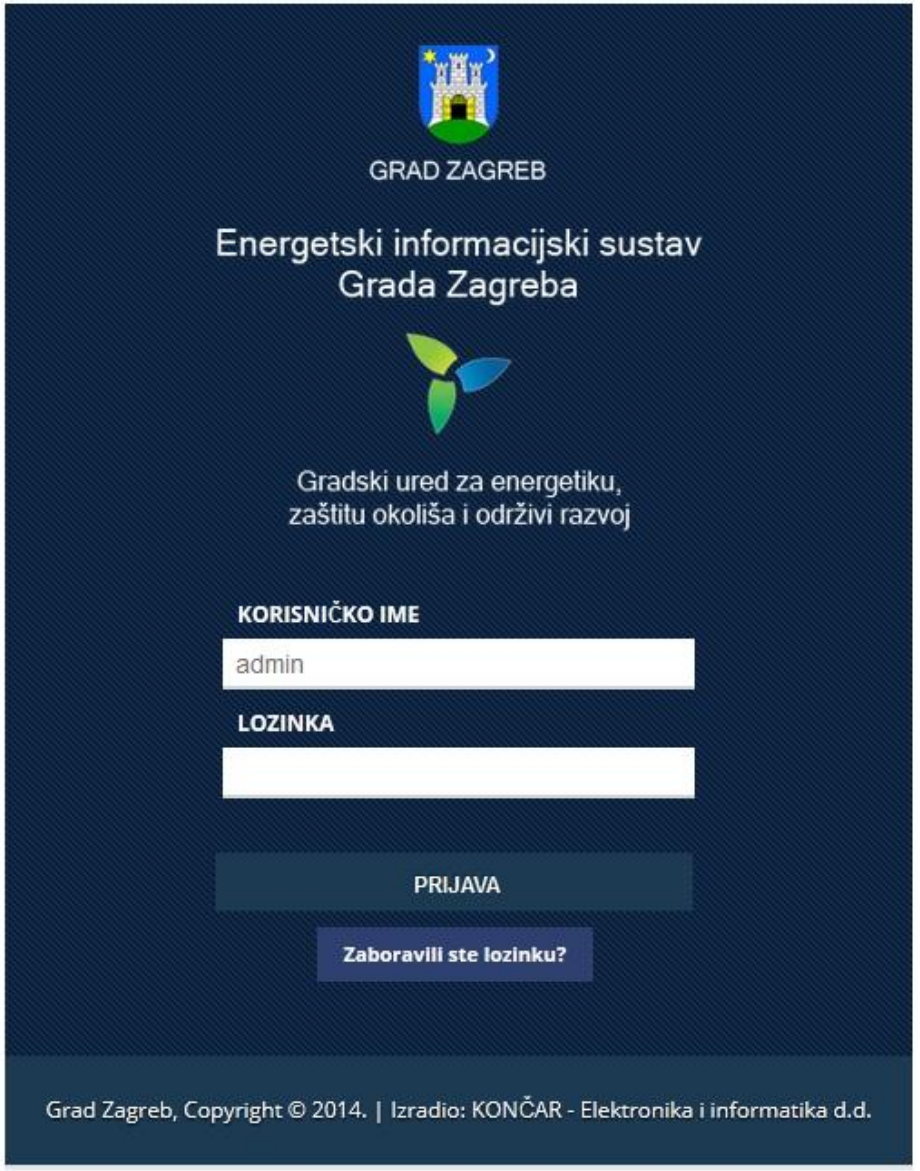
ENERGY INFORMATION SYSTEM

ICT solution for collection and analysis of data on energy consuption



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Main objectives of the EIS

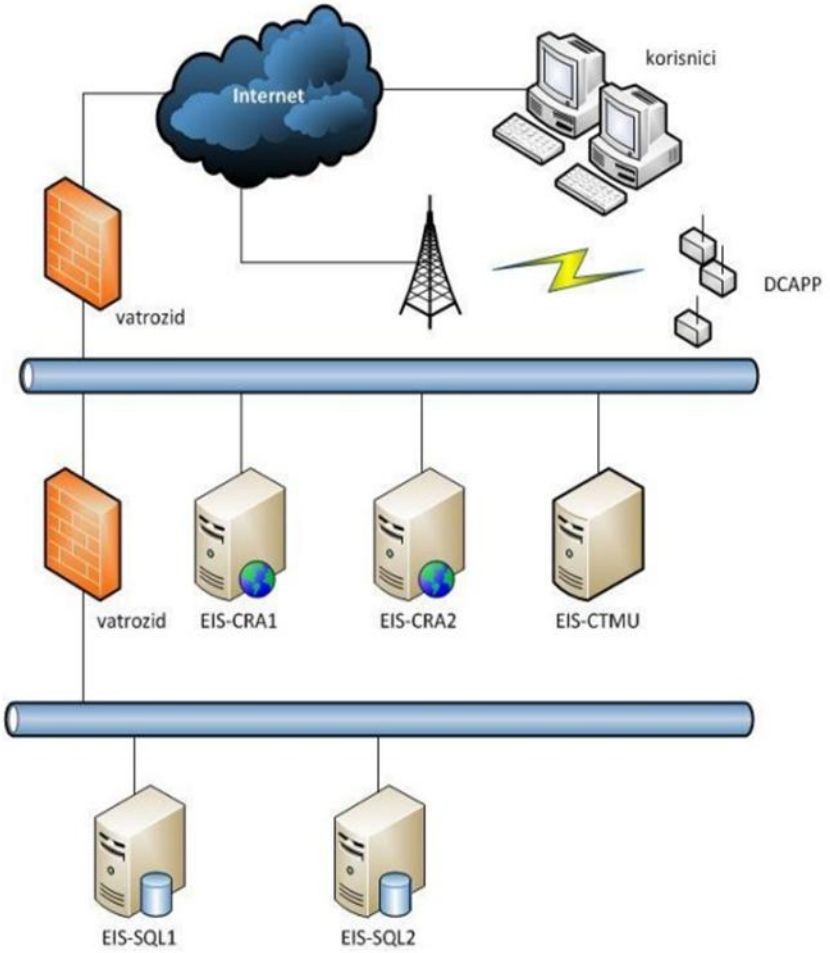
- collecting and storing data on energy consumption
  - early detection and alarming in case of breakdowns, unexpected events and poor energy efficiency
  - monitoring and management of energy consumption
  - analysis of collected data
- support in consumption planning and energy efficiency measures
- support in planning investments into energy refurbishment and monitoring refurbishment projects
- reducing energy consumption
- improving energy efficiency in buildings
- taylor-made tool for facility management

Domain of the EIS

- buildings owned by the City of Zagreb
- monitoring energy and water consumption for about 900 facilities owned by the City of Zagreb through energy information system
- the average energy consumption of the buildings is about 275 GWh/a (heating, hot water and electricity)
- net usable area of objects is about 1.5 mil m^2

EIS system architecture

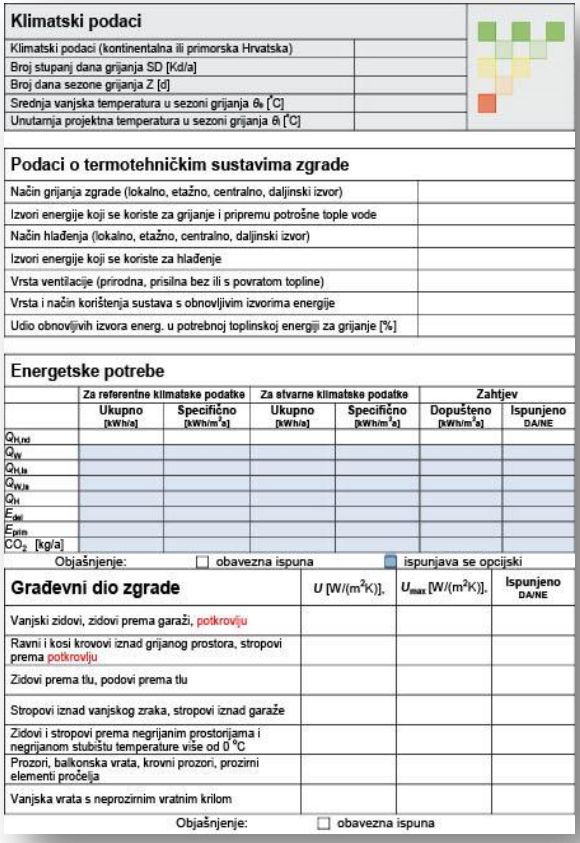
- OBJECTS - buildings
- SUBJECTS – users
- DATA :
- static
  - related to the object
  - related to the subject
- dynamic
- ANALYSIS
- REPORT



