How to power tower cranes with minimal draw from the electricity grid

Dr. ir. Bart Meersman

CE+T Partner forum 2023

26 - 28 September 2023, Malmedy, Belgium

Neargrid

Neargrid

It is our mission to supply the construction site with sustainable power on locations where the available distribution grid cannot deliver.

Neargrid

We develop battery systems focusing on a worry-free integration in the building process, garantueeing a maximum operational reliability

Neargrid

Neargrid today

- 43 systems in use
- In Belgium, the Netherlands and France
- + 350.000 hours of operation without failure

VANDAELE RENTAL

VAN DER SPEK VIANEN

STADSBADER CONTRACTORS

MONUMENT GROUP

FRANKI CONSTRUCT

ALGEMENE BOUWONDERNEMING VANDENBUSSCHE WIJ TREKKEN UW PLAN

haex

VAN ROEY van roey BOUWEN MET MENSEN

Dethier

EIFFAGE SODEMAT

JURI

MATHIEU GIJBELS Bedrijfs- en Kantoorbouw De Voordenkers

benelmat

STRABAG

Vanhout

BOUWONDERNEMING CATTEEU

bouwbedrijf FLORÉ n.v.

DEMOCO

bam interbuild

Electrification in the construction industry

"Horizontal" sites

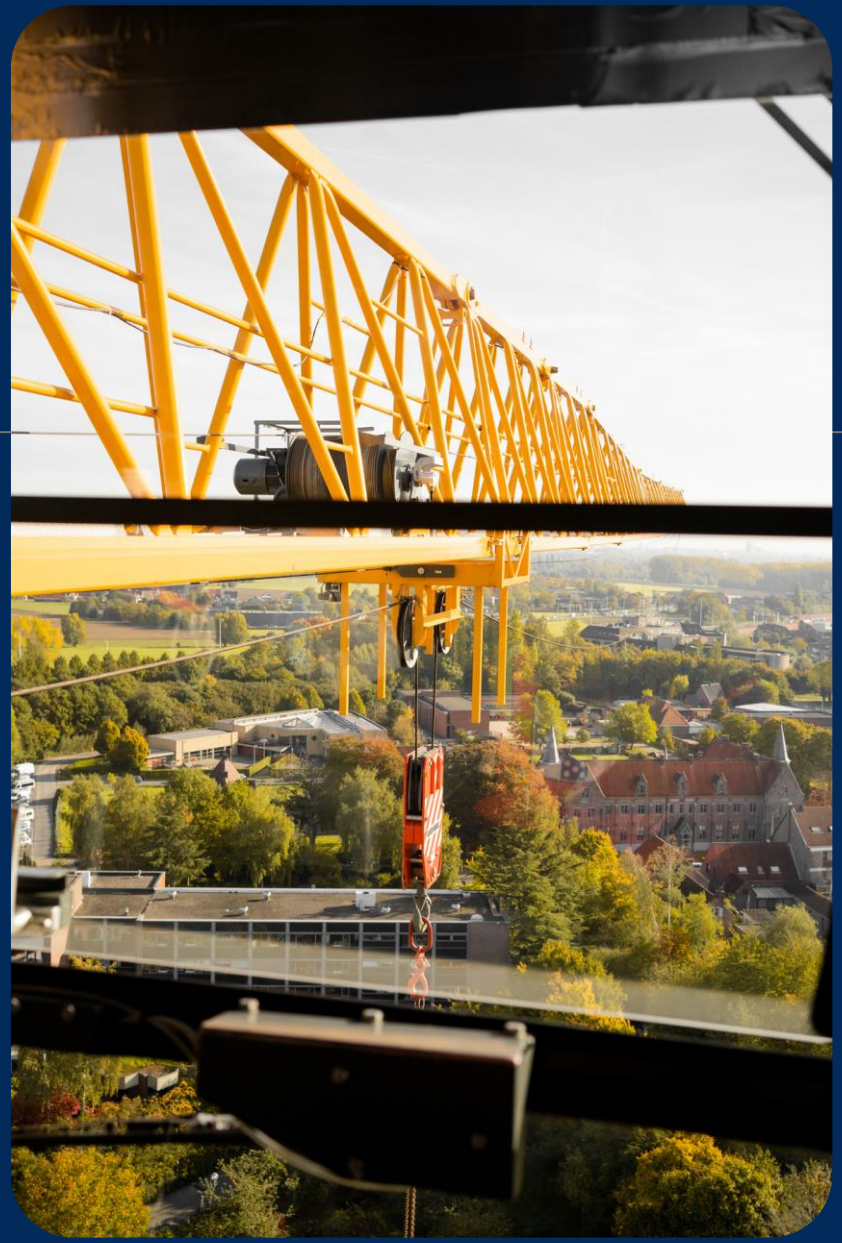
- Civil engineering: roadworks, railways
- Machinery: excavators, asphalt pavers
- Energy intense applications
- Often, no grid connection available

"Vertical" sites

- Building construction, industrial construction
- Machinery: cranes, tower cranes
- Power intense applications
- Often limited grid connection available

The application defines the storage and power requirements

Neargrid



Neargrid supplies upto 3 tower cranes with power, using only a 32 Ampere grid connection

Application on site – Example

Distribution grid connection

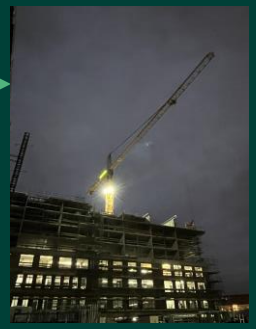
63A at 3x400V

44 kVA

1x250 ; 2x160A

3 tower cranes

32A



Tower crane lighting

32A

Other small consumers

63A

63A

Heating and lighting of welfare units

Pumps

Neargrid

This is our alternative for diesel gensets

- Reduce your CO_2 footprint
- Improve the overall working conditions
- No local sooth and noise emissions
- No need for periodic refueling of diesel
- No periodic maintenance needed
- Lower operational and internal costs

Neargrid product portfolio

Neargrid Compact

Vertical sites:
Smaller cranes
capacity < 8 ton

Horizontale sites:
Cycling applications

Neargrid Boost

Vertical sites:
1 tower crane
capacity < 20 ton

Neargrid Force

Vertical sites:
1 tower crane
capacity 20 ton and more

3 tower cranes
capacity < 20 ton

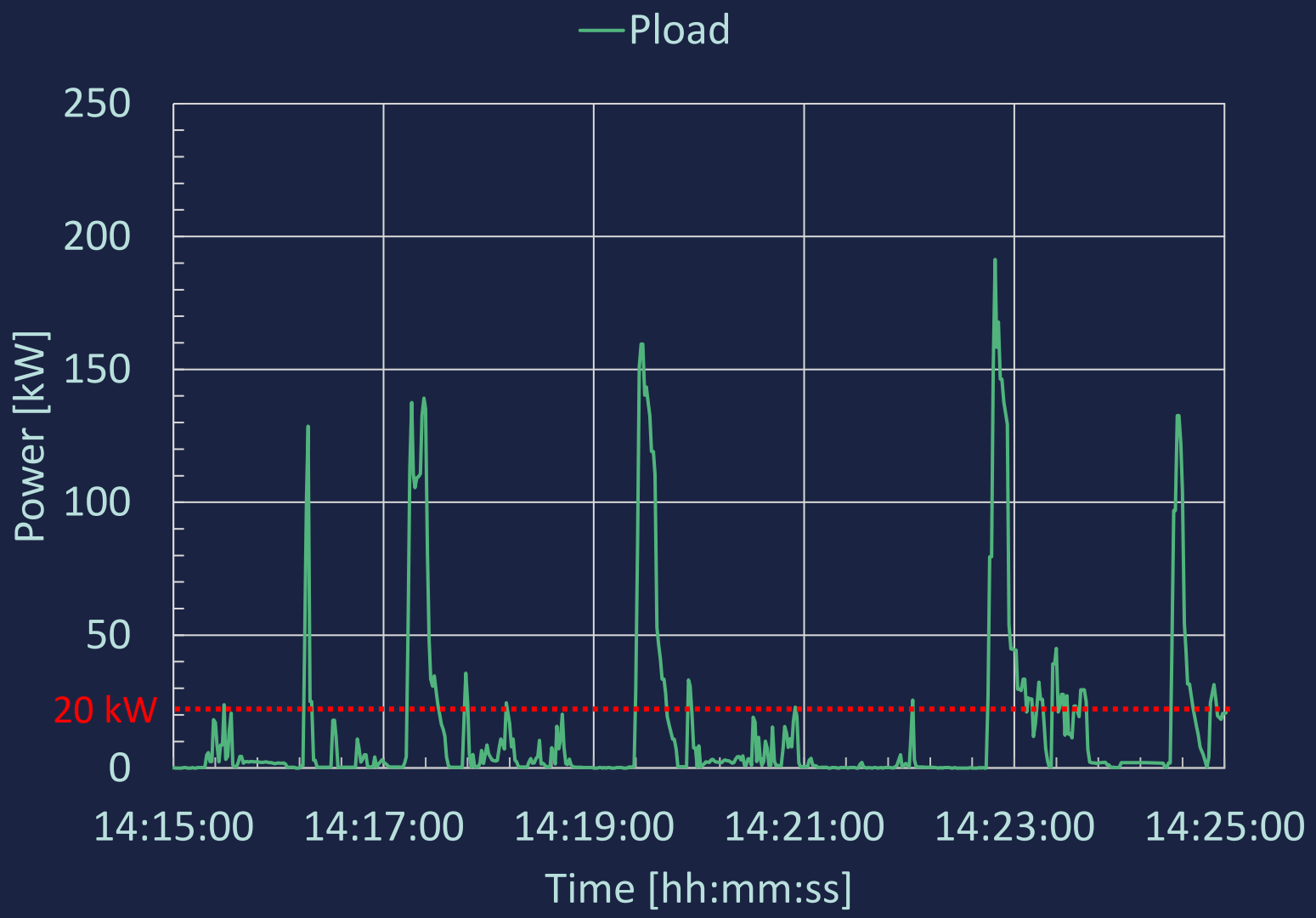
Neargrid

Technical issues with diesel gensets

- A diesel gensets nominal power needs to be chosen 3-5 times the tower cranes nominal power
- Diesel efficiency for supplying tower cranes is 5%, 150kVA genset stage III consumes 9-15l per hour supplying a 10-12 ton tower crane.
- Maintenance is required every 500 hours resulting in operational and logistical costs
- Refueling must not be forgotten

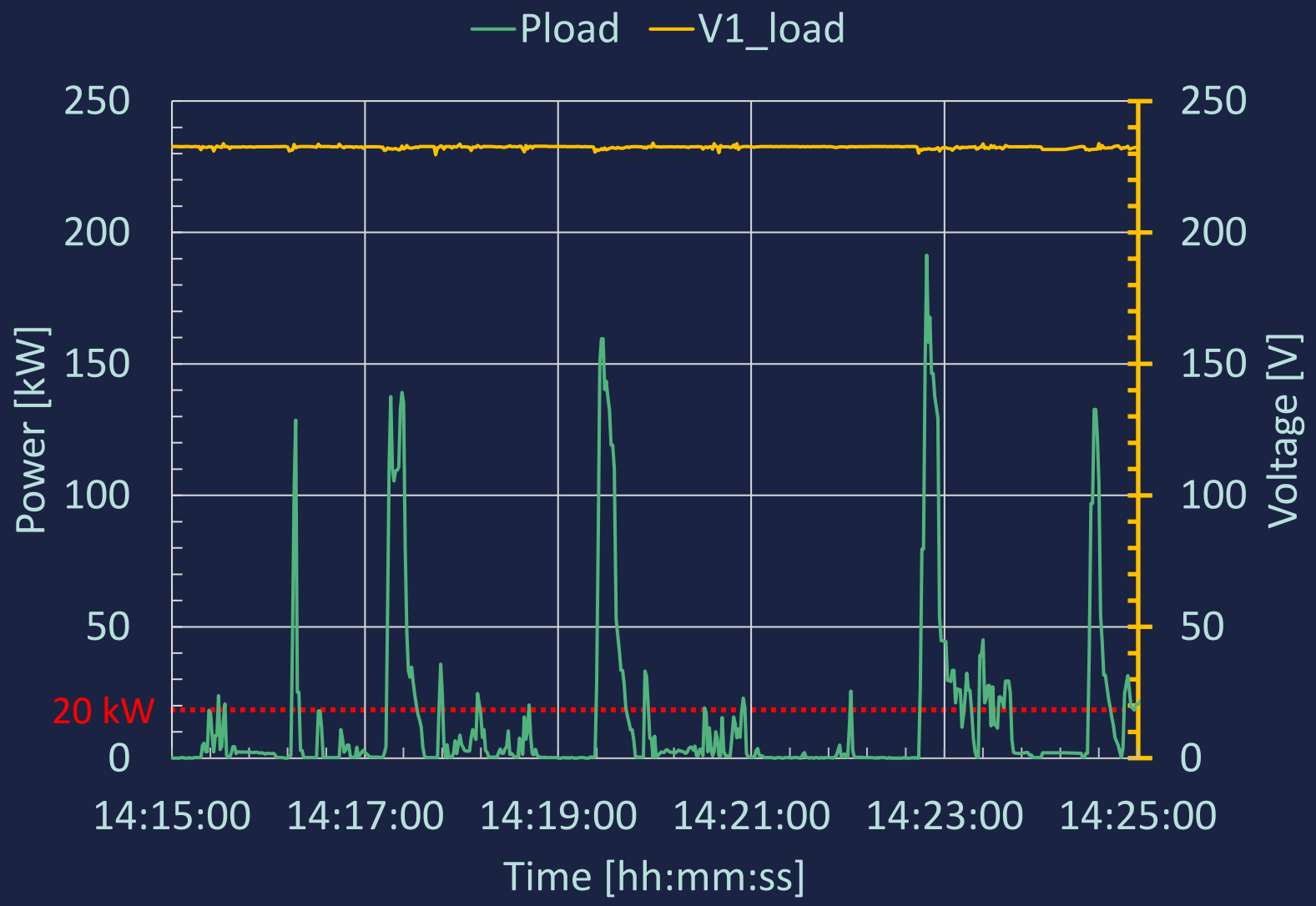
Neargrid

Observations – Liebherr 630EC-H (110 kW hoist)



