



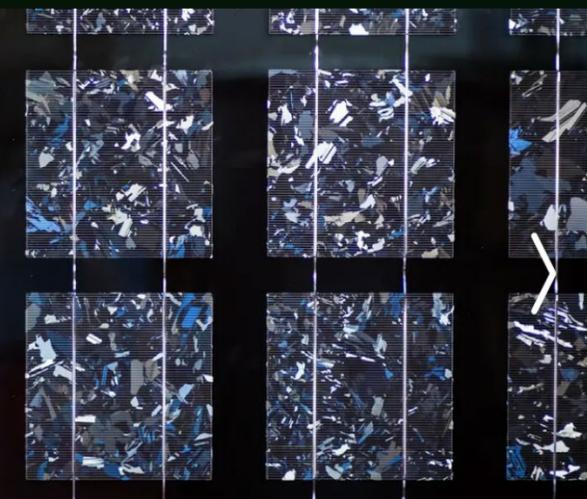
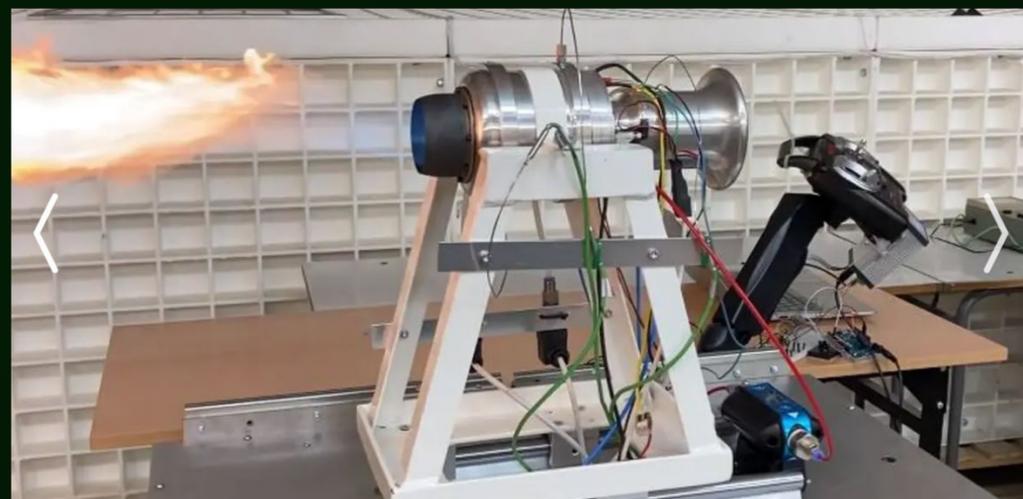
**AGH University of Krakow**

