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TAKING
COOPERATION
FORWARD



University of Maribor, Faculty of Energy Technology (SI)

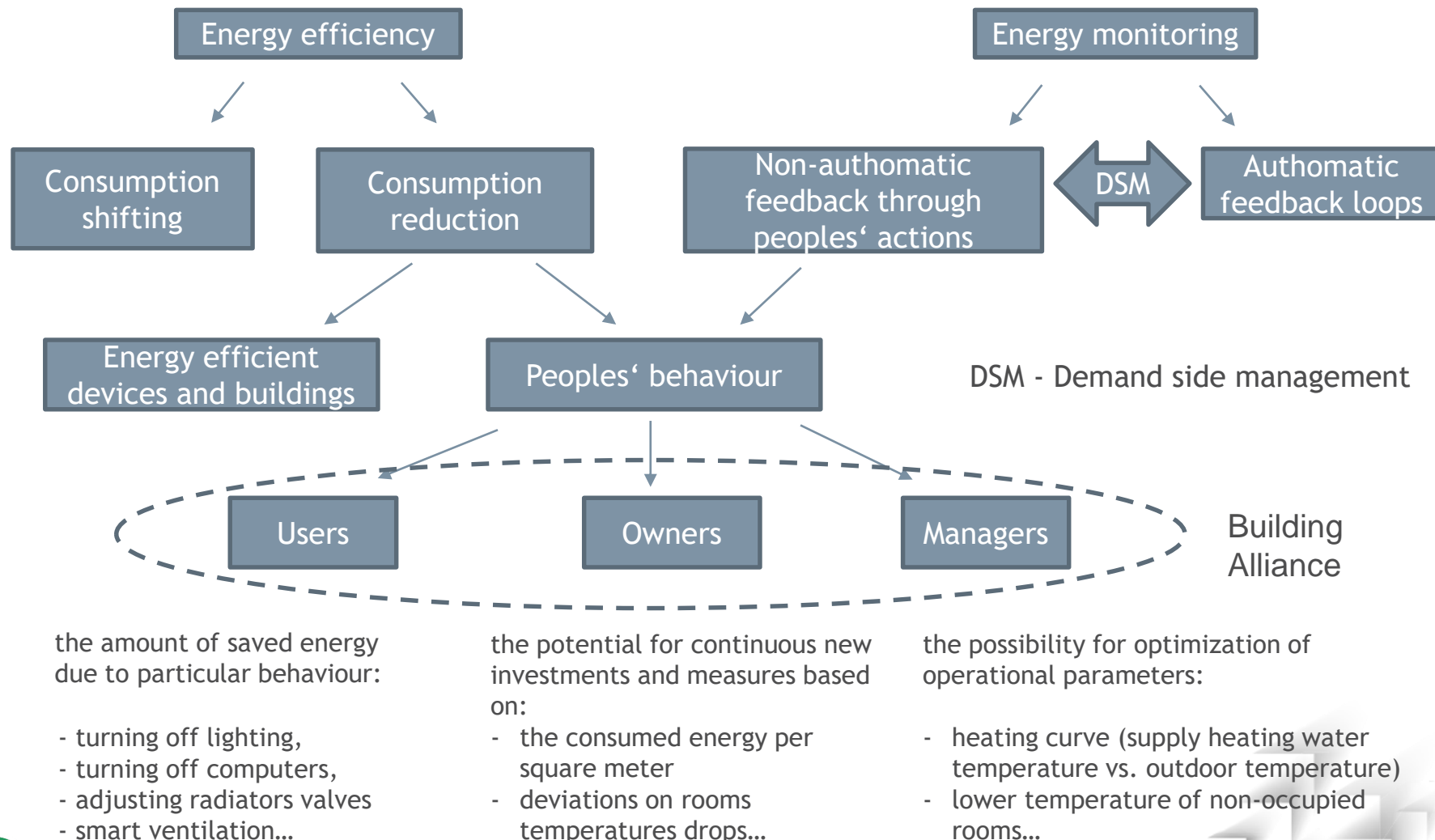


Improving energy efficiency through energy monitoring



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HOW CAN BE ENERGY EFFICIENCY RELATED TO ENERGY MONITORING?



