



ClearGen™ Demo

**Field Demonstration of Large Stationary Fuel
Cell System for Distributed Generation**

(Contract Number 303458)

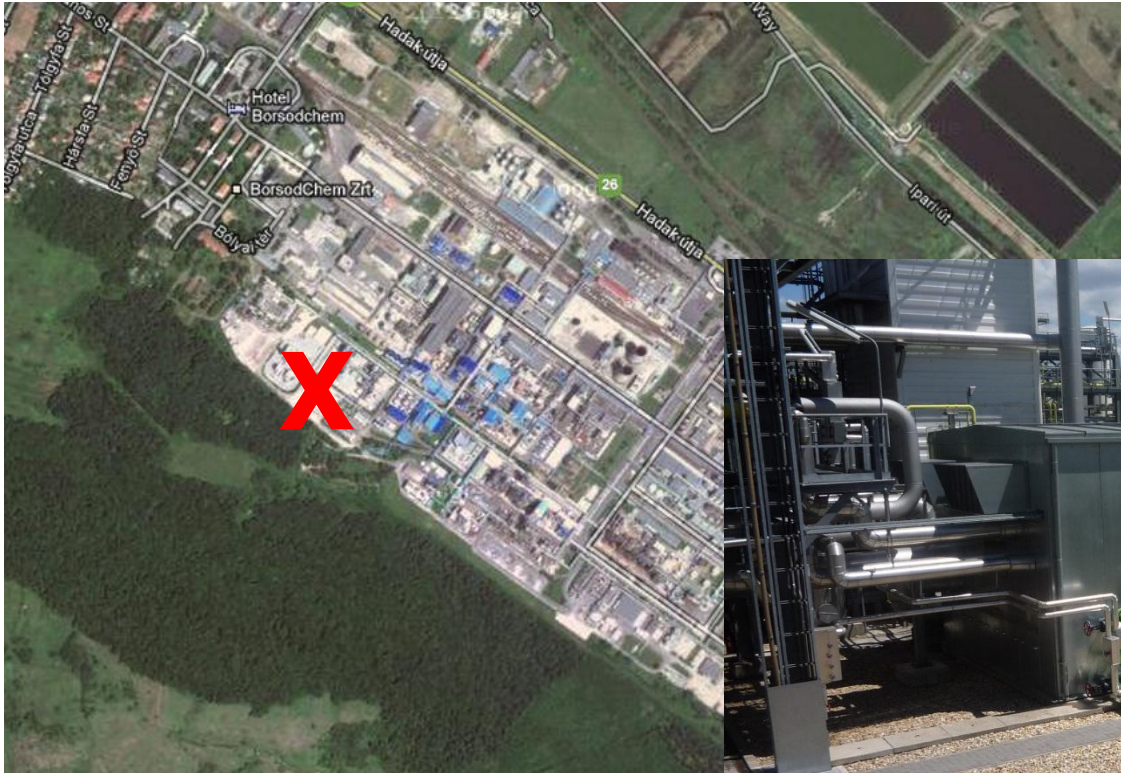
*Bill Ireland
Logan Energy Limited*

0. Project & Partnership

Description - General Overview

- **ClearGen™ Demo:** Field Demonstration of Large Stationary Fuel Cell System for Distributed Generation
- **Project Duration:** 65 months, (previously 80) to be completed in Q3 2017
- **Total Budget:** 10.1 million euros, 4.6 million euros FCH JU funding
- **Consortium:**
 - **Logan Energy Limited** – Co-ordinator, integration, site installation, service and maintenance
 - **Dantherm Power AS** – IEC Certification, component integrator, field service support for equipment supplier Ballard Power Systems
 - **Linde Gas Hungary** – Host Site, hydrogen supplier
 - **Budapest University of Technology and Economics** – Analysis and dissemination of information

0. Project & Partnership Description - General Overview



Kazincbarcika, HU



1. Project Objectives

High Level

High level objectives:

- The development and construction of a large scale fuel cell system, developed and purpose-built for the European market
- The validation of the technical and economic readiness of the fuel cell system at megawatt scale, and
- The field demonstration and development of megawatt scale system at a European chemical production plant, running on by-product hydrogen.

