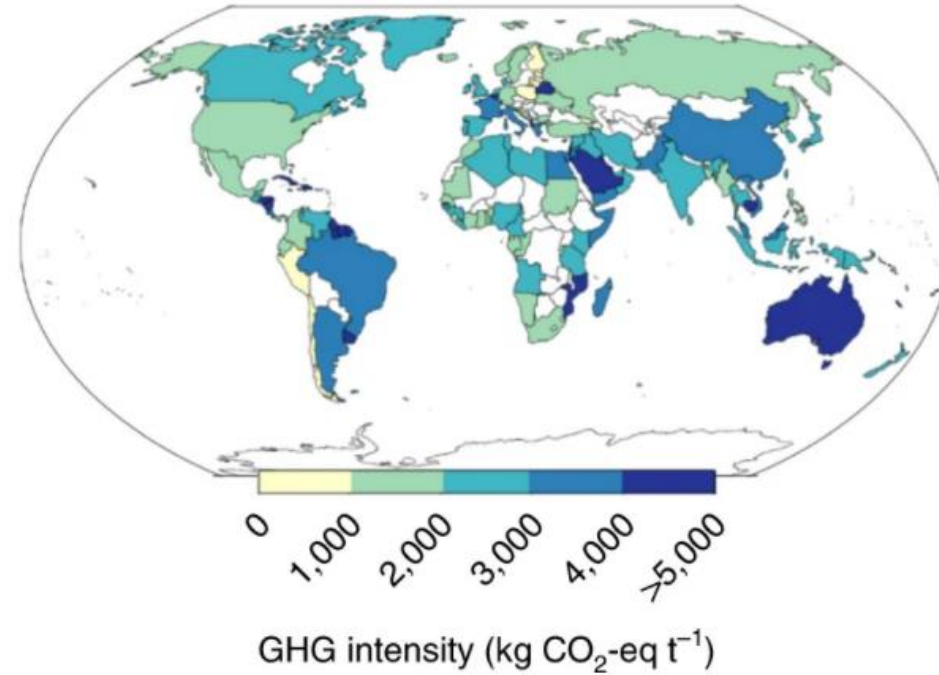




## Mer klimavennlig sjømatproduksjon

Det blir mer og mer viktig å finne løsninger for å redusere klimagassutslipp.

# Økende interesse for matens klimaavtrykk



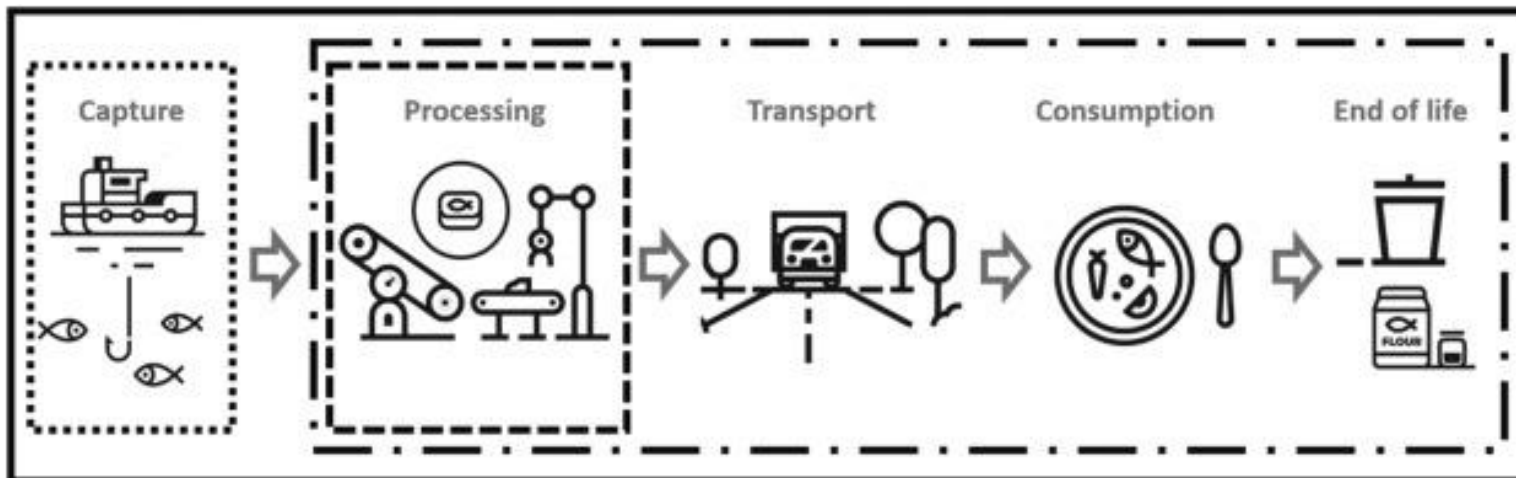
Nye Selvåg Senior reduserer klimagassutsleppa med 42 prosent

