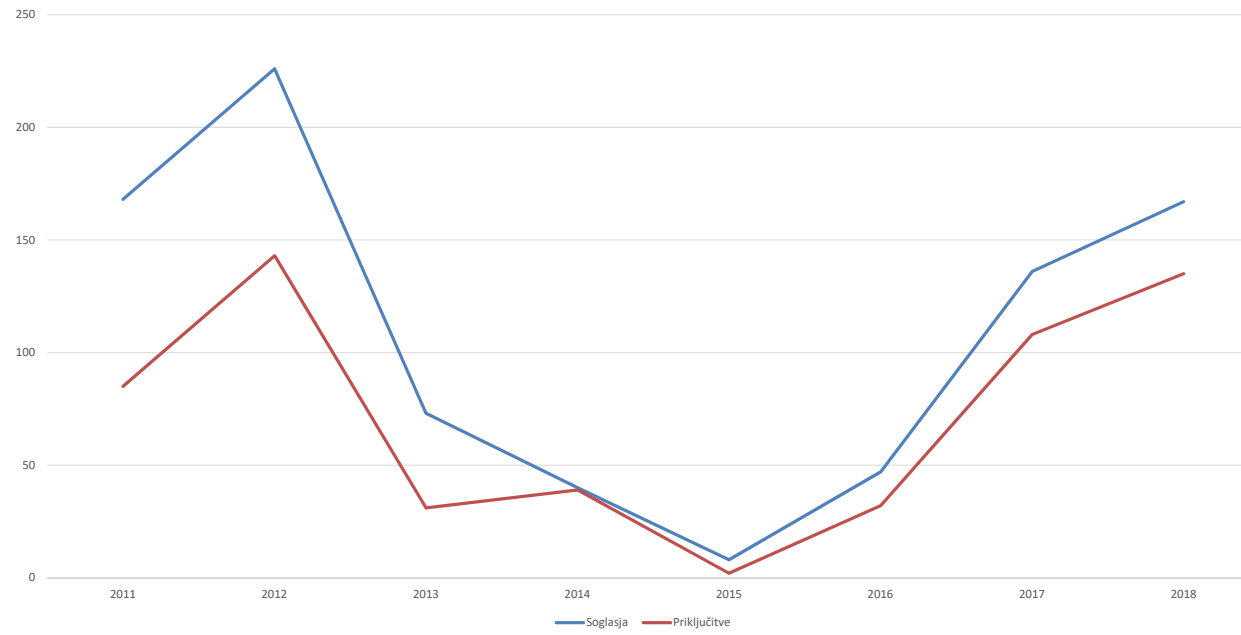


**Uporaba naprednih distribucijskih tehnoloških sistemov v  
razvojno raziskovalnih projektih EG**

Razpršeni viri EG



## Vsebina

- Tehnološki sistemi EG v razvojno raziskovalnih projektih
- Pregled projektov INCREASE, STORY, TDX ASSIST, EASY RES
- Izzivi prihodnosti
- Razprava



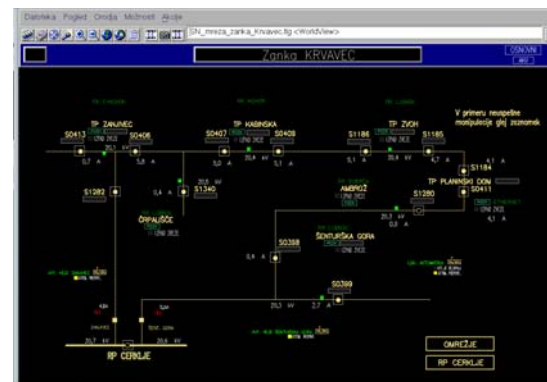
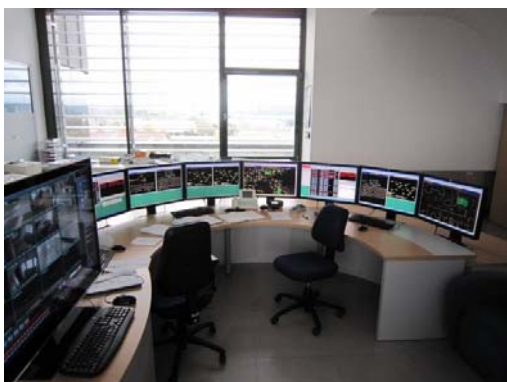
# RAZVOJ PAMETNIH OMREŽIJ – PROJEKTNI SKLOPI

<b>Povečanje spoznavnosti</b>	Ocenjevalnik stanja (podeželsko in mešano omrežje)
	Vizualizacija napetostnih profilov in obremenitev
	Napredni sistemi za trajno spremljanje PQ
	Določanje izvora motenj
<b>Povečanje vodljivosti</b>	Reglacija napetosti TR VN/SN, SN/NN
	Daljinsko vodene TP
	Kompenzacija motenj
<b>Zaščita elementov</b>	Implementacija zaščitne sheme zaradi RV
<b>Vodenje omrežja</b>	Vodenje omrežja ob visokem deležu RV v omežju
	Lociranje okvar in povečanje zanesljivosti obratovanja
<b>Aktivno vključevanje odjema</b>	Krmiljenje odjema gospodinskih odjemalcev
	Krmiljenje odjema poslovnih in industrijskih odjemalcev
	Kritične konične tarife za gospodinske in industrijske odjemalce
	Kratkoročna napoved odjema
<b>Aktivno vključevanje proizvodnje</b>	Tehnična virtualna elektrarna
	Kratkoročna napoved proizvodnje iz obnovljivih virov
<b>IKT</b>	Dostopne tehnologije za podporo obratovanju in za končne uporabnike
<b>Integracija sistemov</b>	Integracija sistemov znotraj EDP
	Izmenjava podatkov med akterji na trgu z električno energijo

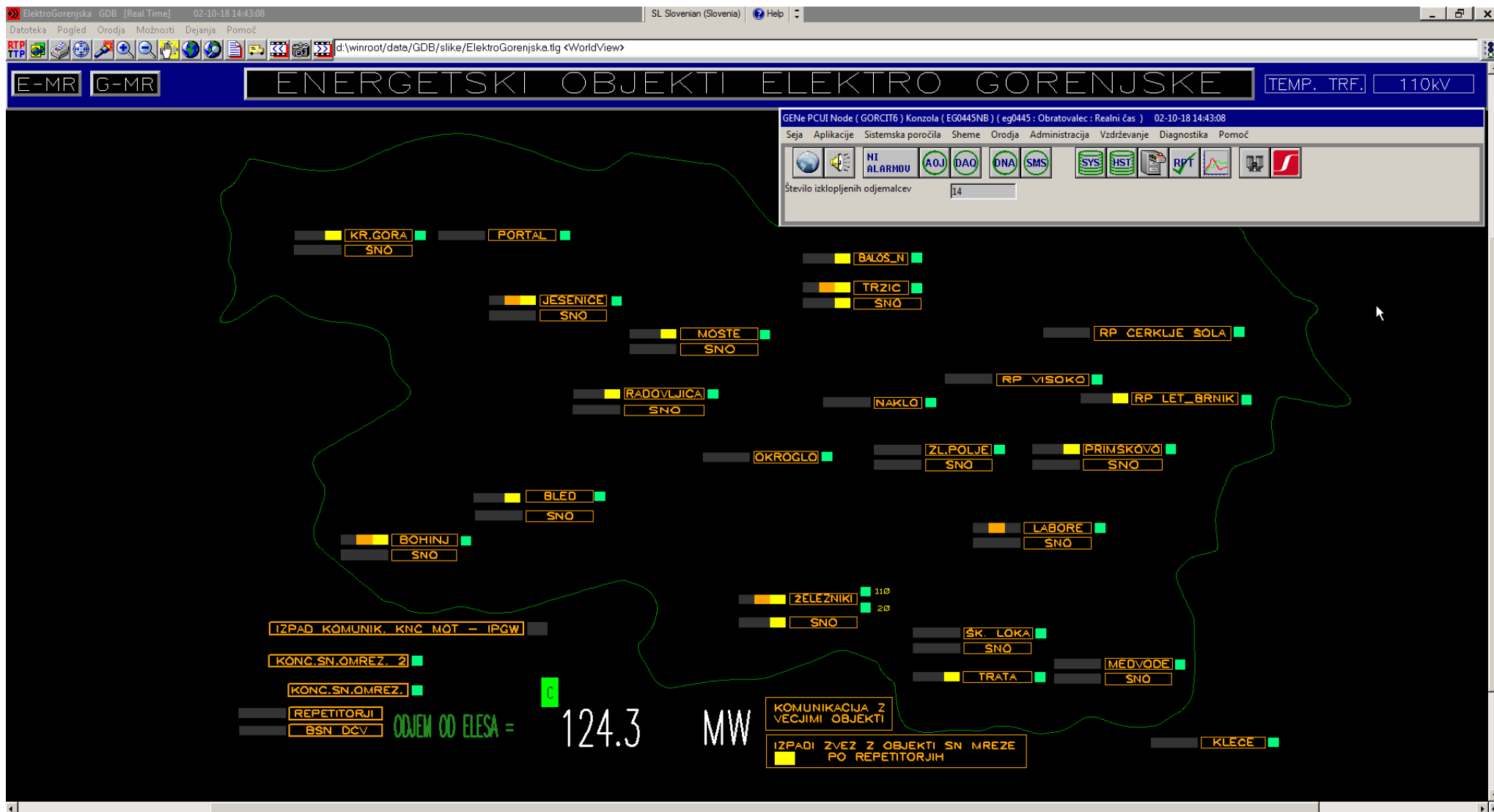
Vir: Vizija razvoja pametnih omrežij, Program razvoja pametnih omrežij in Nacionalni demonstracijski projekt pametnih omrežij

# Povečanje spoznavnosti SCADA EG

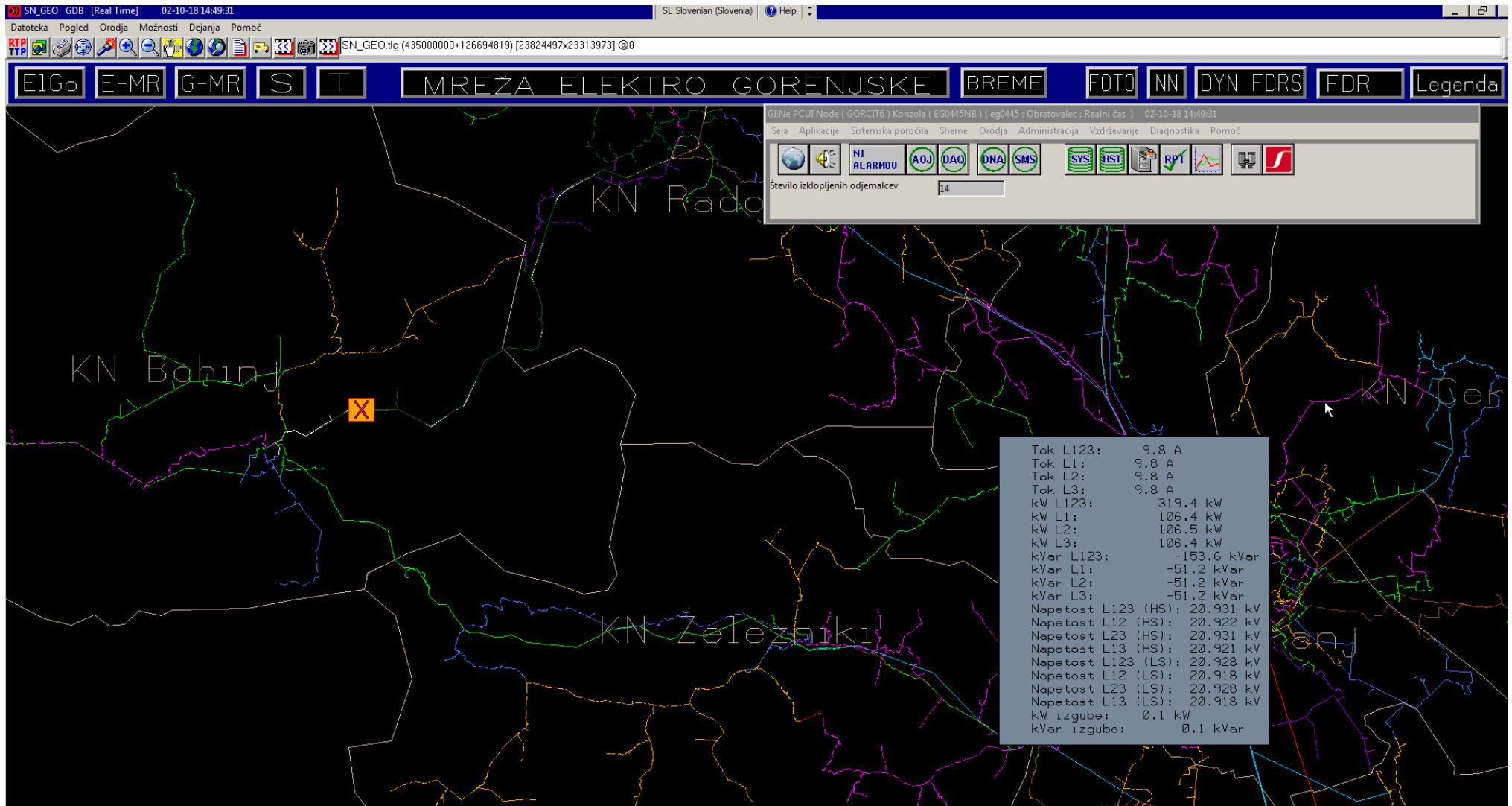
- **Distribucijski center vodenja (DCV):**
  - vodenje in nadzor SN omrežja do izvoda iz RTP
  - Daljinsko vodenih 25% stikal (1011) od tega 100 % v RTP/RP, 10 % stikal na mreži (79 objektov) in 9% TP (117),
  - V SN omrežju uporabljamo avtomatiko zank

