Continental South East
REGIONAL WORKSHOP WITH STAKEHOLDERS

on "TYNDP & RgIP 2012 methodologies and results"
and
"Network Code on Grid Connection Requirements for Generators"

Zagreb, 12th December 2011

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AGENDA

09:30	*Registration and coffee*	
10:00	Introduction	**Y. Kabouris** Convenor RG Continental South East
10:05	Welcome addresses	**D. Sabolić** CEO of HEP-OPS **Ž.Rajić** Director of Electricity Department - Croatian Energy Regulatory Agency **B. Makšijan** Head of Energy Network Unit, Energy Directorate, Croatian Ministry of Economy, Labour and Entrepreneurship
10:15	General presentation on ENTSO-E, Ten Year Network Development Plan and Regional Investment Plan	**D. Međimorec** ENTSO-E Board Member
10:35	Ten Year Network Development Plan & Continental South East Regional Investment Plan 2012 methodology: - Market and adequacy studies - Grid studies	**Y. Kabouris** Convener RG Continental South East **A. Paunoski** Member Regional Group Continental South East
11:05	*Coffee break*	
11:15	Continental South East Regional Investment Plan 2012 - preliminary results	**A. Neris** Member Regional Group Continental South East
11:45	Towards Ten Year Network Development Plan 2014 and further	**I. Minciuna** ENTSO-E Secretariat
12:00	Discussion	All
12:30	*Lunch*	
13:30	The network code development process Network Code for Connection Requirements applicable to all Generators – main content	**E. Haesen** ENTSO-E Secretariat **R. Pfeiffer** European Planning Standards Working Group
14:30	Final Discussion	All
	Conclusions and Close-up	**Y. Kabouris** Convenor RG Continental South East
15:00	*End of Workshop*	

General presentation on ENTSO-E, Ten-Year Network Development Plan and Regional Investment Plan

Damjan Međimorec
ENTSO-E Board Member

CSE Regional Stakeholder Workshop on TYNDP & RgIP 2012 and NC on Grid Connection Requirements for Generators

Zagreb, 12 December 2011

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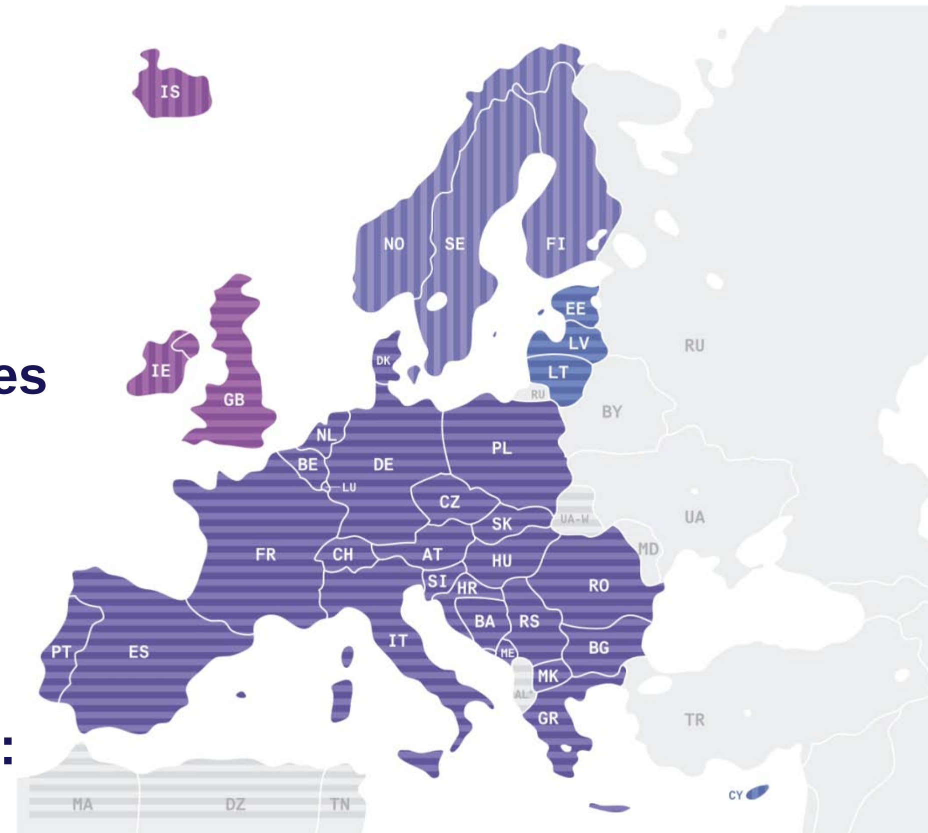
ENTSO-E: a trans-European network

- **Fully operational since July 2009**

- **Represents 41 TSOs from 34 countries :**
  - **525 million citizens served**
  - **828 GW generation**
  - **305,000 km of transmission lines managed by the TSOs**
  - **3,400 TWh/year demand**
  - **400 TWh/year exchanges**



- **Replaces former TSO associations:**

ATSOI, BALTSO, ETSO, NORDEL, UCTE, UKTSOA

Regulation 714/2009– an important raison d'être for ENTSO-E

Article 4: European network of transmission system operators for electricity

- **Completion and functioning** of the internal market in electricity and cross-border trade
- **Optimal management, coordinated operation and sound technical evolution** of the European electricity transmission network

Article 6: Establishment of network codes

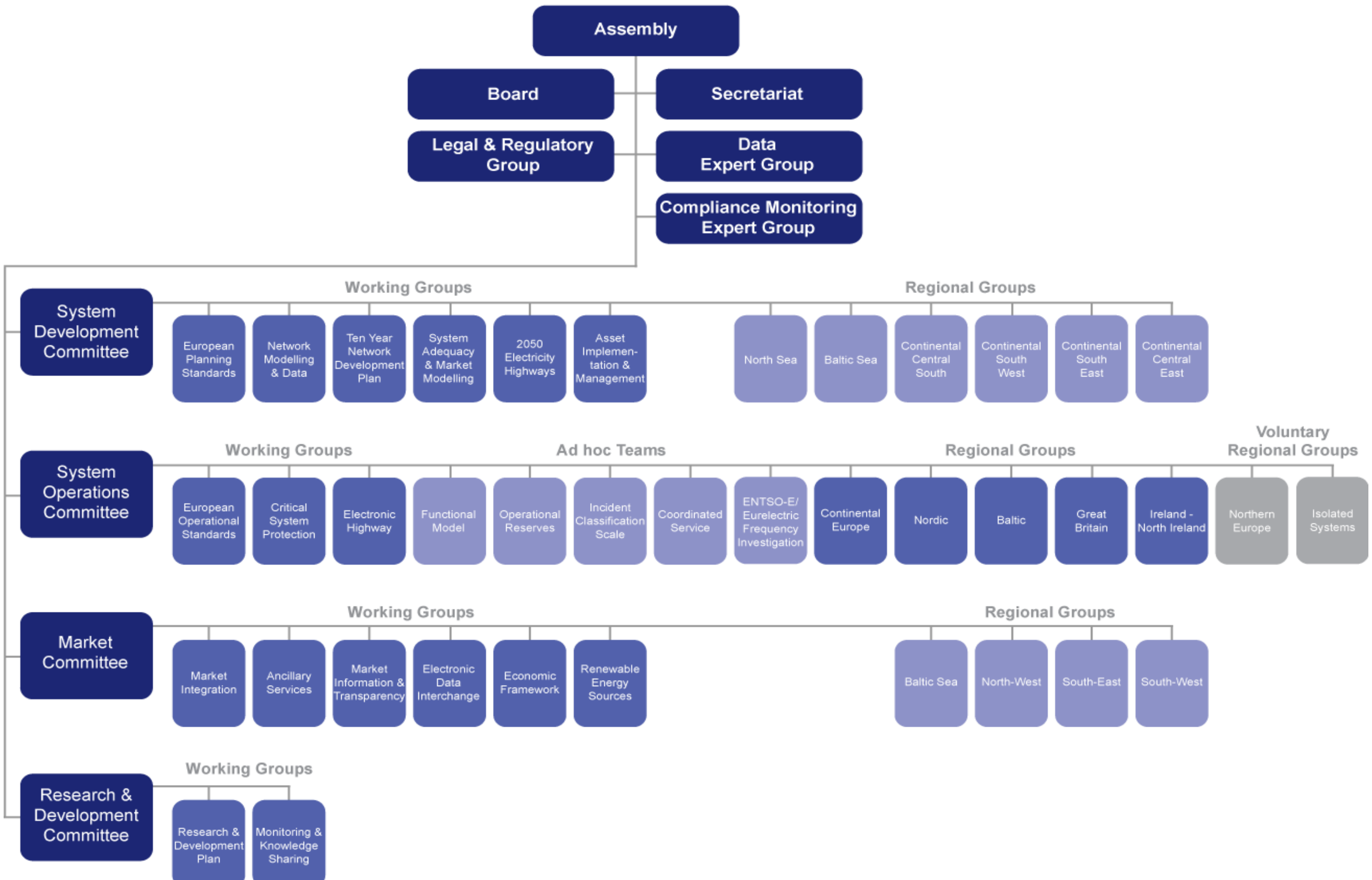
Article 8: Tasks of the ENTSO for Electricity

- **Network codes**
- **Common network operation tools**
- **Non-binding Community-wide 10-year network development plan**, including a European generation adequacy outlook, every two years
- Work programme, annual report, **summer/winter outlooks, monitoring**

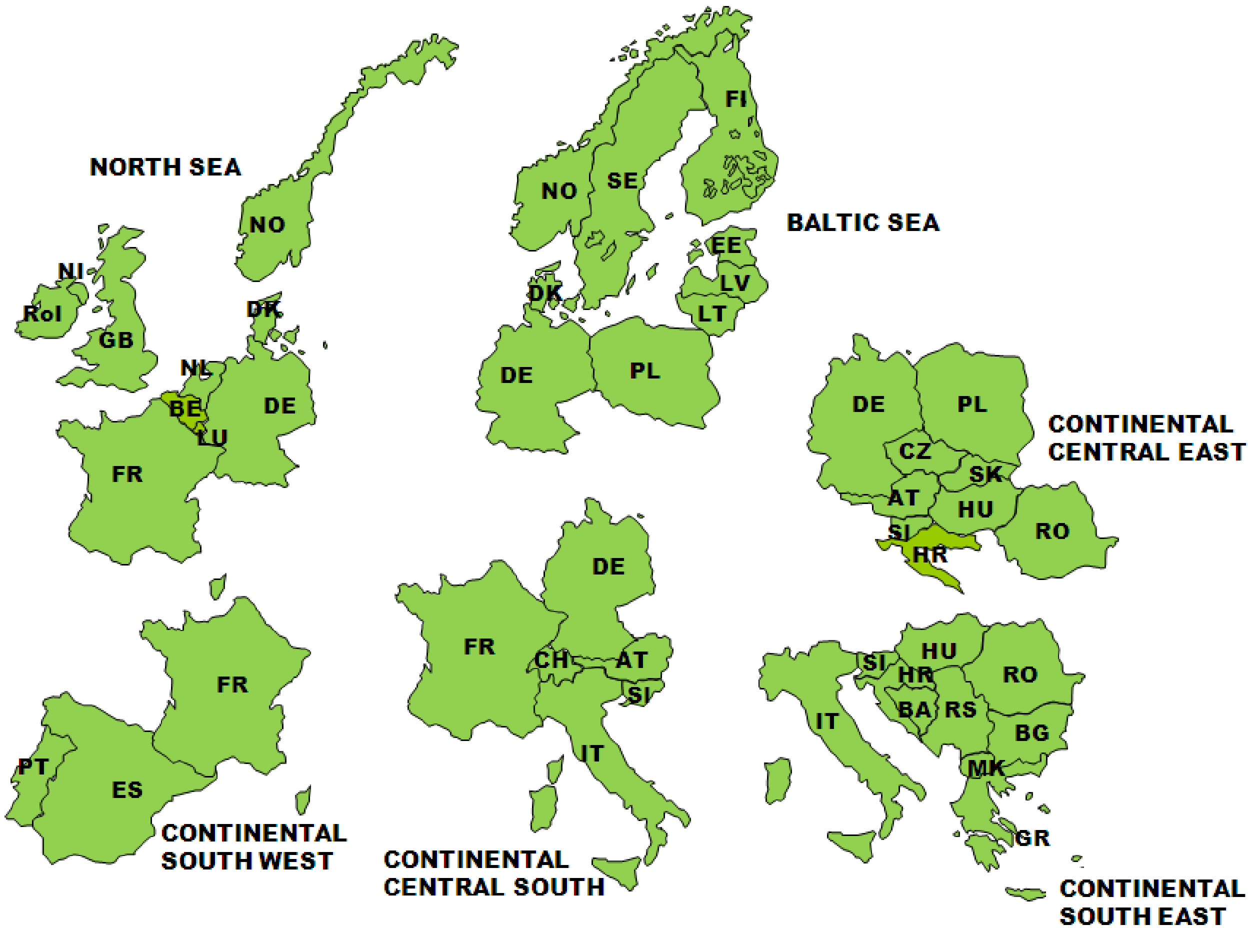
ENTSO-E operational because
a fully developed IEM and the integration of RES demand urgent TSO action

Reflecting the tasks given to ENTSO-E under the 3rd Energy Package

ENTSO-E organizational structure



ENTSO-E Regional Groups for System Development



The most appropriate framework for grid development in Europe

Every RG gather countries sharing the same common concerns

Overlaping, in order to ensure overall consistency

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Approach to system development

Goal

Consistent scenarios
(2020 – 2030 – 2050)
Integrated network and market modeling

System Adequacy Retrospect Summer/Winter Reviews TYNDP 2010 Assessment	Retrospective
Winter Outlook 2011-2012 Summer Outlook 2012	Short term
Scenario Outlook & Adequacy Forecast 2011-2025 Regional Investment Plans TYNDP 2012	Medium-long term
Modular Development Plan for Electricity Highways North Seas Offshore grid	Long term

- An ambitious and comprehensive work program looking at all time horizons
- TSO expertise and experience under a common working framework
- Transparency and stakeholder involvement

The 3rd Package defines the TYNDP

Non binding
Every 2 years

EU-TYNDP

- Generation adequacy outlook 5 yr up to 15yr (→ 2025!)
- modelling integrated networks
- Scenario development
- Assessment of resilience
- Based on reasonable needs of system users
- Identify investments gaps
- Review barriers to increase cross border capacities arising from approval procedures

Regulators check consistency

Build on nat. gen. adequacy outlooks and invest. plans

Take into account

Binding
Every year

Nat. TYNDPs

- Existing and forecast supply demand
- Efficient measures to guarantee adequacy & SoS
- Indicate main transmission infrastructure to be built
- Based on reasonable assumptions about evolution of generation
- Supply consumption and exchanges

Non binding
Every 2 years

Regional Investment Plans

Take into account

Take into account

The Ten-Year Network Development Plan 2010

42.100 km of new lines (mostly overhead)

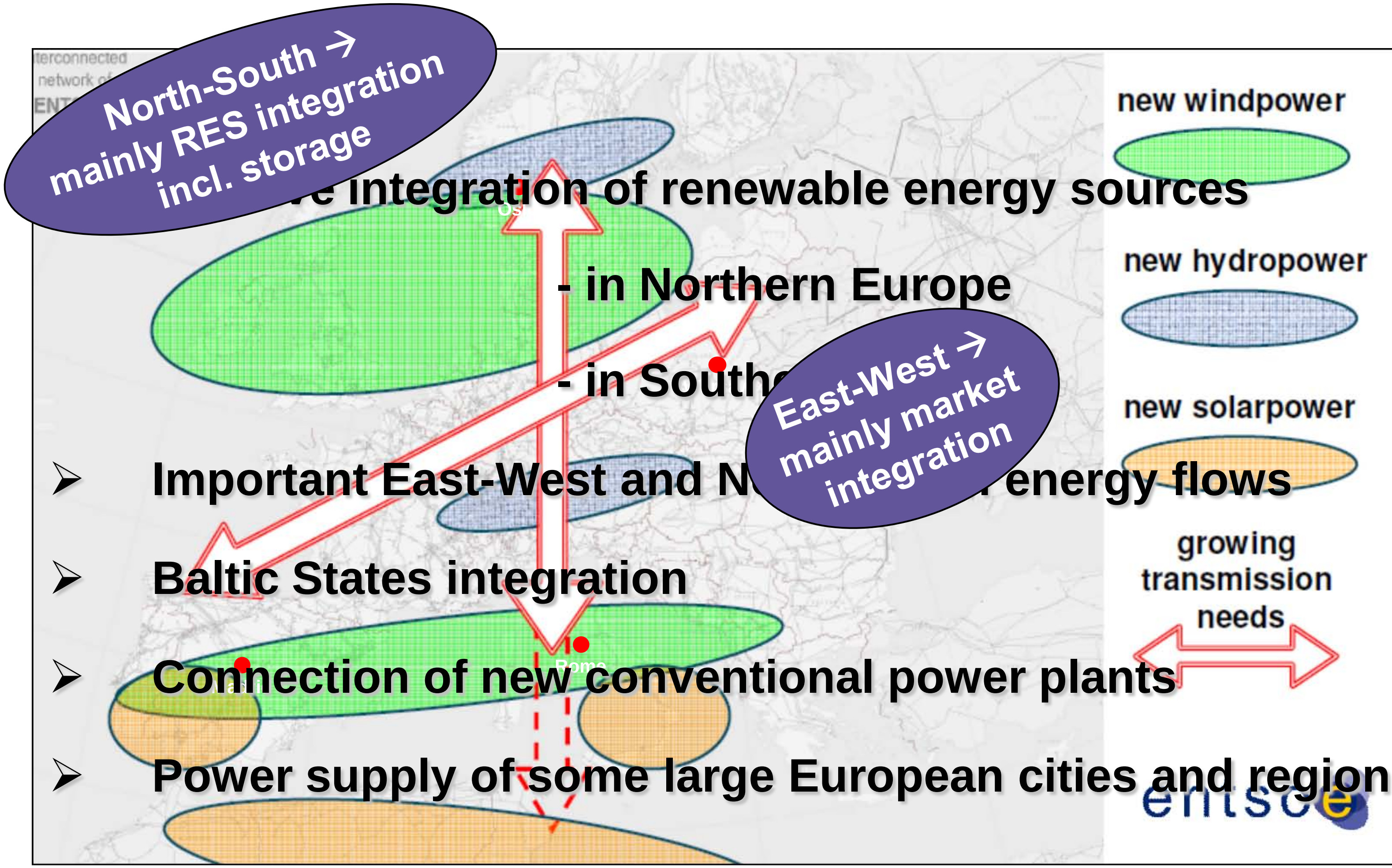
- **500 individual projects all required!!**

mostly along EC corridors

€ 28 billion (5 years)

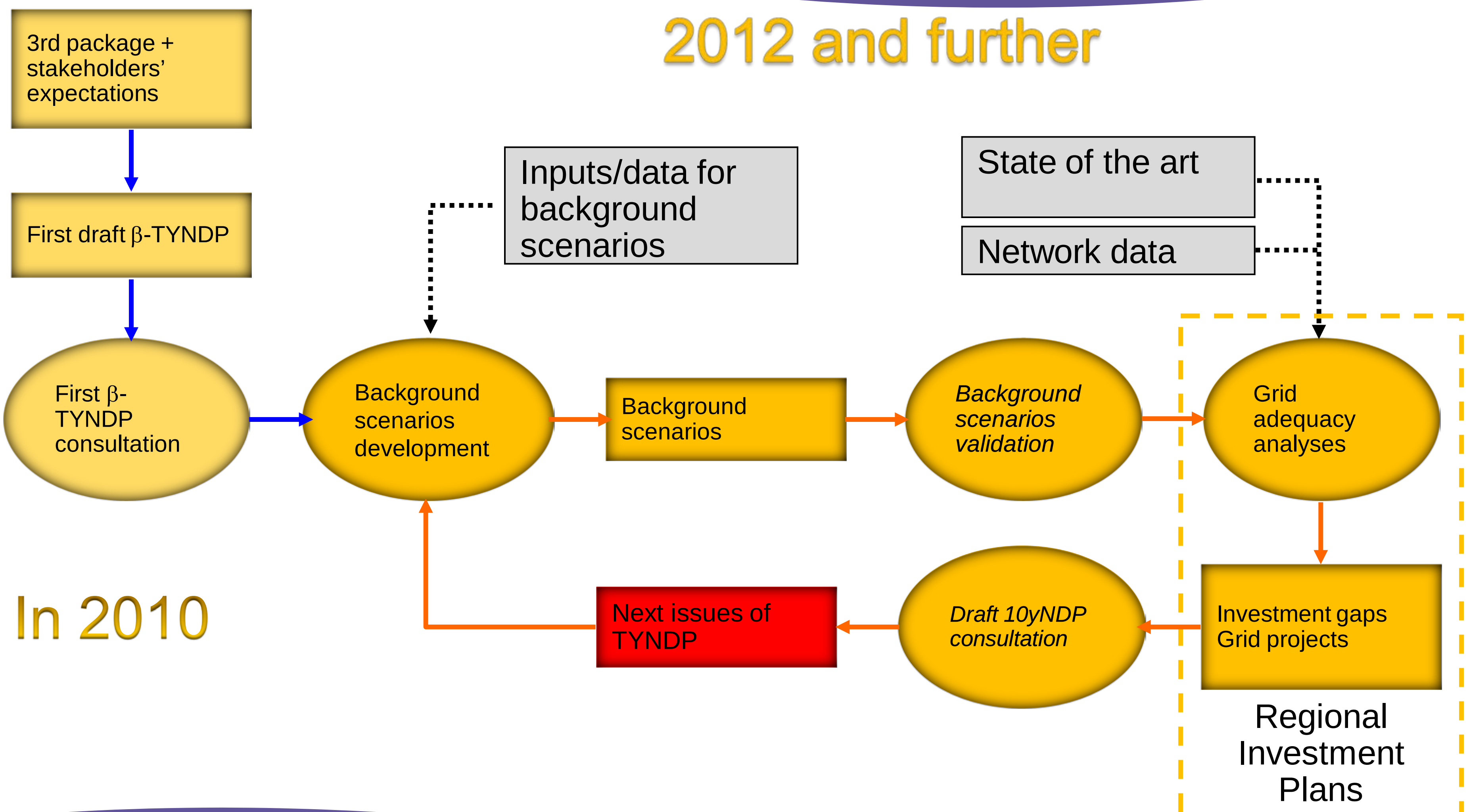
<u>On top of</u> investments for growing demand and aging assets!

Main drivers identified already in 2010



- ...ve integration of renewable energy sources
  - in Northern Europe
  - in Southe...
- ➢ Important East-West and N... ...energy flows
- ➢ Baltic States integration
- ➢ Connection of new conventional power plants
- ➢ Power supply of some large European cities and regions

RgIP & TYNDP 2012 elaboration process

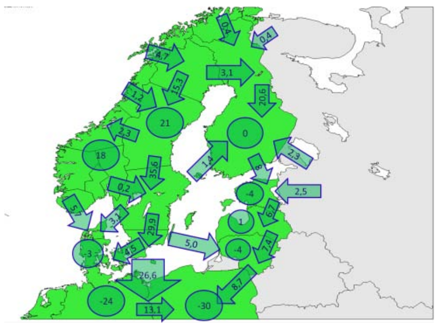


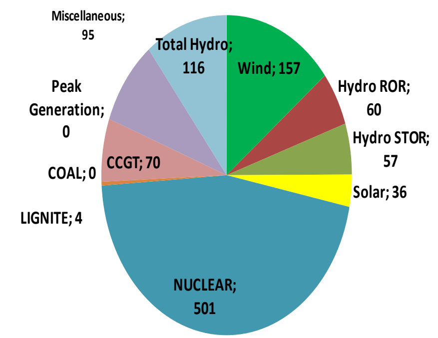
TYNDP 2012 package improves

- Explicit definition of projects of pan-European significance
- Public procedure to identify the 3rd party projects
- More scenarios : top down + bottom up scenarios + Nuclear phase-out sensitivity analysis
- Regional market & network studies – based on the common set of data
- Project assessment based on a set of clear indicators
- More compact reports easy to understand

Transparency

A dense 2-year long study process



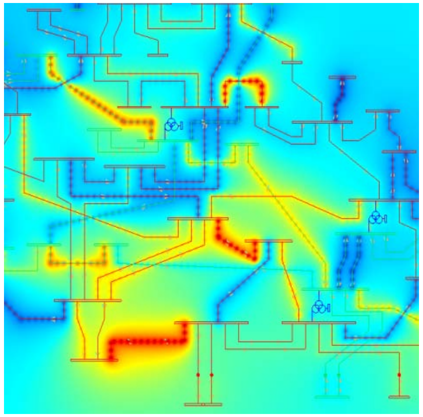


- Scenario elaboration & validation

- Market studies
- Network studies

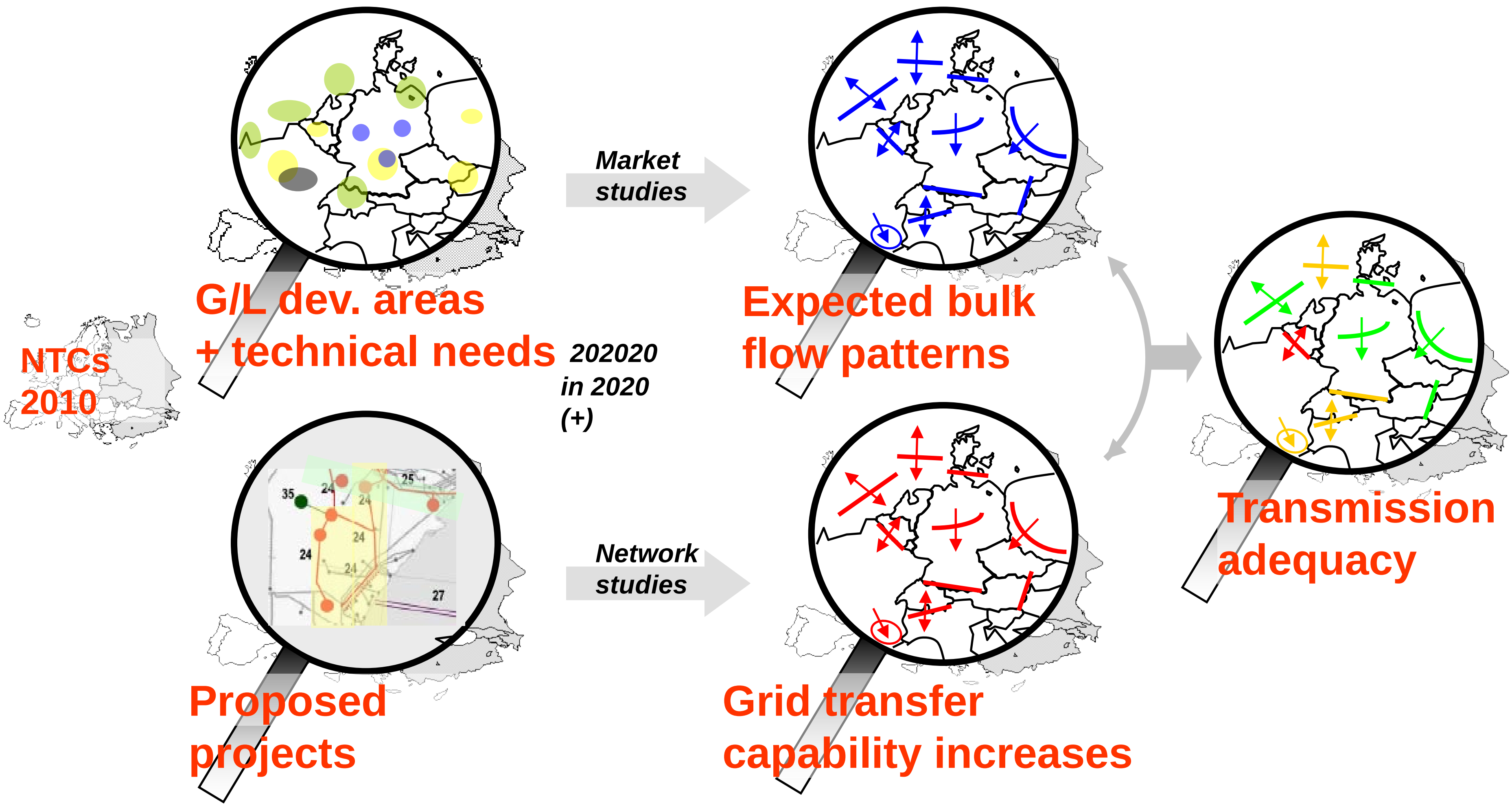
- Project identification & valuation

		Grid TC	SoS	RES	Social Welfa	CO2 mitigati	Energy effici	Tech. resilie	Flexibility
(Project A name description)	+... MW								
(Project B name description)	+... MW								



