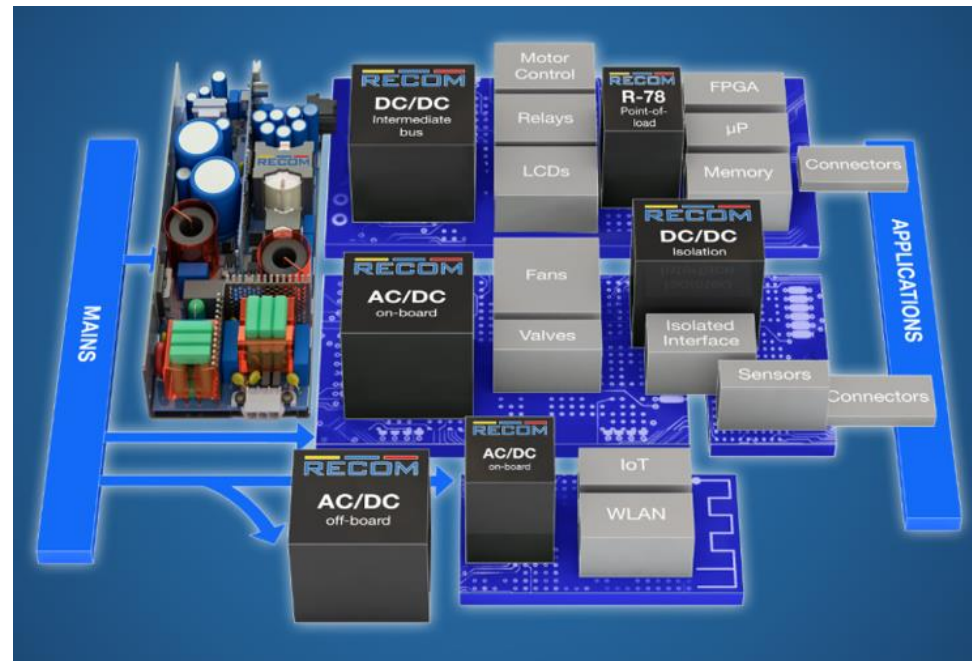


RECOM's easy design-ins for EV-Charging, Energy Storage and Mobility Solutions - 27.06.2023 - Florian Boess, RECOM Electronic



RECOM - Standard Product Portfolio



DC/DC Converters isolated

from 0.25W up to 1000W (1kV - 20kVDC Isolation)



Switching Regulators

Step Down and Buck Boost from 10mA up to 50A

Power Modules SMD 1A up to 20A



AC/DC Converters

from 1W up to 1200W



LED drivers

AC & DC input
from 3W to 72W

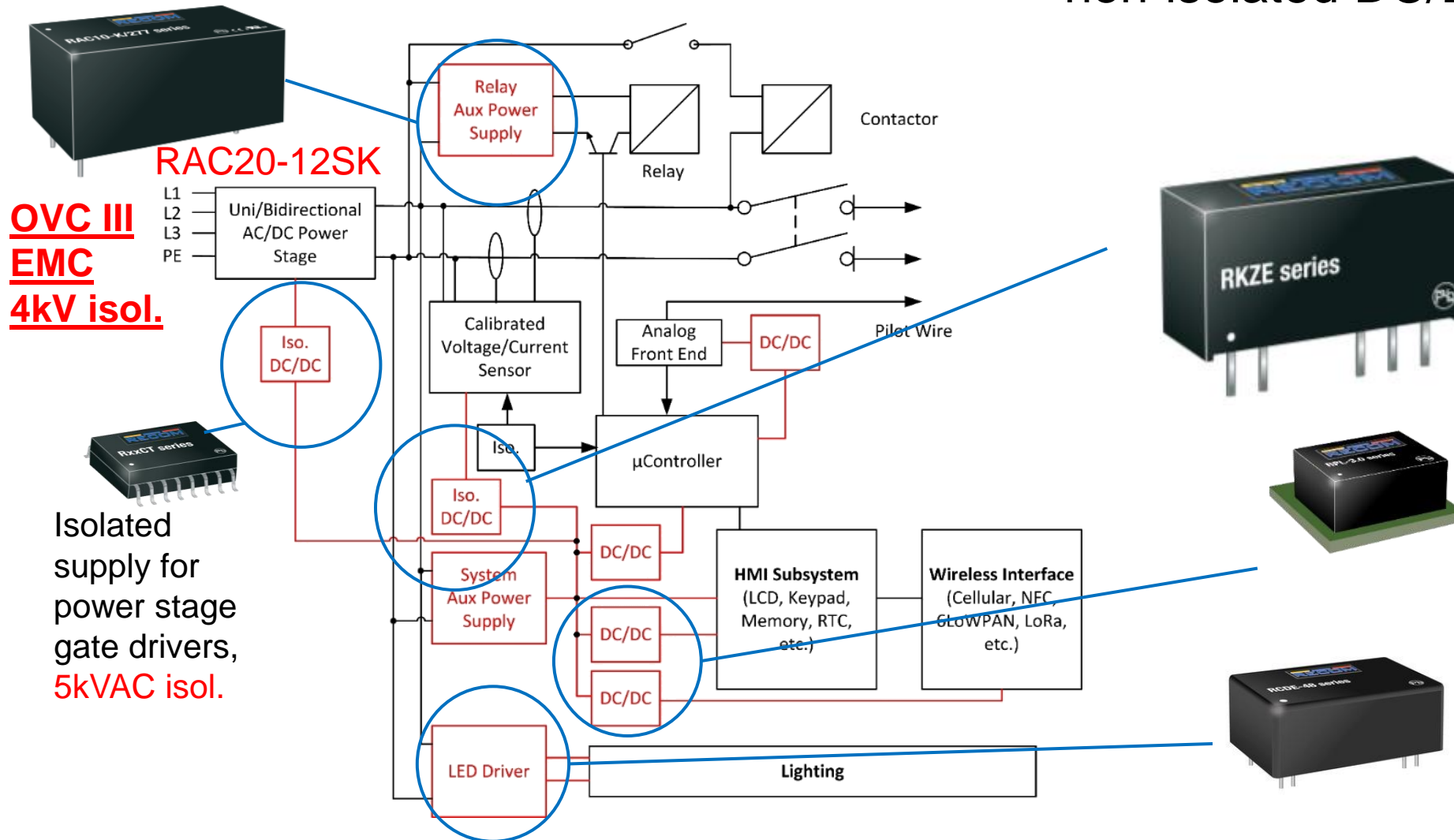


AC - Public Charging: High power charger



Solution: RAC, RKZE, RPL, RxxCTxx, RCDE-48

Example applications of isolated and non-isolated DC/DCs:



**OVC III
EMC
4kV isol.**

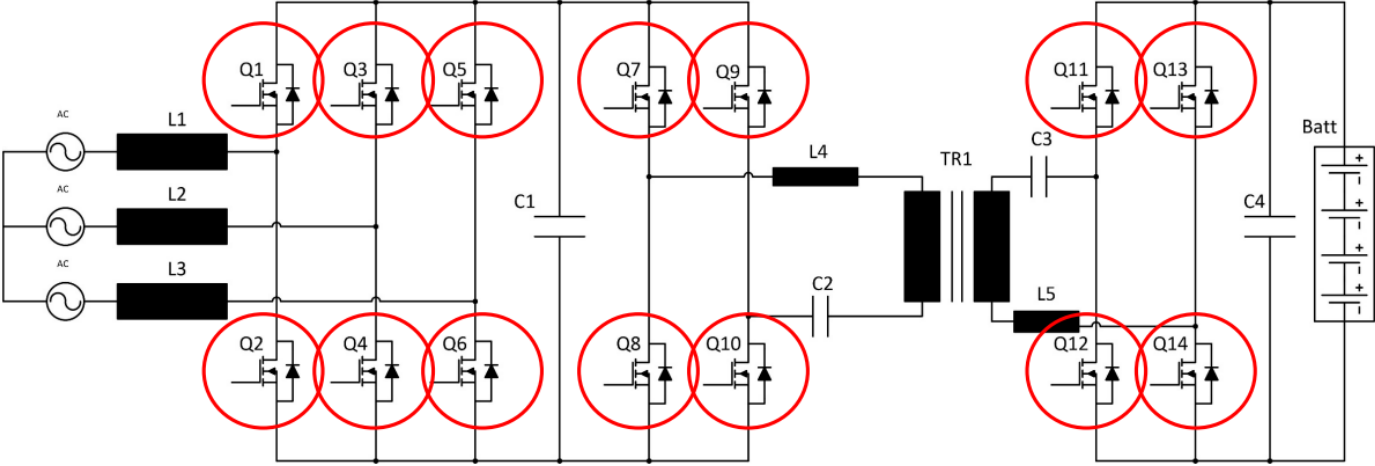
Isolated supply for power stage gate drivers, **5kVAC isol.**

Isolated supply for AC power monitoring circuit using **RKZE-1212S/H2**: a low cost 2W DC/DC with 4kVDC isolation and operation from -40°C to +80°C, no derating

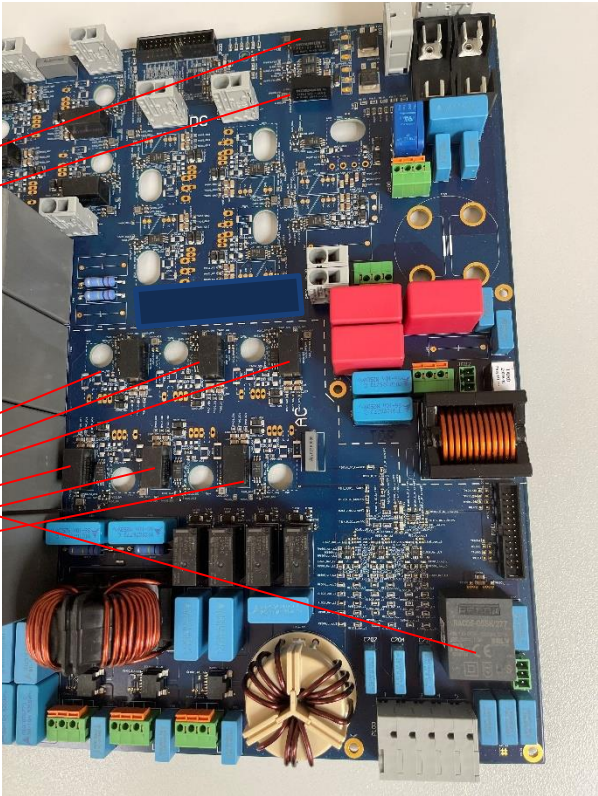
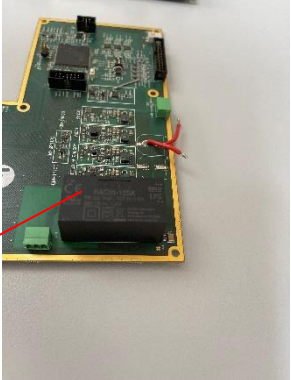
Non-isolated 3.8VDC/3A supply for data modem using **RPL-3.0**: a tiny 3mm² integrated inductor buck converter with adjustable output and full protection (SCP, OLP, OVP, OTP, UVLO).

