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CENTRUM ODNAWIALNYCH ŹRÓDEŁ ENERGII I TECHNOLOGII WODOROWYCH W RYBNIKU

(CENTRE OF RENEWABLE ENERGY SOURCES AND HYDROGEN TECHNOLOGIES IN RYBNIK)

Aldona Rosner, PhD - Deputy Director of Branch of the Silesian
University of Technology in Rybnik



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THE CENTRE FOR RENEWABLE ENERGY SOURCES AND HYDROGEN TECHNOLOGIES IN RYBNIK

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THE CENTRE FOR RENEWABLE ENERGY SOURCES AND HYDROGEN TECHNOLOGIES IN RYBNIK

Funding



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under Priority FESL.10 European Funds for the Just Transition / Action FESL.10.05 Innovative Infrastructure Supporting the Economy

launched under a **non-competitive procedure**



Beneficiary: **Silesian University of Technology**



Total budget: **~25.5 milion PLN**

Funding amount: **~ 21 milion PLN**

<https://funduszeue.slaskie.pl/lsi/nabor/101>



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THE CENTRE FOR RENEWABLE ENERGY SOURCES AND HYDROGEN TECHNOLOGIES IN RYBNIK

Scientific Disciplines



Automation, Electronics, Electrical Engineering and Space Technologies



Information and Communication Technologies



Environmental Engineering, Mining and Energy



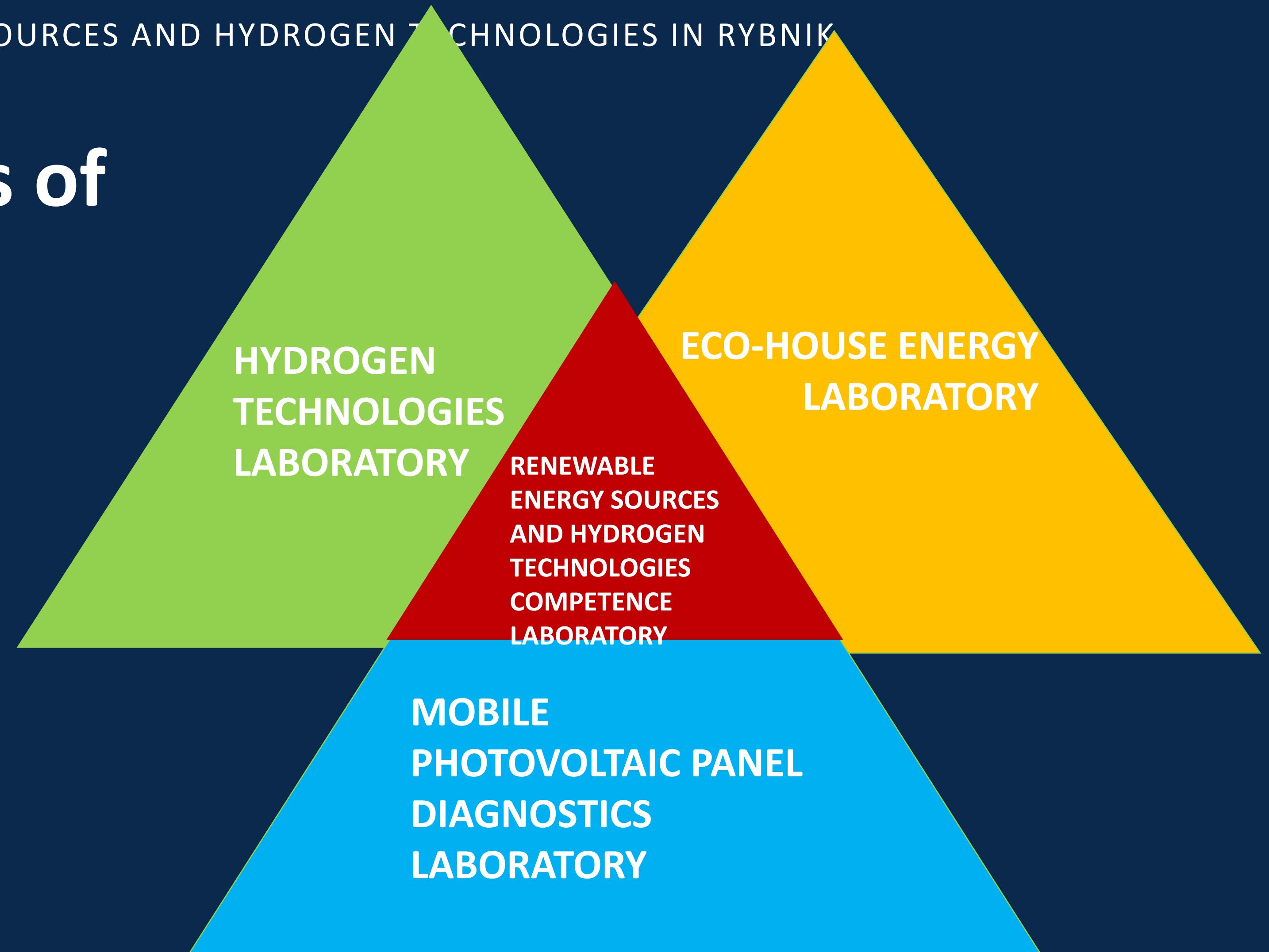
Mechanical Engineering



Computer Science

THE CENTRE FOR RENEWABLE ENERGY SOURCES AND HYDROGEN TECHNOLOGIES IN RYBNIK

The Centre consists of four components



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Implementation of EU and Regional Strategies

The investment will strengthen cooperation with the business community and contribute to the implementation of the following strategic objectives:



The Regional Innovation Strategy for the Silesian Voivodeship 2030, including Specific Objective C1. Increasing the capacity of entities within the regional innovation ecosystem to generate and implement innovations and modern technological solutions.



The Partnership Agreement for 2021–2027, specifically the strategic objective, „**More eco-friendly zero-emission Europe**” (CP2) through the implementation of an initiative in the area of “circular economy and efficient use of resources.”