- Reports compilation

Main deliverables TYNDP 2012

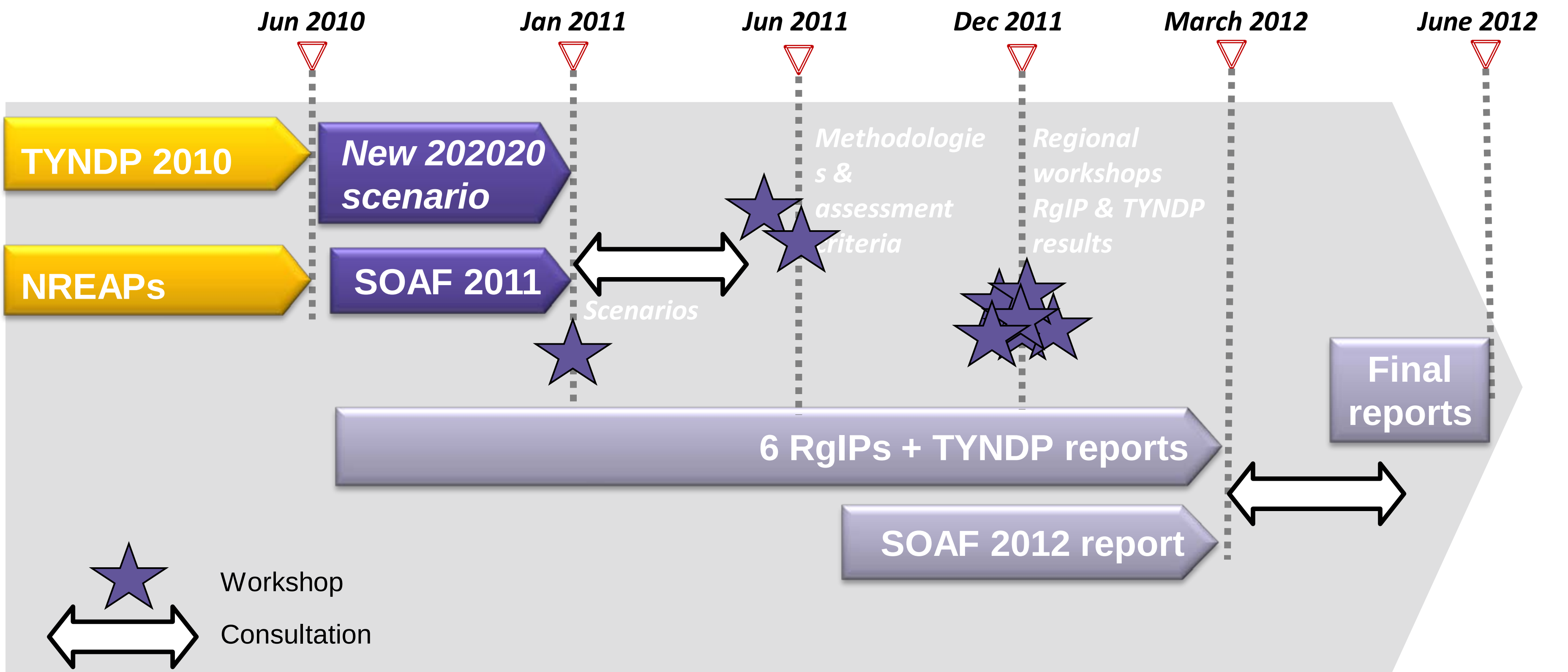


The TYNDP 2012 package

Comprised of 8 documents :

- ➢ **Scenario outlook & adequacy forecast (SOAF) report**
- ➢ **6x Regional Investment Plans reports**
  - Detailed grid development issues, regional level
- ➢ **Ten-Year Network Development Plan report**
  - Synthetic compilation, pan-European level

Overall schedule TYNDP 2012



Conclusions

- A consistent ENTSO-E approach in all planning horizons
- The pilot TYNDP in 2010 first overview of the needs, drivers and the necessary European infrastructure
- TYNDP 2012 improvement: more comprehensive, common studies, top-down approach added, open to the 3rd party projects
- The TYNDP as the factual and methodological basis for key policy and investment decisions.
- Transparency - stakeholder involvement is the key success factor

THANK YOU FOR YOUR ATTENTION

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12 December 2011

Continental South East Region
Methodology for RgIP and TYNDP contributions

ENTSO-E Continental South East Regional Stakeholder Workshop

12 December 2011

Yannis Kabouris,

Convener of RG Continental South East

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Overview of the presentation

- The Region
- Methodology for Market studies
- Evaluation of projects
- Conclusions and discussion

Continental South East Region

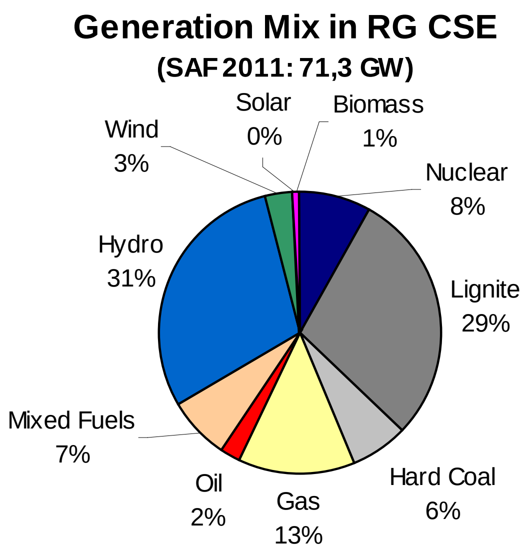
11 TSOs

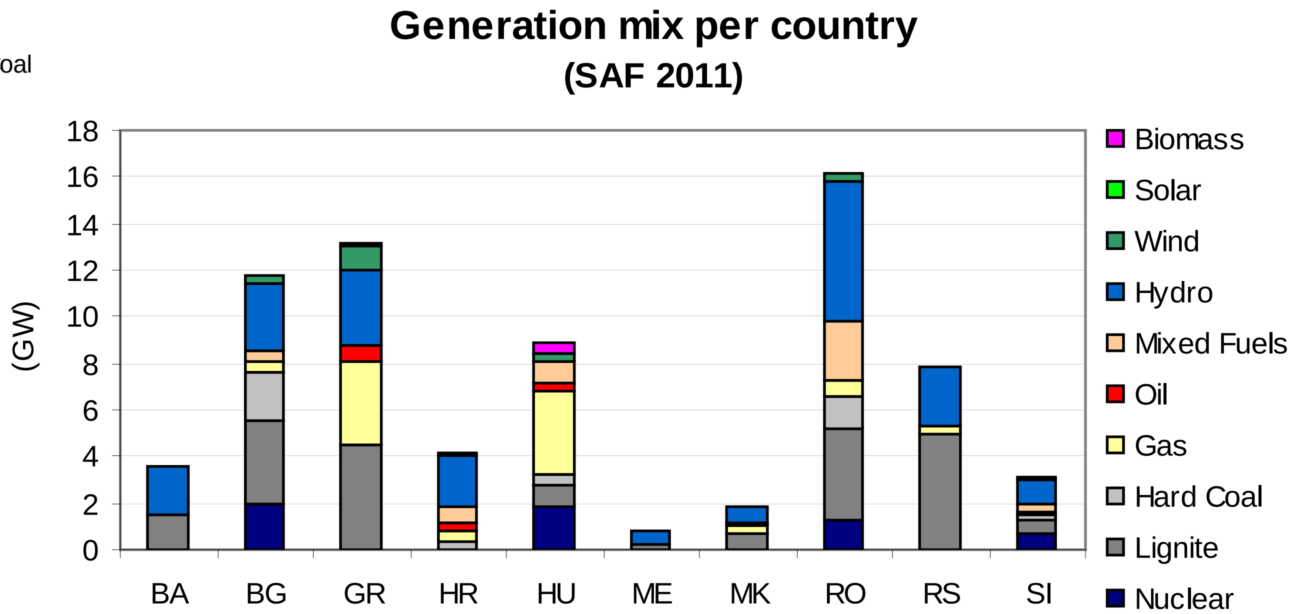
+ CY (corresponding member)

+ AL (collaboration in data provision and modeling)

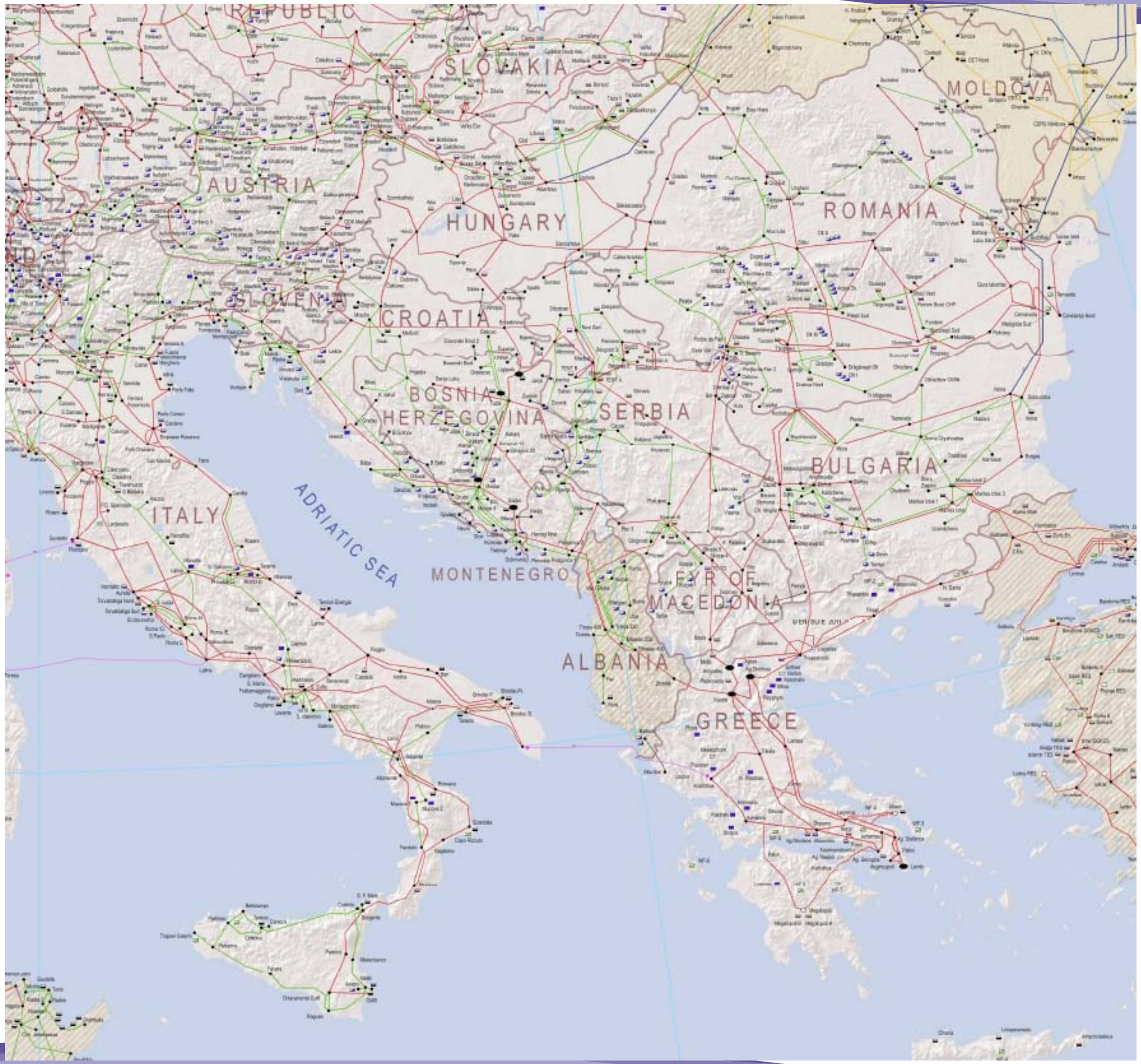
HTSO	GR
TERNA	IT
ESO	BG
MEPSO	MK
EPCG	ME
NOsBiH	BA
HEP-OPS	HR
EMS	RS
TRANSELECTRICA	RO
ELES	SI
MAVIR	HU

Installed Capacity in the RG CSE – SAF 2011





Regional network of today



Major recent evolutions:

- Interconnection of CESA with Turkey (September 2010)
- New 400kV interconnector Podgorica (ME)-Tirana (AL) (May 2011)
- New 400kV interconnector Ernestinovo (HR)-Pecs(HU)

CSE Region – Main characteristics

- Sparse network
- Predominant power flow directions
- Flows sensitive to generation location due to the network sparcity / high interdependency of flows
- Steam turbines / non-flexible generation
- Low RES development (GR ~1,5 GW wind, ~0,4GW PV)
- Network security is a main issue
- High uncertainty for new generation (especially RES)
- Uncertainties with new connectees (TR, UA/MD)

Objective of Pan-European Market Database (PEMD)

- Provide the means to <u>consistently</u> assess projects of European significance for the Ten Year Network Development Plan.

- Provide an aid to regions to consistently model outside their region in a easy-to-use but realistic manner.

- Provide a back-up data set for modelling within a region.

- Common rules for generation modelling

Default assumptions for thermal units

Scenario	Fuel Prices	CO_2 price (€/ton)
EU 2020	IEA 2010 scenario	90
SAF A/B	IEA 2010 scenario	25

Cat	Type	Efficiency range %	Standard efficiency used in PEU modeling %	Fuel	Availability %	CO2 emission factor kg/GJ	Minimum stable generation %
1	Nuclear	30%-35%	33%	UR	85%	0.00	50%
2	Lignite new	37% - 46%	43%	LI	85%	139	43%
3	Lignite old	30% - 37%	36%	LI	80%	139	43%
4	Hard coal new	40% - 48%	46%	CO	85%	94	43%
5	Hard coal old	25% - 40%	35%	CO	80%	94	43%
6	Nat Gas CCGT new	53% - 60%	58%	NG	85%	58	35%
7	Nat Gas CCGT old	33% - 53%	48%	NG	85%	58	35%
8	Nat. Gas conv. old.	25% - 40%	35%	NG	80%	58	35%
9	Nat Gas OCGT new	36% - 44%	40%	NG	85%	58	30%
10	Nat Gas OCGT old	25% - 36%	30%	NG	85%	58	30%
11	Oil	25% - 40%	35%	HO	80%	87	35%
12	Oil Shale new	36% - 39%	39%	OS	85%	99	40 %
13	Oil Shale old	28% - 31%	29%	OS	80%	102	40 %

Scenarios

- 2 basic scenarios
- Strongly differentiated to cover future uncertainties

Key features	
Scenario EU 2020	**Scenario B**
Top down	Bottom up
Based on Long term vision of the future (3X20 targets)	Based on anticipated generation projects + short term vision (max. 7 years)
EU targets: National Renewable Energy Action Plans (RES capacity/energy and consumption) plus TSO assessment of conventional generation	Potential overestimation of generation capacity
Merit order: gas before coal	Merit order: coal before gas
No location information regarding new generation units	Location of new generation units are known

Scenarios Analysed Regionally

- EU2020 and B2020
- 90 €/tn 25 €/tn CO2 emissions cost
- Sensitivity analysis taking into account Nuclear Phase Out in Germany and Switzerland, scenarios EU2020 and B2020 are altered only on the boundary conditions with ROW
- Sensitivity analysis for different CO2 prices in the two main scenarios

	EU2020	B2020
	(TWh)	
Demand (excluding pumping)	337,6	338,6
RES generation	133,2	118,5
Net imports from ROW		
Basic Scenario	10,4	-11,1
Nuclear Phase Out Scenario	7,3	-15,4

Gas vs. coal strongly impacts the situation (import/export)

Impact of CO2 emission price on merit order

	Sc. EU2020	Sc. B
Renewables, other non-dispatchable units and must-runs	1	1
Nuclear units	2	2
CCS (Carbon capture and storage)	3	3
CCGTs	4	6
Hard coal power plants	5	5
Lignite power plants	6	4
Oil-fired power plants and OCGTs	7	7

CO_2 price effect

In Scenario B, merit order is as of today

In Scenario EU 2020, due to the high CO2 price, gas fired generators are dispatched before coal fired generators

Brief description of the Methodology

The methodology involves generation simulation (Market studies) and Network analysis

Main steps:

- **Joint simulation of all generation systems in the region in order to determine the ‘least cost’ dispatch of available generation,**
- **Simulation takes into account a merit order, the flexibility of the units and must-run constraints, ignoring network system constraints (copper plate)**
- **Probabilistic Simulation to calculate energy balances and reliability indices**
- **Based on market simulation, DC power flows are performed to detect possible future congestions (inv. needs)**
- **Duration curves of loading of transmission network elements are calculated**
- **GTCs on boundaries are calculated using AC LF**
- **Hourly power flows are compared to GTCs achieved in order to check TRANSMISSION ADEQUACY**
- **Exhaustive security assessment (N & N-1) for extreme snapshots**
- **Based on the results of the precious steps, the project indicators are calculated**

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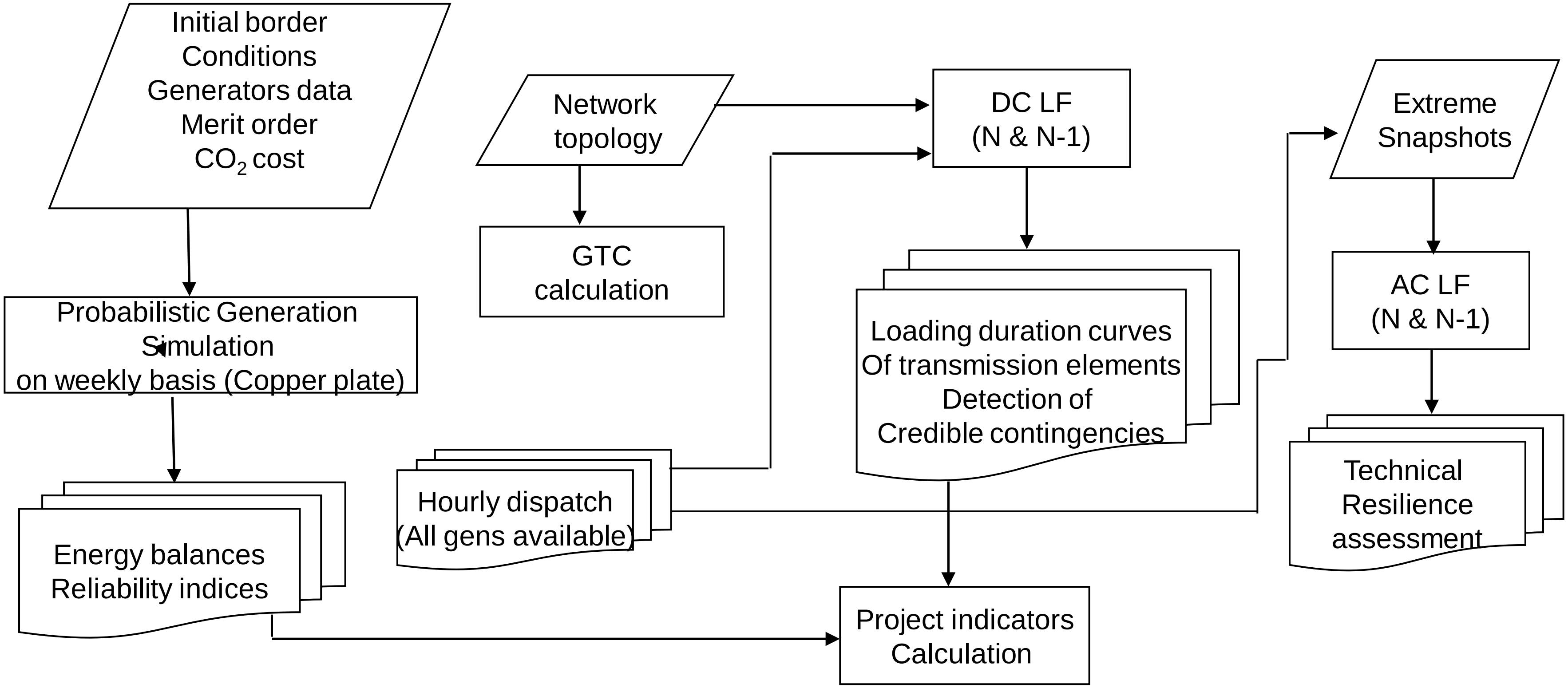
Schematic description of the Methodology



If flows on any corridor > GTC – TRM the generation dispatch is modified to meet the transmission constraints

Market Simulation - Basic Modeling Assumptions

Simulation of the generation system is performed through the following steps:

- Aggregation of data: All national timeseries data is aggregated into single timeseries
- 'Rest of World' (ROW): is taken into account through predetermined import/export scenarios, provided by CCE (based on PEMDB process)
- Maintenance scheduling: A predefined maintenance schedule on a weekly basis is taken into account, or created for each control area
- Renewables: Contribution of RES is taken into account by subtracting predicted RES operation timeseries from the forecasted hourly load timeseries for each control area in the Region
- Storage Hydro Plants: Simulation of Storage Hydros for each control area in the Region is performed by appropriately modifying the Load Duration Curve (on a weekly basis) using a Peak Shaving technique, in order to achieve the desired weekly energy taking into account minimum and maximum production constraints (data provided in the PEMDB)
- Pump-storage units: A module for simulating the operation of pump storage hydro plants has been developed. The model adds a pre-defined pumping load to weekly or daily valley loads and then shaves appropriately weekly or daily peak loads (compulsory operation)
- Remaining loads are met by thermal units using probabilistic techniques

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Market Simulation - Dispatch of thermal units

The Merit Order of thermal units is defined in weekly basis, in two steps:

- Step 1: Base units are committed until two conditions are satisfied:
  - Minimum Condition: committed units are dispatched above their technical minimum (1st block)
  - Maximum Condition: The total capacity of committed units must cover the peak load plus spinning reserve requirements
  - Step 1 determines the commitment of the non-flexible generators
  - Non-flexible generators not committed in Step 1 are shut down for the entire week
- Step 2: the remaining capacity blocks of all available units (units not in maintenance or shut down in Step 1) are placed in the merit order in ascending order of their incremental cost

Data and Modeling Hypotheses

- All countries except IT (including AL) modeled in details (full network topology for all voltage levels >150kV, detailed generation models)
- Initial boundary flows were provided by the PEMDB
- Generators modeled in more details than in PEMDB
- Hypothesis of 500 MW export at the Turkish borders
- No exchanges with UA/MD
- RES capacities for member states compatible to NREAPs
- Not accurate meteorological data for RES potential in several regions
- Network topology as by WINTER 2020 network model provided by WG NM&D
- Compatibility checks (still on-going)

Network Studies

The aim of network studies for TYNDP:

- Calculation of GTCs
- GTC: a rough number for the comparative assessment of transmission capacities at a glance

- Check and validate the technical resilience of the projects by the investigation of extreme snapshots

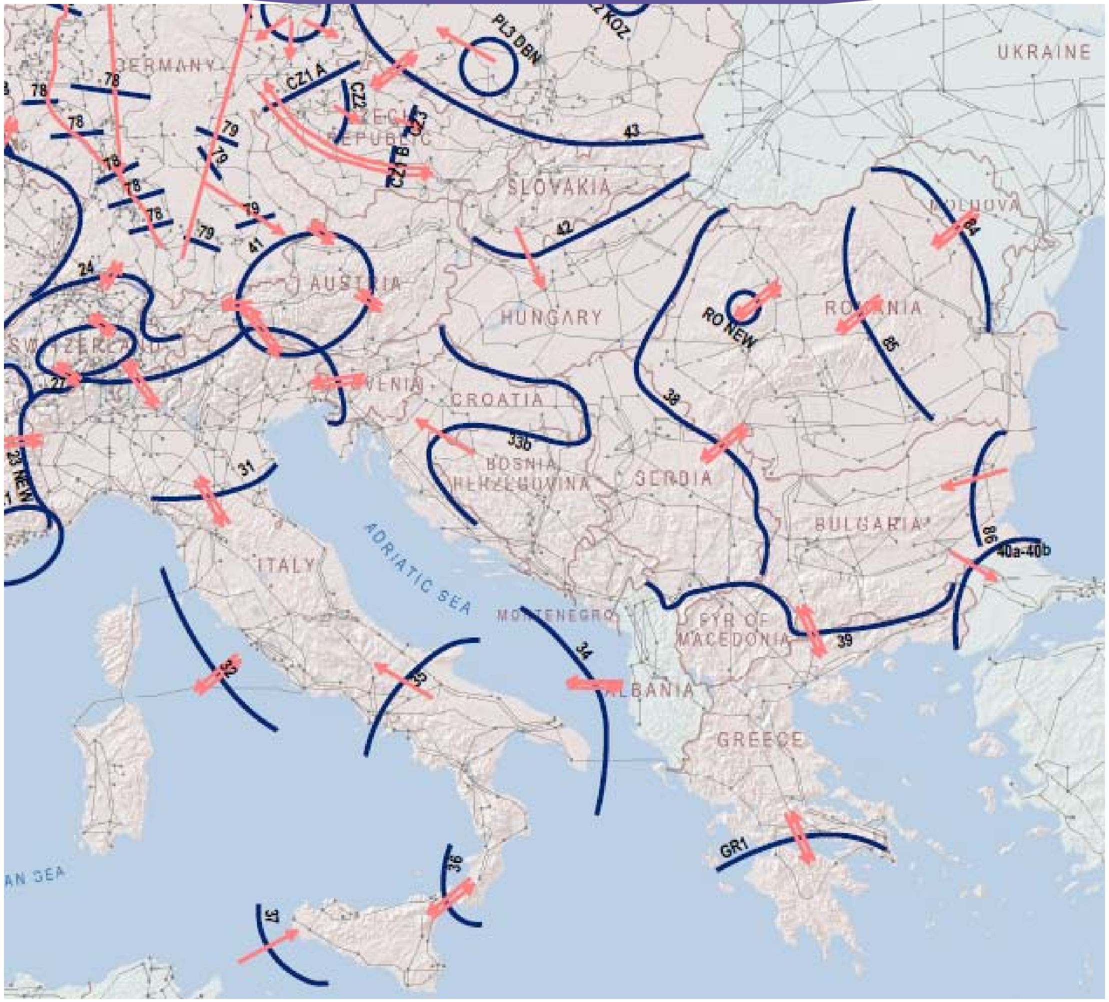
- Simple rules to assess a reasonable Transmission Reliability Margin (TRM) for the interconnectors within each cluster of projects

Snapshots investigated

- Based on outputs by the Market studies (hourly dispatching)
- Construction and analysis of “extreme” snapshots
- Even more stressed snapshots (to check technical resilience)
  - No wind
  - High wind
  - High correlation of wind among neighboring regions
- Static security assessment for N and all N-1 “credible contingencies” (provided by local TSOs)
- Indicative snapshots for the January 19 and July 11 also analysed

Boundaries and Power Flows

- 6 main cross border boundaries
- Internal Boundaries
- Detected by the model and TSOs knowledge
- Hourly simulation results are used as input for DC load flow calculations.



Projects of European significance

- A *Project of European significance* is…
  - … a set of EHV assets (with at least one part in Europe);
  - … all contributing to a same grid transfer capability increase across a grid boundary, valuated in MW;
  - … matching the following thresholds:
    - main equipment > 220 kV for OHL AC and > 150 kV else
    - Grid Transfer Capability Increase either
      - enabling > 500 MW of additional NTC; or
      - enabling or securing output of > 1 GW/1000 km² of generation (new and/or existing); or
      - securing for > 10-year load growth for an area > 3 TWh/yr.

EC Reg. 2010/617 on notification of infrastructures

EC 2009/72

Assessment of projects - Indicators

- The goal of project assessment is to characterize the impact of transmission projects, both in terms of added value for society (increase of capacity for trading of energy and balancing services between price zones, RES integration, increased security of supply, etc.) as well as in terms of costs.
- ➢ Grid Transfer Capability Increase (GTC)
- ➢ Social Economic Welfare (SEW)
- ➢ RES integration
- ➢ Security of Supply (SoS)
- ➢ Losses variation
- ➢ CO2 emissions
- ➢ Technical Resilience
- ➢ Flexibility
- ➢ Social and Environmental impact

Project Assessment- Indicators (I)

- **Grid Transfer Capability (GTC)** is the ability of the grid to transport electricity across a boundary, i.e. from one area (price zone, area within a country or a TSO) to another. It depends on the considered state of consumption, generation and exchange, as well as the topology and availability of the grid. It is expressed in MW, and represents maximum transfer capability between two areas calculated under certain conditions. GTC represents a rough estimation of the ability of the grid to transfer power. It should not be confused with NTC.
- **Social Economic Welfare (SEW)** on electricity markets is characterized by the ability of a power system to reduce congestions and thus providing an adequate grid transfer capability, reflecting to the needs and willingness to pay market players and consumers. The social and economic welfare benefit is calculated from the reduction in total variable generation costs associated with the GTC variation that the project allows
- **RES integration** is defined as the ability of the system to allow the connection of new RES and unlock existing “green” generation, while minimizing curtailments. RES integration is facilitated by increasing the GTC between an area with excess of RES generation and another area where this production can be consumed by reducing other type or generation.

