Institute of Fluid – Flow Machinery, Polish Academy of Sciences, Gdańsk

Renewable Energy Sources. Research Programs leading to distributed prosumer/citizen Power Engineering

Scientific competences and research potential.

Prof. **Jan Kiciński**, Deputy Director

e-mail: kic@imp.gda.pl www.imp.gda.pl

PolSCA MEETING

Next generation of renewable energy sources, including solar, marine, and geothermal energy

VENUE: Rue du Trône 98, 1050 Brussels, PolSCA Office, 1st floor

A few words about the institute

Institute of Fluid Flow Machinery of the Polish Academy of Sciences in Gdańsk

Average employment

Total 205 emploees (160 full time)

120 scientific staff

– 30 professors

– 40 research fellows

– 50 research assistants

The greatest Institut of the PAS in north Poland and the second largest in the country

Institute possesses all possible authorisations and academic rights, including the rights to award the title of full professor in the area of mechanics as well as machine construction and exploitation.

Renewable Energy Sources RES

Scientific Competences and Research Potential

Projects and Laboratories

1 - The new "Energy-plus" Research Centre of the PAS in Jabłonna
2 - The largest „Green Energy" Strategic Project in Poland (ARE - Autonomous Regions of Energy)
3 - Key project (Domestic micro-CHP/ Home Power Plant)
4 - Baltic Ecoenergy Cluster
5 - MARE – WINT (Offshore Wind Turbines technology
6 - Other Projects

The new “Energy-plus” Research Centre of the PAS in Jabłonna

Energy – Plus technology for small private and public buildings.

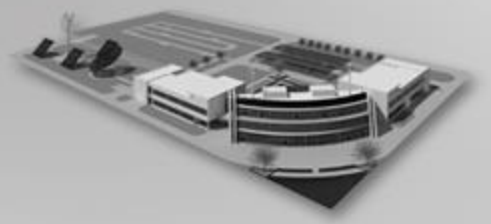
What the Center should offer?

Cheap, hybrid mini/mikro CHP power plants

New solutions for energy storage

Local Smart Grid Applications for „cloud computing”

MOTTO OF THE CENTER:
Micro Plus-Energy Technologies for houses and public buildings



μT+E

Centrum Badawcze PAN Jabłonna
KONWERSJA ENERGII I ŹRÓDŁA ODNAWIALNE

How to do it?

L1. Solar Technology Laboratory

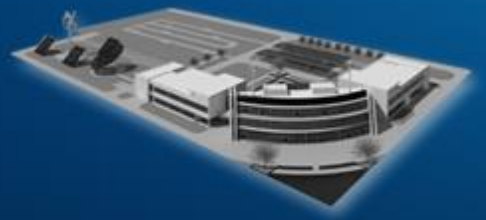
L2. Micro-Cogeneration Plants and Ecological Boilers Laboratory

L3. Wind Energy Laboratory

L4. Safety Engineering Laboratory for Energy Generation

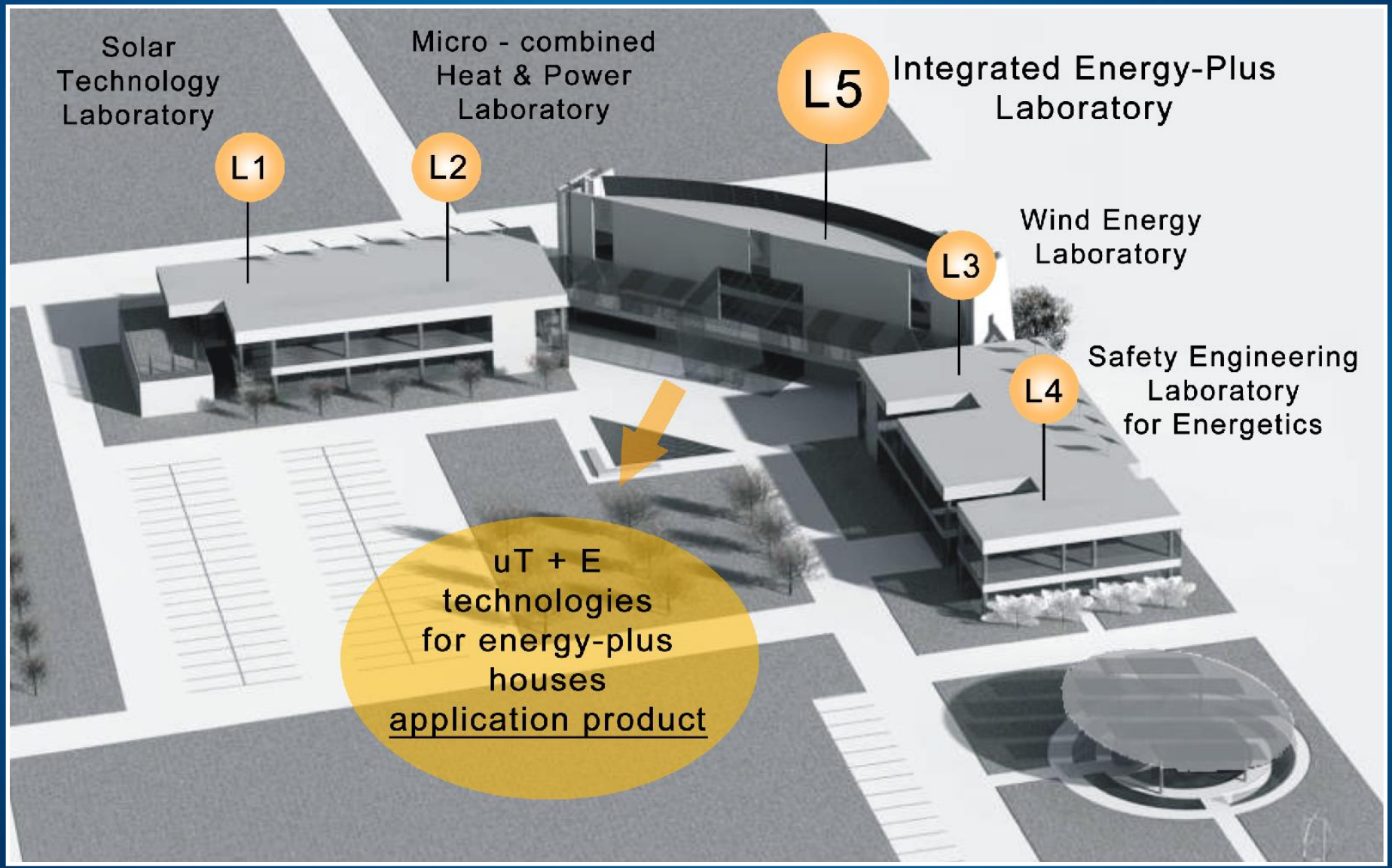
L1 + L2 + L3 + L4 → Integrated Plus-Energy Laboratory L5 → μT+E