Static data

1. Static data related to buildings (objects)
    - collection of static data objects is made from energy audits and energy certificates of buildings
    - area of heating / cooling

Construction characteristics of the building, the condition of the envelope
    - annual heating/cooling demand
    - heat losses of the building
    - energy source for heating / cooling
    - energy classification
    - type of implemented renewable energy
    - energy and cost savings measures



Klimatski podaci	
Klimatski podaci (kontinentalna ili primorska Hrvatska)	
Broj stupanj dana grijanja SD [Kd/a]	
Broj dana sezone grijanja Z [d]	
Srednja vanjska temperatura u sezoni grijanja θ_e [°C]	
Unutarnja projektna temperatura u sezoni grijanja θ [°C]	

Podaci o termotehničkim sustavima zgrade	
Način grijanja zgrade (lokalno, etažno, centralno, daljinski izvor)	
Izvori energije koji se koriste za grijanje i pripremu potrošne tople vode	
Način hlađenja (lokalno, etažno, centralno, daljinski izvor)	
Izvori energije koji se koriste za hlađenje	
Vrsta ventilacije (prirodna, prisilna bez ili s povratom topline)	
Vrsta i način korištenja sustava s obnovljivim izvorima energije	
Udio obnovljivih izvora energ. u potrebnoj toplinskoj energiji za grijanje [%]	

Energetske potrebe	Za referentne klimatske podatke		Za stvarne klimatske podatke		Zahtjev	
	Ukupno [kWh/a]	Specifično [kWh/m²a]	Ukupno [kWh/a]	Specifično [kWh/m²a]	Dopušteno [kWh/m²a]	Ispunjeno DA/NE
$Q_{H,nd}$						
Q_W						
$Q_{H,la}$						
$Q_{W,la}$						
Q_H						
E_{del}						
E_{prim}						
CO_2 [kg/a]						

Objašnjenje: ☐ obavezna ispuna ▢ ispunjava se opcijski

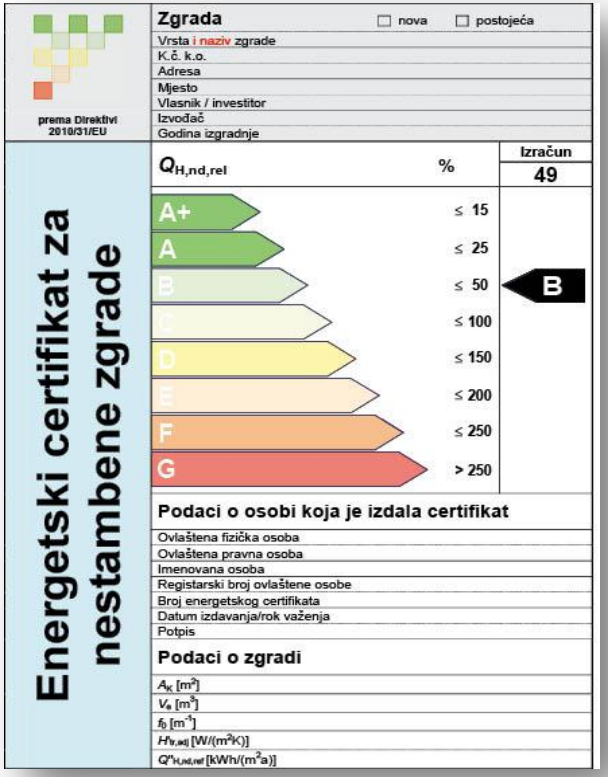
Građevni dio zgrade	U [W/(m²K)],	U_{max} [W/(m²K)],	Ispunjeno DA/NE
Vanjski zidovi, zidovi prema garaži, potkrovlju			
Ravni i kosi krovovi iznad grijanog prostora, stropovi prema potkrovlju			
Zidovi prema tlu, podovi prema tlu			
Stropovi iznad vanjskog zraka, stropovi iznad garaže			
Zidovi i stropovi prema negrijanim prostorijama i negrijanom stubištu temperature više od 0 °C			
Prozori, balkonska vrata, krovni prozori, prozirni elementi pročelja			
Vanjska vrata s neprozirnim vratnim krilom			

Objašnjenje: ☐ obavezna ispuna

Static data

- 2 .Static data related to users (subjects):

- information about the users
- number of users
- purpose of the use
- hours of use



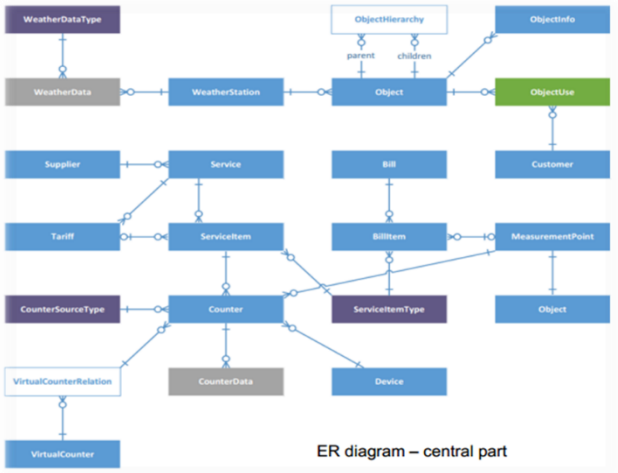
Dynamic data

- 1. consumption of energy and water :
  - according to power bills from the energy supplier (usually on a monthly level) which is entered into the system manually
  - by remote meter devices, on an hourly basis
- 2. daily meteorological data :
  - temperature data
  - the number of Celsius degree-days of the heating/cooling season (according to season)
  - the amount of solar radiation
- 3. produced energy by RES systems