Step-down constant current LED-Driver using **RCDE-48**: Wide Vin, high ambient operating temp. and two means of dimming: PWM/digital control and analogue voltage dimming.

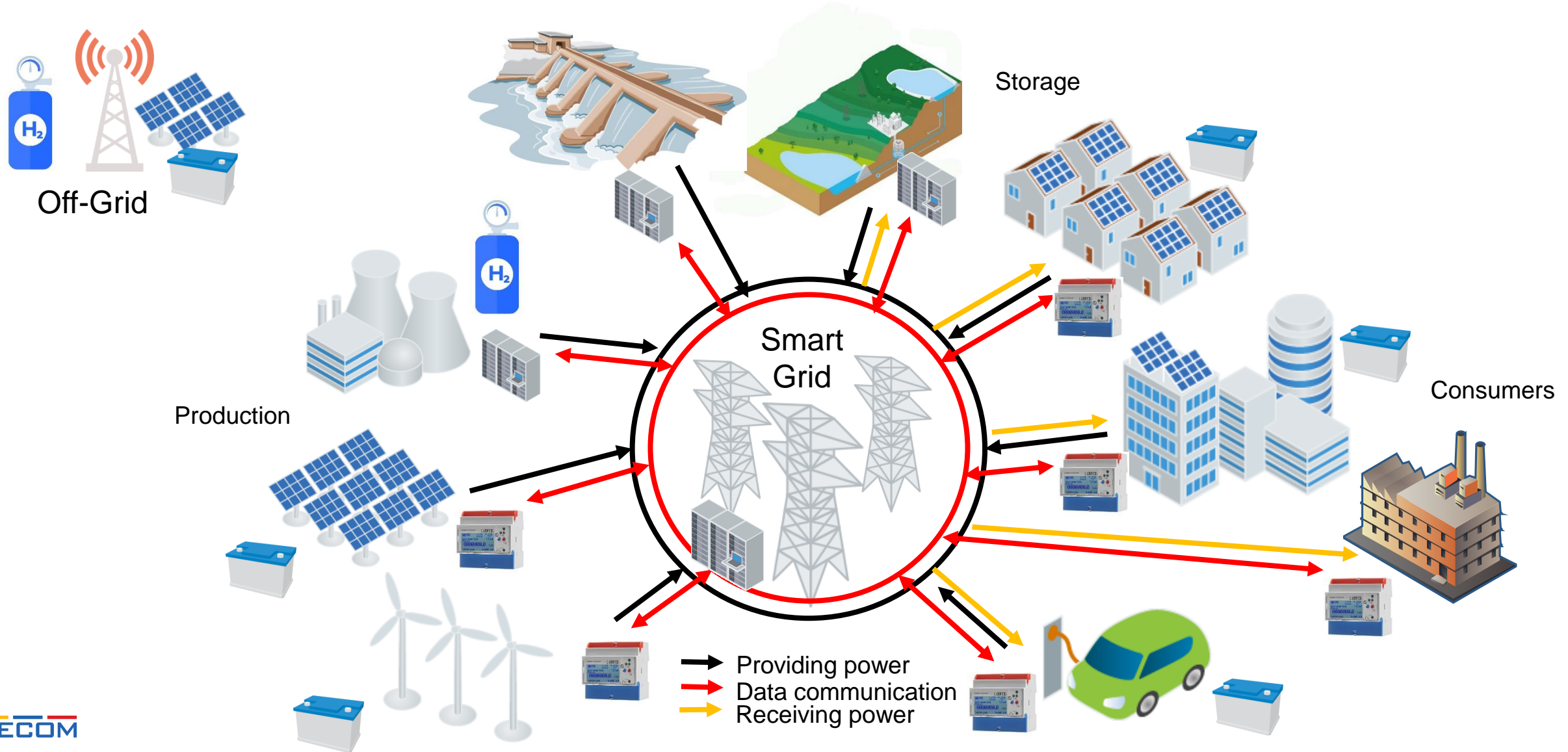
DC/DC – EV – Charger → HPC Bidirectional



- 2 x RAC20-12SK ($\pm 12V$)
AC/DC 20W, 12VOut
- 1 x RAC05-05SK/277
AC/DC 5W, 5VOut
- 2 x RK-0515S
DC/DC 1W, 3kV Isolation
- 16 x R05P22005D or
Now R05P2K2005D
DC/DC 2W, Asym. Output +20V / -5Vout,
6,4kV Isolation voltage



Smart Grid – Energy and Mobility Solutions – RECOM and Renewable Energy



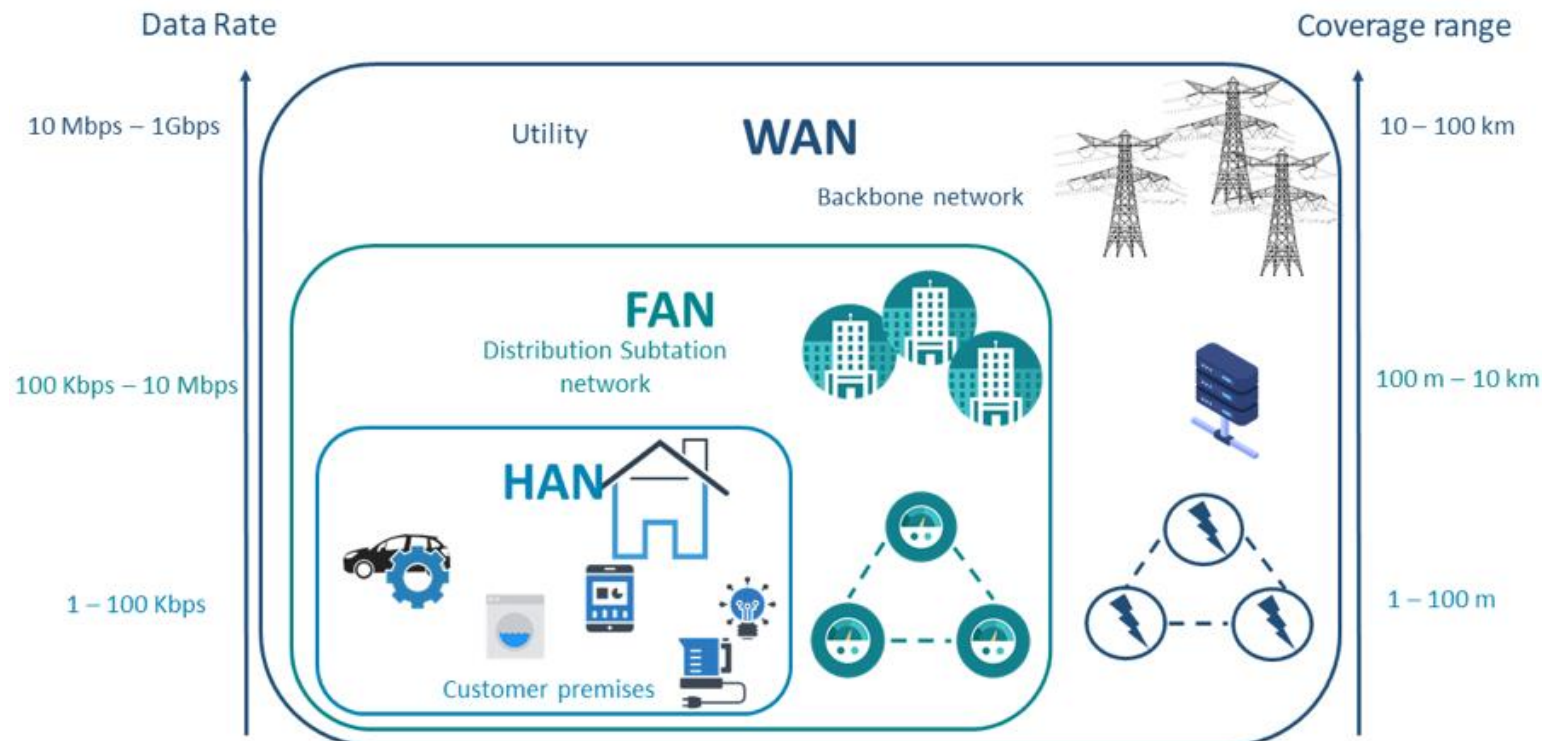
Smart Grid

Main disadvantages of current Grid:

- Power instability
- Load shifts / demand peaks
- High maintenance cost
- Unreliable energy harvesting (wind, solar, etc.)
- No control / up-to-date information of usage

