GridTECH.EU

INNOVATIVE **GRID-IMPACTING TECHNOLOGIES**
ENABLING A CLEAN, EFFICIENT AND SECURE
ELECTRICITY SYSTEM IN EUROPE

The European GridTech project

Hans Auer (EEG TU Wien)
Angelo L' Abbate (RSE SpA)

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Co-funded by the Intelligent Energy Europe Programme of the European Union

About the project

Contract number:
IEE/11/017 / SI2.616364

Full title:
Impact Assessment of New Technologies to Foster RES-Electricity Integration into the European Transmission System

GridTech is a project co-funded by the European Commission under the **Intelligent Energy Europe** Programme.

Duration:
May 2012 - April 2015

Budget:
1,958,528

EC contribution:
1,468,896

Co-funded by the Intelligent Energy Europe Programme of the European Union

About the project

GridTech's main goal:

→ Conduct a ***fully integrated assessment of new grid-impacting technologies and their implementation*** into the European electricity system.

This will allow comparing different technological options, towards the exploitation of the full potential of future **electricity production from renewable energy sources (RES-E)**, with the lowest possible total electricity system cost.

Project objectives (I)

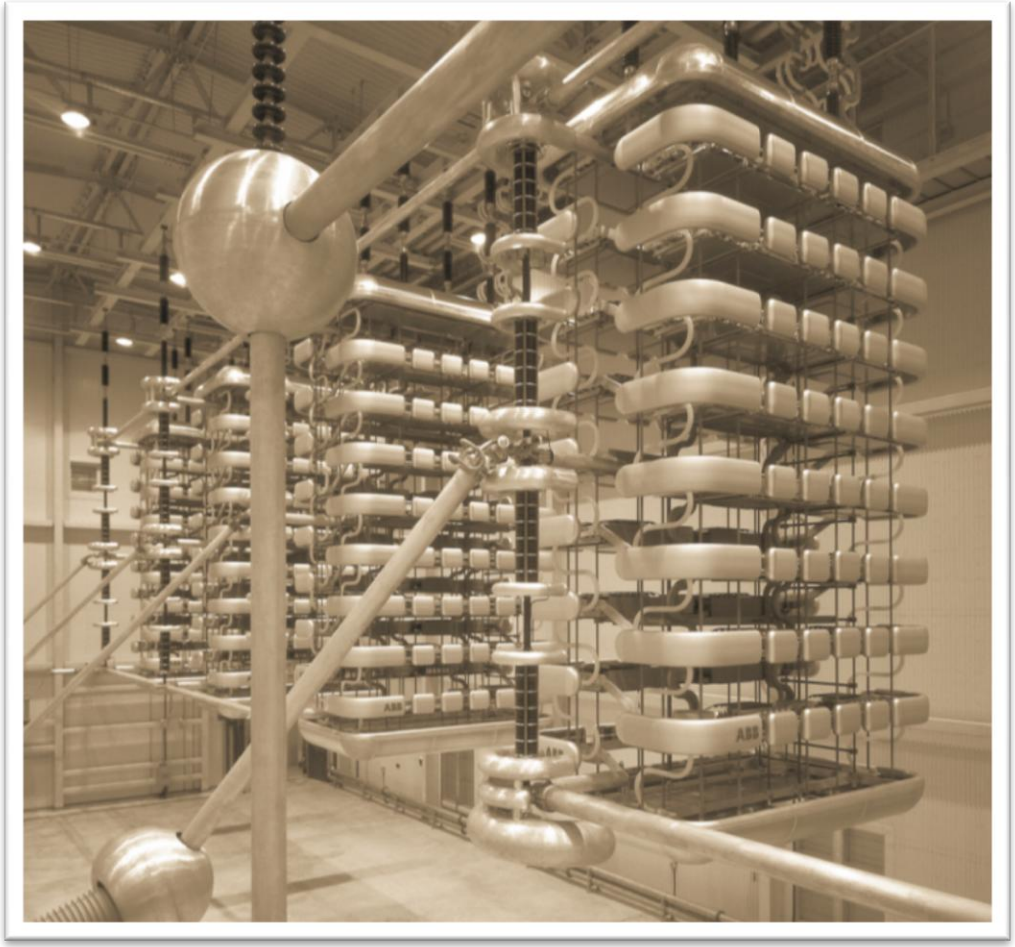
- Assess the **non-technical barriers** for transmission expansion and market compatible renewable electricity integration in Europe.
- Develop a robust **cost-benefit analysis methodology** on investments in most suitable **new technologies fostering large-scale renewable electricity integration** into the European transmission grid.
- Apply and verify the cost-benefit analysis methodology for **investments in the transmission grid, on national and European level**.

Project objectives (II)

- Achieve a common understanding among key actors and target groups on **best practise** criteria for the implementation of new technologies fostering large-scale renewable electricity and storage integration.
- Deliver tailor-made **recommendations** and **action plans**, taking into account the legal, regulatory, and market framework.

Technology focus

The analysis focuses on the most promising and innovative technologies that directly or indirectly impact on the transmission system.



Grid-impacting technologies (overview)

- Onshore and offshore wind energy
- Large-scale solar technologies: Concentrated Solar Power (CSP) and Photovoltaics (PV)

Electricity generation technologies, with a focus on variable RES-E

- Pumped Hydro Energy Storage
- Compressed Air Energy Storage

Bulk energy storage technologies

Demand Response Technologies/ Measures and electric vehicles

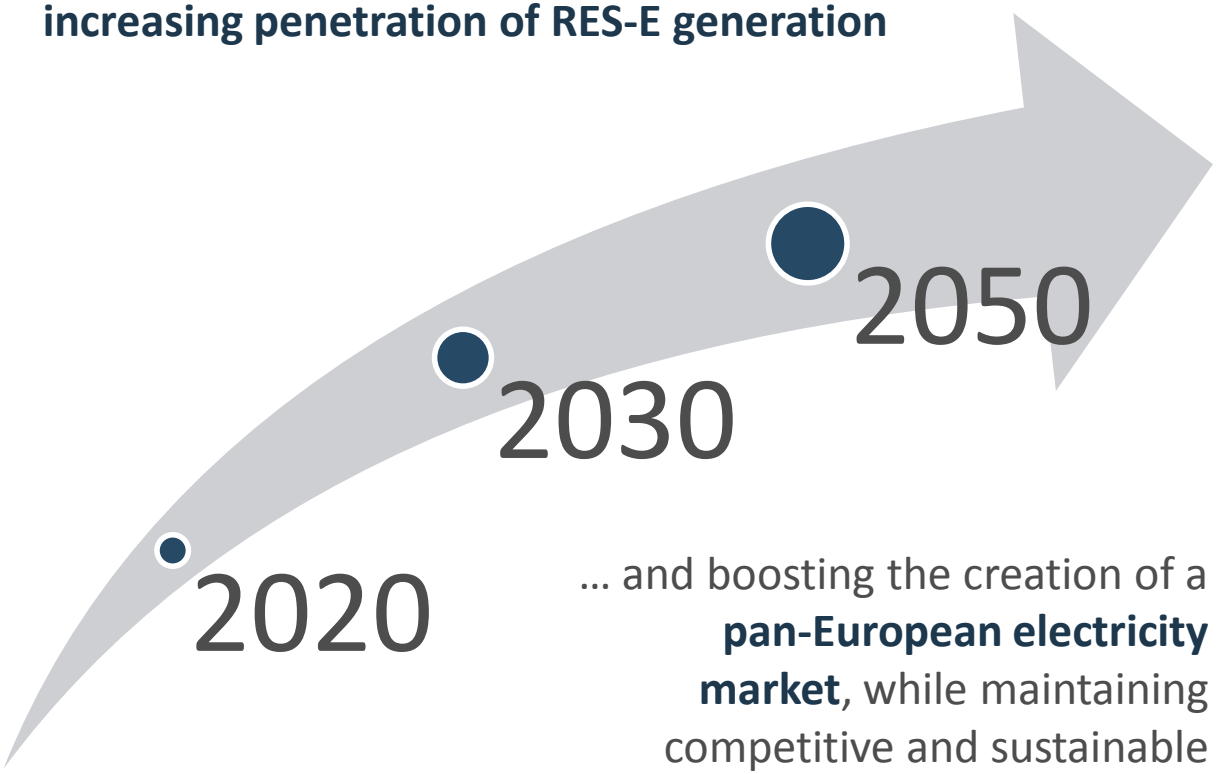
- HVDC - High Voltage Direct Current, both VSC (Voltage Source Converter)-based and CSC (Current Source Converter)-based
- FACTS - Flexible Alternating Current Transmission System
- PST - Phase Shifting Transformers
- WAMS - Wide Area Monitoring System
- DLR/RTTR - Dynamic Line Rating/Real-Time Thermal Rating-based devices