Neargrid

Challenges with the grid connection

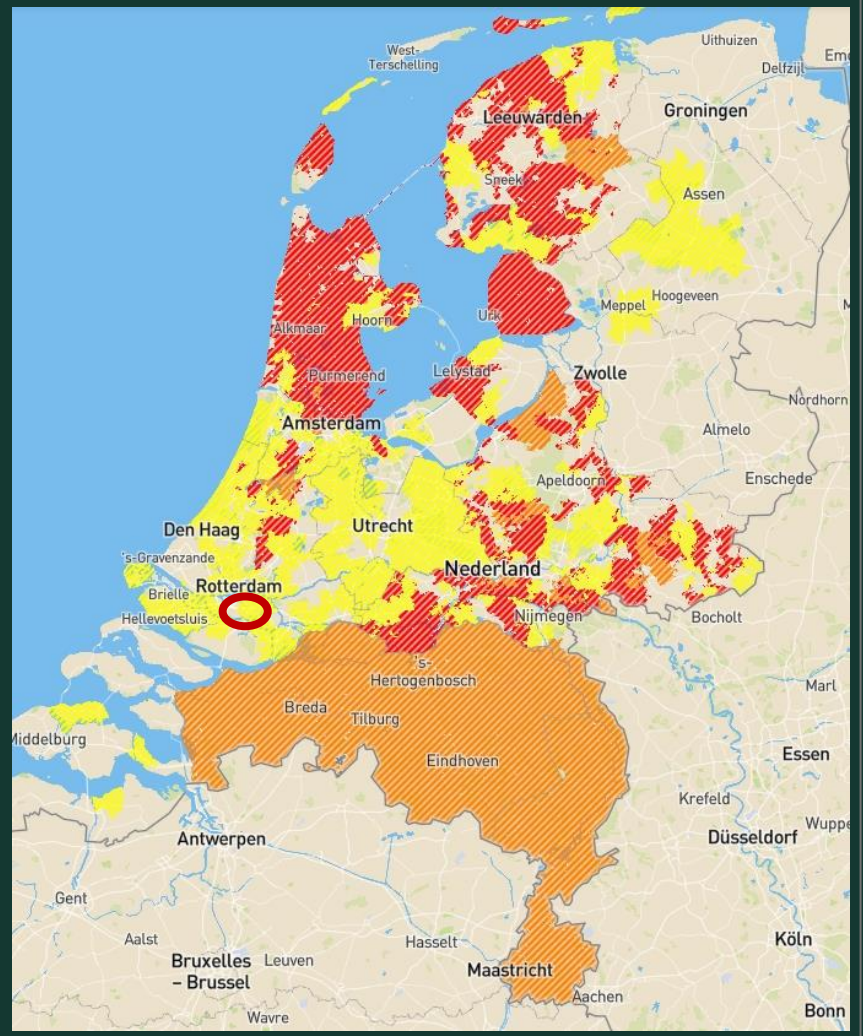


Neargrid

Grid congestion is real

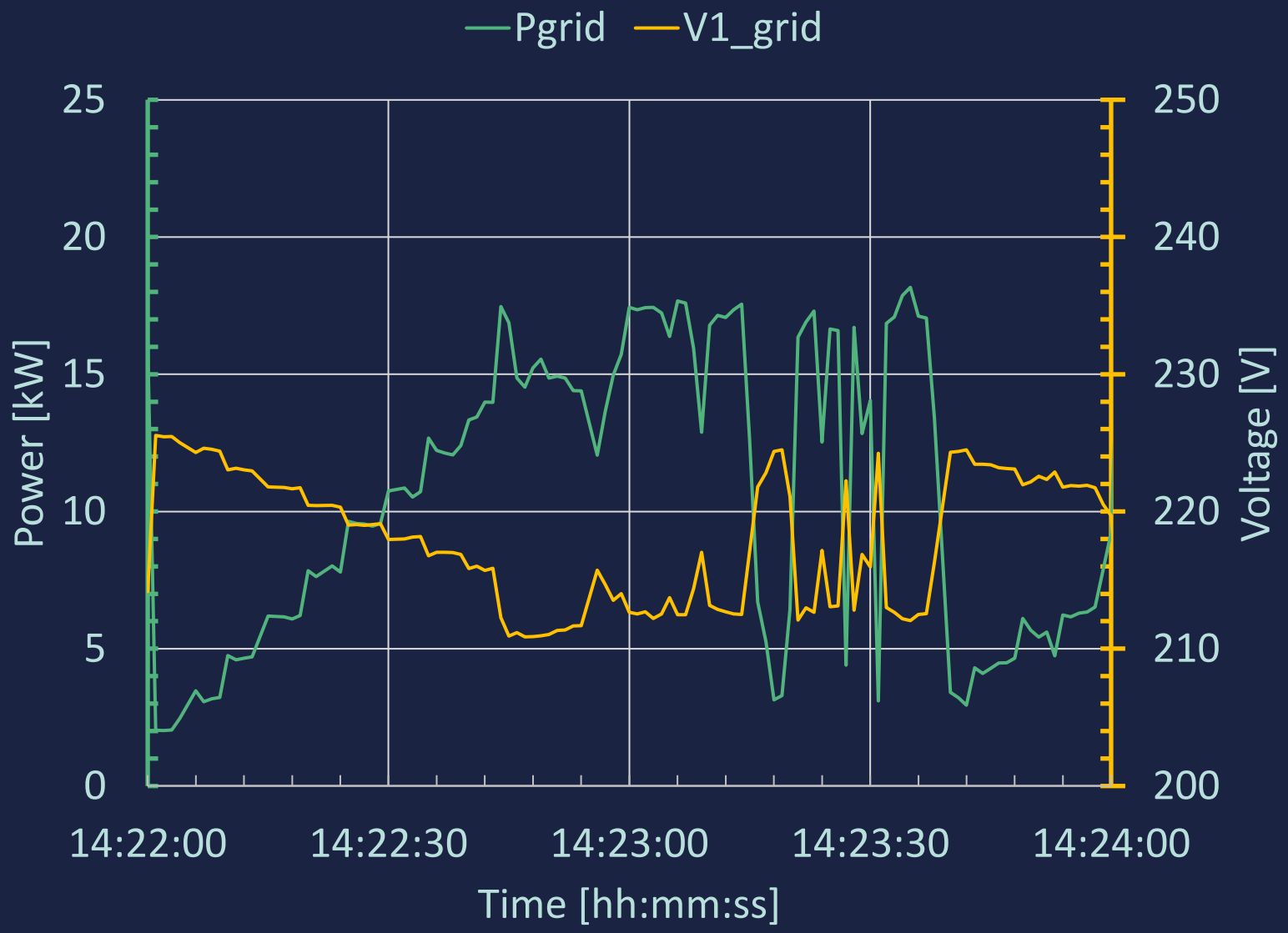
- Grid congestion is increasing e.g. the Netherlands
- In the Netherlands the Public Electricity Network is full, resulting in long lead times and difficulties to get grid connection
- Grid connection is becoming “weaker”.

