ENTSO-E’s first Network Code “Requirements for Generators”

BY Helge Urdal, NGET

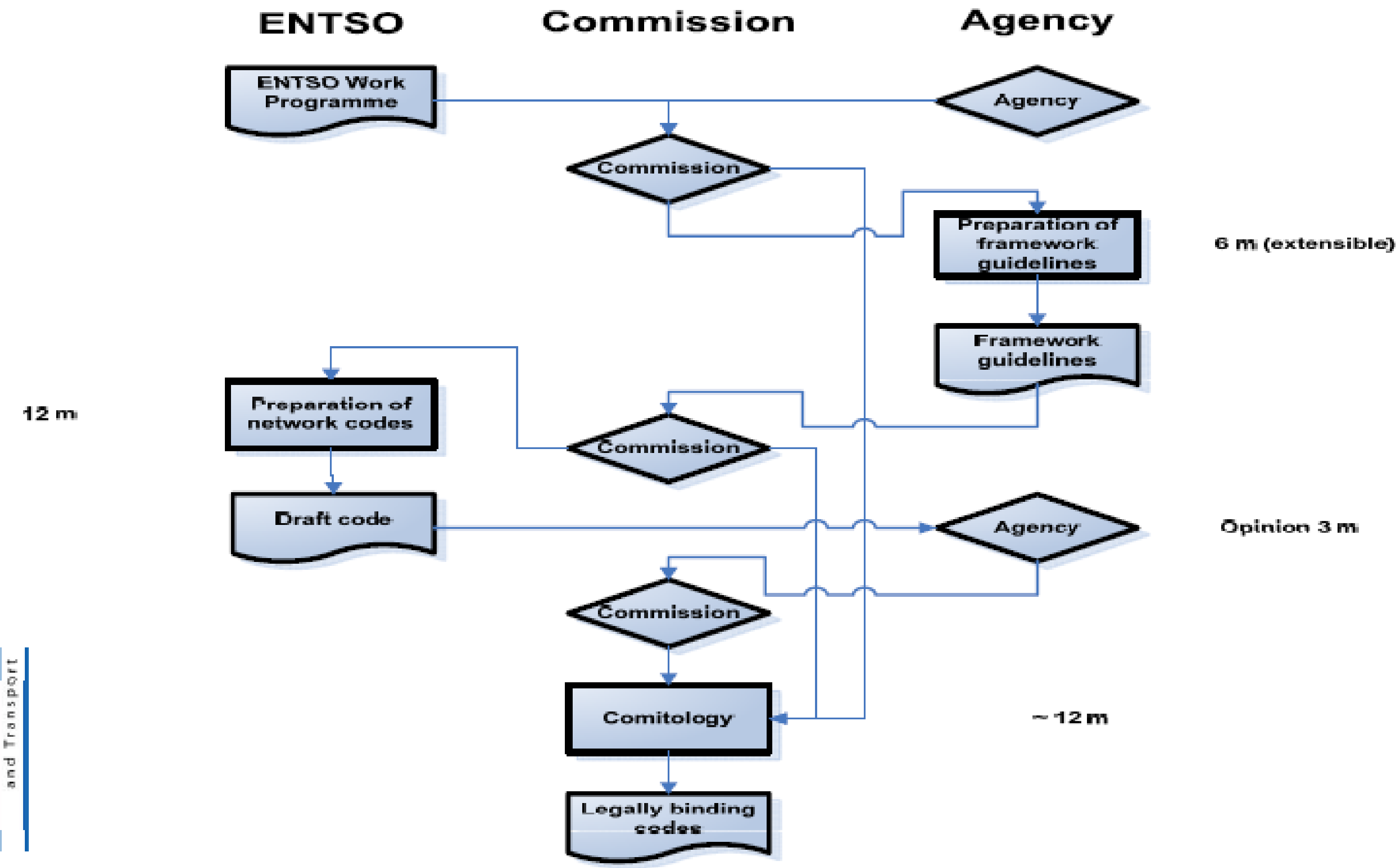
Contents 1

- EU
  - Matti Supponen, EU Energy Commissioner 5 November at 2nd Stakeholder open workshop.
  - EU code process
  - Content expected of EU Codes by Article 8
  - EU Electricity Rules – structure + work in progress
- Regulators
  - Framework Guidelines for Pilot Code by Tahir Kapetanovic, Director E-Control, ERGEG ENMF Co-Chair
  - Development process
  - Following formal consultation
    - FG Key issues
    - Code Key issues

Contents 2

- ENTSO-E - overview
  - A Trans-European Network
  - A tentative list of Codes to be initiated in the next 3 years
  - 3rd package: Splits of responsibilities in developing codes
  - Pilot Code for Grid Connection with special focus on wind
  - Bilateral meetings with special interest stakeholder groups
  - Next steps
  - Conference in February in Brussels “Towards electricity infrastructure for a Carbon Neutral Europe”
- The draft code
  - One Framework Guideline – several Network Codes
  - Code structure
  - Capacity Thresholds
  - Requirements – categorised & thresholds for each
  - Compliance
  - Sample code in relation to FSM and LFSM
- Conclusion – your opportunity to engage

