Requirements for Generators (RfG) - Review of banding thresholds

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Agenda

- RfG – background on Generator banding
- Introduction to Type A-D requirements
- GB synchronous area banding thresholds
- National Grid proposal on banding
- Analysis of banding proposals
- Interim conclusions from analysis
- Next steps
- Additional Material

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RfG – background on Generator banding

- RfG sets harmonised rules on grid connection for power generators in EU, facilitating (amongst other things)…
  - Improved system security
  - Better integration of renewable electricity sources
  - A more efficient use of the network, as well as increased competition (for benefit of consumers)
- The concept of banding was to ensure a proportionate level of generator response, dependent on their capacity and connection
- The requirements in Types A-B tend to reflect a more passive SO engagement, whereas C-D require timely response

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RfG – background on Generator banding

- Once the code enters into force, TSOs in each synchronous area can adjust thresholds downwards from their starting point (i.e. to be more onerous)
  - TSOs will be required to take any proposals through public consultation
  - Generators are required to support this by providing data
  - Any proposals are ultimately submitted for NRA approval
  - There is a three year window until another adjustment is permitted
- Once proposed new bandings are ratified, by default they would only apply to new connectees from that point onwards

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Introduction to Banding – Type A

- A basic level necessary to ensure capability of generation over operational ranges with limited automated response and minimal system operator control
- Type A ensure that there is no large-scale loss of generation over system operational ranges, minimising critical events, and include requirements necessary for widespread intervention during system-critical events.

Overview of technical requirements:

- Operation across a range of frequencies
- Limits on active power output over frequency range
- Rate of change of frequency settings applied (likely to be at least 1Hz/sec)
- Low-level communication capability

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Introduction to Banding – Type B

- Type B provides for a wider range of automated dynamic response, with greater resilience to more specific operational events
- They ensure an automated response to alleviate and maximise dynamic generation response to system events

Overview of technical requirements

- Type A, plus…
- Ability to automatically reduce power on instruction
- Control schemes, protection and metering
- **Fault ride through requirements (prevents faults causing cascade tripping)**
- Ability to reconnect
- Reactive capability
- Reactive current injection

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Introduction to Banding – Type C

- Provide for a refined, stable and highly controllable (real-time) dynamic response, aiming to provide principle ancillary services to ensure security of supply
- These requirements cover all operational network states with consequential detailed specification of interactions of requirements, functions, control and information to utilise these capabilities

Overview of technical requirements:

- Type A-B, plus…
- Active power controllability
- **Frequency response**
- **Monitoring**
- Automatic disconnection
- Black start
- Stable operation anywhere in operating range
- Pole slipping protection
- Quick resynchronisation capability
- Instrumentation and monitoring requirements
- Ramp rate limits
- Simulation models

Introduction to Banding – Type D

- Requirements specific to higher voltage connected generation with an impact on entire system control and operation
- They ensure stable operation of the interconnected network, allowing the use of ancillary services from generation Europe-wide

Overview of technical requirements

- Type A-C (latter band parameters take precedence when requirements overlap), plus…
- Wider Voltage ranges / longer minimum operating times
- Synchronisation on instruction
- Fault ride through

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GB synchronous area banding thresholds

- January 2014 RfG draft set GB parameters as follows:

A	B	C	D
0.8KW-0.999MW	1MW-9.999MW	10-29.999MW	30MW+

- NGET *understands* that the next draft (date TBC) will adjust GB to align with January 2014 CE parameters:

A	B	C	D
0.8KW-0.999MW	1MW-49.999MW	50-74.999MW	75MW+

- NGET has been working on a intermediate proposal position, which whilst unlikely to be incorporated in the RfG, can be adopted via a TSO adjustment procedure. Here is NGET's *proposed* bandings:

A	B	C	D
0.8KW-0.999MW	1MW-29.999MW	30-49.999MW	50MW+

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National Grid proposal on banding

