Evaluation of remuneration schemes for renewable energy technologies

(1) Energie-/Klimapolitik, Versorgungssicherheit
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Motivation

Midst of the ongoing energy transition, the German government decided to evaluate the development of market driven deployment of renewables and to present a proposal by march 2024 for financing renewables after the coal phase-out [1]. Research activities in project TradeRES [2] of EU's Horizon 2020 programme aim at developing electricity market designs for ~100% renewable power systems, and address the associated question: Are remuneration schemes for fluctuating renewable energies needed and, if so, how could they be designed? To this end, we analyse a range of remuneration schemes for renewable energy sources with regards to their power system effects and assess the overall market dynamics via performance indicators.

Methodology

Analyses are carried out using the Agent-based Market model for the Investigation of Renewable and Integrated energy Systems (AMIRIS) [3, 4, 5]. AMIRIS simulates electricity prices endogenously based on the simulation of strategic bidding behaviour of prototyped market actors. Their bidding behaviour does not only reflect marginal prices, but can also consider effects of support instruments like market premia, uncertainties and limited information [6].
We ran multiple simulations with a range of five different remuneration schemes for renewable energy sources: no remuneration (except of a fixed feed-in tariff for rooftop-PV) ("None"), fixed market premia ("MPfix"), variable market premia ("MPvar"), contracts for differences ("CfD") and capacity premia ("CP"). In precalculations for each remuneration scheme the premia are adjusted such that each renewable energy technology refinances on average and, at the same time, overpayments are avoided. Thus, each technology's revenues exactly match their cost within a 1% tolerance.
For the analysis in this paper we use a scenario based on the status quo of 2019 with lower shares of renewable energies. Besides the different remuneration schemes, all scenario parameterisations are equal. We examine technology-specific annualised cost and revenue as well as economically induced curtailment situations.

Results and Conclusions

Results reveal that total system costs for dispatch, volume-weighted average electricity prices as well as the market-based cost recovery per technology are quite similar without or with any support instrument. However, the market-based cost recovery in Figure 1 clearly shows that remuneration schemes for renewables are needed, since market revenues are not high enough to cover their cost. Depending on the technology, between 28% (for PV) to 66% (for wind offshore) of the total cost cannot be covered at the day-ahead market. Looking at the total cost recovery in Figure 2, the total cost recovery is close to 100% if support mechanisms are employed. This confirms that the parameterisation of the simulations leads to support instruments that are both effective and efficient as renewables recover their cost and overpayments are avoided.
Since all results were produced with a scenario based on the historic situation in 2019, it is likely that these results will change considerably with higher shares of renewables in the power system. We aim at presenting results for a nearly carbon-neutral power system in due time.

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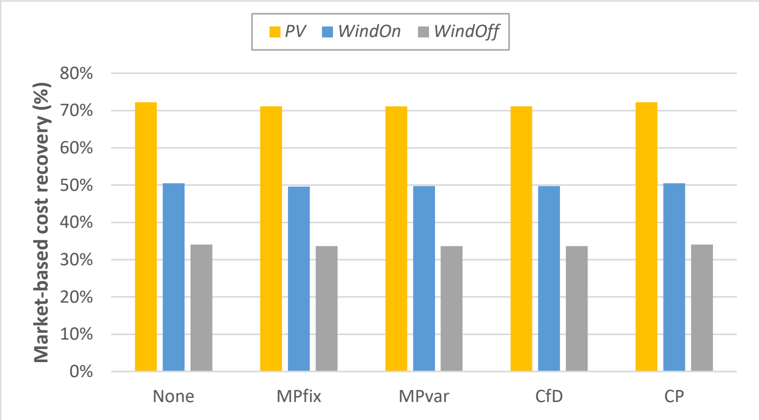

Figure 1: Market-based cost recovery at the day-ahead market for different renewable energy technologies and support schemes

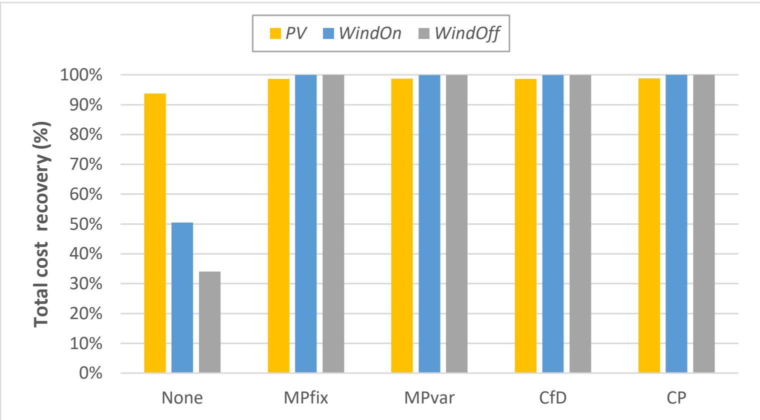

Figure 2: Total cost recovery for different renewable energy technologies and support schemes (in case "None", PV is partially supported via a Feed-in tariff)

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TradeRES
New Markets Design & Models for 100% Renewable Power Systems

Literature

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