

From: [Jonathan Dean](#)
To: [NDE](#)
Cc: [PMQ](#)
Subject: NDF consultation
Date: 15 November 2019 09:57:14
Attachments: [Draft NDF policy 10 - 13 consultation feedback v0.2.pdf](#)
[Draft NDF consultation feedback addendum v0.1.pdf](#)
[Draft NDF consultation feedback - comparison of renewables approaches v0.2.pdf](#)
[Draft NDF consultation feedback - overall renewables strategy v0.2.pdf](#)
[Draft NDF consultation feedback - renewables target v0.1.pdf](#)

Just to make sure you have got all my feedback, here are the attachments again to supplement my emails. I must apologise for this somewhat scatter gun approach, but I haven't had time to consolidate everything into a single document

Thank you for involving me and happy to get more involved with improving the NDF

Jonathan

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Dr Jonathan F Dean



<https://you.38degrees.org.uk/petitions/anglesey-says-no-to-pylons>

Additional feedback on draft National Development Framework

1. Introduction

1. In the draft National Development Framework¹, the Welsh Government presents a bold and ambitious picture of how Wales will develop between 2020 and 2040.
2. This feedback focuses on policies 10 – 13 and how these would impact Anglesey. The focus is on Anglesey due to the personal knowledge of the author, but the findings may well be applicable to other areas of Wales:
 - Policy 10 – Wind and Solar Energy in Priority Areas;
 - Policy 11 – Wind and Solar Energy Outside of Priority Areas;
 - Policy 12 – Wind and Solar Energy in National Parks and Areas of Outstanding Natural Beauty (AONB); and
 - Policy 13 – Other Renewable Energy Developments.
3. The areas selected for large scale wind power, including about of quarter of Anglesey, were selected following two reports by the consultants Arup²³, but these contain significant differences to an earlier report by Arup⁴ for Isle of Anglesey and Gwynedd County Councils.
4. While it is recognised that these reports were produced at different times, with differing objectives and constraints, some critical findings in the earlier report are glaring omissions in the later reports, calling into question the validity and/or motives of selecting Anglesey as a Priority Area for large scale wind energy.

2. Arup report for Anglesey & Gwynedd Councils, 2013

5. This report was produced to provide evidence in formulating land use strategies for the Anglesey and Gwynedd Joint Local Development Plan (JDLP). It covers many forms of renewable generation alongside wind and solar. It deals with wind energy on Section 3.2 pg15. Generation potential is considered at two scales:
 - commercial, using 2 MW turbines – these might typically be 130 m high
 - micro, using 6 kW turbines – these might typically be 13 m high

¹ <https://gov.wales/sites/default/files/consultations/2019-08/Draft%20National%20Development%20Framework.pdf>

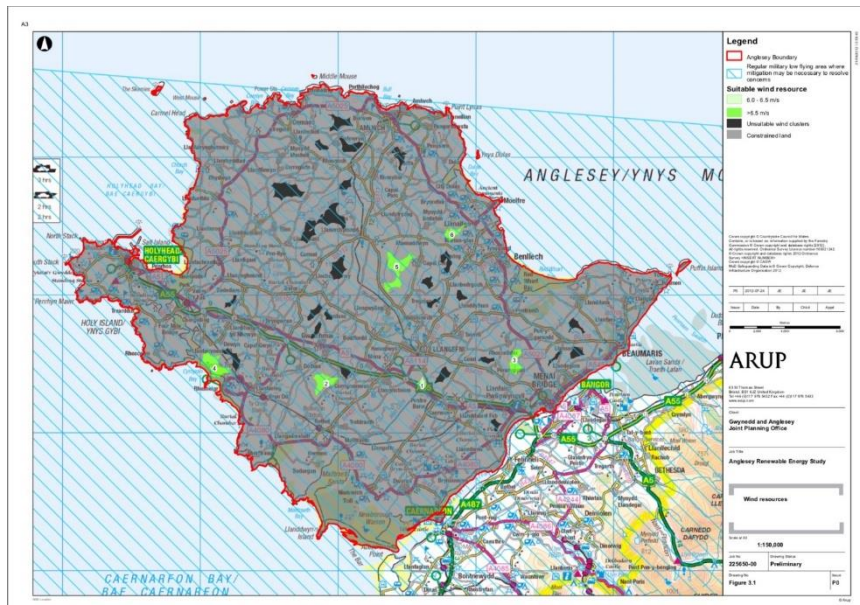
² <https://gov.wales/sites/default/files/publications/2019-08/stage-1-development-of-priority-areas-for-wind-and-solar-energy.pdf>

³ https://gov.wales/sites/default/files/publications/2019-08/stage-2-refinement-of-priority-areas-for-wind-and-solar-energy_0.pdf

⁴ [https://www.gwynedd.llyw.cymru/en/Council/Documents---Council/Strategies-and-policies/Environment-and-planning/Planning-policy/Supporting-documents/Renewable-Energy-Capacity-Study-Anglesey-\(DC.013\).pdf](https://www.gwynedd.llyw.cymru/en/Council/Documents---Council/Strategies-and-policies/Environment-and-planning/Planning-policy/Supporting-documents/Renewable-Energy-Capacity-Study-Anglesey-(DC.013).pdf)

6. Applying various constrains for turbine location, such as maintaining a 500 m buffer zone with any residence, and only considering areas with sufficient wind speed, six locations were identified for siting commercial scale turbines (see the bright green areas in Figure A). Note: although referred to in the report, this figure is missing from the report copy on file and had to be obtained directly from Gwynedd County Council.

