

## Logan Energy

Logan Energy has proven expertise in delivering integrated energy systems with an emphasis on hydrogen technology and storage projects. We have deployed small, medium and large-scale fuel cells since being established in 1995 in the US and in 2005 in the UK. In the last 10 years we have concentrated on renewables and hydrogen energy systems.

We have deployed the majority of the UK's stationary fuel cell installations, four hydrogen refuelling stations in the UK and we are in the process of deploying refuelling stations in UK, Spain and Germany. We offer a full turnkey service from project inception, design development, integration, manufacturing and installation, to operation and maintenance. This includes feasibility studies, detailed whole system design, off the shelf and bespoke equipment procurement, project management, installation, commissioning, operation and maintenance. Being manufacturer independent and technology agnostic, we are able to analyse and select the most appropriate complementary equipment for the project. We have developed an extensive network of UK and European suppliers that enable the delivery of fully compliant and cost optimised hydrogen systems.

We have experience in installing a range of electrolyser sizes for hydrogen production, both stand-alone and integrated in to a hydrogen refuelling station. Electrolysis can be powered by grid electricity or directly by renewable electricity, using a local water supply, in order to produce hydrogen. On-site generation has logistical and economic advantages over relying on an external supply.

The characteristics of hydrogen allows a wide range of utilisations, bringing world changing solutions to the global transition to renewable and clean energies. We have developed economic models that capture the evolution of hydrogen technology, (electrolysis, storage and fuel cells), the cost and subsidies for wind and solar energy production and the cost of transporting and distributing hydrogen as a gas. These models allow the optimal sizing of hydrogen systems to maximise return on investment while maintaining the operation of the system to the strictest safety standards.

Our specialisms include:

- Integrated Energy Systems
- Energy Centres
- Energy Storage
- Hydrogen Production and Refueling Stations

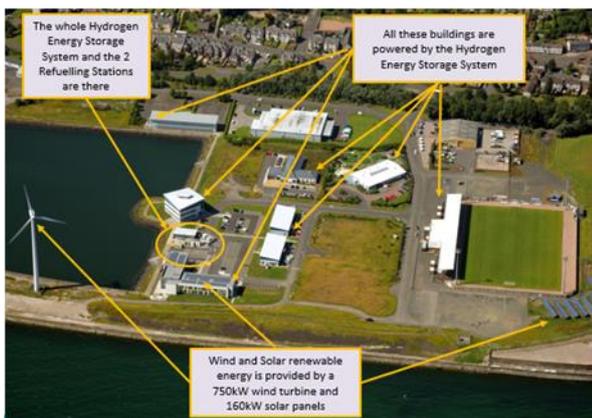
## The Levenmouth Community Energy Project

Client Name: Bright Green Hydrogen  
Contracted Company: Logan Energy  
Date of Contract: July 2015  
Date of Ready: April 2017  
Value: >€1m

We designed, built, installed, commissioned, and maintain the Levenmouth Community Energy Project (LCEP) hydrogen generation, storage, and distribution system. Collaboration with the project partners, including Fife Council and Bright Green Hydrogen was essential to define the required building modifications and civil works prior to the installation of the system.

The whole system design demanded the specification, selection and procurement of the following equipment:

- A 270 kW PEM electrolyser to convert excess renewable energy in to hydrogen up to 100kg per day
- A 60 kW PEM electrolyser integrated in to a containerized refueler, 25kg/day
- A 60 kW Alkaline electrolyser integrated in to a containerized refueler, 25kg/day
- Hydrogen storage tanks at 450bar holding 30kg of hydrogen in each refueler
- Two high pressure hydrogen compressors (450bar), one in each refueler
- A 100kW PEM fuel cell to power the micro-grid



All pipework, valve and safety systems were designed, selected and installed by Logan Energy. Pressure testing of the equipment under the Pressure Equipment Directive requirements (PED directive 2014/68/EU) was also undertaken by Logan Energy and the whole hydrogen system was CE certified.

Planned Preventative Maintenance was conducted on all of the installed equipment to ensure reliability.

