Part 3: Low- and high temperature TES in maritime sector

Intro: Thermal storage – an enabler of zero-emission shipping?

- Taking **cruise ships** and **fishing vessels** as good examples
  - Both ships have a large energy demand for thermal systems onboard
- Two KSP-projects with the "same" aim:

Development of innovative, energy-efficient and environment-friendly concepts for heating and cooling production on-board

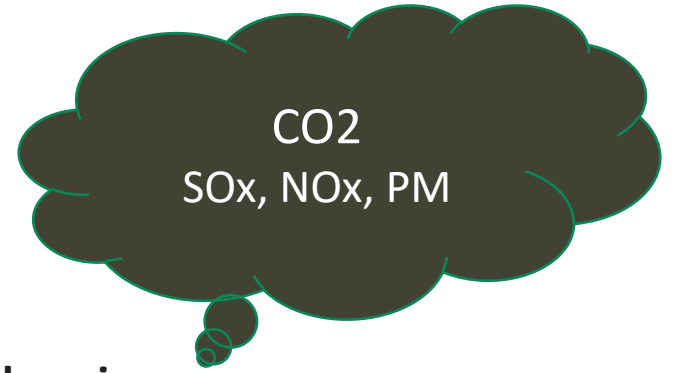
CoolFish

Project manager: Kristina Norne Widell, SINTEF Ocean

CruiZE

Project manager: Cecilia Gabrielii, SINTEF Energi

Energy production onboard



- Power demand for propulsion and other needs - e.g. HVAC & refrigeration: **fossil fuel engines**

- Heat demand – e.g., space heating, showers, galley: preferably by **WHR from engine's exhaust gas and cooling water**
  - **Oil-fired boiler** is used when there is not enough waste heat: e.g., *in port / battery operation*

- **Increasingly stricter regulations – emission cuts and zero-emission zones**

- Development towards **hybrid energy production** onboard
  - Diesel /LNG engines + batteries and shore power
  - Reduce emissions and enable periods of zero-emission operation

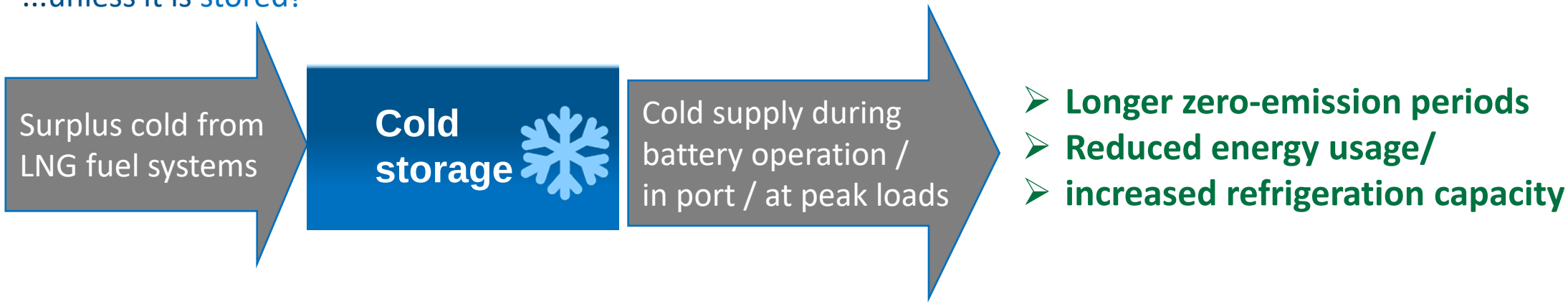
Zero-emission operation – Cruise ship

Zero emission operation period	Challenge	Consequence	"Obvious" solution	Challenge
In port - shore power	No waste heat from engine	Oil-fired boiler operation → emissions	Electric boiler	Limited shore power capacity
In fjords - battery				Requires "too large" battery

- **Longer zero-emission periods**
- **Reduced energy usage**

Zero-emission operation - fishing vessel

- Apart from propulsion, **refrigeration** is often the primary energy consumer
- Utilize surplus cold from LNG fuel system: "LNG cold recovery":
  - can reduce power usage for refrigeration
  - but only when LNG engines are running…
- ...unless it is stored!



- **Longer zero-emission periods**
- **Reduced energy usage/**
- **increased refrigeration capacity**

- 13:30 **Part 3: Low- and high temperature TES in maritime sector**
  - Intro: Thermal storage – an enabler of zero-emission shipping? - Cecilia Gabrielii (SINTEF Energy Research)
  - Opportunities for compact TES on board fishing vessels and cruiseships – Erling Vingelsgård (SINTEF Ocean), Angel Pardiñas (SINTEF Energy Research) & Håkon Selvnes (SINTEF Energy Research)
  - Some reflections on the utilization of PCMs in thermal systems - Chris-Andre Larsen, Bjørn Holo (Teknotherm)
  - Piloting Integrated HT/LT system on 600pax Ro-Pax vessel – Bernt Aage Ulstein (Ulmatec Pyro)