

Technology-Based Energy Consumption Breakdown

September 2, 2025

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Abbreviation

BMS	building management system
PV	photovoltaic panels
E1, E2, ...	experimental halls
L1, L2, ...	laser halls
HVAC	heating, ventilation, and air conditioning
UPS	uninterruptible power supplies
UT	central heating (Czech: ústřední topení)
MF	multifunctional part of the ELI Beamlines facility
OF	office part of the ELI Beamlines facility
LB	laboratories (part of the ELI Beamlines facility)
DHW	domestic hot water

This document aims to illustrate the energy consumption of the ELI Beamlines facility in Dolní Břežany. More specifically, it shows the energy consumption of the technologies in use. The focus is on electricity, heat, and cold consumption. The original purpose was to enable the refinement of the OMEGAlpes model of the facility.

The content of this document is based on the data measured in the facility available through BMS. In order to capture the weather dependency of consumption over the year, the majority of the content deals with the data from 2024. However, due to the ongoing installation of new technologies or the lack of measured data, a different time period is chosen at certain points.

The structure of the document is as follows. First, the part Electricity summarizes the total electricity consumption in 2024 and its distribution to the switchboards. Then, technologies powered by switchboards are listed and their consumption is illustrated together with their typical consumption trends¹ (daily, weekly, yearly, ...). At the end of this chapter, there are figures that show the estimated distribution of total electrical energy consumption in more detail. Lastly, there is a summary of heat and cold consumption in the parts Heat and Cold with the distinction based on the circuits in the facility.

¹The power consumption trend is typically shown through figures depicting power consumption in time, where the power values are always in kW. The unit is missing in the figure itself, but is always stated in the caption.

1 Electricity

1.1 General

The main source of electrical energy in the ELI Beamlines facility is the electrical grid. In addition to that, photovoltaics (PV) and a cogeneration unit are used to generate electricity. Electricity is distributed to the facility through switchboards RH1, RH2, RH3, and RH03. The total electricity consumption in 2024 was 11.6 GWh. This includes both the electrical energy produced by the cogeneration unit and photovoltaics, which is considered for approximately half of the year 2024 due to the availability of data. Figure 1 shows the percentage of energy consumed by each switchboard. While the electricity from the cogeneration unit is distributed to all switchboards, the PV electricity powers only the RH2 switchboard, and thus the corresponding portion of the RH2 consumption is shown as dark blue color in Figure 1. It is important to note that the percentage of PV would be higher if its use were considered over the entire year.

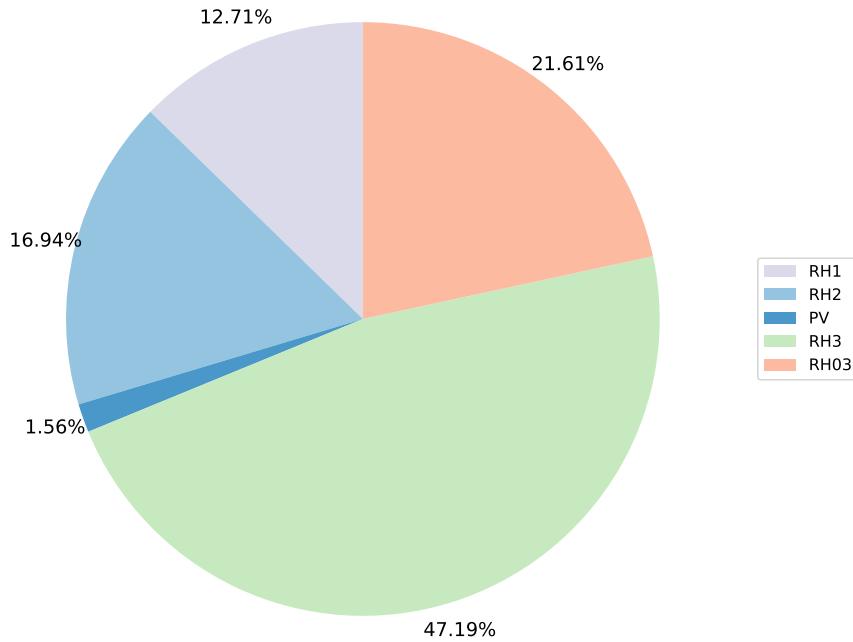


Figure 1: Total electrical energy consumption, 2024

1.2 Switchboard RH1

The RH1 switchboard powers “S floor - additional consumption”. The rest of the consumption (including control room, canteen, some of the HVAC units, lifts, lecture hall, radiation laboratory, ...) from this switchboard is not measured separately. This corresponds to the consumption marked as “not measured” in Figure 2. The total consumption of the RH1 switchboard in 2024 was 1.47 GWh. However, Figure 2 depicts the percentages from 2/26/2025 to 7/29/2025 due to the availability of the data. Next, Figures 3 and 4 show the yearly RH1 power consumption and an example of weekly RH1 power consumption. Figure 5 shows the power consumption of “S floor - additional consumption” from 2/26/2025 to 7/29/2025.

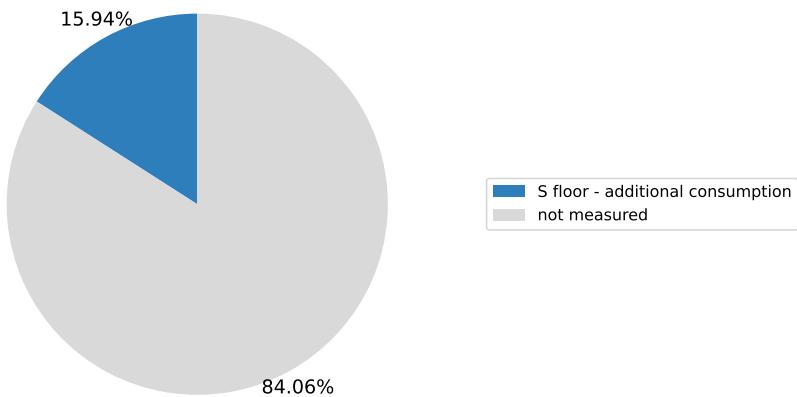


Figure 2: RH1 energy consumption, 2/26/2025 - 7/29/2025

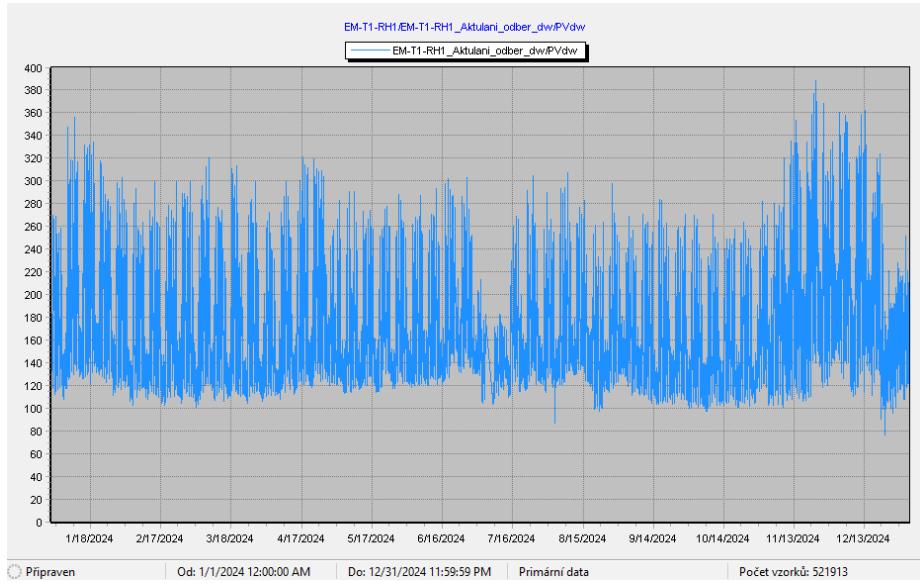


Figure 3: RH1, power consumption, 2024, [kW]

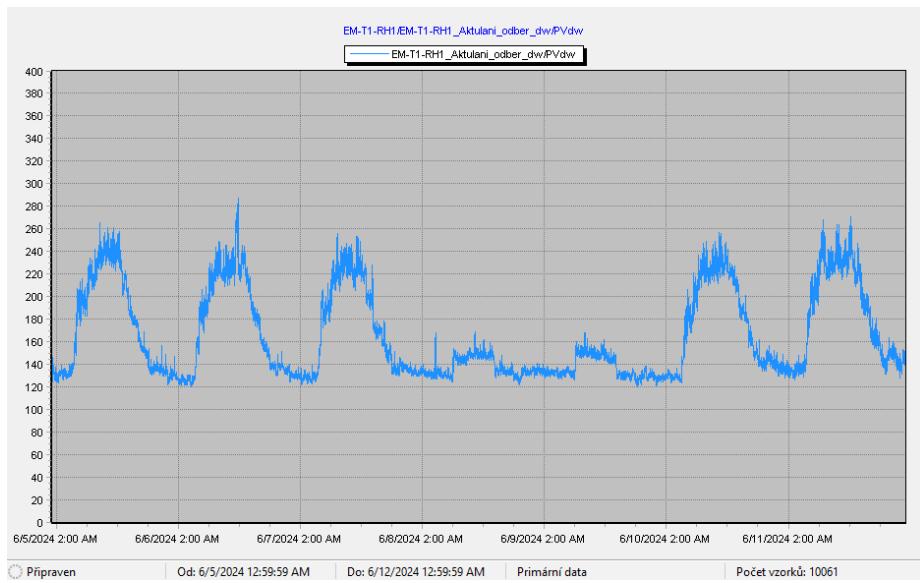


Figure 4: RH1, weekly power consumption example (6/5/2024 - 6/11/2024; (Wednesday to Tuesday)), [kW]

1.2.1 S floor - additional consumption

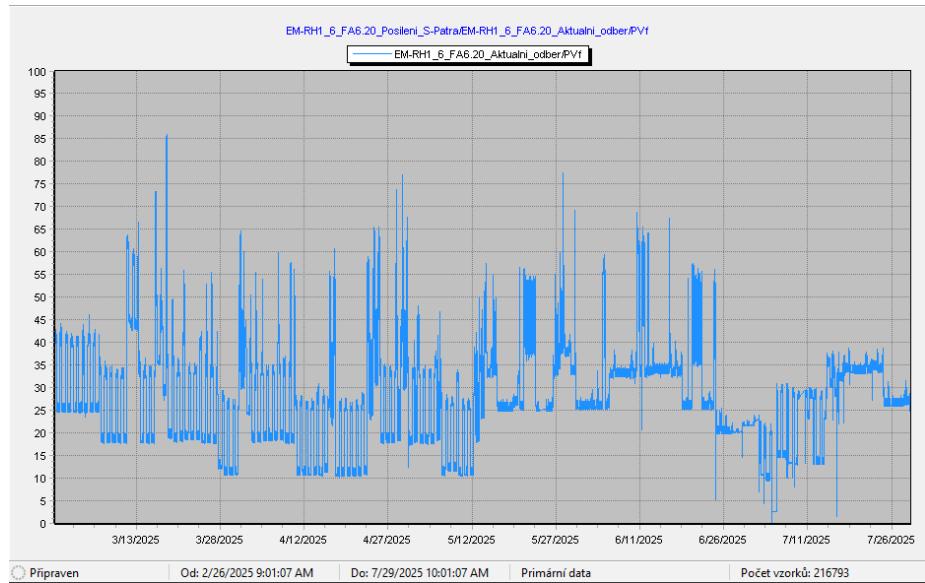


Figure 5: S floor - additional consumption, power consumption, 2/26/2025 - 7/29/2025, [kW]

1.3 Switchboard RH2

The total consumption of the RH2 switchboard in 2024 was 2.14 GWh. This includes 0.18 GWh generated by PV (considered since approximately half of the year 2024, presumably more if considered over the entire year). The technologies powered by RH2 and their part of the consumption are depicted in Figure 6. The yearly and weekly power consumption of RH2 excluding PV electricity is shown in Figures 7 and 8. Lastly, Figures 9 - 33 illustrate the trends of power consumption of the technologies powered through RH2. Note that the naming of the vacuum pumps (e.g. Vacuum pumps E5 - consumption) refers to their placement in the service rooms rather than a hall (e.g. hall E5) that uses them.

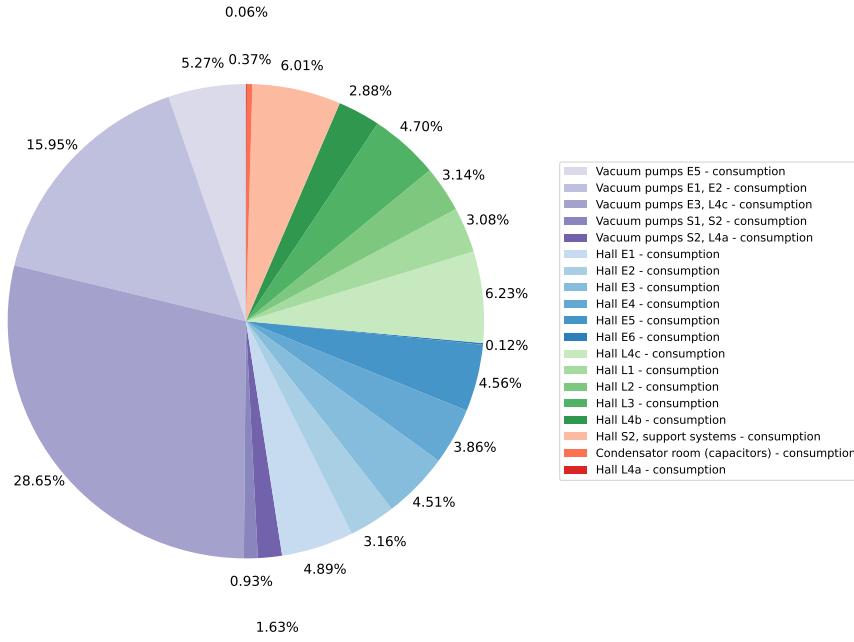


Figure 6: RH2 energy consumption, 2024

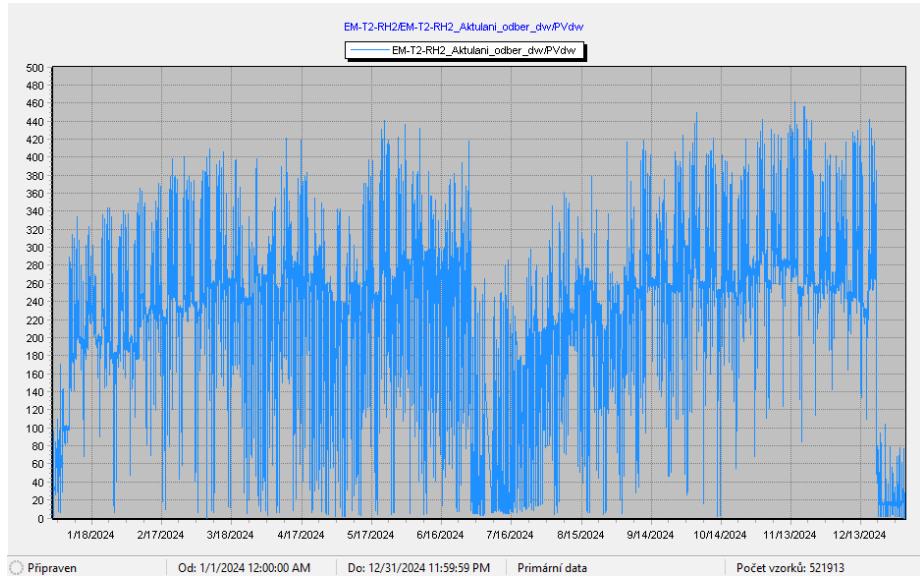


Figure 7: RH2, power consumption, 2024, [kW]