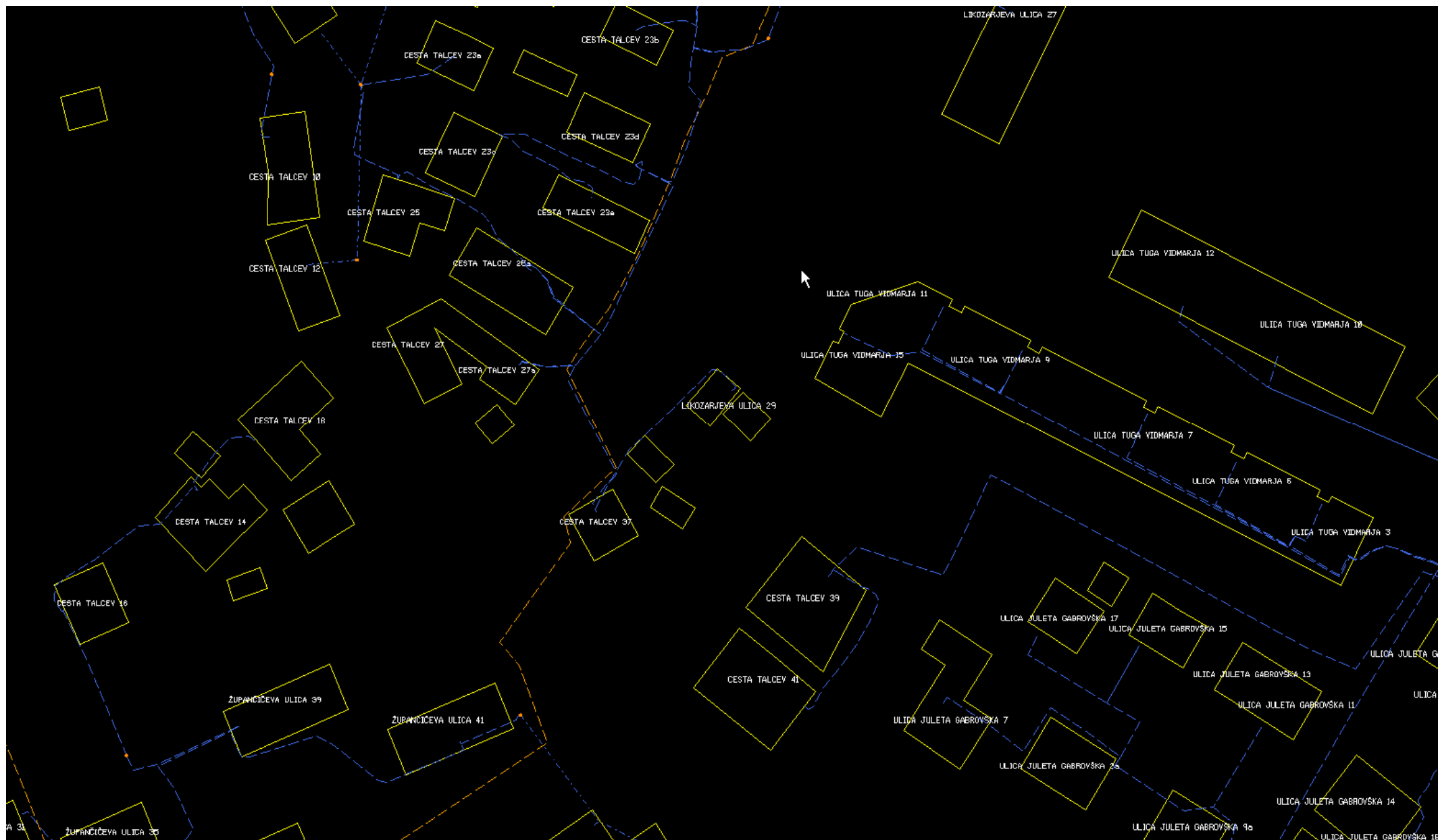


# Povečanje spoznavnosti SCADA EG



# Povečanje spoznavnosti SCADA EG





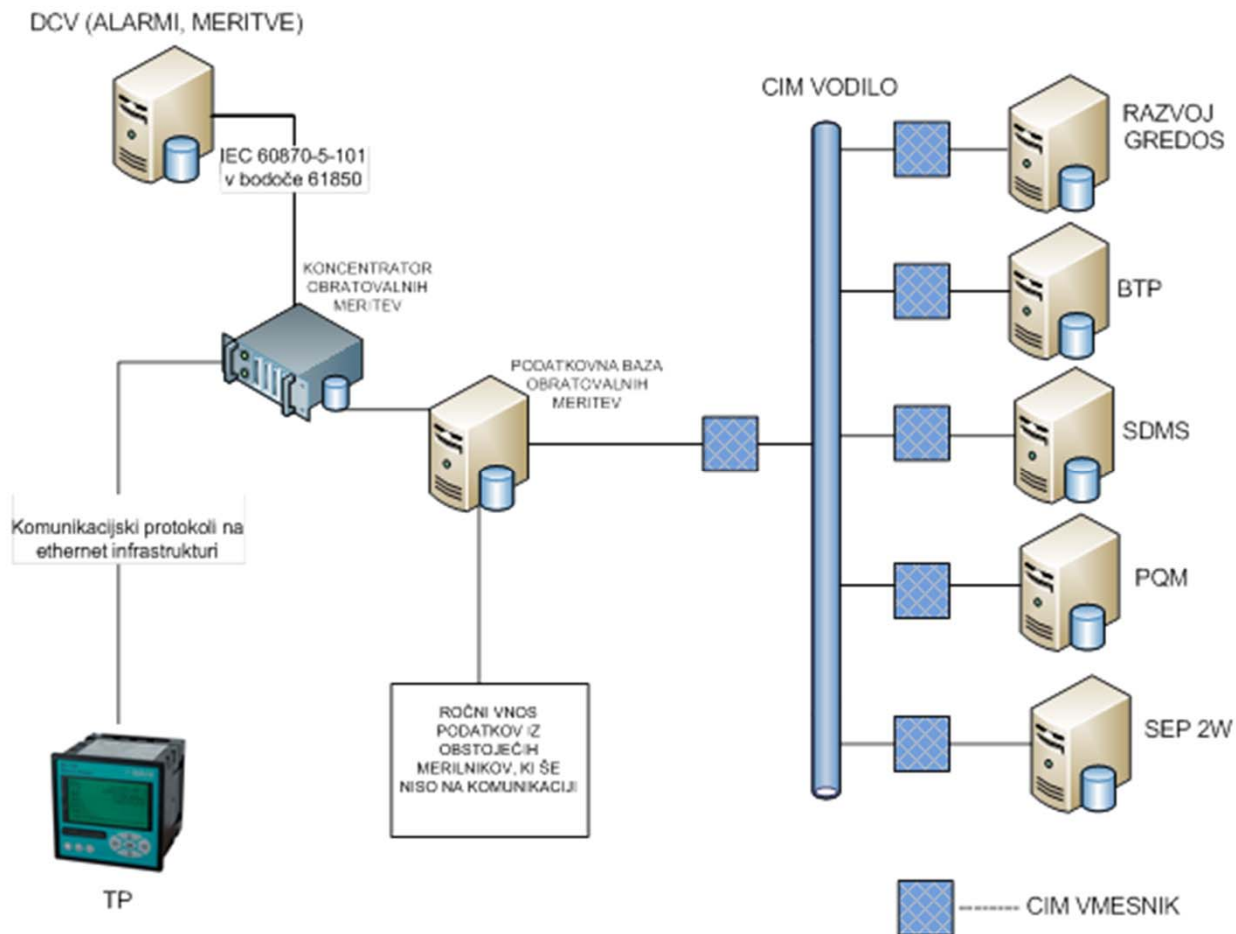




ULICA 31 ŽUPANČIČEVA ULICA 39

ULICA JULETA GABROVSKA 9a ULICA JULETA GABROVSKA 16

# Povečanje spoznavnosti Obratovalne meritve EG



# Povečanje spoznavnosti Obratovalne meritve EG

Obratovalne meritve v TP SN/NN in NNO:

- Vgrajenih > 500 merilnikov
- prenaša se do 64 veličin (perioda povprečenja 1,5,10 min),
- 10 alarmov (U <>, I >, T).

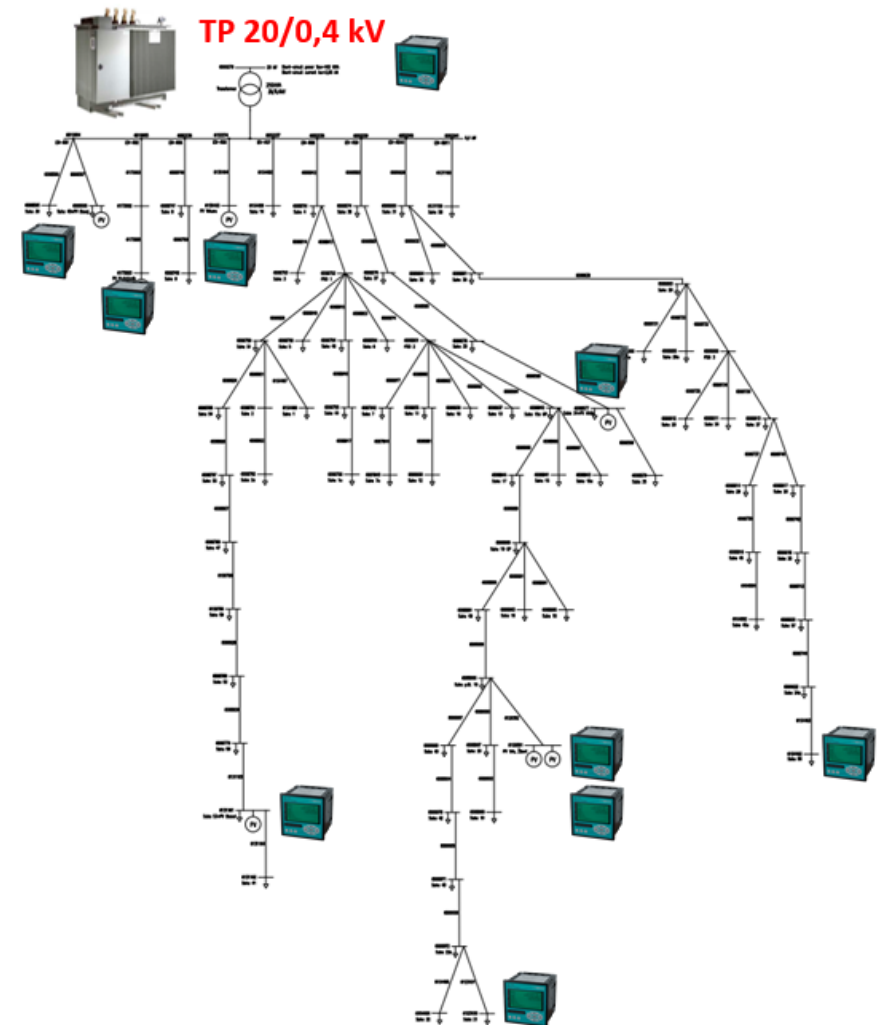
– pomen za:

- Vodenje in obratovanje
- Razvoj omrežja
- Kontrolo odjema EE

– vgrajuje se merilnik

MC 760/750/684 (Iskra MIS)

– komunikacija: Ethernet, IEC 61850, OPC UA



# Povečanje spoznavnosti - MiSMART

Measurements Alarms Quality Events

### View filters

By timespan:

From:  To:

By status:

By text:

By measurement type:

- Measurement groups
  - Energija
  - Fliker
  - Harmoniki
  - Moč
  - Napetosti
  - Others
  - Tokovi
  - Virtual measurements

### MRP structure tree

Topology View

Search tree:

- Elektro Gorenjska
  - KN BOHINJ
  - KN CERKLJE IN VISOKO
  - KN JESENICE IN KRANJSKA GORA
  - KN KRANJ
  - KN RADOVLJICA IN BLED
  - KN ŠKOFJA LOKA IN MEDVODE
  - KN TRŽIČ
  - KN ŽELEZNIKI
  - Kompaudacija
  - PROJEKTI
    - INCREASE
      - PVE Ahčin
      - PVE Basaj
      - PVE Bassol
      - PVE Hudobivnik
      - PVE Urh
      - PVE Vrhunc
      - PVE Žibert
      - Suha 21
      - Suha 56
      - TP T0284 SUHA
        - T0284 SUHA
          - (MC750) @ T0284 Suha pri Predosljah
- STORY
  - (MC750) @ Banka ledu
  - (MC750) @ NNR Urh
  - (MC750) @ SFE Primskovo
  - (MC750) @ SPT Primskovo

Alarms on this MRP are displayed in selected timespan:

### Measurements

View Type:  Together  Separate

Chart

Measurements

- Energija
- Moč
- Napetosti
- Others
- Tokovi

Reload all previous items Delete all previous items

T0284 Suha pri Predosljah - Skupna delovna moč P (Moč) [60s];

From:  To:

Zoom from:  Zoom to:  Zoom:

# Povečanje vodljivosti

## Regulacijski transformator 20/0.4 kV (OLTC)



Minera Sgrid

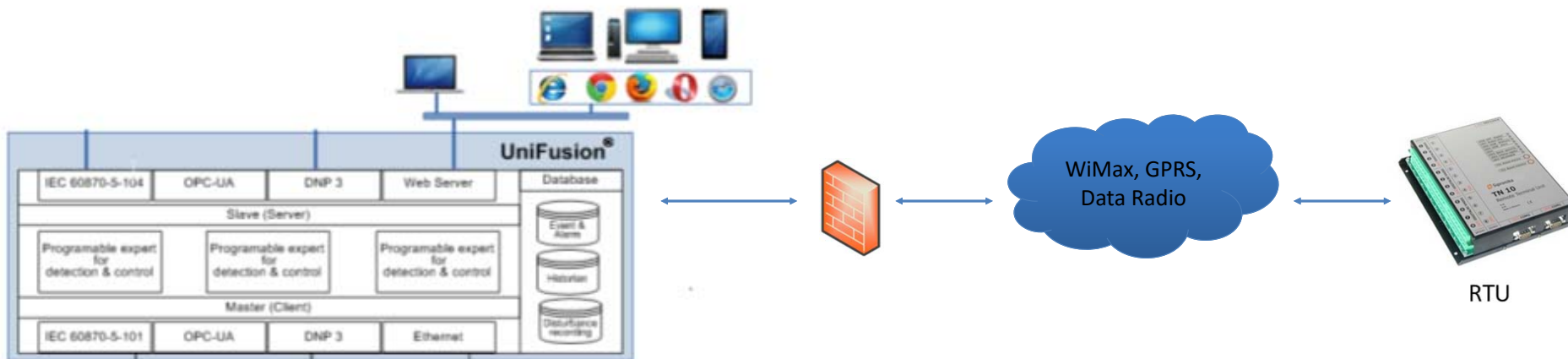


9 stopenj - 1.5 %

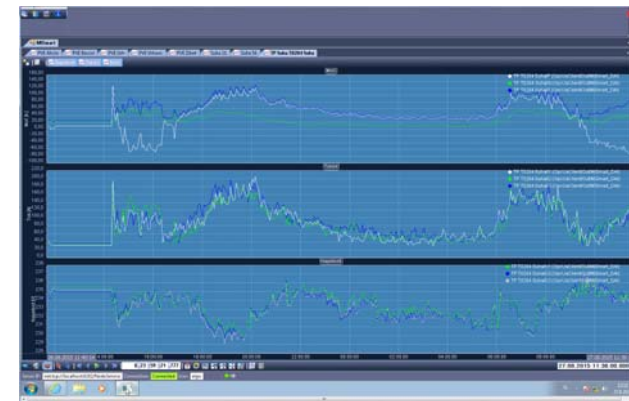


# Vodenje omrežja

## Sipronika - sistem vodenja SN omrežja - SCADA UniFusion



UniFusion SCADA



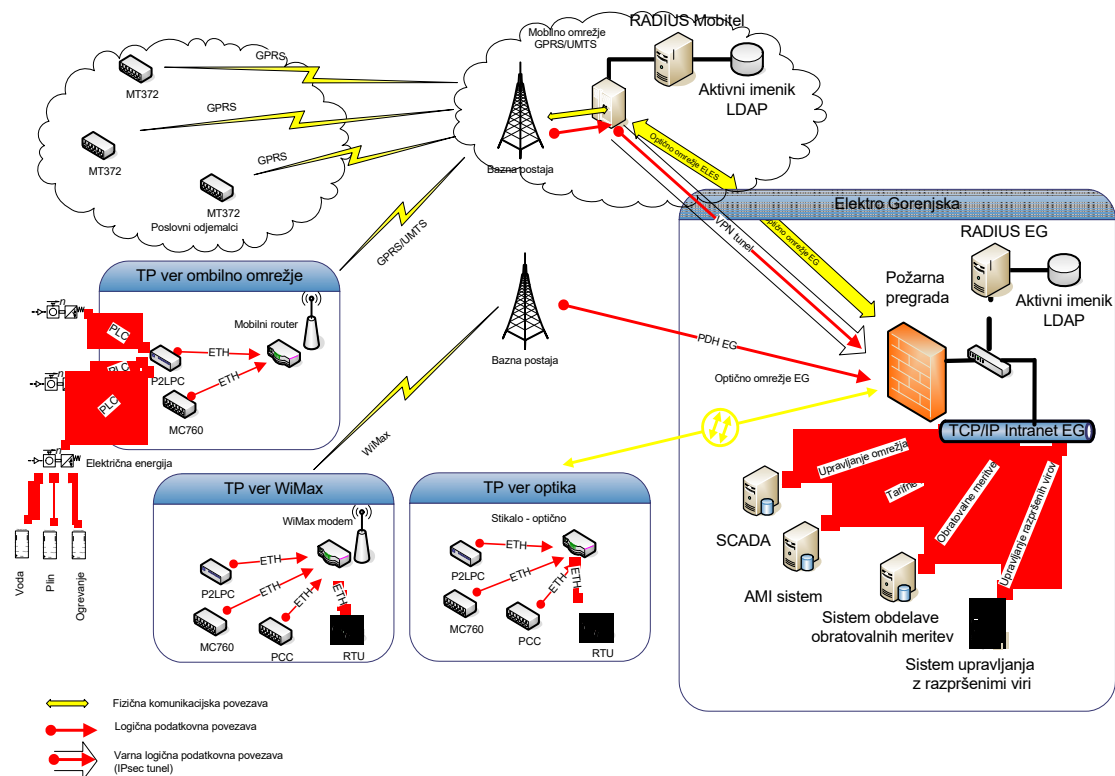
# Vodenje omrežja

## Upravlja je proizvodnje sončne elektrarne

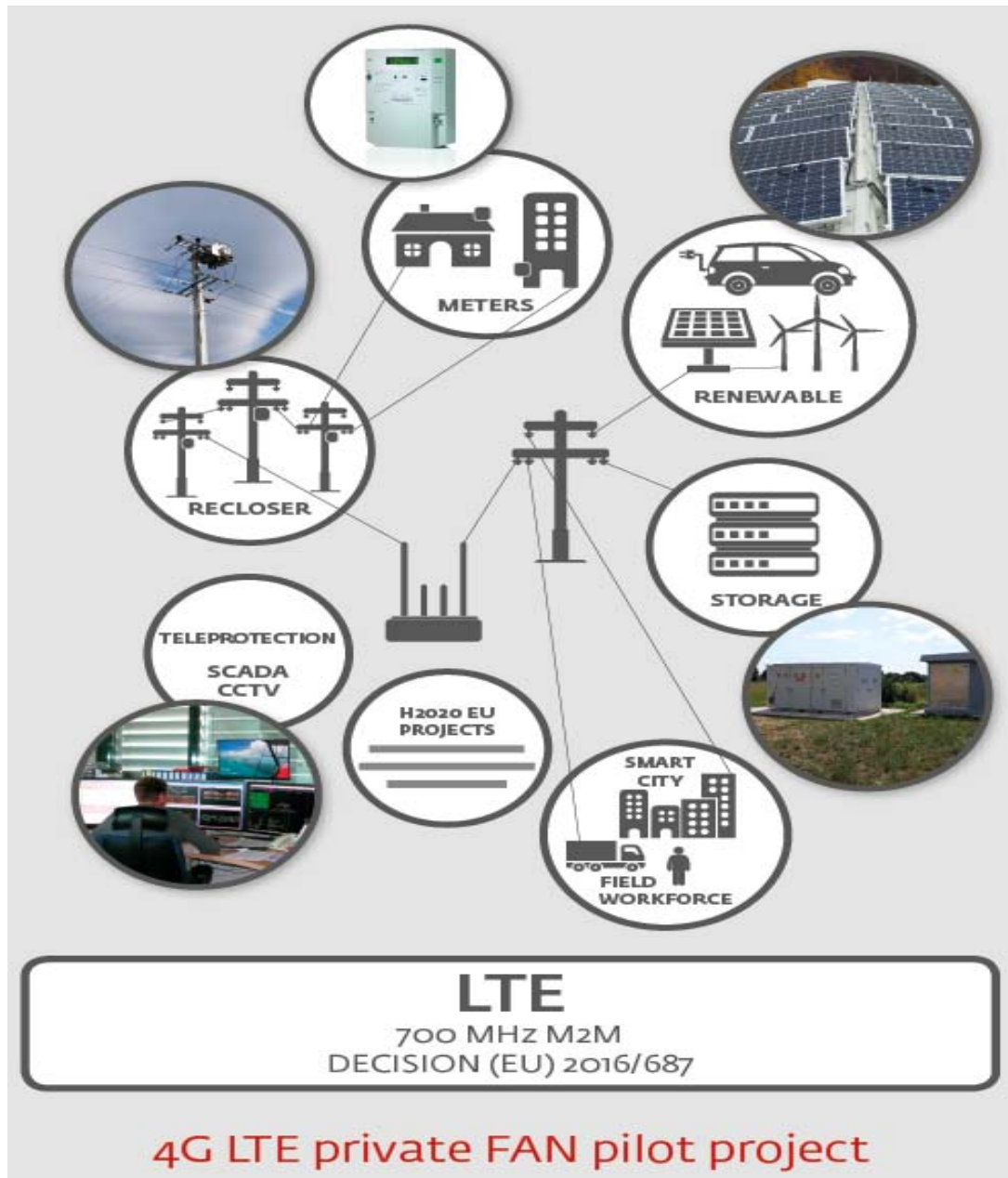


## Širokopasovno omrežje WiMAX

- 2006: prvi pilotni projekt - WiMAX in GPRS
- Avgust 2008: WiMAX 450
- 6.9.2010: Testna bazna postaja na Dobrči
- 23.5.2011: Odločba o dodelitvi radijskih frekvenc
- Avgust 2012: V 6 mesecih v sodelovanju s podjetjem ISKRATEL postavimo sistem s šestimi baznimi postajami
- Danes več skoraj 500 TP opremljenih z WiMAXom
- Danes pilotni projekt LTE in NB IoT

