REP2I [ALLIANCE]

ALL-RED-01

The Mid Wales (Powys) Conjoined Public Inquiry into 5 Windfarm Proposals and a 132kV overhead Electric Line Connection

Re-determination of the applications by RES (Llanbrynmair) and RWE (Carnedd Wen)

The Alliance

Introduction

Introduction

1. The Alliance is an umbrella for 22 local groups and established organisations mainly in Montgomeryshire and Shropshire comprising some five thousand members. The Alliance team scrutinised all documentary evidence produced throughout the Conjoined Public Inquiry (CPI) and thoroughly researched each topic area, application by application, enabling the team to conduct our case from a position of authority. Statements of Case were produced by the Alliance in each area, supported by detailed Proofs of Evidence, with both researched and original material. The extent of this can be seen from the Alliance Closing Submission provided as CPI document ALL-030R and reproduced as Annex 7 to the Inspector's Report[1]. The Alliance team attended every session of the CPI and was also represented at site visits. The team cross-examined expert witnesses and was in turn cross examined. Through cross -examination, the local knowledge of the developers' expert witnesses was frequently revealed as limited.

2. The Alliance studied the Inspector's Report and has noted the marked difference in approach between his reporting of issues for the SSA B sites compared with earlier sections addressing the SSA C sites. For the SSA C sites, the various factors which could influence the ultimate decision are described and in a way which identifies the main points raised by the Alliance and other parties so as to inform the SoS's decision. But for the SSA B sites, and despite a substantial body of evidence supplied by the Alliance, he recites the "*main considerations are therefore*" (for Llanbrynmair) limited to the effects of the AIL route and the effects when seen from Glyndwr's Way (IR 266) and that the *main consideration* for Carnedd Wen was essentially limited to the impacts arising from the "Carnedd Wen 5" (IR 339). He is there effectively reciting only the issues arising between PCC and the Developers. He does not, in those sections, give the SoS the benefit of

[1] The Alliance's 113 page Closing Submissions are at pages 728-842 of the pdf copy of the Inspector's Report. The page numbering of that report on pages 2-3 is incorrect, being 19 pages out at the end of its range.

an analysis of the Alliance case on (for example) landscape and visual impacts beyond that narrow compass.

3. The SoS must, therefore, revisit the Alliance evidence and will, in that task, be guided by the Alliance Closing Submissions and by parallel papers submitted alongside this one.

4. There have been a number of significant developments since the closure of the CPI which we would respectfully draw to the attention of the Secretary of State.

Welsh Heritage

5. The Historic Environment Wales (2016) Act has become law and awaits preparation of policy, advice and guidance. There is a clear intention that more effective protection be given to ancient monuments (including those that are not scheduled) and the weight that must be given to *'sustaining and enhancing our historic environment'*.

6. The Inspector's Report discusses impact on the setting and interrelationship of Scheduled Ancient Monuments for SSA C although ultimately giving little weight to the rich heritage of the area. But in complete contrast, the no less rich cultural landscape of SSA B is ignored. This is despite the fact that the Alliance drew attention to all the proximate SAMs and to the developers' own wireframes demonstrating the very substantial harm that would accrue to the setting of a number of these nationally important assets (see for example Carnedd Wen ES December 2008 Vol.4A figures fig.10B.4, lower figure - Ffridd Cwm y Ffynnon)[2]. The image is reproduced on the next page but does not reproduce well at this scale. It therefore needs to be viewed in the original document.

[2] This document is not listed on the Programme Officer's list of documents, but Vol 3 of the December 2008 ES is given Inquiry Document number AD/RWE/007

7. It is clear that the provisions of the Historic Environment Wales Act show that considerable extra weight should be given in the planning balance to the significant impact on sites of heritage value even where the fabric is not actually destroyed. The SoS will need to revisit the Alliance evidence for a description of those assets, their significance and the effects likely to arise from the proposals. Sections 13 and 14 of the Alliance Closing Submissions will guide the Secretary of State to the Alliance's evidence on the topic. Substantial weight should be given to the Cultural Heritage aspects which are there described.

Westminster policy on localism and on-shore windfarms/subsidies

8. In June 2015 the UK Government Policy on localism relating to on-shore windfarms was made very clear. Windfarms of any size should be determined locally and there must be a clear mandate from the majority of the local community in favour of construction. This is unequivocal. Although Wales has devolved planning policy responsibility and has chosen not to implement a localism agenda for the communities of Wales, it remains that windfarms over 50MW are determined in Westminster with energy policy still a reserved matter.

9. The Inspector states in his report: *"the vast majority of persons who spoke at, or made written representations to the inquiry were opposed to the proposed developments"*[3] and *"the petition, consultations and surveys organised by the Alliance and Community Councils, together with the many individual representations made by local residents in*

[3] Inspector's Report page 20 paragraph 83

writing, also leave me in no doubt that a very high proportion of local residents object to the proposals."[4] Indeed every public participation session filled large halls to well over capacity and of the hundreds of people at Llangadfan (open session for SSA B, held on the evening of 4 December 2013) only one spoke in favour, commenting that farmers were merely following subsidy. People spoke in English and Welsh and were of all ages and occupations, united in their opposition.

10. The Alliance draws the obvious conclusion which is that it cannot be said that there is anything approaching a clear mandate of local support for windfarms of this scale.

11. The absence of any such mandate of local support is further demonstrated by decisions of Powys County Councillors. They, as the elected representatives, not only rejected the applications at Planning Committee but voted publicly and unanimously (April 2012) for a moratorium on any further windfarm developments pending the complete review of TAN 8 (now nearly 6 years overdue). Montgomeryshire's AM and its MP both appeared at the Inquiry and made forceful statements supporting the Alliance case. No mandate of local support from them. Many town and community councils also spoke, most of them having undertaken community wide surveys / polls showing overwhelming opposition to the proposals. No mandate of local support from them.

12. The June 2015 Government statement also made clear that on-shore wind had made sufficient contribution to the energy mix and ROCs subsidies would be phased out and replaced by the competitive Contracts for Difference system as was subsequently confirmed in the Energy Act 2016 (May 2016). The recognition that there is sufficient energy from on-shore wind and that other more reliable and productive technologies should be encouraged to come forward, would reduce the weight to be given to any perceived need for onshore turbines in the

[4] Inspector's Report page 95 paragraph 554

overall planning balance. The over-riding importance given by the Inspector to wind energy over other material planning considerations in the planning balance must thus be revisited and reduced.

13. In its Closing Submissions, for each of the windfarms the Alliance acknowledged, but set into context, the potential contribution to electricity supply as at that date. The contributions are small and, in the overall balance which needs to be drawn, the adverse environmental effects summarised in that Closing and further illustrated above and in parallel submissions weigh very heavily against granting consent.

Submitted on behalf of the Alliance

29 July 2016

ALL-RED-02

The Mid Wales (Powys) Conjoined Public Inquiry into 5 Windfarm Proposals and a 132kV overhead Electric Line Connection

Re-determination of the applications by RES (Llanbrynmair) and RWE (Carnedd Wen)

The Alliance

Landscape and Visual, and Peat

Alliance response to Statement of Matters

1. Firstly the Alliance provides a general landscape and visual impact representation relevant to matters 1, 2, 3, 4, 5, 6 and 7. This is followed by representations on each matter in turn.

2. We make reference to many images provided by the applicants, and have included copies of these within the text. However, at the scale of this document they do not reproduce as well as they do in the original documentation (although when viewed electronically, the image size can be increased). The reader should therefore have to hand original paper copies of the following documents, and refer to the original images therein:

   i) Mr Stevenson's Landscape and Visual Considerations Proof of Evidence for Carnedd Wen for Session 2 (SSA B) (Sept 2013) (referred to subsequently as Mr Stevenson's Proof), Appendices 4 and 5.[1]

   ii) Llanbrynmair Wind Farm Supplementary Environmental Information (August 2013) Volume II-A - Supporting Appendices Addendum: Appendix 4.1 - Figures and Wireframes[2] and Volume III – Supporting Figures[3] (referred to subsequently as Llanbrynmair SEI 2013 Vol IIa App 4.1, and Llanbrynmair SEI 2013 Vol III).

   iii) Alliance Closing Submissions to the Inquiry.[4]

General landscape and visual impact

3. The Montgomeryshire landscape is wholly defined by an upland plateau cut into by river valleys throughout. This characteristic topography gives the remarkable and outstanding far reaching tranquil and dramatic views.

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1 Inquiry Document RWE-LAND-POE-STEVENSON-SSA-B
2 Inquiry Document AD/RES/031
3 Inquiry Document AD/RES/034
4 Inquiry Document ALL-030R

4. This upland plateau is bounded by the heights of Snowdonia massifs such as Cadair Idris and the Arans and by Long Mountain and Corndon Hill to the east and the Kerry Ridgeway to the south creating an 'amphitheatre' effect. Any development on the plateau is not only extremely visible and disconcerting across that landform but also visible from the surrounding heights.

5. The river valleys are not in general deeply incised, but ones where the transition from small scale landscape features through 'ffridd' to the upland moor and forestry can be readily appreciated by residents and visitors alike.

6. In order to appreciate this characterful, tranquil and restful landscape the Glyndŵr's Way National Trail was created in the 1990s and this long distance walk winds its way from Knighton to Welshpool and then, via Offa's Dyke Path National Trail, returns to Knighton. It passes through both the Llanbrynmair and the Carnedd Wen sites.

7. A good illustration of this upland plateau with surrounding heights can be found in Mr Stevenson's Proof at Appendix 4 fig 6.15E, upper photo, as reproduced below. We repeat the caveat that the copies of images included in this document do not necessarily reproduce well at this scale. It is therefore important also to view all the images in their original documents.

An illustration of the typical valley landscape backed by the plateau is in Mr Stevenson's Proof at Appendix 4 fig 6.15V (upper photo), as below.

8. The Hobhouse Report (1947) recommended this upland area be given special protection as a National Park and designation was not subsequently conferred due to local council objection. The Alliance accepts that it was not designated but the Report and subsequent agreement of the then Secretary of State that it was worthy of designation demonstrates the exceptionally high landscape quality in national terms.

9. The Inspector in his report (page 68 paragraph 384) draws attention to Powys County Council's view that the landscape is of a type which is well suited to accommodating the change of the scale proposed and states his agreement. However, the majority of the population and visitors to the area do not endorse that view and as the Inspector points out (paragraph 385) the present qualities are clearly valued by local residents and visitors. The landscape has a tranquillity and serenity associated with its predominant horizontal emphasis that would be destroyed by white moving metal and fibreglass vertical structures of above 120 metres height. Looking again at figure 6.15E and comparing the lower photograph (as below), with a windfarm installed, to the upper one (see paragraph 7 above) the loss can be easily visualised (although the effect is hard to see at the scale of reproduction below).

Even at a distance of 9.7km to the nearest turbine the grand vista and the relationship with the surrounding heights is destroyed as visually the turbines reach the height of the hills and incongruous motion removes the tranquillity. The scale, i.e. number of turbines of each scheme, is sufficient to overwhelm the so called 'substantial scale and simplicity' of the landscape and to most receptors the developments remove precisely the qualities they so value.

Matter 1

10. Llanbrynmair windfarm is positioned on the upland plateau so will affect both the landscape and visual amenity from other locations on that plateau as well as from the 'surrounding heights' as described above.

11. Using the Llanbrynmair SEI 2013 Vol III, relevant photomontages can be viewed to appreciate the effects:

a) Fig 4.34.3: Even at a distance of 25 kilometres from the turbines the main vista from the Kerry Ridgeway Promoted Trail at Two Tumps is severely affected as the long array of moving blades is thrown into prominence against the Arans and associated hills.

b) Fig 4.31.3: Likewise the view from the Arans, a popular challenge trek, is severely compromised by the long length of the moving array.

c) Fig 4.27.3: Even at 11km at the Wynford Vaughan Thomas Memorial viewpoint the turbines are prominent

d) Fig 4.26.3: At Bryn y Gadair, 9kms away, the turbines are very prominent in the view.

e) A photomontage from Llyn y Grinwydden open access land is not presented in the Llanbrynmair SEI 2013 Vol III but by looking again at Mr Stevenson's Proof at Appendix 4 it can be seen from fig 6.26N

(lower figure) that the effect of the Llanbrynmair array will be very similar to that of the Carnedd Wen array.

From this it can be seen that that is a complete disfigurement of the upland landscape and the resulting visual effects.

f) Returning to the Llanbrynmair SEI 2013 Vol III, further graphic representation as to how the landscape and visual amenity will be affected, and also experienced by those walking the Glyndwr's Way National Trail, can be ascertained in the following sequence of photomontages. The sequence covers a traverse of approximately 19.5km of Glyndwr's Way, perhaps a day's walk for most. The sequence is:

i) fig 4.22.3 Brynaere

ii) fig 4.13.9 above Cwmderwen

iii) fig 4.13.10 above Cwmderwen

iv) fig 4.13.11 above Cwmderwen

v) fig 4.13.12 above Cwmderwen

vi) fig 4.13.13 above Cwmderwen

vii) fig 4.17.6 Neintherion

viii) fig 4.17.7 Neintherion

ix) fig 4.17.8 Neintherion

x) fig 4.16.6 Cefnllys-uchaf

xi) fig 4.16.7 Cefnllys-uchaf

xii) fig 4.16.8 Cefnllys-uchaf

xiii) fig 4.18.4 and 5 Moel Ddolwen

xiv) fig 4.18.4 and 5 Moel Ddolwen

xv) fig 4.36.8 Crossing Pen Coed

xvi) fig 4.36.9 Crossing Pen Coed

xvii) and fig 4.25.3 Pennyfford.

The above photomontages obviously only represent a selection of points on the uplands where the array will have an effect and their presence will be all pervading in many other locations reached by road, byway or public rights of way.

g) The scheme will also have a dramatic effect on the Nant yr Eira valley and its residents. Figures 4.15.7 and 8 show the upper reaches of the valley and the windfarm landscape that will affect it and the residence at Ffridd Fawr.

Figure 4.15.7 Ffridd Fawr

Figure 4.15.8 Ffridd Fawr

There is also a residence at Castel y Gwynt very near to the photographer's position. Figure 4.17.6 (page 10 above) illustrates the position a short way down the valley with the residences at Neinthirion again having to experience a windfarm landscape.

Figure 4.35.3 (below) depicts the lower valley and not only are residences badly affected but the 'spatial arrangement' of the windfarm would appear to be totally contrary to the widely used 'best practice' of developers. As can be seen this is a sensitive aspect and the setting of the very highly regarded Llanerfyl mosaic lands is totally disregarded.

Figure 4.35.3 Minor Road within Nant yr Eira

h) Figure 4.23.3 shows how the settlement of Llan and its conservation area in the Twymyn valley south of Llanbrynmair has its setting badly compromised.

Figure 4.23.3 Llan village

i) Figure 4.25.3 (page 15 above) illustrates that the Banwy valley is also badly disfigured with an array similar to that of the Carnedd Wen scheme.

12. Such effects upon settlements and residences are used strongly by the Inspector in the balance for recommending refusal of Llanbadarn Fynydd (page 104 paras 623, 625 and 626) and Llaithddu (pages 100 and 101 paras 596 and 601) windfarms. Although the effects are just as great, if not greater, in SSA B they are not recognised in the planning balance. Further, for Llaithddu (para 601), the Inspector states there would be conflict regarding impact on settlements and residences with paragraph 3.1.1 of PPW which seeks to protect the amenity and environment of towns, cities and the countryside. Such

reasoned recourse to planning policy is never applied for the even greater adverse effects of Llanbrynmair or Carnedd Wen.

13. The Alliance believes it should be recognised that residential amenity wireframes for proximate properties at Llanbrynmair were only produced in the Llanbrynmair SEI 2013 Vol. II-A - App 4.1 during the Inquiry. At no time between the planning application of March 2009 and the Inquiry were residents provided with, or consulted on, such illustrative material.

    By reference to the following wireframes from Llanbrynmair SEI 2013 Vol. II-A - App 4.1 it is clear how severely amenity would be affected for residents. Insufficient emphasis has been placed on this aspect by the Inspector in his planning balance. The wireframe representations of the turbines are shown in red for Carnedd Wen and in blue for Llanbrynmair.

