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RIGA TECHNICAL UNIVERSITY

Riga Technical University
Cooperation ideas

Professor Nadezhda Kunicina
Riga Technical University

28.04.2023.

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Riga city

- ✓ Riga, the capital of Latvia http://www.riga.lv was founded in 1201
- ✓ It has a population of around 706 400 (1/3 of Latvia population) and its area is around 307 square kilometers
- ✓ Riga has always been a city at the cross roads of the large markets of Western Europe and the East
- ✓ The historic center of Riga exemplifies all architectural styles characteristic for the Northern Europe from Gothic to Modernism including unique ensemble of Art Nouveau buildings
- ✓ In 1997 the historic center of Riga due to this valued architecture was inscribed into the UNESCO World Heritage List.
- ✓ See more at tourism information portal : http://www.liveriga.com

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Price for Energy efficient building in Riga 2014

3

Story about RTU

https://www.youtube.com/watch?v=i8gvSFuRHNs

https://cybphys.rtu.lv/

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Background

- RTU is the only polytechnic university in Latvia and the largest university in the country – it educates more than 15 thousand students.
- RTU is focused on becoming a third generation university that not only provides high quality education, but also conducts advanced research, innovation and technology transfer.
- Study programs at RTU have been persistently developed in cooperation with employers to provide tertiary education in cutting-edge technologies and engineering that meets the needs of the global labor market.
- RTU graduates easily integrate in the labor market and to develop a successful professional career.
- RTU provides opportunities to pursue a career in science to the alumni who are interested in research.

RTU conferences

- •9-11 of October: 64th International Scientific Conference on Power and Electrical Engineering of Riga Technical University, Riga, Latviahttp://www.conference.rtu.lv/
- •4-6 October IEEE Day, IEEE Workshop on Microwave Theory and Techniques in Wireless Communications MTTW 2023 http://mttw.rtu.lv/
- •5-6 October IEEE Section of Information Technology and Management Science (ITMS'2023) http://itms.rtu.lv/
- •15-16 of November FRUCT 34 https://fruct.org/conferences/

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Organized Scientific Events

International Doctoral School at the RTU
https://ieei.rtu.lv/ids-ecst/
May 26-27, 2023

- IIEEE organized annual **International doctoral school in Electrical Engineering and Power Electronics**
- The intention is to provide **an opportunity for doctoral students to learn** about scientific innovation, share the scientific experience with leading scientists, discuss their own recent achievements.

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FACULTY OF POWER AND ELECTRICAL ENGINEERING TODAY

Started at the beginning of 2013 the new building of FPEE was completed in less than a year

A separate laboratory building was built in 2015 where various laboratory equipment is still being installed currently

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THE STRUCTURE OF THE FACULTY

Today incorporates three institutes:

- Institute of Power Engineering
- Institute of Industrial Electronics and Electrical Engineering
- Institute of Energy Systems and Environment

Each institute implements a dedicated study program – starting from bachelor's and up to the doctoral level

INSTITUTE OF INDUSTRIAL ELECTRONICS AND ELECTRICAL ENGINEERING - IEEI

Structure:

- Department of Industrial Electronics and Electrical Technologies
- Department of Electrophysics
- Departament of Electrical Machines

Research directions include:

- Power Electronics for Renewables, Energy Storage Systems, Reactive Power Compensation and Active Filtering
- Electrical Drives and Motion Control
- Industrial Automation and Robotics
- LED Lighting Systems
- Decision Support Systems in Railway Automation

Study program:

- Computer Control of Electrical Technologies
- Adaptronics

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OUR EXPERIENCE IN ERASMUS PLUS PROJECTS SINCE 2012:

Coordinated projects:

- Development of practically-oriented student-centred education in the field of modelling of Cyber Physical Systems - CybPhys https://cybphys.rtu.lv/
- “Improvement of master-level education in the field of physical sciences in Belorussian universities”, - “Physics” https://physics.rtu.lv/
- Establishing Smart Energy System Curriculum at Russian and Vietnamese Universities https://essence-erasmus.org/
- “Development of Training Network for Improving Education in Energy Efficiency” https://energy.rtu.lv/

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OUR EXPERIENCE IN ERASMUS PLUS PROJECTS SINCE 2012:

Projects in partnership:

- Knowledge Triangle for a Low Carbon Economy – KALCEA kalcea.com
- Development of master curricula for Electrical Energy Markets and Engineering Education - ELEMEND https://elemend.ba/
- Innovative Approach Towards a Master Program on Smart Cities Technologies -SMARTCITY https://smart-city.center/
- Applied curricula in space exploration and intelligent robotic systems – APPLE https://robolabor.ee/apple/

Our core competences: ***electrical engineering, cybersecurity engineering, innovation management, and project quality assurance*** https://international.rtu.lv/masters-studies/

- **Cybersecurity Engineering**
- Faculty of Computer Science and Information Technology

https://international.rtu.lv/masters-studies/cybersecurity-engineering/

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SCIENTIFIC JOURNALS

RIGA TECHNICAL UNIVERSITY

The results of RTU academic and scientific staff research are published in the editions «Scientific Journal of RTU» in the following fields:

- Architecture
- Civil Engineering
- Computer Science
- Power and Electrical Engineering
- Engineering Economics and Management
- Material Science and Applied Chemistry
- Humanities and Social Sciences
- Electronics and Telecommunications
- Transport and Mechanical Engineering

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SCIENTIFIC JOURNALS

Electrical, Control and Communication Engineering
The Journal of Riga Technical University
https://content.sciendo.com/view/journals/ecce/ecce-overview.xml?tab_body=editorial

LATVIAN JOURNAL of PHYSICS and TECHNICAL SCIENCES

http://fei-web.lv/en/journals

Special issue
[Sustainability] Special Issue "Advances in Education for Sustainable Computing, Communications and Applied Engineering"
Sustainability receives its 9th Impact Factor, 3.889 (2021)
Deadline for manuscript submissions: **31 January 2024**
https://www.mdpi.com/journal/sustainability/special_issues/A552B3XK6D

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Potential cooperation in development of projects

CALL 1: Fundamentals of Software Engineering (RIA)
https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/opportunities/topic-details/horizon-cl4-2024-digital-emerging-01-22
Budget: 4-6 mill EUR - Indicative number of grants: 4 - Start at TRL 2 - Deadline: 19 March 2024
has a low TRL, I still haven't found anyone who has done something similar, but because of the low TRL there is a possibility that we can prepare a project proposal.

CALL 2: Open Source for Cloud/Edge to support European Digital Autonomy (RIA)
https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/opportunities/topic-details/horizon-cl4-2024-digital-emerging-01-21
Budget: 4-6 mill EUR - Indicative number of grants: 4 - Start at TRL 4 - Deadline: 19 March 2024
has TRL 4, but I have 2 partners who worked on previous projects, and I could talk to them to be part of the consortium. We still have the problem of finding industrial partners.

eINFRA

CALL 3: Research infrastructure concept development
https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/opportunities/topic-details/horizon-infra-2024-dev-01-01
Budget: 1-3 mill EUR - Indicative number of grants: 5 - Deadline: 12 March 2024
is a much smaller project, however there are already key players here who often realize projects, but there is a chance for some project proposal.

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Potential cooperation in development of projects

One of draft example is attached for project calls WIDERA

11. Widening participation and strengthening the European Research Area

HORIZON-WIDERA-2023-ACCESS-02-01 CSA

Widening countries Bulgaria, Croatia, Cyprus, Czechia, Estonia, Greece, Hungary, Latvia, Lithuania, Malta, Poland, Portugal, Romania, Slovakia, Slovenia and

all **Associated Countries** with equivalent characteristics in terms of R&I performance (Albania, Armenia, Bosnia & Herzegovina, Faroe Islands, Georgia, Kosovo4, Moldova, Montenegro, North Macedonia, Serbia, Tunisia, Turkey, Ukraine, and once associated Morocco), as well as the Outermost Regions

Another project application will be Regarding the call: HORIZON-CL4-2024-DIGITAL-EMERGING-01-21

Development of AGRO projects: AgroSPARC more details here https://doi.org/10.3390/telecom3010004 [2]),

INTERREG I am also adding Hrvoje from our research group LARES (https://www.lares.fer.hr [3]). We had several attempts and possible partners (across EU) from those previous ones. Also, another one that is coming with deadline of 6/2023, perhaps worth to investigate, is https://www.interregeurope.eu [4].

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Potential cooperation in development of projects

From Strasser Thomas Thomas.Strasser@ait.ac.at SINERGY (see https://project-sinergy.org/). AIT Electric Energy Systems unitt.

ERIGrid 2.0 Research Infrastructure project which I am> currently coordinating. Under https://erigrid2.eu/lab-access/ you can find information on how to access the ERIGrid 2.0 labs; especially under https://erigrid2.eu/ait, you can find the offers from AIT side (i.e., access to the SmartEST infrastructure).

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Laboratories of EVIF faculty

- **Latvenergo student’s laboratory**

The Faculty of Electrical Engineering and Environmental Engineering has a student creative workshop set up with the financial support of Latvenergo AS, the aim of which is to develop students' practical skills in electronics and electrical engineering.

- **Laboratory of Semiconductor Converters for Solar and Wind Energy Systems**.

The laboratory carries out research in renewable energy resources in order to integrate them into traditional power supply systems.

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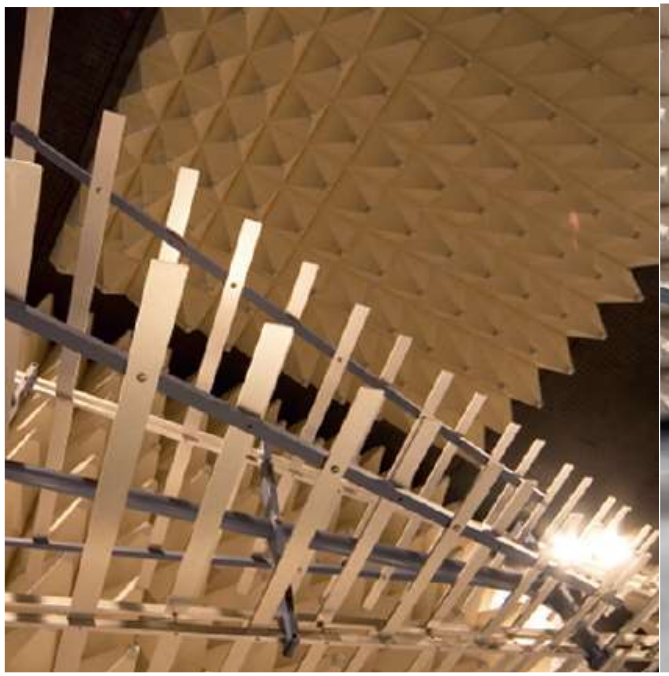
Laboratories

- **Accredited EMC testing laboratory “LEITC”**

RTU EMC testing laboratory “LEITC” is located in RTU facilities, created and sustained together with Latvian Electrical Engineering and Electronics Industry Association – LETERA.

EMC laboratory provides technical base for experiments and research in electromagnetic compatibility and electrical safety.



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Laboratories

- **Science Laboratory of Electromechatronics**

The Laboratory’s current focus lies on the research of human-robot interaction with physical motion simulator based on KUKA KR 600 R2830 with passenger, BEC gondola shell including projection system and software licenses for BEC simulator-software.

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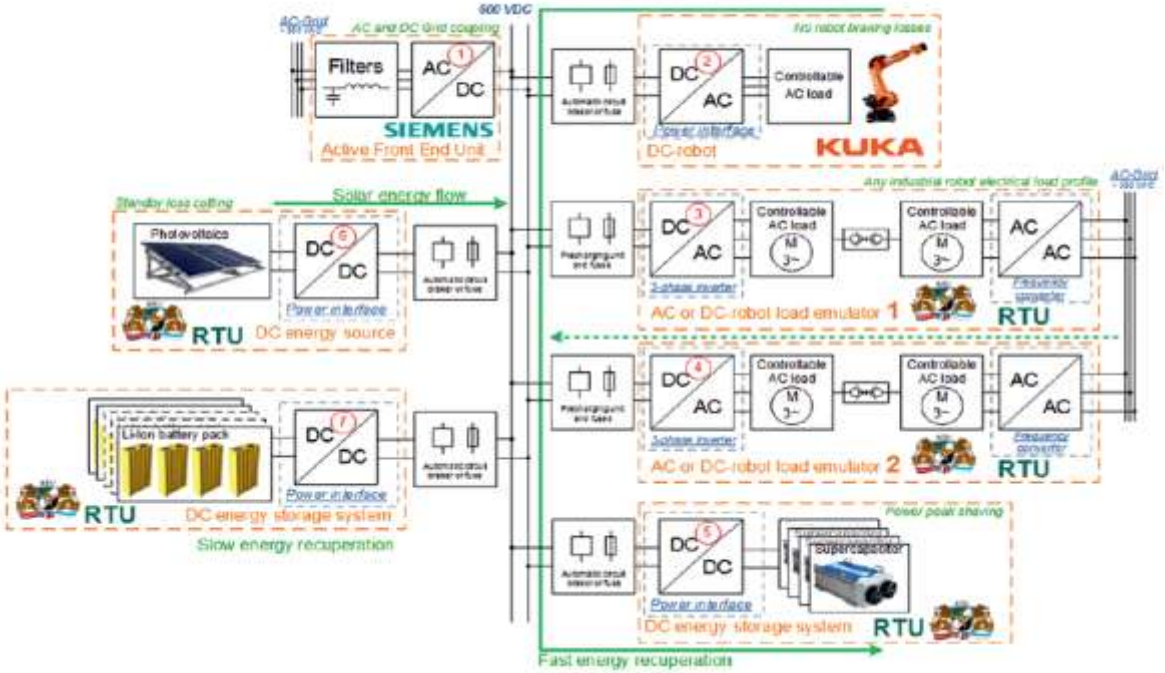
Laboratories

- **Laboratory of Industrial Robots and DC Micro-Grid Research**

DC Micro-Grid LAB was especially developed for H2020 project AREUS demonstration purposes, and is able to demonstrate novel AREUS approach of industrial DC power supply system where energy is exchanged, harvested, stored and recovered at factory level.

