

**From:** [Rosemary Watton](#)  
**To:** [NDE](#)  
**Subject:** Response to NDF Consultation  
**Date:** 11 November 2019 11:34:26  
**Attachments:** [NDF Consultation Nov 2019 Final version.docx](#)

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Dear NDF Team,

Please find attached my response to the NDF consultation.

As the response runs to 51 pages, I have also sent by post a paper version and a copy on a USB Flash Drive in case the attachment does not arrive correctly.

Yours sincerely,

Rosemary Watton

## RESPONSE TO NATIONAL DEVELOPMENT FRAMEWORK

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Dear NDF team,

Thank you for the opportunity to respond to the National Development Framework Consultation. I wish to respond briefly to questions 10 and 16, and in more detail to question 7.

### RESPONSE TO QUESTION 10: Mid and South West Wales (policies 23-26)

*Swansea Bay and Llanelli is the main urban area within the region and is our preferred location for growth. We also identify a number of rural and market towns, and the four Haven Towns in Pembrokeshire, as being regionally important. The haven Waterway is nationally important and its development is supported. We support proposals for a Swansea Bay Metro.*

*• To what extent do you agree or disagree with the proposed policies and approach for the Mid and South West Region?*

<i>Strongly agree</i>	<i>Agree</i>	<i>Neither agree nor disagree</i>	<i>Disagree</i>	<i>Strongly disagree</i>	<i>Don't know</i>	<i>No opinion</i>
				✓		

I am concerned at the proposal to single out three towns namely Llandrindod Wells, Newtown and Aberystwyth as the focus of growth for housing, employment and key services in rural Mid-Wales.

Such a model depends on good public transport links between the smaller towns and communities and these regional growth centres. These public transport links do not exist in rural Mid-Wales and such a narrow focus for key development will leave many citizens in our smaller communities disenfranchised.

Our smaller town and villages form the bedrock of our way of life in rural Mid-wales. This policy would inevitably accelerate the loss of vital services in our smaller communities – schools, doctors, dentists, shops, banks, post offices, libraries, youth services – all the services that enable a community to function and to thrive. The chosen hot spots will perhaps thrive but in the smaller communities it will lead to decline. As these smaller communities decline the opportunities for work will decline, with a loss of young people and an increasingly ageing population.

Lack of public transport between these smaller communities and the growth towns will inevitably lead to a significant increase in private vehicles on our rural roads as people have to travel further for work, and a consequent increase in carbon emissions.

The effect of this policy would be counter to the stated aims of the Well Being and Future Generations Act. Rather than focussing on the three towns of Aberystwyth, Llandrindod and Newtown in rural Mid- Wales for growth and key infrastructure I beleive that a more even focus across all our communities will lead to a more equal society and allow all communities to thrive.

It is of significant concern that the ARUP map, Centres of Population (Appendix D, drawing 4.1), contains numerous errors, including the following town omitted or shown incorrectly in Mid-Wales: Llandrindod Wells and Newtown (identified as growth areas), Builth Wells, Llanwrtyd Wells, Brynmawr, Ystradgynlais, Brecon, Rhayader and Llanidloes.

How can we have any confidence in the conclusions with regard to population growth and development when a key map is so full of errors?

The fact that these errors have not been picked up would indicate a lack of representation of the citizens of rural Mid-Wales.

**RESPONSE TO QUESTION 16: Are you...?**

<i>Providing your own personal response</i>	yes
<i>Submitting a response on behalf of an organisation</i>	no
<i>Responses to the consultation will be shared with the National Assembly for Wales and are likely to be made public, on the internet or in a report. If you would prefer your response to remain anonymous please tick here.</i>	

**RESPONSE TO QUESTION 7 : Renewable Energy and District Heat Networks**

*To what extent do you agree or disagree with the NDF's policies to lower carbon emissions in Wales using...*

	<i>Strongly agree</i>	<i>Agree</i>	<i>Neither agree nor disagree</i>	<i>Disagree</i>	<i>Strongly disagree</i>	<i>Don't know</i>	<i>No opinion</i>
<i>Large scale wind and solar developments</i>					✓		
<i>District heat networks</i>						✓	

*If you disagree with the NDF's approaches to green infrastructure, renewable energy or district heat networks, what alternative approaches should we consider to help Wales to enhance its biodiversity and transition to a low carbon economy?*

I fully support the move from fossil fuels to more sustainable sources of energy. However, this must not be done at the expense of the landscape and environment when there are alternative measures that I do not feel have been given sufficient attention or prominence in the NDF.

The NDF represents a significant change in WAG policy from *optimising* the potential for renewable energy with its implication of finding the *best* solution to one the aim of which is to *maximise* the land area available for large scale wind and solar generation.

I will consider the impact of Policy 10 under the following headings:

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1	Democracy and Involvement at Local Level	5-9
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3	Impact on Tourism	13-15
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5	Wellbeing of Future Generations Act	17-19
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A	<b>Contribution of Powys to Renewable Energy in Wales</b> The Low Carbon Energy Generation in Wales: Updated Study of Low Carbon Energy Nov. 2015	32-34
B	<b>REGENERIS:</b> Study into the potential economic impact of wind farms and associated grid infra structure on the Welsh Tourism Sector (FEB 2014)	35-39
C	<b>Offshore Wind:</b> International Energy Agency (IEA)	40-41
D	<b>Crown Estate Auction of New Seabed Rights and Strike Prices</b>	42-43
E	<b>Recent Advances in Battery Technology and Storage</b>	44-46
F	<b>Green Alliance Report</b> How Consumer Choice is changing the UK energy system      April 2017	47
G	<b>Solar PV and Battery Storage</b>	48-50
H	<b>Micro Hydropower</b>	51

I will refer to the following key documents:

- **NATIONAL DEVELOPMENT FRAMEWORK 2020-2040** Consultation Draft 7 Aug- 1 Nov 2019
- The Welsh Government : **ASSESSMENT OF ONSHORE WIND AND SOLAR ENERGY POTENTIAL FOR WALES STAGE 2** – Refinement of priority Area for Wind and Solar Energy
- AECOM: **Renewable Energy and Low Carbon Energy Assessment November 2016**
- AECOM: **Renewable Energy and Low Carbon Energy Assessment May 2017**
- ENPLAN: **Powys Renewable Energy Assessment: Landscape Sensitivity Study for Solar farm Development May 2017**

## 1. DEMOCRACY and INVOLVEMENT AT LOCAL LEVEL

1. The environment Wales Act 2016 states that net Welsh emissions must be at least 80% lower than a defined base level and in order to achieve this the NDF sets the following targets:

- Wales to generate 70% of its electricity consumption from renewable energy by 2030
- One gigawatt of renewable electricity capacity in Wales to be locally owned by 2030
- Renewable energy projects to have at least an element of local ownership by 2020.

However, I have heard the Energy Minister, Lesley Griffiths, state that her aim is not that Wales should generate 70% of its electricity consumption from renewable energy by 2030 nor even that Wales should be self-sufficient in Renewable Energy, rather the Assembly aim is that Wales should be a **net exporter of Renewable Energy** to Europe including to large rich developed countries such as Germany.

It would appear that in order to achieve this aim the wonderful unspoilt uplands of rural Mid Wales are to be turned into an industrial wasteland and its communities, its economy and its way of life sacrificed. The proposals in Policy 10 will bring distress, anger, distrust and disharmony to the affected communities for decades to come. I fear that if the concerns of rural Mid Wales residents are ignored then it will lead to widespread distrust and resentment of the Welsh Assembly.

If this were the only way to combat climate change and meet the WAG goals, then it might just be acceptable. However, it is **not** the only way to reduce carbon emissions and meet the WAG goals with regard to Renewable Energy.

I would urge the WAG to think **more imaginatively and creatively** and in particular to be far more open to consider **rapidly developing technologies**.

2. In November 2016, the proposal in the draft Powys LDP to allocate up to 40% of Powys uplands as suitable for wind LSAs generated very significant public concern. Over 600 Powys residents, including myself, responded to the public consultation on Renewable Energy with over 25 then going on to speak at the hearing sessions which were each packed with members of the public from all backgrounds. Many of us gave up significant time to engage in the democratic process over a period of 18 months, reading the many documents and producing responses and reports of our own. Some, like myself started with little knowledge but others had deep and wide knowledge of renewable energy, its requirements and its implications. The Renewable Energy proposals for rural mid Wales contained in the NDF make a mockery of that democratic engagement.

3. The WAG document: **Community Strategies and Planning Part 2** states on page 47:

## Community involvement

**7.11** *The involvement of local people is central to the effective development and implementation of community strategies, and to wider change and improvements in the longer term. There is an **often untapped pool of ideas, knowledge, skills, experience, energy and enthusiasm among individuals, groups and communities as a whole which, if realised, can be a real driver for change.** Community strategies should provide an opportunity to **put local people at the heart of partnership working and should be grounded in the views and expectations of those people.***

**7.12** *If community strategies are to respond to public concerns, there needs to be **genuine public engagement and involvement throughout the process.** It is important that community planning enables communities to be **fully involved in establishing both the long-term vision and the shorter-term priorities for action.** It would not be sufficient simply to consult communities on a range of options determined by the authority and its partner organisations. Attention should be given at an early stage to ensuring that all sections of the community have the opportunity to participate.*

Did the NDF strategy put local people *at the heart of partnership working*?

How can the strategy be *grounded in the views and expectations of those people* if we were not involved in the development of the policy?

Are we not simply being consulted on a *range of options determined by the authority and its partner organisations*?

The country is on the verge of a Brexit crisis – a crisis largely due to the fact that the demands of the rich and powerful have been allowed to dominate whilst the concerns and needs of those at the bottom have been ignored or worst still derided. It is the large global multi-national companies, far removed from the locality that gain from large scale wind and solar farm developments whilst the local community suffers the consequences in the destruction of treasured landscapes.

**4.** **Planning Policy Wales 10** defines *sustainable* development as “the process of improving the economic, social, environmental and cultural well-being of Wales by taking action, in accordance with the sustainable development principle, aimed at achieving the well-being goals.”

I appreciate that the proposals offer diversification and potentially significant financial benefit for some individuals. However, there are many more people for whom the environmental, economic and emotional impacts will be devastating. The resulting conflict could destroy community cohesion for many years to come.

**5.** I have always in principle supported the establishment of the Welsh Assembly believing that it would transfer power from the top down government of a distant Westminster Government to the smaller communities of Wales. However, it would appear from the NDF that in too many respects we have simply swapped top down government in Westminster for top down government in Cardiff.

Can we not demonstrate a better form of democracy in Wales? A democracy that isn't city and large town based but that starts from the bottom and is rooted in our villages and small towns that form the bedrock of rural Wales. A democracy that encourages informed debate and draws citizens together to solve problems rather than one that imposes solutions on them.

**6.** The company chosen to perform the assessment for the Renewable Energy policy has the following stated mission on its website:

### **Renewable Energy**

*"With extensive experience in solar, hydro, both onshore and offshore wind, **we work with clients to ensure renewable energy sources for years to come. From helping acquire large scale developments, to designing to designing the right offshore foundation through to project management, we support renewable energy programmes from start to finish.***

A company with this stated mission will inevitably produce a report that is biased towards maximising the land available for large scale wind and solar projects in order to meet its stated aspirations to its clients.

ARUP, a global company, is a company of city- based professionals, far removed from rural Mid Wales, who demonstrate little knowledge or understanding of rural mid Wales, who do not value its cherished unique qualities and who show scant regard or care for its communities and its way of life.

7. The NDF Statement of Public Participation (Revised July 2019) states:

**3.7** *It is important that people have the opportunity to be involved in the preparation of the key NDF documents **before they are published for consultation.** Effective engagement means people will have had the opportunity to shape the emerging NDF before the consultation stages including providing evidence they feel should be considered through the process.*

With regard to the ARUP research it is of significant concern that the initial *Stakeholder* workshops in September 2018 were held in Swansea and Llandudno, and that the final *Stakeholder* workshops, in December 2019 were held in Cardiff and Llandudno, three urban centres far removed in distance, culture and economy from rural Mid Wales that will bear the consequences of these decisions.

I would ask the questions:

- i. Who were the *extensive range of stakeholders* that along with the WAG identified the initial range of constraints?
- ii. Did they include a full range of representatives from environmental groups and from the residents of rural mid Wales?
- iii. If not, then how can we have any confidence that the full implications of these proposals were properly considered?

8. It also of significant concern that the workshops for refining the priority areas consisted only of representatives from WAG, NRW and ARUP. The ARUP report states in Appendix I page 3 that local *knowledge* of the four considered PSAs was put forward by members of NRW.

Under the discussion regarding Priority Area 6, it is stated:

*"Attendees raised concern that there is a significant amount of renewable energy generation already within this area. Data provided by Welsh Government on existing generation shows that **only Garreg Llwyd 34MW wind farm currently exists within this priority area.**"*

This statement is incorrect. It clearly demonstrates a lack of local knowledge as the highly controversial Hendy Windfarm 17MW lies within the boundary of PSA 6. It also ignores the 20 LSAs for Solar Power designated in the Powys LDP, adopted April 2018.

It is also highly misleading to consider only four of the proposed PSAs in the refinement workshops. PSAs 5,6,7 and 8 all lie within Powys and together they occupy a significant percentage of upland Powys, forming an almost unbroken 50-mile chain from Welshpool to Brecon and almost completely surrounding Llandrindod Wells on three sides.

When nuclear and offshore wind are excluded Powys is already making a **significantly higher contribution** to renewable energy than any other local authority in Wales (based on WAG figures from 2015).

With its **existing** Renewable Installed Capacity (AECOM May 2017 p56), Powys is already generating 163% of its projected electricity demand for 2026.

With the additional proposed installed capacity of 61.7MW from the 20 LSA's for Solar, Powys will be generating **188%** of its projected electrical demand for 2026 from renewable sources (AECOM May 2017 p56)

See **APPENDIX A** (p32-34) for detailed breakdown of Powys' very significant contribution to Renewable Energy in Wales.

It is clear that the representation of *local knowledge* was significantly deficient, and the conclusions reached as a result of this process cannot be sound.

