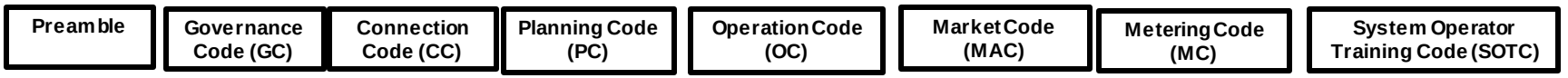
ADB & World Bank: GMS Power Market Development

Regional Grid Code Development

RPTCC-24 Presentation
Dr Graeme Chown
Naypidaw, 19th June 2018

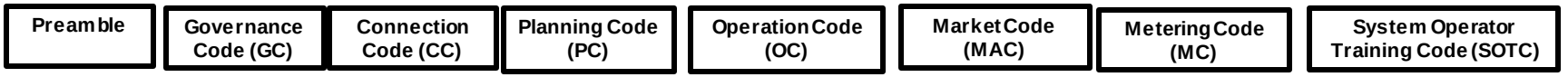
Agenda

- Summary of comments received on GMS Grid code sections
  - Preamble
  - Governance
  - Connection Code
  - Market Code
  - Training Code
- Planning Code discussion and summary of need of a Regional Planning Code in the GMS Grid Code



Progress to date for codes under WB project

Activity	Status
▪ Preamble	Version 0.3
▪ Governance Code	Version 0.4
▪ Connection Code	Version 0.4
▪ Market Code	Version 0.2
▪ Operations Training Code	Version 0.2
▪ Planning Code	To be decided



Code Document 1: Preamble

The document provides the context for the Regional Grid Code and its various sub-sections

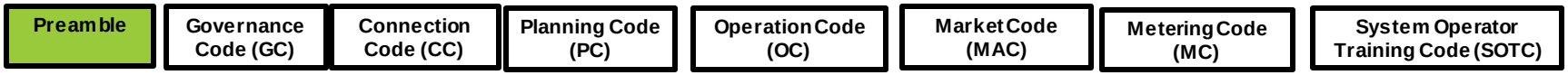
Key elements of the document

1. Background on Regional Power Trade in the GMS
   - Objectives for Regional Power Trade
   - Regional and National Grid Code Relationship
   - Separate Synchronous Areas
2. Legal Authority
   - Legislation
   - Applicability
3. Regional Grid Code
   - Definition
   - Need for a Grid Code
   - Objectives
   - Grid Code Overview
4. Glossary
   - Definitions
   - Acronyms / Abbreviations
5. Notices and domicile

Preamble	Governance Code (GC)	Connection Code (CC)	Planning Code (PC)	Operation Code (OC)	Market Code (MAC)	Metering Code (MC)	System Operator Training Code (SOTC)

Preamble – summary of comments

#	Comment	Consultants review and Recommendation
1	Grid code definitions aligned with set of glossary terms in Policy 5	Definitions have been aligned and included in draft version 0.3 Definitions to be removed from preamble as there is a separate glossary of terms document
2	What is the relation between Policies and Section of GC. How we could harmonize and take into account the contents of Policies in RGC?	Policies will be converted to form the grid code.
3	Relationship between National GC and RGC. What happen as the NGC and RGC have the gaps, conflict, etc?	The regional grid code is for all equipment that impacts interconnected operations and has precedence over NGC. NGC will need to be aligned where RGC is stricter than NGC and the requirement impacts interconnected system. Where NGC is stricter then no mandatory change is required unless the RGC.



Preamble – summary of comments

#	Country Comment	Consultants review and Recommendation
4	We suggest the following content should be considered in the grid code: (1)risk evaluation and control; (2)demand for protection and system stability devices; (3) demands for communication devices.	(1) Risk is covered in system operations planning and security codes (2) Demand protection will be covered in demand connection code (3) Communications is covered in Operations Code
5	The development of RE is orientation and direction of each GMS country, hence the GMS Grid Code should take into account the technical requirements for RE, particularly wind and solar energy	Connection code section 3 covers DC connected power plant modules and has as much detail as is in the European Grid Code
6	In GMS Grid Code, it mentioned about the technical requirements, so what is relation and harmonization between technical performance and technical requirements	Technical performance is covered in many places – please provide examples of where technical performance is missing

Code Document 2: Governance Code (GC)

This document sets out how the regional Grid Code will be maintained and a process to update