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Project Assesment – Indicators (II)

- **Security of Supply (SoS)** is the ability of a power system to provide an adequate and secure supply of electricity in normal conditions. SoS is evaluated by the reduction of proportion of time that the system is at risk due to constraints in transmission system following ENTSO-E standards.
- **Losses variation** has been considered as the ability of a transmission grid to minimise thermal losses in the power system.
- **CO2 emissions** is a result of SEW (unlock of generation with lower carbon content) and losses variation CO2 emissions are calculated using standard emission rates (CO2 emission) for each power plant given in the Pan European Market Data Base.
- **Technical Resilience** is the ability of the system to withstand extreme system conditions (rare contingencies)
- **Flexibility** is the ability of the proposed reinforcement to be adequate in different possible future development paths or scenarios
- **Social and environmental impact** characterizes the project impact as perceived by the local population, and as such, give a measure of probability that the project will be build at the planned commissioning date.

Project assessment – Qualitative presentation

- Every project valuated against 9 criteria

Grid transfer capability increase	Social and economic welfare	RES integration	Improved security of supply	Losses variation	CO_2 emissions variation	Technical resilience	Flexibility	Social & environmental impact
+ … MW								
+ … MW								
+ … MW								

- Basis for further selection of

  Projects of Common interest

+ technical description
+ monitoring

Conclusions and Discussion

- Various scenarios to check the flexibility of the plan
- Detailed modeling of generation plants
- Detailed modeling of transmission network
- Probabilistic assessment of energy balances and reliability indicators
- Exhaustive network analysis
- In general results seem realistic

Market Modeling: Hypotheses check and possible improvements:

- Re-consider the assumption of same cost for same type of generation
- Take into account internal bottlenecks also in the market models
- Apply constraints on minimum level of local generation within each control area (TSO)
  - Cross-border regulation possibilities
- similar constraint on maximum non-dispatchable (intermittent) generation
- Investigation of various hydraulic conditions

(**To be considered for TYNDP 2014**)

Thank you for your attention.

Yannis Kabouris

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Grid Studies Methodology

ENTSO-E Continental South East Regional Stakeholder Workshop

12 December 2011

Aleksandar Paunoski

member of RG Continental South East

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Goals of Grid Studies Methodology

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Project/Cluster benefits on regional level

- Selection of projects of European significance
- Matching the threshold ΔGTC > 500 MW
- Projects grouped in clusters, all contributing to same increase of GTC
- For each cluster is defined boundary and exchange scenario according to prevalent market transactions

What is GTC ?

DRAFT

Grid Transfer Capability – GTC

- is ability of the grid to transport electricity across a boundary, and represents maximum transfer capabilities between two areas calculated under certain conditions

Flow based approach

- GTC is identical with real flows between systems while maximal possible exchange is obtained and N-1 criterion is satisfied

What is GTC ?

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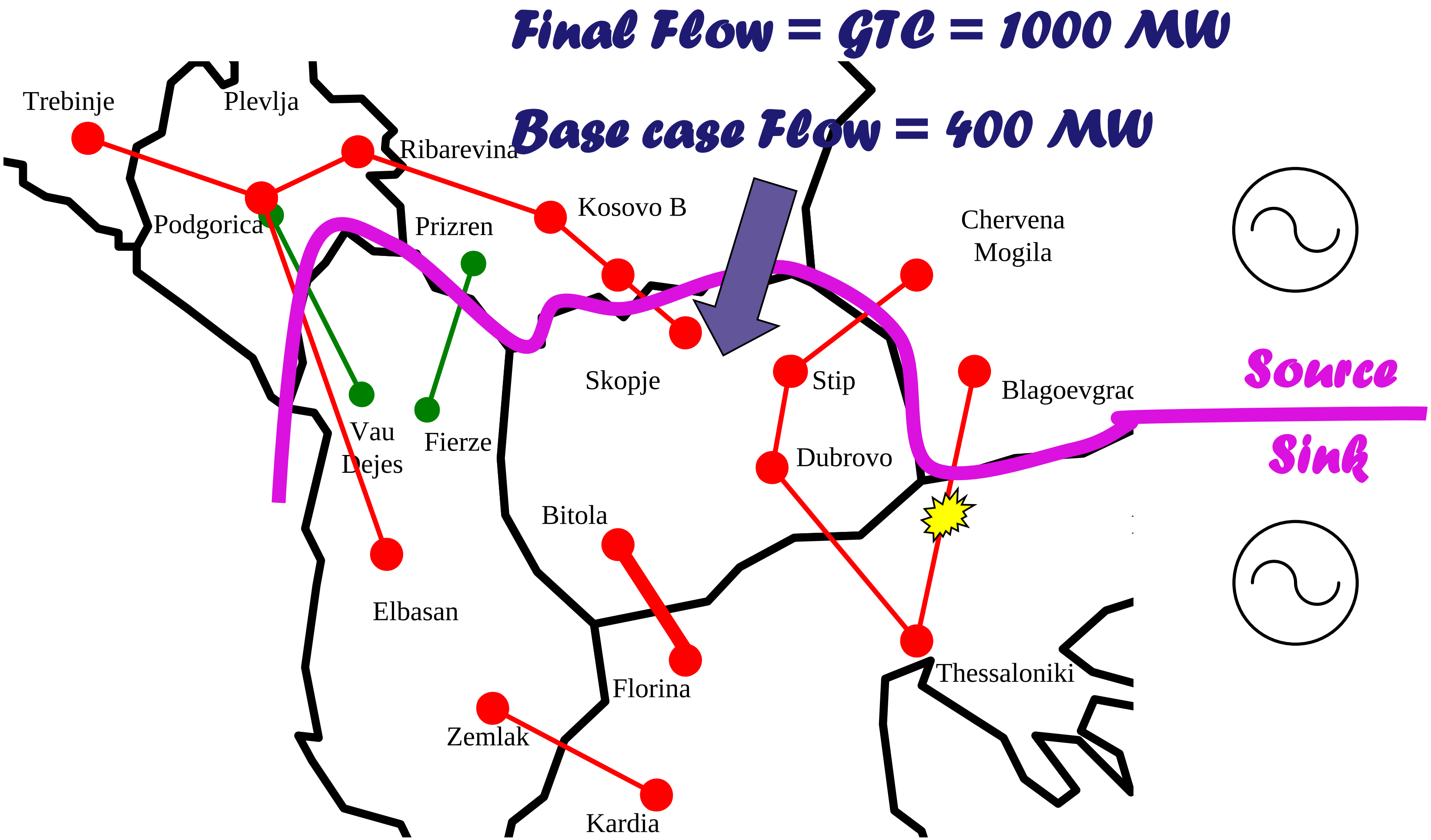

Methodology

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ΔGTC increase by every regional project

- Starting point is WP 2020 regional model with all new projects **IN** operation
- Grouping of investments in projects,
  all selected projects contribute to increase of GTC for typical power transfer
- Contribution of each project is assessed by removing only this cluster and assessing ΔGTC variation in the respective boundary

$$\Delta GTC_{\text{cluster X}} = GTC_{\text{all clusters IN}} - GTC_{\text{cluster X OUT}}$$

Calculation technique

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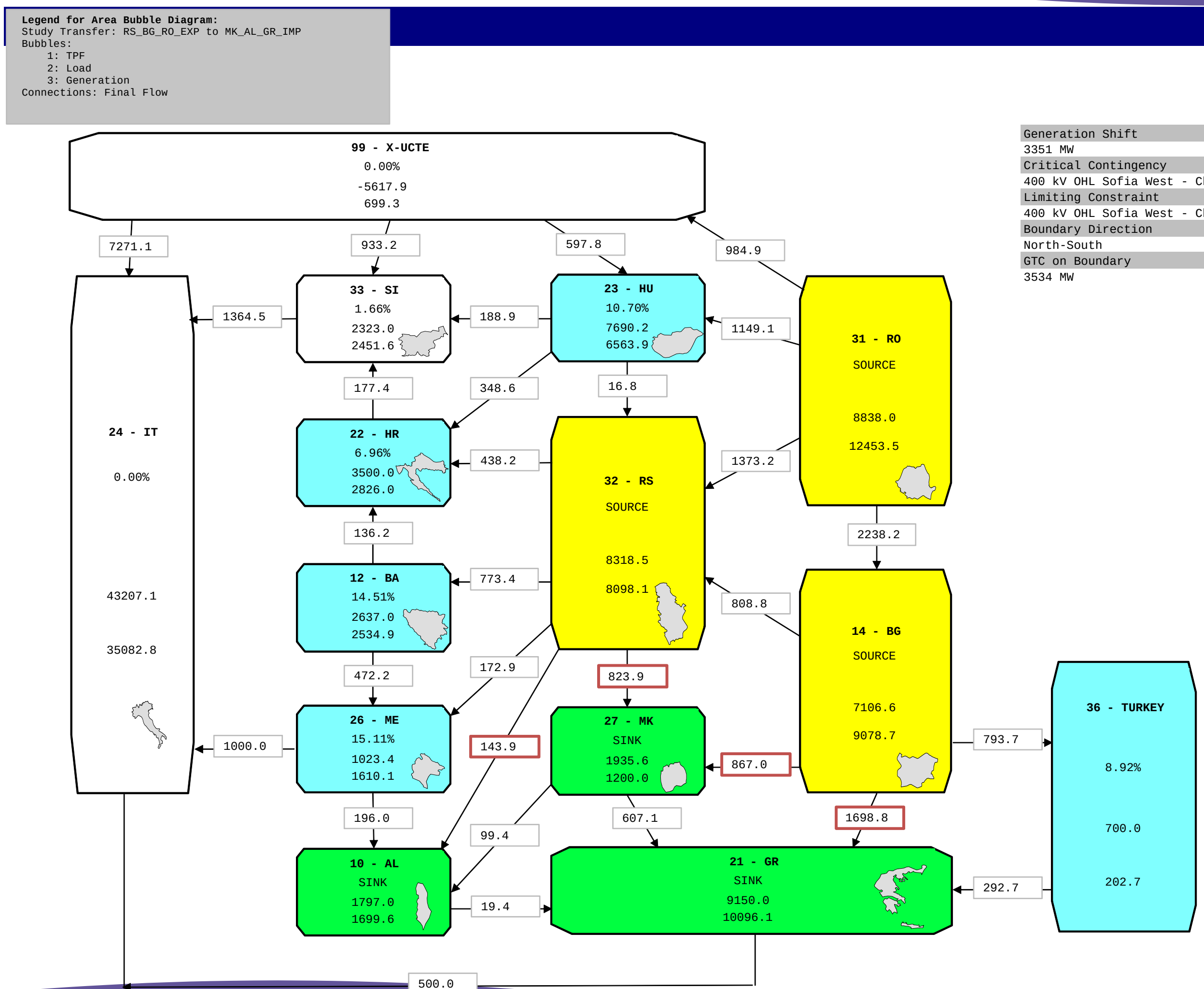
PSS^{TM}MUST 9.0

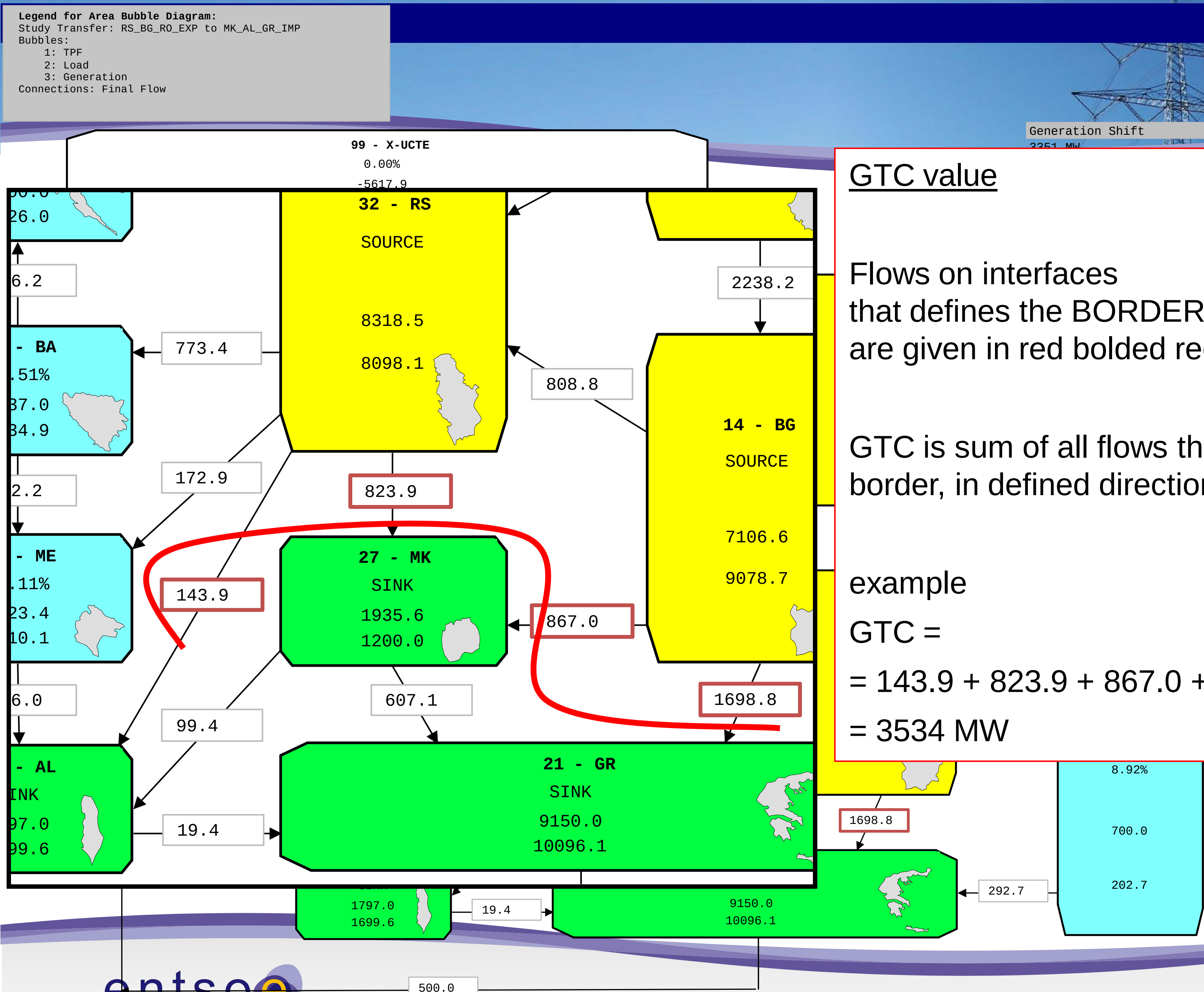
Linear calculation technique

- very fast incremental linear model
  around non-linear AC starting flows
- use of power transfer distribution factors, PTDF

interpretation of the results (bubble diagrams) DRAFT



Generation Shift	
3351 MW	
Critical Contingency	
400 kV OHL Sofia West - Chervena Mogila id 1	
Limiting Constraint	
400 kV OHL Sofia West - Chervena Mogila id 2	
Boundary Direction	
North-South	
GTC on Boundary	
3534 MW	



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GTC value

Flows on interfaces
that defines the BORDER
are given in red bolded rectangles

GTC is sum of all flows through
border, in defined direction

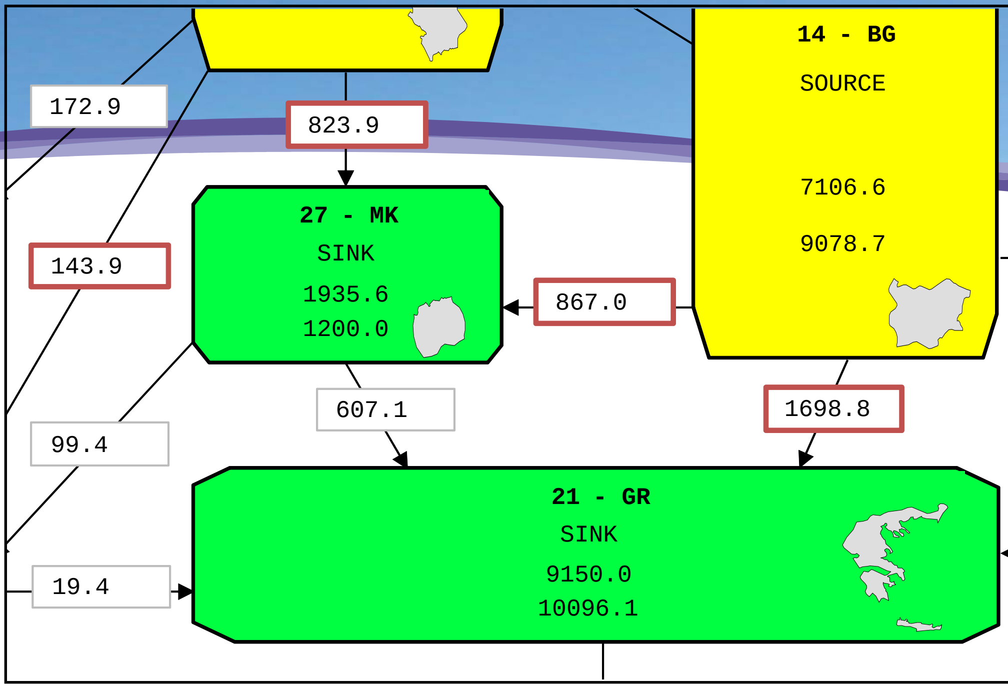
example

GTC =

= 143.9 + 823.9 + 867.0 + 1698.8 =

= 3534 MW

DRAFT

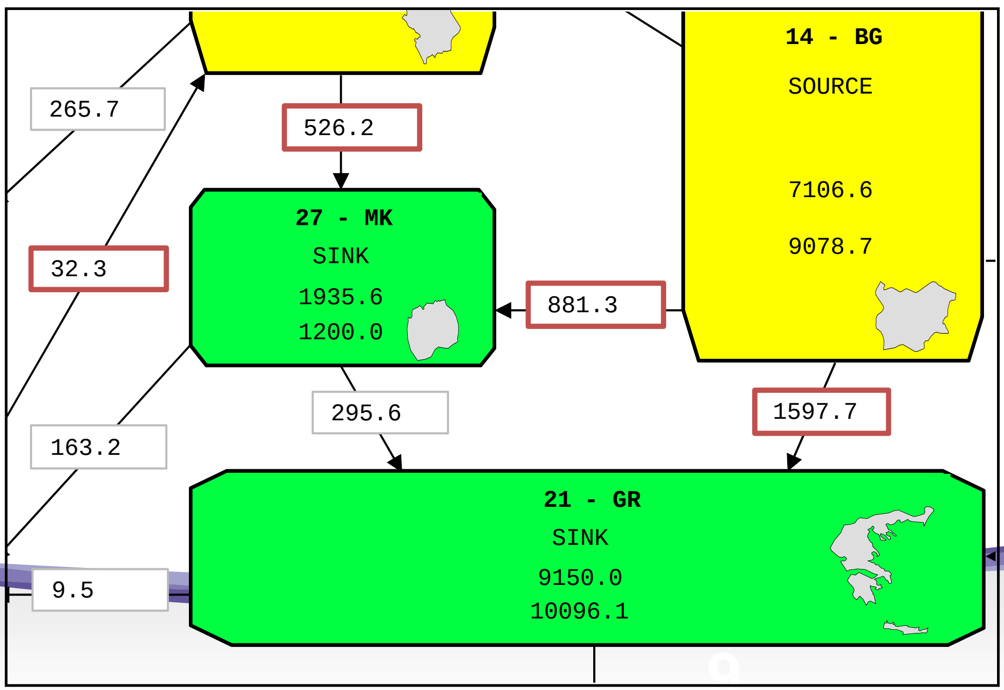


All projects IN

GTC = 3534 MW

Studied project OUT

GTC = 2973 MW



ΔGTC = 561 MW

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Conclusions

DRAFT

- European grid model added high value to regional network planning
- Joint planning practice of regional TSO’s is essential in identification of problems and developing optimal solutions
- GTC results give good bases for preliminary evaluation of projects
- ΔGTC on all projects in SEE fulfill the threshold > 500 MW,

DRAFT

Thank you for your attention.

Aleksandar Paunoski

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Continental South East Regional Investment Plan 2012- preliminary results

ENTSO-E Continental South East Regional Stakeholder Workshop

12 December 2011

Aristomenis Neris

member of RG Continental South East

entsoe

Reliable Sustainable Connected

Overview of the presentation

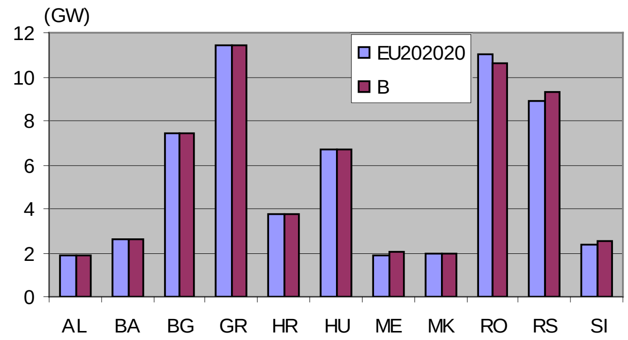
draft

- Market studies in CSE Region
- Assessment of bulk power flows in the Regional network
- Investment needs (MT up to 2016 and LT>2017)
- Projects of European significance and clustering of investments in the Continental South East European Region
- Grid studies in CSE Region
- Statistics of the projects of European significance and an overview of their benefits
- Main messages

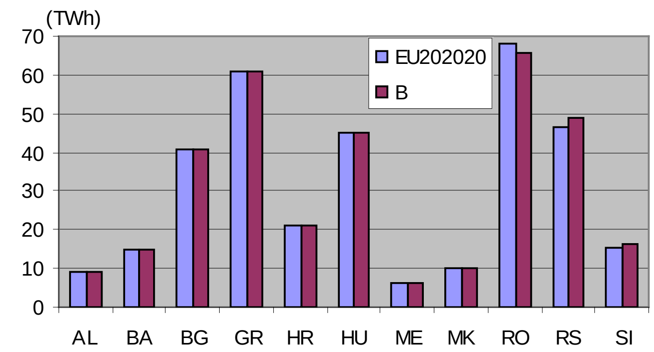
Summary of input data for market studies

draft

Peak Load

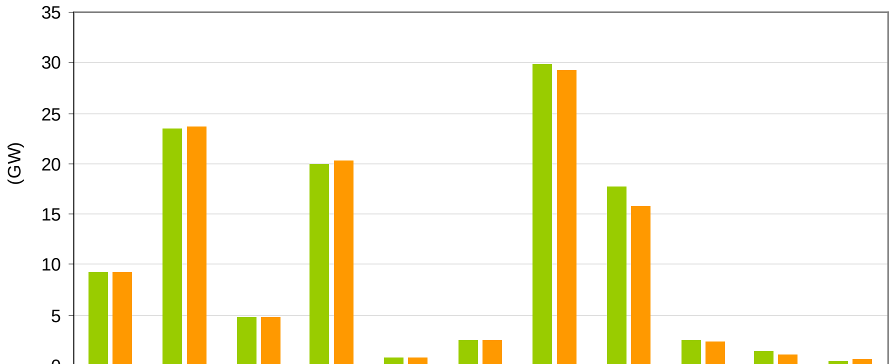


Energy Demand



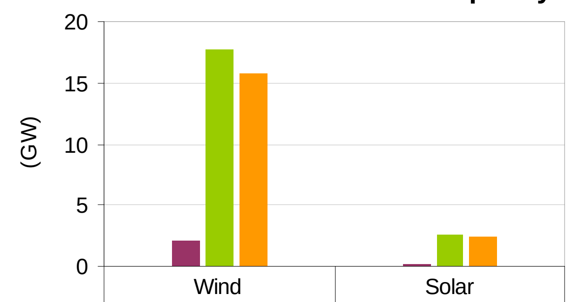
Aggegated installed capacities in 2020

(CSE total: EU2020 = 113 GW, Scenario B = 110 GW)



	Nuclear	Lignite	Hard Coal	Gas	Oil	Mixed Fuels	Hydro	Wind	Solar	Biomass	Other RES
EU2020	9,2	23,4	4,8	20,0	0,8	2,5	29,9	17,8	2,6	1,4	0,5
Scenario B	9,2	23,6	4,8	20,2	0,8	2,5	29,3	15,8	2,4	1,1	0,6

Installed Wind and Solar Capacity



	Wind	Solar
2010	2,2	0,1
EU2020	17,8	2,6
Scenario B	15,8	2,4

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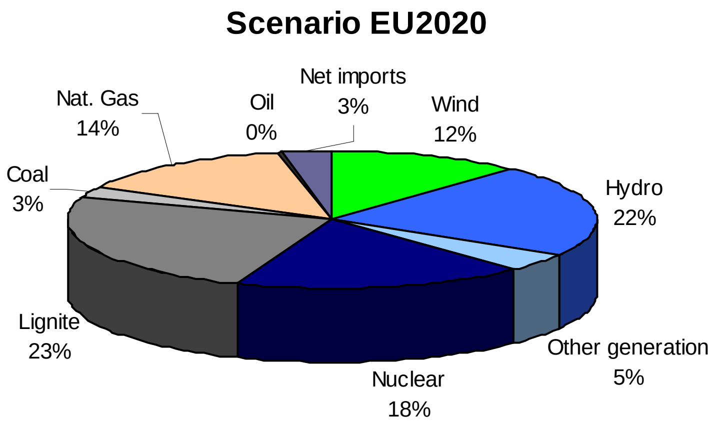
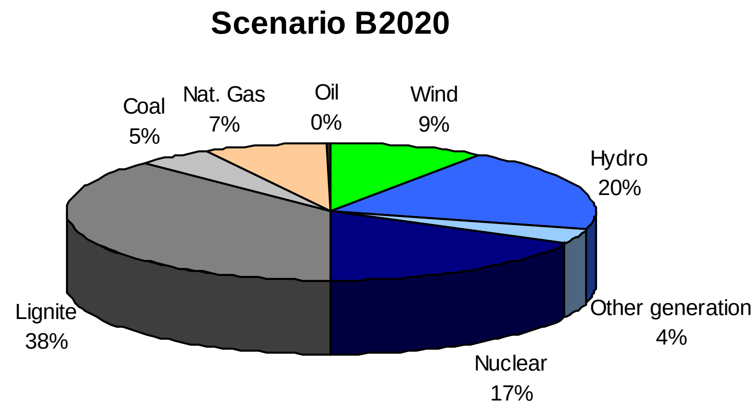
draft

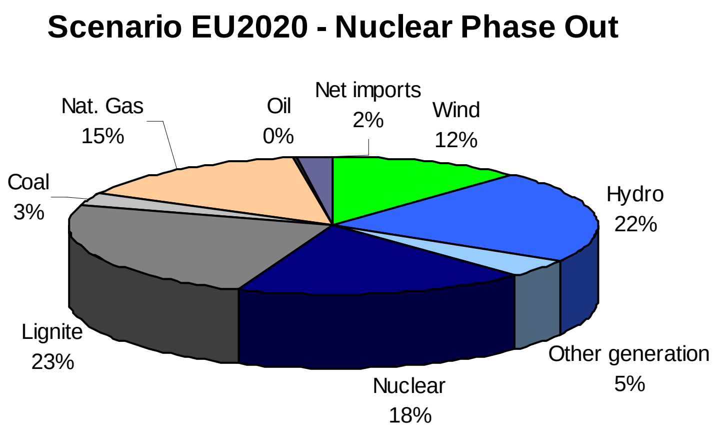
Contribution of fuel type on annual energy balances



