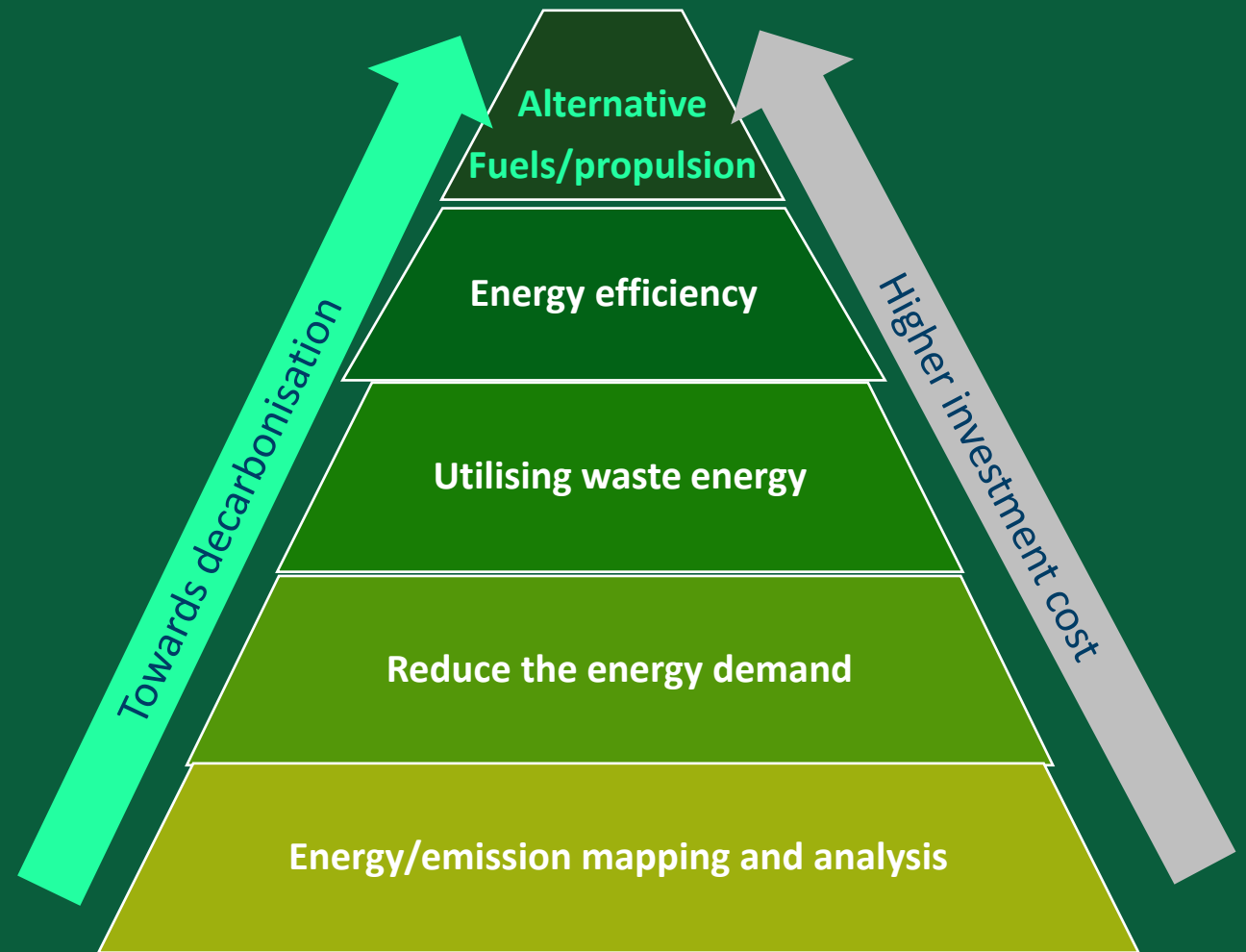




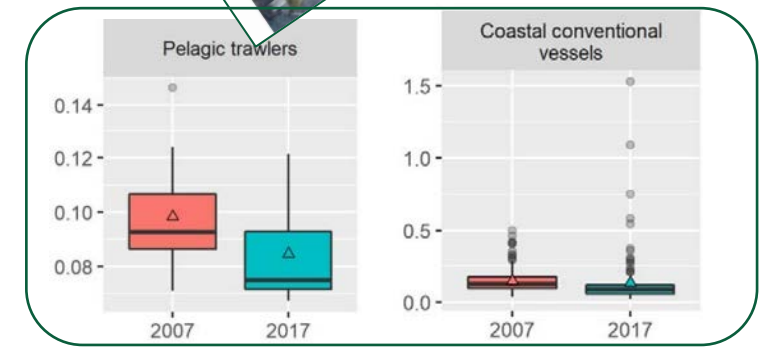