Transmission technologies directed at improvements in network control and flexible electricity system operation

2020
and beyond

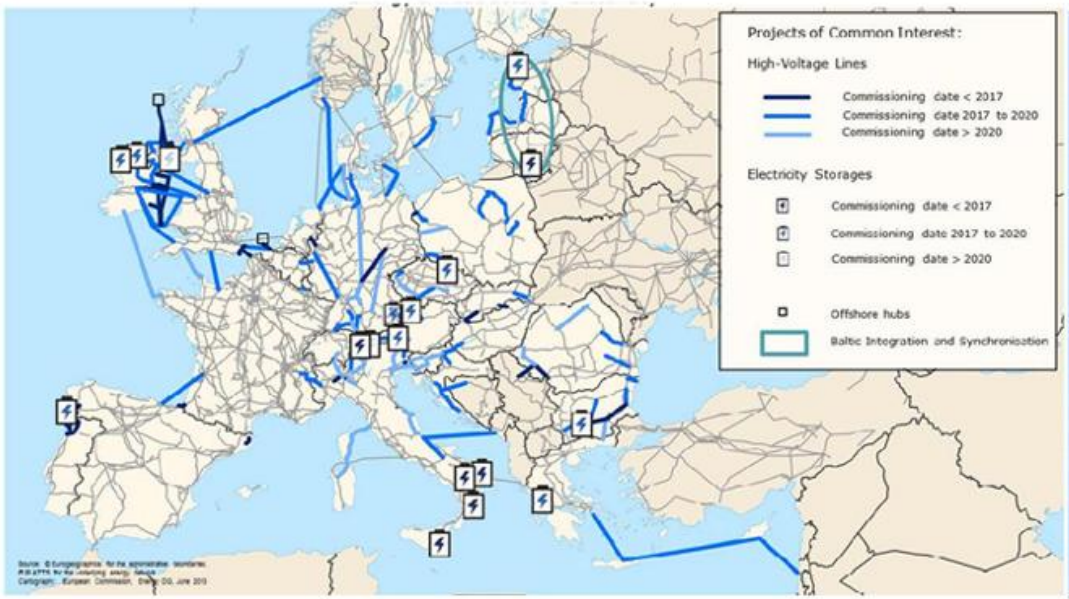
Within the 2020, 2030 and 2050 time horizons, the aim is to assess, among **innovative technologies**, i) **which**, ii) **where**, iii) **when**, and iv) **to which extent** they could effectively contribute to the further development of the European transmission grid

… fostering the **integration of an ever-increasing penetration of RES-E generation**



… and boosting the creation of a **pan-European electricity market**, while maintaining competitive and sustainable electricity supply.

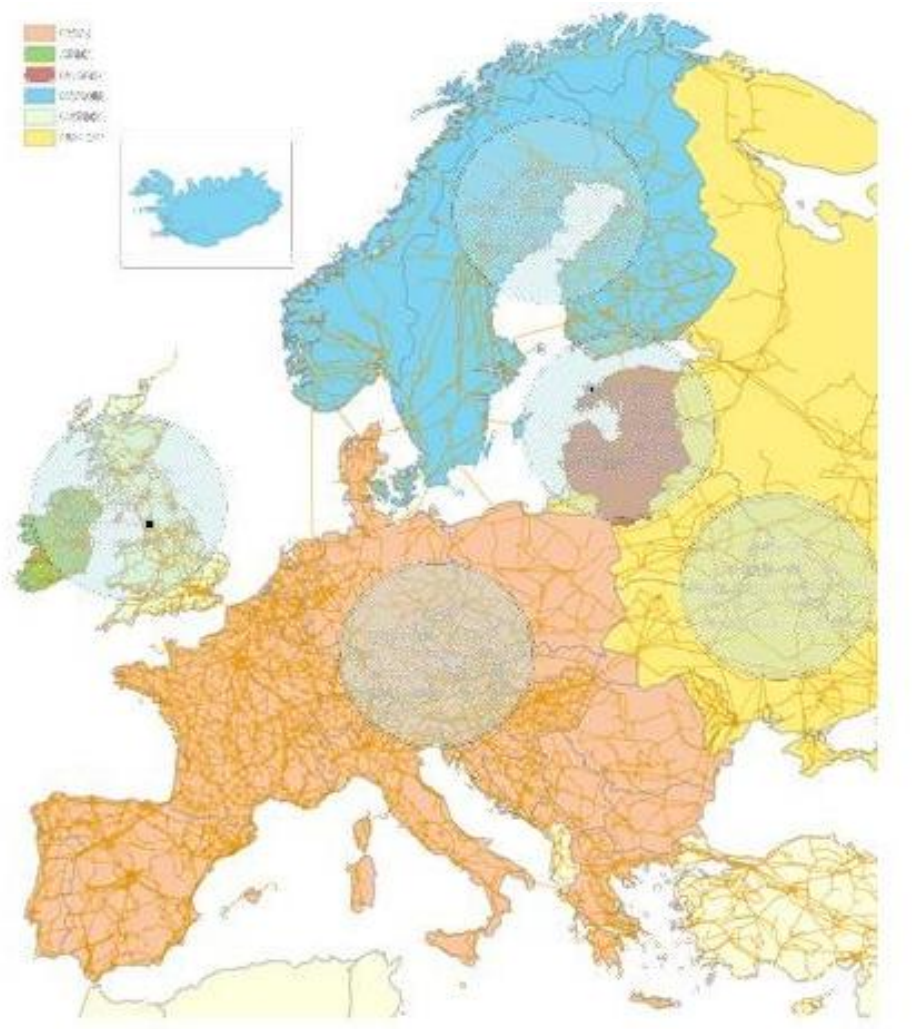
Screening of grid and storage projects



PCI projects and PECI projects

Pan-European system

Synchronous European systems (2010)



Source: JRC (2010)

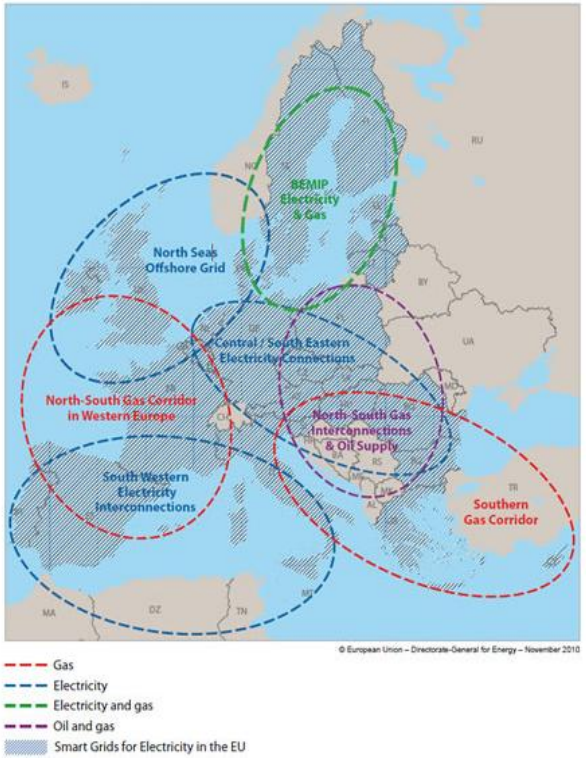
Long-term grid scenarios

Towards a potential pan-European SuperGrid?

