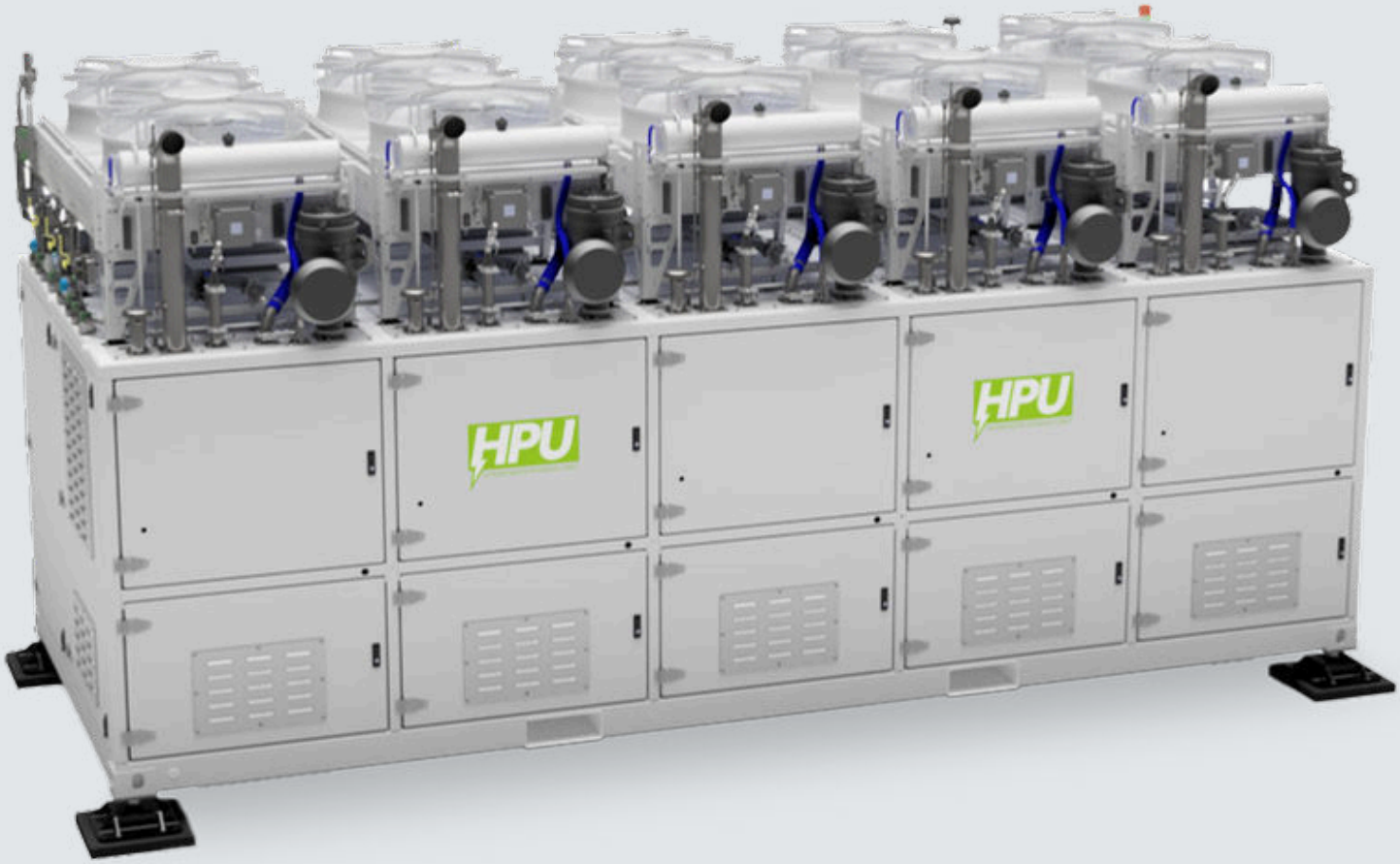
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HPU2



Technical Specification

ZERO EMISSION FUEL

GREEN POWER GENERATION

HPU2 Technical Specification

GeoPura uses fuel cell technology to provide zero emission electricity when and where it's needed - the only by-product is pure water and heat. The use of green hydrogen in our Hydrogen Power Units (HPUs) does not harm the environment unlike the use of diesel and even bio replacements like HVO, which still produce harmful emissions such as CO2, SOx, NOx and PM that have a devastating impact on natural habitats and health.

Building on the success of HPU1, HPU2 represents a significant step forward in zero emission three-phase power generation, with improved power density, efficiency, and cost-effectiveness. Fuelled by green hydrogen to ensure zero emissions, the HPU2 is designed for heavy-duty industrial power applications such as EV charging, festivals, construction, film/TV, sports events, and data centres.

Key features:

Highest Power Density and Efficiency:
With 500kW of fuel cell power, the HPU2 offers unmatched power density and efficiency, seamlessly synchronising with supplies such as: Battery Energy Storage System (BESS), mains/micro grid, GeoPura HPU1, reciprocating engine, or other renewable energy generators

Scalable Power Solutions:
The HPU2 can be deployed in 1MW, 2MW, 3MW or 4MW 'power block' configurations, and each power block can be paralleled as often as required to make resilient power capabilities up to 50MW

Lowest Possible Costs:
From components and construction to deployment, operation, and maintenance, every aspect of the HPU2 is optimised for cost-efficiency without compromising on quality

Ease of Manufacture and Serviceability:
Designed with simplicity in mind, the HPU2 ensures easy manufacturing and straightforward maintenance

GeoPura's HPU2 is mass-manufactured in the UK by Siemens Energy. This ensures it is built to the highest standards, leveraging advanced manufacturing techniques for reliability, quality and performance



Figure 1 HPU2 unit manufactured by Siemens Energy

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HPU2 System Overview

A deployable 'HPU2 system' consists of the following three key components - all provided by GeoPura as standard

1 **HPU2 Unit**
GeoPura's 500kW zero emission (fuel cell driven) 400V three phase AC electrical power generator

2 **HPU2 Grid Connection Panel (GCP)**
GeoPura supplied 400V three phase AC electrical distribution panel. The GCP provides the connection/interface/telemetry between the HPU2 unit, synchronous supply and load/customer. This can be provided by GeoPura or customer as required

3 **HPU2 Satellite Gas Panel (SGP)**
GeoPura supplied hydrogen gas panel. The SGP provides the pressure regulation/control/telemetry between on-site bulk hydrogen storage (300Barg) to HPU2 unit (10Barg). This can be provided by GeoPura or customer as required

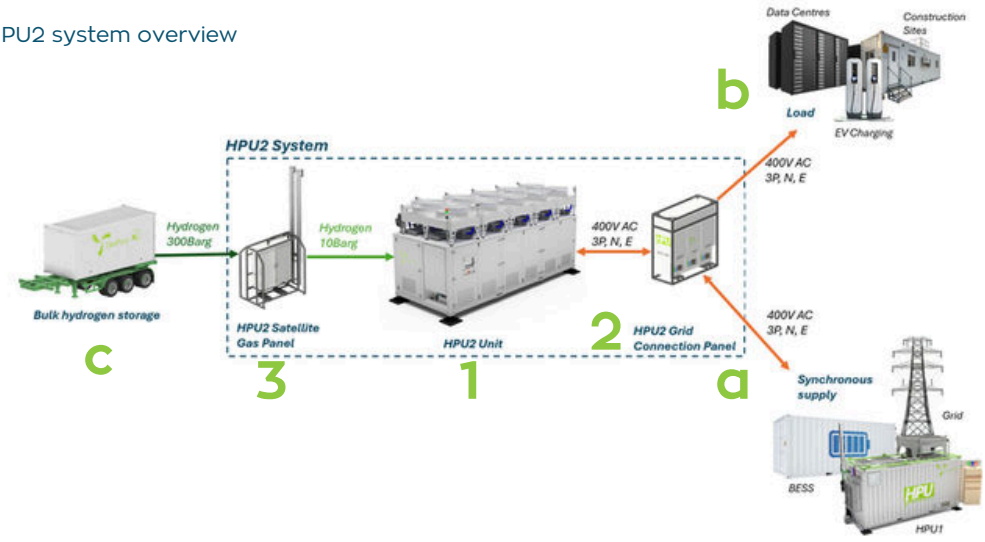
For the 'HPU2 system' to operate, exporting power to a load/customer, the following are required

a **Synchronous supply**
a suitably rated (63A/phase minimum), 400V three phase AC electrical supply. This could be Battery Energy Storage System (BESS), mains/micro grid, GeoPura HPU1, reciprocating engine, or other renewable energy generators. This can be provided by GeoPura or customer as required

b **Load/customer**
customer demand side

c **Bulk hydrogen storage**
on-site storage of 300Barg hydrogen gas in multi-cylinder pack (MCP), Multi-Element Gas Container (MEGC) or tube trailer formats. This can be provided by GeoPura or customer as required