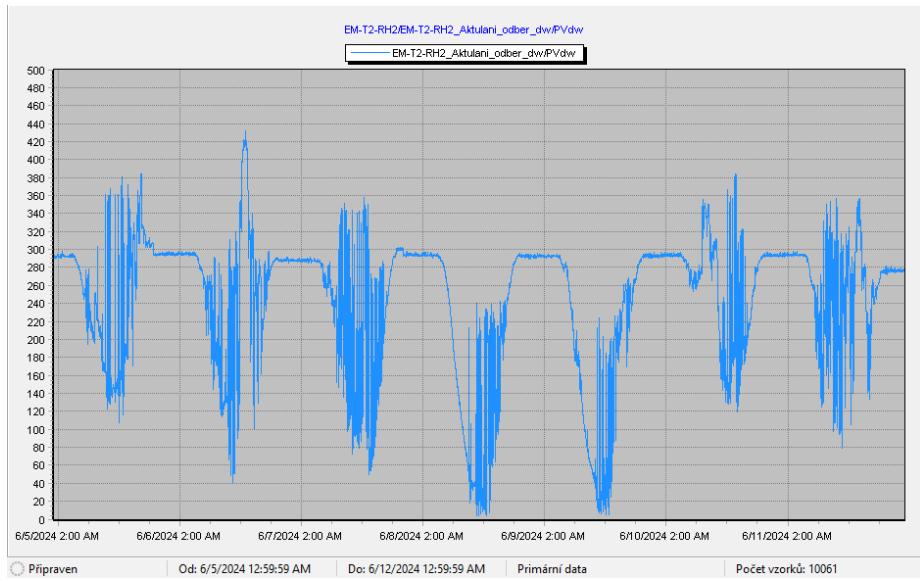


Figure 8: RH2, weekly power consumption example (6/5/2024 - 6/11/2024; (Wednesday to Tuesday)), [kW]

1.3.1 Vacuum pumps

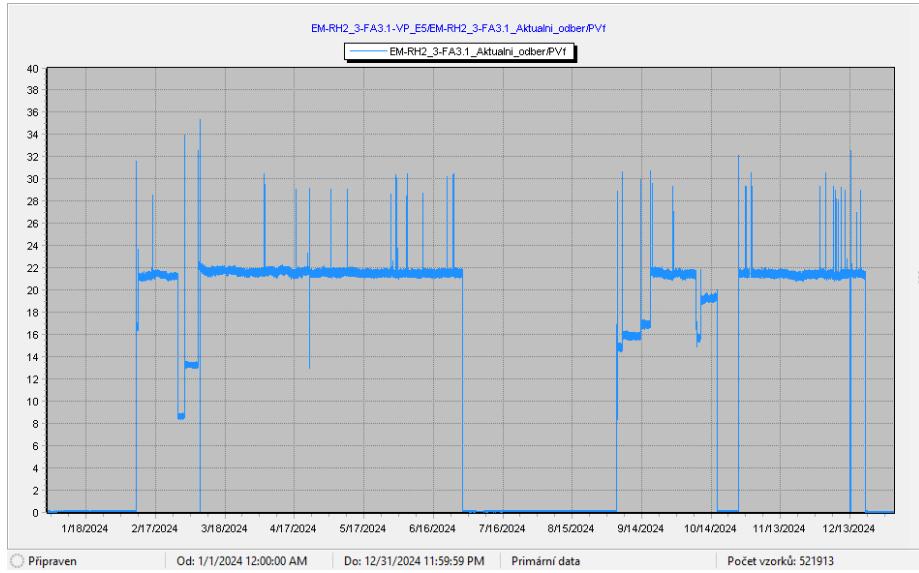


Figure 9: Vacuum pumps E5, power consumption, 2024, [kW]

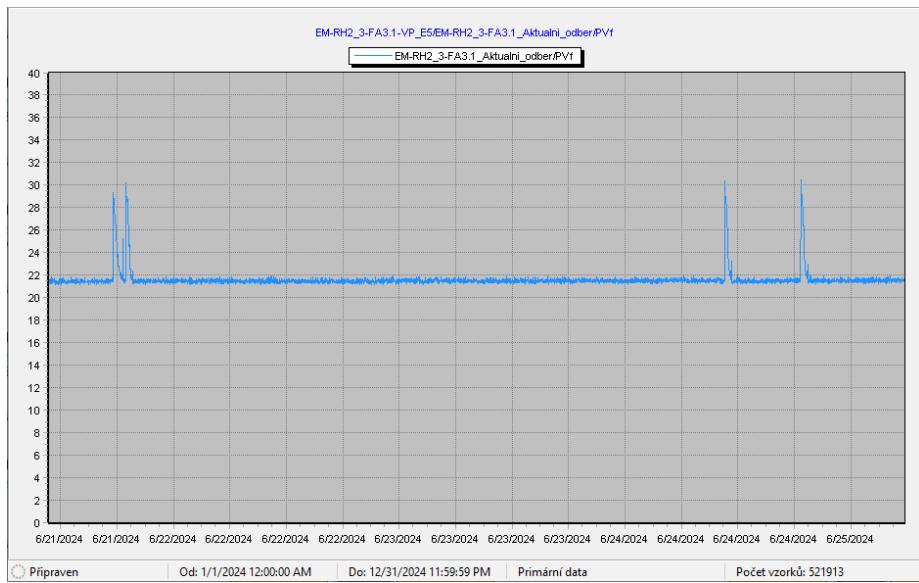


Figure 10: Vacuum pumps E5, power consumption, ~ 4 days during the summer of 2024, illustration of the peaks and their duration, [kW]

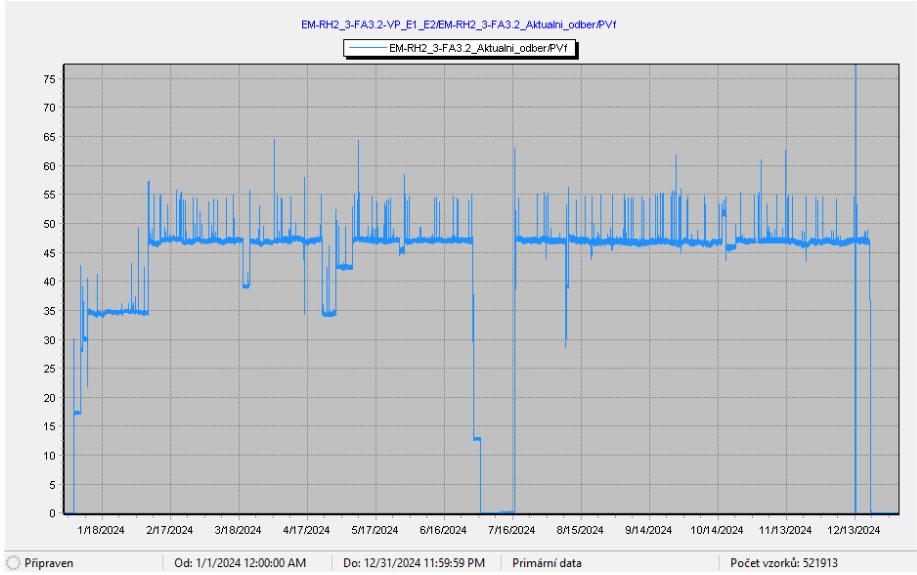


Figure 11: Vacuum pumps E1, E2, power consumption, 2024, [kW]

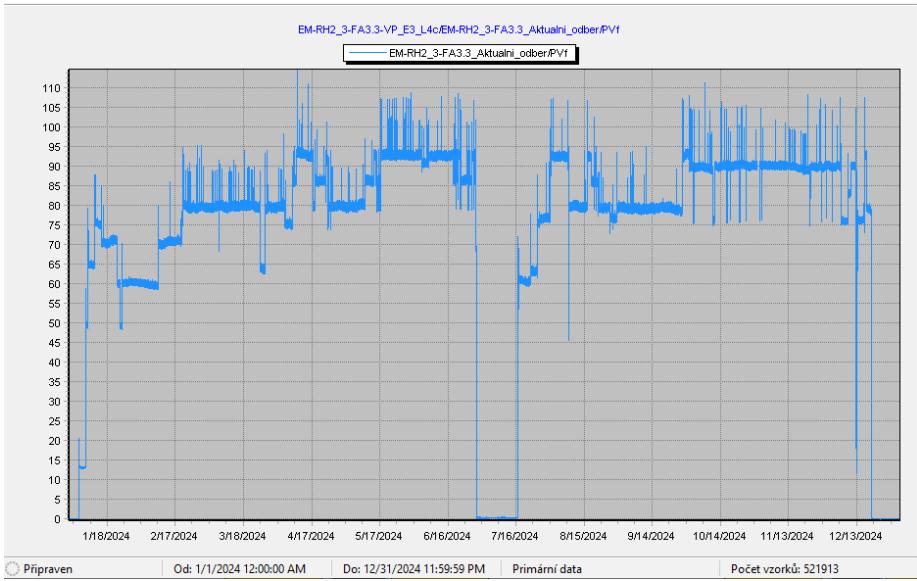


Figure 12: Vacuum pumps E3, L4c, power consumption, 2024, [kW]

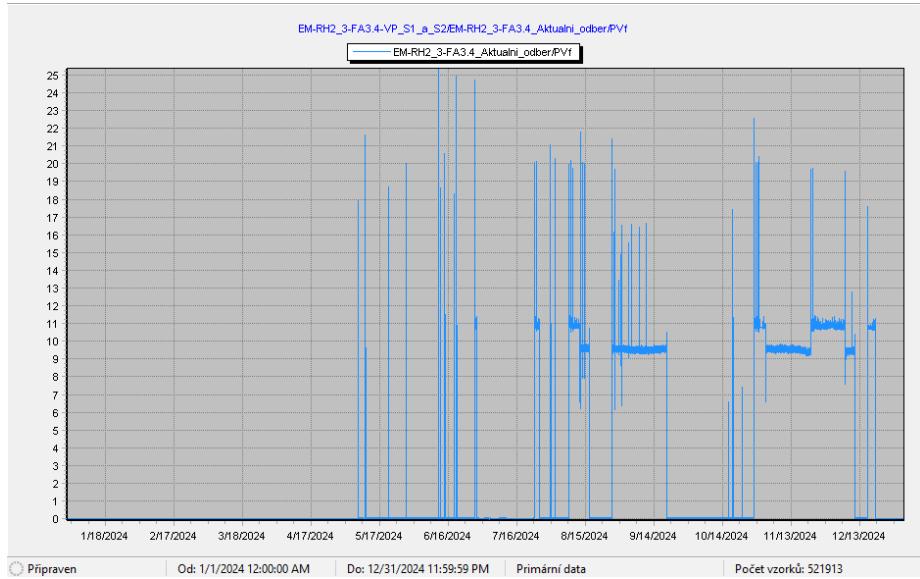


Figure 13: Vacuum pumps S1, S2, power consumption, 2024, [kW]

1.3.2 Experimental halls

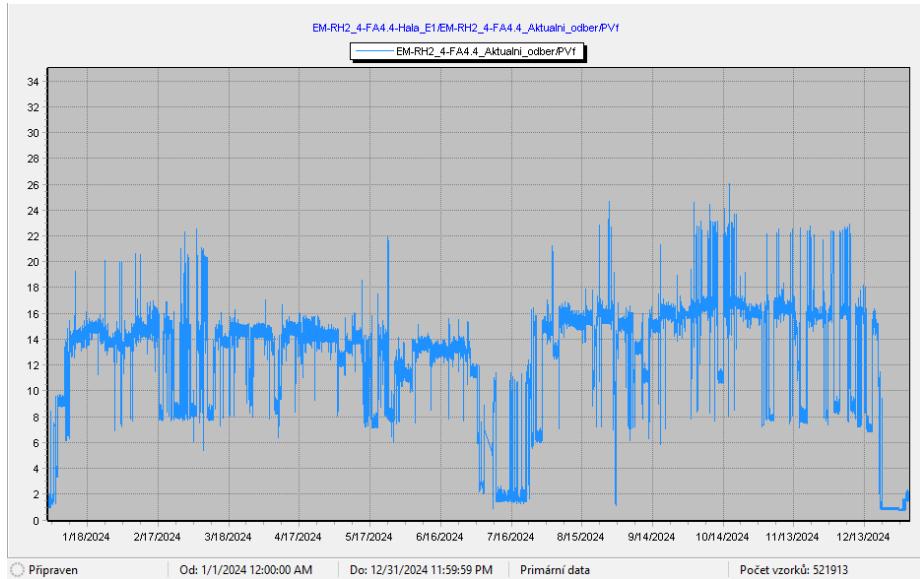


Figure 14: Experimental hall E1, power consumption, 2024, [kW]

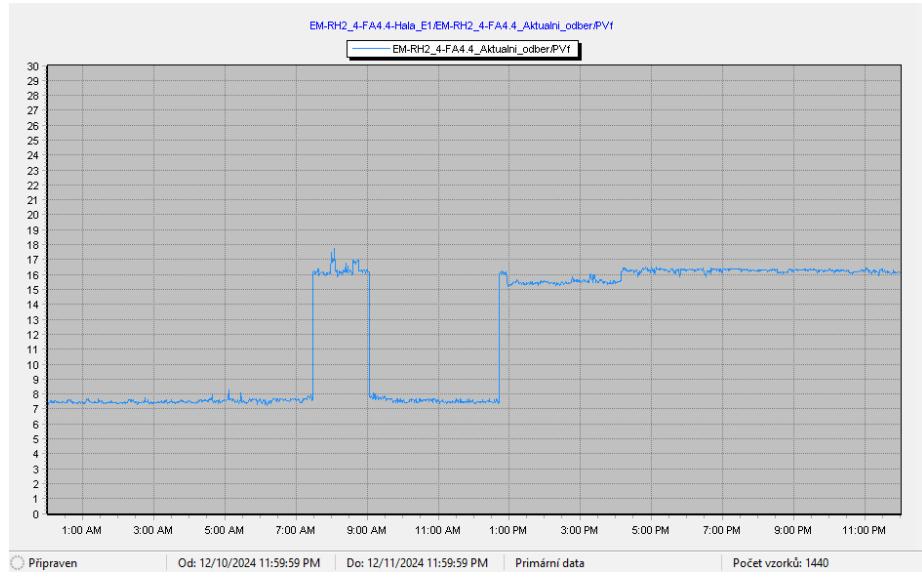


Figure 15: Experimental hall E1, daily power consumption example 1, [kW]

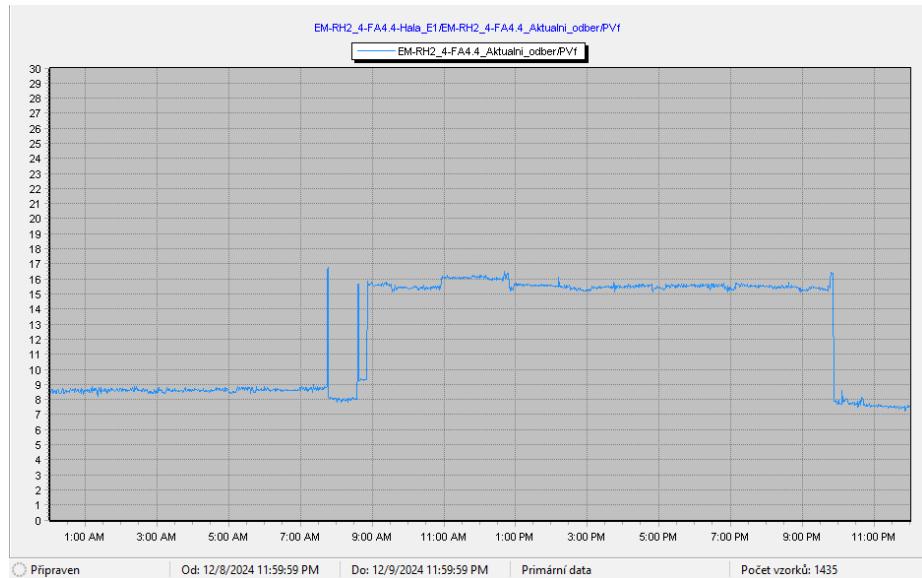


Figure 16: Experimental hall E1, daily power consumption example 2, [kW]

