



Minutes

Energy research in Wales

**Presentations by David Thomas, Sêr Cymru National
Research Network for Low Carbon, Energy and
Environment (NRN-LCEE)**

&

Jianzhong Wu, Cardiff University

Wednesday 13 June 2018 @ 12.00pm

Media Briefing Room, Senedd

Attendees

Assembly Members

Llyr Gruffydd AM

Industry Members

Aled Rowlands, National Grid

Amanda Biss, Egnida

Andy Regan, CAB

Beca Roberts, Community Energy
Wales

Bethan Proctor, National Energy
Action (NEA) Cymru

Brett John, Plaid Cymru Intern

Carole Morgan-Jones, National

Energy Action (NEA) Cymru

Carolyn Pugsley, Freshwater

Caryl Lewis, Work experience with
Jenifer Pride

Catrin Jones, Tidal Lagoon Power

Catriona Brown, Welsh Assembly

Chris Rossiter, Freshwater



Grŵp Trawsbleidiol
ar Ynni Cynaliadwy
Cross Party Group
on Sustainable Energy

Mewn partneriaeth â | In partnership with

freshwater
ARUP

Daniel Patterson, WSP
David Clubb, RenewableUK Cymru
David N Thomas, Sêr Cymru
Fozia Akhtar, Llanelli Councillor
Gareth Williams, CITB Bircham
Newton
Georgia Gandy, Intern to Simon
Thomas AM
Gerallt Hughes, ARUP
Gwenllian Elias, Savills
Huw Jenkins, Intern to Simon Thomas
AM
Jane Taylor, Sustainable Wales
Jennifer Pride, Welsh Government
Jianzhong Wu, Cardiff University
Katherine Route-Stephens, Natural
Resources Wales
Mari Arthur, Cynnal Cymru

Mark Summers, Acuity Legal Limited
Martyn Popham, Cenin Renewables
Ltd
Matthew John, Tai Calon Community
Housing
Neil Woollard, Tidal Lagoon Power
Richard Duffy, Cardiff University
Robert Proctor, Renew Wales/Adfywio
Cymru
Sara Powell Davies, RenewableUK
Cymru
Shea Buckland-Jones, Institute of
Welsh Affairs
Sian Caiach, Llanelli Rural Council
Sjoerd van Acht, USW
Stephen Nottingham, Freelance
Writer/ Journalist
Steve Knowles, Cardiff Council



Welcome: Llyr Gruffydd

- The purpose of this meeting is to discuss energy research in Wales, with an opportunity to have an update on the academic contributions

Presentation: David Thomas, Director of Sêr Cymru National Research Network for Low Carbon, Energy and Environment

Introduction to the Network

- Funded through the Sêr Cymru Initiative. Started operations in 2013 and funding is due to end at the end of 2018.
- The overarching mission to research into the sustainable use of natural resources for the provisioning of energy, water and food within the delivery of other ecosystem services. All funding received comes under this headline.
- The goals of the Network are to:
 - achieve research excellence that is internationally recognised
 - increase funding streams to Wales,
 - increase the quantity of excellent research outputs
 - increase the number of excellent scientists/future leaders working in Wales
- There has been funding of £7m from the Welsh Government and HEFCW, £9.1m institution funding leveraged and £12.7m of research funding leveraged.
- Targets have been met, and the Network has a variety of highly-qualified researchers (including 18 postdoctoral fellows and 12 PhD students) in eight research clusters. There has been a funded initiative to support scientists coming back into work (such as those returning from maternity/paternity leave etc).

Research Clusters

- Each cluster has to have multiple Welsh organisations involved, as well as UK and international organisations.
- Clusters include:
 - Marine renewable energy
 - Geological carbon storage and geothermal microbial activity
 - Plants and architecture
 - Coastal resilience
 - Aquaculture
 - Three clusters looking at sustainable land use management

Plants and Architecture Cluster

- A partnership between Aberystwyth, Cardiff and Bangor University researchers.

Objectives

- There are three main prongs to the research:
 - Nature-inspired design – bringing the architects together with the plant scientists
 - Learning from architecture – how to improve crop management, development and breeding



- How to use plans to reduce urban heat island effects and through vertical farming for food production and wellbeing. Helping the world adapt to a future in which 75% of the global population will be living in cities by 2050. It's about bringing together the natural and built environments to create the cities of tomorrow.

Energy Saving Green Roofs

- State-of-the-art research facility established – to be launched June/July 2018
- Aiming to examine impacts on new buildings complied with latest building regulations
- Research into summer and winter insulation
- Mapping urban heat islands and hotspots within Cardiff leading to sophisticated models about urban heat

Energy Efficient Farming

- Smart LED lighting and renewable energy to provide precision agriculture with low energy and water consumption in urban/challenging environments where food production is not usually on the agenda.
- Collaboration between industry and government bodies

Urban Heat Islands and Urban Greening Options

- Mapping heat island and hot spots in Cardiff
- Placing sensors all over the city and modelling data – leading to sophisticated models of urban heat

Bio-insulation materials

- Bangor University is leading the research in this.
- How to use plant-based insulation materials
- Testing for their longevity and insulation properties and linking with the growth pattern of the plant material.

