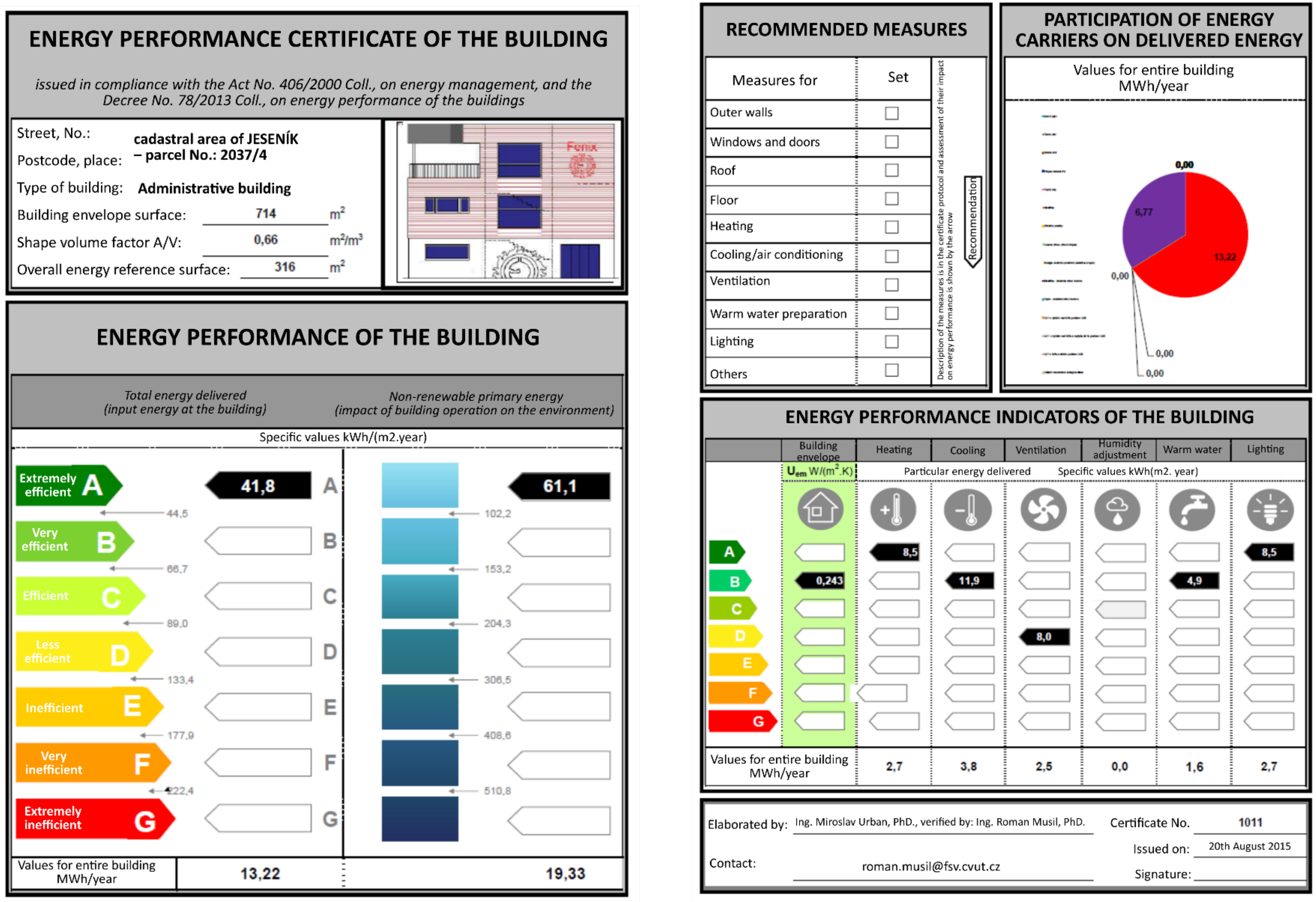
FENIX

The nZEB as an active element of the energy system

3 years of operation!

The building's energy label

calculated according to the 2020 standard



ENERGY PERFORMANCE CERTIFICATE OF THE BUILDING

issued in compliance with the Act No. 406/2000 Coll., on energy management, and the Decree No. 78/2013 Coll., on energy performance of the buildings

Street, No.: **cadastral area of JESENÍK – parcel No.: 2037/4**
Postcode, place:
Type of building: **Administrative building**
Building envelope surface: 714 m^2
Shape volume factor A/V: 0,66 m^2/m^3
Overall energy reference surface: 316 m^2

ENERGY PERFORMANCE OF THE BUILDING

Class	Total energy delivered (input energy at the building) – limit	Value	Non-renewable primary energy (impact of building operation on the environment) – limit	Value
Extremely efficient A	44,5	41,8	102,2	61,1
Very efficient B	66,7		153,2	
Efficient C	89,0		204,3	
Less efficient D	133,4		306,5	
Inefficient E	177,9		408,6	
Very inefficient F	222,4		510,8	
Extremely inefficient G				
Values for entire building MWh/year		13,22		19,33

Specific values kWh/(m2.year)

RECOMMENDED MEASURES

Measures for	Set
Outer walls	☐
Windows and doors	☐
Roof	☐
Floor	☐
Heating	☐
Cooling/air conditioning	☐
Ventilation	☐
Warm water preparation	☐
Lighting	☐
Others	☐

Description of the measures is in the certificate protocol and assessment of their impact on energy performance is shown by the arrow — Recommendation

PARTICIPATION OF ENERGY CARRIERS ON DELIVERED ENERGY

Values for entire building MWh/year

ENERGY PERFORMANCE INDICATORS OF THE BUILDING

	Building envelope U_{em} W/(m^2.K)	Heating	Cooling	Ventilation	Humidity adjustment	Warm water	Lighting
A		8,5					8,5
B	0,243		11,9			4,9	
C							
D				8,0			
E							
F							
G							
Values for entire building MWh/year		2,7	3,8	2,5	0,0	1,6	2,7

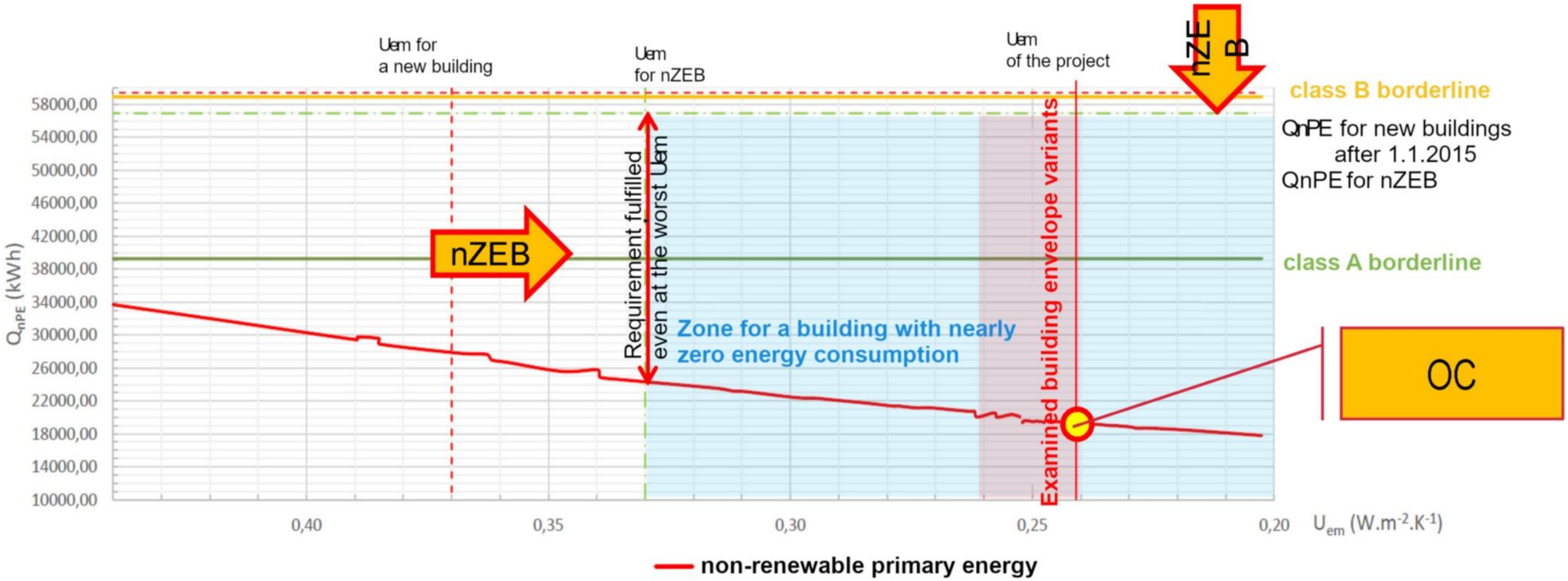
Particular energy delivered — Specific values kWh/(m2. year)

Elaborated by: Ing. Miroslav Urban, PhD., verified by: Ing. Roman Musil, PhD.
Certificate No. 1011
Issued on: 20th August 2015
Contact: roman.musil@fsv.cvut.cz
Signature:

Built to the nZEB standard, the fully electrified building features an electric radiant heating system.

UCEEB

Achieved level of NPE



FENIX

Office center - a building with nZEB parameters

A fully electrified building operating as an active element of the grid

Presentation of the idea of an nZEB as an active element of the grid - 2013-2014.

Building design - cooperation with the Czech Technical University in Prague (CTU) from 04/2015 to 08/2015
Construction commenced – 10/2015
Construction completed – 05/2016

Cooperation between a 7.2 kWh rooftop PV system with a 26kWh home battery and the energy distribution grid.
The battery is used not only to enable the building to make 100% use of the energy from the PV system but also to allow active cooperation with the grid. This means that it is charged during the low-tariff period, and fully takes over the task of supplying the building with energy during the high-tariff period.

A group of specialists representing the Ministry of Industry and Trade, the Ministry of the Environment, the Energy Regulatory Office, ČEZ-ESCO, ČEZ - Distribution, ČEPS and the CTU was appointed to monitor the nZEB for two years and evaluate the achievement of goals.
Data concerning energy consumption as well as the quality of the indoor environment were collected by CTU – UCEEB.

FENIX

Three surprises from the construction process

1) Due to careful project preparation and the optimization of costs, the total investment costs were at the 2015 price level for standard structures of a similar type!

