



Advanced Control of a 48kWh battery storage system in real live Smart-Grid ready building

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WHY ?

BUILT ENVIRONMENT RESPONSIBLE FOR...

- ... 40% of total European energy usage
- ... 36% of European CO2 emission

FOCUS EXCISTING BUILDINGS...

- ... biggest volume, most impact
- ... most buildings in 2030 have been built

FOCUS CONTROLS B(E)MS

- ... adding smart software
- ... creating flexibility for Smart-Grid

TESTING THEORY IN PRACTICE

- ... real live test
- ... energy flexibility with comfort

Why THIS Office? (Kropman Breda)

The Building

- Built in 1994
- 1.700 m²
- Most frequently built 'standard' office building
- Solid and boring

HVAC

- Gas: HR-boiler
- Elektrical : steam humidifier, compression cooling machine, lighting, AHU, BMS



“if we can make it here, we can make it anywhere...”

Research project SG-BEMS



Smart Grid Building Energy Management System (SG-BEMS)

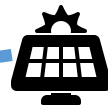
Renewable energy and prediction (InsiteSuite)

Battery storage

Flexibility in control HVAC

B(E)MS





PV



AHU



Chiller



Lighting

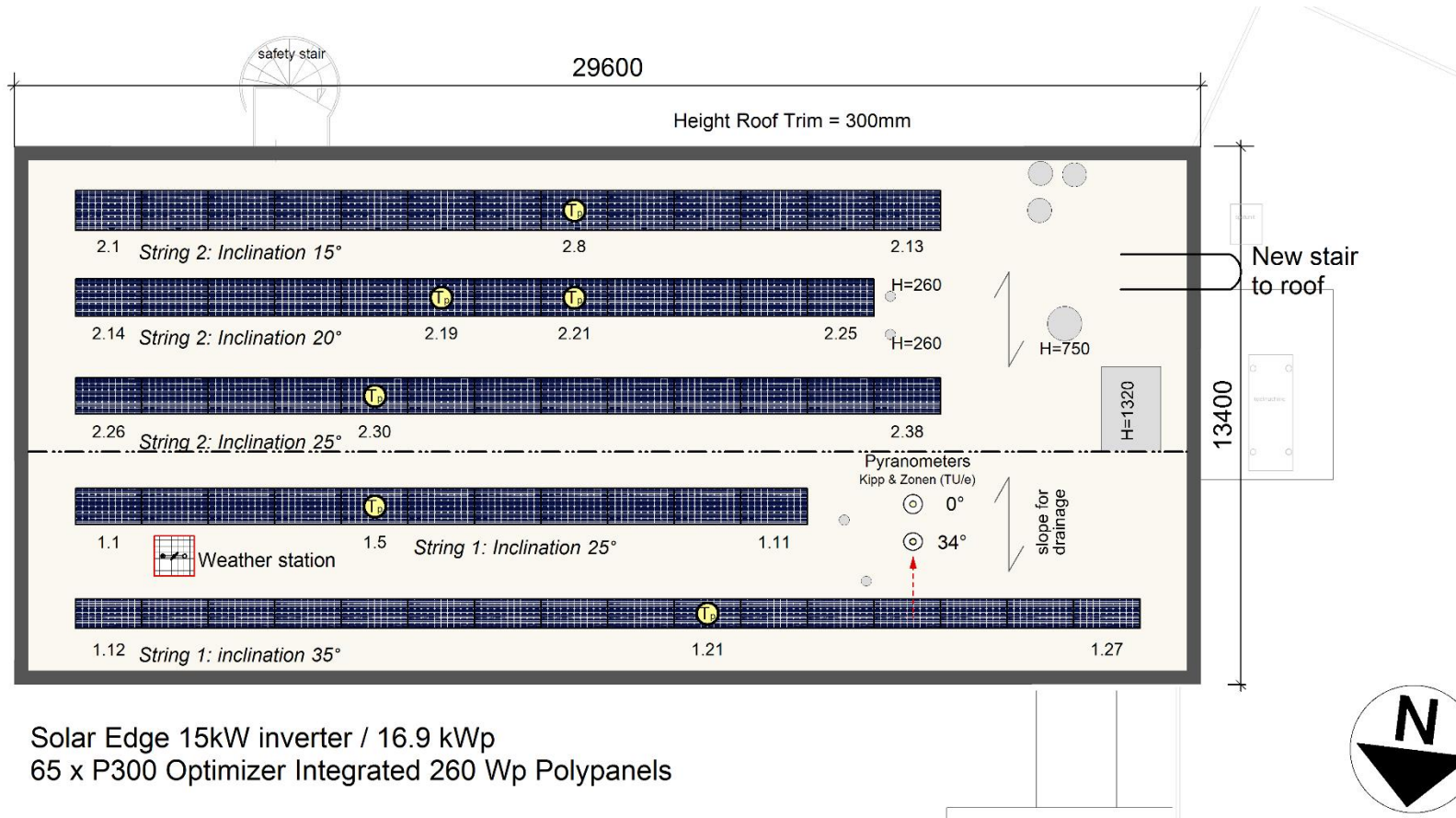
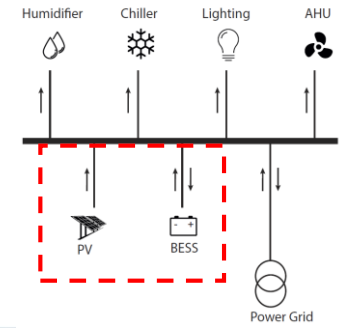


