GC0090 – HVDC
Workgroup Meeting 1

18 September 2015

Agenda

- European Network Code intro
- Lessons learnt from ENCs so far…
- HVDC Code Overview
- Project Plan
- Future meetings

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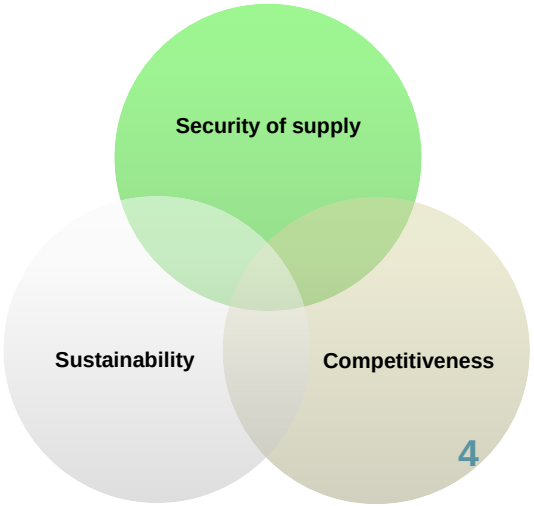
European Network Code intro

Richard Woodward

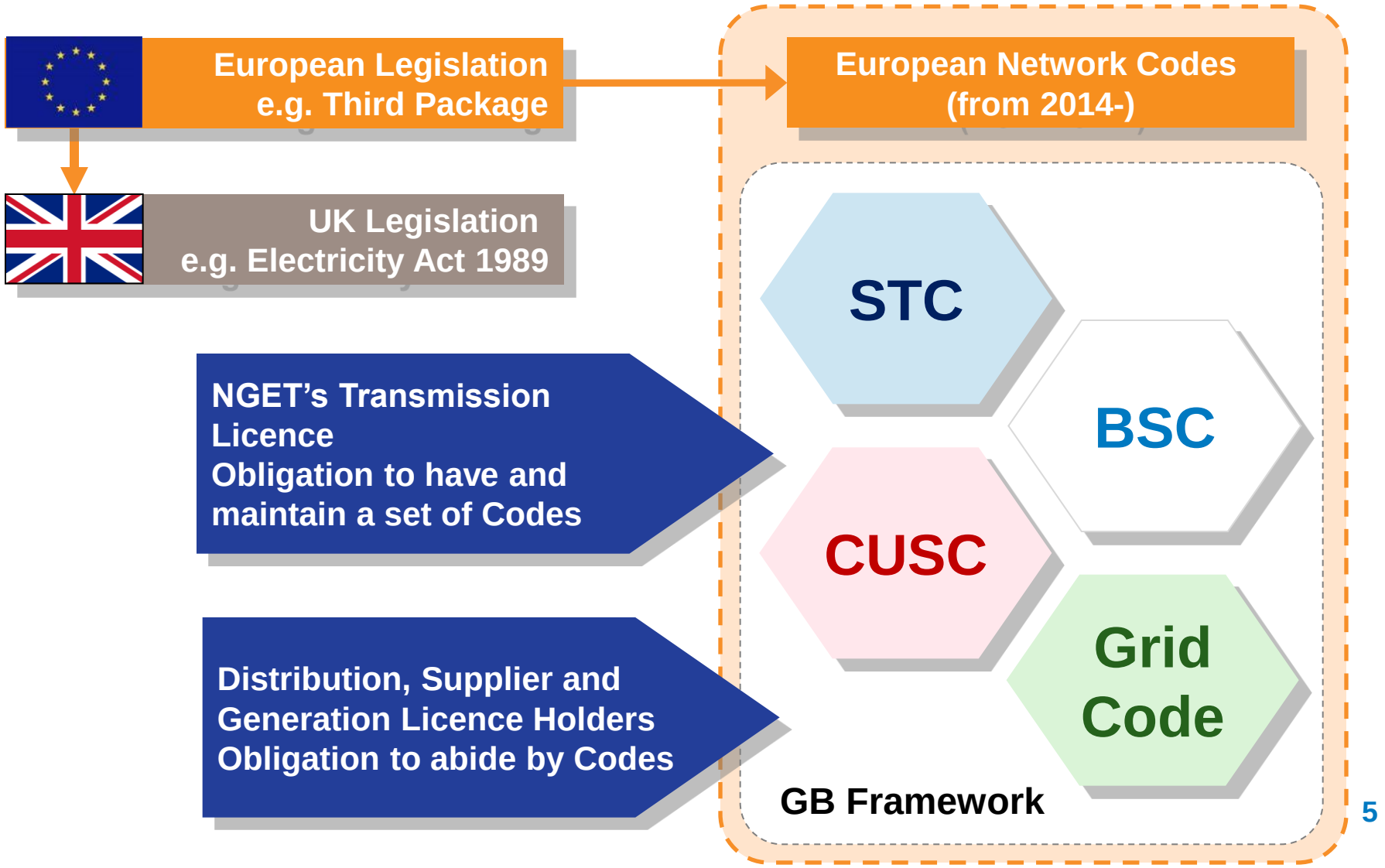
The Third Energy Package

- 3 regulations and 2 directives.
- Adopted July 2009, law since March 2011
  - Key step forward in developing a (more) harmonised European energy market
  - Separation of ownership of monopoly energy transmission activities
  - Formation of European Transmission System bodies, ENTSOG and ENTSO-E
  - Formation of ACER – Agency for Cooperation of Energy Regulators

Enabling renewables	Creating clear connection rules.	Providing harmonisation to benefit manufacturers.	Creating markets to reduce risks.
Ensuring security of supply	A coordinated approach to system operations.	Greater optimisation to enhance efficiency.	More flexible markets (e.g. balancing).
Enhancing competition	A single market design across Europe (in all timescales).	Promoting cross border trade & enhancing liquidity.	Reducing risk for all market players



