

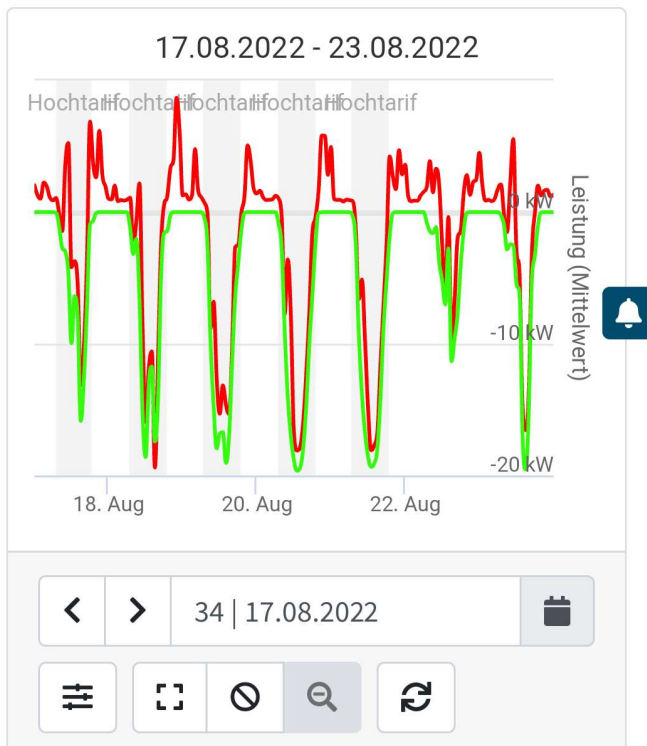
## **NILM in practice: Flexibility prediction and control**

1. Smart Energy System (SES): NILM Services
2. Load profile with flexibilities
3. Detecting flexibilities and photovoltaic systems (PVS)
4. Disaggregation load profiles
5. Forecast for 24 – 72 hours
6. Load management and peak shaving

