#HorizonEU

TUHH PARTICIPATION IN HORIZON EUROPE

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DECARBOMILE

September 2022 - August 2026

HORIZON-CL5-2021

Five pillars to DECARBOnize the last MILE logistics

Objective

DECARBOMILE aims to trigger an unprecedented improvement of the green last mile logistics in Europe. To reach that goal, DECARBOMILE relies on a strong experience of decarbonating urban logistics through European initiatives such as CIVITAS. Partners will build upon all previous results to develop improved delivery methods, tools and methodologies, and implement them across Europe. The solutions developed in DECARBOMILE will demonstrate the full potential of decarbonised last mile logistics in four living labs (in Logrono - Spain, Nantes -France, Hamburg - Germany and Istanbul - Turkey) and 4 satellites (Tallinn - Estonia, Getafe - Spain, Ghent - Belgium and Sarajevo - Bosnia and Herzegovina) will be involved at a smaller scale to test and study the solution in their own local contexts. To be successful in its implementation, DECARBOMILE will rely on developed methodologies to implement the new solutions and delivery methods in collaboration with all relevant local stakeholders, based on their needs and behaviours.

The relation with and between stakeholders will be facilitated by the creation of a collaborative urban consolidation logistics framework that will include a digital platform, methodologies for collaboration, and ICT and IoT tools.

This common framework, along with tailored innovative business models and recommendations on local policies, will allow for a strong collaboration during the project, allow to learn more about the end-users' needs and behaviours. The delivery methods will be strongly improved with urban consolidation centres, micro urban consolidation centres including smart lockers, innovations on cargo bikes and how they can be used with load pooling for instance, electric barge and more. The goal is to use and improve existing solutions and allow their interoperability and modularity to improve their efficiency and use their complementarity.

Societal impact

In the context of the DECARBOMILE project, increased participation of local stakeholders and increased quality of life in urban areas are the main societal impacts expected.

Other societal impacts are an increased road safety and a decrease of congestion and noise.

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Contribution of TUHH to the project

As a scientific partner, the researchers from the Institute of Transport Planning and Logistics of TUHH will analyse the characteristics of the four living labs and the four satellite cities and will define with the partners the baseline scenarios and use cases. In order to develop suitable solutions for all living labs and satellite cities, TUHH will run interviews, conduct workshops and perform ecological and economical calculations. TUHH takes care of a harmonised testing, operation and monitoring of full potential last mile solutions in the demonstration phase. To evaluate the results of the new last mile solutions, TUHH is leading the environmental, economic and social assessment of all labs. Besides the quantitative analysis of the four living labs' demonstration phase, TUHH will develop a methodological approach for the involvement of stakeholders.

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SAFECREW

November 2022 - April 2026

HORIZON-CL6-2022-ZEROPOL-LUTION-01

Climate-resilient management for safe disinfected and non-disinfected water supply systems

Objective

Safe and affordable supply of drinking water (DW) in the EU under the pressure of climate change is a key priority. Despite long-term experience with the reliable operation of disinfected and non-disinfected drinking water supply systems (DWSS), a number of challenges around microbial stability, the (future) need for disinfection and the consequences of disinfection by-products (DBPs) formation for human health remain open, directly deriving from climate change impacts such as increasing water temperature and higher levels of natural organic matter (NOM). SafeCREW aims to support the novel EU DW Directive by generating advanced knowledge and developing tools and guidelines for disinfected and non-disinfected DWSS and addresses improved comprehensive water quality characterization, novel treatment solutions to actively respond to identified threats, and the management of distribution networks to avoid water quality deterioration up to consumers.

Novel data sets on the occurrence and concentration of so far unknown DBPs will be created, and commercial actors stimulated to further develop tools for DBP quantification and mitigation. Transferable tools will be provided to end-users (water utilities, national/EU regulators, researchers, SMEs), including:

(I) reliable methods to evaluate microbial stability, characterise NOM, detect DBPs and account for DBP human health toxicity,

(II) protocols to select proper materials in contact with disinfected water,

(III) monitoring and modelling tools, also exploiting machine learning, for real-time optimisation of DWSS management, and

(IV) an integrated risk assessment framework to guide future interventions which ensure that both disinfected and non-disinfected DWSS can continue providing safe DW in the face of climate change. SafeCREW will increase the preparedness of the EU water sector to challenges arising from climate change and will support the EU's leading position in science-based policy making for DW consumer protection.

Social impact

SafeCREW will contribute to UN SDG 6 Clean Water and Sanitation. It will develop tools and guidelines which support resilient and adaptive management of drinking water supply systems under climate change conditions. SafeCREW focusses on securing high water quality and reducing pollution by minimizing the formation of undesired disinfection by-products.

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Contribution of TUHH to the project

The Institute of Water Resources and Water Supply at Hamburg University of Technology (TUHH) is closely affiliated with the DVGW (German Technical and Scientific Association for Gas and Water) Research Centre at the TUHH. Their research areas range from water collection to water treatment and distribution. They include, among others, the optimisation of water treatment processes, hygiene issues concerning water distribution, and energy efficiency. A key area of their work is the North German water supply with its special characteristics. The DVGW Research Centre at TUHH coordinates the SafeCREW project and its 11 partners. With its experience with microbiological analysis and charged porous materials it will develop an innovative membrane-based process to minimise disinfection by-product formation and contribute to the membranes study for the development of a new passive sampler.

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QCFD

November 2022 - October 2026

HORIZON-CL4-2021-DIGITAL-EMERGING-02-1

Quantum Computational Fluid Dynamics

Where Quantum and Fluids entangle

Objective

Scientific and technological progress is broadly underpinned by the ability to accurately predict and optimise complex fluid flows which arise across the physical and life sciences including climate research, as well as in the energy, chemical, automotive, aircraft, and ship building industries. The wide separation of length and time scales that need to be covered when designing and optimising flows and a large number of design parameters make numerical simulations highly demanding. Current capabilities are thus insufficient to meet future demands of users in academia and industry.

We will tackle this challenge by developing a quantum software framework for solving a wide range of industrially relevant computational fluid dynamics problems. This will consist of platform-independent quantum algorithms and hardware optimized software for platforms in the European Quantum Technology Flagship Projects. Tensor-network simulations, gate-level classical simulations including realistic quantum noise models, and implementations on quantum hardware will provide detailed information on quantum hardware requirements, achievable quantum advantages, and provide feedback to hardware developers. The quantum software will be verified and benchmarked against standard computational fluid dynamics results. It will be developed in agile cycles to respond quickly to user demands and progress in the quality of quantum hardware.

We will demonstrate the feasibility and advantages of the quantum approach starting from a core set of highly scalable and industrially relevant design examples arising in the thermal management of battery-electric-vehicles aimed at increasing their efficiency. Subsequently, we will extend our approach to a wider class of fluid flows and industry partners. We will create an interface between the quantum software framework and the industry standard computational fluid dynamics software OpenFOAM to make it widely available and maximise its impact.

