DC/DC converters to couple renewable energy sources and storage

- Epic power Converters — Raúl Ramón — rramon@epicpower.es
- Elincom Electronics — Hans Zijlstra — h.zijlsta@elincom.nl

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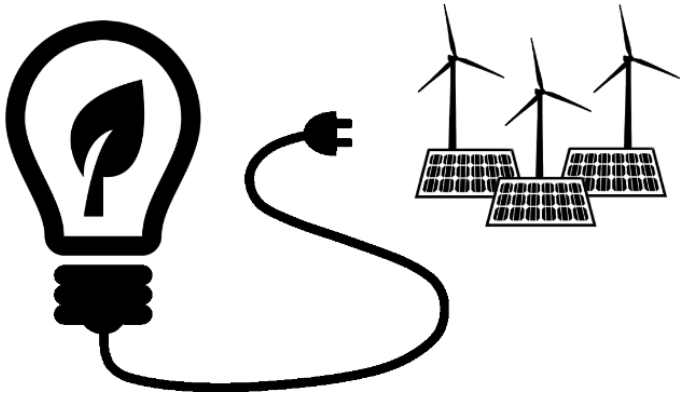
Agenda

- Epic power Converters & Elincom Electronics
- DC/DC Converters & applications
- Energy transition include renewables, what about storage?
- Give it a good mix!
- Green power to H2
- Are electrolyzers and fuel cells that different?
- Can the problem be solved by batteries alone?
- Who’s in charge!
- Conclusions



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Elincom Electronics

- Value added distributor since 1975
- Technical focus
- Over 900 B-to-B customers in the BENELUX
- Components & modules for industrail automation & industrial electronics

- Power Electronics / Energy Storage Event:

POWER CONVERSION

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PREMO Innovating in Magnetics
KOCH
DEUTRONIC Elektronik GmbH EDWANZ group
BLOCK
XP Power

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EVE ENERGY VERY ENDURE
VINATech
DJbattery
GeB
cleantron
TEFOO

BATTERY CHARGING

epic power
delta-q TECHNOLOGIES
mascot

SWITCHING

celduc relais
Panasonic INDUSTRY
MERSEN

Epic Power Converter S.L.

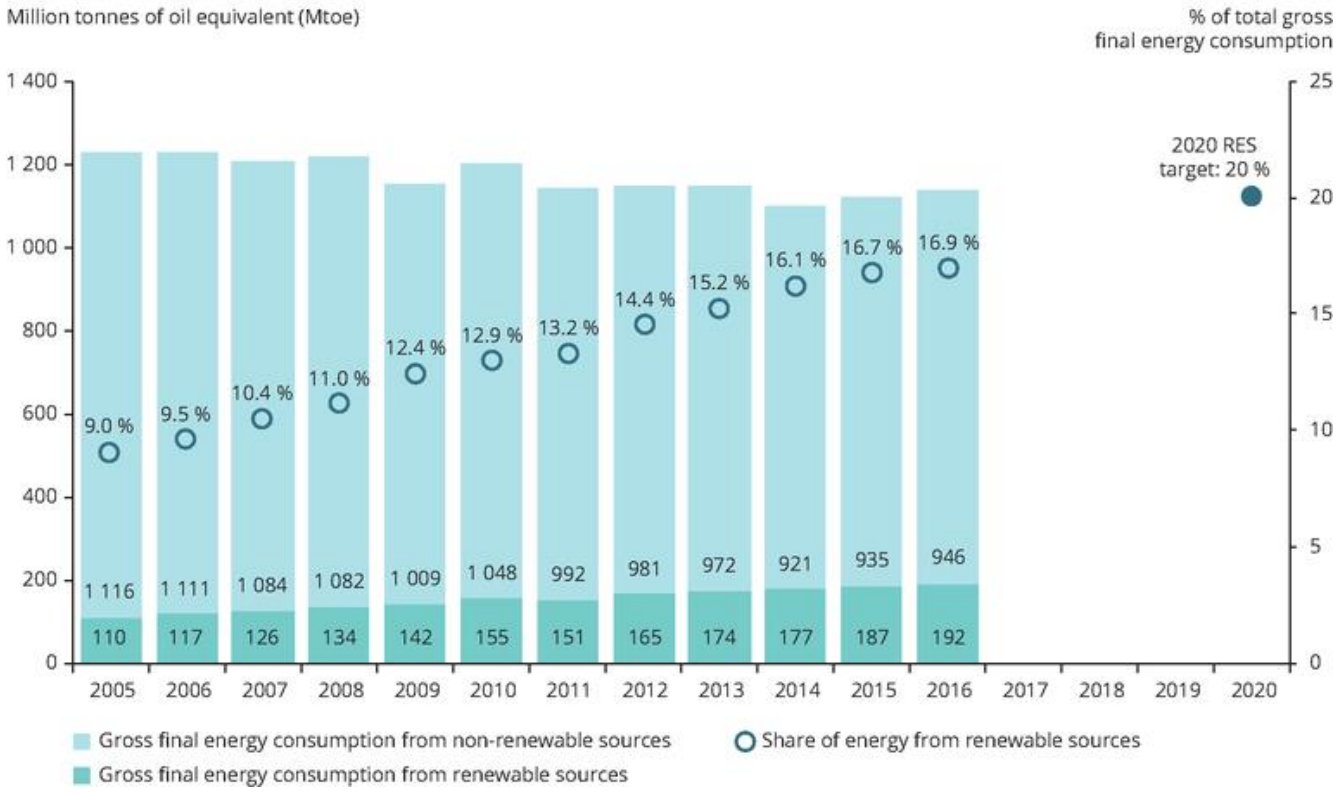
Bidirectional DC/DC Converters for

Lift / Crane sector

Intralogistics

Energy storage and usage

Energy transition include renewables, what about storage?



