

# NH3CRAFT – Safe and efficient storage of ammonia within ships

Alexandros Giannakis

Hydrus Engineering SA, Athens, Greece

Towards Zero Emission Synergies Workshop,  
IST Lisbon, 10/12/2024

**Towards Zero emissions  
Synergies Workshop**

**10th December 2024  
from 09:00 to 13:00**

IST Congress Centre,  
Lisbon, Portugal



Co-funded by the  
European Commission

UK participation in NH3CRAFT Project is funded by UK Research and Innovation (UKRI) under the UK government's Horizon Europe guarantee [grant numbers 10018546 and 10037828].

# Agenda of NH<sub>3</sub>CRAFT

- Hydrus presentation
- Project Outline
- Project Overview
- WP breakdown of NH<sub>3</sub>CRAFT
- Gantt chart
- Key pillars and exploitable results per WP
- Next steps

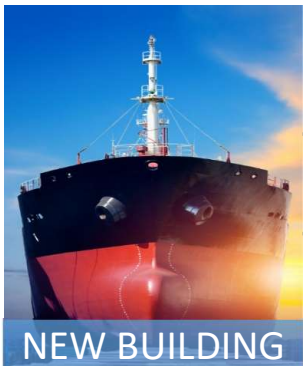
# Hydrus Engineering SA intro



NH3CRAFT | Horizon Europe | GA 101056831

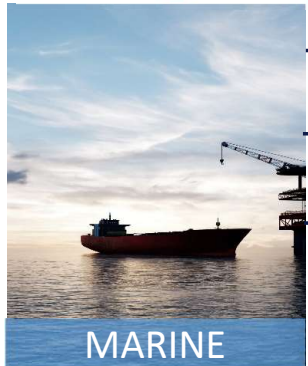
## ✓ General information

Hydrus Engineering S.A. is a global engineering firm delivering integrated solutions in the maritime, oil and gas and energy sectors (established in 2009).



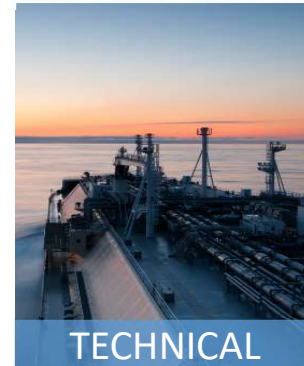
NEW BUILDING

- Plan Approval
- Site Office



MARINE

- Attendances
- Procurement
- HSSQEE



TECHNICAL

- Operations
- Innovation Hub**
- Shipping
- Naval

350+ Dry-Dock Supervisions, 600+ Retrofit Supervisions, 10+ installation projects

3+ ship designs, 1500+ Integration Designs, 1250+ Engineering Consultancy



Co-funded by the European Commission

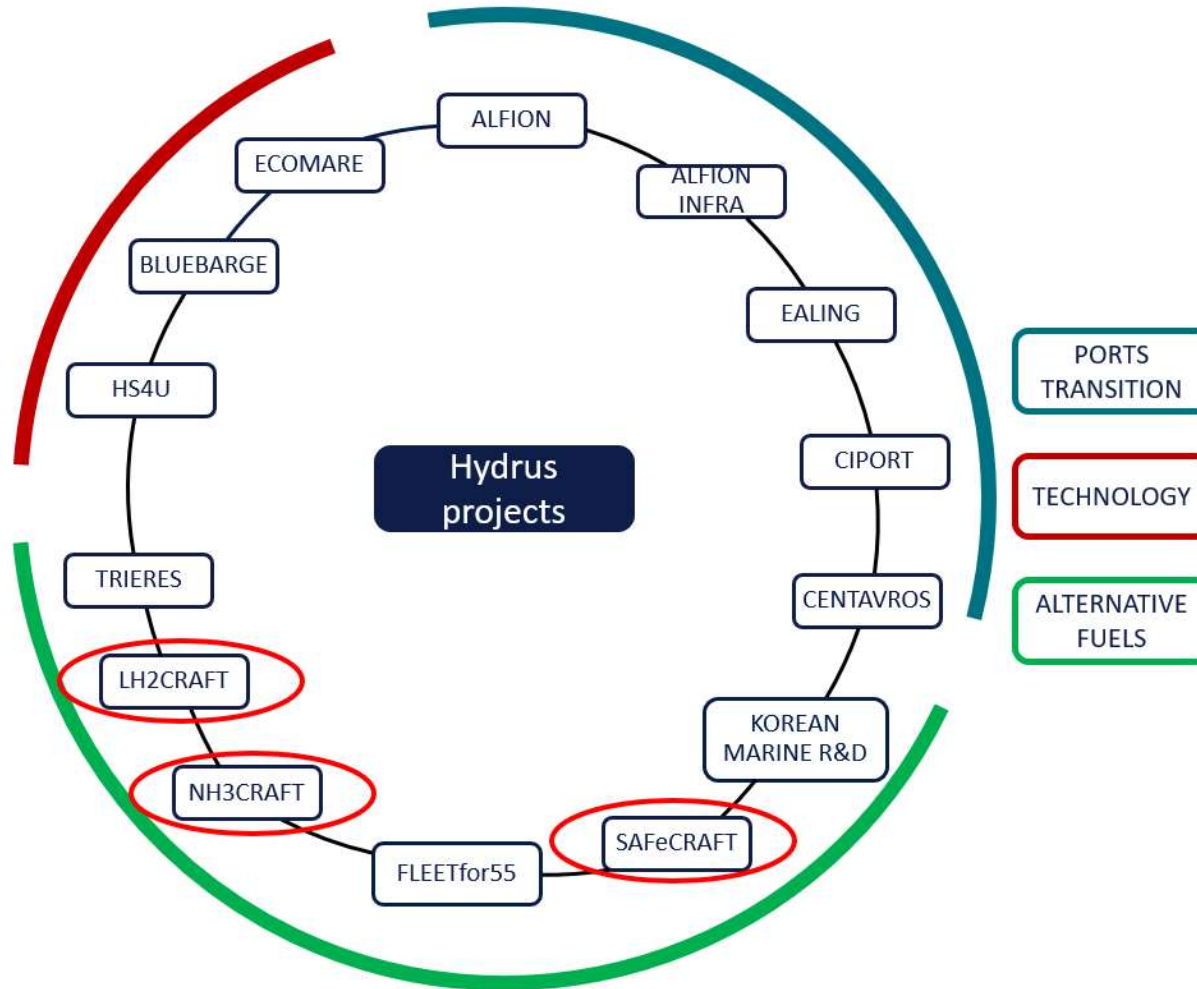
UK participation in NH3CRAFT Project is funded by UK Research and Innovation (UKRI) under the UK government's Horizon Europe guarantee [grant numbers 10018546 and 10037826].