Social impact

Computational Fluid Dynamics (CFD) is critical in environmental sciences as well as in engineering. Relevant applications range from large-scale climate modelling to renewable energy generation or transportation industries. Moreover, CFD-based design is becoming increasingly relevant in biomedical and health research applications such as the development of drug delivery systems and medical devices or theanalysis of physiological flows. Supplementary to the mere societal impact of its use, CFD has become a significant economic aspect in digital engineering. The global CFD market in 2020 was estimated at US $1.9 Billion and is projected to grow to US $3.2 Billion by 2027. These facts give only a glimpse view of the importance of CFD in e.g. the transportation sector.

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Contribution of TUHH to the project

TUHH has experience in various aspects of computational and physical modeling of flows, as well as optimisation with Partial Differential Equations (PDES). We will contribute with identifying crucial benchmark examples and support the transfer of mathematical models, algorithms and building blocks of classical CFD algorithms into Quantum CFD (QCFD). This includes fundamental as well as industrial examples. Using classical hardware we will supply multi-scale benchmark solutions to support the analysis and validation of the to-be-produced quantum software. In a subsequent step, we will identify practical cases particularly suitable for QCFD. Examples will be selected based on their industrial relevance and scalability.

Partner

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BIOCTANE

November 2022 - October 2026

HORZON-CL5-2021-D3-03-03

Synergetic integration of BIO-teChnology and thermochemi-cal CaTalysis for the cAscade coNvErsion of organic waste to jet-fuel

Objective

The reduction of GHG emissions according to the Paris Agreement is particularly challenging regarding the production of "green" liquid fuels with a high energy density for the aviation sector (drop-in biokerosene). In this context, the BIOCTANE project aims to develop and optimize an innovative process for the conversion of organic waste materials naturally characterized by a high-water content (e.g. food-waste, organic material from the food processing industry) into carbon-neutral market-ready drop-in jet-fuels.

In particular, BIOCTANE project will develop a proof of concept on the synergetic coupling of biotechnological and thermocatalytic processing routes by a disruptive and interdisciplinary strategy that will result in an efficient valorization of the organic wastes into renewable jet-fuel, maximizing the recovery of chemical energy, nutrients and carbon use.

First, the complex organic waste will be converted into platform molecules (acetoin and 2,3-butanediol) by creating a breakthrough link between biotechnological processing of biowaste and hydrothermal gasification technology.
Subsequently, a novel one-pot chemical process will be developed by the combination of different catalytic steps through which the platform molecules are converted to jet-fuel range hydrocarbons. Based on an extensive process flow modelling, the process efficiency and the techno-economic requirements for full market integration as well as the environmental impact will be assessed. Best environmental performance, including recovering nutrients for reuse will be aimed for throughout the process development.

Therefore, BIOCTANE will establish a novel pathway involving hybrid processes and multifunctional catalysts, contributing to implement sustainable, secure and competitive renewable energy technologies in Europe, boosting the use of advanced biofuels and with a direct impact on strategic areas like aviation transport.

Social impact

By turning organic wastes into renewable fuels, the BIOCTANE project aligns with the EU's objectives of a bio-economy that supports a sustainable Europe. The project also follows the European Green Deal by using life cycle assessment methods to ensure the sustainability of the renewable fuels value chains, considering their social, economic and environmental impacts and the use of biogenic waste. The application of comprehensive life-cycle criteria will help to establish a value chain that is environmentally and socially responsible, and to gain public trust by showing that it is a sustainable system.

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Contribution of TUHH to the project

Two institutes of TUHH are contributing to BIOCTANE: The Institute of Technical Microbiology (TMI) and the Institute of Environmental Technology and Energy Economics (IUE). TUHH TMI (Institute for Technological Microbiology) investigates the biotechnological conversion of a substrate leading to acetoin or 2,3-butanediol. Both compounds are known as valuable platform chemicals and can be produced from the central metabolite pyruvate which is formed in major amounts via the autotrophic Calvin cycle metabolism, but also within the propionic acid metabolism. The bacterium Cupriavidus necator will be applied as a biocatalyst to be engineered for the production of these two platform chemicals. TUHH IUE (Institute for Environmental Technology and Energy Economics) leads the activities in WP4: Process evaluation.

This aims – based on an extensive process flow modelling – to assess the process efficiency (e.g., material flow, energy flow, carbon-use efficiency) for the individual conversion steps as well as the overall process relative to the main target product as well as the overall product spectrum. The challenge is to transfer the data provided on a reasonably low TRL to a higher TRL to allow for realistic overall process schemes and, thus, for realistic statements about the strengths and weaknesses of this conversion approach. These results are the basis for a subsequent economic and environmental assessment carried out to analyze the overall process, e.g., related to the fuel provision costs as well as the resulting greenhouse gas (GHG) emissions – and this for different future time horizons respectively different stages of development.

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EDIH HAMBURG

December 2022 - November 2025

DIGITAL-2021-EDIH-INITIAL-01

EDIH for urban interconnected supply and value Ecosystems

Objective

Hamburg is not only an important European logistics and business location but also an award-winning "Smart City" in the sense of a European innovation metropolis. In its function in the metropolitan region of Hamburg, it fulfills an important economic, but also geographic bundling function, in which intermodal transport, logistics, industry, and (public and private) infrastructure providers are concentrated in a confined space and interact with each other.

The European Digital Hub Hamburg (EDIH Hamburg) will be both aligned with the specific economic and geographic conditions of the location and its needs in the future, as well as developed in line with innovation policy per the Smart Specialization and Regional Innovation Strategy (RIS3) of the metropolitan region. In particular, the requirements for critical infrastructure will change considerably, so new technological solutions must be evaluated and implemented, whether in the areas of cybersecurity, AI, HPC, or digitalization. This is exactly where the portfolio and network of the EDIH Hamburg comes in: Provide services that will enable the ecosystem to invest in these technological solutions, let it be, new traffic and logistics concepts, which will be supplemented by, for example, autonomous vehicles or also drone technologies, or also innovative autonomous logistics node concepts. Thus, the EDIH services will supply specific formats that will combine the technological areas with the use cases and requirements of these innovations.

Due to the well-established beneficiaries, the EDIH Hamburg consortium has sufficient maturity to establish the innovation ecosystem at the location in a target-oriented manner and to comprehensively map the role of an EDIH required by the EU. Years of working in the innovation ecosystem of the metropolitan provide the project partners with experience and target group access.

Social impact

Society is made aware that only together can we achieve the transformation in the sense of the Green Deal and the SDGs. Among numerous advisory, information, and learning formats, EDIH Hamburg shapes the minds of tomorrow and empowers them to use the tools of digitalization in the sense of a sustainable economy and society.

Education creates empowerment so that more people in society can be activated and included in participation. The EDIH Hamburg helps to educate a critical mass and to promote technological developments and applications according to European standards and focus areas.

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Contribution of TUHH to the project

In cooperation with the Mittelstand-Digital Zentrum Hamburg, the TUHH contributes to the EDIH Hamburg in the pillar "Skills & Training" (work package 4). The aim of the pillar is to promote the acceptance of digital transformation among small and medium-sized enterprises (SMEs) to lower barriers and obstacles to digitalization and to provide impetus for the first important steps. To this end, various lecture formats are offered for the presentation of potentials, barriers, success factors, and changes resulting from the use of digital technologies. In addition, the aim is to create professional and methodological competencies for the implementation of digitization projects among SMEs. TUHH offers qualification formats to identify areas of application for digitalization and to conceptualize and implement applications.