European Environment Agency

To carbon neutral by 2050:

- Share of renewables must increase
- Transmision and interconnection must be improved

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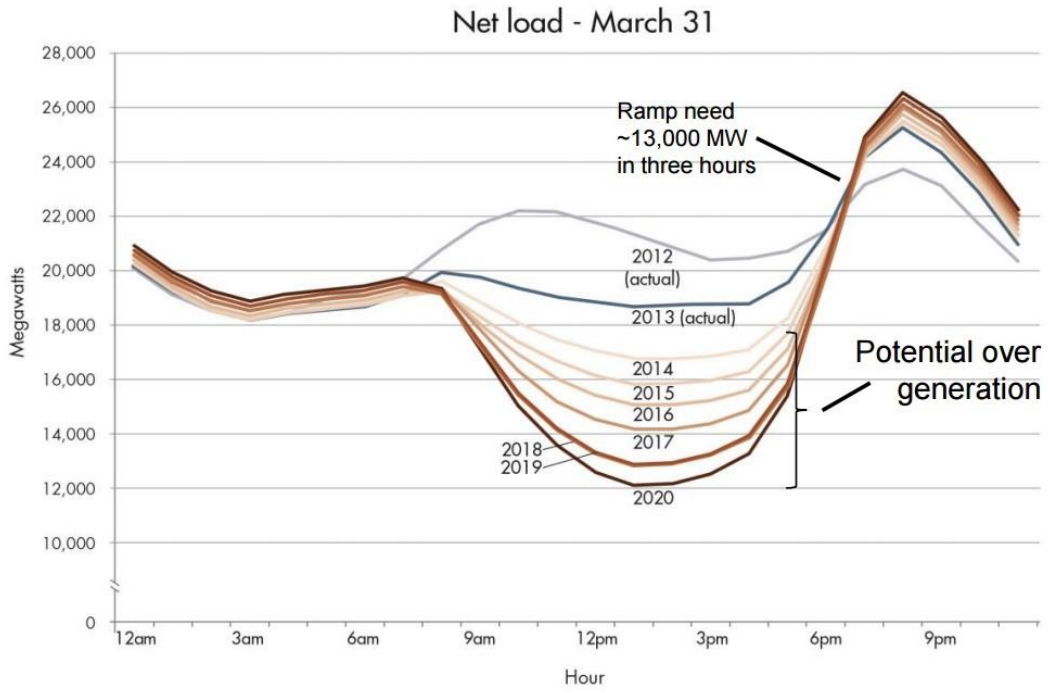
Energy transition include renewables, what about storage?



California ISO – Duck curve

Challenges:

- Maximize production
- Include short and long duration storage
- Ensure grid reliability with fluctuations

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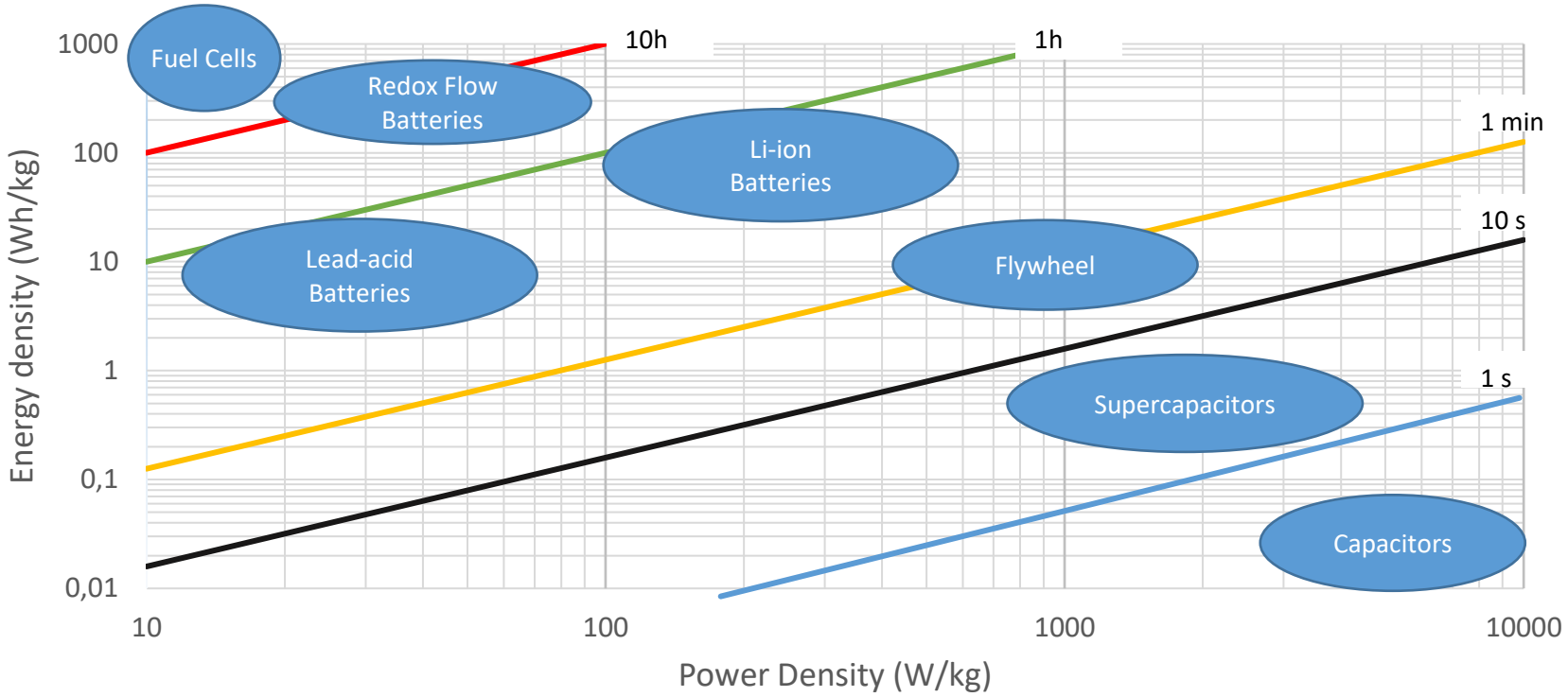
Energy transition include renewables, what about storage?