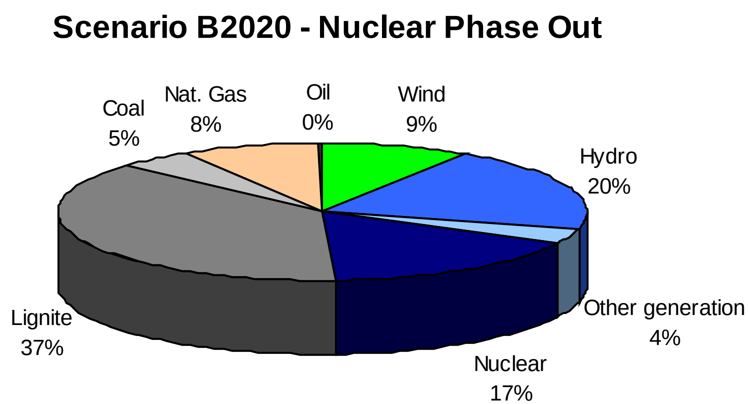
Import 10,4 TWh



Export 11,1 TWh



Import 7,3TWh

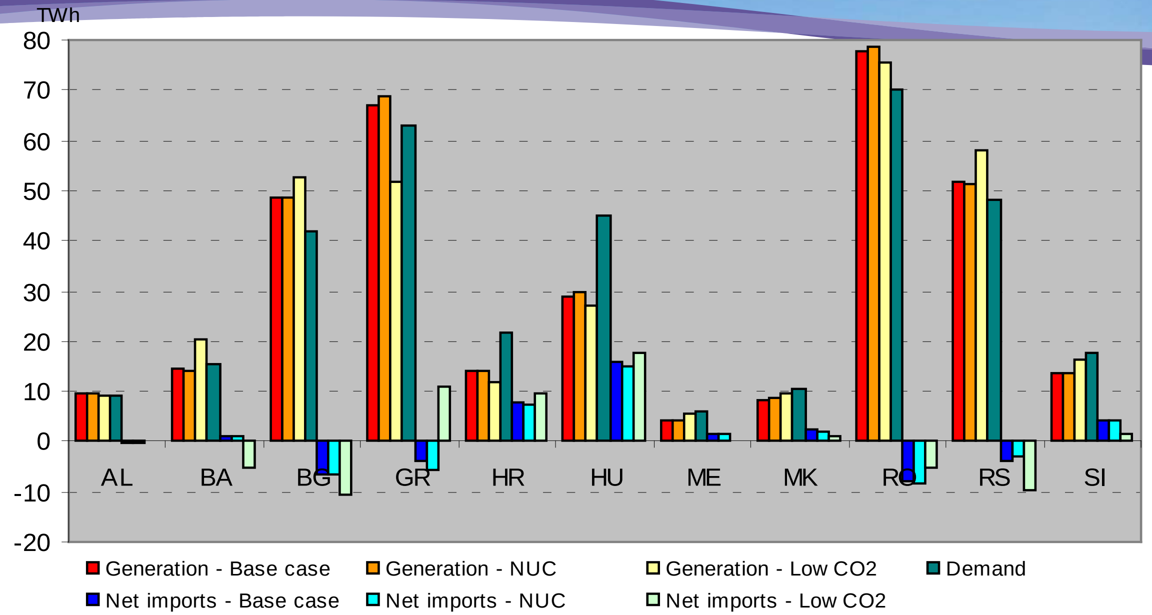


Export 15,4 TWh

Negligible loss of load probability & expected unserved energy

Market Studies Results per country- EU2020

draft



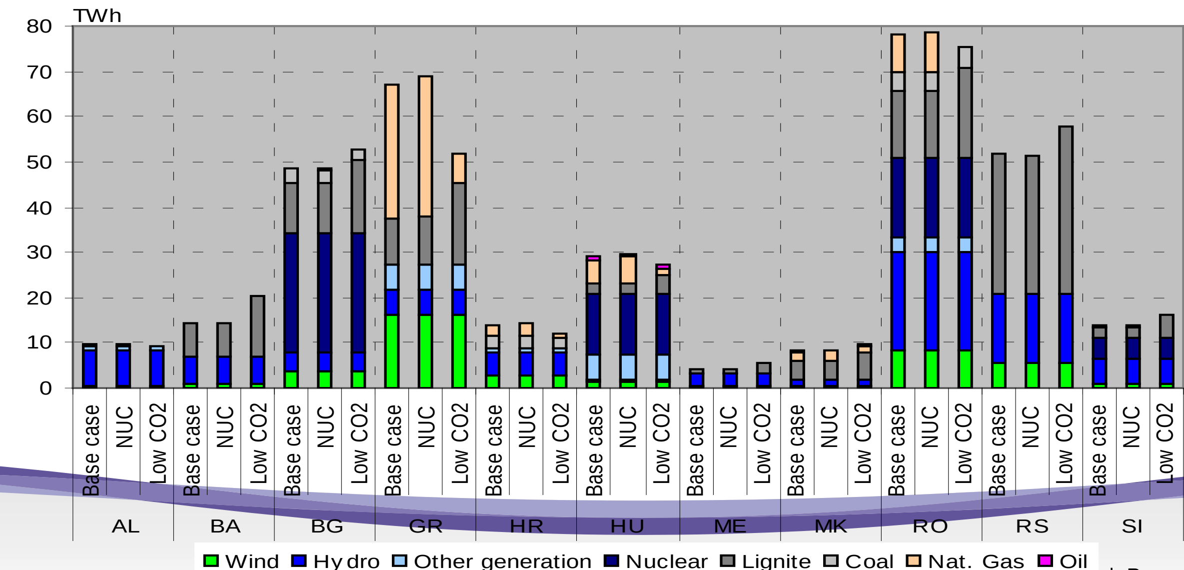
Surpluses in RS, RO, BG and GR (RES) for the base case

Low CO2 price turns GR into an importing country and BA into an exporting country

Still significant generation from lignite and coal units

Nuclear phase out slightly increase CCGTs production mainly in GR,HU,RO

Low CO2 price variant results in a shift from natural gas to cheaper lignite generation



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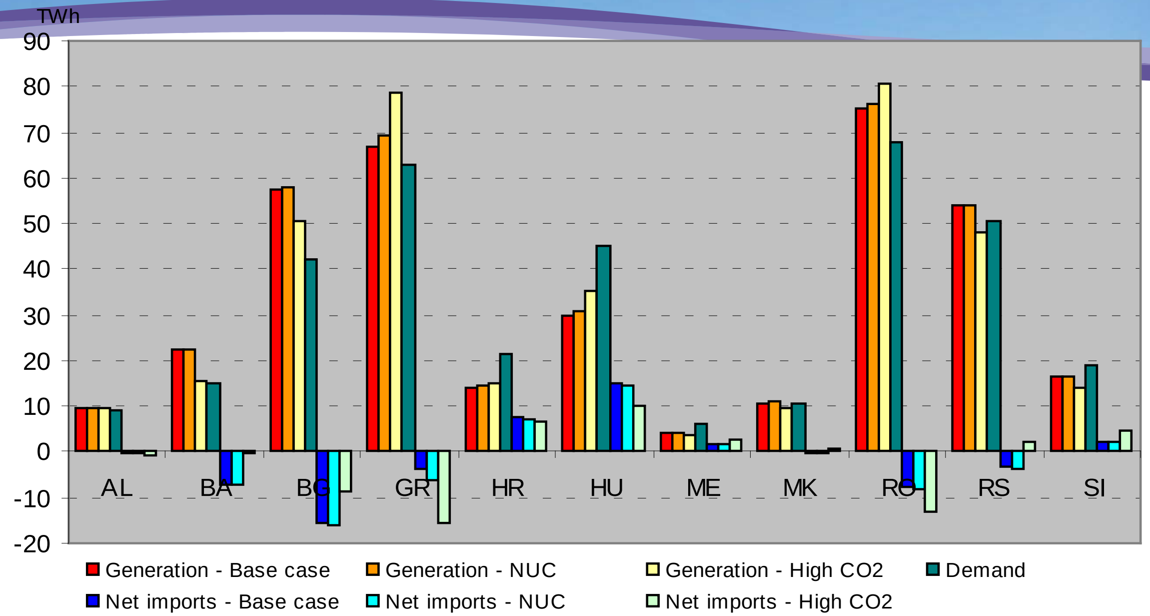
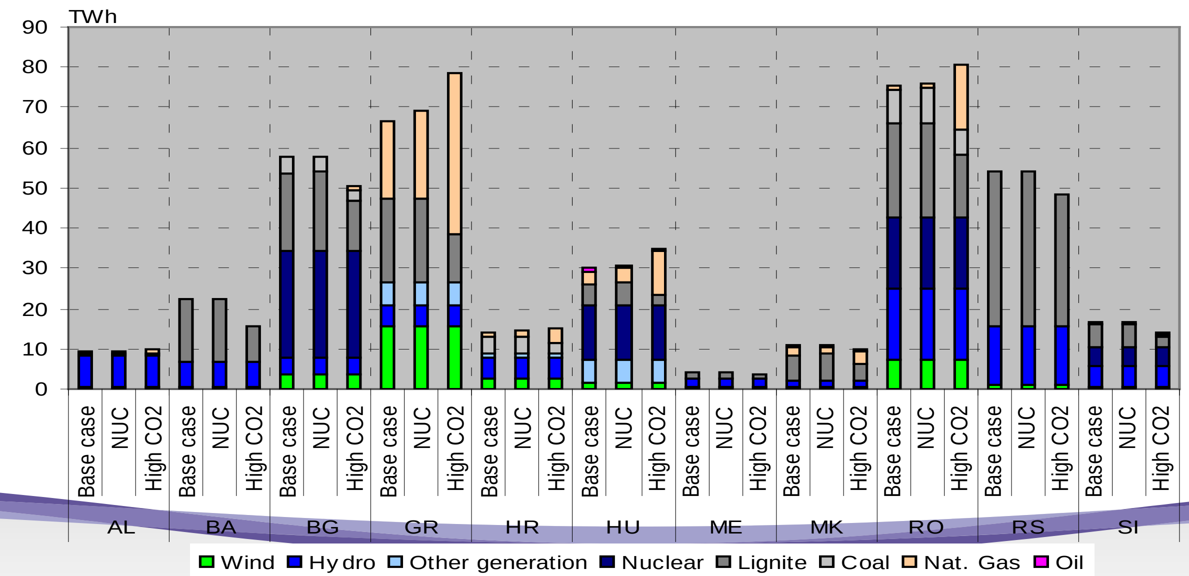
Market Studies Results per county- Scenario B

draft

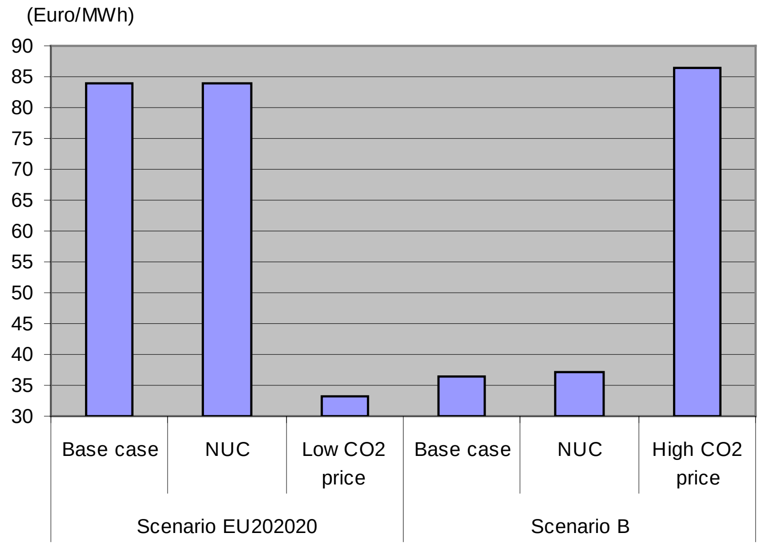


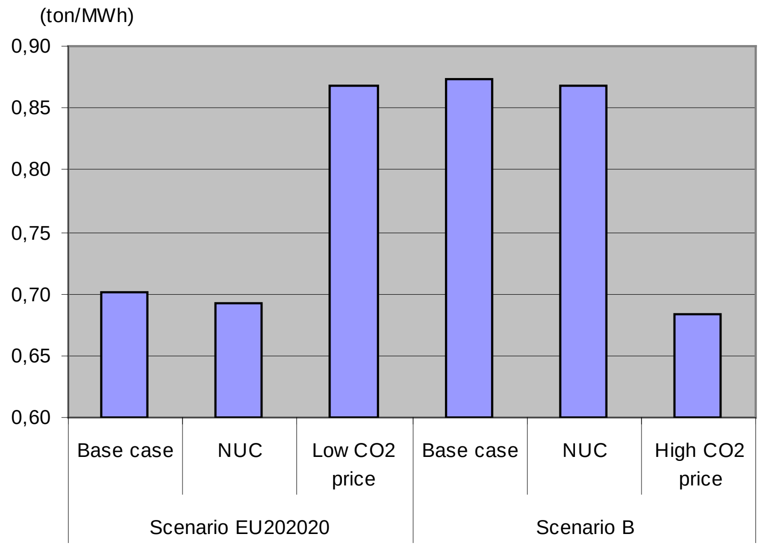
Surpluses in RS, RO, BG,GR (RES) and BA for the base case
High CO2 price turns RS and MK to importers

High Lignite contribution due to low CO_2 costs
Nuclear phase out slightly increase CCGTs production mainly in GR,HU,RO
High CO2 price variant results in a shift from lignite to natural gas generation



Generation cost of thermal units and CO2 emissions for the different market scenarios

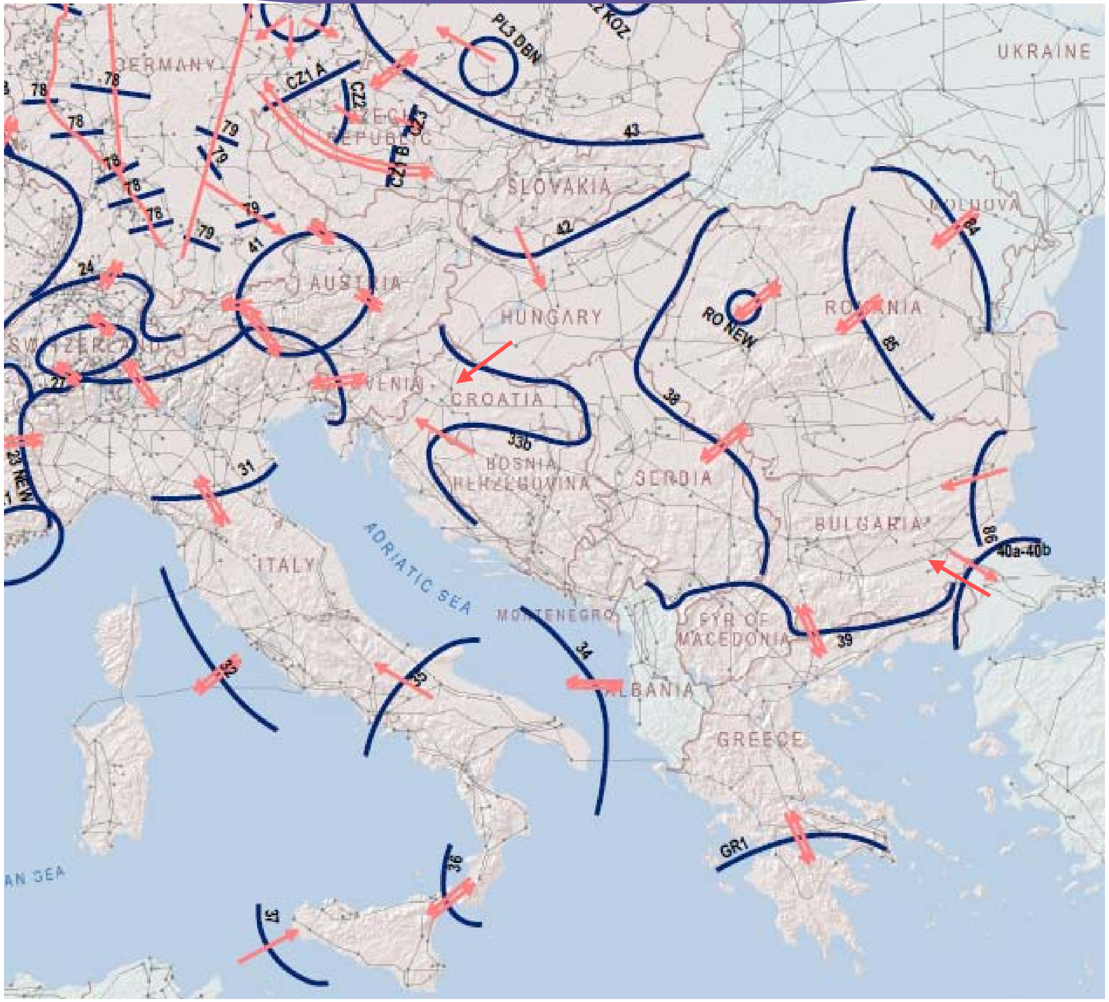




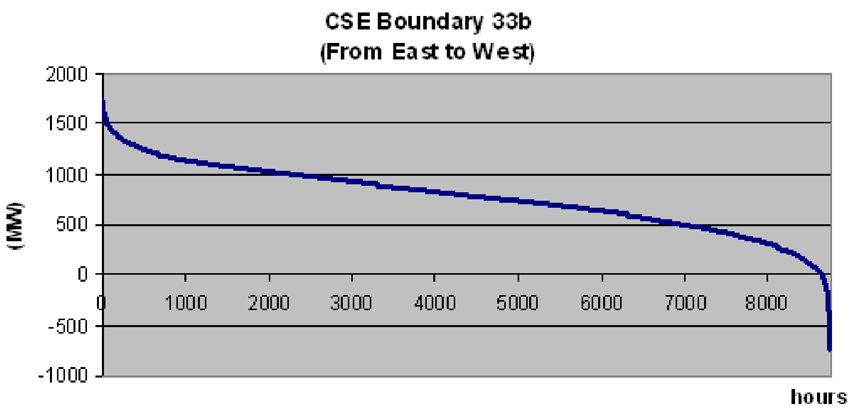
draft

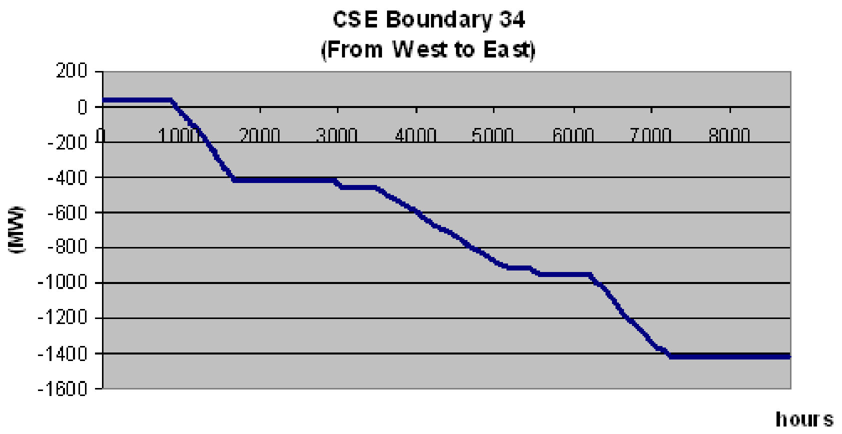
Boundaries and Power Flows

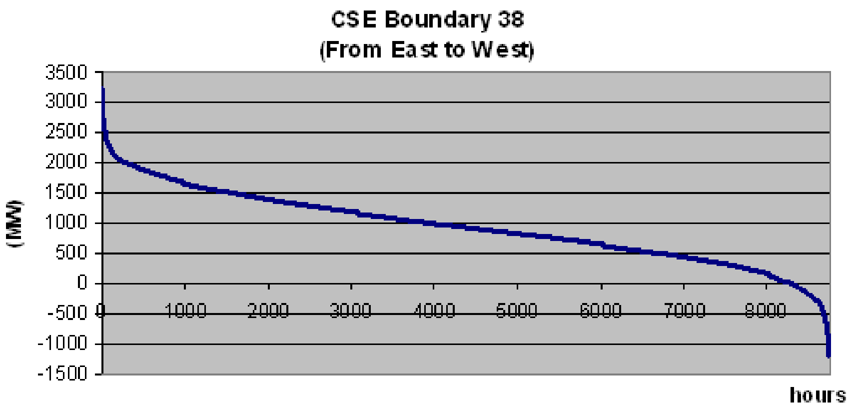
- 6 main cross border boundaries
- 4 Internal Boundaries
- Detected by the model and TSOs knowledge
- Hourly simulation results are used as input for DC load flow calculations in order to assess bulk power flows for cross border boundaries
- Bulk power flows for internal boundaries are provided by the respective TSOs

