



Cigré 2016 Opening Keynote:
Evolution of Power System Planning to Support
Connection of Generation, Distributed Resources
and Alternative Technologies

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Outline



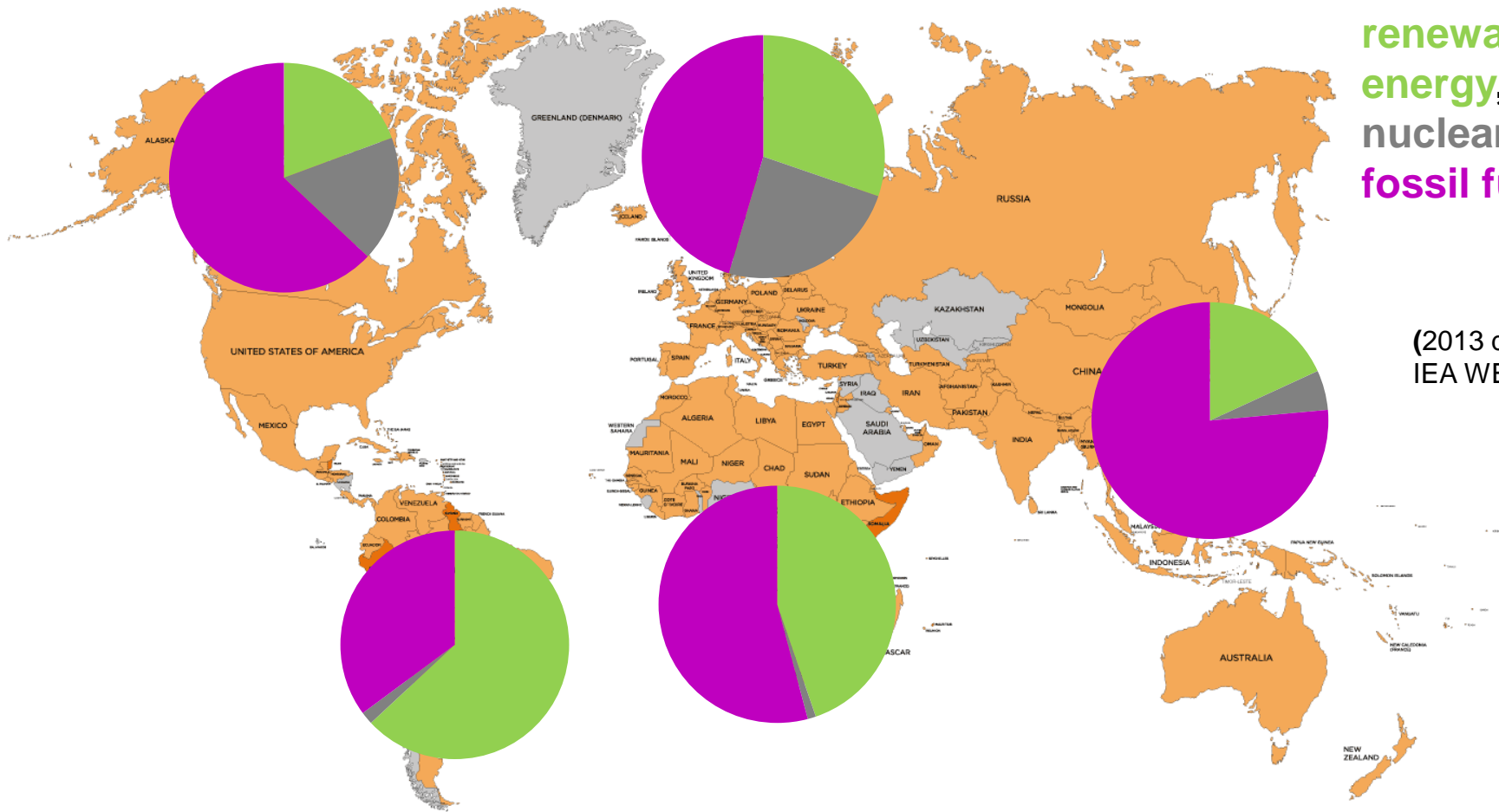
- 1) Expectations for the future, globally and in Europe**
- 2) Flexibility and other challenges**
- 3) How to meet the challenges, especially network codes**


