



Silesian
University
of Technology



RESEARCH
UNIVERSITY
EXCELLENCE INITIATIVE
Ministry of Science
and Higher Education



Department
of Thermal
Technology

DEPARTMENT OF THERMAL TECHNOLOGY

DEPARTMENT EXPERTISE - RECENT ACTIVITIES - ONGOING PROJECTS

September 2023

Department of Thermal Technology

Staff and students

- 8 Full-time Professors
- 10 Associate Professors
- 6 Assistant Professors
- 11 Post-Docs and Researchers
- 23 PhD Students
(+11 implementation PhD Students)



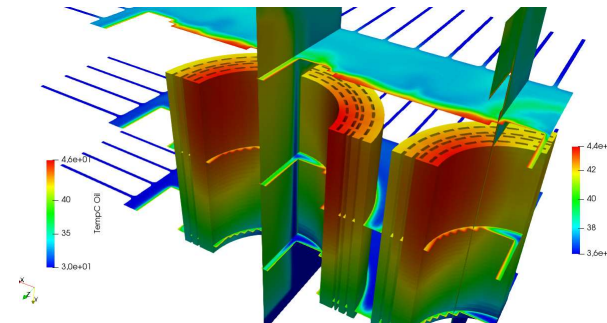
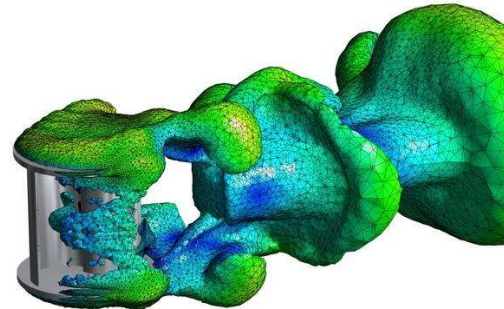
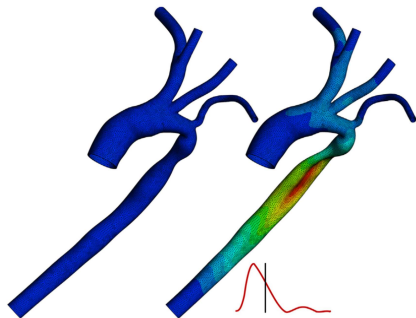
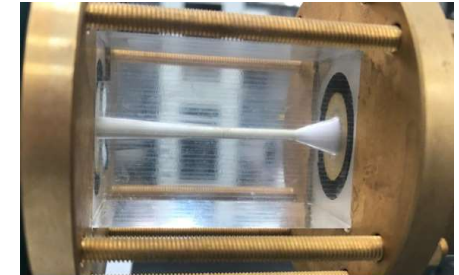
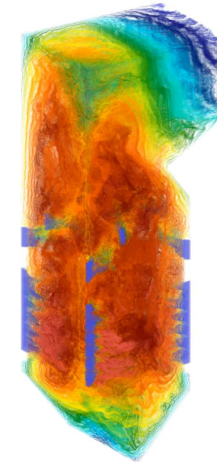
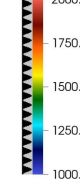
Our expertise

Selected subjects of interest

- Coupled modelling of electrical devices
- Natural ejector-based refrigeration and heat pumps
- Food thermal preservation and cold chain
- Biomedical engineering, e.g. cardiovascular biomechanics
- Combustion, especially ammonia, oxy, mild combustion
- Renewables, e.g. wind turbines, biomass

DB: Comanche
Cycle: 1591 Time:15.91

Volume
Var: temperature (K)
2000.



Conferences

Organised by DTT in recent years

- CPOTE: Contemporary Problems of Thermal Engineering (2016/2018/2020/2022)
- ECOS: International Conference on Efficiency, Cost, Optimisation, Simulation and Environmental Impact of Energy Systems (2019)
- EUROTHERM: European Thermal Sciences Conference (2016)
- NHT: Numerical Heat Transfer (2015)

- Congress of Thermodynamics (2017)
- Energy from Gas Conference (2016)



Ongoing & recently completed national projects

- Fundamental research funded from **National Science Centre**



- Industrial research funded from **National Centre for Research and Development**



OPTI_AI_UNIT project

NCBR

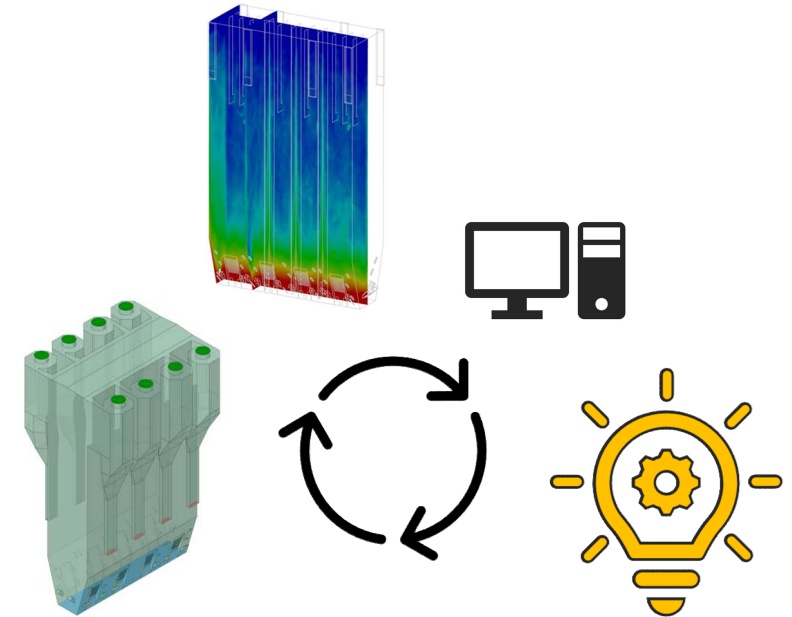
National Centre for Research
and Development

