OVERLAPPING REGULATORY AUTHORITIES: STRATEGIC STATE COMPLIANCE WITH THE CLEAN POWER PLAN IN WHOLESALE ELECTRICITY MARKETS

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Overview

In August of 2015 the U.S. Environmental Protection Agency (EPA) finalized a rule to reduce CO_2 emissions from existing electricity generation units in the U.S. to 32% below 2005 levels by 2030 (U.S. EPA, 2015a).This rule, more commonly referred to as the Clean Power Plan (CPP), requires existing fossil fuel electricity generation units (EGUs) within each state to achieve a generation weighted average emissions intensity (in lbs CO_2 per MWh) that is at or below a rate-based standard assigned to each state. Alternately, at the discretion of each state government, states can require that the sum of all emissions (in short tons CO_2) from EGUs be less than or equal to a mass-based standard, which is also established by the CPP. States are expected to begin compliance in 2022, with the standards becoming more stringent following a pre-specifed trajectory or 'glide-path' of emissions reductions established by the CPP, until the most stringent standards are achieved in 2030.

In addition to the choice of complying using a rate-based or mass-based standard, states have several options with which to comply with the CPP: they can develop individual plans that are trade ready or not, or they can comply as a coalition and thus submit a multi-state plan. If states comply individually, they are required to submit an implementation plan detailing how EGUs within their state will comply to their preferred rate or mass standards both for an interim period and by 2030, and are given some flexibility in designing their own glide paths. States must also decide whether to make their plans 'trade ready' or not. If a state adopts a rate-based standard, a trade-ready plan allows EGUs within the state to trade emission rate credits, denominated in lbs CO_2 per MWh, with EGUs in any other state or coalition(s) of other states that has also adopted a rate-based standard that is trade-ready. Conversely, if a state adopts a mass-based standard a trade-ready plan allows EGUs in the state to trade emission allowances, denominated in short-tons CO_2, with EGUs in any other state or coalition(s) of other states that has also adopted a mass-based standard that is trade-ready. If states comply as a coalition, the coalition submits a multi-state implementation plan where EGUs within the coalition must achieve a generation weighted average of state rate-based standards or a coalition-wide emissions cap equal to the sum of states within the coalition's mass-based standards.[1]

To establish the rate and mass base standards for each state the EPA considered the Best System of Emissions Reductions (BSER) that EGUs could achieve. The BSER was based upon three "building blocks": improve heat-rate efficiency at existing coal plants, increase utilization of natural gas generation units through re-dispatch, and increase renewables in electricity generation. The EPA's Regulatory Impact Analysis (U.S. EPA, 2015b) that accompanied the CPP anticipates that states will principally be able to reduce emissions from EGUs by using any feasible combination of these three methods, as well as two other abatement pathways: retain or expand generation from existing nuclear units, and increase demand-side energy efficiency.[2]

States have been provided unprecedented flexibility to comply with the CPP. However, it remains unclear how states' compliance choices will impact the existing configuration of organized wholesale electricity markets. Centralized dispatch of power generation units in these markets, which frequently span multiple states, is controlled by Regional Transmission Organizations/Independent System Operators (RTOs/ISOs). This paper seeks to understand the costs of the CPP when states' strategic compliance choices are affected by the fact that, for many states, the state's EGUs are under the dispatch control of an RTO/ISO. Unlike previous work on the *proposed* CPP (Bushnell et al. 2015, Burtraw et al. 2015, Ross et al. 2015), our model explicitly considers both how the existing control of dispatch across states by RTOs may influence states' compliance decisions under the *final* CPP, and how states' compliance choices may or may not alter the configuration of existing electricity markets.

Methods

We consider a stylized electricity network comprised of four nodes that spans two states (with two nodes in each state), where power is supplied and demanded across three representative hours. Each hour corresponds to a load period when one of three generator types (coal steam, natural gas combined cycle and oil/gas steam units) sets the market-clearing electricity price. Prior to the CPP, we assume that generation units in both states are under the centralized dispatch authority of a single RTO. The regional system operator solves a direct current optimal power

[1] The CPP also permits hybrid plans, whereby some EGUs within a state could be covered by individual plans, and others by multi-state plans, and perhaps more than one. We abstract from this in our analysis.

