



**Βασιλόπουλος**  
...και του πουλιού το γάλα!



# ICT Energy Management System applied in building clusters: The case of AB Vassilopoulos in Greece

Georgios Karampatos

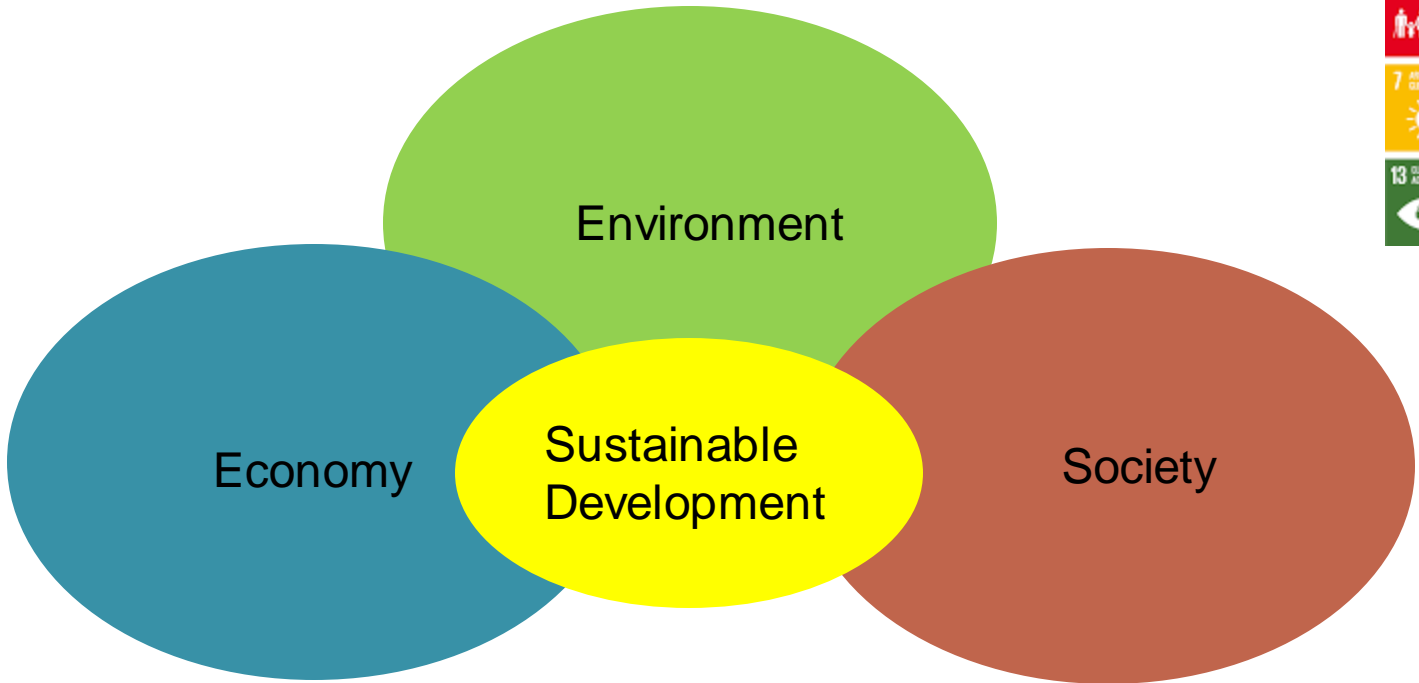
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4<sup>th</sup> HAEE Annual Symposium, Divani Caravel Hotel, 6-8 May 2019

# AB Vassilopoulos

- ❑ 312 stores
- ❑ 5 Distribution Centers (Warehouses)
- ❑ Central Offices
- ❑ Total Sales Area 342.500 m<sup>2</sup>
- ❑ Annual Energy Consumption 206,9 GWh
- ❑ Annual GHG Emissions 176,5 kton. CO<sub>2</sub>

# SUSTAINABLE DEVELOPMENT MODEL



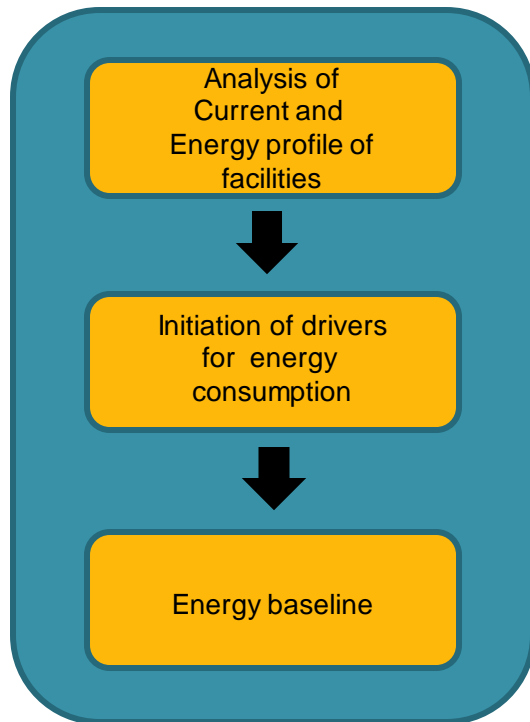
# Sustainable Retailing

«Working for a healthier society supports our long term business success and the communities we serve. It means that our decisions need to benefit both our business and society. Increasing vitality through healthier food, eliminating food waste and running an inclusive business is where we choose to make the difference»

