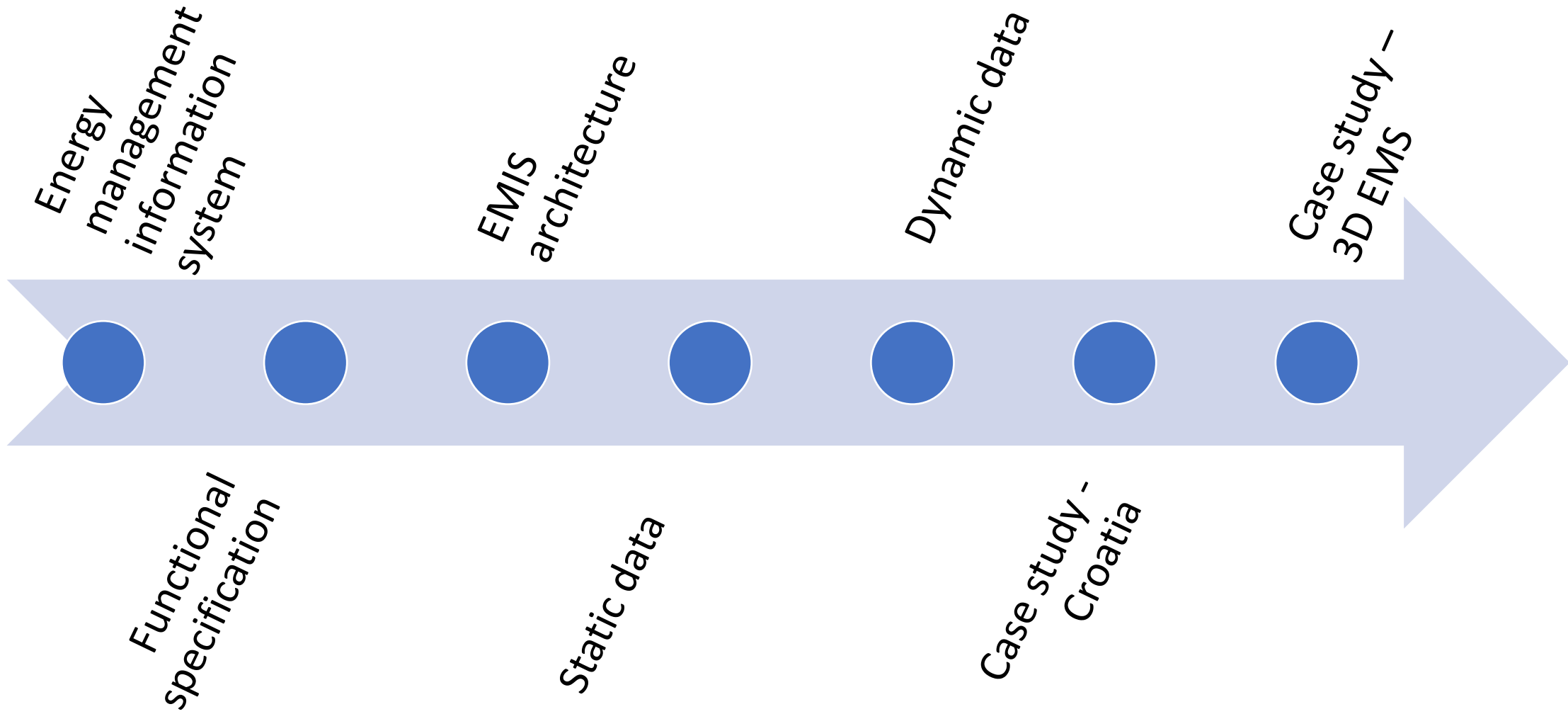


Energy Management  
Information System and  
examples of energy  
management system tools

# Table of contents



# Energy Management Information System

- Systematic energy management is a body of knowledge and skills based on an organizational structure that links people with assigned responsibilities, efficiency monitoring procedures (monitoring consumption indicators and setting targets for improvement) and continuous measurement and improvement of efficiency
- EMIS software tool that connects processes of entering data on buildings and their energy consumption, monitoring indicators and reporting energy consumption savings
- EMIS is a web application, database-driven application, its data structure composed of tables with data

# EMIS enables

- Continuous updating and maintenance of a database of general information on buildings in a municipality/city/county/country
- Continuous entry and monitoring of consumption data for all types of energy and water in buildings
- Calculation of consumption indicators by user-selected independent variables entered in the database data and via preset parameters
- Monitoring and target setting for energy expenses and energy savings for individual buildings and group of buildings
- Report creation according to user preferences or according to preset templates

# EMIS functional specification

- Functional specification describes how the final software application should work, through a description of the minimum required functional product features
- It is a guideline for the development team on how to develop software, serves as a basis for determining needed work, and represents an informal agreement between the parties about what exactly should be developed
- It also serves as a point of coordination for the project team

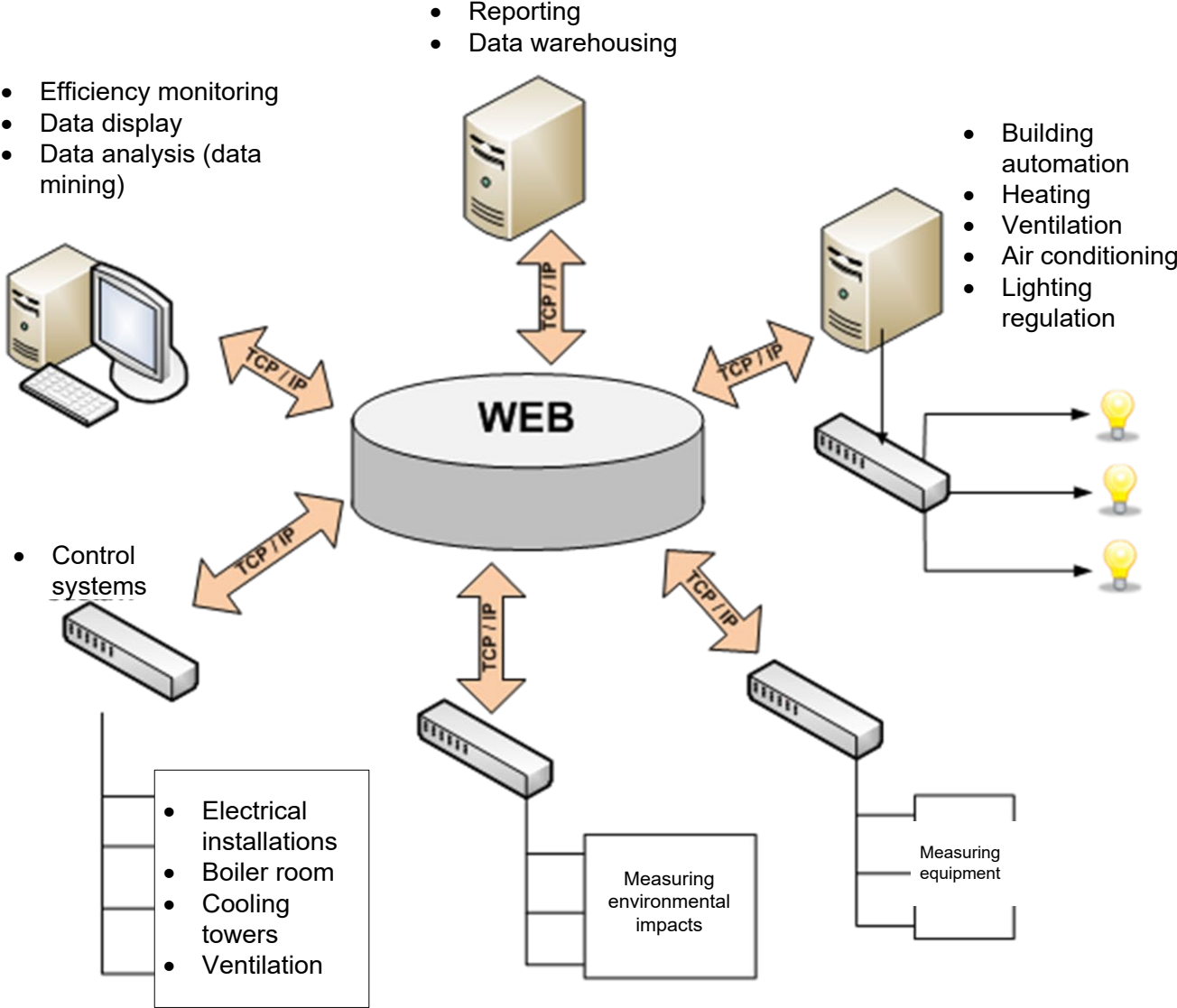
# User specification

- The system has the following types of users:
  - Person in charge of technical issues in the buildings – primarily uses EMIS for the registration and control of data
  - Buildings manages (housekeeping manager – primarily uses EMIS for data verification and entry
  - Energy manager – Uses EMIS as one of the basic tools for energy management, responsible for a group of buildings owned by the city/county/ministry
  - Supervisor / controller – primarily uses EMIS to view reports and trends in consumption (access to all data)
  - Guest – review of data marked as available to the public
  - System administrator – person who provides technical support in terms of software maintenance, users and tables in the database management

