Joint European Standing Group (JESG)
Requirements for Generators
Stakeholder workshop feedback and Issues Log

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National Grid

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Justification

Qs from Issues Log

The ENTSO-E position on justification

Requirements in existing EU legislation for NC development

The GB context of fit for purpose

Justification

Q- Is NGET going to produce a GB specific justification document?

- The EU legal system for development of NCs requires:
  - An Impact Assessment – from ACER to accompany the NC to comitology
  - ENTSO-E expects an update of the existing initial IA produced by ERGEG
    - In Europe this is a justification of position statement
  - If and only if ENTSO-E's NC deviates from ACER's IA;
    - Is ENTSO-E required to produce an IA, explaining the deviation
    - ENTSO-E has no current plan for any deviation
    - However, ENTSO-E has chosen to provide both M&A & FAQs
- The NC RfG is an ENTSO-E documemt not a GB product.
- The national component arrives later, then in two forms
  - Selection of national choices and parameters – GCRP process applied
  - National process for retrospective action – CBA for any proposal taken forward with stakeholder input + consultation + OFGEM decision

Justification

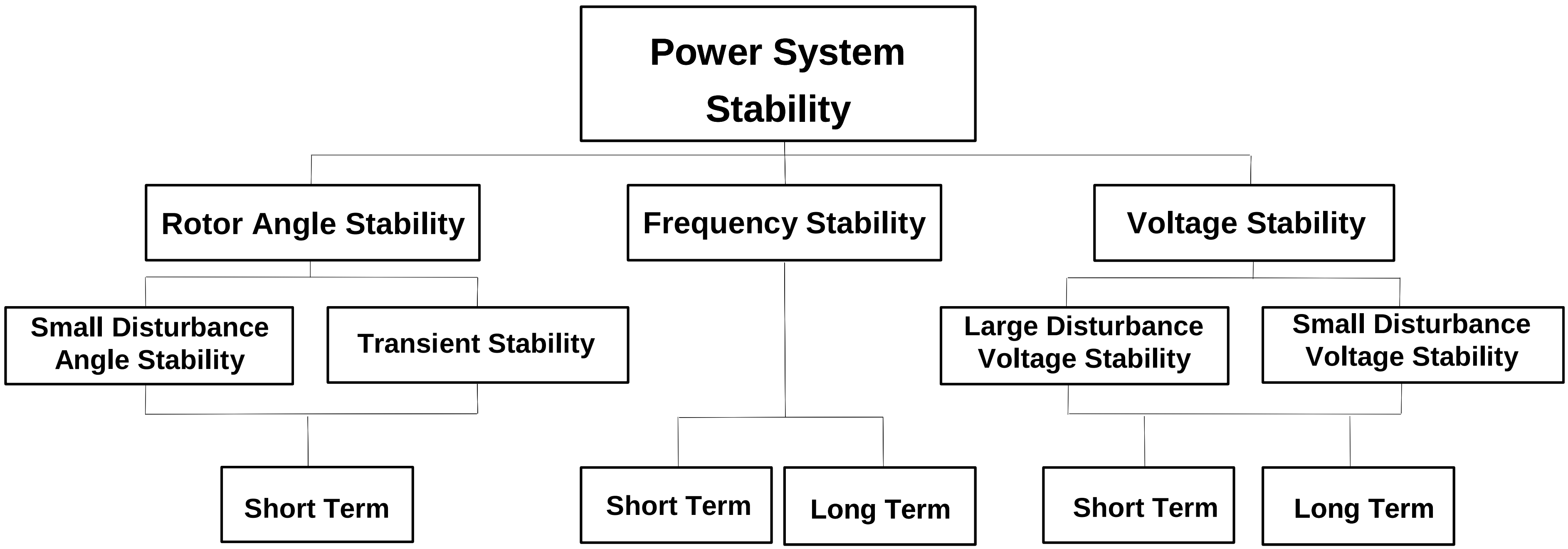
Q- Where is the CBA for FRT for Type B/ Type C generators?

- As explained, the EU legal process does not call for CBAs in NC drafting
- ENTSO-E sets out its view re CBA in general in chapter 3 in the Motivation & Approach document
  - Reasons for selecting a qualitative approach as provided in the M & A (not an impractical quantitative CBA) are clearly set out.
  - Section 3.2 of M &A also explain the absence of cost data in spite of ENTSO-E requesting this from Stakeholders.
- Re the FRT requirement there are no fundamental changes, only a modest move towards harmonising existing national requirements.
- The requirements remain consistent with the GB approach to avoid embedded generation loss for 400 & 275kV faults
  - Lessons have been learnt from the 8 years of challenge to calculate retained voltage at CP.
  - A better, much simpler but closely equivalent method has now been chosen. We believe Project Managers will welcome this simplicity.
- Extending requirements to smaller units is explained in M&A (2.4) and FAQs 7 & 24

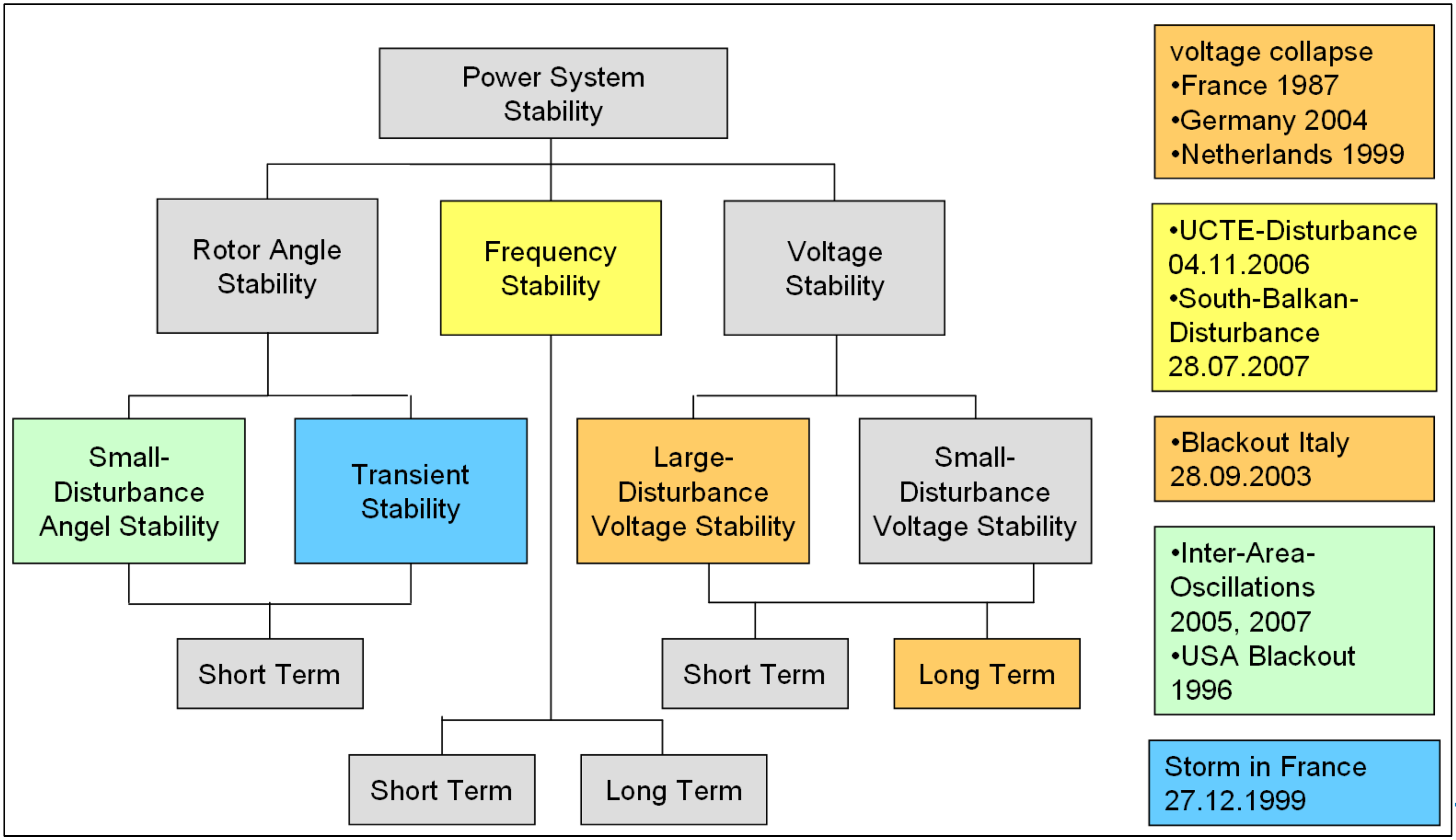
DT stated conclusions:

- “Technical requirements are solidly founded on
  - Existing national codes;
  - Experience from major events and near misses.
- The changes from existing Grid Codes are modest.
- To cover the objective of facilitating RES it is essential to allow TSOs and DSOs to resolve the associated new system challenges.
- The requirements are proportionate to these needs.
- The requirements will serve the end consumers well”

Foundation for Cross-Border trading
A stable system



Major Continental Europe loss of stability events, including significant loss of supply



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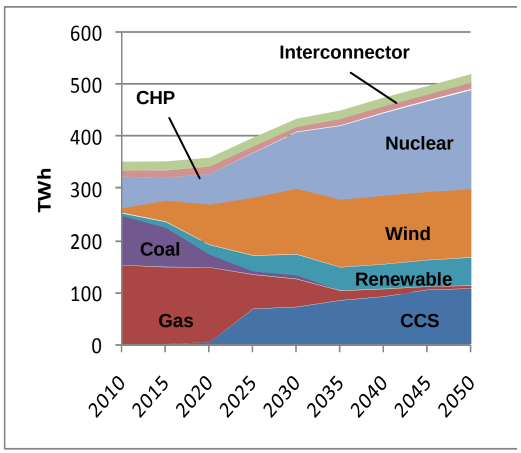
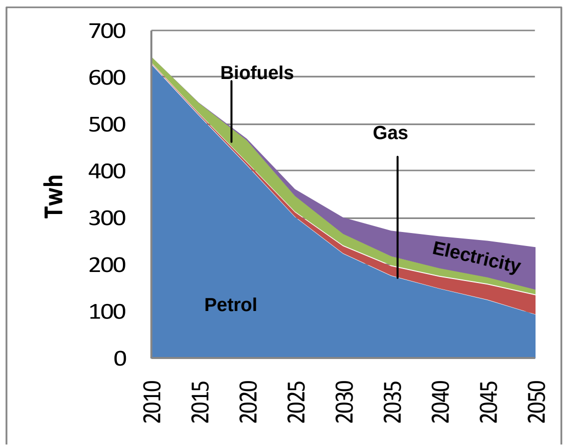
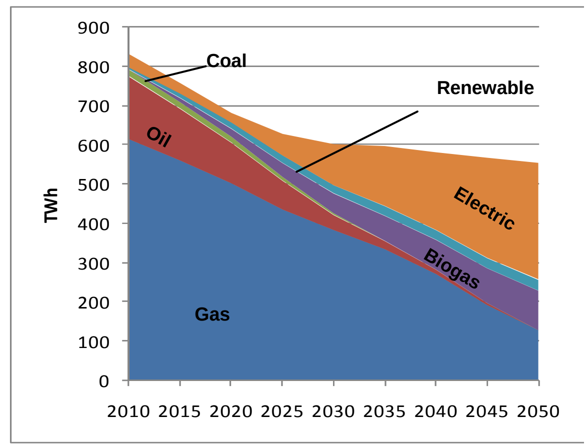
UK Future Energy Scenarios to 2050 to meet Renewable + CO_2 targets. NC RfG fit for purpose at least to 2030







UK energy landscape is changing

Sustainability

Affordability

Security of supply

Existing power station closures

~25%

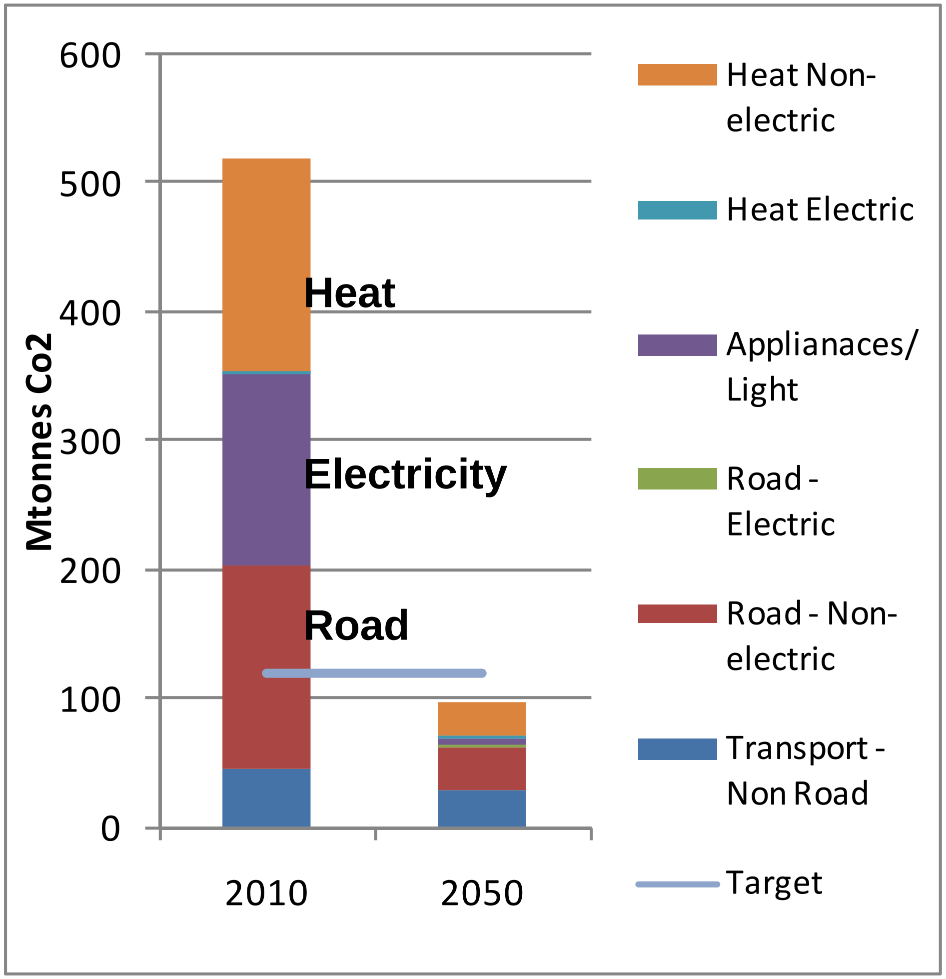
of total capacity by 2020

Gas from UK sources

~25%

of total supplies by 2020

Emissions by sector



- Aim is to reduce emissions from 505M tonnes to 118M tonnes
- Emissions from all 3 main sectors greater than 118M tonnes – need to take action on all.
- Emissions reduce to 96Mtonnes in Gone Green scenario as agricultural emissions are not modelled
- Aviation emissions drop slightly as biofuel is diverted to air as electricity replaces petrol in cars and LGVs.

