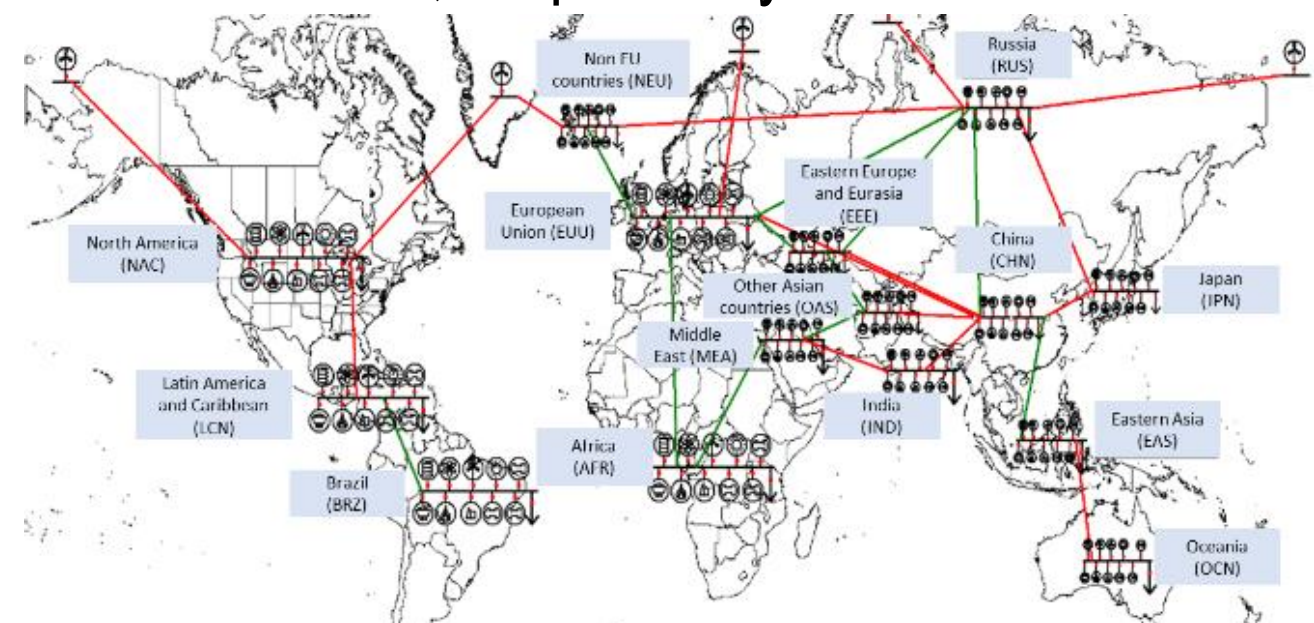


Research context and motivation

- Power system needs a strong transformation, to accommodate increasing variable generation from renewables. Global Energy Interconnection (GEI) aims at promoting higher final use electrification and renewables penetration, by the construction of a super grid connecting the main renewable production areas to the major consumption zones.
- Our earlier research showed that, by forming the power transmission corridors between Europe and its neighboring areas, GEI would bring down not only the European cost by 63.5% and 65% but also the European GHG emission by 92 % and 69% for the years 2030 and 2050, respectively.