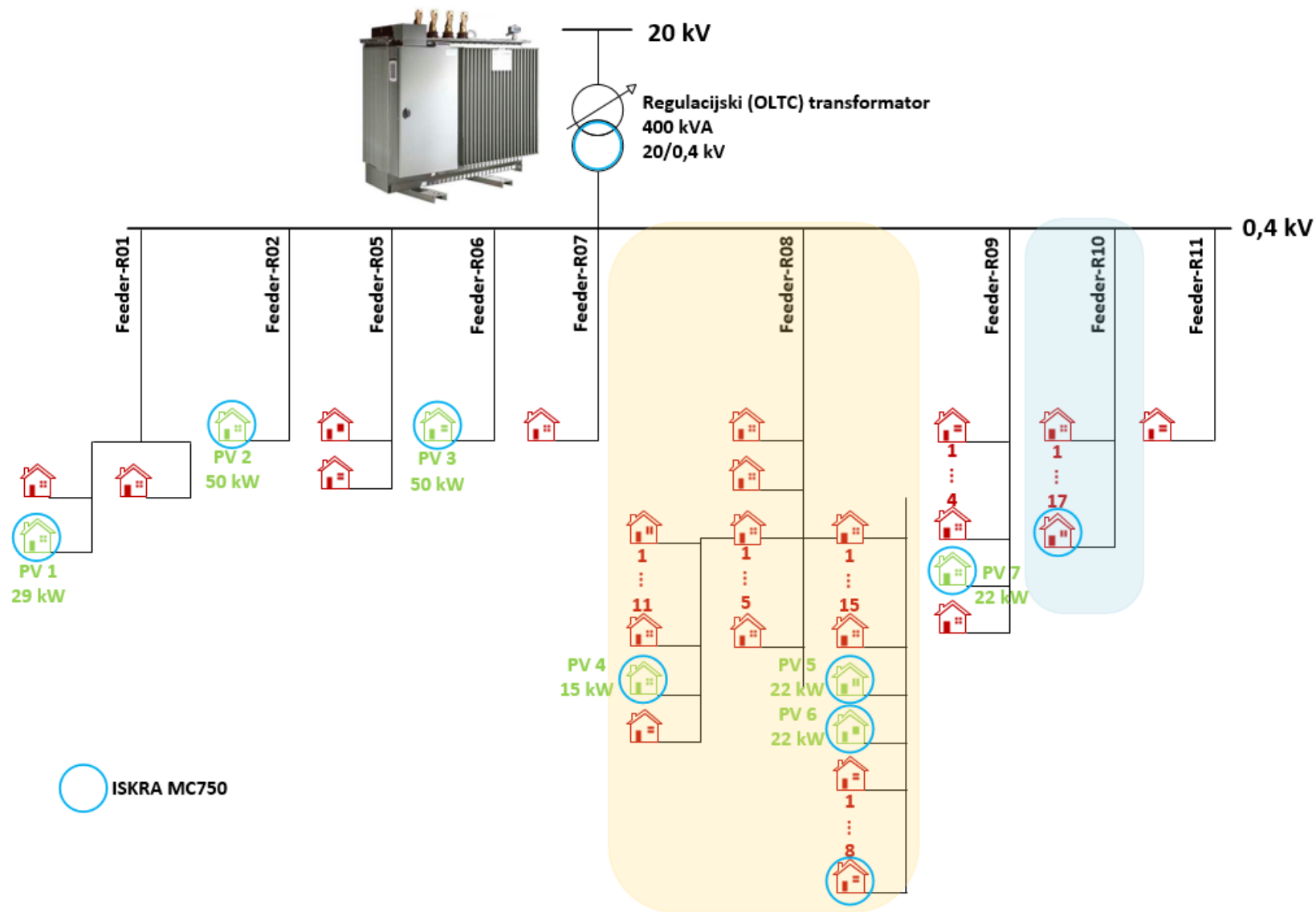






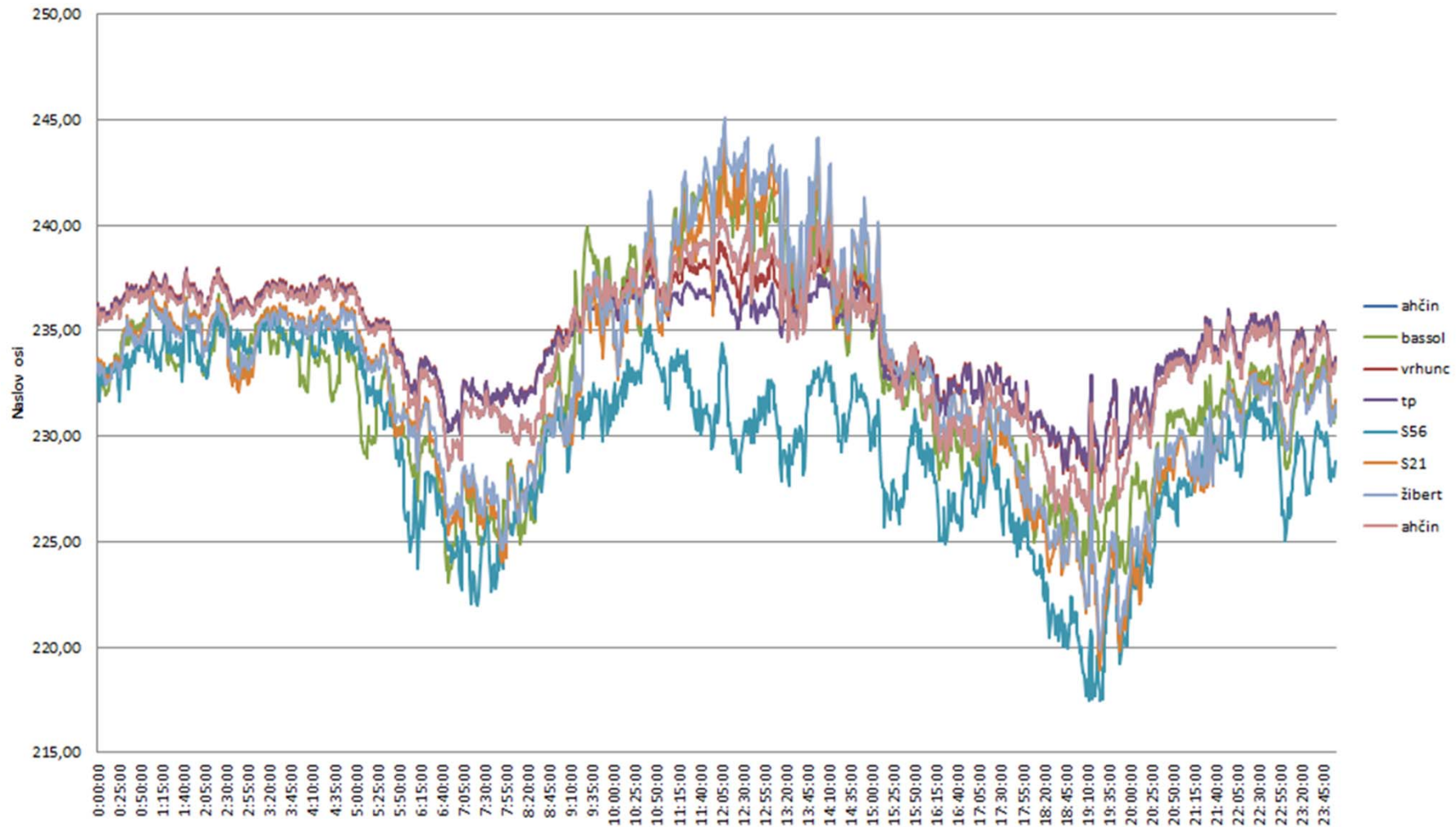
# H2020 projekt INCREASE

## koordinirana in lokalna regulacija napetosti v NNO

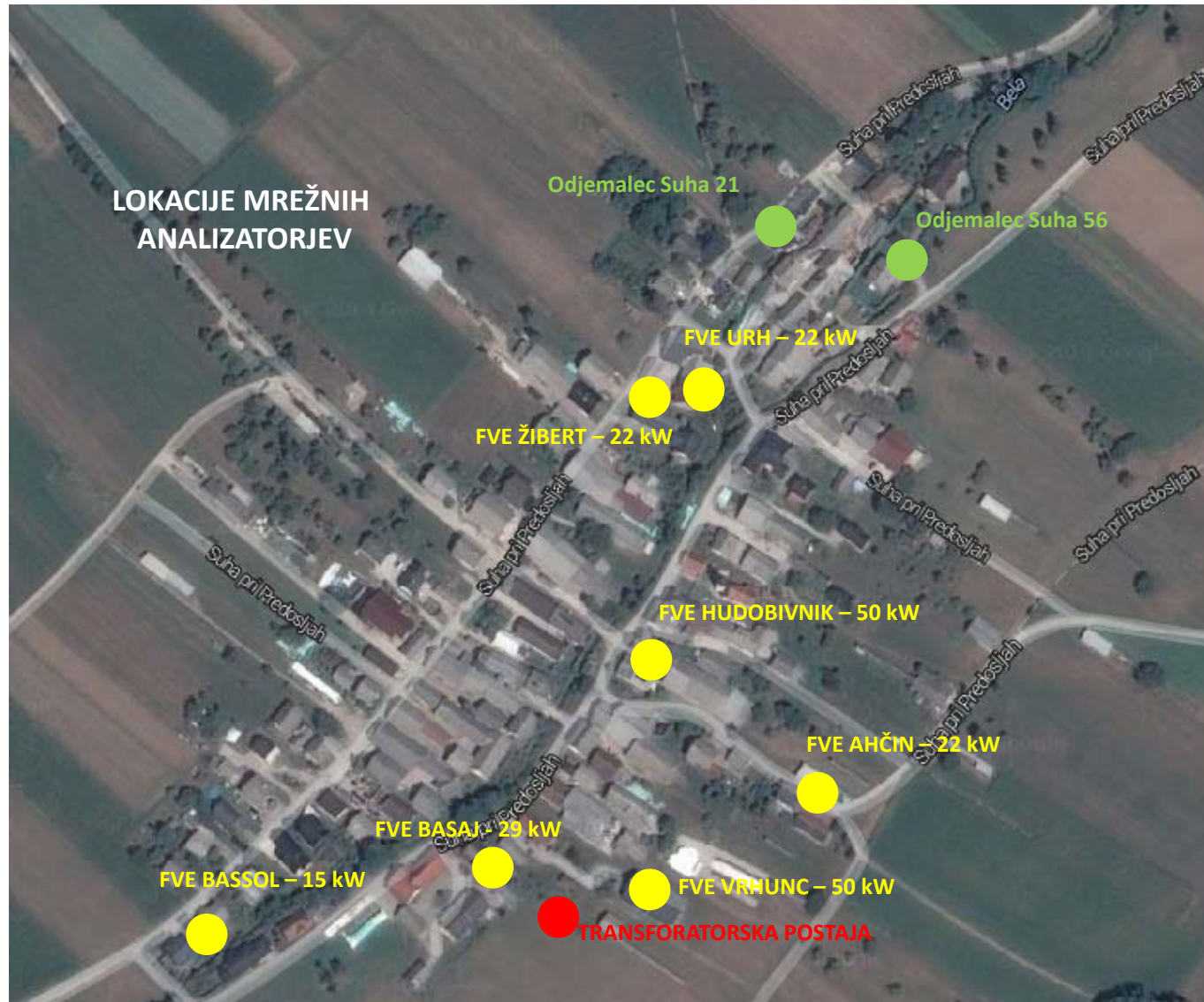


# Napetostne razmere NNO Suha

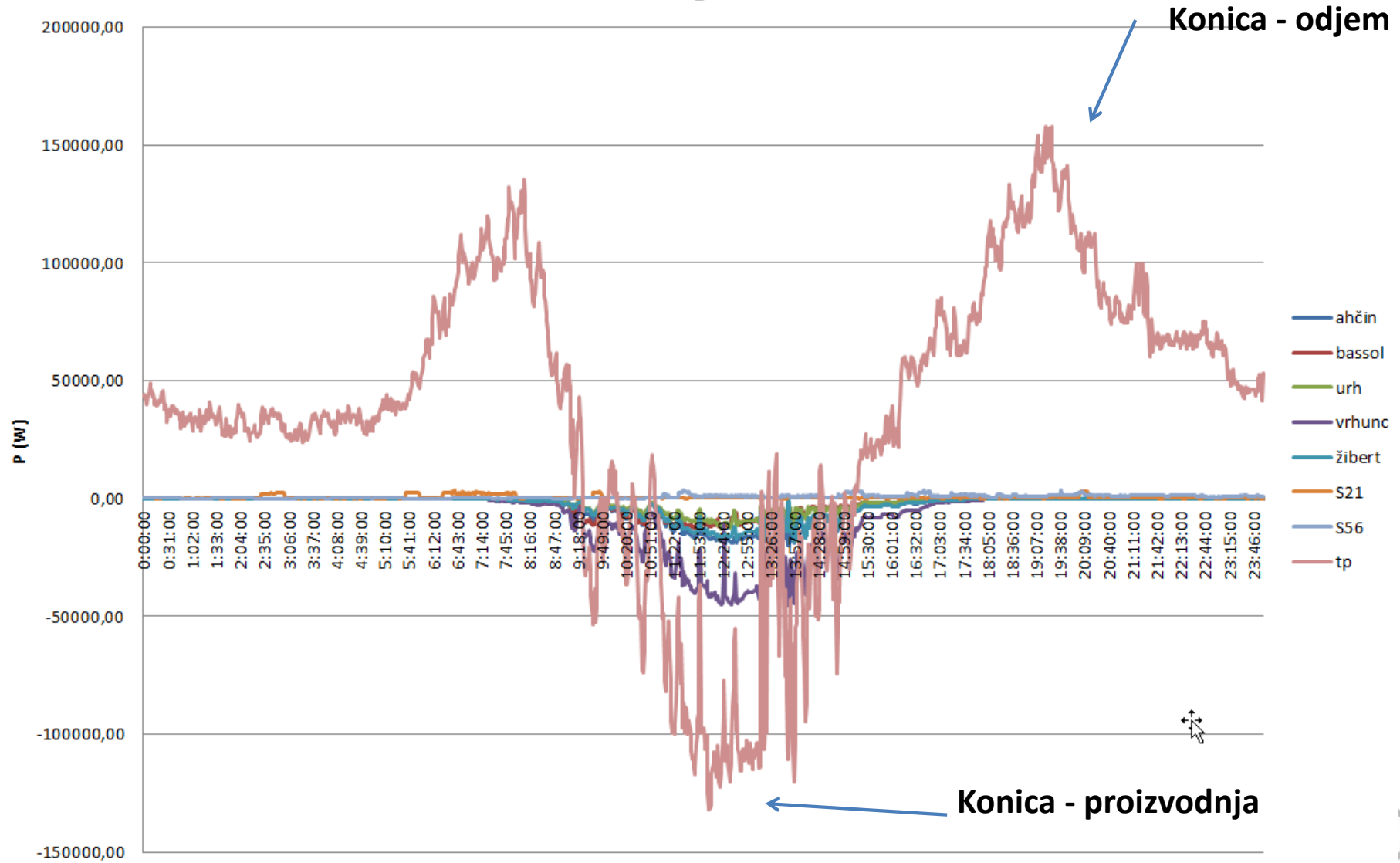
U NNO Suha



# Topološka shema



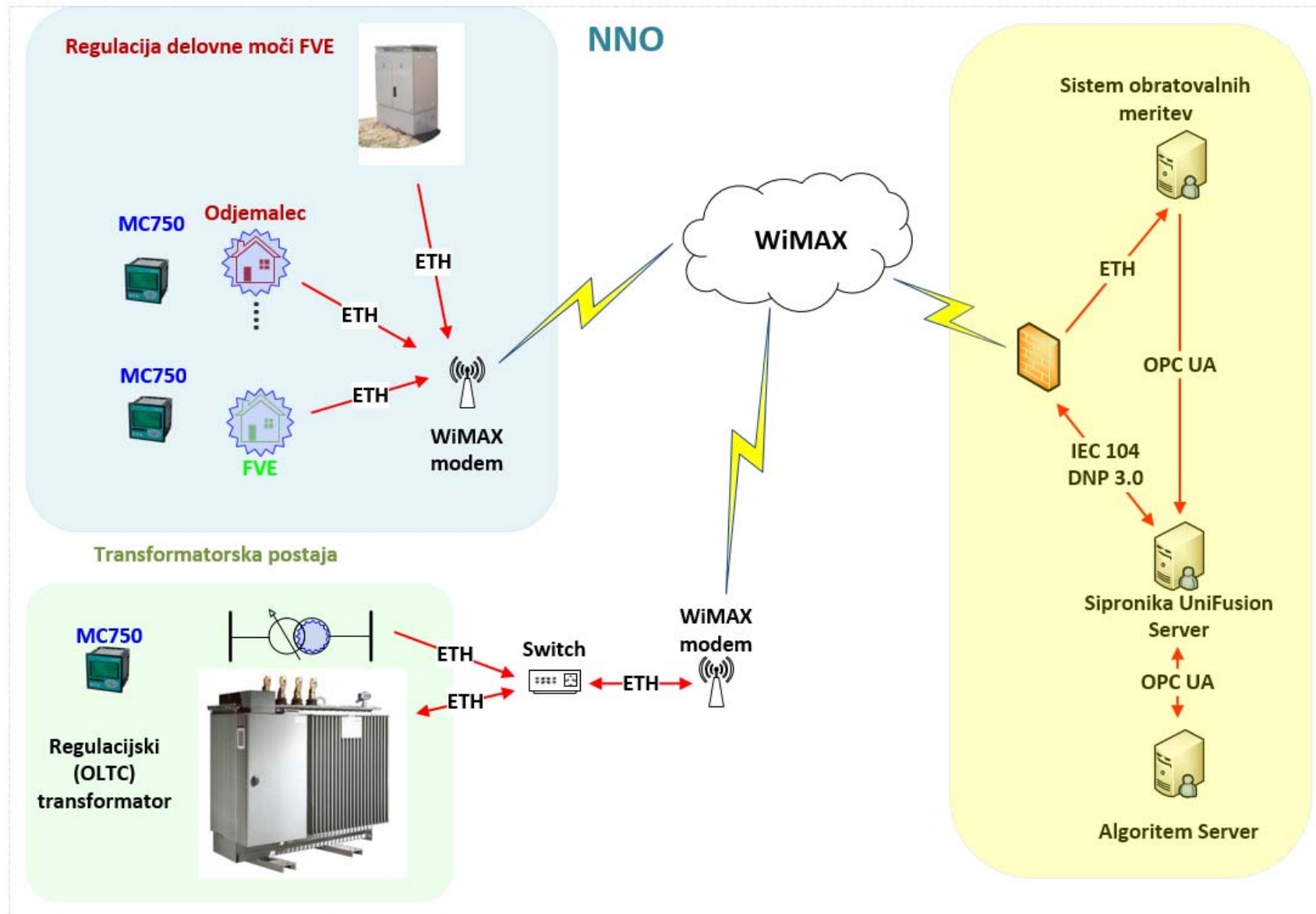
# P diagram



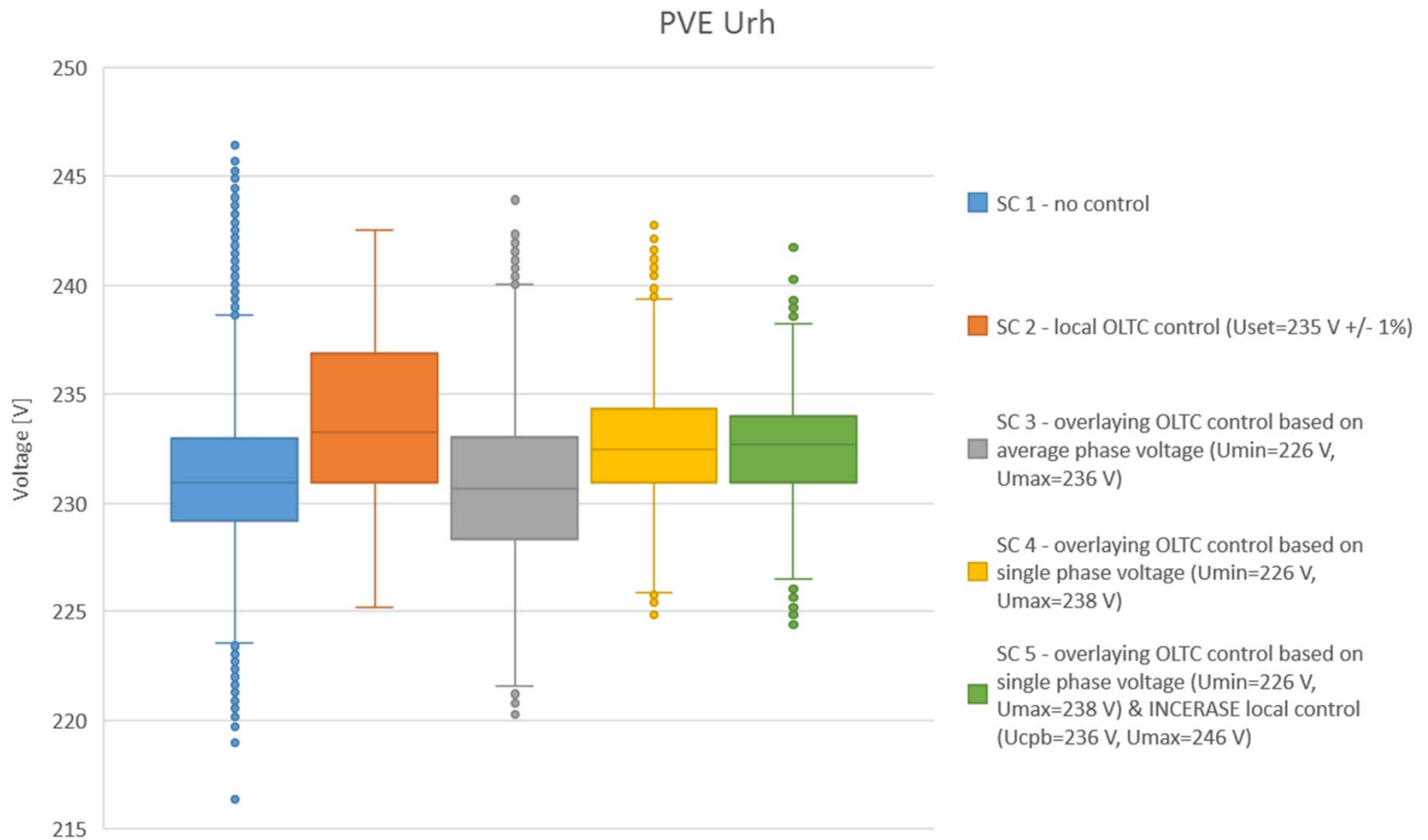
P diagram – 26. 9. 2014



# Principielna shema vodenja



# Rezultati meritev – lokacija FVE

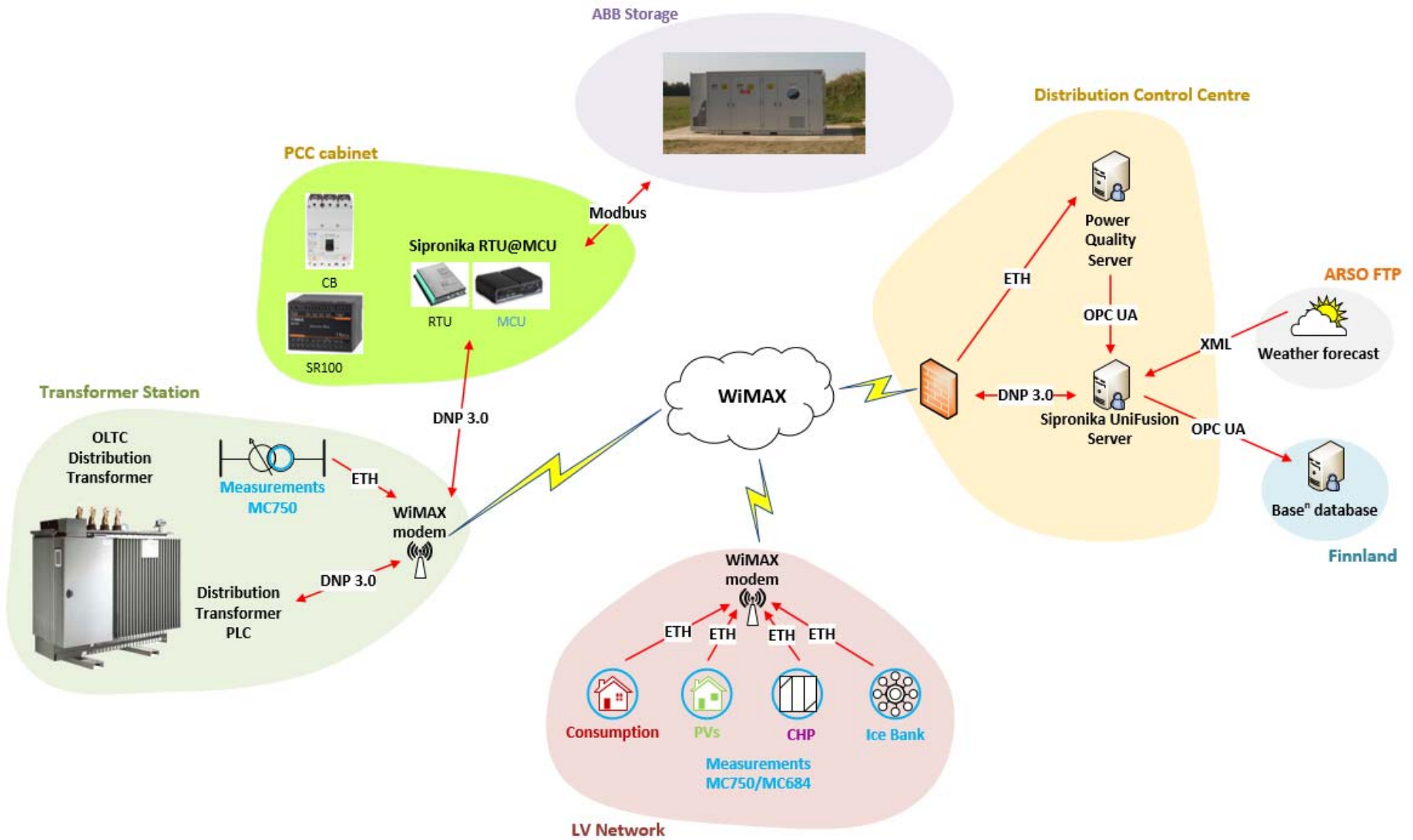


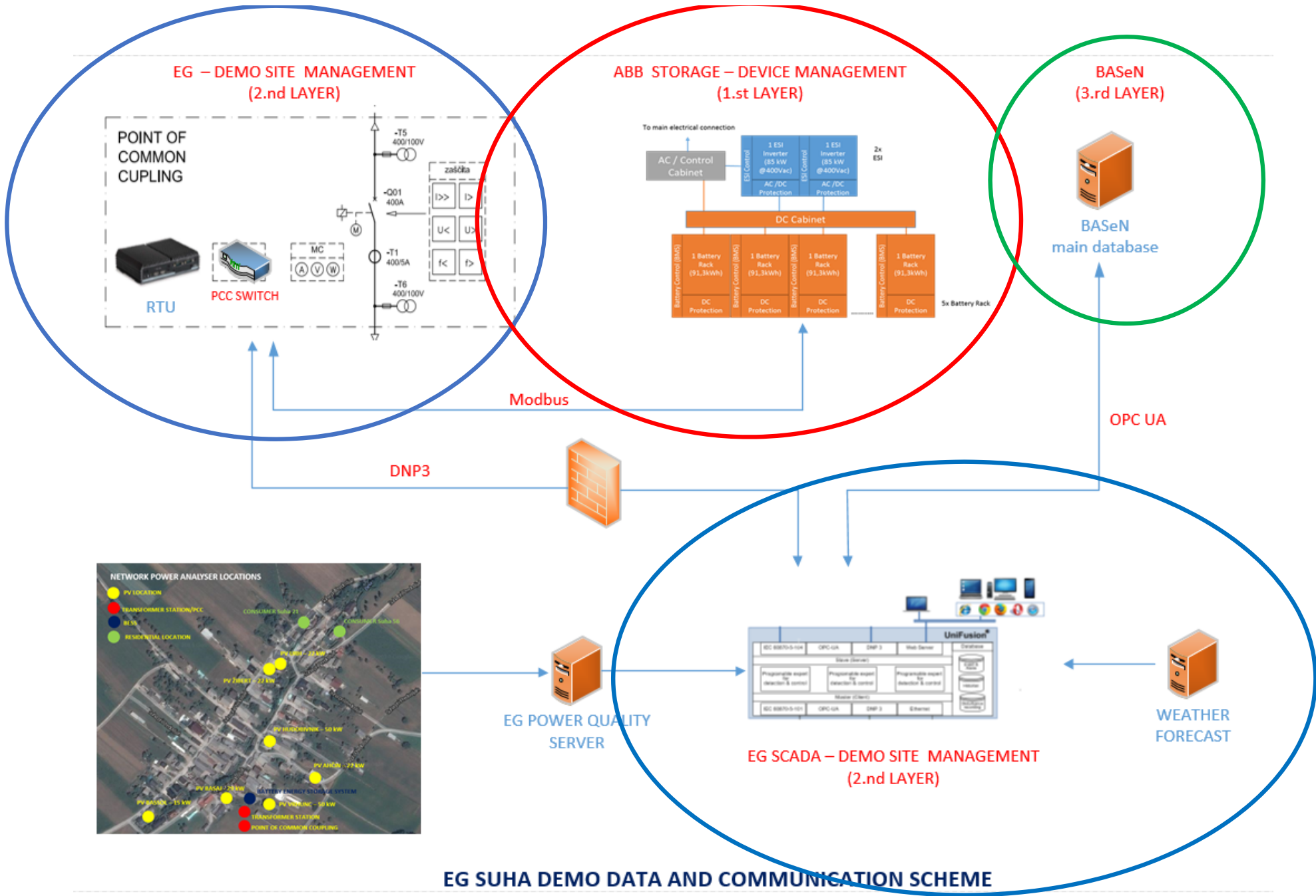
**H2020 projekt STORY**  
**implementacija večjega hranilnika energije v NNO**

**TP Suha- ruralno omrežje**  
**TP Elektro – industrijsko omrežje**

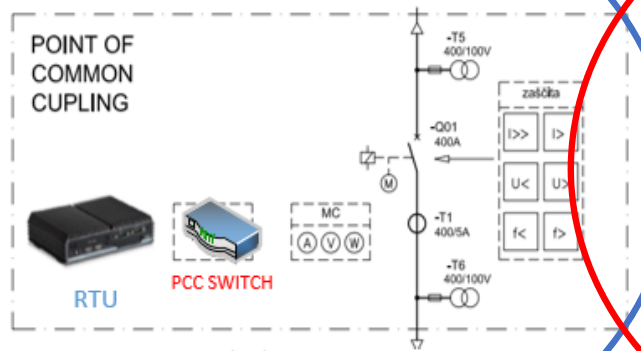