Partner

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MFLOPS

January 2023 - December 2026

HORIZON-MSCA-2021-DN-01

Multiphase Flow Optimisation Strategies with Industrial Applications

Objective

New adjoint-based optimisation approaches to multiphase flows.

Multiphase flows, fluid flows consisting of more than one phase, are ubiquitous in industry. They seem to be holding the key to the efficient design of electrification technologies for the transport sector, such as battery thermal management systems and proton exchange membrane fuel cells for innovative aviation propulsion systems. However, methods for optimising multiphase flows for industrial applications are lacking. Funded by the Marie Skłodowska-Curie Actions programme, the MFLOPS project aspires to develop coupled multiphase flow and optimisation methods, including adjoint methods, and apply them to cases specified by non-academic beneficiaries and partners. Efforts to reduce CO2 emissions require innovative and technologically viable solutions to be developed.

Technology holds the greatest potential to help society address the challenges of designing energy efficient concepts at affordable prices. Among the wide envelope of factors, one core characteristic relevant to this proposal is the occurrence of multiphase flows, which are ubiquitous in nature and industry.

For example, hydraulic turbomachines, ship propeller systems, and e-fuel injectors are compromised by the occurrence of catastrophic cavitation. In the field of power generation, boiling heat transfer is the predominant energy conversion method. Multiphase flows for immiscible fluids seem to hold the key to the efficient design of emerging electrification technologies of the transport sector, such as battery thermal management systems and Proton Exchange Membrane fuel cells for innovative aviation propulsion systems, as well as in the design of energy efficient marine vessels. Optimisation methods for designing efficient systems are largely missing from the relevant technological sectors. MFLOPS aspires to develop coupled multiphase flow and optimisation methods, including adjoint methods, and apply them to cases specified by MFLOPS's non-academic beneficiaries and partners.

This coupling of research with industry makes MFLOPS a truly innovative network for Doctoral researchers to start their career. A holistic training is provided by scientists and industry leaders to facilitate the accomplishment of the scientific tasks and to apply them to industrial practice. Additional networking, transferable skills and rigorous scientific training on the relevant topics make MFLOPS a well-connected cohort of future leaders with the ability to communicate across disciplines, aiming to support European industries, while been heavily involved in the public mandate for global CO2 reduction.

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REWIRE

January 2023 - December 2026

HORIZON-MSCA-2021-DN-01

Technology-driven combinatorial therapy to rewire the spinal cord after injury

Objective

ReWIRE will combine innovative translational neurotechnologies and rehabilitation interventions for the repair and restoration of neurological functions following injury of the spinal cord (SC). The proposed research program will equip next-generation scientists with unique skills to develop disruptive therapeutic solutions for patients with paralysis. Recent technological breakthroughs have triggered a paradigm shift in the conception of therapies aimed to restore function after spinal cord injury (SCI). Novel drug delivery systems and biomaterial bridges have been engineered to reduce secondary injury and scarring, to stimulate and guide regenerating nerve fibres across the lesion site, and to promote functional reconnection with intact tissue. Additionally, neuromodulation therapies can reactivate spinal circuits below a SCI, allowing people with chronic paralysis to regain voluntary control of walking. In conjunction with rehabilitation, neurological recovery was promoted that persisted without neuromodulation, suggesting a rewiring of the SC as demonstrated in preclinical models. To bypass an injury, neuromodulation has been linked to brain signals to re-establish cortical control over spinal circuits by employing electrical nerve stimulation and robotic systems.

Advances in robotics are significantly augmenting the impact of neurorehabilitation by inducing new natural "wired" connections. The aim of ReWIRE is to leverage all these technical and therapeutic breakthroughs in the framework of multiple PhD projects that will continuously interact to converge toward effective combinatorial treatments for SCI. ReWIRE will focus on three inter-woven objectives: i) establish an international, interdisciplinary, and intersectoral educational network, ii) build an SCI clinical data platform, and, iii) position Europe at the forefront of therapy for SCI.

Social impact

Traumatic SCI is primarily caused by mechanical damage to the central nervous system, with traffic accidents and falls as its main causes. Global SCI prevalence ranges between 280 and 316 cases per million people, often resulting in impairment of motor, sensory, and autonomic functions due to loss of neurons, degeneration of axons, and interrupted neuronal connections, as well as death of supportive cells and scar tissue formation at the lesion site. ReWIRE will leverage different state-of-the-art techniques with the goal of developing and translating new combinatorial SCI therapies from bench to bedside, improving the quality of life and reducing societal burden.

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Contribution of TUHH to the project

The Institute for Microsystems Technology at TUHH performs cutting-edge research in the field of Micro Electro-Mechanical System (MEMS) technology with a focus on micro, nano and bio integration. Its areas of expertise include sensor technology (micro analytics), microfluidics, and medical engineering (micro implants), addressing applications in biotechnology, medicine, and process engineering. Notably, TUHH has developed a novel mechanical Microconnector System (mMS) for the re-adaptation of spinal cord injuries, achieving an up to now unattained level of recovery in hindlimb locomotor function following acute SC transection in rats. In the context of "ReWIRE" TUHH is responsible for creating the next-generation mMS (mMS+) by integrating bioactive materials within the device through a series of objectives:

The first objective relates to the development of a 3D printed biodegradable mMS+ with bio-integrating coating by employing Selective Laser Etching (SLE) and/or Two-Photon Polymerization (2PP) 3D printing technologies. The SLE process will be adapted to cast soft hydrogel mMS+, made from PEG or CNF.

While PEG crosslinks can degrade via hydrolysis or matrix metalloproteinases, CNF can be degraded on demand by adding cellulase via the mMS+ channels at specific time points. At the same time 2PP, a 3D printing technology with micrometer resolution in all 3 axes, will be investigated to enable the custom printing of the mMS+, making it possible to account for different lesion shapes and sizes using similar materials. The second objective regards the inclusion of photonic waveguides and electrodes, among which biodegradable electrodes made of carbon/Pt-loaded microgels, directly within the mMS+ structure. This will be achieved through the use of SLE and direct printing techniques, enabling the integration of sensors and actuators in the implant, with the purpose of monitoring and promoting functional recovery.

Finally, drug delivery systems will be incorporated into the mMS+ to temporarily attract the regenerating axons into the biomaterial bridges, allowing them to subsequently grow back into the healthy tissue below the SCI.