PILOT ACTIONS TO ACHIEVE BEHAVIOUR CHANGE

Pilot buildings of the project Together :

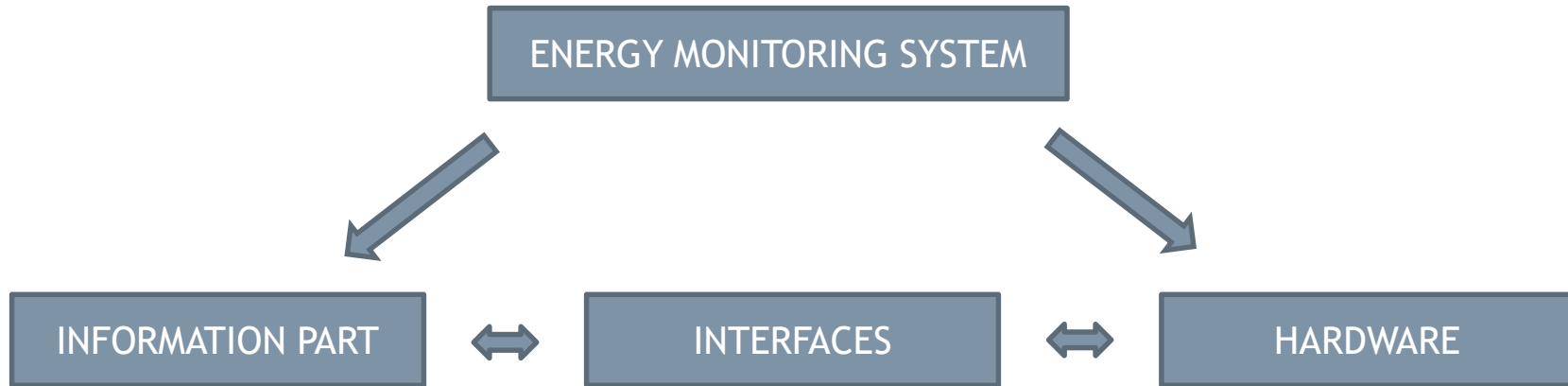
- 3 Student Dormitories
- 4 Faculties

Pilot Actions flow during 3rd/4th period of the project Together:

- Implementation of **energy audits** to improve energy efficiency
- Installation of **energy monitoring systems** in 4 pilot buildings (3 student dormitories and 1 faculty)
- Organizing **training** activities
- **Elaboration of Energy Efficiency action plan (Pilot Concept Design)** (D.T3.2.3) to predict most suitable Energy Efficiency measures to different types of pilots
- Putting Energy Efficiency action plan into practice (operative building alliance)



IMPLEMENTATION OF ENERGY MONITORING SYSTEMS - TECHNICAL ASPECT



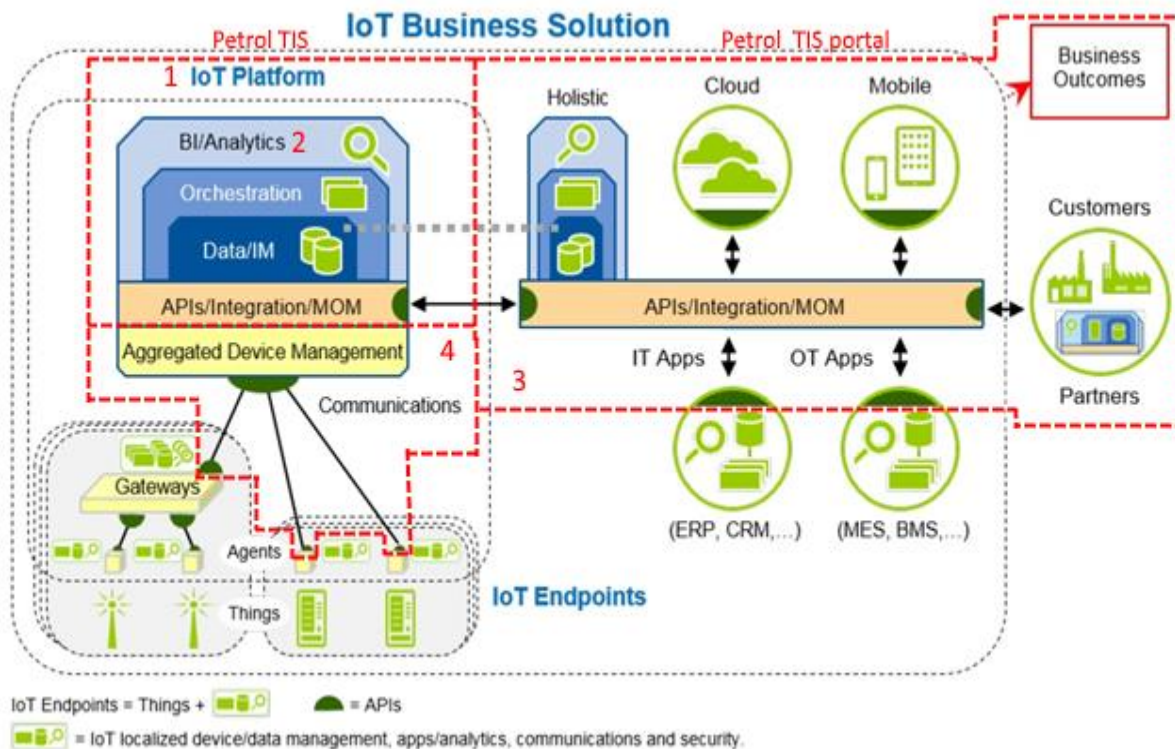
INSTALLATION OF ENERGY MONITORING SYSTEMS - INFORMATION PART AND INTERFACES

- The external provider - Petrol have offered their Technological Information System (TIS), which consists of:
 1. SCADA (control and supervisory on heat consumption)
 2. Energy bookkeeping (bills tracking)
 3. Wireless tag application/system (measurement of internal comfort)
 4. Energy info point (informing users about energy consumption)