Electricity Codes: The industry's rule book



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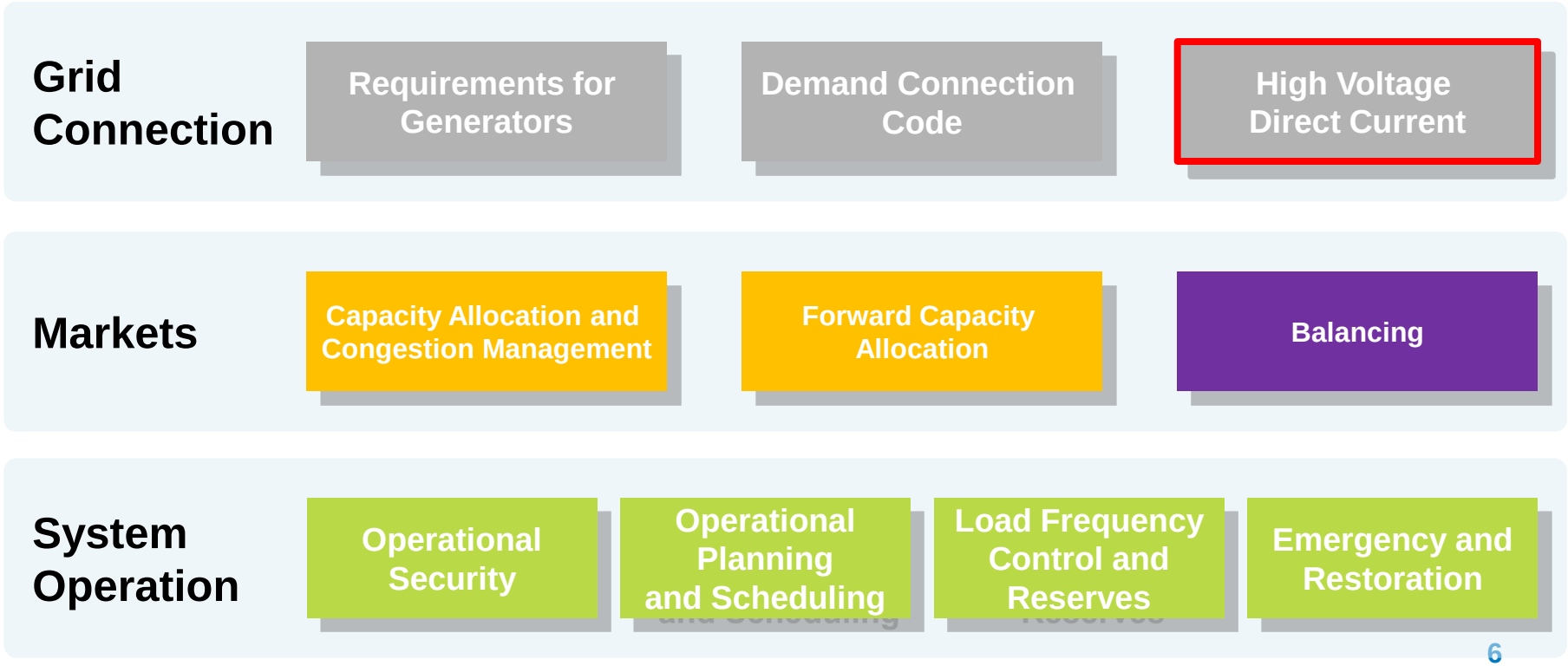
European Network Codes (ENC)

- There are 10 ENCs in development.
- When in force (published as law) they will take precedence over GB codes



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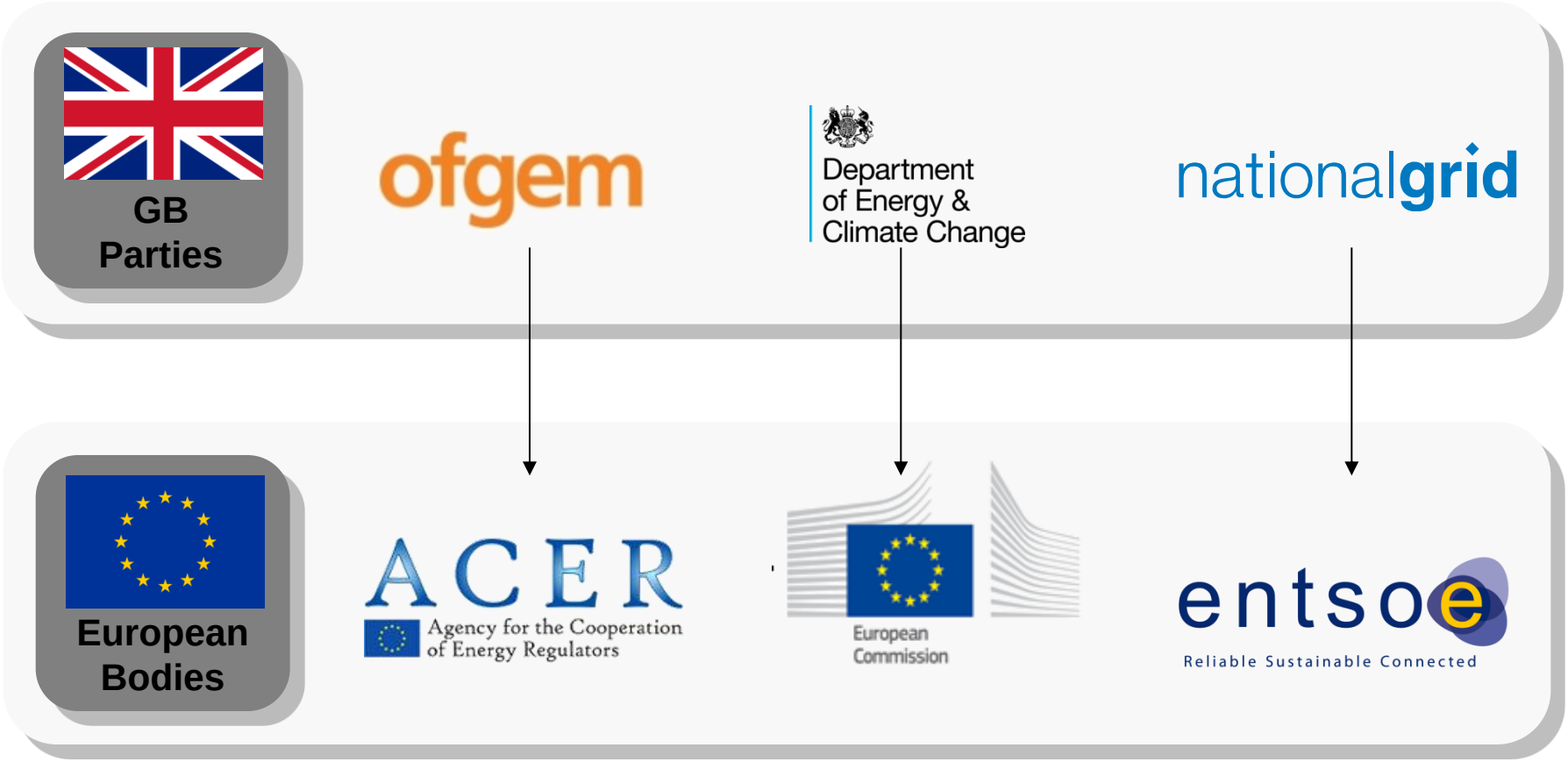
The key players in ENC Development