Network codes

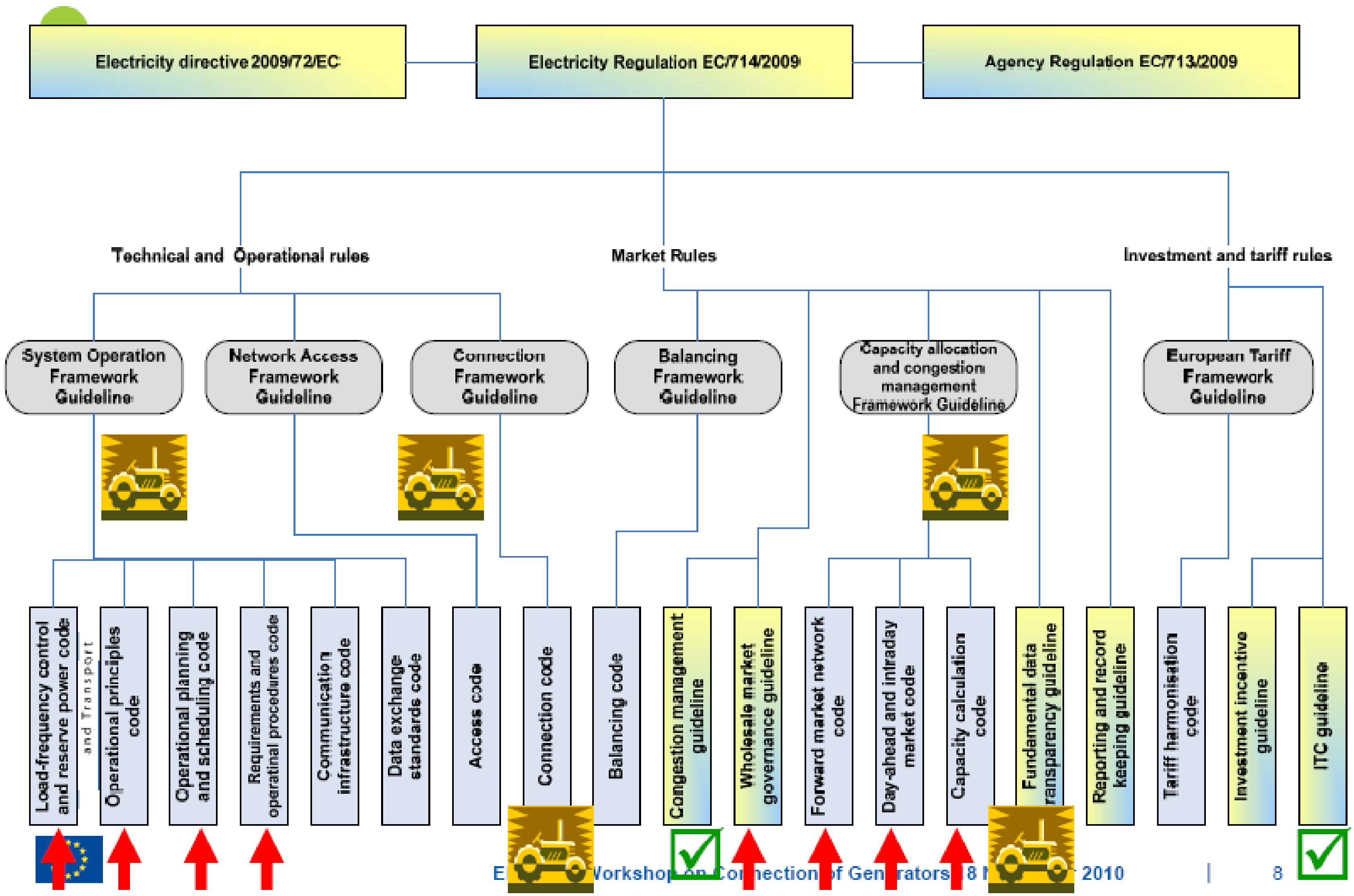


Directorate-General for Energy and Transport

Network codes, Article 8 of Electricity regulation

1. network security and reliability rules including rules for technical transmission reserve capacity for operational network security;
2. grid connection rules;
3. third party access rules;
4. data exchange and settlement rules;
5. interoperability rules;
6. operational procedures in an emergency;
7. capacity allocation and congestion management rules;
8. rules for trading related to technical and operational provision of network access services and system balancing;
9. transparency rules;
10. balancing rules including network related reserve power rules;
11. rules regarding harmonised transmission tariff structures including locational signals and inter-TSO compensation rules;
12. energy efficiency regarding electricity networks

European Electricity Rules



Background and History

- Electricity Grid Connection as the area for FG Pilot Project
- 3 Expert Group meetings: 04. November 2009, 13. January 2010, 08. March 2010
  - Problem Identification
  - Objectives
  - Discussion on Policy Options
- Public workshop on 16. April 2010:
  - Positive feedback from stakeholders
  - New and more detailed inputs and comments from EC

  → *Makeover of IIA and FG structure + partial amendments of the contents*

FG – Key Issues

- Distinguish between DSO / SO and DSO / grid user
- Extend min. requirements applicable for all grid users
- Glossary, Terms, Definitions: DSO as grid user, SO, …
- Governance (a whole new section added)
- Demand response only on contractual basis
- Grid users with specific requirements – together
- No exceptions as a part of the codes
- Clear and more prescriptive specific requirements
- More detailed cost / benefits analysis

Codes – Key Issues

- Differentiation between existing and new grid users must be clearly implemented including transitory period
- Definition of „significant“ units needs to be elaborated
- DSOs to be involved in the code development process
- Cost-benefit analysis demanded when thinking about the detailed requirements
- Change management process
- Exception handling process
- Generic and non-discriminatory treatment (rather exhaustive general requirements needed)