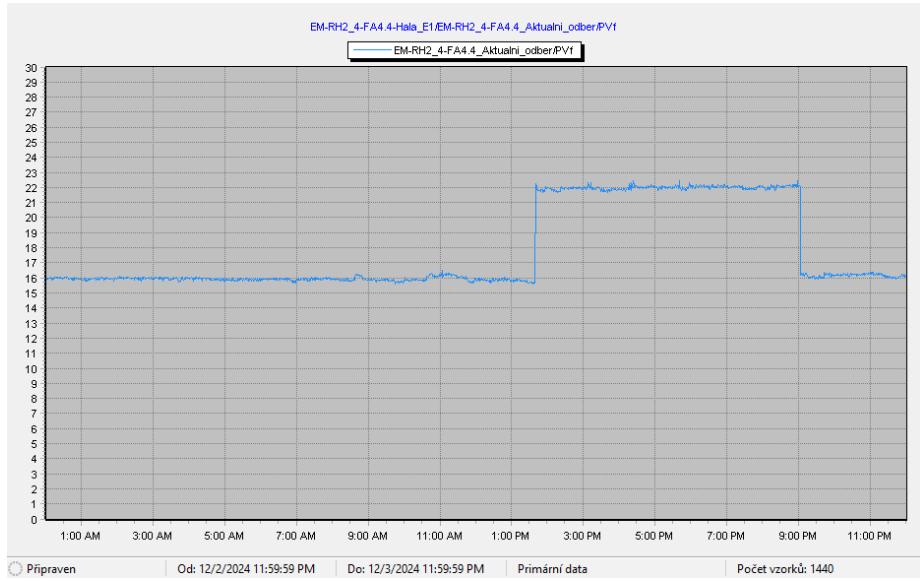


Figure 17: Experimental hall E1, daily power consumption example 3, [kW]

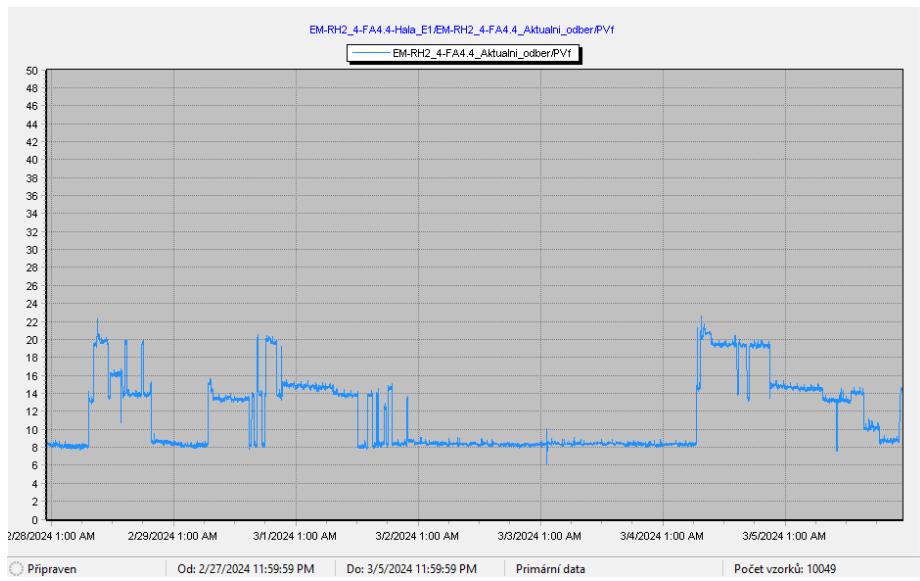


Figure 18: Experimental hall E1, weekly power consumption example 1, [kW]

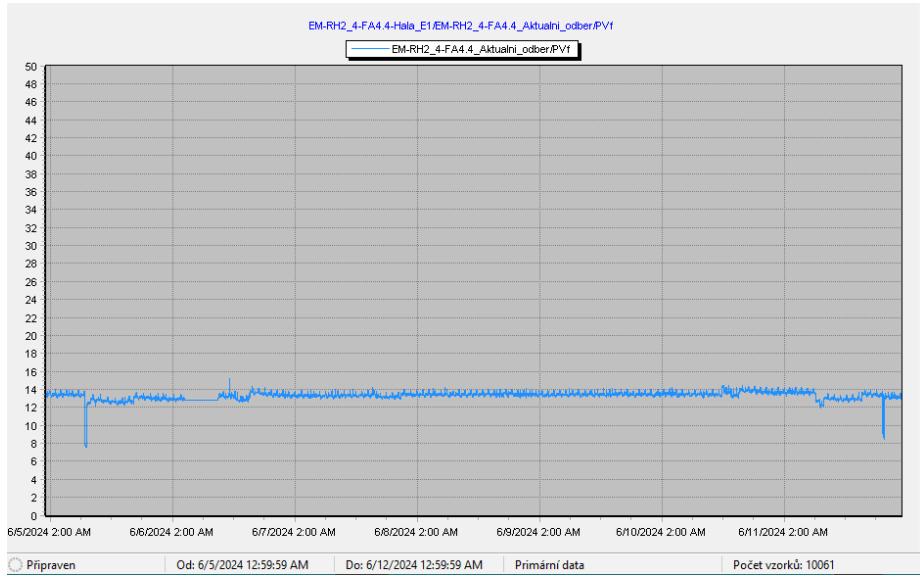


Figure 19: Experimental hall E1, weekly power consumption example 2
(6/5/2024 - 6/11/2024; (Wednesday to Tuesday)), [kW]

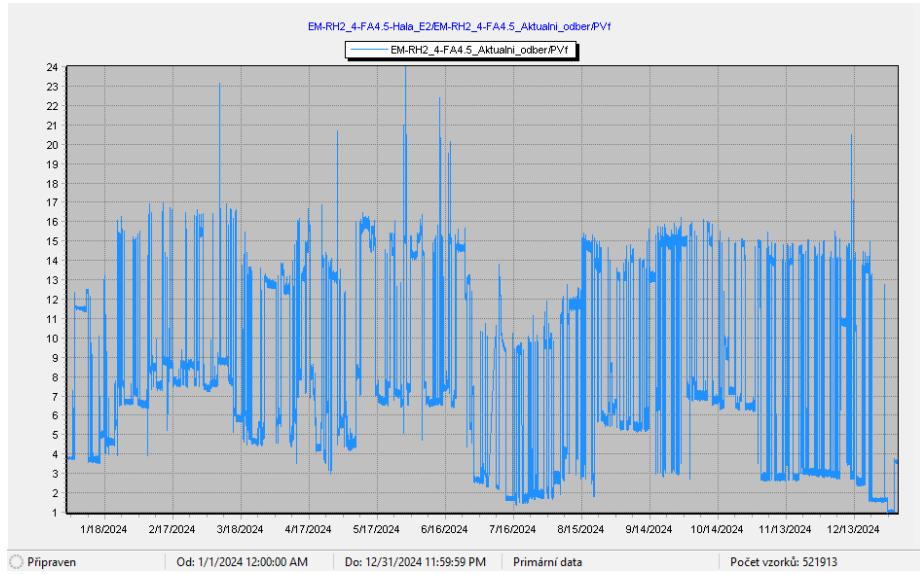


Figure 20: Experimental hall E2, power consumption, 2024, [kW]

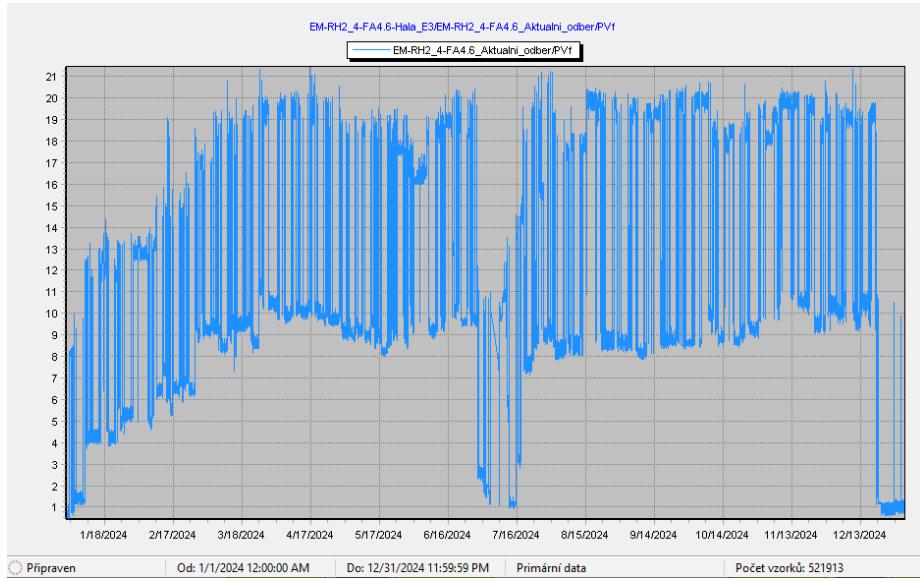


Figure 21: Experimental hall E3, power consumption, 2024, [kW]

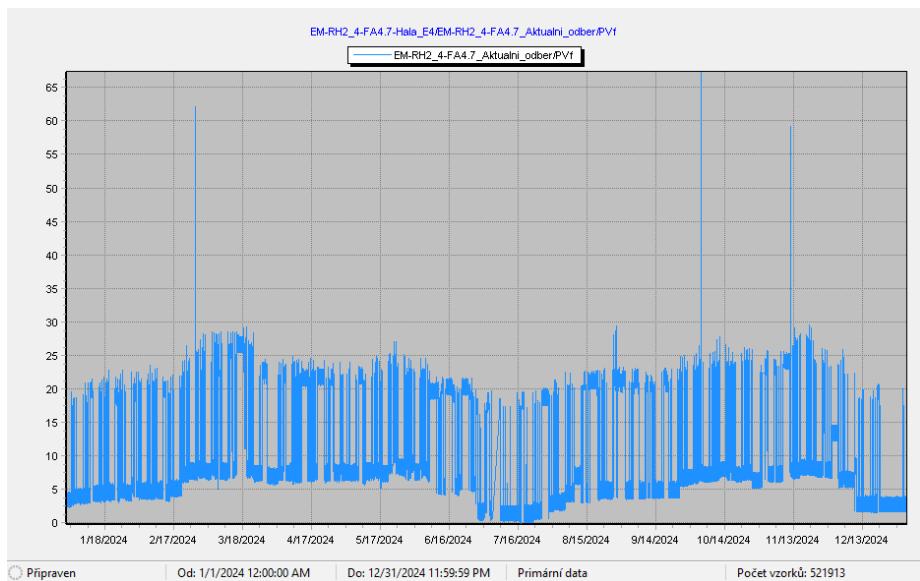


Figure 22: Experimental hall E4, power consumption, 2024, [kW]

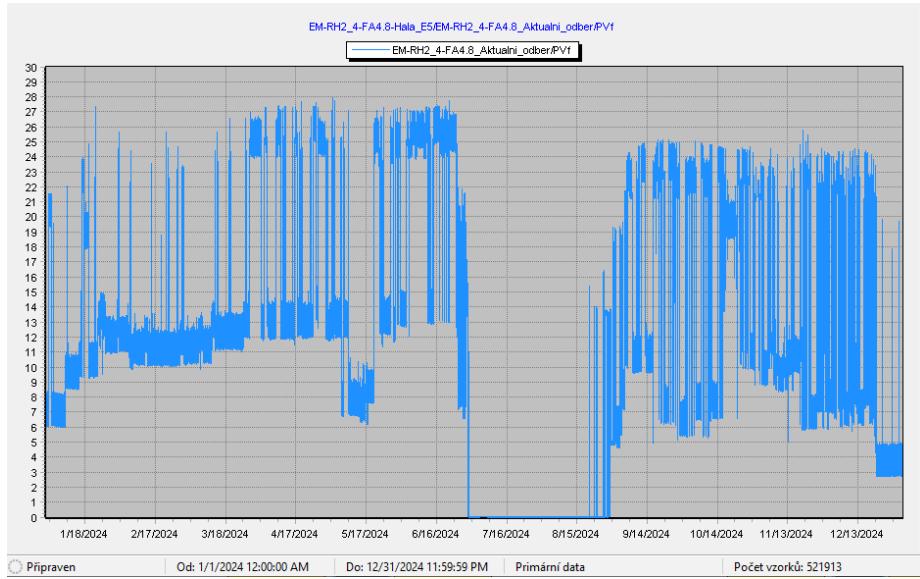


Figure 23: Experimental hall E5, power consumption, 2024, [kW]

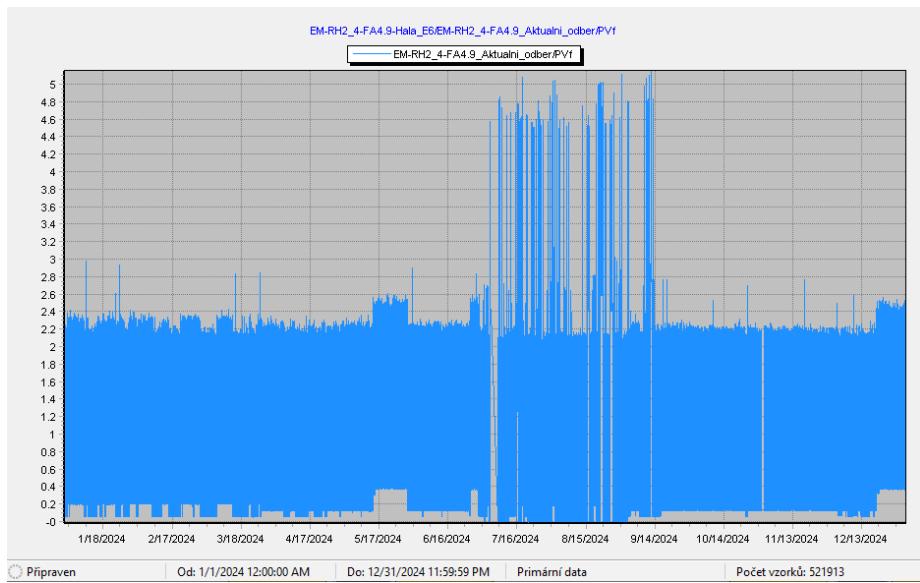


Figure 24: Experimental hall E6, power consumption, 2024, [kW]