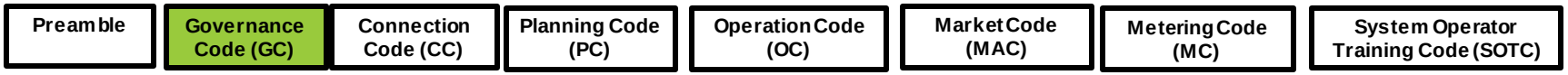
Key elements of the document

1. Regional Grid Code Overview
2. Administrative Authority
3. The Regional Grid Code Review Panel
   - Constitution of the GCRP
   - Functioning of the GCRP
   - The Regional Grid Code Secretariat
4. Regional Grid Code Participants
5. Regional Grid Code Amendment and Exemption Procedure
   - Changes to the Grid Code
   - Submissions to the GCRP
   - Recommendations by GCRP to the RPTCC
   - Approval by RPTCC
6. Dispute mediation, resolution and appeal mechanisms
7. Compliance
8. Regional Grid Code Violations and Sanctions
9. Code Audits
10. Version Control

Preamble	**Governance Code (GC)**	Connection Code (CC)	Planning Code (PC)	Operation Code (OC)	Market Code (MAC)	Metering Code (MC)	System Operator Training Code (SOTC)

Governance Code – summary of comments

#	Comment	Consultants review and Recommendation
1.	Add 'Inter-Governmental Memorandum of Understanding for the Establishment of the Regional Power Coordination Centre in the Greater Mekong Subregion,'	Text added in version 0.3
2.	Change RPTCC to RPCC board	Text added in version 0.3
3.	We suggest more than 1 person for each TSO can join the Grid Code Review Panel, because the review work scope is very comprehensive which is more than 1 person can handle.	The person appointed by each TSO ensures the relevant person in their organization reviews and comments on proposed change. Grid Code Review Panel can co-opt Technical Groups, Working Groups or experts for detailed assessment, clarification, reformulation and/or recommendation to assist with reviewing changes as per section 7.2 (6a).
4.	Increase the term of office of a Member from two to three years	Accepted – changed in version 0.3



Code Document 3: Connection Code (CC)

This document sets connection conditions for Generators, HVDC connections including DC connected generators and demand connections

Key elements of the document

1. Requirements for Generators (RfG)

Frequency tolerance, active power and frequency control requirements, voltage tolerance, voltage control and reactive power provision, fault ride through capability, protection requirements, system restoration, islanding and black start capability, information requirements, connection and testing requirements

2. High Voltage Direct Current Connections (HVDC)

Frequency tolerance, active power and frequency control requirements, active power controllability, control range and ramping rate, provision of synthetic inertia, voltage tolerance, voltage control and reactive power provision, fault ride through capability, short circuit contribution during faults, power quality, protection requirements, control requirements and synchronisation requirements, system restoration, islanding and black start capability, information requirements and connection and testing requirements

3. Demand Connection

Frequency tolerance, active power and frequency control requirements, voltage tolerance, voltage control and reactive power provision, short circuit requirements, reactive power requirements, protection requirements, control requirements, information requirements, demand disconnection or demand connection and power quality

Connection Code - Summary of Comments

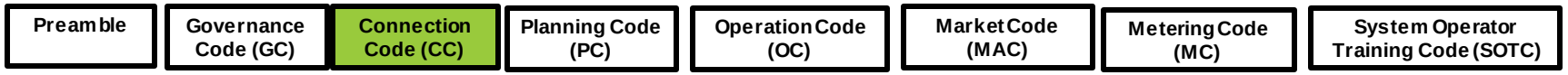
#	Comment	Consultants review and Recommendation
1.	Changes requested to GMS Performance Standard agreed figures. Including frequency, voltage, fault-ride through, short circuit and plant size	No changes made to these values as they have been agreed
2.	Table of Under Frequency Relay Setting should be added.	Table 4.2 added with proposed Under Frequency Relay Settings
3.	Connection Code is a very detail document for Regional Interconnection	Understood but this is in line with international best practice. Specifically when IPP's, ITC's and independent Demands are part of the interconnected system and trading in GMS.
4.	We suggest PMU(Phase Measure Unit) should be installed in power plant where type C and D generators connected to system above 230kV.	Agree – section 2.2.2 (11) and section 3.2.2 (11) added to version 0.3

Connection Code - Summary of Comments

#	Comment	Consultants review and Recommendation
5.	AGC (automatic generation control) function should be necessary for type C and D generator. Furthermore, the amount of AGC capacity should be defined, such as not less than 40%. .	Agree – text added to section 2.2.2 (10) added to version 0.3
6.	How about the requirements for RE (wind and solar); we do not think the technical requirements is similar to traditional generations	Agree this is stipulated in section 3.1 DC (non-synchronously) connected power park modules.
7.	Could you pls explain the requirements of Type A in the table. As far as understand that type A will not be required to provide FC?	Most international standards requires mandatory primary frequency response for all units above 50.5 Hz.