The creation of modern research infrastructure will contribute to regional development, as well as to attracting and developing human resources, particularly in the areas of regional and smart specializations — energy, green economy, and ICT — through activities in the following areas:

1. **Energy** – reducing greenhouse gas emissions through the use of hydrogen technologies; reducing primary energy consumption through electricity demand forecasting and the prediction of photovoltaic panel failures.
2. **ICT and AI methods** – environmental management, monitoring the effects of climate change, energy resource management, and analysis and forecasting of energy demand.
3. **Green Economy** – solutions based on renewable energy sources (RES) and smart construction.



THE CENTRE FOR RENEWABLE ENERGY SOURCES AND HYDROGEN TECHNOLOGIES IN RYBNIK

HYDROGEN TECHNOLOGIES LABORATORY



Prof. PŚ Leszek Remiorz

Head of the Hydrogen

Technologies Laboratory

A laboratory enabling the production of green energy using hydrogen technologies.

NEEDS ANALYSIS

2020

a) The EU Hydrogen Strategy (COM/2020/301) was adopted. It proposed actions in the following areas: 1) **investment support**; 2) **support for production and demand**; 3) **development of the hydrogen market and infrastructure**; 4) **research and cooperation, including international cooperation** in this area.

b) As part of the Fit for 55 package, a number of legislative proposals were presented, establishing a specific European policy framework for hydrogen. This framework includes proposals to **set targets for the use of renewable hydrogen in industry and transport** by 2030.

2021

c) The government adopted **the Polish Hydrogen Strategy, which sets out an action plan for hydrogen technologies** through 2030, with a perspective to 2040. It defines six objectives: **deployment of hydrogen technologies in the energy and heating sectors; the use of hydrogen as an alternative fuel in transport; support for industrial decarbonisation; hydrogen production in new installations; efficient and safe transmission, distribution and storage of hydrogen**; and the creation of a stable regulatory framework.

