

# ENERGY INFORMATION SYSTEM

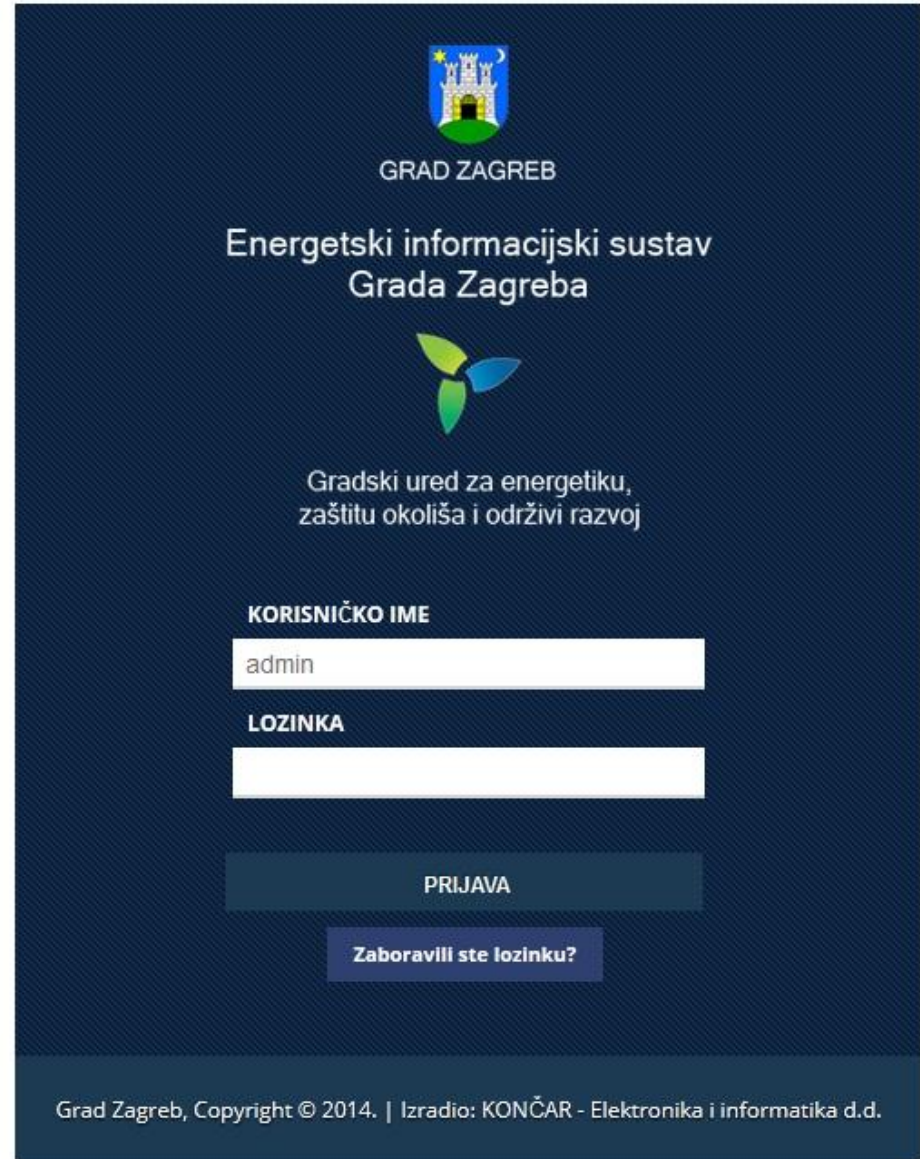
ICT solution for  
collection and analysis of  
data on energy  
consumption

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Environment and Sustainable Development*

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*Končar, Electronics and Informatics Inc.*



GRAD ZAGREB

Energetski informacijski sustav  
Grada Zagreba

Gradski ured za energetiku,  
zaštitu okoliša i održivi razvoj

KORISNIČKO IME

admin

LOZINKA

PRIJAVA

Zaboravili ste lozinku?

Grad Zagreb, Copyright © 2014. | Izradio: KONČAR - Elektronika i informatika d.d.

