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Zero2050 - WP1: Phase 3

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Executive Summary

This document outlines the work that Digital Engineering (DE) has conducted during Phase 3 of its work package within the Zero2050 South Wales project. This phase of DE's work primarily focused on using external literature sources to estimate possible futures in South Wales, North Wales and the rest of Great Britain (GB). Hereafter, DE will be referred to as WP1 (aka Work Package 1 – Generation).

During this phase of the project WP1 has delivered the following:

- Estimates of peak demand and renewable capacities for North Wales in 2050
- Estimates of peak demand and renewable capacities for England and Scotland in 2050
- Estimates of the feasible renewable capacities within South Wales in 2050 from literature (for sense checking outputs of WP7's optimisation)
- A summary of existing and planned renewable generators ≥ 50 MW in North Wales

To produce the estimates outlined above, WP1 used the following primary sources:

- National Grid ESO: Future Energy Scenarios (2020) (1) (2)
- Climate Change Committee: Technical Report (2019) (3)
- Department for Business Energy & Industrial Strategy: Renewable Energy Planning Database (2020) (4)

WP1 also delivered estimates of the potential split between embedded and transmission-connected wind and solar generation in 2050, for South Wales, North Wales and the rest of GB.

1 Literature Review

In the first stage of Phase 3, WP1 reviewed what data was available within the primary sources agreed with NGET (1) (2) (3) (4). In particular, WP1 focused on national and sub-national estimates for peak demand or installed capacities, both for 2020 (i.e. current levels) and out to 2050. When using the Future Energy Scenarios (FES) sources (1) (2) WP1 assumed that the Leading the Way (LW) scenario was the most relevant to the ambitions of the Zero2050 project.

Please note that the data outlined in this section was also delivered to NGET in a separate spreadsheet (5).

1.1 National Demand and Renewable Capacities

All values provided below are estimates for 2050.

Table 1: Peak demand and renewable capacities in 2050 from various sources

	NGESO FES 2020 (LW)	CCC technical report (low)	CCC technical report (high)
All GB wind offshore (GW)	83.97	95.00	245.00
All GB wind onshore (GW)	41.52	29.00	96.00
All GB solar PV (GW)	71.13	145.00	615.00
Peak GB demand (GW)	76.30	-	-

1.2 Regional Demand and Renewable Capacities

Where necessary, and based on advice from NGET, WP1 used the FLOP zones outlined in Table 2 to assign individual grid supply points (GSPs) to different geographic regions.

Table 2: Assumed FLOP Zones within each GB region

Region	South Wales	North Wales	Scotland	England
FLOP Zones	H*	M*	S*, T*	All except H*, M*, S* & T*

1.2.1 Renewable Energy Planning Database (currently installed)

The REPD lists renewable generators that have sought planning permission, with their locations. However, the database has few generators below 1 MW capacity and does not provide any future projections beyond the planning application window.

The regional shares of wind onshore, wind offshore and solar PV capacities as per the REPD (Q2 2020) (4) are summarised in Table 3 below. Note that these summarise the current levels of installed capacity (as of Q2 2020).

Table 3: REPD (Q2 2020) (4) regional shares of wind and solar capacities

	South Wales	North Wales	Rest GB
Wind onshore capacity (GW) [share]	0.69 [5.7%]	0.40 [3.3%]	11.05 [91.0%]
Wind offshore capacity (GW) [share]	0.00 [0.0%]	0.73 [8.5%]	7.77 [91.5%]
Solar capacity (GW) [share]	0.58 [7.1%]	0.17 [2.0%]	7.49 [90.9%]

1.2.2 Future Energy Scenarios (2050)

The FES 2020 regional workbook contains future estimates of peak demand and renewable capacities, but only includes embedded generation. Therefore, this workbook does not include consideration of transmission-connected wind or solar farms (note that almost all offshore wind is transmission-connected). WP1 used the FLOP zones listed in Table 2 to assign embedded generation to each region.

