Environment and Sustainability Committee
Inquiry into Energy Policy and Planning in Wales
EPP 9 – Geoffrey Weller

DOES TAN 8 SUPPORT THE WELSH ENERGY POLICY AND THE CLIMATE CHANGE STRATEGY FOR WALES? *by G C Weller BSc CEng FIET*

Introduction

At the heart of the Welsh Energy Policy[1] is the need to reduce greenhouse gas emissions, and production of low carbon electricity on a large scale one is one of the stated actions. A key target of Climate Change Strategy for Wales[2] is to cut greenhouse gas emissions by 3% per year from 2011 in areas of devolved competence. The intention of this review is to show how the planning guidance TAN 8 does not adequately support these objectives, and that TAN 8 needs to be revised as a result.

Carbon payback in the lifetime of a renewable energy project

The transition to low-carbon electricity requires the construction of new plant and infrastructure. During the construction phase of any renewable energy project, a significant amount of energy is consumed, and so there is a carbon cost that must be taken into account in assessing the overall CO_2 saved during the project lifetime. The 'carbon payback' time is the time it takes for saved carbon emissions (those produced by generating the same amount of power using fossil fuel) to outstrip those produced during construction.

It is normally assumed that the carbon payback time is short compared with the project lifetime. In this context, the term 'project lifetime' is intended to mean the whole duration of the project life cycle, including the consecutive phases of: (a) planning; (b) construction; (c) operation, repair and maintenance; (d) decommissioning; and (e) restoration of site.

Obviously, if the carbon payback time were longer than the project lifetime, there would be an adverse impact on greenhouse gas emissions. Even in this scenario, the power plant could truthfully be said to generate low carbon electricity during its operation, as it would utilise a renewable (that is, naturally replenished) source of energy. It may be inferred that the fact that a new power plant proposes to use a renewable energy source, rather than fossil fuel, does not necessarily mean that the power plant would help reduce greenhouse gas emissions.

Onshore wind and carbon payback

Onshore wind is often quoted as one of the renewable energy sources with a short carbon payback time. Renewable UK states 'the average wind farm will pay back the energy used in its manufacture within 3-5 months of operation' [3]. The House of Lords Science and Technology Committee was less optimistic and estimated a 1.1-year typical energy payback time[4]. Figures like these compare well with the average 25-year life expectancy of a wind farm.

Additional carbon cost of building on upland areas

However, special considerations apply when the wind farm is built in an upland area, because the loss of

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[1] The Welsh Assembly Government Energy Policy Statement March 2010
http://wales.gov.uk/docs/desh/policy/100331energystatementen.pdf

[2] Climate Change Strategy for Wales
http://wales.gov.uk/topics/environmentcountryside/climatechange/tacklingchange/strategy/walesstrategy/?lang=en

[3] Renewable UK - Top Myths About Wind Energy http://www.bwea.com/energy/myths.html

[4] House of Lords Select Committee on Science and Technology Fourth Report
http://www.publications.parliament.uk/pa/ld200304/ldselect/ldsctech/126/12620.htm

CO_2 from displaced peat and/or forestry considerably worsens the situation. The Scottish Government acknowledges these special considerations by a guidance document entitled 'Calculating the carbon savings from wind farms in Scottish peat lands' [5] from which the following extract is taken:

> 'The total C emission savings from a wind farm are estimated with respect to emissions from different power generating sources, loss of C due to production, transportation, erection, operation and dismantling of the wind farm, loss of C from backup power generation[6], loss of C-fixing potential of peat land, loss of C stored in peat land (by peat removal and by drainage of the site), C saving due to restoration of habitat and loss of C-fixing potential as a result of forest felling.'

The document contains a well-researched account of best practice for calculating carbon savings, including a link to a spreadsheet[7] for facilitating the calculation of carbon payback time. The methodology is sensitive to variations in input parameters (such as estimated depth of peat on the affected land), and most developers would produce a range of results, described as worst, intermediate and best scenarios depending on input values used.