Figure 2 HPU2 system overview



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HPU2 System Overview

Figure 3 HPU2 unit and Grid Connection Panel



Figure 4 HPU2 unit



Figure 5 HPU2 unit



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HPU2 Unit Specification

- 500kW zero emission 400V three phase AC electrical power generator
- Power generation from industrial grade Proton Exchange Membrane Fuel Cells (PEMFC)
- Split into five repeating 100kW 'power modules' for reliability and redundancy of supply
- Truly 100% zero harmful emission – the only exhaust is pure water and heat
- Full flexibility in synchronous supply; Battery Energy Storage System (BESS), mains/micro grid, GeoPura HPU1, reciprocating engine, or other renewable energy generators
- Combine HPU2 with a GeoPura BESS for a fully resilient 1MW, 2MW, 3MW and 4MW system, allowing operation in off-grid (island), grid augmentation / synchronisation (mains current limitation) and back-up power modes
- Multiple HPU2 / BESS can be combined to provide a fully scalable and redundant solution up to 50MW
- Quiet operation, significantly below the noise levels of an equivalently sized diesel generator
- Standard ISO 20ft high cube container form factor with C5-M paint specification
- Four-point bottom lift with an industry standard lorry mounted crane
- Cybersecure monitoring & control over 4G network using a Dynamic Multipoint Virtual Private Network (DM VPN)
- Full G99 compliance when operating in a mains grid synchronisation mode
- Full CE / UKCA accreditation, with third party NoBo approval
- Safety control systems fully compliant with BS EN ISO 13849-1
- Site set-up and layout fully compliant with DSEAR (2002), BCGA GN13, BS EN IEC 60079-10-1, EIGA 75
- Manufactured to GeoPura's CE type approved design, by Siemens Energy, according to ISO 9001 and 14001 quality standards, in Newcastle upon Tyne UK

HPU2 Optional Extras

Combined heat and power

250kW of hot water (60°C) at peak electrical power output

EV fast charging

Provision of EV charging posts to create temporary or permanent grid-independent EV charging facilities

Ruggedisation

Bolt on features to permit use of HPU2 in extreme environments outside of standard nameplate values

Solar PV

Fully integrated solar PV system

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HPU2 Technical Overview

Item	Value
Power output (kW) see HPU2 unit electrical characteristics in separate section	500
Length (m)	6.1
Width (m)	2.44
Height (m)	2.9
Combined weight no fluids (kg)	9,610
Combined weight with fluids (kg)	9,860
Hydrogen system operating pressure (Barg) see HPU2 SGP operating pressure in separate section	10
Coolant system operating pressure (Barg)	1 (atmospheric)
Max noise level >1m (dB)	< 65
Hydrogen supply quality	ISO 14687:2025, grade D
Maximum hydrogen usage (kg/hr)	42
Hydrogen usage per MWhe (kg/MWh) based on LHV of hydrogen	60
Condensed liquid water production (L/hr) at 100 / 200 / 300 / 400 / 500kW power output	20 / 40 / 60 / 80 / 100
Lifting	4-point bottom lift
Positioning / pad loading	4 pads / 97kN/m2 per pad
Certifications	Full CE accreditation to applicable EU Directives EN IEC 62282-3-100:2020 See Figure 23 in Appendix

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HPU2 Technical Overview

	Operation	Storage/Transport
Temperature max. (°C)	40	60
Temperature min. (°C)	-10	-10
Relative humidity max. (%)	100	100
Altitude (m)	1000 Approximately 1% system power de-rate per 100m above 1000m	1000

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HPU2 Electrical Characteristics

Item	Value
HPU2 power output (kW)	500
Power output / synchronising line voltage (V)	400 to 415 3P / N / PE
Power output / synchronising frequency (Hz)	50/60
Maximum continuous output current per phase (A)	722
Main power contactor (A)	1600
Minimum synchronising current per phase (A)	63 no RCD / earth leakage
Short circuit current rating (kA)	85
Main power connection	L1, L2, L3, N, PE PowerSafe panel mount drain connectors - x2 off sets in parallel Bolted bus bar connections (optional)
Auxiliary power* voltage (V)	230 to 240 1P / N / PE
Auxiliary power* current (A)	16
Auxiliary power* connection	L, N, PE 16A CEE form socket
Maximum generating earth fault loop impedance at connection point, Zs (Ω)	0.5
Maximum auxiliary earth fault loop impedance at connection point, Zs (Ω)	0.8
Maximum conductor size of main earthing point using Powerlocks (mm2)	x2 off 300 Standard deployment uses x2 off 240 mm2

* the auxiliary power supply allows for energisation of the HPU2 balance of plant, including heaters, HMI and 4G router during storage and maintenance. No power can be produced / outputted in this configuration

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HPU2 Electrical Data & User Interfaces

Main Power Connections

- 750A PowerSafe panel mount drain connector
- L1, L2, L3, N, PE
- x2 off sets in parallel to provide cable connection diversity
- Automatic load disconnect



Auxiliary Power Connection

- 16A 1P CEE form socket
- L, N, PE



Data and I/O Connections

- HPU2 Grid Connection Panel (GCP)
- HPU2 Satellite Gas Panel (SGP)
- Custom connection (RJ45 Ethernet & I/O)
- Remote E-stop function





Communication Protocols

- MODBUS TCP/IP
- OCP UA

User Interfaces

- HMI screen: local control of HPU2 unit
- E-Stop button: complete & safe full de-energisation of HPU2 unit
- Mains power button: used for HPU2 unit start sequence
- Auxiliary power button: used for HPU2 auxiliary system start (comms/data, GPS, heater)

DC Connections

- Amphenol DC connections: x2 PL082Y-301-10D8-2
- Max DC current: 300A per connection



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Figure 6 HPU2 unit electrical, data and comms interfaces

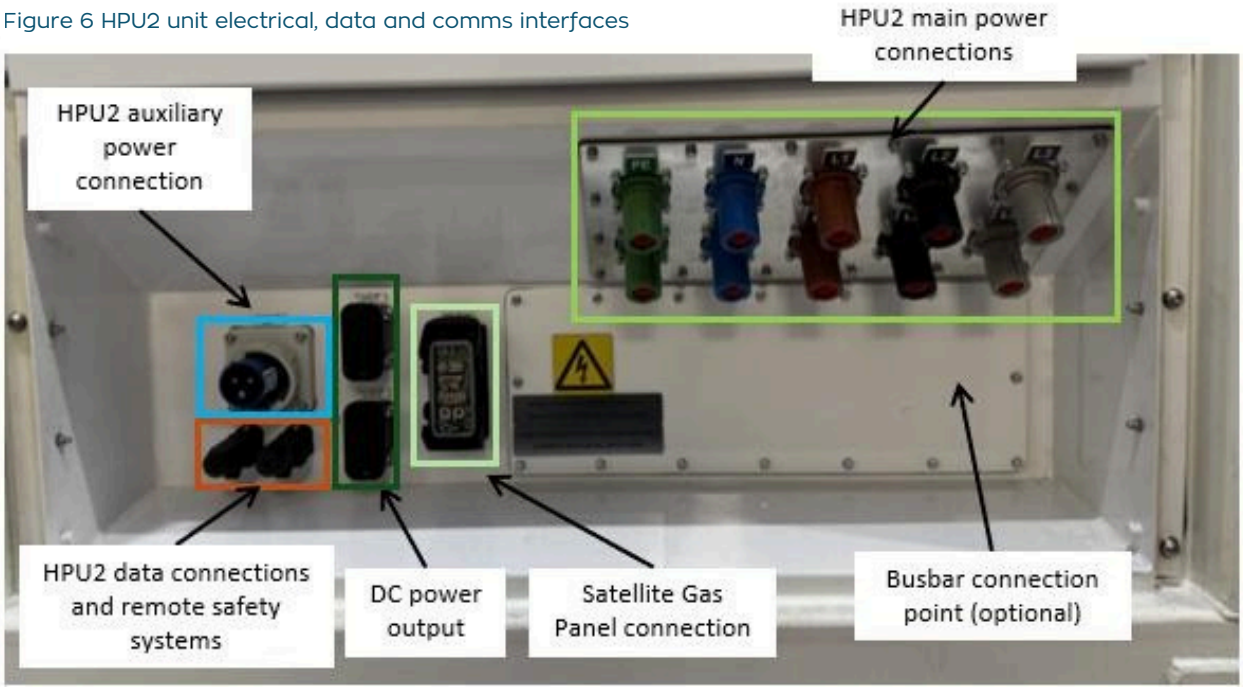
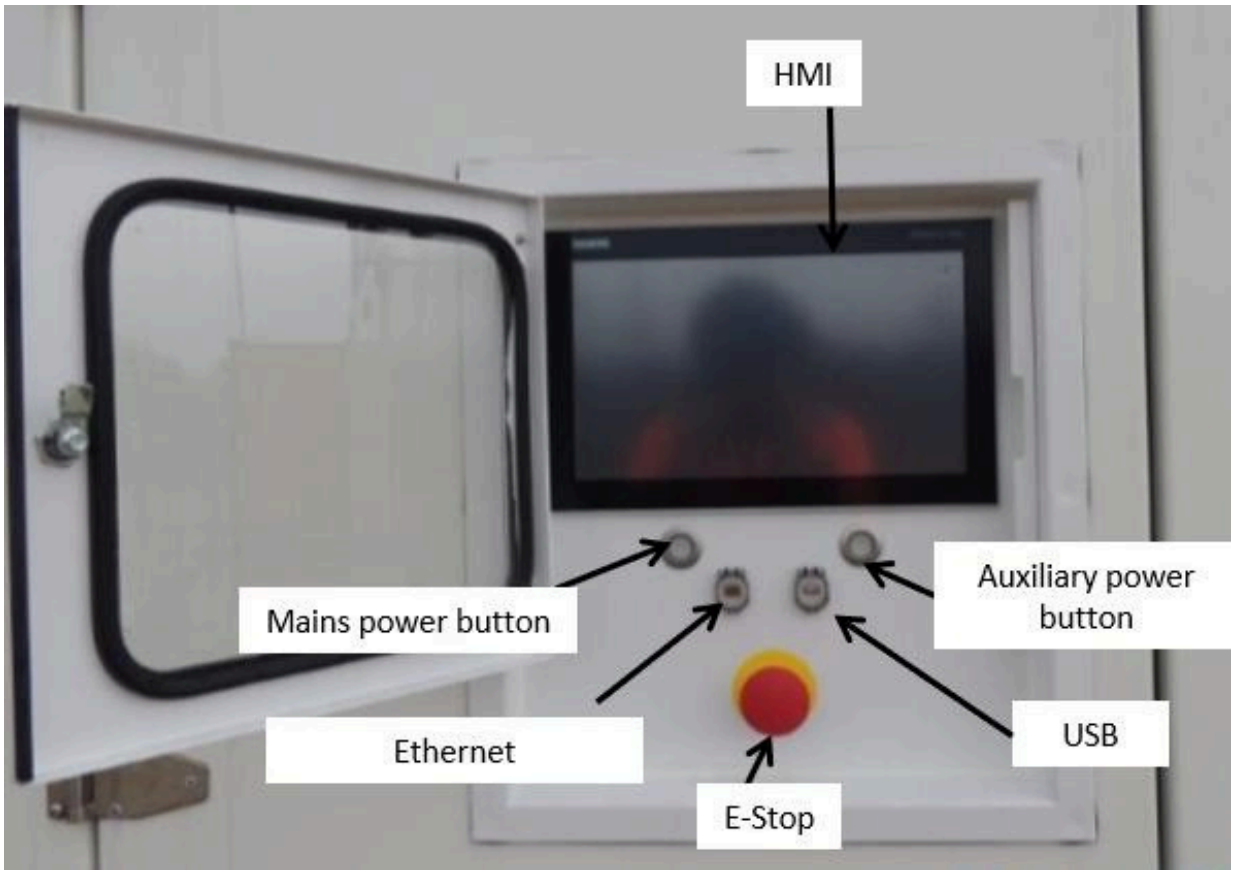