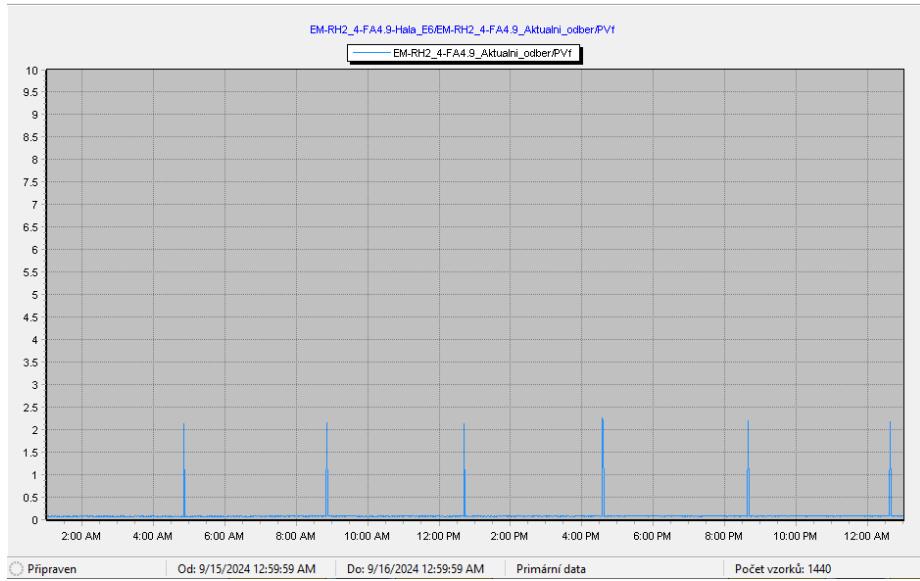


Figure 25: Experimental hall E6, daily power consumption example, [kW]

1.3.3 Laser halls

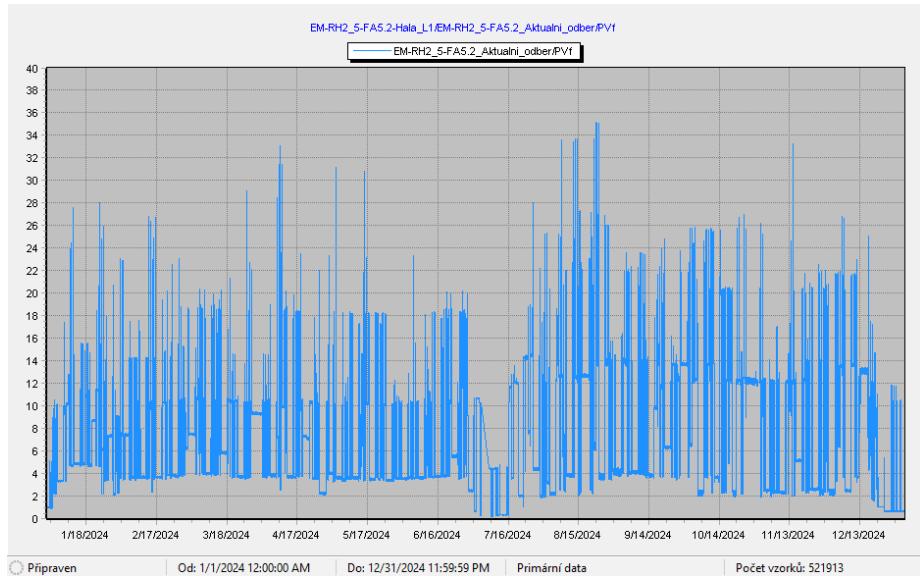


Figure 26: Laser hall L1, power consumption, 2024, [kW]

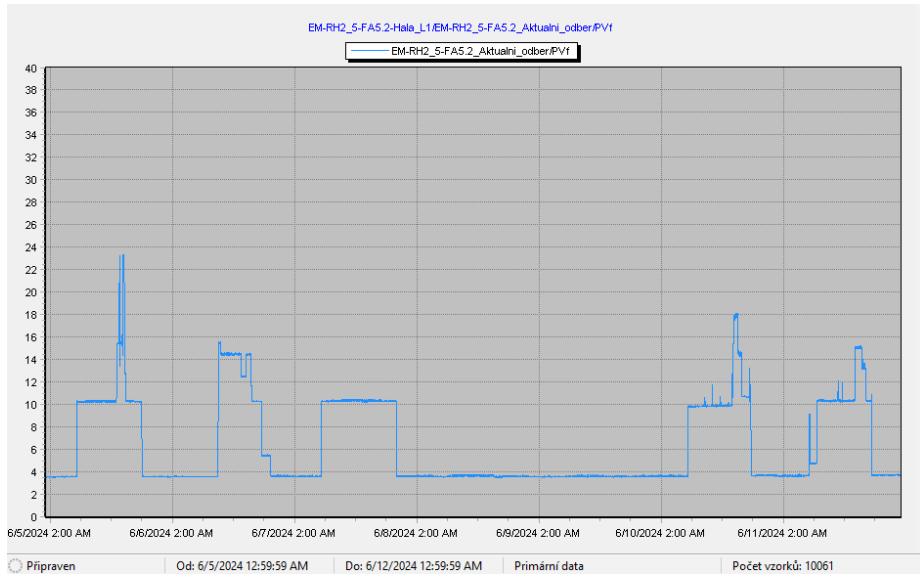


Figure 27: Laser hall L1, weekly power consumption example (6/5/2024 - 6/11/2024; (Wednesday to Tuesday)), [kW]

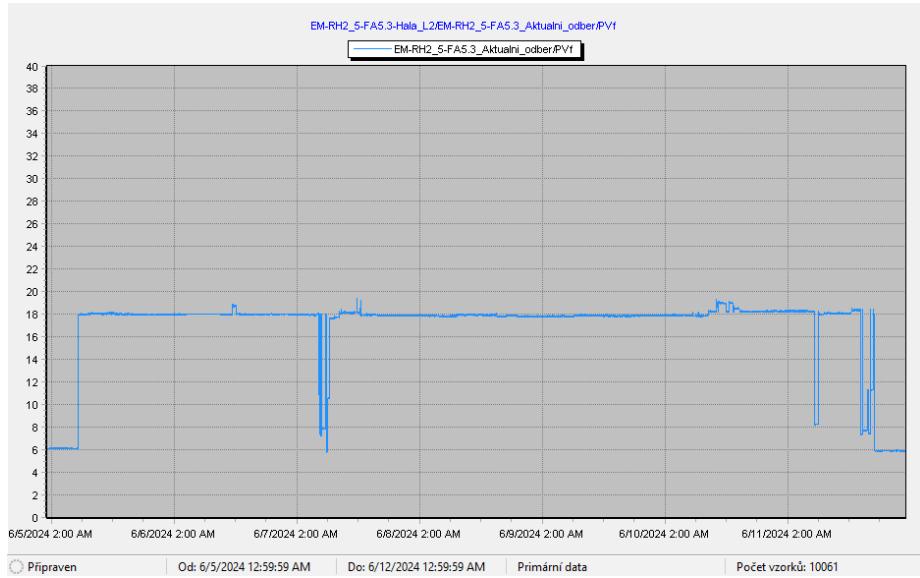


Figure 28: Laser hall L2, weekly power consumption example (6/5/2024 - 6/11/2024; (Wednesday to Tuesday)), [kW]

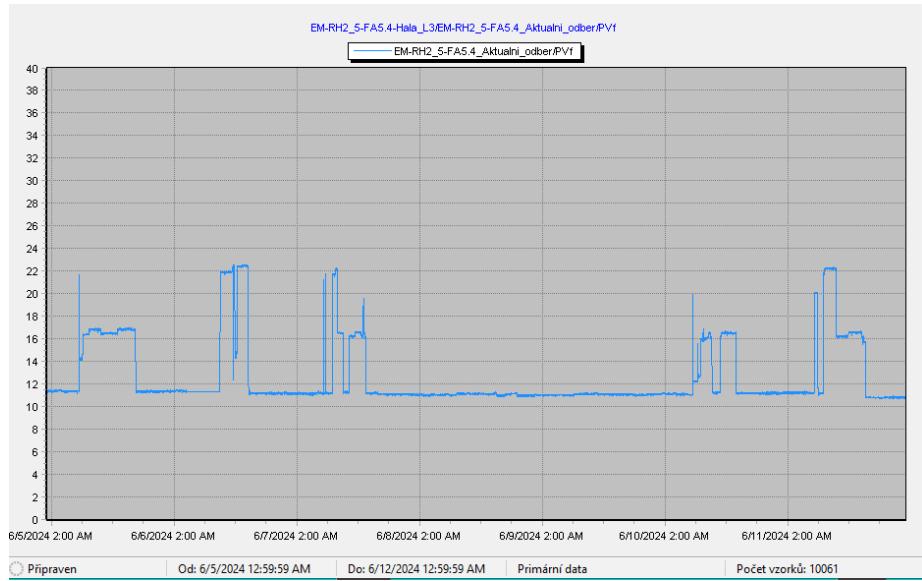


Figure 29: Laser hall L3, weekly power consumption example (6/5/2024 - 6/11/2024; (Wednesday to Tuesday)), [kW]

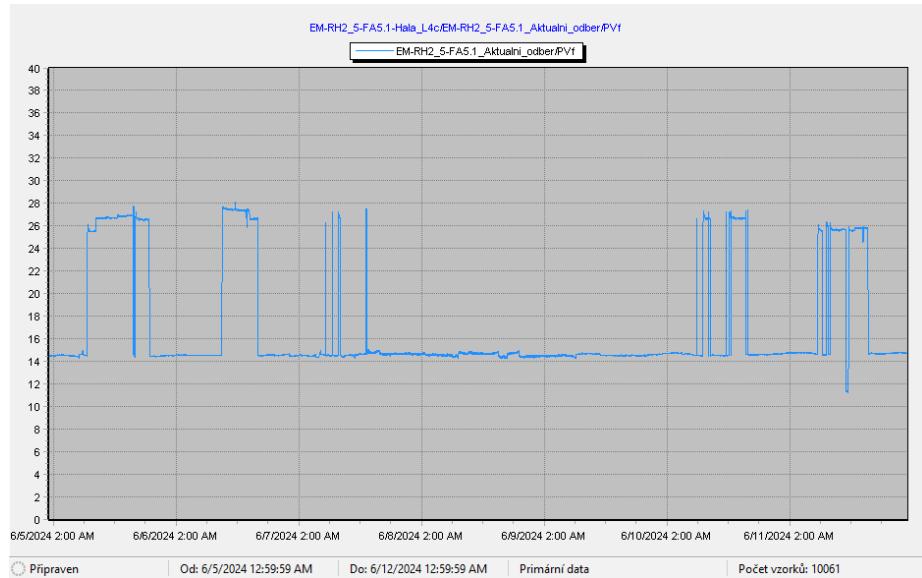


Figure 30: Laser hall L4c, weekly power consumption example (6/5/2024 - 6/11/2024; (Wednesday to Tuesday)), [kW]

1.3.4 Other

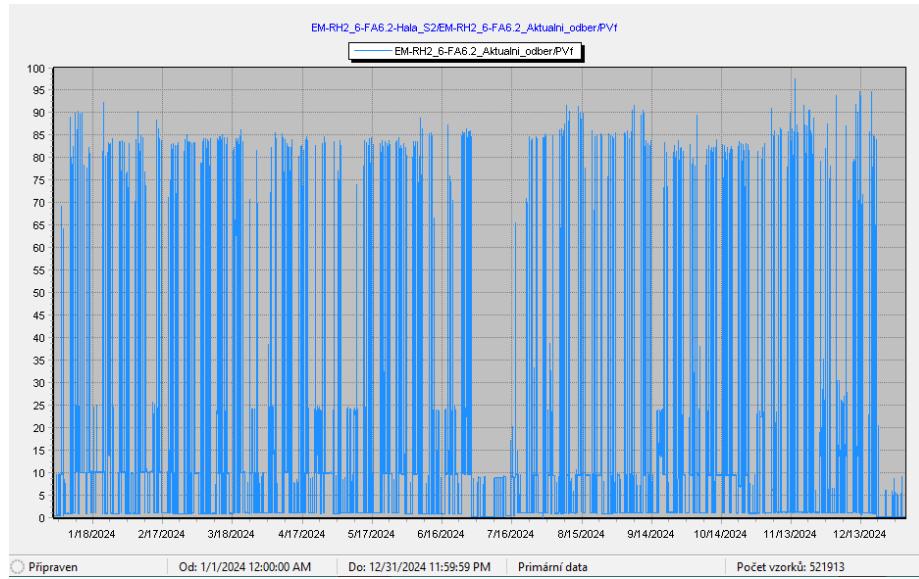


Figure 31: Hall S2, support systems, power consumption, 2024, [kW]

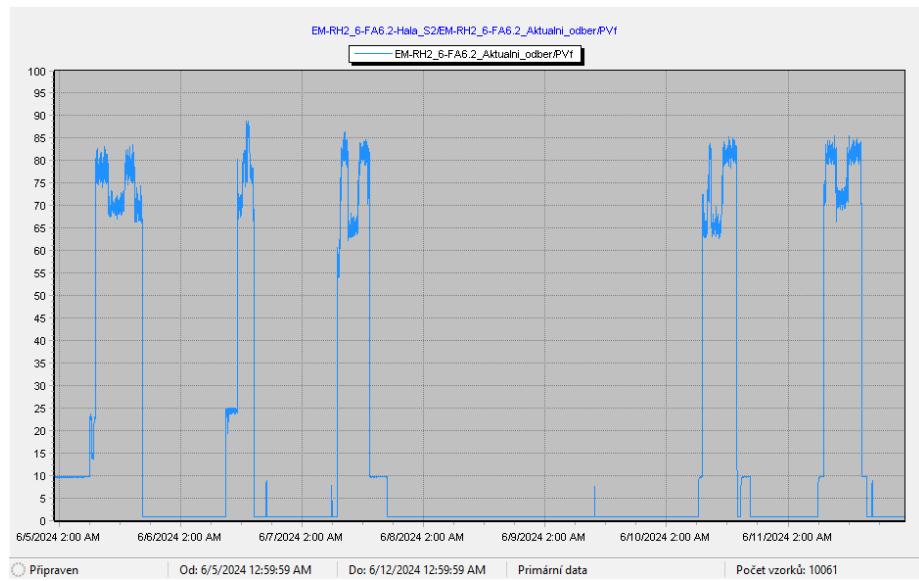


Figure 32: Hall S2, support systems, weekly power consumption example (6/5/2024 - 6/11/2024; (Wednesday to Tuesday)), [kW]

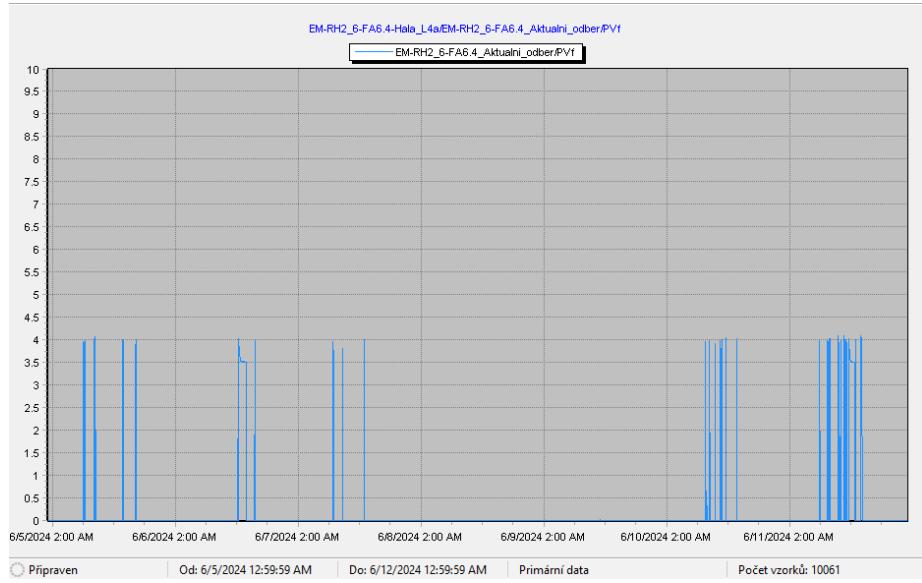


Figure 33: Hall L4a, power consumption, (6/5/2024 - 6/11/2024; (Wednesday to Tuesday)), [kW]

1.4 Switchboard RH3

The total consumption of RH3 switchboard in 2024 was 5.46 GWh. The technologies powered by RH3 and their part of the consumption are depicted in Figure 34. The part “Fire protection, diesel generator” includes the electricity consumed by technologies backed up by diesel generator and UPS batteries (some of the HVAC units, server rooms, part of the experimental halls and laser halls consumption, …). The distinction considering the consumption through UPS is shown in Figure 35. The yearly and weekly power consumption of RH3 is shown in Figures 36 and 37. Lastly, Figures 38 - 54 illustrate the power consumption curves of the technologies powered by RH3.