# Hydrus Engineering SA intro



NH3CRAFT | Horizon Europe | GA 101056831



Co-funded by the European Commission

UK participation in NH3CRAFT Project is funded by UK Research and Innovation (UKRI) under the UK government's Horizon Europe guarantee [grant numbers 10018548 and 10037828].

10/12/2024  
4 of 27

# Project Outline



NH3CRAFT | Horizon Europe | GA 101056831

## NH3CRAFT - "Safe and efficient storage of ammonia within ships"

### Scope:

Development and demonstration of tangible solutions for large-storage of ammonia as fuel onboard

### Numbers:

- Type of action: HORIZON-IA → TRL7-8
- Project starting date: June 2022
- Project duration: 36 months
- Project budget: 12,862,888.75€
- Funded budget: 8,497,104.00€
- Number of partners: 13

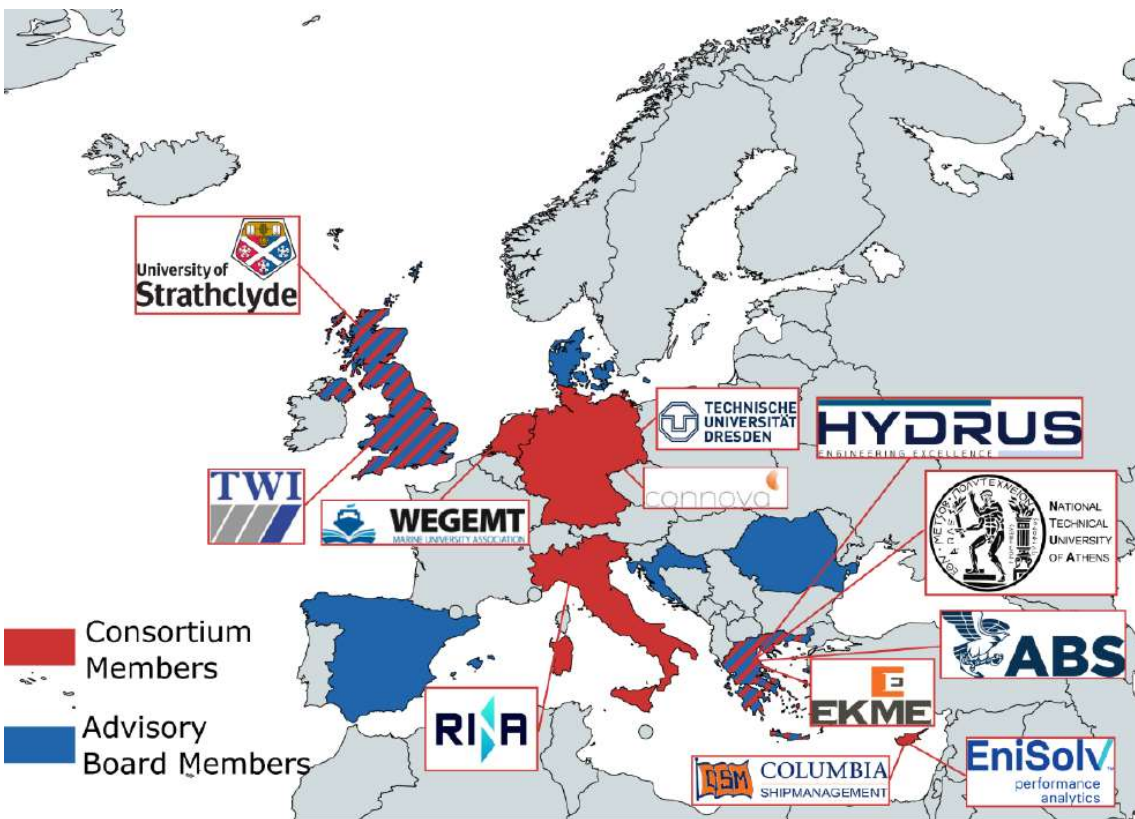
### Key Project objectives:

- Ammonia storage on-board ships as fuel
- Design, manufacturing and demonstration of metallic & composite NH3 tanks
- Detailed design of a full-scale retrofit of a general cargo vessel
- Modular and scalable design with application in five (5) retrofit and NB desktop studies
- Scalable structural integration of fuel tanks
- Enhanced implementation of NH3 fuel through the development of new pertinent technical rules
- Issuance of Approval in Principle for the tanks and auxiliaries design

# Partners Overview



NH3CRAFT | Horizon Europe | GA 101056831



## Industry partners



## Ship operators



## Associations



## academic institutions



## classification societies



Co-funded by the European Commission

UK participation in NH3CRAFT Project is funded by UK Research and Innovation (UKRI) under the UK government's Horizon Europe guarantee [grant numbers 10018548 and 10037828].



# WP breakdown of NH3CRAFT



NH3CRAFT | Horizon Europe | GA 101056831



WP1

Project Management

**WP2** RINA  
Demonstration Implementation Plan and Evaluation Criteria

**WP3** EKME  
Engineering Design Process for the Tank Storage Systems

**WP4** HYDRUS  
Engineering Design Process for the Auxiliary Systems

**WP6** COLUMBIA SHIPMANAGEMENT  
Assembly, on-board installation and Functionality Testing of System

Technical - Engineering

**WP5** TECHNISCHE UNIVERSITÄT DRESDEN  
Digital Integration and Virtual Demonstration

**WP7** University of Strathclyde  
Safety & Risk Assessment

**WP9** ABS  
Development of Pertinent Technical Rules

R&A – Requirements – Platform

**WP8** Institute for Energy Efficient and Sustainable Ship Design  
Assessment of Operational and Modularity Characteristics

**WP10** TWI  
LCA, Technical Assessment and KPI evaluation

**WP11** COLUMBIA SHIPMANAGEMENT  
Dissemination, Exploitation and Communication

Non-technical

Co-funded by the European Commission  
UK participation in NH3CRAFT Project is funded by UK Research and Innovation (UKRI) under the UK government's Horizon Europe guarantee [grant numbers 10018546 and 10037828].