Consumption Limitation from DSO



Neargrid

Impact on the grid voltage

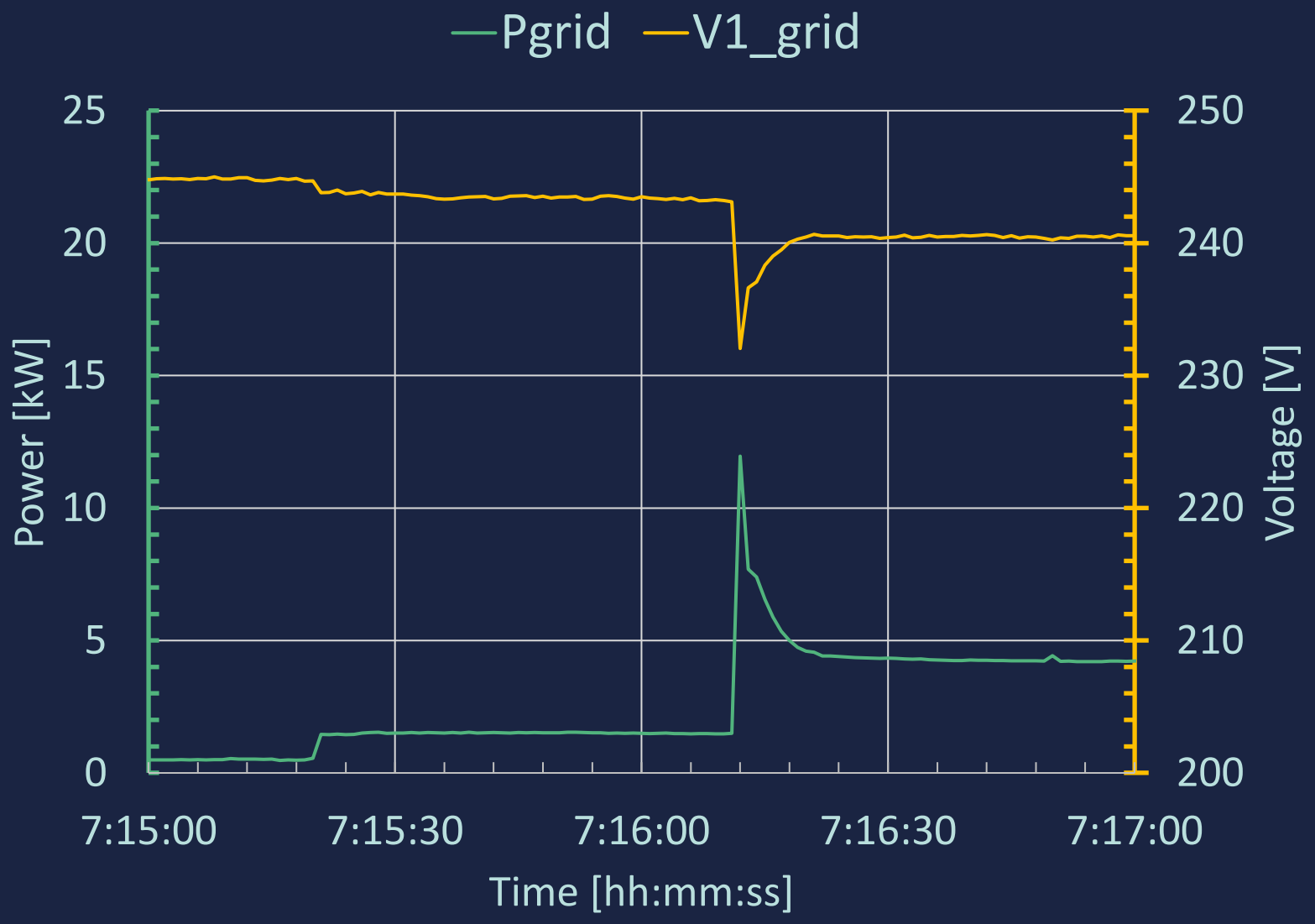


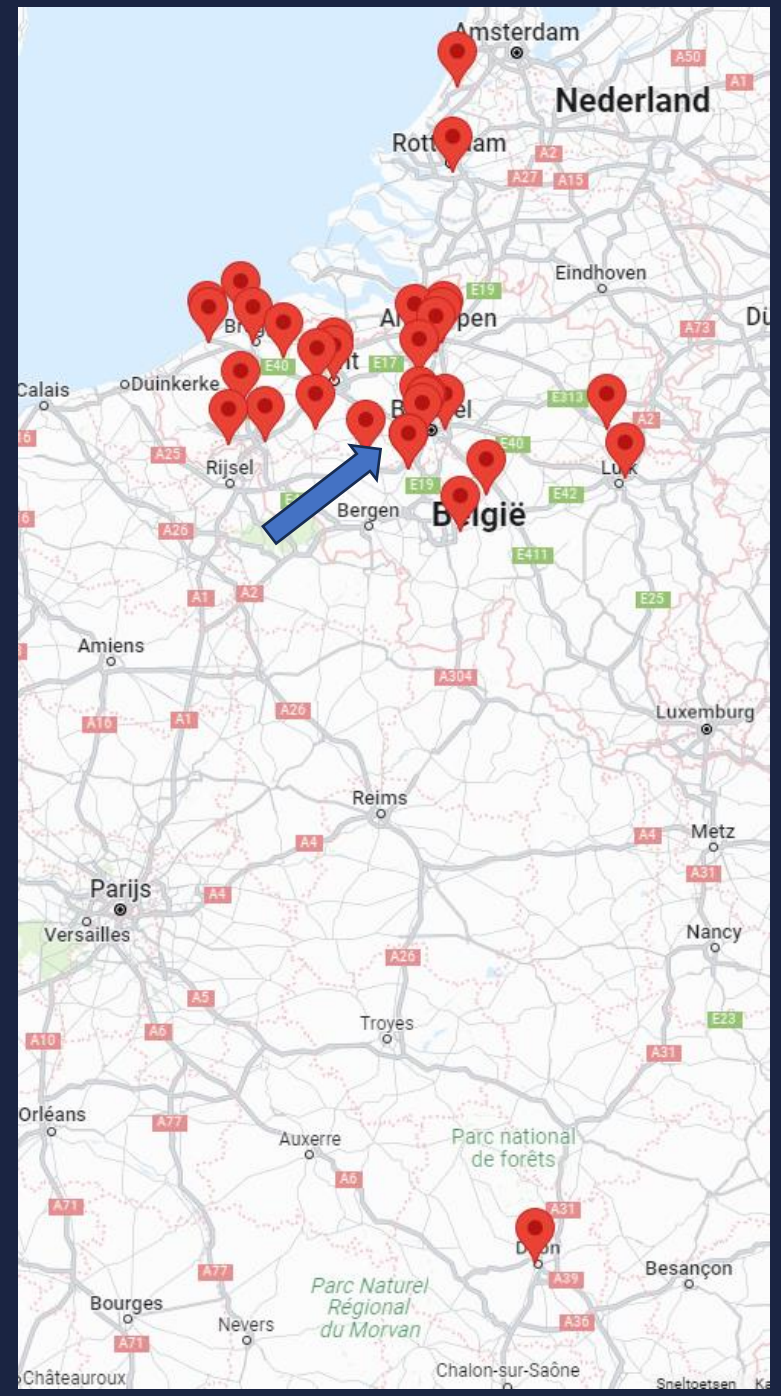
Consequences:

- Instability of the public grid
- Loads that will switch due to under-voltage

Neargrid

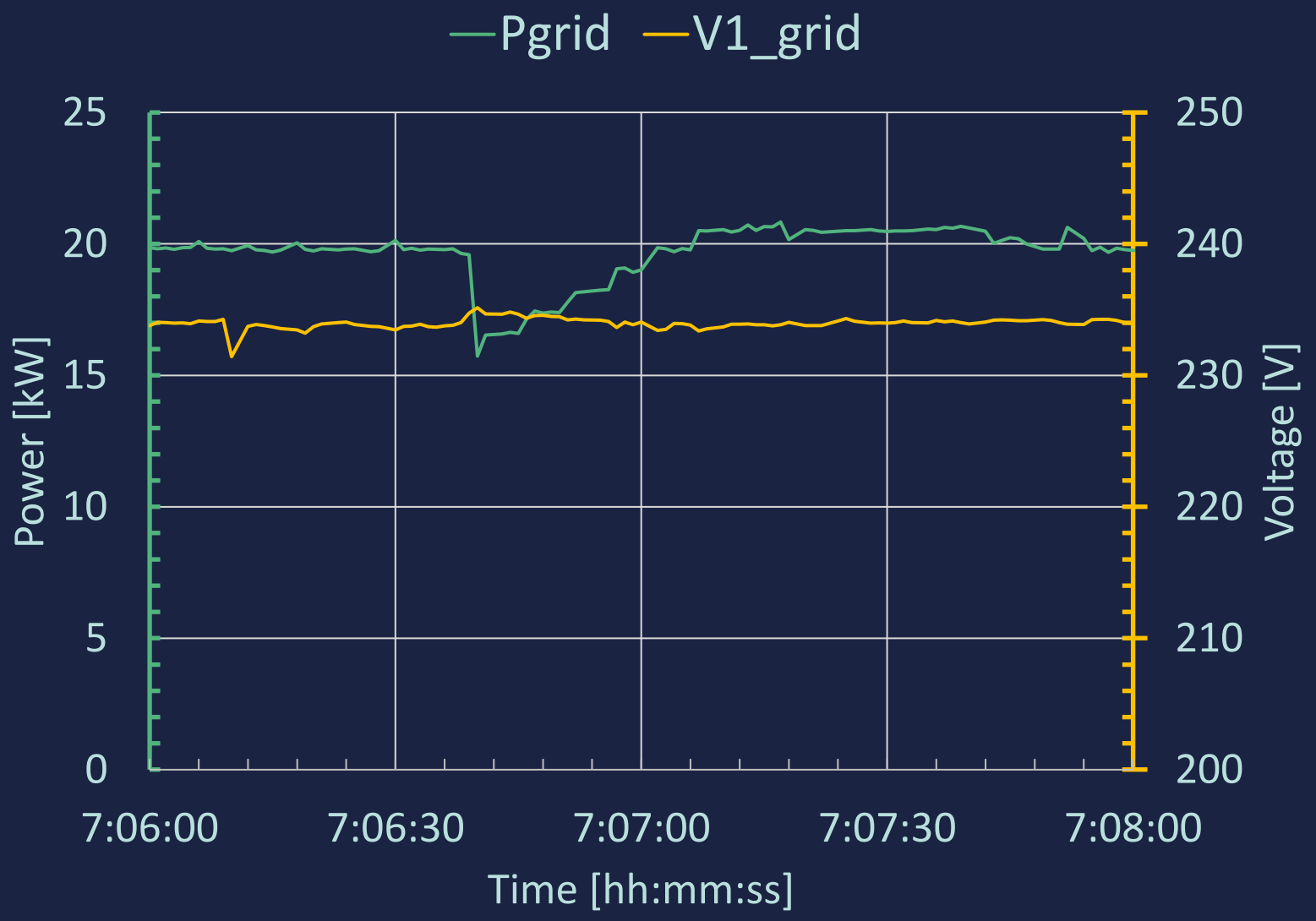
Impact on the grid voltage





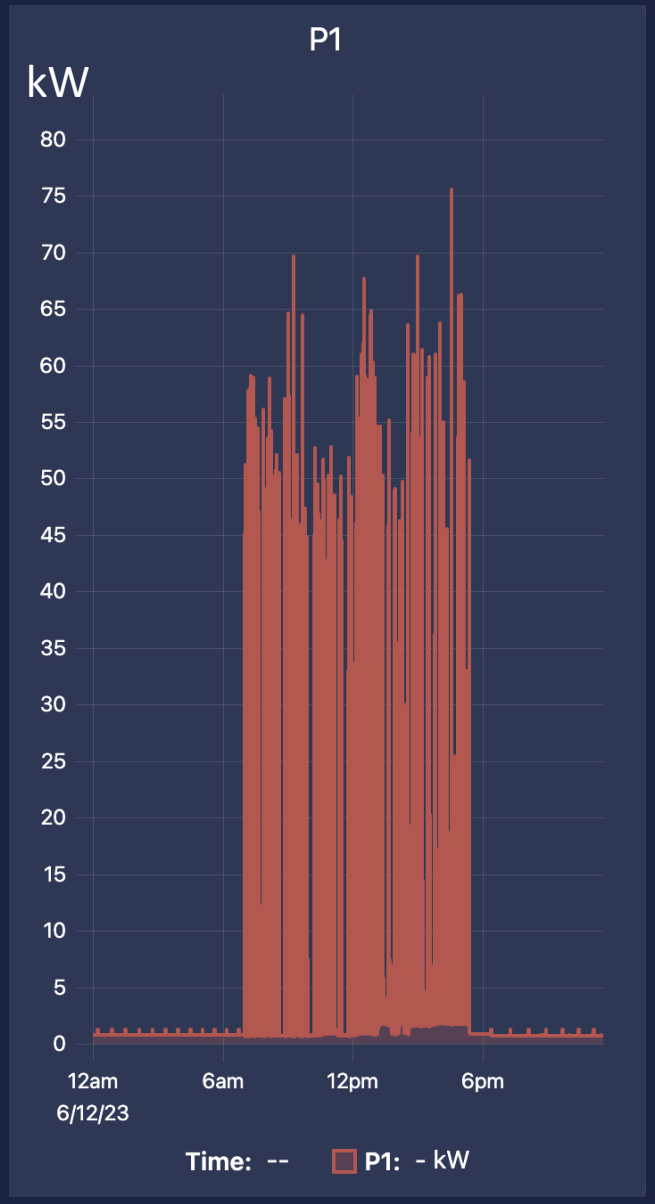
Neargrid

Impact on the grid voltage

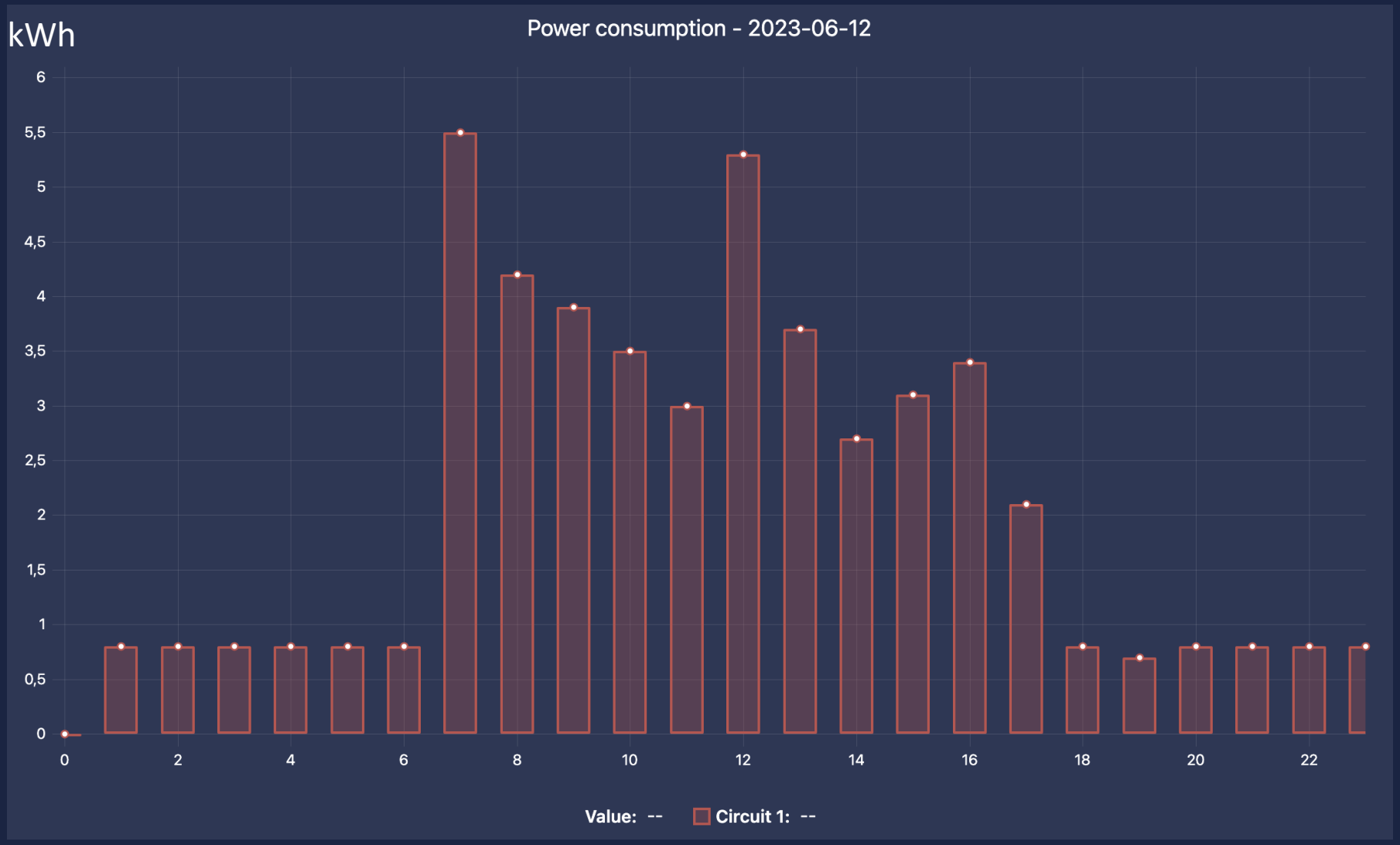


Energy requirements

Neargrid

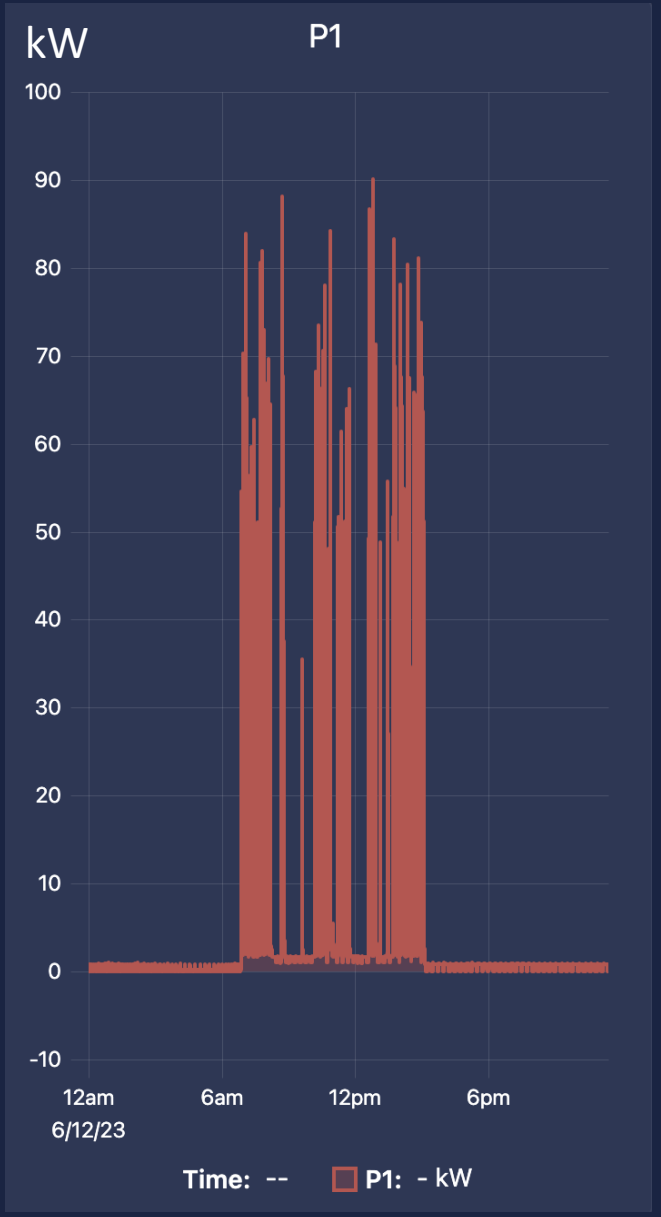


Tower crane: Wolff 7032.12 – around 47kWh per day

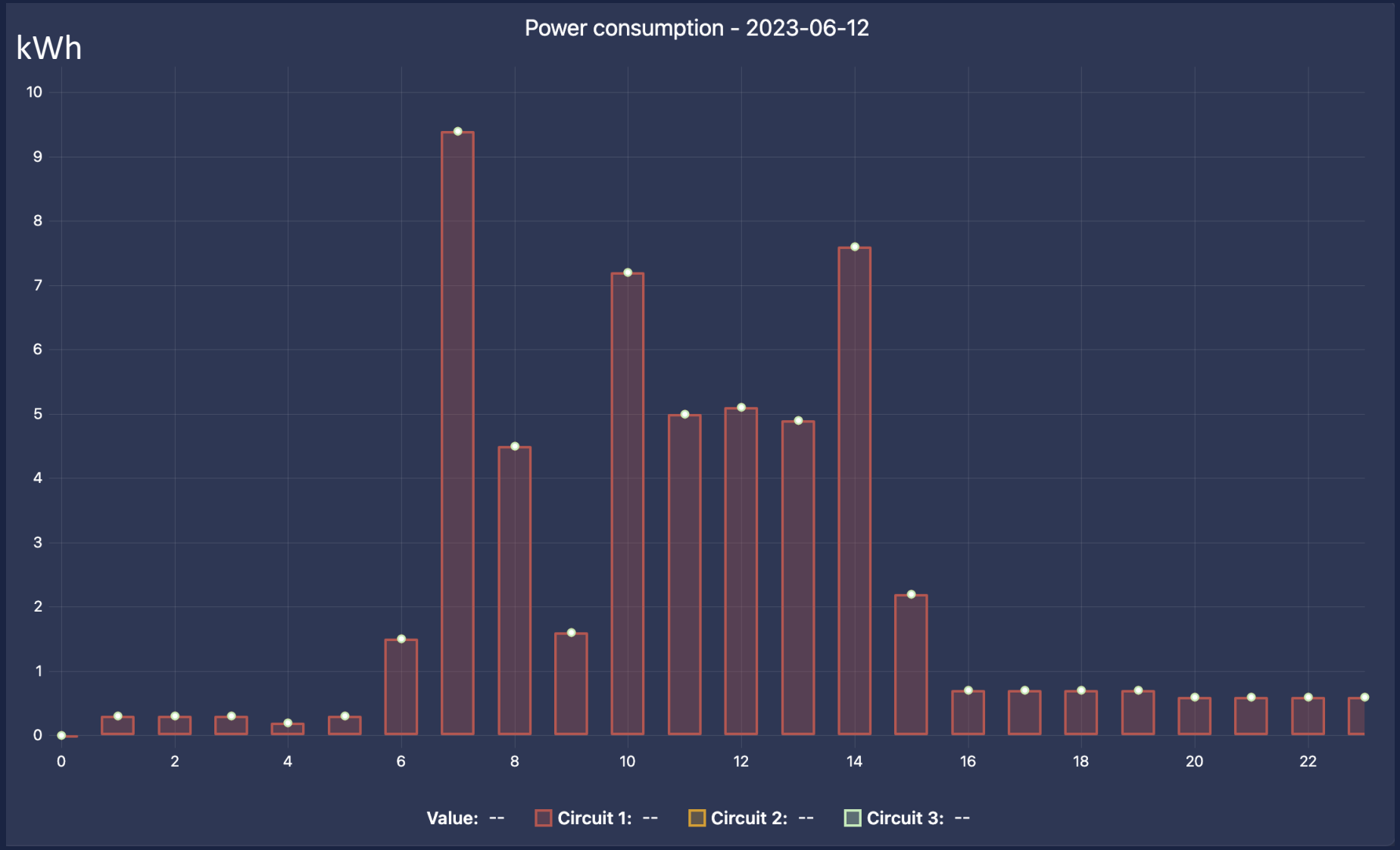


Energy requirements (2)

Neargrid



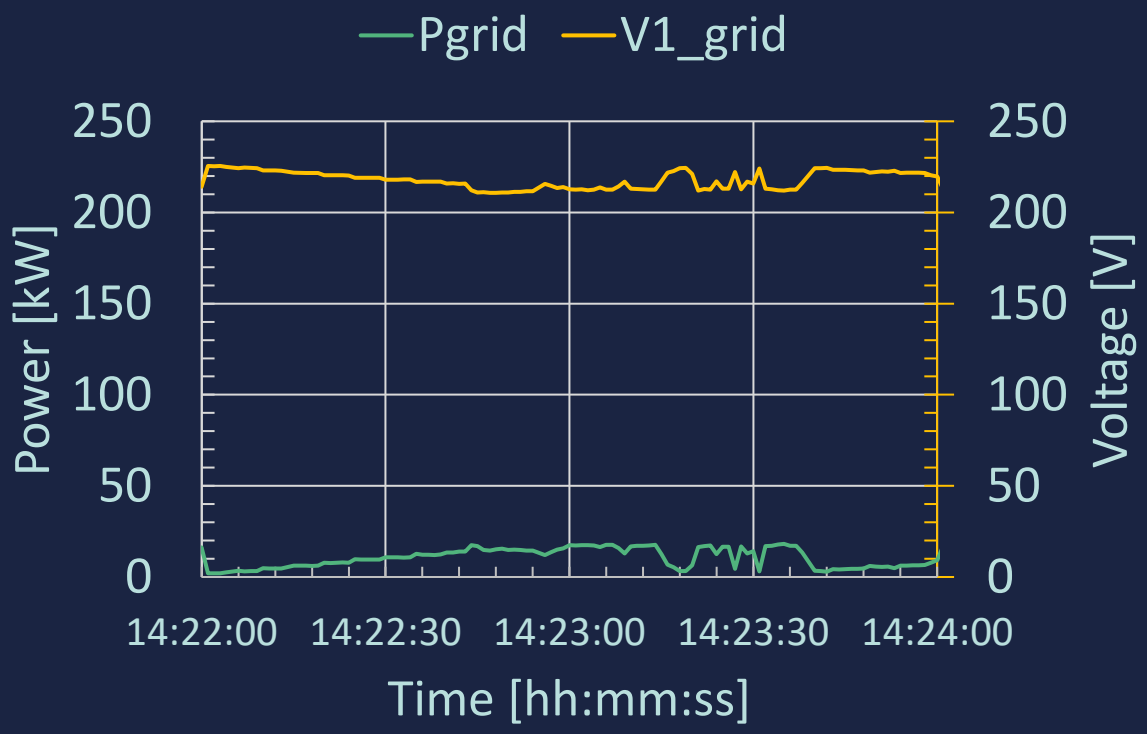
Tower crane: Terex Comedil CTT331 – around 43 kwh per day

