TF4 – Development of Technologies for End Users

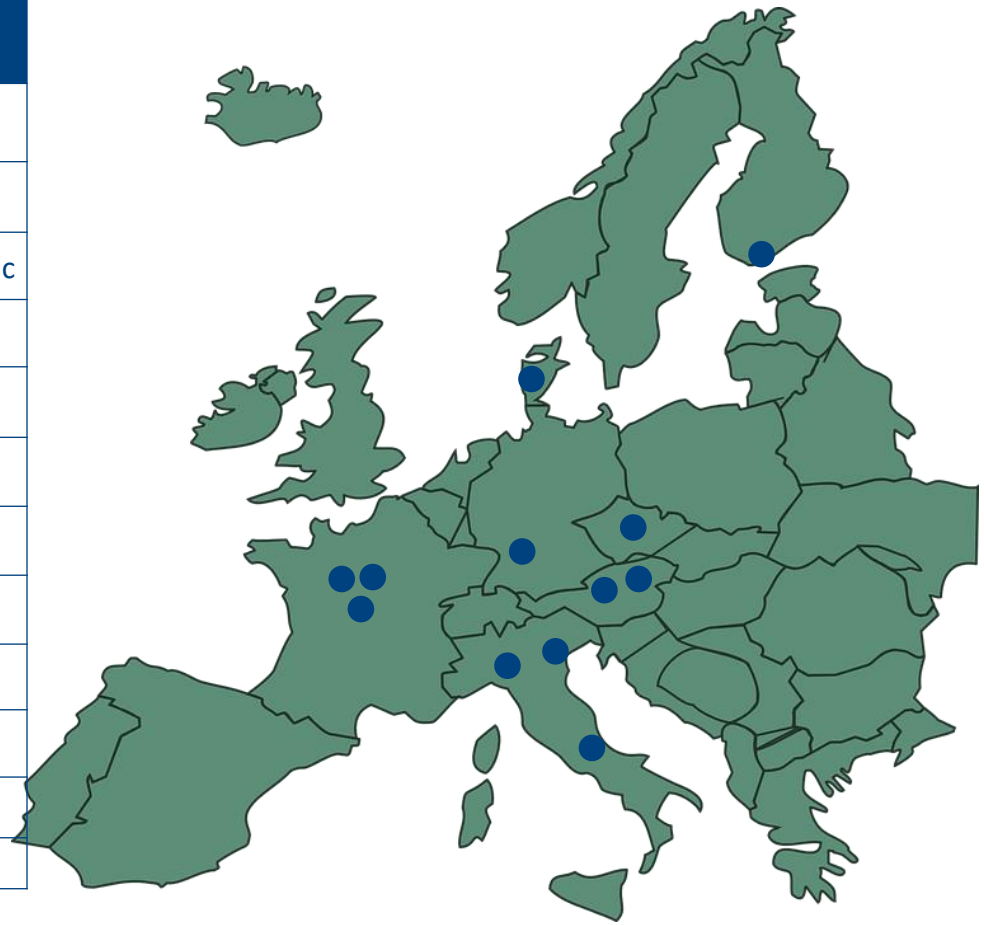
IPCEI HYDROGEN

2nd General Assembly, Berlin

TF4 Update

TF4 – Overview of Direct Participants

ID	Direct Participant	Company Type	Country
AT04	Plastic Omnium New Energies Wels	LE	Austria
AT13	Bosch Austria	LE	Austria
CZ02	Iveco Czech Republic	LE	Czech Republic
DE21	Daimler Truck	LE	Germany
DK10	ØRSTED HYDROGEN GREEN FUELS DK A/S	LE	Denmark
FI05	Neste Oyj	LE	Finland
FR09	Alstom	LE	France
FR11	Plastic Omnium	LE	France
FR16	HYVIA	SME	France
IT13	Fincantieri	LE	Italy
IT20	Iveco S.p.A.	LE	Italy
IT43	Alstom Ferroviaria	LE	Italy



TF4 – Development of Technologies for End Users

Technology Field 4 (TF4) focuses on the development of hydrogen technologies for **mobility** of persons (e.g. railway, buses and maritime), **transport of goods** (e.g. heavy duty trucks, railway and maritime) and utilization in **fuel production** applications. The activities considered in TF4 aim to contribute towards the following overarching objectives:

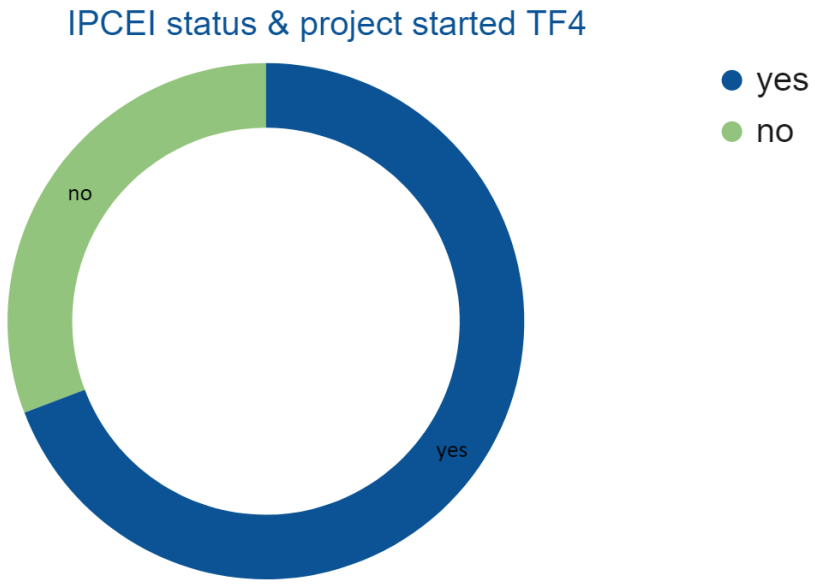
- The development and implementation of hydrogen technologies, processes and equipment for the specific use cases that will ensure improved lifetime, durability, safety and lowered emissions;
- The adaptation and integration of FC systems ("FCS") for mobility and transport applications;
- The assessment of regulations, standards and safety issues for the use of hydrogen technologies;

In order to achieve those objectives, the following streams of activities will be pursued:

- The design and development of hydrogen technologies (R&D&I & FID);
- The integration, testing and standardisation of hydrogen technologies (R&D&I & FID); and
- The development process for pilot lines and scale-up of hydrogen technologies (FID).