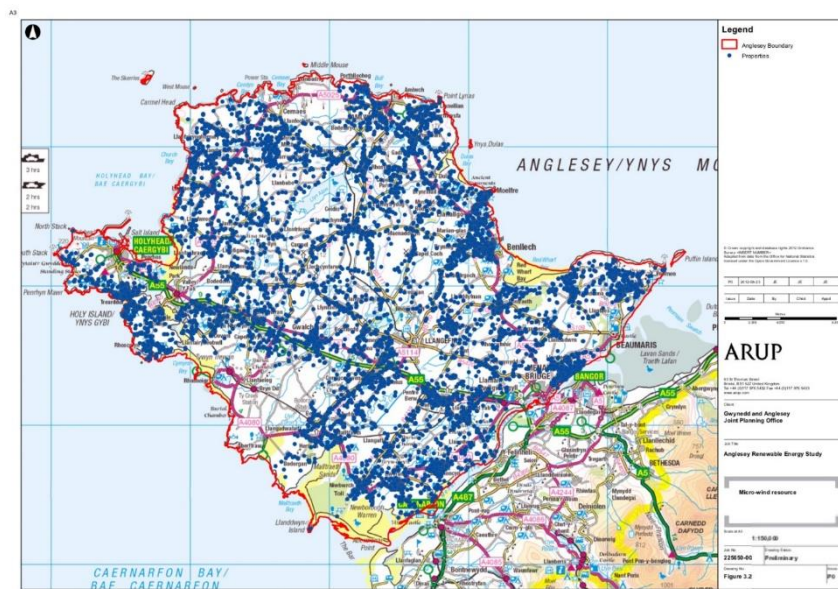
Figure A (3.2 in original report) Potential location for commercial scale turbines



7. The total generation potential of these areas was estimated at (see Table 15 in original report):
- 77.8 MW installed capacity
 - 39 turbines
 - 184 GWh (0.2 TWh) annual production
8. However area number 4 is placed directly on top of the base at RAF Valley, while number 2 is on a direct line with the runway at Mona used for emergency landing (and training for emergency landing) so is unlikely to be permitted. With these removed the generation potential is:
- 45.1 MW installed capacity
 - 23 turbines
 - 107 GWh (0.1 TWh) annual production
9. It can only be assumed that these “errors” were introduced due to lack of local knowledge and were not identified in an earlier draft.
10. The black areas on Figure A are areas a suitable distance from residences, but there is insufficient wind speed for this scale of turbine.

11. It is noted that the entire island is a regular military low flying area and that “mitigations may be required to resolve concerns”. One such concern was raised by the Safeguarding Officer MOD⁵ to a planning application for a single 79 m turbine in Rhosgoch due to unacceptable interference with ATC radar and unacceptable effects on military activities in already congested airspace. The planning application was not granted.
12. For micro scale generation a total of almost 20,000 residential and non-residential buildings were deemed suitable to use this scale (6 kW, 13 m) of turbine, with the locations shown in Figure B. Note: again this figure is missing from the report copy on file and had to be obtained directly from Gwynedd County Council.

Figure B (3.2 in original report) Potential location for micro scale turbines



13. The total generation potential was estimated at (see Table 16 in original report):
 - 120 MW installed capacity
 - 20,000 turbines
 - 105 GWh (0.1 TWh) annual production
14. At least half of the suggested locations are within the Anglesey AONB so may not be approved should applications be made. A small number are aligned with the runways at Valley and Mona and applications are known to have been not granted due to concerns raised by the MOD.

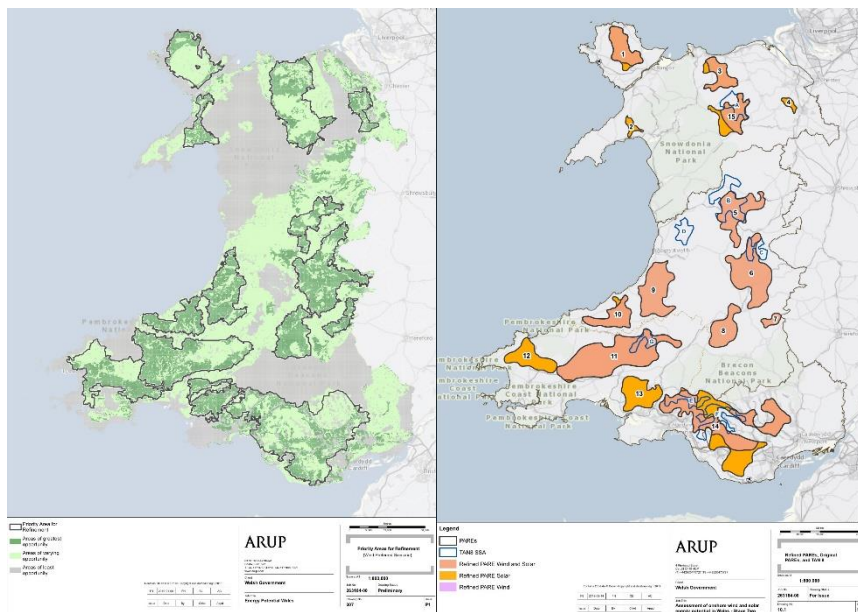
3. Arup reports for the Welsh Government, 2019