# NH3CRAFT core technologies



NH3CRAFT | Horizon Europe | GA 101056831

Core technology	Way forward
Design and engineering (TRL 5)	Implement engineering techniques regarding design of high-pressure vessels for the storage of ammonia as fuel (TRL 7)
Digital integrated systems (TRL 5)	Design and develop a digital platform to integrate all core simulation, data-driven and physical models, through digital interfaces (TRL 7)
Modular Storage Systems – Metallic Tanks (TRL 5)	Design issues related to the storage of ammonia within high-pressure vessels. Tests and certification for naval applications (TRL 7)
Modular Storage Systems – Composite Tanks (TRL 5)	Design issues related to the storage of ammonia within high-pressure vessels. Tests and certification for naval applications (TRL 7)



Co-funded by the European Commission

UK participation in NH3CRAFT Project is funded by UK Research and Innovation (UKRI) under the UK government's Horizon Europe guarantee [grant numbers 10018546 and 10037828].

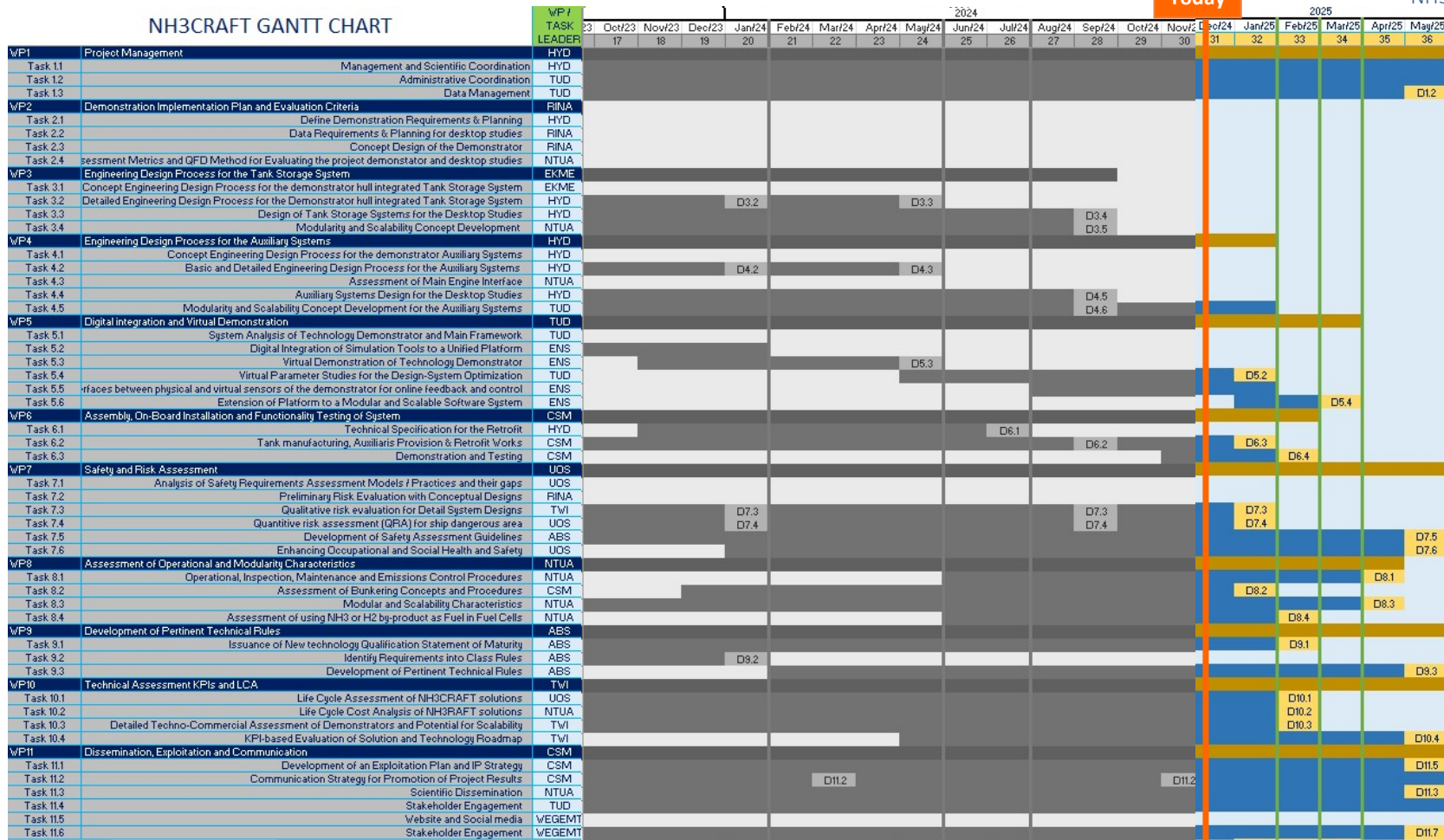
10/12/2024  
8 of 27



# Gantt Chart of the project



NH3CRAFT | Horizon Europe | GA 101056831

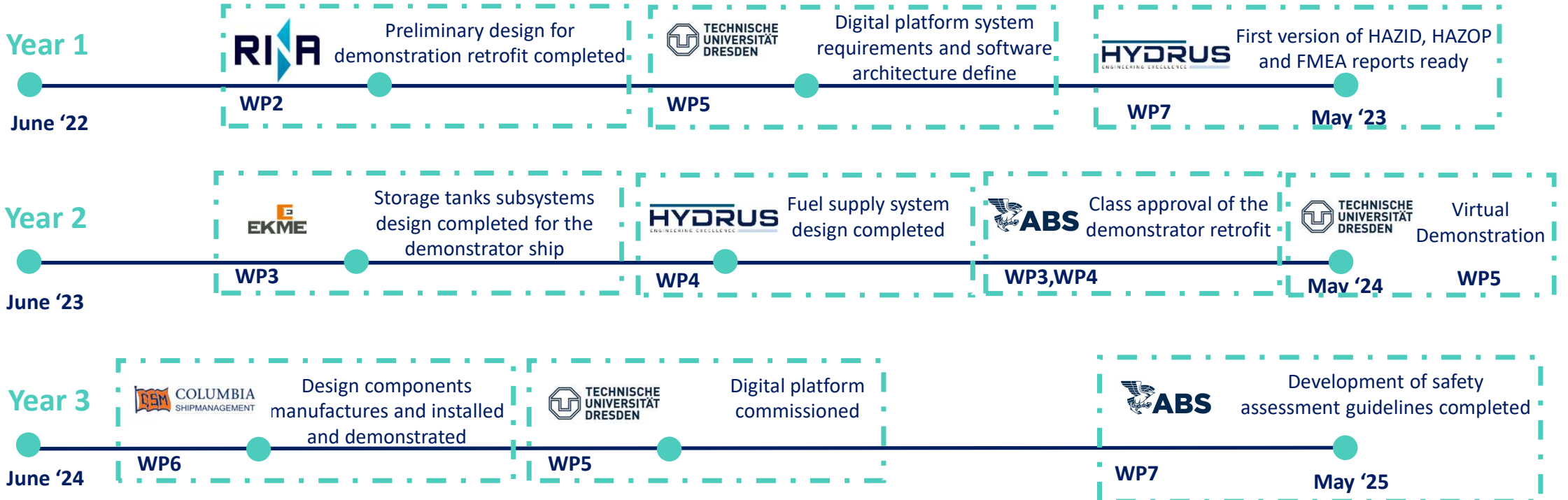


Co-funded by the European Commission

UK participation in NH3CRAFT Project is funded by UK Research and Innovation (UKRI) under the UK government's Horizon Europe guarantee [grant numbers 10018518 and 10037828].



# Key milestones timeline



# WP2 Developments & Outputs

Status: **Concluded**

Workshop with  
**Ship Operator**



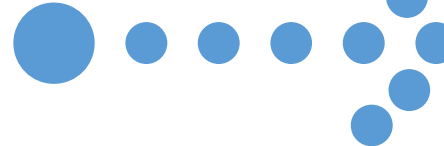
Workshop with  
**industry** partners



Workshop with  
