The Clean Power Plan, proposed by the Environment Protection Agency (EPA) in June 2014, aims at significantly reducing CO2 emissions from the power sector. In particular, it targets fossil fuel-fired generating units, such as coal, natural gas, and oil generators, by proposing CO2 emissions rate targets for each U.S. state that have to be complied with starting in 2030. Nationwide, this rule aims for an approximate reduction of CO2 emissions from the power sector of 30% from 2005 levels. Despite providing a detailed description of the underlying assumptions for these target rates, the EPA has not introduced legislation supporting the states in achieving the goals. Instead, states are forced to design electricity policies themselves and present a compliance plan in the coming years.

We assume the role of the state of Texas, and, more specifically, the Energy Reliability Council of Texas, and design two policies: (1) a tradeable performance standard (TPS) and (2) a carbon tax. Both policies are designed to achieve compliance with the proposed CO2 emissions targets in 2030 and a 2020 to 2029 phase-in period. In order to design, evaluate, and compare the two policies, we use a state-of-the-art long-term power generation expansion planning model. We compare and evaluate the two policies with respect to the following measures: welfare, investment and retirement decisions of generators, generation mix, and performance of coal generators.

Our long-term power generation expansion planning model features investment and retirement decisions over a long planning horizon of more than 20 years, as well as an hourly representation of day-ahead electricity
markets in which sellers of electricity face buyers. This combination makes our model both unique and challenging to solve. Decomposition algorithms, and especially Benders decomposition, can exploit the model structure. We present a novel method that can be seen as an alternative to generalized Benders decomposition and relies on dynamic linear overestimation. We prove its finite convergence and present computational results, demonstrating its superiority over traditional approaches. In certain special cases of our model, all necessary solution values in the decomposition algorithms can be directly calculated and solving mathematical programming problems becomes entirely obsolete. This leads to highly efficient algorithms that drastically outperform their programming problem-based counterparts.