Connection Code - Summary of Comments

#	Comment	Consultants review and Recommendation
8.	What are differences between HVDC connection and AC?. Would you pls show us	There are a few changes. Section 3.3 Synthetic inertia, section 3.5 short circuit fault contribution, Section 3.6 power oscillation damping, section 3.9 power quality and harmonic damping, some protection requirements in section 3.10 being the main – the main thing is that the same frequency and voltage criteria.
9.	Should we have detailed regulations for customers connection?; we are not sure that how much influence the customer/demand to interconnection grid?. The consultant is requested to clarify and explain for us	Large consumers that can impact interconnection must meet requirements plus customers that are members of GMS – size of demand to be decided upon
10.	Add: - For the case that the relay protection of power-generating facility owner need to connect with Grid relay protection, the relay protection of power-generating facility owner must satisfy the TSO requirement and have the acceptance of SO. - The reliability of relay protection must not less than 99% - Power plant must have FR with GPS - Power plant bigger than 300MW must have PMU with GPS Line that connect the Power plant connecting to 220kV grid must have 2 separate communication channel for Relay protection.	Agree. Version 0.4 updated. Paragraph 2.5 (5) added for protection relay requirements Paragraph 2.5 (6) added with fault recorder and PMU requirements



Connection Code - Summary of Comments

#	Comment	Consultants review and Recommendation
11.	It should have the regulation in detail regarding to dynamic performance test of excitation system, especially the test of PSS behavior (refer to WECC, NERC regulation) What is the role of SO in the tests? such as the requirement of excitation and governor controller	Agree please provide the relevant test requirements. We can reference the tests in NERC or IEEE. To be discussed at next meeting. The SO can be a witness or participate in tests (section 2.8 (5)) SO is required sign off that the tests demonstrate grid code compliance. (section 2.8 (6)) SO can request additional tests (section 2.8 (7))
12.	Should add requirement for Total Harmonic Distortion	Agree - Section 4.10 (3) added with reference to IEC 61000 - 4.
13.	Should add article on monitoring harmonic after commissioning of DC-connected power park modules	Agree - Section 4.10 (4) added with reference to IEC 61000 - 4.

Code Document 6: Market Code (MC)

This code contains a set of operational requirements for the GMS Market including Capacity Allocation and Congestion Management, Forward Capacity Allocation, and Electricity Balancing.

Key elements of the document

1. Capacity Allocation and Congestion Management Code

The Capacity Allocation and Congestion Management Code sets out non-discriminatory rules for access conditions to the network for cross- border exchanges in electricity and, in particular, rules on capacity allocation and congestion management for interconnections and transmission systems affecting cross-border electricity flows.

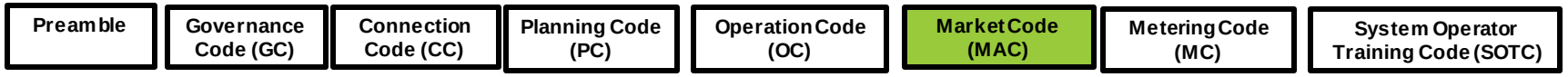
2. Electricity Balancing Code

The Electricity Balancing Code establishes a GMS-wide set of technical, operational and market rules to govern the functioning of electricity balancing arrangements. It sets out rules for the procurement of balancing capacity, the activation of balancing energy and the financial settlement of balancing energy. The Electricity Balancing Code provides balancing and imbalance rules for the cases with and without a day-ahead market / intraday market and with and without a balancing market.

Preamble	Governance Code (GC)	Connection Code (CC)	Planning Code (PC)	Operation Code (OC)	Market Code (MAC)	Metering Code (MC)	System Operator Training Code (SOTC)

Market Code - Summary of Comments

#	Comment	Consultants review and Recommendation
1	North American Electric Reliability Corporation (NERC) standard is proposed for determination of cause of imbalance energy in this section. The proposed methodology should be based on ENTSO-e instead of NERC as the previous codes are based on the ENTSO-e.	Disagree – The European code does not have performance criteria and this has led to a recent dispute between all members and Kosovo. No action could be taken against defaulting party. Similarly no performance criteria were in Gulf codes leading to many disputes. This was changed a few years ago.
2	Market Code needs to be reviewed by WGRI	Noted – document has been reviewed by WGRI consultant and Market Code should be sent to WGRI for their review



Code Document 8: System Operation Training Code (SOTC)

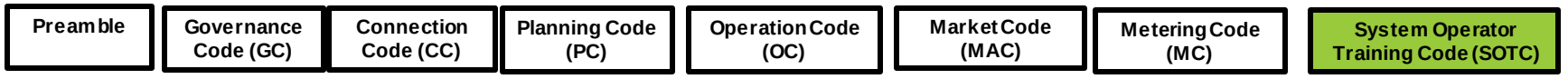
This code contains a set of operational training requirements for the operation for the GMS interconnected system.