9. I would contend that a process that starts at community level would produce a very different solution.

UK MP's from six House of Commons select committees are inviting 30 000 citizens chosen randomly from across the UK to take part in a Climate Assembly which will be held in Birmingham over four weekends from January to March. Of those receiving invitations, 110 will finally take part in the Climate Assembly UK to discuss how the UK should respond to the climate emergency and what policies should be implemented to meet the target of net zero carbon emissions by 2050.

Labour's Rachel Reeves, the chair of the business, energy and industrial strategy committee has stated:

*"Adopting the net zero target was a major milestone for the UK, reflecting the strong cross-party support for action on climate change. We now need to set out a clear roadmap, and finding solutions which are equitable **and have public support will be crucial.**"*

She further stated:

*"Parliament **needs to work with the people** and with government to address the issue of climate change."*

Could the WAG convene a Citizens' Assembly to discuss how to respond to the Assemblies goals?

Alternatively, could the WAG invite the many citizens who contributed to the public consultation on Renewable Energy in Powys to contribute their wide experience, ideas and views with regard to the Renewable policy for Mid and South West Wales?

**10.** The **manner in which the results from this survey are analysed and presented** will significantly affect the conclusions that are drawn from the survey.

If the results are **purely analysed and presented** at National Level or at Regional level, then in Mid and South West Wales there is a high probability that the voices of those in rural Mid- Wales, who will be significantly affected by this policy, will be drowned out by the voices of those in the urban centres of Swansea, Llanelli and Neath Port Talbot- voices that are far removed from the devastation of the Mid Wales landscape.

If there is to be any sense of fair democratic representation, then it is vital that the results are not only analysed and presented at National or Regional level but also **at the level of individual Local Planning Authorities**. If this is not done, then the process would lack legitimacy and would not comply with The WAG document: Community Strategies and Planning Part 2 7.11 and 7.12 (above).

**11.** In the interests of democracy, I would also ask that the Welsh Assembly make every effort to publish in **FULL** all submitted responses to the NDF consultation.

## **2. IMPACT ON LANDSCAPE**

**1.** The landscape has significant importance in terms of the economy and tourism of Powys.

The **intrinsic** value of this landscape in terms of culture, history, beauty, spirituality and sense of remoteness cannot be overstated.

It is therefore of significant concern that the list of *variable* constraints includes:

- Special Sites of Scientific Interest (SSSIs)
- National Nature Reserves
- LANDMAP Visual Sensory: High, Outstanding
- Open Access
- Historic Landscape
- Regionally Important Geological and Geomorphological Sites (RIGS)

An area containing a variable constraint is classed as being “*an area of varying opportunity*”.

Given the recent highly controversial decision by the WAG Energy Minister to overturn the decision of both the Powys Planning Committee and the considered and balanced decision of the Independent Inspector with regard to the Hendy Wind Farm development, we can have very little confidence that there will be sufficient safeguards in the policy to protect our most precious and sensitive landscapes.

The NDF proposals will devastate the landscape of rural mid Wales and in particular the wonderful, remote and unspoilt landscape of Powys.

2. A significant grid infrastructure upgrade would extend the devastation of the landscape far beyond the identified PSAs.

3. Most of the PSAs are outside the existing SSAs and, in a complete reversal of TAN 8 guidance, there is now *“a presumption in favour of development for these schemes and an associated acceptance of landscape change”*.

In addition, developers are only required to demonstrate that the following adverse effects have been **minimised**.

- landscape and visual impacts;
- cumulative impacts;
- the setting of National Parks and Areas of Outstanding Natural Beauty;
- visual dominance, shadow flicker, reflected light or noise impacts;
- electromagnetic disturbance to existing communications systems; and
- the following identified protected assets:
  - archaeological, architectural or historic assets;
  - nature conservation sites and species;
  - natural resources or reserves

The above adverse impacts from a particular development could be highly detrimental but as long as the developer can show that the impact has been *minimised* then according to Policy 10 the application will be regarded as acceptable.

### **Policy 10 thus removes almost all protection from the landscape.**

This is a highly detrimental change from TAN 8 which gave greater protection for the landscape and sought to protect communities from cumulative impact.

#### **TAN 8**

2.13 Most areas outside SSAs should remain free of large wind power schemes. Local planning authorities may wish to consider the cumulative impact of small schemes in areas outside of the SSAs and establish suitable criteria for separation distances from each other and from the perimeter of existing wind power schemes or the SSAs. In these areas, there is a balance to be struck between the desirability of renewable energy and landscape protection. Whilst that balance should not result in severe restriction on the development of wind power capacity, *there is a case for avoiding a situation where wind turbines are spread across the whole of a county. As a result, the Assembly Government would support local planning authorities in introducing local policies in their development plans that restrict almost all wind energy developments, larger than 5MW, to within SSAs and urban/industrial brownfield sites. It is acceptable in such circumstances that planning permission for developments over 5MW outside SSAs and urban/industrial brownfield sites may be refused.*

Section 2.13 emphasizes the need for balance and crucially it states:

**there is a case for avoiding a situation where wind farms are spread across the whole of a county**

It is of significant concern that Policy 10 removes this protection and could result in a situation where wind and solar farms **are spread across the whole county of Powys**.

4. It is of significant concern that under section 3, p16 (Landscape & Visual Assessment), the report states:  
*“There is **no Wales-wide** sensitivity assessment for wind energy or solar development.”*

Surely, such an assessment for an **all-Wales** Renewable Energy policy should be essential?

5. The report further states (p16) that:

*“To help avoid including the most sensitive landscapes during the refinement of the Priority Areas, a review of the **existing** landscape sensitivity and capacity assessments available in Wales was undertaken.”*

*“In addition to this, a review of whether LPA’s had undertaken REA’s and whether these studies consider landscape sensitivity was also undertaken.”*

It is therefore a major concern that there are significant errors and omissions in the above review by ARUP.

#### Appendix C3: Summary of Sensitivity Assessments

LPA	Sensitivity Assessment	Type of development considered	Reference?	Coverage of Study	Comment/Summary	Which Priority Area for Wind and Solar Energy falls with the LPA
Powys County Council	None published on website	N/A	N/A	N/A	N/A	5,6,7,8, 14

The above information is **clearly incorrect** as a detailed Landscape Sensitivity assessment for Solar Farm Development was undertaken by ENPLAN for Powys County Council and published in May 2017.

#### Appendix C4: Summary Renewable Energy Assessments

LPA	REA?	Reference	Does it consider landscape sensitivity to wind or solar development?	Comment	Which Priority Area for Wind and Solar Energy falls with the LPA
Powys County Council	Yes	AECOM (November 2016) Renewable and Low Carbon Energy Assessment	No	The REA constitutes an evidence base to inform the preparation of Powys’ LDP. The REA consists of a high level assessment of the potential for renewable and low carbon energy generation at different scales , and at different levels of detail.	5,6,7,8, 14

AECOM was responsible for producing the original report which underpinned the Powys Renewable Energy Policy November 2016. Following responses from over 600 Powys residents, expressing deep concern, it was found that the AECOM report (Nov 2016):

- Had significant shortcomings in methodology
- Relied on a significantly flawed dataset that underpinned the policy
- Resulted in a totally disproportionate Renewable Energy Target for Powys.

It is therefore a matter of deep concern that this flawed document is the one quoted and used in the NDF.

AECOM undertook the whole exercise again and a **new report was published in May 2017.**

6. With regard to **Wind Energy Resource**, the **May 2017 AECOM** report included the following considerations:

- i. Opportunities for wind development of between 5MW and 25MW principally outside the existing SSAs but in the interest of obtaining the **maximum available resource** it included areas both inside and outside the existing SSAs.
- ii. Wind speeds: AECOM created a 1.5km<sup>2</sup> grid GIS data layer for the Powys LPA area showing average annual speeds at 45m above ground level attributed to each 1.5km<sup>2</sup> cell.

It was assumed that there is no wind energy potential in an area with an average annual wind speed of less than 6.0m/s.

- iii. Constraints: These included Statutory Designations (listed on page 23) and Non-Statutory Designations (listed on p24).
- iv. Grid Connection: PPW requires consideration of the electricity grid as part of renewable energy evidence base to inform LDP policies. Electricity grid comprising 33, 66 and 132kV was mapped by AECOM with only sites with available resource within 10km of any line being considered accessible.

AECOM then concluded with regard to LSAs for wind (p24):

***There are **no** remaining least constrained land parcels of sufficient area to identify wind LSAs for local authority wide schemes of installed capacity range 5-25MW***

7. With regard the **Solar Power Resource** the AECOM (May 2017) report:

**Identified 33 initial LSAs for Landscape Assessment (p43) and of these 20 remained after the **Landscape Assessment** and these 20 are identified in the LDP approved in April 2018**

Given that representatives from the WAG attended the Hearing Sessions regarding Powys Renewable Energy Policy I find it difficult to understand why the above very significant errors in the ARUP review have not been picked up.

Has the data behind the ARUP report been subject to sufficient scrutiny by WAG?

If the May 2017 AECOM report and its conclusions were not available to ARUP how can we have any confidence in the report produced by ARUP?

**How can its conclusions be reliable with regard to Powys if it used the discredited 2016 AECOM report and took no account of the revised May 2017 AECOM report and the May 2017 ENPLAN Sensitivity Assessment?**

### 3. IMPACT ON TOURISM

When the impact on tourism is considered we have to consider the **cumulative impact** of the NDF proposals on **the already significantly high number of wind farms in Powys, the SSAs for wind, the proposed 20 LSAs for Solar Farms, and the potential for further wind and solar farms outside the SSAs, LSAs and PSA's.**

The tourism industry on which so many people in Powys depend for their living is based around our beautiful scenery. People come to Powys, to view our wonderful scenery, to explore the quiet, remote and beautiful uplands, to cycle along our quiet country lanes and to breathe in our pure clean air. Everything that tourists come for will be destroyed by the further industrialisation of our landscape.

Tourism brought £720 million into the Powys economy in 2015, an income that the county simply cannot afford to lose. In the **short term**, the construction of these wind farms and solar farms will provide construction jobs but at the **permanent long- term** cost of the destruction of our landscape and tourism industry.

Has the impact of Policy 10 on the type of tourism that is specific to Powys been given sufficient consideration and weight in selecting the PSAs? It depends heavily on the unspoilt landscape, its remoteness, its tranquillity and its spirituality. These are all attributes that are heavily impacted by the presence of windfarms and their associated infrastructure. Have the implications for the wider economy with its significant links to tourism been sufficiently considered?

The following report produced by REGENERIS for the Welsh Assembly Government provides evidence that highlights the **specific impact** of Windfarms on Tourism in South Powys.

The REGENERIS report was published in 2014, however, its reasoning and conclusions are equally valid today.

Although the REGENERIS report relates to Wind Farms, **both Wind and Solar Farms amount to an industrialisation of the landscape** and it is the unspoilt and remote nature of the landscape that is key to the tourism industry in Powys.

## REGENERIS: Study into the Potential Economic Impact of Wind Farms and Associated Grid Infrastructure on the Welsh Tourism Sector (FEB: 2014)

### •Tourism Impact of Onshore Wind Farms in Wales •

#### Powys South – Small tourism economy and a small share of total employment

Framework Indicator	Sensitivity	Justification
Scale of development	5	Two large, established wind farms and a number of large wind farms in planning system.
Clustering of multiple wind farms	4	All wind farms in relatively close proximity. Potential for some cumulative effects, although limited to some extent by topography of area.
Dominance of wind farms on landscape in key tourism areas	3	Large wind farms in close proximity to some visitor assets (Glyndwr's Way, open access land), but not major in terms of visitor numbers. Elan Valley another important visitor asset which is further from wind farms.
Scenery and Landscape Quality	3	Some wind farms in areas assessed as high for landscape quality, others assessed as moderate. Landscapes not as dramatic as other areas of Powys (Brecon Beacons). Wind farms may enhance the landscape for some visitors in some locations (eg Llandinam).
Unspoiled, open landscapes central to visitor offer	4	Open, unspoiled landscapes and feeling of isolated wilderness are important part of offer, but fishing, walking, cycling and other outdoor activities also popular.
Capacity of Local Tourism Sector	4	Limited information available for Powys or local area. Mid Wales tourism strategy indicates occupancy levels are low but this covers a very wide area. Likely to be seasonal.
Loyalty of tourist base	4	Visitor surveys indicate one in ten visitors to Powys are repeat visitors who may be more sensitive to wind farm development.
Diversity of visitor base	4	Limited information for the study area itself, but Mid Wales tourism strategy shows that half of visitors to Powys are "empty nesters" aged 55+. These visitors may be more sensitive to wind farm development.
Overall Assessment	4	The scale of development combined with the visitor profile and wilderness offer of this study area leave it more sensitive to wind farm development than other areas of Wales. Narrow visitor offer and proximity to other more established tourism areas mean there may be less potential for replacement of visitors than other areas. <b>Potential for effect on visitor economy. The effect is likely to be small but there is a risk that it could be moderate for some visitor markets.</b>

### •Tourism Impact of Onshore Wind Farms in Wales •

#### Powys North – Small tourism economy but important sector given narrow economic base

Framework Indicator	Sensitivity	Justification
Scale of development	5	Over 150 existing turbines and a number of consented or planned wind farms in close proximity. Also new proposed grid infrastructure.
Clustering near other wind farms	5	There would be three separate clusters of wind farm developments if all applications were approved.
Dominance of wind farms on landscape in key tourism areas	4	Large wind farms in close proximity to visitor assets (Glyndwr's Way and open country)
Scenery and Landscape Quality	3	Wind farms mostly in areas of upland moorland and grazing land, which are less dramatic than other parts of Powys. Largest wind farms are located in an area assessed as poor for landscape quality because of forestry plantations.
Unspoiled, open landscapes central to visitor offer	4	Open, unspoiled landscapes and feeling of isolated wilderness are important part of offer, but fishing, walking, cycling and other outdoor activities also popular.
Capacity of Local Tourism Sector	4	Limited information available for Powys or local area. Mid Wales tourism strategy indicates occupancy levels are low but this covers a very wide area. Likely to be seasonal.
Loyalty of tourist base	4	Visitor surveys indicate one in ten visitors to Powys are repeat visitors who tend to be more sensitive to wind farm development
Age of visitors	4	Half of visitors to Powys are "empty nesters" aged 55+. This group tends to be more sensitive to wind farm development.
Overall Assessment	4	The scale of development combined with the visitor profile and wilderness offer of this study area leave it more sensitive to wind farm development than other areas of Wales. Narrow visitor offer and proximity to other more established tourism areas mean there may be less potential for replacement of visitors than other areas. <b>Potential for impact on visitor economy. The impact is likely to be small but there is a risk that this could be moderate for certain visitor markets.</b>

Each indicator has been rated on a scale of one to five, where one equals very low sensitivity and **five equals very high sensitivity.**

For the purposes of comparison, I have included in **APPENDIX B** (p35-39) the sensitivity tables for the 8 other regions considered in the study. These tables show clearly that in two regions, **South Powys** and **North Powys**, the **tourism economy is significantly more sensitive to windfarm development.**

The cumulative impact will become very significantly greater if the current proposals for 20 Solar LSAs and 4 PSAs in Powys become reality.

