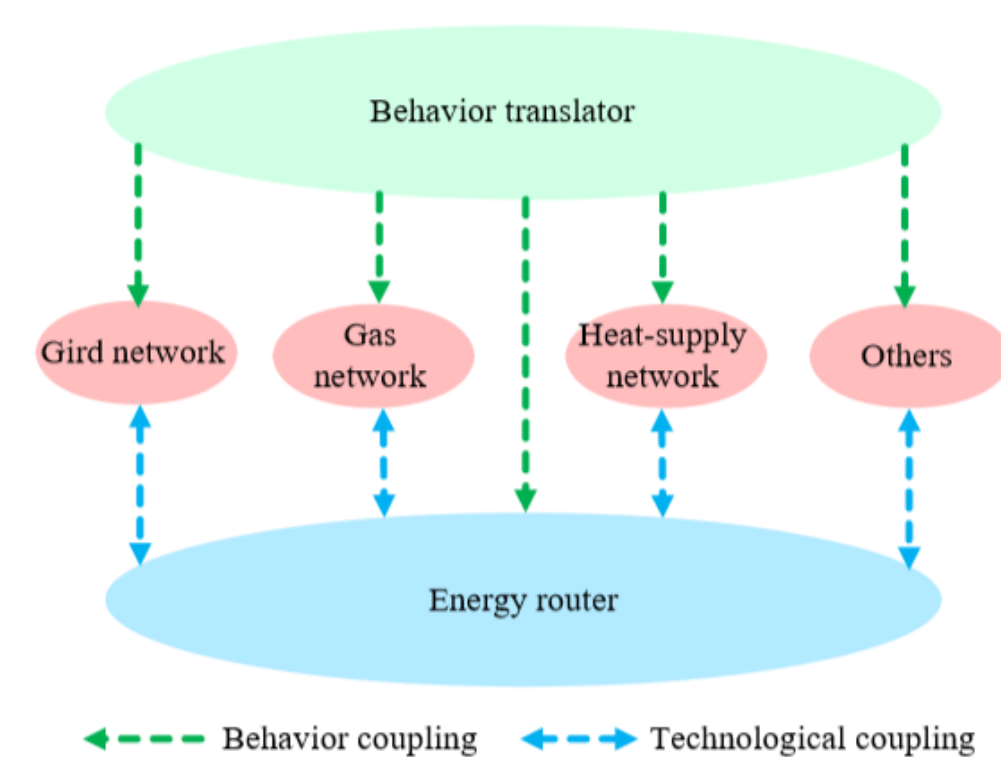


## Research context and motivation

- Electrification based on Global Energy Interconnection (GEI) is one of the possible pathways towards decarbonization in energy systems. In accordance to this scenario, the electricity from renewables produced in large world areas, like the North Pole and the African deserts, should be delivered to large consumption areas through the adoption of ultra-high voltage energy system, and could have several challenging implications from the technological, environmental, political, economic, and regulatory point of view.
- The integration of the global energy interconnection is a challenge while opportunity for the European Union, as well as for any other part of the world. Starting from the study from the previous project conducted under the umbrella of the global energy interconnections with the perspective of the flows around the world, we put our focus on further develop the strategies of adopting the global energy interconnectors in the EU, especially from the surrounding areas.

## Addressed research questions/problems

- **Q1: Indicator system for the benefits.** The wider geographic spans of both the physical equipment location and energy flow dispatch of the intercontinental power corridors in the GEI context has raised the complexity to a higher level. Therefore, the indicator system for both economic and non-economic benefits should be re-established.
- **Q2: Quantification of policy impacts.** The often case is that the effects of energy policies on economic or non-economic indicators are indirect. In order of an impact assessment of the policy, it is necessary to establish the systematic corresponding between the policy and the related quantitative indicators.
- **Q3: The coupling of human and the coordinated operation mode.** The human behavior and interaction among persons have the great impacts on operation, planning, supervision and market of the systems. There are two coupling ways among different types of energies: technological coupling (energy router) and behavior coupling (behavior translator).