15. These reports were produced for the Welsh Government in 2019 to identify Priority Areas for large scale wind and solar power generation for the National Development Framework. The work is presented in two stages:

⁵ Letter dated 8 May 2013 to IoACC re planning application number 38C292C

- Stage 1 – March 2019 - this identified a number of Priority Areas for Refinement throughout Wales, considering wind turbines of between 150 – 250 m high (up to 12 MW), based on factors such as wind speed, average solar radiation and high level constraints such as designated landscapes (see Figure C, dark green areas are high potential, light green areas lower potential)
- Stage 2 – June 2019 – this refined the Priority Areas by considering factors such as grid connections, impact on listed buildings, proximity to urban areas, impact on designated landscapes. The areas identified in stage 1 were generally “trimmed down” (see Figure C)

Figure C – Priority Areas selected in stage 1 (left) and stage 2 (right)



16. Some of the Arup personnel involved in producing these reports had also been involved in the earlier work for Anglesey and Gwynedd Councils.
17. The main focus of this work was selecting the areas of Wales to be designated for large scale energy production. The size of wind turbines considered is quite different to those in the earlier report. Although landscape impacts have been addressed at macro scale, no consideration has been given to micro (within each area) scale.
18. In the stage 2 report, Appendix E, page E1, a table is presented showing the energy generation target and potential of each of the Priority Areas. This appendix is referenced from Section 5 – Grid Connection, pages 37-38 of the main report. No information is provided how these figures were arrived at.
19. For Anglesey, Priority Area 1, the figures are:

• renewable energy target	701,606 MWh	0.7 TWh
• low coverage	743,796 MWh	0.7 TWh
• medium coverage	3,718,980 MWh	3.7 TWh

- high coverage 7,437,961 MWh 7.4 TWh

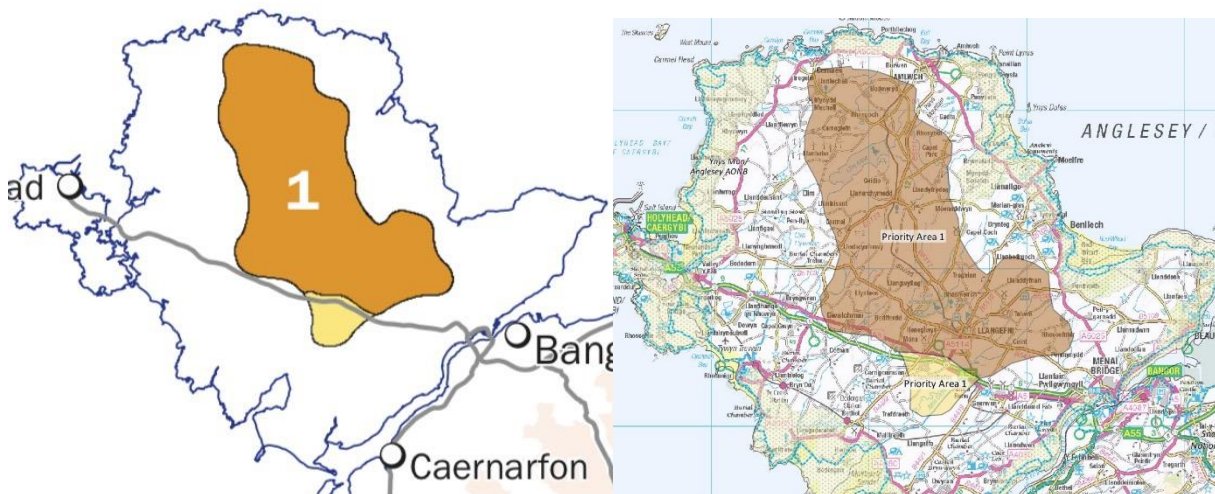
20. In the absence of any explanation, it can only be assumed that these figures are a combination of both wind and solar, and represent the degree with which the selected area is covered with energy infrastructure. The target is presumably the additional renewable generation required to bring generation up to the NDF target of 70% of demand. The target for the whole of Wales is 9.1 TWh while the high coverage estimate is 95.9 TWh – enough to provide approx. one third or the entire UK with renewable power at the 2030 demand estimate!⁶

4. Issues with the Arup reports

Target and generation potential

21. A rough estimate of the generation potential is possible if high level benchmarks are used. The area selected on Anglesey is roughly 65 square miles (see Figure D) based on about a quarter of the island being selected.⁷

Figure D Priority Area 1 (left from Welsh Government, right from CPRW)



22. A benchmark "power density" figure⁸ for wind power is 2-3 W/m². The London Array produces 2.5 W/m². Using this figure, Anglesey could produce 3.7 TWh from Priority Area 1 using about 70 turbines of 250 m high.
23. Benchmark power density figures for PV solar range from 5 W/m² in Germany to 20 W/m² in open desert. Using a figure of 5 W/m², Anglesey could produce 7.4 TWh.
24. If both wind and solar are used, Anglesey could generate over 10 TWh. This is a similar order of magnitude to the slightly lower figure arrived at in the Arup report which is based on far more rigorous analysis of high and lower potential areas.