ENTSO-E: A Trans-European Network

Represents 42 TSOs from 34 countries

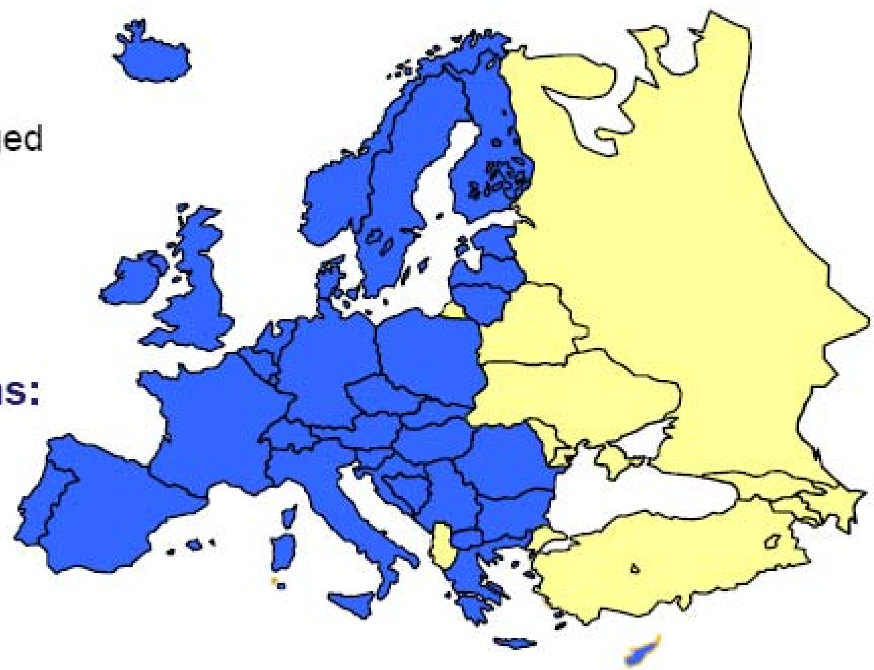
525 million citizens served

880 GW generation

270,000 km of transmission lines managed by the TSOs (≥220kV)

3,300 TWh/year demand:

400 TWh/year exchanges:



Replaces former TSO organisations:

ATSOI, BALTSO, ETSO, NORDEL, UCTE, UKTSOA

Tentative list of Codes to be initiated in the next 3 years

Market related

Day-Ahead code

Intraday code

Capacity Calculation code

Forwards

System Operation related

Load frequency and reserve power code
1. Primary, secondary and tertiary control and reserves

System operation code
2. **Operational security**
3. Operational planning and scheduling

Emergency code
4. Requirements and operational procedures

Data exchange code
5. Communication infrastructure
6. Data exchange standards

System Development related

Network connection code

DSO and industrial load connection

Grid connection procedures, Grid connection requirements for HVDC links

3rd Package and Network Codes

The 3rd package addresses the lack of cross-border regulatory framework by providing for institutions (ACER, ENTSO-E) and tools (Framework Guidelines, Network Codes) towards an efficient IEM

Network Codes

- must be in line with non-binding Framework Guidelines ("WHAT TO DO") (by ACER)
- can become LEGALLY BINDING through EC comitology process
- and ENTSO-E has the task of elaborating them ("HOW TO DO")

Transparency and extensive consultation is required in the process

Pilot Code for Grid Connection with Special Focus on Wind Generation

ENTSO-E identified in 2009 wind connection as the most prominent topic for a rapid introduction of Network Codes

- Based on ERGEG's FWGL on grid connection
- With the strong support of the EC and the Florence Forum
- Based on the on-going significant investment efforts on wind generation for achieving EU **environmental and security of supply policy goals**

Objectives

- Facilitate **adoption of best practices**
- **Reduce development and investment costs**
- **Harmonize structure and technical** contents of national codes

Meetings with stakeholders

Bilateral meetings started on April 2010 and will continue:

DSO Associations

- Eurelectric (WG Network), CEDEC, GEODE

Eurelectric (WG Thermal) – Power Plant Operators

EWEA – representatives of wind manufacturers

Manufacturers of conventional units

- (e.g. Siemens (CCGT, Hydro), ABB (Excitation control systems), GE (CCGT), Alstom (CCGT), Toshiba (Nuclear), AREVAnp (Nuclear), VATech (Hydro))

Foreseen in the short term:

- Solar PV representatives (EPIA), Turbine manufacturers, Companies supplying power plants, components and services