- NGET believes it's position represents a reasonable intermediate proposal between draft GB, and the *potential* draft CE levels (the latter not aligning to Grid Code levels)
- Our work here seeks to inform a GB position on both existing draft levels and any revision, which could be proposed post-entry into force through RfG adjustment process
- The following slides present preliminary analysis on the position of generators under the two banding drafts (GB/CE), and the NGET intermediary proposal. It seeks to identify trends and local specificities which may merit further investigation

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Analysis of banding proposals

- The following treatments have been applied to the *available* data for use in analysing the bandings:
  - 100MW or greater schemes are excluded (inevitably Type D)
  - Data on connection voltages is sporadic, therefore this is not factored into the analysis yet. **NB 110KV connections or greater are deemed as Type D** (important particularly for Scottish sites given the 132KV transmission threshold)
  - Where DNO data provides aggregate view of projects and MWs, an average has been used to determine the banding
  - Region (i.e. England & Wales/Scotland) not properly captured in some DNO data, so ignored for now
  - Data captures connections from 2015 onwards (so excludes existing assets)

Analysis of banding proposals - TEC/embedded register view

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Future Schemes (2015-)

	Type A Projects	Type A MW	Type B Projects	Type B MW	Type C Projects	Type C MW	Type D Projects	Type D MW
GB (Jan 14)	0.8KW-1MW	0.8KW-1MW	1MW-10MW	1MW-10MW	10-30MW	10-30MW	30MW+	30MW+
Eng & Wal	0	0.000	0	0.000	3	30.000	1	70.000
Scotland	0	0.000	58	237.810	49	1,022.720	85	4,955.600
CE (Jan 14)	0.8KW-1MW	0.8KW-1MW	1MW-50MW	1MW-50MW	50-75MW	50-75MW	75MW+	75MW+
Eng & Wal	0	0.000	3	30.000	1	70.000	0	0.000
Scotland	0	0.000	143	2,666.230	30	1,843.600	19	1,706.300
GB (NGET Proposal)	0.8KW-1MW	0.8KW-1MW	1MW-30MW	1MW-30MW	30-50MW	30-50MW	50MW+	50MW+
Eng & Wal	0	0.000	3	30.000	0	0.000	1	70.000
Scotland	0	0.000	107	1,260.530	36	1,405.700	49	3,549.900

Green denotes decrease to GB (as-is); **Red** denotes increase
Upper level bands rounded up – see slide 9 for full banding levels

- Type A out of scope
- Increase in Type B generators from the existing GB proposal, more so if CE parameters are adopted
- Whilst number of schemes under C fall under both proposals, MWs increase as bigger projects are incorporated in a lower band
- Significant Type D reduction from GB draft (more so CE than NGET proposal)

Analysis of banding proposals - DNO data view

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Future Schemes (2015-)

	Type A Projects	Type A MW	Type B Projects	Type B MW	Type C Projects	Type C MW	Type D Projects	Type D MW
	0.8KW-1MW	0.8KW-1MW	1MW-10MW	1MW-10MW	10-30MW	10-30MW	30MW+	30MW+
GB (Jan 14)	1146932	5869.923	1595	3676.567	88	1352.696	9	450.000
	0.8KW-1MW	0.8KW-1MW	1MW-50MW	1MW-50MW	50-75MW	50-75MW	75MW+	75MW+
CE (Jan 14)	1146932	5869.923	1683	5029.263	9	450.000	0	0.000
	0.8KW-1MW	0.8KW-1MW	1MW-30MW	1MW-30MW	30-50MW	30-50MW	50MW+	50MW+
GB (NGET Proposal)	1146932	5869.923	1683	5029.263	0	0.000	9	450.000

Green denotes decrease to GB (as-is); **Red** denotes increase
Upper level bands rounded up – see slide 9 for full banding levels

- **1.15m** projects categorised as Type A
- As with TEC view, increase in Type B from the existing GB view
- 9 schemes re-categorised as Type D under NGET proposals (rather than GB as-is). These would be Type C under CE drafting
- As stated before, **connection data is not factored here**. Arguably a lot of sites connecting to Scottish DNOs could be banded 'D', as well as some current 'medium' scale generators in E&W