# Carbon Footprint (CF) assessment

- A simplified form of LCA
- + single numerical index - emission of Green House Gases: kg CO<sub>2</sub><sub>eqv</sub>
- Only includes climate impact - excluding all other environmental aspects.
- The CF of a product is the total emissions during the defined system boundaries



**Selvåg Senior, miljøfakta**  
 Reduksjon i utslepp ved LNG-drift og alle tiltak:  
 SO<sub>x</sub>: 97%  
 NO<sub>x</sub>: 85%  
 CO<sub>2</sub>: 45%

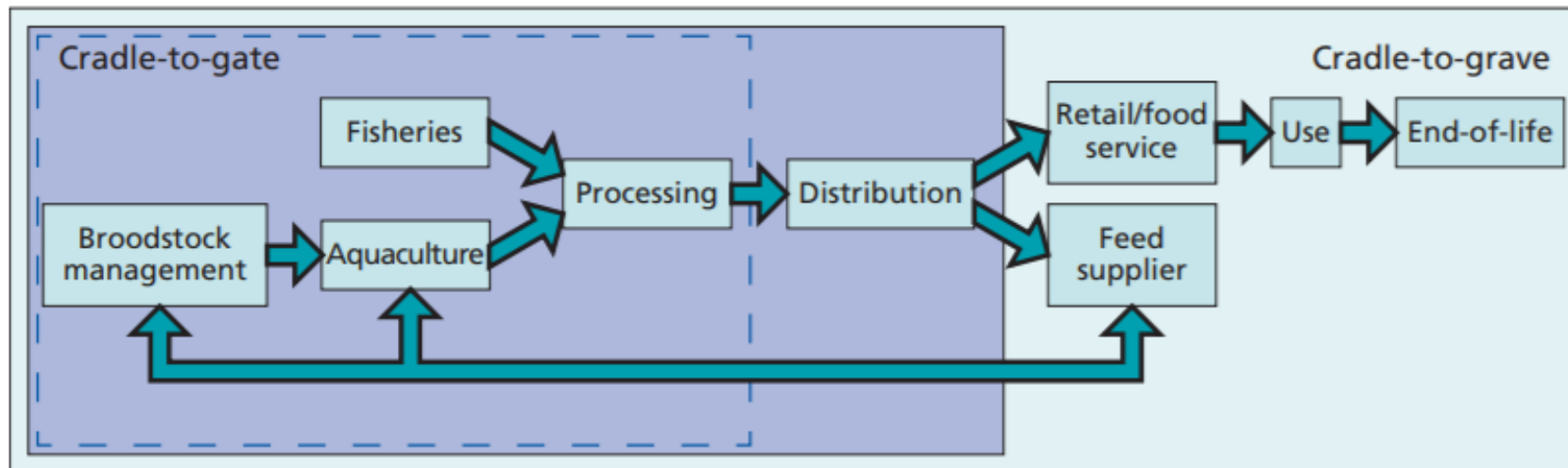


"cradle to grave": all stages of the life cycle     
  "cradle to gate": from the beginning to a midpoint of the life cycle  
 "gate to gate": intermediate stage of the life cycle     
  "gate to grave": from a midpoint to the end of the life cycle