Plugs

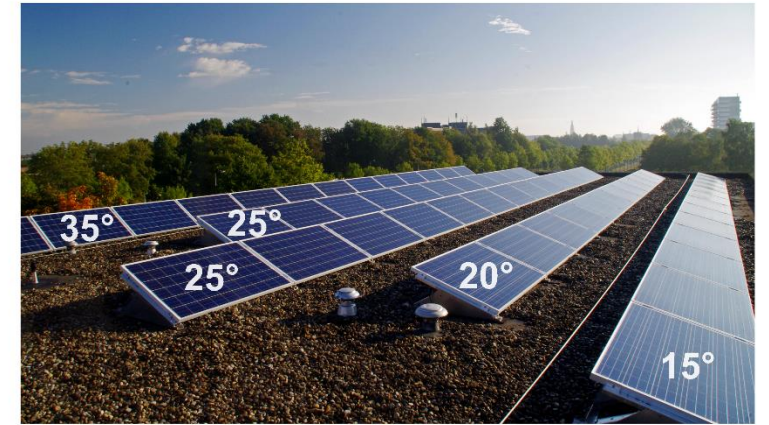


BESS

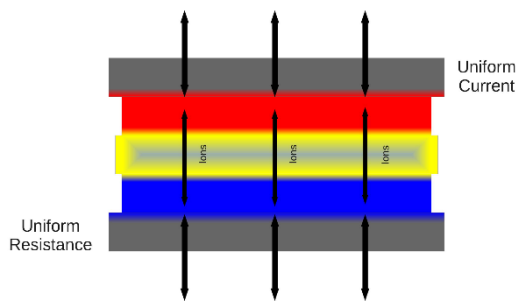
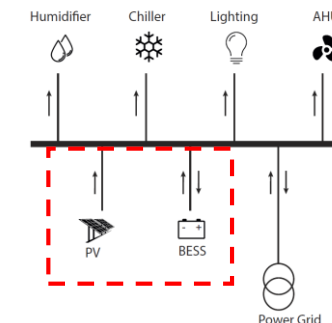
Renewable energy: PV 17 kW (SolarEdge)



Solar Edge 15kW inverter / 16.9 kWp
65 x P300 Optimizer Integrated 260 Wp Polypanels



Electrical storage: NiMH battery 48kWh (Nilar)



Environmentally-friendly

Nilar EC batteries are made with minimal hard-to-recover raw materials. Unlike most industrial batteries, nickel metal hydride batteries do not contain cadmium, mercury or lead to deliver powerful results. And unlike some other chemistries, which is often more costly to recycle than mine, nickel is an actively recycled and reused material.