A potential pan-European SuperGrid may include, in the long term (**2030-2050**), an enlarged HVAC continental network, synchronously interconnecting also Turkey, Baltic countries, and possibly Moldova and Ukraine, and further asynchronously interlinked with Scandinavia and British islands, embedding VSC-HVDC links and also combining offshore grids, in presence of a potentially closed (by HVAC/HVDC) MedRing and interconnections between the shores across the Mediterranean Sea.

Islands like Malta (via HVAC), Cyprus and Iceland (via HVDC) would be electrically linked to such system as well.

Russia (including Kaliningrad enclave) and Belarus would be asynchronously interconnected.

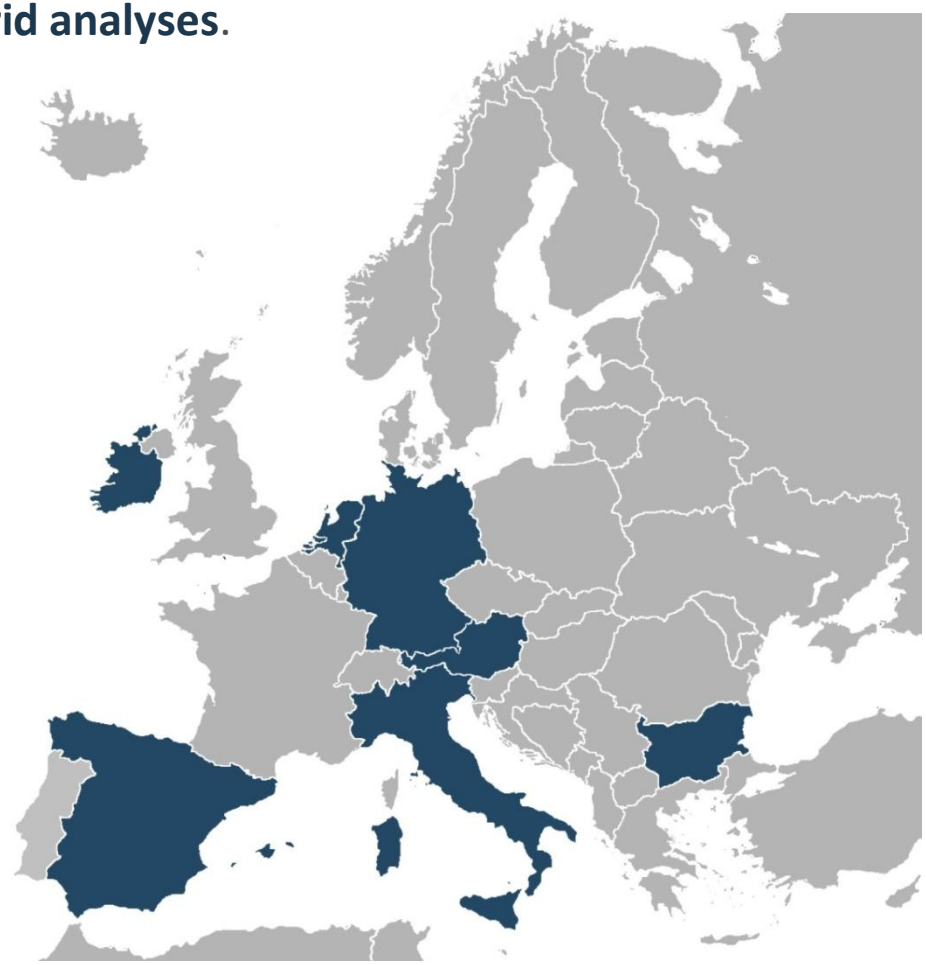


Source: EIP (2010)

Target countries

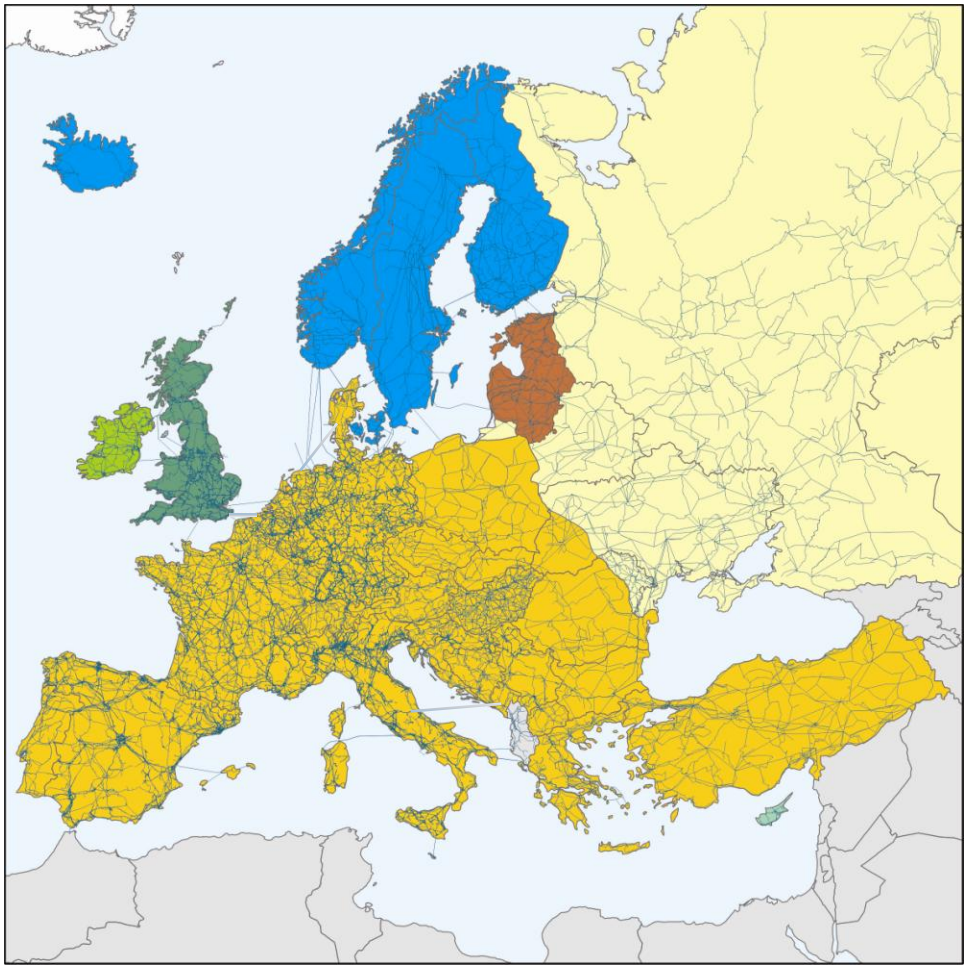
AUSTRIA
BULGARIA
GERMANY
IRELAND
ITALY
NETHERLANDS
SPAIN

In addition to top-down modelling on EU30+ and taking stock from it in a consistent data input-output flow, GridTech focuses on **7 countries**, representative of the existing and future European electricity systems, **studied at 2020, 2030 and 2050 by grid analyses**.



