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European Regional Development Fund



REPUBLIC OF SLOVENIA  
**MINISTRY OF EDUCATION,  
SCIENCE AND SPORT**

# **CLASS** **Conference 2014** CloudAssisted Services

## Use of Cloud Computing Technology for Energy Efficiency Monitoring in Business and Industrial environment

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# Project SPEU

## Identification

- SPEU: Energy Efficiency Monitoring Web Portal
- Call for funds e-storitve 2012, Ministry of Education Science and Sport (from Nov 2012 to Maj 2014)
- Consortium: INEA, XLAB, Domel
- Result: Merging of advanced IT technology (cloud computing) and energy efficiency monitoring service in Web portal.



# Project SPEU

## Project goal

- Prototype of the energy monitoring service
  - Set up of the energy monitoring application on Cloud computing platform
  - Use of various end user mobile devices
  - Transfer of the application from end user environment to the service provider
  - Dissemination of the technical data into the business environment

# Project SPEU

## Service functionalities

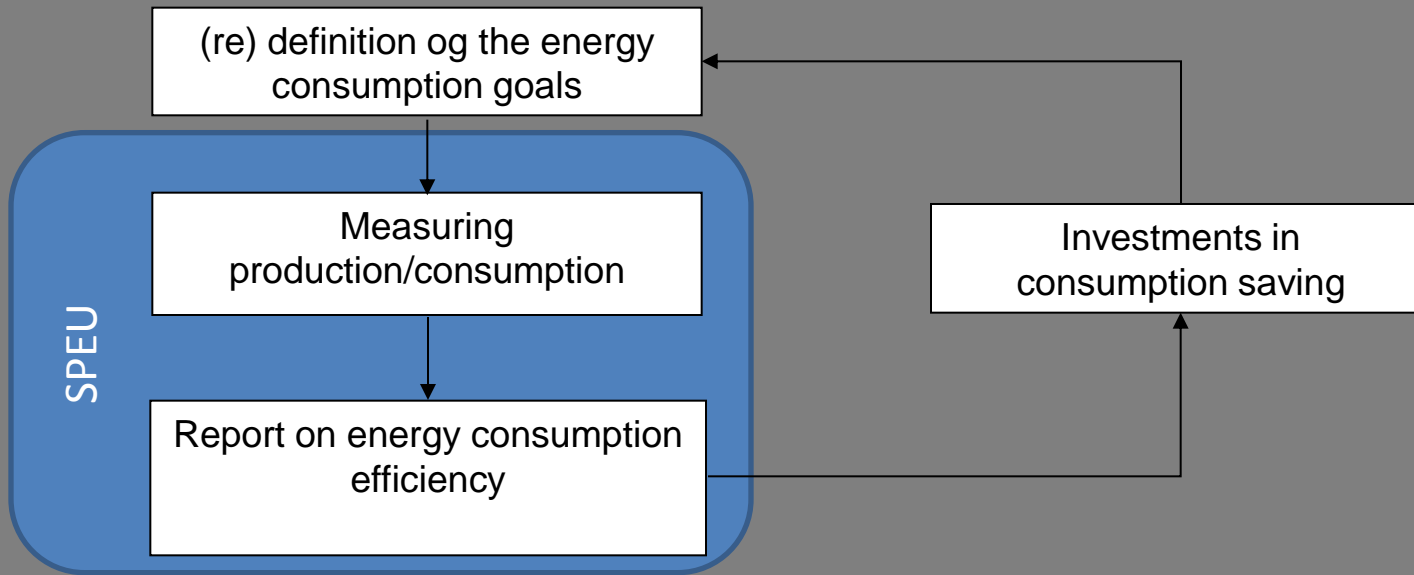
- Consumption and cost monitoring
  - Measurement collection and storage
  - Monitoring on various levels (company, location, process, device)
- Consumption efficiency calculation
  - Preparation of the performance indicators
  - Historical consumption and cost comparison
  - Comparison with other users on the common bases - benchmarking

# Business process of the monitoring

- Savings

- Unnecessary consumption removal
- Process efficiency improvement
- Device efficiency improvement