The following points are taken from p98 of the REGENERIS document and relate specifically to South Powys:

#### 6.152 Key Points for Assessment

- The number of turbines would increase significantly if all planned wind farm developments were approved. These would be highly clustered and may be perceived to be dominant features on the landscape across a large part of the study area, including parts of the Glyndwr's Way. The large number of turbines may deter some walkers and other visitors who hold negative views towards wind farms from visiting these areas.
- Like Powys North, the area most affected by wind farm development has fewer visitor assets than surrounding areas, but attracts visitors for feelings of peace and quiet, isolation and wilderness. Visitors also tend to be older and are repeat visitors.
- The area has a narrow visitor offer. Walking, wildlife watching and cycling are all popular activities. However the area is not as established as other areas for these activities.
- Although the literature points to small changes in visitor behaviour as a result of wind farm development, the points above would indicate that this area's visitor economy is more sensitive to wind farm development than other parts of Wales.

And on p134:

#### Higher sensitivity to wind farms for certain visitor markets in close proximity

9.17 While most of the evidence points toward limited impacts on tourism from wind farms, there are examples of certain locations which are, on balance, more sensitive to wind farm development. This is on account of their landscapes, types of visitor, limited product diversity and proximity to wind farms. This is particularly the case where the key visitor markets are older people visiting for the tranquillity, remoteness and natural scenery offered in some parts of Wales. **Remoter parts of Powys are the most notable examples of where this may be the case.**

It is very difficult to see how the proposals in Policy 10 could do anything other than decimate the tourist industry in Powys and be anything other than detrimental to the many other business which rely on tourism.

## 4. LACK OF EFFECTIVE CONSIDERATION GIVEN TO WIDER CUMULATIVE IMPACTS

What is *Cumulative Impact*? TAN8 p63 8.2 provides the following definition:

***Cumulative effects** are those which occur, or may occur, as a result of more than one wind farm project being constructed. The degree of cumulative impact is a product of and the distance between individual wind farms, the inter-relationship between their sub-areas of visual influence, the overall character of the landscape and its sensitivity to wind farms themselves. It is important to recognise that cumulative effects consist of those both upon **visual amenity** as well as effects on the **landscape**. The degree of cumulative impact also gives rise to the notion of thresholds, **beyond which impacts may not be acceptable**.*

### Significant Noise Nuisance

During the construction phase, which will continue for decades into the foreseeable future:

- Our roads and quiet country lanes will need to be widened and straightened to accommodate noisy and intrusive convoys of lorries, concrete mixers, cranes, diggers, and work vans.
- Our roads and the villages through which they pass will be subject to the disruption and noise caused by convoys of abnormal loads.
- The tranquillity and *spirituality* of our uplands, and the sound of birds, will be replaced by the massed whoosh of turbine blades.

### Effect on Safety

- These proposals will produce years of heavy traffic on our roads, our lanes, our byways and our hills. I can find no discussion of the impacts on the safety of motorists, cyclists, horseriders or pedestrians. I can find no discussion on the impacts on emergency vehicles – ambulances, fire engines and police cars.
- It is very difficult to see how such large-scale and long-term proposals will compromise not just highway safety but upland safety for all users

### Effect on Environment

1. When hundreds of tons of concrete foundations are dumped into our uplands they interfere with upland hydrology and can cause catastrophic destruction of peat formations. Presently, the water holding capacity of the hills is the source of 80% of our drinking water and absorbs potential flood waters.

Given the catastrophic consequences of flooding that we are all witnessing with increased frequency and the sheer scale of what is being proposed for the uplands of rural Mid Wales has this issue been given sufficient attention?

2. Turbine foundations allow pollutants to enter the water table, and may put water supplies at risk – something that is already occurring around wind farms in Powys.

3. Undisturbed peatlands bind carbon which is then released as a greenhouse gas (CO<sub>2</sub>) when the peat is disturbed.

Given the sheer scale of what is being proposed for the uplands of rural Mid-Wales has the potential increase in CO<sub>2</sub> from disturbed peatlands been sufficiently considered?

## 5. WELLBEING OF THE FUTURE GENERATIONS ACT

Goal	Description of the goal
A prosperous Wales.	An innovative, productive and low carbon society which recognises the limits of the global environment and therefore uses resources efficiently and proportionately (including acting on climate change); and which develops a skilled and well-educated population in an economy which generates wealth and provides employment opportunities, allowing people to take advantage of the wealth generated through securing decent work.
A resilient Wales.	A nation which maintains and enhances a biodiverse natural environment with healthy functioning ecosystems that support social, economic and ecological resilience and the capacity to adapt to change (for example climate change).
A healthier Wales.	A society in which people's physical and mental well-being is maximised and in which choices and behaviours that benefit future health are understood.
A more equal Wales.	A society that enables people to fulfil their potential no matter what their background or circumstances (including their socio economic background and circumstances).
A Wales of cohesive communities.	Attractive, viable, safe and well-connected communities.
A Wales of vibrant culture and thriving Welsh language.	A society that promotes and protects culture, heritage and the Welsh language, and which encourages people to participate in the arts, and sports and recreation.
A globally responsible Wales.	A nation which, when doing anything to improve the economic, social, environmental and cultural well-being of Wales, takes account of whether doing such a thing may make a positive contribution to global well-being.

The stated objectives of the above act include:

- *A Wales of Cohesive Communities.*
- *A healthier Wales*
- *A Wales of Vibrant Culture and Thriving Welsh Language*
- *A prosperous Wales.*

I appreciate that the NDF proposals with regard to Renewable Energy offers diversification and potentially significant financial benefit for a few individuals. However, there are many more people and communities for whom the environmental, economic and emotional impacts will be devastating. The resulting conflict could destroy community cohesion for many years to come.

In the medium term, Policy 10 will achieve the Assembly's goals with regard to Renewable Energy and carbon emissions but what damage will it do to rural Mid Wales in the far longer term – damage that the Wellbeing of the Future Generations Act is intended to avoid?

I include below the aspirations that Powys County Council sets out in its vision for the county under the Well-being of Future Generations Act.

What do we know	The Powys we want
<ul style="list-style-type: none"> <li>• We have 80 sites of special scientific interest (SSSI)</li> <li>• Just over 70% of the land in Powys is farmed</li> <li>• Powys has good air quality</li> <li>• We have lower CO2 emissions than the rest of Wales</li> <li>• Several water sources in Powys are contaminated with pollutants</li> <li>• The global climate is changing (rising sea levels, increasing Carbon Dioxide emissions, higher average temperatures). In Powys, this could lead to increased instances of flooding in some areas, damage to ecosystems, and increased pests and diseases</li> <li>• We are recycling increasing proportions of our waste</li> <li>• Most people use their own vehicles for regular travel</li> <li>• Over half of Powys properties are not connected to the gas network</li> </ul>	<ul style="list-style-type: none"> <li>• The nationally recognised Brecon Beacons National Park and Natural Resources Wales visitor centres are established in Powys promoting access to our unique environment</li> <li>• The rights of way network is developed to offer local residents and visitors alike a selection of circular walks opening up our beautiful countryside for all to enjoy</li> <li>• People's health and well-being improves as more residents take full advantage of the opportunities that exist to explore the countryside</li> <li>• Our green environment and way of life attracts people to move to Powys boosting our economy and population</li> <li>• Powys is a centre of excellence for environmental research, sustainable and green technologies and renewable energies</li> <li>• Jobs created in land use, forestry and sustainable housing provide choices for those seeking work and those looking to move into a more energy efficient home</li> <li>• Powys is an exporter of renewable energy through investment and development of locally owned solar panels, hydro and other schemes</li> <li>• Powys has built up a network of charging stations that supports the use of electric cars and vehicles</li> <li>• The sustainable use of ecosystems supports employment and helps mitigate flooding and other natural events</li> </ul>

In assessing the impact of the NDF proposals against the above aims under the Well-being of Future Generations Act, it is vital that the impact is considered not in isolation but in terms of the **cumulative impact** that this proposal will have in addition to the number and geographical extent of the Renewable Energy Projects that already exist in Powys and the proposed 20 Solar Farms in the LDP:

***Aim 1:** The nationally recognised Brecon Beacons National Park and Natural Resources Wales visitor centres are established in Powys promoting access to our unique environment*

Our unique environment is dependent on our unique and unspoilt landscape.

***Aim 2:** The rights of way network is developed to offer local residents and visitors alike a selection of circular walks opening up our beautiful countryside for all to enjoy*

This proposals significantly impact on the rights of way network. The beautiful countryside that can currently be enjoyed from the ROW network will be destroyed.

***Aim3:** People's health and well-being improves as more residents take full advantage of the opportunities that exist to explore the countryside.*

Who will want to explore a countryside dominated by an industrial landscape of wind and solar farms?

Many farming families depend on tourism in one form or another to supplement their income – what effect will Policy 10 have on their livelihood and the ability of our rural economy and all the traditions associated with it to survive?

*Aim 4: Our green environment and way of life attracts people to move to Powys boosting our economy and population.*

Who will want to live and work in Powys when our landscape and the opportunities that it provides for the economy are destroyed?

Who will want to live and work in Powys when our green environment is dominated by industrial sites?

How will we attract doctors, nurses, teachers and other professionals if we sacrifice so much of our green environment - a task that is already very difficult. What are the implications for the future health and prosperity of Powys if we fail to attract professional people?

Llandrindod is identified as a growth town in the NDF. Who will want to live and work in a town where the surrounding uplands are destroyed and dominated by an industrial landscape?

What will be the effect on our small rural school if, as a result of depopulation, there is a decline in pupil numbers? If our small rural schools close, what effect will this have on social cohesion?

*Aim 5: Powys is a centre of excellence for environmental research, sustainable and green technologies and renewable energies.*

This is a laudable aim that I **fully support** but there is so much more to renewable energy than simply building large scale wind and solar farms.

I believe that the alternative more responsive and imaginative approaches that I will outline in this response are far more in tune with this desired outcome than a policy that simply prioritises maximum installed capacity and maximum generation.

*Aim 6: Powys is an exporter of renewable energy through investment and development of locally owned solar panels, hydro and other schemes.*

I fully support the development and support of small-scale technology. Given the already significant contribution that Powys makes to large scale wind energy (and potentially solar energy) I believe that an alternative, positive and forward-looking vision is far more likely to gain public support, support the NDF proposal will clearly not have.

If you were a pioneer in innovative Renewable Energy technology, would you want to live in a country where the thinking is dominated by large-scale land-based wind and solar industrial development sites, or would you want to live and work in a country that is forward looking, imaginative and creative, open to and supportive of new ideas, ideas that perhaps challenge its traditional thinking?

## 6. IMPACT ON PUBLIC RIGHTS OF WAY NETWORK and OPEN ACCESS LAND

How can it be appropriate to exclude OPEN ACCESS land and COMMON LAND from the fixed the constraints?



Open access land. Areas of open country, registered common land or dedicated land (under the Countryside and Rights of Way Act 2005) open to people to walk, run, explore, climb, watch wildlife etc., without having to stay on paths.

The CROW Act 2005 gave “right to roam” on open access land.

In Powys, open access land defines the tops of some of our wildest and most unspoilt hills. How can it therefore be considered *appropriate* to exclude open access land and common land from the constraints? What happens to the rights of citizens to roam, run, explore, climb and watch wildlife?

How can these rights be protected during two decades of large scale industrial construction on our uplands? Given that SOLAR PV sites are fenced off and the public excluded, how can these rights possibly be protected?

I do not believe that NDF proposals offer sufficient protection for Open Access land and Common Land. I therefore do not believe that in its current form it is fit for purpose.

### Planning Policy Wales: Chapter 12 Infrastructure & Services

*12.10.1 In determining applications for renewable and low carbon energy development and associated infrastructure local planning authorities should take into account:*

- *the need to minimise impacts on local communities to **safeguard quality of life for existing and future generations***
- *ways to avoid, mitigate or compensate identified adverse impacts*

**Walking** is probably the best single way of promoting both physical and mental health yet to be devised. It helps to promote healthy weight, reduces the incidence of cardiac disease and diabetes and improves mental well-being. If everyone walked regularly, fewer people would need doctors and the NHS would be significantly better off.

With presumption in favour of development the proposals in the NDF will destroy much of our most beautiful walking country. The ability of LPA's to *safeguard the quality of life for existing and future generations* will be significantly reduced.

## 7. CHANGE IN EMPHASIS OF UK POLICY

### 1. (OFGEM: UPGRADING OUR ENERGY SYSTEM: JULY 2017)

The emphasis of UK policy is shifting now from simply generating energy to managing supply and demand in the form of battery storage, responsiveness to innovation and rapidly developing technologies, and smart use of energy. (Ofgem: **Upgrading our Energy System: July 2017**)

[https://www.ofgem.gov.uk/system/files/docs/2017/07/upgrading\\_our\\_energy\\_system\\_-\\_smart\\_systems\\_and\\_flexibility\\_plan.pdf](https://www.ofgem.gov.uk/system/files/docs/2017/07/upgrading_our_energy_system_-_smart_systems_and_flexibility_plan.pdf)

This is an important document and it is a document that should influence the thinking of both the UK Government and the Welsh Assembly Government.

