

2016 CIGRÉ USNC International Colloquium
Evolution of power system planning to support connection of
generation, distributed resources and alternative technologies

EUROPEAN SYSTEM EVOLUTION FORECAST

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Pan-European development plan -
TYNDP

2

Framing the future – what scenarios
tell us

3

Connection network codes and
TYNDP work together

4

Conclusions

Ambitious EU energy policy targets

	Share of renewable energy sources (RES) in overall energy consumption	Share of RES in electricity consumption	Decrease of greenhouse gas emissions (compared to 1990)	Increase of energy efficiency (compared to 2007 forecast)
2020	20%	30-35%	20%	20%
2030	27%	45%	40%	27%

Pan-European development plan - TYNDP

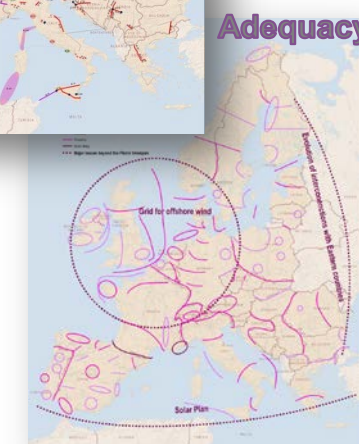
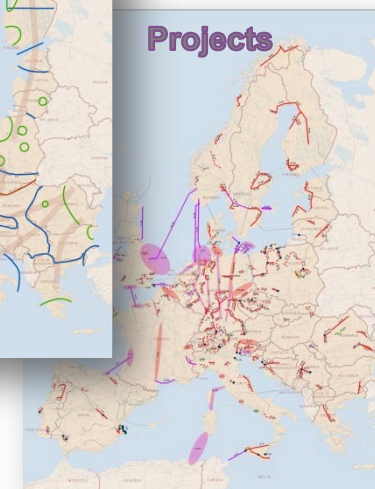
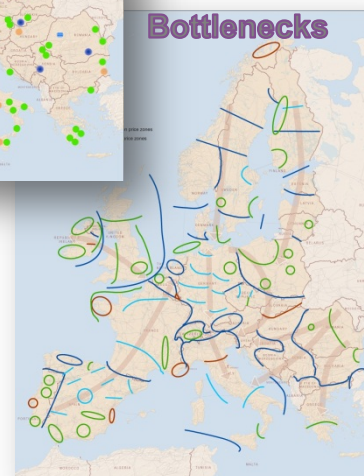
Regulation (EC) 714/2009 – “In order to ensure greater transparency regarding the entire electricity transmission network in the [Union], the ENTSO for Electricity should draw up, publish and regularly update a non-binding [Union]-wide ten-year network development plan”