**Faculty of Mechanical Engineering and Robotics**

**Department of Power Systems and Environmental Protection Facilities**

**Head: Paweł Madejski, PhD, DSc, Eng**

**Address: Al. Mickiewicza 30, 30-059 Kraków, Poland**





# Department staff

**Total: 29**

Associate Professor: 7

Assistant Professor: 16

Assistant: 2

Administration: 2

Technical Staff: 1

**PhD Students: 11**

## RESEARCH GROUPS

**Thermal and Flow Processes in Energy**

Leader: Paweł Madejski

**Fluid Flow and Acoustics in Power Systems**

Leader: Ireneusz Czajka

**Renewable Energy and Environmental Protection**

Leader: Marian Banaś



# Department of Power Systems and Environmental Protection Facilities

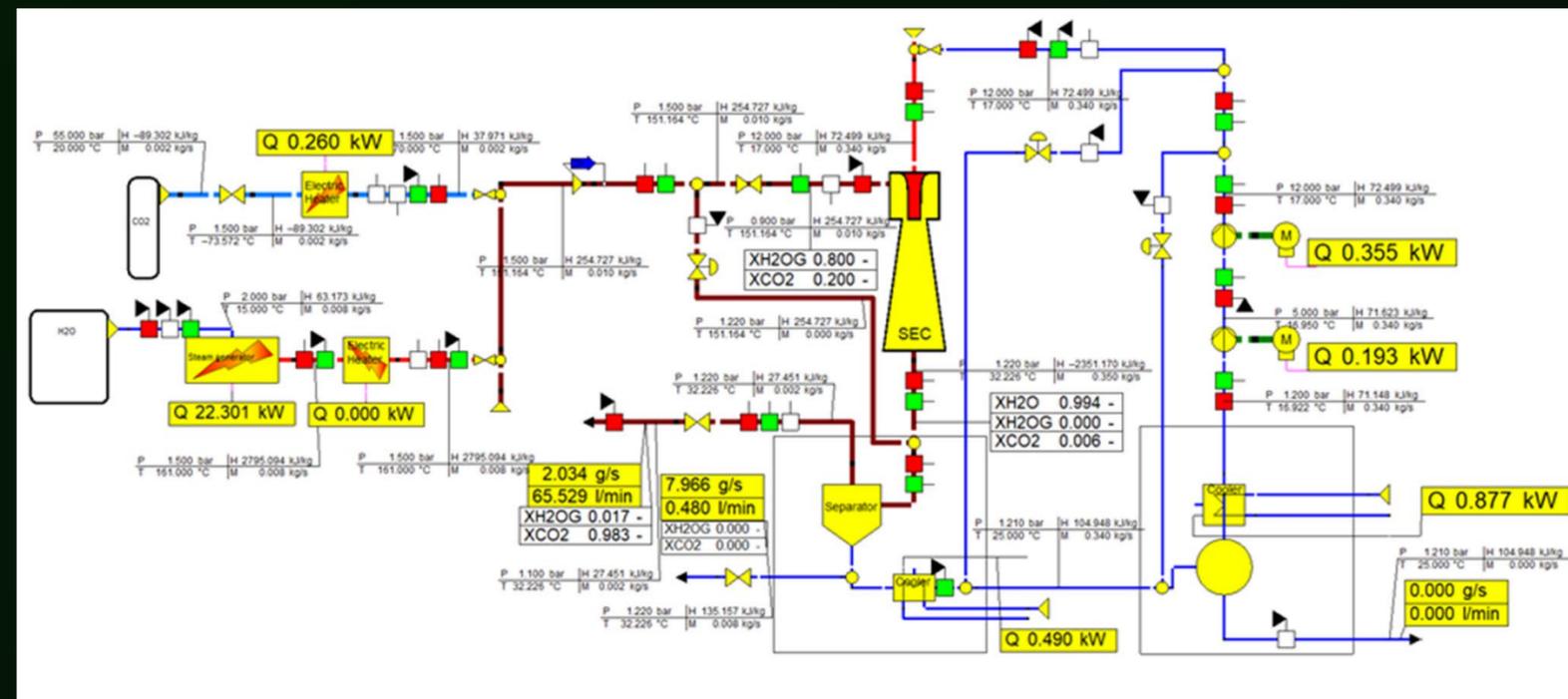
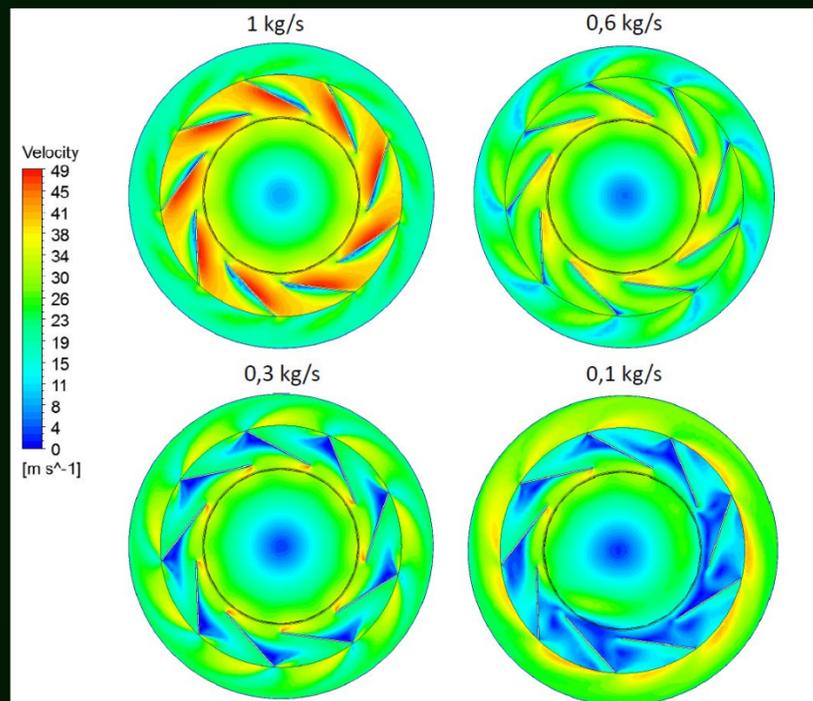
The area of scientific and research activity encompasses the design, operation, and diagnostics of energy systems, machines, and devices, as well as technical facilities where energy is processed, considering their environmental impact. For years, we have been combining scientific research and educating students in the field of efficient energy and limiting its impact on the natural environment.