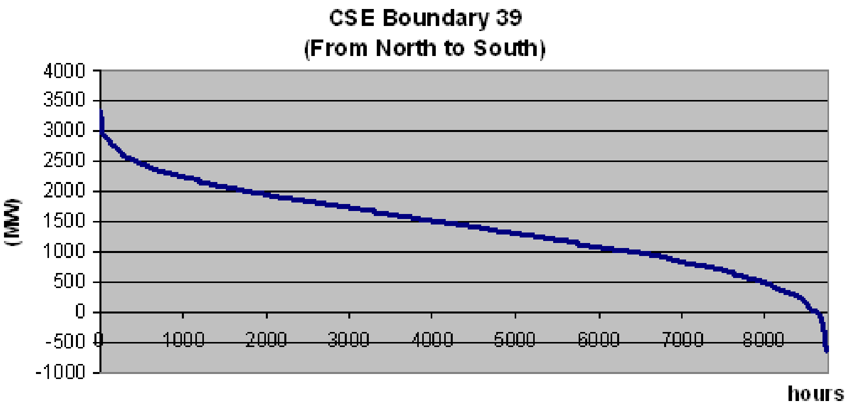


Scenario EU2020-Flows in boundaries between different price zones

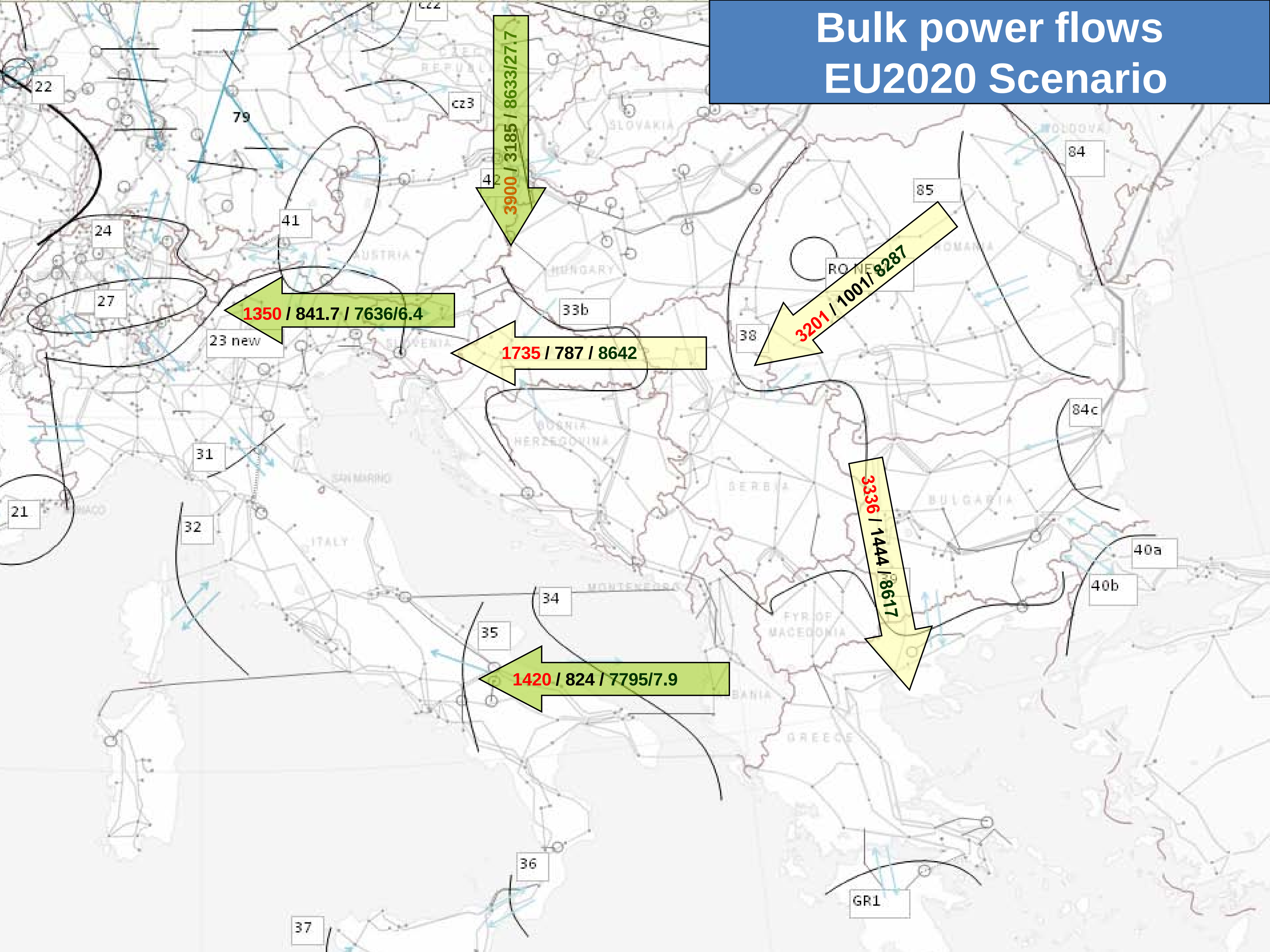




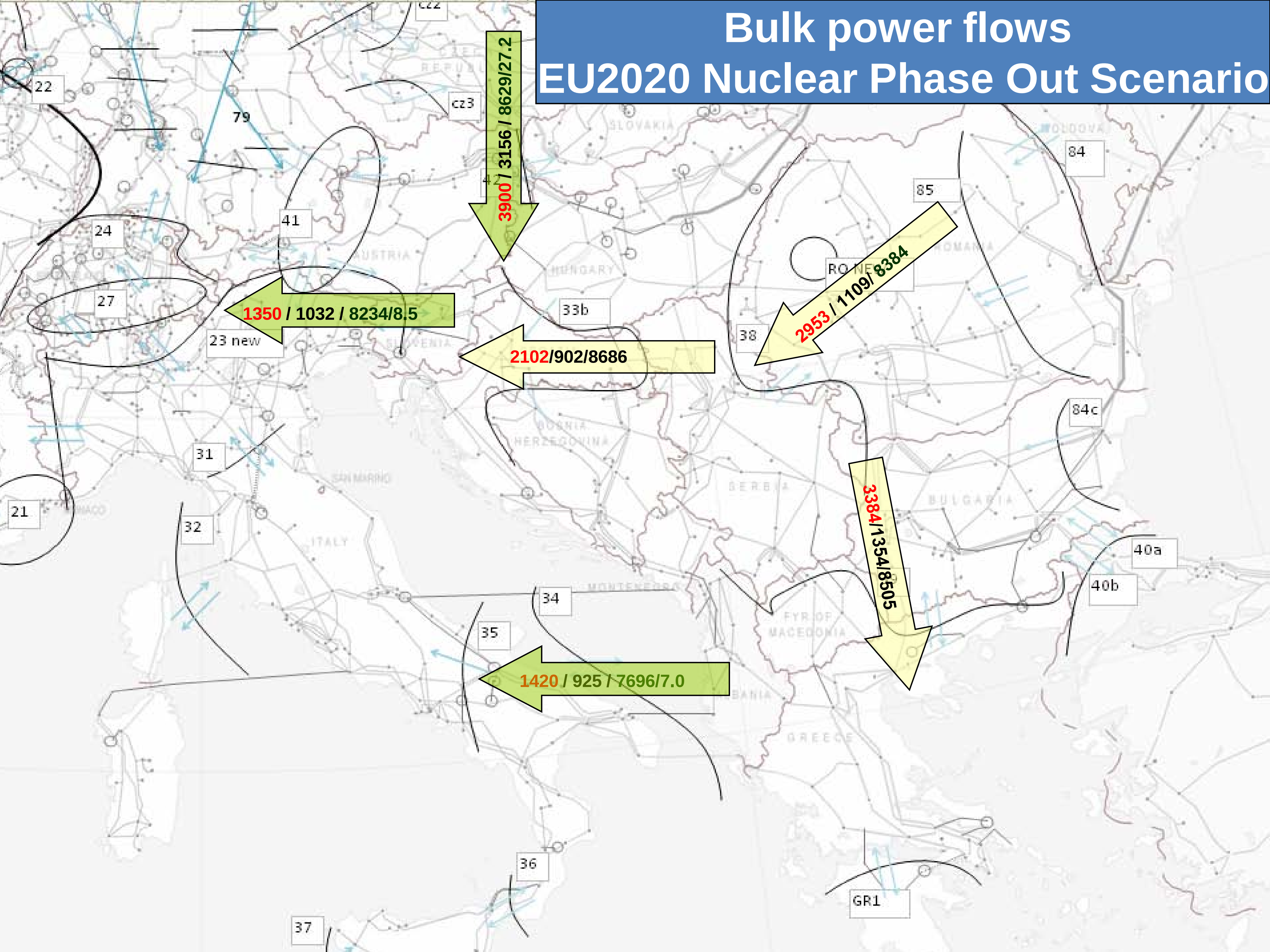




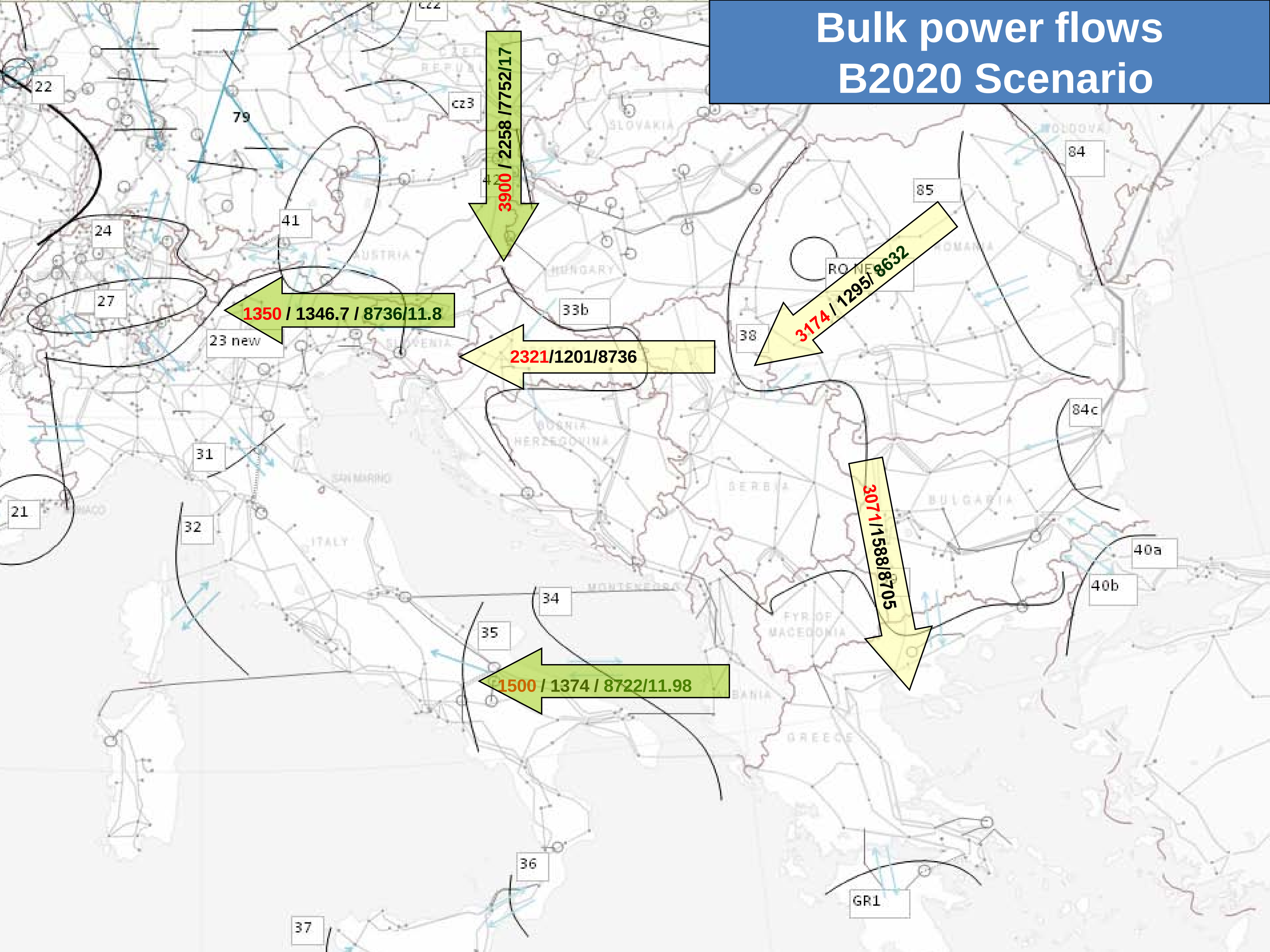
Bulk power flows EU2020 Scenario



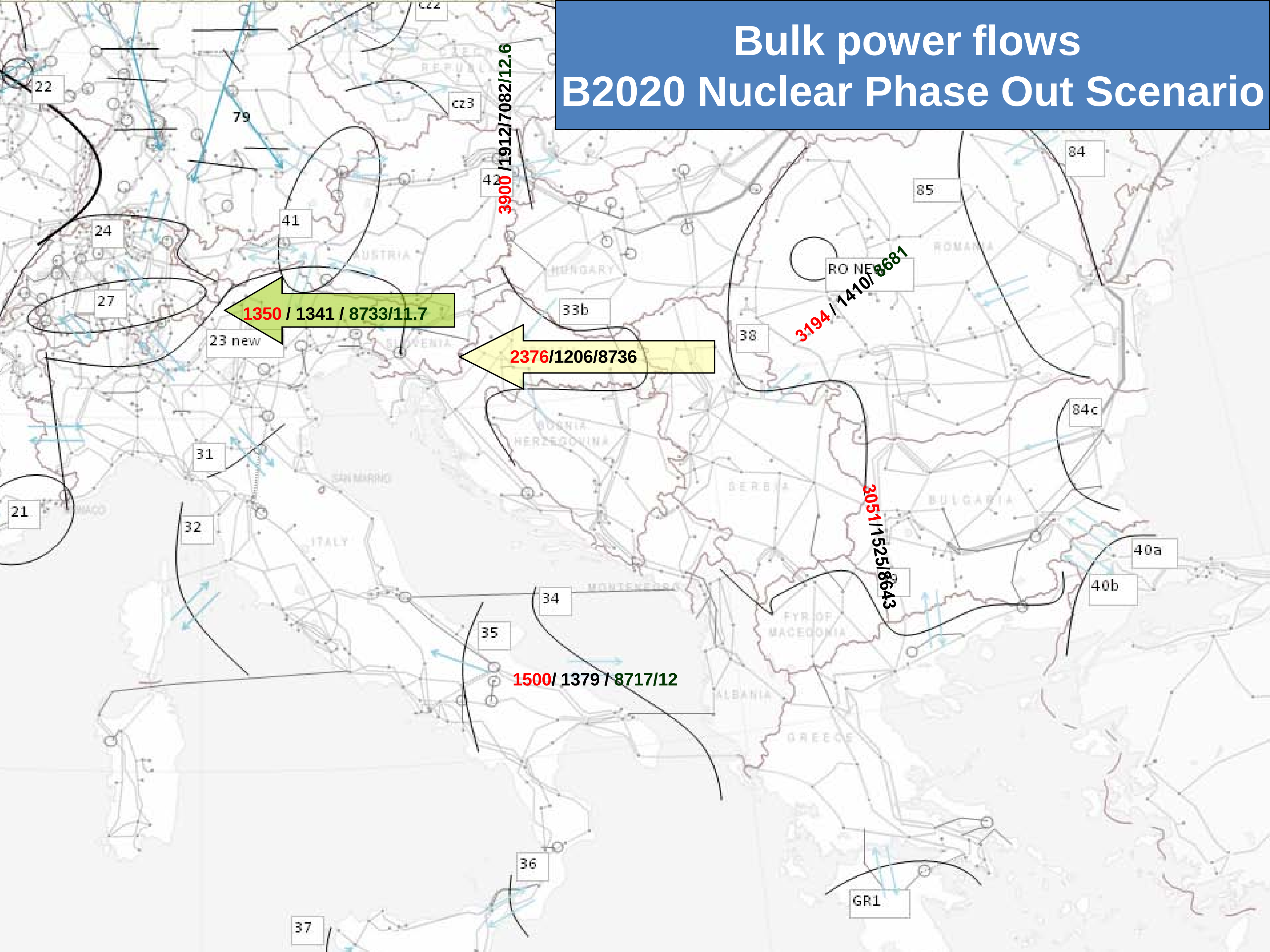
Bulk power flows
EU2020 Nuclear Phase Out Scenario



Bulk power flows B2020 Scenario

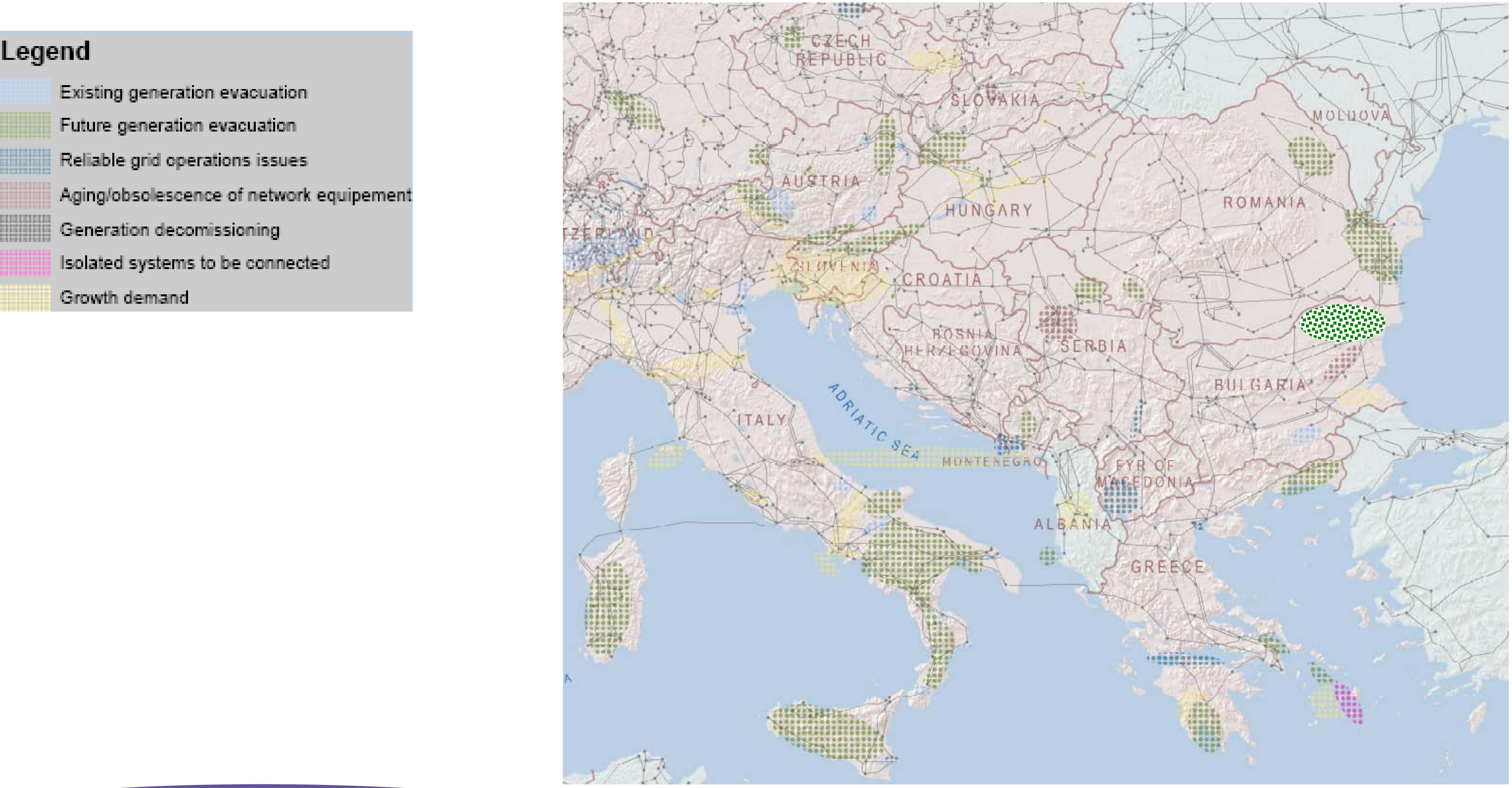


Bulk power flows
B2020 Nuclear Phase Out Scenario



CSE investment needs (mid-term)

draft

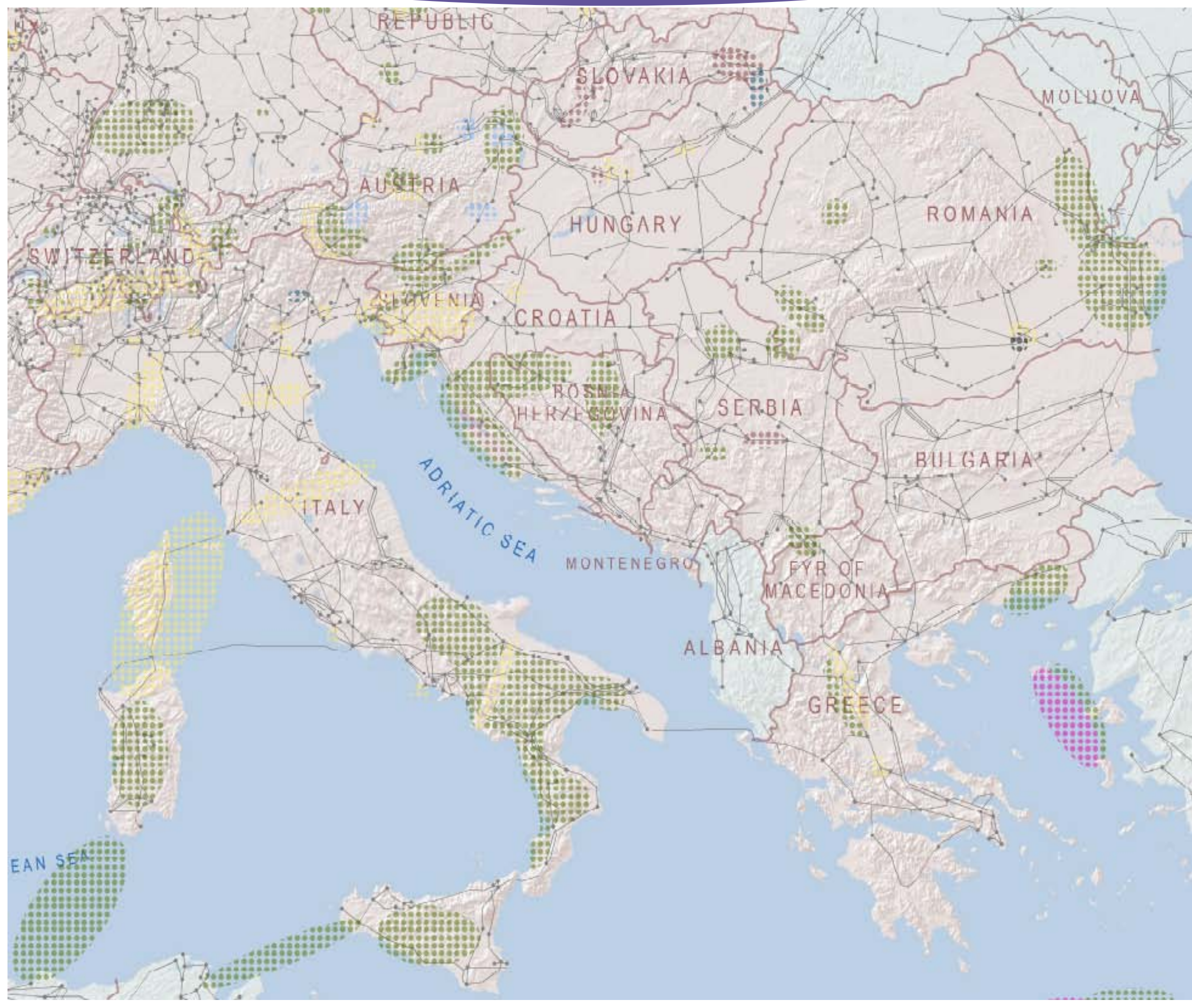


CSE investment needs (long term-term)

draft

Legend

- Existing generation evacuation
- Future generation evacuation
- Reliable grid operations issues
- Aging/obsolescence of network equipement
- Generation decomissioning
- Isolated systems to be connected
- Growth demand



Key drivers for Grid development in CSE

draft

Security of Supply

- Certain regions in Hungary, Bulgaria, Greece and Slovenia
- Strengthening of the transmission network – improved security

Market integration in the whole South East region

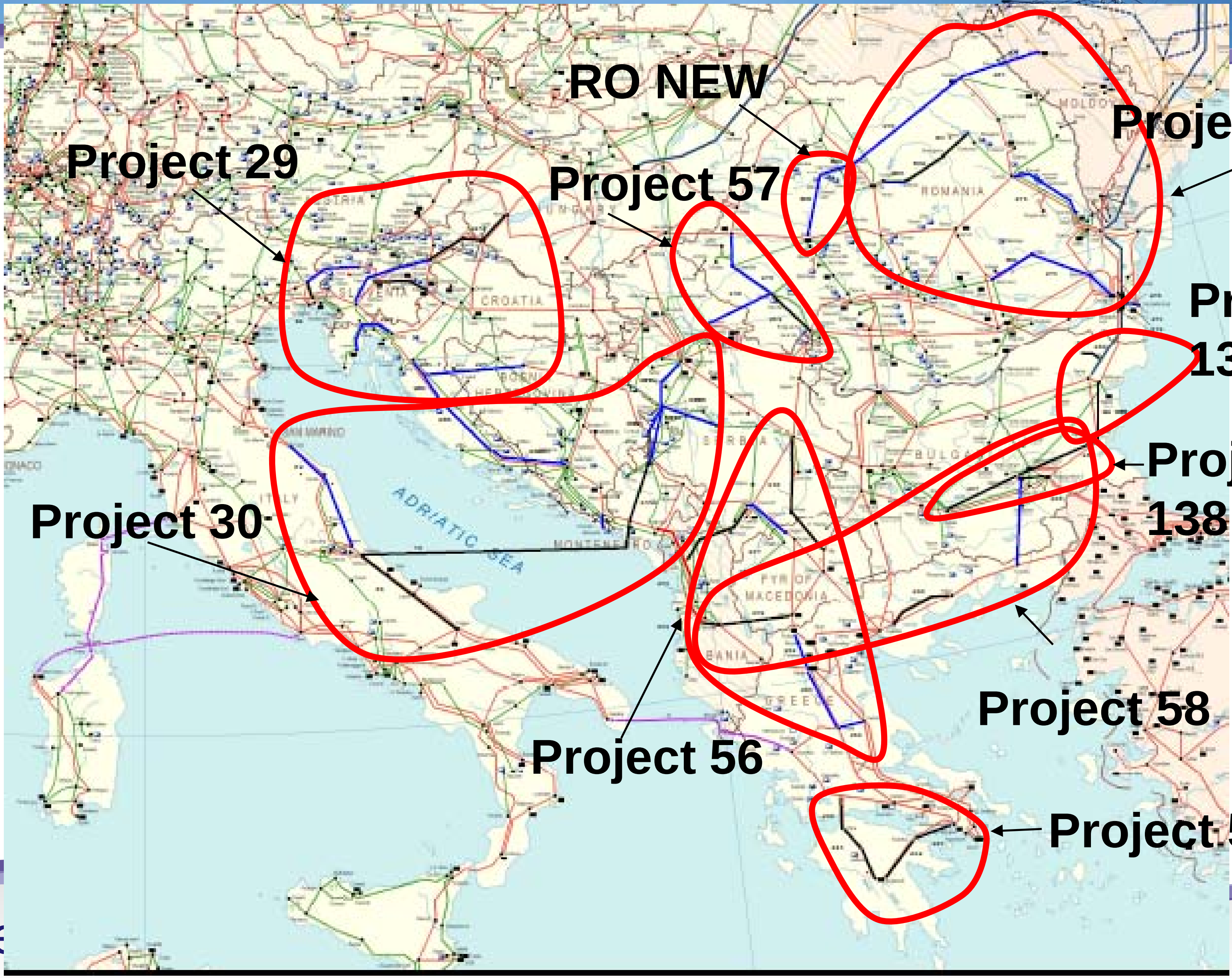
- Increase transfer capacities to accommodate the predominant power flow directions (N-S, E-W)
- Increase transfer capacities to Italy
- Increase transfer capacity in the North of the Region (HU-Slovakia), as well as at the East (CESA-TR)

Integration of renewables – (and conventional generation)

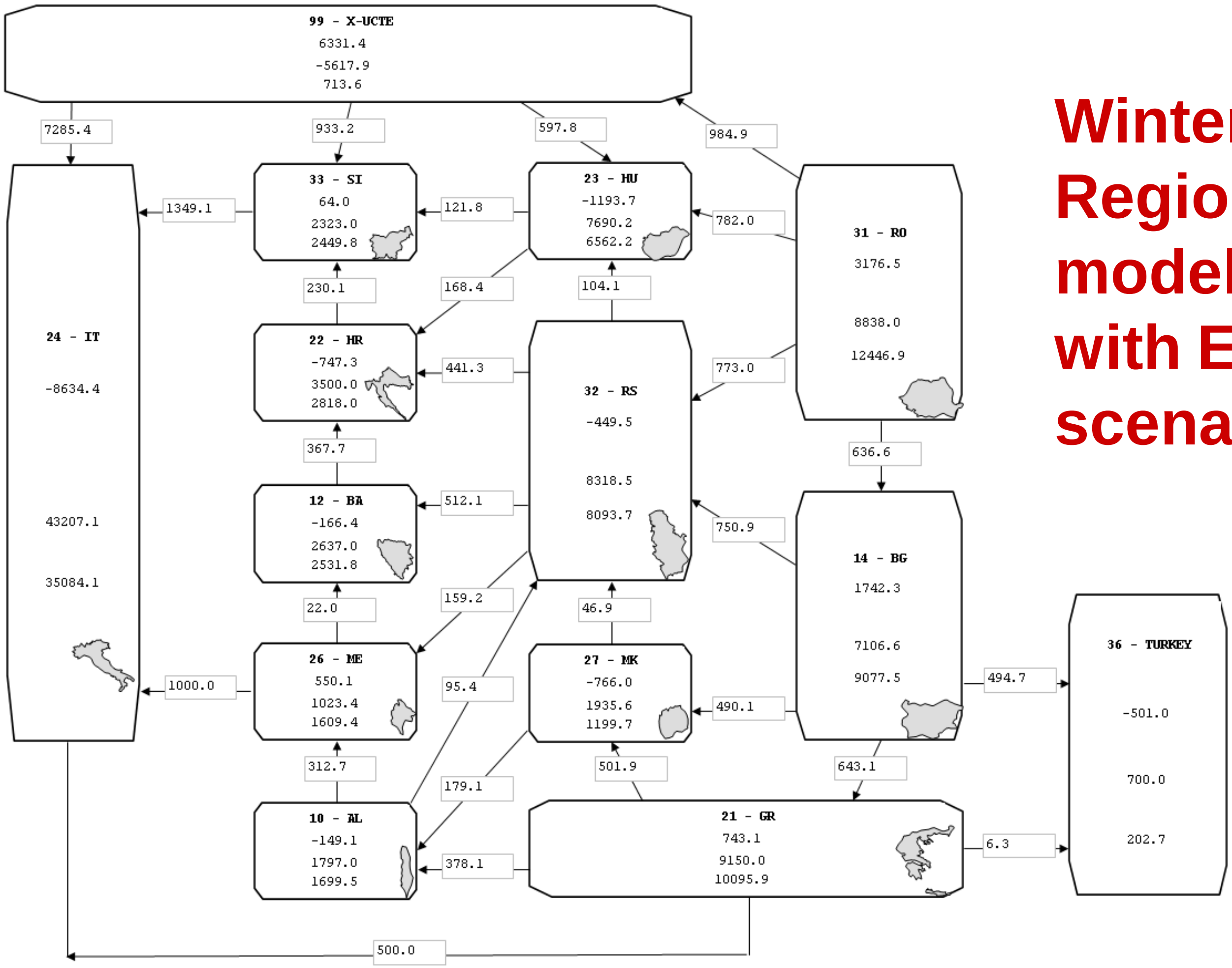
- Regional RES integration in mid-term (GR, RO,BG, ME) extended also to (RS,BA and HR) in the long term
- Significant thermal generation integration

CSE projects of European Interest

draft



Base case model for transfer capacity calculations

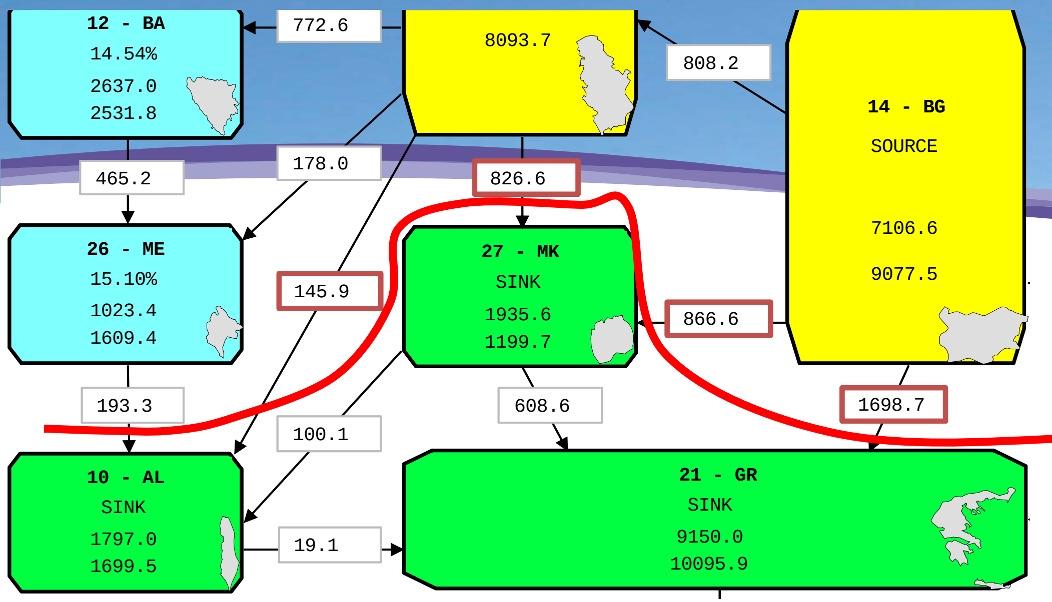


Winter Peak 2020 Regional grid model compatible with EU2020 scenario

draft

All projects IN

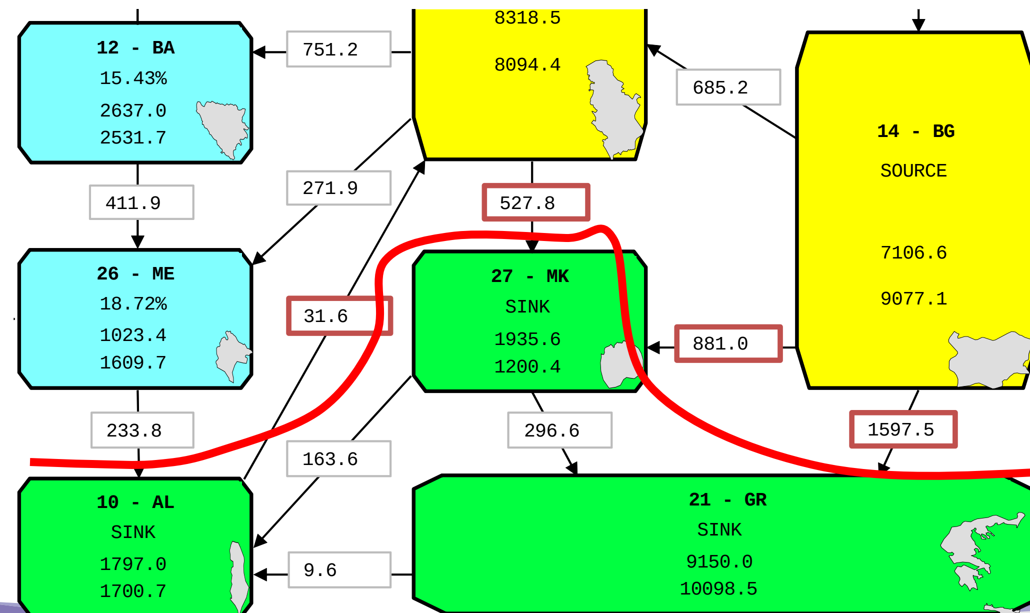
GTC=3537MW



Critical Contingency
400 kV OHL Sofia West - Chervena Mogila id 1
Limiting Constraint
400 kV OHL Sofia West - Chervena Mogila id 2