In the last few years there have been repeated announcements on the rapid development of electric vehicles by car manufacturers. The UK government plans to invest millions of pounds to explore how the batteries in electric cars can help the national power grid and increase the take-up of cleaner vehicles. British businesses will be able to bid for government funding for research and trials of **vehicle -to-grid technology**, which officials believe holds enormous potential benefits.

Additional Renewable Energy Infrastructure will certainly be required to meet future energy demand in the UK as the above document acknowledges. However, in order to achieve a resilient and stable supply, these infrastructure projects will need to be **diverse in nature and spread geographically around the UK** as Renewable Energy output is and will remain highly weather dependent. The above approach is supported by numerous statements from the above OFGEM document including:

- P4 *There are also fundamental changes taking place within the energy markets, which will see new sectors, technologies, and services flourish.*
- P5 *A smart, more flexible energy future can bring significant benefits for consumers, the system and the wider economy. A study for the Government estimates the benefits of a smart energy system to be £17-40bn to 2050.2 These benefits come from **avoided or deferred network reinforcements, avoided generation build**, avoided curtailment of low carbon generation, and better operation of the system.*
- P6 *By harnessing the potential of **energy storage, demand-side response** and smarter business models, we have an opportunity to upgrade to one of the most efficient, productive energy systems in the world. This is central to how we deliver secure, affordable and clean energy now and in the future.*
- P8 *We want to encourage **innovation**. A key role for the Government and Ofgem is to create the environment for new ideas to flourish by removing barriers to innovation. **Our energy system needs technologies and infrastructure that are both cheap and clean, but it also needs innovation in processes, transactions and consumer offerings. This is a fundamental part of the Government's Industrial Strategy and Ofgem's approach to regulation***
- P9 ***We want to work in partnership with others to deliver change at the required pace.** Other countries around the world are facing similar challenges. We are looking at different approaches, with the Government working with other governments and Ofgem working with other regulators. In GB, the System Operator, transmission owners, distribution network operators, generators, suppliers, aggregators, tech companies, Local Enterprise Partnerships, local authorities, community energy groups, and consumer groups, amongst others, are already considering the challenges and opportunities smart technologies bring. This Plan maps out how we want to work together on this transition.*

P11 We want to see **storage** become a genuinely viable proposition in the energy system.

Progress on the above goals is outlined in the updated October 2018 document:

**Upgrading Our Energy System- Smart Systems and Flexibility Plan:** Progress Update October 2018 which can be found at the following link: <https://www.ofgem.gov.uk/ofgem-publications/140649>

The approach of the Welsh Assembly Government is very much one of **maximising generation** of Renewable Energy. The approach outlined in the Ofgem document is concerned in a far more rounded way with **optimising the potential of Renewable and Low carbon energy**.

**If the wind is not blowing in Powys it doesn't matter how many wind farms are installed very little energy will be generated.**

The NDF states that it is the Assembly's aim that Wales should be a *world leader* in renewable energy. Are we a world leader, if in pursuit of this goal, we destroy our most precious asset and cause disharmony and economic damage in our rural communities? Being a world leader shouldn't mean that we have to give the maximum amount of land to large scale solar and wind farms. It means that we should think imaginatively and creatively and take a lead in being open to rapidly developing renewable energy technologies.

The Ofgem document (Ofgem: **Upgrading our Energy System: July 2017**) is a valuable document and it provides arguments, evidence and indications of future thinking that I believe should be given far more significance in the NDF policy on Renewable Energy.

I believe that in order to maintain a consistent and reliable source of Renewable Energy both at Powys and National Level we should be considering a broader base of Renewable Energy technologies including at a National level:

- Offshore wind
- Wave power
- Tidal power
- Battery storage to balance supply and demand
- Solar power combined with storage in appropriate locations

A real openness to, and investment in, emerging technologies related to the above broader spectrum of technologies could indeed see Wales become a *world leader* in renewable energy technology.

### **The Effect of the Development of Tidal and Wave Power and Offshore Wind**

Wind power (at 27% efficiency) and solar PV farms at (at 10% efficiency) are inefficient renewable technologies. Wales, with its long coastline, is surrounded by water and has a significant capacity for offshore wind, and wave and tidal power generation. In the longer term, as these technologies develop, they will have the capacity to deliver a very significant proportion of Wales electricity far more efficiently. **As such the demand for large scale less efficient land-based technologies is likely to reduce.**

Has the effect of these developing water-based technologies been given sufficient consideration in the long-term planning for renewable energy?

Has sufficient consideration been given to the fact that the rapid development of these technologies will mean that there will be less of a need for reliance on large scale land-based technologies?

**Are we needlessly destroying our countryside in the rush to meet targets that will rapidly be able to be met by a range of emerging technologies? I would urge the Assembly to pause and think again.**

## OFFSHORE WIND DEVELOPMENTS

A recent analysis by the **International Energy Agency (IEA)** stated that erecting wind turbines on the world's best offshore sites could provide **more than enough clean energy to meet global electricity demand.**

The study of the world's coast lines found that offshore windfarms alone could provide more electricity than the world needs – even if they are only built in windy regions in shallow waters near the shore.

The analysis by the IEA revealed that if windfarms were built across all useable sites which are no further than 60km (37 miles) off the coast, and where coastal waters are no deeper than 60 metres, they could generate 36,000 terawatt hours of renewable electricity a year. **This would easily meet the current global demand for electricity of 23,000 terawatt hours.**

A press release by the IEA on 25<sup>th</sup> October 2019 stated:

*"The huge promise of offshore wind is underscored by the development of floating turbines that could be deployed further out at sea. **In theory, they could enable offshore wind to meet the entire electricity demand of several key electricity markets several times over, including Europe, the United States and Japan.**"*

See **APPENDIX C** (p 40-41) for further information from the above report

The full IEA report can be found at the following link:

<https://webstore.iea.org/offshore-wind-outlook-2019-world-energy-outlook-special-report>

The UK has 8.5GW of offshore wind generation capacity, which provides more than 8% of the UK's annual electricity needs. The government has agreed to support the industry to expand the UK's offshore wind capacity to 30GW by 2030.

The industry's trade body, Renewable UK, has estimated that the next generation of offshore wind development would bring almost £21bn of investment in today's prices, and support about 9,000 full-time jobs.

Luke Clark, of Renewable UK, has stated that the industry hopes to treble the size of its offshore wind sector **by 2030 to generate more than a third of the UK's electricity.**

The strike prices of £39.65 and £41.61 (2023/24 and 2024/25 delivery years) for every megawatt hour of electricity generated demonstrate the rapid cost reduction since CfD Round 2. The cost of Offshore wind is now lower than the Government Reference Prices, and very likely to be close to future wholesale electricity prices.

Under the **Labour** party's plans for Green Industrial Revolution **the offshore wind industry would grow five-fold in a decade, with the addition of an extra 37 giant offshore windfarms** and 70,000 new jobs.

See **APPENDIX D** (p 42-43) for more details of recent strike price for offshore wind.

**Given the significant potential that offshore wind in particular offers, why are we needlessly proposing to destroy so much of our precious landscape?**

## **SEVERN TIDAL BARRAGE**

The 20 billion pound **Severn Barrage** would involve the construction of a 10 mile long *barrage* between Lavernock Point south of Cardiff, Wales, and Brean Down in Somerset, England. The barrage would act as a bridge between England and Wales and will have an operational lifetime of up to 200 years. It would be the world's largest ever renewable energy project, and the UK's largest engineering project since the Channel Tunnel.

The tidal turbines along the barrage would generate the same amount of electricity as three of the latest nuclear power stations – 8.6 GW during flow and 2 GW on average. This would be sufficient to provide 5-6% of the current electricity usage of England and Wales – **equivalent to 8 large coal-fired power stations**.

Producing on average in excess of **17 billion kWh** of electricity annually, the UK's **carbon emissions** would be **cut by 16 million tonnes each year** (assuming Severn Barrage electricity replaced electricity which would otherwise be generated in coal-fired power stations) which equates to **3%** of total current emissions.

## **TIDAL LAGOON POWER POTENTIAL AROUND WALES**

The following statements are taken from the TIDAL LAGOON POWER website:

<http://www.tidallagoonpower.com/>

### **Swansea Tidal Lagoon**

*Swansea Bay Tidal Lagoon will be the world's first tidal lagoon power plant.*

*It will comprise 16 hydro turbines, a 9.5km breakwater wall, generating electricity for **155,000 homes for the next 120 years**.*

The lagoon's backers also believe its prospects will be boosted by adding floating solar panels to the lagoon, significantly increasing the amount of electricity it generates. UK water companies have already used floating solar power on reservoirs in Manchester, near Heathrow and elsewhere.

The addition of solar panels should increase the Swansea lagoon's annual energy output by more than a third, up from 572 GWh to about 770GWh, enough to power **200,000 homes**.

### Cardiff Tidal Lagoon

*The Cardiff Tidal Lagoon is being developed as the first full-scale lagoon in our programme. Located in the Severn Estuary, the project seeks to harness the second highest tidal range in the world.*

*With a potential installed capacity of around 3GW and a potential annual power output of around 5.5TWh **the project could comfortably meet the equivalent of the annual electricity requirement of every home in Wales.***

### Newport Tidal Lagoon

*A tidal lagoon at Newport would harness the power of the Severn Estuary and provide us with an excellent opportunity to bring forward our ambition to deliver:*

- *An energy-generating lagoon, with between 1,400MW and 1,800MW installed capacity and an annual output of between 2TWh and 3TWh – **enough to power the equivalent of 500,000 Welsh homes***
- *Clean, renewable and entirely predictable power for 120 years*

### Colwyn bay Tidal Lagoon

*A Tidal Lagoon in Colwyn Bay is a huge opportunity for North Wales. Not only can we harness the power of the tides to generate low-carbon electricity, we can also deliver a range of economic, social and environmental benefits to the region.*

*For two years, early feasibility and engagement work has been undertaken across Conwy and Denbighshire where we have already held over 100 meetings with stakeholders and community groups. We remain very encouraged by the enthusiastic support shown to date by local people and very much hope that this will be one of the full-scale tidal lagoons that we go on to develop after Tidal Lagoon Swansea Bay.*

*The North Wales coast has been greatly affected by flooding with the December/January storms of 2013/14 causing significant damage to coastal defences around the coastline. It is estimated that flooding in Wales cost an estimated £71 million between November 2011 and March 2014. Tidal Lagoon Colwyn Bay has the potential to act as a flood defence, protecting some of the communities that are often worst hit by flooding along the North Wales coast.*

These projects have not received support from the UK government due to the comparative costs with other technologies. However, as these technologies develop it is inevitable that the costs will significantly decrease.

I would urge the Welsh Assembly to take a lead in supporting these developing technologies – technologies that will not only contribute to Renewable Energy but that will also bring wider economic benefits and gain widespread public support.

## RAPID ADVANCES IN BATTERY TECHNOLOGIES

### 1. GRAVITRICITY WINCH AND HOIST SYSTEM

The Edinburgh based **Gravitricity** has developed a winch and hoist system that could utilise **disused mine shafts** to store energy at half the cost of lithium iron batteries. It aims to offer the best characteristics of lithium batteries and pumped storage.

A full-scale project would drop 24 weights to a depth of 800 metres to produce enough electricity to power 63,000 homes for more than an hour.

This can be done multiple times a day for many years, without any loss of performance. This makes it very competitive against other forms of energy storage – including lithium-ion batteries.

See **APPENDIX E** (p44-46) for more details of this project.

The Gravitricity website can be found at the following link:

<https://www.gravitricity.com/#technology>

### 2. HIGHVIEWPOWER CYROBATTERY

British battery developers, Highview Power, plan to build Europe's largest energy storage project using a cryogenic battery that **can store renewable energy for weeks or months rather than hours**.

The device will be built on the site of an old fossil fuel plant in the north of England to power up to 50,000 homes for up to five hours.

The plants can be situated anywhere, are built using mature components from established suppliers and have a lifespan of 30+ years.

The full-scale cyrobattery has a capacity of 50MW or 250MWh over a five-hour release time.

See **APPENDIX E** (p44-46) for more details of this project.

The Highview Power website with full details of the technology can be found at the following link:

<https://www.highviewpower.com/technology/>

## 8. THE INCREASINGLY SIGNIFICANT ROLE OF SMALL- SCALE TECHNOLOGIES

The **Green Alliance Report** (April 2017) – **How Consumer Choice is Changing the UK Energy System** states on p2:

*“Within the next three years, it will make economic sense for commercial buildings to install their own solar and defect from the grid. Low cost batteries, including those in EVs, mean many individual households and commercial buildings could operate off grid for months at a time by 2025.”*

The Green Alliance Report stresses the importance of the rapidly growing micro-generation market as **primary** source of renewable energy (p3):

*Rather than intervening to restrict popular, small- scale energy in favour of large generators, the state can govern intelligently and actively, and enable large and small to work together. **Doing so would mean seeing consumer led, market driven, small scale energy as primary**, even if it is not the largest source of power. Large scale energy would need a new, more explicit governance framework to enable it to support small scale energy, particularly in the winter time, allowing the whole system to decarbonise at least cost while keeping the lights on.*

*Active energy governance in the UK requires four main interventions:*

- i. An independent system designer should provide robust technical analysis and option testing of the best ways to **integrate small energy** into the overall system.*
- iii. The capacity market should **value small scale energy technologies**, so underutilised, distributed, flexible sources can help to balance the grid, rather than undermining it.*

The report further states on p5:

*“Within the next few years, **small scale technologies** will begin to fundamentally reshape the power market and, in doing so, **they will completely change the government’s role in the energy system.**”*

In the light of this report has sufficient weight been given to **small scale technologies**, including micro hydro and residential battery storage in Policy 10?

