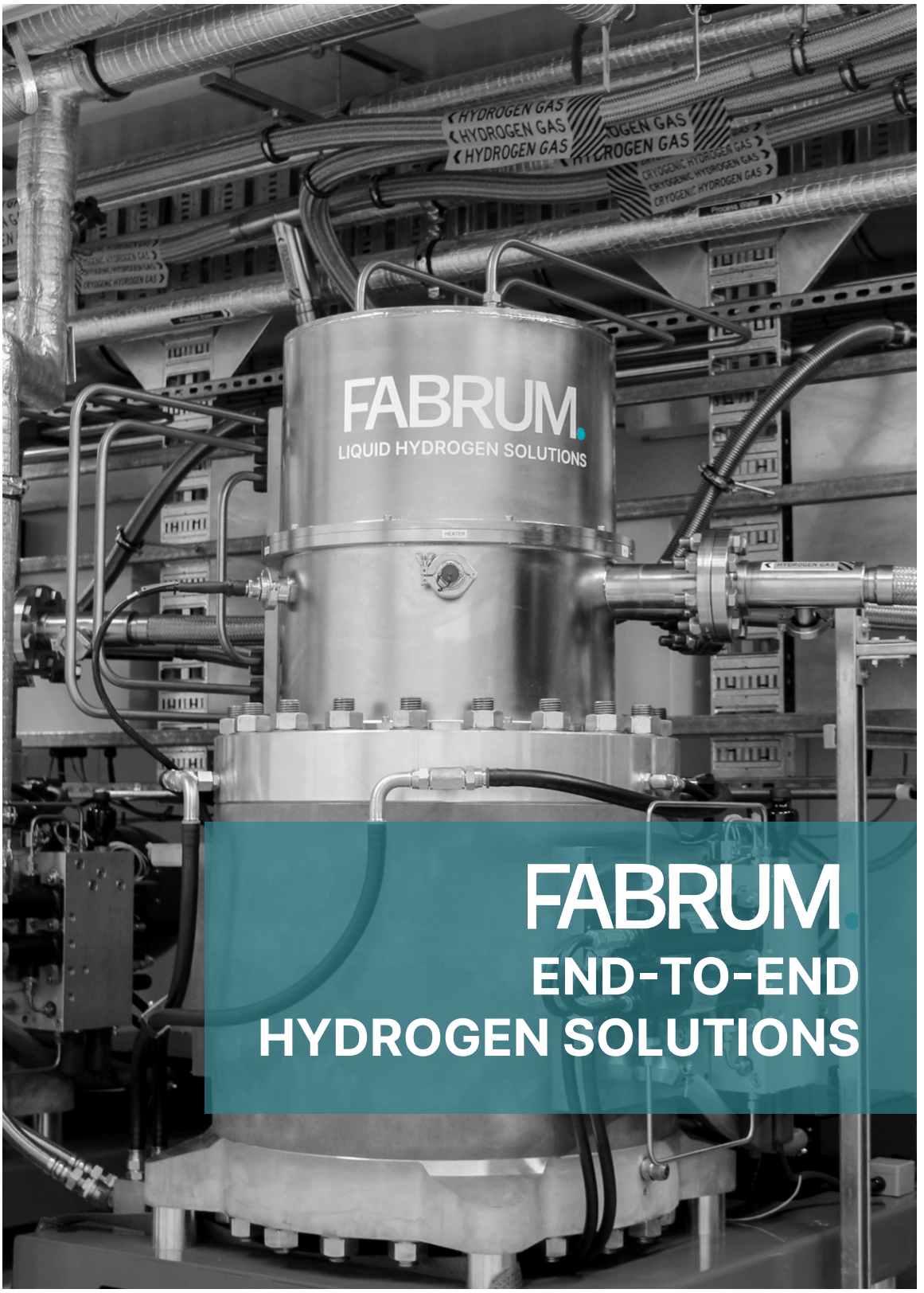



# FABRUM.

## END-TO-END HYDROGEN SOLUTIONS

# HYDROGEN LIQUEFIERS

**01** Designed for point-of-use liquid hydrogen production and boil-off-gas management of existing liquid hydrogen storage systems.