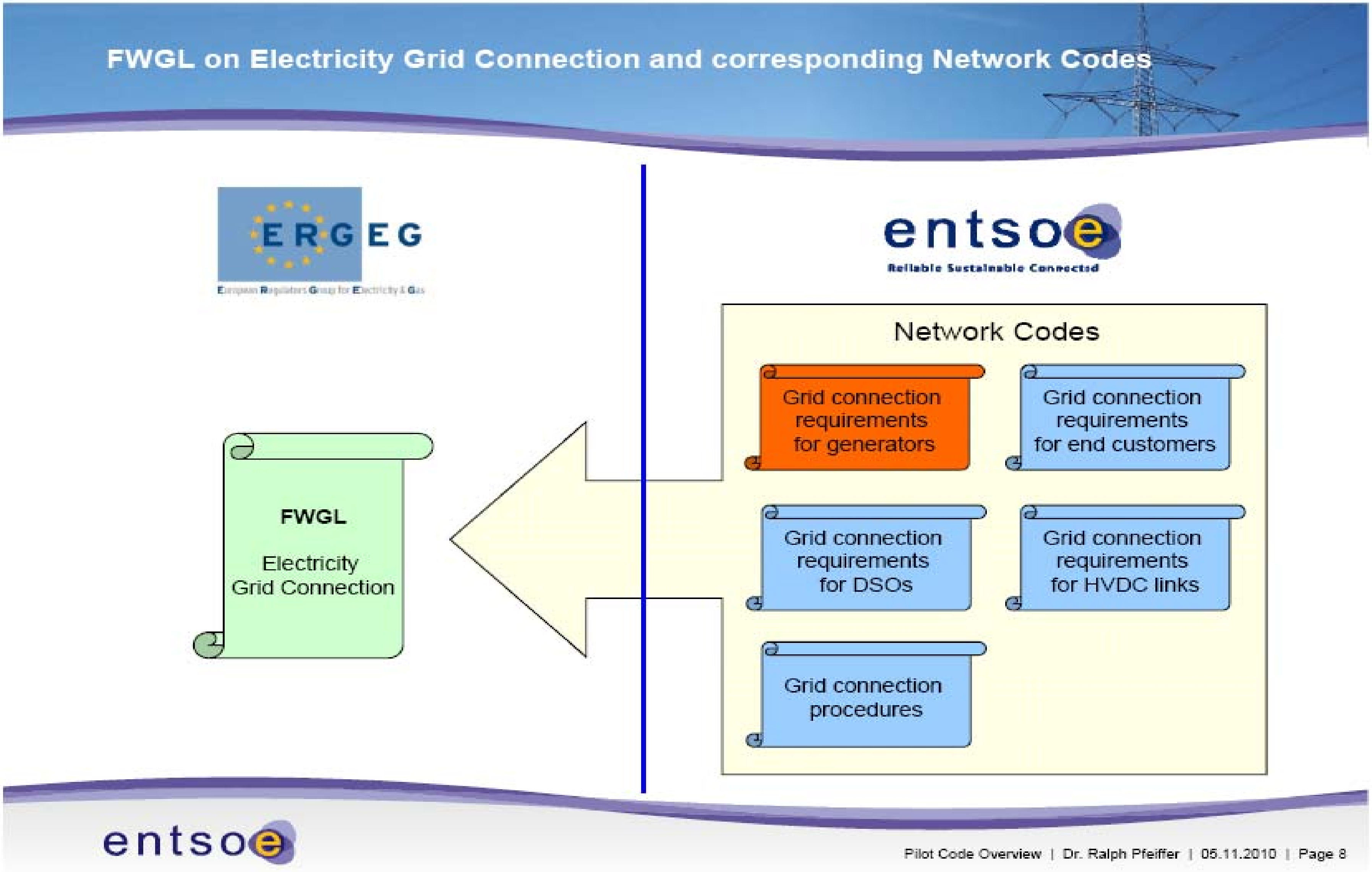
Next steps

- Continuous revision of collected comments
(e. g. from internal workshops, TSO's and external stakeholders)
- Final Pilot **FWGL** expected for December 2010
- Check if **Network Code** is in line with the final FWGL
- Pilot Code to be released for public consultation end of Q1 2011
- Drafting team works closely with stakeholders (EWEA, Eurelectric (WG Thermal), DSO Associations (Eurelectric (WG Networks), GEODE, CEDEC), Manufacturers) and ERGEG.
- Legal revision of the draft with refinement of requirements where applicable

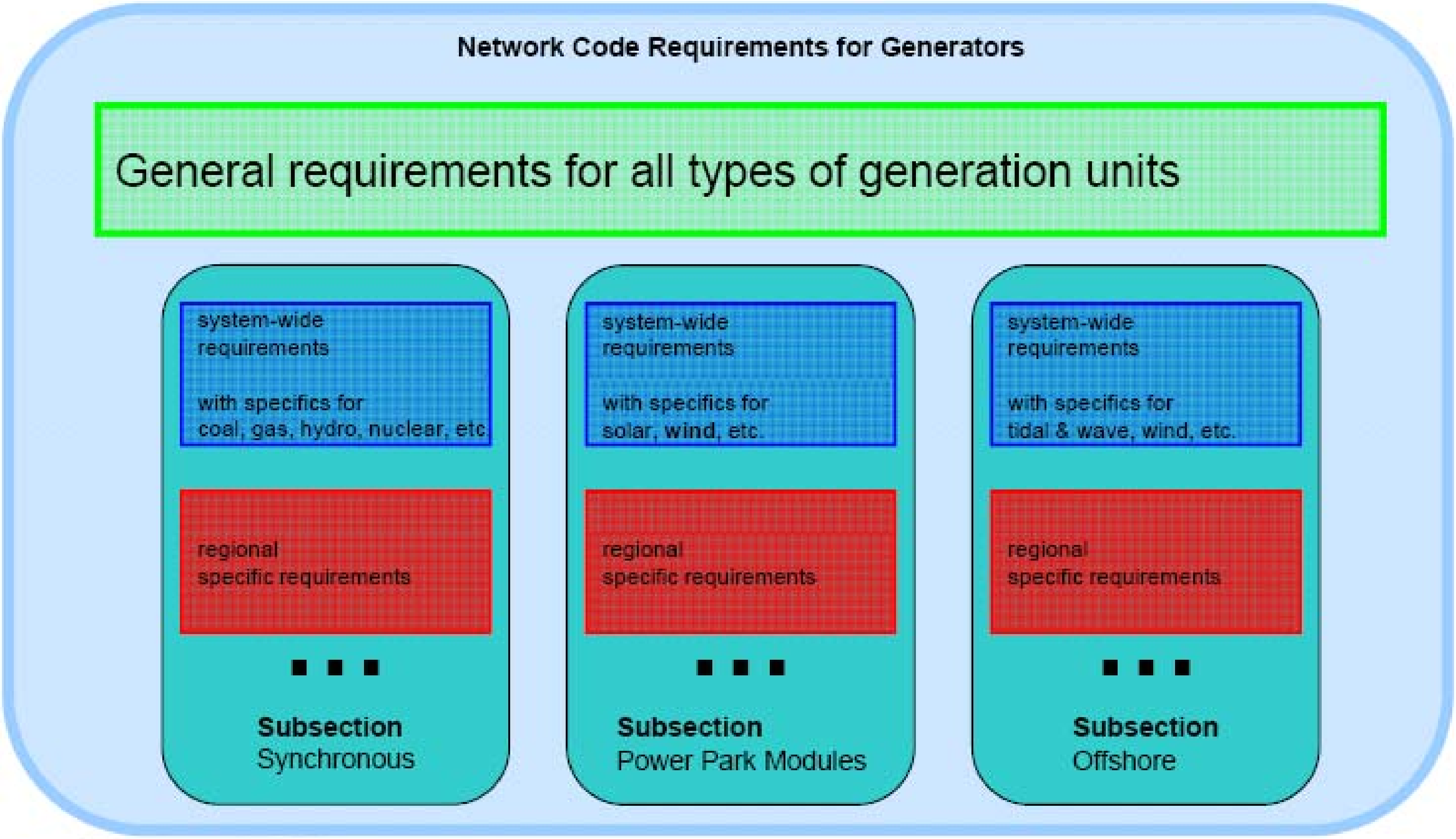
➢ Further code development continues as scheduled