We are approaching a situation that will cause stresses on the National Grid. On the one hand the grid will be unable to accept all the electricity generated at peak times by BIR’s and Solar PV and on the other hand the impact of a large number of households recharging cars at the same time (typically at night) could lead to a situation where supply cannot cope with demand. The role of residential battery storage to even out the over-supply and over-demand will become increasingly important.

The Green Alliance Report discusses several cases in the UK, wider Europe and the US where this situation has been dealt with in an innovative, progressive and positive manner and others where the approach has been regressive and negative.

The following article is taken from p19 of the report and it highlights a progressive approach to evening out supply and demand.

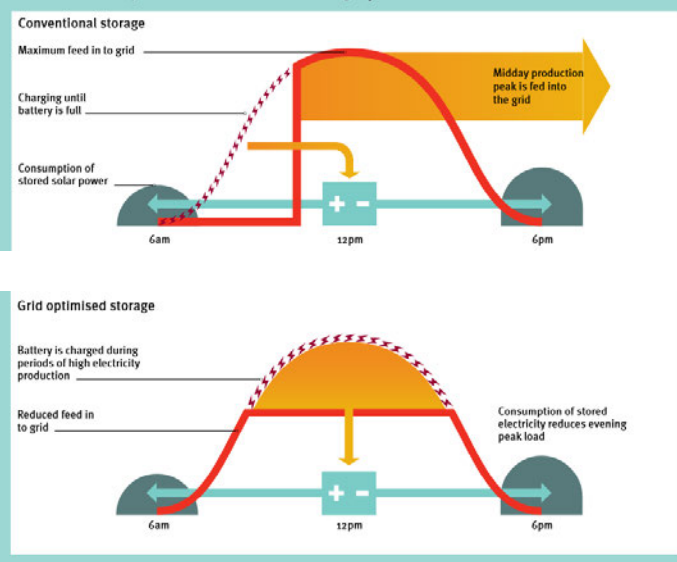
## Germany: giving consumers freedom to take control

The German government has taken steps to encourage the coupling of residential storage and solar PV, to prevent overloading the grid during periods of peak production (see below).<sup>42</sup> In the absence of storage, feeding surplus power back into the grid can lead to grid congestion, if it takes place during the midday production peak. This requires costly network upgrades to handle the inflow of electricity or it can lead to curtailment of renewable generation.

To ensure the optimal integration of small to medium solar PV, the government has set targets for self-consumption and has subsidised the installation of residential battery systems to reduce PV maximum feed-in to 50 per cent.<sup>43</sup> These limits enable 66 per cent greater penetration of PV, giving households and businesses the freedom to take control over their energy without disrupting the grid.<sup>44</sup>

Nearly one in two new solar installations in 2015 included battery storage, and the programme has been extended to 2018, aiming to reach 100,000 installations by the time of completion.<sup>45</sup>

### Conventional and optimised use of solar PV and storage systems<sup>44</sup>



The full report can be found under the following link:

[http://www.green-alliance.org.uk/resources/People\\_power\\_how\\_consumer\\_choice\\_is\\_changing\\_UK\\_energy\\_system.pdf](http://www.green-alliance.org.uk/resources/People_power_how_consumer_choice_is_changing_UK_energy_system.pdf)

SEE **APPENDIX F (P47):** Green Alliance Report

## Application to Rural Mid Wales

Powys has a significantly high proportion of homes not connected to Mains Gas and also **significant restraints with regard to the grid network**. The Powys **PSB Well Being Assessment 2017** states on p8:

*Approximately 53% (31,000) properties in Powys are not connected to the gas network, this is greater than the figure for Wales (15%). Properties that are not connected to the gas network are likely to rely on alternative, more carbon intensive forms of heating, such as oil, LPG and night-time storage heaters.*

Many of these properties will be isolated rural properties or in rural villages.

The same will be true of other rural areas in Mid and South West Wales.

The Green Alliance report is important in the context of the very significant capacity that already exists for Renewable Energy and Low Carbon **generation** in Powys. There is an argument to be made that given its significant generating capacity and also its significant network constraints the focus particularly in Powys should now be shifting to:

- Efficiency and reduction
- Roof top solar pv and battery storage
- responsiveness to innovation and rapidly developing technologies
- smart ways of managing supply and demand.
- Micro technologies and community- based schemes.

With regard to solar power could the emphasis across Wales but particularly in rural Mid Wales move from PSAs to the promotion of installations on all types of roof tops, including residential housing, public buildings and commercial buildings? Given the advancement in battery technology could a partnership be set up with a battery manufacturer so that this energy can be stored for use when it is needed rather than being transported to a grid structure which at the moment is inadequate to deal with the additional potential energy generated.

An article in the Guardian outlined a trial in South Yorkshire where 30 homes will have energy storage batteries fitted free to see if they can make solar power more valuable to homeowners whilst reducing the amount of energy exported to the grid. Given the lack of adequate grid infrastructure in Powys could this form part of an alternative, positive, and forward-looking vision for renewable energy in rural Mid Wales – a vision that would be far more likely to gain widespread public support.

The following link gives more details of the above trial:

<http://www.moixa.com/press-release/home-battery-trial-aims-increase-electricity-network-capacity-enable-solar-homes-save-millions-customers/>

See **APPENDIX G** (p48-50) for a full paper copy of the article in the link above.

## Micro Hydro Power

*Micro* hydro is typically defined as the generation of electricity from a few hundred watts up to 100kW. **It is a technology that lends itself particularly to rural villages and rural properties. Has sufficient consideration been given to the development of this technology in areas with low and medium sensitivity?**

The following statement is taken from the TGV Hydro website:

*“Hydro power is a reliable and proven technology with minimal environmental impact, no major planning obstacles, and is well suited to the topography and climate of Wales. **We have developed a highly efficient micro-hydro system suited to small sites. If you have access to a fast running stream that drops more than 20m, you could soon be generating your own electricity and making money.**”*

<http://www.tgvhydro.co.uk/overview/guide-to-microhydro/>

See **APPENDIX H** (p 51) for a copy of the article in the above link

With large-scale onshore wind and solar developments, the financial benefits go to wealthy large multi-national companies and a few landowners, while the people at the bottom bear the consequences in destroyed landscapes and communities. The benefits of smaller technologies are shared far more widely amongst those at the bottom of society and they are far less intrusive on the physical environment.

As such they will gain far more widespread public support. A public that is actively and fully engaged in the process and which feels the benefits of the process will be far more knowledgeable and far more likely to take further individual action to reduce carbon emissions.

## **9. CONCLUDING STATEMENT**

I moved to Wales as a student when I was eighteen years old. I learnt the language and I came to love and value its history, its culture, its strong sense of community, and most of all its wonderful landscape - a timeless landscape that inspires and uplifts; a landscape that has brought me and so many others the deepest joy, solace and contentment.

I have lived and worked in Powys for over 40 years. This policy will needlessly destroy almost everything I hold dear in Wales and most particularly in the beautiful county that is my home, Powys.

Climate change is a terrible threat, and one that has to be urgently addressed, but to destroy our most precious asset is not the answer.

I finish my response with a heartfelt plea. Our cherished hills and wild uplands are far more than a *resource* to be *exploited* for maximum potential. They fill our senses and they feed our souls. They are vital for our mental and physical well-being and they enrich our lives beyond measure. We have a duty to future generations to conserve, protect and enhance these precious areas. Yes, we have to urgently address climate change and reduce carbon emissions but future generations will not forgive us if we needlessly sacrifice their heritage, their tranquillity, their right to freely roam our cherished hills and uplands, in the pursuit Renewable Energy targets which I believe could be, and now should be met through a range of alternative measures.

I strongly ask you to reject the policies in the NDF with regard to large scale wind and solar farms, reconsider, consult the people and produce a plan that will gain large scale public support.

Yours faithfully,

Rosemary Watton

## 10. APPENDICES

Appendix Number	TITLE	Pages
A	Contribution of Powys to Renewable Energy in Wales The Low Carbon Energy Generation in Wales: Updated Study of Low Carbon Energy Nov. 2015	32-34
B	REGENERIS: Study into the potential economic impact of wind farms and associated grid infra structure on the Welsh Tourism Sector (FEB 2014)	35-39
C	Offshore Wind: International Energy Agency (IEA)	40-41
D	Wind power windfall: crown estate to sell offshore windfarm rights	42-43
E	Recent Advances in Battery Technology and Storage	44-46
F	Green Alliance Report How Consumer Choice is changing the UK energy system April 2017	47
G	Solar PV and Battery Storage	48-50
H	Micro Hydropower	51

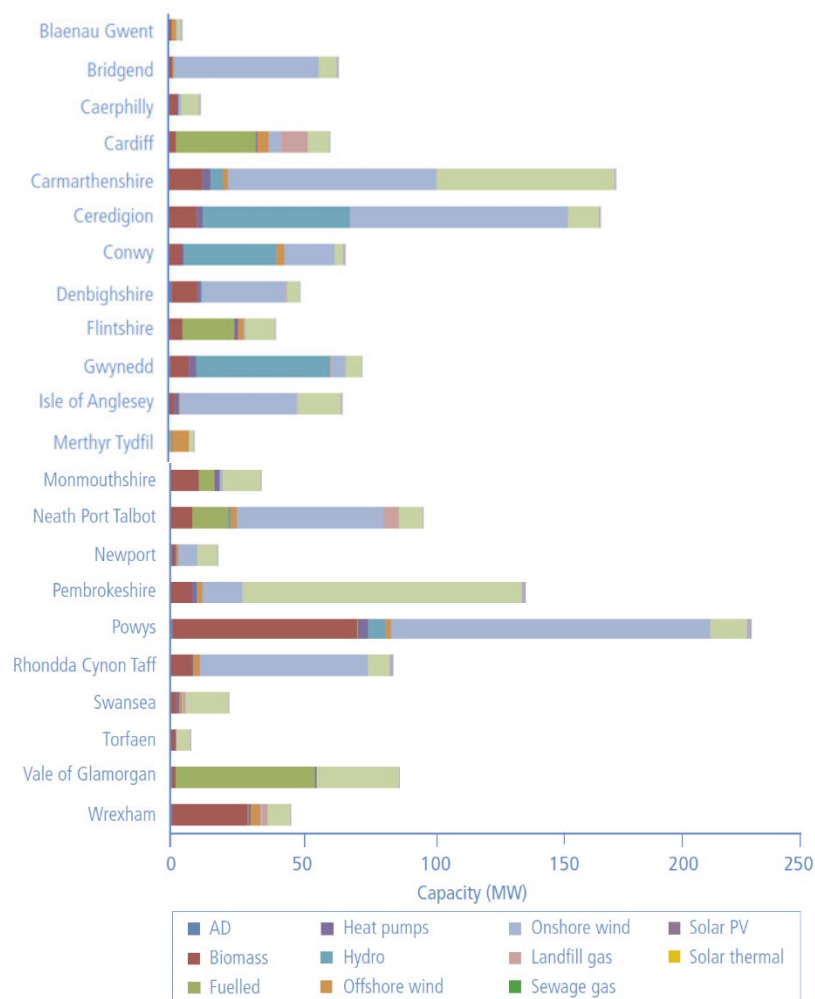
## APPENDIX A: Contribution of Powys to Renewable Energy in Wales

### EXISTING RENEWABLE ENERGY CONTRIBUTION MADE BY POWYS

1. The chart below shows clearly that when nuclear and offshore wind are excluded Powys is already making a **significantly higher contribution** to renewable energy than any other local authority in Wales (based on WAG figures from 2015).

### *Low Carbon Energy Generation in Wales: Updated Study of low carbon energy Nov 2015 (WAG)*

Figure 2: Capacity by local authority (excluding nuclear and offshore wind)



I include below a summary table to show the position of Powys in relation to other local authorities for a range of renewable energy sources. All data is taken from the above WAG document p12 – 29.

Renewable Energy Source	Comment
Heat p12	<i>The greatest increase in renewable heat was in <b>Powys</b>, where approximately a third of new renewable heat capacity in Wales has been installed</i>
Anaerobic Digestion p13	<i>Denbighshire and <b>Powys</b> have the most anaerobic digestion projects with two projects each.</i>
Biomass	<i>The local authority with the highest number of biomass installations is <b>Powys</b></i>
Heat Pumps	<i><b>Powys</b> experienced the most growth in heat pump installations and remains the local authority with the highest number of heat pump projects, totalling 430.</i>
Hydropower	<ul style="list-style-type: none"> <li>• <i>Five local authorities, Ceredigion, Gwynedd, Conwy, <b>Powys</b> and Carmarthenshire have 99 percent of the hydropower capacity across Wales.</i></li> <li>• <i>Gwynedd and <b>Powys</b> remain the two local authorities with the highest number of projects, with 45 and 44 schemes respectively.</i></li> <li>• <i><b>Powys</b> has a larger number of smaller projects with a total capacity of 7.0 MWe</i></li> </ul>

In, particular, Powys already has significantly more onshore wind capacity than any other county in Wales and by a very significant margin.

On Shore Wind Power p25 of above WAG document.

**Table 12 p25: Onshore wind by local authority**

Local Authority	Number of projects	Capacity (Mwe)	Estimated generation (Mwhe)	Ranking
Blaenau Gwent	2	0.50	1,181	
Bridgend	8	54.71	128,928	
Caerphilly	12	1.17	2,759	
Cardiff	6	4.74	11,172	
Carmarthenshire	101	78.43	204,104	
Ceredigion	74	82.05	193,348	
Conwy	29	19.07	44,948	
Denbighshire	30	31.36	73,886	
Flintshire	25	0.32	749	
Gwynedd	55	5.47	12,892	
Isle of Anglesey	56	44.11	103,948	
Monmouthshire	26	0.56	1,312	
Neath Port Talbot	6	57.48	135,458	
Newport	7	7.48	17,635	
Pembrokeshire	110	15.41	36,307	
Powys	151	125.34	295,350	1
Rhondda Cynon Taf	8	66.05	155,641	
Swansea	4	0.34	801	
Torfaen	4	0.03	70	
Unknown	24	2.34	5,514	
Vale of Glamorgan	6	0.10	236	
Wrexham	12	0.68	1,601	
<b>Total</b>	<b>756</b>	<b>597.75</b>	<b>1,427,838</b>	

\*

***“The local authority with the most onshore wind capacity is Powys, with 151 projects and 21 percent of the total Welsh onshore wind capacity, equating to 125.3 MW<sub>e</sub>. Outside of Powys, five local authorities have an installed onshore wind capacity of over 50 MW<sub>e</sub>, which with Powys accounts for over half of the total installed capacity in Wales. These are Bridgend, Carmarthenshire, Ceredigion, Neath Port Talbot and Rhondda Cynon Taff.”***

2. Table 31 (AECOM May 2017, p56) gives the following data for Powys:

Projected electrical demand in 2026 497 000MWh

	Installed Capacity MW	Energy Generated MWh	% of demand met in 2026 by renewables
Existing	336.7	809 557	163%

In other words, with its **existing** Renewable Installed capacity Powys is already generating 63% more electricity than its total requirement for 2026 from renewable sources.