# Functionalities

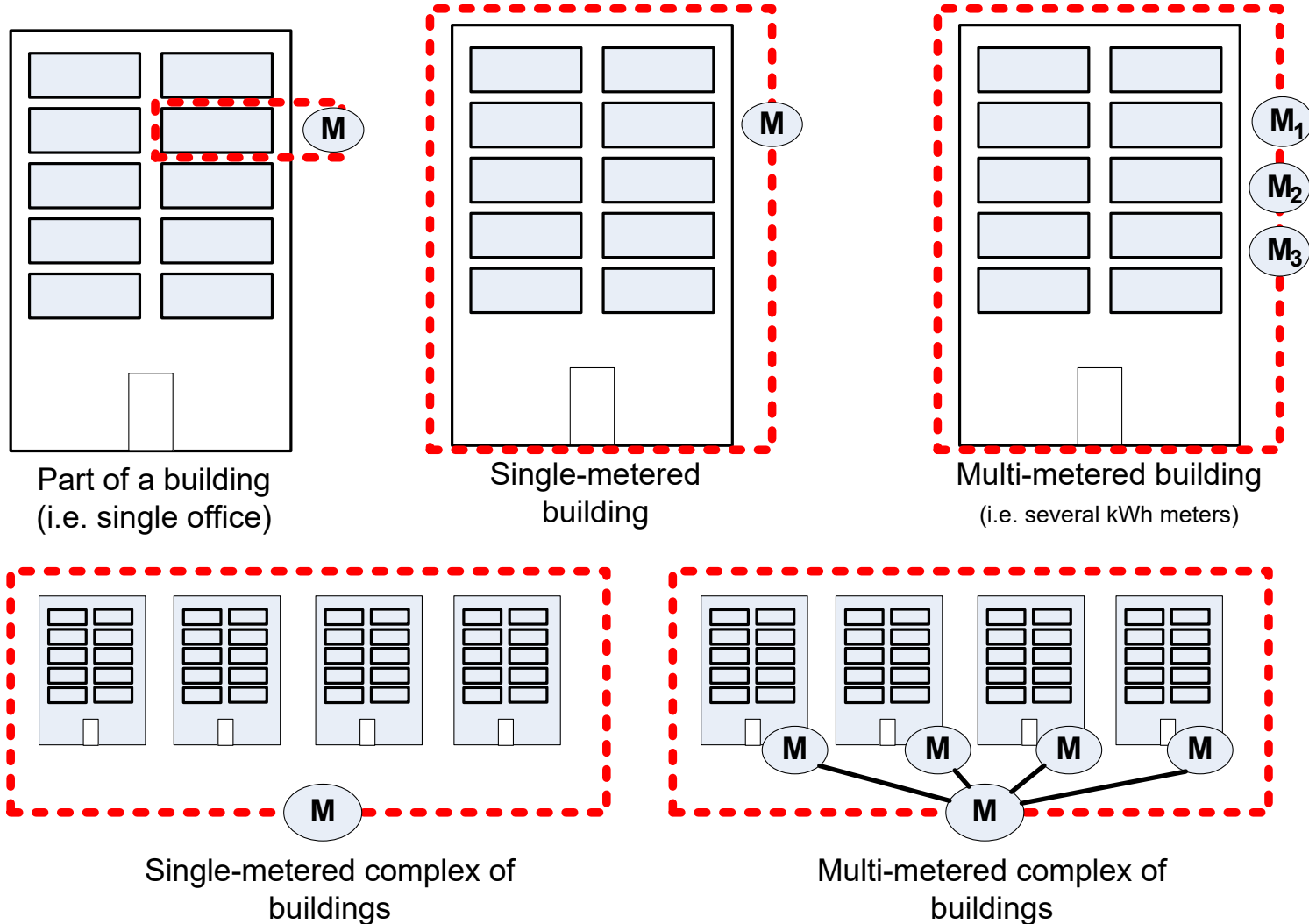
- Application login/logout
- The system of informing and warning users
- Managing tables and table columns
- Grouping buildings by categories
- Managing user rights
- Creating database backups
- Building data entry
- Sorting by building groups

# EMIS architecture





# Possible architecture of metering devices and buildings



# Static data on building

- Enable upload of documents (pdf, doc, xls, jpg) and their storage on the server and Building picture upload
- Identification number
- Name
- Location (address; city/block/municipality/county)
- Purpose
- User
- Ownership
- Share of the use of total building area [%]
- Number of the energy certificate according to the ECZ registry
- Energy class according to the current energy certificate

# Static data on building

- Phone
- Fax
- E-mail
- Flat gross floor area of the building [ $\text{m}^2$ ]
- Useful area surface of the building,  $A_k$  [ $\text{m}^2$ ]
- Heated surface area of the building,  $A$  [ $\text{m}^2$ ]
- Heated volume area of the building,  $V_e$  [ $\text{m}^3$ ]
- Number of working days per year
- Number of working hours per working day
- General remarks on the use of the building

# Static data on building

- Coefficient of heat passing through windows (openings) [ $\text{W}/\text{m}^2\text{K}$ ]
- Coefficient of heat passing through floors [ $\text{W}/\text{m}^2\text{K}$ ]
- Coefficient of heat passing through the ceiling [ $\text{W}/\text{m}^2\text{K}$ ]
- Coefficient of heat passing through walls to unheated spaces [ $\text{W}/\text{m}^2\text{K}$ ]
- Transmission coefficient of heat loss per unit of surface area of heated buildings,  $HT'$  [ $\text{W}/\text{m}^2\text{K}$ ]
- Annual thermal energy needed for heating [ $\text{kWh}$ ]

# Dynamic data (daily / weekly readings)

---

Consumption of energy and water meters	N	<ul style="list-style-type: none"><li>• Weekly readings of energy and water.</li><li>• Monthly inputs of bills received from suppliers.</li><li>• Update of the possible selection of energy and calorific value is required. Calorific values should be taken from Rules of the energy certification of buildings (NN 113/08).</li><li>• ...</li></ul>
Outside temperature taken from reference weather stations	N	
Indoor temperature	N	Temperature of the referent room. Possible input from smart meters
Possible input of average number of people during the week	N	If 3. or 4. = 0, application refers to "Building usage". Building users must be able to change or/and enter correct number of people (users) of the building in the observed week.
Possible input of working hours during the week	N	

# Energy consumption data entry

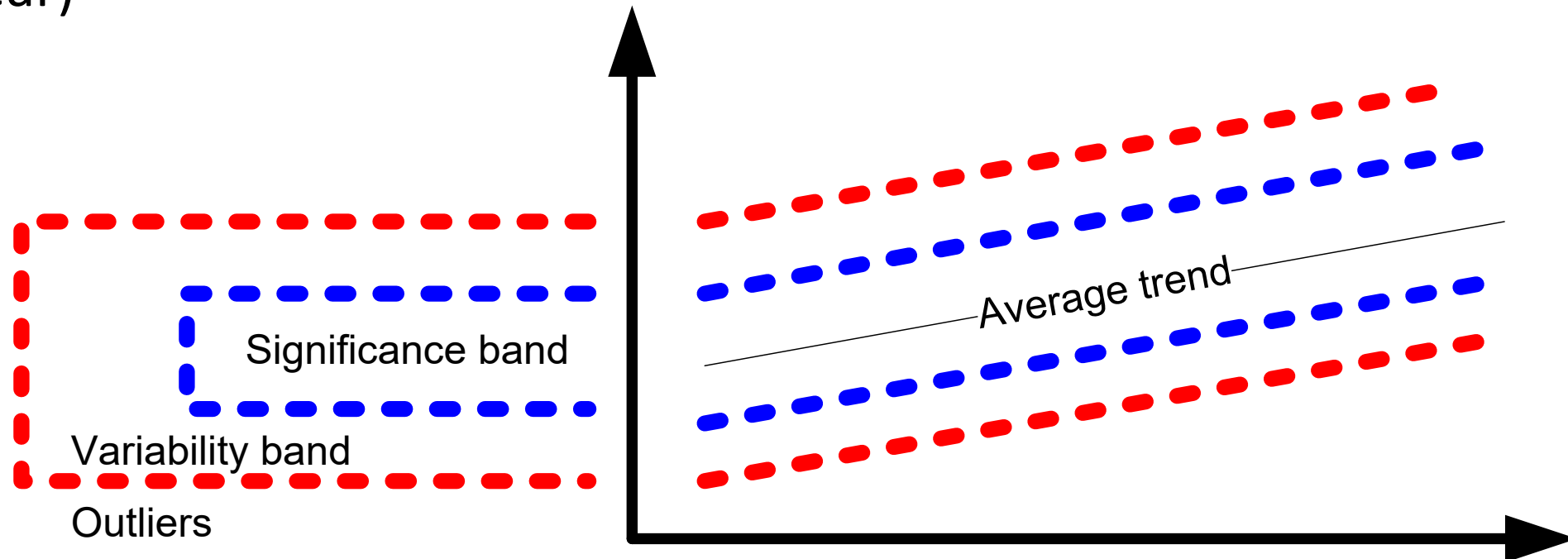
- Based on predefined data for a particular building, user can predefine energy resources used.
- Entry of the thirteenth payment period is enabled - scheduled to enter any correction to the energy consumption of the annual accounts of the calculation
- Monthly bills for energy: natural gas, extra light fuel oil, light fuel oil, firewood, heat (heating), steam, electricity, water and drainage, etc.