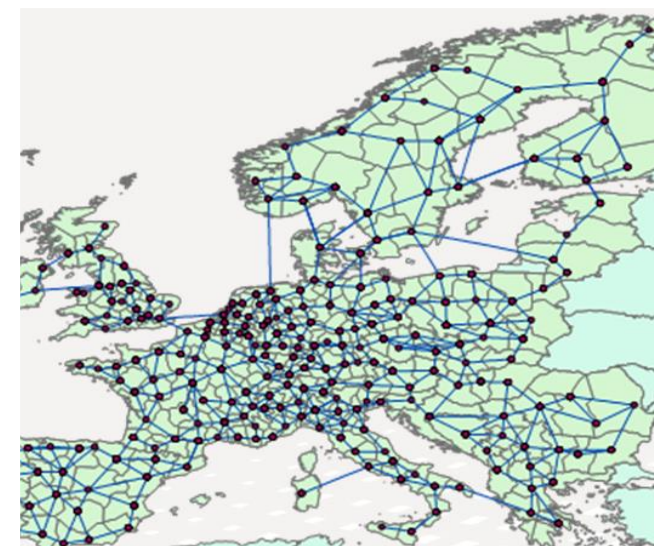
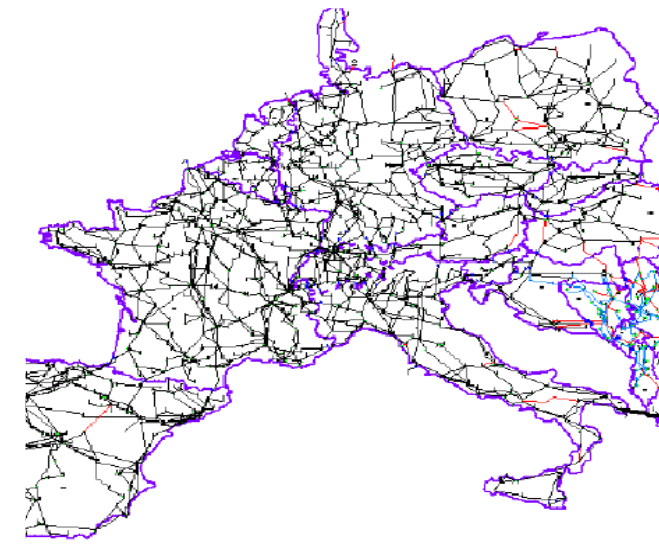
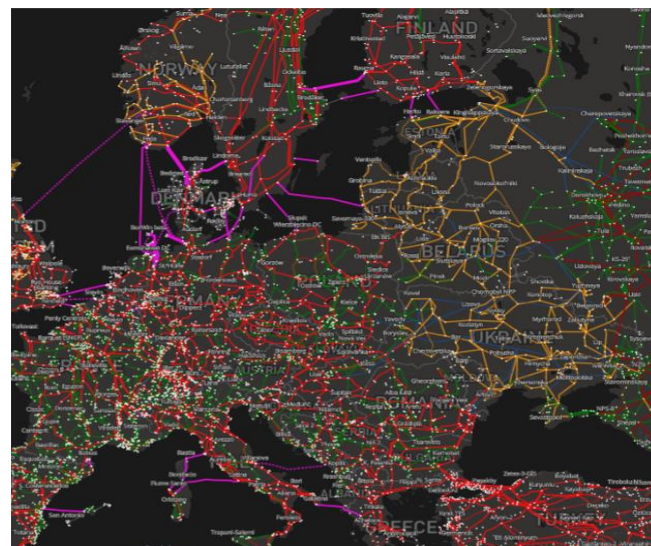


Corridors	2030		2050	
	Cap [GW]	Lines	Cap [GW]	Lines
Africa	300	25	900	75
Arctic region	100	9	1000	84
China	200	17	500	42
Eurasia	100	9	300	25
Russia	100	9	200	17

- From the EU point of view, this research is to assess the compatibility of its current planning with GEI scenario with massive power flows injected into EU power grid.

Addressed research questions/problems

- EU Grid Modelling. Different network models were evaluated. Latest information from TYNDP-2018 is used to update the 257 buses model (Hösch et al.) and eventually the updated model contains the geographic information essential to consider the interconnections from different directions.



- Optimizing the Locations of the Interconnectors. 1) allocate the interconnectors to different countries by A'WOT method according to the information of geography, economies, the potentials of power grid, etc.; 2) optimizing the locations of buses in the assigned country, with multiple objectives and constraints.