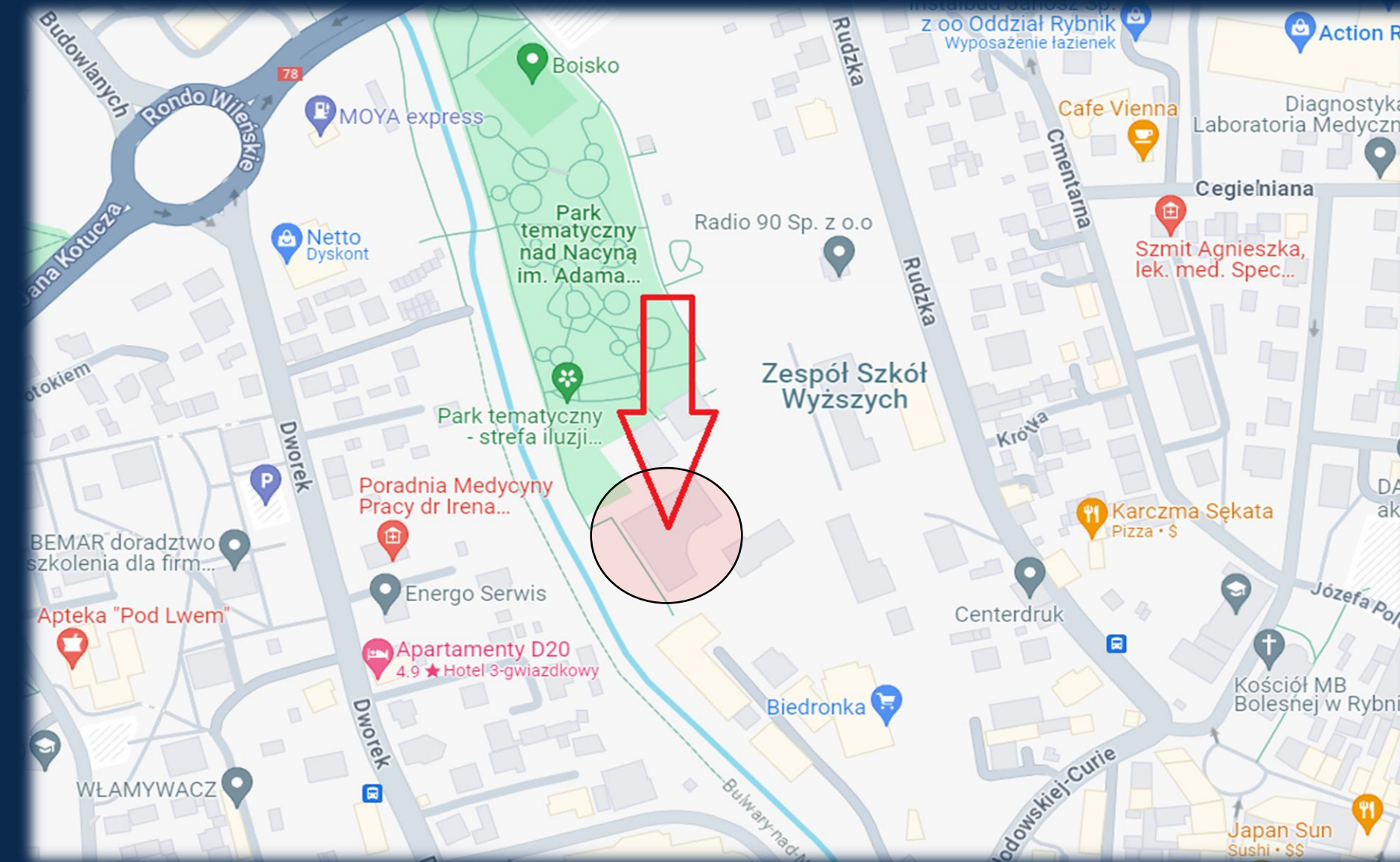
d) The Sectoral Agreement for the **Development of the Hydrogen Economy in Poland** was signed in Warsaw.

2022

e) The Polish government announced a draft **Hydrogen Act** (amending the existing Energy Law), which, among other things, **recognises hydrogen as a fuel, provides for the establishment of a hydrogen network and transmission infrastructure, and sets out the rules for establishing a hydrogen system operator**.

2023

f) The European Commission formally published two legislative acts setting out detailed rules concerning the **definition of renewable hydrogen** in the EU.



Location: 13 Rudzka Street, Rybnik

RESEARCH ACTIVITIES

General research areas identified in the Polish Hydrogen Strategy include:

- a) hydrogen technologies in the energy and heating sectors,
- b) the use of hydrogen as an alternative fuel in transport,
- c) support for industrial decarbonisation,
- d) hydrogen production in new installations,
- e) hydrogen distribution, storage and safe transmission.

Examples of specific research activities:

- 1) Characterisation, parameterisation, performance, durability, etc. of all components of hydrogen technologies, including electrolyzers, fuel cells, hydrogen storage systems, auxiliary equipment, etc.
- 2) Optimisation studies related to the appropriate selection of components for hydrogen systems
- 3) Research, modelling and optimisation of complete energy generation systems, e.g. wind turbine - electrical buffer - electrolyzer - hydrogen buffer - fuel cell - power supply for end-use equipment
- 4) Research into hydrogen-based power supply systems for end-use equipment, e.g. emergency power supply for a hospital using a hydrogen generator (or similar applications).
- 5) Research into the use of hydrogen to power heat engines, e.g. a Stirling engine
- 6) Analysis and research into safety systems for hydrogen installations.