# 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



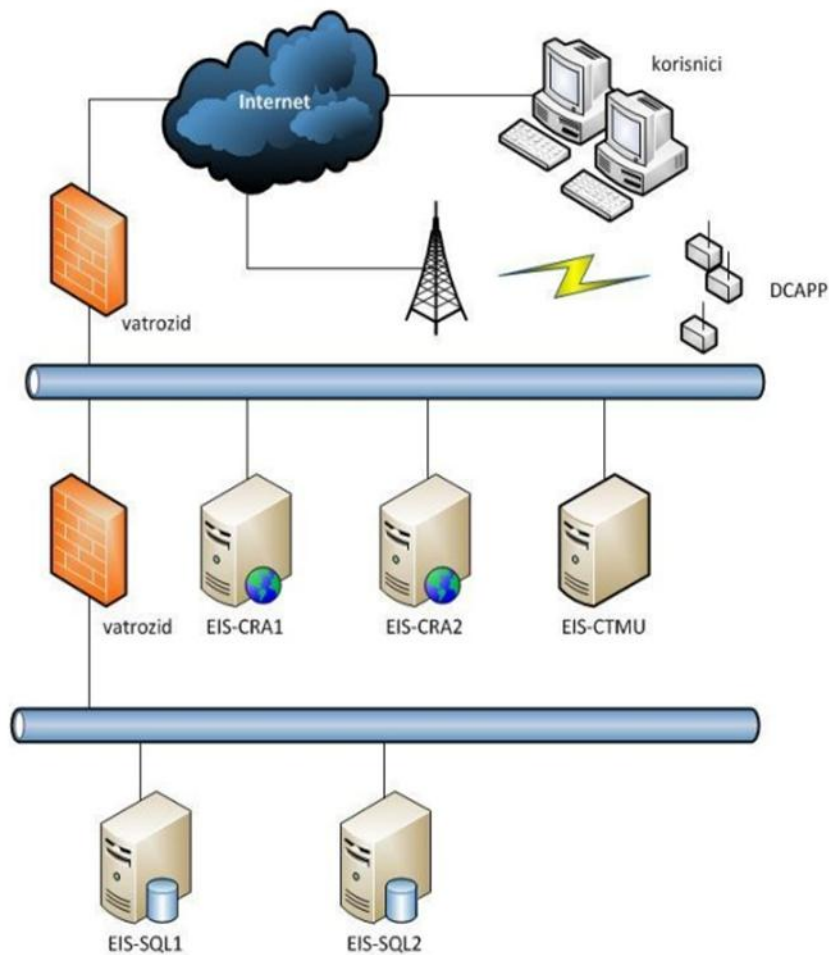
# Domain of the EIS



- 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<sup>2</sup>

# 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 $\theta_a$ [°C]						
Unutarnja projektna temperatura u sezoni grijanja $\theta_i$ [°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/m²·a]	Ukupno [kWh/a]	Specifično [kWh/m²·a]	Dopušteno [kWh/m²·a]	Ispunjeno DANE
$Q_{hw}$						
$Q_w$						
$Q_{ht}$						
$Q_{ht}$						
$Q_{ht}$						
$E_{pwh}$						
$E_{pwh}$						
$CO_2$ [kg/a]						
Objašnjenje: <input type="checkbox"/> obavezna ispunjena <input checked="" type="checkbox"/> ispunjava se opcijski						
Građevni dio zgrade			$U$ [W/(m²K)],	$U_{max}$ [W/(m²K)],	Ispunjeno DANE	
Vanjski zidovi, zidovi prema garaži, <b>potkrovlju</b>						
Ravni i kosi krovovi iznad grijanog prostora, stropovi prema <b>potkrovlju</b>						
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, prozorni elementi pročelja						
Vanjska vrata s neprozirnim vratnim krilom						
Objašnjenje: <input type="checkbox"/> obavezna ispunjena						

# Static data

- 2 .Static data related to users (subjects):
- information about the users
- number of users
- purpose of the use
- hours of use

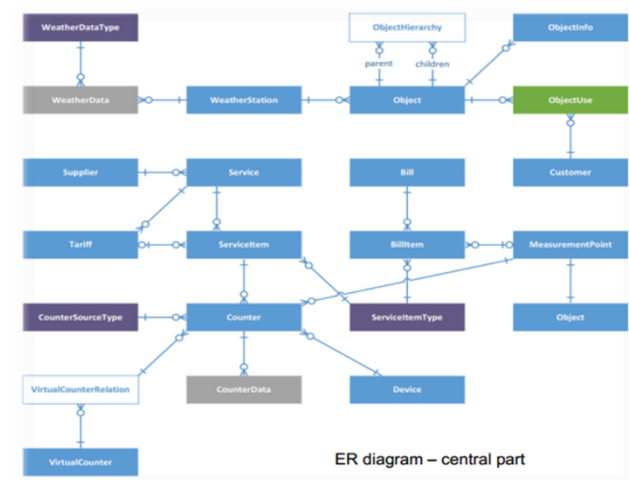
Zgrada		<input type="checkbox"/> nova <input type="checkbox"/> postojeća	
Vrsta i naziv zgrade			
K.č. k.o.			
Adresa			
Mjesto			
Vlasnik / investitor			
Izvođač			
Godina izgradnje			
prema Direktivi 2010/31/EU			
<b>Energetski certifikat za nestambene zgrade</b>	$Q_{H,nd,ret}$	%	Izračun <b>49</b>
	A+	≤ 15	
	A	≤ 25	
	B	≤ 50	<b>B</b>
	C	≤ 100	
	D	≤ 150	
	E	≤ 200	
	F	≤ 250	
	G	> 250	
	<b>Podaci o osobi koja je izdala certifikat</b>		
Ovlaštena fizička osoba			
Ovlaštena pravna osoba			
Imenovana osoba			
Registarski broj ovlaštene osobe			
Broj energetskog certifikata			
Datum izdavanja/rok važenja			
Potpis			
<b>Podaci o zgradi</b>			
$A_c$ [m <sup>2</sup> ]			
$V_e$ [m <sup>3</sup> ]			
$f_0$ [m <sup>-1</sup> ]			
$F_{H,nd,ret}$ [Wh/(m <sup>2</sup> k)]			
$Q'_{H,nd,ret}$ [kWh/(m <sup>2</sup> a)]			

# 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 dynamic 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





# Report – Object sheet

10.11.7.119:8080/ReportingModule/DisplayGeneralReports#

Izbornik admin ENERGETSKI INFORMACIJSKI SUSTAV GRADA ZAGREBA 1.0.9.0 STAGE

Opći izvještaji POKRENI SKLADIŠTE PODATAKA

## UPRAVLJANJE IZVJEŠTAJIMA

- Izvještaji
  - Za objekte
    - Kartica objekta**
    - Energetski pregledi i certifikati
    - Potrošnja na objektu
    - Zastupljenost energenata za grijanje
    - Oprema
  - Za subjekte
    - Površine objekata po grupama
    - Potrošnja energenata po namjeni
    - Potrošnja svih energenata po vrstama subjekata
    - Potrošnja subjekata
  - Izvoz podataka
    - Objekti
    - Subjekti
    - Korišćenje objekata
    - OMM-ovi za objekte
    - OMM-ovi za subjekte
    - Kartice objekata
    - Mjere uštede

GRAD ZAGREB  
Gradski uređ za energetiku, zaštitu okoliša i održivi razvoj  
Ulica pored Dupležanina 3, 10000 Zagreb

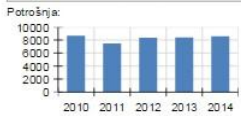
**Opći podaci:**

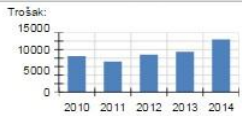
Grupa : Zgrada	Godina završetka izgradnje :
Naziv : [1] DV Kriješnice	
Adresa : Kordunska 1	
ID objekta : 2389	Energetski razred prema pregledu :
Korisnik : Dječji Vrtić Kriješnice	Ak (m2) : 617
Energent grijanje : Prirodni plin	Q H.nd.ref :
Energent hlađenje :	Q H.nd.ref (kWh/m2) :
Broj korisnika : 0	