Key elements of the document

1. Training Programs
   - Initial Training Program for new dispatchers including On-the-Job training
   - Continuous Training Program to keep and extend the *dispatchers'* knowledge and competences
2. Inter TSO Training

   Training with neighbouring TSO's including visits, common training courses and on-shift cross periods, meaning visits by neighbouring dispatchers for spending full real-time shifts
3. Training Organization and Dispatchers Accreditation

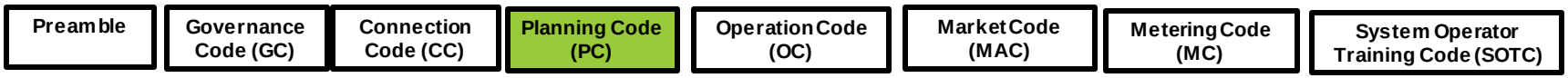
   Accreditation means a written endorsement of the proved qualifications of a person for the position of a dispatcher. The accreditation validity is subject to the dispatcher successfully completing continuous training
4. Basic requirements for Dispatcher Training Simulator



GMS Grid Code – Regional Planning Code Discussion

International Regional Planning Codes

- International regional planning codes set out the principles for planning and cover the following:
  - Planning process
  - Data and confidentiality thereof
  - Economic and security criteria
  - Project selection process
- Most National Grid Codes have Transmission Planning as part of the code
- Examples of international regional planning codes
  - ENTSO-e / ACER - Regulation No 347/2013
  - USA Regional Transmission Operator's – Federal Energy Regulatory Commission (FERC) Order 1000
  - East African Power Pool – Regional Grid Code



International Regional Planning Codes - Europe

Regulation No 347/2013 lays down guidelines for the timely development and interoperability of priority corridors and areas of trans-European energy infrastructure

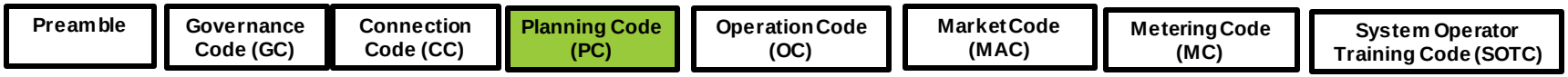
In particular, Regulation:

(a) addresses the **identification of projects of common interest** necessary to implement priority corridors and areas falling under the energy infrastructure categories in electricity, gas, oil, and carbon dioxide;

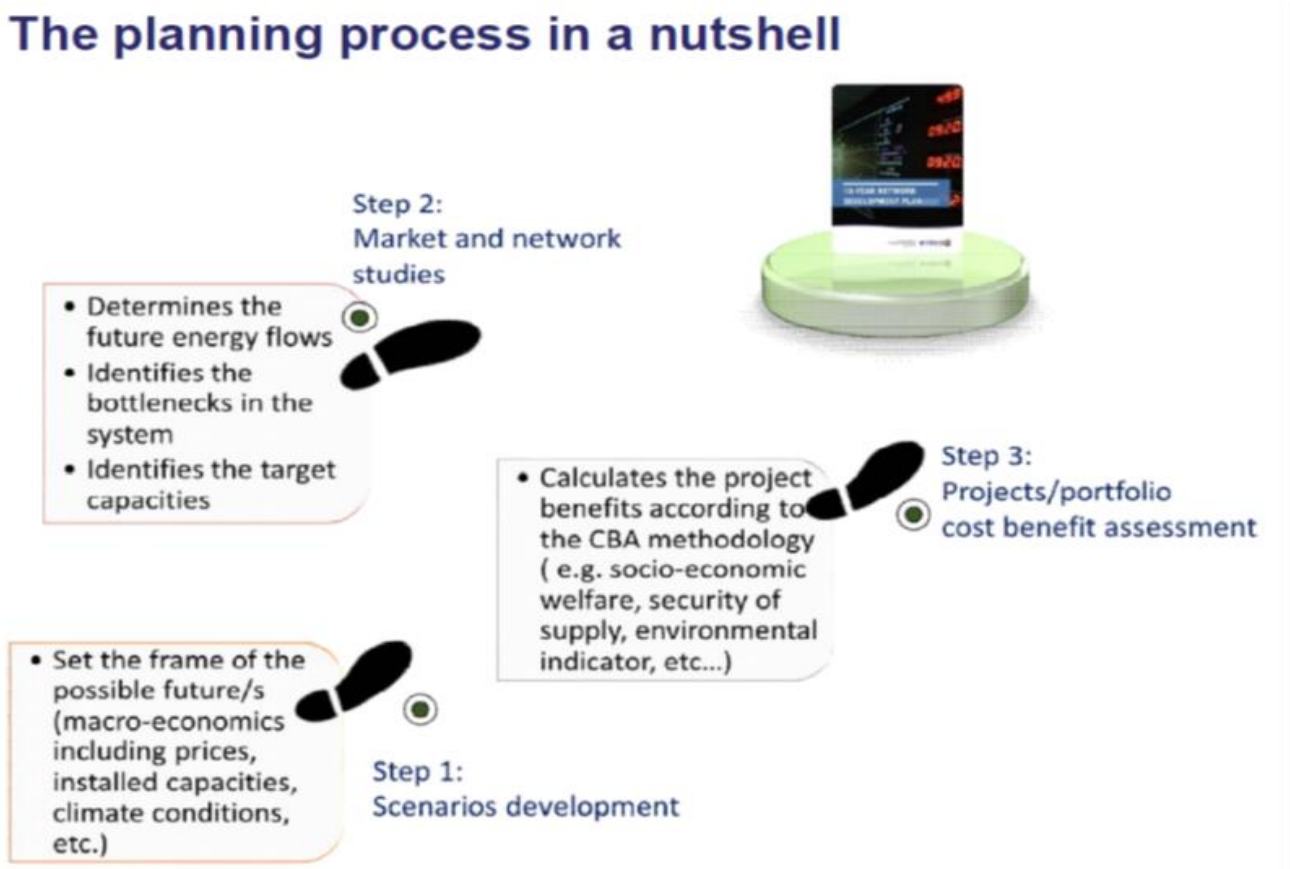
(b) facilitates the **timely implementation of projects of common interest** by streamlining, coordinating more closely, and accelerating permit granting processes and by enhancing public participation;