Figure 7 HPU2 user interfaces



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HPU2 Mechanical Interfaces

Hydrogen Inlet Connection	• NVFCL140801 Quick release coupling, screw to connect, male full sealing • Size 16, 1" BSPP, Viton seal, 316 stainless steel
Combined Heat and Power Connections	• 51mm hose tail connection on CHP flow and return • Five sets of flow / return connections i.e. per 100kW 'power module'
Process Water Output	• 1" male camlock interfaced with 1" female camlock and hose

Figure 8 Mechanical interfaces



Notes

- Other mechanical connections: hydrogen vent line, hydrogen PRV line and process output lines are fully integrated into the standard HPU2 unit, with no on-site connections necessary
- A low-pressure hydrogen hose is provided to connect the HPU2 unit to the Satellite Gas Panel (SGP), see figure 2
- A high-pressure hose is provided to connect the Satellite Gas Panel (SGP) to the hydrogen storage asset (MEGC/MCP), see figure 2

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HPU2 Grid Connection Panel

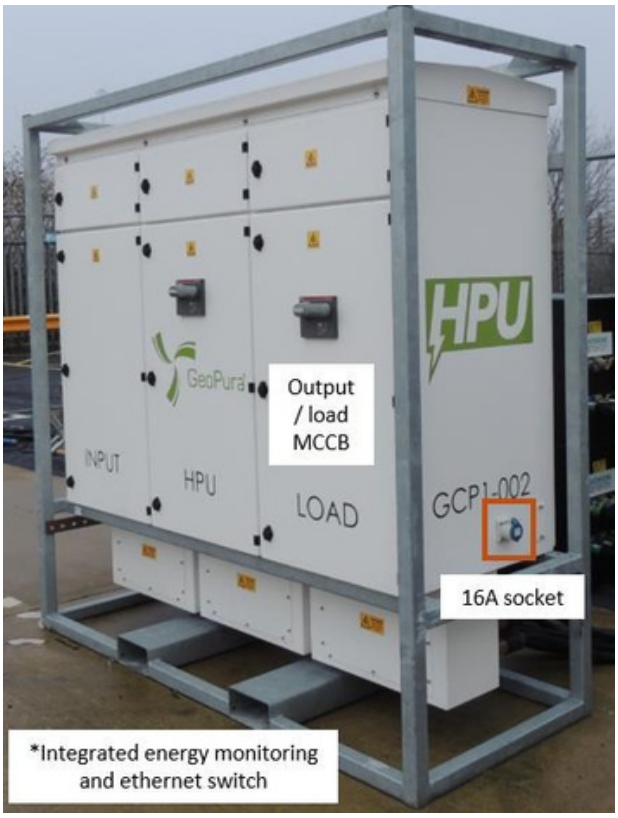
GeoPura supplied 400 to 415V three-phase, neutral and earth AC electrical distribution panel.

The GCP provides the connection/ interface/ telemetry between HPU2 unit, synchronous supply and load/customer. This can be provided by GeoPura or customer as required.

The HPU2 GCP monitors the Distribution Network Operator (DNO), Independent Distribution Network Operator (IDNO) or Private Network Operator (Micro Grid) service termination equipment.

This monitoring provides HPU2 with the information required to set a suitable power output. Alternatively, this monitoring equipment can be integrated into the client's distribution equipment

Figure 9 Grid Connection Panel



Item	Value
Line voltage (V)	400 to 415 3P / N / PE
Frequency (Hz)	50/60
Load / HPU / Input Current (A)	1600 / 800 / 800
Length (m) X Width (m) x Height (m)	2 x 0.8 x 2
Weight (kg)	780
Lifting	Forklift pockets, 4 lifting eyes
Certifications	Full CE accreditation to Low Voltage Directive 2014/35/EU
Connections	See section: HPU2 GRID CONNECTION PANEL: CONNECTIONS
HPU2 Circuit Breaker Specification	XT6S 800 Ekip Dip LS/I In=800 4p F F
Load Circuit Breaker Specification	XT7S 1600 Ekip Dip LSIG In=1600A 4p F F

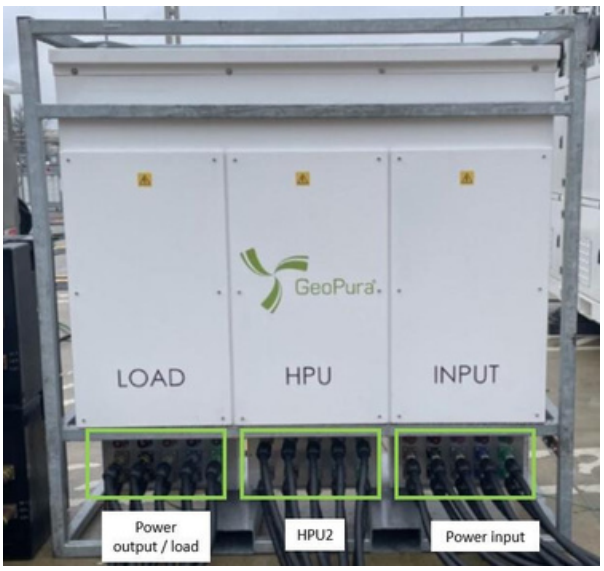
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HPU2 Grid Connection Panel Connections

Power Output / Load	• This is the customer interface point • 750A PowerSafe panel mount source connector • L1, L2, L3, N, PE • x3 off sets in parallel to provide cable connection diversity and throughput of 1600A • Optional ground fault protection available	
HPU2	• 750A PowerSafe panel mount source connector • L1, L2, L3, N, PE • x2 off sets in parallel to provide cable connection diversity	
Power Input	• 750A PowerSafe panel mount drain connector • L1, L2, L3, N, PE • x3 off sets in parallel to provide cable connection diversity and throughput of 1600A	
16A Output	• 16A RCBO 30mA	
Integrated Earthing Busbar	• Copper busbar with M10 bolt connections	
Comms Connection	• Ethernet connection with integrated network switch • x4 off RJ45	

Figure 10 Grid Connection Panel connections



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HPU2 Satellite Gas Panel

GeoPura supplied Satellite Gas Panel (SGP) regulates bulk hydrogen storage (MEGC/MCP) from 300Barg to 10Barg for use with HPU2.

It is equipped with two primary hydrogen inputs controlled by electrical solenoid actuated valves, enabling uninterrupted operation during bulk hydrogen storage asset swaps.

Also features a third manually operated hydrogen input to provide back-up supply with bi-directional flow for filling spent assets. Finally, a low- pressure outlet supplies HPU2. Vent stack is easily removed for transport.

Figure 11 Satellite Gas Panel



Item	Value
Length (m) X Width (m) x Height (m)	2.01 x 1.2 x 4.2
Weight (kg)	~500kg
Lifting	Forklift pockets
Certifications	Full CE accreditation to applicable EU Directives Pressure Equipment Directive (PED) 2014/68/EU, ATEX Product Directive 2014/34/EU, Low Voltage (LV) Directive 2014/35/EU
Connections	See table on next page
Maximum Hydrogen Inlet Pressure (Barg)	300
Maximum Hydrogen Outlet Pressure (Barg)	10
Hydrogen Supply Quality	ISO 14687:2025 grade D