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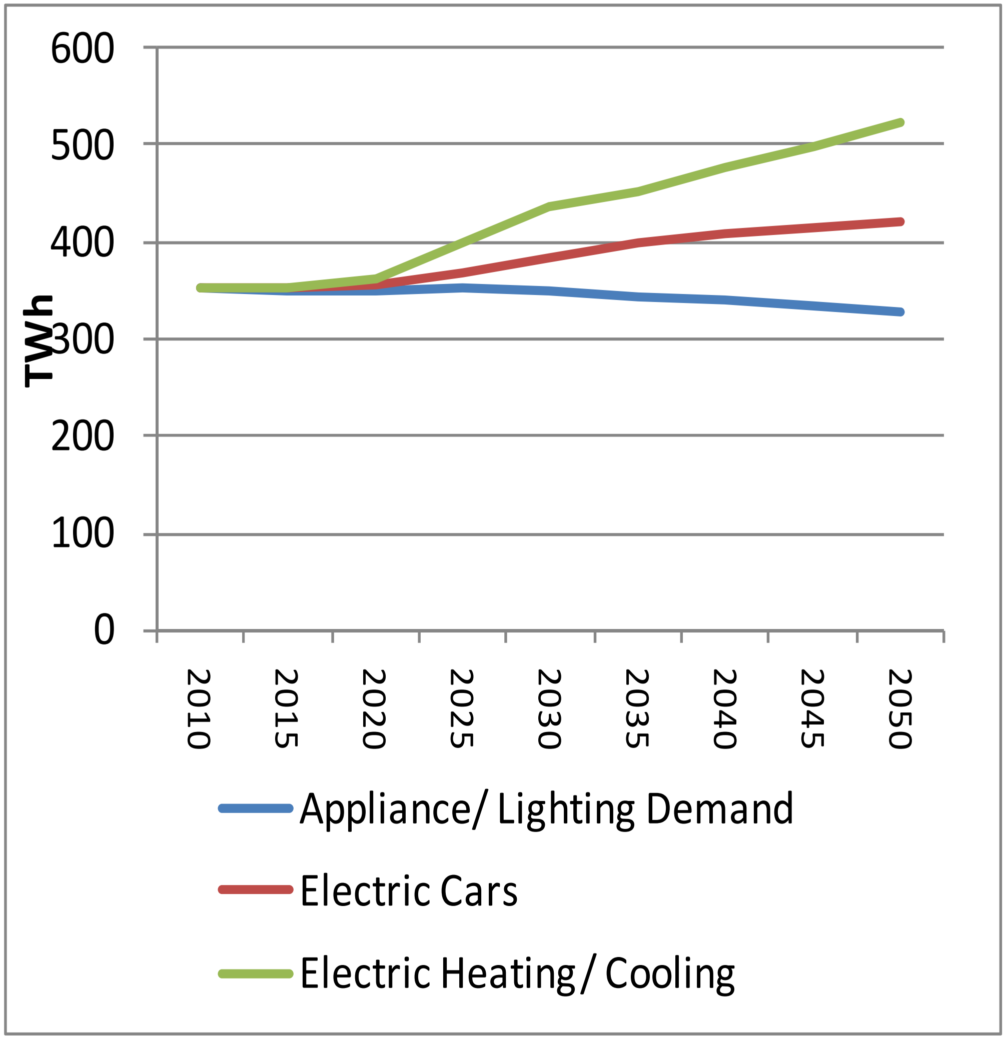
Energy Consumption - Electricity



- Decline in use for appliances & lighting despite increasing household numbers
  - From LED lighting and A+ rated smarter appliances
- Increased electrification of transport when battery issues are resolved
- Home heating shifts to heat pumps
  - Off gas grid properties retrofitted initially
  - Gas properties switch to heat pumps for base load heat later

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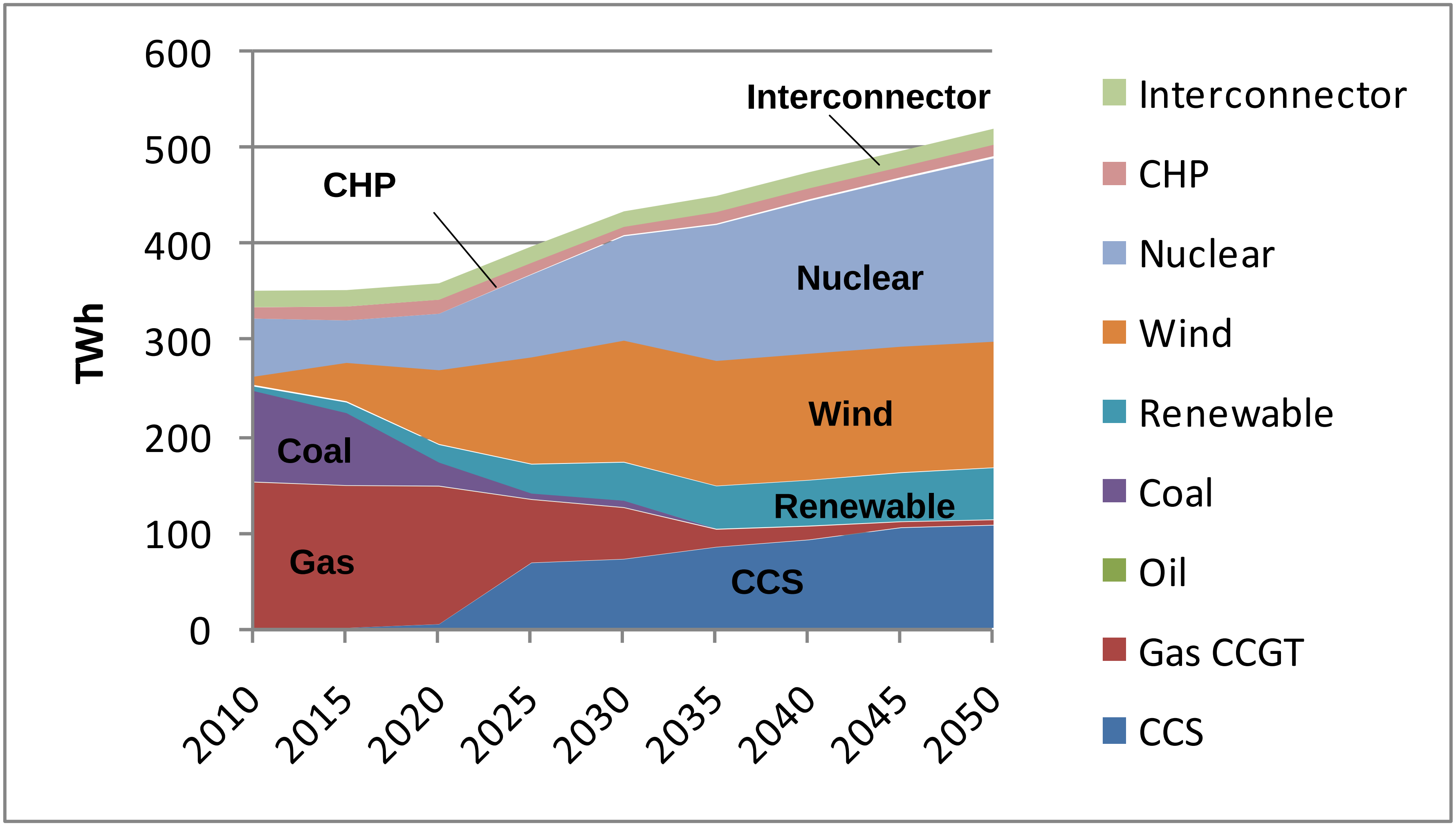
Electricity Profile 2010-2050. Our codes "fit for purpose" for main scenarios, including Gone Green



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Electricity Supply – 2020
Generation mix overhaul
Transmission focus => less fossil fuel more wind…

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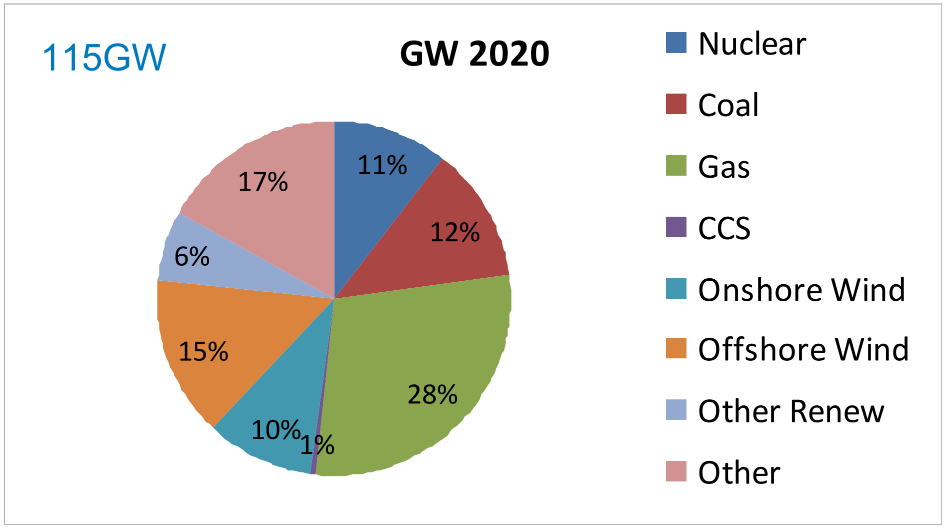

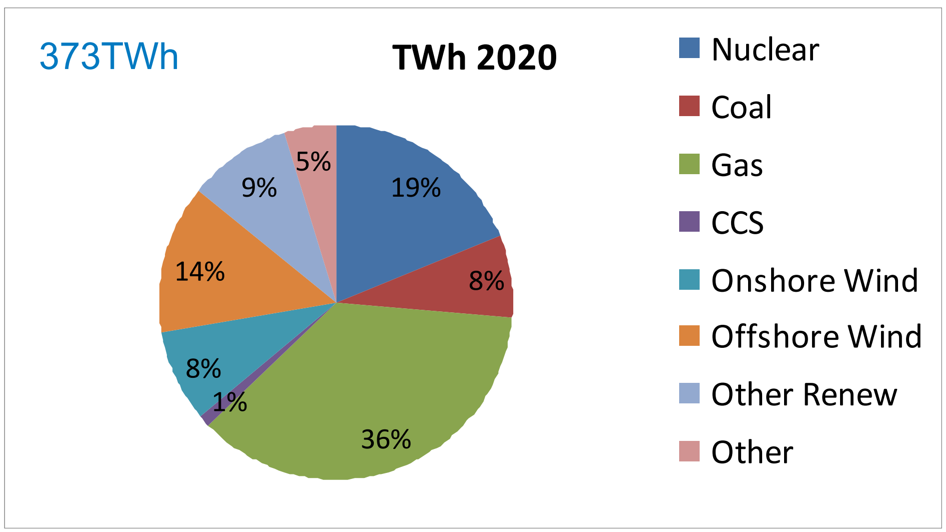

- Demonstration project for CCS supply small amount of load
- Some new nuclear online by 2020, existing plant has 10yr life extension
- 28GW of wind on the system (17GW offshore)
- Small (7GW) amounts of other renewables
- Significant CCGT build ensure plant capacity margin as oil and coal close. Start to operate as peaking plant managing wind intermittency