The ClearGen Demo Project is still in the contracting stage and limited technical development work has been started.

1. Project Objectives

Detailed

Detailed ClearGen™ Demo project objectives:

- Design and construct a 1 MWe fuel cell system to meet the demands of European customers, demonstrating
 - High system reliability and availability
 - Efficient power production
 - Long lifetime and low maintenance requirements
- Develop potential for European businesses to realise supply chain opportunities through sourcing local components
- Develop a service network in the European Union
- Evaluate lifecycle costs of the ClearGen™ installation
- Conduct techno-economic analysis, proving achievement of efficiencies, cost and lifetimes.

1. Project Objectives

Detailed (continued)

Detailed ClearGen™ Demo project objectives (continued):

- Demonstrate commercial viability of fuel cells for use in distributed power generation and the benefits associated to the modularity that this technology offers
- Facilitate EU objectives in environmental sustainability by means of Life Cycle Assessments studies, carried out according to the ILCD Handbook requirements
- Communicate and disseminate project results

2. Alignment to MAIP/AIP

Expected output AIP Topic: 3.6 Call: 2011		ClearGen Demo Project Objectives
<i>Demonstration Size</i>	<i>> 1 MWe</i>	<i>1 MWe at single site</i>
<i>FC System Electrical Efficiency</i>	<i>50%</i>	<i>48%</i>
<i>FC Stack Lifetime</i>	<i>>10,000 hrs</i>	<i>40,000 hrs</i>
<i>FC System Lifetime</i>	<i>>20,000 hrs</i>	<i>15 yrs with preventative & corrective maintenance</i>
<i>FC System Cost Target</i>	<i><3000 €/kWe</i>	<i>3000 €/kWe</i>
<i>FC System Performance Loss</i>	<i><3%</i>	<i>0% loss in net power output</i>

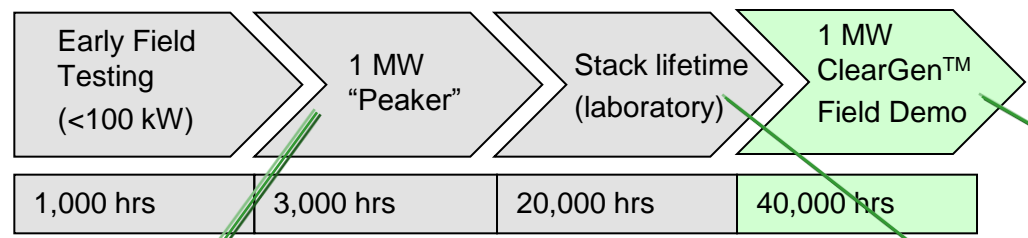
Comments on AIP Targets

- **Efficiency** – direct correlation to capital cost of fuel cell system. Although high efficiency is targeted, deploying systems using ‘waste’ hydrogen, reduce emphasis on efficiency. Efficiency improvements will follow
- **Lifetime and cost** – in stationary power applications, the cost per kilowatt hour is key factor in business case (i.e. cost and lifetime are not independent). Higher capital cost with longer fuel cell stack lifetime can be justified trade off
- **Lifecycle cost** - key impact on business case not addressed by targets. Maintenance and refurbishment costs need to be considered

2. Alignment to MAIP/AIP

Innovation focus on lifetime improvement

Increase in FC stack lifetime key technology advancement



Next generation long life stack under development by Ballard for base load applications