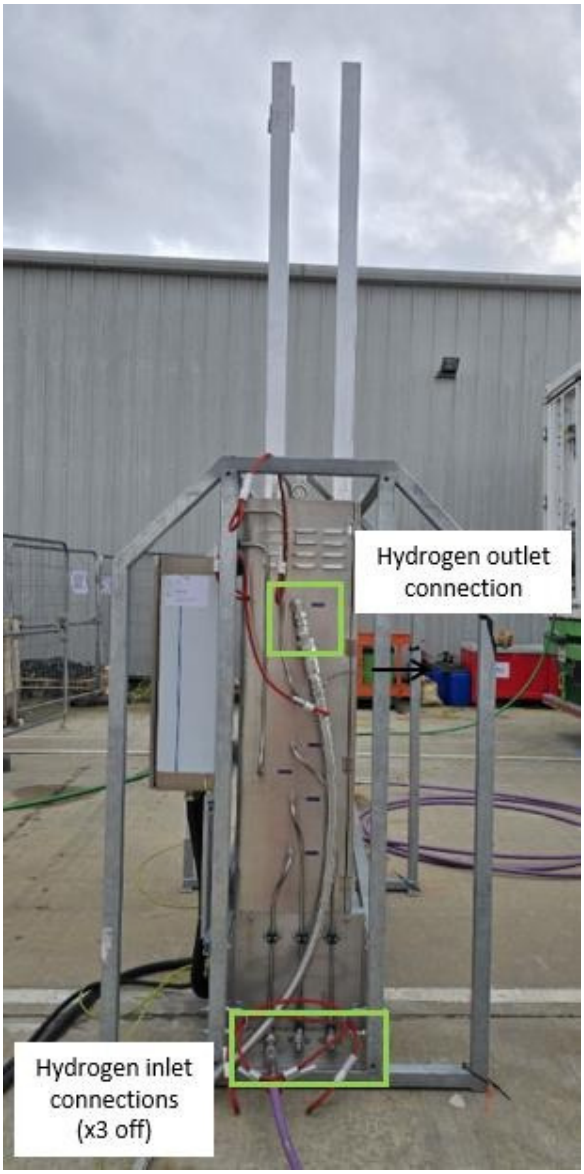
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HPU2 Satellite Gas Panel

Connections	
Hydrogen Inlet Connection	• x3 off NVFCL096730 Quick Release Coupling, Screw to Connect Male • Size 12, 1/2 BSP Male, Viton Seal, 316 Stainless Steel
Hydrogen Outlet Connection	• NVFCL141823 Quick release coupling, screw to connect, full flow male • Size 16, 1" BSPP, Viton seal, 316 stainless steel

Figure 12 Satellite Gas Panel connections



Notes

- A low-pressure hydrogen hose (DN25 MH Series hydrogen compatible hose) is provided to connect the HPU2 unit to the Satellite Gas Panel (SGP).
  - 316 stainless steel convoluted metal core, with 304 stainless steel over braid
  - 1 inch nominal internal diameter
- A high-pressure hose (DN16 HHP series hydrogen compatible hose) is provided to connect the Satellite Gas Panel (SGP) to the hydrogen storage asset (MEGC/MCP).
  - Polyamide core tube with multilayer steel wire reinforcement and polyamide cover
  - 16 mm internal diameter

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HPU2 General Arrangement

Figure 13 HPU2 unit general arrangement

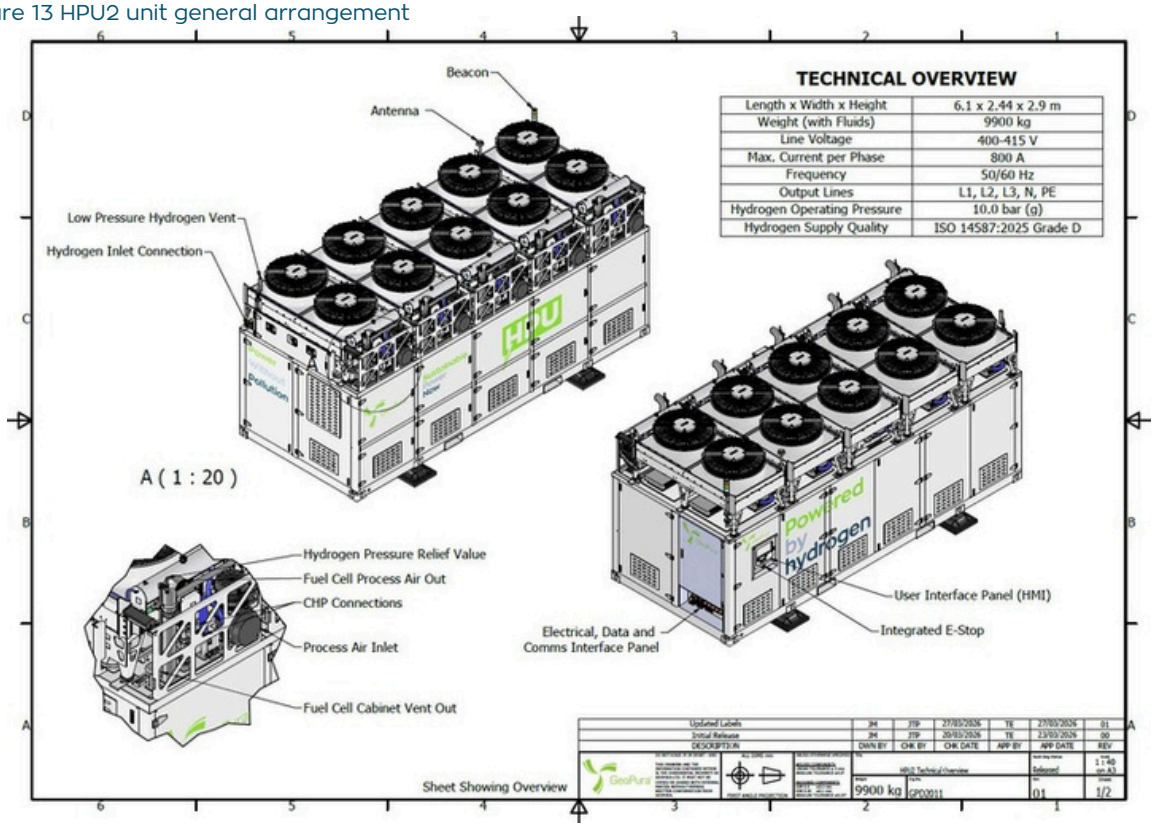
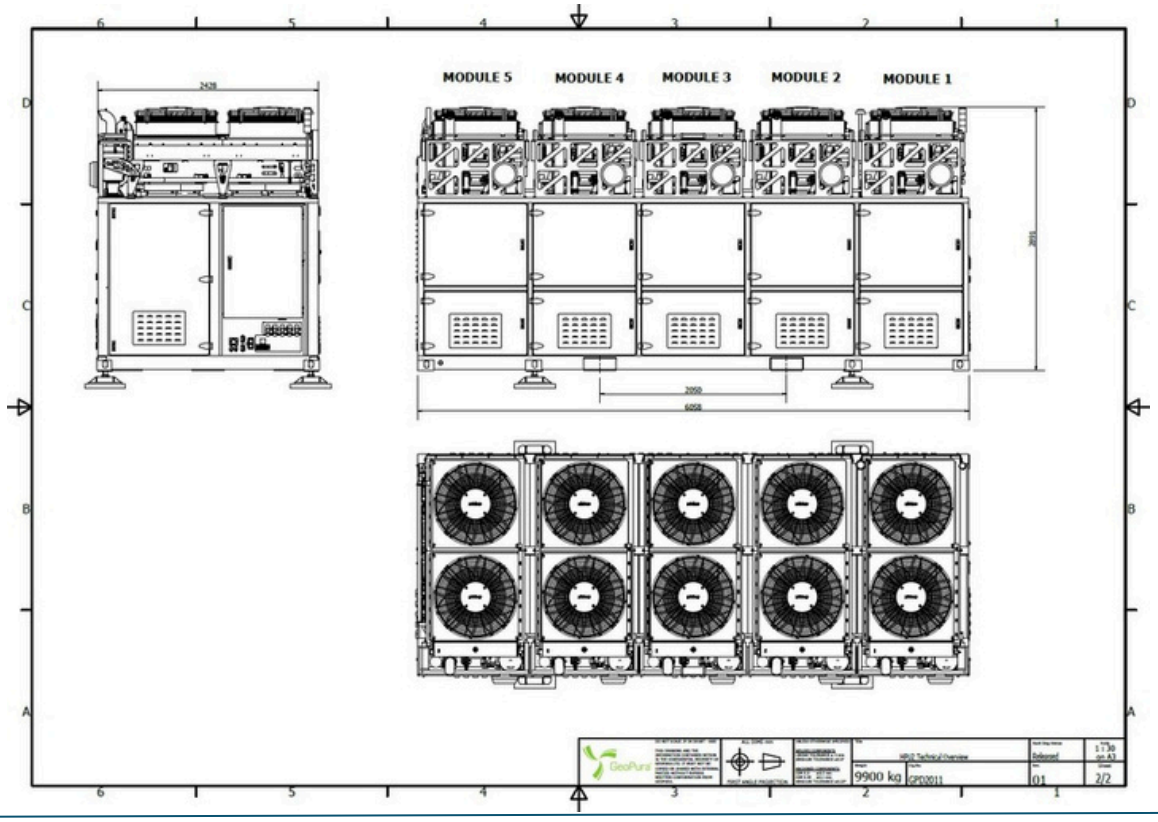