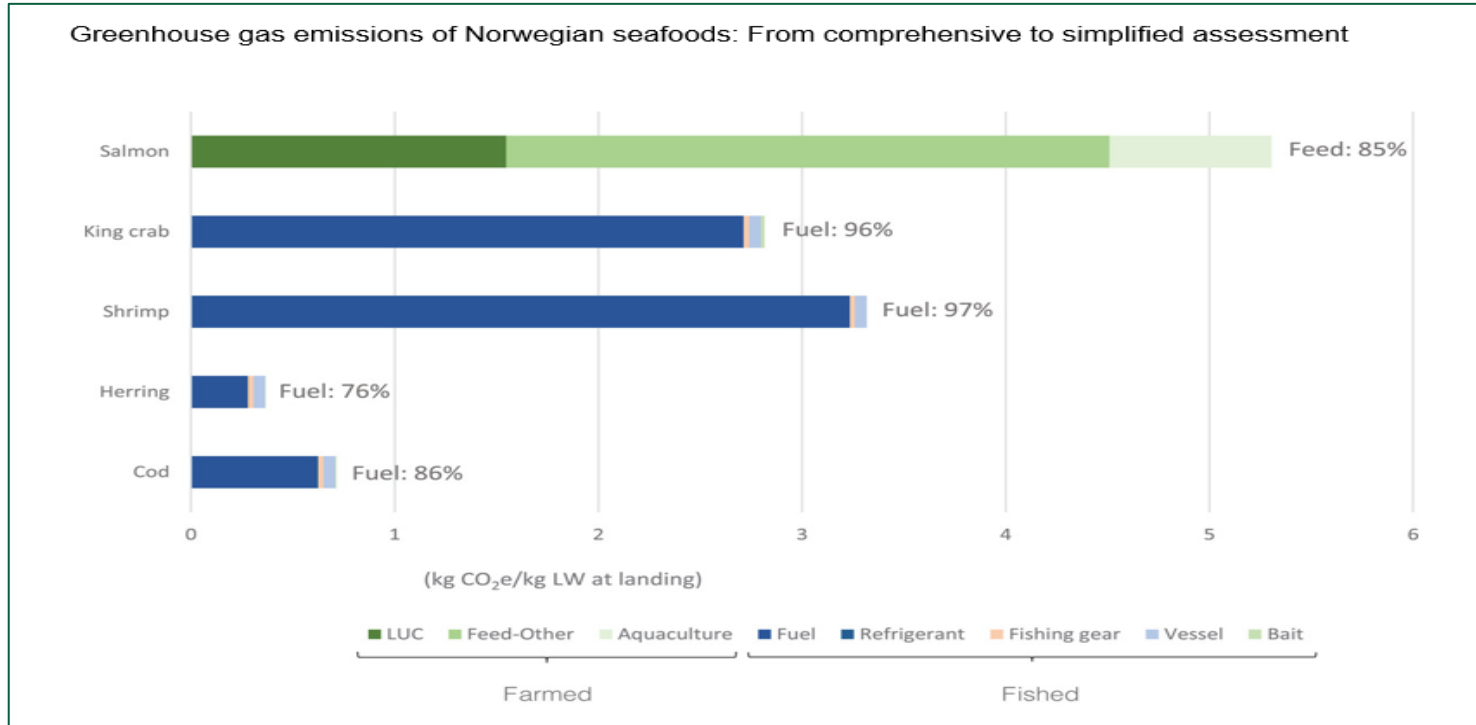
SINTEF