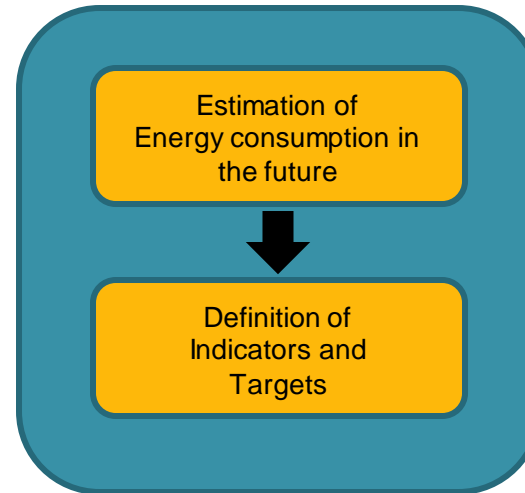
**MITIGATION OF CARBON FOOTPRINT**

# Energy strategy

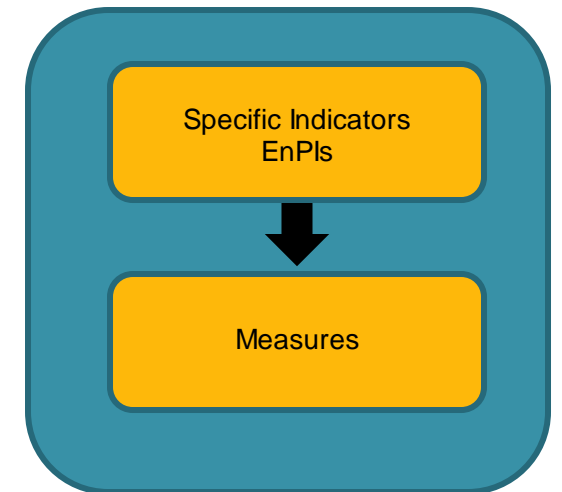
## Analysis of Current situation



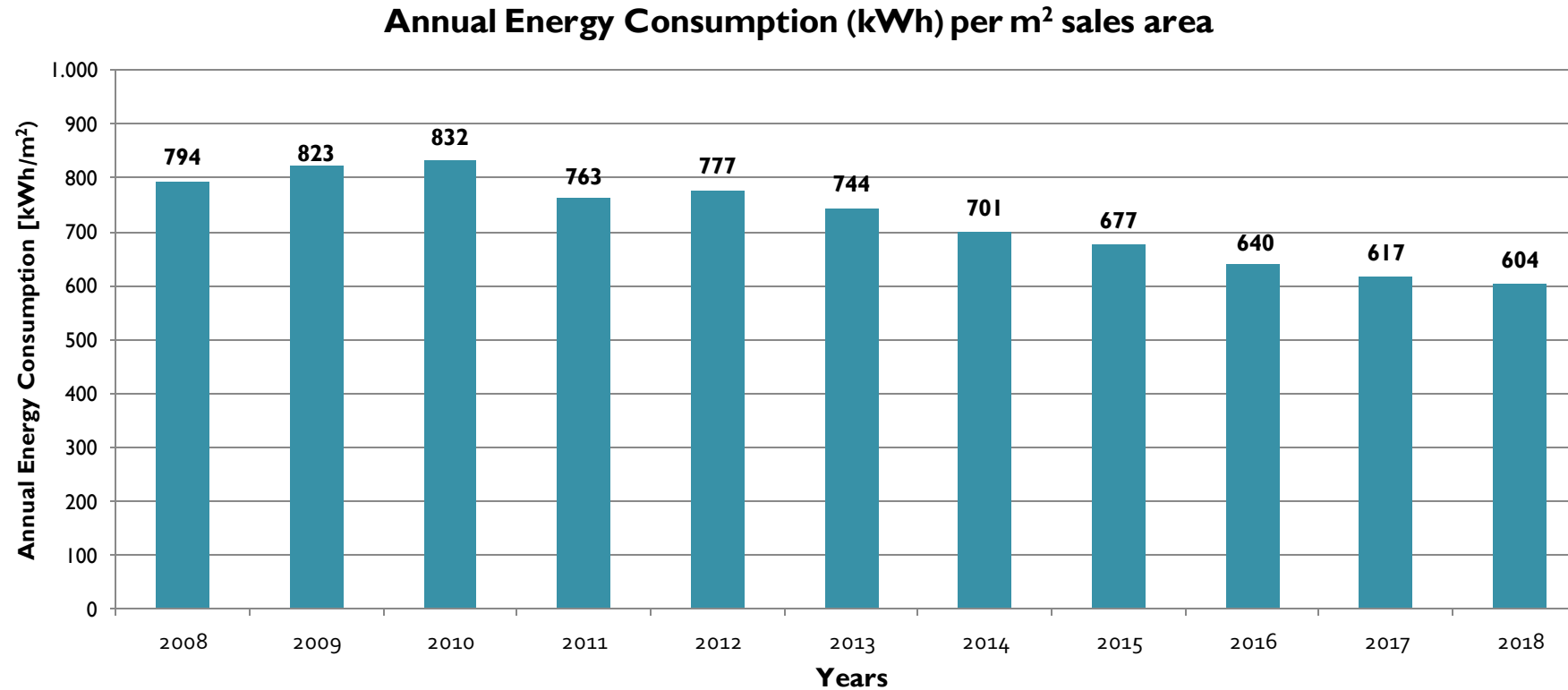
## Targets



## Tools/ Methods

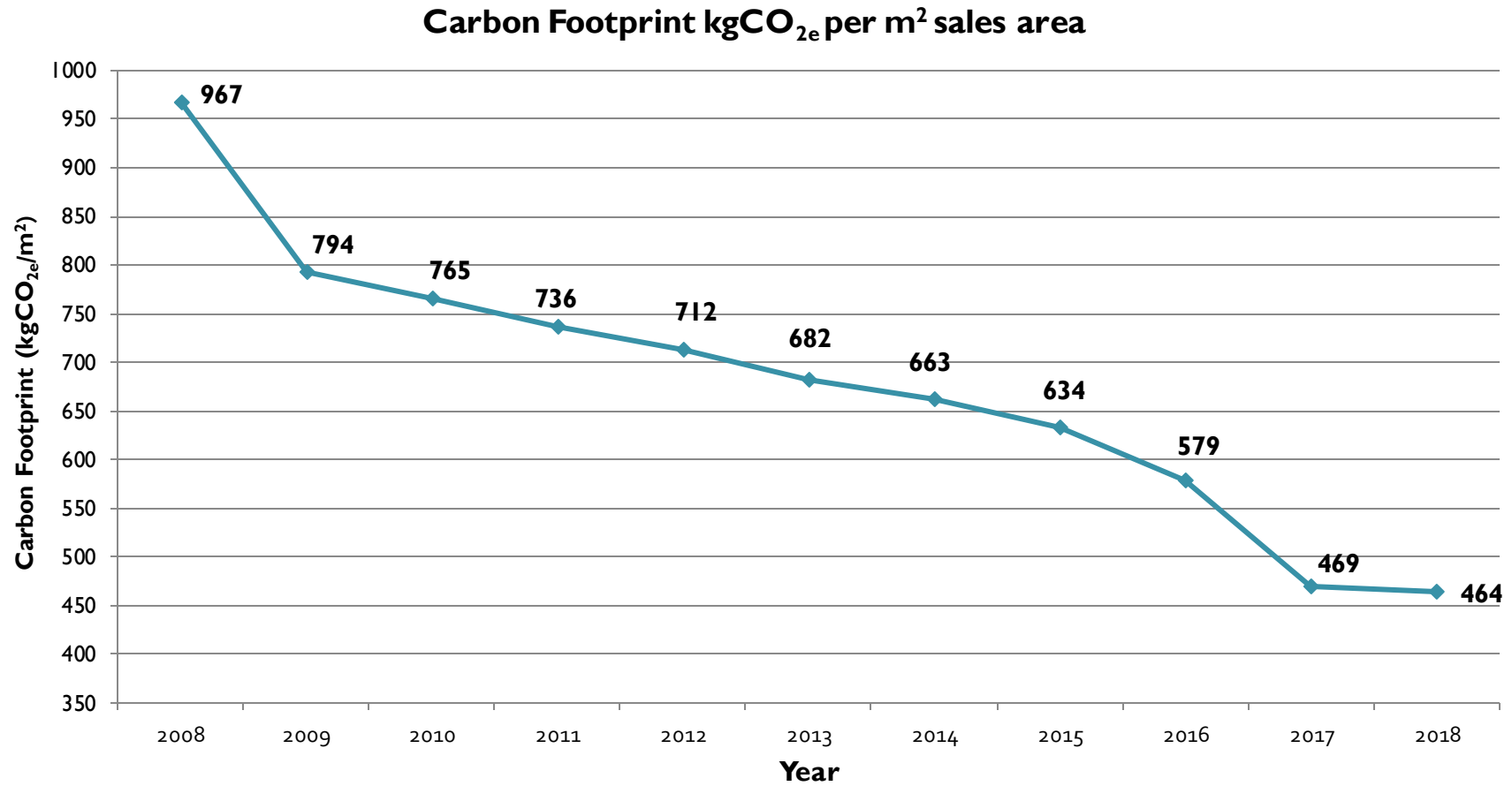


# Reduction of energy consumption



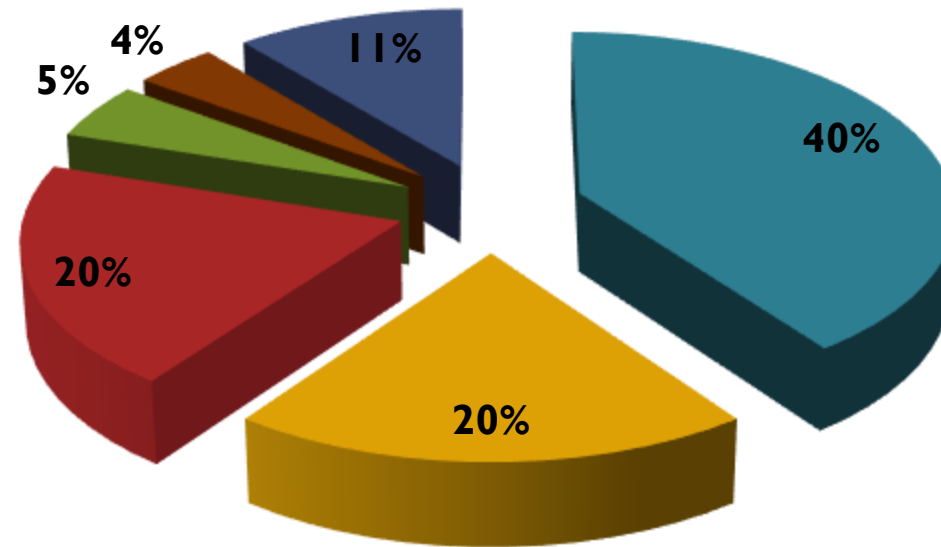
**Reduction – 24 % from 2008**

# Mitigation of Carbon Footprint



**Reduction – 52 % from 2008**

# Typical Electric Energy Usage



■ Refrigeration

■ HVAC (Heating/ Cooling & Ventilation)