⁶ <http://fes.nationalgrid.com/fes-document/>

⁷ <https://en.wikipedia.org/wiki/Anglesey>

⁸ <https://www.energycentral.com/c/ec/future-energy-why-power-density-matters>

25. This suggests that the term “high coverage” does mean that all of the available land in Priority Area 1 would be covered with generation infrastructure - 65 square miles of solar park and 70 wind turbines. This would generate x10 of the target allocated to Anglesey and almost the entire target for Wales.

Micro-siting issues

26. Figure A shows the small number of areas where turbines of up to 2 MW, ca 130 m high, could be located allowing for a 500 m buffer zone around properties. Presumably for turbines almost twice as high this buffer zone would be greater, say 1,000 m. This would then reduce the available area for locating them (potentially removing them altogether).
27. Applying the same location constraints as used in the 2019 Arup stage 2 report, to the locations identified in the 2013 Arup report, only area 5 falls within Priority Area 1 along with a number of areas excluded due to low wind speed. Assuming that these areas became viable due to the larger turbines (wind speed is higher at greater altitude), and that the buffer zone was not increased, at least 90% of Priority Area 1 cannot be used for wind energy unless the buffer zones are removed entirely.
28. It is not clear why the knowledge and experience gained by Arup in the 2013 report has not been used to better inform the conclusions in the 2019 reports.

5. Discussion and conclusions

29. The Welsh Government have proposed an area on Anglesey that has the potential to almost meet the entire renewable energy target for Wales. This would require about 65 square miles of central Anglesey being turned into a solar park, with in addition, about 70 wind turbines of up to 250 m high.
30. All buffer zones between energy infrastructure and residences would have to be removed. A significant number of homes (thousands) and communities would be surrounded. However, in the draft NDF⁹ on page 36 it states “*Communities will be protected from significant cumulative impacts to avoid unacceptable situations whereby, for example, smaller settlements could be potentially surrounded by large wind schemes*”. This statement is incompatible with the proposal of Priority Area 1 for wind and solar.
31. The inconsistency between the area on the maps from 2013 and 2019, and the words in the draft NDF, raises a number of questions for which there are currently no answers:
- Has the work by Arup been rushed in order to meet a political deadline, and with further time and effort the Priority Areas could be better refined such that developers stood a chance of bringing forward proposals that could both gain consent and would be optimal for energy generation?
 - Why has the knowledge clearly available within Arup not been fully utilised to provide a better quality output?

⁹ <https://gov.wales/sites/default/files/consultations/2019-08/Draft%20National%20Development%20Framework.pdf>

- Do the Welsh Government genuinely intend standing by their word to bring forward guidance to protect communities, or are the promises simply to sooth the anticipated anger raised by the proposals? Without such guidance it is difficult to assess the local impact
- Do the Welsh Government intend removing all buffer zones around energy developments? This would be necessary for Priority Area 1 to be a credible selection
- Is the intention to allow many small developers to “randomly scatter” turbines of varying scale around the Priority Area rather than a small number of large scale, coherently designed developments?
- What input has there been from the wind and solar industry – are the proposed areas the kind of developments they are seeking? Individual negotiations would need to be successfully concluded with hundreds of farms on Anglesey alone. The approach¹⁰ used by the Crown Estate may be a model to follow
- Is the NDF simply a threat, aimed at reducing local opposition to currently proposed solar parks or wind turbines (which are almost exclusively outside the proposed area)?
- Is the aim of the NDF to encourage far greater installation of micro-generation with the Priority Area acting as a fall back?
- Is selecting central Anglesey simply being done to give the appearance of doing the right thing, safe in the knowledge of knowing that an offshore windfarm is likely to remove any need for onshore generation?
- Are the Welsh Government making a political point, drawing attention to their lack of control over development at sea?
- Why have such large areas of Wales been selected when Anglesey alone (or several other Priority Areas) has the potential to supply all of Wales (Ynni Môn Mam Cymru)?
- Why have the lower potential areas been included at all when the total area selected is vastly in excess of requirements?
- Are the Welsh Government aware of plans, or planning to instigate, the closure of the RAF base at Valley and Mona?
- Is the selection of Anglesey a knee jerk reaction to the suspension of the Wylfa Newydd project? This has created a huge void in the economic plans for North Wales, and the Welsh Government has no control over it. A large scale wind and solar project gives the appearance of taking action to fill that void

¹⁰ <https://www.thecrownestate.co.uk/en-gb/what-we-do/on-the-seabed/offshore-wind-leasing-round-4/offshore-wind-potential-new-leasing/>

- What is the Welsh Government doing to create the demand that the over specified wind and solar power developments can supply. A switch to EVs and heat pumps would create that demand, but the demand and supply need to be developed together, unless the aim is to “dump power” into the grid using England as a power soak until Welsh demand develops
- Is the aim to use renewable power as a cash cow or bargaining tool in future negotiations with Westminster post Brexit?
- The combined pressures of Brexit/subsidies and dietary change will be putting strain on Welsh livestock production, itself a large producer of greenhouse gases (methane from ruminants). Is converting central Anglesey into an energy park intended to help some farmers leave the land?