Rii-Seez-Net 170B/s 90% 10:06

mart-energy-system.ch

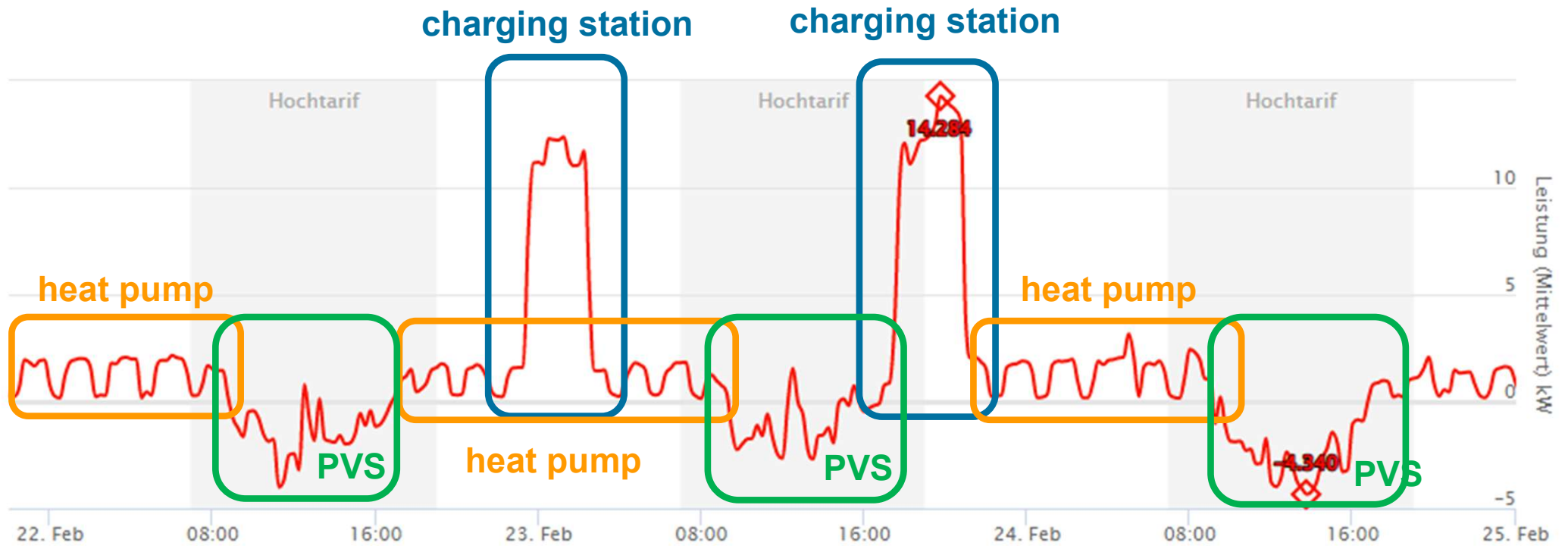
Mein Konto Abmelden



## ➤ NILM Services

- Detecting flexibilities
    - Heat pump, water heater, charging station, battery and photovoltaic system (PVS)
  - Disaggregating flexibilities
- Flexibility Forecast and load profile prediction
- Control of flexibilities
- ripple control or smart grid ready signal
- Measurement- and billing service for distribution system operator (DSO)
- Load management and peak shaving
- Energy data management (EDM)

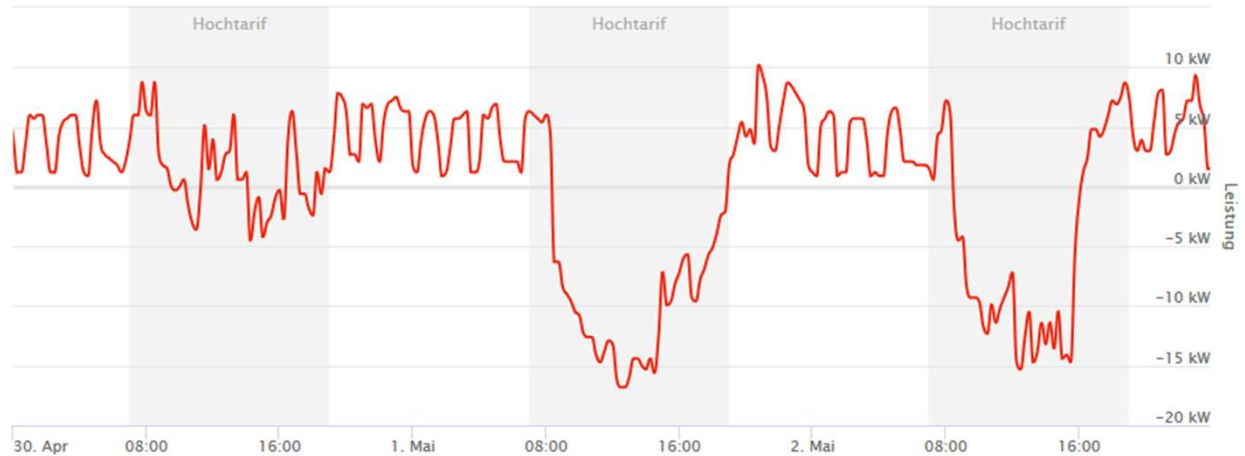
# Load profile with flexibilities



**Red: Load profile with flexibilities: Heat pump, charging station and PVS**



Residential building



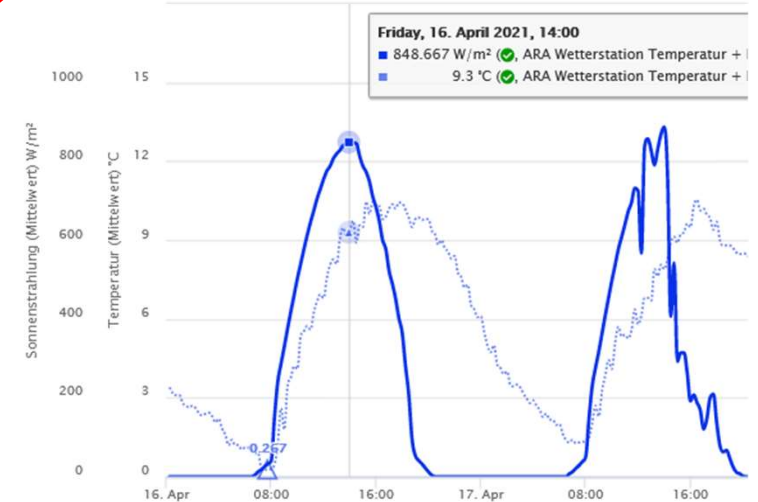
Entry point load profile: 15-minute measurement data