Analysis of banding proposals – combined view

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Future Schemes (2015-)

	Type A Projects	Type A MW	Type B Projects	Type B MW	Type C Projects	Type C MW	Type D Projects	Type D MW
GB (Jan 14)	**0.8KW-1MW**	**0.8KW-1MW**	**1MW-10MW**	**1MW-10MW**	**10-30MW**	**10-30MW**	**30MW+**	**30MW+**
TEC / Emb Reg	0	0.000	58	237.810	52	1,052.720	86	5,025.600
DNO	1,146,932	5,869.923	1,595	3,676.567	88	1,352.696	9	450.000
TOTAL	1,146,932	5,869.923	1,653	3,914.377	140	2,405.416	95	5,475.600
CE (Jan 14)	**0.8KW-1MW**	**0.8KW-1MW**	**1MW-50MW**	**1MW-50MW**	**50-75MW**	**50-75MW**	**75MW+**	**75MW+**
TEC / Emb Reg	0	0.000	146	2,696.230	31	1,913.600	19	1,706.300
DNO	1,146,932	5,869.923	1,683	5,029.263	9	450.000	0	0.000
TOTAL	1,146,932	5,869.923	1,829	7,725.493	40	2,363.600	19	1,706.300
GB (NGET Proposal)	**0.8KW-1MW**	**0.8KW-1MW**	**1MW-30MW**	**1MW-30MW**	**30-50MW**	**30-50MW**	**50MW+**	**50MW+**
TEC / Emb Reg	0	0.000	110	1,290.530	36	1,405.700	50	3,619.900
DNO	1,146,932	5,869.923	1,683	5,029.263	0	0.000	9	450.000
TOTAL	1,146,932	5,869.923	1,793	6,319.793	36	1,405.700	59	4,069.900

Green denotes decrease to GB (as-is); **Red** denotes increase

Upper level bands rounded up – see slide 9 for full banding levels

- 10% **increase** in Type B schemes GB draft to CE draft; 8.5% increase GB draft to NGET GB proposal (97% and 61% **increase** in MWs respectively)
- 71% **decrease** in Type C schemes from GB Jan'14 to CE Jan '14, with only a negligible reduction in MW; 74% **decrease** to NGET proposal, with 41% decrease in MW
- Significant **decrease** in number of Type D schemes in CE proposals, with NGET proposal half way in between

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Interim conclusions from analysis

- NGET's intermediary banding represents a reasonable intermediate proposal between the extremes of the January 2014 drafts for GB and CE
- Regardless of this, there are a significant number of Type B generators who will be **required** to provide Fault-Ride Through, who today would not currently envisage doing so
- Significant range of generator capacity for Type C (especially both CE draft and NGET proposals), who will be **required** to provide Frequency Response. However these capture bigger capacity schemes than current GB drafting

Next Steps

- Do you agree with the proposed banding level which National Grid has formed? If not, what work needs to take place to refine it?
- Can you help us identify and obtain additional (better?) sources of data not currently incorporated into our banding analysis (particularly for ‘Type B and C’ scale-generators)
- Do we need to better understand the cost implications for the System Operator and for Generators implementing the technical requirements set out in RfG before agreeing on banding?
- **Any other comments?**

References

- TEC + Embedded Register 7th Nov 2014:
  - http://www2.nationalgrid.com/UK/Services/Electricity-connections/Industry-products/TEC-Register/
  - http://www2.nationalgrid.com/UK/Services/Electricity-connections/Industry-products/Embedded-Generation-Register/