RES takes lead in covering the future demand




renewable energy,
nuclear
fossil fuels

(2013 data from IEA WEO 2015)



 Countries that have signed the Paris Agreement

 Countries that have ratified the Paris Agreement*

Source : UNFCCC

In terms of investment \$, renewables dominate almost everywhere:

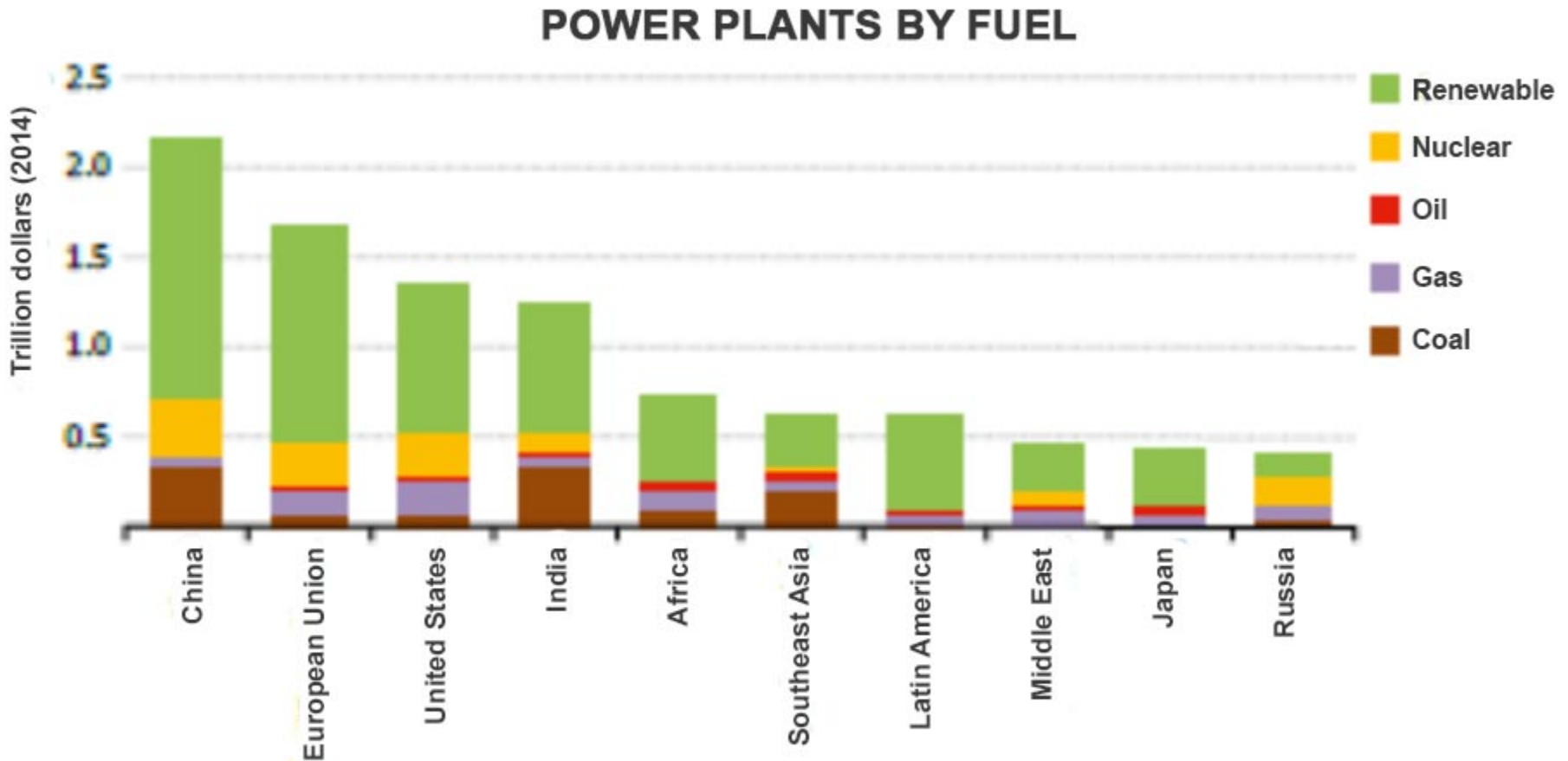


Figure 2.19
Cumulative investment in energy supply by selected region in the New Policies Scenario, 2015-2040

