batteries (fully/partly electrified) | | Hydrogen | | Biogas | | Biodiesel | | LNG | |
|---|---|---|---|---|---|---|---|---|---|---|
| **SHIP TYPE:** | Feasibility | Impact | Feasibility | Impact | Feasibility | Impact | Feasibility | Impact | Feasibility | Impact |
| **Bottom trawler** | | | | | | | | | | |
| **Pelagic trawler** | | | | | | | | | | |
| **Deep sea (auto-liner)** | | | | | | | | | | |
| **Coastal fishing** | | | | | | | | | | |

# Further work

- WP1 & WP2: When developing integrated cooling and heating solutions for fishing vessels:
  - Identify waste heat characteristics for ships applying alternative (hybrid) propulsion systems / fuels
  - Develop models to estimate the available waste heat onboard such ships for different operating modes.
- WP3: When adapting methods for estimating the carbon footprint of fishing vessels:
  - Identify changes in fuel consumption and emissions for ships with alternative propulsion systems / fuels.
  - Develop models for estimating the fuel consumption / emissions for different operational modes
    - disaggregated between propulsion and auxiliaries

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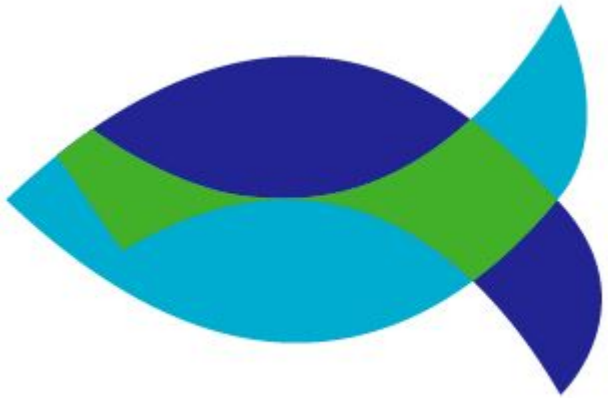

# Thank you!

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