## HyTIME

Client Name: Veolia  
Contracted Company: Logan Energy  
Date of Contract: October 2017  
Date of Ready: July 2018

We won a competitive tender to supply a hydrogen refuelling station (HRS) for the HyTIME project, which is trialling a range of hydrogen and diesel dual-fuel vehicles. The HRS design provides a flexible and resilient hydrogen fuel supply, whilst at the same time optimising refuelling capacity vs capital investment and operating costs. The HRS will meet the requirement to dispense a minimum of 10kg of hydrogen per day in order to fill two dual fuel ultra-low emission Refuse Collection Vehicles operated by Veolia for Westminster City Council, London. The vehicles each have 5kg of onboard hydrogen storage. The wider project involves testing other types of dual-fuel vehicles, including transit vans and ambulances. It aims to show that 40-70% reduction in tailpipe CO<sub>2</sub>e is possible by displacing diesel, alongside improving real world air quality relative to the MY16 standards, and a 'Well to Wheel' CO<sub>2</sub>e reduction of 5%-60% depending on the source of hydrogen.



Alongside the containerised hydrogen refuelling station, we have installed a containerised alkaline electrolyser, which will generate the hydrogen dispensed by the refueller. This electrolyser is supplied by de-ionised water and is connected to the local power grid.

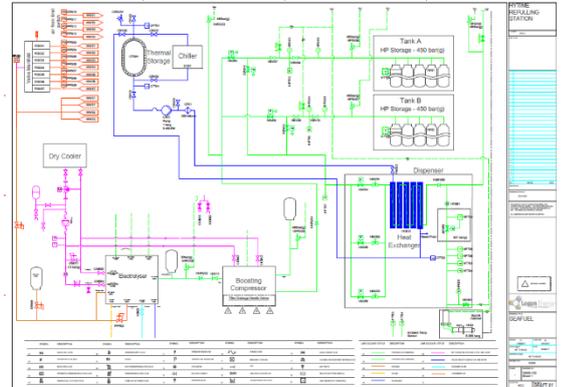
Maintenance of the containerised electrolyser and the hydrogen refuelling station will be conducted at regular intervals. We have one 1-year maintenance and support contract in place including the provision of deionised water to site.

## SEAFUEL

Client Name: InterReg Atlantic Area  
 Contracted Company: Logan Energy  
 Date of Contract: December 2017  
 Date of Ready: June 2019  
 Value: >€1m

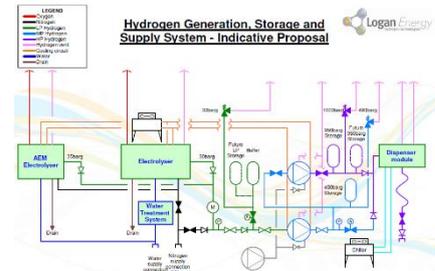


As one of the project partners, we are designing, building, commissioning, demonstrating and implementing the hydrogen technology installations for the SEAFUEL project. The hydrogen production and storage and the hydrogen cooling and dispensing systems will have all the relevant certification. We will also ensure that local operatives will be trained so that have a working knowledge of the installations. We will undertake all planned preventative maintenance until 2020 and we will support the other project partners and the project leaders with the feasibility of transferring the technology to other regions.



## IZES HRS (GenComm)

Client Name: IZES gGmbH (Germany)  
 Contracted Company: Logan Energy  
 Date of Contract: October 2018  
 Date of Ready: May 2019



The GENCOMM project (GENerating energy secure COMMunities through Smart Renewable Hydrogen) is aiming to provide a roadmap for communities to transition to renewable, hydrogen-based energy matrixes.

We won a competitive tender to supply a hydrogen refuelling station (HRS) for a vehicle trial at the IZES gGmbH research facility in Saarbrücken, Germany. This is a unique project for Logan Energy that combines two electrolyser technologies, a PEM electrolyser and an AEM electrolyser, for seasonal storage of a 35 kW solar PV array. 50kg of hydrogen is stored on site at a range of pressures between 950 bar and 30 bar in order to provide 6kg per day of hydrogen for one passenger vehicle.



Maintenance will be provided for 2 years for the complete refuelling installation.

## Fuel Cell Installation and Maintenance

We have extensive experience of designing, installing and commissioning not only hydrogen systems but also fuel cell CHP and CCHP systems, having installed approximately 98% of the installed capacity of stationary fuel cells in the UK totalling over 1.1MWe. These have involved detailed coordination requiring road closures in central London, specialist lifting equipment to move heavy loads through shop fronts and lowering into basement plantrooms.