Long Duration

Quick response

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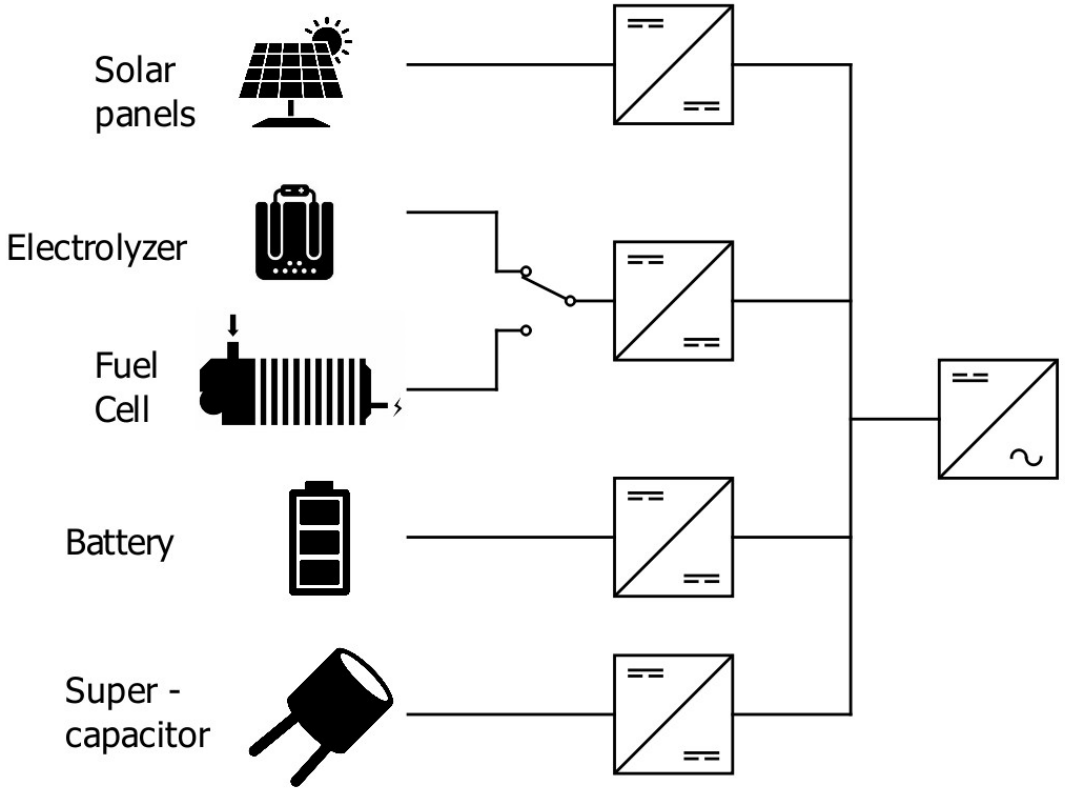
Give it a good mix

Multiple long duration and short duration energy storages must be integrated in the grid...
Why not doing the mix, where the energy is generated or stored!?



Transportation in AC ✓

Generation in Low-DC ✓

Storage in Low Voltage DC ✓

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Green Power to H2

European Project Ely4Off

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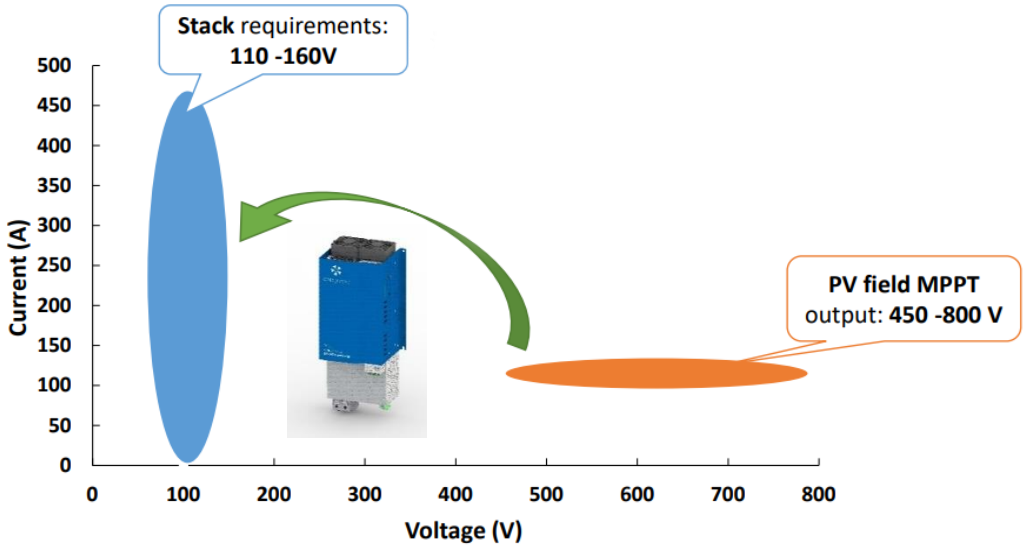
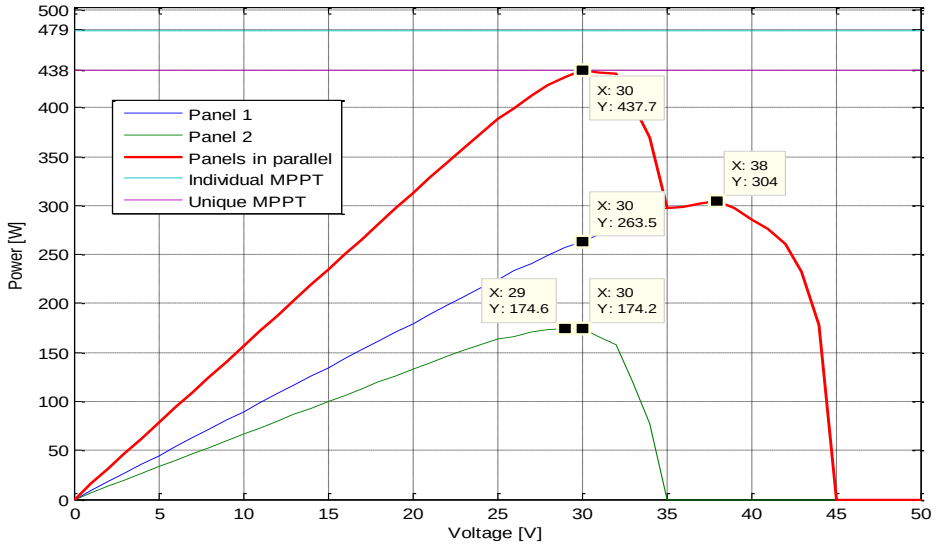
Green Power to H2