**02** Integration into existing operation.

**03** No requirement for sacrificial liquid nitrogen precooling.

**04** Rapid turn-up/turn-down response: ideal for renewable energy.

**05** Utilisation of high-frequency pulse-tube, Gifford-McMahon, and turbo-expander technologies for high-efficiency cooling.

Fabrum's patented PTC1000 pulse-tube cryocooler

| PRODUCT SPECIFICATIONS | FABRUM HLQ500 | FABRUM HLQ1000 | FABRUM HLQ5000 |
|---|---|---|---|
| Nominal daily liquefier capacity (kg) | Up to 30 | Up to 75 | Up to 400 |
| Liquefaction pressure (barg) | 6-10 | 3-7 | 3-7 |
| Hydrogen supply purity requirement (%) | 99.9 | 99.9 | 99.9 |
| Turn-down available | Yes | Yes | Yes |
| Minimum output (% of full scale) | - | 5% | 10% |
| Storage included (L) | 1,500 | 3,000 | 10,000 |
| Zero boil-off mode | Optional | Yes | Yes |
| Footprint [1] | Optional configurations | 1 x 40' ISO container | 5 x 40' ISO container |
| Input voltage | 380 - 480 VAC @50 Hz, 3 phase | 400 VAC @50 Hz, 3 phase | 400 - 480 VAC @60 Hz, 3 phase |
| Nominal power consumption (kW) | 70 | 95 | 525 |
| Cold Start | ~2 hours | <1 hr | <1 hr |

[1] Excluding main storage vessel

# BOIL-OFF-GAS MANAGEMENT
## ($LH_2$ AND LNG)

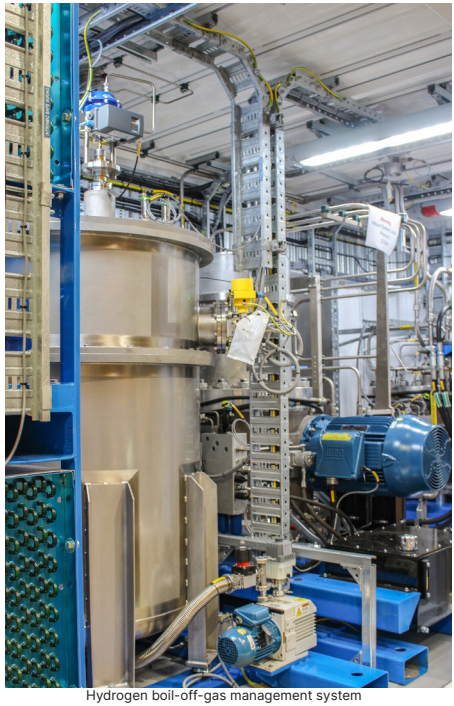
**01** Utilisation of high-frequency pulse-tube and Joule-Thomson technologies for high-efficiency reliquefaction systems.

**02** Design of end-to-end fuelling systems for maximum overall efficiency.

**03** Retrofittable to existing storage to eliminate boil-off losses.

**04** Pressure-management systems for optimised liquid transfer and storage.

**05** Patented pressure-wave-generator pulse-tube cryocooler technology.



Hydrogen boil-off-gas management system

Fabrum delivers boil-off-gas management (BOGM) systems for liquid natural gas (LNG) and liquid hydrogen ($LH_2$), tailored for diverse applications across industries that include aviation, mining, marine and heavy-vehicle road transport.

| PRODUCT SPECIFICATIONS | FABRUM HRL500 | FABRUM PTC330-LNG |
|---|---|---|
| Applications | Liquid Hydrogen | Liquid Natural Gas |
| Nominal daily reliquefier capacity (kg) | 100 | 230 |
| Reliquefaction pressure (barg) | 6-10 | 8 |
| Turn-down available | Yes | Yes |
| Footprint | 1 x 20' ISO container | 1.3 x 0.8 x 1.7 m |
| Nominal power consumption (kW) [1] | 65 | 12 |
| Specific energy consumption (kWh/kg) [1] | 15 | 1.5 |
| Start up time | <1 hr | <10 min |

