Challenge 3: Enabling Climate Neutrality with Storage Technologies, Renewable Fuels and CCU/CCS

Aage Stangeland and Isabel Cabrita

Co-funded by the European Union

TRI 3 – CCUS, hydrogen and renewable fuels

Aim

- Facilitate the emergence of **CO_2 capture, transport, utilization and storage (CCUS)** through targeted financing of innovation and research activities.

- Facilitate the development and adoption of technologies for effective production, transport, storage and end-use of **hydrogen and renewable fuels**, including security aspects.

- Accelerate the time to market for **hydrogen and renewable fuel technologies**. This will require industrial involvement in research and innovation activities.

DRIVE

Deep removal of CO_2 and innovative electrification concepts

Peter van Os, TNO

TRI 3 – New projects starting this autumn (1)

Project	Title / topic	Coordinator
ACLOUD	Advancing chemical-looping combustion of domestic fuels	Chalmers
AMbCS	Advanced membrane-based solutions for CCUS in shipping	Aqualung Carbon Capture AS
BUCK$$$	Brine utilisation for CO2 to be solidified and stored	Sapienza
CO2RR	Establish the first commercial international multi-modal CO2 transport value chain in the Europe	South Pole
CTS	CO2 transport and storage directly from a ship offshore storage.	NORCE
DRIVE	Deep removal of CO2 and ionnovative electrification concepts	TNO
GreenSmith	Gas processing for climate neutral steelmaking	TNO
LEGACY	Field studies for de-risking existing wells and CCS site geology	SINTEF
RamonCO	Risk-based framework for assessing CO2 storage monitoring	NORCE
SENSATION	Sorbent assisted carbon capture tailored for low CO2 concentrations	SINTEF

TRI 3 – New projects starting this autumn (1)

Project	Title / topic	Coordinator
HOOPLA	Effect of hydrogen as a function of structural condition in pipeline distribution and storage tanks	VZÚ Plzeň
HyCoMM	Clean hydrogen construction and mining machines	Fraunhofer
HydrOTEC	Hydrogen production with the use of solar assisted ocean thermal energy conversion in the Mediterranean Sea	Cyprus University of Technology
HyLife	Microbial risks associated to hydrogen underground storage in Europe	NORCE
UNICORN	Unlocking the full potential of electrolysis with next-generation proton exchange membrane stacks	SINTEF

TRI 3 Wrap up

- All new projects have potential for delivering new knowledge needed for the green transition
- The projects will close knowledge gaps within CCUS, hydrogen and renewable fuels and pave way for large scale deployment
- CETP have huge expectations and are looking forward to following the projects
- New possibilities in the CETP Call 2023 for new applications within CCUS, hydrogen, and renewable fuels

Challenge 4: Efficient zero emission Heating and Cooling Solutions

Gerdi Breembroek

Co-funded by the European Union

TRI4 H&C Overview of projects from 2022

Proposal Acronym	Proposal Name	Funding Agencies(acronym)
STRAWBERRIES	Solar Thermal Agriculture with Bifacial Collectors for Farming Synergies	FCT, FZJ/PtJ, BF Portugal, Germany, Finnland
TRAINING	Thermal energy storing and digitalization in district heating to enable transition to renewable and resource efficient energy systems	RCN, SWEA, FZJ/PtJ Norway, Sweden, Germany
LEG-DHC	Large-scale climate neutral Energy Geostructures in District Heating & Cooling systems/networks	RCN, IFD, MiSE, MKM, ANR, GSI Norway, Denmark, Italy, Estonia, France, Ireland
PVT4EU	Photovoltaic Thermal For Europe	FCT, SWEA, IFD Portugal, Sweden, Denmark

STRAWBERRIES

Solar Thermal Agriculture with bifacial collectors for farming synergies

Project Team

Technische Hochschule Ingolstadt
Institute of new Energy Systems

Prof. Wilfried Zörner
Principal Investigator

Thorsten Summ, M.Sc.
Research Group Leader

Citrin Solar®

MERIAURA ENERGY
Savosolar

Universidade do Minho

Bürger BEG Energie Genossenschaft

SELOY

Co-funded by the European Union

The competition for land is increasing


https://www.swlb.de/nachhaltigkeit


https://next2sun.com/agri-pv/

- Finding land for large-scale solar heating projects is a challenge
- Planners, municipalities, system providers are hindered to install more of these systems

- Vertical Agri-PV installations offer multiple land-use and reduce the land footprint
- None of the current solar heating technologies can effectively achieve that …