Transparency

TSO cooperation platform

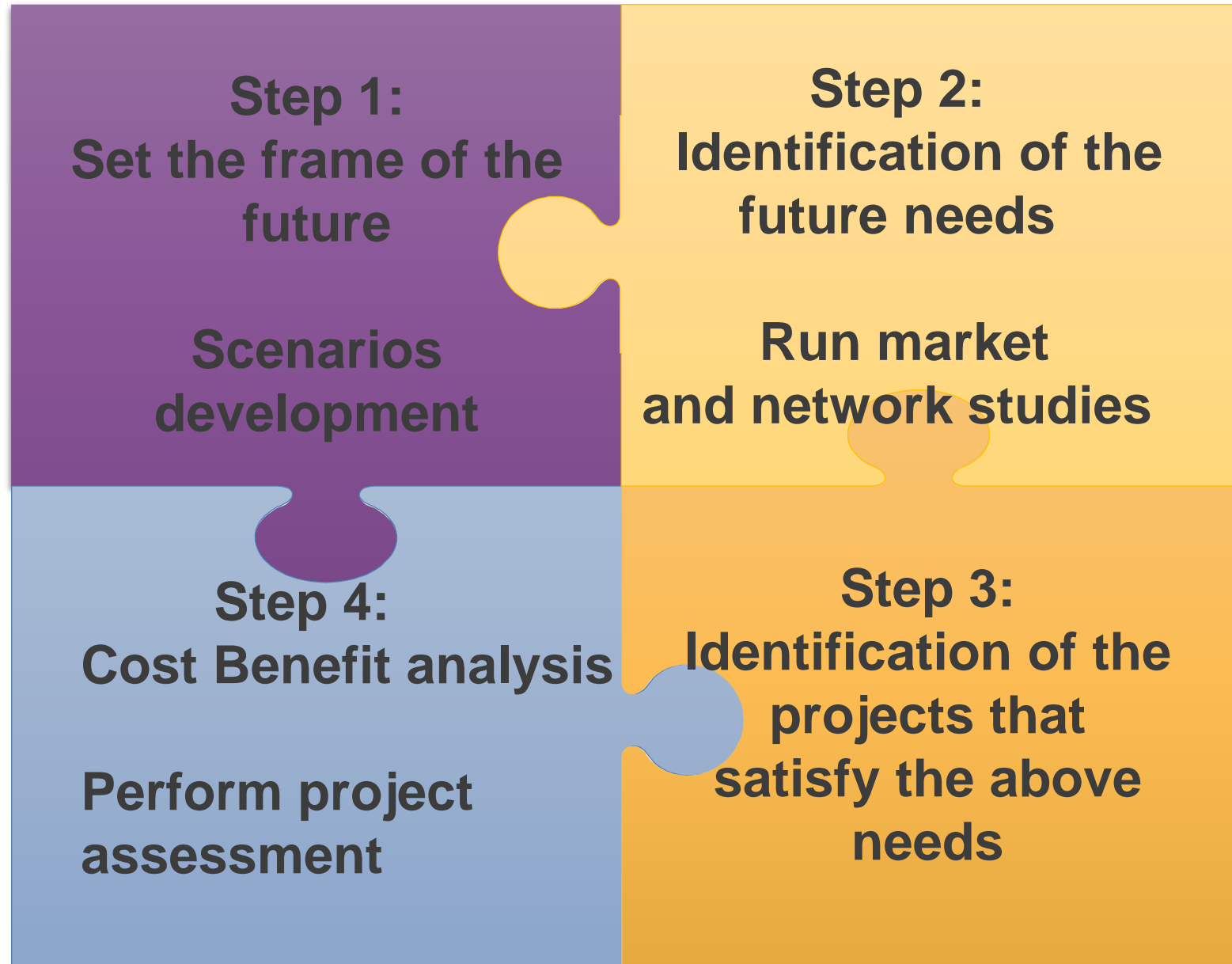
Stakeholder involvement

Inform EU policy and investment decisions

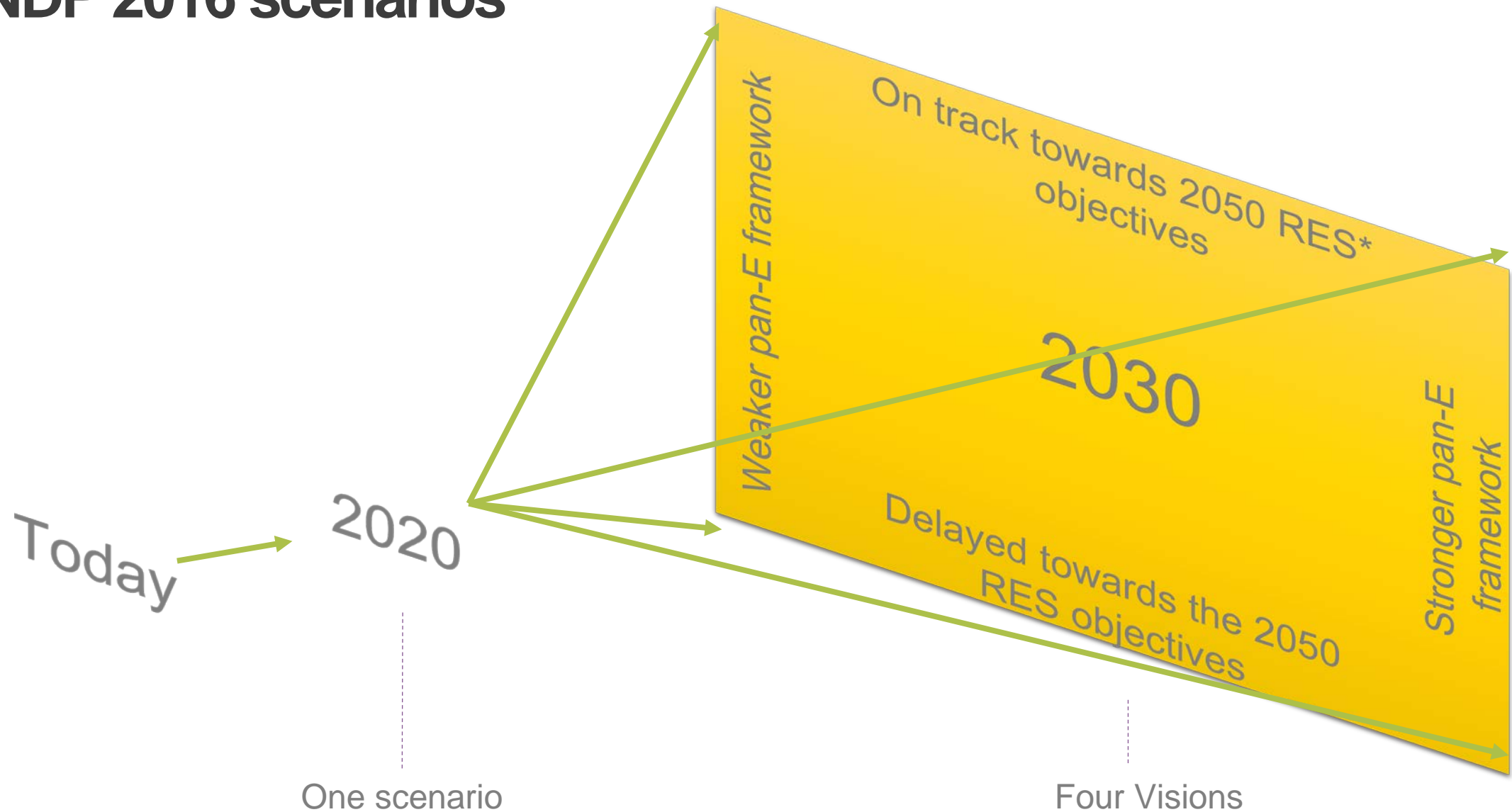


Grid planning

From framing
the future to
specific
projects



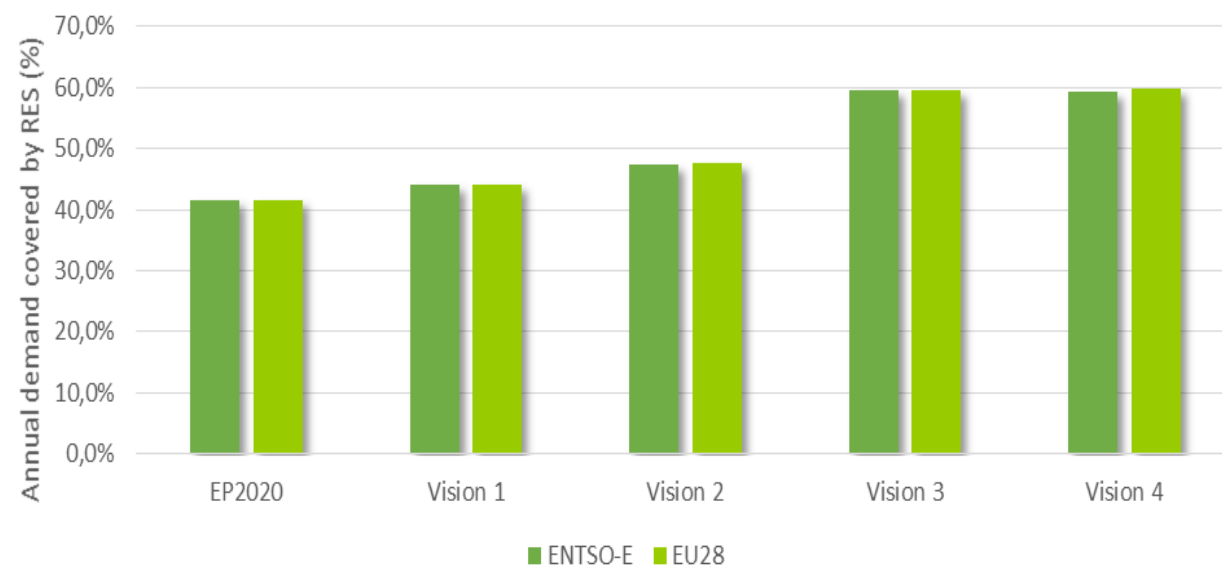
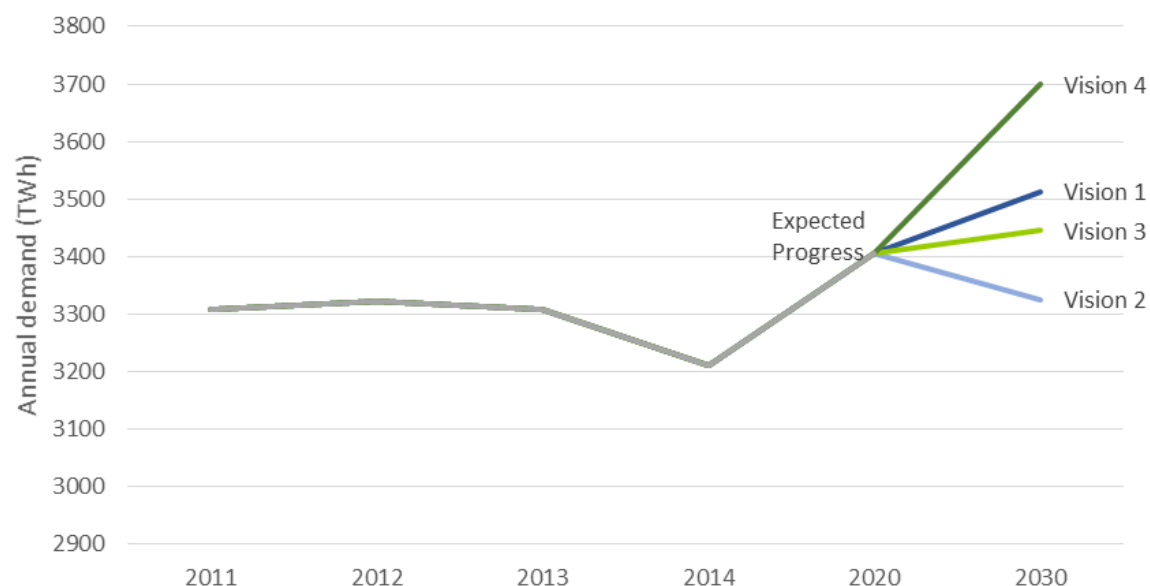
TYNDP 2016 scenarios