TECHNICAL INFORMATION SYSTEM (TIS)

- The hierarchy of TIS is as follows:



Data flow:

Sensors, controllers
SCADA/DAQ



Data filtration



Data processing/analyzing



Data storage (BIG DATA)



Displaying monitored data
on external devices



TECHNICAL INFORMATION SYSTEM (TIS)

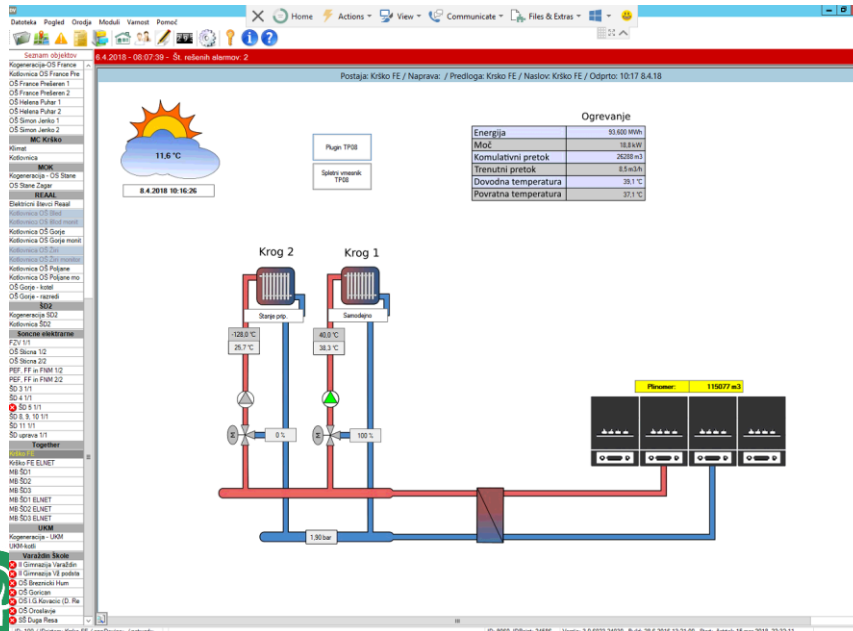
SCADA

Its key advantages are:

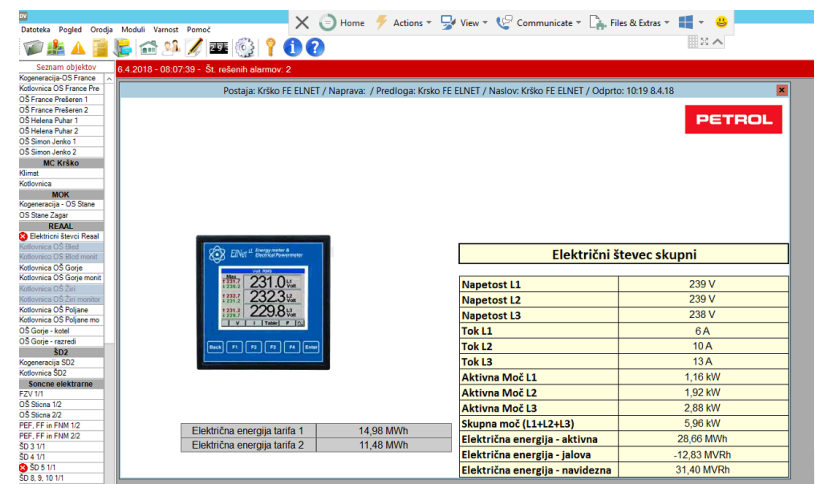
- Data archiving
- On-line implementation
- Automatic remote monitoring
- Alarming

Users of the system/software are **energy managers** of each pilots including the staff of Petrol d.d. and accessibility is governed by usernames & passwords