Micro Plus-Energy Technologies μT+E



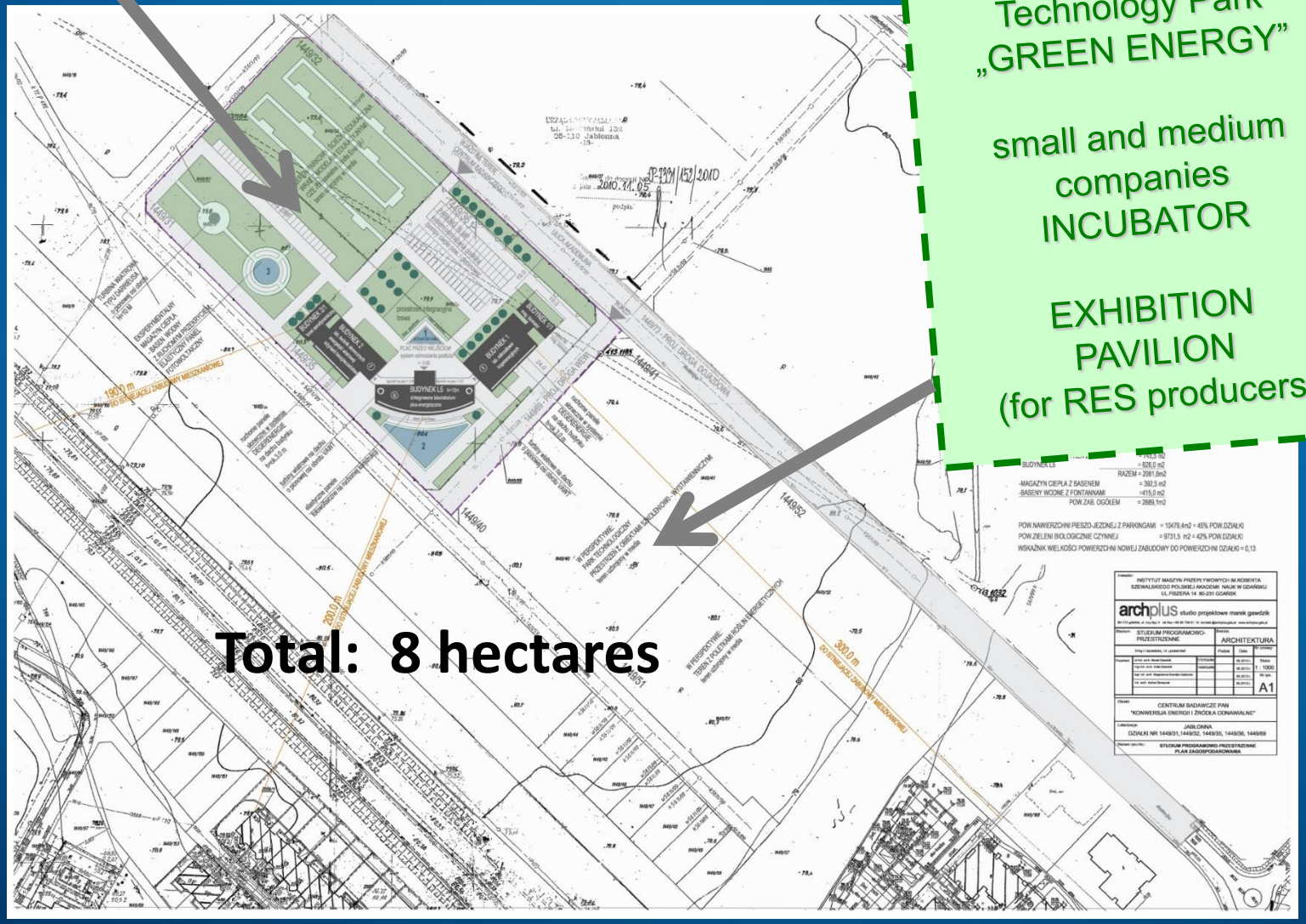
Concept of laboratories in Jablonna


Prosumer energy trading
Shows, conferences
Education and promotion
Research and development
Research Center Offer
Commercial research (Field tests)
L1
L2
L3
L4
L5
µT+E


Solar
Technology
Laboratory
L1
Micro - combined
Heat & Power
Laboratory
L2
L5
Integrated Energy-Plus
Laboratory
Wind Energy
Laboratory
L3
Safety Engineering
Laboratory
for Energetics
L4
uT + E
technologies
for energy-plus
houses
application product

Topographical location

Research Center



Jablonna Center take the energy from Nature

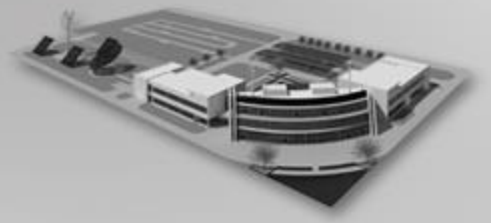
Plus Energy Balance

In the energy-plus configuration in summer, autumn and spring when there is sufficient sunlight the following devices will be activated:

- Photovoltaics
- The heat pump and absorption system
- Solar collectors

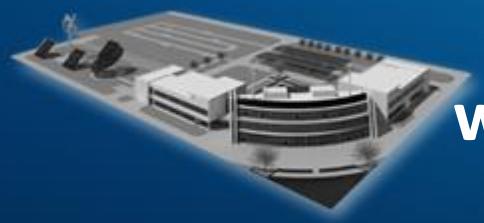
PV cells will produce about 200 kW of electrical power
Heat pumps will use 55 kW of electricity
We will get 155 kW of coolness and 160kW of heat

In summer, spring and autumn, we can realize the Energy – Plus idea of the Center

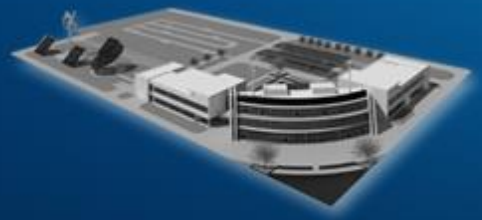


145 kW may be transmitted to external grid.
(after securing own needs)