■ Lighting

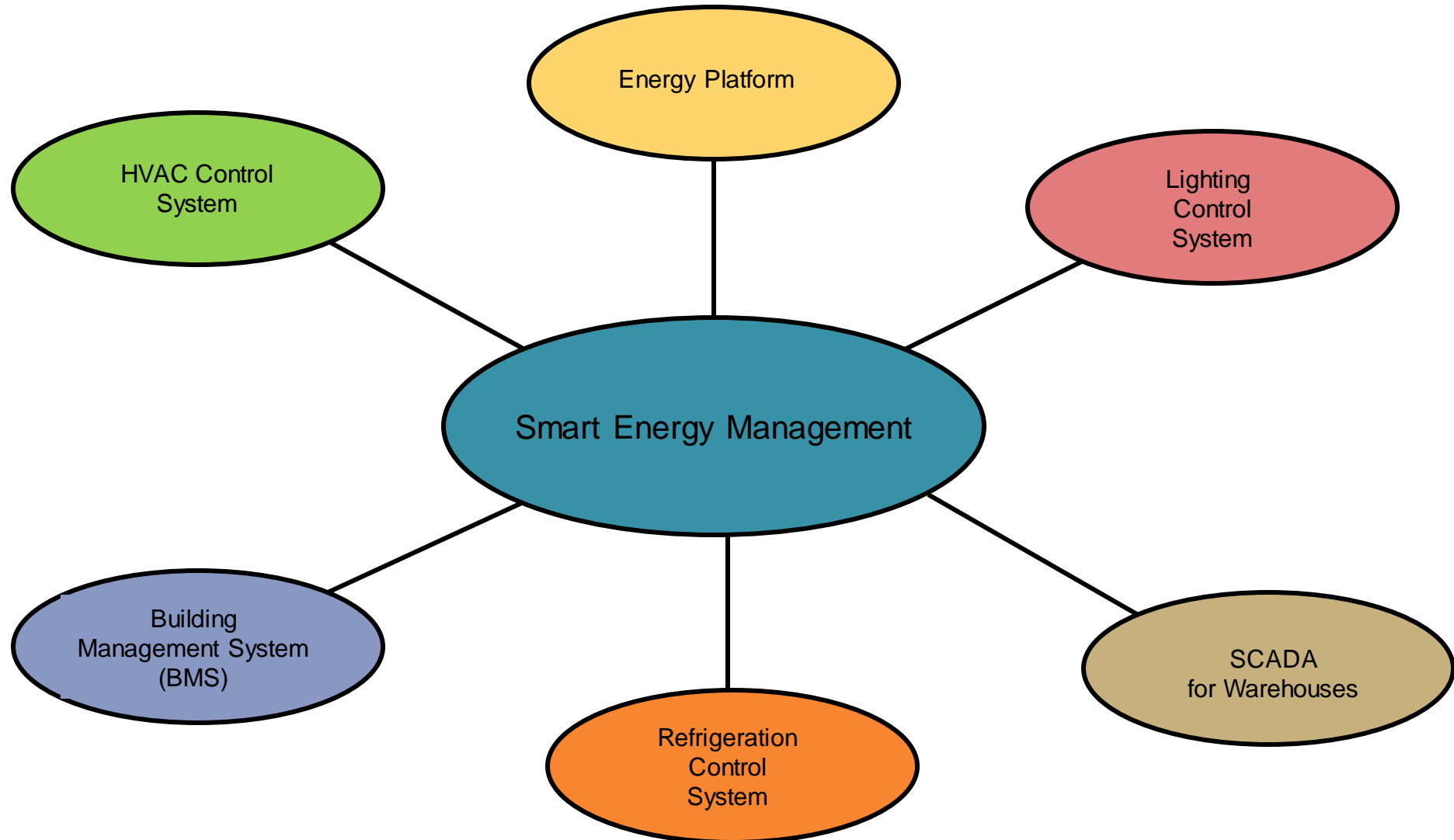
■ Cooking

■ IT

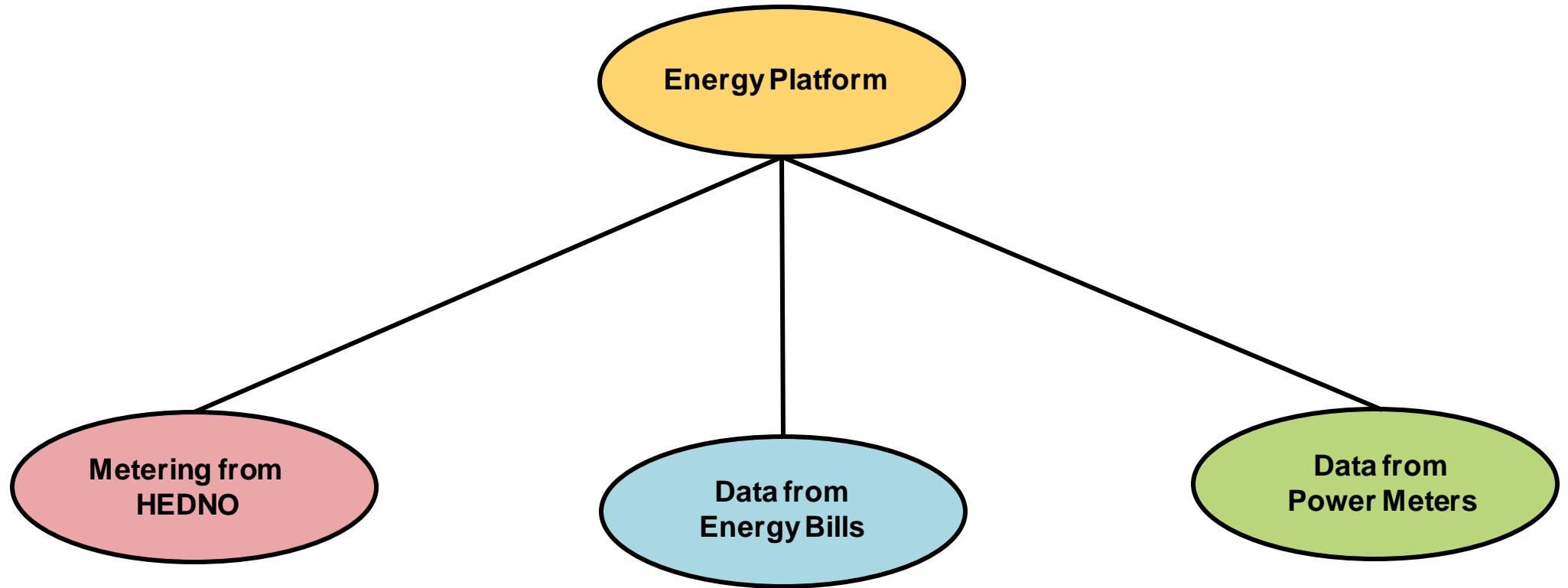
■ Others



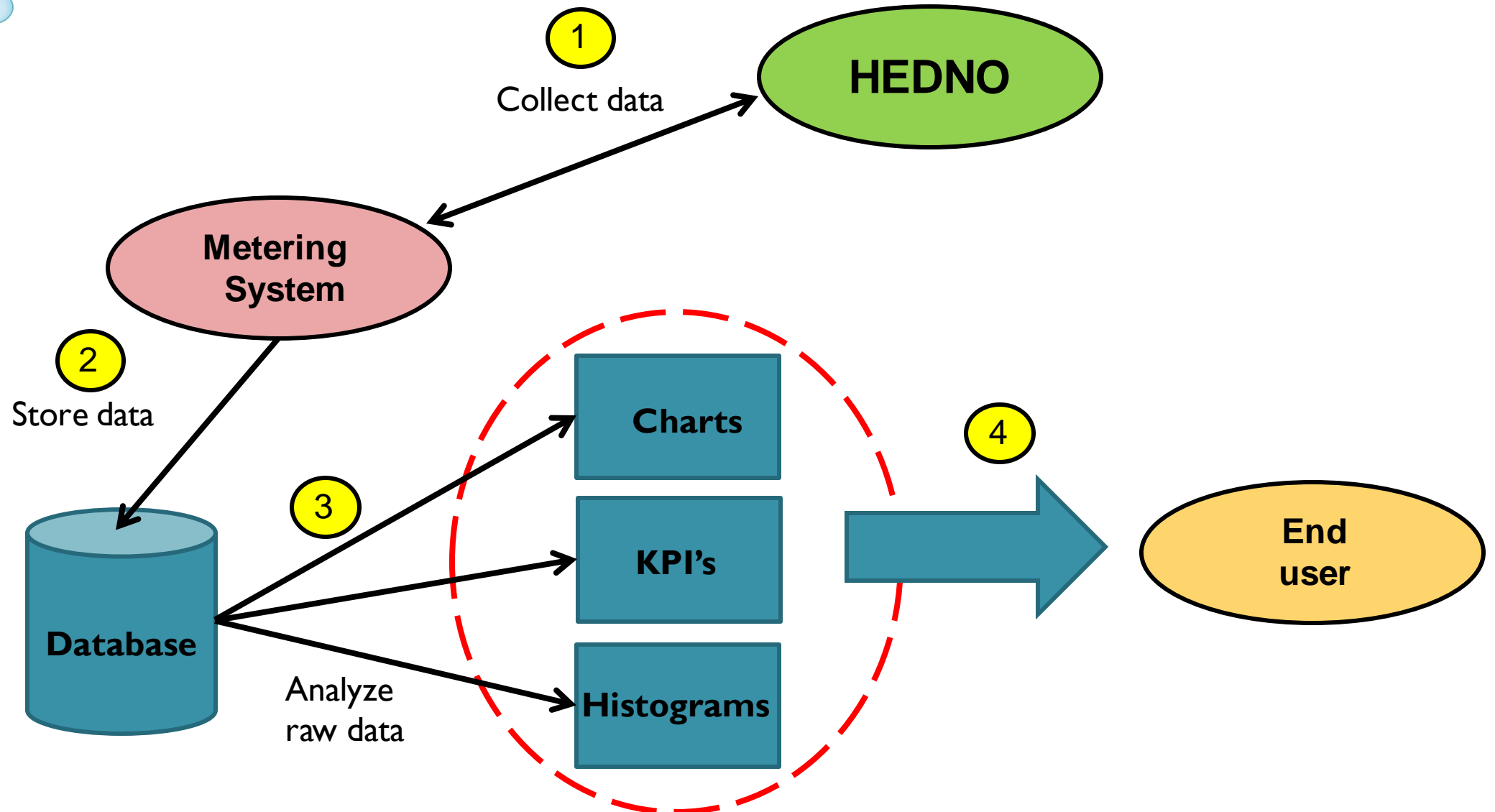
# Energy Management of Facilities



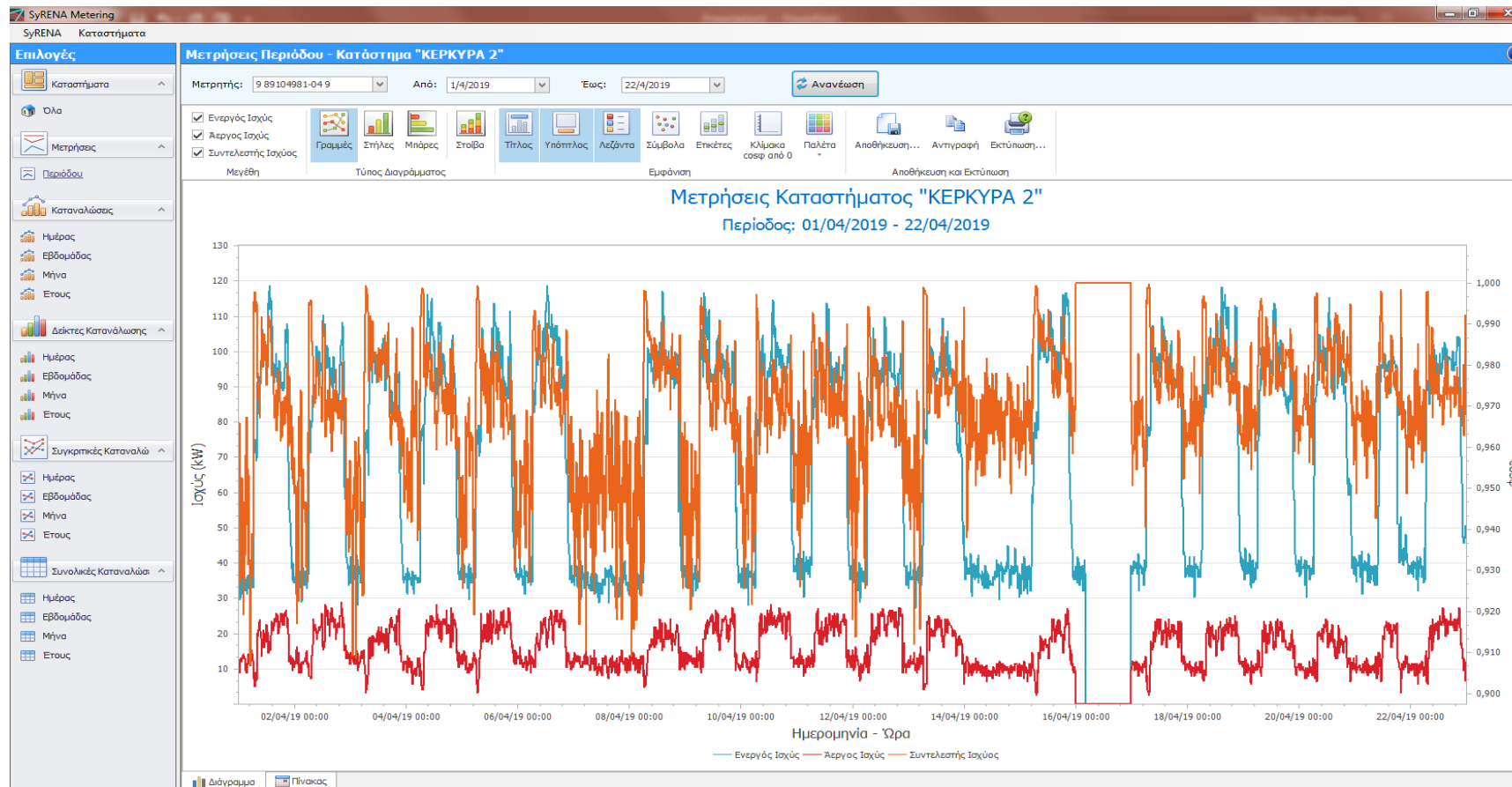