Thank you

ENTSO-E organizing a Conference 'Towards electricity infrastructure for a carbon neutral Europe', in Brussels on 10-11 February 2011


FWGL on Electricity Grid Connection and corresponding Network Codes
ERGEG
European Regulators Group for Electricity & Gas
entsoe
Reliable Sustainable Connected
FWGL
Electricity Grid Connection
Network Codes
Grid connection requirements for generators
Grid connection requirements for end customers
Grid connection requirements for DSOs
Grid connection requirements for HVDC links
Grid connection procedures
entsoe
Pilot Code Overview | Dr. Ralph Pfeiffer | 05.11.2010 | Page 8

Scope of the Pilot Code



Categorisation of Generating Units and Power Park Modules

Type of Generating Unit or Power Park Module	Voltage level of Grid Connection	Capacity threshold (Preliminary Values!)	
A	< 110 kV		400 W
B	< 110 kV	Continental Europe:	0.1 MW
		Nordic:	0.1 MW
		Great Britain:	10 MW
		Ireland:	0.1 MW
		Baltic:	1 MW
C	< 110 kV	Continental Europe:	50 MW
		Nordic:	1.5 MW
		Great Britain:	50 MW
		Ireland:	5 MW
		Baltic:	5 MW
D	≥ 110 kV		./.

Assignment of Requirements for All Generators (I)

Requirement	Title	Requirement type	Type A	Type B	Type C	Type D
R5.1	FREQUENCY RANGES	Frequency stability	X	X	X	X
R5.2	VOLTAGE RANGES	Voltage stability				X
R5.3	RATE OF CHANGE OF FREQUENCY WITHSTAND CAPABILITY	Frequency stability	X	X	X	X
R5.4	ACTIVE POWER CONTROLLABILITY AND CONTROL RANGE	Frequency stability			X	X
R5.5	LOSS OF STABILITY	General system management			X	X
R5.6	STEADY-STATE STABILITY	Robustness of Generating Units			X	X
R5.7	INERTIA	Frequency stability			X	X
R5.8	FREQUENCY SENSITIVE MODE	Frequency stability			X	X
R5.9	LIMITED FREQUENCY SENSITIVE MODE (OVERFREQUENCY)	Frequency stability	X	X	X	X
R5.10	LIMITED FREQUENCY SENSITIVE MODE (UNDERFREQUENCY)	Frequency stability			X	X
R5.11	FREQUENCY RESTORATION CONTROL	Frequency stability			X	X

Assignment of Requirements for All Generators (II)

Requirement	Title	Requirement type	Type A	Type B	Type C	Type D
R5.12	DISCONNECTION DUE TO UNDERFREQUENCY	Frequency stability			X	X
R5.13	MONITORING OF FREQUENCY RESPONSE	Frequency stability			X	X
R5.14	SHORT CIRCUIT CONTRIBUTION	Voltage stability			X	X
R5.15	BLACK START	System restoration			X	X
R5.16	CAPABILITY TO TAKE PART IN ISOLATED NETWORK OPERATION	System restoration			X	X
R5.17	TRIP TO HOUSELOAD	System restoration			X	X
R5.18	IDENTIFICATION OF HOUSELOAD OPERATION	System restoration			X	X
R5.19	ELECTRICAL PROTECTION SCHEMES AND SETTINGS	General system management		X	X	X
R5.20	CONTROL SCHEMES AND SETTINGS	General system management		X	X	X
R5.21	PRIORITY RANKING OF PROTECTION AND CONTROL	General system management		X	X	X
R5.22	AUTO RECLOSURES	Robustness of Generating Units		X	X	X

Assignment of Requirements for All Generators (III)

Requirement	Title	Requirement type	Type A	Type B	Type C	Type D
R5.23	SYNCHRONISATION	General system management		X	X	X
R5.24	SYSTEM PARALLELING AND TORSIONAL OSCILLATIONS	Robustness of Generating Units			X	X
R5.25	RECONNECTION AFTER TRIPPING ONTO AUXILIARY SUPPLY	System restoration			X	X
R5.26	CAPABILITY OF RECONNECTION AFTER AN INCIDENTAL DISCONNECTION DUE TO A NETWORK DISTURBANCE	System restoration		X	X	X
R5.27	INFORMATION EXCHANGE	General system management		X	X	X
R5.28	INSTRUMENTATION	General system management			X	X
R5.29	POWER/VOLTAGE QUALITY RAPID VOLTAGE CHANGES	General system management	X	X	X	X
R5.30	CHANGES TO/MODERNISATION OR REPLACEMENT OF EQUIPMENT OF GENERATING UNITS	General system management		X	X	X
R5.31	SIMULATION MODELS	General system management			X	X
R5.32	INSTALLATION OF DEVICES FOR SYSTEM OPERATION AND/ OR SECURITY	General system management			X	X
R5.33	COOPERATION FOR ANALYSIS OF FAULTS AND DISTURBANCES	General system management		X	X	X