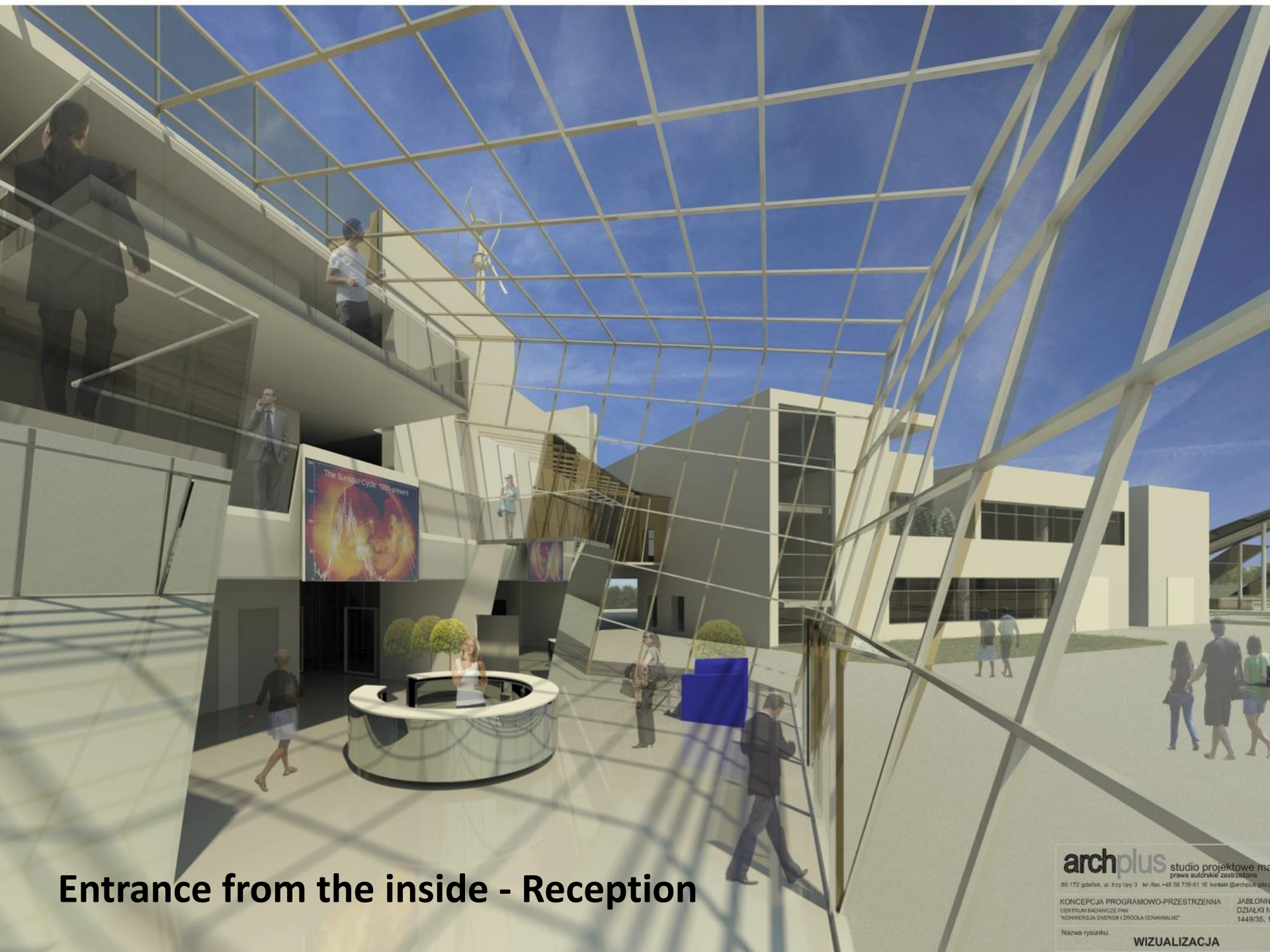
So our center will look like…….



South side
with Integrated Plus-Energy Laboratory



North side with the main entrance



Entrance from the inside - Reception

THE LARGEST „GREEN ENERGY” PROJECT IN POLAND

2

Strategic Program

Advanced Power Generation Technologies

Task 4. Development of integrated technologies for the production of fuel and energy from biomass, agricultural waste and other

www.strateg-z4.imp.gda.pl

The main objectives of the project

Building and implementation of 16 pilot plant demonstration.

These installations, as the main result of this offering, will provide the basis for future deployments of new technologies in the field of energy conversion of biomass and waste, and construction of biogas systems integrated with co-generation sets

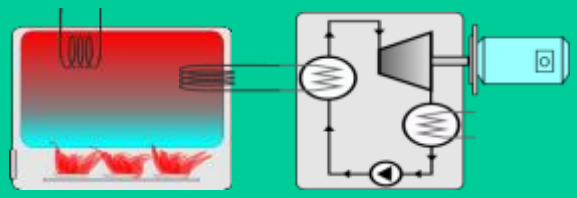
IMP PAN GDAŃSK

Energa

ECO-ENERGY CHP STATIONS

BIOMASS CHP STATIONS

Biomass pellet boiler
(thermal output of 1.1 MW)
ORC Power Station
With electric Power 145 KW



MULTI-FUEL BURNER

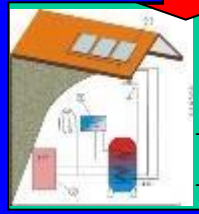
MICROTURBINE ORC (LOW-TEMPERATURE BOILING MEDIA)

FINAL EFFECTS: PROTOTYPES, DEMOS, CUSTOMER IMPLEMENTATIONS

MICRO WIND TURBINE STATIONS

Cheap wind turbine for Individual customers

MICROGRIDS



HYBRID SYSTEMS:

- SOLAR AIR-CONDITIONING
- FULE CELLS

SMALL PHOTOVOLTAIC STATIONS

MICRO HYDRO POWER STATIONS

Low head hydro turbines

ARE
Autonomous Regions of Energy

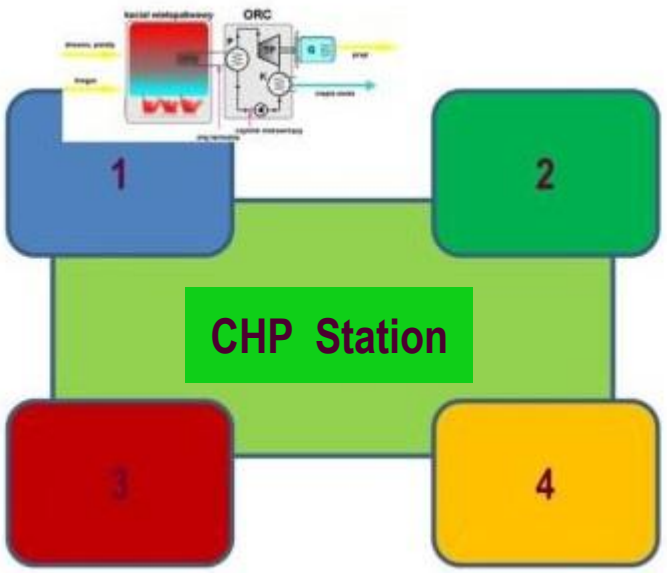
ARE

Main task: to modernize the old heating plant and to build a modern CHP station

Problem: what to do with excess of the heat in the summer time?

Solution: building of ORC module (1), which operates all year

other modules (2,3,4) will be included depending on the energy needs of the community