Pan-European study

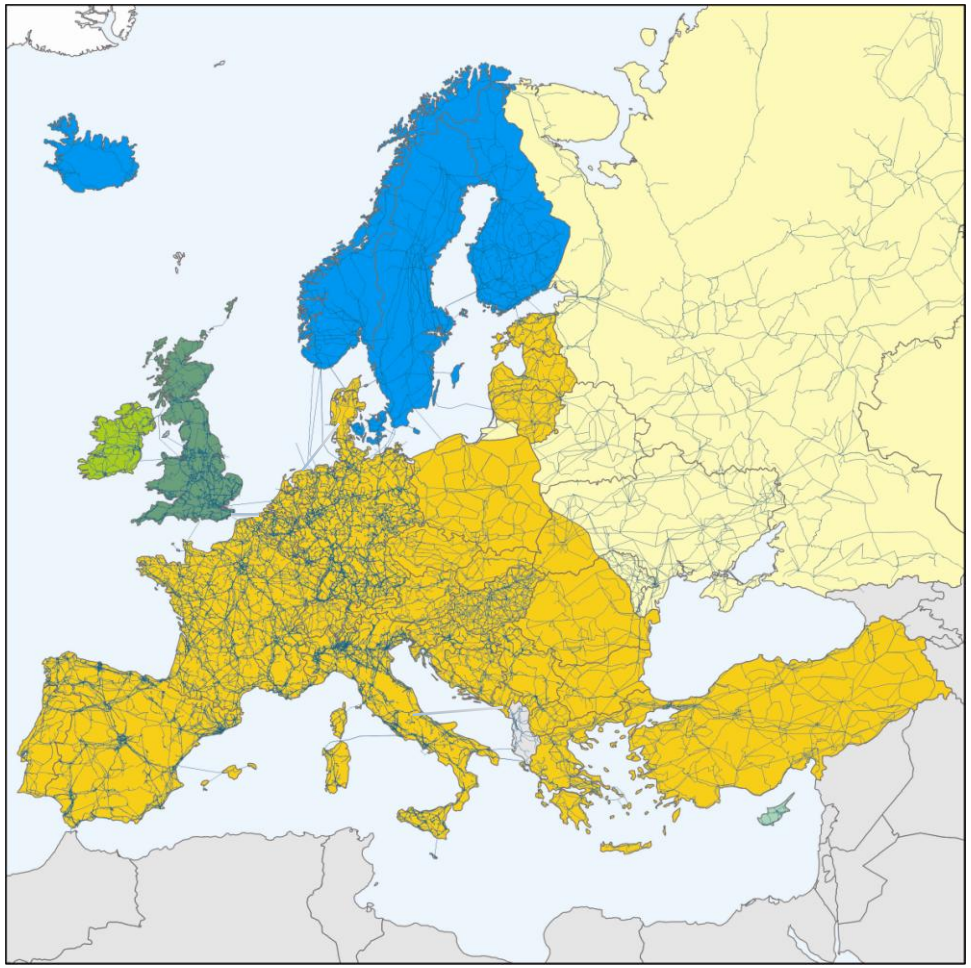
European transmission system (2020, planned)



Source: JRC

Pan-European study

European transmission system (2030, preliminary)



Source: JRC

Pan-European study

The Pan-European study, based on **EU30+ zonal model**, endogenously includes:

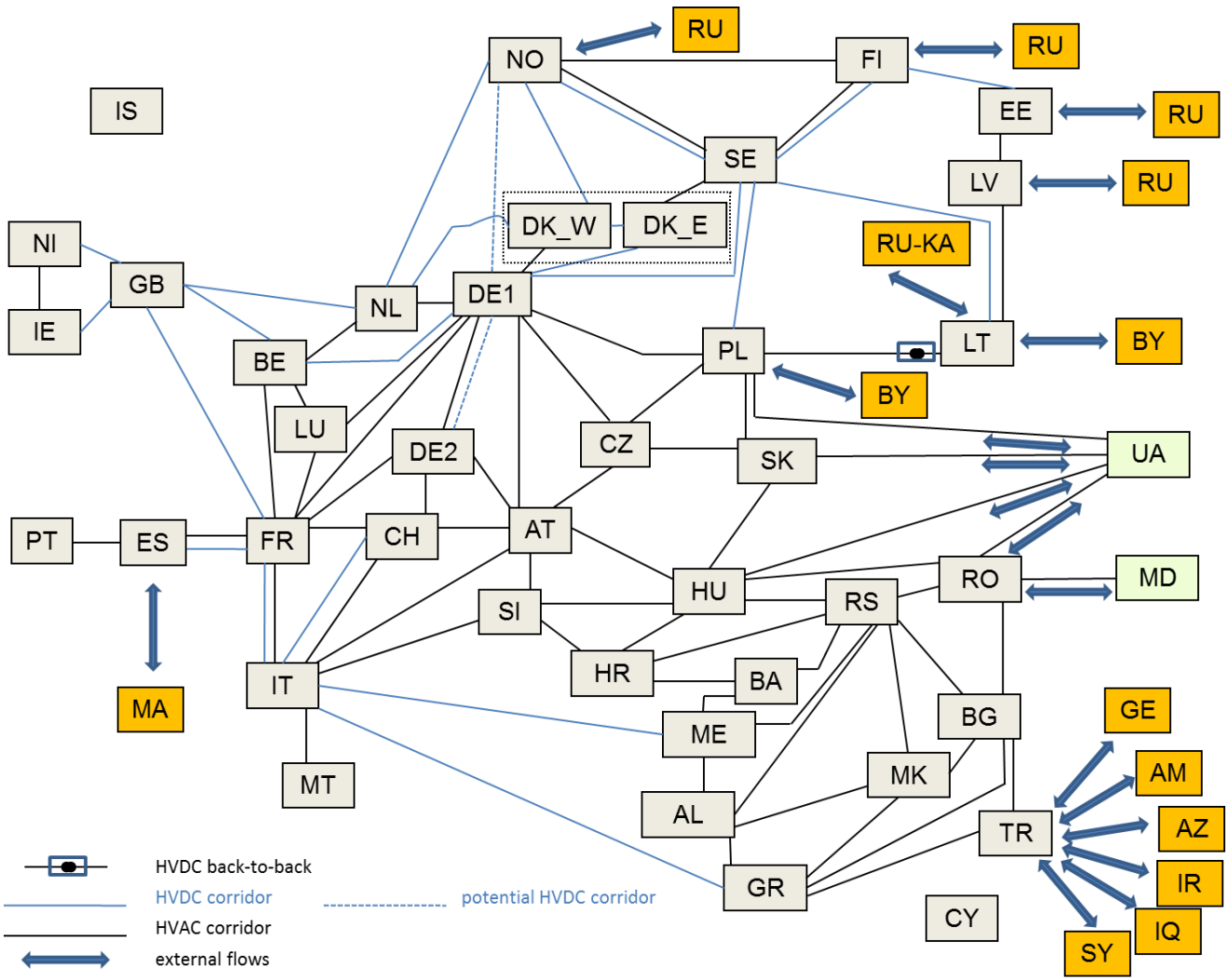
- EU28 countries -> 30 systems (including 2 German zones + Northern Ireland)
- EEA countries -> 3 systems
- Western Balkans -> 5 systems
- Turkey
- additional 5-7 offshore islands (only after 2030)

Pan-European study exogenously includes:

- Bordering systems of North Africa
- Bordering systems of Middle East
- Bordering systems of north-eastern and south-eastern edges (Russia, Belarus, Ukraine, Moldova)