Co-funded by the European Union

Bifacial Insulating Glass Collectors can …

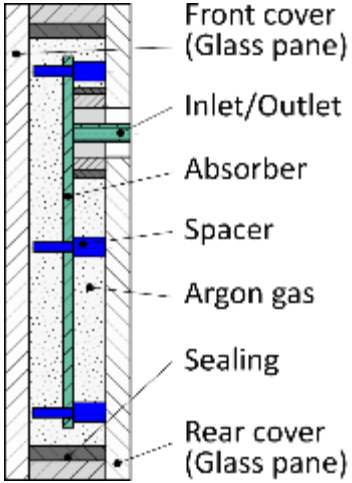
Insulating glass unit production

+

Design principle of flat-plate collectors

cross section

view



- Provide a novel technological solution to the described problem
- Efficiently provide renewable heat and conserve the landscape
- Increase the land use efficiency and reduce the land footprint

Contact details

- Prof. Dr.-Ing. Wilfried Zörner | Thorsten Summ, M.Sc.
- https://thi.de/go/energy
- https://www.linkedin.com/school/technische-hochschule-ingolstadt

Co-funded by the European Union

LEG-DHC

Large-scale climate neutral Energy Geostructures in District Heating & Cooling systems/networks

“Developing approaches and tools for better management of energy geostructures and promoting their use on a larger scale (hybridisation, coupling, individual and collective heating networks)”

Intro

- Professor Hussein Mroueh
  - Full professor, University of Lille, France
  - LGCGE
- Partnership: 16 partners from 6 countries
  - France : A. Di Donna (UGA), H. Mroueh (ULille), R. Vasilescu (Pinto) → SETEC
  - Ireland : Z. Li (UCC) → TII, CODEMA
  - Italy : D. Salciarini (UNIPG) → WISE, INGV, GEOLAV
  - Norway : R.M. Singh (NTNU) →Sandness and Jaerbetong, Seabrokers Fundamentering AS, Huth & Wien Engineering AS, TALTECH (Estonia), VIA (Danmark)

Co-funded by the European Union

Challenge we are tackling

- Energy geostructures: A promising solution for Smart infrastructures
  - Dual-role: heat transfer and structural function
  - Cost-effective shallow geothermal energy solution
  - Low Carbon footprint
  - Relatively mature technology
  - **Barriers to dissemination** in professional practice due to the absence of well-documented case studies – **Lack of Awareness, Lack of a European legal framework and standardisation procedures**
- Who experiences the problem → social, key decision/policy makers
- What is your approach → Overcoming technical barriers – Upscaling at district/city scale
- How will you ensure the impact → Cost Action Foliage (CA21156)

Co-funded by the European Union

Challenge we are tackling

Co-funded by the European Union

Solution to be provided

WG 0

- Scientific Management
- Financial and administrative management
- Reporting

Project Management

WG 1

- EGS Pilot Case Studies
- Monitoring EGS
- Modelling EGS

Geothermal Heating & Cooling production

WG 2

- Thermal Sources
- Optimization of Thermal Sources
- Thermal Performance of EGS
- Mechanical Performance of EGS

GeoThermal storage

WG 3

- Data collection in Pilot Case Studies
- 3D geographic information system (GIS) model
- Analysis of geothermal distribution in 5GDHC
- GIS simulation for geothermal distribution and 5GDHC

Geothermal Distribution

Contact details

- Prof. Hussein Mroueh, hussein.mroueh@univ-lille.fr
- Website - tbd
- www.linkedin.com/in/hussein-mroueh-9593235a

LEG-DHC

Co-funded by the European Union

TRAINING

Thermal energy storing and digitalization in district heating to enable transition to renewable and resource efficient energy systems

Project challenge - to evaluate the flexibility in DH systems and utilize renewables by identifying means to exploit flexibility and sector coupling potentials without necessitating new investments

Intro

- Introduce yourself
  - Professor/ Project coordinator / Department of Energy and Process Engineering, Norwegian University of Science and Technology
- Introduce consortium

Country	Partner
Norway	NTNU
	Asplan Viak
	Norsk energi
Sweden	Högskolan Dalarna (HDa)
	Absolicon Solar Collector AB
	Utilifeed
Germany	Fraunhofer Institute for Energy Economics
	SmartPlace

Challenge we are tackling

- **The identified problem in our project**
  - District heating (DH) systems and existing buildings are huge free assets to store thermal energy and thereby enable bigger flexibility of the entire energy system. Further, there is potential for sector coupling between electricity and DH due to increasing deployment of EV and PV in the residential sector.
- **Who experiences the problem**
  - Buildings and DH system
- **What is your approach**
  - Intelligent management system for smart control
  - Combination of physical and data-driven models to enable faster modelling
- **How will you ensure the impact**
  - Case studies and their replicability
  - Replicability of the optimization and control algorithms