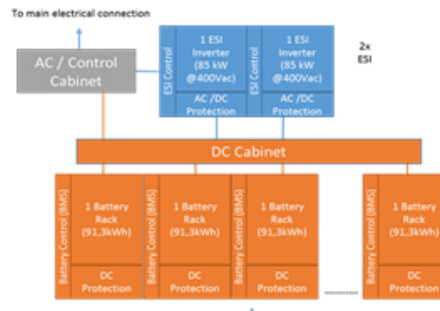




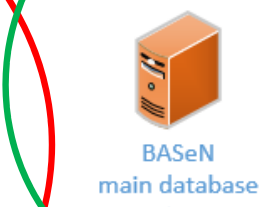
**EG – DEMO SITE MANAGEMENT (2.nd LAYER)**



**ABB STORAGE – DEVICE MANAGEMENT (1.st LAYER)**



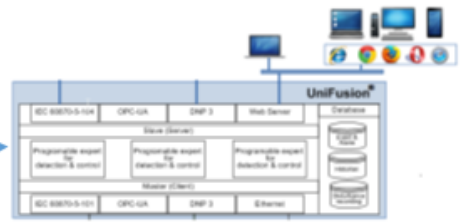
**BASen (3.rd LAYER)**



Modbus

DNP3

OPC UA

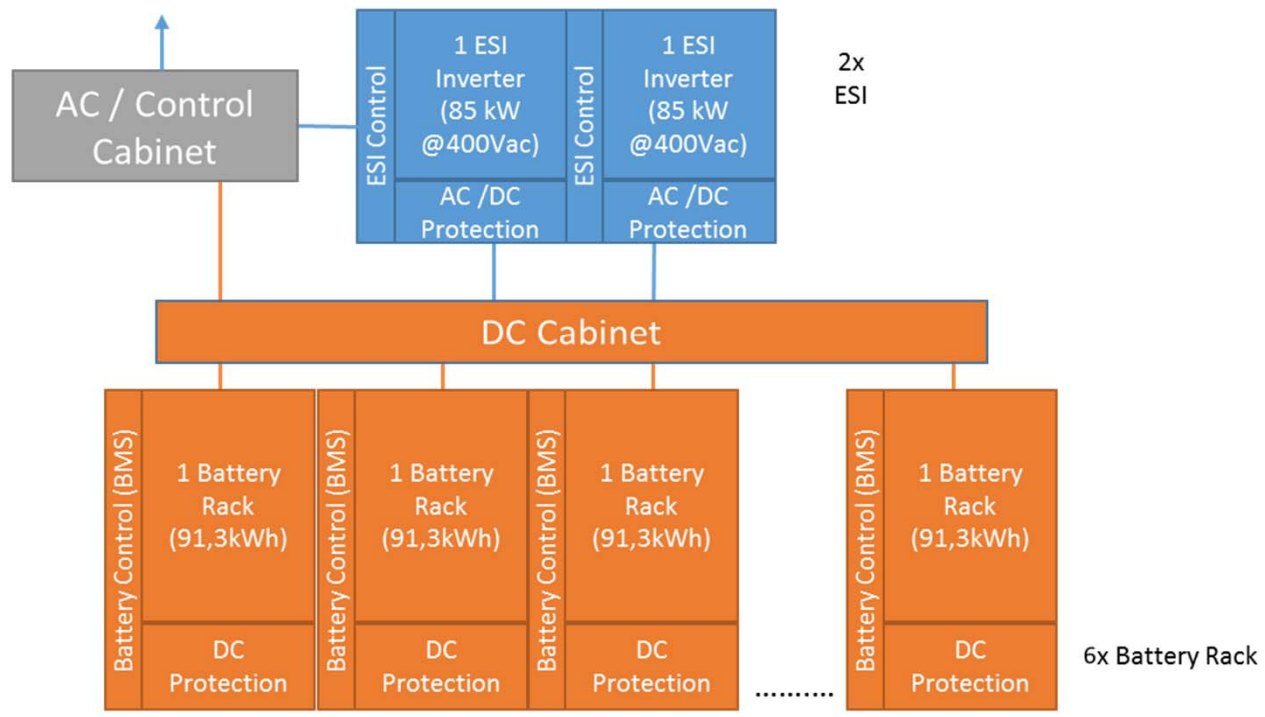


System parameter	Value
Total Installed Power (kW)	170 kVa @400 Vac
Power per ESI unit (kW)	85 kVA @400 Vac
Range of Power Factor	Fully inductive to fully capacitive 100% P(kW) or Q(kvar)
Total Installed Energy (kWh)	552 kWh in 3-wires configuration and considering full Voltage Range and State of Charge (SoC) of batteries
Installed Energy per Rack (kWh)	91,3 kWh
Total Usable Energy BOL	66% of Total Installed Energy @ Bol*
Inverter Parasitic Loads	2.5% of Losses @ Rated Power
Battery Parasitic Loads	2% of Losses @ Rated Energy
Auxiliaries Parasitic Loads (LV)	1.5% of Losses @ Rated Power / Energy
Typical <u>round trip</u> efficiency AC/AC	>85% for 1 Full cycle at Full Charge or Discharge of Usable Energy in 1 hour (1C).
Max Temperature for Battery (°C)	25°C – Ambient Temperature
Max Temperature for PCS (°C)	40°C – Ambient Temperature
Max Charge / Discharge Rate	Full Charge or Discharge of Usable Energy in 1 hour (1C).
Communication EMS/MCU	Via Modbus protocol**
Communication EMS/PCS	Via Modbus protocol
Communication EMS/BBMS	Via Modbus protocol

