

NH3CRAFT |Horizon Europe | GA 101056831

NH3CRAFT – Safe and efficient storage of ammonia within ships

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Agenda of NH₃CRAFT



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Project Outline

Project Overview

WP breakdown of NH₃CRAFT

Gantt chart

Key pillars and exploitable results per WP

Next steps



Hydrus Engineering SA intro



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Hydrus Engineering SA intro





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> 10/12/2024 4 of 27

Project Outline



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:

- \blacktriangleright Type of action: HORIZON-IA \rightarrow 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



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NH3CRAFT core technologies



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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)		



Gantt Chart of the project



Todav NH3CRAFT | Horizon Europe | GA 101056831 2025 NH3CRAFT GANTT CHART 23 Oct/23 Nov/23 Dec/23 Jan/24 Feb/24 Mar/24 Apr/24 May/24 Jun/24 Jul/24 Aug/24 Sep/24 Oct/24 Nov/2 Pc/24 Jan/25 Feb/25 Mar/25 Apr/25 May/25 TASK FADE 34 HYD Task 11 ment and Scientific Coordination HYD Task 12 Administrative Coordination TUD Data Management Task 13 TUD D1.2 WP2 entation Plan and Evaluation Criteria BINA Task 2.1 Define Demonstration Requirements & Planning HYD Task 2.2 Data Requirements & Planning for desktop studies RINA Task 2.3 Concept Design of the Demonstrator BINA Task 2.4 sessment Metrics and QFD Method for Evaluating the project demonstator and desktop studies NTUA Engineering Design Process for the Tank Storage System WP3 EKME Task 3.1 Concept Engineering Design Process for the demonstrator hull integrated Tank Storage System EKME Task 3.2 Detailed Engineering Design Process for the Demonstrator hull integrated Tank Storage System HYD D3.2 D3.3 Design of Tank Storage Systems for the Desktop Studies HYD D3.4 D3.5 Task 3.3 Task 3.4 Modularity and Scalability Concept Development NTUA WP4 ering Design Process for the Auxiliary Systems HYD Task 4.1 Concept Engineering Design Process for the demonstrator Auxiliary Systems HYD Task 4.2 Basic and Detailed Engineering Design Process for the Auxiliary Systems HYD D4.3 Task 4.3 Assessment of Main Engine Interface NITHA D4.5 D4.6 Task 4.4 Auxiliary Systems Design for the Desktop Studies HYD Modularity and Scalability Concept Development for the Auxiliary Systems Task 4.5 TUD Digital integration and Virtual Demonstration TUD Task 5.1 System Analysis of Technology Demonstrator and Main Framework TUD Digital Integration of Simulation Tools to a Unified Platform ENS Task 5.2 Virtual Demonstration of Technology Demonstrator ENS Task 5.3 D5.3 Task 5.4 Virtual Parameter Studies for the Design-System Optimization TUD D5.2 ENS Task 5.5 rfaces between physical and virtual sensors of the demonstrator for online feedback and control Task 5.6 Extension of Platform to a Modular and Scalable Software System ENS D5.4 tallation and Functionality Testing of System CSM /P6 Task 6.1 Technical Specification for the Retrofit HYD D6.1 Task 6.2 Tank manufacturing, Auxiliaris Provision & Retrofit Works CSM D6.3 Task 6.3 Demonstration and Testing CSM D6 4 Safety and Risk Assessment /P7 UOS Task 7.1 Analysis of Safety Requirements Assessment Models / Practices and their gaps UOS Task 7.2 Preliminary Risk Evaluation with Conceptual Designs BINA TVL D7.3 D7.4 D7.3 Task 7.3 Qualitative risk evaluation for Detail System Designs D7.3 D7.4 Quantitive risk assessment (QRA) for ship dangerous area UOS D7.4 Task 7.4 D7.5 Task 7.5 Development of Safety Assessment Guidelines ABS Enhancing Occupational and Social Health and Safety UOS D7.6 Task 7.6 VP8 f Operational and Modularity Characteristics NTUA Task 8.1 Operational, Inspection, Maintenance and Emissions Control Procedures NTUA D8.1 Task 8.2 Assessment of Bunkering Concepts and Procedures CSM D8.2 Modular and Scalability Characteristics D8.3 Task 8.0 NTUA Task 8.4 Assessment of using NH3 or H2 by-product as Fuel in Fuel Cells NTUA D8.4 WP9 nt of Pertinent Technical Rules ABS Task 9.1 Issuance of N ogy Qualification Statement of Maturity ABS D9.1 Task 9.2 Identify Requirements into Class Rules ABS D9.2 D9.2 Task 9.3 Development of Pertinent Technical Rules ABS Technical Assessment KPIs and LCA WP10 TWI Task 10.1 Life Cucle Assessment of MH3CBAET solutions. LIOS D10.1 Life Cycle Cost Analysis of NH3RAFT solutions NTUA D10.2 Task 10.2 D10.3 Detailed Techno-Commercial Assessment of Demonstrators and Potential for Scalability Task 10.3 TVL D10.4 Task 10.4 KPI-based Evaluation of Solution and Technology Roadmap TWI CSM WP11 on and Communication Task 11.1 Development of an Exploitation Plan and IP Strategy CSM D11.5 CSM Task 11.2 Communication Strategy for Promotion of Project Results Task 11.3 Scientific Dissemination NTUA D11.3 Task 11.4 Stakeholder Engagement TUD Task 11.5 Website and Social media WEGEMT Task 11.6 Stakeholder Engagement WEGEMT D117 National Technical University of Athens TECHNISCHE WEGEMT connova COLUMBIA enisolv EKME SHIPMANAGEMENT

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> rant numbers 10038548 and 1003782 10/12/2024 9 of 27

Key milestones timeline



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WP2 Developments & Outputs

Status: Concluded





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 m³ *Container capacity*: 2,019 TEU



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

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10/12/2024

12 of 27

WP2 Developments & Outputs



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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	М	Upper Deck aft side and fwd of accommodation	R	Ν
Short sea ferry scenario 1	C type	М	Deck 2 (car garage)	R	Ν
Short sea ferry scenario 2					Y
Tanker scenario 1 Tanker scenario 2	C type	M M & C	Upper Deck	R	Ν
Containership scenario 1 Containership scenario 2	C type	M & C M	Inside No.5 Cargo Hold	NB	N
RoPax scenario 1	C type	M	On Deck 1 (lowest level of car garage)	R	Ν
RoPax scenario 2 RoPax scenario 3			On Deck 1 (lowest level of car garage) and on Deck 9		Y

HYDRUS RIR WABS TWI Strathclyde Glasgow Installation of the ammonia storage tanks – utilization of available spaces

Operational (actual) range specification

Nominal range specification

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10/12/2024 13 of 27

WP3 Developments & Outputs



<u>Status</u>: 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



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



3D Model of metallic tank 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







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

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

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10/12/2024 17 of 27

Combined outputs of WP3/WP4



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



WP5 Developments & Outputs



Status: On-going

Key Objectives

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



WP7 Developments & Outputs



<u>Status</u>: On-going <u>Key Objectives</u>

- 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.





20 of 2

WP7 Developments & Outputs



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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	

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10/12/2024 22 of 27

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



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



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



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Synergies Background

Strategic position, joint publications and review papers Knowledge database of keyenabling technologies for NH3 in waterborne transport

Concrete suggestions for technology applications for the participating partners at candidate ships

Joint decarbonization efforts towards the maritime industry

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10/12/2024 27 of 27