Challenges for the European Low-Carbon Transition

A Quantitative Assessment of the Stranded Asset Problem

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Overview

Increasing concerns about the adverse effects of global warming lead to an intensifying debate in both science and policy about future realizations of the global energy system, especially concerning the role of fossil fuels. Burning fossil fuels is the biggest driver for global greenhouse gas (GHG) emissions and therefore implies a fossil phase-out (IPCC 2014). This paper computes multiple pathways for the European energy system until 2050, focusing on one of the challenges of the low-carbon transition: the issue of unused capacities and stranded assets (Johnson et al. 2015). The paper computes three different scenarios, utilizing the Global Energy System Model (GENeSYS-MOD) for calculations. A major feature is the introduction of different scenarios with limited foresight to the multi-sectoral approach of the model. In order to reach the 2°C goal, a swift transition towards renewable energy sources is needed, leading to unutilized capacities of fossil-fueled plants - an effect that is even stronger, when short-term goals are prioritized over long-term targets. Thus, the need for strong, clear signals from policy makers arises to combat the threat of investment losses.

Methods

This paper analyzes the transition of the European energy system for the sectors power, heat, and transport towards a largely decarbonized future. A special focus is placed on capacities and the eventually arising stranded-asset problem, as ambitious decarbonization goals force fossil energy sources out of the energy mix. To analyze these scenarios, an extended version of the "Global Energy System Model" (GENeSYS-MOD) by Burandt, Löffler, and Hainsch (2018) is used. The model uses a system of linear equations to search for lowest-cost solutions for a secure energy supply, given externally defined constraints on GHG emissions. While an omniscient, cost-optimizing planner is often used in optimization models, real-life decisions are usually based on incumbent parties, political influence, and imperfect foresight (Haas 2017). This paper introduces two new scenarios, RED and POL, featuring reduced foresight for the years up until 2030. The POL scenario also includes political boundaries, such as the assumption that national targets for renewable integration will not see an over-achievement, and lifetime extensions for conventional capacities. A major addition to previous studies is the inclusion of scenarios featuring reduced foresight, as well as current policy trends, in order to quantify the magnitude of the potentially arising stranded asset problem. By including all three major sectors of the energy system (power, heating, and transportation), a comprehensive outlook can be given which also includes the interdependencies between the single sectors.

Results

The model results show that reduced foresight does affect the short-term decision making process when it comes to long-term goals such as climate targets. This effect is even increased, if political drivers delay, or even prevent, the theoretically cost-optimal measures. All three scenarios manage to uphold the 2°C goal, and are thus technically feasible, but the shorter planning horizon leads to shifts in energy use and a swifter need for emission reduction in the later years, which, in turn, leads to unused capacities and stranded assets. The given emissions budget of 49.27 gigatons of CO_2, in addition to renewable technologies becoming more and more competitive, and cheap storages being available, leads to a drastic change in the total energy mix between 2015 and 2050. As seen in Figure 1, the resulting energy mix shifts from a strong dependence on fossil energy carriers to a system based on renewable energies such as wind, solar, and hydropower. Especially recently built power plant capacities face severe monetary problems, as carbon constraints and increasing market penetration of cheap renewable energy sources limit their stream of

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income. Introducing limited foresight to the model, and thus moving away from a planners perspective, even increases this problem, as new capacities are being constructed but become quickly obsolete.

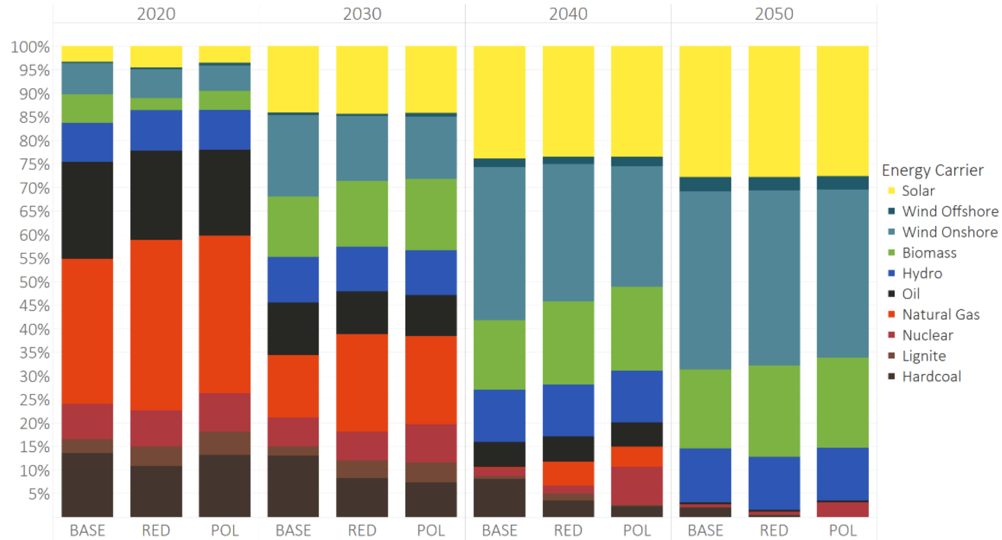

Figure 1: Development of the relative energy mix for Europe per scenario; Source: Own illustration

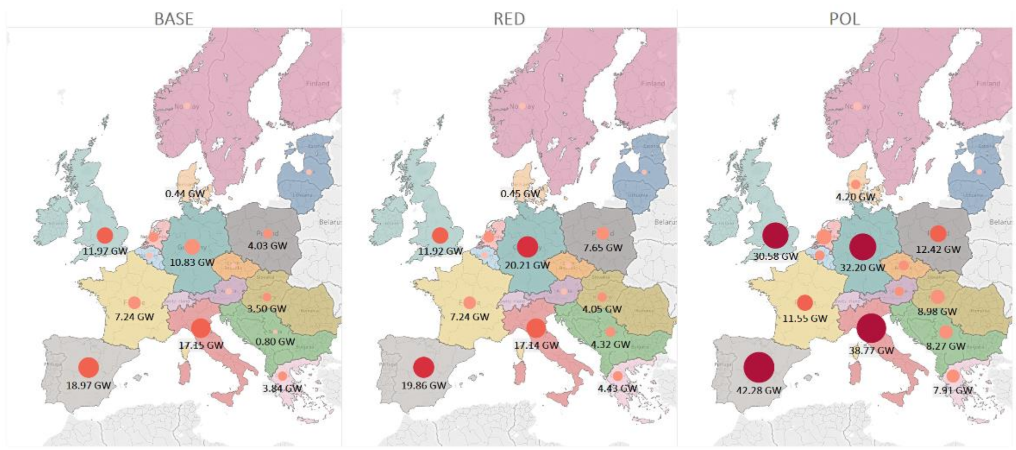

Figure 2: Unused capacities for gas & coal in the year 2035 for each scenario; Source: Own illustration

Conclusions

The results show that there could be massive amounts of unutilized capacities in Europe in the upcoming years if climate targets are taken seriously. Introducing reduced foresight similar to short-sighted political and business point of views to the model further increases this problem, leading to new constructions of conventional generation capacities in the 2020s that quickly become obsolete. The decreasing competitiveness of conventional energy generation poses difficult challenges for investors, owners, and policy makers, as issues such as stranded assets and job security arise. Thus, strong and clear signals from policy makers are needed to combat the threat of investment losses that could increase significantly when short-term goals are prioritized over long-term targets.

References

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