2) The building was equipped with flexible electric radiant heating. The evaluation of a possible alternative variant using a warm-water system together with a heat pump suggested that return on investment would only occur after 25 years of operation, i.e. after approx. double the lifespan of the heat pump. The real energy consumption of the building after 3 winter seasons confirmed this information. If the return on investment were calculated just for the heating system (without considering the cooling system, which is practically unused), it would take up to 40 years to occur.

3) Monitoring of the operating cycles of the battery storage system confirmed its lifespan will exceed 25 years.

FENIX

Comparison of expected and real results after 24 months of operation:

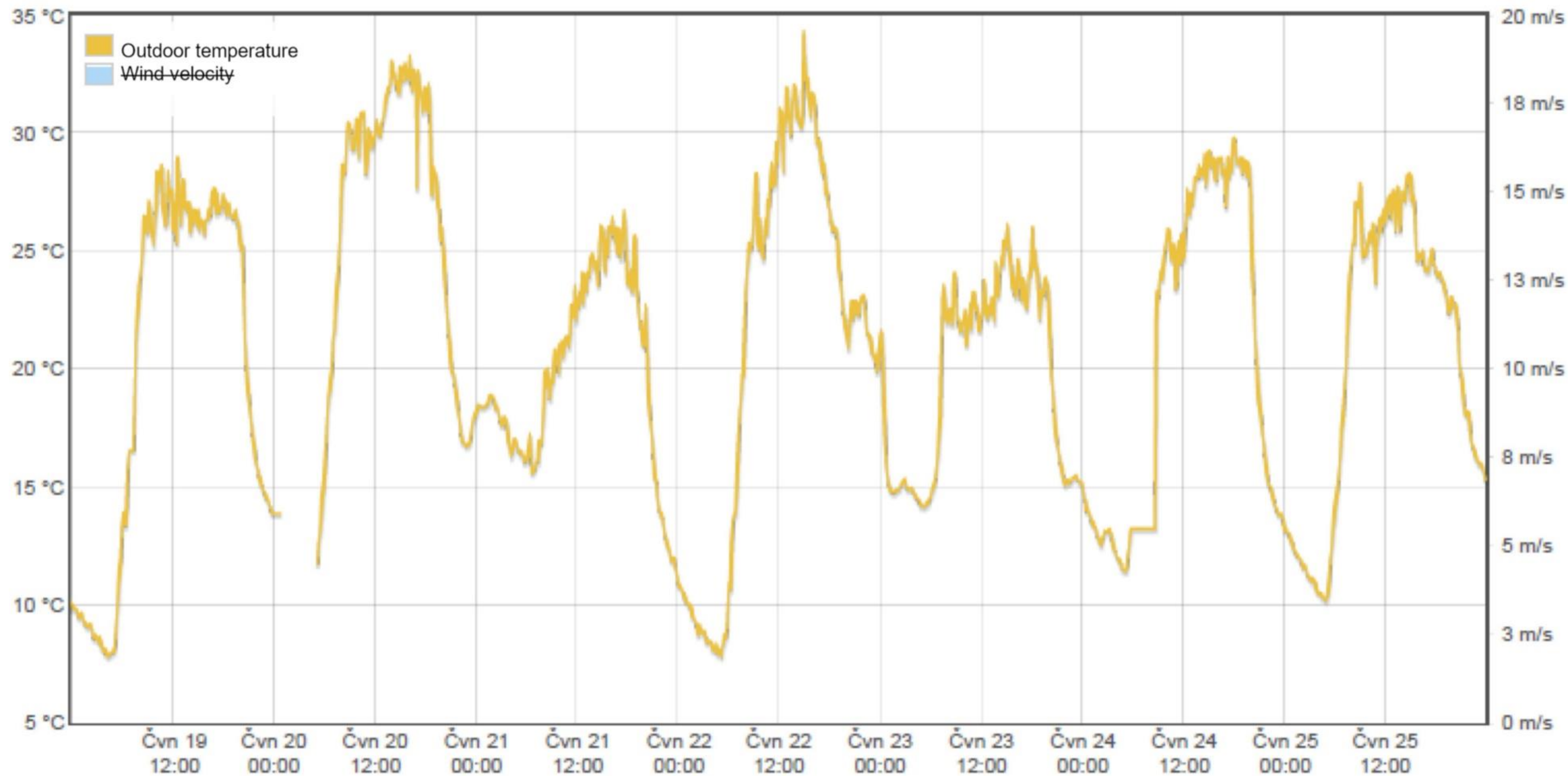
Expected yearly energy consumption	**UCEEB –**	**approx. 27 000 kWh**	
Real energy consumption		**26 626 kWh (2017)**	**- 1.4%**
		27 193 kWh (2018)	
		24 454 kWh (2019)	
Energy consumption from the grid		**21 000 kWh (2017)**	
		20 100 kWh (2018)	
		17 223 kWh (2019)	
Energy consumption for heating and hot water:		**12 402 kWh (2016/2017)**	
:		**10 500 kWh (2017/2018)**	**-15.4%**
:		**7 300 kWh (2018/2019)**	**- 31 %**
Energy from the building's own PV system		**PV – 7 200 kWh**	
Real production		**6 050 kWh (2017)**	
		7 123 kWh (2018)	
		7 221 kWh (2019)	

It was verified that the controlled supply model used is fully functional and can provide advantages both for the grid operator and for the users themselves!

