WHAT, WHY, HOW - UNDERSTAND IN A NUTSHELL THE FINAL 2015 REGIONAL INVESTMENT PLANS, TYNDP 2016 SCENARIOS AND PROJECTS LIST

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Reliable Sustainable Connected

ENTSO-E Public webinar, 16 December 2015

Overview TYNDP 2016 activities

Regional Investment Plans

Next steps TYNDP 2016

Questions and Answers session

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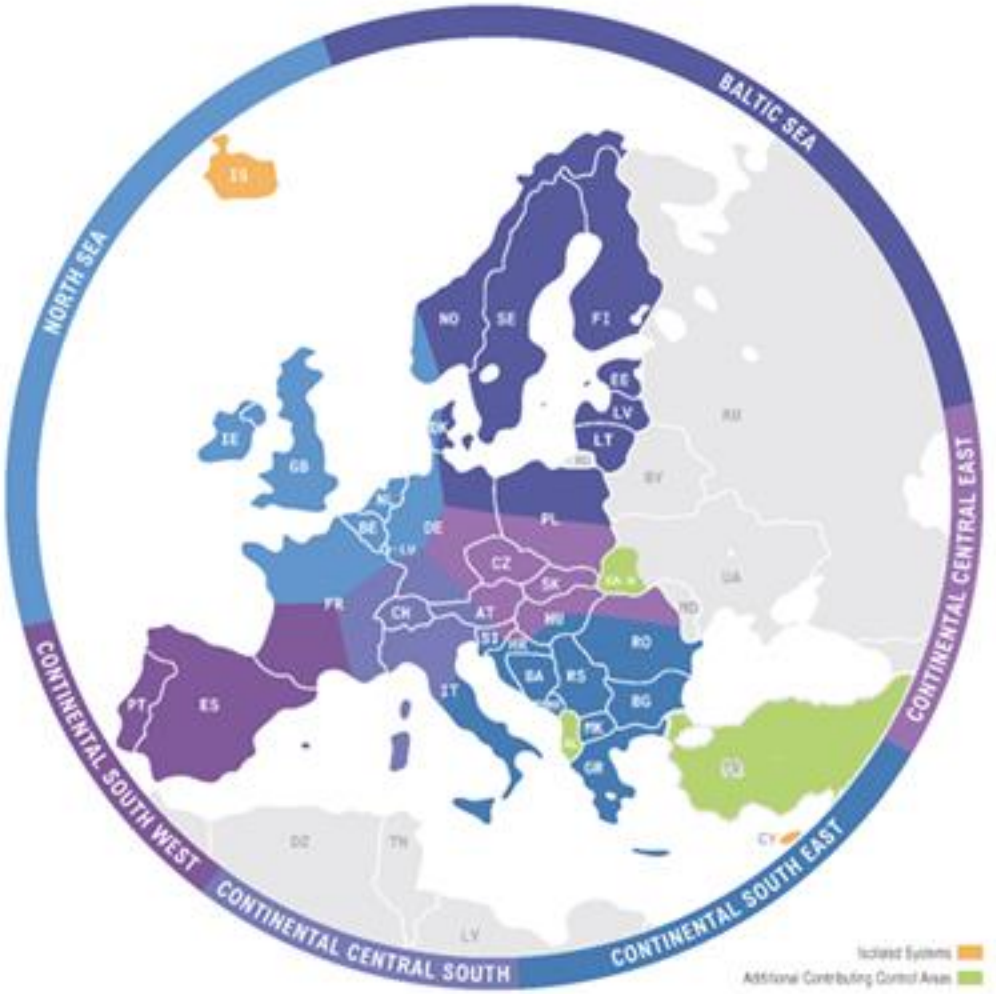
Overview TYNDP 2016 activities

Edwin Haesen, TYNDP 2016 Project Management Office

- **Objectives**
- **Timeline for all deliverables**
- **Ongoing project assessments**



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TYNDP2016 objectives

- Explore and explain a vision of the future power system
- Highlight investment needs based on coordinated regional planning studies
- Assess cost/benefits of projects of pan-European relevance in a transparent and non-discriminatory manner
- Provide data, assumptions, methodologies

TYNDP2016 timeline

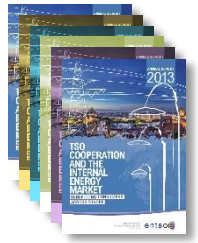
		2015				2016			
Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4

Scenario development

Scenario Development Report

Coordinated planning

Regional Investment Plans & draft list
TYNDP2016 Project Candidates



Project identification

CBA assessments

Final TYNDP2016

Public consultation

TYNDP2016 deliverables

Scenarios	• Storylines of possible futures • Methodologies
Regional Investment Plans	• Planning studies • Regional context
Project list	• Descriptions • Technical characteristics • Classification
Data sets	• Market (generation, demand) • Grid models (TYNDP2014)
TYNDP2016 report	• Project CBA assessments • System analyses • Vision

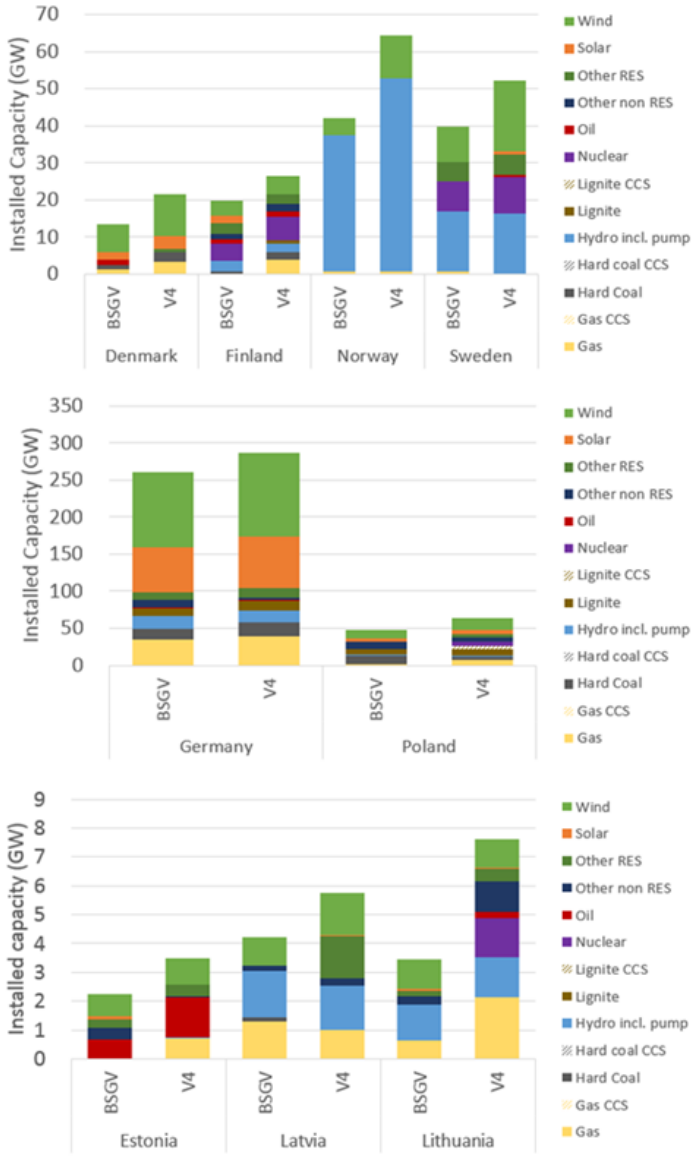
Planning studies

Scenarios and sensitivities

Market-based target capacities

Network studies

Investment needs & Project candidates



Illustrative example for BS region

Planning studies

Scenarios and sensitivities

↓

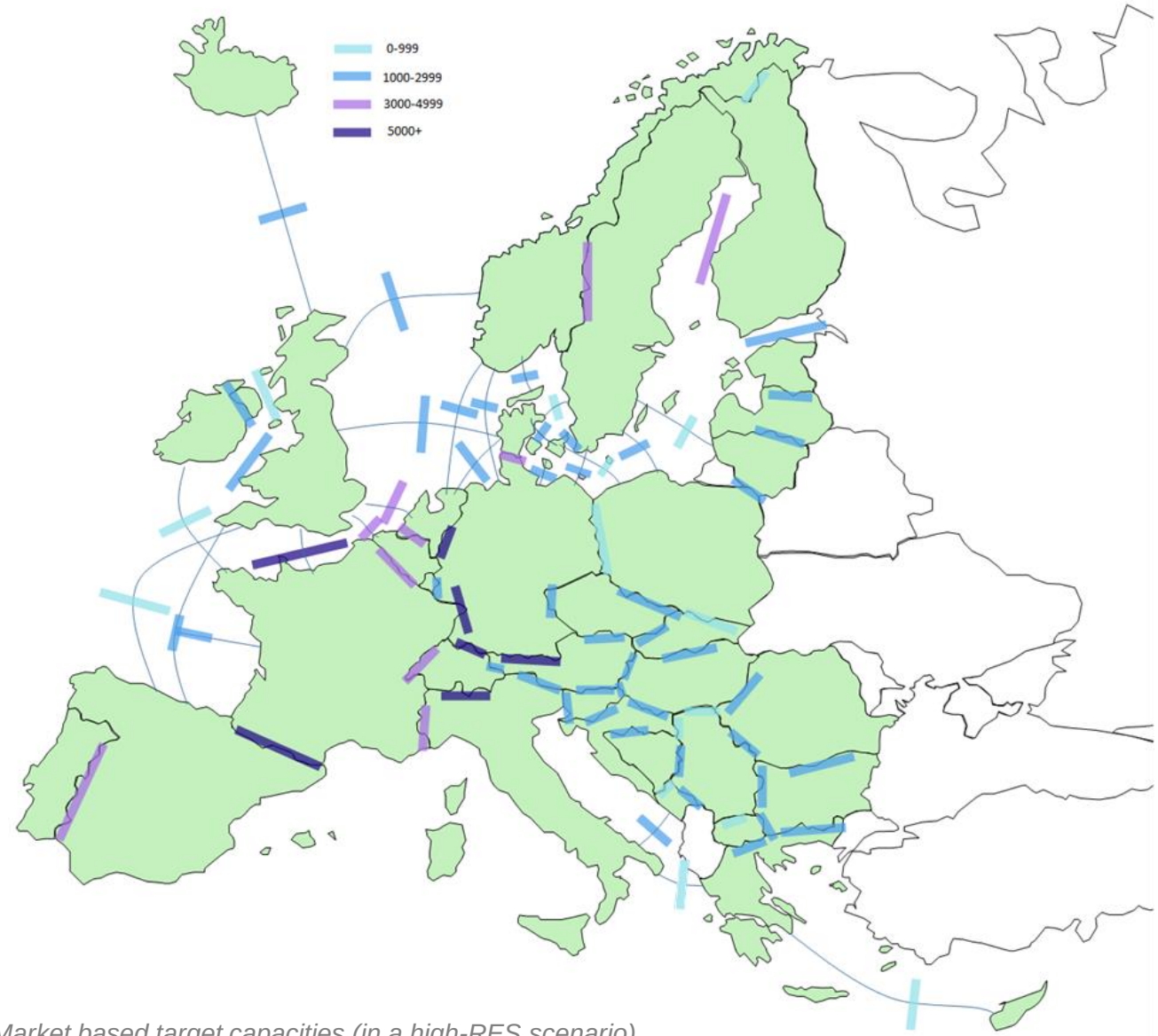
Market-based target capacities

↓

Network studies

↓

Investment needs & Project candidates



Market based target capacities (in a high-RES scenario)