Fig 15c Neinthirion / Neint Hirion (below)

Fig 15d Neinthirion / Neint Hirion (below)

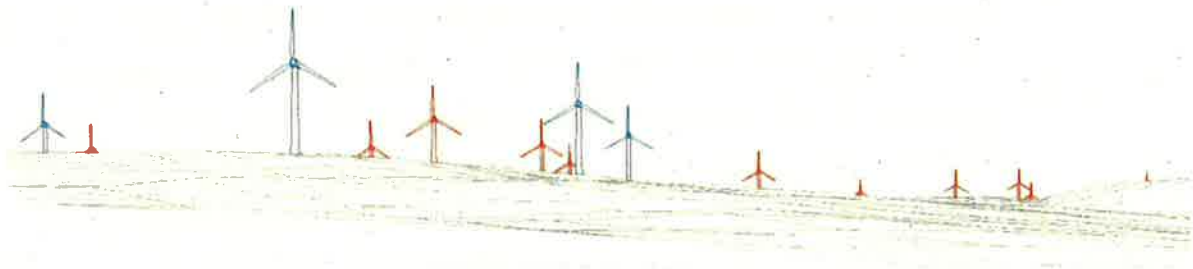


Fig 15e Neinthirion / Neint Hirion (below)

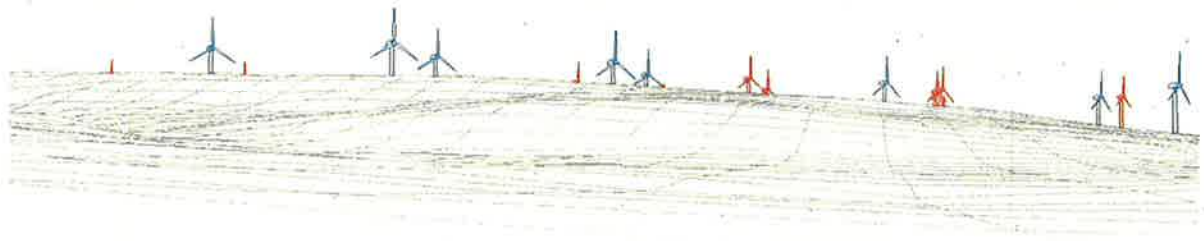


Fig 16c Beulah Chapel House (below)

Fig 16d Beulah Chapel House (below)

Fig 16e Beulah Chapel House (below)

Fig 21c Ffriddfawr (below)

Fig 21d Ffriddfawr (below)

Fig 21e Ffriddfawr (below)

Fig 22c Castell Y Gwynt (below)

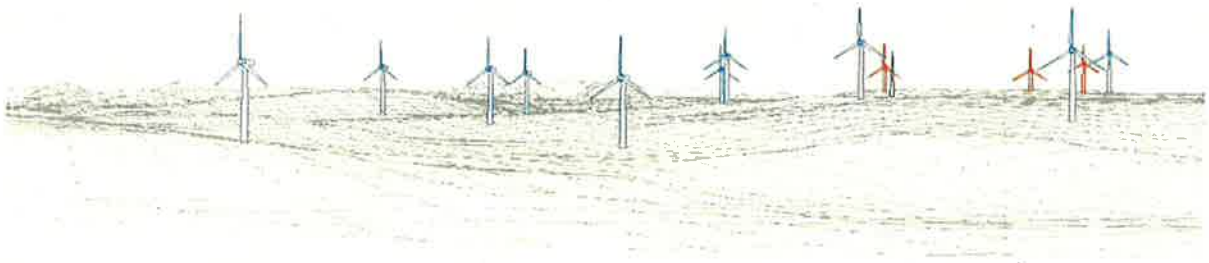


Fig 22d Castell Y Gwynt (below)

and fig 22e Castell Y Gwynt (below)

Matter 2

14. Carnedd Wen is located adjacent to Llanbrynmair on the upland plateau and thus the effect upon that landscape and the 'surrounding heights' is very similar. Having 50 rather than 30 turbines and being located on slightly higher ground and generally to the north and west of Llanbrynmair gives some differences of degree.

15. The Alliance would draw the Secretary of State's attention to the following photomontages from Mr Stevenson's Proof, Appendix 4 for the effects as similarly described above for the Llanbrynmair scheme. We re-emphasise the need to look at the original paper material, partly because the Carnedd Wen photomontages do not reproduce as well as those for Llanbrynmair.

a) 2013-042 Viewpoint SNPA2 Two Tumps Kerry Ridgeway

b) 2013-025 Fig 6.15I Viewpoint I Wynford Vaughan Thomas Memorial

c) 2013-019 Fig 6.15E Viewpoint E Garreg Hir

d) 2013-029 Fig 6.15M Viewpoint M Llyn Foeldinas Snowdonia National Park

e) 2013-030 Fig 6.15N Viewpoint N North west of Mynydd Waun Fawr Llyn y Grinwydden

f) 2013-028 Fig 6.15L Viewpoint L Foel Dugoed Snowdonia National Park

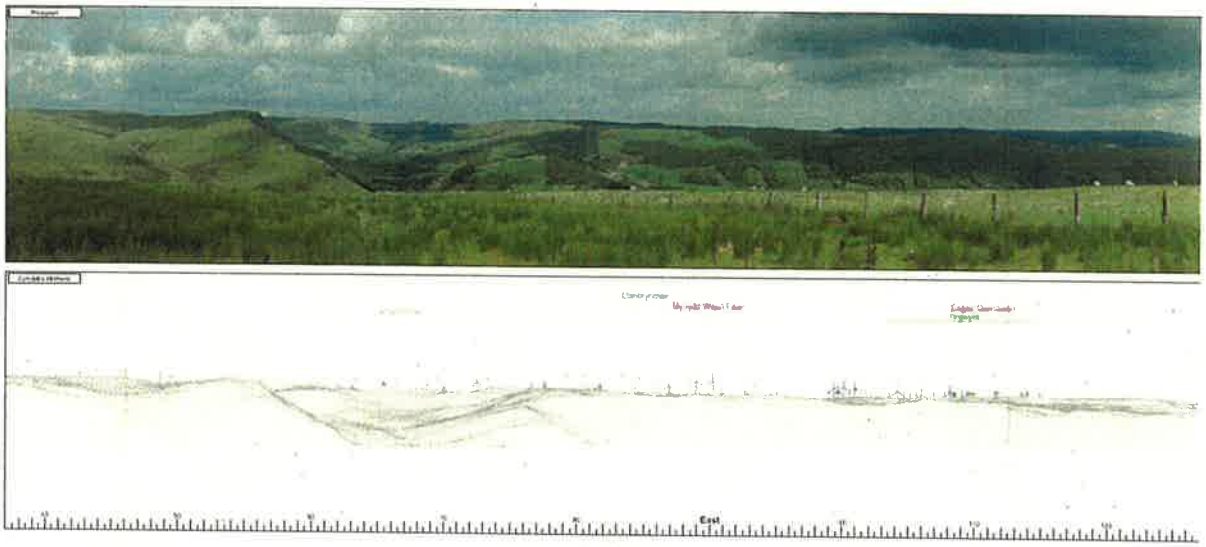
16. The same 19.5km walk on Glyndwr's Way National Trail can be undertaken for the Carnedd Wen development as for Llanbrynmair (Matter 1) referring to the Carnedd Wen photomontages and those of Llanbrynmair where they include Carnedd Wen turbines.

17. RWE failed to supply any representation whatsoever of the effect where Glyndwr's Way would pass through an 'avenue' of 10 turbines for some 2kms despite the serious detriment. To appreciate something similar to the scale of this refer to Llanbrynmair SEI 2013 Vol III photomontage Figs 4.13.9, 10, 11, 12 and 13 above Cwmderwen (pages 8 to 10 above).

18. It is important to understand that the maps used in Mr Stevenson's Proof Appendix 4 figures 6.11 and 6.12 show an earlier, pre- 2000 routing of Glyndwr's Way which did not pass through the turbine area. The route was officially revised some 18 years ago and since then has passed along the bridleway from Neinthirion through the forest of Cors Fforchog and past Cerrig y Tan to Llanbrynmair. This route is clearly shown in the official pamphlets published in 2000 and on the OS Explorer Map of 2009.

19. The sequence of photomontages for the walk are from Mr Stevenson's Proof Appendix 4 Updated Figures or Appendix 5 Cumulative Visualisations.

a) Appendix 5 Cumulative Viewpoint 1a Brynaere Photograph and Cumulative Wireframe

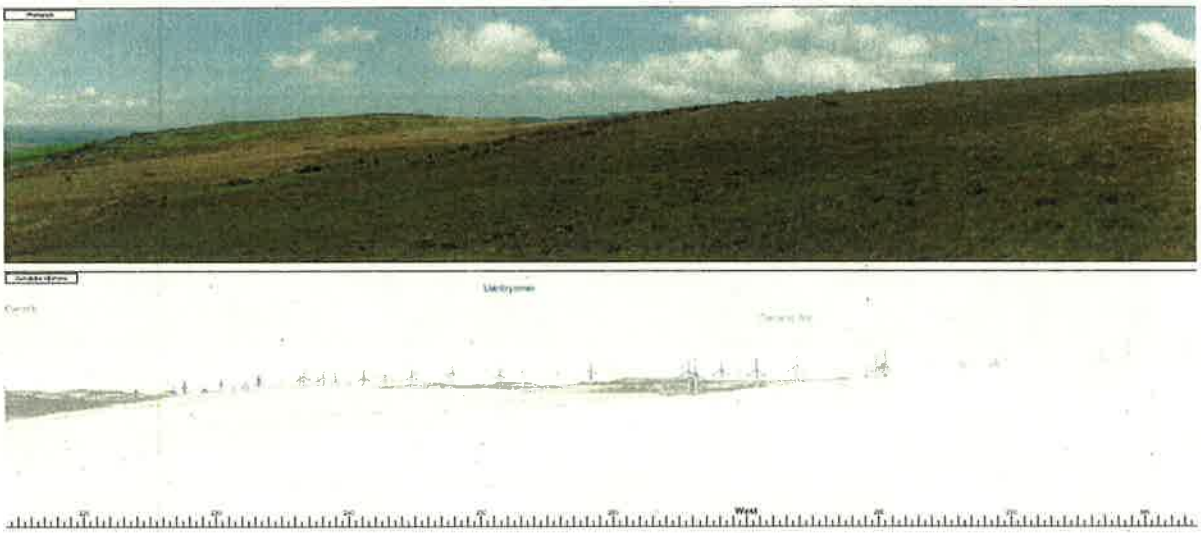


b) Appendix 4 Fig 6.15C Viewpoint C Esgair Fraith

c) No suitable Viewpoint for avenue of 10 turbines

d) Appendix 4 Fig 6.15O Viewpoint O Glyndwr's Way Dolwen

e) Appendix 5 Cumulative Viewpoint 9b Glyndwr's Way crossing Pen Coed Photograph and Cumulative Wireframe



f) Appendix 4 Fig 6.15V Viewpoint V Glyndwr's Way near B4395

20. The Carnedd Wen scheme will also have severe effects upon the valley landscapes of the Nant yr Eira and the Banwy. Although the CW turbines are not as close to the Nant yr Eira as those of Llanbrynmair, their presence and number will have a similar effect at some locations. This is more difficult to judge from the Carnedd Wen photomontages as there is only one located in the valley (Figure 6.15O Viewpoint O, page 26 above) and that is of extremely poor quality. However using the Llanbrynmair SEI 2013 Vol II A App 4.1, which has wireframes for both the windfarms' effect in the valley, a better idea can be obtained. Severe effects of the Carnedd Wen scheme upon residences and the landscape of the valley are shown by the following examples (the

wireframe representations of the turbines are shown in red for Carnedd Wen and in blue for Llanbrynmair):

a) Fig 11c Dolwen Isaf

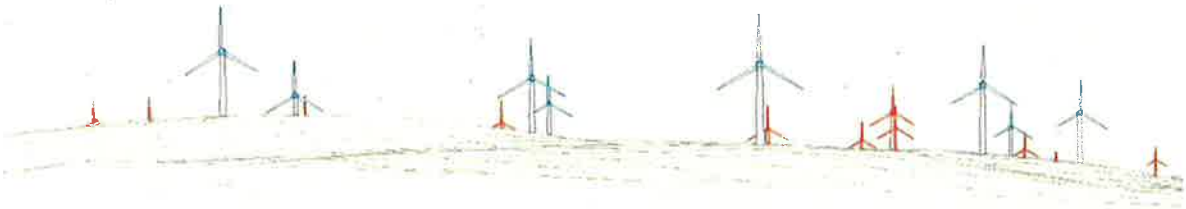
b) Fig 11d Dolwen Isaf

c) Fig 11e Dolwen Isaf

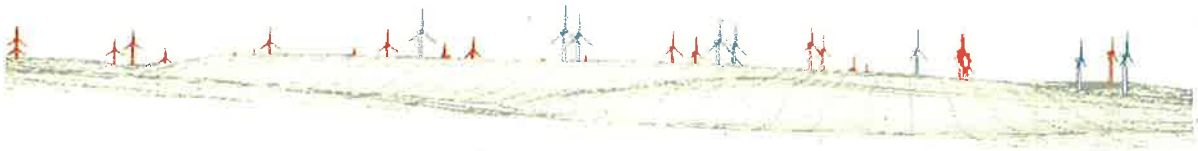
d) Hafod Y Beudy (fig14b)

e) Fig 18c Dolau Ceimion

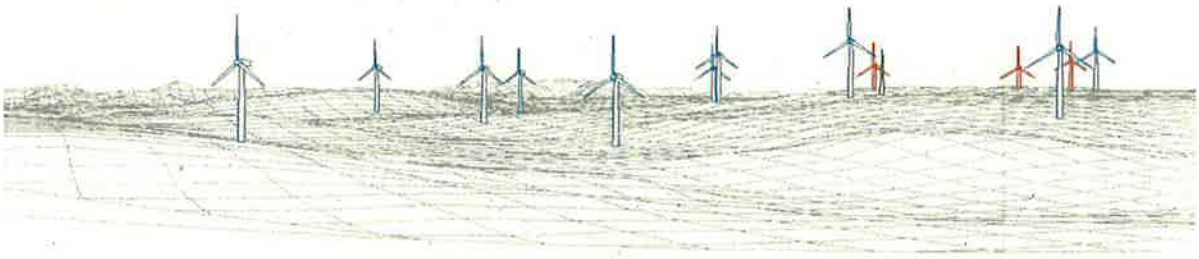
f) Fig 18d Dolau Ceimion



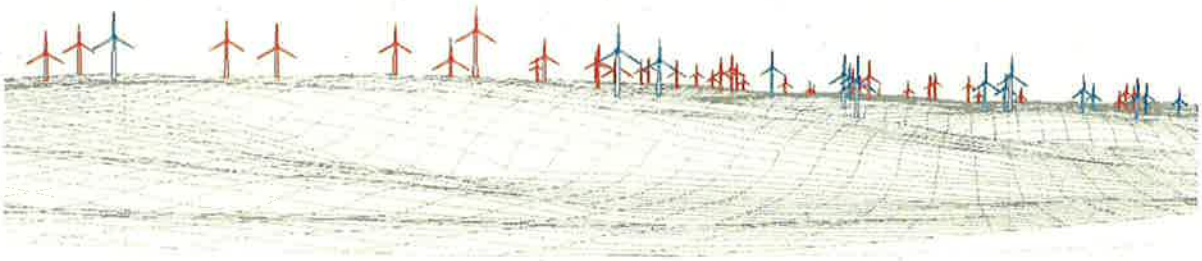
g) Fig 18e Dolau Ceimion



h) Fig 22 c Castell Y Gwynt



i) Fig 22 d Castell Y Gwynt



j) Fig 22 e Castell Y Gwynt

21. As at Llanbrynmair (see Matter 1), the Inspector has once again failed to adopt the same detailed reasoning he properly used for the Llaithddu and Llanbadarn Fynydd schemes.

22. The Banwy valley is seriously affected by the Carnedd Wen scheme as shown in the photomontages in Mr Stevenson's Proof Appendix 4,

figures 6.15U, V and W. The inspector in paragraph 341 agrees that the valley is of high scenic quality and considerable amenity value.