Data models

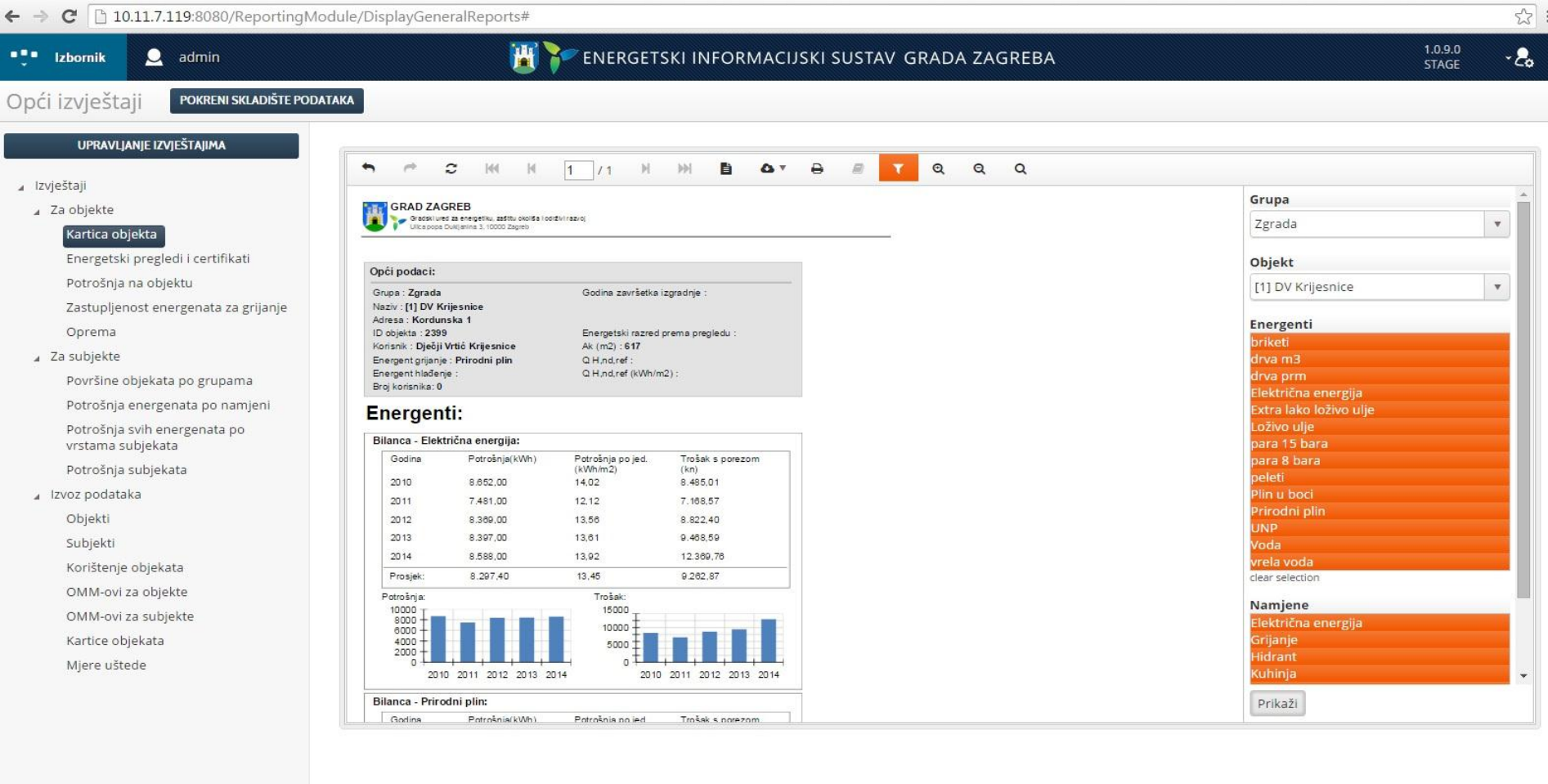
- hierarchical relations
  - between object and subject (by connection more-more over a time period)
- relations many to many
  - (object, subject, static and dyamic data)
  - each object is tied to one or more users

  (subjects) that use the object in a specific period
- Time domain
  - objects and users are monitored in a time domain with regards to the changes in object use