[2] The abatement options available to states are not limited to these five options. The CPP discusses a plethora of possible abatment pathways in Section VIII.K (U.S. EPA, 2015a). However, in evaluating the costs and benefits of the CPP in the RIA, the EPA only considered these five abatement options, which were considered the most cost-effective options available to states.

flow problem that determines the balance of electricity supply and demand that maximizes producer and consumer surplus, subject to transmission and operational constraints in the network.

We model government decision-making as a simultaneous move non-cooperative game in which states make several discrete and continuous choices. First, each state decides whether to comply individually using a trade ready rate-based standard, individually using a non-trade ready rate-based standard, individually using a trade ready mass-based standard, individually using a non-trade ready mass-based standard, as a coalition using a generation weighted average of coalition states' rate-based standards, or as a coalition using a sum of coalition states' mass based standards.

If only a single state adopts a trade-ready plan, trading will not emerge. Moreover, if one state adopts a trade-ready rate-based standard while the other chooses to comply with a trade ready mass-based standard, trading will also not emerge, as the CPP only allows for trading in emission rate credits *or* allowances. Thus, in order for trading to emerge both states must choose either to comply using rate-based standards or mass-based standards, *and* both states must choose to adopt a trade-ready plan. Likewise, in order for either coalition option to emerge, unanimity by both states is required.

Second, if a state decides to comply with the CPP without adopting a trade-ready plan, it could maintain generation units within its boundaries under RTO dispatch or take over dispatch of those units from the RTO. When this occurs, we assume that each state establishes a state dispatch authority that determines dispatch in much the same way as the RTO does (i.e., dispatch decisions maximize producer and consumer surplus for those units and demand nodes within its domain), although under partial information regarding the flow of electricity through the transmission system. Moving from the status quo of RTO dispatch to multiple state dispatch does not require unanimity, but retaining RTO dispatch does. If states choose to comply with trading or as a coalition, we do not allow multiple state dispatch as we assume that states that permit trading or comply as a coalition will have no incentive to deviate from RTO dispatch.

Conditional on these discrete choices, states or the coalition of states strategically select their abatement strategies from any combination of the abatement pathways discussed above. We outline the optimization problems for each combination of discrete choices available to states, identify feasible equilibria that could arise in the model when the two states make decisions simultaneously, and formalize the conditions under which different equilibria are likely to emerge as the final decision-making equilibrium.

Preliminary results

We illustrate how the options provided to states to comply with the CPP impact the costs of the CPP when the dispatch of generation units is determined by regional or state dispatch authorities. We find that states' choices are likely to have important implications on the current configuration of organized wholesale electricity markets in the U.S. Intuitively, a state's compliance choice implies spillovers that may alter the compliance choices made by other states, possibly resulting in shifts in power generation across states. For example, a state may impose a carbon price on emissions from its existing generation units, or may invest in renewables or energy efficiency programs, both of which may alter the dispatch of that state's existing generation fleet within the RTO and could increase power generation costs in neighboring states. This may create an incentive for some states to take over dispatch of their generation units, which may imply additional efficiency costs from the CPP as state dispatch operators make decisions under partial information to exclusively benefit consumers and producers under their own dispatch authority.

Conclusions

This paper examines how states' compliance choices will impact and be affected by the existing configuration of organized wholesale electricity markets. We show how the unprecedented flexibility permitted by the CPP may empower states to make decisions in their own self interest that may have important implications for these markets and raise the costs of the CPP. These results are illustrative and are not meant to predict state choices, which are likely to be based upon many other important dimensions not included in the present analysis. For instance, our analysis ignores the reliability benefits and lower transaction costs that RTO dispatch provides to regional electricity markets, which should give states pause before subsuming control of dispatch.

References

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