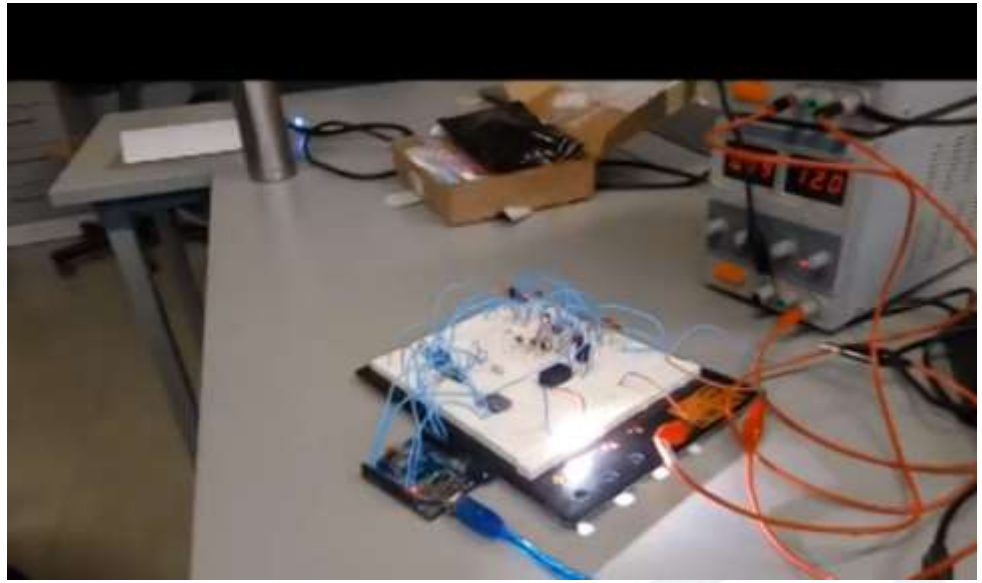


AREUS

Automation and Robotics for EUropean Sustainable manufacturing

PBL at the course of Elements of automations

Mixed group of Erasmus exchange and international master students in RTU student's development laboratory



A prototype of VeloLight solution

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The practical development of Smart pill box

’Smart pills” prototype creation process

Demonstration of product prototype

Smart pill box development project was a challenge for students.

The initially thought of using a micro solenoid for the control of gates, but we had to deal with a huge setback considering the solenoid was a failed idea.

Then decided to control the gates with a more convenient way by using a micro DC motor.

During the course of the development the students found out that it is hard to implement app based control of the smart pill box, however they managed to do it with Bluetooth connectivity.

In this course, the involvement of students in the idea development process through individual contribution and group training was successfully tested

The industry – academia collaboration

- In order to promote the development of students innovation and entrepreneurial abilities the Cabinet of Ministers introduced a new model of student grant system.
- The grants to be issued to support industry - academia projects, which involve students
- Latvian Rural Development Program 2014-2020 Support for new products, methods, processes and technologies project application", the project "Autonomous beekeeping", years 2018-2021.
- Latvian Rural Development Program 2014-2020 "Support for the EIB for the implementation of the project of agricultural productivity and sustainability task forces", the project "Low-dose bone marrow monitoring and early diagnosis of subacute ciliary acacia (SARA) in cows" – years 2018-2022.

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The industry – academia collaboration

RTU has an expertise as a project coordinator in Higher Education and Capacity Building projects. “Development of Training Network for Improving Education in Energy Efficiency”

The cooperation through international projects, dealing with development of the quality assurance system for development of study programs, and deployment of new generation of study approaches in the innovative topics is an ongoing activity of IEEI. Truly complex, engineered systems, known as CPS are emerging that integrate physical, software, and network aspects.

EU COST Action number IC1404 Multi-Paradigm Modelling for Cyber-Physical Systems (MPM4CPS)

ERASMUS+ Capacity-building in the Field of Higher Education 2015, PHYSICS

Energy Markets and Engineering Education - ELEMEND

“Establishing smart energy system curriculum at Russian and Vietnamese universities - ESSENCE”

Innovative Approach Towards a Master Program on Smart Cities Technologies - SMARTCITY, the Erasmus plus KA 2 project

Competences and experience of Faculty of Electrical and Environmental Engineering

Competences and experience

Faculty of Electronics and Telecommunications (FET) incorporates:

- ✓ Institute of Radio Electronics
- ✓ Institute of Telecommunications
- ✓ Chair of Transport Electronics and Telematics
- ✓ Electromagnetic Compatibility and Electric Security Research Centre

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Experience in research

The main national projects:

- ✓ Latvian climate change financial instrument “Designing of LED based lamp for an illumination of the streets lightening using intelligent control system”
- ✓ Latvian climate change financial instrument “Intelligent wind”
- ✓ Power electronics technologies to reduce energy consumption and to promote the use of renewable energy sources in Latvia
- ✓ Wind and hydrogen power supply an autonomous system
- ✓ Intelligent hybrid uninterruptible power systems and components design and research to improve energy efficiency
- ✓ A modular slow speed electric generator design of wind turbines




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IoT Product Segments

Conveyor (Tier2) Components and Parts (Tier3)

- Drive Heads
- LTU & Winches
- Belt Structure
- Belting
- Pulleys
- Feeder Breakers
- Components (a.u. idlers, motors, etc.)

Suppliers of these Products are:

- Potential partners, and;
- Future Service Providers

One customer, KGHM, one component

- **120 km conveyers**
- **720.000 idler bearings**

ARROWHEAD

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Automation requirements

- Interoperability between devices and systems
- Scalability
- Real time performance
- Security
- Engineering simplicity
- Evolvable System of Systems

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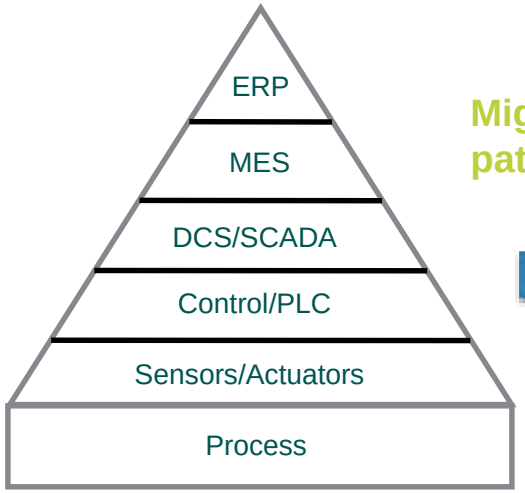
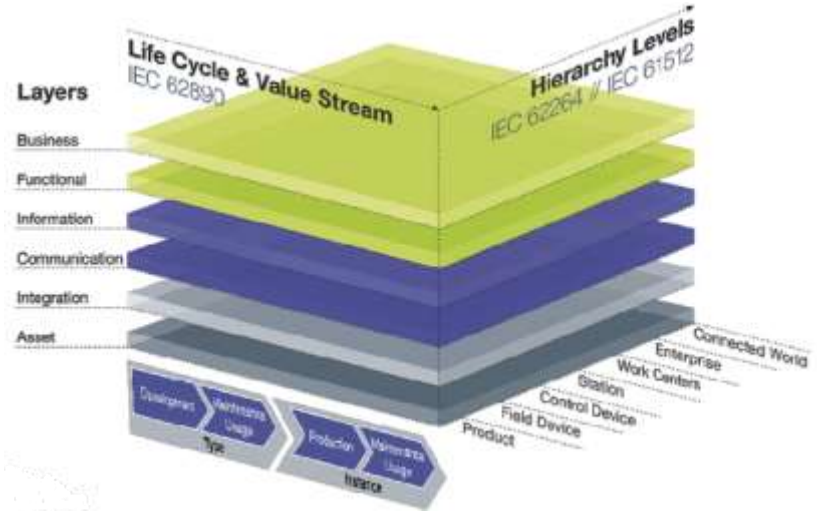
ISA95

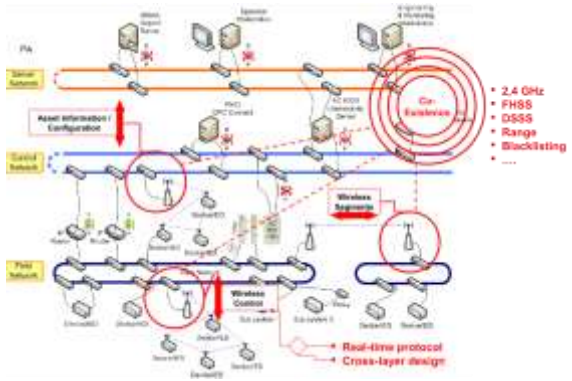


Migration path

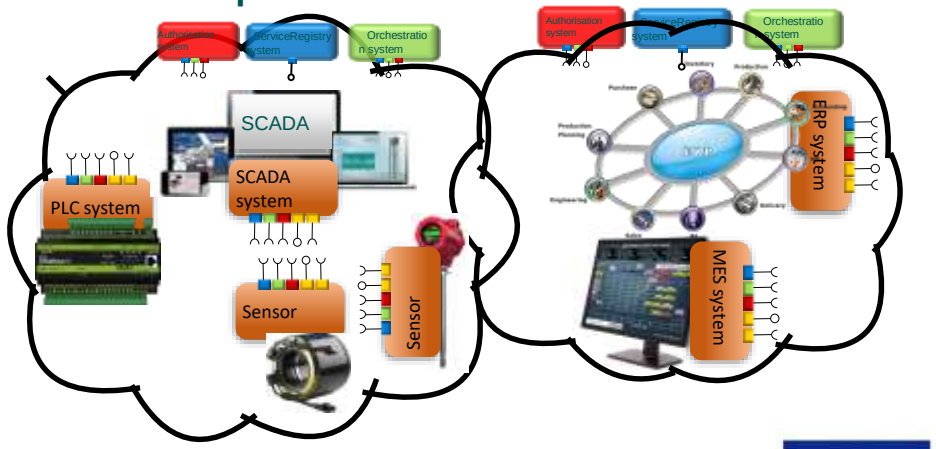
RAMI4.0



Hierarchical system implementation



Local automation cloud implementation



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Arrowhead

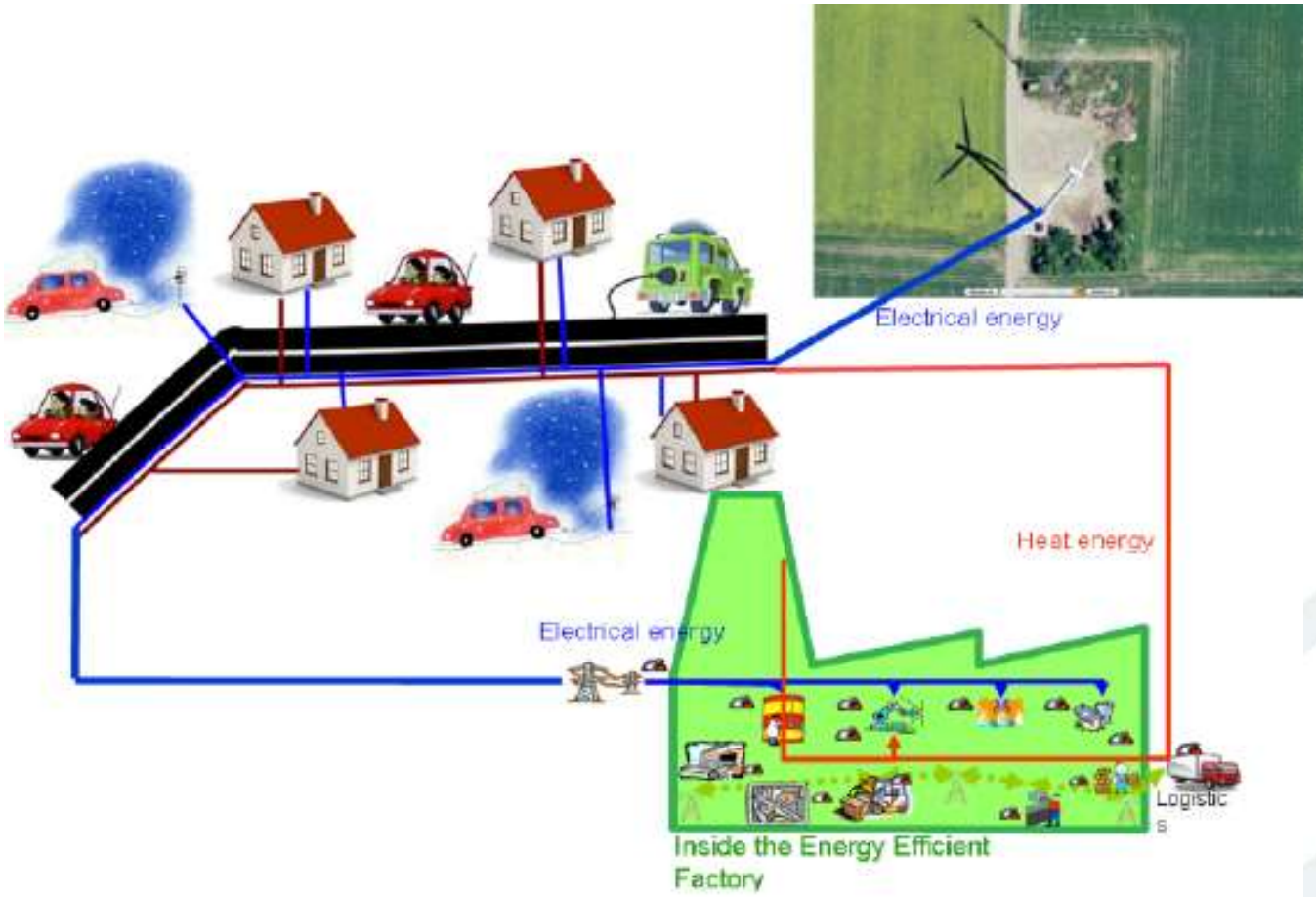

Figure 1.1: Arrowhead will improve production efficiency and energy efficiency and flexibility through collaborative automation innovations.