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Solution to be provided

- The proposed solution
  - The project concept is based on a unique smart control idea to optimize at the same time the demand side based on the variable energy prices and the supply side based on the resulting demand prediction and thereby to use renewables in resource efficient way for heating and cooling purpose.
- How hypothesise solution will solve the problem initially
  - Load forecast considering dynamic pricing, thermal storing, and flexibility will be developed.
  - Smart management at the DH system level will be developed.
  - Machine learning methods and IoT will be utilized for data collection and development of new control.
- What are the challenges on which upcoming RDI projects should work in this thematic field?
  - Cost-effective energy efficiency measures in buildings, thermal storage, higher level of digitalization

Co-funded by the European Union

Contact details

- Name: Natasa Nord
- Website: https://www.ntnu.edu/employees/natasa.nord
- LinkedIn: https://www.linkedin.com/in/natasa-nord-1837b331/

Co-funded by the European Union

PVT4EU

Photovoltaic Thermal For Europe

Intro

- Partnership: 6 partners from 3 countries
  - 3 Industrial partners.
  - 3 Academic/Research institutions.

- **Sweden:** MGSustainable, SolarPeak, Solarus Renewables AB, University of Gävle
- **Denmark:** DTU
- **Portugal:** LNEG

Co-funded by the European Union

Challenge we are tackling

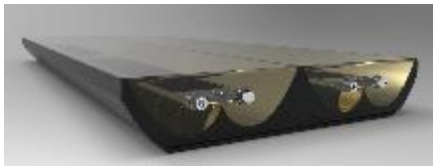
- Low energy conversion efficiency by PV panels.
- PV panels lower their efficiency with temperature.
- PVT technologies are limited to residential applications.
- Complexity of solar thermal systems can be a great market barrier.

Co-funded by the European Union

Solution to be provided

PVT4EU will develop, and test high-efficiency and cost-effective Renewable Energy Technologies based on **hybrid PVT solar collectors** integrated with **heat pumps and absorption chillers**, which satisfies both heating and cooling demand, expanding its application in both the industrial sector and the built environment.

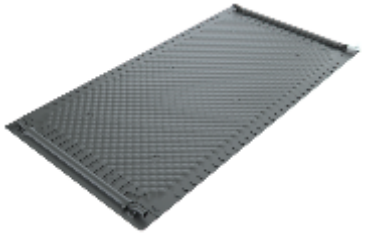
Solarus



PVT-MG

20-140°C

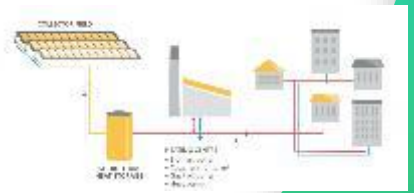
SolarPeak



PVT-SP

PV panels retrofits

Intelligent control system



Different heating & cooling applications

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Contact details

- **Project Coordinator**
- Iván Acosta Pazmiño, Ph.D, ivan@mgsust.com
- MG SUSTAINABLE ENGINEERING AB
- www.mgsust.com

Co-funded by the European Union

TRI4 H&C Wrap-up

- All new projects on the topic of heating and cooling will facilitate the climate transition. We are looking forward to their results!
- The projects contribute to producing and storing heating and cooling more efficiently, from renewable sources. Crucial for the transition.
- These projects will become part of the ‘CETPartnership knowledge community’ to ensure sufficient interaction and mutual learning.
- There are opportunities to develop other valuable approaches to facilitate the heating and cooling transition in the 2023 Joint Call.

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Coffee Break
Please be back at 11:50 CEST

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Challenge 5: Integrated Regional Energy Systems

Tina Ringenson

Co-funded by the European Union

TRI5: Integrated Regional Energy Systems

- Projects that can create or strengthen local regional systems, and its network of actors
- Depart from existing needs in the region
- Make use of existing plans, roadmaps, and regional initiatives

Dmytro Romanchenko
IVL Swedish Environmental Research Institute

Overview of accepted proposals 2022

Proposal Acronym	Proposal Name	Abstract
QuantumIRES	Increasing control and efficiency in regional energy systems using quantum sensors and machine learning	A major challenge connected to the integration of renewable energy sources into power grids is to control the energy distribution on a local system level taking into consideration individual power
ProSeCo	Thermal energy storing and digitalization in district heating to enable transition to renewable and resource efficient energy systems	In this project, a new concept for energy management systems (EMS) to increase the share of renewable energies in the electrical energy system is being researched and developed.
SmartLem	Photovoltaic Thermal For Europe	We aim to develop and validate a business model-oriented platform with applications (SMART-LEM) for developing Local Electricity Markets (LEM) and accelerating clean energy transition.
ECom4Future	Large-scale climate neutral Energy Geostructures in District Heating & Cooling systems/networks	Today, energy systems include prosumers and energy communities, which have novel objectives. They can collect detailed information of their consumption and generation.