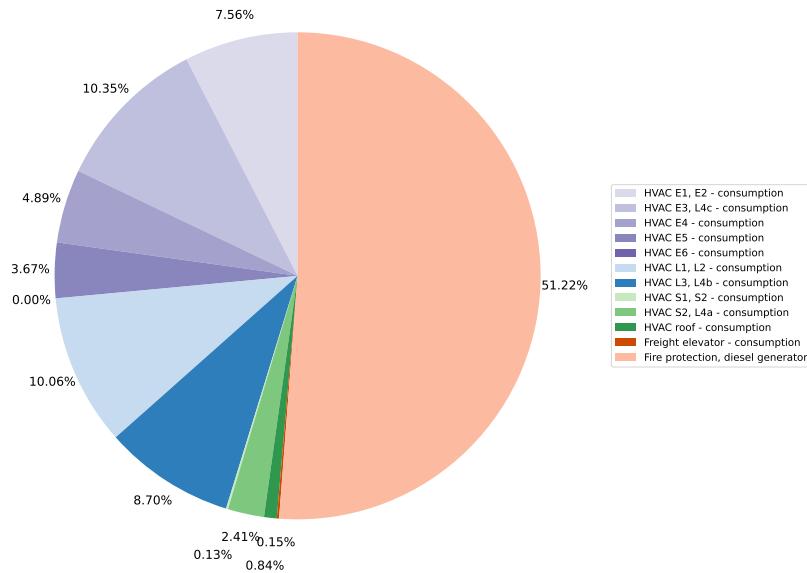


Figure 34: RH3 energy consumption, 2024

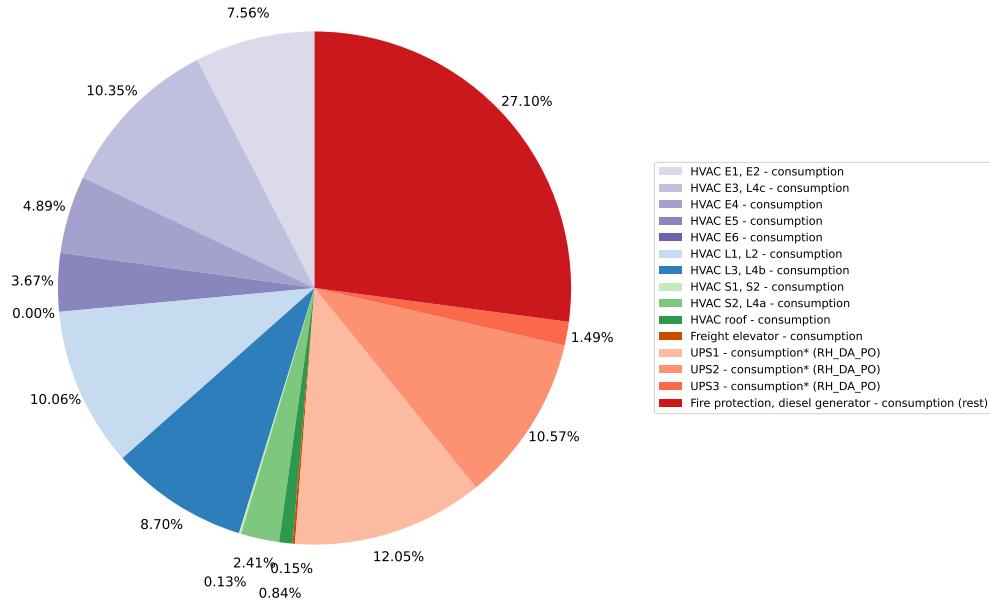


Figure 35: RH3 energy consumption (UPS distinction included), 2024

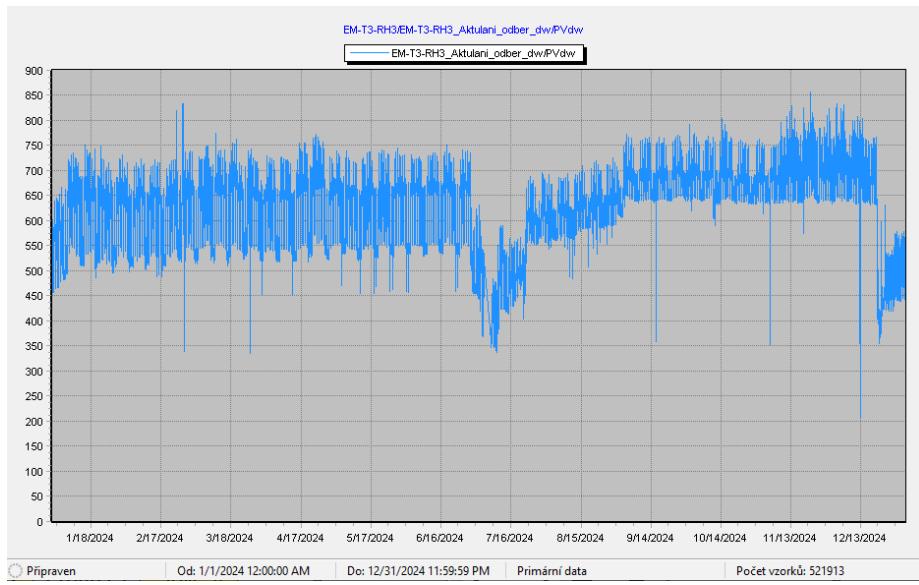


Figure 36: RH3, power consumption, 2024, [kW]

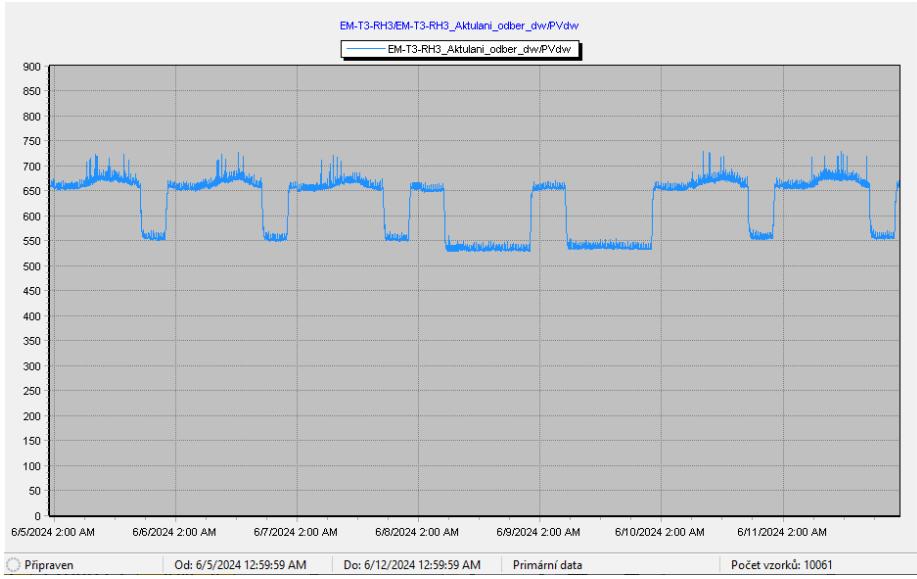


Figure 37: RH3, weekly power consumption example (6/5/2024 - 6/11/2024; (Wednesday to Tuesday)), [kW]

1.4.1 HVAC - experimental halls

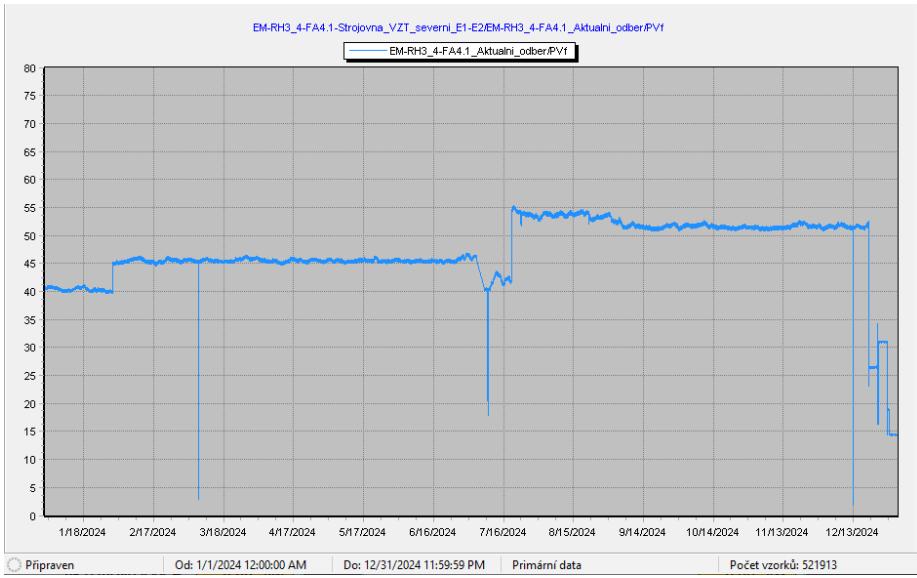


Figure 38: HVAC E1, E2, power consumption, 2024, [kW]

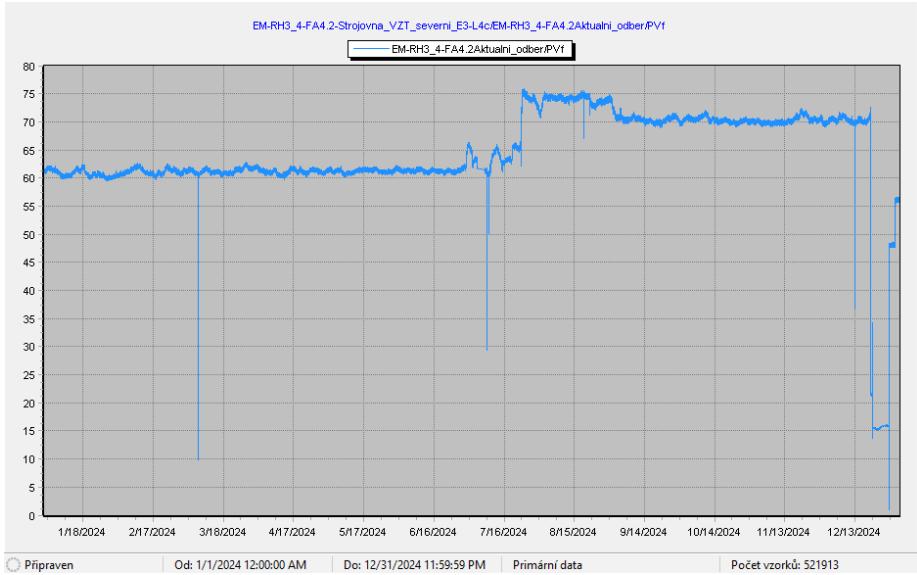


Figure 39: HVAC E3, L4c, power consumption, 2024, [kW]

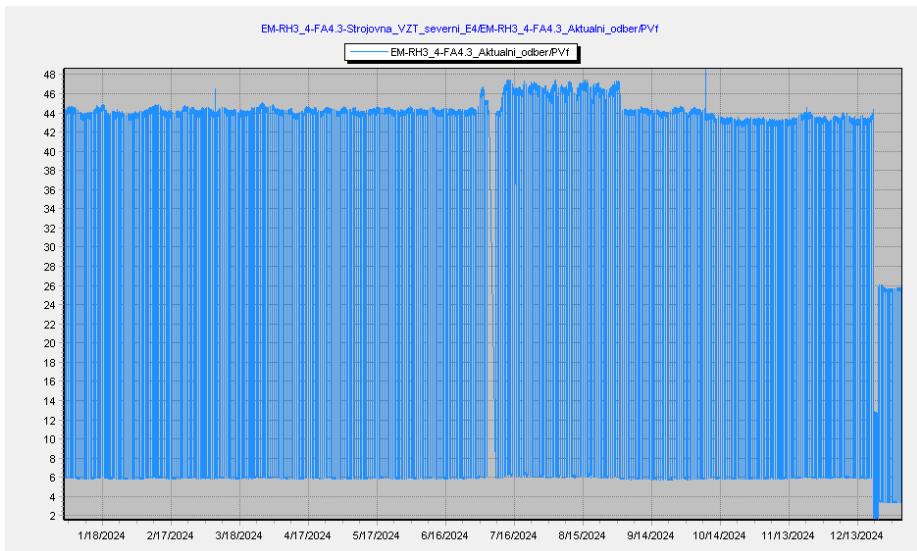


Figure 40: HVAC E4, power consumption, 2024, [kW]

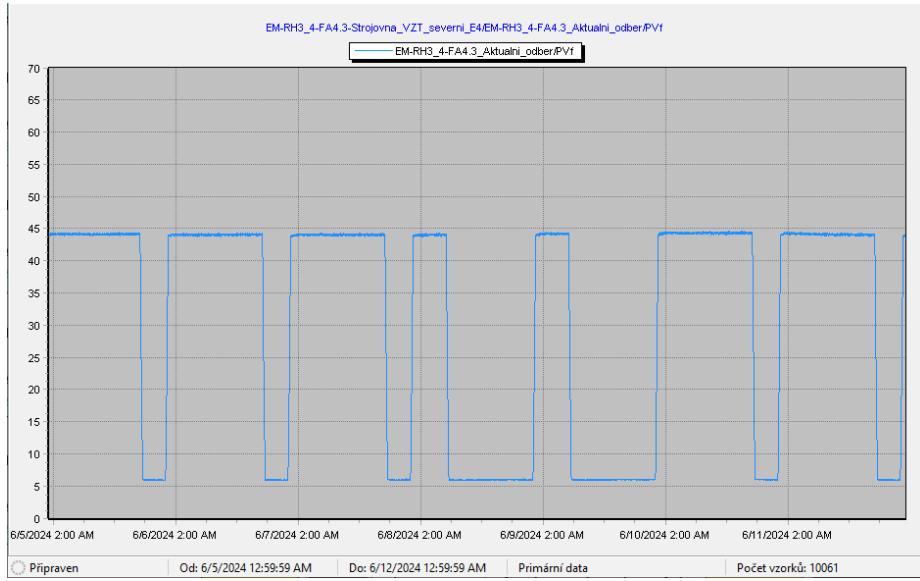


Figure 41: HVAC E4, weekly power consumption example (6/5/2024 - 6/11/2024; (Wednesday to Tuesday)), [kW]