# Energy platform



# Metering from HEDNO

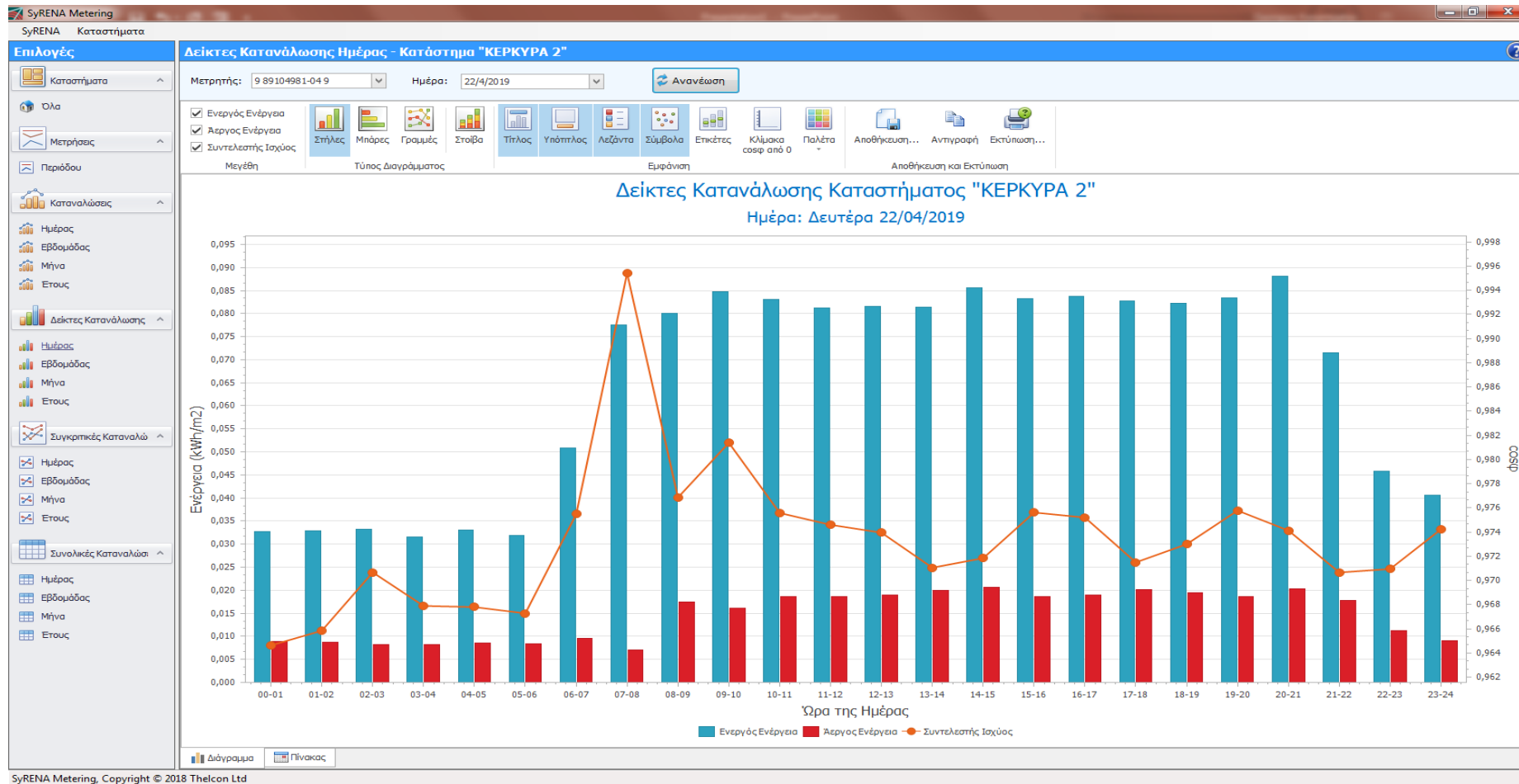


# Metering from HEDNO



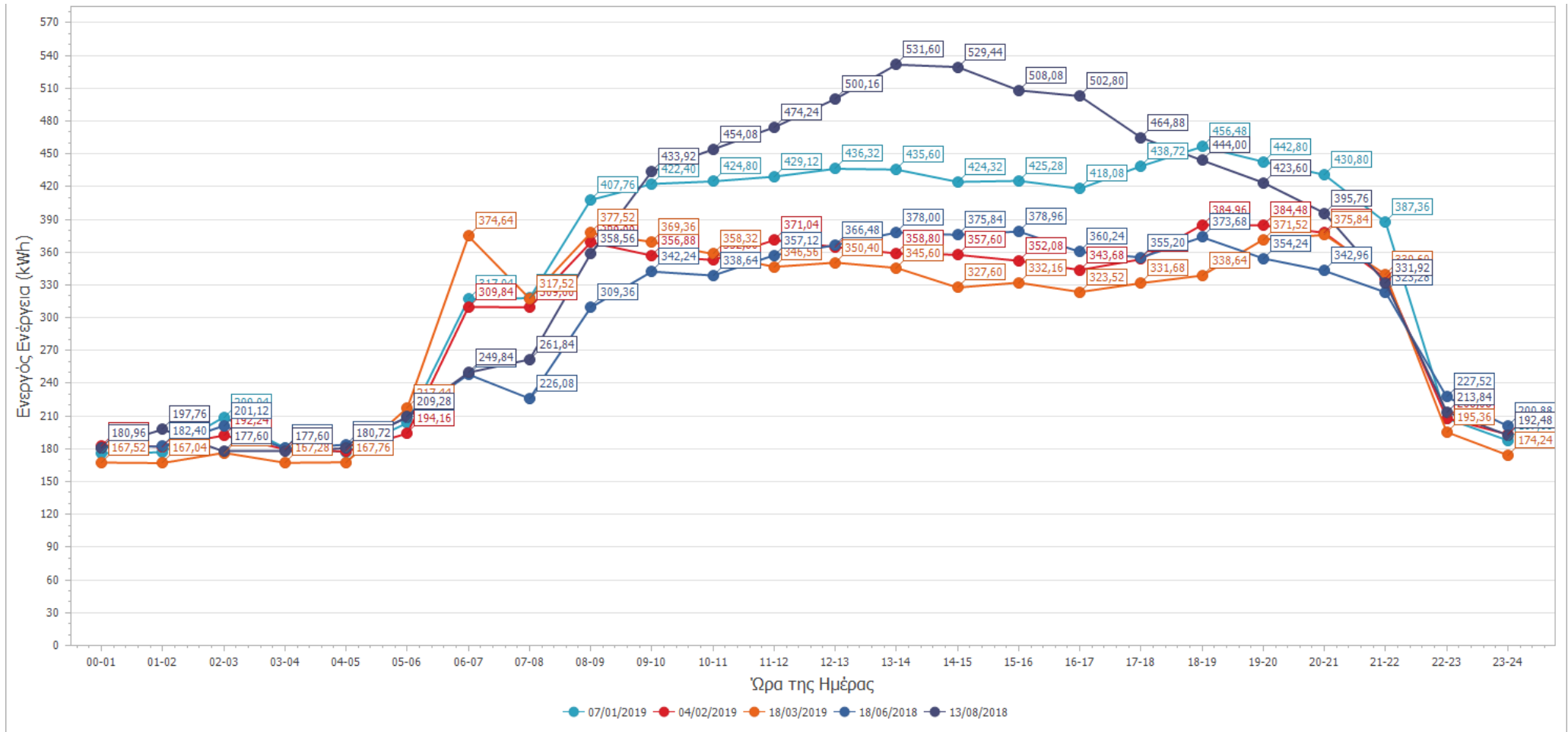
Monitoring of real, reactive power and power factor ( $\cos\phi$ )

