



Hydrogen Research Unit



Hydrogen & Fuel Cell Strategy and Activities in Wales

Jon Maddy

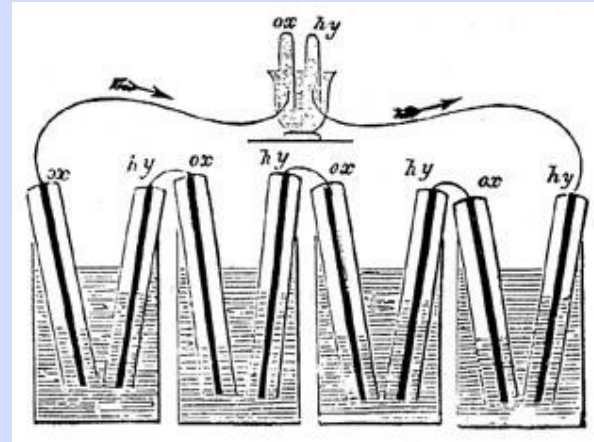
University of Glamorgan Hydrogen Research Unit

All-Energy Conference Aberdeen 25th May 2005

Hydrogen and Fuel Cells: An early Welsh Connection



Sir William Robert Grove
Born in Swansea 1811



Grove's Gas Voltaic Battery 1839
Forerunner of the modern fuel cell

Grove conducted his original experiments in what is now Swansea Museum



University of Glamorgan Hydrogen Research Unit



Multidisciplinary Research Expertise:

- Biological hydrogen production
 - Fermentation of crops and co-products
- Biological fuel cells
- Hydrogen and blend engine performance
- Hydrogen economy transition
 - Technical / Economic/ Social / Environmental and Policy aspects
 - Public Awareness & Education

Hydrogen Research Unit: Biological Hydrogen Research

Sustainable Biohydrogen Production: Process Optimisation

UK Sustainable H₂ Energy Consortium: Year Round Fermentative Hydrogen from Crops (SUPERGEN)

Sustainable H₂ Production from Wheat Starch Co-products I & II

Hydrogen from Sewage Sludge.

Hydrogen Production from Multiple Biomass Feedstocks

Biological Fuel Cells (SUPERGEN Consortium)



Funding bodies: EU FP6, EPSRC, Carbon Trust, ERDF, National Assembly for Wales & Various Industrials

The Hydrogen Economy and Wales

Hydrogen Research Unit



Hydrogen Research Unit: Other Research



A Sustainable Energy Supply for Wales: Towards the Hydrogen Economy

Economics of Hydrogen from food co-products

Development, Deployment and Assessment of Hythane® and Hydrogen Fleets & Infrastructure

Hydrogen injection to diesel engines

A whole-system approach to analysing bioenergy demand and supply

Schools Hydrogen and Fuel Cell Education Programme

Funding bodies: EU FP6, NERC, EPSRC, Carbon Trust, Various Industrials

The Hydrogen Economy and Wales

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A Hydrogen Economy Framework for Wales

Research at the University

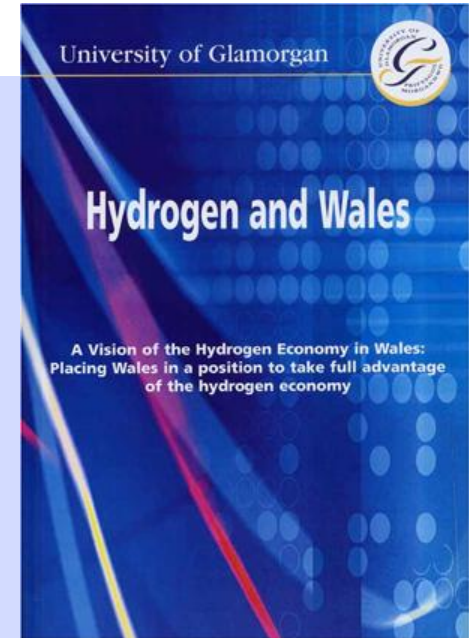
Thorough stakeholder consultation

Comprehensive review of hydrogen state of the art

Technical, social, economic, environmental & policy aspects

Outline hydrogen's role in Wales' future energy mix

Timeline with recommended actions



Visit: www.h2wales.org.uk

In support of the collaborative approach

HYCOM PRE - FEASIBILITY STUDY

Final Report
March 2005

**Commissioned and guided by the
European Commission, DG Joint Research
Centre**

**Institute for Energy and Institute for
Prospective Technological Studies**

Coordinated by S.D. Peteves, S. Shaw and A. Soria

*“A good example of such
visions is the Wales
Hydrogen Vision, which
brings together the various
stakeholders and outlines
priorities and actions in a
longer-term perspective
(see www.h2wales.org)”*