Energy monitoring process

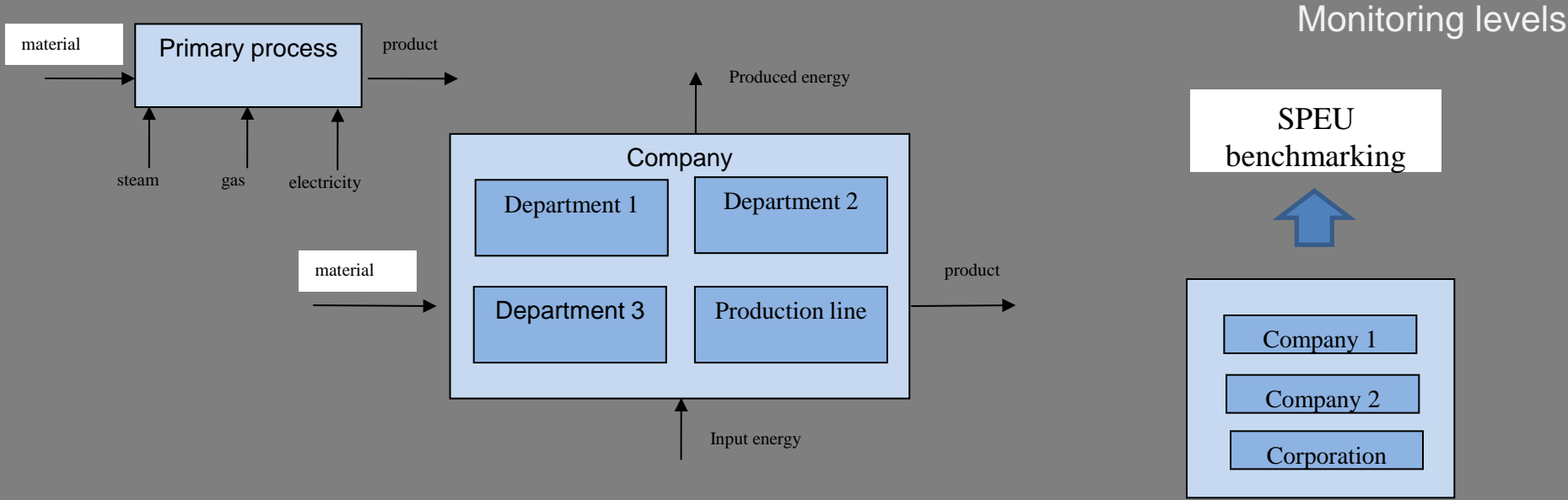


# Classification of the performance indicators

- **Commercial buildings**
  - Typical consumption of Electricity, Heating, water
  - Efficiency of HVAC systems
  - Performance indicators (consumption per user, consumption per size)
- **Industrial processes**
  - Sort per industrial branch
  - Production efficiency
- **Business processes**
  - Consumption per income
  - Consumption per product