Note: The following are also members of ENTSO-E
For GB, SHET Plc, SPTL // For UK, SONI

Lessons Learnt on ENCs so far…

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GB Implementation Approach for Connection Codes

- Each EU member state needs to decide how to implement the European Network Codes (ENC) locally
- In GB there were three approaches considered:
  1. DECC led legislative approach
  2. Ofgem led Third Package powers to direct changes
  3. Industry-led – via existing Code modification processes
- For the Connections suite of ENC – RfG;DCC;HVDC approach **three** was agreed between DECC/Ofgem and NGET
- This was agreed in Q1 2014 following engagement through the Code Panels and groups like ECCAF

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Advantages of Using Existing Codes Processes

- Familiarity in using code governance routes and their support processes (e.g. modification workgroups/industry consultations etc.)
- Utilises close GB working relationships between DECC/Ofgem/NGET and the wider industry; acknowledging that better representation for smaller-scale generators is necessary
- Wide range of technical experts and regulatory knowledge already engaged in GB code governance, and strong awareness of European codes
- Strong and supportive governance from Code Panels, for oversight of any workgroup/consultation and code implementation work

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GC0048 RfG workgroup successes to date

- Well attended by industry
- Project Plan for implementation; a GB Risks Register
- Proposed structure for work packages to set national parameters stipulated in RfG
- Preparatory work on items requiring Cost-Benefit Analysis
- Proposals for structural changes to the D-Code, as well as new supporting documents [presentation to follow]

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GC0048 RfG workgroup challenges to date

- Getting continued industry engagement on key issues, particularly from smaller parties (e.g. Solar)
- Ensuring timely completion of stakeholder actions
- Potential for resource stretching for all workgroup parties across multiple work streams
- Resolving difficult topics (e.g. generator banding thresholds) in a timely manner

Additional benefits of GC0048 approach

- Has filled a vital role in coordinating GB stakeholder engagement on RfG to influence the Commission via ACER
- Progress on code implementation – GB are ahead of all other member states
- Have built a genuinely collaborative approach to finding the best GB solution for all parties

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MODIS lessons learnt

- The Commission Regulation (EU) No 543/2013 sets out electricity market data items required to be published on Central European Transparency Platform
- This better enables EU market participants to take efficient production, consumption and trading decisions
- MODIS was the chosen platform for GB, and went live in January 2015
- A report on the key learning points from this NGET lead-implementation is available here:
- http://www2.nationalgrid.com/Transparency-Regulation-Electricity.aspx

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Application of HVDC

Antony Johnson

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Topics

- Purpose and Scope of HVDC Code
- Plant covered by HVDC Code
  - Exclusions
- Summary of the Technical Requirements
- Applicability to existing HVDC Systems and DC Connected Power Park Modules
- Implementation Issues
- Next Steps

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Code Purpose

- Sets rules and requirements for HVDC systems and DC-connected PPMs
- Contributes to system security and facilitates the use of renewable generation
- Promotes coordinated development of HVDC infrastructure
- Facilitates competition in the European internal electricity market

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Scope of HVDC Code

- Article 3 defines what the requirements of this Regulation apply to:
  - HVDC Systems connecting synchronous or control areas including back to back schemes.
  - HVDC Systems connecting Power Park Modules to a Transmission network or distribution network (as per Article 2(2).
  - Embedded HVDC Systems within one control area and connected to the Transmission Network
  - Embedded HVDC Systems within one control area and connected to the distribution network when a cross border impact is demonstrated by the Relevant TSO. The Relevant TSO shall consider the long term development o the network in this assessment.
- Note exclusions in Article 3; Clauses 2 – 7 (see next slide)
- Existing Plant is covered under Article 4 (see slides 32-33)

Exclusions (Article 3; Clauses 2–7)