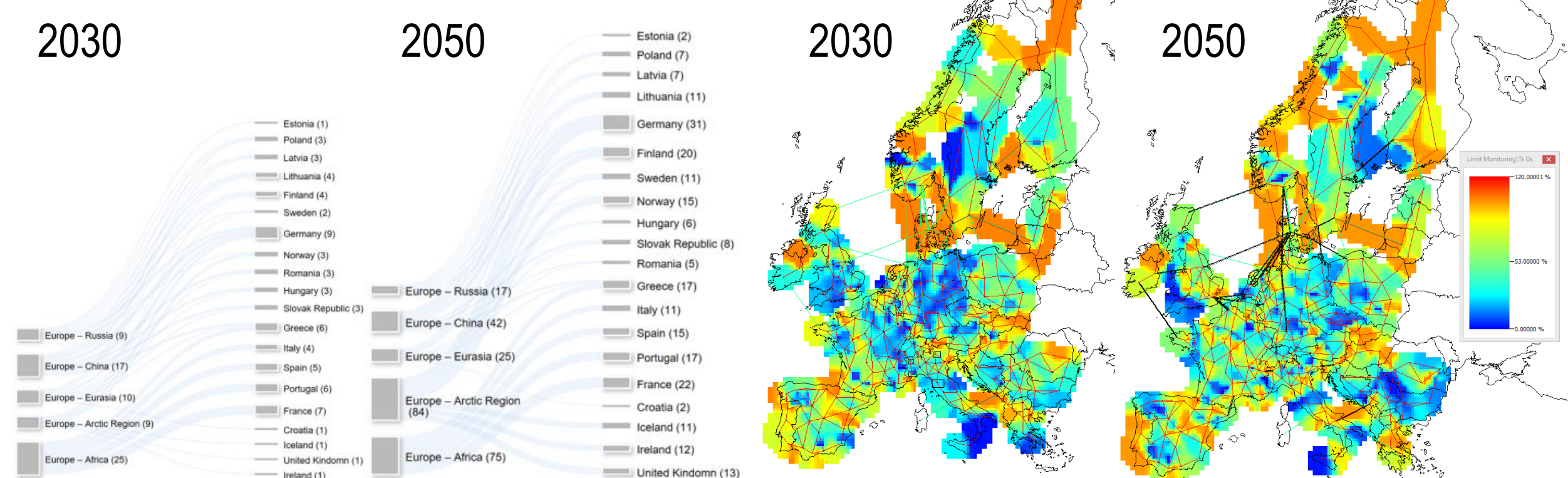
Novel contributions

- This study develops a framework of assessing the impact of other scenarios on the official ENTSO-E development plans for the EU network.
- Optimization models were developed to consider the external constraints imposed on the already planned network for accommodating further/other development originally not introduced.
- Depicts a picture of the future European power grid in the context of GEI scenario as an application.
- The results show that the proposed method can optimally arrange the interconnectors with minimal impact on the EU network.
- The ex-post analysis can also identify the frequent congestion bottle-necks of the EU network, such as between the Scandinavia area and the European continent.