# Metering from HEDNO



Monitoring of specific KPI's

# Metering from HEDNO

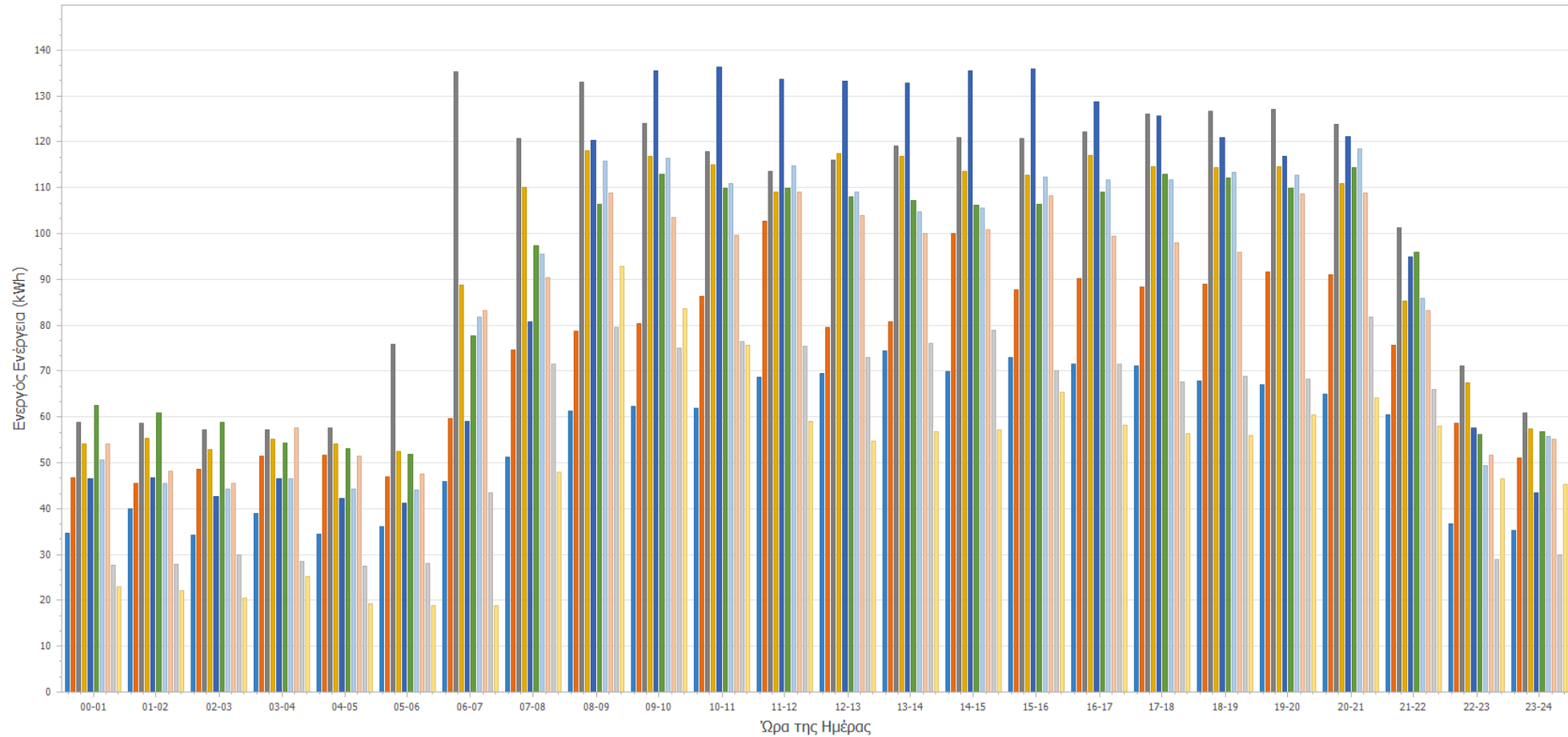


Comparison of daily energy consumption of store

# Metering from HEDNO

Ωριαίες Καταναλώσεις Ημέρας Καταστημάτων

Ημέρα: Τρίτη 23/04/2019

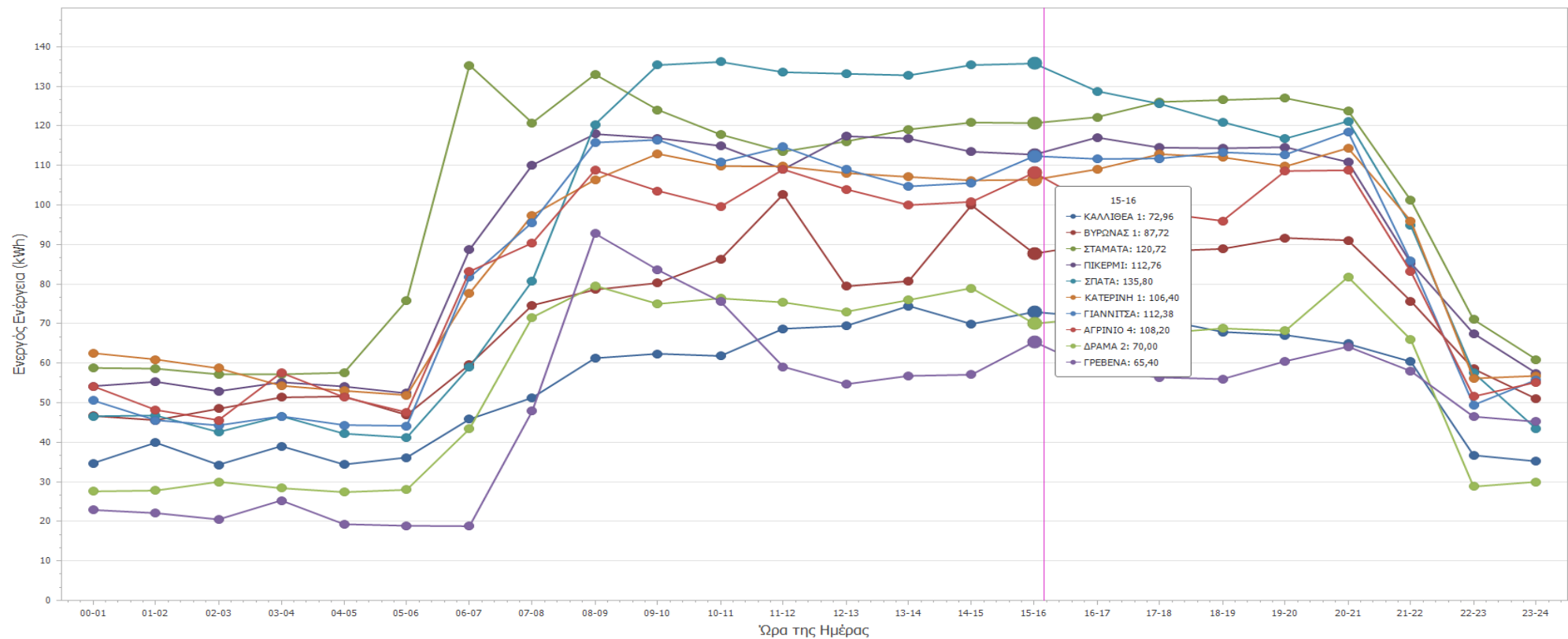


Comparison of daily energy consumption for similar stores

# Metering from HEDNO



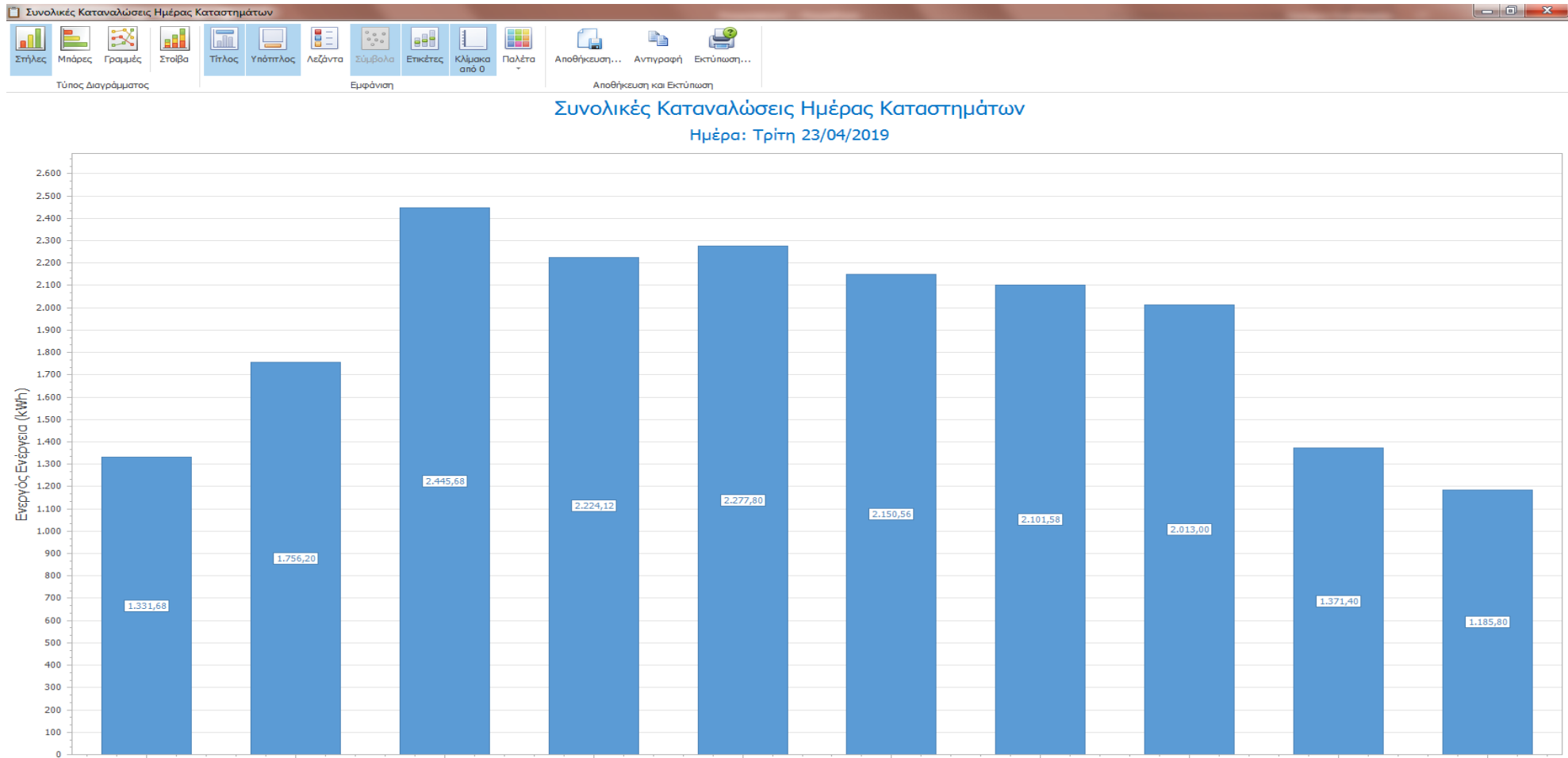
Ωριαίες Καταναλώσεις Ημέρας Καταστημάτων  
 Ημέρα: Τρίτη 23/04/2019