FENIX

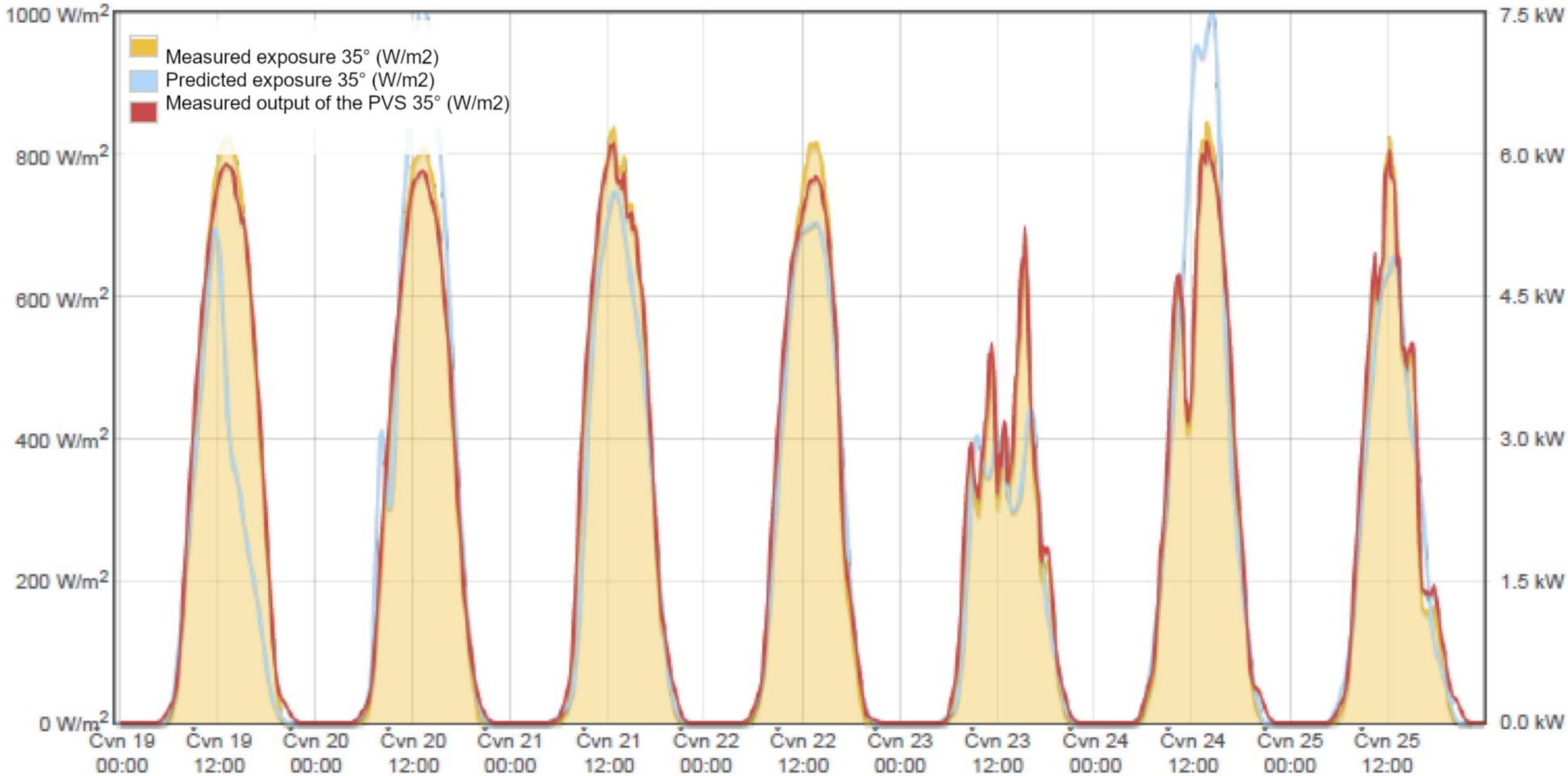
Summer operation - 19. - 25. 6. 2017

Outdoor environment



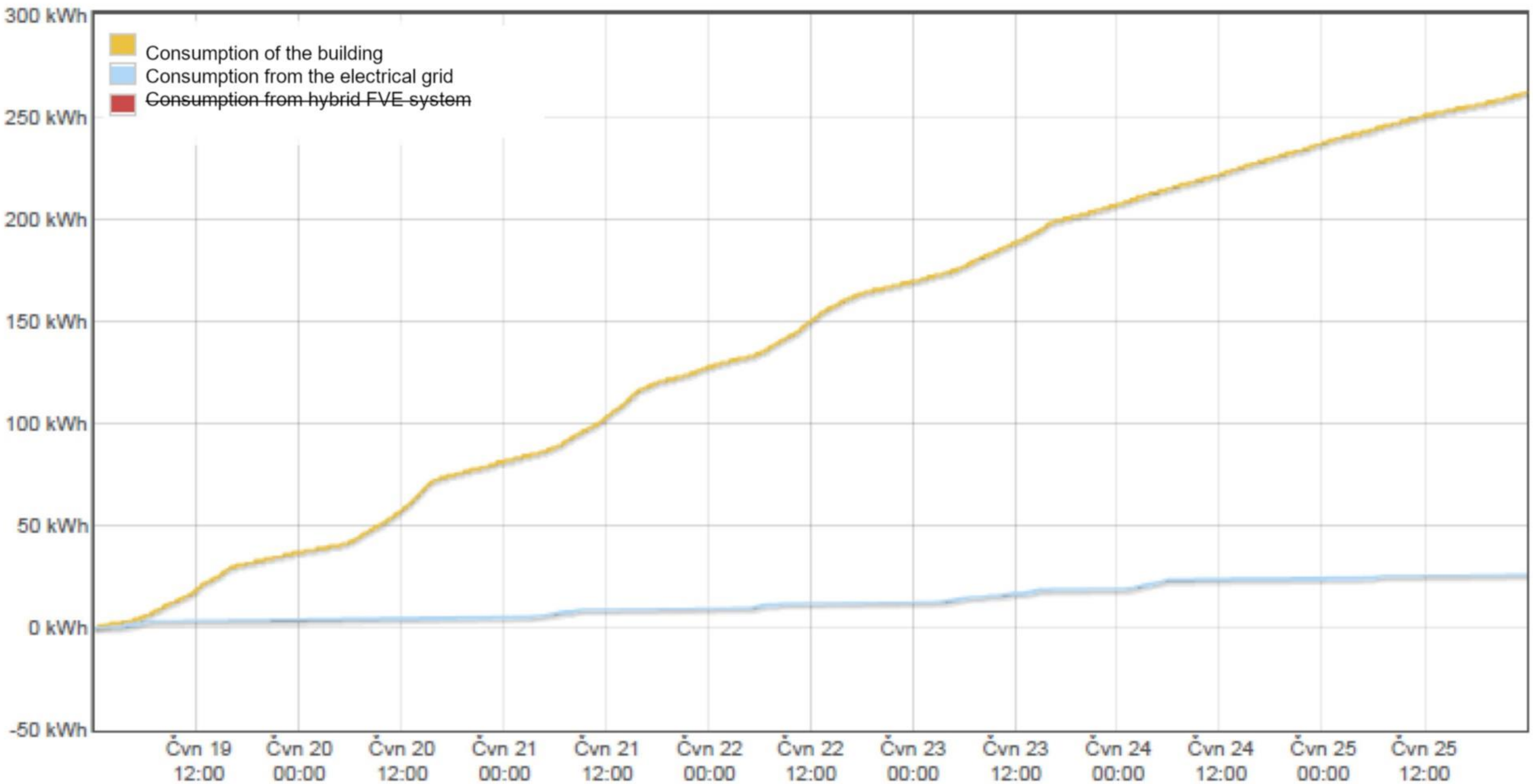
Sunny summer days with daytime temperatures of over 30°C

Solar exposure and produced wattage - 35° angle



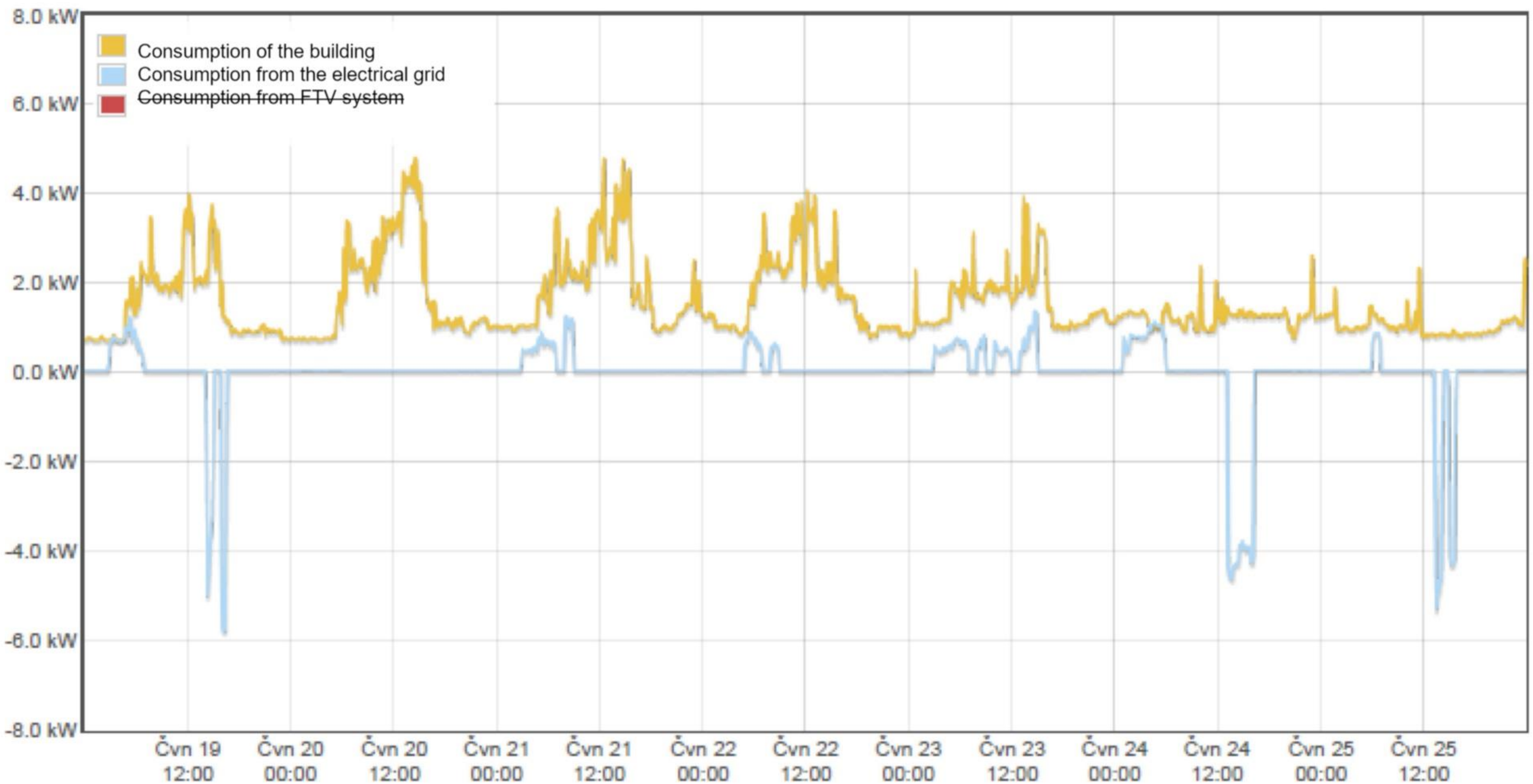
Comparison of planned and real PV system electricity production

Consumption of the building, production and supply (kWh)



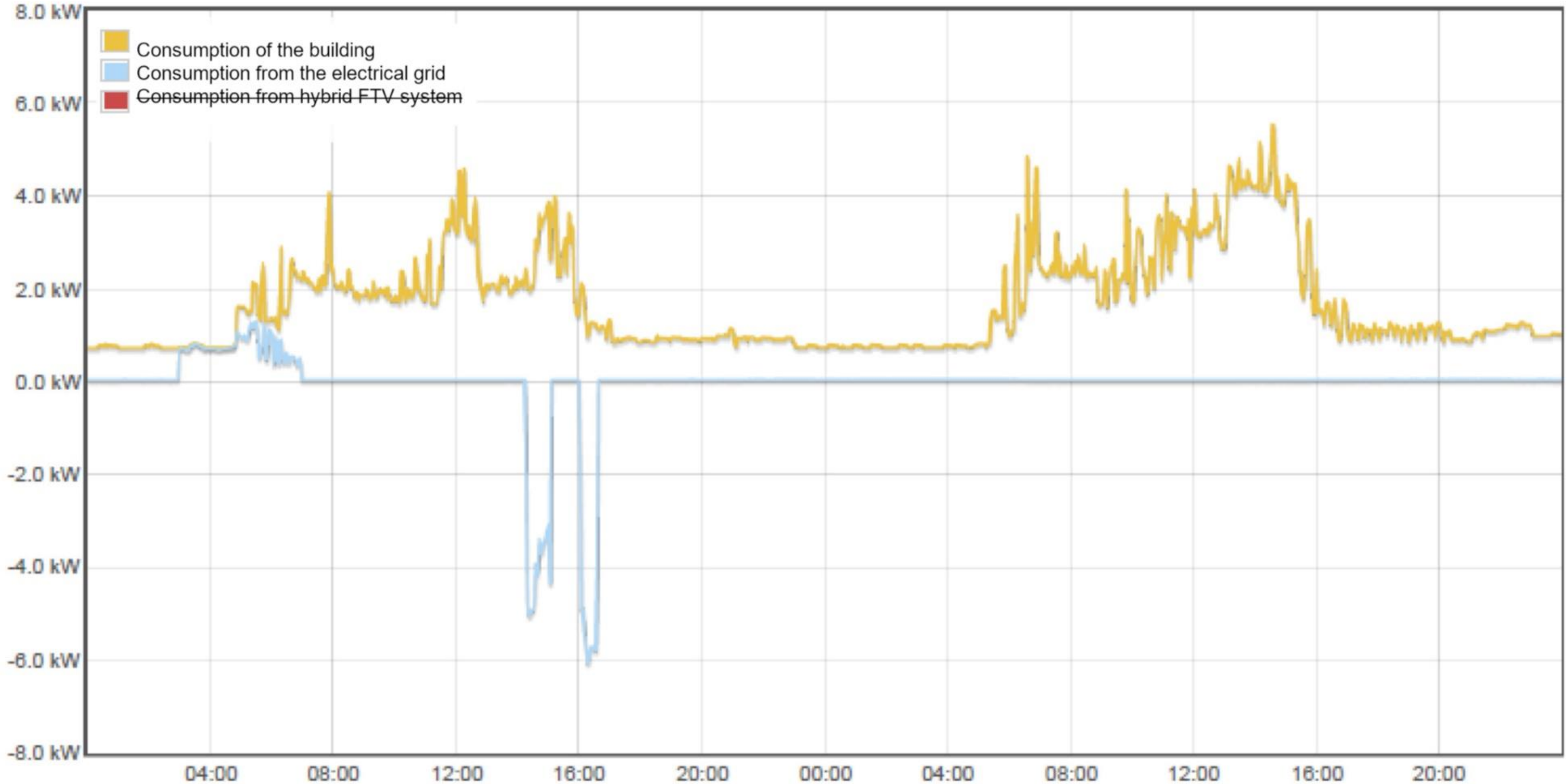
The building's PV system covered 91% of the energy needs of the building under these conditions

Consumption of the building, production and supply (kWh)



Comparison of the real electricity consumption of the building with consumption from the grid – it shows small amounts of controlled consumption during the night and the opposite (controlled supply) during the daytime (HT).