Title: Development and demonstration of a computer system for controlling operation and managing the availability and reliability of industrial infrastructure based on artificial intelligence algorithms (2020-2023)

AIM: Development of innovative strategy for intelligent, effective and robust controlling and monitoring working condition for the industrial unit

Partners: SUT & Tauron Wytwarzanie S.A. & Sumitomo SHI SW

Total budget: €4.7 M (21 M PLN)



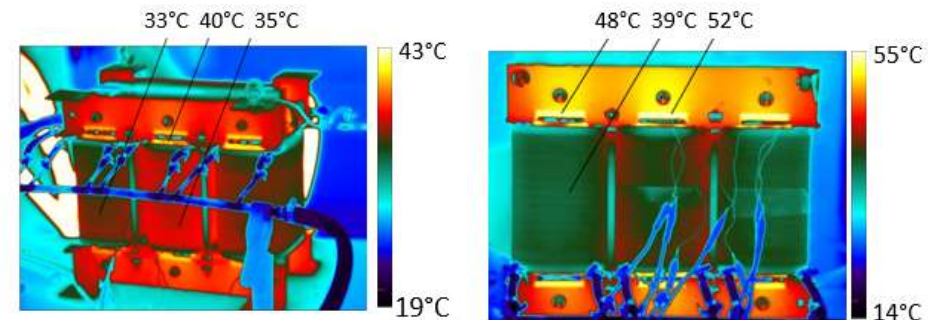
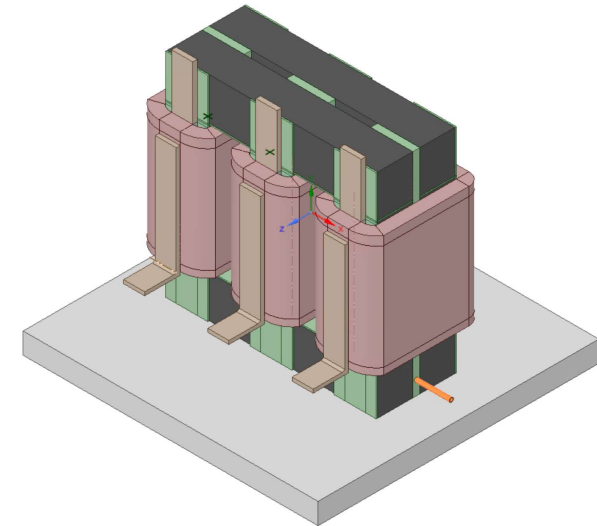
Panta Rhei project

Title: Implementation of industrial research and experimental development works to develop and implement an innovative liquid cooling system for medium and low voltage chokes through the use of cooling panels with optimal configuration and arrangement (2020-2021)

AIM: Design of effective cooling system for three-phase chokes of medium power

Partners: SUT & TRAFECO

Total budget: €120 k (555 k PLN)



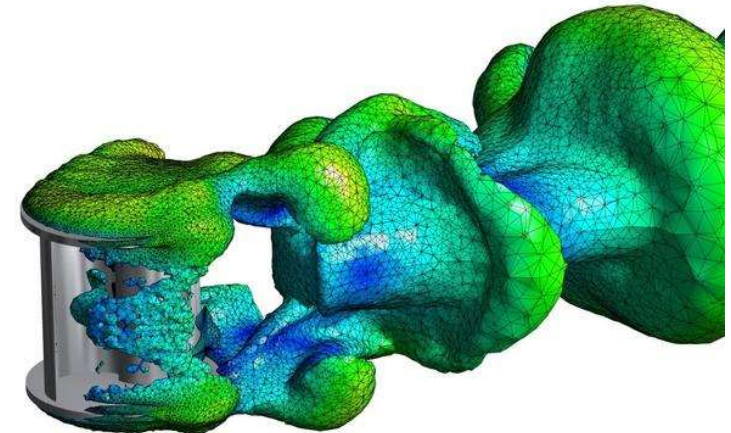
OptiROM project

Title: Heuristic optimisation algorithm with coupled reduced order model generation for computation of wind turbines (2018-2023)

AIM: Development of innovative numerical methods for vertical axis wind turbine computation.

Partners: SUT

Total budget: €216 k (1.01 M PLN)



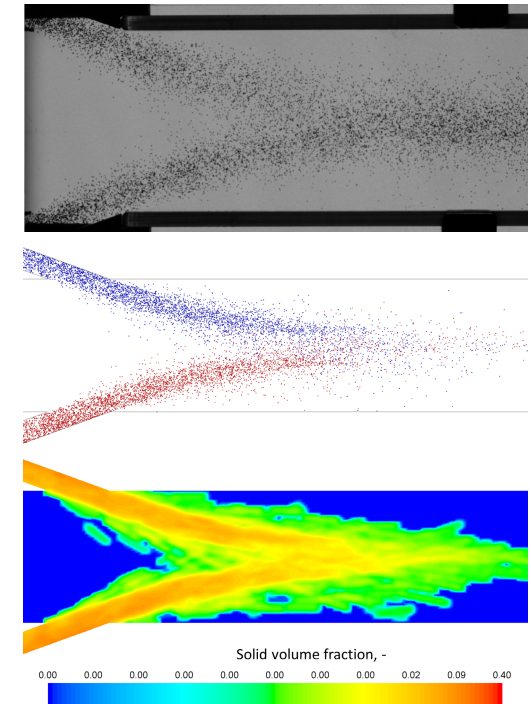
OPUSgranular project

Title: A novel approach for modeling of complex granular flows)
(2018-2023)

