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Scenarios for a Future EU Energy System Until and Beyond 2050 - Charting Energy Visions towards 2060

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Motivation and central research question

The global energy transition requires a massive re-thinking of the ways we generate, consume, and transform energy. To achieve the set climate targets of the European Union of 100% emission reductions in 2045-2050 [1], heavy electrification, combined with a significant expansion of variable renewable energy sources (vRES) is required. However, the current unstable geopolitical landscape, both globally, but also with nationalistic trends emerging within Europe itself, poses several additional challenges to the already gargantuan task of the needed rapid decarbonization.

Methodology

To chart these uncertainties towards 2050 and beyond, the “European Energy Vision 2060” or EU-EnVis-2060 scenarios have been created. The scenario generation process included several workshops between experts from academia, industry and policy stakeholders, as well as need-owners from the CETP project “Man0EUvRE”. The result of this process were four distinct qualitative storylines, mapping the major driving forces and key uncertainties facing the European energy transition (see Figure 1).

These qualitative storylines were then parametrized and translated into usable information for the use in energy system models. For this analysis, the Global Energy System Model (GENeSYS-MOD) [1] will be used to quantify the Pan-European pathways that result from the four developed scenarios. GENeSYS-MOD is a sector-coupled, open-source energy system model that includes the sectors electricity, buildings, industry, and transport, and performs a linear cost optimization of the energy system towards the future –in this case 2060 [3]. Main model results include investment trajectories, capacity expansion plans, the energy dispatches of the different energy carriers, as well as the flexibility and transmission requirements (see Figure 2).

Results and Conclusions

The expected results will show possible developments of the European energy system towards 2060 and possible solutions to achieve set climate targets while navigating the societal, geopolitical, and technological challenges that we face, including the uncertainty that exists around them. The GENeSYS-MOD outputs will display the necessary deployment and ramp-up of renewable energy sources and showcase no-regret options across the different storylines. Within the Man0EUvRE project, the Pan-European energy system results will then be passed on to regional and sectoral models in an iterative fashion –incorporating the findings from these models into the broader energy system model. The main goal of the project is to give detailed feedback to the National Energy and Climate Plans (NECPs) of the European member states to improve the planning for a sustainable, secure and robust energy system of the future.

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