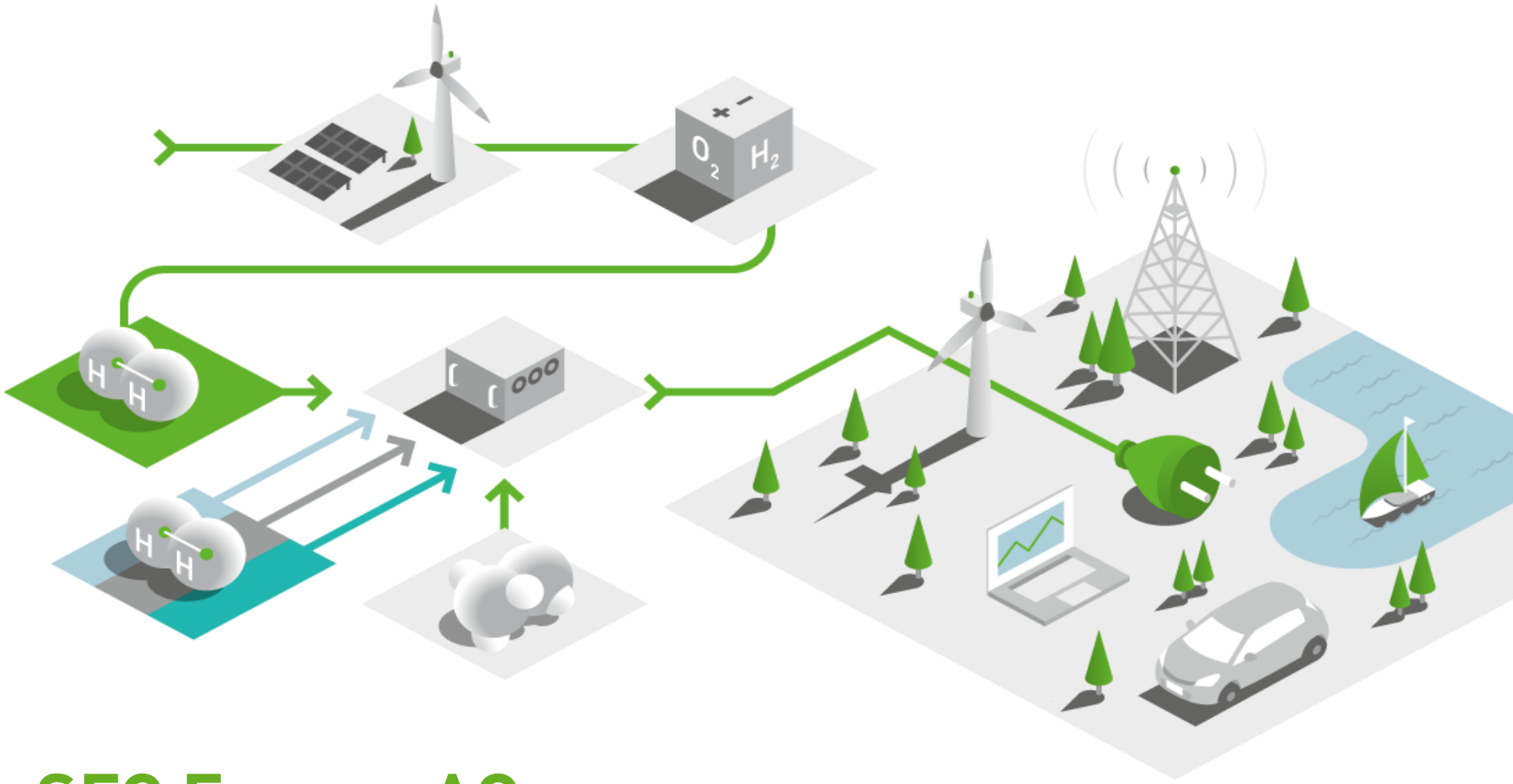


SFC Energy AG

EFOY Hydrogen Product Training

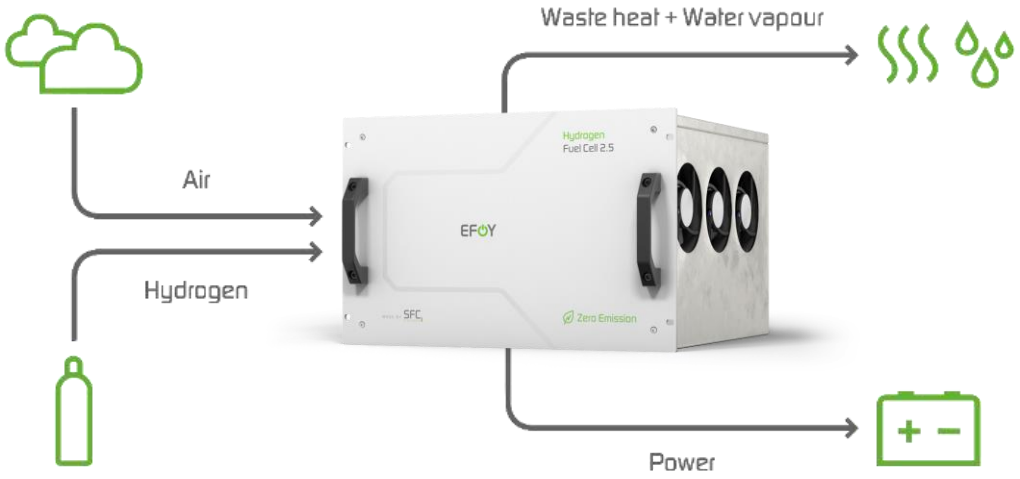
SFC Energy AG

Vertraulich / Confidential

EFOY Hydrogen Fuel Cell

Clean stationary power up to 50 kW

- Clean energy
- Proven technology
- Low maintenance
- Cluster for higher Power



100% CO_2 emission-free

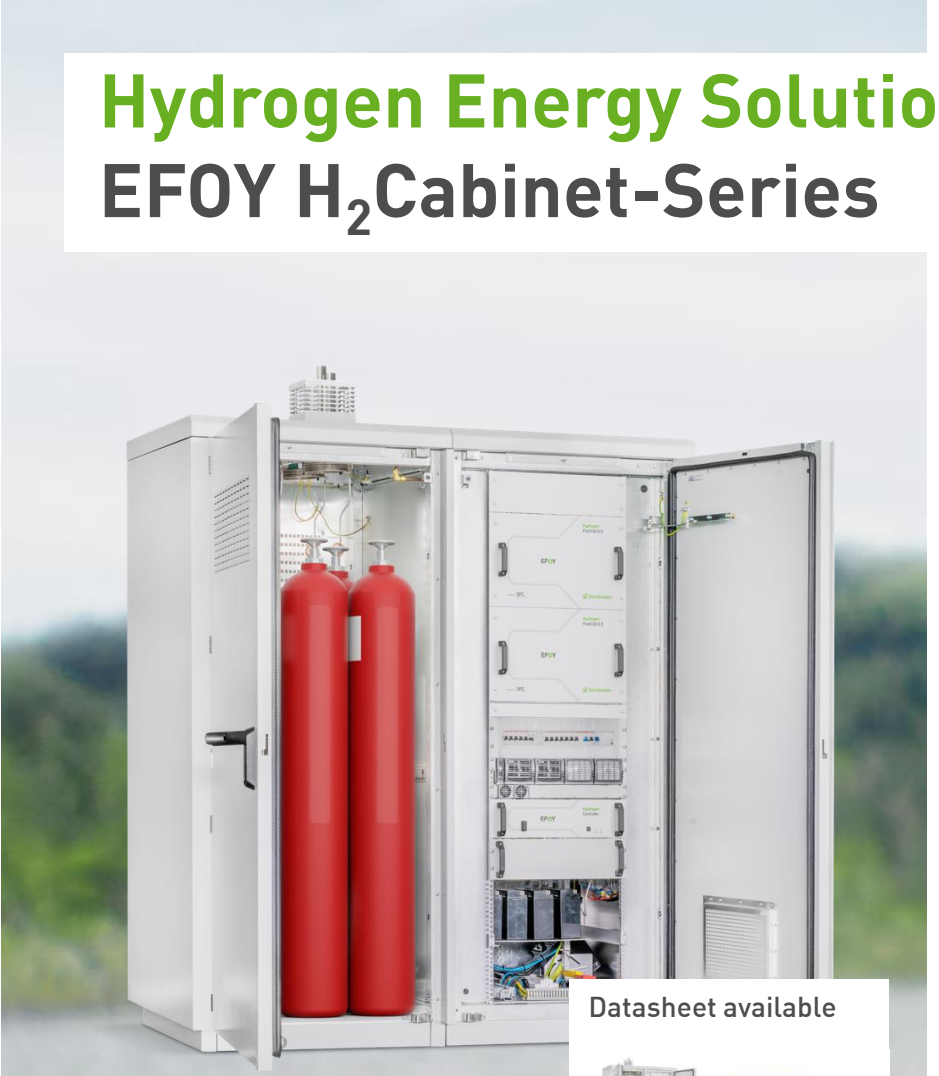
EFOY Hydrogen Energy Solutions

- Proven technology
- Long autonomy, maintenance-free
- Cluster for even higher power

- Scalable between 2.5 kW up to 50 kW
- EFOY Hydrogen Controller for centralised system management
- Features:
  - Remote Monitoring
  - Data communication (Modbus RTU)
  - Automatic self-test

Hydrogen Energy Solutions by SFC