AIM: Development of an alternative approach for modeling
multiphase flows using machine learning techniques

Partners: SUT & Lappeenranta University of Technology (LUT)
& Université Libre de Bruxelles (ULB)

Total budget: €224 k (996 k PLN)



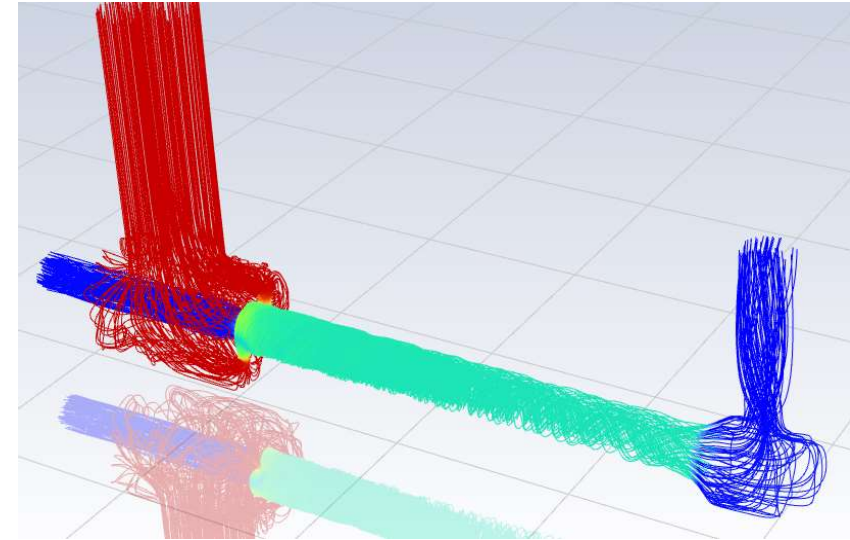
ATHLETE project

Title: Investigation of mass, thermal and phase separation in the Ranque Hilsch Vortex Tube: from fundamentals to technological concepts in energy and process engineering (2022-2025)

AIM: A better understanding of the mechanisms of mass, temperature and phase separation and their qualitative improvement potential

Partners: SUT & UNC (Italy)

Total budget: €275 k (1.28 M PLN)



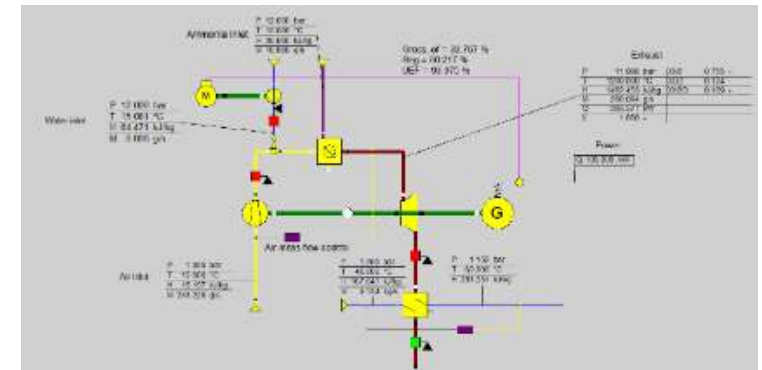
ADONIS project

Title: Ammonia Hydrogen Combustion in Micro Gas Turbines (2022-2025)

AIM: To demonstrate possibility of ammonia combustion in micro gas turbines using combination of CFD and elemental process experimental assesment

Partners: SUT & IFPEN & AIST & University of Tokyo & SINTEF & Zurich University of Applied Sciences & Orleans University

Total budget: €152 k (684 k PLN)



CO₂JetVision project

Title: Experimental and numerical investigation of R744 refrigerant flow and mixing processes within two-phase ejector (2018-2021)

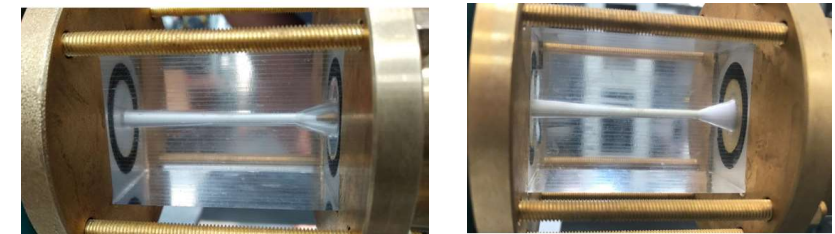
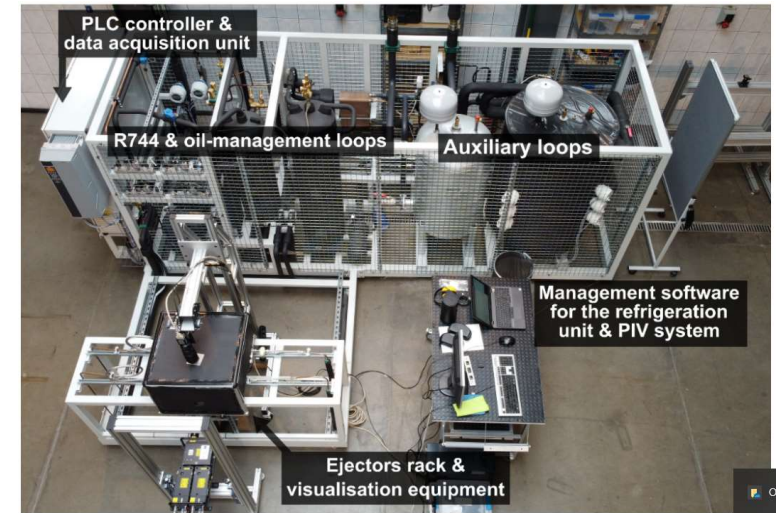
AIM: Visualisation as well as computational modelling of flow and mixing processes of R744 fluid within two-phase ejector