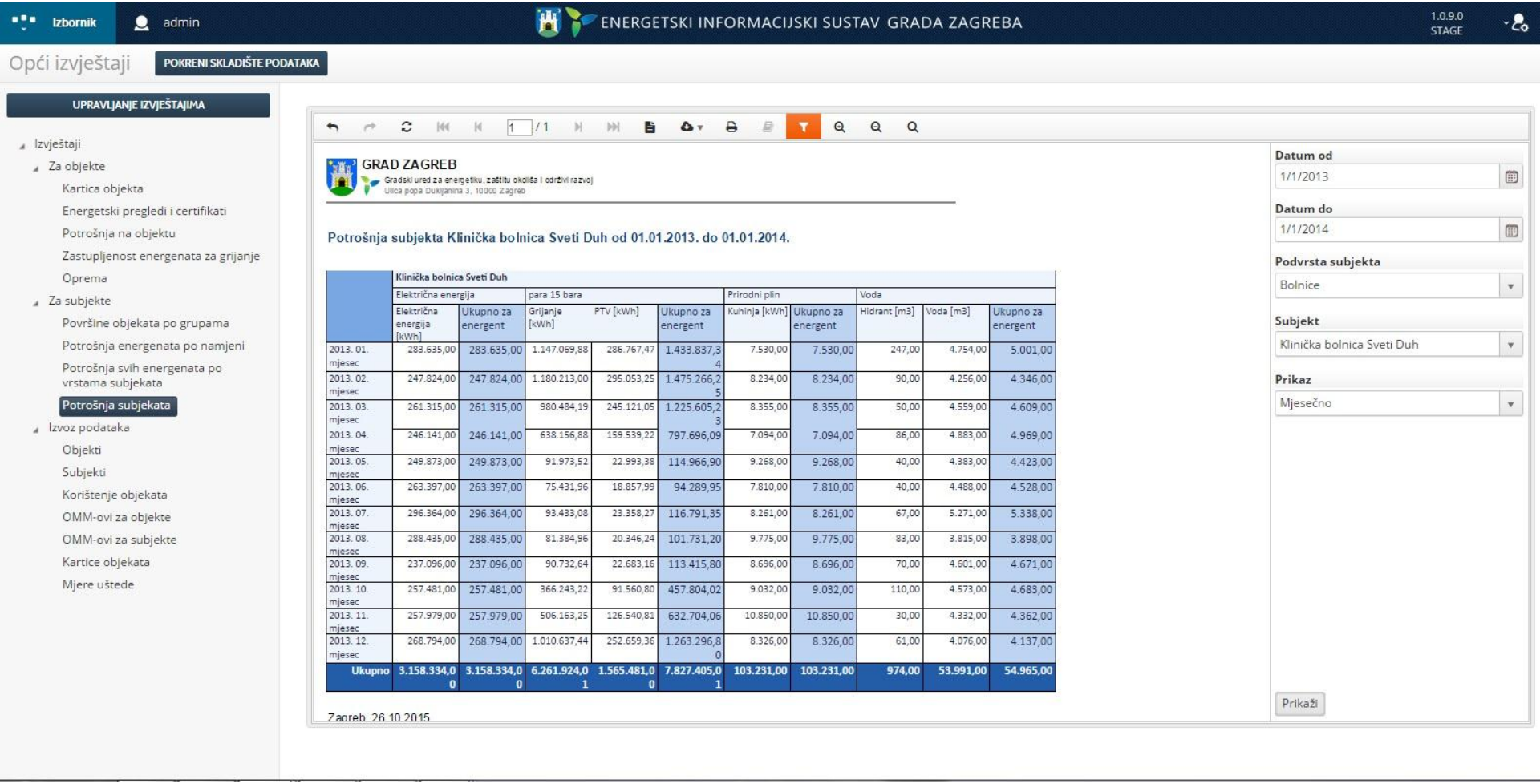


ER diagram – central part

Report – Object sheet

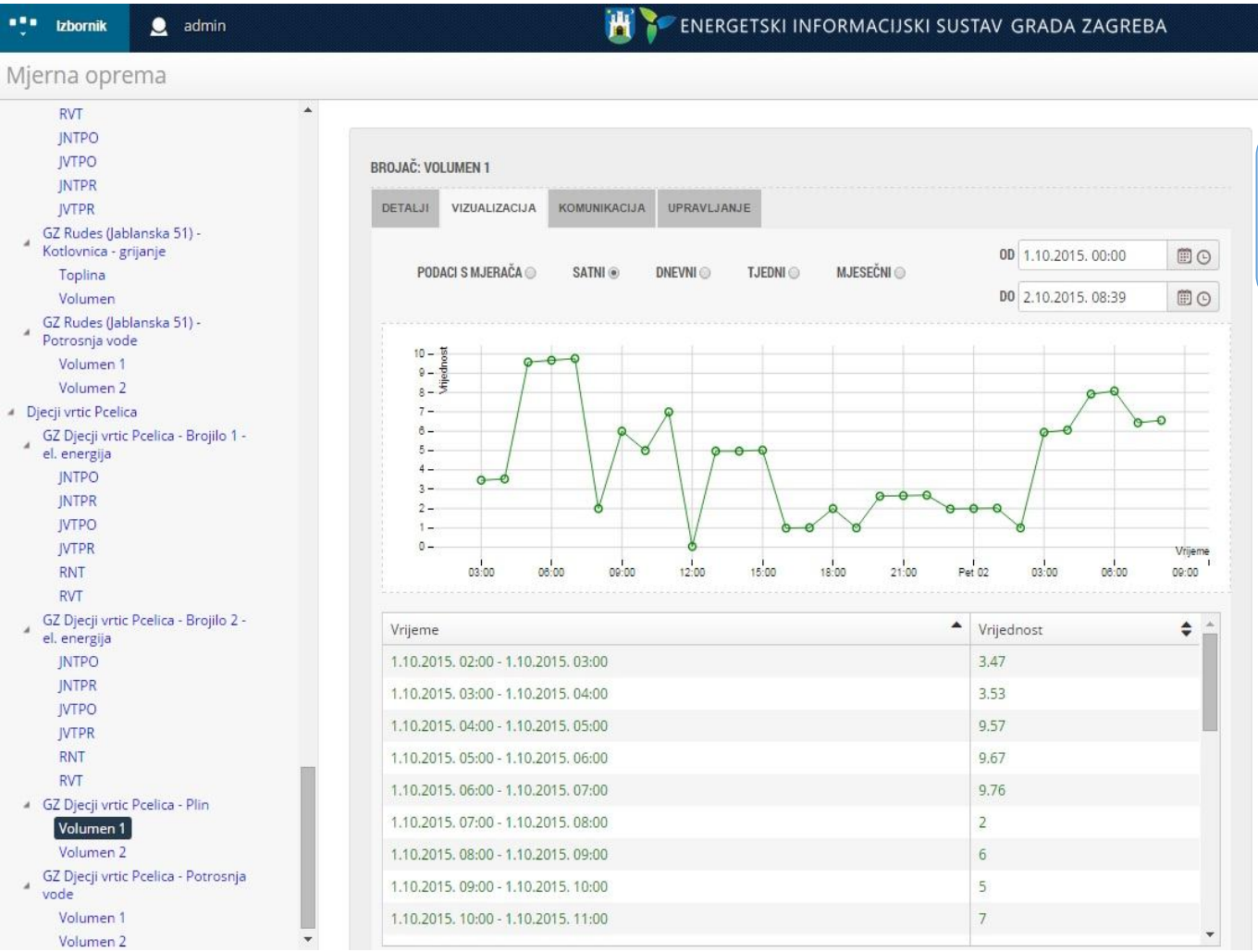


Report on energy consumption of the buildings



	Klinička bolnica Sveti Duh									
	Električna energija		para 15 bara			Prirodni plin		Voda		
	Električna energija [kWh]	Ukupno za energent	Grijanje [kWh]	PTV [kWh]	Ukupno za energent	Kuhinja [kWh]	Ukupno za energent	Hidrant [m3]	Voda [m3]	Ukupno za energent
2013. 01. mjesec	283.635,00	283.635,00	1.147.069,88	286.767,47	1.433.837,34	7.530,00	7.530,00	247,00	4.754,00	5.001,00
2013. 02. mjesec	247.824,00	247.824,00	1.180.213,00	295.053,25	1.475.266,25	8.234,00	8.234,00	90,00	4.256,00	4.346,00
2013. 03. mjesec	261.315,00	261.315,00	980.484,19	245.121,05	1.225.605,23	8.355,00	8.355,00	50,00	4.559,00	4.609,00
2013. 04. mjesec	246.141,00	246.141,00	638.156,88	159.539,22	797.696,09	7.094,00	7.094,00	86,00	4.883,00	4.969,00
2013. 05. mjesec	249.873,00	249.873,00	91.973,52	22.993,38	114.966,90	9.268,00	9.268,00	40,00	4.383,00	4.423,00
2013. 06. mjesec	263.397,00	263.397,00	75.431,96	18.857,99	94.289,95	7.810,00	7.810,00	40,00	4.488,00	4.528,00
2013. 07. mjesec	296.364,00	296.364,00	93.433,08	23.358,27	116.791,35	8.261,00	8.261,00	67,00	5.271,00	5.338,00
2013. 08. mjesec	288.435,00	288.435,00	81.384,96	20.346,24	101.731,20	9.775,00	9.775,00	83,00	3.815,00	3.898,00
2013. 09. mjesec	237.096,00	237.096,00	90.732,64	22.683,16	113.415,80	8.696,00	8.696,00	70,00	4.601,00	4.671,00
2013. 10. mjesec	257.481,00	257.481,00	366.243,22	91.560,80	457.804,02	9.032,00	9.032,00	110,00	4.573,00	4.683,00
2013. 11. mjesec	257.979,00	257.979,00	506.163,25	126.540,81	632.704,06	10.850,00	10.850,00	30,00	4.332,00	4.362,00
2013. 12. mjesec	268.794,00	268.794,00	1.010.637,44	252.659,36	1.263.296,80	8.326,00	8.326,00	61,00	4.076,00	4.137,00
Ukupno	**3.158.334,00**	**3.158.334,00**	**6.261.924,01**	**1.565.481,00**	**7.827.405,01**	**103.231,00**	**103.231,00**	**974,00**	**53.991,00**	**54.965,00**