32. With so many, wide ranging, questions unanswered, while the creation of the NDF is laudable, the section on renewable power generation covered by policies 10-13 seems out of place. The motives for the policies are superficially clear and transparent, but digging just a little bit into the detail leaves the impression that the renewable energy policies are just not ready yet.

Additional feedback on draft National Development Framework – energy scenarios

1. Introduction

1. In the draft National Development Framework¹, the Welsh Government presents a bold and ambitious picture of how Wales will develop between 2020 and 2040.
2. This feedback focuses on the following policies:
 - Policy 7 – Ultra Low Emission Vehicles;
 - Policy 10 – Wind and Solar Energy in Priority Areas;
 - Policy 11 – Wind and Solar Energy Outside of Priority Areas;
 - Policy 12 – Wind and Solar Energy in National Parks and Areas of Outstanding Natural Beauty (AONB);
 - Policy 13 – Other Renewable Energy Developments;
 - Policy 14 – Priority Areas for District Heat Network;
 - Policy 15 – Masterplanning for District Heat Networks;
 - Policy 22 – North West Wales and Energy.

2. Estimated future energy generation

3. There is no shortage of papers and reports laying out blueprints for how the country can become carbon neutral, to a degree, by various deadlines, including:
 - “Thirty recommendations by 2030”² prepared for the Labour Party;
 - “Re-energising Wales”³ by the Institute for Welsh Affairs;
 - “Zero Carbon Britain”⁴ by the Centre for Alternative Technology; and
 - “Future Energy Scenarios 2019”⁵ by National Grid ESO.
4. This feedback compares these to the vision presented by the Welsh Government in the NDF. Observations from “Future Energy Scenarios 2019”, which includes four scenarios, two 2050 compliant, are included in the “Thirty Recommendations by 2030” report.

¹ <https://gov.wales/sites/default/files/consultations/2019-08/Draft%20National%20Development%20Framework.pdf>

²² <https://labour.org.uk/wp-content/uploads/2019/10/ThirtyBy2030report.pdf>

³ https://www.iwa.wales/wp-content/uploads/2019/03/IWA_Energy_WP6_Digital-2.pdf

⁴ <https://www.cat.org.uk/info-resources/zero-carbon-britain/research-reports/zero-carbon-rethinking-the-future/>

⁵ <http://fes.nationalgrid.com/fes-document/>

5. Those reports that consider the whole of the UK can be scaled for just Wales using the ratio of Welsh to UK energy consumption. In 2017:
 - Wales consumed 89 TWh of energy⁶;
 - the UK consumed 149.1 million toe of energy⁷ equivalent to 1,734 TWh; therefore
 - Wales consumes just under 5% of UK energy.
6. Using population figures to scale would give a similar result. Where relevant, the scaled figure for Wales are shown [like this].
7. CATs “Zero Carbon Britain” is, unsurprisingly, the most extreme, outlining how the UK can become “net zero” as required by Westminster for 2050. It is also, though, the oldest report dating to 2013, before many of the recent cost and technology improvements in battery storage, solar PV, EVs etc. It presents, perhaps, an “end state” vision, and would be worth bringing up to date.
8. “Thirty Recommendations by 2030” and “Re-energising Wales” are both 2019 publications, aiming to achieve a step change, but not net zero, over a relatively short timescale. Fossil fuels still have an important role to play in these scenarios.
9. National Grid’s “Future Energy Scenarios”, which is updated annually, presents four possible trajectories, but only two of these, “Community Renewables” and “Two Degrees” achieve the 2050 target of 80% emissions reduction. This report highlights that different pathways exist to achieve the same objectives, which may vary by region, but all have common “no regret” early activities aligned with “Thirty Recommendations by 2030” and “Re-energising Wales”.

3. Comparison between the NDF and other scenarios (Tables 1 & 2)

10. All future scenarios include for major improvements in building energy consumption as a means of reducing the energy required for heating. This needs to be via increasing the requirements in building standards for new build, as well as retrofitting existing buildings. The NDF makes no mention of any such changes, although it does designate areas for development, there seems to be no change to the standards homes are built to.
11. The NDF only addresses onshore wind and solar PV with estimates for the combined installed capacity ranging from⁸ 4 GW (minimum to achieve target) to 46 GW (where all of the Priority Areas are filled with generation infrastructure). In comparison, the other future scenarios give the following combined wind and solar capacity:
 - 5.9 GW Thirty Recommendations by 2030;

⁶ <https://www.regen.co.uk/publications/energy-generation-in-wales-2017/>

⁷ https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/736148/DUKES_2018.pdf

⁸ See page E1 in https://gov.wales/sites/default/files/publications/2019-08/stage-2-refinement-of-priority-areas-for-wind-and-solar-energy_0.pdf

- 6.9 GW Re-energising Wales;
- 11.6 GW Zero Carbon Britain; and
- 4.2 GW Future Energy Scenarios – Community Renewables.

12. This would suggest the minimum installed capacity, using one tenth of the land in the Priority Areas, might be more appropriate than the vast swathes of Welsh countryside in the NDF.

13. The NDF makes no specific mention, at all, of offshore wind, although does concede “other technologies are supported in principle”. All of the future scenarios see a role for offshore wind of at least a similar order of magnitude to onshore. The “Zero Carbon Britain” and “Future Energy Scenarios” reports have significantly more offshore than onshore. Offshore capacity for Wales would be similar to some of the current developments in the North Sea.