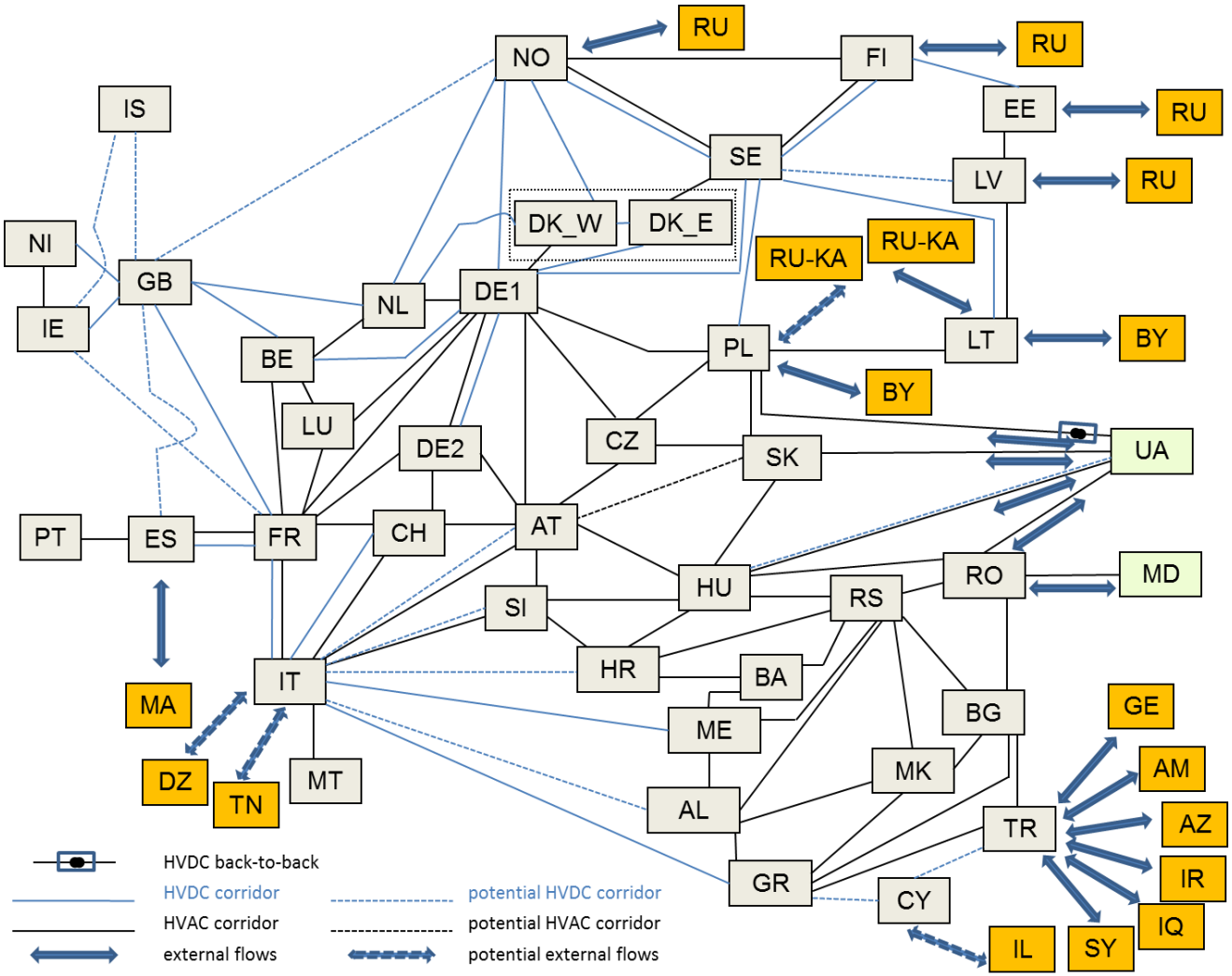
Pan-European study

Pan-European zonal model (2020, planned)

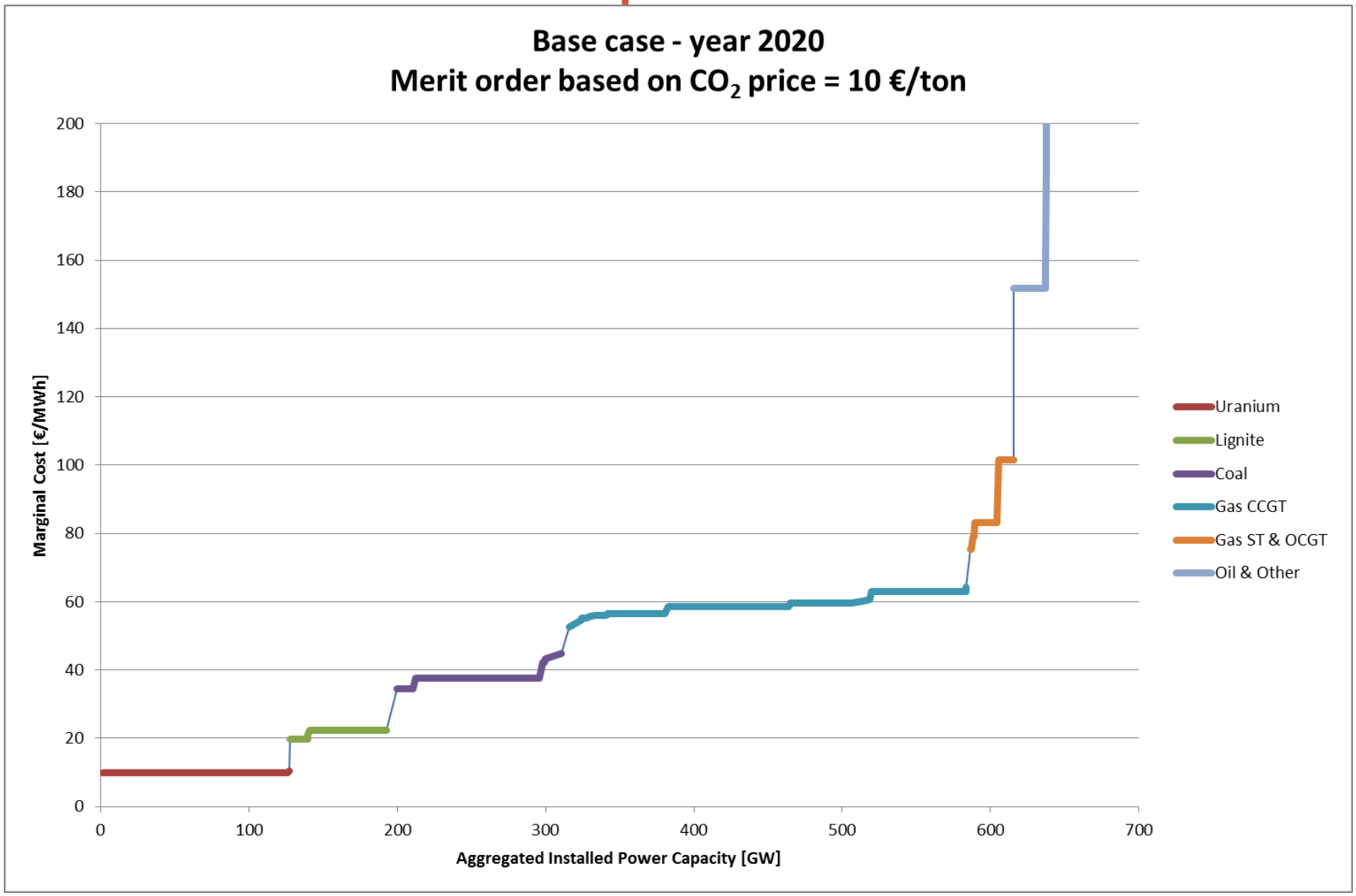


Pan-European study

Pan-European zonal model (2030, potential/updated)