Results will vary widely depending on methodology and assumptions

# Carbon footprint – methodologies/standards

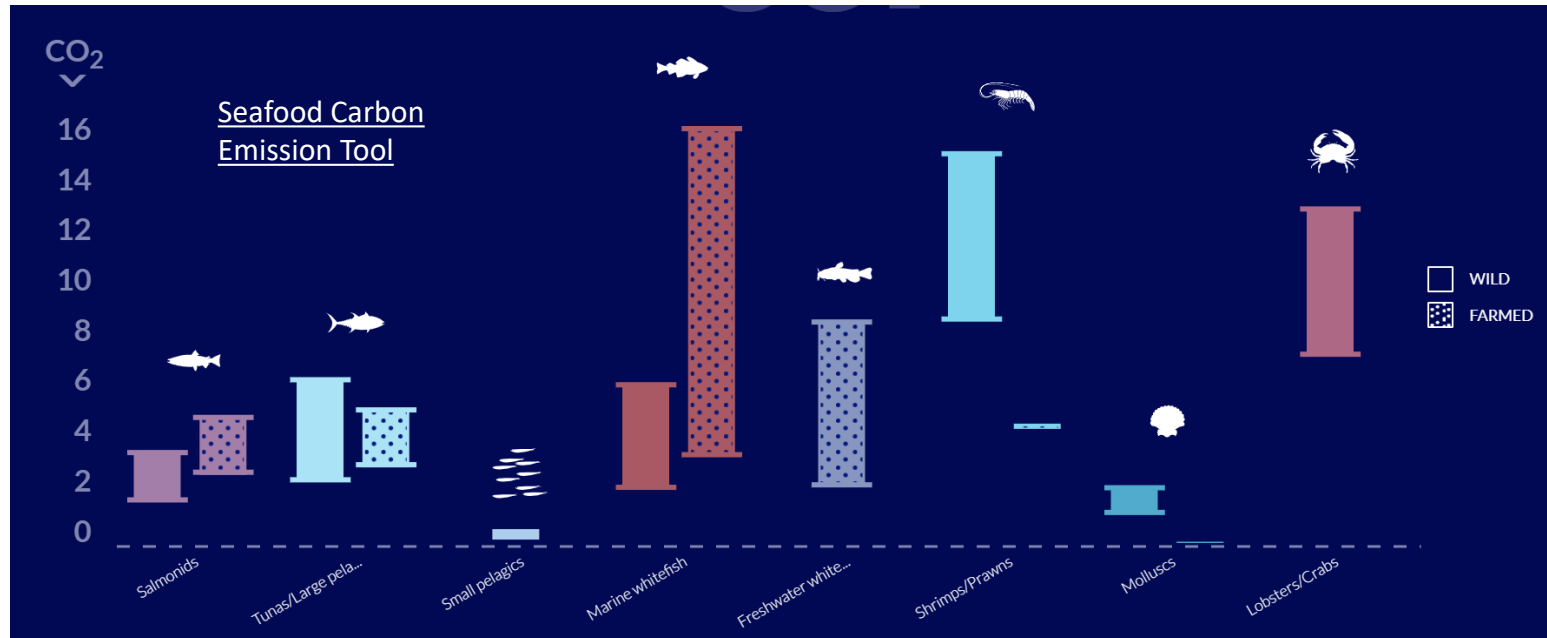
- Only a few specifically developed for seafood.
- **Norwegian NS-9418:** product category rules for calculating & communicating CF of seafood products
  - *based on ISO 14067*
- **The British Standard PAS2050:2** requirements for the CF assessment of seafood products



# Carbon footprint – tools

Results will vary widely depending on methodology and assumptions

- Several on-line tools for estimating the CF of seafood products.
- The assessment of the fishery stage is based on default data of:
  - total fuel use (propulsion, refrigeration etc) for conventional diesel engines
  - refrigerant leakage