**Classification Societies**



Identification  
of key  
engineering  
aspects



Demonstrator	Desktop Studies
31k DWT General Cargo vessel	50k DWT Tanker
	50k DWT Bulk Carrier
	27k TEU Containership
	Short-sea shipping ferry
	1500 Passenger RoPax

# WP2 Developments & Outputs

## 31K DWT Demonstrator vessel



*Type of ship:* General Cargo Ship  
*Overall length:* 193.90 m  
*Breadth (moulded):* 28.2 m  
*Depth (moulded):* 15.6 m  
*Draught (moulded):* 11.2 m



*Deadweight:* about 31,000 tons  
*Cargo capacity:* abt. 39,700 m<sup>3</sup>  
*Container capacity:* 2,019 TEU

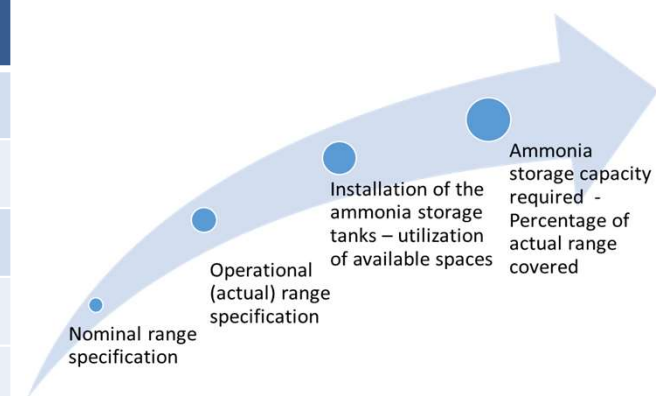


*M/E CSR:* 10,458 kW x 119.7 rpm  
*Service speed (@CSR):* 16.8 knots  
*Endurance:* 15,000 n.miles

# WP2 Developments & Outputs

## Desktop studies

Sample vessel	Type of storage tank	Material of storage tank (M -> for metallic/ C -> for composite)	Indications on location (depends on space and ship type)	New build (NB) vs retrofit (R)	Use of fuel cells onboard (Y/N)
Bulk carrier scenario	C type	M	Upper Deck aft side and fwd of accommodation	R	N
Short sea ferry scenario 1	C type	M	Deck 2 (car garage)	R	N
Short sea ferry scenario 2					Y
Tanker scenario 1	C type	M	Upper Deck	R	N
Tanker scenario 2		M & C			
Containership scenario 1	C type	M & C	Inside No.5 Cargo Hold	NB	N
Containership scenario 2		M			
Containership scenario 3	A type	M			
RoPax scenario 1	C type	M	On Deck 1 (lowest level of car garage)	R	N
RoPax scenario 2			On Deck 1 (lowest level of car garage) and on Deck 9		Y
RoPax scenario 3					



# WP3 Developments & Outputs



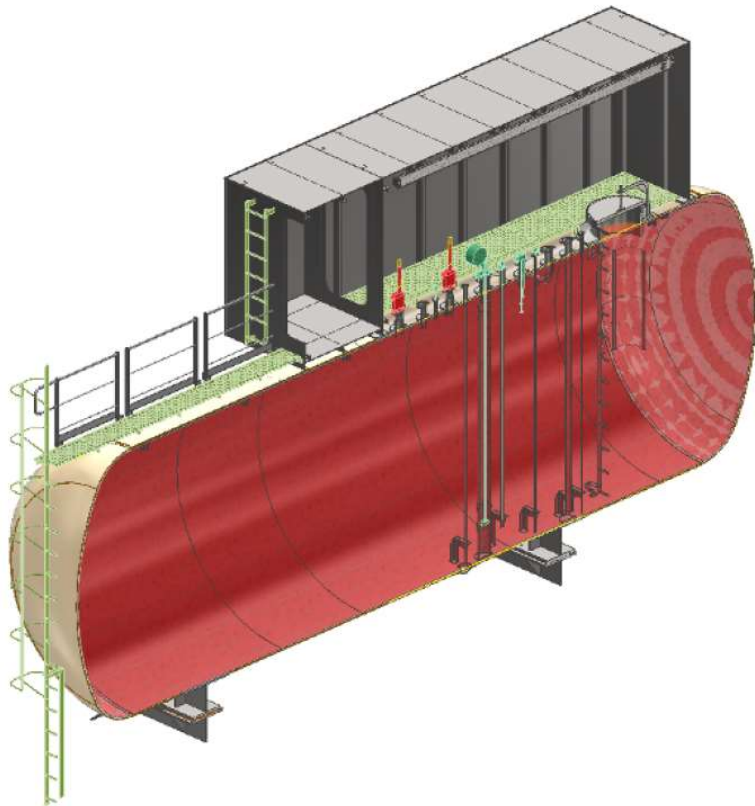
NH3CRAFT | Horizon Europe | GA 101056831