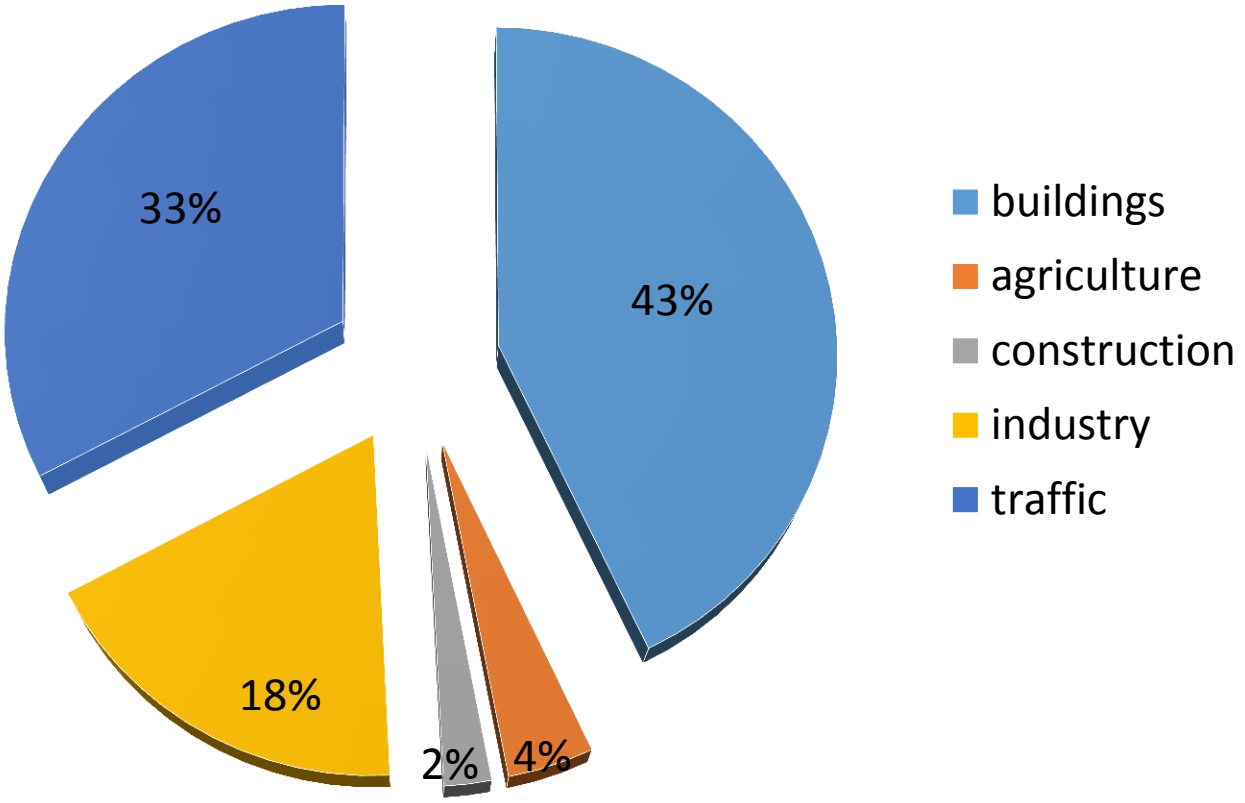
Consumption – remote measurements



Automatic reading of energy consumption in real time mode

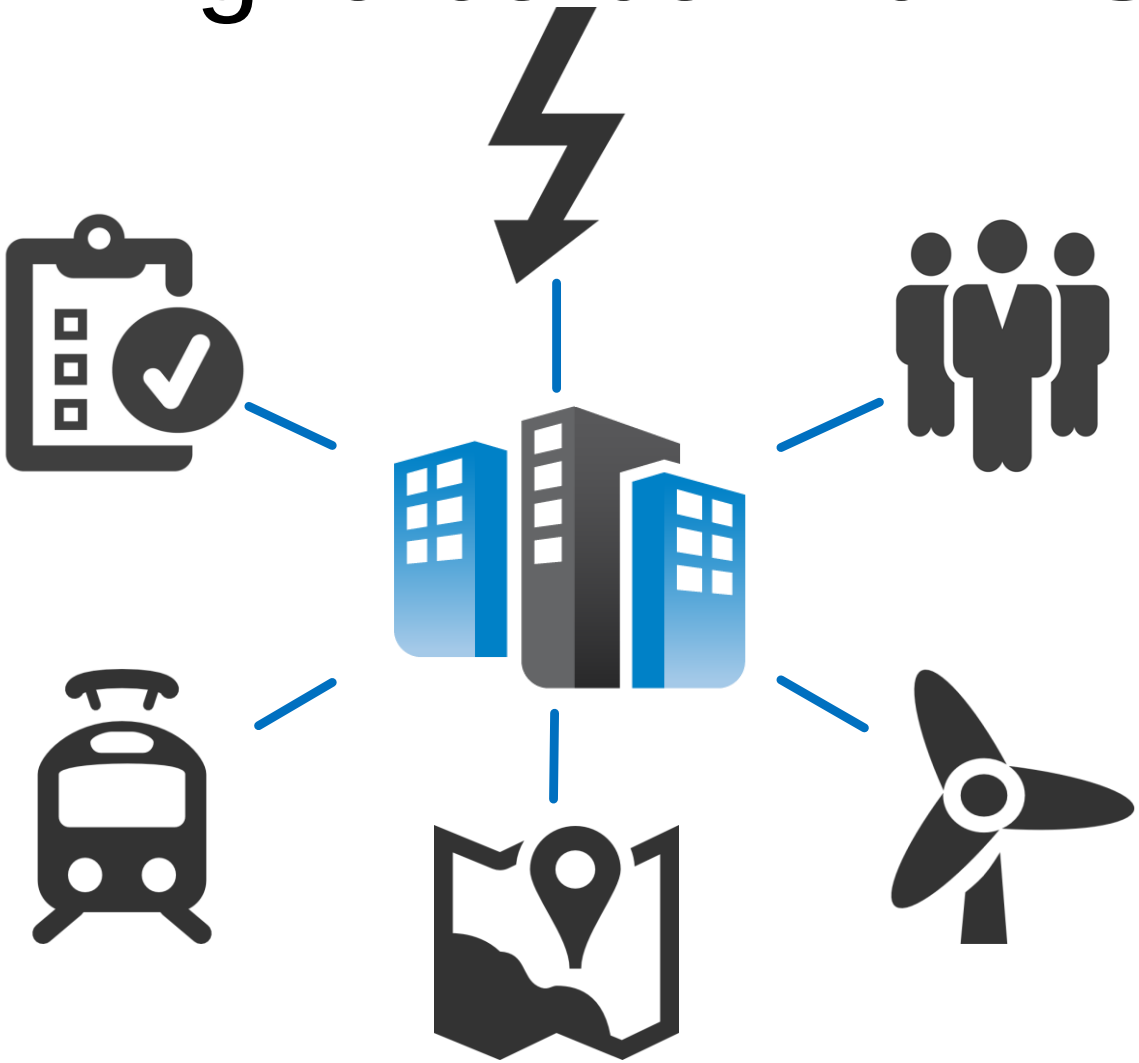
Hourly consumption of natural gas during heating season in kidergarten