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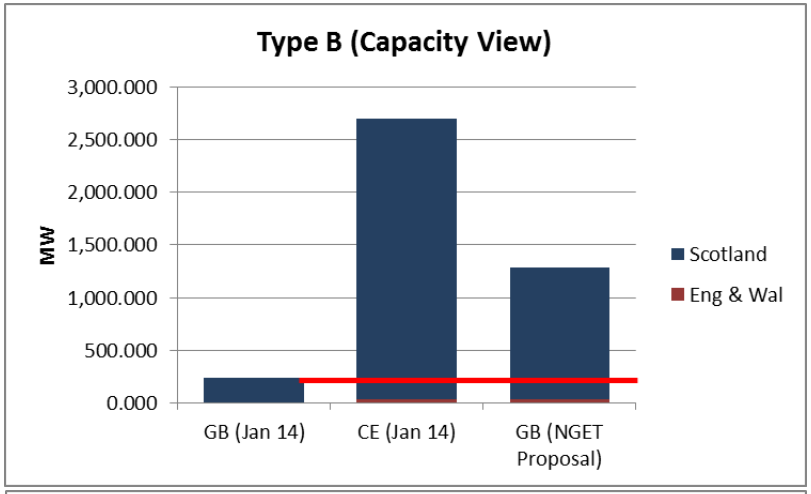
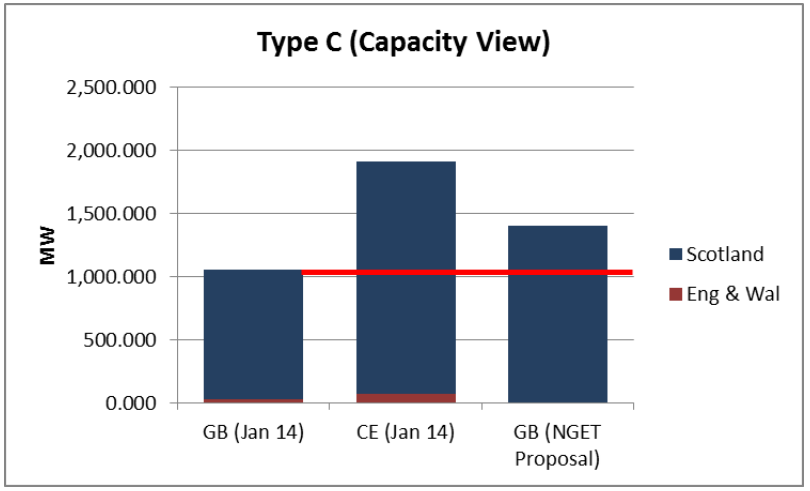
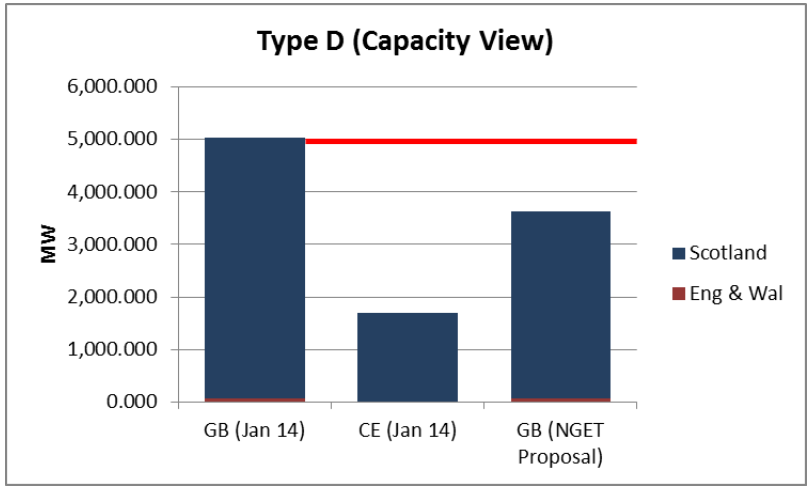
Additional Material