Status: Almost completed (Desktop studies assessments ongoing)

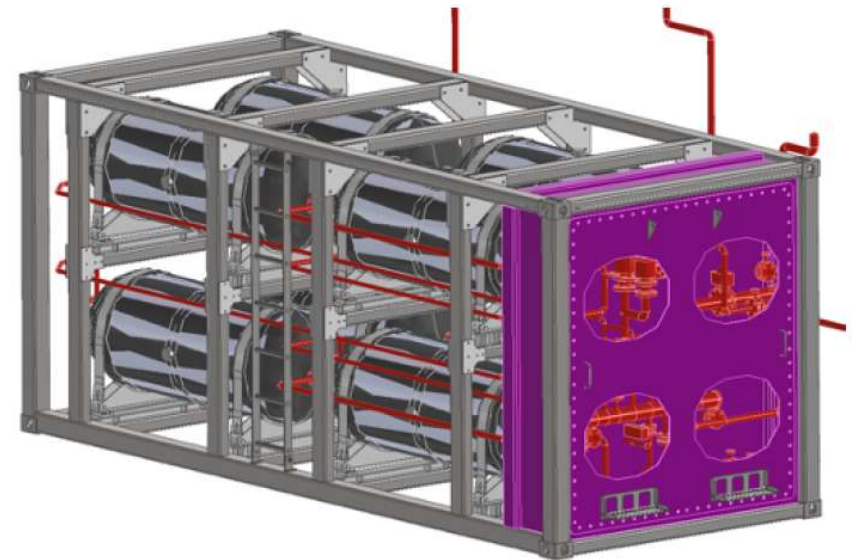
## Key Objectives

- Development of the concept/basic/detailed **design package** of the tank containment system for the **demonstrator** and the **desktop studies**
- **Structural assessment** (FEA, load cases definition, fatigue analysis and sloshing calculations) of the tank containment system
- **3D model** development
- Tank **material** selection and evaluation

# WP3 Developments & Outputs



3D Model of metallic tank with all components – perspective view



3D Model of composite tanks within TEU container with all components – perspective view

# WP4 Developments & Outputs



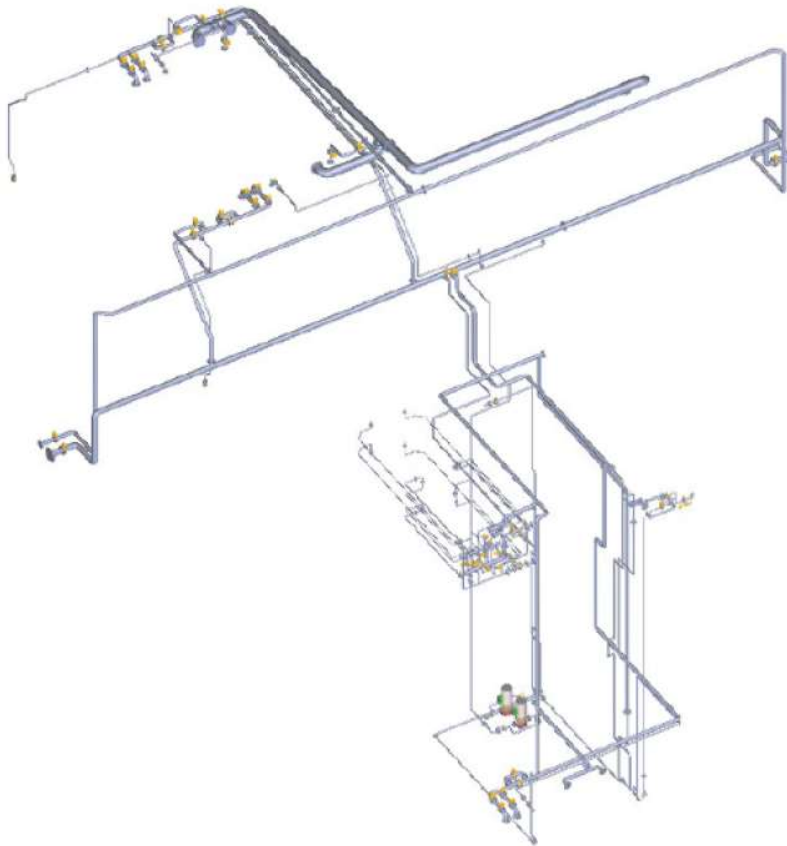
Status: Almost completed (Desktop studies assessments)

## Key Objectives

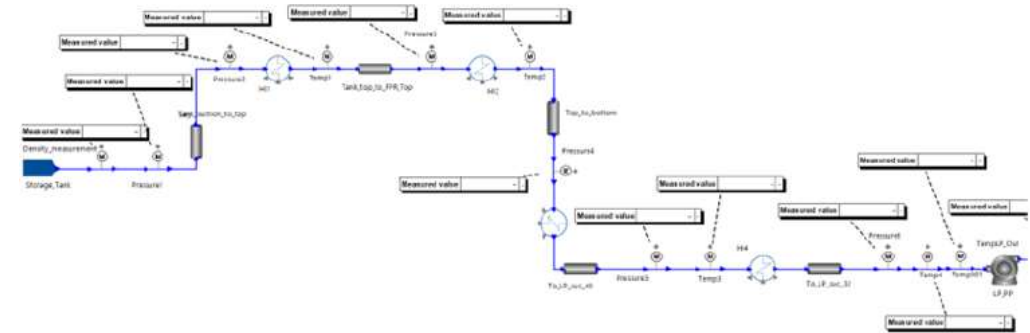
- Development of the concept/basic/detailed **design package** of the auxiliaries' systems for the **demonstrator** and the **desktop studies**
- **3D piping** development
- PFD, Operation modes, system schematics creation
- Detailed engineering calculations including pipe thickness calculations, system components calculation and specifications, material evaluation and selection
- Simulation model creation for the optimization of the performance of the system