EFOY H_2Cabinet-Series



Datasheet available

X-Series

Outdoor Sites

Datasheet available

N-Series

Indoor Sites

EFOY Hydrogen Energy Solutions

X-Series: Outdoor Solution – 48 V DC

Configuration	EFOY H_2Cabinet X2.5	EFOY H_2Cabinet X5.0
Nominal Output Power	2.5 kW	5.0 kW
Fuel Cell(s)	EFOY Hydrogen Fuel Cell 2.5 (1 unit)	EFOY Hydrogen Fuel Cell 2.5 (2 units)
Controller	EFOY Hydrogen Controller Monitoring and control of the EFOY Hydrogen Fuel Cell(s)	
Power Distribution	Power distribution and protection of all components inside the cabinet	
System voltage	48 V DC	
Output voltage	41 - 57 V DC	
Compatible H_2 source	6 bottles[1], 300 bar, Hydrogen 3.0 or higher	
Battery installation	48 V / 30 Ah 4 batteries of 12 V and 30 Ah in series	48 V / 60 Ah 4 batteries of 12 V and 60 Ah in series
Housing	EFOY H_2Cabinet X2.5 1FC-6H2-P300-39U or EFOY H_2Cabinet X2.5 1FC-12H2-P300-39U	EFOY H_2Cabinet X5.0 2FC-6H2-P300-39U or EFOY H_2Cabinet X5.0 2FC-12H2-P300-39U
Optional Configuration	- Remote Monitoring System - Rectifier and/or Inverter for AC power output - DC/DC module for constant DC power output - Charge controller for integration of PV-modules - Uninterruptible power supply module - Additional hydrogen storage (space for 6 extra bottles, additional hydrogen compartment, bigger cabinet dimensions) - Flexible hydrogen connection to various hydrogen storage solutions	

Input: none
Output: 48 V DC

EFOY Hydrogen Energy Solutions

X-Series: Outdoor Solution – EPS (230V/400V)

