

Auctions for Renewables: Does the Choice of the Remuneration Scheme Matter?

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Auctions are increasingly used to support renewable energy sources (RES). However, regulators do not have a consensus on the design of remuneration schemes in auctions. In recent auctions (held from 2017 to 2019), remuneration schemes in Denmark, Germany, the Netherlands, Greece, and Poland were based on a premium on spot market prices to promote RES investors to generate during hours with higher market prices (henceforth, the FIP scheme). In contrast, auctions in countries such as Argentina, Chile, Portugal, Canada, and the UK remunerated RES generation at a fixed feed-in rate (henceforth, the FIT scheme).

This paper analyzes the effects of remuneration schemes on RES auctions' success in markets with strategic behavior. To this end, I develop a theoretical two-stage game-theoretical auction/operation model. I show that FIP auctions cannot achieve true-cost bidding and allocative efficiency because the true value of winning for incumbents is driven by factors additional to costs. Moreover, in FIP auctions, incumbents are in an advantageous position compared to a newcomer, making them more likely to win, which may lead to higher payments per unit of RES generation. The non-realization risk is also higher in FIP auctions. Social welfare, however, may be higher in a FIP auction since it leads to lower CO₂ emission externalities.

This paper also presents a simulation approach based on a data-driven machine learning method that uses actual market outcomes to simulate counterfactuals corresponding to FIP and FIT auctions. Results demonstrate that, for a 14GW auction of onshore wind in France, choosing a FIP remuneration (instead of a FIT one) may lead to 0.55 EUR/MWh (1.40%) higher market prices, and 247 million euros lower consumer surplus, which is equal to 1.27% of the annual transactions in the French electricity market in 2019. This is not only statistically significant but also economically important, given that all other aspects of the auction design are identical. Note that the simulated 1.40% effect also demonstrates the whole impact that actual onshore wind generation had on prices. The price effect will get larger as the size of the auctioned RES increases dramatically in the future.

If policymakers primarily expect RES support to reduce spot market prices, they must introduce investor diversification measures to further incentivize newcomer firms to participate in the auctions or choose FIT auctions. On the other hand, from a social welfare point of view, policymakers may need to favor FIP remuneration if the marginal conventional technology's externality is too high. In contrast, FIT remuneration should be favored in markets with relatively high markups (low competitiveness) compared to the marginal technology's externality, e.g., in a market with a single incumbent and nuclear at the margin.

On the other hand, FIP incentivizes investment in RES projects whose generation profile is more correlated with the demand. Nevertheless, in the presence of risk, FIP may lead to higher payments to RES investors compared to FIT because exposure to uncertain market prices means that investors may require higher *risk premiums*. I showed that incumbents might benefit from an additional *strategic premium*. Consequently, when deciding between FIP and FIT remunerations,

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policymakers of imperfectly competitive markets should consider the tradeoff between having a more desired generation profile against both risk and strategic premium.

Most common non-realization penalties treat all investors (newcomer or incumbent) equally. Given that non-realization incentives are investor-specific, policymakers may need to consider investor-specific penalties to level the playing field; for instance, in a relatively simple approach, the regulator might make penalties proportional to the pre-existing capacity (or generation) of the bidding firm. Policymakers may also reduce incumbents' *winning-not-to-realize* incentives by reducing the time between the cancellation deadline and finding a new replacement. For previously awarded auctions in which the regulator cannot make such changes, regulators should condition possible delay renegotiations on extra penalties reflecting the incumbents' extra profits from the delay.