Circular Economy

Nilar batteries are fully recyclable. From the nickel used to power them to the seals and casing used to the contact plates transferring the energy, the different elements that make up the battery can be reused in industrial manufacturing, such as the production of new Nilar batteries. The Circular Economy philosophy has been a central part of the R&D process for Nilar EC.

Operating temperature: -20°C to +50°C

Nilar batteries have always been recognized for their broad temperature operating range. Covering from -20°C to +50°C, you can rely on the battery to perform whatever the conditions. Added to this the robust nature of the bi-polar battery chemistry and you have a battery that provides safety and flexibility when needed.

Designed for a service life of 20+ years

Thanks to the ruggedness of the NiMH design, Nilar EC delivers a stable performance curve throughout the life of the battery. Meanwhile, it can be deep cycled thousands of times, providing reliable power for many years.



Safer than "safe"

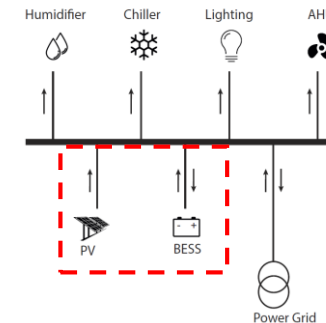
Nilar provides battery systems that are safer than many so called "safe" solutions available on the market. The Nilar battery system contains water based, non-flammable electrolyte. It does not generate short circuit failure even under low temperature charging. The electrodes cannot ignite spontaneously and will not cause heat propagation between modules. Additionally, the newly patented cooling ensures stable temperature throughout the whole pack and decreases the risk of overheating. That's why we argue that we are safer than "safe".

Fully recyclable

Safer than "safe"



Batteries Bi-directional inverter



AC 400V (3fase)