System parameter	Value
Manufacturer	LG Chem
Module Type	JH3-2P (M48126P3B)
Module energy	6.52 kWh
Rack type	JH3-2P R800
Elements included in rack	Modules (14), Battery Protection Unit (1), Rack BMS (1)
Number of modules per rack	14
Rack energy	91.3 kWh
Rack voltage nominal (Vdc)	725
Rack Voltage maximum (Vdc)	823.2
Rack voltage minimum (Vdc) – 3 Wires	588.0
Rack voltage minimum (Vdc) – 4 Wires	650.0 – Limited by Inverter Voltage Range in 4wires
Maximum Charge / Discharge Rate	Full Charge or Discharge of Usable Energy in 1 hour (1C).
Self-discharge (% per year based on cell)	<6% * based on cell
Operating ambient temperature	21° C ± 4°C
Maximum ambient operating humidity	<80% with none condensation
Indoor installation	Up to 1000 m above sea level
Rack protection degree	IP20
Rack cooling	Air-cooling front to rear
Rack dimension	W x D x H: 520 x 670 x 1800 mm (unpacked)
Weight	710kg
DC cable connection	Top
DC protection	Main <u>contactor</u> and fuses
Compliant with standards:	IEC 62133, UL 1642, UN 38.3, KBIA 10104-01, SBA S1101



To main electrical connection



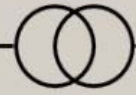


User : abb

# Main

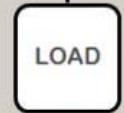


Grid Data	
P	: 0.0 kW
Q	: 0.0 kVA
Cos f	: 0.0



BESS data	
P	: -2.9 kW
Q	: 0.8 kVA

Main AC Closed  
 Main Tripped



Auxiliaries data	
P	: 3.1 kW

Load data	
P	: 0.0 kW

Start

Stop

Reset Fault

ESI : 1

Unit : Ready

Filter : Stopped

ESI : 2

Unit : Ready

PeakShaving  
 Manual Mode

U dc ESI : 638.6 V

### BBMS

SOC	: 70.5%
SOH	: 100.0%
Stack Volt	: 755.0 V
Stack Current	: 0.0 A
Max Temp	: 30.0 °C
N Rack	: 6
Status	: Normal
Connected	

Connect

Disconnect

Reset

ESI 1 Preload DC Close  
 ESI 1 Preload Tripped  
 ESI 2 Preload DC Close  
 ESI 2 Preload Tripped

- Main
- Parameters
- Events
- Trends
- Users config

- Connection status
- System
- DIOs
- Battery data
- Battery settings
- Function settings
- Battery control
- Main user Setting
- ESI status
- Alarms
- Warnings
- Voltage
- Line Currents
- Temperatures
- Powers
- Power analyzer
- Aux consumption

System Table		
Started	Status	
40,50 %	SOC	
100,00 %	SOH	
From main controller	Automatic mode	
Idle	StartStopAckFault	
Remote	Mode switch position	

Peak shaving from BESS			
-----	-----	Activate peak shaving from BESS controller	Exe
0,00 kW		Upper limit for Peak shaving	
0	Upper limit for Peak shaving	0,00 kW	Lower limit for Peak shaving
0	Lower limit for Peak shaving	0,00 kW	Power output target
0	Power output target		

Control from Main controller			
-----	-----	Activate control from Main controller	Exe

Self consumption compensation			
Disabled	Self consumption comp. for P <> 0		
Disabled	Self consumption comp. for P == 0		
-----	-----	Enable self consumption comp. for P <> 0	Exe
-----	-----	Disable self consumption comp. for P <> 0	Exe

Main Control			
Accepted	17. 09. 2018 07:22:35	Start	Exe
Failure	16. 09. 2018 18:23:54	Stop	Exe
Failure	16. 09. 2018 09:32:13	Ack Fault	Exe

on-line

Charts

- System
- DIOs
- Function settings
- Battery data
- Battery control
- Battery settings
- Measurements
- Line Currents
- Powers
- ESI status
- Network analyser
- P...
- Aux consumption
- Temperatures
- Algorithm

- Peak shaving algorithm
- Status
- Real-time control

Real-time control



Peak shaving algorithm



Cursor1	Value	Name
73,68 kW	40,86 kW	8.6 Powers/Active pow
60,00 %	88,00 %	Items/SOC
108,84 kW	36,48 kW	BESS/P_Sum
66,95 kW	66,95 kW	BESS/P_High_Morning
-1,00 kW	-1,00 kW	BESS/P_Low_Morning
89,15 kW	111,49 kW	BESS/P_High_Evening
0,00 kW	0,00 kW	BESS/P_Low_Evening
-44,87 kW	0,00 kW	P_Bat_Inv/P_Bat_Inv
-35,16 kW	4,38 kW	Power analyser/P_Bat

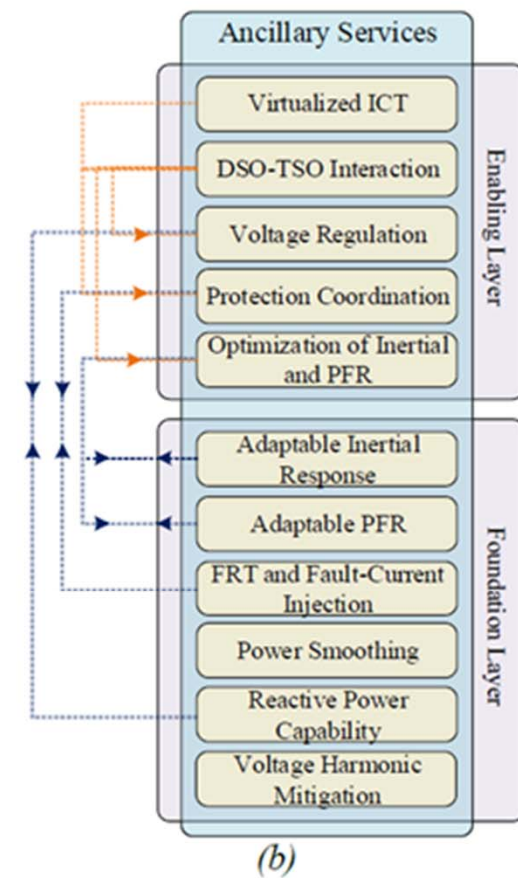
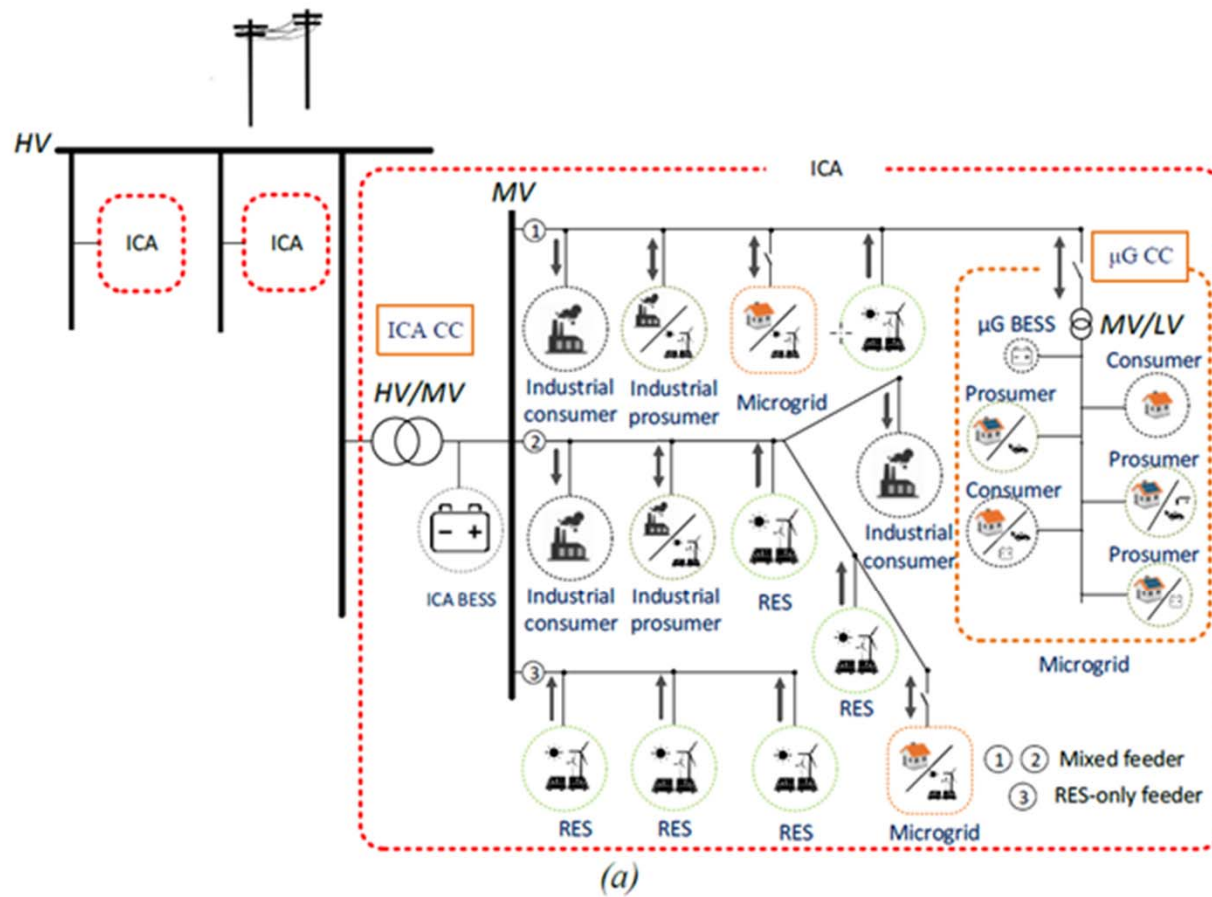
Cursor1	Value	Name
63,97 kW	58,43 kW	BESS/P_TP_Forecast
51,75 %	54,16 %	BESS/SoC_Forecast
114,36 kW	58,43 kW	BESS/P_TP_Profile
66,95 kW	66,95 kW	BESS/P_High_Morning
-1,00 kW	-1,00 kW	BESS/P_Low_Morning
89,15 kW	111,49 kW	BESS/P_High_Evening
0,00 kW	0,00 kW	BESS/P_Low_Evening
-50,39 kW	0,00 kW	P_Bat_Forecast_Inv/P
2,98 kW	2,98 kW	BESS/P_Aux_Avg