Total energy consumption in Croatia



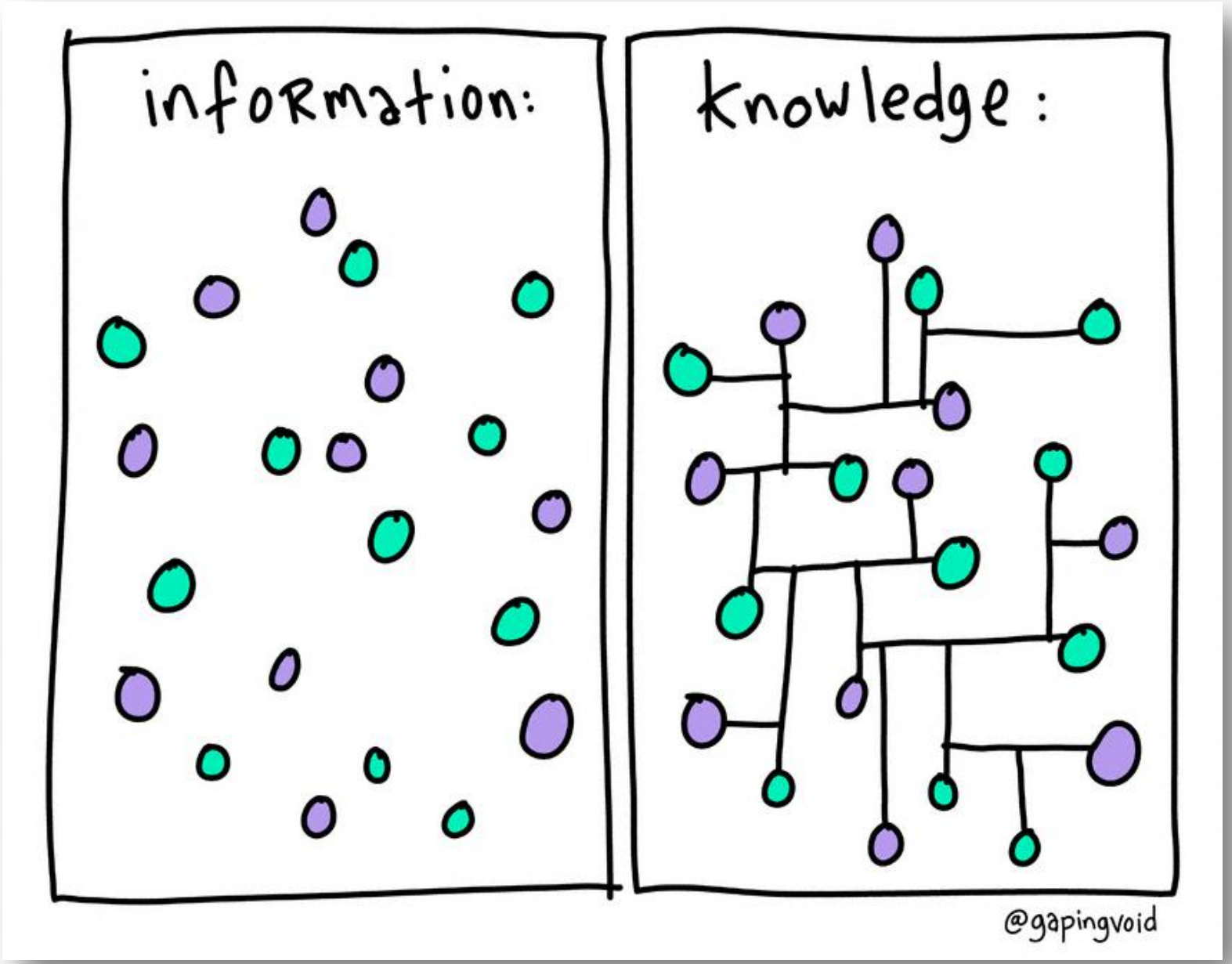
Izvor: Energija u Hrvatskoj 2011, EIHP

The driving force behind EIS

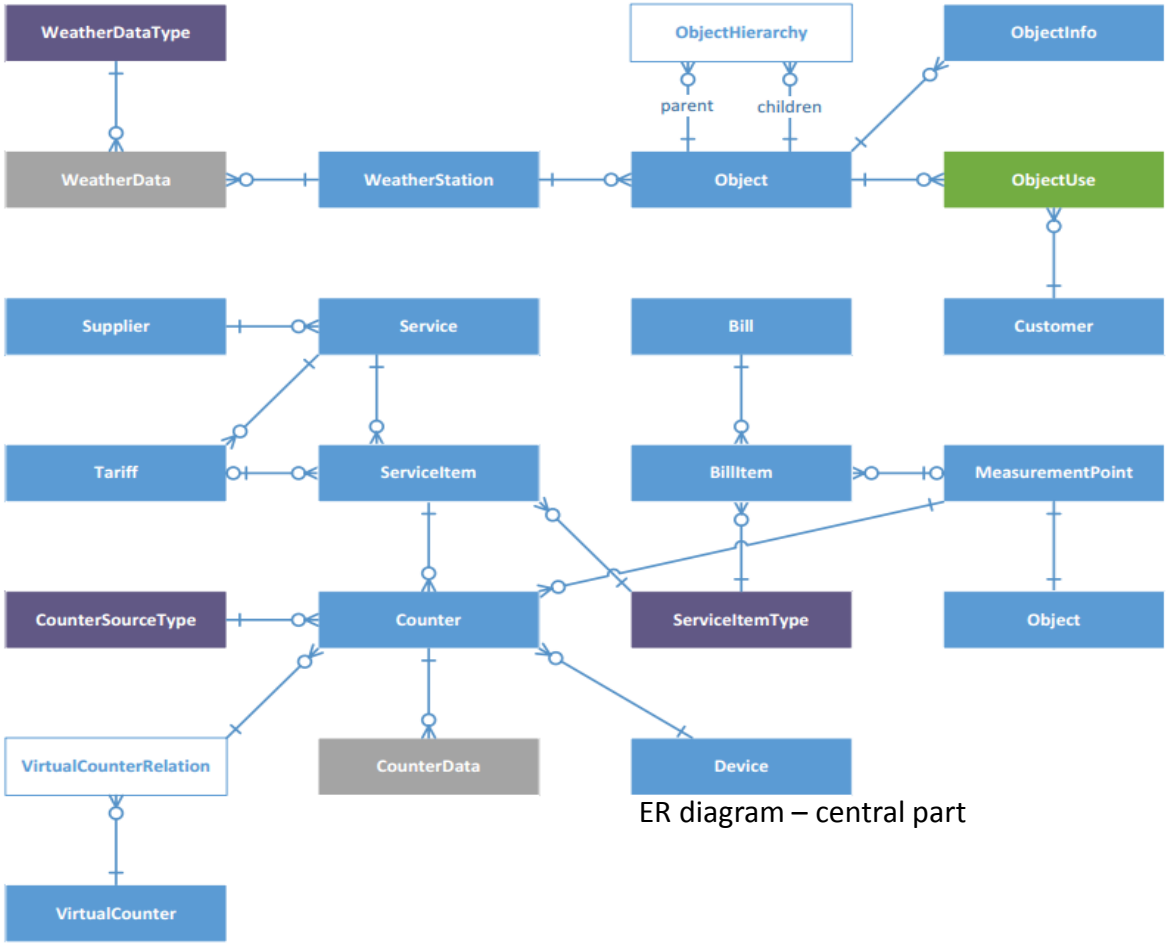


EIS – The City of Zagreb

- Integral solution for energy management
  - Data collection
    - Allows integration with smart technologies (smart metering, demand response, smart grids …)
    - Wide range of date sources
      - Import of supplier or distributor data
      - Manual input, scanning support (QR)
  - Analysis
    - Business intelligence reporting
    - Advanced analysis based on different criteria and correlation
    - Analysis based alarming
  - Consumption planning
  - Investments planning


information:
knowledge :
@gapingvoid

EIS data model



ER diagram – central part

- An object can have one or more users who change over time (they can use an object in different periods of the day)
- They can use one or more energy sources for different purposes
- All this changing over time and while being different for each energy source suppliers through time ...

EIS – Advanced Metering Infrastructure

Local area network (LAN)

Wide area network (WAN)