Comparison of daily energy consumption for similar stores



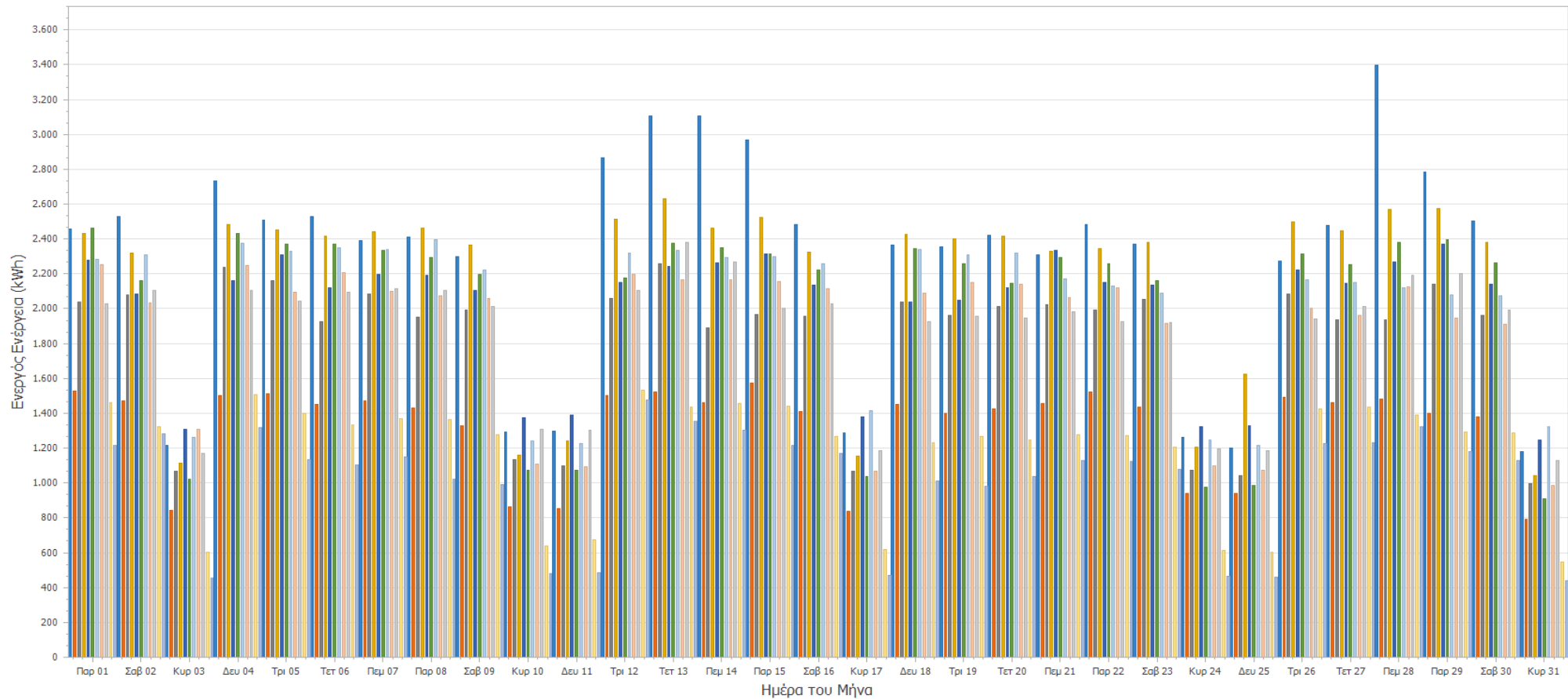
# Metering from HEDNO



Comparison of daily energy consumption for similar stores

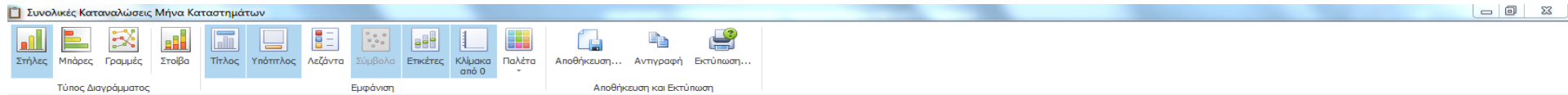
# Metering from HEDNO

Ημερήσιες Καταναλώσεις Μήνα Καταστημάτων  
Μήνας: Μάρτιος 2019

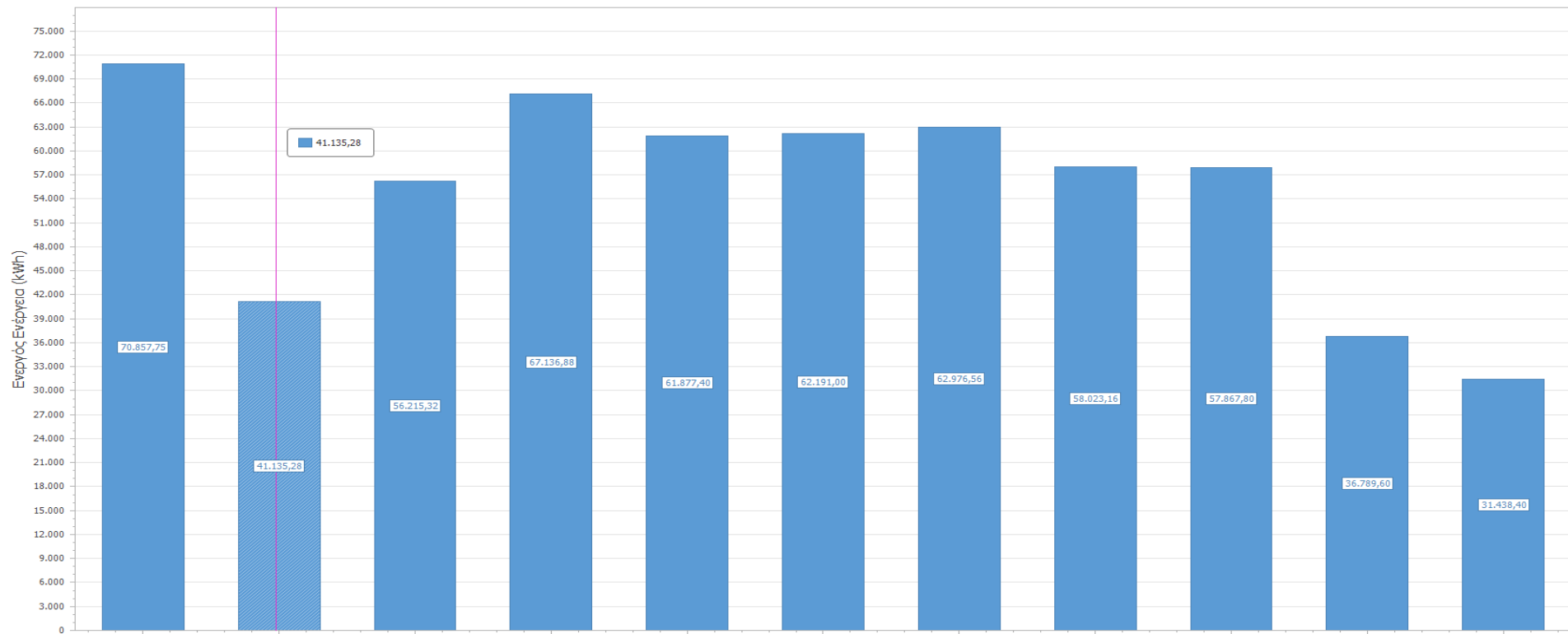


Comparison of monthly energy consumption for similar stores

# Metering from HEDNO

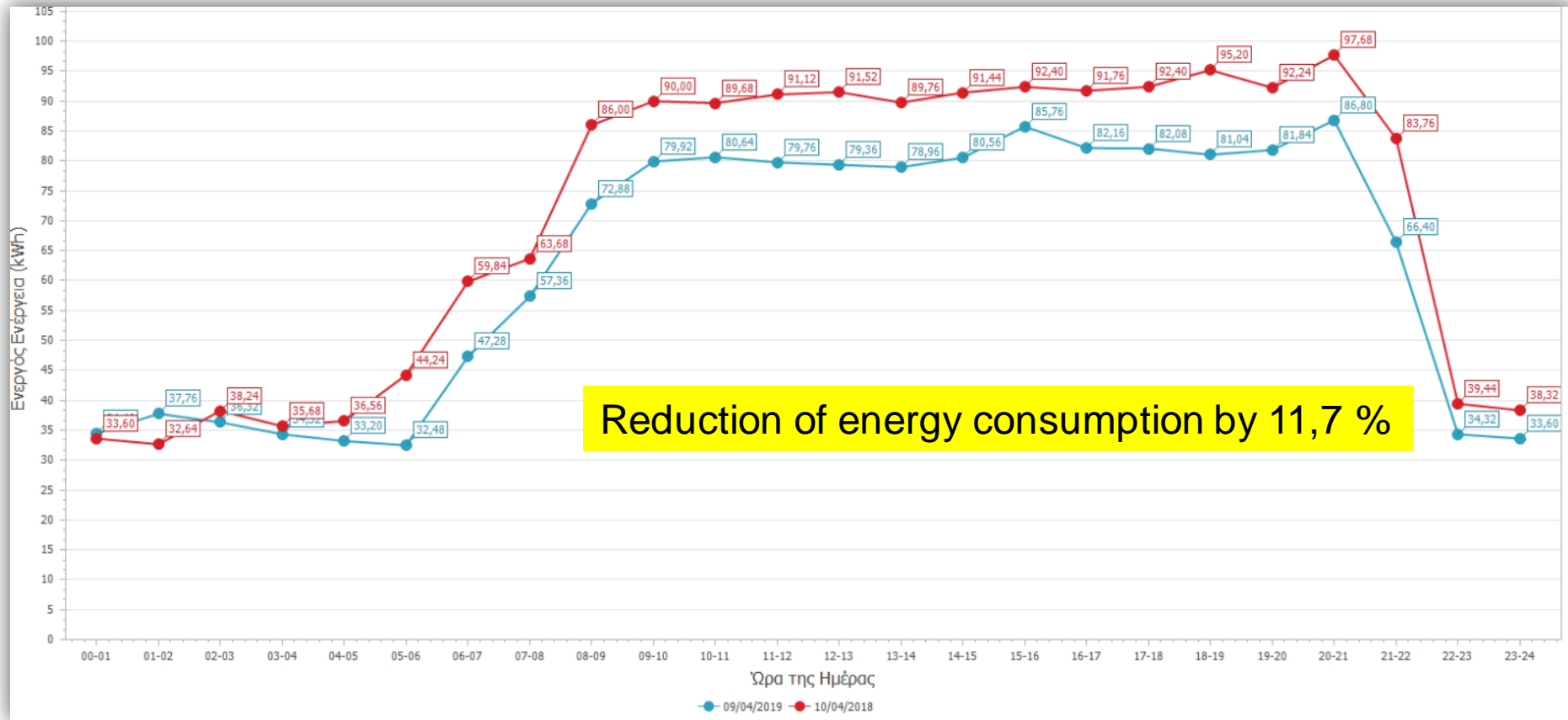


Συνολικές Καταναλώσεις Μήνα Καταστημάτων  
Μήνας: Μάρτιος 2019



Comparison of monthly energy consumption for similar stores

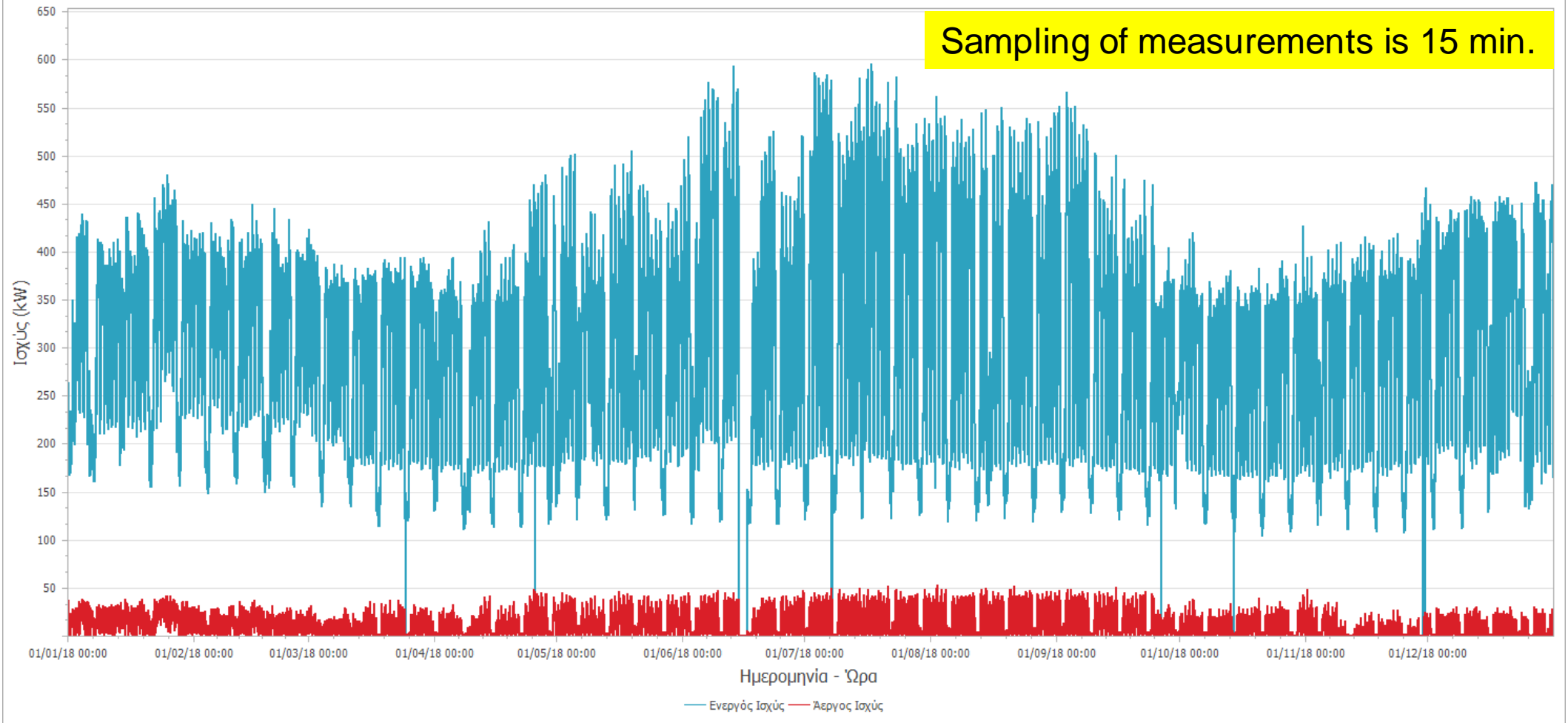
# Comparison of energy consumption before and after installation of LED lights in store