ORC module
0,14 MWe
0,83 MWt

Steam module
2,70 MWe
5,20 MWt

Coal boiler
0,00 MWe
17,00 MWt

Gas engines
3,10 MWe
3,40 MWt

IMP PAN GDAŃSK

Energa

Biomass gasification plant

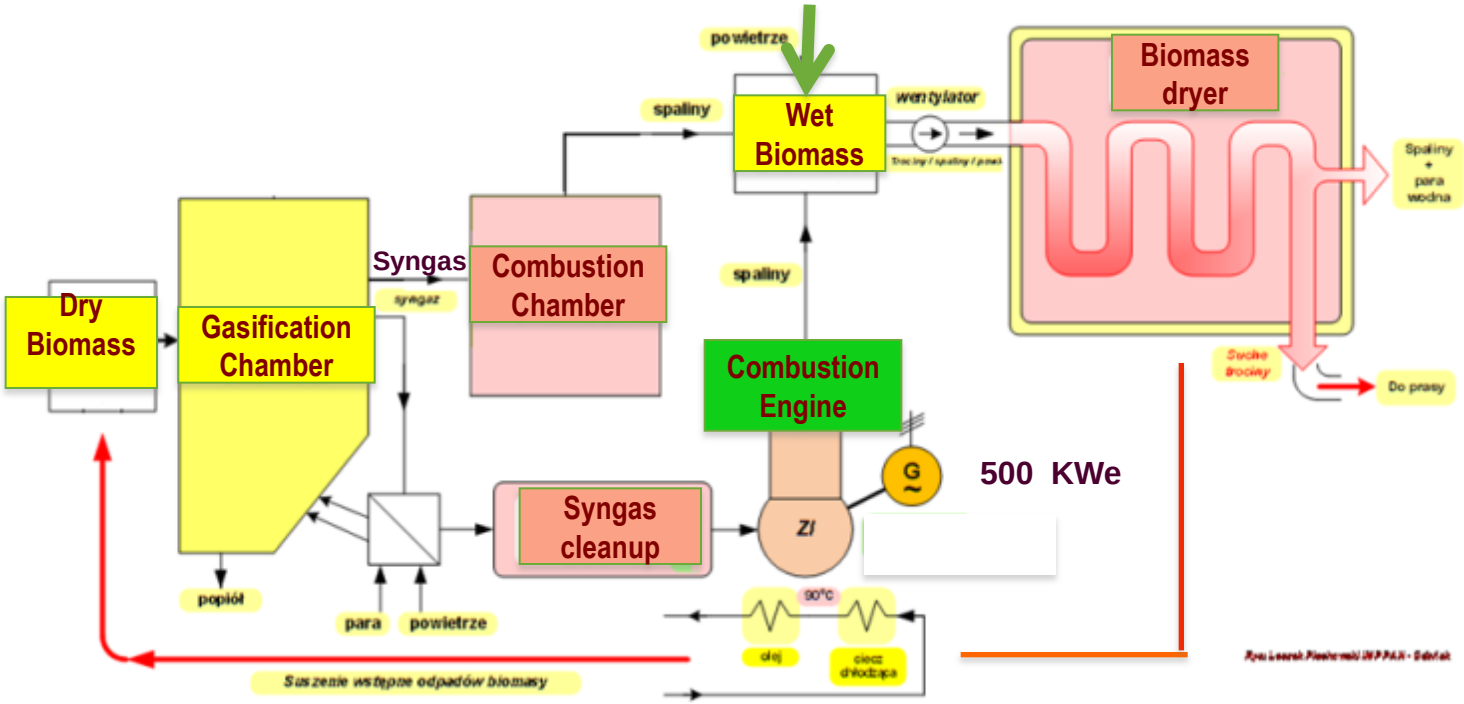
Today: only the production of syngas with a low calorific value and quality

Our Task: to build a modern CHP plant

Problem: how to improve the quality of syngas?

Solution: biomass pre-heating using waste heat

The result: the ability to burn syngas in the combustion engine
Cogeneration: Electric Power of 500 KW
Syngas for commercial purposes



IMP PAN: Laboratory of micro CHP

Today

After construction in 2014

Poligeneration Power Plant

Elements supplied and installed in the laboratory

The boiler thermal oil heater - heat source of the ORC

Radial Cooler - a source of cooling the ORC

IMP PAN: Laboratory of micro CHP

Key project

3

Operational Programme: Innovative Economy (POIG)

R&D PROJECT

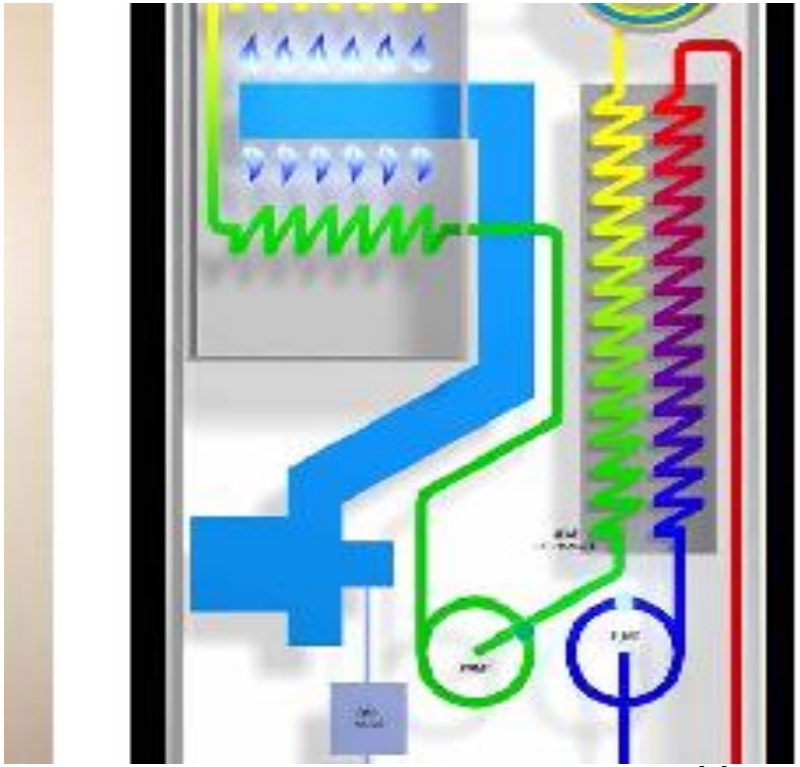
„MODEL AGROENERGY COMPLEX IN DISTRIBUTED COGENERATION OF HEAT AND POWER”

Coordinator: IFFM-PAS

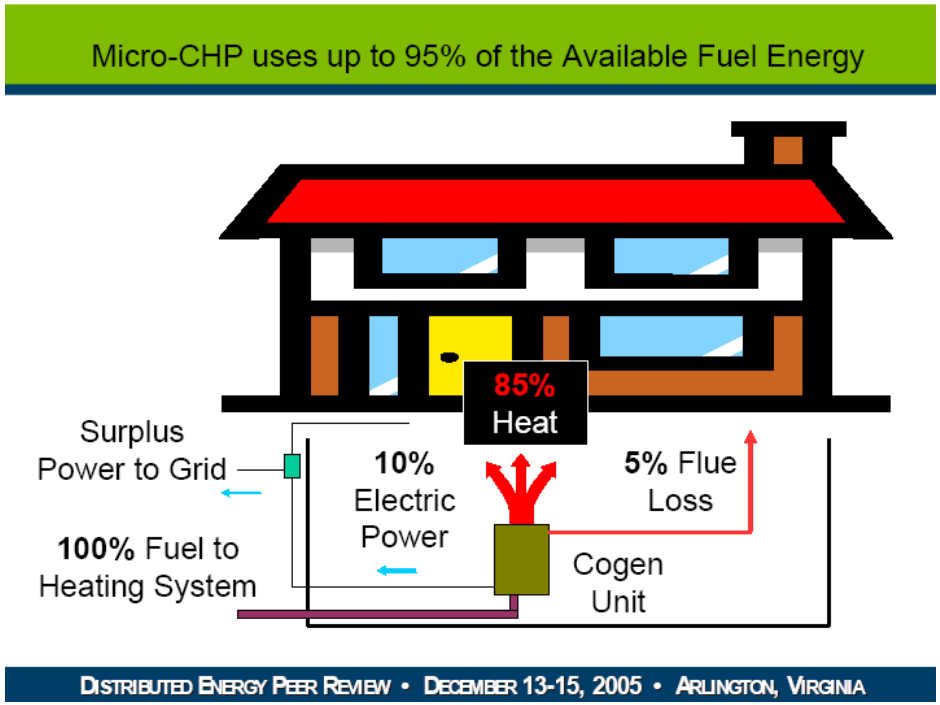
HOME MICRO POWER PLANTS

CHP – ORC systems [electricity power only several KW]
Cogeneration micro power plants in cooperation with ecological boilers.
Organic Rankine cycles - ORC. Feeding: biomass, biogas, biofuel