More on Hydrogen Collaboration in Wales



Cymru H₂
Wales



H₂Valley



Cymru H₂Wales

- Led by University of Glamorgan
- Advance the strategy for transition to a hydrogen economy in Wales
- Key stakeholder engagement
- Initiate development and demonstration projects
- Information resource (www.h2wales.org.uk)

H₂Valley

- WDA led initiative to attract and support hydrogen related industry to Wales
- Develop leading edge technologies and stimulate emerging markets

Additional local groups & actions (e.g. Carmarthenshire H₂ Energy Forum)
Underpinned by Government Statutory Duty on Sustainability

Political Support for Hydrogen in Wales

“Hydrogen has the greatest potential to deliver a low carbon economy future as a fuel source for both the energy and transport sectors”

Rt. Hon Rhodri Morgan, First Minister, 11th June 2003



"The Welsh Assembly Government is committed to sustainable development and if Wales is to become a significant global player in the future development of a hydrogen economy we need to grasp the available opportunities”

Andrew Davies, Minister for Economic Development and Transport, 24th February 2005

“We are committed to finding alternative energy sources and plan to strengthen the knowledge and research base in Wales for emerging hydrogen economy systems”

Carwyn Jones, Minister for Environment, Planning and Countryside, 23rd March, 2004



South Wales Hydrogen Infrastructure

Coincident with main transport route & 60% of population
Unique in UK
Potential to develop an early “hydrogen community”



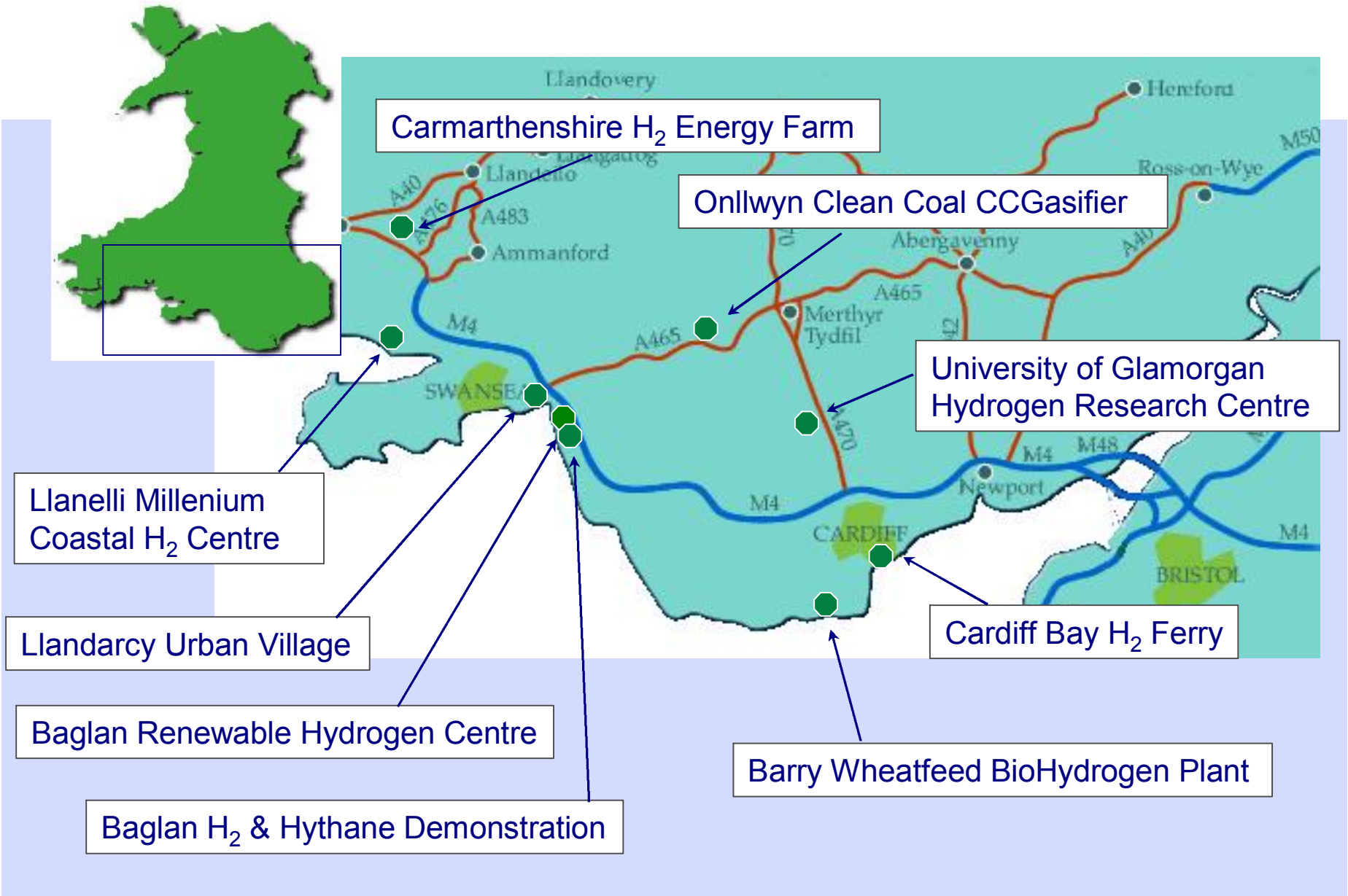
- Existing hydrogen production facilities
- Proposed clean / renewable hydrogen projects