**Energenti:**

**Bilanca - Električna energija:**

Godina	Potrošnja(kWh)	Potrošnja po jed. (kWh/m2)	Trošak s porezom (kn)
2010	8.652,00	14,02	8.485,01
2011	7.481,00	12,12	7.188,57
2012	8.399,00	13,56	8.822,40
2013	8.397,00	13,61	9.488,59
2014	8.588,00	13,92	12.369,76
Prosjeak	8.297,40	13,45	9.262,87

Potrošnja: 

Trošak: 

**Bilanca - Prirodni plin:**

Godina	Potrošnja(kWh)	Potrošnja po jed.	Trošak s porezom
--------	----------------	-------------------	------------------

**Grupa:** Zgrada

**Objekt:** [1] DV Kriješnice

**Energenti:**

- briketi
- drva m3
- drva prm
- Električna energija
- Extra lako loživo ulje
- Loživo ulje
- para 15 bara
- para 8 bara
- peleti
- Plin u boci
- Prirodni plin
- UNP
- Voda
- wrela voda
- clear selection

**Namjene:**

- Električna energija
- Grijanje
- Hidrant
- Kuhinja

Prikaži

# Report on energy consumption of the buildings

- UPRAVLJANJE IZVJEŠTAJIMA
- Izvještaji
    - Za objekte
      - Kartica objekta
      - Energetski pregledi i certifikati
      - Potrošnja na objektu
      - Zastupljenost energenata za grijanje
      - Oprema
    - Za subjekte
      - Površine objekata po grupama
      - Potrošnja energenata po namjeni
      - Potrošnja svih energenata po vrstama subjekata
      - Potrošnja subjekata**
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 Gradski ured za energetiku, zaštitu okoliša i održivi razvoj  
 Ulica popa Dukljanina 3, 10000 Zagreb

Potrošnja subjekta Klinička bolnica Sveti Duh od 01.01.2013. do 01.01.2014.

	Klinička bolnica Sveti Duh				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
<b>Ukupno</b>	<b>3.158.334,00</b>	<b>3.158.334,00</b>	<b>6.261.924,01</b>	<b>1.565.481,00</b>	<b>7.827.405,01</b>	<b>103.231,00</b>	<b>103.231,00</b>	<b>974,00</b>	<b>53.991,00</b>	<b>54.965,00</b>

Zagreb, 26.10.2015.

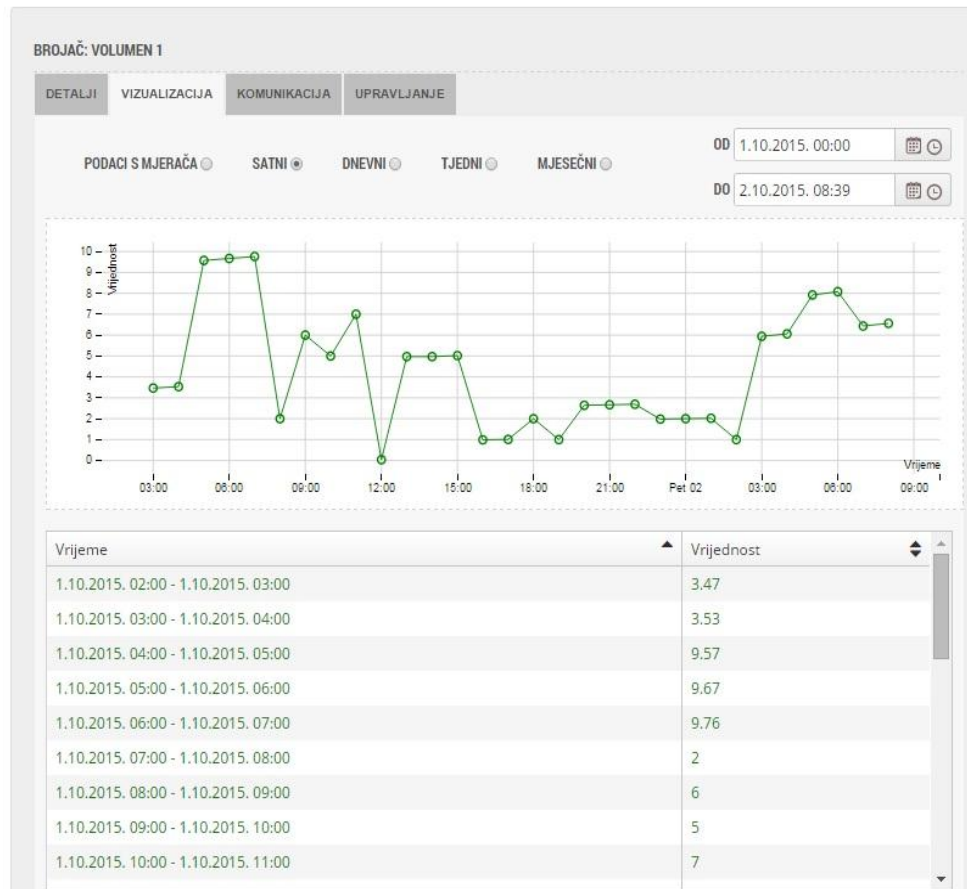
Datum od: 1/1/2013  
 Datum do: 1/1/2014  
 Podvrsta subjekta: Bolnice  
 Subjekt: Klinička bolnica Sveti Duh  
 Prikaz: Mjesečno