Partners: SUT

Total budget: €300 k (1.339 M PLN)



 <https://ejector.pl/>



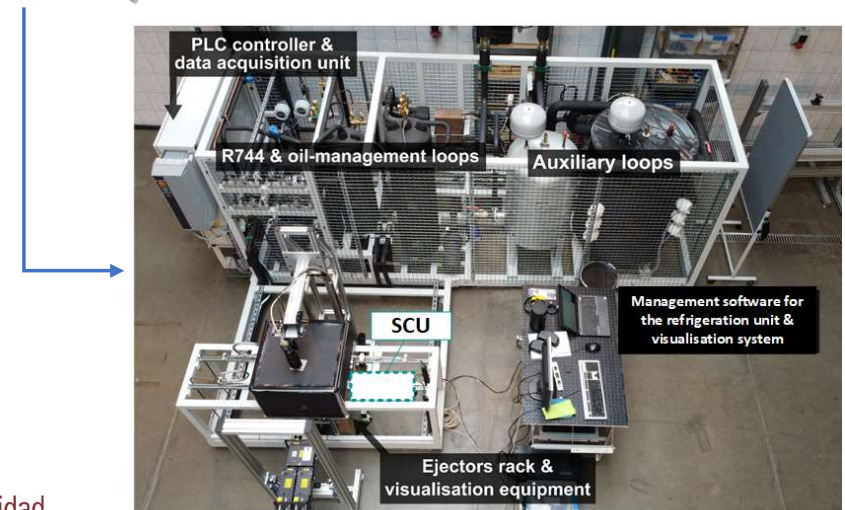
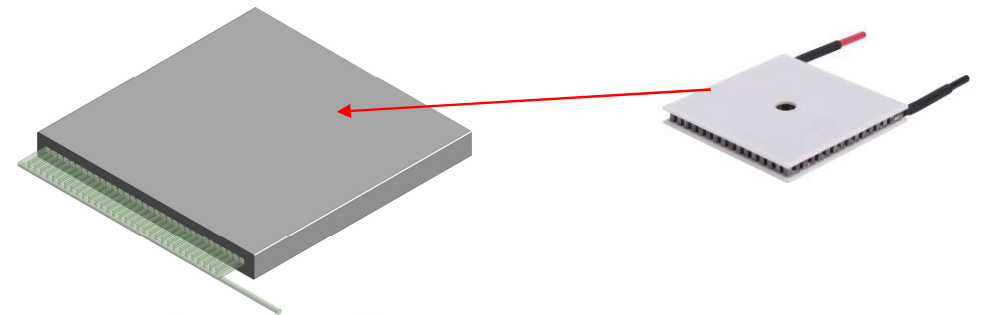
SubCoolJet project

Title: Comprehensive study of the thermoelectric sub-cooling as a future in the state-of-the-art ejector-based refrigeration cycle for food chain reduction

AIM: Evaluate the effect of the thermoelectric sub-cooling unit integration together with the ejector-based system using natural working fluids

Partners: SUT & UJI (Spain) & UPNA (Spain)

Total budget: €145k (707 k PLN)



SubCoolJet



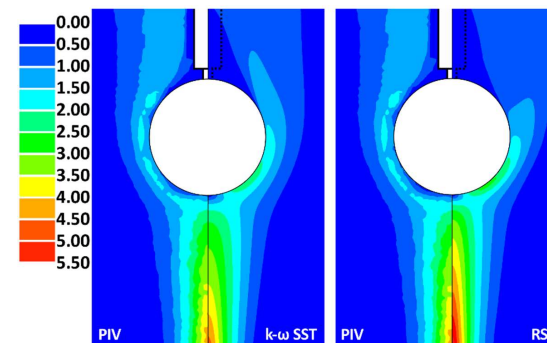
CoolFood project

Title: Experimental and numerical analysis of conjugate heat and mass transfer phenomena in food freezing using hydrofluidisation impingement method (2017-2021)

AIM: Freezing time reduction for small-size food products

Partners: SUT & NTNU, Norway & UNL, Argentina

Total budget: €325 k (1.473 M PLN)



 <https://coolfood.pl/>

VacPCM project

Title: Experimental and numerical analysis of the rapid vacuum-freezing process combined with efficient cold storage system for various types of food products