2 x 1 MWe "Peaker" ClearGen Units in US

Lab results indicate 20,000 hr base load capability

2. Alignment to MAIP/AIP

Leverage development & learning from other applications



Long life



Low cost, automated production

Residential Cogeneration



Backup and Supplemental Power

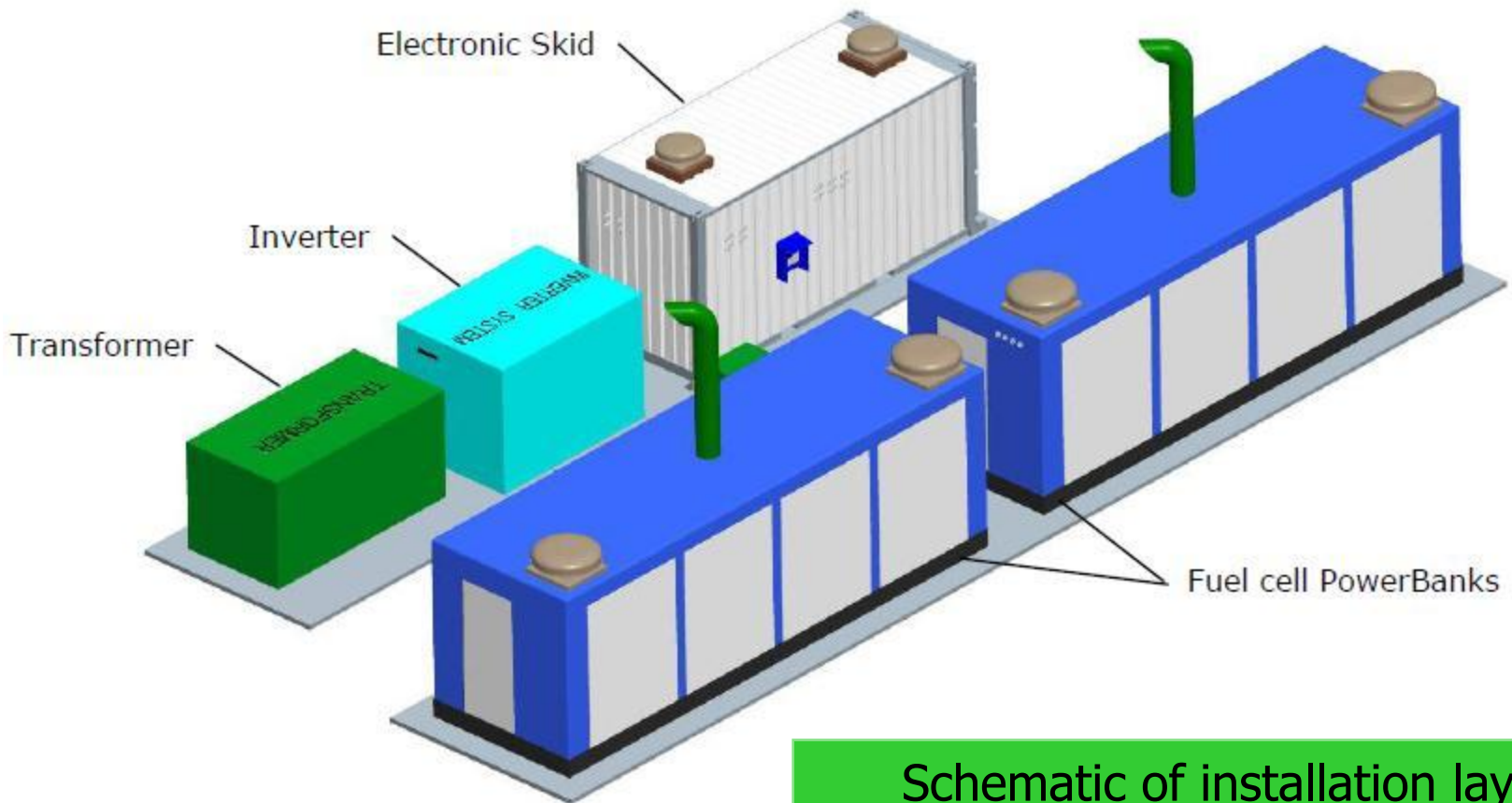


Leveraged into 4 markets

Distributed Generation



2. Alignment to MAIP/AIP 1 MWe Scalable System



Schematic of installation lay-out

2. Alignment to MAIP/AIP

Commercial Value Proposition

Convert waste product into electricity

By-product hydrogen from chemical production often vented or burned → capture as a low-cost, high-value input for electricity and heat production

Benefits to end users

Offsetting power demand or selling to the grid results in operating cost savings or new revenue stream

Zero-emission power production contributes to carbon reduction initiatives



2. Alignment to MAIP/AIP

Commercial Value Proposition

Benefits to utilities

Demand side management avoids cost of expanding centralized generation and transmission costs

Clean power production to meet RPS guidelines

Energy Storage

Unreliable, excess renewable electricity generation
→ produce hydrogen, stored , used in FCs to produce electricity when needed



Training and Education

- Visitor experience (if allowable access)

Safety, Regulations, Codes and Standards

- *Utility regulations*, the usual HAZOP, ATEX, IEC, EC Directives ...