Emma Sarin
HSB Living Lab

Challenge 6: Integrated Industrial Energy Systems

Hannele Holttinen

Co-funded by the European Union

TRI 6 – Industrial Energy Systems

Aim

- Industrial energy systems integrated with local, regional and national heat and power networks
- Linked with emission reductions, renewable hydrogen utilisation and CCU

Challenges

- Industrial energy systems with smart sector coupling to increase flexibility in power and energy systems
- Adoption of new technologies for reduction of process-related greenhouse gas emissions in industries
- Removing industrial greenhouse gas emissions from the carbon cycle

Co-funded by the European Union

CORALIS

TRI6 – Theme previous project interview

- Rickard Fornell RISE, Sweden, project CORALIS (https://www.coralis-h2020.eu/).
- Questions :
  a. What are the project's key results and how do they contribute to the TRI challenge?
  b. What do you need to even better exploit/valorize your results?
  c. What are the challenges on which upcoming RDI projects should work in this thematic field?

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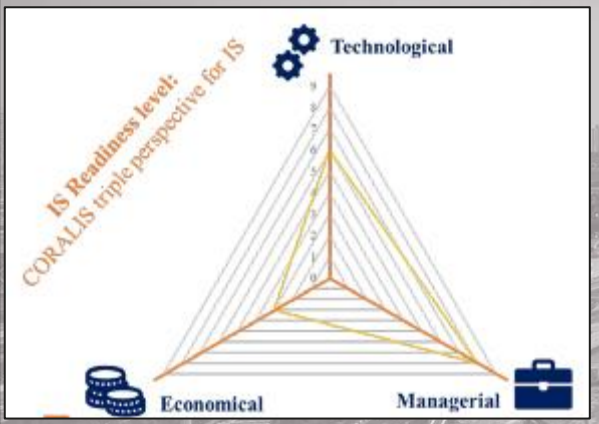
CORALIS

Industrial Symbiosis in Energy Intensive Industries

https://www.coralis-h2020.eu/



Brescia

Escombreras

Frövi

Linz.

Basauri

Izmit

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 958337.

TRI 6 – New projects starting this autumn

Project	Title / topic	Coordinator
OxyKraft	Improving recovery boiler operation in paper and pulp industry, to allow for concentration of CO2, opening opportunities for several integrated green technologies, such as bioenergy with carbon capture and storage or use.	Åbo Akademi
LoCoMoSa	Improving medium voltage electrical heater and molten salt thermal energy storage in medium-temperature industrial processes, allowing for emission reductions and flexibility in industrial energy systems, for several industry sectors.	DTU
ISSDemo	Improving high-temperature latent heat storage based on molten metal for high temperature applications. This central element of a Power-to-Heat for process steam application will help industry to increase the share of renewable energies and enable a flexible partial electrification in several industry sectors.	Fraunhofer

TRI6 – approved projects interviews

OxyKraft. Interview with Patrik Yrjas/Åbo Akademi

Improving recovery boiler operation in paper and pulp industry, to allow for concentration of CO2, opening opportunities for several integrated green technologies like bioenergy carbon capture and use

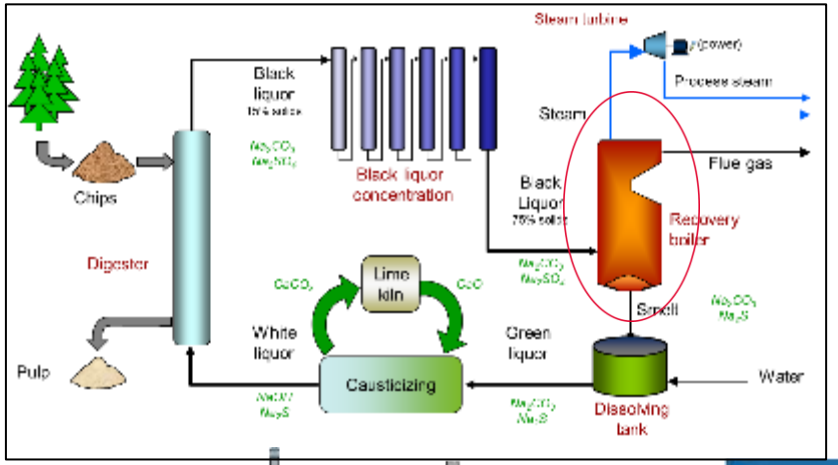
ISSDemo. Interview with Felix Kugler /Fraunhofer

Improving high-temperature latent heat storage based on molten metal, to allow for Power-to-Heat for process steam to increase the share of renewable energies and enable a flexible partial electrification