Project 56 OUT

GTC=2957MW

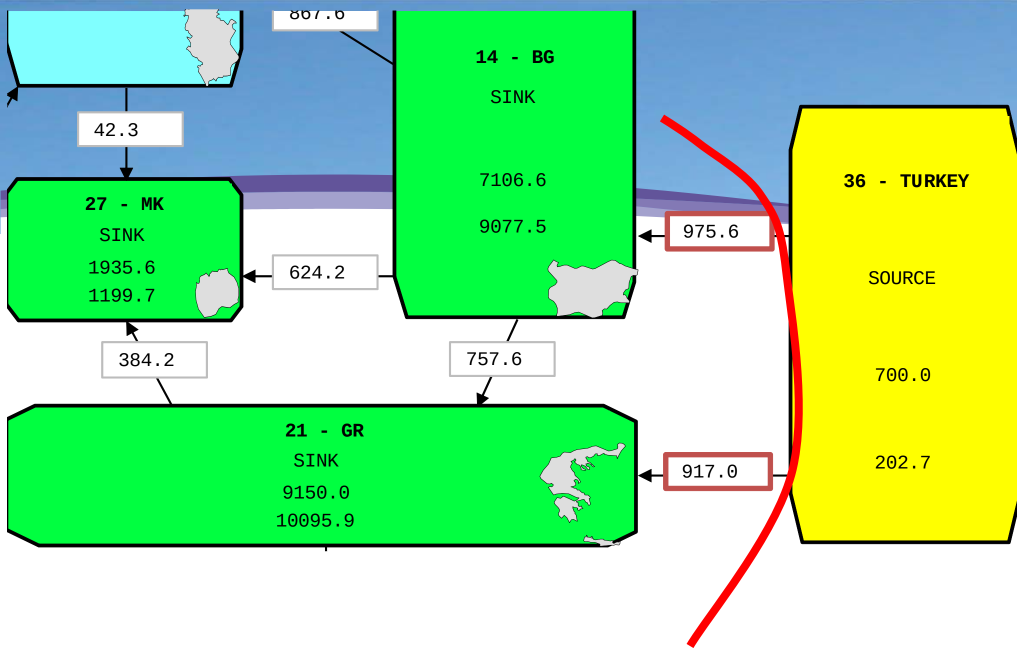


ΔGTC = 563 MW

All projects IN

GTC=1893MW

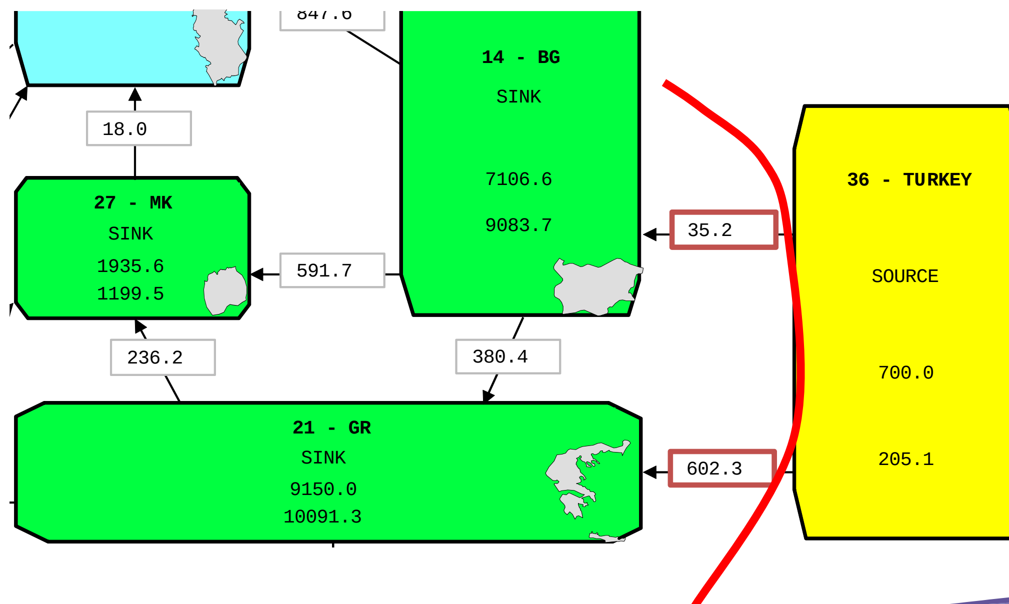
draft



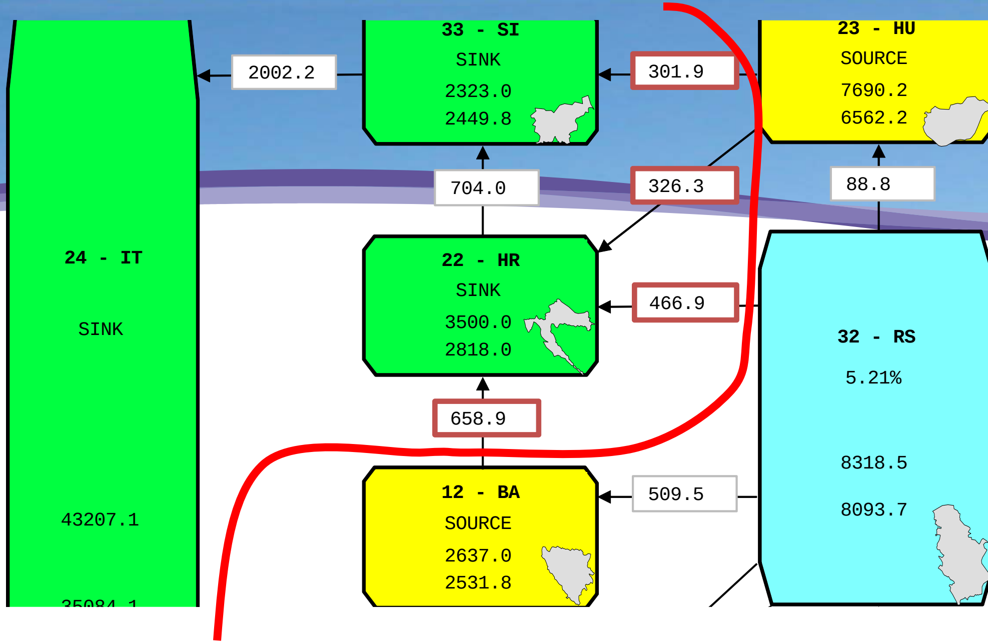
Critical Contingency
400 kV Nea Santa - Babaeski
Limiting Constraint
400 kV C. Mogila - Vetren
Boundary Direction

Project 58 OUT

GTC=637.5MW



ΔGTC = 1255MW



All projects IN

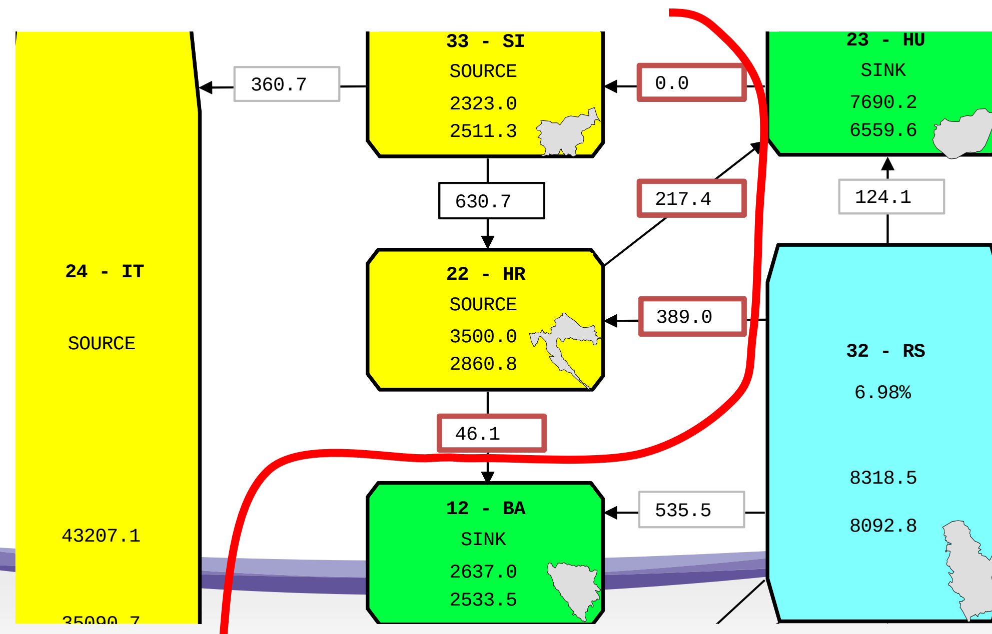
GTC=1754MW

draft

Critical Contingency
400 kV Redipuglia - Divaca
Limiting Constraint
220 kV Padriciano - Divaca

Project 29 OUT

GTC=125.5MW



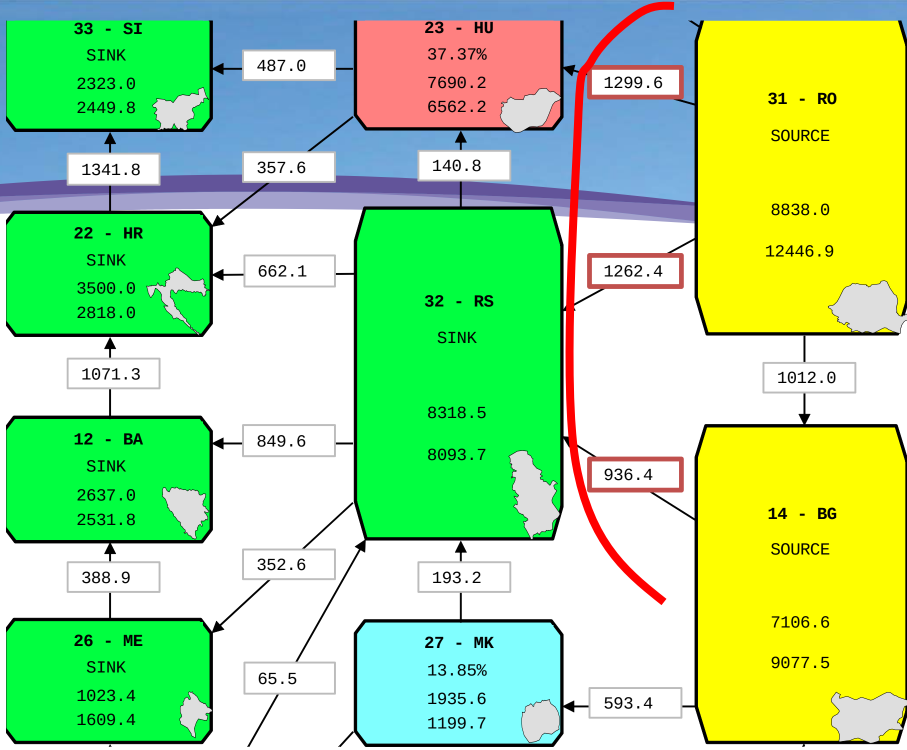
ΔGTC = 1629 MW

entsoe

draft

All projects IN

GTC=3499MW

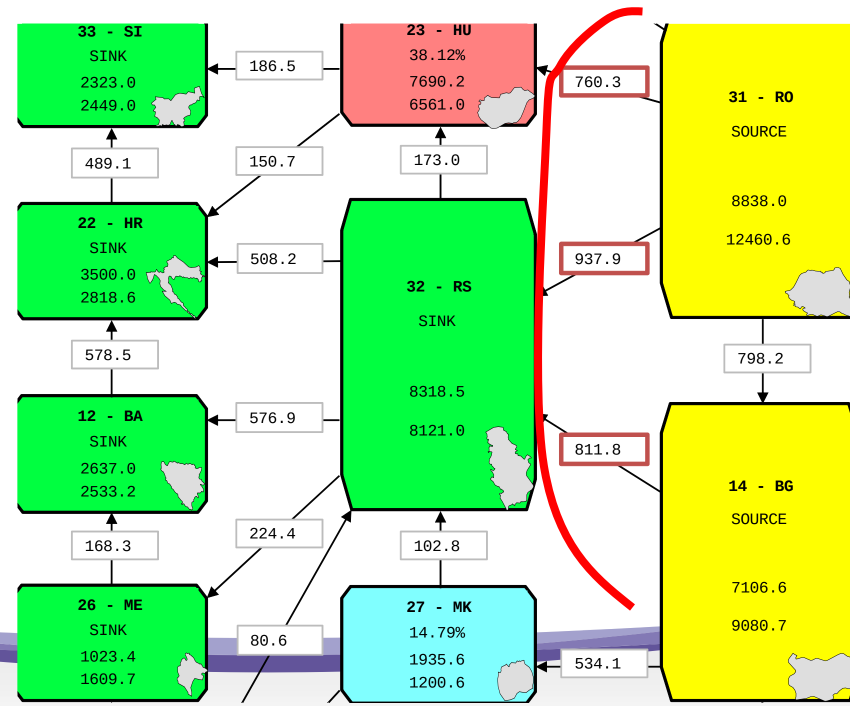


Critical Contingency
400 kV Pancevo - Vrsac
Limiting Constraint
400 kV Portile de Fier - Djerdap

Project 57 OUT

GTC=2510MW

Critical Contingency
400 kV Sofia West - Nis
Limiting Constraint
400 kV Porrtile de Fier - Djerdap



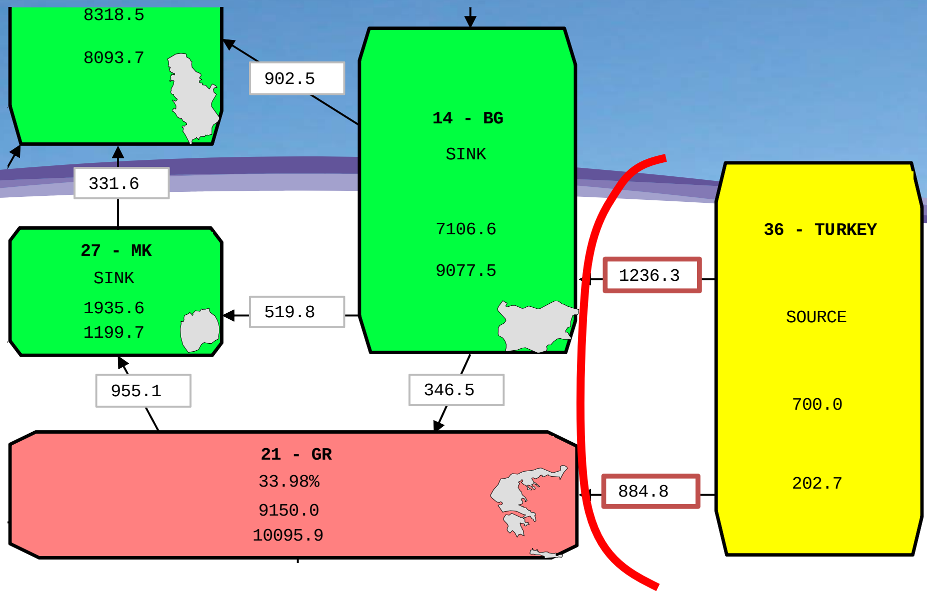
ΔGTC = 988 MW

entsoe

draft

All projects IN

GTC=2121 MW

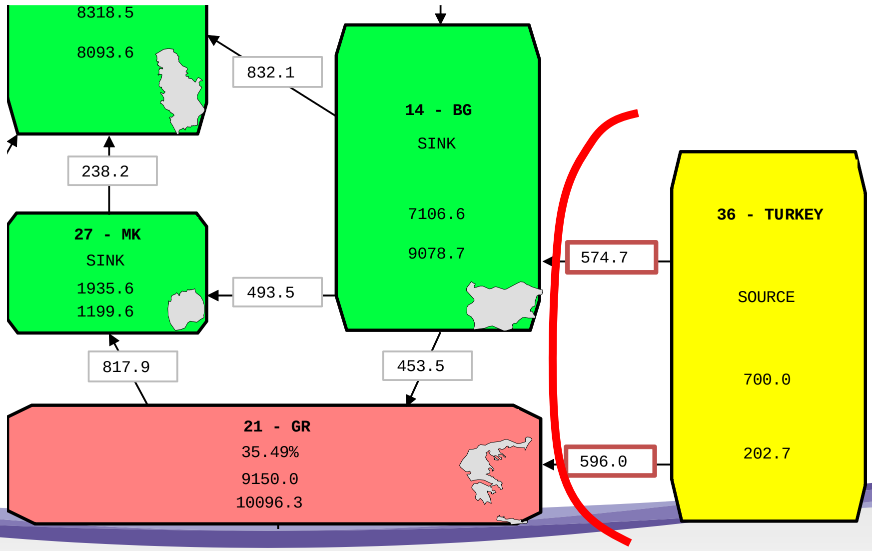


Critical Contingency
400 kV Maritsa East 3 - Maritsa East 1 id1
Limiting Constraint
400 kV Maritsa East 3 - Maritsa East 1 id2

Project 138 OUT

GTC=1171MW

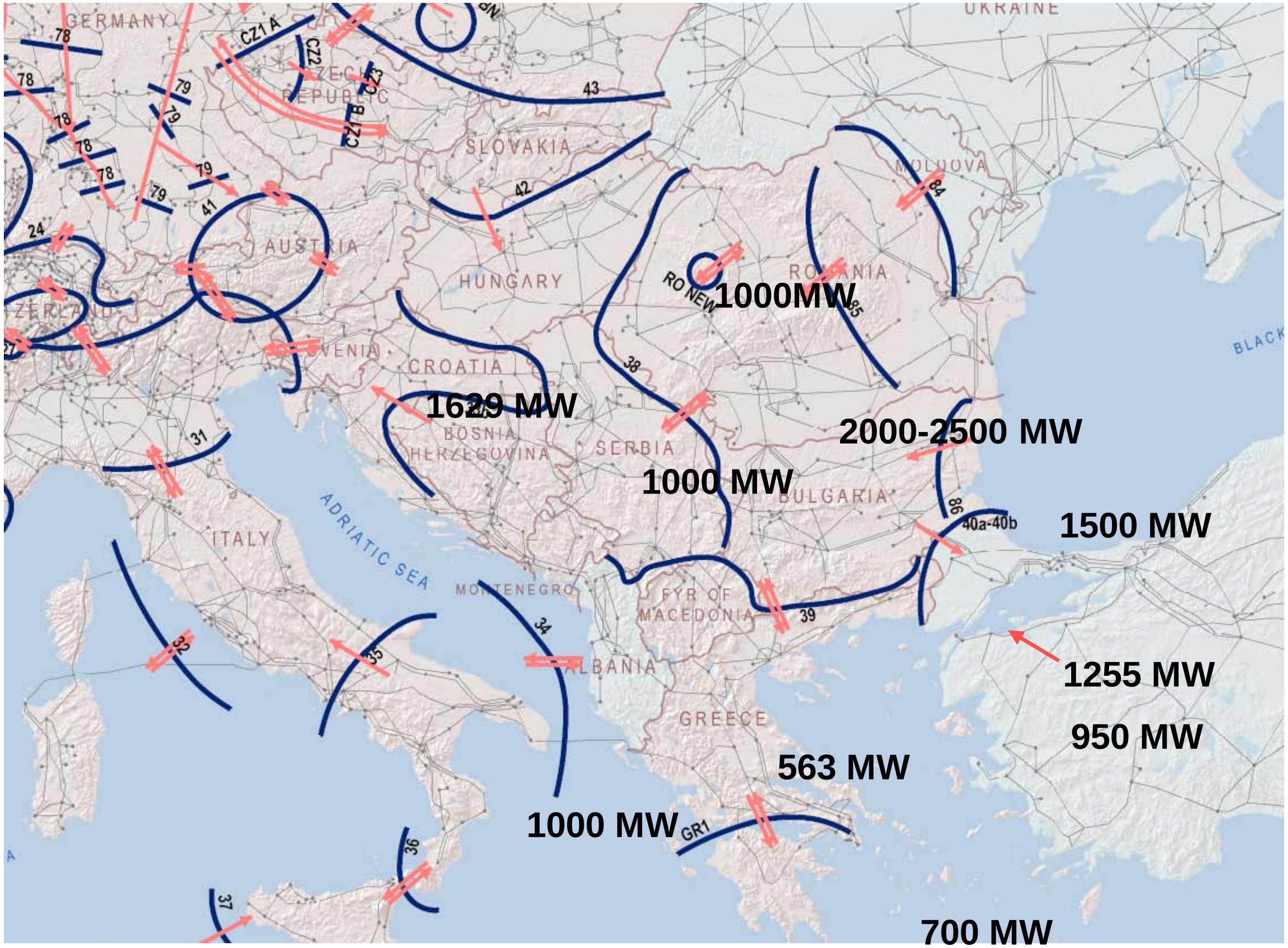
Critical Contingency
400 kV Nea Santa - Bababeski
Limiting Constraint
400 kV Maritsa East 3 - Maritsa East 1 id1
Boundary Direction



ΔGTC = 950 MW

Estimated GTC increase

draft



draft

Transmission adequacy

Legend

TAI

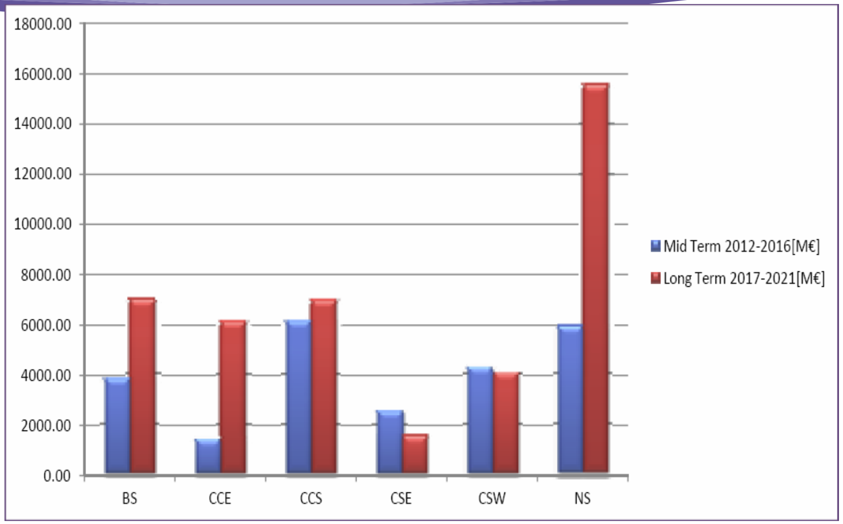
TAI_color

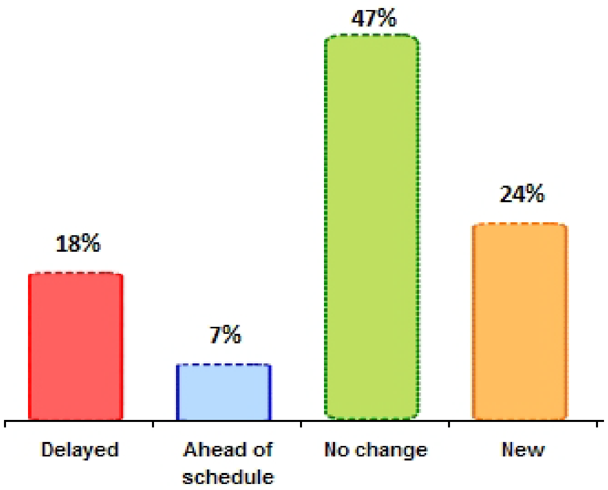
- Missing data or need to be checked
- With all projects in the Plans, in the span of scenarios considered in the Plans, no further investment likely to be reported related to this boundary in the editions of the Plans for the 5 year to come
- Problem solved in most cases but some very rare situation or provided no adverse future materialise
- On top of all projects in the Plans, additional investments are needed to cope with congestion on this boundary

Regional focus – RG CSE

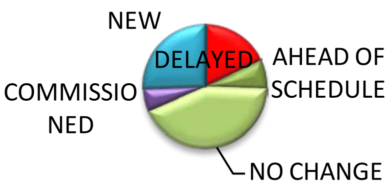
By the end of the decade…

- 21 projects of pan-E significance
- 10400 km,
- About € 4 billions investments
- Higher cost of investments in MT
- Reasons for delays include financial or permitting difficulties, environmental issues or postpone due to the implementation of another project





Status in 2012 compared to planned 2010



Statistics

draft

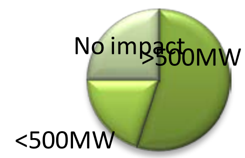
	Km	%	Total ENTSO-E	%
AC new	6883	87.5	28982	23.7
Ac upgrade	979	12.5	9994	9.8
Total AC	**7862**			
DC new	2221	86.1	9075	24.5
DC upgrade	358	13.9	358	100.0
Total DC	**2579**			

	MT	%	**LT**	%	**ENTSO-E MT**	**ENTSO-E LT**
Cost (Meuro/%)	2,556.36	10.6	1,505.28	3.6	24,183.83	41,278.16

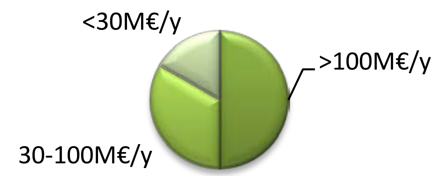
Support to EU policies

- More than 50% of the projects have a significant impact to RES integration in the Region
- About 50% of the projects have a significant effect in variable generation shavings
- Projects of EU interest in the Region are contributing significantly in the SoS of the area
- A positive impact also identified in CO2 emissions savings

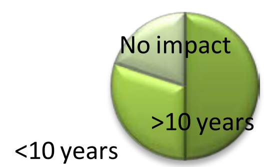
RES :



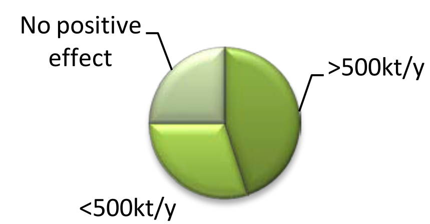
Social & Economic Welfare



Secutity of Supply :



CO2 emissions savings :

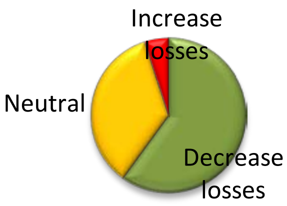


Technical Performance

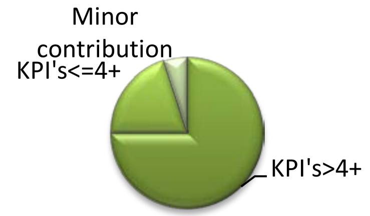
draft

- More than 50% of the projects of European interest in the Region have a positive effect on decreasing losses
- A significant contribution of new projects to the Regional System resilience and flexibility is foresee
- The impact of new projects on nature and human activities is anticipated that will may have an adverse effect only to a small portion of new projects

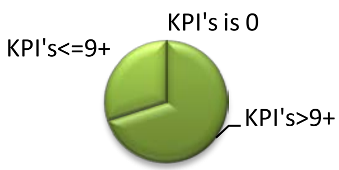
Losses variation



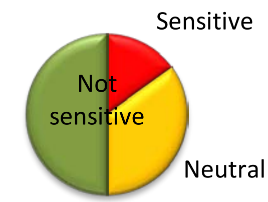
Technical Resilience :



Flexibility:



Social & envir. Indicator :



draft

Main messages and challenges for South East Region

- From a Regional point of view, foreseen installed generation in the year 2020 is sufficient to reliably meet the anticipated demand in all examined cases
- Prevailing power flow directions N-S and E-W continue to exist in the year 2020 for all examined scenarios
- CSE region is an exporter for scenario B and an importer for scenario EU2020
- RES targets and their fast evolution necessitate the accelaration of several grid developments
- Uncertainties regarding the market development in the CESA-TR borders
- Market integration with Western Europe (especially Italy) is a key development issue in the area
- Changing of power balance in Germany affects CSE Region but not in a considerable extend.
- Strong interdependency – realization of projects must be highly coordinated

draft

Thank you for your attention.

Aristomenis Menios

aneris@desmie.gr

entsoe

“Towards Ten Year Network Development Plan 2014 and further”

Irina Minciuna
Planning Data Advisor
ENTSO-E

ENTSO-E Continental South East Regional Workshop

12 December 2011, Zagreb

Reliable Sustainable Connected

European transmission grid – key role in reaching the EU policy goals

Energy policy goals

- **Sustainability/GHG**:
  - More renewables, further from the loads
  - More heating and mobility with electricity
- **Competitiveness/market integration:**
  - More long-distance flows
- **Security of supply**
  - More optimal resources sharing

all require Grid capacity !

Proactive initiatives of TSOs and ENTSOE

- ENTSOE founded December 2008, fully operational July 2009

3rd PACKAGE ENFORCED IN MARCH 2011

- **Pilot TYNDP published in June 2010**
  - ✓ First overview of the needs, drivers and the necessary European infrastructure
  - ✓ To get stakeholders' feedback for the TYNDP 2012
  - ✓ To set up organisation framework and methodologies
  - ✓ To highlight key challenges for grid development
  - ✓ To launch policy debate (financing, permitting) that used to be taboos,

and thus to pave the way for the **EIP**

From TYNDP 2010 to TYNDP2012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European Network of
Transmission System Operators
for Electricity

TEN-YEAR NETWORK
DEVELOPMENT PLAN 2010-2020

28.06.2010

NON-BINDING COMMUNITY-WIDE TEN-YEAR NETWORK
DEVELOPMENT PLAN – PILOT PROJECT
FINAL

TYNDP 2012 improvements compared to pilot TYNDP 2010

- ✓ Explicit definition of projects of pan-European significance
- ✓ Public procedure to identify the 3rd party projects
- ✓ More scenarios: top down + bottom up scenarios + Nuclear phase-out sensitivity analysis
- ✓ Regional market & network studies – based on the common set of data
- ✓ Project assessment based on a set of clear indicators
- ✓ More comprensive reports

OFFICIAL SUBMISSION
1 -14 SEP 2011

2nd WORKSHOP ON "202020 SCENARIO"
10 JAN 2011

STAKEHOLDER'S WORKSHOP
15 JUN 2011

Two difficult questions!