Partner

DWI Leibniz-Institut für Interaktive Materialien

cea

ONWARD

PEPSCAN Part of the Biosynth Group

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AI4SOILHEALTH

January 2023 - December 2026

HORIZON-MISS-2021-SOIL-02-02

Accelerating collection and use of soil health information using AI technology to support the Soil Deal for Europe and EU Soil Observatory

AI 4 Soil Health

Objective

The objective of AI4SoilHealth is to co-design, create and maintain an open access European-wide digital infrastructure, compiled using state-of-the-art Artificial Intelligence (AI) methods combined with new and deep soil health understanding and measures. The AI-based data infrastructure functions as a Digital Twin to the real-World biophysical system, forming a Soil Digital Twin. This can be used for assessing and continuously monitoring Soil Health metrics by land use and/or management parcel, supporting the Commission's objective of transitioning towards healthy soils by 2030. The project is divided into seven (7) work-packages including:
(WP2) Policy and stakeholder engagement – networking and synchronising with EU and national programmes, (WP3) Soil health methodology and standards – developing/testing methodology to be used by WPs 4-6, (WP4) Soil health in-situ monitoring tools and data – developing field and laboratory solutions for Observations & Measurements, (WP5) Harmonised EU-wide soil monitoring services – developing the final suite of tools, data and services, (WP6) Multi-actor engagement pilots - organizing field-works and collect users' feedback, (WP7) Soil literacy, capacity building and communication – organising public campaigns and producing educational materials. Key deliverables include:
Coherent Soil Health Index methodology, Rapid Soil Health Assessment Toolbox, AI4SoilHealth Data-Cube for Europe, Soil-Health-Soil-Degradation Monitor, and AI4SoilHealth API and Mobile phone App. Produced tools will be exposed to target-users (including farmer associations in >10 countries), so their feedback is used to improve design/functionality. Produced high-resolution pan-European datasets will be distributed under an Open Data license, allowing easy access by development communities. AI4SoilHealth will provide an effective Soil Health Index certification system to support landowners and policy makers under the new Green Deal for Europe.

Social impact

AI4SoilHealth aims to generate the digital twin of European soils. This open access digital infrastructure enables assessment and monitoring of soil health to support the EU 'The Soil Health & Food Mission' towards reaching its targets set by the EU Soil Strategy 2030. The outcome of AI4SoilHealth will be an essential component for sustainable and resilient agricultural system. This will yield numerous advantages for society including improved food security & public health, climate change mitigation, rural development, reduced soil degradation, salinisation and compaction and increased net productivity and profitability of European agriculture.

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Contribution of TUHH to the project

The Institute of Geo-Hydroinformatics at TUHH will play a pivotal role in the assessment and prediction of soil salinisation and degradation across Europe, leveraging an extensive array of data and cutting-edge AI-assisted tools.

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FASTER-H2

January 2023 - March 2026

HORIZON-JU-CLEAN-AVIATION-2022-01-SMR-03

Fuselage, Rear Fuselage and Empennage with Cabin and Cargo Architecture Solution validationand Technologies for H2 integration

Objective

The FASTER-H2 project will validate, down select, mature and demonstrate key technologies and provide the architectural integration of an ultra-efficient and hydrogen enabled integrated airframe for targeted ultra-efficient Short/Medium Range aircraft (SMR), i.e. 150-250 PAX and 1000-2000nm range.
To enable reduction of climate impact flight, aircraft for short and medium-range distances have to rely on ultraefficient thermal energy-based propulsion technologies using sustainable drop-in and non-drop-in fuels. Besides novel highly efficient propulsion technologies, sustainable materials for the fuel storage, distribution as well as the overall fuselage, empennage and cabin and cargo structures are essential to meet an overarching climate-neutrality of the aviation sector. Greener propulsion and fuel technologies will have a major impact on the full fuselage, including the rear fuselage, the empennage structure as well as cabin and cargo in so far as the integration of storage and the integration of systems for the chosen energy source are concerned (H2, direct burn, fuel cell). Not only do the specific properties of hydrogen necessitate a re-consideration of typical aircraft configurations, requiring new design principles formulation and fundamental validation exercises, but they also raise a large number of important follow-on questions relating to hydrogen distribution under realistic operational constraints and safety aspects.

The project will explore and exploit advanced production technologies for the integrated fuselage, i.e. structure – cabin – systems, to reduce production waste and increase material and energy exploitation with Integrated Fuselage concept selected (maturity TRL3/4) until end of first phase in 2025. An anticipated route to TRL6 until end of the Clean Aviation programme in 2030 will ensure entry-intoservice in 2035.

Social impact

FASTER-H2's primary goal is to reduce aviation's environmental impact. It focuses on minimizing production waste and optimizing energy use in aircraft fuselage production. To achieve that a significant collaboration between international industry companies and academia is necessary enhancing European unity and partnerships, and creating new jobs in aerospace, materials, manufacturing, and research. These aspects boost the competitiveness of the European aviation industry on a global scale, contributing to economic growth and prosperity.

CLEAN AVIATION

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101101978. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

Co-funded by the European Union

Contribution of TUHH to the project

The activities of the FST in FASTER-H2 includes conducting system architecture studies, technology assessment and integration. For this purpose, technologies from past European projects, such as Clean Sky, are currently collected, consolidated and recorded in a technology database. The focus is on structural and system-relevant questions, taking technology incopatibilities into account. In a further step, a method will be developed to compare and evaluate the tech nologies collected. Evaluation parameters such as costs and life cycle assessment will be used. The method is applied in the context of a comparative study. Here, two aircraft concepts with the energy sources SAF (Sustainable Aviation Fuel) and liquid hydrogen are evaluated and compared with each other. The results are to be transferred to and used in the Clean Aviation Project ACAP (SMR Aircraft Architecture and Technology Integration project).

Partner

AIRBUS

DLR

AERnnova

ALESTIS AEROSPACE

CirComp Competence in Composites

DASSAULT AVIATION

ETW EUROPEAN TRANSONIC WINDTUNNEL

FH AACHEN UNIVERSITY OF APPLIED SCIENCES

Fraunhofer

CTA

Gaiker MEMBER OF BASQUE RESEARCH & TECHNOLOGY ALLIANCE

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#HorizonEU

SMR ACAP

January 2023 - June 2026

HORIZON-JU-CLEAN-AVIATION-2022-01-SMR-01

SMR aircraft architecture and technology integration project

Objective

The SMR Aircraft Architecture and Technology Project (SMR ACAP) shall be the central place to assess and integrate all technologies at aircraft level, from across the projects in the SMR pillar. Establishing the link to projects with relevant technologies in the other Clean Aviation "Pillars" and transverse projects associated with novel certification methods is part of the work plan of the project. The setup of the ACAP project is tailored to steer and manage the definition of the targeted SMR aircraft configurations with all key performance features required for the SMR architecture.
In order to accelerate the maturation of the SMR aircraft technologies, ACAP will provide a digital collaborative framework with tools, means andskills enabling to continuously link all R&T activities within the SMR pillar (strongly linked to other Clean Aviation pillars) to deliver solutions meeting the Clean Aviation high level goals: reduce the greenhouse gases by -30% compared to a 2020 state of the art technology; support the launch of new product by 2035, to replace 75% of the fleet by 2050, and exploit the synergies with other national and European related programmes.

Coordinated by Airbus, the project consortium is composed of a well balanced mix of innovative actors from the aeronautical industry covering almost all technical disciplines of aircraft R&T complemented by a strong foundation of Academia and Research and Technology Organisations, which is further widened via linking to other CA projects.