Analysis of banding proposals – TEC/Embedded register - Capacity

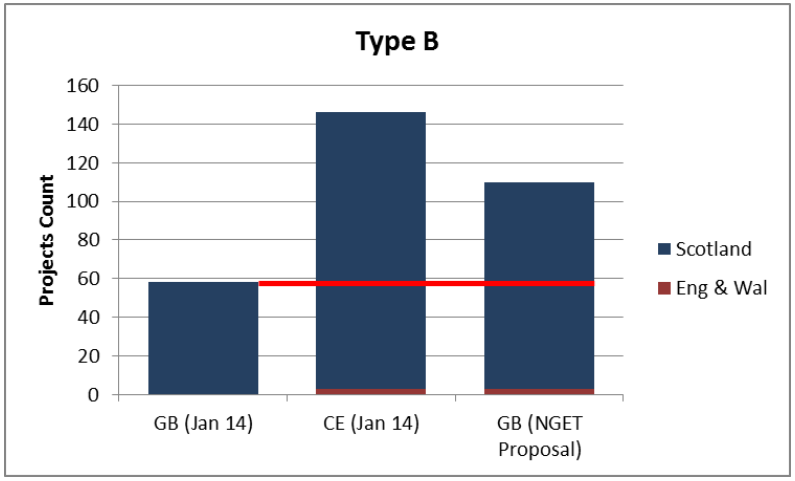


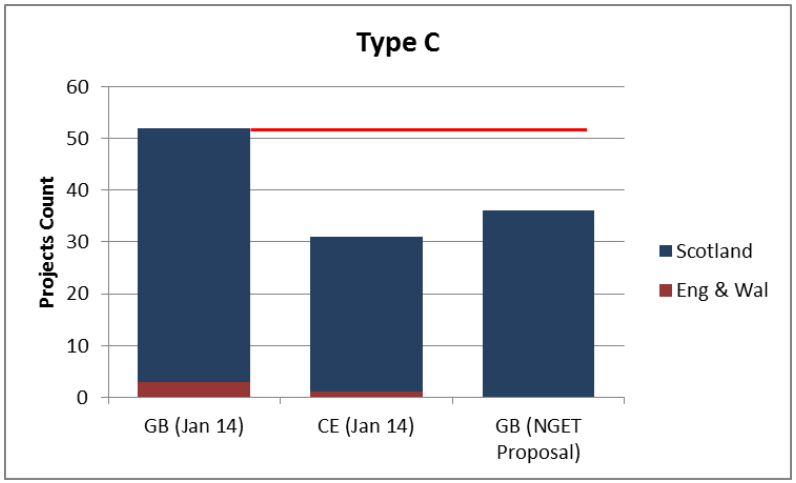


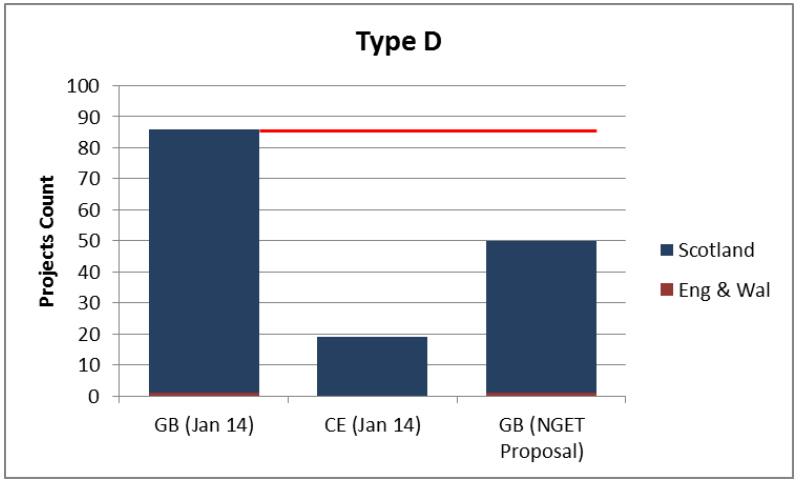


- Significant increase in Type B under CE proposals
- However reduction in both for Type D