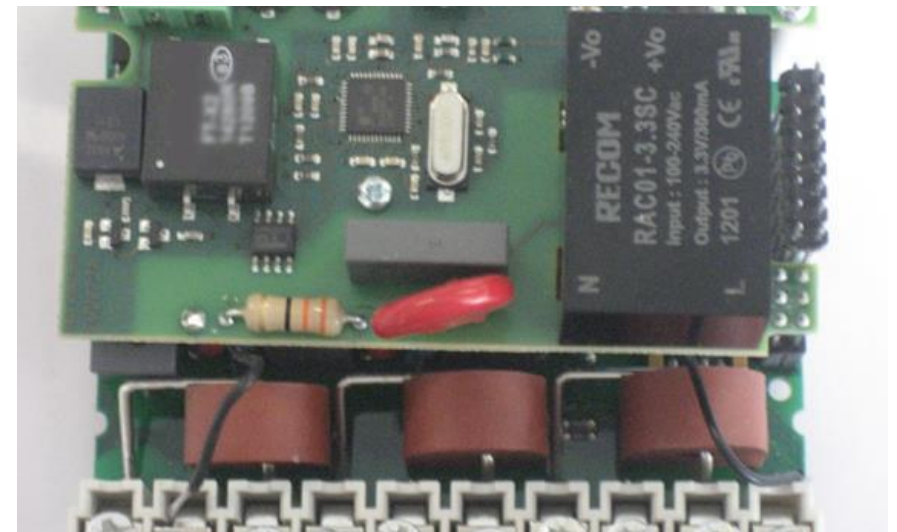
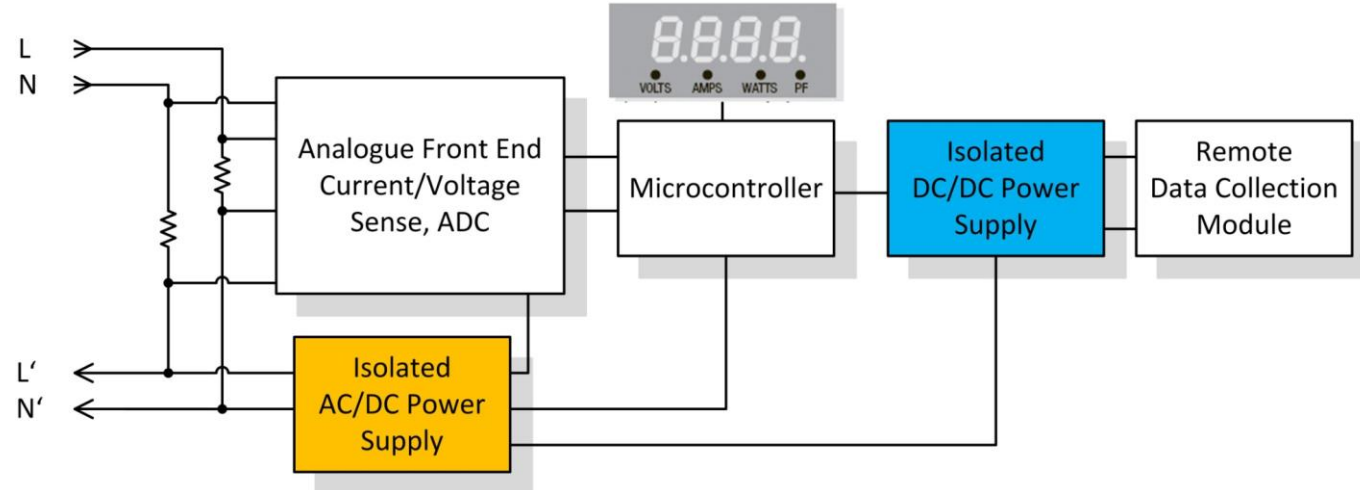
Main advantages of a Smart grid:

- Balance energy production / demand
- Store excess energy
- Reduce maintenance cost
- Monitor usage and stability
- Low latency, high bandwidth data networks



Smart Grid Hierarchy:
HAN = Home Area Network
FAN = Field Area Network
WAN = Wide Area Network

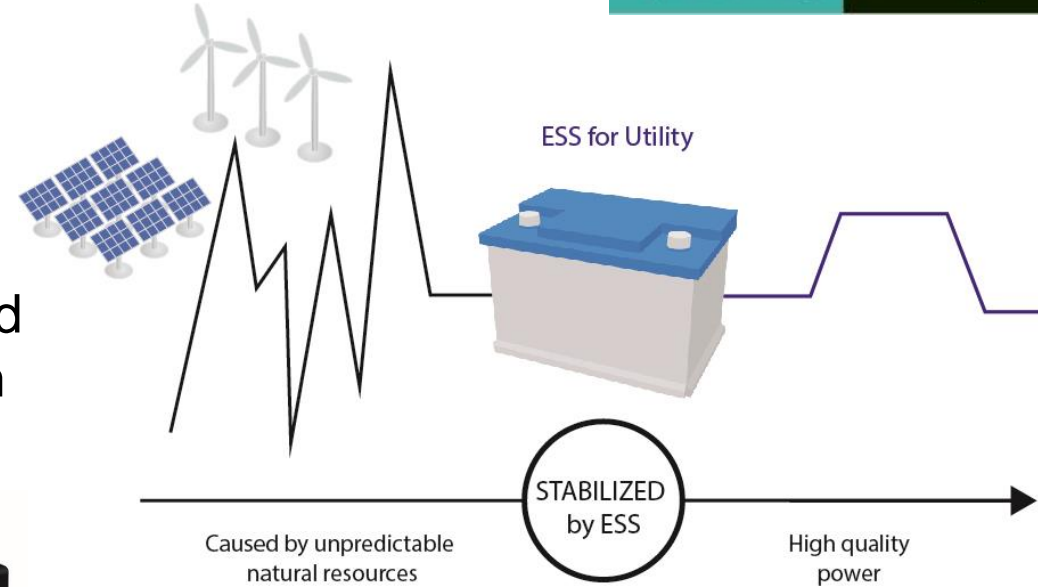
HAN Smart Meter



RAC01-GB RAC01-SC	1W, 80-264V AC input, 1.3" x 0.8", 30mW in standby,
RAC02E-SK/277	1W, 80-305V AC input, 1.3" x 0.9", 4 kVAC isolation, low cost

Substation Voltage Stabilization:

- Energy Storage System (ESS) improves power quality in a Smart Grid
- Typically 110 VDC / 1-to-3 kAh backup batteries
- Battery Management System (BMS) monitors and controls charge/discharge cycles – powered from the 110 V supply.



RP12-AR	12W, 36-160 VDC input, 1" x 1"
RP20-FR	20W, 43-160 VDC input, 1" x 2"
RP40-FR	40W, 43-160 VDC input, 1" x 2"



Renewable Energy - Options

- Wind
- Solar
- Hydroelectric
- Hydrogen
- Off-Grid
- ESS

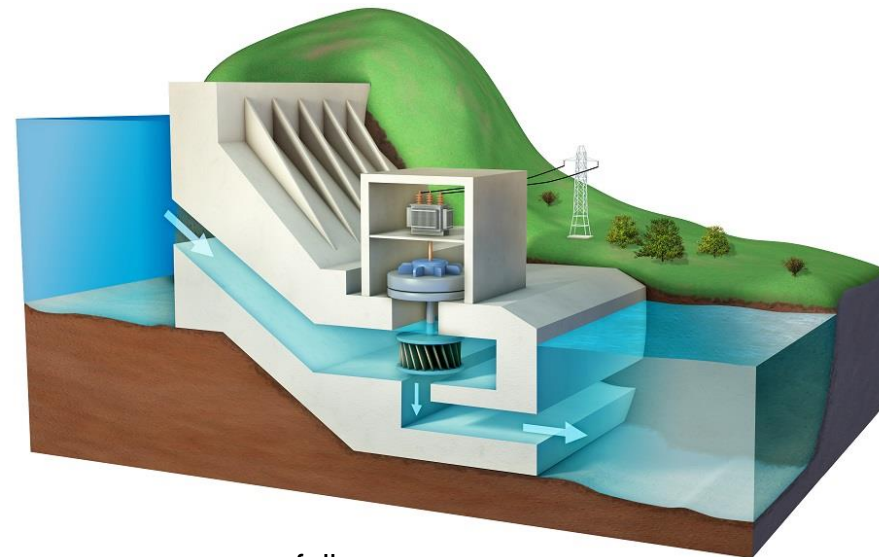


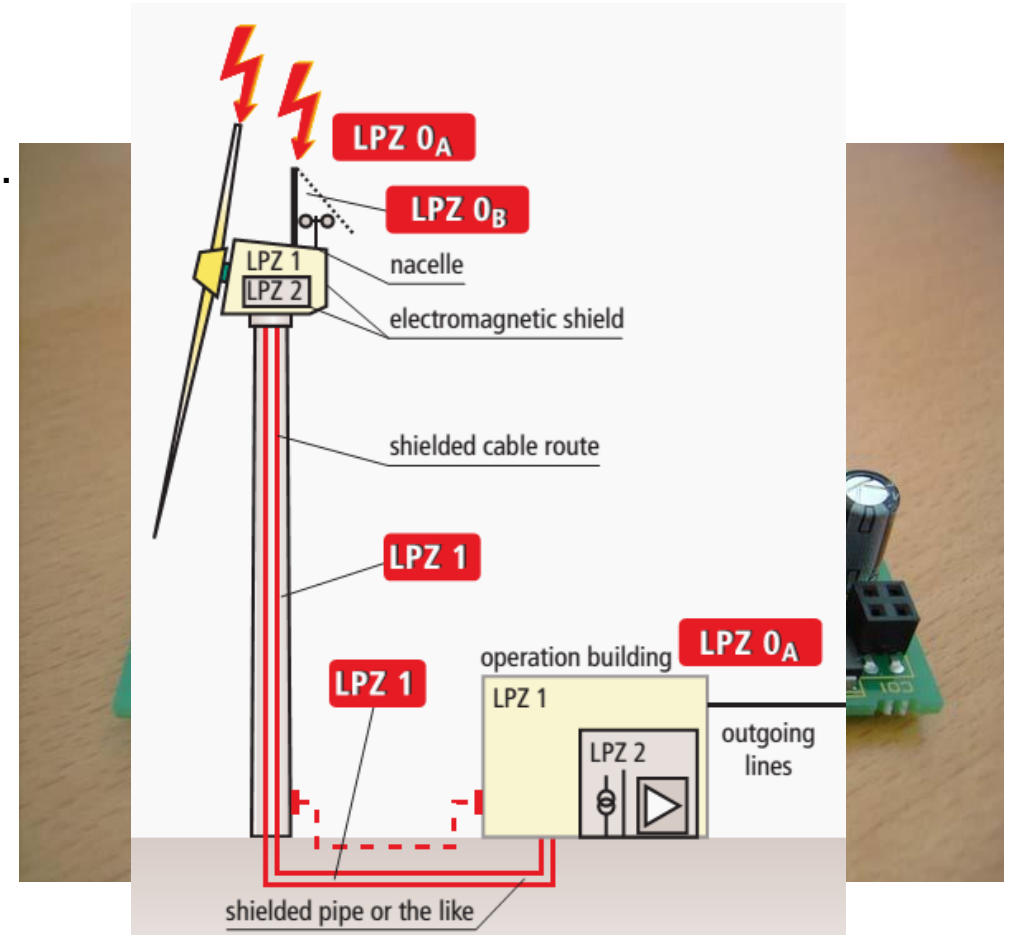
Image source: energyfollower

Wind Turbines

Besides physical damage to the blades, nacelle and generator: „...by far the most common is damage to the control system (electronics)“ US National Fire Protection Association.