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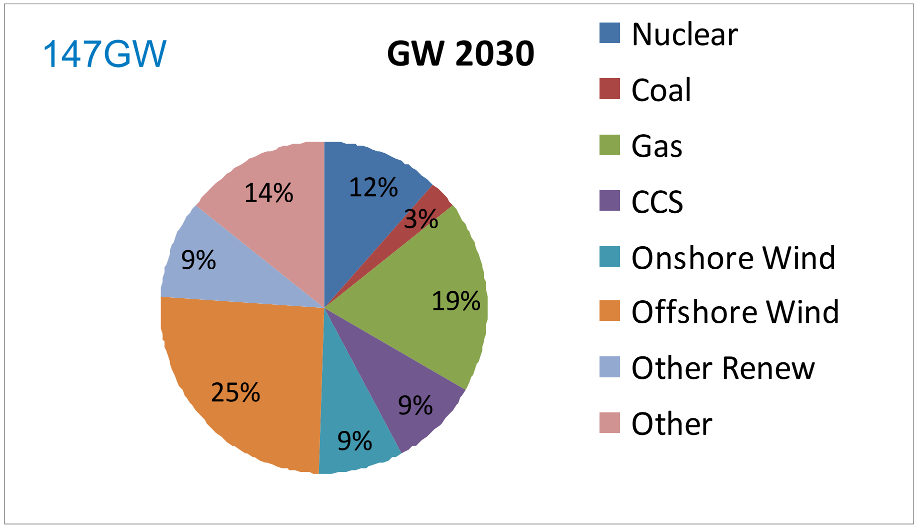
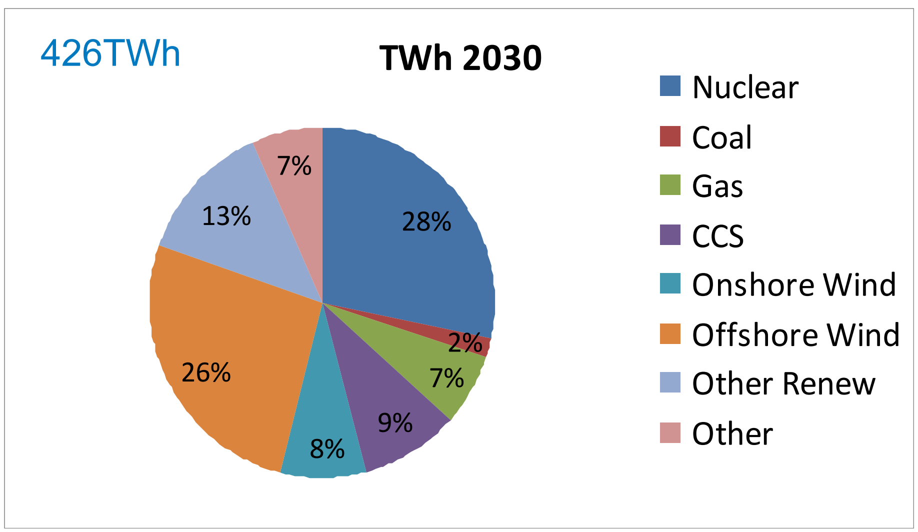
Electricity Supply – 2030
Nuclear replanting, CCS goes commercial & growth in demand





- Increase in Wind Generation to 49GW
- CCGTs marginal supply source for non-windy days.
- Most coal retired, CCS gas and coal increase to 13GW around clusters
- Nuclear new build well underway (13GW installed by 2030)
- Increased interconnection to balance system
- Electric car commercialisation

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How will we balance supply and demand?

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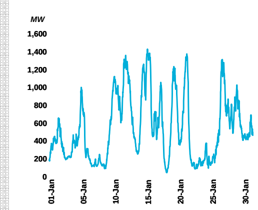
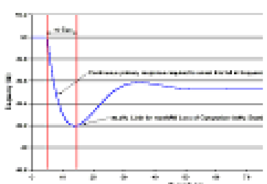
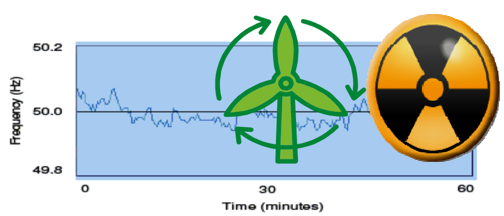
Variable generation

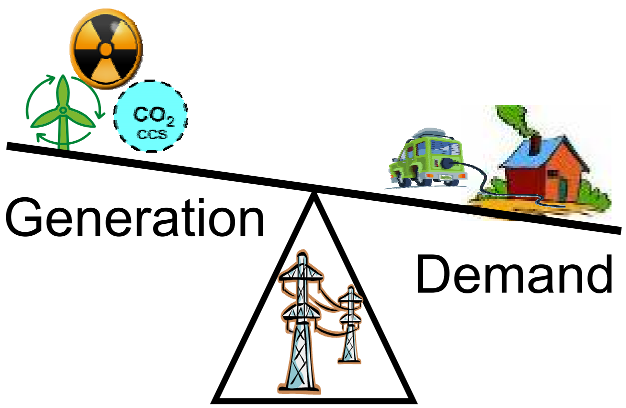


Large generation



Inflexible generation

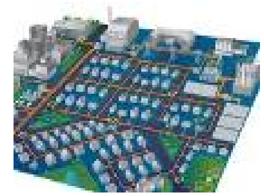




Smarter transmission

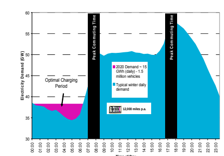
Smart zones
HVDC
Series compensation
WAM

Active distribution networks



Smart(er) grids & meters, energy storage

Active demand



Time of use tariffs

Distributed generation

Large Frequency Incident on 27 May 2008 Led to Automatic Demand Disconnections

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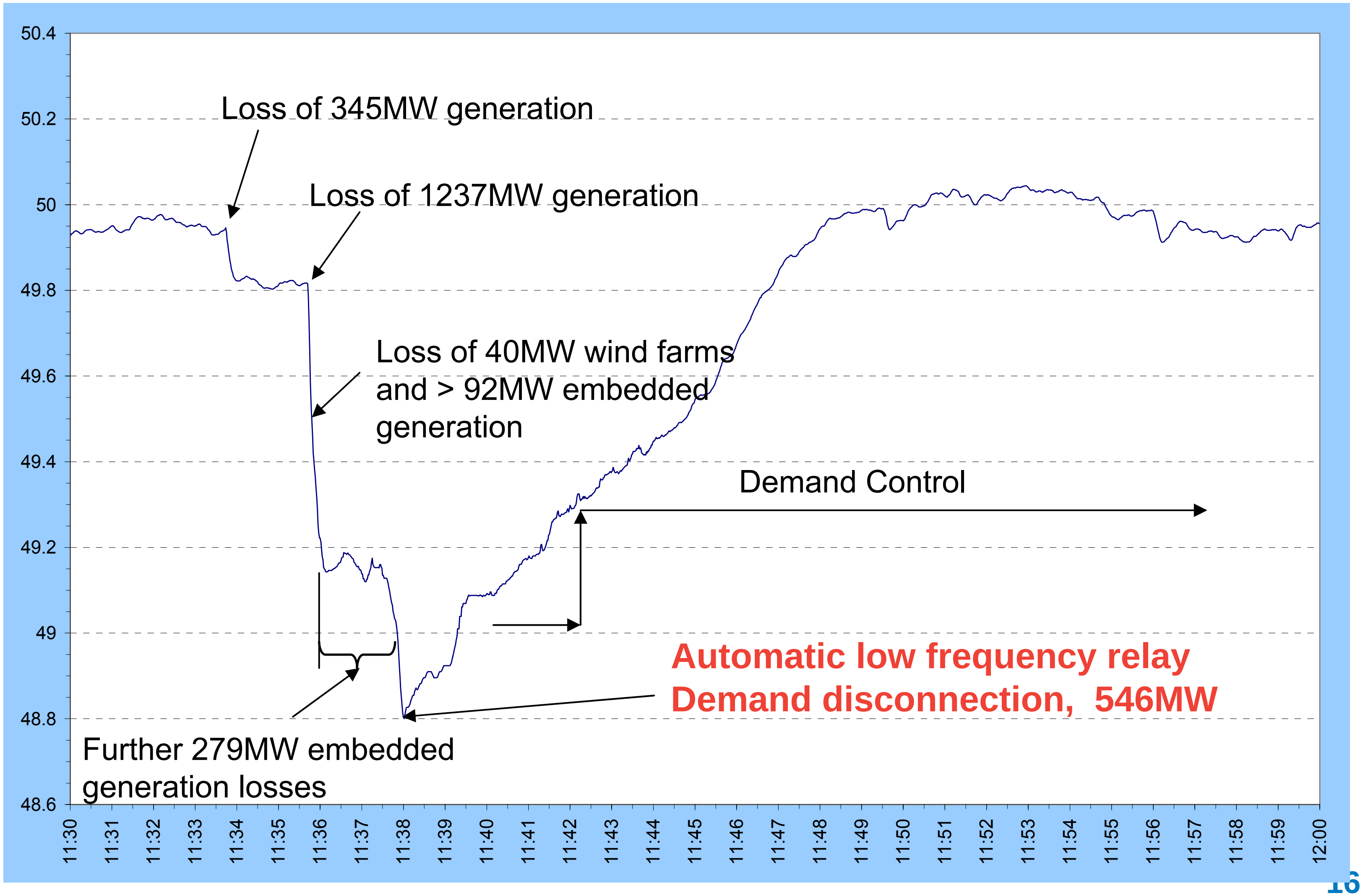
With 1800MW loss this becomes a routine challenge



Offshore Wind Scenarios
Four scenarios including Gone Green

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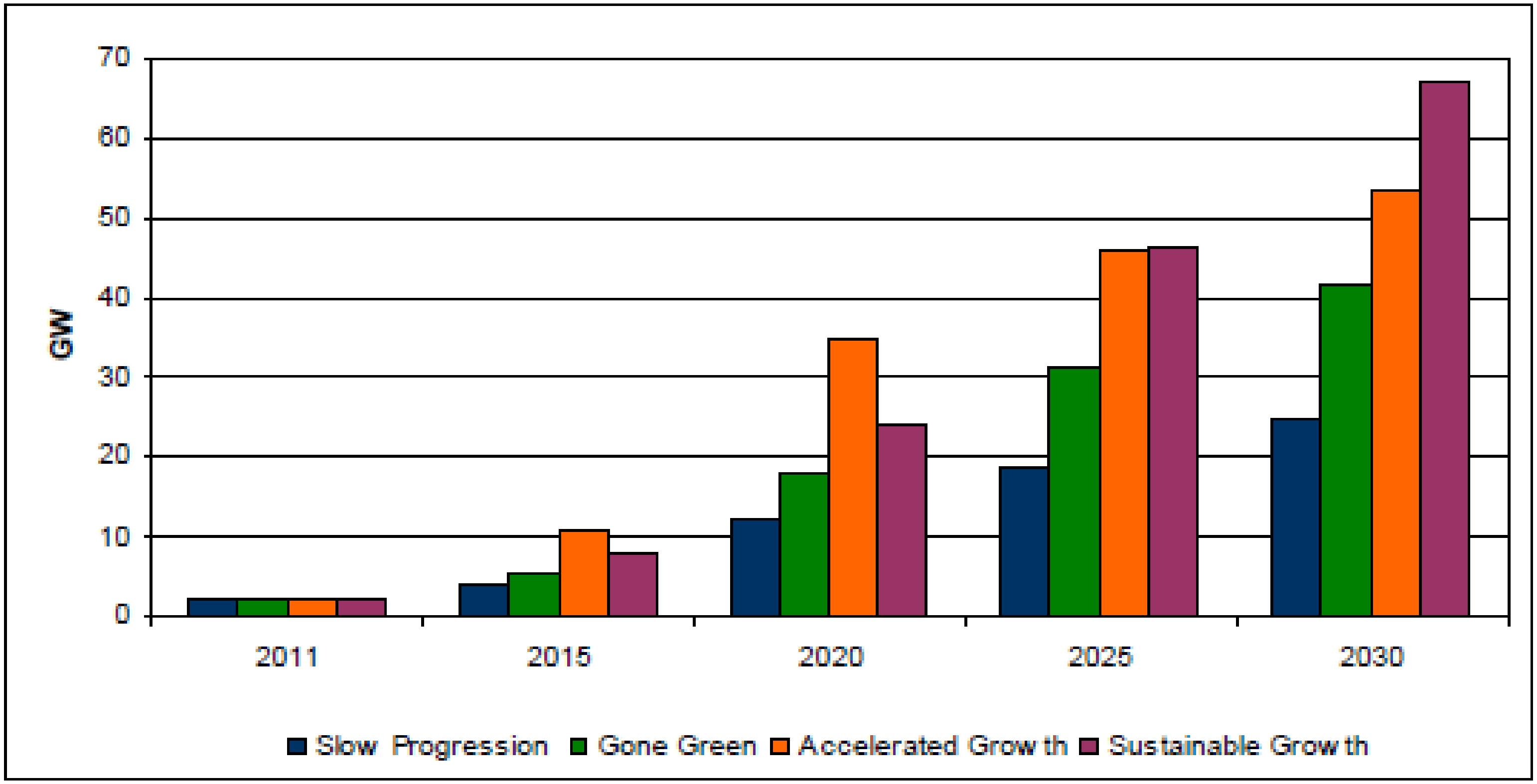
Up to 2020 transmission connection contracts roughly in line with Accelerated Growth