Configuration	EFOY H_2Cabinet X2.5 NEA 230VAC P300	EFOY H_2Cabinet X5.0 NEA 230VAC P300
Output Power AC	2.0 kW	4.0 kW
Nominal Fuel Cell Output Power	2.5 kW	5.0 kW
Fuel Cell(s)	EFOY Hydrogen Fuel Cell 2.5 (1 unit)	EFOY Hydrogen Fuel Cell 2.5 (2 units)
Controller	EFOY Hydrogen Controller Monitoring and control of the EFOY Hydrogen Fuel Cell(s)	
Power Distribution	Power distribution and protection of all components inside the cabinet	
System voltage	48 V DC	
Output voltage	230 V AC-50/60 Hz	
Input voltage	230 V AC-50/60 Hz	
Compatible H_2 source	6 x H_2 50 Litter bottles[1], 300 bar, Hydrogen 3.0 or higher	
Connection of H_2 bottles	6 x W30 x 2 LH, DIN 477-5 Num.57	
Division of H_2 Connection	2 x Connection for service operation (Active strand) 4 x Connection for Back-up operation (Passive strand) Semi-automatic switching (Automatic switching on, Manuel switching off)	
Battery installation	48 V / 40 Ah 4 batteries of 12 V and 40 Ah in series	48 V / 40 Ah 4 batteries of 12 V and 40 Ah in series
Housing	EFOY H_2Cabinet X5.0 2FC-6H2-P300-39U	
Configuration	- Converter: SDW 40-06 (48 V DC: 2.0 kW) - Inverter: CE+T Bravo TSI 48/230 (230 V AC: 2.0 kW) - Electromagnetic switching unit (EMU 2.0) - Heating for deep temperature operation (Max. 1.2 kW, 48V DC)	

Input: 230 V AC
Output: 230 V AC

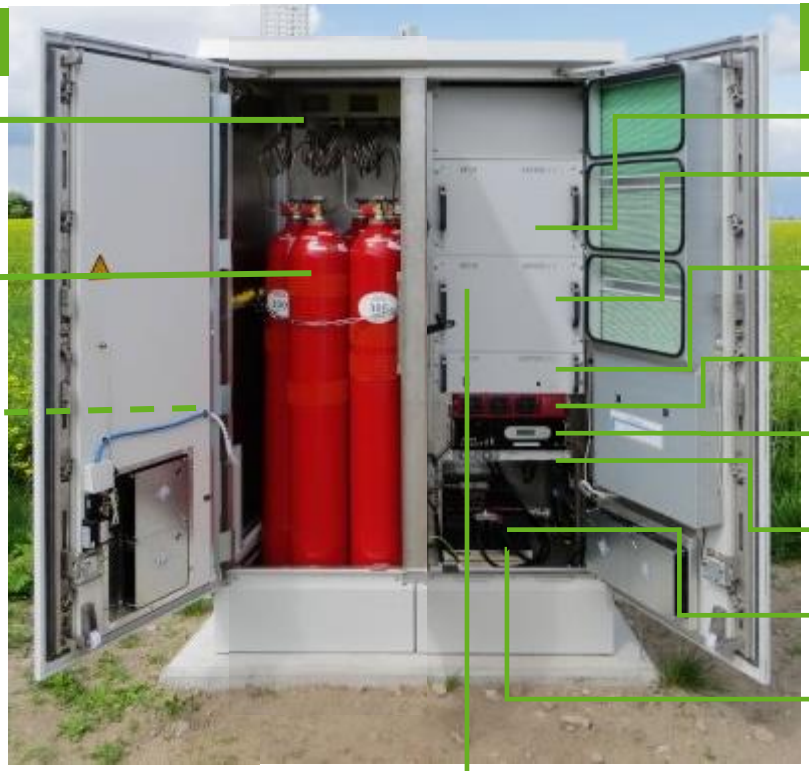
EFOY H_2Cabinet X2.5 / 5.0
X-Series: Outdoor Solution

Hydrogen storage

Pressure reducer 300/14 bar

4+2 Hydrogen bottles (300 bar)

Optional – Extension: 6x Hydrogen bottles (300 bar)