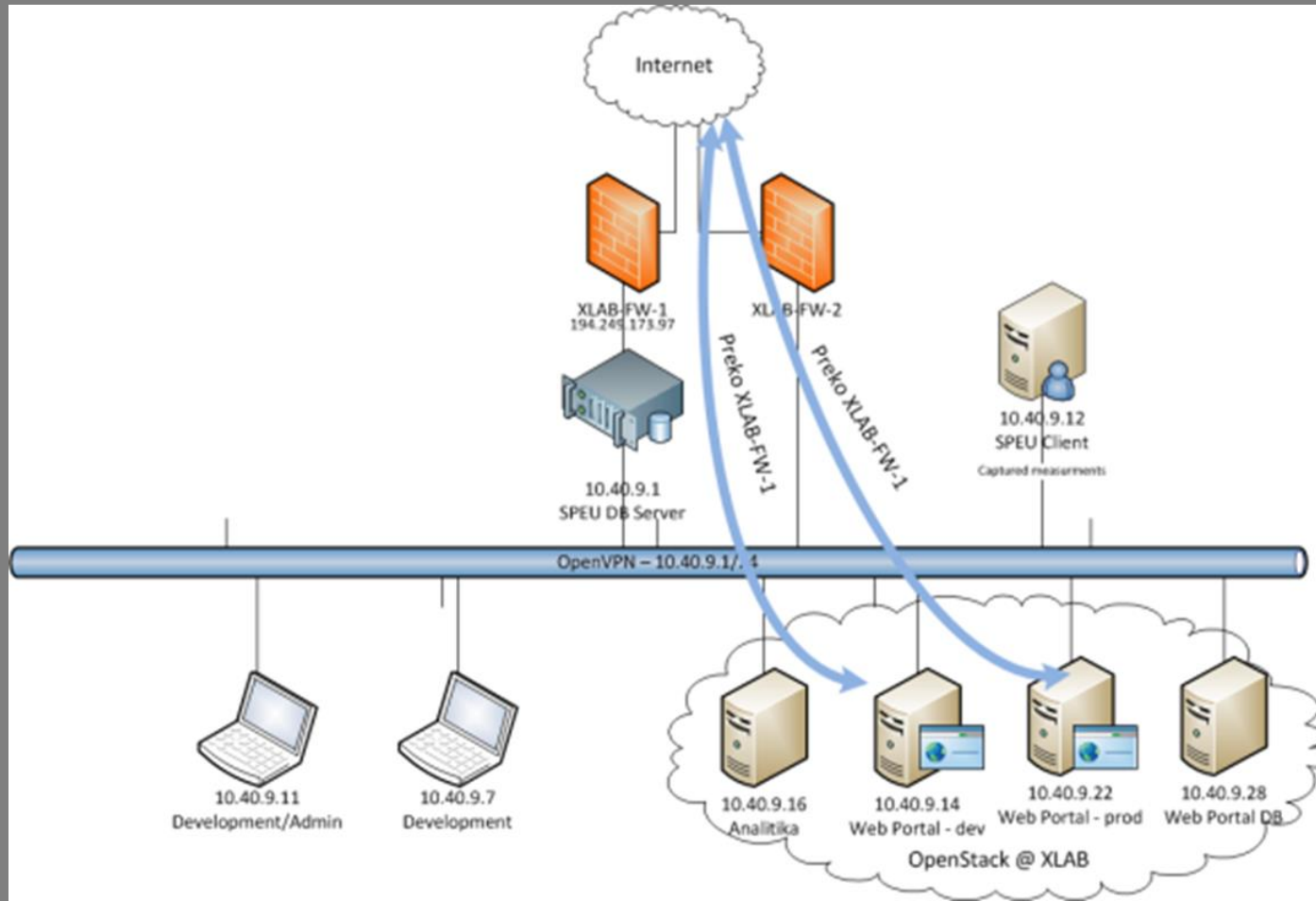
# Monitoring levels

- Primary process
- Production Line/department
- Company/Location
- Corporation
- City