Figure 14 HPU2 unit general arrangement



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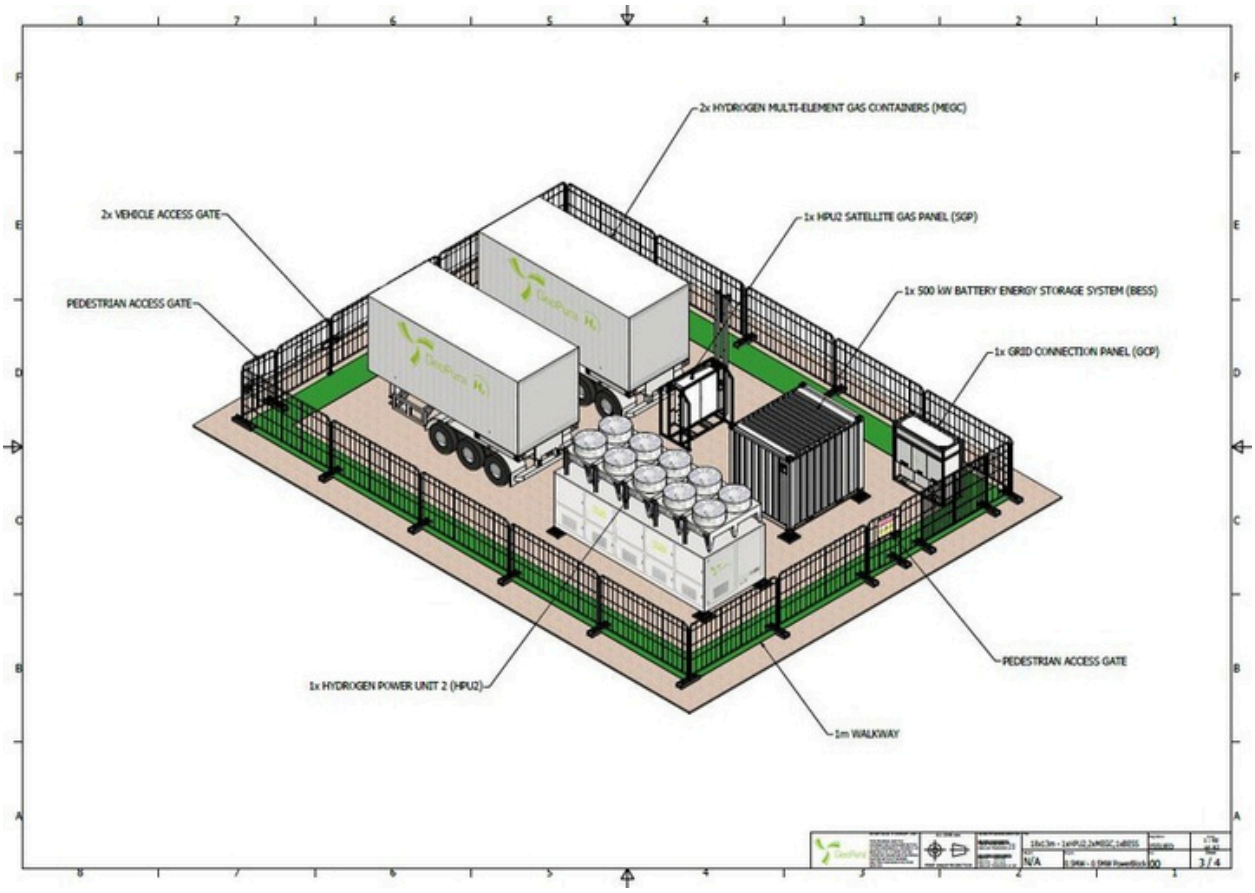
HPU2 Example Compound Layouts

- Site layouts shown are generic examples and will be subject to a customer site survey
- All site set-ups and layouts compliant with DSEAR (2002), BCGA GN13, EN IEC 60079-10-1, EIGA 75

0.5MW / 0.5MW PowerBlock (average power / peak power capability)

- x1 off 500kW (0.5MW) HPU2 unit
- x1 off 0.5MW BESS (0.5MW, 0.25MWh battery system)
- x1 off HPU2 Grid Connection Panel
- x1 off HPU2 Satellite Gas Panel
- x2 off GeoPura 20ft hydrogen MEGCs (bulk hydrogen storage)
  - 300kg of hydrogen storage per MEGC ~ 5MWh of usable electricity
- Compound layout dimensions: 13m x 18m

Figure 15 Generic compound layout showing 0.5MW / 0.5MW PowerBlock



Notes

- Off-grid system illustrated – on grid options at 400V / 11kV / 33kV available
- Different bulk hydrogen storage asset options / sizes available

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HPU2 Example Compound Layouts

Figure 16 Generic compound layout showing 0.5MW / 0.5MW PowerBlock

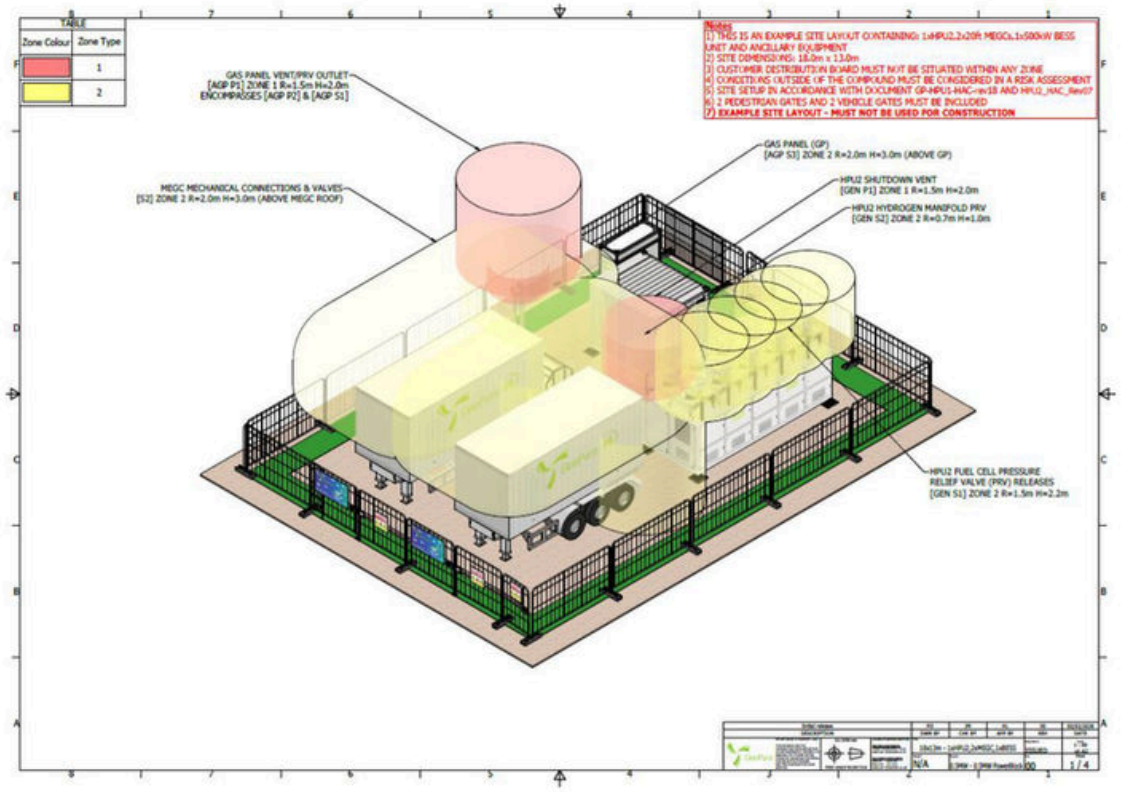
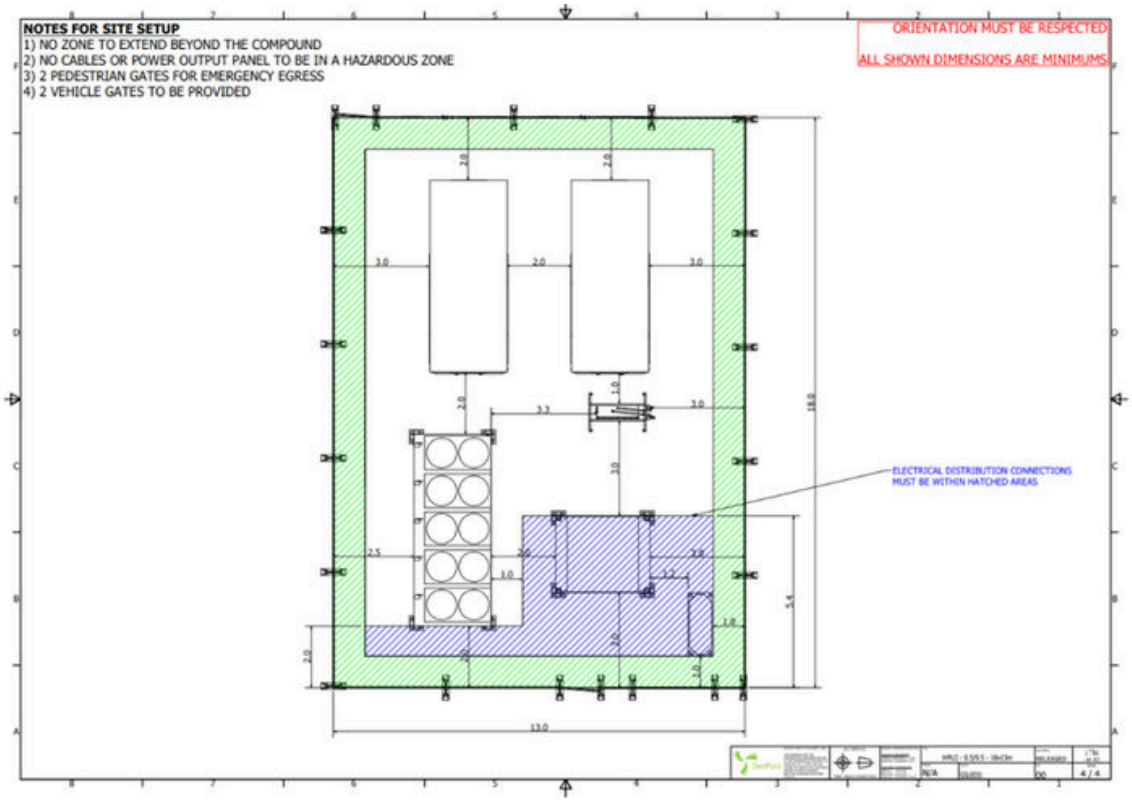