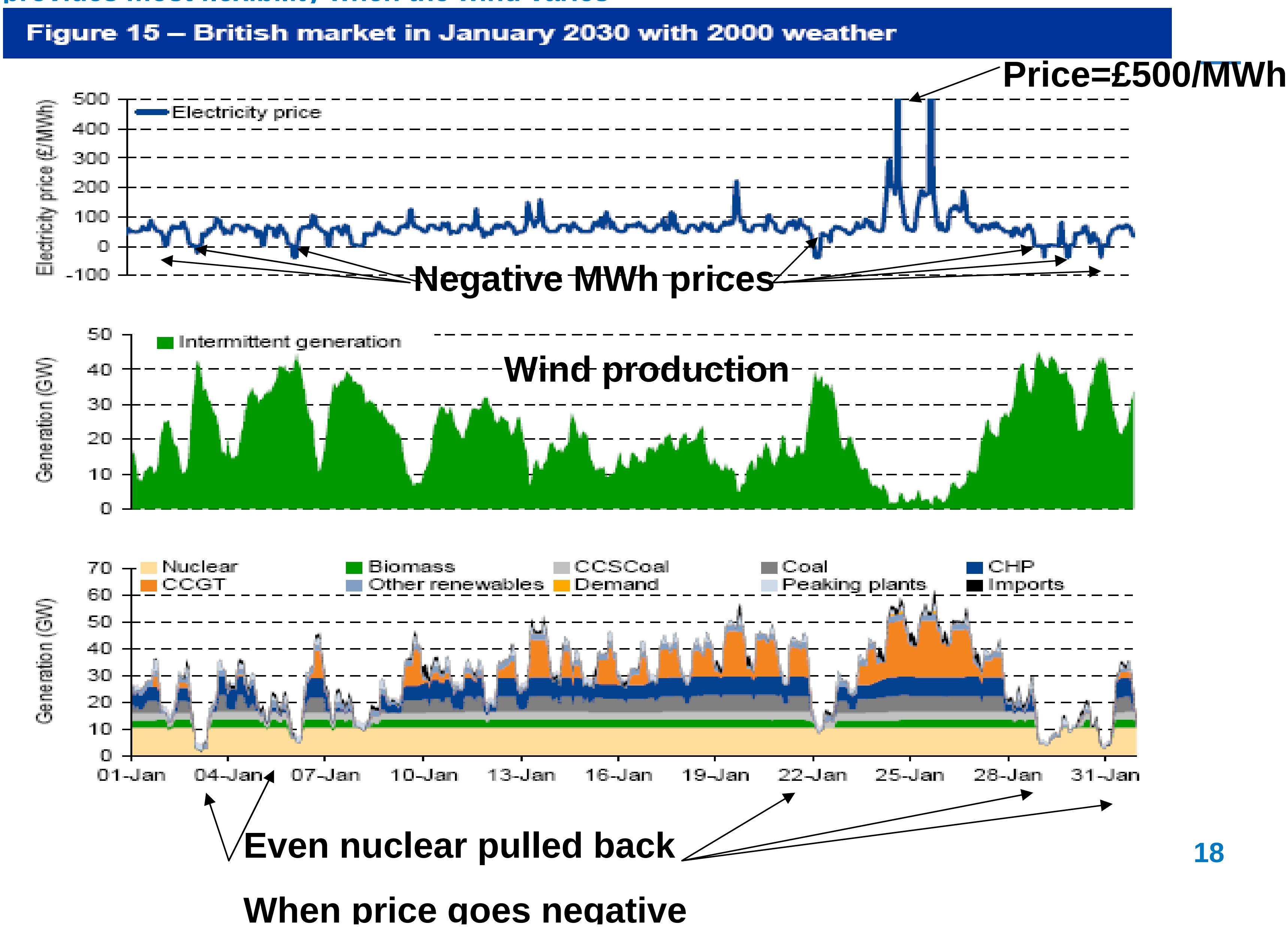
How large will the program slippage be? 18 critical months

Future Scenarios - Offshore Generation (Wind and Marine – Accumulative Installed Capacity)

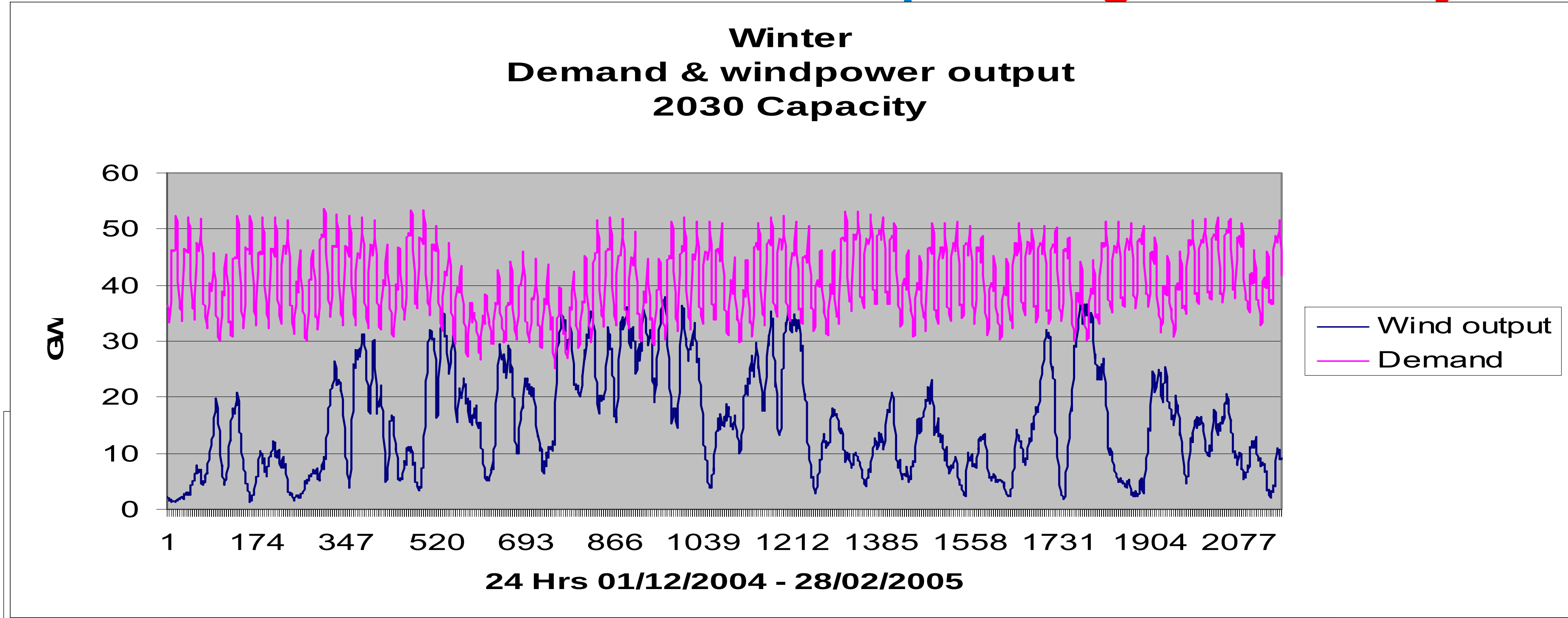


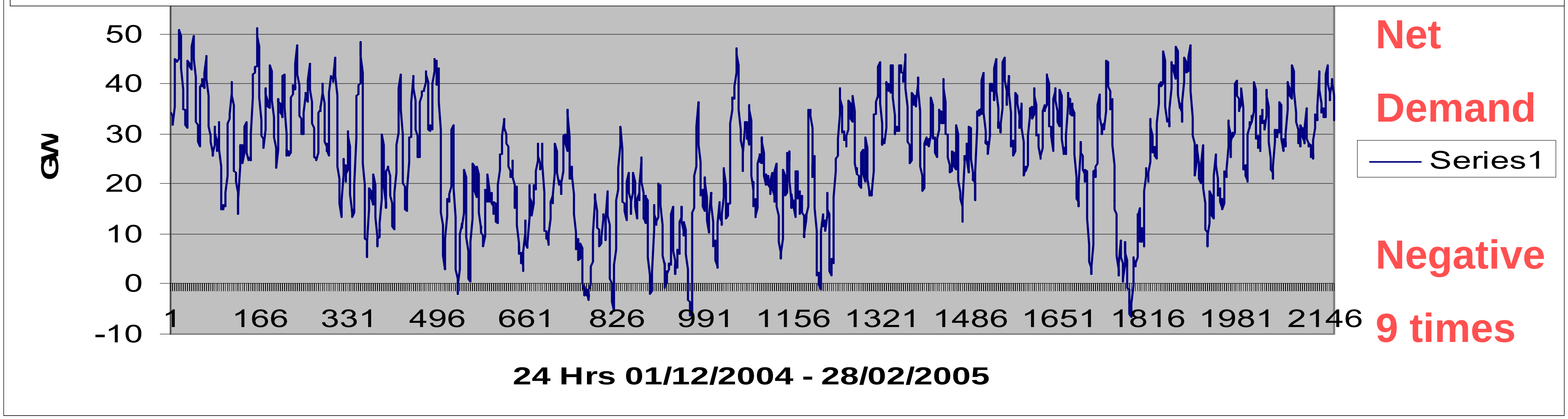
Assumed 40GW of wind capacity

Poyry Report – Jan 2000 (2030 generation) - No baseload left
CCGTs provides most flexibility when the wind varies



2005 data rerun with 40GW wind installation
Three Winter Months - Dec to Feb
Net demand = Demand – Wind Output . Negative 2% of year!





Net Demand

Negative 9 times

Banding/Parameter Selection

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Banding/Parameter Selection

Q - How and why were the boundaries for Types A,B,C and D selected?

- **See the slides to follow**

They look more onerous than other EU zones.

- **They are very closely aligned with the similar sized Nordic area and as expected larger values applies for CE and smaller applies for Irish synchronous areas**

Q - How and why were the GB zone specific parameters selected in the RfG?

- **By the drafting team as for all other areas, selected to be proportional, appropriate and in a balanced way reflect the size of each synch area. See also answer to following Qs.**

Banding/Parameter Selection

Q- Methodology/ criteria for selection for Type boundaries should be included in RfG

- The advice from the EU law legal eagles
  - EU law states “what”
  - EU law does not state “why”
- The answers to “why” are in the M & A and the FAQs
- See also slides following

Content

1. Network Code Objectives
2. Significant Generating Units
3. Level of detail
4. Application to Existing Generating Units
5. Derogations
6. Reimbursement of costs

What are significant Generating Units?

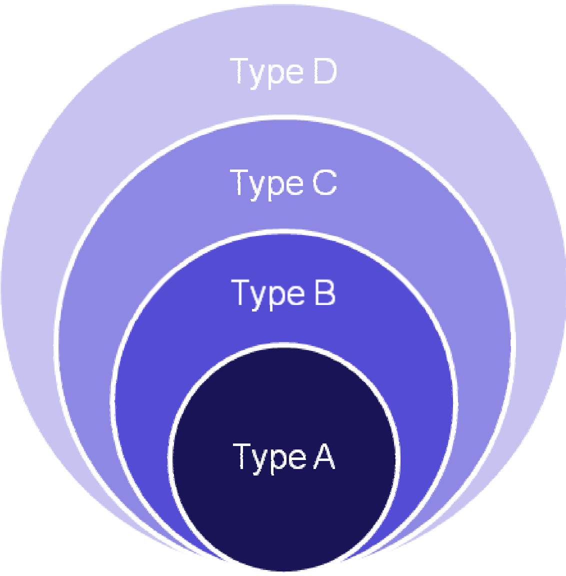
- Generator capabilities are formulated from a system performance perspective, independent from technology
- Significance is regarded per requirement

Wide-scale network operation and stability including European-wide balancing services

Stable and controllable dynamic response capabilities covering all operational network states

Automated dynamic response and resilience to operational events including system operator control

Basic capabilities to withstand wide-scale critical events; limited automated response/operator control



Graded approach on significance

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Network Code prescribes max. thresholds at synchronous area level

- Criteria based on MW capacity and voltage level thresholds (see table)

Synchronous Area	maximum capacity threshold from which on a Generating Unit is of Type B	maximum capacity threshold from which on a Generating Unit is of Type C	maximum capacity threshold from which on a Generating Unit is of Type D
Continental Europe	**1 MW**	**50 MW**	**75 MW**
Nordic	**1.5 MW**	**10 MW**	**30 MW**
Great Britain	**1 MW**	**10 MW**	**30 MW**
Ireland	**0.1 MW**	**5 MW**	**10 MW**
Baltic	**0.1 MW**	**5 MW**	**15 MW**
	and	and	or
Voltage level	**< 110 kV**	**< 110 kV**	**≥ 110 kV**

Banding/Parameter Selection

Q- Has "significant" been interpreted correctly?

- ENTSO-E's reasons for its approach to significance is set out in depth in both M&A & FAQs
  - Please study carefully
- ENTSO-E and National Grid believes the answer is yes.
- ACER has indicated that there is no principle problem with ENTSO-E's graded significance approach.
- ENTSO-E believes it is the most proportional and flexible approach.
  - It allows ENTSO-E to deal carefully with subsidiarity
  - It has allowed adjustments to be made as development and consultation has progressed
- ENTSO-E observes the continued vast difference in views between different stakeholder groups with respect to subsidiarity
  - This was obvious in the stakeholders' presentations made in the consultation WS
  - Manufacturers want clarity in order to reduce costs
    - EWEA even wishes to double the technical content – this position known for 26 months
  - Plant owners and DSOs prefer greater subsidiarity

Banding/Parameter Selection

Q- Band boundaries can be lowered on a national basis so why weren't the GB bands set at current levels so they can be reviewed and lowered as appropriate to the proposed levels?

- The wording of the question indicate a need to first understand their total different basis, which do not allow direct comparison

The two cannot be directly compared as

- GB GC is stated in terms of a Power Station
  - With large regional variations and onshore / offshore variations
- NC RfG is based on unit similar to our BMU on synchronous area basis.
  - Allows national choices to be made for lower values, which do not threaten the determined level of contribution to security of supply
  - GB is the only synchronous area completely contained inside one country, see later Q
- An E&W embedded PS with 4 units of 25MW connected below 110kV would be a large PS. However, it would only be type C. Existing GB code more severe.
- On the other hand a PS connected at 33kV with a single unit at 35MW would be a Type D
  - In E&W – onshore small PS and Type D – RfG more severe
  - In Scotland or offshore – large and Type D – No difference
- **There is no current level.** The draft RfG reflects well the size of the different synchronous areas. ENTSO-E wishes to retain this proportional approach.
  - NGET has discussed with the DT RfG not to have any values for GB.

Banding/Parameter Selection

Q- Band C and D boundaries move the current LEEMPS obligations down to 10MW generators

- Answer covered previously
- Direct comparison of “BMU” and PS is misleading

Banding/Parameter Selection

Q- The application of additional reactive and stability obligations on >10MW generators (i.e. non-synchronous) will add cost to generators and DNOs

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- See previous about direct comparisons of PS and BMU equivalents.
- Making system security contributions by a growing amount of embedded volume of generation which displaces central units is a proportional response as explained in M & A (2.4) and in FAQ 7 & 22

Banding/Parameter Selection

Q- Type A/B boundaries require for there to be an appropriate regime in place to certify mass market products but this is currently not the case.