# Attributes of the monthly bills for energy

- Natural gas
    - Month
    - Year
    - Bill number
    - Supplier
    - Natural gas – unit price (kn/m<sup>3</sup>)
    - Natural gas – amount (m<sup>3</sup>)
    - Infrastructure
    - notes
  - Electricity – transmission and distribution
    - Month
    - Year
    - Bill number
    - Supplier
    - NT-R – unit price (EUR/kWh) // low tariff active
    - NT-R – amount (kWh) // low tariff active
    - VT-R – unit price (EUR/kWh) // high tariff-active
    - VT-R – amount (kWh) // high tariff-active
    - VT-J – unit price (kn/kVArh) // high tariff-reactive
    - VT-J – amount (kVArh) // high tariff-reactive
    - Engaged electric power (kW)
    - Renewable energy fee
    - Etc.
- + supply

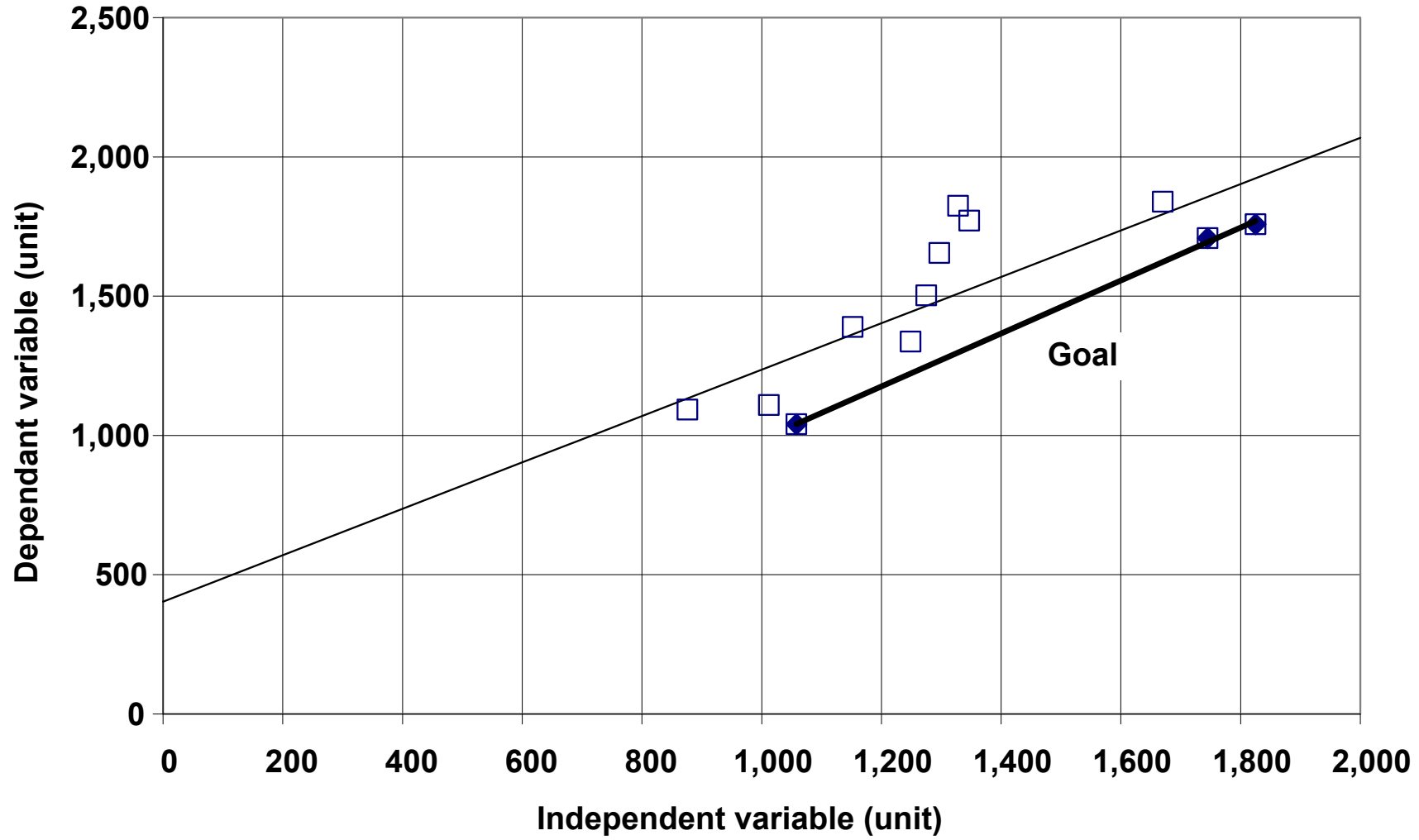
# Data verification and oversight

- EMIS must check the time consistency of the data
- Analysis of deviation from the default periodicals (day, week, month)
- Number of entries in a group of data (i.e. number of readings in a year)