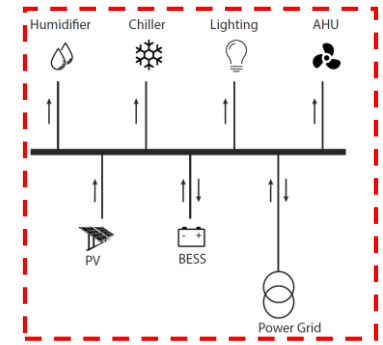
DC 500-800 V



Rated power: **33kW**
Rated current: 48A
Efficiency: 96.1%

48 kWh: 40 packs (120 VDC / 10Ah)
Max. cycle efficiency: 92%

Smart-Grid Ready office Kropman Breda

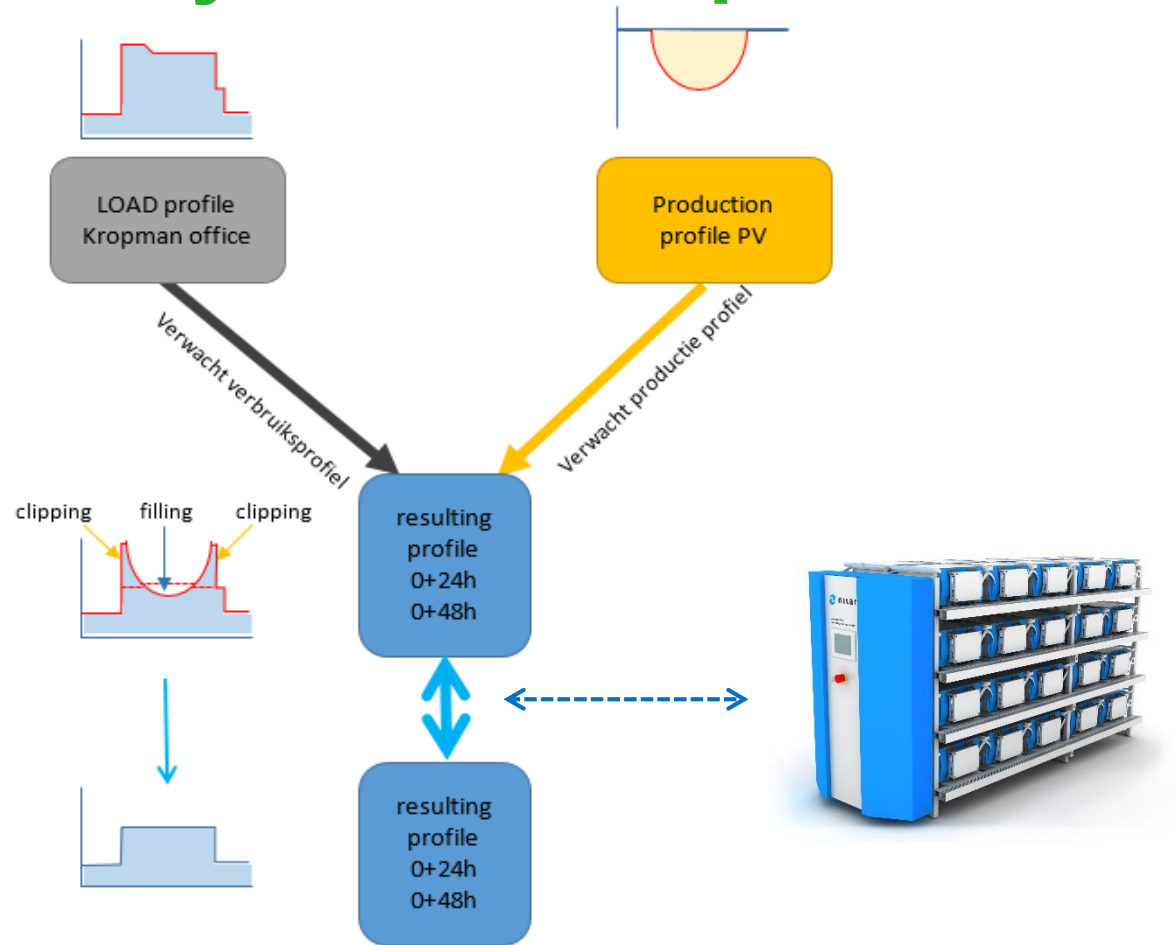


Systems approach