Assignment of Requirements for Synchronous Generators

Requirement	Title	Requirement type	Type A	Type B	Type C	Type D
R6.1	REACTIVE POWER CAPABILITY AT MAXIMUM ACTIVE POWER	Voltage stability		X	X	X
R6.2	REACTIVE POWER CAPABILITY BELOW MAXIMUM ACTIVE POWER	Voltage stability		X	X	X
R6.3	FAULT RIDE THROUGH CAPABILITY OF SYNCHRONOUS GENERATORS CONNECTED AT 110 kV OR ABOVE	Robustness of Generating Units				X
R6.4	FAULT RIDE THROUGH CAPABILITY OF SYNCHRONOUS GENERATORS CONNECTED BELOW 110 kV	Robustness of Generating Units		X	X	
R6.5	POST FAULT ACTIVE POWER RECOVERY	Robustness of Generating Units		X	X	X
R6.6	COORDINATION OF SPEED AND POWER CONTROL OF SYNCHRONOUS GENERATING UNITS	General system management			X	X
R6.7	VOLTAGE CONTROL SYSTEM	Voltage stability		X	X	X
R6.8	STEADY STATE VOLTAGE CONTROL	Voltage stability		X	X	X
R6.9	TRANSIENT VOLTAGE CONTROL	Voltage stability		X	X	X
R6.10	POWER OSCILLATIONS DAMPING CONTROL	Robustness of Generating Units			X	X
R6.11	EXCITER SPECIFICATION	Voltage stability		X	X	X
R6.12	STATOR CURRENT LIMITER	Voltage stability				X

Assignment of Requirements for Power Park Modules

Requirement	Title	Requirement type	Type A	Type B	Type C	Type D
R7.1	REACTIVE POWER CAPABILITY AT MAXIMUM ACTIVE POWER	Voltage stability		X	X	X
R7.2	REACTIVE POWER CAPABILITY BELOW MAXIMUM ACTIVE POWER	Voltage stability		X	X	X
R7.3	FAULT RIDE THROUGH CAPABILITY OF POWER PARK MODULES CONNECTED AT 110 kV OR ABOVE	Robustness of Generating Units				X
R7.4	FAULT RIDE THROUGH CAPABILITY OF POWER PARK MODULES CONNECTED BELOW 110 kV	Robustness of Generating Units		X	X	
R7.5	REACTIVE POWER CONTROL MODES	Voltage stability	X	X	X	X
R7.6	FAST ACTING VOLTAGE CONTROL	Voltage stability		X	X	X
R7.7	PRIORITY TO ACTIVE OR REACTIVE POWER CONTRIBUTION	Voltage stability			X	X
R7.8	POST FAULT ACTIVE POWER RECOVERY	Robustness of Generating Units		X	X	X
R7.9	VOLTAGE SUPPORT MONITORING	Voltage stability		X	X	X
R7.10	SYNTHETIC INERTIAL CAPABILITY TO A LOW FREQUENCY EVENT	Frequency stability			X	X

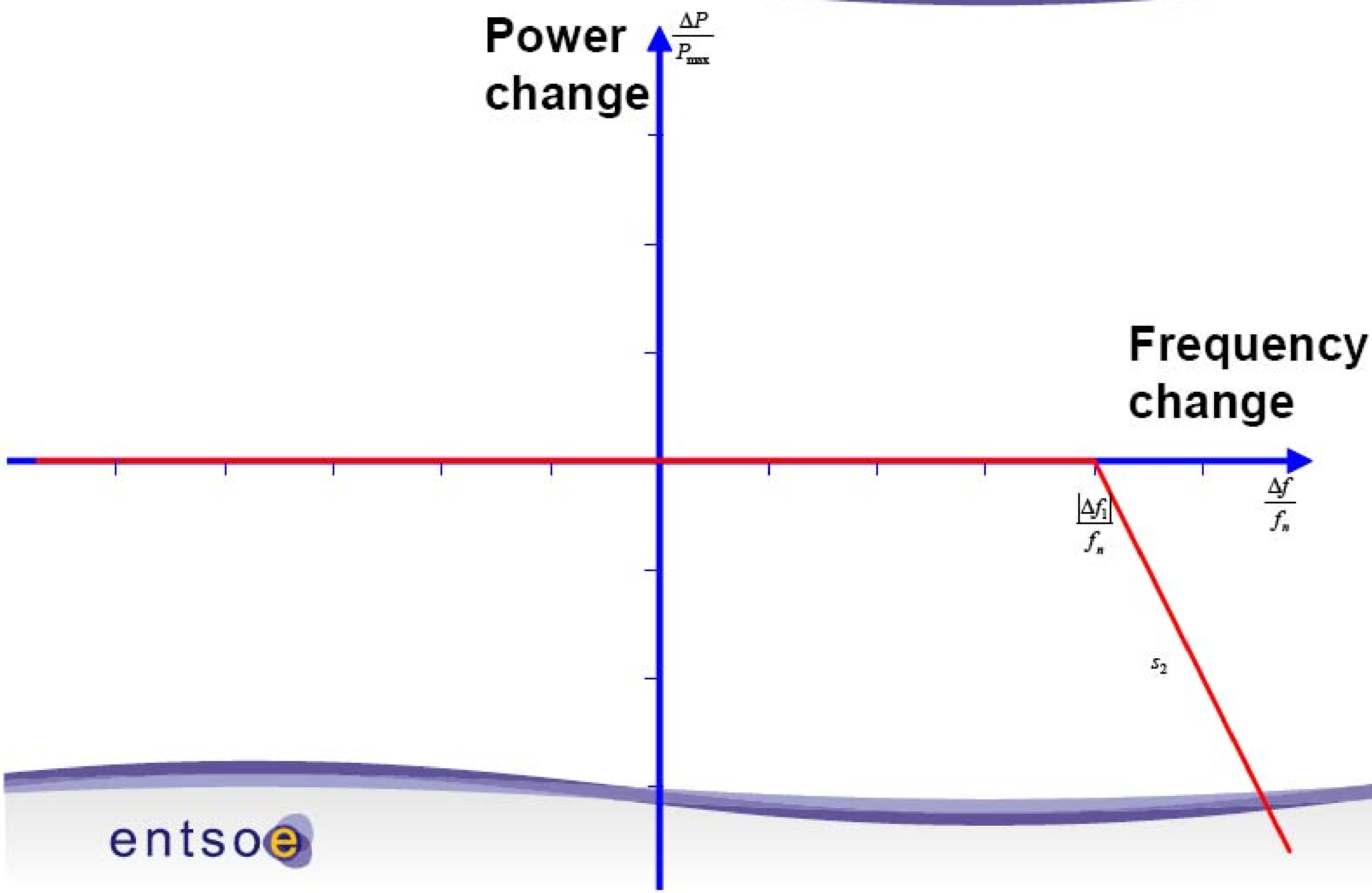
entsoe

Compliance

- **Compliance tests**
  - Purpose and description:
    Demonstrating the fulfilment of the grid connection requirements
  - Assessment criteria defined in the network code
  - Carried out by the Power Generating Facility operator
  - Can be witnessed by the responsible Network Operator
  - Assessment of test results by the responsible Network Operator