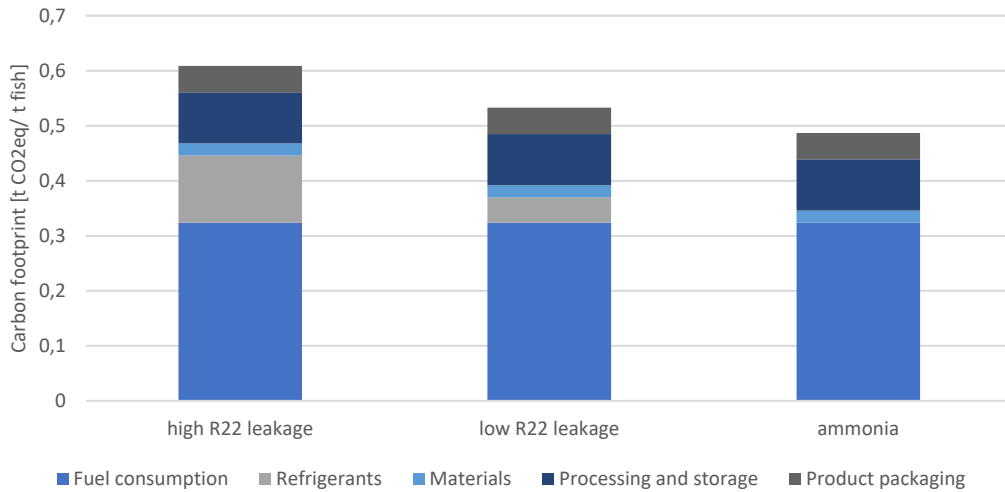




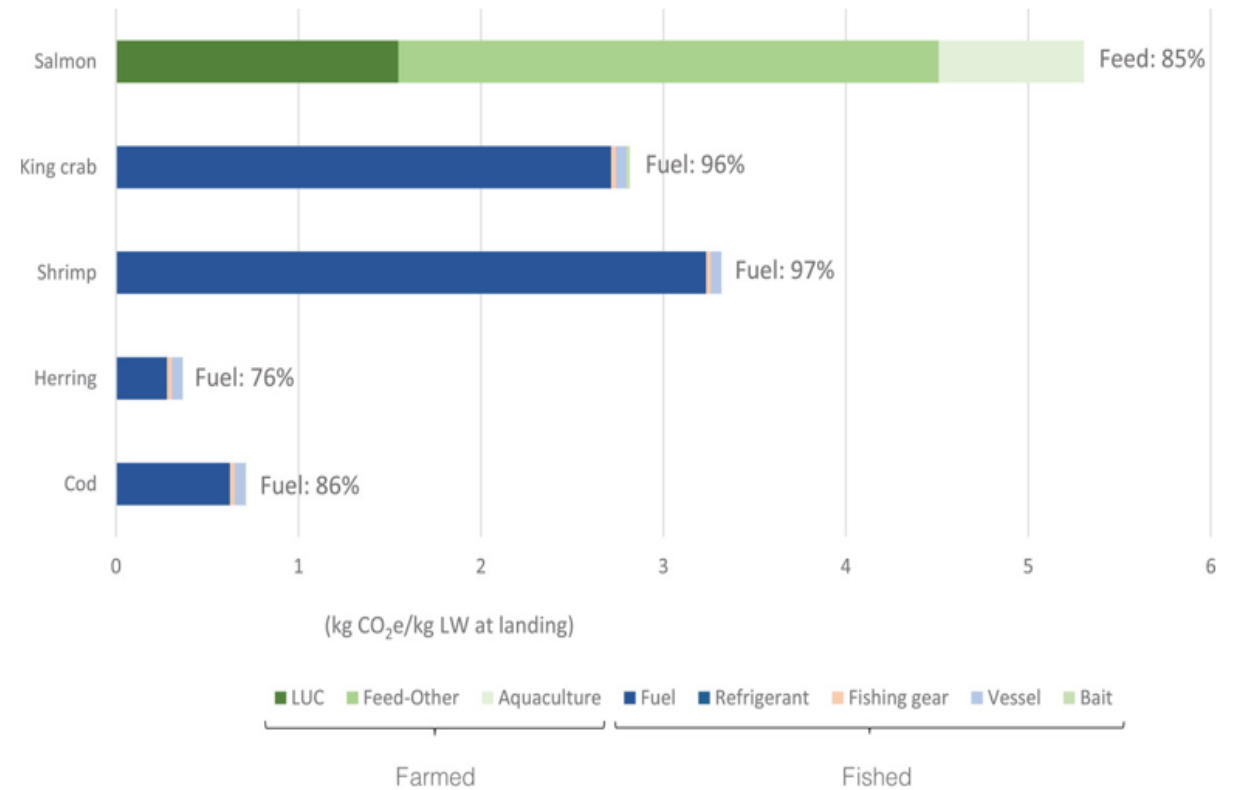
# Scientific studies on CF of captured seafood