[1] Excludes chiller

# HYDROGEN TEST-SITE FACILITY

**01** Expert support and experience.

**02** Scalable and flexible by design.

**03** Strategic location
- Christchurch International Airport

**04** Safety-focused design and operation.

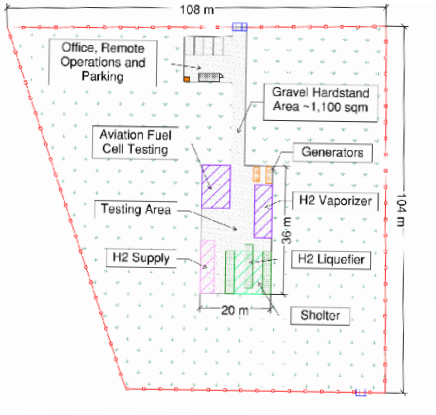
**05** Multi-project testing capability.

**06** Collaboration with industry and academia.

## Testing Capabilities

At Fabrum's hydrogen test facility, we offer a comprehensive range of testing services designed to meet the diverse needs of our global clients. Our facility is equipped to handle both gaseous and liquid hydrogen testing, ensuring the highest standards of safety and accuracy. Our clients can conduct material testing to evaluate the compatibility and durability of various materials in hydrogen environments, which is crucial for the development of reliable hydrogen infrastructure. Additionally, our fuel cell testing capabilities allow us to assess the performance and efficiency of hydrogen fuel cells. We also offer specialized testing for hydrogen storage systems, leak detection, and purity analysis, making Fabrum's hydrogen test facility the ideal destination for all your hydrogen-related testing.

## Facility Layout

# ONBOARD LIQUID HYDROGEN STORAGE

**01** Proprietary triple-skin design enables rapid fuelling and reduces boil-off losses during a warm filling by more than an order of magnitude

**02** High GI from 30-65% for composite tanks and 10-30% for metallic tanks and mining-vehicle tanks.

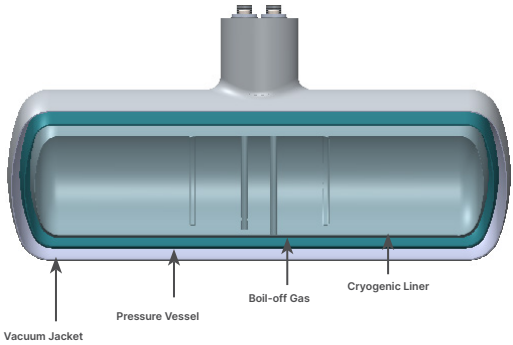
**03** Dormancy period of up to 72 hours after refuelling, during which there is no hydrogen venting.

**04** Composite tanks for aviation with liquid-hydrogen capacity from 10 kg to 500 kg.

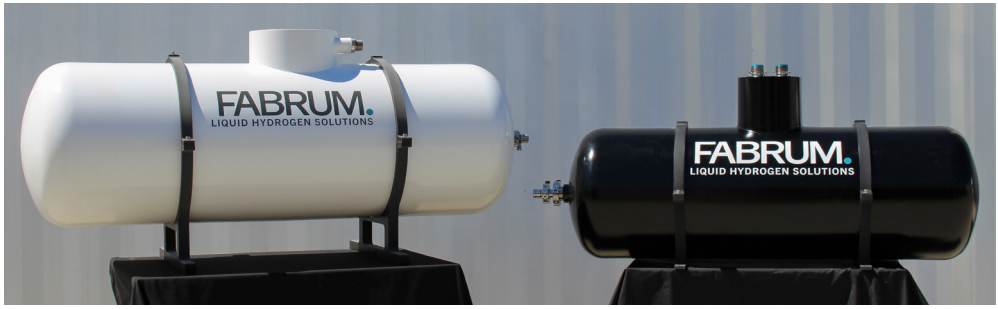
**05** Proprietary hydrogen-delivery system (HDS) for controlled delivery of gaseous hydrogen.