The regional shares of embedded wind and solar PV capacities as per FES 2020 (2) are summarised in Table 4 below. Note that these are based on the 2050 values from the Leading the Way scenario.

Table 4: FES 2020 (2) (Leading the Way scenario 2050) regional shares of wind and solar capacities, and peak electricity demand

	South Wales	North Wales	Rest GB
Embedded wind capacity (GW) [share]	2.24 [9.8%]	2.01 [8.7%]	18.68 [81.5 %]
Embedded solar capacity (GW) [share]	4.21 [6.1 %]	1.79 [2.6 %]	62.68 [91.3%]
Peak electricity demand (GW) [share]	2.99 [3.9 %]	1.21 [1.6 %]	72.10 [94.5%]

2 Extrapolation

No single literature source included estimates of installed renewable capacity, or peak demand, for all combinations of generation technologies or geographic regions. Therefore, WP1 combined various sources to create this data. Of particular interest was the breakdown of capacity and demand between North and South Wales, and the rest (i.e. non-Wales) of GB. Two literature sources did allow for a breakdown between these regions;

- REPD includes capacities and locations of existing and planned onshore wind, offshore wind and solar PV
- FES 2020 Regional Breakdown provides estimates of embedded wind, embedded solar PV and peak demand in 2050, broken down by FLOP zone

Both of these sources have been used to split national estimates of wind and solar capacities in 2050 from FES 2020 and CCC Technical Report in this section. These national estimates include both embedded and transmission-connected generation capacities.

2.1 Regional Extrapolation Based on REPD

Table 5: National projections of wind and solar capacities, split regionally based on current levels of installed capacity as per REPD Q2 2020

	Region	REPD 2020 Q2: % share	FES 2020: LW 2050	CCC Tech Report: Low	CCC Tech Report: High
Wind onshore	GB	100%	41.5	29.0	96.0
	South Wales	6%	2.4	1.7	5.5
	North Wales	3%	1.4	1.0	3.2
	Non-Wales GB	91%	37.8	26.4	87.3
Wind offshore	GB	100%	84.0	95.0	245.0
	South Wales	0%	0.0	0.0	0.0
	North Wales	9%	7.2	8.1	20.9
	Non-Wales GB	91%	76.8	86.9	224.1
Solar PV	GB	100%	71.1	145.0	615.0
	South Wales	7%	5.0	10.2	43.4
	North Wales	2%	1.4	2.9	12.5
	Non-Wales GB	91%	64.7	131.8	559.2

2.2 Regional Extrapolation Based on FES 2020

Table 6: National projections of wind and solar capacities and peak electricity demand, split regionally based on FES 2020 Regional Breakdown (Leading the Way, 2050)

	Region	FES RB: % share *	FES 2020: LW 2050	CCC Tech Report: Low	CCC Tech Report: High
Wind onshore/ offshore	GB	100%	125.5	124.0	341.0
	South Wales	10%	12.2	12.1	33.3
	North Wales	9%	3.6	2.5	8.4
	Non-Wales GB	81%	33.8	23.6	78.2
Solar PV	GB	100%	71.1	145.0	615.0
	South Wales	6%	4.4	8.9	37.7
	North Wales	3%	1.9	3.8	16.0
	Non-Wales GB	91%	64.9	132.3	561.2
Peak demand	GB	100%	76.3	-	-
	South Wales	4%	3.0	-	-
	North Wales	2%	1.2	-	-
	Non-Wales GB	94%	72.1	-	-

* % share based on embedded wind and solar only

3 North Wales Renewable Generators

WP1 conducted a further literature review to gather information on existing and planned major renewable generators (i.e. ≥ 50 MW installed capacity) in North Wales. For this exercise North Wales was defined as any generation that would likely connect within the NW1 to NW4 boundaries (6).