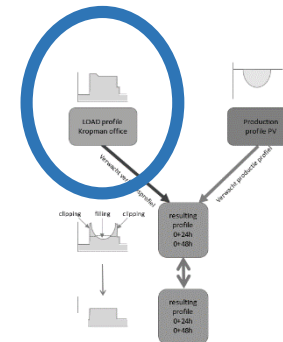
- Main strategic control
- local (sub) controllers

Profile setting

- Phase 1: flat (peak shaving)
- Phase 2: predefined
- Phase 3: SG-demand



Prediction energy-profile

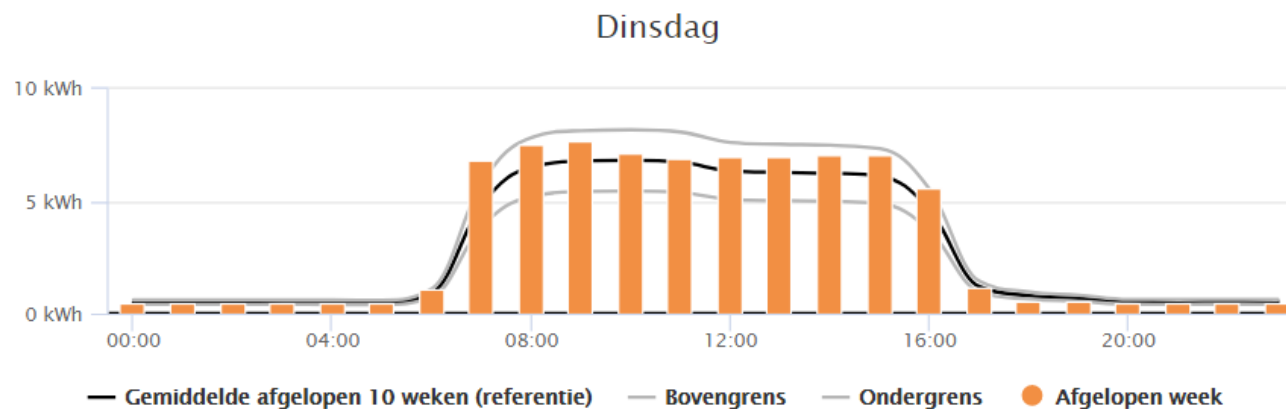
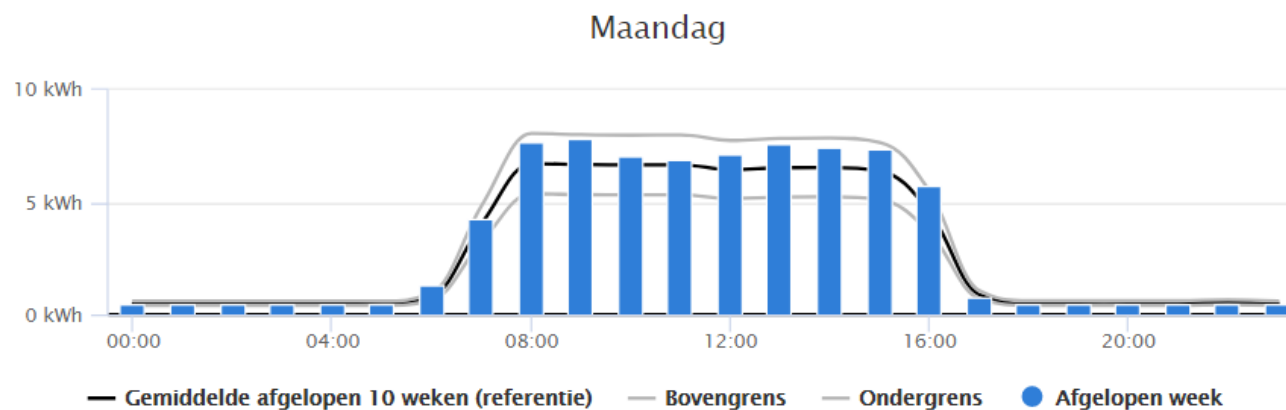