- **Compliance simulations**
  - Purpose and description:
    Model validation and demonstrating the fulfilment of the grid connection requirements
  - Assessment criteria defined in the network code
  - Carried out by the Power Generating Facility operator
  - Assessment of simulation results by the responsible Network Operator

LFSM The relationship between the relative change in frequency (Δ f/fn) and the required response in terms of relative power change (ΔP/Pmax)



entsoe

Contribution to control of frequency during large imbalances
Limited Frequency Sensitive Mode (LFSM) - Low frequency events

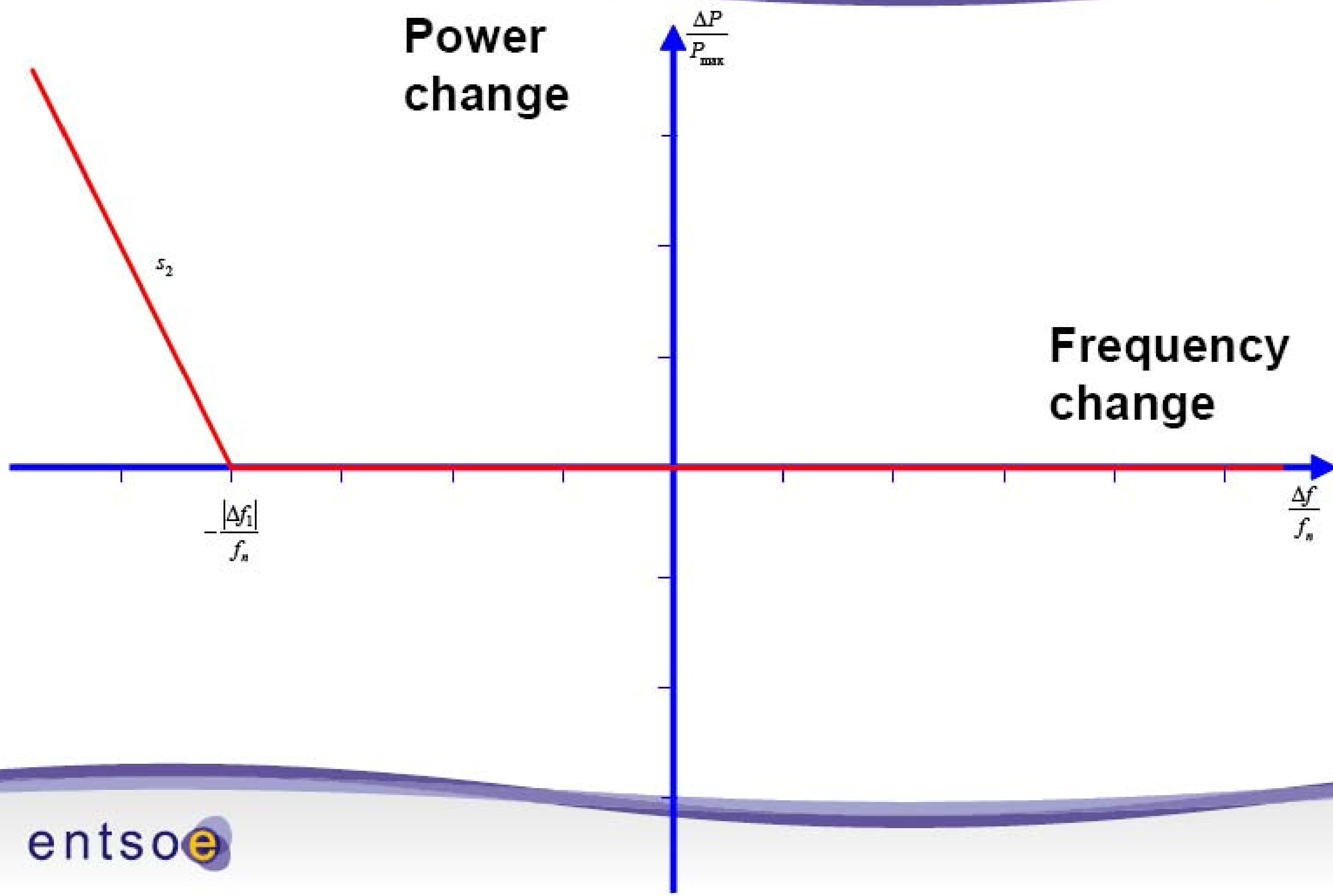
(Applies to Type C and D)

Each Power Generating Units shall be capable of providing Active Power Frequency Response according to figure 6 when not operating in frequency sensitive mode.