- Article 3(2) – Application of Regulation for DC Connected Power Park Modules connected to a Transmission or Distribution network which is not part of a synchronous area. All AC collected Power Park Modules which are DC Connected are covered by this regulation.
- Article 3(3) – Articles 55 to 59, 67 to 72 and 82 shall not apply to HVDC Systems within one control referred to in Article 2(1) (c) and (d) - ie HVDC Systems owned by the Relevant TSO, and/or entities which exercise control over the Relevant TSO
- Article 3(4) – Requirements applicable under Title II shall apply at the AC Connection Points except Articles 29(4), 29(5) (modelling / mitigation of other plants), 31(5) (modelling / mitigation regarding SSTI) and 19(1) (fast fault current at the terminals of the HVDC Converter Station.
- Article 3(5) – Requirements for DC Connected Power Park Modules and Remote end HVDC Converter stations covered in Title III shall apply at the HVDC Interface Point except Articles 39(1)(a) and Article 47(2) (frequency signal transfer).
- Article 3(6) – Refusal to connect a new HVDC System or DC Connected Power Park Module which does not comply with the requirements or does not have a derogation
- Article 3(7) – The regulation shall not apply to:
  - HVDC Systems whose connection points are below 110kV unless a cross boarder impact is demonstrated;
  - HVDC Systems or DC Connected Power Park Modules connected to the transmission or distribution system which are not operated synchronously with a Member State Synchronous Area

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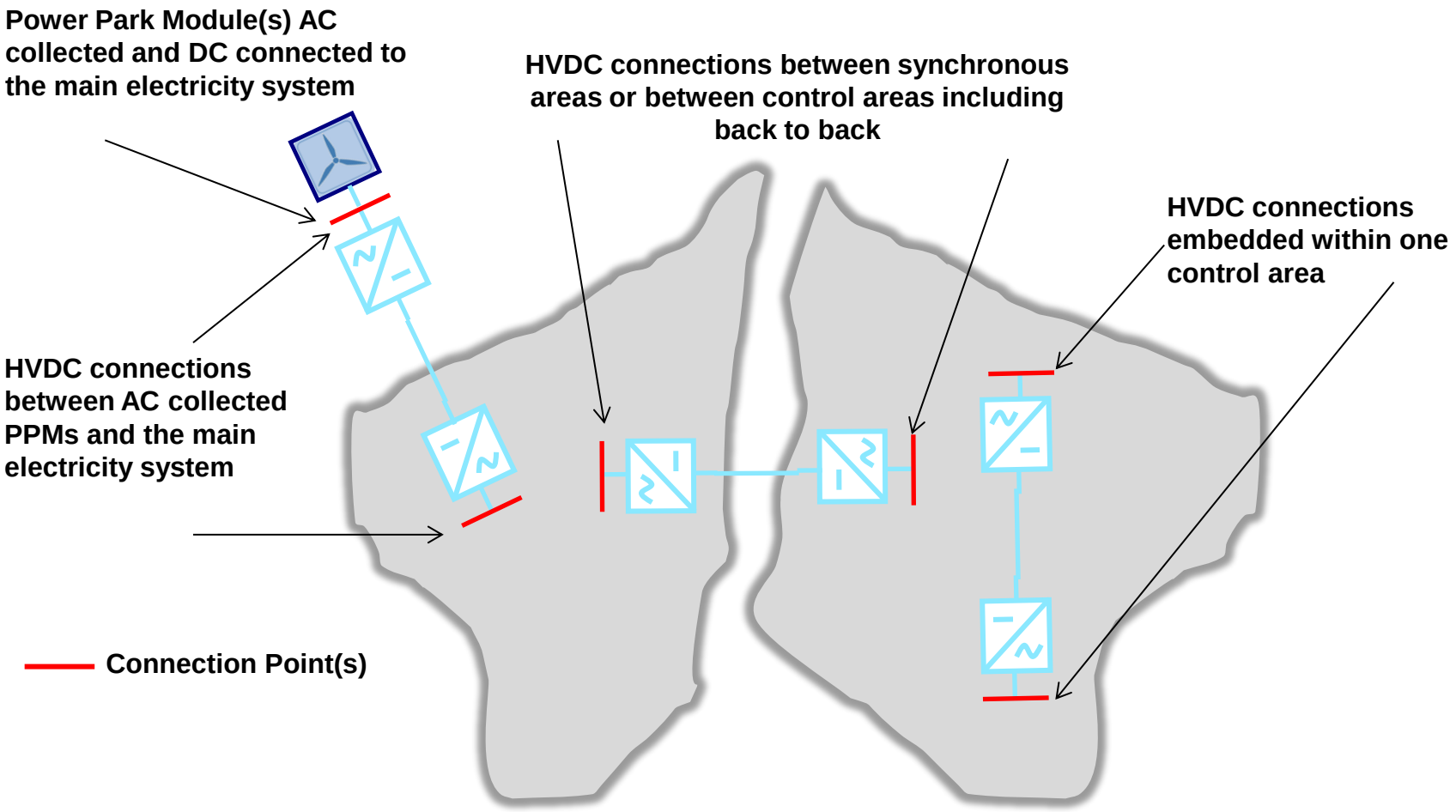
Preliminary Scope – Significant Grid Users



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The requirements at a high level

- Title II – General Requirements for HVDC Connections
- Title III – Requirements for DC Connected Power Park Modules and Remote End HVDC Converter Stations
- Title IV – Information and Coordination
- Title V – Operational Notification Procedure for Connection
- Title VI – Compliance
- Title VII – Derogations
- Title VIII – Final Provisions
- Annex – Technical Parameters

Title II - Technical Requirements applicable for HVDC Connections (1)

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- Frequency Range
- Rate of Change of Frequency Withstand
- Active Power Controllability, control range and ramping rates
- Synthetic Inertia
- Requirements relating to frequency sensitive mode, limited frequency sensitive mode and under frequency
- Frequency Control
- Maximum loss of Active Power
- Voltage Range
- Short contribution during faults and fast fault current injection
- Reactive Power Capability
- Voltage Control / Reactive Power Control or Reactive Power Control

Title II - Technical Requirements applicable for HVDC Connections (2)

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- Priority of Active or Reactive Power Contribution
- Power Quality
- Fault Ride Through
- Post Fault Active Power Recovery
- Fast Recovery for DC Faults
- Energisation and Synchronisation of HVDC Converter Stations
- Interaction between HVDC Systems and Other Plant / Equipment
- Power Oscillation Damping
- Subsynchronous Torsional Interaction Damping Capability
- Network Characteristics
- HVDC System Robustness
- Electrical Protection Schemes and Settings
- Black Start