Heat consumption control



Electricity consumption monitoring

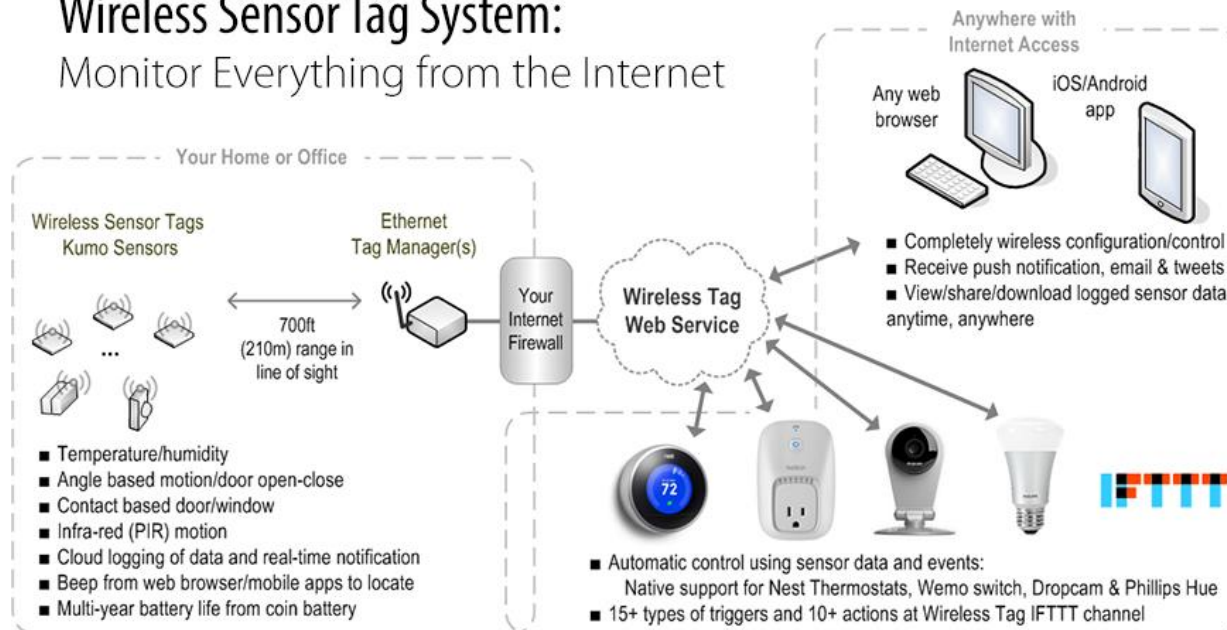


TAKING COOPERATION FORWARD

SYSTEM FOR MEASURING INDOOR COMFORT IN THE REFERENCE ROOMS

- Temperature, humidity, brightness and presence - Wireless Sensor Tags, <http://wirelesstag.net/>

Wireless Sensor Tag System: Monitor Everything from the Internet



Data flow:

Sensors (wireless)



Main unit (router)



Cloud service



Data displaying
(web access, mobile application)

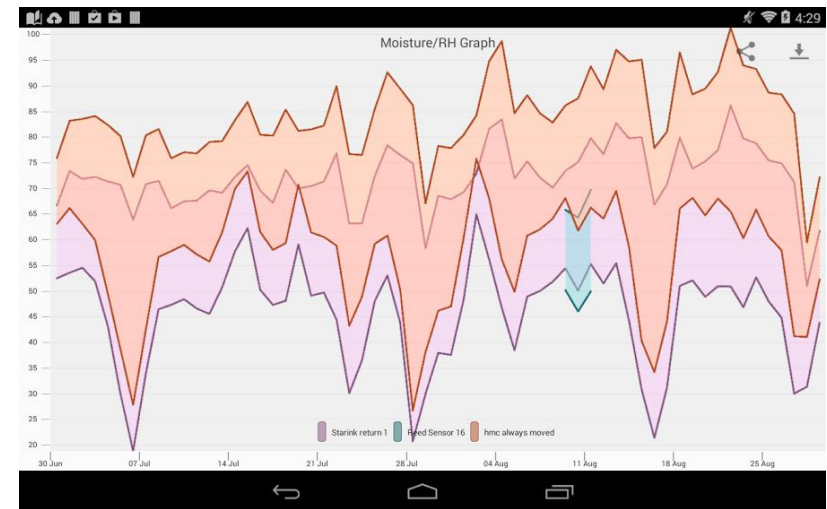
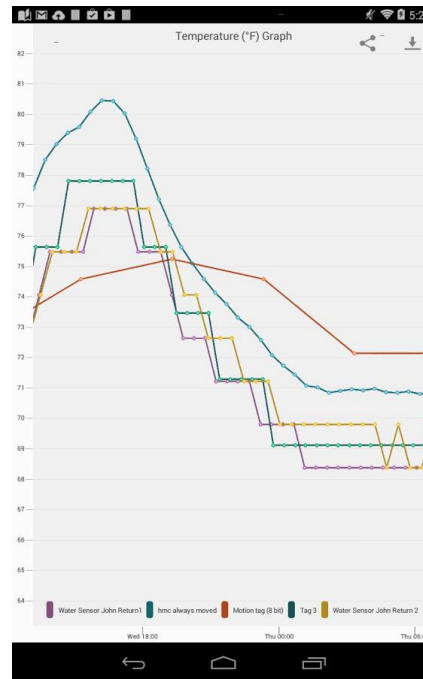
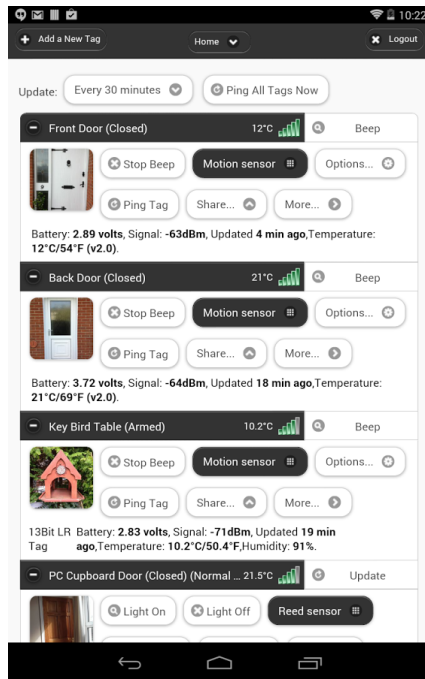