Analysis of banding proposals – TEC/Embedded register - Projects

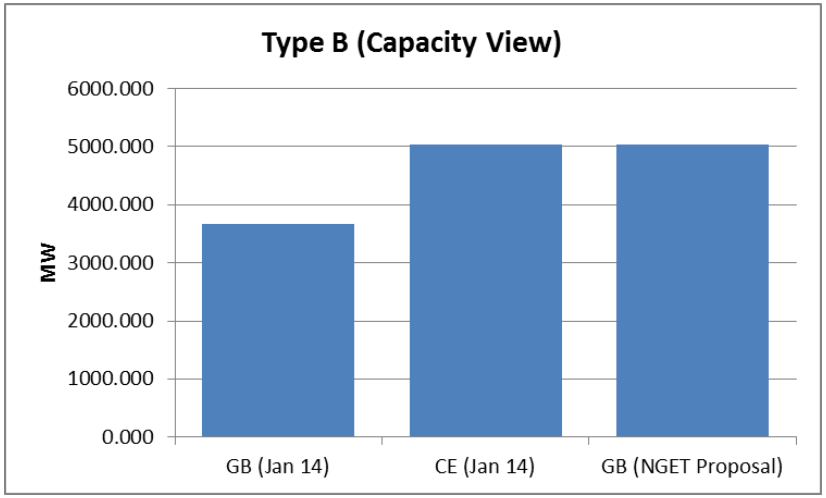


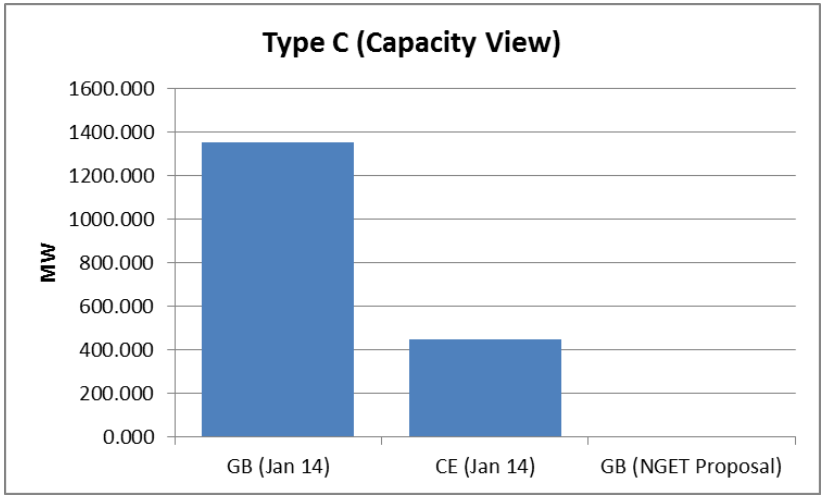


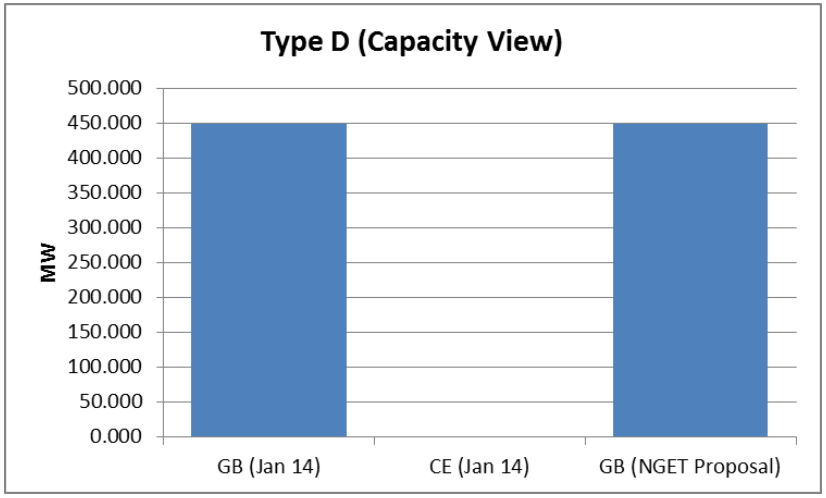


- Number of schemes under CE and GB (NGET) proposal for Type C and D fall
- Increase in B, which has lesser technical requirements
- Need to investigate connections for Scottish schemes. 110KV or above connections = band D