# System architecture

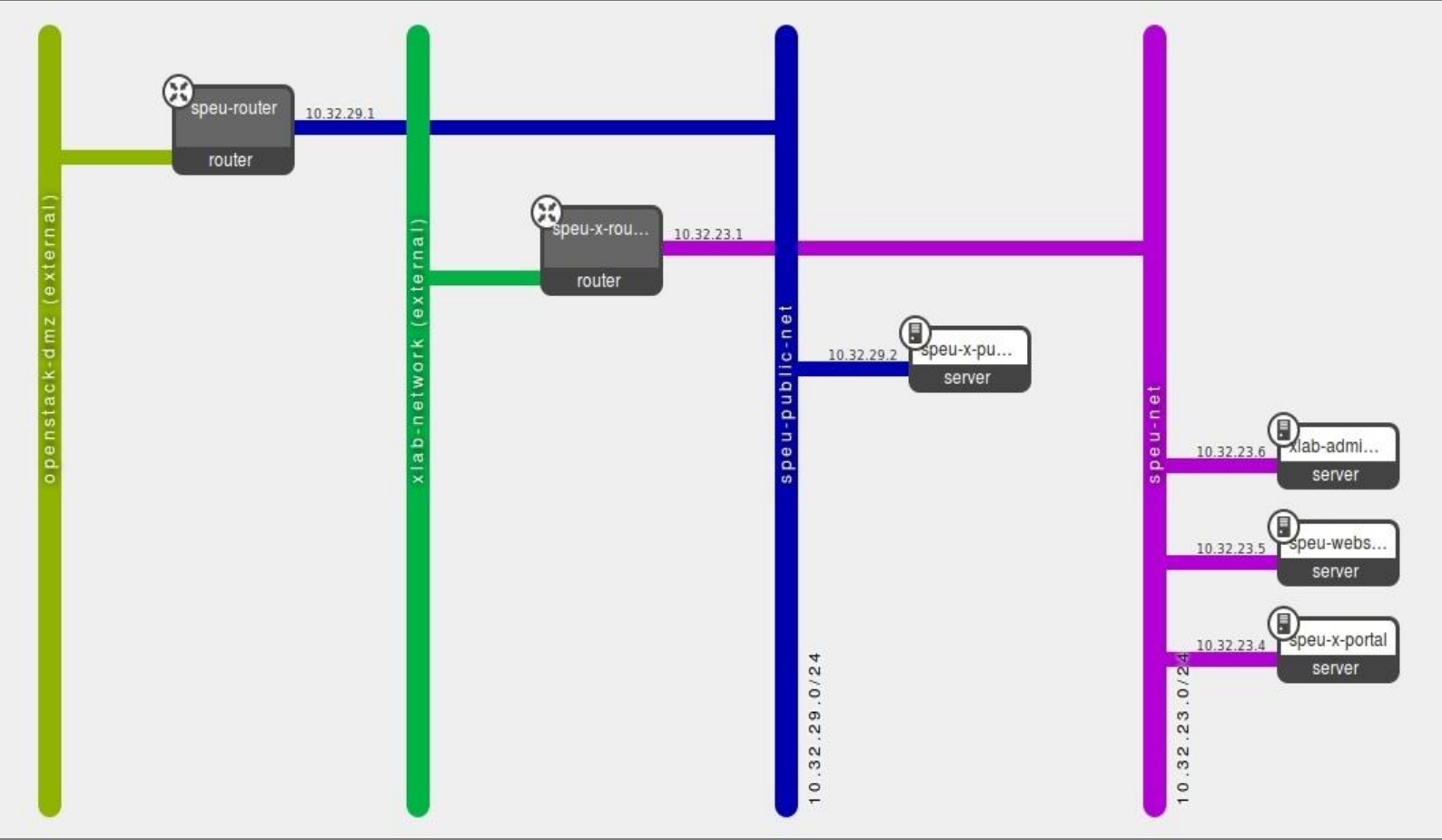
## SPEU cloud computing architecture





# System architecture – OpenStack Network Infrastructure

OpenStack details



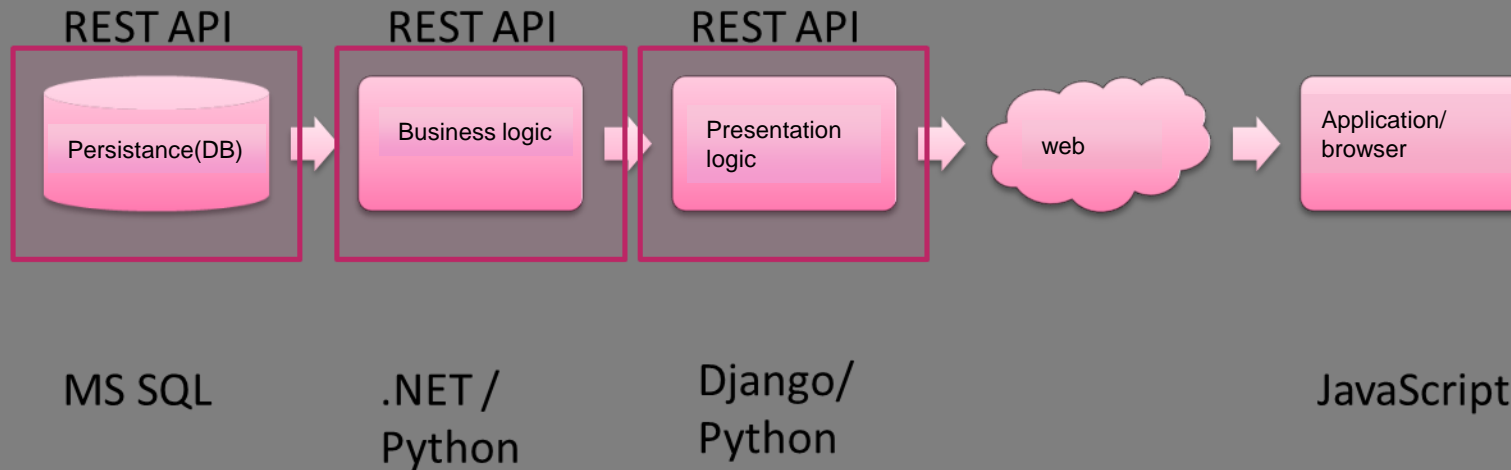
# Web portal functionalities

- Log in via Single Sign on mechanisms
- Safe communication (SSL/TLS) with the option of external user database connection
- Definition of different user roles with corresponding adaptation of interface (coordinator, administrator, user)
- Web interface for administration of the users and companies
- Use of CLI interface
- Monitoring data visualization

# Integration Architecture

## Use of REST interface

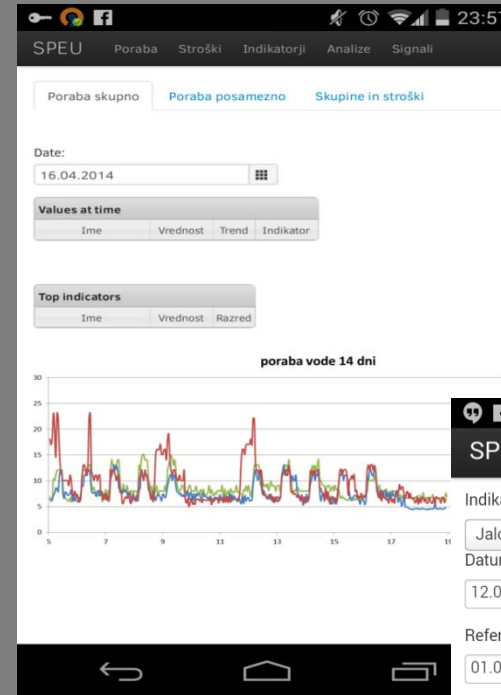
Use of REST interface



# Use of mobile devices

Mobile device display

- Self detection of the end user device
- Adaptation of the display components
- Use of adapted CSS (Bootstrap library)
- REST: It is possible to develop dedicated HTML5 application (not yet available)



Indikator:

Datum:

Referenčno obdobje:

Interval:

Definicija indikatorja

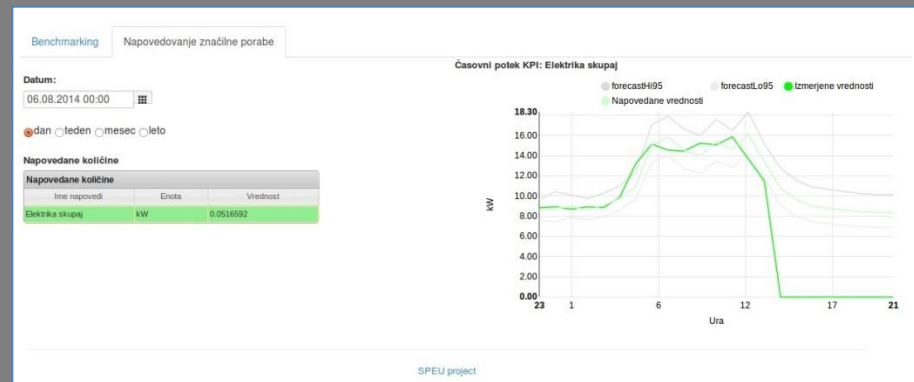
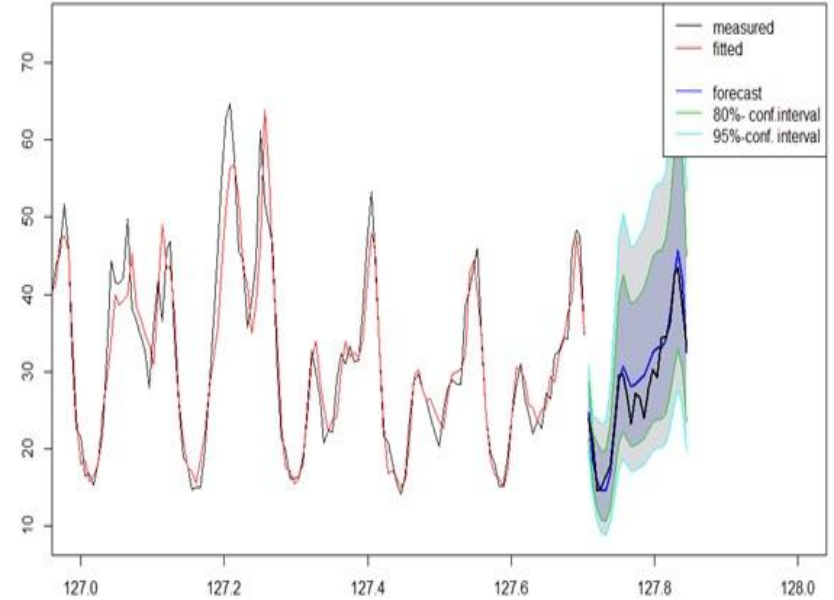
Števec	Ime
Jalova moč	Elektrika

Vrednosti indikatorja

Ime	Vrednost
maximal_value (May 12 2014)	0
minimal_value (May 12 2014)	0
average_value	0
Max_num	0

- Statistical method being used
- 3-staged service
  - consuming data from the DB
  - Forecast algorithm
  - pushing data back to DB
- Method applicable to periodic signals
- Forecast based on data for a 28 days
- Hourly forecasts with 80% and 95% confidence interval
- Alarms are triggered if current usage falls out from the interval

Napoved 24h iz preteklih 28 dni (na slikoprikaz samo zadnjih 5 dni + napoved)



Poraba skupno [Poraba posamezno](#)

Datum:

28.08.2014 08:38

Referenčno obdobje:

01.01.2014 00:00

Interval:

trenutna  dan  teden  mesec  leto

Statistika porabe

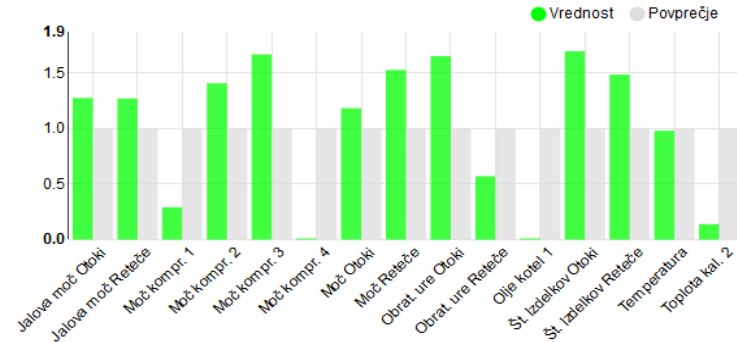
Ime	Vrednost	Povprečje	Poraba	Povprečna por
Jalova moč Otoki	21.24kW	16.67kW	1713.13kWh	1345.29kWh
Jalova moč Reteče	112.45kW	88.63kW	9067.6kWh	7157.8kWh
Moč kompr. 1	17.19kW	58.94kW	1386.08kWh	4827.76kWh
Moč kompr. 2	66.75kW	47.46kW	5382.38kWh	3808.91kWh
Moč kompr. 3	83.21kW	49.96kW	6709.57kWh	4035.4kWh
Moč kompr. 4	0kW	0kW	0kWh	0kWh
Moč Otoki	1701.69kW	1439.45kW	137220kWh	116116kWh
Moč Reteče	185.22kW	121.38kW	14935.6kWh	9816.7kWh
Obrat. ure Otoki	10251.Sure/dan	6211.41ure/dan	826655ure	500873ure
Obrat. ure Reteče	837.5ure/dan	1468.58ure/dan	67533.9ure	118422ure