The ACAP project is aiming to identify "best athlete" SMR aircraft concepts before the end of CA phase 1 and, based on sound analysis of the expected impact with respect to the CA objectives, to propose which technologies shall be further developed and demonstrated in a Clean Aviation phase 2.

Social impact

Developing and integrating hydrogen-powered aircraft, as it is the focus of ACAP, will help with drastically cutting down the aviation sector's environmental footprint. The advent of the next generation of low carbon aircraft is heralding an era where travel meets environmental responsibility. Moreover, adopting hydrogen propulsion can rejuvenate the aviation industry, leading to job creation in new technological sectors. The broader societal implications of ACAP could, therefore, resonate deeply, influencing policy, economy, and the global pursuit of a more environmentally aware future.

CLEAN AVIATION

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Co-funded by the European Union

Contribution of TUHH to the project

In the scope of ACAP, the TUHH analyses and trades non-propulsive on-board system concepts and architectures by applying the GeneSys methodology to identify the most promising solutions for energy efficiency at aircraft level. The GeneSys methodology comprises a set of consistent and integrated system models and all relevant interdependencies between individual systems are modeled. Moreover, knowledge-based positioning heuristics and parametric methods for sizing and simulation are used to rapidly evaluate competing systems architectures. The process is structured to be both flexible to perform integrated iteration loops with overall aircraft design partners and comprehensive to integrate physics-based sizing and steady-state simulation models derived from the system detailed design stage.

As highly disruptive hydrogen-powered aircraft will be subject to the studies performed in ACAP, the GeneSys methodology is extended to study the required steps in order to integrate hydrogen supply and distribution systems into commercial aircraft. Furthermore, methods and tools are developed for the preliminary design of hybrid-electric kerosene and hydrogen-based propulsion systems. In this context, it is of particular interest of how new propulsion concepts, such as the Water Enhanced Turbofan (WET), can be integrated into the hybrid propulsion system and the overall system architecture. Finally, the TUHH is developing energy management strategies and operational concepts for hybrid propulsion systems, aiming for an optimal energy balance at aircraft level.

Partners

AIRBUS, DLR, esploro projects, SAINT EXUPÉRY, MTU Aero Engines, ONERA THE FRENCH AEROSPACE LAB, ΠΑΝΕΠΙΣΤΗΜΙΟ ΠΑΤΡΩΝ UNIVERSITY OF PATRAS, SAFRAN, DTU Technical University of Denmark, TUHH Technische Universität Hamburg, Tekniker MEMBER OF BASQUE RESEARCH & TECHNOLOGY ALLIANCE, Lufthansa Technik, Fraunhofer, CHALMERS UNIVERSITY OF TECHNOLOGY, LIEBHERR, Avio Aero a GE Aerospace company, ikerlan MEMBER OF BASQUE RESEARCH & TECHNOLOGY ALLIANCE, TU Delft, THALES, ecoinvent, Rolls-Royce, UNIVERSITY OF CAMBRIDGE

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RESCUE ME

February 2023 - July 2026

HORIZON-CL2-2022-HERITAGE-01-08

Equitable RESilience solutions to strengthen the link between CUltural landscapEs and coMmunitiEsy

RESCUE ME
RESILIENT CULTURAL LANDSCAPES

Objective

Our common heritage is a central element of our communities and economies, and a principal but vulnerable dimension of our common identity as Europeans. It has been proven that cultural heritage contributes to well-being, social cohesion, identity, local economy, territorial attractiveness, and environmental sustainability, but the climate crisis and natural hazards endanger this heritage. We propose RescueME to take immediate action for demonstrating how an innovative data-driven, community-based, heritage-centric actionable landscape approach to resilience enhancement can protect our cultural heritage and landscapes while supporting the transition toward a green society and economy that sustains resilient, cohesive, nature-connected communities. RescueME proposes a call for action, broadening the scope, triggering action, untapping and mobilizing resources, engaging actors, and facilitating the decision making and the implantation of co-created just resilience solutions to protect our common heritage.

RescueME will develop, test and demonstrate the effectiveness of an Actionable Framework based on the Resilient Historical Landscape approach (RHL) complemented by data, models, methods, and tools able to assess risks and opportunities, co-develop inclusive and just resilience strategies and innovative solutions to protect European cultural heritage and cultural landscapes from climate change, disaster risk, as well as other stressors (such as pollution and over-tourism) with special focus on European coastal landscapes since a large share of this endangered heritage there.

The five case studies (Psiloritis in Creta, Neuwerk in Hamburg, Portovenere, Cinque Terre & the Islands, València and the city of Zadar) have been selected carefully as complementary representatives of European coastal landscapes. They will act as resilience landscape laboratories (R- labscapes), validate the results and ensure their replicability.

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Contribution of TUHH to the project

The Institute of River&Coastal Engineering, TUHH is leading the subtask dedicated to the hazard and stressor characterisation and to the definition of climate change scenarios for the project case study areas (R-labscapes), establishing the relation between climate change and natural hazards with cultural landscapes. Furthermore, TUHH is coordinating the activities related to the hazard assessment in all R-labscapes, building upon the existing projects and plat forms including CMIP, ISIMIP, CORDEX and Copernicus Climate Change Service model simulations and addressing different types of natural hazards being pluvial, fluvial and coastal floods (and extreme sea level, including the sea level rise), wind storm, protracted droughts, water scarcity, desertification (including soil erosion) and landslides.

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FITNESS

April 2023 - March 2027

HORIZON-EIC-2022-PATH-FINDEROPEN-01

Flexible IntelligenT NEar-field Sensing Skins

FITNESS
Flexible smart skins

Objective

The FITNESS project will realise flexible smart skins able to provide a non-contact sense of "touch". The envisioned smart skins will operate at microwave frequencies, and the same device will also allow far-field communication. The key technology enabling these functionalities is that of metasurfaces (MTS), i.e., structured and essentially twodimensional materials with unusual electromagnetic properties. MTS are composed of hundreds or thousands of subwavelength patches, with varying dimensions, printed on a dielectric substrate. The ambition of FITNESS is to exploit flexible MTSs for near field sensing, in the first instance in the area of collaborative robotics. The major concern in this field is the risk of collision with humans. Hence, tasks performed by robots are too slow and too simple, which is an important obstacle to robot use in healthcare, agile manufacturing and many other fields. By equipping robots with flexible sensing skin, in addition to standard sensors (e.g., cameras, lidars and radars), the risks can be essentially eliminated. The FITNESS microwave technology will enable for the first time a smooth transition from the near-field "sensing aura", to far-field communication, using the same device, which is beyond the capabilities of present-day proximity sensors. FITNESS envisions a near-field to far-field sensor, based on surface waves and their possible transformation into leaky waves, to be wrapped around robots or humans. The measurement of the correlation between transmitted and received signals at all pairs of ports will also be used to monitor the eNects of folding the flexible skin. FITNESS will integrate ultra-low power operation from the beginning. The new devices will essentially work through the measurement of the transmittance between a limited number of ports (sparse electronics), through surface waves following the shape of the smart skin which is wrapped around a robot or the body. FITNESS includes important innovations toward thin integrated electronics distributed along the MTS. Thinned CMOS chips bonded onto a compliant host substrate will enable mechanical flexibility and high-frequency operation. The silicon-on-insulator (SOI) technology is chosen, as it provides high linearity, excellent passivation, and low loss. Also, so far advances regarding flexible microwave materials are lagging behind, curtailing the development in the field. The integration of mechanical properties (i.e., plastic deformation, self-healing) in low-loss materials is a challenge. In FITNESS, new multifunctional polymer substrates and compatible metallisation techniques for MTSs and electronics will be developed to achieve low losses and advanced mechanical functions, e.g., structures that are flexible, stretchable, or even self-heal.