(c) provides **rules and guidance** for the cross-border allocation of costs and risk-related incentives for projects of common interest;

(d) determines the **conditions for eligibility of projects** of common interest for Union financial assistance.



International Regional Planning Codes - Europe

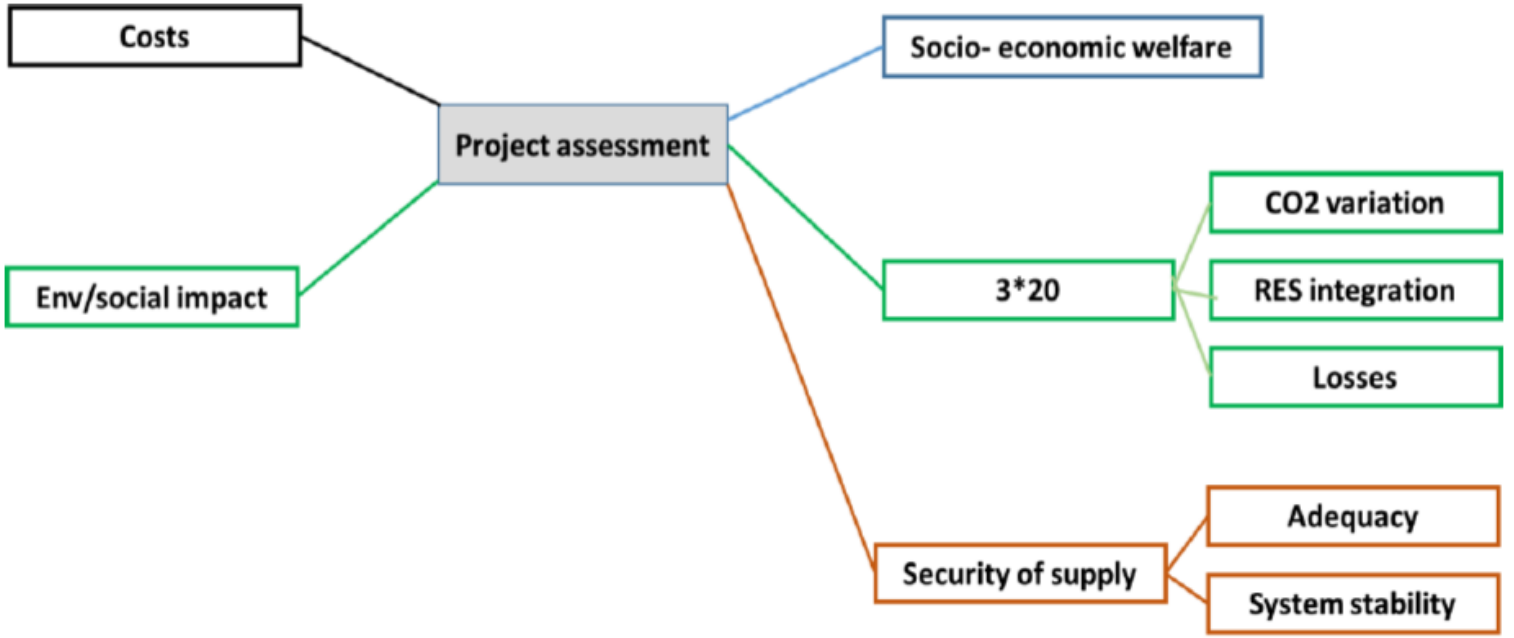


* Study on the Formation of the ASEAN Power Grid Generation and Transmission System Planning Institution (AGTP) literature report, TEPCO, March 2018