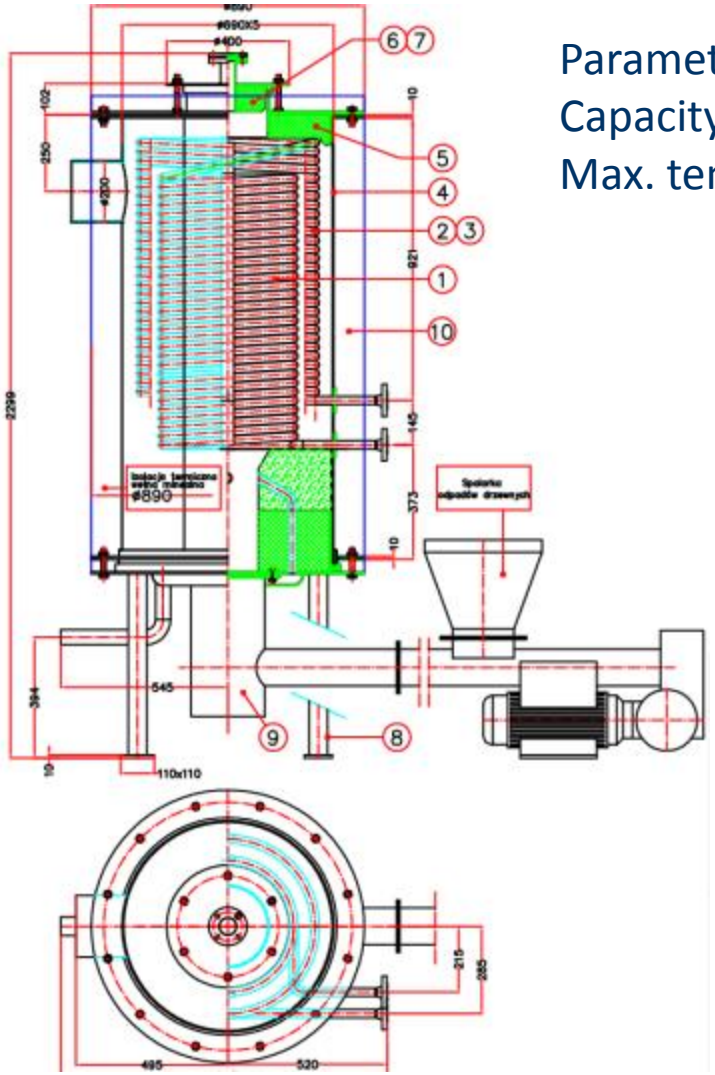
Electric current



Heat



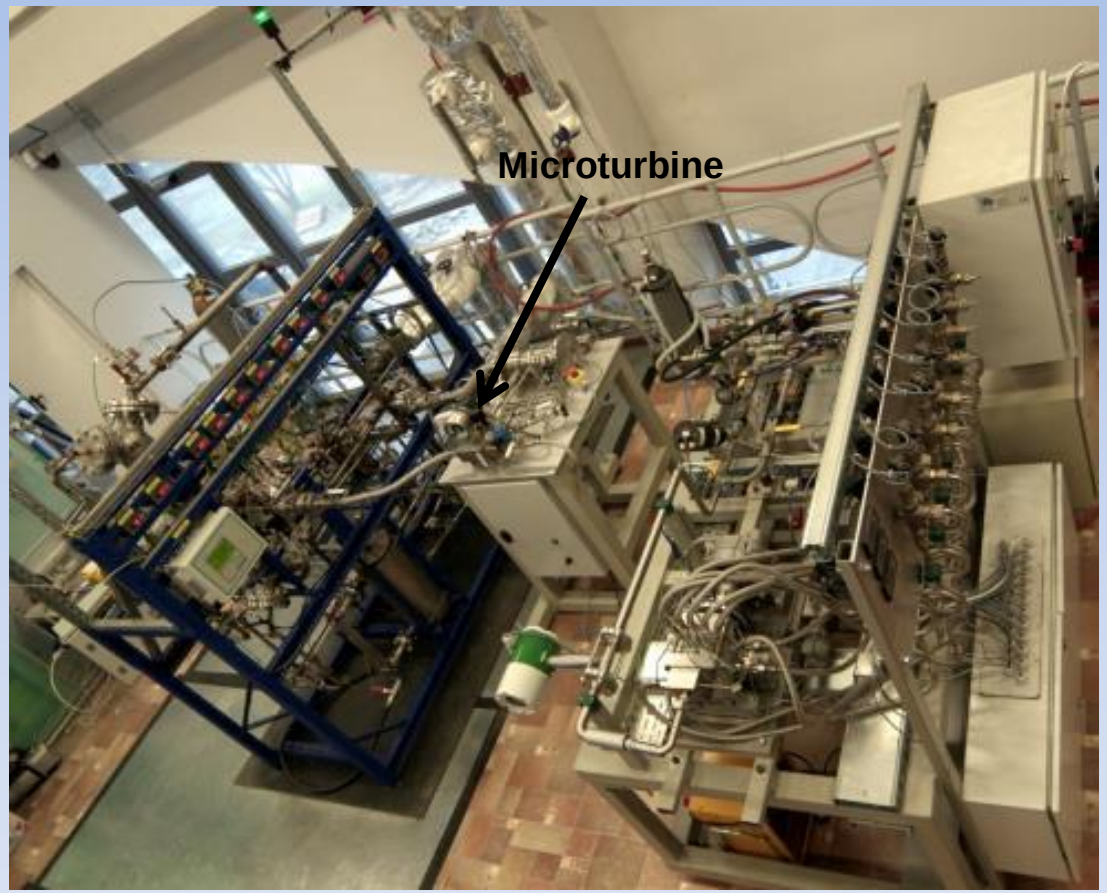
Oil boiler with a cooling loop



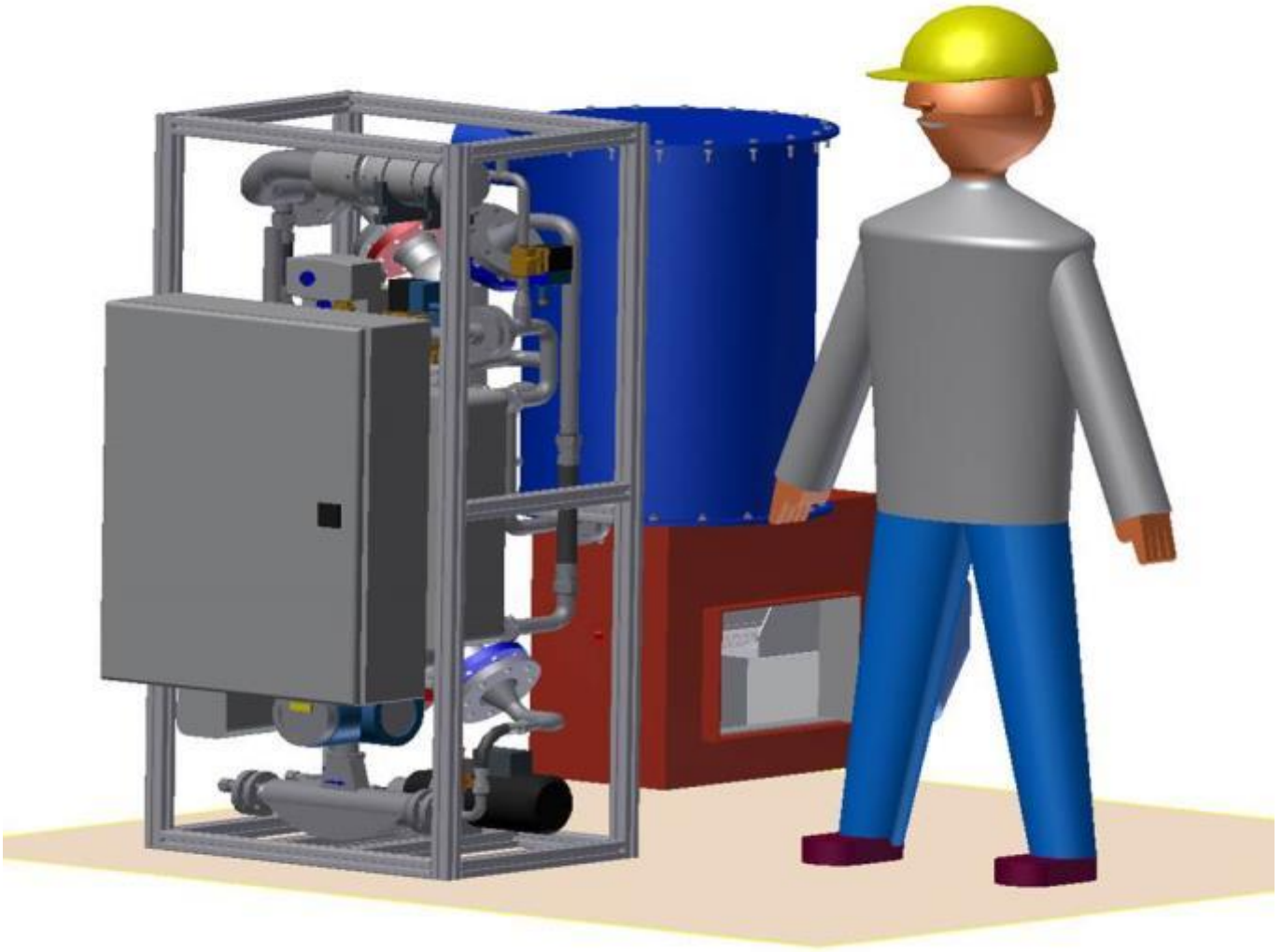
Parameters:
Capacity 30kW, Maximum pressure 16bar
Max. temperature 250 C, Coil volume 40l, Mass 500kg

Domestic micro CHP ORC

IMP PAN Laboratory - Present State



Domestic micro CHP – commercial (target) version



We suggest mini & micro-scale ORC-based CHP