With the additional proposed installed capacity of 61.7MW (LDP 2018), Powys will be generating **188%** of its projected electrical demand for 2026 from renewable sources (AECOM May 2017 p56)

Given that the excess capacity will need to be exported and carried by the National Grid beyond Powys this raises questions about the capacity not only of the Powys grid network but also of the UK grid network to absorb such a disproportionately high contribution.

**With existing installed capacity Powys is therefore making a significant contribution to both its own electricity needs and also WAG goals and targets**

## APPENDIX B: REGENERIS: Study into the Potential Economic Impact of Wind Farms and Associated Grid Infrastructure on the Welsh Tourism Sector (FEB: 2014)

### TOURISM IMPACT OF ONSHORE WIND FARMS IN WALES

#### •Tourism Impact of Onshore Wind Farms in Wales •

##### North Anglesey – Small tourism economy within impact area but important sector locally

Framework Indicator	Sensitivity	Justification
Scale of development	2	Large number of turbines in the north of the island, but are mostly smaller developments. Not the focus for large scale future development over next decade.
Clustering near other wind farms	4	Wind farms are located close to each other, and all wind farms can be seen from certain locations in the north of the island. But confined to a relatively small area.
Dominance of wind farms on landscape in key tourism areas	2	Wind farms are judged to be a dominant presence on the landscape in a large area of lowland farmland. Some are located close to the AONB, however they are unlikely to be visually intrusive on coastal landscapes and beaches for most visitors.
Scenery and Landscape Quality	2	All located in pleasant but unremarkable inland countryside. Assessed by LANDMAP as moderate quality, although presence of turbines influence this assessment.
Unspoiled, open landscapes central to visitor offer	2	Unspoiled coastal landscapes are central to visitor offer, but wind farms not likely to detract from these. Visitor offer is diverse, including beach holidays, watersports and outdoor activities.
Capacity of Local Tourism Sector	3	DMP shows visitor numbers are highly seasonal, so likely to be operating under capacity during winter months. Most visitors during winter months are likely to be older visitors who may be more sensitive to wind farms.
Loyalty of tourist base	3	DMP shows around 60% of visitors to serviced accommodation and 50% of self catering are repeat visitors, but these are not likely to be any more concentrated amongst those more sensitive to WF development.
Age of visitors	3	40% of visitors are aged 55+, attracting a large number of older couples who may be more sensitive to WF development. Families are also an important market, but these are not particularly sensitive to WF development.
Overall Assessment	2	Although a number of indicators point to potential for increased sensitivity to wind farms, IACC's own research has not identified negative effects. Case study identifies some anecdotal evidence of visitors staying away but a large proportion of operators have not experienced fall in visitor numbers due to wind farms. Diversity of offer means there is high potential for replacement of visitors who are deterred. <b>Overall, minimal visitor economy impacts expected.</b>

#### •Tourism Impact of Onshore Wind Farms in Wales •

##### North Ceredigion – Small tourism economy but very important sector given the narrow economic base

Framework Indicator	Sensitivity	Justification
Scale of development	2	Four operational wind farms containing 77 turbines, but spread across wide area. One large wind farm containing 39 turbines. No future wind farms planned.
Clustering near other wind farms	1	Wind farms spread out over a wide area, with little potential for cumulative effects.
Dominance of wind farms on landscape in key tourism areas	3	Some walkers in Cambrian mountains likely to come in close proximity to Cefn Croes but most wind farms further distance from key visitor assets and routes. No evidence that Cefn Croes has affected visitor numbers.
Scenery and Landscape Quality	3	Two of the landscapes containing wind farms assessed as "outstanding" in LANDMAP, including Cefn Croes. Others assessed as "moderate".
Unspoiled, open landscapes central to visitor offer	3	Important part of visitor offer in Cambrian mountains, but part of a more diverse offer which is less sensitive to wind farm development.
Capacity of Local Tourism Sector	3	Tourism is highly seasonal, but large proportion of business turned away during summer months, and smaller proportion during shoulder months. Most tourism visitors to Cefn Croes would be in summer months. So some potential for replacement of visitors.
Loyalty of tourist base	2	Tourism strategy notes that many of the older visitors staying in caravans by coast are repeat visitors to the area, but most of these are remote from wind farm development.
Age of visitors	4	48% of visitors are "empty nesters" over 55, with potential for this group to be more sensitive than average to wind farm development.
Overall Assessment	2	No evidence identified that existing wind farm development has affected visitor numbers. Most sensitive area would be around Cefn Croes. Some visitors could be discouraged, but likely to be limited in extent and potential for these to go to other local destinations not affected by developments. <b>Overall, minimal visitor economy impacts expected.</b>

●Tourism Impact of Onshore Wind Farms in Wales ●

Powys South – Small tourism economy and a small share of total employment

Framework Indicator	Sensitivity	Justification
Scale of development	5	Two large, established wind farms and a number of large wind farms in planning system.
Clustering of multiple wind farms	4	All wind farms in relatively close proximity. Potential for some cumulative effects, although limited to some extent by topography of area.
Dominance of wind farms on landscape in key tourism areas	3	Large wind farms in close proximity to some visitor assets (Glyndwr's Way, open access land), but not major in terms of visitor numbers. Elan Valley another important visitor asset which is further from wind farms.
Scenery and Landscape Quality	3	Some wind farms in areas assessed as high for landscape quality, others assessed as moderate. Landscapes not as dramatic as other areas of Powys (Brecon Beacons). Wind farms may enhance the landscape for some visitors in some locations (eg Llandinam).
Unspoiled, open landscapes central to visitor offer	4	Open, unspoiled landscapes and feeling of isolated wilderness are important part of offer, but fishing, walking, cycling and other outdoor activities also popular.
Capacity of Local Tourism Sector	4	Limited information available for Powys or local area. Mid Wales tourism strategy indicates occupancy levels are low but this covers a very wide area. Likely to be seasonal.
Loyalty of tourist base	4	Visitor surveys indicate one in ten visitors to Powys are repeat visitors who may be more sensitive to wind farm development.
Diversity of visitor base	4	Limited information for the study area itself, but Mid Wales tourism strategy shows that half of visitors to Powys are "empty nesters" aged 55+. These visitors may be more sensitive to wind farm development.
Overall Assessment	4	The scale of development combined with the visitor profile and wilderness offer of this study area leave it more sensitive to wind farm development than other areas of Wales. Narrow visitor offer and proximity to other more established tourism areas mean there may be less potential for replacement of visitors than other areas. <b>Potential for effect on visitor economy. The effect is likely to be small but there is a risk that it could be moderate for some visitor markets.</b>

●Tourism Impact of Onshore Wind Farms in Wales ●

South Coast Urban – Large visitor economy dominated by Cardiff city centre

Framework Indicator	Sensitivity	Justification
Scale of development	1	All operational, consented and planned wind farms are very small (comprising one or two turbines each)
Clustering near other wind farms	1	Two wind farms in close proximity but both very small
Dominance of wind farms on landscape in key tourism areas	1	Size of windfarms and urban context means they are not dominant feature on landscape
Scenery and Landscape Quality	1	All in areas assessed as low or moderate for landscape quality
Unspoiled, open landscapes central to visitor offer	1	Urban context means unspoiled landscapes do not feature in visitor offer
Capacity of Local Tourism Sector	1	Surveys indicate hotel occupancy in Cardiff is below capacity, however this is less relevant in this context
Loyalty of tourist base	1	Day visitors likely to be frequent visitors, but this is for shopping and cultural breaks. Weekend breaks less likely to be repeat visitors
Age of visitors	1	Attracts a broad mix of age ranges
Overall Assessment	1	No threat to visitor economy from wind farm development because of nature of visitor offer (shopping, culture, city breaks) and limited scale of wind farm development. <b>No specific impacts expected on the visitor economy.</b>

●Tourism Impact of Onshore Wind Farms in Wales ●

Carmarthenshire – Sizeable visitor economy and an important source of employment and income

Framework Indicator	Sensitivity	Justification
Scale of development	3	Most operational wind farms are small, but future wind farms will be larger. Largest wind farm will be the consented Brechfa Forest East (28 turbines).
Clustering near other wind farms	3	Operational wind farms are distributed over wide area. Planned and consented wind farms may create a cluster of three wind farms in Brechfa Forest.
Dominance of wind farms on landscape in key tourism areas	2	Small wind farm located close to coast which is a key visitor asset, but unlikely to be intrusive for visitors to beach or walkers. Future wind farms in Brechfa Forest may be dominant in some areas, but dense forestry would limit intrusiveness.
Scenery and Landscape Quality	3	Brechfa Forest landscapes assessed as high scenic value. Presence of wind farms may detract from views and overall enjoyment for some visitors.
Unspoiled, open landscapes central to visitor offer	2	Open landscapes are important part of offer in the east of the County but less so in impact area. Beaches unlikely to be affected by wind farm development. Brechfa Forest is popular with mountain bikers who are likely to be less sensitive to wind farm development.
Capacity of Local Tourism Sector	2	Very little information available, but likely to be seasonal. Mountain biking in Brechfa Forest likely to be less seasonal than other activities.
Loyalty of tourist base	N/A	Very little information available for level of repeat visits to Carmarthenshire as a whole or the impact area.
Age of visitors	2	Limited information available. East Carmarthenshire survey showed area is popular with older visitors. However, area most affected is Brechfa Forest which is likely to attract younger visitors (mountain bikers) who are in general less sensitive to WFs.
Overall Assessment	2	The scale of development in Carmarthenshire is limited compared to other parts of Wales. Some visitors to Brechfa Forest may be deterred by change to landscape, however the area is popular for mountain biking and other outdoor activities. These visitors are less sensitive to wind farm development. <b>Nevertheless, very little overall visitor economy impacts expected.</b>

●Tourism Impact of Onshore Wind Farms in Wales ●

Powys North – Small tourism economy but important sector given narrow economic base

Framework Indicator	Sensitivity	Justification
Scale of development	5	Over 150 existing turbines and a number of consented or planned wind farms in close proximity. Also new proposed grid infrastructure.
Clustering near other wind farms	5	There would be three separate clusters of wind farm developments if all applications were approved.
Dominance of wind farms on landscape in key tourism areas	4	Large wind farms in close proximity to visitor assets (Glyndwr's Way and open country)
Scenery and Landscape Quality	3	Wind farms mostly in areas of upland moorland and grazing land, which are less dramatic than other parts of Powys. Largest wind farms are located in an area assessed as poor for landscape quality because of forestry plantations.
Unspoiled, open landscapes central to visitor offer	4	Open, unspoiled landscapes and feeling of isolated wilderness are important part of offer, but fishing, walking, cycling and other outdoor activities also popular.
Capacity of Local Tourism Sector	4	Limited information available for Powys or local area. Mid Wales tourism strategy indicates occupancy levels are low but this covers a very wide area. Likely to be seasonal.
Loyalty of tourist base	4	Visitor surveys indicate one in ten visitors to Powys are repeat visitors who tend to be more sensitive to wind farm development
Age of visitors	4	Half of visitors to Powys are "empty nesters" aged 55+. This group tends to be more sensitive to wind farm development.
Overall Assessment	4	The scale of development combined with the visitor profile and wilderness offer of this study area leave it more sensitive to wind farm development than other areas of Wales. Narrow visitor offer and proximity to other more established tourism areas mean there may be less potential for replacement of visitors than other areas. <b>Potential for impact on visitor economy. The impact is likely to be small but there is a risk that this could be moderate for certain visitor markets.</b>

●Tourism Impact of Onshore Wind Farms in Wales ●

South Wales Valleys – Growing visitor economy but not an important source of employment

Framework Indicator	Sensitivity	Justification
Scale of development	5	102 turbines already installed, and a large number of wind farms with consent or in the planning system, including Pen y Cymoedd (76 turbines). This will create large scale development in NPT and RCT
Clustering near other wind farms	5	Large cluster of wind farms in NPT/RCT, including existing and consented wind farms
Dominance of wind farms on landscape in key tourism areas	4	Large wind farms in close proximity to visitor assets (Afan Forest Park and upland areas of NPT and RCT). Visibility of wind farms may be reduced in forested areas. Dominance on landscape may be limited by proximity to developed areas.
Scenery and Landscape Quality	2	Half of wind farms are in areas assessed as high for landscape quality. However many are close to former industrial areas and settlements which detracts from “unspoiledness” of landscapes
Unspoiled, open landscapes central to visitor offer	2	Unspoiled, open landscapes are part of offer in some areas. The countryside offer is not fully developed for tourism compared to other locations in Wales. Mountain biking, culture and heritage, beaches and outdoor activities more important.
Capacity of Local Tourism Sector	3	Evidence from case studies showed a mixed picture. Some markets have experienced strong growth, but overall tourism growth has been flat and there is likely to be some capacity.
Loyalty of tourist base	1	Not clear from the evidence, but mountain bikers are a key market and likely to be repeat visitors for mountain bike trails in Afan Forest Park. This market is less sensitive to wind farm development.
Age of visitors	2	Area attracts a large proportion of younger visitors for mountain biking and activities. These markets are less sensitive to wind farm development.
Overall Assessment	2	Large scale development but not established as a visitor location for high scenic value. Visitors tend to be younger and come for specific activities. Case study indicates limited potential for some visitors to be deterred but high potential for replacement of deterred visitors with other markets. <b>Very little overall impact on visitor economy expected, and some WF related opportunities.</b>