SYSTEM FOR MEASURING INDOOR COMFORT IN THE REFERENCE ROOMS

- Application available for Android & iOS:

<https://play.google.com/store/apps/details?id=com.wirelesstag.android3>

- DSM tool to influence the users' behaviour



MONITORING SYSTEM HARDWARE - FACULTY OF ENERGY TECHNOLOGY

Real time input data (indoor comfort and outdoor temperature)

Smart multipurpose sensor (temperature, humidity, illumination, presence)



External temperature sensor



MONITORING SYSTEM HARDWARE - FACULTY OF ENERGY TECHNOLOGY - BOILER ROOM



MONITORING SYSTEM HARDWARE - FACULTY OF ENERGY TECHNOLOGY - BOILER ROOM



MONITORING SYSTEM HARDWARE - FACULTY OF ENERGY TECHNOLOGY - HEAT ENERGY

Heat meter



Controller



Communication with data system via internet

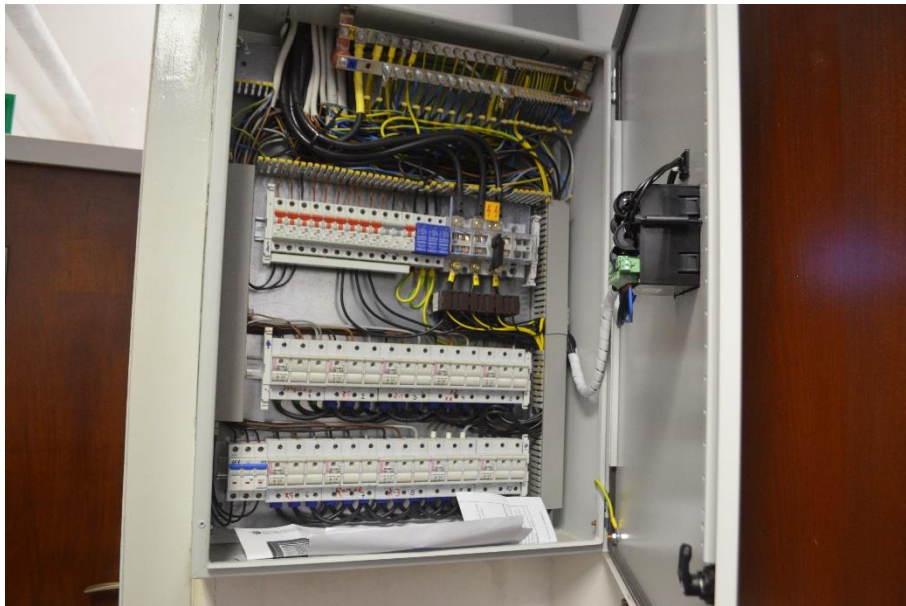


Gas meter

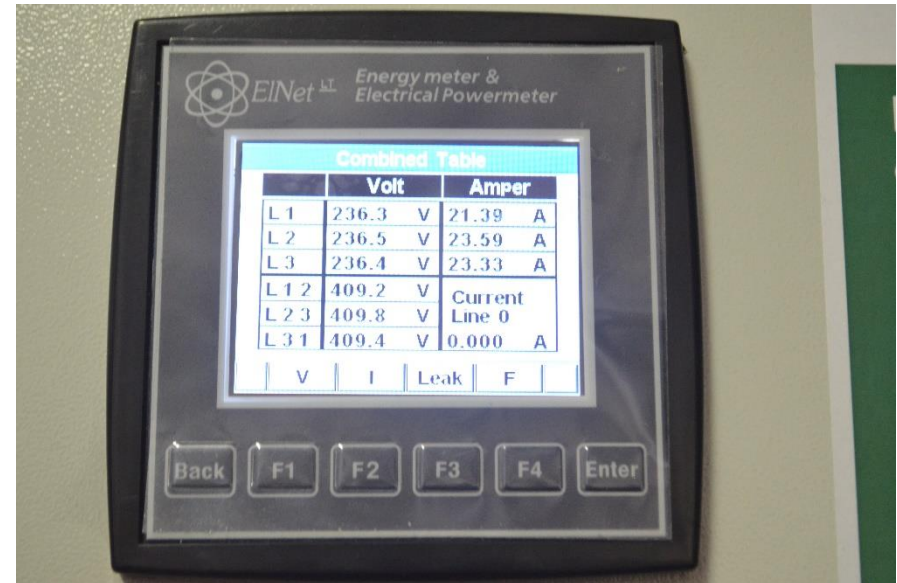


MONITORING SYSTEM HARDWARE - FACULTY OF ENERGY TECHNOLOGY - ELECTRICITY

Electric cabinet with current measurement transformers



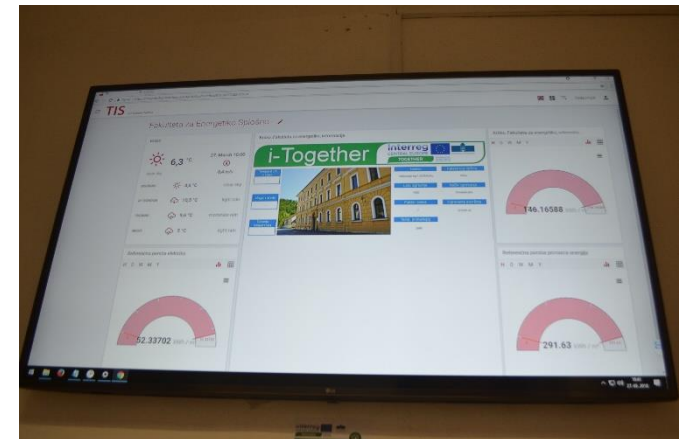
Electricity meter



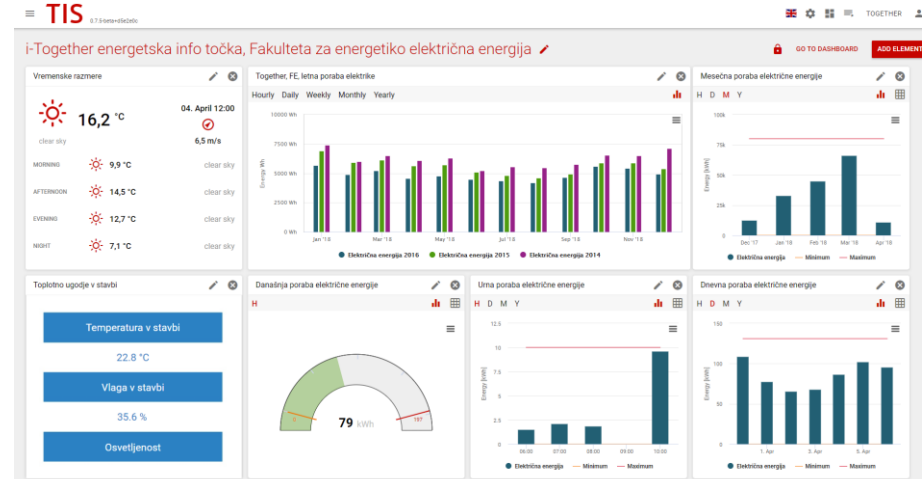
MONITORING SYSTEM HARDWARE - FACULTY OF ENERGY TECHNOLOGY

Screen for raising awareness through:

- real time energy measurements and
- historical data analytics.