European Project Ely4Off

- Maximize the solar production by doing MPPT per solar string
- Feed the electrolyzer directly from PV with DC/DC Converters
- Increase the production reliability with battery support
- Improve lifetime of PEM electrolyzer with minimal ripple in regulation





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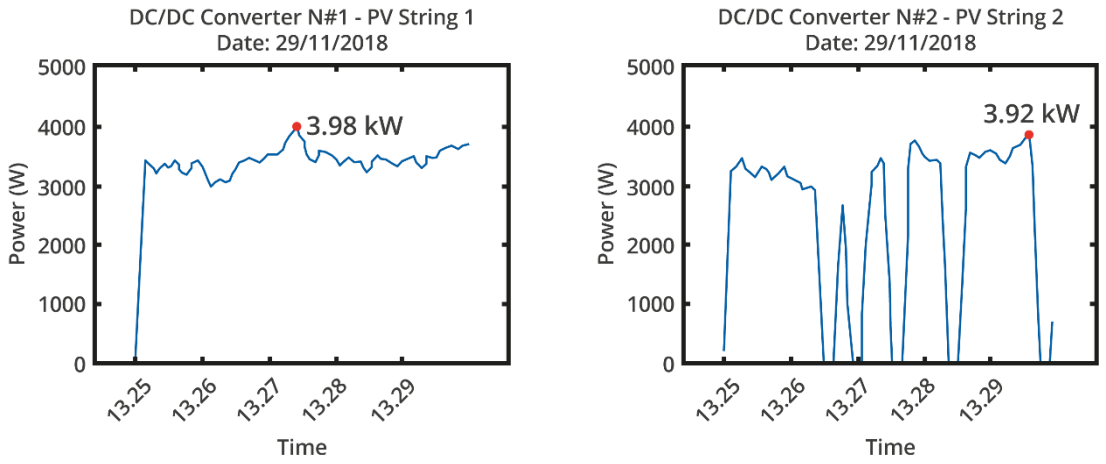
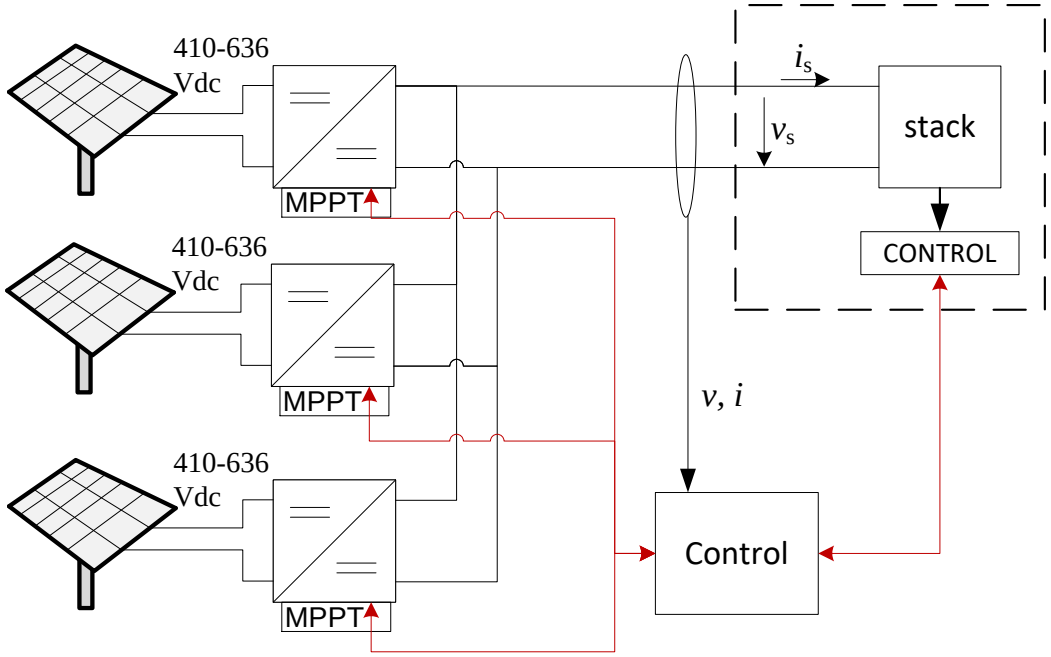
Green Power to H2