Energie verbruik verlichting van het gebouw

Van afgelopen week

Prediction:

- Based on historic data
- Including human behaviour

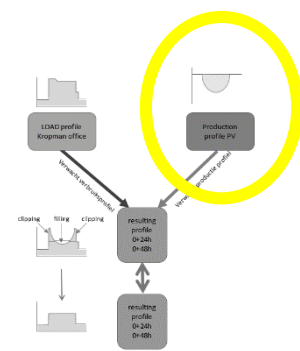




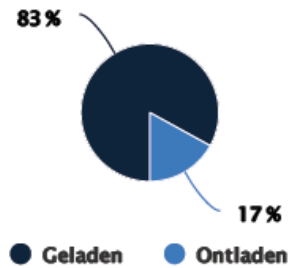
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Zonne-opwekking voorspelling & Status accu-opslag

Voorspelling van opwekking 2 dagen vooruit



Accu-opslag systeem



Het accu-opslag systeem is voor **83%** geladen

Het accu-opslag systeem mag worden ontladen ✓



Strategies Battery Control

Workdays

Determine baseline (**BL**) and initial state of charge (**SoC_{ini}**)

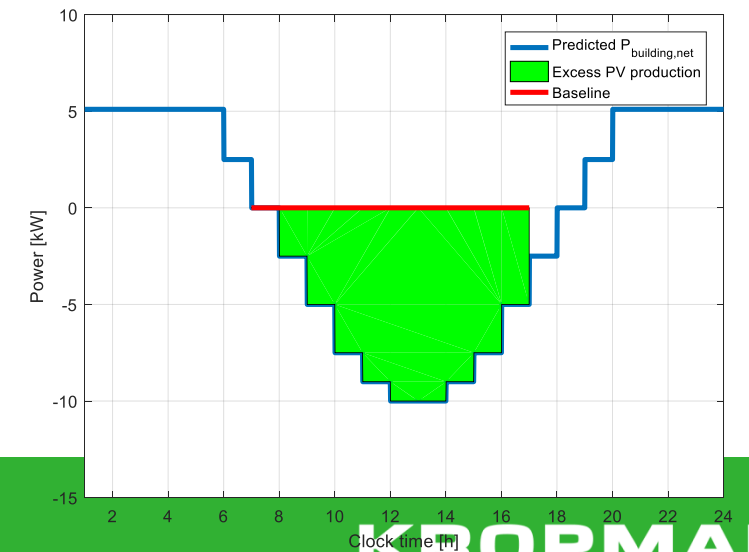
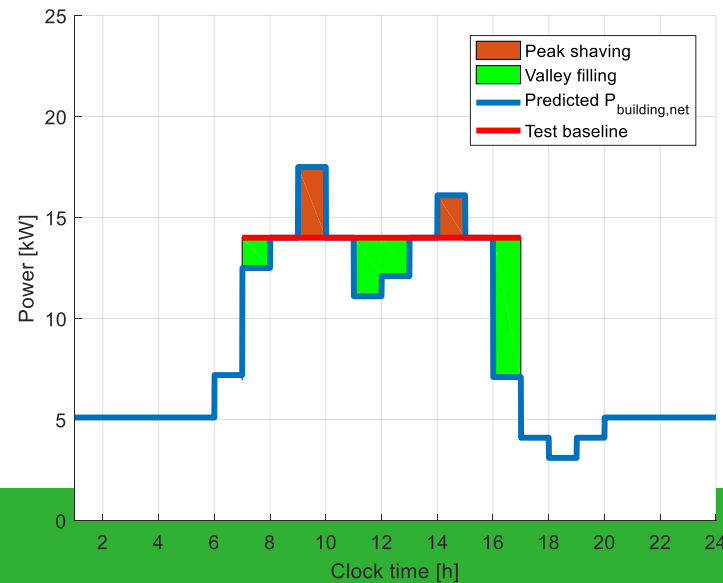
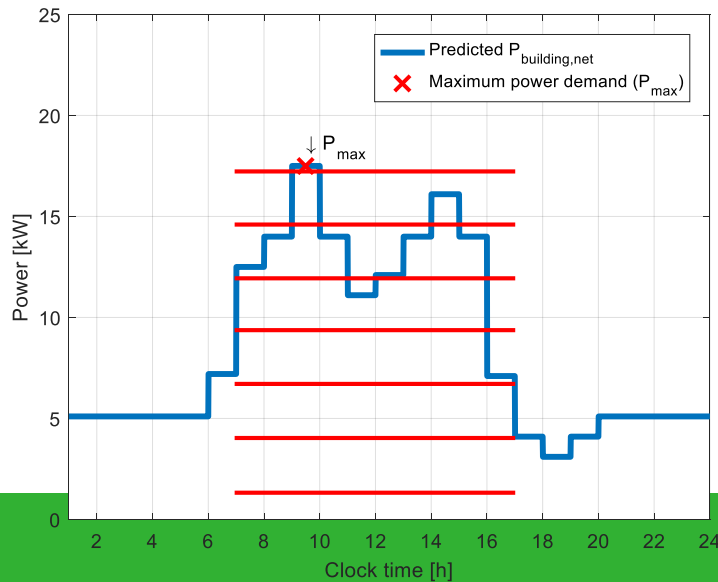
- Define X_{charge} (*inability to charge*)
- Define $X_{\text{discharge}}$ (*inability to discharge*)

→ Many cases with different **BL**, **SoC_{ini}**, X_{charge} and $X_{\text{discharge}}$

→ Pick best case with moderate **BL**- and **SoC_{ini}** values

(ir. Rick Cox, TU/e)