Dissemination & public awareness:

- Project website
- Stakeholder Engagement Plan
 - potential user and customers of FCs

Publications:

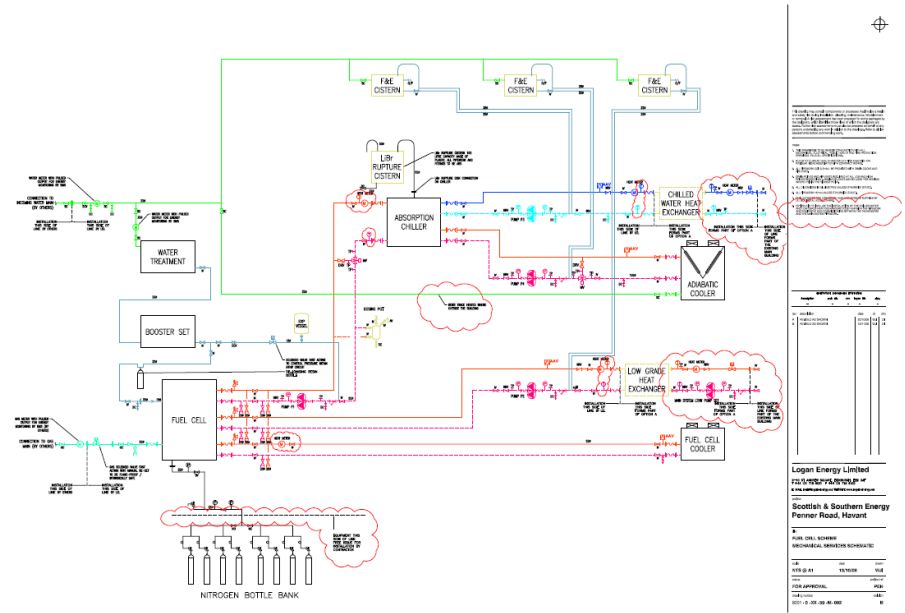
- Biannual newsletter

4. Enhancing cooperation Integration/Application/Implementation

Large Scale Stationary installations



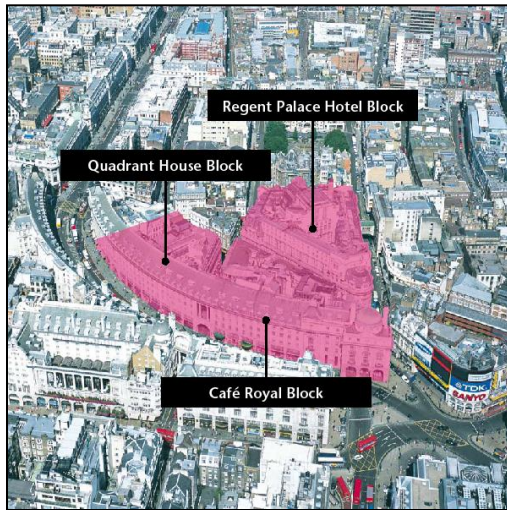
PAFC, TfL Palestra, London



PAFC, SSE Penner Rd, UK

4. Enhancing cooperation Integration/Application/Implementation

Large Scale Stationary installations



MCFC, Quadrant 3,
London



MCFC, 20 FS,
London



PEM, Toyota, CA

4. *Future perspectives*

- Enabling SME's to Coordinate FCH JU project – difficult at present
- EU suppliers/integrators/users are few and far between – international funding of projects to allow truly international collaboration
Enhance EU export potential if regions expanded