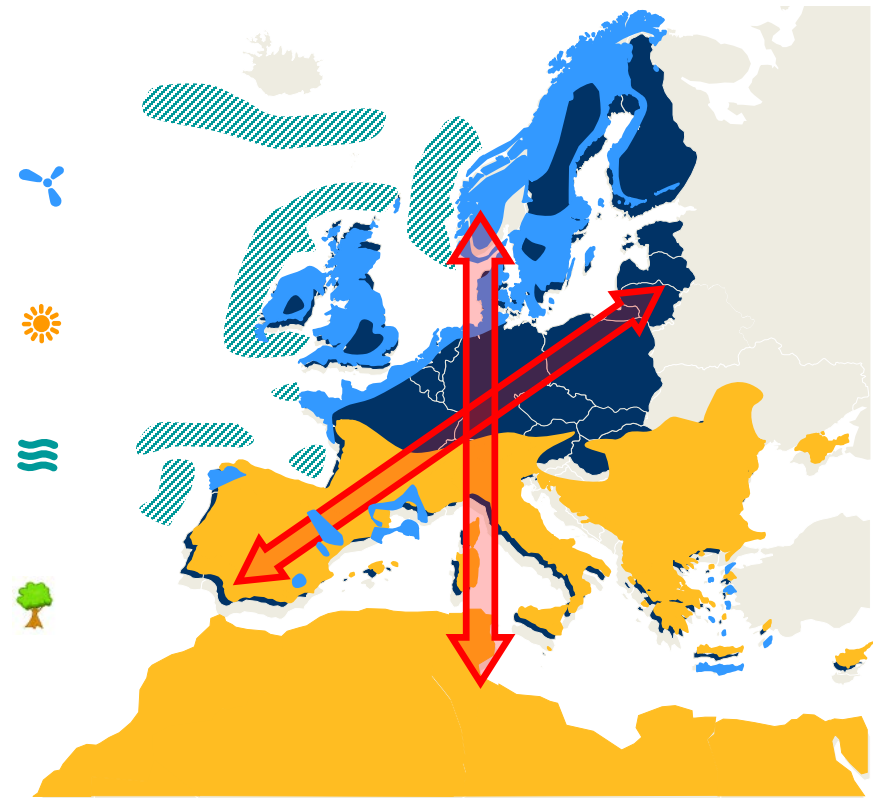
Europe needs strong and smart grids to manage big changes in generation and flows