Workshop on Decarbonising the EU fishing sector Examples from Norway

Cecilia Gabrieli
SINTEF Energy Research, Norway



Mapping of GHG emissions

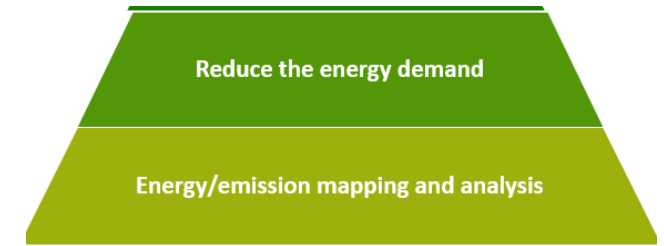


- Challenge: lack of operational data
 - today based on annual fuel consumption, or installed engine power
 - need for continuous onboard measurement on various energy consumers

Analysis of energy consumption

- Research cruise on a pelagic trawler for data collection and observations
 - Detailed fuel consumption – time, operational modus, various consumers
 - Refrigeration system performance
 - Temperature measurements in chilling tanks and landed fish
 - Weather, catch, operational behaviour

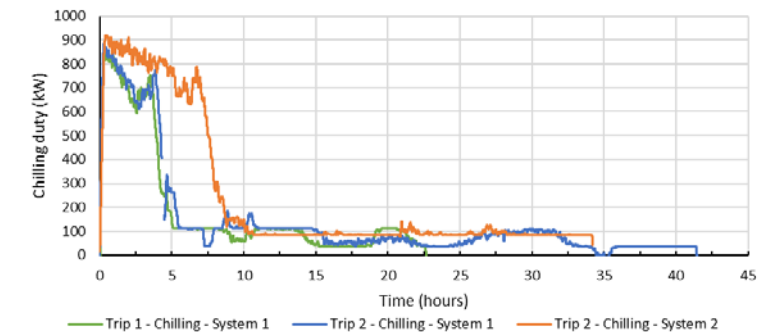
- Data analysis for reducing the energy demand on existing ship and new-builds
 - Talk with crew, discuss "simple every day" measures
 - Input for designing the next ships