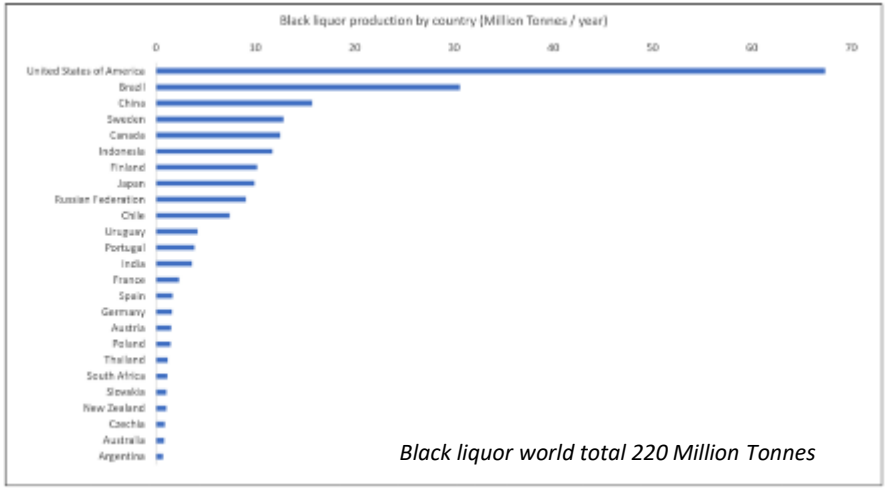
OxyKraft

Oxy-Kraft RB

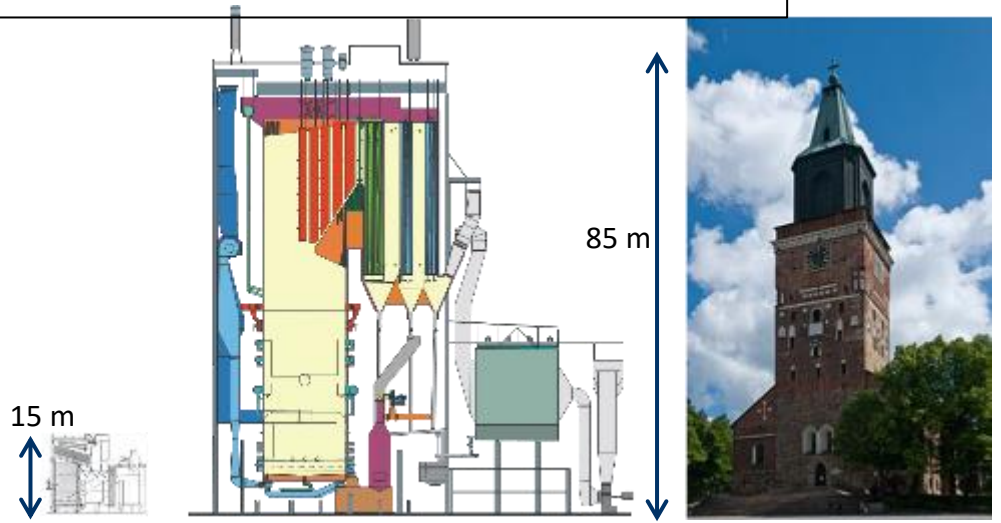
- Enable the operation of Kraft recovery boilers in oxy-fuel mode.
- Kraft recovery boilers burn black liquor to generate both electricity and heat while recovering the pulping chemicals for their reuse.
- In Finland alone, over 10 % of the energy consumption is covered by black liquor, and black liquor is the largest biomass-based energy source in the world with about 700 boilers worldwide.
- Partners: Åbo Akademi University (coordinator, Finland), University of Zaragoza (Spain), KTH Royal Institute of Technology (Sweden), Andritz Oy (Finland), International Paper Inc. (USA), Valmet Technologies Oy (Finland), and Valmet Technologies Ab (Sweden).



