[The future of renewable energy auctions: Model-based assessment of long-term trends in a changing electricity system]

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Overview

This paper informs on our model-based scenario assessment of long-term trends in the EU-27 energy system and their impact on the refinancing of renewable electricity sources (RES) via the electricity markets.

In order to tackle climate change and as part of the European Green Deal, with the European Climate Law, the EU has set itself a binding target of achieving climate neutrality by 2050. Complementary, in the Fit for 55 package and as an intermediate step towards climate neutrality, the EU has raised its 2030 climate ambition, committing to cutting emissions by at least 55% by 2030 [1]. To reach this latter target, the current EU-level target of at least 32% of renewable energy sources in the overall energy mix to is raised to at least 40% by 2030. Both medium- and long-term targets translate into a requirement for a massive uptake of renewable energy supply and in particular for renewable electricity generation.

To stimulate this necessary deployment of renewable energies, all European Member States have resorted on a multitude of support mechanisms, given that historically electricity prices on European spot markets were insufficient to stimulate investments in RES. In recent years, auction schemes for the allocation of support for RES have been advancing rapidly across Europe. They have contributed to bring down costs and respectively government support requirements for newly installed capacities. For instance, the international energy agency (IEA) judges that 'solar PV is now the cheapest source of electricity in history' [2] and thus below both the range of levelized cost for conventional power plants and the current level of electricity prices at the European spot markets. This particularly holds true as of early 2022, where wholesale prices reach record levels due to the post pandemic demand recovery and the Russia–European Union gas dispute. In consequence, first zero subsidy auctions and market driven RES expansion through via power purchase agreements and merchant contracting already occurred in Europe.

However, there remains considerable uncertainty whether this trend towards subsidy free RES expansion will persist along the way towards a decarbonized energy system in Europe. As a matter of fact, the value that renewable producers can realise through participating in markets depends to a large degree on the system's capacity to incorporate intermittent renewable electricity. This capacity to incorporate RES-E depends to a large extend on the amount of available flexibility stemming inter alia from sector coupling and demand response and the levelling of volatile RES-E feed across regional borders thus the degree of centralisation. The higher the capacity for renewable integration, the higher the market values and hence the higher probability for market driven RES expansion. Yet given the intrinsic uncertainty of future developments regarding the design of the future energy system, the analysis of plausible trends for market values of renewable electricity output is critical to determine the role for policy interventions and RES auctions in the time frame from 2030 and 2050.

Therefore, this paper assesses the impact of future trends in the energy sector on the requirements for ongoing financial support for the deployment of renewable energy sources. It provides insights under which circumstances future deployment of renewables can be purely market driven and where this does not possible. It reveals financial support costs for that European Member States need to provide for reaching the Fit for 55 deployment targets. And finally as a sensitivity and to take into account recent political developments, it also investigates the impact of raising gas prices in the medium term.

Methods

From a methodological point of view, we carry out a model-based scenario analysis. Scenario analysis is not a prediction about what the future will be, but rather about what a plausible future might be, based on informed judgements about key drivers for system development and – in the context of electricity systems - certain commitments (e.g., the 2030 & 2050 emissions reduction targets). The scenarios for which we present the quantitative assessment have originally been developed as qualitative scenarios by [4] within the AURES2[1] project

[1] AURES II is a Horizon 2020 project (http://aures2project.eu/). We gratefully acknowledge the intellectual and financial support provided by the Horizon 2020 programme, operated by the European Commission, Executive Agency for Small and Medium Enterprises

under whose umbrella also the work presented in this paper was carried out. They describe said plausible visions of EU electricity markets and networks in the period 2030 to 2050 based on two key trend parameters, i.e., the level of flexibility as well as the level of decentralization. In turn, the possible future socio-economic and -political conditions from the four qualitative scenarios, namely *Top Down Tech*, *Shiny happy energy citizens*, *Leviathan* and *Make-do-and-mend*, were translated into quantifiable scenarios with specific technical parameters. The scenarios that we modelled and their respective technical parameters are presented in Figure 1. Common condition for all scenarios is the assumption that the European intermediate and long term decarbonization targets are met.