Social impact

One of the main societal outputs will consist of a more harmonious cooperation between robots and humans through the constant probing of their respective near-field environments. FITNESS seeks to equip robots with a flexible sensing skin in addition to standard sensors (e.g., cameras, lidars and radars), to essentially eliminate the risks of colliding with humans. This will enable a new standard for collaborative robotics and impact robot use in healthcare, agile manufacturing, and many other fields. The first demonstrator will be realised in the field of robotics, while later applications are envisioned in the medical area.

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Funded by the European Union

Contribution of TUHH to the project

The TUHH will design and synthesise new flexible microwave materials as substrates for the metasurfaces (MTS), the key enabling technology in FITNESS. The new materials will comprise multifunctional polymer substrates that are low loss in the targeted wavelength regions and have advanced mechanical functions, e.g., are flexible, stretchable, or even self-healable. Furthermore, the substrates will be optimised to be compatible with large area processing techniques and state-of-the-art metallisation procedures for MTSs and electronics. This requieres a careful balancing of material properties.

Partner

UCLouvain

cnrs

Fraunhofer FHR

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eV Technologies Think Energy!

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SUSTRONICS

June 2023 - May 2026

HORIZON-KDT-JU-2022-2-RIA

Sustainable and green electronics for circular economy

Objective

The EU requires also electronics industry to achieve the ambitious goals of the EU Green Deal, Circular Economy Action Plan and Industrial Strategy for reduction of energy and material consumption, and utilization of circular value chains. Sustronics project is targeting to improve capabilities of European electronics industry to meet these goals and develop new business opportunities from sustainable and greener electronics combined with increase in productivity and new functionalities.

The current electronic industry poses significant environmental impacts, such as increasing amount of e-waste, great demand for critical raw materials, and high energy consumption during manufacturing. Electronics industry can specifically decrease its environmental burden by shifting from fossil-based materials to bio-based materials, decreasing use of metals, utilizing additive manufacturing processes, and developing miniaturized and integrated components, but also in broader scope by utilizing efficient circular economy business models that enable reuse, recycle and repair of critical materials and components.

Sustronics main goal is to support renewal of European electronics industry towards circular economy, eco-design, bio-based materials, and material- and energy-efficient manufacturing processes. Thereby, Sustronics will re-design electronics products into circular, compostable and reusable products, and demonstrate that there are business opportunities in sustainable electronics.

Quantification of environmental impact, definition of business models, involvement of external stakeholders, and means to guarantee compatibility with policies and standards will guide the project implementation. The pilots will focus on healthcare, diagnostics, and industrial sectors, including topics such as medical and personal health devices, single-use and wearable diagnostics, sustainable lighting solutions and embedded electronics for automotive.

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SUSTAINLIVWORK

September 2023 - August 2029

HORIZON-WIDERA-2022-ACCESS-01-two-stage

Centre of Excellence of AI for Sustainable Living and Working-jet-fuel

SustAIn Liv Work

Objective

SustAInLivWork aims at creating a Centre of Excellence (CoE) in Lithuania for Sustainable Living and Working (SustAInLivWork), specialized in the development and application of R&I solutions based on Artificial Intelligence (AI) in the manufacturing, energy, health and transport sectors. This CoE will act as a lighthouse with far reaching impact strengthening R&I in the national and international scope, nurturing from a cooperation between key national partners - the four leading universities of the country- (KTU, VILNIUS TECH, VMU, LSMU) and advanced international ones (TAU, TUHH), that will contribute with their knowledge to boost value creation from advanced technologies. The CoE is necessary to improve the low development of AI based R&I solutions in the 4 mentioned sectors and to increase the sustainability of the country, by developing new business models and business process solutions with lower CO2 emissions, using Explainable AI to make those solutions safe, trustworthy and transparent.

It will have an impact on the country and on the whole Baltic Sea Region and beyond, by the operation of 4 HUBs that will derive into new educational and training programmes, an enhanced cooperation with the private sector and public authorities and the creation of a Lithuanian AI Cluster to foster transition towards sustainability with a particular focus on the S3 priorities areas. It will finally improve the Lithuanian position in EU Innovation scoreboards, increase the international collaborations, mobilise national, European and other international funding programmes by creating service packages, AI labs and different collaborations both national and international.

Social impact

AI has emerged as an innovative approach with a relevant impact on the society. Recent developments already influence and simplify our daily lives. However, advancements of these methods are necessary for a sustainable working environment. Sustainable research strands in AI methods will be promoted by reinforcing linkages between academia and business.

The stimulation of systematic and institutional reforms will result in a more modernized R&I system in Lithuania. Developing guidelines for the responsible deployment of AI methods in everyday work. In a close collaboration with TUHH and TAU, SustAInLivWork aims to strengthen the scientific excellence and educational programs, improving the international outreach.

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Funded by the European Union

Contribution of TUHH to the project

TUHH, as advanced partner, will contribute with their expert knowledge and experience in developing AI for health care. The Institute of Medical Technology and Intelligent Systems has a broad background in ML algorithms for medical image processing and AI guided diagnosis and treatment as well as robotic systems in medicine. In addition to its scientific expertise, the TUHH will contribute its experience collaborating with industrial partners for research and development of AI solutions. Furthermore, the knowledge of establishing and operating infrastructure and laboratories will be relevant for creating the new research labs in Lithuania. TUHH is also known for its innovative teaching, e.g., as part of a network of six Hamburg universities supporting the Hamburg Open Online University. Tech-transfer: TUHH was the first German public university to establish a technology transfer company (TUTech) to facilitate cooperation with industry, seen as a role model for universities in Germany and be-yond. Study Program:

TUHH is one partner of twelve European universities forming the European Consortium of Innovative Universities (ECIU).

Partner

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MCMXXII VYTAUTO DIDŽIOJO UNIVERSITETAS

LITHUANIAN UNIVERSITY OF HEALTH SCIENCES

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SEC4AI4SEC

October 2023 - September 2026

HORIZON-CL3-2022-CS-01

Cybersecurity for AI-Augmented Systems

Objective

With AI-enhanced components being deployed everywhere, including the very toolchains used for secure software development, the traditional security focus on software and hardware assets can no longer guarantee "secure services, processes and products, [and] digital infrastructures" in the EU Strategic Plan 2021-2024.