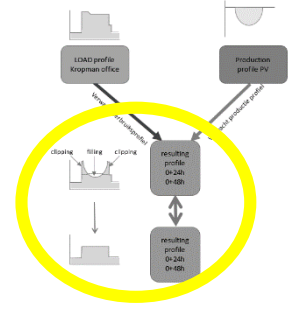
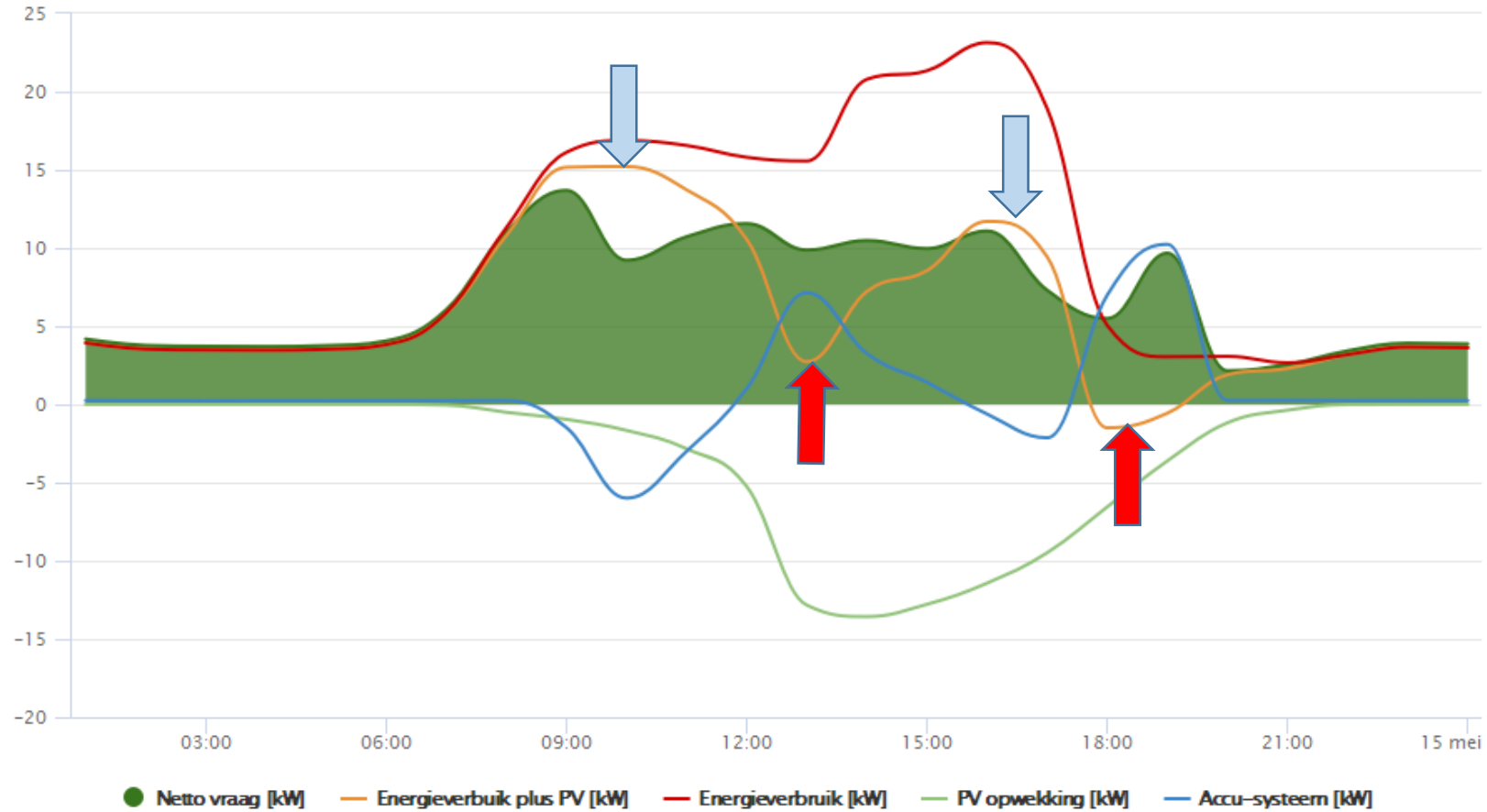
- **Weekends**
- Increase self-consumption



Energieprofiel Elektriciteit stromen van en naar het netwerk



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CONCLUSION

Advanced Controls for making existing office building more sustainable

- Not simple task, but can be done
- Building automation can also take control of flexibility
- Integral approach is needed, knowledge of buildings processes is essential
- User comfort can still be provided
- Building can be an active partner in Smart-Grid (and assist in net-stability)

EV will give extra possibilities in future !





Thanks !

Groenere, gezondere en efficiëntere gebouwen.

KROPMAN
GEBOUWAUTOMATISERING

CONTACT

Links for more information :

- BMS: InsiteView
- BEMS: InsiteView
- Controls: InsiteView
- Reporting: InsiteReports

Groenere, gezondere en efficiëntere gebouwen.

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