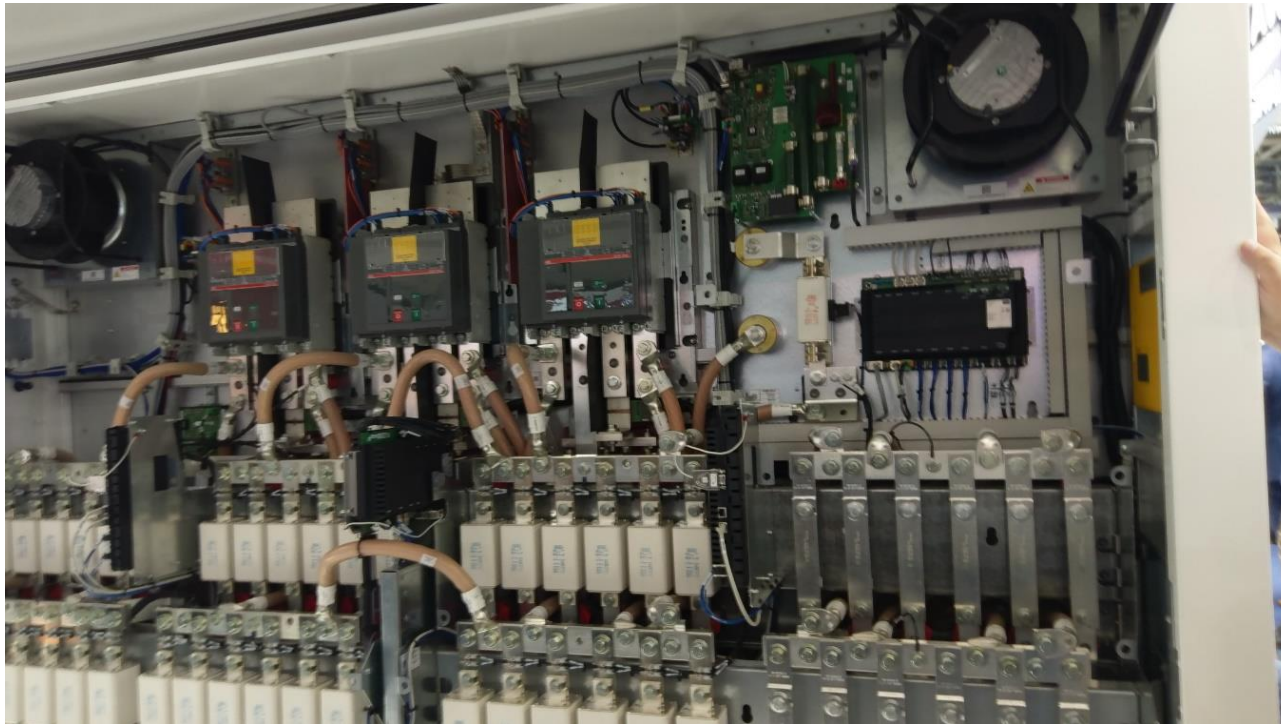
Solution is to fit protective grounding...
...and to isolate all signal and power paths with opto-couplers, transformers and isolated DC/DC converters.

RK-xxxxS/H6	6.4 kVDC isolation in SIP7
RxxPxx/R8	8 kVDC reinforced isolation in SIP8
RHV3-xxxxS/R20	20 kVDC reinforced isolation in SIP16



Solar Farms

The PV DC bus voltage is typically 800-1000 VDC, with newer farms running at 1200 VDC, so high voltage, very wide input range, isolated DC/DC converters are needed to power the DC switchboard monitoring and communication equipment.



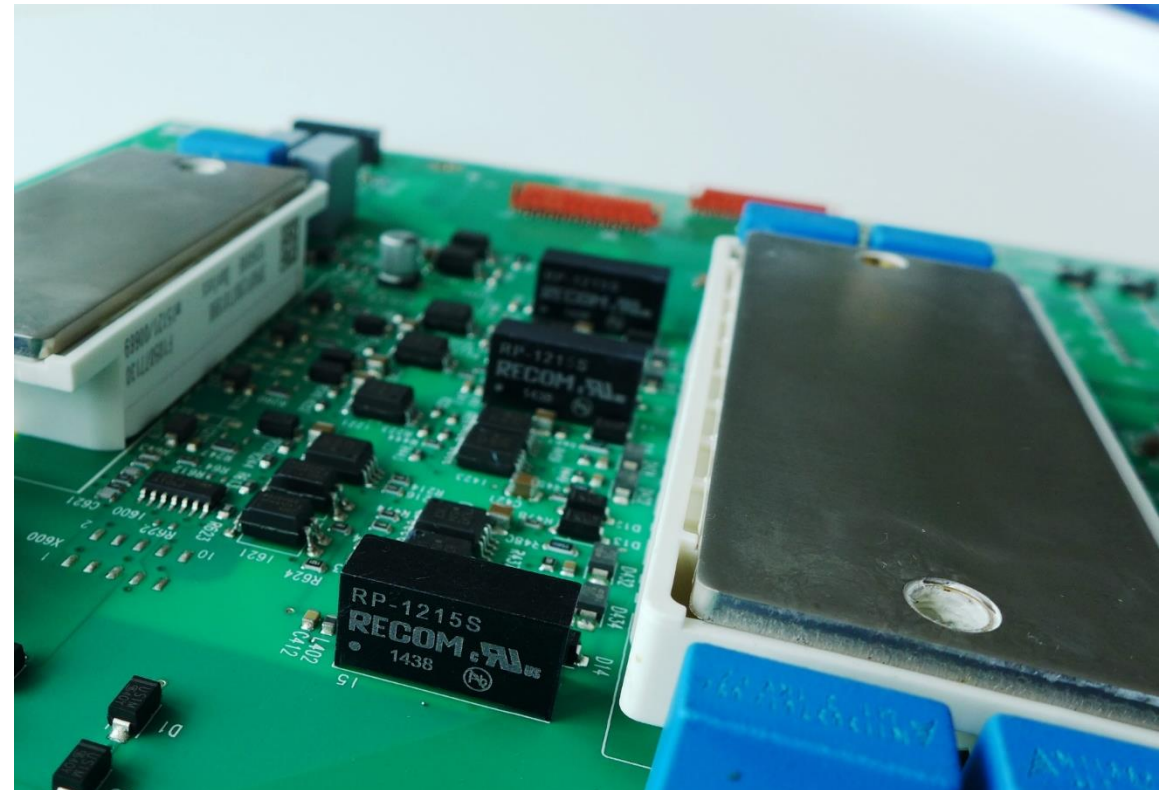
RPV30-DK
(custom)

30W, **200-1700 VDC input**, dual independent isolated outputs

Solar Farms

Smaller scale AC inverters (e.g. Fronius, Kaco, Solar Edge, SEPSA) use multiple isolated DC/DC converters for the high side gate drivers and to isolate the control bus-interfaces.

RS3E	3 kVDC isolation in SIP8, regulated
RP-1215S	5.2 kVDC basic isolation in SIP7 (pot core)
RxxP21503D/R	6.4 kVDC reinforced isolation in SIP8



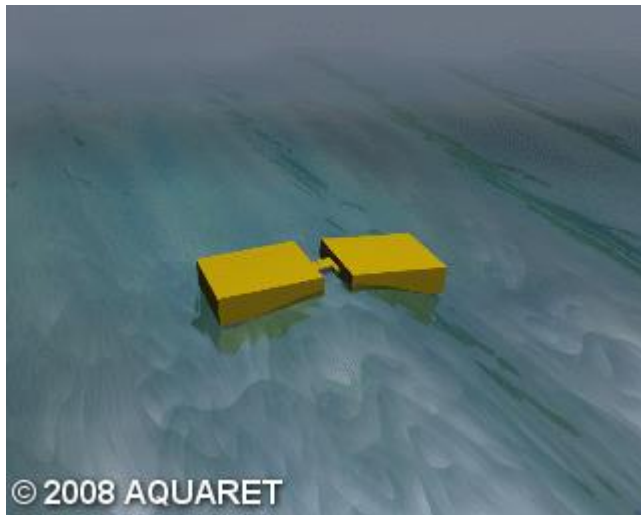
How is RECOM supporting ESS?

- 1: Providing power supply infrastructure for the gas and hydrolysis chemical plants
- 2: High power DC/DC converters designed for Fuel Cells
- 3: Battery Management System power supply components
- 4: Battery Load Balancing



Hydroelectric

Outside of Austria, countries with coastlines like the Netherlands can use Wave Energy Converters (WEC) to harness „*the liquid grid*“

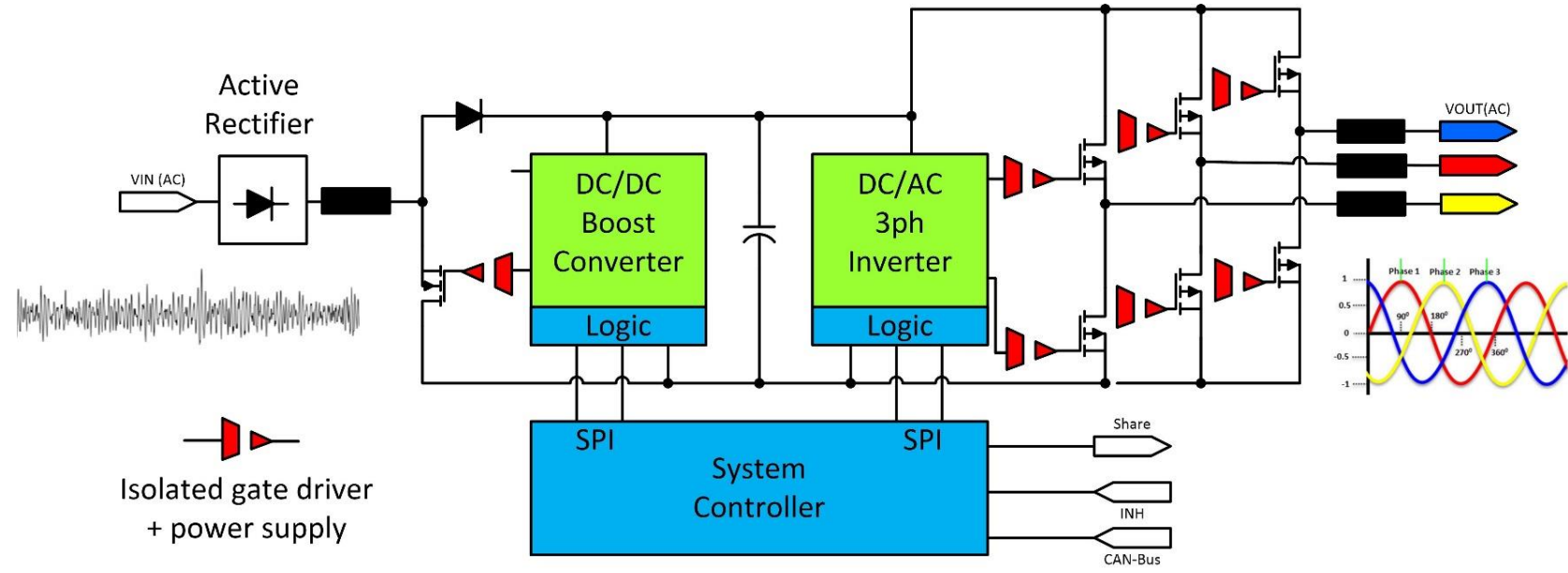
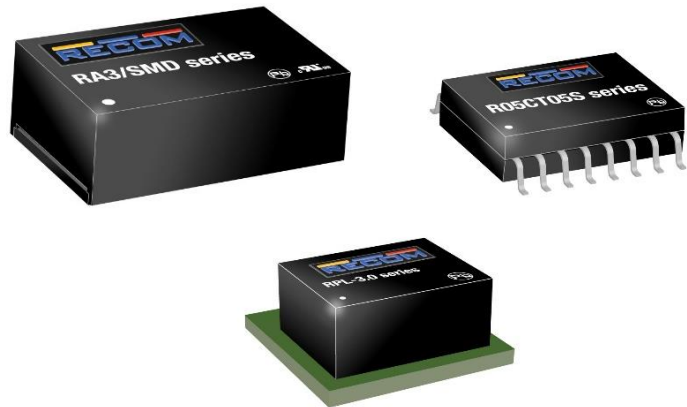