Fig 6.15U

Fig 6.15V

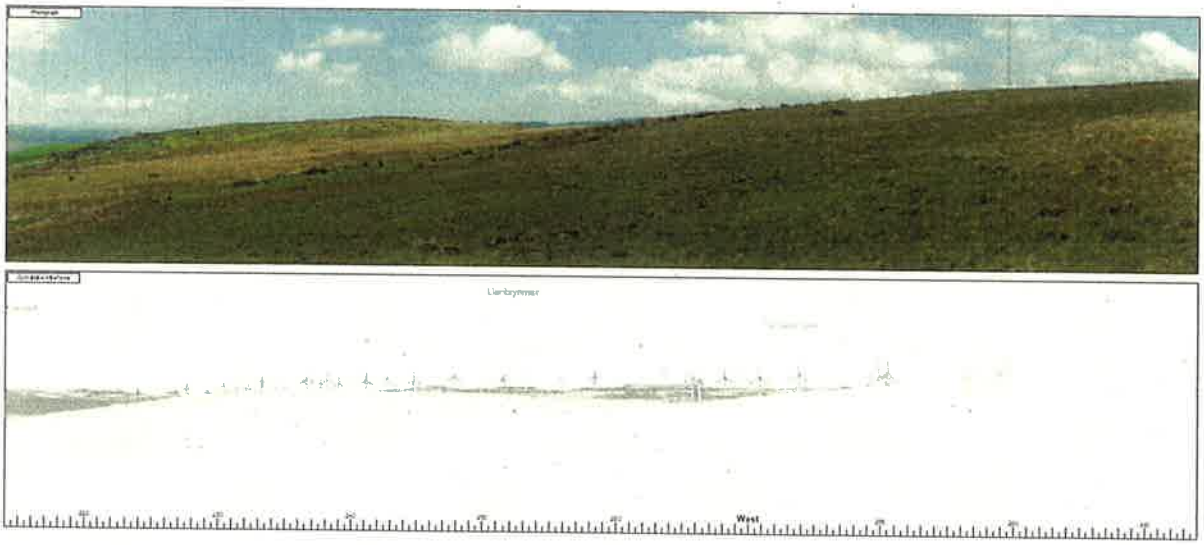
Fig 6.15W

Matter 3

23. The Alliance is, as is obvious from our evidence at the Inquiry and our representations above, adamant that the landscape and visual effects of each scheme alone are such that they should not be contemplated in the much valued landscape of Montgomeryshire.

24. We would like to draw the Secretary of State's attention to just two wireframes as examples of the devastation that would be inflicted if both schemes were to be built:

a) Mr Stevenson's Proof of Evidence App 5, Cumulative Viewpoint 9b Glyndwr's Way crossing Pen Coed Photograph and Cumulative Wireframe. This illustrates the devastation of the upland landscape adjacent to a National Trail brought about to showcase the tranquil nature of such areas.



b) Llanbrynmair SEI 2013 Vol II App 4.1, page 22 figs 22c, d and e (see page 30 above). This combined residential wireframe for Castell y Gwynt illustrates the destruction of the stunning setting and view for a residence and the landscape of the upper reaches of the Nant yr Eira valley. Again this is an area loved and visited for its tranquillity and unique upland valley environment.

25. The Inspector in his report does not, unlike inspectors in other appeal reports, fully report the effects on such residences and landscape - even when they had been drawn to his attention by the Alliance and residents. His discussion of the effects on landscapes and residences (paras 383 - 387) is very general and most curiously falls a long way short of the necessary and detailed discussion that was undertaken for

such effects at Llaithddu (paras142 - 158) and Llanbadarn Fynydd (paras192 - 214).

Matters 4, 5 and 6

26. A full consideration of the cumulative aspects of the proposed developments with other windfarms is beyond the resources of the Alliance in the three weeks allowed. The planning position regarding many windfarms considered in the cumulative aspect at the Inquiry has now changed. It appears most of the analysis undertaken by all the parties and subsequently the Inspector must now be considered to be wholly overtaken.

27. However there are some particular issues we would wish to raise.

28. The Alliance is concerned that methods of analysing cumulative effect are often used that do not reflect the perceptions of the general public. To most people in the community when a windfarm scheme is added to others the total cumulative landscape and visual effects are increased. However the methodology often used in Environmental Statements tends to suggest that the cumulative position is not as bad.

29. As an example, the Llanbrynmair SEI 2013 (Vol I) table 4.20 (page 114) gives the significance of the effect of Llanbrynmair alone at Viewpoint 10 (Glyndwr's Way, Brynaere) as *"Major, long-term"*.

30. Turning to table 4.39 (page 140) it can be seen for the same viewpoint (now CVP1) the significance for assessment Scenario A with more windfarms is *"Moderate"* and with even more windfarms in Scenario B the effect is now *"Minor"*. If the reader is not fully aware that this is so called 'additional effect' and glances at a table with such significances a totally wrong interpretation of the total cumulative effect can be obtained. In fact it is difficult to see how a proper judgement can be

made regarding the total cumulative effect as that does not appear to be an analysis that is carried out by the professionals. This is clearly an area where the needs of the community and decision makers are at variance with the methodology employed by professionals.

31. The Inspector states in his report (para 501) that cumulatively the proposed developments in SSA B and SSA C would be rarely experienced sequentially as part of a journey. However, this obviously omits the sequential effect for the high sensitivity receptors, namely the walkers on Glyndwr's Way National Trail. Since the Inquiry, Garreg Lwyd Hill windfarm in SSA C has received approval from the Welsh Government and is currently being constructed. This windfarm has a major detrimental effect on the Trail for approximately a day's walking. Thus the sequential cumulative effect of Garreg Lwyd Hill and Llanbrynmair and Carnedd Wen on the Trail will be overwhelming, destroying its integrity and raison d'être.

Grid aspects

32. The cumulative analysis must also consider the transmission lines required to extract the power from each of the windfarms. The Local Area Network in Mid Wales is at capacity and therefore National Grid, at the invitation of the local network operator (SPEN), has, since 2005, been working up a scheme for the building of a 400kV hub and transmission line from SSA B to the National Grid in Shropshire. Many £ millions have been spent on extensive design studies, consultation, land surveys etc. This hub system is therefore a direct result of the applications for windfarms and Carnedd Wen and Llanbrynmair are now the largest schemes proposed in the area requiring the system. National Grid suspended work after the Secretary of State's decisions of 7 September 2015 were announced. It is instructive that they have not withdrawn their scheme entirely after Llanbadarn Fynydd, Llaithddu and Mynydd y Gwynt were refused, but are awaiting the decisions on Carnedd Wen and Llanbrynmair.

33. At the CPI the Inspector instructed the developers to produce a report on whether different schemes could be used to transmit the power without the use of a 400kV system. This resulted in the Grid Connection Option Review by Mott Macdonald and the SEI on Grid Connection Scenarios by LUC.

34. The Alliance undertook a review of these documents and presented evidence to the Inquiry (ALL-GRID-POE-S4-01/ALL-S4-POE-01). Although Mott Macdonald stated that transmission by 132kV systems was possible it is obvious from their report and summary it is considered an unlikely option. For example in the summary the words *'an usually long way at this voltage for this amount of generation'* and *'there are technical issues concerning voltage regulation, summarised in Appendix A, which are on the limit of acceptability but which can probably be satisfactorily managed.'* Also, *'there would also be significantly more power lost in transmission at 132kv compared with 400kv'*. The experts in transmission and distribution and other chartered engineers in the Alliance cannot believe that such a 132kV system would be chosen over the 400kV system that has been comprehensively worked up and therefore must remain as a consideration as a direct consequence of these two windfarms.

35. In its Closing Submissions, the Alliance set the position of Grid Connections into their factual and policy contexts (ALL-030 section 8) and does not repeat it here.

36. It is axiomatic that the landscape, visual, environmental and cultural heritage effects of the 400kV transmission scheme must be considered in the cumulative effects of each of these windfarms.

Matter 7

37. The developers of both Carnedd Wen and Llanbrynmair are proposing to undertake felling of softwood forest and 'restoration' of the land to a bog type habitat. Leaving aside for a moment the issue as to whether this is possible, it is instructive to try and obtain some idea as to whether the result would be meaningful in landscape and visual terms. The Carnedd Wen scheme, the larger of the two regarding restoration measures, can to some extent be visualised by reference to the following photomontages from Mr Stevenson's Proof Appendix 4.

    a) Fig. 6.15L illustrates the visual and landscape effect from the Snowdonia National Park. A considerable proportion of forest has been removed but we are of the opinion that the end result shows little if any aesthetic improvement and whilst the turbines are in situ is of no consequence as their scale dwarfs any such mitigation.

Fig. 6.15L Viewpoint L Foel Dugoed Snowdonia National Park

b) A similar argument applies to the scheme as seen from the east (Fig. 6.15V). The aesthetic qualities have actually been further diminished as very unnatural blocks of forestry have been left in place.

Fig. 6.15V Viewpoint V Glyndwr's Way near B4395

Computer generated wireline drawing

38. Although there are no such photomontages for the Llanbrynmair restoration scheme as far as we are aware, the smaller size of the scheme would be extremely unlikely to generate any really tangible landscape or visual change before or after the removal of the turbines.

39. Regarding visual changes at a more local level, the benefits claimed would not in our opinion be of any great consequence and would indeed be negative for a considerable time. The removal of very large areas of forest will for at least five years, if not considerably longer in our experience, produce a very ugly wood brash, disturbed and bare earth environment. This often leads, unless there is extremely rigorous

management, to colonisation by rank vegetation, far from the desired outcome.

40. The establishment of a successful ecological bog environment by the blocking of drains etc. is still a very variable process as the Natural England literature (Restoration of degraded blanket bog NEER003 May 2013 4.5 and 4.7 and full text) as our evidence (ALL-PEAT-POE-SSA-B-05 / ALL-SSAB-POE-05) and that of Dr Cresswell (doctorate in ecological physiology) at the Inquiry showed. The likelihood of obtaining the required increase in water table height is slight and it is not, we believe, sensible to subject such large areas to such risk in a fragile ecological area. The Alliance is not convinced, particularly after cross examining the Carnedd Wen technical team at the Inquiry, that the onerous and numerous conditions that would be required in all their management plans would be translatable to the extreme site conditions. They also showed no likelihood of implementing proper ecological co-ordination with the Llanbrynmair workings. For example, the Carnedd Wen forest extraction already pushes acidification to the limits without even considering the Llanbrynmair workings on the same uplands.

41. The loss of carbon from the felling of the forest would not be balanced by the gains from the remedial measures as our evidence shows (ALL-SSAB-POE-05 paras 4.2, 4.3 and 11.1) and the Inspector agrees (para 358).

42. We, the Alliance, representing the local community therefore believe that the ecological mitigation, restoration or remedial measures offer little or no landscape, ecological or carbon benefits to offset the massive landscape and visual harm of the developments. What is more the local community will have to suffer the considerable disturbance of removing a forest at a rate up to 5 times that of normal felling operations per annum for at least four years. Our evidence

(ALL-SSAB-POE-05) to the Inquiry shows this is a major risk: this has not been taken into account by the Inspector.

43. There is no evidence to suggest that the risks and probability of failure or success of such a large restoration scheme, in this case over an upland area of approximately 24 sq.kms, has been properly and independently assessed by relevant experts. To ensure that severe environmental degradation is not brought about in these ecologically important but fragile areas we would have thought that such a process as an 'appropriate assessment ' must be undertaken.

44. The risks to successful implementation on the scale proposed are so high that the community would most likely be left with a badly degraded environment that would rapidly deteriorate as the ecological management ceases after 25 years and, ironically, a likely 'repowering' of the windfarm takes place at the same time resulting in even greater landscape and visual devastation.

45. A much less risky and more ecologically balanced solution would be achieved under the UK Forestry Standards requirements, particularly for peatlands, when the forest is more sustainably removed under normal cropping arrangements.

46. It is also relevant that the present forest is not seen by the community or visitors as the hugely negative environment that the developers and the Inspector portray. Indeed on a recent 'Ramblings' broadcast on Radio 4 (19/5/16 at 1500) Claire Balding accompanied a person who had walked all over Wales and chose the precise section of Glyndwr's Way between Llangadfan and Llanbrynmair that is so badly affected by these schemes as one of her favourite walks in Wales and her favourite part of Glyndwr's Way. A major part of the pleasure of that walk was the contrast between the moorland and forest sections and she described the forest section as 'magical' and the upland sections as a 'wilderness experience'. Both these qualities will of course be

irrevocably lost with the development. This serves to emphasise that what the general public values in the landscape can be so at variance with the perceived wisdom of landscape experts.

47. The 'Carnedd Wen five' removal of five turbines from the Carnedd Wen proposals was advocated by the County Council's landscape witness as suitable mitigation for the immense landscape and visual damage caused by the scheme. It is said that these five are especially damaging as they 'spilled' over the edge and gave the impression that the windfarm was also in the Banwy valley. The Alliance is of the opinion that this reduction is of little consequence and does not offset the adverse landscape and visual impacts to any degree. Mr Stevenson's Proof Appendix 4 photomontage 2013-039 V2 Glyndwr's Way shows that in this view across the Banwy valley removing 5 of the front turbines will make little or no difference. The array will still be seen as on the edge of the plateau and therefore contravening so called 'best practice' in windfarm design. The effect upon the Banwy valley will still be major.

Photomontage 2013-039 V2 Glyndwr's Way

48. In visualising the combined Carnedd Wen and Llanbrynmair schemes in Mr Stevenson's Proof Appendix 5 it will be seen in Cumulative Viewpoint 2b photomontage that the removal of the 'five' is of even less consequence in limiting the damage of the huge combined array.

Cumulative Viewpoint 2b: Glyndwr's Way, Penyfordd: Cumulative Photomontage

Summary

49. In its Closing Submissions, for each of the windfarms the Alliance acknowledged, but set into context, the potential contribution to electricity supply as at that date. The contributions are small and, in the overall balance which needs to be drawn, the adverse environmental effects summarised in that Closing and further illustrated above and in parallel submissions weigh very heavily against granting consent.

Submitted on behalf of the Alliance

29 July 2016

ALL-RED-03

The Mid Wales (Powys) Conjoined Public Inquiry into 5 Windfarm Proposals and a 132kV overhead Electric Line Connection

Re-determination of the applications by RES (Llanbrynmair) and RWE (Carnedd Wen)

The Alliance

Wildlife and Ecology

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1. The Alliance welcomes the opportunity to contribute to the re-determination of both Carnedd Wen and Llanbrynmair applications as we have very particular concerns regarding the failure of the Inspector's Report to advise the SoS of the important attributes of Llanbrynmair Moors as a whole. Indeed, the whole access route and the combined sites (1,700ha) warranted just paragraphs: 35, 322, 323, 324 and 653. There can be no doubt that Llanbrynmair Moors was of National Importance in the 1980s[1] and it is indisputable that the still good peatland will be damaged by the proposals.

2. More specifically, the SoS was not fully advised as to the special attributes and sensitivities of the peat and associated ecological aspects.

3. The SoS will need to revisit the Alliance evidence, guided by our Closing Submissions on Ecology and Wildlife[2]. The burden of the evidence submitted by the Alliance was given little or no space in the Inspector's Report, and the habitats and wildlife of this vast blanket bog moorland were given exceptionally short time during this year long Inquiry. However, NRW states[3], *"The former CCW formally objected to the proposal and the subsequent revisions in a letter sent as a consultation response to DECC on 12 October 2012. The objection letter was attached to the former CCW's original statement of case submitted in January 2013."* And similarly in the Carnedd Wen SOC[4].

4. The original Statements of Case were produced by CCW, the only independent advisory public body on nature and habitats in Wales. The full document says[5]: "*The mapping of habitats and peat on the site is considered to have a number of uncertainties and the Applicant has failed to take this into account in the design of the scheme".* No evidence was brought before or available to the Inquiry to reduce these

1 PoE Dr. Ann Cresswell § 3.2 presented to the Inquiry on 3 December 2013
2 Inquiry Document ALL-030R pages 39 - 42
3 CON-003-SOC-SSA-B-2 NRW Amended SoC Llanbrynmair windfarm Sept 2013 §1.3
4 CON-003-SOC-SSA-B-1 NRW Amended SoC Carnedd Wen windfarm Sept 2013 §1.3
5 See appendix - CCW original SOC Jan 2013 §17-21

uncertainties; however, the Inspector reported, in relation to peat that *the site had been well surveyed*[6] and that NRW had no objection[7] on grounds of peat, and habitats; however, the SOC makes it clear that CCW ecologists had real concerns[8] and these did not go away.

5. NRW also disagreed with the Inspector's conclusion in relation to bats: "*I also consider that insufficient survey evidence has been provided to satisfactorily support the conclusions*"[9]. It is clear from the Inspector's statements that he failed to report to the SoS or to take into account the professional (though unpaid) evidence of the Alliance in reaching his conclusions.

6. It should be noted that the Statements of Case were submitted on 14th May 2013, just six weeks after the new body, NRW, had been formed through the amalgamation of CCW with EA and FC. At this time its priorities changed and the new public body no longer objected, and matters that were clearly of considerable concern disappeared from their radar; PCC took their advice from NRW, so this left the Alliance as the only party to object or wish to question either developer regarding the habitat and ecology of Llanbrynmair Moors.