Title III - Requirements for DC-Connected Power Park Modules

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- Frequency Stability Requirements, Frequency Ranges, Rate of change of Frequency Withstand and Frequency Response
- Reactive Power and Voltage Requirements
- Control Requirements
- Network Characteristics
- Protection Requirements
- Power Quality
- General system management requirements applicable to DC connected Power Park Modules

Title III Requirements for Remote End HVDC Converter Stations

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- Frequency Stability requirements
- Reactive Power and Voltage Requirements
- Voltage Ranges
- Network Characteristics
- Power Quality

Title IV - Information Exchange and Coordination

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- Operation of HVDC Systems
- Parameters and Settings
- Fault Recording and Monitoring
- Simulation Models

Article 4 – Application to existing HVDC Systems and DC-Connected Power Park Modules (1)

- Except for Articles 26, 31,33 and 50 existing HVDC Systems and existing DC connected power park modules are not subject to the requirements of this regulation unless:
  - The HVDC System or DC Connected Power Park Module has been subject to modernisation of plant or replacement which affects its technical capabilities
  - If the Relevant TSO considers the extent of the modernisation or replacement requires a new connection agreement
- The Regulatory Authority or Member State decide if the existing connection agreement needs to be revised or a new connection agreement is required and which requirements of this regulation shall apply.
- A Regulatory Authority or where applicable a Member State decides to make an existing HVDC System or existing Power Park Module subject to all or some of the requirements of this Regulation following a proposal from the relevant TSO in accordance with paragraphs, 3, 4 and 5.

Article 4 – Application to existing HVDC Systems and DC-Connected Power Park Modules (2)

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- An HVDC System or DC Connected Power Park Module shall be considered existing if:
  - It is already connected to the network on the date of entry into force of this Regulation or
  - The HVDC System Owner or DC Connected power park module owner has concluded a final and binding contract for the purchase of main generating plant or HVDC equipment by two years after entry into force of the Regulation.
  - The regulation may be applied to existing HVDC Systems and DC Connected Power Park Modules subject to a public consultation and backed up by a cost benefit analysis.
  - Before carrying out a cost benefit analysis the TSO shall carry out a preliminary comparison of costs and benefits and obtain approval from the relevant regulatory authority.
- The Relevant Regulatory shall decide on the extension of the applicability of this regulation to existing HVDC systems or DC Connected Power Park Modules within 6 months of receipt of the report
- The Relevant TSO shall take account of the legitimate expectations of HVDC System Owners and DC Connected Power Park Modules as part of the assessment of the application of this Regulation to existing HVDC Plant and DC Connected PPM's
- The Relevant TSO may assess the application of some or all of the provisions of this Regulation to existing HVDC Systems or DC Connected Power Park Modules every three years in accordance with the criteria and process set out above

Implementation Issues

- The GB Grid Code currently defines the technical requirements and then the type of plant that should meet that requirement, e.g. Reactive Capability, Frequency Response etc.
- RfG classifies each Generator and the requirements that apply to each of them dependent upon size and type
- It is important that the code is made as easy as possible to interpret and understand. It therefore seems appropriate to have a separate section in the Grid Code which defines the requirements applicable to HVDC Converters and HVDC Connected Power Park Modules

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Next Steps

- Consider the detail of the technical requirements
- Consider how the requirements will implemented into the GB Code
  - Are there consequential GB code changes elsewhere?
- Should the technical issues be categorised into Subgroups as per RfG (e.g. Frequency, Fault ride through, voltage etc.)?
- Note interactions with RfG Network Code (and DCC?)

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HVDC Project Plan

Celine Reddin

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HVDC implementation overview

	2015		2016				2017				2018				2019
	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1
Code Approved	SEPT														
Entry Into Force			MAR												
Implementation			2 YEARS												
Compliance Deadline															MAR

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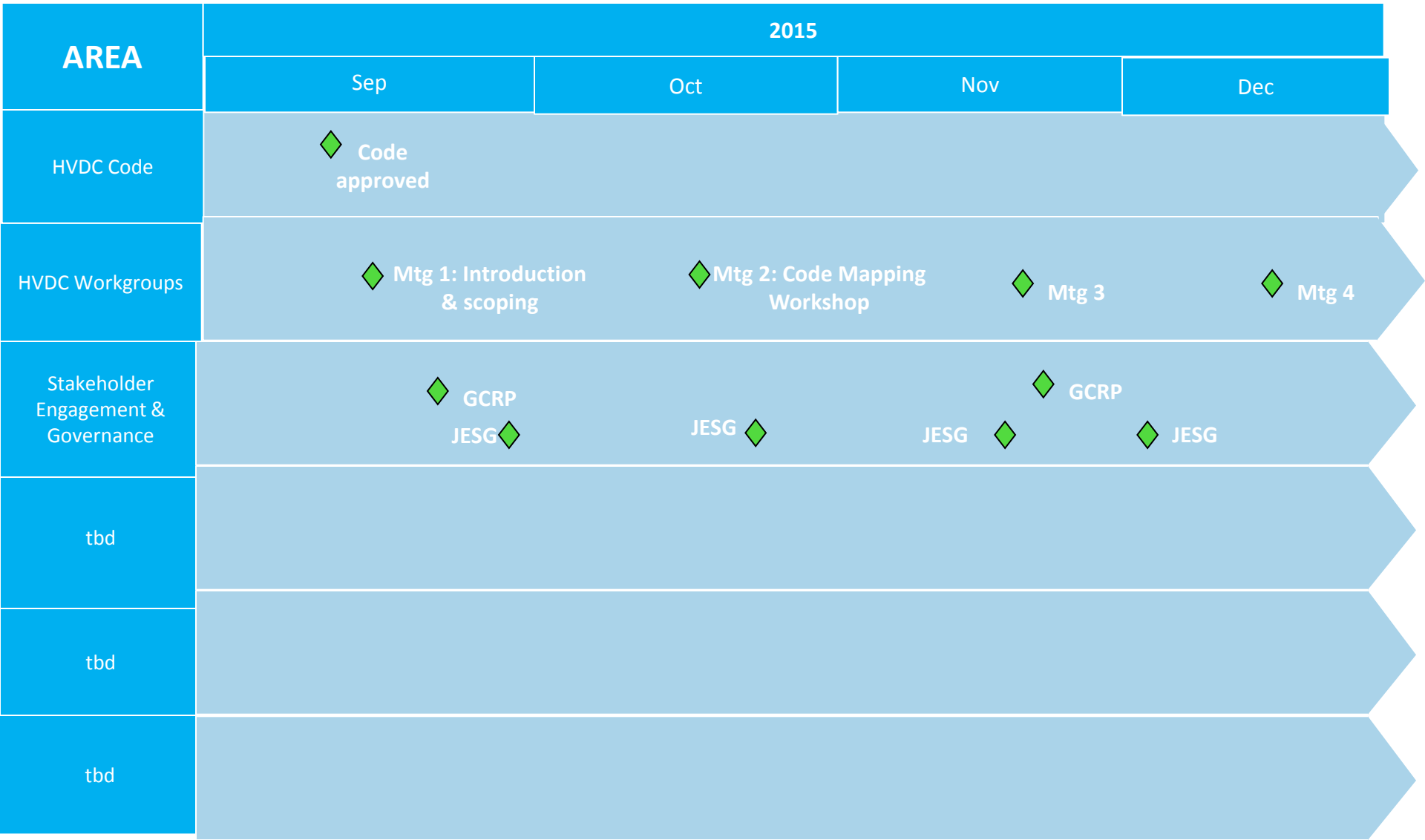
HVDC – Plan on a page