## Thermal and Flow Processes in Energy

- ✓ **Leader:** Paweł Madejski ([madejski@agh.edu.pl](mailto:madejski@agh.edu.pl))
- ✓ **Research Areas:** Mechanical Engineering, Thermal Engineering, Power Engineering, Modeling in Energy, Energy Conversion and Storage



# Research groups



## Fluid Flow and Acoustics in Power Systems

- ✓ **Leader:** Ireneusz Czajka(iczajka@agh.edu.pl)
- ✓ **Research Areas:** Flow Acoustics, Fluid Mechanics, Thermoacoustics, Noise and Vibrations, Mechanical Engineering

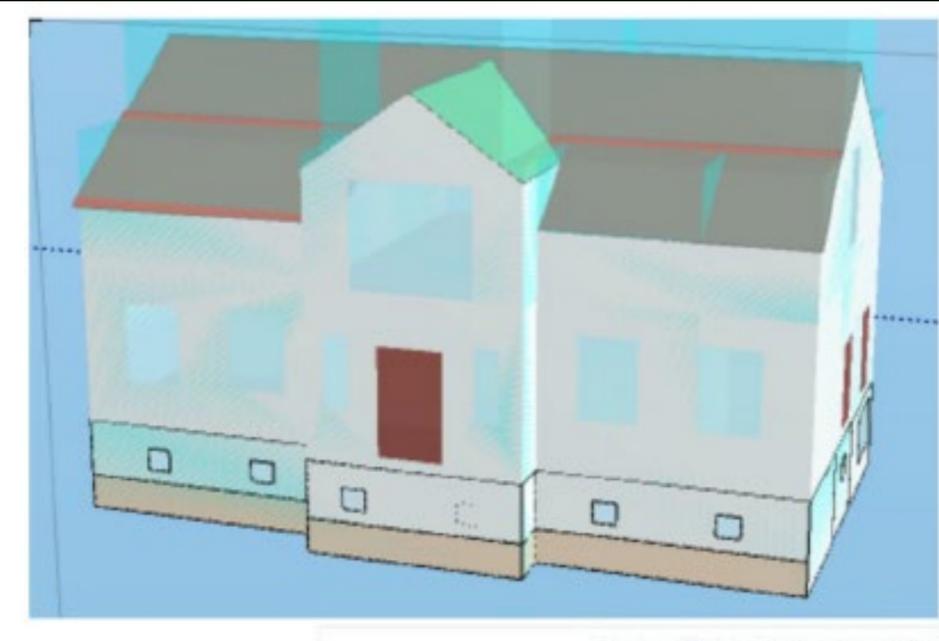
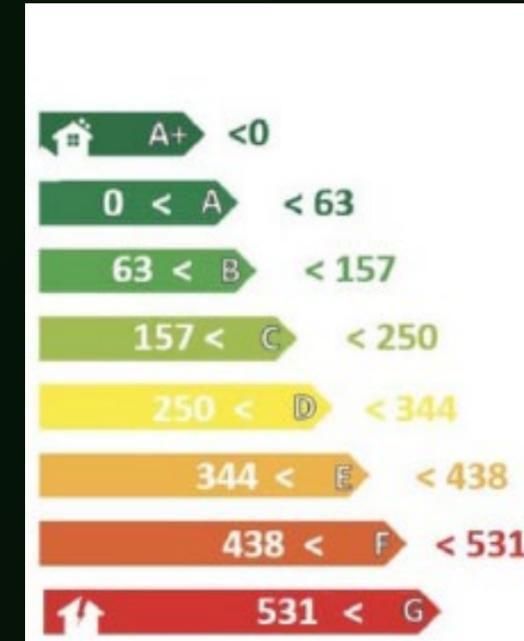


# Research groups



## Renewable Energy Sources and Environment Protection

- ✓ **Leader:** Marian Banaś (mbanas@agh.edu.pl)
- ✓ **Research Areas:** Renewable Energy, Environmental Protection Facilities, Energy Recovery Optimisation



# Research Projects

- ✓ Negative CO<sub>2</sub> emission gas power plant (2020-2024)
- ✓ Development of a prototype station for experimental research on improving the efficiency of H<sub>2</sub>O/CO<sub>2</sub> jet condensers for applications in CCUS technologies (2021-2024)
- ✓ Identification of PCM thermal properties with the selected heat transfer enhancement addition (2021-2022)
- ✓ Modeling and simulation of hybrid cogeneration energy system concepts supported by the RES and heat storage unit (2024-2025)
- ✓ Intensification of condensation in direct contact through the formation of droplets during the breakdown of a liquid stream in a gaseous medium (2025-2028)



# Research offer

- ✓ Thermodynamics, heat transfer, and combustion system analysis,
- ✓ CFD modeling, experimental fluid mechanics (wind tunnels)
- ✓ Research on high-speed flow processes (high speed camera, PIV),
- ✓ Advanced thermovision,
- ✓ Numerical modeling and simulations,
- ✓ Power plant and energy system analysis,
- ✓ 3D prototype testing (3D printing, 3D scanning, lab tests),
- ✓ Measurement of density, thermal conductivity, grain size and particle shape,
- ✓ Expertise in ventilation and air conditioning, thermal comfort, heating and cooling systems,
- ✓ Analysis of the sound intensity, thermoacoustics, noise and vibrations
- ✓ Complex smart systems,
- ✓ Clarification process, suspensions, geothermal heat plants, municipal waste thermal systems.