Submitted and published works

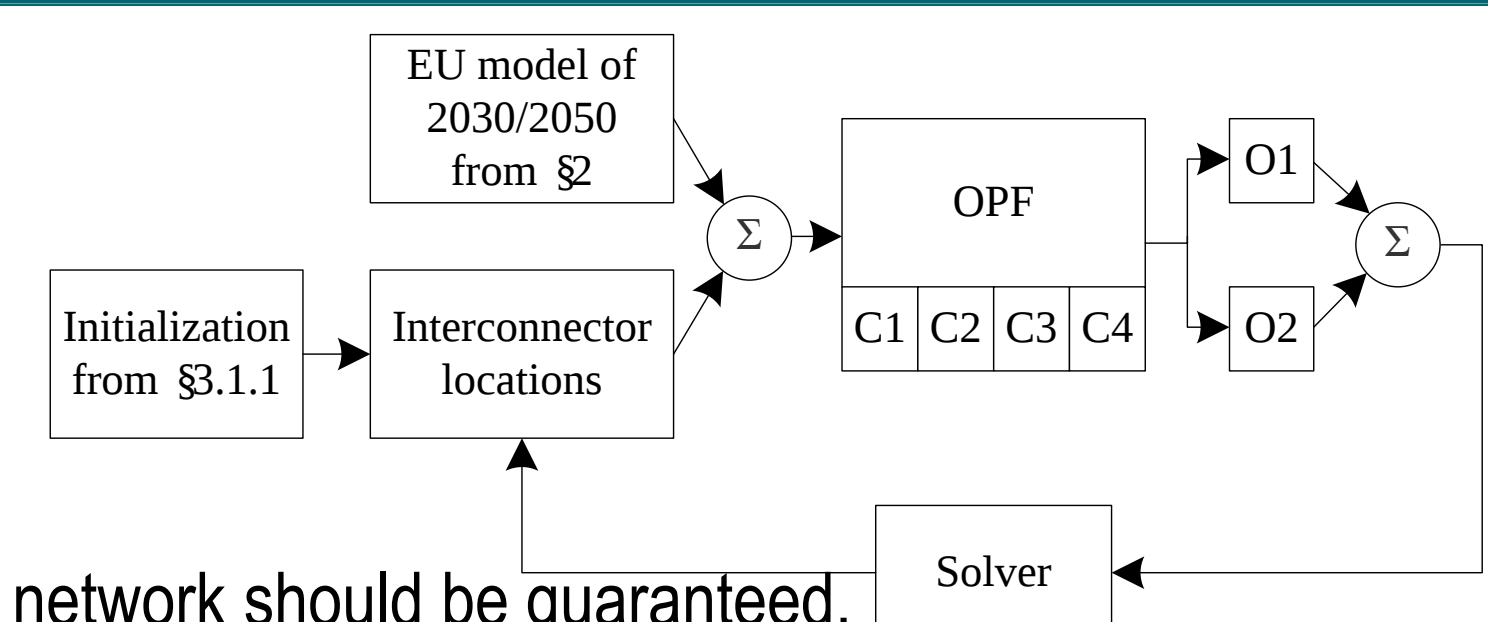
- Z. Han, G. Crespi, T. Huang, E. Bompard, and S. CORGNATI, "European Power Grid Development and Its Compatibility with Global Energy Interconnection," in The 35th Annual Academic Conference of Power Systems and Automation in China's Colleges and Universities, 2019, pp. 1–6.
- G. Crespi, Z. Han, T. Huang, E. Bompard, and S. P. Corgnati, "A SIMPLIFIED ELECTRICAL NETWORK MODEL FOR TECHNO- ECONOMIC ANALYSIS OF GLOBALLY INTEGRATED," in 4th Energy for Sustainability International Conference - Designing a Sustainable Future, 2019, pp. 24–26.
- R. Xu et al., "Development of Cable Accessories with SIR Insulation for 320kV HVDC Cables," in E3S Web of Conferences, 2019, vol. 115, p. 01004.
- Y. Luo, Z. Han, X. Lei, M. Zhou, H. Ye, and H. Wang, "Techniques for Designing Prefabricated Cable Accessories Based on Hyperelastic Material Model," in 12th IEEE International Conference on the Properties and Applications of Dielectric Materials, 2018, pp. 1020–1024.
- H. Ye et al., "Design Aspects on HVDC Cable Joints," in 12th IEEE International Conference on the Properties and Applications of Dielectric Materials, 2018, pp. 304–308.
- H. Ye et al., "Review on HVDC cable terminations," High Volt., vol. 3, no. 2, pp. 79–89, Mar. 2018.
- G. C. Montanari et al., "Criteria influencing the selection and design of HV and UHV DC cables in new network applications," High Volt., vol. 3, no. 2, pp. 90–95, Nov. 2017.