CONCENTRATOR

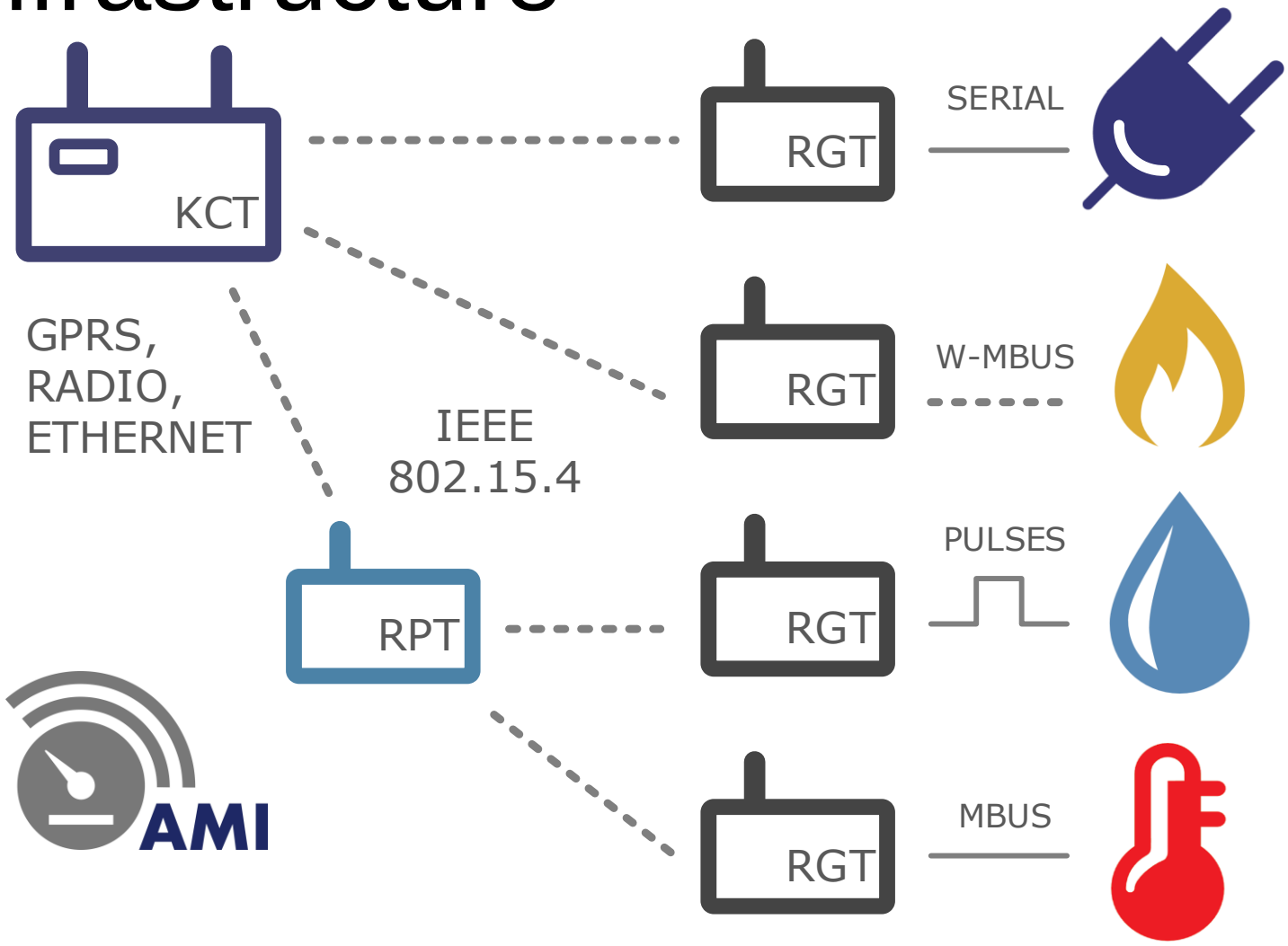
PLANNING

ANALYSIS

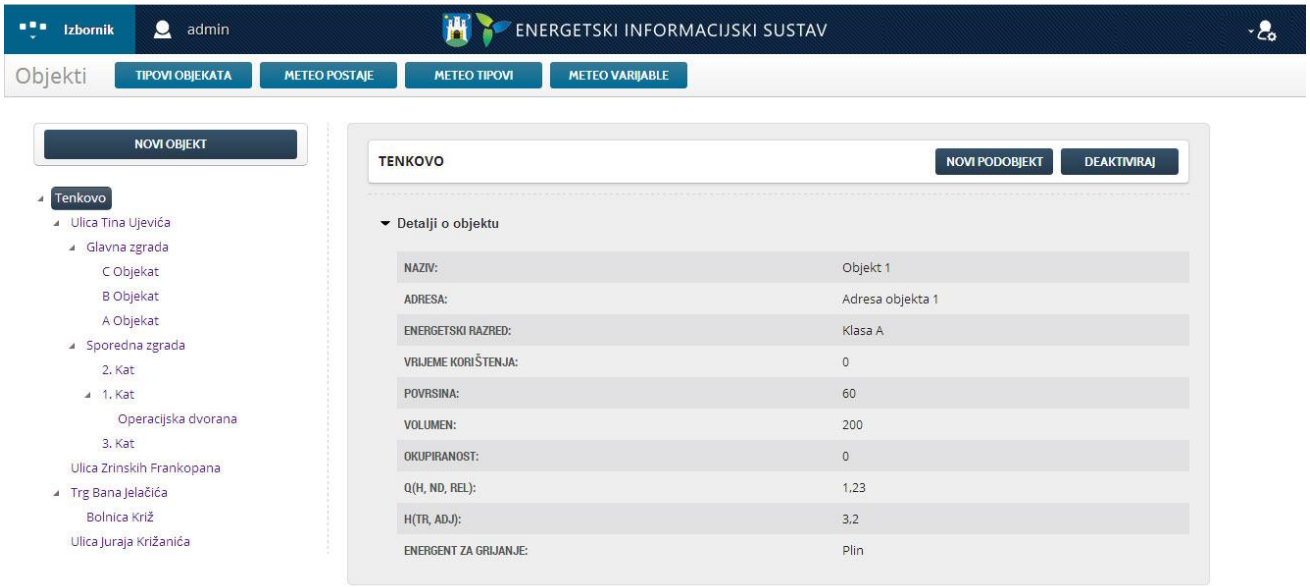
EIS

Dana collection, alarming, reporting

Advenced Metering Infrastructure



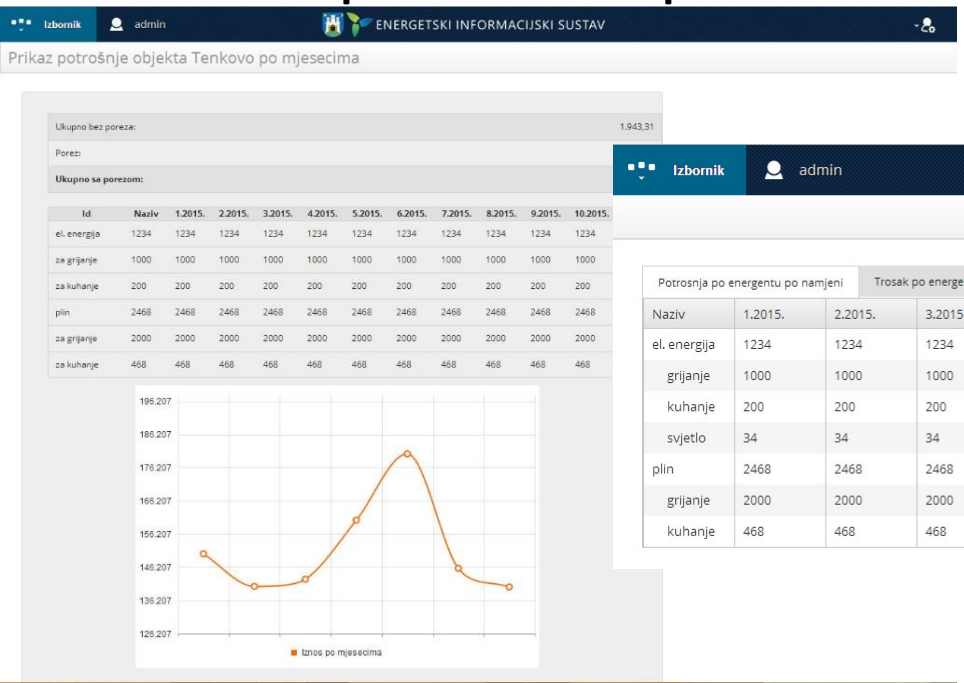
The power of EIS

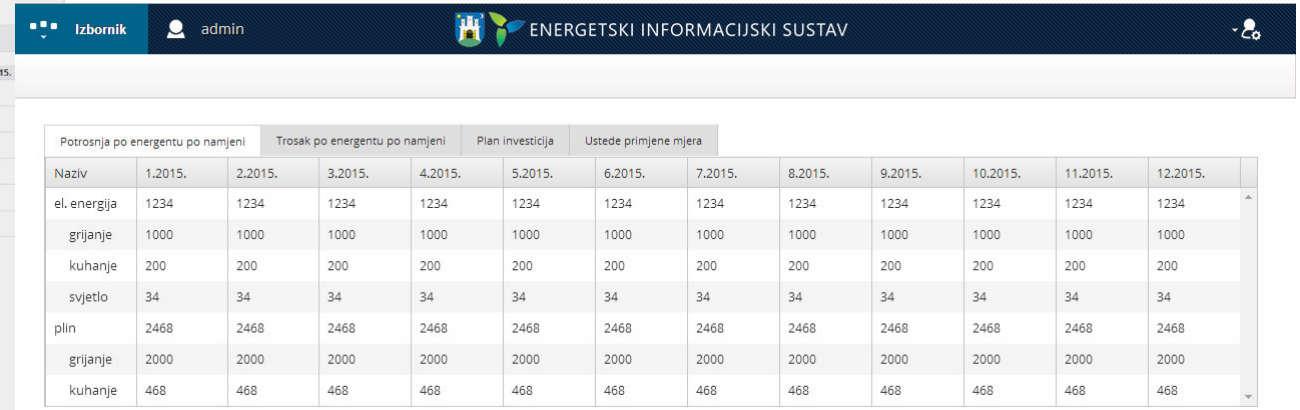


- Supports hierarchical relationships between objects and subjects
- Support relations many to many (subjects, objects, measurands)
- Supports analysis of the use of the building and all the changes through time