Fuel Cell & Energy management

EFOY Hydrogen Fuel Cell 2.5

EFOY Hydrogen Fuel Cell 2.5

EFOY Hydrogen Controller

DC/AC Inverter

DC/DC 48V DC Distribution

Rectifier

Battery Pack 48 V

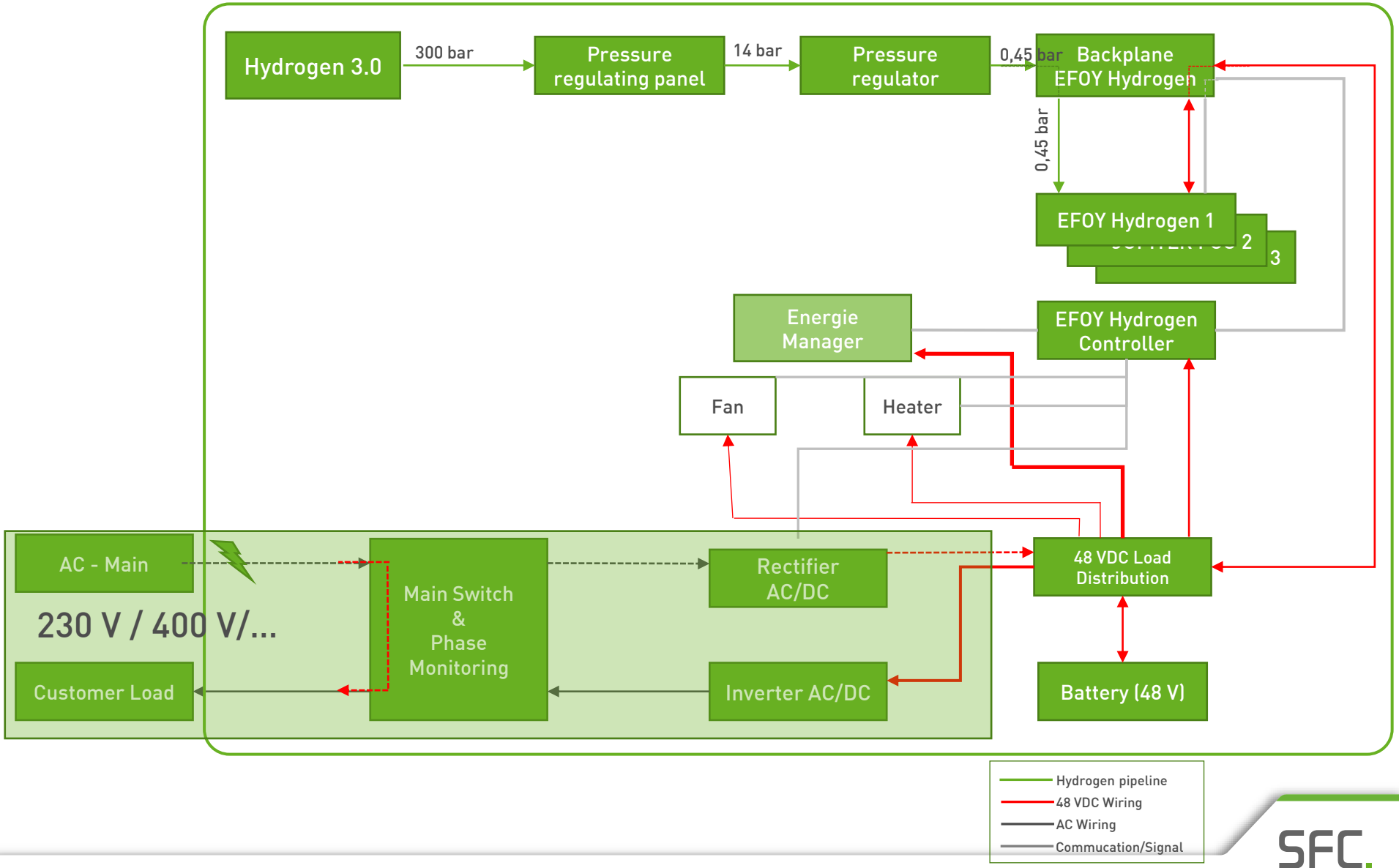
Heating and cooling components

Pressure reducer 14 / 0,5 bar and hydrogen sensors

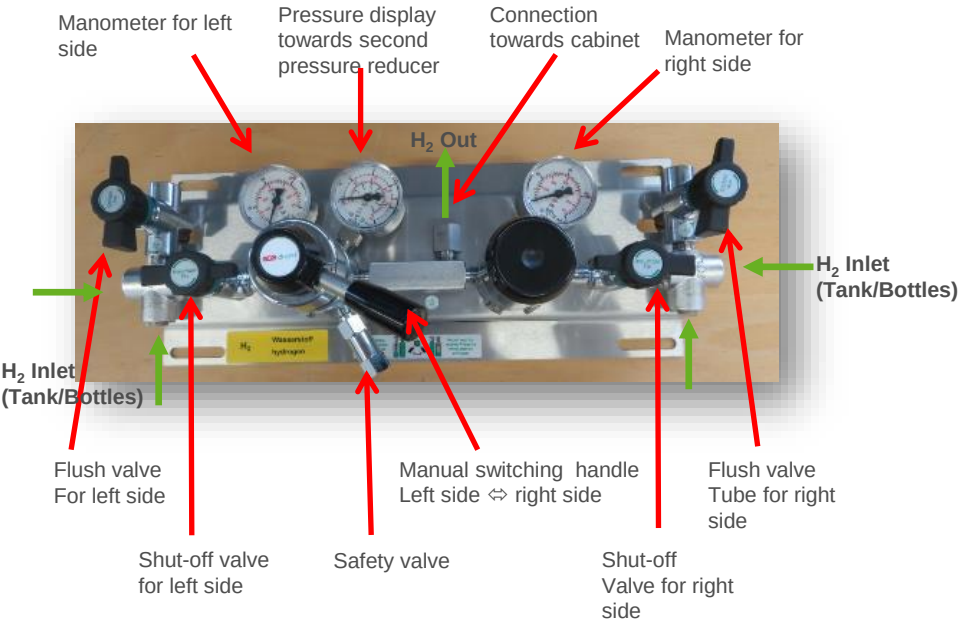
Modular Energy solution for different power outputs and runtimes

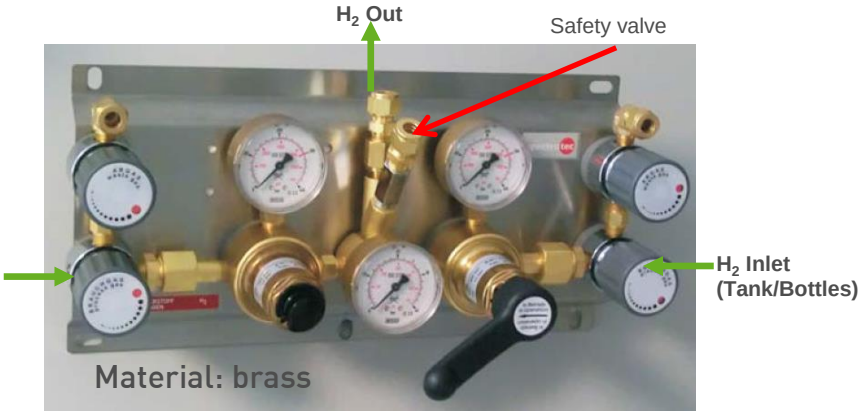
SFC ENERGY

Block diagram X-Series



Hydrogen pressure reducer 300 bar → 14 bar





- Pressure reducer from 300 bar or more than 300 bar to ca. 14 bar (this value depends on manufacturer. The second pipeline pressure reducer –H2 Cube- needs 10-18 bar.)
- Manual or automatic switching from tube 1 (left) to tube 2 (right), if pressure at tube 1 ‹ 14 bar
- H_2 bottles of the passive (unused) tube can be replaced when FC is working
- Overpressure protection realized by integrated safety valves (mostly at 30 bar)
- Different materials available: brass, chrome brass, steel
  - Different materials are allowed for hydrogen solutions. To get a certification with steel easier, because Certification authority mostly have experience with steel.
  - Brass has to be protected from high humidity or water during storage/assembly → Because of the corrosion handling is important
- Flow rate of high pressure reducer: ›416 Nl/min (›25 Nm^3/h) N_2 @14 bar