14. Other technologies such as tidal stream, tidal reach, wave, floating wind, hydro etc all have roles to play in the scenarios but get no mention in the NDF.

15. “Future Energy Scenarios” includes the following as “no regret” immediate actions, whatever pathway is taken towards net zero:

- improving the thermal efficiency of homes so that the majority are rated at EPC Class C or higher by 2030;
- accelerate the rate of heat pump installation with at least 2.5 million [125,000] by 2030, and more than 23 million [1.2 million Wales] by 2050; and
- regional plans to optimise low-carbon heating solutions (heat pumps, biogas, hydrogen, district etc).

16. “Future Energy Scenarios” in the longer term (2050), includes for:

- a total installed generating capacity in excess of 200 GW [10 GW Wales] to accommodate a peak demand of over 70 GW [3.5 GW Wales], dominated by wind, 80 GW [4 GW Wales] and solar, 50 GW [2.5 GW Wales];
- offshore wind dominates generation at 200 TWh [10 TWh Wales] with onshore at 50 TWh [2.5 TWh Wales] amongst other renewables, with a total output of 480 TWh [24 TWh Wales];
- significant use of interconnectors with other countries [grid connections with England and interconnectors with Ireland];
- large scale use of smart charging EVs for grid storage and to help balance the grid; and
- small use of CCS equipped gas generation.

17. Ground source heat pumps are more efficient than air source, but can require significant land use (compared to the properties heated) for the geothermal collector systems. However, this land can be returned to agriculture or community use once the collector pipes

are installed. Allowing for this land use needs to be included in planning guidance and standardised access mechanisms (a two acre wildflower meadow could heat five homes).

18. District heating is the one area where the NDF aligns with the other scenarios, and while heat pumps are alluded to, the dense housing suggested by P1-4 might exclude ground source heat pumps. No provision appears to have been made for heat pumps in rural areas to access agricultural land for geothermal collection.

4. Conclusions

19. Regarding renewable energy, the NDF contains some interesting ideas, but these appear to be very formative and unrefined. The principle of renewable generation is not wrong, but the scale and consequences seem ill thought through. There are valuable learnings from all the other scenarios discussed that the Welsh Government can learn from.
20. The NDF seems to allow for far more generating capacity than Wales needs, or any of the other future scenarios predict. Either the Priority Areas need further revision or the Welsh Government is planning on using renewables as a major economic tool, which is not explained in the NDF.
21. Despite this vast excess of onshore capacity, the NDF includes for no offshore wind capacity, which all of the other future scenarios include, or any of the other marine technologies which Wales has some of the best resources for.
22. There is much missing that needs to be included:
 - improvements to building standards and retrofitting of the existing housing stock – this may require taking some homes out of the use as the cost of retrofitting may be prohibitive;
 - provisions for ground source heat pumps to have “access rights” to geothermal energy in land not associated with the property;
 - regional decarbonised heat strategies, which may involve regional hydrogen or biogas production. Such regional heating systems would fit extremely well with aims for local ownership;
 - storage and balancing facilities need planning for, with former power station sites suitable for repurposing; and
 - clarity over the role of nuclear would be helpful, and where this will be permitted, although Wylfa Newydd is unlikely to be commissioned, or SMRs commercialised, by 2030, so this is a more long term view.
23. Overall, the entire section of the NDF concerning renewable energy appears like a collection of input material to a first draft, but requires much more thought and consultation before it can be considered anywhere near mature enough for policy.

TABLE 1	Draft National Development Framework for Wales	Thirty Recommendations by 2030	Re-energising Wales	Zero Carbon Britain
Sponsor	Welsh Government	The Labour Party	Institute for Welsh Affairs	Centre for Alternative Technology
Target	70% of electricity from renewables	77% reduction in energy emissions	100% renewable electricity	94% GHG reduction 6% GHG removal
Renewables and low carbon	4 – 46 GW installed capacity 9.1 TWh – 95.9 TWh generation	137 GW installed capacity [7 GW Wales] 375 TWh generation	11 GW installed capacity	770 TWh energy demand
Scope	Wales	UK	Wales	UK
Deadline	2030	2030	2035	No deadline
Energy conservation	Not really addressed although P1-4 aim to reduce transportation, P7 supports EVs	Upgrade almost 27 million homes to reduce heat demand by 20% and electricity demand by 11% [1.4 million Wales]	Upgrade 870,000 homes to reduce energy demand by 20%	Reduce heat demand by 50% by improved building standards & retrofitting Reduce transport demand by 78% by EVs, less flying, more public transport
Onshore wind	4 GW min – 46 GW max installed capacity 9.1 TWh – 95.9 TWh generation	30 GW installed capacity [1.5 GW Wales] 69 TWh generation	2.5 GW installed capacity	20 GW installed capacity [1 GW Wales] 51 TWh generation
Solar PV		35 GW installed capacity [1.8 GW Wales] 37 TWh generation	2.7 GW installed capacity	75 GW installed capacity [3.6 GW Wales] 58 TWh generation
Offshore wind	Other technologies supported in principle	52 GW installed capacity [2.6 GW Wales] 172 TWh	1.7 GW installed capacity	140 GW installed capacity [7 GW Wales] 530 TWh generation