Preamble	Governance Code (GC)	Connection Code (CC)	Planning Code (PC)	Operation Code (OC)	Market Code (MAC)	Metering Code (MC)	System Operator Training Code (SOTC)

International Regional Planning Codes - Europe

- Cost Benefit Analysis



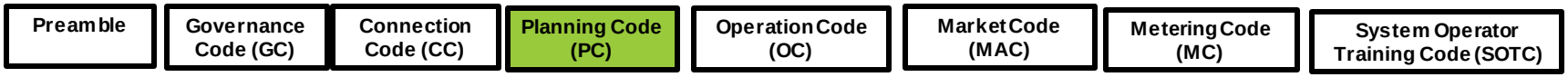
* CBA 2.0 Improving the pan-European cost-benefit analysis methodology, ACER Workshop K Wewering, May 2016

Preamble	Governance Code (GC)	Connection Code (CC)	Planning Code (PC)	Operation Code (OC)	Market Code (MAC)	Metering Code (MC)	System Operator Training Code (SOTC)

International Regional Planning Codes – USA

- FERC Order Nos. 890 and 1000*
  - Order No. 890, issued in 2007, outlined general requirements for local as well as regional transmission planning practices and procedures.
  - Order No. 1000, issued in 2011, laid out specific requirements for:
    (1) regional transmission planning;
    (2) consideration of transmission needs driven by public policy requirements;
    (3) non-incumbent transmission development;
    (4) interregional transmission coordination; and
    (5) cost allocation for transmission facilities selected in a regional transmission plan for purposes of cost allocation.

* U.S. Department of Energy (DOE), Annual U.S. Transmission Data Review, March 2018



International Regional Planning Codes – Western Electricity Coordinating Council (WECC)