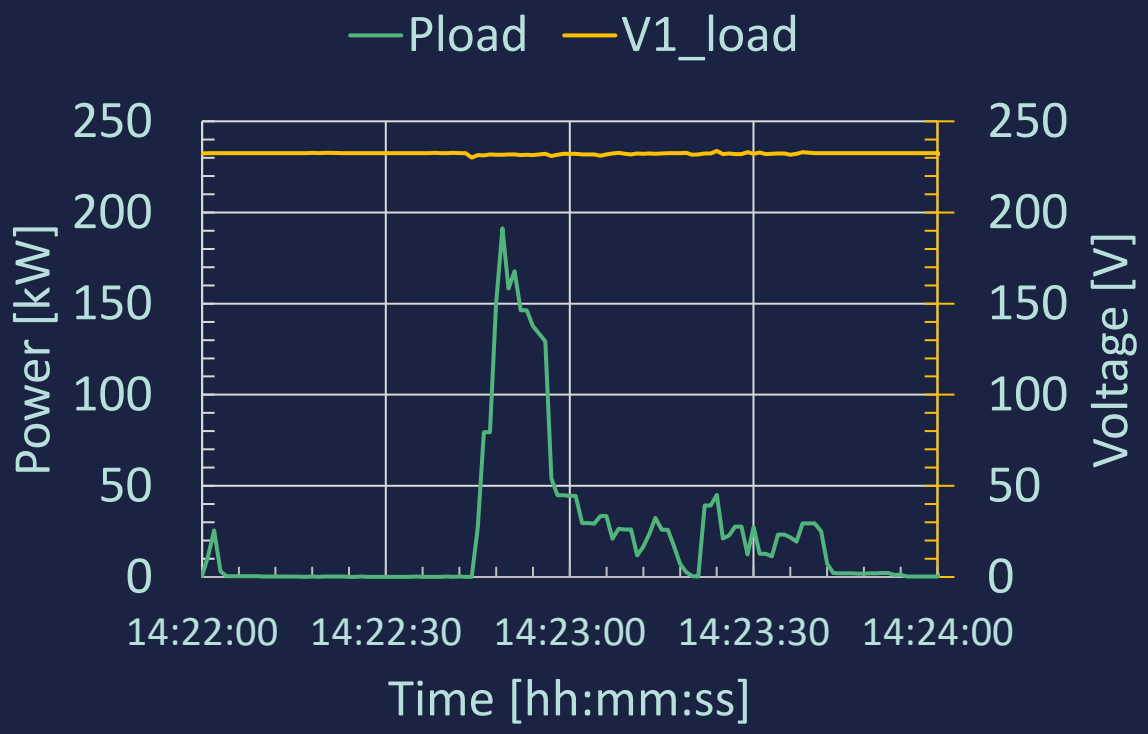


Battery system as a solution

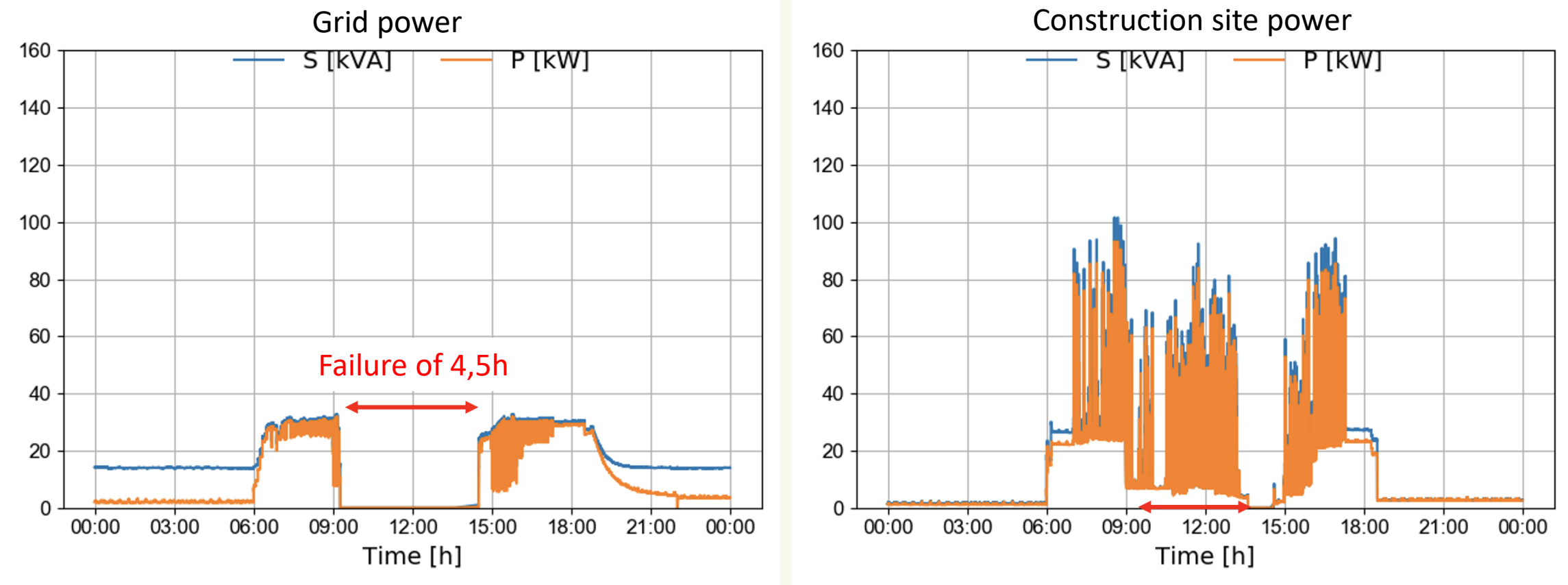
- Use of a residential grid connection is simple and is often quickly available

→ the solution for the problem.



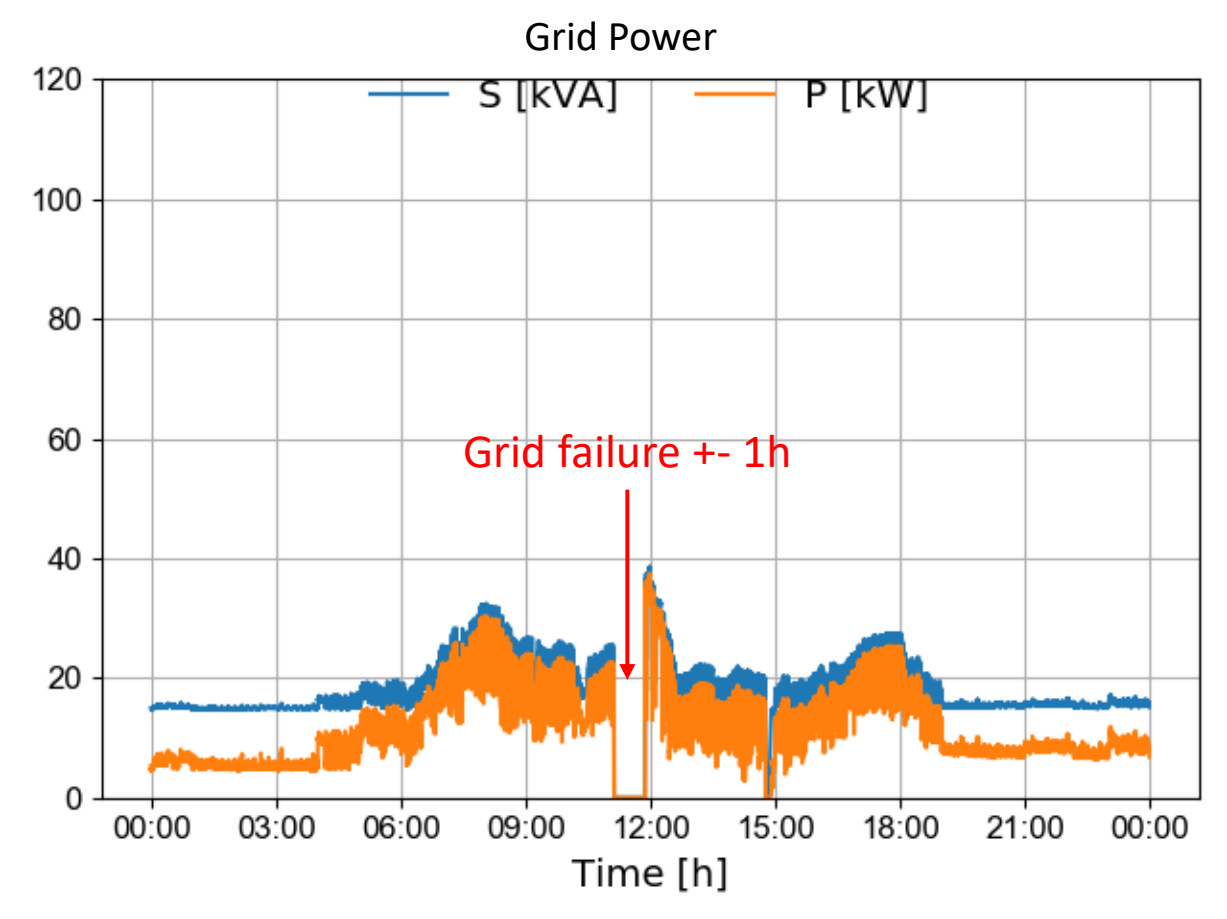


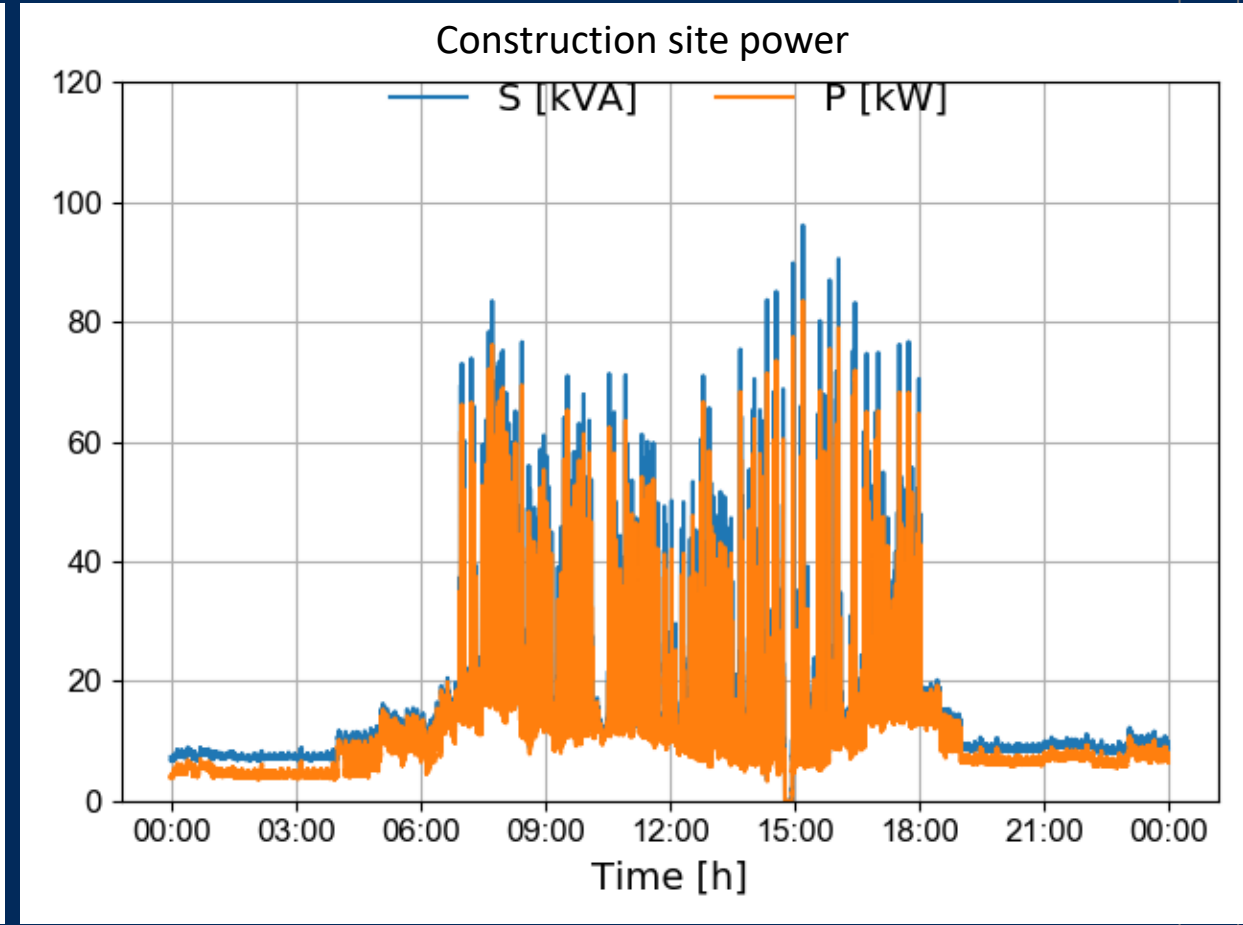
Battery technology in case of a grid failure



Construction site with 2 *Wolff 6031* cranes
Contractor proceeded its operations for 4h, then it was decided to shut down under control until the grid connection was restored 0,5h later.

Battery technology in case of a grid failure



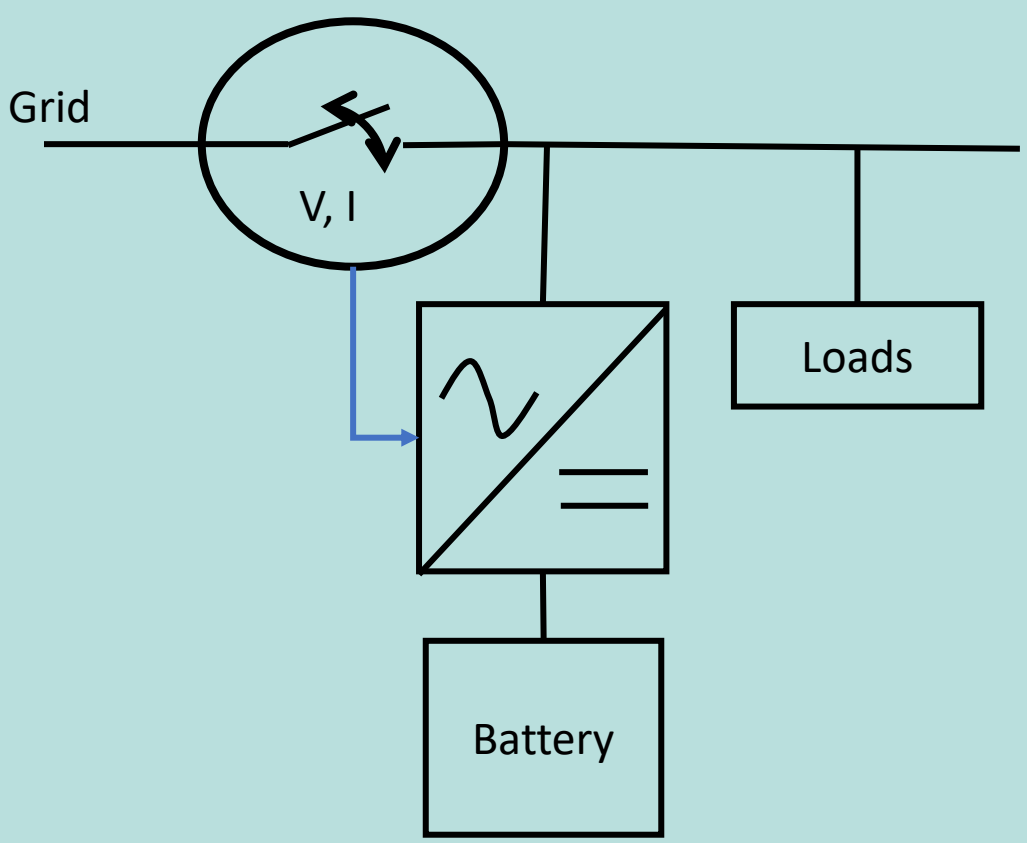


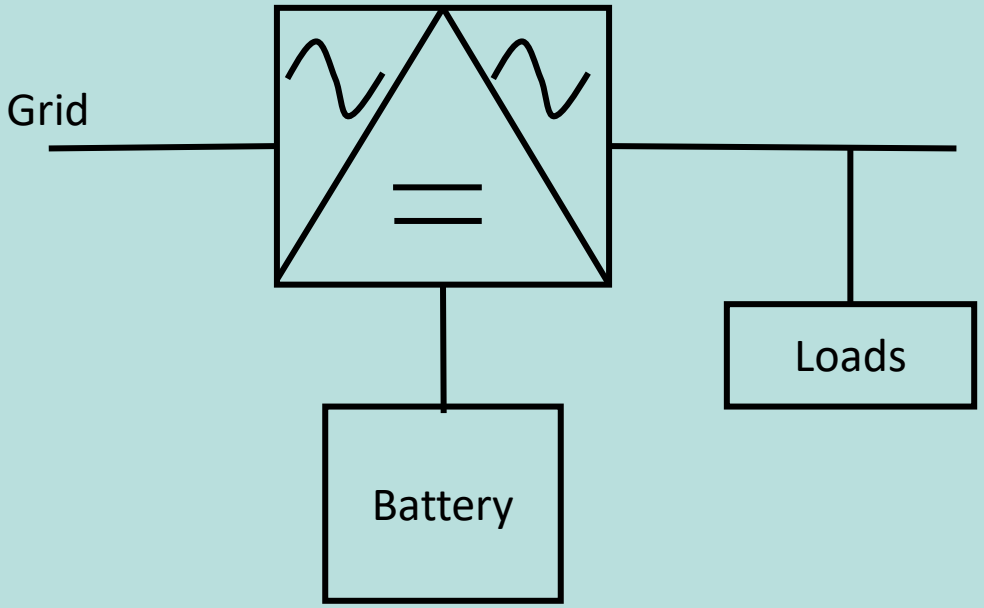
Construction site with *Potain MDT 349 and Potain MDT 319* cranes.
Contractor proceeded its operations during the grid failure without loss of productivity.