2nd GA IPCEI Hydrogen – TF4 Update

- 9/12 projects started with funding agreements in place
- First Milestones achieved by DPs
- Initial collaborations within TF4 and across other TFs of Hy2Tech have been established
- Dissemination/ Spill-over activities started



Topics and highlights of TF4 projects

Vehicles (heavy duty & light commercial)

- Plastic Omnium: 150 kW Fuel Cell Module for heavy duty applications & storage tanks
- Iveco s.p.A.: Hydrogen truck development
- Daimler: Fuel cell truck development
- Bosch: Hydrogen Large Engine development
- HYVIA: Light commercial FC vehicles
- Iveco Czech Republic: Fuel cell powered intercity buses

Benchtop prototype commissioned and characterised

Homologation of the first vehicle

Hydrogen trains

- ALSTOM: Hydrogen-powered shunting locomotive & H2 hydrogen train powered generator to be connected to electric locomotives in non-electrified sections
- Alstom Ferroviaria: Regional H2 train

Three prototype trains realised

Hydrogen ship

- Fincantieri: H2 cruise ship and H2 technologies (FC and ICE) hybrid architecture

Design for optimal onboard configuration started

Fuel production and refinery integration

- Neste: Electrolysis hydrogen production plant investment to the Porvoo refinery
- Ørsted: Conversion of renewable electricity to hydrogen and green fuels

Plant in Basic Engineering

Thank you!

Sonja Auvinen, Neste
On behalf of TF4

BOSCH IPCEI PROJECT - AT13 HCCELEA

Hydrogen, **C**arbon-free and **C**arbon-neutral Fuel **E**nabled **L**arge **E**ngine **A**pplications

IPCEI H2-CONFERENCE | Berlin

Dr. Roland Fortenbach (PS-LE/PRM) | 2023-12-06

BOSCH

Funded by
the European Union
NextGenerationEU

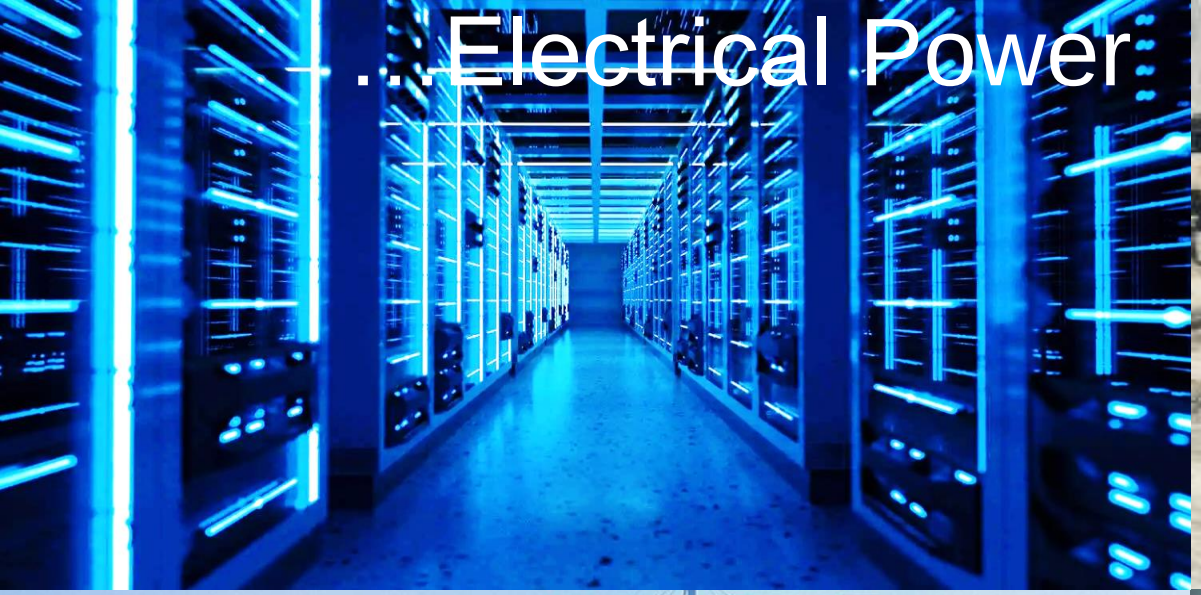
Federal Ministry
Republic of Austria
Labour and Economy

Federal Ministry
Republic of Austria
Climate Action, Environment,
Energy, Mobility,
Innovation and Technology

aws

FFG
Promoting Innovation.

BOSCH



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01

IPCEI H2-CONFERENCE
2023-12-06 | Berlin

Bosch Group

AT13 HCCELEA – IPCEI H2-CONFERENCE, Berlin

Bosch Group | Four business sectors 2022

Mobility Solutions

60%	52,6	226 000
share of Bosch Group sales	billion euros sales revenue	associates (approx.)

Industrial Technology

8%	6,9	34 000
share of Bosch Group sales	billion euros sales revenue	associates (approx.)

Energy and Building Technology

8%	7,0	34 000
share of Bosch Group sales	billion euros sales revenue	associates (approx.)

Consumer Goods

24%	21,3	83 000
share of Bosch Group sales	billion euros sales revenue	associates (approx.)