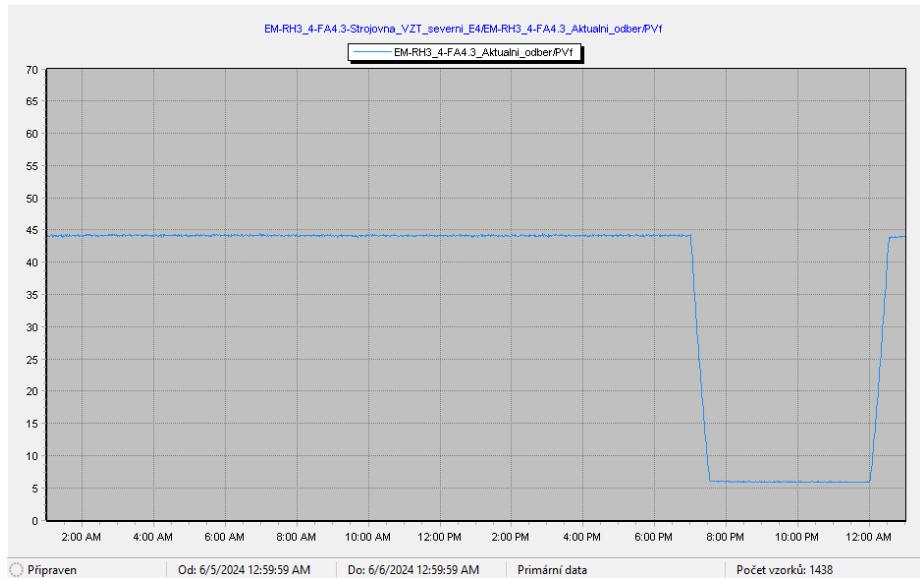


Figure 42: HVAC E4, weekly power consumption example (workday), [kW]

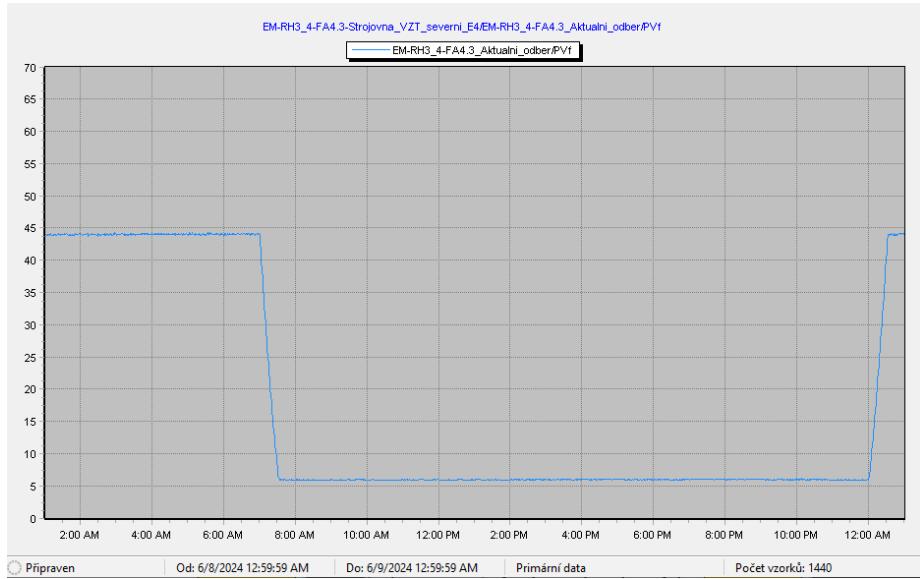


Figure 43: HVAC E4, weekly power consumption example (weekend day), [kW]

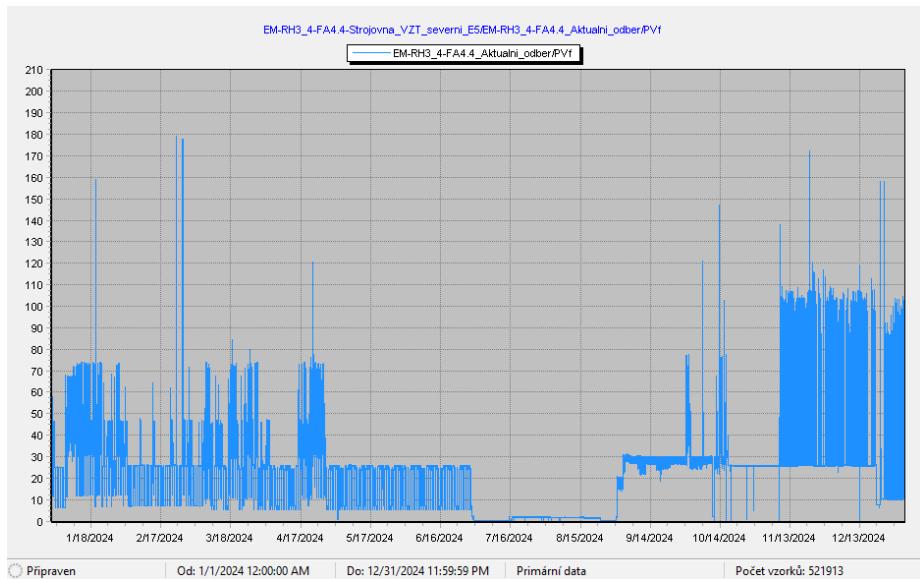


Figure 44: HVAC E5, power consumption, 2024, [kW]

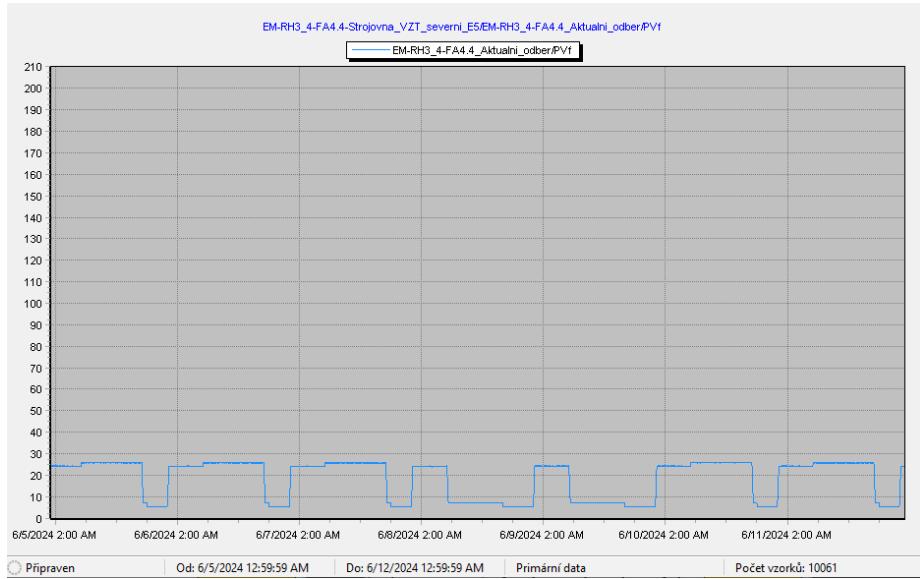


Figure 45: HVAC E5, weekly power consumption example (6/5/2024 - 6/11/2024; (Wednesday to Tuesday)), [kW]

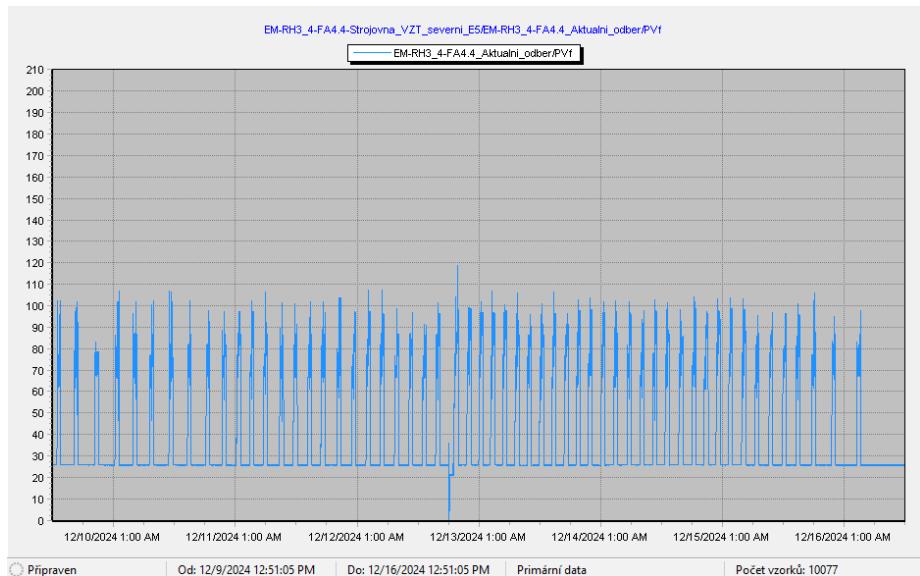


Figure 46: HVAC E5, weekly power consumption example (a week by the end of the year), [kW]

1.4.2 HVAC - laser halls

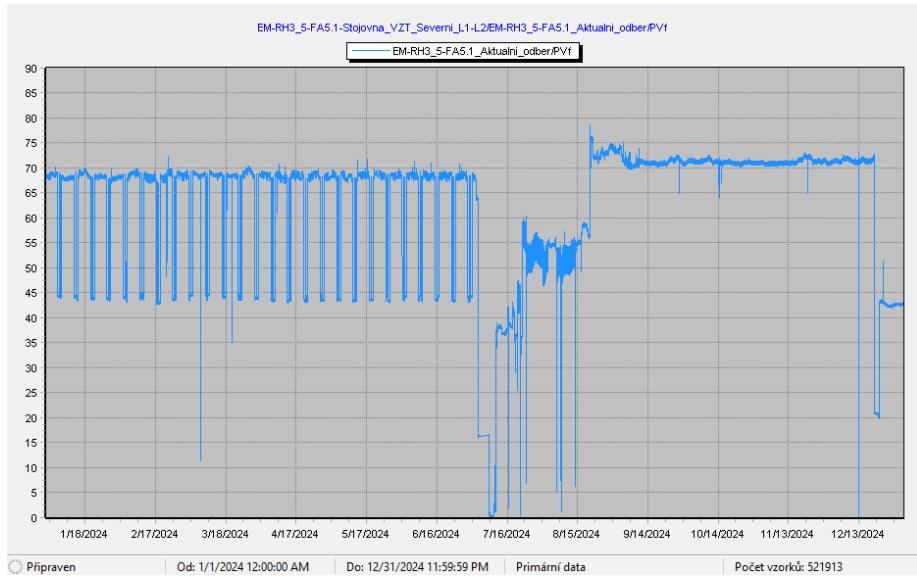


Figure 47: HVAC L1, L2, power consumption, 2024, [kW]

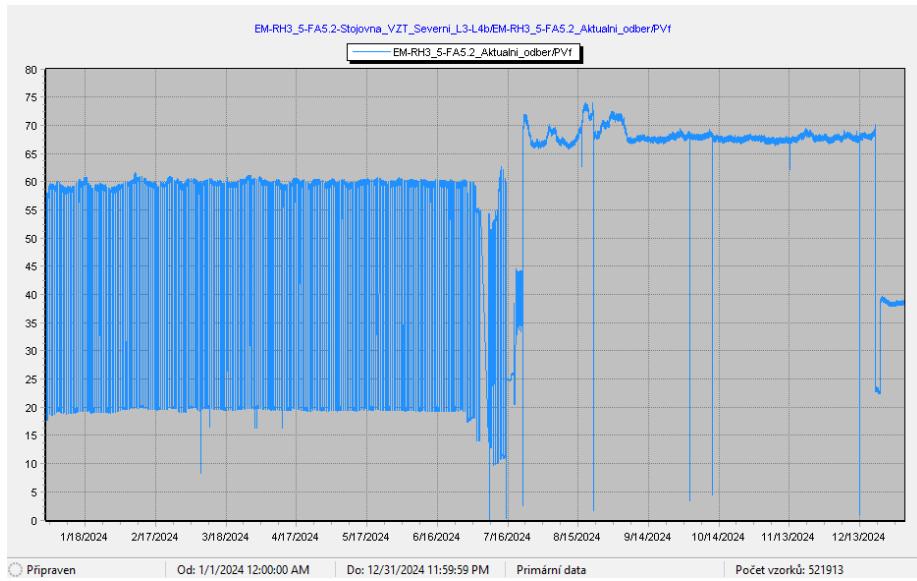


Figure 48: HVAC L3, L4b, power consumption, 2024, [kW]

1.4.3 HVAC - other

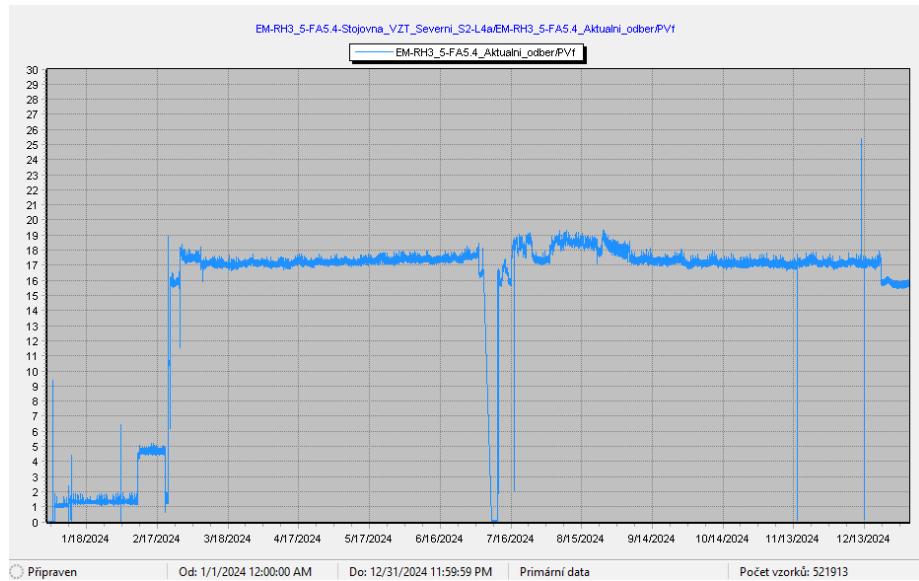


Figure 49: HVAC S2, L4a, power consumption, 2024, [kW]

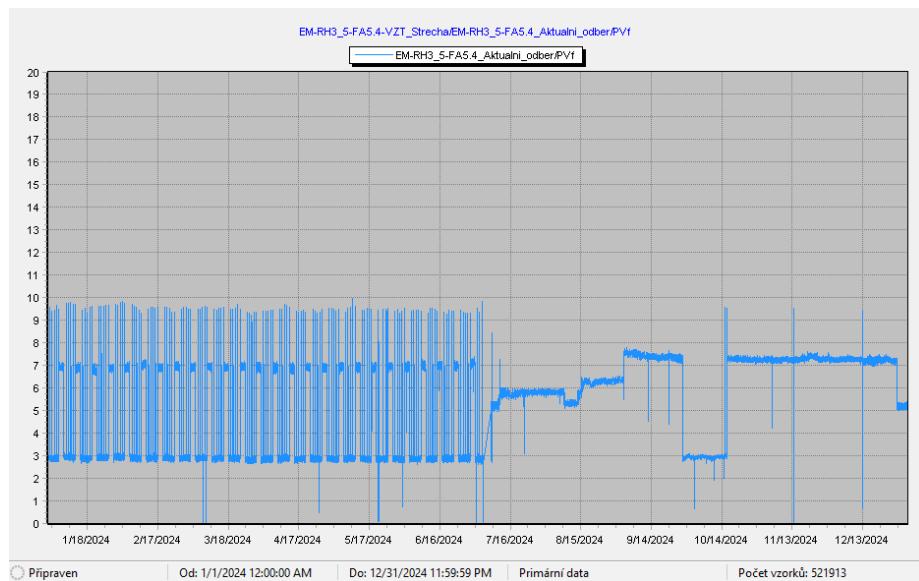


Figure 50: HVAC roof, power consumption, 2024, [kW]