European Project Ely4Off

DC converters regulate voltage on the stack:

- Voltage limit = EoL stack voltage
- Power or current limits for plant power
- MPPT conditions for input power





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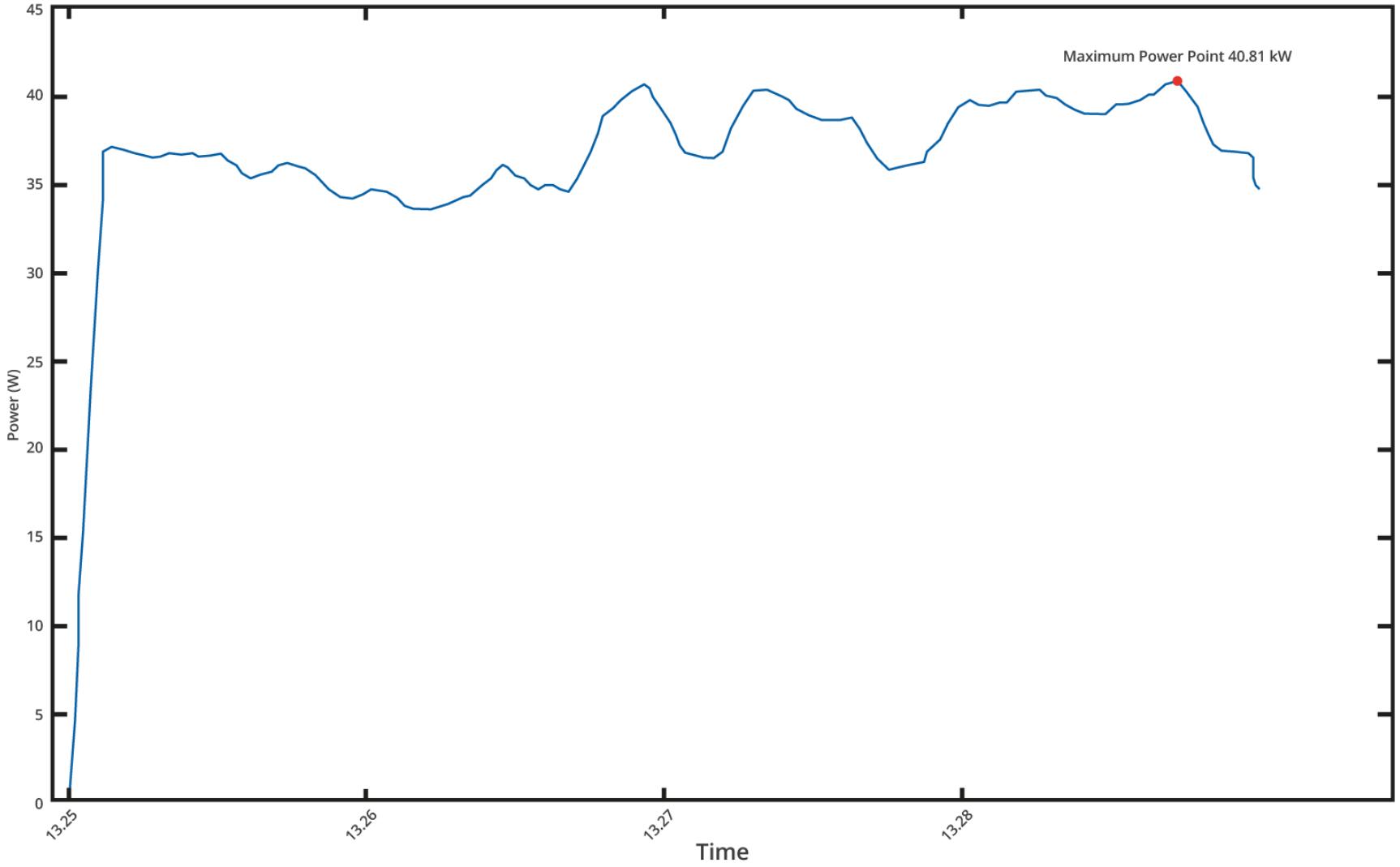

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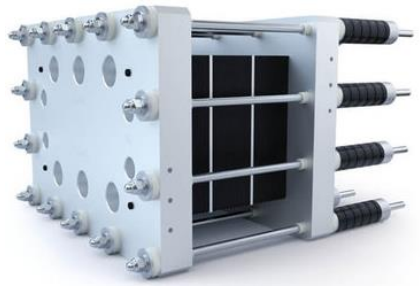
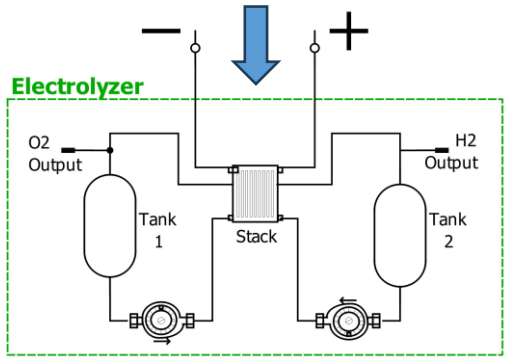
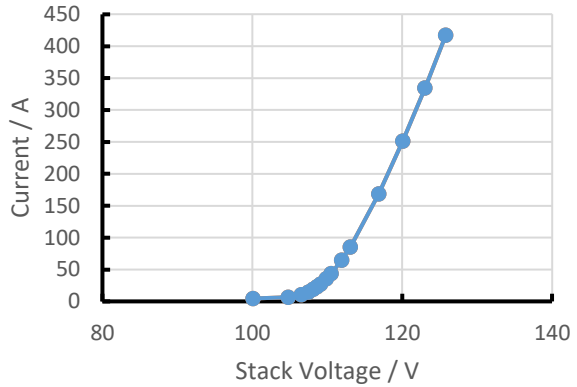
Are electrolyzers and fuel cells that different?