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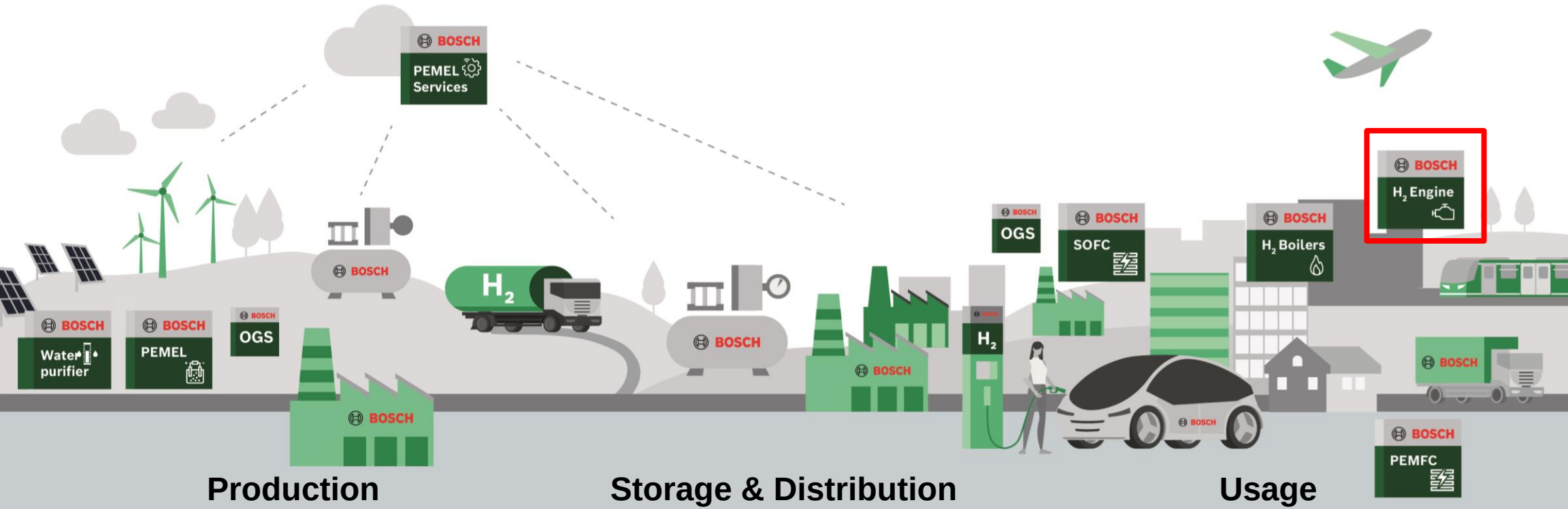
AT13 HCCELEA – IPCEI H2-CONFERENCE, Berlin

Bosch Group | Hydrogen Economy



PEMEL = Proton exchange membrane electrolysis; PEMEL Services = Electrolysis services;
OGS = Optical Gas Spectrometer; SOFC = Solid oxide fuel cell; PEMFC = Proton exchange membrane fuel cell

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02

IPCEI H2-CONFERENCE
2023-12-06 | Berlin

Bosch Business Unit LE - Large Engines

BOSCH

AT13 HCCELEA – IPCEI H2-CONFERENCE, Berlin

BU Large Engines | Headquarter Hallein, Austria

BOSCH

AT13 HCCELEA – IPCEI H2-CONFERENCE, Berlin

Four FIE Application Segments

POWER GENERATION

Continuous, stand-by, peaking power

- Generator Sets
- Power Plants

RAILWAYS

Locomotives

- Mainline
- Shunting

Vehicles/Machinery

- Construction Machines
- Mining Vehicles
- Oil & Gas mech. Drives

CONSTRUCTION & INDUSTRY

MARITIME

Propulsion / Auxiliary
(Ocean, coastal, inland river)

- Pleasure Boats
- Cruise liner
- Commercial Ships

LE: > 560kW

Annual New Builds

Approx. 70.000 in 2022

Installed Base
/ in Field

> 1 mio. engines

Age: up to 30 years and more

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Large Engines – HARSH CONDITIONS

Source: https://thermex-systems.com/engine-heaters/portathaw_frozen-mining-haul-truck-cat/