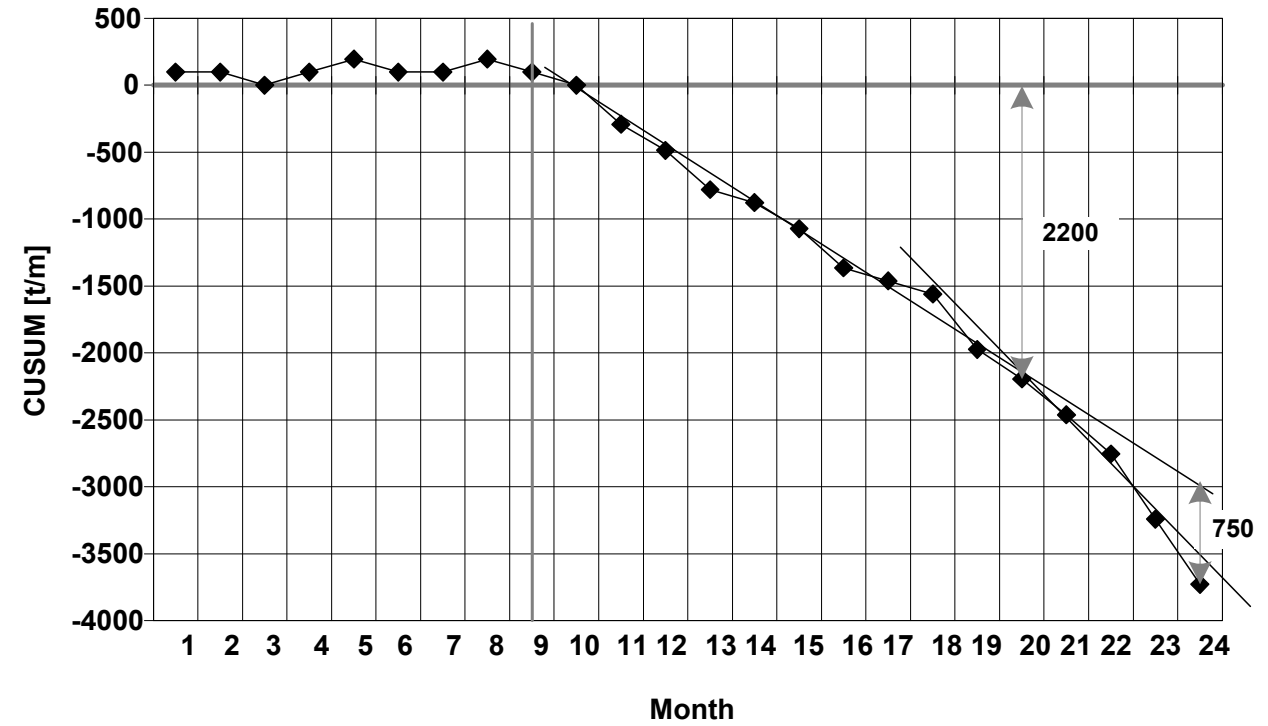
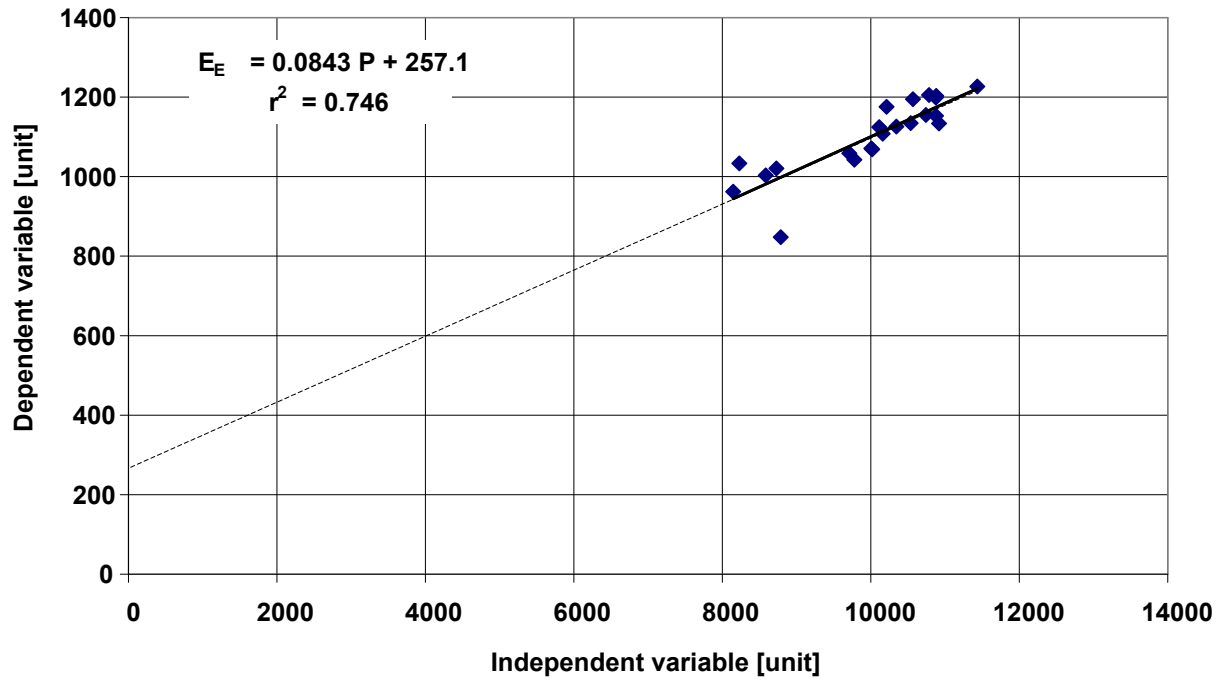




# Targets – setting goals for individual building



# ET curves and CUSUM graphs



# Energy Management Information System

- Energy Management Information System (EMIS) – web based application that is used as a main tool for continuous collection, storage, analysis and interpretation of energy consumption data in municipality, city, county, region, at the national level.
- EMIS should be easily accessed through any personal computer connected to the Internet
- Manual or automatic data entry (remote metering system) should be enabled
- EMIS development is an iterative process because there are always new requirements
- In its essence the application should always support the process of energy management in buildings

# EMIS development

## FIRST ADAPTATION (1.9. - 31.10.2011.)

- new tables managing
- setting goals for object groups
- alarming system upgraded
- new graphs

## SECOND ADAPTATION (7.5. - 9.7.2012.)

- verification of monthly energy bills entered
- meter consumption “locking”
- determination of referent year(s)

## THIRD ADAPTATION (19.10. - 1.11.2012)

- analysis of automatic readings
- new analysis module
- new system statistics module

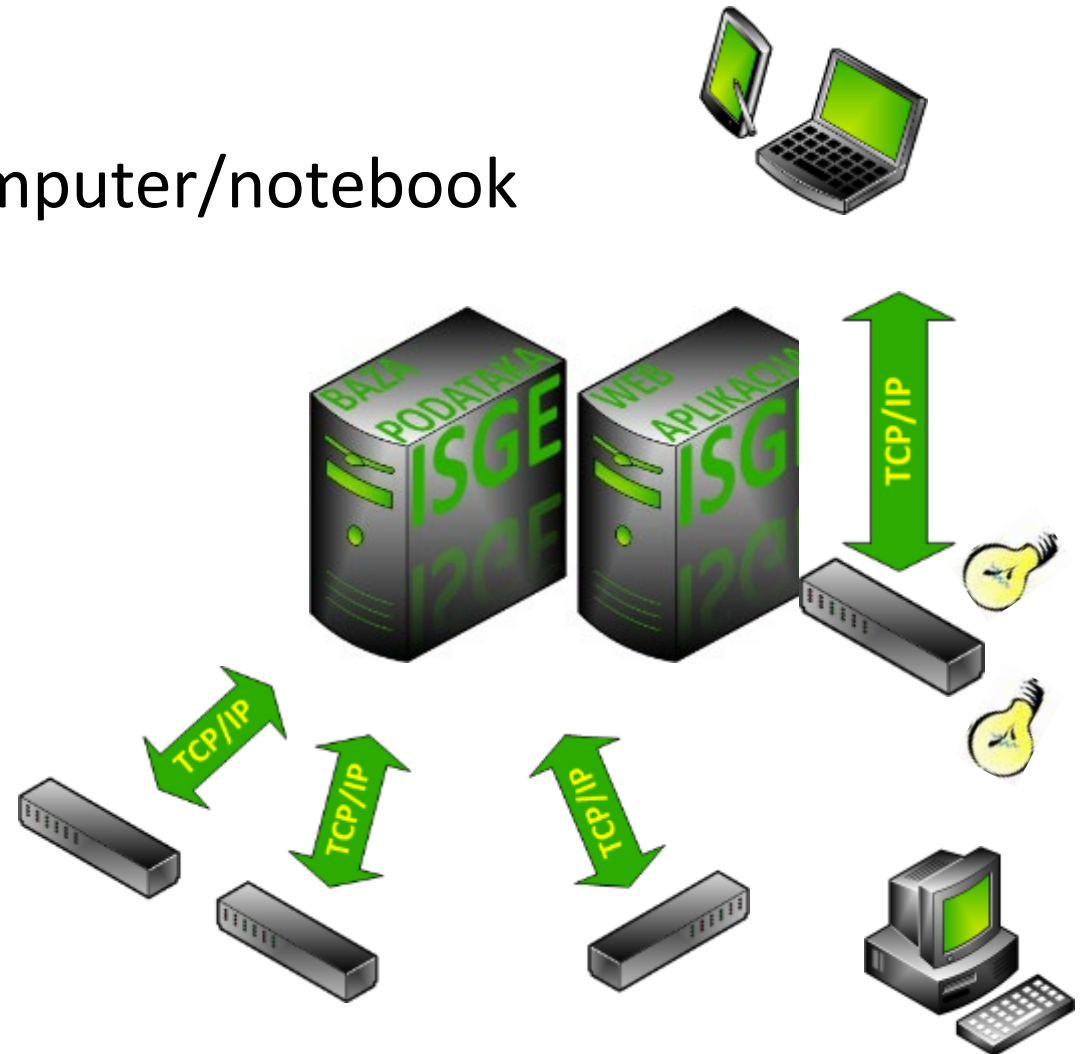
## FOURTH ADAPTATION



## TWENTIETH ADAPTATION

# EMIS structure

- National system
- Web access from local server, desk computer/notebook
- Remote reading systems
- Collecting data from smart systems
- Measuring impact on environment