Consumption of the building, production and supply (kWh)



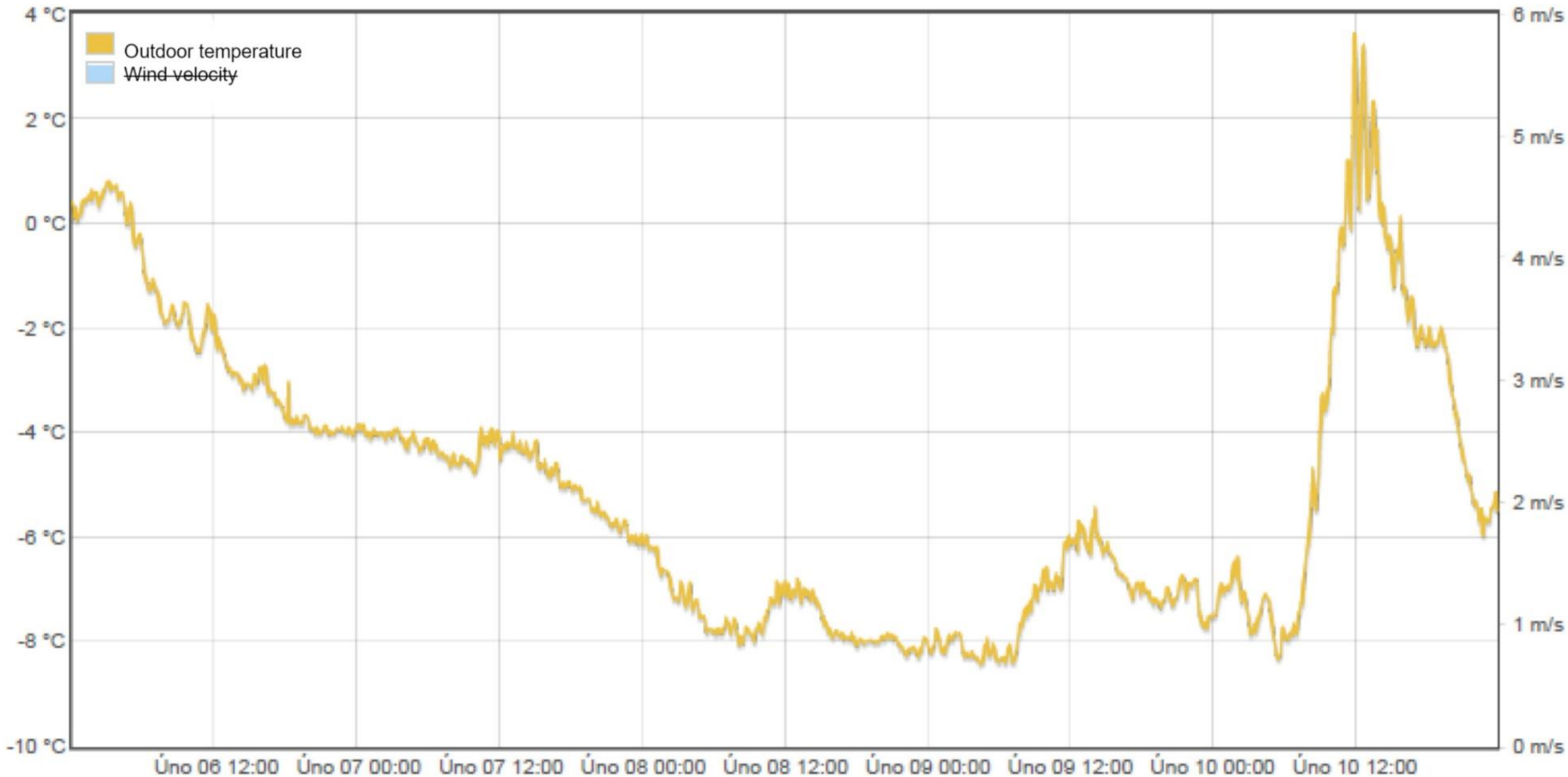
For a clearer picture - a close-up view of two days: 19. - 20. 6. 2017

FENIX

Winter days - 6.-10.2.2017

Outdoor environment

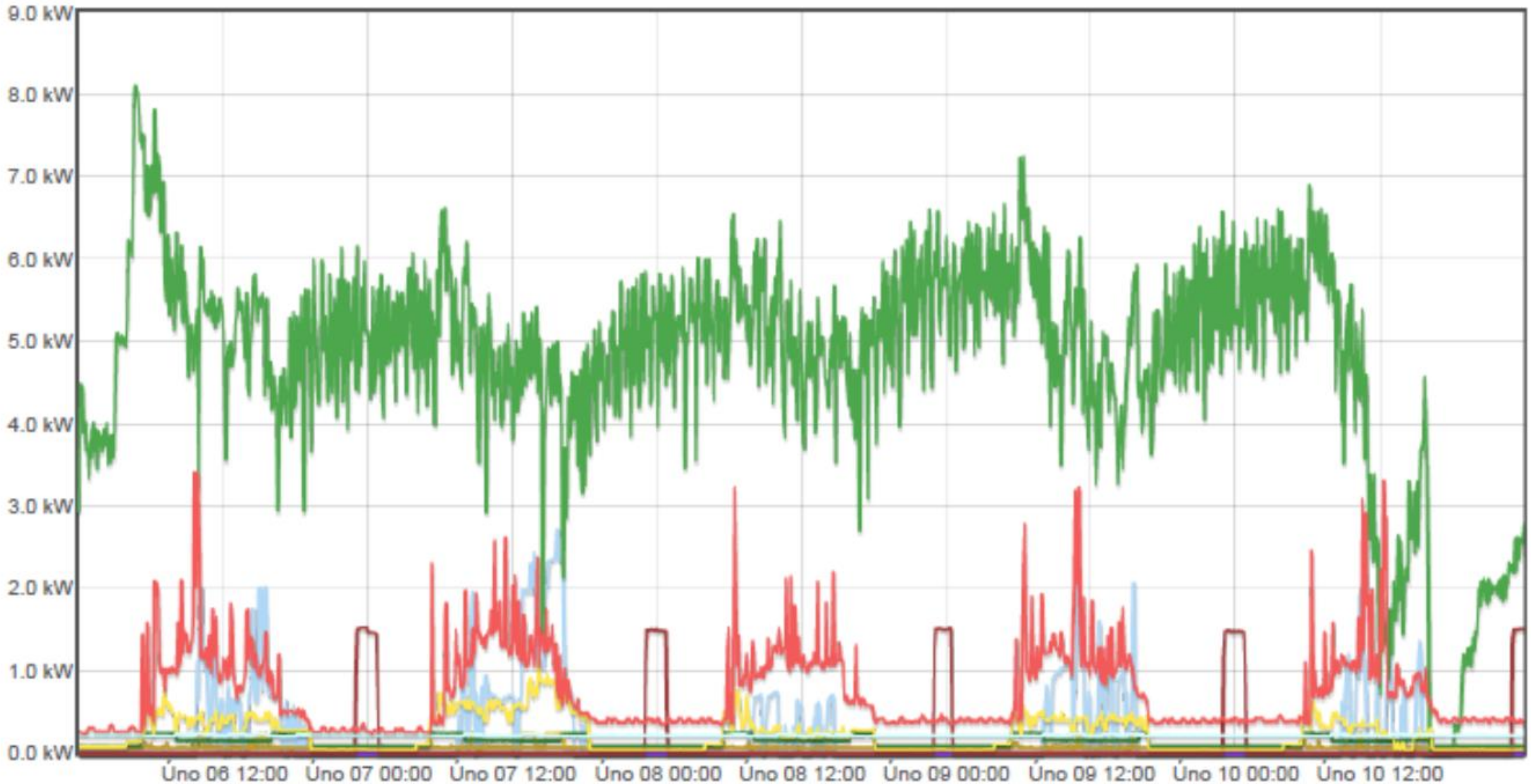
6. – 10. 2. 2017



Daytime temperatures were below freezing point, with the exception of Friday 10. 2. 17, when the daytime temperature rose sharply to +3°C.

Energy consumption by individual systems (kW)

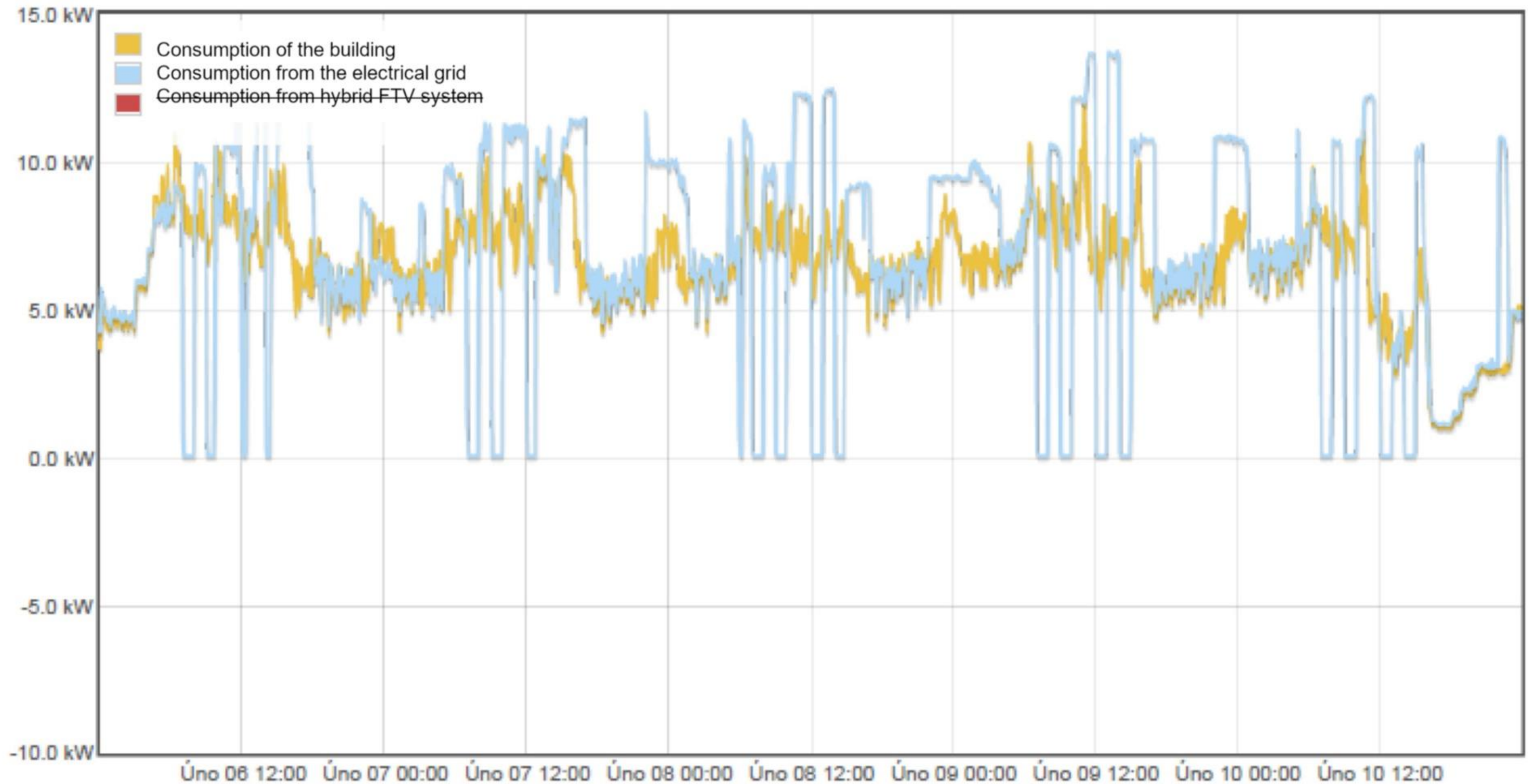
6.-10.2.2017



Energy consumption for heating (green) is influenced by the presence of persons and the operation of office equipment (lower consumption during the day) and reacts significantly to the warmer weather on Friday 10th!