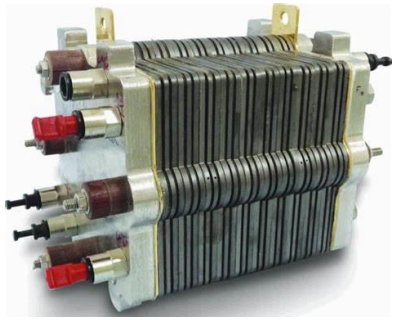
Electrolyzer stack

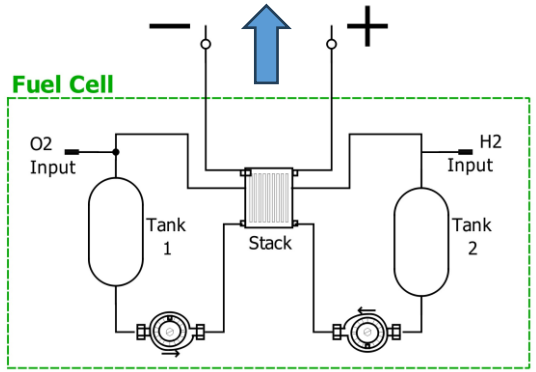


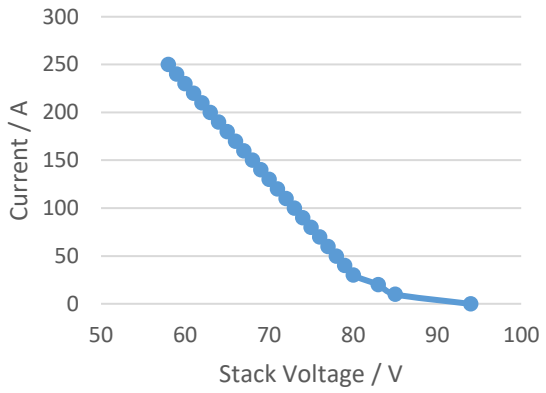


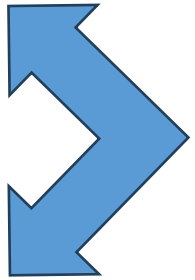


Fuel Cell Stack









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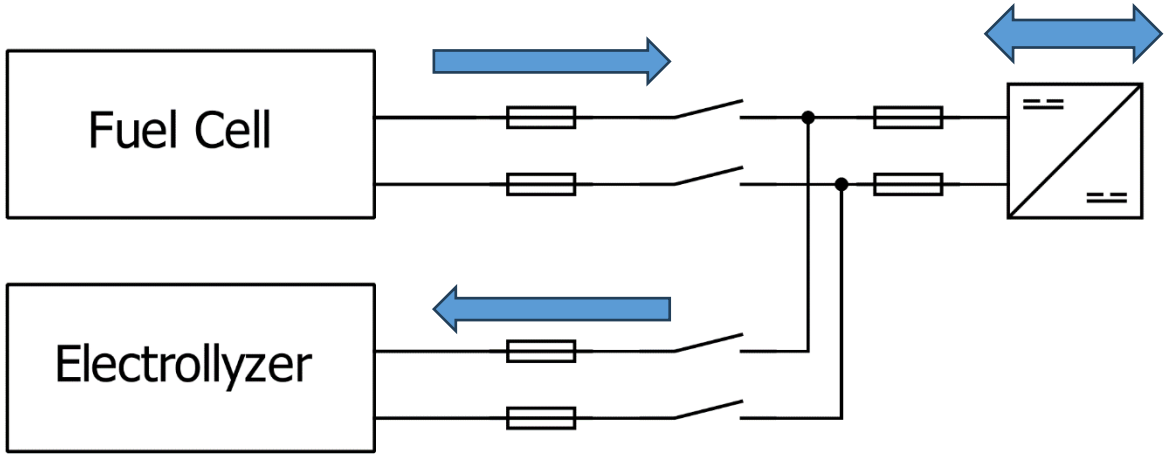

Bidirectional DC/DC Converters

can work with both!

- **Electrolyzer only works when there are renewables available**
- **Fuel cell is only used when the electrolyzer is off**

