Sustainability Committee

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Submission to the Welsh Assembly Sustainability Committee from the Welsh Energy Research Centre

This short paper is in response to a request that the WERC participate in the Welsh Assembly's Sustainability Committee inquiry into carbon reduction in Wales. It will present the formation and activities of the WERC and also views of some of the WERC members.

Current energy research outlook

At this time Wales needs over 9 million tons of oil equivalents per year to sustain its current economic and social activity. The majority of that fuel is provided by hydrocarbons in the form of petroleum and natural gas. Continued growth of GVA is only assured by the provision of power and energy, and lots of it. The majority of scientific opinion is that GHG emissions from this use of hydrocarbons and fossil fuels in general are driving anthropogenic climate change. There is a large assumption that technology will come to our rescue, we can not rely on this assumption, we (society) need to rescue technology before it will rescue us. At this time we have underfunded, disjointed and an ineffective energy research happening in Wales. As an example the WERC has currently nine ERDF funded projects running; from coal gasification to marine energy use, from low power LED lighting to built environment modelling for PV in urban developments. Because of disjointedness between ERDF Objective 1 funding and Convergence Funding the assembled expert teams and knowledge have been decimated by the inability to keep the researchers at our institutes together. A long term plan needs to be put in place with underpinning, bridging, 3rd mission funding available. This needs to be in addition to the HEFCW reconfiguration and collaboration funds (LCRI), this funding is to keep the ERDF work progressing forward, this will impact on the green jobs and economic development in Wales. Industry and especially the energy companies are lagging in the provision of R&D spend in this area, of the top 100 companies in the world judged by spend on R&D just one was an energy company. The R&D spend in the Pharmaceutical and health industries dwarf the energy R&D budgets. We need to encourage industry to invest in R&D to enable us to use what we have more efficiently and reduce carbon emissions and to encourage industry to do R&D in Wales to develop high tech jobs. We do not have enough critical mass in research to attract the right companies to Wales or to develop indigenous firms.

Welsh Energy Research Centre

The formation of the Welsh Energy Research Centre was encouraged in 2004 by the then Minister for Economic development Andrew Davies AM and his officer Dr. Ron Loveland, picking up on an idea in a WEFO submission by Prof. Phil Bowen of Cardiff School of Engineering. The original members of the WERC were; Cardiff School of Engineering (Combustion), Swansea School of Engineering (Power Electronics, Marine Energy), IGER (Biomass), Bangor School of Chemistry (PV), Welsh School of Architecture (Built Environment) and Glamorgan University (Hydrogen). The WERC was formed with five objectives;

facilitate and encourage interdisciplinary collaborative research and development,

exploit the added value potential of a network/consortium approach to attract inward R&D investment to Wales,

provide independent authoritative advice to the Welsh Assembly Government in respect of its Energy Policy,

support the Welsh economy in alleviating barriers to delivering products to market and demonstration,

and to be recognised by and to interact with other centres of excellence.

The WERC Networking and daily operations was supported by a one man secretariat funded by a Technology Transfer Network (TTN) grant from the Knowledge Exploitation Fund (KEF). The driving theme was the development of near term research through to demonstration, working with contemporary and renewable industries for economic exploitation. The board was supplemented by invited industry representatives (South Hook LNG, Sharp UK, Corus, International Rectifiers, Welsh Power Group Ltd, Dulas and Falck Renewables).

With the cooperation of the academic members funding was achieved to develop nine projects;

SMART Meters for multiple inputs such as PV, Micro CHP.

Tidal stream mapping for tidal current turbine deployment.

Coal Gasification, using the gases from coal and leaving the carbon where it is.

PV coatings, using the whole building as a PV panel

Combing biomass with coal in large power stations.

Hydrogen as an energy vector demonstration.

Virtual Village modeling for renewables (VIRVIL)

Development of biofuels

Solar thermal absorption cooling integration with buildings

These projects will finish on the 30th June 2008.

In April this year a new body was initiated as a further development by the original academic members of the WERC, this body is supported by HEFCW with £5m of Reconfiguration and Collaboration funding. The Low Carbon Research Institute (LCRI) will work across the Welsh HE institutes to encourage collaborative science and R&D. Some of the work carried out by WERC will be absorbed by the LCRI. The relationship between WERC and LCRI is currently under analysis.