Source: Theliquidgrid.com



Hydroelectric – WEC generator

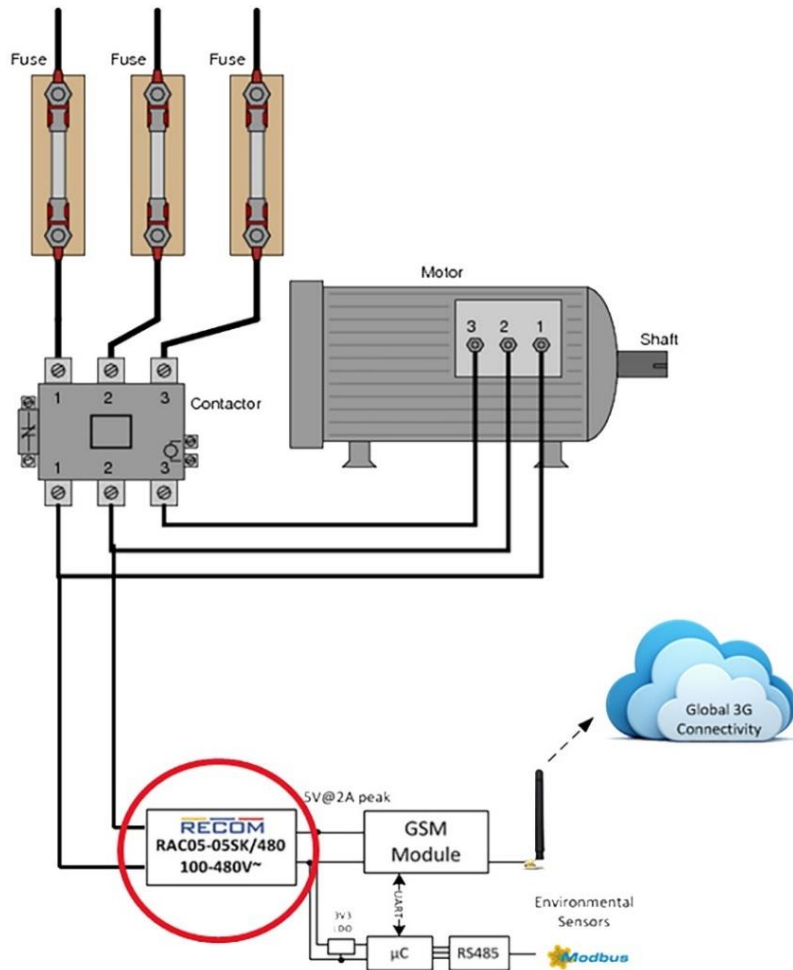
Output from WEC generators is AC, but highly erratic, therefore AC → DC → AC converters are needed:



RA3-xx2005D/SMD	3 W, 5.2 kVDC isolation in SMD, +20/-5V
RxxCTxx	0.5 W, 5 kVAC reinforced isolation, regulated output
RPL-3.0	3 A POL in 10 pad LGA (3mm ² footprint)

Hydroelectric – Chemical Plant „SCADA“

Such complex systems rely heavily on a SCADA („Supervisory Control And Data Acquisition“) structure



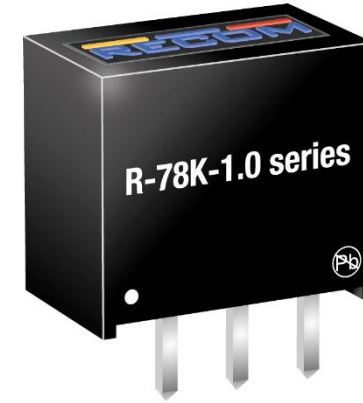
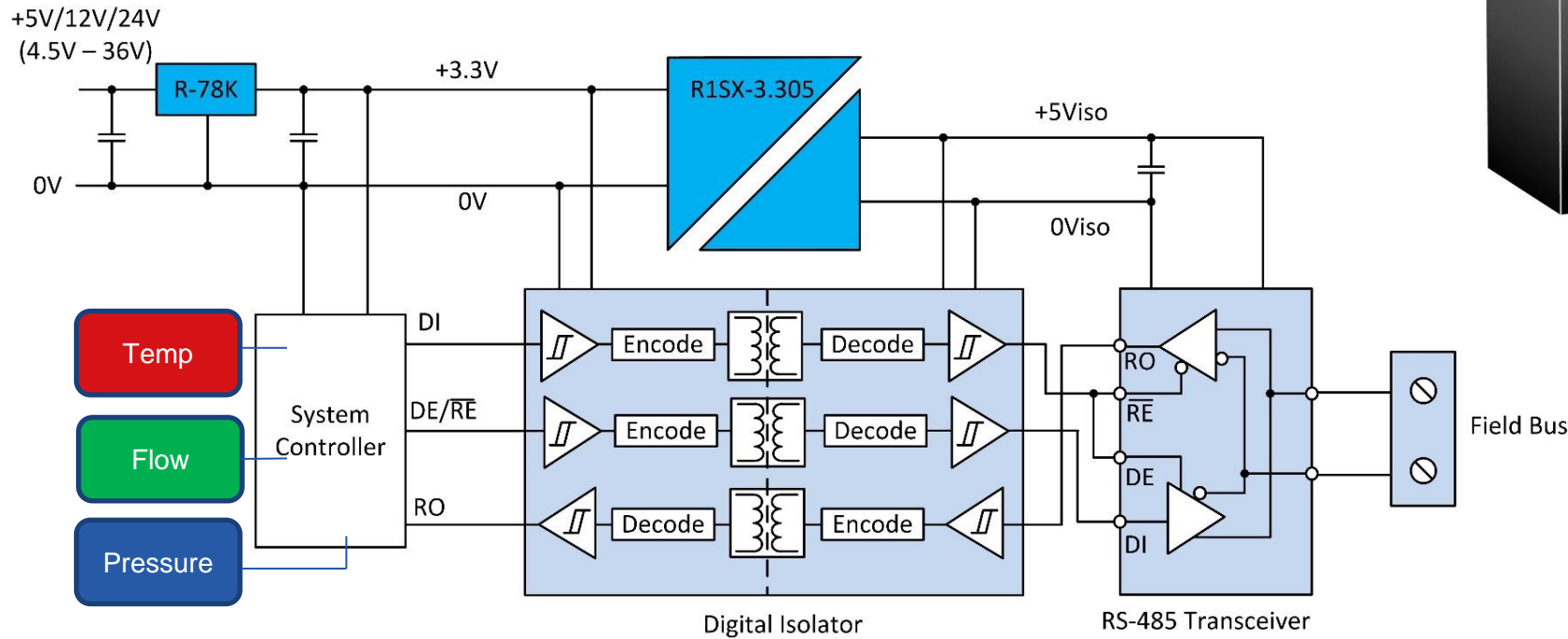
Source: Andritz



RAC05-K/480	85-528 VAC input, OVCIII 5.4 kVAC isolation, 5 W in 2“x1“ case.
RAC15-K/480	85-528 VAC input, OVCIII 4 kVAC isolation, 15 W in 2.1“ x 1.6“ case.
RAC25-K/480	85-528 VAC input, OVCIII 4 kVAC isolation, 25 W in 3.3“ x 1.8“ case.

Hydrogen – sensors supply and isolation

For example – RS-485 isolated bus interface (25 Mbps)
 -low cost R-78K series switching regulator
 -low cost isolated DC/DC converter



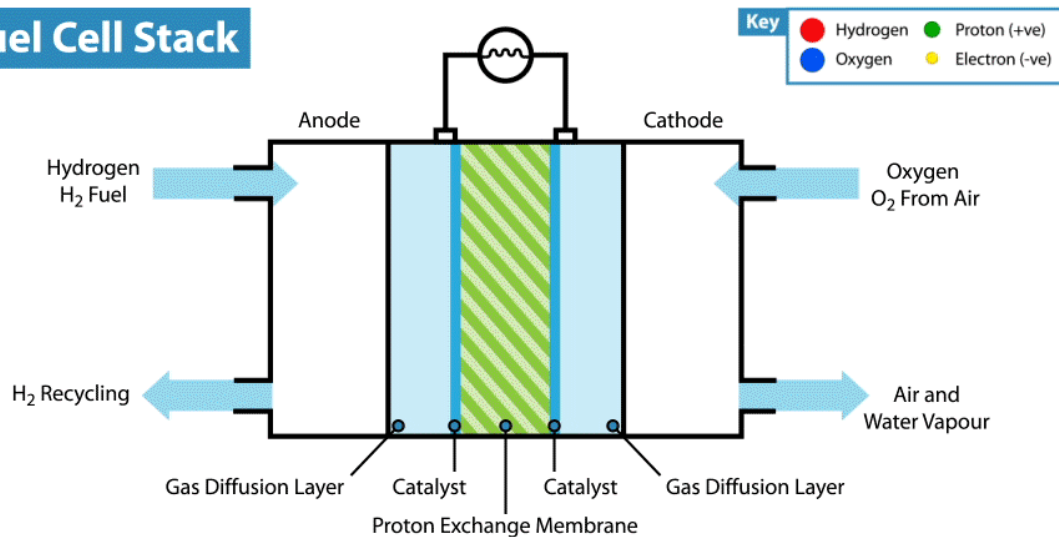
R-78K3.3-1.0	4.5 - 36 VDC input, 1 A output
R1SX-3.305/H	3.3 V input, 5 V output, 3 kVDC isolation

Hydrogen – Fuel Cell

Stationary fuel cell power systems provide decentralised or emergency power, or can be used as ZE grid-independent generators.