Fuel Cell Testing System

System type: Arés 100 kW

Model: FCS-2M-100kW-ST

Fuel Cell Test Station Proposal No. 230825/02

Revision: 1

Customer: Silesian University of Technology, Poland



SERVICE ACTIVITIES

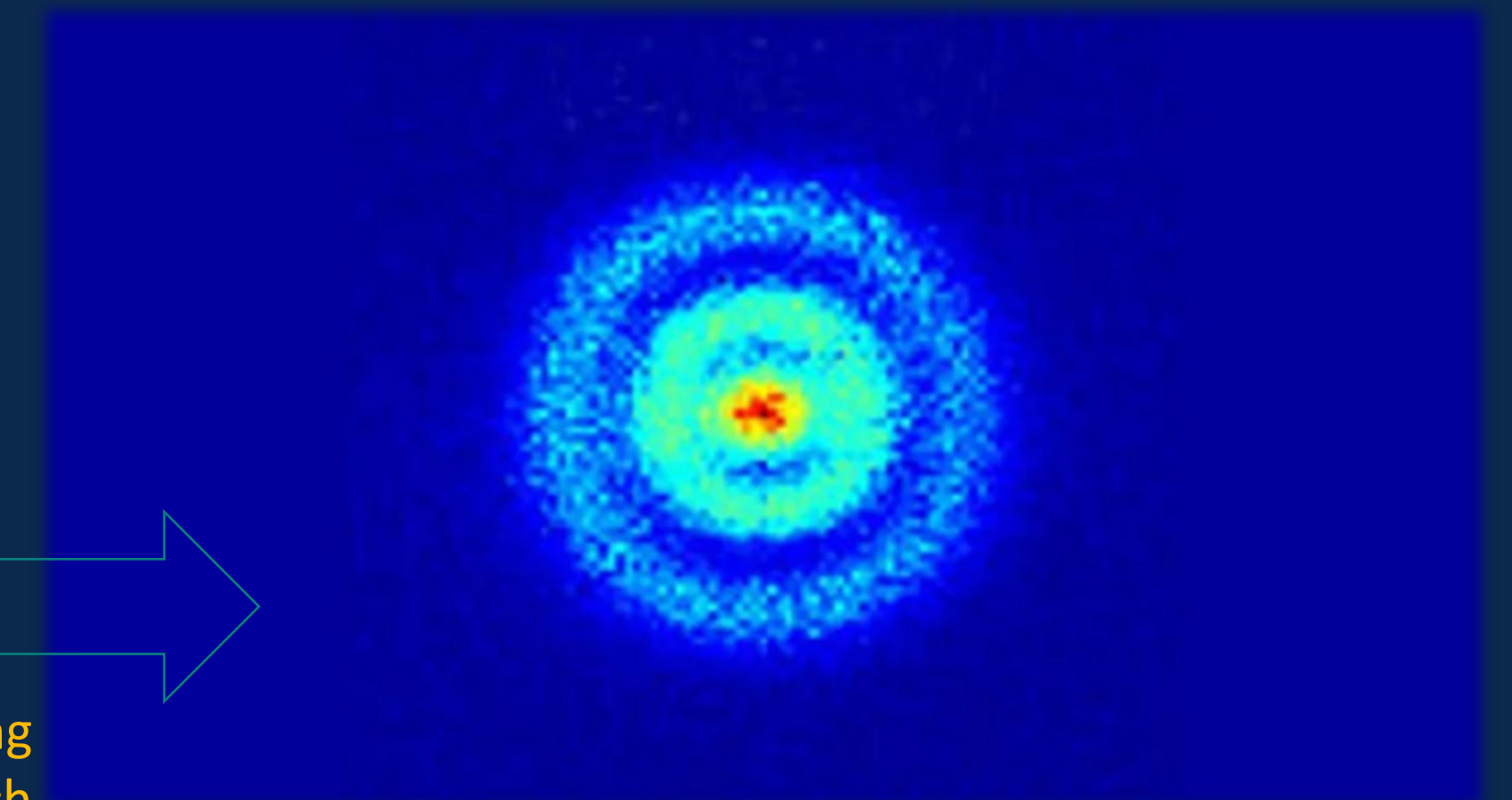
- 1) **Consulting, advisory** services and training in the construction and operation of hydrogen devices and systems related to the energy sector
- 2) **Training programmes / courses** for engineering personnel in the field of hydrogen technologies
- 3) **Commercial research and testing** of hydrogen devices and technologies to verify their technical performance
- 4) **Audits and verification** of hydrogen installations and equipment – technical and techno-economic optimization
- 5) **Joint projects** with industrial partners covering all research areas
- 6) **Other commercial services**, which are currently difficult to specify due to the early stage of development of the hydrogen market



Summary

Research into hydrogen applications in the energy sector is currently crucial for several reasons:

- 1) hydrogen is currently **the most attractive option for deep decarbonisation of global energy systems**,
- 2) it is an efficient energy carrier and **will replace carbon-based fuels**,
- 2) it enables the **rational use of renewable energy sources**,
- 3) it offers an opportunity to **move away from energy-intensive and CO₂-intensive production processes**.