Activities

It was felt by members of the WERC that a more strategic and long term approach was needed in energy research, demonstration and deployment. Two task groups were formed to give a route map or framework in their themed areas, the two so far are The PV Task Group (PVTG) and the Marine Energy Task Group (METG), and further task groups such as energy storage and biomass are being discussed. The task groups terms of reference are to work with industry, researchers and government to identify, lobby and enact whatever is needed to deploy their specific forms of energy production in the shortest term and to develop if possible a sustainable low carbon industry in Wales. Each task group has a statement of their aims given below. Each of the Task Groups can work independently and has a large component of industry, NGOs and government. They will work across all funding regimes and have developed long term frameworks regardless of the funding available; they connect with funding schemes, venture capital or other capital as is needed. The LCRI R&D funding bid currently lodged with WEFO will be a part of this input in early stage development of the technologies.

What needs to be done

The focus here is within the scope of the committee's interest in this energy generation section of their enquiry. We take energy generation to be electricity and heat, converted specifically from fossil fuels, and the renewable inputs such as Wind, Wave, Tidal Stream, Solar, biomass and biofuels. The present system of supplying electrical power from large central generators utilizing fossil fuels will change over the next few decades to a more distributed system using various fuel feedstocks. At this time negligible heat from the generator boilers is being used, this will also change in the future. Many of the new sites for generation will be in isolated rural and coastal areas away from urban conurbations and grid connections.

There is research needed to be done in almost all areas associated with power generation and distribution.

Distribution

Smart grids need to be developed with sufficient control for a more distributed system. Systems and methods need to be developed for safe working in a two way flow system which is different from the current one way supply system. This is equivalent to developing an internet for power distribution.

Domestic

Smart meters need to be developed and deployed to give more information to the distributor companies and to the householder. Better net metering needs to be introduced for home micro generation. Use of other fuels and energy storage needs to investigated for domestic use.

Community energy use

Community sized Combined Heat and Power systems fuelled by biomass and waste need to be deployed and developed. Integration of solar PV and solar thermal into our built environment and perceptions about its use. Social sciences need to be involved on how best to develop community participation. What is the best transportation of the fuel supply, what is the most efficient way of combusting the material and what to do with the ash and many other questions need be asked.

Microgeneration

Even with high fossil fuel prices many of the renewable low carbon options are still too expensive. Work by the PVTG needs to be supported to bring down the whole system costs for PV, supply lines for biomass CHP need to be investigated. Critically training needs to start to provide engineers, installers etc for the new systems. Some specific points have been brought up by some members for achievable WAG actions to boost microgen towards the mass market:

Clear planning / building regulatory measures to kickstart demand

Create exemplars across public sector estate

Concentrate resource on areas of Welsh advantage (wood fuel, PV, research strengths)

General

A large amount of research and training needs to be done to implement the changes needed to adopt a low carbon generation

infrastructure. In particular Marine suffers from high risk high costs in its development, strong support needs to be given to enable the deployment of this technology. No particular position has been taken on nuclear generation other than to suggest that to maintain a low carbon security of supply at least some replacement of decommissioned nuclear generators will need to take place. However driving all available investment capacity toward a new nuclear platform will limit our options in deploying other technologies as they mature. Our opinion is that some new nuclear capacity should be invested in but the French and Irish interconnections could be made use of in the short term whilst renewables are brought on stream.

This is by no means an exhausting list of the research needed. Wales does not have the scientific or infrastructural capacity to attempt all that needs to be done. In general, in terms of new technology development and deployment a strategic long term view needs to be set involving all stakeholders. The task groups will be a critical part of this process.

WERC PV Task Group

Project Vision 11/1/2008

The WERC PV Task Group has been formed to develop a plan for technology innovation that will substantially improve the uptake of PV solar energy in Wales. A consequence of success in this objective will be the development of a wealth creating and internationally competitive industry in PV manufacture, its associated supply chain and PV systems installation. To achieve this aim the PVTG have addressed the reasons why uptake has been low until now and where it has occurred it has relied on some form of subsidy. The current cost per kWh for PV solar energy is currently 5 times higher than for a commercial competitive rate. Although prices are falling we may not reach a break even in cost competitiveness until 2020. The PVTG aim to bring about a substantial reduction in cost per kWh of PV solar energy through an innovative systems approach to implementation of existing technology and then to seek further, substantial, cost reductions through incorporation of new PV technology. The latter would take the same approach as the short term in taking a total systems approach and seeking innovation, not only in each technology component but also in the way that this is put together. The short term can be viewed as having outputs on a 2 year timescale and the longer term having output on a 5 year timescale.