- Agree.
- It is probably not appropriate for ENTSO-E to lead on this, but it wishes to see timely progress.
  - If DSOs and or European Standards organisations would take a lead, this would be welcomed.
  - An opportunity for DSO EG to help move things forward.
- ENTSO-E would be pleased to encourage:
  - A regime for registering the certifying parties.
  - Registration happens at a European level
    - Savings+ open market
    - More complicated, because need to cover national parameters and be suitable to provide facility certificates without site activities.

Banding/Parameter Selection

Q- Definition for "Generating Unit" is ambiguous

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- Thank you – well spotted.
- Representation made to the DT
- Code changed to remove the problem.
  - There is now only one type of use of the term “Generating Unit”.
  - See revised definition of “Generating Unit”.
  - The other use has now been changed to “….If there is more than one unit generating power within …”
- There is a close equivalence between in the GB GC a BMU and in the NC RfG a Generating Unit.

Banding/Parameter Selection

Q- Which parameters/ obligations "change", "will not change" and "may change"?

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- See comparison tables provided
- In the end the level of change is determined in the main by the approach taken at national level.
- If the national approach in the main sets out to replicate existing parameters then the differences would be minor for transmission plant, while smaller units would have some new obligations, predominantly related to frequency.

RfG Implementation

Q- What is the formal governance process for the setting of TSO parameters within RfG defined ranges?

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- Article 4 paragraph 3 states that National rules applies.
  - "…shall be performed under the conditions of the applicable national legal framework and in accordance with the principles of transparency, proportionality and non-discrimination and, as the case may be, with the involvement of the National Regulatory Authority."
- National Grid has committed to apply GCRP processes
- The draft EU law proposes a time constraint of completion within 3 years of which it is expected that
  - National choices completed within 2 years
  - This will allow 1 further year for preparation

RfG Implementation

RfG Implementation

Q- What will be the impact of RfG on the Grid Code and the other codes?

- The national codes affected will have to be amended. None are allowed to contravene the European NC.
- On what principle this should be done has not been settled. The European NC text should it be:
  - Copied into GB codes (e.g. with different font to indicate that it cannot be modified by national decisions)

  Or

  - Just be full of X-references making it necessary to move between documents.
- So far comparisons have been made for GC, STC and D-code.
  - See separate documents provided.
- A lot of impact can be expected on G59, 75 and 83.
- Impact on CUSC has not yet been analysed. Probably this will be more affected by a later code, the Connection Procedures Code.

RfG Implementation

Q- How will GC compliance be demonstrated?

- Europe has decided to copy the GB regime which itself is awaiting OFGEM decision following A10 consultations.

Subject to national process outcome, expect:

- For the largest units no change from current practice.
  - Hopefully more international co-operation on MD&PTC to improve engineering resource efficiency for individual units.
- For types A & B
  - European based factory process – normally no site activity
- For type C
  - Does the process need simplification? Fewer stages?

RfG Implementation

- Q- The code forces a formal EON; ION; FON process on us for all generation – ie energization notice, initial operation notice, final operation notice. This is the process NGET use for all transmission connected generators. It seems it needs to be applied right down to 400W inverters now. I'm sure we can tame the bureaucracy below 10MW, but we'll probably be stuck with some new process and admin to some degree.
- Agree bureaucracy needs taming
- Answers in the previous slide applies
  - The proposed processes do require GB DNOs to facilitate their implementation

RfG Implementation

Q- When will RfG obligation apply to new generators?

- Three years after comitology
  - If process follows programme towards end of 2016
- National selection of options and parameters is expected to be completed roughly 1 year earlier.
- Generators with binding contracts before comitology will not be new generators
  - Is this a good contract cut-off date?
- In GB differences for larger generators (Type D) probably so small that this will hardly matter
  - Generators may even prefer new code, e.g. FRT

Retrospectivity

Retrospectivity

Q- What is the precise methodology
for assessing whether retrospectively is applied?

- **See the following slides for the proposed process**

Q- Can the Authority unilaterally apply obligations retrospectively?

- **No, but OFGEM is the decision maker on proposals brought to it and ACER has a supervisory role in terms of NC implementation**

Content

Application to existing Generating Units?

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ACER Framework Guideline on Electricity Grid Connection

"The applicability of the standards and requirements to pre-existing significant grid users shall be *decided on a national basis by the NRA, based on a proposal from the relevant TSO**, after a public consultation. The TSO proposal shall be made*** *on the basis of a sound and transparent quantitative cost-benefit analysis* ***that shall demonstrate the socio-economic benefit, in particular of retroactive application of the minimum standards and requirements ...***
The *format and methodology or principles of the cost-benefit analysis* ***shall be prescribed by the network code(s)."***

Application to existing Generating Units

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Generation Units not yet under construction are considered to be existing, if

- Legally binding contract for main plant is in force
- Evidence is provided within 6 months after entry into force of the code
- Network Operator can request confirmation by National Regulatory Authority

Decision on application to Existing Generating Units

- On a national basis
- Cost Benefit Analysis process initiated by TSO and supported by stakeholders
- Final approval of retroactive application (based on TSO proposal) by the National Regulatory Authority

Cost-benefit Analysis

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A full quantitive CBA is a resource intensive process

➲ A <u>filtering</u> (CBA stage 1) is performed based on engineering review

1: Analyse retrofit via Stage 2 CBA

2: Make further judgment; check against ENTSO-E library

No further action

Cost of modification

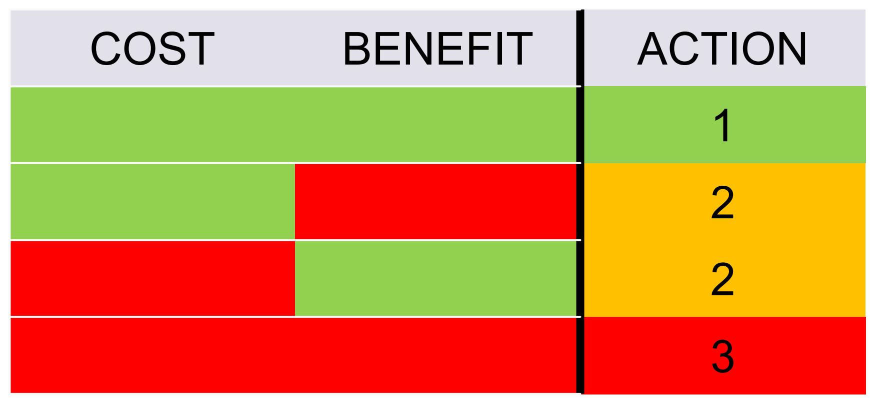
Insignificant

Significant

Benefit in reduced demand loss / balancing costs

No/low impact

Significant impact



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Cost-benefit Analysis

Green light: reasonable prospect of justifying retroactive application ⇨ quantitative CBA (stage 2)

CBA techniques

- Net Present Value / Return On Investment / Rate of Return / Time to Break Even.
- Discount rate at TSO's discretion

Cost components

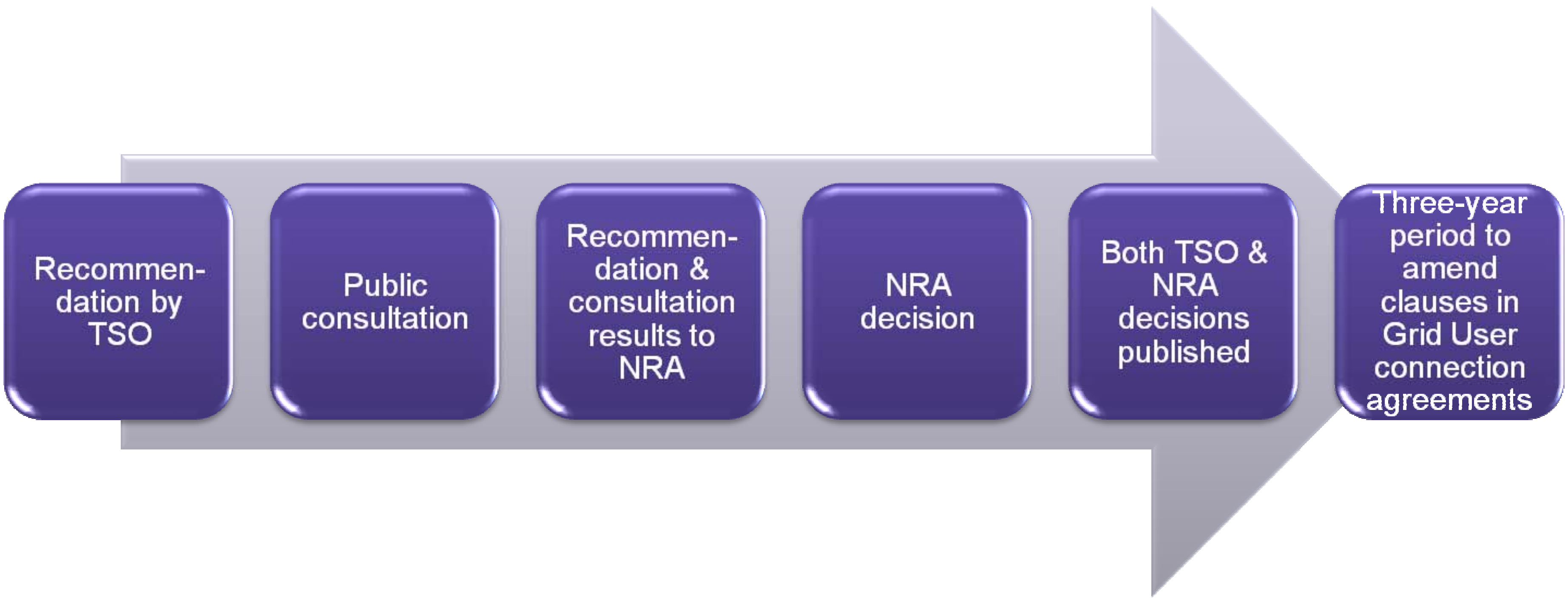
- Costs for implementing the requirement
- Any attributable loss of opportunity
- Change in maintenance costs

Societal Benefits

- Improvement of security of supply (black out probability)
- Improvement to the internal market in electricity and cross-border trade (reactive power provision, freq. response, reserves, ...)
- Facilitation of the integration of Renewable Energy Sources

Application to existing Generating Units

If CBA justifies retroactive application for a user or a class of users



What about Generating Units out of the scope?

- If retroactive application for a requirement is not enforced
  - → Existing Generating Unit remains bound by technical requirements pursuant to national legislation or by contractual agreements.
- National legislation
  - → may remain in force, in case it refers to requirements not covered by the Network Code
- If national legislation is repealed
  - → Existing Generating Unit remains bound by technical requirements pursuant to national legislation such as it was the day before it ceased to be in force.
- Former derogations to national legislation
  - → are not valid as derogation for the European Network Code, but provide evidently useful information

Specific Technical elements

Specific Technical elements

Q- The parameters for the reactive power range may be too inflexible and should therefore be future proofed

- Considering the flexibility written into the code, this is a surprising statement.
- We may not have understood fully the concern behind this question.
- RfG has greater flexibility for Q than existing GB requirements
  - Balance between leading & lagging can be adjusted
  - V-Q shape can be selected
  - Both dimensions of freedom are in use within Germany
- See the following slides for the requirements

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1. Foundation for cross-border trading of electricity – *a stable system*

2. Frequency stability – *related requirements*

3. Voltage stability – *requirements for reactive reserves*

4. Fault ride through – *linked to all three main forms of system stability*

Voltage stability
Requirements for reactive reserves

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Motivation

- Regulate voltage to support active power transfers & avoid widespread voltage collapse
- Continental Europe: most common cause of widespread demand disconnection

Reactive requirements for synchronous generators and PPMs

- Reactive power versus voltage (at 100% P)
- Reactive versus active power (at nominal voltage)

Voltage Stability requirements

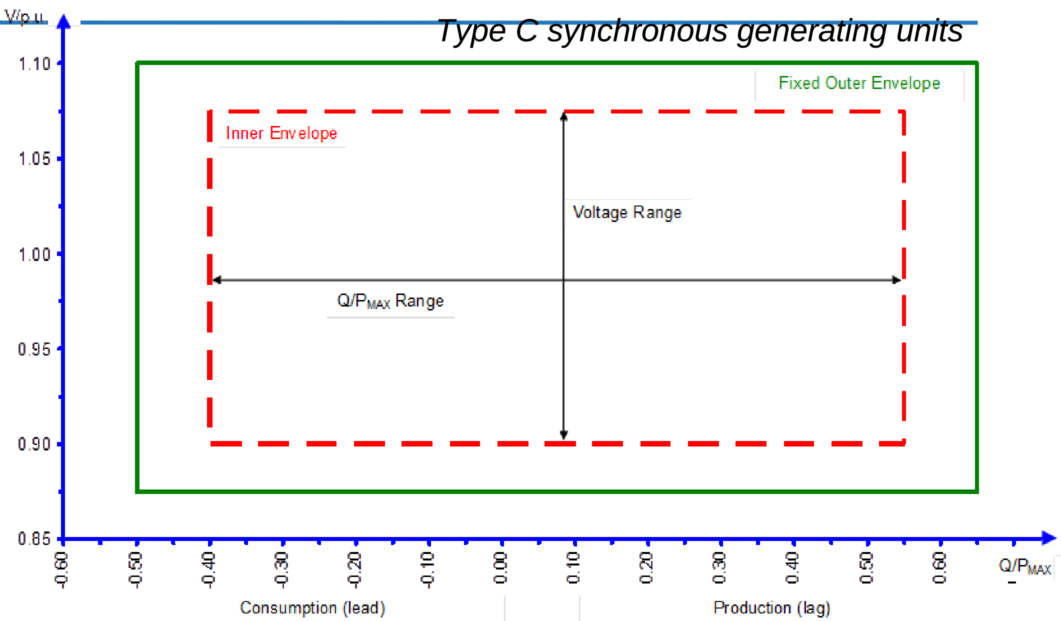
Title	Type A	Type B	Type C	Type D
General requirements				
HIGH/LOW VOLTAGE DISCONNECTION			X	
VOLTAGE RANGES				X
Synchronous Generator requirements				
REACTIVE POWER CAPABILITY (SIMPLE)		X		
VOLTAGE CONTROL SYSTEM (SIMPLE)		X		
EXCITER SPECIFICATION				X
REACTIVE POWER CAPABILITY AT MAXIMUM ACTIVE POWER			X	X
REACTIVE POWER CAPABILITY BELOW MAXIMUM ACTIVE POWER			X	X
STATOR CURRENT LIMITER				X
STEADY STATE VOLTAGE CONTROL			X	X
TRANSIENT VOLTAGE CONTROL			X	X
VOLTAGE CONTROL SYSTEM				X
POWER OSCILLATIONS DAMPING CONTROL				X
POWER SYSTEM STABILIZER				X
Power Park Module requirements				
REACTIVE POWER CAPABILITY (SIMPLE)	X	X		
REACTIVE CURRENT INJECTION		X	X	X
PRIORITY TO ACTIVE OR REACTIVE POWER CONTRIBUTION			X	X
REACTIVE POWER CAPABILITY AT MAXIMUM ACTIVE POWER			X	X
REACTIVE POWER CAPABILITY BELOW MAXIMUM ACTIVE POWER			X	X
REACTIVE POWER CONTROL MODES			X	X

Voltage stability
Reactive power capability – general concept

Need for reactive power depends strongly on the type of network (length, cable/overhead, loading, …)

- Network Operator defines U-Q/Pmax shape within red envelope
- Red envelope can be moved within boundaries
- Dimensions red envelope depend on synchronous area
- Green outer boundary is based on all relevant grid codes in Europe. Note: the green boundary is not the requested range.

