

Eyes on the price: Which power generation technologies set the market price?

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Wholesale power markets follow the principle of short-run electricity markets where the market clearing price is determined by the intersection of supply and demand at any given hour. In theory, the resulting hourly day-ahead market price is equal to the marginal costs of the last (marginal) unit in the merit order necessary to satisfy the demand. Given that this marginal unit sets the price for all power generation units operating during that particular hour, one can label it as ‘price setting’.

In the literature, it is frequently stated that in most central European markets, gas- and/or coal-fired power plants are usually the marginal price-setting units, which is why we refer to it as conventional wisdom. The nature of European power plant portfolios with significant coal- and gas-fired generation capacities (and their marginal pricing) comprise the basis for this conventional wisdom - as do causal relationships between coal and/or gas prices and wholesale power prices that a number of scholars have researched. However, there is, to our knowledge, no academic literature that looks in detail into the actual price setting on European markets and the extent to which coal- and gas-fired power plants are indeed commonly price-setting.

This paper aims to fill this gap and investigate price setting on European power wholesale markets using a fundamental electricity market model. From the hourly calculations of European power markets, one can derive the marginal price-setting technology for any given hour. Taking a whole year as a time-frame, it is possible to analyse how the hours of a year are structured and what share different generation technologies take in providing the marginal price-setting units. The core objective is to broaden knowledge of price setting on European power markets, and obtain a more nuanced picture of what technologies set market prices. Given that the European power market is integrated and significant cross-border flows are occurring, the analysis looks at 20 integrated central European power markets. This helps to understand interdependencies and in what ways larger markets dominate price setting elsewhere.

In view of ongoing public debates on CO₂ price floors and the announcement of the Dutch government that one be introduced, this paper analyses how different CO₂ price floors affect the price setting as part of a sensitivity analysis. This sheds light on the question of how carbon price floors influence marginal price setting and if a given price floor will result in a shift from coal to gas as a dominant price-setting technology.

A key observation is that, with respect to the marginal price-setting units, the modelling results indicate a higher level of interconnectivity than one might assume. Large countries tend to dominate the price setting—presumably quite simply due to the large number of power plants and their differentiated marginal costs. Hence, electricity markets and wholesale power prices of comparably small countries are significantly influenced by the energy policies of their larger neighbours. Indeed, modelling results show that in terms of price setting, foreign energy policies can have a larger influence on a given state’s electricity market than domestic policies.

Looking at the technologies one notes that for the large majority (>90%) of total hours in all countries, reservoirs, pumped-hydro, nuclear, gas-, coal- and lignite-fired power plants provide the marginal price-setting units. Other technologies such as stochastic renewables or other fossil plants play an almost negligible role in terms of price setting. Altogether, the modelling results show that gas-fired power

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plants provide the price-setting units for almost a third of the total hours, and thus for more hours than any other generation technology. Coal- and lignite-fired power plants follow, and together provide the price-setting units for over a quarter of the total hours (whereby lignite-fired power plants take a larger share than coal-fired ones). A notable point is that reservoirs and pumped-hydro power plants are also price setting for another quarter of the total hours. Nuclear power plants set the price for just below 10 percent of the hours, a share similar to that of renewables, including run-of-river power plants. On an individual country basis, the picture of price-setting technologies can look very different depending on countries'—and surrounding, connected countries'—generation portfolios.

Scenarios with different carbon price floors show that the general structure of the price setting remains largely unaffected by the researched carbon price changes; yet a more substantial impact on wholesale power prices, fuel switching, CO₂ emissions and import/export balances can be observed. We find that the proposed Dutch carbon price floor would lead to rising Dutch imports and ergo reduced Dutch emissions, but with little to no emission reductions on a wider European level. A theoretical multilateral carbon price floor of the countries of the Pentalateral Energy Forum would result in rising wholesale prices and reduced emissions that are, unlike in the scenario of the Dutch carbon price floor, not fully offset by rising emissions elsewhere.

Altogether the research shows that large countries tend to have a strong influence on price setting in smaller neighbouring countries, as long as there are sizeable interconnector capacities. National policy measures such as coal phase-outs or carbon price floors thus have substantial effects across national borders. Generally, we find a price-setting pattern that is more complex and nuanced than the conventional wisdom suggests, and that power generation technologies other than coal- and gas-fired power plants provide the marginal price-setting units more often than one may assume. This should be taken into account upon discussion on the price setting on electricity wholesale markets.

Last but not least, it is shown that whilst carbon price floors have little effect in terms of switching the price-setting technology, they can—if executed on a multilateral basis—trigger substantial emission reductions at a wider European level. The proposed unilateral Dutch carbon price floor would in contrast only shift production and emissions abroad.