●Tourism Impact of Onshore Wind Farms in Wales ●

North Wales – Small visitor economy with average share of employment in tourism

Framework Indicator	Sensitivity	Justification
Scale of development	3	Six operational wind farms, but mostly small or medium in scale (largest has 25 turbines). Potential for six future developments which would be larger.
Clustering near other wind farms	3	Potential for clustering of wind farms around Clocaenog forest if applications were approved, but limited clustering overall. Also some screening in these areas due to forestry locations.
Dominance of wind farms on landscape in key tourism areas	3	Wind farms are in close proximity to Llyn Brenig and Mynydd Hiraethog SSSI. These are popular areas but lower profile than other visitor assets. Wind farms may be visible from parts of Snowdonia and Clwydian Range but would be unlikely to be dominant features on landscape.
Scenery and Landscape Quality	3	Some wind farms in areas assessed as high for landscape quality, but greatest concentration of turbines in an area assessed as low due to forestry plantations.
Unspoiled, open landscapes central to visitor offer	3	Scenery is a key reason for visiting the area. But areas also popular for nature watching, fishing, walking, mountain biking and watersport, so there is potential for replacement of visitors who are deterred.
Capacity of Local Tourism Sector	N/A	Very little evidence about capacity of local tourism sector. Likely to be seasonal.
Loyalty of tourist base	3	Around ¼ of visitors are repeat day visitors who have not travelled far. Some repeat visitors may be deterred by wind farms, but large number of visitors likely to have visited out of convenience and may be less sensitive to wind farm development.
Age of visitors	4	51% of visitors are over 55. Visitors in this age group may be more sensitive to wind farm development.
Overall Assessment	2	Large number of wind farms but mostly dispersed over a wide area. Although some people who visit for the scenery may be deterred, there are numerous alternative visitor markets which may be less sensitive to wind farm development. Also potential for positive effects by using wind farms as a visitor asset, identified by Denbighshire and Conwy County Councils. <b>Very little overall impact on visitor economy and some WF related opportunities</b>

●Tourism Impact of Onshore Wind Farms in Wales ●

Pembrokeshire – Small visitor economy accounting for small share of employment

Framework Indicator	Sensitivity	Justification
Scale of development	1	Two existing wind farms and up to three future developments, but all small in scale
Clustering near other wind farms	2	Four of the wind farms are in close proximity, but these are all small so this does not have significant effect
Dominance of wind farms on landscape in key tourism areas	1	Size and locations of wind farms in less scenic areas means they are unlikely to be dominant presence in key visitor locations
Scenery and Landscape Quality	2	One wind farm is close to scenic areas of Pembrokeshire Coast National Park, but all wind farms are in farmland assessed as moderate by LANDMAP
Unspoiled, open landscapes central to visitor offer	1	Unspoiled coastal landscapes and seascapes are central to the visitor offer, but wind farms are remote from these locations.
Capacity of Local Tourism Sector	1	Highly seasonal, but less relevant for this case study where wind farms would be unlikely to have any effect on visitor behaviour
Loyalty of tourist base	2	85% of visitors to Pembrokeshire are repeat visitors, but this is less relevant when considered alongside other factors which suggest wind farms would have limited effect on visitor behaviour
Age of visitors	1	Pembrokeshire visitor survey shows area is popular with younger visitors who tend to be less sensitive to wind farm development.
Overall Assessment	1	Small scale of development and location of wind farms away from the beaches and coastal areas with high scenic value mean there is likely to be limited potential for impact from wind farms and <b>no overall impact on the visitor economy.</b>

## APPENDIX C: OFFSHORE WIND INTERNATIONAL ENERGY AGENCY (IEA)

A recent analysis by the **International Energy Agency (IEA)** stated that erecting wind turbines on the world's best offshore sites could provide more than enough clean energy to meet global electricity demand.

The study of the world's coast lines found that offshore windfarms alone could provide more electricity than the world needs – even if they are only built in windy regions in shallow waters near the shore.

The analysis by the IEA revealed that if windfarms were built across all useable sites which are no further than 60km (37 miles) off the coast, and where coastal waters are no deeper than 60 metres, they could generate 36,000 terawatt hours of renewable electricity a year. **This would easily meet the current global demand for electricity of 23,000 terawatt hours.**

Offshore wind currently provides just 0.3% of global power generation, but its potential is vast.

The study predicts offshore wind generation will grow 15-fold to become a \$1tn (£780bn) industry in the next 20 years and will prove to be the next great energy revolution.

The IEA stated that global supplies of renewable electricity were growing faster than expected and could expand by 50% in the next five years, driven by a resurgence in solar energy. **Offshore wind power would drive the world's growth in clean power due to plummeting costs and new technological breakthroughs, including turbines close to the height of the Eiffel Tower and floating installations that can harness wind speeds further from the coast.**

The next generation of floating turbines capable of operating further from the shore could generate enough energy to meet the world's total electricity demand 11 times over in 2040, according to IEA estimates.

The report predicts that the EU's offshore wind capacity will grow from almost 20 gigawatts today to nearly 130 gigawatts by 2040, and could reach 180 gigawatts with stronger climate commitments.

The report stated that offshore wind would not only contribute to generating clean electricity, **but could also offer a major opportunity in the production of hydrogen, which can be used instead of fossil fuel gas for heating and in heavy industry.**

The process of making hydrogen from water uses huge amounts of electricity but abundant, cheap offshore wind power could help produce a low-cost, zero-carbon alternative to gas.

In the North Sea, energy companies are already planning to use the electricity generated by giant offshore windfarms to turn seawater into hydrogen on a floating "green hydrogen" project, backed by the UK government. The clean-burning gas could be pumped back to shore to heat millions of homes by the 2030s.

(Initial source Guardian Newspaper 25 Oct 2019)

A press release by the IEA on 25<sup>th</sup> October 2019 stated:

*“The huge promise of offshore wind is underscored by the development of floating turbines that could be deployed further out at sea. **In theory, they could enable offshore wind to meet the entire electricity demand of several key electricity markets several times over, including Europe, the United States and Japan.**”*

*“Offshore wind currently provides just 0.3% of global power generation, but its potential is vast. “More and more of that potential is coming within reach, but much work remains to be done by governments and industry for it to become a mainstay of clean energy transitions.”*

***Governments and regulators can clear the path ahead for offshore wind’s development by providing the long-term vision that will encourage industry and investors to undertake the major investments required to develop offshore wind projects and link them to power grids on land. That includes careful market design, ensuring low-cost financing and regulations that recognise that the development of onshore grid infrastructure is essential to the efficient integration of power production from offshore wind.”***

The full IEA report can be found at the following link:

<https://webstore.iea.org/offshore-wind-outlook-2019-world-energy-outlook-special-report>

## APPENDIX D

### Crown Estate Auction of New Seabed Rights and Strike Prices

The crown estate has opened the first leasing round for offshore windfarms in a decade to usher in a new generation of wind projects expected to eventually generate an investment of £20bn.

The business intends to auction off new seabed rights in the waters around **England and Wales** to wind power developers. The leasing scheme allows up to 7GW of electricity generation capacity – enough to meet the needs of more than 6m homes.

The auction is expected to be hard fought by energy companies eager to profit from the UK's growing offshore wind sector.

The UK has got 8.5GW of offshore wind generation capacity, which provides more than 8% of the UK's annual electricity needs. The government has agreed to support the industry to expand the UK's offshore wind capacity to 30GW by 2030.

The industry's trade body, Renewable UK, has estimated that the next generation of offshore wind development would bring almost £21bn of investment in today's prices, and support about 9,000 full-time jobs.

Luke Clark, of Renewable UK, has stated that the industry hopes to treble the size of its offshore wind sector **by 2030 to generate more than a third of the UK's electricity.**

According to Renewable UK, the growth of the renewables industry is good news for energy bills, as well as the environment, due to the steep fall in the cost of wind and solar power technologies over recent years.

Luke Clarke of Renewable UK has further stated that:

"The cost of new offshore wind projects, for example, has just fallen to an all-time low, making onshore and offshore wind our lowest-cost large scale power sources."

The strike prices of £39.65 and £41.61 (2023/24 and 2024/25 delivery years) for every megawatt hour of electricity generated demonstrate the rapid cost reduction since CfD Round 2. The cost of Offshore wind is now lower than the Government Reference Prices, and very likely to be close to future wholesale electricity prices.

On 20 Sept 2019 the **Carbon Trust** stated:

*"We are now in a market where developers are no longer receiving subsidy payments from government, but they are given revenue certainty. The CfD regime has shown to provide vital long-term revenue certainty for developers, which is essential for a project's bankability. Specifically, CfDs for offshore wind will help ensure the **30GW Sector Deal targets by 2030 can be realised.**"*

*“This is an important milestone, which will help move the UK offshore wind sector further towards the Committee on Climate Change’s recommendation of 75GW energy from wind by 2050, but there is still much to be done.”*

Under the **Labour** party’s plans for Green Industrial Revolution **the offshore wind industry would grow five-fold in a decade, with the addition of an extra 37 giant offshore windfarms** and 70,000 new jobs.

*(Initial source Guardian Newspaper 19 Sept 2019 and 14 Oct 2019)*

## APPENDIX E: RECENT ADVANCES IN BATTERY STORAGE TECHNOLOGY

As the world generates more and more electricity from intermittent renewable energy sources, there is a growing need for technologies which can capture and store energy during periods of low demand and release it rapidly when required.

### 1. GRAVITRICITY WINCH AND HOIST SYSTEM

The Edinburgh based **Gravitricity** has developed a winch and hoist system that could utilise **disused mine shafts** to store energy at half the cost of lithium iron batteries. It aims to offer the best characteristics of lithium batteries and pumped storage.

The technology operates in the 1MW to 20 MW power range and enables existing grid infrastructure to be used more efficiently with renewable energy.

The patented technology is based on a simple principle: raising and lowering a heavy weight to store and release energy. The Gravitricity system suspends weights of 500 - 5000 tonnes in a deep shaft by a number of cables, each of which is engaged with a winch capable of lifting its share of the weight. Electrical power is then absorbed or generated by raising or lowering the weight. The weight is guided by a system of tensioned guide wires (patents applied for) to prevent it from swinging and damaging the shaft. The winch system can be accurately controlled through the electrical drives to keep the weight stable in the hole.

The scheme mimics hydropower projects which have played a key role in helping to balance the electricity grid, including the Dinorwig project in Wales.

Charlie Blair, Gravitricity's managing director, states:

"The beauty of this is that this can be done multiple times a day for many years, without any loss of performance. This makes it very competitive against other forms of energy storage – including lithium-ion batteries."

A full-scale project would drop 24 weights to a depth of 800 metres to produce enough electricity to power 63,000 homes for more than an hour.

The Gravitricity website can be found at the following link:

<https://www.gravitricity.com/#technology>

*(Initial Source Guardian 21<sup>st</sup> October 2019)*

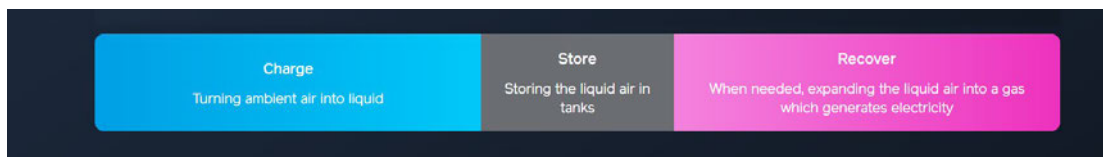
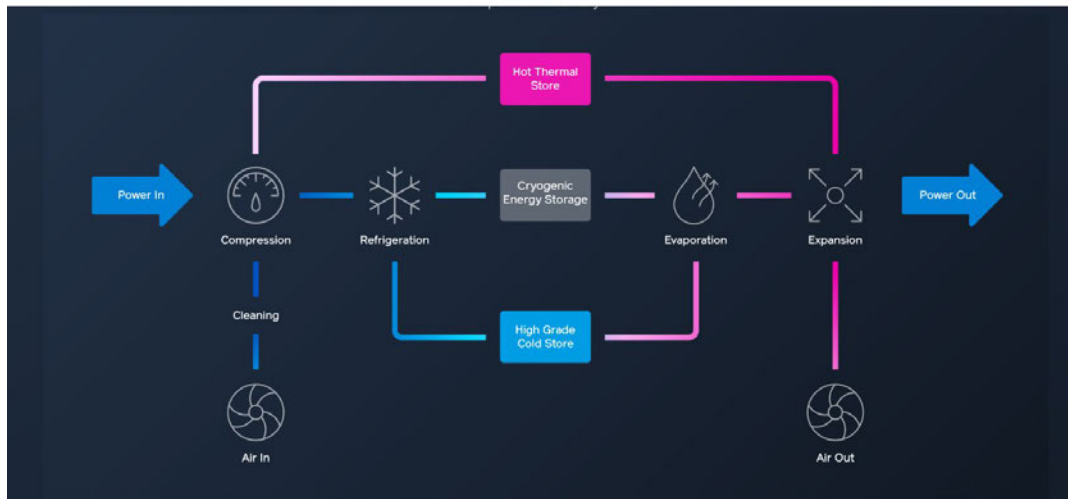
### 2. HIGHVIEWPOWER CYROBATTERY

British battery developers, Highview Power, plan to build Europe's largest energy storage project using a cryogenic battery that **can store renewable energy for weeks or months rather than hours**.

The device will be built on the site of an old fossil fuel plant in the north of England to power up to 50,000 homes for up to five hours.

Unlike traditional lithium-ion batteries, which typically store electricity for a few hours, the “cryobattery” will be able to store energy for months.

In common with all energy storage systems, the cryogenic energy storage system comprises three main processes: a charging system, an energy store, and power recovery.



According to Highview Power, the plants can be situated anywhere, are built using mature components from established suppliers and have a lifespan of 30+ years.

The cryobattery uses renewable electricity to chill air to -196C, transforming it into a liquid that will be stored in large metal tanks.