Hydrogen atom, imaged using a quantum microscope at the Dutch Institute for Atomic and Molecular Physics

https://www.reddit.com/r/DamnThatsInteresting/comments/o9mdf0/first_photo_ever_inside_an_hydrogen_atom/?rdt=48074

ECO-HOUSE ENERGY LABORATORY



Prof. PŚ Jan Kaczmarczyk

Head of the Eco-House Energy

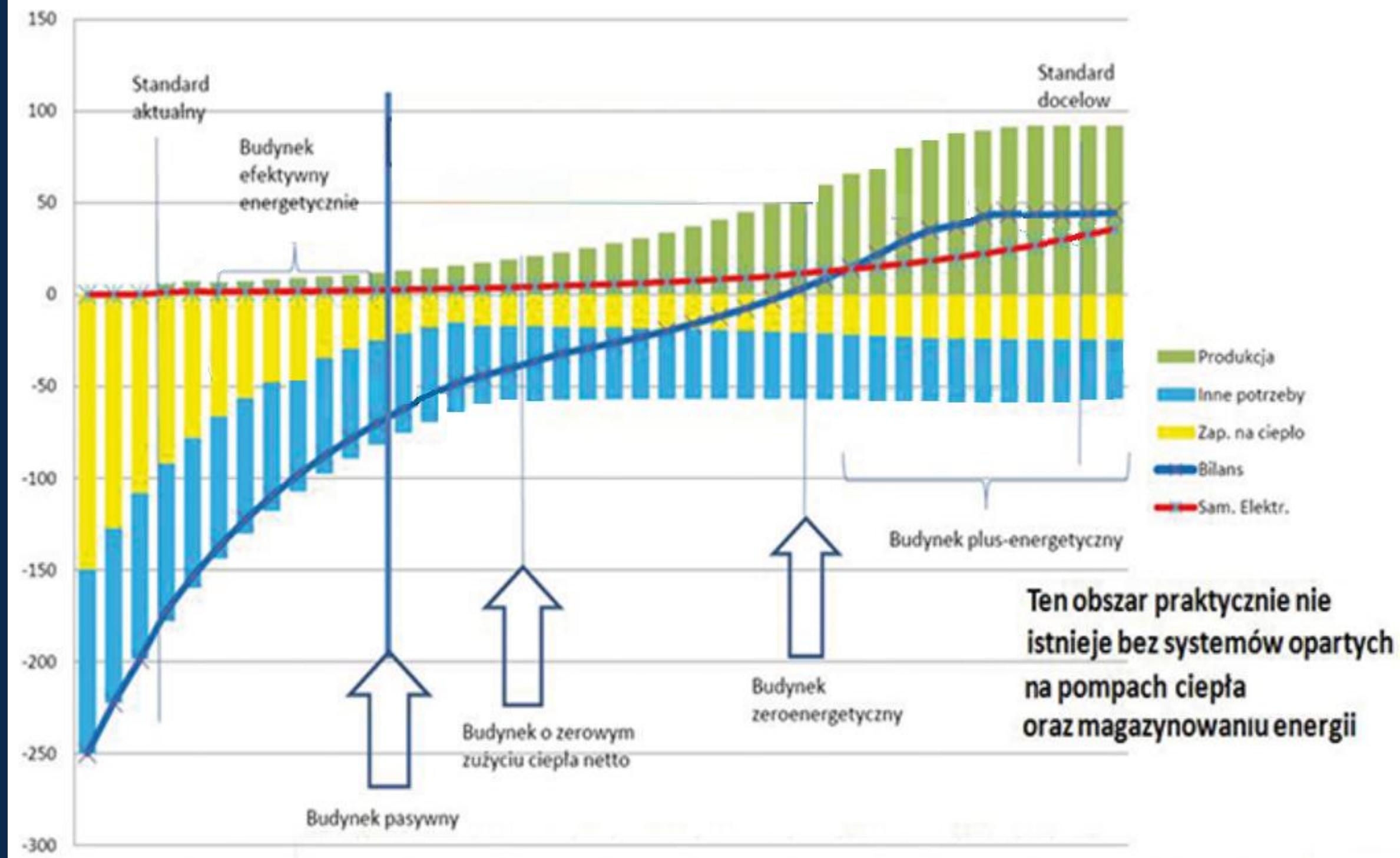
Laboratory

Construction of a model single-family house incorporating the latest technologies in the following areas:

- renewable energy sources,
- building technical systems,
- waste management,
- AI-based management of building systems.