There are some very useful parameters that the PVTG can use to guide this process. The first is the WAG Microgeneration plan which sets a target of 200,000 microgeneration units in Wales by 2020. Each PV solar system installed would count as one microgeneration unit. The PVTG project would aim to facilitate achieving this target, not through demonstrators, which implies subsidy, but through enabling economic and commercial implementation of PV solar energy systems.

An essential strength of the PVTG is representation of different parts of the technology chain, including the house builder, Redrow, who will evaluate the potential for low cost implementation of innovative technology resulting from the project. Essentially, the question is whether Redrow or any other builder would consider the package on offer to be both an economically viable addition to the building and an attractive addition for the house purchaser. The innovation in technology, whether it will be power electronics, module design, building integration or the installation system. This will probably take the PVTG down the path of defining the "system" as being at least the whole roof and possibly the whole building. By taking this approach the PVTG believe that they can provide added value, make more rapid advantage of new PV technology and encourage a volume approach to PV systems that will drive down cost.

Marine Energy Task Group

Marine renewable energy is an innovative zero carbon energy source in which the UK has the lead at present. If the UK invests now in infrastructure to support this industry, it is predicted to be worth £3bn in the UK alone by 2020 with a significant export market.

With 13.5m tidal ranges, tidal velocities in excess of 8 knots, consistent waves and offshore winds, Wales in ideally placed as a World centre for research, development and innovation within the Marine Renewable Sector.

Some of the technologies capable of exploiting this resource may produce power at predictable times (eg tidal devices), others may be less predictable (offshore wind, wave) but Wales is unique in that it is suitable for a varied portfolio of Marine Energy technologies which is not only attractive to electricity generation companies but also offers some degree of energy security.

Wales is well suited to engage in the marine energy sector. There is a good base of heavy industrial companies to build devices, a number of large ports with good facilities, strong university support, WERC, Pembroke Energy Technium and a strong commitment to this technology area in the "Wales Energy Route Map".

The formation of this Marine Energy Task Group is a consequence of the WERC-funded project HE09 WERC 1001 - Tidal Stream. The calibre of the institutions involved in this 18 month project has, not surprisingly ensured the formation of a truly independent, fully multidisciplinary partnership. A measure of the range of expertise that make up the current project are appended to this document.

The Marine Energy Task Group will therefore build on the success of the current WERC project and form a more strategic body representing the entire marine energy sector across Wales.

The scope of the Group will encompass all marine renewable technologies including, barrages, lagoons, offshore wind, offshore impoundments, wave and tidal stream. The Marine Energy Task Group will consider technologies capable of deployment throughout the Welsh coastline.

Biomass

Some specific comments from Dr. John Valentine IBER WERC, biomass expert

The Renewable Energy Route Map for Wales indicates that indigenous and imported biomass might generate 4-7TW h /year of electricity and about 1.5 TW h/ year of heat, resulting in 600-860 Kt of carbon savings per year. This will need to come from forests, energy crops, wastes and imports.

It should be noted that

1. biomass is one of the most economic forms of RE, and is not intermittent

2. it is the only source of RE that can provide liquid biofuels. Next generation biofuelss from ligno-cellulose (such as Miscanthus and high sugar ryegrasses) under development offer a more carbon efficient way of deriving biofuels than from first generation biofuels from wheat and oilseed rape, with much reduced competition with primary food production.

3. In England, a £22m Biomass Infrastructure Scheme has been announced and there are planting grants for energy crops aimed at overcoming market failure. England are finding take-up of planting grants very low, it being difficult to compete with current cereal margins, and Defra are likely to return unspent money to the Treasury, yet energy crops can better compete in grassland areas.

4. It is estimated that using biomass from energy crops in place of fossil fuels will save 4-6t/ ha of C / year and also sequester 0.5-1.0 t/ha/ year in the soil. Thus 60,000 ha of energy crops would save 0.27 - 0.42 mt /year (16.5 - 25.6% of total emissions from Welsh agriculture or 2.0 - 3.1% of total Welsh emissions) without taking into account the substitution of methane from animals (42% of total agricultural emissions). It should be borne in mind that energy crops are just a part of biomass raw materials