Učinkovitost porabe

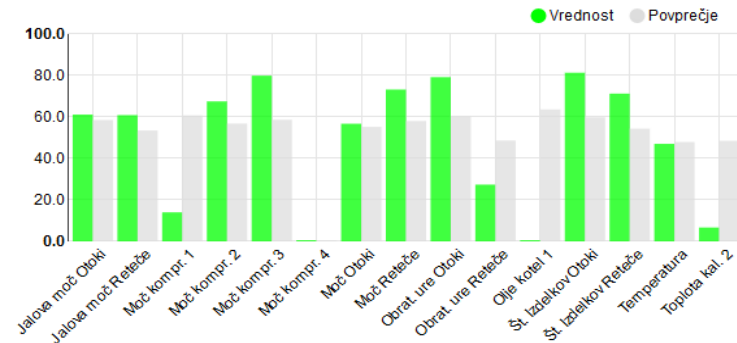
Ime	Vrednost	Razred
Jalova moč Otoki	0	A
Jalova moč Reteče	0.8	D
Moč kompr. 1	0	A
Moč kompr. 2	0	A
Moč kompr. 3	0	A
Moč kompr. 4	0	A
Moč Otoki	0	A
Moč Reteče	0.77	D
Obrat. ure Otoki	0	A
Obrat. ure Reteče	0	A

C

Relativna moč glede na povprečje



Poraba in povprečna poraba



Indikatorji skupno
Indikatorji posamezno
Ciljno spremljanje

**Indikator:**

**Datum:**  **Referenčno obdobje:**

**Interval:**  
 dan  teden  mesec  povprečje  min  max  datum  ciljna leto

Definicija indikatorja	
Števec	Imenovalec
Moč Reteče	Obrat. ure Reteče

Vrednosti Indikatorja	
Ime	Vrednost
Vrednost indikatorja	1.13 kWh
Povprečje indikatorja	2.2 kWh
Maksimum indikatorja	2.77 kWh
Čas maksimuma	Apr 30 2014 11:59PM
Minimum indikatorja	1.13 kWh
Čas minimuma	Aug 28 2014 12:44PM

**Potek vrednosti**

**Potek odvisnih količin**

SPEU project

Poraba skupno   Indikatorji posamezno   Ciljno spremljanje

Indikator:

Jalova energija

Datum:

28.08.2014 00:00

Referenčno obdobje:

01.01.2014 00:00

Interval:

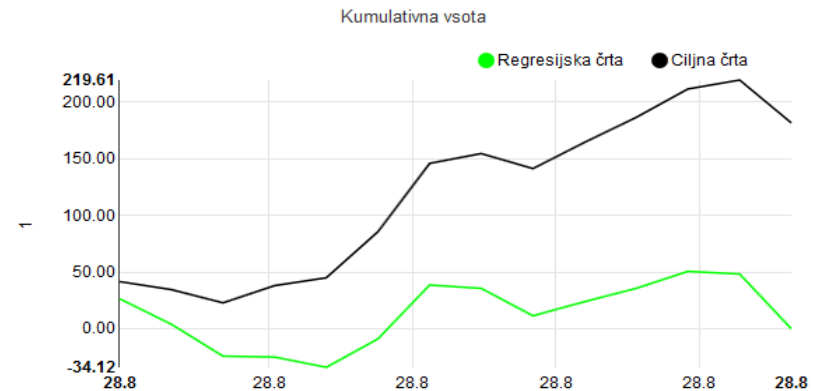
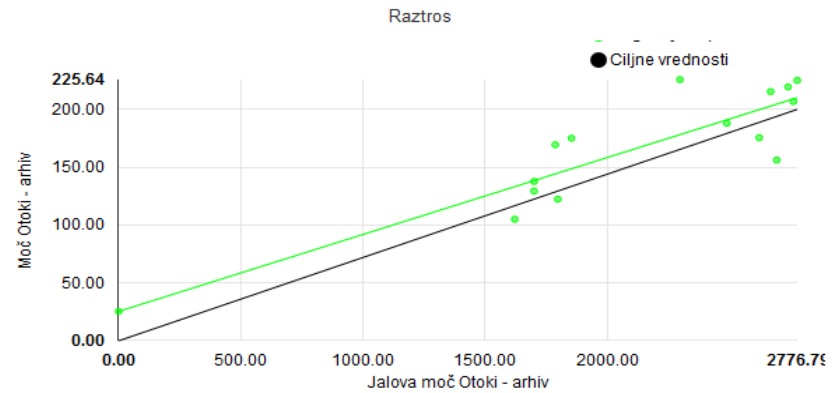
dan    teden    mesec    leto