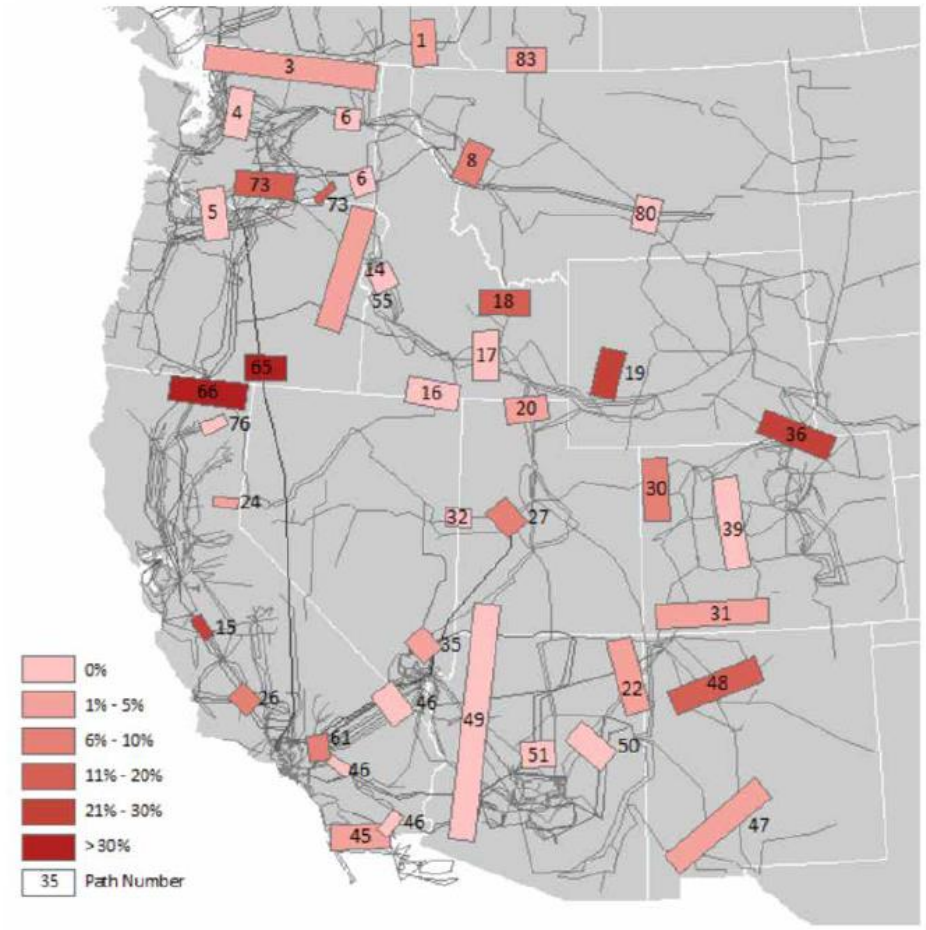
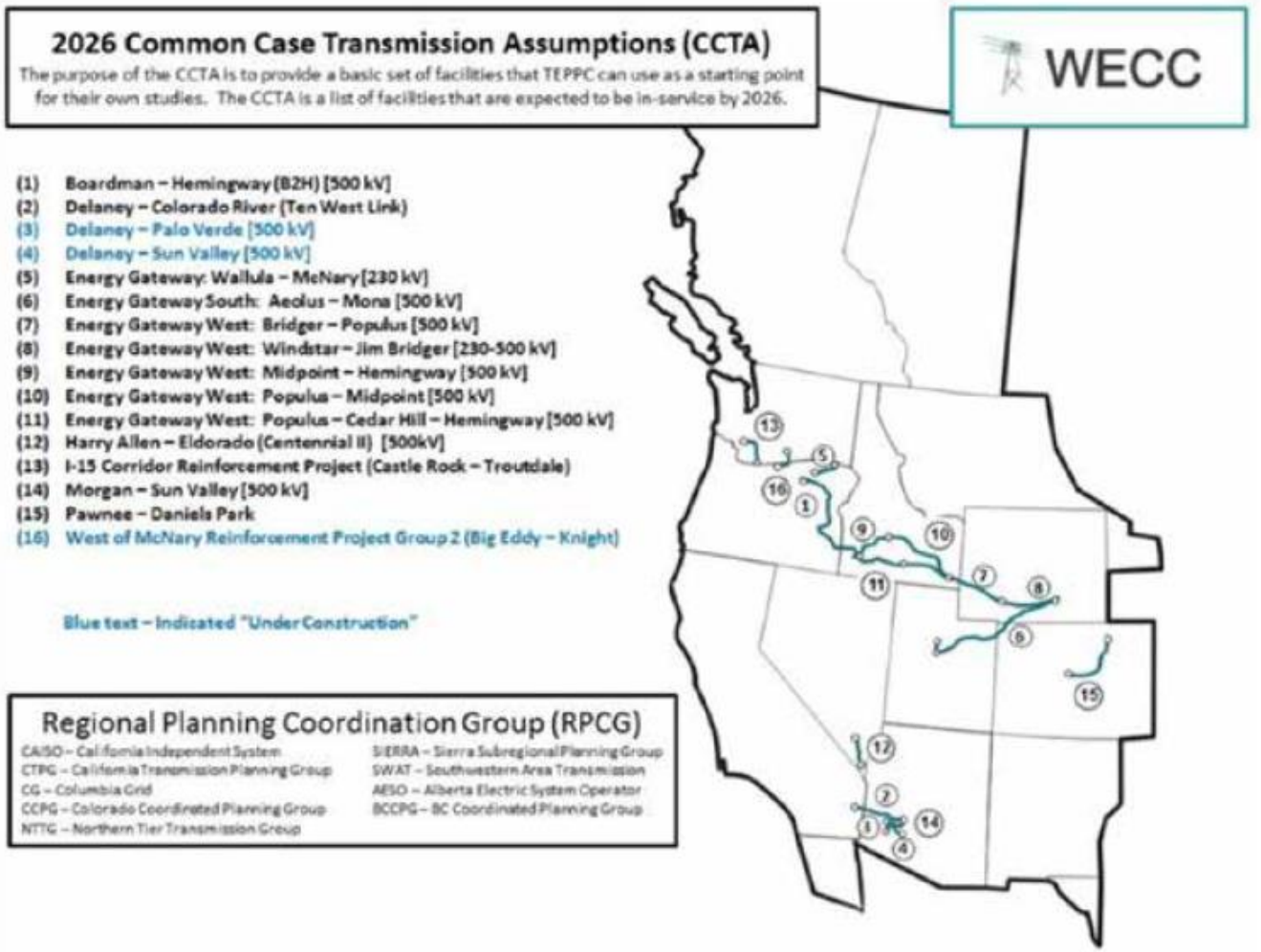


Figure 4-7. WECC Major Paths and U75 for 2016

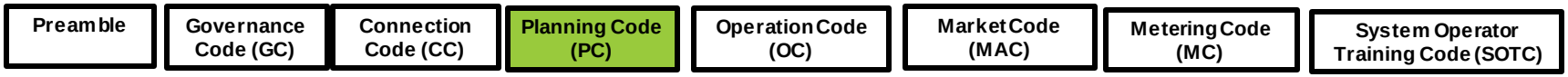
International Regional Planning Codes – Western Electricity Coordinating Council (WECC)



Preamble	Governance Code (GC)	Connection Code (CC)	Planning Code (PC)	Operation Code (OC)	Market Code (MAC)	Metering Code (MC)	Information Exchange Code (IEC)	System Operator Training Code (SOTC)