European demand – covered up to 60% by RES in 2030

Annual demand covered by RES

Demand across all scenarios



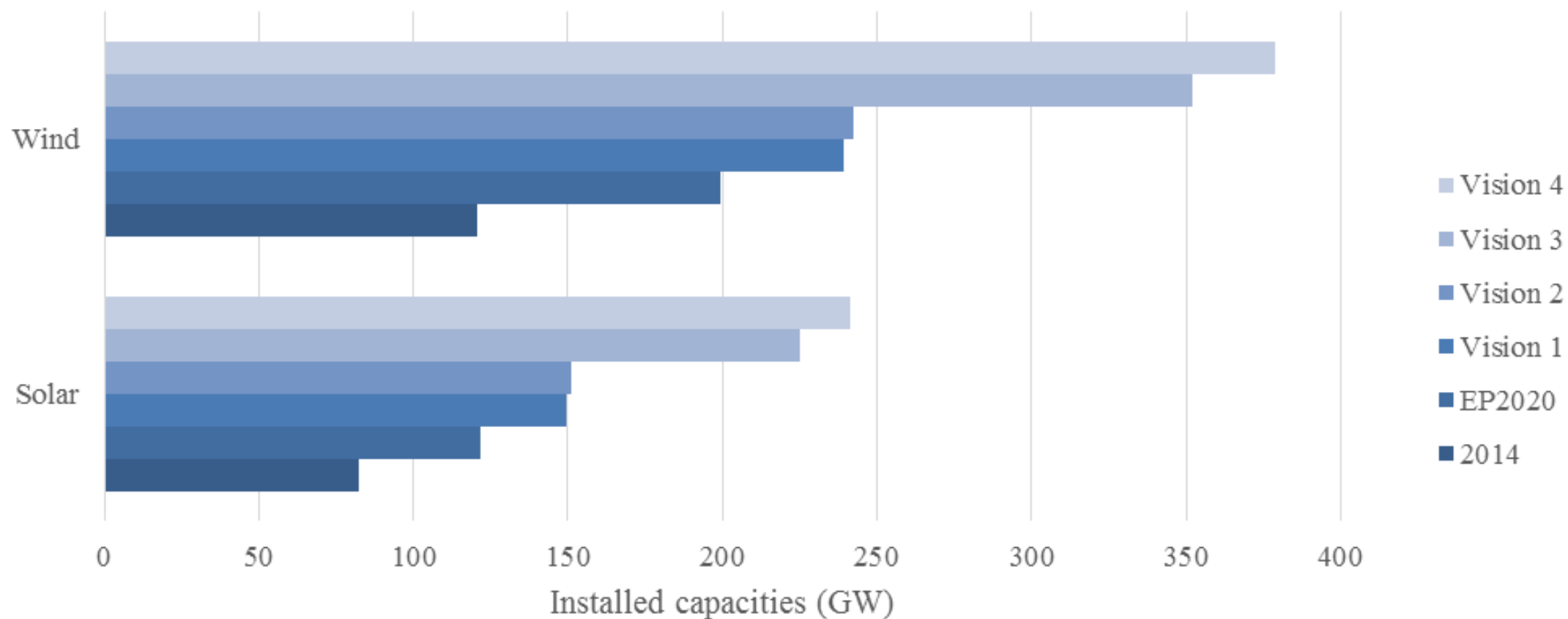
ENTSO-E:

EU28:

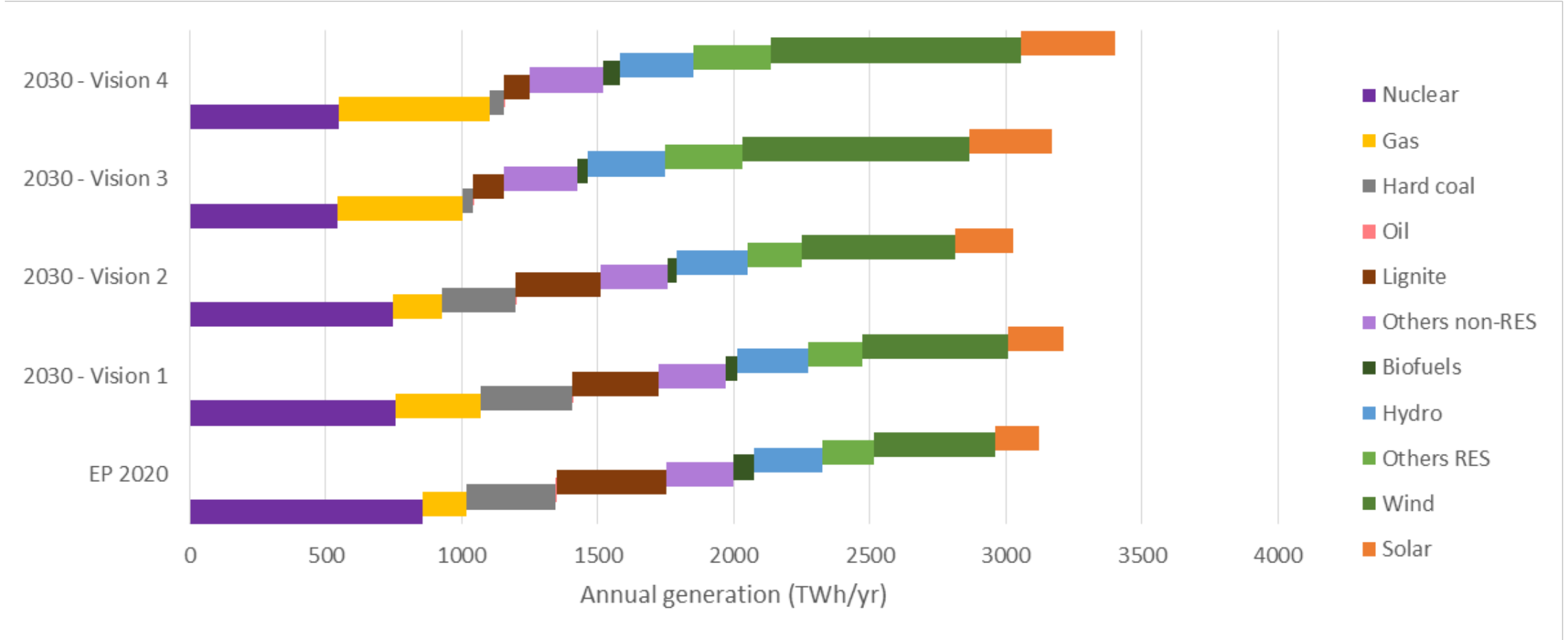
covers 34 countries of ENTSO-E members

covers 28 EU Member States

Wind/PV across all scenarios

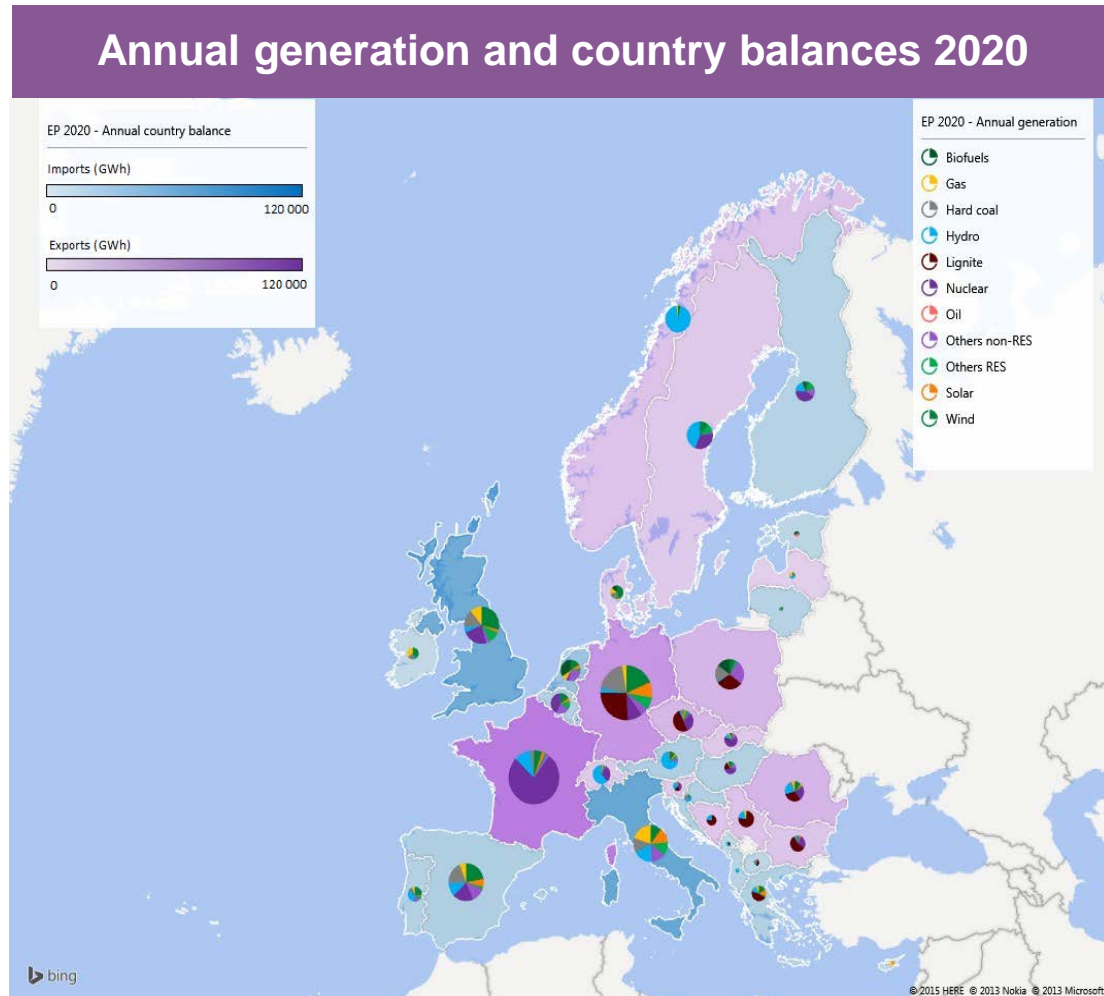


TYNDP scenarios: a wide range of plausible futures

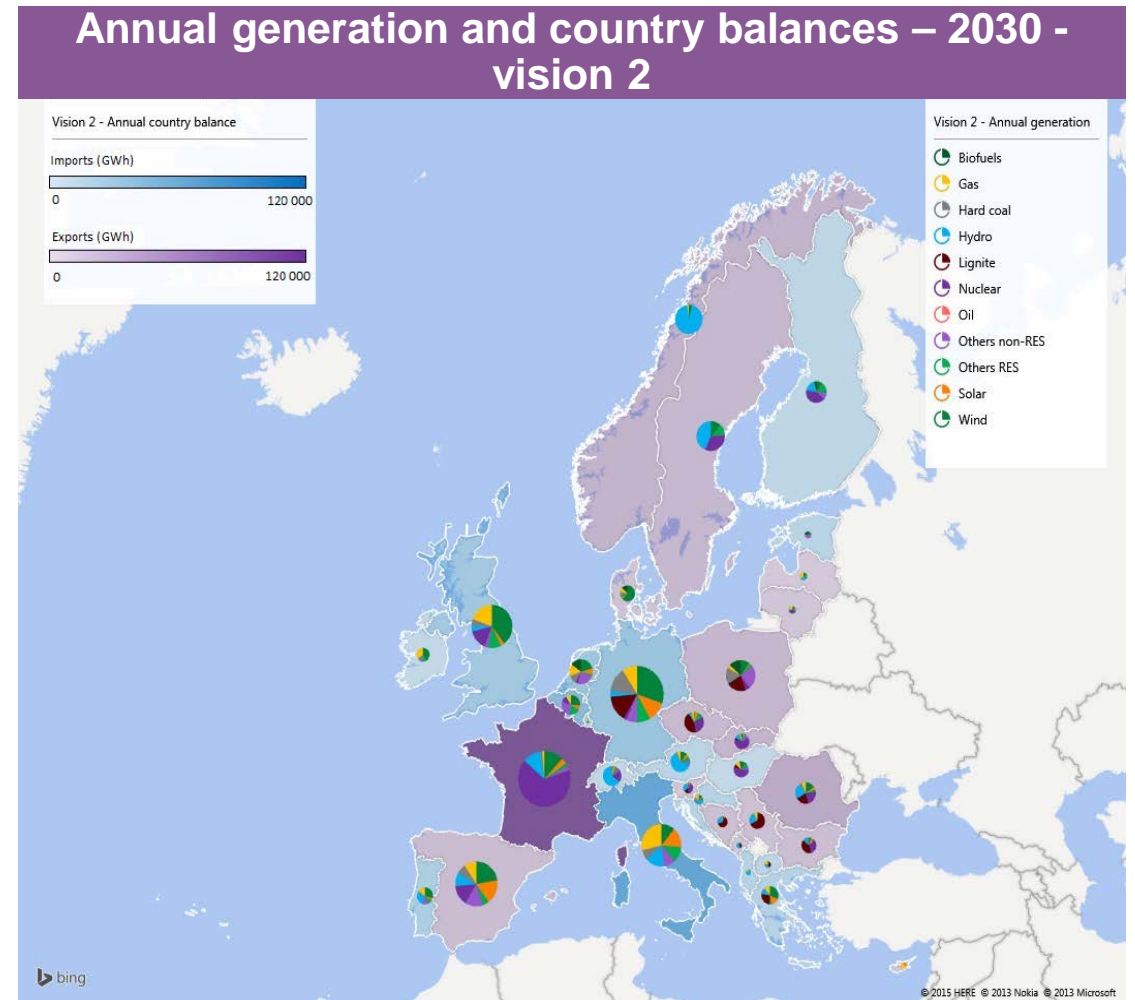
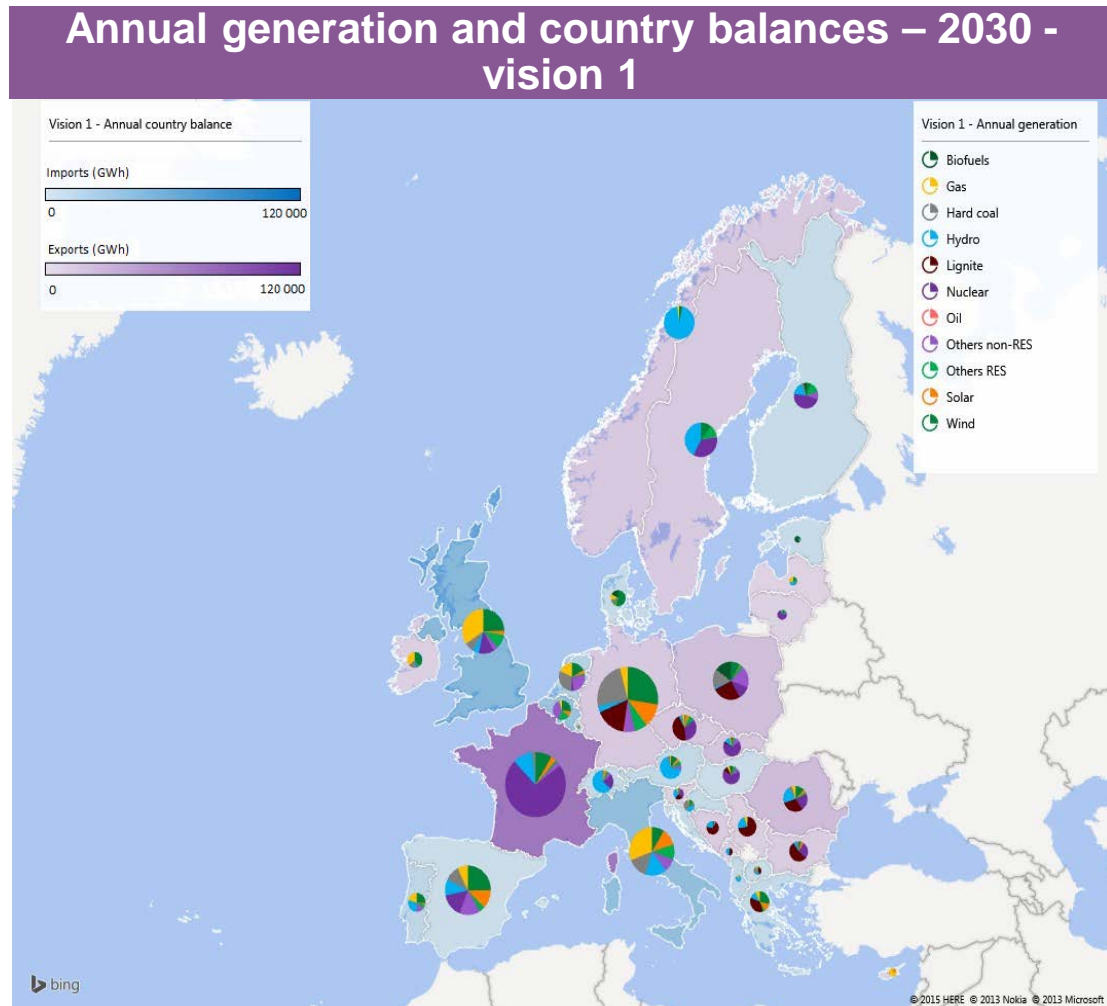