# Laboratories

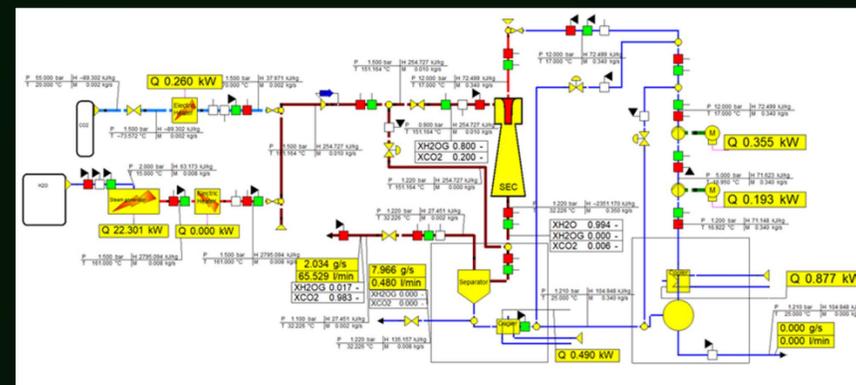
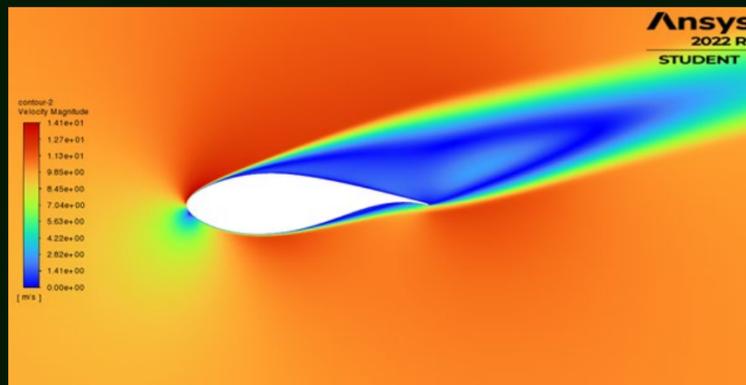
- ✓ **Laboratory of Computational Modeling of Thermal and Flow Processes in Energy**
- ✓ **Laboratory of Energy Conversion and Storage**
- ✓ **Laboratory of Fluid Thermomechanics**
- ✓ **Laboratory of Heating, Ventilation and Air Conditioning Systems**
- ✓ **Laboratory of Water Protection Equipment**
- ✓ **Laboratory of Fundamental Physicochemical Properties of Suspensions**
- ✓ **Laboratory of Aerodynamics and Turbomachinery**