THOUSANDS OF SMALL UNITS



LARGE FLOWS ALL OVER EUROPE



Demand: need to accommodate RE fluctuations



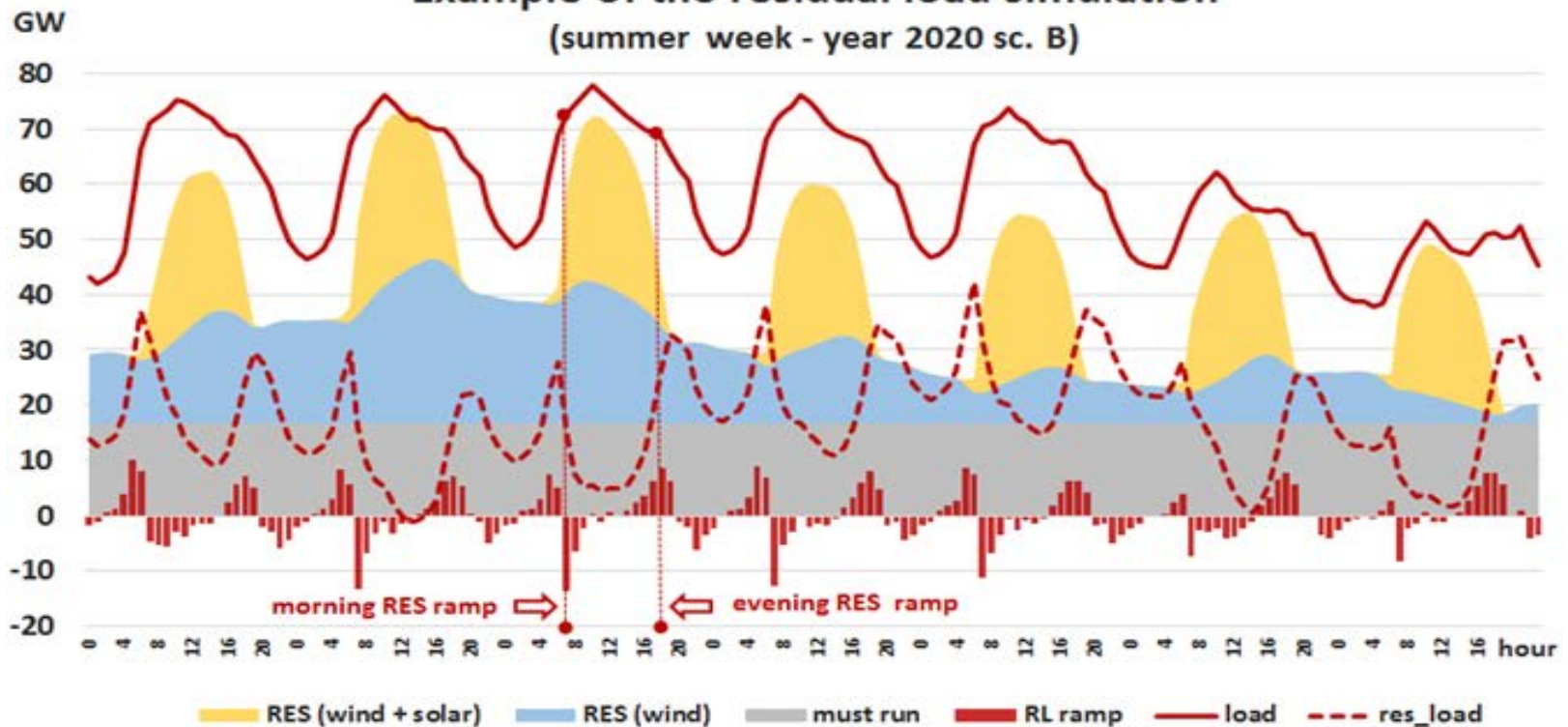
Electricity
replaces
fossil fuels

More efficient
heating, transport,
industries with
less CO₂

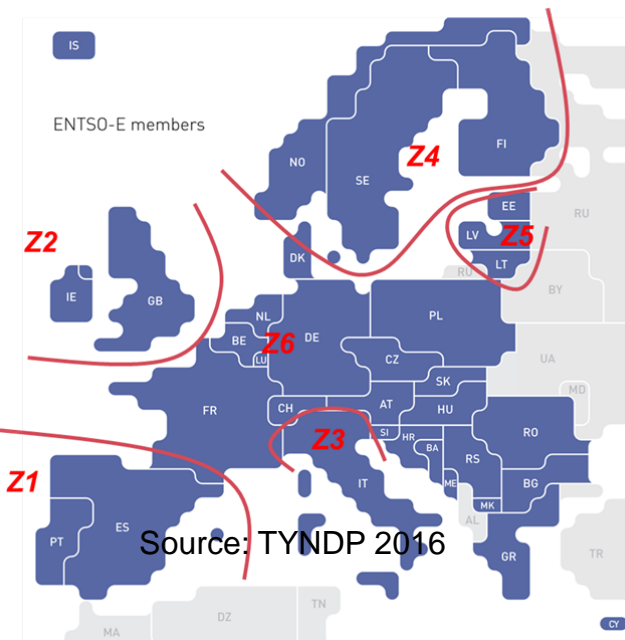
Cheaper to
decarbonize

Flexible demand
needed because
of RE fluctuations

Example of the residual load simulation
(summer week - year 2020 sc. B)