NEEDS ANALYSIS

Energy Balance in Buildings



SUSTAINABLE ARCHITECTURE

Sustainable Architecture
Green Architecture

CIRCULAR ECONOMY

Circular Economy in Architecture and
Construction

NEW EUROPEAN BAUHAUS

Principles and EU Guidelines for
Contemporary Architecture

ACCESSIBILITY STANDARDS FOR
COHESION POLICY
for Architectural Structures

The Need for Efficient Use of Renewable Energy Sources and Energy Storage



Building Visualisation

Location: Rudzka Street, Rybnik, next to the building at 13 Rudzka Street



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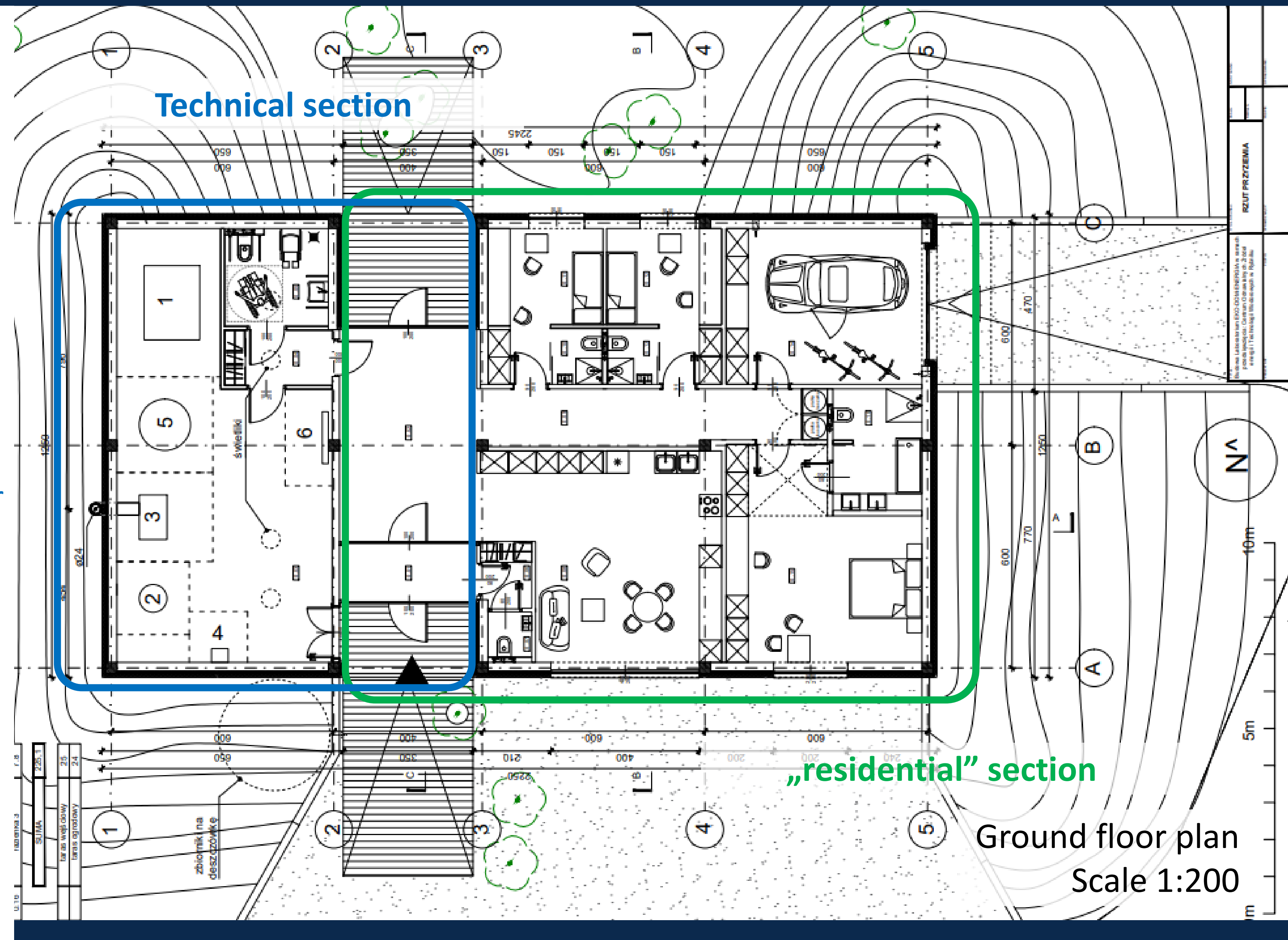
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Equipped with the latest technologies in the fields of RES, water and wastewater systems, and waste management