# Laboratory of Computational Modeling of Thermal and Flow Processes in Energy



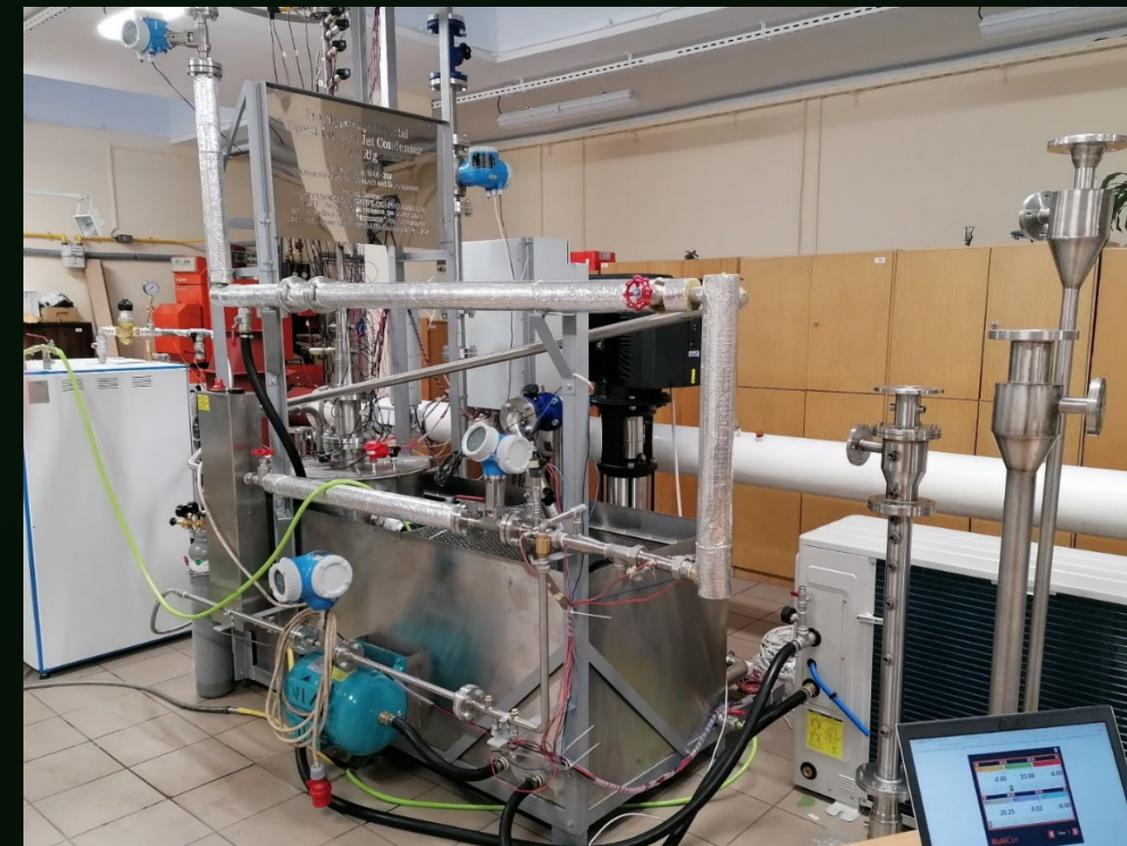
- CFD modeling and optimization of flow systems.
- Analysis of energy device performance in simulation software (NX, Star-CCM+, Epsilon Professional, TRNSYS).
- Manufacturing of prototypes and components using FDM and SLA technologies.
- 3D printing of complex geometries (porous materials) using soluble supports in FDM technology for complex structures.
- Thermal analysis of 3D printed components (Trident).



# Laboratory of Energy Conversion and Storage



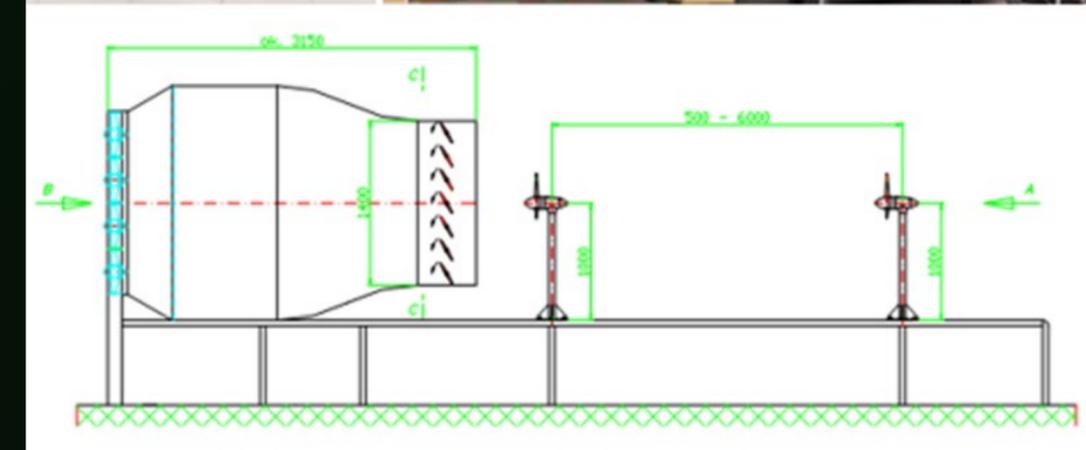
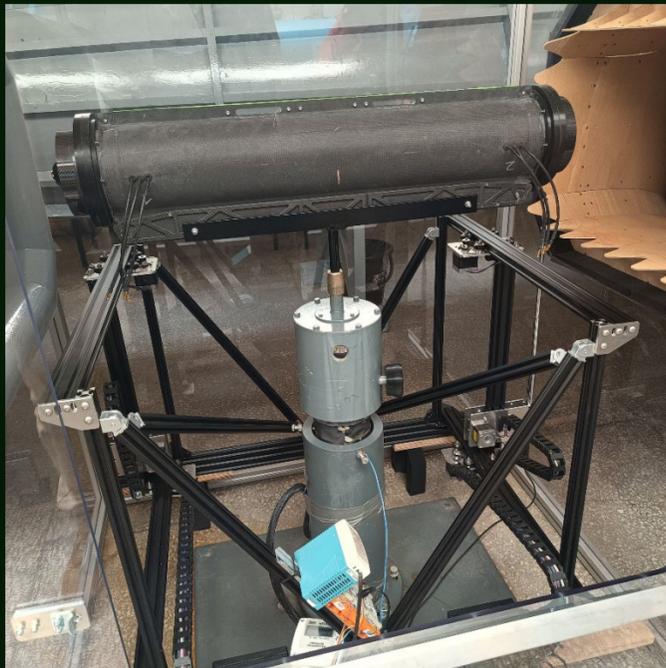
- Gas combustion, exhaust gas analysis.
- Multiphase flows, water and steam nozzles.
- Heat exchangers, condensers, ejectors.
- Melting and solidification processes of phase-change materials in thermal energy storage.
- Investigating extremely fast processes using a high-speed Phantom Miro C211 8GB color camera vision system.