Useful dates - 2015

	September	October	November	December
HVDC Workgroup	18th September	*21st October**	*18th November**	*11th December**
GCRP	16th September	n/a	25th November	n/a
JESG	29th September	20th October	17th November	2 December

* Provisional dates

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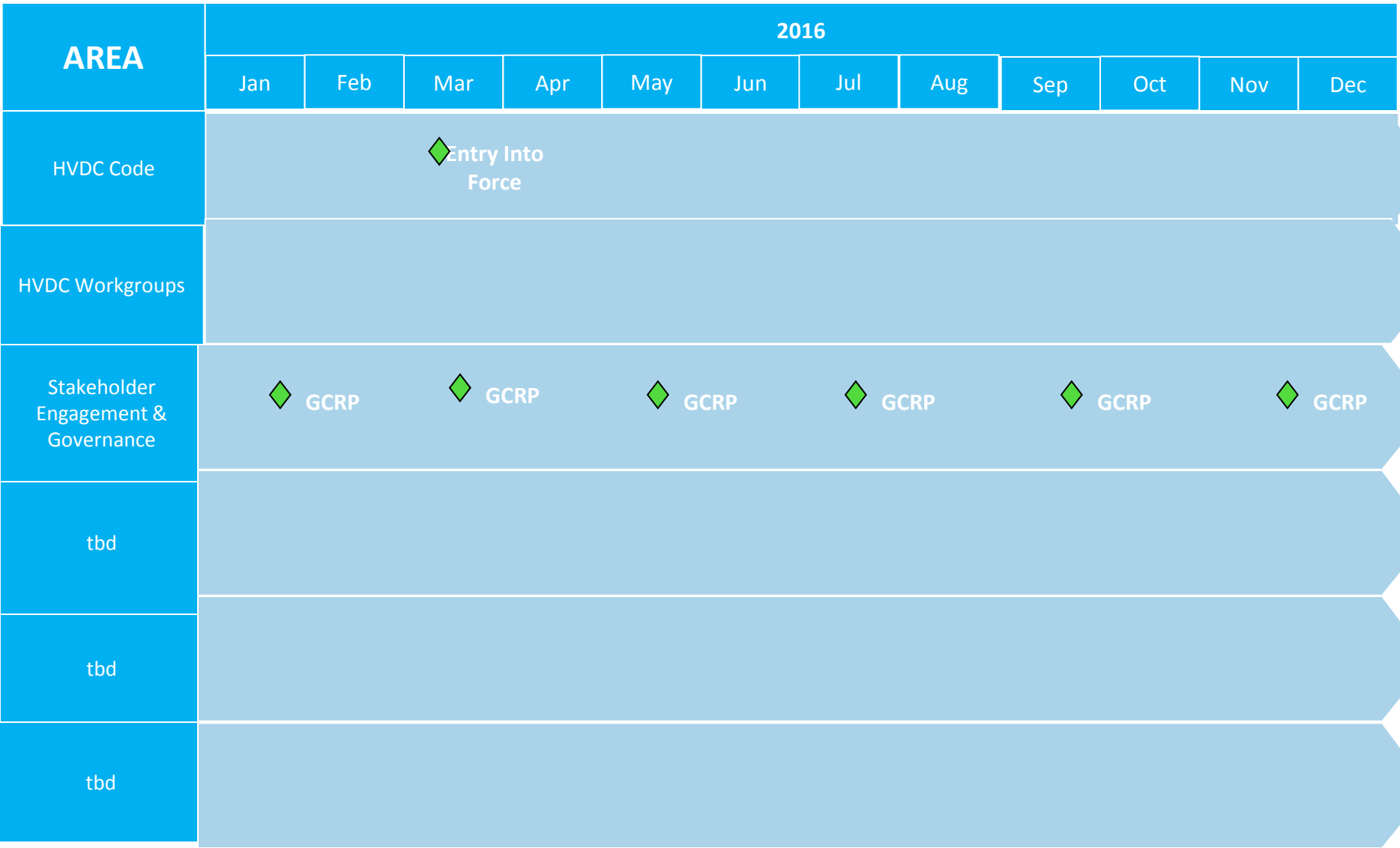
HVDC – Plan on a page