# WP4 Developments & Outputs

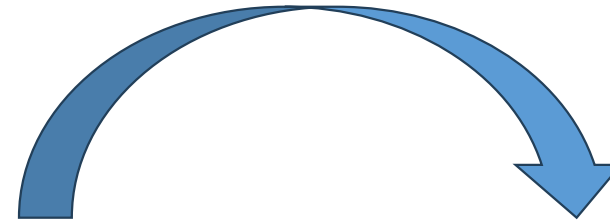
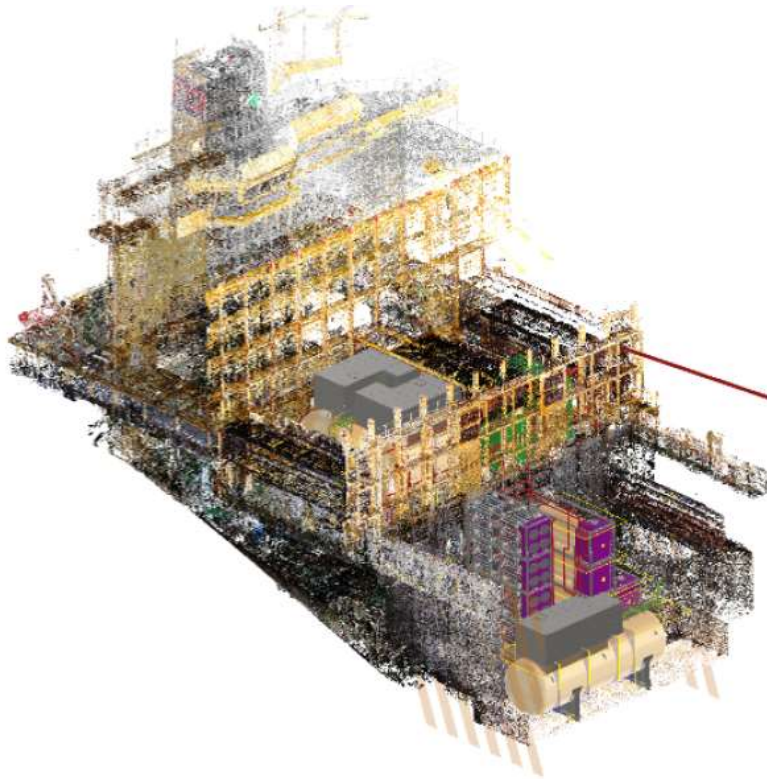


3D Model of the auxiliary systems piping network of the ammonia fuel supply and distribution system



Heat and mass balance model snapshot software used to optimize the performance of the ammonia fuel supply system

# Combined outputs of WP3/WP4



Issuance of the **new technology qualification (NTQ)** statement of maturity for the developed systems and technologies

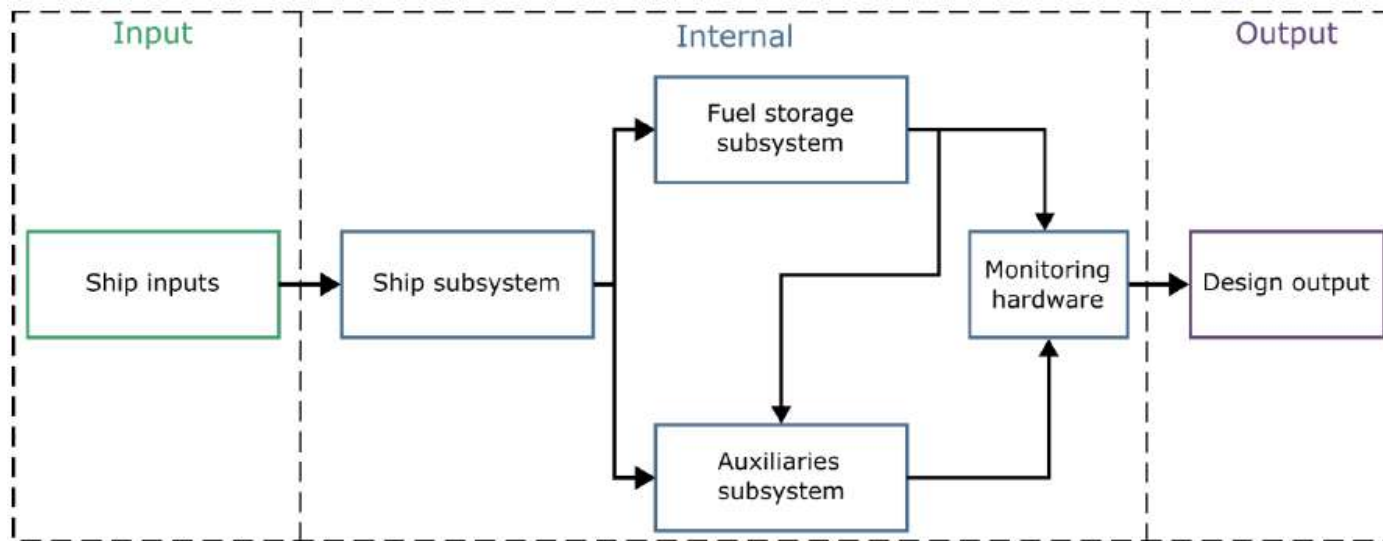
*3D Model of tank containment system fitted within the demonstrator vessel*

# WP5 Developments & Outputs

Status: **On-going**

## Key Objectives

- Digital platform setup, to virtually demonstrate the feasibility of using ammonia as fuel