# EMIS data, analysis, implementation

- DATA AQUISITION

- daily, weekly, monthly
- data entry via Internet

- ANALYSIS

- regular inputs in database
- detecting deviations
- early fault detection

- IMPLEMENTATION

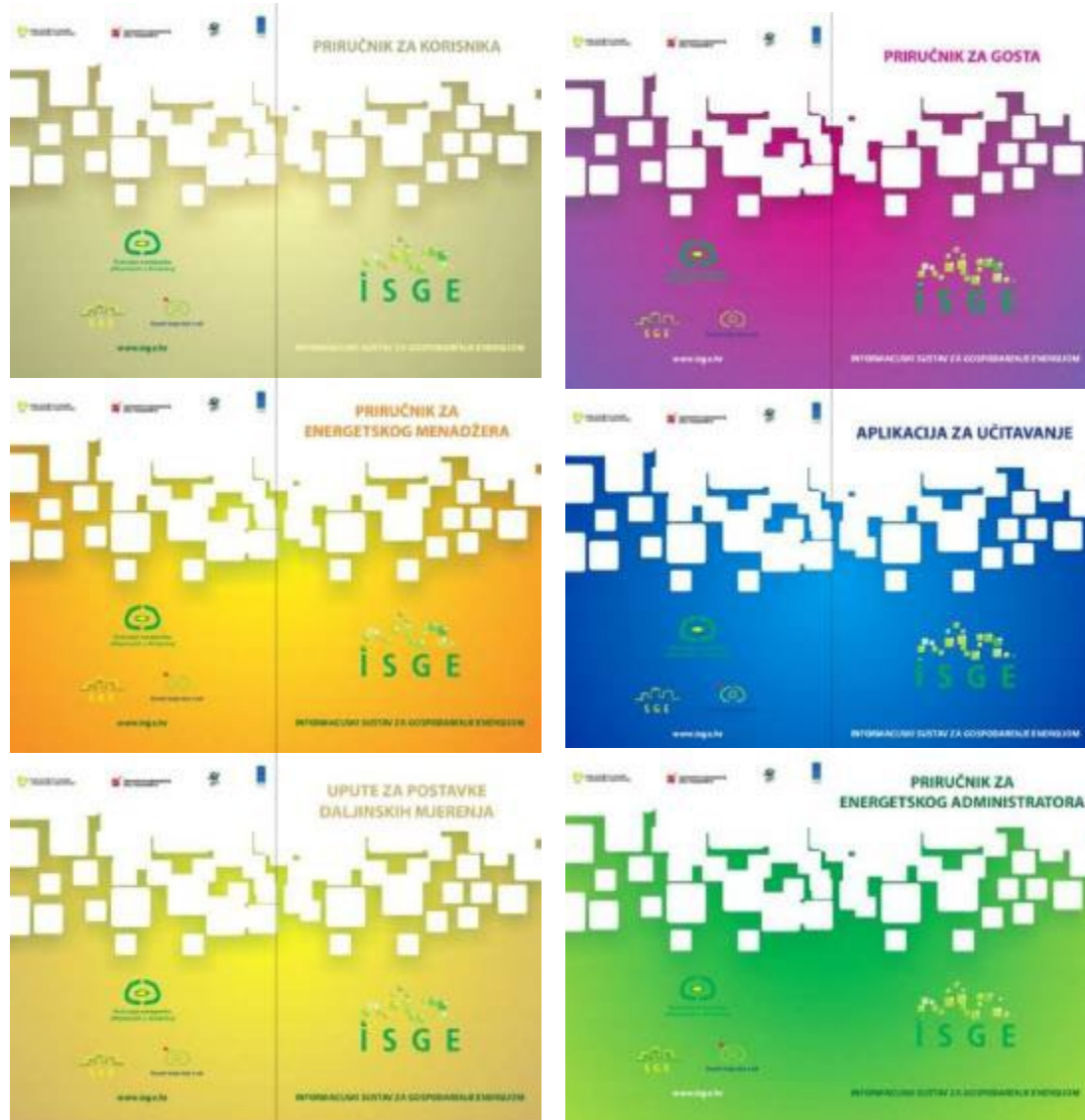
- where, when and what we consume every day
- insight into possible savings
- currently responding to system irregularities



# EMIS functionalities

- Different user interfaces for each user role
- Advance database filtering
- Excel, pdf data export
- Assortment of different building types
- Custom definition of energy bills
- Automatic readings
- Indicators of consumption
- ET curves, QUSUM graphs
- Locking verified places of consumption
- Nelson rules
- Communication and alarming system
- ...

# EMIS user manuals





## Dobro došli u INFORMACIJSKI SUSTAV ZA GOSPODARENJE ENERGIJOM

**Novo!** [Upute za slanje godišnjih izvještaja - Energetski administrator](#)

**Novo!** [Upute za slanje godišnjih izvještaja - Korisnik](#)

Korisničko ime :

Zaporka :

Login

[Zaboravili ste zaporku?](#)



Broj odbijenih zaključanih godina / mjernih mjesta: 32. Datum zadnjeg odbijanja: 31.05.2021. [Pregled](#)

[STATISTIKA](#)
[STATISTIKA MOJIH OBJEKATA](#)

Ukupni statistički podaci ISGE baze podataka (11.10.2021.)						
Vrsta ETC-a	Broj objekata	Broj mjernih mjesta	Broj automatskih mjernih mjesta	Broj računa	Broj očitavanja	Broj automatskih očitavanja
Kompleks	1.019	3.351	436	506.132	16.880.583	16.373.236
Zgrada u kompleksu	4.110	3.809	507	548.403	15.046.015	14.481.914
Slobodnostojeća zgrada	10.626	26.676	849	4.178.272	24.471.254	22.527.650
Dio zgrade	3.720	7.078	73	975.589	1.973.067	1.745.504
<b>Suma - Zgradarstvo</b>	<b>19.475 (14.736)</b>	<b>40.914</b>	<b>1.865</b>	<b>6.208.396</b>	<b>58.370.919</b>	<b>55.128.304</b>
Javna rasvjeta	24.139	23.238	3	4.127.942	1.163	0
<b>Suma</b>	<b>43.614</b>	<b>64.152</b>	<b>1.868</b>	<b>10.336.338</b>	<b>58.372.082</b>	<b>55.128.304</b>

Aktivni ISGE korisnici	
Uloga	Broj
Gost	1
Korisnik	1054
Energetski menadžer	11
Energetski administrator	180
Administrator sustava	10
<b>Ukupno</b>	<b>1256</b>

### Grafovi računa

[Grafovi računa](#)
[Grupe energenata](#)
[Projektna referentna potrošnja](#)
[Trenutni grafovi / zaključavanje](#)

2000 - 2021    2000    2001    2002    2003    2004    2005    2006    2007    2008    2009    2010    2011    2012    2013    2014    2015    2016    2017    2018    2019    2020    2021