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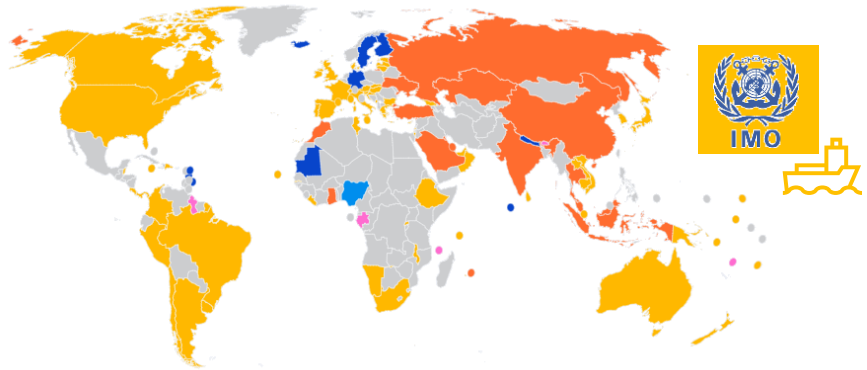
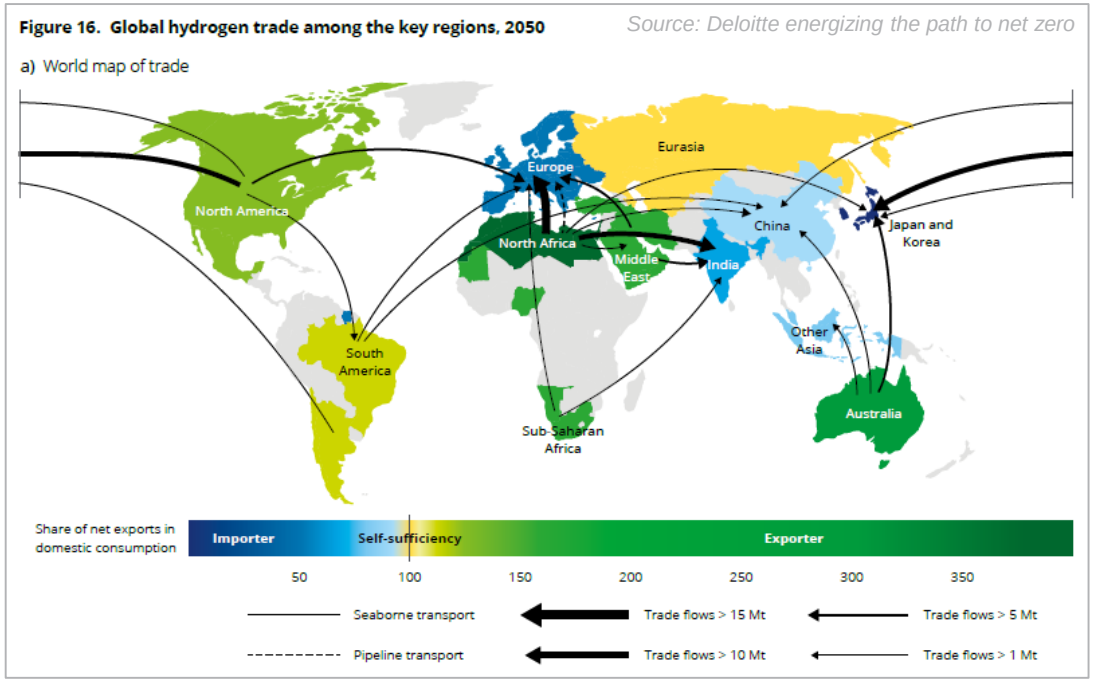
Decarbonization – around the globe



Source: based on www.climatewatchdata.org



- **~40% of ww LE applications (w/o IMO) not yet targeted in terms of CO2 reduction (net zero till 2050)**
- **Geopolitical developments move energy security to the top of the agenda → risk / chance for decarb.?**
- **Local energy production prioritized over energy import. However, global trade inevitable**

03

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2023-12-06 | Berlin

Bosch HCCELEA Project - Content and Status

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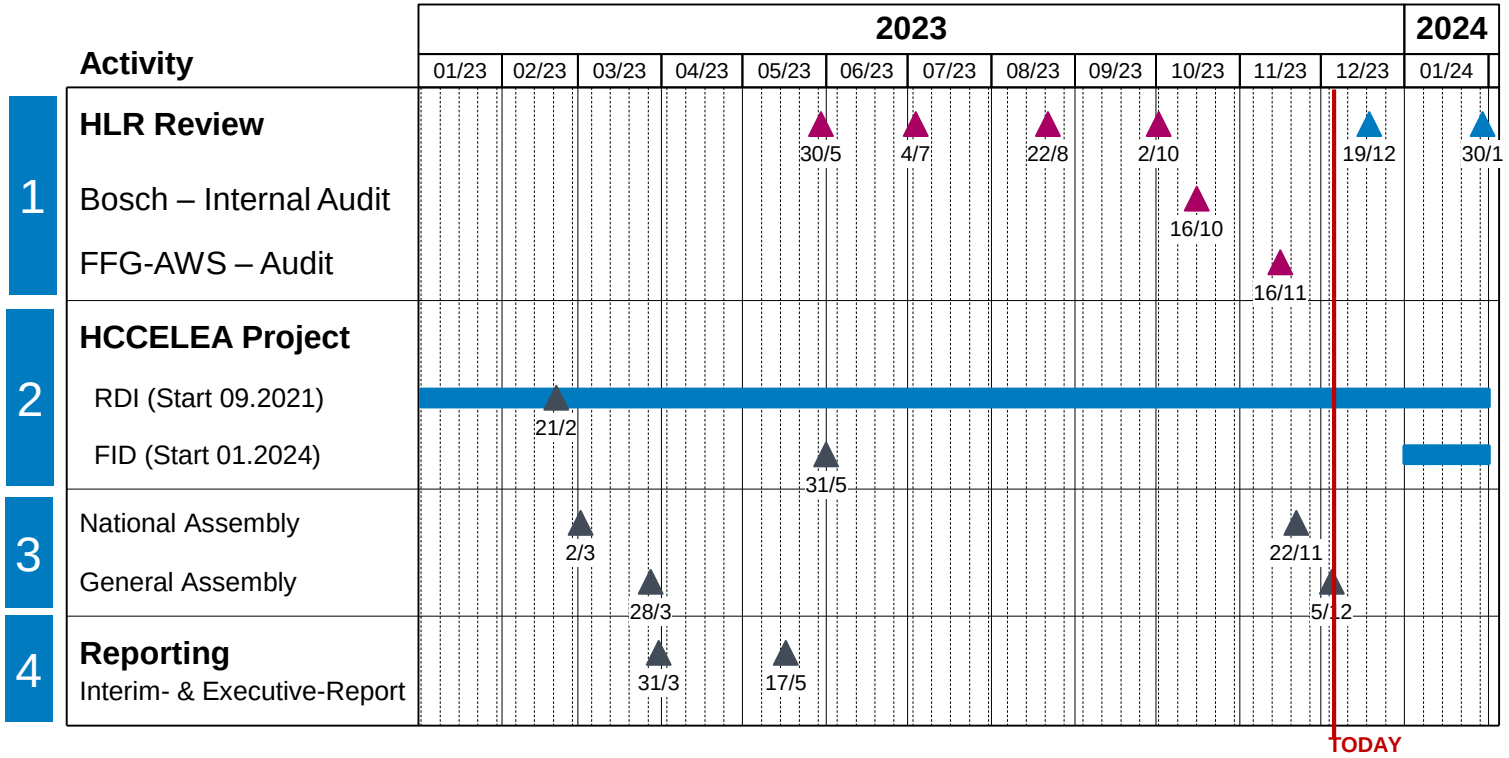
IPCEI AT13 HCCELEA – H2-CONFERENCE, Berlin