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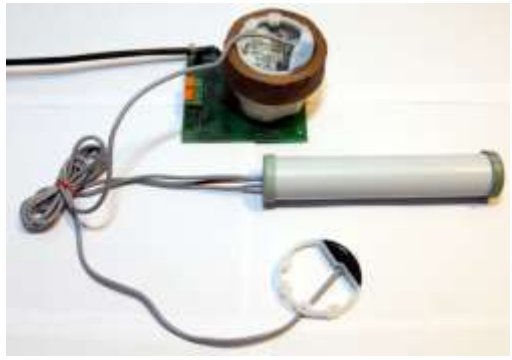
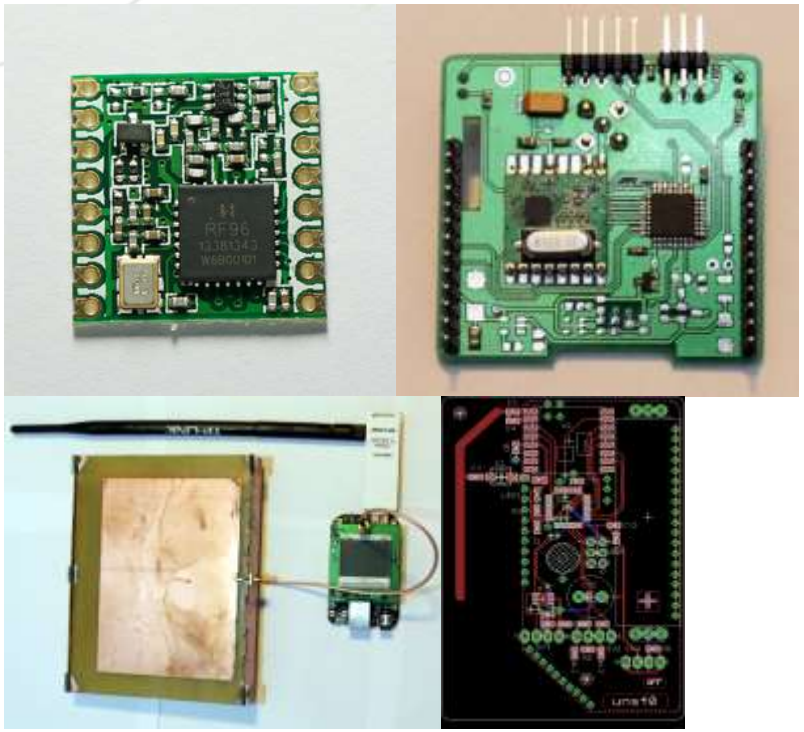
Sensor (metering) node development



- Temperature: actual, cumulative
- Pressure
- Humidity
- Electricity meter readout (impulse)
- Electricity meter readout using IEC62025 (work in progress)
- Water flow readout (impulse)
- CO2 metering (almost finished)
- Lithium Thionyl Chloride battery – estimated life times of at least 5 years
- Various combination of metering interfaces

Heating energy – 1 impulse, 2 digital temperature

RF module and antenna designs

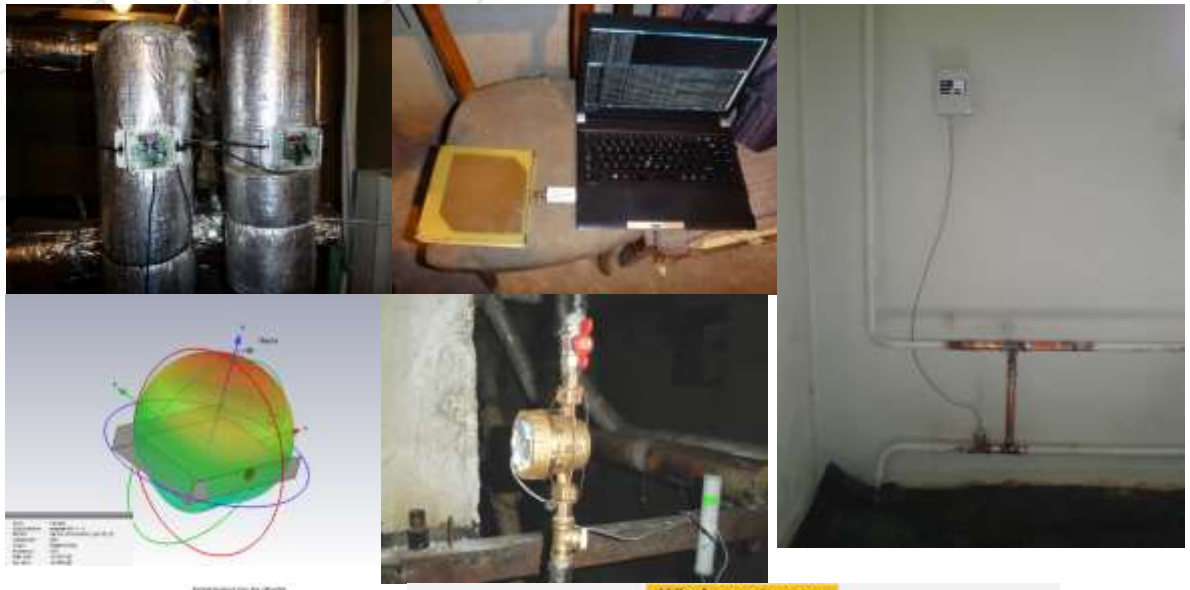


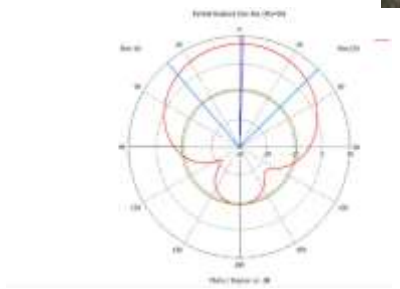
- ISM band 868Mhz HopeRF transmitters
  - Modulation: GFSK, manchester
  - Optional encryption (RFM69)
  - LoRa option (RFM92W, RFM95W) being tested (long range ~5km
  - Support for high performance (G)FSK modes for systems including WMBus, IEEE802.15.4g
- Antennas
  - Manual resonance frequency correction
  - Automatic resonance frequency correction (wip)

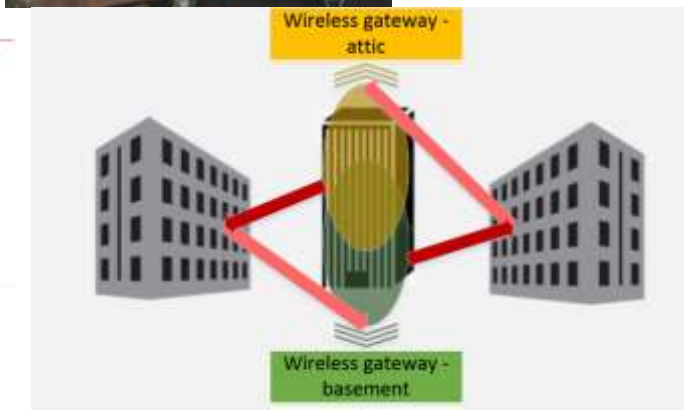
Applications – test deployments 1

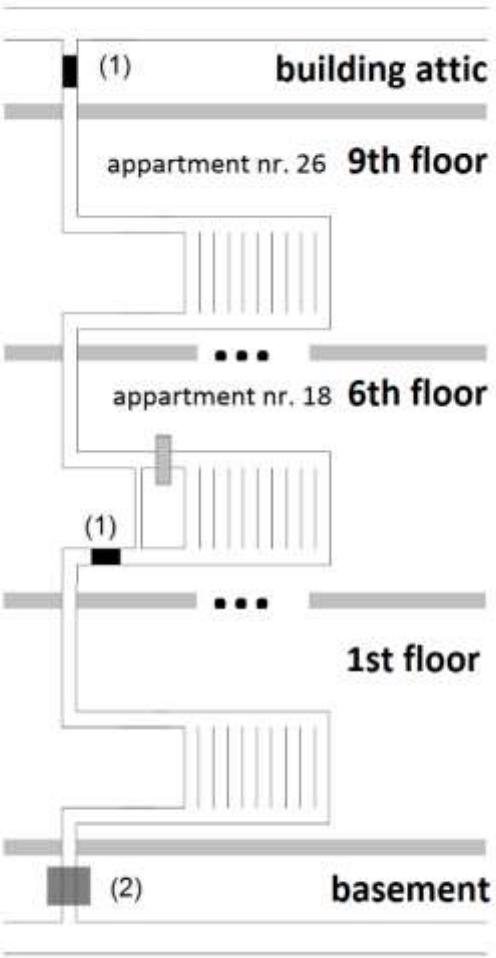
- Water supply network monitoring
  - Leak detection
  - Water consumption accounting
- Elderly people environment monitoring and event triggering for care services
- Heating system monitoring and high rise apartment building individual energy accounting, energy efficiency analysis

Applications – test deployments 2



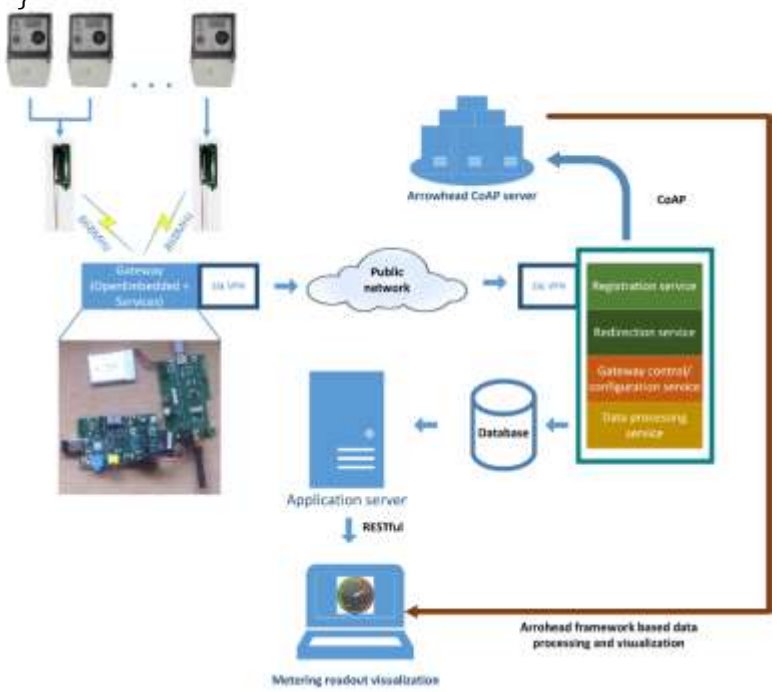






Data tranmission and processing


```
{"e":[
      { "n": "1.8.1*0", "t": 0, "u": "kWh", "v": 0 },
      { "n": "1.8.2*0", "t": 0, "u": "kWh", "v": 1.2622 }],
      { "n": "1.8.3*0", "t": 0, "u": "kWh", "v": 0 }],
      { "n": "1.8.4*0", "t": 0, "u": "kWh", "v": 0.0512 }],
      { "n": "1.8.0*0", "t": 0, "u": "kWh", "v": 1.3134 }],
      { "n": "3.8.0*0", "t": 0, "u": "kWh", "v": 0.3134 }],
      { "n": "4.8.0*0", "t": 0, "u": "kWh", "v": 0.1351 }],
   "bn": "urn:dev:egm5epqs:00a0b10000001a1a/",
   "bt": 1392126364,
   "ver": 1,
   "bu": "kWh"
  }
```

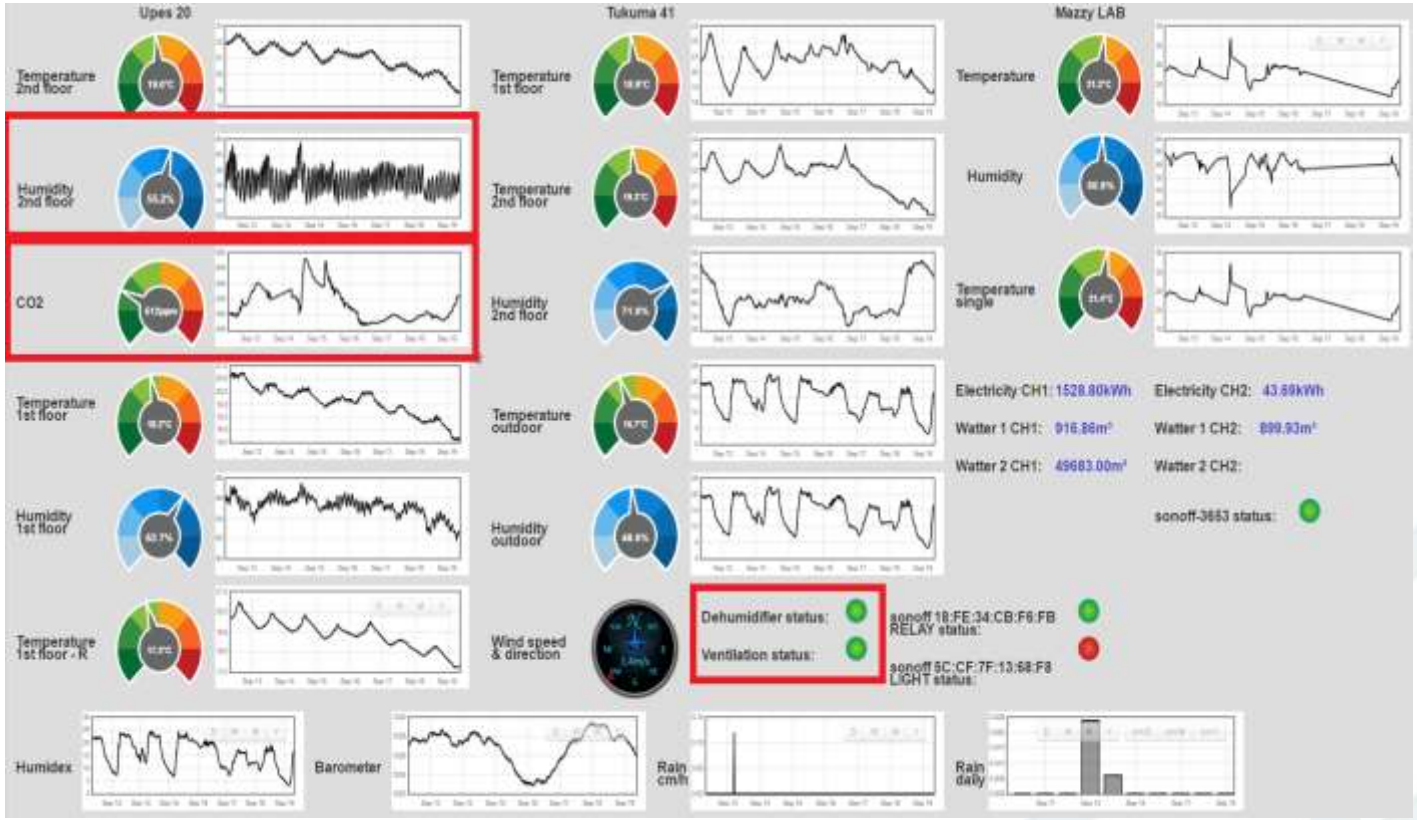



- Sensor data transmitter to gateway
  - Queue management if network connection lost
  - Queue verification of delivery via selective queue clearing
  - Automatic data dumping to database in offline mode or in walk-by-mode
- Repeater nodes – channel switching or sinking principle
- Radio channel optionally secured
- Gateway backend server communication using HTTP optional SSL VPN for gateway/site grouping
- Gateways control and online decoding scheme transfer
  - **Heartbeats**
  - **Registration requests**
  - **Post requests**
  - **Decode reply**
  - **Redirection service**