QUOTIENT Cluster - Quantification, Optimisation and Environmental Impacts of Marine Renewable Energy

- Led out of Bangor University with Swansea and Cardiff Universities and many international organisations (including support from Supercomputing Wales).
- Marine energy could develop 27gw of installed capacity by 2050 if funded correctly.
- Possibility for a hi-tech industry development in the UK
- Wave and tidal energy could contribute between £1bn - £4bn to the UK GDP up to 2050

Objectives

- Research assessment
- Optimisation of new technology
- Environmental impacts
- Impacts of environment on the devices themselves



Direct/indirect effect of waves on tidal energy

- Waves influence turbulence properties and therefore have to be considered in device design – this has not been done before
- There is an interaction between wave and current – those interactions has not been adequately assessed in the modelling and work done to date
- This Cluster models the interaction between waves and currents in high energy, high turbulent systems.
- This Cluster has £500k funding from EPSRC to run the SURFTEC project and floating tidal turbines.

Tidal Lagoon Power Plants

- Turbine design – proven technology – interested to see where debate goes

What's next for Quotient cluster?

- QUOTIENT funding coming to an end in 2018
- Well-renowned internationally, and many high-profile partners across the world.
- The science that is based in Wales is being recognised internationally, and the hope is to be recognised nationally in Wales as well.

GeoCarb Cymru Cluster

- Led out of Aberystwyth University, involving the British Geological Survey in Wales and Cardiff University.

Objectives

- To look at geological carbon storers (GCS)
- Innovative research in ground water heating systems in Wales – how to extract heat from ground water systems in the future.

Novelty and Impact

- Microbiological activity can have a significant impact on the fate and security of CO₂ and the generation of subsurface heat
- Understand these microbial processes and their coupling to physical and chemical processes
- Allows control of microbiological processes to enhance subsurface energy potential
- Potential for Wales to be real world leaders
- Wales could offer 10% of UK sub surface carbon storage. BGS has been mapping and assessing resources.
- Storage appears to be safe and stable.
- Microbes on rock surfaces in the subsurface appear to be important for the adsorption and storage of CO₂.
- To understand the role of microbes on geochemical processes related to energy, we have developed advanced microbial-thermal, hydraulic, chemical and mechanical models



- Network will continue to work together on the role of microbial processes on the subsurface energy
- Work will contribute to the development of low carbon technology economy in Wales
- Facilitated by funding from EPSRC, Marie Curie and ITN, KESS and Royal Society
- Wider links with Tata Steel on carbon sequestration projects
- Hope to be recognised nationally and a way is found to support this Cluster and make them more sustainable on an international platform

Presentation: Jianzhong Wu, Professor of Multi-Vector Energy Systems, School of Engineering, Cardiff University on Future Energy Supply Networks

Introduction

- This research looks at integrated energy networks including electricity, gas heating, cooling, hydrogen and low carbon transportation, and assessed their similarities to enhance their performance
- The pace and magnitude of growth and development of technological departments suggests that we are on the verge of an 'energy revolution'.
- Energy networks play an important role in linking resources with demand

UK Energy Landscape

- The UK energy landscape is very important to inform the development of the Welsh energy system
- The majority of energy sources is still fossil fuels in the UK and there is pressure to have lower emissions
- In the 1980s, the UK became an energy exporter for a short amount of time, however the UK is now an energy importer
- There are three aspects to consider when looking to find a solution
 - Energy Sustainability – keep emissions as low as possible
 - Affordability – the cost of energy shouldn't be too high
 - Energy security – we want to keep the lights on.
- There is no single energy solution for the UK or Wales

Development in Electricity Sector

- Traditionally, electricity is supplied by centralised plants through a hierarchical power grid
- Renewables are connected at a different level to the grid, however most are intermittent
- How do we better manage these resources, including energy storage and flexible demand?
 - Micro grid – this is a low voltage grid to supply energy to local houses. The costs of this is high.
 - Cell grid – to supply energy to a district or a bigger area. This would balance generation of energy and demand and try to improve self supply.
 - National grid – group a lot of renewable resources and self service the grid to have the whole energy system.
 - Peer to peer – to trade or share energy among themselves locally.



- How to use ICT information and communication to mobilise energy is another big pressure, which is where a SMART grid comes from.