Typical stationary generator capacity is 25-70 kW

Fuel Cell Stack



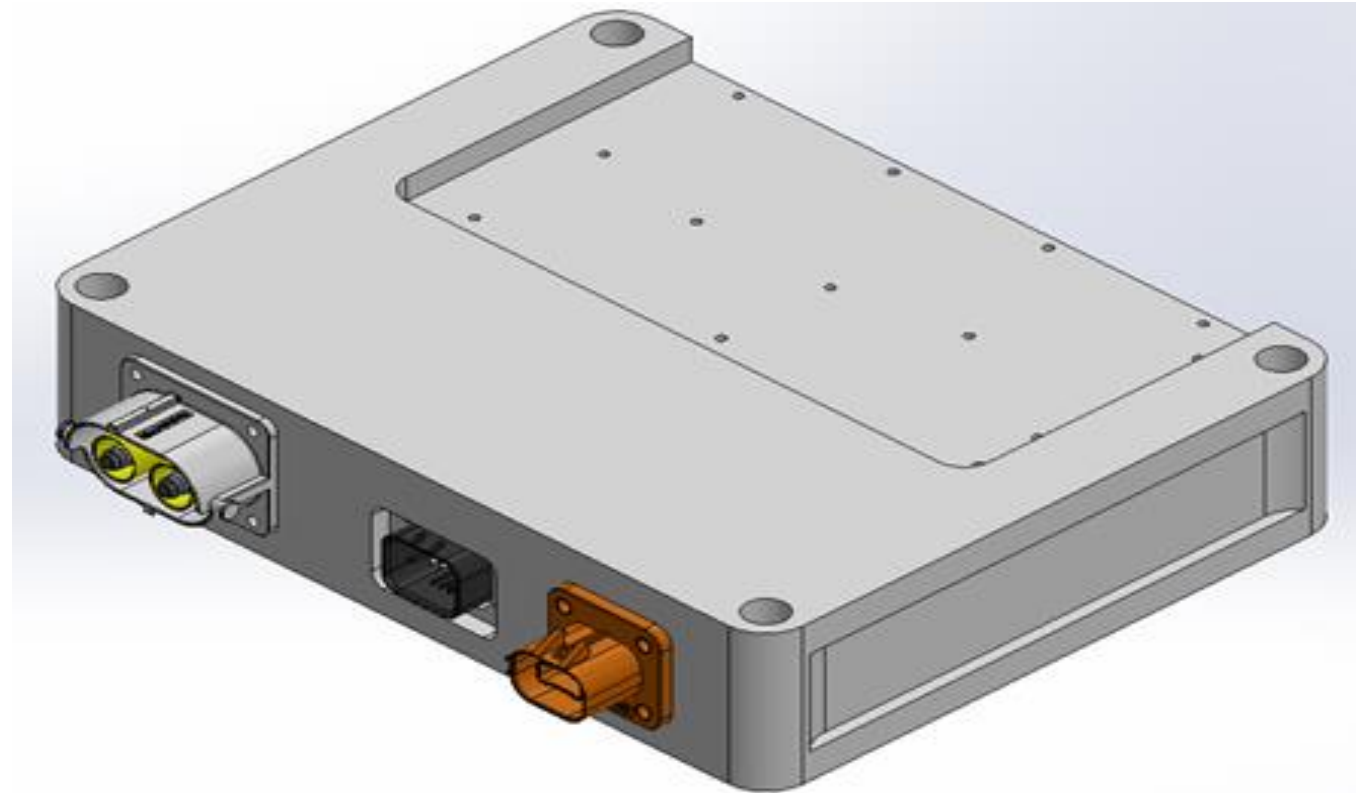
Source: Wikipedia

Quelle: https://www.intelligent-energy.com/static/img/animations/fuel_cell_stack.gif

Hydrogen – High voltage DC/DC-Converter up to 75kW

(RECOM product under development)
10-75 kW DC/DC, cascade-able

- $V_{in} = 25-280 \text{ VDC} @ 500 \text{ A max}$
- $V_{out} = 200-800 \text{ VDC}$
- $>97\%$ efficiency
- Reverse polarity + surge protection built-in
- MPP tracking
- Active current sharing
- Liquid cooled baseplate



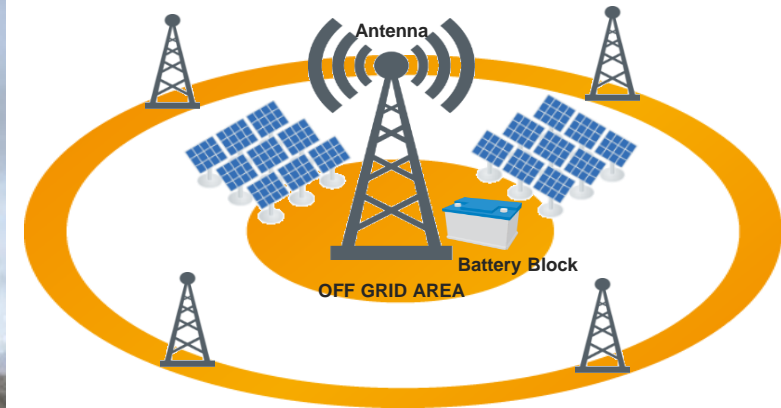
Off-Grid

Zero Emission off-grid power generation

- PV / Wind / Battery combi-systems



IPS XXXX	3000 VA inverter (1Phase 230V AC)
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Off-Grid – Fuel Cells

Hybrid Methanol Fuel Cell Systems (30x energy density of lead acid batteries)

Stand-alone refrigeration units for trailers

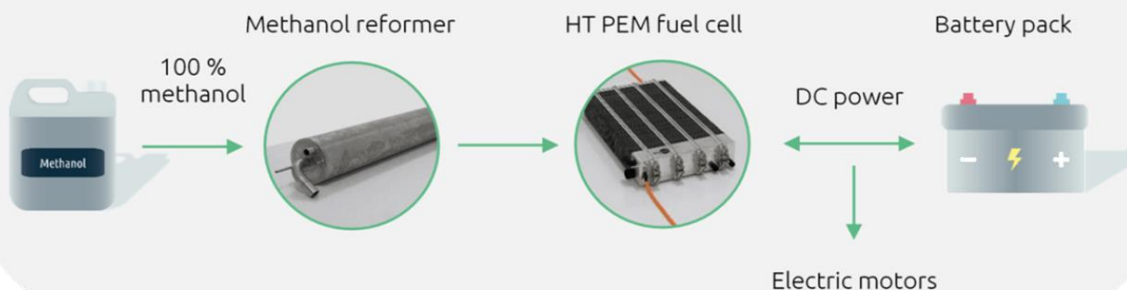
Zero Emission off-grid power generation

- Military, mining, construction
- Emergency supply (telecoms)
- PV / Battery / FC combi-systems



Source: McConnell Transport

A hybrid methanol fuel cell system



Source: SFC Energy

Off-Grid – Fuel Cell Applications

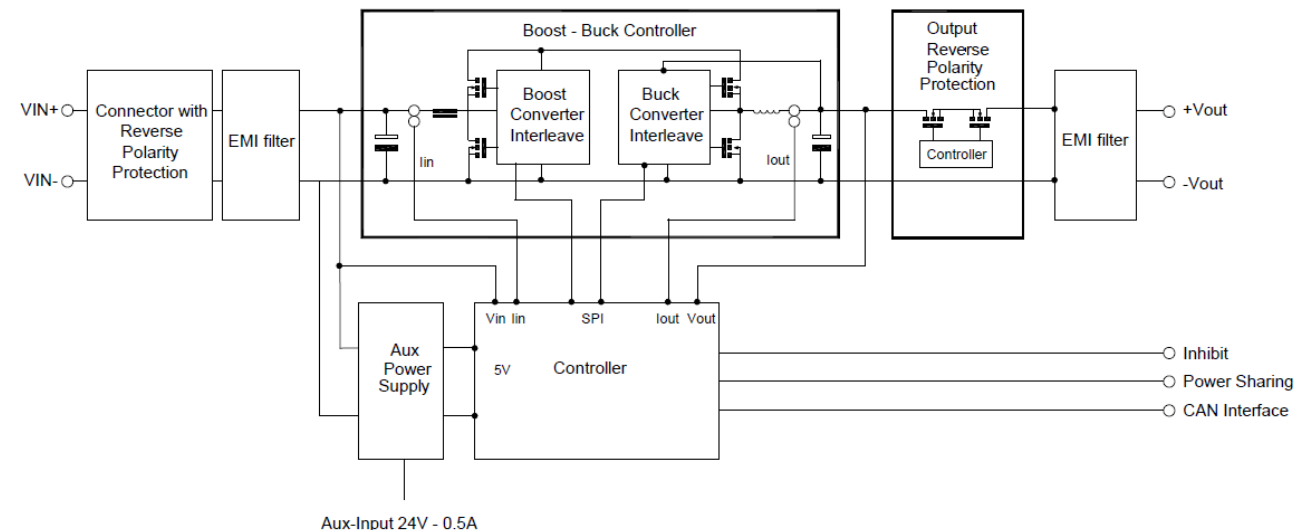
7 kW SD7008-X-48-2

- $V_{in} = 48 \text{ VDC}$ (30-70 VDC) @ 220 A max
- $V_{out} = 48 \text{ VDC}$ (36-60 VDC adj.) @ 190 A max
- Buck/Boost with >97% efficiency
- Reverse polarity + surge protection
- MPP tracking (Solar or Fuel Cell)
- Liquid cooled baseplate
- CAN-bus interface



4.8 kW SD4008-X-24

- $V_{in} = 36 \text{ VDC}$ (18-54 VDC) @ 200 A max
- $V_{out} = 20-56 \text{ VDC}$ adj.
- (24 V @ 185 A max / 48 V @ 110 A max)
- Buck/Boost with >95% efficiency
- Reverse polarity + surge protection
- MPP tracking (Solar or Fuel Cell)
- Baseplate cooled (fanless)
- Analogue or digital control