Sec4AI4Sec wants to develop security-by-design testing and assurance techniques for AI-augmented systems, their software and AI assets. AI-augment systems provide an opportunity to democratize security expertise and give access to intelligent, automated secure coding and testing, by enabling novel capabilities, lowering development costs and increasing software quality (AI4Sec). They are also a risk: AI-augmented systems are vulnerable to new security technical threats specific to AI-based software, in particular where matters of fairness or explainability are important (Sec4AI). Sec4AI4Sec addresses these challenges to the fullest extent: "AI for better security, security for better AI."

The Sec4AI4Sec project will address these two facets of AI to achieve a deep scientific, economic and technological impact, while contributing to addressing key societal issues. It will validate its approach on three key scenarios of the EU Digital Compass towards Digital Sovereignty: 5G core virtualization, Autonomy for safety systems in aviation and security and Quality for 3rd party software assessment and certification.

Sec4AI4Sec assembled a team with 5 leading Universities (Amsterdam, Cagliari, Hamburg, Lugano, Trento), 2 innovative SMEs (FrontEndART, Pluribus One), 3 Large Enterprises (Airbus, SAP, Thales) and 1 Center for digital innovation (Cefriel). The project will generate a set of innovative techniques and open-source tools, new methodologies for secure design and certification of AI-augmented systems, as well as reference benchmarks that can be used to standardize the assessment of research results in the secure software research community.

Social impact

With a sharply rising attention of the general public in AI-based software systems, Sec4AI4Sec's goals and objectives are timely and highly relevant. In the public debate, security of such systems is often not sufficiently considered from a technical perspective.

With the creation of tools and techniques that lead to more secure AI-based systems, the project can directly impact the security of products used by the broad public.

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Contribution of TUHH to the project

TUHH's Institute for Software Security has the role of research leader in the Sec4AI4Sec project.

TUHH also leads one of the seven work packages, which is concerned with the generation of code fixes for identified security vulnerabilities. Specifically, TUHH leads a task on the creation of a dataset of reproducible vulnerabilities that fosters future research on the topic, participates in a task that enhances automatic vulnerability repair techniques, and leads a task that is concerned with human aspects of automatic vulnerability repair. TUHH evaluates existing exploit generation techniques and improves patch generation techniques with the help of AI.

Further, TUHH participates in a work package about security assurance of AI-based systems. TUHH inventorizes architectural design flaws, design guidelines, and best-practices for designing AI-based software systems.

Partner

Università di Trento · SAP · TUHH Technische Universität Hamburg · Airbus · Università degli Studi di Cagliari · Thales · Frontendart · Pluribus One – pioneers on adversarial machine learning · Cefriel – Politecnico di Milano · VU Vrije Universiteit Amsterdam · Oppida

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DYNAPORT

January 2024 - November 2027

HORZON-CL4-2023-TWIN-TRANSITION-01

DYNAPORT
DYNAMIC NAVIGATION AND PORT CALL OPTIMISATION IN REAL TIME

Objective

Decarbonisation of maritime transport through carbon-free fuel is a daunting and expensive process. New propulsion systems, such as Wind Assisted Propulsion Systems, will contribute to fuel-savings. To push towards the pathway for a sustainable transition towards net zero emissions by 2050; more energy-efficient operations remain a prerequisite. This applies to the ship sailing as well as the port call processes. Efficient and viable voyage and port call optimisation require increased cooperation between parties and overcoming several important barriers such as charter parties and contracts, enabling just in time arrivals and more explicit risk/benefit sharing; improved transparency and reduce cybersecurity risks; reliable and efficient voyage and port call information sharing among all parties. Any new voyage optimisation tool must take all these constraints into consideration and ensure full transparency and agreement on arrival times between parties before the optimized route is activated. The goal of DYNAPORT is to develop new optimisation and coordination tools for ports and ships that both reduce the fuel consumption of ships and increases the efficiency of ports with by at least 10%. Key performance indicators (KPI) will be developed to quantify and measure these savings. The tools will be built on information sharing through internationally accepted protocol standards and communication systems. To improve port efficiency as well as port approach safety, the system will integrate the port Vessel Traffic Services in arrival and departure planning and execution.

This goal is fully aligned with the Strategic Research and Innovation Agenda for the partnership on Zero-Emission Waterborne Transport. It highlights the lack of standardised technologies and infrastructure that enable operational integration with ports as one of the main barriers to faster decarbonization of maritime transport. At the same time, the project goes hand in hand with the IMO's strategy to reduce greenhouse gas emissions from ships and with broader European Commission initiatives such as the European Green Deal.

Social impact

Impacts include the creation of a framework for continuous development and innovation in port operations that promotes market growth and employment in Europe. Improved port call efficiency mitigates negative social impacts like land use, noise, and greenhouse gas emissions. Aligned with environmental goals, DYNAPORT promotes climate-neutral fuels, electrification, and sustainability.

It contributes to smart, efficient, and safe maritime integration into logistics chains. Collaboration with international organizations ensures standards for interoperability and cybersecurity.

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Contribution of TUHH to the project

Through on-site studies, the Institute of Maritime Logistics (MLS) is developing 'blueprints' for optimising port processes that consider differences between various types of ports, from large multi-terminal ports such as Rotterdam to small international ports such as Aalborg. The main objectives of the MLS in the DYNAPORT project include providing a firm planned arrival time for ships, investigating the tolerance of stakeholders to changes in arrival time, identifying challenges and improvements in cooperation, information exchange, and IT systems. In addition, the MLS contributes to the system definition of the DYNAPORT project, including requirements, components, and functions. In the area of integrated simulation and KPI development, MLS is developing a discrete esvent simulation model for medium to large port scenarios to determine overall savings. The creation of KPIs to measure system performance, including emissions, safety, and port efficiency, is supported by case study-based simulations.

Partners

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SPACE NORWAY
Fix Log Consulting
NAVTOR
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MAASIVE

January 2024 - December 2026

HORZON-CL4-2023-TWIN-TRANSITION-01

MANUFACTURING AS A SERVICE TO INCREASE RESILIENCE IN VALUE NETWORKS

Objective

MAASiveTraditional value chains are facing challenges due to the fast-moving markets, customer demands, and unpredictable manufacturing and logistics. To address these challenges, Manufacturing as a Service (MaaS) is introduced as a concept that utilizes existing resources in a value network by connecting manufacturers to service providers on demand through a connected network. The MAASive project aims to develop models of value networks that enable companies to recover from unforeseen external events by connecting to new services and reconfiguring value networks utilizing internal and external manufacturing services. MAASive will provide a toolkit for industry, which will consist of a blend of existing methods and technology applied in the MaaS context, and new models and technology developed as part of the project. Four distinct aspects are addressed in the MAASive project to increase resilience in value networks: network building, impact assessment, reorchestration of networks, and value network operation. The overall aim of MAASive is to increase value network resilience by enabling manufacturers to rapidly respond to unforeseen external events or sudden changes in supply or demand, utilizing manufacturing as a service.

MAASive uses an iterative approach to develop technical solutions and identify potential technology risks early on. The project is focused on creating a toolkit from a human-centered perspective and involving professionals and workers in requirement and scenario definition. The iterative approach follows three loops focusing on 1) model foundations, 2) impact simulation and scenarios, and 3) network orchestration and operation. The results of MAASive will be developed in two use case demonstrators.