ORC Technology (Organic Rankine Cycle) utilises working fluid with low boiling-medium for steam cycles in small and micro-scale cogeneration

In our opinion it is the most promising technology with short realization time

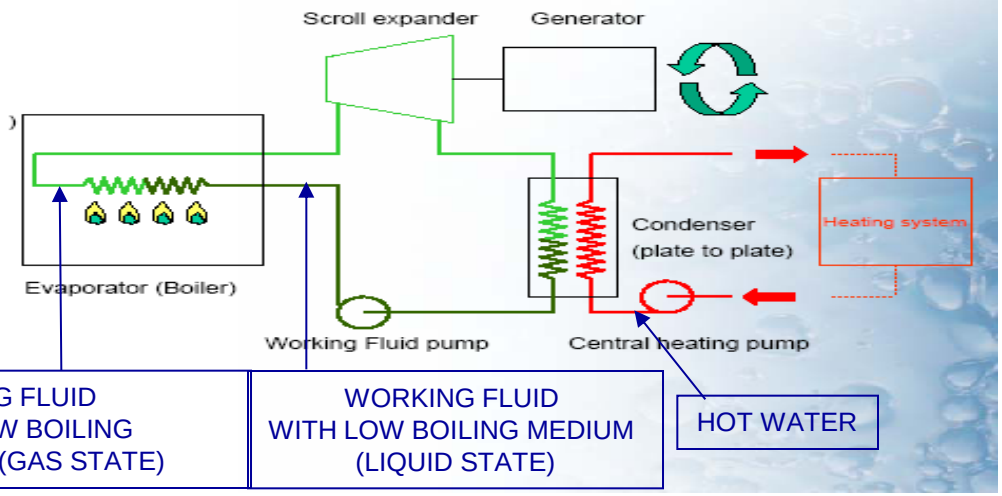
Mini-scale CHP
(Local/Commune Energy Centers)

Thermal power: from several hundred kW to 5 MW
Electric power: from several dozen kW to 1 MW

Micro-scale CHP
(Home/building scale combined H&P)