- Heat pumps W/W, A/W
- PV Panels
- Electrical, thermal and cooling Energy storage systems
- Various technical solutions for heating and cooling systems
- CAV and VAV ventilation systems with heat recovery
- free-cooling option
- Ground heat exchanger (GHE) for ventilation
- Rainwater retention and utilisation
- Electric vehicle charging station



RESEARCH ACTIVITIES

- Real-time analysis of building performance in terms of indoor environmental quality and energy consumption of individual building services systems and equipment
- Assessment of the efficiency of components (renewable energy sources) and/or the entire system under real-world (variable) operating conditions
- Assessment of user comfort conditions
- Development of effective control strategies for HVAC equipment and systems using artificial intelligence methods for various building use scenarios
- Development of the building's digital twin



SERVICE ACTIVITIES

- In-situ testing of heat pump performance under various operating conditions
- In-situ testing of the performance of thermal, cooling and electrical energy storage systems
- In-situ testing of the performance of ventilation units/systems
- Development of control algorithms for HVAC equipment under various building operating conditions



MOBILE PHOTOVOLTAIC PANEL DIAGNOSTICS LABORATORY



Prof. PŚ Damian Grzechca

Head of the Mobile Photovoltaic

Panel Diagnostics Laboratory

Development of a mobile laboratory—a fully equipped vehicle designed to perform on-site diagnostics of photovoltaic panels.

Existing Challenges and Identified Gaps:



Lack of a means to verify PV panel performance and compliance with specifications prior to installation—often a requirement for obtaining panel insurance. This highlights **the need for a laboratory compliant with IEC 60904-9**.



No possibility of testing PV panels on site (e.g. at solar farms), meaning that potentially large numbers of panels must be transported to a laboratory for testing. This entails additional costs and a risk of damage, highlighting the need for a mobile testing solution. Due to the size of the panels, this requires an **L3H2-class panel van**.