CoolFish 



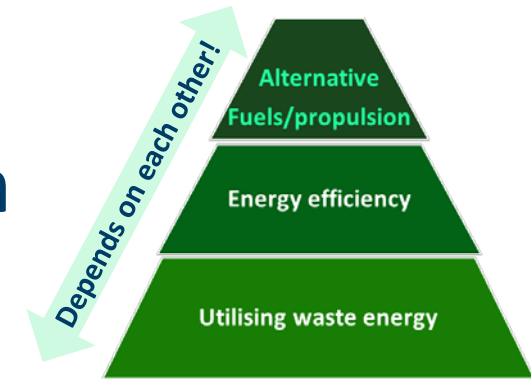
Chilling duties





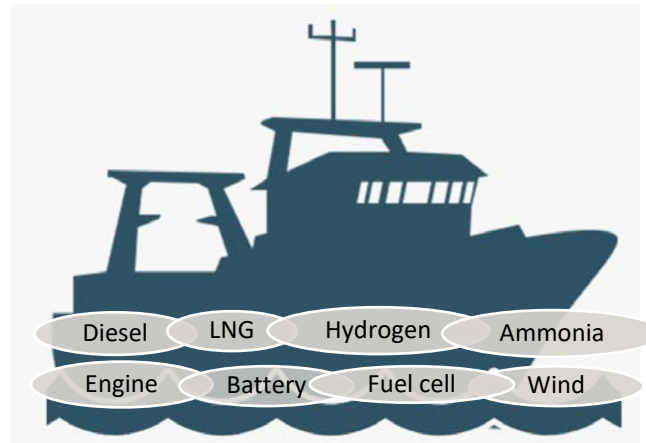
SINTEF

System thinking – to avoid sub-optimisation



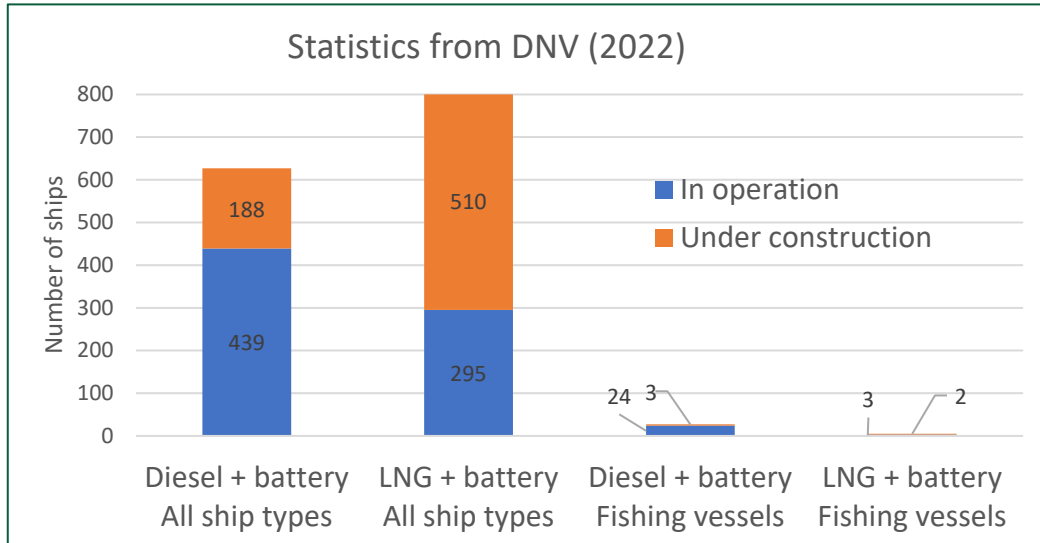
One example:

- New propulsion systems / alternative fuels offers various opportunities for waste energy recovery
 - LNG/LBG and LH2 enables cold recovery to support the refrigeration systems
 - Combustion engines and HT fuel cells enables heat recovery for power production/refrigeration/heating
 - LT Fuel cells and batteries has limited heat recovery options



- The choice of propulsion system and fuel must be made with an integrated system approach

Available and used today



The first diesel-battery fishing vessel (2016)



The first LNG-battery fishing vessel (2021)

Available and used "tomorrow" (examples)

- LNG and diesel can be replaced by biofuels and e-fuels
- Ammonia (NH₃) and hydrogen (H₂) in combustion engines or fuel cells

MAIN CHALLENGES with NH₃ (and H₂)

- Bunkering infrastructure
- Safety issues – public acceptance
- End use - Onboard technology
- Value chain – cost, emissions


Green Shipping Programme



The first NH₃ fishing vessel? (?)

- Some of the benefits with ammonia:
 - Less space is required onboard (compared to H₂)
 - Already used in refrigeration systems onboard fishing vessel
 - Existing LNG bunkering infrastructure can be used



SINTEF

State-of-the-art fishing vessel energy recovery and energy efficiency

Energy efficiency

Utilising waste energy

- 40% reduction in total GHG reduction compared to a similar vessel with conventional technology

Hybrid propulsion with combustion engines and batteries

- Fuel: LNG (LBG when available)
- GHG reduction from switching from **diesel to LNG: 20%**

The vessel is designed to keep energy usage at a minimum level.

To be delivered 2023



20% GHG reduction from energy efficiency and energy recovery

- Cold recovery from LNG: supports refrigeration compressors
- Efficient refrigeration system, advanced temperature control
- Power production and heat supply from engine waste heat

- Battery - peak shaving and optimised engine operation
- Shore power
- Energy recovery from electric winches
- Designed for lower maximum speed



SINTEF

How to realise use of carbon-neutral maritime fuels?

- Key success factors for introducing new maritime fuel
 - Infrastructure for production and distribution must be established together with the prototypes being tested
 - Collaboration projects with partners from the whole value chain

The Green Platform Initiative – Norwegian Government

- provides funding for enterprises and research institutes engaged in green growth and restructuring driven by R&I.
- stimulate bigger and more rapid investments from companies in green sustainable solutions and products