Åbo Akademi University



Black liquor world total 220 Million Tonnes



First Tomlinson RB, 1937

Modern Recovery Boiler

Turku Cathedral, 13th century

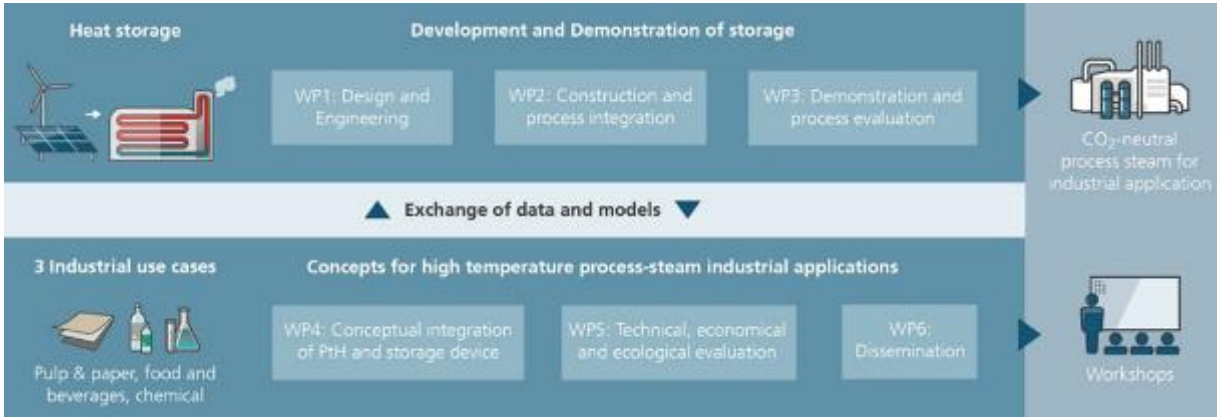
ISSDemo

ISSDEMO

Industrial process Steam Supply – DEMOnstration of an ultra-dynamic thermal energy storage

Overall Goal

- Scaling a high-temperature latent heat storage system with metallic PCM for process steam generation→ ultra-dynamic P2H storage solution for industry.
- Demonstration of the system at a large beverage manufacturer
- Transferable application scenarios of the storage system based on three industrial sectors→ Illustrate and accelerate process integration in further industries



Partner

Universitat de Lleida
Fraunhofer UMSICHT
Silesian University of Technology
BUILD TO ZERO
proen gliwice

TRI 6 Wrap up

- All new projects have potential for delivering new knowledge needed for the green transition – emission reductions in industry (pulp and paper) and flexibility for integrated industrial energy systems
- The projects will close knowledge gaps within P2Heat for process steam and pulp&paper industry bioenergy carbon capture.
- CETP have huge expectations and are looking forward to following the projects
- New possibilities in the CETP Call 2023 aiming for emission reductions and integrated energy systems from industry

Challenge 7: Integration in the Built Environment

Stefan Nowak

Co-funded by the European Union

TRI 7 Mission *is to provide solutions and technologies for existing and new* ***buildings to become an active element in the energy system****, with enhanced capability to* ***produce, store and efficiently use*** *energy in the residential and non-residential sector, comprising public and commercial buildings, service and mobility infrastructure buildings, etc.*

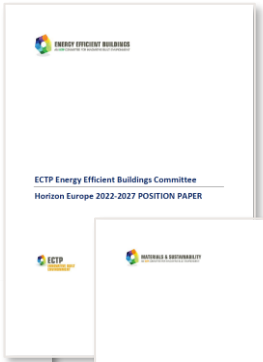
Co-funded by the European Union

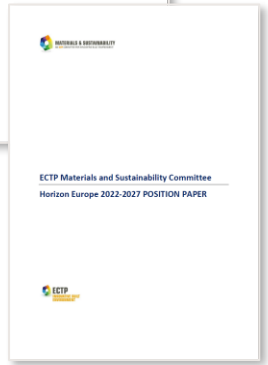
Operating in a complex context !

DUT Driving Urban Transitions

IWG5 BUILDINGS

Smart Built4EU
The European Smart Buildings Community





Built4People

EERA

ECTP INNOVATIVE BUILT ENVIRONMENT

URBAN EUROPE

EMIRi

Co-funded by the European Union

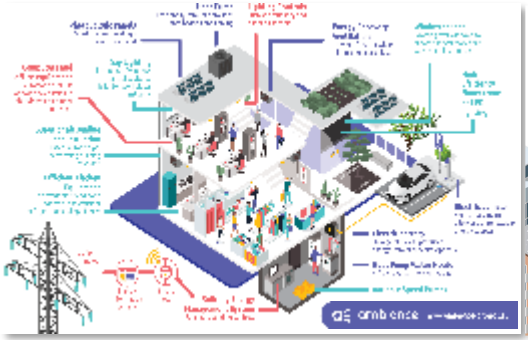
TRI 7 Call 2023 – Overview

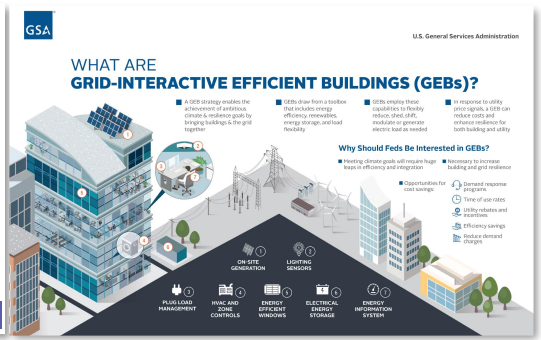
- Title: “Clean energy integration in the built environment”
- Call modules **10A (ROA)** and **10B (IOA)**: the only difference is the TRL
- Compared to 2022: more focussed call
- Project consortia from the energy, building and construction community (public & private research organisations and industry)
- The following countries are supporting projects within TRI 7: Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Hungary, Ireland, Israel, Italy, Malta, The Netherlands, Poland, Spain, Sweden, Switzerland, Tunisia, Türkiye, UK/Scotland