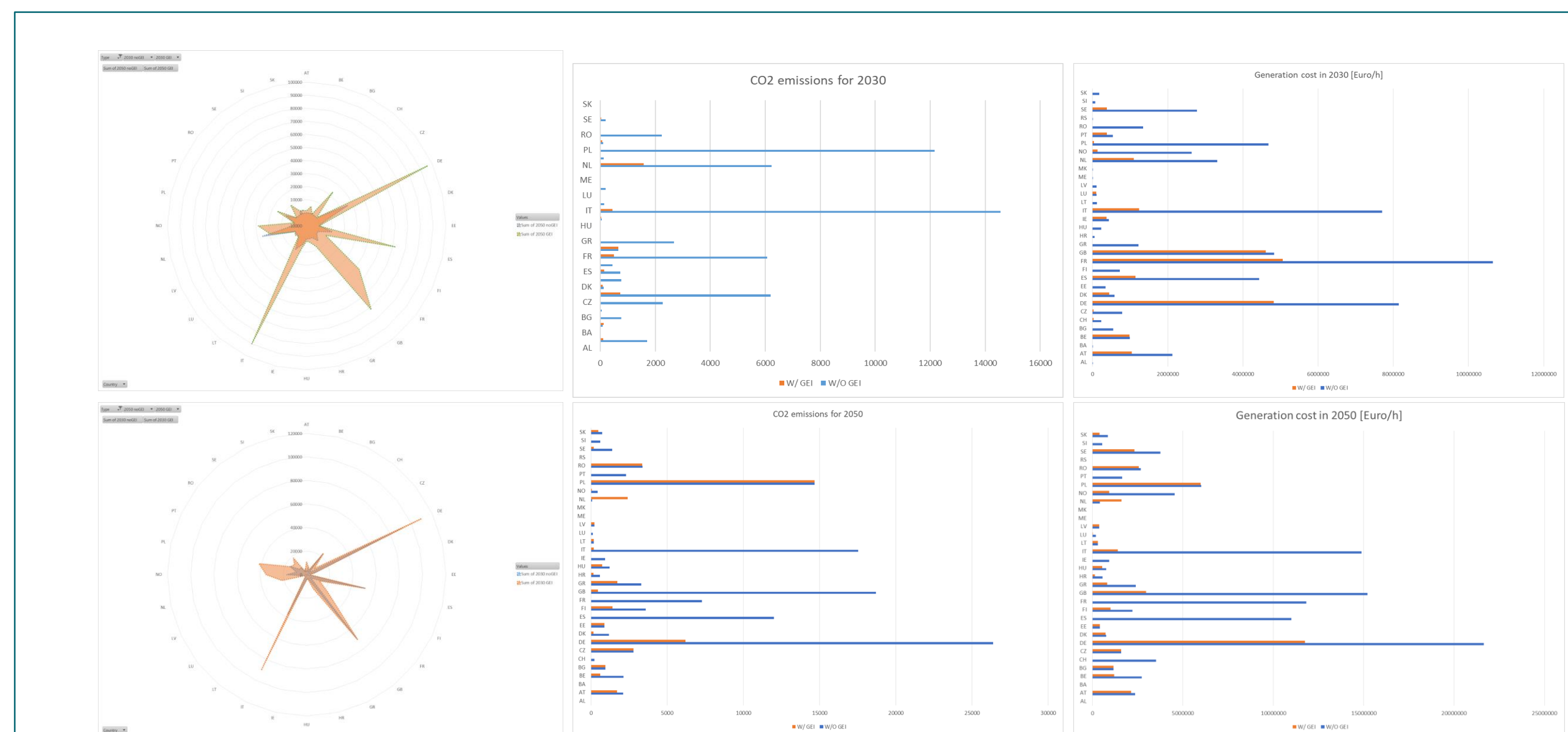


## Novel contributions

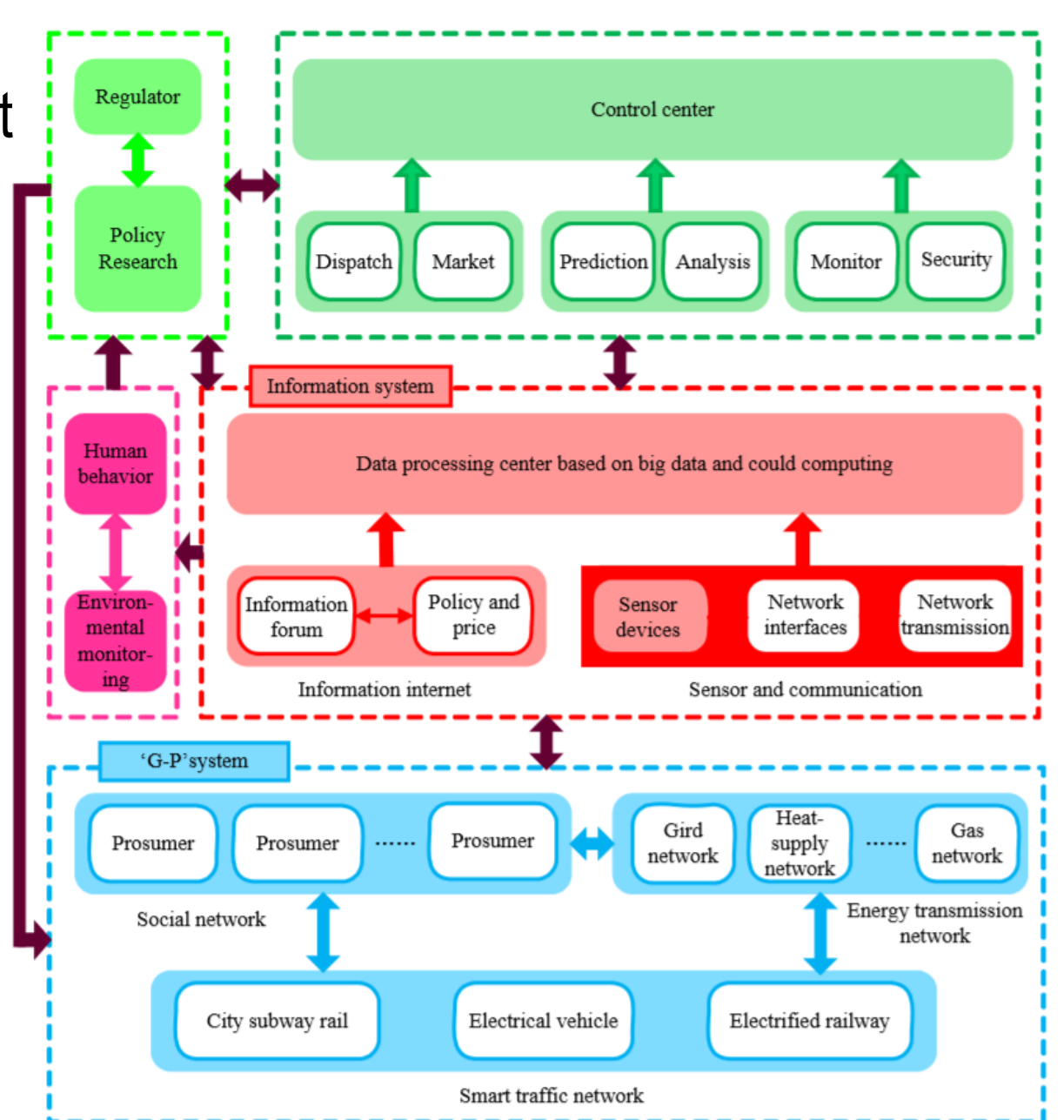
- This study established an indicator system from the perspectives of security, environment, and economy, which can be used to assess energy scenarios.
- This study also introduced a methodology for assessing policies. It is capable to quantify the impacts of either a single policy or a combination of policies on the indicator system, in spite of their indirect interacting mechanism.
- In the light of the aforementioned indicator system and methodology, this study conducted an analysis on the GEI scenario and its impacts on the current official planned EU power grid of 2030 and 2050 proposed by ENTSO-E. The result shows that the massive power corridors from GEI can create both economic and environmental benefits for EU users by offering cheaper electricity generated outside EU, and also improves the grid security for having more installed capacities as reserve.
- The GEI scenario is necessarily characterized by a significant set of policy implications. In particular, a relevant change of regulations and policies for supporting a strong electrification of the final uses are requested. With respect to the measures requested for the more traditional scenarios, those needed by the GEI ones strongly impacts on the entire structure of the energy chain and on the several dimensions.

## Submitted and published works

- Montanari G.C., Morshuis P., Zhou M., "Criteria influencing the selection and design of HV and UHV DC cables in new network applications", High Voltage, vol. 2, no. 2, 2016, pp. 90-95
- Ye H., Fechner T., Lei X., "Review on HVDC cable terminations", High Voltage, vol. 3, no. 2, 2018, pp. 79-89
- Bompard, E.; Grosso, D.; Huang, T.; Profumo, F.; Lei, X.; Li, D. "World Decarbonization through Global Electricity Interconnections", Energies 2018, 11, 1746.
- WEI X., GAO S., LI D. "Cascading Fault Graph for the Analysis of Transmission Network Vulnerability under Different Attack", Proceedings of the Chinese Society of Electrical Engineering 38(2) 2018: 465-474.