Type C synchronous generating units

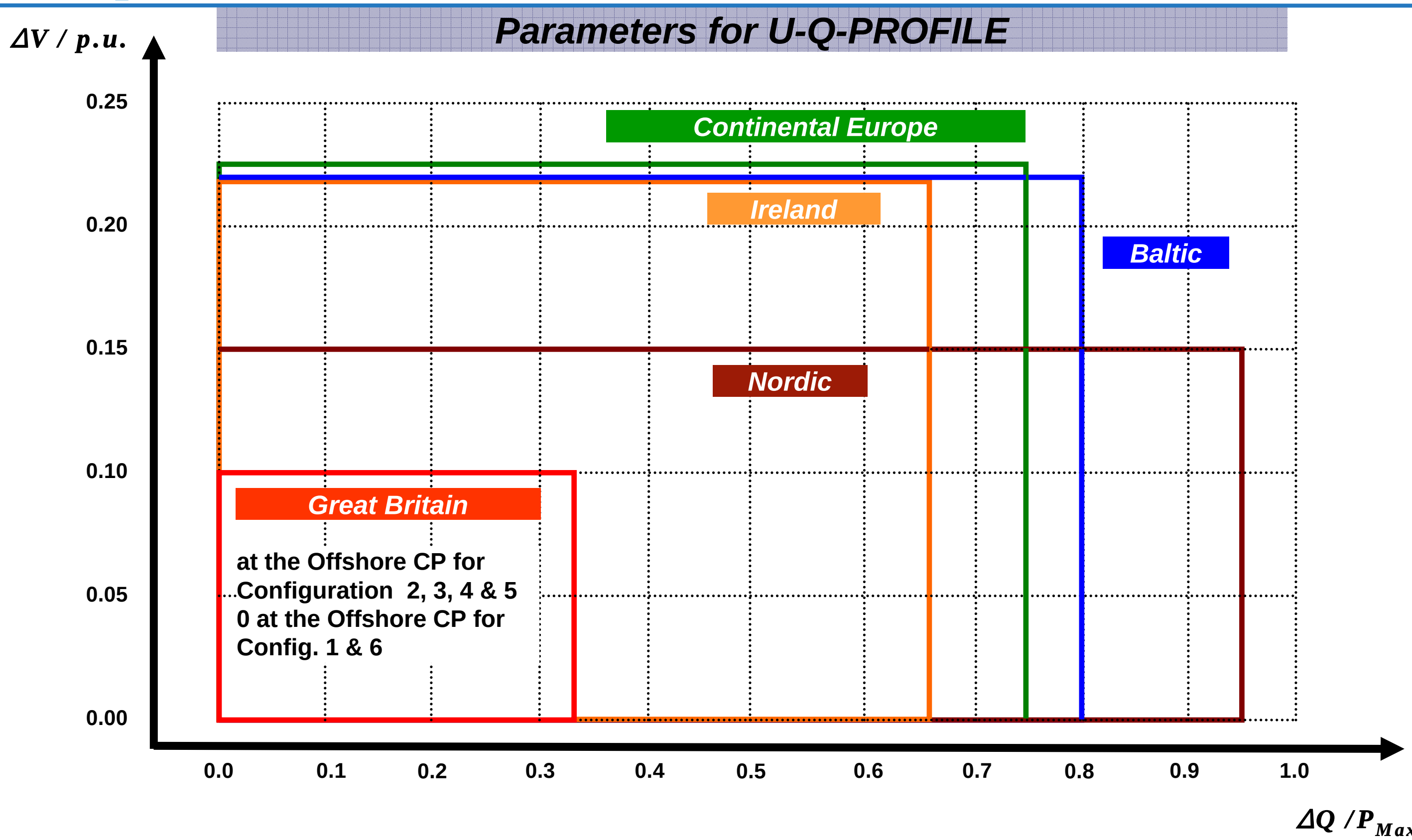


Synchronous Area	Range of Q/P_{max}	Range of steady state voltage level in PU
Continental Europe	**0.95**	**0.225**
Nordic	**0.95**	**0.150**
Great Britain	**0.95**	**0.100**
Ireland	**1.08**	**0.218**
Baltic States	**1.0**	**0.220**

Provides a basis for efficient voltage regulation in constantly evolving networks

Voltage stability

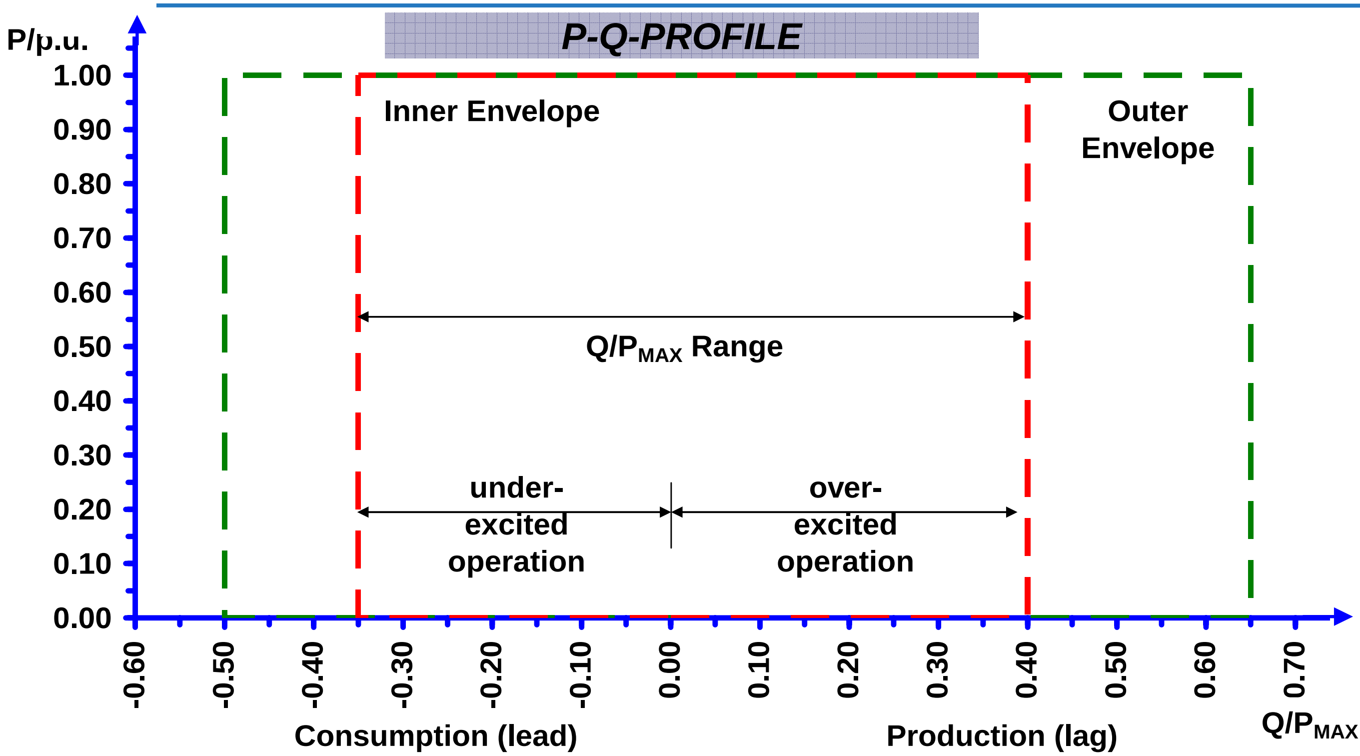
V-Q- parameters for PPMs Offshore



FOR OFFSHORE POWER PARK MODULES

One reason for GB difference is separate onshore reactive power requirement under the Offshore Transmission Network Owner (OFTO) regime

P-Q profile for PPMs onshore and offshore



Extending the PPM reactive power capability down to zero power makes it reliable for operators by making it independent of sudden power output variations (e.g. due to wind speed).

Specific Technical elements

Q- Does the proposed drafting for Article 9 Paragraph 2(a)(1) of the RfG NC comply with the current GB obligations around Electronic Despatch Logging (EDL) in the Grid Code?

- Considering the primacy of NC over national codes, maybe it is more appropriate to turn this Q around.
- The NC has limited detail on capability of the specific control facilities provided.
- Introduction in GB (nearly all others have it already) of AGC (Automatic Generator Control) capability for new generators will in time open up new possibilities for Operation & Markets. This may include new SMARTer ways of dealing with post fault network constraints as well as restoring frequency response after a frequency event.
- In terms of use of such facilities, System Operation and Market Network Codes will be more relevant.

Specific Technical elements

Q- Article 9 paragraph (b) concerns the provision of inertia and contains the wording “may be required” which is very open.

However the decision whether Synthetic Inertia is required will be delegated to the national level.

- Followers of GCRP and its WGs will know, this topic is already active in GB.
- The NC is unlikely to affect the GB process.
- See also the introduction slides and slide following

System Inertia
Why is this increasingly an issue?

- PPMs do not naturally provide any contribution to system inertia, which reflects the ability to slow down change in frequency.
- In synchronous areas where sometimes the RES component of generation is high (e.g. during high wind), inertia becomes an increasing problem for instantaneous penetration > 50%.
- Unless countermeasures are taken, either the RES has to be constrained off in operation or a ceiling on RES development has to be established.
- Already a problem for two synchronous areas – Ireland & GB
- Counter measures for PPMs are under development – NC RfG allows for these to be applied where justified at national level

Specific Technical elements

Q- The upper voltage operating limit is currently 15 minutes in Grid Code but in the RfG it has been increased to 20 min

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- The DT RfG has been approached about this, a change was agreed and the NC RfG now states 15 min.

Specific Technical elements

Q- What were the assumptions behind the minimum Fault Ride Through (FRT) obligations for sub 132kV network?

- There is no intent to make any substantial change, only to implement the existing requirement in a more efficient and harmonised manner.
- For GB this is based on the experience since 2005 of a substantial effort needed to calculate retained voltage for faults at 275/400kV.
- By making a fixed % retained voltage allowance unnecessary complexity is dispended with. This process has already started for offshore by offering an option for a fixed retained voltage “allowance”.
- See also the following slides:

Specific Technical elements

- **Q- Fault Ride Through is now applied at the generator connexion point. In the current GB code it is defined at the interface between transmission and distribution. So this represents quite a change. Whilst this is a surprise, it might not be a bad thing in that it at least makes the requirements consistent for every DG connexion point. Some of it does look over specified – in effect the RfG is specifying the FRT for 11kV faults as well as supergrid faults**

- There is no GB intent to move away from generators, including embedded generators being immune to trip for 400/275 kV faults. This capability incidentally makes embedded generators capable of riding through some LV faults.
- See previous slide and those that follow.