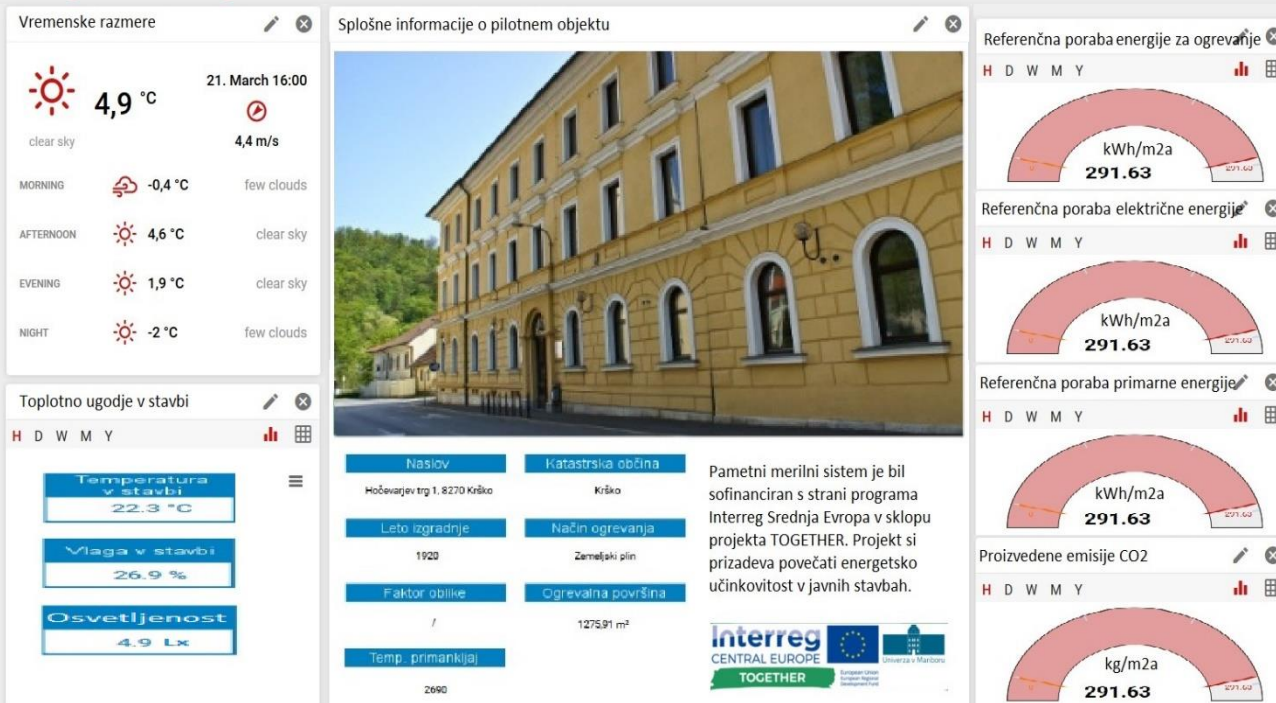


- ## Printscreens (case of Faculty of Energy Technology):



Together Energy Info Point - general data

i-Together energetska info točka



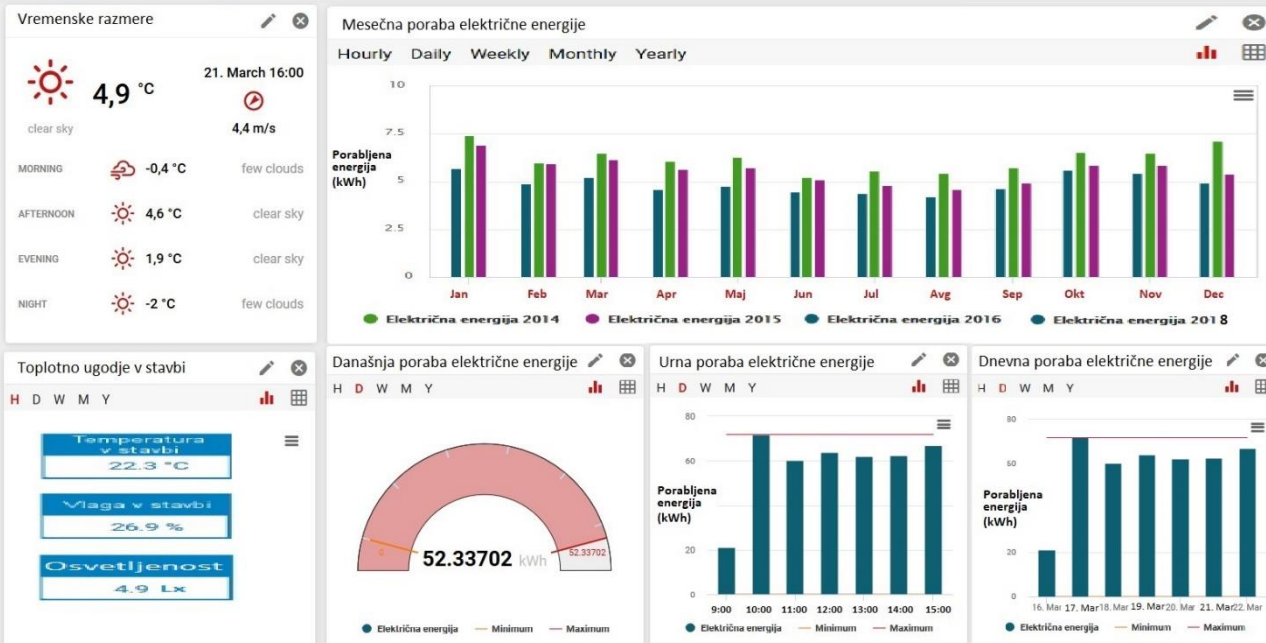
Info point - general data:

- Real time weather conditions
- Thermal comfort in the building (temperature in the building - reference room, illumination)
- General data of the building (year of construction, energy source, heating surface, temperature deficit)
- Average/reference energy consumption for heating per square meter
- Average/reference electricity consumption for heating per square meter
- Average/reference primary energy consumption per square meter
- Produced emissions per square meter