Green Initiatives

Norway Approves 10 Million Dollar Grant for World's First Green Ammonia Terminal

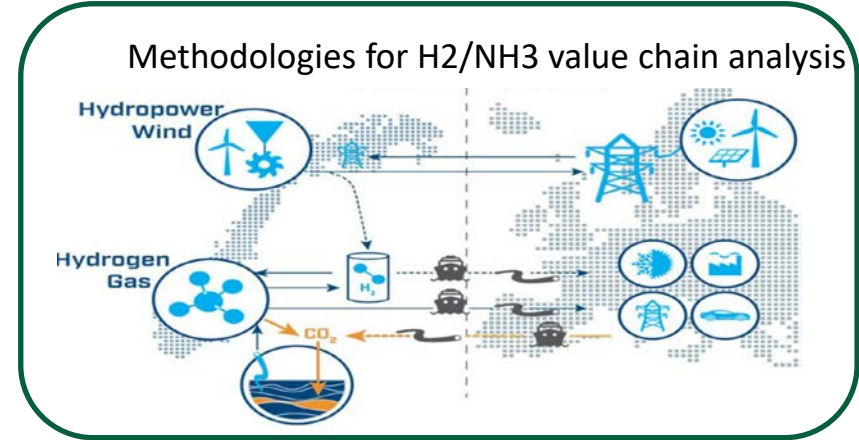
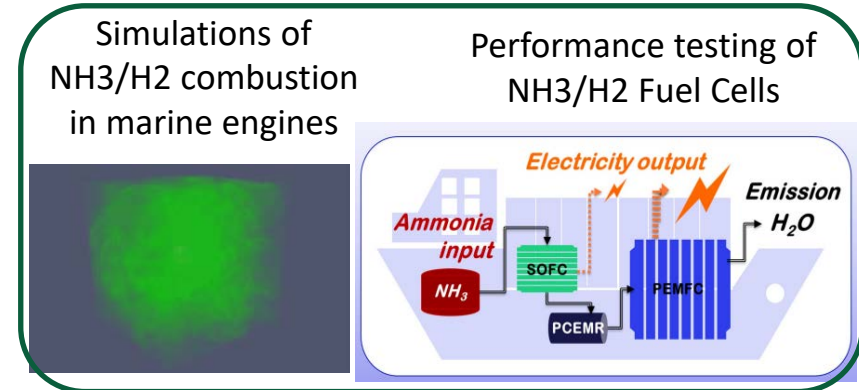
Ammonia Fuel Bunkering Network



Ammonia Fuel bunkering network

Industry project main goal: Realize an ammonia fuel value chain for the first ammonia-fuelled ships

Research project: develop and disseminate knowledge to facilitate realization of a cost-efficient value chain and safe use of NH₃ as a zero-carbon maritime fuel.



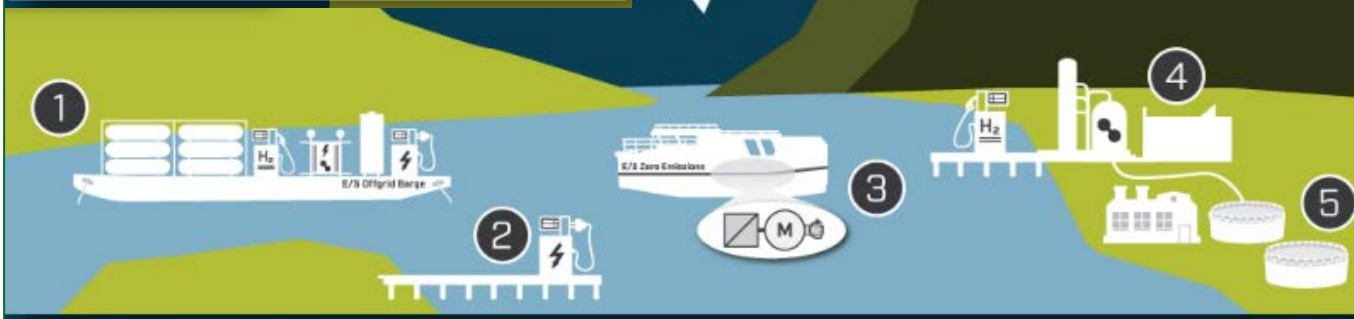


SINTEF

Another "Green Platform" project: Hydrogen for coastal fishing vessels

ZEROKYST

1. Barge with hydrogen and electricity storage, fuel cell, charging point and hydrogen filling station
2. Pier with charging point
3. Boat with zero-emission powertrain
4. Electrolysis plant with hydrogen storage and hydrogen filling station
5. Fish hatchery with oxygen and heat supply from the electrolysis plant



ZeroKyst will set into motion a rapid technology shift for all vessel types in the fisheries and aquaculture industry



Develop and demonstrate a zero-emission powertrain



Develop a new zero-emission vessel



Retrofit 10 vessels to zero-emission propulsion



Flexible supply of electricity and hydrogen



SINTEF

Thank you!