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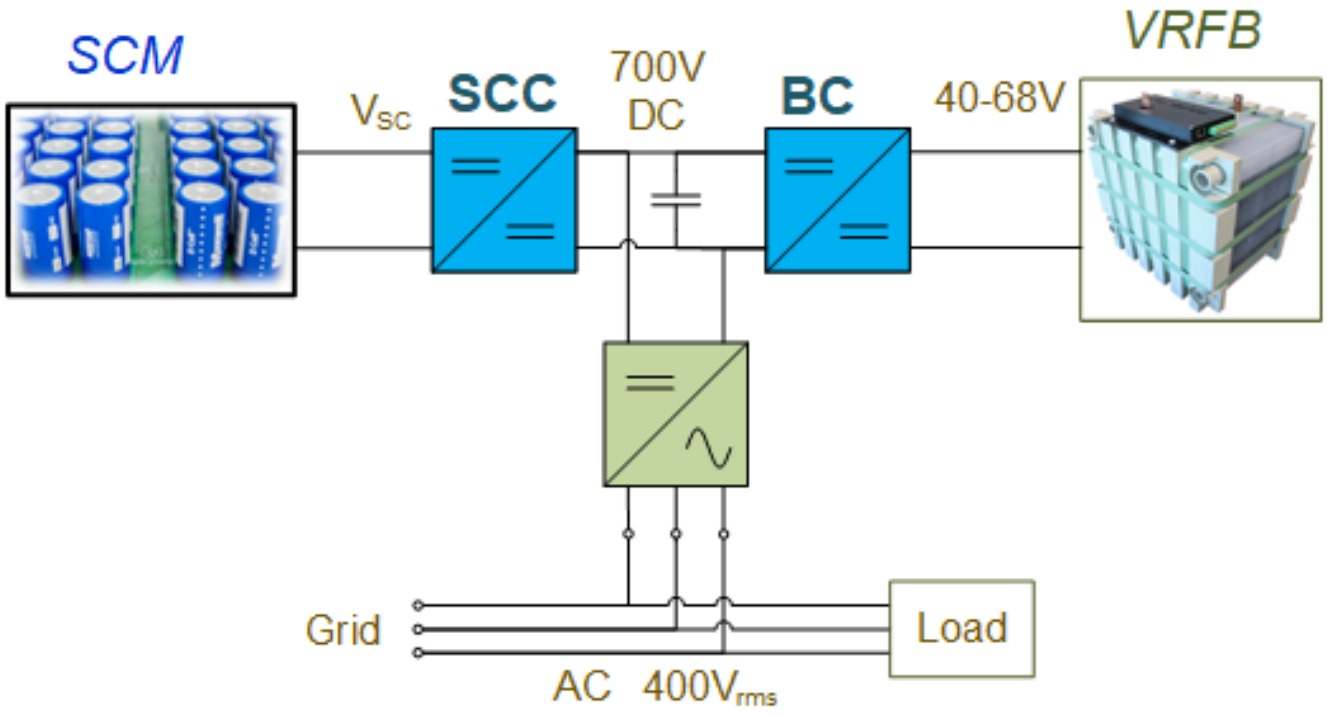
Can the problem be solved by batteries alone?



HyFlow - European Project

- Develop high-power VRF battery
- Hybridize with organic supercapacitors
- Interconnect and manage the system

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Can the problem be solved by batteries alone?

	Supercapacitors	Batteries
Cycles	> 1 Million	> 1000
Efficiency	> 98 %	70-90 %
Energy Density (Wh/kg)	4 – 9	100 - 265
Power Density (W/kg)	4000 – 10000	300 – 1500
Operation time	Seconds	Hours
Converters	Working from 0 V	Voltage & current regulation required