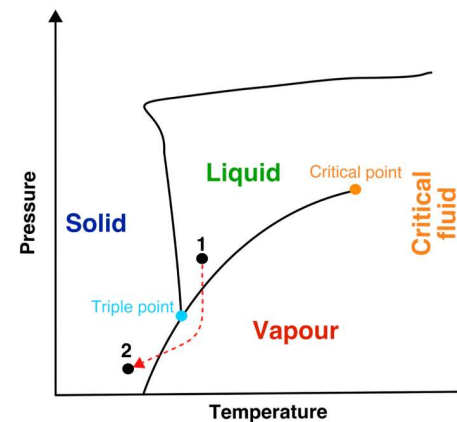
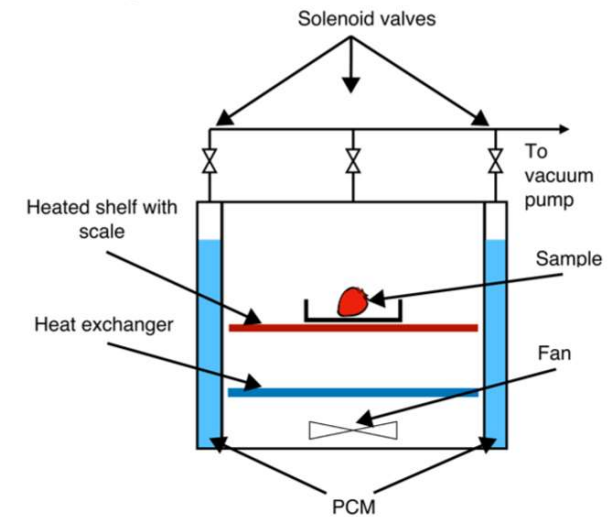
AIM: Development of a new energy efficient vacuum freezing system integrated with CTES-aided storage container

Partners: SUT & NTNU (Trondheim, Norway)

Total budget: €178k (809 k PLN)



VacPCM



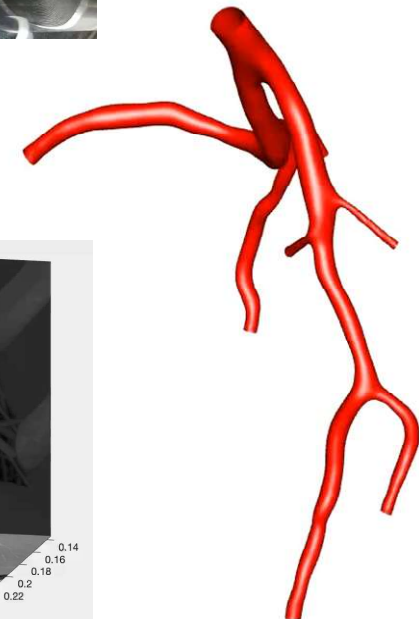
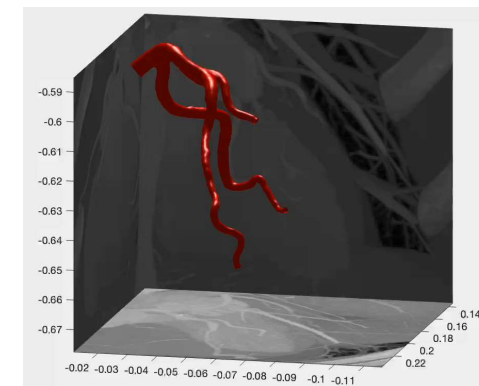
Myocardial Bridge project

Title: Numerical modelling and analysis of systolic pressure of vessels onto the deposition of the atherosclerotic plaque within the coronary arteries (2018-2023)

AIM: Investigation of the influence of flow patterns and wall shear stress onto the deposition of the atherosclerotic plaque

Partners: SUT & Silesian Centre for Heart Diseases

Total budget: €330 k (1.483 M PLN)



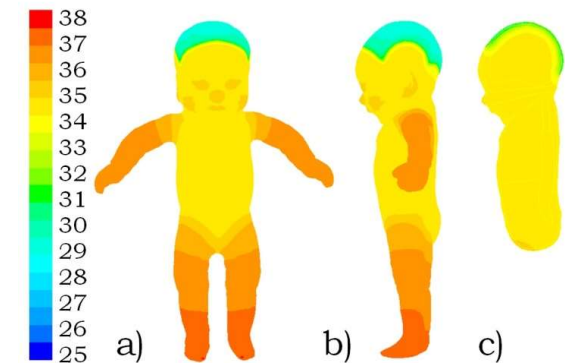
BrainCooling project

Title: Experimental investigations and computer modelling of heat transfer processes in therapeutic hypothermia of a newborn's brain cooling (2018-2021)

AIM: Comparison of the heat transfer processes occurring during the selective as well as the whole body of Therapeutic Hypothermia

Partners: SUT & University Clinical Hospital in Opole & University of Opole

Total budget: €220 k (998 k PLN)



HOXY project

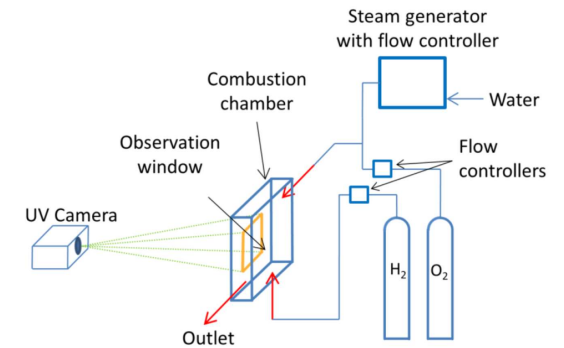
Title: Hydrogen oxycombustion for zero-emission and high-efficiency electric power generation (2021-2024)

AIM: Understand the MILD combustion of the hydrogen in O_2 - H_2O mixtures

Partners: SUT

Total budget: €300 k (1.380 M PLN)

Possible application in gas or steam turbine cycles



Solar pyrolysis of biomass

Title: Study of the solar pyrolysis process of waste biomass (2017-2021)