Neargrid

The different inverter topology solutions

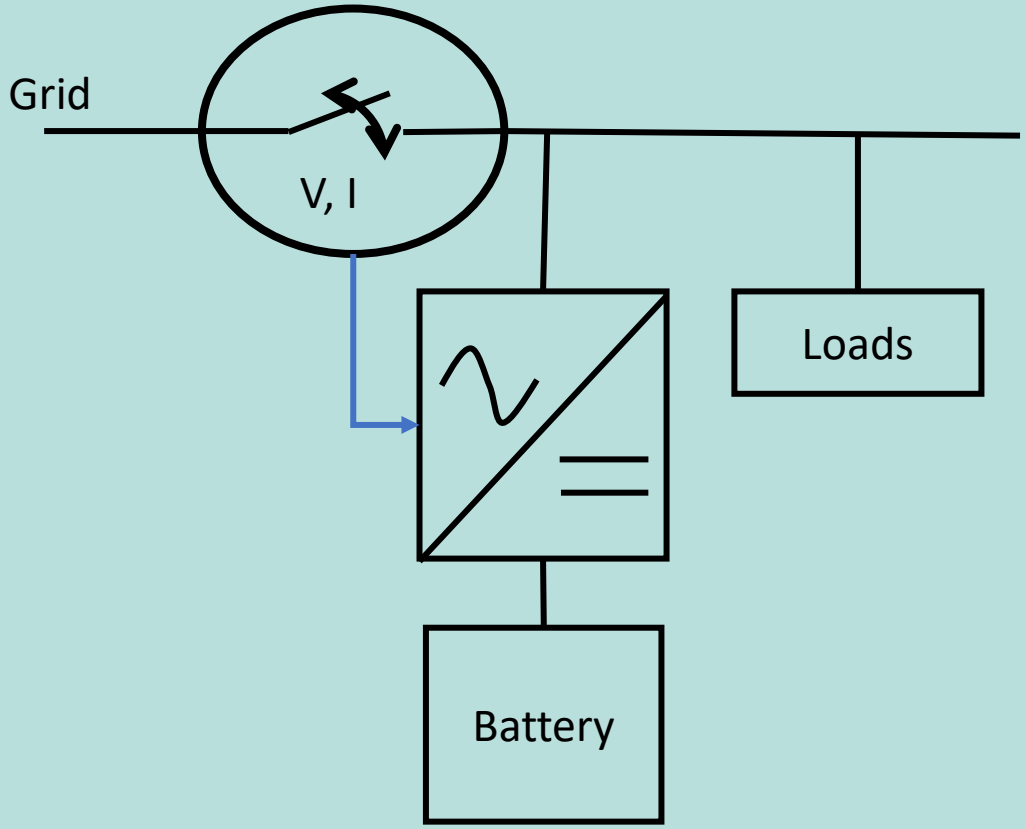
- There are 2 ways to connect the inverter to the grid and the load:





The power supply – inverter topology

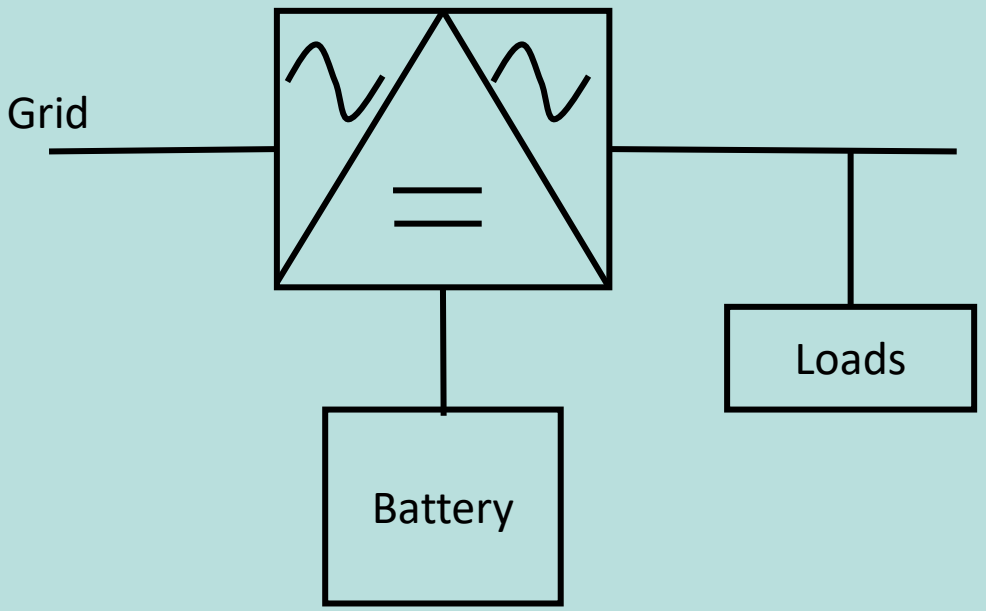
- Grid parallel operation
- Inverter adds the necessary power to supply the load
- When grid is unavailable, the power that can be delivered is dependent on the inverter power rating
- Grid code can limit the inverter power rating



Neargrid

The power supply – inverter topology

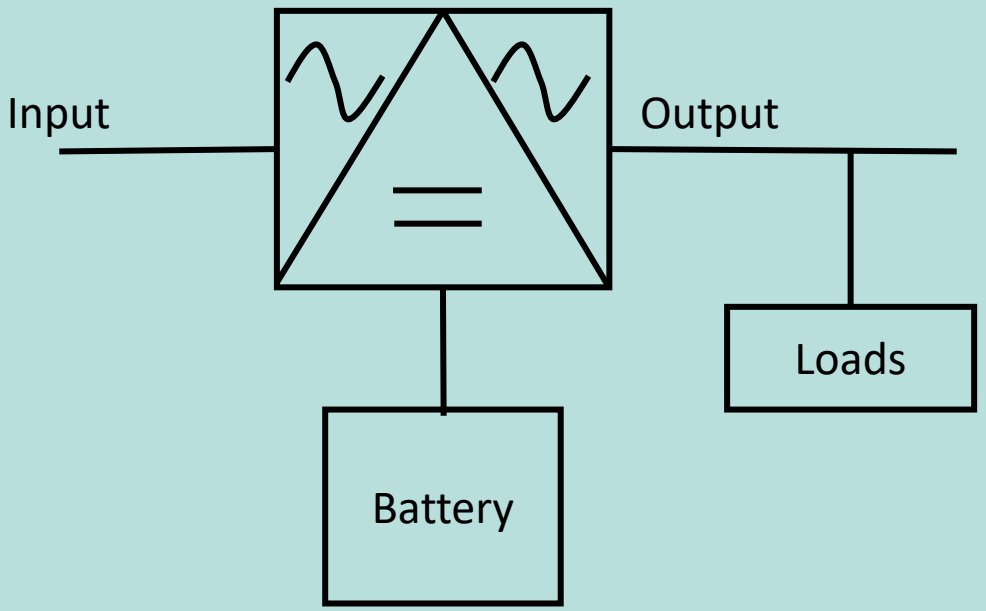
- Grid series connection
- The inverter creates his own grid to supply the loads
- When grid is unavailable, the load remains to be supplied with energy coming from the battery



Neargrid

Requirements at Input

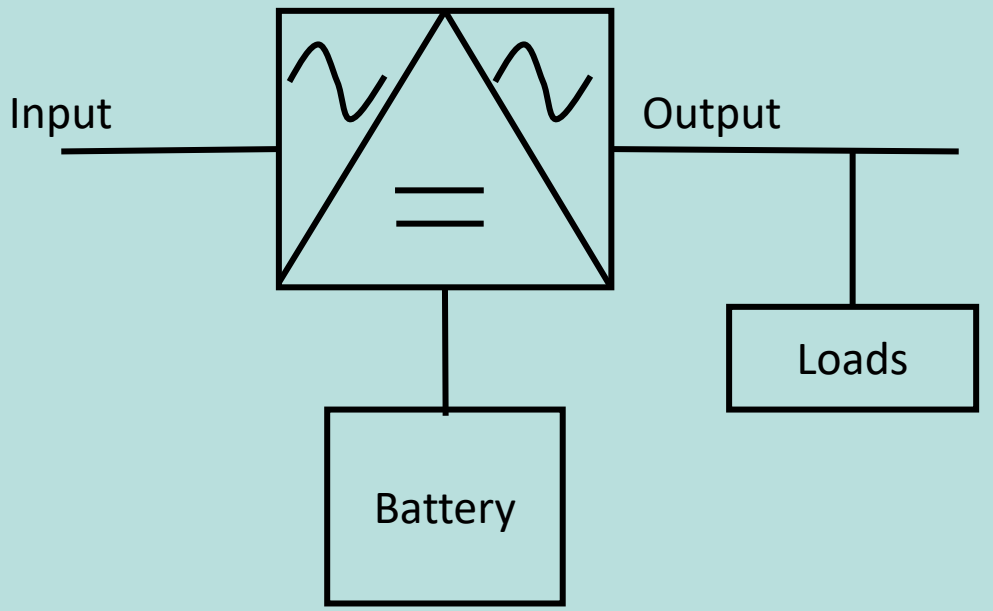
- Enable use of weak grid connection
- Ability to connect diesel genset 20kVA-60kVA
- Ability to limit the input power to a certain value



Neargrid

Requirements at Output

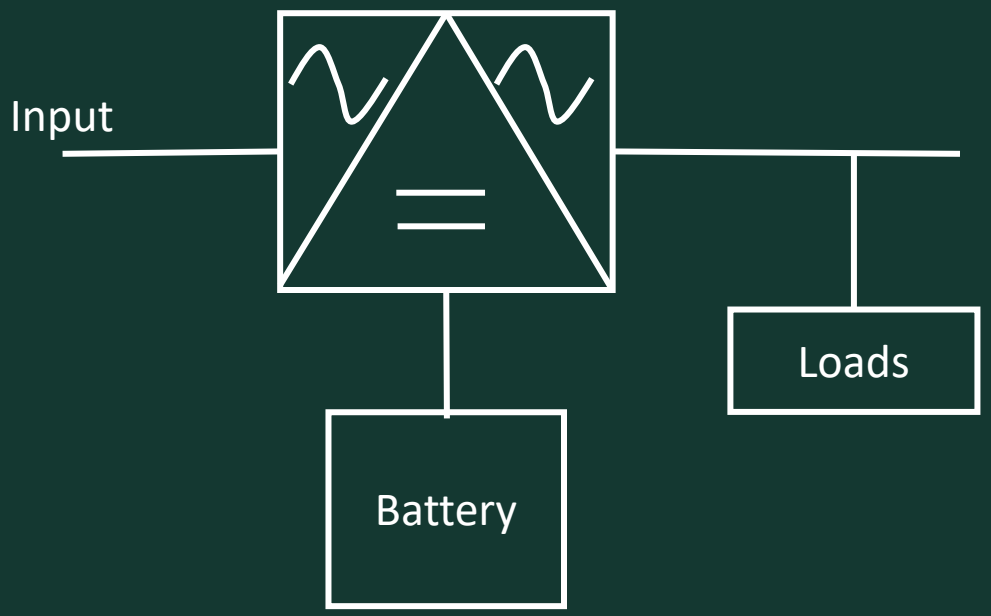
- Output power upto 200kVA nominal and 300kVA peak
- Short-circuit current capability
- Bidirectional power flow where energy first goes to battery and to grid if battery is full
- Limited leakage current (<70mA for 200kVA system)