Gateway modes and operation

- Based on custom OpenEmbedded build
- Custom service and self monitoring capability
- Option to use LiPo UPS system with monitoring options – power outage handling
- Gateways have video output for onsite diagnostics – receiving, post, system status, networking
- USB RF dongle for mobile diagnostic terminal usage and active monitoring

An example of service humidity control



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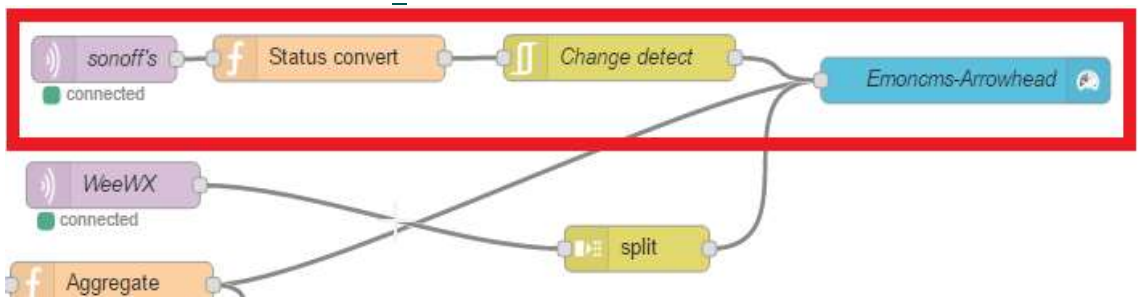
An example of service humidity



- The application logic receives periodic MQTT messages that after decoding are injected into EmonCMS inputs
- Status convert node – extracts the MAC address and builds a new MQTT message with a corrected structure by stripping colon symbols that might interfere with automatic processing systems
- Change detect node – blocks repeated MQTT messages an allows the flow only if the last message topic and payload differ from the previous.

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Sensors and gateway developed by RTU

The implemented system consists of a set of custom designed Smart Metering units providing different types of telemetry data and control applications:

- Pressure measurements – water supply systems
- Water flow – water flow for domestic meters
- Electricity meters – impulse interface for common electricity meters
- Temperature meters
- Humidity meters
- CO2 meters
- Strain meters – usable for deformation registration and scale applications

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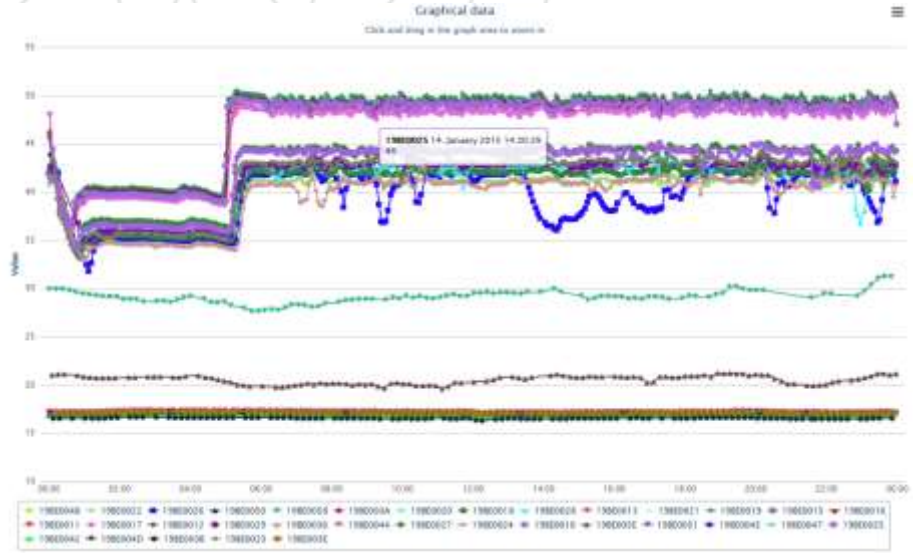
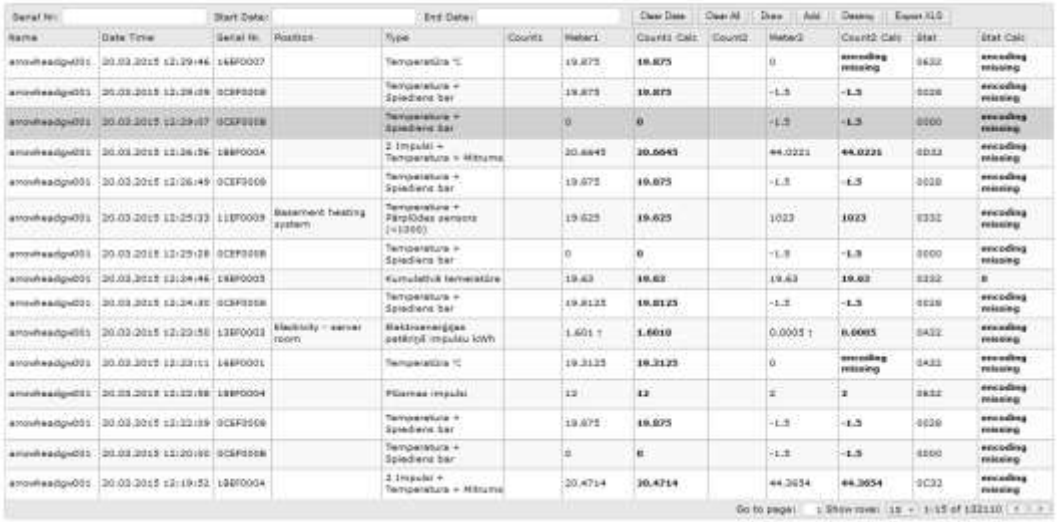
Demo frontend





- Data decoding library
- Gateway control interface
- Gateway factory **registration**/ **delegation** service control
- Simple decoding and graphing
- API for Arrowhead integration

Partners & associations

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Partners

KAUNO TECHNOLOGIJOS
UNIVERSITETAS

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Facts about IIEEE

- IIEEE founded in year **1987**.
- From 2006 IIEEEI is registered as scientific institution
- Academical & Scientifical personnel - **41**

45

Key Research Fields & Competence Areas

- Industrial Robotics
- Power electronics and electrical drives
- Hydrogen, PV and wind energy systems
- DC and AC traction systems
- Advanced LED lighting systems
- Industrial automation and robotics
- Computer Control and Communications for Power electronics
- Electronics and Electrical technologies

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Laboratories of IIEEE

- Fuel cell system laboratory
- Industrial automation and mechatronics laboratory
- Power electronics laboratory
- EMC testing laboratory
- Electric drives laboratory
- Lighting technology laboratory
- Intelligent control system laboratory
- Non-destructive testing (NDT) laboratory

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Grid emulator

- **Emulator (Egston Compiso) power upto 200kW.**
- 10 outputs / open, controllable, compatible with computer models.
- Integrated measurement

Co-funded by the
Erasmus+ Programme
of the European Union

Motion emulator (KUKA + BEC gondola)

Co-funded by the
Erasmus+ Programme
of the European Union

LITES Project in Riga

LITES project solution delivers an intelligent public street lighting service using solid-state lights (LED), sensors and ZigBee communication reducing energy consumption up to 70 %.

It was the first project that tested this approach in real public lighting systems (Riga, Bordeaux and Aveiro).

LITES project has started on **2009** till **2014**

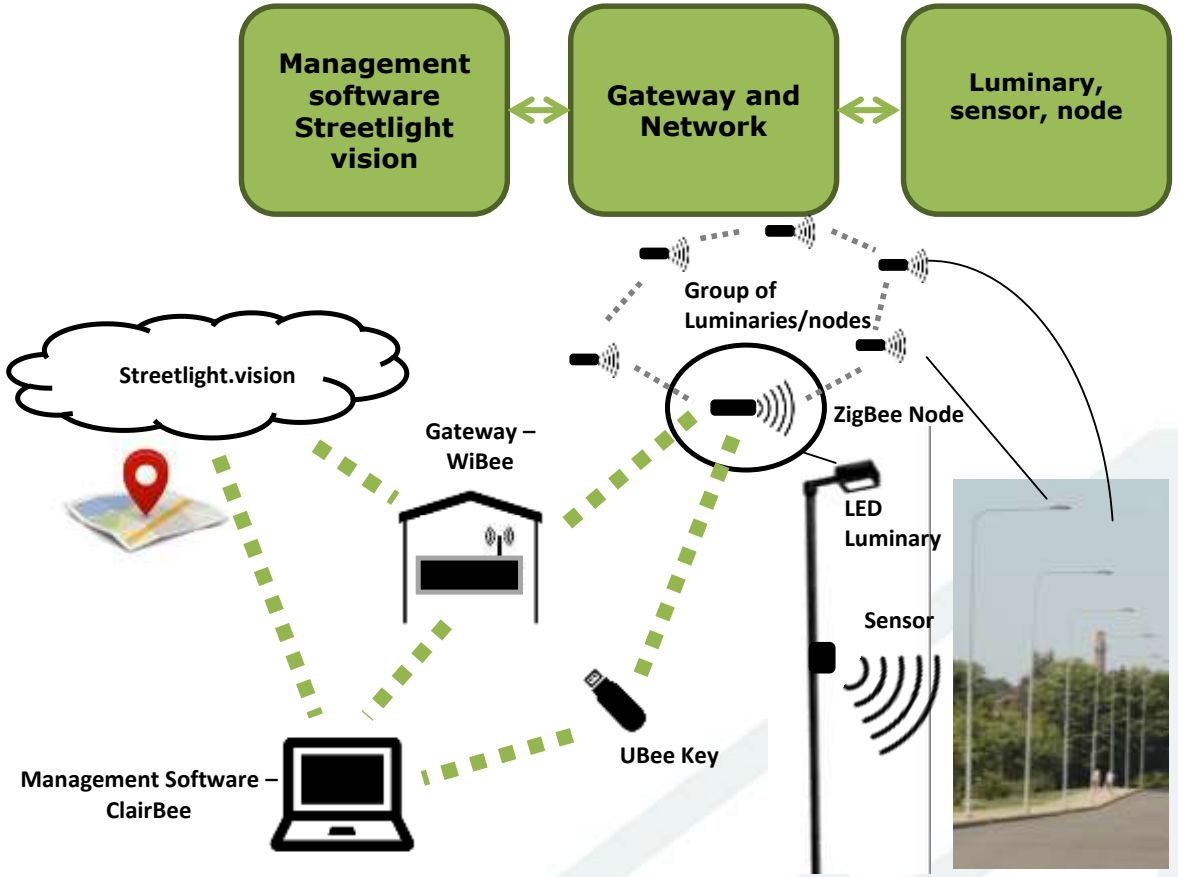
Total budget of demonstration project was EUR 2 559 754

Riga Technical

Co-funded by the Erasmus+ Programme of the European Union

LITES Technology

- The LITES technology consists of three main blocks:
  - Luminary, sensor and communication node
  - Gateway and Network infrastructure
  - Local management tool and online management tool Streetlight vision



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Riga Pilot Site

THORN Dyana with dimming capacities

Type of luminaires & lamps	Malaga HPS 100W HPS 150W
Total installed power (W)	3 450

Old system

LITES system:

54% less installed power

Type of luminaires & lamps	Dyana LED 56W LED 95W
Total installed power (W)	1 864

LITES system

Luminary power	Installed luminaries	Total installed power
Additional 65 W	3 pcs	195 W
Additional 95 W	1 pcs	95 W
	In total:	**2215 W**

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Riga Pilot Site

Co-funded by the
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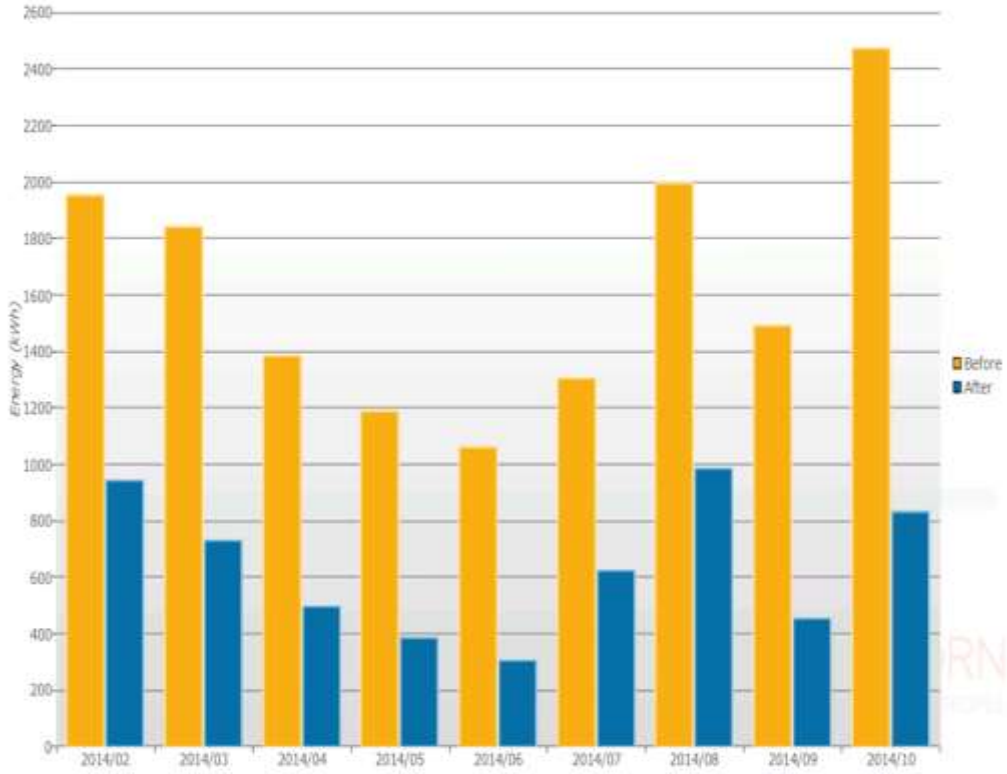
of the European Union

Monthly energy savings



- LITES system consumption for the recording period is 2,427 MWh against a project consumption of 9,210 MWh for the old HPS system.
- The energy saving is 6,78 MWh or 73,6%.
- The average annual per pole saving is then equal to 296 kWh
- Annual CO_2 savings per LITES pole are equal to 34 kg/pole (1,5 tn of CO_2 for the full LITES pilot site).