1. Foundation for cross-border trading of electricity – *a stable system*

2. Frequency stability – *related requirements*

3. Voltage stability – *requirements for reactive reserves*

4. Fault ride through – *linked to all three main forms of system stability*

Fault Ride Through capability. *What requirements are involved and for what purpose?*

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Defines the voltage profiles where no trip is allowed

- Angular stability for synchronous generators

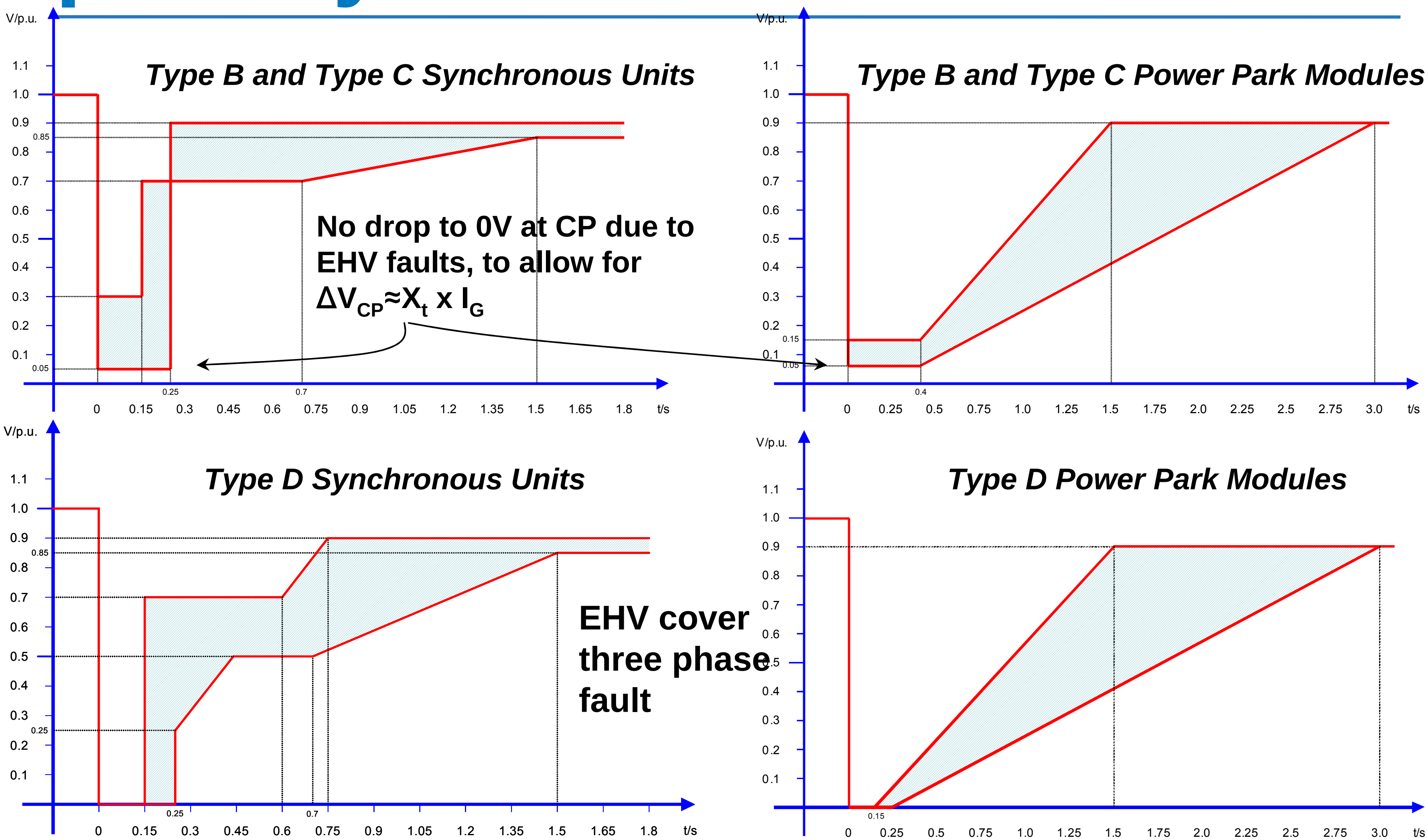
Defines the reactive current injection during the fault for PPMs and the dynamic voltage control after the fault

- Voltage stability

Defines the real power recovery after the voltage has recovered. Small synch area, need fast P recovery .

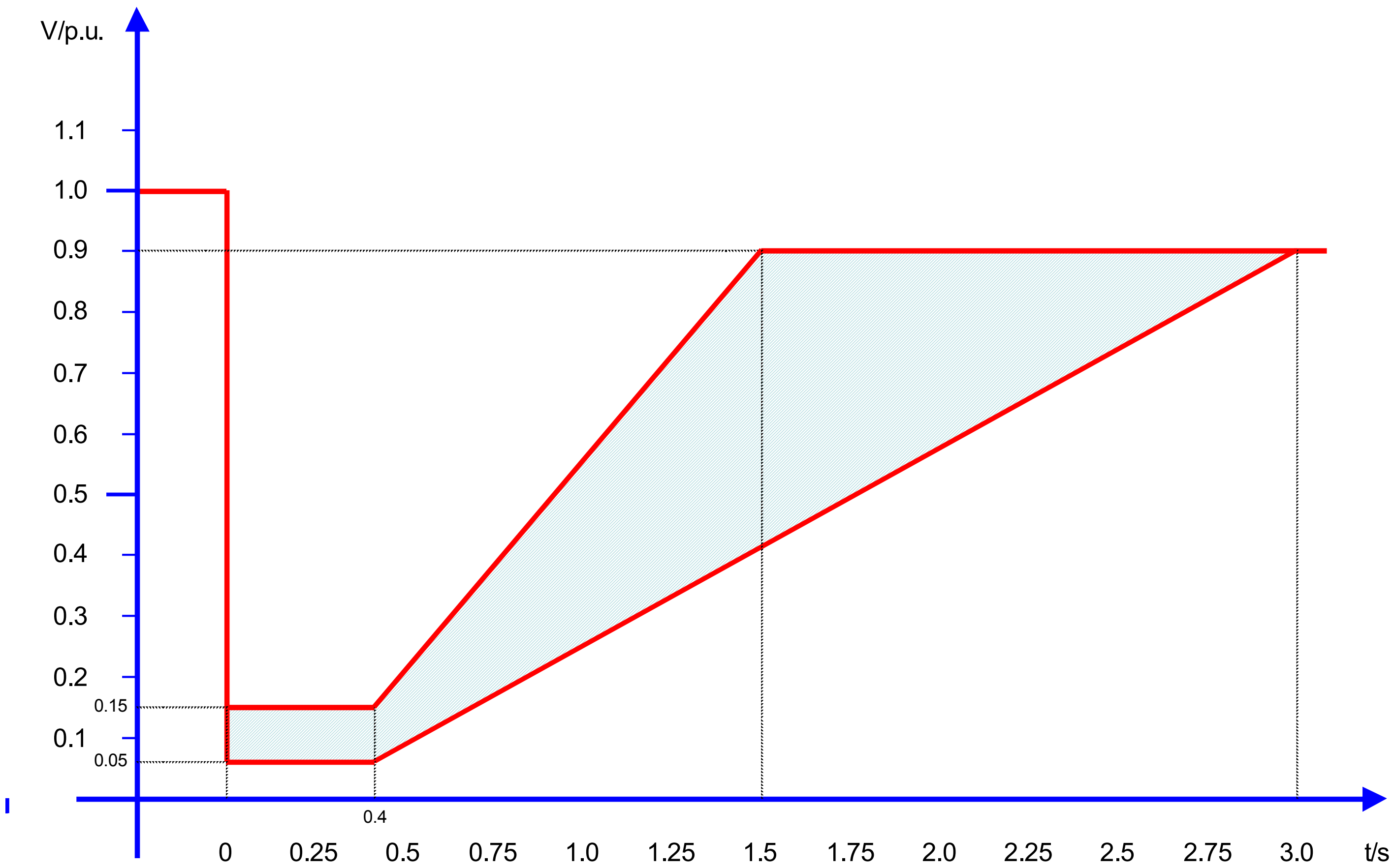
- Frequency stability

Fault-Ride-Through Capability



Fault Ride Through capability

Type B and Type C Power Park Modules



Fault Ride Through capability
National variances allowed

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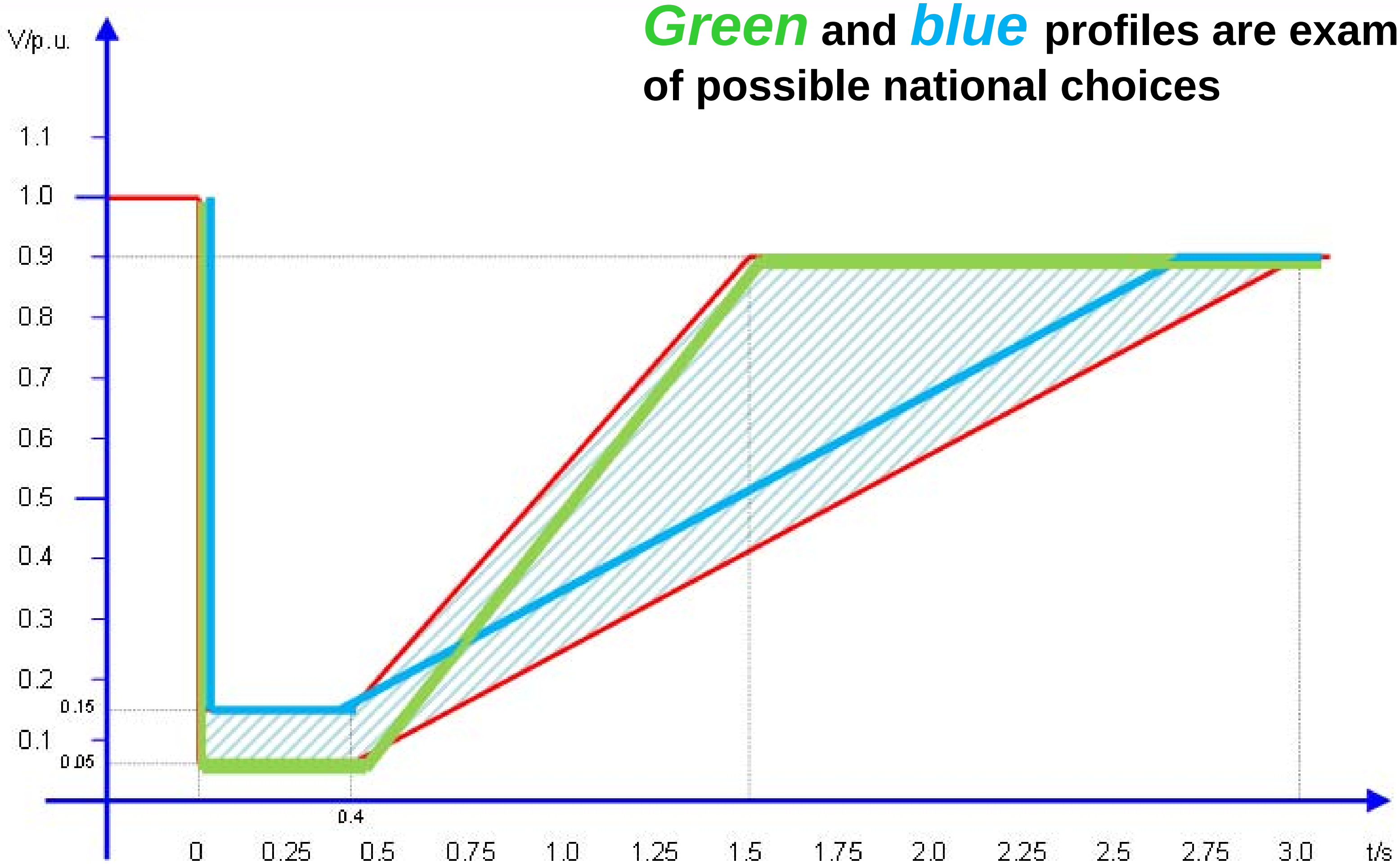

Green and *blue* profiles are examples of possible national choices

Fault Ride Through capability
Interpretation of requirement

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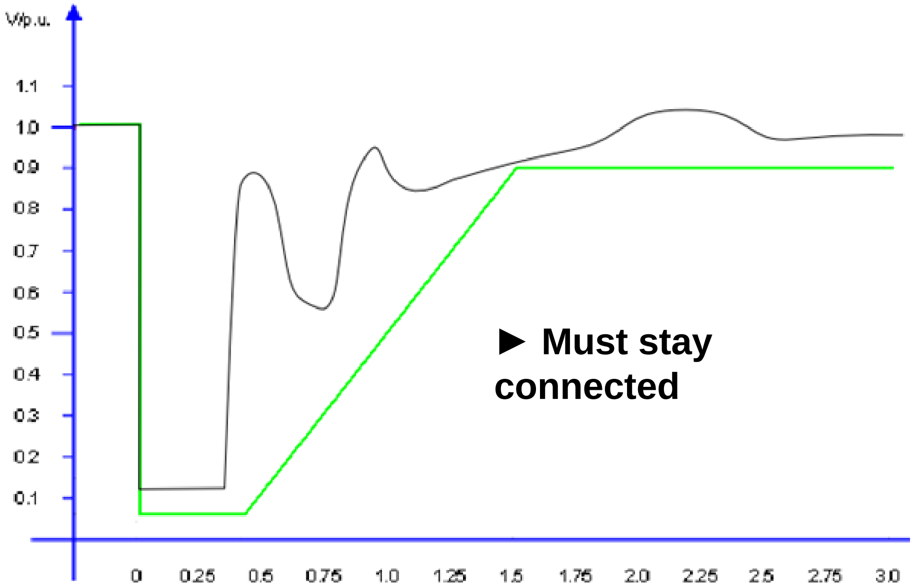
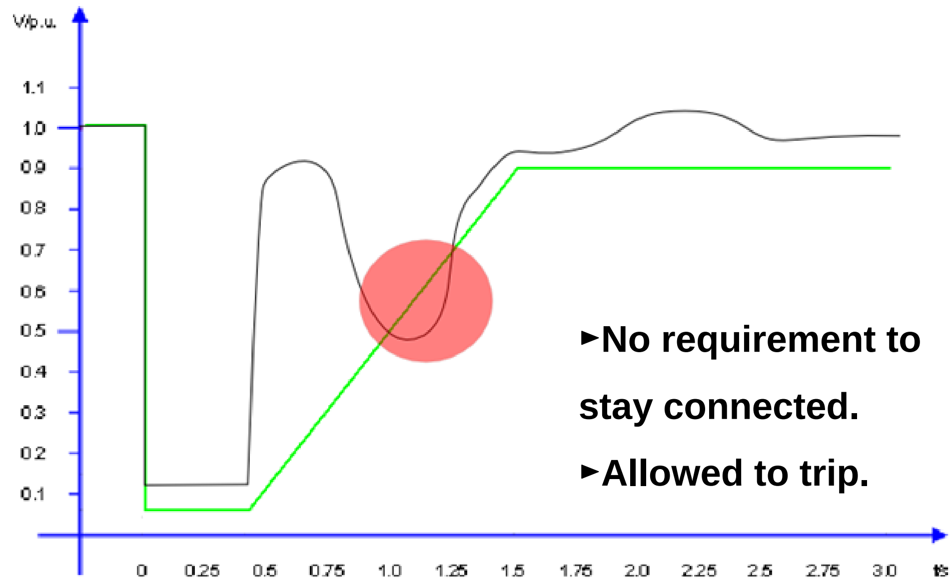