Planning studies

Scenarios and sensitivities

↓

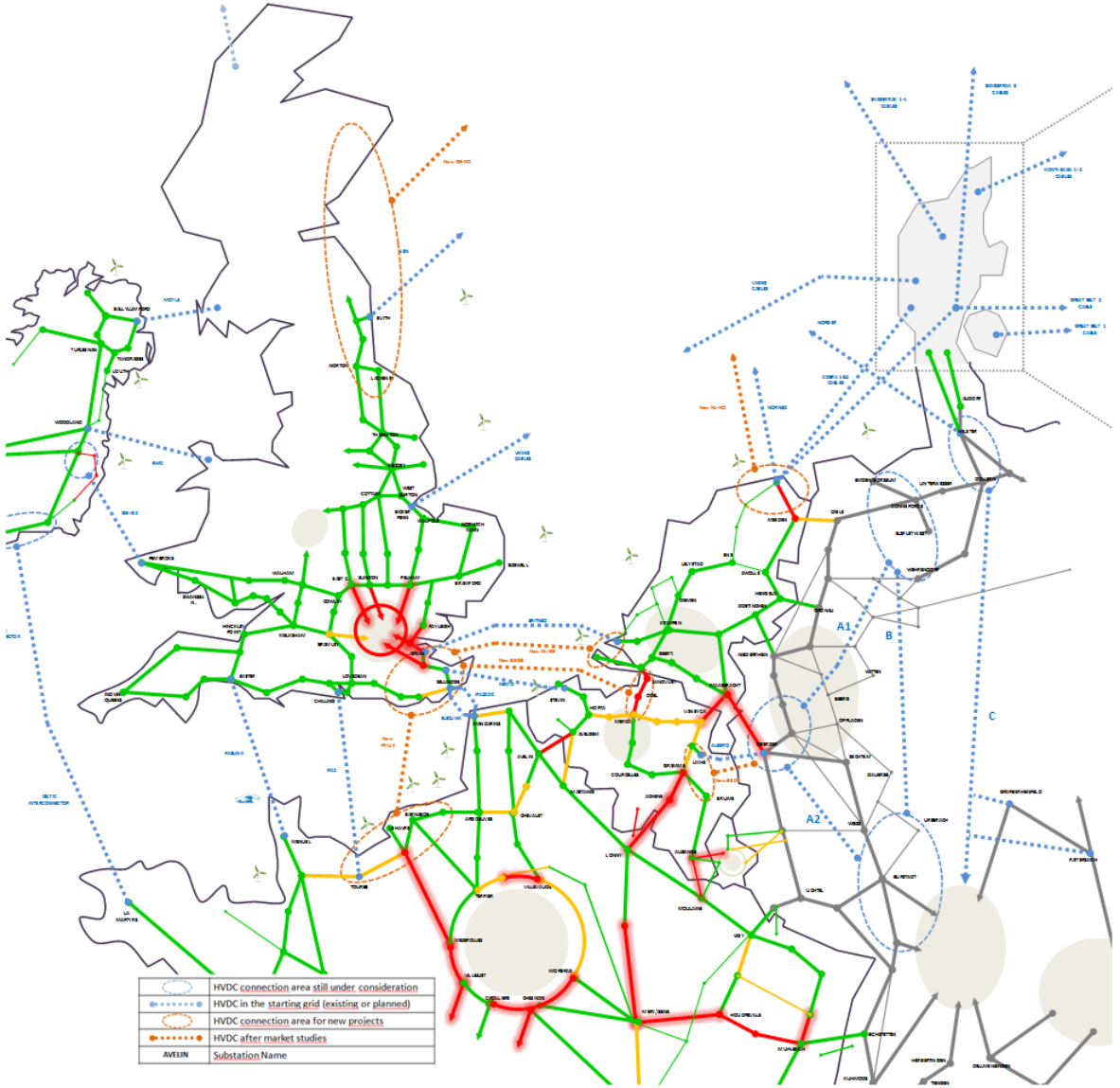
Market-based target capacities

↓

Network studies

↓

Investment needs & Project candidates



Example of North Sea region

Planning studies

Scenarios and sensitivities

↓

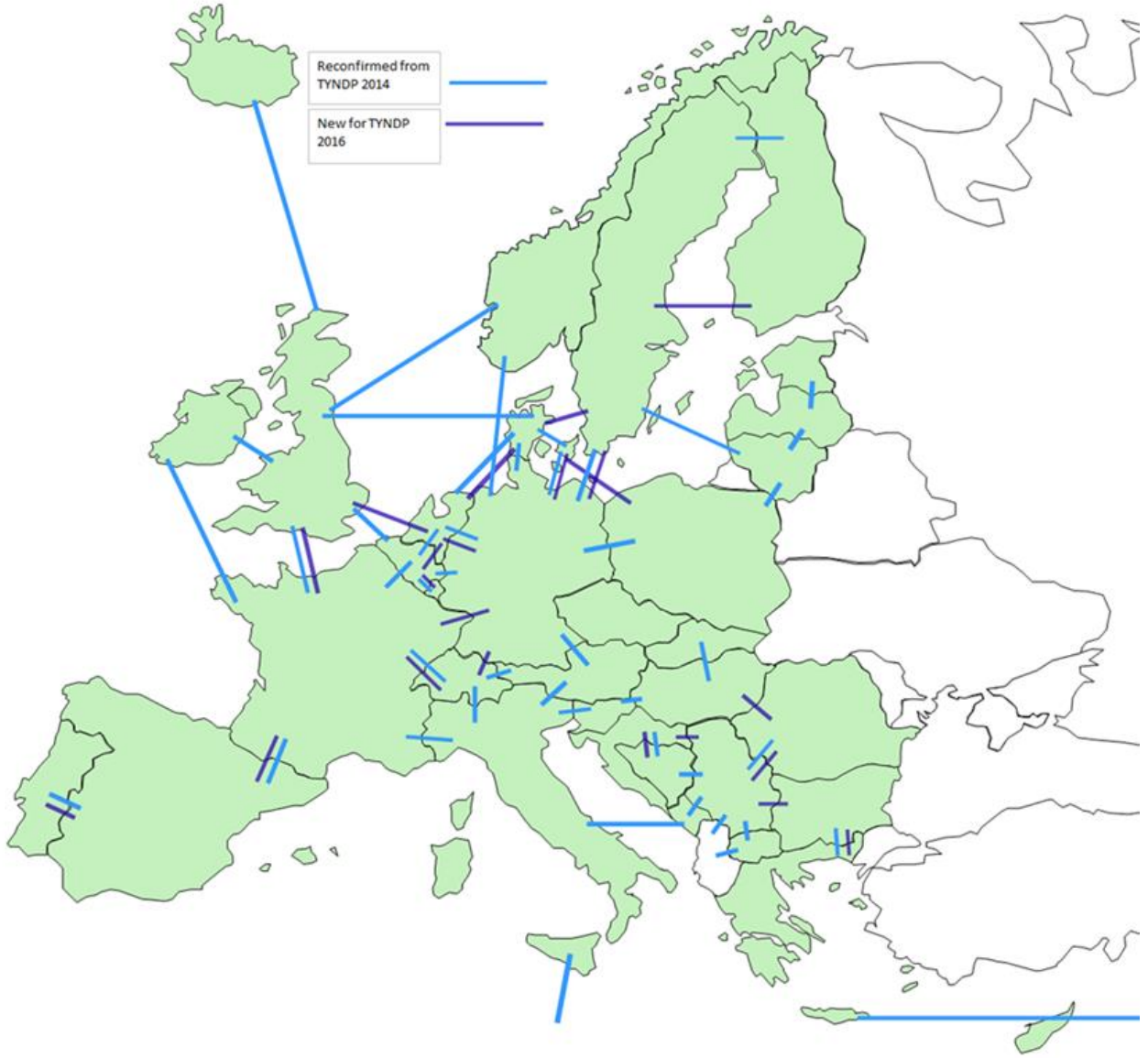
Market-based target capacities

↓

Network studies

↓

Investment needs & Project candidates

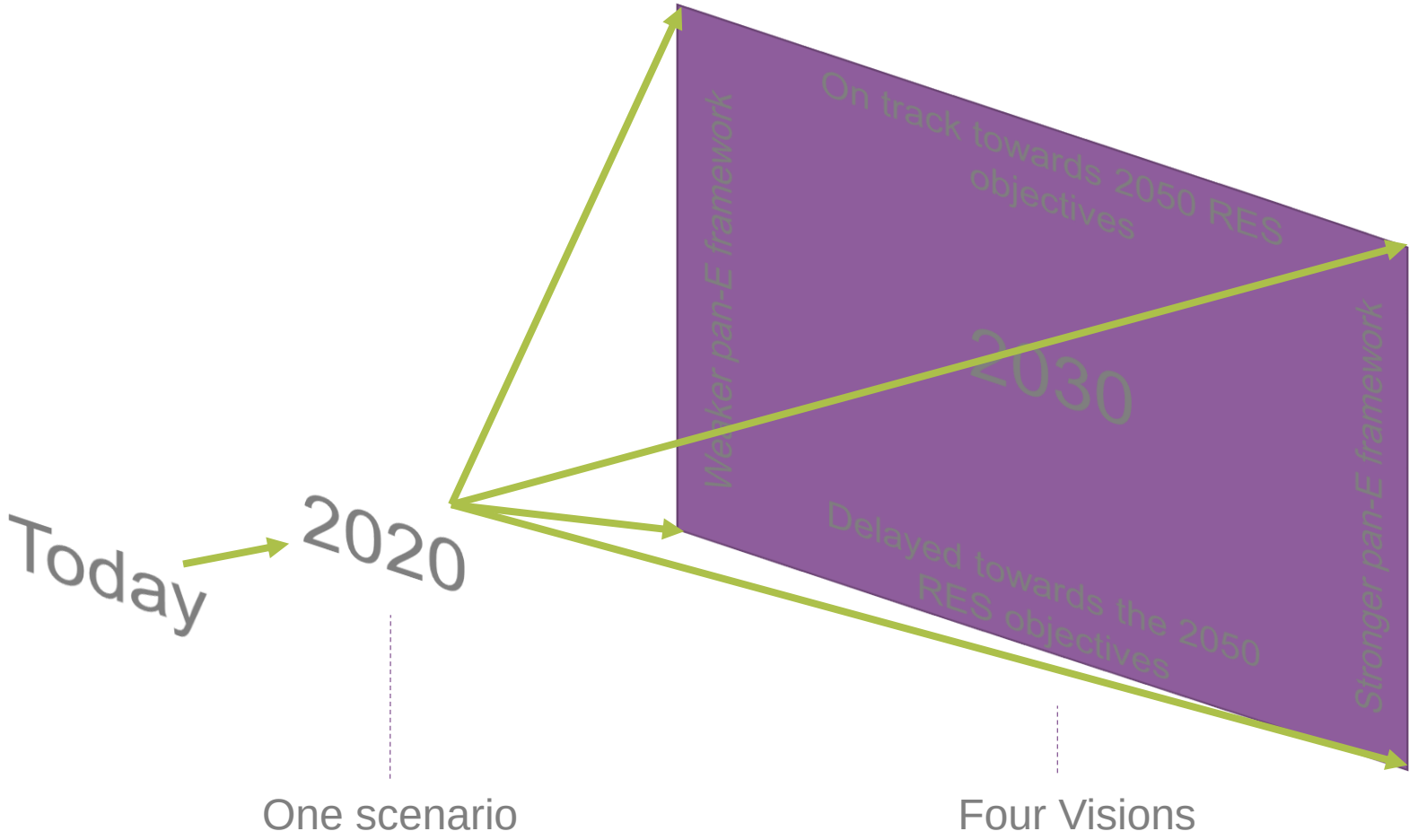


Note: map focuses on cross-border projects only

Scenario building – framing the uncertainty

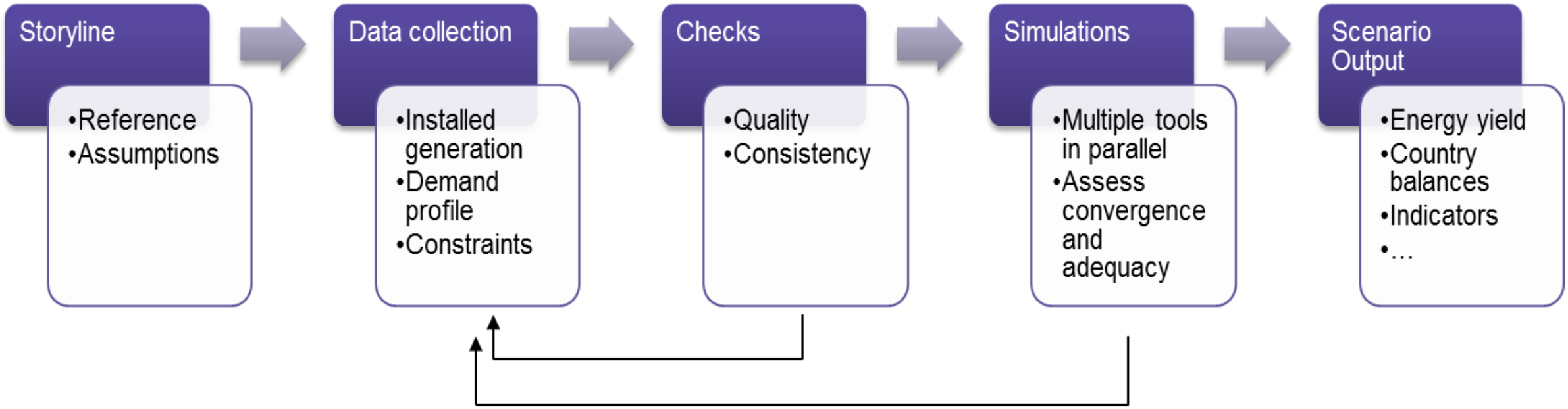
- How will 2020 and 2030 look like?
- What parameters to consider (demand, technology, policies)?
- How to deal with inherent uncertainties?

The further you look, the more scenarios we need to ensure a robust study framework



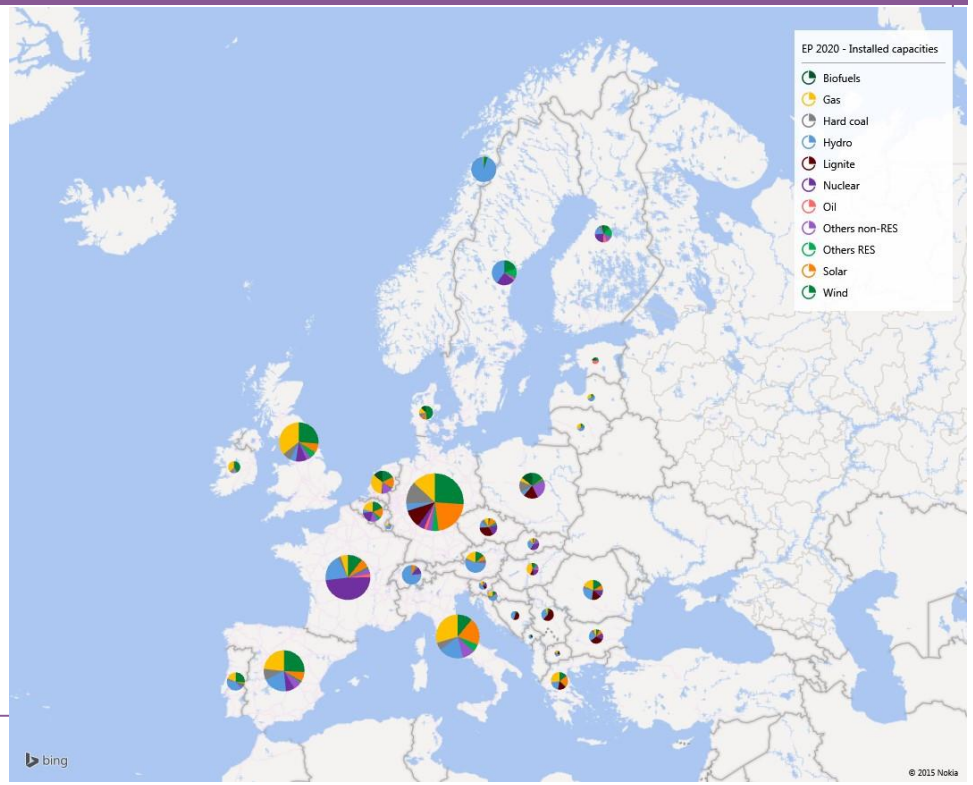
Scenario building – methodology

- What do you need to build scenarios?
- How do you handle complexity?
- What do you get out of it?

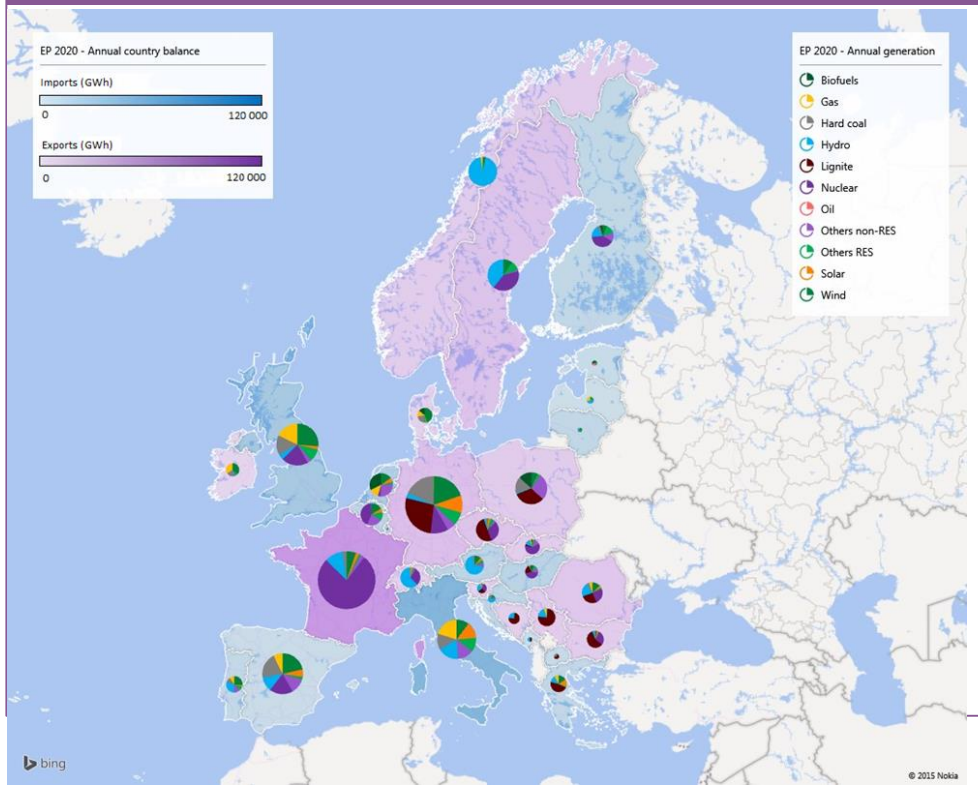


Scenario building – Examples of outputs (I)

Installed capacities

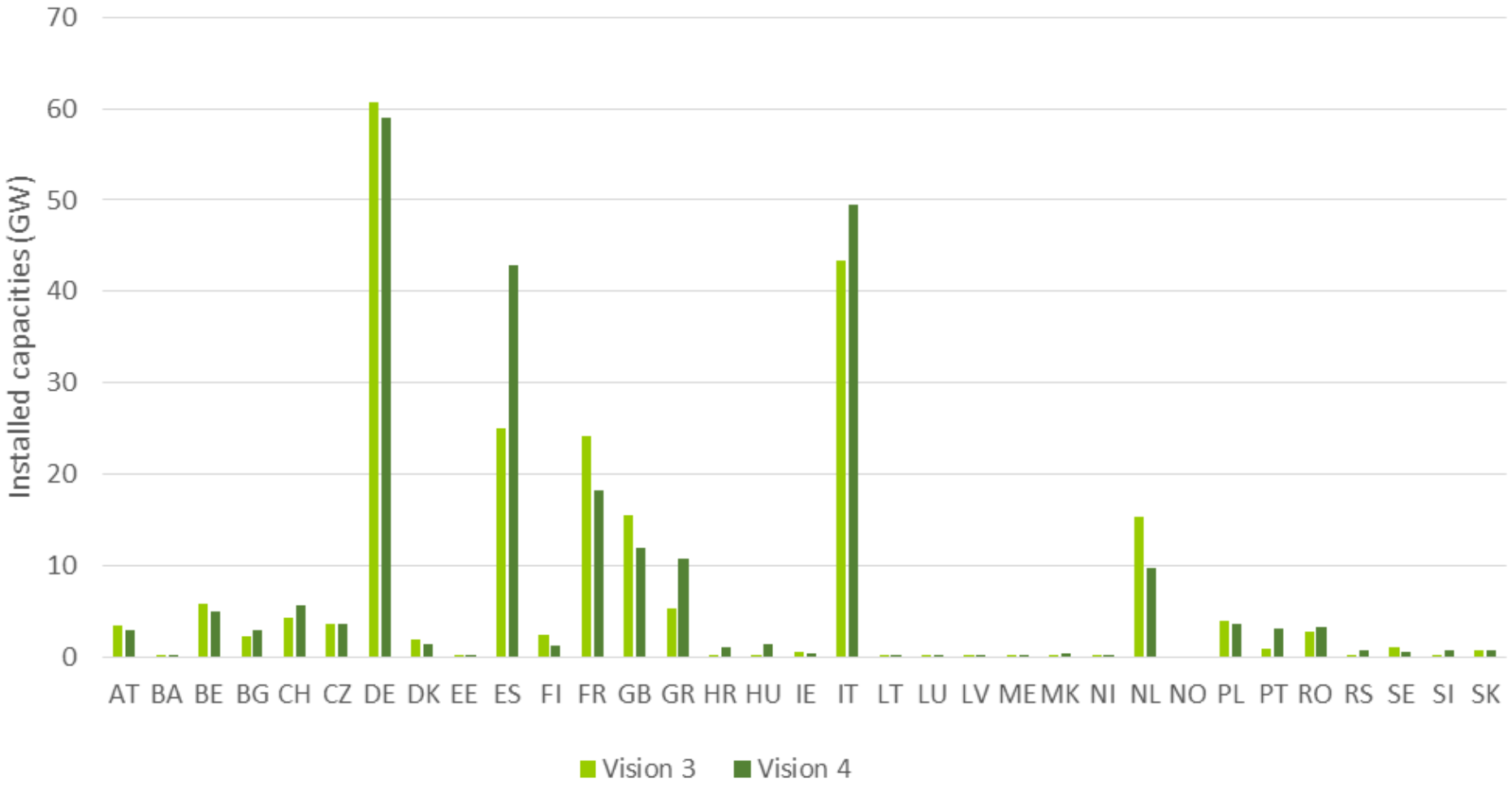


Generation and country balances



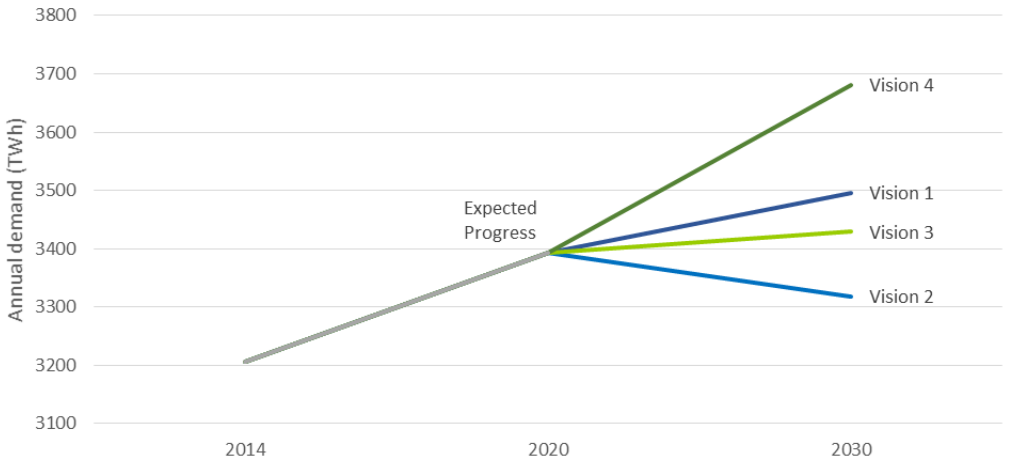
Scenario building – Examples of outputs (II)

PV re-allocation from Vision 3 to Vision 4

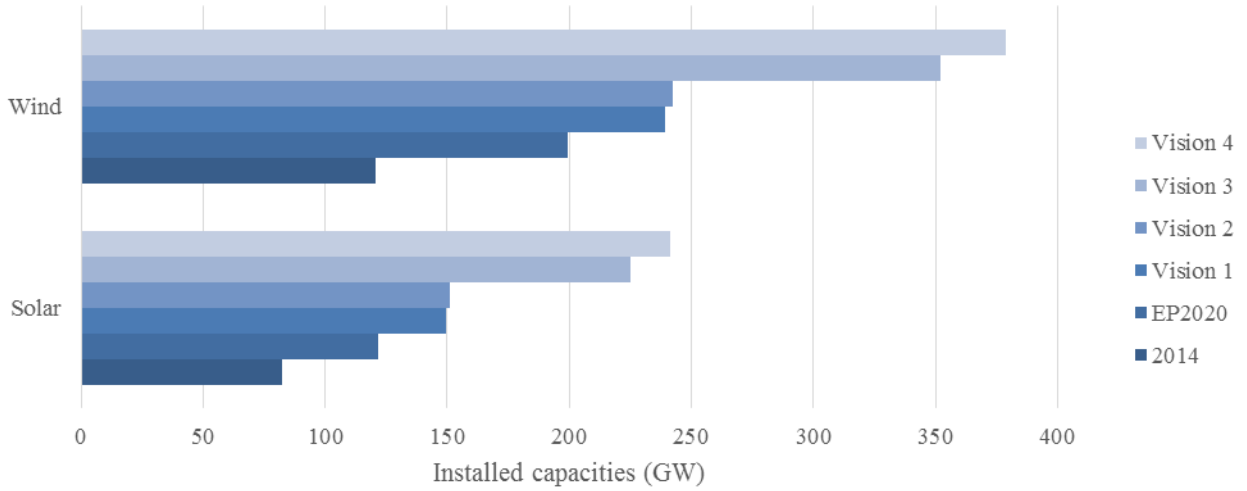


Scenario building – Examples of outputs (III)

Demand across all scenarios



Wind/PV across all scenarios



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Overview TYNDP 2016 activities