# Laboratory of Aerodynamics and Turbomachinery



- Wind tunnel with an Eiffel chamber and a strain gauge.
- Open wind tunnel with a measuring space of 1m x 1m.
- Aerodynamic force and moment tests.
- Aerodynamic profile tests.
- Aerodynamic tests of vehicles and their components.



# Laboratory of Fluid Thermomechanics



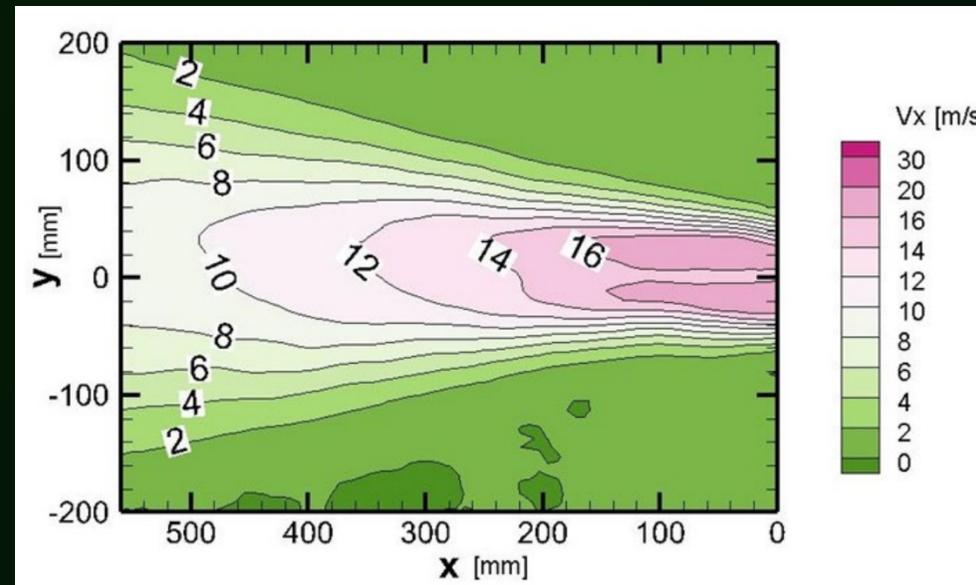
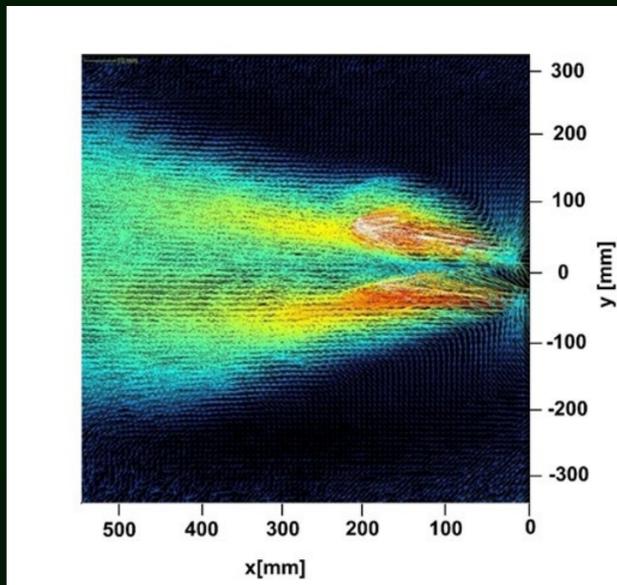
- Non-contact analysis of temperature distribution using a thermal imaging camera.
- Analysis of the efficiency of evaporative cooling and air humidification processes.
- Determination of the heat of combustion of solid fuels.
- Measurement of the current-voltage characteristics of fuel cells



# Laboratory of HVAC systems



- Determining the flow characteristics of fans and ventilation system components.
- Testing heat exchangers used in ventilation systems.
- Multi-point air velocity and temperature measurements to assess thermal conditions and air velocity distribution in rooms.
- Measurement and analysis of indoor air quality (IAQ), thermal comfort, and microclimate.