7. We reiterate; nothing changed, except the priorities of the public body. The design, access and implementation as well as the quality of the survey work did not alter significantly from January to May 2013, nor over the following year.

8. The Inspector did not accept the Alliance evidence on the fragility and value of blanket bog and species rich acid grassland, and did not begin to illustrate the nature of that evidence so that the SoS could weigh the

6 Inspector's report §334
7 Inspector's report §362
8 See Appendix, Original CCW SOC
9 NRW PoE Llanbrynmair Bats §5.1 (Inquiry Document CON-003-BATS-POE-MATTHEWS-SSA-B)

matter[10]. It was only the Alliance that undertook carbon sequestration calculations, which the Inspector confessed *never to have understood.*

9. It is evident that the Inspector has failed adequately to report the biodiversity of the Moor itself in his report: This is perhaps most clearly shown by his claim that "... *the harm to the environmental and landscape qualities of Powys could be largely avoided by use of the alternative route"*[11]. Indeed there is no clear indication that he took on board the burden of the evidence submitted by the Alliance.

10. The Inspector encouraged local representation, and the Alliance benefitted from wide ranging and highly professional expertise and yet its evidence was not adequately reported despite being the only party at the Inquiry working Pro Bono and with intimate local knowledge and local expertise.

11. More than 2,000Ha comprise active blanket bog and as is seen on the image on the front cover of the Carnedd Wen 2013 SEI Non-Technical summary[12], much of this is diverse and species rich for example Corsydd Llanbrynmair[13]. The Report fails to inform the SoS of the importance or the fragility of these habitats. Restoration and improvement works on the scale contemplated are unprecedented. The Alliance evidence shows just how precarious the whole scheme would be by reference to the reliance upon complex and interrelated management schemes which will need to jostle with construction and tree-felling operations. Little, if any, of the Alliance evidence relating to the risks and consequences of risks was reported to the SoS for him / her to weigh in reaching a decision.

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10 Inspector's report §323
11 Inspector's report § 653
12 Inquiry Document AD/RWE/030
13 Alliance Closing Statement p96 § 13.13[

12. In addition, there are 18 designated Wildlife Sites that will be affected by any changes to Llanbrynmair Moors. Impact on these has not been assessed, and so the Inspector could not report on them

13. The applications fail to meet the guidance in TAN 5[14] and contravene Planning Policy Wales 5.1, to "*look for development to provide a net benefit for biodiversity conservation with* ***no*** *significant loss of habitats or populations of species,* ***locally*** *or nationally*" [our emphasis].

14. The 'round-table hearing session' on 3 and 5 December 2013 was for both sites on Llanbrynmair Moors and its wider ecosystem. It was very limited; questions were restricted and the developers were not questioned in depth, with no testing of their statements. These included the acceptance of *a certain level of incidental mortality* of the bat population through blade strike, disregarding TAN5[15] guidance and PPW, "*to ensure that the range and population of protected species is sustained*".

15. Research is constantly updated and as stated there is significant lack of UK research data into impact on bats and a number of other species[16], but we can gain a good understanding from European and North American studies.

16. The same policies and guidance are contravened with regard to birds and we refer you to our Closing Submissions.[17] We also refer you to *Birds of Conservation Concern 4: the Red List for Birds*[18] published in December 2015. The Alliance also drew the Inspector's attention to the avian population because of the importance of specified songbirds as indicator species[19].

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14 TAN5 p4 §2,1.4th bullet point
15 TAN5 p5 §2.4 7th bullet point & PPW6 §§5.2.3, 5.5.11 & 5.5.12
16 Alliance Closing Statement Ecology and Wildlife p41 § 6.16
17 Alliance Closing Statement p40 §§6.9 – 6.11; p98 §§13.27, 13.29; p111 §§14.29 - 14.32
18 https://www.bto.org/science/monitoring/psob
19 Alliance Closing Statement Carnedd Wen §14.31

17. Red list birds are known to use the site[20] and BTO states, *Five upland birds (Curlew, Dotterel, Grey Wagtail, Whinchat and Merlin) were added* [to the new list], *bringing the total for this* [upland] *habitat to 12.* Of the twelve species known to use uplands 8 are present on Llanbrynmair Moors: curlew, merlin, hen harrier, lapwing, dotterel (passage bird), cuckoo, skylark and lesser redpoll. The Inspector states that there would be particular benefit to hen harrier and black grouse,[21] and also says that other avian populations would *change*. No evidence was presented or is available to suggest that the change would be anything other than negative.

See: *Greater impacts of wind farms on bird populations during construction than subsequent operation: results of a multi-site and multi-species analysis.* Journal of Applied Ecology pages: 386 – 394: authors James W. Pearce-Higgins, Leigh Stephen, Andy Douse, Rowena H. W. Langston[22]

a. *The potential to affect birds through disturbance or collision, but the extent to which such developments cause general population declines, and therefore are of wider conservation concern, remains largely untested.*

b. *Monitoring data from wind farms located on unenclosed upland habitats in the UK were collated to test whether breeding densities of upland birds were reduced as a result of wind farm construction or during wind farm operation.*

c. *Data were available for ten species although none were raptors.* [These included] *curlew Numenius arquata densities all declined on wind farms during construction. Red grouse densities recovered after construction, curlew densities did not. Post-construction curlew densities on wind farms were also significantly lower than reference sites.*

d. *Suggesting for the first time that wind farm construction can have greater impacts upon birds than wind farm operation.*

18. Timber extraction and development on this scale has not been tested, but we have evidence of the impact on upland birds on the 10 schemes

20 Confirmed with Montgomeryshire Wildlife Trust
21 Inspector's report p65 §363
22 See http://onlinelibrary.wiley.com/doi/10.1111/j.1365-2664.2012.02110.x/full

studied by Higgins et al, none of a scale or duration of construction proposed here.

19. Water quality and the effect of even 'minor' pollution in Afon Gam and other watercourses and pools on the Moors has not been clearly reported to the SoS, although the evidence submitted by the developer[23] and the Alliance made clear the level of impact and likely effects on a food chain.

20. The Alliance asks that the Secretary of State reviews the ecological case made by the Alliance that was developed by local experts with practical and research experience of peat and habitat restoration, habitat management and surveying. The Alliance Closing Submissions (ALL-030R) will guide the SoS to the evidence which the SoS needs to review in order to fill the gaps left by the Report [24].

21. In its Closing Submissions, for each of the windfarms the Alliance acknowledged, but set into context, the potential contribution to electricity supply as at that date. The contributions are small and, in the overall balance which needs to be drawn, the adverse environmental effects summarised in that Closing and further illustrated above and in parallel submissions weigh very heavily against granting consent.

Submitted on behalf of the Alliance
29 July 2016

23 2008 ES §8.3.114 and §9.4.36, and ALL 030R 13.27
24 Please note that ALL-SSAB-POE-05 to which reference is made, is listed on the CPI website as ALL-PEAT-POE-SSA-B-05 Effects on Peat.

ALL-RED-04

The Mid Wales (Powys) Conjoined Public Inquiry into 5 Windfarm Proposals and a 132kV overhead Electric Line Connection

Re-determination of the applications by RES (Llanbrynmair) and RWE (Carnedd Wen)

The Alliance

Tourism and the Economy

Economy

1. The Alliance contested the claim that Carnedd Wen and Llanbrynmair would bring significant economic benefits to the rural economy. Some of the most reliable evidence on economy comes from the Cardiff University and Business School study of the impact of windfarms on the rural Welsh economy (2011 Munday et al). The study showed few local jobs were created as confirmed locally with the construction of Tir Gwynt and Garreg Lwyd Hill. In neither case has work gone to Powys contractors, components are being shipped in from outside the UK and even haulage is contracted to a company from the North East of England. Local jobs depend upon local supply chains and as the Cardiff University study found rural windfarms are overall resulting in small job losses generally due to reduced tourism.

2. Economically Powys remains robust enjoying statistically full employment limiting local workforce availability. It is more likely that short term intensive construction activity offering predominantly low skilled and low paid jobs will destabilise and adversely skew an economy, particularly when based on predominantly small and innovative enterprises with a high skill level (Powys and Ceredigion have the highest proportion of their populations with NVQ Level 4 or above qualifications in Wales).

3. The Inspector preferred to base his case on the largely discredited claims for jobs made by the Regeneris report (2012)[1] from projections and assumptions based on the totally different South Wales economy. As he agrees that local supply chains may not be capable of taking full advantage of opportunities available and that a higher proportion of expenditure may have to be made abroad due to limits in UK manufacturing capacity it is difficult to follow the reasoning. The Regeneris report is not grounded in actual experience and uses job

1 Regeneris (Welsh Economic Research Unit) for RenewablesUK Cymru (2012): Economic Opportunities for Wales from further on-shore development

numbers far in excess of those predicted by the developers at Carnedd Wen and Llanbrynmair. Existing Mid Wales windfarms show that some 5 permanent jobs are created per 100 turbines with some of these being remote or highly qualified 'flying squads' of engineers rather than local. Turbine part manufacturing units have closed (Siemens, Newtown) or downsized (Mabey Bridge, Monmouthshire). Regeneris estimates can be seen as wholly unrealistic rather than 'somewhat optimistic' and are certainly not translating into a boost to rural Welsh economies. The Cardiff University study demonstrated that community benefits from windfarms were not proving to be an economic driver in rural communities and again the Alliance showed that local communities in receipt of windfarm 'benefits' continue to be some of the most depressed in the region on socio-economic parameters.

4. It would be naive in the extreme to place any reliance on the Regeneris report in a decision making process.

Tourism

5. Tourism is a key component of the local economy. Annual Visit Wales surveys (Powys Booster) show that the stunning and varied landscape, rurality, quiet lanes and unspoilt tranquillity are the unique selling point for Montgomeryshire.

6. Substantial weight needs to be given to such an important facet of the rural economy that also supports local infrastructure. Rural tourism frequently exhibits very narrow profit margins so is highly susceptible to even modest fluctuations in the market.

7. That evidence had been incorrectly and prejudicially construed or ignored is clear. A complete deconstruction of this section of the report is not appropriate in the timescale available but a few examples suffice to make the point.

8. The Inspector's Report exhibits that key factors regarding tourism were not grasped. At para 521 the Inspector states: *'the area that would be directly affected by the proposed wind farms would amount to a small proportion of the land area'*. This misses the point. The actual footings may occupy a small area but these are structures of over 120m height and the developers' ZTVs and a simple understanding of the upland plateau nature of the area demonstrate how the striking long distance views to and from the Arans, Berwyns, Snowdonia, Cadair Idris, Kerry Ridgeway etc. will all be affected.

9. That the proposed windfarms would *'be away from most key natural assets and tourism locations'* ignores the fact that the landscape and the opportunities to enjoy the rural tranquility <u>are</u> the key natural assets and tourist attraction. That most holiday park homes *(some 5,000 within a 15km radius of the windfarms - more than any equivalent non-coastal area anywhere in the UK*[2]) are located in valleys well away from the proposed windfarms is true, they are not located on exposed hillsides away from all facilities. They are, in the main, located in areas where they have no impact on the tranquil open countryside: that is the point. Those who come to them are, however, attracted by that tranquil open countryside. Visitors do not simply stay in their park homes but come to walk, ride or simply enjoy the wonderful scenic environment with which they are surrounded. It must also be taken into account that the valleys are destined to carry the 132kV and/ or 400kV overhead lines necessitated by placing windfarms in remote, dispersed locations distant from the Grid and in an area where the Local Area Network is at capacity. The Inspector goes on *'and are well positioned to take advantage of key natural assets and visitor attractions that would not be affected'* again totally missing the point of what the visitor attractions are and how in long panoramic views the windfarms would become an ever present intrusion.

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2 Alliance insertion in italics. Evidence presented annex B to Alliance PoE on Tourism and the Economy (Inquiry Document ALL-SOCIOECO-POE-S4-04 / ALL-S4-POE-04)

10. A high proportion of visitors enjoy walking, cycling, horse riding and other quiet rural pursuits. The Alliance presented recent, unequivocal evidence from the British Horse Society, Mountaineering Council of Scotland and the John Muir Trust whose extensive surveys of equestrians, walkers and those that enjoy visiting the countryside demonstrated significant numbers avoiding, or intending to avoid, areas with windfarms (over 60% in the case of long distance walkers). The Inspector's Report dismisses the surveys as having provenance from organisations actively campaigning against windfarms. This is certainly not true of BHS who have worked closely with windfarm developers and was only the case with the Mountaineering Council after their survey indicated the strength of members' opposition. JMT do actively campaign to maintain the integrity of wild land and rural places but their remit is far from exclusively anti-windfarm. That we presented similar results from surveys of rural visitors commissioned by Visit Wales and Visit Scotland, neither of them anti-windfarm campaigning bodies, was ignored. Tellingly the Visit Wales survey showed how multiple windfarms in a view increased antipathy to nearly 60% amongst rural visitors, the ones we should be considering here. Any evidence presented to the contrary by the developers' hired experts (despite the dearth of robust large sample post build studies) was accepted unquestioningly although the Alliance demonstrated serious methodological flaws.

11. Montgomeryshire has one of only two National Trails completely in Wales and this would be severely affected by Carnedd Wen and Llanbrynmair, even more so in conjunction with the under-construction Garreg Lwyd Hill (not approved at time of the CPI). Walkers would be either in, or in view of, windfarms for many hours of walking; not the experience most walkers seek. The many circular walks created encompassing Glyndwr's Way attract day visitors and provide a local amenity but would become considerably less attractive. Walkers are already horrified at the scale of destruction and the diversions

occasioned by construction of Garreg Lwyd Hill and are reluctant to return to the area. As the Inspector states, walkers can indeed choose not to visit windfarm sections of Glyndwr's Way if they wish. There will be little left they can visit and they will miss the variety of outstanding scenery on offer that is a key promotional feature of the Trail and local business will miss their custom.

12. The Inspector states at paragraph 522: *'I have identified no likely significant adverse effect on the overall integrity or use of Glyndwr's Way, the use of other recreational rights of way, or any other tourist attraction or resource.'* The Alliance invites the SoS to reject that conclusion. Clearly there is no evidence to support this assertion and it is notable that elsewhere in Wales Inspectors take the opposite view of the impact of a few turbines on PRoWs that are not even Promoted, let alone National, Trails and use the potential impact as factors weighing against an application (cf for example: Inspector Nixon: Land at Pentre Tump, New Radnor 2014 and Inspector Jones: Mynydd Llanllwni Appeal Decision 2014). To dismiss the impact of turbines at Llanbrynmair and Carnedd Wen on Glyndwr's Way where walkers will see and walk through them for many kms must verge on incomprehensibility.

13. Powys CC did not provide evidence on tourism because of a lack of resources for expert witnesses in all areas and in the knowledge that the WG had commissioned a detailed study with Regeneris and The Tourism Company. This latter was completed in February 2014 but not released by the WG until the Inquiry was ending due to adverse findings regarding North Powys. There was just time for the Alliance to analyse the findings and bring them to the attention of the Inquiry at the final stage.

14. Yet again the Inspector fails to see the significance of findings that North Powys was different from other areas of Wales studied. Here,

the landscape attraction; the scale of windfarm development proposed; the demography of visitors, and the reasons people visit make an adverse impact on tourism more likely with new visitors hard to attract.

15. A 'tipping point' is a concept often referred to beyond which the value judgments made by visitors may change. The Inspector avers, without evidence, that there is no rate of development that would occur in practice that would trigger the tipping point. However, the Regeneris report recognises that the sheer number of turbines proposed in the area is a critical factor and, given increased public antipathy to multiple windfarms in a landscape, the 'tipping point' could be imminent in North Powys. With two further windfarms now under construction and the existing, albeit much smaller, turbines at Llandinam, Cemmaes, Carno and Adfa, we are clearly reaching saturation. Further construction would result in few turbine-free views and that tipping point reached.

Experience of windfarm construction in Powys since the CPI

16. Since the Inquiry ended two windfarms have commenced construction, Tir Gwynt and Garreg Lwyd Hill, so the public have now seen construction work in progress and there is no misapprehension over ungrounded concerns. The impact on the uplands of creating lengthy access tracks, hard standing and borrow pits is all too apparent. A photograph at Tir Gwynt is appended as an illustration at the end of this paper. Walkers on Glyndwr's Way (Garreg Lwyd Hill) are appalled by the immensity of the disruption and destruction and are unlikely to return.