International Regional Planning Codes – East African Power Pool (EAPP)

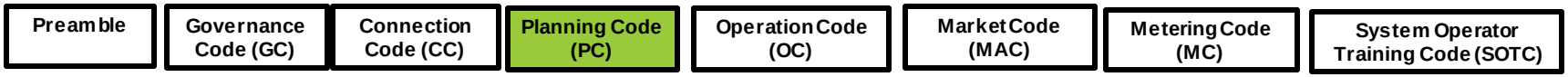
- The Planning Code (PC) specifies the minimum technical and design criteria, principles and procedures:
  - To be used within EAPP in the planning and in the medium and long term development of the Interconnected Transmission System of Eastern Africa;
  - To be taken into account by Member Utilities on a coordinated basis, and
  - To specify the planning data required to be exchanged by Member Utilities and EAPP Sub-Committee on Planning to enable the EAPP Interconnected Transmission System to be planned in accordance with the planning standards.



International Regional Planning Codes – EAPP

The Planning Code (PC) contents:

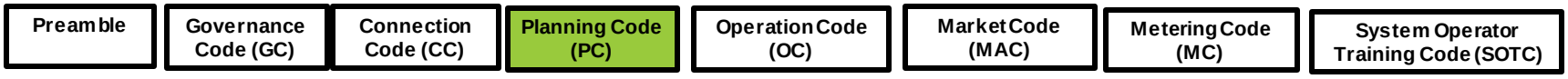
- Principles of the Planning Code - The planning principles are concerned with planning of the interconnection between *National Systems,* connections with *External Systems* and with those facilities within *National Systems* which have, or could have, an impact on the reliability of the *EAPP Interconnected Transmission System*.
- Reliability Criteria – N-1 (similar to system operations code) – no economic criteria
- The Planning Process – 10 year plan updated every 5 years
  - Power Balance Statement - A forecast, the *Power Balance Statement*, by *TSOs* for each *National System* of their expected demand and generation over the planning horizon. This forecast will define the requirements for generation support from the *EAPP. Interconnected Transmission System* for individual *National Systems*, and
  - Transmission System Capability Statement - An assessment, the *Transmission System Capability Statement* by *EAPP Sub-committee on Planning* and *TSOs* of the capability of the *EAPP Interconnected Transmission System* to support the required energy flows across both *National Systems* and cross-border interconnections.



International Regional Planning Codes – EAPP

The Planning Code (PC) contents:

- EAPP Power System Modelling
  - Responsibilities - system studies will be carried out by both the *EAPP Sub-committee on Planning* and the *TSOs* and shall be performed using a **common set of principles and a common database** … the *EAPP Sub-committee on Planning* shall establish a set of common objectives for the development and submission of system data for *EAPP* power system modelling.
  - Planning Data Confidentiality - System planning data shall be treated as **non-confidential** when the *EAPP Sub-Committees on Planning and Operations* and *TSOs* use such data:
    - In the preparation of forecasts, *Power Balance Statements* and *Transmission*
    - *System Capability Statements;*
    - For the planning of the *EAPP Interconnected Transmission System*;
    - To consider a Connection Application or provide advice to a *User;*
    - Under the terms of an Interconnection Agreement with an *External System*.



Code Document 4: Planning Code (PC)

This document specifies the minimum technical and design criteria, principles and procedures

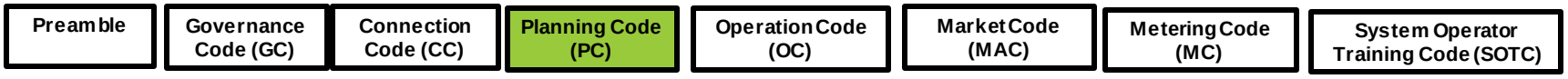
Key elements of the document

1. Principles of the Planning Code
2. Reliability and Cost Criteria
3. The Planning Process
   - Power Balance Statement
   - Transmission System Capability Statement
4. GMS Power System Modelling
   - Responsibilities
   - Planning Data Confidentiality

Preamble	Governance Code (GC)	Connection Code (CC)	**Planning Code (PC)**	Operation Code (OC)	Market Code (MAC)	Metering Code (MC)	System Operator Training Code (SOTC)

Need for a Planning Code - WG discussion

- "3 for" & "3 against"
  - Those against – Grid Code is Operational Code and Long Term Planning is a separate issue:
  - Those for – Planning code is important as there is a lot of expansion ongoing in GMS. Planning should include generation planning.
- Possible alternative solutions:
  - Produce a separate stand-alone document
  - Make the 'Planning Code' a guideline in code



Thank you

Dr Graeme Chown
Ricardo Energy & Environment

graeme.chown@ricardo.com