1.4.4 Other

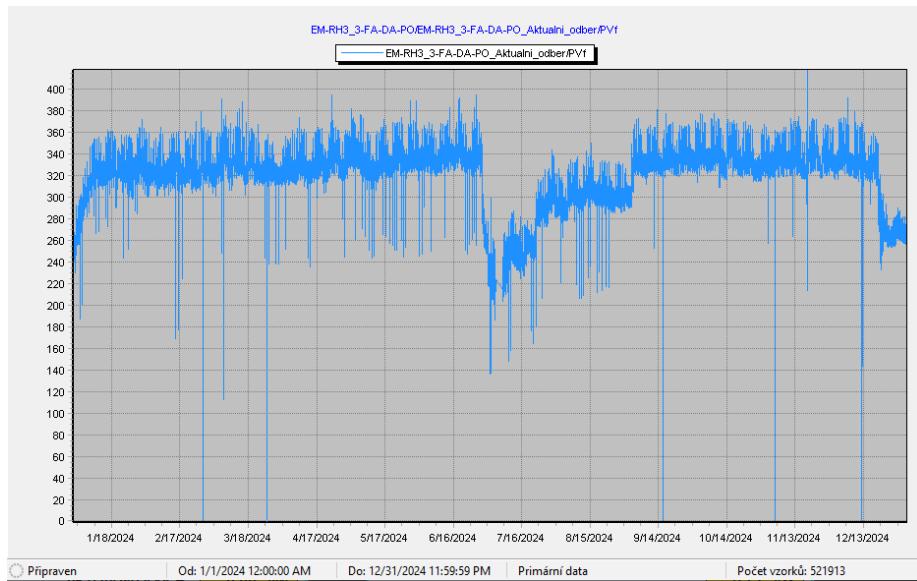


Figure 51: Fire protection, diesel generator, power consumption, 2024, [kW]

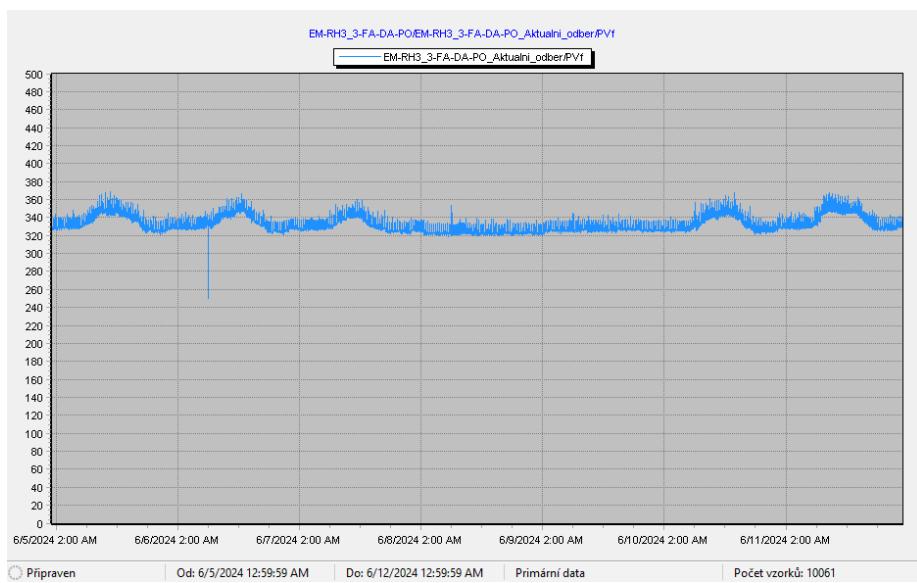


Figure 52: Fire protection, diesel generator, weekly power consumption example (6/5/2024 - 6/11/2024; (Wednesday to Tuesday)), [kW]

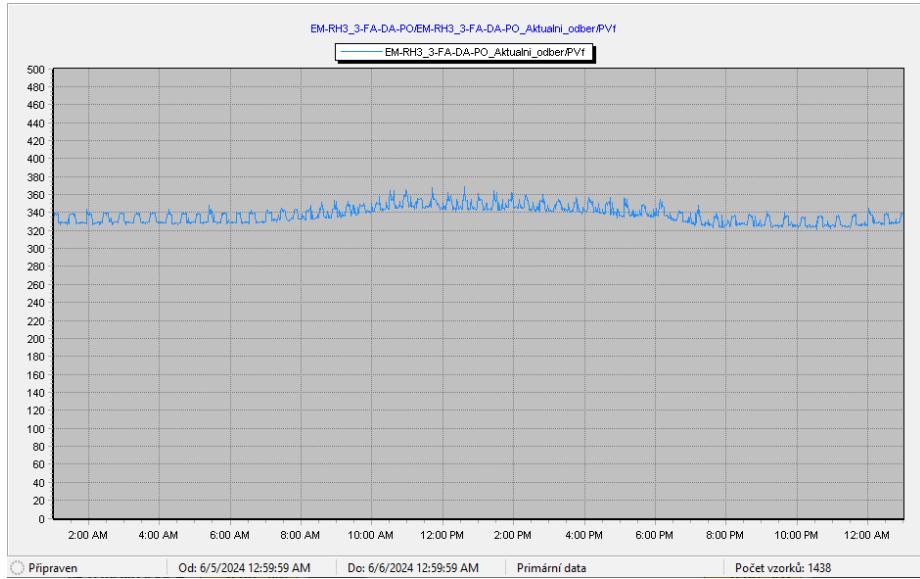


Figure 53: Fire protection, diesel generator, daily power consumption example (workday), [kW]

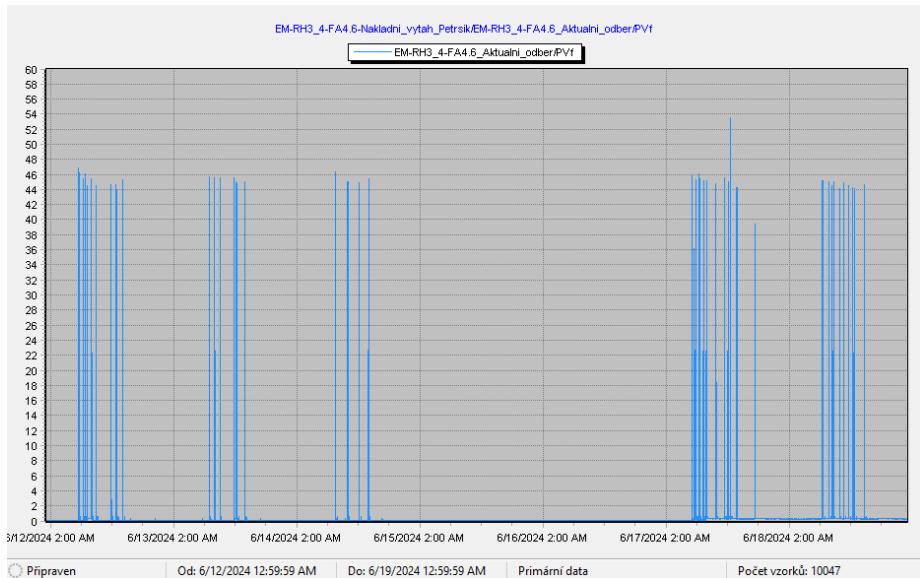


Figure 54: Freight elevator, weekly power consumption example (6/12/2024 - 6/18/2024; (Wednesday to Tuesday)), [kW]

1.5 Switchboard RH03

The total consumption of the RH03 switchboard in 2024 was 2.50 GWh. The technologies powered by RH03 and their part of the consumption (June 2024 to June 2025) are depicted in Figure 55. The consumption marked as “not measured” in Figure 55 (containing cooling towers, pumps, compressors, ...) is not measured separately. The power consumption from a period of more than a year and an example week of RH03 is shown in Figures 56 and 57. Lastly, Figures 58 - 61 illustrate the power consumption trends of the Chiller 1 and Chiller 2. Figure 62 shows the total current consumed by Chiller 3 (since the power is not measured in this specific case).

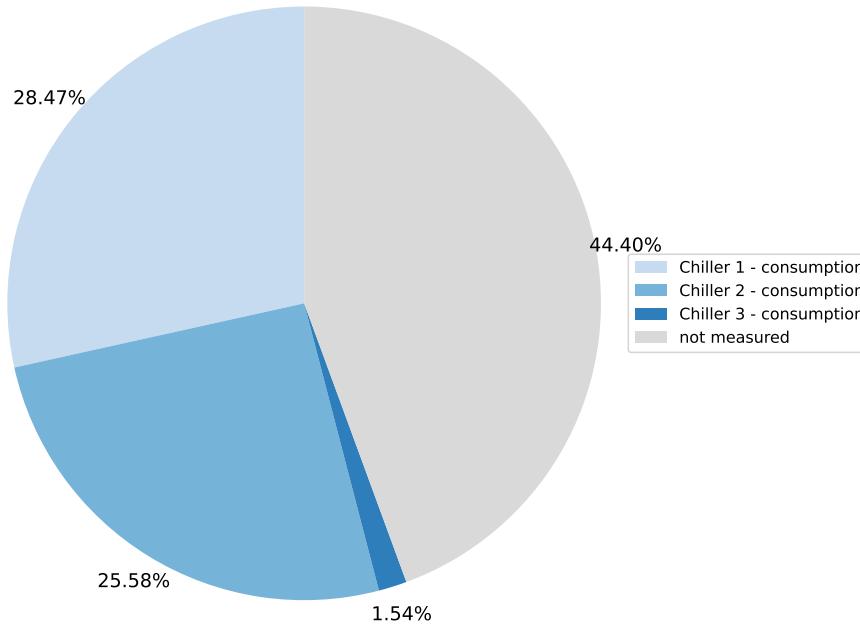


Figure 55: RH03 energy consumption, 6/1/2024 - 6/1/2025

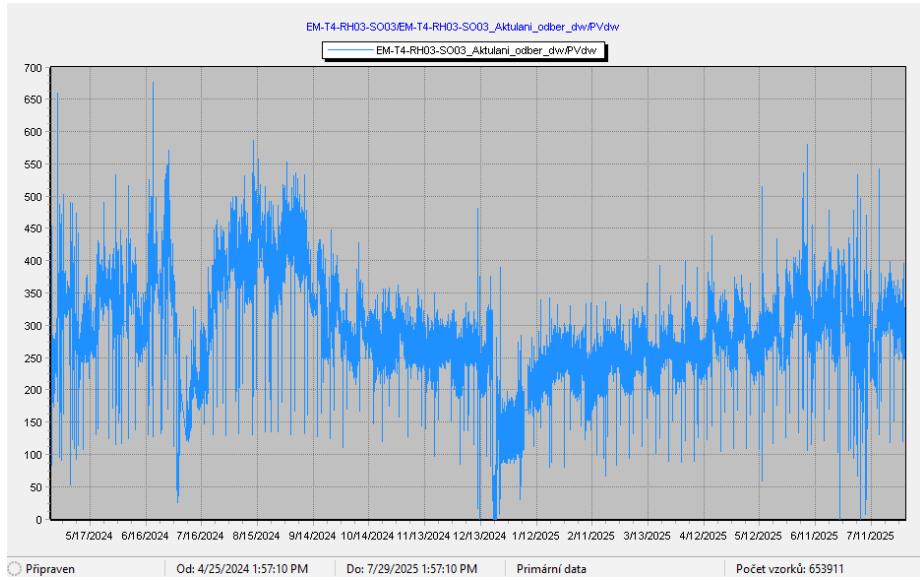


Figure 56: RH03, power consumption, 4/25/2024 - 7/29/2025, [kW]

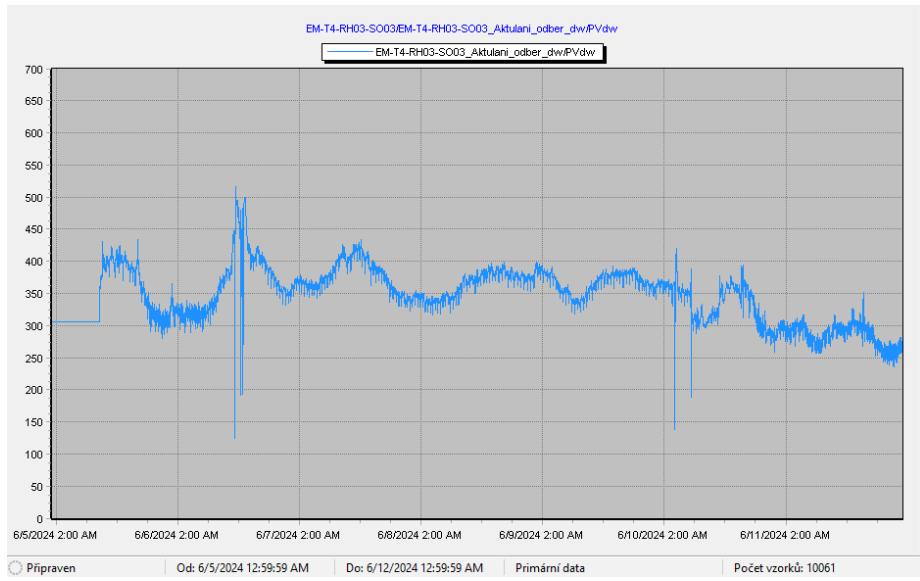


Figure 57: RH03, weekly power consumption example (6/5/2024 - 6/11/2024; (Wednesday to Tuesday)), [kW]

1.5.1 Chillers

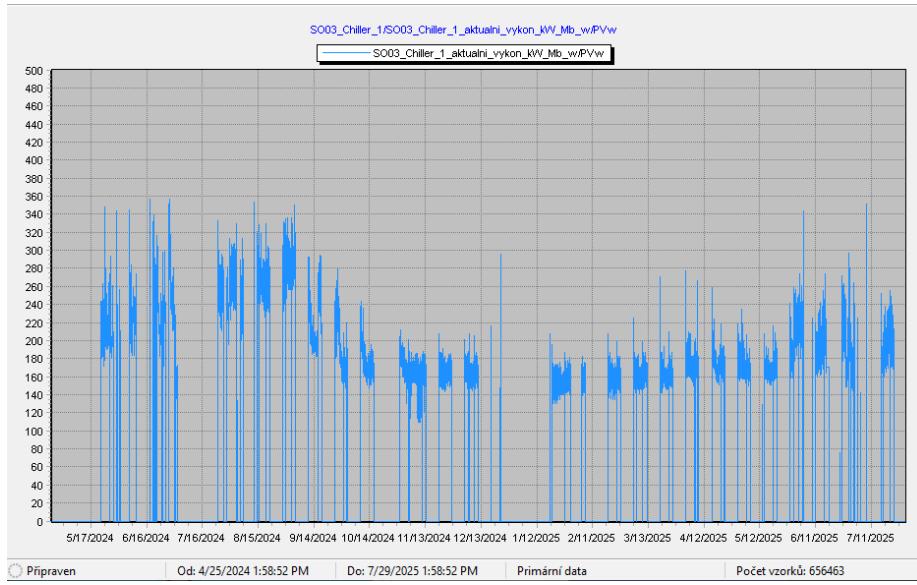


Figure 58: Chiller 1 - consumption, power consumption 4/25/2024 - 7/29/2025, [kW]