Development in Gas Sector

- In Europe, the distribution and transport grid is 2.2m km, with about 100bn cubic metres storage in Europe and 200m gas based systems running in household, industry, power plants and mobility
- How do we use this infrastructure to transport renewable gas (eg hydrogen)? This is a challenge.

Development in Heat Sector

- This used to be an inefficient steel based system, which has now moved onto a fourth generation system to enable us to
 - Use the heat more easily
 - Open the market for everybody to trade heat products in the network
- There is a lot of linkage between the sectors, which makes the energy network very complicated. It needs to be looked at holistically to ascertain the best use of all aspects of energy.
- We need to optimise the design of the system so we can use it better.

Why do we look at this?

- Characteristics of this integrated multi vector system
 - Complementary advantages of various energy vectors for system design and operation. Electricity storage is still expensive, but heat and gas storage is a lot cheaper, so why not use them together to reduce costs?
 - Explore and facilitate the integration of local sustainable and renewable energy resources
 - Flexibility to collect more renewables to put them to the grid which will increase reliability and resilience
 - Still supply energy locally and use this to help combat rural fuel poverty areas
 - Improve energy efficiency and reduce costs
 - If there is a failure in one network, it could cascade to other networks.

Warwick University Campus

- This is a real example of a multi-vector energy system
- A number of technologies have been connected on this campus
 - Power units to supply electricity and heat at the same time
 - Grid powered electricity
 - Local cooling network
- This example can be used to inform best operation strategy and what equipment is needed
- An integrated system can save £2m on the energy bill, and for larger areas there is a larger potential for saving.
- There are similar environments to Warwick University Campus in Wales



Peer to Peer (P2P)

- A local energy system can be created where people can trade and share energy, rather than having it provided by the big utility suppliers. This is a popular concept with many community groups working on this in Wales
- We need to utilise the energy suppliers because energy cannot be divorced from power
- The P2P system splits the energy network into different layers,
 - Power grid layer
 - ICT layer
 - Control layer
 - Business layer
- As many people rely on electronics to control their energy flow, there is the possibility of working with Welsh industry to maximise efficiency.
- There is fast global development and huge investment in this area.

Latest development in Wales

- Flexis has 19 packages looking at the different aspects of energy systems
- It is the aim of Flexis to look at one area in Wales and design a whole energy integrated model – which is an innovated global position.
- Flexis will work closely with WPD, WW and Tata Steel in this area.

Conclusion

- Integrated multi-vector energy network is a key for cost effective transition to a more secure, reliable, sustainable and affordable energy future
- Efficiency - significant opportunities from integrating multiple energy conversion, transmission and utilisation.
- Flexibility - significant opportunities from integrating key energy infrastructure, e.g. heat/cooling, gas, electricity, and transport.
- Setting out appropriate policy, regulation and market will be important for a cost effective transmission.
- Opportunities for Wales to take a leading role globally.

Questions and answers

■ Question

Andy Beacon, Energy and Policy Research Team, Citizen's Advice Bureau

I'd just be interested to hear a bit more about your last point in terms of what appropriate policy and regulation might look like, and whether you've got any more detail for us on what is needed for this.

Response (JW)

This is a very interesting question to ask in terms of Peer to Peer. The technology for P2P is developing very quickly. The local distribution network operator doesn't want to lose their 'cake', so they do not embrace the concept of P2P. If someone wants to do something with their neighbour, what arrangements should be made to open the door for this to happen? A lot of companies, because they are at an advantage, don't want to change their method of working, they don't want to lose their 'cake' so we need to do something. For multi vector, we have electricity, gas, heating and we must show why people should work together and why it's vital for the whole energy system.



■ **Question**

Rob Proctor, Community Energy Wales

I was also interested in the peer work, because we're involved in some Peer to Peer work. I would be interested to delve into a little bit more detail about the policy changes because obviously one of the challenges is the way that we pay for the grid. So what sort of policy changes are you looking at? Is it looking at a sort of nationalisation and paying for it out of taxation?

Response (JW)

If we consider what we pay for electricity, over 50% is for generation supply, about 5% to National Grid, about 14% to a local distribution company, about 20% tax and the other is tariffs. If we are going to look to reduce the cost, it needs to be the 50% generation supply. We need the National Grid and the distribution company because they must have the grid to serve us, and there is a capacity charge as well. If we can tighten up from a technology point of view, then we can give that as a solution. Then we can talk to National Grid and say we don't need this service, and this is what we want to do. So at that point, we need to try and negotiate with them to remove those costs. It must be a group effort because if people want to use the energy that they have generated themselves, they still need to use the power company infrastructure. It must be made cost effective for National Grid and they must be incentivised to do it. It's very challenging and not an easy question.