Residual load ramps quantify flexibility needs



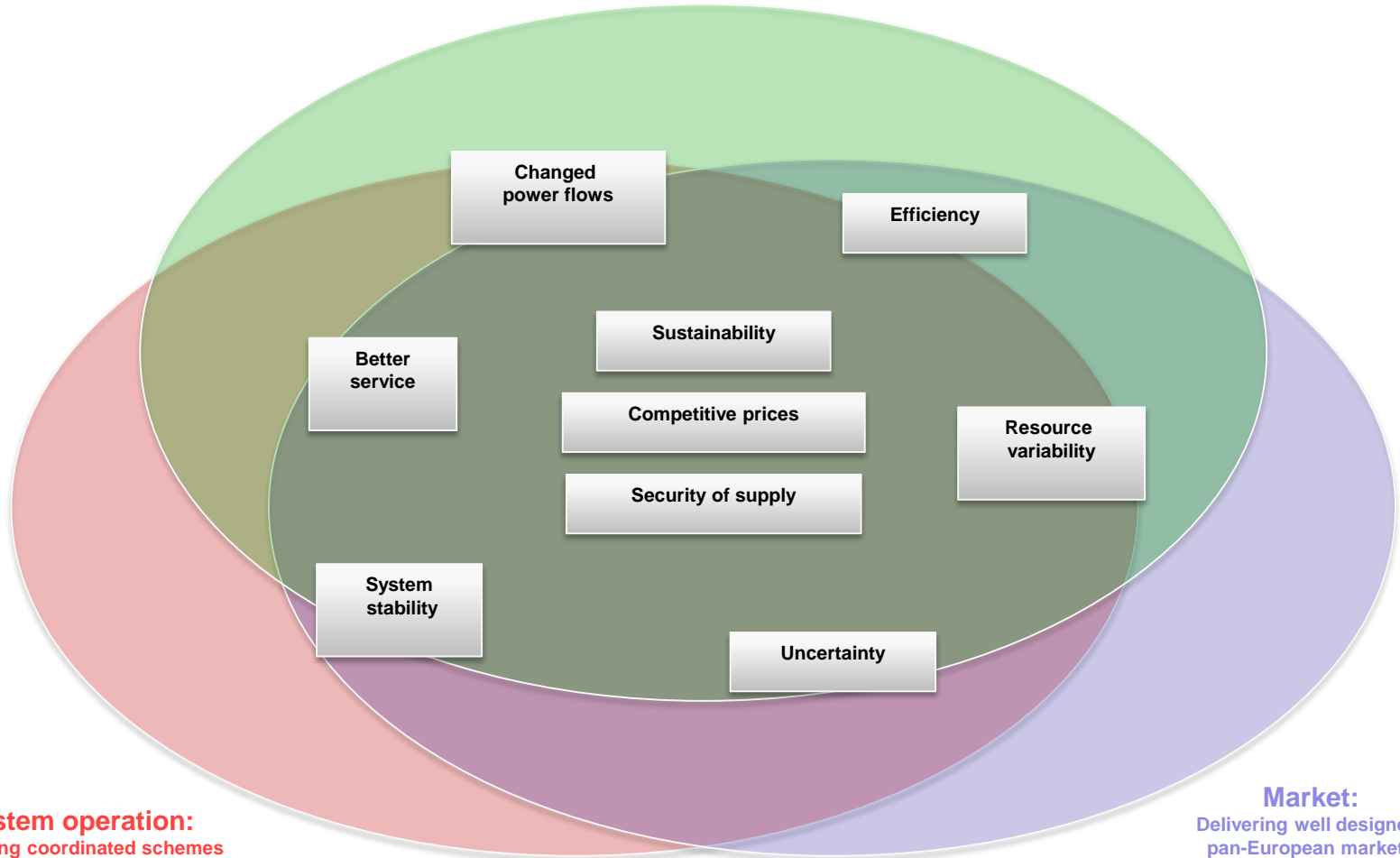
[MW/h]	Iberian peninsula	Nordics	Baltics	UK	Italy
EP2020	6120	4637	544	8830	8060
Vision 1	6893	4624	656	8201	8723
Vision 2	9350	4326	572	10355	7438
Vision 3	7387	4179	552	13788	9003
Vision 4	14340	4366	584	10460	9429

Residual load ramps (= load minus RES) indicate, that high RES Visions display strong ramps of available conventional generation, call for new flexibility sources.