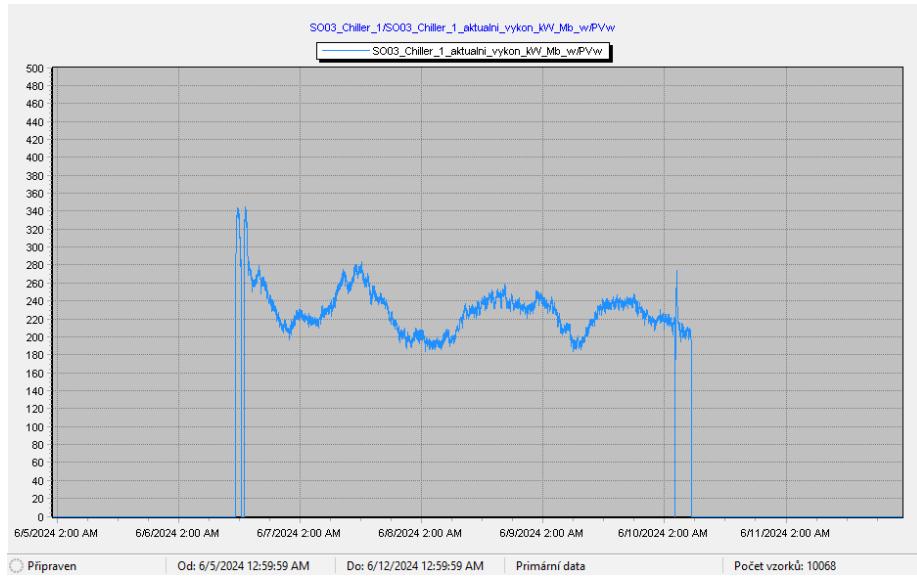


Figure 59: Chiller 1 - consumption, weekly power consumption example (6/5/2024 - 6/11/2024; (Wednesday to Tuesday)), [kW]

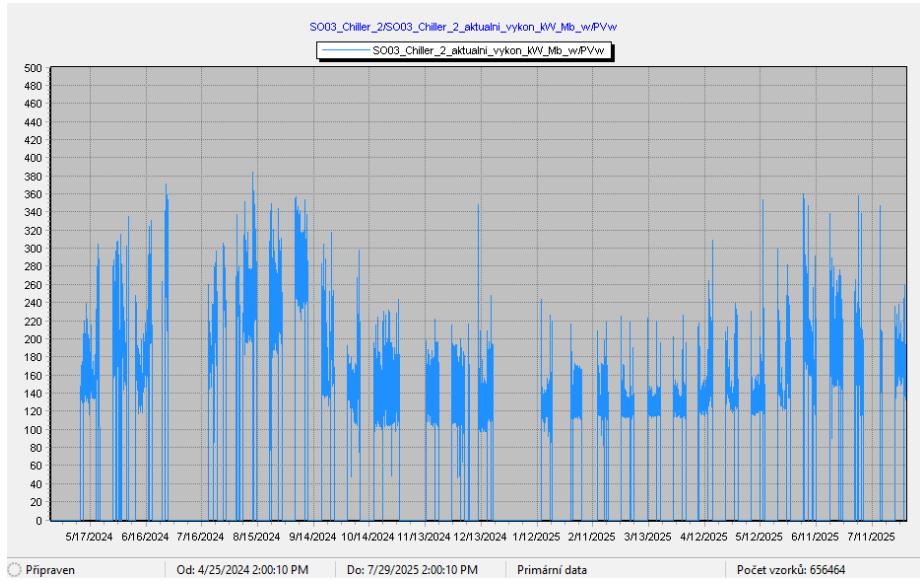


Figure 60: Chiller 2 - consumption, power consumption 4/25/2024 - 7/29/2025, [kW]

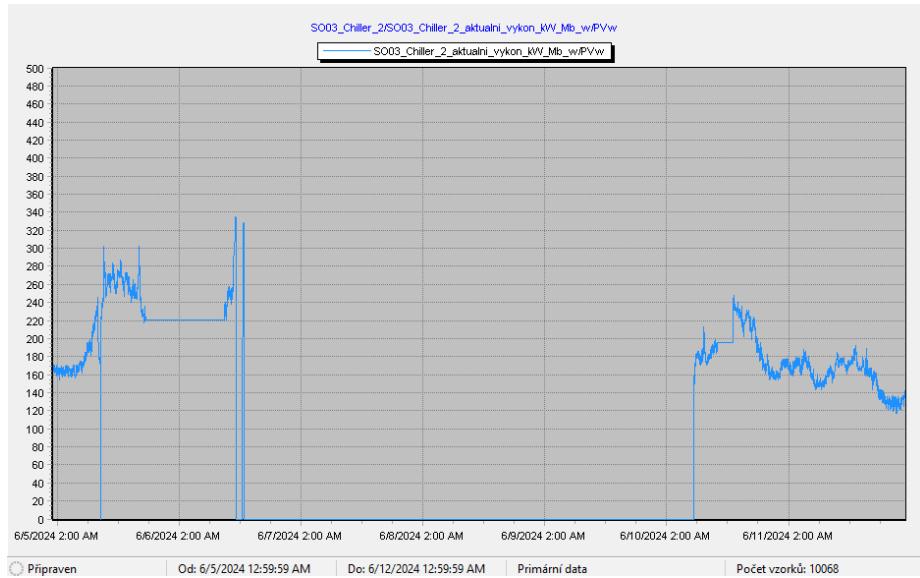


Figure 61: Chiller 2 - consumption, weekly power consumption example (6/5/2024 - 6/11/2024; (Wednesday to Tuesday)), [kW]

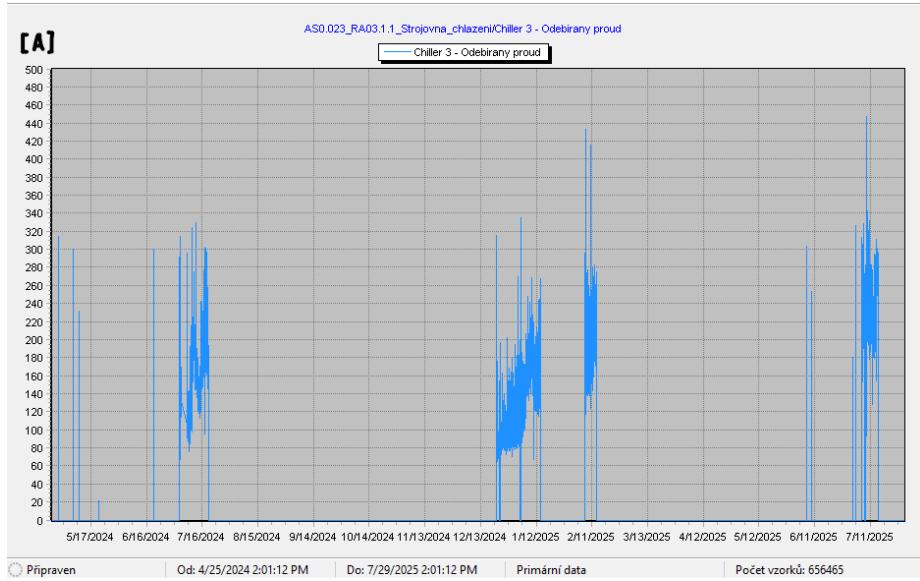


Figure 62: Chiller 3, total current 4/25/2024 - 7/29/2025, [A]

1.6 Estimated distribution of total consumption

In this section, we provide an estimated distribution of total electrical energy consumption. Figure 63 (identical to Figure 1) serves as the fundamental distribution (by switchboards), which is then divided into smaller components based on the findings presented in the previous sections. This breakdown is illustrated in Figure 64 and Figure 65, with the latter offering more detailed information (including the UPS distinction, similar to Figures 34 and 35).

The estimation is due to the fact that the subdivided components are based on data from different time periods. We also remark that the consumption of the RH2 switchboard may be underestimated for the reasons already mentioned in Section 1.1. In both figures, gray indicates the portion of consumption that is not monitored and measured in greater detail. Consumption “Fire protection, diesel generator” (and “Fire protection, diesel generator - rest”, respectively) is also included here, since the distinction by technologies or operations is unavailable. These figures could help in more accurate identification of the parts of the energy associated with specific purposes.

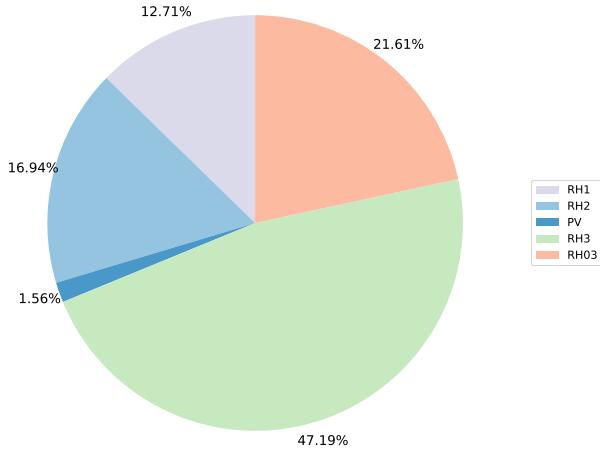


Figure 63: Total electrical energy consumption, 2024

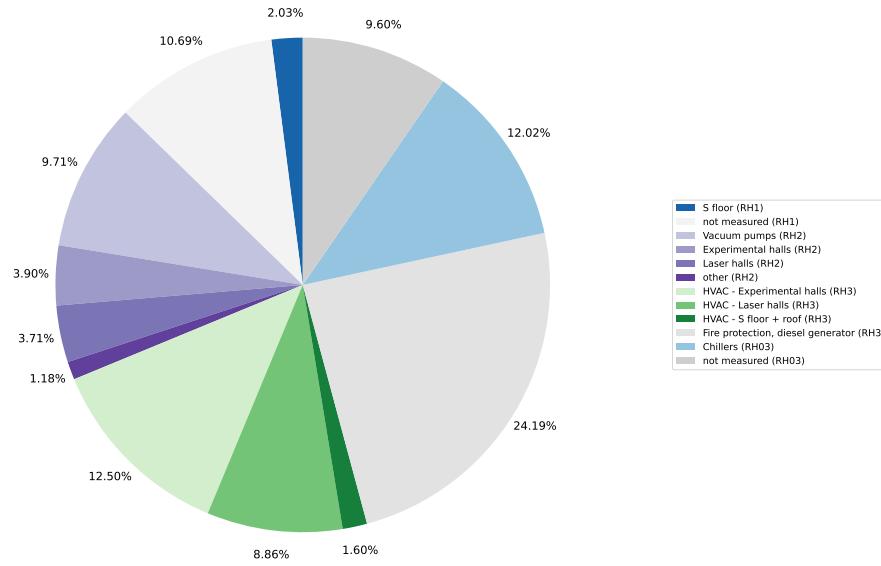


Figure 64: Estimated distribution of total electrical energy consumption

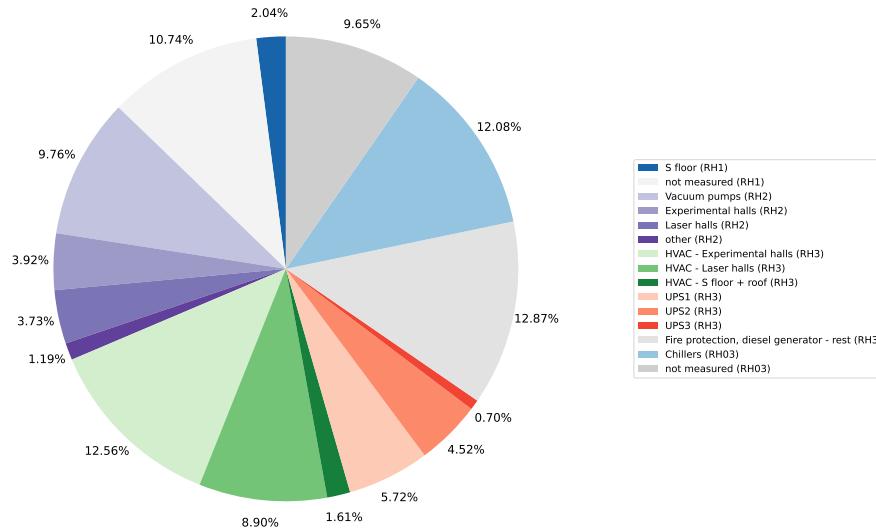


Figure 65: Estimated distribution of total electrical energy consumption (UPS distinction included)

2 Heat

Figure 66 shows the proportion of heat consumption in a year (August 2024 - August 2025; due to the availability of the data). The total consumption in this period was estimated to be 2.51 GWh (sum of the values measured by the calorimeters placed in each circuit).

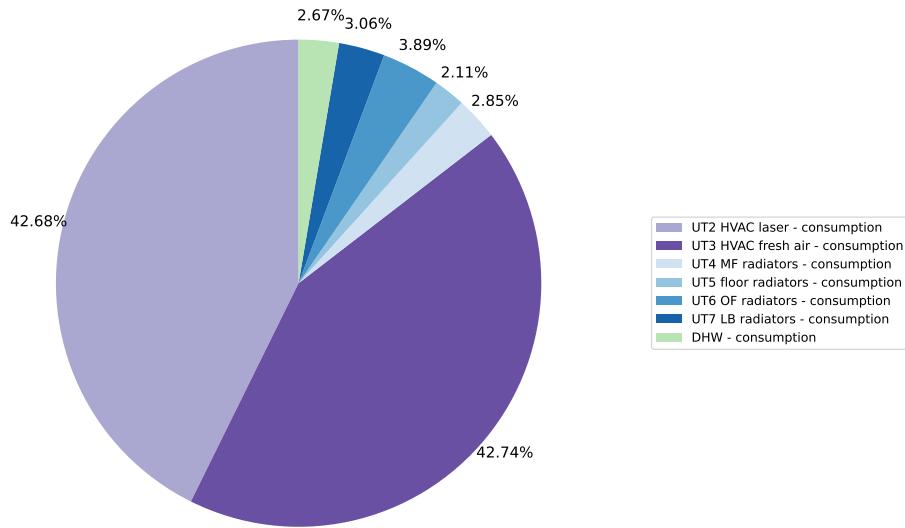


Figure 66: Total heat consumption, 08/2024 - 08/2025

3 Cold

Figure 67 shows the proportion of cold consumption in 2024. The total consumption in this period was estimated to be 6.95 GWh (sum of the values measured by the calorimeters placed in each circuit).

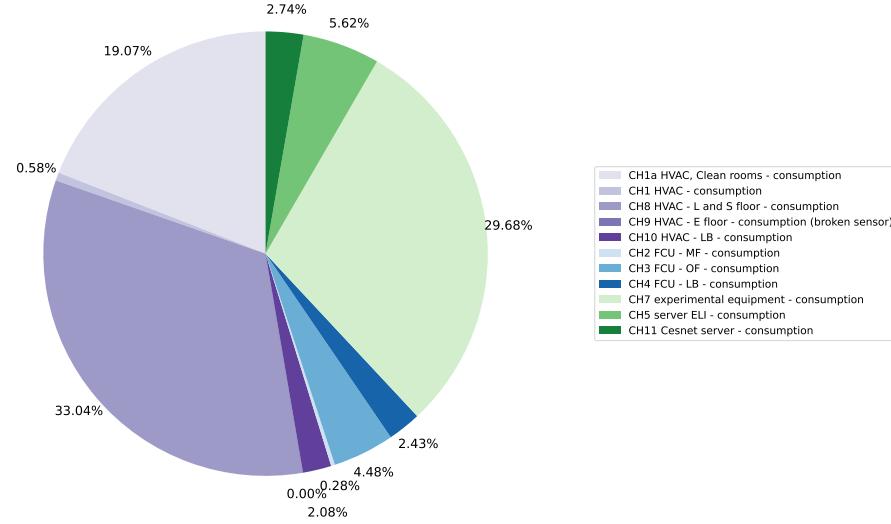


Figure 67: Total cold consumption, 2024