The power of EIS

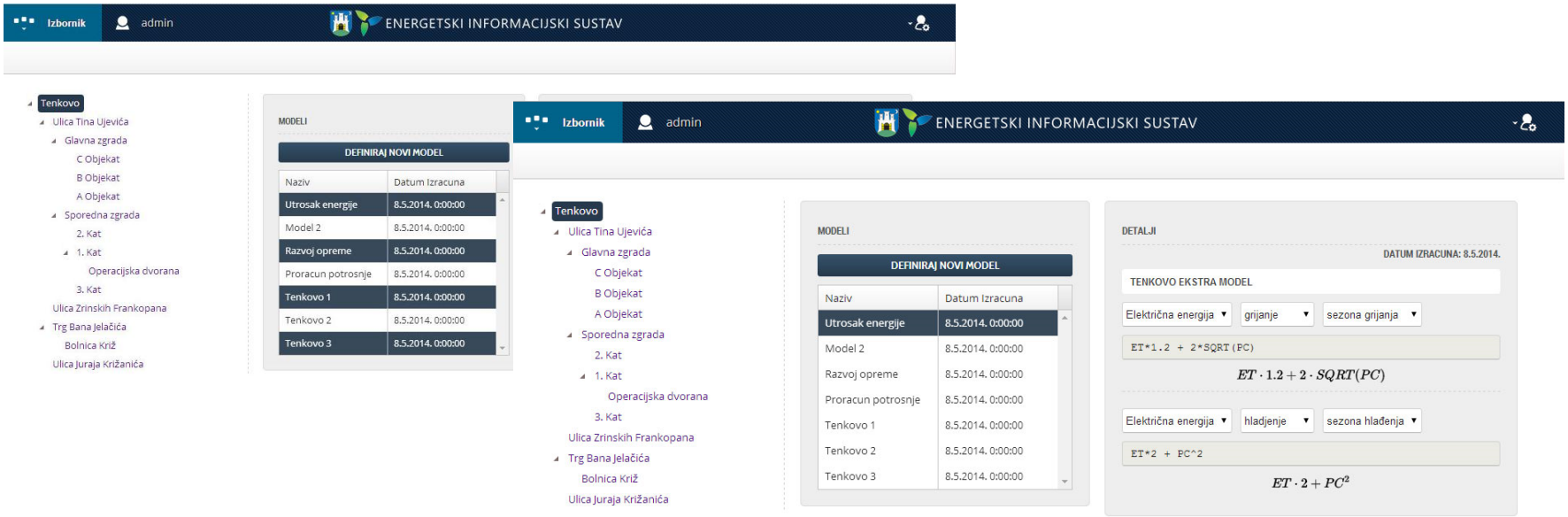
- Real-time data monitoring and historical analysis of the data regardless of the source
- Estimates impacts of different scenarios of energy efficiency
- Comparison of planned and actual consumption





The power of EIS

- EE measures management (from the review, the project, ...) and the combined measure
- Modeling estimates of consumption at the level of the building, period, energy ...



Example scenario

- What is the best way to invest 5 mil € in EE renewal?
  - 25 Kindergartens
  - 12 schools
- Analysis shows:
  - Kindergartens consumes 20 % more heat
  - Schools consume 30 % more electricity
- Modeling scenario:
  - Adding electrical equipment and public events as a parameters (lighting & time of use to object school)
  - Including temperature prediction model for next year (warmer year expected)
- Savings will be bigger with schools renewed first!

Conclusion

- EIS allows integrated management of energy
  - Monitoring
  - Planning
  - Investment optimization

- The flexibility of the system allows
  - analysis of the different user indicators
  - extension of the analysis to larger areas in the hierarchy (street, city district, city) depending only on the availability of the data
  - model adjustment to estimate actual future consumption
  - investment management budget to most effective way
  - support for a new generation Smart metering systems

About Končar – Electronic and Informatics Inc.

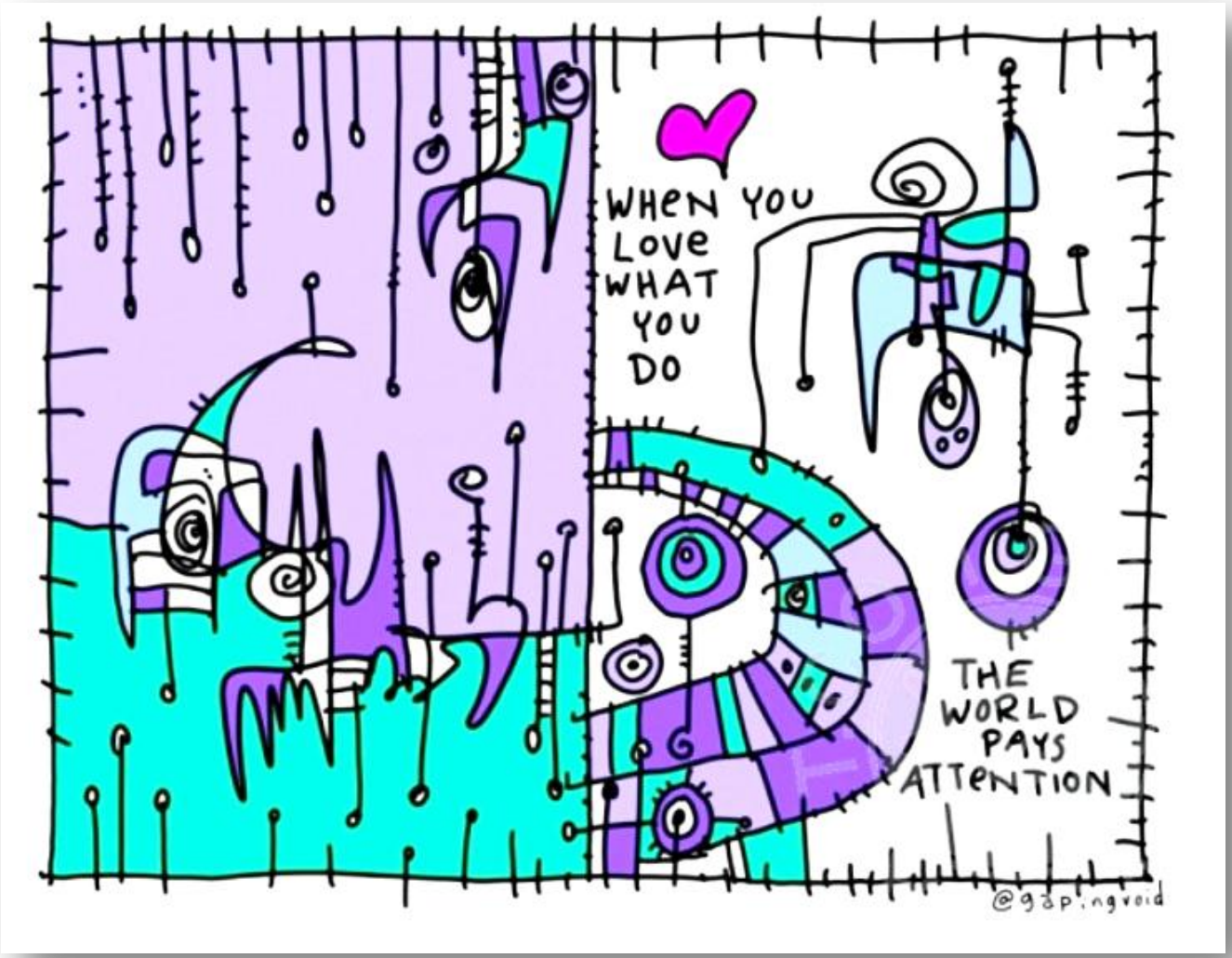
40 years as part of KONCAR group

Leading regional manufacturer and system integrator:

- **ICT systems** – Smart Metering, computers and servers, BI systems, electronic modules production
- **Energy sector** - excitation systems, protection relays, electric measurements devices and systems, process informatics,, DC and AC UPS, renewable energy sources
- **Transport** - converters and control systems for railway vehicles, EV chargers

- Main activities:

development, engineering and projecting, production, testing, commissioning and maintenance of ICT systems and devices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PAYS
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... thank you!