To give an example, Viking Energy quoted three carbon payback scenarios in their Environmental Impact Assessment for their Shetland wind farm. The methodology was in line with the Scottish Government peat land guidance and used the spreadsheet described above for calculation. The conclusion was that the carbon payback for the wind farm would be 2.3 years in the best case, 3.7 years in the intermediate case and 14.9 years in the worst case.[8] The developer stated that in the worst-case scenario the wind farm would not start saving any CO_2 until it was half way through its life.

In the TAN 8 areas of Mid Wales, there are other carbon costs to consider, described under the next two headings.

Additional carbon cost of infrastructure

In the TAN 8 areas of Mid Wales there are further carbon cost implications because of the need to construct a major electricity grid infrastructure if the higher values of generation capacity are to be achieved. Also, major road infrastructure modifications will be required to allow transportation of the heavy components such as supergrid transformers that are required for a 132/400kV substation, and the very large turbine components that have become the norm since TAN 8 was originally published.

The road modifications are only required because of wind farm development. They are only of benefit to wind turbine transportation, and do not help conventional road traffic in journey times, relief of congestion or road safety. All the carbon costs are therefore attributable to wind farm development.

The new electricity infrastructure, known as the 'Mid Wales Electricity Connection' project by National Grid and SP Energy Networks, is designed to transmit a gigawatt of wind power and will cost £200 million[9]. The project is only required to take energy out of Wales - it is not required to supply local industry or homes.

There is a strong probability that the additional infrastructure will not be reusable after the wind farms have been removed at the end of the life, because onshore wind power will be obsolescent by that time. With the current rate of advances in science and engineering, the technology will almost certainly have been superseded by new carbon-free sources of power (see Appendix B) that have less intermittency and

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[5] The Scottish Government publication 'Calculating carbon savings from wind farms on Scottish peat lands' http://www.scotland.gov.uk/Publications/2008/06/25114657/0

[6] See Appendix A

[7] Scottish Government Excel Workbook File Download 'Calculating carbon savings from wind farms on Scottish peat lands' http://www.scotland.gov.uk/publications/2008/06/25114657/4

[8] Viking Energy News http://www.vikingenergy.co.uk/news-detail.asp?item=39

[9] House of Lords Economic Affairs Committee, Economics of Renewable Energy, Tuesday 24 June 2008. http://www.publications.parliament.uk/pa/ld200708/ldselect/ldeconaf/195/8062406.htm

unpredictability, and do not need generating plant that occupies large land areas. All the carbon costs of the infrastructure are therefore attributable to the present generation of proposed wind farms.

Additional carbon cost of energy loss in transmission

The transmission of electricity from wind farms to the places where the energy is used is a significant source of loss, which increases the further the generation is from the place of consumption. In the case of wind farms in Mid Wales the place of consumption may be regarded as the point of connection to the UK National Grid in Shropshire, which is remote from the sources of generation. The energy transmission loss during the operation phase any planned wind farm project should be taken into account in assessing the carbon payback predictions.

Lifecycle Carbon Predictions in Wind Farm Planning

To quote from Scottish Natural Heritage: Technical Guidance Note on Windfarms and Carbon Budgets, ' if the payback time approaches say 15 years then it may be worth studying the carbon budgets more rigorously, or questioning whether the project is justified on the basis of climate change benefits' [10].

At present a wind farm developer is not obliged to submit a lifecycle carbon budget calculation with the planning application – it is not a requirement of the Environmental Impact Assessment. Developers of renewable energy schemes might argue that there is no requirement to submit a carbon budget for any other type of power plant in Wales, so why should they be treated differently? The counter argument is that there is no need to build non-renewable power plants in the countryside, since fossil-fuel and nuclear power plants can be built in industrial areas close to consumers, or else on brown-field sites close to existing grid connections.

Implicit in a windfarm planning application is that saving greenhouse gas emissions is a justification for building in a landscape where other forms of development would not be permitted. However, the whole rationale for constructing a wind farm is to reduce overall greenhouse gas emissions, and if this objective is not satisfied, or barely satisfied, then the development cannot be in sympathy with the Welsh Energy Policy. At present there is no compulsion in TAN 8 for any new plan to demonstrate a reduction of overall carbon emissions (compared with fossil fuel generation), taking into account the whole project lifecycle, a valid share of the new infrastructure that is necessary for the construction and operation of the wind farm, and electrical losses.