Analysis of banding proposals – DNO data - Capacity

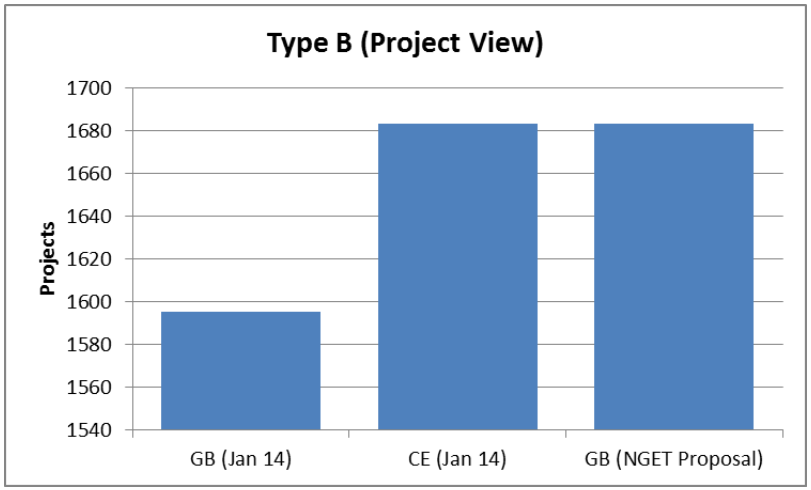


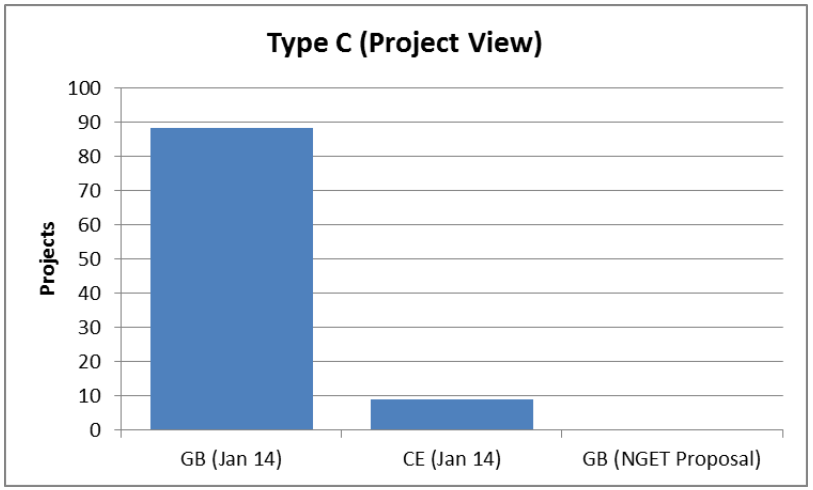


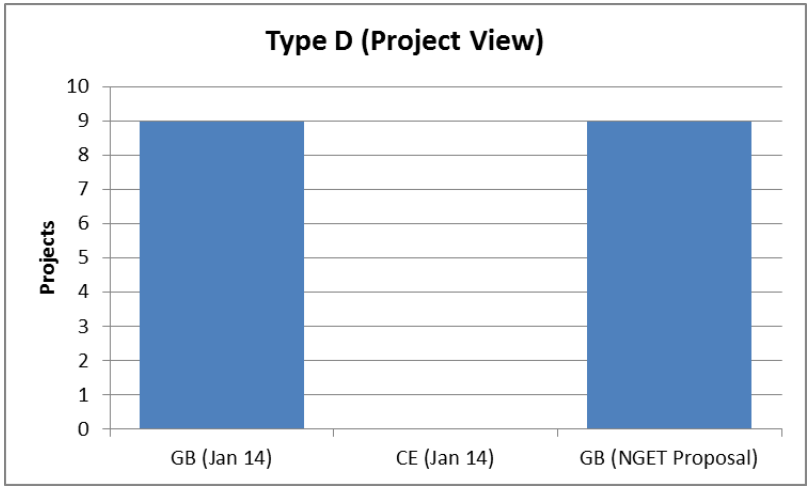


- Increase in Type B as already discussed elsewhere
- Type C for CE becomes Type D for NGET proposal

Analysis of banding proposals – DNO data - Projects







- No difference in Type B MW for CE draft and NGET proposal
- As before, Type C for CE becomes Type D for NGET proposal