Weather data:  
Radiation and temperature

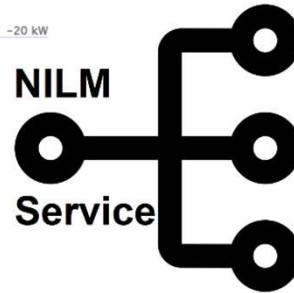
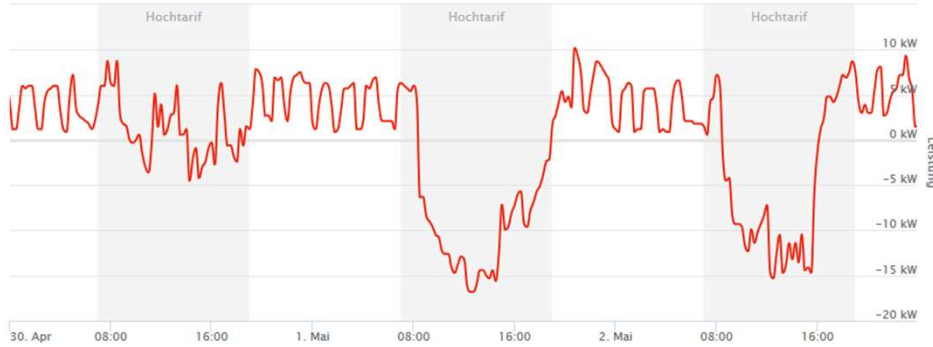
## Recognized flexibility

Load profile period	Workflow	Certainty	Installed	Deviation	Detected	Certainty D
04/08/2023 - 05/08/2023	Heatpump	Sure yes	12.000 kW	24 %	9.074 kW	0.967
04/08/2023 - 05/08/2023	Photovoltaic	Sure yes	29.800 kW	31 %	20.661 kW	1.000

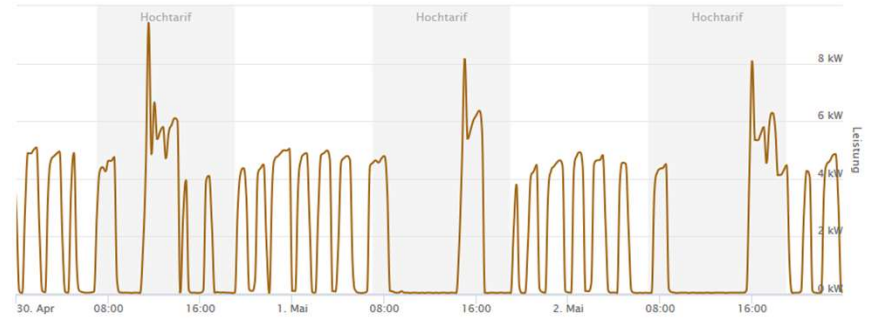


# Disaggregation load profiles

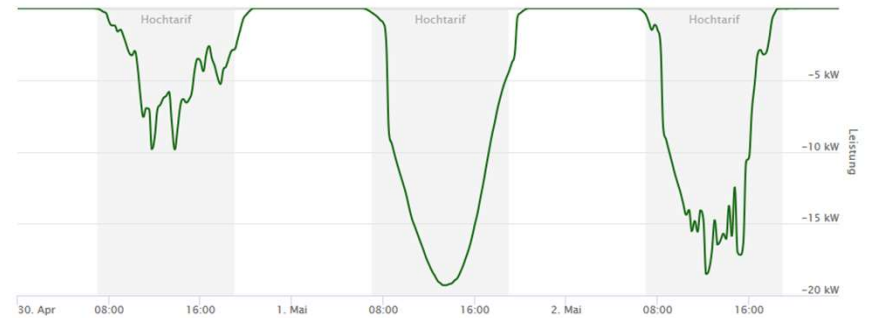
## Smart meter load profile at the entry point