Three pillars for addressing the future challenges



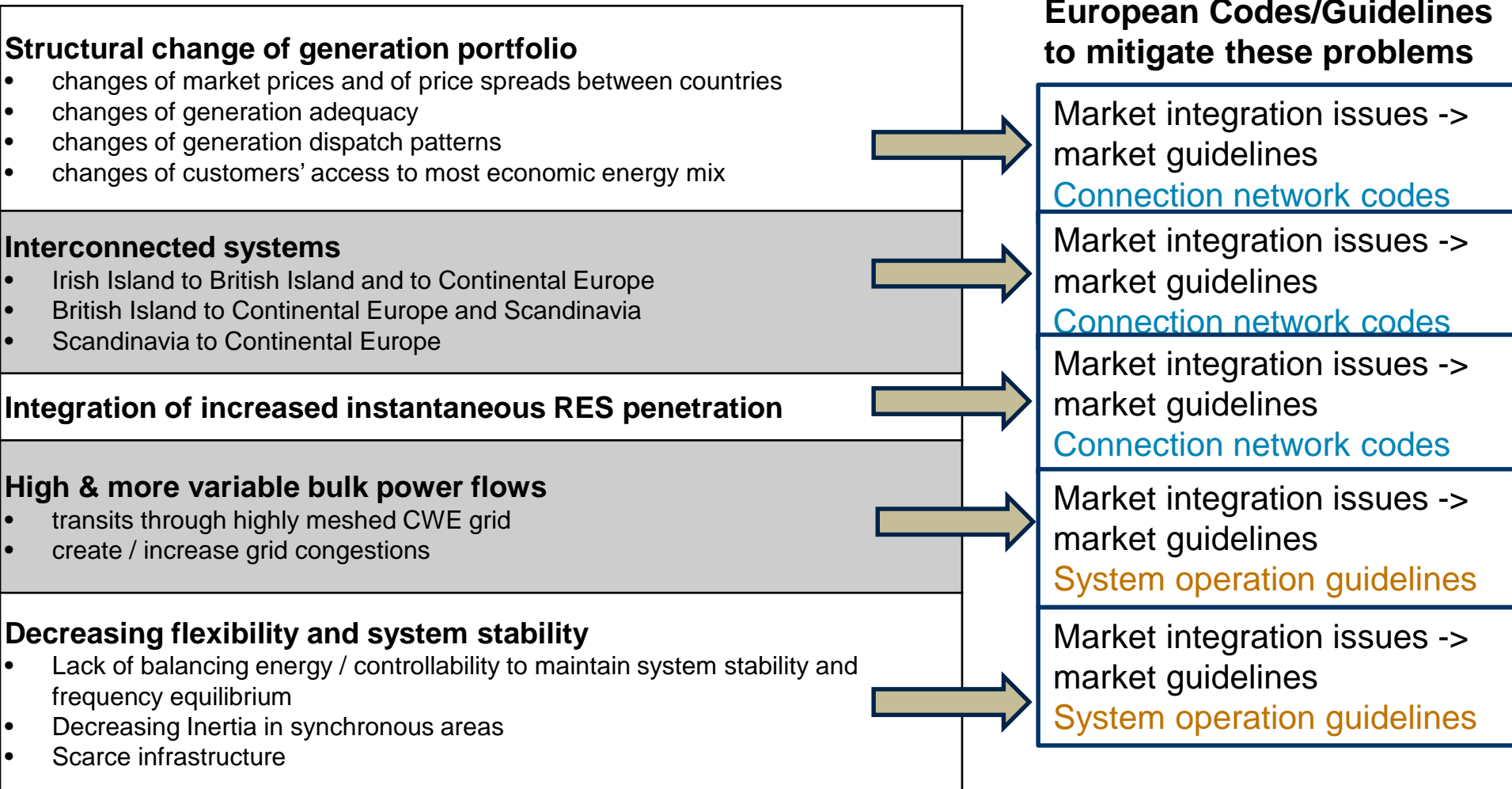
Infrastructure:
Delivering a fit for purpose network