TEC/Embedded register view – Project pipeline (technology)

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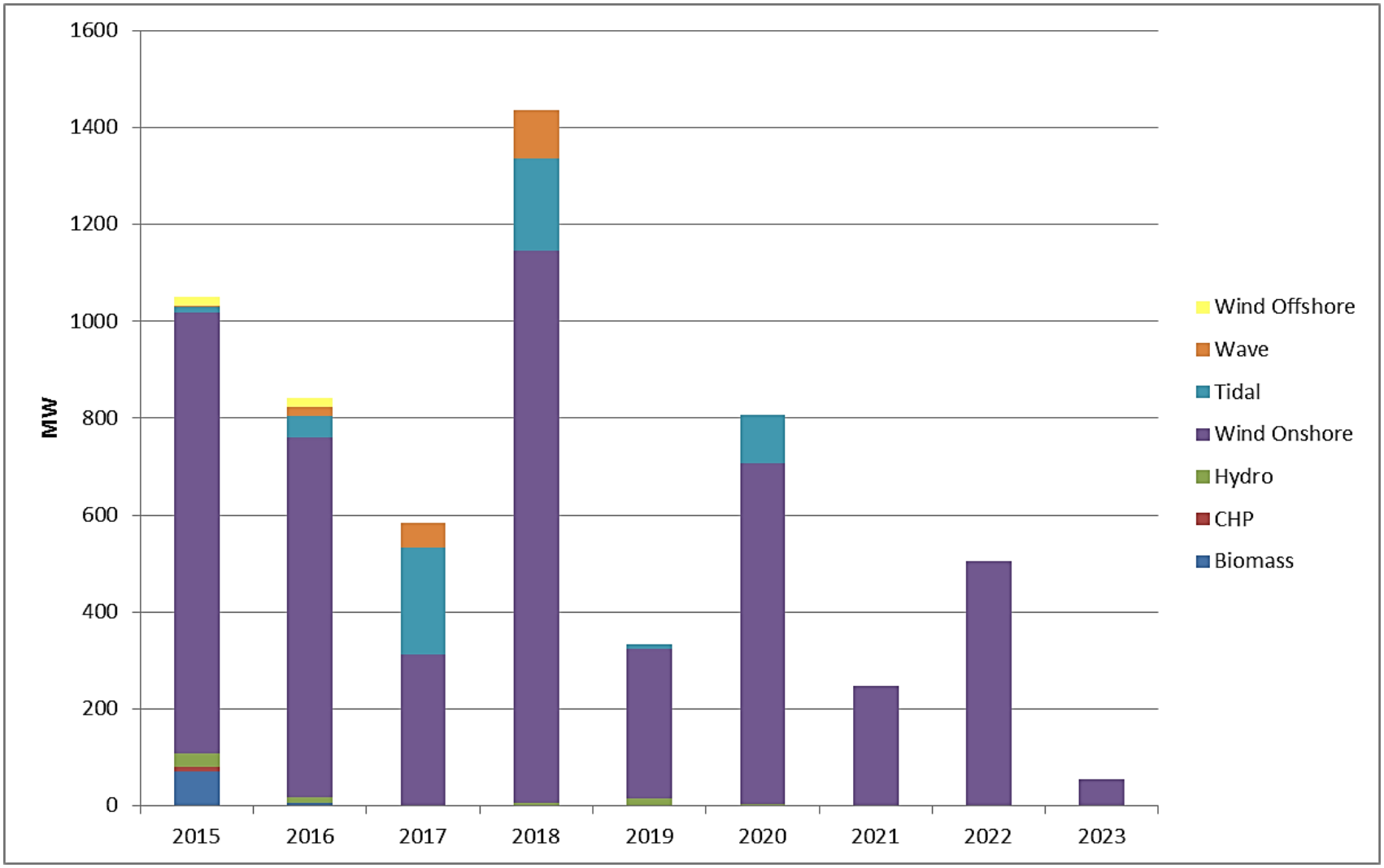

DNO data view – Project pipeline (technology)

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