Regional Investment Plans

Next steps TYNDP 2016

Questions and Answers session

1 Regional Group Baltic Sea

2 Regional Group North Sea

3 Regional Group Continental Central East

4 Regional Group Continental South West

5 Regional Group Continental Central South

6 Regional Group Continental South East

Regional Investment Plan Baltic Sea 2015

Arne Pettersen, convener RGBS

Regional Investment Plan Baltic Sea 2015

Region Baltic Sea

- 3 synchronous areas
- 9 countries

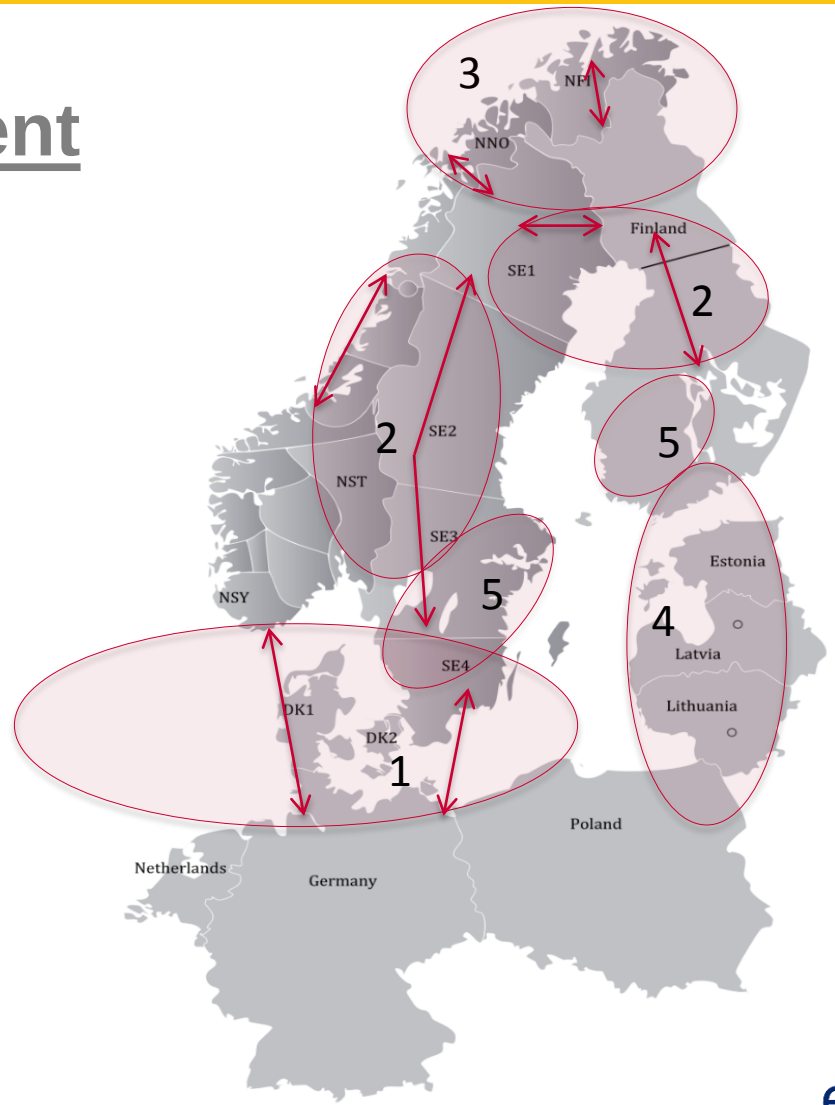
General drivers in the region

1. Generation shift
2. FLEX needs for RES integration
3. Maintaining SOS
4. Market integration

RIP 2015 - Key drivers towards 2030

Key drivers for grid development
(Region Baltic Sea)

1. New interconnectors
2. North-South flows
3. Arctic consumptions
4. Baltic integration
5. Nuclear and thermal decommissioning



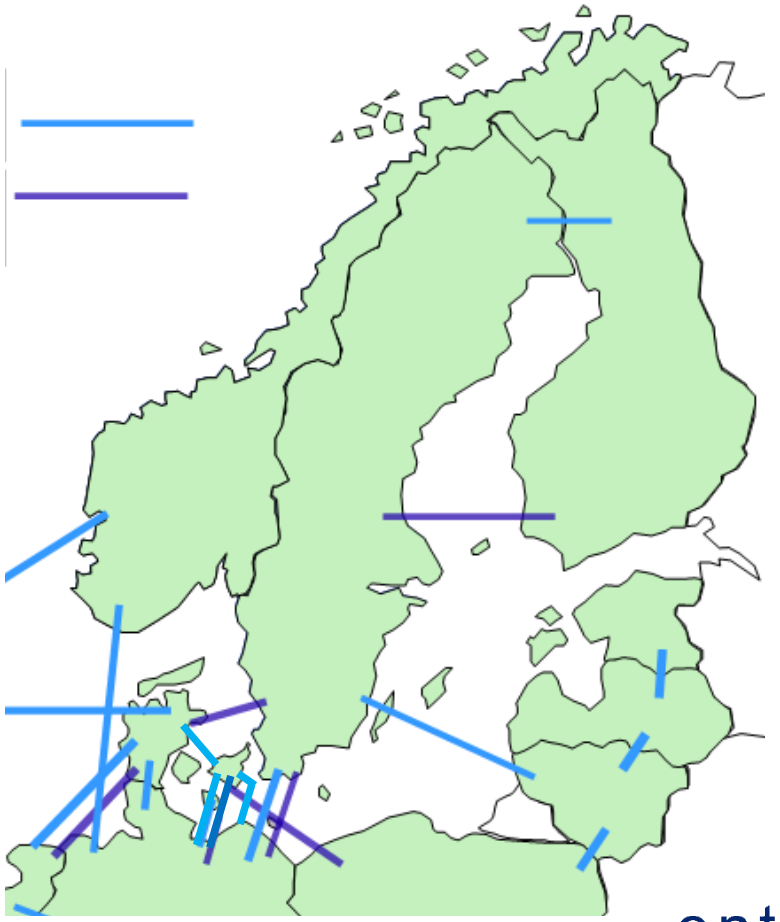
RIP 2015 - Project to be assessed, TYNDP 2016

Projects to be assessed (RGBS), TYNDP 2016:

New project candidates - RGBS
(based on Common Planning Studies, Regional plans 2015)

Border	Additional in RegIP2015 [MW]
SE-DE	700
DKe-PL	600
DKe-DE	600

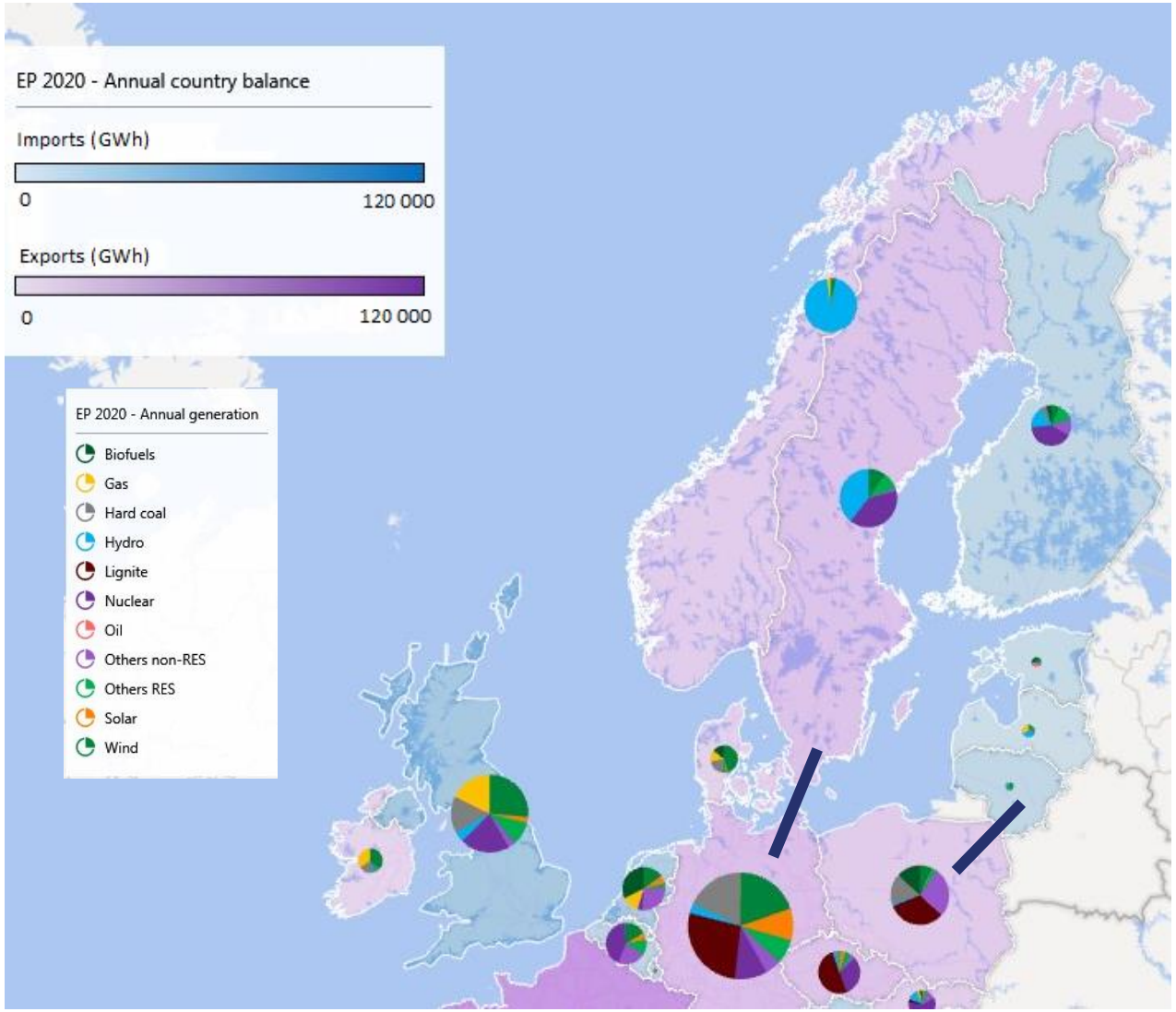
TYNDP	Boundary	Project candidate name
36	Denmark-East - Germany	Kriegers Flak CGS
62	Estonia - Latvia	Estonia-Latvia 3rd IC
96	Finland North-South	Keminmaa-Pyhänselkä
111	Finland - Sweden	3rd AC Finland-Sweden north
123	Poland - Lithuania	LitPol Link Stage 2
124	Lithuania - Sweden	NordBalt phase 2
126	Sweden North-South	SE North-south reinforcements
170	Baltics - Continental Europe	Baltics synchro with CE
176	Germany - Sweden	Hansa PowerBridge 1
179	Denmark-East - Germany	DKE - DE
197	Finland North-South	N-S Finland P1 stage 2
232	Denmark-East - Germany	Kontek-3
234	Denmark-East - Poland	DKE-PL-1
238	Denmark-West - Sweden (SE3)	Kontiskan 2
239	Finland-Sweden (SE3)	Fenno-Skan 1 renewal
267	Sweden (SE4)-Germany	Hansa PowerBridge 2



Projects showing positive benefits, but not nominated:
- Norway-Denmark
- Sweden-Poland

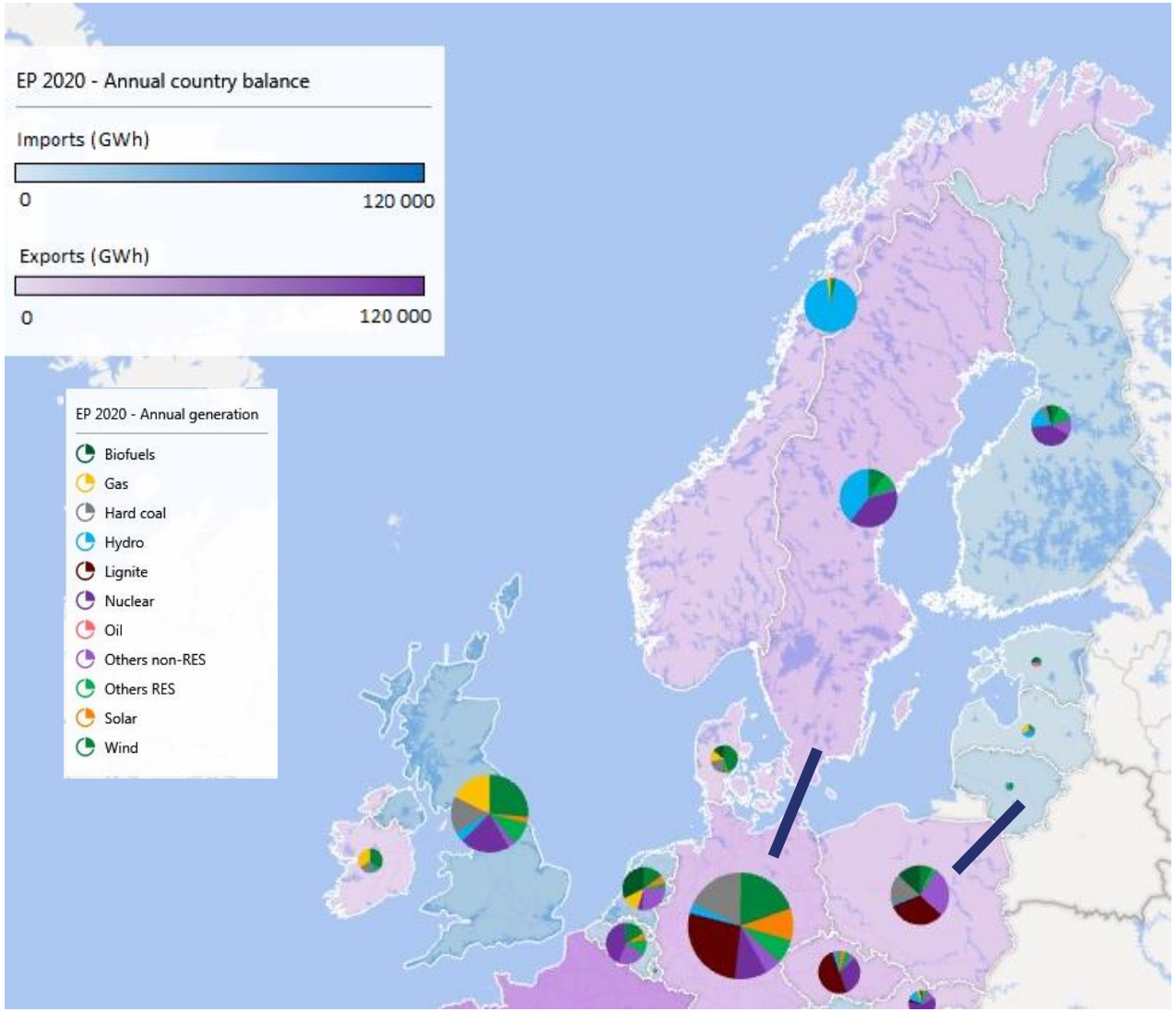
This based on the fact that Norway/Sweden already are realising many interconnector-projects. Further analysis/evaluations need to be done before adding project-candidates on top of these.

TYNDP 2016 - First results 2020 - case 1 (preliminary results)



LitPol Link Stage 2 (TYNDP-project 123)	
Short description	Stage 2 HVDC Poland-Lithuania. Capacity 500 MW.
SEW [Meuro/year]	60-70 Meuro/year]
RES [MW or MWh]	7000-8000 MWh
CO2 [Mton/year]	300-400 Mton (decrease)

TYNDP 2016 - First results 2020 - case 2 (preliminary results)



Hansa PowerBridge 1 (TYNDP-project 176)	
Short description	New HVDC Sweden-Germany. Capacity 700 MW.
SEW [Meuro/year]	25-35 Meuro/year
RES [MW or MWh]	3500-4500 MWh
CO2 [Mton/year]	500-700 Mton (decrease)

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Regional Investment Plan North Sea 2015

Teun van Biert, convener RGNS

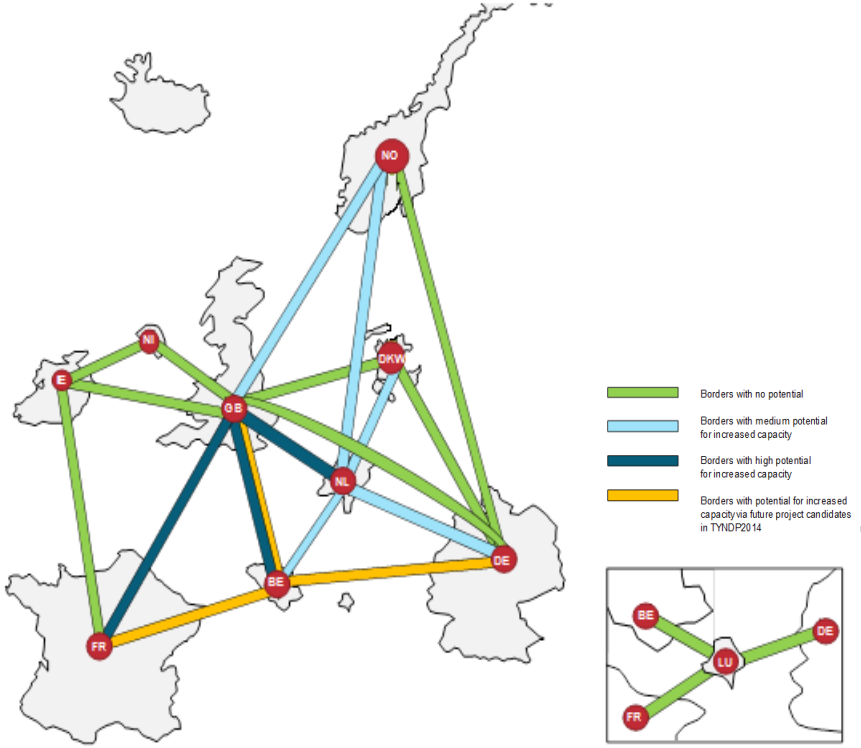
Regional Investment Plan North Sea 2015

Key drivers

Key drivers for regional grid development

1. Generation shift
    1. Thermal to RES
    2. Nuclear phase out (DE/BE)
    3. Shift of coal to gas
2. FLEX needs for RES integration
3. Maintaining SOS
4. Market integration

Resulting in needs to facilitate extra West-East and South-North power flows



Potential transfer capacity increases additionally to TYNDP14 interconnection capacity level resulting from market analysis on TYNDP 2014 high RES scenario

Regional Investment Plan North Sea 2015

New projects to be assessed for TYNDP 2016

New project candidates - Region Group North Sea
(based on Common Planning Studies, CPS)

Borders	Current Capacity online in 2015 [MW]	Projects in TYNDP 2014 Starting point for Common Planning Studies [MW]	Future project candidates identified in RegIP 2015 [MW]	Total suggested Capacity 2030 "HIGH RES Target capacity" [MW]
BE-DE *)	0	1000	1000	2000
GB-BE *)	0	1000	1000	2000
FR-BE *)	3300/1800	1000	1000	5300/3800
GB- FR	2000	3400	1000	6400
GB-NL	1000	0	1000	2000
DKW-NL	0	700	700	1400
NL-DE	2500	1500 500 500	1000	6000
BE-NL	1400	1000	1000	3400