The next stage for Wales: Hydrogen energy demonstration projects

- Sustainable hydrogen energy R D & D projects
- Concentrating on local factors:
 - Resources, skills and application needs
- Collaborative approach
 - Academic, government, industry and community
 - Based on strategy, finance & enthusiasm
- In support of policy
 - Local, national and international
- Raising awareness, acceptance and demand
- Platform for technical and economic development



Proposed Clean / Renewable Hydrogen Projects



Proposed projects in Wales:

Case 1: Renewable hydrogen demonstration at Baglan Energy Park



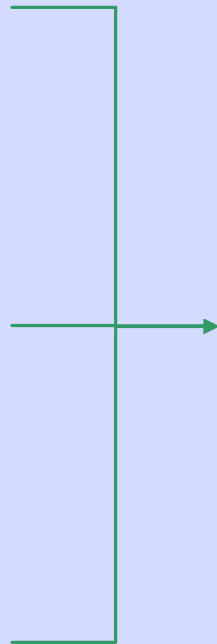
Existing Solar Centre
13kW PV array



New Hydrogen Centre
PV array + R & D



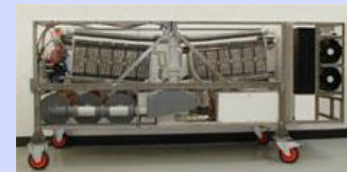
Remote Wind Farm via
real time data-link



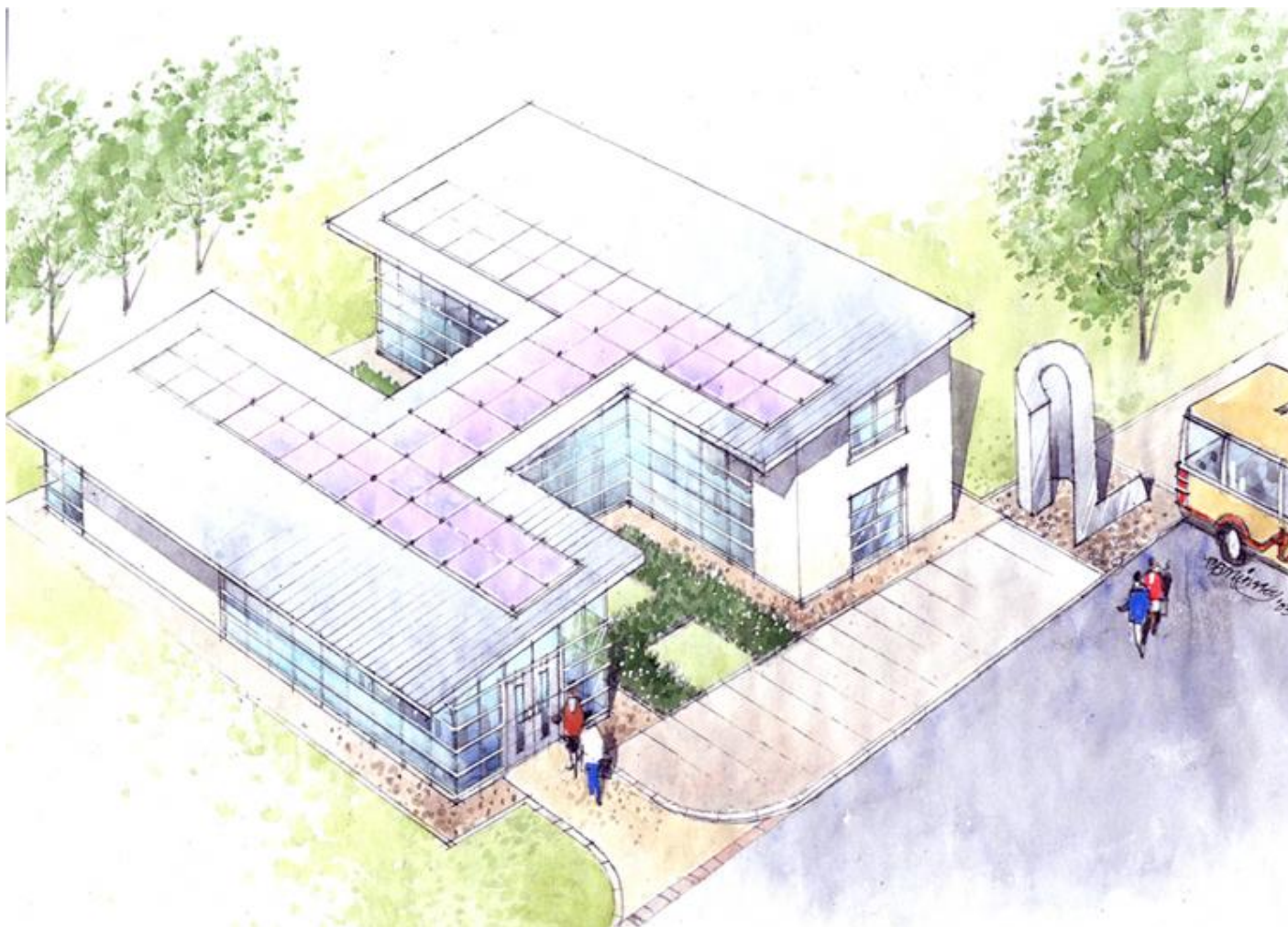
Hydrogen production
Electrolysis
Compression
Storage and Dispensing