The fuel cell installation projects are:

### Crown Estate, Quadrant 3

Client Name: Crown Estate  
 Contracted Company: Logan Energy  
 Date of Contract: December 2011  
 Date of Ready: July 2013  
 Value: >€1m



Quadrant 3 is a 30,000 ft<sup>2</sup> flagship retail, restaurant and office space development located at the foot of London's Regent Street.

The 300 kWe CCHP fuel cell system designed and installed by Logan Energy provides 10-20 per cent of the energy required and is part of the Crown Estate's £1 billion, 20 year investment strategy for Regent Street.

Maintenance was contract for 5 years with an option to extend for another 5 years.

### 20 Fenchurch Street

Client Name: LandSecurities/Canary Wharf Contractors  
 Contracted Company: Logan Energy  
 Date of Contract: November 2013  
 Date of Ready: July 2015  
 Value: >€1m

20 Fenchurch Street is a £300m iconic development by Land Securities and Canary Wharf group designed by architect Rafael Viñoly, and construction managed by Canary Wharf Contractors.

Logan Energy designed and installed a 300kW fuel cell CCHP system which facilitated planning permission by saving 8% carbon dioxide emissions on building regulations.

Maintenance was contracted for 5 years with an option to extend for another 5 years



## **TfL Palestra Building**

Client Name: Transport for London  
Contracted Company: Logan Energy  
Date of Contract: December 2008  
Date of Ready: June 2010  
Value: >€1m

Logan Energy completed the installation and integration of a 200kWe PAFC power module and associated cooling module at the TfL Palestra Building in Southwark, London.



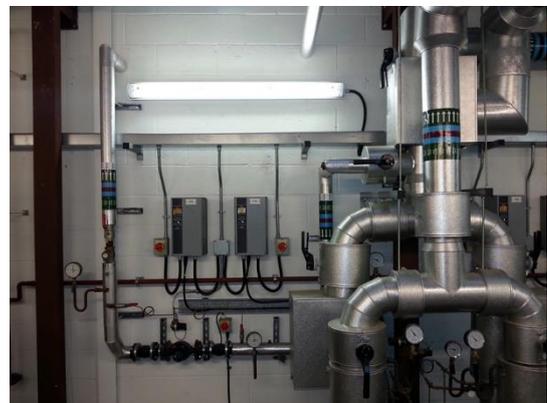
The fuel cell forms part of an integrated tri-generation system providing electrical energy, heat and cooling to the Palestra building. It is the largest capacity fuel cell operating in London.

Maintenance has been provided since installation.

## **SSE Penner Road**

Client Name: SSE  
Contracted Company: Logan Energy  
Date of Contract: December 2008  
Date of Ready: July 2019

SSE's customer service centre, IT and telecoms businesses, energy sales, metering and administration under one roof in the former Autoliv factory on the shore of Langstone Harbour.



Logan Energy Ltd Installed a 200kWe PAFC (Phosphoric Acid Fuel Cell), second system of this type and capacity in the UK. Operating on natural gas and providing quality electrical and thermal energy to reduce the demand on the existing building services systems. Reducing carbon production by 18 -20%, when compared to grid supplied electrical energy.

Maintenance was provided for 3 years.

## Hydrogen Trailer Supply, Management & Maintenance

Client Name: Calvera  
Contracted Company: Logan Energy  
Date of Contract: May 2017  
Date of Ready: May 2017 to May 2021

We are contracted by Calvera to perform the project management and the planned preventative maintenance of the five compressed hydrogen mobile storage units (trailers) in Orkney. The trailers are used to store and transport 250kg of hydrogen at 200bar from an electrolyser owned by EMEC on the island of Eday to a hydrogen fuel cell at a site at Kirkwall Harbour.



Logan Energy has also won a competitive tender to supply three compressed hydrogen mobile storage units for the GENCOMM project in Northern Ireland.