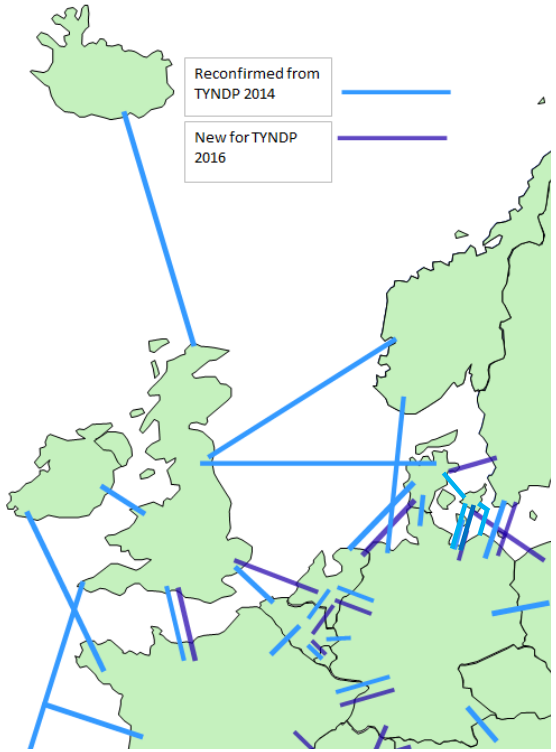
*) introduced already in TYNDP14 as projects under consideration in case of high-RES conditions and reconfirmed in CPS 2015

Projects showing positive benefits (CPS) but not nominated:

- Norway-Netherlands

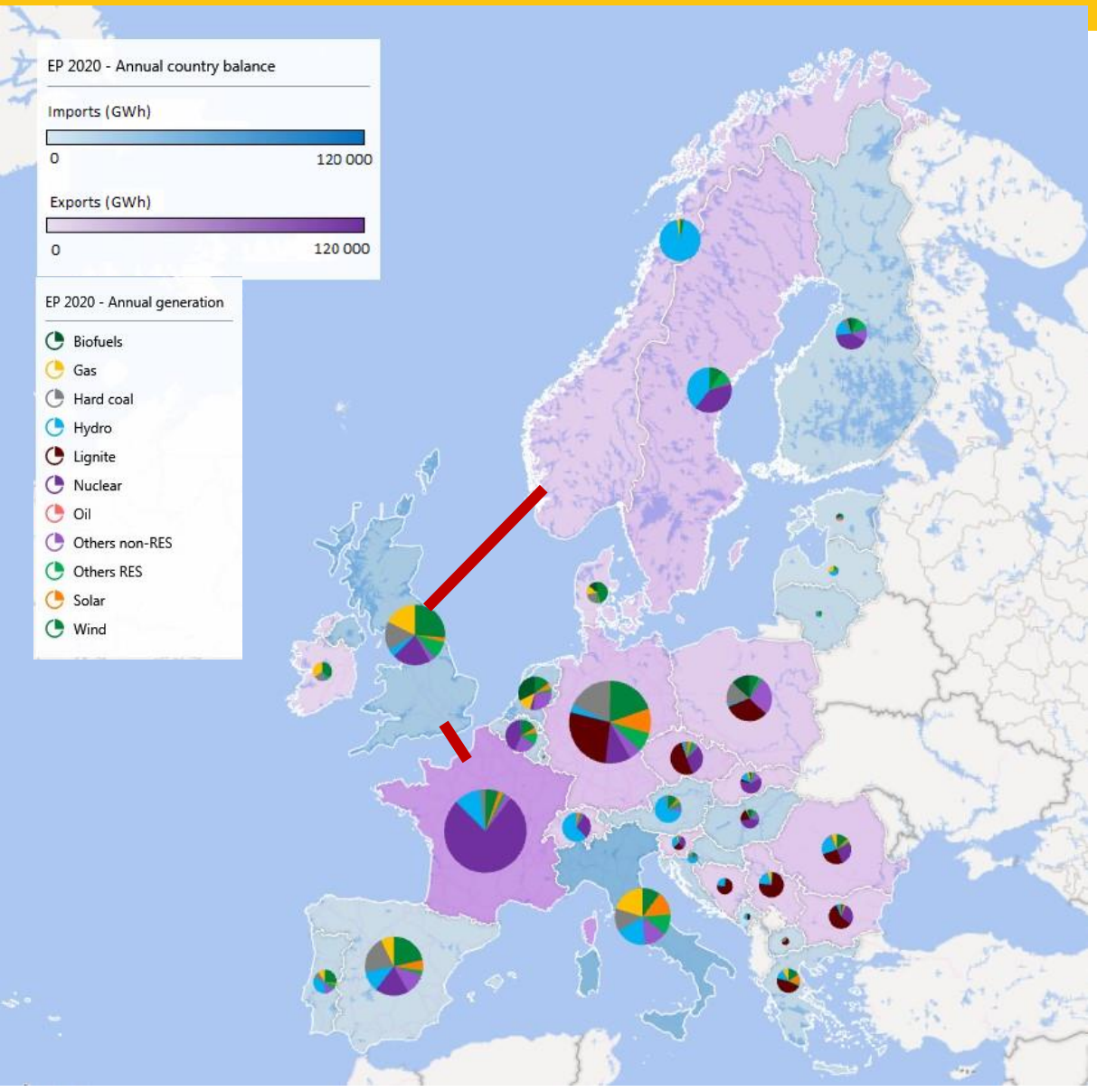
This based on the fact that Norway has already built and is planning to build several interconnectors out of southern and western part of Norway in a succession up until 2021. Prior to the assessment of a further increase in capacity out of southern Norway, further analysis/evaluations need to be done before adding project-candidates on top of these.

Projects to be assessed, TYNDP 2016:



TYNDP 2016 - first assessment results for scenario EP2020 – 2 examples

Preliminary results



	NSN (TYNDP #110)	IFA2 (TYNDP #25)
Short description	A 1400MW HVDC subsea interconnector between Norway and Great Britain	A 1000MW HVDC subsea interconnector between Great Britain and France
SEW	155-220 Meuro/year	70-100 Meuro/year
RES	70000-110000 MWh/year	0-10000 MWh/year
CO2	1850-2550 Mton/year	1350-1800 Mton/year

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Regional Investment Plan Continental Central East 2015

Andrew Kasembe, convener RG CCE

Key findings in Common Planning Studies in CCE region

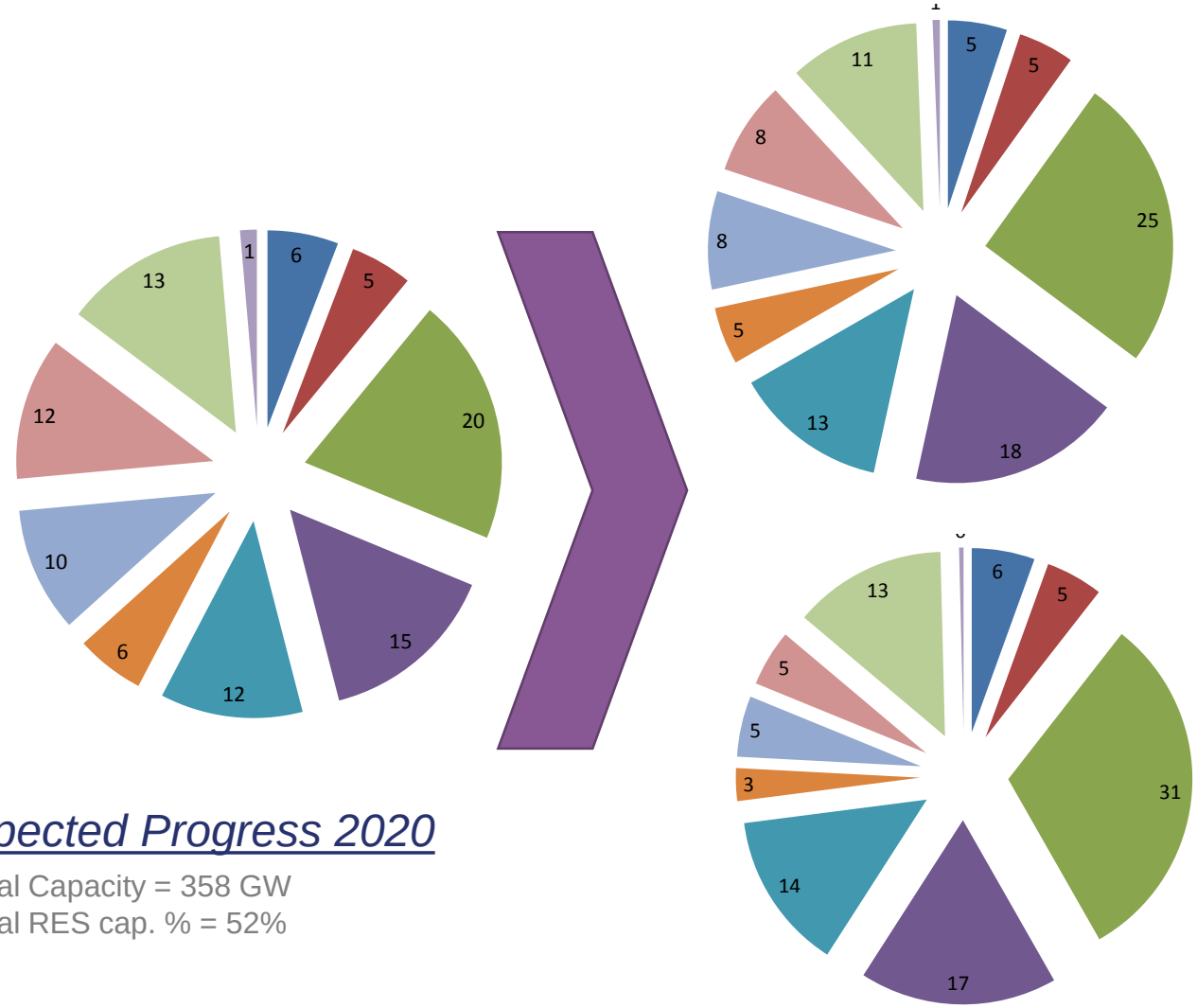
- **New generation capacities with a big share from RES:**
  - Increase of power flow volatility (higher surpluses, deeper imports)
  - Connection of traditional generation to ensure security of supply even though European market is not in favor of these capacities

- **Projects for TYNDP2016 assessment in CCE RG**
  - 25 midterm transmission projects

- **2 new transmission projects with expected cross-border impact evolved during the process (high RES scenario)**
  - 3rd interconnection between DE and PL (Project no. 229 GerPol PowerBridge II) after finishing Project no 94 and Project no. 230 (GerPol Power Bridge I) involving PSTs installation resp. extension of PL internal transmission grid for the increase of capacity on western border
  - New interconnection between Hungary and Romania and internal reinforcements in RO

RG CCE
- 10 TSOs
- 9 countries

Regional Group CCE – Net Generation Capacity [%]



Expected Progress 2020

- Total Capacity = 358 GW
- Total RES cap. % = 52%

Vision 1 2030

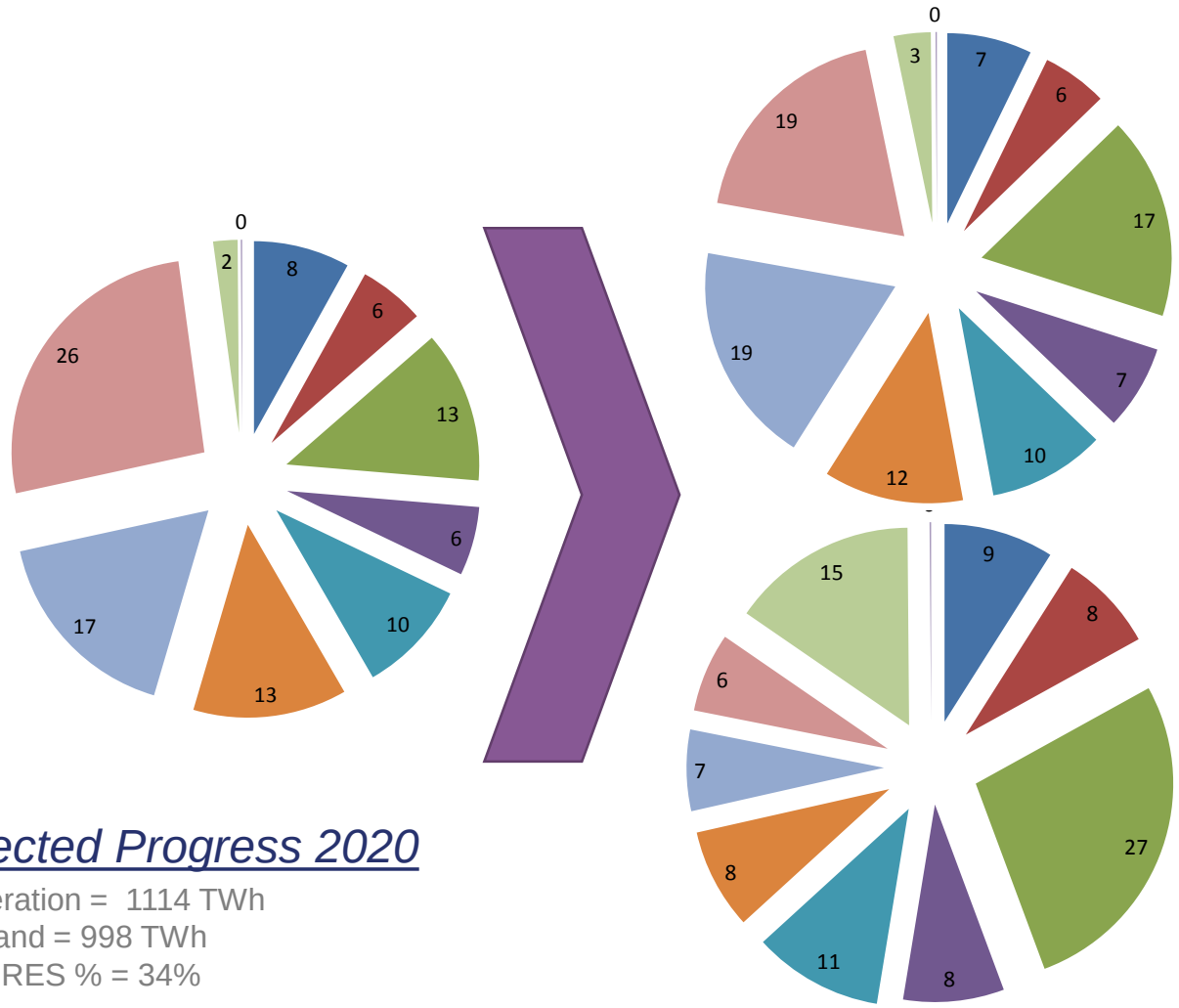
- Total Capacity = 376 GW
- Total RES cap. % = 62%

Vision 4 2030

- Total Capacity = 424 GW
- Total RES cap. % = 67%

- Others non-renewable
- Others renewable
- Wind (on & off)
- Solar
- Hydro
- Nuclear
- Hard Coal
- Lignite
- Gas
- Oil

Regional Group CCE – Annual Generation Dispatch [%]



Expected Progress 2020

- Generation = 1114 TWh
- Demand = 998 TWh
- Total RES % = 34%

Vision 1 2030

- Generation = 1121 TWh
- Demand = 1046 TWh
- Total RES % = 40%

Vision 4 2030

- Generation = 1048 TWh
- Demand = 1048 TWh
- Total RES % = 54%

- Others non-renewable
- Others renewable
- Wind (on & off)
- Solar
- Hydro
- Nuclear
- Hard Coal
- Lignite
- Gas
- Oil

First results 2020 – Project 94 GerPol Improvements

Preliminary results

PCI project

3.15 Cluster Germany — Poland between Vierraden and Krajnik (currently known as "GerPol Improvements„)

Assessment results are still provisional

Project 94 GerPol Improvements	
Short description	This Project contributes to the following: ▪ Decreasing of unscheduled flow from DE to PL, PL to CZ and PL to SK by increasing of controllability on entire synchronous profile; ▪ Enhancement of market capacity on Polish synchronous profile - PL/DE as well as PL-CZ/SK border in case of both import and export. ▪ Increase of cross border exchange capacity over synchronous cross section of 1500 MW (export) and 500 MW (import)
Investments included in the project	Installation of PSTs in substation Mikułowa – 2016 Installation of PSTs in substation Vierraden – 2017 Upgrade of 220 kV line Krajnik – Vierraden to 400 kV – 2017
SEW [Meuro/year]	110 ÷ 150
RES [GWh/year]	11 ÷ 16
CO2 [Mton/year]	-300 ÷ -400

First results 2020 – Project 48 New SK-HU intercon. – phase 1

Preliminary results

PCI project

3.16 Cluster Hungary - Slovakia between Gőnyü and Gabčikovo
3.17 PCI Hungary - Slovakia interconnection between Sajóivánka (HU) and Rimavská Sobota (SK)

Assessment results are still provisional

Project 48 New SK-HU Interconnector	
Short description	This project will increase the transfer capacity between Slovak and Hungarian transmission systems, improve security and reliability of operation both transmission systems and support North - South RES power flows in CCE region
Investments included in the project	Main investments of this project are double circuit AC OHL 400 kV from new Gabcikovo (Slovakia) substation to Gönyű (Hungary) substation, with one circuit connected to the Veľký Ďur (Slovakia) substation and double circuit AC OHL (preliminary armed only with one circuit on Hungarian side) 400 kV from Rimavská Sobota (Slovakia) substation to Sajóivánka (Hungary) substation
SEW [Meuro/year]	5 ÷ 10
RES [GWh/year]	0
CO2 [Mton/year]	-100 ÷ -200

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Regional Investment Plan Continental South West 2015

Claire Fourment, convener RG CSW

Main drivers for grid development in RG CSW region

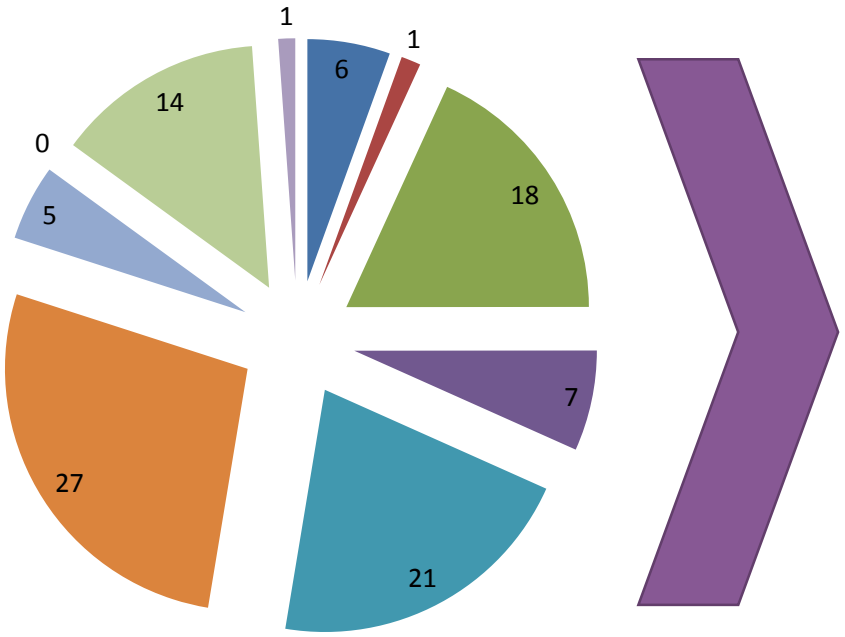
Internal Energy Market (IEM):