# Annual Energy Consumption of store

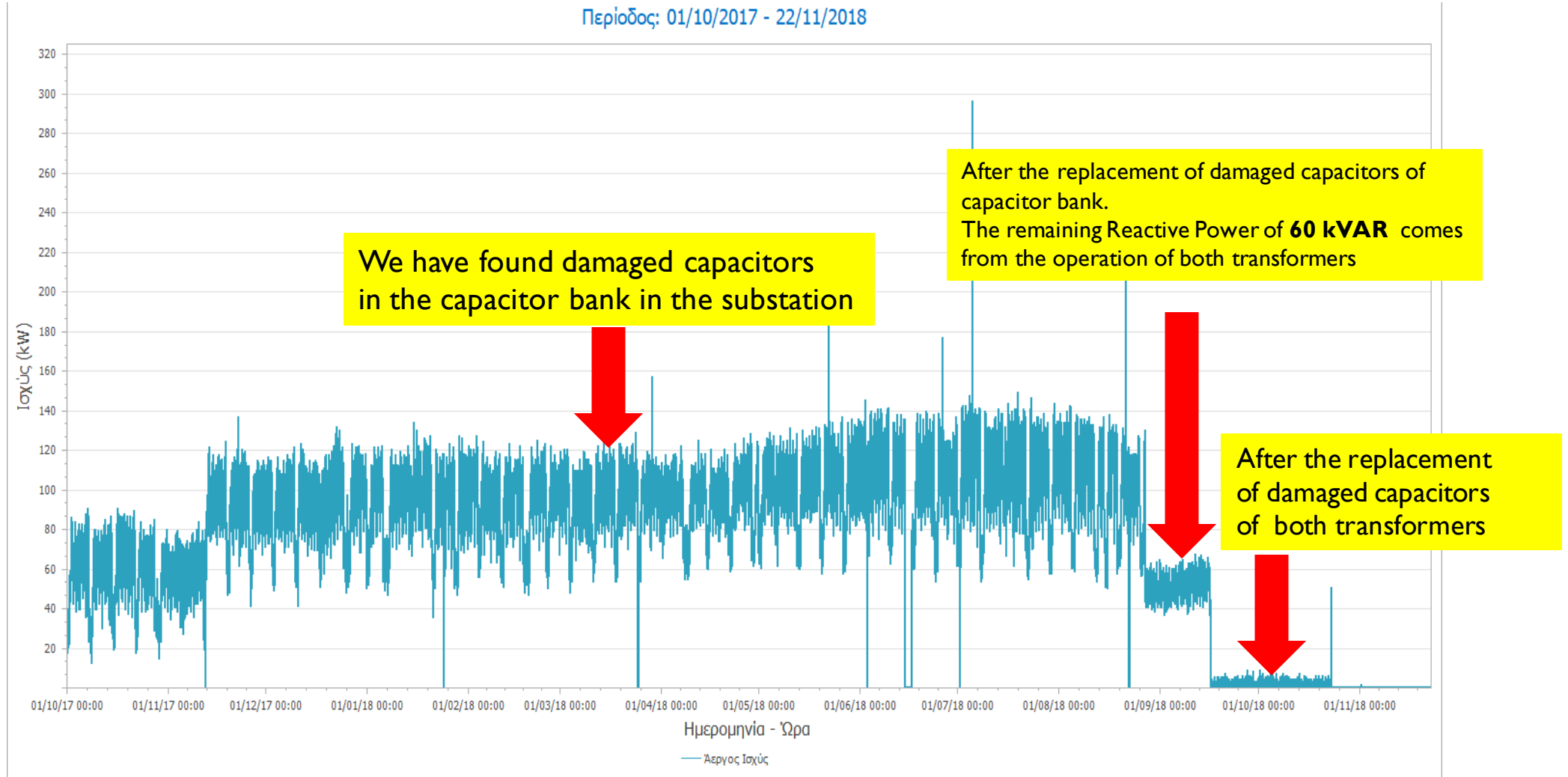
Περίοδος: 01/01/2018 - 31/12/2018

Sampling of measurements is 15 min.

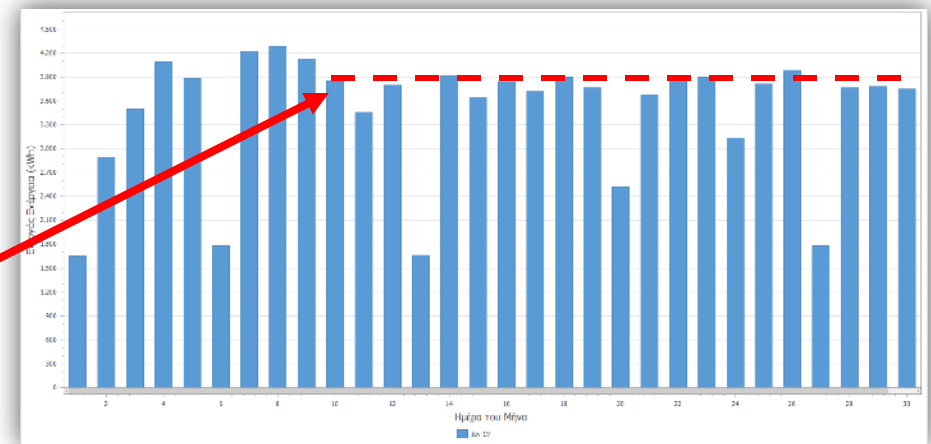
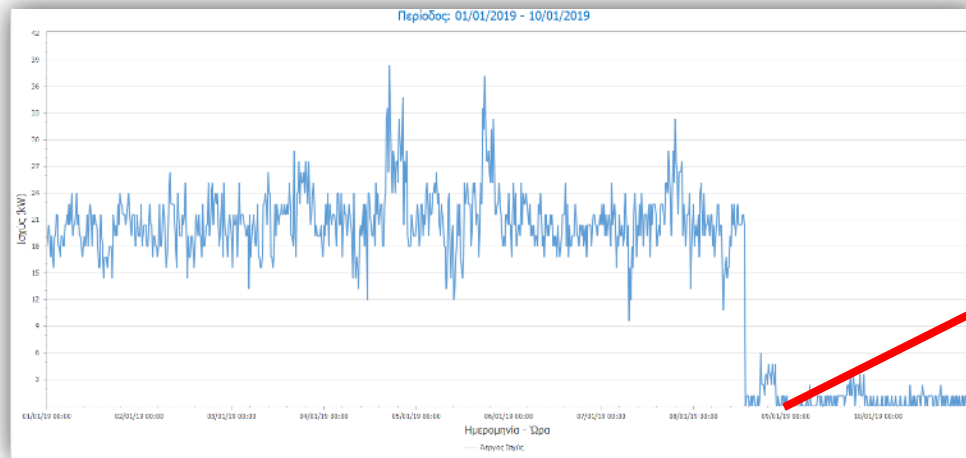