**Energent**

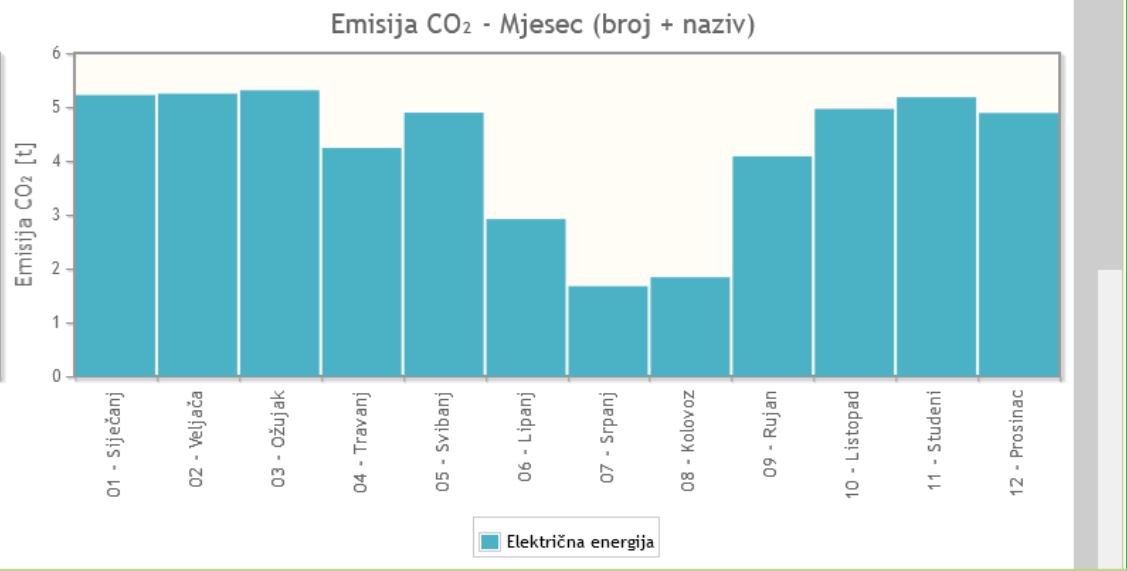
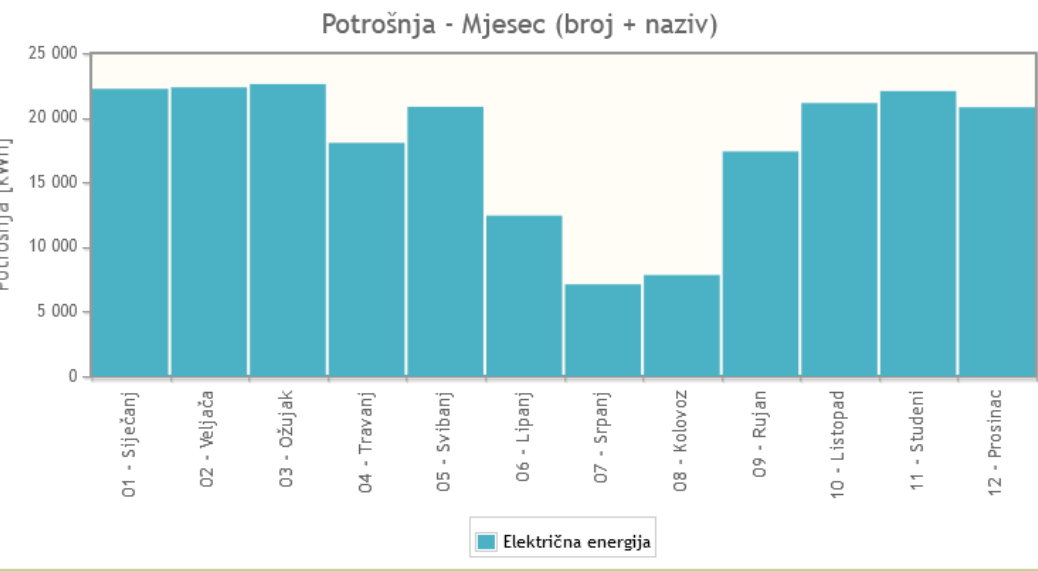
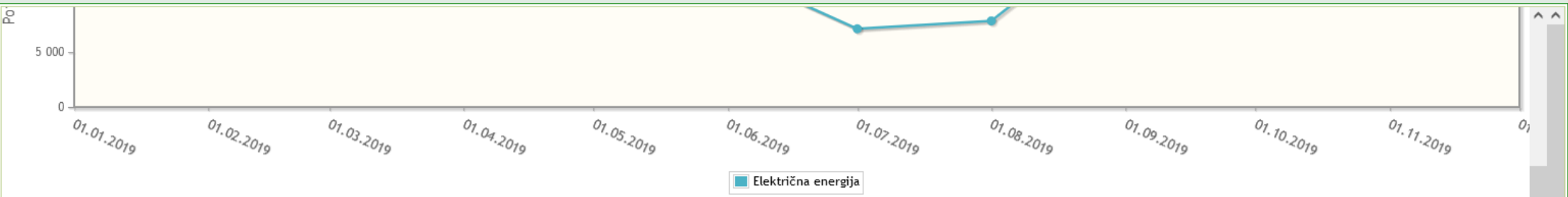
- Svi energenti
- Električna energija**
- Prirodni plin
- Plin u boci
- Loživo ulje ekstra lako
- Voda

**Grupa energenata**

- EE
- Grijanje
- Voda

**Mjerno mjesto (Električna energija)**

- 0172530015
- 0172533071



**Apsolutne vrijednosti**

- Apsolutne vrijednosti
- Apsolutne vrijednosti
- Usporedba s očitanim

**Indikatori**

- Potrošnja [kWh]
- Energija [kWh]
- Emisija CO<sub>2</sub> [t]
- Primarna energija [kWh]
- Trošak [kWh]

**ET**

- Temperatura [°C]
- Stupanj da

**Kumulativna**

- Potrošnja [kWh]
- Energija [kWh]
- Emisija CO<sub>2</sub> [t]

# Case study - Ukraine

- Eight types of software are used for energy monitoring and management: AIS Energyservice, ASEM, Energobalance, UMUNI, ISE, Energyplan, EManagement24 and Kyivshchyna Energoefectyvna
- Data collected: year of construction, heating area and volume, heat load, energy consumption

The screenshot shows a software interface for energy monitoring. At the top, it identifies the building as "Київщина енергоефективна" located at 01001, м.Київ, вул. Мельникова, 40. It provides contact information: 044-206-74-47. A map shows the location in Kyiv. The main section, "Інформація про будівлю", displays various metrics: Category: "Будинок або споруда навчального закладу"; Heating: "Вимкнено"; Floors: "2"; Heating area: "3000.0 м²"; Heating volume: "9600.0 м³"; Area: "3000.0 м²"; Number of people (working hours): "257"; Heat load: "9600.0 м³"; Heating status: "Вимкнено".

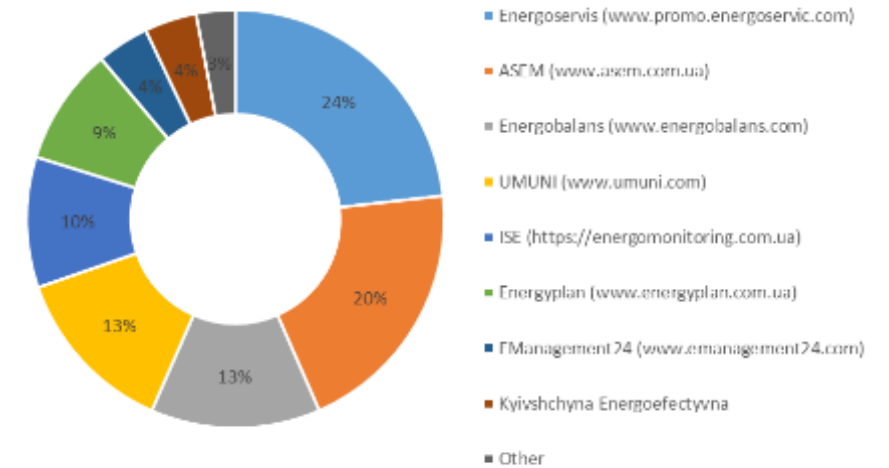
The screenshot shows a software interface with detailed information about a building. The title is "Інформація про будівлю" for "017-ЗОШ № 9 (основне приміщення)" (Code: N0040005) located at Школярів вул., Дніпрова № 102. A photo of the building is shown. The interface includes two tables of data:

Температурна зона	1	Висота	8.0 м
Точка збору фактичної температури	Україна Центр	Площа	1392.7 м²
Категорія	Будинок або споруда навчального закладу	Об'єм	6821.0 м³
Рік	1937	Опалювана площа	1392.7 м²
Поверхівки	2	Опалюваний об'єм	6821.0 м³
Кількість людей (робочий час)	504	Максимально допустиме значення теплової потужності	28 кВт/1000 м²
Кількість людей (неробочий час)	2	Теплове навантаження на опалювання	Голокват
Опалення	Центральне опалення		

# Case study - Ukraine

- Possibility of data comparison (not at the national level)
- Difficult and time consuming to transfer from one EMS to another (risk of losing data)
- Need to have a national EMS (open database accessible to all municipalities)
- Benchmarking is missing as well as national statistics needed for programming of future national building energy retrofit action plans

Energy management systems used in Ukraine



# OnePlace platform – 3D EMS

Interreg CENTRAL EUROPE BOOSTEE-CE

## OnePlace

The Online Energy Platform

HOME LIVING ENERGY MARKETPLACE ENERGY EFFICIENT CITIES FINANCING ENERGY EFFICIENCY 3D ENERGY MANAGEMENT SYSTEM

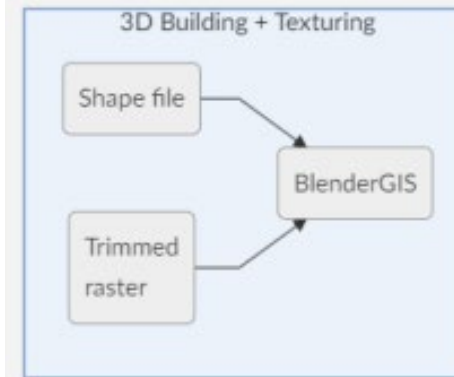
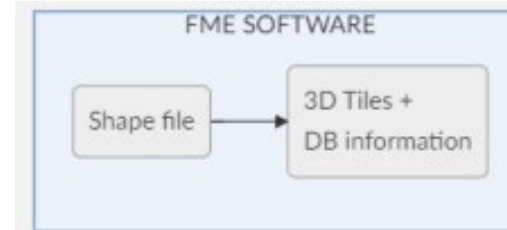
### OnePlace

## The Online Energy Platform

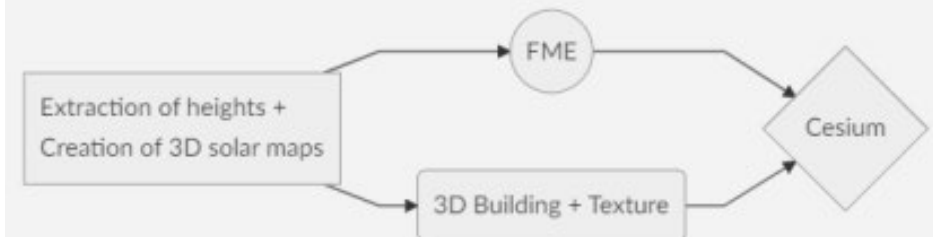
This is an open platform where you can find interesting guidebooks, presentations, online tools and case studies, that will help you improve the energy efficiency of your building(s) and involve public authorities and users in energy saving activities.