- Insufficient cross border capacity between the Iberian Peninsula and mainland Europe, despite commissioning of the new HVDC in eastern part of the FR-ES border
  - Current cross border congestion ~ 70-80% of the time with significant price difference (~17 €/MWh in 2014)
  - 10% interconnection ratio by 2020 established by the EC as a prerequisite for IEM
  - 15% interconnection ratio by 2030 “while taking into account costs aspects and the potential of commercial exchanges”
  - Madrid Declaration (04/03/15) signed by the three Governments and the EC

Sustainability: RES generation integration

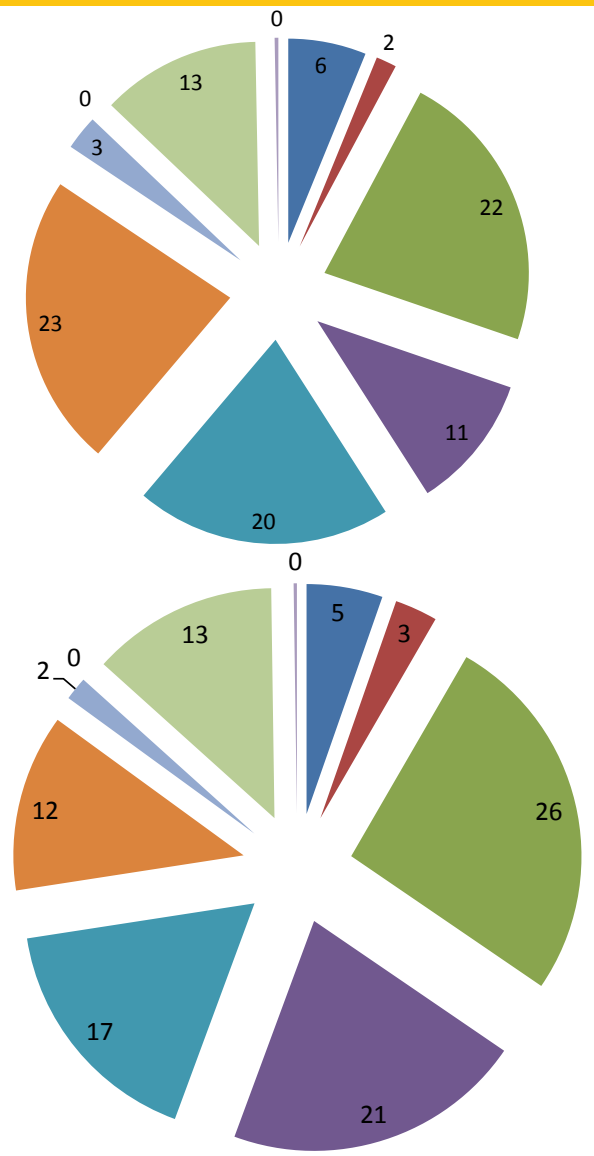
Security of Supply (SoS) issues in the region have low European impact

Regional Group CSW – Net Generation Capacity [%]



Expected Progress 2020

- Total Capacity = 258 GW
- Total RES cap. = 47%



Vision 1 2030

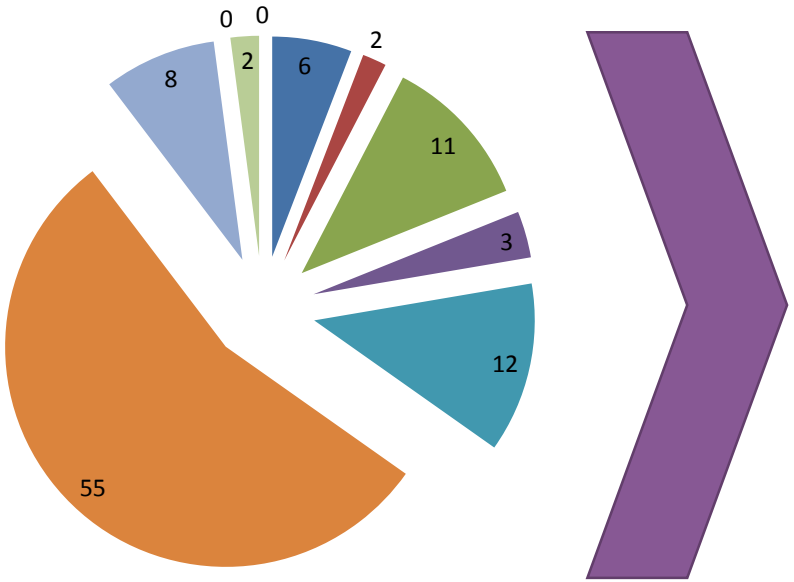
- Total Capacity = 279 GW
- Total RES cap. = 55%

Vision 4 2030

- Total Capacity = 359 GW
- Total RES cap. = 67%

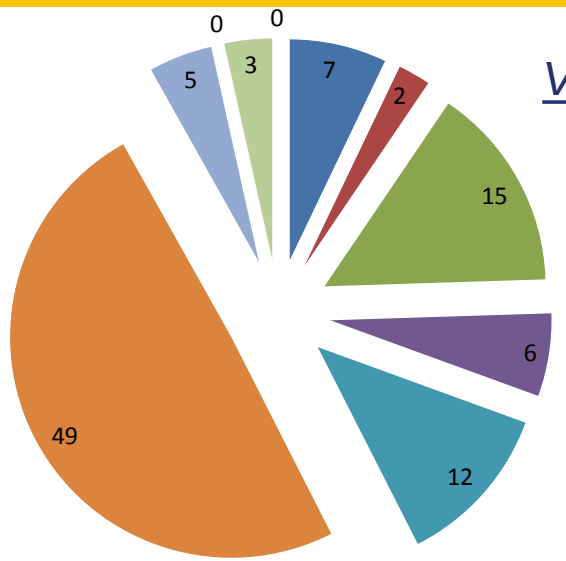
- Others non-renewable
- Others renewable
- Wind (on & off)
- Solar
- Hydro
- Nuclear
- Hard Coal
- Lignite
- Gas
- Oil

Regional Group CSW – Annual Generation [%]



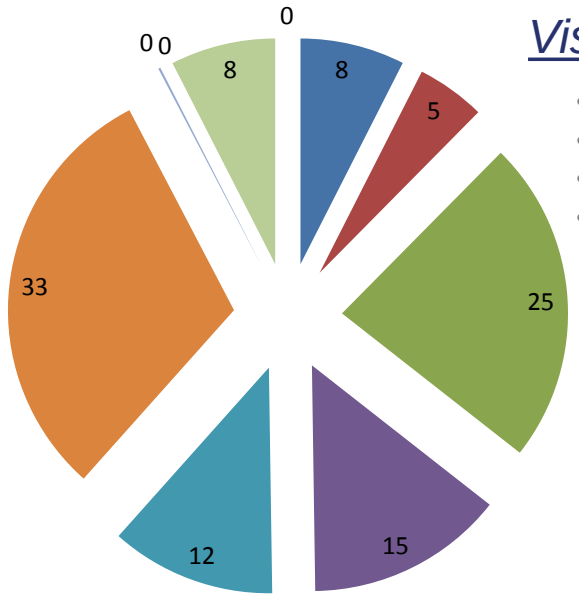
Expected Progress 2020

- Generation = 900 TWh
- Demand = 821 TWh (*)
- Total RES % = 29%
- Exchanges = 68 TWh (export)



Vision 1 2030

- Generation = 921 TWh
- Demand = 818 TWh
- Total RES % = 35%
- Exchanges = 97 TWh (export)



Vision 4 2030

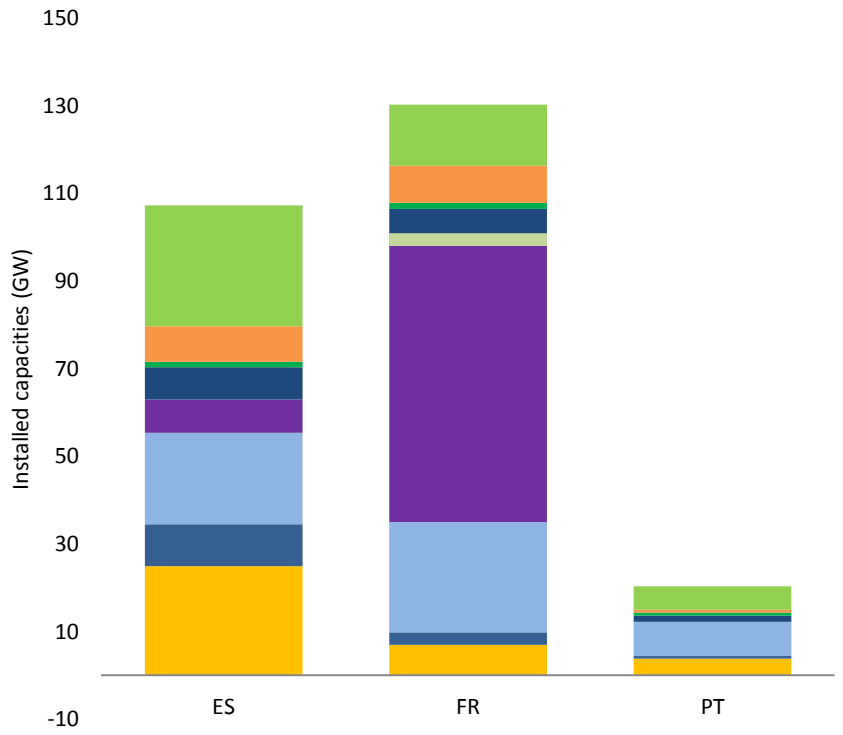
- Generation = 990 TWh
- Demand = 937 TWh
- Total RES % = 57%
- Exchanges = 38 TWh (export)

- Others non-renewable
- Others renewable
- Wind (on & off)
- Solar
- Hydro
- Nuclear
- Hard Coal
- Lignite
- Gas
- Oil

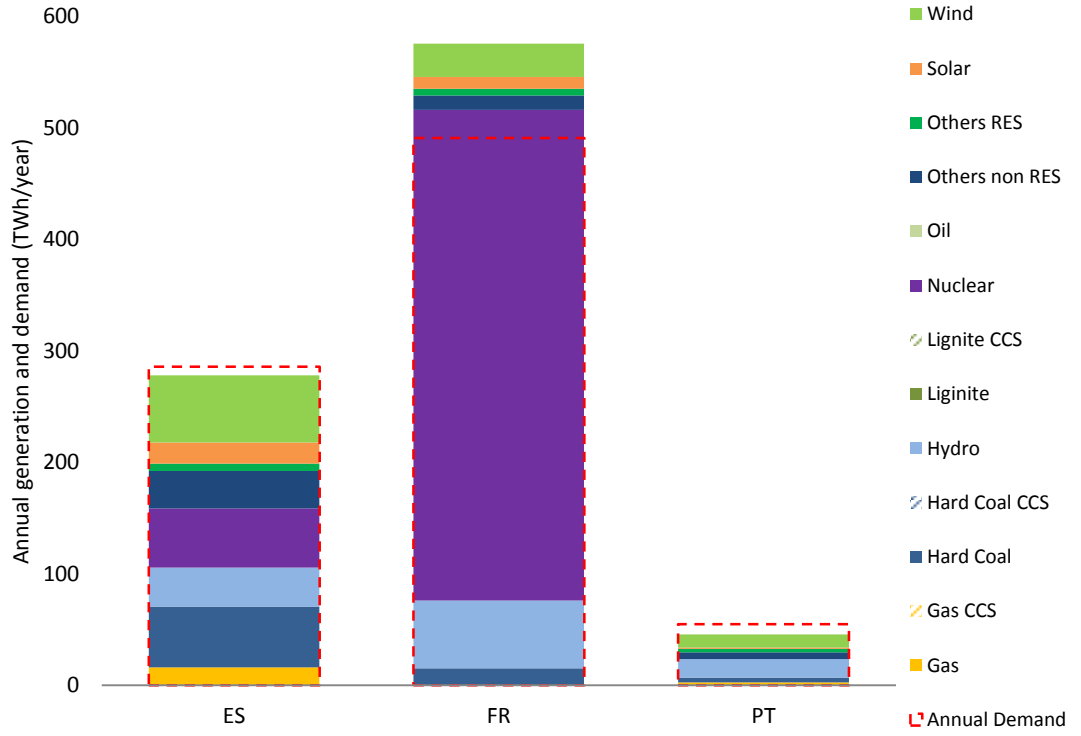
(*) w/o pumped storage

RG CSW - EP 2020 Generation & Demand (National detail)