EFOY Hydrogen Product Portfolio

EFOY Hydrogen Fuel Cell 2.5

- Without DC/DC converter on the main board of Fuel Cell → Stack is connected directly to the battery
  - Battery voltage defines the operation point of the Fuel Cell
- Purge operation → Flushing of nitrogen and water drop (from H_2 Bottles) on anode side with hydrogen (approx. every minute) → the Fuel Cell provides the output power during this operation
- Short circuit operation → At start-up and then every hour to clean up the oxide layer on the cathode side → The stack is disconnected from the battery via a board on the Fuel Cell and Energy Solution cannot provide power during the short circuit phase for the duration of 200 ms. → for example like the effect of the refreshing phase in DMFC EFOYs
- CAN Communication with the EFOY Hydrogen Controller
- Controller has to be connected to the Fuel Cell(s)
- Exhaust: Vapor and ‹‹1% hydrogen (purge operation)
- Stack Current: 0- 80 A (80 A @41,0 V)
- Air flow rate: 10 – 700 m³/h (Nominal: 250 m³/h)
  - Additional fan is not required in the air duct
- Operation pressure: 0.45 bar (0.36 – 0.55 bar)
- Altitude: 0 - 3000 m
- Start time: ~60 sec. = ›2.2 kW @48 V

EFOY Hydrogen Fuel Cell 2.5

Technical data

EFOY Hydrogen Fuel Cell 2.5 48V	Technical Data
Power output[1]	2.5 kW
Max. Power output after 5,000 h operation time	2.0 kW
Nominal voltage	48 V DC
Supply voltage	41 – 57 V DC
Weight	28.5 kg
Connection with H_2	1/4" NPT female connection
Fuel	Hydrogen
Purity of the fuel	3.0 or better
Inlet pressure at the Fuel Cell	0.5 bar
Nominal Consumption	0.06 kg H_2 / kWh
Leakage rate during operation [2]	Approx. 0.35 l H_2 / min.
Oxygen consumption	Approx. 335 l / kWh
Power consumption in standby mode	‹ 50 W
Operating temperature [3]	+ 3 °C to + 50 °C
Storage temperature	- 40°C to 70°C Recommended: 10°C to 25°C
Altitude [4]	Up to 3,000 m above sea level
Dimensions D x W x H	535 x 483 x 310 [mm]
IP Class	IP 20
Data interface	Internally between Fuel Cell and Controller: CAN BUS

1 Only achievable with supply air temperatures ‹ 30 C°

2 The leakage rate increases proportionally with the operation time of the fuel cell

3 When installed in a suitable cabinet with integrated heating. When used in the minimum ambient temperature, a base load of 1,000 W is required

4 With increasing altitude there is a reduction in power output

EFOY Hydrogen Product Portfolio

EFOY Hydrogen Controller

- Monitoring and Control unit for Hydrogen Fuel Cell units
- Up to 4 can be connected with the EFOY Hydrogen Controller
- Controls permanent the 48 V DC conductor rail and switches on the FC-modules when the voltage is below a certain voltage limit
- Communicates via CAN with FC modules
- Operates sensors and magnetic valves for safe operation
- Controls alarm contacts
- Monitoring / Data protocols:
  - Offers Web-Interface for diagnostic analysis and maintenance
  - Integration in higher-level systems (e.g. Energy Manager) via RS485-ModBus possible

The Hydrogen Controller is the central element for controlling different components

Thank you
for your attention

More than 50,000 SFC Fuel Cells in the market

SFC ENERGY