Prikaži

# Consumption – remote measurements

Mjerna oprema

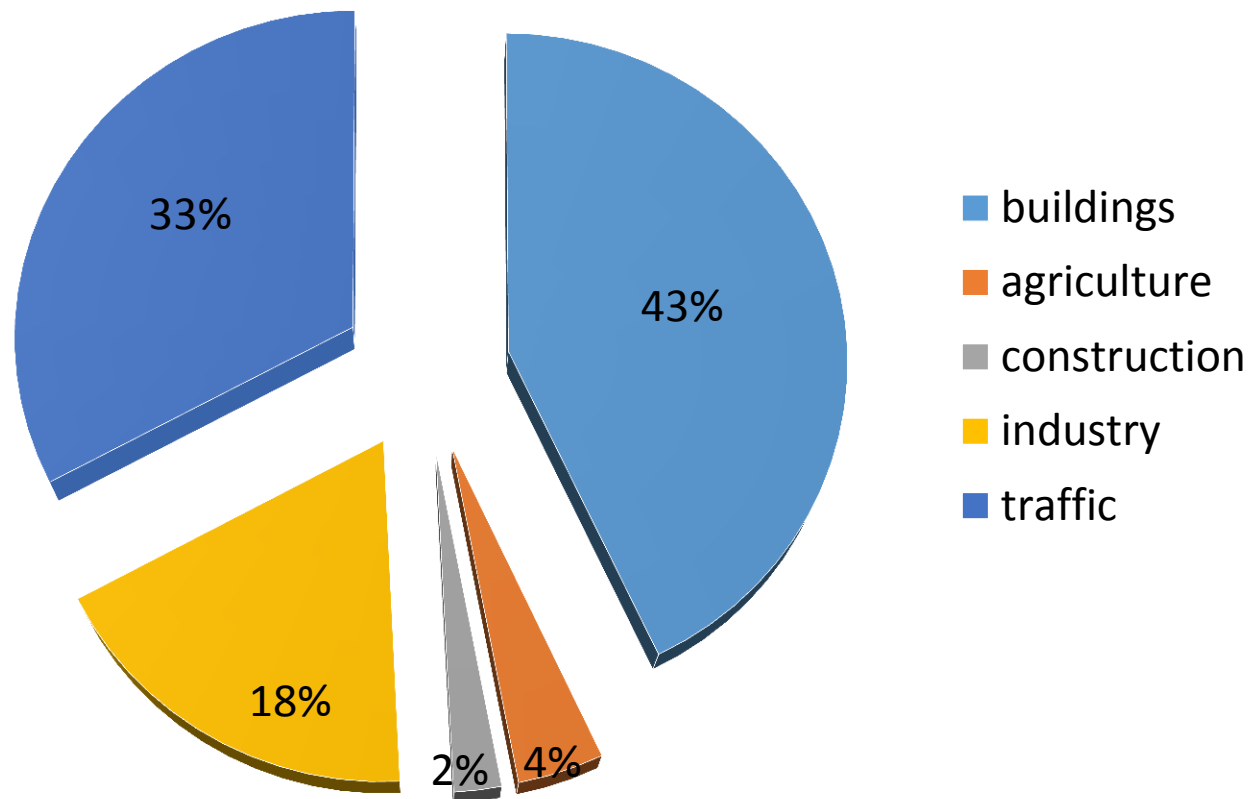
- RVT
- JNTPO
- JVTPD
- JNTPR
- JVTPR
- GZ Rudes (Jablanska 51) - Kotlovnica - grijanje
  - Toplina
  - Volumen
- GZ Rudes (Jablanska 51) - Potrosnja vode
  - Volumen 1
  - Volumen 2
- Djecji vrtic Pcelica
- GZ Djecji vrtic Pcelica - Brojilo 1 - el. energija
  - JNTPO
  - JNTPR
  - JVTPD
  - JVTPR
  - RNT
  - RVT
- GZ Djecji vrtic Pcelica - Brojilo 2 - el. energija
  - JNTPO
  - JNTPR
  - JVTPD
  - JVTPR
  - RNT
  - RVT
- GZ Djecji vrtic Pcelica - Plin
  - Volumen 1**
  - Volumen 2
- GZ Djecji vrtic Pcelica - Potrosnja vode
  - Volumen 1
  - Volumen 2



Automatic reading of energy consumption in real time mode

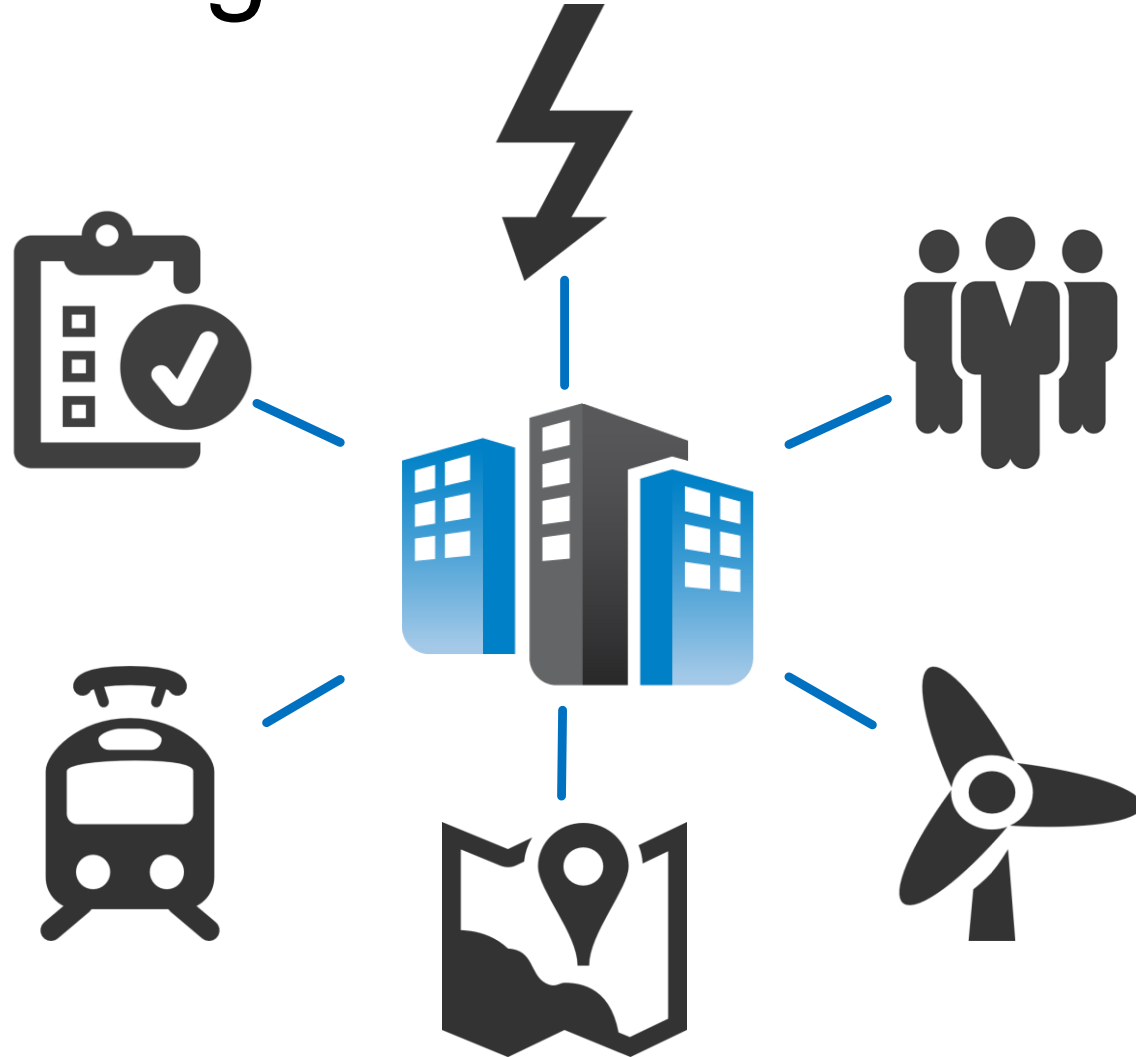
Hourly consumption of natural gas during heating season in kindergarten