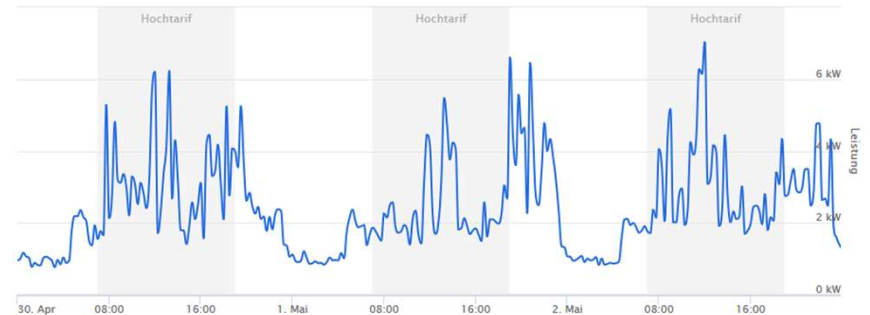
## Heat pump (HP)



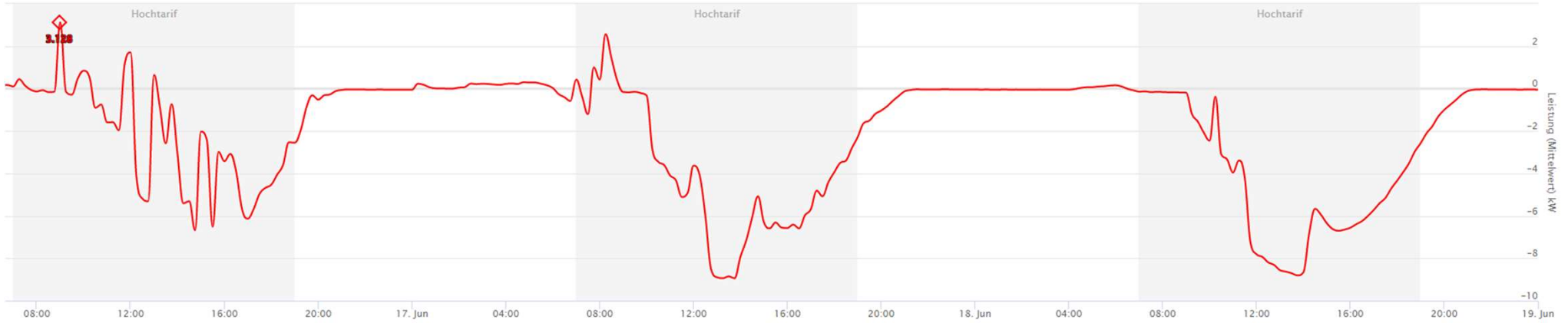
## Photovoltaic system (PVS)



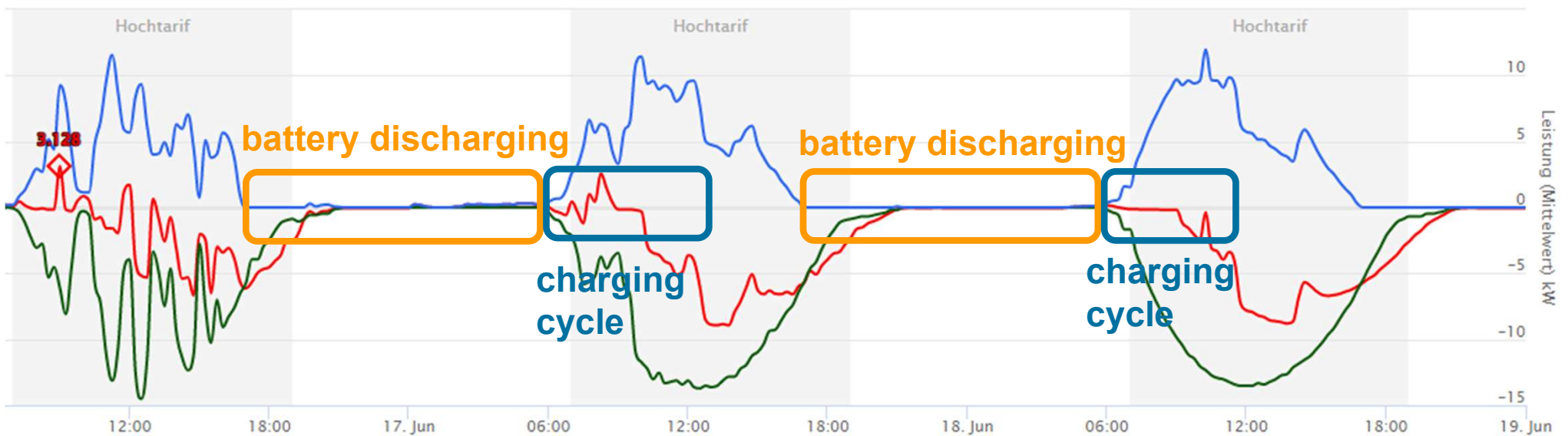
## Consumer (apartments, general use)