When renewable electricity levels are low the liquid can be turned back into gas, which is used to turn a turbine and generate electricity, but without burning the gas and releasing emissions.

The full-scale cryobattery has a capacity of 50MW or 250MWh over a five-hour release time.

It follows the success of a 5MW pathfinder project built next to a landfill site in Bury, Greater Manchester, in summer 2018 with £8m of funding from Innovate UK.

The chief executive of Highview Power, Javier Cavada, has said that the battery could provide cost-efficient energy storage at old fossil fuel plants across the country to help balance the energy system.

*“More and more power plants are going to be decommissioned, and we are bringing a solution which can use the same energy infrastructure and grid connections to give a new life to these sites,”*

He added that long-duration, giga-scale energy storage was the “*necessary foundation*” to help build a carbon-free energy system that relies heavily on wind and solar power.

At commercial scale, this technology has the potential to play an important role in providing long-duration storage to balance the UK grid.

Cavada has stated that the company plans to finalise agreements with its project partner and would secure deals with National Grid to help provide grid balancing services.

Highview Power states that the cryobattery would cost about £110 per MWh of electricity, using a 200MW system, which would make it one of the cheapest energy storage technologies.

The Highview Power website with full details of the technology can be found at the following link:

<https://www.highviewpower.com/technology/>

*(Initial Source Guardian Newspaper 22 October 2019)*

## APPENDIX F: Green Alliance Report

### How Consumer Choice is changing the UK energy system

April 2017

The full report runs to 37 pages and it can be found under the following link:

[http://www.green-alliance.org.uk/resources/People power how consumer choice is changing UK energy system.pdf](http://www.green-alliance.org.uk/resources/People_power_how_consumer_choice_is_changing_UK_energy_system.pdf)

**The Green Alliance** is a charity and independent think tank focused on ambitious leadership for the environment. Its website states:

*Green Alliance was launched in 1979 with the aim ‘to ensure that the political priorities of the United Kingdom are determined within an ecological perspective’. Our name originally referred to the large group of eminent individuals from a wide range of professional spheres who were the founding members.*

#### **Status and mission**

*A charity and company limited by guarantee, Green Alliance is now the leading UK think tank working on environmental policy and politics. Always maintaining a non-partisan, pluralist stance, we work across all sectors, in partnership with companies and NGOs and with all the main political parties, to inspire and achieve policy change for a better environment.*

*Our stated mission is to promote sustainable development by ensuring that the environment is at the heart of decision-making.*

*Our three core aims are:*

- *to make the environment a central political issue;*
- *to integrate the environment into public policy and decision making;*
- *to stimulate new thinking and advance the environmental agenda into new areas.*

## APPENDIX G

## Solar PV and Battery Storage

The following article is taken from the Moixa Website:

January 19 2017

Moixa, Northern Powergrid and Energise Barnsley have teamed up in a ground-breaking trial to demonstrate how clusters of home batteries can increase capacity on the electricity network and enable more homes to install solar panels.

Moixa Smart Batteries will be installed in 40 homes and linked in a virtual power plant in the first project to study how this solution can reduce peak solar output onto the electricity networks when there is low local demand and save customers millions in the cost of running the UK's power network.

Electricity distributor Northern Powergrid, is funding installation of the batteries in Oxspring, near Barnsley, in properties owned by Barnsley Council and managed by Berneslai Homes. Community energy company Energise Barnsley has rolled out solar to homes in the area but came up against some network constraints in the village which meant that five houses could not be connected within the timescales of the project. The trial will include all 30 homes in the housing estate with solar PV panels plus 10 others without.

Simon Daniel, CEO of Moixa, said: "Batteries will allow the electricity system to support much higher levels of low-carbon renewable power and increase UK energy independence. By managing clusters of home batteries in a virtual power plant and allowing homeowners to use more of their solar energy, thereby exporting less, we believe we can significantly reduce peak solar generation output onto the network. This will allow more homes to go solar without imposing new costs on network operators.

"Solar homes with batteries can halve their electricity bills, and this solution will become increasingly popular as costs of storage and PV fall. We are working closely with Northern Powergrid and this project will deliver insights to develop incentives which we hope will allow us to roll out solar plus storage to tens of thousands of homes in their region, by creating a business case for homeowners to invest and also by increasing the number of solar connections allowed on each substation."

The £250,000 trial will seek to demonstrate that the virtual power plant can reduce peak solar output onto the network sufficiently to enable panels to be installed on more homes using existing substations and cable networks. If successful, Northern Powergrid believes UK network operators could save millions for customers by reducing the need to upgrade infrastructure, which will help ensure network-related charges on customers' electricity bills remain good value. The trial will also feed into national design guidance for low voltage networks supplying housing estates.

Andrew Spencer, System Planning Manager for Northern Powergrid, said: "This partnership is one of a number of ways we're working to explore innovations that can benefit our customers and the communities we serve.

"Batteries will play a key role in the smart energy system of the future, keeping costs down for customers whilst allowing the power network to support greater concentrations of solar power. This innovative project will provide valuable data on how the inclusion of batteries in solar schemes can enable our designers to connect more PV panels before further network reinforcement is required."

The first batteries will be installed at the end of January and will cost residents nothing. Solar panels typically cut electricity bills by up to 30% and batteries can add further savings of up to 20% by allowing residents to use free energy generated during the day at night.

Moixa will manage the cluster of batteries to reduce peak generation output onto Northern Powergrid's local electricity network by storing solar electricity instead of exporting it to the grid. Its software includes 'learning algorithms' which respond to solar generation, electricity network needs and each user's behaviour to maximise the benefits of storage.

By linking the batteries in a virtual power plant Moixa will also be able to provide services that make the wider electricity grid more efficient, greener and cheaper to run, such as maintaining a stable frequency, so reducing the need for back-up power from coal, oil and gas. In the future, residents will also receive a share of income from Moixa for these grid services.

The growth of renewable power has put increasing pressures on the network because it must be able to cope with maximum generation on a windy or sunny day at times when demand is low. This has created constraints in some areas where homes with solar panels are clustered and existing infrastructure cannot cope with more peak generation without costly upgrades. In many parts of the country social landlords wanting to install solar panels on their estates have had to wait to connect the final few properties on their projects until the local electricity network is reinforced to accommodate the full scheme output.

Andy Heald, Director of Energise Barnsley said that they had only been able to install solar PV on two in three homes in the area as planned because of existing grid constraints, while in a project in Carmarthenshire only 37% could connect.

The community energy company works with local authorities around the country to develop rooftop solar energy and owns the panels on Berneslai's homes. "Solar power is a key part of Barnsley council's plan to reduce high levels of fuel poverty in the region. Battery costs are falling rapidly and storage has huge potential to accelerate the national roll-out of solar and improve the lives of vulnerable people," said Mr Heald.

He said solar was of particular benefit to elderly people who are at home and using electricity during the day, like many of the residents in the Oxspring trial. Some people with solar panels were saving up to 50% on their energy bills and he believed batteries could take this as high as 80%.

Stephen Davis, Director of Assets, Regeneration and Construction, for Berneslai Homes, said: "We are keen to explore the savings potential that battery storage can bring to our tenants' energy bills. Our tenants face ever increasing energy costs from the energy suppliers they buy their electricity from and solar panels coupled with battery technology have the potential to ease some of that cost."

ENDS

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NOTES TO EDITORS

Moixa Technology ([www.moixa.com](http://www.moixa.com)) is the UK's leading [home battery](#) company and the partner of choice for leading installers, housing associations and utility companies. It helps everyone from individual homeowners, to councils and large property companies to manage and cut their electricity bills by allowing them to use more of their solar energy. It manages clusters of batteries in virtual power plants in order to support the grid and earn money for its customers.

Moixa has an unrivalled track record in the UK [home battery](#) market, with over 10 years of research and development, strong international patents and pilots from 2010. It has installed Moixa Smart batteries in more than 650 homes nationwide with a combined capacity of over 1.3MWh and over five million hours of use. It has worked with councils and housing associations, energy utilities and network operators to deliver more than £5 million of projects.

The Moixa Smart Battery is a compact (50cm x 30cm x 20cm), cost-effective, wall-mounted unit that fits easily into homes and is easily installed. It is an all-in-one Lithium FerroPhosphate battery system, requiring no additional equipment, and AC-coupled, so it can take advantage of smart tariffs by importing electricity from the grid when it is cheap. USB ports allow customers to charge mobile phones and other devices and can support efficient LED lighting, providing power even during outages. It has a 20-year lifespan and comes with an extendable ten-year guarantee.

Northern Powergrid is the electricity distributor responsible for safely delivering electricity to 8 million customers across 3.9 million homes and businesses in the North East, Yorkshire and northern Lincolnshire. Its network consists of more than 63,000 substations, 59,000 miles of overhead lines and underground cable, spanning some 10,000 square miles.

Northern Powergrid does not sell electricity. It charges customers' chosen electricity supplier for using Northern Powergrid's network to transport electricity to customers' doors. Its network-related charges equate to around 6% per cent of a typical-dual fuel domestic energy bill. For more information on Northern Powergrid, visit [www.northernpowergrid.com](http://www.northernpowergrid.com)

Energise Barnsley is a Community Benefit Society established in 2015 as an energy company. Since inception it has delivered the largest community energy solar PV project in the UK, by number of roofs installed on – 321 tenanted houses of Berneslai Homes, and 16 Barnsley Metropolitan Borough Council Buildings, including schools and sheltered housing blocks. Details of Energise Barnsley can be found at [www.energisebarnsley.co.uk](http://www.energisebarnsley.co.uk)

Berneslai Homes is Barnsley Council's managing agent for the management and maintenance of council housing in Barnsley. It manages approximately 18,655 properties and employs just under 500 employees. [www.berneslaihomes.co.uk](http://www.berneslaihomes.co.uk)

Moixa is the UK's leading home battery and platform for managing storage services.

Our Smart Battery is British invented and manufactured. We offer full sales and technical support locally in the UK. We're the partner of choice for leading installers, housing associations and utility companies.

The following article is taken from the TGV Hydro Website:

TGVHydro

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## Guide to microhydro

Hydroelectric plants work by converting the potential energy from water at height into electrical energy. This is achieved through water powering a turbine – using the rotational movement to transfer energy through a shaft to an electric generator.

The two basic classifications of hydro electric generators are 'High head' and 'Low head'. *Head* refers to the height from which the water drops before reaching the turbine. Therefore 'low head' refers to mills and generators in large rivers with great volumes of water that meander through the lowland valleys. 'High head' is used to describe those systems that use only a small amount of water but are able to use the water once it has dropped from a great height.

To capture this potential energy in a controlled form, some or all of the water in a natural waterway can be diverted from a watercourse through an intake and into a pipe which will transport the water downhill. The pipe is smooth bored compared to the rough stream bed. There is far less friction loss in the pipe and this saved friction is the energy that is used to drive the turbine. In the turbine house at the bottom of the system the water can be directed in a focussed jet under pressure onto a turbine wheel. The rotation of the turbine and the generator, to which it is attached, convert the energy into electricity that can be exported to the national grid.

Micro hydro is typically defined as the generation of electricity from a few hundred watts up to 100kW.

### How to calculate power potential

Hydro power is a mature and well-understood technology that offers many advantages over other renewable energy:

- High efficiency and high power density
- Long system lifetime (up to 50 years)
- Predictable energy outputs
- Excellent load factor characteristics

The particular technologies required for generation differ from site to site according to various site characteristics and these are outlined below. The fundamental elements which make up the basic power generation equation are explained in below. However, there are several other factors which will reduce the *actual* power that can be generated at any site. There are multiple factors that reduce your potential energy during conversion. These include head loss in pipes, efficiency of turbines, loss in cables, and loss in inverters.

In order to simplify the calculation at the planning stage of a hydroelectric installation, these efficiency losses are assumed to amount to **50%** of the ideal calculation.

Simple power calculations can then be calculated from the flowing variables:

- **Q (flow):** this is the amount of water that can be abstracted from a given point in a stated period of time. It is usually measured in m³/s or l/s. The abstraction limit if often limited to the annual mean flow of the river (see below for additional note on abstraction limits).
- **H (head):** This is the vertical distanced that water drops from the source to the turbine. It is measured in meters, m.
- **Gravity constant:** Also known as acceleration due to gravity, it is represented by the letter 'g' and for the purposes of this calculation can be regarded as a constant of 10m/s²
- **System efficiency:** Overall system efficiency.
- **Power:** The potential output of any site is usually expressed in Kilowatts (kW)

The basic power of a system can be expressed by the equation:

- Power (in kW) = Q (in m³/s) x H (in m) x g (in m/s² x Efficiency (as a fraction)

**Example:** At the abstraction point a watercourse has an annual mean flow of 0.03m³/s. The vertical height difference from the intake point to the turbine house is 100m. Assume a 50% system efficiency. Hydro system potential in this case would be about 0.030 x 100 X 10 x 0.5 = 15 kW.

In determining the limits of abstraction from a water course the Environment Agency (EA) will not allow any installation to abstract all of the water in a river or stream. The EA have regulations and standards to protect both the local flora and fauna in the depleted reach and also the greater riparian system. Consequently the Environment Agency will place a restriction on the water that can be abstracted.

Stream flows are usually measured in terms of Q% values. A Q rate of Q75 represents the stream flow that is in the stream for at least 75% of the year. In most cases the EA will set an initial amount of water that must remain in the water course at all times; this is known as the Hands off Flow (HOF). No abstraction can take place while the stream flow is less than the HOF. The HOF is usually set between Q85 and Q95.

The EA will then set the abstraction regime above the HOF. Current guidance is that abstraction can be 100% of flow above the HOF but only up to a limit equivalent to Qmean.

Hydro scheme's intake dam/weir designs and automatic flow regulators ensure that the agreed abstraction regime is maintained.

Due to the seasonal variations in flow maximum abstraction will often only be achievable for 25% of any year. High head turbines maintain good efficiencies down to about 10% of their maximum design flow, because of this the seasonal flows mean that typical high head hydro scheme will not produce significant levels of power for about 20% of any year.