17. There have been a number of variations to the original applications and conditions that increase the overall negative visual and ecological impact:

i) Garreg Lwyd Hill: additional borrow pits and roadworks; use of a longer turbine blade that will increase the swept path area and thus visual impact; felling of trees with bat roosts; additional hedgerow removal, and planning approval for a length of overhead line without any public consultation.

ii) Tir Gwynt: changes in access resulting in greater scarring of landscape and complete change of character of rural lanes; alteration of watercourses.

The public can have no confidence in the LPA and their ability to discharge conditions or enforce stop notices on unscheduled or mismanaged works, further increasing concern regarding the impact of yet more windfarm development.

iii) Component transport: Tir Gwynt transport is taking place throughout the summer months for six days a week (main Midlands to coast tourist route) despite assurance this would be avoided. There has been major roadwork disruption to adapt the highly unsuitable local road network for Abnormal Indivisible Loads and hundreds of HGVs. Trial runs have shown how delays can easily result in loads coming through at peak times and backing up local traffic and public transport for lengthy periods.

18. The Inspector (paragraph 522) is sanguine that problems can be avoided: *'it is vital that any negative impacts during construction should be minimised and mitigated, but this can be secured by the agreed conditions.'* As we have now seen with the construction of Garreg Lwyd Hill and Tir Gwynt neither conditions as to transportation or construction may be met or enforced or are necessarily satisfactory so there can be no certainty that negative impacts will be in anyway minimised or mitigated.

19. Tir Gwynt is a 12 turbine windfarm. At Carnedd Wen and Llanbrynmair consideration is of a total of 80 wind turbines; the construction of sub-stations and overhead export lines and clear felling over 4 years, the like of which has never been seen in Wales, with quantities of up to five times the normal amount being removed in any one year (not even including the unknown quantity of felling required at Llanbrynmair as well). The impact of this on rural roads, small businesses, tourism economy, the lives of local communities and the impact on our fragile upland ecosystems is almost inconceivable in its magnitude.

Tourism - recent strategies

20. Since the closure of the Inquiry the Welsh Government has become even more robust in its promotion of tourism and it is now one of the eight key priorities for the Welsh economy. Last year Wales became one of the 10 most visited countries in the world, a significant achievement for the promotion strategies of Visit Wales that are predominantly focussed on the outstanding scenery and opportunities for outdoor activity. In Mid Wales the focus remains on promoting all year round, repeat and higher value tourism. Tourism continues to provide 12% of Powys GDP (the highest single sector along with agriculture) and is increasing steadily.

Summary

21. Again the Alliance would respectfully refer the Secretary of State to consideration of our Closing Submission on Community and Tourism and the Economy for an overview of our case and the supporting and compelling evidence base for the application of the precautionary planning principle where there is every likelihood that the impact will be adverse.

22. In its Closing Submissions, for each of the windfarms the Alliance acknowledged, but set into context, the potential contribution to electricity supply as at that date. The contributions are small and, in the overall balance which needs to be drawn, the adverse environmental effects summarised in that Closing and further illustrated above and in parallel submissions weigh very heavily against granting consent.

Submitted on behalf of the Alliance

29 July 2016

Tir Gwynt windfarm under construction, demonstrating the impact on unspoilt agricultural uplands - Summer 2016

ALL-RED-05

The Mid Wales (Powys) Conjoined Public Inquiry into 5 Windfarm Proposals and a 132kV overhead Electric Line Connection

Re-determination of the applications by RES (Llanbrynmair) and RWE (Carnedd Wen)

The Alliance

Supplementary Evidence of Dr John Constable

Supplementary Evidence relating to the Llanbrynmair and Carnedd Wen wind farm proposals

Introduction

1. I have been asked by The Alliance to provide updated evidence regarding the generation benefits of both the Llanbrynmair and Carnedd Wen wind farm proposals, on which I have commented in previous phases of the planning process. This document supplements evidence supplied to the Conjoined Public Inquiry (CPI) and should be read in conjunction with it.

2. For brevity I will not repeat many of the background points presented in my earlier evidence. Simply, as before, the intention of the material presented here is to enable the decision-maker to rationally balance the benefits of the proposals (including their electricity generation and contribution to targets) against the harm to interests of acknowledged importance.

3. I have reviewed earlier evidence, as summarised in the Alliance's Closing Submissions (ALL-030R) and see no reason to revise any of the statements and observations on the likely output, emissions savings, or contributions to security of supply. These contributions are, in spite of the physical scale of the proposals, modest at best.

4. Similarly, no substantial change needs to be made to the estimation of *scale* of contribution to the electricity component of the EU Renewables Directive (2009) target. The output of these wind farms is a small fraction of the overall requirement for electrical energy towards meeting the EU Renewable Energy Directive, individually being well under half of one per cent; and taken together only just over half of one percent, as given in the following tables drawn from the Alliance's Closing Submissions, but modified to make reference to the possible withdrawal of five turbines in the Carnedd Wen proposal, which I understand would reduce the capacity to 135 MW:

Llanbrynmair (RES)

Table 1: Llanbrynmair wind farm proposal: Capacity, output and scale of contribution to the electricity component (110 TWh) of the EU Renewables Directive (2009) target for 2020.[1]

Number of Turbines	*Nameplate capacity (MW)*	*Annual Output (@ approx. 30% load factor) MWh*	*EU Target Contribution*
30	90	236,520	0.2%

Carnedd Wen (RWE)

Table 2: Carnedd Wen wind farm proposal: Capacity, output and scale of contribution to the electricity component (110 TWh) of the EU Renewables Directive (2009) target for 2020.

Number of Turbines	*Nameplate Capacity (MW)*	*Annual Output (@ approx. 30% load factor) MWh*	*EU Target Contribution*
50 (with "CW 5")	150	392,100	0.36%
45 (without "CW 5")	135	354,780	0.32%

5. However, the *context* in which the contributions of these applications must now be placed, namely the contribution towards targets by other, already consented renewable electricity capacity, has changed significantly since earlier evidence, as discussed in the following section.

Significance of the Contribution to the EU Renewables Directive Target

6. In previous evidence to the CPI (ALL-CLO-POE-01) I noted that there was sufficient consented renewable electricity capacity to generate about 116 TWh (see para 9), which was 6 TWh over the 110 TWh required. Due to extremely rapid growth in the sector, this potential

1 During the course of the CPI timetable the expected target quantity was revised slightly downwards from about 120 TWh expected in the National Renewable Energy Action Plan of 2009 to 110 TWh in the updated NREAP of 2013, as discussed in my evidence to the CPI, ALL-CLO-POE-01, para 6.

overshoot from consented capacity has now (as of June 2016) risen to about 38 TWh, or 34% above the 110 TWh contribution expected from renewable electricity.

7. The potential overshoot is described in the table below, which is drawn from ongoing work by the charity Renewable Energy Foundation[2] to track progress towards the electricity component of the EU Renewables Directive (2009) for 2020. The fundamental data relating to the capacities of the various technologies is drawn from the UK Government's Renewable Energy Planning Database (REPD).[3] Output is estimated by reference to empirical load factors over an extended period of years, as recorded in the UK Government's *Digest of United Kingdom Energy Statistics*.

Table 3: Renewable electricity capacities Operational, Under or Awaiting Construction or submitted to the planning system; together with estimated outputs.
Source: Renewable Energy Foundation, Department of Energy & Climate Change (now Business, Energy and Industrial Strategy), calculations by REF.

	Bio-mass	***Hydro***	***Solar***	***Marine***	***Waste***	***Off-shore Wind***	***On-shore Wind***	***Total***
Operational (GW)	3.2	0.5	6.7	0.0	1.0	5.1	9.1	25.5
Under Construction (GW)	0.5	0.0	0.4	0.0	0.2	0.8	2.9	4.8
Awaiting Construction (GW)	3.3	0.0	3.2	0.5	0.7	13.6	3.2	24.5
Total Consented Capacity (GW)	6.9	0.5	10.3	0.5	1.9	19.5	15.2	54.8
Submitted to Planning (GW)	0.2	0.0	0.9	0.2	0.2	3.1	5.9	10.5
Probable Load Factor	62%	35%	9%	7%	38%	35%	26%	-
Est. output from consented capacity (TWh)	37.7	1.6	8.1	0.3	6.1	59.6	34.3	147.7
Est. output from in-planning capacity (TWh)	1.0	0.0	0.7	0.1	0.5	9.5	13.3	25.2

2 http://www.ref.org.uk/planning/index.php
3 https://www.gov.uk/government/publications/renewable-energy-planning-database-monthly-extract

8. As noted in earlier evidence (ALL-CLO-POE-01-RESPONSE) there is no governmental intention to reach a higher target, and there is no subsidy budget within the Treasury's 'Levy Control Framework' available to support excess generation. Indeed, the implied budget overshoot is very substantial, amounting to about £2bn a year. In a recent peer-journal article[4] (copy supplied with this submission as an appendix), my colleague Dr Moroney and I calculate that an overshoot on this scale could add some £40 billion to the lifetime cost of the programmes concerned. Exceedance on this scale is unlikely to be permitted.

9. It is important to note also that the planning system is in the process of considering a further 10,500 MW of capacity, amongst which the 240 MW of capacity proposed at Carnedd Wen and Llanbrynmair are a part. This capacity in planning would be capable, as the table shows, of generating an additional 25 TWh of electrical energy, increasing the target overshoot to some 63 TWh, or nearly 60%, above the 110 TWh required.

10. In other words, if all the consented capacity is built, the total generation would come to about 148 TWh, some 38 TWh or 34% above the required level of 110 TWh. If in addition to this all the capacity in planning is consented and built the total output would rise to some 173 TWh, or nearly 60% above the required level.

Conclusion

11. In the light of these circumstances I therefore conclude:

    i) The electricity component of the EU Renewables Directive target for the UK in 2020 has been in principle more than met by already

4 John Constable, Lee Moroney, "Economic hazards of a forced energy transition: inferences from the UK's renewable energy and climate strategy", *Evolutionary and Institutional Economics Review* (2016). DOI 10.1007/s40844-016-0041-6.

consented capacity, and there is now a 38 TWh or 34% overshoot from this consented capacity, for which there is no subsidy budget.

ii) There is a considerable further oversupply of renewable electricity capacity being brought forward in the planning system, some 10,500 MW in fact. This capacity is sufficient to generate a further 25 TWh of electrical energy, enough to increase the overshoot to nearly 60%.

iii) Since the target has been in principle met by already consented capacity, and there is no renewable energy target subsequent to the EU RE Directive (2009) target, it is clear that decision makers should certainly give less and arguably no weight to the 2020 target contribution of any proposals currently under consideration.

Dr John Constable

11 August 2016

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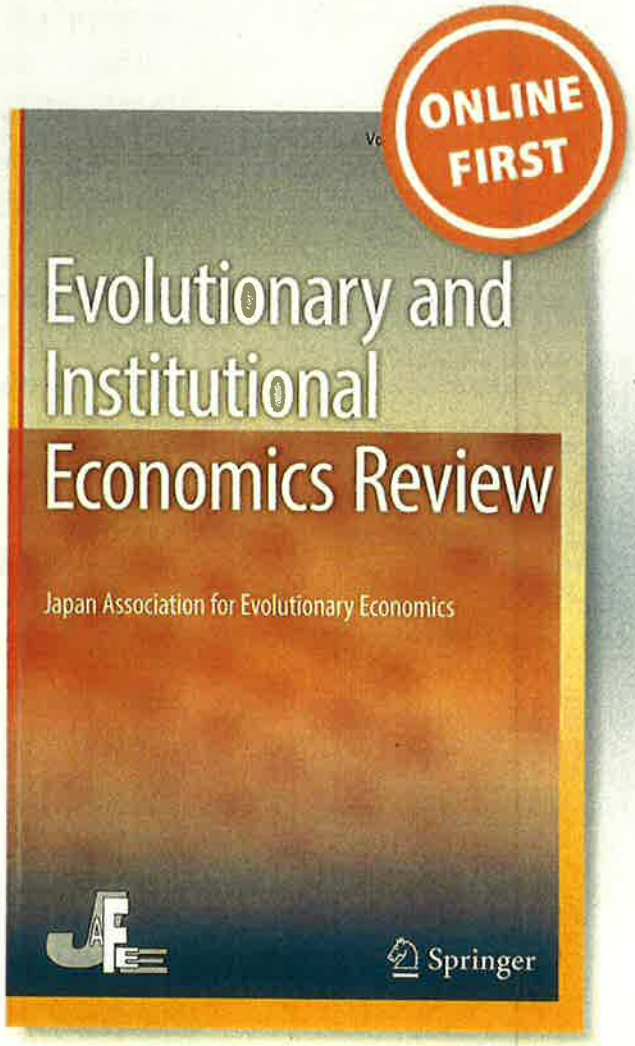

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ARTICLE

Economic hazards of a forced energy transition: inferences from the UK's renewable energy and climate strategy

John Constable[1] · **Lee Moroney**[1]

Abstract The UK government has recently announced a reorientation of its energy and climate policy, scaling back subsidies to renewables, suggesting that uncontrollable generators, such as wind may be required to meet their own system costs, and emphasizing the need for research and development towards an as yet undiscovered, fundamentally economic, low carbon transition. The government also aims to open the way for nuclear power, and the maximization of oil and gas recovery both from the North Sea, and, on-shore, from hydraulic fracking. The present authors argue that although this policy is self-characterised as a re-liberalisation of the markets, the revision is only in part political, and is better understood as a force majeure response to cost and technical problems with the previous renewables-centred policy. Specifically, subsidies have led to an overheated renewables sector with high costs that will exceed Treasury limits and place heavy burdens on consumers. Subsidies to renewables have also weakened investment signals to conventional generation, leading to low capacity margins that necessitate a costly Capacity Mechanism, in effect a subsidy, to guarantee security of supply. Taken together, these costs are significant, and are a matter for particular concern, since there are already signs of a trend towards a de-electrification of the UK economy, a trend which is undesirable for many reasons, including climate policy.

Keywords Renewables · Subsidy · Green economy · System costs

A · E · N · O · Q

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1 Introduction: new energy and climate policy directions in the United Kingdom

On the 18th of November 2015, some 6 months after a general election at which the Conservative party was unexpectedly returned with an absolute majority, the Rt Hon Amber Rudd MP, Secretary of State for Energy and Climate Change, announced a major reset of the United Kingdom's policy. This speech confirmed that coal would have no part in electricity generation after 2025, but also admitted that previous ambitions for renewable energy were unrealistic, that gas and nuclear were central to the UK's energy future, and that the recovery of oil and gas from the North Sea must be maximised, as well as supported by gas from on-shore hydraulic fracking (DECC 2015b). Indeed, for the first time in some years, government seemed to be offering a focused energy policy, rather than a climate agenda, in which energy was compelled to play an ancillary part. Long-term income support subsidies to renewables were explicitly rejected—"Subsidy should be temporary, not part of a permanent business model", "No more blank cheques"—and uncontrollable generators, such as wind and solar, were even warned that the indirect subsidy resulting from the socialization of their system costs would not continue: "we also want intermittent generators to be responsible for the pressures they add to the system when the wind does not blow or the sun does not shine."

Overall, the speech goes well beyond the manifesto promise to end the development of on-shore wind, and clearly surprised many. However, revisions to the government's approach had been emerging piecemeal since the election, some giving fair warning of what was to come, including cuts in subsidy levels for new projects, the early closure of some support schemes for certain technology types, and, perhaps, the most significant of all, the removal of the Climate Change Levy (CCL) exemption for renewable energy, which was in effect a cut in subsidy income for all renewable generation, even those constructed and operational. Nevertheless, even if not entirely surprising, the speech may seem from the outside to be quite inconsistent with the government's position at COP21. However, the change of direction, while substantial, is not so much a rejection of the climate agenda, as an urgent attempt to remedy economic and technical problems arising from the subordination of energy policy to climate concerns, combined with the hope that climate goals can in fact better be achieved within the new framework. Indeed, it appears that far from being a purely political action, reflecting the only moderate concern with climate policy in the Conservative parliamentary party, membership, and vote-base, these are actions that any party in power would now have to take; in other words, there is an element of force majeure underlying the government's announcements. The difficulties all resolve themselves ultimately in terms of cost, though the fundamental causes vary in character. Total annual subsidies to renewable energy, particularly electricity, are growing so fast that they are certain to breach consumer spending limits set by the government unless firm action is taken. Furthermore, the electricity system costs of integrating uncontrollable renewables are being confirmed as highly significant, not least, because the market distortions of renewables subsidies have weakened investment signals for conventional generation

leading to tight capacity margins that have necessitated the introduction of expensive subsidies to conventional generation via the new capacity mechanism.