AIM: Experimental and numerical analysis of the waste biomass (wood, straw, sewage sludge) solar pyrolysis processes

Partners: SUT

Total budget: €180 k (825 k PLN)



Oxy-liquefaction of plastic waste

Title: Oxidative liquefaction of plastic waste. Experimental research with multidimensional data analysis using chemometric methods (2022-2025)

AIM: Experimental and chemometric analysis of the oxidative liquefaction of plastics, including waste turbine blades, COVID-19 waste, and general samples of major groups of plastic waste

Partners: SUT

Total budget: €304 k (1 385 k PLN)



FlowChar project

Title: Flow electrodes from biomass-derived char (2021-2023)

AIM: The idea behind FlowChar is to combine heat and power generation through biomass gasification with clean water production using flow-electrode capacitive deionization

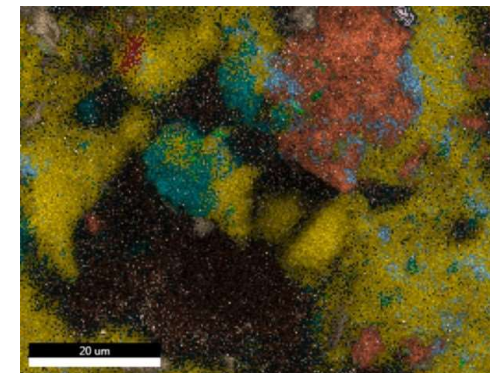
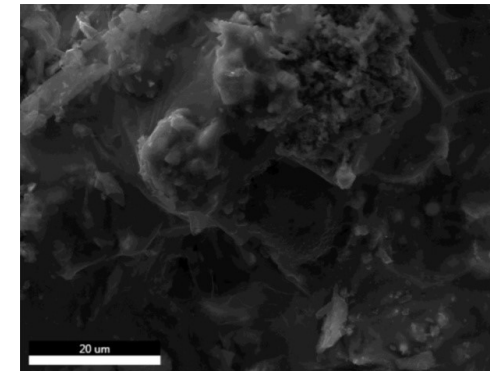
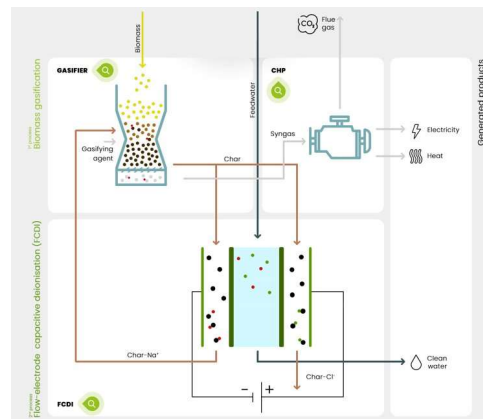
Partners: SUT

Total budget: €193 k

**PROJECT
FLOWCHAR**

 FlowChar

 <https://flowchar.pl/>



Ongoing international projects

- **Fundamental research funded from the Norway Grants and National Science Centre**



- **Industrial research funded from the Norway Grants and National Centre for Research and Development**



- **H2020 and Horizon Europe projects**



BIOTRAFO project

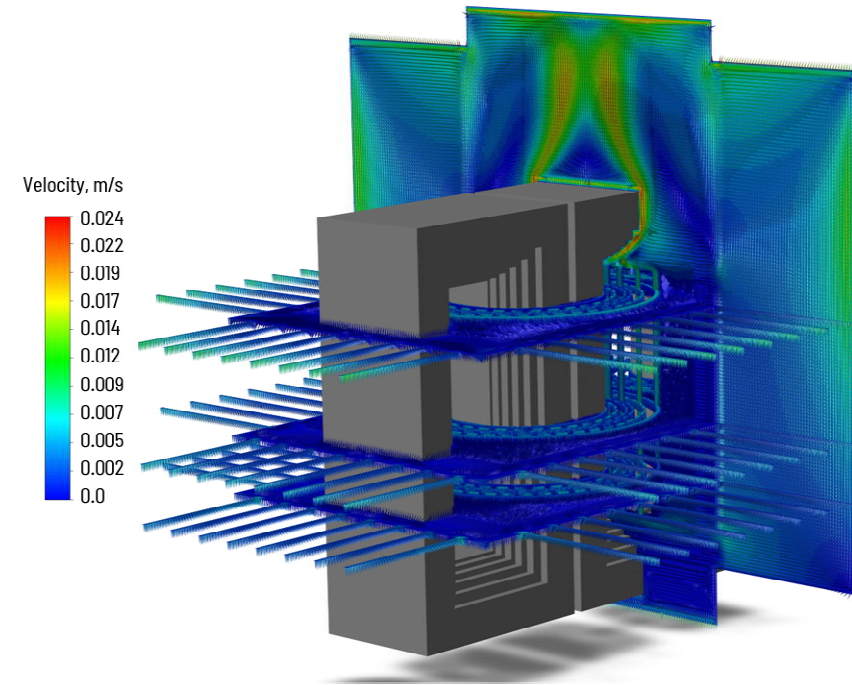


Title: Raising knowledge and developing technology for the design and deployment of high-performance power transformers immersed in biodegradable fluids (2019-2023)

AIM: Development of technology for the large power transformer cooling with biodegradable oils

Partners: SUT & UCantabria & National U of Litoral & BEST & Tadeo Czerweny & UStuttgart & others (13 in total)