Co-funded by the Erasmus+ Programme of the European Union

AREUS
Automation and Robotics for EUropean Sustainable manufacturing

SEVENTH FRAMEWORK PROGRAMME

This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 609391.

AREUS – INNOVATIVE HARDWARE AND SOFTWARE FOR SUSTAINABLE INDUSTRIAL ROBOTICS

UNIMORE
UNIVERSITÀ DEGLI STUDI DI MODENA E REGGIO EMILIA

CHALMERS UNIVERSITY OF TECHNOLOGY

Danfoss

KUKA

DAIMLER

DELFOI
IT WILL BE

RTU

DTU Technical University of Denmark

SIEMENS

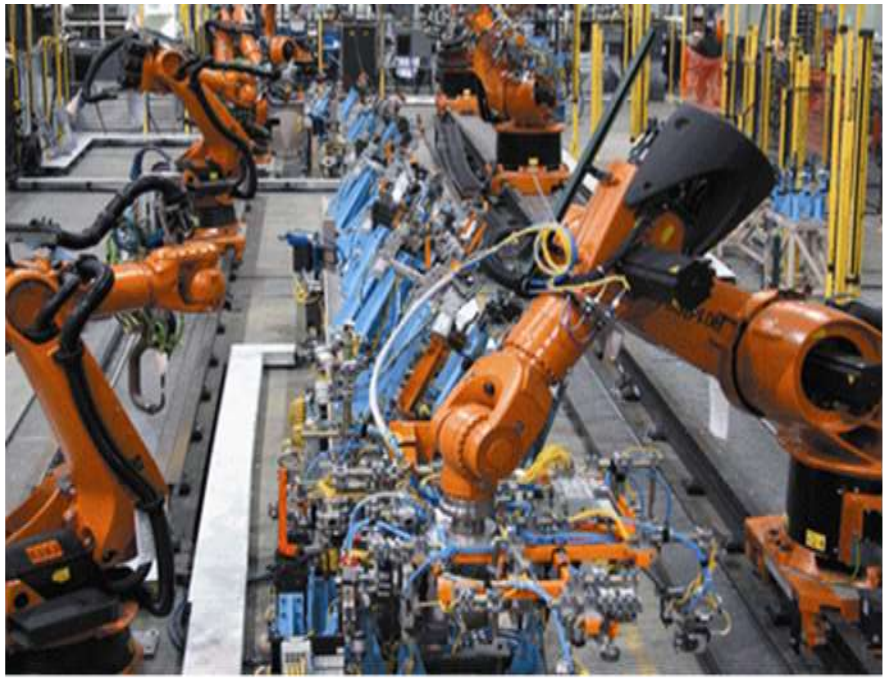
EngRoTec

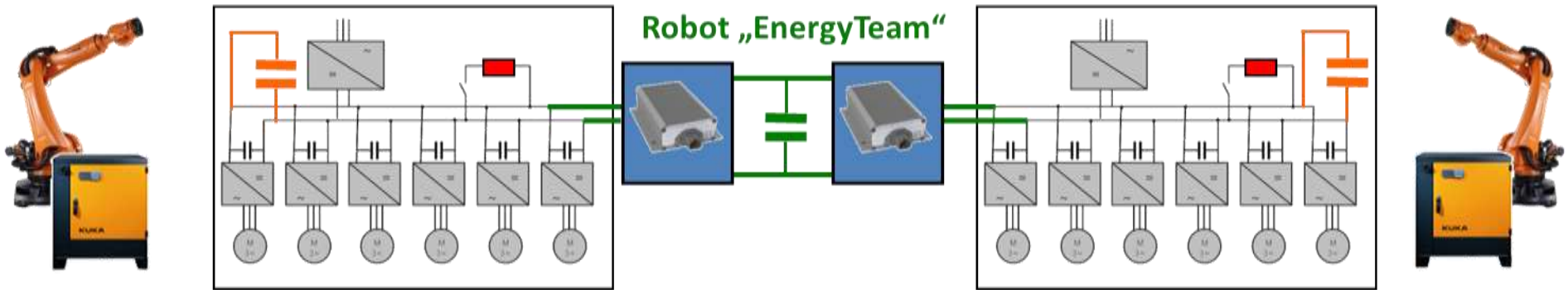
SIR
SOLUZIONI INDUSTRIALI ROBOTIZZATE

www.areus-project.eu

R-ECO:
Energy Consumption Reduction technologies (WP1)

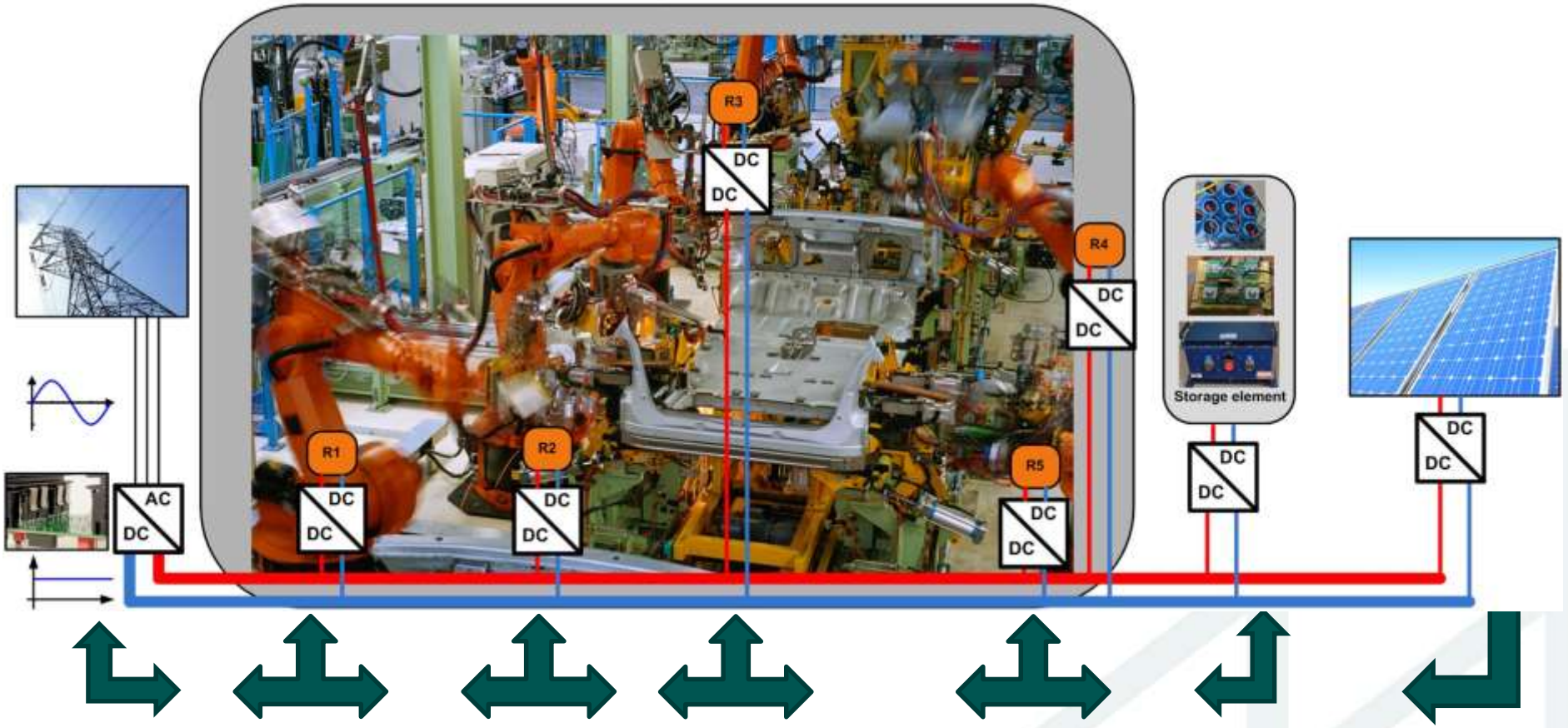
Singe robots **DC bus regenerative approaches** leveraged at Factory level:





Industrial DC smart grid (WP1)

DC-Smart Grid @ Factory level



Bidirectional, recuperative, higher quality Energy Flow with seamless integration of renewable sources

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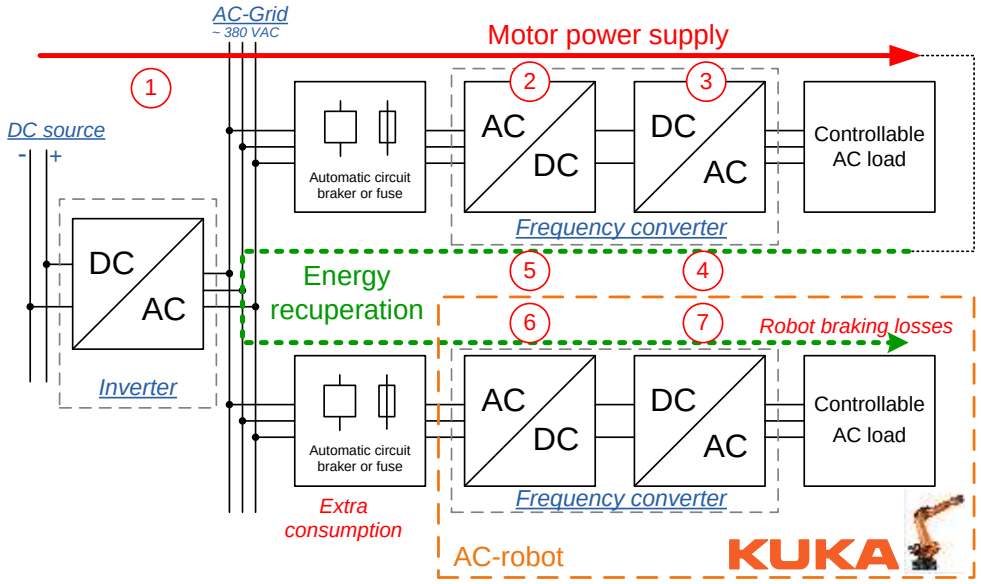
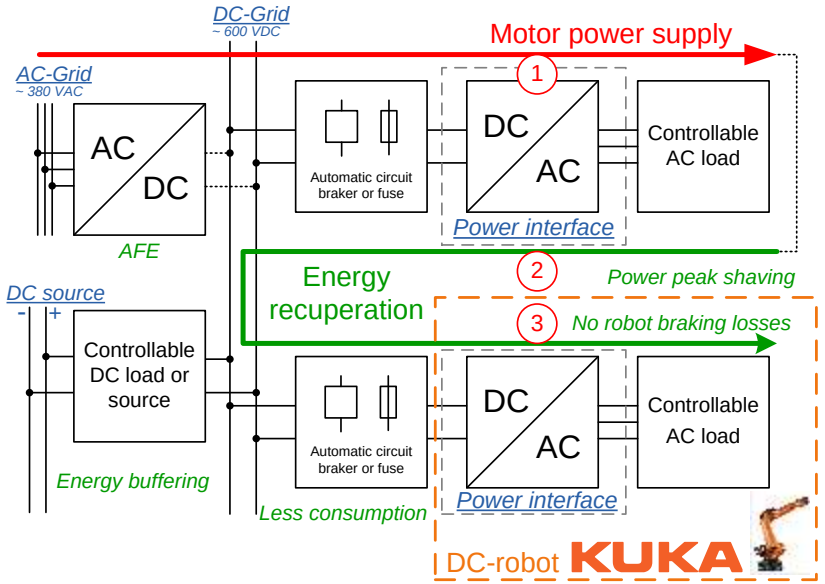
AREUS DC-Grid approach



State of the art system (1-7 represent conversion stages)