Table 7: North Wales renewable generators

Project name	Technology	Size (MW)	Status	Commission year	Location	Reference	Note
Gwynt y Môr	Wind Offshore	576	Operational	2015	Offshore	(4)	
Awel y Môr	Wind Offshore	576	Scoping	~2030	Offshore	(7) (8)	
Burbo Bank II	Wind Offshore	258	Operational	2017	Offshore	(4)	
Codling Park	Wind Offshore	1000	Scoping	~2024	Offshore	(7) (9)	[i]
Rhyl Flats	Wind Offshore	90	Operational	2009	Offshore	(4)	
North Hoyle	Wind Offshore	60	Operational	2003	Offshore	(4)	
North Wales Offshore Wind Farm	Wind Offshore	1440	Scoping	~2033	Offshore	(7)	[ii][iii]
Clocaenog Forest Wind Farm	Wind Onshore	96	Under construction	N/A	Denbighshire	(4)	
Llanbrynmair Wind Farm	Wind Onshore	69	Planning Application Submitted	N/A	Powys	(4)	[iv]
Llandinam Windfarm Repowering & Extension	Wind Onshore	102	Planning Permission Granted	N/A	Powys	(4)	[iv]
Carnedd Wen Wind Farm	Wind Onshore	150	Planning Application Submitted	N/A	Powys	(4)	[iv]
Wylfa Newydd	Nuclear	2900	Abandoned/Looking for new investment	N/A	Anglesey	(10)	
Trawsfynydd	Nuclear SMR	up to 440	Scoping	N/A	Gwynedd	(11) (12)	[v]
Anglesey biomass	Biomass	299	Planning approved	N/A	Anglesey	(4)	
Western Link	HVDC	2200	Operational	2018	Deeside	(13)	
East–West Interconnector (EirGrid)	HVDC	500	Operational	2012	Deeside	(14) (15)	
MARES	HVDC	750	Awaiting Consents	~2025	Bodelwyddan	(15)	[i]
Dinorwig Power Station	Pumped hydro	1728	Operational	1984	Gwynedd	(4) (16)	

Ffestiniog Power Station	Pumped hydro	360	Operational	1963	Gwynedd	(4) (16)	
Glyn Rhonwy	Pumped hydro	100	Planning approved	N/A	Gwynedd	(4) (16)	
Rhyd y Groes	Solar	49.9	Planning approved	N/A	Anglesey	(4)	[vi]
Shotwick Solar Park	Solar	72	Operational	2016	Flintshire	(4) (17)	
Elwy Solar Energy Farm	Solar	62	Scoping	N/A	Denbighshire	(18)	
North Wales Hybrid	Solar/Storage	53	Scoping	~2026	Denbighshire	(7)	[vii]
Wylfa Substation	Solar/Storage	120	Scoping	~2024	Anglesey	(7)	[iii][viii]
West Anglesey Tidal Demonstration (Morlais)	Tidal	240	Planning Application Submitted	N/A	Anglesey	(4) (19)	
North Wales Tidal Lagoon (Colwyn Bay)	Tidal	2500	Scoping	N/A	Denbighshire	(20)	
Port of Mostyn	Tidal	210	Scoping	N/A	Flintshire	(7)	
Holyhead Deep	Tidal	80	Scoping	N/A	Anglesey	(21) (22)	[ix]

Note:

Projects have been flagged where there could be issues, such as: weak literature sources, possible duplications with other projects, incorrect locations. These issues are listed below:

- i. Project is dependent on developments in the Republic of Ireland.
- ii. Very few specifics about Round 4 exist yet (was pushed back very recently).
- iii. No secondary reference could be found to corroborate the validity of this project.
- iv. The proposed site is in mid-Wales, but the grid connection location is unknown.
- v. Technology is still in development in the UK. Final capacity is unknown.
- vi. If commissioned as stated, the capacity is close but below the 50MW threshold requested by NGET.
- vii. It is possible this is the same project as Elwy Solar Energy Farm, referenced as being developed by the same company, Solar Century. No reference can be found describing each as separate projects.
- viii. It is possible this is the same project as Rhyd y Groes.
- ix. The developers only have a lease agreement for a 10MW array at this point. The company has delivered a scoping report for future expansion to 80MW.

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