Annual generation in each scenario – breakdown per technology class

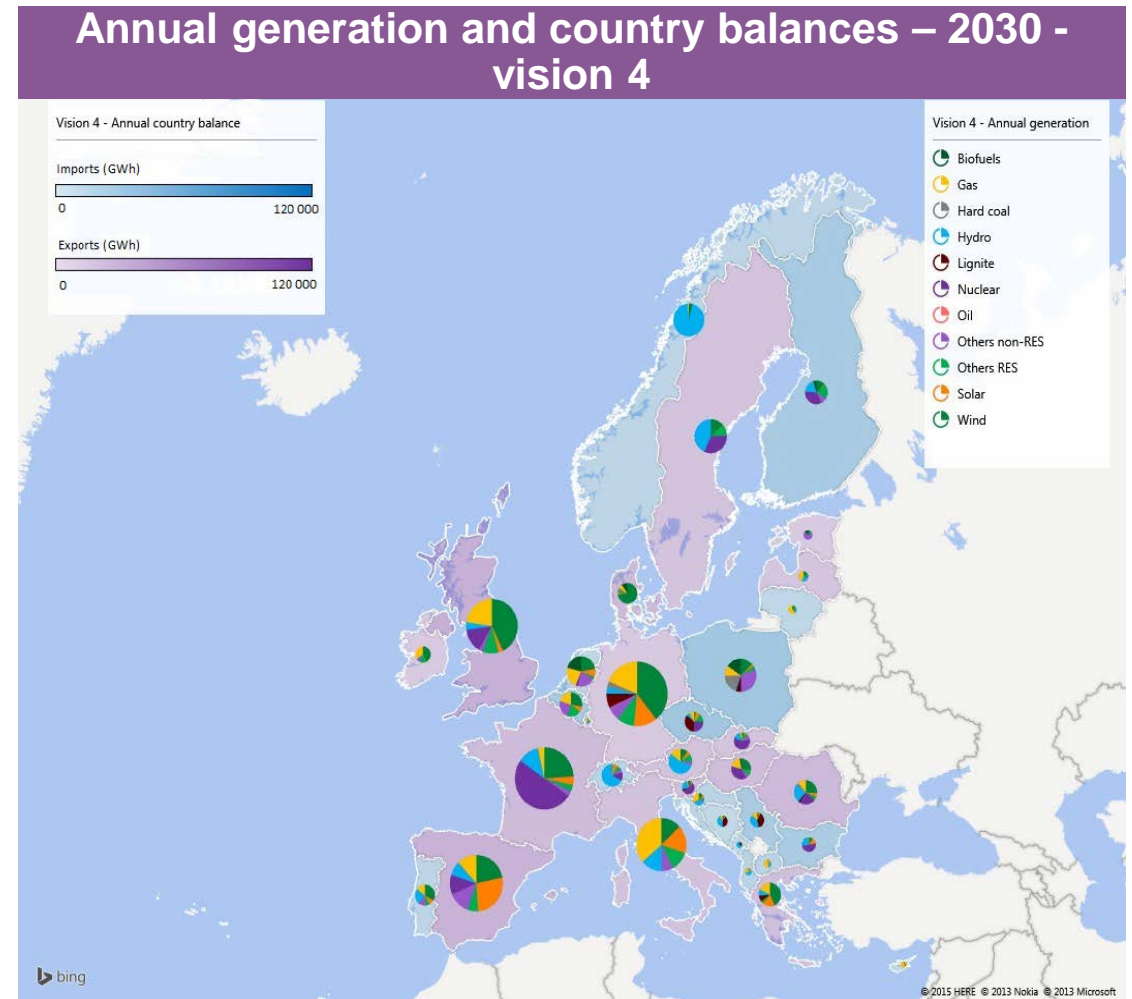
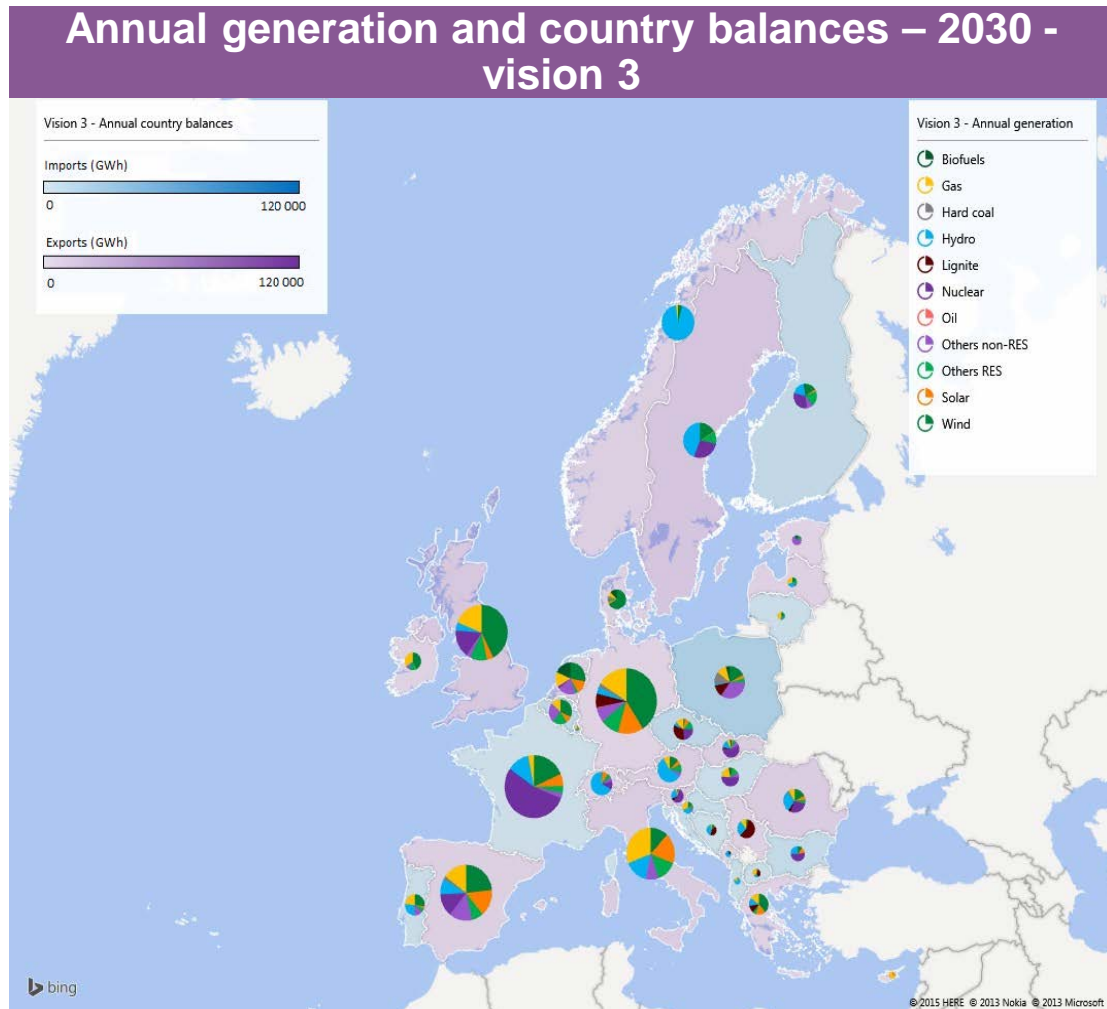
2020 expects significant shift in generation mix and high flows across Europe



