Low-carbon options for the French power sector: What role for renewables, nuclear energy and carbon capture and storage?

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Résumé

In the wake of the Paris agreement, France has set a zero net greenhouse gas emission target by 2050. This target can only be achieved by rapidly decreasing the share of fossil fuels and accelerating the deployment of low-carbon technologies. We develop a detailed model of the power sector to investigate the role of different low emission and negative emission technologies in the French electricity mix and we identify the impact of the relative cost of these technologies for various values of the social cost of carbon (SCC). We show that for a wide range of SCC values (from 0 to 500/tCO2), the optimal power mix consists of roughly 75% of renewable power. For a SCC value of 100/tCO2, the power sector becomes nearly carbon neutral while for 200/tCO2 and more, it provides negative emissions. The availability of negative emission technologies can decrease the system cost by up to 18% and can create up to 20MtCO2/year of negative emissions, while the availability of new nuclear is much less important. This study demonstrates the importance of an effective SCC value (as a tax for positive emissions and remuneration for negative emissions) to reach carbon neutrality for moderate costs. Negative emissions may represent an important carbon market which can attract investments if supported by public policies.

Mots-Clés: Power system modelling, Variable renewables, Negative emissions, Social cost of carbon, Nuclear energy

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