- GEI has proposed a possible solution for the global decarbonization process, but also set new challenges to regional power grids, further work should be done to study the compatibility of regional power grids with GEI solution.



Adopted methodologies

- O1: minimization of the congestion in the EU network, and
- O2: minimization of the electricity costs from the EU generators under the unified EU electricity market assumption,
- C1: the power balance of the entire network should be guaranteed,
- C2: the power flows should avoid exceeding the maximum current rating of transmission lines (if possible)
- C3: the needed interconnections should be distributed as evenly as possible, and
- C4: the set of interconnector-connected buses in 2030 should be included in the set of 2050.

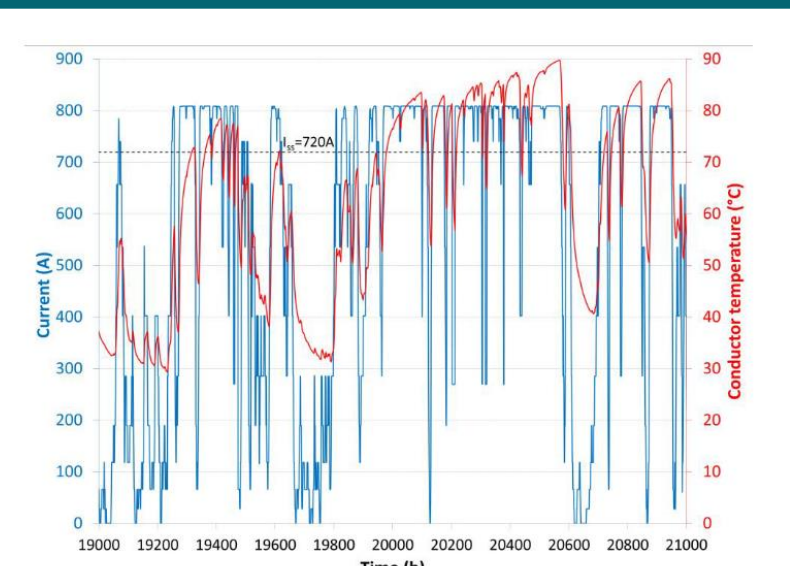
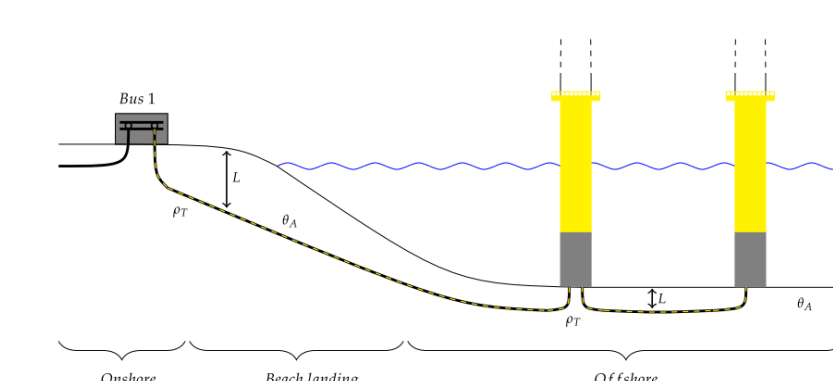