Together Energy Info Point - electricity

i-Together energetska info točka



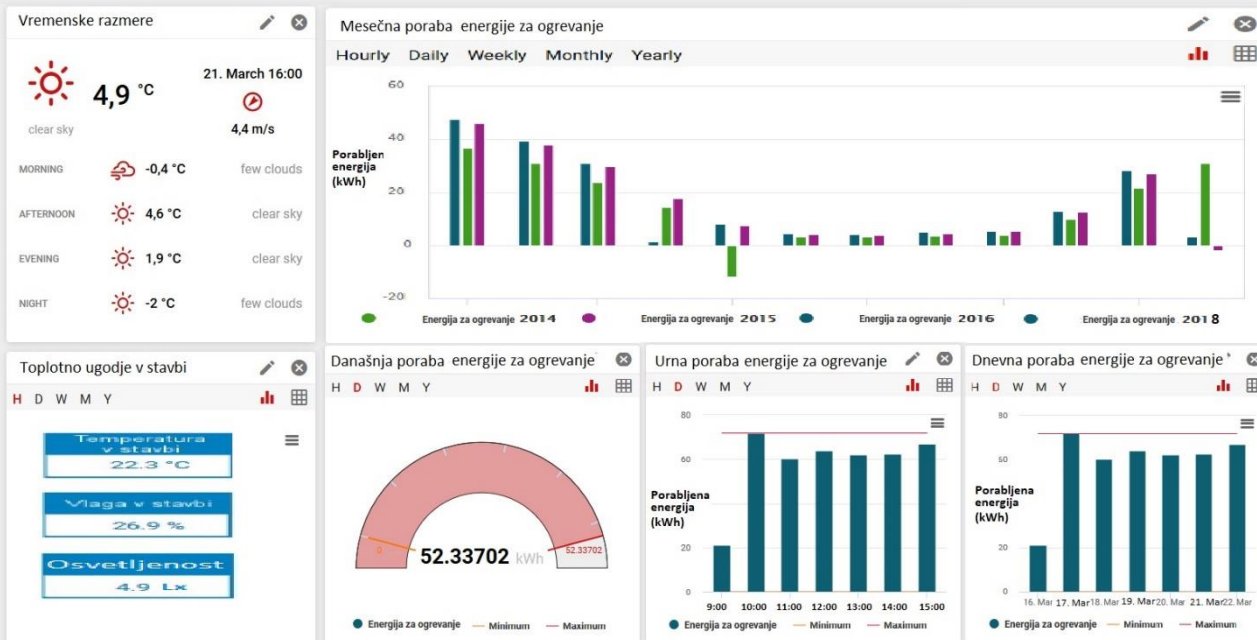
Info point - electricity:

- Real time weather conditions
- Thermal comfort in the building (temperature in the building - reference room, illumination)
- Monthly electricity consumption for last three years
- Total daily real time electricity consumption
- Hourly electricity consumption compared to the past 6 hours
- Daily electricity consumption compared to the last 6 days



Together Energy Info Point - heating

i-Together energetska info točka



Info point - heating:

- Real time weather conditions
- Thermal comfort in the building (temperature in the building - reference room, illumination)
- Monthly heat consumption for last three years
- Total daily real time heat consumption
- Hourly heat consumption compared to the past 6 hours
- Daily heat consumption compared to the last 6 days

Negative-reconciliation bill-before monitoring



MONITORING SYSTEM - FACULTY OF ENERGY TECHNOLOGY



MONITORING SYSTEM - STUDENT DORMITORIES



TRAININGS ON MONITORING SYSTEMS AND INFLUENCE ON ENERGY EFFICIENCY

Financial training



Trainings on monitoring systems increase users/owners/managers awareness about:

- the amount of saved energy from particular behaviour (turning on/off lighting, computers...) - users
- the potential for new investments and measures based on the consumed energy per square meter - owners
- the possibility for optimization of operational parameters (e.g. heating curve: supply temperature vs. outdoor temperature) – managers

Trainings form and strengthen Building Alliance of buildings managers, owners and users.

DSM training



Technical training



CONCLUSIONS - ACTION PLAN TO IMPROVE ENERGY EFFICIENCY AND ITS IMPLEMENTATION

1. Advanced technological measures:
 - **Installation of Monitoring systems**
 - **Energy info Points**
2. Recommended measures based on Extensive Energy Audits
3. 12 days of Trainings:
 - **Technical**
 - **Financial**
4. Forming the groups of stakeholders (dynamic panel according to the needs and **competencies** e.g. users, managers, owners, experts)
5. Material for fostering Energy Efficiency measures:
 - **Sticker for sanitary facilities**
 - **Stickers about losing calories on the stairs**
 - **Sticker in elevators**
 - **Posters about effective handling in common spaces**
 - **Instruction for effective handling for students who move into dormitories**
6. Round tables on Energy Efficiency in public buildings
7. Building alliance for each pilot



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