HCCELEA – At a glance



ON SCHEDULE

- Bosch Internal ÖgP-Audit **2023.10.16**
- FFG-AWS Digital System Audit **2023.11.16**
- FID-contract: AWS announced contract up-date for A2024
- National Assembly, Linz **2023.11.22**
- General Assembly, Berlin **2023.12.05**
- Reporting: completion w/ Autit results
- Cooperation opportunities with all direct partners (#10) inside IPCEI Hy2Tech: **Cooperation can be manifold and of overarching objective**

Fourth quarter dominated by Audits and Assembly meetings & continued partner cooperation
IPCEI HCCELEA RDI project running since 09.2021 – FID phase scheduled for 01.2024

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Future Portfolio | **IPCEI Focus / Content**

FUEL
(e- and bio-)

- **Ammonia** (gaseous & liquid)
- **Ammonia** (liquid)
- **Methanol** (liquid)
- **Hydrogen** (gaseous)
- **Methane** (gaseous)

TECHNOLOGY

- **Port Fuel Injection**
- **Port Fuel Injection**
- **Direct Injection**

FIE

Large Engine Gas Valves

LEGV50 LEGV400 *sample*

AFI-LP
Alternative-fuel injector – low pressure

Injector *sample*

AFI-HP
Alternative-fuel injector – high pressure

Injector

concept

AFP
Alternative-fuel pump

Pump *study*

Control Unit

Engine control unit

ECU

LE-ECU-MD1CE200-LE
Engine Control Unit for Large Engines, also available w/ marine certification

sample

PS-LE/PRM-Fortenbach | 2023-12-06 | 2023-0049

FIE...fuel injection equipment

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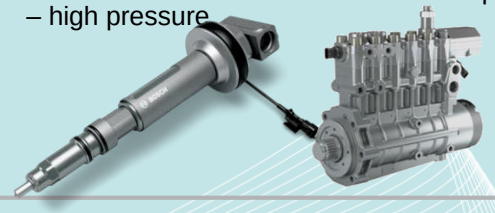
Status | **IPCEI Focus/Content**

Large Engine - Gas Valves

AFI-LP
Alternative-fuel injector – low pressure

AFI-HP
Alternative-fuel injector – high pressure

AFP
Alternative-fuel pump



	Large Engine - Gas Valves	AFI-LP	AFI-HP / AFP

Status	• LEGV on customer engine with H2 (performance, reliability, in field)
	• LEGV on test bench with NH3 (performance in focus)
	• C-samples available
		• Samples available
		• Testing facility build-up
		  • Performance and endurance testing ongoing
		• Engine test: DI H2- and PF/DI MeOH
		  • Various pilot projects, completion of requirements
		• Process chain development SE, ISEC, IDN
			• Technical Requirements evaluation
			• Concept analyses started
			• Based on injector status: conceptional
			  • SW-update

Nest Steps	• Industrialization and SOP	• Completion of injector performance • Industrialization and SOP	• Continue Requirement Engineering • Market assessment

LE-ECU
Engine Control Unit

IPCEI AT13 HCCELEA – H2-CONFERENCE, Berlin

Challenges

- Challenges Technology:
  - Variety of possible technologies
  - Technical requirements not all defined by OEMs
- Challenges Market:
  - Regulation, legislation
  - Infrastructure | H2 and Fuel availability
- Challenges IPCEI:
  - Documentation requirements: spill over, collaboration, deliverables KPIs, …. and currently audited

BOSCH

Thank you very much for your attention

Neste and Renewable Hydrogen

Heidi Bergman, Head of Investment Projects, Renewable Hydrogen

1st IPCEI Hydrogen Conference

5-6.12.2023

NESTE

Contents

- Introduction to Neste
- Neste and renewable hydrogen
- Moving forward with hydrogen investments

Our purpose is to create a healthier planet for our children

https://www.youtube.com/watch?v=Ovkgs-Qll6Y&t

Neste in a nutshell

- We are the world’s leading producer of sustainable aviation fuel and renewable diesel, as well as a provider of renewable feedstock solutions for various polymers and chemicals industry uses.
- We refine waste, residues and innovative raw materials into renewable fuels and sustainable feedstock for polymers and chemicals.
- We are introducing liquefied waste plastic as refinery raw material.
- We have production facilities in Finland, Netherlands, Singapore and a joint venture in Martinez, California.
- We have committed to reaching carbon-neutral production by 2035.
- In 2022, our revenue totaled EUR 25,707 million and we reached EUR 3,537 million comparable EBITDA.

Neste and development of renewable hydrogen solutions

Focus on **renewable hydrogen** is an essential part of Neste's strategy.

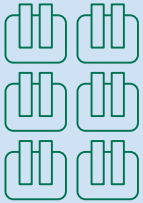
- Replaces fossil hydrogen in Neste refinery processes
- Contributes to reach of Neste's climate commitments
- Helps making Porvoo refinery the most sustainable refinery in Europe by 2030
- Creates a platform for e-fuel production
- Increases national energy self-sufficiency and supply security

Green hydrogen for Porvoo refinery

Neste's objective is to reach Final Investment Decision readiness during 2024. Production could then start 2026.