The results of MAASive will contribute to companies being more resilient towards external, unforeseen events, by being able to utilize services in a value network better and faster, while also increasing utilization of network resources.

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Contribution of TUHH to the project

In MAASive, the Institute of Business Logistics and General Management (LogU) of the TUHH will contribute expertise in the field of production operations and logistics in connection with the resilience of value networks and Manufacturing-as-a-Service.
TUHH will lead Work Package 1 (Opportunities and Requirements), where the MAASive resilience framework for value networks will be developed based on the state-of-the-art and practice analysis and contribute to building the requirements and reference architecture for Manufacturing as a Service. Additionally, TUHH will lead the project task within Work Package 2 (WP2), which involves defining the requirements and developing the governance procedures for the MAASive models and toolkits. TUHH will also significantly contribute and participate in other WPs and tasks as well as engaging with potential external stakeholders. Moreover, TUHH will lead one of two demonstration cases (WP4) based on the home appliance manufacturer Arcelik (Turkey) by supporting it in testing the MAASive solutions in the real operational environment as well as the orchestration and reorchestration of value networks as an adequate response to events that can disrupt the value chain.
Furthermore, TUHH will lead the exploitation task (WP5), where the MAASive exploitable results will be designed, structured and valorised and the exploitation plans for the scientifically and commercially relevant exploitable results will be developed. Beyond the scientific contribution, TUHH will lead the quality assurance and risk management task (WP6) and act as a Risk, Quality and Exploitation manager of the project.

Partner

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MAASIVETWIN

April 2024 - March 2028

HORZON-CL4-2023-TWIN-TRANSITION-01

MaaSiveTwin–MAnufacturing as a service And Supply chain predictIVE Twin for critical raw materials

Objective

MaaSiveTwin aligns with the vision of creating a competitive and sustainable digital Europe and green value chain by even combining the two aspects! This twin enables Manufacturing as a Service by tracking the mining and processing of critical raw materials (CRM) which will be tested by the first Li-refinery in Europe, RockTech and the first large scale LiFePO4 battery manufacturer, ElevenEs. The twin helps to improve efficiency of the supply chain, reduce uncertainty, and support informed decision making, all of which are critical for supporting the transition to a more sustainable economy. Additionally, by providing real-time data analysis and insights of CRM mining, shipping, and processing, and sustainability and predicting scenarios based on disruptive events such as Suez channel blockage, the tool will to enable participants to use other suppliers as Manufacturers as a Service in case of Supply Chain disruption to keep machinery in their factories running, increase utilisation and enable fully integrated, resilient value chains from mining of CRM till the end products.

MaaSiveTwin extends the analysis of critical materials for e.g Li, Co, Ni that go into batteries, light and heavy rare earth elements that go into magnets for wind turbines and e-motors, Vanadium that go into redox flow cells, Pt that go into H2 fuel cells and many more to enable the transition to green energy technologies which are based on CRM to achieve the Green deal goals, "fit-for-55" and the just announced EU critical raw material act from 03/2023. This digital twin will track the path towards our ambiguous EU goals and make European CRM value chains more digital and more resilient.

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Funded by the European Union

Contribution of TUHH to the project

The Resilient and Sustainable Operations and Supply Chain Management Group of TUHH brings in their expertise in the sustainability assessment of products with global supply chains.
As the leader of work package 2, TUHH coordinates the supply chain tracking efforts of the project, covering activities from mining to the final product of critical raw materials, sudden events, and sustainability aspects.

In addition, TUHH contributes to the development of indicators and models for sustainability and risk assessment.

Partner

Batteronics

ElevenEs
Empower Everything

RockTech Lithium

TUHH
Technische Universität Hamburg

Technical University of Crete

RTD Talos

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EFFITORCH

October 2024 - September 2028

HORIZON-CL5-2024-D3-01-10

Efficient valorisation of CO2 and bio-waste for long-term energy storage using a microwave plasma torch and quenching using the reverse Boudouard reaction

EffiTorch

Objective

Now that renewable energy generation is already competitive in cost with electricity obtained from fossil fuels, the development of efficient long term energy storage methods seems crucial for a faster transition to a net-zero greenhouse gas emissions EU economy. Power-to-X methods are promising due to their negligible discharge rate but up to now all the efforts have been based on the use of H2 obtained by electrolysis, and the TEAs have shown that the high cost of the electrolysers hinders greatly its possibilities of industrial use. EffiTorch aims at developing an alternative breakthrough technology for Power-to-X based on the direct splitting of CO2, using an ultra-high temperature thermal plasma, with the simultaneous valorisation of low value bio-waste, leading to the efficient production of syngas. EffiTorch aims to reach carbon efficiencies higher than 90% and energy efficiencies higher than 60%, outperforming the best solutions available presently.
Some of the research groups in Effitorch have a vast experience in CO2 splitting using Microwave (MW) plasma torches. Nevertheless, recently a compound approach that combines CO2 splitting by thermal plasmas with a quenching using the very endothermic reverse Bouduard reaction (RBR) has been developed in China that vastly improves the promising results obtained in the splitting of CO2 , while solving one of the yet unresolved issues, that of the efficient separation of the gases obtained.
EffiTorch aims to explore the possibilities offered by a much improved version of the experimental set-ups used by the Chinese groups, including additional sophistications like the ultrasonic atomization of a bio-oil obtained by Hydrothermal Liquefaction (HTL) from sewage sludge, the use of high temperature reactors with plasma confinement and the implementation of a secondary heating of the plasma by induction with HF frequency (100-400 KHz), that could improve the energy efficiency and reduce costs.

Social impact

The EffiTorch project has the potential to enhance the sustainability of energy production and to improve energy storage processes. Through its innovative approach to CO2 splitting and valorization of bio-waste, it contributes directly to the transition to a net-zero economy. By converting bio-waste into valuable syngas, the project promotes circular economy principles and targets pollution and waste management challenges. Additionally, the EffiTorch advances long-term energy storage solutions that address the challenges of a fluctuating renewable electricity supply.

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Funded by the European Union

Contribution of TUHH to the project

The Hamburg University of Technology (TUHH), represented by the Institute of Environmental Technology and Energy Economics, plays a crucial role in the EffiTorch project, leveraging its extensive expertise in energy technology and process evaluation.
TUHH leads Work Package 5, which focuses on the comprehensive evaluation of the entire process. This work package starts with defining the framework assumptions, system boundaries, and conditions for the overall system. Based on these initial definitions, an integrated process model is developed to assess the overall energy efficiency and carbon conversion rates of the proposed CO2 splitting technology. This step involves detailed analyses of material and energy flows, optimization of process parameters, and exploration of synergies between different technological components to enhance process performance. The model is populated with data sourced from both literature and experimental results provided by the other project partners.
The findings from this process modeling form the basis for a subsequent economic and environmental assessment. This analysis evaluates the entire process, including the costs associated with the provision of synthesis gas or downstream products for potential markets, as well as the resulting greenhouse gas (GHG) emissions.

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