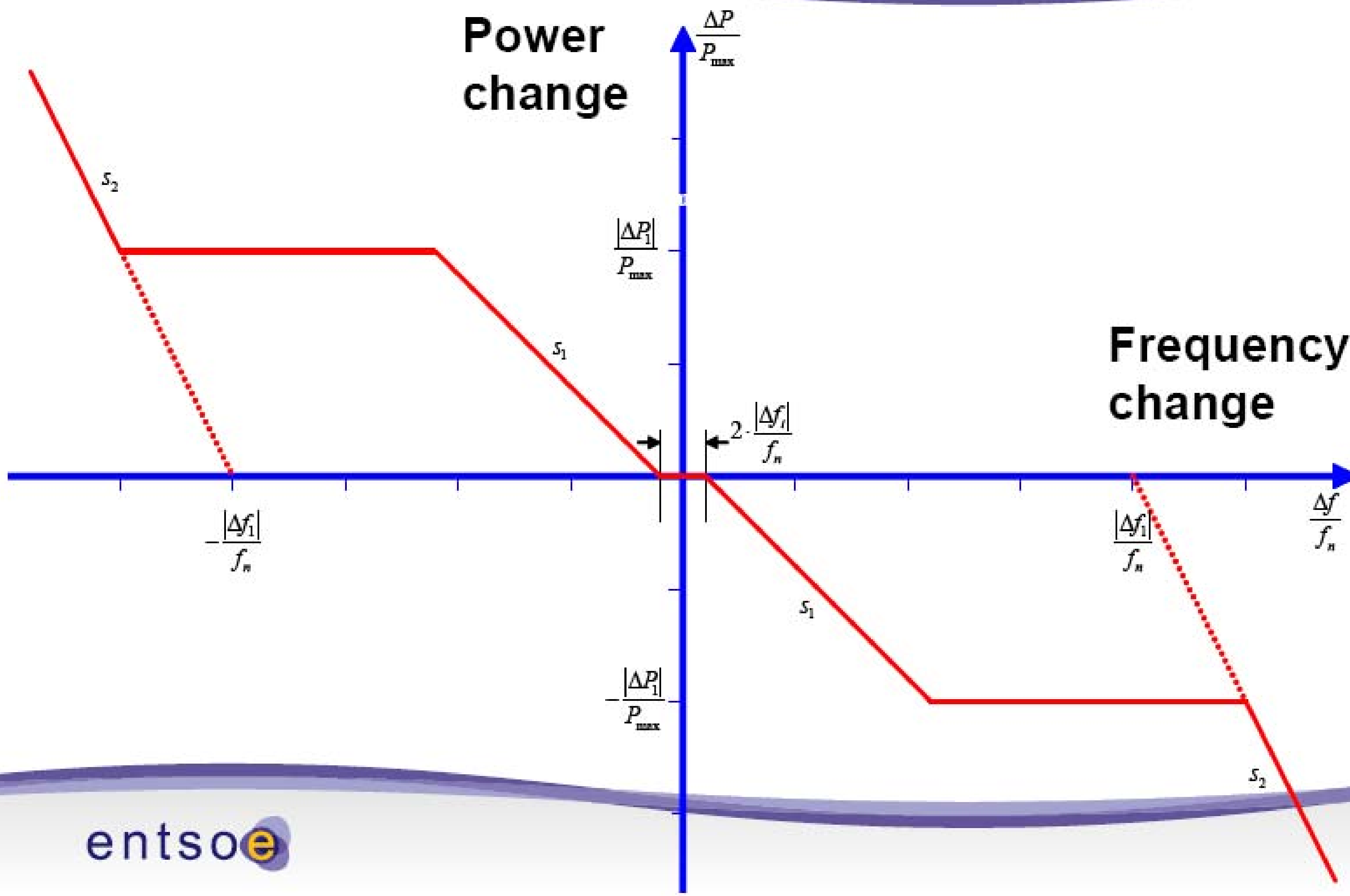
The initial delay of activating Active Power Frequency Response shall be as short a possible and reasonably justified if greater than 2 sec.

The Power Frequency Response shall be activated in a range of 1 - 10% of Maximum Capacity per second.

LFSM The relationship between the relative change in frequency (Δ f/fn) and the required response in terms of relative power change (ΔP/Pmax)



FSM The relationship between the relative change in frequency (Δ f/fn) and the required response in terms of relative power change (ΔP/Pmax)



entsoe

The parameter ranges for Frequency Sensitive Mode
Actual parameters defined by TSO to match varied requirements.

Parameters	Ranges	Ranges in %
Active power range related to **Maximum Capacity** $\frac{\lvert\Delta P_1\rvert}{P_{\max}}$	-	2 – 10 %
Threshold of frequency deviation from nominal frequency $\frac{\lvert\Delta f_1\rvert}{f_n}$	200 – 500 mHz	0.4 – 1.0 %
Static or dynamic Insensitivity range $\frac{\lvert\Delta f_i\rvert}{f_n}$	$\pm$10 – 15 mHZ	$\pm$0.01 – 0.015 %
Slope s_1	-	2 – 20 %
Slope s_2	-	2 – 12 %

Conclusion
Your opportunity to get involved

- 3rd package, EU & Regulator driving this
- ENTSO-E drafting the Pilot & outline programme for many more
- Massive Stakeholder engagement programme, even for this one NC.
- Your opportunities to engage:
  - Through one of 5 special interest groups – contact them
  - Send comments at informal stage for consideration
  - Comment at formal stage – with response
- Method for GB implementation not yet known
  - Awaiting broad guidance from final FG from Regulators
  - Expected mid December 2010
  - Work out GB implementation process
    - May need to be completed <1 year
    - Replicate in GB Code or refer to EU NC?

Implementing binding decisions

- Covered in DECC's consultation on the implementation of the EU third package
- Member states must ensure that:
  - National Regulatory Authorities (NRAs) are given duties to implement and comply with decisions of the Agency for the Co-operation of Energy Regulators (ACER) and the Commission;
  - NRAs are granted "enabling powers in order to carry out regulatory tasks in an efficient and expeditious manner"; and
  - a right of appeal is available for any party affected by the NRA's proposals.

nationalgrid

THE POWER OF ACTION

Implementing binding decisions

To comply with these requirements, DECC propose

- Replace current collective licence modification process with a process that allows Ofgem to reach its decision subject to appeal
  - Present 20% rule means Ofgem cannot implement without reference to CC
- Allow Ofgem to initiate code modifications where they are essential for implementation of decision
  - Usual industry process will then take effect including provision for ‘alternatives’.
  - However any such process would need to respect timescales set for implementing a decision