The building’s energy consumption, production and supply (kW)

6.-10.2.2017



A comparison of the real energy consumption of the building with its energy consumption from the grid shows the ability of the battery storage system to achieve zero consumption from the grid during peak periods (HT) and harmonize the consumption of the building over 24 hours.

Battery storage system operation – 26 kW

The battery is charged from the PVP and also from the network in a controlled manner for a maximum period of 4hours/24hours – Operation verified

Expected period of controlled autonomous operation: 4 - 7 hours/day – Operation verified

Expected period of reduced stable consumption (2kW): 6 - 9 hours/day

The option of using a battery to remove peaks and to lower main circuit breaker values was verified. **The building could thus operate with a 3 x 25 A circuit breaker during the winter even though the output would suggest a 3 x 40 A circuit breaker should be used.**

During the shutdown of a transformer station, **autonomous operation** in the event of a power outage was also verified – the building functioned from **6:00 to 20:00 completely without limitations** and no technical failures occurred when power began to be drawn from the battery storage system.

The battery storage system proved to be a very flexible tool for the optimization of the building's energy consumption during the 24 hour cycle. Its ability to work with limited wattage while satisfying all the needs of the household was also proved. A storage system with a three-phase connection also significantly contributes to the balancing of energy consumption during the individual phases of the day!

Heating

Electric radiant system with individual control of each room (9 kW installed).

Heating energy consumption was higher than expected, reaching 12 045 kWh between 10/16 and 5/17, 10 050 kWh from 10/17- 05/18 (-15.3%) and 7 300 kWh from 10/18-5/19 (-31%).

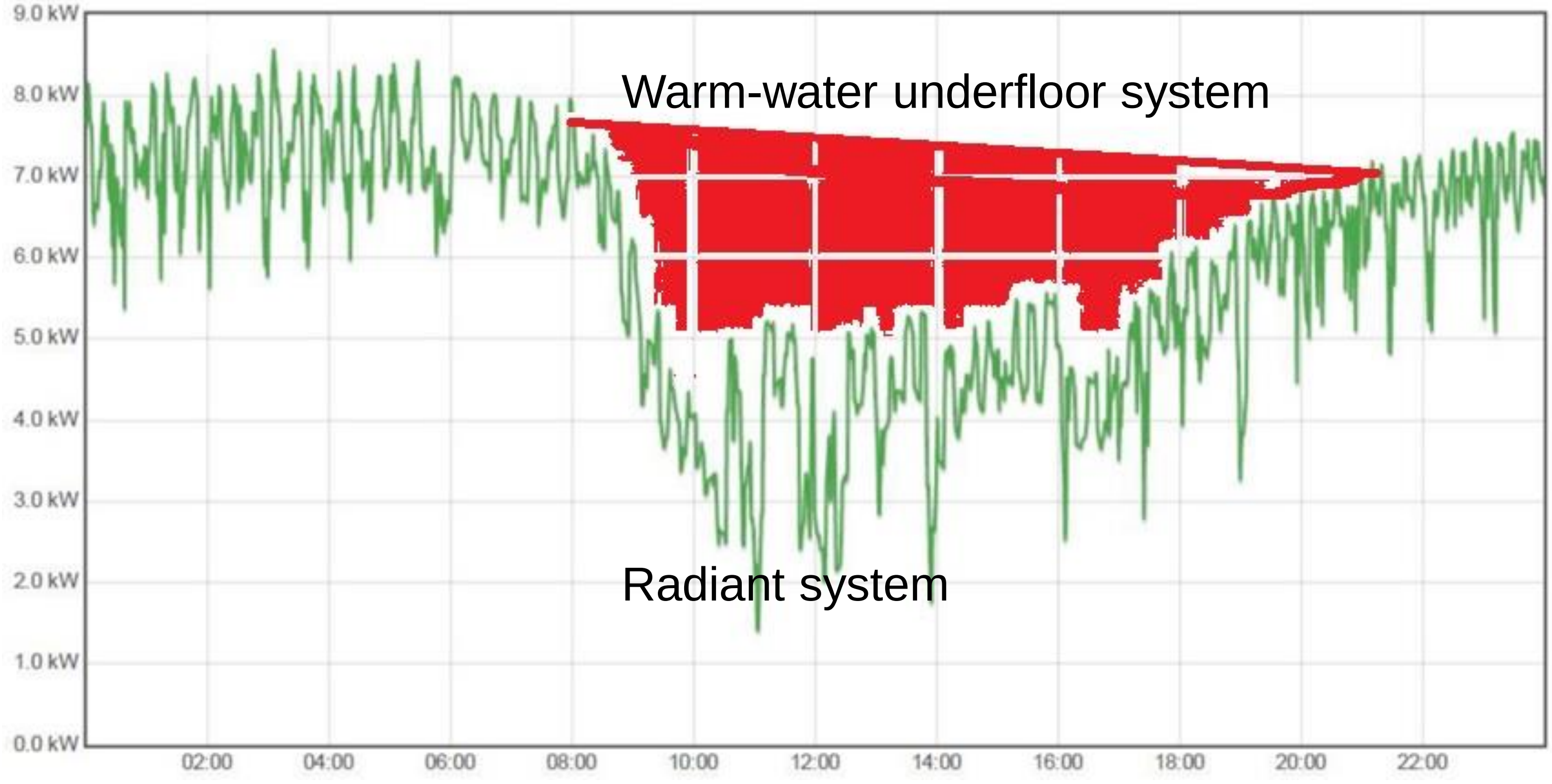
The results for 2019 clearly show the potential for savings in flexible radiant heating. According to information from the Association for District Heating of the Czech Republic, non-flexible warm-water systems had savings of only 8% in the same period.

During the test, the advantages and disadvantages of the “attenuation mode” were examined (- 2°C). The savings achieved are very interesting (17%), though it causes large morning consumption peaks which can be solved by increasing the capacity of the battery.

Overall, the heating system reacted very flexibly both to temperature changes and the occupancy of the individual heated zones. It clearly proved its significant advantages over “warm-water systems” with their high inertia!

An extremely cold day (-12°C) - overcast

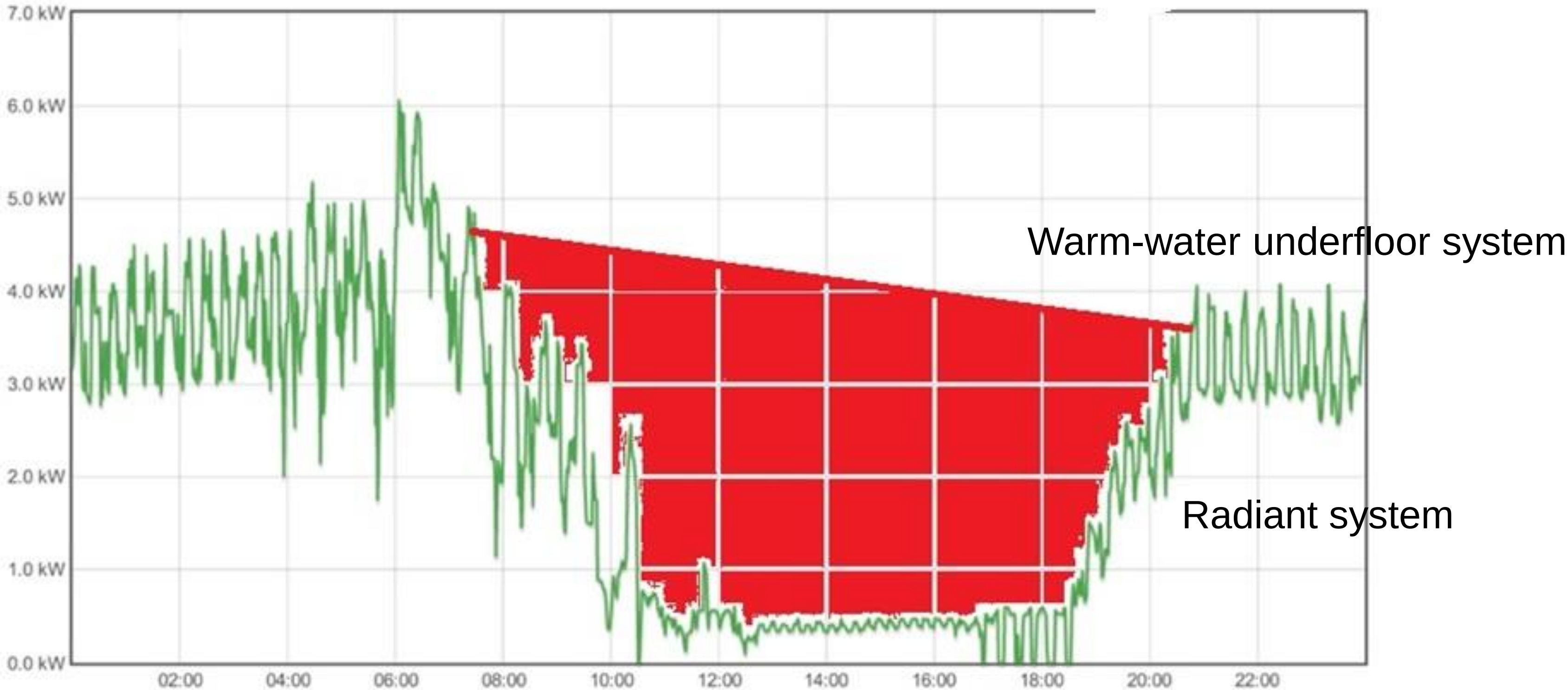
Electric radiant heating in comparison with a warm-water system
Energy supply to the heated area



The energy consumed for heating (radiant heating system) reacts flexibly to changes in outdoor temperatures and particularly to random heat gains (people – equipment).
In contrast, the warm-water system with its high inertia and long reaction time isn´t capable of reacting fast and thus significant energy losses occur.