Facts:

1. *Less than 1% of overhead lines built during the last decade*
2. *TYNDP 2010 - 14,4% increase needed by 2020*

Questions:

- What would happen if the projects in the TYNDP cannot be delivered?

- Do you think that the TYNDP projects will be delivered?

From words to actions

1. Permitting and public acceptance

- Slow and cumbersome permitting procedures the main obstacle for delivering investments
- Public acceptance cannot be improved by TSOs alone

Policy makers, Mayors, NGOs, Administrations and Media should deliver the same message:

“a sustainable and CO_2 free power system tomorrow implies more transmission lines from now on”

2. Legislative implementation

– Some compatibility among the 27 MS energy policies

– Some stability in EU legislation - avoid new concepts becoming part of official documents

3. Attractive financing framework

- “real” return in line with similar risk profiles businesses
- incentives for activities “really” managed by TSOs
- legislation and regulation in line with 20 to 50 years assets

The Energy Infrastructure Package

- A timely legislative initiative addressing the most urgent issues
  - Huge step forward to streamline permitting procedures
  - Positive but unfocused effort to facilitate investments on the transmission grid
    - Cost-allocation is just part of the overall picture – cost-benefit analysis not a panacea
    - Incentivizing TSOs to deliver on time should be the priority
  - Regional approach for decision making with TYNDP as the main starting point – Projects of Common Interest

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The role of ENTSO-E after 2012

- The TYNDP as the only basis for identifying projects of common interest
  - With an open, transparent and non-discriminatory procedure for including non-TSO projects
- Deliver a cost-benefit analysis adapted to the real needs of the deciding bodies
  - A common basis for identifying financing gaps
- Provide the top-down technical overview at the EC regional Groups
  - Avoiding duplication of efforts

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Conclusions

- The Energy Infrastructure Package is a much needed policy initiative
  - Streamlining permitting processes must happen now
- Focus on regulation that incentivizes TSOs
- ENTSO-E is ready to undertake the new roles to be assigned to it …
- … continuing being a listening organization, operating in transparency and involving all stakeholders

Thank you for your attention.

Irina Minciuna
irina.minciuna@entsoe.eu

Network Code Development

Edwin Haesen

Planning Methods Advisor, ENTSO-E

RG Continental South East

12 December 2011

Reliable Sustainable Connected

Topics

Network Code Development Process

- Regulation (EC) 714/2009
- EC/ACER/ENTSO-E work program
- Consultation Process

Timeline NC development

- Pilot process
- Formal period
- Next steps

Network Code Development Process

Background Regulation (EC) 714/2009

Why European Network Codes?

The development of *European wide Network Codes* in various domains by

- bringing together the expertise of diverse stakeholders
- in an open and transparent process
- creating a coherent approach on common issues

is a crucial enabler of *Europe's Energy goals* in

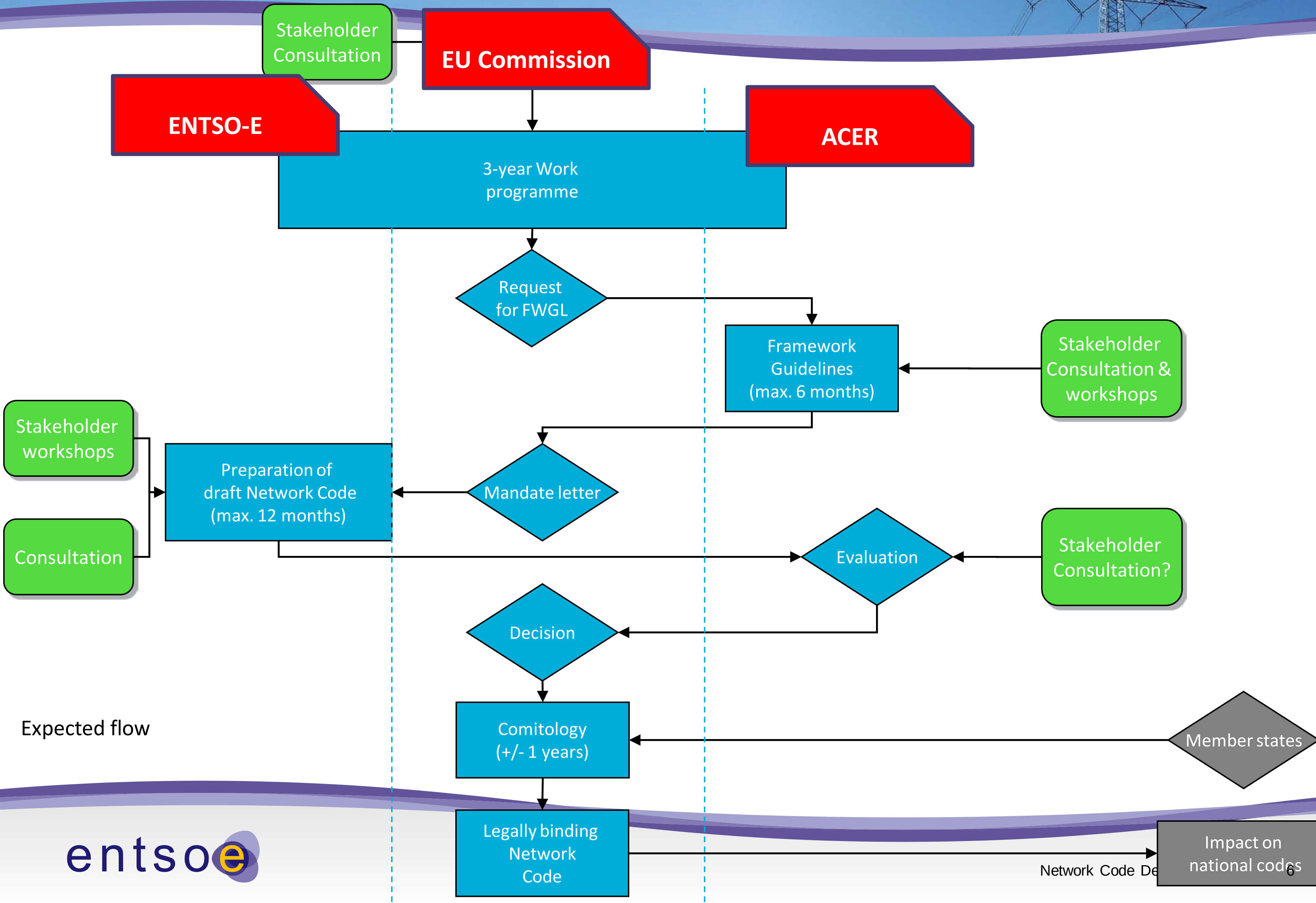
- increasing the amount of renewables
- guaranteeing an adequate Security of Supply
- contributing to an Internal Energy Market

Article 8 – Tasks of ENTSO-E

6. "The network codes … cover the following areas, taking into account, if appropriate, regional specificities:"

- ***a. network security and reliability rules incl. rules for technical transmission reserve capacity for operational network security;***
- ***b. network connection rules;***
- *c. third-party access rules;*
- *d. data exchange and settlement rules;*
- *e. interoperability rules;*
- ***f. operational procedures in an emergency;***
- ***g. capacity-allocation and congestion-management rules;***
- *h. rules for trading related to technical and operational provision of network access services and system balancing;*
- *i. transparency rules;*
- *j. balancing rules incl. network-related reserve power rules;*
- *k. rules regarding harmonised transmission tariff structures incl. locational signals and inter-transmission system operator compensation rules; and*
- *l. energy efficiency regarding electricity networks.*

General Framework - Regulation 714/2009



Expected flow

Article 8 (cont.)

*7. "The network codes shall be developed for **cross-border network issues** and **market integration issues** and shall be without prejudice to the Member States' right to establish national network codes which do not affect cross-border trade."*

Article 10 – Consultations

*1. "… While preparing the network codes … ENTSO for Electricity shall conduct an **extensive consultation process, at an early stage and in an open and transparent manner**, …, in accordance with the rules of procedure referred to in Article 5(1). .."*

*2. "**All documents and minutes of meetings** related to the consultations referred to in paragraph 1 shall be made **public**"*

*3. " …ENTSO for Electricity shall indicate how the observations received during the consultation have been taken into consideration. It shall provide **reasons where observations have not been taken into account***

Prioritization of Network Codes

12 domains in (EC) 714/2009 → Framework guidelines → ENTSO-E code development → ACER evaluation → Comitology

- **Discussed in the Florence Forum with all stakeholders**
- **Regularly discussed by EC / ACER / ENTSO-E**
- **Resulting in a three-year work program**
  - ***High priority***: Listing all Network Codes that are to be finalized by 2014 (creation of the European internal energy market)
  - ***Low priority***: timeline to be discussed
  - Under public consultation by EC (April 2011): http://ec.europa.eu/energy/international/consultations/20110410_external_dimension_en.htm

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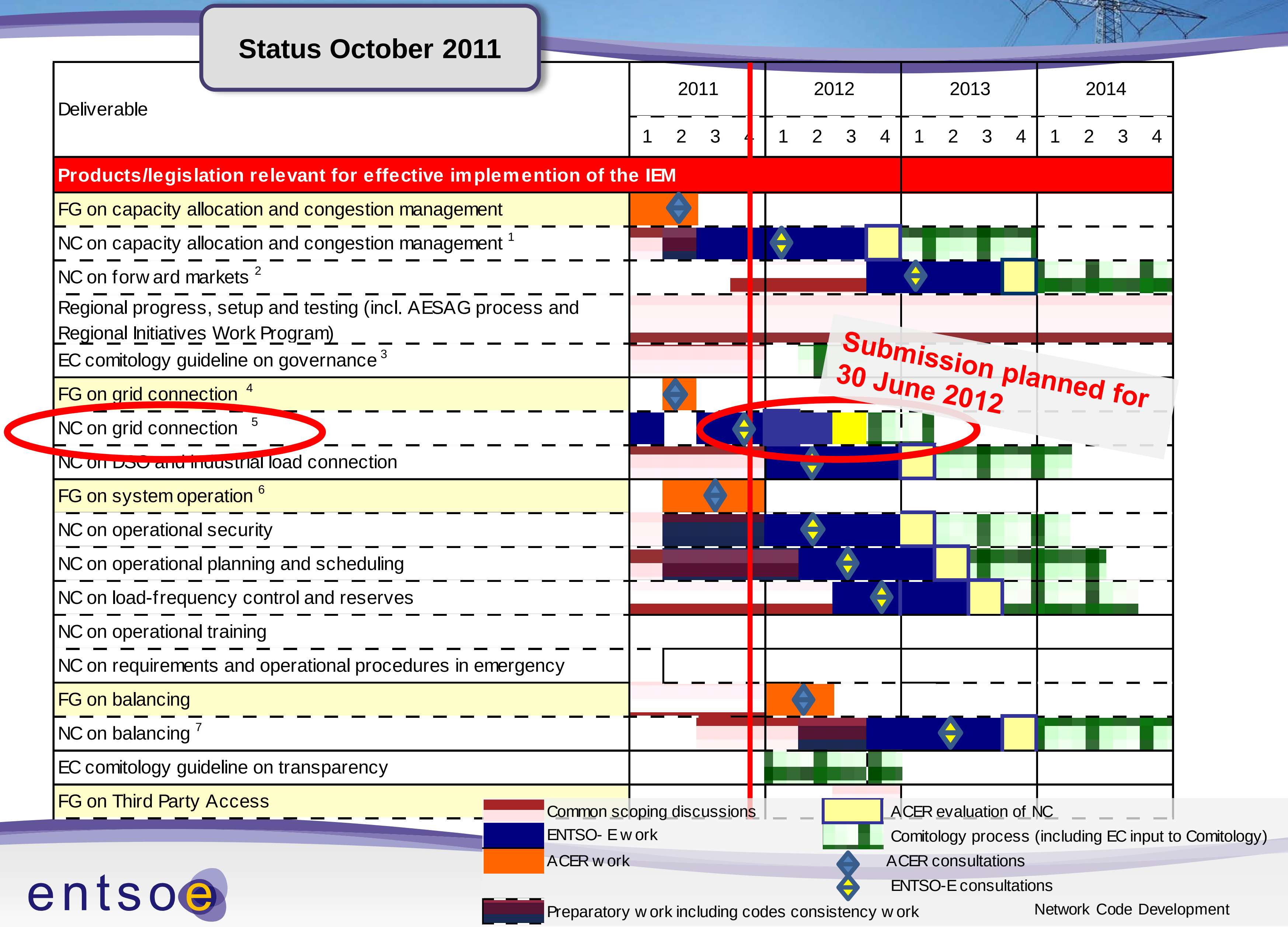
EC / ACER / ENTSO-E high priority list



ENTSO-E Consultation process

When?

- Network Code development
- Annual Work Program
- Ten Year Network Development Plan

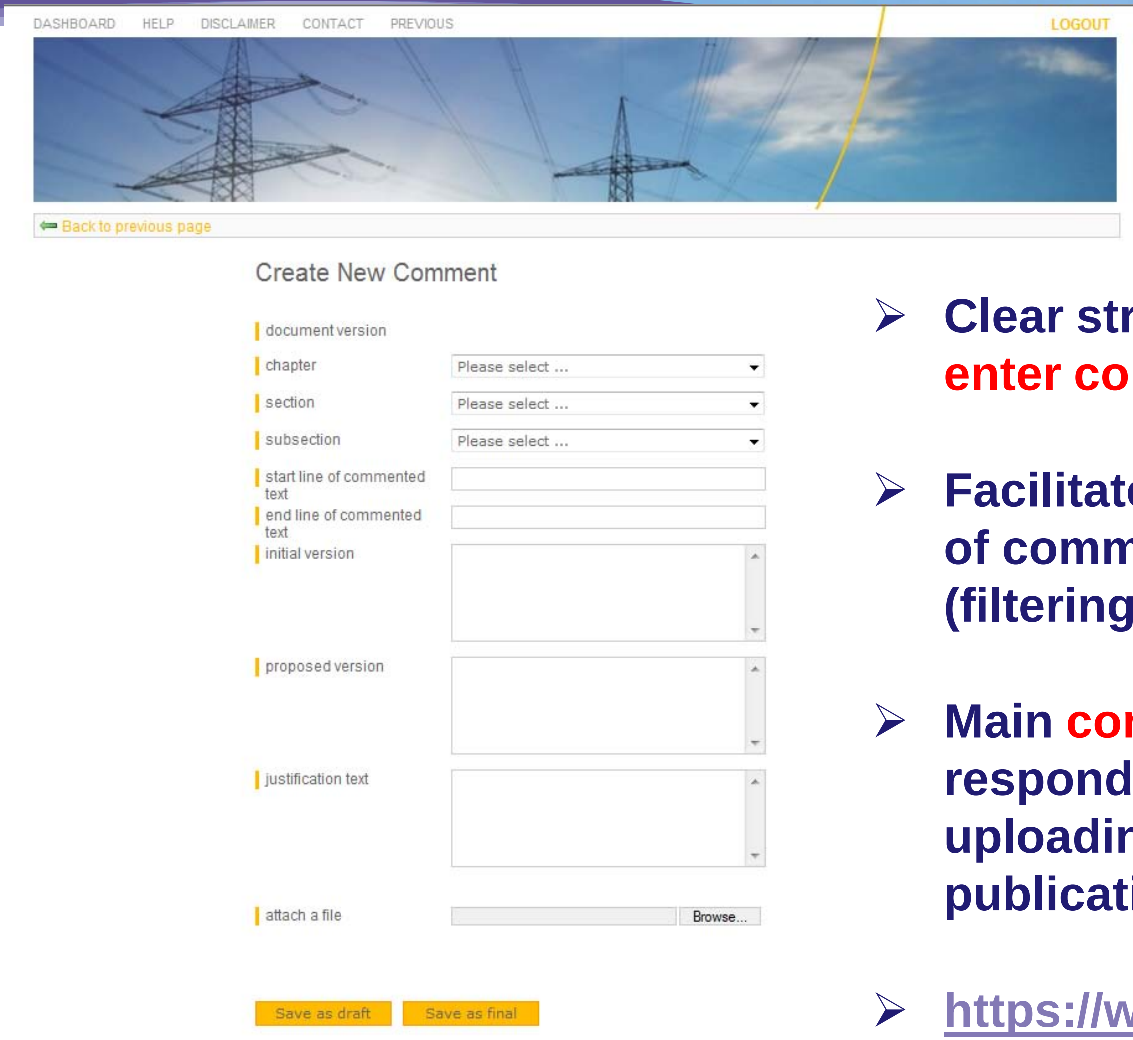
Public Consultation Process

- All (non-confidential) responses received to formal consultations and the total number of responses received will be made public. Note: In case of NC: all comments are treated as non-confidential
- The final ENTSO-E position following the consultation including an evaluation of the responses received explaining the reasons why comments have or have not been taken into account, in accordance with Article 10(3) of the Regulation, will be made public

Tool?

- Web consultation tool to facilitate submission, review and publication of comments
- https://www.entsoe.eu/consultations/

ENTSO-E web consultation tool



- **Clear structure for respondents to enter comments**
- **Facilitates handling of a large number of comments by ENTSO-E reviewers (filtering, assigning, cross-checking)**
- **Main communication tool to respondents: sending of notifications, uploading additional information, publication of comments and review**
- https://www.entsoe.eu/consultations/

Network Code on Connection Requirements applicable to all Generators

Timeline

Starting point

ENTSO-E has identified in 2009 wind connection as the most prominent topic for a rapid introduction of network codes

- Based on ERGEG's framework guideline on grid connection
- With the strong support of the EC and the Florence Forum

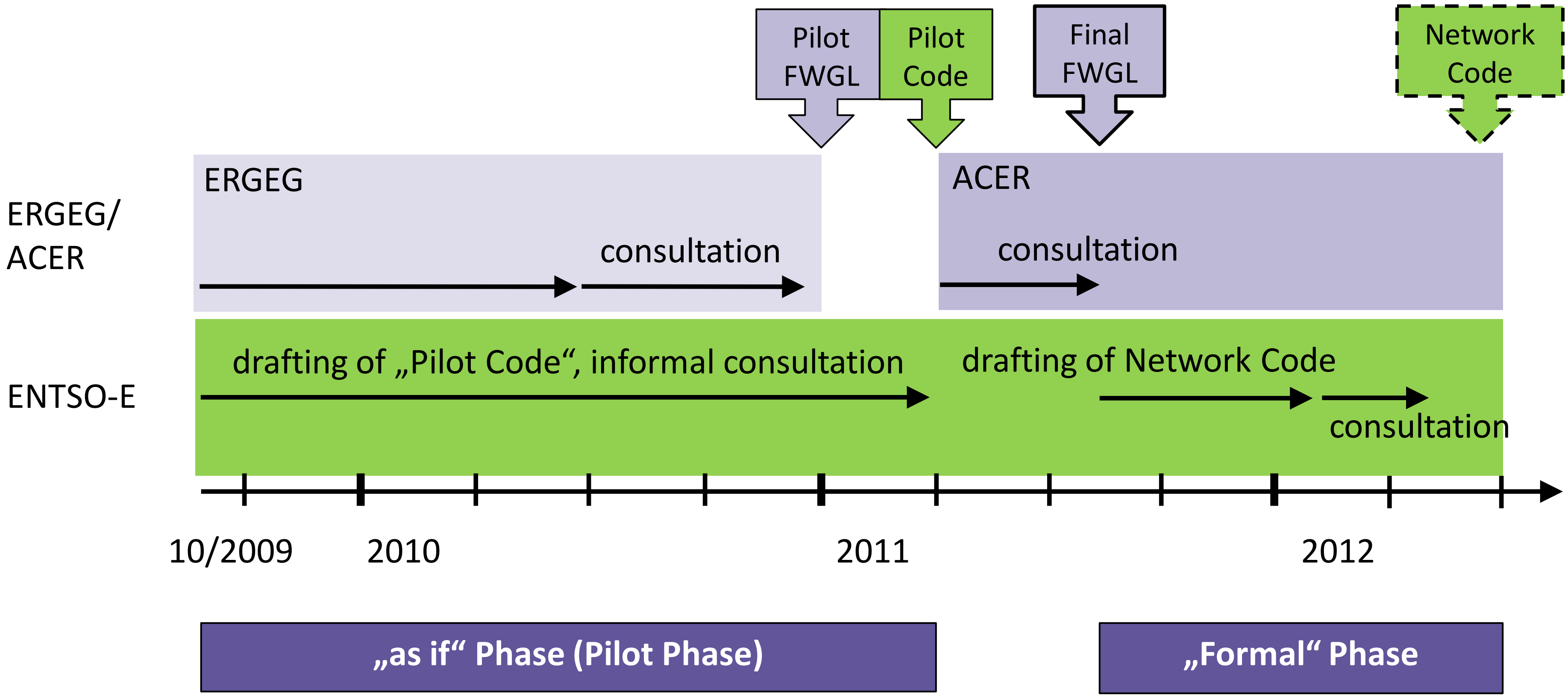
Objectives

- Enable **EU energy and climate policies** while securing **reliability of the power system**
- Facilitate adoption of best practices
- Reduce development and investment costs
- Harmonize structure and technical contents of national codes

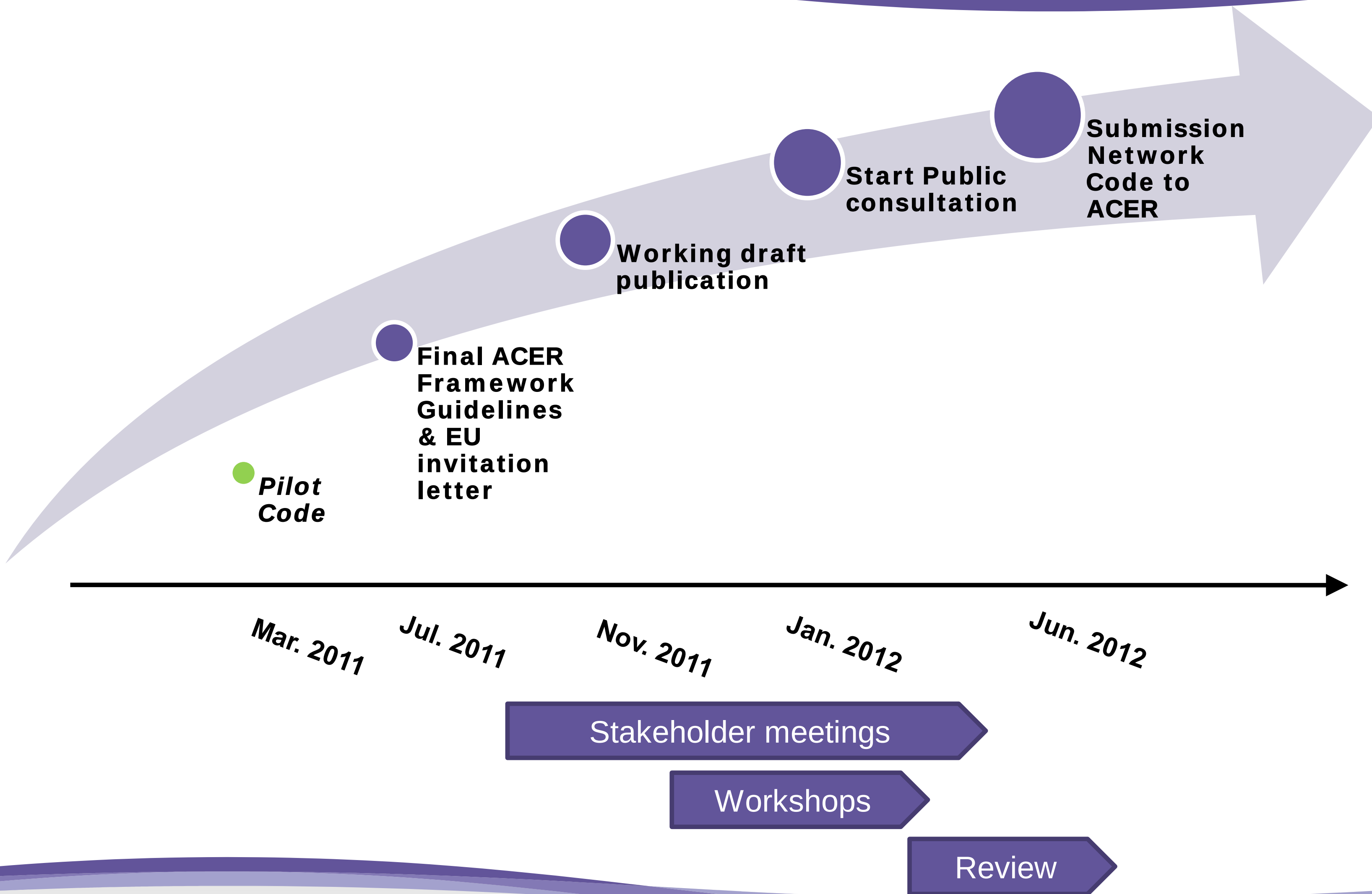
Pilot process

- Scope generalized to all types of generation connection
- Parallel development of code (ENTSO-E) and framework guidelines (ERGEG) to develop the process
- Ending in March 2011 with the entry into force of 3rd Energy Package

Pilot process versus formal process



Formal Network Code process



Stakeholder interaction

Public ENTSO-E workshops

- May 2010
- November 2010
- December 2011 (regional workshops)
- ***15 February 2012***

National level (TSO initiative)

- User groups
- Seminars, …

Bilateral meetings

DSO associations

- CEDEC
- Eurelectric DSO
- Geode

Industrial customers

- IFIEC

Manufacturers & Generators

- EWEA
- EPIA
- EUTurbines
- EUR
- Eurelectric WG Thermal / VGB

Status and next steps

- Working document published on 2 November 2011
- Ongoing bilateral meetings with stakeholders to further develop the draft code

- **Next steps**
  - **Public consultation (two months) starts end of January 2012**
    - ***Publication of updated draft code***
    - ***Publication of FAQs with technical motivation of the code requirements***
    - ***Publication of an explanatory note on the approach taken***
  - **Public workshop on 15 February 2012 in Brussels**
  - **ENTSO-E review of all comments, response and adaptation fo the code where needed in Q2/2012**
  - **Submission to ACER by 30 June 2012**

Conclusions

- The European power system is changing fast and significantly to achieve energy and climate objectives
- Grid connection codes are urgently needed to enable these policies in order to maintain security of supply at least cost for European citizens
- ENTSO-E's neutrality and expertise garanties the process
- Strong involvement of stakeholders, and in particular DSOs, are absolute prerequisites
- Consultation is ongoing; ENTSO-E is listening in pursuit of the best solutions acceptable by all

Thank you for your attention!

Questions?

Key documents

- **Latest working draft document -** https://www.entsoe.eu/media/news/newssingleview/browse/1/article/working-draft-network-code-on-connection-requirements-applicable-to-all-generators-updated/
- **Web consultation tool -** https://www.entsoe.eu/consultations/
- **ENTSO-E Network Code updates -** https://www.entsoe.eu/resources/network-codes/nc-rfg/

Network Code on Connection Requirements applicable to all Generators - Main content

Ralph Pfeiffer

drafting team convener

RG Continental South East
12 December 2011

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Reliable Sustainable Connected

Topics

- Definition of “cross-border issue”
- Significant users
- Level of detail
- Retroactive Application (Application to Existing Generating Units)
- Derogations
- Compatibility with existing standards
- Allocation/reimbursement of costs

What is a cross-border issue?

ACER Framework Guideline on Electricity Grid Connection

A.o. in definition of Significant Grid Users – *"Pre-existing grid users and new grid users which are deemed significant on the basis of their impact on the cross border system performance via influence on the control area's security of supply, including provision of ancillary services."*

Cross-border issues

(EC) 714/2009 – Art. 8 (7)

- *"The network codes shall be developed for **cross-border network issues and market integration issues** and shall be without prejudice to the Member States' right to establish national network codes which do not affect cross-border trade"*

Context 3rd Energy Package

- supporting the completion and functioning of the internal market in electricity and cross-border trade
- facilitating the targets for penetration of renewable generation
- maintaining security of supply

ENTSO-E definition

- All requirements that **contribute to maintaining, preserving and restoring system security** in order to **facilitate proper functioning of the internal electricity market** within and between synchronous areas, and to **achieving cost efficiencies through technical standardization** shall be regarded as "**cross-border network issues and market integration issues**".

Cross-border issues

Why are even small domestic units considered?