2030 expects significant shift in generation mix and high flows across Europe



2030 expects significant shift in generation mix and high flows across Europe



Network codes and TYNDP work together



Connection codes

DCC: Demand connection

HVDC: Grid connection of high voltage direct current systems and direct current-connected power park modules

RfG: Requirements for grid connection of generators

Operation Codes

ER: Electricity emergency and restoration

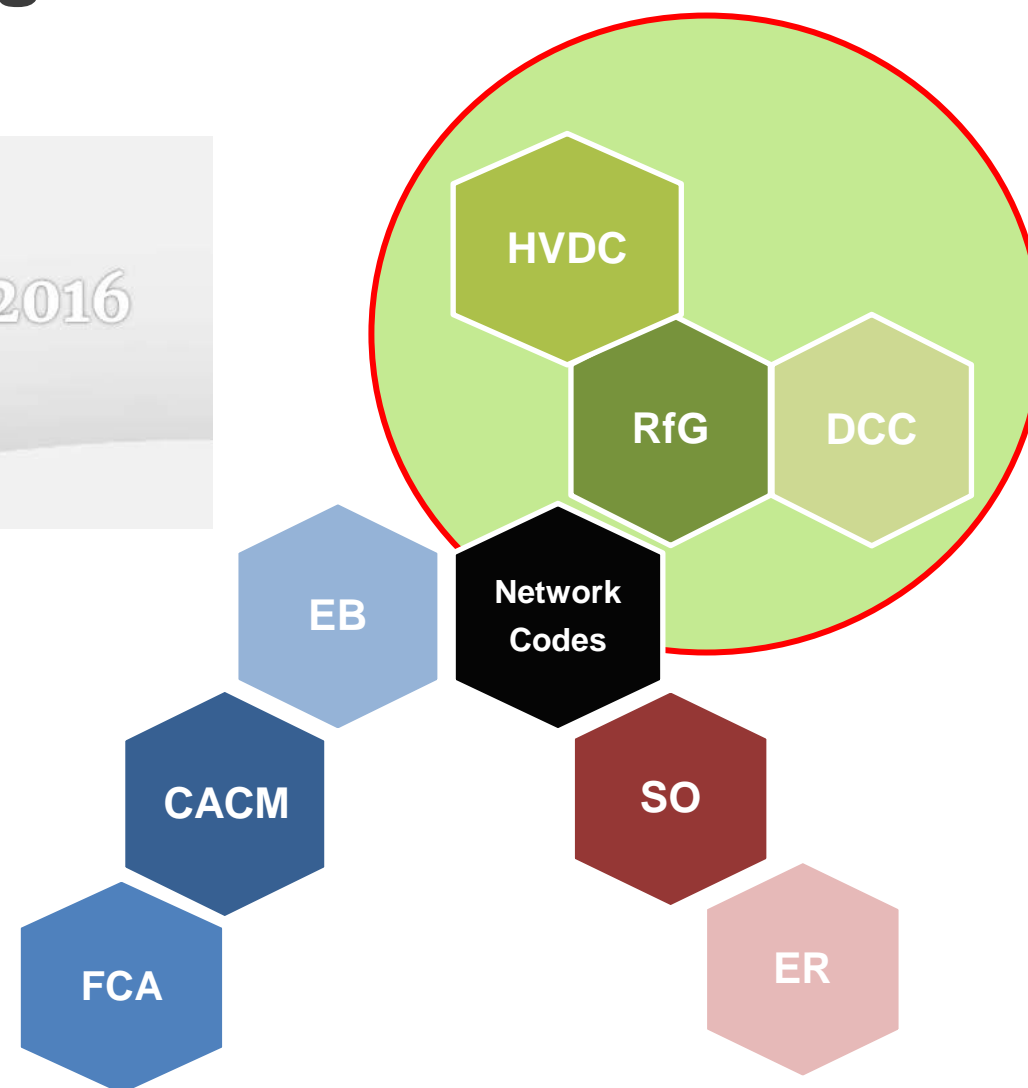
SO: Electricity transmission system operation

Market Codes

CACM: Capacity allocation and congestion management

EB: Electricity balancing

FCA: Forward capacity allocation



What problems are to be tackled by/in 2030

Structural change of generation portfolio

- changes of market prices and of price spreads between countries
- changes of generation adequacy
- changes of generation dispatch patterns
- changes of customers' access to most economic energy mix

Interconnected systems

- Irish Island to British Island and to Continental Europe
- British Island to Continental Europe and Scandinavia
- Scandinavia to Continental Europe

Integration of increased instantaneous RES penetration

High & more variable bulk power flows

- transits through highly meshed CWE grid
- create / increase grid congestions

Decreasing flexibility and system stability

- Lack of balancing energy / controllability to maintain system stability and frequency equilibrium
- Decreasing Inertia in synchronous areas
- Scarce infrastructure

European Codes/Guidelines to mitigate these problems

Market integration issues -> market guidelines
Connection network codes

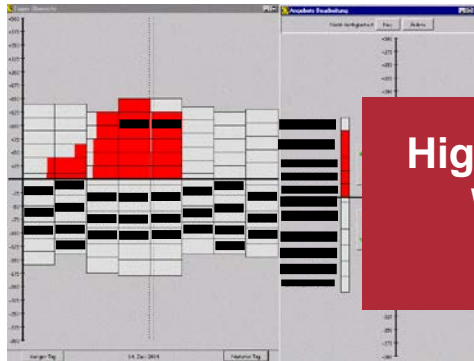
Market integration issues -> market guidelines
Connection network codes

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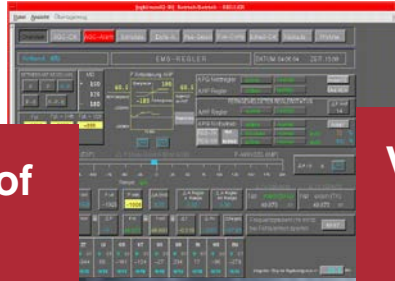
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System operation guidelines

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System operation guidelines

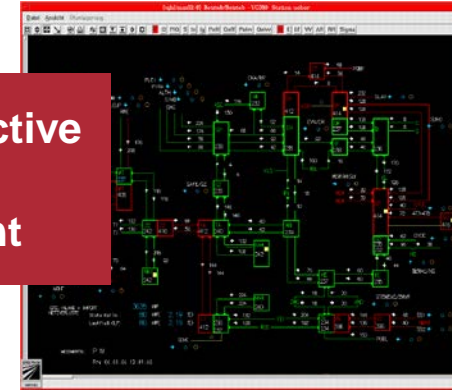
Efficiently operating the power system – it's getting harder!