The aim is to utilize the heat generated in the electrolysis process for district heating purposes.

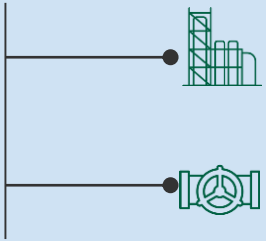
120 MW electrolyzer for green hydrogen production at Neste Porvoo refinery



Green hydrogen

Production of green hydrogen by electrolysis, execution in phases

First phase, 120 MW, in basic engineering phase (ca. 2t/h of green hydrogen)

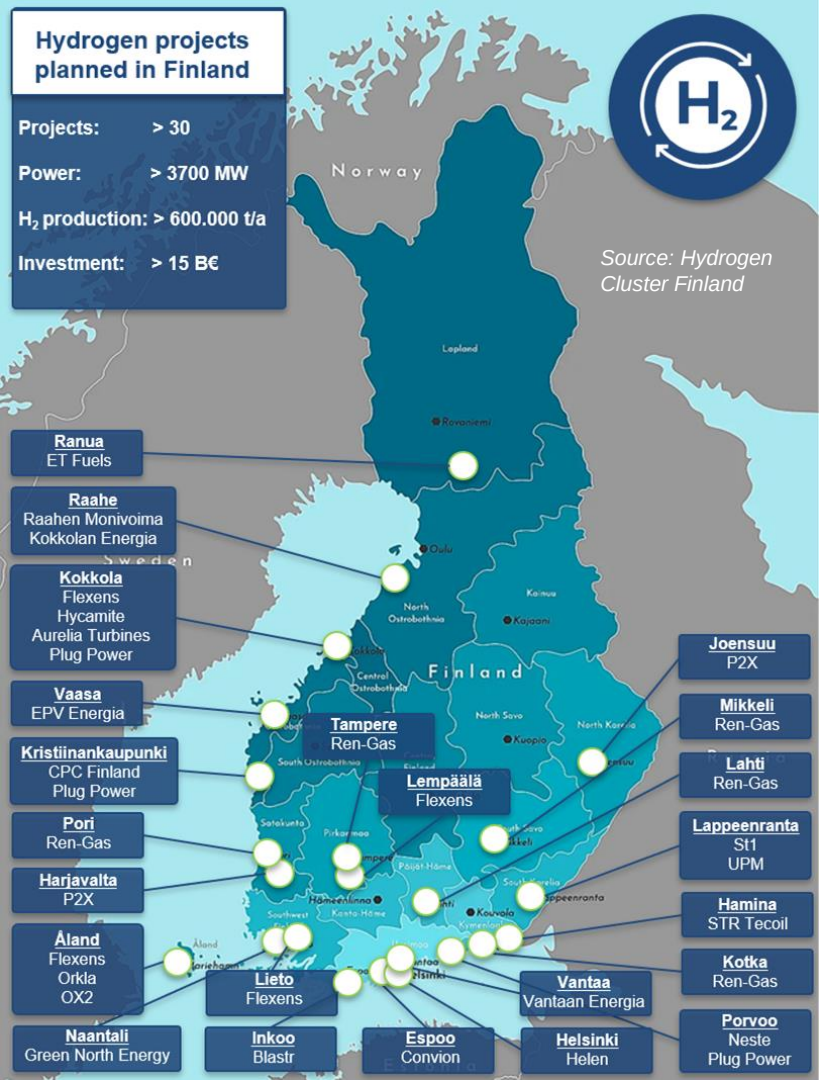


Green hydrogen to refining

Utilization of green heat

Funding:

- IPCEI grant of 27.7 MEUR to hydrogen projects in Porvoo by Business Finland
- Energy investment aid of 1.96 MEUR for heat recovery from hydrogen production by Ministry of Economic Affairs and Employment in Finland



Strengths of Finland in Hydrogen Economy

- A robust and clean electricity system as a basis for clean hydrogen expansion
- Competitive price of electricity
- Vast resources of clean water
- Extensive sector coupling opportunities (incl. district heating, biogenic CO_2 sources)

NESTE

Moving forward with the hydrogen investments - What is Critical?

1. National implementation of RED III

- **Transport sector:** It is critical that the use of RFNBO hydrogen will be incentivised. CAPEX support is not enough.
  Neste welcomes the binding minimum share for RFNBO in transport sector and recommends a prompt and timely implementation in the Member States.
- **Industry sector:** Neste supports mandatory phasing in of RFNBO hydrogen in industry. Neste recommends positive incentives in the implementation in the Member State.

2. Infrastructure

- Efficient execution of both electricity and hydrogen infrastructure investments, starting from enabling local hydrogen ecosystems as the first step.

3. Synchronization of schedules

- Needed between implementation of the regulation and funding schemes to support the investment decision making processes. E.g. RRF schedule requirements are far too strict.


NESTE
Change runs on renewables

IPCEI – Important Projects of Common European Interest

Caterina Cobino
Head of Special Projects and Partnerships
Program Manager Wave 2 the Future
A IPCEI Hy2Tech project TF2/TF4