Thermal power: several dozen kW
Electric power: from few to several kW

TWO SEPARATE CYCLES: working fluid with low boiling medium & water

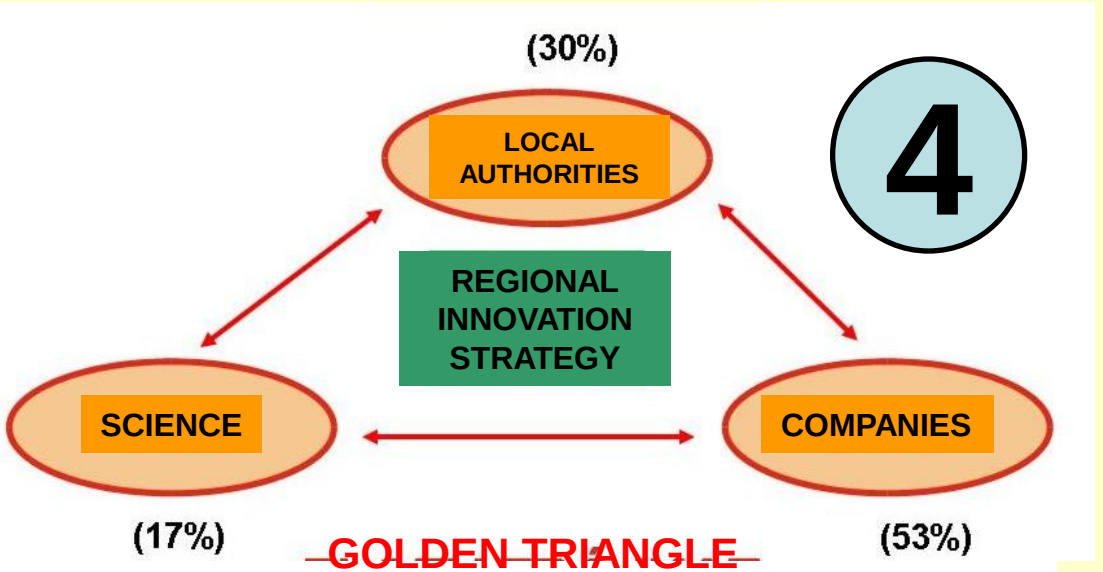


mCHP-ORC

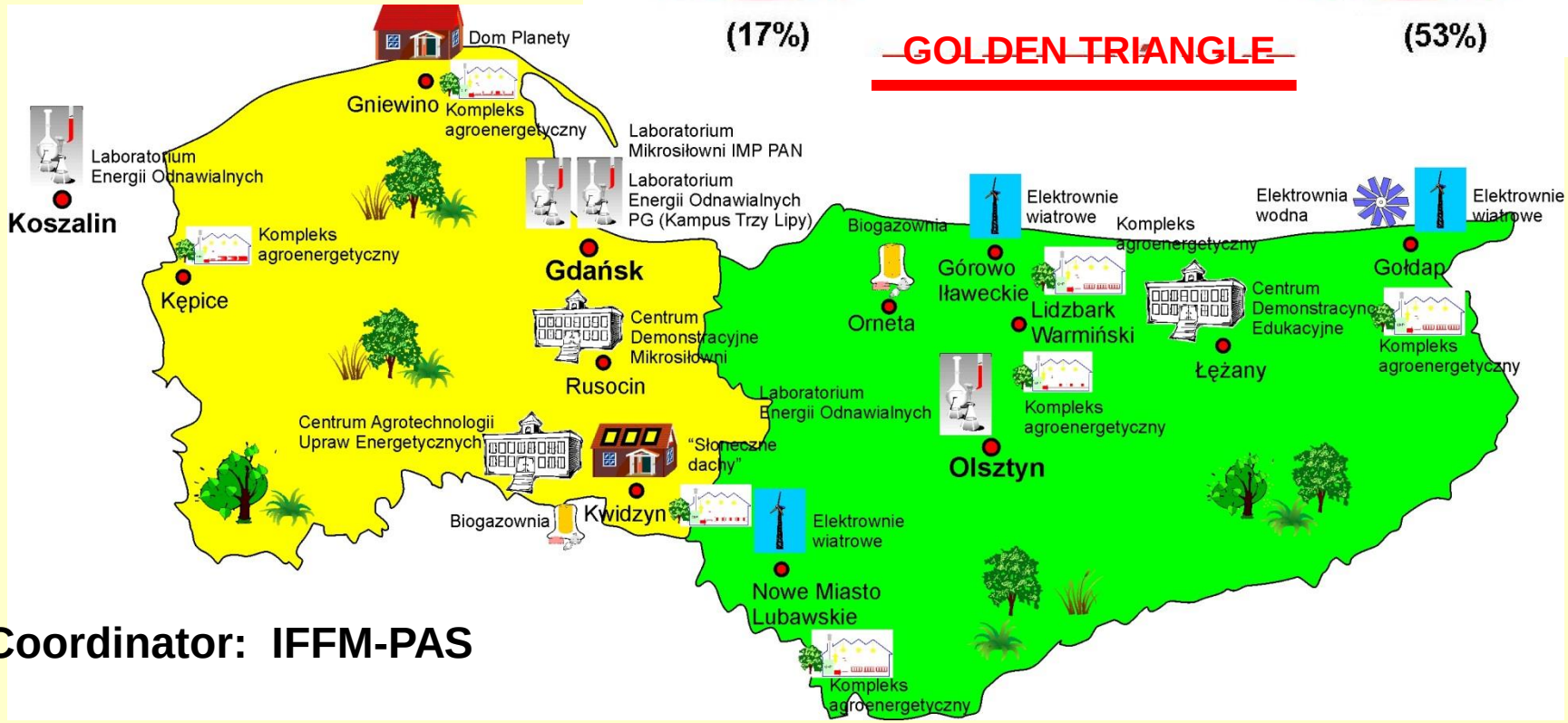
BALTIC ECOENERGY CLUSTER
contains 90 entities

THE LARGEST ECOENERGY CLUSTER in POLAND!!

BKEE



GOLDEN TRIANGLE



Coordinator: IFFM-PAS

5

MARE-WINT
new MAterials and REliability
in offshore WINd Turbines technology

4 year FP7 PEOPLE Marie Curie ITN

Total Project Value: € 3.82 Mio

14 Early Stage Researchers

23 Patrners

Coordination

EU PROJECTS: „Bioenergy Promotion”

6

Bioenergy Promotion

Baltic Sea Region Programme 2007-2013

Part-financed by the European Union (European Regional Development Fund and European Neighbourhood and Partnership Instrument)

The project aims to strengthen the development towards a sustainable, competitive and territorially integrated Baltic Sea Region in the field of sustainable use of bioenergy.

Lead Partner: Swedish Energy Agency
Duration: 2009-2012
Total budget: € 5 mln (IFFM-BEEC €166 500)

IFFM-BEEC

realizes selected tasks among different Work Packages in the project, and above all,
plays a role of the WP5 Business Leader!

To find out more please visit:
http:// www.bioenergypromotion.net

PEA – Public Energy Alternatives – Sustainable Energy Strategies as a chance for regional development

Baltic Sea Region Programme 2007-2013

Part-financed by the European Union (European Regional Development Fund)

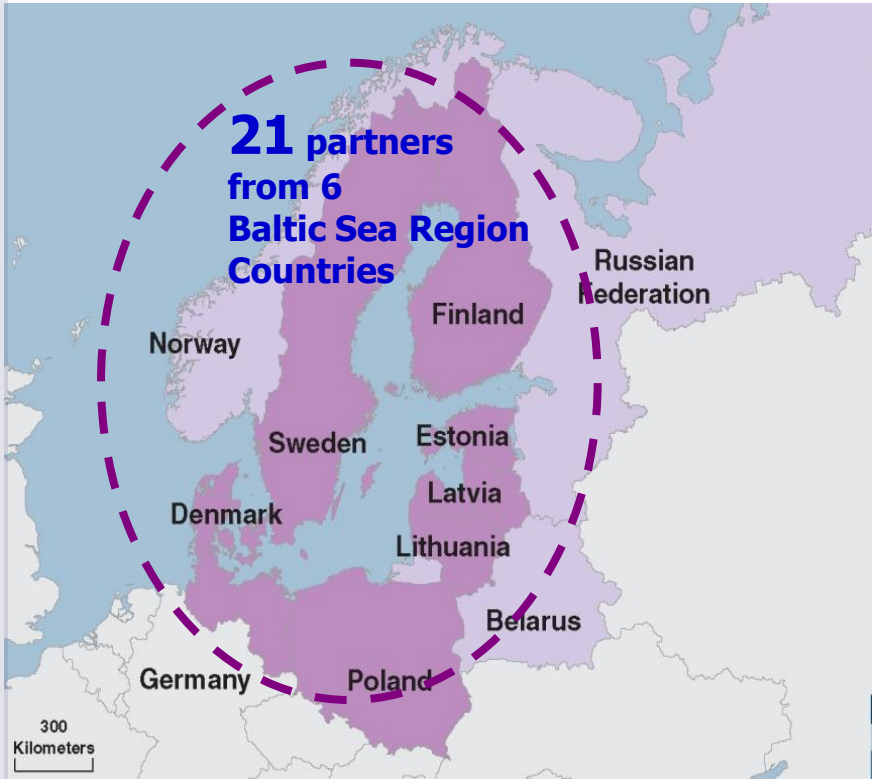
The project aims to foster regional development through reduction of energy related costs, added value based on new value chains and sustainable technological innovations.