2020 base case inputs: merit order

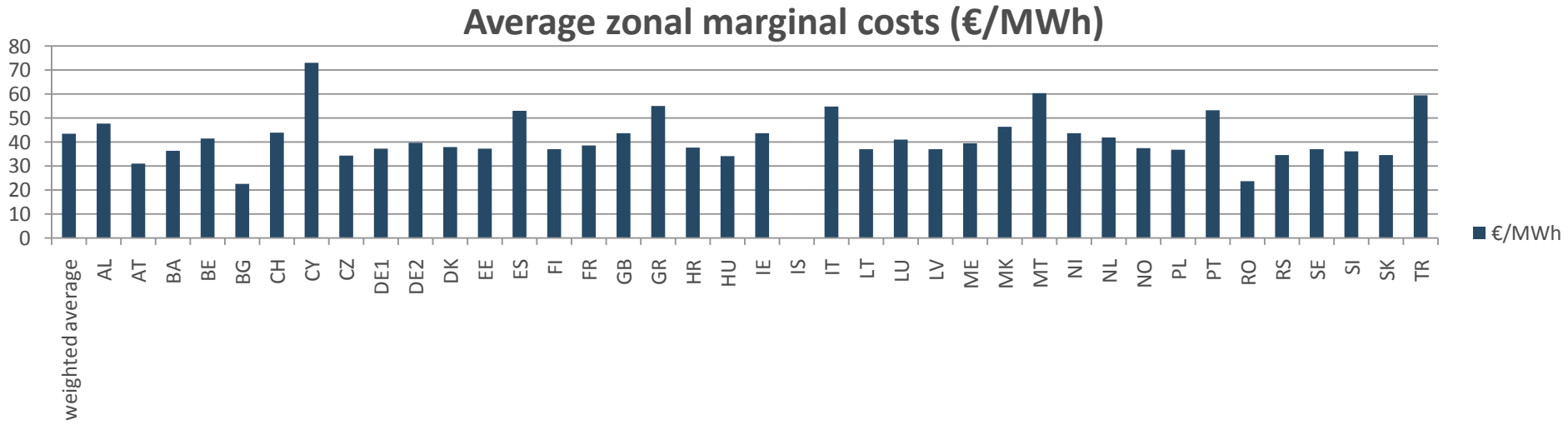


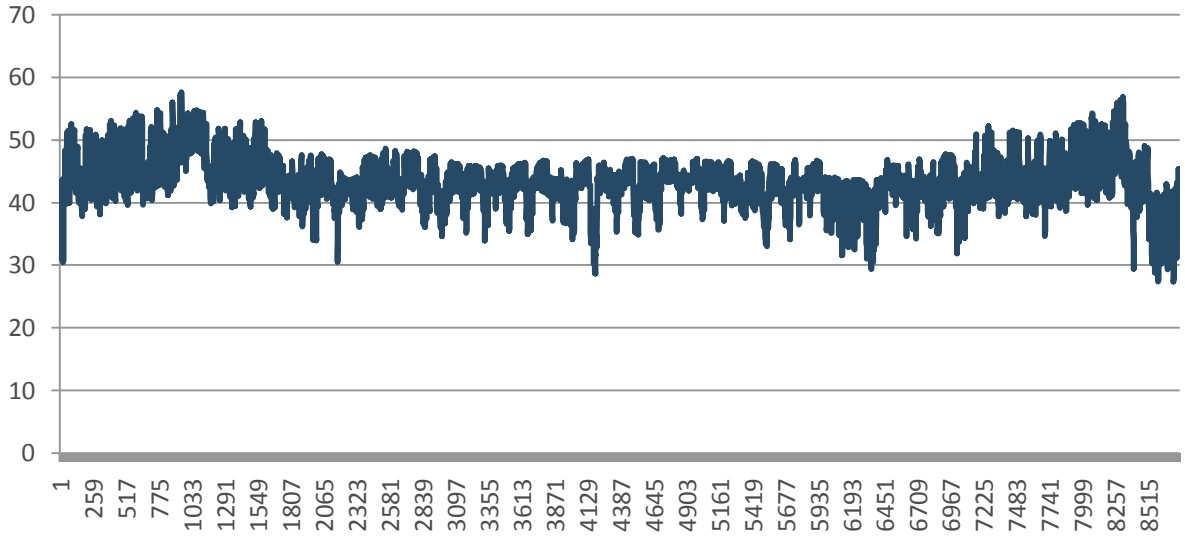
Pan-European study results (base 2020)

Main outcomes:

- Load shedding is null
- RES curtailment (2.67 TWh) is mostly concentrated in IE, IS and is very limited in DE1, ES, NI, PT
- Zonal costs are changing depending on countries, RES penetration, energy mix
- HVDC corridors are rather fully utilised

2020 base case results: zonal costs



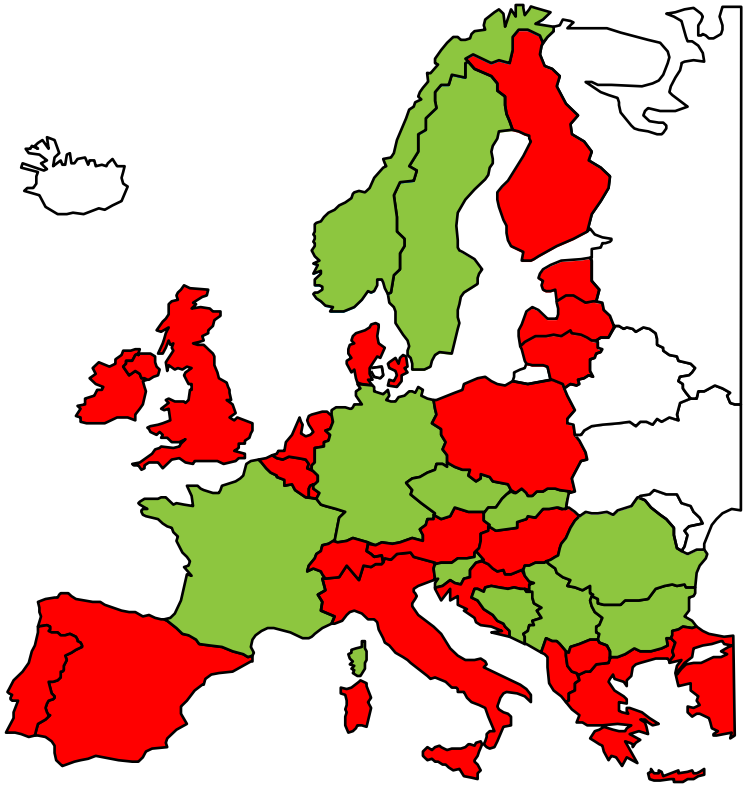


Average hourly zonal marginal cost (weighted over zonal load) in Europe (2020 base case) (in €/MWh)

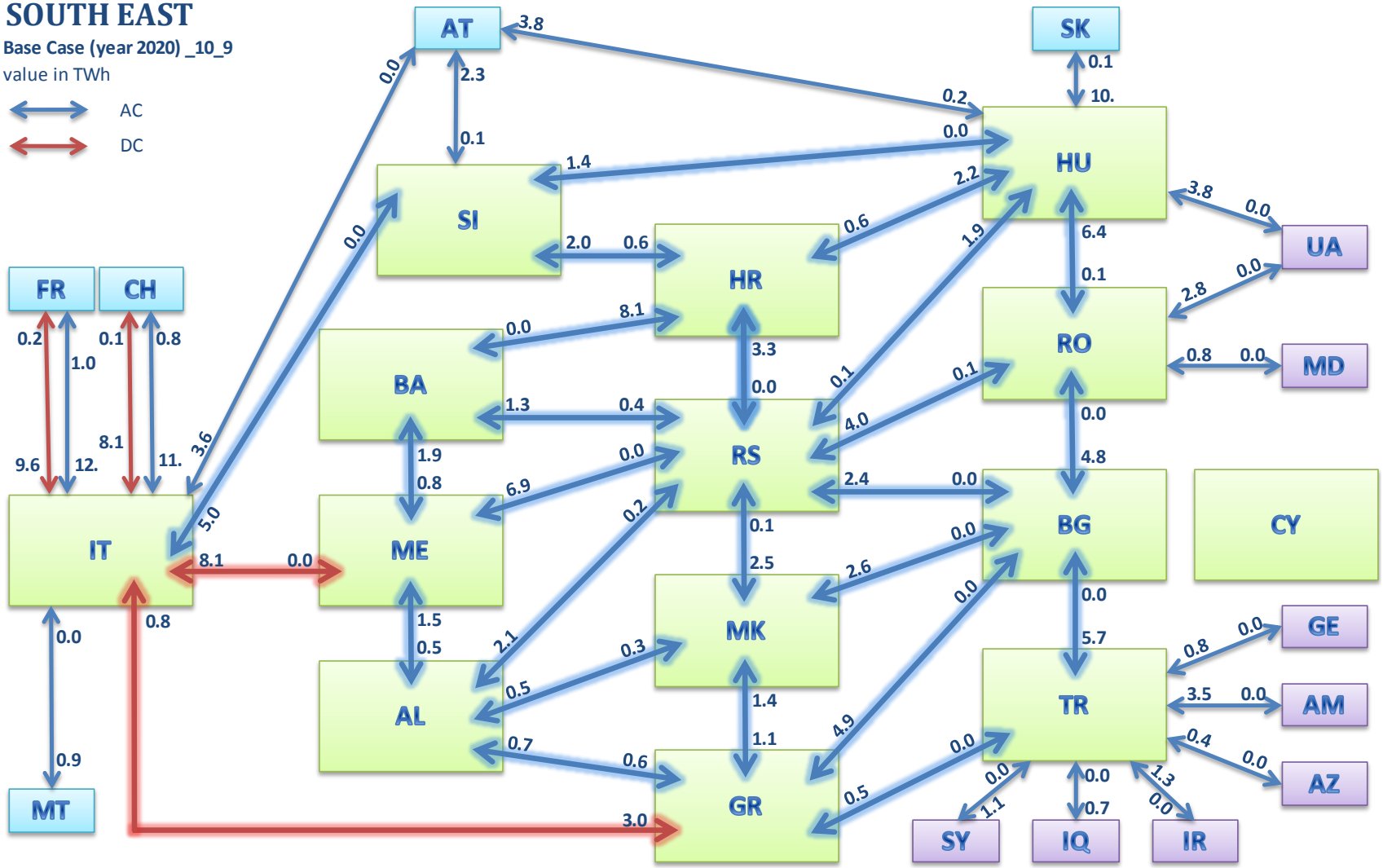
2020 base case results: inter-zonal flows