The OnePlace platform has 4 main modules:

- Living Energy Marketplace
- Energy Efficient Cities
- Financing Energy Efficiency
- 3D Energy Management System



Web application based in Cesium:

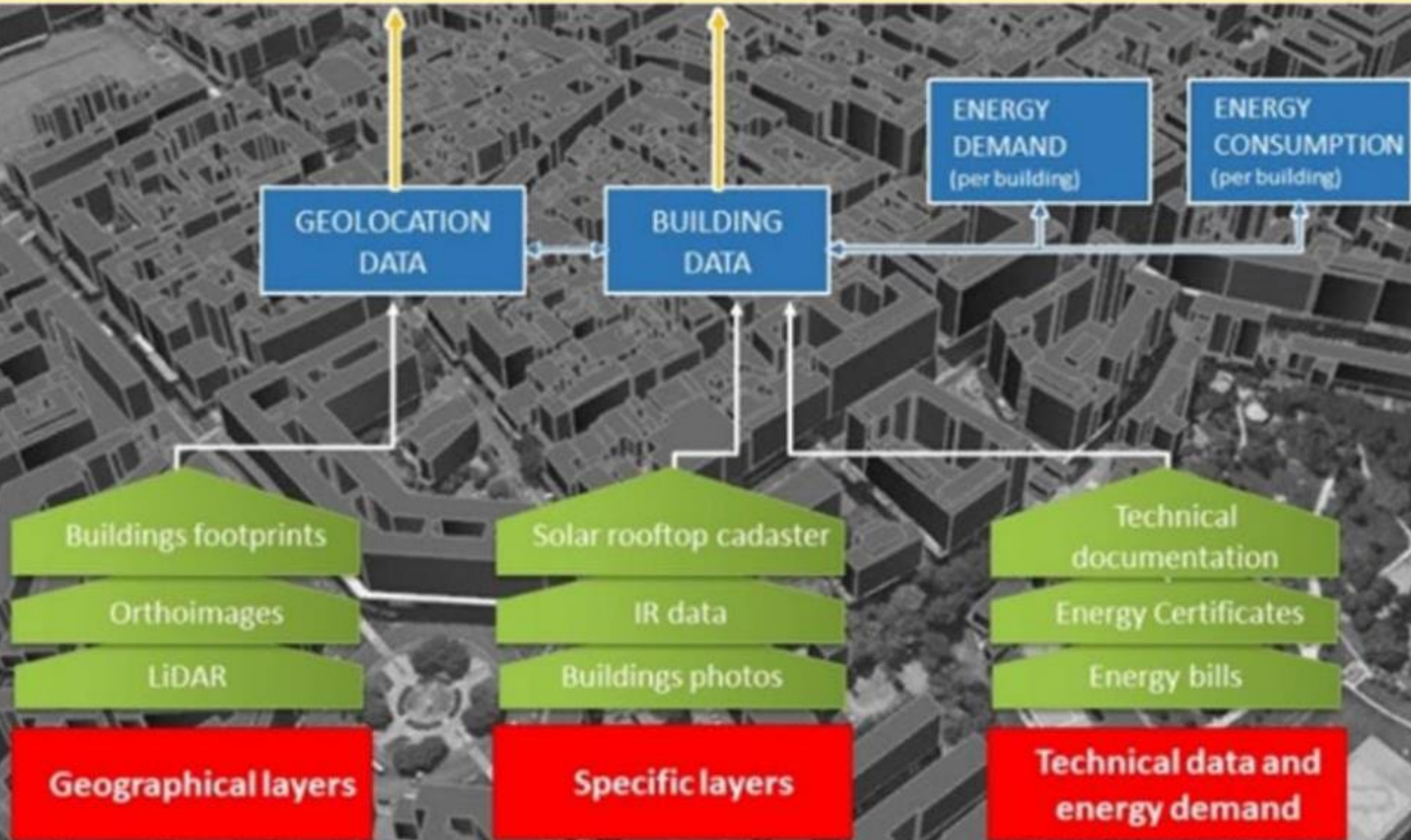


# OnePlace platform

- <https://oneplace.max.si/3d>
- 4 modules
  - Living Energy Marketplace – LEM
  - Energy Efficiency Cities – EEC
  - Financing Energy Efficiency – FEE
  - 3D Energy Management System – 3DEMS
- The viewer is a webGIS that allows users to interactively navigate a map or 3D building models of a pilot location, select a building of interest and retrieve energy and other cadastral/building information, including non-spatial data



# Energy Geodatabase for public buildings





### 3D ENERGY MANAGEMENT SYSTEM

#### Cities

Velenje, Slovenia

#### Color by attribute

- Default
- By height
- By area
- By perimeter

#### Filter

By height:

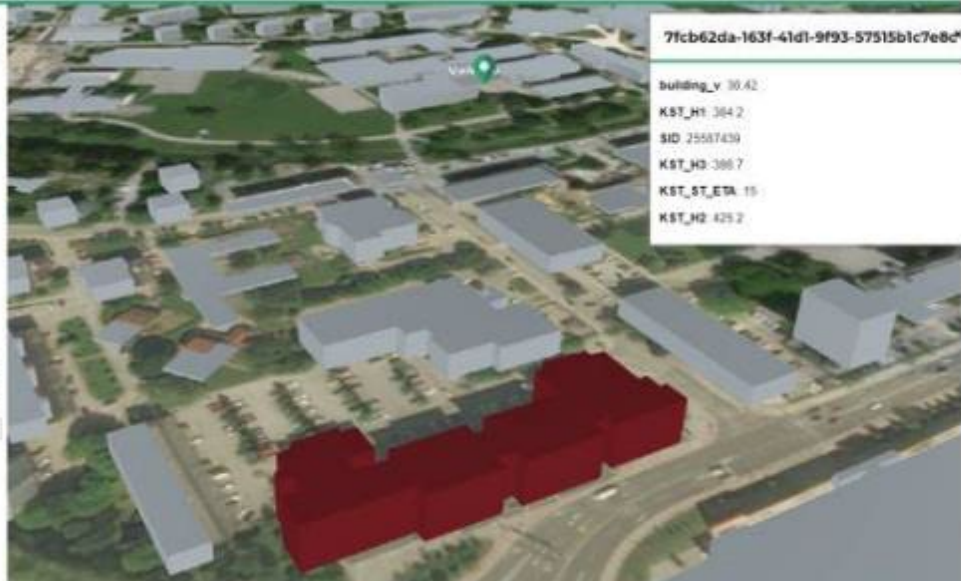
Larger than:

Value for filter:

Filter

#### Display options

- Shadows



7fcb62da-163f-41d1-9f93-57515b1c7e8c

building\_v: 30.42  
 KST\_H1: 304.2  
 SID: 25587439  
 KST\_H0: 306.7  
 KST\_ST\_ETD: 15  
 KST\_H2: 425.2

### 3D ENERGY MANAGEMENT SYSTEM

#### Cities

Koprivnica, Croatia

#### Color by attribute

- Default
- By height
- By area
- By perimeter

#### Filter

By height:

