Co-firing coal with biomass under mandatory obligation for renewable electricity: Implication for the electricity mix

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EXECUTIVE SUMMARY

Co-firing coal with biomass is usually seen as a transitory option before a deeper energy transition toward a carbon-free power sector. However, whereas co-firing reduces the carbon intensity of existing coal plants, it still generates CO_2 emissions. Hence, any policy that promotes co-firing against traditional renewables may result in higher CO_2 emissions in the long run, if it gives incentive to use coal plants under co-firing instead of investing in the renewable technologies that do not emit CO_2.

Several European states have implemented arrangements to include co-firing in their support schemes for renewable electricity (*e.g.* Poland, UK, Denmark, Netherlands), which raised concerns about the consequences for coal's contribution to the electricity mix (even through co-firing with biomass) and the resulting CO2 emissions. As recently pointed out in debates on energy agreements in the Dutch parliament, it may seem strange that some coal plants are set to close down due to environmental regulation while the same units can receive subsidies when co-firing biomass. This raises questions about the actual incentives to invest in traditional renewables (e.g. wind, solar, dedicated biomass units) to meet European targets and the consequences for future energy mixes.

The question of consequences when promoting co-firing as a renewable energy source (RES) has retained little attention in the economic literature. To date, to the best of our knowledge, the only contribution comes from Lintunen and Kangas (2010), which provides a theoretical model to analyze the effect of co-firing in a stylized and simplified power system with static power demand.[1] Results show that promoting co-firing as a RES decreases investments in wind turbines. However, their modeling approach does not allows investigating consequences for CO_2 emissions in the long run, when the electricity mix is continuously modified by policy promoting co-firing against pure RES.

Our paper considers a more general treatment through simulations that rely on a detailed representation of power system with dynamic time horizon, decommissioning of old capacities, rising power demand and increasing renewable targets. Notably, our approach allows investigating the long-term effects when co-firing steadily displaces traditional RES over time, resulting in a power plant fleet that is more carbon intensive at the end.

We provide simulations for the French and German power sectors. Results indicate that, if co-firing is recognized as a RES, coal may crowd-out traditional renewables with increased generation and additional investments. Regarding CO_2 emissions, we find surges when co-firing is recognized as a RES. The rise is more significant in Germany than in France due to its much greater coal capacities. In France, the magnitude depends on the share of nuclear power, with fewer increases when old nuclear power stations are prolonged. Finally, we

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[1] Lintunen, J., Kangas, H.L., 2010. The case of co-firing: The market level effects of subsidizing biomass co-combustion. *Energy Economics*, 32, 694–701.

show that including co-firing in the set of RES reduces the overall costs associated with managing the power system. When balancing this cost saving against the increased social cost from higher CO_2 emissions, results show that the cost saving may be dominated by the increased carbon cost with carbon valuation around 100 Euros per tCO_2. An exception comes from France when the service life of old nuclear power stations is prolonged. In this case, the cost saving is very high and the increased CO_2 emissions are slight (because co-firing competes higher in the merit order and base-load continues to be generated by massive carbon-free nuclear power) with the result that the cost saving always dominates the increased carbon cost.

Overall, our paper raises questions about the incentives to invest in traditional RES if co-firing is recognized as a renewable. The consequences may be detrimental for the future energy mixes in European countries, with more coal (even if implemented under co-firing), fewer renewables, and resulting higher CO_2 emissions. The cost arising from adapting electricity to climate change is an important issue with populations that are increasingly concerned by this issue. As illustrated in the US presidential campaign, policy makers can also face complicated trade-offs between climate concerns and employment from the coal industry. In this context, co-firing can be a useful option in the short run, but it can be risky in the long run if it jeopardizes a deeper transition towards more renewables and less carbon in energy. More generally, any policy that promotes co-firing against traditional renewables may result in higher CO_2 emissions in the long run, if it gives incentive to use coal plants under co-firing instead of investing in pure renewables. Whereas co-firing reduces the carbon intensity of coal plants, it still generates CO_2 emissions. Hence, if co-firing steadily displaces investments in traditional RES over time, one may expect the CO_2 emissions from electricity to be higher in the long run. This is something policy makers should remember when considering whether it is opportune to include provisions for co-firing in the support schemes for renewable electricity.