Total budget: €685 k



DEPARTMENT OF THERMAL TECHNOLOGY

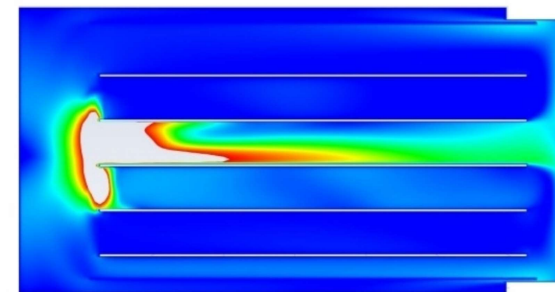
FrostWave project

Title: Development of novel microwave-assisted freeze-drying unit combined with natural working fluid-based refrigeration system for agriculture and marine foods (2020-2023)

AIM: Development of a novel microwave assisted freeze drying device with a natural working fluid in refrigeration system

Partners: SUT & NTNU & SINTEF & FrostX

Total budget: €1.5 M (7.155 M PLN)



ENOUGH project

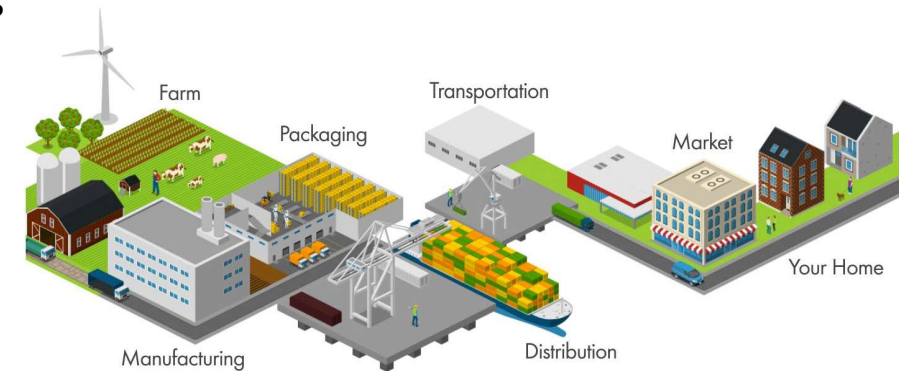


Title: European food chain supply to reduce GHG emissions by 2050 (2021-2025)

AIM: The project will provide technologies, tools and methods to contribute to the EU Farm to Fork strategy to achieve climate neutral food businesses

Partners: SUT & SINTEF Ocean & London SBU & NTNU & UBirmingham & KU Leuven & IIR & others (29 in total)

Total budget: €11 M



@EUEnoughProject

EU Enough Project

<https://enough-emissions.eu/>



EST 1892
LSBU



INRAE
la science pour la vie, l'humain, la terre



KU LEUVEN

NTNU

ENTHRAL project

NATIONAL SCIENCE CENTRE
POLAND

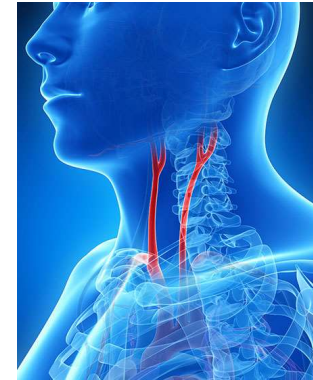
Norway
grants


Title: Non-invasive in-vivo assessment of the stiffness of human artery walls (2020-2024)

AIM: Determine the local stiffness of arteries using inverse analysis and ultrasound imaging

Partners: SUT & NTNU & Gliwice Municipal Hospital No.4

Total budget: €1.49 M (6.97 M PLN)



 Gliwice Municipal
Hospital No 4

 NTNU

 <https://enthral.pl/>

ACTIVATE project



Title: Ammonia as carbon free fuel for internal combustion engine driven agricultural vehicle (2020-2023)

AIM: Develop engine technology which aims to solve the challenges of fueling an engine with ammonia and burn it efficiently with the evaluation and demonstration in an agricultural demonstration vehicle

Partners: SUT & NTNU & LOGE & UAK

Total budget: €1.45 M (6.584 M PLN)



 **Activate-norwaygrants**
 <https://www.activateproject.eu/>

ACTIVATE

 NTNU

 LOGE
Polska Sp. z o.o.

 UNIVERSITY OF AGRICULTURE IN KRAKOW

CHEERS project

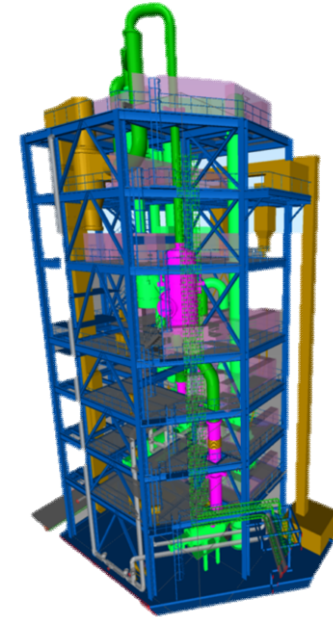


Title: Chinese-European Emission-Reducing Solutions (2017-2023)

AIM: To demonstrate chemical looping application for an oxycombustion of petcoke

Partners: SUT & SINTEF Energy & others (7 European + 3 Chinese)

Total budget: €16.8 M



 CHEERS CLC EU Horizon 2020

 <https://cheers-clc.eu/>



DEPARTMENT OF THERMAL TECHNOLOGY

EUReCOMP



Title: European recycling and circularity in large composite components (2022-2025)

AIM: Providing a sustainable methods towards recycling and reuse of composite materials, coming from components used in various industries, such as aeronautics and wind energy

Partners: SUT & others (21 European)