TABLE 1	Draft National Development Framework for Wales	Thirty Recommendations by 2030	Re-energising Wales	Zero Carbon Britain
	14 towns selected for district heating	Onshore & offshore wind to provide 55% demand		
Other marine	Developments of 100 units to consider district heating	3 GW installed capacity with 1 GW min tidal stream (7 TWh)	4 GW installed capacity of tidal range, tidal stream, wave and floating wind	10 GW/25 TWh wave 20 GW/42 TWh tidal
Other renewable		Install 8 million heat pumps to supply 22% of heat demand [400,000 in Wales] Heat networks in urban areas Solar thermal supported Organic waste to biogas Hydro 0.5 GW additional installed capacity (8 TWh)	Install 170,000 heat pumps (ground, air, hybrid) 55 MW in-stream hydro 115 MW of fuelled technologies (biomass, anaerobic digestion, energy recovery) 9 TWh of heat energy from sustainable bioenergy	3 GW/24 TWh geothermal 3 GW/8 TWh hydro 25 TWh solar thermal 15 TWh geothermal 105 TWh ambient (heat pumps) 274 TWh biomass (inc synfuels)
Nuclear (low carbon)	Supported in NW Wales only 3.5 GW	9 GW installed capacity 63 TWh generation	Not included	Not included
Storage & balancing	Not addressed	Hydrogen, battery, CCS on gas peaking plants	Biomass fuel, hydrogen, battery, pumped storage	Hydrogen, biogas, syngas, pumped storage

TABLE 2	Draft National Development Framework for Wales	Future Energy Scenarios			
		Community Renewables scenario		Two Degrees scenario	
Sponsor	Welsh Government	National Grid ESO			
Target	70% of electricity from renewables	Progressing to “80 by 50”	80% emissions reduction	Progressing to “80 by 50”	80% emissions reduction
Renewables and low carbon	4 – 46 GW installed capacity 9.1 TWh – 95.9 TWh generation	150 GW total installed [7.5 GW] [4.2 GW wind & solar]	160 GW total installed [8 GW] [7.1 GW wind & solar]	220 GW total installed [11 GW] [3.9 GW wind & solar]	215 GW total installed [10.8 GW] [6.1 GW wind & solar]
Scope	Wales	GB [Wales]			
Deadline	2030	2030	2050	2030	2050
Energy conservation	Not really addressed	Improve the thermal efficiency of homes so that the majority are rated at EPC Class C or higher by 2030			
Onshore wind	4 GW min – 46 GW max installed capacity 9.1 TWh – 95.9 TWh generation	23 GW installed [1.2 GW]	42 GW installed [2.1 GW]	20 GW installed [1 GW]	25 GW installed [1.3 GW]
Solar PV		30 GW installed [1.5 GW]	53 GW installed 2.7 GW]	22 GW installed [1.1 GW]	42 GW installed [2.1 GW]
Offshore wind	Other technologies supported in principle	30 GW installed [1.5 GW]	46 GW installed [2.3 GW]	35 GW installed [1.8 GW]	53 GW installed [2.7 GW]
Other marine	14 towns selected for district heating	About 10 GW installed [500 MW]			
Other renewable	Developments of 100 units to consider district heating				
Nuclear (low carbon)	Supported in NW Wales only 3.5 GW	4.5 GW	8 GW	4.5 GW	16.5 GW
Storage & balancing	Not addressed	12.5 GW	28 GW	12.5 GW	23 GW

	Draft NDF	NMP	Comments
2018 consumption			91 TWh total energy, 14.9 TWh electricity of which 7.4 TWh is from renewables (50%)
2030 target	70% of electricity from renewables		<p>Setting a target is the right thing to do, but as neither the NDF or NMP give figures for the absolute level of generation, this is somewhat meaningless as it gives no indication as to how much generating capacity is required. Particularly relevant as the total energy mix will change with growing use of electric heating and EVs.</p> <p>One Arup report gives a “target” of an additional 9 TWh generation, 4.3 GW capacity for onshore wind & solar (total of 16.4 TWh from renewables).</p> <p>With major uptake of EVs and heat pumps, and total phase out of fossil fuels for generation, demand might be as high as 31.3 TWh total with 23.9 TWh from new capacity (see below)</p>
Energy conservation	✗	✗	All credible future scenarios predict this needs to be significantly improved. Neither NDF or NMP explicitly address this, although NDF P1-4 aim to reduce transportation and P7 supports EVs
Onshore wind	✓		The NDF focuses on land area, selecting 15 areas that equate to 20% of the land area of Wales. No estimates for the energy potential of this area are given, except buried in an appendix of one Arup report the range 9.6 TWh generation, 4.6 GW capacity up to 95.9 TWh generation, 46 GW capacity , more than Wales needs
Solar PV			
Offshore wind		✓	<p>All these technologies are supported by the NMP, but none have targets set for generation or even an estimate of the generation potential, other than tidal stream and wave, not yet commercialised in Wales, at 6.4 GW capacity.</p> <p>There seems to be a particular focus on tidal stream and wave, which doesn't align with the recent advancements in marine generation which have all been in wind energy</p> <ul style="list-style-type: none"> Record low generation costs below £40/MWh (4p/kWh) Floating turbines rather than fixed base <p>Tidal range has great potential in both north and south Wales and brings additional opportunities such as coastal protection and housing development</p>
Tidal stream			
Tidal range			
Wave			
Other	✓	✓	Other technologies supported in principle in the NDF such as biomass, district heating and even marine biomass (fuel production from algae) in the NMP
Hydrogen	✗	✗	Although barely commercialised at present, this is likely to become a significant energy source during the life of both the NDF and NMP
Nuclear	✓	✓	This is supported in north west Wales only with a combined capacity from Wylfa Newydd and an SMR at Trawsfynydd of about 3.5 GW
Storage & balancing	✗	✗	Battery storage and both transmission and distribution connected gas peaking stations, as well as substations and cabling will all be required, but get no specific mention