Figure 17 Generic compound layout showing 0.5MW / 0.5MW PowerBlock



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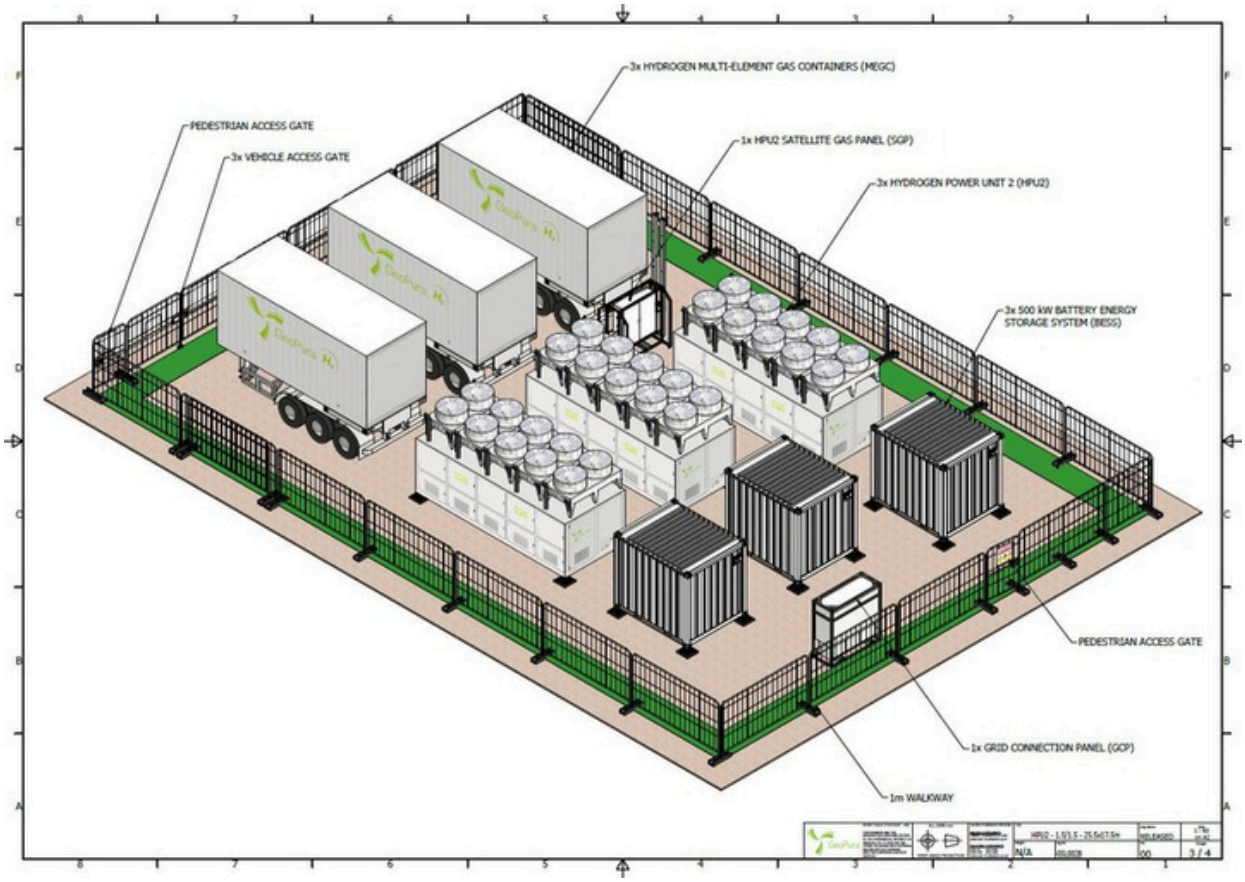
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HPU2 Example Compound Layouts

1.5MW / 1.5MW PowerBlock (average power / peak power)

- x3 off 500kW HPU2 systems (1.5MW)
- x3 off 0.5MW BESS (1.5MW)
- x1 off Grid Connection Panel
- x1 off HPU2 Satellite Gas Panel
- x3 off GeoPura 20ft hydrogen MEGCs (bulk hydrogen storage)
  - 300kg of hydrogen storage per MEGC ~ 5MWh of usable electricity
- Compound layout dimensions: 18m x 26m

Figure 18 Generic compound layout showing 1.5MW / 1.5MW PowerBlock



Notes

- Off-grid system illustrated – on grid options at 400V / 11kV / 33kV available
- Different bulk hydrogen storage asset options / sizes available

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HPU2 Example Compound Layouts

Figure 19 Generic compound layout showing 1.5MW / 1.5MW PowerBlock

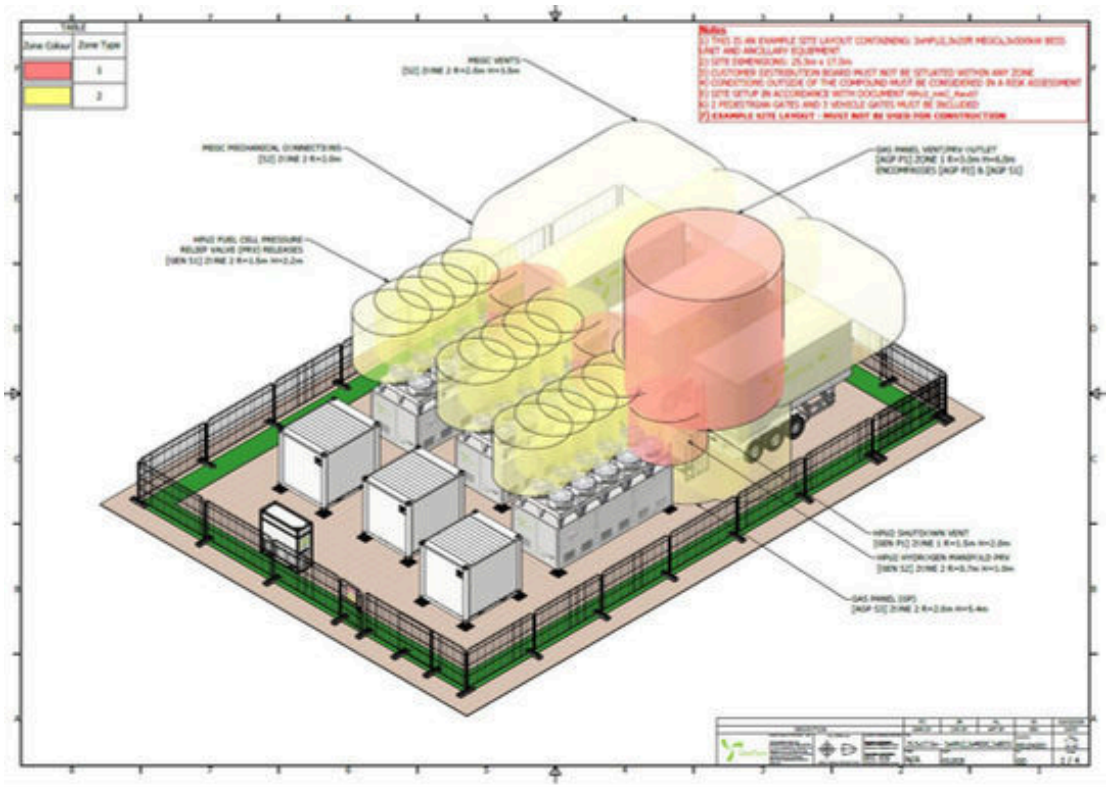
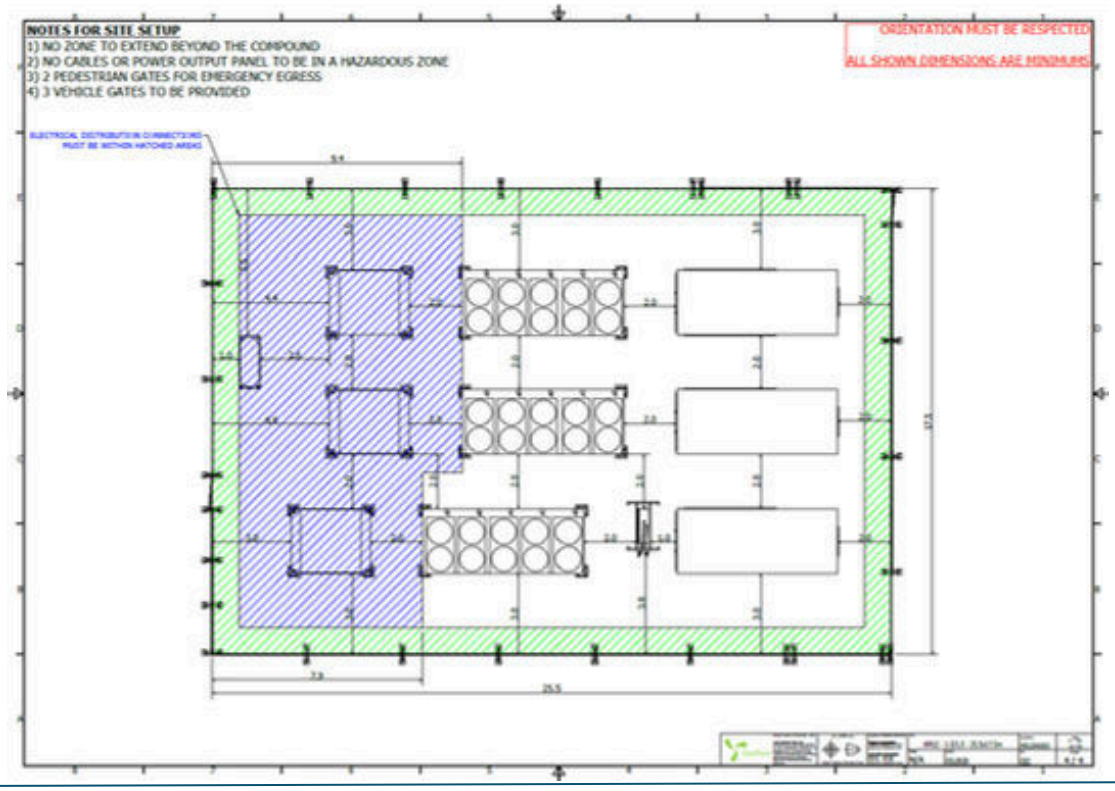