Total budget: €8.9 M



R6 strategy
Reuse, Repair, Refurbish,
Remanufacture, Repurpose and Recycling
of parts from end-of-life large scale products

 @eurecomp

 EuReComp

 <https://eurecomp.eu/home>



Politecnico di Torino



Phy2Climate project



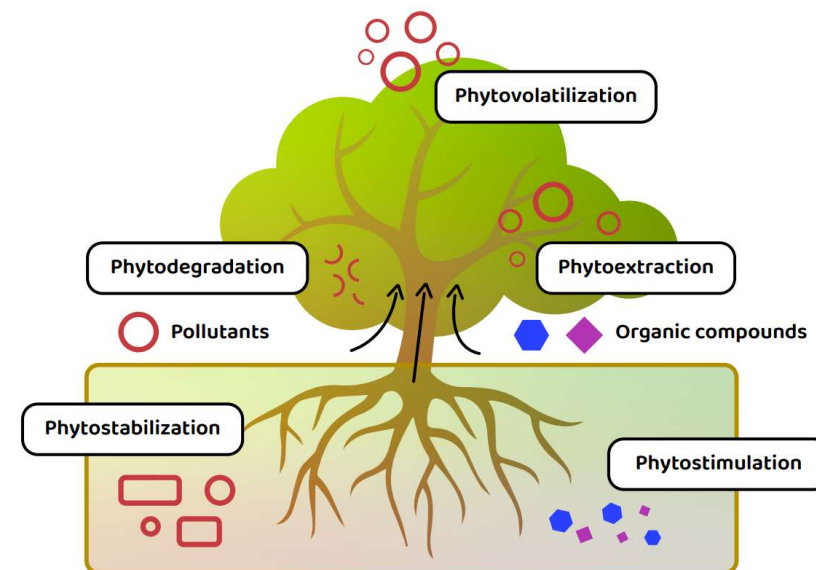
Title: A global approach for recovery of arable land through improved phytoremediation coupled with advanced liquid biofuel production and climate friendly copper smelting process (2021-2025)

AIM: Development of technology for phytoremediation and production of oil and metalurgical coke

Partners: SUT & others (15 European + 1 Argentinian + 1 Indian)

Total budget: €4.1 M

 @phy2climate
 Phy2Climate Project
 <https://www.phy2climate.eu/>



PROMETHEIA project

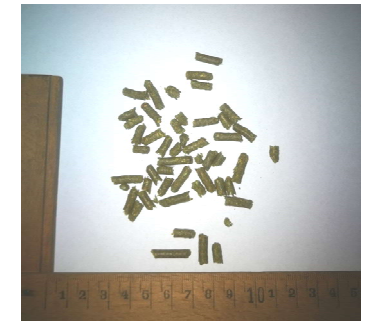


Title: Processes for metal-to-char encapsulation
(2021-2024)

AIM: To verify possibility of metal trapping in unreactive biochar

Partners: SUT & TU Vienna & TU Ljubljana

Total budget: €1.1 M



University of Ljubljana



TECHNISCHE
UNIVERSITÄT
WIEN

Silesia – blue sky restored



Title: Comprehensive implementation of the Air Quality Plan for the Silesian Voivodeship (2022-2027)

AIM: Improve air quality in Silesia region.
In particular role of DTT is to develop approach to conversion heating systems of public buildings to climate-neutral

Partners: more than 80 municipalities in Silesia region

Total budget: €294 k (1.32 M PLN)



 <https://przywracamyblekit.slaskie.pl>

NET-Fuels project



Title: Increasing biomass conversion efficiency to carbon-negative sustainable biofuels by combination of thermal and bio-electrochemical processes (2022-2026)

AIM: Aim of the project is to develop technology of conversion of low calorific value bio wastes into useful biofuels

Partners: SUT & Uni Bologna, Fraunhofer, LEITAT, Ithaka Institute, REACH Innovation, WGR Europe

Total budget: €460 k (2.07 M PLN)



 @NetFuels_HEU

 NetFuels

 <https://www.netfuelsproject.org/>



ithaka institute



SET_HEAT project



Co-funded by
the European Union

Programme for the Environment and Climate Action
LIFE Clean Energy Transition sub-programme



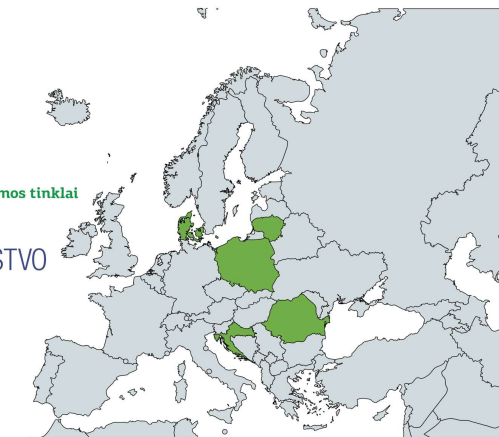
Title: Supporting Energy Transition and Decarbonisation in District Heating Sector (2023-2026)

AIM: The overall objective of the project is to trigger:

- ❑ Strategic investment programmes of DH companies in Croatia, Lithuania, Poland, and Romania,
- ❑ Tangible projects in the field of integration of low-grade renewable energy and waste heat into high-temperature heating networks.

Total budget: €1.6 M

Partners:



<https://setheat.polsl.pl/>



THANK YOU FOR ATTENTION

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SILESIA N UNIVERSITY OF TECHNOLOGY
DEPARTMENT OF THERMAL TECHNOLOGY

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