- Wei X., Gao S., Zang T., "Social Energy Internet: Concept, Architecture and Outlook", Proceedings to the Chinese Society of Electrical Engineering 38(17) 2018: 4969-4986
- Gao S., Liu Y., Zang T., "Self-sensing Energy Internet Application Architecture Ubiquitous in the Power Internet of Things", Proceedings to the Chinese Society of Electrical Engineering, submitted



- To promote the development of GEI, an energy internet was proposed, taking account of the interactions between human and multi-energy system from the perspective of the social attributes of the energy internet. The information forum and real-time update platform for policy and price can be constructed to improve the users' participating enthusiasm. The users can attract comments for current policies in the information forum and require energy information from the real-time update platform. Meanwhile, the policy research can analyze the user behavior to adjust the current policies and guide the users' actions.



## Adopted methodologies

- According to the requirements of different evaluations, multi-dimensional evaluation indicators are proposed to comprehensively evaluate a specific project from different aspects such as economy, safety and environment.
- Scene-based sensitivity analysis methods are used to construct the impact of different policies on the benefits of planning solutions. In this method, several scenarios are modeled under different policies and then the indicators are computed in each scenario separately. By decoupling the corresponding between the indicator changes and scenarios, the impact factors of individual policy or portfolio policies can be obtained.

## Future work

- Europe presents some areas with considerable storage and RES potentials, which still need to be exploited. In this regard, the future work is about policies needed in order to foster the development of these clean technologies at national level, as well as fees or taxation for fossil-fuel plants, for reducing their use and to phase out the more emitting ones.

## 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)