Driving Urban Transitions

Figure 8: Illustration of a Positive Enbergy District

Identifying the focus of TRI 7





Individual Technologies — Integration in Buildings — Areal Concepts

TRI 7: Focus on the Interface
- Emphasis on Integration

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Focus of TRI 7

- Interface between individual technologies and the system
- Addressing the building / built environment related aspects
- Identification of the integration aspect
- Generation, Use and Storage (electricity, heat, cold)
- Network issues (electricity, heat, cold)
- Smart operation and management
- Role of Digitalization

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The scope more specifically

The scope of the TRI 7 Call Modules is to transform the built environment from a passive towards an active role in the future energy landscape.

- Challenge 1: Integrate renewable energy conversion technologies for power, heat and cold in buildings. Connect the buildings in networks. Integrate energy storage, zero emission fuel, and activate building parts as energy storage.
- Challenge 2: Digitalisation for planning, construction phase, commissioning, and operation as well as decommissioning and disposal.

TRI 7 – new projects starting this autumn

- **NewHeatIntegrated**: Highly flexible and modular PCM based thermal energy storage system for efficient heating applications in the built environment. Coordinator: Fraunhofer ICT
- **TRANSMIT**: Semi-transparent micro-stripped thin-film photovoltaics for energy-harvesting windows. Coordinator: International Iberian Nonotechnology Laboratory (INL)
- **REFORM**: Power Generation from Perovskite Architectural Elements. Coordinator: Universitat de València UVEG)

NewHeatIntegrated –

Joint Call 2022 Call Module 7.2
Solutions to energy transition in the built environment

NewHeatIntegrated in a nutshell

WHAT

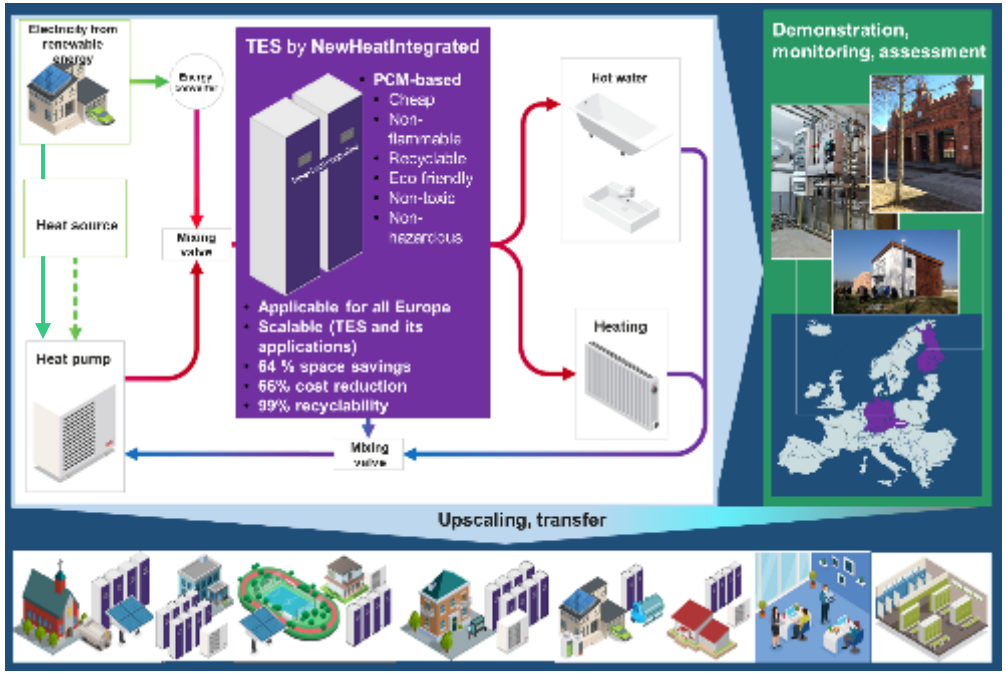
The main objective of **NewHeatIntegrated** project is to develop a technically innovative but inexpensive solution for building-integrated Thermal Energy Storage (TES) applications in Europe. The system will be optimized for heat pumps in combination with surface heating systems.

HOW

By adapting and putting into practice a modular high-performance latent heat thermal energy storage (LHTES) concept.
The TES is based on switchable phase change materials (sPCM) in a compartmentalised storage tank and a holistic AI supported monitoring and control system.