## Load profile with PVS, heat pump and battery



Disaggregation    ■ PVS production    ■ Consumption including charging the battery



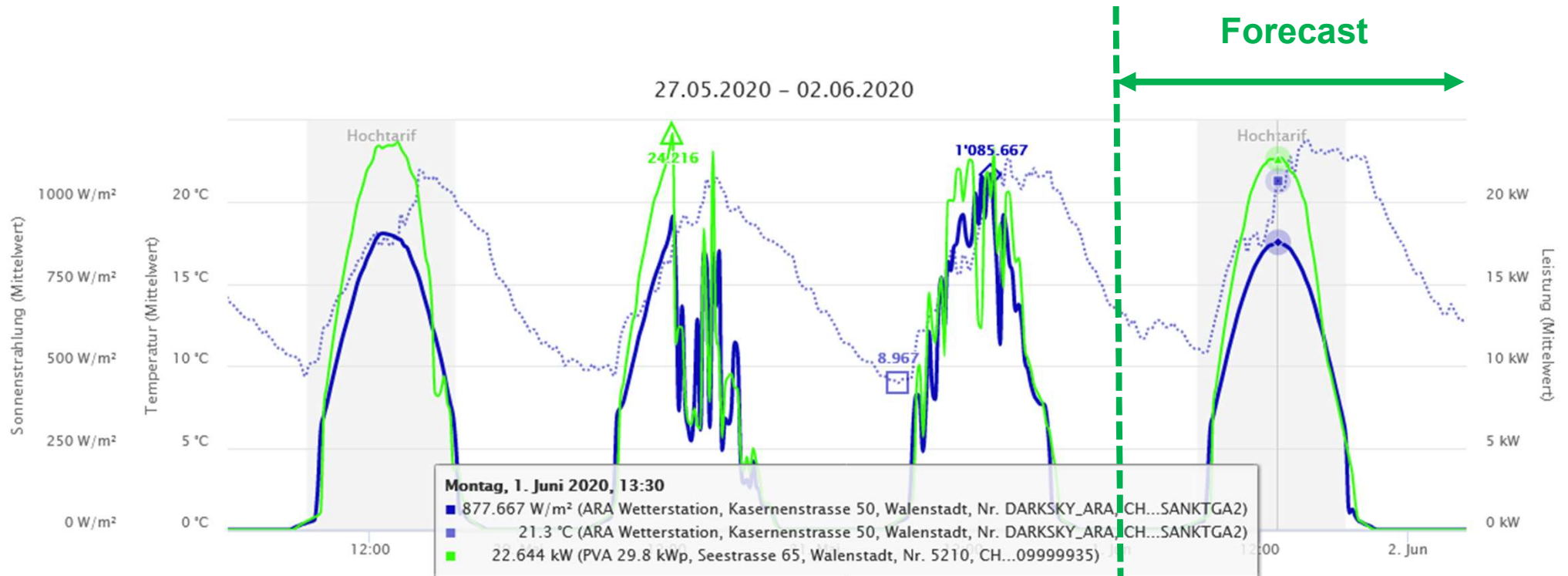
# Forecast: Heat pump load profile



## Metadata

- Maximum power consumption
- On / off switching duration depending on temperature and radiation
- Result: Load profile forecast for the next 24 - 72 hours