EP 2020 – Installed Generation Capacities

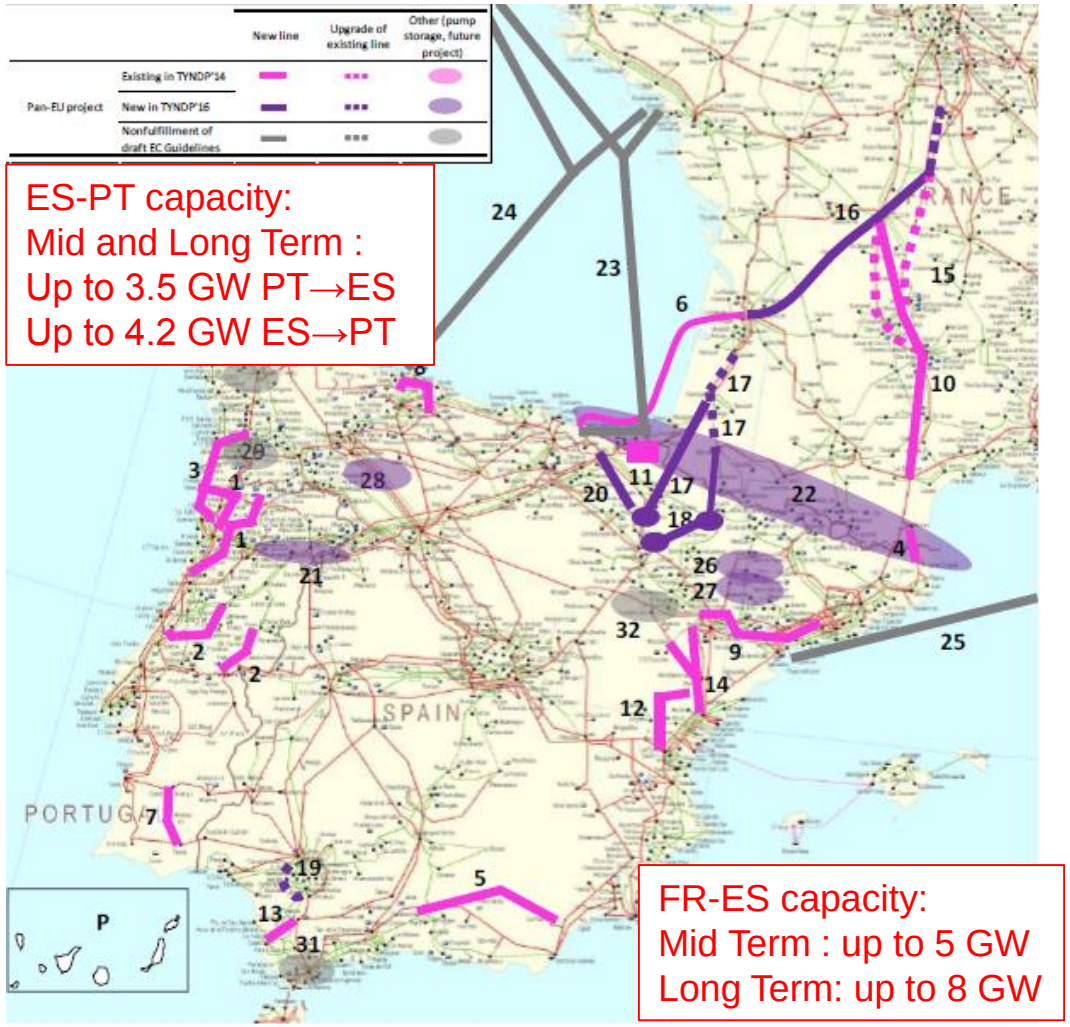


EP 2020 – Generation & Demand

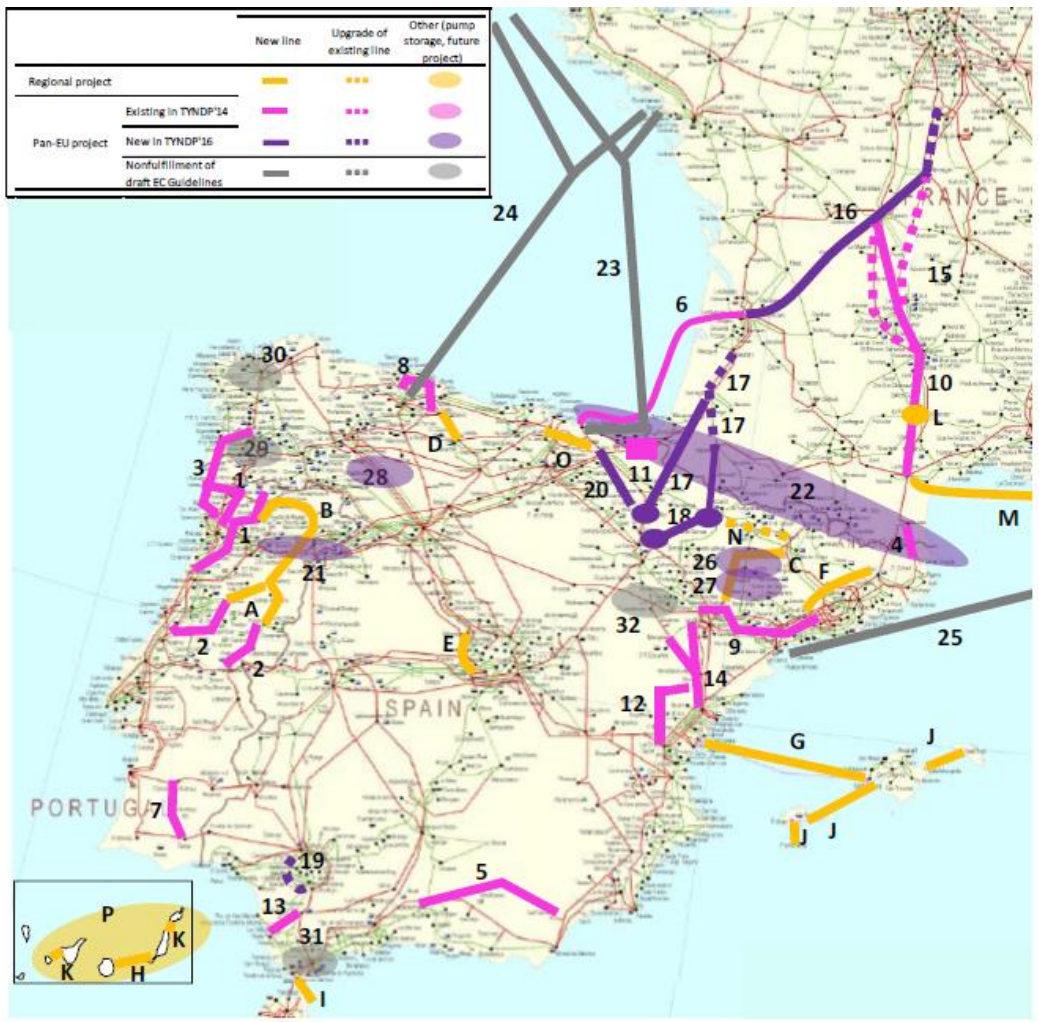


RG CSW projects porfolio in TYNDP2016

Pan European projects

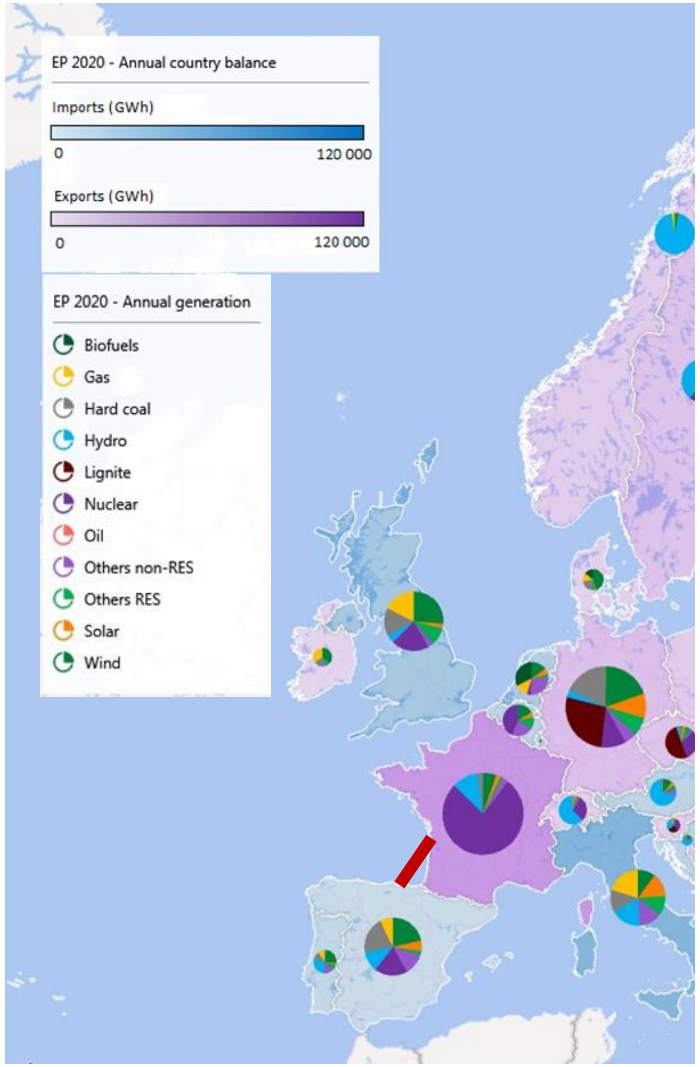


Pan European and regional projects



First results EP2020 – Biscay Gulf

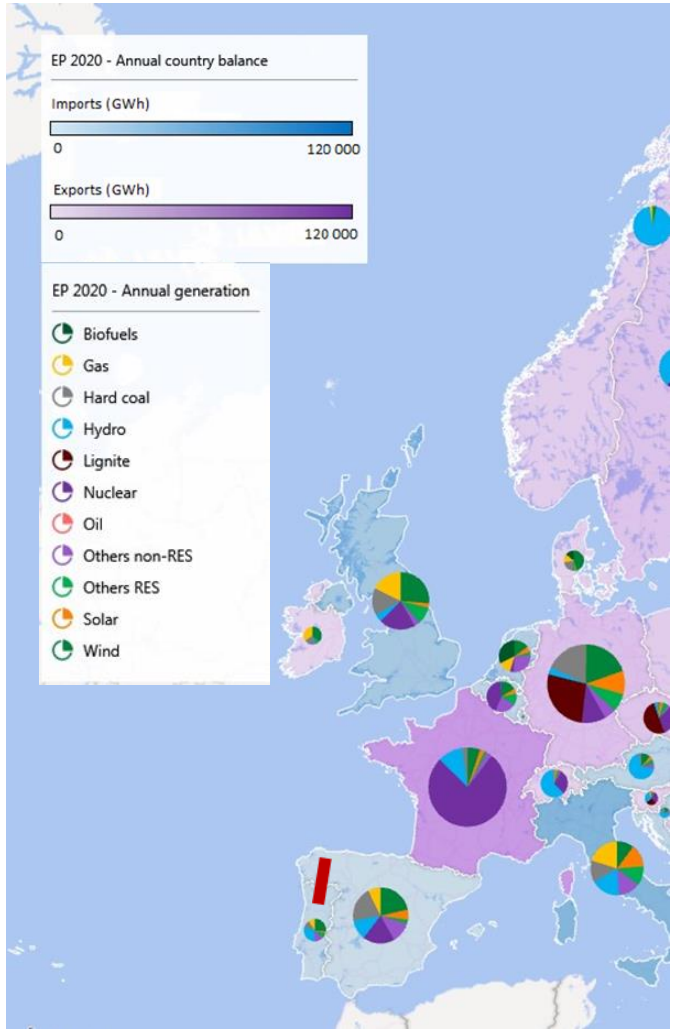
Preliminary results



FR-ES project in the Biscay Gulf	
2000 MW HVDC subsea link in the western part of the Spanish-French border, bringing the ES-FR interconnection capacity up to 5 GW. It aims at improving the integration of the European market and avoiding RES spillage, especially in the Iberian Peninsula. The project complies with the Madrid Declaration and increases the Spanish interconnection ratio.	
2*1000 MW HVDC subsea and underground link between Gatica (Basque country, Spain) and Cubnezais (Aquitaine, France) with converter stations at both ends Total length ~370 km	
SEW	200 ± 30 M€/year
RES	45 ± 45 GWh/year
CO2	2.4 ± 0.5 Mton/year *(increase due to coal/gas substitution in this scenario)*

First results EP2020 – ES-PT

Preliminary results



Interconnection Portugal-Spain

This project will allow to increase the interconnection capacity between Portugal and Spain up to 3200 MW (complying with the governmental agreements) in order to establish a complete operational Iberian Electricity Market (MIBEL). This project will also allow Portugal to reach the objective of at least 10% for the interconnection ratio, and improve the Spanish ratio.
The project includes a new 400 kV interconnection route between Minho (PT) and Galicia (ES), besides some 400 kV internal reinforcements required.

Investments included in the project:
400 kV OHL Beariz– Fonte Fria – Ponte de Lima – Vila Nova de Famalicão– Recarei/Vermoim
Substations: Vila Nova de Famalicão (PT), Ponte de Lima (PT), Fonte Fria (SP), Beariz (SP)
Total length of the project: ~222 km
Expected date of commissioning: 2018 (the section Vila Nova de Famalicão– Recarei/Vermoim and the Vila Nova de Famalicão substation are expected to be commissioned until the end of 2015)

SEW	6 ± 5 M€/year
RES	n.s.
CO2	0,25 ± 0,06 Mton/year (Increase of CO_2 emissions: CCGT are replaced by Coal)

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Regional Investment Plan Continental Central South 2015

Ettore Elia – Convener of RGCCS

CCS Region – Main messages

Outstanding characteristics of the region

- large development of variable RES especially at the corners of the CCS region,
- storage potentials (especially hydro-pumping in the Alps)
- at present slightly exporting electricity to the rest of Europe (less structural in the long term time horizon)
- intense interaction between CCS countries and neighbours (highly meshed system)

Main drivers for power system evolution in the Region

- massive RES integration → stronger and flexible transmission system
- integration of storage plants → facilitate the efficient use of RES
- thermal and nuclear phase-out → adequacy and security needs
- wide area power flows → load / generation divergence (time and location) requires investments in transmission grid

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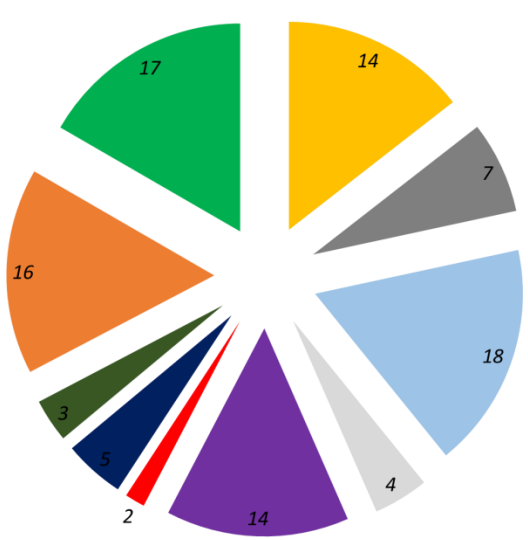
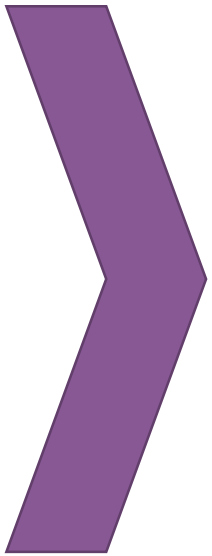
Reliable Sustainable Connected

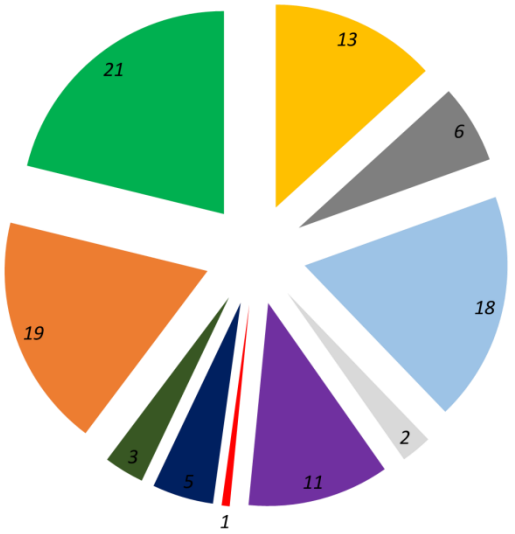
TYNDP 2016 scenarios
CCS Region – Net Generation Capacity [%]

Expected Progress 2020

- Total Capacity = 524 GW
- Total RES cap. % = 54%

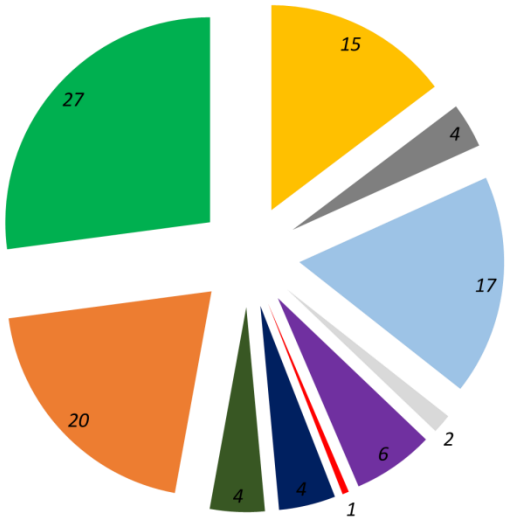






Vision 1 2030

- Total Capacity = 535 GW
- Total RES cap. % = 60%

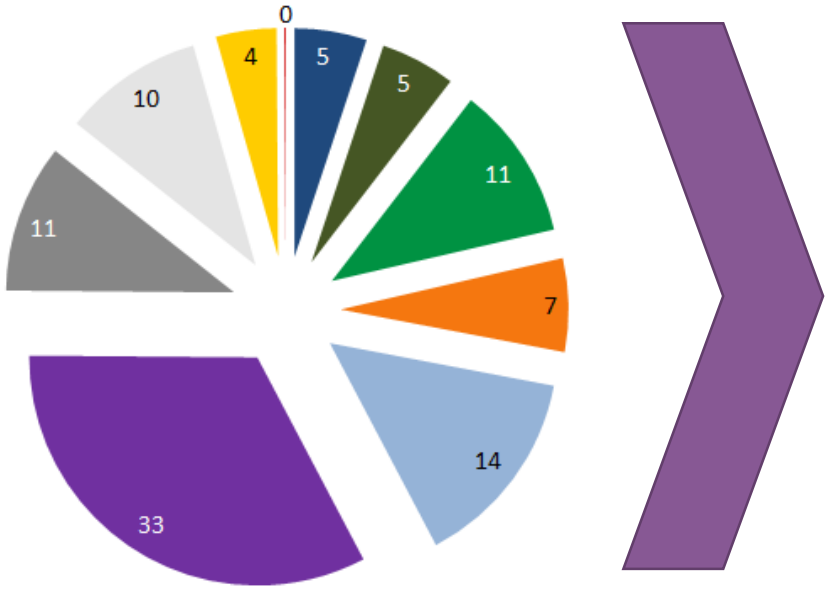


Vision 4 2030

- Total Capacity = 631 MW
- Total RES cap. % = 70%

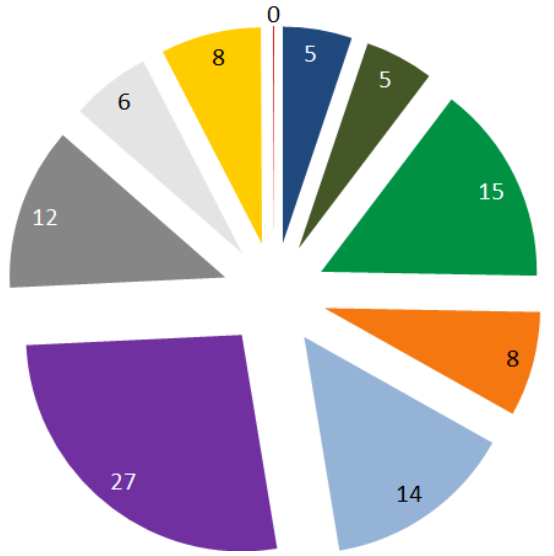
- Gas
- Hard coal
- Hydro
- Lignite
- Nuclear
- Oil
- Others non-RES
- Others RES (inc.biofuels)
- Solar
- Wind

TYNDP 2016 scenarios
CCS Region – Annual Generation [%]



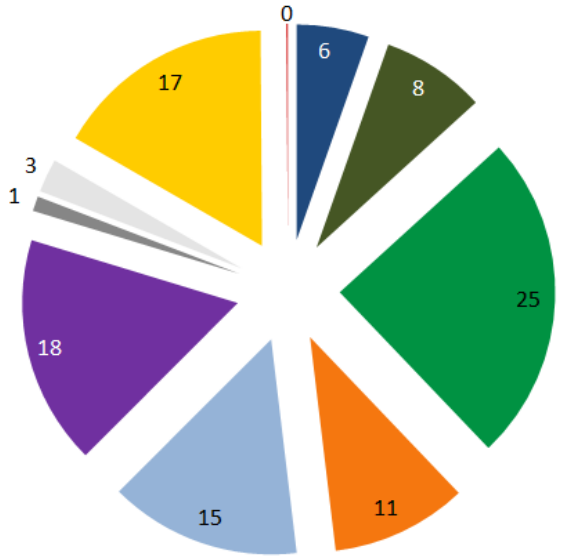
Expected Progress 2020

- Generation = 1591 TWh
- Demand = 1501 TWh *
- Total RES % = 37%
- Exchanges = + 67 TWh



Vision 1 2030

- Generation = 1580 TWh
- Demand = 1506 TWh *
- Total RES % = 42%
- Exchanges = - 38 TWh



Vision 4 2030

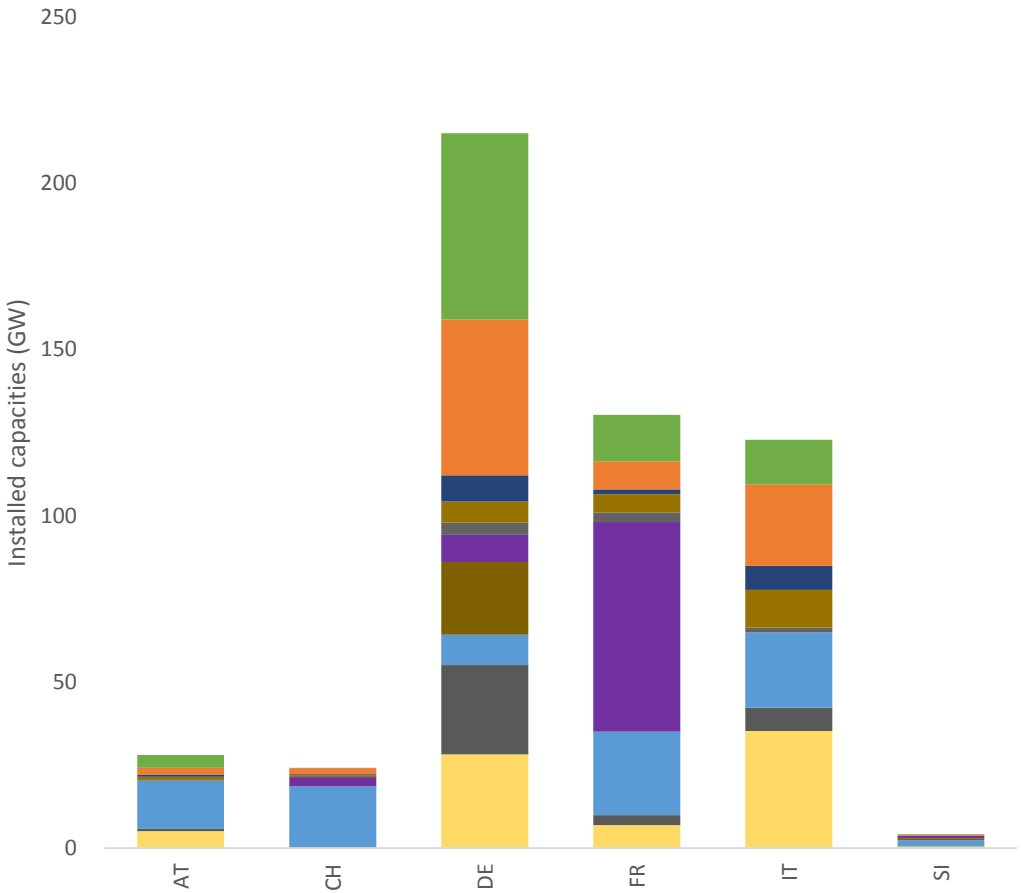
- Generation = 1608 TWh
- Demand = 1558 TWh *
- Total RES % = 60%
- Exchanges = +35 TWh