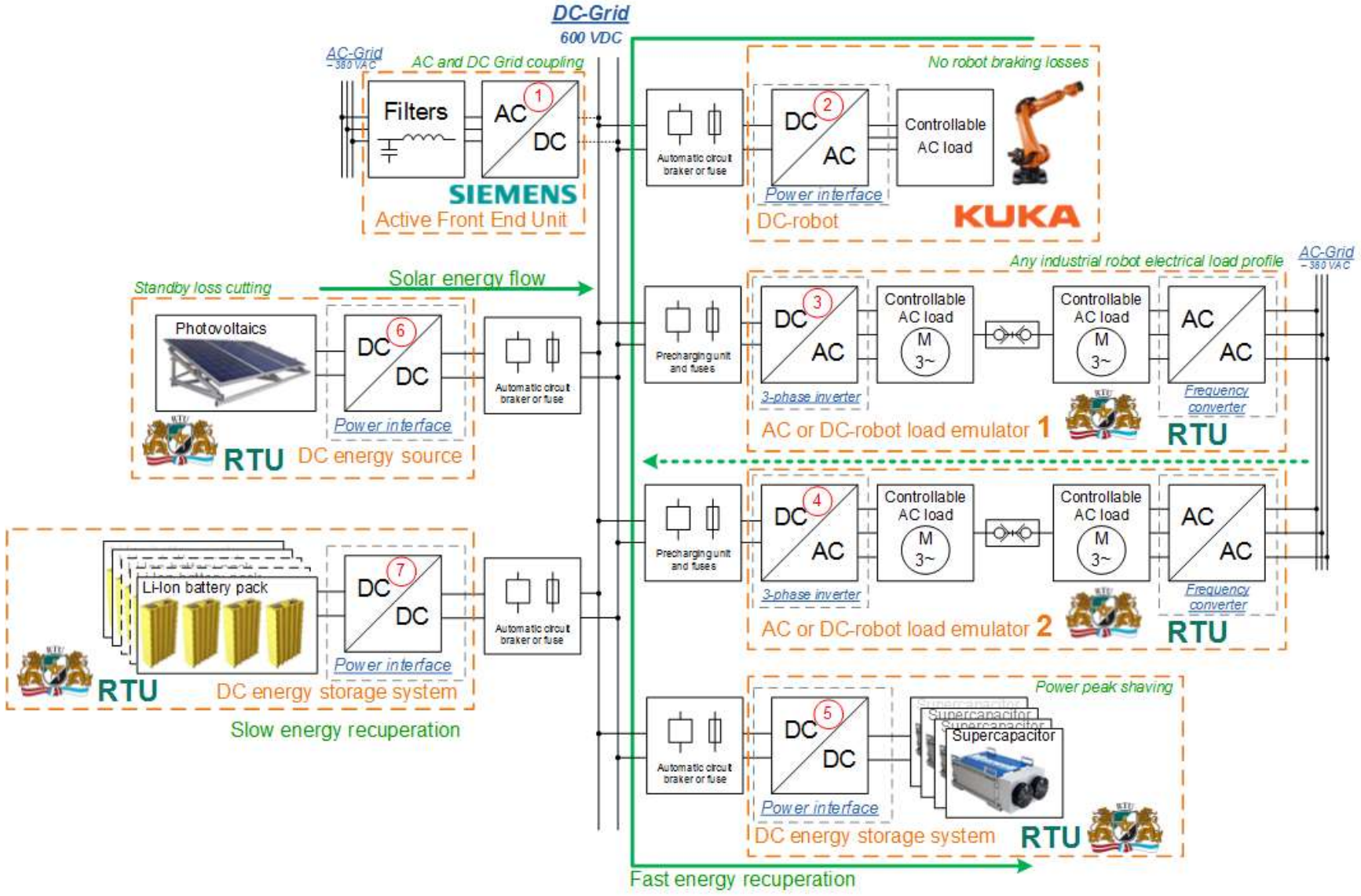
DC-based power system (1-3 represent conversion stages)

DAIMLER AG:
Electrical energy consumption is **44%** of total energy.

Only **5%** savings would be **44 mio EUR** - annually

AREUS Experimental Validation (WP5) at RTU

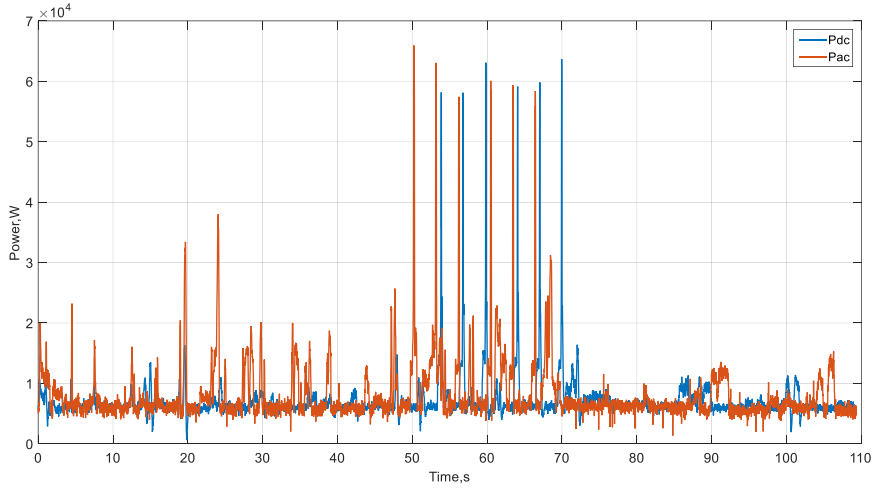
Industrial DC-Grid at RTU Demo Lab – for SME application



Factory level AC vs DC tests

RTU developed DEPUIS system for measurements

13 simulataneous real-time measurements



average AC power 8,089 kW,
average **DC** power 7,070kW,

12,6% less energy consumption at Cell level

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uMOL project

NACIONĀLAIS ATTĪSTĪBAS PLĀNS 2020

EIROPAS SAVIENĪBA
Eiropas Reģionālās attīstības fonds

IEGULDĪJUMS TAVĀ NĀKOTNĒ

European Regional Development Fund project "New control methods for energy and ecological efficiency increase of greenhouse plant lighting systems (uMOL)"

Grant Agreement No: 1.1.1.1/16/A/261

Partners LLU, SIA «Eltex» and SIA «Latgales dārzeņu loģistika»

3 luminary types

LED COB type
«HELLE TOP LED» - 280W,
470 µmol/s

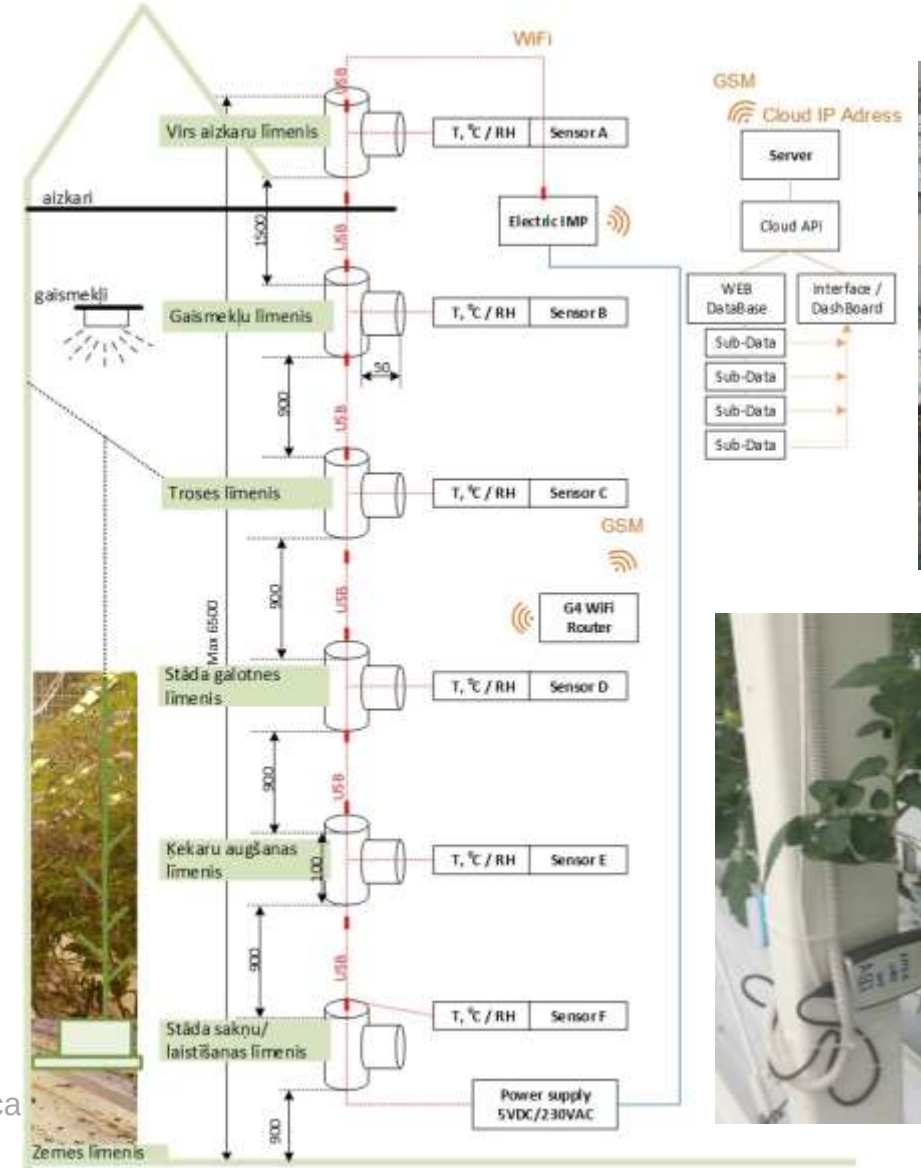
HPS type «Helle Magna»
400W

induction type
«BLSR-400 SPA
PskovAgroinnovation» 420@,
533 µmol/s

LED linear type lumianry
“Philips GreenPower LED
toplighting module” – 190W
520 µmol/s

uMOL technology

IoT sensors with WiFi communication



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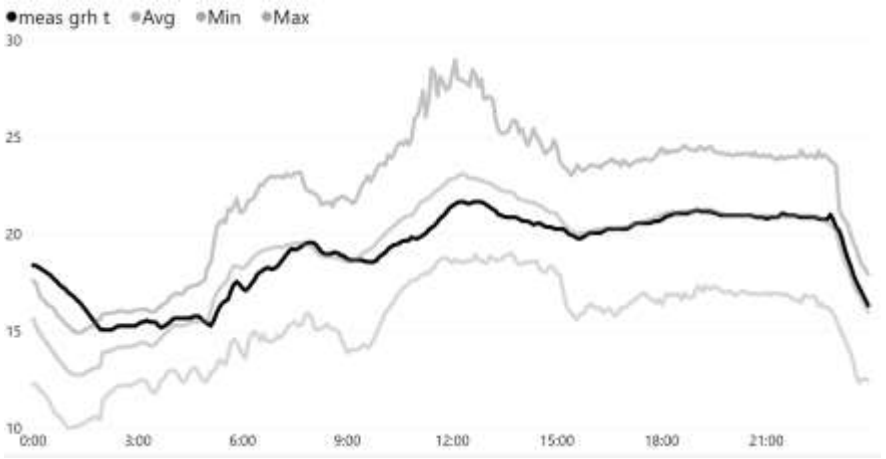
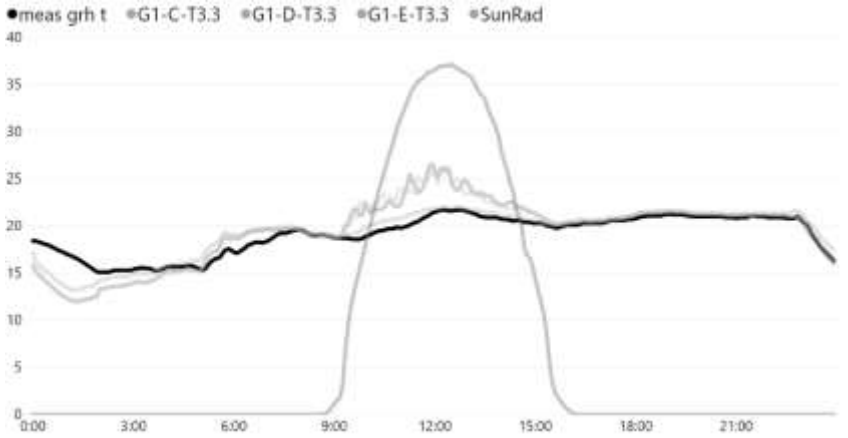
Obtained data



uMOL system and greenhouse system temperature data comparison using all levels



uMOL system G pole C,D,E sensor level, greenhouse temperatures (M=1:1) and sun radiation readings (M=1:20)

NACIONĀLAIS ATTĪSTĪBAS PLĀNS 2020
EIROPAS SAVIENĪBA
Eiropas Reģionālās attīstības fonds
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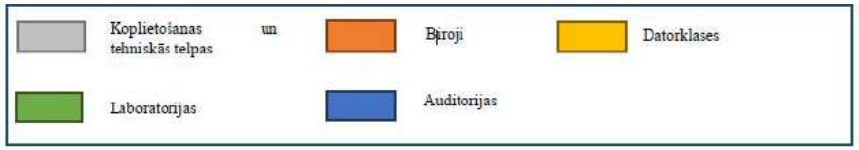
LoRa IoT sensor system

SIA Lattelecom research project No. 1.13. **“Development of data collection, analysis and aggregation model for industrial object and their energy system control"**.