# Forecast: Photovoltaic power

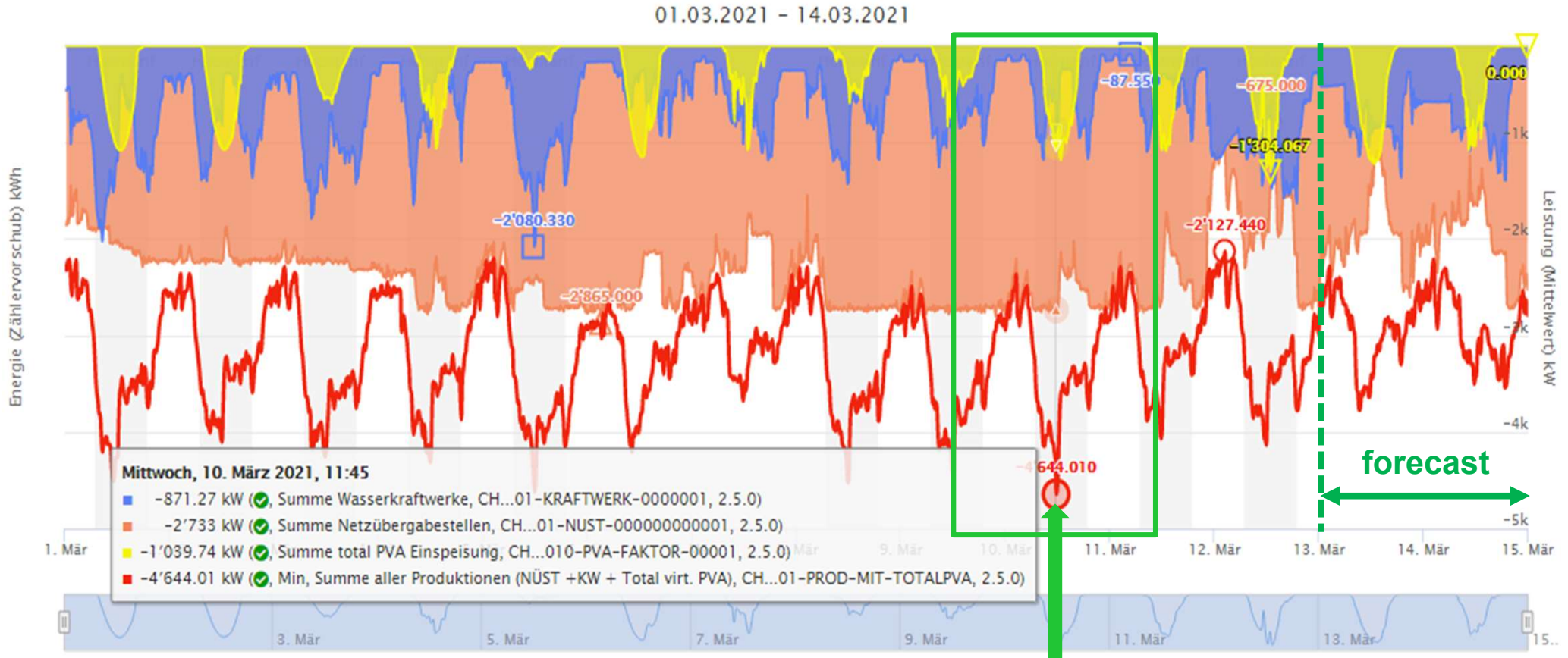


## Photovoltaic power in relation to radiation and temperature

- Forecast of the photovoltaic power output for the next 24 - 72 hours
- Cloud energy manager for prosumers