The total annual scale of the additional costs of the climate policy for renewable electricity is not only significant, but would result in emissions abatement costs greatly in excess of even high estimates of the Social Cost of Carbon.

There is also a clear trend towards a reduction in energy consumption that cannot be satisfactorily explained by energy efficiency improvements, and suggests fundamental economic weakness. Of these, the most remarkable of all is the sharp decline in the consumption of electricity, a decline that reverses the historical trend since the 1880s. This downward trend is not entirely the result of policies (the economic turbulence of 2008 appears likely to be relevant), but it does seem reasonable to infer that the policy costs are inhibiting recovery.

In this context, it is hardly surprising that the government of the United Kingdom has had to act, if only, because attempts to reduce the state deficit are posited on future economic growth. The UK case is of general interest in that other governments may well find themselves in similar positions; even where the geographical and economic character of the country concerned is very different. This can be brought out by considering each of the major pressures on the UK government in turn, beginning with the trends in energy consumption, and then examining the costs of meeting the EU Renewables Directive (2009), before turning to the capacity margin question, and finally, the issue of emissions abatement costs.

2 Energy in the United Kingdom: recent history

2.1 Final energy consumption in the United Kingdom

There are two principal features in the trend in the Final Energy Consumption (FEC). The first is the surprising decline in this quantity since the turn of the millennium. After a long period of steady increase, FEC peaked in about the year 2000, stalling at about 160 mtoe per year, and in 2005, began a steep decline that appears to be continuing, with consumption in 2014 of about 135 mtoe per year, a level not observed since the 1960s. While this might appear to be an indication of improvements in efficiency, or a shift towards a 'knowledge' economy, and, therefore, to be welcomed, the abrupt nature of the change, and the approximate coincidence with the economic downturn of 2008, all give cause for concern. Moreover, there are reasons, grounded in the Jevons paradox (Jevons 1865), for thinking that larger quantities of energy will be consumed in spite, and, indeed, because of improvements in efficiency.

The second major story regarding FEC is the displacement of coal by petroleum, electricity, and natural gas. In 1948, coal accounted for 1180 TWh or nearly 80 % of FEC, yet by 2008, this proportion had fallen to 30 TWh, less than 2 % of FEC, as can be seen in Fig. 1.

It is worth noting at this point that at the primary consumption level, the reduction in coal's share is less marked, declining from 90 % (1489 TWh) to 16 %

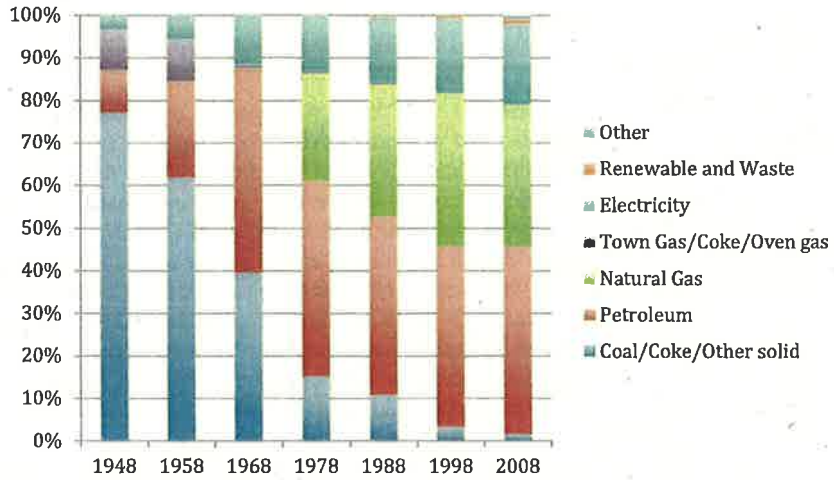

Fig. 1 Final energy consumption in the United Kingdom, 1948–2008, by fuel type Source: DECC (2008), 8. Chart by the authors

(441 TWh), a level largely accounted for by the continuing importance of coal in the electricity generation sector.

Of the displacing fuels, the transition towards electricity is, perhaps, the most important in the longer term, as well as being the most unproblematically positive in character. As a very high grade *carrier* of energy, electricity offers cheap and rapid transmission over long distances, and ready transformation into a wide range of forms of energy at the point of consumption. Historically, it is recognized as facilitating the more intensive use of available resources, a feature that continues today (Byatt 1979, 4), and is part of the reason that electrification is widely considered to be central to any viable long-term decarbonisation of global energy supplies, and therefore, a key component in policies intended to address climate change (IPCC 2014). Further electrification of final energy consumption, then, seems straightforwardly desirable, and likely to occur spontaneously, since it improves human wellbeing with few downsides.

However, the trend towards electrification appears to be faltering. Instantaneous load on the transmission network of Great Britain peaked at roughly 60 GW (gigawatts) in about 2002, and is now falling, with the peak currently at about 54 GW, a level last seen in the mid 1990s. Such a fact could be accounted for, by general, efficiency improvements in conversion devices, such as the use of low wattage Compact Fluorescent Lights (CFLs) and Light Emitting Diodes (LEDs), and also a substantial rise in embedded generation, so is not necessarily troubling in itself, though, as with the fall in Final Energy Consumption discussed above, the timing, the scale, and the abrupt nature of the change, and various other theoretical considerations, suggest that this explanation is not entirely satisfactory.

The significance of these concerns can be confirmed by reference to final consumption of electrical energy (MWh), which includes energy from embedded generation, represented in Fig. 2 between 1965 and 2014.

Other data related to major power producers and in the same set (DECC 2015e) shows a more or less smooth increasing trend from 1920 to the early 1960s, where this chart begins, after which clear perturbations appear, and from the late 1960s and the early 1970s, the pace of electrification appears to slacken, before going into decline, having peaked in 2005, at 349 TWh. The increasingly widespread use of gas for domestic heating and cooking is doubtless a key factor in the trends of the early 1970s. In later years, efficiency improvements should doubtless also be considered. However, the downturn must remain a matter for concern, because a fall of this scale, a little over 45 TWh in under a decade, is clearly inconsistent with the UK's rising population, up from 59 m in 2000 to 64 m in 2013, a 9 % increase (Office of National Statistics 2014). Remarkably, the United Kingdom is now using less electricity than it was in the mid 1990s.

The decline in overall electricity consumption can be further analysed by sector, as shown in Fig. 3.

The fall in consumption appears to be a general phenomenon, and not confined to industry alone. The domestic and industrial sectors peak in about 2005, while the commercial sector flatlines from that date, and may now be in decline. As would be expected, public administration is more resilient, with only a slight decline over the period. While improvements in energy efficiency may account for part of the general trend, it seems very unlikely to account for all of it. Certainly, in industry, where demand is more elastic, it seems reasonable to infer that if efficiency measures were actually working, then, consumption would rise as the output of these businesses became more attractive both within the UK and in the international markets.

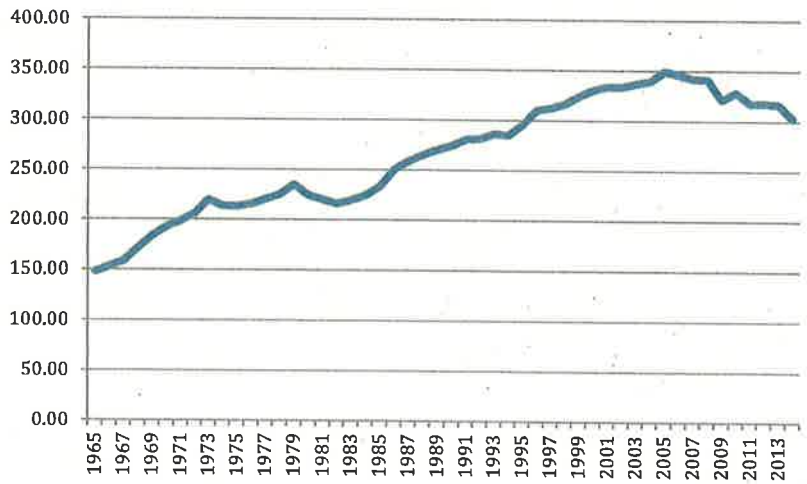

Fig. 2 Final electricity consumption (TWh), 1965–2014 Source: DECC (2015e). Chart by the authors

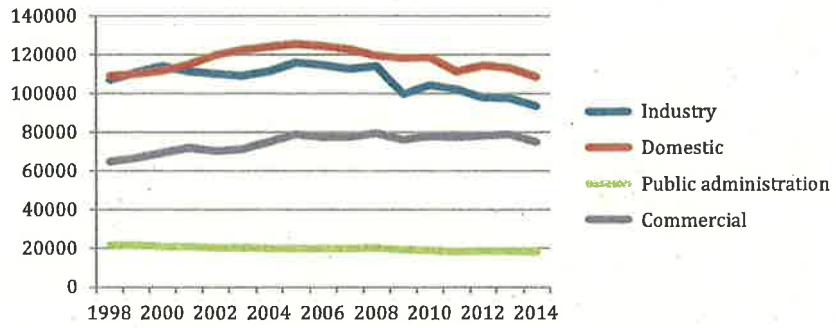

Fig. 3 Final consumption of electricity 1998–2014 (GWh) for the industrial, domestic, public administration, and commercial sectors Source: DECC (2015a) Table 5.1. Available at https://www.gov.uk/government/statistics/electricity-chapter-5-digest-of-united-kingdom-energy-statistics-dukes)

If the pace of electrification is slackening off, and it is still an open question, this would be particularly regrettable since, as with Primary Energy consumption, the main shift in electricity, since the Second War has been from coal to gas and nuclear, with a dramatic increase in thermal efficiencies (rising from just under 10 % in 1926 to approximately 40 % in 2014 (DECC 2013), with a consequent reduction in specific emissions (currently about 0.4 to 0.5 tonnes per MWh). In 1948, coal fuelled almost all electricity generation in the UK, but by 2008, it had fallen to about 35 %, with gas at nearly 50 %, and nuclear contributing just over 10 % (though now declining, since closing power stations are not being replaced). Admittedly, the combined impact of two separate regulations, the Large Combustion Plant Directive (LCPD), which required the fitting of Flue-gas Desulphurisation, and Selective Catalytic Reduction to remove oxides of nitrogen, and the Carbon Price Floor, created a perverse incentive for owners of coal stations that were not opted into the LCPD program to run intensively and use up their remaining allotted hours of operation before the rising Carbon Price Floor eroded profit margins. In 2012, this created the remarkable and embarrassing spectacle of a sharp increase in the output of coal-fired generation combined with a collapse in gas-fired output. Although the peak of this effect has passed, gas has yet to fully recover, partly because of low load factors, discussed further below, due to growth in renewables (14 % of demand on the transmission system), and partly due to falling demand.

Thus, it appears that while government was ostensibly in favour of new gas-fired generation, policies were and are discouraging such development. Similarly, and though no one would suggest that the fall in electricity demand is entirely the result of policy, government may be theoretically in favour of electrification, but at the same time inhibiting demand recovery through policy costs, such as renewable electricity subsidies. In this context, and given the importance of the sector, both to policy and to the future of the UK economy, it is useful to consider the character of the electricity industry and its relation with policy.

2.2 UK electricity market history and character

In her speech, Amber Rudd divided the recent history of the UK electricity sector into two phases, that inaugurated by Nigel Lawson's liberalisations, and that begun by Tony Blair's 2007 undertaking to commit the UK to the EU Renewables Directive of 2009. This is not wrong, both are certainly major landmarks, but a more detailed consideration brings out other facts, particularly the role of the state in the sector, and the extent to which the current moves represent a reversal of a non-interventionist approach.

It is conventional and correct to see Lawson's reforms as an unravelling of the nationalized industry created in 1948 by the Attlee government as part of its institution of a socialist planned economy. However, the deeper history shows Lawson's project as still more original in that it ran against tendencies evident over the entire history of electricity in the UK. Indeed, even in the Electric Lighting Act of 1882, the state not only put a ceiling on prices but also mandated the public purchase of private electricity companies at a written down value after a period of 21 years (Hannah 1979, 9). By 1903, local government authorities were supplying over two-thirds of the electricity load (Byatt 1979, 7). Furthermore, as early as the 1920s, the sector was gradually being moved towards centralization, largely as the result of the recognition that an interconnected system of transmission cables would be desirable, a conclusion reached by the Weir Report of 1925 to the Department of Transport. The study's title is suggestive: *Report of the Committee appointed to review the National Problem of the Supply of Electrical Energy* (Weir 1925). Bearing this mind, the formal nationalization of the six hundred or so private and municipal companies in 1947 was, in essence, less of a departure from the past than Lawson's privatisations of the 1990s, a point that prepares us for the equally surprising fact that as early as 2001, when privatisation culminated in the introduction of the New Electricity Trading Arrangements (NETA) and bilateral trading in electrical energy, the drift back towards state management had already begun. Indeed, it seems reasonable to identify the Royal Commission on Environmental Pollution report of 2000, The Changing Climate (RCEP 2000), not only as the herald of climate policy, but also of a return to the view that electricity constituted a 'national problem' best handled by the state. This tendency rapidly gathered pace, though obscured by repeated governmental claims to be only guiding a liberal market, and by 2014, a significant and growing part of the total charge to the electricity consumer was not the result of the wholesale market, but of climate and other state policies, including the Climate Change Levy (2001), the Renewables Obligation (RO) (2002), the EU Emissions Trading Scheme (2005), the Feed-in Tariff (2010), and numerous cross subsidies from one set of consumers to another to fund energy efficiency and related social measures. Indeed, government itself estimated that in 2014, 17 % of the retail price to domestic households, for example, resulted from policies rather than the wholesale market (£164/MWh as compared to £140/MWh without policies) (DECC 2014). By 2020, the Department estimated that this would have risen to 27 % of the price of electricity in the central fossil fuel price scenario, and still higher fractions in the low fossil fuel price scenario. These fractions, it should be remembered, are based on the direct subsidy

or cost impacts only, and do not include system and other management costs imposed by the renewables policies.

It is now clear that this phase is coming to an end, and that a return to liberalisation is the intention of the current government, though this is recognized as being a medium-term goal. As Amber Rudd puts it in her speech:

> We want to see a competitive electricity market, with government out of the way as much as possible, by 2025. Getting there will not be easy. The process of privatisation itself spanned five Parliaments. (DECC 2015b).

Indeed, judging from the policy measures currently being proposed by the government 'Getting there', will involve a great deal of further state involvement as part of transitional arrangements intended to correct previous errors. The government's freedom of movement is further constrained by the UK's commitments under the European Union's Renewables Directive of 2009, and the strength of the UK's commitment to this Directive is questionable in the light of these difficulties.

3 The UK and the European Union renewables directive (2009)

The EU renewables directive (2009) requires that 20 % of EU Final Energy Consumption, across all sectors, heating, transport, and electricity, should be renewable by 2020, with transport having a mandatory level of 10 %. The United Kingdom's burden share entails that 15 % of its FEC should be renewable by the target date, one of the larger proportionate increases amongst the major economies, up from 1.5 % in 2009, and with the implication of disproportionately high costs. Indeed, the UK government analysis during the negotiations in 2007 preceding the Directive calculated that upwards of 25 % of the EU wide costs of the policy would fall on the UK alone.[1]

FEC in 2020 is, of course, uncertain, but we can estimate that the UK would need to generate approximately 230–270 TWh of renewable energy along the following lines:

Transport fuel: 45 TWh (10 % of UK transport fuel).
Electricity: 120 TWh (~30 % of UK electricity).
Heating and cooling: 70 TWh (~12 % of UK heating and cooling).

It has already been noted that both Final Energy Consumption and electricity consumption are falling in the United Kingdom. This is mixed blessing: on the one hand, it reduces the quantum of renewable energy required; on the other, because

[1] The 25 % figure is a government estimate contained in a document leaked from within the department of Business Enterprise and Regulatory Reform in 2007 (BERR 2007). The text is published on the Guardian website: (http://image.guardian.co.uk/sys-files/Guardian/documents/2007/08/13/RenewablesTargetDocument.pdf) Note that the European Commission estimated the total cost to the EU of the renewable energy target at 24 billion euros in 2020 (See Table 4???). BERR thought that this was an underestimate, but also estimated the costs to the UK at some £6–10 bn (see Table 3, but note that the table unfortunately transposes the figures for a 14 and a 15 % target).

the UK has been planning to rely very heavily on renewable electricity, with a large pipeline of construction that can only be restricted with difficulty, it implies that a very much larger share of electricity consumption will be taken by renewable generators, with significant technical implications and a detrimental impact on the economics of those generators meeting the residual load and guaranteeing security of supply.