Figure 20 Generic compound layout showing 1.5MW / 1.5MW PowerBlock



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HPU2 Deployment Photos

Figure 21 HPU2 and HPU1 on deployment



Figure 22 HPU2 with bulk hydrogen storage



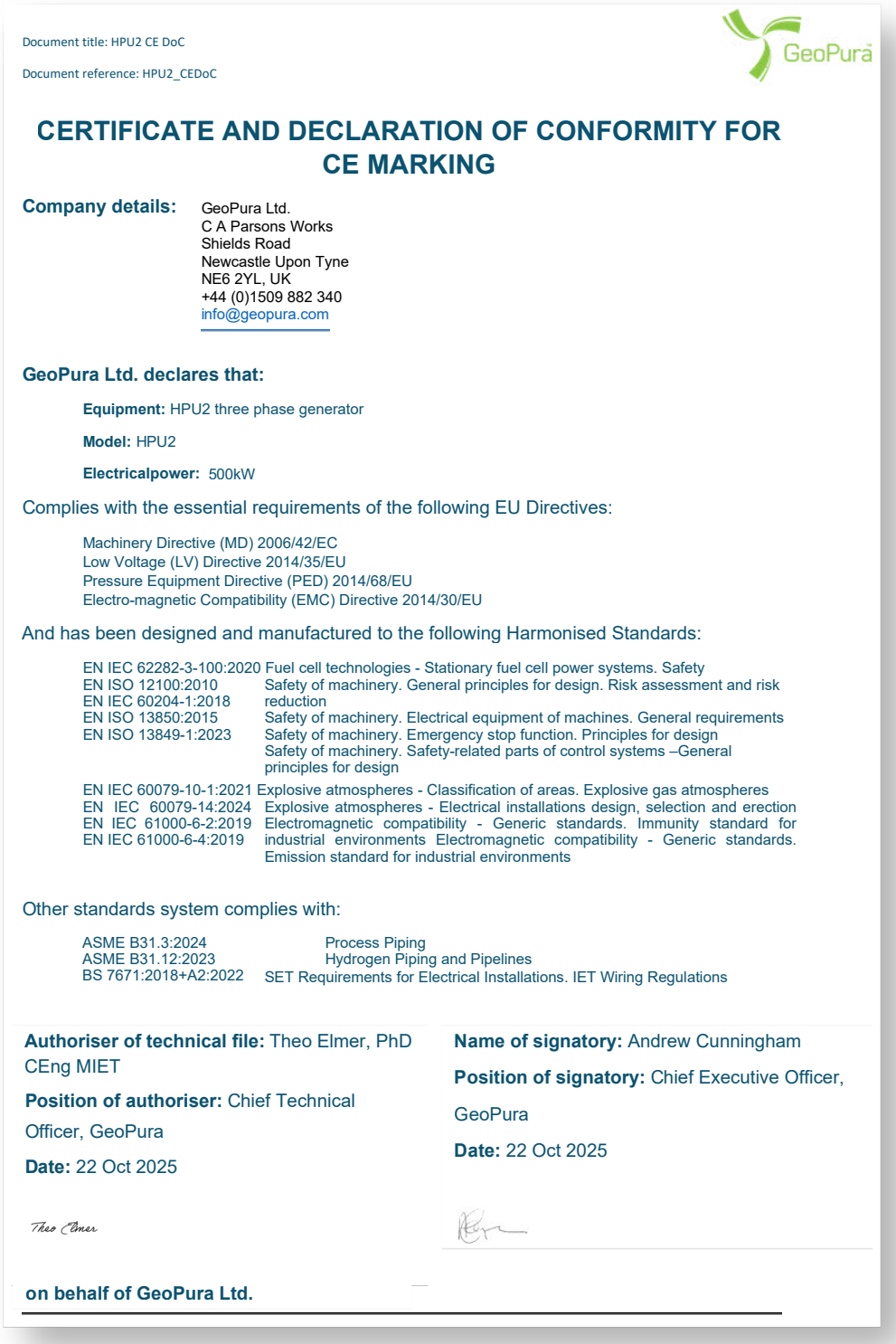
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Appendix

HPU2 UNIT: CERTIFICATION

Figure 23 CE Declaration of Conformance



Document title: HPU2 CE DoC

Document reference: HPU2_CEDoC

GeoPura

CERTIFICATE AND DECLARATION OF CONFORMITY FOR CE MARKING

Company details:

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GeoPura Ltd. declares that:

Equipment: HPU2 three phase generator

Model: HPU2

Electricalpower: 500kW

Complies with the essential requirements of the following EU Directives:

Machinery Directive (MD) 2006/42/EC
Low Voltage (LV) Directive 2014/35/EU
Pressure Equipment Directive (PED) 2014/68/EU
Electro-magnetic Compatibility (EMC) Directive 2014/30/EU

And has been designed and manufactured to the following Harmonised Standards:

EN IEC 62282-3-100:2020	Fuel cell technologies - Stationary fuel cell power systems. Safety
EN ISO 12100:2010	Safety of machinery. General principles for design. Risk assessment and risk reduction
EN IEC 60204-1:2018	
EN ISO 13850:2015	Safety of machinery. Electrical equipment of machines. General requirements
EN ISO 13849-1:2023	Safety of machinery. Emergency stop function. Principles for design Safety of machinery. Safety-related parts of control systems –General principles for design
EN IEC 60079-10-1:2021	Explosive atmospheres - Classification of areas. Explosive gas atmospheres
EN IEC 60079-14:2024	Explosive atmospheres - Electrical installations design, selection and erection
EN IEC 61000-6-2:2019	Electromagnetic compatibility - Generic standards. Immunity standard for industrial environments
EN IEC 61000-6-4:2019	Electromagnetic compatibility - Generic standards. Emission standard for industrial environments

Other standards system complies with:

ASME B31.3:2024	Process Piping
ASME B31.12:2023	Hydrogen Piping and Pipelines
BS 7671:2018+A2:2022	SET Requirements for Electrical Installations. IET Wiring Regulations

Authoriser of technical file: Theo Elmer, PhD CEng MIET

Position of authoriser: Chief Technical Officer, GeoPura

Date: 22 Oct 2025

Theo Elmer

Name of signatory: Andrew Cunningham

Position of signatory: Chief Executive Officer, GeoPura

Date: 22 Oct 2025

on behalf of GeoPura Ltd.