# DSO: Forecast: 24 – 72 hours



## Power maximum

- Monthly power maximum: Around 60% of the total grid cost

## Forecast

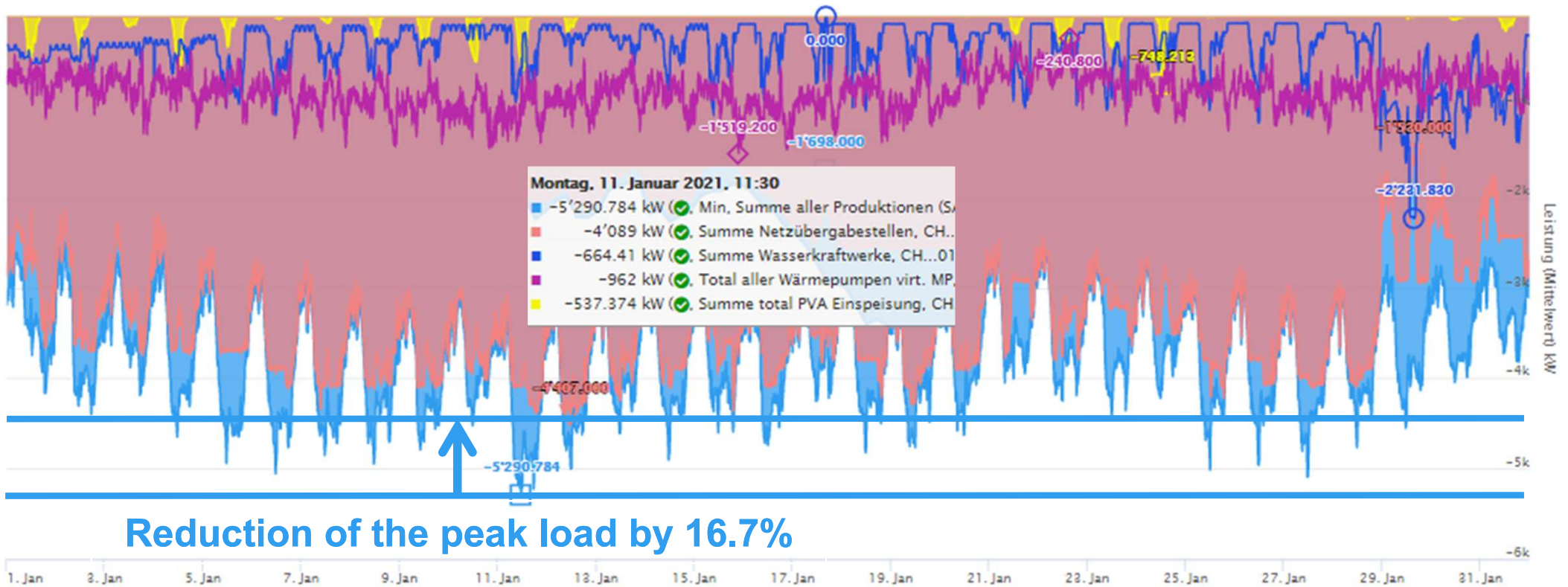
- Total load profile: Heat pump, water heater-, charging station, PVS
- Time based load profile potential for flexibilities

# Heat pumps: Peak shaving potential

Monthly peak load date	Time	Grid entry point maximum power [kW]	Heat pump power [kW]	Heat pump percentage [%]	Winter months Heat pump power [kW]	Winter months Heat pump percentage [%]	Summer months Heat pump power [kW]	Summer months Heat pump percentage [%]
24.01.2022	19:00:00	3'936	836	21.2	836	21.2		
13.02.2022	06:15:00	3'102	686	22.1	686	22.1		
10.03.2022	06:30:00	2'853	512	17.9	512	17.9		
01.04.2022	16:30:00	1'782	121	6.8			121	6.8
12.05.2022	10:45:00	1'149	304	26.5			304	26.5
17.06.2022	11:45:00	783	58	7.4			58	7.4
15.07.2022	20:30:00	990	201	20.3			201	20.3
13.08.2022	13:30:00	981	19	1.9			19	1.9
26.09.2022	12:00:00	1'404	60	4.3			60	4.3
26.10.2022	11:45:00	1'587	238	15.0	238	15.0		
30.11.2022	18:30:00	3'447	546	15.8	546	15.8		
30.12.2022	18:45:00	3'852	839	21.8	839	21.8		
<b>Average</b>		<b>2'156</b>	<b>368</b>	<b>15.1</b>	<b>610</b>	<b>19.0</b>	<b>127</b>	<b>11.2</b>

- During the winter months the flexibility of the heat pump influences the monthly peak load by 19%.
- Shift-off potential with an average of 610 kW for at least 2 hours

# Load management and peak shaving



## Conclusions

- DSO: Reduction of the monthly peak load
- The customer receives a compensation for his flexibility
- Win-Win situation

Questions?

**Thank you for your attention!**



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