- The following countries/zones result to be net exporter at 2020:
BA, BG, CZ, DE1, FR, ME, NO, RO, RS, SE, SI, SK

- The following countries/zones result to be net importer at 2020:
AL, AT, BE, CH, DK, DE2, EE, ES, FI, GB, GR, HR, HU, IE, IT, LT, LU, LV, MK, MT, NI, NL, PL, PT, TR



2020 base case results: inter-zonal flows



Pan-European study results (base 2030)

Main (updated) outcomes:

- Load shedding is null
- RES curtailment (9.4 TWh) is rather higher than in 2020: it mostly concerns CY, DE1, DK, ES, GB, IE, IS (while it is very limited in MT, NI, NL, PT)
- Zonal marginal costs are higher than in 2020
- HVDC corridors are rather fully utilised
- The system needs first reinforcements across British islands, in Balkan, Iberian and Baltic regions, on north-south Central Europe axis and around isolated zones

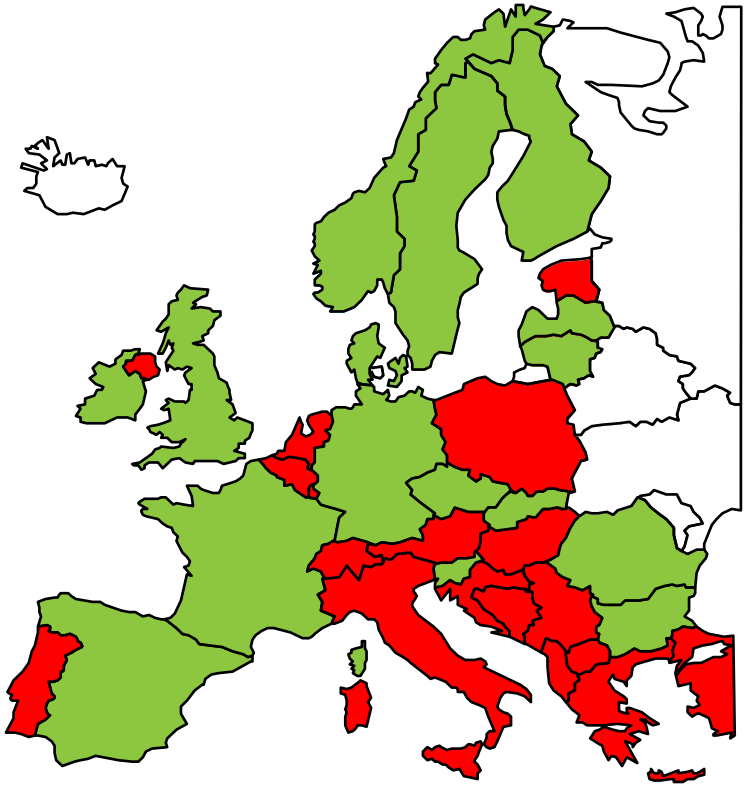
2030 base case results: inter-zonal flows

- The following countries/zones result to be net exporter at 2030:

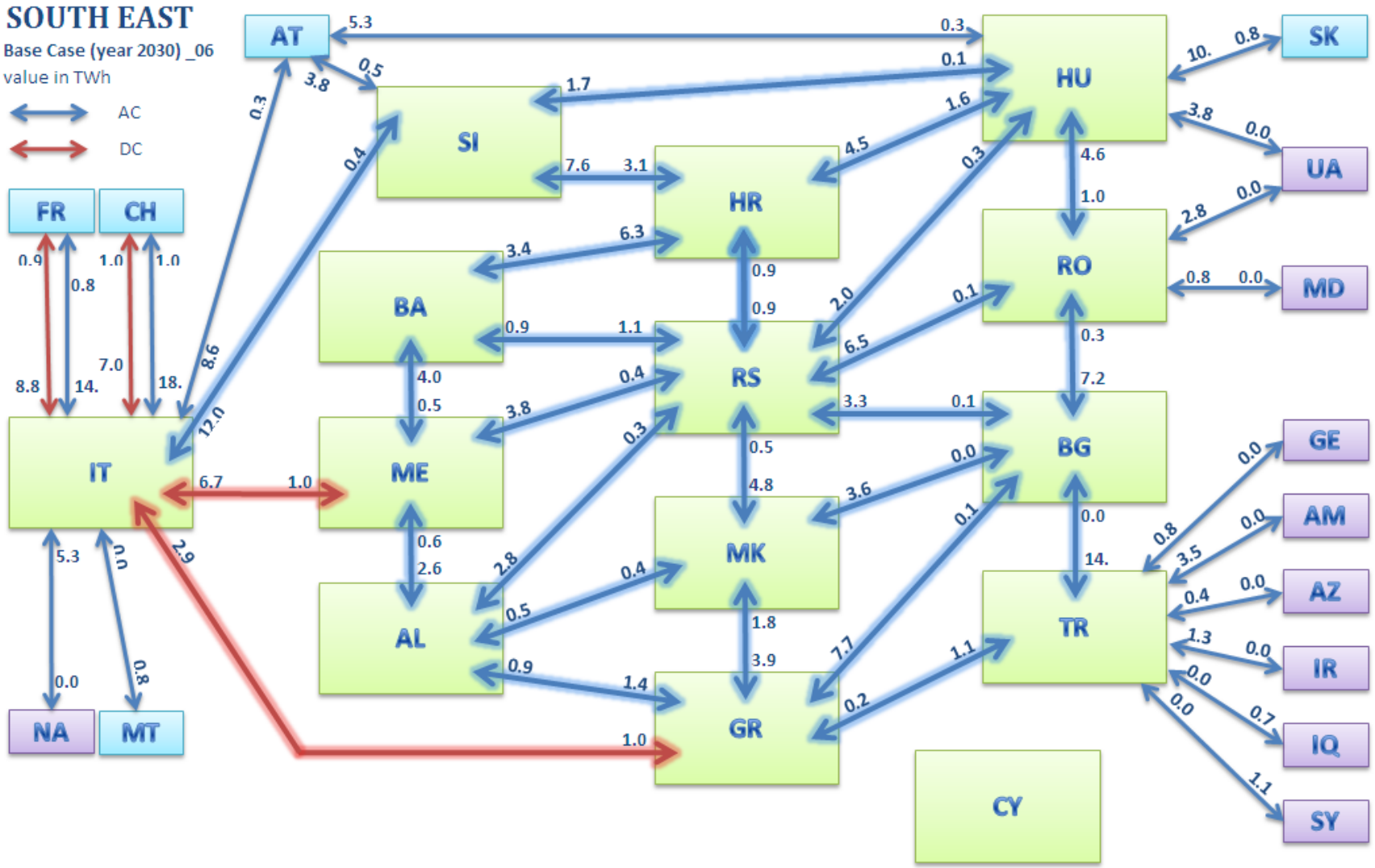
BG, CZ, DE1, DK, ES, FI, FR, GB, IE, LT, LV, ME, NO, RO, SE, SI, SK

- The following countries/zones result to be net importer at 2030:

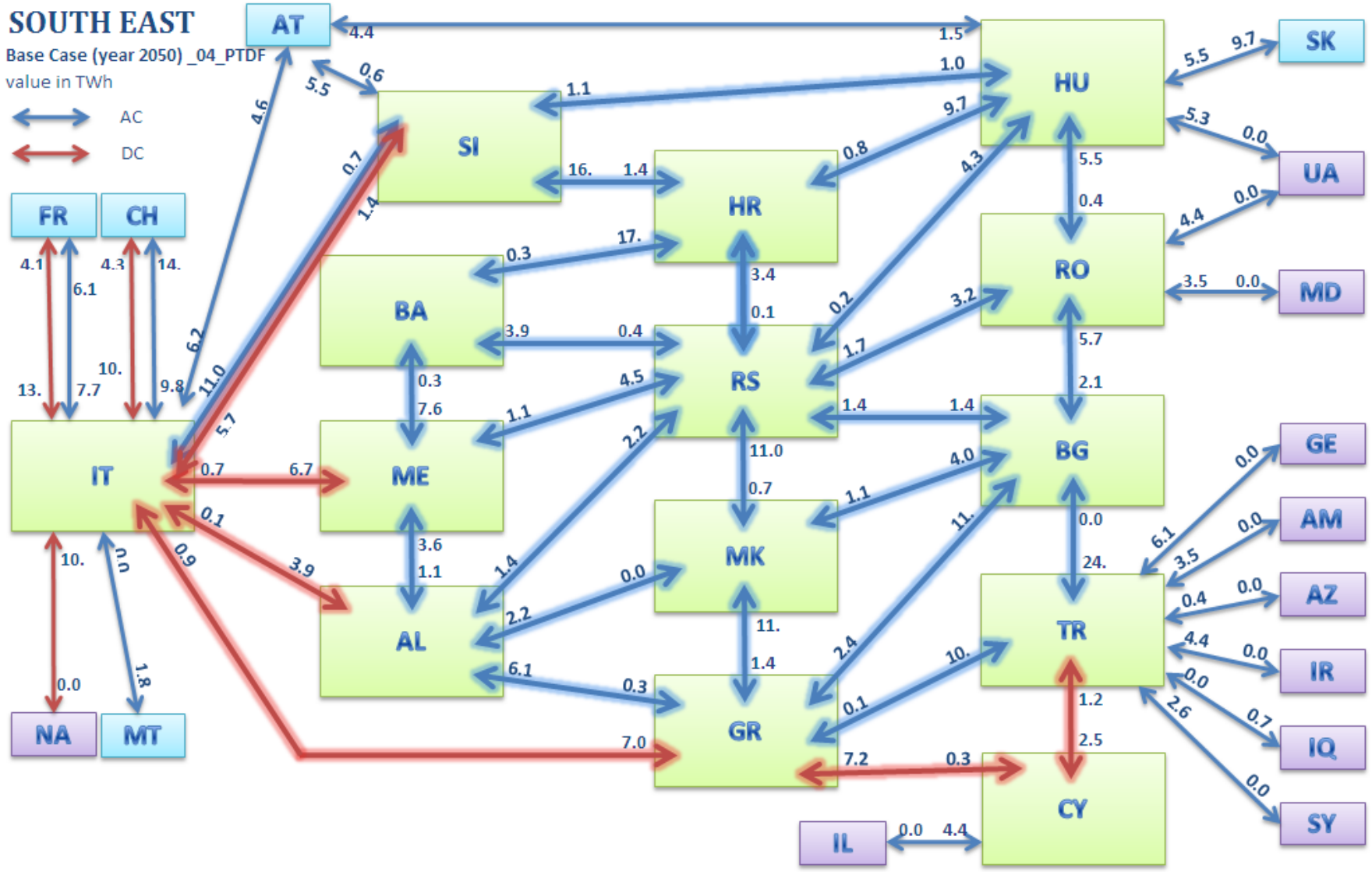
AL, AT, BA, BE, CH, DE2, EE, GR, HR, HU, IT, LU, MK, MT, NI, NL, PL, PT, RS, TR



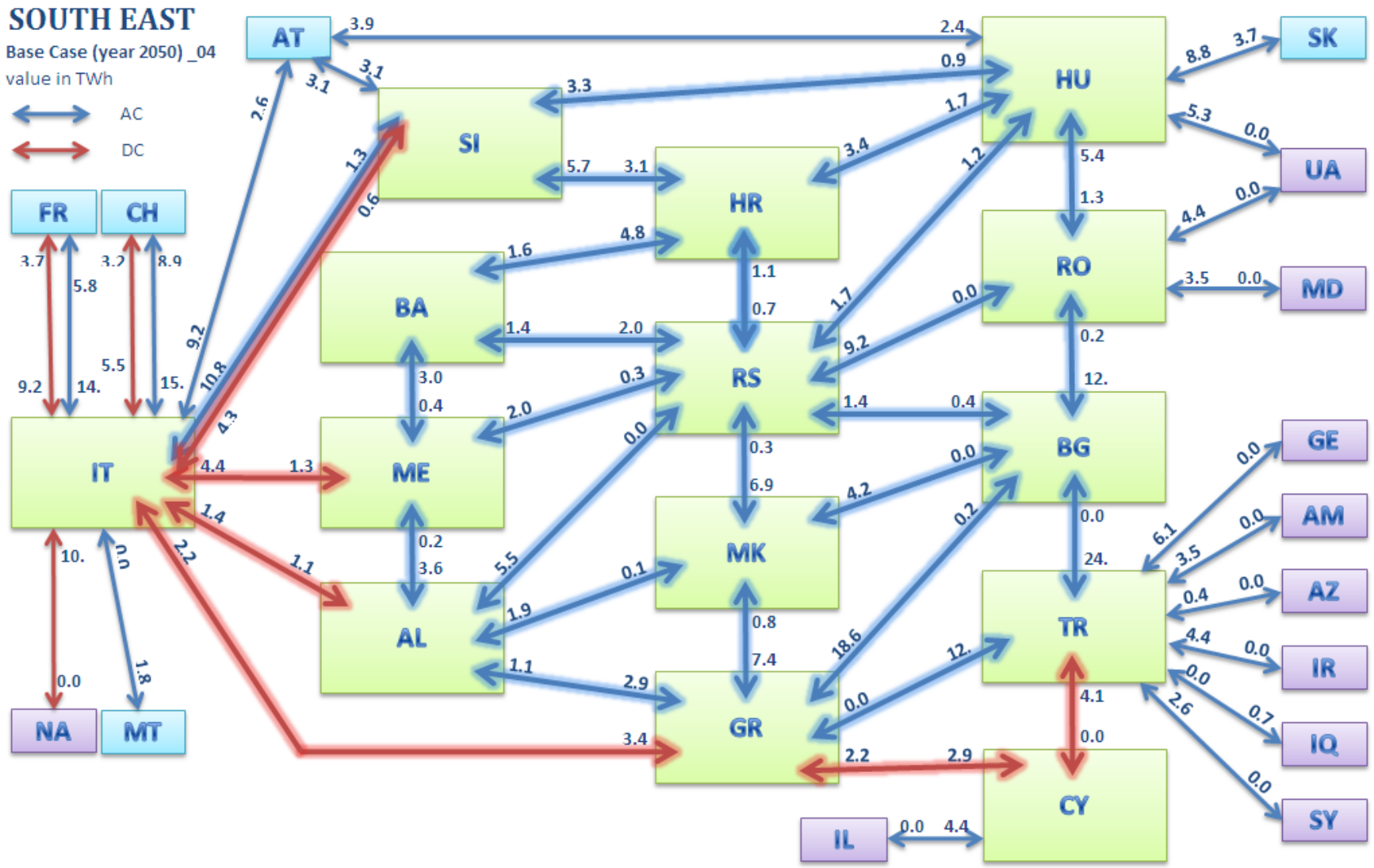
2030 base case results: inter-zonal flows



2050 case (with PTDF): inter-zonal flows



2050 variant (no PTDF): inter-zonal flows



Elements for techno-economic assessments

- Costs
- Social Welfare
- CO2 emission
- RES spillage
- Losses
- Reliability
- Resilience
- Flexibility
- Controllability
- Observability
- Socio-environmental impact

Elements for the discussion

- Long-term developments (beyond 2030)
- RES and demand growth in SEE region
- HVDC and other grid developments in SEE region
- PHES and other storage developments in SEE region
- EVs and DSM/DR developments in SEE region

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For more information about the project, please visit:

http://www.gridtech.eu

or contact:

Dr. Hans Auer (EEG TU Wien)
Project coordinator
auer@eeg.tuwien.ac.at

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Dr. A. L'Abbate, RSE SpA

angelo.labbate@rse-web.it

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Merci!