Sunny day 16. 2. 2017 - average temperature +4.7 °C

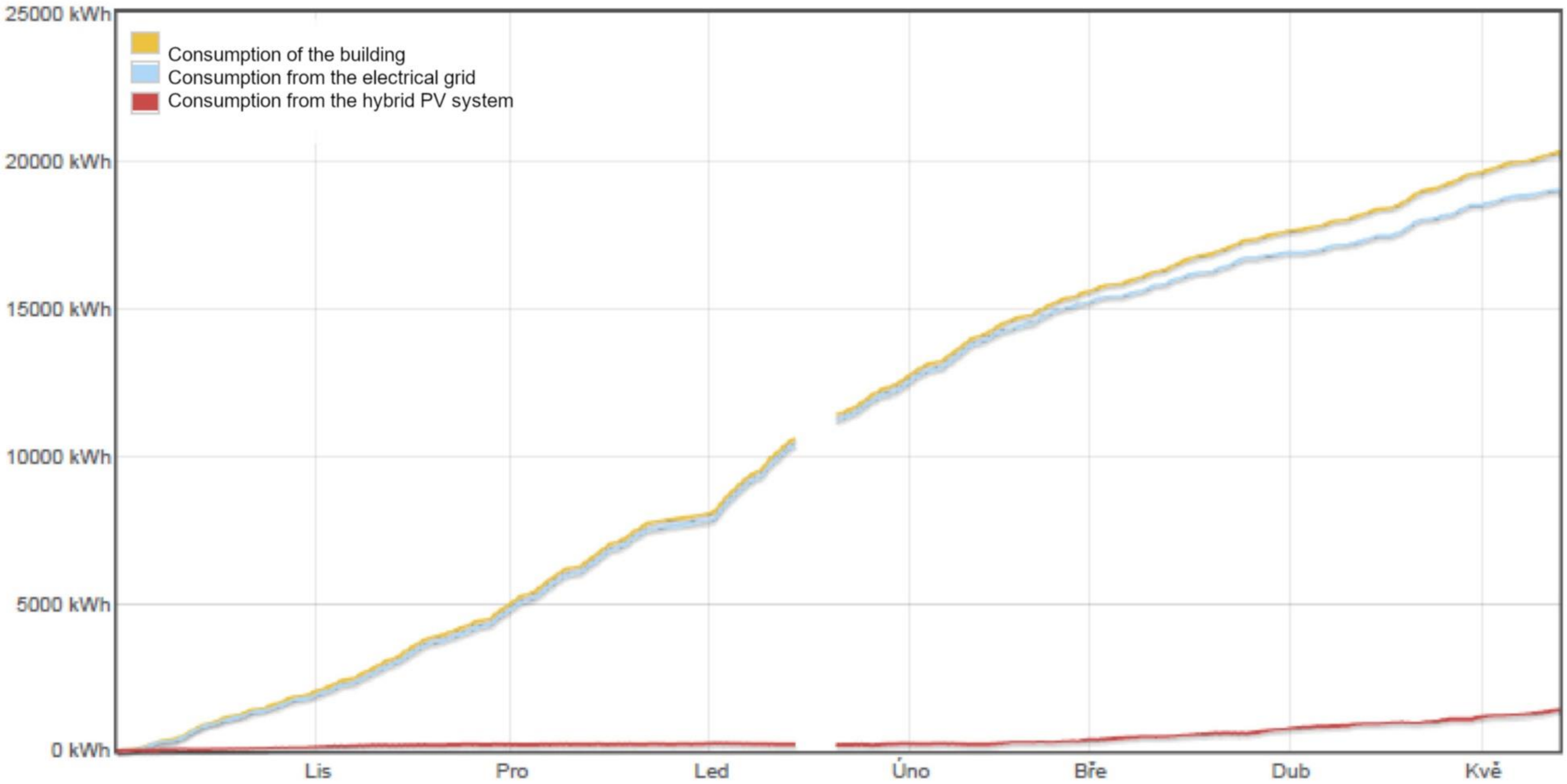
An even more significant difference in efficiency



The significant effect of heat gains (sun-people-equipment) on energy consumption can be seen from this graph, which shows energy consumption for heating. In order to make full use of this effect, it is essential to use a flexible heating system capable of reacting swiftly in each heated area independently.

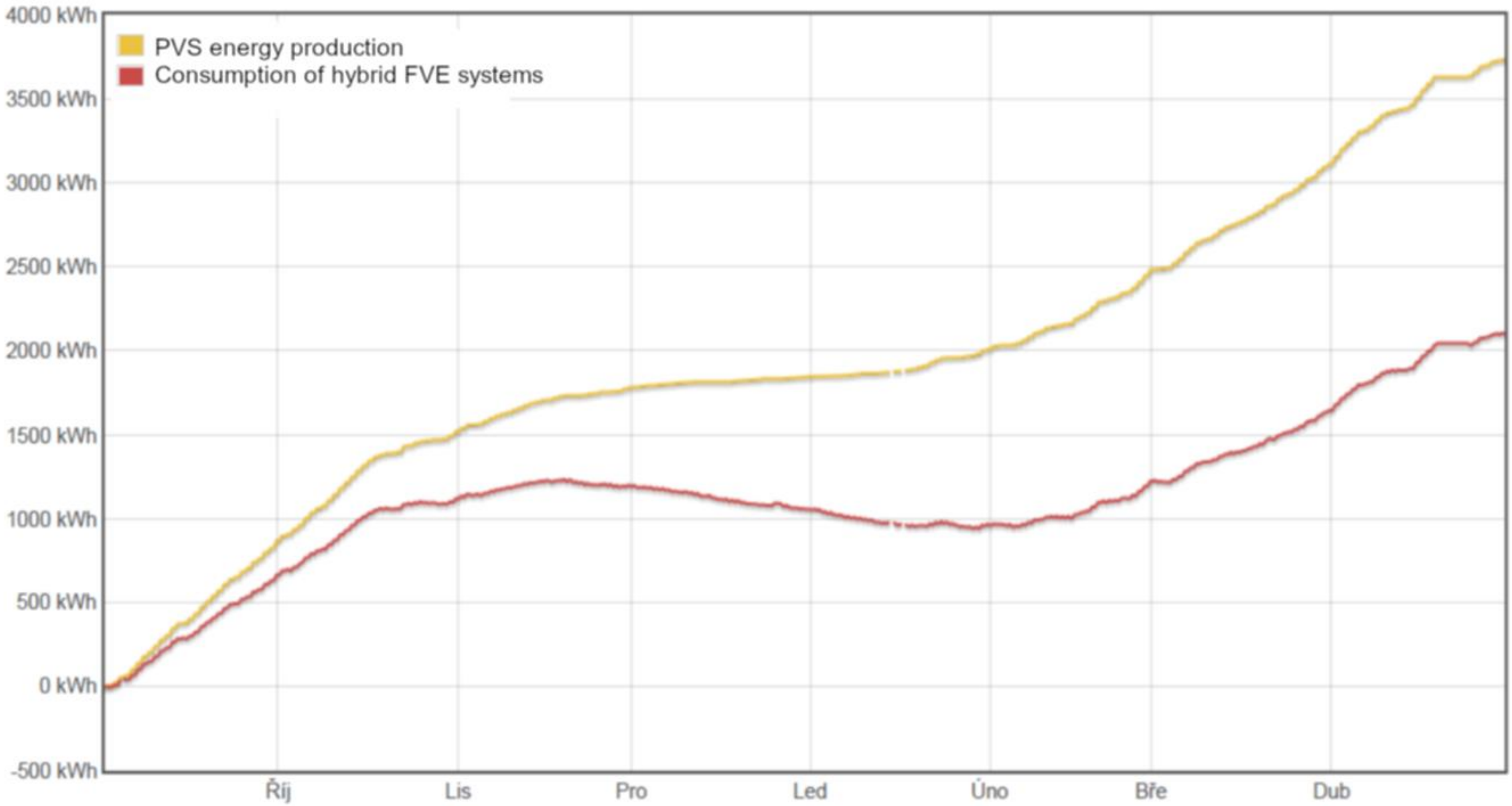
Standard warm-water systems (with any source) do not have this ability in nZEB!

The building’s electricity consumption, production and supply (kWh)



During the heating season, 20 005 kWh were used in the first year, 20 000 kWh in the second and 17 500 kWh in the third.

Electricity produced by the hybrid PV system (kWh)



In the heating season of 2016/17, the PV system produced 2 507 kWh, i.e. approx.12.5% of the total consumption. In 2017/18 it was 3 500 kWh, i.e. approx. 17.5% of the total consumption, and in 2018/19 it was 3 750 kWh, i.e. 21.4 %.

FENIX

Controlled ventilation with recuperation - cooling, air conditioning

During the first 5 months of operation, the system was adjusted – final adjustment – reaction to the level of CO_2 in individual areas + the provision of minimal ventilation. In the summer months, the input air temperature was set to 20°C, while in the winter months it was set to the temperature of the vented air.

In the summer months, intensive night ventilation of the building was set when high daytime temperatures occurred.

The cooling of the air entering the building via an air handling unit was found to consume 3x more energy than the cooling of the interior using a multisplit air conditioning unit.

However, the subjective feeling of comfort noticed in the building by staff was higher in the first case.

Yearly energy consumption - ventilation: 980 kWh (2017), 650 kWh (2018)
- multi-split: 350 kWh (2017), 340 kWh (2018)

Quality of the indoor environment

The following parameters were monitored in the individual rooms:
- temperature
- humidity
- CO_2
- VOC

The evaluation was carried out by the Department of Indoor Environmental and Building Services Engineering, CTU - Dr. M. Urban.
(an extensive independent report).