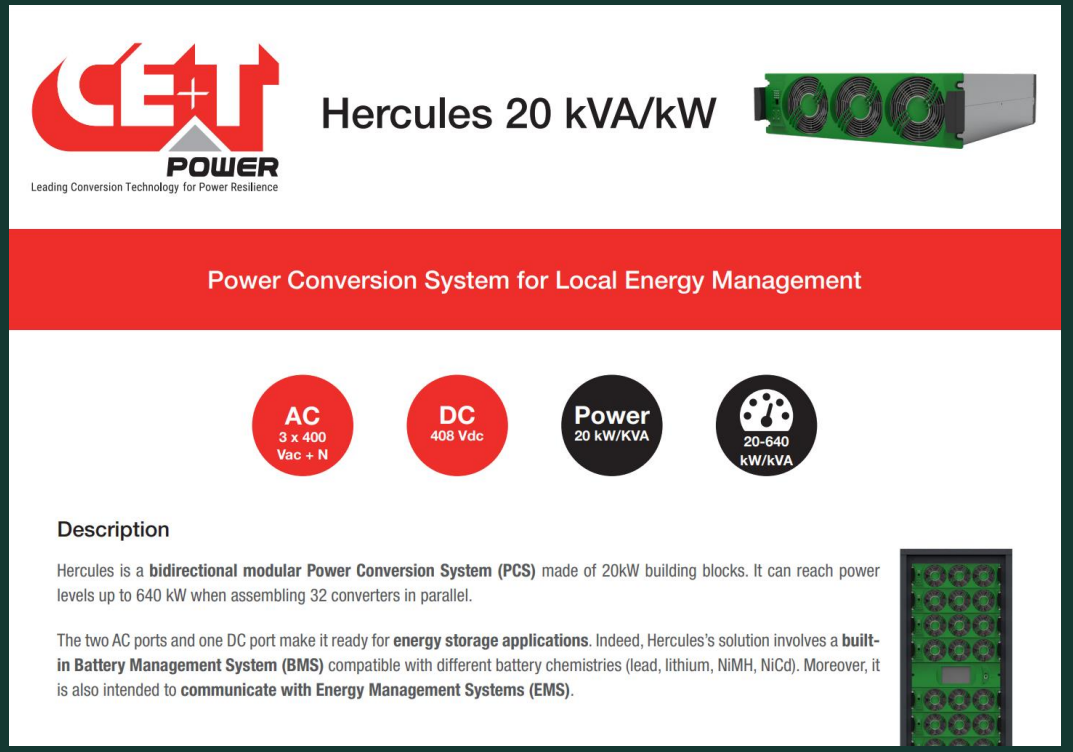


Neargrid

The chosen inverter - input

- Enable use of weak grid connection

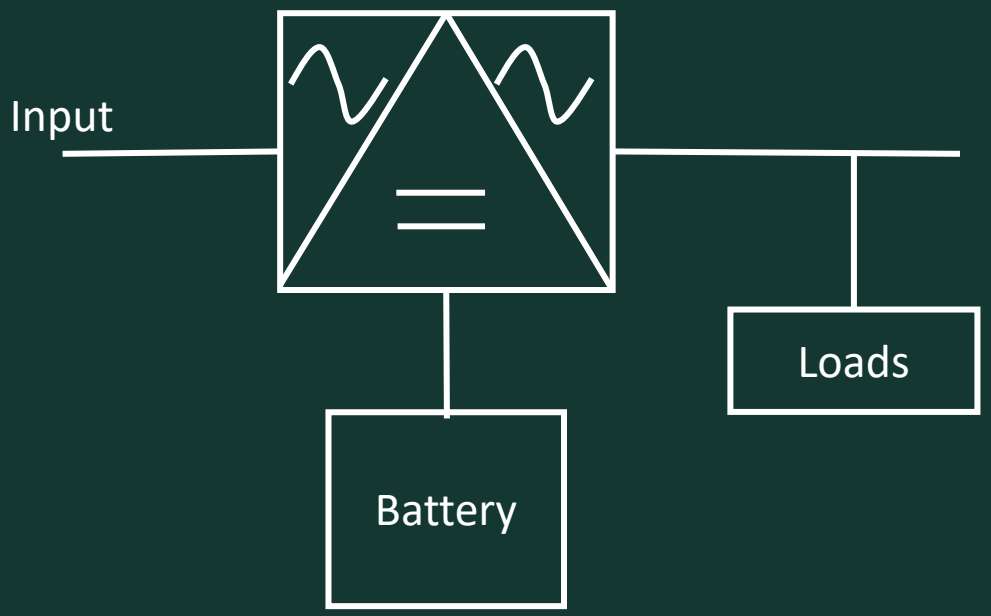


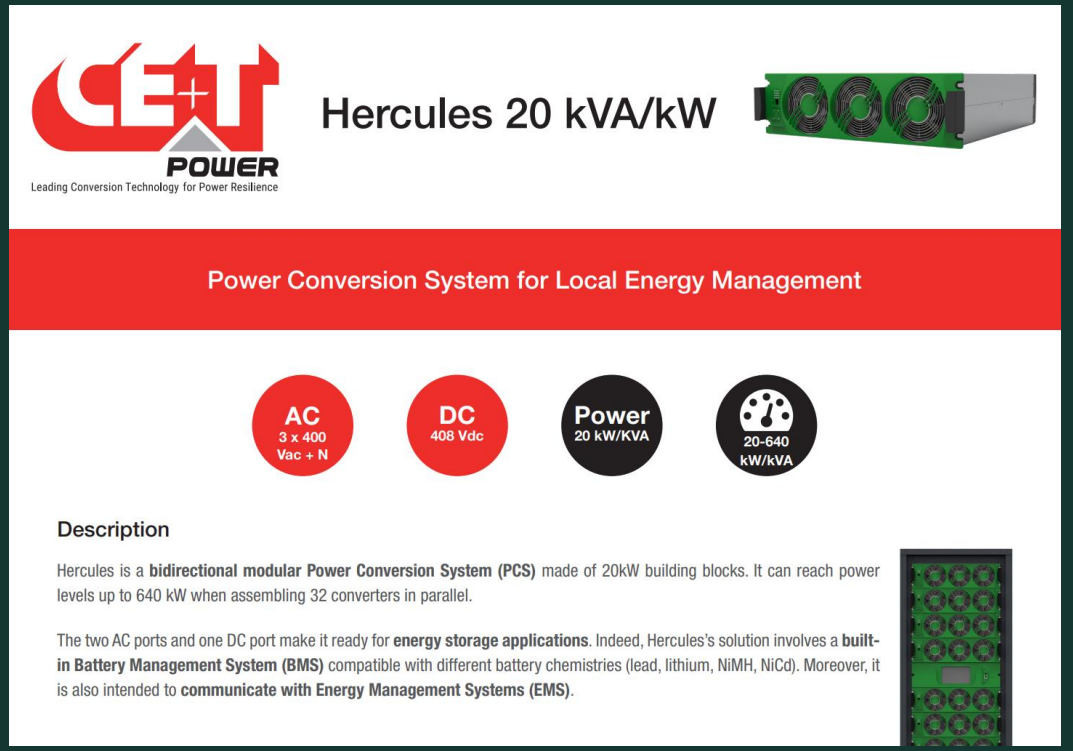


Neargrid

The chosen inverter - input

- Enable use of weak grid connection
- Ability to connect diesel genset 20kVA-60kVA



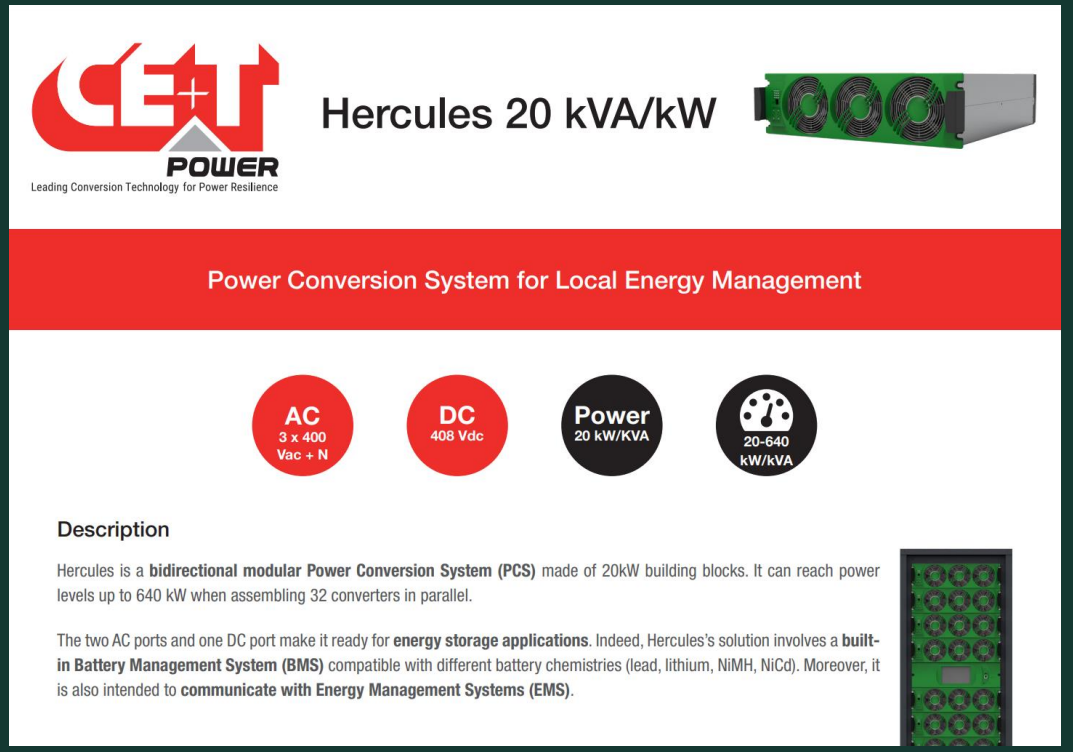


Neargrid

The chosen inverter - input

- Enable use of weak grid connection
- Ability to connect diesel genset 20kVA-60kVA
- Ability to limit the input power to a certain value