**High Penetration of
Wind & Solar
Generation**



**Voltage & Reactive
Power
Management**

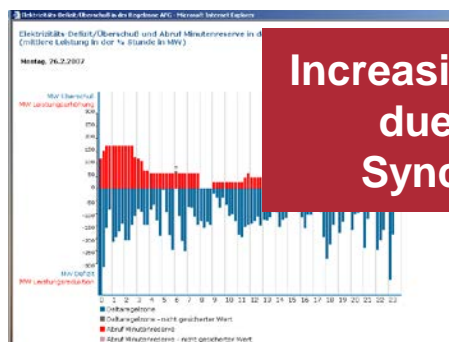


**Delays in Grid
Reinforcements**

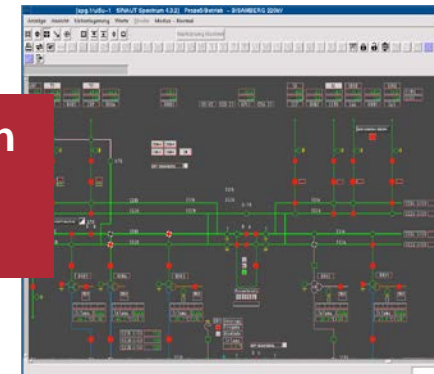
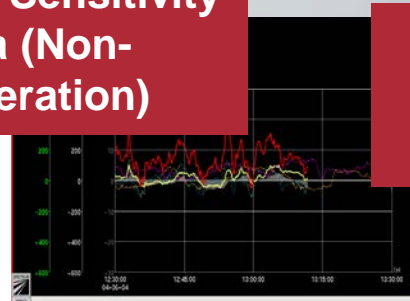
**Remote Generation and
Market-Driven Power
Flows**