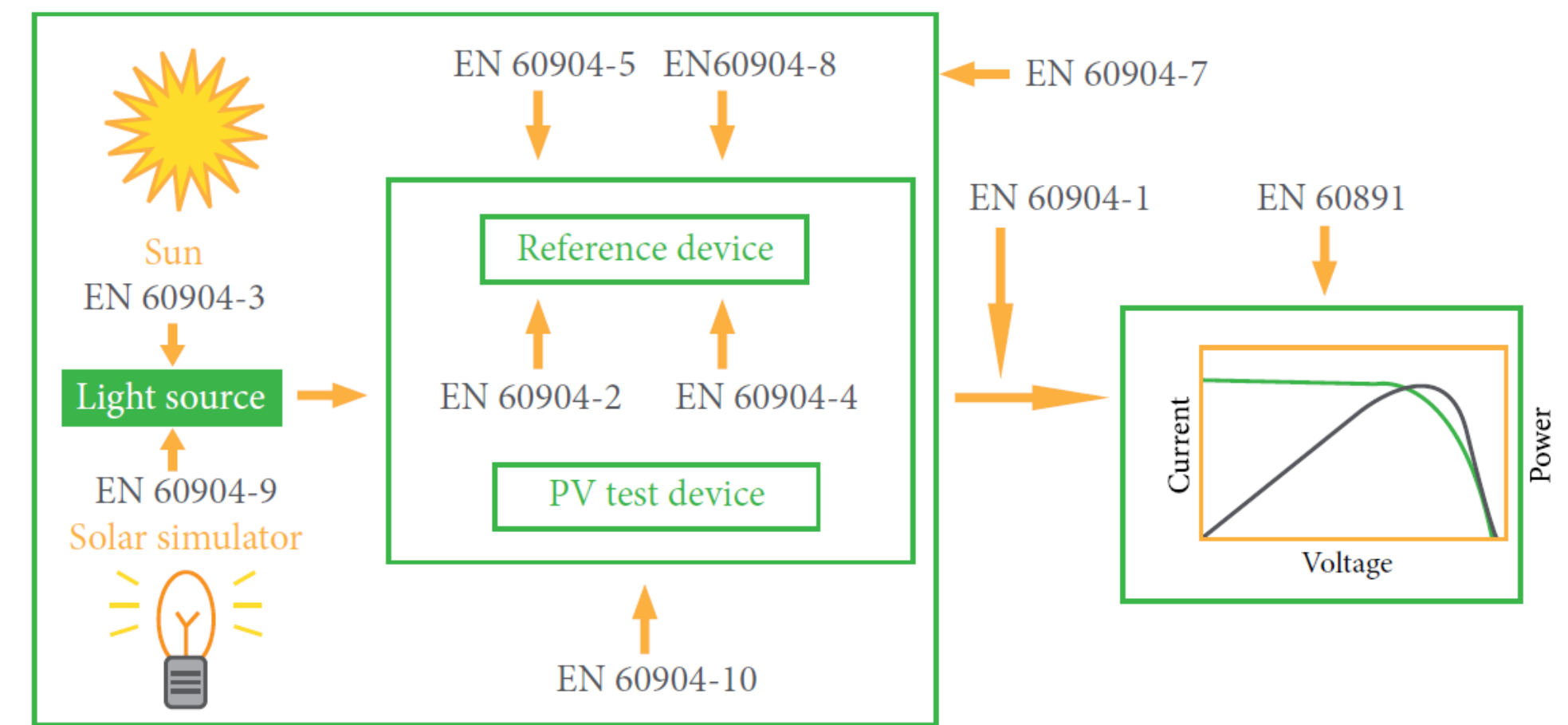


Lack of validated data on PV panel degradation **under local climatic conditions**, resulting in limited accuracy in long-term electricity generation forecasts due to **the lack of appropriate degradation models**.



Lack of a Poland-specific database and validated degradation models, which are **essential for energy-mix planning and long-term forecasting of electricity generation**.

RESEARCH ACTIVITIES



The advanced mobile research and measurement facility will enable:

- Integration of a certified light source meeting one of the classes specified in IEC 60904-9
- Testing of electrical and structural parameters, including the use of cameras for electroluminescence imaging
- Development of PV panel degradation models, specifically tailored to local climatic conditions
- Development and refinement of diagnostic tests that account for degradation processes, improving predictive models for electricity generation

SERVICE ACTIVITIES

1. PV panel testing services at solar farms (maintenance, screening and inspection).
2. PV panel validation services prior to initial use (installation).
3. Training in PV panel testing and parameter validation for external and internal users.
4. Training in the operation of the mobile testing unit.

Summary



- **Maximum PV module dimensions:** 1,400 × 2,700 mm.
- **PV module types covered by testing:** framed and frameless glass-glass or glass-foil modules, bifacial solar modules, monocrystalline or multicrystalline modules, PERC modules, and thin-film modules.
- **Damage testing and diagnostics:** electroluminescence inspection, detection of hidden defects (microcracks, inactive areas), pre-measurement electrical connection and bypass diode testing, hot-spot detection, and grounding tests.



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RENEWABLE ENERGY SOURCES AND HYDROGEN TECHNOLOGIES COMPETENCE LABORATORY



Dr inż. Aldona Rosner

Head of the OZEiTW

Competence Laboratory

Adaptation of the auditorium at the Rybnik Branch of Silesian University of Technology to serve as the Renewable Energy Sources and Hydrogen Technologies Competence Centre

OZEITW COMPETENCE LABORATORY

- Adaptation of the auditorium to accommodate its new functions as the Renewable Energy Sources and Hydrogen Technologies Competence Centre
- Conferences, seminars, training sessions and educational activities, including vocational training in the field of renewable energy sources and hydrogen technologies
- Equipping the facility with audio-visual equipment to enable:
 - **virtual access to real-time data;**
 - **training sessions, seminars, webinars and other educational activities** using real-world data and demonstrating the practical aspects of selected technologies;
- video streaming:
 - hybrid conferences (on-site and online), including **Massive Open Online Courses (MOOCs);**
 - enhanced education and the development of continuing and **Life Long learning (LLL).**
 - Access to data from the newly established laboratories will **make conferences more interactive** and enable the organisation of **hands-on workshop sessions.**
- The larger space will allow for the presentation of **hydrogen-powered vehicles**, such as drones.
- The facility will also enable vocational training using **Virtual Reality (VR) technologies.**

Thank You for Your Attention



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