# Total energy consumption in Croatia



Izvor: Energija u Hrvatskoj 2011, EIHP

# The driving force behind EIS

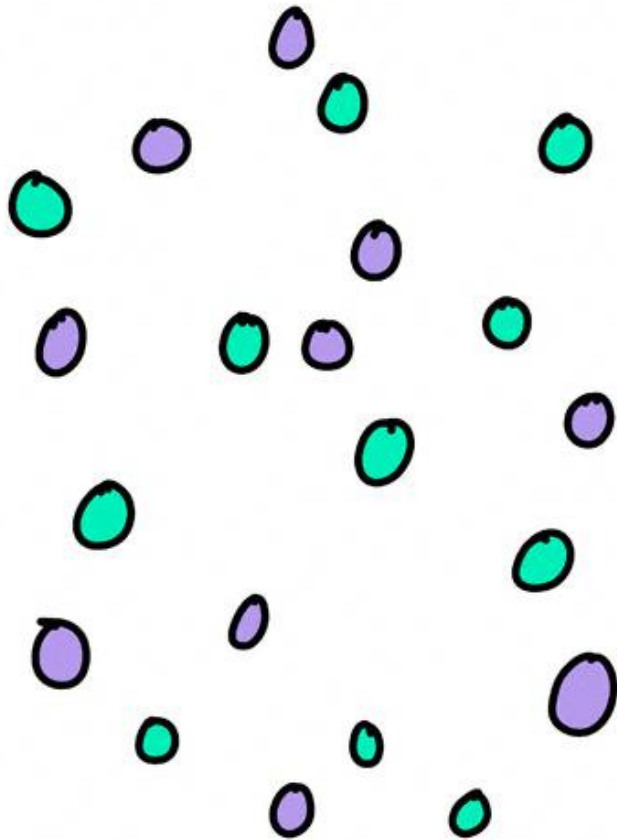


# EIS – The City of Zagreb

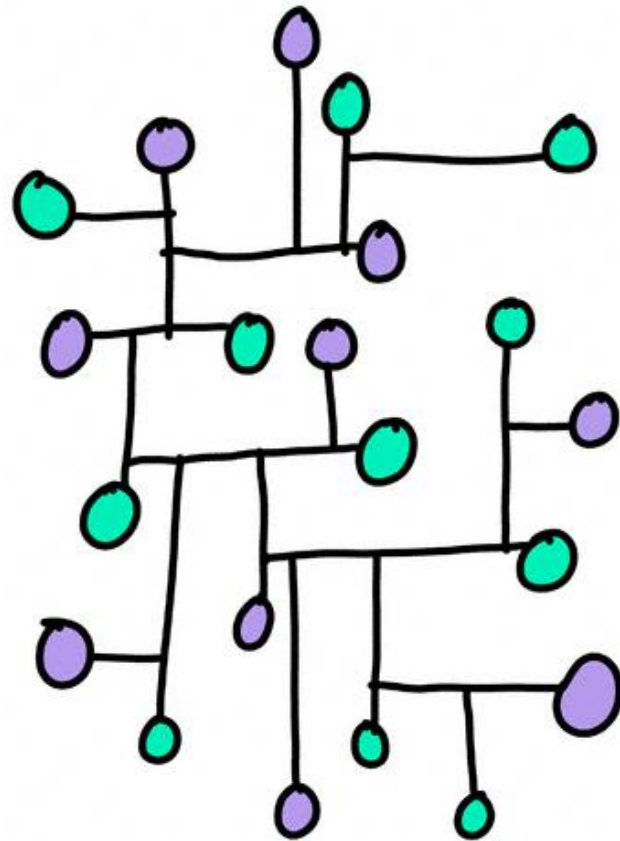
- Integral solution for energy management
  - Data collection
    - Allows integration with smart technologies (smart metering, demand response, smart grids ...)
    - Wide range of data sources
      - Import of supplier or distributor data
      - Manual input, scanning support (QR)
  - Analysis
 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



information:

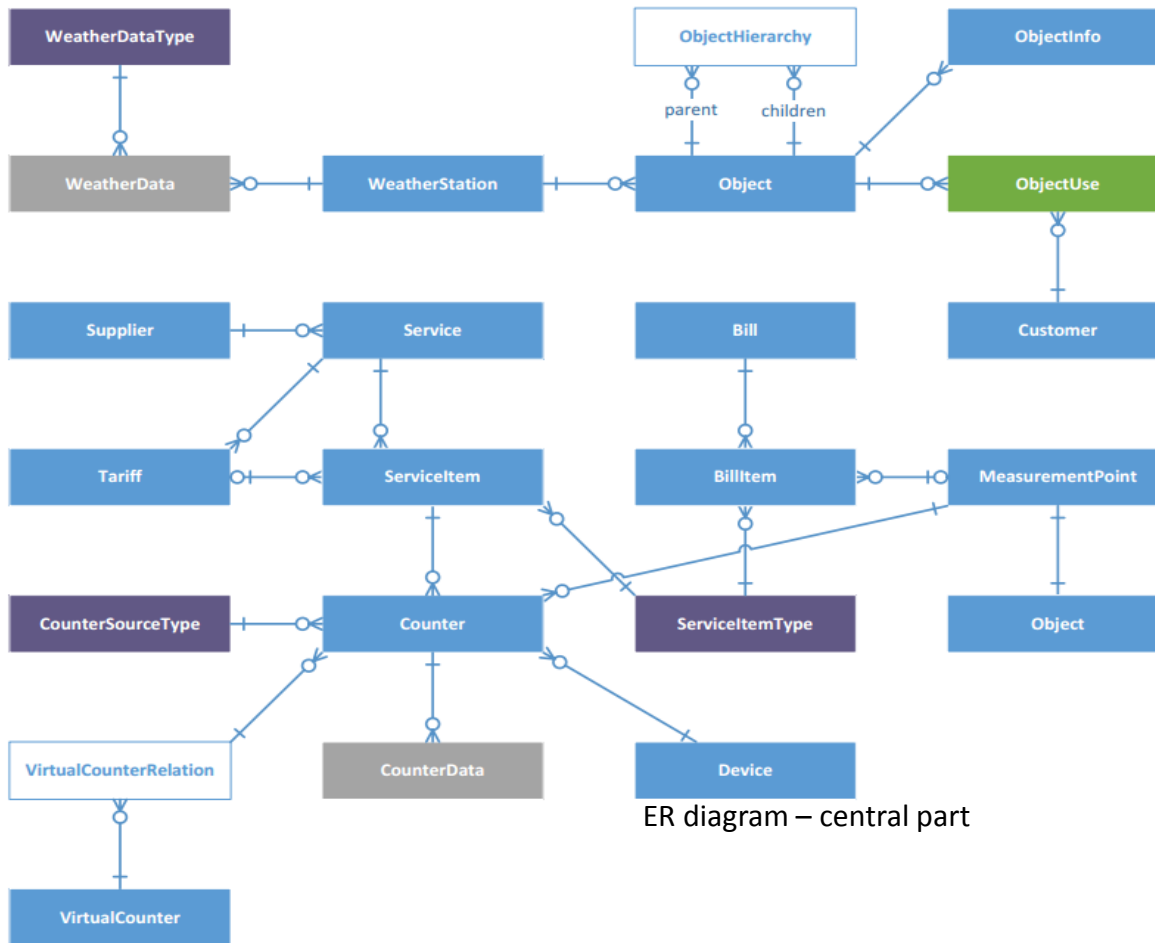


knowledge:



@gapingvoid

# EIS data model

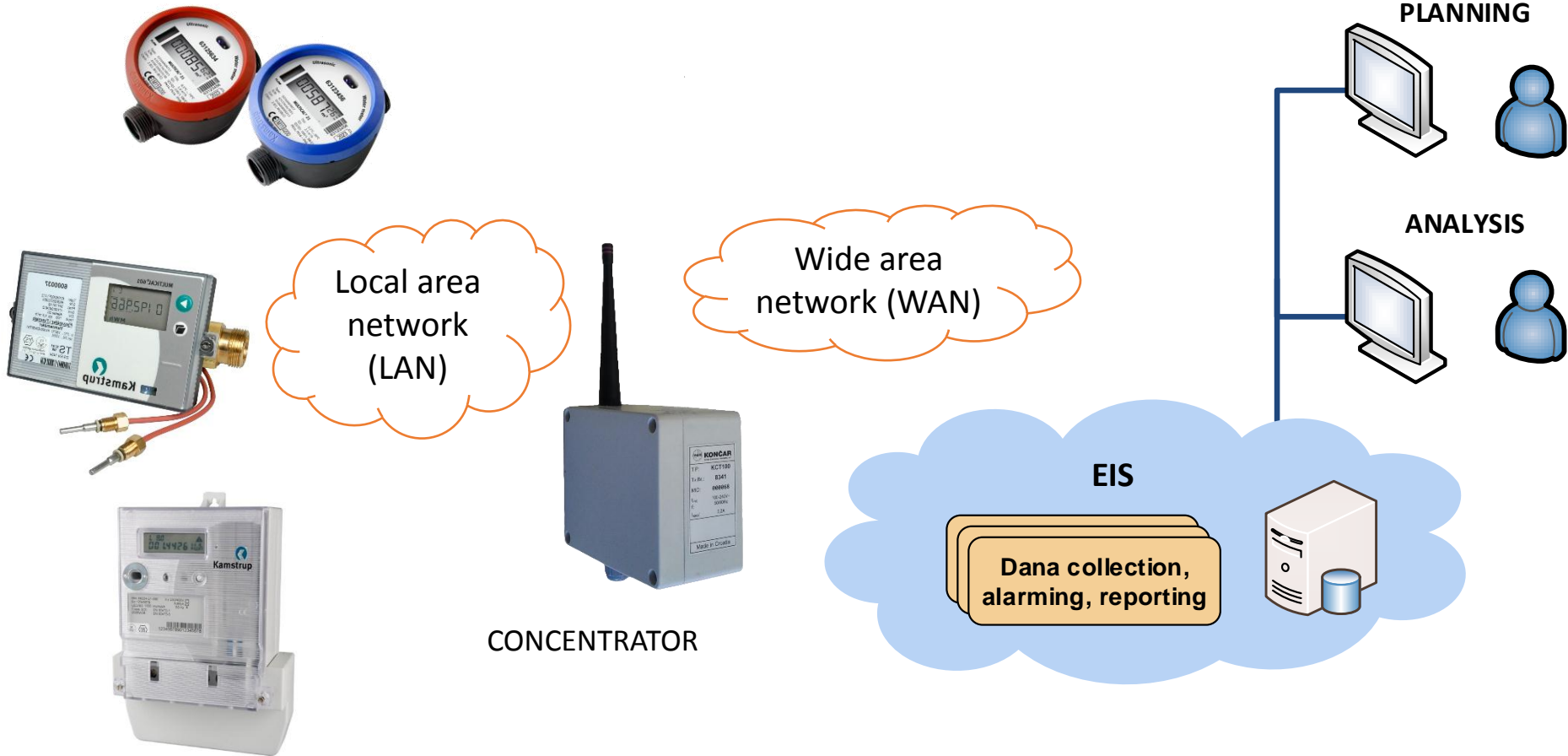


ER diagram – central part

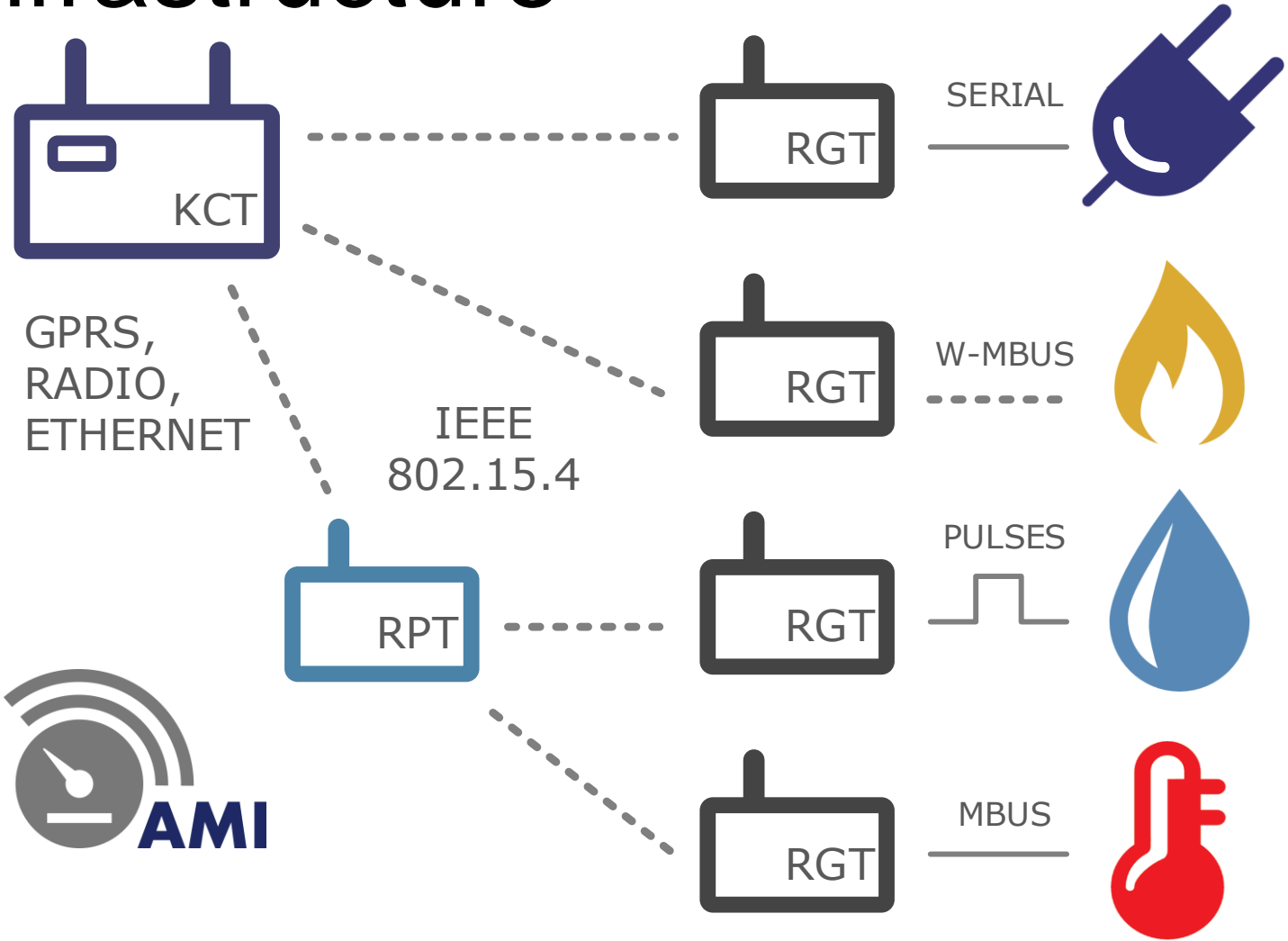
- An object can have one or more users who change over time (they can use an object in different periods of the day)
- They can use one or more energy sources for different purposes
- All this changing over time and while being different for each energy source suppliers through time ...



# EIS – Advanced Metering Infrastructure



# Advanced Metering Infrastructure



# The power of EIS



The screenshot shows the ENERGETSKI INFORMACIJSKI SUSTAV (EIS) web interface. The top navigation bar includes the user role 'Izbornik' and the name 'admin'. The main menu features 'Objekti' with sub-options: 'TIPOVI OBJEKATA', 'METEO POSTAJE', 'METEO TIPOVI', and 'METEO VARIJABLE'. A sidebar on the left shows a hierarchical tree structure under 'Objekti', with 'Tenkovo' selected. The main content area displays details for the 'TENKOVO' object, including a table of attributes and values.