# Laboratory of Water Protection Equipment

- Analysis of coagulation and flocculation processes.
- Static and dynamic sedimentation studies.
- Determination of solid phase particle size characteristics.
- Determination of solid phase concentrations.
- Development of technologies for the treatment of industrial and municipal slurries
- Design and modernization of sedimentation tanks.



# Laboratory of Fundamental Physicochemical Properties of Suspensions



- Measurement of particle size distribution of suspensions using laser diffraction.
- Determination of particle size distribution of suspensions using the wet method using a sedimentation balance.
- Determination of the viscosity of suspensions at low contaminant concentrations.
- Measurement of liquid viscosity.
- ✓ Morphologi 4 - Automated particle characterisation tool for the measurement of particle size and shape



## ✓ Mechanical Engineering (First Cycle Studies)

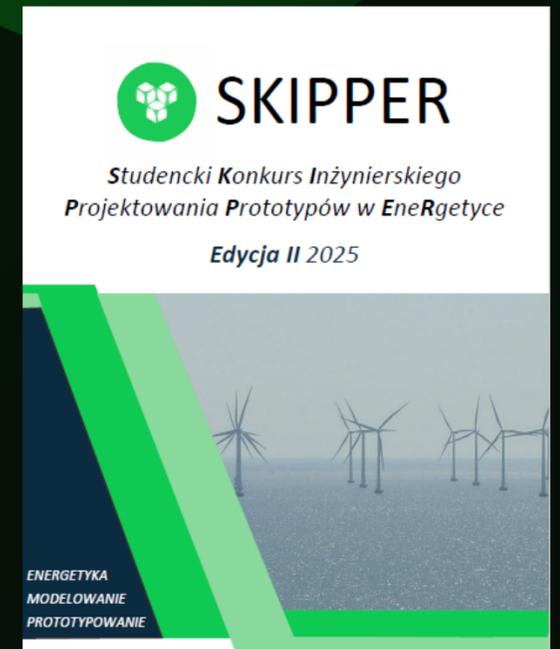
- Thermodynamics
- Fluid Mechanics
- Computational Methods and Design of Experiment
- Fundamentals of Information Technology
- Energy Technologies
- Environmental Protection

## ✓ Mechanical Engineering (Second Cycle Studies)

- Computer Science in Mechanical Engineering
- Smart systems
- Information Systems and Modeling in Energy



## ✓ Student prototyping content

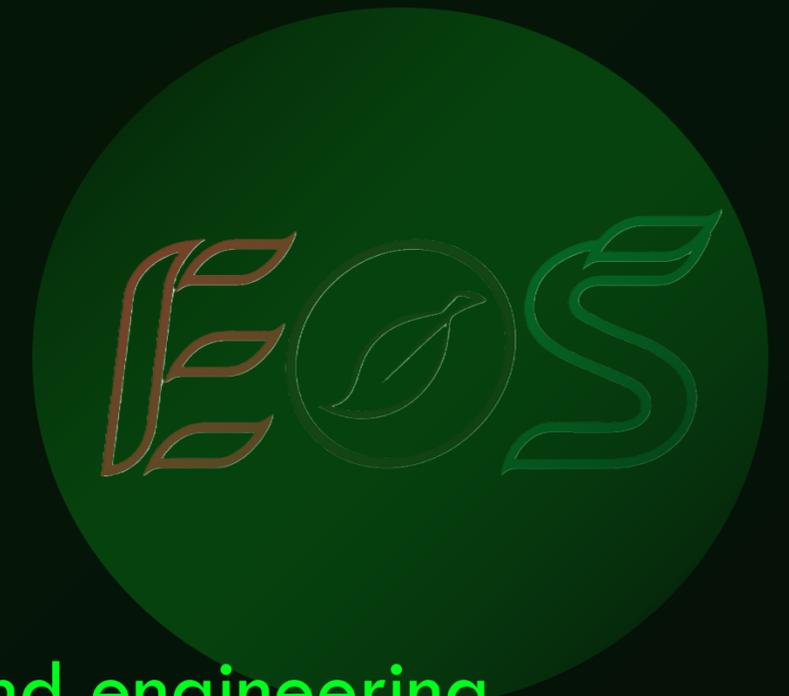


# Teaching

## ✓ Postgraduate study programmes

- Thermal engineering
- Renewable energy sources
- Technical and administrative aspects of environmental protection and engineering
- Energy auditing and certification of buildings
- Modern low-emission energy technologies and energy sources