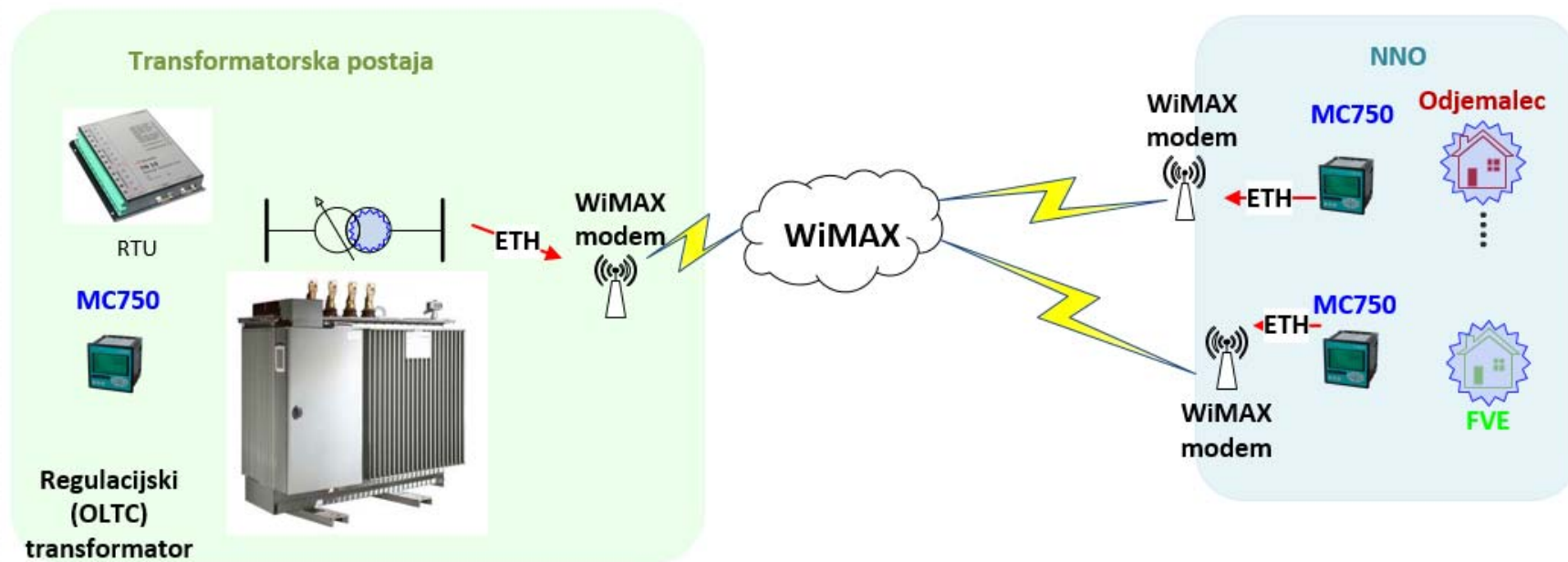
# H2020 projekt EASY RES

## Sistemske storitve z uporabo razpršenih virov



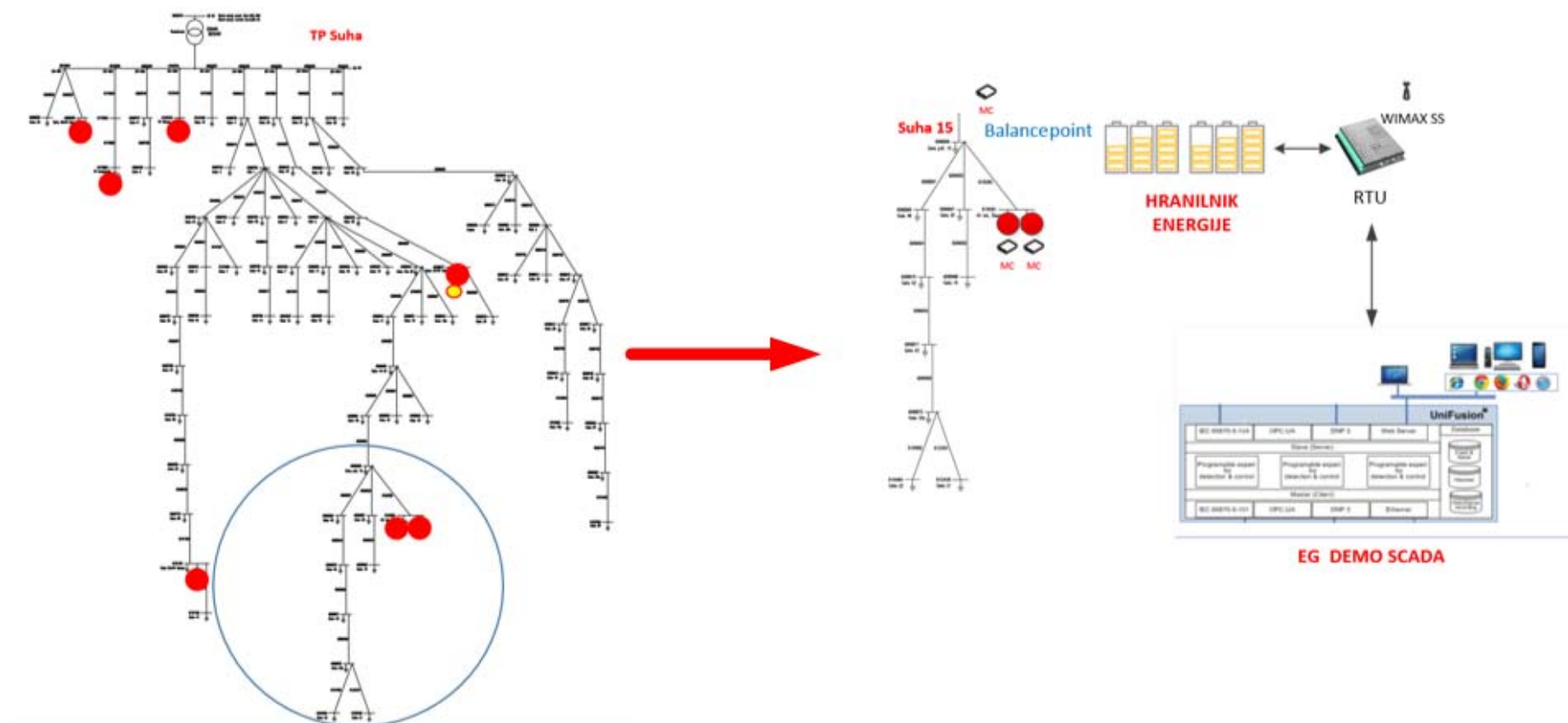
# Izzivi prihodnosti

## Lokalna koordinirana regulacija napetosti

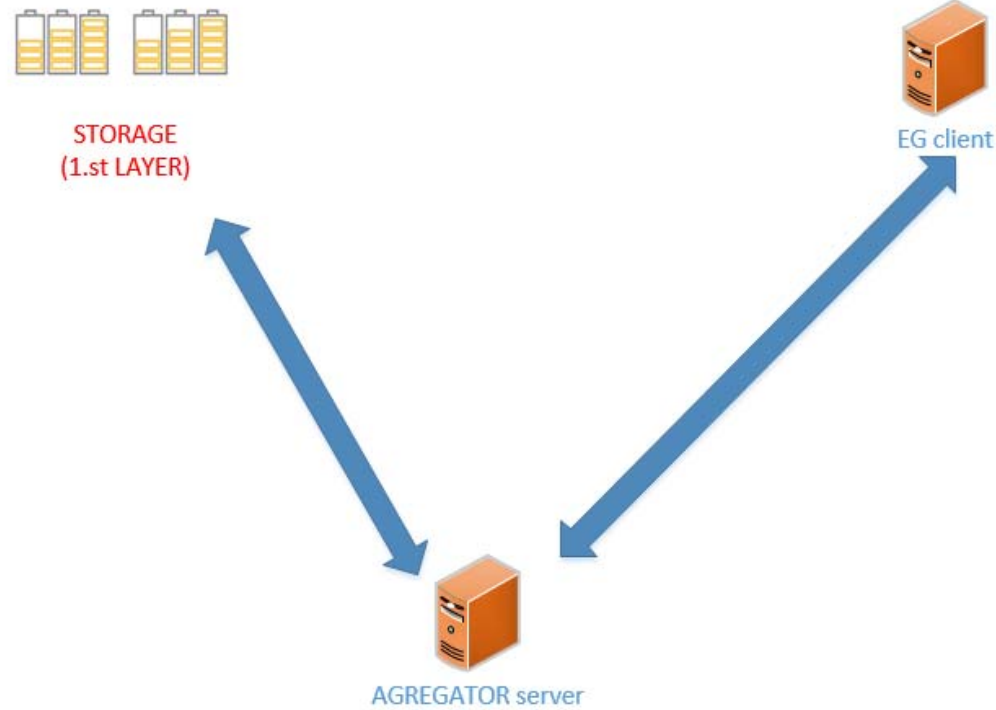
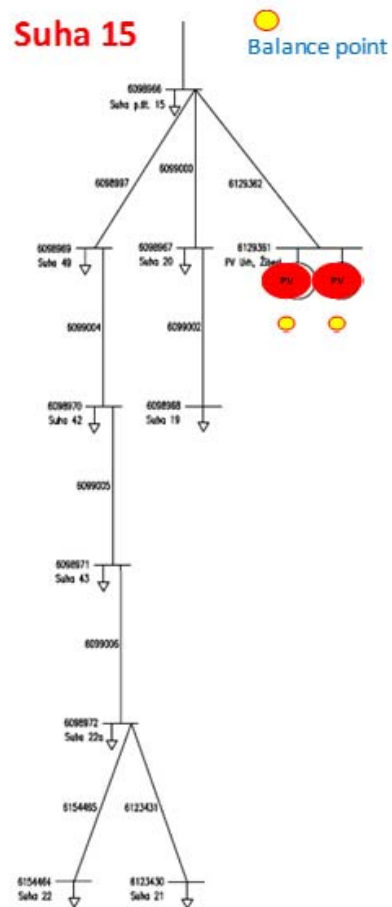


# Izzivi prihodnosti

## Lokalni hranilnik energije – mikro omrežja



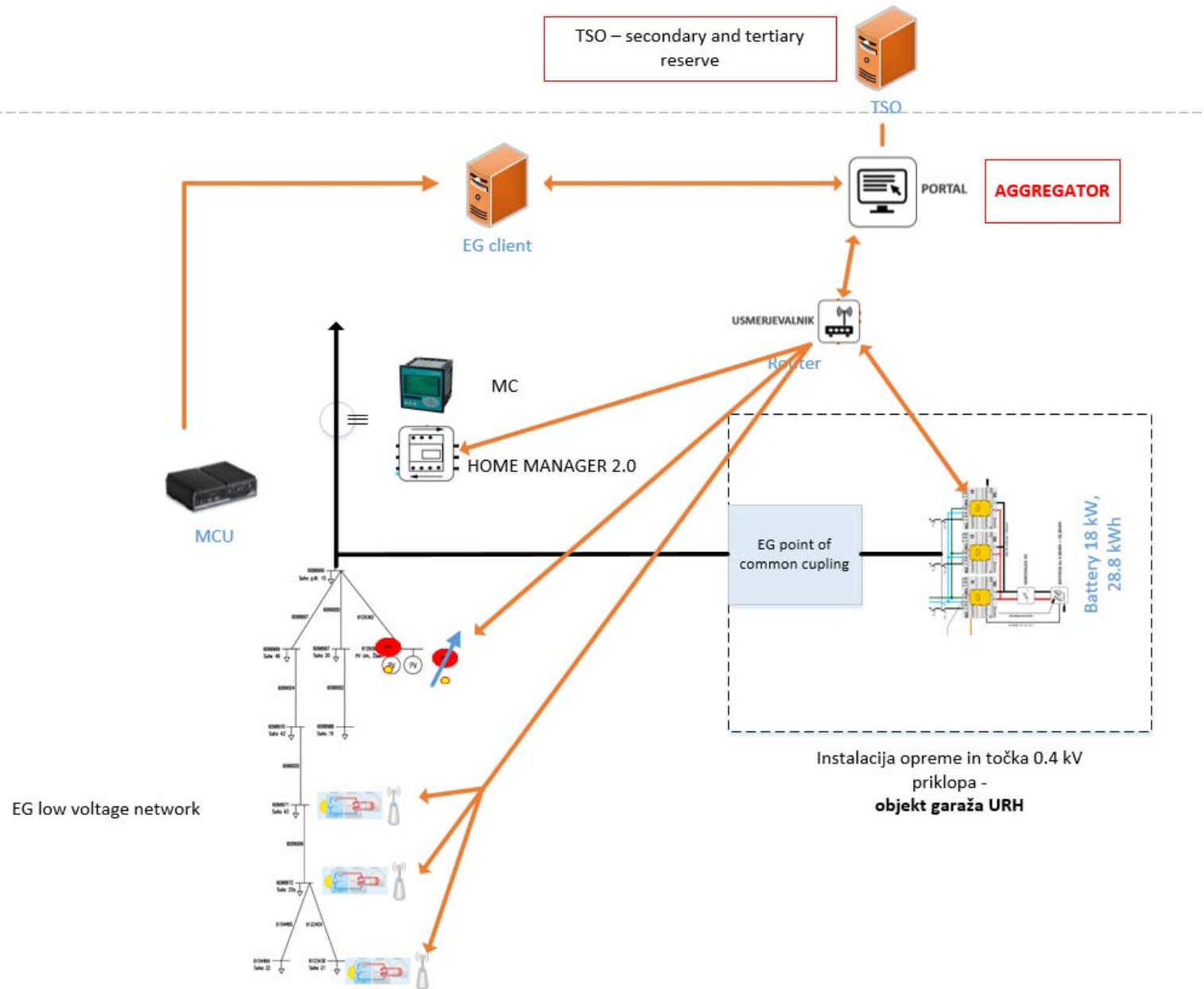
## Suha 15



- **Primarni nivo:** instalacija hranilnika v NNO ( predvidena lokacija poleg FVE Urh in na merilnem mestu Suha 15)
- **Sekundarni nivo:** integracija hranilnika v sistem virtualne elektrarne - podpora regulacije frekvence (sekundarna, terciarna)
- **Funkcionalnosti hranilnika:**
  - Rezanje konic (peak shaving)
  - Uravnavanje obremenitve (load balancing)
  - **Zagotavljanje sistemskih storitev terciarne in sekundarne regulacije**
  - Kompenzacija jalove obremenitve

- PRIČETEK : **oktober 2018**
- REALIZACIJA: **februar 2018**

# H2020 call - Flexibility and retail market options for the distribution grid



HVALA ZA POZORNOST