# Improvement of Capacitor Compensation

Περίοδος: 01/10/2017 - 22/11/2018



# Improvement of reactive power Q

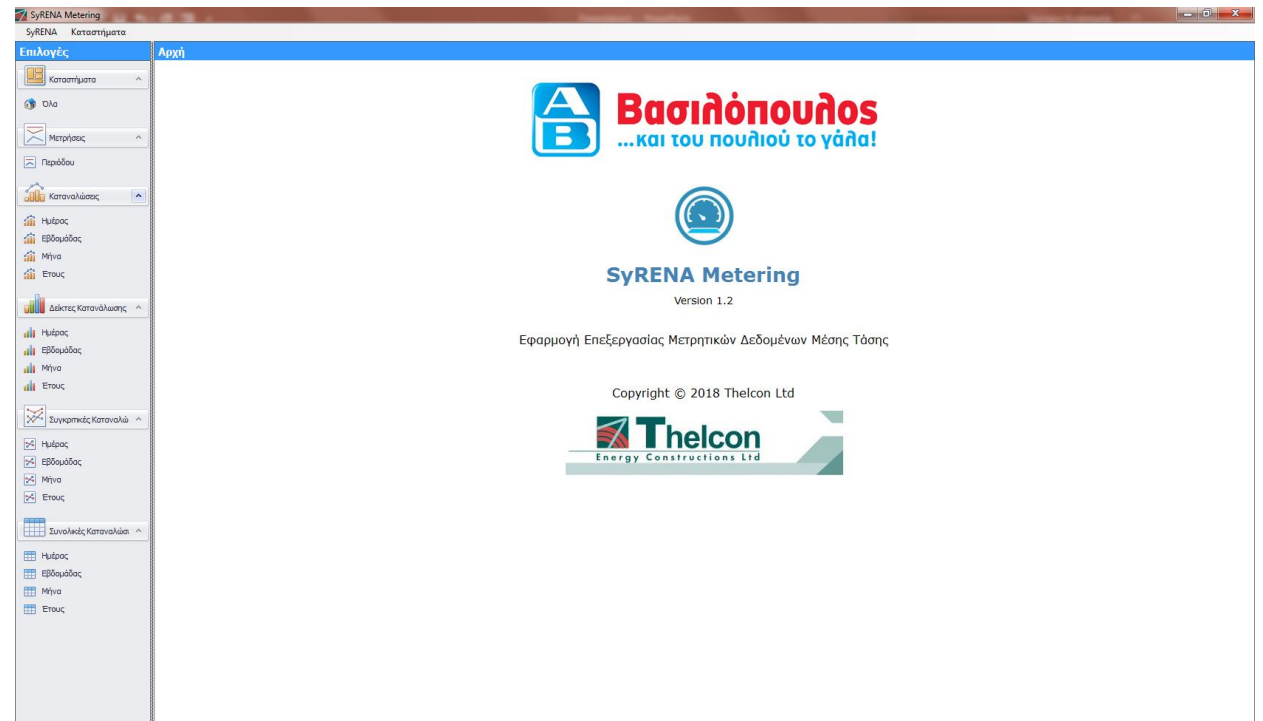


Reduction of Reactive power of transformer → Reduction of loads of store

# Metering from HEDNO

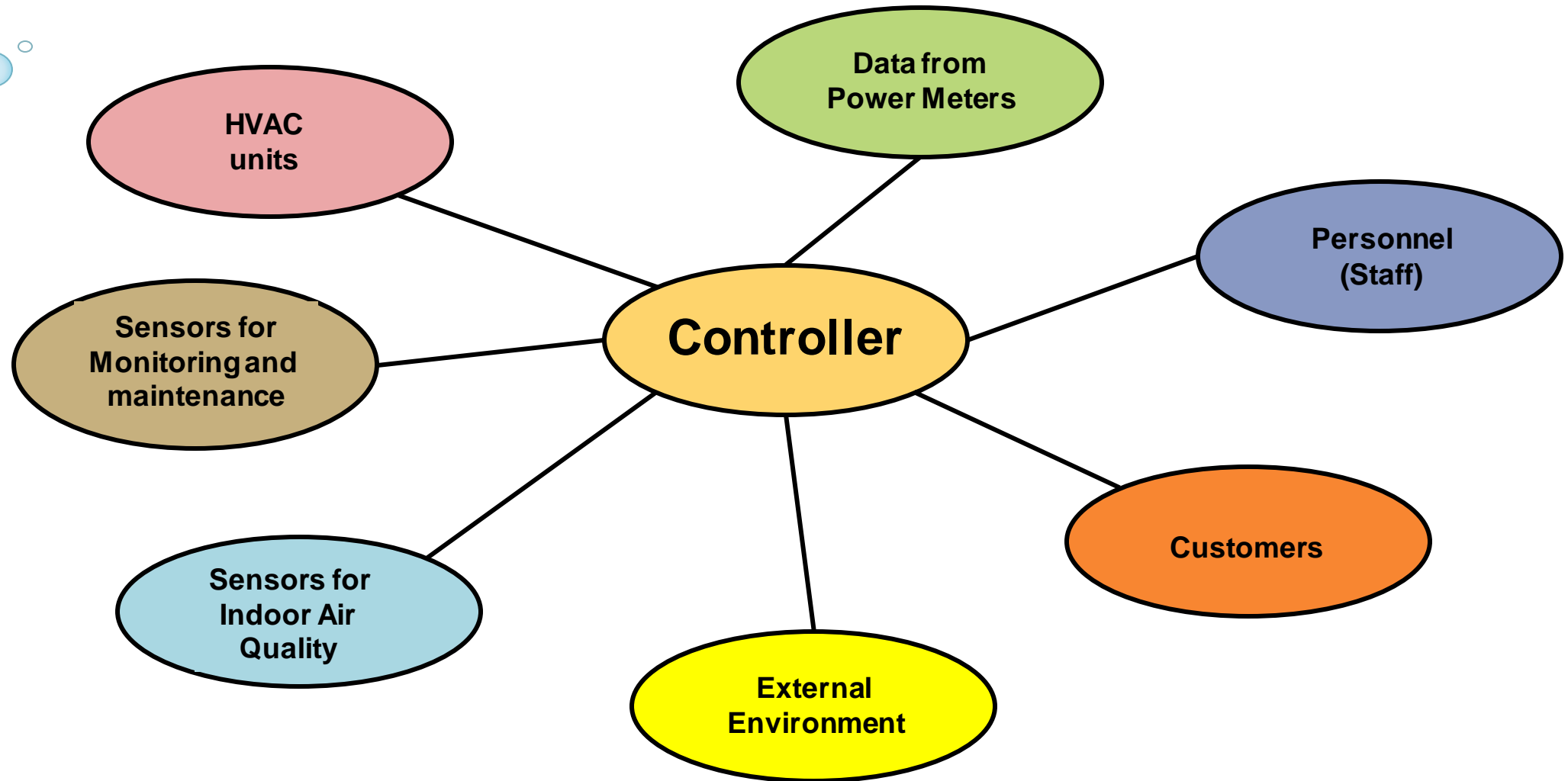
## Benefits :

- ❑ Daily efficient management of facilities
- ❑ Energy forecast and prediction
- ❑ Preventive Maintenance
- ❑ Monitoring of substations (reactive power)
- ❑ Identification of peak loads
- ❑ Measuring the performance of a renovated store
- ❑ Benchmarking of stores and Distribution Centers





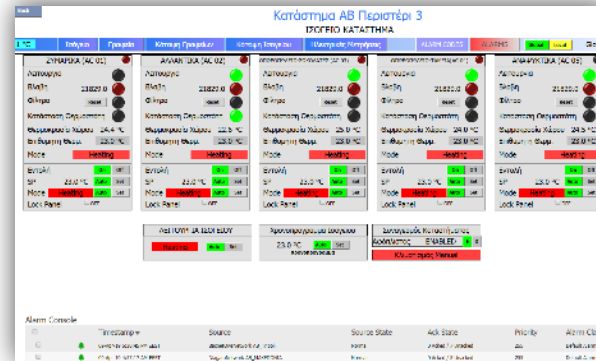
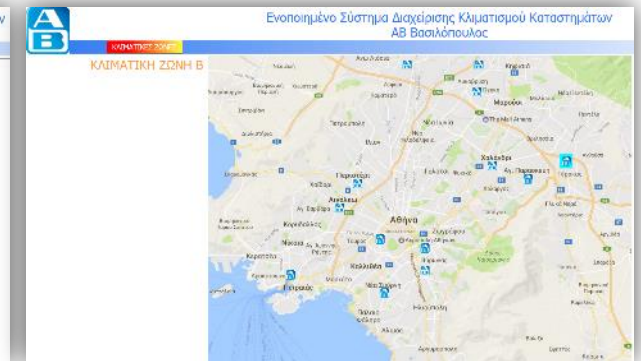
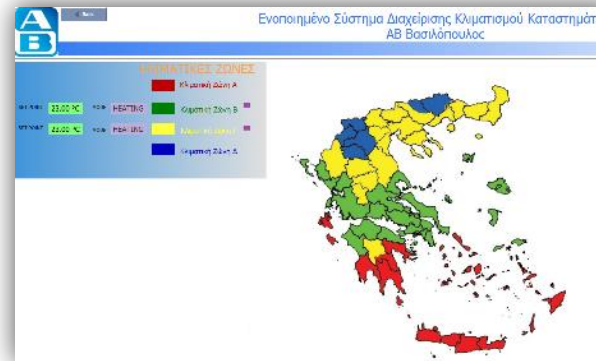
# HVAC Control System



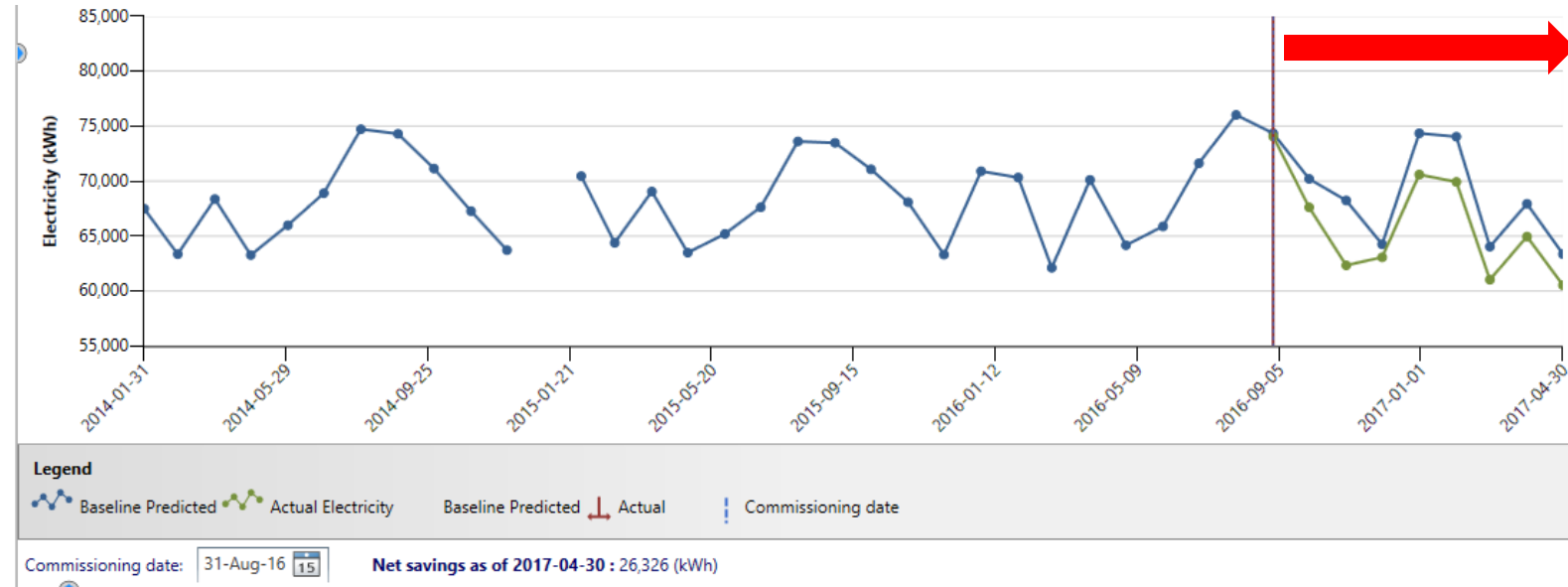
# HVAC Control System

## Benefits :

- ❑ Efficient management of HVAC units
- ❑ Reduction of energy consumption by 5%
- ❑ Preventive Maintenance
- ❑ Healthier working conditions for personnel
- ❑ Improvement of store images



# HVAC Control System



According to IPMVP results :

- ❑ Reduction of energy consumption by 5,1 %
- ❑ Pay back period of investment in 3,4 years

# HVAC Control System

## Equation

$Y = a \cdot x_1 + b \cdot x_2 + c \cdot x_3 + d$

Dependent variable (Y)	Electricity (kWh)
Independent variable (x1)	Heating degree-days 16°C (°C-d)
Independent variable (x2)	Cooling degree-days 18°C (°C-d)
Independent variable (x3)	Occupancy (people)

## Regression results

<b>Number of observations:</b>	31
<b>Number of iterations:</b>	2
<b>Sum of residuals:</b>	209.0537
<b>Average residual:</b>	6.7437
<b>Residual sum of squares - Absolute:</b>	80,025.2132
<b>Residual sum of squares - Relative:</b>	80,392.2768
<b>Standard error of the estimate:</b>	54.5664
<b>Coefficient of multiple determination (R<sup>2</sup>):</b>	0.8139
<b>Coefficient of multiple determination - Adjusted (Ra<sup>2</sup>):</b>	0.7932
<b>Root-mean-square error (RMSE):</b>	54.4417

## Coefficient results

Name	Value	Standard error	t-ratio	Prob(t)
a	58.8402	9.1751	6.413	7.179E-07
b	41.987	3.984	10.5389	4.5501E-11
c	0.4436	0.1391	3.1889	0.0036
d	1,703.6611	123.4782	13.7973	9.5567E-14



**Thank you !**