"Competence Centre of Information and Communication Technologies" of EU Structural funds, contract No. 1.2.1.1/16/A/007 signed between IT Competence Centre and Central Finance and Contracting Agency

Co-funded by the Erasmus+ Programme of the European Union

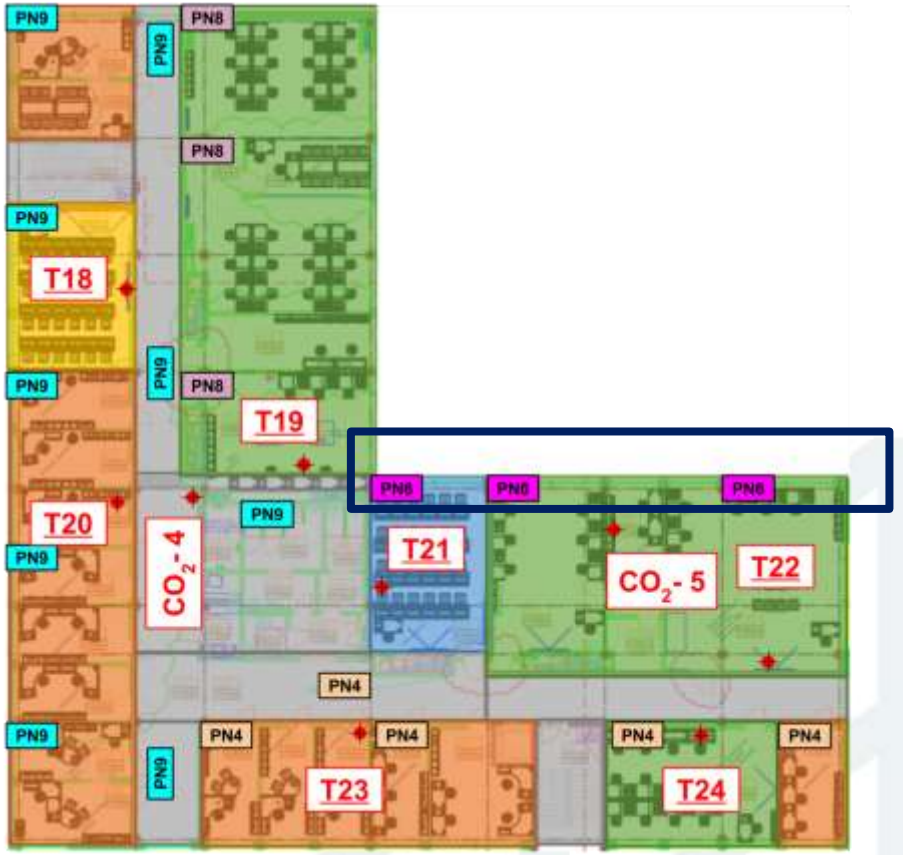
EEF - sensor placement



1. floor

Temperature sensors: 6 pcs
CO_2 sensors: 3 pcs

4. floor



Temperature sensors: 7 pcs
CO_2 sensors: 2 pcs

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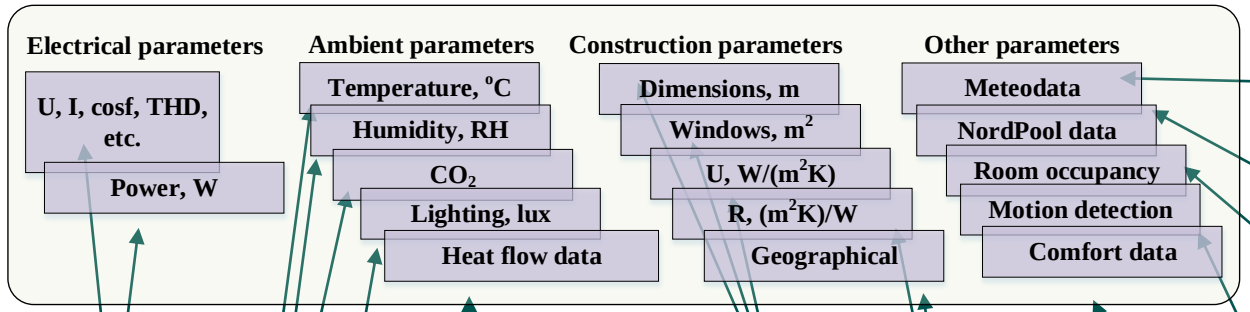
Model input data



EEF meteostation

Nordpool web

RTU room planning system

CIR-E3

Danfoss + LoRa

Building technical documentation and protocols

LoRa net + sensors

LoRa network + sensors

Luxmeter – EC1

questionaire. Other sensors

to sensor

CO2 sensors

LoRa router

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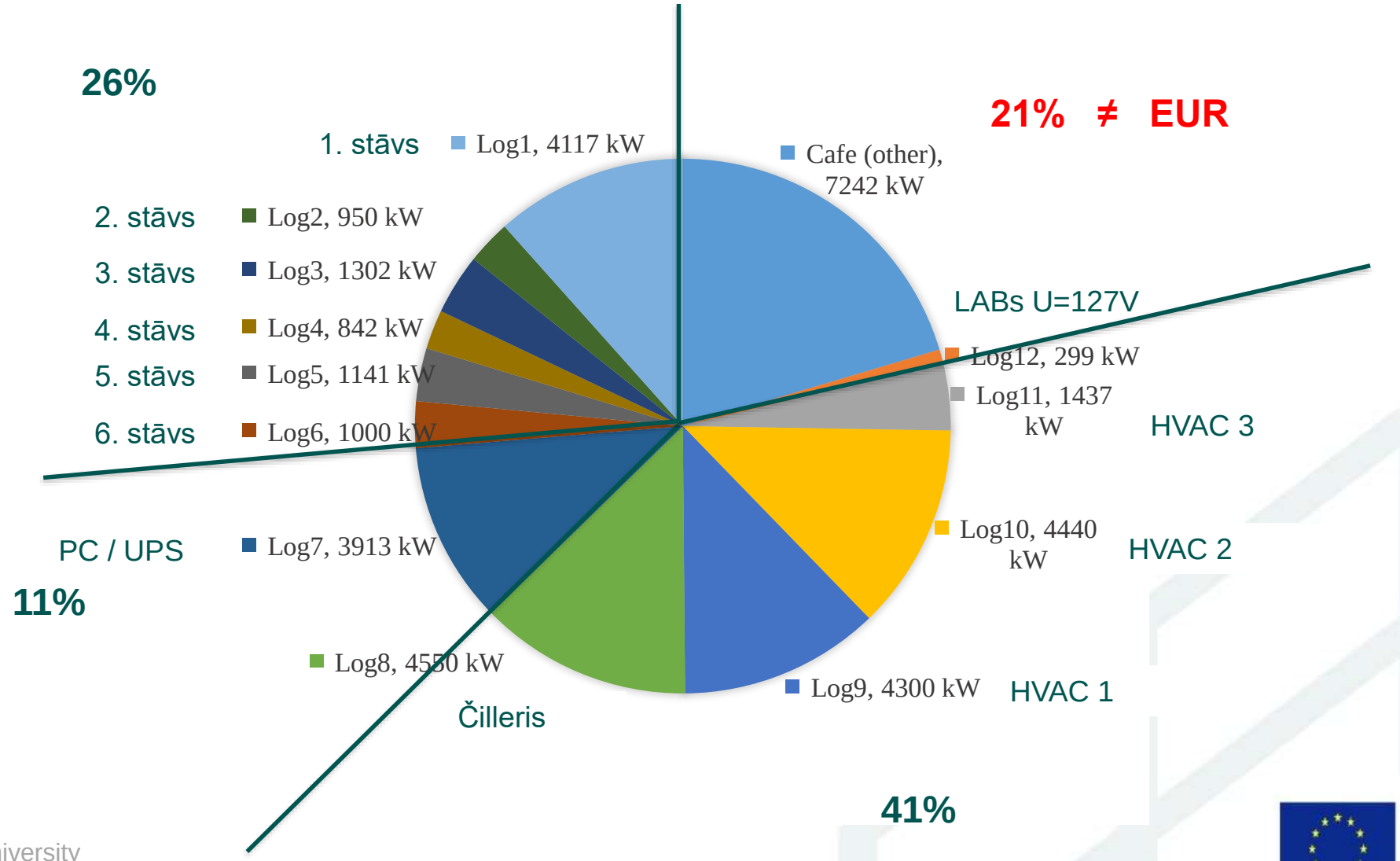
LoRa IoT sensor results



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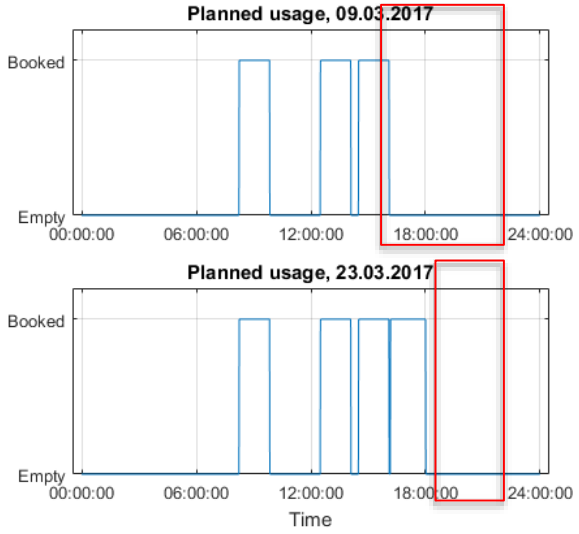
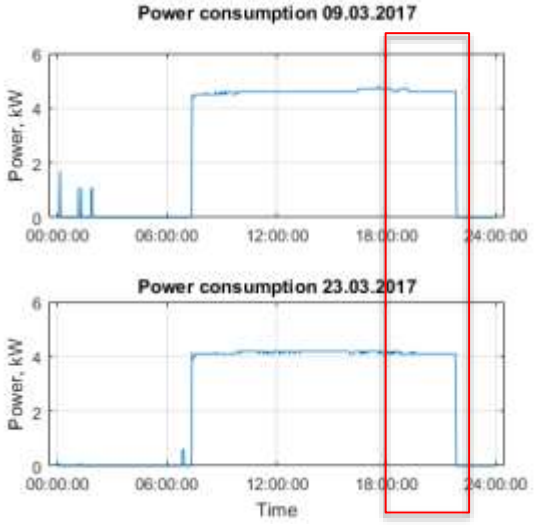
Measurements and analysis results

MatLab analysis: Electrical measurement data vs room occupancy schedules



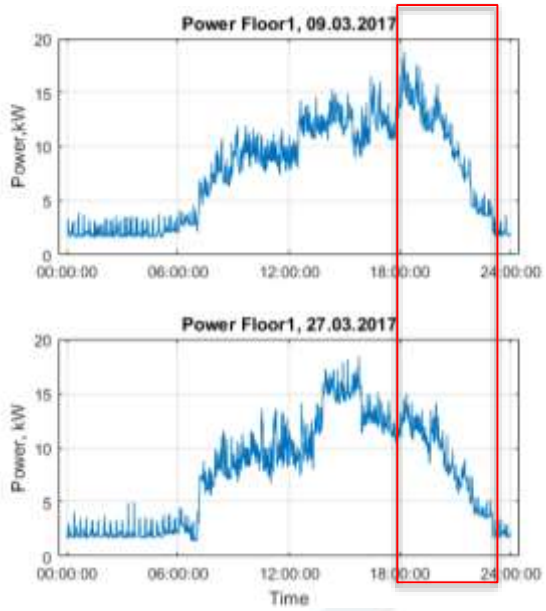
Planned occupancy schedules at RTU EEF auditorium N116

In date 09.03. room is occupied 135 min and in 27.03 – 180 min



Measured HVAC power consumption related to RTU EEF auditorium N116

HVAC system operated 870 min (each day) consuming 66kWh daily



Electrical energy consumption on floor 1 of RTU EEF building, including auditorium N116.

potential savings are 15,5% and 20,68% accordingly, if HVAC system could be adjusted to room usage schedules

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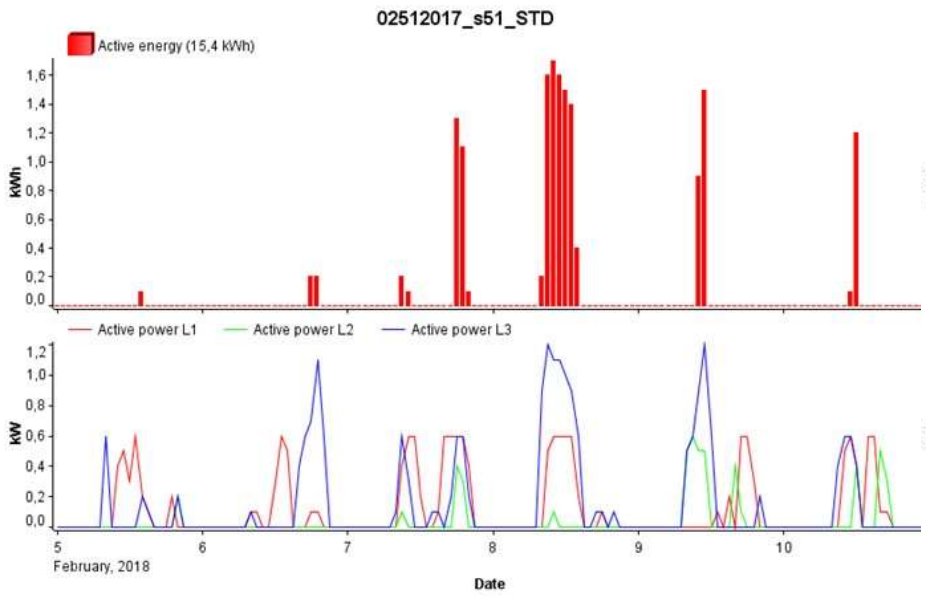
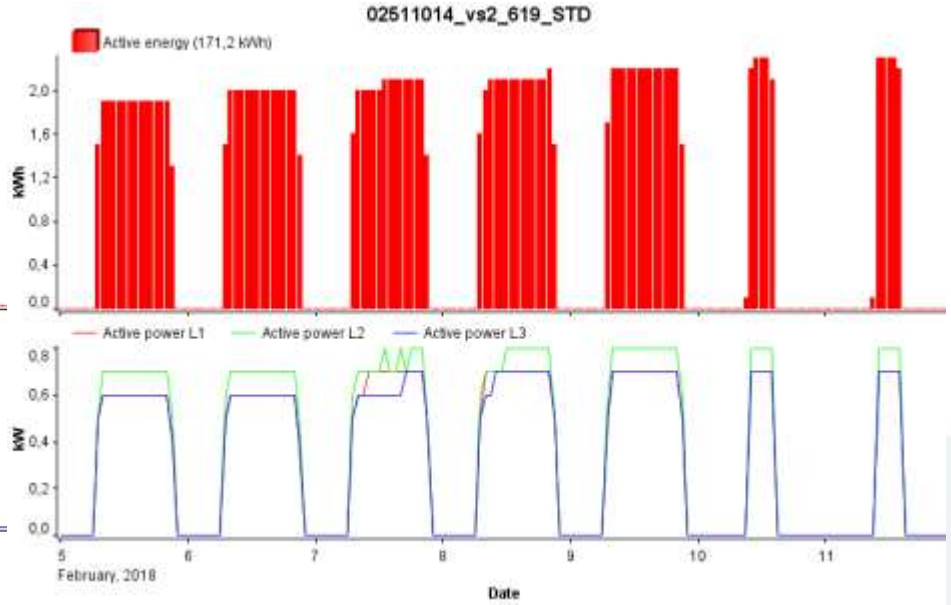
Measurements and analysis results – PN6 zone