- Others non-RES
- Others RES
- Wind (on & off)
- Solar
- Hydro
- Nuclear
- Hard Coal
- Lignite
- Gas
- Oil

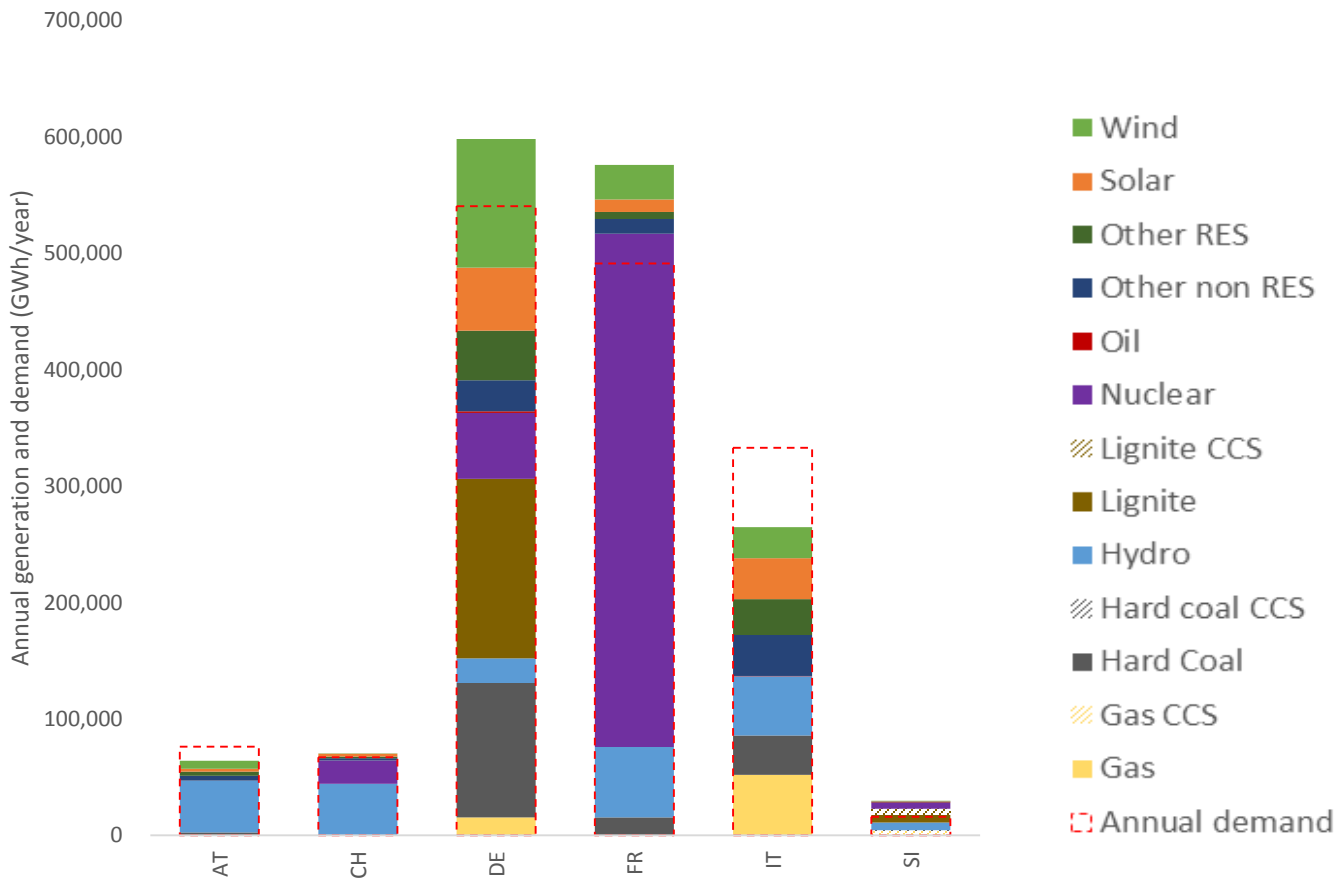
* Without pumping

TYNDP 2016 – EP 2020 scenario
CCS Region – Generation & Demand (National detail)

EP 2020 – Installed Generation Capacities

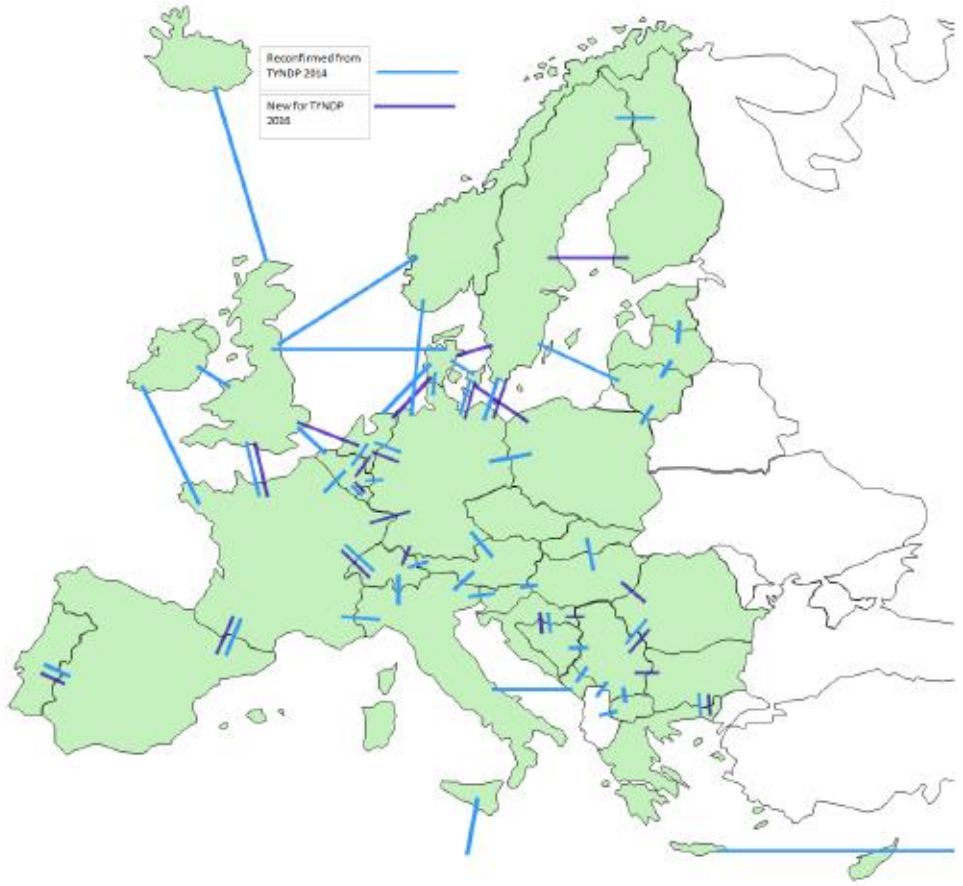


EP 2020 – Generation & Demand



CCS Region – list of mid-term projects to assess in the EP2020

TYNDP 2016 Project Index	Project candidate name	Border/Boundary
21	Italy-France	FR - IT
22	Lake Geneva West	CH - IT
28	Italy-Montenegro	IT - ME
29	Italy-Tunisia	IT - TU
31	Italy-Switzerland	CH - IT
33	Central Northern Italy	IT Center – IT North
47	AT - DE	AT - DE
127	Central Southern Italy	IT Center – IT South
150	Italy-Slovenia	IT - SI
174	Greenconnector	CH - IT
210	Wurmlach (AT) - Somplago (IT)	AT-IT
250	Castasegna (CH) - Mese (IT)	CH-IT
264	Swiss Roof I	CH-DE / CH-AT
266	Swiss Ellipse I	Internal CH



First results 2020 – Example of project 28 Italy – Montenegro

Preliminary results

PCI project

3.19.1 Interconnection between Villanova (IT) and Lastva (ME)

Assessment results are still provisional

- HVDC link (475 km)
- Voltage: +/-500 kV
- GTC: 1200 MW
- Inv. costs: 1130 M€ *
- Status: under construction
- Commissioning: 2019

Project 28 – Interconnection Italy - Montenegro	
Short description	The project, having a significant cross border impact, makes possible to increase the use of existing and future interconnections all along the corridor between Italy and Continental East Europe through the Balkans; it helps to use most efficient generation capacity; enables possible mutual support of Italian and Balkan power systems; contributes to RES integration in the European interconnected system by improving cross border exchanges.
Investments included in the project	The Italy-Montenegro interconnection project includes a new HVDC subsea cable between Villanova (Italy) and Lastva (Montenegro) and the DC converter stations.
SEW [Meuro/year]	119 ÷ 161
RES [GWh/year]	37 ÷ 56
CO2 [Mton/year]	1,6 ÷ 2,2

* Estimated Investment cost of project 28 reported in TYNDP 2014

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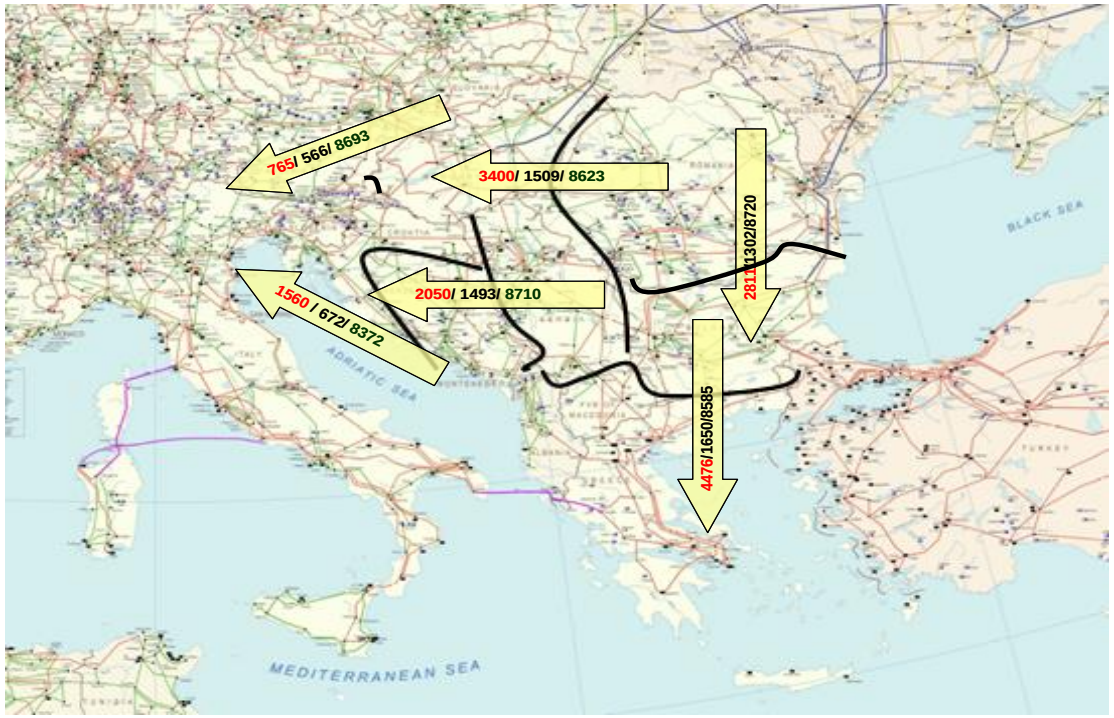
Regional Investment Plan Continental South East 2015

Yannis Kabouris – Convener of RG CSE

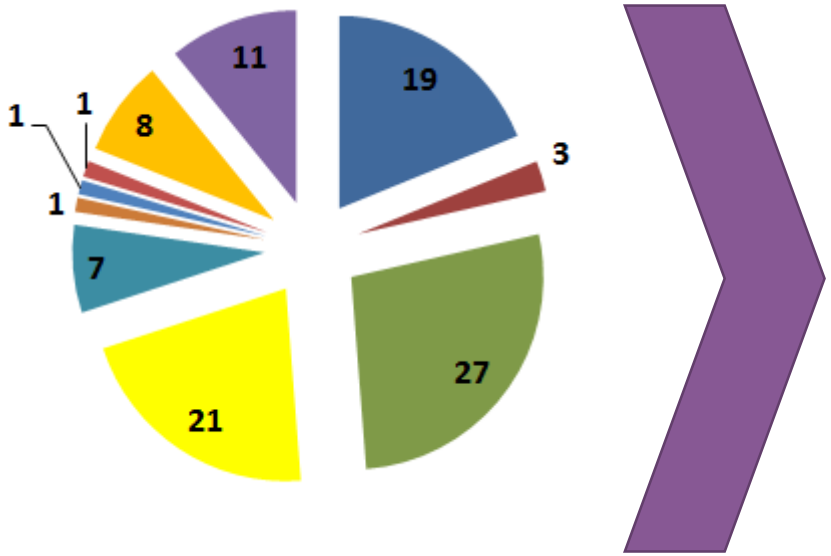
Regional Group CSE

- Market integration: Increase of cross-border and internal transfer capacities in order to assist market integration in the Region.
- Massive RES penetration: The anticipated large RES penetration (mainly wind, PV and hydro) in the Region in order to achieve EU and National targets requires extensive grid developments.
- Evacuation of future conventional generation mostly in the West part of the Region.

- Sparse Network
- Predominant N->S and E->W power flow directions

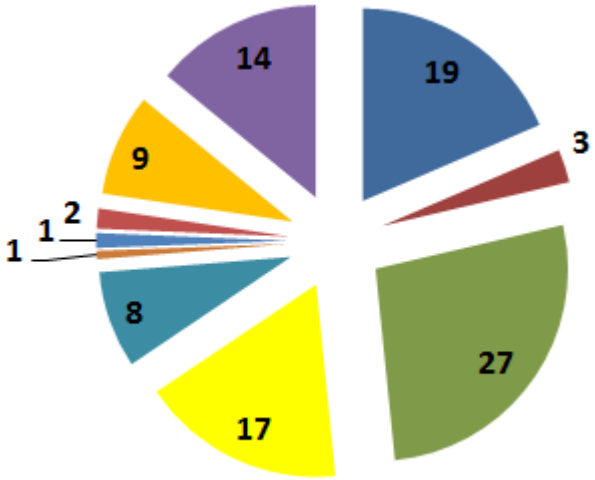


Regional Group CSE – Net Generation Capacity [%]



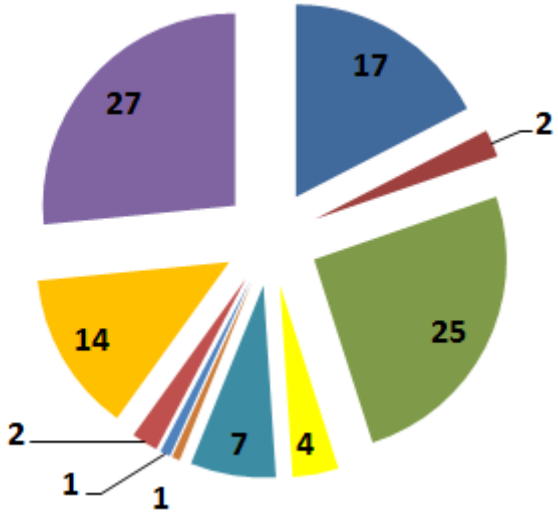
Expected Progress 2020

- Total Capacity = 98 GW
- Total RES cap. % = 30%



Vision 1 2030

- Total Capacity = 116GW
- Total RES cap. % = 26%

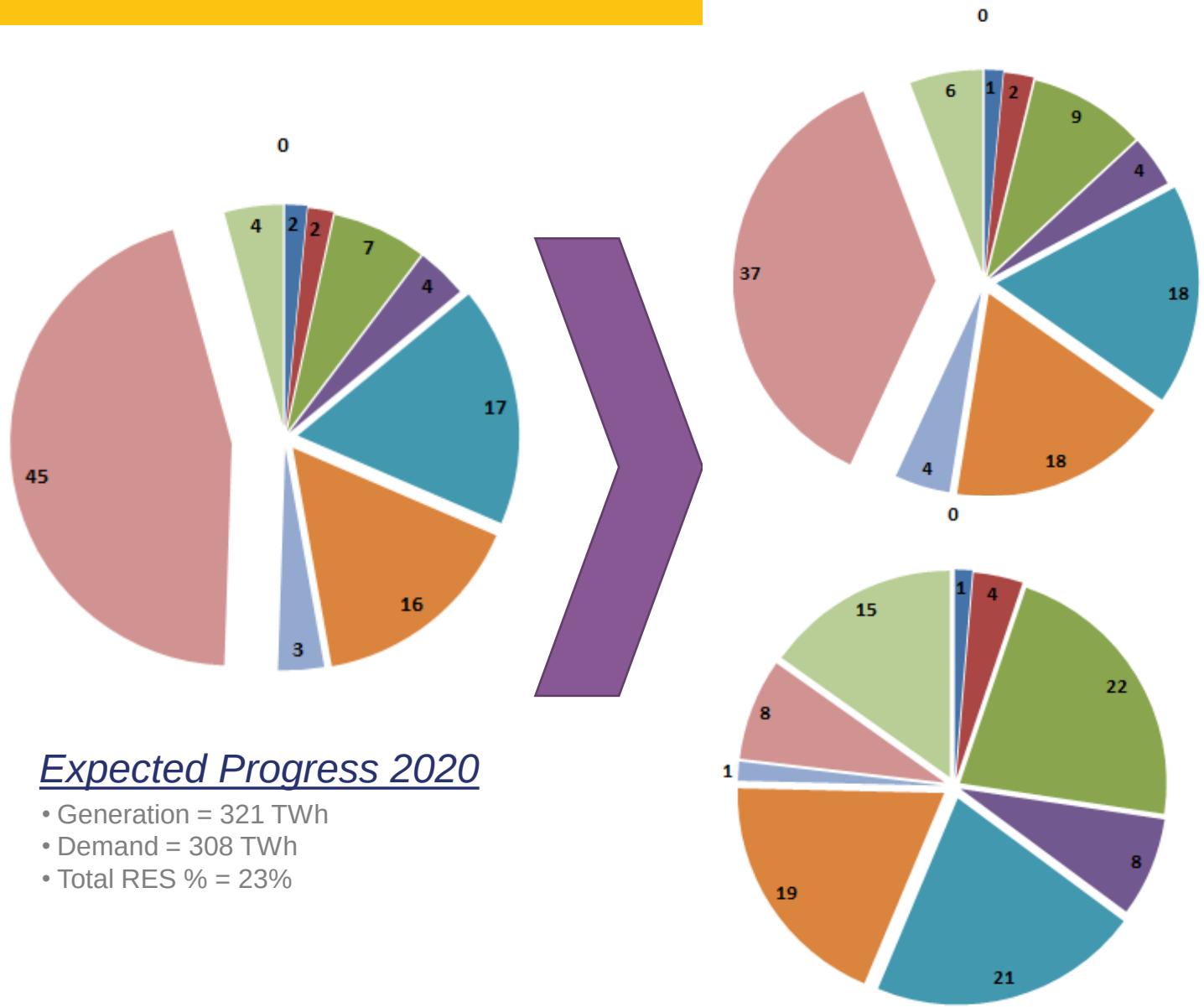


Vision 4 2030

Total Capacity = 131 GW
Total RES cap. % = 50%

- Gas
- Hard coal
- Hydro
- Lignite
- Nuclear
- Oil
- Others non-RES
- Others RES
- Solar
- Wind