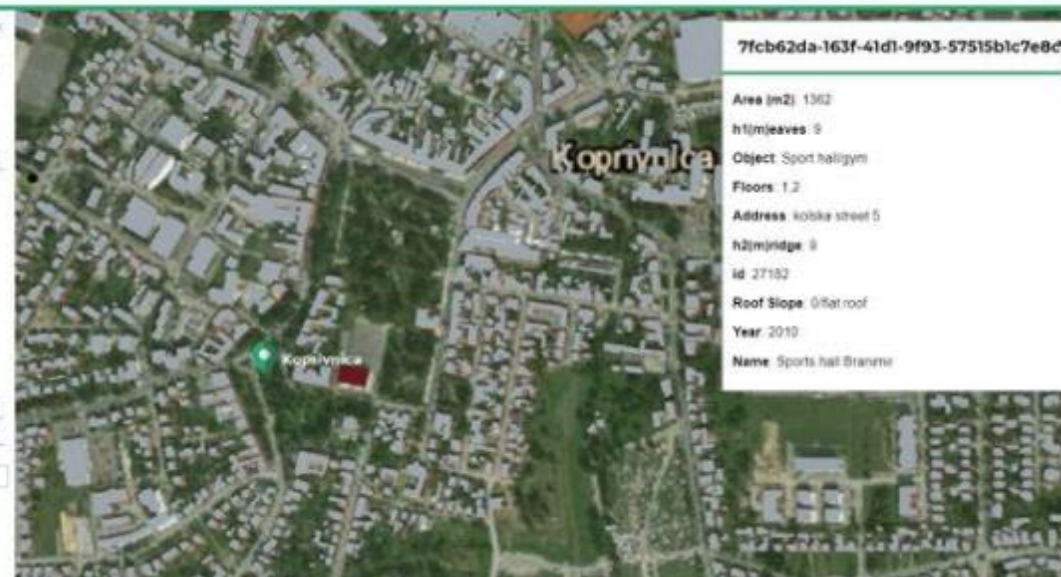
Larger than:

Value for filter:

Filter

#### Display options

- Shadows



7fcb62da-163f-41d1-9f93-57515b1c7e8c

Area (m2): 1362  
 h1(m)/leaves: 9  
 Object: Sport haligym  
 Floors: 1.2  
 Address: kolka street 5  
 h2(m)/ridge: 8  
 id: 27182  
 Roof Slope: 0/flat roof  
 Year: 2010  
 Name: Sports hal Braner

### 3D ENERGY MANAGEMENT SYSTEM

#### Cities

Judenburg, Austria

#### Color by attribute

- Default
- By height
- By area
- By perimeter

#### Filter

By height:

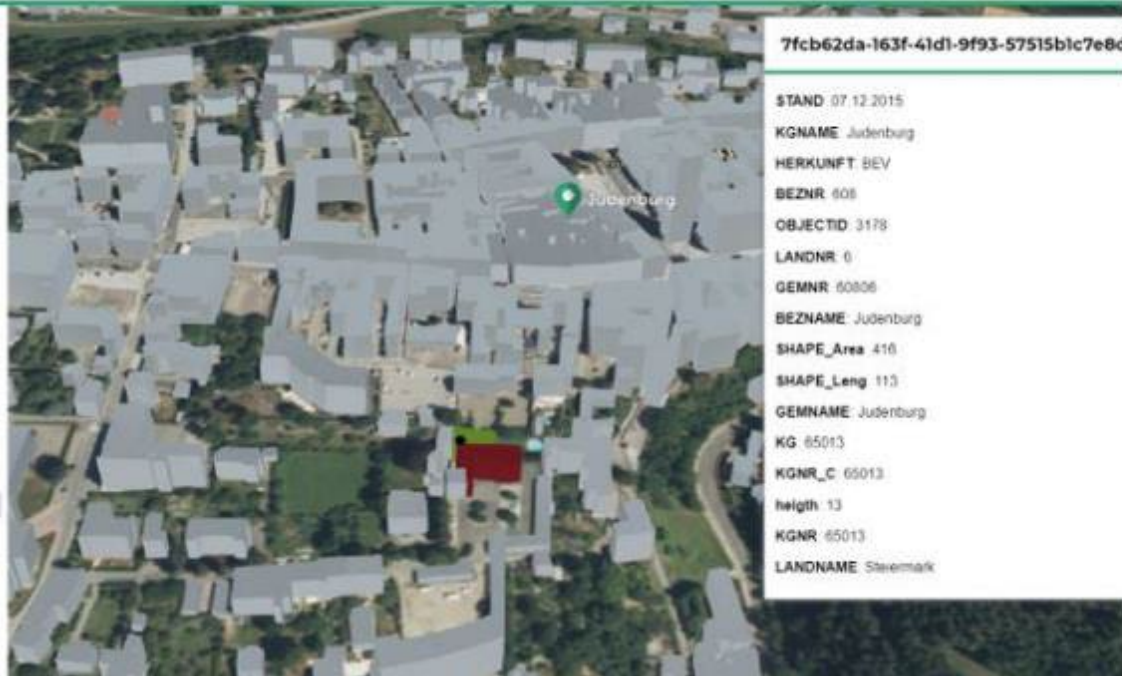
Larger than:

Value for filter:

Filter

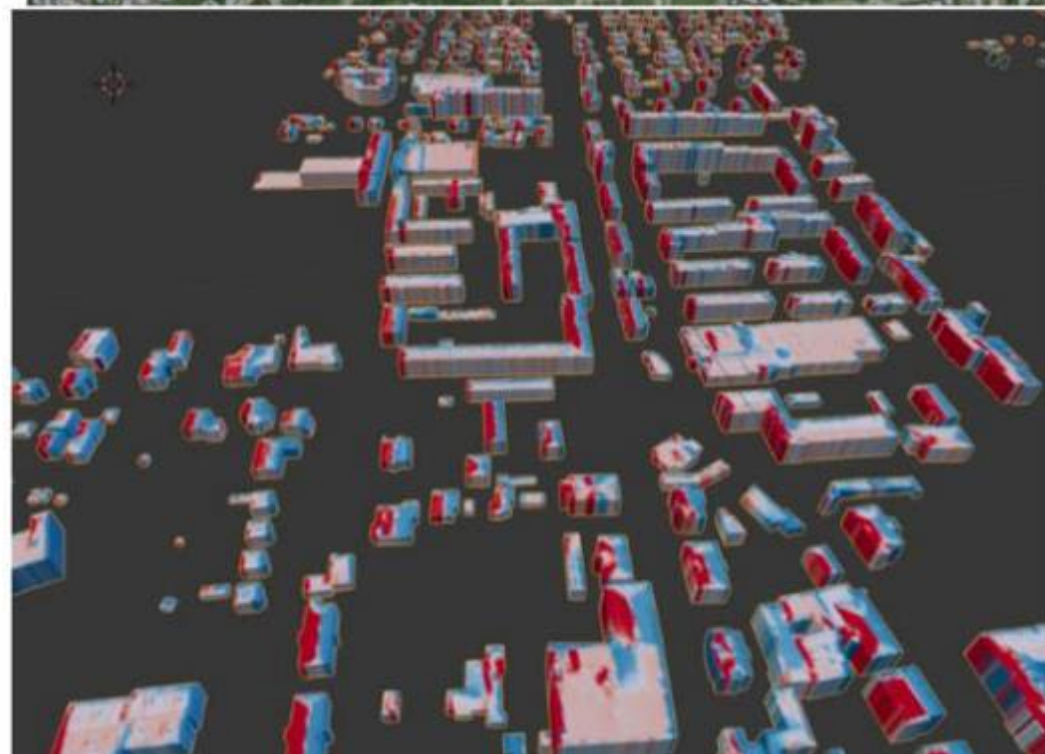
#### Display options

- Shadows



7fcb62da-163f-41d1-9f93-57515b1c7e8c

STAND: 07.12.2015  
 KGNAME: Judenburg  
 HERKUNFT: BEV  
 BEZNR: 608  
 OBJECTID: 3178  
 LANDNR: 0  
 GEMNR: 60806  
 BEZNAME: Judenburg  
 SHAPE\_Area: 416  
 SHAPE\_Leng: 113  
 GEMNAME: Judenburg  
 KG: 85013  
 KGNR\_C: 65013  
 height: 13  
 KGNR: 65013  
 LANDNAME: Staremark



# The Energy Atlas – Berlin, Germany

- The Energy Atlas of Berlin presents an integrated approach for strategic energy planning and use of renewable sources in urban areas
- Visualizing the effects of planned measures
- Based on CityGML semantic 3D city model of Berlin (information such as building address, height, volumes, purpose, etc.)
- Solar potential estimated for ca. 500,000 Berlin's roof from the Solar Atlas Berlin (roof pitch, solar irradiation, average efficiency and price of solar cells)
- Data and modelling approach for various utility network (i.t. gas, water, electricity, etc.) developed in the SIMKAS-3D project
- Methodology to perform assessment of the energy retrofit of buildings and heating energy consumption

# The Energy and Climate Atlas – Helsinki, Finland

- The Helsinki Climate and Energy Atlas is using 3D city model. The energy atlas of the city is part of the mySMARTLife project
- The atlas has compiled energy-related data on its buildings stock and made it freely available for public use
- Information such as: energy efficiency retrofit potential, performance classification, energy source used for heating
- Sophisticated analyses and simulations are also available
- Three thematic categories:
  - Basic building information: use, height, number of floors, building materials, year of construction, etc.
  - Building energy and retrofit information (heating system, energy source, energy certificates, etc.)
  - Building consumption data



Q&As

Thank you for your attention!

Matija Vajdić