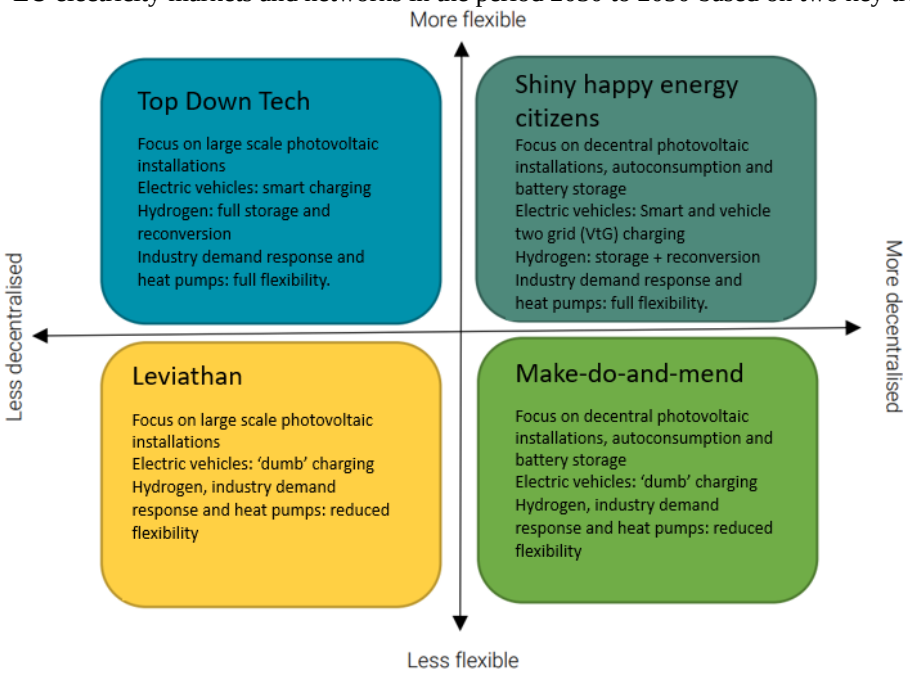

Figure 1 Scenario overview

They differ regarding extend of sector coupling, e.g. the amount of heat pumps, electric vehicles and usage of hydrogen technologies, additional flexibility from electrical storage technologies such electric batteries as well as the degree of decentralisation that is implemented via the value attributed towards decentral electricity generation.

To provide quantifications for those scenarios, we apply a modelling framework consisting of two distinct energy models that are combined via soft model coupling. First, we use the open-source partial equilibrium model *Balmorel*, that optimises the investment and dispatch of technologies in the electricity and grid related heating sector. Market values for the renewable energy sources are derived and then fed into our techno-socio-economic bottom-up model Green-X. Green-X in turn is applied to performing a detailed quantitative assessment of the actual RES deployment until 2050 based on the existing real-world policy context at national and European level. Iterations of those values are carried out until the framework converges.

Results

This forward-looking exercise provides for each of the four scenarios quantifications as the future market values for RES technologies, usage and investment into flexibility, support costs and the technology mix for RE deployment from 2030 until 2050. Preliminary results suggest that while market values for renewable technologies increase with additional flexibility provision and a higher valuation of decentral approaches, their level remains below their deployment costs. This surprisingly holds true even under the sensitivity of extremely high CO2 and gas prices.

Conclusions

We conclude that the current phase of extremely high spot market prices remains a temporary phenomenon and that costs of the respective flexibility options constitute a ceiling for long term electricity prices that is continuously lowering when conventional technologies phase out and the merit order effect of additional RES deployment increases in size. That entails that continuous financial support will be required in order to reach the ambitious European and national deployment targets.

References

[1] 'Fit for 55': delivering the EU's 2030 Climate Target on the way to climate neutrality, Brussels, 14.7.2021, COM(2021) 550 final
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[3] D7.3, October 2020, The future of renewable energy auctions – Scenarios and pathways, Bridget Woodman and Oscar Fitch-Roy (UNEXE), 30 October 2020 (M24), AURES 2 project