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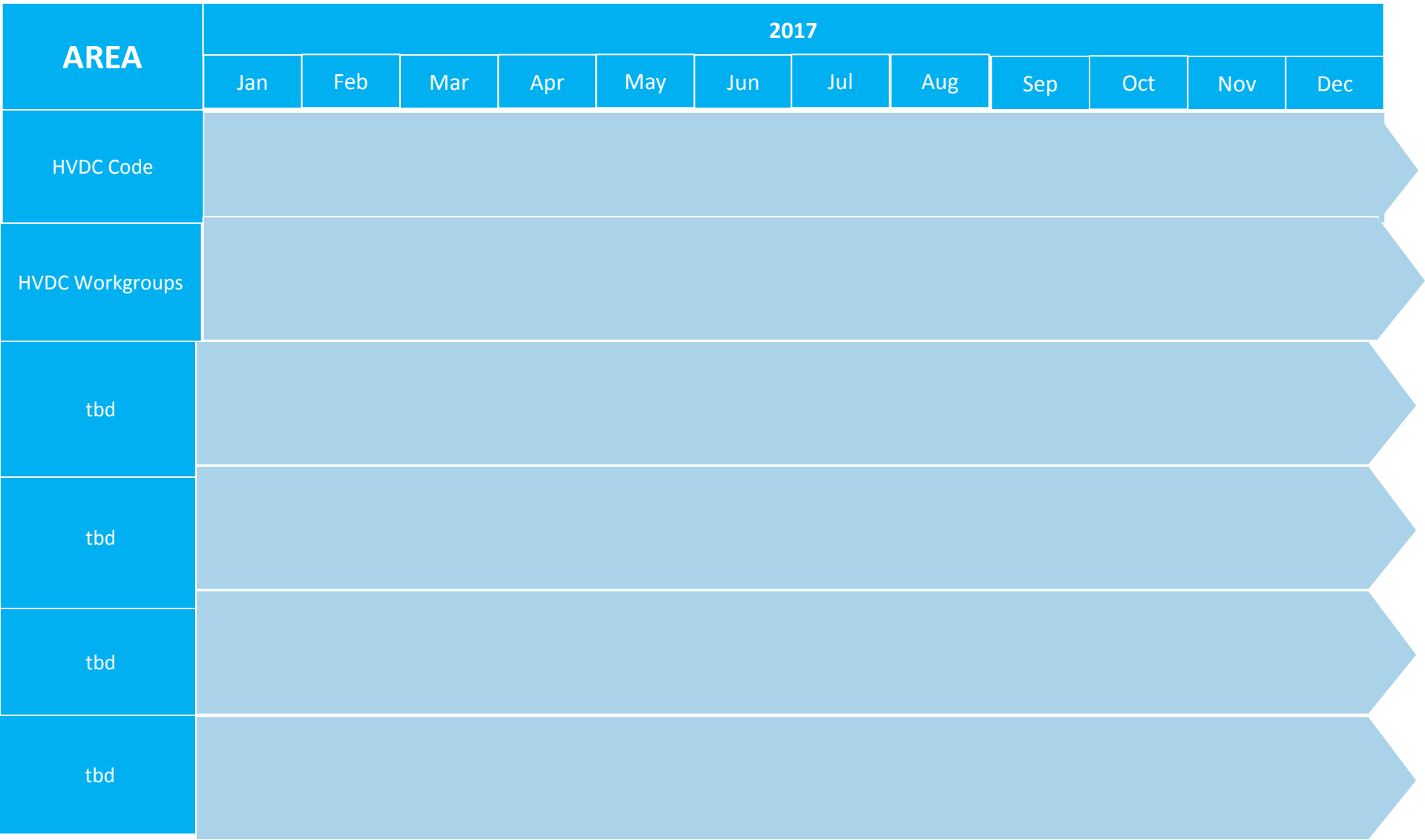

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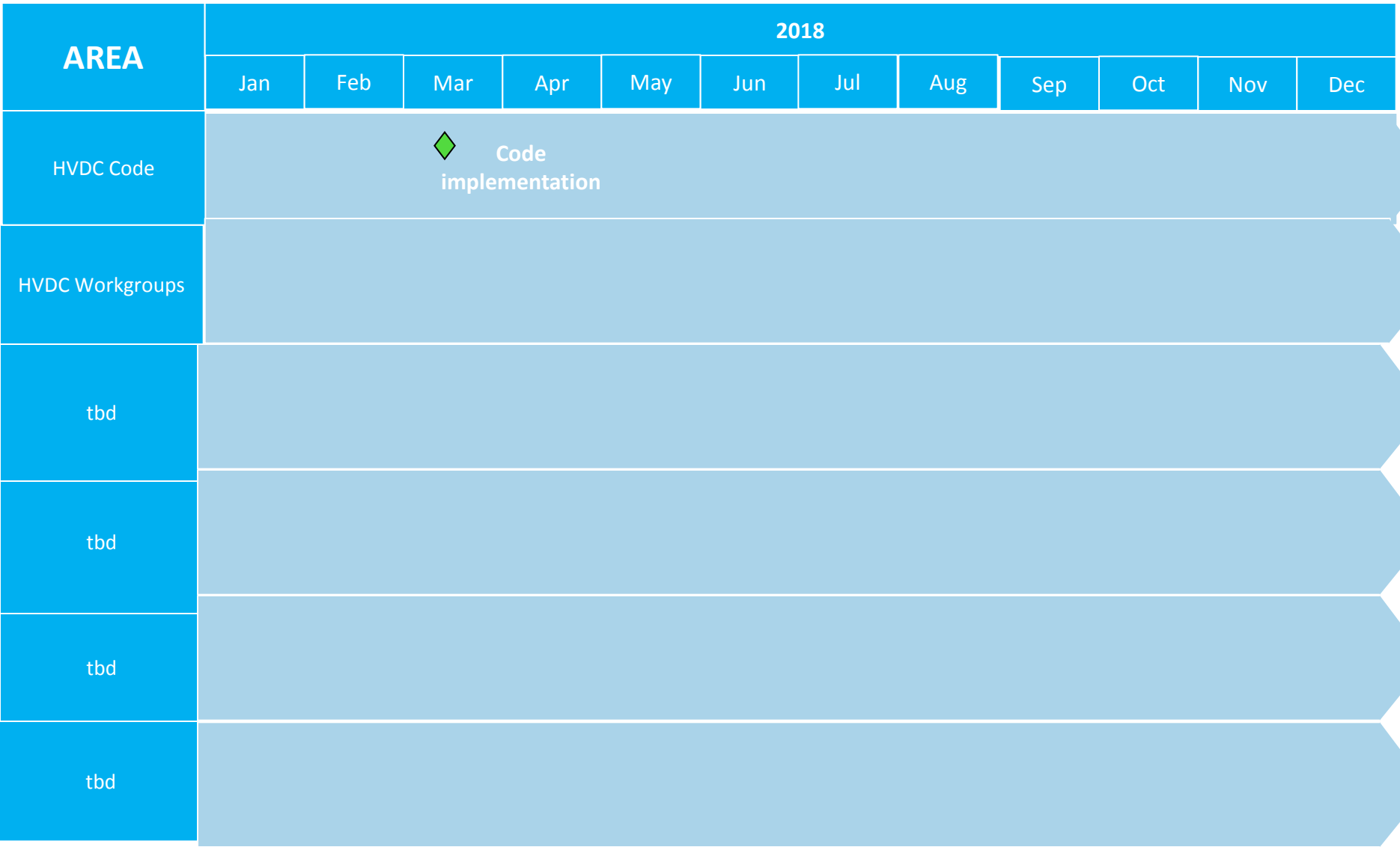