**Increasing Frequency Sensitivity
due to less Inertia (Non-
Synchronous Generation)**

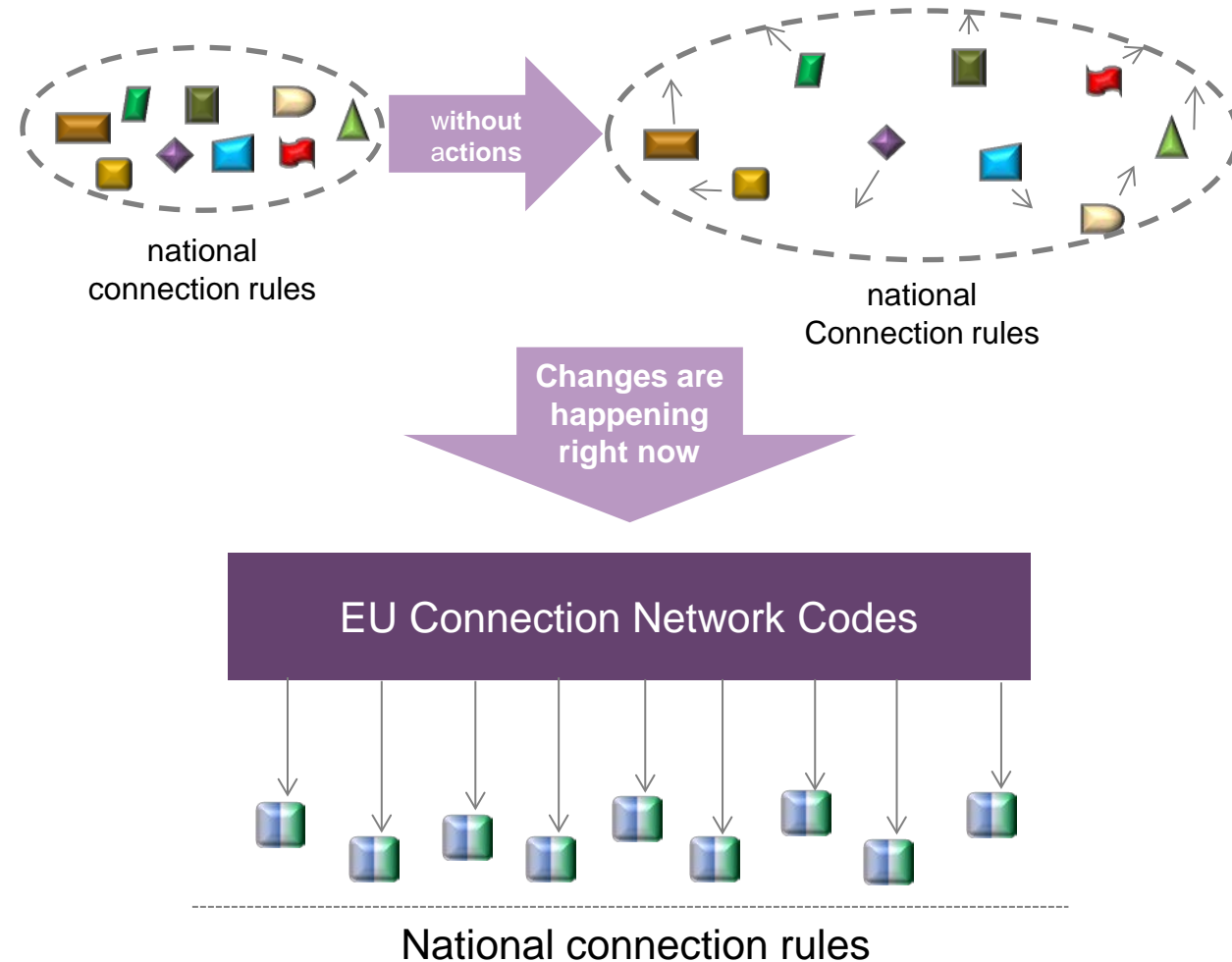


**Priority Dispatch
of Renewable
Generation**

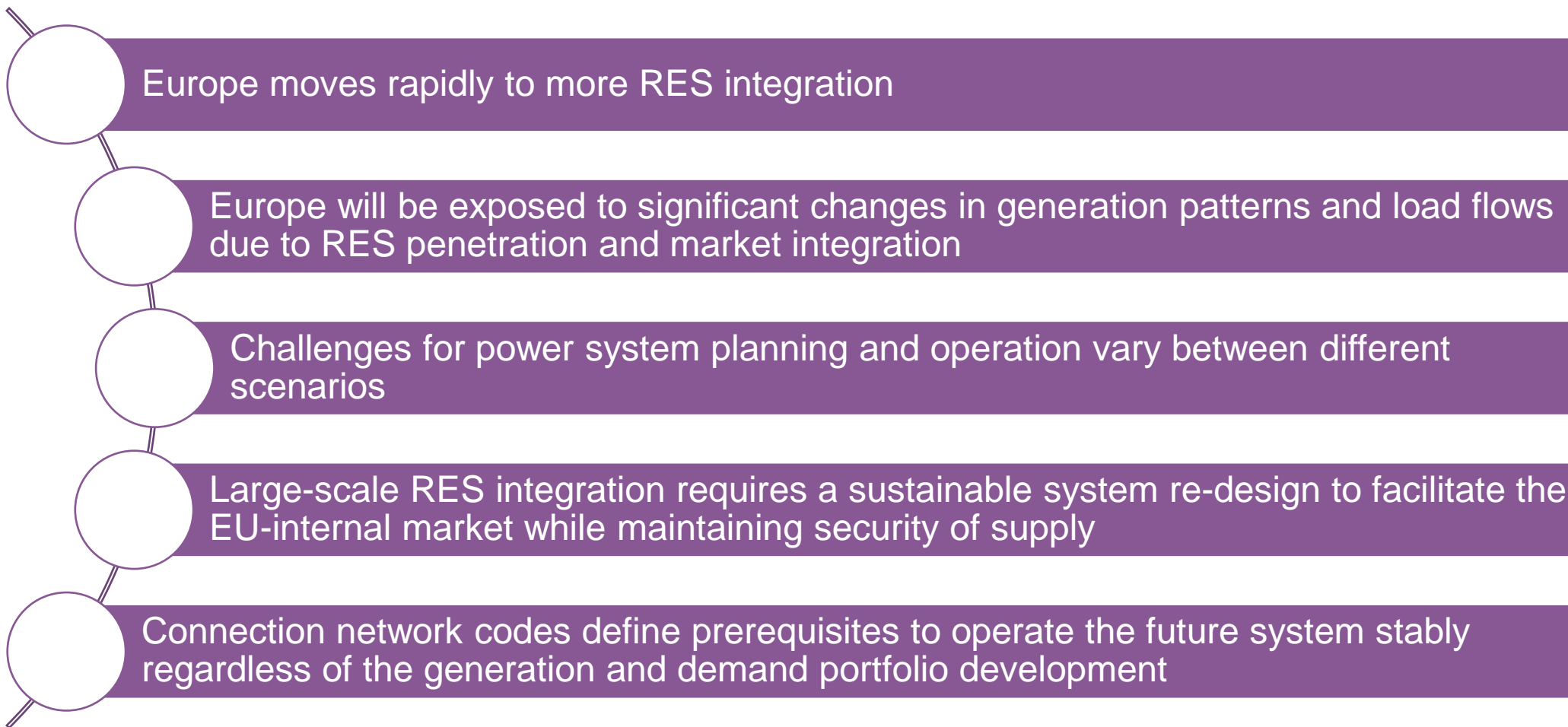


NC RfG – What are the key principles?

- Coping with a long-term **time horizon**
- Tolerance to varying **scenario developments**
- Balancing **European** harmonized settings and **regional** specificities
- **Proportional** approach from smallest demand/generation to largest plants and industrial loads



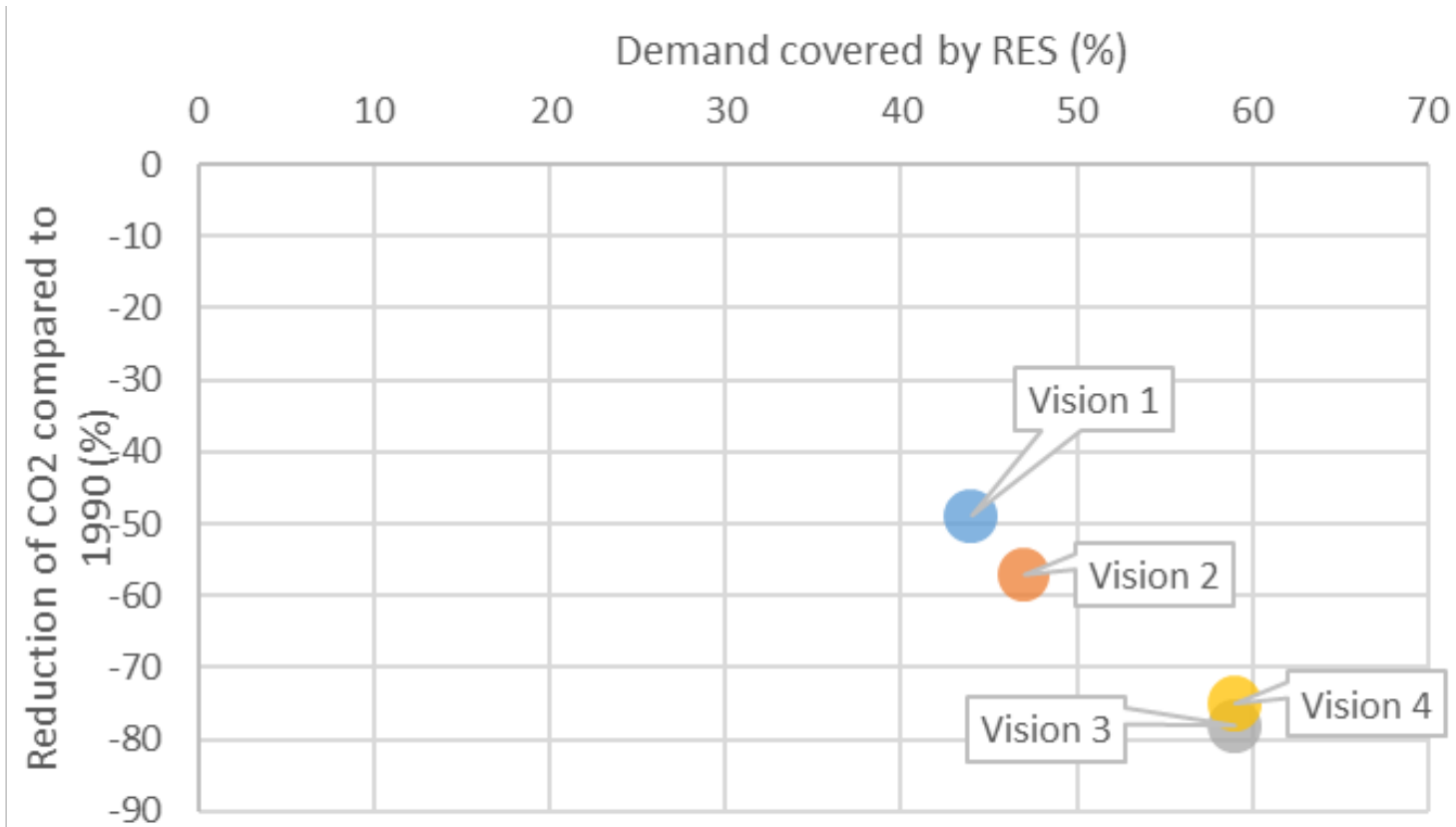
Conclusions



Back-up slides

	Slowest progress	Constrained progress	National green transition	European green revolution
	V1	V2	V3	V4
Economic and financial conditions	Least favourable	Less favourable	More favourable	Most favourable
Focus of energy policies	National	European	National	European
Focus of R&D	National	European	National	European
CO ₂ and primary fuel prices	low CO ₂ price, high fuel price	low CO ₂ price, high fuel price	high CO ₂ price, low fuel price	high CO ₂ price, low fuel price
RES	Low national RES (>= 2020 target)	Between V1 and V3	High national RES	On track to 2050
Electricity demand	Increase (stagnation to small growth)	Decrease compared to 2020 (small growth but higher energy efficiency)	stagnation compared to 2020(Increase (growth demand)
Demand response (and smart grids)	As today	Partially used	Partially used	Fully used
Electric vehicles	0%	5%	5%	20%
	No commercial break through of electric plug-in vehicles	Electric plug-in vehicles (flexible charging)	Electric plug-in vehicles (flexible charging)	Electric plug-in vehicles (flexible charging and generating)
Heat pumps	0%	5%	5%	10%
	Minimum level	Intermediate level	Intermediate level	Maximum level
Adequacy	1%	5%	5%	9%
	National - not autonomous limited back-up capacity	European - less back-up capacity than V1	National - autonomous high back-up capacity	European - less back-up capacity than V3
Merit order	Coal before gas	Coal before gas	Gas before coal	Gas before coal
Storage	As planned today	As planned today	Decentralized	Centralized

TYNDP scenarios: a wide range of plausible futures



All 2030 Visions matching the renewables objectives of the electricity system.
(V1-2 and V3-4 show a strong differentiation in spatial distribution of generation)