Conclusion: For all parameters, the quality of the indoor environment was class I for the whole period of the use of the building.

ČEZ distribution testing modes

“Smoothened” OM diagram with regard to the distribution network

Aim - the longest possible operation in the constant mode.

Balanced islanding operation (with a connection to the grid)

Aim - the longest possible zero consumption from the grid (the “hairy zero” mentioned during talks).

Energy supply to the grid forced by the distributor

Aim - to supply the maximum wattage possible to the distribution grid upon the request of the Distributor.

Limitation of the overflow of wattage from the PV system to the distribution grid to a pre-arranged value of installed PV output

Aim - upon the request of the Distributor, to supply a lower (e.g. half) wattage to the distribution grid than the electricity production system could supply in reality.

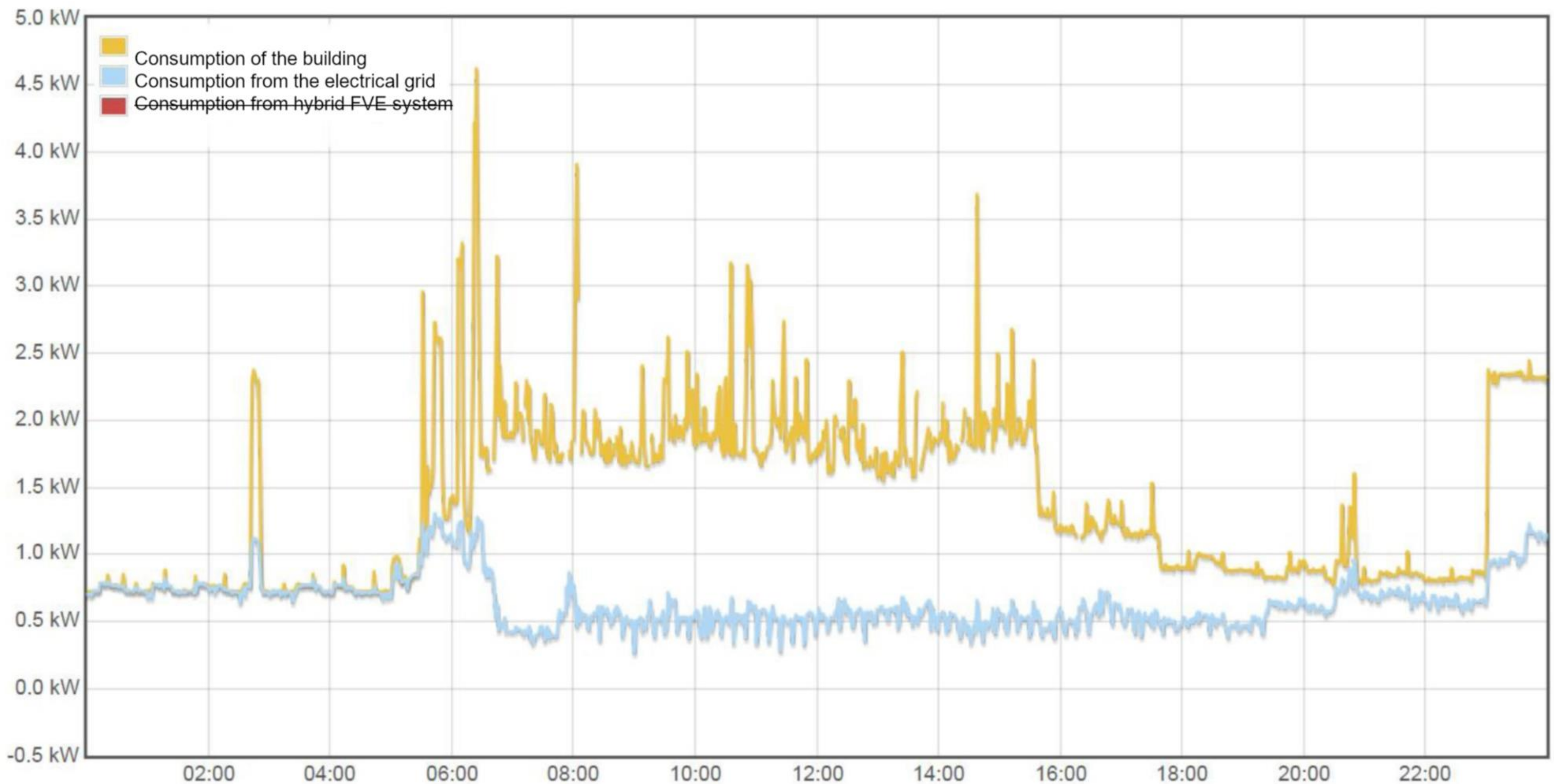
Consumption limited by the Distributor to a pre-arranged limit

Aim - upon the request of the Distributor, to take less (e.g. half) power from the grid than the supply point consumed in the given period.

The tests took place from 14.- 28. 5. 2018

The building's electricity consumption, production and supply (kW)

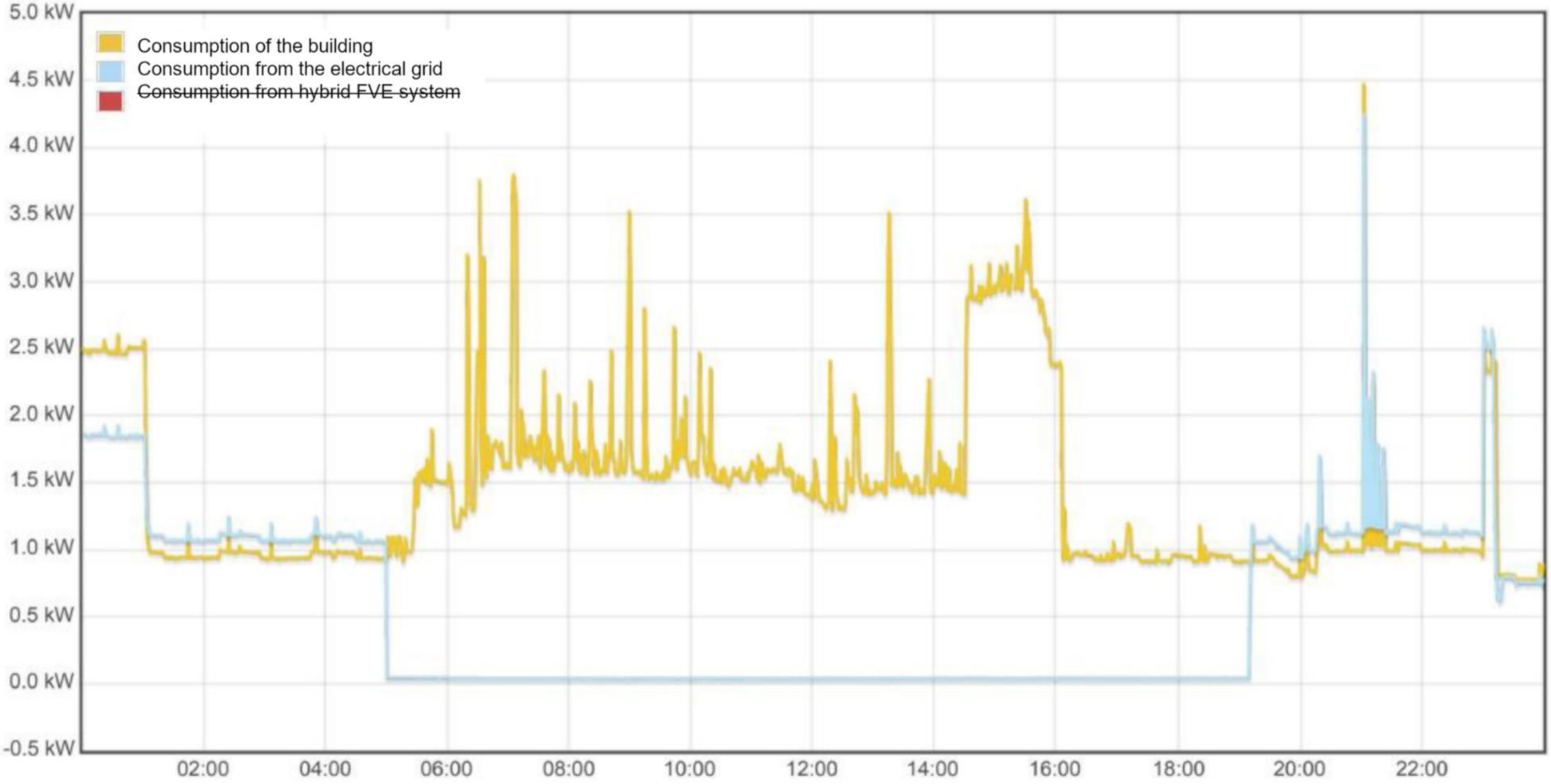
Testing mode - balanced consumption diagram



The total maximum consumption of the building was 4.5 kW
The maximum energy consumption from the grid was 1.2 kW