*Results will vary widely depending on methodology and assumptions*

- Typically, 70% – 90% are related to the fishing stage
- primarily from fuel to power the fishing vessel.
- refrigerant leakage from HCFC/HFC systems



Greenhouse gas emissions of Norwegian seafoods: From comprehensive to simplified assessment



- **Transport** can also play an important role:
  - fresh products by air, or frozen products over long distances.

# Alternatives fuels

## CARBON FUELS

### Liquefied Natural Gas (LNG)



Established infrastructure   Long-term solution   Global fuel availability



Safe to handle   Increased CAPEX

+ Clean fuel, rapidly developing infrastructure  
- Methane slip

### Liquefied Petroleum Gas (LPG)



Global fuel availability   Safe to handle

+ CO<sub>2</sub> emissions

### Methanol / Ethanol



Increased CAPEX   High fuel cost

+ Easy-to-handle, well developed terminal network  
- Refueling challenges, flammable

## CARBON NEUTRAL

### Biofuels / Biomethane



Safe to handle



High fuel cost

+ Increasingly used as marine fuel, can be used as drop-in fuel

- Sustainable scaling up needed

### Synthetic methane / SNG



Safe to handle



High fuel cost

+ Easily adapted to LNG infrastructure, can be used as drop-in fuel

- Large-scale production challenges, requires renewable energy source

## ZERO CARBON

### Hydrogen



Long-term solution   Increased CAPEX   High fuel cost

+ Low energy density per volume and favorable specific density by mass

- Storage challenges, flammable

### Ammonia

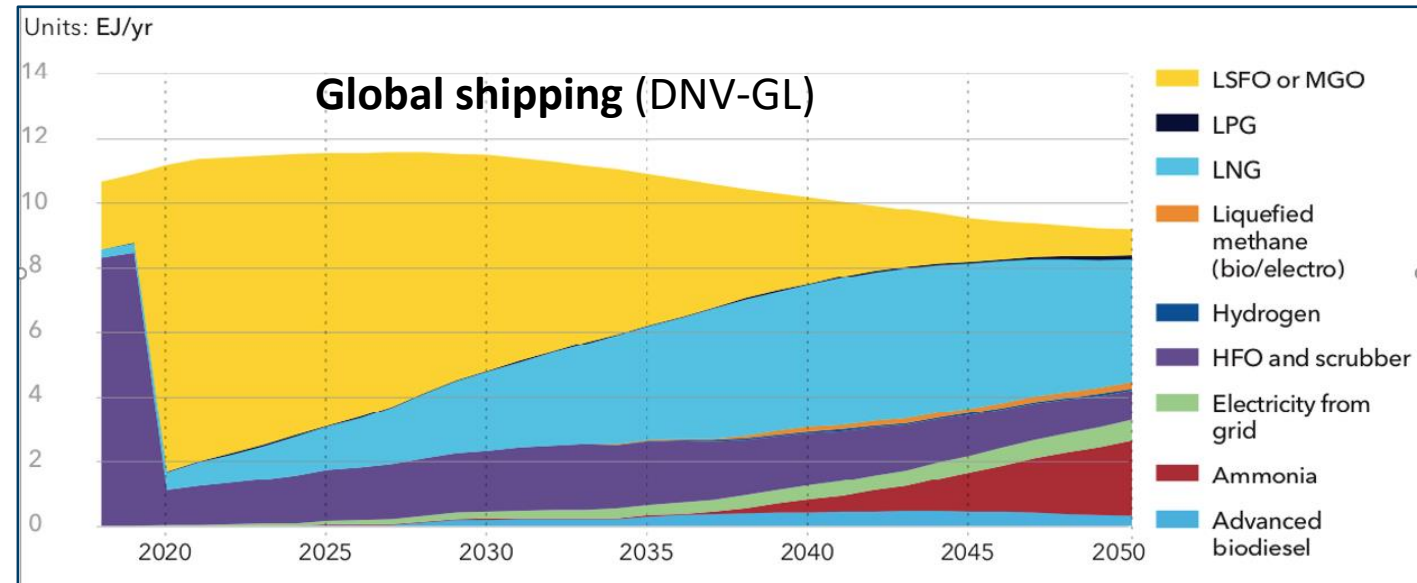


Long-term solution   Increased CAPEX   High fuel cost

+ Solution for internal combustion engines and fuel cells

- Limited bunkering, toxic effects on human health

# Future fuels - some predictions



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

SHIP TYPE:	Batterier (fully/partly)		Hydrogen		Biogas		Biodiesel		LNG	
	Feasibility	Impact	Feasibility	Impact	Feasibility	Impact	Feasibility	Impact	Feasibility	Impact
Bottom trawler	High	Low	High	Low	High	Low	High	Low	High	Low
Pelagic trawler	High	Low	High	Low	High	Low	High	Low	High	Low
Deep sea (auto-liner)	High	Low	High	Low	High	Low	High	Low	High	Low
Coastal fishing	High	Low	High	Low	High	Low	High	Low	High	Low

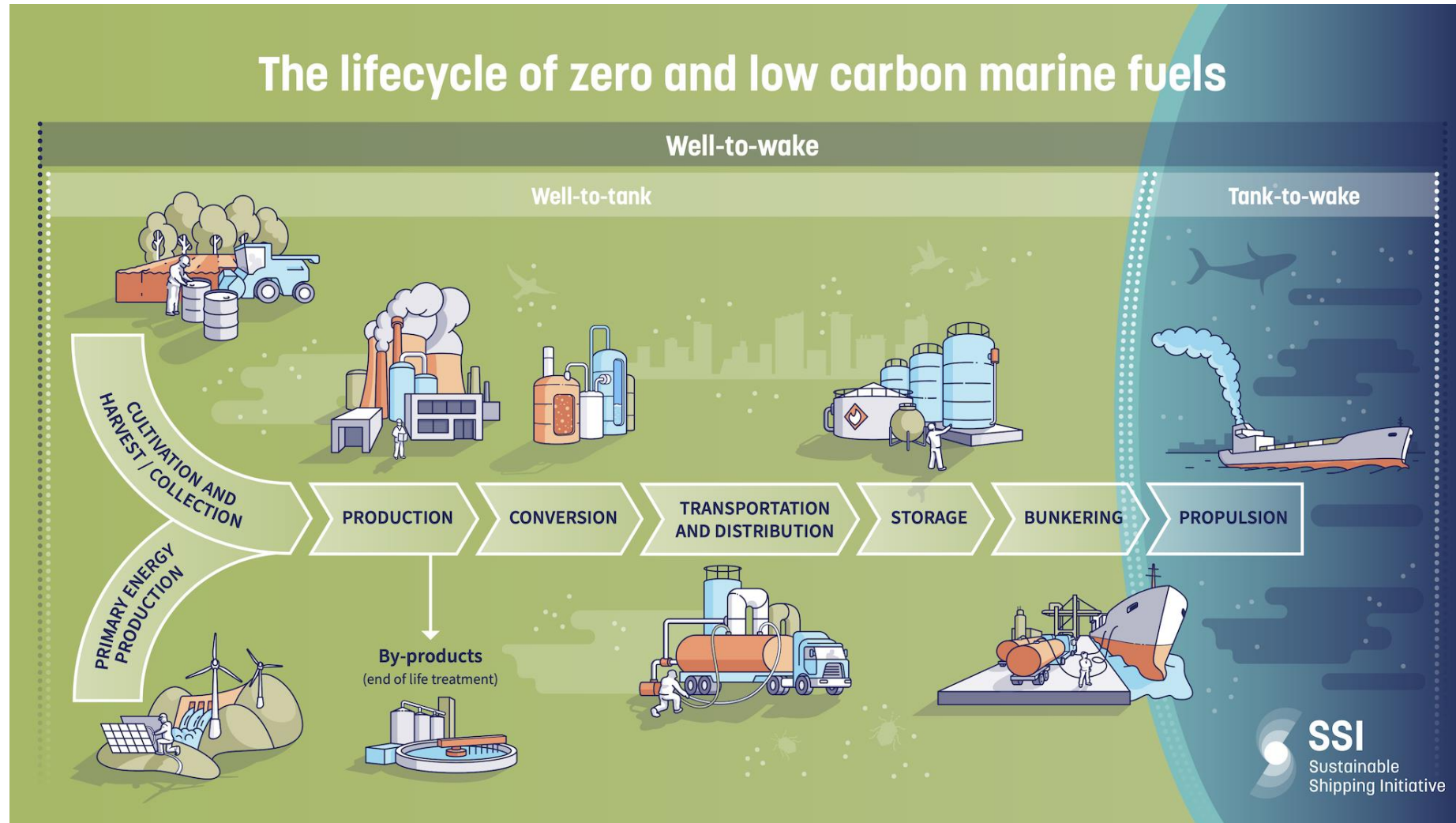
**Får 120 millioner kroner til hydrogenrevne fiskebåter**