Nevertheless, electricity is the core of the UK's attempts to comply with the Directive, and efforts have not been half-hearted. Government has employed a series of policies that coerce the economy into purchasing renewably generated electricity at an above market price, starting with the Renewables Obligation (RO) in 2002, a scheme that will close to new entrants in 2017 and be replaced with a scheme of Feed-in Tariffs with Contracts for Difference (so-called CfDs). A separate system of feed-in tariffs aimed at smaller developments, though open to projects with an installed capacity as large as 5 MW, was initiated in 2010. The annual additional cost of these schemes to the consumer is charted in Fig. 4.

The total, cumulative, cost from April 2002 to March 2014 is approximately £19.6 billion. Her Majesty's Treasury introduced a limit to this spending, the Levy Control Framework (LCF), starting in 2011, with a Framework cap to spending in 2020 of £7.6 bn a year (equivalent to about 0.5 % of the current UK GDP).

Such subsidy expenditures have ensured that there has been a very rapid progress towards the renewable electricity target, as can be seen from Fig. 5.

In 2010, the United Kingdom was not on track to meet the 2020 target, but the sector expanded rapidly in the period 2010–2014, probably in response to increased subsidies for off-shore wind, and continued support from the Liberal Democrat-led Department of Energy and Climate Change during the Coalition Government, which was widely perceived as sheltering the sector from the Treasury's attempts to limit spending.

On the basis of the present trends, it seems reasonable to conclude that the UK will meet the electricity share of the target. Indeed, reference to project pipeline data suggests that the scale of development exceeds that required by a large margin. Table 1 uses data from DECC's Renewable Energy Planning Database (REPD) to calculate the likely output from all capacity that is either operational or under or awaiting construction. In other words, it estimates output from all projects that have already received land-use planning consent from the relevant governmental authority. Table 1 also gives data for the capacities still seeking such planning consent.

There is 54.6 GW of capacity with planning consent, of which 23.2 GW is operational and 31.4 either under or awaiting construction. A further 11.6 GW is awaiting a planning consent decision from the relevant governmental authority.

The output from the consented capacity would be approximately 149 TWh, some 35 % in excess of the 110-TWh target for electricity. If all these capacities were constructed and subsidized at current levels, the cost would overshoot the Levy Control Framework (LCF) by about £2 billion (30 %). The principal causes of this overshoot are growth in solar photovoltaic, which at 9.6 GW consented, is now over 6 GW in excess of that anticipated in the National Renewable Energy Action Plan (NREAP); and off-shore wind, which at 20 GW consented, is now 7 GW in excess

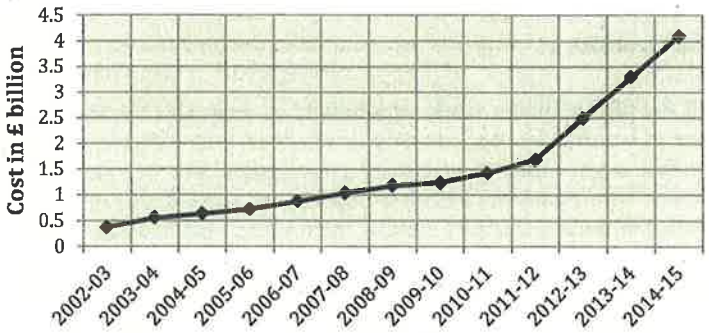

Fig. 4 Renewable electricity subsidy cost 2002/3–2014/15 Source: DECC, Ofgem. Calculations and chart by authors

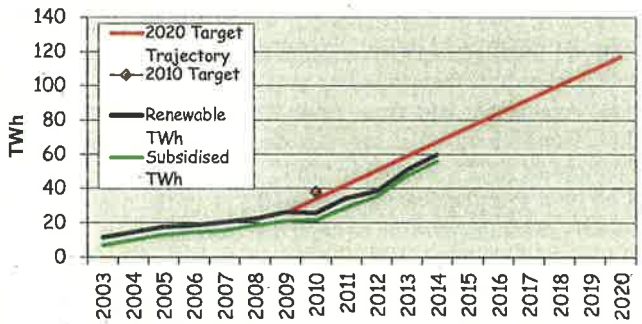

Fig. 5 Renewable electricity generation (TWh) in the United Kingdom Source: DECC, Ofgem. Calculations and chart by the authors. The *blue line* represents total renewable electricity; the *green line* shows the subsidized component. The *orange diamond point* represents the 2010 renewable electricity target, which was missed, and the *red line* the trajectory needed to meet the electricity contribution to meeting the EU Renewables Directive (2009) in 2020

of that anticipated in the NREAP. On-shore wind is already at the upper level anticipated for 2020, 15 GW, and there is, as can be seen, a further 6 GW seeking planning consent.

In earlier work for the Renewable Energy Foundation, we estimated the cumulative subsidy cost (i.e., over and above the cost of the conventional energy) of meeting the electricity component of the UK's commitment under the EU Renewables Directive at about £160 billion from 2002 to 2040, even conservatively assuming that while no new subsidies were available after 2020, existing contracts would be honoured (Renewable Energy Foundation 2011). An overshoot of £2 bn in 2020 would add, very approximately, a further £40 bn to the cumulative cost.

The new Conservative government appears to take the Levy Control Framework seriously, and some degree of negligence in previous administration is implicit in Amber Rudd's remark that she had "inherited a department in which policy costs on

Table 1 Renewable energy capacities, operational, under, or awaiting construction, and in the planning system Source: Department of Energy and Climate Change (DECC) online Renewable Energy Planning Database (REPD), for December 2015, accessed 16 January 2016; and DECC's latest renewable sources data (Table 6.7 in DUKES 2015 Chapter 6: Renewable Sources of Energy) and the UK National Renewable Action Plan (NREAP)

	Biomass	Hydro	Solar	Marine	Waste	Off-shore wind	On-shore wind	Total
Operational (GW)	2.9	0.5	5.2	0	0.9	5.1	8.6	23.2
Under construction (GW)	0.5	0	0.5	0	0.2	0	2.1	3.4
Awaiting construction (GW)	3.7	0.1	3.9	0.5	0.7	14.9	4.2	28
Total consented capacity (GW)	7	0.6	9.6	0.5	1.9	20	15	54.6
Submitted to planning (GW)	0.2	0	1.9	0	0.1	3	6.4	11.6
Load factor	62 %	35 %	9 %	7 %	38 %	35 %	26 %	NA
Est. output from consented capacity (TWh)	38.1	1.7	7.5	0.3	6.1	61.2	33.9	148.9
Est. output from in-planning capacity (TWh)	1.2	0	1.5	0	0.2	9.2	14.4	26.6

Assumed load factors are then used to calculate probable outputs from the consented capacity, i.e., all that with formal planning permission from the relevant state authority

bills had spiralled". Indeed, the principal proximal goal of her renewable policy changes is to bring costs back within the Treasury limits, but it remains to be seen whether the reductions in subsidies and early closure of schemes will be sufficient to discourage the surplus generation capacity already consented from proceeding to construction before the RO closes in 2017. After that time government has more control over subsidy costs, since the granting of CfD contracts is at their discretion. Assuming that these measures are successful, some grounds for concern remain. First, according to the Department's own modelling, the impact of renewables subsidies will have a very significant impact on electricity prices and consumer bills even in the High Fossil Fuel Price scenario, where policies were expected to increase electricity prices to domestic households by 30 % in 2020 (£217/MWh as compared to £168/MWh), and prices to medium-sized businesses by 45 % (£152/MWh as compared to £105/MWh) (DECC 2014). In the Low Fossil Fuel Price scenario, which now seems more probable than not, the household impact would be to increase prices by 42 % (£186/MWh as compared to £131/MWh), and the impact on medium-sized businesses an increase of some 77 % (£122/MWh as compared to a pre-policy price of £69/MWh). Indeed, it was a commonplace of analysis before 2015 that the UK renewables policy was in effect a wager on the future price of fossil fuels, and one interpretation of the present redirection of policy is as a discrete admission that this bet has been lost.

4 UK electricity generation capacity

The activity visible in the renewables sector contrast sharply with that in the conventional generation, where there is a very little development at all, and in which, capacity margins over peak load on the GB network are now at low levels. Indeed, one clear intention of Amber Rudd's speech is to add rhetorical support to other government measures aimed at drawing private investment into the construction of new gas generation in the short and medium terms, and nuclear, thereafter, to ensure secure electricity supplies.

4.1 The capacity crisis?

All casual discussions of the 'electricity crisis' begin with the question of 'keeping the lights' on; in other words, a doubt as to whether there is sufficient generation capacity to meet instantaneous load, a question that is all the more exciting and novel, since system reliability in the UK over the last 40 years has been, industrial action aside, generally excellent. However, this has not always been the case, and as Hannah observed in his standard history, in the years immediately post-war "[...] demand sometimes exceeded the capacity available to meet it, with very slender margins of capacity over potential load. As a consequence, both power cuts and voltage reductions were essential". It was against this background, and in the knowledge that other systems in the world operated with larger margins, that a more generous provision was planned from about 1968 onwards (Hannah 1982). Consequently, margins during the Central Electricity Generating Board (CEGB) period were uniformly large, around 30 % and sometimes much higher. This

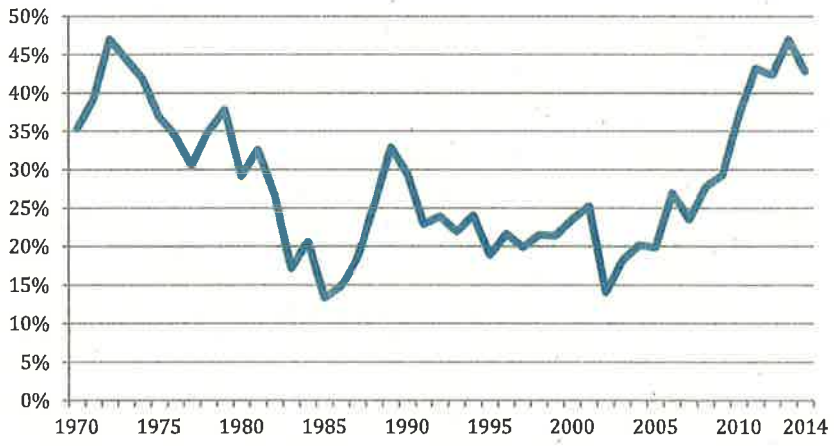

Fig. 6 Capacity margin (%) in the United Kingdom, 1970–2014. Calculated as the margin Total Declared Net Capacity (DNC) over the simultaneous maximum load met on the system in that year Source: DECC (2013). Chart by the authors

arguably too conservative level was gradually reduced, as can be seen in Fig. 6, with the process beginning well before the privatisation often identified as the cause. Indeed, if anything, the Dash for Gas of the 1980s seems to have bolstered the capacity margin.

A glance at this chart might suggest that there is no particular problem at the present, since the capacity margin seems to have been growing steadily since 2002, with current levels comparable to early 1970s, partly as a result of falling peak load and partly as a result of new power plant construction. To be specific, in 2014, there were power stations with a Declared Net Capacity (DNC) of some 77 GW, against a peak load of about 55 GW (down from 60 GW in 2005). Current concerns arise from the fact that much of the new capacity is non-firm wind and solar generation and so variable and uncontrollable and, consequently, has a low probability of generating at a specified output at any specified time, peak load on a dark cold windless, and winter's afternoon for example.

At the time of writing (January 2016), the UK has a total operational renewable electricity fleet of about 23 GW, of which 80 % is not firm (5 GW of solar; 13 GW of wind, on-, and off-shore). A further 31.4 GW of capacity is under or awaiting construction, of which 80 % is not firm (4 GW of solar; and 21 GW of wind, on-, and off-shore).[2] In other words, of the over 54 GW of renewable electricity capacity consented since 2002, over 80 % (44 GW) contributes little or nothing towards the capacity margin. Thus, in spite of quite remarkable rates of construction, and major capital investment (ca. £40bn), the renewables explosion has done little to address the need for new firm capacity required to replace the conventional oil, coal, and nuclear power stations as they retire.

This problem has been well understood for some time, and analysts have been remarking on the matter, since the rapid development of renewables first began in response to the introduction of subsidies under the Renewables Obligation in 2002. EdF, one of the Big Six vertically integrated electricity companies, was amongst the first in the field, providing crucial data in evidence submitted to the government's "Energy Review" of 2006, data that predicted a rapid decline in the conventional generation:

> The UK is facing an electricity generation capacity shortage during the next decade as coal- and oil-fired power stations close, largely in response to new environmental controls imposed by the Large Combustion Plants Directive (LCPD), and as gas cooled nuclear power stations reach the end of their useful lives. [...] Between now and 2016, 13 GW of coal and oil plant that have "opted out" of the LCPD will close. "Opted in" coal plant may also be closed by 2016 depending on the economics of fitting further equipment to reduce emissions of nitrogen oxides—for which new limits are to be introduced after 2015. 7.5 GW of nuclear closures is scheduled by 2015. [...] The UK will have a generation gap of 32 GW in 2016, assuming moderate demand growth and expected growth in renewables in line with the Renewables Obligation

[2] Calculated from data collected by DECC for the Renewable Energy Planning Database, and reprocessed by the Renewable Energy Foundation at www.ref.org.uk: http://www.ref.org.uk/planning/index.php.

(RO). Even under very optimistic scenarios regarding grid electricity demand reduction, the generation gap will still be 25 GW in 2016 (EdF 2006, 12).[3]

These concerns quickly became mainstream, and in 2009, the regulator Ofgem initiated 'Project Discovery', a "year-long study of whether the current arrangements in GB are adequate for delivering secure and sustainable electricity and gas supplies over the next 10–15 years" (Ofgem 2010). Ofgem reported on this work in February 2010, and "identified a number of concerns with the current arrangements and have concluded that a significant action will be called for given the unprecedented challenges facing the electricity and gas industries" (Ofgem 2010, 1), one of the principal concerns identified being lack of capacity:

> Short-term price signals at times of system stress do not fully reflect the value that customers place on supply security which may mean that the incentives to make additional peak energy supplies available and to invest in peaking capacity are not strong enough (Ofgem 2010, 5).

In its latest report on the subject, Ofgem expects there to be some 71.6–75.3 GW of capacity, depending on scenario, in 2017/18, of which only 58–61 GW will be firm capacity. Consequently, the capacity margin will range from −1.9 to 5.1 % depending on scenario, which is low by most standards (Ofgem 2015a, 14).

Given the clear need, it is reasonable to wonder why so little conventional capacity reached Final Investment Decision. The explanation lies partly in the opportunity cost of broad-scale renewables development, which has absorbed a large part of the capital available for power sector investment, but the principal cause is that the presence of so much subsidized renewable generation has weakened investment signals for, otherwise, fundamentally economic technologies. Ofgem itself notes:

> Capacity in the market has continued to drop, since last year's assessment. National Grid now expects a net reduction of around 4 GW of installed capacity between winter 2014/15 and 2015/16. This is a 2-GW net reduction compared to the expectations in Future Energy Scenarios 2014. National Grid projects this reduction is mainly caused by gas-fired plants leaving the market either permanently or through mothballing, due to poor plant economics (Ofgem 2015a, 14).

In other words, gas plant has become uneconomic, because the electricity market has been coerced into accepting so large a share, some 20 % in fact, of subsidized renewables that gas-fuelled generators are no longer able to recover their costs of operation. In fact, Combined Cycle Gas Turbines (CCGT), which are technically capable of a 90 % load factor, have in the last few years been compelled to run at a level that DECC itself concedes is about 30 % (DECC 2015a, 122). Load factors this low inevitably make investment in and even the operation of existing CCGTs unattractive. Furthermore, with renewables poised to take still larger shares of the market, investment in the conventional plant becomes extremely unlikely.

[3] EdF's work, and that of others is reported and analysed in Sharman and Constable (2009), 1–4. See also Sharman and Constable (2008).

The present Secretary of State for Energy and Climate Change, the Rt Hon Amber Rudd MP, recognizes this in the reset speech with which this discussion began:

> We now have an electricity system where no form of power generation, not even gas-fired power stations, can be built without the government intervention (DECC 2015b).