Berlin 6 December 2023

FINCANTIERI

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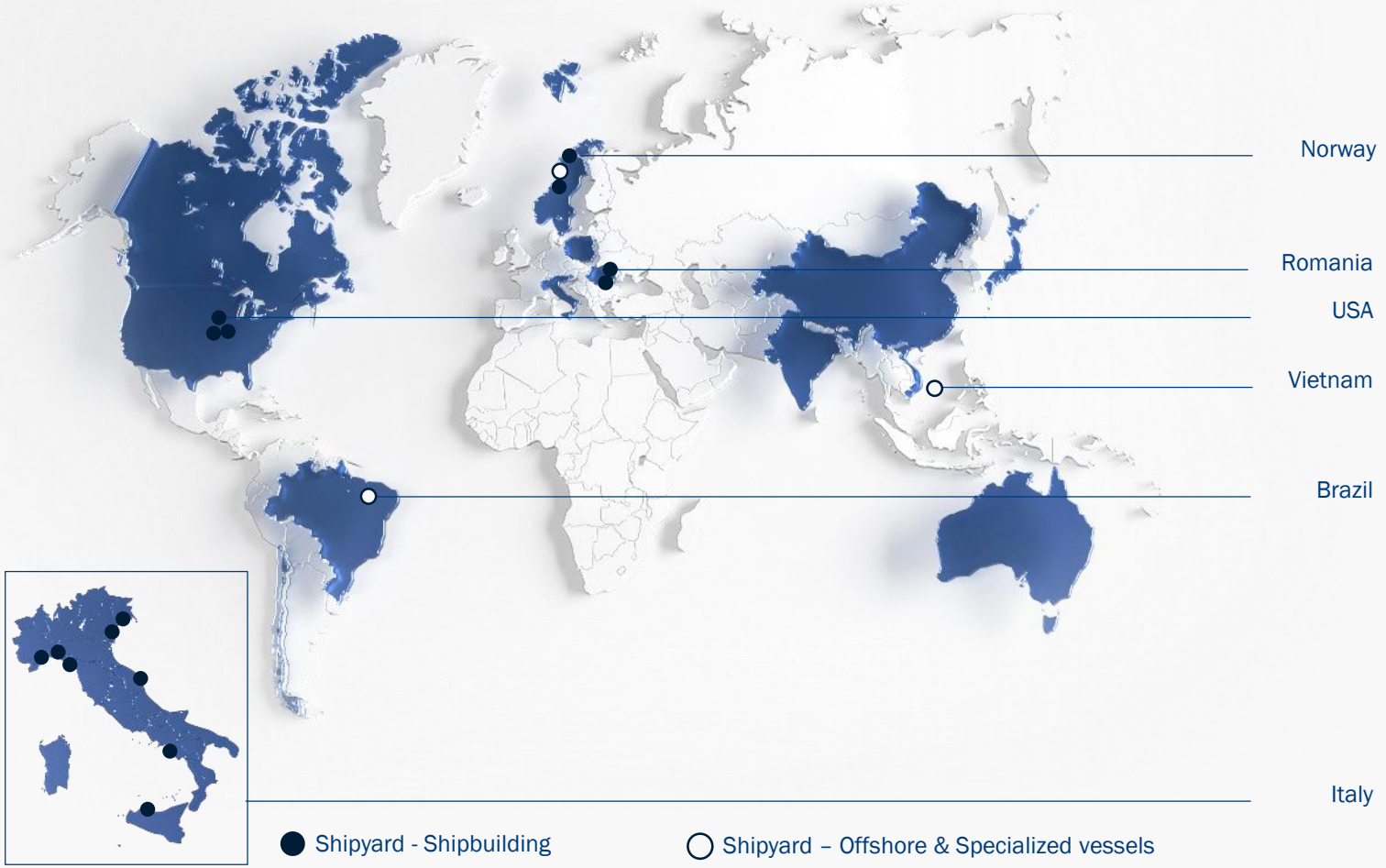
Fincantieri in brief

Company profile 06.2023

Fincantieri

We are an Italian Group with a global footprint

52% of our employees are based in Italy and 87% of revenues come from international clients(1)



#1 Western designer & shipbuilder(2) with 230 years of history and over 7,000 ships built

Our figures

- **~ € 7.4 bn** revenues(3) in FY 2022, **87%** of which come from international clients
- **€ 33 bn** total backlog(4,5)

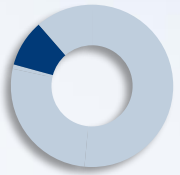
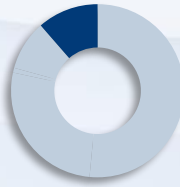
Our global reach

- **18** shipyards in **4** continents
- **>20,000** employees, il **52%** of which are based in Italy
- **~ 90,000** including subcontractors
- **~ 100** subsidiaries

(1) At December 30, 2022
(2) By revenues, excluding naval contractors in the captive military segment. Based on Fincantieri estimates of shipbuilders' revenues in 2016Excluding the effect of pass-through activities
(3) Excluding pass through activities
(4) At June 30, 2023
(5) Sum of backlog and soft backlog; soft backlog represent the value of existing contract options and letters of intent as well as contracts in advanced negotiation, none of which yet reflected in the order backlog

Products, clients and backlog

One of the most diversified product portfolio in the world combined with a wide client base and a strong backlog

		Main products	Key clients	Revenues 2022[1]	Backlog[2]
Shipbuilding	 Cruise	• All cruise ships: - Luxury/Niche[3] - Upper Premium - Premium - Contemporary	(4) Carnival Corporation & PLC; (5) Norwegian Cruise Line Holdings Ltd.; Silversea; Viking Ocean Cruises; Virgin Voyages; MSC Cruises; TUI Cruises; Ponant; Oceania Cruises	 € 4,139 m 51.5%	€ 18,589 m (55 ships)
	 Naval	• All surface vessels (also stealth) • Support & Special vessels • Submarines	Italian Navy and Coast Guard; US Navy; Qatar Emiri Naval Forces; United Arab Emirates Navy; Algerian Navy; Royal Saudi Navy	 € 2,162 m 26.9%	
Offshore and Specialized vessels		• SOV • Fishery • Ferries • Offshore wind • OPV • Specialized vessels	DCF Subsea; Norwind Offshore; Norwegian Coast Guard; Prysmian Group; Boreal; Framherji; Ocean Infinity; North Star Renewables; Van Oord	 € 751 m 9.3%	€ 1,408 m (33 ships)
Equipment, Systems and Infrastructure		• Marine systems, components & turnkey solution • Mechatronic • Infrastructure	Italian Navy and Coast Guard; US Navy; MSC Cruises; EDF Fenice; P&O Cruises; Carnival; webuild; Cunard; Sanas	 € 916 m 11.4%	€ 2,425 m