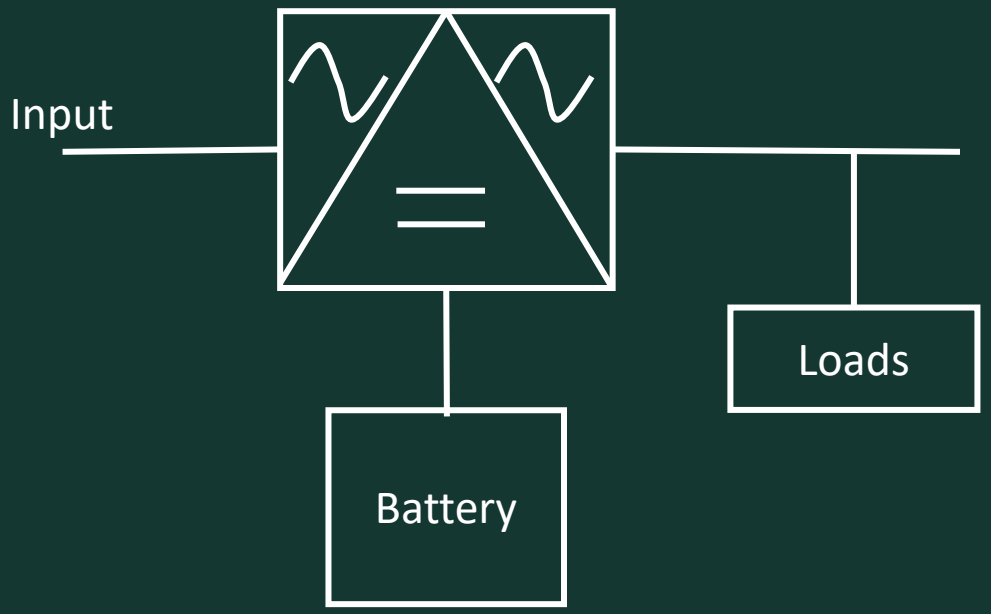
→ Input requirements met



Neargrid

The chosen inverter - output

- Modular output power



CE+T POWER
Leading Conversion Technology for Power Resilience

Hercules 20 kVA/kW

Power Conversion System for Local Energy Management

AC 3 x 400 Vac + N

DC 408 Vdc

Power 20 kW/KVA

20-640 kW/kVA

Description

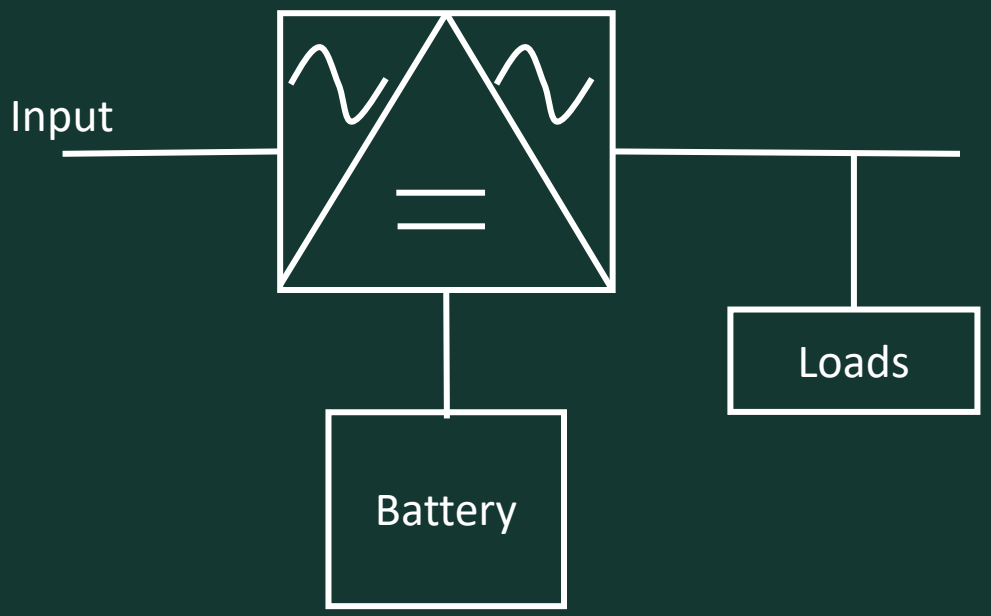
Hercules is a **bidirectional modular Power Conversion System (PCS)** made of 20kW building blocks. It can reach power levels up to 640 kW when assembling 32 converters in parallel.

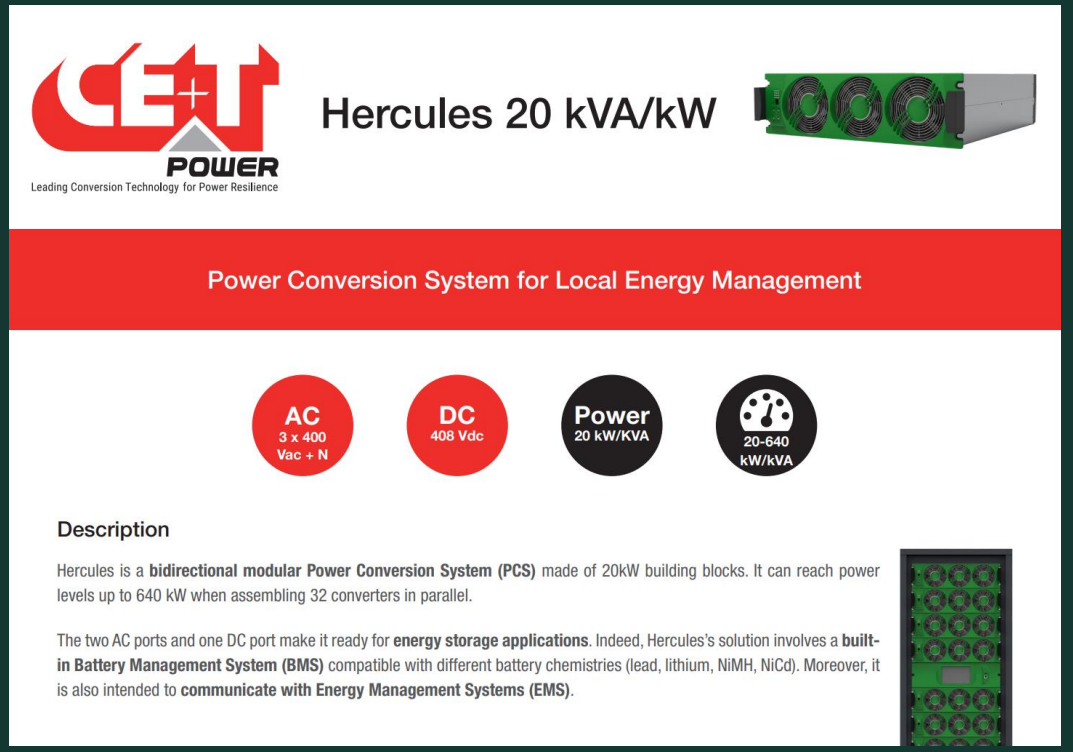
The two AC ports and one DC port make it ready for **energy storage applications**. Indeed, Hercules's solution involves a **built-in Battery Management System (BMS)** compatible with different battery chemistries (lead, lithium, NiMH, NiCd). Moreover, it is also intended to **communicate with Energy Management Systems (EMS)**.

Neargrid

The chosen inverter - output

- Modular output power
- Short-circuit current capability

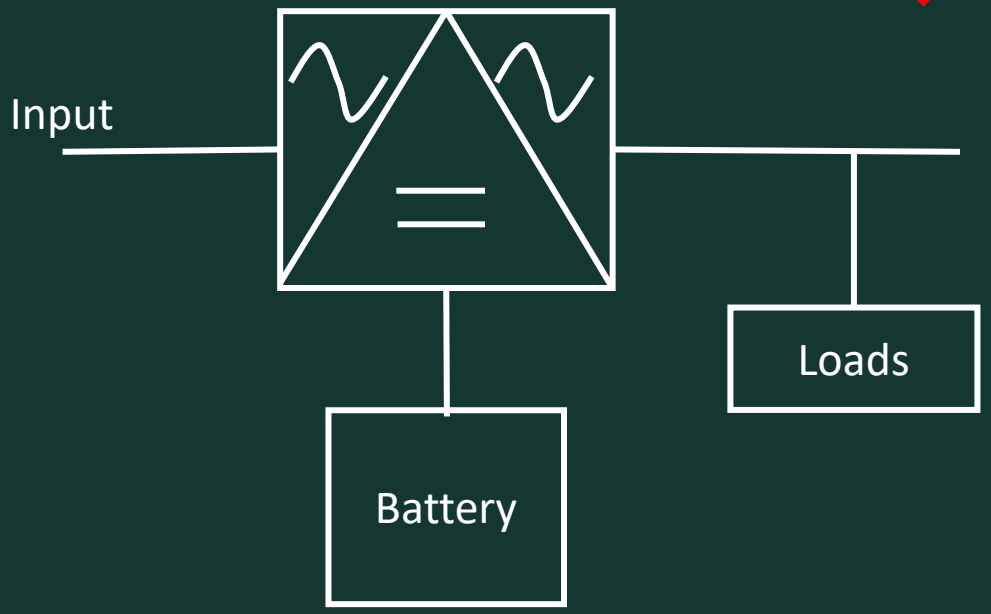


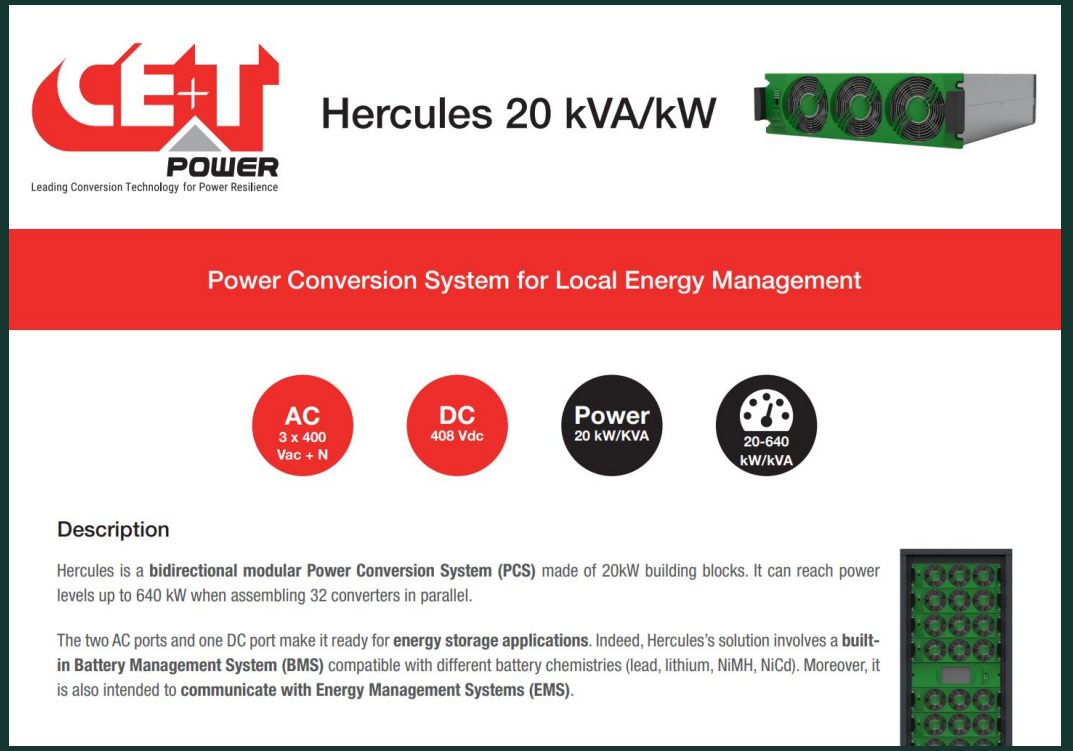


Neargrid

The chosen inverter - output

- Modular output power
- Short-circuit current capability
- Limited leakage current

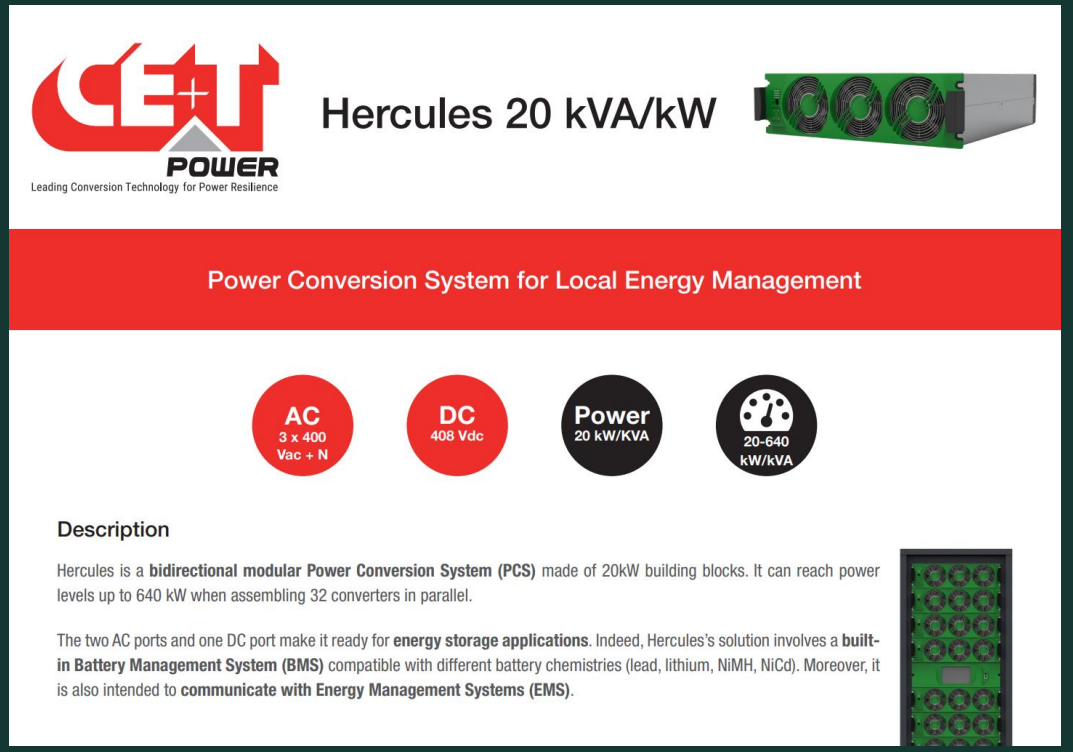




Neargrid

The chosen inverter - output

- Modular output power ✓
- Short-circuit current capability ✓
- Limited leakage current ✓
- Bidirectional power flow where energy first goes to battery and to grid if battery is full ✗



Neargrid

Takeaways

- Grid connection is becoming a challenge
- Battery solution is much more interesting compared to a diesel gensets
- The power quality is decreasing making three-port systems more interesting

Neargrid

Questions?

Bart Meersman
Founder

+32 497 66 71 68
bart@neargrid.solutions

Frank Vermeulen
Founder

+32 478 65 27 43
frank@neargrid.solutions

Gil De Backer
Business development

+32 471 80 02 70
gil@neargrid.solutions