In effect, by distorting the markets so extensively with subsidies to renewables, the government has driven conventional, firm generation from the market, and so reduced the capacity margin to uncomfortable levels. Government has, thus, been obliged to introduce expensive system management tools to guarantee security of supply. In effect, having damaged the market with subsidies to one sector, it is now compelled to introduce a Capacity Mechanism, to subsidise the conventional generation that in an undistorted market would be fundamentally economic and spontaneously attractive.

4.2 Future electricity demand

Of course, the question of where there is sufficient plant in the system to meet load relies crucially on projections of future demand. Obviously, if electrification had continued to grow there would have had to be a major expansion of generating capacity, probably not dissimilar to that predicted by Bending and Eden, whose 1984 study, UK Energy, foresaw consumption of about 452–666 TWh per year in 2020 and a fleet of between 113 and 166 GW (Bending and Eden 1984). Even in 2006, as noted earlier, EdF expected moderate demand growth. However, load and demand have not grown, leaving analysts with the uncomfortable necessity of hedging. As Ofgem wrote in its recent Security of Supply Report of the approaching winter of 2016/17, "our assessment is that there is potential for the risks to be managed by either a strong market response or a continued reduction in demand" (Ofgem 2015a, 4). In other words, if load and demand return to growth, there would have to be a strong market response if the government's security of supply standard, a Loss of Load Expectation (LOLE) 3 h per year (i.e., 0.03 %), is to be satisfied, but if the trend is towards further reductions in demand, then no additional market response will be called for.

However, electricity demand forecasting is notoriously difficult over anything longer than a few years, and reference to earlier projections, such as those of Bending and Eden, which are impeccably reasoned, should be fair warning. With this sort of background, no current public decision maker can afford to gamble on future demand staying low. Since 2013, three mechanisms have been introduced to allow National Grid to address the increasing risks to security of electricity supply:

1. Supplemental Balancing Reserve (SBR), which is a scheme in which power stations that would, otherwise, close or be mothballed contract to be available at a specified time (at present described as weekdays in winter between 18.00 and 20.00) (National Grid 2014a).

2. Demand Side Balancing Reserve (DSBR) is a scheme, in which large energy users can contract to reduce their energy demand in return for payments from the consumer, via National Grid (National Grid 2014a).
3. The Capacity Mechanism (CM) is a scheme under which a power station, new or old, receives a guaranteed income, in effect, a retainer, irrespective of the energy (MWh), it generates, and in return undertakes an obligation to supply capacity (MW) on request (National Grid 2014b).

SBR and DSBR are already active, and have been employed in winters 14/15 and 15/16, while the CM will become active in 2018/19. In passing, it is worth noting that while all three are implemented in such a way that they retain elements of competition, via auctions, they have the general consequence of reducing competition in the electricity markets, and accelerating the trend towards administrative pricing noted above. While arguably necessary in the short term, it is doubtful whether this is in the longer term interests of the consumer.

However, these mechanisms are powerful and can address the difficulties insofar, as they can be foreseen. One of Ofgem's principal findings in its most recent review is that without the SBR and DSBR, LOLE fails to meet the government's Reliability Standard in 2015/16, potentially reaching levels of as many as 20 h of interrupted supply, with a capacity margin of around 4 % or less, and with the possibility of it running into negative numbers. However, with the special measures now available, the LOLE falls to around 4 h, or less, and the margin to around 6 %, and no less than 3 % (Ofgem 2015a, 12).

Nevertheless, it is worth noting that the measures are not resulting in comfortably high margins, and, indeed, the situation in 2016/17 deteriorates, and margins are predicted to vary between 0 and 4 % in spite of the available measures, though in 2017/18, the outlook improves as the Capacity Mechanism brings mothballed firm generation plant back into service. Even so, margins are still hardly impressive, with Ofgem only feeling able to predict a margin of about 3–7 %, and LOLE "broadly [...] within the government's reliability standard". This qualified result is disappointing given the costs of the mechanisms, to which we will now turn, putting them into the context of current and earlier Balancing Services Use of System Costs (BSUoS).

4.3 Balancing services use of system costs

The UK System Operator, National Grid, must correct for errors in the demand and generation forecast, and also for congestion in the transmission network. These include purchasing additional generation at short notice, as well several other ancillary services (National Grid 2015b). The cost of these services, which are known as Balancing Services Use of System (BSUoS), and National Grid's own administration costs and profit, are initially charged to generators and to electricity suppliers, though, obviously, ultimately recovered from electricity consumers (National Grid 2015a).

Fig. 7 tracks Balancing Services Use of System (BSUoS) charges since 2001/2.

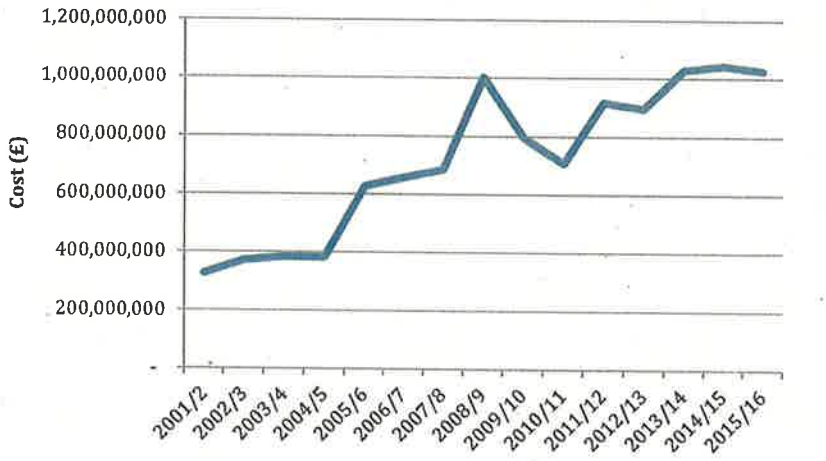

Fig. 7 Balancing services use of system (BSUoS) costs (£) 2001/2 to 2014/15 Data source, 2001/2–2014/15, current and historic datasets available at: http://www2.nationalgrid.com/bsuos/. Data for 2015/16, from National Grid (2015c), 39. Chart by the authors

BSUoS costs have increased by a factor of three in the decade 2001–2012, a point that is all the more remarkable against the backdrop of falling demand, meaning that the BSUoS cost per unit of electricity carried through the system-to-consumers has increased by a factor well in excess of three, and has now reached levels of about £3.5/MWh.

Constraint, i.e., congestion, costs account for a large part of the increase of BSUoS costs, and the rapid rise in constraint costs is largely caused by the rapid expansion of the on-shore wind power fleet located north of the Anglo-Scottish border, which is a major grid bottleneck separating these generators from the centres of load in England. The problem is simply that wind power generation often exceeds demand in Scotland, but cannot be exported to England, in spite of being contracted into the market. Consequently, National Grid must curtail wind output to protect the system. Wind loses its subsidy income, about £45/MWh, when it is curtailed, though it retains its wholesale payment. Consequently, National Grid must compensate wind generation for this lost income. However, and arguably, because wind generators are aware of their market power, this payment usually exceeds the subsidy lost. Indeed, when these payments began in 2011, some wind farms asked for and received very high prices, some as high as £999/MWh, twenty times the lost income, and though these fell sharply as the result of adverse publicity in the national press, current prices still exceed lost income, with the publicly controversial result that wind farms make more money when discarding their energy than when they sell it to consumers. Furthermore, volumes continue to grow sharply. 2015 was a record year, both in total payments to wind power and in volumes of energy, as can be seen in Table 2.

Table 2 Constrained off volumes of wind energy and payments to wind generators in the United Kingdom, 2011–2015 Source: Fundamental data from BM Reports: reprocessed and analysed by the authors. For latest data, see also www.ref.org.uk

Year	Cost (millions)	GWh	Average price £/MWh
2011	£12.8	59	£218
2012	£5.9	45	£130
2013	£32.7	380	£86
2014	£53.2	659	£81
2015	£90.5	1,274	£71

The total volume constrained off in 2015, 1.27 TWh is approximately 7 % of total on-shore wind energy generated in the UK (roughly 19 TWh per year at present), and the payments to wind alone are nearly 10 % of current BSUoS costs.

It should be noted, of course, that when wind is constrained off in Scotland, the market is, consequently, out of balance, and the conventional generation must be constrained on south of the constraint to rectify this error. This cost is not included in Table 2, and is extremely difficult for those outside National Grid to estimate, but since these conventional generators are being asked to respond at short notice, the cost can not be low, and will constitute a significant fraction of the now £1bn a year total BSUoS cost.

An obvious means of reducing such constraint payments is to add new grid and reinforcements to alleviate the bottlenecks, and this is currently occurring. However, while BSUoS may now fall, as constraint payments are eased by the construction of these grid reinforcements, including subsea High Voltage Direct Current (HVDC) cables on the eastern and western sides of Scotland (Ofgem 2015c), overall costs to consumers will probably not fall, since the capital cost of these new lines and reinforcements must also be recovered from consumers at a rate of between 5 and 10 % of the capital cost for the life of the assets, say 30 years, and this annual cost is unlikely to be less than hundreds of millions of pounds a year. Indeed, it is conceivable, perhaps, likely, that overall cost to consumer may exceed that of constraint payments, since under-utilised grid is almost certainly a less efficient way of dealing with the overbuild of Scottish wind power than constraint payments.

Furthermore, the special instruments introduced by National Grid are themselves expensive. SBR and DSBR, which are holding the fort, while the Capacity Mechanism is implemented, cost £31.3 m in 2014/15, £34.7 m in 2015/16, and National Grid has successfully requested that both schemes be extended to 2017/18 (Ofgem 2015b). While this cost will presumably lapse when the CM starts, the overall cost to consumers will not fall. The Office for Budget Responsibility has estimated that in its first year, 2018/19, the CM will cost some £600 m. In 2019/20, this expected this to rise to £1.1bn and then to £1.3bn in 2020 (OBR 2015). These estimates would appear to be approximately correct. The first auction, for the year 2018/19, secured 49,300 MW at a cost of £19,400/MW, giving a total cost of £956 m (DECC 2015d). The second auction, for the period 2019/20 secured

46,534 MW at a price of £18,000/MW, giving a total cost of £834 m (DECC 2015c). Thus, the total cost is approximately £1.79bn for just one element of BSUoS for these 2 years, 2018/19 and 2019/20, almost exactly the OBR's estimate.

These costs are all the more striking when it is recalled that before the current energy and climate policies began to bite, i.e., before 2002, BSUoS was in total costing £300 m a year, and that the need for the services covered by that charge, for instance, Frequency Response and Black Start have not disappeared. The CM costs are additional to the earlier BSUoS costs and do not replace them.

None of this is really surprising, and many analysts foresaw the problems. In 2011, work by the present authors for the Renewable Energy Foundation used work written for the Institute of Engineers and Shipbuilders in Scotland (IESIS) by Mr Colin Gibson, former Power Networks Director (PND) at National Grid, to estimate that the systems costs of the renewables target alone would put an additional £5bn a year, on the national electricity bill, including additional rapid response plant to cover errors in the wind forecast, additional grid, and grid reinforcements, and the additional cost of running at low load factor a conventional generation fleet equivalent to peak load (plus a margin) to guarantee security of supply (Renewable Energy Foundation 2011).

Additional costs of this kind add to concerns about the cost of reducing emissions from the current policies, and it is to this subject that we will now turn.

5 Emissions abatement costs in the UK

Table 3 calculates the subsidy cost per tonne of carbon dioxide saved by the various renewable technologies in the United Kingdom, assuming that each MWh of renewable electricity displaces grid average emissions of approximately 0.5 tonnes of carbon dioxide, a generous assumption, since renewables tend to displace gas in

Table 3 Estimated abatement costs per tonne of carbon dioxide in the United Kingdom Source: Calculations by the authors from subsidy and grid average abatement figures from the United Kingdom's Department of Energy and Climate Change and the Department of Environment Food, and Rural Affairs (DEFRA); where multiple costs per tonne of CO_2 appear, this reflects the increasing level of subsidy as the size of the generator decreases

Technology type and band	Subsidy cost per tonne CO_2
Roof mounted solar PV	$380–$1450
Free-standing solar PV	$228
Small on-shore wind (<500 kW)	$608
Large on-shore wind (>1 MW)	$137
Off-shore wind	$274
Dedicated biomass	$198
Hydro	$0–$137–$684
Anaerobic digestion	$274–$380
Incinerated municipal biomass	$0

the UK, with much lower savings. Conversion to dollars has been made assuming an exchange rate of $1.5 to the pound.

If we add system costs to these subsidy costs; then, the cost per tonne on-shore wind, for example, rises to about $350/tonne, and that for off-shore to about $470/tonne. The system costs of solar in the UK are not sufficiently well understood to permit analysis, but we can be reasonably certain that they will add significantly to the total abatement cost.

Such costs can be compared with the estimates of the Social Cost of Carbon (SCC), for example, in Marten (2011), which suggests a range of $0–$206/tCO_2. In work by the Environmental Protection Agency of the United States government, which finds SCC ranging from $12 per tonne to $120 per tonne in 2015, depending on discount rate, and $29–$240 per tonne in 2050 (United States Environmental Protection Agency 2015).

Even at the upper ends of the SCC estimates, the costs of abatement from the major renewable energy technologies do not appear spontaneously compelling. Indeed, it would appear to be rational to prefer climate change and its harms to the economic harm resulting from the costs of adopting renewables.

In other words, efforts to drive low carbon energy into the sector with subsidies that simultaneously increase the costs of the conventional generation or otherwise disadvantages conventional generation and discourages investment in that sector are, from the perspective offered in this paper, simply mistaken, and will all, however, inevitably put the low carbon agenda on a collision course with the human desire to seek greater wellbeing for themselves and their offspring. This is the clear microcosm in the UK case, where the additional costs implied by renewable electricity will be about £14 billion a year (i.e., £7.6bn plus £5bn system costs plus VAT), equivalent to just under 1 % of the current GDP. Such costs will be damaging in themselves, but will also drive the UK further towards de-electrification, a phenomenon that is already observable in the data and which raises grave doubts about the fundamental health of the UK economy.

6 Conclusion: high cost explains new directions

This paper began by remarking on the Secretary of State for Energy's announcement of a new direction in energy and climate policy. We can now see that this is in essence a response to economic problems arising from the current policies, problems that have been neglected under previous governments, and are now pressing. The UK government has very little room for manoeuvre or further delay. However, as noted above, this does not imply a rejection of climate change concerns, for as the Secretary of State remarked in her speech,

> Our most important task is providing a compelling example to the rest of the world of how to cut carbon while controlling costs. [...], it is not clear we have done that so far (DECC, 2015b).

While it is rational to have an insurance policy against climate change, that policy can only offer real cover against the hazard if it is compelling to others, and

consequently, the policy must pass two fundamental tests: The premium must be intrinsically affordable and proportional to the risk (i.e., the scale of the hazard multiplied by its estimated probability). The UK's policies do not appear obviously satisfactory by such standards, and should, therefore, be redesigned. In this light, perhaps, the most encouraging remarks of all in Rudd's speech were those which admitted in clear terms what many others; for example, the authors of a series of papers issued under the aegis of the Hartwell Group (Prins et al. 2013) have been urging for some time, namely, that current low carbon technologies are neither adequate nor affordable and that an aggressive invention and innovation policy is required. As Amber Rudd put it:

> Let's be honest with ourselves, we don't have all the answers to decarbonisation today. We must develop technologies that are both cheap and green.[4]

What the UK will do to transform this recognition into practical policy is far from clear. A revenue neutral carbon tax might well be best from a theoretical perspective, but increased R&D funding, with all the risks of waste and ineffective targeting that this brings, is likely to be more politically probable in the short term. However, it is, perhaps, significant that the Secretary of State went out of her way to comment on the EU Emissions Trading Scheme (ETS), and to say that in spite of its flaws, it represented the best chance for co-ordinated action at the European level, and that her government was committed to restoring the ETS to "full health". This may be taken as an indication of a growing preference within government for carbon taxation to provide a signal for invention and innovation, rather than an attempt to deliver set volumes of emissions savings through the subsidized deployment of existing technologies.

The largest question hanging over this policy reset is whether the realisation of the ambitions will be adequate to the task, particularly in the light of low fossil fuel prices. It is conceivable that retrospective cuts in subsidies to renewables will be required, and though the removal of the Climate Change Levy exemption is a precedent, such moves would be legally very complex and may not be possible so long as there is a commitment to renewable targets as part of climate policy at the European level. Assuming that the UK does not vote to leave the EU in the 2016 referendum, it seems certain that energy and climate will be a focus for a restoration of national self-determination in any negotiations between Westminster and Brussels.

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