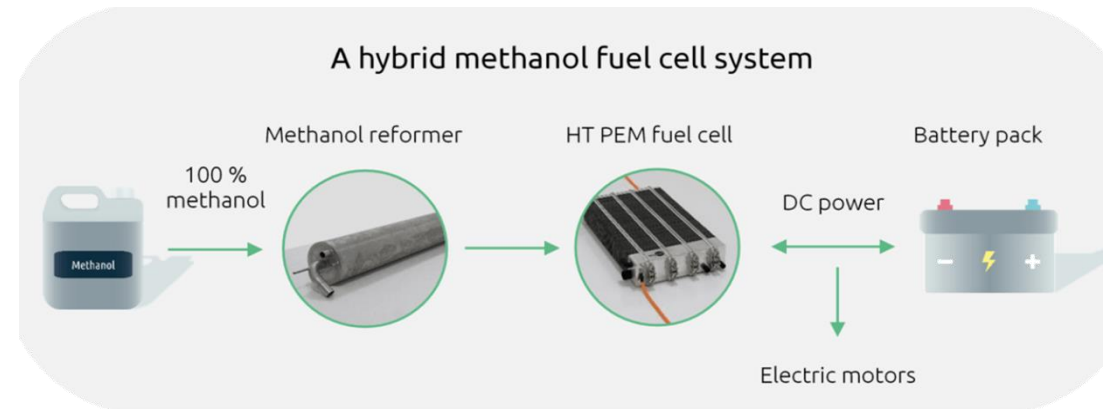
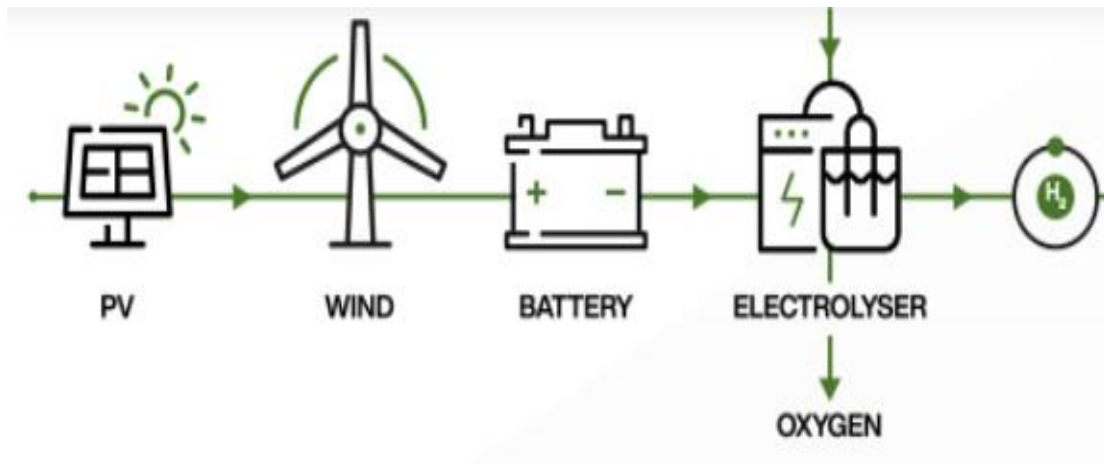
Part 2: Energy Storage

Currently there are three promising solutions for Energy Storage Systems (ESS)

1: Using excess electricity to hydrolyse water into hydrogen and oxygen

2: Extracting carbon out of the atmosphere to make methane gas

3: Large scale battery arrays



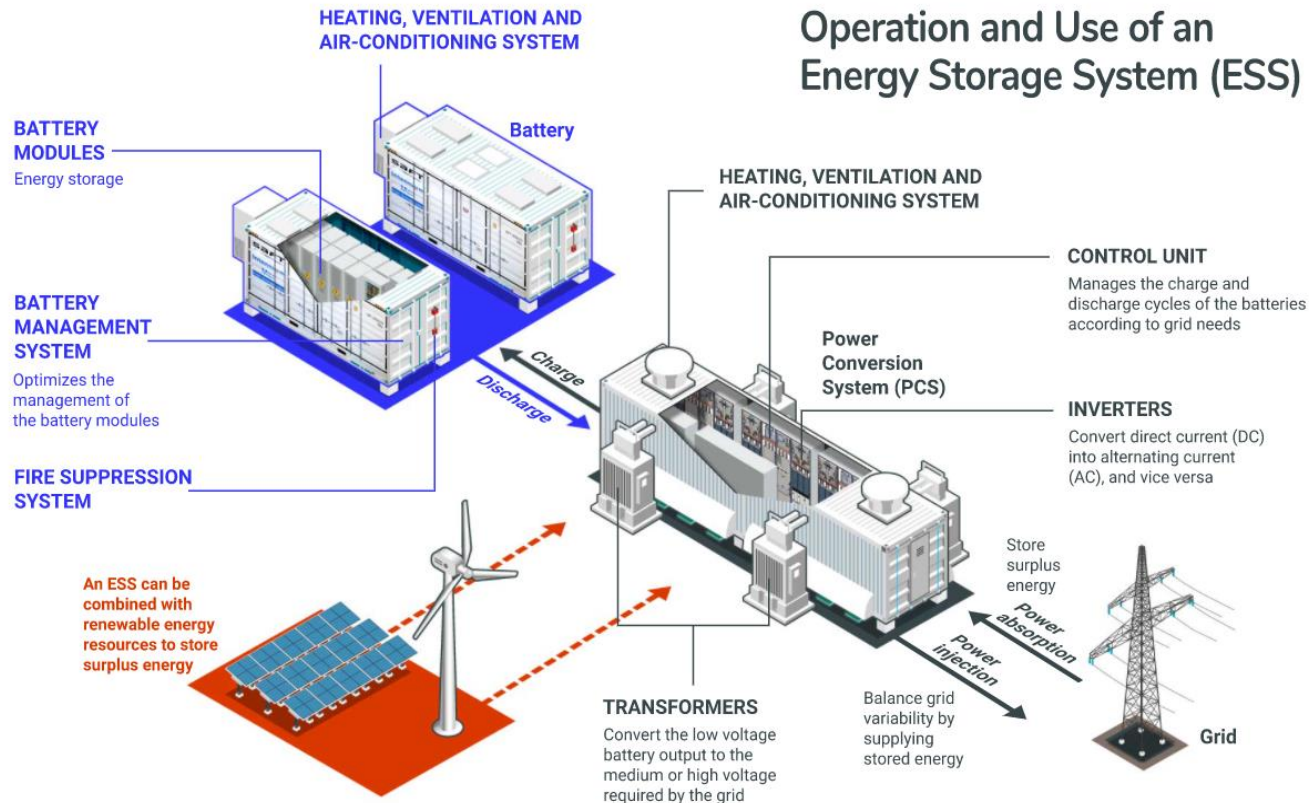
Energy Storage

Energy Storage Systems

- Li-Ion Batteries
- Redox Flow Batteries
- Sodium Batteries

„USA will need to install more than **5 TWh** of grid storage capacity to meet its goal of 80% renewably-sourced electricity by 2050“
US Department of Energy

(for comparison: global RE production in 2021 was only 0.3 TWh)

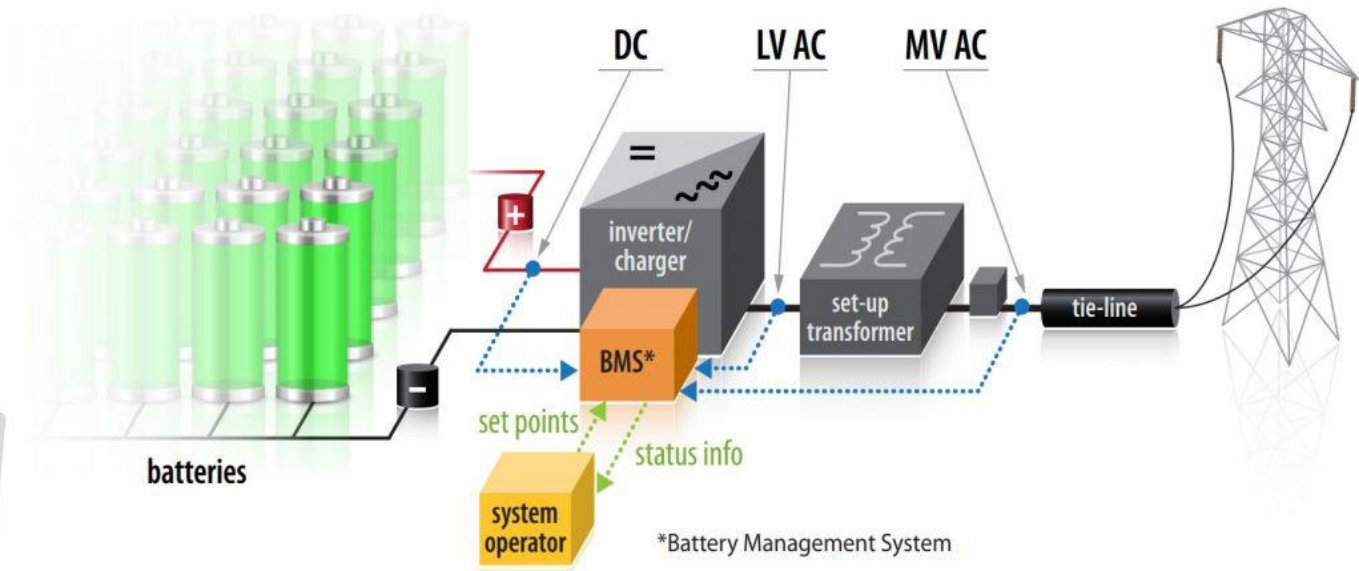


Source: REGlobal

Energy Storage

Battery Management Systems

- Maintain cell Safe operating area (SOA)
- State of Charge (SoC)
- State of Health (SoH)



Source: OSMbattery

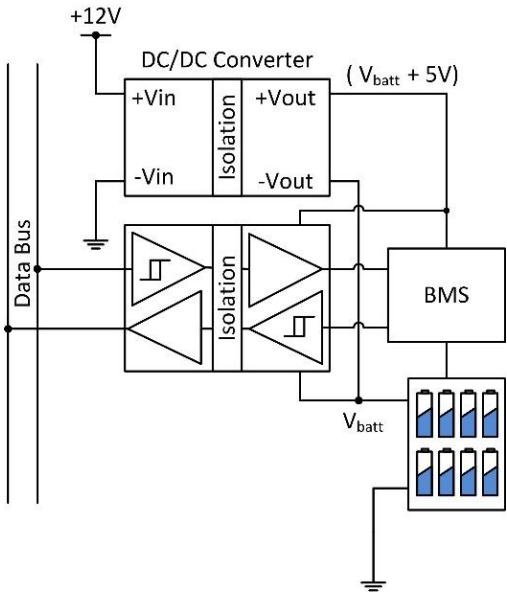
SA5000

5 kW cascade - able battery charger

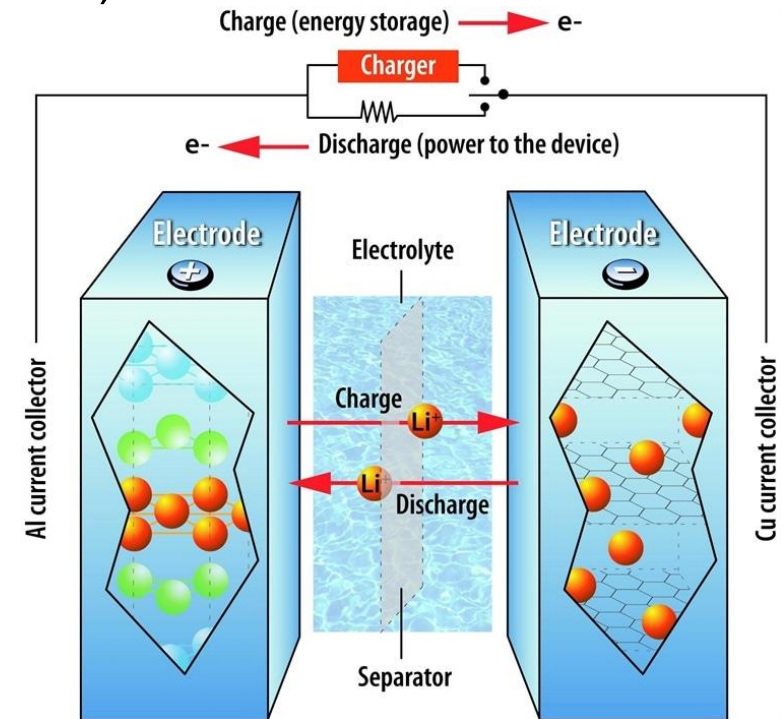
Energy Storage

Battery Conditioning

- Bidirectional battery balancing (1.45 kW – 11 kW)
- Controlled charge / discharge rates to maximise cell capacity and counteract aging effects
- Reconditioning battery packs after deep discharge (deintercalation)