## ✓ Student research groups



# Conferences/Seminars



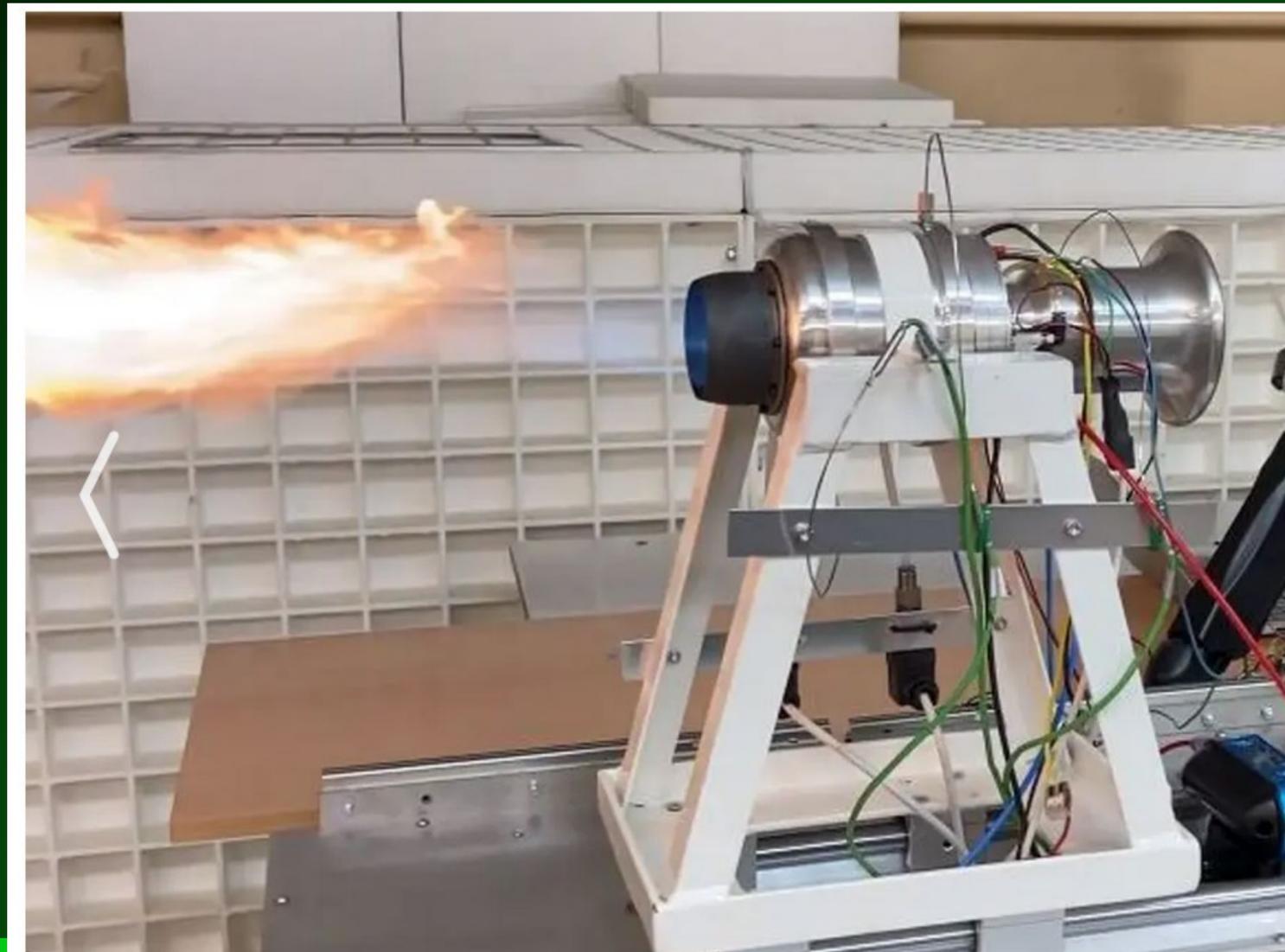
- ✓ 3rd International Technical Seminar – IT, Automation, Energy – a new era in energy quality, November 2025, Kraków, Poland
- ✓ DecarbCities 2025 13 - 14 May 2025, Kraków, Poland
- ✓ Conference Environmental Protection and Engineering – Sustainable Development (16 editions, every year), Kraków, Poland
- ✓ 5th Spring School Lattice Boltzmann Methods with OpenLB Software Lab 6 – 10 June 2022
- ✓ 3rd Krakow Ventilation Seminar (I, II, III) editions, 2015, 2016, 2017, Kraków Poland



# Department of Power Systems and Environmental Protection Facilities

[www.kseiuos.imir.agh.edu.pl](http://www.kseiuos.imir.agh.edu.pl)

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RESEARCH  
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AKADEMIA GÓRNICZO-HUTNICZA  
IM. STANISŁAWA STASZICA W KRAKOWIE  
AGH UNIVERSITY OF SCIENCE  
AND TECHNOLOGY