Assuming green curve selected in National code:

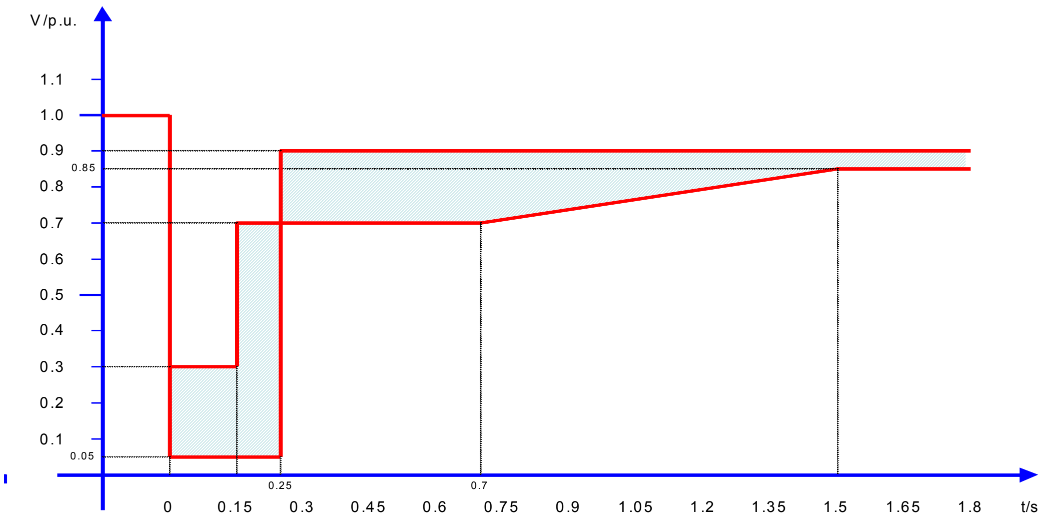
- ~~"Stakeholder is responsible to ensure recovery V profile is above this green curve"~~

✓ **No responsibility to deliver a voltage profile**
✓ **Requirement for unit to stay connected IF recovery voltage remains above.**

Fault Ride Through capability
Main Articles

Article 11.3a - Synchronous generator Type B

1. TSO will define its own voltage-time profile in within shaded area
2. Voltage-time profile for all faults at connection point. Red line refers to lowest phase voltage



3. Each TSO will set out pre/post conditions
4. TSO to provide system representation for simulations of Fault Ride Through capability
5. Undervoltage protection settings to be widest possible
6. Fast valving prohibited unless locally permitted

Reactive current injection during fault and voltage recovery provides a contribution to support system voltage & fault Level

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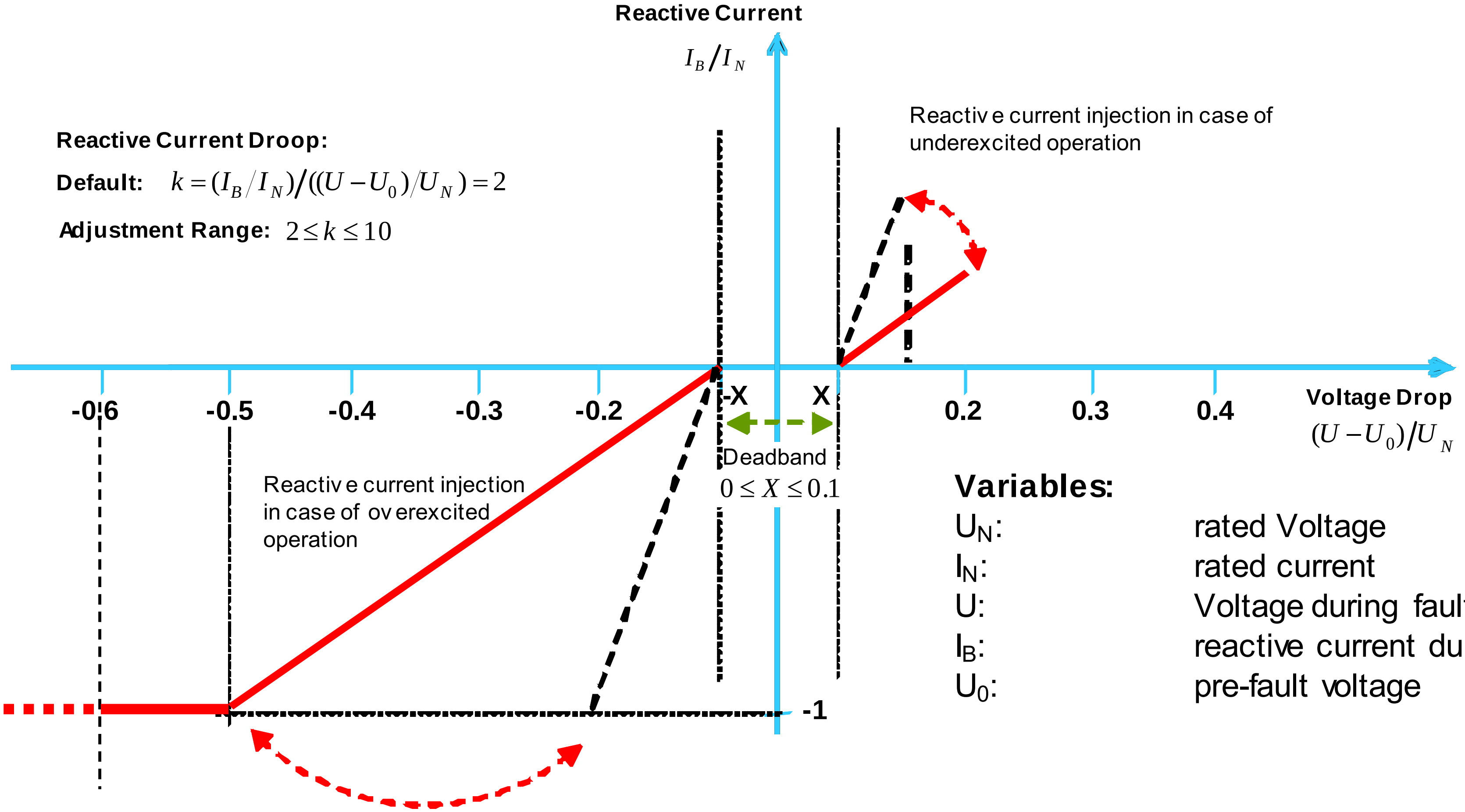
Reactive Current Droop:

Default: $k = (I_B/I_N)/((U-U_0)/U_N) = 2$

Adjustment Range: $2 \le k \le 10$



Variables:

U_N:	rated Voltage
I_N:	rated current
U:	Voltage during fault
I_B:	reactive current during fault
U_0:	pre-fault voltage

Specific Technical elements

Q- What happens when there is a common/ shared Point of Connection e.g. Cruachan and Ffestiniog?

- The issue has been taken up with DT RfG
- It is believed that the problem has been resolved
- There is no longer any hindrance in two units sharing one transformer being treated like separate PMUs in GB.

Specific Technical elements

Q- The proposed rate of change of frequency withstand is 2 Hz/sec for 1.25s

- The time aspect has been removed.
- It should now reflect exactly the current GB practice, ensuring robustness for fast df/dt events, which were originally introduced following overseas black-outs caused by GTs suffering flame-out.

Specific Technical elements

Q- Who will own the Dynamic System Monitoring (DSM) equipment? (Fault recorders)

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- No change is envisaged for GB

Specific Technical elements

Q- Auto-reclosure obligations have changed (8-2(a))

- Does this Q still relate to Article 8 paragraph 2 a)?
- If so has the latest version resolved the issue?
- It not can someone help with a fuller explanation of what the issue is?
- 8-2 a) only requests power reduction capability for Type B only in steps of 20%.
- Enabling including completing the infrastrudture is a national choice – dependent upon need – which itself mostly depend upon level of penetration and hence loss of necessary SO control of power flows

Specific Technical elements

- **Q- The offshore provisions do not seem to affect DNOs. Offshore is defined as having a connexion point offshore – which cannot be the case for DNOs in GB – so I think all that drafting only applies to transmission in GB.**

- This is a statement, not a question. No comment required.
- PS See next slide for the offshore configurations allowed for.

Offshore Power Park Modules
Categorization of grid connection configurations

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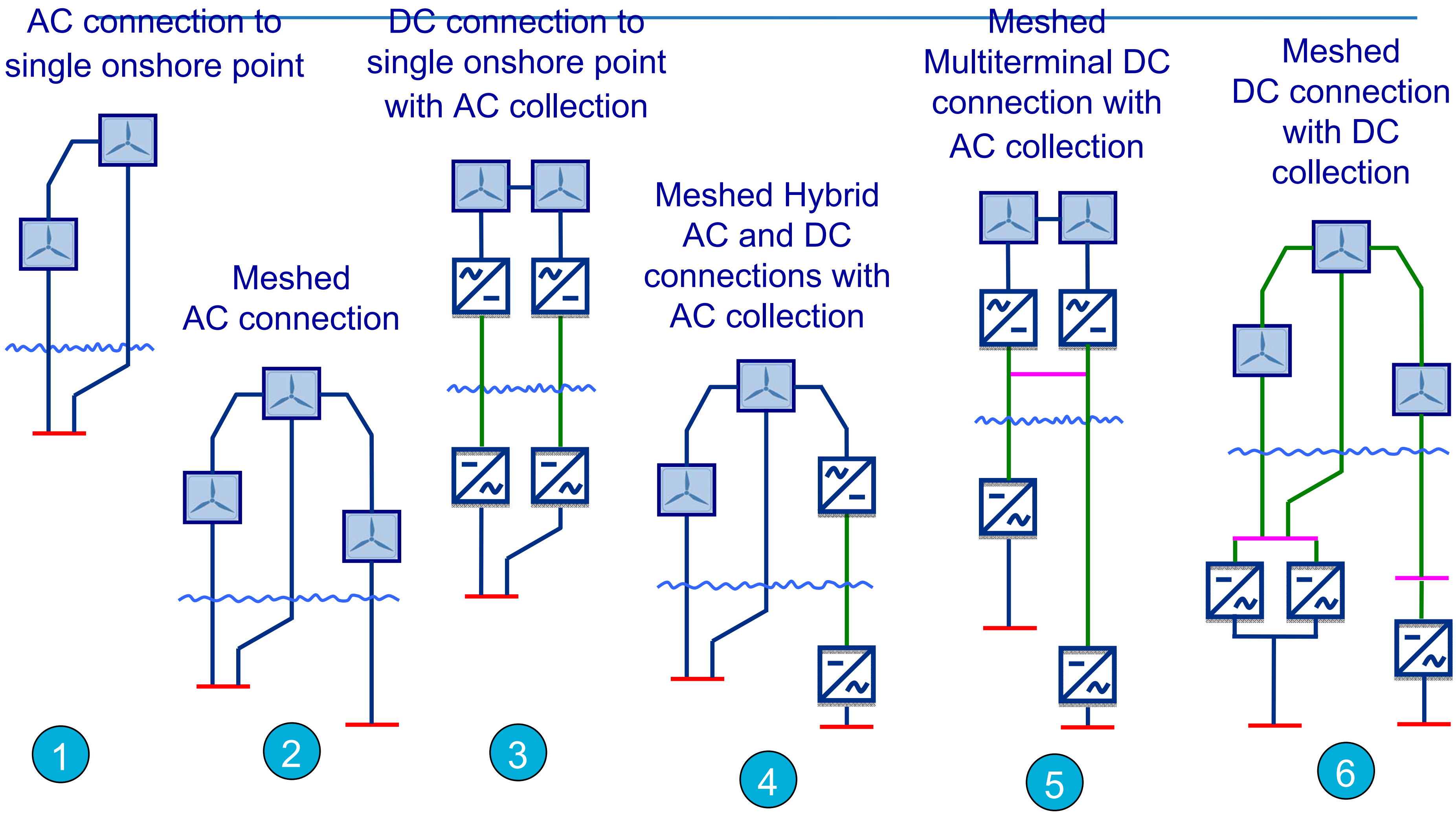

Style/ Drafting Approach

Style/ Drafting Approach

Q- RfG drafting is not clear

- Apart from certain EU legal format restrictions, such as numbering, if you have proposals for improvements, please get busy commenting on the web site.
- The DT is not flush with native English speakers.
- If this comment however is about engineering clarity, I guess it is more likely to refer to the point that in most cases “nothing is finished”. I agree, it is not, it usually ends in a reference to Article 4 (3).
- You cannot have a X-border test on everything, apply the principle of subsidiarity when X-border test does not support EU decision without ending up with a “bitty product”. It is deliberately a half finished product!
- If you do not believe me ask EWEA

EWEA on lack of detail in RfG

Recent consultation has resulted in even more subsidiarity

Style/ Drafting Approach

Q- Recitals may require updating

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- Legal input needed to finalise draft of this section
- Please include specific comments in your consultation responses to ensure that the issues are not lost and are dealt with

Key references

- Consultations overview - https://www.entsoe.eu/resources/consultations/
- Web consultation interface - https://www.entsoe.eu/consultations/
- Last status on « Requirements for Grid Connection applicable to all Generators» - https://www.entsoe.eu/resources/network-codes/nc-rfg/

Thank you
for your attention.

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