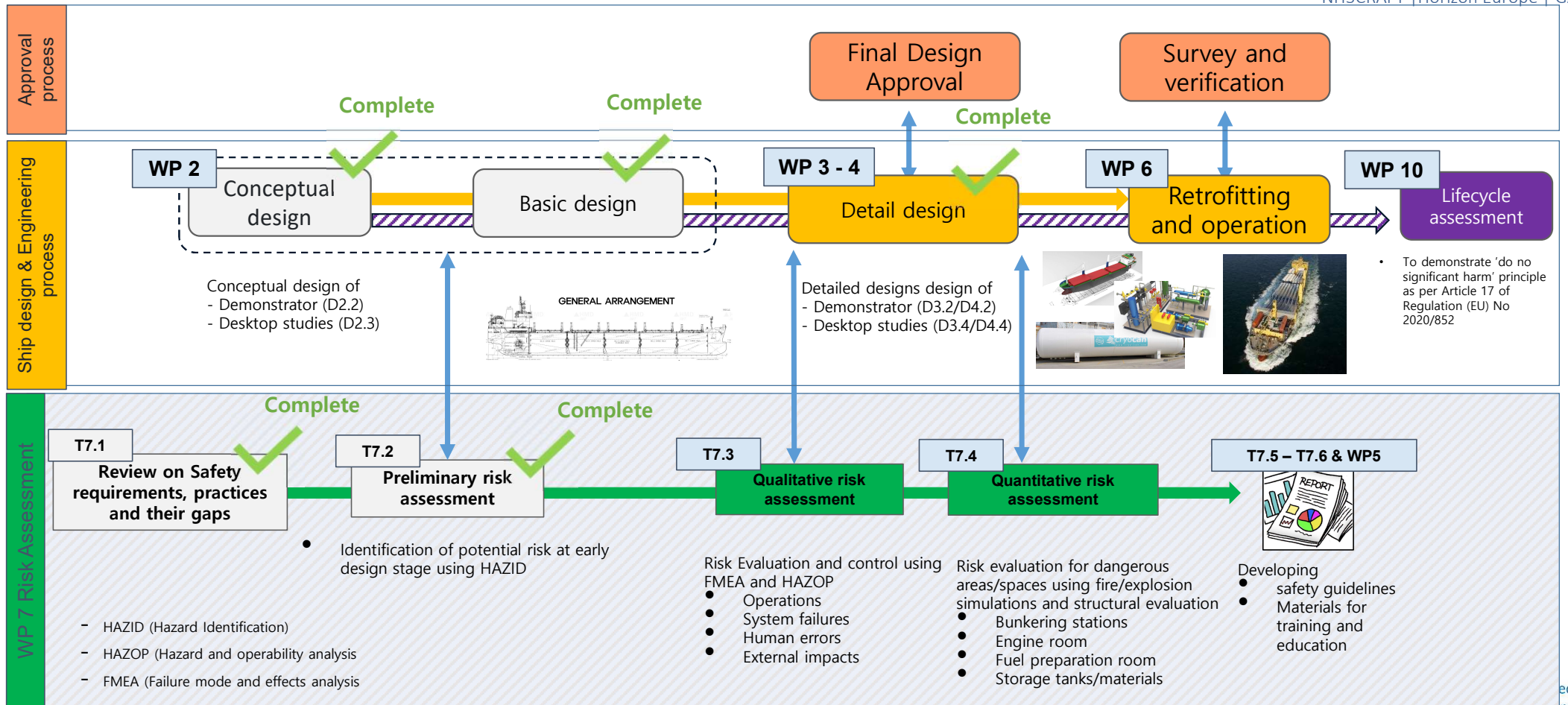
# WP7 Developments & Outputs

Status: On-going

## Key Objectives

- **Safety evaluation** of conceptual and detailed designs of demonstrator and desktop studies conducted from WP2-6.
- Propose **optimal solutions against potential risks** associated with using ammonia as marine fuel.
- **Methodology development** in consideration of key elements of potential hazards (causes, consequences, safeguards, categorization, recommendations etc.).
- Control and reduction of identified risks, implementation of safety solutions to the demonstrators.
- Offering **practical design guidelines** for general applicability.

# WP7 Developments & Outputs



led by the European Commission

# WP9 Developments & Outputs

## Existing Regulatory framework

Date	Committee	Selected key documents
2015	-	MSC 95/22
2016	-	MSC 370/93
2019	CCC 6	CCC 6/14, Annex 2
2021	CCC 7/3/9	MSC 104/15/9
2022	CCC 8	CCC 8/13, 8/13/1, 8/13/2
2023	CCC 9	CCC 9/3, 9/3/1, 9/3/2, 9/3/13, 9/3/14, 9/INF.7, 9/INF.16, 9/INF.27
2024	CCC 10	

# Next steps

## Demonstration

- **Demonstration** will take place on land facilities with water, due to the challenges of handling, storing and ammonia discharging
- **Metallic and composite** tanks are already under manufacturing
- **Auxiliary systems** are under manufacturing & procurement
- **Tests** will commence in the beginning of 2025
- **Demonstration** will take place in April 2025



NH3CRAFT | Horizon Europe | GA 101056831



Co-funded by the  
European Commission

UK participation in NH3CRAFT Project is funded by UK Research and Innovation (UKRI) under the UK government's Horizon Europe guarantee [grant numbers 10018548 and 10037828].

10/12/2024  
23 of 27

# Next steps

## Review & Validation

- Issuance of the **new technology qualification (NTQ)** statement of maturity for the developed systems and technologies
- Development of Class **pertinent technical rules**



NH3CRAFT | Horizon Europe | GA 101056831



Co-funded by the  
European Commission

UK participation in NH3CRAFT Project is funded by UK Research and Innovation (UKRI) under the UK government's Horizon Europe guarantee [grant numbers 10018548 and 10037828].

10/12/2024  
24 of 27



# Next steps

## Additional studies

- LCA, LCCA, KPI of NH3CRAFT solution preparation
- Modularity and scalability characteristics development
- bunkering specifications and procedures development
- Digital platform finalization and optimization