System operation:
Delivering coordinated schemes

Market:
Delivering well designed
pan-European markets

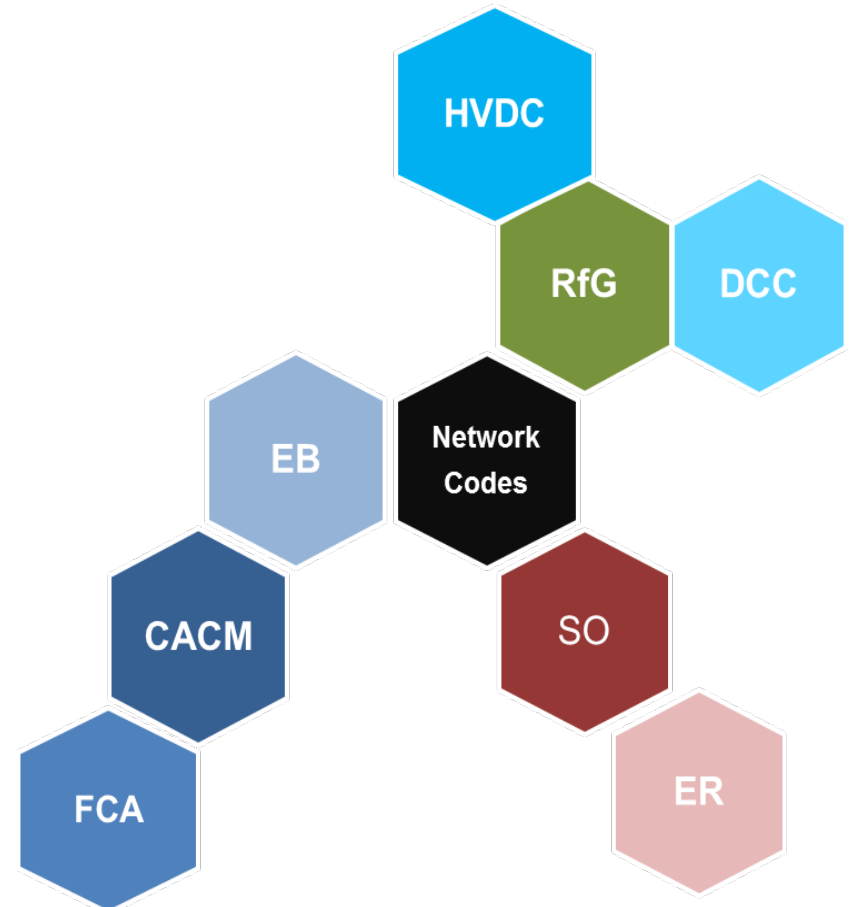
Network codes help address the future challenges



What is a network code

- **A set of rules applying to a cross-border integration issue in the electricity sector**
- **That defines the future necessary system capabilities**
- **That sets rules on how to mitigate, operate and restore an interconnected electric system**
- **That sets the market rules for all the market participants and all the frames**

e.g. European codes



Network codes / guidelines: The foundations of the EU Internal Energy Market

3 CONNECTION CODES

Requirements for:

- Generators
- Demand side
- HVDC connections

**...paving the way
for offshore wind...**

3 MARKET CODES

Rules for:

- Day ahead / Intraday
- Forwards
- Balancing

**...market
coupling...**

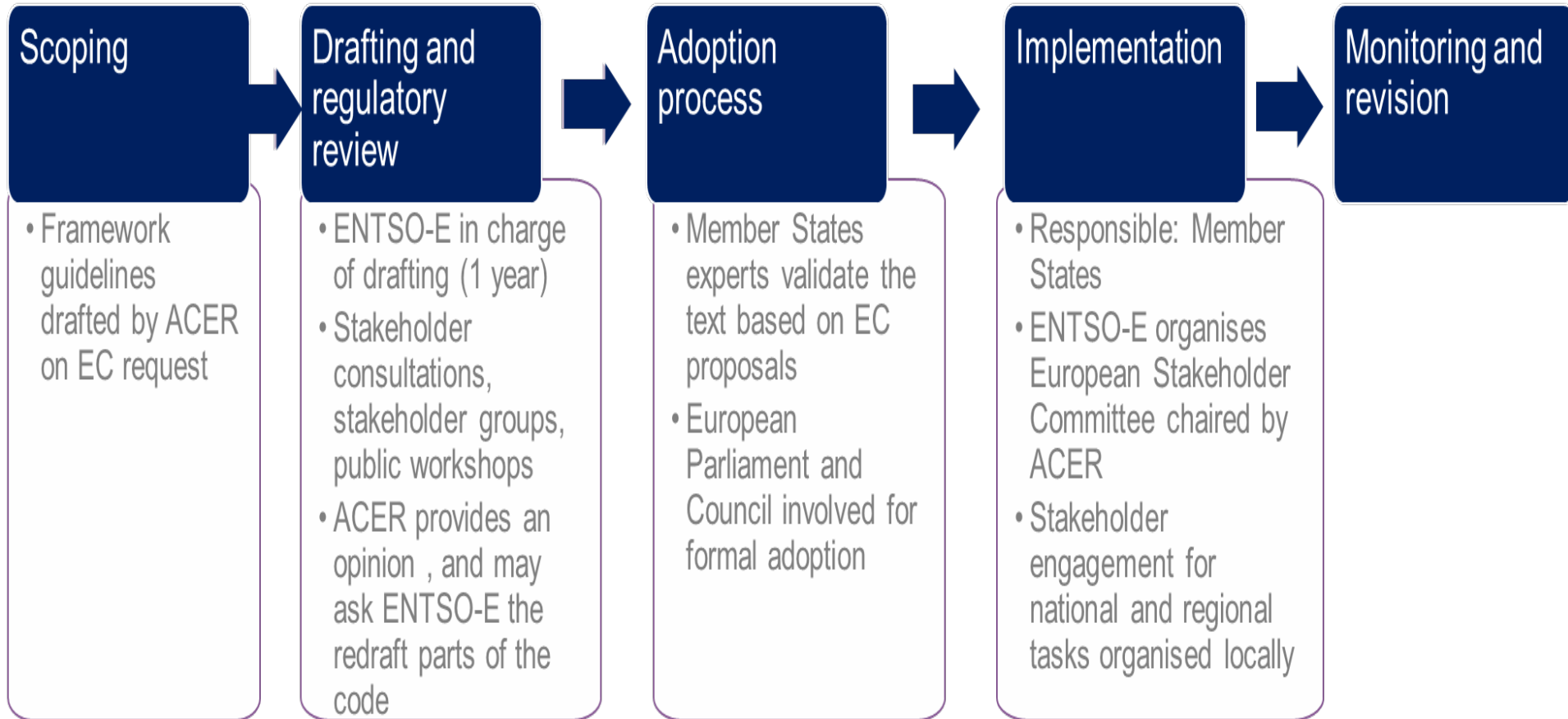
2 OPERATIONAL CODES

Rules for:

- System Operation
- Emergency situations

**...regional
cooperation to
increase security**

Codes / guidelines development process



Almost all codes are voted, many in force

UPDATE OCTOBER 2016

3 CONNECTION CODES
Requirements for generators
Demand connection
HVDC connections

3 MARKETS CODES
Capacity Allocation & Congestion Management
Forward Capacity Allocation
Balancing

2 OPERATIONAL CODES
System Operations
Emergency & restoration

- Published in the EU Official Journal and/or in force
- Validated by member states' representatives, awaiting validation by EU Council & Parliament
- Pending validation by member states' representatives

Cigré WG C1.18 emphasized importance of grid codes:

Cigré TB 527 Feb. 2013 – WG C1.18 Observations:

Coping with Limits for Very High Penetrations of Renewable Energy



Grid Codes for Increasing Operational Scheduling and Dispatch Challenges

- Dispatch, ramping, reactive power, fault ride through capabilities of all plants ↑.
- At high levels of VNSR ancillary services need to be provided by the VNSR.
- Needs credible grid code enforcement.

Forecasting: Key requirement for all penetration levels for efficient system operation.

Voltage Stability, Transient Stability, Inertia, and Fault Levels:

- Where studied, present binding limiting factor for high penetrations of VNSR.

Network Design and Build:

- For medium and high levels of VNSR, additional grid infrastructure required.
- In Europe, 80% of 150 billion € transmission investment until 2030 driven by RES

Governance: Need for greater information sharing and transparency between systems.
Other observations on ancillary services, storage, offshore wind, transients, markets.

Implementation of codes – a major effort for TSOs, regulators, stakeholders



DELIVERED



Proposal of a Congestion Income Distribution Methodology > CACM

Proposal of Definition of Capacity Calculation Regions > CACM

CACM Monitoring Plan > CACM



ONGOING

List of monitoring information to be submitted to ACER > CACM

Bidding zone review > CACM

Common grid model > CACM

Intraday gate opening time > CACM

CNC national implementation

Early implementation projects:

Harmonised allocation rules > FCA guideline /

Balancing pilots > Balancing guideline /

Regional Security Coordinators > System

Operation guideline

Stakeholder Committees



- 1 stakeholder committee per family of code.
- Grid Connection and Market already in place.
- ACER chairs.
- ENTSO-E in charge of secretariat.
- All information publically available on www.entsoe.eu

We build a future...