**06** Maximum allowable working pressure up to 10 barg (customised solutions with higher MAWP are also available).

## Triple-Skin Technology




Our proprietary triple-skin liquid-hydrogen tank technology provides enhanced thermal insulation, fast refuelling and a vast reduction in boil-off losses during filling. Ground-based vehicle tanks with an outer metal skin are engineered for maximum durability, while aviation tanks are entirely composed of advanced composites, prioritising the highest gravimetric index achievable and maximising thermal performance.



Fabrum's liquid-hydrogen solution

# HYDROGEN REFUELLING STATIONS
## LIQUID

**01** End-to-end solutions from production, liquefaction, storage and dispensing.

**02** Liquid hydrogen transfer and fuelling time from 30 kg/min to 120 kg/min.

**03** Full system optimisation to minimise losses and maximise energy efficiency.

**04** Boil-off-gas management throughout entire ecosystem.

Our proprietary technology for incorporating boil-off-gas management and high-flow liquid transfers ensures minimum liquid-hydrogen losses and maximum energy efficiency across the entire system. We address every facet of liquid-hydrogen management, from generation, liquefaction, zero-loss storage, high-flow liquid transfers and dispensing, controlled evaporation and temperature and pressure-controlled fuel-cell delivery.


Hydrogen liquefaction plant at a mine site in Western Australia


# HYDROGEN REFUELLING STATIONS
## GAS

**01** Supports onsite hydrogen production and/or tube-trailer supply (hub and spoke).

**02** Scalable to meet growing demand.

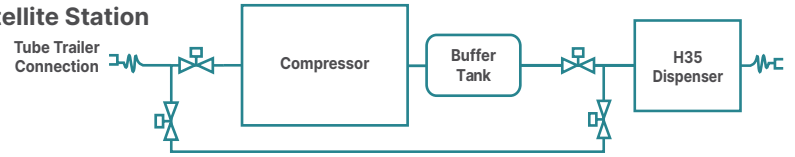
**03** 350-bar and 700-bar vehicle fuelling.

**04** Designed for optimum fuelling profiles and maximum energy efficiency.

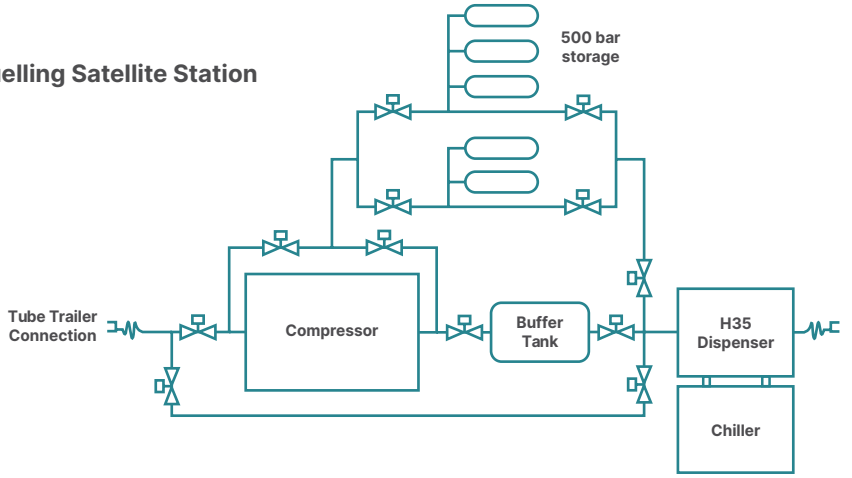
**05** Liquid-hydrogen fuelling.

**06** Standard designs for 1-MW and 5-MW stations.

### Simple Satellite Station




### Fast-Fuelling Satellite Station



“We operate at the bottom of the world but we perform at the top of it; and this is just the beginning of our story.”