Client Name: Viridian  
Contracted Company: Logan Energy  
Date of Contract: To be signed  
Date of Ready: 8 months from contract signature

## Integration & Installation Review Support

Client Name: Confidential  
Contracted Company: Logan Energy  
Date of Contract: October 2018  
Date of Ready: November 2018

We have been employed to review the integration and installation of an electrolyser, as well as providing a short course on hydrogen with the goal of familiarising staff. This is to ensure that lessons can be learned and applied from the previous installation and ensure future projects benefit from this learning.

## Feasibility Studies

We have undertaken a number of feasibility studies that cover the production, storage and utilisation of hydrogen. United Utility's Davyhulme wastewater treatment works could not increase its throughput to its full capacity as the site had NOx and SOx emission restrictions. Our study showed that by using biomethane in fuel cells the plant's full capacity could be reached without exceeding the restrictions, which increased the return on investment in the WWTS. HySeas I and II, the development of a hydrogen fuel cell electric hybrid ferry with CMAL has now progressed to production of the first vessel. The development of a cost model, for DECC (now BEIS), for the conversion of a town's natural gas distribution network

and consumer appliances to 100% hydrogen has assisted in progressing hydrogen deployment.

## Product Range

Our experience in the hydrogen industry, specifically, hydrogen generation, refuelling and fuel cell, hybrid or dual-fuel vehicles, makes us ideally placed to offer solutions to reduce the emissions of a vehicle fleet. H2Tec, has developed two standard products for hydrogen refuelling.

One refueler (H2KeyGen) is a self-contained hydrogen refuelling station with onboard hydrogen generation capability. It generates hydrogen from local water and electricity supplies, and compresses, stores and dispenses hydrogen providing an autonomous transport fuel system. It can be adapted for a range of requirements, with the base model providing 25kg of hydrogen at 350bar per day.



The other unit (H2Key) is a highly versatile hydrogen refuelling station that uses supplied hydrogen, either delivered by trailers, or by on-site electrolysis. Integrated hydrogen compression and storage provides a flexible transport fuel system. Packed in a 12' by 8' container (8'8" height), it can be transported, deployed and installed with minimum site works. The refueler can be supplied in a variety of options to accommodate individual requirements, with a daily refuelling capacity of up to 100kg of hydrogen at 350bar.



## **Key Personnel**

Logan Energy has built up an experienced team dedicated to developing and manufacturing hydrogen technology products.

### **Bill Ireland**

Bill Ireland (MA, CEng, MCIBSE, MFEANI) has over 30 years' experience in engineering with specialist knowledge in energy within the built environment, alternative technologies, sustainable design and innovation in technology.

As Operations Director in 2008 then MD and CEO since 2012, Bill has made Logan Energy the designers, integrators, installers, and maintainers of the majority of the UK's installed capacity of fuel cell distributed generation and developed the business into a world leading provider of hydrogen-based solutions for energy storage and energy sector shifting, which is demonstrated at the Levenmouth Community Energy Project amongst other installations.

Bill believes that proven hydrogen and fuel cell technologies integrated with existing energy and transport systems will play an increasing role in our future energy solutions, providing lower cost, security of supply, and alternative transport fuels delivering reduction in carbon dioxide and other pollutant emissions.

### **Keigh Taylor**

Keigh Taylor (CEng, BA) is a Chartered Engineer with a passion for taking products to market. He has strong management and engineering skills in both fluid systems and structural/mechanical design, and throughout his career he has placed a strong emphasis on planning, transparency, and efficiency in order to drive projects through on time and to budget.

His 11-year career has given him experience in Mechanical Design Engineering, Project Engineering and Project Management. He aims to build products, with a design flair and an attention to detail, that are simple to use and that stand the test of time.

Keigh joined Logan Energy in 2017 to develop the product design of the refuelling systems to the next stage. His aims are to reduce the costs and improve the design of our integrated hydrogen solutions, bringing his past experience in high-pressure fluid systems and using this to drive forward innovation in the team.

### **Nick Stapley**

Nick Stapley (MBA, MSc, BSc) has been an integral part of Logan Energy's team since 2017, having previously held positions in the oil industry with Total and Perenco. His MBA from the University of Edinburgh led to him taking up an opportunity with Logan Energy, initially as Market Analyst and now as Business Development Manager. Nick is helping to lead Logan Energy's growth in the hydrogen sector by identifying solutions to meet customers' needs in all market sectors.