### Podatki o premicah

Ime	Vrednost
regresija nagib	0.06649788171231368
regresija odmik	25.367593852568376
cilj nagib	0.072
cilj odmik	0

### Tabela odstopanj

Datum	Števec	Imenovalec	Deviacija
2014-08-28 04:00	225.6378	2296.5178	0.2671
2014-08-27 22:00	174.9933	1853.0000	0.1777
2014-08-28 03:00	169.3222	1786.5378	0.1745
2014-08-28 09:00	225.0167	2776.7860	0.0714
2014-08-28 07:00	215.2867	2667.8100	0.0617
2014-08-28 08:00	219.2532	2739.0958	0.0566
2014-08-28 01:00	137.6622	1700.0367	-0.0054
2014-08-28 10:00	206.6525	2760.8484	-0.0110
2014-08-28 05:00	187.8847	2488.8449	-0.0156
2014-08-28 02:00	129.3173	1699.8447	-0.0657





### Alarmi

28 08 2014 00:00

Datum:

Izberite tip alarma

Ni podatkov

Izberite ime alarma

No equidistant for client Dom...

Interval:

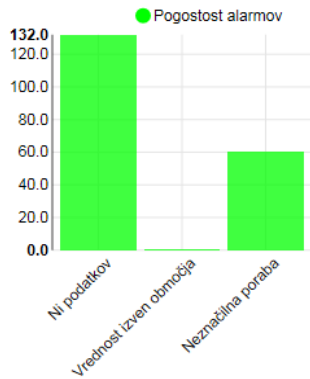
dan  teden  mesec  leto

Trenutni alarmi

Stanje alarma	Ime	Opis
3 - Pretekli nepotrjen	Št. Izdelkov Otoki	No signal for client Domel-Sap (alarm on Moč Otoki - arhiv)
1 - Nepotrjen	Moč Otoki	No signal for client Domel-Otoki (alarm on Moč Otoki - arhiv)
3 - Pretekli nepotrjen	Moč Otoki - arhiv	No signal for client Domel - arhiv (alarm on Moč Otoki - arhiv)
1 - Nepotrjen	Jalova energija	No KPI for client Domel (alarm on Jalova energija - arhiv)
1 - Nepotrjen	Moč Otoki - arhiv	No equidistant for client Domel (alarm on Moč Otoki - arhiv)
3 - Pretekli nepotrjen	Moč Otoki - arhiv	Abnormal consumption : DOMEL, Moč Otoki - arhiv