ZEROKYST - GRØNN PLATTFORM



# The proposal for "Fuel EU Maritime Initiative"

- Ship owners must reduce the GHG intensity of the fuel they use by 75% by 2050 (compared to 2020)
- The reduction in GHG intensity shall be based on the well-to-wake method



# Estimation of well-to-wake emissions (one example)

## CO<sub>2</sub> emissions of alternative fuels in shipping

- TTP - tank to propeller
- WTT - well to tank
- Range of methane emissions in CO<sub>2</sub> equivalent

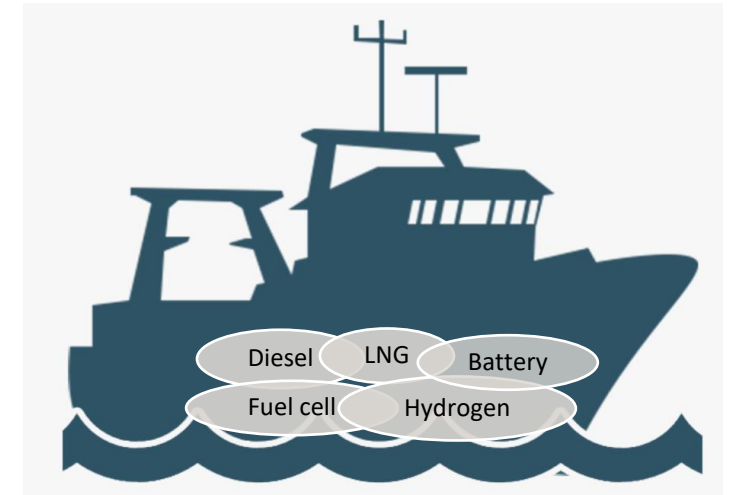


# What about energy efficiency??

*"En spart kWh er bedre enn en produsert kWh"*

Energy savings through:

- **Hybrid propulsion** – combining combustion engines and batteries
- Optimisation of hull, propeller, electrification of fishing gear
- **Energy efficient cooling and heating technologies**
- **Waste energy recovery**
- **Energy system integration**



Future propulsion systems and fuels imply **changes in the energy system onboard**

- waste heat characteristics & availability
- heating and cooling load profiles

Sørheim viser til at det er summen av tiltak som gir den positive effekten med nær halverte utslepp av klimagassar.

- I grove trekk får vi halvparten av gevinsten med å bruke LNG som drivstoff, medan andre halvparten kjem som eit resultat av andre tiltak som varme- og kuldegjenvinning, skrogutforming, elektriske vinsjar osv., seier Sørheim.



**Nye Selvåg Senior reduserer klimagassutsleppa med 42 prosent**





SINTEF

Technology for a  
better society