■ **Question**

Carol Morgan Jones, National Energy Action Cymru

I was interested in what you were saying about the ability to reduce energy bills, but in terms of Peer to Peer, I'm obviously concerned about social equity and in particular how low income households are impacted. As I understand it, those who go on to this Peer to Peer system are off the grid, but how are other people then paying for it? I'm just wondering what the challenges are that make it fair for people, because energy is obviously an essential service for everybody.

Response (JW)

It is a very good question, and it's complicated as it's not just about technology and economics – it's also about the social side too. In terms of generation from people's houses, even if they have investment from outside, it's about how to keep the equity among people. This is very challenging. And also, how do we bring people into the loop, and really encourage them to get involved and actively contribute to this? There is another European project, which I didn't mention in my slides, called District Future. In the project, houses are being built outside of London, using different building fabric, different low carbon technology and the selling point is zero bills. After one year, the results have come in. In the winter, people open their windows as they want fresh air. They don't care, because it's zero bills. Is this good or not? We need to really bring the people into the group; this is why in the Flexis Project, we have a very close collaboration to look at the social side.



■ **Question**

Mari Arthur, Cynnal Cymru

A quick question for David. It's widely accepted in the carbon industry that the project has been quite successful and you've highlighted some of the projects that you're currently working on. I didn't realise that this stage was ending this year. What comes next?

Response (DT)

You need to ask the Welsh Government. It's been a successful programme in terms of the metrics and it worries me that there doesn't seem to be a succession in plan for these networks to move forward. Sêr Cymru is being looked at by an external consultant to see if it has been successful, but it's up to Welsh Government to make a decision about what they do next. Some of the Post-Docs, who have been involved in the project, are leaving on account of the uncertainty - we brought researchers into Wales, they've performed, and now because we can't promise them anything, they are leaving and that seems to be a bit of a shame.

■ **Follow Up Question**

Whose responsibility in Welsh Government is it?

Response (DT)

The responsibility comes under the Chief Scientific Advisor for Wales, so Peter Halligan's office.

■ **Question**

Sian Caiach, Llanelli Rural Council

I am interested in the energy solutions for our rural areas where, as we have desperately bad infrastructure, so our grid isn't exactly great anyway. I would like to ask you about how improvements both in the infrastructure of these networks and in storage could help? You talk about the cities wasting energy but we waste tonnes of energy all the time with livestock farming. Is there anything that could actually improve the grid system without rebuilding it?

Response (JW)

Mostly the electricity grid was built after the Second World War. So especially for rural areas it is very challenging. And over 98% of faults occur at the local area. So how do we really keep the lights on? There are two solutions.

1. We upgrade the infrastructure. But it is very costly and who will pay for that? It's not clear, so we need a good business model.
2. A softer solution is how to better manage the grid. Electricity storage would play a very important role, however storage is still more expensive. So it's very difficult to justify the cost. There are a lot of trials that try to do that and some companies push this very hard as a solution. It doesn't bring the cost down very much, but you still need a good technology breakthrough to bring this to market and compete with grid electricity. I think there is still some way to go.



So this is why I like the idea of Peer to Peer. There are a lot of interesting questions and one very important thing is that a lot of communities set up their community interest company or group to take ownership of the infrastructure of the storage, and get the investment back at some point. If we do something like this, only some people will do it and others will take advantage of it and not pay, and is that fair? So, there are a lot of questions to answer, but it is a very interesting area that people should look at.

■ **Question**

Huw Jenkins, Intern to Simon Thomas AM

What do you think is the potential for Wales to develop its own hydrogen for both domestic use and export?

Response (JW)

It's a very good question. Going back 15 years and hydrogen was very popular with people labelling it the hydrogen economy. But because the technology was still very expensive, it got stuck. But now it has come back again. So, a lot of people are saying that hydrogen will be the future. So where does the hydrogen come from?

1. Using electricity to produce hydrogen, like a hydrogen wheel or heating or cooking.
So this is a very attractive solution especially for remote areas
2. Using natural gas to produce hydrogen

So there is a link to this energy use and we need to do something, such as linking research and industry closer together to look at these possibilities and looping in the policy makers as well.

■ **Question**

Katherine Route-Stephens, Natural Resources Wales

My question is for David about marine renewable energy. One of the biggest challenges that faces them is consenting and gaps in the evidence base, so it's really interesting to hear about the QUOTIENT project. I just wondered if that links in with any of the UK joint industry programmes such as AUDIT Promotion Energy to try and address some of those risks.

Response (DT)

So you're absolutely right - it's an imperative that it is joined up. QUOTIENT themselves have not done that. There are larger programmes in Wales, like the very successful SEACAMS2 that will address this. But it is clear in all of the discussions that I go to, that the scientists involved are fully aware that it's not going to go any further if it's not joined up.

Close

LG informed attendees that the next meeting will be 25 September (AGM) and that the Renewable UK Cymru SMART Energy Conference is on 4 July.