Conclusions

TAN 8 advises the planning authorities on the approval of renewable energy projects in strategic areas in which many other forms of development would not normally be accepted. However, TAN 8 makes no reference to saving or reducing the amount of CO_2 produced in Wales. Neither does the document address the carbon costs that would be involved, particularly the overall costs if the higher values of generation were to be achieved, taking due regard of the infrastructure needed to support wind farm development, and electrical transmission and backup generation losses.

TAN 8 places no obligation on developers to plan for an overall saving in greenhouse gas emissions before the plant reaches the end of its life.

For these reasons TAN 8 does not adequately support the Welsh Energy Policy or The Climate Change Strategy for Wales, both of which stress the need for CO_2 emissions reduction. TAN 8 should therefore be revised.

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[10] Scottish Natural Heritage Technical Guidance Note - Windfarms and Carbon Savings
http://www.orkneywind.co.uk/advice/snh%20carbon%20savings.pdf?PHPSESSID=to5j687l4korrh51agdau4ed97

Appendix A – Backup power requirements

Wind farms require backup power generation from conventional power stations because of the variability and unpredictability of the wind supply, and the Scottish guidance document (see reference 5) includes loss of C from this source in its calculation. The document states that when wind power starts to contribute more than 20% to the national supply (the EU renewable energy target for 2020), extra backup power capacity equal to 5% of the rating of the wind plant is needed (Dale et al 2004). To have the non-wind power stations ramp up or down to compensate for random wind variations causes a 10% reduction in thermal efficiency for such power stations, which is taken into account in calculating the carbon payback time in the Scottish model.

In 2009, Helsinki-based Pöyry Energy Consulting completed a year-long study[11] entailing 20,000 hours of effort and costing a million euros into the effect of wind variability in the UK and Ireland. The report shows that reserve generation requirements in the UK will increase from approximately 5500MW in 2010, to 9100MW in 2020, as a direct result of increasing wind penetration. The loss of Carbon due to the construction of additional fossil-fuel reserve generating plant is not taken into account even in the Scottish model.

Appendix B – New technology

As an example of the type of technology that could become available within 25 years, Underground Coal Gasification with Carbon Capture and Storage, which has the potential to allow vast reserves of un-minable coal in South Wales to be used for electricity generation, with the resultant CO_2 being permanently sequestered underground in the spent coal seams and not released to the atmosphere.[12]

Another example is liquid-fluoride thorium reactor (LFTR) technology [13], which is the subject of intensive research and development in the US, India, Japan and China[14]. LFTR has the potential of being intrinsically fail-safe, causing insignificant hazardous waste, having no weapons applications, and having a plentiful source of fuel (the ore Thorite can even be found in Wales[15]).

Wind energy may have a future without the need for valuable land area, using offshore High Altitude Wind Energy (HAWE) generators[16]. These are designed to tap into the high velocity, stable air currents that exist at altitudes anywhere from 200m to 20 km above the earth; a source for generating cheaper and more abundant electricity than current wind technology. HAWE systems are currently being developed by at least 22 companies, for example California-based Makani Power, which has received a $15 million grant from Google to build a prototype of its 'wing concept'. The company plans to have products on the market in 2013-14, with a 1MW model on sale in 2015.

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[11] Impact of Intermittency: How Wind Variability Could Change the Shape of the British and Irish Electricity Markets http://www.poyry.com/linked/group/study

[12] British Coal Gasification Ltd http://www.britishcoalgasification.co.uk/

[13] World Nuclear Association Information Page http://www.world-nuclear.org/info/inf62.html

[14] Climate Action in Partnership with the United Nations Environmental Program http://www.climateactionprogramme.org/news/china_research_surge_to_dominate_thorium_nuclear_technology/

[15] Parnell, J. & Eakin, P., 1989. Thorium-bitumen mineralization in Silurian sandstones, Welsh Borderland. Mineralogical Magazine, 53, 111-116.

[16] Garrad Hassan News, 25 August 2011 http://www.gl-garradhassan.com/en/news_23772.php