Sources

Energy Generation in Wales 2018

<https://www.regen.co.uk/wp-content/uploads/Energy-Generation-Wales-2018-1.4.pdf>

Draft National Development Framework (NDF)

<https://gov.wales/sites/default/files/consultations/2019-08/Draft%20National%20Development%20Framework.pdf>

National Marine Plan (NMP)

https://gov.wales/sites/default/files/publications/2019-11/welsh-national-marine-plan_5.pdf

Stage 2 – Refinement of priority areas for wind and solar energy

https://gov.wales/sites/default/files/publications/2019-08/stage-2-refinement-of-priority-areas-for-wind-and-solar-energy_0.pdf

How much electricity does Wales need?

Wales currently uses 91 TWh of energy of which 14.9 TWh is electricity. Of the 14.9 TWh, 7.4 TWh is generated from renewable sources, and 7.5 TWh comes from mainly gas and some coal and diesel.

The remaining 76.1 TWh is primarily gas, oil and coal for heating and petrol, diesel and paraffin for transportation.

Estimating future electricity consumption depends on the assumptions made for the:

- trend in current electricity use for homes and industry;
- quantity of electricity required to displace gas, oil and coal for heating buildings (homes, factories, retail etc); and
- quantity of electricity required to replace petrol and diesel for transportation.

DUKES 2018¹ estimates² that a complete (100%) electrification of all heating (using air, ground and water source heat pumps) and light transportation (EVs), with hydrogen and biofuels for heavy transportation would lead to a threefold increase in electricity use

- Total (100%) electrical demand would be = $3 \times 14.9 = 44.7$ TWh
- Total electrical demand to achieve target = 70% of 44.7 = 31.3 TWh
- Existing renewable = 7.4 TWh
- New renewable generation required = $31.3 - 7.4 = 23.9$ TWh

This level of generation could be provided by 360 GE Haliade-X 12 MW offshore wind turbines³, less than the combined Hornsea 1, 2 & 3 in the North Sea.

¹ <https://www.gov.uk/government/collections/digest-of-uk-energy-statistics-dukes>

² Page 61 of <https://news.files.bbc.co.uk/include/newsspec/pdfs/bbc-briefing-energy-newsspec-25305-v1.pdf>

³ <https://www.ge.com/renewableenergy/wind-energy/offshore-wind/haliade-x-offshore-turbine>

The renewable generation target of 70% by 2030 needs to be based on a realistic forecast of likely demand ...

NDF target¹	70% of electricity from renewables			
2018 consumption²	91 TWh total energy, 14.9 TWh electricity of which 7.4 TWh is from renewables (50%)			
	2030 electricity consumption estimate based on ...			
	2018 consumption	Arup report 2, page 155³ "target"	DUKES/BBC⁴ estimate	Arup report 2, page 155 "high" using the 15 Priority Areas to full extent
Total demand	14.9 TWh	= 16.5/70% = 23.6 TWh	= 14.9 x 3 = 44.7 TWh	= 103.4/70% = 147.7 TWh
Renewable demand	= 14.9 x 70% = 10.4 TWh	= 7.4 + 9.1 = 16.5 TWh	= 44.7 x 70% = 31.3 TWh	= 7.4 + 96.0 = 103.4 TWh
2018 renewable generation	7.4 TWh	7.4 TWh	7.4 TWh	7.4 TWh
Additional renewable generation required	= 10.4 – 7.4 = 3.0 TWh	9.1 TWh	= 31.3 – 7.4 = 23.9 TWh	96.0 TWh
Number of GE Haliade-X 12 MW (67 gross AEP⁵) offshore turbines needed to meet additional generation requirement	= 3.0 x 1000/67 = 45	= 9.1 x 1000/67 = 136	= 23.9 x 1000/67 = 357	= 96.0 x 1000/67 = 1,433

... or wildly differing estimates of generating capacity result, discrediting the NDF

¹ <https://gov.wales/sites/default/files/consultations/2019-08/Draft%20National%20Development%20Framework.pdf>

² <https://www.regen.co.uk/wp-content/uploads/Energy-Generation-Wales-2018-1.4.pdf>

³ https://gov.wales/sites/default/files/publications/2019-08/stage-2-refinement-of-priority-areas-for-wind-and-solar-energy_0.pdf

⁴ <https://news.files.bbc.co.uk/include/newsspec/pdfs/bbc-briefing-energy-newsspec-25305-v1.pdf>

⁵ <https://www.ge.com/renewableenergy/wind-energy/offshore-wind/haliade-x-offshore-turbine>