Co-funded by the European Union

NewHeatIntegrated - slightly more detail



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NewHeatIntegrated - Highlights

- Storage tank temperature levels are adapted to the actual heat demand[1]
  - ~ 3/4 at 35 °C for space heating and ~1/4 at 55 °C for hot water
- Compact storage volume[2]
  - ~ 40 % space compared to a hot water storage with the same capacity
- Almost lossless storage for resilient heat supply on demand
  - Supercoolable salt hydrate based sPCM
- Holistic energy system management
  - Optimal operating strategy based on machine learning
  - Coordinated wireless sensor network

Assumptions:

1. Hot water demand of a 4-person household with 160 l/day and specific heating demand of 70 kWh/(m²*a) according to EU energy efficiency level B for residential buildings.
2. Compared to a 750 l hot water storage with storage capacity of ~26,5 kWh @ ΔT = 30 °C

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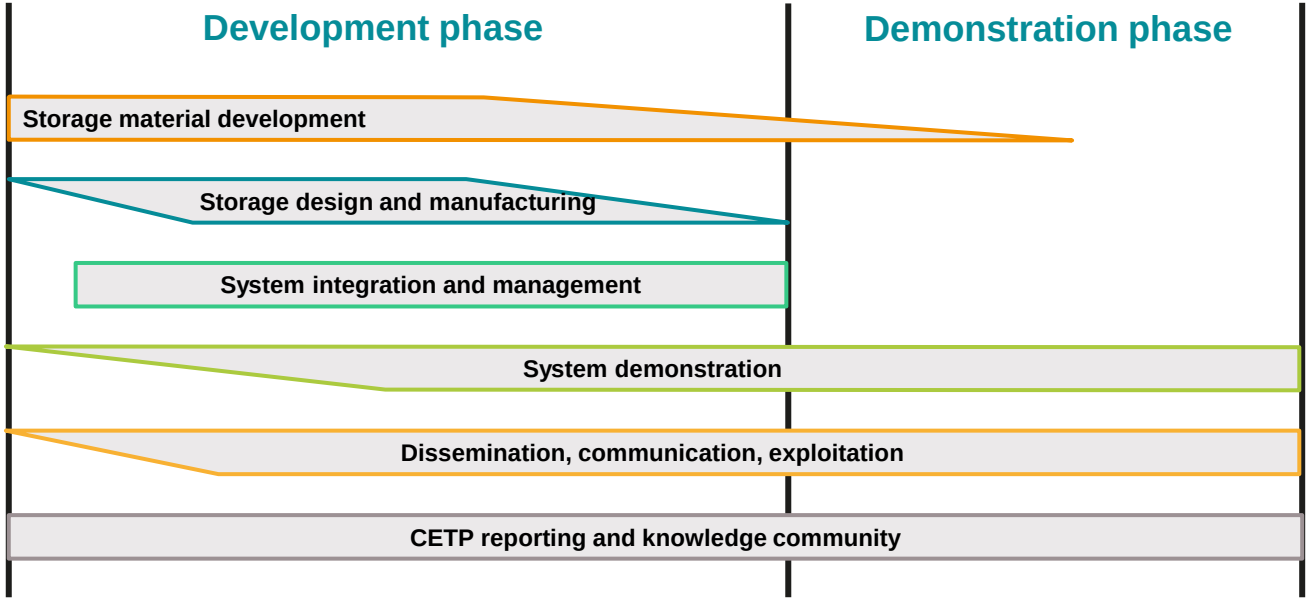
NewHeatIntegrated - work plan (short)



Co-funded by the European Union

NewHeatIntegrated - the consortium behind

5 partners from **3** countries

- Fraunhofer Association with two institutes (Germany)
  - PCM development, storage manufacturing
- Technical University of Ostrava (Czech republic)
  - System control and sensor management
- University of Vaasa (Finland)
  - thermal system planning and social assessment
- BME Dr. Golbs & Partner (Germany)
  - Storage design and manufacturing
- nolla_E (Finland)
  - System control algorithms and modelling

Figure 2: Partners and their involved locations

Co-funded by the European Union

NewHeatIntegrated - contact

M.Sc. Moritz Walter, research associate,
Fraunhofer ICT

✉ moritz.walter@ict.fraunhofer.de

✉ Project coordinator: vladislav.kolarik@ict.fraunhofer.de

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Coming next!

Co-funded by
the European Union

25/10 Afternoon: Joint Call 2023 Q&A event

Agenda

- 14:00: Joint Call 2023 presentation on call structure, topics as well as transnational and national eligibility rules
- 14:15: General Q&A session with slido
- 14:45: Thematic Q&A sessions in group sessions
- 15:15: Tips on how to find good consortium partners
- 15:30: Farewell and official closing of the session
- 15:30 – 17:30: Matchmaking opportunity in bilateral meetings

Thank you and see you this afternoon!