ARE RENEWABLES PROFITABLE IN 2030? A COMPARISON BETWEEN WIND AND SOLAR PV ACROSS EUROPE

Valentin Bertsch, German Aerospace Center and University of Stuttgart, Germany, +49 711 6862 8843, valentin.bertsch@dlr.de
Valeria Di Cosmo, University of Turin, Italy, valeria.dicosmo@unito.it

Overview

The European Commission (EC) and the European Council have set ambitious energy targets for 2030 in order to secure clean and efficient energy in the European Union. In 2014, EU countries agreed that by 2030, the share of renewables should be 27% of total energy consumption in order to achieve the overall target of 40% GHG emission reduction. In 2018, this overall renewable target has been increased to 32% of total energy consumption. This target holds at the EU level, so all countries should work together either by reducing the energy demand or increasing generation from renewable energy sources (RES), to achieve the overall goals. Electricity generation is one of the sectors affected by the EU targets together with transport, agriculture and industry, as it is one of the major sectors responsible for total emissions. Following the track started with the 2020 targets on emission reductions, renewable electricity generation (RES-E) should increase to 49% of total electricity demand by 2030 in order to be consistent with the overall target on total energy demand, as noted by the in its own impact assessment analysis.

The installed capacity in renewable energy has increased strongly during the last decade, when every EU country set up different incentives to promote the investment in renewable generation. There are several works that focus on the costs and the regulatory changes needed to promote the investments in renewable energy. All these works highlight that subsidies given to renewables are positively related with the investment in this type of generation in all EU countries. Despite the positive correlation between subsidies and investment in RES-E, it is widely recognised that the use of subsidies is suboptimal with respect to the first best solution of carbon-pricing, so a rigorous analysis is needed to assess under which conditions investments in renewable energy are economically profitable without subsidies. Looking at 2030, investment costs associated with renewables should decrease over time, making the investment in renewable energy more attractive to market operators.

However, European countries are quite different in terms of natural resources and the availability of wind and solar irradiation, thus a careful analysis of the profitability of investments in renewable technologies is required to determine where it is optimal to invest in the future, as capital costs of renewables are often higher than for fossil fuels. Despite the importance of the subject, there are not many studies focusing on the profitability of renewable technologies in 2030 or beyond, in particular when it comes to comparing countries across Europe.

Methods

In this work we therefore investigate whether the investment in specific renewable technologies (solar, wind onshore and wind offshore) is profitable across Europe. In particular, we compare several scenarios to determine under which conditions investment in renewables would be profitable in each country without additional financial support. We use a power systems model to simulate the whole European electricity market in 2030 aimed at investigating the costs and benefits of investment in renewable technologies for all EU countries. We then use the output of the power systems model to calculate the internal rate of return for solar PV, wind onshore and wind offshore investments in each country in Europe. We focus on these technologies in this paper because significant investments in additional hydro capacity are rather unlikely and limitations to the feedstock potential are found to limit the expansion of biomass for electricity only generation. Finally, we also carry out a number of sensitivity analyses to explore the impact of varying key factors, such as the fuel prices, technology costs and technology lifetimes.

Results

We find that investments in the considered technologies are not homogeneously profitable across Europe. Our results reveal four categories of countries. The first category includes a number of countries in Scandinavia and other parts of Northern or Western Europe where wind onshore is rather profitable, while the profitability of solar PV is low. The second category consists of a group of countries in the South-Eastern part of Central Europe (e.g., the Czech Republic, Slovakia, Hungary and Bulgaria) where solar PV is rather profitable, whereas wind onshore investments achieve very low IRRs. The third category includes countries in Central Europe (e.g., Luxembourg, Lithuania and Slovenia) where neither solar PV nor wind onshore are perticularly profitable. Finally, the fourth category consists of countries in Southern Europe with coastal access (e.g., Portugal, Greece and Cyprus) where the profitability of both solar PV and wind onshore is rather high. Wind offshore is not found to be profitable under our baseline assumptions.

Moreover, our sensitivity analyses show that a reduction in the lifetime of the projects, increased technology costs / less than anticipated technology cost reductions by 2030 and lower fuel prices significantly reduce the profitability of wind and solar investments. More specifically, we observe that the downside risks and the upside potentials of the investments are distributed asymmetrically, i.e. the downside risk of lower fuel prices and shorter technology lifetimes is larger than the corresponding upside potential of higher fuel prices and longer lifetimes. In contrast, the upside potential of decreased technology costs is larger than the downside risk of increased costs.

Conclusions

There are a number of messages that policy-makers can take away from this research. First, our analysis shows that allowing for some form of trading renewable generation between countries or providing some other mechanism for joint target achievement / cooperation between European countries (as opposed to national targets that have to be met nationally only) can be expected to achieve the overall targets at lower costs. Comparing the 2030 target shares and profitabilities by country reveals that some countries have high RES-E targets while the profitability is rather moderate or low and vice versa. This suggests that either financial support payments will be required (ultimately leading to higher costs to consumers) to meet the targets in these countries or the targets may not be met. Trading of renewable generation between countries can resolve both problems. Should countries, for whatever reason, wish to achieve certain technology-specific national targets, our analysis provides quantitative support in determining which technologies need support in which countries. Moreover, our analysis shows that in most countries at least one technology (wind onshore or solar PV) is profitable by 2030 even in absence of any financial support payments. Second, our analyses provide insights for policy makers as to how sensitive a successful RES deployment and target achievement are to uncertainties related to different factors. For technology developers, these analyses can be used to derive targets in relation to technology cost reductions and lifetimes. Third, our results show that in quite a few countries, wind onshore is more profitable than solar PV, and definitively more profitable than wind offshore. Beyond these economic considerations, however, the public acceptance of energy infrastructure investments is a prerequisite for a successful deployment of renewables, which has been shown to be higher for solar PV and wind offshore compared to wind onshore in many cases in the literature. It is therefore crucial for policy makers to have an open and transparent discourse about the tradeoff people make between consumer costs (depending, amongst others, on the profitability of investments) and acceptance related to different renewable technologies. Our analyses provide an important contribution to understanding the investment economic side of this tradeoff.