NH3CRAFT | Horizon Europe | GA 101056831

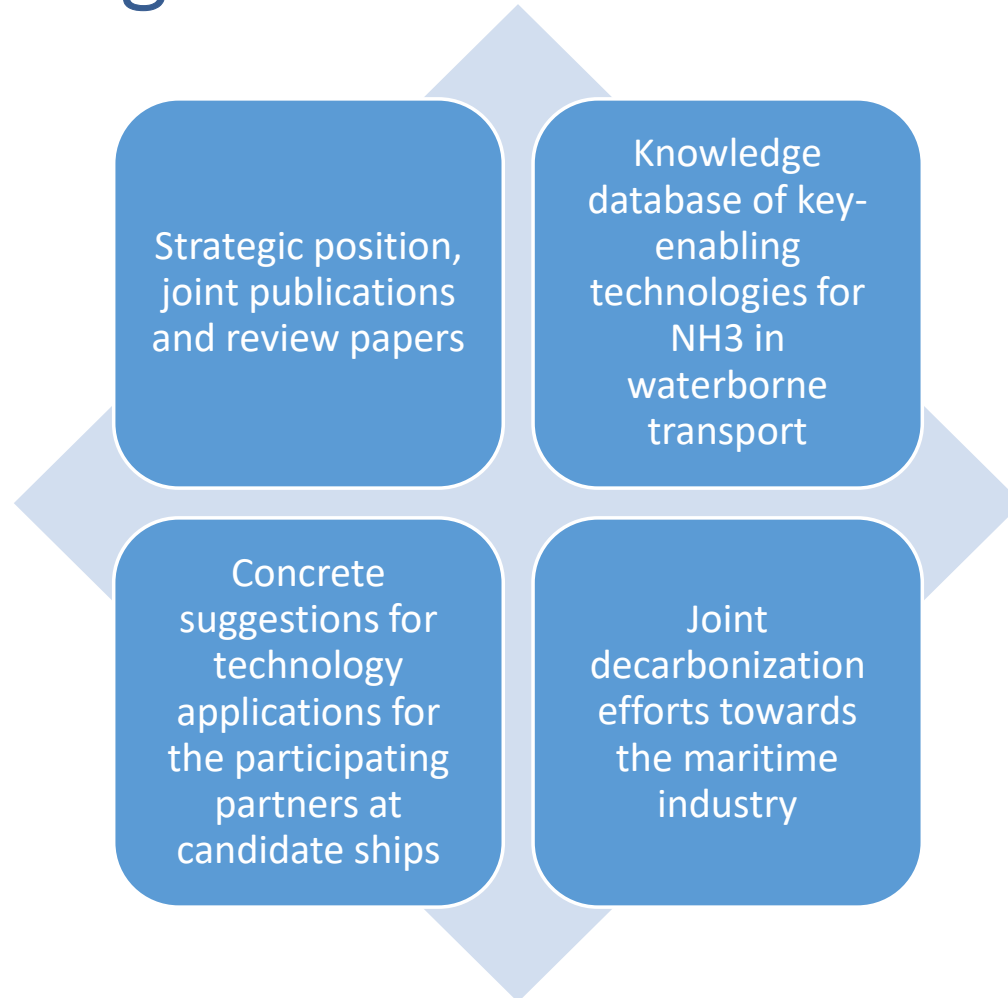


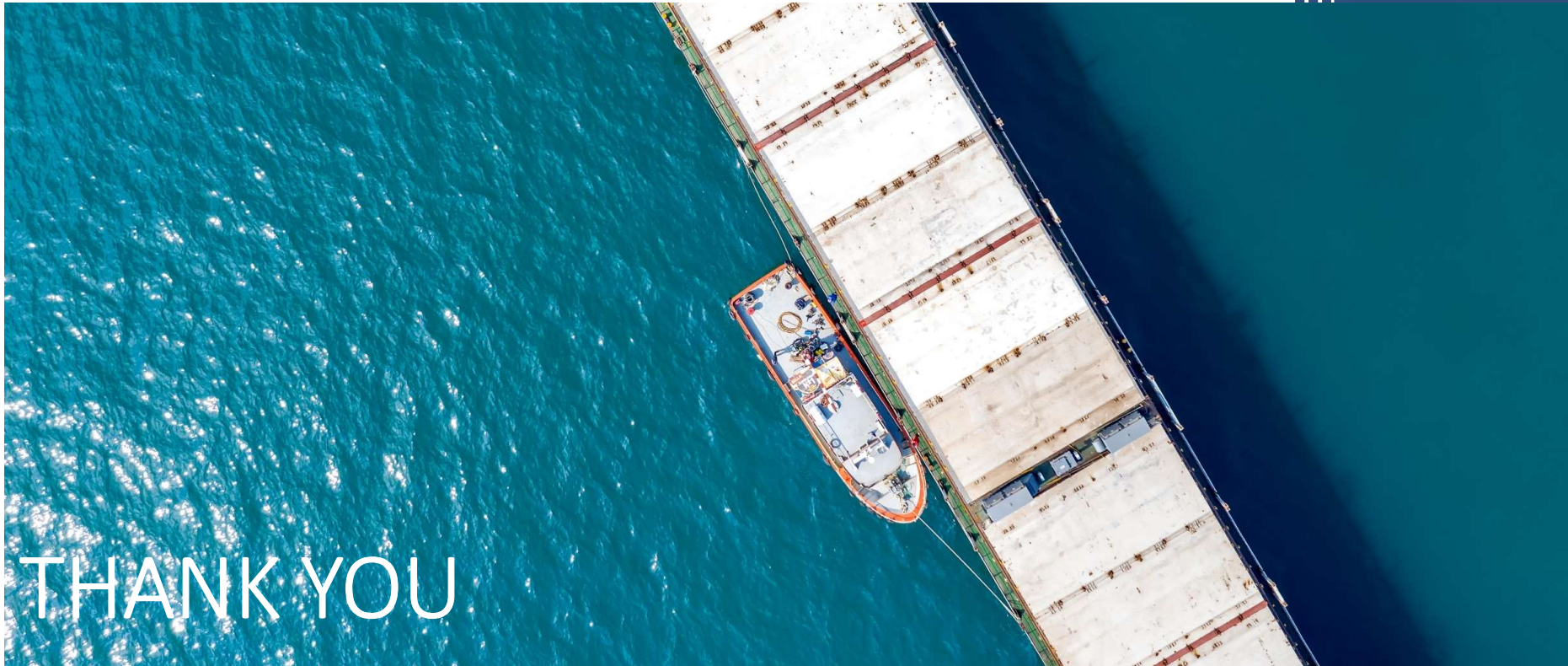
Co-funded by the  
European Commission

UK participation in NH3CRAFT Project is funded by UK Research and Innovation (UKRI) under the UK government's Horizon Europe guarantee [grant numbers 10018548 and 100378226].

10/12/2024  
25 of 27

# Synergies Background





THANK YOU

**Alexandros Giannakis**  
 Senior Engineer – Innovation Hub  
[a.giannakis@hydrus-eng.com](mailto:a.giannakis@hydrus-eng.com)



Co-funded by the European Commission

UK participation in NH3CRAFT Project is funded by UK Research and Innovation (UKRI) under the UK government's Horizon Europe guarantee [grant numbers 10018548 and 10037828].