Pogostost alarmov

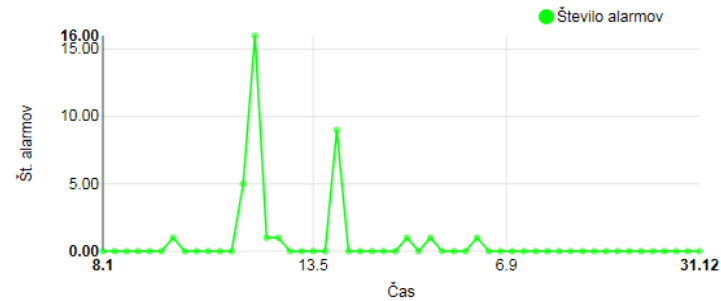
število  trajanje



### Informacija o alarmih

	Ime signala	Opis	Začetek	Trajanje	Potrditev
1	Moč Otoki - arhiv	No equidistant for client Domel (alarm on Moč Otoki - arhiv)	21-08-2014	174ur	
2	Moč Otoki - arhiv	No equidistant for client Domel (alarm on Moč Otoki - arhiv)	28-07-2014	101ur	
3	Moč Otoki - arhiv	No equidistant for client Domel (alarm on Moč Otoki - arhiv)	09-07-2014	1ur	
4	Moč Otoki - arhiv	No equidistant for client Domel (alarm on Moč Otoki - arhiv)	03-06-2014	16ur	05-06-2014
5	Moč Otoki - arhiv	No equidistant for client Domel (alarm on Moč Otoki - arhiv)	02-06-2014	23ur	05-06-2014
6	Moč Otoki - arhiv	No equidistant for client Domel (alarm on Moč Otoki - arhiv)	30-05-2014	2ur	05-06-2014
7	Moč Otoki - arhiv	No equidistant for client Domel (alarm on Moč Otoki - arhiv)	30-05-2014	1ur	05-06-2014
8	Moč Otoki - arhiv	No equidistant for client Domel (alarm on Moč Otoki - arhiv)	30-05-2014	5ur	05-06-2014
9	Moč Otoki - arhiv	No equidistant for client Domel (alarm on Moč Otoki - arhiv)	29-05-2014	3ur	05-06-2014
10	Moč Otoki - arhiv	No equidistant for client Domel (alarm on Moč Otoki - arhiv)	29-05-2014	5ur	05-06-2014
11	Moč Otoki - arhiv	No equidistant for client Domel (alarm on Moč Otoki - arhiv)	29-05-2014	1ur	05-06-2014
12	Moč Otoki - arhiv	No equidistant for client Domel (alarm on Moč Otoki - arhiv)	28-05-2014	12ur	05-06-2014
13	Moč Otoki - arhiv	No equidistant for client Domel (alarm on Moč Otoki - arhiv)	25-04-2014	0ur	05-06-2014
14	Moč Otoki - arhiv	No equidistant for client Domel (alarm on Moč Otoki - arhiv)	16-04-2014	0ur	05-06-2014
15	Moč Otoki - arhiv	No equidistant for client Domel (alarm on Moč Otoki - arhiv)	15-04-2014	0ur	05-06-2014

Zgodovina alarmov



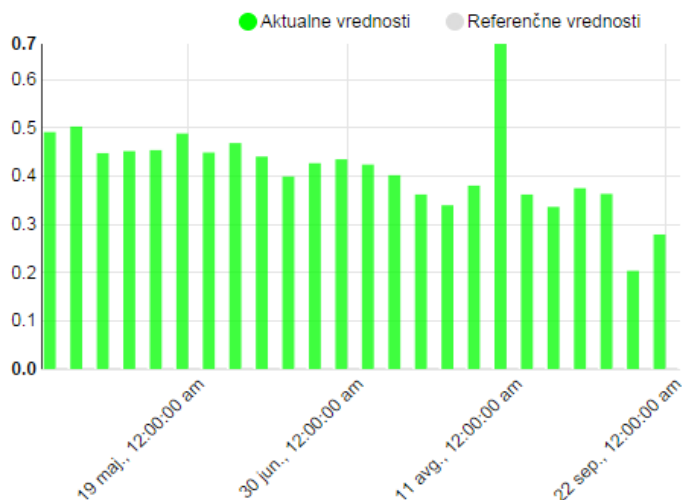
### Indikatorji porabe

#### Indikatorji poslovnih stavb

##### Indikatorji poslovne stavbe - kliknite za spremembo

Ime	Vrednos	Kvalifikator	Enota
Razmerje tarif [1]	0.43	002	1
Poraba toplote na m2 [kWh/m2]	0.03	004	kWh/m2
Energija na delovno uro [kWh/h]	2.52	007	kWh/h

#### Potek vrednosti: Razmerje tarif [1]

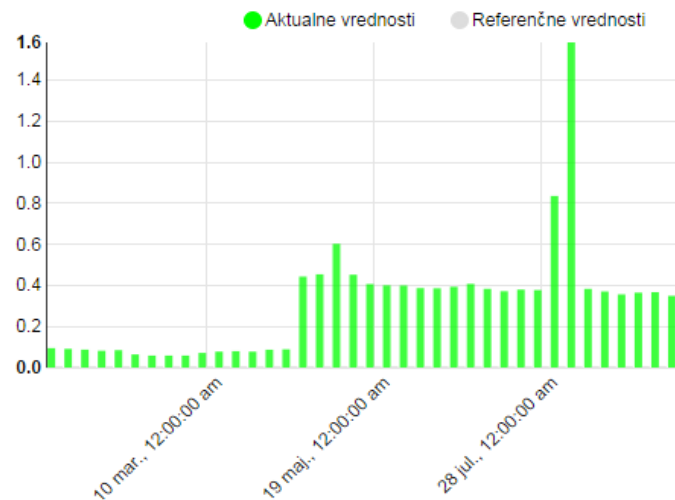


#### Indikatorji v industriji

##### Indikatorji - kliknite za spremembo

Ime	Vrednos	Kvalifikator	Enota
Jalova energija [1]	0.34	001	1
Poraba energije na obratovalno uro	3.87	003	kWh
Razmerje tarif [1]	0.43	002	1
Poraba toplote na m2 [kWh/m2]	0.03	004	kWh/m2

#### Potek vrednosti KPI: Jalova energija [1]



# Next steps

- The use of REST interfaces enables us deployment to PaaS platforms (easier management)
- Introduction of load balancers where needed
- Monitoring, auditing of the resources
- Alternative protocols for connections between external sensors and DB's interfaces

# Thank You

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CloudAssisted Services