Fuel cell and combustion
engine hydrogen hybrid
vehicles



Fuel cell for building
heat and power



Baglan Renewable Hydrogen Project: Summary

- ✓ Sustainable H₂ energy demonstration focusing on local resources, skills and needs
- ✓ Collaborative project between academics, government, industry and community
- ✓ Supports Wales, UK, European and UN policies for sustainable development
- ✓ Enhance public awareness and perception of hydrogen energy in Wales
- ✓ Landmark project for the UK - 1st in Wales
- ✓ Focal point for hydrogen technologies & business development
- ✓ The basis for a future European Hydrogen Community



Proposed projects in Wales:

Case 2: Carmarthenshire hydrogen energy farm

Production of hydrogen or H₂ rich biofuels in a rural / agricultural scenario

Assessing and eventually producing renewable H₂ by:

- Small scale gasification of woody biomass
- Fermentation of “wet” biomass e.g. grass
- Electrolysis using renewable electricity
- Reforming methane from anaerobic digestion

Exemplar for agriculture / biomass industry

Public facing

Interreg IIIA application with Waterford



Proposed projects in Wales:

Case 3: **Cardiff Bay hydrogen ferry**

The development & demonstration of a 50-seater hydrogen ferry in Cardiff Bay

Early adoption requires public and decision makers to accept and have familiarity with the technology. Cardiff Bay is highly visible.

Planned Activities:

From feasibility analysis to operation of the ferry:

- Research and analysis of operational requirements
- Power train modelling analysis and design
- Detailed boat design and construction
- Ferry type-approval
- Design and procurement of refuelling facility (multi-purpose)
- Socio-economic, public awareness and education research



Proposed projects in Wales:

Case 4: **Barry Wheatfeed Bio-hydrogen Plant**

Pilot scale development of successful lab scale research
Utilising wheat industry co-product with massive potential

Planned Activities:

Design & construct reactor for continuous hydrogen and methane production from wheatfeed

Full experimental programme

Assess yield and energy balance under full operating conditions

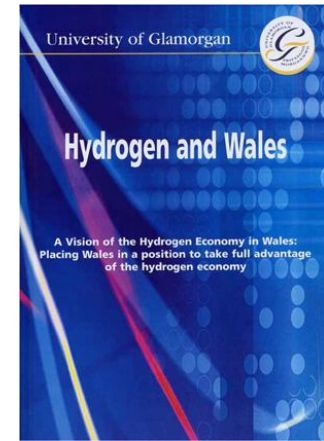
Full economic analysis

Funding in place & project starting



Conclusions

Wales has a strong hydrogen and fuel cell research base
Matched with energetic stakeholders and political support
Initial framework is in place and should be constantly reviewed



Wales has an existing hydrogen infrastructure to build on
Early transition via demonstration projects
Coalesce individual projects with existing infrastructure

Pointless Wales acting in isolation

Concerted and co-ordinated approach needed for the UK as a whole





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jmaddy@glam.ac.uk

+44(0)1443 654528

www.glam.ac.uk/serc

www.h2wales.org.uk