(1) At December 31, 2022, excluding the effect of pass-through activities and before eliminations and consolidation adjustments
(2) At June 30, 2023
(3) Terminology used in the cruise sector to indicate smaller, more intimate cruises with fewer guests dedicated to more exploratory destinations (e.g. Alaska or polar regions)
(4) Parent company of several brands, among which our clients are: Carnival Cruise Lines, Costa Crociere, Cunard, Holland America Line, P&O Cruises, Princess Cruise Lines and Seabourn Cruise Lines
(5) Parent company of several brands: Norwegian Cruise Line, Oceania Cruises, Regent Seven Seas Cruises

Key competitive strengths

Consolidated leadership, high diversification and flexible global production network

A) Global and flexible production network

- Global engineering and production network with 18 shipyards
- State-of-the-art facilities
- Flexible capacity

B) High flexibility

- Highly customized products
- Flexible utilization of resources globally
- Tailored project set-up to meet client needs

C) Superior system integrator capabilities

- Ability to coordinate a broad network of specialized suppliers (more than 3.000 just in Italy)
- Integrated production model
- Proven track record of on-time deliveries

D) Technological leadership

- Best-in-class know-how and leadership in high-end vessels
- Strong commitment to R&D
- Innovation across full product offering

Wave 2 the Future

A IPCEI Hy2Tech Project

FINCANTIERI

Wave 2 the Future

Wave 2 the Future

TF2
Fuel Cells Technology

TF4
End User Technology

WP1
Development of Hybrid Green Power Generation System (HGPGS)

WP2
Development of a Green Combined Cycle Gas Turbine fuelled by H2 (G-CCGT)

WP3
Integration of Hydrogen-based technologies onboard Green Cruise vessels

Status

The project is approved by MS ITA
MS ITA funding decision: Aug. 3rd, 2023

Wave 2 the Future activities started on March 22nd

WP1 and WP2 activities started in Q3-2023

WP3 activities started on March 22nd

WP1 TF2

W2F project will develop an EU manufactured Hybrid Green Power Generation System fuelled by Hydrogen which includes engine, fuel cells and batteries, including the Power Management System and the Remote Management System.

Activities are developed in Bari (Puglia).

1

WP2 TF4

H2 technologies of WP2 - developed within TF4 - will focus on the design, development and implementation of a maritime high efficiency integrated combined cycle plant for heat and power generation fuelled by hydrogen (CCGT).

The activities are developed in Liguria.

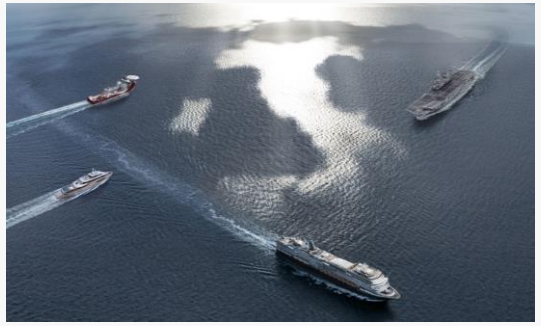
2

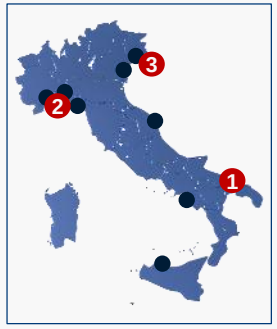
WP3 TF4

H2 technologies - developed within TF2 - could be used in WP3 if the timing of maturity will be matched.

3 Design activities are developed in Trieste (Friuli Venezia Giulia).

The construction of the prototype ships will be done in two Italian yards of Fincantieri, still to be identified according to production scheduling.





Wave 2 the Future and TF4

TF4 End User Technology

	WP2 Development of a Green Combined Cycle Gas Turbine fuelled by H2 (G-CCGT)	WP3 Integration of Hydrogen-based technologies onboard Green Cruise vessels
Technological Advancement	Selection of ship reference to derive main specifications of the CCGT. Agreements were reached with Academia and a Classification Society on studies for hydrogen handling.	Study on Risk Assessment aiming to obtain the Approval in Principle. The identification of critical suppliers started, and the design phase was kicked off to identify onboard the optimal configuration.
Forecast	Activities will focus on design of the H2 handling system (both LH2 and CH2) and definition of CCGT package will continue.	Activities will focus on the completion of ship structural assessment and third-party certification. Procurement of main components will start.

Spillover and Partnerhips

Since the project start in March 2023 Fincantieri kicked off dissemination and spill over activities and contacted Direct Partners to finalize the partnerships

Conferences	Open Days	Publications	Stakeholders' contacts	PhDs	Academia

Lauched Direct Partnerhips

EKPO

Nedstack

Symbio

Fincantieri established Direct Partnerships with EKPO, Nedstack and Symbio, with the purpose to contribute to the definition of Proton Exchange Membrane (PEM) Fuel Cell system and relative components through the exchange of experience and sharing of application requirements.
With the mentioned direct partners, we laid the foundations of the partnership by fixing in dedicated meetings the objectives, the general contents and tools to achieve them.

Many DPs

Fincantieri has established Direct Partnerships for the development of a suitable SOFC solution to be potentially installed on Fincantieri Cruiseship. The companies will join their mutual technical expertise in SOFC manufacturing and ship design/construction to define a proper SOFC power generation system for maritime.
In addition Fincantieri established Direct Partnerships to develop components for hydrogen-ICE marine applications.

THANK YOU

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FINCANTIERI