Regional Group CSE – Annual Generation [%]



Expected Progress 2020

- Generation = 321 TWh
- Demand = 308 TWh
- Total RES % = 23%

Vision 1 2030

- Generation = 372 TWh
- Demand = 341 TWh
- Total RES % = 22%

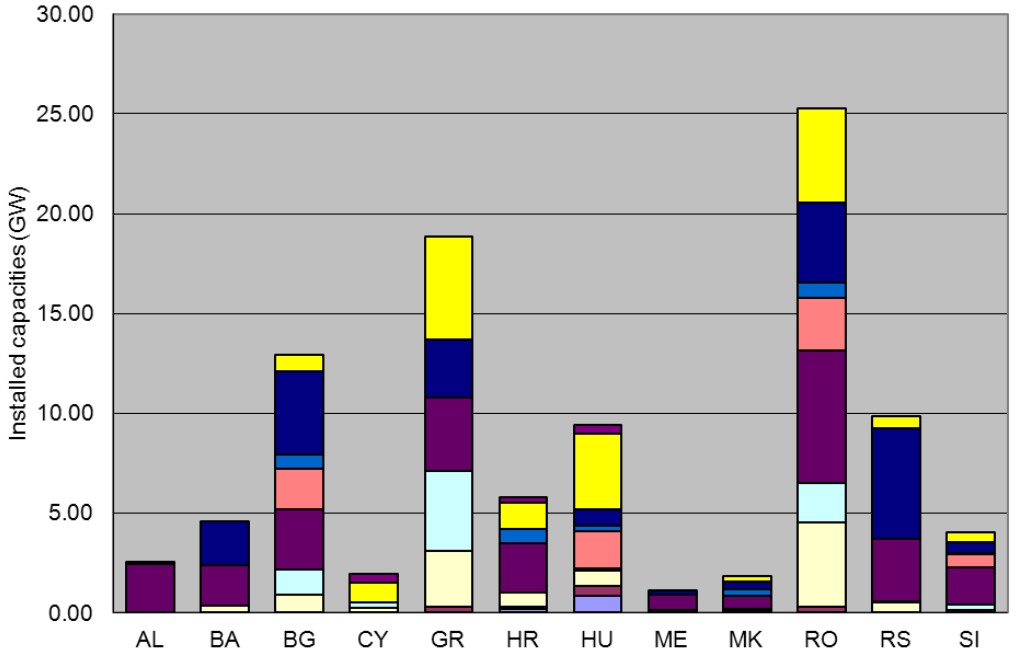
Vision 4 2030

- Generation = 342TWh
- Demand = 344 TWh
- Total RES % = 45%

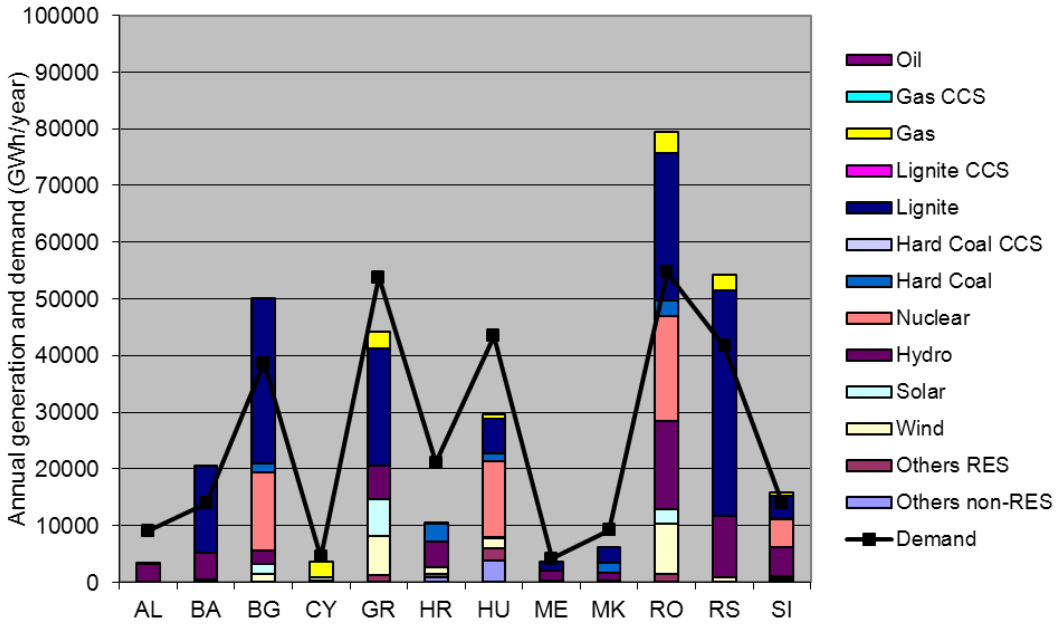
- Others non-renewable
- Others renewable
- Wind (on & off)
- Solar
- Hydro
- Nuclear
- Hard Coal
- Lignite
- Gas
- Oil

RG CSE - EP 2020 Generation & Demand (National detail)

EP 2020 – Installed Generation Capacitles



EP 2020 – Generation & Demand



First results 2020 - case 1
Preliminary results

[CSE 1, HR-BA borders]	
Short description	The project aims to support market and RES integration in the area – South and Mid HR and North and Mid BA.
Investments included in the project	The project includes a new 400kV HR-BA interconnector as well as internal 400kV projects in HR.
SEW [Meuro/year]	25-30
RES [MW]	830
CO2 [Mton/year]	0,4-0,5

First results 2020 - case 2
Preliminary results

[Mid Continental East corridor, RO-RS borders]	
Short description	The project aims to increase transfer capacity along the E->W corridor of the area.
Investments included in the project	The project includes a new 400kV double circuit RO-RS interconnector as well as 400kV reinforcements of the network along the Western border in RO.
SEW [Meuro/year]	45-55
RES [MWh]	2000-3000
CO2 [Mton/year]	0,8-0,9

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Overview TYNDP 2016 activities

Regional Investment Plans

Next steps TYNDP 2016

Questions and Answers session

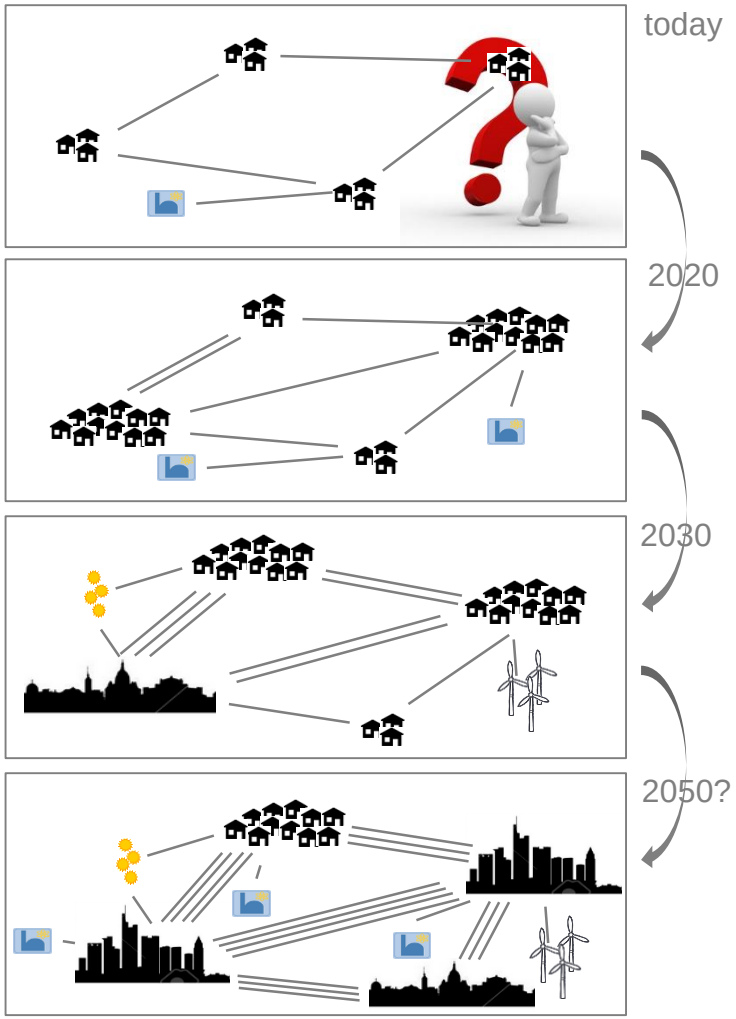
Next steps TYNDP 2016

Felix Maire, TYNDP 2016 Project Management Office

Assessment of individual projects

- **Most projects influence each other**
- **How do we ensure an objective and transparent assessment?**

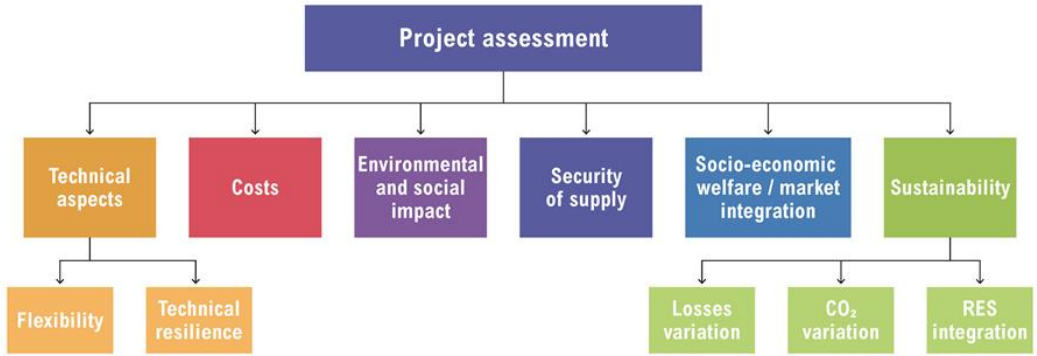
  - Impact is based on taking a project out of the reference; or adding it on top of the reference
  - A reference grid for each time horizon, which includes all mature projects
  - Impact is measured by several indicators
  - Full approach documented in Cost Benefit Analysis Methodology, developed by ENTSO-E in past years, reviewed and approved by ACER and EC.



Assessment of individual projects

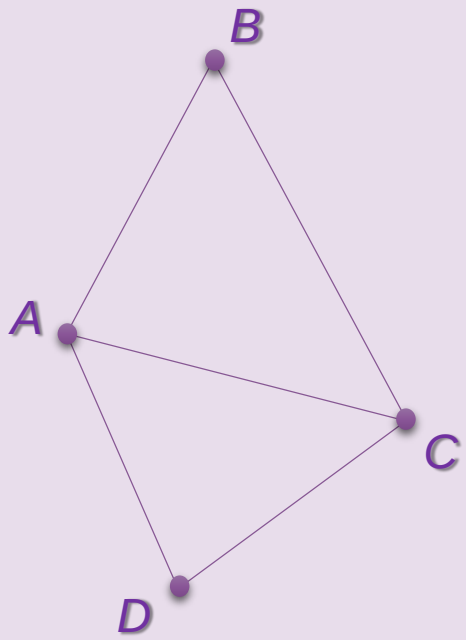
Indicators

- Multi-criteria approach
- Some criteria scenario-specific
- Coordinated ENTSO-E study
- Specific tailoring for storage projects
- Based on scenario/project data available on ENTSO-E website

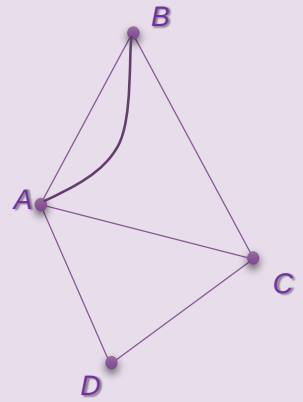


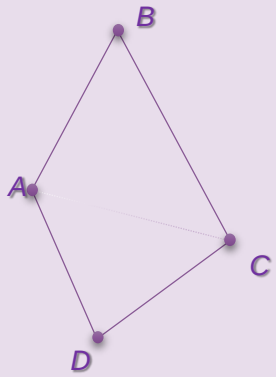
Approach

Put one IN at a Time (PINT)



Reference grid





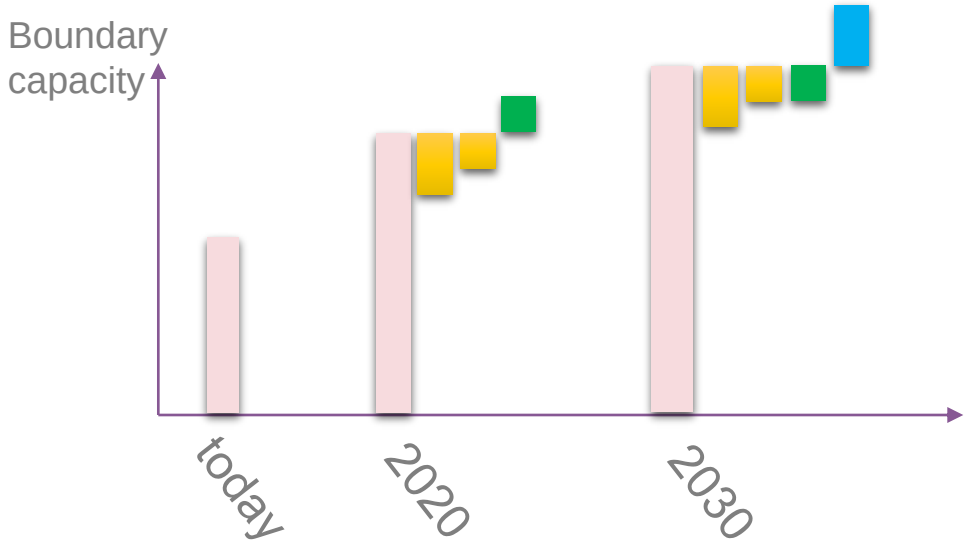
Take One Out at a Time (TOOT)

Assessment of individual projects

- Reflect maturity of projects
- Assess at two time horizons

→ Classify projects & define reference capacities

Mid-term project		Long-term project		Future project
Planned	Commissioning =< 2022	Planned	2022 < Commissioning =< 2030	Others



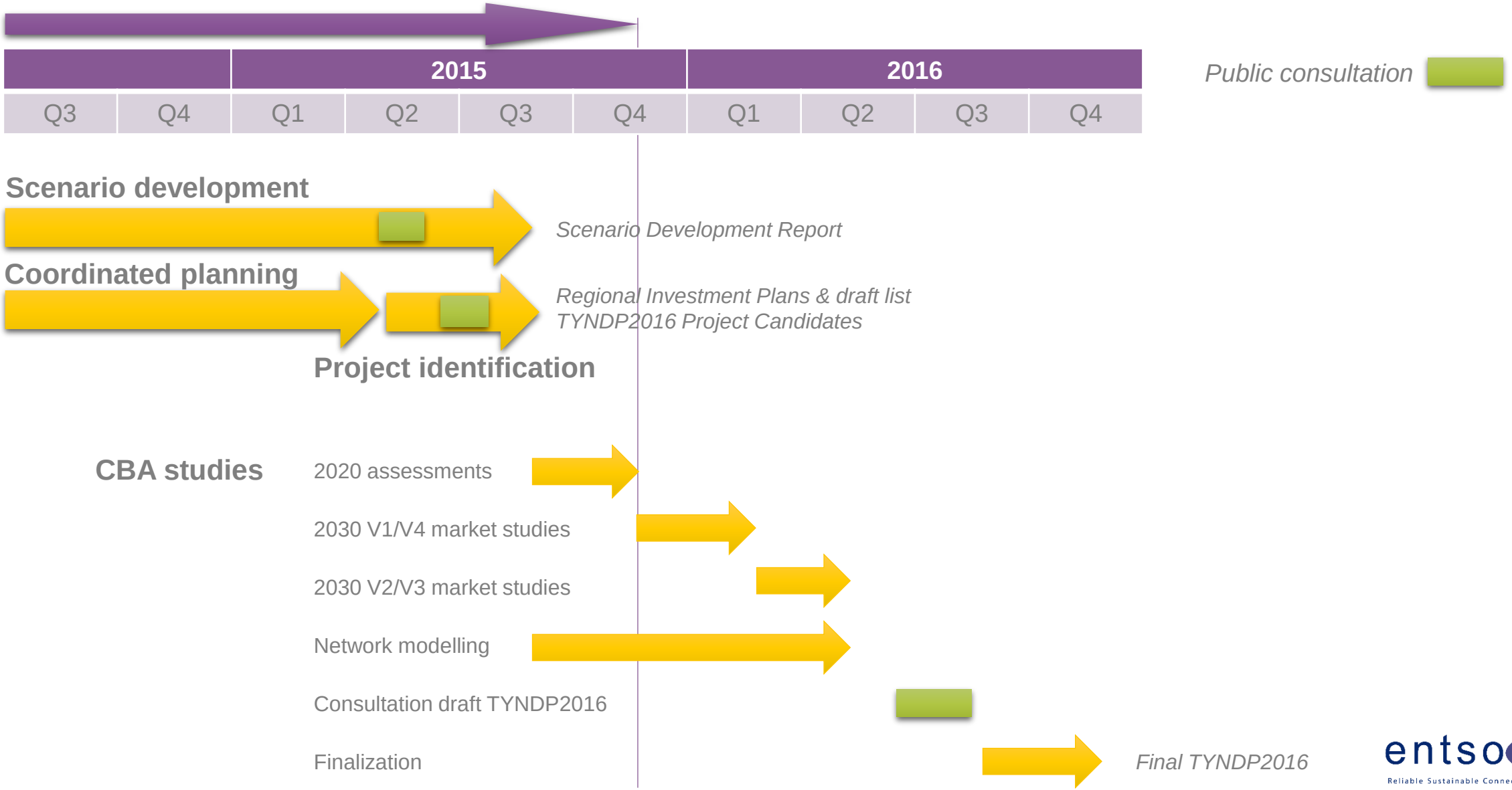
Reference capacity

- Expected/planned development of the grid
- Parameter for market modelling tools
- Confirmed by network studies
- Possibly different values in either direction

Going beyond standardized CBAs

- **Storage tailoring**
  - Flexibility
  - Peak generation deferral
- **Capacity analyses**
  - View on relation between capacity and welfare
  - Explain impact of sequence of commissioning
  - Analyze areas with low interconnection rate
- **System analyses**
  - Impact of high-RES scenario
  - Technology review

Approach for coming months



TYNDP website

https://www.entsoe.eu/major-projects/ten-year-network-development-plan/Pages/index.html

Thank you for your attention

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http://www.entsoe.eu
tyndp@entsoe.eu