Future work

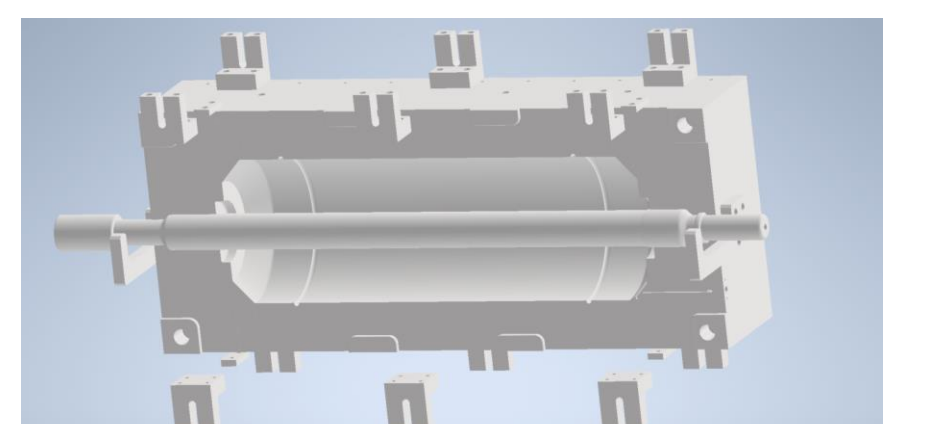
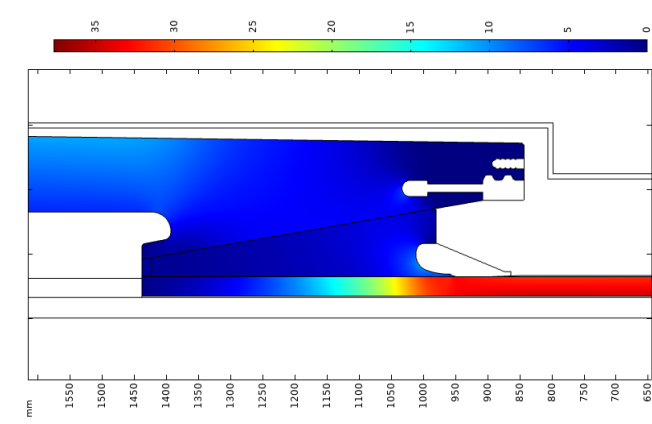
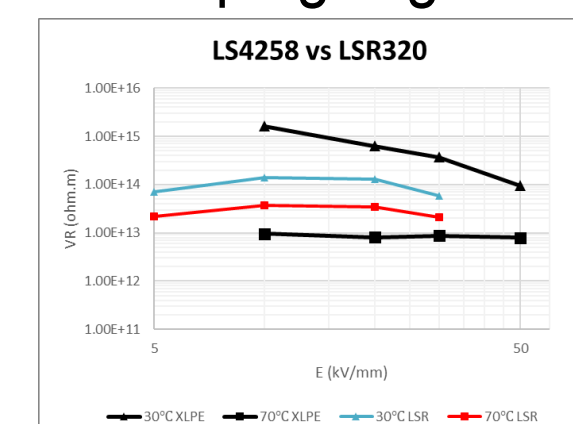
- Based on the static computation results in this study, the next step is to design a method to choose the HVDC technologies that support the implementation of such network.
- Dynamics of the scenarios with selected HVDC technologies will be examined based on a set of indices.

External Research

- Dynamic Dimensioning of Power Cables for Wind Farms



- Developing High-voltage Direct Current Cable Accessories



List of attended classes

- 02LWHRV – Communication (16/05/2019, 6.67)
- 08IXTRV – Project management (14/02/2019, 6.67)
- 01RISRV – Public speaking (19/02/2019, 6.67)
- 01SYBRV – Research integrity (05/07/2019, 6.67)
- 01SWPRV – Time management (08/02/2019, 2.67)
- External – Academic writing essentials (17/02/2019, 4)
- External – Punctuation Mastery (06/02/2019, 3)
- External – Modern communication technology and computer network (20/11/2018, 32)
- External – Dynamic power system theory and method (19/11/2018, 32)
- External – Modern control theory (06/11/2018, 32)
- External – Electromagnetic basis of modern electrical engineering (09/10/2018, 32)
- External – Wind Power System Technology (09/10/2018, 32)
- External – Advanced functional analysis (08/10/2018, 48)