HyFlow - European Project

- Develop high-power VRF battery
- Hybridize with organic supercapacitors
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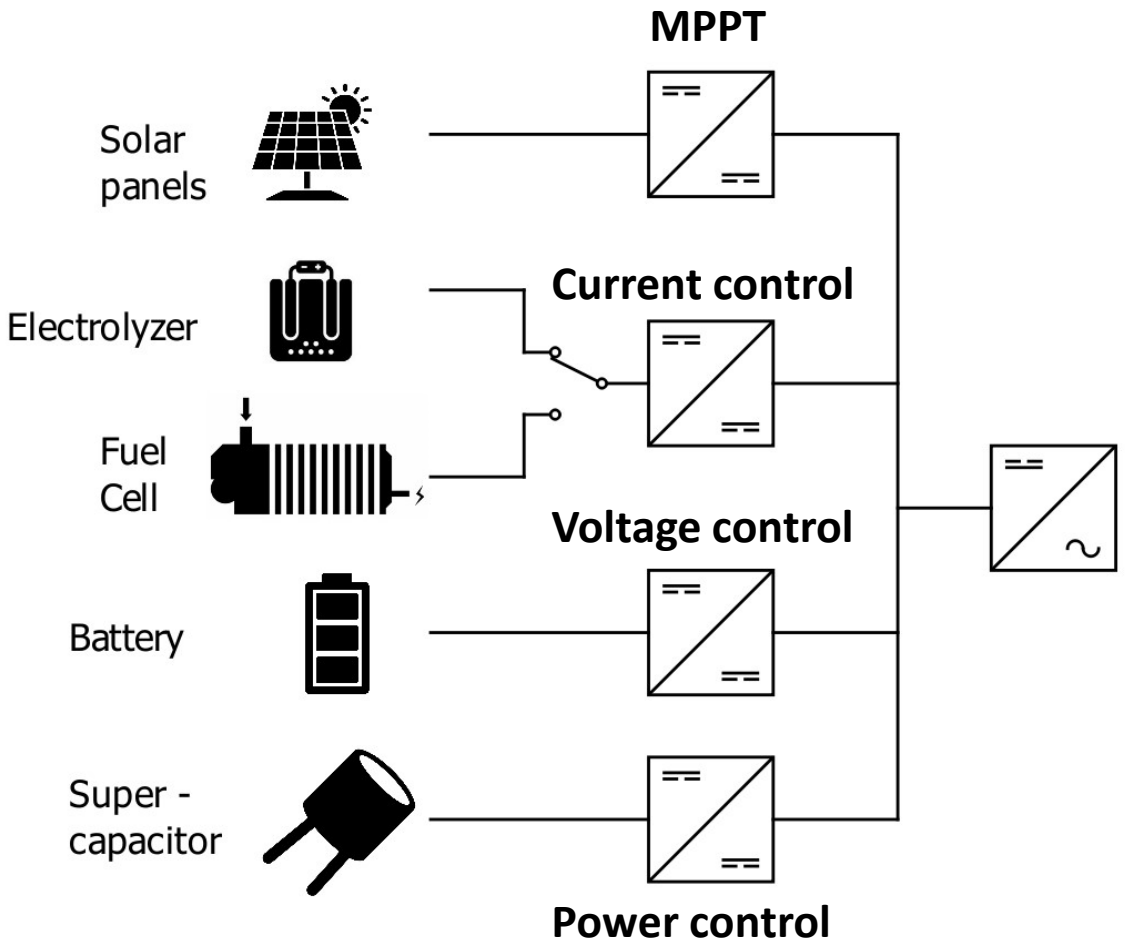
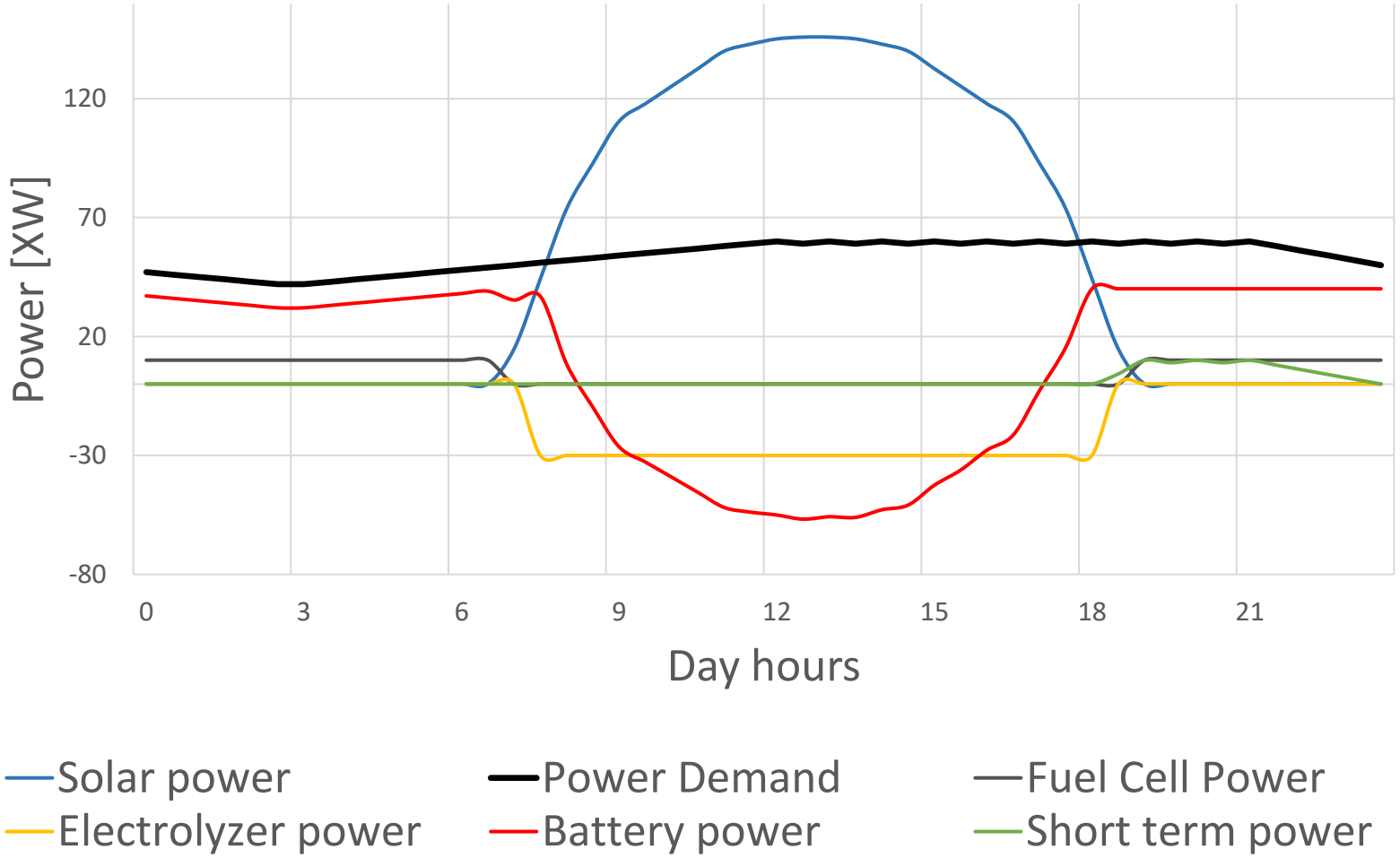
Who's in charge?!



With power controlled inverter:

- Converter with batteries
  → Quick voltage control
- Converter with solar panels
  → MPPT
- Converter with electrolyzer/fuel cell
  → Current control
- Converter with supercapacitors
  → Power control

Who’s in charge?!



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Conclusions:

1. Different storage technologies are required for a reliable grid
2. The use of bidirectional electronics simplifies the system definition
3. It is posible to operate fuel cells and electrolyzers with 1 single bidirectional converter
4. Each storage technology requires specific electronics (quick response, start from 0 V…) and control
5. Working in DC can reduce the amount of elements in the installation and increase the efficiency

Bidirectional DC/DC converter range

Model	Isolated	High side Voltage [Vdc]	Low side Voltage [Vdc]	Power per unit [kW]
EPC 3k5 648i	✓	510-848	38-59	3.5
EPC 5k5 648i	✓	510-848	38-59	5.5
EPC 2k2 624i	✓	510-848	19-30	2.2
EPC 2k2 348i	✓	280-450	38-59	2.2
EPC 2k2 324i	✓	280-450	19-30	2.2
EPC 4k8 6125i	✓	430-830	110-165	4.8
EPC 7k 670i	✓	510-848	40-80	7
EPC 8k 8380i	✓	650-800	280-600	8
EPC 50A 0848		50-848	0-798	up to 40
EPC 50A 1200		50-1200	0-1150	up to 57

Thanks! For more information: stand nr. 1

- Epic power Converters Raúl Ramón rramon@epicpower.es
- Elincom Electronics Hans Zijlstra h.zijlsta@elincom.nl

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