Lead Partner: City of Wittenberge, Germany
Duration: 2010-2013
Total budget: ca. € 3,7 mln (IFFM-BEEC € 244 657)

IFFM-BEEC

will realize selected tasks among different Work Packages in the project, and **will play a role of the WP5 Leader!**

WP5 – „Sustainable energy production, supply chain management and preparation of investments"



European Collaborative projects

with our participation and coordination – Transport including Aeronautics

5FP	*AITEB*	*5.6 mln Euro*	*15 partners*	*Rolls-Royce D*
6FP	*AITEB-2*	*7.3*	*17*	*Rolls-Royce D*
	FLIRET	*7.7*	*16*	*AIRBUS*
	TLC	*8.1*	*19*	*SNECMA*
Coordination -				
	UFAST	*3.8*	*18*	*IMP PAN*
7FP	*ERICKA*	*7.0*	*18*	*Rolls-Royce*
	FACTOR	*7.5*	*21*	*SNECMA*
	E-BREAK	*30.5*	*42*	*TURBOMECA*
Coordination –				
	TFAST	*4.5*	*16*	*IMP PAN*

Aeronautics

Coordination

IMESCON

Coordination

4 year FP7 PEOPLE Marie Curie ITN

Total Project Value: € 2.25 Mio

12 Early Stage Researchers and Experienced Researchers

2 Universities (LIV, KU Leuven), 2 Research Institutes (IMP PAN and TASK) 4 Large Industries (PZL Swidnik, LMS, Agusta-Westland) and 2 SMEs (CEDRAT, Fibersensing).

IMP PAN GDAŃSK

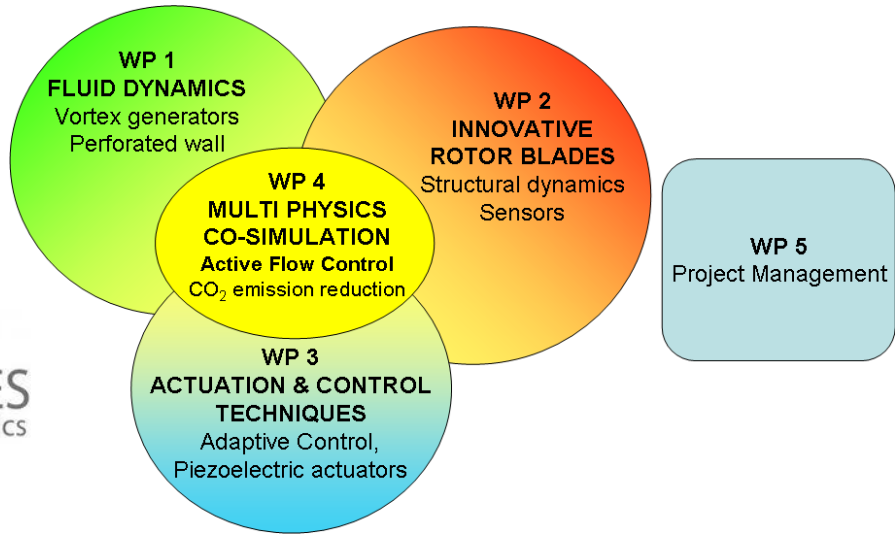
UNIVERSITY OF LIVERPOOL

LMS A Siemens Business

AgustaWestland PZL-ŚWIDNIK S.A.

KU LEUVEN

CEDRAT TECHNOLOGIES Innovation in Mechatronics



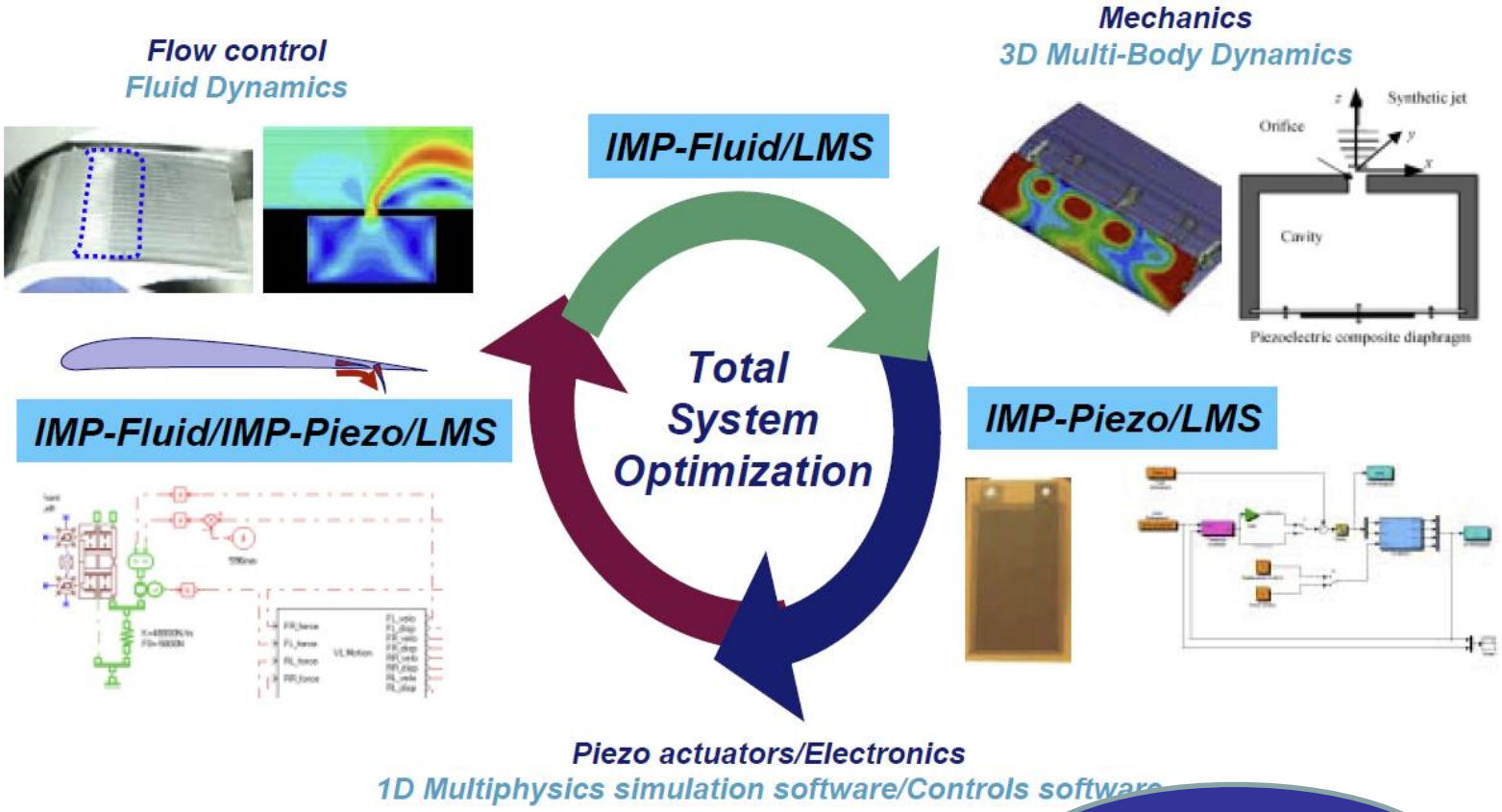
Aeronautics

www.imescon.eu

STAtic and DYnamic piezo-driven StreamWIse vortex generators for active flow COntrol

STA-DY-WI-CO

- STA-DY-WI-CO project overview (www.stadywico.eu)



Active Flow Control

Coordination

THANK YOU

AND GREETINGS FROM BALTIC SEA AND GDAŃSK