TENKOVO	
NAZIV:	Objekt 1
ADRESA:	Adresa objekta 1
ENERGETSKI RAZRED:	Klasa A
VRIJEME KORIŠTENJA:	0
POVRSINA:	60
VOLUMEN:	200
OKUPIRANOST:	0
Q(H, ND, REL):	1,23
H(TR, ADJ):	3,2
ENERGENT ZA GRIJANJE:	Plin

- 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

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



- └ Tenkovo
  - └ Ulica Tina Ujevića
    - └ Glavna zgrada
      - └ C Objekat
      - └ B Objekat
      - └ A Objekat
    - └ Sporedna zgrada
      - └ 2. Kat
      - └ 1. Kat
        - └ Operacijska dvorana
        - └ 3. Kat
    - └ Ulica Zrinskih Frankopana
    - └ Trg Bana Jelačića
      - └ Bolnica Križ
      - └ Ulica Juraja Križanića

DEFINIRAJ NOVI MODEL	
Naziv	Datum Izracuna
Utrosak energije	8.5.2014. 0:00:00
Model 2	8.5.2014. 0:00:00
Razvoj opreme	8.5.2014. 0:00:00
Proracun potrosnje	8.5.2014. 0:00:00
Tenkovo 1	8.5.2014. 0:00:00
Tenkovo 2	8.5.2014. 0:00:00
Tenkovo 3	8.5.2014. 0:00:00



- └ Tenkovo
  - └ Ulica Tina Ujevića
    - └ Glavna zgrada
      - └ C Objekat
      - └ B Objekat
      - └ A Objekat
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Tenkovo 1	8.5.2014. 0:00:00
Tenkovo 2	8.5.2014. 0:00:00
Tenkovo 3	8.5.2014. 0:00:00

MODELJI

DATUM IZRACUNA: 8.5.2014.

TENKOVO EKSTRA MODEL

Električna energija  grijanje  sezona grijanja

$ET \cdot 1.2 + 2 \cdot SQRT(PC)$

$ET \cdot 1.2 + 2 \cdot SQRT(PC)$

Električna energija  hlađenje  sezona hlađenja

$ET \cdot 2 + PC^2$

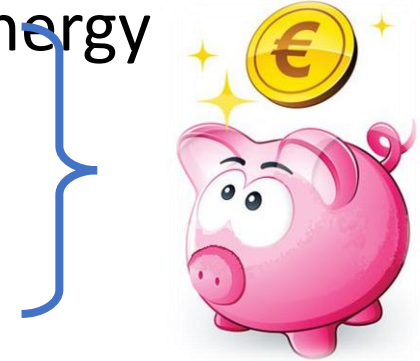
$ET \cdot 2 + PC^2$

# 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

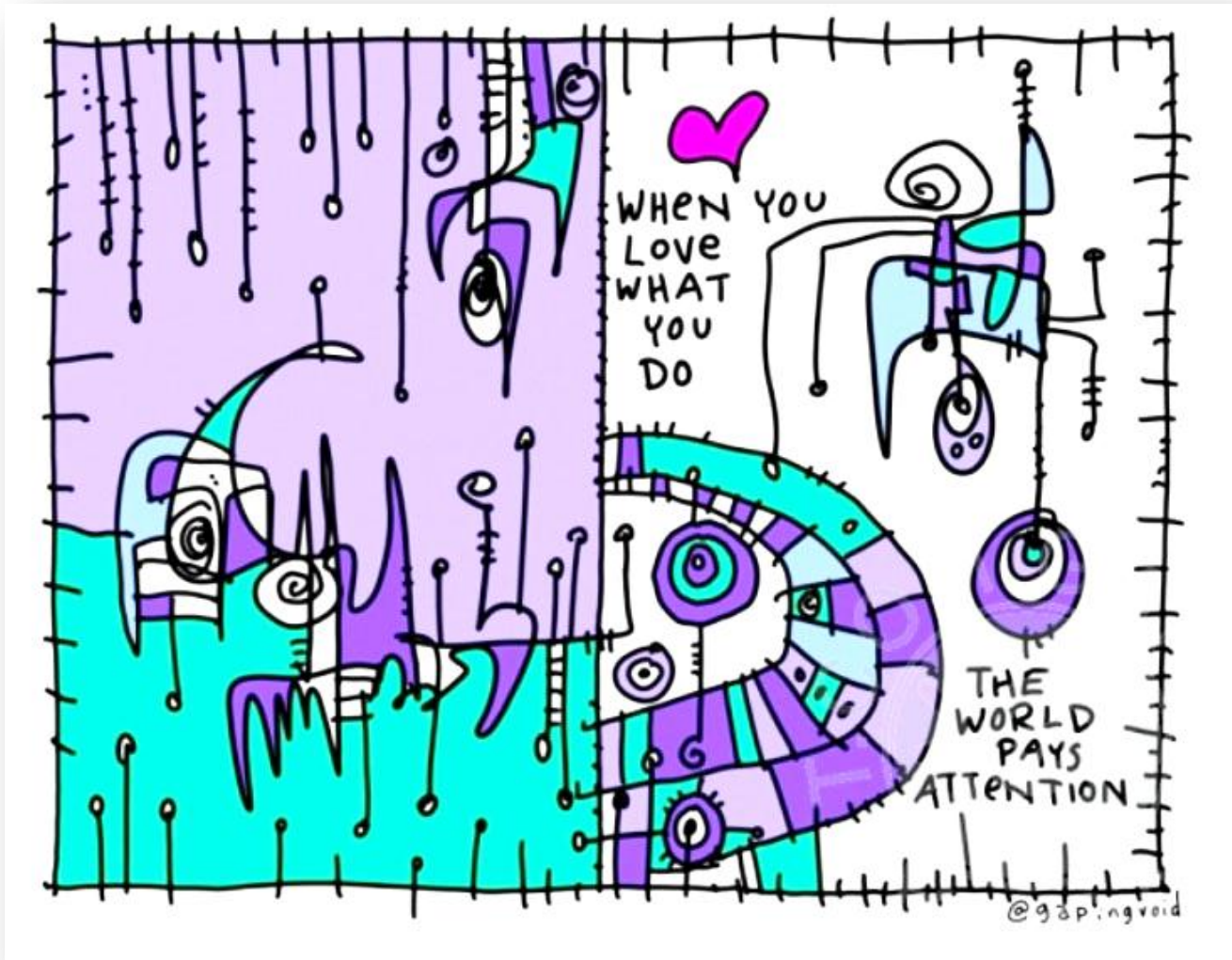
Leading regional manufacturer and system integrator:

- **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

40 years of excellence







... thank you!