RxxCTExx	1 W iso. in SOIC16 SMD, -40°C to 125°C
MA11000	11 kW bidirectional battery balancer



Source: Argonne National Laboratory

Battery Management System – Load Balancing

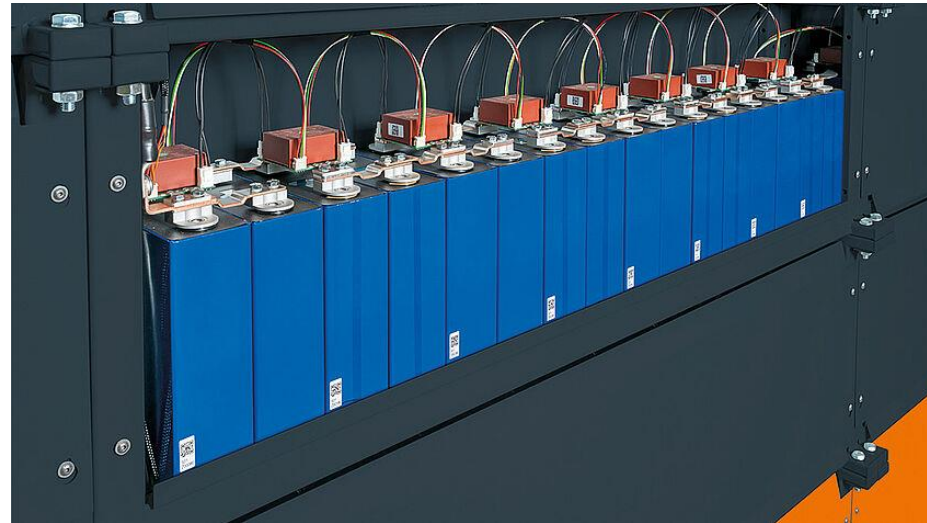


Load Balancing:

- Same load level for all battery cells
- Long time reliability

RAC20-04SK/X1A custom

- AC/DC 20W
- 4,0 Vout
- Enable / disable
- special constant current mode



Railway, UPS Safety Brake Supply Unit

Application: Railway Transportation
UPS Safety Brake Supply Unit

Plug & Play, Single output
DC/DC with ultra wide range and UPS-function
EMC Filter included



RMD500

- DC/DC 500Watt
- Fully railway approved for EN50155 (S2) applications
- EN50121-3-2, EN50124-1, EN62368-1, EN61373, EN45545-2
- Plug & Play unit for natural convection cooling
- Wide range input for nominal 72V and 110V
- Excellent efficiency and functionality
- Parallel and redundant operation
- Extremely reliable and robust



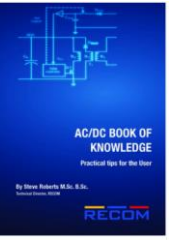
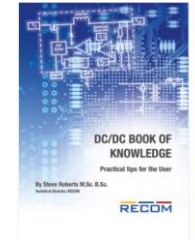
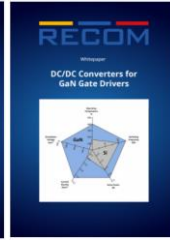
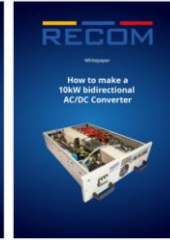
40W to 1000Watt power levels

RECOM offers much more than just products



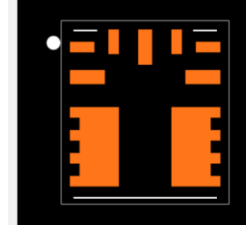
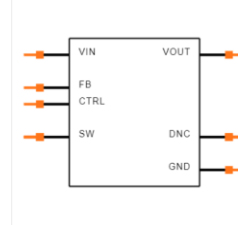
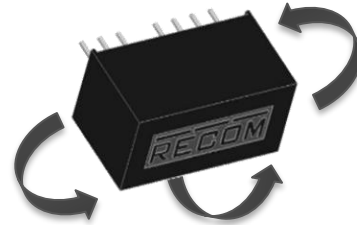
■ Technical Documentation

- Application notes
- Whitepapers
- Book of Knowledge



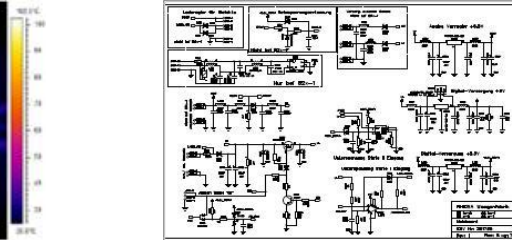
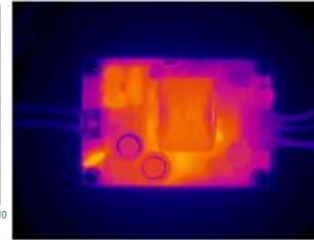
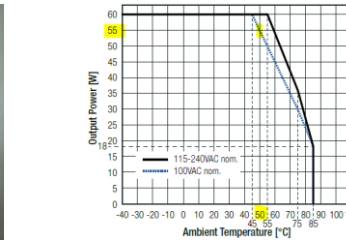
■ Web Product pages

- 3D Files
- PCB Layout Files
- Podcast



■ Design-Support

- Thermal Support
- Schematics Review
- Any kind of Tech-Support

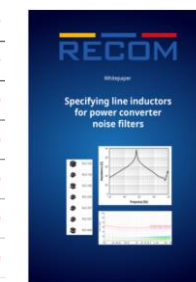


■ EMC Support

- Filter recommendations
- Line Inductors
- Customer testing
- Seminars



RLS Series	Suitable for these RECOM DC/DC Series
RLS-397	R13, R5, R50, R12, R53 R-78xx-0.5, R-78xx-1.0, R-78xx-0.5, R-78Axx-0.5, R-78Bxx-1.0, R-78Bxx-1.5
RLS-567	RK/H6, R13, R5, R53, RW2, R-78xx-0.5, R-78xx-1.0, R-78Axx-0.5, R-78Cxx-1.0, R-78Bxx-1.5
RLS-126	R15, R25, R15E, RH/H6, RKZ, R5, R50, RECS, R12, R-78xx-0.5, R-78xx-1.0, R-78Cxx-1.0, R-78Bxx-1.5
RLS-186	RECS
RLS-226	RO, RM, ROM, RK, RB, RP, RE, ROE, RK/H6, RH/H6, RxxPxx, RKZ, RECS, RW2
RLS-686	R-78xx-1.0
RLS-105	RECS

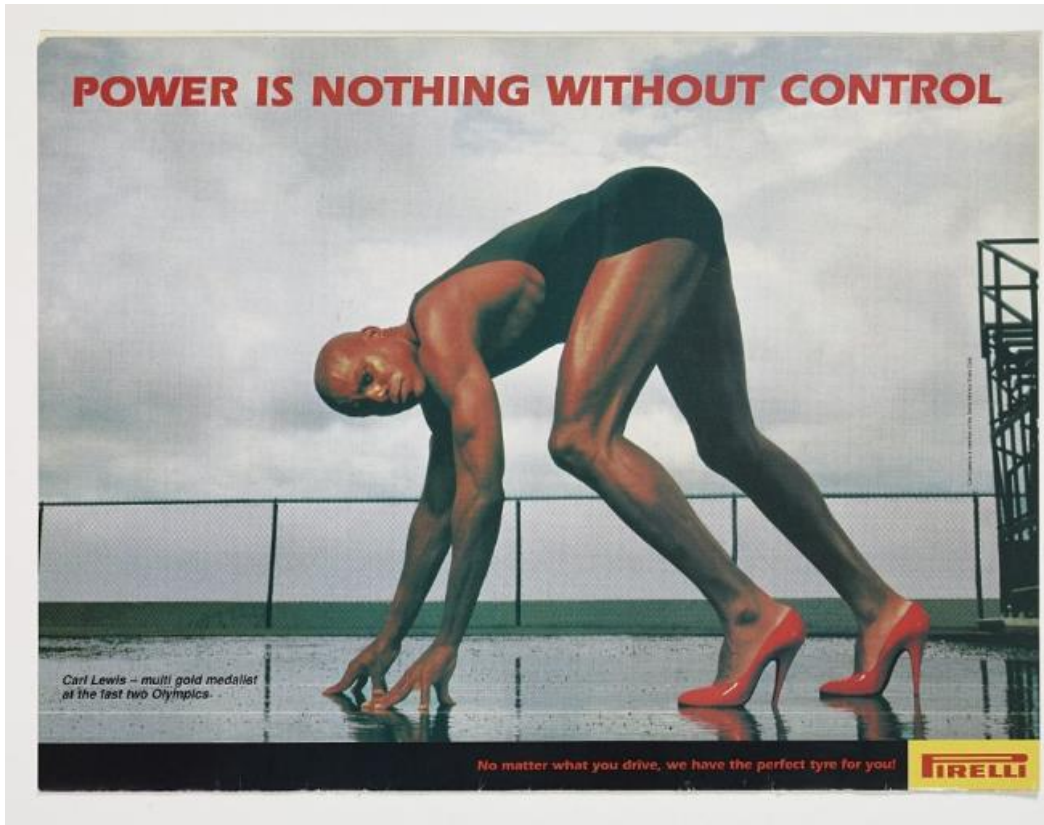


„Power is nothing without control“ -- RUTRONIK Booth No. 30.

Power Supplies and DC/DC-Converters, you need them everywhere!



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Power Electronics & Energy Storage event
27 juni 2023 | 1931 Congrescentrum 's-Hertogenbosch

ENERGY STORAGE