5th floor PN6 zone lighting



ventilation system PN6

Electrical energy consumption data for 8th week of 2018

(from 02.12.2018 to 02.18.2018)

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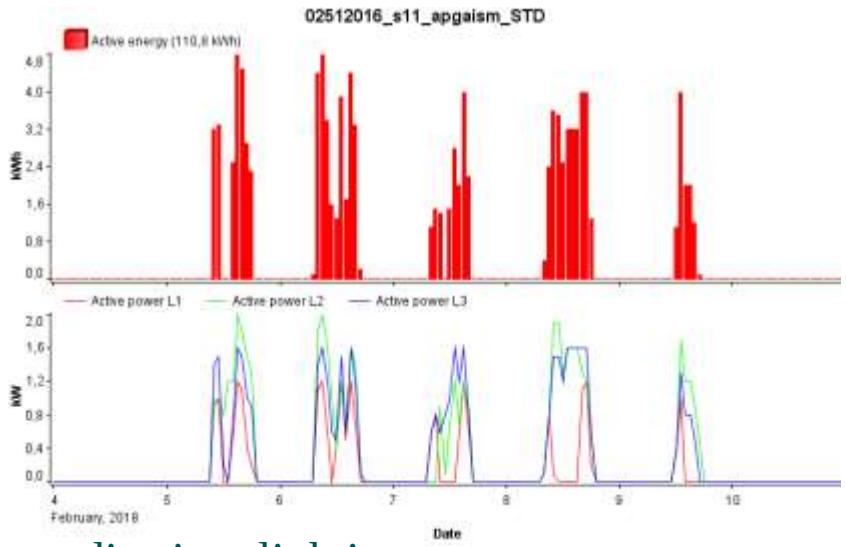
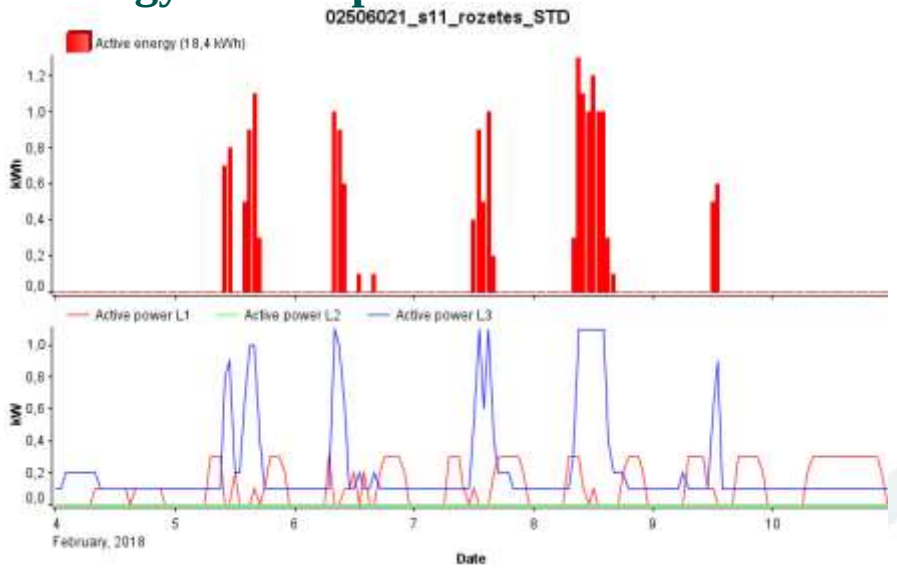
Measurements and analysis results – room level

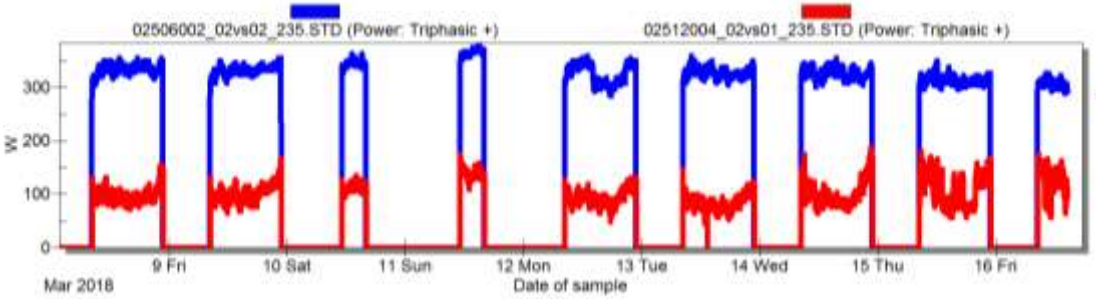
Room level auditorium (115, 116) electrical energy consumption data



auditorium lighting



power supply sockets for presentation equipment



Difference?
Is it normal?

HVAC power consumption measurements (red - PN1; blue - PN2)

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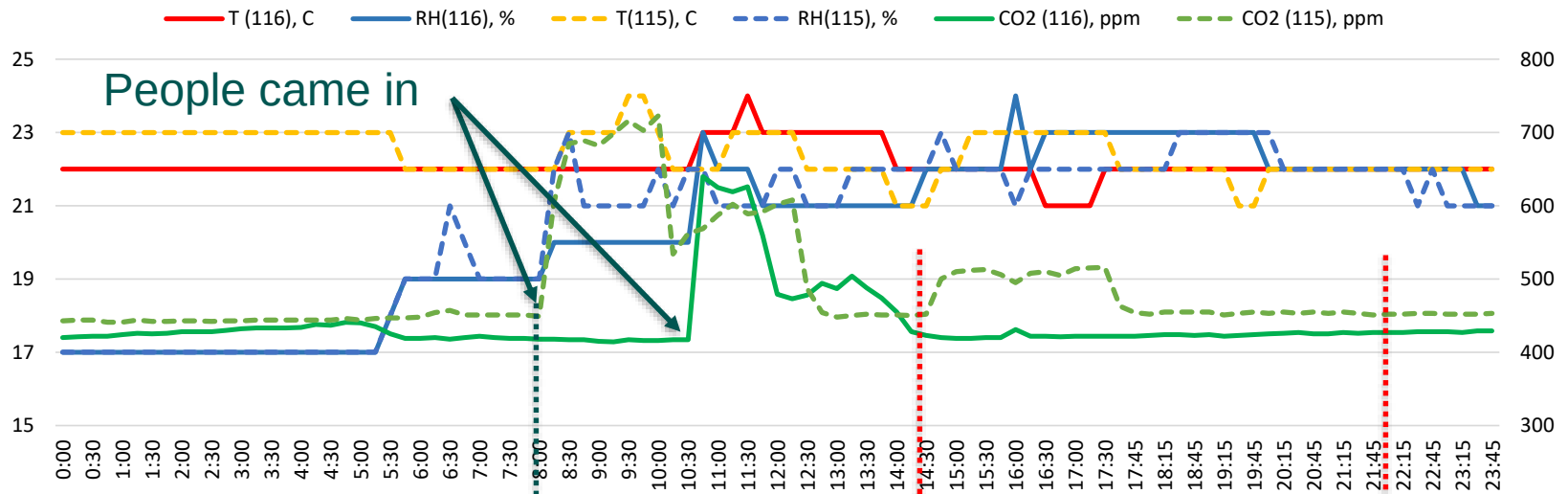
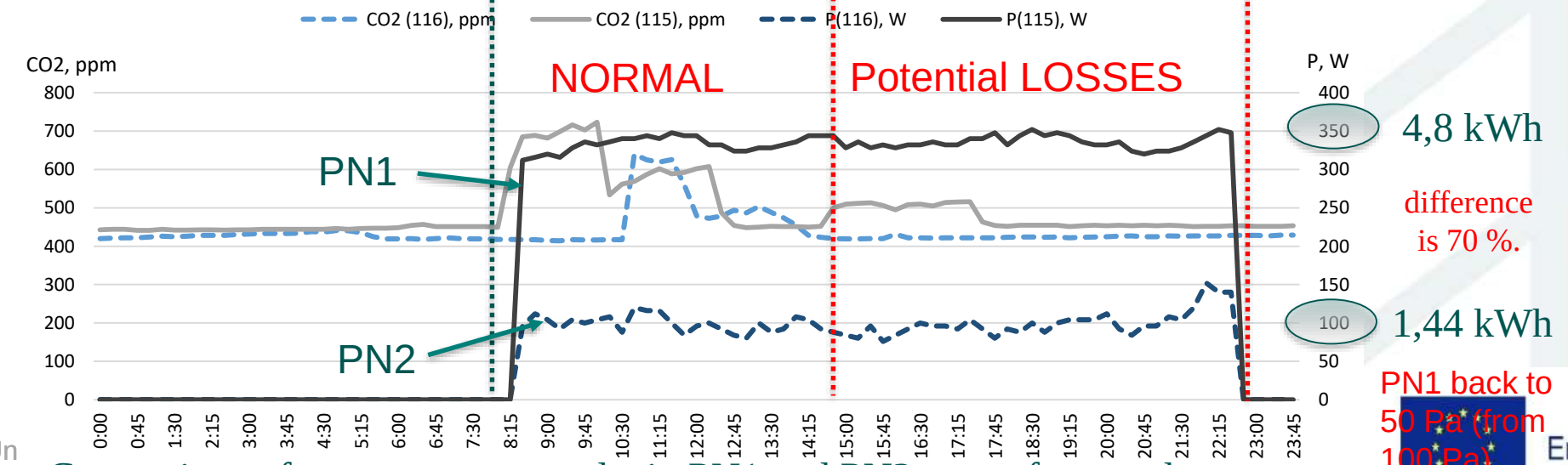
Measurements and analysis results – room level



PN1 and PN2 zone measurement results of LoRaWAN sensors



Comparison of measurement results in PN1 and PN2 zones for one day

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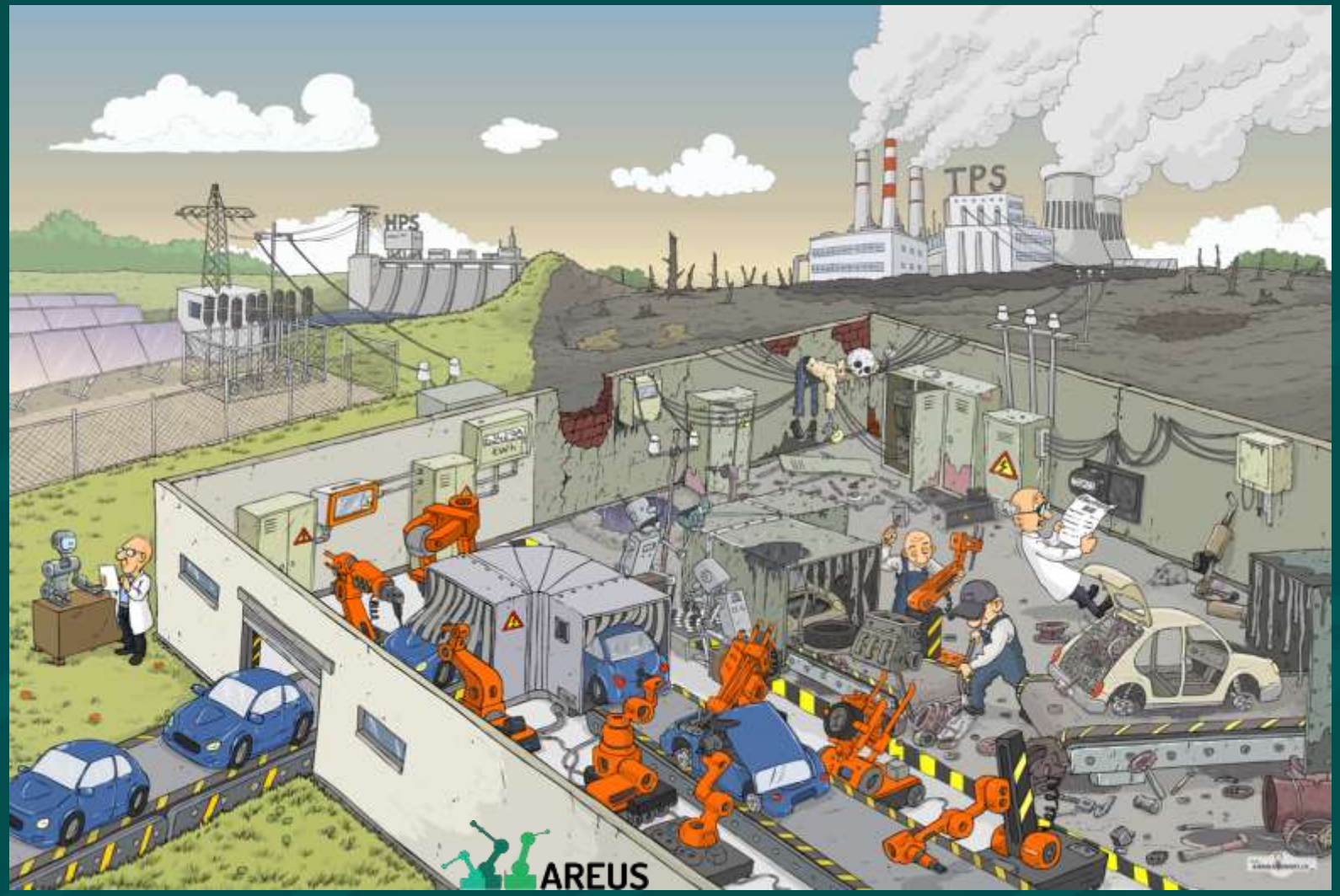
Learn more - save more!



Thank You!

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Nadezda.Kunicina@rtu.lv

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