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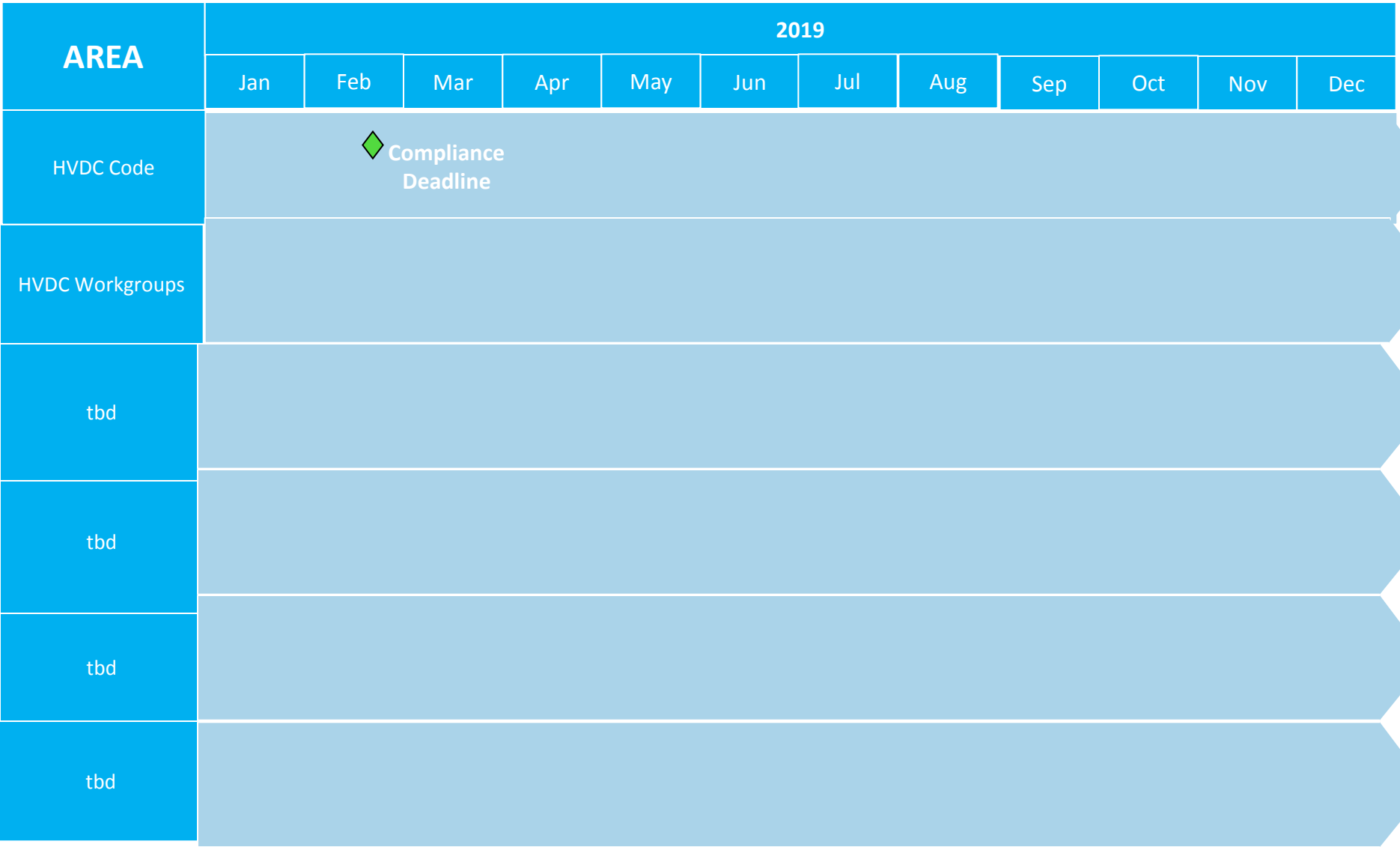

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Future meeting date proposals

2015

- Weds 21st October (Code Mapping workshop?)
- Weds 18th November
- Fri 11th December

2016

- Weds 27th January
- Weds 24th February
- Weds 23rd March