- One 5kW PV panel his negligible impact on a synchronous area level.
- What if all units respond similarly to a given stimulus? E.g. disconnection on a sunny day of 200.000 units of 5kW at a frequency rise of 50.2Hz results in a sudden production loss of 1000MW

How can a voltage problem be a cross-border issue?

- A frequency deviation is measured system wide.
- A voltage dip/rise could be a local issue, which can be locally resolved.
- A voltage dip/rise could occur system wide, resulting in a voltage collapse if no **coherent action** is taken. Note: a local measurement cannot identify a starting voltage collapse.

Cross-border issues

Automatic disconnection due to frequency deviations prohibited within the following ranges:

Frequency Range	Time period for operation				
	Continental Europe	Nordic	Great Britain	Ireland	Baltic
47.0 Hz – 47.5 Hz			20 seconds		
47.5 Hz – 48.5 Hz	To be determined* by each TSO, but not less than 30 minutes	30 minutes	90 minutes	90 minutes	90 minutes
48.5 Hz – 49.0 Hz	To be determined* by each TSO, but not less than the period for 47.5 Hz – 48.5 Hz	To be determined* by each TSO, but not less than 30 minutes	To be determined* by each TSO, but not less than 90 minutes	To be determined* by each TSO but not less than 90 minutes	To be determined* by each TSO, but not less than 90 minutes
49.0 Hz – 51.0 Hz	Unlimited	Unlimited	Unlimited	Unlimited	Unlimited
51.0 Hz – 51.5 Hz	30 minutes	30 minutes	90 minutes	90 minutes	90 minutes
51.5 Hz – 52.0 Hz			15 minutes		

** under the conditions off the existing national framework, and respecting the principles of transparency, publicity and non-discrimination*

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What is a Significant Grid User?

ACER Framework Guideline on Electricity Grid Connection

- *"The network code(s) developed according to these Framework Guidelines shall define appropriate minimum standards and requirements applicable to all significant grid users."*
- *"The minimum standards and requirements shall be defined for each type of significant grid user and shall take into account the voltage level at the grid user's connection point. The network code(s) shall specify the criteria and methodology for the definition of significant grid users. These shall be based on a predefined set of parameters which measure the degree of their impact on cross-border system performance via influence on control area`s security of supply, including provision of ancillary services ("significance test")…"*

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Significant users

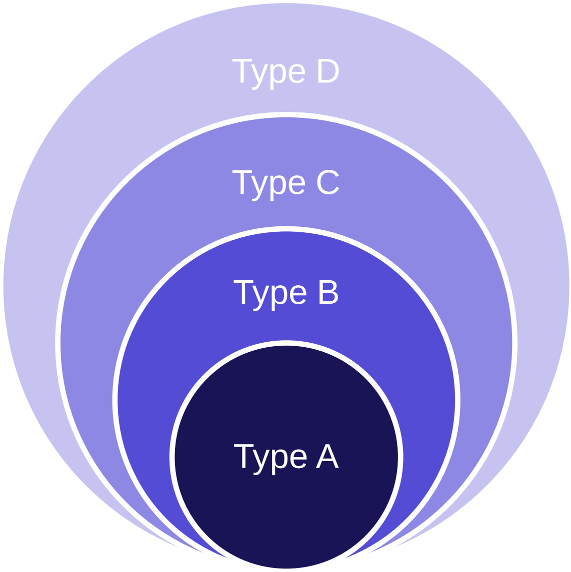
- **Generator capabilities are formulated from a system performance perspective, independent from technology**
- **Need to be able to cope with evolutions in generation mix**
- **Significance is regarded per requirement**

Wide-scale network operation and stability including European-wide balancing services

Stable and controllable dynamic response capabilities covering all operational network states

Automated dynamic response and resilience to operational events including system operator control

Basic capabilities to withstand wide-scale critical events; limited automated response/operator control



Significant users

Network Code gives max. thresholds at synchronous system level

- Criteria based on voltage level (> 110kV → Type D) and MW capacity (table)
- Decision at national level by National Regulatory Authority

Synchronous Area	maximum capacity threshold from which on a Generating Unit is of Type B	maximum capacity threshold from which on a Generating Unit is of Type C
Continental Europe	0.1 MW	10 MW
Nordic	1.5 MW	10 MW
Great Britain	1 MW	10 MW
Ireland	0.1 MW	5 MW
Baltic	0.1 MW	5 MW

What is the appropriate level of detail for Network Code requirements?

ACER Framework Guideline on Electricity Grid Connection

“Furthermore, the network code(s) shall define the requirements on significant grid users in relation to the relevant system parameters contributing to secure system operation, including:

- *Frequency and voltage parameters;*
- *Requirements for reactive power;*
- *Load-frequency control related issues;*
- *Short-circuit current;*
- *Requirements for protection devices and settings;*
- *Fault-ride-through capability; and*
- *Provision of ancillary services.*

…

The network code(s) shall set out how the TSO defines the technical requirements related to frequency and active power control and to voltage and reactive power management.”

Network Code structure

- **General provisions**
  - Definitions
  - Scope
- **Requirements**
  - General requirements
  - Synchronous Generating Units
  - Power Park modules
  - Offshore Power Park modules
- **Operational Notification Procedure for Connection**
  - New generating units
  - Existing generating units
- **Compliance**
  - Compliance monitoring
  - Compliance testing
  - Compliance simulations
- **Derogations**
  - Request
  - Decisions
- **Final Provisions**
  - Entry into force and application of the Network Code

Network Code requirements

Prescriptive requirements

- The Network Code lays down requirements and specific parameters
- ***E.g. frequency disconnection***

Framework requirements

- The Network Code gives a coherent approach to formulate requirements
- Avoids divergence of requirements throughout Europe
- Specific setting of parameters based on a given legal framework, e.g. NRA approval, consultation, in mutual agreement, other Network Codes, …
- ***E.g. reactive power provision***

Principle requirements

- High level requirement on functionality
- Specific implementation prescribed by other agreements, national legislation, Network Codes, …
- ***E.g. information exchange***

Level of detail

Harmonization

- Favored by manufacturers: larger market for same product
- Favored by project developers: less resources to engineering
- Concern by project developers: excuse for increased prices
- Note: Harmonisation is no objective in itself (3rd Energy Package)

Viewpoint of system security

- Different needs in each synchronous zone
- Different need of details in all requirements

Conclusion

- Level of detail differs per requirement
- General principles as well parameter settings exist in the Network Code

Retroactive application?

ACER Framework Guideline on Electricity Grid Connection

“The applicability of the standards and requirements to pre-existing significant grid users shall be decided on a national basis by the NRA, based on a proposal from the relevant TSO, after a public consultation. The TSO proposal shall be made on the basis of a sound and transparent quantitative cost-benefit analysis that shall demonstrate the socio-economic benefit, in particular of retroactive application of the minimum standards and requirements ... The format and methodology or principles of the cost-benefit analysis shall be prescribed by the network code(s).”

Retroactive application

Generation Units not yet under construction are considered to be existing, if

- Legally binding contract for main plant is in force
- Evidence is provided within 6 months after entry into force of the code
- Network Operator can request confirmation by Third Party auditor

Decision on retroactive application

- On a national basis
- Cost Benefit Analysis process initiated by TSO and supported by stakeholders
- Final approval of retroactive application (based on TSO proposal) by the National Regulatory Authority

Retroactive application

A full quantitive CBA is a resource intensive process

➲ A filtering (CBA stage 1) is performed based on engineering review

Cost of modification
Insignificant
Significant

Benefit in reduced demand loss / balancing costs
No/low impact
Significant impact

- 1: Analyse retrofit via Stage 2 CBA
- 2: Make further judgment; check against ENTSO-E library
- No further action

COST	BENEFIT	ACTION
Insignificant	Significant impact	1
Insignificant	No/low impact	2
Significant	Significant impact	2
Significant	No/low impact	3

Retroactive application

Green light: reasonable prospect of justifying retroactive application ⇨ quantitative CBA (stage 2)

CBA techniques

- Net Present Value / Return On Investment / Rate of Return / Time to Break Even.
- Discount rate at TSO's discretion

Cost components

- Costs for implementing the requirement
- Any attributable loss of opportunity
- Change in maintenance costs

Societal Benefits

- Improvement of security of supply (black out probability)
- Improvement to the internal market in electricity and cross-border trade (reactive power provision, freq. response, reserves, …)

Retroactive application

If CBA justifies retroactive application for a user or a class of users

- Recommendation by TSO
- Public consultation
- Recommendation & consultation results to NRA
- NRA decision
- Both TSO & NRA decisions published
- Three-year period to amend clauses in Grid User connection agreements

Retroactive application

- **If retroactive application for a requirement is not enforced**
  - → Existing Generating Unit remains bound by technical requirements pursuant to national legislation or by contractual agreements.
- **National legislation**
  - → may remain in force, in case it refers to requirements not covered by the Network Code
- **If national legislation is repealed**
  - → Existing Generating Unit remains bound by technical requirements pursuant to national legislation such as it was the day before it ceased to be in force.
- **Former derogations to national legislation**
  - → are not valid as derogation for the European Network Code, but provide evidently useful information

Are derogations possible and how are they approved?

ACER Framework Guideline on Electricity Grid Connection

- *"The network code(s) developed according to these Framework Guidelines shall describe the process and criteria for applying for derogation. This process is applicable to pre-existing (and in exceptional cases new) significant grid users."*
- *"The derogation process shall be transparent, non-discriminatory, non-biased, well documented and based on the cost-benefit analysis performed by the TSO."*
- *"The network code(s) may provide that derogation from all or some of the minimum standards and requirements may be granted to classes of pre-existing (and, in exceptional cases, new) significant grid users, non-discriminatorily, without the cost-benefit analysis being performed, if the TSO submits to the NRA a reasoned request and the exemption from the cost-benefit analysis is authorised by the NRA."*

Procedure for derogations

Application to the Relevant Network Operator

Assessment of the request and submission to the NRA

Decision by the NRA

Assessment of the decision by ACER and recommendations to the NRA

Register of derogations maintained by the NRA

Is the Network Code compatible with existing standards?

Compatibility with existing standards

The European Network Code will evidently show deviations from existing grid codes

Deviation	Impact
Number of requirements	Modest for most countries
Strictness and range of requirements	Modest for most countries
Units affected by the requirements	Harmonization of requirements to smaller units (also distribution level)
Compliance procedures and tests	Intensity increases

Compatibility with existing standards

ENTSO-E network code is drafted, based on best practices and existing grid codes throughout Europe

Earlier versions of the network code have been challenged in a public consultation (pilot process) and various bilateral discussions

All comments have been thoroughly assessed and if needed integrated in the code

ENTSO-E states that the Network Code does not impose significant variations from existing standards and grid codes

Stakeholders are invited to comment on this if needed in the public consultation (Q1/2012)

How are costs related to imple-menting Network Code require-ments allocated and reimbursed?

ACER Framework Guideline on Electricity Grid Connection

- *"The network code(s) shall always require the system operators to optimise between the highest overall efficiency and lowest total cost for all involved stakeholders. In that respect, NRAs shall ensure, that, whatever the cost-sharing scheme is, the cost split follows the principles of non-discrimination, maximum transparency and assignment to the real originator of the costs."*

Provision of ancillary services driven by markets

Connection requirements need to provide forward looking capabilities

- What will the system situation be like in 10, 20, 30,… years time? Shift of providing grid services by smaller units is likely to continue further.
- Technical capabilities have impact on the basic design of generating units
- Manufacturers consider the requirements technically feasible, but R&D is needed to deliver adequate products.
- Short term market decisions can be detrimental for system security.

The actual provision of a number of ancillary services needs to be market based

- Based on adequate remuneration
- Based on market-related Network Codes to be developed (e. g. Balancing)

Capability to provide services

Market framework to provide services

Conclusions

- Requirements target system security as the relevant cross-border issue in the context of this network code.
- Significance is determined per requirement and per type of generating unit. Thresholds for categories of generating units are fixedon national basis.
- Requirements are either prescriptive, set frameworks/ boundaries or give general principles, depending on the specific needs for system security.
- Requirements set mandatory design capabilities for all generators. Operation or market rules are based on other agreements or codes.

Thank you for your attention! Questions?

Key documents

- **Latest working draft document -** https://www.entsoe.eu/media/news/newssingleview/browse/1/article/working-draft-network-code-on-connection-requirements-applicable-to-all-generators-updated/

- **Web consultation tool –** https://www.entsoe.eu/consultations/

- **ENTSO-E Network Code updates -** https://www.entsoe.eu/resources/network-codes/nc-rfg/

Backup

Pilot process

Redrafting based on ACER's final framework guidelines

Working draft publication

Continued stakeholder interaction

Public consultation

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ENTSO-E Draft Requirements for Grid Connection Applicable to all Generators

27 October 2011

Notice

This draft represents the conclusion of the preparatory work undertaken by ENTSO-E in the context of the "network code for requirements for grid connection applicable to all generators". The contents of this draft, organised in a manner similar to the anticipated structure of the final network code, reflect the status of the work done by TSO experts as of 18 October 2011, in line with the ACER Framework Guidelines on Electricity Grid Connection published on 20 July 2011 It is based not only on the input of an extensive informal dialogue with stakeholders as well as public workshops that took place during the pilot period between Summer of 2009 and 3 March 2011, the date on which Regulation (EC) 714/2009 entered into force, as well as ongoing formal discussions after the EC mandate letter was received by ENTSO-E on 29 July 2011.

The current early publication of this draft intends to enable the stakeholders to already start assessing in full transparency the results of the informal and formal preparatory work, following the policy option choices according to ACER's framework guidelines.

The formal consultation is expected to be organised in the first quarter of 2012, during which period stakeholders will have the option to provide comments via the web-based ENTSO-E consultation tool. After due consideration of these comments in an open and transparent manner in compliance with Article 10 of Regulation (EC) 714/2009, ENTSO-E will adopt its "network code for requirements for grid connection applicable to all generators" and submit it to ACER.

Disclaimer

This draft does not represent a firm, binding and definitive ENTSO-E position on the contents, the structure, or the prerogatives of the "network code for requirements for grid connection applicable to all generators" and on which a formal public consultation will be organised by ENTSO-E according to Regulation (EC) 714/2009.

ENTSO-E AISBL • Avenue Cortenbergh 100 • 1000 Brussels • Belgium • Tel +32 2 741 09 50 • Fax +32 2 741 09 51 info@entsoe.eu • www.entsoe.eu

Working draft available at
http://www.entsoe.eu

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Why is there no Network Code per type of generation technology?

ACER Framework Guideline on Electricity Grid Connection

“Where additional requirements beyond those defined in the minimum standards and requirements are mandated for a particular class, technology, size or location of significant grid user, the network code(s) shall set out and justify these additional requirements.”

Types of generation

Examples

- *« Why not differentiate between variable and constant primary sources? »*
- *« Why not differentiate between technologies with inherently different inertia? »*

Network Code built from a system perspective

- Voltage/frequency/angular stability
- Balancing
- Information exchange
- …
- are all independent from prime mover

Connection interface is of importance

- Synchronous generator
- Power electronic interface (Power Park Module)

Additional requirements for offshore wind

Consistent set of requirements aids in equitable treatment of all Grid Users

Retroactive application

Examples	Cost	Benefit	Action
Reactive capability for large old generators different to new code, but not dramatically less Q range than code.			No further action
Generator narrow frequency range. Plant ok for full range, but require frequency trip settings change.			Quantitative CBA
Solar PV: Trip at modest system frequency deviation. Implement frequency range change and LFSM (at 50.2-50.5Hz).		Cont. Eur.	Quantitative CBA
		Other area	Further review
Limited frequency range of domestic CHP, volume modest			Further review
Early wind farms with inadequate reactive capability and reactive control facilities, as well as inadequate FRT capability		Great Britain	No further action
		Spain	Further review

How to understand Fault-Ride-Through capability?

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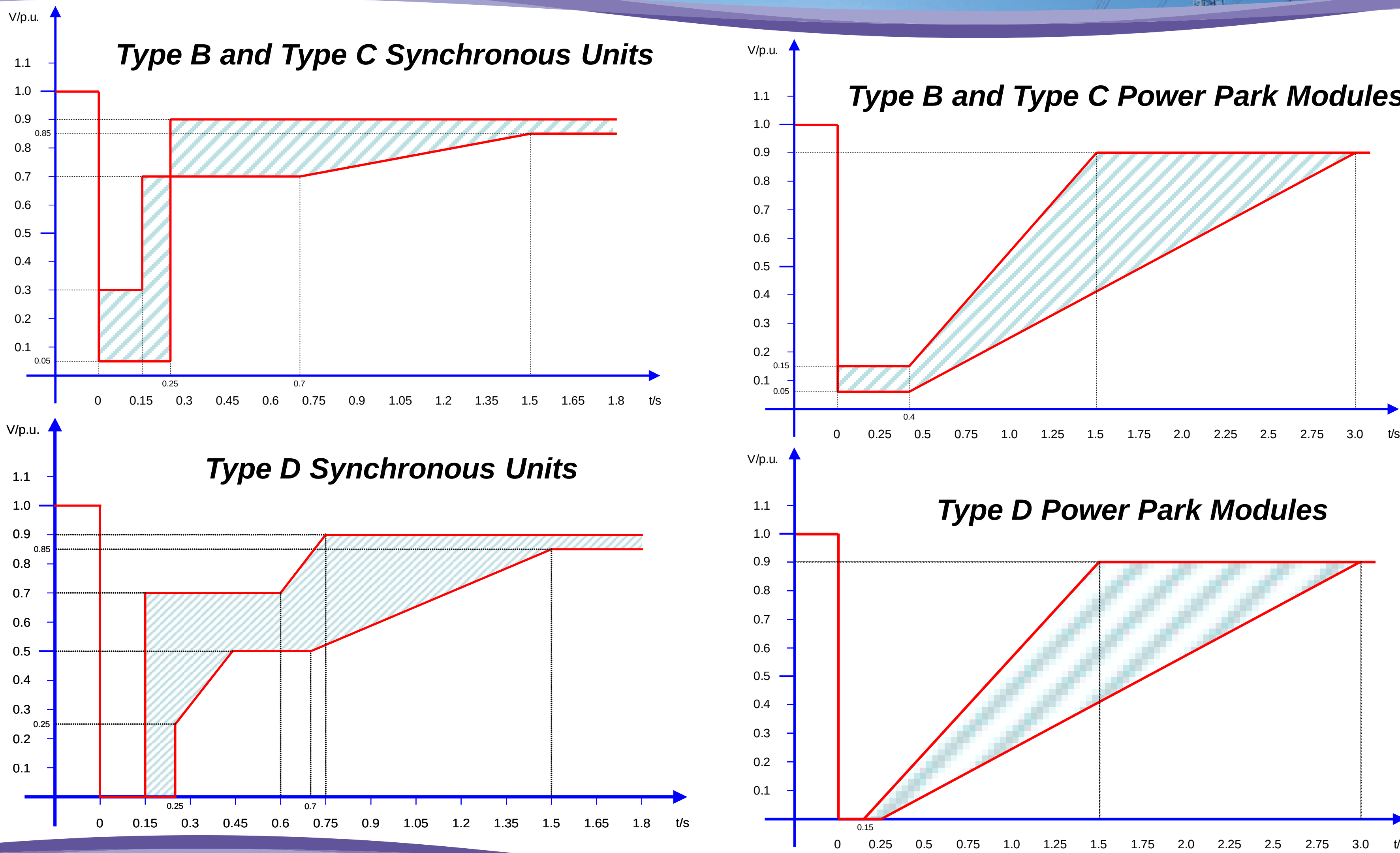
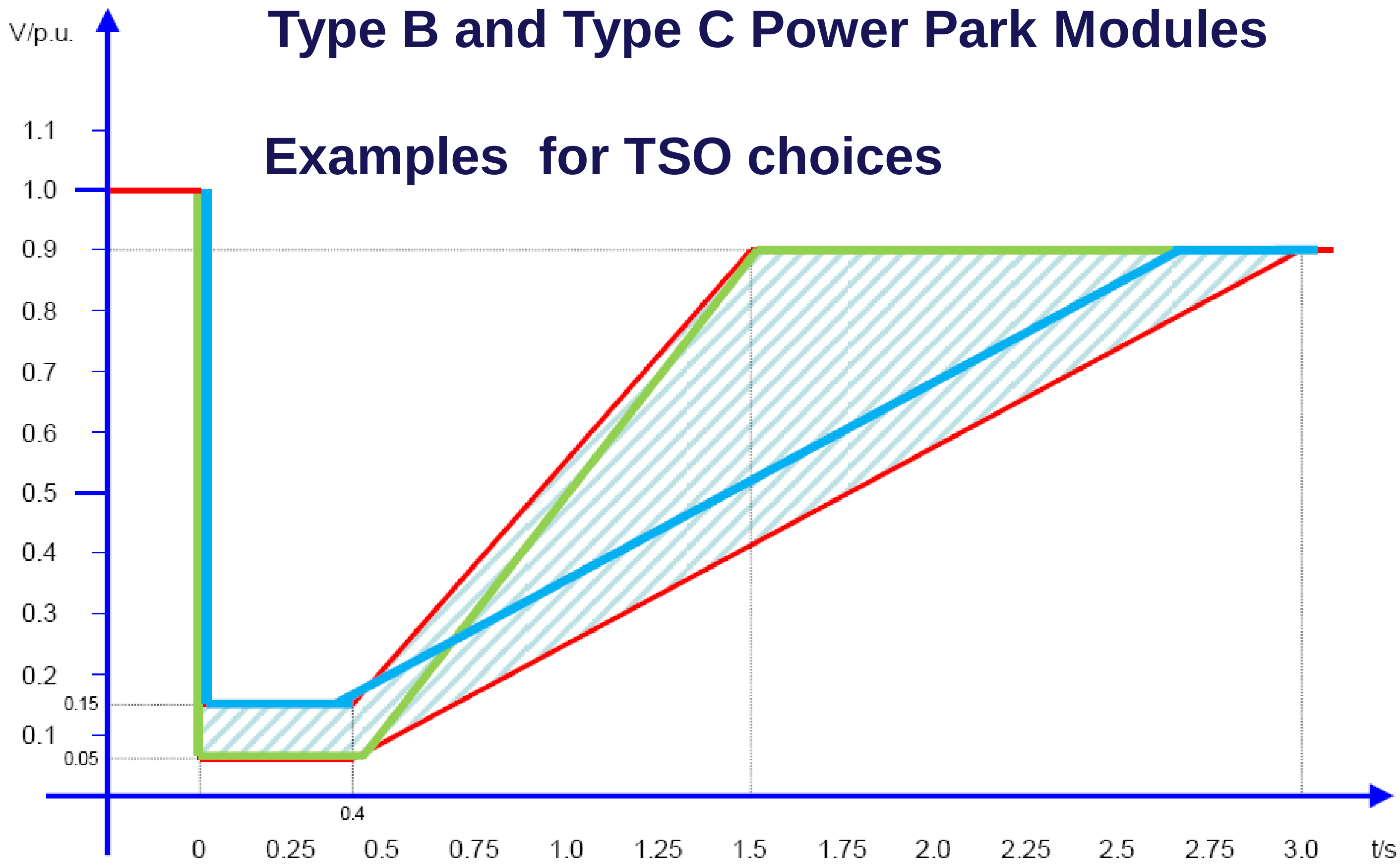
Fault-Ride-Through Capability



Fault-Ride-Through Capability

Type B and Type C Power Park Modules

Examples for TSO choices



Fault-Ride-Through Capability

Successful Fault-Ride-Through depends on actual voltage recovery profile

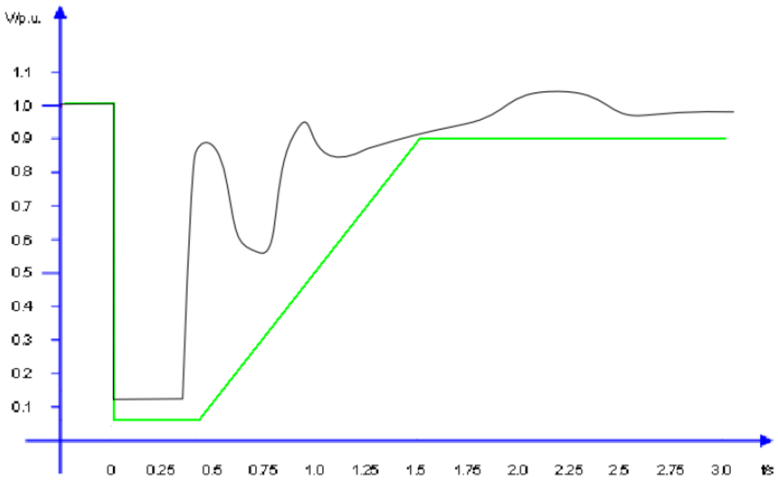


Figure 1: Fault-Ride-Through required

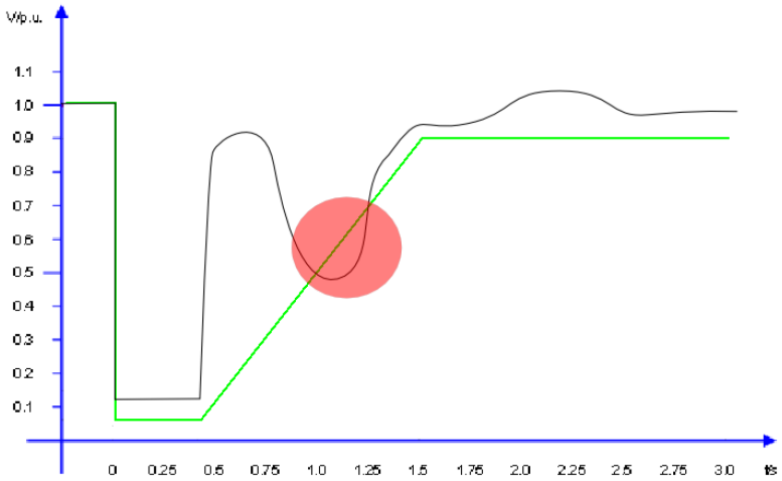


Figure 2: Disconnection admissible

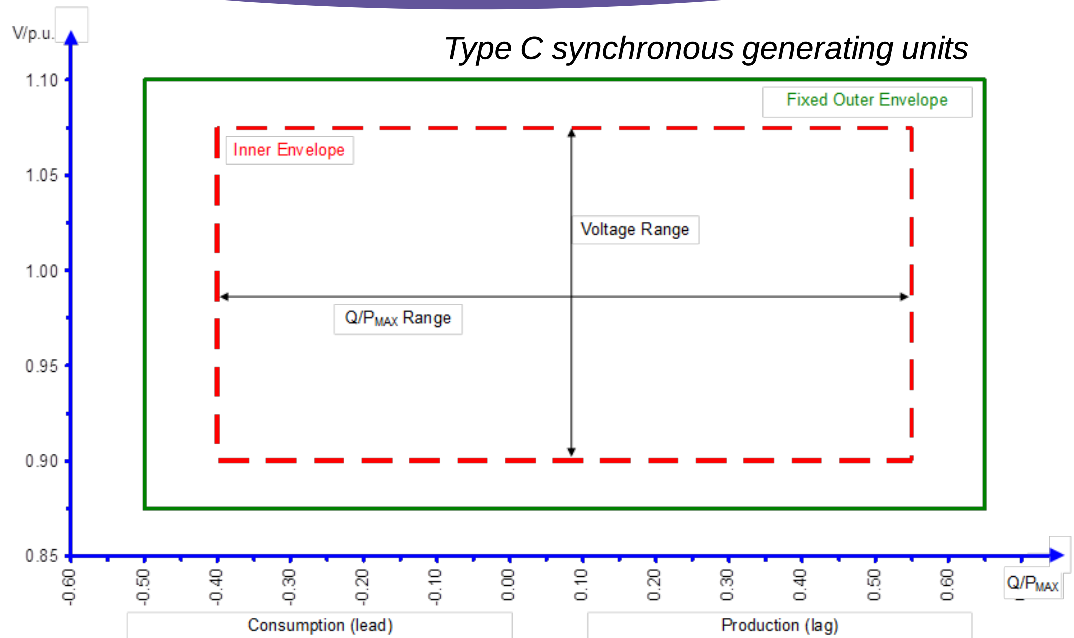
Why is the reactive power capability so wide?

Reactive power capability

Need for reactive power depends strongly on the type of network (length, cable/overhead, loading, …)

- ❑ Network Operator defines U-Q/Pmax shape within red envelope
- ❑ Red envelope can be moved within boundaries
- ❑ Dimensions red envelope depend on synchronous area
- ❑ Green outer boundary is based on all relevant grid codes in Europe. Note: the green boundary is not the requested range.

Provides a basis for efficient voltage regulation in constantly evolving networks



Synchronous Area	Range of Q/P_{max}	Range of steady state voltage level in PU
Continental Europe	0.95	0.225
Nordic	0.95	0.150
Great Britain	0.95	0.100
Ireland	1.08	0.218
Baltic States	1.0	0.220

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