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Appendix

HPU2 UNIT: PERFORMANCE DATA

Figure 24 HPU2 System efficiency at 20% different duty strike

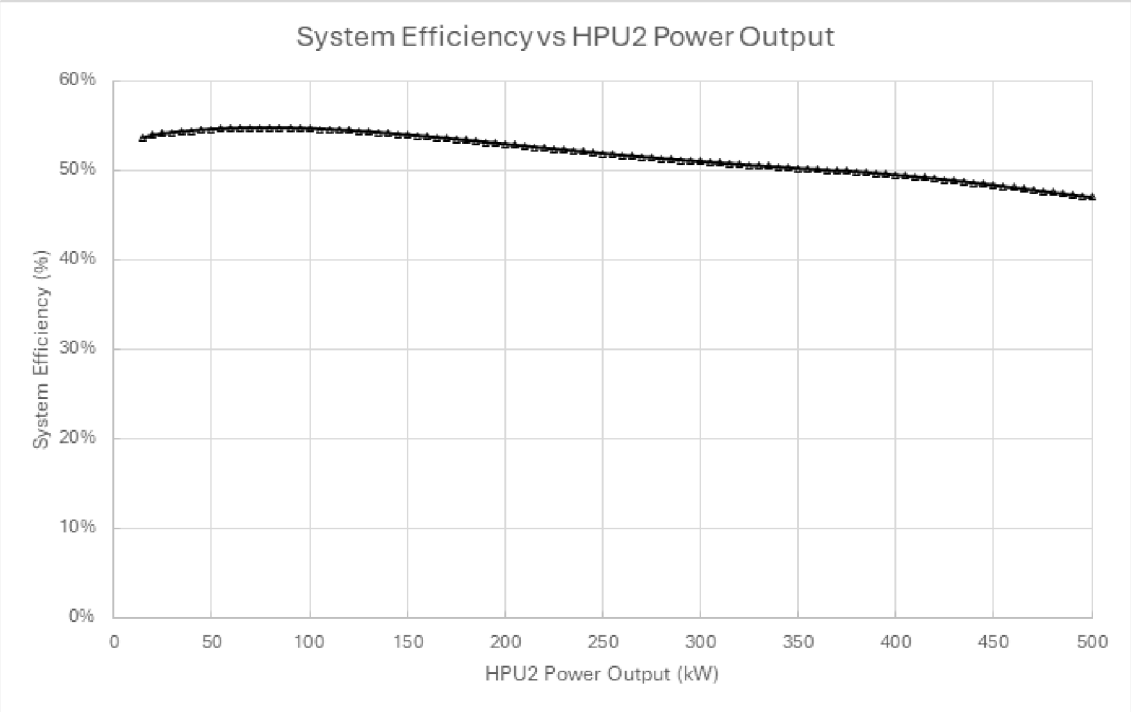
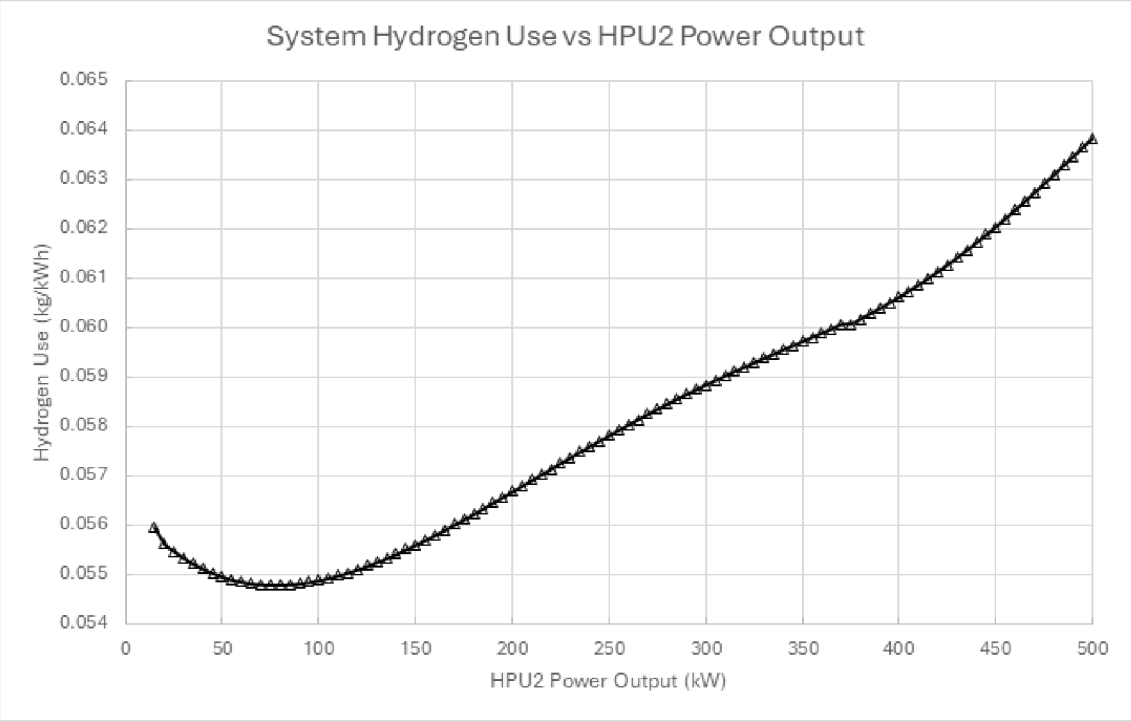


Figure 25 HPU2 system hydrogen use at 20% duty strike



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Appendix

HPU2 UNIT: PERFORMANCE DATA

Figure 26 HPU2 condensed water production

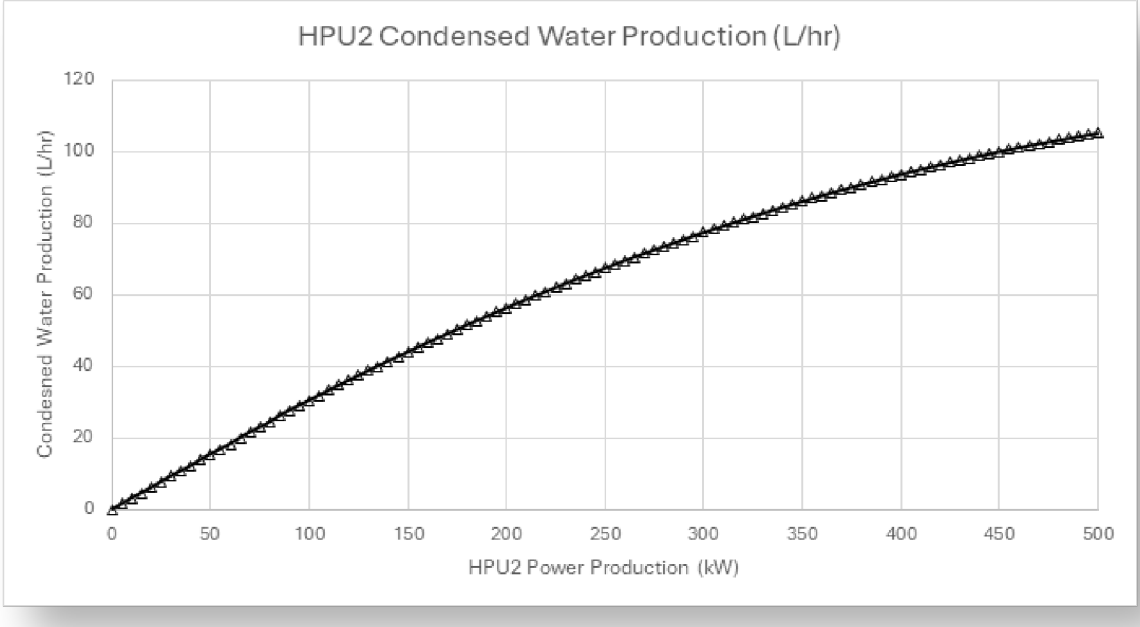
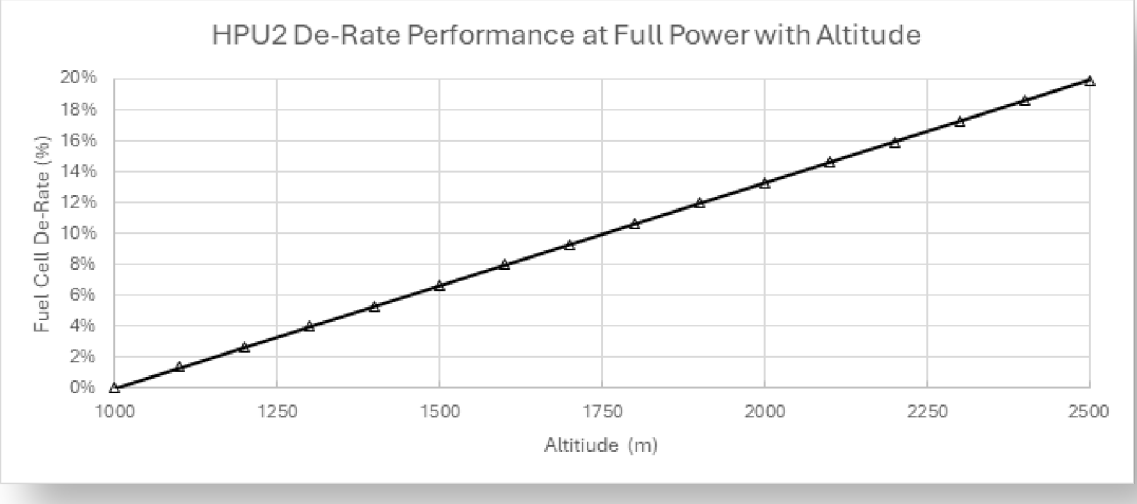


Figure 27 HPU2 de-rate performance



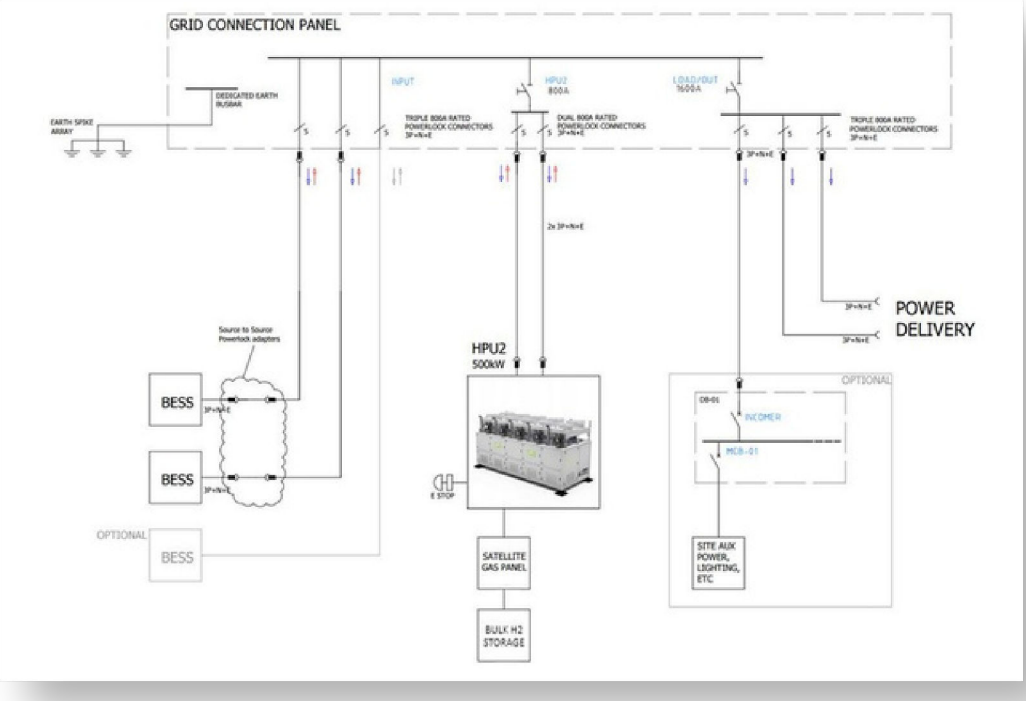
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Appendix

HPU2 SYSTEM: ELECTRICAL INTEGRATION

Figure 28 Example integration of an HPU2 system with BESS units as synchronous supply



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