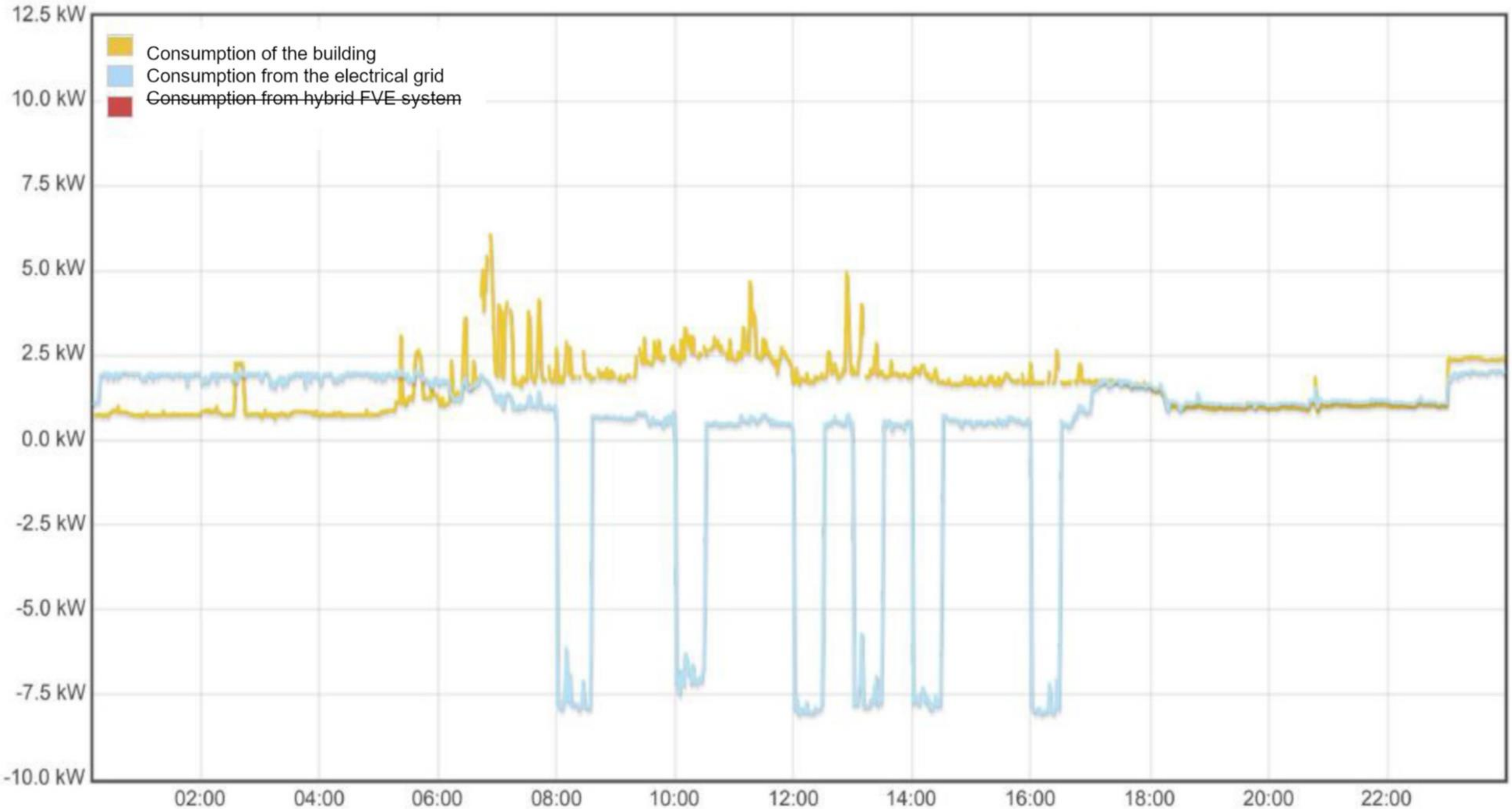
The graph clearly shows the complete separation of the real energy consumption of the building from

The building's electricity consumption, production and supply (kW)



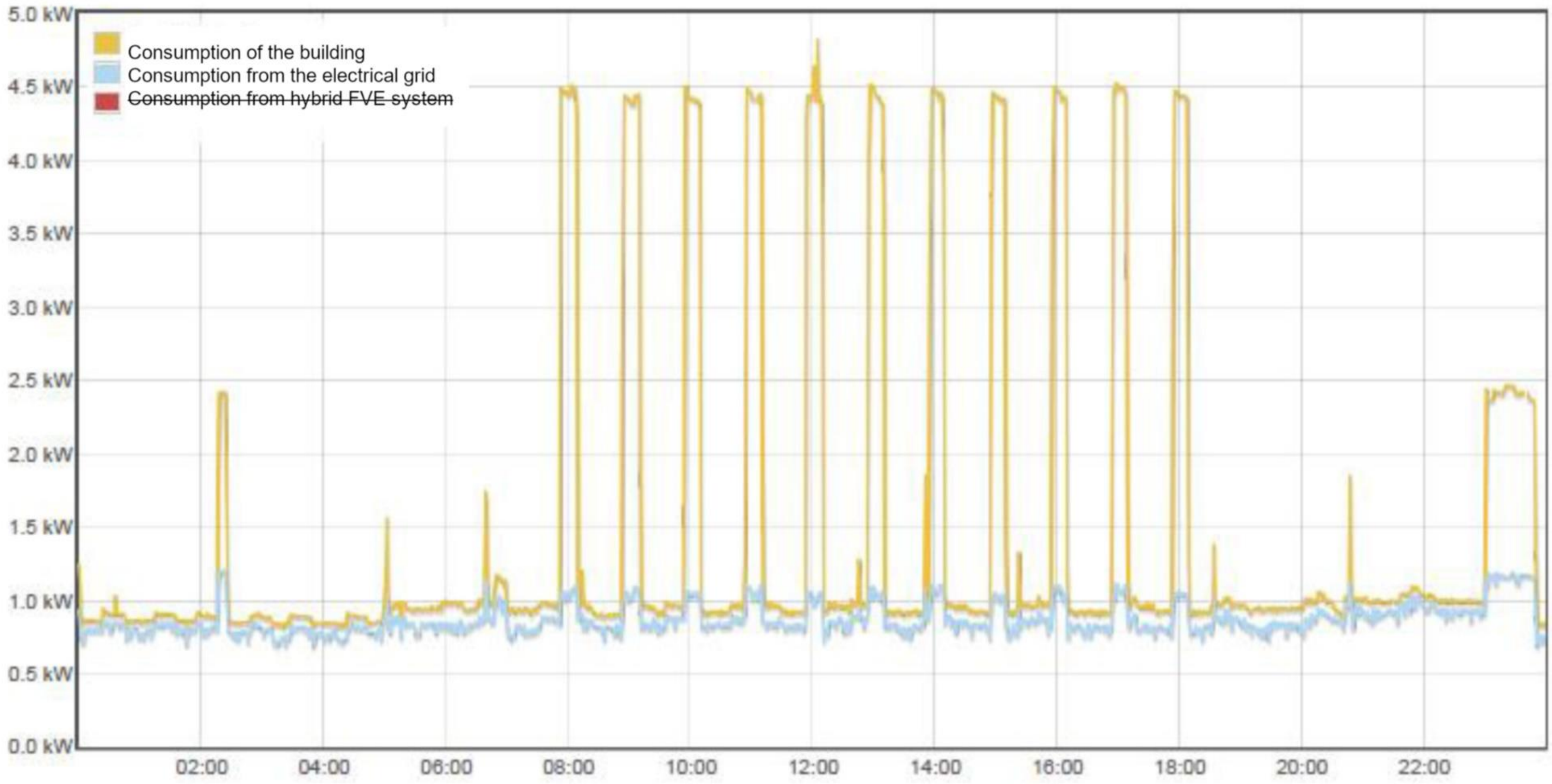
18. 5. – an attempt to achieve zero consumption was made from 5 a.m. (maintained for 14 hours until 7 p.m.)

The building’s electricity consumption, production and supply (kW)



21. 5. 2018 - balanced consumption with controlled energy supply to the grid

The building's electricity consumption, production and supply (kW)



Maintenance of balanced consumption from the grid of 1 kW max. despite the increase in load up to 4.5 kW at regular intervals.

Conclusions:

- It was proved that the presented concept is able to cooperate efficiently within the context of future “smart grids”, as well as the current electric grid management system using DSM.

- Measurements by ČEZ showed that the influence of the activities of HPV systems on the grid is completely insignificant.

- It was shown that it is absolutely essential to produce materials for designers which define the relationship between the wattage of a building, the size of its PV system and the size of its battery storage system.

- Cooperation on the monitoring and evaluation of SAS Jeseník in 2018-2019 was agreed.

Collaborative project Fenix - CTU-UCEEB

within the framework of NCK (2019-2020) programmes

Residential buildings:

Development of an algorithm for the optimum management of the indoor environment in a residential building constructed to the nZEB standard with renewable energy resources and electrical energy storage. The aim is for a building with a PV system to maintain its indoor environment via the optimum operation of electric heating, ventilation and lighting, and with the efficient use of locally produced electrical energy via its storage system.

A two-year project - cooperation: UCEEB – Fenix – WAFE – AERS – S-Power – TECO Kolín

Collaborative investigation and subsequent commercial cooperation during project implementation

CAMEB PROJECT - a control algorithm for a superior control unit which controls all the equipment of a fully electrified family home built to the nZEB standard, fitted with a rooftop PV system, a battery storage system, ventilation with recuperation and electric radiant heating.

A two-year project implemented via cooperation between CTU - UCEEB, Fenix, TECO, S-Power, AERS, WAFE and TECO Kolín

Project location: OMICE

Investor: Ing. Dalibor Veverka

FENIX

Awards :

The concept of the house as an active element of the energy system received a special award as part of the CZECH TOP 100 awards announced at Prague Castle on 16.6.2016: Environmental feat of the year in the energy sector.

3) On 27.3. 2017, the business centre project was awarded a prize by the regional representative of the Olomouc Region.

Building of the year 2016

4) We consider the fact that this project was one of the **10 official exhibits presented as part of the Czech exhibit at the World Exhibition in Astan (06/17-10/17) to be the greatest award.**

The motto of the exhibition was energy savings and energy efficiency.

ČEEP 2016

ČESKÝ ENERGETICKÝ A EKOLOGICKÝ PROJEKT | STAVBA | INOVACE ROKU

VYPISOVATELÉ: MINISTERSTVO PRŮMYSLU A OBCHODU · Ministerstvo životního prostředí · MINISTERSTVO PRO MÍSTNÍ ROZVOJ ČR

HLAVNÍ PARTNER: PRE

PARTNEŘI: ČESKÝ INSTITUT INFORMATIKY ROBOTIKY A KYBERNETIKY ČVUT V PRAZE · TA ČR · PRAHA PRAGUE · ČVUT UCEEB · A.E.M · CENTRUM PASIVNÍHO DOMU · TEPLÁRENSKÉ SDRUŽENÍ České republiky · SPS · SP · ČKAIT · czech smart city cluster · TPUE

TITUL ČEEP 2016

Kategorie: C – TECHNOLOGIE, INOVACE

Chytrý energetický management administrativní budovy Fenix Group

Přihlašovatel: ČVUT UCEEB

Výrok poroty: Za optimalizaci stavebního řešení, která v kombinaci s FV umožnila budovu s elektrickým vytápěním klasifikovat jako A - mimořádně úspornou. Projekt ověřil spolupráci střešních FVE s domovními bateriemi a distribuční „smart grid" a byla prokázána efektivita tohoto inovačního řešení.

21. LISTOPADU 2017

Ing. Drahomír Ruta, předseda poroty

Ing. Miloslava Veselá, organizátor

TOP EXPO

EXPO 2020 DUBAI - Pavilion of the Czech Republic

FENIX - an official partner of the Czech participation

Fenix was contacted by the General Commissioner for Czech participation and its contribution to this great world exhibition was agreed. The exhibits will be a model of the Fenix office center and an AES 10 modular battery storage system.

FENIX

Thank you for your attention

www.fenixgroup.cz